



REPORT TITLE: **REQUEST FOR INFORMATION FOR RETRACTABLE
Air To Air REFUELLING SYSTEM**

PROJECT: **FIGHTER AIRCRAFT**

CLASSIFICATION: **RESTRICTED**


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**AIRCRAFT RESEARCH & DESIGN CENTRE
DESIGN COMPLEX
HINDUSTAN AERONAUTICS LIMITED
BENGALURU – 560037**

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REQUEST FOR INFORMATION FOR RETRACTABLE Air To Air REFUELLING SYSTEM

1. INTRODUCTION:

HAL is engaged in Design, Development, Manufacture and Repair & Overhaul of Aircraft, Aero Engines, Helicopters and Accessories. HAL has designed and developed various fixed wing aircraft which are being used by Indian Defense services and Helicopters used for both defense and civilian applications.

HAL is currently involved in the design and development of Fighter aircraft involving state of the art technologies. The fighter aircraft is proposed to be fitted with Retractable Air-to-Air refueling system as a part of inflight refueling system to accomplish certain functions like extending combat radius, longer range and endurance.

The system shall consist of the following parts:

1. Probe Nozzle
2. Weak link
3. Extension and retraction mechanism
4. Hydraulic Motor
5. Probe Light Integrated in the Probe tip and Drogue light.

The unit shall be installed in the front fuselage of the aircraft. The Retractable Refueling system is of probe and drogue type, where in the Refueling drogue along with Refueling hose is deployed from the Refueling Pod of the mother aircraft. Refueling is performed with aircraft refueling nozzle coupled to mother aircraft's Refueling assembly: Hose, Reception Coupling and stabilizing Drogue Assembly.

In this regard, we require detailed information on the Retractable (Articulated or Telescopic or combination of both) refueling system proposed to be offered by vendor for the Fighter aircraft to enable to carry out a feasibility study of integrating on the aircraft.

2. GENERAL REQUIREMENTS

It is to provide In-flight refueling capability to the aircraft. The air refueling system has the function of safely transferring fuel from the tanker receptacle into the receiver aircraft. The aircraft should have the night refueling capability also.

1. The arrangements of retractable refueling probe on the various aircraft is attached at Appendix-A for reference. The final decision on the location of probe is based on the accommodation of associated mechanisms; pipeline and electrical routing required for the system within the available space envelope of the aircraft.

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2. Broad requirements for Retractable Refueling system, aircraft resources available and technical details requested are placed at Appendix –B to the RFI.

3. The vendor shall ensure the End-to-End Integration of system and its performance on aircraft including the technical support during the development flight trials and later for the in service aircrafts also.

4. The vendor should support for any defect investigation as part of Retractable Refueling system.

3. SUBMISSION OF RESPONSE

The vendor shall furnish the following information on the Retractable refueling system.

- a. Detailed technical specifications of the equipment being offered as response to this RFI. Details sought at Appendix – A and B shall be submitted.
- b. Different configurations of available Retractable refueling system, additional capabilities, features and specifications of the system shall also be mentioned.
- c. Information regarding system limitations, constraints and restriction, if any, shall be provided.
- d. Details of dependency on other OEMs for the supply of the Retractable Refueling system including other vendors LRUs being used is to be provided.
- e. Licensing requirements, if any, for supply of items to India are to be specified along with time lines for obtaining the same.
- f. Status of development of the Retractable Refueling system and time lines for availability of the Retractable Refueling system for integration on aircraft.

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Appendix-A

The arrangement of Retractable refuelling Systems on other aircrafts are shown below for reference. The final arrangement/ scheme will be based on volume required for probe and associated mechanisms, pipelines and electrical routing required for each option vis a vis space available in the proposed aircraft.

Fig. 1: Telescopic Refueling Probe



Refueling probe extension and retraction is achieved through telescopic mechanism. The inner concentric cylinders will slide through the outer cylinder mechanism.

Fig. 2: Retractable/Foldable type refuelling probe



The fuel probe pivotally mounted on aircraft. The retracted position of the probe is completely inside the aircraft.

Fig. 3: Retractable/Telescopic actuated type refuelling probe



Retractable Refueling system with telescopic and actuated mechanism. The Probe is provided with a support jack. The jack mechanism is based on either Mechanical / Electrical operation.

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Requirements:

1. **Envelope:** Vendor shall provide initial envelope / dimensions for the installation study. The final dimensions shall be established after detailed feasibility study is completed by Vendor along with ARDC design team.
2. **Mechanism:** To be established by the vendor in consultation with ARDC design. Rate of retraction and extension to meet MIL requirements.
3. **Indication:** Indication on extension and retraction of the probe shall be provided by the vendor.
4. **Electrical lights:** The vendor shall provide the electrical lighting details required for probe lights as well as for the drogue light
5. **Model:** vendor should provide a 3D model (compatible to CATIA) for carrying out the system drawings at our end and mock unit in extended and retracted condition for integration checks on the aircraft.


