Aircrew Helmet Communications Upgrade

1. Purpose

1.1. The purpose of this Request for Information (RFI) is to give a high-level description of the Aircrew Helmet Communications Upgrade project and to help Canada understand the level of interest and potential solutions from industry.

2. Background: Aircrew Helmet Communications Upgrade (AHCU)

2.1. Aircrew in the Royal Canadian Air Force (RCAF) face hostile conditions towards hearing health. The need to attenuate noise while also clarifying important audio signals is not only important during the mission but to the health and long term wellbeing of aircrew member - long after their military service is complete.

2.2. Current aircrew helmets require improved hearing protection and communications intelligibility for Rotary Wing aircrew in many flight conditions; and for Fixed Wing aircrew during door open operations and close formation flying. DND/RCAF has identified a requirement to modify the current aircrew helmets to provide improved hearing protection and intelligibility.

3. High Level Technical Requirements

3.1. An “AHCU modification kit”, must be designed for the GENTEX Model HGU-56/P and GENTEX Model 190A (equivalent to HGU-55P) helmets. This includes the replacement of the Boom Microphone and Headphone speakers as well as an ear-inserted ear bud or “Communication Ear Plug (CEP) for all existing helmets of those types.

3.2. Every measure possible should be made to ensure the CEP is comfortable and does not become an encumbrance. (Including making it wireless/non snagging, noise cancelling and enabling talk-through capability). It must be comfortable and not interfere with the aircrew’s effectiveness or hearing operational sounds: e.g. indication sounds, warning signals, noises that indicate equipment failure, etc.

3.3. This modification kit must comply with airworthiness standards as proposed in Annex B Requirements and standards This includes requirements for testing, documentation and training of DND technicians on installation. DND may carry out some verification and in-flight testing, to ensure compliance but potential bidders will increase their chances of becoming compliant the more proof that they can supply that the product has been tested to the appropriate standards (for example, to the standards proposed in the aforementioned Annex B).

3.4. The AHCU must result in superior communications intelligibility and noise attenuation to the harshest rotary wing environments for up to 20 hours without replacing or charging batteries (if batteries required)

3.5. The solution must provide for fabrication of custom Communication Ear Plugs (CEPs) based on ear canal impressions that are comfortable and will be interfaced with the helmet audio/ aircraft intercommunication system (ICS) audio.

3.6. The audio attenuation properties of the ear plugs should be tuned for the specific aircraft types' general audio sound pressure level spectrum such as found at Fig 5 of Ref A. These custom CEP orders must also conform to Airworthiness standards, notably including pressure relief ports for unpressurized high altitude (above 10,000ft). A need for support in providing CEP impressions will continue for over 10 years, which means that the knowledge of manufacturing process must be open to ensure this product can be obtained if commercial availability diminishes.

3.7. A number of active noise reducing (ANR) modules must also be integrated into the CEPs. Estimated numbers for these modules found in Annex C: Provisioning Estimates.

3.8. The AHCU modification kit must not increase the weight of more than 65g and must not substantially change from the current form factor of installed audio equipment or the function of the affected aircrew helmets.

3.9. The proposed modification must conform to stringent environmental standards, as specified in Annex B. The microphone must operate reliably in cold (Below 0°C) environments with continuous exposure to condensation from the operator's breath. These environmental requirements are also specified in the proposed standards in Annex B.

Helmet Assembly - Nomenclature	**Part Number**	**NSN**
190A* (Medium)	85F7023-4	8475-01-375-6161
190A* (Large)	85F7023-5	8475-01-375-6160
190A* (X-Large)	85F7023-6	8475-01-375-6159
HGU-56/P (XX-small)	01560145	8475-01-539-1179
HGU-56/P (X-small)	01560146	8475-01-539-0696
HGU-56/P (Small)	01560147	8475-01-539-1180
HGU-56/P (Medium)	01560148	8475-01-539-1184
HGU-56/P (Large)	01560149	8475-01-539-1199
HGU-56/P (X-large)	01560150	8475-01-539-1204

