



Application Note

Honeywell ALF502/507

Fan Trim Balance

Part Number: 11-200-0187

AppNote Number: E-HO-ALF502/507-4040-FB

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Application Note

Application Note Number	E-HOALF502/507-4040-FB
Version	1.01
Function	Fan Trim Balance
Airframe	ALL
Engine	Honeywell ALF502/507
E-Setup Number	N/A
ACES Systems Analyzer	Viper 4040
Firmware Version	1.04 or Higher
Procedure	N/A

Introduction

This Application Note describes the steps necessary to conduct a Fan Trim Balance procedure on the ALF502/507 engine using the ACES Viper 4040 Analyzer.

A. Equipment Set Up

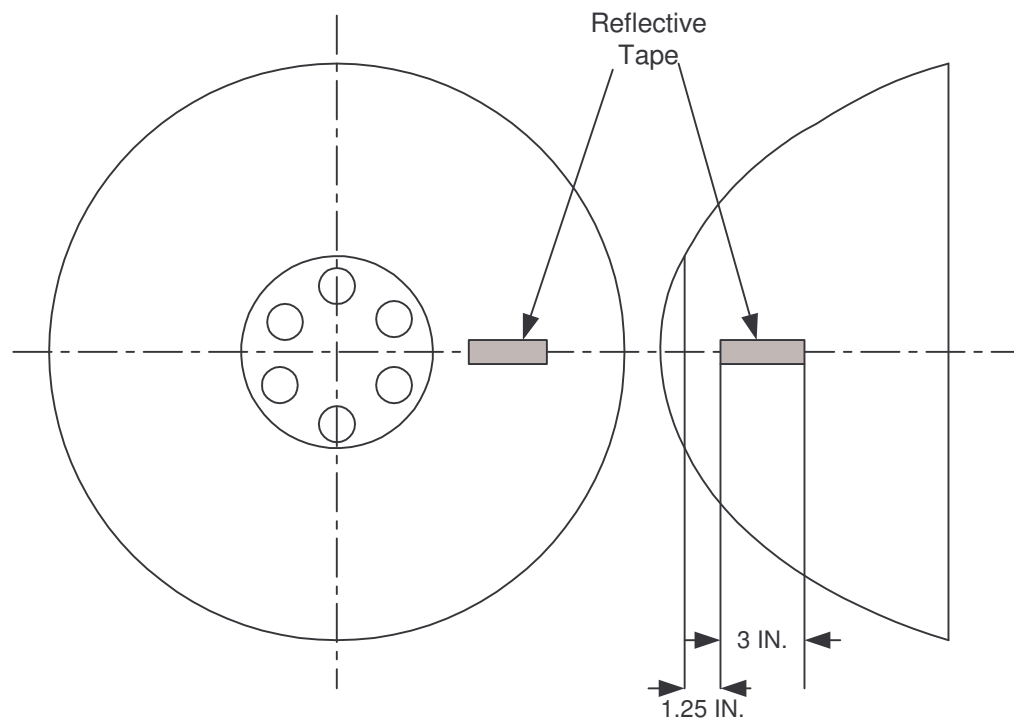
Required Equipment: The following equipment is required to accomplish a single engine fan trim balance.

Item	Quantity	Description	Part Number
1.	1EA	Analyzer, Viper 4040	10-100-4040
2.	1EA	Cable, Vibe, 6 Pin Generic, 50 Ft.	10-320-0127
3.	1EA	Sensor, Velocity, CEC 4-128	TBD
4.	1EA	Cable, Tachometer, Generic, 50 Ft.	10-320-0126
5.	1EA	Cable, Sensor, CEC-TO-2020/4040 2 FT	10-320-0305
6.	1EA	Tachometer, Lasetach II, 299 (Reflective tape included)	10-100-1300
7.	1EA	Mount, Lasetach Swivel	10-100-0369

Optional Equipment: The following items are optional for the FAN TRIM BALANCE operation only. The 991V sensor is not approved for use for the pass/fail vibration survey requirements.

8.	1EA	SENSOR, VIBE, VELO, 991V	69-100-0064
9.	1EA	CABLE,INTERF,991V-GEN VIB CBL,1725/1730	10-320-0142
10.	1EA	MOUNT,1/4X28 SENS, VIBE, 1/4" HOLE, ALU	22-430-0056

