

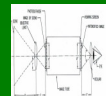


Night Vision Systems in Aviation

Captain Michel Lortie
Canadian Forces

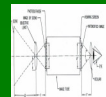
6 Dec 06

OPTI 696BX



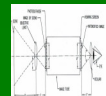
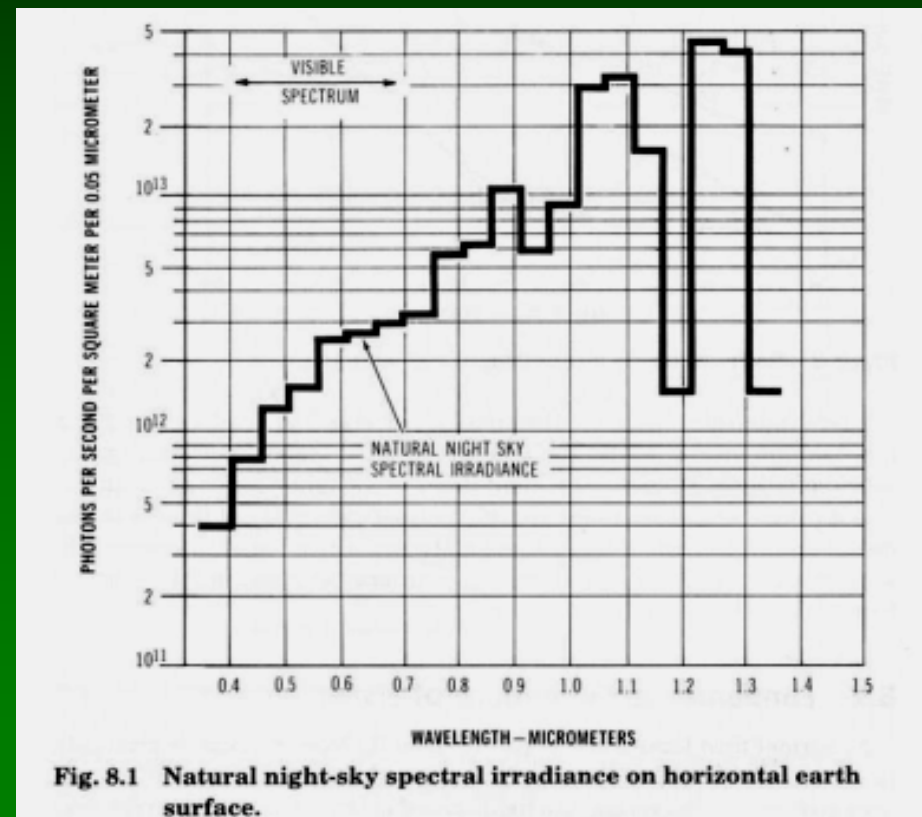
Outline

- How do they work ?
- Design Considerations
- Integration Issues



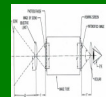
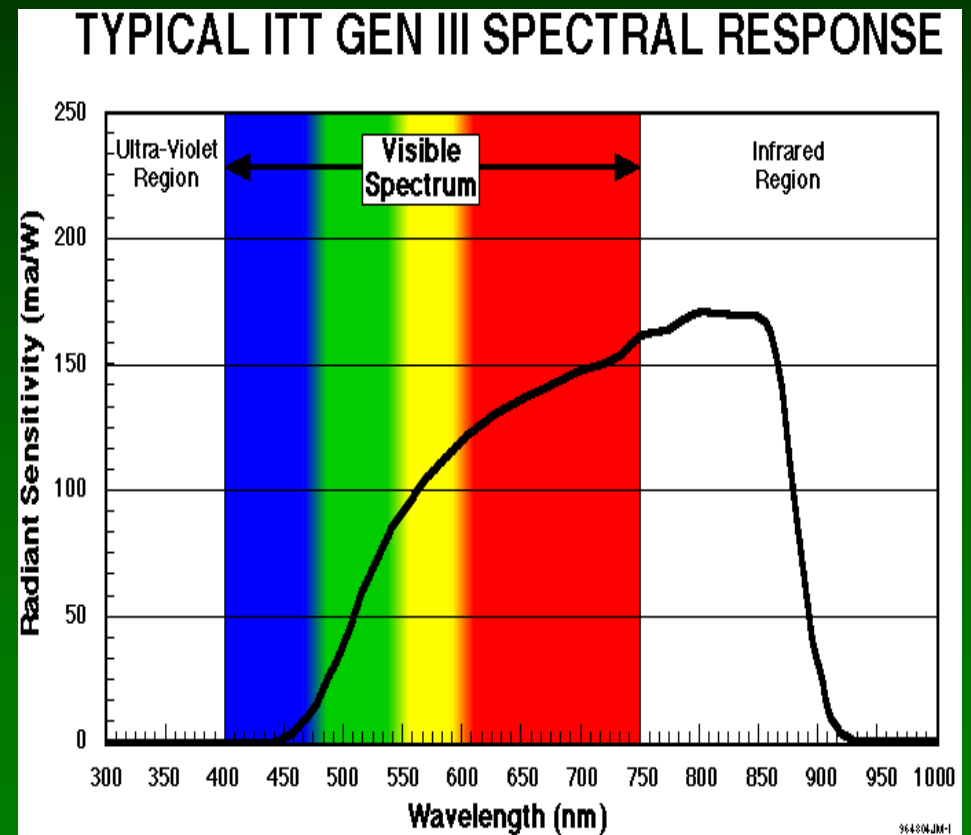
Understanding Night Vision

