MILITARY SPECIFICATION

TEST REQUIREMENTS, GROUND, HELICOPTER

This specification has been approved by the Department of Defense for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 This specification covers the ground testing of items peculiar to helicopters and of all types of helicopters in general.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standard, and publications, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

Military

MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-H-3136	Hydrocarbon-Fluid, Standard Test
MIL-L-6880	Lubrication of Aircraft, General Specification for
MIL-T-6053	Tests; Aircraft Landing Gear Shock Absorber Drop

STANDARDS

MIL-STD-129	Marking of Shipments

PUBLICATIONS

Air Force-Navy-Civil Bulletins

ANC-5	Strength of Metal Aircraft Elements
ANC-12	Vibration and Flutter Prevention Handbook

(Copies of specifications, standards, drawings, and publications required by contractors 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 test requirements.-

3.1.1 Place of tests.- The contract will specify whether the tests are to be conducted by the Government or by the contractor. If the tests are to be

performed by the contractor, the contract will specify the tests of Section 3 of this specification that will be required, will amplify or modify the tests of Section 3, and may specify other tests under appropriate paragraph headings of this specification.

3.1.2 Addition of tests.- If the tests required by the contract, to be performed by the contractor, are inadequate to prove that the helicopter meets the specified design requirements, the contractor or the procuring activity shall propose amendment to the contract to include tests which will prove adequately that the structure incorporates specified strength and rigidity.

3.1.3 Tests conducted by procuring activity.- In the event that tests are conducted by the Government, it shall be the responsibility of the contractor to provide qualified personnel to act in an advisory capacity in connection with the planning and execution of the tests, unless otherwise specified by the procuring activity, to provide all pertinent reports of loads, analyses, and tests of prototypes (if any), and to provide general assembly drawings of the test article as necessary to enable the procuring activity to plan and conduct the tests. These data shall be submitted at least 30 days prior to the delivery of the test article. The responsibility for stopping any test upon indications of premature failure, in order to make structural alterations or reinforcements as necessary to preclude premature failure, shall rest with the procuring activity. The contractor shall be responsible for services and material as necessary for incorporation of changes in the test article ensuing from premature failure.

3.1.4 Design yield load.- Design yield load as used in this specification refers to 1.15 times design load for Navy procurement, and 1.0 times design limit load for USAF procurement.

3.1.5 Disposition of test articles.- The disposition of the test articles shall be in accordance with instructions issued by the procuring activity. Prior to receipt of such instructions, test articles shall not be intentionally damaged or mutilated, except as necessary during required tests.

3.1.6 Use of tested parts.- Unless proof-load tests only are required, or unless specifically approved by the procuring activity, parts of structural test articles which have been subjected to structural tests shall not be used on a flight article.

3.1.7 Test witnesses.- Before conducting any required test, other than tests conducted under the provisions of paragraph 3.1.3, the local representative of the procuring activity shall be notified in sufficient time, in order that he or his representative may witness the test to certify and approve the results and observations obtained during the test. If the test is such that interpretation of the behavior of the article under test is likely to require engineering knowledge and experience, the local representative shall be so notified in advance. In that case, he will provide a qualified engineer who will witness the test and certify or approve for the procuring activity the observations and results obtained during the test.

3.1.8 Sequence of structural tests.- Unless otherwise specified by the procuring activity, required structural tests of Section 3 shall be conducted in such sequence and timeliness that tests to the loads and sinking speeds, or tests required to be completed prior to release for flight, release for other than normal flying, release for demonstration, and delivery of helicopters for trials and service use shall be completed prior to request for release or delivery. Required structural tests specified herein, wherein occurrence of failure would result in damage and necessary repairs to the test article that would significantly delay completion of other required structural tests or influence the validity of subsequent tests, shall be conducted in such sequence that:

(a) Repeated load tests of integral fuel tank structures are completed prior to conducting tests of any other conditions to loads in excess of the specified load at which yielding shall not occur. Repeated load tests of control systems shall be completed before static tests of the particular system are carried to loads greater than the design limit load.

(b) Ultimate load tests for flight conditions are completed prior to conducting tests of other than flight conditions to ultimate loads.

(c) (For Bureau of Aeronautics use only.) All design ultimate load static tests are completed prior to conducting drop tests to design ultimate sinking speeds.

(d) All repeated load tests, ultimate load tests, basic weight ultimate sinking speed, and overload weight limit sinking speed tests are completed prior to conducting required tests to failure.

3.1.9 Support during test.- In a test of a structural component, the actual interaction between the component being tested and its adjacent components shall be existent, or simulated satisfactorily. Structural components may be tested in a jig or loaded by dummy structure only when there is no possibility of interference or deflections that result in loading of adjacent components and only when the loads and reactions that act on the component being tested are statically determinate, or the reactions may be rendered statically determinate by neglecting redundant reactions that do not have an effect on loads in the component being tested.

3.1.9.1 Safety devices.- When loads during structural tests are applied in such manner that they are not relieved as the rate of deformation of the article increases rapidly, as when failure occurs; safety devices, such as shear links or pressure blowoff valves, shall be employed to the satisfaction of the procuring activity in order to preclude excessive deformation or overloading of other parts of the structure.

3.1.9.2 Control systems.- All control systems shall be tested while installed in the structural test article. At the option of the procuring activity, rotating parts of the control system may be bench tested.

3.1.10 Loading requirements.-

3.1.10.1 Distribution.- The distributions of loads during the tests shall be subject to the approval of the procuring activity. They shall duplicate the actual distribution as closely as practicable, except as modified by paragraph 3.1.10.2.

3.1.10.2 Simplification and combination.- Loading conditions may be simplified by modifying the distribution of the loads applied to regions of a structure that are not critical in the loading condition being simulated in the test, or that are similar in construction to other regions of the structure, that are more highly stressed during the same or another test condition. However, simplification of loading shall not be such that permanent deformations or failures occur because of simplifications of the method of loading. Where practicable, one or more loading conditions may be applied simultaneously to different portions of the structure, provided that the interaction of separate loading conditions does not affect the critical design loading on any portion of the structure.

3.1.10.3 Temperature effects.- Temperature effects, such as those occurring in service operation resulting from operation of the powerplant and de-icing systems, which may produce significant induced stresses and significant reductions in strength of the structure, shall be simulated or compensated for in appropriate tests.

3.1.10.4 Load increments for static tests.- Up to limit load, the test loading shall be applied in increments of not more than 20 percent of limit load. Test loads between limit and 150 percent of limit load shall include design yield load if design yield load for the component is specified: The test loading shall be applied in increments not greater than 10 percent of limit load.

3.1.10.5 Structure to be loaded.- All parts of the structure, including carry-through structure, except noncritical parts, the loading of which has no significant influence on critical parts, shall be loaded during a required structural test. In each static test required by headings under paragraph 3.2, all parts of the helicopter that are critical for the pertinent design condition shall be tested and shall be loaded simultaneously, if practicable. Critical ribs, formers, and frames of each typical design shall be subjected to critical design loading during tests of the component in which these members are incorporated.

3.1.10.6 Positions of control systems and control surfaces.- Control systems and control surfaces shall be displaced to the positions corresponding to the loading condition for which the parts are being tested.

3.1.10.7 Deformation of doors, cowlings, locks, and fasteners.- It shall be shown during structural tests that doors, cowling, movable and removable coverings, and items of mechanical equipment, such as landing gears, remain in their intended positions consistent with specified structural design requirements.

3.1.10.8 Determination of yield strength load.- For those tests that are to be carried above design yield load, if design yield load is specified, the yield strength load for each structural component shall be determined during each test of that component, except that the yield strength load need not be determined if the structure withstands the ultimate load without yielding.

3.1.10.9 Failing load.- At the option of, and subject to the approval of the procuring activity, specified failing load tests shall be conducted until a major failure occurs in important structural members of the component under test. Reinforcements in accordance with paragraph 3.2.1.2 shall be made as necessary to establish reasonable structural continuity until major failure occurs during these tests. If, during the course of conducting a required failing load test for a design condition selected as critical under the provisions of paragraph 3.2, a load equal to 125 percent of the calculated ultimate strength is attained without failure, at the option of the procuring activity the test shall be discontinued, and in lieu thereof, a test shall be conducted to failure in the next most critical design condition. This requirement shall apply only where a second design condition exists which is critical for a portion of the structure being tested.

