



# Application Note

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## Williams International FJ44-2C

### Fan Trim Balance

**Part Number: 11-200-0279**

**AppNote Number: E-WI-FJ44-2C-4040-FB (Rev 0, 10 Mar 10)**

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# Application No

Application Note Number	E-WI-FJ44-2C-4040-FB
Revision	1
Function	Fan Trim Balance
Airframe	All
Engine	Williams Int FJ44-2C
E-Setup Number	e-wifj44-4040-fb
ACES Systems Analyzer	Viper 4040
Firmware Version	2.04 or greater
Procedure	N/A

## Introduction

This Application Note covers the required equipment, equipment installation, analyzer setup, data acquisition and solution process for using the ACES Systems Model 4040 to perform a Fan Trim Balance on the *Williams International FJ44-2C with spinner PN 57040 installed*. General instructions for the use of the Model 4040 can be found in the Model 4040 User Manual. All procedures for Fan Trim Balance and all adjustments should be made in accordance with the Aircraft Maintenance Manual.

## A. Required Equipment

The following ACES Systems equipment is required:

Item	Quantity	Description	Part Number
1.	1EA	ANALYZER, 4040 VIPER	10-100-4040
2.	1EA	SENSOR, VIBE, VELO 991V	69-100-0064
3.	1EA	CABLE,INTERF,991V-GEN VIB CBL,1725/1730	10-320-0142
4.	1EA	CABLE, TACH, GENERIC 50 Ft.	10-320-0126
5.	1EA	CABLE, VIBE, 6 PIN GENERIC, 50 Ft.	10-320-0127
6.	1EA	TACHOMETER,OPTICAL,LASERTACH II, 299 (NEW)	10-100-1300
7.	1EA	MOUNT, SENSOR, FJ44 VIBRATION (Williams P/N TL37253)	22-430-0063
8.	1EA	CABLE, VIBE, 6 PIN GENERIC, 50 FT.	10-320-0127
9.	1EA	MOUNT, LASETACH SWIVEL	10-100-0369



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10.	Various	WEIGHTS, SCREW (used as trim balance weights)	Williams International PN  AN565AC524H-4/ - 5/ -6/ and -10.
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\*This listing shows the latest design parts. It is acceptable to perform this task using previous designs with the appropriate accessories. For compatibility issues, contact ACES Systems.

### Optional Equipment None

### Miscellaneous Equipment

**Tape or tie wraps** to secure cables to airframe. Set screws for use as balance weights per FJ44-1A maintenance manual.

**MAT-096 adhesive** (used in the installation of the setscrew weights).

**MAT-033 Marker** (used to index the spinner, spinner pilot plat and fan rotor.)

## B. Equipment Installation

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1. Equipment is called out in these steps by item numbers which correspond to the item numbers listed in the table in the previous section, A. Required Equipment.
2. Use the MAT-033 marker to make a “match-mark” or index mark across the junction of the spinner, spinner pilot plate and the fan rotor disk. Make the mark in line with the centerline of any spinner attaching bolt. When the spinner and spinner pilot plate are removed in the balance process, this mark will serve as the index for reinstallation.
3. Remove the spinner by removing the six spinner attaching bolts. Remove all previously installed fan trim balance screw weights from the back side of the spinner then reinstall the spinner on the engine using the reference match-mark to insure it is being reinstalled in the same position.
4. On the engine spinner, locate the “match-marked” spinner attaching bolt hole . Clean the area two inches wide along a line between the spinner tip and center of this bolt hole with MEK or other solvent that will leave the surface clean and free of oil and residue, and then dry thoroughly with a clean cloth.
5. Cut a two to three inch length of reflective tape ( included with the lasetach II, item 6.).
6. Remove the backing from the reflective tape and attach it to the spinner on the cleaned area of and along a line beginning at the forward edge of the spinner attaching bolt hole and extending toward the spinner tip. The tape should be positioned so that the leading edge is parallel to and aligned with a line between the bolt hole and the spinner tip as shown in Figure 1. below. Make sure there are no bubbles in the tape and that all edges are firmly pressed down and attached to avoid lifting and blowing off during engine runs. The bolt hole in line with the leading edge of the tape is now designated as the “0” or index hole for the purpose of locating hole numbers for adding trim balance weights. (See figures 1., 2 and 3 below).

### Equipment Installation Diagram

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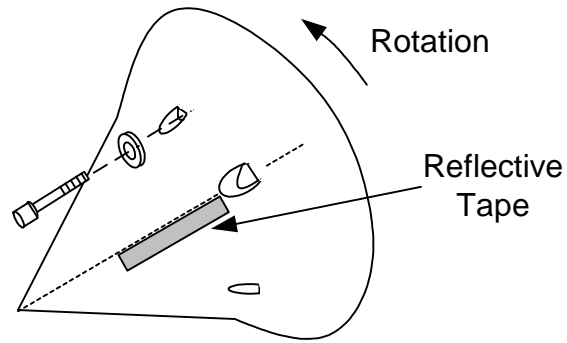


Figure 1. Reflective tape installation on spinner.

