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AERONAUTICAL DESIGN STANDARD
HANDBOOK

SOURCE APPROVAL AND ENGINEERING TEST REQUIREMENTS FOR ALTERNATE SOURCES OF HELICOPTER DRIVE SYSTEM ASSEMBLIES AND COMPONENTS

UNITED STATES ARMY AVIATION AND TROOP COMMAND

ST. LOUIS, MISSOURI

AVIATION RESEARCH AND DEVELOPMENT CENTER

DIRECTORATE FOR ENGINEERING

Source Approval and Engineering Test Requirements for Alternate Sources of Helicopter Drive System Assemblies and Components

1 Scope

1.1 This Aeronautical Design Standard (ADS) specifies Source Approval and Engineering Test requirements for alternate sources of helicopter drive system assemblies and components. These requirements are necessary to insure that an alternate source has the advanced manufacturing and assembly skills required to produce these complex parts. Completion of these requirements before contract award is necessary to reduce procurement risk associated with overcoming technical issues with first-time producers of these parts. Fielding of parts before the capabilities of the alternate source is substantiated could result in failures and/or early removals in the field, which may significantly impact the safety and reliability of the weapon systems they are used on. These requirements are based on the requirements used to qualify the original source of the part. The requirements specified in this ADS must be substantiated by a candidate alternate source before they will be approved to bid on a contract for that part.

1.2 This ADS does not specify fatigue test requirements.

1.3 This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

2 References

Competition Advocates Shopping List (CASL)	
Engineering Test Standard One (TEST-STD-1)	Engineering Test Requirements for New Sources
Quality Engineering Standard One (QE-STD-1)	Flight Safety Parts - Quality System Requirements

3 Requirements

3.1 General

3.1.1 Components for which this ADS applies are listed in Attachment 1.

3.1.2 Approval of a candidate alternate source to provide a specific component does not imply the alternate source is approved to provide other components.

3.1.3 When a component listed in Attachment 1 is an assembly (i.e., it contains other components) the alternate source must become approved to produce those parts used in that assembly which are not being procured from approved sources. The alternate source must meet the requirements specified in this ADS for all of the components they produce themselves and for which they have not previously been given approval. They must also meet the requirements specified in this ADS for the assembly itself. Components which are assemblies of other parts are listed in Attachment 1.

3.2.2.1 When the design of a component listed in Attachment 1 is controlled by a Source or Specification Control Drawing (SCD), the candidate alternate source shall provide their detail design drawings for review and approval. Complete and specific qualification requirements and a detailed statement of work shall be provided to the candidate alternate source after their design drawing is approved. For SCD parts, qualification of the *design* as well as of the manufacturing and/or assembly *process* is required. Components controlled by Source or Specification Control Drawings are identified in Attachment 1.

3.2 Source Approval

3.2.1 General

3.2.1.1 Most of the substantiating documentation required by this ADS is submitted as part of a sources Source Approval Request (SAR) per the Competition Advocates Shopping List (CASL) Instructions. All documentation and data required by this ADS which is not submitted as part of the SAR shall be submitted to ATCOM Engineering, AMSAT-R-EB.

3.2.2 Specifications

3.2.2.1 The candidate alternate source shall certify they have legal access to all required specifications (e.g., assembly, manufacturing, processing, inspection, etc.) required by the applicable drawing and Spares Technical Data Package (STDP).

3.2.3 Material

3.2.3.1 For all components, the candidate alternate source shall certify that the material used meets all applicable drawing and material specification requirements. For components produced from castings or forgings, the candidate alternate source shall certify that the casting or forging supplier is an Government-approved source. Components made from castings or forgings are identified in Attachment 1.

3.2.4 Flight Safety Parts

3.2.4.1 Processes affecting Critical Characteristics of Flight Safety Parts must be performed by Government-approved sources. The candidate alternate source shall identify all sources who will be performing processes which affect Critical Characteristics. Flight Safety Parts are identified in Attachment 1.

3.2.5 Manufacturing Plan

3.2.5.1 When required, the candidate alternate source shall provide a copy of the manufacturing plan to be used for the component. When applicable, the manufacturing plans for any subcontractors used in the production of the part shall also be provided.

3.2.5.2 The manufacturing plans shall completely define the manufacturing and inspection process, including sequence of operations, equipment used for each task, specifications and standards used, inspection requirements, personnel requirements, etc. For assemblies of parts, the assembly procedure shall be defined. Details of process sensitive operations such as furnace loading, heat treatment times, temperatures, quench methods, maximum time delay prior to bake after plating, shot peening setup, etc., shall be provided when applicable. When applicable, balancing procedures shall be provided. Components which require balancing are listed in Attachment 1.

