HEAVY LIFT HELICOPTERS

A DDC BIBLIOGRAPHY

DDC-TAS-72-16-1

APRIL 1972

Approved for public release; distribution unlimited.
### ABSTRACT

This bibliography contains unclassified references on Heavy Lift Helicopters with a minimum payload of about 9,000 pounds or a minimum gross weight of 17,000 pounds. These references relate to rotor characteristics, rotor systems, rotor loads, lift propulsion, payloads, heavy lift rotors, configurations, design, and performance capabilities of the heavy lift helicopters.

Computer-generated indexes of Corporate Author-Monitoring Agency, Subject, Personal Author, and Title are included.
<table>
<thead>
<tr>
<th>KEY WORDS</th>
<th>LINE A</th>
<th>LINE B</th>
<th>LINE C</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Heavy Lift Helicopters</td>
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<td>*Helicopters</td>
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<td>*Bibliographies</td>
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<tr>
<td>Heavy Lift Rotors</td>
<td></td>
<td></td>
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<tr>
<td>Helicopter Engines</td>
<td></td>
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<td>Helicopter Rotors</td>
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<td>Payload</td>
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<td></td>
<td></td>
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<tr>
<td>Rotor Blades (Rotary Wings)</td>
<td></td>
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<tr>
<td>HLH (Heavy Lift Helicopters)</td>
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<td>Cargo</td>
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<tr>
<td>CH-53A Aircraft</td>
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<tr>
<td>S-60 Aircraft</td>
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<td></td>
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<td>H-53 Aircraft</td>
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<td>Weight</td>
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HEAVY LIFT HELICOPTERS

A DDC BIBLIOGRAPHY

October 1962 - January 1971

DDC-TAS-72-161

APRIL 1972

Approved for public release; distribution unlimited.
FOREWORD

This bibliography contains 34 unclassified references relating to Heavy Lift Helicopters with a minimum payload of about 9,000 pounds or a minimum gross weight of 17,000 pounds. These references were selected from entries processed into the Defense Documentation Center Data Bank during the period of January 1953 through December 1971.

BY ORDER OF THE DIRECTOR, DEFENSE SUPPLY AGENCY

OFFICIAL

[Signature]

ROBERT B. STEGMANN, JR.
Administrator
Defense Documentation Center
CONTENTS

Page

FOREWORD ............................................. iii

AD BIBLIOGRAPHIC REFERENCES .......................... 1

INDEXES

CORPORATE AUTHOR-MONITORING AGENCY ............. 0-1
SUBJECT ........................................... 0-1
TITLE ................................................ 1-1
PERSONAL AUTHOR .................................. P-1
RESULTS OF EXPERIMENTAL RESEARCH ON HELICOPTER ROTORS ARE PRESENTED IN THE HOVERING REGIME. OPTIMUM PARAMETERS ARE DISCUSSED FOR HEAVILY LOADED ROTORS. A GENERALIZED VORTICITY THEORY OF THE HELICOPTER LIFTING RO OR IS SE FORTH; THIS MAKES I POSSIBLE TO DETERMINE THE INDUCED VELOCITY A ANY POINT IN SPACE FOR THE BASIC FLIGHT MODE. THE RESULTS OF AERODYNAMIC RESEARCH ON COMPUTATION OF THE FLIGHT CHARACTERISTICS OF THE HELICOPTER ROTOR IN THE VERTICAL-DESCENT MODE ARE SET FORTH. METHODS ARE GIVEN FOR DETERMINING THE CHARACTERISTICS OF THE ROTOR. (AUTHOR)
A PRELIMINARY DESIGN STUDY HAS BEEN COMPLETED OF A TWIN-ENGINE HOT CYCLE RESEARCH HELICOPTER UTILIZING THE EXISTING ROTOR WITH THE FOLLOWING DESIGN OBJECTIVES: (1) 15,300 LB DESIGN GROSS WEIGHT; (2) 25,500 LB ALTERNATE HEAVY-LIFT HOVERING GROSS WEIGHT; (3) 145 KT AT A GROSS WEIGHT OF 15,300 LB, HELICOPTER MODE; AND (4) 197 KNOTS AT A GROSS WEIGHT OF 10,000 LB AUTO GYRO MODE. MAJOR DESIGN AREAS COVERED IN THE STUDY INCLUDE THE ROTOR MODIFICATIONS, AIRFRAME, ENGINE INSTALLATION, ENGINE CONTROLS, FLIGHT CONTROLS, DIVERTER VALVES, BLADE DUCT VALVES, FLIGHT INSTRUMENTATION, ELECTRICAL SYSTEM, HYDRAULIC SYSTEM, AND FUEL SYSTEM.

(AUTHOR)
UNCLASSIFIED

DESCRIPTIVE NOTE: TECHNICAL REPT.
OCT 65 111P
CONTRACT: DA-44-177-AMC-25(T)
PROJ: DA-1M12.401D144
TASK: IM12401D11412
MONITOR: USAAVLABS; TR-65-68K

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: PREPARED IN COOPERATION WITH
CONTINENTAL AVIATION AND ENGINEERING CORP.,
DETROIT, MICH.; REPT. NO. CAE-942. SEE ALSO AD-
624 814.

DESCRIPTORS: (*HELICOPTER ENGINES, DESIGN);
(*TURBOJET ENGINES, DESIGN), (*HELICOPTER ROTORS,
DESIGN), ROTOR BLADES (ROTARY WINGS), HOVERING,
FUEL PUMPS, JET ENGINE INLETS, LIFT
IDENTIFIERS: HEAVY LIFT HELICOPTERS

THE REPORT DISCUSSES THE DESIGN OF THE MODEL 357-
1 ENGINE FOR ROTOR TIP OPERATIONAL ENVIRONMENT.
THE DETAIL DESIGN MEETS REQUIREMENTS OF MIL-E-
50078 EXCEPT FOR ITEMS PECULIAR TO ROTOR TIP
OPERATION. THESE ITEMS INCLUDE OPERATIONAL
ATTITUDES, EFFECT OF CONTINUOUS GYROSCOPIC COUPLES
AND HIGH G FIELD ENVIRONMENT. THE REPORT INCLUDES
AN ANALYTICAL DESIGN ANALYSIS OF THE STATIC
STRUCTURE, ROTATING ELEMENTS, BEARINGS, ACCESSORY
DRIVES, LUBRICATION SYSTEM, AND MISCELLANEOUS ENGINE
PARTS. (AUTHOR)
HEAVY-LIFT TURBOJET ROTOR SYSTEM, VOLUME III: DESIGN LAYOUT STUDIES.(U)