- NVG objective larger than eye
- NVG sensitive to wider spectrum
- Peak night radiance
- Electron Multiplication



Understanding Night Vision

- NVG objective larger than eye
- NVG sensitive to wider spectrum
- Peak night radiance
- Electron Multiplication



Night Vision Goggles

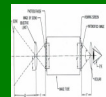
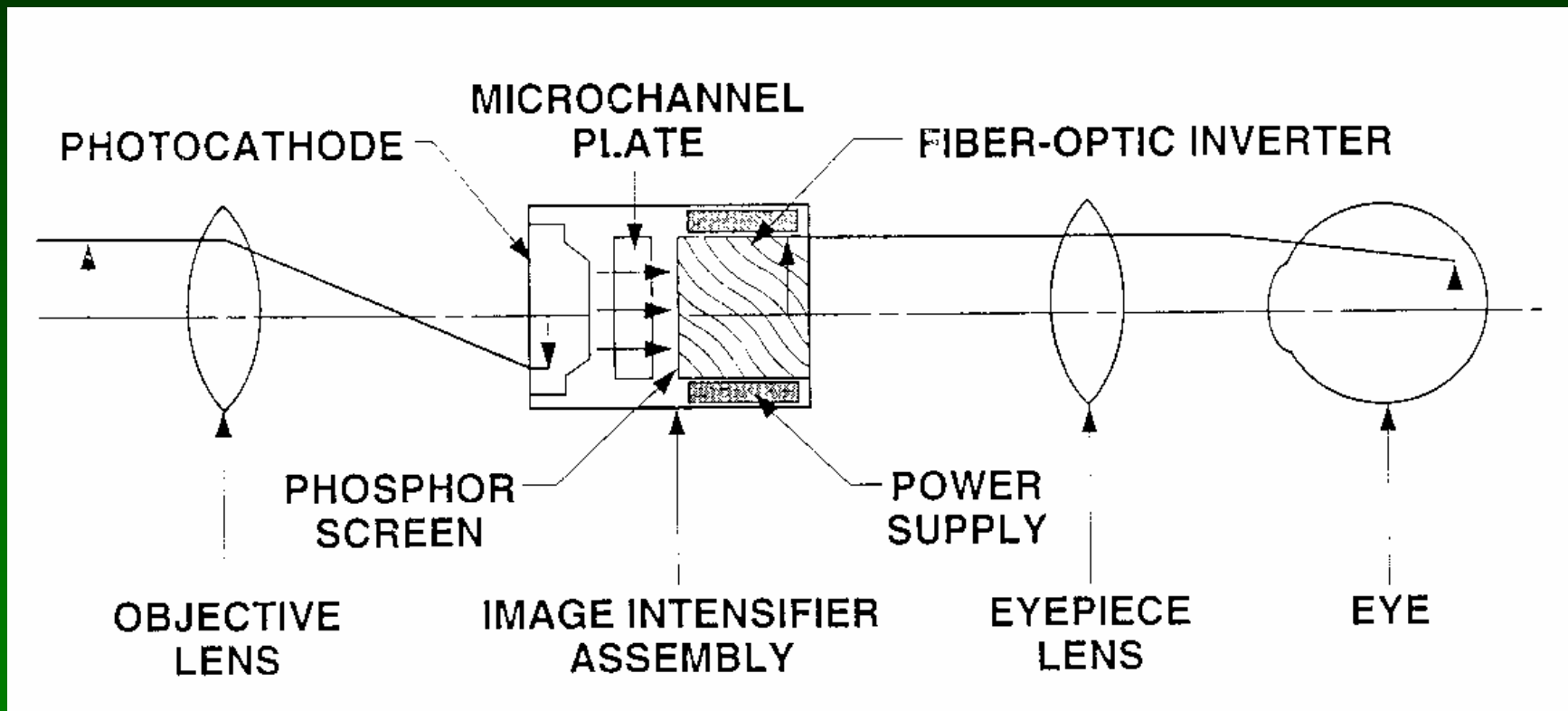
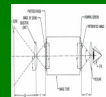
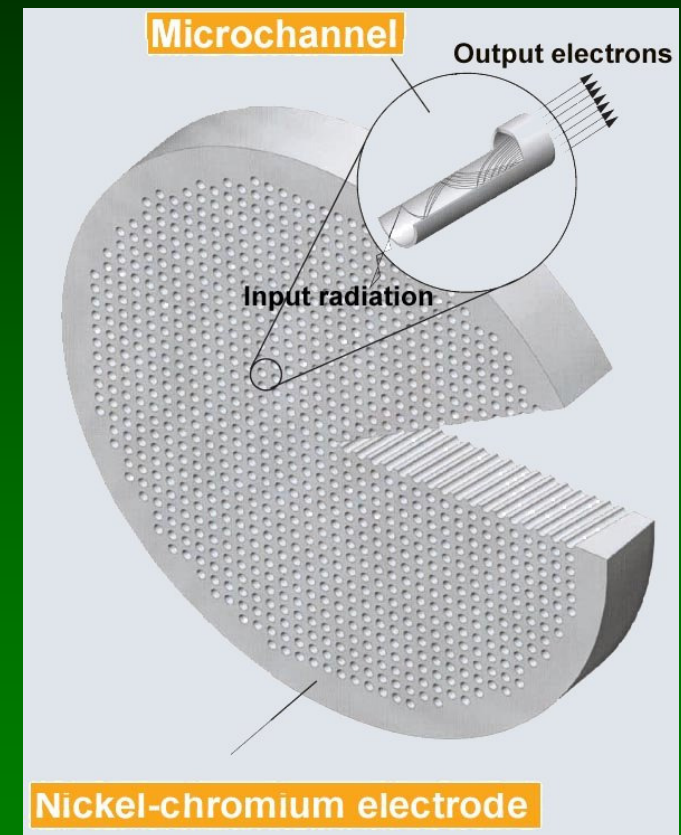


