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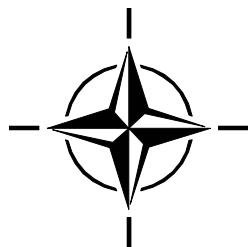
RTO AGARDograph

AG-SCI-089

## Flight Testing of Night Vision Systems in Rotorcraft

(Test en vol de systèmes de vision  
nocturne à bord des aéronefs  
à voilure tournante)

This AGARDograph has been sponsored by SCI-172,  
the Flight Test Technical Team (FT3) of the Systems  
Concepts and Integration Panel (SCI) of the RTO,  
and serves as Volume 25 of the  
RTO AGARDograph 300 Flight Test Techniques Series.



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- NMSG NATO Modelling and Simulation Group
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- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

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# Nomenclature

|           |  |
|-----------|--|
| ADS-33    | Aeronautical Design Standard                       |
| AETE      | Aeronautical Engineering and Testing Establishment |
| AGL       | Above Ground Level                                 |
| AHO       | Above the Highest Obstacle                         |
| ANVIS     | Aviator Night Vision Imaging System                |
| AOB       | Angle of Bank                                      |
| CONOPs    | Concept of Operations                              |
| CRT       | Cathode Ray Tube                                   |
| DIMSS     | Dynamic Interface Modelling and Simulation System  |
| DZ        | Designated Zone                                    |
| EEG       | Electroencephalogram                               |
| FOR       | Field Of Regard                                    |
| FOV       | Field of View                                      |
| Ft        | Feet   |
| FTE       | Flight Test Engineer                               |
| GVE       | Good Visual Environment                            |
| HMD       | Head Mounted Displays                              |
| HQR       | Handling Quality Rating                            |
| HUD       | Heads Up Display                                   |
| IFR       | Instrument Flight Rules                            |
| IGE       | In-Ground-Effect                                   |
| IMC       | Instrument Meteorological Conditions               |
| IR        | Infrared   |
| LCD       | Liquid Crystal Display                             |
| LED       | Light Emitting Diode                               |
| LLTV      | Low Light Level Television                         |
| $L_{max}$ | Maximum Luminance                                  |

---

|                  |   |
|------------------|---|
| L <sub>min</sub> | Minimum Luminance   |
| LZ               | Landing Zone  |
| m <sup>2</sup>   | Meters Squared  |
| MTF              | Modulation Transfer Function                                    |
| NASA TLX         | National Aeronautics and Space Administration – Task Load Index |
| NATO             | North Atlantic Treaty Organisation                              |
| NR <sub>B</sub>  | Night vision radiance for class B NVG filters                   |
| NRC              | National Research Council                                       |
| NVGs             | Night Vision Goggles  |
| NVIS             | Night Vision Imaging System                                     |
| OGE              | Out-Of-Ground-Effect  |
| OMNR             | Ontario Ministry of Natural Resources                           |
| PRSA + V         | Automatic Flight Control Systems And Visual Cueing              |
| PVC              | Polyvinyl Chloride  |
| Rad Alt          | Radio Altimeter   |
| RPM              | Revolutions per Minute  |
| SAR              | Search and Rescue   |
| UCE              | Usable cuing environment  |
| USAF             | United States Air Force   |
| VA               | Visual Acuity   |
| VCR              | Visual cuing ratings  |
| VMC              | Visual Meteorological Conditions                                |

## Preface

Dr. Gregory Craig has a PhD in human visual perception (psychology) from Carleton University in Ottawa. He is a human factors researcher at the National Research Council of Canada, specializing in advanced display and cueing systems for fixed and rotary wing aircraft. He has conducted over 600 hours of helmet mounted display, head down display and night vision goggle flight testing.

Dr. Todd Macuda has a PhD in Neuroscience from the University of Western Ontario and has examined changes in basic visual perception with pilots using night vision goggles in low level helicopter flight. Dr. Macuda has conducted several NVG research projects for military, law enforcement and forestry management applications. Dr. Macuda is also actively conducting research on pilot brain activity during flight manoeuvres using a neural recording system.

Sion Jennings received an M.A.Sc. in Systems Engineering and is a human factors engineer at the Flight Research Laboratory of the National Research Council of Canada. His research has included the integration of advanced display systems, enhanced visual imagery (infrared and mm-wave), and pilot-vehicle interfaces to enhance pilot performance. He is currently active in research on NVG applications, helmet mounted displays and heads-up displays in civilian and military applications.

Major Guy Ramphal has a B.Sc. in Industrial Engineering from the University of Toronto and a Master of Flight Test Technology from the National Test Pilot School in Mojave, CA. Major Ramphal is a qualified military test pilot and a qualified flight instructor with 3600 hours of flight experience, 400 hours with night vision goggles and 40 hours with helmet-mounted and panoramic night vision goggle systems. Major Ramphal is currently a fixed-wing instructor for the Canadian Department of National Defence at the National Flight Test Center in Moose Jaw, Saskatchewan.

Major Andrew Stewart was an experienced test pilot with the rotary wing of the Aeronautical Engineering and Testing Establishment (AETE) with several (100 – 200) hours of experience flying with night vision goggles. Currently, Mr. Stewart pilots helicopters for an air ambulance company in Alberta, Canada.

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| Avionics                             | Guidelines   | Night vision                |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Comparison                           | Head up displays   | NVG (Night Vision Goggles)  |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Compatibility                        | Helicopters  | Operational effectiveness   |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Display devices                      | Helmets  | Optical detection           |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Electro-optics                       | Human factors engineering  | Performance evaluation      |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Flight control                       | Lab test procedures  | Performance tests           |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Flight crews                         | Low light level viewing  | Procedures                  |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Flight tests                         | Man machine systems  | Simulation                  |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Flight test methods                  | Methodology  | Testing and assessment      |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| Goggles                              |  |                             |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |
| <b>14. Abstract</b>                  | <p>This AGARDograph presents a general summary of suggested Night Vision Goggle (NVG) testing methods and should be used as a framework for developing airborne and laboratory based experiments to evaluate equipment. The objective of this document is to provide an inventory of rules, standards, procedures, methods and means needed to test and evaluate night vision systems. In order to meet its objective, the scope of this AGARDograph is limited to the testing of night vision devices based on image intensification technology for use in rotorcraft. This AGARDograph includes sections covering the basic theory of the systems in use today, human vision and its relationship to the technology, general flight test methodology and an inventory of flight test techniques from NATO countries.</p> <p>This publication serves as Volume 25 of the RTO AGARDograph 300 Flight Test Techniques Series.</p> |                             |   |          |            |              |            |                  |                            |               |             |                           |                 |         |                   |                |                           |                        |                |                     |                   |              |                         |            |              |                     |            |                     |             |                        |         |  |  |





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