*note: Gentex 190A helmets are based on the HGU-55/P
Table 1: Applicable Helmets and available sizes

Ref A: Flight test investigation of cabin noise exposure in the Royal Canadian Air Force CH-147F helicopter Ghinet, Sebastian; Price, Andrew; Wickramasinghe, Viresh; Chen, Yong; Grewal, Anant: Flight test investigation of cabin noise exposure in the Royal Canadian Air Force CH-147F helicopter (canada.ca)

4. Your Company Contact Information (Required):

Company Name:
Company Contact:
Email:
Website:
Address:

5. Questions to Industry (Please answer all that apply):

5.1. What do you foresee as the biggest obstacle your company would have in providing the proposed task referenced at **Para 3.1: The Systems Engineering for the Communication Ear Plug (CEP) and Microphone?**

5.2. What do you foresee as the biggest obstacle your company would have in providing the proposed task referenced at **Para 3.2: CEP wireless capability and Talk-through capability, CEP Comfort and ability to stay secure in-ear?**

5.3. What do you foresee as the biggest obstacle your company would have in providing the proposed task described by **Para 3.2? Do you have the ability to demonstrate compliance with Airworthiness and Environmental Standards with as per the requirements laid out at ANNEX B?** What test reports/proof do you have to demonstrate the above?

5.4. Referencing Para 3.4, **Describe how your proposed system have the ability to provide satisfactory communications intelligibility in the harshest of noise conditions for long periods of up to 20 hours without replacing batteries?**

5.5. Describe the general electrical compatibility requirements to operate your proposed components, if available. E.g., sensitivity, voltage bias, average current draw, impedance requirements.

5.6. Referencing the task described in Para 3.5; **What challenges do you foresee in collecting Aircrew Ear Canal Data and continuous manufacturing custom Communications Ear Plugs**? How would you approach ensuring this service and manufacturing sources are available into the future?

5.7. As described in Para 3.6**; Are there particular challenges or feasibility in design or sourcing of a Communication Ear Plug whereby the audio response of the plug material is capable of being "tuned" to optimally attenuate harmful noise per aircraft type**?

5.8. Para 3.7 speaks to the requirement for Active Noise Reducing modules to provide to a number of aircrew members who cannot fit custom Communication Ear Plugs. **What would the proposed ANR system be and how would you approach challenges to integrating the ANR product to utilize with the system in the case where a custom CEP could not be fitted?**

5.9. Ref Para 3.8; **How would you approach challenges to keeping the proposed system weight and footprint down?**

5.10. According to Para 3.9; the system must perform under the harshest of operational conditions. Of particular interest is avoiding condensation on the microphone element in sub-zero temperatures. **How would you approach this challenge and what proof or assurance would you produce to give Canada confidence to select your product?**

5.11. **Any other comments/questions**: Please describe any other information that you think Canada should consider for this project? This is also an opportunity to describe your product and company as identified as e.g. Canadian content, Indigenous community benefit, or otherwise providing some additional benefit/partnership to Canada for consideration in this project.

Thank you for your feedback!

Category	Standard	Requirement	Possible Method of Compliance	Industry Proposed alternative Method/Standard
General	C-05-005-001/AG-002	RCAF Airworthiness Design Standards Manual	Part 2, Certification Process Part 3, Chapter 15 ALSE (Helmets)	
	C-05-005-001/AG-001	RCAF Technical Airworthiness Manual	2.5.2.R1 Type Design Examination	
Noise Reduction	C-02-040-009/AG-001	When installed on a properly fit Helmet, the Hearing-Protected Overall Sound Pressure Level must not exceed exposure limits set by Canada Occupational Health and Safety Regulations (Part VII)	Baseline aircraft noise - ISO 5129 (2001), At ear insertion Loss, ANSI/ASA S12.42, 2010	
	C-02-040-009/AG-001	When installed on a properly-fit Helmet and receiving audio input from ICS, the Sound Pressure Level at the user's ear must not exceed occupational exposure limits	C-02-040-009/AG-001 Chapter 10	