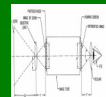
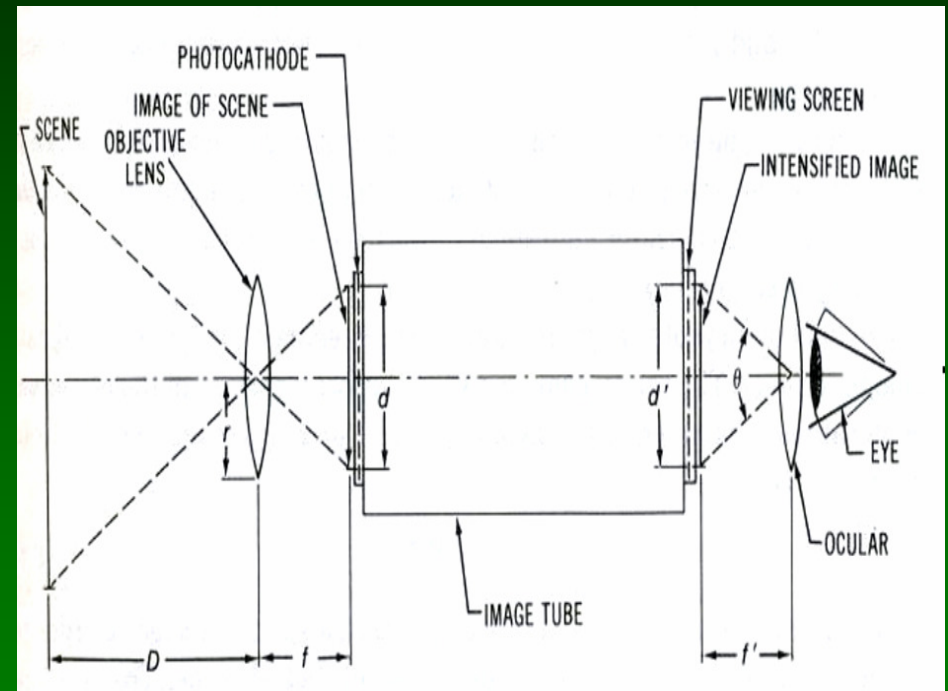
Image Intensifying Tubes

