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MILITARY SPECIFICATION

MOCKUPS, AIRCRAFT, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense

1. SCOPE

1.1 Scope - This specification covers the general requirements for the construction of aircraft and related system mockups for formal evaluation and the preparation of mockup data.

1.2 Classification - Mockups covered by this specification are for the following types of aircraft:

Fixed and Variable Sweep Wing
Rotary Wing and VTOL/STOL
Remotely Piloted Vehicle (RPV)

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

2.1.1 The document applicable to this specification is the contract detail/prime item development specification for the actual aircraft for which the mockup is constructed. For Navy procurement, the Specification Sheets listed on Supplement I shall also be applicable.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General - The physical characteristics of a mockup shall simulate those of the proposed aircraft. Unless otherwise specified, the

mockup shall be a full size representation of the aircraft to the extent specified herein and shall permit the checking of compatibility with the handling, maintaining, loading and operating requirements for the aircraft and its equipment, particularly in regard to crew and passenger stations, cargo and weapons provisions, equipment arrangements, propulsion system, installations, vision, clearance, lighting, personnel safety, etc. Approval of a mockup enables the contractor to proceed with the design of the actual aircraft with reasonable assurance that the general arrangement and installations of equipment will be service accepted and will not be radically modified. Use of the exact structure to be employed in the actual aircraft is not required. However, the general type of construction shall be indicated and the size and location of members which affect vision and critical clearances shall be correctly simulated and accurately located. Cables, tubing, piping, structural members in areas of possible interference with the maintenance or removal of equipment or with aircrew escape shall be mocked-up to show the accessibility provided. Provisions for hoisting the entire aircraft and for removable components too heavy for manual handling shall be mocked-up. Unless otherwise specified, items mocked-up need not be of actual material or weight but shall be mounted in the proper locations and be of actual size and shape with mounting points. Controls, limits, and direction of control movements shall be accurately simulated. All items not readily identifiable shall be clearly marked with the appropriate designation and descriptive name. Items subject to relocation shall be attached to the structure in a manner which will permit the location to be easily changed. Items having both an installed and stowed location shall be located in the installed position and stowage provision shall be mocked-up. Provision for servicing propulsion system components, and all other components that require servicing, shall be mocked-up. These mocked-up components shall be identified, and their access openings shall be provided and marked appropriately. Any installations specifically required by the aircraft detail/prime item development specification to be approved by the Mockup Board shall be identified. Any installations representing deviations from applicable specifications which are incorporated in the mockup prior to receipt of specific procuring service approval, shall also be identified. A photographer shall be made available to take self-developing film photographs (Polaroid or equivalent) depicting each area of recommended change as required by Mockup Board Representatives.

3.1.1 Categories of Mockups -

Class 1 - Constructed of inexpensive materials, proportionally but not necessarily dimensionally accurate. Used to determine shape, allocate space, or used to present a new idea.

Class 2 - Constructed of good grade materials with overall dimensions as close to drawing as practical. Production materials are used in critical areas and installations are per drawing. Used in detail design and as a demonstrator.

Class III - Constructed of production materials with production tolerances. All structures and equipment should be actual or simulated wherever practical. Used to determine layout of plumbing lines, electrical wiring runs, and to prove out all installations prior to actual production.

3.1.2 Government furnished equipment (GFE) - Items of government furnished equipment (including dummy or non-serviceable items and all personal and safety equipment to be used in the aircraft such as parachutes, oxygen equipment, anti-exposure suits, anti-blackout equipment, pressure suits, protective helmets, etc.) which are required for a mockup and are not available to the contractor's plant, shall be requested from the procuring activity not less than 90 days prior to the date of official Mockup Board Inspection. So far as practicable, government-furnished-equipment (GFE) items for a mockup will be as specified in the detail specification for the actual aircraft. In cases where GFE is not available, the contractor shall provide a dimensionally identical article as specified by the procuring activity.

3.1.3 Mockup and mockup conference room - The mockup and the mockup conference room shall be located in quiet areas. The mockup conference room shall be located in the same area as the mockup or as close as practicable. Provision shall be made for not less than three persons to stand outside the mockup on each side of the cockpit. Platforms and walkways, if used for this purpose, shall have non-slip surfaces and be properly guarded and removable.

3.1.4 Security - The mockup and the mockup conference room (during conferences) shall be accessible only to persons authorized by the DCASO (see 6.2) unless otherwise approved by the procuring service.

3.1.5 Strength requirements - The strength of the structure shall be sufficient to support all mockup equipment and the weight of mockup inspection personnel. The strength of the stick or control column, throttle, rudder pedals and adjusting mechanism, seats and adjusting mechanism, walkways, work platforms, steps, handholds and attaching structure shall be such as to withstand repeated and severe usage during mockup inspections.