B. Equipment Installation Diagrams

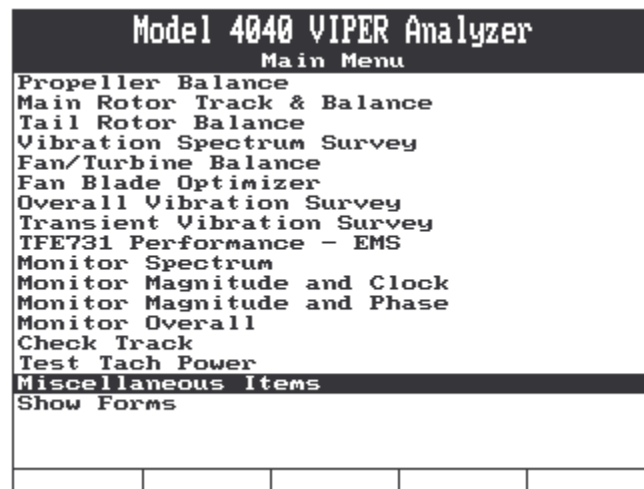


1. Remove the fan spinner cap and gain access to the fan disk. Locate 0 degrees (#1 bolt). The reflective tape should be attached on the spinner with the leading edge of the tape aligned with the center of the #1 bolt.
2. Clean the area of the spinner where the tape is to be attached with cleaning solvent to insure good adhesion. Apply a 3 inch length of 3M brand 7610 reflective tape (supplied with the Lasetach) with reference to the diagram above.
3. Install the fan spinner and cap with match marks aligned, using six tab washers and bolts. Torque the bolts to 70 – 90 inch pounds and secure all tab washers
4. Install the velocity sensor, item 3 or 8, on the engine using the installed sensor mount or the ¼ x 28 991V sensor mount, item 10, as appropriate.
5. Connect the appropriate sensor cable, items 5 or 9 as appropriate, to the installed velocity sensor.

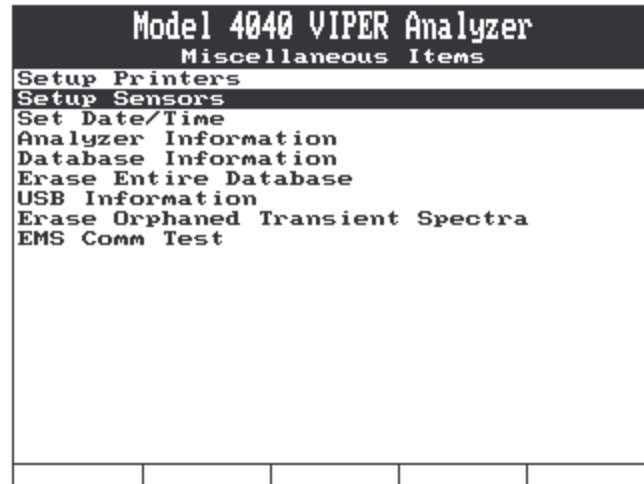
6. Connect the 50 ft. generic vibe cable, item 2, to the sensor cable. Route the cable away from hot and high voltage components, then along the fuselage to the cockpit or location where the analyzer will be operated. Secure the cable every 36 inches with wire ties or aluminum speed tape. Connect the cable to the 4040 Analyzer, item 1, at the CHAN A input.
7. Assemble the 299 Lasetach, item 6, to the Lasetach swivel mount, item 7, if necessary. Install this assembly to the top of the wing near the leading edge. The Lasetach should be off center to the engine where a direct line of sight to the installed reflective tape on the spinner is possible. It is not necessary to have the laser perpendicular to the tape but the angle should be less than 40 degrees. Secure the base of the swivel mount to the wing using duct or aluminum speed tape. Alignment of the laser will be accomplished later in this procedure.
8. Connect the Generic tachometer cable, item 4, to the 299 Lasetach and route the cable to the cockpit where the analyzer is located. Connect the cable to the TACH 1 input of the 4040 analyzer.

C. Analyzer Setup

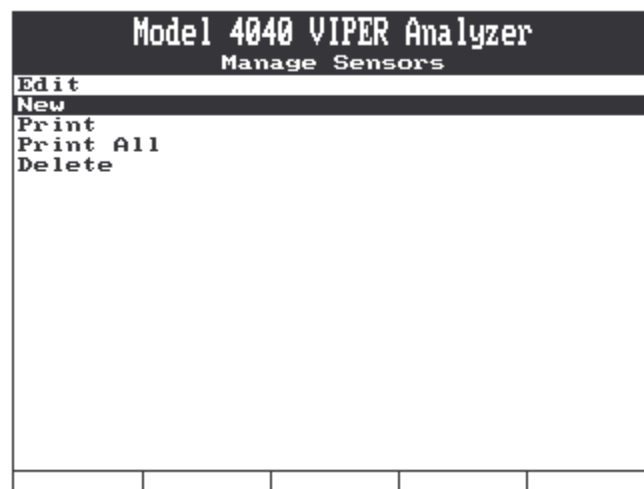
1. Turn the analyzer ON by pressing the ON/OFF key.
2. After a series of self-checks, the analyzer will display the main menu, shown below. Use the [DOWN ARROW] keys to select “Miscellaneous Items” and press [ENTER].