- Hollow fibers fused together together
- Amplifies signal
- Technological generations



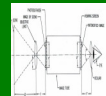
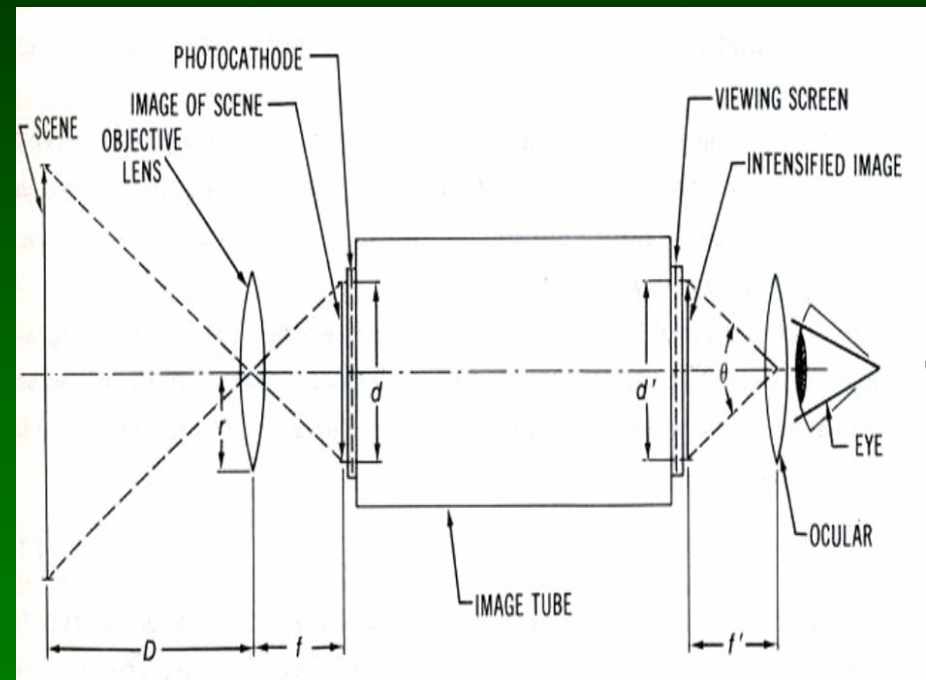
Design Considerations

- 1 X Magnification
- Resolution limit- MCP
- Automatic Gain Control
- Compact Design



Design Considerations

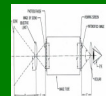
- No vignetting
- Diopter Adjustment
- Redundancy



Performance Specs

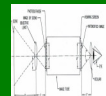
- Sensitivity (1800 mA/Im^*)
- SNR (21^*)
- Resolution (64 lp/mm^*)

* State-of-the-art performance spec examples



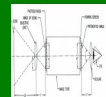
Problems

- Narrow FOV
- Low depth perception
- Inadequate illumination
- Vision through Fog/Snow/Smoke/Sand
- Noise
- Weight