3.2.5.3 The manufacturing plan shall include all quality assurance procedures that will be implemented on production components. This plan shall include type of inspection performed, number of components in each lot inspected, lot sizes, Critical Characteristic inspection compliance procedures, etc. Plans for use of components/coupons for heat treat/carburization quality assurance purposes shall be provided.

3.2.5.4 The candidate alternate source shall provide a complete listing of all equipment to be used in the manufacture and inspection of the component. Calibration requirements for all equipment shall be provided.

3.2.5.5 The manufacturing plan shall include a complete listing of all subcontractors used during the manufacturing process. The list shall include subcontractor name, CAGE (Contractor and Government Entity) Code, address, telephone number, and description of the work to be done by the subvendor. Certification by the sub-vendor that they have agreed to perform the work indicated shall be provided. This information must be provided for the subcontractor who will actually perform the work, not for a list of subcontractors who are capable of doing the work.

3.2.5.6 The candidate alternate source shall provide a copy of any non-Government documents referenced in the manufacturing plan. Proprietary data will be fully protected by the Government.

3.2.5.7 Components for which manufacturing plans are required are listed in Attachment 1.

3.2.6 Bevel Gears

3.2.6.1 The candidate alternate source shall certify that they have legal possession of all master gears required for the manufacture and inspection of bevel gears, as well as those required for calibration purposes. All master gears utilized shall be calibrated with appropriate higher-level master gears held by the original manufacturer of the component. The Government will not supply any master gears of any level to candidate alternate sources. Bevel gears are identified in Attachment 1.

3.2.6.2 The candidate alternate source shall certify they have all equipment required for the manufacture, inspection (including roll checks), and calibration of bevel gears, including Zeiss (or equivalent) gear inspection equipment. The specific equipment to be used shall be provided in the manufacturing plan (see 3.2.5 above).

3.2.6.3 The candidate alternate source shall certify that they have legal access to all required prime manufacturers' gear manufacturing/inspection specifications, or have an ATCOM-approved alternate specification.

3.2.6.4 The candidate alternate source shall provide detailed master gear calibration plans, including certification of the current calibration status of master gears used in the manufacturing process. Certification of the calibration status of all master gears shall be provided to the Government.

3.2.7 Approval

3.2.7.1 Source Approval shall be based upon review and acceptance by the Government of all data required above, and review of the Source Approval Request against the requirements of the CASL Instructions. Upon approval, all manufacturing and inspection plans shall become "frozen," and shall not be changed without first obtaining the Government's approval. Test components shall be manufactured in accordance with these plans.

3.3 Engineering Test

3.3.1 General

3.3.1.1 The candidate alternate source shall supply all parts required during the engineering test, inspection, and evaluation process.

3.3.1.2 The candidate alternate source must provide certification that all components submitted for test, inspection, and evaluation have been manufactured/assembled in accordance with the approved "frozen" planning.

3.3.2 Inspection and Test

3.3.2.1 Inspection consists of using *non-destructive* techniques as needed to substantiate component or assembly compliance with drawing and specification requirements. Components which require compliance inspections are identified in Attachment 1.

3.3.2.2 Testing consists of metallurgical or material inspection, strength or physical property testing, endurance testing, and/or fatigue testing. The specific type of testing required for components and assemblies is identified in Attachment 1. For those components and assemblies requiring both conformance inspection and testing, all inspections must be completed and inspection results approved before testing can begin.

3.3.3 Inspections

3.3.3.1 Compliance

3.3.3.1.1 One of the components produced by the candidate alternate source shall undergo a complete dimensional and nondestructive evaluation by a Government-approved facility to substantiate compliance with applicable drawing and specification requirements. The Government reserves the right to witness any or all of these inspections. Requirements which cannot be substantiated after the component is completed (e.g., dimensions before shot peen, etc.) must be substantiated during processing of the component.

3.3.3.1.2 For Flight Safety Parts, the compliance inspection shall include an inspection of all Critical Characteristics.

3.3.3.1.3 Components which require compliance inspection are identified in Attachment 1.

3.3.3.2 Bevel Gears

3.3.3.2.1 Bevel gears shall undergo the following inspections. Inspections which cannot be performed on the final product shall be verified in-process by the Government. The Government reserves the right to witness any or all of these inspections.

