

UNITED STATES ARMY AVIATION BOARD  
Fort Rucker, Alabama

DRAFT MILITARY CHARACTERISTICS,  
FLYING CRANE VEHICLE  
PROJECT NR AVN 2558

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NAME - AVN-2558 - GENERAL

1. STATEMENT OF REQUIREMENT. - A heavy lift VTOL vehicle capable of transporting externally an 18-ton payload for a 20-mile radius of action. Operations will be conducted under visual conditions only. This item will be employed as a special means of transport of heavy equipment in tactical and logistical operations. Development and operation of this vehicle, subject to approval of the Secretary of Defense, will be in consonance with memorandum from the Secretary of Defense, 26 November 1956, subject: "Classification of Roles and Missions to Improve the Effectiveness of Operation of the Department of Defense." (LR) CDOG subparagraph number is 533a(14).
2. OPERATIONAL CONCEPT. - The vehicle will be employed in special, tactical, and logistical operations requiring air lift of heavy items of equipment over short ranges in order to cross natural or man-made barriers. The vehicle will have a vertical takeoff and landing capability. Only external loads will be transported.
3. ORGANIZATIONAL CONCEPT. - This vehicle will be assigned to units of the field army and will be attached or placed in support of subordinate elements for special operations requiring a heavy vertical lift capability.
4. CONSIDERATION OF TRIPARTITE, NAVY, AIR FORCE, AND MARINE CORPS DEVELOPMENT ACTIVITIES. - Consideration shall be given to the development of similar equipment by the US Navy, Air Force, and Marine Corps in order to prevent duplication of funds and effort. Close coordination will be maintained with the United Kingdom and Canada in order to take advantage of information on similar developments.
5. FEASIBILITY OF DEVELOPMENT. - If, during the development phase, it appears to the developing agency that the characteristics listed herein require the incorporation of certain impractical features and/or unnecessarily expensive and complicated components or devices, costly manufacturing methods and processes, critical materials, or restrictive specifications which do not enhance the military value of the Flying

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Crane Vehicle, such matters should be brought to the immediate attention of the Department of the Army and US CONARC for consideration before proceeding with final design.

6. BACKGROUND. -

a. At present, the Army's heaviest lift helicopter has a 3-ton payload. Army development of a 5-ton payload helicopter was halted in 1956 due to considerations of cost and complexity. The mobility required of Army units indicates that the Army must be capable of moving through the air across barriers to ground movement. Heavy items of equipment, such as weapons and combat vehicles, must accompany troops in the crossing of obstacles. A flying crane vehicle, having only an external load capability, appears to offer the best method of meeting the heavy lift requirement.

b. Proposed military characteristics (Project Nr ACD 753) for a heavy lift (flying crane) helicopter were prepared by Headquarters Board No. 1, Fort Bragg, N. C., and submitted to Chief, Army Field Forces, Fort Monroe, Virginia, ATTN: ATDEV-7, on 21 July 1953. In a letter from Office, Chief of Army Field Forces; Fort Monroe, Virginia, ATDEV-7 452.1/9, 25 January 1954, to Assistant Chief of Staff, G-3, Department of the Army, Washington 25, D. C., ATTN: Orgn. RD Br, O & T Div, it was recommended that no requirement be considered to exist at that time for the "flying crane" type helicopter in the Field Army.

c. Funding for parametric studies of the flying crane helicopter was approved by Ch/R&D, OCS, DA, in March 1956. Based on this approval, the Transportation Corps initiated Subtask No. 506 AV, Project No. 9-38-04-000. The first interim report on Project 9-38-04-000 "Summary of Parametric Studies of Flying Crane Helicopters" was completed in August 1957. This report concluded that it is feasible to build a flying crane with lift capability up to the 16-ton maximum considered in the study.

## II - OPERATIONAL CHARACTERISTICS

7. CONFIGURATION. - These MC's describe a multi-turbine powered, single or multi-rotor vehicle specifically designed for Army use. No specific designs are recommended; however, consideration shall be given the pressure jet and tip-mounted turbojet engines as a means for driving the rotor(s) (if applicable).

a. Structure and Design. The following are required:

(1) Multi-turbine power utilizing engines, if feasible, from the new family of turbine engines.