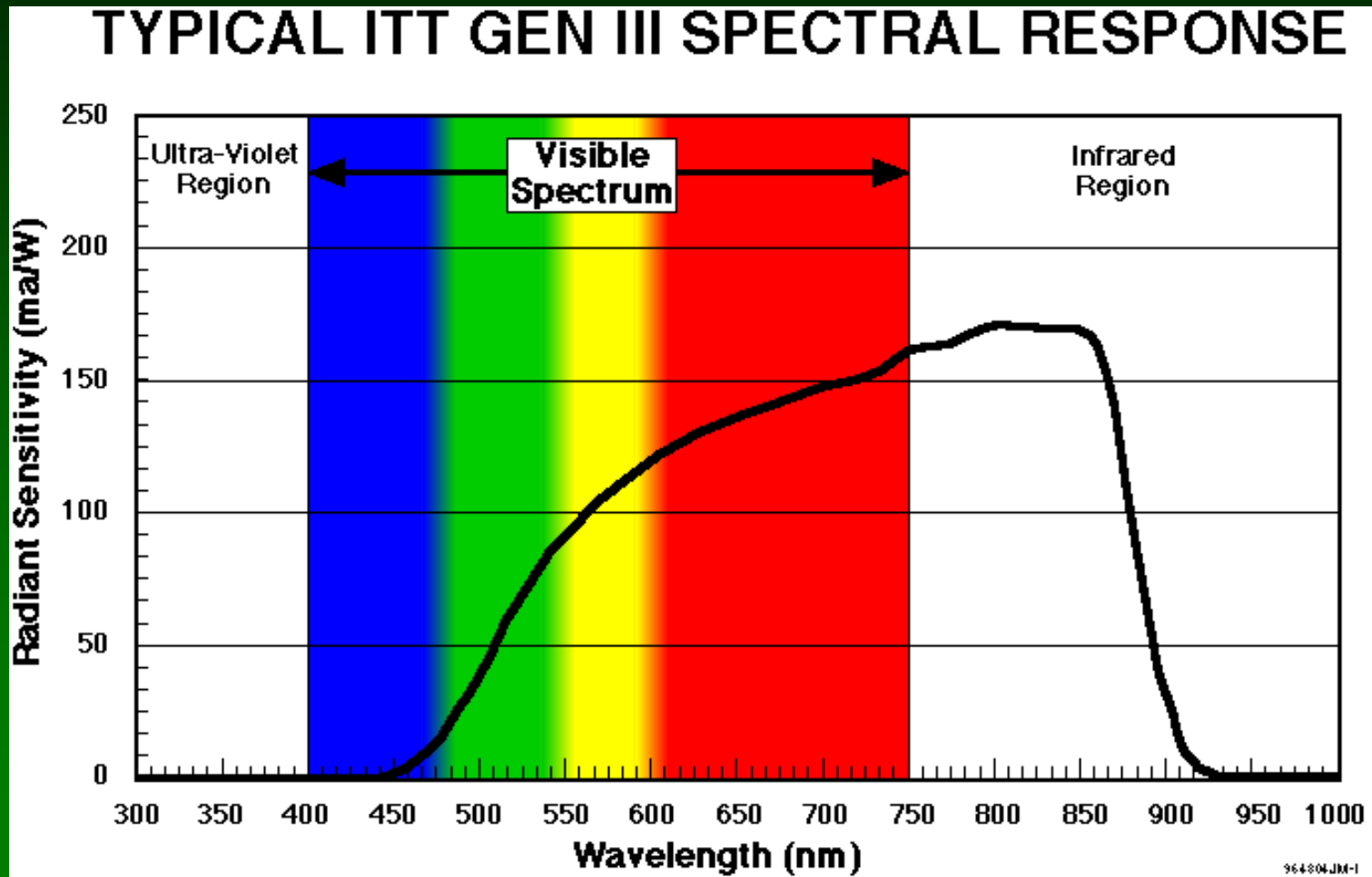


Outline

- How do they work ?
- Design Considerations
- Integration Issues

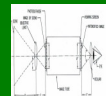


Spectral Response (no filter)