	ANSI S3.5-1997	microphone must reject ambient environmental noise pickup to the level required for improved and acceptable speech intelligibility during aircraft operations in flight and on ground	Intelligibility –modified Rhyme Test SII value of 0.72 or better during normal operations with ICS volume level set to mid-range.	
EMI/EMC	MIL-HDBK-516C 13.1.1	**Flight/safety critical equipment requirements.** Verify that all flight-critical and safety-critical equipment comply with all electromagnetic environmental effects requirements, including lightning susceptibility, that are appropriate for the system application; or verify that appropriate flight restrictions are imposed.	Lab Test, MIL-STD-461 F or G RE102 & RS103 report provided by OEM	
	MIL HDBK-516C Para 9.53 ALSE MIL-HDBK-516C 9.5.1 Life support functionality MIL HDBK-516C Para 9.2.7 HFE	Where the life support system must interface with other air vehicle subsystems, verify that the operation of the life support system is not degraded by interference, and does not degrade, the normal or failure modes of operation of those subsystems (for example, controls and displays, escape systems, communication, environmental management system (EMS) CBRN Operations	User Testing	
	MIL HDBK-516C, Para 9.5.3, ALSE; Electrical Compatibility: • CEP • Speakers • ANC • Microphone Match all AHCU impedance and connectors with ICS system requirements and ICU compatibility and ensure adequate power supplied to all components	"AHCU modified helmets must be compatible with Electrical and physical characteristics of the ICS of the aircraft for which they are used.	*Verify the impedance for the device under test is matched to the specific aircraft system (5 ohm vs 150 ohm)* *Verify the Bias Voltage level (if provided) from the aircraft ICU to the AHCU modified helmet microphone and the nominal microphone voltage signal level to the ICU for AHCU modified*	

			helmets are compatible with the aircraft ICU	
	Information Publication-27, SDIP-27 (Ref P) Level A/Level B	Must meet NATO Security and Evaluation Agency Doctrine TEMPEST/Emission Security (EMSEC)	*Canadian Industrial TEMPEST Program (CITP)*	
	MIL-HDBK-516C 13.2.1	**Mutual electromagnetic compatibility of equipment and subsystems.** Verify that all equipment and subsystems exhibit mutual electromagnetic compatibility.	Aircraft-level EMI/EMC Source-Victim Ground/ Flight Test	
Software	FAA AC 20-171 FAA AC 20-115C RTCA DO-178C	Firmware development for AHCU and ANR will conform to Design Assurance Level D or above or equivalent	Assurance that software development passed verification IAW RTCA DO-178C (DAL D)	
Environnemental Qualification	MIL-STD-810G	Heat exposure Minimal deterioration of performance when exposed to plus 55ºC	Method 501.5	
	MIL-STD-810G	Cold Exposure Minimal deterioration of performance when exposed to minus 45°C	Method 502.5	
	MIL-STD-810G	a. Fog, mist, rain, sleet, snow and sea spray; and b. Condensation from user's breath	METHOD 506.5 METHOD 521.3 Procedure III or similar	
	MIL-STD-810G	Must withstand repeated freeze/thaw conditions, a. Freezing rain; b. Freezing spray; c. Hoar frost; and d. Freezing condensation from user's breath	METHOD 507.5, METHOD 521.3	