THE REPORT DESCRIBES THE DESIGN LAYOUT STUDIES PERFORMED DURING THE PRELIMINARY DESIGN OF A TIP TURBOJET ROTOR SYSTEM APPLICABLE TO A HELICOPTER OF 60,000 POUNDS TO 80,000 POUNDS GROSS WEIGHT. THE BASIC ROTOR SYSTEM GEOMETRY FOR WHICH THESE STUDIES WERE PERFORMED WAS ESTABLISHED BY MEANS OF A PARAMETRIC DESIGN STUDY. DESIGN INVESTIGATIONS WERE DIRECTED PRIMARILY TOWARDS THE COMPONENTS ABOVE THE ATTACHMENT OF THE ROTOR SYSTEM TO THE AIRFRAME. THESE INCLUDED ROTOR HUB AND BLADE RETENTION CONFIGURATION, ROTOR BLADE STRUCTURAL ARRANGEMENT, POWER PLANT INSTALLATION, FLIGHT CONTROLS, AND AIRFRAME/ROTOR MOUNTED FUEL, LUBRICATION, ELECTRICAL, ENGINE STARTING, AND POWER MANAGEMENT SYSTEMS. CONSIDERATION WAS ALSO GIVEN TO TAIL ROTOR AND ACCESSORIES DRIVE SYSTEMS. THESE DESIGN STUDIES AND ASSOCIATED STRESS AND WEIGHT ANALYSES HAVE ESTABLISHED THE PRACTICABILITY OF THE DESIGN AND FABRICATION OF THE TIP TURBOJET ROTOR SYSTEM, AS WELL AS PROVIDING VERIFICATION FOR THE SYSTEMS' WEIGHT EQUATIONS. DEVELOPMENT OF A TIP TURBOJET HELICOPTER OF 60,000 POUNDS TO 80,000 POUNDS GROSS WEIGHT HAS BEEN FOUND TO BE WELL WITHIN THE STATE OF THE ART OF ALL TECHNOLOGIES ASSOCIATED WITH THE DESIGN AND FABRICATION OF AN AIRCRAFT OF THIS TYPE.
UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY  SEARCH CONTROL NO. /Z0M09

AD-624 763  1/3
HILLER AIRCRAFT DIV FAIRCHILD HILLER CORP PALO ALTO
CALIF

HEAVY-LIFT TURBOJET ROTOR SYSTEM. VOLUME IV. STATIC
AND DYNAMIC LOADS.  (U)

DESCRIPTIVE NOTE: TECHNICAL REPT.
OCT. 65  117P
REPT. NO.  ENGINEERING-64-44
CONTRACT: DA-49-177-AMC-25(T)
PROJ: DA-1M121401D144
TASK: 1M121401D1441
MONITOR: USAAVLABS ,  TR-64-68D

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-624 762.

DESCRIPTORS: (*HELIicopter ROTORS, DESIGN),
LOADING(MECHANICS), STRUCTURAL PARTS, TURBOJET
ENGINES, ROTOR BLADES(ROTARY WINGS), HELICOPTERS,
LIFT
IDENTIFIERS: HEAVY LIFT HELICOPTERS  (M)

THE REPORT PRESENTS THE STRUCTURAL DESIGN CRITERIA,
STATIC DESIGN LOADS, AND DYNAMIC DESIGN LOADS FOR THE
MODEL 1108 HELICOPTER. THE VOLUME IS THE BASIS
FOR THE STRUCTURAL DESIGN AND ANALYSIS OF THE TIP
TURBOJET MAIN ROTOR SYSTEM. (AUTHOR)  (U)
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM, VOLUME VI, DYNAMIC AND AEROELASTIC STUDIES.

DESCRIPTIVE NOTE: TECHNICAL REPT.

OCT. 65 55P
REPT. NO. HILLER-ER-64-46
CONTRACT: DA-44-177-AMC-25(T)
TASK: 1M121401D-14412

SUPPLEMENTARY NOTE: SEE ALSO AD-624 763.

DESCRIPTORS: (*HELICOPTER ROTORS, DESIGN); (*ROTOR BLADES (ROTARY WINGS), AERODYNAMIC CHARACTERISTICS); HELICOPTER ENGINES, TURBOJET ENGINES, LIFT, AEROELASTICITY, FREQUENCY, FLUTTER, SIMULATION, ANALOG COMPUTERS, HELICOPTERS

IDENTIFIERS: HEAVY LIFT HELICOPTERS

THE STUDIES PERTAIN TO DYNAMIC AND AEROELASTIC PHENOMENA OF THE ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER EMPLOYING TURBOJET ENGINES MOUNTED AT THE TIPS OF THE ROTOR BLADES. A MAJORITY OF THE ROTOR BLADE FREQUENCY AND BLADE FLUTTER BOUNDARY WORK WAS ACCOMPLISHED USING A LUMPED MASS ROTOR BLADE SIMULATION ON A DIRECT ANALOG COMPUTER. THE IMPORTANT RESULTS OF THESE STUDIES AS WELL AS OTHER DYNAMIC INVESTIGATIONS WHICH ARE NECESSARY TO INSURE ADEQUATE HELICOPTER PERFORMANCE ARE INCLUDED.