(2) Landing gear design shall permit straddling of typical loads cited in paragraph 7a(9) below, so that loading may be accomplished with the crane resting on the ground.

(3) Landing gear designed for flotation equivalent to that of a standard  $2\frac{1}{2}$ -ton truck. It shall permit landings on slopes of up to 10 degrees and preclude lateral spread occurring during landing or take-off. Landing gear shall permit running takeoffs and landings, and facilitate ground handling.

(4) Landing gear designed for operating from unprepared areas with provisions made for installation of kit(s) to facilitate operating in snow, mud, and swampy areas.

(5) Non-susceptibility to destructive ground resonance.

(6) Provisions for hoisting, jacking, mooring, and ground handling.

(7) Rapid blade-folding (or removal) to facilitate camouflage, concealment, maintenance, and movement by surface transport means.

(8) Minimum practicable overall dimensions.

(9) Provisions for lifting and carrying external loads only using both rigid connection to the airframe and sling carry. Typical loads shall be considered either regular or irregular in shape, at least 128 inches in width, 121 inches in height, and 480 inches in length in the form of single pieces of equipment, composite loads in cargo net(s) or on platform(s).

(10) Emphasis on simplicity of design and ease of maintenance.

(11) Rotor brake(s).

(12) Stability and controllability to permit ease of operation comparable to standard cargo helicopters.

(13) Exhaust flame suppressors.

(14) Maximum noise suppression.

(15) Down-wash velocities not to exceed 60 knots.

b. Pilot's and Copilot's Compartment. The following are required:

(1) Dual, primary flight controls.

(2) All switches and auxiliary controls, necessary for flight and navigation of the crane, accessible to the pilot and copilot when wearing winter flying clothes.

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(3) Three way adjustable pilot and copilot seats. (Fore-aft, up-down, and tilt to facilitate tow operation)

(4) Adjustable rudder pedals.

(5) Maximum practicable all-around visibility for the pilot and copilot.

(6) Door and cockpit space to permit ingress and egress when wearing winter flying clothes.

(7) Jettisonable door(s).

(8) Friction, or similar, locks for all power and flight controls.

c. Integral Equipment.

(1) General. The following are required:

(a) Dual engine and flight instruments as required for day and night operations; the type, size, location, and quantity to be based on the latest Army instrument studies.

(b) Windshield wipers for pilot and copilot.

(c) Adequate windshield defrosting and de-icing.

(d) Rotor blade de-icing or anti-icing protection for moderate icing conditions.

(e) Unobstructed crew view of the terrain in the hemisphere ( $360^{\circ}$  horizontally and  $-90^{\circ}$  vertically) below the aircraft so that sling operations can be observed.

(f) Automatic stabilization equipment.

(g) Controls for emergency shutdown of each engine, so designed that movement of a single emergency control will close the emergency fuel and oil shutoff valves and other necessary switches for individual engine and system cleanup.

(2) Cargo Provisions. The following are required:

(a) Provisions for both sling loading and rigid fastening of the load to the airframe.

(b) A cargo hook assembly capable of supporting loads of 36 tons.

(c) An appropriate cargo hook cable and quick release hook.

(d) The cargo hook assembly shall be designed to attach at or near the aircraft c. g. so as to preclude imparting undesirable moments to the aircraft due to acceleration of the load.

(e) Power driven mechanical means to facilitate loading and unloading. This means will permit lifting of 18-ton loads for rigid fastening to the airframe when crane is on the ground, and permit lowering and locking cargo hook cable for sling operations.

(f) Adequate clearance for sling load when swinging at moderate amplitudes.

(g) An electrically activated, load release switch located in accordance with latest MS standards. Hand operated mechanical emergency load releases will be accessible to each crew member at his station.

(h) An adequate means of discharging static electricity prior to and during load hookup and prior to and during load discharge.

(i) Automatic release upon ground contact of suspended load, after release of a safety lock that is easily accessible to the pilot and copilot.

(j) A means of stowing sling and hook when not in use.

(3) Electrical System. The following are required:

(a) Standard Army aircraft external power receptacle with protective cover.

