



Application Note

Application Note Number	A-ECEC155-20-40-MR
Revision	1
Function	Main Rotor Track and Balance
Airframe	Eurocopter EC-155
Engine	N/A
E-Setup Number	A-ECEC155-20-40-MR.asf
ACES Systems Analyzer	Model 4040 or Model 2020 w/Main Rotor Enhanced
Firmware Version	1.0 and 2.00 or greater
Procedure	N/A

Introduction

This outline covers the required equipment, equipment installation, analyzer setup, data acquisition, and solution process for using the ACES 4040 Viper or 2020 ProBalancer to perform a main rotor track and balance on the Eurocopter EC-155 helicopter. General instructions for the use of the Model 4040 Viper can be found in user manual #4040OM. General instructions for the use of the Model 2020 ProBalancer can be found in user manual #2020OM-01. All adjustments to the aircraft are to be performed IAW the EC-155 Maintenance Manual.

A. Required Equipment

The following ACES Systems' equipment is required.

Item	Quantity	Description	Part Number
1.	1	Model 4040 Analyzer	10-100-4040
2.	1	Optical Tracker Model 540-2	75-900-0542
3.	1	Sensor, Vibration, 991D-1	69-100-0075
4.	1	Cable, Sensor, 991D, 25'	10-320-0162
5.	1	Mount, Vibe Sensor, .250" "Z"	22-430-0037
6.	1	Cable, Magnetic Pickup 25'	10-320-0052
7.	1	Magnetic Pickup Bracket	10-100-0479
8.	1	Magnetic Pickup	75-900-0187

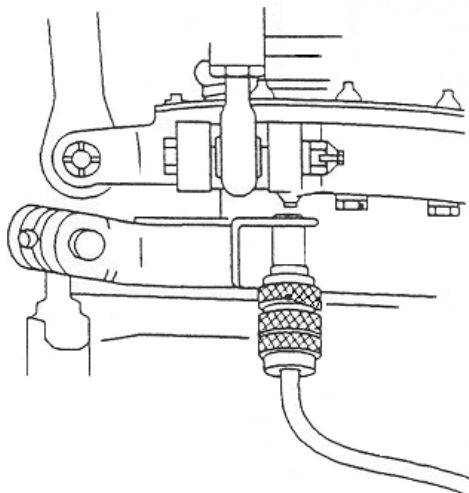
Miscellaneous Equipment

Tape or tie wraps to secure cables to airframe.

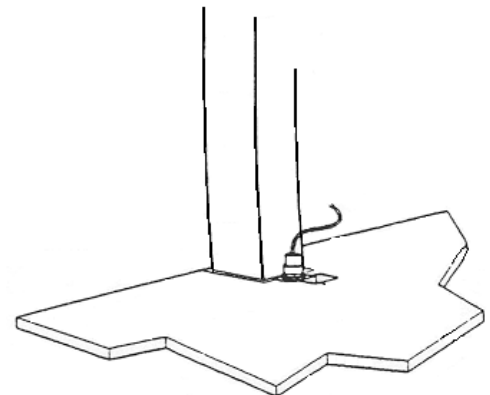
B. Equipment Installation

1. Turn main rotor and position the Red blade over the left hand side of the helicopter.
2. Install magnetic pickup bracket (P/N 10-100-0479) on the stationary swashplate with screws, shims, and nuts.
3. Remove upper jam nut from magnetic pickup (P/N 75-900-0187). Install the pickup into pickup bracket. Loosely install upper jam nut.
4. Check that the interrupter and magnetic pickup align. Adjust the clearance between the interrupter and pickup to .040 - .050 in. Tighten upper jam nut and safety wire.
5. Connect magnetic pickup cable (P/N 10-320-0052) to pickup and route into cabin area. Secure cable with tape or adel clamps. Connect cable to Tach Channel 1 on analyzer.
6. Mount 991D-1 sensor (P/N 69-100-0075) and bracket (P/N 22-430-0037) to the floor at the bottom of the 9 degree frame. Connect sensor cable (P/N 10-320-0162) to the sensor and route to the analyzer. Connect the cable to channel A of the 4040 analyzer.
7. Connect the Optical Tracker (P/N 75-900-0542) to the Aux./Comm port on the 4040 analyzer.