(AUTHOR)
THE REPORT DISCUSSES STATISTICAL, ANALYTICAL, AND EMPIRICAL WEIGHT ANALYSIS METHODS USED TO EVALUATE THE EMPTY WEIGHT OF THE HELICOPTER. BLADE LAG CHARACTERISTICS ARE ALSO DISCUSSED, INCLUDING AN ANALYSIS SHOWING BLADE LAG ANGLES WITH ONE AND TWO ENGINES INOPERATIVE. INCLUDED ARE AIRCRAFT BALANCE PREDICTIONS. (AUTHOR)
WIND-TUNNEL TESTS WERE CONDUCTED TO PROVIDE NACELLE DESIGN INFORMATION WHICH WOULD ASSIST IN THE DESIGN OF THE TIP TURBOJET INSTALLATION. THE MODEL WAS CONSTRUCTED TO PROVIDE FOR SINGLE, OVER-UNDER, AND SIDE-BY-SIDE ENGINE ARRANGEMENTS. THE NACELLE LOADS WERE MEASURED WITH A SIX-COMPONENT STRAIN-GAGE BALANCE. TESTS WERE CONDUCTED AT NACELLE REYNOLDS NUMBERS FROM 450,000 TO 1,830,000 WITH MOST OF THE DATA TAKEN AT THE HIGHER VALUE. THE MODEL PITCH ANGLE WAS VARIED FROM -3 DEGREES TO +12 DEGREES AND THE YAW ANGLE WAS VARIED FROM -20 DEGREES TO +20 DEGREES. NACELLE INLET TO FREESTREAM VELOCITY RATIOS WERE VARIED FROM 0 TO 7.625. THE MAXIMUM OBTAINABLE WITH FREESTREAM TOTAL PRESSURE SUPPLYING THE ENERGY NECESSARY TO OVERCOME INTERNAL LOSSES, (AUTHOR)
THE REPORT DISCUSSES THE PROPOSAL OF A COMBINATION HYDROMECHANICAL-ELECTRONIC FUEL CONTROL AND FUEL PUMP FOR CONTROL OF A HELICOPTER ROTOR TIP MOUNTED ENGINE (CAE MODEL 357-1) WHICH DURING NORMAL OPERATION IS SUBJECTED TO 235G OF CENTRIFUGAL FORCE. THE PROPOSED PRELIMINARY DESIGN IS SUBMITTED TO MEET THE SPECIFICATION REQUIREMENT OF THE ENGINE IN THE TIP TURBOJET HOVER MODE OF OPERATION. ANALYTICAL DESIGN STUDIES AND PRELIMINARY TEST RESULTS SHOW FEASIBILITY OF THIS DESIGN FOR OPERATION IN A 235G FIELD. (AUTHOR)
THE STUDY OF A TIP-TURBOJET-POWERED ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER, WHICH IS PRESENTED IN THIRTEEN VOLUMES, IS SUMMARIZED. INCLUDED UNDER THIS GENERAL SUBJECT ARE STUDIES ON PARAMETRIC DESIGN, PERFORMANCE, STRUCTURES AND DYNAMICS, WIND TUNNEL, PRELIMINARY DESIGN, WEIGHT AND BALANCE, STABILITY, AND POWER PLANT. (AUTHOR)
UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. /ZOM09

AD-625 819 1/3 21/5
HILLER AIRCRAFT CORP PALO ALTO CALIF

HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM, VOLUME II. PARAMETRIC DESIGN STUDY. (U)

DESCRIPTIVE NOTE: ENGINEERING REPT.
OCT 65 104P
REPT. NO. ER-64-92
CONTRACT: DA-45-177-AMC-25(T)
TASK: IM12140101412
MONITOR: USAAVLABS, TR-64-688

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-625 818.

DESCRIPTORS: (*HELICOPTER ROTORS; DESIGN), HELICOPTERS, LIFT, TURBOJET ENGINES, ROTOR BLADES (ROTARY WINGS), OPTIMIZATION, WEIGHT, AERODYNAMIC CHARACTERISTICS, CONFIGURATION (U)
IDENTIFIERS: HEAVY LIFT HELICOPTERS (M)

THE PARAMETRIC ANALYSIS DETERMINES THE OPTIMUM DESIGN PARAMETERS OF A 24,000-LB.-PAYLOAD HELICOPTER POWERED BY TURBOJET ENGINES INSTALLED AT THE ROTOR BLADE TIPS. THE METHOD USED DETERMINED A GROSS WEIGHT WHICH WOULD SATISFY STATISTICAL COMPONENT WEIGHT EQUATIONS AND AERODYNAMIC EQUATIONS SIMULTANEOUSLY. THE OPTIMIZING CRITERION WAS THE MINIMUM GROSS WEIGHT REQUIRED TO PERFORM A SPECIFIC MISSION. THE RESULTS OF THE ANALYSIS INDICATE THAT THE OPTIMUM CONFIGURATION USING THE CONTINENTAL MODEL 357-1 ENGINE IS A HELICOPTER WITH (A) FOUR BLADES, (B) TWO ENGINES PER BLADE, AND (C) A CRANETYPE FUSELAGE. THE OPTIMUM CONFIGURATION WITH A GENERALIZED OR 'RUBBER' ENGINE IS A HELICOPTER WITH (A) THREE BLADES, (B) ONE ENGINE PER BLADE, AND (C) A CRANETYPE FUSELAGE. (AUTHOR) (U)
UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. /ZOM09

AD-625 820 1/3
HILLER AIRCRAFT CORP PALO ALTO CALIF

HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM. VOLUME V.
STRUCTURAL ANALYSIS. (U)

DESCRIPTIVE NOTE: ENGINEERING REPT.
OCT. 65 127P
REPT. '40, ER-64-45
CONTRACT: DA-44-177-AMC-25(T)
TASK: IM121401D1 412
MONITOR: USAAVLABS, TR-64-68E

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-624 814.

DESCRIPTORS: (*HELICOPTER ROTORS, DESIGN); (*ROTOR
BLADES(ROTARY WINGS), DESIGN); HELICOPTERS,
TURBOJET ENGINES; LIFT; STRESSES (U)
IDENTIFIERS: HEAVY LIFT HELICOPTERS (H)

THE REPORT DISCUSSES STRESS CALCULATIONS FOR MAJOR
STRUCTURAL COMPONENTS OF THIS SYSTEM. TIP ENGINE
ATTACHMENT HARDWARE IS ALSO ANALYZED. (AUTHOR) (U)
THE REPORT PRESENTS A PERFORMANCE AND CHARACTERISTICS SUMMARY OF THE MODEL 1108 TIP TURBOJET-POWERED HEAVYLIFT HELICOPTER. THE CONFIGURATION WAS SELECTED FROM A PARAMETRIC ANALYSIS (USAAVLABS TECHNICAL REPORT 64-68B). STANDARD PERFORMANCE METHODS ARE USED, MODIFIED WHERE NECESSARY BY FACTORS PECULIAR TO TIP TURBOJET PROPULSION. (AUTHOR)
THE REPORT DISCUSSES THE RESULTS OF A STABILITY AND CONTROL ANALYSIS OF A LARGE CRANE-TYPE HELICOPTER POWERED BY A TIP-MOUNTED TURBOJET SYSTEM. SPECIFICATION MIL-H-8501A WAS USED AS A GUIDE FOR CRITERIA. SPECIFICATION CRITERIA WERE MET; HOWEVER, FOR IMPROVEMENTS IN HANDLING QUALITIES, A STABILITY AUGMENTATION SYSTEM IS RECOMMENDED. (AUTHOR)
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM, VOLUME XIII. PRELIMINARY MODEL SPECIFICATION FOR CONTINENTAL MODEL 357-1 ENGINE.