(b) Integral self-starters with starter controls accessible to both the pilot and copilot.

(c) Position lights.

(d) Landing light(s).

(e) Lighting provisions to facilitate cargo loading and unloading.

(f) Appropriate lighting for all instruments, dials, and switches.

(g) Anticollision light(s).

(h) Blackout provisions in accordance with the latest studies for Army aircraft.

(4) Armor and Protection. The following are required:

(a) Fifty percent (50%) self-sealing fuel tanks and oil sumps.

(b) Fire warning system.

(c) Fire extinguishing system(s) for all engines.

(d) Design to minimize crash injuries and fire hazards.

(e) Provisions for installation of lightweight armor kits for the protection of the aircraft crew and vital components from low-velocity fragments and small-arms fires. This may consist of a combination of individual body armor and installed protective devices.

(f) Provisions for minimum infrared radiation.

(5) Human engineering is required.

8. PERFORMANCE. - Capabilities at design gross weight and under NACA standard conditions, except subparagraph "c" below.

a. Payload (excludes crew, cargo hook and sling assembly, fuel, and oil) - 16 tons for a radius of 20 nautical miles with a fuel reserve of 10% of the initial fuel.

b. Cruise speed (no load) - not less than 60 knots.

c. Shall meet Army hot-day requirement of being capable of hovering out of ground effect at an altitude of 6,000 feet above sea level and a temperature of 95 degrees Fahrenheit at design gross weight.

d. Safe autorotation in event of power or transmission failures. In the event a servo or control boost is furnished, such mechanism shall be operable during autorotation.

e. Stability and control comparable to standard cargo helicopters shall exist throughout the speed range and in all regimes of flight.

f. Shall be capable of an operating range of 100 nautical miles using installed fuel cells by substituting fuel for part of the maximum payload.

g. Shall be capable of a ferry range of 800 nautical miles using auxiliary fuel cells (kit) by substituting fuel for all of the payload.

h. Shall be capable of lifting loads of various sizes and configurations (see paragraph 7a(9)) and be capable of attaching and detaching loads from a hover and while resting on the ground.

i. Shall be capable of flight under day and night visual conditions.

9. DURABILITY AND RELIABILITY - The following are desired:

a. A minimum number of dynamic components all of which should be of the simplest design with a minimum of maintenance and service requirements. All dynamic components (except engines) should have a minimum service life of 1,000 flying hours without replacement. Design should facilitate component replacement under field conditions without special tools and equipment.

b. Engines and other dynamic components not to be materially affected by dust, sand, etc., encountered in operations from unprepared areas.

10. TRANSPORTABILITY.

a. Consideration should be given to the maximum extent possible, without altering operational requirements, to air transportability of components of this vehicle and to military sea transport.

b. A ferry range of 800 nautical miles with zero payload and without refueling is required.

11. ASSOCIATED EQUIPMENT - The following are required:

a. General.

(1) Standard safety belt and shoulder harness with inertial reel for all crew members.

(2) An installed auxiliary power unit of sufficient capacity for sustained operation of all systems without assistance from the primary engines.

(3) Provisions for installation of a kit to provide this crane with an air-ground tow capability.

b. Complete provisions shall be made for installation of the following tactical electronic equipment.

(1) Communications:

(a) UHF Radio Set.

- (b) FM Tactical Radio Set.
- (c) Intercommunication system between crew members to include external jacks.

(2) Navigation:

- (a) FM Homer.
- (b) LF Automatic Direction Finder.

(3) Identification: IFF Transponder.

c. Installed equipment of a non-tactical nature, i. e. anti-collision light, should not be included in the empty weight of the aircraft, but should be considered a penalty against payload. These items should be easily removable for tactical operations where maximum payload capability is desired.