3.1.6 Table top mockup (mobile items of contractor furnished support equipment) - If requested by the procuring activity, a tabletop mockup of the aircraft and all mobile items of contractor furnished support equipment shall be provided. The tabletop mockup shall not be smaller than 1/20th scale or as specified by the procuring service and shall accurately reproduce all envelope and clearance dimensions to scale. It may be constructed of the most economical material suitable for the purpose stated herein. The aircraft model shall simulate by manual means the following functions when applicable: wing folding, wing sweeping, wing tilting, rotor tilting; for helicopters: main, tail rotor and pylon folding, flap extension, fin folding, engine installation and removal, but need not simulate landing gear retraction. The purpose of this mockup is to detemine that the envelope and clearances of the aircraft and contractor furnished mobile support equipment, for which full scale mockup is not feasible, are compatible with the use of existing equipment in an operating environment and/or a shipboard environment, if applicable.

3.1.7 Deviations - Deviations from this specification will not be permitted unless specifically approved by the procuring service.

3.1.8 Human performance requirements for mockups and models - At the earliest practical point in the development program and well before fabrication of system prototypes, Class I or II full-scale three-dimensional mockups of equipment involving critical human performance (such as an aircrew compartment, maintenance work shelter, or a command control console) shall be constructed. The proposed Human Engineering Program Plan shall specify mockups requiring procuring service approval and modification to reflect changes. The workmanship shall be no more elaborate than is essential to determine the adequacy of size, shape, arrangement, and panel content of the equipment for use by man. The most inexpensive materials practical shall be used for fabrication. These mockups and models shall provide a basis for resolving access, workspace and related human engineering problems, and incorporating these solutions into the weapon system design. In those design areas where equipment involves critical human performance and where human performance measurements are necessary, functional mockups shall be provided, subject to prior approval by the procuring service. The mockups shall be available for inspection as determined by the procuring service. Upon approval by the procuring service, scale models may be substituted for mockups. Disposition of mockups (see 5.1) and models shall be as directed by the procuring service after approval by the Mockup Board and prior to delivery of the final contract aircraft detail/prime item development specification for the applicable weapon system.

3.2 Airframe systems - The external configuration of the mockup shall represent that of the actual aircraft as far as practicable.

3.2.1 Wing group - The left wing panel shall be completely mocked-up. Mockups for folding wing or sweepwing aircraft, when applicable, shall permit folding and sweeping of the wing and securing it in the folded and sweep positions. Control surfaces shall be movable where clearances with the ground, external stores, folding or sweepwing wings are critical. The right wing panel shall be mocked-up only as necessary to demonstrate access, or asymmetrical installations. However, where applicable on multiengine aircraft, the right wing panel shall be partially mocked-up to include the nacelles to permit checking of the engine installation and removal and checking of the propellers and cowl flaps. In lieu of this requirement, the propellers and cowl flaps may be simulated in space by other means. Tiedown, jacking and hoisting provisions shall be mocked-up.

3.2.2 Main and tail rotors - Rotor hubs and complete main rotor blades including complete tail rotor shall be mocked-up as necessary to demonstrate blade clearances, folding, and blade stowage.

3.2.3 Tail group - The left side of the tail group shall be completely mocked-up except for helicopters (see 3.2.2). Control surfaces shall be movable where clearances (including clearances with the ground or external stores) are critical. Mockups of aircraft with folding tail and helicopters with folding tail rotors shall permit folding of the tail and tail rotor and securing it in the folded position and shall include all connections, releases, etc. required to accomplish the folding operation. The right side of the tail need be mocked-up only as necessary to demonstrate accessibility. Tandem rotor helicopters shall be fully mocked-up.

3.2.4 Body group - When applicable, the fuselage or hull shall be completely mocked-up including crew stations, passenger stations, cargo compartments, cargo handling equipments and helicopter slings/rescue hoists, equipment compartments, sleeping quarters, mess facilities, sanitation facilities, doors, hatches, escape provisions, handgrips, steps, tiedown, hoisting or jacking provisions, etc. except that the right side of the fuselage or hull may be left uncovered. Emergency escape routes for crew and passengers shall be clearly indicated. Convenient and ready access shall be provided to all crew stations, passenger stations, cargo compartments, equipment, etc.

3.2.5 Landing gear -

3.2.5.1 Ground type - The landing gear shall shall be mocked-up to correspond to a static 1g load condition. Tie down and jacking provisions shall be mocked-up, including dummy retracting mechanism, if applicable. Retractable-type main landing gear shall be capable of movement from the retracted to the extended position, but need not be operable from the cockpit. The auxiliary landing gear shall be completely mocked-up, including fairing and dummy retracting mechanism, if applicable.

3.2.5.2 Water type - The normal load-water-line shall be shown on the hull of seaplanes. The left auxiliary float or hydrodynamic planing or lift device shall be completely mocked-up with bracing and dummy retracting mechanism, if applicable. For helicopters, flotation provisions shall be mocked-up.

3.2.5.3 Ski type - The requirements of 3.2.5.1 shall apply. Also, the ski and snubbing system shall be mocked-up and inspected in both the retracted and extended positions for clearance while fixed and in transit.