AD-625 823 1/2 21/5
HILLER AIRCRAFT CORP PALO ALTO CALIF

DESCRIPTION NOTE: TECHNICAL REPT.
65 53P
OCT 65
CONTRACT: DA-44-177-AMC-25(T)
TASK: H121401D14412
MONITOR: USAAVLABS TR-64-68M

THE REPORT CONTAINS CONTINENTAL PRELIMINARY MODEL SPECIFICATION NO. 2253-A, WHICH CONTAINS REQUIREMENT, CAPABILITY, AND ENGINE PERFORMANCE DATA ON THE CONTINENTAL MODEL 357-1 (1700-POUND THRUST) TURBOJET ENGINE FOR HELICOPTER ROTOR-TIP MOUNTING. (AUTHOR)
THE REPORT DEALS WITH THE ANALYSIS OF THE 110.4 HOURS OF CH-54A SKYCRANE DATA. CENTURY 4098 OSCILLOGRAPH RECORDERS WERE USED TO COLLECT THE PARAMETERS MEASURED, INCLUDING AIRSPEED, ALTITUDE, VERTICAL ACCELERATION AT CENTER OF GRAVITY, MAIN ROTOR RPM, LONGITUDINAL CYCLIC STICK POSITION, COLLECTIVE STICK POSITION, OUTSIDE AIR TEMPERATURE, TORQUE ON EACH ENGINE, AND GAS PRODUCER RPM ON EACH ENGINE. BAROMETRIC PRESSURE AND TAKEOFF-AND-LANDING GROSS WEIGHT ESTIMATES WERE ALSO RECORDED AS SUPPLEMENTAL INFORMATION. THE FLIGHT DATA WERE DIVIDED INTO FOUR CATEGORIES BY MISSION: ASCENT, MANEUVER, DESCENT, AND STEADY STATE. THE AIRCRAFT WERE PERFORMING THEIR NORMAL MISSION FUNCTIONS DURING THE PERIOD IN WHICH THE DATA WERE COLLECTED. TIME HISTOGRAMS, HISTOGRAMS, PEAK COUNTS, AND EXCEEDANCE CURVES WERE GENERATED FROM THE DATA. AS A RESULT OF THIS STUDY, DESIGNERS NOW HAVE A LIMITED SAMPLE OF CONDITIONS EXPERIENCED BY FOUR CH-54A AIRCRAFT IN THE FIELD. (AUTHOR)
A parametric analysis and a preliminary design study were conducted to determine the optimum characteristics of a shaft-driven rotor which would result in the lightest gross weight helicopter capable of lifting military loads in the 12- to 20-ton range. The study considered single- and tandem-rotor helicopters with internal cargo and cargo pod. Types of rotors analyzed were articulated, teetered, rigid, and matched-stiffness. Existing turbine engines or growth versions thereof were considered. Component weight equations were developed and a computer program was utilized to determine the rotor characteristics for each helicopter configuration. For a given set of rotor parameters, the program computed the power plant rating, fuel required, and the empty weight corresponding to the helicopter which would satisfy the most critical mission requirements with the minimum gross weight. The performance of the resulting configuration was determined. Design studies of the rotor system, rotor controls, rotor/propulsion arrangement, and the general arrangement were made. Rotop loads were developed and a structural design analysis of the rotor system, including fatigue and weight analyses, was prepared.
STUDIES WERE CONDUCTED ON VARIOUS MULTIENGINE GAS TURBINE PROPULSION SYSTEMS FOR A SHAFT-DRIVEN, HEAVY-LIFT HELICOPTER. THE HELICOPTER WAS BASED ON A DESIGN GROSS WEIGHT OF 75,000 TO 85,000 POUNDS, HAVING A 40,000-POUND PAYLOAD. GROWTH VERSIONS OF EXISTING GAS TURBINE ENGINES WERE APPLIED TO THE STUDY. THE FOLLOWING TYPES OF ENGINE SYSTEMS WERE INVESTIGATED: FREE-POWER TURBINE, MECHANICAL COUPLING, REGENERATIVE, FRONT DRIVE, FIXED-POWER TURBINE, GAS COUPLING, NONREGENERATIVE, AND REAR DRIVE. THE ENGINE PACKAGING ARRANGEMENTS WERE VERTICAL AND HORIZONTAL INSTALLATIONS IN SINGLE-, TANDEM-, AND QUAD-ROTOR HELICOPTERS. THE PRIME STUDY CRITERIA WERE WEIGHT SAVINGS (FUEL PLUS INSTALLED ENGINE) AND HELICOPTER PERFORMANCE. ADDITIONAL SUBJECTS OF STUDY WERE: POWER AUGMENTATION BY WATER-METHANOL INJECTION OR INCREASED TURBINE-INLET TEMPERATURE; ELECTRICAL, HYDRAULIC, AND PNEUMATIC STARTING SYSTEMS; AND CONTROL PROBLEMS CONCERNING LOAD SHARING, ENGINE-OUT OPERATION, AND STABILITY. (AUTHOR)
IN A PRELIMINARY DESIGN STUDY OF A ROTOR SYSTEM FOR A HOT CYCLE HEAVY-LIFT HELICOPTER, THE FOLLOWING ITEMS WERE ACCOMPLISHED: (1) AN ANALYTICAL PROCEDURE WAS DEVELOPED THAT PERMITTED CALCULATION OF FULLY COUPLED BLADE RESPONSE AND DYNAMIC STABILITY CHARACTERISTICS; (2) PARAMETRIC AND CONFIGURATION STUDIES INVOLVING BASIC CHARACTERISTICS OF THE ROTOR SYSTEM WERE CONDUCTED; (3) DESIGN LAYOUTS, STRUCTURAL DESIGN STUDIES, AND DETAILED WEIGHT ANALYSES WERE MADE (DESIGN AND ANALYSIS WERE LIMITED TO THE INTEGRATED LIFT-PROPULSION SYSTEM WITH EMPHASIS ON THE ROTOR SYSTEM); (4) PRELIMINARY DESIGN WAS COMPLETED, AND PERFORMANCE OF THE OPTIMUM ROTOR FOR THE HEAVY-LIFT MISSION REQUIREMENTS WAS DETERMINED; (5) A FULLY COUPLED BLADE LOADS ANALYSIS OF THE OPTIMUM ROTOR WAS MADE; AND (6) A FULL-SCALE MOCKUP OF THE ROTOR HUB AREA WAS CONSTRUCTED. (AUTHOR)
THE PRIMARY OBJECTIVE OF THE PROGRAM WAS TO SELECT AND DESIGN A SHAFT-DRIVEN LIFTING ROTOR SYSTEM FOR A HEAVY LIFT HELICOPTER. THE SELECTION INCLUDED A COMPLETE PARAMETRIC ANALYSIS OF THE AIRCRAFT, BASED ON THREE DEFINED MISSIONS: LIFTING A 20-TON PAYLOAD 20 NAUTICAL MILES, LIFTING A 12-TON PAYLOAD 100 NAUTICAL MILES, AND FERRYING. SEVERAL AIRCRAFT CONFIGURATIONS WERE STUDIED, AND A SINGLE ROTOR CRANE ARRANGEMENT WAS SELECTED. INCLUDED IN THE STUDY WERE SELECTION OF ENGINES AND PARAMETRIC SIZING OF ALL MAJOR AIRCRAFT COMPONENT SYSTEMS. THE AIRCRAFT DEFINED HAS A TAKEOFF GROSS WEIGHT FOR THE 20-TON MISSION OF APPROXIMATELY 79,000 POUNDS, AND USES A SINGLE LIFTING ROTOR 91.6 FEET IN DIAMETER. FERRY RANGE EXCEEDS 2400 NAUTICAL MILES. WHILE DIFFERING IN DETAIL FROM ANY EXISTING HARDWARE, THE ROTOR SYSTEM DESIGN follows DIRECTLY FROM PRESENT PRACTICE. ANALYSES OF AIRCRAFT STABILITY AND CONTROL CHARACTERISTICS AND ROTOR SYSTEM STABILITY FOR THE SELECTED CONFIGURATION WERE PERFORMED, AND THE METHODS AND RESULTS REPORTED. FOR ALL OF THE PROPERTIES STUDIED, BOTH THE AIRCRAFT AND THE ROTOR SYSTEM WERE SHOWN TO MEET OR EXCEED THE REQUIREMENTS OF APPLICABLE SPECIFICATIONS AND/OR ACCEPTED PRACTICE. (AUTHOR)
UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. /ZOM09