3. From the Miscellaneous Items menu page, use the [DOWN ARROW] key to select “Setup Sensors” and press [ENTER].



4. From the “Manage Sensors” menu page, use the [DOWN ARROW] key to select “New” and press [ENTER].



5. In the “Sensor Setup” page, complete each field as follows for the CEC-128 Velocity sensor:
- In the **Name:** field, use the analyzer keypad to enter “CEC-4-128”. Move to the next field by pressing the [DOWN ARROW] key.
 - In the **Amplitude Units :** Field, use the [RIGHT ARROW] key to select “IPS”. Press the [DOWN ARROW] key to move to the next field.
 - In the **Probe Sensitivity:** field, use the numeric keypad to enter “105”. This represents 105 mV per IPS as the sensitivity for the sensor. (NOTE: Check the spec sheet for the sensor you are using to insure this value is correct. Sensitivity may vary even within a sensor with the same part number of model.) Press the [DOWN ARROW] key to move to the next field.
 - In the **Reverse Polarity :** field, insure the field reads “No”. If it does not, press the [RIGHT ARROW] key to change. Press the [DOWN ARROW] key to move to the next field.

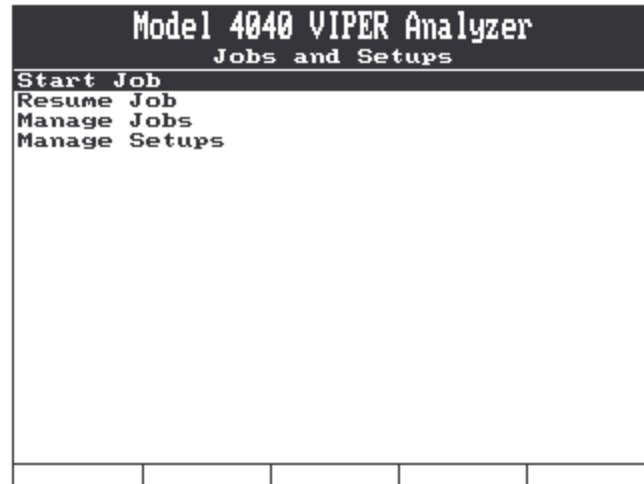
- e. In the **Input Type** : field, insure the field reads “Single Ended”. If it does not, press the [RIGHT ARROW] key to change. When all fields are complete, press [ENTER] to accept your settings and return to the “Manage Sensors” screen. From that screen, press [BACKUP] until the Main Menu is displayed.

Model 4040 VIPER Analyzer				
Sensor Setup				
Name:	CEC 4-128			
Amplitude Units:	IPS			
Probe Sensitivity:	105.000			
Reverse Polarity:	No			
Input Type:	Single Ended			

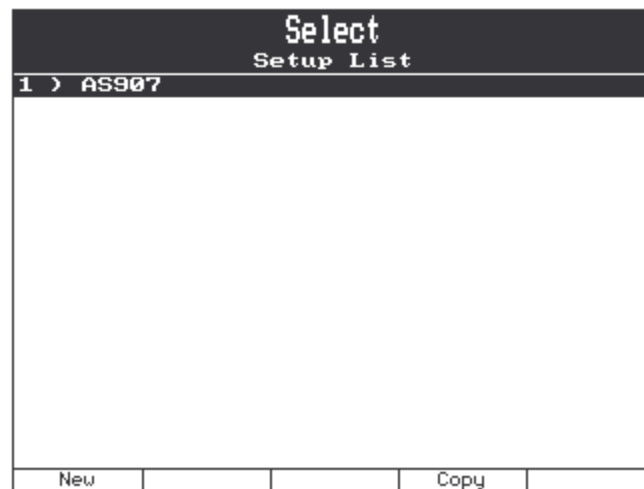
6. From the Main Menu screen, use the [DOWN ARROW] key to select “Fan/Turbine Balance” and press [ENTER].

Model 4040 VIPER Analyzer				
Main Menu				
Propeller Balance				
Main Rotor Track & Balance				
Tail Rotor Balance				
Vibration Spectrum Survey				
Fan/Turbine Balance				
Fan Blade Optimizer				
Overall Vibration Survey				
Transient Vibration Survey				
TFE731 Performance - EMS				
Monitor Spectrum				
Monitor Magnitude and Clock				
Monitor Magnitude and Phase				
Monitor Overall				
Check Track				
Test Tach Power				
Miscellaneous Items				
Show Forms				

7. The Jobs and Setups page will be displayed. Use the [DOWN ARROW] key to select “Start Job” and press [ENTER].



8. The analyzer will display one of two screens. If any fan trim balance setups have been entered previously, the Setup List will be displayed. Check to see if the ALF502 is in the list. If it is, use the [DOWN ARROW] key to select it, press [ENTER] and go to step 13 below. If the list is displayed but the ALF502 is not on the list, press the [F1] "New" key and go to step 9. below.



