

## **VERY LARGE TELESCOPE**

<p style="text-align: center;"><b>ASM Seeing Monitor, Modifications to the Motor Assembly.</b></p>
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Prepared by: M. Ravensbergen.

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**CHANGE RECORD.**

Issue:	Date:	Section/Page affected:	Comments:
Draft 1	6 Nov. 1996	All:	First draft
Draft 2	15 Jan. 1997	Ch. 1: Ch. 5: All:	'DIMM' changed into 'Seeing Monitor' Added. 'xx' filled in, more details added.
Draft 3	3 Mar. 1997	Ch. 1: Ch. 3.2: Ch. 5 (limit switches): Ch. 6.2 (oil seal):	Bullet list: add Change limit switches. Encoder mounting screws are M2x8. New chapter inserted. New chapter inserted.

TABLE OF CONTENTS

1. INTRODUCTION .....	4
2. REFERENCE DOCUMENTATION .....	4
3. ENCODER MOUNTING .....	4
3.1. BACKGROUND .....	4
3.2. REQUIRED PARTS.....	4
3.3. PROCEDURE .....	4
4. MOTOR MOUNTING .....	5
4.1. BACKGROUND .....	5
4.2. REQUIRED PARTS.....	5
4.3. PROCEDURE .....	5
5. LIMIT SWITCHES .....	6
5.1. REQUIRED PARTS.....	6
5.2. PROCEDURE .....	6
6. OTHER ISSUES .....	6
6.1. GEAR BOX BACKLASH.....	6
6.2. OIL SEAL.....	6
6.3. SPRING ON TELESCOPE AXIS.....	6
7. FUNCTIONAL TEST.....	6

## **1. INTRODUCTION**

This document describes the modifications that are to be done on the Seeing Monitor drive motor in order to upgrade them for compliance with the VLT environment.

The modification consists basically of two items:

- changing the fine resolver into an incremental encoder.
- changing the motor into a motor/tacho combination.
- change the type of limit switches.

## **2. REFERENCE DOCUMENTATION**

RD1 Drawing 'Seeing monitor, Ensemble Motorisation'. DWG number 1043 02 3/00/00 Rev. D, dated 15 nov 1988.

## **3. ENCODER MOUNTING**

### **3.1. BACKGROUND**

The old system with the 'fine' resolver suffered from electrical interference on the encoder signal. The resolver is also not supported in the VLT environment. Therefore, it has been replaced with a Heidenhain incremental encoder. This encoder is however thicker than the resolver, has also a thicker axis and also a different mounting diameter. The axis (RD1 item 16) and the encoder mount (RD1 item 15) must therefore be exchanged with new pieces. Also, the bearing and the sealing ring must be exchanged.

### **3.2. REQUIRED PARTS**

Per motor assembly, the following parts are needed:

- Encoder mount (item 15) according drw. VLT-DWG-ESO-17413-0778
- Encoder axis (item 16) according to drw. VLT-DWG-ESO-17413-0777
- Bearing (item 29). This item is the same as the old one, but it is needed because the old one cannot be removed from the axis without the risk of damaging it.
- Seal ring (item 30). This item is the same as the old one, but it is needed because the old one cannot be removed from the axis without the risk of damaging it.
- Encoder. Heidenhain ROD 454M.0000-01000 Ident 28116327.
- Encoder mounting clips, quantity 3. Heidenhain Ident. 200 032 02.
- Encoder mounting crews M2x8 , quantity 3
- Setscrew M3x20 (new, instead of RD1 item 55).

### **3.3. PROCEDURE**

1. Unscrew the RD1 item 15 from the motor assy by unscrewing 4x RD1 item 63. Note: the locator pins (RD1 item 62) are useless and are not used any more on the new assy.
2. Dismount the toothed wheel (RD1 item 13/14/68), springring (RD1 item 44) and ring (RD1 item 20). Note: the toothed wheel is spring loaded to eliminate the backlash. Keep these pieces together and be careful that the springs are not lost.
3. Mount the new encoder axis (item 16) on a new bearing.
4. Mount a new oil seal (item 30) in the new encoder mount (item 15). Careful for the 'inside and outside' direction (the text must be visible after mounting), use a cylinder of the corresponding size in order to push the seal into its fitting.
5. Turn the setscrew (item 56) on the encoder axis below the surface and carefully insert the axis with bearing through the seal until the bearing fits in its seat.
6. Mount the ring (RD1 item 20), toothed wheel assy (RD1 item 13/14/68) on the encoder axis. Mount the spring ring (RD1 item 44) and fix the setscrew (RD1 item 54).

7. Mount the encoder, using the encoder mounting clips and the 3 screws M2x8.
8. Fasten the setscrew (RD1 item 56) that fixes the encoder axis to the encoder. The Encoder mount (Item 15) has a special hole for this purpose. Mount the encoder such that the cable exit pointing backwards with ref to RD1.
9. Mount a setscrew M3x20 in the encoder mount. (This takes the job of RD1 item 55). Preload the assy 13/14/68 so that the holes in the assy align and screw the setscrew so far in that it goes though this hole. Note: this locks the toothed wheel in its preloaded situation and allows mounting of the whole assembly to the motor assy.
10. Put the flat oil seal (RD1 item 21) on the motor assy and mount the new encoder assy with the 4 screws RD1 item 63.
11. Unscrew the setscrew M3x20 so far that it aligns with the outer surface of the encoder mount. Lock it and make it oil-leakage proof with Locktite.

