

Dazzle Laser Defense Eyewear

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Designing Effective Aircrew Laser Eye Protection Solutions

John Cueva
Director of Performance Optics
Gentex Corporation
jcueva@gentexcorp.com
+1.914.762.1774

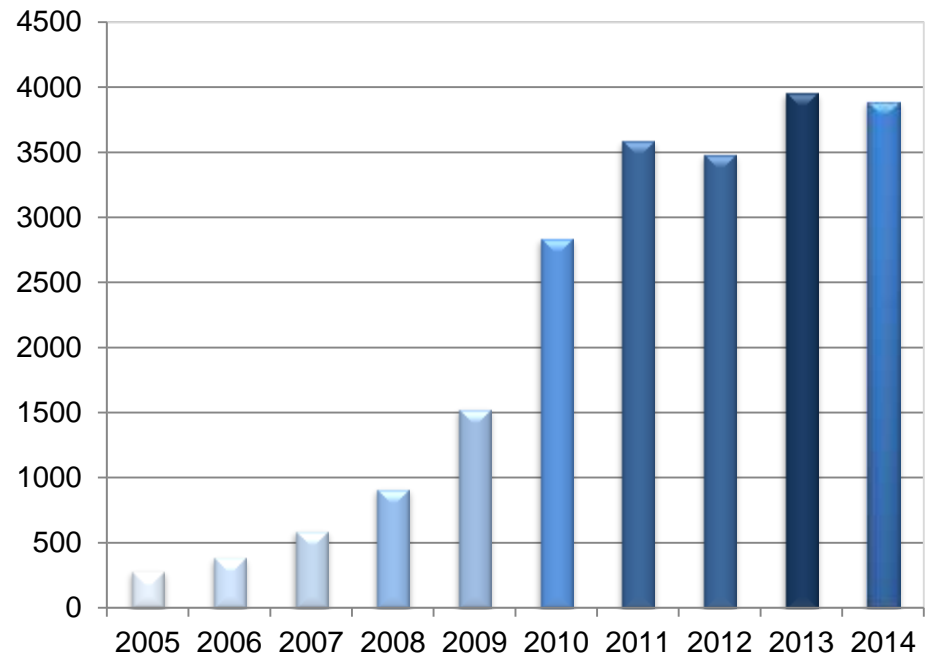
AGENDA

- Introduction: Laser Dazzling Problem
- Threat Assessment
- Key Product Design Aspects
 - Laser Filter
 - Spectacle Frame
- Gentex Dazzle Laser Defense Eyewear
- Summary

Introduction: Laser Dazzle Problem

14x increase in laser incidents from 2005 to 2014

- Inexpensive lasers being used to distract pilots
- Hazardous and potentially lethal distraction
- Cause afterimages, eye discomfort, blurry vision, headache, blindness
- Concern for both civilian and military pilots
- Law enforcement measures alone not capable of preventing lasing events