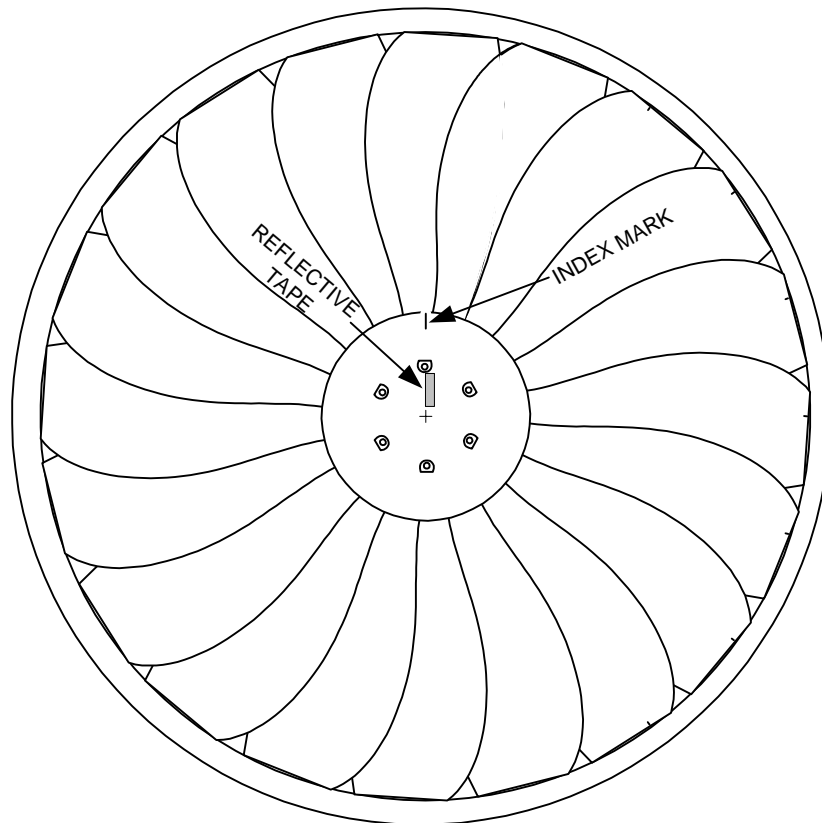


Figure 2. Reflective tape installed.



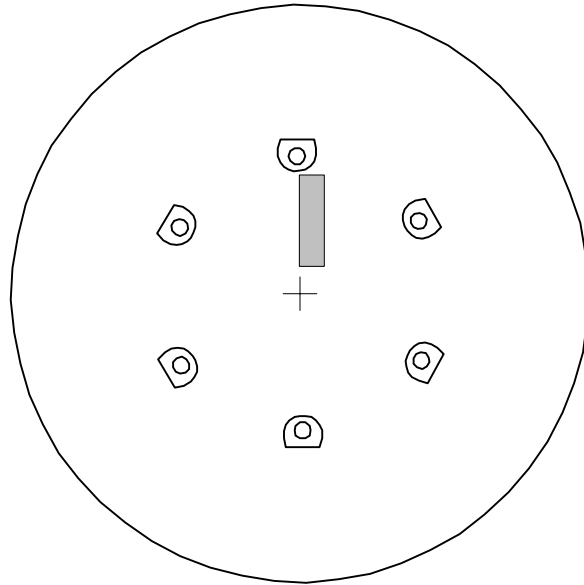


Figure3. Installation of reflective tape.