#### **4. MOTOR MOUNTING**

##### **4.1. BACKGROUND**

In the old system, the resolver provided some kind of tachometer signal. As the resolver(s) are not used any longer, the motor must be equipped with a tacho. The tacho on the motor axis provides also better speed feedback than the resolvers: they were located 'away' from the motor axis.

##### **4.2. REQUIRED PARTS**

Per motor assembly, the following parts are needed:

- Motor /tacho unit. Mattke F12M2+FC12T, Ident MF12M2TFC12T. Note that the motor axis must have a flat part according to dwg. VLT-DWG-ESO-17413-0774. This can be provided by Mattke: Ident. AWAF12M2ESO.
- Setscrew M3x4 (to close the hole due to the removal of RD1 item 18).
- Connector support parts as per dwg. VLT-DWG-ESO-17413-0775. The connector support is shown in detail on dwg. VLT-DWG-ESO-17413-0773.

##### **4.3. PROCEDURE**

1. Unscrew the old plate and connector (RD1 item 11 and 12, together with the mechanics and relays that are mounted on it).
2. Put the motor assembly with the motor pointing upwards and dismount 6 screws RD1 item 60.
3. Carefully lift motor unit + motor support (RD1 Item 4). The lifting is a bit 'sticky' because of the O-ring RD1 item 36. Use 2 screwdrivers to do the first few mm of the lifting. Careful, part of the Harmonic Drive (RD1 item 19) will come along also, so move the motor support ONLY UPWARDS. The small bearing (RD1 item 28) might come along. If so, put it back into the intermediate axis RD1 item 5.
4. Loosen set-screw RD1 item 58.
5. Remove the old motor by unscrewing 6 screws RD1 item 64.
6. Remove the 'coarse' resolver axis RD1 item 18.
7. Align the new motor/tacho unit with the setscrew RD1 item 58, fix the motor/tacho to the motor support (RD1 item 4) and fasten the setscrew RD1 item 58. Note: rotational alignment of the motor/tacho is not relevant.
8. Carefully slide the prepared assy back in to the motor housing. Take care that the harmonic drive is not damaged.
9. Fix the motor support to the motor housing with the 6 screws RD1 item 60 .
10. The motor cable that is delivered with the motor does not fit between motor and hood (RD1 item 1): Remove the tachometer first and mount 2 wires 0.75mm<sup>2</sup>. Use same colors as original cable. Mount tacho afterwards.
11. Mount the connectors and connector support as per dwg. VLT-DWG-ESO-17413-0775. The electrical connections are shown in dwg. VLT-DWG-ESO-17413-0768.

12. Modify the hood, RD1 item 1, so that the new connectors can be fed through. Perform functional tests before re-mounting the hood.

## **5. LIMIT SWITCHES**

### **5.1. REQUIRED PARTS**

Per motor assembly, the following parts are needed:

- 3 limit switches, type Baumer IFR 08.24.15.
- Loctite

### **5.2. PROCEDURE**

1. Unscrew the old limit switches.
2. Mount the new ones, adjust them for correct mounting height and seal them with Loctite.

## **6. OTHER ISSUES**

The following issues were found on the spare motor. They should be checked on each other motor as well.

### **6.1. GEAR BOX BACKLASH**

The gear box RD1 item 24 must be checked that the fixed ring is really fixed to the motor. (Rev. D of RD1). If not, the WHOLE motor must be disassembled in order to fix the screws RD1 item 53 AND put Loctite on the fixed gear ring. The testing for backlash can easily be done if the motor is on a test stand with the autocollimator.

It is difficult to measure by 'feeling' on the telescope axis because of the big friction of the main bearing RD1 item 25.

### **6.2. OIL SEAL**

The oil seal RD1 item 31 has the wrong orientation: the chamber with the small gear cannot be filled with oil, only the chamber with the big gear is filled with oil. The sealing direction of the seal must therefore be in the direction of the chamber with the big gear.

If the motor leaks oil or has to be opened for other reasons, take the opportunity to mount the oil seal in the right orientation.

### **6.3. SPRING ON TELESCOPE AXIS**

The drw RD1 shows a spring (RD1 item 70), which was NOT mounted in the spare motor unit. This has the advantage that the motor 'can turn forever'. Very likely, this spring was intended to remove backlash. It was probably not mounted because of the fact that the bearing friction and the unbalance are big and that the spring could not generate sufficient counter-torque to react against these two.

Anyway, to make all motors the same, the spring SHOULD be removed if it is mounted. This can easily be checked by opening cover RD1 item 6.

## **7. FUNCTIONAL TEST**

1. Try to rotate the motor axis by hand.
2. Connect the motor power leads to a power supply and verify that the motor turns with a current of about 4 Amps.
3. Verify positive rotation: a positive voltage on motor connector pin 1 must result in clockwise rotation of the telescope axis (seen from telescope axis side). If not, interchange the motor leads at the motor connections.

4. Verify positive tacho signal: a positive rotation must result in a pos tacho voltage on tacho connector pin 1. If not, interchange the tacho leads at the tachometer.
5. Check the operation of the limit switch.
6. Verify that going off-limit in the positive direction is not critical in timing with the encoder zero pulse (important for proper init of the encoder). Rotate the encoder slightly if these 2 points are too close together.