### III - SPECIAL CHARACTERISTICS

#### 12. ENVIRONMENTAL AND TERRAIN REQUIREMENTS.

a. Temperature and Heat Requirement:

- (1) Capable of operation from -25°F to +125°F without modification.
- (2) Crew compartment ventilation system to provide endurable conditions with outside temperature of +125°F.
- (3) A crew heater system to provide an inside temperature of +40°F with an outside air temperature of -25°F. These conditions must be met for both air and ground operations.
- (4) Provisions for installation of a kit(s) to make the flying crane operable at temperatures down to -65°F and to provide the crew compartment with a minimum temperature of +40°F. These conditions must be met for both ground and air operations.

b. Materials shall be used that provide maximum resistance to the harmful effects of fungi, humidity, rain, snow, salt water, and extreme dust and dirt.

c. Conform with storage requirements of paragraph 7d, AR 705-15, 14 August 1957.



13. CBR AND ATOMIC REQUIREMENT. - Provisions shall be made to permit loading and unloading of nuclear weapons of the Army missile family.

14. KIT REQUIREMENTS. - The following are required:

a. A winterization kit (if applicable) to permit operation in temperatures from  $-25^{\circ}\text{F}$  to  $-65^{\circ}\text{F}$ , and capable of installation without major modification to the airframe.

b. A heater kit (if applicable) to provide a crew compartment temperature of  $+40^{\circ}\text{F}$ , for both ground and air operations, at outside temperatures from  $-25^{\circ}\text{F}$  to  $-65^{\circ}\text{F}$ .

c. Armor kit(s), as required, to protect the crew and vital components on the vehicle.

d. Long range ferry kit(s).

e. Air-ground towing kit.

f. Refueling system, aerial.

g. Landing gear conversion kit.

15. MAINTENANCE AND INTERCHANGEABILITY REQUIREMENT. - Structural and design features shall provide for:

a. Ease of unit replacement of major components under field conditions. Quick disconnects shall be utilized wherever possible. The "go right" or "no go" design principle shall be employed.

b. Ease of maintenance, servicing, and ground handling at the using echelon with minimum of special tools and equipment.

c. Interchangeable and individually replaceable rotor blades (if applicable).

d. Visual inspection of all fluid reservoirs to determine fluid level without removal of covers or fairings.

e. Maintenance of high points by use of integral steps and handholds.

f. Adequate means of fueling and rapid integral de-fueling to include jettisoning. Fuel opening shall accommodate standard fuel nozzles and be readily accessible.

g. An interval between periodic inspection of the vehicle of at least fifty (50) hours.

#### IV - ORDER OF PRIORITY OF CHARACTERISTICS

16. If, during the development of this equipment, certain desirable characteristics are unattainable without compromise of other desirable characteristics, the priority of desired characteristics shall be as follows:

- a. Payload at stipulated operational conditions (performance).
- b. Durability and reliability.
- c. Maintenance and interchangeability.
- d. Transportability.

#### V - ITEMS SUPERSEDED BY THIS ITEM

17. This vehicle does not replace any existing aircraft or vehicle; however, these MC's do supersede "Proposed Military Characteristics for Heavy Lift (Flying Crane) Helicopter" Project No. ACD 753, Headquarters Board Nr 1, Office, Chief of Army Field Forces, Fort Bragg, N. C., 21 July 1953.

APPENDIX

COORDINATION

"Draft Military Characteristics, Flying Crane Vehicle, Project Nr AVN 2558," was coordinated locally with the United States Army Aviation School, which provided the following reply:

1. Reference 1st Indorsement AASCD 452.1, dated 24 Jun 58, subject: "Qualitative Materiel Requirement for a Flying Crane Vehicle," United States Continental Army Command, to letter ATSWD-S 452.1/224 (29 May 58), dated 29 May 58, subject: Same as 1st Indorsement.
2. In the 1st Indorsement referenced in paragraph 1 above, the United States Army Aviation School questioned the desirability of submission of a statement of materiel requirement for an eighteen (18) ton capacity "flying crane" type vehicle at this time and recommended development of a ten-twelve (10-12) ton flying crane type vehicle as being more nearly within the state-of-the-art, the next logical step in the evolution of helicopters, and more reasonable in cost.
3. However, if it has been determined by Headquarters, United States Continental Army Command that despite the above, a requirement does exist for an eighteen (18) ton flying crane, the United States Army Aviation School concurs with the draft military characteristics, subject as above, as written.
4. Due to insufficient time for determination, the Training Devices Requirements will be forwarded under separate correspondence in approximately 15 days.

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