Hole "0" or Index hole

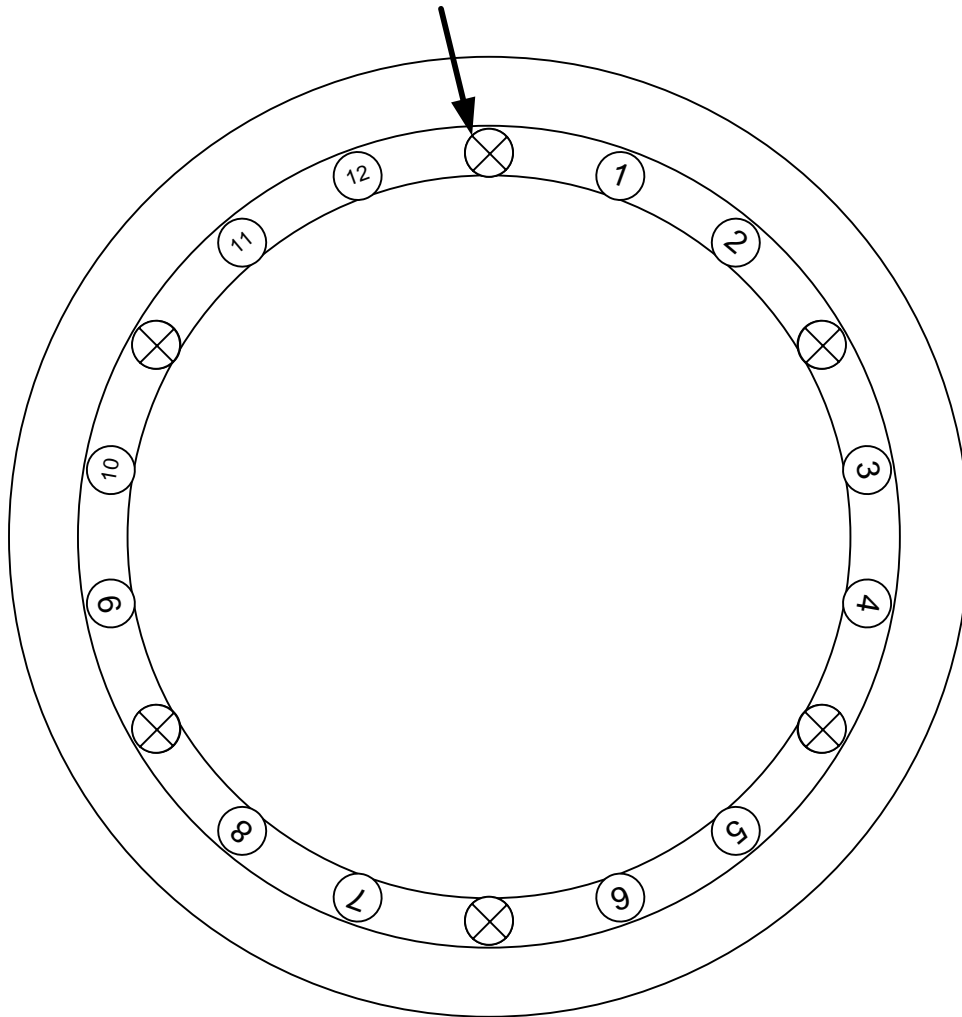


Figure 4. Screw weight holes and spinner mounting holes (marked with "X") as viewed from the aft side of the spinner.



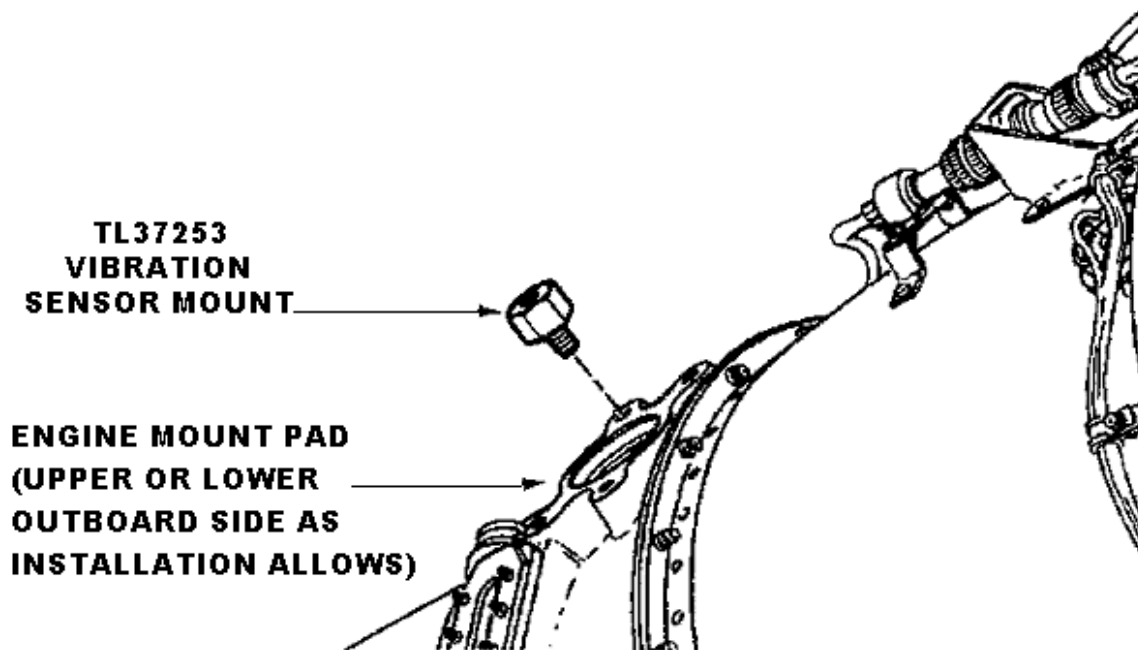


Figure 5. Installation of vibration sensor mount.