3.1.10.10 Effects of internal pressurization.- Loads resulting from the specified pressure differential between pressurized portions of the structure and the ambient atmosphere acting in combination with applicable external air loads shall be simulated during test. This requirement is applicable also to the loads resulting from the pressurization of items of equipment such as fuel cells.

3.1.11 Test measurements.-

3.1.11.1 Deflection and strain.- Deflections and strain measurements shall be recorded and evaluated during the structural tests of all major structural components, such as fuselage, rotor blades, and alighting gear, to verify assumptions on which the calculations of loads on and in the structure depend, to

demonstrate compliance with applicable rigidity requirements, and, as necessary, to detect incipient premature failure. Deflection and strain measurements shall be obtained at a sufficient number of load increments below limit load to establish the rates of deflection, strain, and permanent set. If a change in rate occurs, the subsequent increments shall be sufficiently small to determine if this change is linear or curvilinear.

3.1.11.2 Force and stroke positions.- The vertical, drag, and side forces transmitted through the main and auxiliary alighting gears, and the stroke position of the shock absorbers, shall be recorded on the same time scale throughout the deceleration of the aircraft in the specified drop tests. In instances where the test article has simplified alighting gear provisions, such as skids, floats, etc, the data recorded during drop tests shall be as specified by the procuring activity.

3.1.12 Miscellaneous.-

3.1.12.1 Test correction factors.- If specified by the procuring activity, test results shall be corrected by taking into account the ratio of the strength of a structure having minimum production dimensions and fabricated from material having mechanical properties, as set forth in bulletin ANC-5, to the actual strength of the structure.

3.2 Structural tests.- The Structural tests listed under this heading shall be used as an outline for establishing the required test program. Additional tests may be specified by the procuring activity. Additional tests may also be conducted at the option of the procuring activity to investigate the behavior of the test article under loads resulting from new design criteria determined subsequent to the design of the aircraft. All Structural tests shall be conducted to the satisfaction of the procuring activity. All test loads shall be taken from the aircraft load reports, as approved by the procuring activity.

3.2.1 Structural test articles.-

3.2.1.1 General.- The helicopter (less rotor system, as outlined in paragraph 3.4.2.2.1) used for Structural tests shall be the first helicopter constructed unless otherwise specified by the procuring activity. All test articles shall be structurally identical with the structure of flight articles, except that:

(a) Items of fixed equipment, useful load and their support structures, and fabric coverings, may be omitted from test articles provided that their omission does not significantly affect the load and stress distributions, and the strength or deflection, or both, of the parts of the structure to be tested, and provided that the omitted parts, if installed, would not be critically loaded in the tests.

(b) Substitute parts may be used provided that they reproduce the effects of the parts for which they are substituted and the structural adequacy of the parts for which substitutions are made is demonstrated by separate tests.

(c) Powerplants, accessories, and transmission systems shall be replaced by test fixtures that properly transmit the loads on these items to the powerplant vibration isolators, the engine mount, and other mountings as may be applicable.

(d) Paint or other finishes may be omitted.

3.2.1.2 Reinforcement and repair.- Reinforcements and repairs incorporated in the test article to meet specified strength and rigidity requirements shall be structurally representative of those which will be incorporated in the flight articles. All such reinforcements and repairs shall be subject to approval of the procuring activity. Structural tests on the reinforced structure will be made as deemed necessary by the procuring activity.

3.2.2 Strain gages.- The contractor is not required to install strain gages on articles to be tested at the facilities of the procuring activity. However, such installations by the contractor at certain critical locations and at places inaccessible after final assembly will facilitate these tests. If the contractor desires to expedite the program by installing gages, the procuring activity should be consulted at an early date regarding their installation. The structural analysis pertinent to the components to be instrumented shall be submitted to and approved by the procuring activity prior to the installation of the gages.

3.2.3 Fuselage.-

3.2.3.1 Bending due to critical loads.- Test to failure, except test only to ultimate load if the test of paragraph 3.2.3.2 is more critical.

3.2.3.2 Torsion due to critical loads.- Test to failure, except test only to ultimate load if the test of paragraph 3.2.3.1 is more critical.

3.2.4 Wing and carry-through structure.- Tests shall be conducted to ultimate load for critical conditions.

3.2.5 Empennage.-

3.2.5.1 Horizontal tail and carry-through structure.- The horizontal tail and carry-through structure shall be tested for the failing load tests for critical conditions.

3.2.5.2 Vertical tail and carry-through structure.- The vertical tail and carry-through structure shall be tested for the failing load tests for critical conditions.

3.2.6 Control surfaces.- Fabric- or plywood-covered control surfaces shall be tested to failure by the application of internal pressures, or other means suitable to the procuring activity.

3.2.7 Landing gear installation.-

3.2.7.1 Main landing gear and carry-through structure.-

3.2.7.1.1 Critical unsymmetrical landing condition.- Ultimate load

3.2.7.1.2 Critical ground towing condition.- Ultimate load

3.2.7.2 Auxiliary landing.- Gear and carry-through structure

3.2.7.2.1 Critical unsymmetrical landing condition.- Ultimate load

3.2.7.2.2 Critical ground towing condition.- Ultimate load

3.2.8 Control system.- Additional tests are required for critical portions of dual-control systems not tested during the following tests of the control system.

3.2.8.1 Control system static tests.-

3.2.8.1.1 Longitudinal.- Failing load test for critical condition.

3.2.8.1.2 Lateral.- Failing load test for critical condition.

3.2.8.1.3 Vertical (collective pitch).- Failing load test for critical condition.

3.2.8.1.4 Directional.- Failing load test for critical condition.

3.2.8.2 Control system fatigue tests.-

3.2.8.2.1 Longitudinal.- A load equal to 0.6 times the design limit load shall be applied 100,000 times at a rate not less than 100 cpm, or loads as determined from rational load analyses or flight measurements, whichever are more critical.

3.2.8.2.2 Lateral.- A load equal to 0.6 times the design limit load shall be applied 100,000 times at a rate not less than 100 cpm, or loads, as determined from rational load analyses or flight measurements, whichever are more critical.

3.2.8.2.3 Vertical (collective pitch).- A load equal to 0.6 times the design limit load shall be applied 100,000 times at a rate not less than 100 cpm, or loads determined from rational load analyses or flight measurements, whichever are more critical. Any portion of the throttle system which may be affected by the test loading shall be installed.

3.2.8.2.4 Directional.- A load equal to 0.4 times the design limit load shall be applied 100,000 times at a rate not less than 100 cpm.

3.2.9 Miscellaneous.-

3.2.9.1 Engine, transmission, rotor mounts, and engine cowling.-

3.2.9.1.1 Engine mount and carry-through structure.-

3.2.9.1.1.1 Failing load test for critical flight condition.

3.2.9.1.1.2 Ultimate load test for critical nonflight condition.

3.2.9.1.2 Engine cowling and inspection doors.- Failing load tests for critical condition. (This does not apply to submerged engine installations.)

3.2.9.1.3 Transmission mounts and carry-through structure.-

3.2.9.1.3.1 Failing load test for critical flight condition.

3.2.9.1.3.2 Ultimate load test for critical nonflight condition.

3.2.9.1.4 Rotor mount and carry-through structure.-

3.2.9.1.4.1 Ultimate load tests for crash conditions.

3.2.9.1.4.2 Failing load test for critical flight condition. This is required only if test of paragraph 3.2.9.1.4.1 is not applicable.

3.2.9.1.4.3 Ultimate load test for critical nonflight condition. This is required only if test of paragraph 3.2.9.1.4.1 is not applicable.

3.2.9.2 Fixed equipment.-

3.2.9.2.1 Seat carry-through structure.- Failing load test of each typical seat attachment for the critical condition.

3.2.9.2.2 External.- Tests shall be conducted to substantiate the basic structure and attachment fittings for external armament or fuel tanks. The loads shall be applied o the mounting structure.

3.2.9.2.3 Auxiliary fuel tank supporting structure.- The auxiliary fuel tank supporting structure shall be subjected to an ultimate test for the critical condition.

3.2.9.3 Parts.-

3.2.9.3.1 Cockpit enclosure.-

3.2.9.3.1.1 The cockpit enclosure shall be tested to failure for critical symmetrical flight conditions, except that if the test of paragraph 3.2.9.3.1.2 is more critical, then the test shall be conducted only to ultimate load.

3.2.9.3.1.2 The cockpit enclosure shall be tested to failure for critical unsymmetrical flight condition, except that if the test of paragraph 3.2.9.3.1.1 is more critical, then the test shall be conducted only to ultimate load.