3.3.3.2.1.1 Dimensional (e.g., Zeiss) inspection of gear tooth profile.

3.3.3.2.1.2 Backlash inspection.

3.3.3.2.1.3 Pitch runout and index variation.

3.3.3.2.1.4 Fillet size and shape.

3.3.3.2.1.5 Face and back angle.

3.3.3.2.1.6 Root depth.

3.3.3.2.1.7 Surface micro-finish.

3.3.3.2.1.8 Surface temper (nital etch).

3.3.3.2.1.9 Magnetic particle.

3.3.3.2.1.10 Bearing pattern when rolled against the appropriate mating master gear.

3.3.3.2.2 Final grinding summaries shall be provided to the Government..

3.3.3.3 Bearings

3.3.3.3.1 Bearings shall undergo the following inspections. Inspections which cannot be performed on the final product shall be verified in-process by the Government. The Government reserves the right to witness any or all of these inspections.

3.3.3.3.1.1 Raceway curvature (ball bearings).

3.3.3.3.1.2 Rolling element size.

3.3.3.3.1.3 Magnetic particle inspection (rings and retainers).

3.3.3.3.1.4 Surface temper (nital etch) of rings and rolling elements.

3.3.3.3.1.5 Contact angle rotational check (ball bearings).

3.3.3.3.1.6 Surface micro-finish of raceways and rolling elements.

3.3.3.3.1.7 Radial clearance, end play, and diametral clearance (when applicable).

3.3.3.3.1.8 Diametral retainer clearance.

3.3.3.4 Assemblies

3.3.3.4.1 When applicable, an audit of the assembly process used by the candidate alternate source as specified in the approved assembly plan shall be performed by the Government. The assembly shall then be inspected to the extent necessary to substantiate all applicable drawing and specification assembly requirements have been met.

3.3.3.5 Dynamic Balancing

3.3.3.5.1 When applicable, an audit of the balance process used by the candidate alternate source as specified in the approved balance plan shall be performed by the Government. The

component shall then be inspected to the extent necessary to substantiate all applicable drawing and specification balance requirements have been met. Parts requiring balancing verification are identified in Attachment 1.

3.3.3.6 Hardness

3.3.3.6.1 Components which are heat treated during the manufacturing process shall have hardness checks performed to insure the proper hardness has been obtained. Components requiring hardness checks are listed in Attachment 1.

3.3.4 Test

3.3.4.1 Material

3.3.4.1.1 One of the components produced by the candidate alternate source shall undergo a complete material evaluation by a Government-approved facility. This evaluation shall include destructive and/or non-destructive testing as required to verify applicable metallurgical, material, and/or process requirements of the drawing, material specification, and (when applicable) design specification have been met. The Government reserves the right to witness any or all of these inspections.

3.3.4.1.2 Any heat treat coupons used to control the heat treat process shall be sectioned and compared to the cut-up of the actual part, to insure the heat treat characteristics of the coupon adequately reflects those of the actual parts. If this has been done in-process, copies of all coupon tests and cut-up reports shall be provided.

3.3.4.1.3 Bearings shall have the inner and outer race and rolling elements sectioned to substantiate proper microstructure and hardness.

3.3.4.1.4 Gears shall be sectioned to substantiate proper case depth, core hardness, and microstructure.

3.3.4.1.5 Components requiring metallurgical or material testing and evaluation are identified in Attachment 1.

3.3.4.2 Endurance Testing

3.3.4.2.1 When applicable, one of the components produced by the candidate alternate source shall undergo an endurance test. Endurance testing shall be conducted at a Government-approved facility.

3.3.4.2.2 Components and assemblies requiring endurance testing are to be incorporated into the higher-level assembly that is needed to support testing (hereinafter referred to as the "test assembly"). The level of assembly used (e.g., complete gearbox or a specific quill assembly or module) is usually dependent upon the test facility chosen. For individual components requiring endurance testing, the component shall be incorporated into the test assembly by an approved assembly source. For assemblies requiring endurance testing, the assembly shall be accomplished by the candidate alternate source. Assembly instructions shall be as specified in the approved manufacturing plan.

3.3.4.2.3 Components and assemblies requiring endurance testing are identified in Attachment 1. XXX indicates the length of the endurance test.

3.3.4.2.4 Components undergoing 5-hour endurance testing shall be installed in mesh with components produced by approved and tested sources. Components undergoing endurance tests of duration greater than 5 hours may be run in mesh with other components from untested sources, but will then be required to complete a 5-hour endurance test while run in mesh with a component from an approved and tested source.