3.2.5.4 Amphibious type - The requirements of paragraphs 3.2.5.1 and 3.2.5.2 shall apply.

3.2.6 Flight control system - the flight control system including wing sweep control shall be completely mocked-up with all controls operable throughout their entire movement envelope although they need not operate their respective surfaces. For helicopters, rotor

friction devices shall be mocked-up. Stops shall be installed to limit all control movements to those to be obtained on the actual aircraft. Control locks and means for adjusting the rudder and brake pedals shall be provided. Controls and displays, as applicable, shall be provided for wing sweep, flaps, dive brakes and tabs. Signaling, sensing, computation, and actuation elements and parts of, safety critical flight controls shall be mocked-up to enable physical positions and routing aspects to be ascertained with respect to other aircraft subsystems. Controls and displays, as applicable, shall be provided for wing sweep, flaps, dive or speed brakes, slats, glove vanes, trim and other tabs, etc. The neutral position of the control stick or yoke shall be simulated.

3.2.7 Automatic flight control systems - All major components (including controls) of the AFCS (Automatic Flight Control System) and APC (Approach Power Compensator) shall be mocked-up with hydraulic lines and cabling simulated only in the vicinity of terminating equipment.

3.2.8 Hydraulic and pneumatic systems - All major items of the hydraulic system and pneumatic system shall be mocked-up including main and emergency pumps, reservoirs, accumulators, filters, controls and sufficient piping to show clearances.

3.2.9 Environmental control and anti-icing equipment - The major internal items of air conditioning, pressurization, engine bleed air, defogging, and anti-icing equipment shall be mocked-up including heaters, heat exchangers, air conditioning units, water separators, fluid tanks, pumps, ducts, and controls.

3.2.10 Fire protection - All firewalls, fire shields, fire insulating walls, fire detection and fire extinguishing systems shall be mocked-up. Particular attention shall be paid to the location of fire detection elements. Where applicable, portable fire extinguishers shall be accurately located within the aircraft.

3.3 Aircrew systems -

3.3.1 Cockpit - Cockpits or crew modules shall be completely mocked-up in accordance with requirements of the systems detail specification/prime item development specification and shall include items, if applicable, such as: surfaces fold control levers (and separate lever (handle) for engaging the mechanical lockpins), wing sweep controls, flight controls, propulsion-system controls including propulsion fluid systems, controls for retractable landing gear and tailwheel lock, nose wheel steering control, catapulting controls, arresting-hook controls, for helicopters wheel and rotor brake controls, electrical and electronic consoles and controls, escape system controls, oxygen-system controls, armament equipment and controls, instruments and navigation equipment, automatic-stabilization-system and auto-pilot controls, lighting equipment and controls, photographic equipment and controls, normal and emergency controls for canopy actuation including jettisoning, emergency-escape control

(crew module), cockpit furnishing and equipment including mirrors, quick disconnect for "g" suit, environmental controls, microphones, headphones, etc. All major controls shall be provided with load simulation if practicable. This is particularly important on landing gear, flap, dive brake, and emergency-dump controls. Where applicable, the mockup shall include the catapult throttle grips to show the stationary grip provided the pilot while holding the throttle in "INTERMEDIATE" and "MAXIMUM" thrust positions during launch accelerations. All controls, knobs, handles, etc. shall operate to simulate actual functions on the aircraft (e.g., if the control requires two motions such as turning before pulling, has detents, or a release latch, etc. the mockup shall include these features).

3.3.2 Other crew stations - All other crew stations (e.g., radio operator, radar operator, navigator, systems engineers, Radar Intercept Officer, Missile Control Officer, electronic technician, hoist/cargo/winch operator, gunner, etc.) where applicable, shall be completely mocked-up and shall include all instruments, controls, equipment and external windows as applicable, etc. required at each crew station. Where applicable, the means for crew members to brace during launching shall be completely mocked-up.

3.3.3 Passenger stations - Sufficient passenger stations (including stations for troops, litter patients, medical attendants, etc.) shall be completely mocked-up to show aisle width, and fore and aft clearances between seats with seats in extreme positions of adjustment. In addition, passenger service modules (lighting, oxygen and gasper facilities) and personal emergency equipment shall be indicated.

3.3.4 Vision - Means shall be provided in all mockups for locating the design eye position. Cockpit transparencies including framing, hatches, windows, etc. shall be mocked-up in sufficient detail that overall field of view from the cockpit is accurately depicted. In all cases, the clear viewing area in true relation to the actual vehicle shall be provided. Where practicable, transparencies provided in the mockup shall be within the desired optical quality limits of that installed in the actual aircraft. Radii of curvature, thickness of panels, and framing widths for windshields and other transparencies in the cockpit shall be those approximating the actual aircraft. Data concerning, and devices which demonstrate the extent and magnitude of visual effects, i.e., multiple images, loss in transmission, distortion, etc. resulting from the various angles of incidence, radii of curvature, obstructions, and optical deficiencies shall be provided. Adverse weather vision aids shall be mocked-up. When an automatic thermal protective closure is required, means shall be provided to show the ready and/or stowed positions of the closure and the extent of vision for the specified aircrew population relative to all seat positions.