AD-667 924  1/3  1/2  17/2
BUNKER-RAMO CORP CANDOGA PARK CALIF

ARMY AIRCRAFT VOICE-WARNING SYSTEM STUDY.

DESCRIPTIVE NOTE: FINAL REPT. 10 AUG 67-10 JAN 68, FEB 68  230P  BROWN, JAMES E. & BERTONE, CARMINE M.; OBERMAYER, RICHARD W.; REPT. NO. G0131-801
CONTRACT: DAAD05-68-C-0025
MONITOR: HEL  TM-6-66

UNCLASSIFIED REPORT

DESCRIPTORS: (*.HELICOPTERS, EARLY WARNING SYSTEMS); (*.SHORT TAKE-OFF PLANES; EARLY WARNING SYSTEMS); (*EARLY WARNING SYSTEMS; *VOICE COMMUNICATION SYSTEMS); ARMY AIRCRAFT, OBSERVATION PLANES, PILOTS, MALFUNCTIONS, COCKPITS, AVIATION ACCIDENTS, HUMAN ENGINEERING, STATISTICAL ANALYSIS, DISPLAY SYSTEMS, AUDITORY SIGNALS, INSTRUMENT PANELS, MISSION PROFILES, JOB ANALYSIS, QUESTIONNAIRES
IDENTIFIERS: *.VOICE-WARNING SYSTEMS; UH-1B AIRCRAFT; UH-1D AIRCRAFT; AH-1G AIRCRAFT; H-47 AIRCRAFT; CH-47 AIRCRAFT; CH-54 AIRCRAFT; V-1 AIRCRAFT; OV-1 AIRCRAFT; H-1 AIRCRAFT

THE REPORT DESCRIBES AN ANALYTICAL STUDY THAT WAS INTENDED TO SERVE AS A BASIS FOR THE APPLICATION OF VOICE-WARNING SYSTEMS (VWS) FOR THE UH-1B AND UH-1D (HUEY), AH-1G (COBRA), CH-47 (CHICOY), CH-54 (SKYCRANE), AND OV-1 (MOHAWK). THE FOLLOWING PROBLEMS OF INSTALLING A VWS IN THESE ARMY AIRCRAFT WERE STUDIED:
(1) THE IDENTIFICATION AND SELECTION OF MESSAGES FOR MAXIMUM EFFECTIVENESS; (2) THE DETERMINATION OF PRIORITY SEQUENCES; AND (3) THE INTEGRATION OF THE VWS INTO EXISTING COCKPITS. THE STUDY INVOLVED THE COLLEcTION OF BASIC DATA AND THE CONDUCT AND VALIDATION OF MISSION ANALYSES, OPERATIONAL SEQUENCE DIAGRAMS, TASK ANALYSES, AIRCRAFT CONFIGURATION ANALYSES, PILOT OPINION SURVEYS, AND ARMY AIRCRAFT ACCIDENT ANALYSES. IN THE REPORT, PRIORITY SEQUENCES ARE DERIVED FOR ALL MAJOR EMERGENCIES FOR THE SIX VEHICLES; FURTHER ANALYTICAL EFFORT IS DESCRIBED WHICH REDUCED THE LIST TO 20 MESSAGES FOR INCLUSION IN THE VWS. FOR EACH AIRCRAFT, 2 LISTS OF 20 MESSAGES ARE PROPOSED; ONE LIST ASSUMES ADDITIONAL SENSORS, 25
UNCLASSIFIED

HUG-UNI

SYSTEM, VOLUME VIII. WIND-TUNNEL STUDIES.
(USAAVLABS-TR-64-68H)
AD-624 614

HILLER-ER-64-46
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM, VOLUME VI. DYNAMIC AND AEROELASTIC STUDIES.
AD-624 764

HILLER-ER-64-47
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM, VOLUME VII. WEIGHT AND BALANCE STUDIES.
(USAAVLABS-TR-64-666)
AD-624 813

*KAMAN AIRCRAFT CORP BLOOMFIELD CONN
KAMAN-R-555
A MAIN POWER SYSTEM FOR SHAFT-DRIVEN HEAVY LIFT HELICOPTERS.
(USAAVLABS-TR-65-52)
AD-624 145

*LOCKHEED-CALIFORNIA CO BURBANK
LR-19143
PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER.
(USAAVLABS-TR-66-48)
AD-640 946

*NAVAL AEROSPACE MEDICAL INST PENSACOLA FLA
SAMPLE HELICOPTER FLIGHT MOTION DATA FOR VESTIBULAR REFERENCE.
AD-701 696

*TECHNOLOGY INC DAYTON OHIO
FLIGHT LOADS INVESTIGATION OF CH-54A HELICOPTERS OPERATING IN SOUTHEAST ASIA.
(USAAVLABS-TR-70-73)
AD-881 238

*UNITED AIRCRAFT CORP STRATFORD CONN
SIKORSKY AIRCRAFT DIV
50444
PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY LIFT HELICOPTER.
(USAAVLABS-TR-66-56)
AD-651 416