3.3.4.2.5 Specific Statements of Work (SOW) for the endurance test shall be prepared by ATCOM Engineering after the inspection requirements of Section 3.3.3 above have been completed by the candidate alternate source. Other test requirements are as specified in TEST-STD-1. General requirements are given below.

3.3.4.2.5.1 Test assembly static patterns obtained shall meet the dimensional and positional requirements as given in the SOW. Copies of the static pattern shall be retained for each bevel gear in the test assembly.

3.3.4.2.5.2 After approval of the static patterns is given, the test assembly shall undergo an Acceptance Test in accordance with the SOW. At the conclusion of the Acceptance Test, the dynamic patterns shall meet the requirements given in the SOW.

3.3.4.2.5.3 After approval of the dynamic patterns is given, the test assembly shall undergo an endurance bench test, of duration as specified in Attachment 1.

3.3.4.2.5.4 Testing shall be in accordance with the test spectrum identified in Attachment 1 and provided in Attachment 2. For endurance tests of 25 hours duration or less, other test spectrums may be used. These test spectrums shall be given in the SOW, and in no case will they be to greater levels than the test spectrum identified in Attachment 1.

3.3.4.2.5.5 Dynamic patterns shall be periodically examined (every 25 hours) to insure no adverse wear characteristics are evident.

3.3.4.2.5.6 At the conclusion of the endurance test, the test assembly shall be disassembled in accordance with the SOW to allow a complete evaluation (dimensional, visual, NDI) of the test component and associated assembly components (mating gears, bearings, etc.). Components shall be subjected to nondestructive test procedures as required to insure no adverse wear or damage is present. The Government reserves the right to witness the teardown and evaluation, and to provide written action items (chits) to the candidate alternate source. The candidate alternate source shall be responsible for addressing all concerns raised in the post-test evaluation of the test component and test assembly.

3.3.4.2.6 Approval shall be based on the wear characteristics of the test component or assembly at the conclusion of testing, as determined by the Government. In the event unacceptable wear or other damage is present, the candidate alternate source shall take appropriate actions to revise the manufacturing process in order to produce an acceptable component. The candidate alternate source may be required to repeat the endurance test in whole or in part with new or reworked test components to insure any action taken has the desired result.

3.3.4.3 Clutch Test

3.3.4.3.1 When applicable, one of the components produced by the candidate alternate source shall undergo a clutch performance test. Testing shall be conducted at a Government-approved facility.

3.3.4.3.2 Components and assemblies requiring clutch performance testing are to be incorporated into the higher-level assembly that is needed to support testing (hereinafter referred to as the "test assembly"). The level of assembly used (e.g., complete gearbox or clutch assembly, or a specific quill assembly or module) is usually dependent upon the test facility chosen. For individual components requiring testing, the component shall be incorporated into the test assembly by an approved assembly source. For assemblies requiring testing, the assembly shall be accomplished by the candidate alternate source. Assembly instructions shall be as specified in the SOW.

3.3.4.3.3 Clutch components and assemblies requiring testing are identified in Attachment 1.

3.3.4.3.4 Clutch components undergoing testing shall be installed in mesh with components produced by approved and tested sources.

3.3.4.3.5 Testing shall be conducted by a Government-approved facility. Specific Statements of Work (SOW) for the test shall be prepared by ATCOM Engineering after the inspection requirements of Section 3.3.3 above have been substantiated. Testing shall be accomplished in accordance with TEST-STD-1. General requirements are given below.

3.3.4.3.5.1 Each clutch test assembly shall be subjected to 200 engagements/disengagements.

3.3.4.3.5.2 Each clutch test assembly shall be subjected to 5 hours of overrunning (disengaged), with the driven (input) side at 100% speed and the output side stationary.

3.3.4.3.5.3 Each clutch test assembly shall be subjected to 5 hours of overrunning (disengaged), with the driven (input) side at 100% speed and the output side at the idle speed of the engine used in that particular installation.

3.3.4.3.5.4 Each clutch test assembly shall be subjected to 25 hours of endurance testing (engaged) at the maximum torque capability of the associated gearbox/input.

3.3.4.3.5.5 At the conclusion of the clutch performance test, the test assembly shall be disassembled in accordance with the SOW to allow a complete evaluation (dimensional, visual, NDI) of the test component and associated assembly components. Components shall be subjected to nondestructive test procedures as required to insure no adverse wear or damage is present. The Government reserves the right to witness the teardown and evaluation, and to provide written action items (chits) to the candidate alternate source. The candidate alternate source shall be responsible for addressing all concerns raised in the post-test evaluation of the test component and test assembly.