3.3.4.1 Landplanes - Mockups for landplanes (including the landplane mode of amphibious aircraft) shall include provisions for clearly demonstrating landing vision achievable from the design eye position(s). At a minimum, the demonstration shall include vision quality related to approach and landing on a 300 x 11,600 foot runway from a 3 degree glide slope. Demonstrations shall be made simulating distances of 1/4, 1/2 and 1 mile from the end of the runway with aircraft pitched at a maximum angle of attack of landing.

3.3.4.2 Carrier-based, fixed wing aircraft - Mockups shall include provision for clearly demonstrating the view which the pilot will have of the pilot signal lights of the Integrated Catapult Control Station (ICCS), Fresnel Lens Optical Landing System (FLOLS) and the Landing Signal Officer (LSO) during a catapult launch/carrier approach. Presentations, which shall be suitably located, should show true scale views of the carrier flight deck, flight deck markings, the drop line lights, the FLOLS, and the LSO as they will appear to the pilot at distances of 150 feet, 300 feet, 450 feet, 1/4 mile and 1/2 mile aft of the carrier, measured from the design eye position. For this presentation, the aircraft should be on line with the centerline of the carrier landing area in an attitude corresponding to the minimum approach speed at design arresting weight and on a constant glide path of 4 degrees to the level of the carrier deck aligned so that the arresting hook will touch down 175 feet (for CVA-41 to -62) and 240 feet (for CVA-63 and later carriers) forward of the ramp. The FLOLS should be shown to the left of the centerline of the landing area with its centerline 86 feet from this centerline and located with its base 475 feet forward of the ramp and its datum lights at deck level. The LSO should be assumed to be 125 feet forward of the ramp and 120 feet to the left of the centerline of the landing area (see 3.10.3).

3.3.4.3 Ship-based helicopters - Mockups shall include provisions for the pilot's view of the Glide Slope Indicator (GSI) and the Landing Signalman Enlisted (LSE), during take-off, approach, hover and landing, including hovering for Helicopter In Flight Refueling (HIFR) and Vertical Replenishment (VERTREP) as required by aircraft mission. Presentation shall show scale views of typical ships from which the aircraft will operate and include appropriate Visual Landing Aids (VLA) such as flight deck markings and lighting as they would appear to the pilot for the following conditions:

a. Take-off position on the deck.
b. Approach to the landing area, in line with the approach line, on a constant 3° glide slope, at aircraft attitudes corresponding to a normal approach, at distances of 1/4 mile, 300 feet, 150 feet and in a 15 foot hover over the landing area.

c. In a 15 foot hover over the VERTREP position aligned with the VERTREP line.
d. In a 15 foot hover over the HIFR position, parallel to the centerline of the ship.

3.3.5 Cargo compartments - Cargo compartments shall be completely mocked-up including lighting, normal and emergency ingress and egress doors, hatches, and controls, and shall have provision for demonstrating practicable distribution of cargo and personnel. Cargo tiedown rings, and seat and litter attachment fittings shall be mocked-up to the extent necessary to demonstrate use of these items. Cargo doors shall be mocked-up to show the doors in the fully open position and show clearance for cargo loading equipment. Provision also shall be made for demonstrating loading and unloading facilities.

3.3.5.1 Other compartments - Equipment compartments, avionics racks (with enclosed equipment), passenger accomodations such as toilets, galleys, food stowage facilities, dinettes, bunk areas, clothing stowage, cabinets for publications, secure data and repair equipment, shall be completely mocked-up.

3.3.5.2 Trim and finish - Interior trim surfaces and equipment shall be in accordance with the selected color scheme, and where reflectance considerations are critical, the texture of the proposed finish. Color accuracy of painted, formed and fabric finishes shall be most critical whenever deviations are anticipated from established schemes. Textures and multi-hued patterns, when used, shall approximate the final selections as closely as possible.

3.3.6 Furnishings and equipment - All furnishings and equipment shall be represented as closely as possible to size, shape, and location. Actual safety belts, shoulder harness, parachutes, life rafts, emergency kits, seat pads, back pads, survival kits, armor, portable fire extinguishers, etc., shall be installed. If actual equipment is not available, it may be simulated. Seats shall be of exact size and shape with full adjustment range. Pilot seats shall be capable of actual adjustment and operation by the pilot alone with minimum effort. Escape systems shall be so mocked-up that seat/crew member removal may be demonstrated and that they may be moved along the ejection path for checking clearances with fixed items in the aircraft. All seat components, such as seat kits, seat pads, etc., shall be simulated to represent the actual aircrewman body positions/attitudes throughout the normal operating range. All safety pins for seat and canopy shall be mocked-up. Location of emergency exits shall be clearly marked.

3.4 Propulsion systems -

3.4.1 Engine - The basic and all alternate engine installations shall be completely mocked-up. Engine mounts and air vehicle interface disconnects shall be of actual, or closely simulated components. The mockup shall include provisions for engine removal and reinstallation.