6. Install the FJ44 Vibration Sensor Mount, item 7, on the engine at either the upper or lower outboard engine mount, depending on the engine installation.
7. Install the 991V vibration sensor, item 2, on the FJ44 Vibration Sensor Mount, item 7.
8. Attach the four pin connector end of the 991V-to-GEN VIB interface cable, item 3, to the 991V sensor, item 2.
9. Attach the six pin end of the 991V-to-GEN VIB interface cable, item 3, to the six pin socket end of the 50 foot Generic Vibe cable, item 8.
10. Connect the opposite end of the 50 foot Generic Vibe cable, item 8, to the CHAN A input on the 4040 Analyzer, item 1. Secure the cable along its route to the analyzer with aluminum tape every 24 to 36 inches to prevent engine injection or paint damage from movement.
11. Assemble the Lasetach II, item 6, and Lasetach swivel mount, item 9, as necessary.
12. Mount the assembly on the top of the aircraft wing or side of the fuselage not farther than 30 feet from the engine fan. The selected location must be one which facilitates a direct line of sight to the surface of the spinner. Mount the base of the LaseTach swivel mount to the aircraft surface with duct tape or aluminum tape across all four edges.
13. Connect the 50 Foot Generic Tach Cable, item 4, to the Lasetach connector.
14. Connect the opposite end of the Generic Tach Cable, item 4, to the TACH 1 input of the Viper 4040 Analyzer, item 1. Secure the cable along its route to the analyzer with aluminum tape every 24 to 36 inches to prevent engine injection or abrasive paint damage from movement of the cable during engine run.

## LASER ALIGNMENT

- a. Ensure the Lasetach is securely mounted and connected as described in Equipment Setup.
- b. Turn the analyzer **ON** by pressing the **ON/OFF** key.
- c. At the MAIN MENU select “TEST TACH POWER” and press ENTER.
- d. At the TACH POWER screen, press the [F1] “Tach 1” key. The screen will indicate “Tach power : TACH 1”
- e. Turn the Laser **ON/OFF** switch on top of the LaseTach to the **ON** position.
- f. The **BEAM ON** indicator (red) light adjacent to the Laser **ON/OFF** switch should now be illuminated.
- g. If you place a white paper or your hand in front of the Lasetach aperture, the laser beam should now be visible. Using the gun sight method across the top of the LaseTach case, roughly align the laser beam with the spinner body.
- h. Rotate the fan until the reflective tape passes through the laser beam. The beam will reflect and be very easy to see. Adjust the LaseTach so that the beam strikes the tape at mid span.

### WARNING

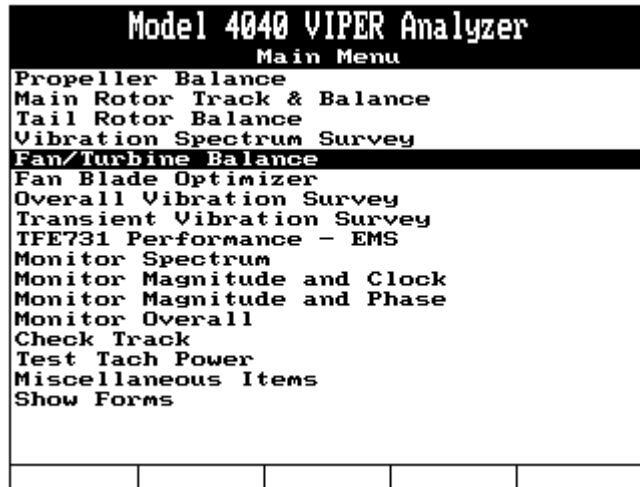
**Do not look into the aperture of the Lasetach. Avoid direct eye exposure. Eye damage may occur due to direct exposure to laser radiation.**

- i. The laser beam should now be striking approximately in the center of the span of the tape. If minor adjustments are necessary, remove and replace the tape to accommodate the change.
- j. 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 case, near the power switch, should turn on as the tape enters the beam and off as it exits.
- k. Insure the swivel mount adjustments are securely locked down and proceed to section C. of this procedure as necessary.

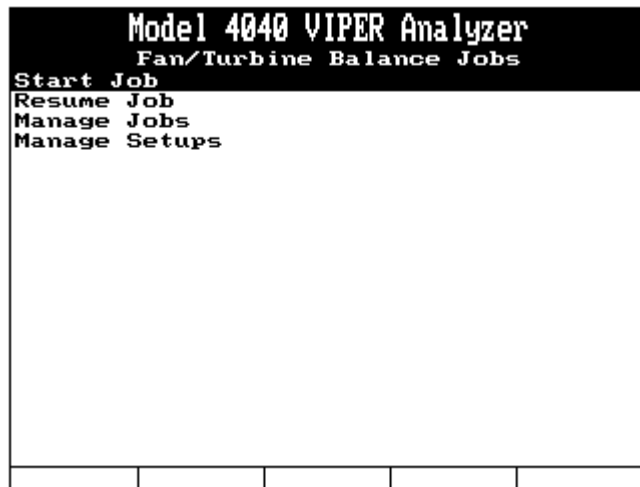
## C. Analyzer Set Up

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1. Turn the analyzer ON. From the Main Menu, select Fan/Turbine Balance and press ENTER.