3.3.4.2.6 Approval shall be based on the wear characteristics of the test component or assembly at the conclusion of testing, as determined by the Government. In the event unacceptable wear or other damage is present, the candidate alternate source shall take appropriate actions to revise the manufacturing process in order to produce an acceptable component. The candidate alternate source may be required to repeat the endurance test in whole or in part with new or reworked test components to insure any action taken has the desired result.

3.3.4.4 Other Tests

3.3.4.4.1 Other tests may be required on specific components and assemblies. The test requirements will be provided for these tests upon request. These components and assemblies are identified in Attachment 1.

3.3.5 Approval

3.3.5.1 Approval of Engineering Test results shall be based upon successful completion of all required evaluations and tests specified above. In the event unacceptable results are obtained, the candidate alternate source shall take appropriate actions to revise the manufacturing or assembly process in order to produce an acceptable component or assembly. The testing may be repeated in whole or in part with new or reworked test components (as determined by ATCOM Engineering) to insure any action taken has the desired result.

3.3.5.2 When a component fails one of the required tests, the item shall be rejected. All failures, whether by noncompliance of hardware (dimensional or metallurgical) or failure during testing, and proposed modifications to either parts or testing procedures shall be documented and submitted to the Government before testing can resume.

3.3.5.3 Upon approval of all test and evaluation results, all manufacturing plans shall become "frozen," and shall not be changed without first obtaining Government approval. Subsequent components shall be manufactured in accordance with these plans. All substantiation evaluation and test documentation shall be provided to the Government.

3.3.5.4 Production components manufactured by the alternate source which do not meet the requirements of the approved drawings, manufacturing plans, and STDP shall not be used without written approval from ATCOM.

3.3.5.5 A change in manufacturing location, such as to another plant of an individual vendor; a change in material processes or subvendors who perform a process; a change in material, casting, or forging suppliers; a change in manufacturing planning from the approved planning process; or a change in machining procedures which may affect component strength or durability, will require re-evaluation of the approval status. Alternate sources shall notify the Government immediately if they are under contract to supply an item in Attachment 1 and any of the above changes have occurred.

3.4 General

3.4.1 If an approved source listed in a Spares Technical Data Package is awarded a contract, and that source has not delivered parts to the Government within the last four (4) years, they must complete a metallurgical evaluation in accordance with paragraph 3.3.4.1, and a 200-hour endurance test in accordance with paragraph 3.3.4.2, to retain their approved status. If a source has not delivered parts to the Government within the last two (2) years, they must complete a metallurgical evaluation in accordance with paragraph 3.3.4.1, and a 25-hour endurance test in accordance with paragraph 3.3.4.2. This effort shall be conducted as part of the First Article Test for the solicitation.

3.4.2 Alternate sources who are awarded contracts for components or assemblies for which they are already an approved source must certify that the part delivered under the additional contract will be produced using the same "frozen" planning used to produce parts under the original contract. Any contract given to an alternate source assumes the alternate source will use approved planning to produce the part. If the source was not required to meet the requirements of this ADS when they became approved to manufacture a part, they shall be required to meet all requirements of this ADS to retain their approval status before being awarded another contract for the part.

3.4.3 The approval status of an alternate source may be rescinded any time evidence is presented that indicates the alternate source has become incapable of producing the part in accordance with the approved process. If approval is rescinded, some or all of the requirements of this document may have to be performed to regain approval. Alternate sources will be notified in writing if the Government intends to rescind their approval status, and will be provided an opportunity to respond to the Government's claims.

APPENDIX A - Definitions

Source Approval - Source Approval is the process used by ATCOM Engineering to determine if a candidate alternate source has the capability to provide a specific assembly or component. The requirements for Source Approval are specified in the Competition Advocates Shopping List (CASL) Instructions, and in this ADS. The Source Approval requirements must be met before Engineering Testing can begin. CASL instructions may be obtained by contacting the ATCOM Source Development Officer at (314)263-3999.

Engineering Test - Engineering Test is the process used by ATCOM Engineering to accomplish inspections and tests of assemblies and components provided by candidate alternate sources. These inspections and tests are used to substantiate that the assemblies or components meet minimum acceptable levels of function, durability, and service life. No candidate alternate source will be considered approved to bid on Army contracts for a specific assembly or component until they successfully complete the Engineering Testing required for that assembly or component. the requirements for Engineering Test are specified in this ADS.