3.4.2 Engine section or nacelle group - The engine section or nacelle group shall be completely mocked-up including engine mounts, ring and engine cowls, adjustable cowl flaps, baffles, air intakes, alternate airdoors, engine inlet ramp and spikes, bult-in working platforms, firewalls, shrouds, maintenance and servicing access doors (including the type of hinge and closing means utilized), engine inlet screen and particle separators, etc., if applicable.

3.4.3 Propulsion system controls - Propulsion system controls shall be completely mocked-up including controls for engine accessories, propeller, starting system, cooling system, lubricating system, fuel components, water injection system, APC/throttle systems, anti-icing system, icing rate meter system, and reverse thrust. For helicopters, gear boxes and drive shafts including rotor brake shall also be mocked-up.

3.4.4 Propeller - The propeller shall be mocked-up in the most critical pitch position for cowl clearance and shall include dummy propeller, spinner, cuffs, etc.

3.4.5 Engine accessories - Engine accessories shall be completely mocked-up including all intake and exhaust ducting to actual size, shape, and location with valves and/or variable area nozzles, pumps, lines and controls.

3.4.6 Starting system - The starting system shall be completely mocked-up including starter, tubing, control valves, other controls as required, and ducting. Non-standard electrical connectors or fittings for which approval has been given or requested shall be displayed.

3.4.7 Cooling system - The cooling system shall be completely mocked-up including engine compartment cooling and baffles.

3.4.8 Lubricating system - The lubricating system shall be completely mocked-up including dummy tanks, filler units, filter units, oil coolers, oil dilution system, provision for propeller oil as applicable, piping, important valves, fittings, drains, disconnects, etc. Piping may be represented by rubber hose or equivalent.

3.4.9 Fuel, vent, smoke abatement and water injection system - The fuel system, fuel vent system, smoke abatement system and water injection system shall be completely mocked-up, including internal and external fuel tanks, filler units, valves, fittings, drains, disconnects, aerial refueling probe, probe actuation system, hose reel, fuel dump outlet, fuel vent inlets and outlets, and all necessary piping to identify any critical clearances.

3.4.10 Auxiliary power unit - The auxiliary power unit shall be completely mocked-up and shall be comparable in detail, weight and center of gravity with the propulsion system installation.

3.4.11 Electric power system - All items of the electric power system shall be mocked-up including generators, generator drives, voltage regulators and/or generator control panels, emergency power package, ram air turbine, voltage regulators, current transformers, cut-outs and inverters. Cooling system and/or lubricating system for electrical power components shall be completely mocked-up including ducts, piping, tanks and valves.

3.5 Avionics systems -

3.5.1 Electronics - All items of electronic equipment shall be completely mocked-up including panels and console structure, antennas, masts, lead-ins,and cooling air. Cabling need be simulated only in the vicinity to the terminating equipments.

3.5.2 Electrical distribution and control - Electrical distribution and control equipment shall be mocked-up. This shall include wiring, cabling, connectors, junction and terminal panels, relays, contractors, switches, circuit breakers, fuses, meters. Where similar items are in large numbers, representative pieces only need be displayed. Major wire runs shall be mocked-up including critical wires (power feeders, electrically unprotected wires, congested area wires) as well as representative wiring to illustrate installation techniques and hardware.

3.5.3 Instruments - All components (including bezels, dials, set-knobs/switches, etc.) representing all specified instruments or other appropriate displays shall be mocked-up and presented in the mockup. Apart from the mockup, additional instrument panels shall also be provided to facilitate review of the instrument arrangements. These instruments and displays may be mocked-up and can have magnetic and/or adhesive backing capable of adequate repeated usage.

3.5.4 Navigation equipment - All major items of navigation equipment shall be mocked-up including chart and plotting boards, drift sights, periscopic sextant, map cases, binoculars, ground-positioning indicators, and dead reckoning tracers.

3.6 Armament systems - The armament installation shall be completely mocked-up including fixed and flexible guns and accessories, turrets, rockets and accessories, fire-control systems, internal or external stores as applicable (including racks, pylons, supports, shackles, sway bracing, displacing gear, etc.), dummy armor plate and bullet resisting glass as applicable, guided missiles, and hoisting provision.

The fixed and flexible guns and fire-control equipment shall permit the full range of adjustment and travel. Particular attention shall be given to showing all armament installations in such detail that clearances (both ground and structural), physical arrangement, loading details, including ejector cartridges, electrical and arming details and hoisting provisions can be readily checked. The arrangement shall be such that hoisting of internal or external stores, loading and unloading of gun ammunition, and removal and installation of guns, as applicable, may be demonstrated. Timed demonstrations of normal service arming procedures may be required. For missile installations, the preceding shall apply as applicable; however, the missile launching mechanism shall be completely mocked-up and capable of movement through the normal operating travel.