2. From the Fan/Turbine Balance Jobs screen, select Start Job and press ENTER.



3. At this point you may encounter the message “The last job performed is incomplete. Do you want to RESUME work on it?” If so, press the [F5] “No” key.

Model 4040 VIPER Analyzer				
Incomplete Job				
<p>The last job performed is incomplete.</p> <p>Do you want to RESUME work on it?</p>				
Yes				No

4. If a Setup List is displayed, press the [F1] “New” key. If no setups were stored in the analyzer, the “Fan/Turbine Balance Setup” screen will be displayed. Complete the screen using the example below for the required information. When all fields are complete, press ENTER to accept your entries and continue.
5. The “Define Class Wts” screen will be displayed. Complete the screen per the example below. Press ENTER to accept your selections and continue.

Model 4040 VIPER Analyzer	
Fan/Turbine Balance Setup	
Name:	FJ44-2C
Eng Rotation:	CCM Viewed From: FLA
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:	4200
Actual RPM @ 100%:	17242
Vib Unit:	IPS
Modifier:	Peak

```

Model 4040 VIPER Analyzer
Fan/Turbine Balance Speeds
Num Balance Speeds: 1

Enter Speeds As N% or Defined RPM
Spd All Sensors
1 100

Use Actual Speeds for Later Runs
    
```

- The “Define Class Wts” screen will be displayed. Complete the screen per the example below. When all fields are complete, press ENTER to accept your settings and selections and continue.

```

Model 4040 VIPER Analyzer
Define Class Wts
Set ID: AN565AC524H MaxErr: 0.10
Num Wts: 5 Placement: Spread
Add/Remove: Remove then Add
Name Wt Span Name Wt Span
NONE 0.000 0
-4 1.290 1
-5 1.610 1
-6 2.090 1
-10 3.970 1
    
```

- The “Balance Plane Information” screen will be displayed. Complete the screen per the example below. When all fields are complete, press ENTER to accept your settings and selections and continue.

```

Model 4040 VIPER Analyzer
Balance Plane Information

Plane: 1
Posn Type: Hole
Num Holes: 12
Num Usable: 2
RivetWt: 0.000

Spacing: Uneven
Hole Num Dir: CW from ALF
MaxWt/Hole: 4.000
MaxWt/Plane: 8.00
Wt Set: AN565AC524H
Trial Wt: 1.6

```

8. Because the holes for adding balance weights are unevenly spaced, the Balance Plane Information screen below will be displayed where the angular location of each hole must be defined. The hole numbers are counted from the index or “0” hole in a clockwise ascending order. The hole angles are measured from the index or “0” hole in an ascending order opposite the direction of engine rotation. Use the example below to define the twelve weight holes and their angles. When complete, press ENTER to accept your settings and continue.

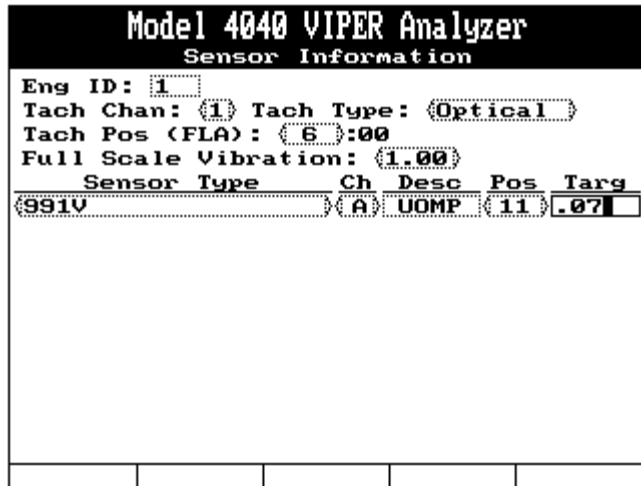
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Model 4040 VIPER Analyzer
Balance Plane Information