Equipment Installation Diagram



Magnetic Pickup Installation



Sensor Installation

C. Analyzer Set Up

1. Turn the analyzer “ON”
2. Enter a new setup as follows; from the “Main Menu” select “Main Rotor Track and Balance” and press **[Enter]**. From the “Main Rotor Tack and Balance” menu, select **[Manage Setups]** and press **[Enter]**. From the ‘Manage Setups’ menu, select **[Edit]** and press **[Enter]**. From the “Edit Screen” press the **[New]** button.
3. The “Main Rotor Setup” screen now appears. Enter the main rotor job setup as shown. When completed press **[Enter]**.

Model 4040 VIPER Analyzer			
Main Rotor Setup			
Name:	EC-155 MAIN ROTOR		
Vertical Chan:	A		
Lateral Chan:	B		
Sensor:	991D-1		
Tach Type:	Mag(Hi)	Tach Chan:	1
Number of Weight Positions:	5		
Blades:	5		
Relative to:	1		
RPM:	342	Trk Units:	in
Conditions			
Ground	Both	Hover	Both
140KTS	Both		Both
	Both		Both

4. The “Main Rotor Conditions” screen will determine the charts to be used when calculating corrections for a given measurement. Chart “ID’s” of similar measurements with the same number will average the readings together for use in solutions. The “limit” field under each measurement type will set the point at which the analyzer will determine whether corrections are needed. Enter the information exactly as it appears in the appropriate fields. When completed, press **[Enter]**.

Model 4040 VIPER Analyzer			
Main Rotor Conds. Setup			
	Vert Chart ID	Lat Chart ID	Track Adj. ID
Ground	0	1	1
Hover	0	1	1
140KTS	0	0	2
Limit	0.20	.1	0.25
Enter ID, or 0 if no adjustment. Different charts use different IDs.			

5. The “M/R Adjustment Symbol Setup” screen is displayed next. The function of this screen is to determine the direction of movement for a + adjustment. Enter the values as shown. When complete press [Enter]. **+ adjustments called out by the 4040 are to be implemented by bending the Tab DOWN. - adjustments are made by bending the Tab UP.**

Model 4040 VIPER Analyzer	
M/R Adj Symbol & Soln Logic	
Adjustment	Positive Value Meaning
Weight:	ADD
Sweep:	FWD
Blade:	UP
TAB:	DOWN
Soln:	MAX

6. The first main rotor chart to define will be the “Lateral”: Ground-Hover chart. This chart will determine the Weight adjustments to perform for lateral vibration reduction. The unit of adjustment is WSR, “Washer”. Enter the information exactly as it appears in the appropriate fields. When completed press [Enter].

Model 4040 VIPER Analyzer	
Main Rotor Chart Setup	
Name:	Lat Ground-Hover
Type:	Regular Sweep Only: No
No Adjustment Bld/Pos:	None
Max ICF Update:	50 % R(°): 45
Adj Unit:	WSR Adj/IPS: 7.000
Bld/Pos MoveLine	Bld/Pos
YELLOW	10 : 15 BLUE
RED	7 : 45
BLACK	
WHITE	
Bld/Pos: in CW or CCM order	
+Adj = WtAdd/SwFwd/BlUp/TabDn	
Help	

7. Next, the “Tracking Influence Setup” screen for Ground/Hover will appear. This chart will determine the amount of pitch change adjustment required to improve track splits at ground and hover. The “Adj./in.” sensitivity tells the balancer the amount of PCL adjustment required to equal one inch of movement at the blade tip. Enter the information exactly as it appears in the appropriate fields. When complete, press [Enter]

Model 4040 VIPER Analyzer	
Tracking Influence Setup	
Conds	Adj Name Unit Adj/in Max Upd%
Ground-Hover	PCL FIT 4.000 50
No Adjustment	Bld/Pos: 1
Blade Names:	
1.	YELLOW
2.	RED
3.	BLACK
4.	WHITE
5.	BLUE
+Adj = WtAdd/SwFwd/BlUp/TabDn	