3.7 Survivability/vulnerability provisions - Survivability enhancement/vulnerability reduction features and techniques peculiar to the specific design shall be mocked-up. These features shall include, but are not necessarily limited to, such designs as voids and associated materials incorporated therein to provide fire protection and/or blocking of fire paths; routing of lines carrying flammable fluids; ballistic shielding of critical components by non-critical components. Other system survivability enhancement features will be depicted in the associated specific systems mock-up requirements of this specification.

3.8 Ship installations and auxiliary gear -

3.8.1 Ship installations - All catapulting provisions, including the launch bar, actuating mechanisms, holdback fitting, uplatches, etc., shall be mocked-up as applicable. Any other provisions for assisted takeoff, such as JATO, shall be mocked-up. The arresting hook installation shall be mocked-up including the hook shank, detachable hook point if applicable, holddown/dashpot, actuator, uplatch, accumulator, fillports/gauges, bumpers and fairings. Provisions for the helicopter recover, securing and traversing systems shall be mocked-up as applicable. For all of the above systems, the external dimensions, shapes, freedom of movement, locations, clearances, etc., shall be accurately represented.

3.8.2 Auxiliary gear - auxiliary gear shall be completely mocked-up including anchor gear, towing provisions, mooring provisions, provision for catapulting and jet-assisted takeoff, leveling provisions, and arresting gear. The arresting hook shall be reproduced to external dimensions, shape of point, degree of movement, point of attachment, and clearances. The hold down and retrieving mechanism shall allow a cycle of operations. Bumpers shall be shown. Leveling provision (plumb bob or leveling lugs) shall be clearly indicated. For those helicopters utilizing any recovery assist system type of hauldown system, the messenger winch cable installation shall be included in the mockup.

3.9 Special equipment and special support equipment - All applicable major items of special equipment and special support equipment shall be mocked-up including beaching gear with means of attachment and provision for handling, target-towing equipment, hoisting slings, propeller and engine hoists, bomb hoists and loading platforms, steering and tow bars, jack pads, control-surface locking device, landing-gear ground locks, wing securing device, ground service equipment, and aircraft launching accessories.

3.10 Photographic equipment - Photographic equipment and controls shall be completely mocked-up.

3.11 Lighting systems -

3.11.1 General - A full scale lighting mockup of the interior and exterior lighting shall be available for inspection by a Lighting Mockup Board as soon as practicable after approval of the aircraft mockup. The mockup shall be so constructed to view the lighting in day or night conditions. The aircraft mockup may be employed for exterior lighting inspection. The aircraft mockup may be employed for crew stations (except the cockpit), passenger stations, cargo compartments, and equipment compartments. An actual aircraft cockpit or cockpit section shall be provided for inspection of cockpit lighting. If an actual cockpit or cockpit section cannot be employed for the cockpit lighting mockup, the cockpit may be simulated. The framing, windows, windshields, bulkheads and other parts on the inside of the cockpit which are visible to the pilot and/or the copilot when in the cockpit, shall be realistic and of the same shape as the production cockpit. Soft metals, plastics and wood, suitably coated to represent the production article may be used in the mockup. If an actual cockpit or cockpit section is not provided, the Mockup Board shall decide whether or not a final inspection will be conducted in an actual cockpit or cockpit section when this becomes available.

3.11.2 Interior lighting - The mockup for interior lighting shall consist of a complete interior lighting system. Provision shall be made for viewing the mockup in a completely darkened area as agreed to by the procuring service. There shall be provision for dark-adapting observers, for at least 30 minutes, either in a darkened room, or by red goggles. Passage from the cockpit lighting mockup to any other lighting mockup station or compartment in the aircraft shall not require readapting observers to darkness. The mockup shall be illuminated as proposed for the actual aircraft and shall be provided with equipment identical to that to be installed. In the case of instruments and console controls, the equipment to be installed or similarly lighted equipment (not paste-ups) shall be used. Where controls for energizing indicator lights cannot be actuated in the mockup, the indicator lights and high intensity lighting shall be energized by switches external to the mockup inspection. Adjustable dimming for all lights shall be provided to allow the intensity of lights to be determined

for night operation and the effects of glare from lights. Separate controls for localized area lighting, designated operator-controlled console or overhead lighting or reduced combinations of general lighting fixtures in various operational modes may be demonstrated. A separate demonstration of emergency egress lighting may be requested by the Mock-up Review Board. Provision also shall be made for inspection of the actual aircraft cockpit or cockpit section in daylight (bright sunlight, approximately 10,000 foot candles) to determine adequacy of warning lights caution lights, etc.

3.11.3 Exterior lighting - The mockup for exterior lighting shall consist of a complete exterior lighting system. Mockups of ship-based aircraft shall have provision for checking the LSO (Landing Signal Officer's)/LSE (Landing Signal Enlisted) view of approach and position lights, including navigation lights. This provision may be made on the aircraft mockup, in which case the LSO/LSE view of approach and position lights will be checked by the Mockup Board while checking the requirements of 3.3.4.2 and 3.3.4.3. For helicopters, a simulated main rotor moveable blade shall be employed to determine distracting lighting reflections to the crew station.