>21,400 laser incidents reported to FAA

Introduction: Laser Dazzle Problem

Cockpit View - No Laser



Introduction: Laser Dazzle Problem

Distraction



Introduction: Laser Dazzle Problem

Glare & Disruption



Introduction: Laser Dazzle Problem

Flash-Blindness



Introduction: Laser Dazzle Problem

From FAA Simulator Video



Introduction: Laser Dazzle Problem

Typical Helicopter Incident

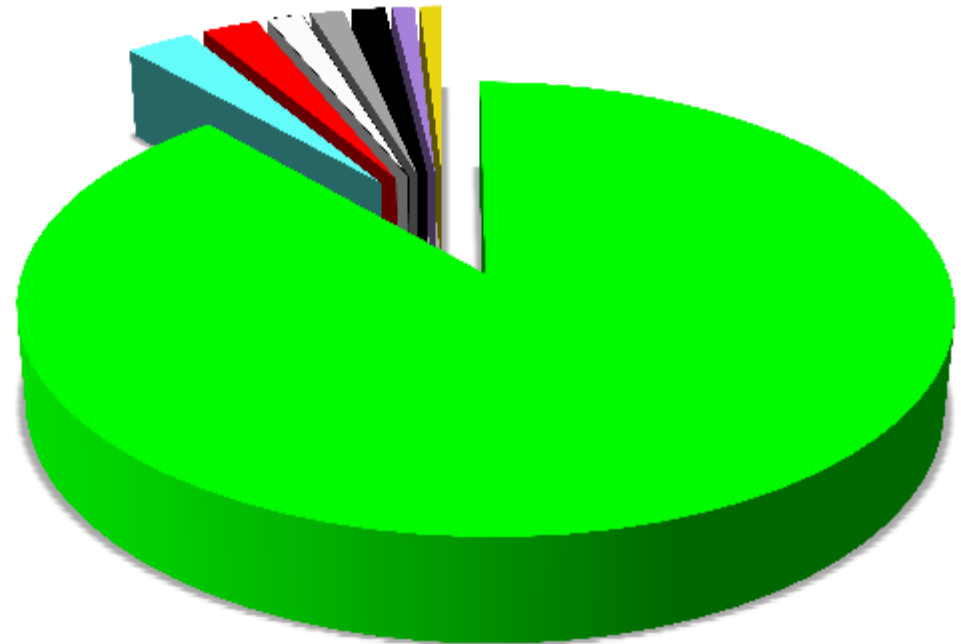


Threat Assessment

- Mode (CW; continuous wave)
- Power (<2W; typically mW)
- Beam Divergence
- Color (wavelength)



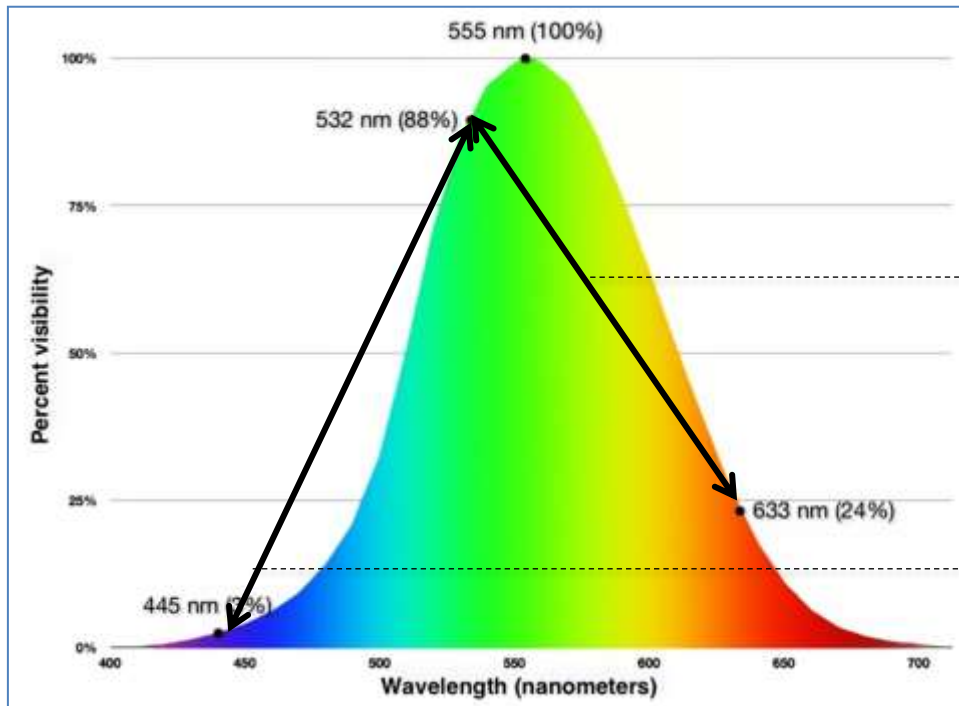
*Laser Illuminations by Color
 Aircraft Reports to FAA, 2013*



■ Green (92.8%)
 ■ Blue (2.4%)
 ■ Red (1.9%)
 White (1.0%)
■ 2+ Colors (0.7%)
 ■ Unknown (0.7%)
 ■ Purple (0.4%)
 ■ Yellow (0.1%)

Threat Assessment

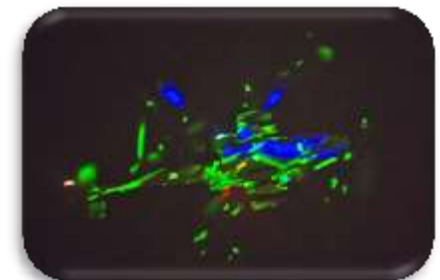
Laser Brightness & Power — Green Most Common and Damaging



Red, only 3x (88/24) lower in apparent brightness than green, but green lasers are 10-100x more powerful than red