If no setups were previously entered, the Fan/Turbine Balance Setup screen will be displayed. If this screen is displayed, go to step 8. for detailed instructions on how to complete the setup for the ALF502.

Model 4040 VIPER Analyzer	
Fan/Turbine Balance Setup	
Name :	
Num Engs :	1
Eng Rotation :	CW
Num Baln Planes :	1
Num Optional Planes :	0
Balance Wt Type :	Class
Num Class Wt Sets :	1
Label Detail Wts :	No
Baln Weight Unit :	g
Num Sens / Eng :	1
Num Baln Speeds :	1
Slow Roll RPM :	0
Min Baln RPM :	6000
Actual RPM @ 100% :	10000
Vib Unit :	g's
Modifier :	Peak

9. Complete the Fan/Turbine Balance Setup as follows:

Name : Use the analyzer keypad to enter “ALF502”

Num Engs : Use the [RIGHT ARROW] key to select 1.

Eng Rotation : Use the [RIGHT ARROW] key to select “CW” for clockwise.

Num Baln Planes : Use the [RIGHT ARROW] key to select “1”.

Num Optional Planes : Use the [RIGHT ARROW] key to select “0”.

Balance Wt. Type : Use the [RIGHT ARROW] key to select “Class”.

Num Class Wt Sets : Use the [RIGHT ARROW] key to select “1”.

Label Detail Wts : Use the [RIGHT ARROW] key to select “No”.

Baln Weight Units : Use the [RIGHT ARROW] key to select “g” for grams.

Num Sens / Eng : Use the [RIGHT ARROW] keypad to select 1 or the number of sensors you are using for this setup.

Num Baln Speeds : Use the [RIGHT ARROW] key to select the total number of balance speeds you will use for this setup or alternately select “Sel. In Job” which will allow you to select the number of balance speeds as you start each job using this setup.

Slow Roll RPM : Use the analyzer keypad to enter “0”.

Min Baln RPM : Use the analyzer keypad to enter an RPM below which you do not want to automatically pick speeds for balancing. This is normally below the low flight range.

Actual RPM @ 100% : Use the analyzer keypad to enter 7600, the RPM of the fan at 100% power.

Vib Unit : Use the [RIGHT ARROW] key to select “IPS”.

Modifier : Use the [RIGHT ARROW] key to select “Peak”

When all fields are complete, press [ENTER] to accept the settings and continue.

Model 4040 VIPER Analyzer
Fan/Turbine Balance Setup

Name: **ALF502**

Num Eng: **1**

Eng Rotation: **CW**

Num Baln Planes: **1**

Num Optional Planes: **0**

Balance Wt Type: **Class**

Num Class Wt Sets: **1**

Label Detail Wts: **No**

Baln Weight Unit: **g**

Num Sens / Eng: **1**

Num Baln Speeds: **Sel. in Job**

Slow Roll RPM: **0**

Min Baln RPM: **2000**

Actual RPM @ 100%: **7600**

Vib Unit: **IPS** Modifier: **Peak**

10. The Define Class Wts screen will be displayed. Complete the screen as shown in the example below for the ALF502. NOTE: Be sure to enter “0.0” as the weight for the -01 weight and to enter “1” for it’s span. This indicates that the -1 is in place when no weight is required for a hole, but fills the empty bolt hole acting attaching hardware only.

Model 4040 VIPER Analyzer
Define Class Wts

Name or PN: **2-043-3D**

Num Wts: **11** Placement: **Spread**

Name	Wt	Span	Name	Wt	Span
(The min wt must be a base wt)					
-01	0.000	1			
-02	0.520	1			
-03	1.510	1			
-04	2.610	1			
-05	3.840	1			
-06	5.140	1			
-07	6.540	1			
-08	8.040	1			
-09	9.620	1			
-10	11.31	1			
12	13.12	1			

11. When the Balance Plane Information screen is displayed, use the [DOWN ARROW] key to move from field to field and complete the form as follows:

Plane ID : Use the [RIGHT ARROW] key to select “1”.

Num Holes : Use the analyzer keypad to enter “16”.

Usable: Use the analyzer keypad to enter “4”.

Rivet Wt : Use the analyzer keypad to enter “0”.

Hole Num Dir : Use the [RIGHT ARROW] key to select “CW” for clockwise.

Spacing : Use the [RIGHT ARROW] key to select “Even”.

MaxWt/Hole : Use the analyzer keypad to enter “13.12”.

MaxWt/Plane : Use the analyzer keypad to enter “52.84”.

Wt Set : This field will default to the only weight set available as defined in step 9 above.

Trial Wt : Use the analyzer keypad to enter “3.84” which is the –05 weight. You may vary this weight as necessary. The trial weight is used only to induce a change to the raw condition (no weights) of the first run in order to calculate an effective influence.

Angle of No. 1 Hole : Use the analyzer keypad to enter “0”.

When all fields are complete, press [ENTER] to accept your settings and continue.