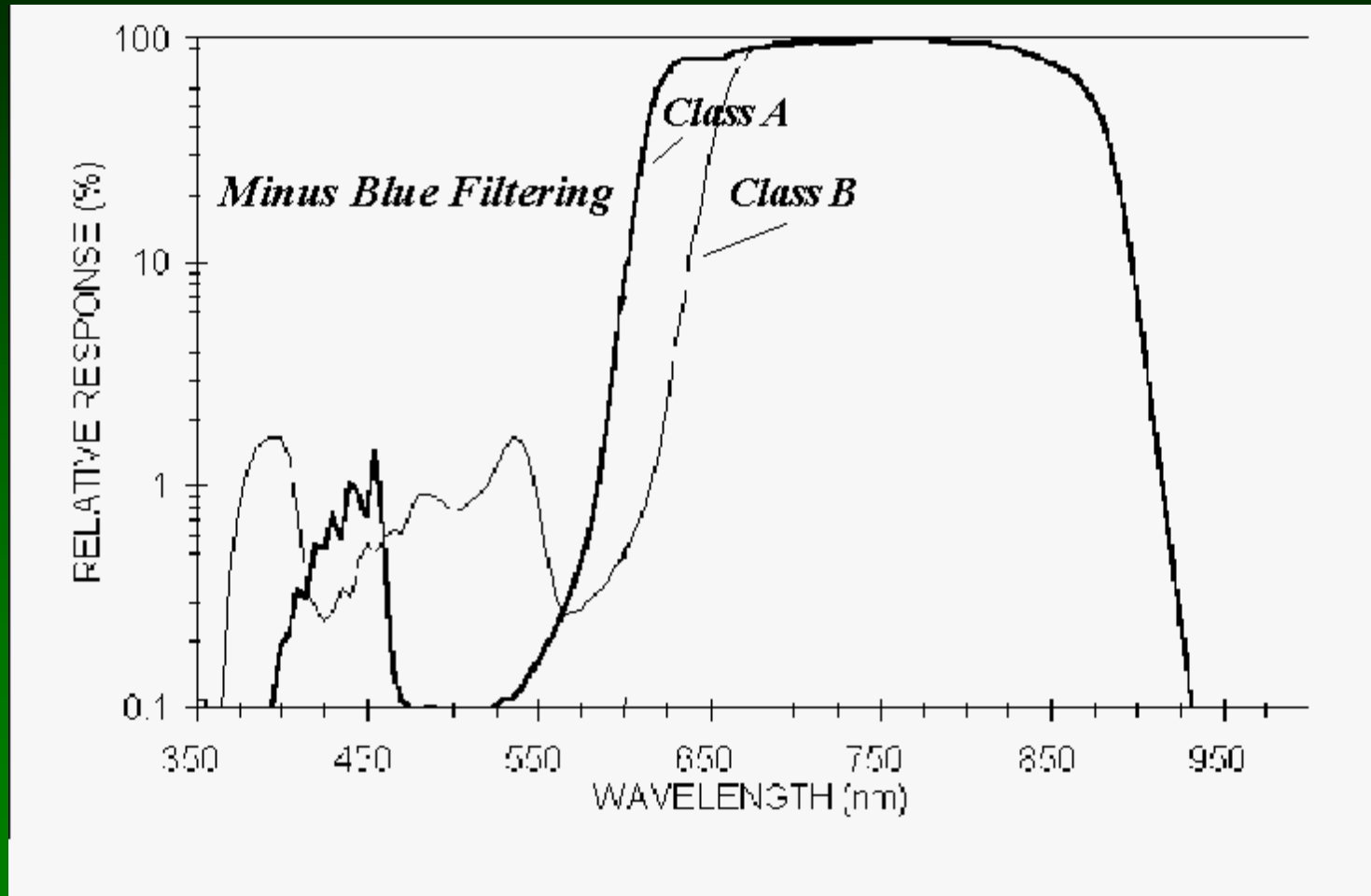


6 Dec 06

OPTI 696BX

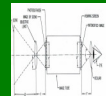


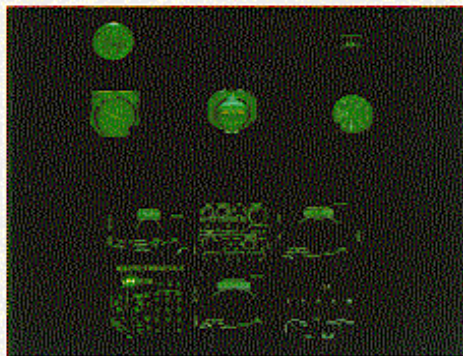
System Response (filtered)