Alternate Source - An alternate source is any source of drive system spare assemblies or components other than the prime or any source listed on a Source Control Drawing. A Candidate Alternate Source refers to the alternate source before they have successfully met the requirements of this ADS and of the CASL instructions. The alternate source may or may not be the actual manufacturer of the assembly or component. Alternate sources are responsible for insuring all requirements of this ADS have been met by all manufacturing sources and their subcontractors of the assembly or component they are providing to the Army.

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AERONAUTICAL DESIGN STANDARD
HANDBOOK

SOURCE APPROVAL AND ENGINEERING TEST REQUIREMENTS FOR ALTERNATE SOURCES OF HELICOPTER DRIVE SYSTEM ASSEMBLIES AND COMPONENTS

ATTACHMENT 1

PARTS LIST

Source Approval and
Engineering Test Requirements for
Alternate Sources of Helicopter
Drive System Assemblies and Components

Attachment 1
Parts List

1 Introduction

1.1 This Attachment to Aeronautical Design Standard (ADS) 39A lists helicopter drive system components and assemblies, and defines the specific requirements that are applicable to those components and assemblies.

1.2 The attached listing information is as follows:

Column Heading	Information Given
Part Number	Part Number for the component or assembly.
Part Name	Nomenclature for the component or assembly.
Part NSN	Part national Stock Number.
Part Used On	The major assembly the part is used on.
Assy?	Indicates the part is an assembly (ASY) of other components.
SCD?	Indicates the part is controlled by a Specification or Source Control Drawing (SCD).
C/F?	Indicates the part is made from a casting (CST) or forging (FRG).
Plan?	Indicates a manufacturing plan (MNF) is required.
FSP?	Indicates the part is designated as a Flight Safety Part (FSP).
Insp?	Indicates a compliance inspection (COM) is required.
Bal?	Indicates the part has dynamic balancing (BAL) requirements.
Hrdn?	Indicates a hardness check (HRD) is required.
Matl?	Indicates a material evaluation (MAT) is required.
End?	Indicates and endurance test (END) is required. Code is END-XXX-Y, where XXX is the length of the test, and Y is the test spectrum from Attachment 2.
Clutch?	Indicates a clutch performance test (CLU) is required.
Other?	Indicates other tests are required (OTH). See Section 4 below for instructions.

2 Database

2.1 A database is being developed to provide enhanced access to the information in this Attachment. Future revisions to this attachment will provide information on accessing and using the database.

3 Use of Attachment 1

3.1. This attachment currently contains requirements for drive system components and assemblies used on the UH-60 Black Hawk, AH-64 Apache, and CH-47D Chinook helicopters. Requirements for drive system components and assemblies on other aircraft should be taken from ADS-39 dated 8 November 1989. Future updates to this Attachment will contain requirements for the remaining aircraft. When a component or assembly is listed in both this ADS and ADS-39 dated 8 November 1989, the requirements of this ADS shall take precedence.

4 Other Requirements

4.1 When Code OT is used in Column 15 of this Attachment, or when a component or assembly is not listed in either this ADS or ADS-39 dated 8 November 1989, requirements may be obtained by contacting

USA ATCOM
ATTN: AMSAT-R-EPD (ADS-39)
4300 Goodfellow Blvd.
St. Louis MO 63120-1798

Phone: 314-263-0308 or DSN 693-0308

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SOURCE APPROVAL AND ENGINEERING TEST REQUIREMENTS FOR ALTERNATE SOURCES OF HELICOPTER DRIVE SYSTEM ASSEMBLIES AND COMPONENTS

ATTACHMENT 2

TEST SPECTRUMS

Source Approval and Engineering Test Requirements for Alternate Sources of Helicopter Drive System Assemblies and Components

Attachment 2 Test Spectrums

1 Introduction

1.1 This Attachment to Aeronautical Design Standard (ADS) 39A lists helicopter drive system component and assembly endurance test spectrums.