3.2.9.3.2 Hoisting sling installation.- The hoisting sling installation shall be tested to failure for the critical condition.

3.2.9.3.3 Rescue hoist installation.- The rescue hoist installation shall be tested to failure for the critical condition.

3.2.9.3.4 Doors, fairings, and removable sections.- Ultimate load tests shall be conducted for those items not previously tested for critical flight conditions.

3.2.9.3.5 Main ribs, bulkheads, and frames.- These items shall be tested to failure for the critical condition where ability to withstand ultimate load has not been demonstrated by other tests.

3.2.9.3.6 Fittings.- Fittings shall be tested to failure for critical condition where the ultimate strength has not been demonstrated by other tests.

3.2.9.3.7 Assemblies and structural elements.- Test to failure shall be conducted where the allowable load and stresses are not known and cannot be calculated with reasonable accuracy.

3.2.9.3.8 Castings.- Class A castings which form part of the primary structure of the aircraft shall have been substantiated by the contractor's tests, and the reports submitted for approval, prior to the structural tests specified herein.

3.2.9.3.9 Blast tests.- Blast tests, which will adequately prove the structural integrity of the aircraft for the critical limit loads resulting from the firing of guns, rockets, ATO units, etc, shall be conducted to the satisfaction of the procuring activity if such tests are deemed necessary.

3.2.9.3.10 Gun recoil tests.- Gun recoil firing tests, which will adequately prove the structural integrity of the aircraft for the critical limit loads specified in the design criteria, will be conducted to the satisfaction of the procuring activity if deemed necessary.

3.2.10 Integral fuel tank repeated load tests.- Tests of integral fuel tanks shall be in accordance with this paragraph or, alternatively, in accordance with a

test procedure approved by the procuring activity that simulates the repeated loading of the integral fuel tanks structure expected during the service life of the helicopter, including loads to not less than 1.1 times limit loads. The following requirements are applicable to the tests specified in paragraphs 3.2.10.1 and 3.2.10.2:

(a) The fluid shall be a hydrocarbon standard test fluid in accordance with Specification MIL-H-3136. For the first 50 percent of the duration of any test, fluid conforming to Specification MIL-H-3136, type III, shall be used. For the remaining period of any test, fluid conforming to Specification MIL-H-3136, type I, shall be used.

(b) In the tests specified in paragraph 3.2.10.1, an inspection, by a method sufficiently sensitive to determine the location of all leaks, shall be made after approximately the 1st, 10th, 100th, 500th, and 1,000th cycles of load application.

(c) If a leak occurs during a test, the tank shall be made tight and the tests shall be repeated in accordance with the following criteria:

(1) If a minor leak develops which can be repaired without redesign of the tank, only the particular test in which the leak occurred need be repeated.

(2) If a leak is such that a redesign of the tank is necessary to prevent the recurrence of the leak, the procuring activity may require repeat of all required tests on the redesigned tank.

(d) The tests of paragraphs 3.2.10.1 and 3.2.10.2 shall extend over a sufficient length of time to insure that probable deteriorating effects of the fuel on the sealants are realized.

(e) Tests as outlined in the following paragraphs 3.2.10.1 and 3.2.10.2 shall be preceded by a soaking period of 48 hours at approximately 70°F, using Specification MIL-H-3136, type III, test fluid. This shall be followed by a dry-out period of 48 hours minimum at 70°F before refilling for the tests outlined in paragraphs 3.2.10.1 and 3.2.10.2.

3.2.10.1 Internal pressure plus repeated load tests.- The integral fuel tank structure shall be loaded 1,000 times from no load to a test load which will cause stresses throughout the tank structure within 15 percent of those caused by limit loads in the symmetrical design loading condition that is critical for the tank structure. If a design loading condition other than the critical symmetrical condition is critical for an appreciable portion of the tank structure, a test shall be conducted for that condition similar to and in addition to the symmetrical condition test. During these repeated load tests, the tank shall be filled with fuel. The pressure at any location in the tank shall be not less than the maximum differential pressure that would exist at that location when the helicopter is subject to the loading condition simulated in the test. If the tank is designed to be pressurized, the maximum operating tank pressure shall be considered in determining the maximum fuel pressure to be used during the test.

3.2.10.2 Integral tank vibration tests.- If it is anticipated that the integral fuel tanks will be subjected to appreciable vibration resulting from the operation of engines or other items of equipment located on or in the vicinity of the tank, the tank shall be tested for leaks under conditions which simulate the vibratory loads resulting from the operation of these items. The requirements for these vibration tests shall be established by agreement between the contractor and the procuring activity.

3.2.11 Integral fuel tank temperature and gunfire tests.-

3.2.11.1 Temperature.- At the option of the procuring activity, the tests of paragraphs 3.2.10.1 and 3.2.10.2 shall be conducted at maximum temperature if a temperature in excess of 180°F, and at minimum temperature if a temperature below -40°F is anticipated because of the integral tank location within the helicopter or because of climatic conditions in the operational area(s) in which it is intended to use the helicopter.

3.2.11.2 Gunfire.- At the option of the procuring activity, tests shall be conducted simulating the hydrostatic pressure developed as a result of impact and passage of a 0.50-calibre projectile through the walls of the fuel tank and at a minimum of 3 inches from and parallel to any seam below the liquid level. This pressure shall not burst any seams of the tank.

3.3 Drop tests.-

3.3.1 General.-

3.3.1.1 Categories.- Drop tests, as included in this specification, are separated into the following two categories for reasons of criteria differences.

3.3.1.1.1 Air Force procurement.- All Air Force helicopter alighting gears shall be drop tested in accordance with Specification MIL-T-6053.

3.3.1.1.2 Navy procurement.- The tests specified under headings of paragraph 3.3 shall be conducted on the complete strength-test structure, and for wheel-type landing gears shall include wheel spin-up sufficient to simulate critical effects of wheel contact velocities within the ranges of contact velocities included in design requirements. The wheel radii employed in the determination of wheel speeds appropriate for particular values of contact velocities shall be the static rolling radii of the tires. Maximum tire pressures employed in drop tests other than those of paragraphs 3.3.2.4 and 3.3.3.2 shall not exceed those practicable for service use, nor those actually recommended in the Contractors' Erection and Maintenance Manual.

3.3.1.2 Basic weight.- At least two drops in each basic weight drop test condition of paragraphs 3.3.2 or 3.3.3 shall be made at the design yield sinking speed with recommended tire pressures and oleo-strut extensions, and at least two drops at design yield sinking speed with minimum design values of tire pressures and oleo-strut extensions. During overload weight drop tests specified in paragraphs 3.3.2 or 3.3.3, variations of oil and air in the oleo-struts, and other adjustments that are practicable for use in service to attain low load factors, shall be investigated. All drop tests shall be conducted on a surface which develops a coefficient of friction equivalent to that developed on unpainted boiler plate.

3.3.1.3 Gross weight.- Drop tests shall be conducted at the gross weights and weight distributions specified in paragraph 3.3.2 or 3.3.3, and also with alternate combinations of internal and external loads for which provisions are required. The combination of pitch and roll attitudes employed in the drop tests of paragraph 3.3.2.3 shall be those determined to be critical from a drop test survey at specified design combinations of roll angle and sinking speed with critical pitch attitudes.

3.3.1.4 Sinking speed increments.- The sinking speed increments during drop tests shall not exceed 2 fps up to 50 percent of limit sinking speed, 1.0 fps between 50 percent and 100 percent of limit sinking speed, and 0.5 fps above limit sinking speed, and shall, if specified, include a drop at yield sinking speed.

3.3.1.5 Simulation of rotor lift.- The method of simulation of rotor lift during drop tests shall be as approved by the procuring activity.

3.3.2 Main landing gear.-

3.3.2.1 Level landing - Basic weight condition.- Design ultimate sinking speed tests shall be conducted at the basic landing design gross weight with the weight distribution that is critical for the main gear and carry-through structure in the level (static) attitude. In the event that this condition is more critical than conditions of paragraphs 3.3.2.2 and 3.3.2.3, tests in this condition shall be conducted to failure.

3.3.2.2 Nose-up landing - Basic weight condition.- Design ultimate sinking speed tests shall be conducted at the basic landing design gross weight with the weight distribution that is critical for the main gear and carry-through structure in the nose-up attitude. In the event that this condition is more critical than conditions of paragraphs 3.3.2.1 and 3.3.2.3, tests in this condition shall be conducted to failure.