SER-50441
DESIGN STUDY OF HEAVY LIFT HELICOPTER EXTERNAL LOAD HANDLING SYSTEM.
(USAAVLABS-TR-67-46)
AD-828 283

0-4
UNCLASSIFIED
SER-50558
HELIQUART TRANSMISSION OIL
HEAT REJEXION INVESTIGATION.
(USAAVLABS-TR-68-83)
AD-859 277

SER-50583
SYNCHRONIZATION OF MULTIPORT
HOISTS.
(USAAVLABS-TR-69-44)
AD-860 439
UNCLASSIFIED
SUBJECT INDEX

• AERODYNAMIC LOADING
  HELICOPTERS
  EVALUATION OF HELICOPTER FLIGHT
  SPECTRUM DATA.*
  AD-680 280
  FLIGHT LOADS INVESTIGATION OF CH-
  54A HELICOPTERS OPERATING IN
  SOUTHEAST ASIA•
  AD-861 298

• AVIATION MEDICINE
  HELICOPTERS
  SAMPLE HELICOPTER FLIGHT MOTION
  DATA FOR VESTIBULAR REFERENCE,•
  AD-701 696

• EARLY WARNING SYSTEMS
  VOICE COMMUNICATION SYSTEMS
   ARMY AIRCRAFT VOICE-WARNING
   SYSTEM STUDY•
  AD-667 924

• FREE RADICALS
  ELECTROSPHERITY
  REFIRN: SPIN CONTAMINATION IN
  SPIN-UNRESTRICTED INDO MOLECULAR-
  ORBITAL WAVEFUNCTIONS•
  AD-660 272

• FUEL PUMPS
  DESIGN
   HEAVY-LIFT TURBOJET ROTOR
   SYSTEM. FUEL PUMP AND CONTROL
   SYSTEM DESIGN•
  AD-624 822

• GAS TURBINES
  HELICOPTERS
  POWER PLANT STUDY FOR SHAFT-
  DRIVEN HEAVY-LIFT ROTARY-WING
  AIRCRAFT•
  AD-649 594

• HELICOPTER ENGINES
  GAS TURBINES
  PRELIMINARY DESIGN STUDY HOT
  CYCLE RESEARCH AIRCRAFT•
  AD-490 650

• HELICOPTER ENGINES
  DESIGN

MAIN POWER SYSTEM FOR SHAFT-
DRIVEN HEAVY LIFT HELICOPTERS.
AD-624 145
HEAVY-LIFT TIP TURBOJET ROTOR
SYSTEM. ENGINE DESIGN.
AD-624 716

FUEL PUMPS
HEAVY-LIFT TURBOJET ROTOR
SYSTEM. FUEL PUMP AND CONTROL
SYSTEM DESIGN•
AD-624 822

LOADING (MECHANICS)
CH-54A SKYCRANE ENGINE LOAD
SHARING•
AD-624 502

TORQUE
CH-47A CHINOOK ENGINE LOAD
SHARING•
AD-682 070

• HELICOPTER HOISTS
  CONTROL SYSTEMS
   SYNCHRONIZATION OF MULTIPONT
   HOISTS•
  AD-860 479

DESIGN
DESIGN STUDY OF HEAVY LIFT
HELICOPTER EXTERNAL LOAD HANDLING
SYSTEM•
AD-828 283

• HELICOPTER ROTORS
  HELICOPTER LIFTING ROTOR
  AERODYNAMICS•
  AD-286 576

CONFIGURATION
STUDY OF THE HEAVY-LIFT
HELICOPTER ROTOR CONFIGURATION•
AD-647 365

DESIGN
HEAVY-LIFT TIP TURBOJET ROTOR
SYSTEM. ENGINE DESIGN•
AD-624 716
HEAVY-LIFT TURBOJET ROTOR
SYSTEM. DESIGN LAYOUT STUDIES•
AD-624 762
HEAVY-LIFT TURBOJET ROTOR SYSTEM STATIC AND DYNAMIC LOADS.
AD-624 763
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM DYNAMIC AND AEROElastic STUDIES.
AD-624 764
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM WEIGHT AND BALANCE STUDIES.
AD-624 813
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM WIND-TUNNEL STUDIES.
AD-624 814
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM FUEL PUMP AND CONTROL SYSTEM DESIGN.
AD-624 822
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM.
AD-625 818
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM PARAMETRIC DESIGN STUDY.
AD-625 819
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM STRUCTURAL ANALYSIS.
AD-625 820
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM PERFORMANCE ANALYSIS.
AD-625 821
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM STABILITY AND CONTROL.
AD-625 822
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM PRELIMINARY MODEL SPECIFICATION FOR CONTINENTAL MODEL 357-1 ENGINE.
AD-625 823
PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER.
AD-630 946
PRELIMINARY DESIGN OF A ROTOR SYSTEM FOR A HOT CYCLE HEAVY-LIFT HELICOPTER.
AD-651 217
PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER.
AD-651 416
DRIVES HELICOPTER TRANSMISSION OIL HEAT REJECTION INVESTIGATION.
AD-859 277
TRANSMISSIONS TRANSMISSION STUDY FOR TANDEM-ROTOR SHAFT-DRIVEN HEAVY-LIFT HELICOPTERS.
AD-622 586
HELICOPTERS AVIATION MEDICINE SAMPLE HELICOPTER FLIGHT MOTION DATA FOR VESTIBULAR REFERENCE.
AD-701 696
DESIGN PRELIMINARY DESIGN STUDY FOR HOT CYCLE RESEARCH AIRCRAFT.
AD-408 650
EARLY WARNING SYSTEMS ARMY AIRCRAFT VOICE-WARNING SYSTEM STUDY.
AD-667 924
FLIGHT TESTING CH-54A SKYCRANE HELICOPTER FLIGHT LOADS INVESTIGATION PROGRAM.
AD-696 369
GAS TURBINES POWER PLANT STUDY FOR SHAFT-DRIVEN HEAVY-LIFT ROTARY-WING AIRCRAFT.
AD-649 534
HOVERING A METHOD FOR DETERMINING A CONCEPTUAL SOLUTION TO ENSURE 301.
AD-710 948
LOADING (MECHANICS) EVALUATION OF HELICOPTER FLIGHT SPECTRUM DATA.
AD-680 280
FLIGHT LOADS INVESTIGATION OF CH-54A HELICOPTERS OPERATING IN SOUTHEAST ASIA
AD-881 230

PERFORMANCE (ENGINEERING)
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM PERFORMANCE ANALYSIS
AD-625 821
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM STABILITY AND CONTROL
AD-625 822
CH-54A SKYCRAFE ENGINE LOAD SHARING
AD-634 503

POWER MAIN POWER SYSTEM FOR SHAFT-DRIVEN HEAVY-LIFT HELICOPTERS
AD-624 195

WEIGHT HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM WEIGHT AND BALANCE STUDIES
AD-624 813