3.12 Data -

3.12.1 Data required prior to mockup review - The contractor shall provide a data package to the procuring activity as specified in the Contractor Data Requirements List (CDRL). The purpose of these data is to provide mockup review attendees with advanced information regarding the basis for aircraft design and trade-off decisions involved in the configuration represented by the mockup. This information generally should describe the aircraft configuration and its subsystems and operation in sufficient depth to enable the attendees to review the aircraft design within their organizational unit prior to attending the mockup review. The data package shall consist of, but not be limited to, the following:

a. Development history, purpose, and mission of the aircraft system as it may be related to the appropriate mock-up inspections.
b. Recommended checklists prescribed by the procuring service (the simple baseline checklist).
c. Appropriate crew/passenger compartment layout drawings and aircraft subsystem, hardware drawings, photographs, and illustrations.
d. Description of features requiring demonstrations of the compatibility of the aircraft with operational, service and maintenance personnel.
e. External vision plot as specified by the procuring service.

f. Photometric data, as appropriate, prior to the lighting mock-up inspection.
g. Appropriate study/analysis data which either relates to the design decisions made prior to the mockup review and/or is required by the contract.

3.12.1.2 Mockup review plan - The procuring service will prepare a mockup review plan which will identify the Mockup Review Board members and other evaluators, the planned duration of the mockup review, the checklist to be used by the evaluators, and other pertinent data. Specific evaluation procedures to be employed by the Mockup Review Board will be established prior to an official mockup demonstration. Such procedures will include definition of any objective scoring technique and necessary tools or devices such as stop watches, motion picture photographs, special lighting, and evaluation check sheets. The evaluation procedures will be based on an operation sequence analysis, task analysis performed earlier during contractor system definition studies (see MIL-H-46855).

3.12.2 Data required at mockup - Copies of the detail/prime item development specification, preliminary drawings, and other material considered necessary or requested by the Board chairman should be made available to the inspection team.

3.12.2.1 Detailed information - The following information shall be made available at the mockup review area for use by the mockup inspection team. The data shall contain brief but adequate description, where applicable, of the following supplemented by drawings (including flow diagrams, schematics, isometric drawings, etc.):

a. Approximately 20 copies of the data package defined in paragraph 3.11.1.
b. Approximately 20 copies of the mockup review plan and check list.
c. A copy of all military specifications and standards listed in the aircraft detail specifications including appropriate anthropometric data for the procuring service.
d. Aircraft structure and major structural assemblies.
e. Crew station geometry data.
f. Personnel stations (including emergency escape routes).
g. Vision plot as specified by the procuring activity.
h. Cargo and equipment compartments.
i. Landing gear.
j. Flight control system (including automatic flight control system and approach power compensator).
k. Engine section or nacelle group.
l. Propulsion installation and all fuel, oil, air, throttle, etc., systems.
m. Auxiliary power plant or electric power unit

n. Instruments and navigation equipment.
o. Hydraulic and pneumatic systems.
p. Electrical, electronic equipment and systems.
q. Armament installation and systems.
r. Furnishings and equipment (including seat/module ejection system).
s. Air conditioning and anti-icing equipment and controls.
t. Photographic equipment and controls.
u. Auxiliary gear.
v. Special equipment and special support equipment.
w. Appropriate working models of aircraft subsystem components (i.e., servo value operation, cutaways of engine components, etc.).
x. Catapulting and arresting gear provisions.
y. Barricade engagements.
z. If required by the procuring service, full scale lighted instrument panels shall be available for evaluating under sunlight conditions.

3.12.2.2 Preliminary drawings - Preliminary drawings, layouts, etc. of the actual aircraft showing general structural arrangement (wing, fuselage, tail, landing gear, etc. including materials to be used), systems installations, linear and angular clearances for internal use and external stores, and unconventional arrangements not simulated on the aircraft mock-up shall be available for insepction by the Mockup Board.

3.12.2.3 Detail/prime item development specification, and weight and performance data - Copies of the detail/prime item development specification, and current weight and performance status, shall be available for information of the Mockup Board.

3.12.2.4 Specification sheets - (FOR NAVY USE ONLY)

3.12.2.4.1 Aircraft mockup specification sheets - Two completed copies of each applicable specification sheet (1 through 8) to this specification shall have been prepared by the contractor and shall be available at the beginning of the aircraft mockup inspection. These Specification Sheets shall be identified by the words "PREPARED BY CONTRACTOR" at the top of each page.

3.12.2.4.2 Lighting mockup specification sheet - Four completed copies of specification sheet 9 to this specification shall have been prepared by the contractor and shall be available at the beginning of the lighting mockup inspection. This completed Specification Sheet shall be identified by the words "PREPARED BY CONTRACTOR" at the top of each page.

3.12.3 Post-mockup data - After completion of the mockup review, the following data shall be submitted to the procuring service as specified herein.