3.3.2.3 Rolled landing - Basic weight condition.- Design ultimate sinking speed tests shall be conducted at the basic landing design gross weight distribution that is critical for the main gear and carry-through structure in the rolled attitude. In the event that this condition is more critical than conditions of paragraphs 3.3.2.1 and 3.3.2.2, tests in this condition shall be conducted to failure.

3.3.2.4 Critical symmetrical - Overload weight condition.- Tests shall be conducted to the basic weight limit sinking speed at 1.15 times the basic landing design gross weight with the weight distribution that is critical for the main gear and carry-through structure in the most critical symmetrical attitude.

3.3.3 Auxiliary landing gear.-

3.3.3.1 Level landing - Basic weight condition.- Design ultimate sinking speed tests shall be conducted at the basic landing design gross weight with the weight distribution that is critical for the auxiliary gear and carry-through structure in the level (static) attitude.

3.3.3.2 Level landing - Overload weight condition.- Tests shall be conducted to the basic weight limit sinking speed at 1.15 times the basic landing design gross weight with the weight distribution that is critical for the auxiliary gear and carry-through structure in the level (static) attitude.

3.4 Rotor system tests.-

3.4.1 Static tests of main and antitorque rotors.- The procuring activity may specify whirl tests in lieu of, or to supplement, the following static tests with main and antitorque rotors.

3.4.1.1 Main rotor.-

3.4.1.1.1 Rotor hub and rotor-blade root end.-

3.4.1.1.1.1 Failing load test for critical design conditions.

3.4.1.1.1.2 Design ultimate load test for starting condition.

3.4.1.1.1.3 Design ultimate load test for rotor-blade ground-wind condition.

3.4.1.1.2 Rotor blade and attachment fittings.- Failing load test shall be conducted for most critical rotor-thrust loads combined with centrifugal force resulting from design maximum rotor speed.

3.4.1.1.3 Rotor blade lag damper and support fittings.-

3.4.1.1.3.1 Failing load test for critical design condition.

3.4.1.1.4 Anticoning device.-

3.4.1.1.4.1 Failing load test for critical design condition.

3.4.1.2 Antitorque rotor.-

3.4.1.2.1 Rotor hub and rotor-blade root end.-

3.4.1.2.1.1 Failing load test for critical design condition.

3.4.1.2.2 Rotor blade and attachment fittings.-

3.4.1.2.2.1 Failing load test for critical design condition.

3.4.2 Fatigue tests.- Fatigue tests of rotors shall be performed in accordance with this heading, or alternately, the contractor shall propose a test procedure and a fatigue loading spectrum, based on the latest applicable flight test data, to be used for Fatigue tests of a sufficient number of main and auxiliary rotor components to substantiate each component for the required service life. Upon approval by the procuring activity of the proposed spectrum and test procedure, the contractor shall conduct the necessary tests and shall correlate results with flight test data to determine a recommended service life for each component.

3.4.2.1 Bench tests.- Bench fatigue tests shall be conducted on specimens of each type of rotor employed on the helicopter. During the application of the test loads, the angular displacement of the hinged components shall be simulated. If two or more bearings of the rotor-blade hinge assembly or hub attachment are critically loaded for more than one condition, this test shall be repeated for each bearing or hub attachment for its particular critical loading condition. Bearings may be tested separately.

3.4.2.1.1 Main rotor hub and rotor-blade root end.- A minimum of three rotor hub hinge assemblies and blade root-end attachment specimens shall be tested as follows:

(a) Two specimens at the design fatigue loading corresponding to high-speed flight at design maximum rotor speed for a number of cycles corresponding to at least 2,000 hours operation at this condition.

(b) One specimen at the critical design fatigue loading resulting from maneuver flight for a number of cycles corresponding to at least 500 hours of operation at this condition.

3.4.2.1.2 Main rotor blade and attachment fitting.- A minimum of six specimens of the rotor blade and attachment fittings shall be tested as follows:

(a) Three specimens at the design fatigue loading condition corresponding to high-speed flight at design maximum rotor speed for a number of cycles corresponding to at least 2,000 hours operation.

(b) One specimen at the maximum design fatigue loading condition resulting from maneuver flight for a number of cycles corresponding to at least 500 hours of operation at this condition.

(c) Two specimens at fatigue loadings intermediate to the four specimens above for a number of cycles corresponding to at least 1,000 hours of operation.

3.4.2.1.3 Main rotor blade lag damper and support fittings.- A minimum of three blade lag damper and support fitting specimens shall be tested as follows:

(a) Two specimens at the design fatigue loading condition corresponding to high-speed flight at design maximum rotor speed for a number of cycles corresponding to at least 2,000 hours of operation.

(b) One specimen at the critical design fatigue loading for a number of cycles at least 500 hours of operation at this condition.

3.4.2.1.4 Antitorque rotor hub and blade root end.- A minimum of three specimens of the antitorque rotor hub, hinge assemblies and blade root end shall be tested as follows:

(a) Two specimens at the design fatigue loading corresponding to high-speed flight at design maximum rotor speed for a number of cycles corresponding to 2,000 hours of operation at this condition.

(b) One specimen at the critical design fatigue loading for a number of cycles corresponding to 500 hours of operation at this condition.

3.4.2.1.5 Antitorque rotor blade and attachment fitting.- A minimum of four specimens of the rotor blade and attachment fittings shall be tested as follows:

(a) Two specimens at the design fatigue loading condition corresponding to high-speed flight at design maximum rotor speed for a number of cycles corresponding to 2,000 hours of operation at this condition.

(b) Two specimens at the maximum design fatigue loading condition resulting from maneuver flight corresponding to 500 hours of operation at this condition.

3.4.2.2 Whirl tests.-

3.4.2.2.1 Test articles.- Unless otherwise specified, the contractor shall deliver to the procuring activity 90 days prior to first flight of the helicopter one complete rotor system. This system shall consist of rotor hub, rotor blades, rotor controls, and such other elements of the control system as required for actuation of collective and cyclic pitch: It shall be identical with the flight articles of each different rotor configuration employed on the helicopter. Paint

or finishes other than permanent finishes such as cadmium plating or anodizing shall be omitted. One rotor drive shaft for each rotor configuration suitable for adapting such rotor system to the procuring activity's test facilities shall be furnished. Suitable spares of expendable parts (such as seals, lockwashers, or snap rings, peculiar to the particular rotor systems) shall be furnished as required for six complete disassemblies and reassemblies. A complete set of special tools, as required for disassembly and reassembly of each rotor system, shall be furnished with delivery of the rotor system. Assembly, subassembly, and detail drawings of all components of the particular rotor system showing fits, tolerances, and assembly notes shall be delivered concurrently with the rotor system.

3.4.2.2.2 Instrumentation.- The procuring activity will normally accomplish instrumentation of rotor systems submitted under paragraph 3.4.2.2.1. In cases where the primary structure is enclosed during fabrication, the contractor will be required to install the necessary strain gages in accordance with the instructions of the procuring activity.

3.4.2.2.3 Failure of parts.- If failure occurs during whirl test of the rotor system, this part shall be replaced with a part of improved design or a part of more suitable material unless the procuring activity authorizes the installation of a new part of original design and material for one which has failed because of faulty material, workmanship, or normal wear on parts specified for periodic replacement. The whirl tests shall be considered complete when every major part of the rotor system has been subjected to the complete tests as specified. At the discretion of the procuring activity, redesign and retesting may be required of any part which fails, or indicates weaknesses or excessive wear after completing the test but which is retained in the rotor system to complete the testing of other parts.

3.4.2.2.4 Main rotor system(s) whirl tests.- The main rotor system(s) including the hub, blades, and rotor controls shall be whirl tested in accordance with the following procedure:

(a) Part 1 - Preflight whirl test:

(1) 10 Hours - Aerodynamic calibration of the static thrust performance of the rotor system over its collective pitch range not to exceed design limit rotor speed and 110 percent military rated power. Stress and motion survey of the rotor system for various design combinations of collective and cyclic pitch, power, and rotor speed up to the above limits.

(2) 30 Hours - Operation at design maximum rotor speed and military rated power.

(3) 30 Hours - Operation at 90 percent design maximum rotor speed and military rated power with 2/3 design cyclic pitch applied.

(4) 30 Hours - Operation at 110 percent design maximum rotor speed and military rated power with full design cyclic pitch applied.