8. Last, the “Tracking Influence Setup” screen for 140 KTS will appear. This chart will determine the amount of Tab change required to improve in-flight track splits. The “Adj./in.” sensitivity tells the balancer the amount of Tab adjustment required to equal one inch of movement at the blade tip. Enter the information exactly as it appears in the appropriate fields. When complete, press **[Enter]**

Model 4040 VIPER Analyzer				
Tracking Influence Setup				
Conds	Adj Name	Unit	Adj/in	Max Upd%
140KTS	TAB	DEC	5.000	50
No Adjustment Bld/Pos: (None)				
Blade Names:				
1.	YELLOW			
2.	RED			
3.	BLACK			
4.	WHITE			
5.	BLUE			
+Adj = WtAdd/SwFwd/BlUp/TabDn				

9. Setup complete, press **[Backup]**, select “Start Job”, press **[Enter]** and then select the EC-155 Main Rotor Setup that was just created.

D. Data Acquisition

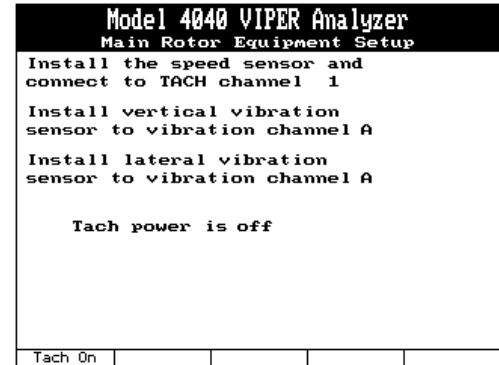
1. “Customer Information” screen. It is recommended to complete this screen so that customer information will appear on printout assisting in identification of the job when it is stored in the analyzer memory. When finished press **[Enter]**.

Model 4040 VIPER Analyzer				
Customer Information				
Enter the following optional Customer information.				
Name:	CUSTOMER NAME			
A/C Registration:	N12345			
A/C Total Time:	0			
Press ENTER to continue				
Names				

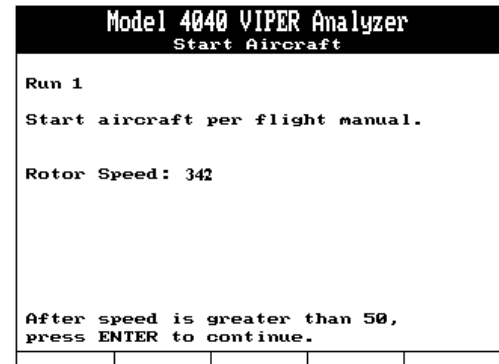
2. “Tracking Selections” screen. Allows the user to select tracking device for this particular job. Select Tracker or Strobe and press **[Enter]**.

Model 4040 VIPER Analyzer				
Tracking Selections				
Track Device:	Tracker			
- For Optical Tracking Only -				
Number of Rotations:	50			
Inches To Blade Tip:	130			

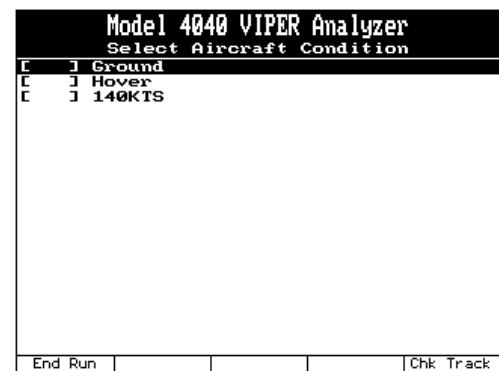
3. “Main Rotor Equipment Setup”. Information screen that prompts the user to verify equipment installation has been performed in accordance with channel selections that were specified when building the setup. Press **[Enter]**.