2 Abbreviations

GEN Generator
SDC Shaft Driven Compressor
TTO Tail Take-off

Test Spectrum "1"
UH-60A Black Hawk
Main Module Gearbox

CONDITION	DURATION (MIN.)	L/H INPUT (SHP)	R/H INPUT (SHP)	TOTAL INPUT (SHP)	TTO OUTPUT (SHP)	MAIN SHAFT OUTPUT
1	20	1414	1414	2828	250	2578
2	15	500	500	1000	70	930
3	25 (4)	1500	1500	3000	250	2750
4	15	1700	Min.	1700	70	1630
5	8	1500	Min.	1500	250	1250
6	50	1414	1414	2828	424	2404
7	15	Min.	1700	1700	70	1630
8	8	Min.	1500	1500	250	1250
9	25	1275	1275	1550	424	2126
10	20	1150	1150	2300	250	2050
11	22	750	750	1500	424	1076
12	22	1414	1414	2828	250	2578
13	30	1050	1050	2100	250	1850
14	25 (4)	1500	1500	3000	250	2750

Notes:
1. 300 minute cycle - repeat as required.
2. All conditions to be run at 100% speed.
   a. Main rotor shaft speed 258 rpm.
   b. Tail takeoff speed 4116 rpm.
   c. Input shaft speed 20,900 rpm.
3. Use MIL-L-23699 lubricant.
4. Alternate runs of 5 minutes duration at 1500 SHP input power and 2.5 minutes duration at 400 SHP input power.
5. Manifold oil pressure 50-65 psig.
6. Oil-in temperature 77±3^{o}C. Sump temperature to be 30^{o}C above oil-in temperature.
7. Main shaft power is neglecting friction losses.
8. Main shaft thrust 24,000 pounds.

Test Spectrum "2"

UH-60L/MH-60K Black Hawk
Main Module Gearbox
UH-60A/UH-60L/MH-60K Black Hawk
Input/Accessory Module Gearboxes

CONDITION	DURATION (MIN.)	L/H INPUT (SHP)	R/H INPUT (SHP)	TOTAL INPUT (SHP)	TTO OUTPUT (SHP)	MAIN SHAFT OUTPUT
1	15	500	500	1000	70	930
2	40	1700	1700	3400	420	2980
3	15	1900	Min.	1900	420	1480
4	8	1760	Min.	1760	170	1590
5	15	Min.	1900	1900	420	1480
6	8	Min.	1760	1760	170	1590
7	20	1700	1700	3400	530	2870
8	20	1760	1760	3520	530	2990
9	25	1530	1530	3060	380	2680
10	20	1360	1360	2720	170	2550
11	29	1190	1190	2380	380	2000
12	35	850	850	1700	420	1280
13	20	1700	1700	3400	170	3230
14	30	1760	1760	3520	170	3350

Notes:
1. 300 minute cycle - repeat as required.
2. All conditions to be run at 100% speed.
   a. Main rotor shaft speed 258 rpm.
   b. Tail takeoff speed 4116 rpm.
   c. Input shaft speed 20,900 rpm.
3. Use MIL-L-23699 lubricant.
4. Alternate runs of 5 minutes duration at 1500 SHP input power and 2.5 minutes duration at 400 SHP input power.
5. Manifold oil pressure 50-65 psig.
6. Oil-in temperature 77±3^{o}C. Sump temperature to be 30^{o}C above oil-in temperature.
7. Main shaft power is neglecting friction losses.
8. Main shaft thrust 27,000 pounds.

Test Spectrum "3"

UH-60A/UH-60L/MH-60K Black Hawk
Intermediate/Tail Gearboxes

CONDITION	DURATION (MIN)	INPUT POWER (SHP)
1	30	330
2	30	120
3	30	330
4	60	530
5	150	180
6	60	530
7	60	180
8	60	410
9	60	180
10	60	330

Notes:
1. 600 minute cycle - repeat as required.
2. All conditions to be run at 100% speed (4116 rpm input to IGB).
3. Use MIL-L-23699 lubricant.

Test Spectrum "4"
AH-64A Apache
Main Transmission

COND.	DURATION (MIN.)	L/H INPUT (SHP)	R/H INPUT (SHP)	MAIN SHAFT OUTPUT	TTO OUTPUT (SHP)	L/H GEN (SHP)	R/H GEN (SHP)	SDC (SHP)	INPUT SPEED
1	30	837	837	1550	(2)	6	6	7	8857
2	150	1388	1388	2570	(2)	28	28	34	9841
3	60	1249	1249	2313	(2)	56	56	50	9841
4	60	1110	1110	2056	(2)	0	0	67	9841
5	120	833	833	1542	(2)	17	17	0	9841
6	30	1526	1526	2827	(2)	11	11	13	10825
7	90	1208	0 (3,5)	(2)	330	56	0 (5)	0	9841
8	30	1388	1388	2570	(2)	28	28	34	9841
9	25	1526	0 (3,5)	(2)	198	0 (5)	22	17	9841
10	5	1735	0 (3,5)	(2)	330	56	0 (5)	0	9841

Notes:
1. 600 minute cycle - repeat as required.
2. Adjust to achieve power balance.
3. Remove coupling as required for this step.
4. Use MIL-L-23699 oil.
5. Alternate right and left hand side every other test cycle.
6. Main shaft power is neglecting friction losses.