Model 4040 VIPER Analyzer				
Balance Plane Information				
Plane ID:	(1)	Num Holes:	16	
Usable:	4	RivetWt:	0.000	
Hole Num Dir:	CW	Spacing:	Even	
MaxWt/Hole:	13.12	MaxWt/Plane:	52.48	
Wt Set:	2-043-3D	Trial Wt:	8.50	
Angle of No.1 Hole:	0			

12. The sensor information page will be displayed. Use the [DOWN ARROW] key to move from field to field and complete the form as follows:

Engine ID : If not defaulted to “1”, use the analyzer keypad to enter “1”.

Tach Chan : Use the [RIGHT ARROW] key to select the tach channel to which you will connect the tachometer input. The field defaults to “1”.

Tach Type : Use the [RIGHT ARROW] key to select the tachometer type you are using for this balance job. The Lasetach is an optical speed sensor. If using the Lasetach, select “Optical”.

Tach Position (FLA) : Use the [RIGHT ARROW] key to select the position where the tachometer is triggered relative to a clock hour as viewed from forward of the engine looking aft into the intake. If using the Lasetach, this will be the position where the laser beam strikes the spinner after setup is complete.

Full Scale Vibration : Use the [RIGHT ARROW] key to select a value you may reasonably expect the level of vibration not to exceed during data acquisition. This value should be as

low as possible while still above that expected maximum value. For the ALF502, 1.00 should suffice. If you experience an “OVERLOAD” indication during the balance procedure you may edit this field to a higher value. Always observe engine operating limitations from the maintenance manual when running the engine.

Sensor Type : Use the [RIGHT ARROW] key to select “CEC-128” or the sensor you are using to do this balance job. This is the sensor entered at the beginning of this application note. If an external sensor is being used, you should enter a setup for that sensor prior to beginning the balance job and edit this setup to select the new sensor at this point. The 991V is resident in the analyzer programming and need not be entered.

Cha : Use the [RIGHT ARROW] key to select “A”. This indicates you will connect the vibration output from the engine to CHANNEL A of the analyzer.

Desc : This is an optional field where you may enter a sensor description. This field is useful when using two sensors where you may define one as HORIZ and one as VERT for instance. If you wish you may enter a description or leave this field blank.

Pos : Is the clock position of the vibration sensor on the engine as viewed from the front of the engine looking aft into the intake. Select the clock position using the [RIGHT ARROW] key. If you do not know the sensor position, select UNK for unknown.

Targ : This is the target vibration level you wish to reach as a result of this balance job. Use the analyzer keypad to enter the IPS level. The analyzer will continue to offer balance solutions until this level is reached or no significant change is made for the application of weights.

When all fields are complete, press [ENTER] to accept your settings and continue.

Model 4040 VIPER Analyzer				
Sensor Information				
Eng ID:	1	Tach Chan:	1	Tach Type: Optical
Tach Pos (FLA):	6	Full Scale Vibration:	2.00	
Sensor Type		Ch	Desc	Pos Targ
991V		A		12 0.050

- After the setup is stored you may turn the analyzer off or proceed to the balance procedure. If you continue with the balance, the customer information screen below will be displayed. The information on this screen is optional and need not be filled in to continue with the job, however; this information will assist you in your record keeping efforts and greatly reduce the effort in recalling the job later from the analyzers memory or for the AvTrend database. Use the keypad to enter the Name, Aircraft Registration, and total aircraft time. If you have entered other names in the Name field previously, you may press the [F1] key and select from

a list containing those stored names. When all fields are complete, press [ENTER] to accept and continue.

Model 4040 VIPER Analyzer				
Customer Information				
Enter the following optional Customer information.				
Name:	<input type="text"/>			
A/C Registration:	<input type="text"/>			
A/C Total Time:	<input type="text" value="0.0"/>			
Press ENTER to continue				
Names				

14. If you elected to Select Balance Speeds in the Job (see step 24.10 above) the “Define Fan/Turbine Balance RPM” banner, shown below, will be displayed. Complete the screen as follows:
- In the **Num Baln Speeds:** field, use the \Rightarrow key to select the number of balance speeds for this job. You may choose up to nine speeds. Three (3) speeds are recommended for the ALF502. Press the \downarrow key to move to the next field.

Model 4040 VIPER Analyzer				
Define Fan/Turbine Balance RPM				
Num Baln Speeds:	<input type="text" value="3"/>			
Entered RPM Relative to Peak:	<input type="text" value="No"/>			
Spd	N%/RPM			
1	<input type="text" value="0.0"/>			
2	<input type="text" value="0.0"/>			
3	<input type="text" value="0.0"/>			
Enter N% or RPM				
Survey				

- In the **Entered PRM Relative to Peak:** field, use the \Rightarrow key to toggle the answer field to No. Press the \downarrow key to move to the next field.
- The **Spd** column will contain a number of rows relative to the number of balance speeds you specified for this balance job. Immediately to the right of those numbers, in the **N%RPM** column, use the keypad to enter the balance speeds. If you wish to conduct a Fan Vibration Survey at this point to determine the best balance speeds, press the [F1]

“Survey” key and follow the instructions on screen. When all fields are complete as necessary, press [ENTER] to accept and continue.