3.12.3.1 Aircraft mockup photographs - Thirty days after completion of the Mockup Board inspection five sets of 8 x 10 inch photographs of the finally approved aircraft mockup shall be submitted to the DCASO which shall forward four sets to the procuring service. The photographs shall be of the complete mockup showing plan, front, left, right, and quarter views and shall include crew stations and sufficient interior views to show the various installations. Photographs of the final approved instruments and arrangements including consoles and sub-panels for all crew stations shall be included with the above photographs.

3.12.3.2 Lighting mockup photographs - Thirty days after completion of the Mockup Board inspection five sets of 8 x 10 inch photographs of the finally approved lighting mockup shall be submitted to the DCASO which shall forward four sets to the procuring service. Daylight photographs shall be furnished of the complete lighting mockup including all crew stations, passenger stations, cargo compartments and equipment compartments. Photographs showing the night effect with lighting "ON" shall be furnished for the cockpit and the instrument panel under bright and dim (half voltage) lighting and for any other stations specified by the Lighting Mockup Board.

4. QUALITY ASSURANCE PROVISION

4.1 Responsibility for inspection - Unless otherwise specified in the contract or detail specification, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or detail specification, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the contract or detail specification where such inspections are deemed necessary to assure suppliers and services conform to prescribed requirements.

4.2 DCASO inspection - Mockups, when completed, shall be inspected by the DCASO for conformance with the requirements of the detail/prime item development specification, the contract, and this specification (including Specification Sheets for NAVY use). The DCASO shall notify the procuring service at least one month in advance of the approximate date of completion of the mockup and at least two weeks in advance of the firm date on which the mockup will be ready for inspection by the Aircraft Board or the Lighting Mockup Board, as applicable.

4.3 Mockup Board inspection - The Mockup Board shall convene at the contractor's specified facility as approved by the procuring activity for inspection of the mockup on the date established by the procuring service. All changes to the mockup shall be as directed by the Mockup Board and shall be accomplished by the contractor as expeditiously as practicable. Changes in the mockup that cannot be accomplished during the period of Mockup Board inspection shall, at the discretion of the Mockup Board, be approved by the DCASO or shall be reinspected by Mockup Board representatives at a later date.

4.4 Mockup Board approval - After completion of the Mockup Board inspection, a report will be forwarded to the contractor by the procuring service which will indicate that the mockup is:

a. Approved.
b. Approved subject to subsequent approval of changes by the Mockup Board or the DCASO.
c. Not approved and to be reinspected by the Mockup Board. In this case the procuring service shall be notified by the DCASO when the mockup is ready for reinspection by the Mockup Board.

4.4.1 Unauthorized deviations - Approval of a mockup shall not constitute approval of any unauthorized deviations incorporated in the mockup. Deviations from applicable specifications shall require specific procuring service approval. This does not preclude the contractor mocking up features for which he intends to make formal application for waivers. Such features should be brought specifically to the attention of the Mockup Board for information.

5. PREPARATION FOR DELIVERY

5.1 Disposition of mockups - Mockups as approved shall be retained by the contractor for reference purposes until the actual aircraft represented has been finally accepted. Final disposition of the mockups shall be specified by the procuring service. Permanent changes shall not be made in the approved mockup unless specifically authorized by the procuring service. Removal of articles originally intended for installation in an actual aircraft may be authorized by the DCASO after approval of the mockup.

6. NOTES

6.1 Intended use - Mockups covered by this specification are required for an early determination of the suitability of actual aircraft for service use. The mockup will provide a full size representation of the physical arrangement sufficient to permit checking compatibility with the handling, maintaining, loading and operating requirements for the aircraft and its equipment, particularly in regard to crew and passenger stations, cargo and weapons provision, equipment arrangments, propulsion system installations, vision, clearance, lighting, personnel safety, etc. Approval of a mockup enables the contractor to proceed with the design of the actual aircraft with reasonable assurance that the general arrangement and installations of equipment will be service accepted and will not be radically modified.

6.2 DCASO - Any reference to DCASO herein shall mean the Defense Contract Administration Services Office or Assigned Government representative office having responsibility for contract administration services at the contractor's plant.

(Copies of this specification for military use may be obtained as indicated in the forward to, or the general provisions of, the Index of Military Specifications and Standards. The title and identifying symbol should be stipulated when requesting copies of specifications.)

Custodians:

Army - AV
Navy - AS
AF - 11

User activities:

Army - AV
Navy - AS
AF - 11

Review activities:

Army - AV
Navy - AS
AF - 11

Preparing activity:

Navy - AS

(Review/user information is current as of the date of this document. For future coordination of changes to this document, draft circulation should be based on the information in the current DOD Index of Specification and Standards.)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

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DOCUMENT IDENTIFIER AND TITLE
MIL-M-8650C MOCKUPS, AIRCRAFT CONSTRUCTION OF GENERAL SPECIFICATION FOR

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A
☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING.

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?
   ☐ YES ☐ NO (If "Yes", in what way?)

4. REMARKS

SUBMITTED BY (Printed or typed name and address - Optional)

TELEPHONE NO.

DATE

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