(5) 10 Hours - Operation at limit design rotor speed and not to exceed 110 percent military rated power and 1/3 design cyclic pitch.

(b) Part 2 - Extended whirl test:

An extended endurance test shall be conducted according to a schedule and procedure proposed by the contractor and approved by the procuring activity. Normally, this test will be performed after the results of the flight strain survey and some flight operation is obtained and shall consist of conditions and procedures based on these test results to establish the service life, overhaul, and replacement periods for major rotor-system components.

3.4.2.2.5 Antitorque rotor whirl tests.- The antitorque rotor system, including the hub, rotor controls, and blades shall be whirl tested in accordance with the following procedure:

(a) Part 1 - 50-Hour preflight test:

(1) 40 Hours - Operation at design maximum tail rotor power.

(2) 10 Hours - Operation at limit design rotor speed, power on, or power off, whichever is greater, and 110 percent design maximum tail rotor power.

(b) Part 2 - Extended endurance test:

An extended endurance test shall be conducted according to a schedule and procedure proposed by the contractor and approved by the procuring activity. Normally, this test will be performed after the results of the flight strain survey and some flight operation is obtained, and shall consist of conditions and procedures based on these test results to establish the operating life and overhaul and replacement periods for major rotor components.

3.5 Mechanical instability, flutter, and vibration isolation tests.-

3.5.1 Sequence of tests.-

3.5.1.1 Mechanical instability.- The component tests specified in paragraph 3.5.2.1 shall be completed and the component test report specified in paragraph 3.5.2.1.4 shall be submitted to and approved by the procuring activity prior to release for the rev-up test specified in paragraph 3.5.2.2. The latter test shall be completed and the rev-up test report specified in paragraph 3.5.2.2.2.3 shall be submitted to and approved by the procuring activity prior to release of the helicopter for extensive ground operation in a free condition or release for extensive flight operation, but no later than prior to release for any of the tests of the flight demonstration requirements specified in the contract.

3.5.1.2 Flutter.- Those applicable tests specified in Bulletin ANC-12 which are necessary to obtain data for required flutter analyses with reference to nonrotating components of the helicopter shall be conducted. A report containing the results of these tests shall be submitted to the procuring activity. Either satisfactory completion of the tests or the report shall be approved prior to release for first flight.

3.5.1.3 Powerplant antivibration system(s).- Unless otherwise specified or approved by the procuring activity, methods and procedures outlined in Bulletin ANC-12 shall be applied in carrying out tests to demonstrate compliance with applicable powerplant antivibration mounting requirements specified in the design critera. All engines, transmissions, and engine-rotor combinations elastically suspended and not a part of the rotor-blade assembly shall be tested. A report of results shall be submitted to and approved by the procuring activity prior to acceptance of the aircraft.

3.5.2 Mechanical instability ground tests.- The following tests shall be performed unless it can be shown to the satisfaction of the procuring activity that the helicopter is free of mechanical instability.

3.5.2.1 Component tests.-

3.5.2.1.1 Hub vibration tests.-

3.5.2.1.1.1 Test conditions.- The hub frequencies, effective mass, and effective damping shall be determined for all combinations of the following conditions:

(a) At a normal atmospheric temperature which shall be recorded. Further, the contractor shall investigate the variation of hub frequency, effective mass, and effective damping throughout the extreme temperature range specified in the aircraft detail specification by any rational scientific method available. If, on the basis of this investigation, it appears to the procuring activity that any parameter may attain a more critical value with reference to its effect on mechanical instability than its previously determined value at the temperature recorded, the procuring activity may require repetition of the tests at the more critical temperatures.

(b) At minimum and maximum gross weight.

(c) When the helicopter is equipped with each different landing gear configuration if the helicopter is intended for normal use with alternate landing gear configurations. If a particular landing gear utilizes pneumatic tires or floats, the tire or float pressure shall be that intended for normal use.

(d) When equipped with a particular landing gear, the helicopter shall rest, unrestrained, upon a surface simulating, insofar as possible, the type of surface from which the helicopter is normally intended to operate when equipped with that landing gear.

(e) In a condition which will simulate hub natural frequencies, effective damping, and effective mass during flight, it is suggested that the helicopter be suspended in such a fashion that it will have a natural frequency less than one-half of the normal operating main rotor speed. For landing gear configurations utilizing pneumatic tires or floats, in lieu of suspension, the helicopter may rest upon the landing gear provided that the tire or float pressure is reduced to less than one-half of that intended for normal use.

(f) For the purposes of these tests, all main rotor blades shall be replaced by equal, concentrated, rigid weights.

3.5.2.1.1.2 Hub frequency and effective damping. All modes of motion, which can be excited by a horizontal force at any main rotor hub and which have frequencies less than 1.2 times maximum rotor speed, shall be determined. For critical modes, the hub effective damping shall be obtained.

3.5.2.1.1.3 Hub effective mass.- The main rotor hub effective mass shall be determined for those modes of motion which analyses show are critical in regard to mechanical instability.

3.5.2.1.2 Hydraulic damper tests.- If main rotor blade, drag hinge, or hydraulic dampers are used (i.e., devices which provide damping forces or torques which are roughly proportional to the linear and angular velocities, respectively), tests shall be conducted to obtain curves of force versus velocity (or torque versus angular velocity), for a velocity range sufficient to include all possible operating conditions. These tests shall be conducted with the device filled with damper fluid (fluid specification number should be noted) and with it emptied of damper fluid (to measure breakaway and static friction). Under both conditions, filled and empty, the tests shall be conducted with the damper and fluid at each of the temperatures the damper will attain when the helicopter operates at each of the two temperature extremes specified by the aircraft detail specification.

3.5.2.1.3 Blade vibration test.- If the helicopter is equipped with main rotor blades which do not have lead-lag hinges, the lowest natural frequency in bending in the plane of rotation shall be determined by test under such conditions that the fixity is properly simulated.

3.5.2.1.4 Mechanical instability component test report.- A report shall be submitted which will contain the results of the tests specified in paragraph 3.5.2.1, together with an analysis of these results which will indicate that the helicopter can be expected to be free of mechanical instability and flywheel type resonance for as many as possible of the conditions specified in the design criteria.

3.5.2.2 Mechanical instability rev-up test.-

3.5.2.2.1 Test conditions.- Freedom from mechanical instability shall be demonstrated by the methods of paragraph 3.5.2.2.2 for all combinations of the following conditions:

(a) At a normal atmospheric temperature which shall be recorded.

(b) At minimum and maximum gross weights, or at most critical gross weight as established by a rational analysis and approved by the procuring activity prior to the rev-up tests.

(c) With the helicopter in an actually free condition, if so desired, and provided that it is certain the helicopter can take off in the event instability is encountered. If not, a mooring system shall be provided which will permit operation of the helicopter in an essentially free condition and which, upon actuation, will quickly control or eliminate mechanical instability. Prior to the rev-up test, the contractor shall obtain the approval of the procuring activity with reference to use of either of the above methods. If the method stated by the contractor proposes the

use of a mooring system, approval of the procuring activity in regard to the proposed mooring system will be required prior to the rev-up test.

(d) Beginning at idling speed of the main rotor, and at increments up to and including 110-percent normal rotor speed.

(e) At collective pitch settings increasing in steps of not more than 20-percent airborne, up to the maximum collective.

(f) For each landing gear configuration, if the helicopter is intended for normal use with more than one landing gear configuration. If a particular landing gear configuration utilizes pneumatic tires or floats, the tire or float pressure shall be that intended for normal use.

(g) With the helicopter on a surface which simulates, insofar as possible, the type of surface from which it is normally intended to operate when equipped with each particular landing gear.

(h) With azimuth control stick excitation furnished in both fore and aft, and lateral direction.

3.5.2.2.2 Test procedure.-

3.5.2.2.2.1 Method of excitation.- Attempts to induce mechanical instability shall be made at each test condition by consecutively accomplishing the following actions:

(a) Move the azimuth control stick back and forth through full travel about 10 times at the estimated instability frequency (or at a frequency of about 0.75 times main rotor rpm if no instability is expected).

(b) Hold the stick at neutral position, and then immediately record the data listed in paragraph 3.5.2.2.2.2.

(c) If it is established that the helicopter is free of mechanical instability and flywheel type resonance, which may tentatively be done without having recourse to the recorded data, the attempt shall be made at the next condition.