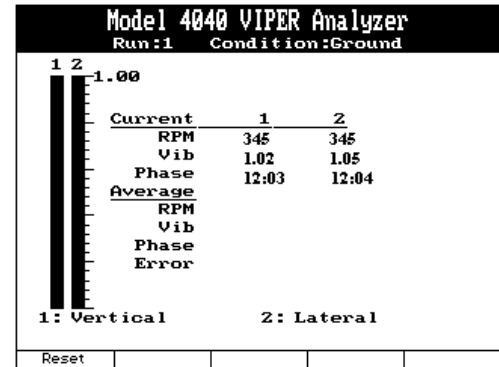
4. “Start Aircraft” screen. This screen allows the user to view the current main rotor rpm. When the aircraft has been started press **[Enter]**.



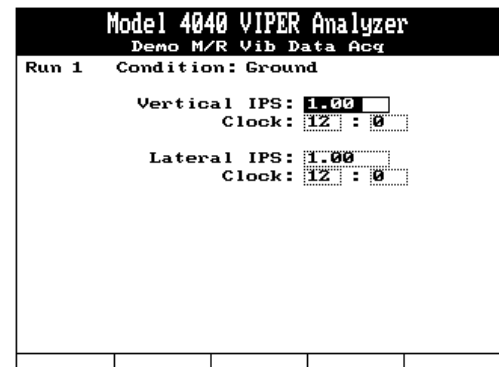
5. “Select Aircraft Condition” screen. Displays the ground and flight regimes that are specified in the setup. Select Ground and press **[Enter]**.



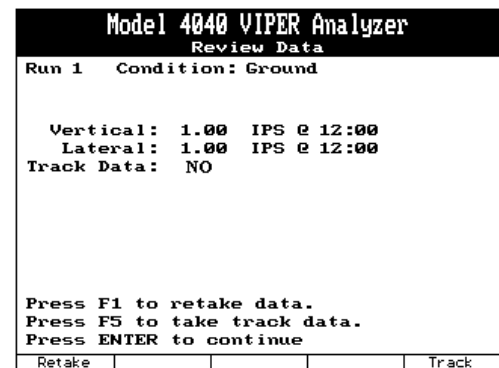
- Acquiring Vibration Data. This screen is displayed during the vibration acquisition. When stable vibration readings are observed, press **[Enter]**.



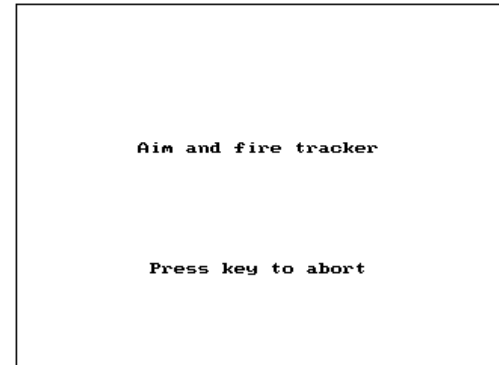
- “Review Data”. This screen allows the user to view the vibration readings that were acquired during the regime. Press **[Enter]** to continue.



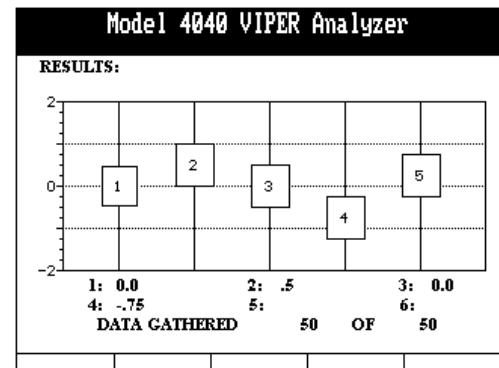
- “Review Data”. This screen allows the user to view the vibration readings that were acquired during the regime. Press **[Enter]** to continue or **[F-5]** to acquire Track data.