15. The Define Fan / Turbine Balance ICFs banner screen will be displayed. Complete the screen as follows:
 - 15.1 In the **All Speeds Use the Same ICF:** field, use the ⇌ key to toggle the answer field to Yes or No as appropriate. If you have individual coefficient influences for each speed, answer No, otherwise answer Yes. Press the ↓ key to move to the next field.
 - 15.2 In the **1** row, and in the **g/IPS** (grams per IPS) column, enter the influence, if known, in grams per IPS. If you do not know the ICF, leave the field at “0.0” Press the ↓ key to move to the next field.
 - 15.3 In the **1** row, and in the **Deg** (Degrees) column, enter the phase correction angle if known. If you do not know the phase angle correction, leave the field at “0”. Press [ENTER] to accept your settings and continue.

Model 4040 VIPER Analyzer				
Define Fan/Turbine Balance ICFs				
Plane ID: 1				
All Speeds Use the Same ICF: (Yes)				
Spd Sensor 1				
	g/IPS	Deg		
1	30.70	325		

- 16 The Fan / Turb Balance Equipment Setup screen will be displayed. Follow the on screen instructions for installing and attaching sensors and cables. Notice that there is a message near the center of the screen reading “Tach power is off”. This indicates the tachometer circuit is currently not powered for alignment of the Lasetach. If you are ready to align the Lasetach, press the [F1] “Tach On” key to power the laser and proceed to the LASER ALIGNMENT procedure on page 19 of this document. When the laser alignment is complete, return to this point and continue.
 - 16.1 If the laser alignment is complete, press [ENTER] to continue. The power indication for the tach may be left in either the On or Off position when exiting this screen without consequence.

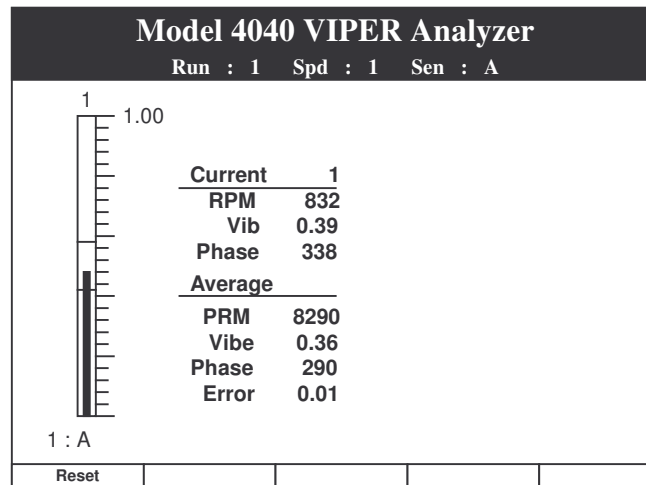
Model 4040 VIPER Analyzer				
Fan/Turb Balance Equipment Setup				
Install the speed sensor and connect to tach channel 1				
Install vibration sensor and connect to vib. channel A				
Tach power is Off				
Tach On				

17. The Start Aircraft banner screen will be displayed. The Run number is indicated at the top left of the screen followed by the information message "Remove all trim weights." Insure all previously installed trim balance weights have been removed. Start the engine(s) and watch for the Current RPM indication on the analyzer screen. When an indication of RPM is noted, allow the engine to warm up to normal operating temperature then accelerate the engine until the Current RPM and the Desired PRM on screen match as closely as possible. The Difference indication will show how many RPM difference there is between the Current and the Desired RPM. When the speeds are matched, allow the engine to stabilize for a short time and make any minor adjustments necessary, and then press [ENTER] to continue.

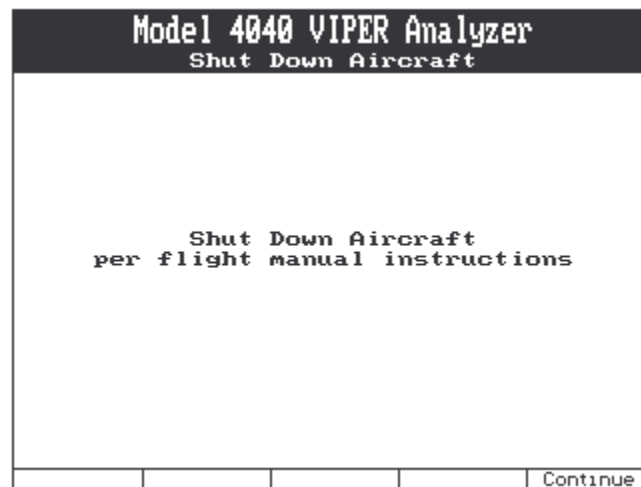
Model 4040 VIPER Analyzer				
Start Aircraft				
Run 1				
Remove all trim weights.				
Start engine(s) per flight manual				
Current RPM: 400				
Desired RPM: 8500				
Difference : -8100				
When speed is stable at desired speed, press ENTER to continue.				