3.5.2.2.2.2 Data.- The data to be obtained at each test condition shall yield the following information and shall preferably be taken by means of equipment incorporating a recording oscillograph:

(a) Main rotor rpm.

(b) Time history of azimuth control-stick motion.

(c) Time history of collective control-stick motion.

(d) Percent of helicopter weight which is airborne.

(e) Time history of oscillating stress or motion in some portion of the landing gear.

(f) Effect of relief valve on force supplied by blade damper (if applicable).

3.5.2.2.2.3 Mechanical instability rev-up test report.- A report shall be submitted to the procuring activity which will contain the results of the tests specified in paragraph 3.5.2.2, and which will demonstrate that the helicopter is free of mechanical instability and excessive flywheel type resonance under all the tested conditions.

3.6 Tie down tests.- The tests described under this heading shall be conducted on the helicopter to demonstrate that the applicable systems will operate satisfactorily in the helicopter. The airframe, engine, rotors, transmission, and all other helicopter parts having an effect upon the loads, including vibrations, shall be the same as those to be employed in the delivered helicopter.

3.6.1 Test conditions.- Unless otherwise specified by the procuring activity, the following test conditions shall apply during the Tie down tests.

3.6.1.1 Test time.- Intervals of operation of less than 1 hour's duration terminated by any failure, shall not be credited to the required test time. The test time shall not be credited by increments shorter than .30 minutes, except when shorter periods are a test requirement.

3.6.1.2 Speed.- The output speed of the engine(s) shall be controlled within ±2 percent of the stipulated speed.

3.6.1.3 Measurements, instrumentation, and apparatus.-

3.6.1.3.1 Temperature measurements.- All temperatures shall be recorded in degrees Centigrade.

3.6.1.3.2 Speed measurements.- The rpm of the input shaft(s) of the engine(s) shall be determined by suitable instrumentation to within an accuracy of ±2 percent.

3.6.1.3.3 Instrument calibration.- All instruments, gages, scales, and other equipment upon which the accuracy of the test results depend, shall be calibrated often enough and to such a degree as to insure laboratory accuracy in accordance with a plan approved by the procuring activity.

3.6.1.3.4 Inspections and adjustments.- Unless otherwise specified by the contractor and approved by the procuring activity, all servicing, such as lubrication, oil cleaner inspection and cleaning, and general external visual inspections, shall be made every 60 ±5 hours of the test.

3.6.1.3.5 Power.- Actual brake horsepower shall be used for the Tie down tests. Engine power shall be controlled within +5 and -0 percent of the desired values. The method of power measurement shall be as specified by the contractor and approved by the procuring activity.

3.6.1.3.6 Power distribution.- During the Tie down tests, except the rotor cycling tests, the power distribution between main rotor(s) and auxiliary rotor(s) shall be that expected under normal flight conditions at the specified input powers. Prior to starting the Tie down test, the contractor shall forward for approval by the procuring activity the rotor power distribution applicable to each separate test period.

3.6.1.3.7 Stress and motion survey.- A stress and motion survey of the rotor hub, blades, and other critical components of the helicopter shall be conducted during Tie down tests. This survey is mandatory during the first 50-Hour ground test period, and may be required in succeeding ground test periods at the option of the procuring activity. During the rotor stress survey, at least six records of clutch engagements representative of probable engagement conditions shall be made.

3.6.2 Tests.-

3.6.2.1 50-Hour preliminary flight approval test.- Each model helicopter shall satisfactorily complete the test described in paragraph 3.6.4 prior to the first flight of the helicopter.

3.6.2.2 150-Hour preproduction test.- Each model helicopter shall successfully complete the test described in paragraph 3.6.5 for each model helicopter.

3.6.2.3 250-Hour ground test.- When required by the procuring activity, a 250-Hour ground test will be conducted. A test schedule shall be prepared by the contractor and approved by the procuring activity.

3.6.3 Test procedures.- The helicopter tests shall be performed in accordance with the following.

3.6.3.1 Clutch and brake engagements.- The clutch and brake engagements required for the Tie down tests shall be performed during the takeoff power runs and as necessary, at each change of power and speed throughout the test(s). In each clutch engagement the shaft on the driven side of the clutch shall be accelerated from rest. The clutch engagements shall be accomplished at a speed and by a method specified by the contractor and approved by the procuring activity. During the deceleration after each clutch engagement, observations shall be made as to the proper functioning of the overrunning unit. During the brake engagements, the clutch shall be disengaged above 40 percent of rated rotor speed, and the rotor allowed to decelerate until it reaches 40 percent of rated speed at which time the rotor brake shall be applied and shall stop the rotors within 30 seconds of initial application. If the clutch design does not permit stopping the rotors with engine running, or no clutch is provided, the engine shall be stopped before each application of the rotor brake, and then immediately restarted after the rotors have stopped.

3.6.3.2 Rotor control positions.- Whenever the rotor controls are not being cycled during the Tie down test(s), the rotor shall be operated to produce each of the maximum thrust positions for the percentages of test time as shown below, using the procedures of paragraph 3.6.3.3:

(a) Full vertical thrust, 20 percent
(b) Forward thrust component, 50 percent
(c) Right thrust component, 10 percent
(d) Left thrust component, 10 percent
(e) Aft thrust component, 10 percent

3.6.3.3 Test cycle.- The 10-hour Tie down test cycle shall consist of the following runs conducted in the order given:

(a) Takeoff power run: One hour of alternate runs of 5 minutes at takeoff power and speed, and 5 minutes at as low an engine idle speed as practicable with the engine declutched from the transmission system and the rotor brake applied during the first 1 minute of the idle run. When declutching the engine, it shall be decelerated at the maximum rate possible in order to permit the operation of the overrunning clutch. During the remaining 4 minutes of the idle

run, the engine shall be clutched to the transmission system. Acceleration of the engine and the transmission system shall be accomplished at the maximum rate. In the absence of a takeoff rating, normal rated power and speed shall be substituted for takeoff power and speed.

(b) Military power run: One hour of alternate runs of 30 minutes at military rated power and speed, and 30 minutes at 60 percent normal rated power at normal rated speed. In the absence of a military power rating, the takeoff power run shall be accomplished in lieu of this run.

(c) Normal rated run: Three hours of continuous operation at normal rated power and speed. During the normal rated run, the main rotor controls shall be operated through a minimum of 15 cycles per hour consisting of the following main rotor pitch positions: (1) full vertical thrust, (2) maximum forward thrust component, (3) maximum aft thrust component, (4) maximum left thrust component, and (5) maximum right thrust component, except that this control movement need not produce loads or blade flapping motion exceeding the maximum loads or motions encountered in flight. The directional controls shall be operated through a minimum of 15 cycles per hour consisting of (1) maximum right thrust, (2) neutral thrust as required by the power applied to the main rotor, and (3) maximum left thrust. Each control position shall be held at maximum for at least 10 seconds.

(d) 90 Percent normal rated run: One hour of continuous operation at 90 percent of normal rated power at normal rated speed.

(e) 80 Percent normal rated run: One hour of continuous operation at 80 percent of normal rated power at normal rated speed.

(f) 60 Percent normal rated run: Two hours of continuous operation at 60 percent of normal rated power at the minimum desired cruising speed, as recommended by the contractor and approved by the procuring activity, or in lieu of this speed, at 90 percent of normal rated speed, whichever speed is lower.

(g) Overspeed run: One hour of continuous operation at 110 percent of normal rated speed at normal rated power. If operation of the helicopter power plant(s) at 110 percent of normal rated speed is prohibited, the speed of this run shall be the highest speed permissible as recommended by the contractor and approved by the procuring activity.

3.6.4 50-Hour preliminary flight approval test.- The helicopter shall be subjected to the following tests, conducted in the order given, unless otherwise specified by the procuring activity.

3.6.4.1 Test periods.- The 50 hours of testing shall consist of five 10-hour test cycles, as outlined in paragraph 3.6.3.3.

3.6.4.2 Clutch and brake engagements.- A total of at least 100 clutch and brake engagements shall be made during and, if necessary, at the end of the 50-Hour preliminary flight approval test without intervening major disassembly. The clutch and brake engagements shall be performed in accordance with paragraph 3.6.3.1.

3.6.4.3 Disassembly inspection.- After the completion of all the runs of the foregoing 50-Hour preliminary flight approval test, the transmission system, rotor hubs, and rotating controls shall be completely disassembled for examination (including fluorescent penetrant and magnetic particle) of all parts and for measurements as necessary to disclose excessively worn, distorted, or weakened parts. These measurements shall be compared with the contractor's drawings or with similar measurements made prior to the test, if available.