Blue, 29x (88/3) lower in apparent brightness than green but about same power as green



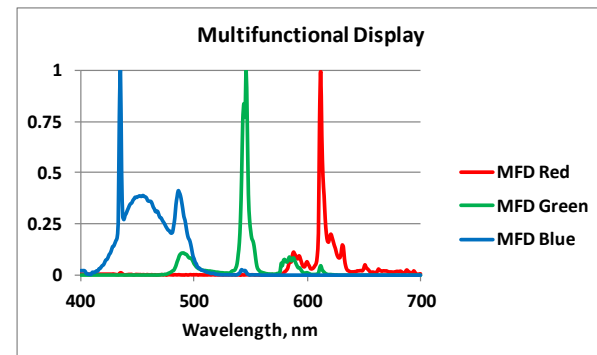
Threat Assessment

Convergence on Assessment

- Based on laser parameters & number of incidences
 - Green is high
 - Blue is medium
 - Red is low
- Based on parameters
 - ED50
 - MPE
 - Sensitivity
 - NOHD
 - Engagement scenarios
- Protection of 1-2 OD
 - Reduces power by 10-100X
- $\geq 40\%$ nighttime visibility (VLT)

Key Design Metrics

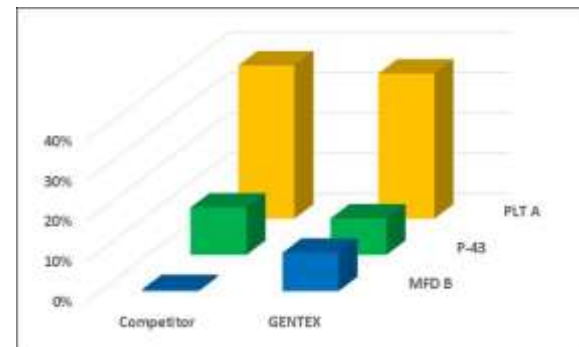
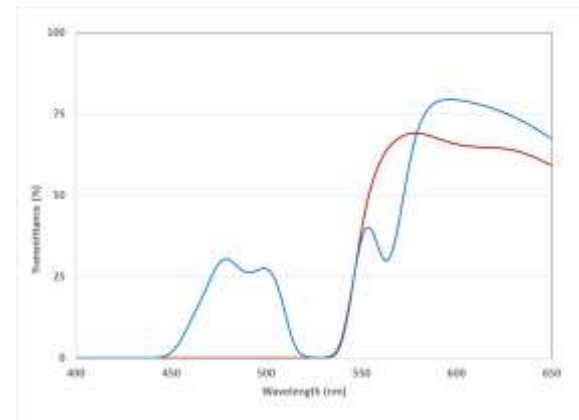
- Two Models (Night / Day)
- Protection
 - Green 532nm (2.5 OD)
 - Blue 445nm (1.5 OD)
 - Red 635nm (trade for VLT)
- Visible Light Transmittance (VLT)
 - Night PLT A $\geq 40\%$
 - Day PLT D65 12-18%
- Display Compatibility
 - P-43, Color LCD Display (MFD) $>10\%$