	MIL-STD-810G	components must resist degradation from immersion in fresh or salt water to a depth of 1 metres and must be functional after being rinsed in fresh water and completely dried;	METHOD 512.5 METHOD 509.5	
	MIL-STD-810G	ACHU components should function while still wet after immersion to a depth of 3 metres in fresh and salt water	METHOD 509.5	
	MIL-STD-810G	Salt/Corrosion resistance	METHOD 509.5	
	MIL-STD-810G	Sand and Dust, Smoke Particulate	METHOD 510.5	
	MIL-STD-810G	Mould/Fungus	METHOD 508.6	
	MIL-STD-810G	Direct Sunlight/ UV	METHOD 505.5	
	MIL-STD-810G	Vibration/Resonance	METHOD 514.6	
	MIL-STD-810G	Explosive Decompression (CEP components safely release pressure during decompression event.)	METHOD 500.5-2 METHOD IV	
Reliability/Endurance	MIL-STD-810G	AHCU components must resist degradation from commonly exposed petroleum, lubricants chemical substances and cleaning or decontamination chemicals	METHOD 504.1	
	ASIC Air Std 4065 ASTM F1930-00 (2008) or similar Heat flux 2 cal/cm^2 for 4 sec	Flame resistant - Exposed components must not combust, melt or drip after exposure to flames or flash fire equivalent to 2 cal/cm2* for a minimum of four (4) seconds	Verification from an acceptable Materials Testing Establishment (QETE or recognized industrial provider)	
	Must continue to meet AHCU performance requirements when worn with corrective, laser or ballistic protective eye glasses	STANAG 3828 22 May 2003	User with eyewear requirement carries out simulated operation with satisfactory results	

	Physical properties must minimize physiological impact on aircrew	Component Physical properties (C of G, Mass, MOI)	User Testing	
	MIL HDBK-516B Para 9.4.1 HFE	Communication Ear Plugs, after proper insertion, are not dislodged from the ear during donning and doffing of the helmet	User carries out simulated operation with satisfactory results	
	MIL HDBK-516B Para 9.4.1 HFE	Communication Ear Plugs, after proper insertion and donning of the helmet do not become dislodges or fall out of the ear during the performance of all aircrew task	User carries out simulated operation with satisfactory results	
System Integration	MIL-STD-1472H, Para 4.16	The design shall be compatible with all systems the user is expected to operate, maintain, or support. (note: in other words, the design must be compatible with other equipment and systems that are used with it. For example, different aircrew clothing (immersion suits, body armour, PHODS mask etc.)	User with experience with various equipment systems in operation finds AHCU System satisfactory during simulated operations; Records additional observations.	
	Sensitivity	-41dBV +/- 3dB @94 SPL	Lab testing carried out by manufacturer and certified by 3rd party	
Electrical Installation	Mil-STD-202G Wiring installation practices	All wiring should be arranged in a neat and workmanlike manner. Wires should be bundled and routed to minimize electrical coupling. Unless suitably protected, wire or cable attached to sensitive circuits should not be placed adjacent to a disturbing circuit.	Crimping: SAE AS 7928 Enclosure: MIL-STD-108	
	Soldering	Electrical and electronic equipment should be assembled, soldered, and cleaned in accordance with the guidelines of PC/EIA J-STD-001	PC/EIA J-STD-001	
Documentation	*Instructions for Continuing Airworthiness* *MIL HDBK-516C Para 9.4.5 procedures and troubleshooting)*	Technical manuals, technical orders and publications are evaluated with respect to usefulness and accuracy in the areas of job instructions (how to perform maintenance tasks), training, and job performance aids (fixed	*Review of user/ technical manuals for clarity and ease of use*	

AHCU Provisioning Rough Estimates				
		Amount	**Connector**	**Existing Mic Element**
Config 1	Non-TEMPEST (HGU-56P)	600	U174/U	M-87 5Ω
Config 2	Non-TEMPEST (190A)	200	U174/U	M-87 5Ω and M-7A 150 Ω,
Config 3	TEMPEST (HGU-56P)	1000	TP106	M162/AIC 150 Ω,
Config 4	TEMPEST binaural (HGU-56P)	200	TP108	M162/AIC 150 Ω,
	Training Aids	20	Training aids and test units to be a proportionally distributed variety of Configs 1/2/3/4	
	Test Units Total	30		
Grand Total Helmet Mod Kits		**2050**		
Active Noise Reduction Modules		**100**		