C. Data Acquisition

- The Run 1, Spd 1, Sen 1 banner screen shown below will display the information for the first run. Indications of the Current and Average RPM, Vibration amplitude, and phase angle are displayed to the right of the converging scale. See the Viper 4040 User manual, chapter 20, Reading Spectrum and Scales for a detailed description of how to read the converging scale. After indications are stable, press [ENTER] to accept the collected data and continue. This screen will repeat for each of the speeds specified for balance. When all speeds are collected, the screen will automatically proceed to the shutdown message below in step 2.



- The Shutdown Aircraft message will be displayed. Press the [F5] "Continue" key to acknowledge and proceed with a normal engine shutdown procedure.



3. The Review Prior Run(s) Data will be displayed for your review of the data collected up to this point. You may view data from all runs by scrolling through the available run data using the \leftarrow and \rightarrow keys. Optionally you may use the [F1] and [F2] keys to Retake One or Retake All data as required. When you are satisfied with the review, press [ENTER] to continue.

Note

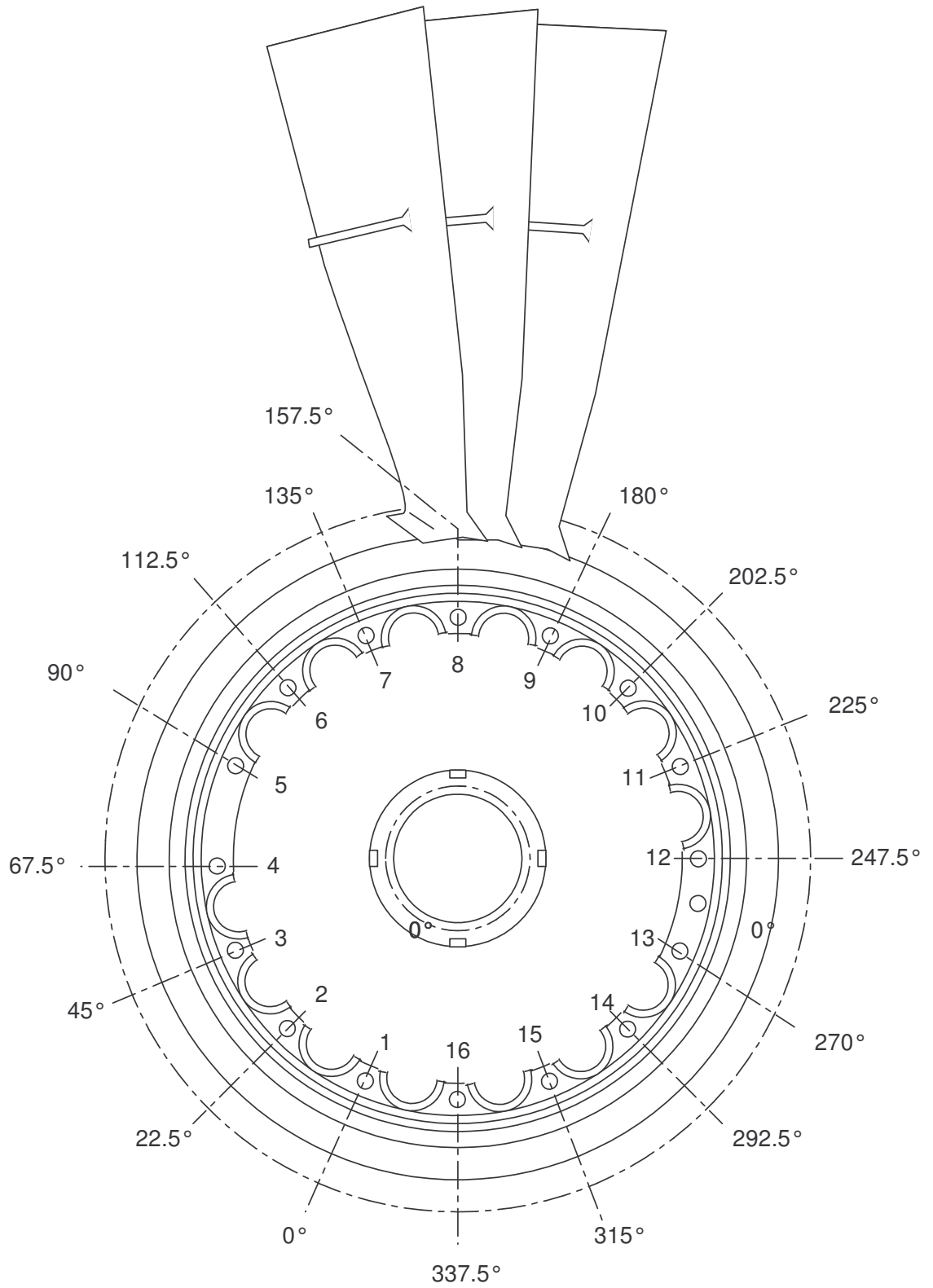
Data shown in these screens are for illustration only and do not reflect actual data corresponding to the ALF502 engine.