Designing Green Protection

Performance Comparison

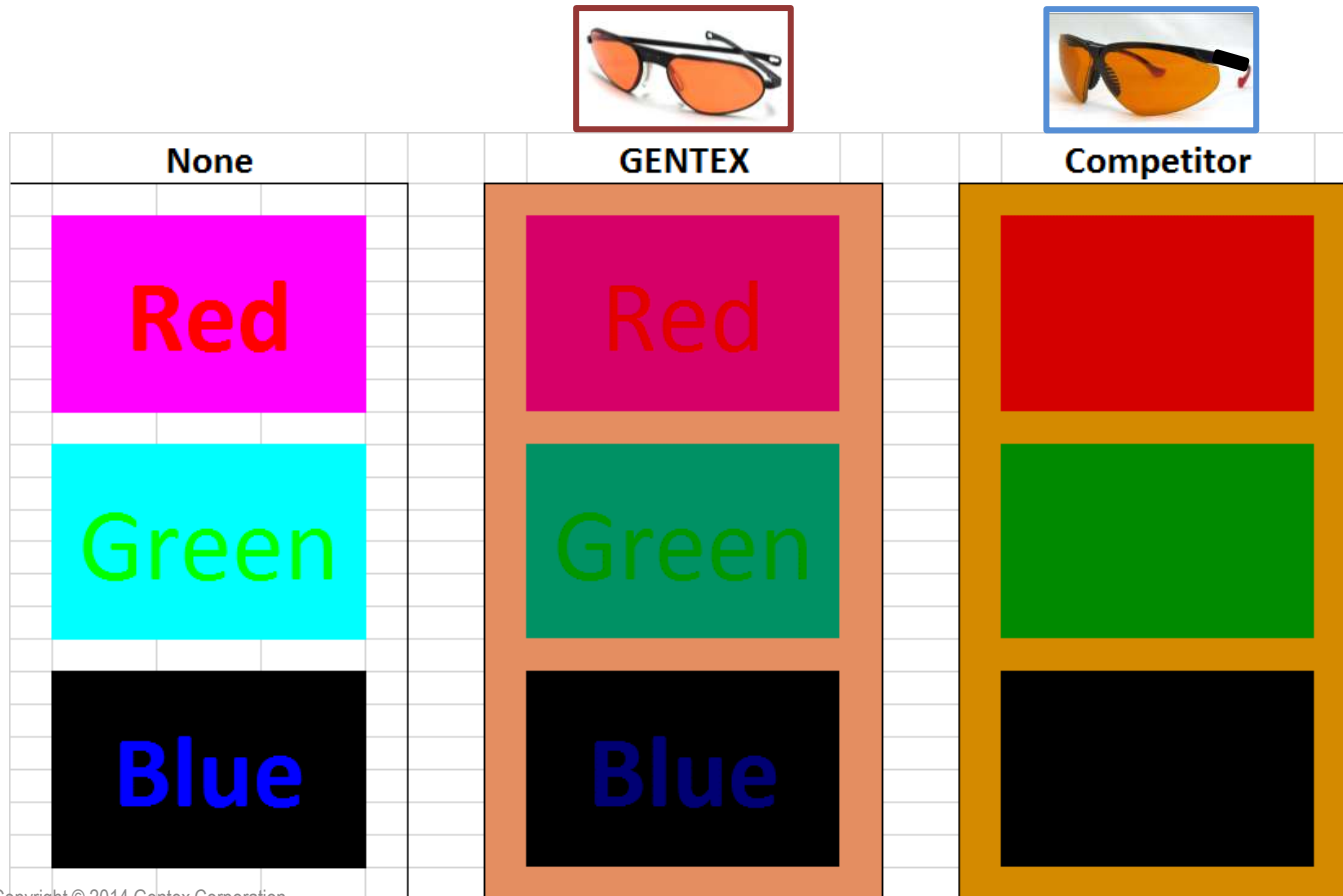
- All dye selection incorporates factors like:
 - Solarization
 - Thermochromism
 - Fluorescence
 - *Saturation*
- Balance between total visual transmittance and visibility of the color display
- Blue light transmittance important and should be traded for overall VLT



Designing Green Protection

Performance Comparison

- All LEP devices result in some color distortion
- Bad dye selection can make some color combinations completely unreadable