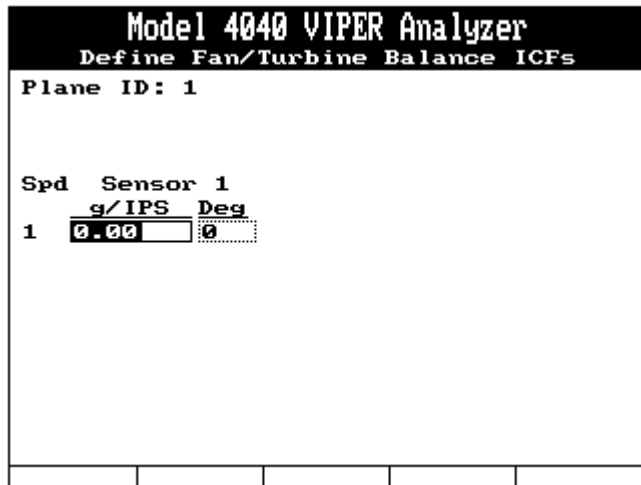
Ang No.  Ang No.
340 1    40 11
320 2    20 12
280 3
260 4
220 5
200 6
160 7
140 8
100 9
80 10

```

9. The “Sensor Information” screen will be displayed. Complete the screen per the example below. This example shows the “Eng ID” as “1” (number one or the left engine). If you are defining this setup for “2” or the right engine, select “1” in the “Pos” field. This setting indicates that the 991V vibration sensor will be located on the upper outboard engine mount (11 o’clock for the #1 engine and 1 o’clock for the #2 engine as viewed from forward looking aft.) When all fields are complete, press ENTER to accept your selections and continue.



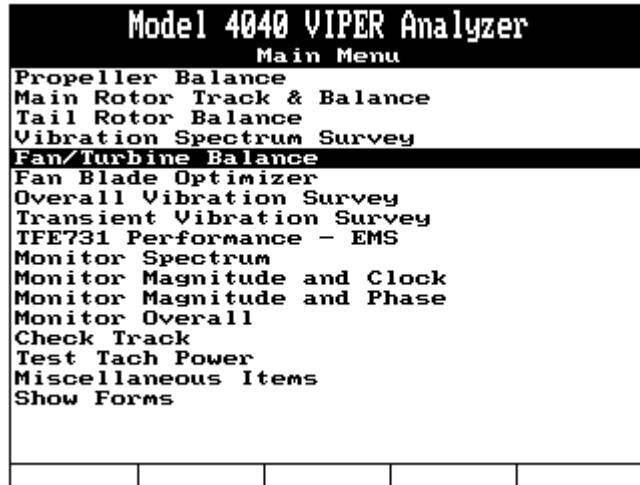
- The Define Fan/Turbine Balance ICFs screen will be displayed. If you have an established ICF for the engine you may enter it in the “g/IPS” (grams per IPS) and Deg (degrees) fields. If you do not have an established ICF for this engine, leave these fields set at “0”. The analyzer will calculate the ICF on the first job in which this setup is used and will store the ICF with this setup when the user presses the “END JOB” function key following a successful balance. Press ENTER to continue. The analyzer will continue into the job where you may continue with the balance job or you may turn the analyzer off until ready to start a job at a later time. If you wish to continue with the balance job now, go to section **D. Data Acquisition**, step 4. below.



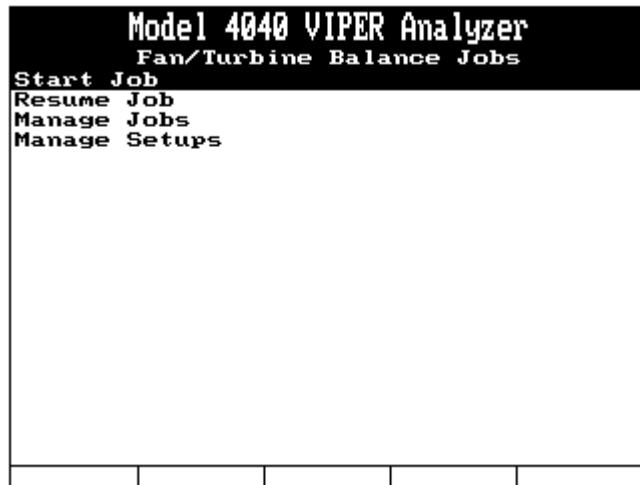
## D. Data Acquisition

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1. Turn the analyzer ON by pressing the ON/OFF key. At the Main Menu, select “Fan/Turbine Balance” and press ENTER.



2. At the “Fan/Turbine Balance Jobs” screen, select Start Job and press ENTER.



- From the Setup List screen, select “FJ44-2C” and press ENTER.

Select Setup List	
1)	CF34-3B
2)	FJ44-1AP
3)	FJ44-2C
4)	PW307A
5)	PW617F O/W FAN

New			Copy	
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- In the Job Identification screen, use the analyzer keypad to enter Job information. You may, as an option, press the [F1] “Names” key and select the Name from previously entered information. When all necessary information is completed, press ENTER to accept and continue.

Model 4040 VIPER Analyzer Job Identification				
Name:	STELLAR FLIGHT			
A/C Registration:	N1235F			
A/C Total Time:	5243			
Press ENTER to continue				
Names				

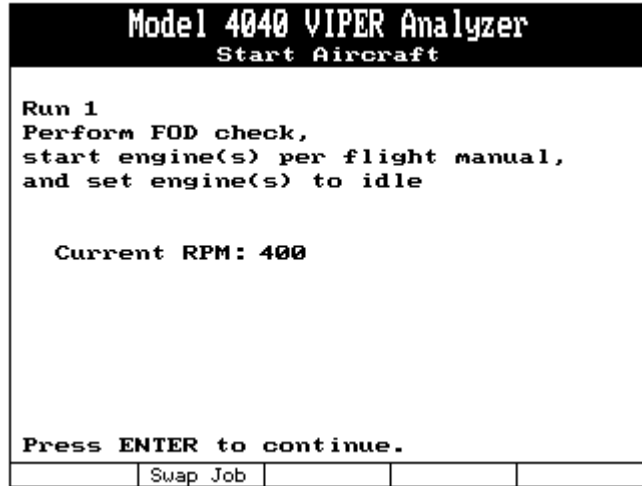
5. In the “Engine Information” screen, use the analyzer keypad to enter engine information. The “Position” field refers to the engines mounted position on the aircraft and is selected by pressing the [RIGHT ARROW] key until the desired position is displayed. All other information is entered using the analyzer keypad. As an option, you may press the [F1] “Serial Nos” key and select the serial number (S/N) from a list of previously entered numbers. Will all information is completed as necessary, press ENTER to accept your input and continue.

Model 4040 VIPER Analyzer				
Engine Information				
Position:				
1				
Engine:				
S/N	[ ]			
Type	[ ]			
TSO	0	[ ]		
TSN	0	[ ]		
Cyc	0	[ ]		
Serial Nos	[ ]	[ ]	[ ]	[ ]

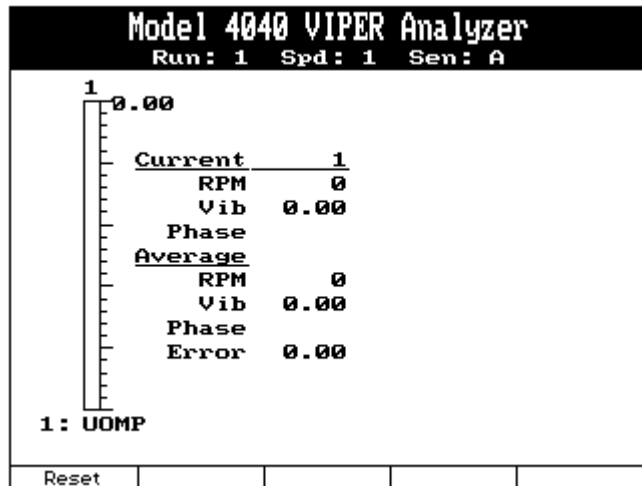
6. At the “Fan/Turbine Balance Equipment Setup” screen, take note of the information screen and comply with the information. The Tach Pwr selection in this screen is used for realignment of the Lasetach, if necessary and its position (On or Off) is of no consequence when exiting this screen. Press ENTER to continue.