HOVERING STABILIZATION SYSTEMS A METHOD FOR DETERMINING A CONCEPTUAL SOLUTION TO ENSURE 301
AD-710 948

INSTRUMENT FLIGHT HOVERING A METHOD FOR DETERMINING A CONCEPTUAL SOLUTION TO ENSURE 301
AD-710 948

LOADING (MECHANICS) HELICOPTERS FLIGHT LOADS INVESTIGATION OF CH-54A HELICOPTERS OPERATING IN SOUTHEAST ASIA
AD-881 238

MOLECULAR ORBITALS ORGANIC COMPOUNDS REPRINT: SPIN CONTAMINATION IN SPIN-UNRESTRICTED INDO MOLECULAR ORBITAL WAVEFUNCTIONS
AD-680 272

OIL COOLERS DESIGN HELICOPTER TRANSMISSION OIL HEAT REJECTION INVESTIGATION
AD-859 277

ORGANIC COMPOUNDS MOLECULAR ORBITALS REPRINT: SPIN CONTAMINATION IN SPIN-UNRESTRICTED INDO MOLECULAR ORBITAL WAVEFUNCTIONS
AD-680 272

ROTOR BLADES (ROTARY WINGS) AERODYNAMIC CHARACTERISTICS HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM DYNAMIC AND AEROELASTIC STUDIES
AD-624 764

DESIGN HEAVY-LIFT TURBOJET ROTOR SYSTEM DESIGN LAYOUT STUDIES
AD-624 762
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM STRUCTURAL ANALYSIS
AD-625 820

MODEL TESTS HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM WIND-TUNNEL STUDIES
AD-629 814

SHORT TAKE-OFF PLANES EARLY WARNING SYSTEMS ARMY AIRCRAFT VOICE WARNING SYSTEM STUDY
AD-667 924

STABILIZATION SYSTEMS HOVERING A METHOD FOR DETERMINING A CONCEPTUAL SOLUTION TO ENSURE 301

UNCLASSIFIED
UNCLASSIFIED

TOR-VOI

AD-710 948

• Torque
  Helicopter Engines
  CH-47A CHINOOK Engine Load
  Sharing.
  AD-682 070

• Transmissions
  Helicopters
  Transmission Study for Tandem-
  Rotor Shaft-Driven Heavylift
  Helicopters.
  AD-622 986

• Oils
  Coolers
  Helicopter Transmission Oil Heat
  Rejection Investigation.
  AD-859 277

• Transport Planes
  Helicopters
  Study of the Heavy-Lift
  Helicopter Rotor Configuration.
  AD-697 765

• Turbines
  Helicopters
  Main Power System for Shaft-
  Driven Heavy Lift Helicopters.
  AD-624 145

• Turbojet Engines
  Design
  Heavy-Lift Tip Turbojet Rotor
  System. Engine Design.
  AD-629 716

• Specifications
  Heavy-Lift Tip Turbojet Rotor
  System. Preliminary Model
  Specification for Continental Model
  357-1 Engine.
  AD-625 853

• Vestibular Apparatus
  Flight
  Sample Helicopter Flight Motion
  Data for Vestibular Reference.
  AD-701 696

D-9

UNCLASSIFIED
UNCLASSIFIED

TITLE INDEX

ARMY: AIRCRAFT VOICE WARNING SYSTEM STUDY, (U)
  *HELICOPTERS

CH-47A CHINOOK ENGINE AD-667 924
  *HELICOPTER ENGINES

CH-54A SKYCRANE ENGINE AD-620 364
  *HELICOPTERS
  HELICOPTER FLIGHT LOADS INVESTIGATION PROGRAM, (U)
  *HELICOPTERS

DESIGN STUDY OF HEAVY LIFT HELICOPTER EXTERNAL LOAD HANDLING SYSTEM, (U)
  *HELICOPTER HOISTS

EVALUATION OF HELICOPTER FLIGHT SPECTRUM DATA, (U)
  *HELICOPTERS

FLIGHT LOADS AD-661 228
  INVESTIGATION OF CH-54A HELICOPTERS OPERATING IN SOUTHEAST ASIA, (U)
  *HELICOPTERS

HEAVY-LIFT TIP TURBOJET AD-629 018
  ROTOR SYSTEM, VOLUME I, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 019
  ROTOR SYSTEM, VOLUME II, PARAMETRIC DESIGN STUDY, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 021
  ROTOR SYSTEM, VOLUME IX, PERFORMANCE ANALYSIS, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 020
  ROTOR SYSTEM, VOLUME V, STRUCTURAL ANALYSIS, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 764
  ROTOR SYSTEM, VOLUME VI, DYNAMIC AND AEROELASTIC STUDIES, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 012
  ROTOR SYSTEM, VOLUME VII, WEIGHT AND BALANCE STUDIES, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 019
  ROTOR SYSTEM, VOLUME VIII, WIND-TUNNEL STUDIES, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 762
  ROTOR SYSTEM, VOLUME XII, STABILITY AND CONTROL, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TIP TURBOJET AD-629 716
  ROTOR SYSTEM, VOLUME XI, ENGINE DESIGN, (U)
  *HELICOPTER ENGINES

HEAVY-LIFT TIP TURBOJET AD-629 022
  PRELIMINARY MODEL SPECIFICATION FOR CONTINENTAL MODEL 757-1 ENGINE, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TURBOJET AD-629 762
  ROTOR SYSTEM, VOLUME III, DESIGN LAYOUT STUDIES, (U)
  *HEAT EXCHANGER DESIGN

HEAVY-LIFT TURBOJET AD-629 767
  ROTOR SYSTEM, VOLUME IV, STATIC AND DYNAMIC LOADS, (U)
  *HELICOPTER ROTORS

HEAVY-LIFT TURBOJET AD-629 022
  ROTOR SYSTEM, VOLUME XII, FUEL PUMP AND CONTROL SYSTEM DESIGN, (U)
  *HELICOPTER ROTORS

HELICOPTER TRANSMISSION AD-897 277
  OIL HEAT REJECTION INVESTIGATION, (U)
  *HELICOPTER ROTORS

A MAIN POWER SYSTEM FOR AD-629 145
STUDY OF THE HEAVY-LIFT HELICOPTER ROTOR CONFIGURATION (U) • TRANSPORT PLANES
SYNCHRONIZATION OF MULTIPLE HOISTS (U) • HELICOPTER HOISTS
TRANSMISSION STUDY FOR TANDEM-ROTOR SHAFT-DRIVEN HEAVY-LIFT HELICOPTERS (U) • HELICOPTER ROTORS

PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER (U) • HELICOPTER ROTORS

PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER (U) • HELICOPTER ROTORS

POWER PLANT STUDY FOR SHAFT-DRIVEN HEAVY-LIFT ROTARY-DING AIRCRAFT (U) • GAS TURBINES

PRELIMINARY DESIGN OF A ROTOR SYSTEM FOR A HOT CYCLE HEAVY-LIFT HELICOPTER (U) • HELICOPTER ROTORS

PRELIMINARY DESIGN STUDY HOT CYCLE RESEARCH AIRCRAFT (U) • HELICOPTERS

PROBLEMS OF THE AERODYNAMICS OF HELICOPTER LIFTING ROTORS (U) • HELICOPTER ROTORS

SAMPLE HELICOPTER FLIGHT MOTION DATA FOR VESTIBULAR REFERENCE (U) • HELICOPTERS

SPIN CONTAMINATION IN SPIN-UNRESTRICTED INDO-MOLECULAR ORBITAL WAVEFUNCTIONS (U) • ORGANIC COMPOUNDS
UNCLASSIFIED

PERSONAL AUTHOR INDEX

*BARTEK, L. R.*

**CH-54A SKYCRANE ENGINE LOAD SHARING.**
AD-634 503

**CH-47A CHINOOK ENGINE LOAD SHARING.**
AD-682 070

*BERTONE, CARMINE M.*

ARMY AIRCRAFT VOICE-WARNING SYSTEM STUDY.
AD-667 924

*BEVERIDGE, DAVID L.*

**SPIN CONTAMINATION IN SPIN-UNRESTRICTED INDO MOLECULAR-ORBITAL WAVEFUNCTIONS.**
AD-680 272

*BILEZIKJIAN, VAHE*

**PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER.**
AD-640 946

*BOSSLER, ROBERT B., JR*

**A MAIN POWER SYSTEM FOR SHAFT-DRIVEN HEAVY LIFT HELICOPTERS.**
AD-624 145

*BRAUN, JOSEPH F.*

**CH-54A SKYCRANE HELICOPTER FLIGHT LOADS INVESTIGATION PROGRAM.**
AD-638 364

*BROWN, JAMES E.*

**ARMY AIRCRAFT VOICE-WARNING SYSTEM STUDY.**
AD-667 924

*BRYCE, JAMES H.*

**PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER.**
AD-640 946

*DOBOSH, PAUL A.*

**SPIN CONTAMINATION IN SPIN-UNRESTRICTED INDO MOLECULAR-ORBITAL WAVEFUNCTIONS.**

*BURROUGHS, LESTER R.*

**DESIGN STUDY OF HEAVY LIFT HELICOPTER EXTERNAL LOAD HANDLING SYSTEM.**
AD-828 283

*CHESTNUTT, DAVID*

**HELCICOPTER TRANSMISSION OIL HEAT REJECTION INVESTIGATION.**
AD-859 277

*BUTCHER, JOHN D.*

**HELCICOPTER TRANSMISSION OIL HEAT REJECTION INVESTIGATION.**
AD-859 277

*CHILDERS, HARRY M.*

**PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER.**
AD-640 946

*CLARKE, DENNIS P.*

**SYNCHRONIZATION OF MULTIPOINT HOISTS.**
AD-860 439

*CONWAY, WILLIAM J.*

**PARAMETRIC ANALYSIS AND PRELIMINARY DESIGN OF A SHAFT-DRIVEN ROTOR SYSTEM FOR A HEAVY-LIFT HELICOPTER.**
AD-640 946
UNCLASSIFIED

AD-680 272

*MALONEY, PAUL F.
EVALUATION OF HELICOPTER FLIGHT SPECTRUM DATA.
AD-680 280

*MOELLMAH, H.
PWR PLANT STUDY FOR SHAFT-DRIVEN HEAVY-LIFT ROTARY-WING AIRCRAFT.
AD-649 534

*NASH, JOHN F.
METH FOR DETERMINING A CONCEPTUAL SOLUTION TO ENSURE 301.
AD-710 948

*NIVEN, JORMA I.
SAMPLE HELICOPTER FLIGHT MOTION DATA FOR VESTIBULAR REFERENCE.
AD-701 696

*OBERMAYR, RICHARD W.
ARMY AIRCRAFT VOICE-WARNING SYSTEM STUDY.
AD-667 924

*O'CONNOR, JOHN F.
A METHOD FOR DETERMINING A CONCEPTUAL SOLUTION TO ENSURE 301.
AD-710 948

*O'CONNOR, SEAN J.
SYNCHRONIZATION OF MULTIPOINT HOISTS.
AD-860 439

UNCLASSIFIED

P-2
POWEL PLANT STUDY FOR SHAFT-DRIVEN HEA Y-LIFT ROTARY-WING AIRCRAFT.
AD-649 534

*PORTERFIELD, JOHN D.

** **
EVALUATION OF HELICOPTER FLIGHT SPECTRUM DATA.
AD-680 280

*RALSTEN, HAROLD E.

** **
DESIGN STUDY OF HEAVY LIFT HELICOPTER EXTERNAL LOAD HANDLING SYSTEM.
AD-628 283

*ROCKAFELLOW, RONALD I.

** **
FLIGHT LOADS INVESTIGATION OF CH-54A HELICOPTERS OPERATING IN SOUTHEAST ASIA.
AD-661 238

*SIMPSON, JOHN R.

** **
PRELIMINARY DESIGN OF A ROTOR SYSTEM FOR A HOT CYCLE HEAVY-LIFT HELICOPTER.
AD-631 227

*STORM, CIRCK A.

** **
HELICOPTER TRANSMISSION OIL HEAT REJECTION INVESTIGATION.
AD-859 277

*TOCCI, R. "CO C.

** **
STUDY OF THE HEAVY-LIFT HELICOPTER ROTOR CONFIGURATION.
AD-647 365

*WAX, CHARLES M.

** **
STUDY OF THE HEAVY-LIFT HELICOPTER ROTOR CONFIGURATION.
AD-647 365
HEAVY LIFT HELICOPTERS

Bibliography (October 1962 - January 1971)

This bibliography contains unclassified references on Heavy Lift Helicopters with a minimum payload of about 9,000 pounds or a minimum gross weight of 17,000 pounds. These references relate to rotor characteristics, rotor systems, rotor loads, lift propulsion, payloads, heavy lift rotors, configurations, design, and performance capabilities of the heavy lift helicopters.

Computer-generated indexes of Corporate Author-Monitoring Agency, Subject, Personal Author, and Title are included.
<table>
<thead>
<tr>
<th>KEY WORDS</th>
<th>LINK A</th>
<th>LINK B</th>
<th>LINK C</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Heavy Lift Helicopters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Helicopters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Bibliographies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy Lift Rotors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helicopter Engines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helicopter Rotors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payload</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor Blades (Rotary Wings)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HLH (Heavy Lift Helicopters)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cargo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH-53A Aircraft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-60 Aircraft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-53 Aircraft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Transportation</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>