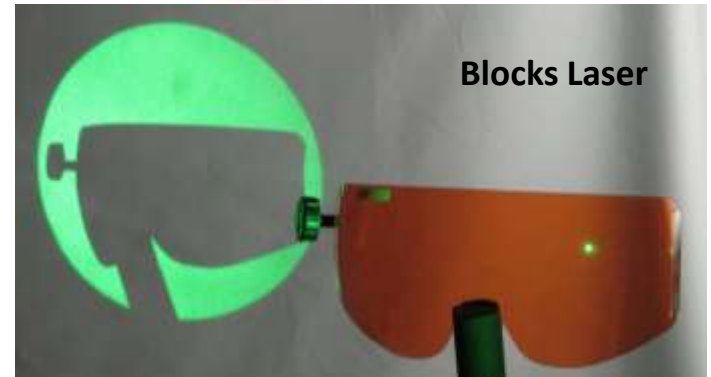
Night Solution – Blue & Green Optimized

Laser Design – Start of Life

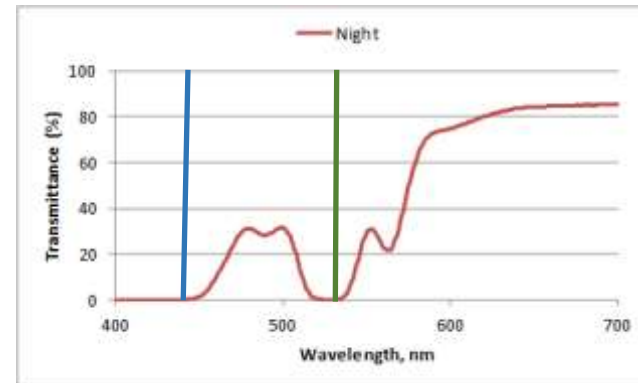
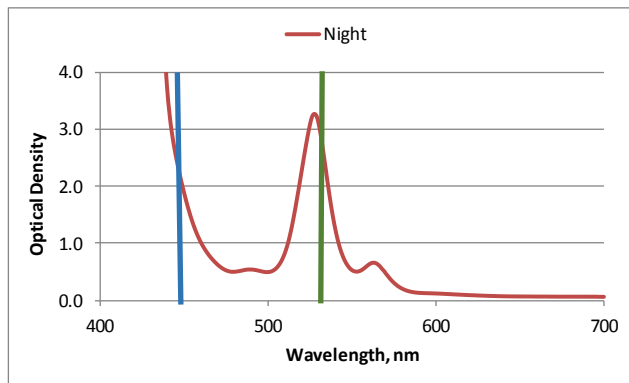
Metric	Value	Metric	Value
Blue	2.5 OD	MFD B	27%
Green	2.8 OD	MFD G	28%
Red	-	MFD R	79%
PLT A	45%	P-43	22%
PLT D65	38%		



HGU-56/P Inner



Blocks Laser



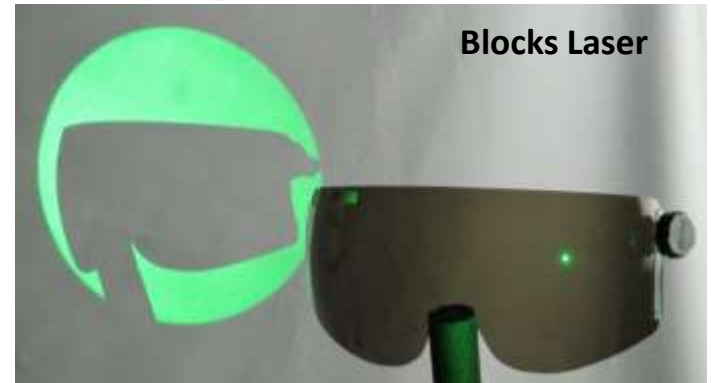
Day Solution – Blue, Green & Red Optimized

Laser Design – Start of Life

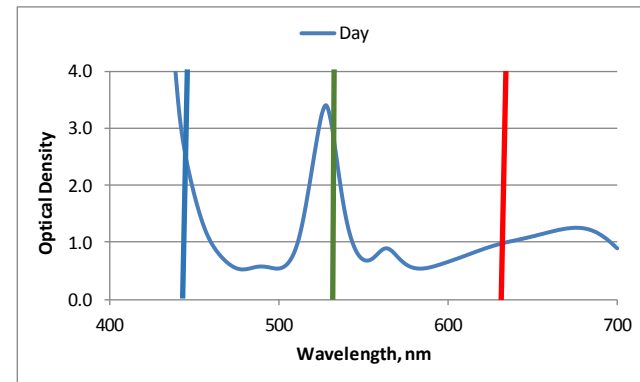
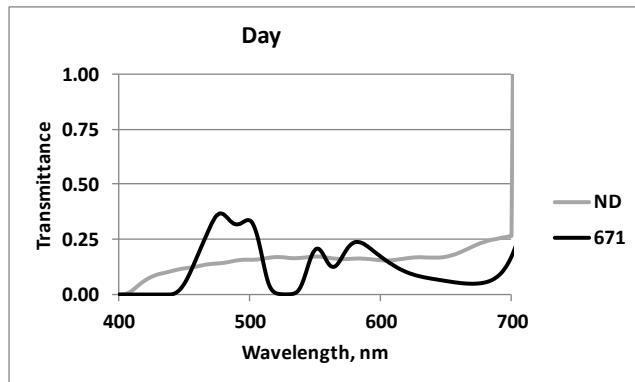
Metric	Value		Metric	Value
Blue	2.5 OD		MFD B	21%
Green	2.9 OD		MFD G	15%
Red	1.1 OD		MFD R	18%
PLT A	17%		P-43	22%
PLT D65	18%			