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				
Remove all trim weights.				
Tach power is Off				
Tach Pwr	[ ]	[ ]	[ ]	[ ]

- At the “Start Aircraft” screen, perform a FOD check, and then start engines normally using appropriate documented procedures. Set the engine to idle and allow it to warm up to normal operation temperatures before you continue with the balance job. Check to insure you have an indicated “Current RPM.” Press ENTER to continue.



- After pressing ENTER from the screen above, the analyzer will add a target speed to this screen and a “difference” field. Advance the engine until the two speeds match and the difference is as close as possible to zero. Allow the engine to stabilize for a few moments and adjust as necessary, then press ENTER. The RUN 1 SPEED 1 screen, shown below will be displayed. Allow the analyzer to collect data until the AVERAGE RPM, VIB, PHASE and ERROR readings are stable. When they are reasonably stable, press ENTER to stop acquisition for this speed point and proceed. If you have selected multiple speeds, the process will repeat until data for all speed points has been collected. After collecting data for the last speed point, the analyzer will display the Review screen.



9. In the Review Prior Run(s) Data screen, shown below, review the speeds and the vibration amplitude (Vib). If any of the data appears abnormal or not consistent with the values noted during the actual runs, you make retake the data by selecting [F1] "Retake One". When you are satisfied with the data displayed on this screen, press ENTER to accept and continue.

Model 4040 VIPER Analyzer				
Review Prior Run(s) Data				
Run 1				
Spd		Sensor 1		
	Rpm	Vib	Deg	
1	17242	0.24	29	
<> Run				
RetakeOne				

10. The Shut Down Engines screen will be displayed. At this point you may either shutdown the engine and proceed with the solutions calculations by pressing the [F5] "Continue" key or, if you are balancing multiple engines in this Job, press [F2] to swap jobs to the next engine.

Model 4040 VIPER Analyzer				
Shut Down Engines				
Shut down engine(s) per manual instructions				
	Swap Job			Continue

11. If you pressed ENTER, the analyzer will do one of two things. 1. If a coefficient of influence was entered and/or stored in the setup file, you will be given a solution to facilitate a balance. If no coefficient was stored in the setup, the analyzer will direct you to install the test weight specified in the setup so that an influence can be calculated on the next run.

In the solution screen the HOLE column indicates the hole in which you should apply the specified weight and the SUGGESTED column indicates the specific weight you should add at that hole. If you install the suggested weight, make sure the HOLE and INSTALLED columns at the right side of the screen match those in the HOLE and SUGGESTED columns at the left side of the screen. Refer to the users manual in the FAN/TRUB BALANCE section for details on this screen.

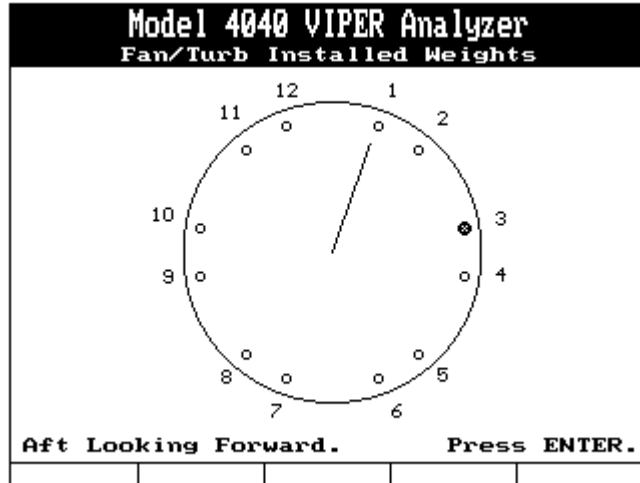
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Model 4040 VIPER Analyzer
Fan/Turb Suggested/Installed Wts
Run 1      Remove Old Wts, Inst. New Wts
Name: Plane 1, AN565AC524H
   Hole  Suggest  Current
   [3]   -4       [-4]
   [?]   NONE     [NONE]

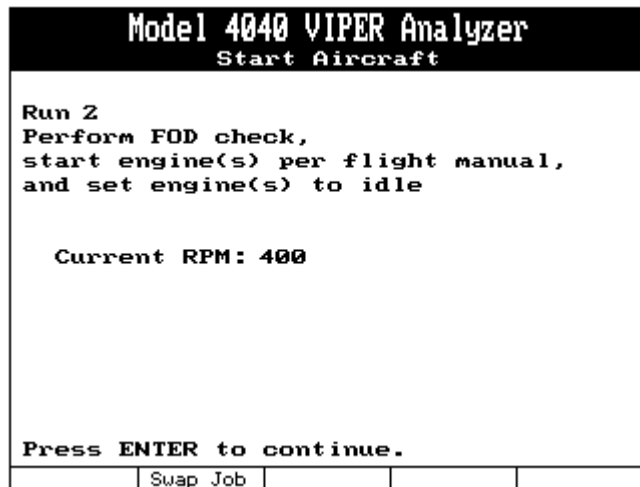
Soln =     1.600 @ 340
Inst =     1.300 @ 280
Inst=Sugg  Inst=None  Edit Weight  Graph  Quit Job