Model 4040 VIPER Analyzer				
Review Prior Run(s) Data				
Run 1	Sensor 1			
Spd	Rpm	Vib	Deg	
1	13746	0.36	290	
2	13572	0.29	293	
3	13224	0.30	295	
Use <> to select run				
RetakeOne	RetakeAll			

4. The Fan / Turb Suggested / Installed Wts screen will be displayed. Notice the first line of text in the screen shows the Run number and the message "Remove Old Wts, Inst. New Wts." Remove all previously installed trim weights from any previous run and install the weights in the "Suggested" column in the hole numbers indicated to their immediate left. The right side of the screen reflects what you have actually installed. Be sure the information in the Hole/Bld and Installed column is correct before exiting this screen. If you install the exact suggested weight, you need only press the [ENTER] key to exit this screen with that information. If you installed different weights or installed weights in different holes than those suggested, use the arrow keys to navigate the chart and indicate your exact installation. This is very important in that the analyzer will use this information to calculate an influence for subsequent runs. Refer to the drawing on page 17 for weight placement. Notice the function keys at the bottom of the screen are labeled for the options of "Inst=Sugg" (install the suggested weights in the suggested holes), "Inst=None" (Install None or no weights), "Sel Pla/W" (select a different Plane or weight set), "Graph" (to show a graphical display of the weight installation) and "Quit Job" (pressed ONLY when you are satisfied with the current balance results). When all fields are complete, press [ENTER] to accept and continue.

Model 4040 VIPER Analyzer			
Fan/Turb Suggested/Installed Wts			
Run 1 Remove Old Wts, Inst. New Wts			
Name: Plane 1, 2-043-3D			
Hole/Bld	Suggested	Hole/Bld	Installed
1	-08	1	-08
16	-02	16	-02
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
1	-01	1	-01
Total: Sugg =		8.500 @ 0	
Total: Inst =		8.524 @ 1	
Inst=Sugg	Inst=None	Graph	Quit Job

- The Start Aircraft banner screen will be displayed for the next sequential run as indicated in the upper left portion of the screen. From this point, the sequence of events from paragraph will repeat until the fan vibration is reduced to an acceptable level. Normally this goal will be attained in one to three runs.



LASER ALIGNMENT

1. Rotate the fan until the reflective tape on the spinner is positioned at the 6:00 position. Clock position is determined from a position forward of the engine, looking aft into the intake.
2. Ensure the Lasetach is securely mounted and connected as described in Equipment Setup. Also check to make sure the Lasetach is securely mounted to the Swivel Head of the Lasetach Mount. If it is loose, tighten by turning the Lasetach clockwise on the mounting stud while holding the Swivel head with the other hand.
3. Remove the plastic aperture cap from the Lasetach.
4. Turn the Laser **ON/OFF** switch on top of the Lasetach to the **ON** position.
5. The **BEAM ON** indicator (red) light adjacent to the Laser **ON/OFF** switch should now be illuminated.
6. Place the open palm of your hand in front of the aperture. The laser beam should be visible on your palm.

WARNING

Do not look into the aperture of the Lasetach. Avoid direct eye exposure. Eye damage may occur due to direct exposure to laser radiation.

7. Loosen the Locking Handle of the Lasetach mount (see figure below) so that the Lasetach swivels with a slight friction. Using the “gunsight” method, sight along the side of the Lasetach using one hand while holding the Locking Handle with the other. If you have trouble acquiring the laser beam visually, you may use a free hand to sight on. No injury will occur as a result of the laser being projected on your skin. You may also choose to have someone hold a sheet of white bond paper near the target for easier acquisition. When the laser beam strikes the tape, it will be very visible. When the laser is on target, center the beam on the length of the tape and immediately tighten the Locking handle by turning it clockwise. Release both hands and recheck the alignment.
8. The laser beam should now be striking approximately in the center of the two-inch span of the tape. If minor adjustments are necessary, loosen the Locking Handle only **SLIGHTLY**. Make adjustments as necessary and re-tighten.
9. When satisfied with the laser position, rotate the fan several times. When the tape passes through the laser beam, the **GATE** (green) light on the Lasetach should turn on as the tape enters the beam and off as it exits. If this test is successful, return to the cockpit and continue with step 31.1 of this procedure.