HGU-56/P Outer



Blocks Laser



Day vs. ND Sunshade

- Practically the same:
 - VLT
 - MFD
 - Chromaticity

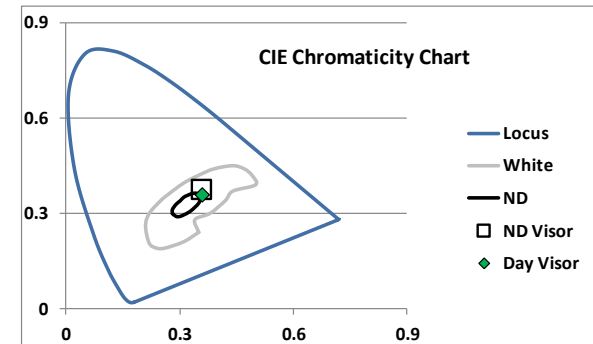
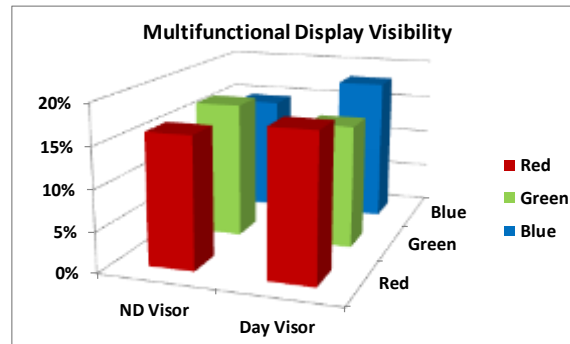
- Feasible to fly LEP all the time
 - Day visor in outer position
 - Night visor or spectacles inner position



HGU-56/P Outer Visor
Class 2: Neutral Gray



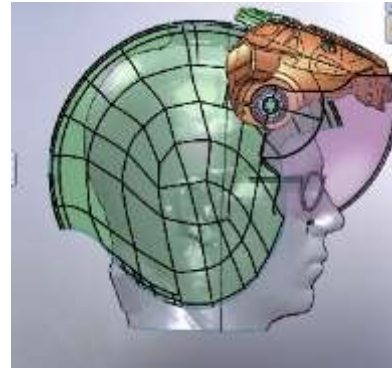
HGU-56/P Outer Visor
Day LEP



High Wrap Spectacle Frame Design

Military Pedigree

- Developed for U.S. Navy to fit under Joint Helmet Mounted Cueing System (JHMCS)
- Sleek lens shape coupled with high wrap fronts keep lens close to eye preventing visor contact
- Compatible with additional headborne equipment such as HMDs and NVGs



Side View



Gentex Dazzle Laser Defense Spectacles Shown with:



JHMCS



Night Vision Cueing Device (NVCD) and Gentex Step-In Visor Assembly



Gentex HGU-55/P Fixed Wing Aircrew Helmet System



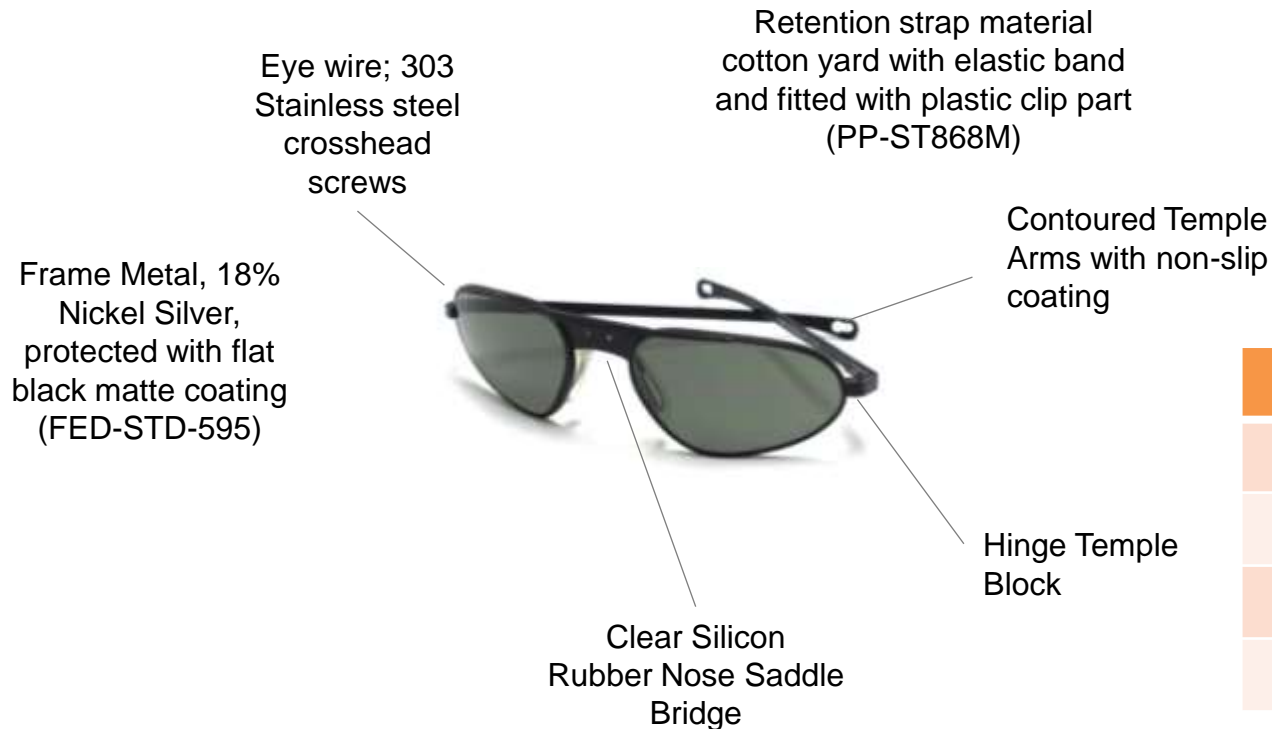
Joint Service Aircrew Mask (JSAM)

Spectacle Fame Materials

Lightweight Yet Durable – For Multiple Users



Spectacle Kit: hard-shell case, frame, soft micro-fiber bag, retention strap



Frame Sizes	
Size	IPD
Small	56mm
Medium	62mm
Large	68mm

Comfortable Frame

For Increased Endurance

- Soft silicone saddle bridge
 - Reduces nasal fatigue
- Spring hinge temple blocks
 - Alleviates temporal hot spots
- Petite temple arms
 - Better compatibility with ear cups

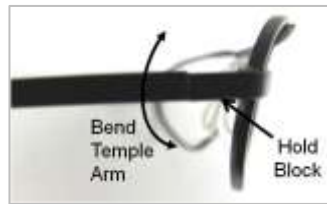


Easy Spectacle Donning

3 Simple Steps to a Proper Fit



1. Adjust the saddle nose bridge to find the correct height



2. Individually adjust temple arms at the hinge blocks to ensure the frame fronts are parallel to the brow line



3. Contour the temple arms for comfort around the head



Proper Alignment

Dazzle Laser Defense Eyewear—Day/Night Models

Day	Night
 <p><i>Dazzle Laser Defense Day Spectacles</i></p>	 <p><i>Dazzle Laser Defense Day/Night Spectacles</i></p>
 <p><i>Dazzle Laser Defense HGU-56/P Outer Visor</i></p>	 <p><i>Dazzle Laser Defense HGU-56/P Inner Visor</i></p>
 <p><i>Dazzle Laser Defense SPH-4/5 Outer Visor</i></p>	 <p><i>Dazzle Laser Defense SPH-4/5 Inner Visor</i></p>

	Protection			Visible Light Transmission	
Lenses	Blue (445 nm)	Green (532 nm)	Red (635 nm)	Day	Night
Day	>1.5 OD	>2.5 OD	>0.8 OD	15%	n/a
Night	>1.5 OD	>2.5 OD	--	30%	40%

Summary

- Most laser dazzling incidents are distraction and glare hazards
- Convergence on requirements by industry and government
- Designed Day and Night models
 - Night model trades red for VLT
- Both models meet the key design metrics and MIL-V-43511
- Spectacles highly compatible with additional headborne equipment such as Helmet Mounted Displays (HMDs) and Night Vision Goggles (NVGs)
- Spectacles are comfortable, easy to fit and robust for re-issue to new users
- Other visor styles could be made available (ex. HGU-55/P)
- Ideal for military, law enforcement and first responders



Contact Us to Learn More About Gentex Dazzle Laser Defense Eyewear

John Cueva

jcueva@gentexcorp.com

+1.914.762.1774

www.gentexcorp.com/dazzle