```

Pressing the [F3] Graph key in the screen above will produce a graphic display (see the next screen below) of the installed weights. Note that the index or “0” degree hole (not visible on the graph) is a spinner mounting bolt hole and is located at 12:00. The #1 hole is the first hole clockwise (as viewed from the back of the spinner). The remaining 11 holes are in ascending order clockwise from that position. DO NOT COUNT SPINNER MOUNTING BOLT HOLES as they are never used to install trim balance set screw weights. Press ENTER to exit the graph screen and ENTER again from the solution screen above to continue.



12. The Start Aircraft screen will be displayed again. From this point, the process will repeat from step 12 through step.



- 13. Subsequent screens will again display the REVIEW, SHUTDOWN and SOLUTIONS screens as before.

Model 4040 VIPER Analyzer				
Review Prior Run(s) Data				
Run 2				
Spd	Sensor 1			
	Rpm	Vib	Deg	
1	17242	0.24	357	
<> Run				
RetakeOne				

Model 4040 VIPER Analyzer				
Shut Down Engines				
Shut down engine(s) per manual instructions				
	Swap Job			Continue



19. When the vibration level has been reduced to or below an acceptable level, press the [F5] “Quit Job” key. This action will terminate the balance routine and store the ICF calculated to obtain the balance in the setup file.

Model 4040 VIPER Analyzer				
Fan/Turb Suggested/Installed Wts				
Run 2	Remove Old Wts, Inst. New Wts			
Name: Plane 1, AN565AC524H				
Hole	Suggest	Current		
2	-5	-5		
6	-6	-6		
Soln = 1.912 @ 247				
Inst = 1.833 @ 249				
Inst=Sugg	Inst=None	Edit Weight	Graph	Quit Job

20. The Warning message below will be displayed. If you are sure the job is satisfactory, press the [F1] key to exit.

Model 4040 VIPER Analyzer				
Warning! You are about to terminate this balance job!				
Are you sure you want to quit?				
Yes				No

20. If you would like to update the stored influence in the analyzer with the last calculated influence for this job, press the [F1] “Yes” key from the screen below.

<b>Model 4040 VIPER Analyzer</b>				
<b>Update Setup ICFs?</b>				
<b>Do you want to update the setup's influence coefficients based on the result of this job?</b>				
Yes				No