3.6.5 150-Hour preproduction test.- The helicopter shall be subjected to the following tests conducted in the order given, unless otherwise specified by the procuring activity.

3.6.5.1 Test periods.- The 150 hours of testing shall consist of fifteen 10-hour test cycles, as outlined in paragraph 3.6.3.3.

3.6.5.2 Clutch and brake engagements.- A total of at least 300 clutch and brake engagements shall be made during and, if necessary, at the end of the 150-Hour preliminary flight approval test without intervening major disassembly. The clutch and brake engagements shall be performed in accordance with paragraph 3.6.3.1.

3.6.5.3 Overspeed test.- After completion of the 150-Hour preliminary flight approval test and without intervening major disassembly, the transmission system shall be subjected to 50 overspeed runs, each 30 ±3 seconds in duration at 120 percent of normal rated speed. If operation of the helicopter powerplant(s) at 120 percent of normal rated speed is prohibited, the speed employed shall be the highest speed permissible, as recommended by the contractor and approved by the procuring activity. Overspeed runs shall be alternated with stabilizing runs of 1 to 5 minutes duration each at from 60 to 80 percent of normal rated speed. Acceleration and deceleration shall each be accomplished in a period not longer than 10 seconds, and the time for changing speeds shall not be deducted from the specified time for the overspeed runs. Overspeed runs shall be made with the rotor(s) in the flattest pitch at which smooth operation can be obtained.

3.6.5.4 Disassembly inspection.- After the completion of all the runs of the 150-Hour preliminary flight approval test, the transmission system rotor hub, and rotating controls shall be completely disassembled for examination (including fluorescent penetrant and magnetic particle inspections) of all parts, and for measurements as necessary to disclose excessively worn, distorted, or weakened parts. These measurements shall be compared with the contractor's drawings or with similar measurements made prior to the test, if available.

3.6.6 Data required.- During the tests, data shall be observed and recorded as follows, and as required in paragraph 3.6.1.3.7.

3.6.6.1 The date, the serial number(s) of the components, test run, and the desired power and speed shall be recorded on each log sheet.

3.6.6.2 The following items shall be recorded at intervals of not greater than 3 hours:

(a) Wet and dry bulb ambient air temperatures
(b) Barometer

3.6.6.3 All of the following items, where applicable, shall be recorded at intervals of not greater than 30 minutes during the tie down testing:

(a) Total test time
(b) Actual time of day
(c) Revolutions per minute of the engine(s) output shaft
(d) Ambient air temperature
(e) Oil temperature into each gearbox
(f) Oil temperature out of each gearbox or in sump
(g) Oil pressure(s) gearbox
(h) Oil-in pressure, gearbox (not taken if wet sump)
(i) Oil-out pressure, gearbox (not taken if wet sump)
(j) Oil consumption, gearbox
(k) Main rotor(s) cyclic pitch position
(l) Tail rotor pitch position
(m) Main rotor(s) collective pitch position
(n) Gearcase pressure
(o) Power - Power source data, as specified by the contractor and approved by the procuring activity, sufficient to insure that the required power and speed values are met during the transmission system testing.

3.6.6.4 Notes shall be placed on the log sheets concerning all incidents of the test, such as special lubrication, leaks, vibration, and any other irregular functioning of the helicopter or component thereof or the test equipment, and the corrective measures taken.

3.7 Transmission tests.- The transmission system shall be run concurrently with, and shall successfully complete, the tests in the order listed of paragraphs 3.6.4, 3.6.5, and 3.6.2.3, when required. Prior to starting the tests of paragraph 3.6.4, the contractor shall have satisfactorily conducted a transmission bench test in accordance with the test program proposed by the contractor and approved by the procuring activity.

3.7.1 Tie down tests.-

3.7.1.1 Test conditions.- Unless otherwise specified by the procuring activity, the following test conditions shall apply during the tests.

3.7.1.1.1 Oil and lubricants.- The grades of oil and lubricants used shall be as specified by the contractor in accordance with Specification MIL-L-6880.

3.7.1.1.2 Oil change.- The oil system shall be drained and filled with new oil at the start of the endurance test and shall thereafter be maintained in accordance with service instructions proposed by the contractor and approved by the procuring activity.

3.7.1.1.3 Oil temperatures.- The oil temperatures of the transmission system components shall be maintained at the maximum specified by the contractor and approved by the procuring activity, ±10°C.

3.7.1.1.4 Main oil pressure(s).- The main oil pressure(s) shall be adjusted at normal rated power and speed operation to the value specified by the contractor and approved by the procuring activity. After initial adjustment, no further adjustments shall be made unless approved by the procuring activity.

3.7.1.1.5 Oil outlet pressure(s).- The oil outlet pressure(s) of dry sump transmission components designed to be operated with an external oil cooler shall be maintained at 40 psi during the testing specified herein, except during tests at less than 60 percent of normal rated speed, at which time it may be less as indicated by test conditions.

3.7.1.1.6 Accessory drive loading.- Actual accessories or suitable loading devices, the type of each to be approved by the procuring activity, shall be installed on all accessory drives and operated at normal loading conditions unless otherwise authorized by the procuring activity.

3.7.1.1.7 Inspection and adjustments.- Disassembly of any part of the transmission system to any extent prior to the final teardown inspection, except for servicing, shall be at the option of the procuring activity. Lubricating oil shall be added to the transmission system gearboxes only at intervals of 30 ±5 test hours. Oil level checks and general external visual inspections may be made at the discretion of the contractor. At convenient times prior to, or during the performance of, the test and during the teardown inspections, the transmission system and its details of construction shall be examined to determine that the transmission conforms to specification and contract requirements.

3.7.1.2 Test procedures.- The Transmission tests shall be performed in accordance with the following.

3.7.1.2.1 Preliminary instructions.- The weight of the transmission system and components thereof, photographs, and other pertinent data desired by the procuring activity shall be obtained prior to the test(s) for incorporation in the test report(s). At the option of the procuring activity, all or part of the transmission system may be disassembled for examination or measurement of parts prior to performance of the test(s).

3.7.1.2.2 Failure of parts.- If a part fails during the testing of a transmission system, this part shall be replaced with a part of improved design or of more suitable material, unless the procuring activity authorizes the installation of a new part of the original design and material for one which failed because of defective material or workmanship. The tests shall be considered completed when every major part of the transmission system has been subjected to the entire test. At the discretion of the procuring activity, redesign and retesting may be required of any part which fails or indicates weakness after completing the test(s), but which is retained in the transmission system in order to facilitate the testing of other parts. A complete list of all the transmission system parts which successfully complete the test(s) shall be compiled and forwarded to the procuring activity.

3.7.1.3 50-Hour preliminary flight approval test.- The transmission system shall be subjected to the tests specified in paragraph 3.6.4.

3.7.1.4 150-Hour preproduction test.- The transmission system shall be subjected to the tests specified in paragraph 3.6.5.

3.7.2 Low temperature tests.- When required by the procuring activity, the transmission shall be subjected to the Low temperature tests, Procedure I, of Specification MIL-E-5272.

3.7.3 Special tests.- Transmission systems designed to operate at two or more gear ratios shall be subjected to special tests agreed upon by the contractor and the procuring activity.

3.7.4 Acceptance test.- Each production transmission system component thereof or combination of components, with the exception of interconnecting shafts, shall be subjected to either Schedule "A" or "B" of the Acceptance test. Schedule "A" shall apply to all production items until such time as the penalty or parts replacement record warrants the use of Schedule "B," as mutually agreed upon by the contractor and the procuring activity. The production items to be tested according to either schedule shall be selected by the Government Inspector.

3.7.4.1 Data required.- Data shall be recorded for all Acceptance test runs, including clutch engagements in accordance with paragraph 3.6.6, as applicable, except that the items listed shall be recorded at intervals of not more than 30 minutes or once during each run.

3.7.4.2 Test conditions.- Unless otherwise specified by the procuring activity, the following test conditions shall apply during the Acceptance test.

3.7.4.2.1 Oil and lubricants.- The grade of oil and lubricants used shall be as specified by the contractor for service operation in accordance with Specification MIL-L-6880.

3.7.4.2.2 Oil temperatures.- The inlet oil or the sump temperature shall be maintained within +0° -15°C of the maximum specified by the contractor and approved by the procuring activity.