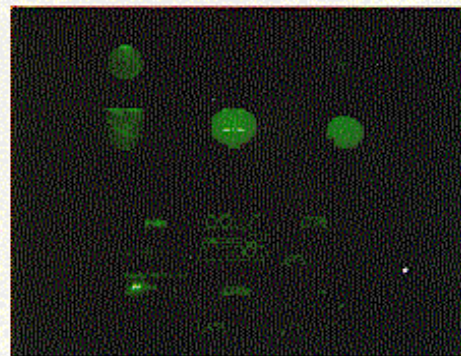
6 Dec 06

OPTI 696BX

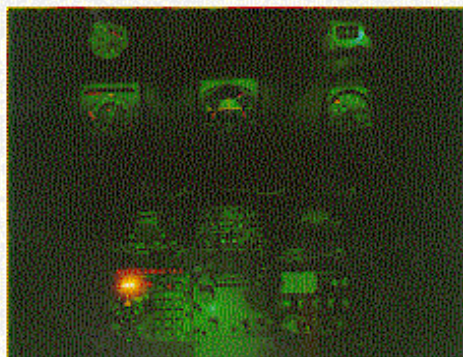




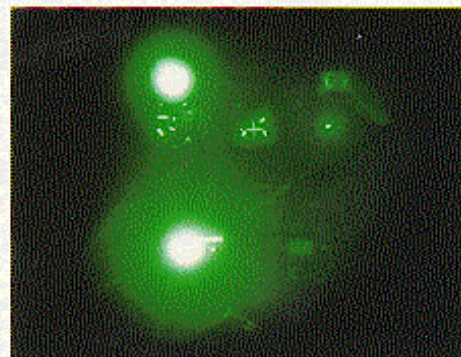
MIL-L-85762A-Compliant Instruments



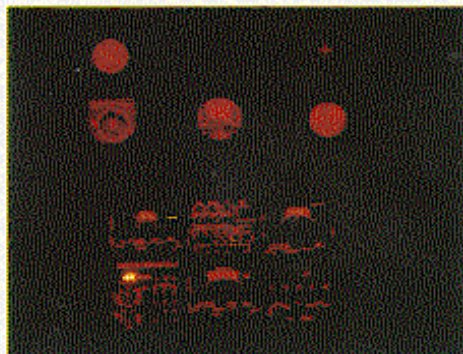
MIL-L-85762A Instruments through Gen III Night Vision Goggles



Night Vision Compatible Instruments



Night Vision Compatible Instruments through Gen III Night Vision Goggles



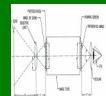
Standard Red Instruments



Standard Red Instruments through Gen III Night Vision Goggles

References

- <http://www.hec.afrl.af.mil/Publications/default.asp>
- www.SPIE.org
- Image Tubes, by Csorba (in Hopf library)

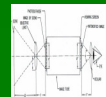




Questions?