Test Spectrum "5"
AH-64A Apache
Intermediate and Tail Gearbox

CONDITION	DURATION (MIN)	INPUT POWER (SHP)
1	30	198
2	30	53
3	30	198
4	60	330
5	150	100
6	60	330
7	60	100
8	60	264
9	60	100
10	60	198

Notes:
1. 600 minute cycle - repeat as required.
2. All conditions to be run at 100% speed (4815 rpm input to IGB).
3. Use MIL-L-23699 lubricant.

Test Spectrum "6"
AH-64A Apache
Engine Nose Gearbox

CONDITION	DURATION (MIN)	INPUT RPM	INPUT POWER (SHP)
1	120	18857	848
2	60	20952	1131
3	60	20952	1273
4	180	20952	1414
5	27.5	20952	1560
6	2.5	20952	1768
7	30	20952	848
8	60	20952	1560/848 (2)
9	60	23047	1560

Notes:
1. 600 minute cycle - repeat as required.
2. Use alternating 5 minute cycles at the conditions indicated.
3. Use MIL-L-23699 lubricant.

Test Spectrum "7"
CH-47D Chinook
Forward and Aft Transmission

CONDITION	DURATION (MIN)	INPUT POWER (SHP)
1	20	4500
2	15	1575
3	25 (7)	4500
4	50	4500
5	25	4050
6	20	3600
7	20	2250
8	20	4500
9	30	3375
10	25 (7)	4500

Notes:
1. 250 minute cycle - repeat as required.
2. All conditions to be run at 100% speed (6912 rpm input).
3. Use MIL-L-23699 lubricant.
4. Manifold lube pressure = 45-65 psig.
5. Sump lube temperature = 115 degree C max.
6. Main shaft power is neglecting friction loss.
7. Alternate runs; 5 minutes at 4600 SHP and 2.5 minutes at 1610 SHP.

Test Spectrum "8"
CH-47D Chinook
Combining Transmission

CONDITION	DURATION (MIN.)	L/H INPUT (SHP)	R/H INPUT (SHP)	TOTAL INPUT (SHP)	FWD OUTPUT (SHP)	AFT OUTPUT (SHP)
1	20	3750	3750	7500	3750	3750
2	15	1310	1310	2620	1310	1310
3	25 (7)	3750	3750	7500	3750	3750
4	15	4600	Min.	4600	2300	2300
5	8	4140	Min.	4140	2070	2070
6	50	3750	3750	7500	3750	3750
7	15	Min.	4600	4600	2300	2300
8	8	Min.	4140	4140	2070	2070
9	25	3375	3375	6750	3375	3375
10	20	3000	3000	6000	3000	3000
11	22	1875	1875	3750	1875	1875
12	22	3750	3750	7500	3750	3750
13	30	2810	2810	5620	2810	2810
14	25 (7)	3750	3750	7500	3750	3750

Notes:
1. 300 minute cycle - repeat as required.
2. All conditions at 100% (12263 rpm at the inputs).
3. Use MIL-L-23699 lubricant.
4. Manifold oil pressure 45-65 psig.
5. Sump lube temperature = 126 degree C maximum.
6. Main shaft power is neglecting friction losses.
7. Alternate runs; 5 minutes at 7500 SHP total input and 2.5 minutes at 2625 SHP total input.

Test Spectrum "9"
CH-47D Chinook
Engine Nose Gearbox

CONDITION	DURATION (MIN)	INPUT POWER (SHP)
1	20	4600
2	15	1610
3	25 (7)	4600
4	50	4600
5	25	4140
6	20	3680
7	20	2300
8	20	4600
9	30	3450
10	25 (7)	4600

Notes:
1. 250 minute cycle - repeat as required.
2. All conditions at 100% (15066 rpm at the inputs).
3. Use MIL-L-23699 lubricant.
4. Manifold oil pressure 40-65 psig.
5. Sump lube temperature = 132 degree C maximum.
6. Main shaft power is neglecting friction losses.
7. Alternate runs; 5 minutes at 4600 SHP total input and 2.5 minutes at 1610 SHP total input.