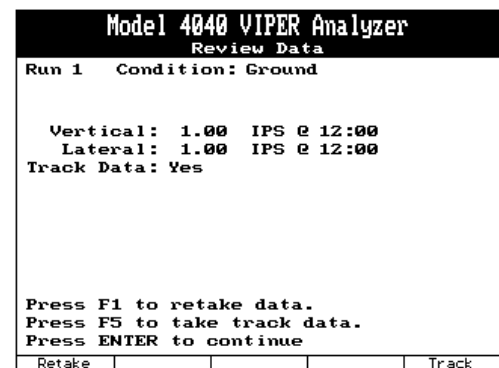
- The "Track Screen" will appear prompting you to aim and fire the tracker. Aim the tracker at the tip of the rotor disk at the 12:00 position. Move tracker up and down until green LED's are illuminated. Press trigger one time and release, continue to hold tracker with green LED's illuminated. The amber LED will pulsate during the acquisition. When tracker acquisition is complete the amber LED will extinguish.



- The track data will now appear on the screen. The track split will be shown. If the number of packets recorded is less than 75% of the total, press **[Enter]** and then **[F-1]** to retake the track reading. After review press **[Enter]** to continue.



- The "Review Data" screen will reappear, press **[Enter]** to continue.



Note

At any time during a flight if the vibration levels are found to be too severe to continue, the user has the option to end run and solve for the vibration data acquired to that point.

12. Repeat sequence through all flight regimes. After all data is acquired press the “Adjust” [F-2] button, shut down the aircraft and review solution options.

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Model 4040 VIPER Analyzer
Select Aircraft Condition
[ x ] Ground
[ x ] Hover
[ x ] 140KTS
    
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End Run	Adjust		Chk Track
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Model 4040 VIPER Analyzer
Shut Down Aircraft

Shut Down Aircraft
per flight manual instructions
    
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			Continue
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13. The analyzer will present all of the solutions possible from the data gathered. It is possible for the analyzer to give two adjustments that would adversely affect the other. The user is ultimately responsible for determining which adjustments to implement and which to discard. Use the attached flow chart to aid in the decision making process. Make the desired adjustments to the rotor system as called for by analyzer and press [Enter]. The user will now be prompted to start the engine and continue with run #2

```

Model 4040 VIPER Analyzer
M/R Suggested/Installed Adjustments

Run 1
Name: Trk Ground-Hover, PCL, F

Bld/Pos Suggested Installed
YELLOW 0.00 0.00
RED -2.00 -2.00
BLACK 0.00 0.00
WHITE 3.00 3.00
BLUE -1.00 -1.00

+Adj = WtAdd/SwFwd/BIUp/TabDn
    
```

Inst=Sugg	Inst=None		Quit Job
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```

Model 4040 VIPER Analyzer
M/R Suggested/Installed Adjustments

Run 1
Name: Lat Ground-Hover, MSR

Bld/Pos Suggested Installed
YELLOW 2.52 2.52
RED 0.00 0.00
BLACK 0.00 0.00
WHITE 0.00 0.00
BLUE 5.80 5.80

+Adj = WtAdd/SwFwd/BIUp/TabDn
    
```

Inst=Sugg	Inst=None		Quit Job
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```

Model 4040 VIPER Analyzer
M/R Suggested/Installed Adjustments

Run 1
Name: Trk 140KTS, TAB, DEG

Bld/Pos Suggested Installed
YELLOW 0.00 0.00
RED 2.50 2.50
BLACK -0.00 -0.00
WHITE -3.75 -3.75
BLUE 1.25 1.25

+Adj = WtAdd/SwFwd/BIUp/TabDn
    
```

Inst=Sugg	Inst=None		Quit Job
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Note

It is important to remember that when installing or removing weights and recording their positions that the influence used for the next run will be updated by the result from the previous run's solution, therefore be as accurate as possible when recording adjustments made regardless whether the recommended solution is implemented. The only entries on this screen should reflect the actual solution implemented.



Application Note

Eurocopter EC-155

Main Rotor Track and Balance

Part Number: a-ecec155-20-40-mr

AppNote Number: 11-200-0085

This Application Note is provided for information only and does not supercede the requirements or guidelines set forth in the applicable engine or airframe maintenance manual. Technology for Energy Corporation assumes no obligation or liability, either express or implied, to the Purchaser arising out of the use of this procedure.

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