6 Dec 06

OPTI 696BX



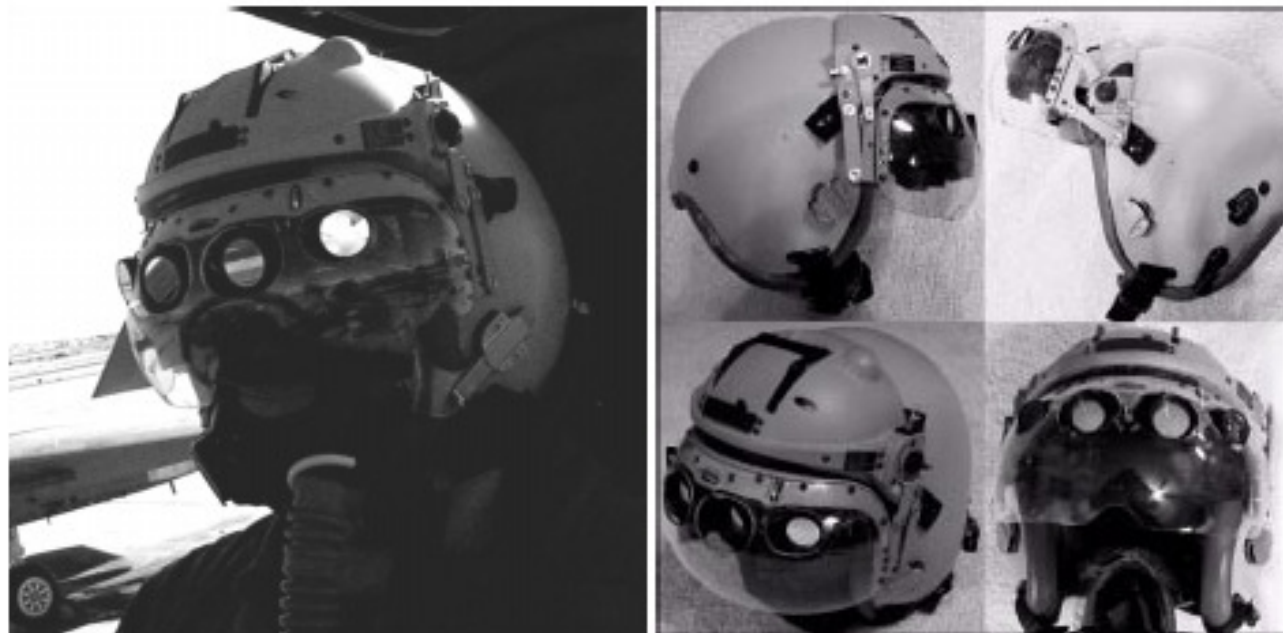
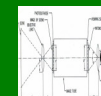
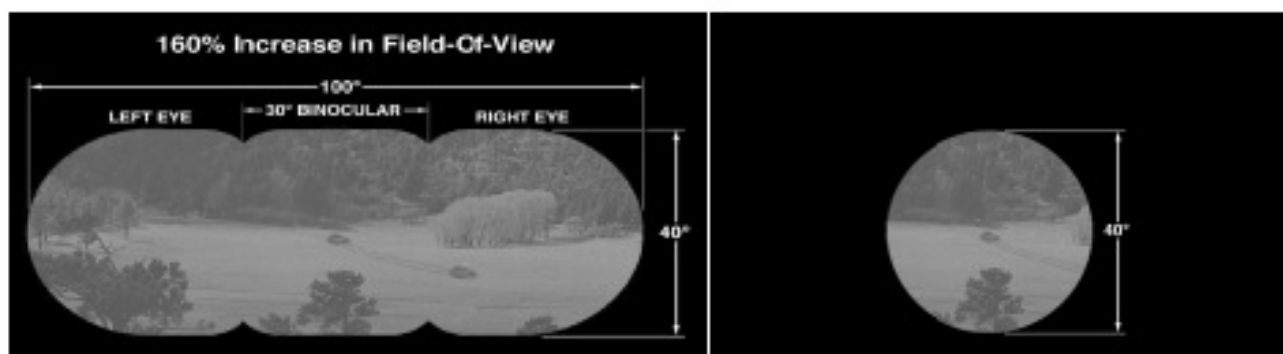
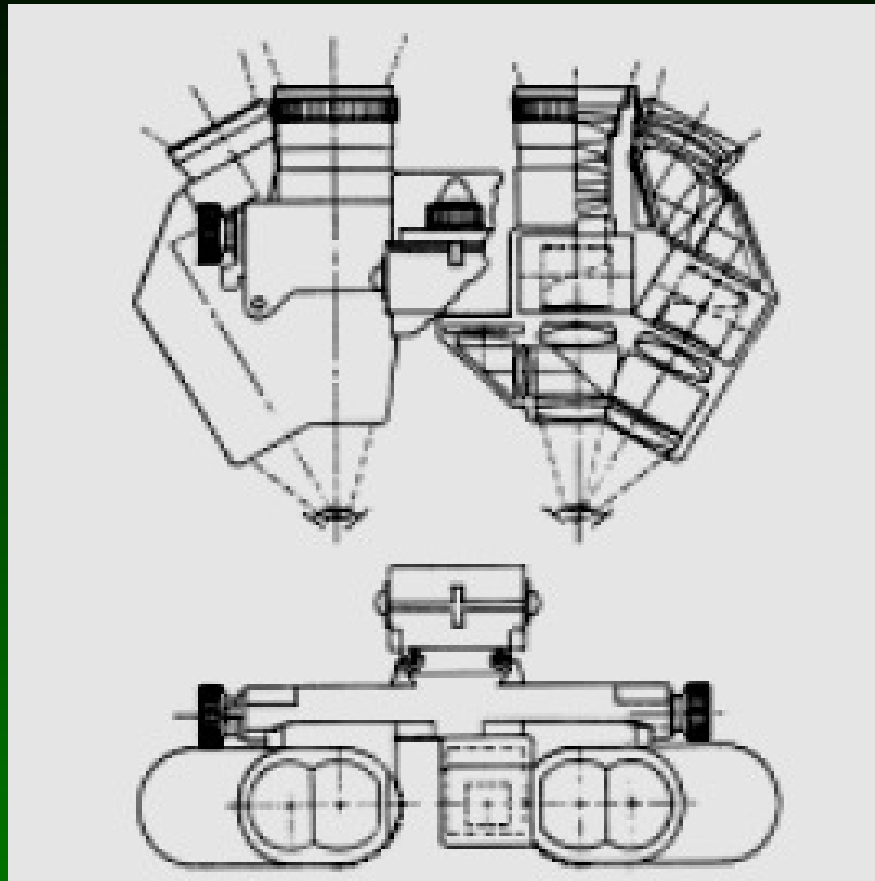


Figure 1. PNVG I, low profile design (Patent # 5,416,315, Other patents pending)





6 Dec 06

OPTI 696BX

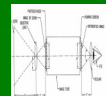


Table 8.2 Illumination Levels for Night and Daylight Conditions

Night Condition	Illumination (lm/m ²)	Photons/mm ² /s
overcast starlight	10 ⁻⁴	1.3 × 10 ⁶
starlight	10 ⁻³	1.3 × 10 ⁷
quarter moon	10 ⁻²	1.3 × 10 ⁸
full moon	10 ⁻¹	1.3 × 10 ⁹
deep twilight	1	1.3 × 10 ¹⁰
twilight	10	1.3 × 10 ¹¹
very dark day	10 ²	1.3 × 10 ¹²
overcast day	10 ³	1.3 × 10 ¹³
daylight	10 ⁴	1.3 × 10 ¹⁴
direct sunlight	10 ⁵	1.3 × 10 ¹⁵