3.7.4.2.3 Speed.- The input speed of the transmission system or component thereof shall be controlled to within ±3 percent of the stipulated speed.

3.7.4.2.4 Power.- Specified powers shall be maintained within +5 -0 percent.

3.7.4.2.5 Measurements, instrumentation, and apparatus.-

3.7.4.2.5.1 Speed measurements.- The rpm of the input shaft of the transmission system or component thereof shall be determined by suitable instrumentation to within ±2 percent.

3.7.4.2.5.2 Temperature measurements.- All temperatures shall be recorded in degrees Centigrade.

3.7.4.2.5.3 Instrument calibration.- All instrumentation shall be calibrated as required to maintain the specified accuracy. The method and frequency of calibration shall be acceptable to the procuring activity.

3.7.4.2.6 Test stand.- If the Acceptance test of the entire transmission system or any component of the transmission system is performed in the helicopter, it shall be conducted prior to the helicopter flight test. The acceptance testing of the transmission system components may be performed in a suitable test stand.

3.7.4.3 Test procedures.-

3.7.4.3.1 Schedule "A".- Under Schedule "A," each production transmission system or component thereof, shall be subjected to both the initial and final tests, outlined herein, conducted in the order given unless otherwise specified by the contractor and approved by the procuring activity.

3.7.4.3.2 Schedule "B".- Under Schedule "B," each production transmission system or component thereof shall be subjected to the final test outlined below, conducted in the order given unless otherwise specified by the contractor and approved by the procuring activity. Following the final test, an inspection shall be conducted as mutually agreed upon by the contractor and the procuring activity.

3.7.4.3.3 Initial test.-

3.7.4.3.3.1 Run-in.- The nature and duration of the run-in accomplished prior to the initial testing shall be determined by the contractor.

3.7.4.3.3.2 Normal rating run.- The transmission system or component thereof shall be operated for 1 hour at normal rated power and speed. Power take-off drive(s) designed for operating auxiliary rotor(s) or accessories shall be loaded at the normal rated power and speed value(s) as specified by the contractor and approved by the procuring activity.

3.7.4.3.3.3 Maximum rating run.- If the transmission system or any component thereof has a takeoff or military rating different from its normal rating, the transmission system or component thereof shall be operated for 3 periods each of 5 minutes duration at the power and speed values of the maximum rating. Each such period shall be preceded by a 1- to 5-minute period of operation at a reduced power setting.

3.7.4.3.3.4 Clutch engagements.- A minimum of five clutch engagements shall be made under conditions of power and speed specified by the contractor and approved by the procuring activity. In each engagement, the clutch output shaft shall be accelerated from rest and loaded in such manner that the speed and power absorbed at the completion of the engagement is comparable to that encountered in service operation of the helicopter. This engagement procedure shall be specified by the contractor and approved by the procuring activity.

3.7.4.3.3.5 Additional runs.- Transmission systems or components thereof which possess special features shall be subjected to additional runs as specified by the procuring activity and accepted by the contractor. Such runs shall be for the purpose of testing the special features, and shall not materially increase the duration of the Acceptance test.

3.7.4.3.3.6 Inspection.- Upon completion of the runs outlined above, the transmission system or component thereof shall be disassembled sufficiently as determined by the procuring activity, to accomplish a detailed inspection of all working parts. Defective parts shall be replaced, and at the discretion of the procuring activity, the transmission system or component thereof shall be subjected to the following penalty run.

3.7.4.3.3.7 Penalty run.- The penalty run shall consist of any or all of the runs specified under initial test at the discretion of the procuring activity. Running-in prior to the penalty run may be performed at the contractor's option for the accommodation of the replaced parts.

3.7.4.3.3.8 Inspection.- After completion of the penalty run, the transmission system or component thereof shall, at the discretion of the procuring activity, be disassembled for inspection of the replacement parts.

3.7.4.3.4 Final test.-

3.7.4.3.4.1 Preliminary instructions.- During the final phase of the Acceptance test, a stoppage for any cause may, at the option of the procuring activity, require the repetition of the particular run during which the stoppage occurred. External oil or lubricant leaks shall be considered as stoppage. If upon inspection at the completion of a run, oil or lubricant leaks are discovered, a check at normal rated power operation shall be made after corrective action has been completed.

3.7.4.3.4.2 Normal rating run.- The transmission system or components thereof shall be operated for 1 hour at normal rated power and speed. On gearboxes utilizing an external oil cooler, at least two determinations of oil flow rate and temperature rise shall be required at conditions of maximum oil inlet temperature specified by the contractor and approved by the procuring activity.

3.7.4.3.4.3 Maximum rating run.- The transmission system or component thereof shall be subjected to one 5-minute maximum-rated power period as outlined in paragraph 3.7.4.2.3.3.

3.7.4.3.4.4 Clutch test.- At least five clutch engagements shall be made as outlined in paragraph 3.7.4.3.3.4.

3.7.4.3.5 Rejection and retest.-

3.7.4.3.5.1 The individual transmission systems or components thereof failing to meet any of the Acceptance test shall be rejected. Any transmission system or component thereof which requires more than 15 hours of running at or above 90 percent of normal speed before running-in prior to the final test, or more than a total of 30 hours of running during the Acceptance test, shall be rejected.

3.7.4.3.5.1.1 Rejected components shall either be replaced with other components or reworked to correct the defects, after which all specified tests shall be repeated. Parts and accessories from rejected components shall not be resubmitted for acceptance without furnishing to the Government Inspector full particulars concerning previous rejection and the corrective action taken.

3.7.4.3.5.1.2 Persistently repetitive failures of a transmission system part or component shall, at the option of the procuring activity, require redesign of the affected parts or assemblies and the subjection of such parts to the testing required by this specification or portions thereof applicable to the components concerned.

3.7.4.3.5.2 Whenever, in the opinion of the procuring activity, there is evidence of malfunction of any part of the transmission system or component thereof, the difficulty shall be investigated and corrected to the satisfaction of the procuring activity before continuing the test. If such investigation requires disassembly of any internal moving parts of the transmission system or component thereof, the portion of the test in which the difficulty was encountered shall, at the option of the procuring activity, be repeated.

3.8 Data requirements.-

3.8.1 Test reports.- The contractor shall submit in report form, to the procuring activity, the following data for review and acceptance. Four copies shall be furnished unless otherwise specified by the procuring activity. Data referred to in a report shall be forwarded to the procuring activity for information before or at the time the report is submitted, unless such data are known to be available to the procuring activity.

(a) A list in report form of the titles of all test reports to be submitted by the contractor.

(b) A preliminary test report describing in detail the proposed test setup and test procedure to be followed. This report shall be submitted at least 45 days prior to the date on which the test is scheduled to be conducted. Initiation of the test shall be withheld until the test report has been approved or until the testing has been authorized by the procuring activity.

(c) A final report describing the test setups and test results of each test shall be submitted to the procuring activity not later than 45 days after completion of the tests.

3.8.1.1 Data to be submitted.- The test reports shall contain the items listed below:

(a) Title page
(b) Index
(c) Object
(d) Summary
(e) Conclusions and recommendations

(f) Descriptions: (Under this heading there shall be included a brief general description of the system or component which differs from the previous model, if any. Photographs are desirable.)

(g) Method of test: (General description of test equipment and methods.)

(h) Record of test: (When required by the procuring activity, all data required by this specification shall be included here as reproduced copies of the original data sheets. In addition, a chronological history of all events in connection with all of the testing shall be shown.)

(i) Analysis of results: (A complete discussion of all phases of the tests, such as probable reasons for failure and unusual wear, comparison in performance with previous models, if any, and analysis of general performance.)

3.8.2 Acceptance test report.- The transmission system Acceptance test report shall consist of the test log sheets containing the data stipulated in paragraph 3.7.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 This section is not applicable to this specification.

5. PREPARATION FOR DELIVERY

5.1 Packaging.-

5.1.1 Data.- The data shall be packaged in such manner that they will not be damaged in shipment.

5.2 Marking of shipments.- Marking shall be in accordance with Standard MIL-STD-129.

6. NOTES

6.1 Intended use.- The tests covered by this specification are for engineering evaluation and acceptance of the articles that are peculiar to helicopters.

PATENT NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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uirements 3.2 Types of aircraft stations. Unless otherwise specified, the rec

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION

ORGANIZATION *(Of submitter)*	CITY AND STATE

CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		$

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*	DATE

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