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Appendix-B


Technical details Requirements

Sl. No.	Parameters	Minimum Requirements	Vendor to specify
1.	Title and description	Retractable Air to Air Refueling system The system shall function as a subsystem of aircraft fuel system and it will be used while performing air-to-air refueling operations. Quantity required per aircraft: 01No.	Vendor to specify the detailed system architecture
2.	MIL Compliance	-	Vendor to specify all the MIL STD compliance of the system. It should cover the detailed part level MIL STD compliance.
3.	Operating media	Aviation kerosene IS 1571-2008/ F35 / Jet A-1 fuel (also mixed with Fuel System Icing Inhibitor) / JP-5 /JP-8, DERD 2494. Fuel System icing Inhibitor (Di-ethylene Glycol Monomethyl ether) conforming to MIL-P-85470/DEF STAN 68-252/AL-41. Mix of JP-4 & Jet A1 for different proportion. Compatible with bio fuel.	Vendor to specify compliance for each of the operating media.
4.	Space envelope	-	The final dimensions shall be established after detailed feasibility study is completed by Vendor along with ARDC design team.
5.	Equipment Definition	The equipment shall be provided with MA-2 Nozzle, weak link, probe mast and aircraft structural interface arrangement for integrating the probe on the aircraft.	
6.	Environmental Temperature	-55 ⁰ C to +95 ⁰ C	
7.	Fuel Temperature	-40 ⁰ C to +80 ⁰ C	


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8.	Design requirements:	<p>Operating pressure:120 psig Proof pressure: 240 psig Burst pressure: 360 psig Surge pressure: 160 psig (Ref. MIL STD) Maximum fuel flow rate: 80 m³/h (1333.4 lpm) at 3.5 bar (50.8 psi) Pressure drop: ≤ 75 kPa (10 psig) @ 990±20 lpm. Shall satisfactorily operate from SL up to 18 km Aircraft Mass: Preferably between 22 to 25Kgs (Including all components of System). Material: Aerospace grade Maintenance: On condition</p>	<p>Retractable refueling system design requirements and constraints if any to be provided by the vendor. Design parameters and test results with certification to be provided by the vendor. Vendor to specify weight details for all the LRUs.</p>	
9.	Mounting details	-	Vendor to specify mounting details	
10.	System interface	<p>Mechanical interfaces: MA-2 nozzle: The AAR probe nozzle shall be a Type 2 Class B MA-2 in accordance with MIL-N-25161C. STANAG 3447: Drogue around the AAR probe shall comply with STANAG 3447. Weak link: The AAR probe assembly shall have a weak link assembly installed between the AAR probe mast and the MA-2 nozzle to protect the probe mast, assembly and airframe from excessive hose loads.</p>	Vendor to provide the weak link details. The equipment shall comply with the relevant standards.	
11.	Equipment Life	<p>The equipment shall be designed to operate without scheduled maintenance for its full useful life Storage Life: The equipment shall not suffer any damage or degradation in performance when stored for no less than five (5) years (minimum) from the manufactured date marked on the identification label</p>	<p>Vendor to specify</p> <ol style="list-style-type: none"> 1. Storage Life 2. Total technical life 3. TBO 4. Functional service life of the equipment 5. Qualification Test schedule / Qualification test report for 	


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		without any periodical checks. Total Technical Life: The installed service life of the AAR probe assembly shall not be less than 3,000 Flight Hours or 45 Years whichever is earliest. Time Between Overhaul: 1000 Hrs./15 years (min.) whichever is earliest. Functional Service Life: The AAR probe assembly shall withstand 10000 fuel flow cycles with Surge pressure.	the unit. 6. Number of contact (includes Dry / Wet to specify.)	
12.	Electrical system and Electronics	Bonding & Grounding: Insulating components: There shall be no insulating Components or isolated conductors within the equipment. Single point failure bonding: Bonding shall not be lost through a single point failure. Bonding resistance: The equipment electrical bonding faying surfaces shall be less than 2.5 milliohms for the life of the AAR probe when measured end to end of the Probe from Nozzle tip to Spigot end. (As per MIL-STD-464)	Vendor to provide details.	
13.	Refueling envelope:	Speed - 400 to 600 kmph (216-324 knots) Altitude- 500 ft to 30,000 ft.	Vendor to specify the speed and altitude range of operation.	
14.	Light:	The probe light shall be twin filament type. The light shall be integrated in the probe tip position. The light shall have dimming facility which shall be controllable through an external potentiometer in the cockpit. The light shall be installed or shielded in such a manner as to prevent the light from being a source of direct	Vendor to provide details of probe and Drogue lights. Probe and Drogue Light should meet the required MIL STD.	

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		<p>or reflected glare to the pilot or crew.</p> <p>The Drogue Light shall be provided for area illumination for Night refueling operation. The light shall have brightness control provision by external potentiometer and it shall be possible to control brightness from zero to max.</p>		
15.	Technical Assistance:	-	Vendor to specify the areas/ stages of integration where vendor involvement will be required for ensuring system performance on aircraft.	
16.	Growth potential:	On growth potential, about 10% average marginal increase is taken in to consideration while designing the fuel system and finalizing the LRUs.	Vendor to specify on what all areas /components can capitalize growth potential.	
17.	Icing:	---	The supplier shall indicate any degradation in performance due to the probe being subjected FAR 25 max icing conditions.	
18.	Mechanism:	The actuation mechanism for Extension and Retraction of the probe shall be through Hydraulic system.	Vendor to confirm type of mechanism & description of functionality of the mechanism.	
19.	Lightning:	Lightning strike: When correctly installed, the AAR probe assembly shall not leak or rupture after being subjected to the appropriate lightning wave forms and levels in accordance with SAE ARP5412 for Zone 1A. (As per MIL-STD-1757A,)		

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20.	Removal / Installation	The unit shall be easily removable on ground and aircraft should be ready to flight at earliest.	Vendor to specify the time.
21	Tools & Tester	Required tools & tester during regular operation and inspection details to be provided.	
22	Door	The probe may be provided with a hinged door.	The attaching door should be within the stay out limits defined in ATP 3.3.4.6 (STANAG 3447). The vendor should provide the details of arrangement of door on aircraft side.

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