AvioTecnica	Technical Report
	R-101-10-02/D

DOC. N. : R-101-10-02	Issue : D	Customer : /

TITLE : **MAIN ROTOR MAST (P/N E1.63.039.202)**
STRUCTURAL STRESS ANALYSIS

Summary

This report presents the structural stress analysis calculations performed to substantiate the static and fatigue strength of the main rotor mast E1.63.039.202 of the ES101 helicopter kit.

FILE : R-101-10-02_D_MR_Mast_Analysis_001.doc	LINKS : N.A.
NUMBER OF PAGES : 36	

Prepared by : Signature: Date:	Aviotecnica October, 16th 2010
Approved by : Signature: Date:	Aviotecnica October, 16th 2010

DISTRIBUTION

CUSTOMER (PDF file)

MODIFICATIONS RECORD

ISSUE	ISSUE DATE	AFFECTED PAGES	REASON OF CHANGE	AUTHOR
A	13/06/2010	ALL	FIRST ISSUE	Aviotecnica
B	13/06/2010	ALL	MINOR CORRECTIONS	Aviotecnica
C	20/06/2010	ALL	MINOR CORRECTIONS	Aviotecnica
D	16/10/2010	ALL	GENERAL MINOR UPDATE AND ADDITIO OF CRASH CONSIDERATIONS	Aviotecnica

TABLE OF CONTENTS

MODIFICATIONS RECORD **2**

TABLE OF CONTENTS **3**

1 INTRODUCTION **5**

2 REFERENCES **5**

2.1 R-101-10-01 5
2.2 TEST REPORT 80083/1 5
2.3 PETERSON'S STRESS CONCENTRATION FACTORS 5
2.4 CATALOG 5000 E 5

3 ACRONYSMS AND ABBREVIATIONS **6**

4 PART DESCRIPTION **7**

FIG. 1 – MAIN ROTOR MAST (P/N E1.63.039.202) **7**

FIG. 2 - MGB ASSEMBLY WITH MR MAST (P/N E1.63.001.102) **8**

5 MATERIAL PROPERTIES **9**

6 APPLIED LOADS **10**

FIG. 3 – MAIN ROTOR LOADS SCHEME **10**

TABLE 1 – MAIN ROTOR MAST LOAD CONDITIONS **11**

7 SHAFT STRESS ANALYSIS **11**

7.1 INTRODUCTION 11
7.2 STRESS CONCENTRATION FACTORS 11

FIG. 4 – MAST SECTIONS **12**

7.3 RESULTS 14

8 SPLINE STRESS ANALYSIS **15**

8.1 SPLINE TEETH SHEAR STRENGTH 16
8.2 SPLINE TEETH COMPRESSIVE STRENGTH 17

9 BEARING LIFE ANALYSIS **19**

FIG. 5 – MAIN ROTOR BEARING LOADS AND REACTIONS **19**

10 SHAFT DEFLECTIONS 21
FIG. 6 – MAIN ROTOR MAST MODEL 21
FIG. 7 – MAIN ROTOR MAST LATERAL DEFLECTIONS 22
11 CRASH CONDITIONS 23
12 CONCLUSIONS 25
ANNEX 1 - OUTPUT OF SHAFT STRESS ANALYSIS 26
ANNEX 2 - OUTPUT OF SHAFT DEFLECTION ANALYSIS 33

1 Introduction

This report presents the structural stress analysis calculations performed to substantiate the static and fatigue strength of the main rotor mast E1.63.039.202 of the ES101 helicopter kit.

2 References

2.1 R-101-10-01

BASIC DESIGN CRITERIA FOR THE ES101 HELICOPTER TRANSMISSION SYSTEM
May 2010
Aviotecnica

2.2 Test Report 80083/1

Static tensile strength tests
March 5th 2009
TEC-EUROLAB

2.3 Peterson's Stress Concentration Factors

By W.D. Pilkey
1997 2nd Edition
John Wiley & Sons

2.4 Catalog 5000 E

General Catalogue
June 2003
SKF

3 Acronysms and Abbreviations

FEA	Finite Element Analysis
g	gravity acceleration
MGB	Main Gearbox
MoS	Margin of Safety
MR	Main Rotor
MS	Margin of Safety
N.A.	Not Applicable
P/N	Part Number
RPM	Revolutions Per Minute
TR	Tail Rotor

4 Part description

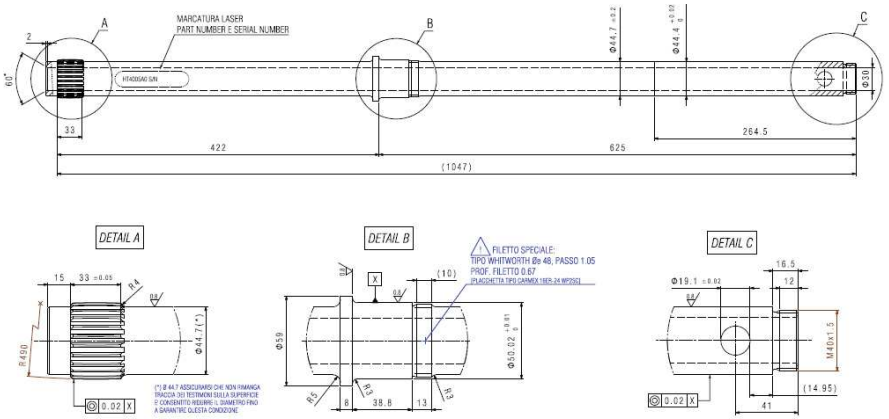

Fig. 1 – Main rotor mast (P/N E1.63.039.202)

The main rotor (MR) mast is the shaft connecting the Main Gearbox (MGB) of the ES101 helicopter to the main rotor.

The MR mast has the function to transmit the torque and rotation (i.e. mechanical power) from the MGB output gear (nominal rotational speed of 535 rpm) to the main rotor hub.

In addition the MR mast has to transmit the lift and the shear forces generated by the main rotor to sustain and to drive the helicopter.

The MR mast is a critical part since its structural failure will compromise any or all its functions so as to cause a catastrophic failure of the helicopter.

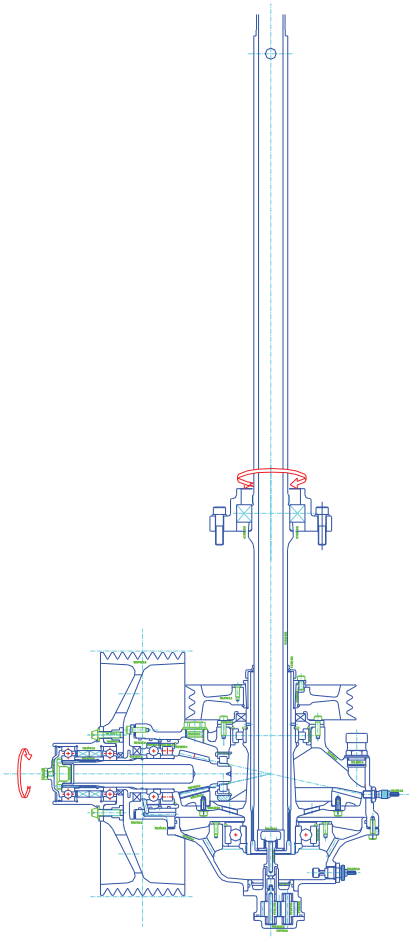

Fig. 2 - MGB Assembly with MR Mast (P/N E1.63.001.102)