



# Application Note

## **Engine Type: GENERAL ELECTRIC CF6-50**

### **Procedure: Fan Trim Balance**

Part Number: 11-200-0229  
AppNote Number: E-GE-CF6-50-4040-FB

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# Application Note

<b>Application Note Number</b>	<b>E-GE-CF6-50-4040-FB</b>
<b>Version</b>	<b>0</b>
<b>Function</b>	<b>Fan Trim Balance</b>
<b>Airframe</b>	<b>ALL</b>
<b>Engine</b>	<b>General Electric CF6-50</b>
<b>E-Setup Number</b>	<b>a-ba-gxp-4040-fb</b>
<b>ACES Systems Analyzer</b>	<b>Viper 4040</b>
<b>Firmware Version</b>	<b>2.04 or greater</b>
<b>Procedure</b>	<b>N/A</b>

## Introduction

This Application Note is number 1 of 1 Application Notes required to perform a fan trim balance on airframes with General Electric CF6-50 series engines. This Application Note describes the steps necessary for set up and operation of the Viper 4040 analyzer and associated equipment.

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

<b>Item</b>	<b>Quantity</b>	<b>Description</b>	<b>Part Number</b>
1.	1EA	ANALYZER, VIPER 4040	10-100-4040
2.	1EA	TACHOMETER, LASETACH MODEL 299	10-100-1300
3.	2EA	CABLE, GENERIC VIBRATION, 50 Ft	10-320-0127
4.	2EA	CABLE, GENERIC TACHOMETER, 50 Ft	10-320-0126
5.	1EA	MOUNT, SWIVEL, LASETACH	10-100-0369
6.	1EA	Vibration sensor and interface cable per customer specs.	

**Optional Equipment:** None.

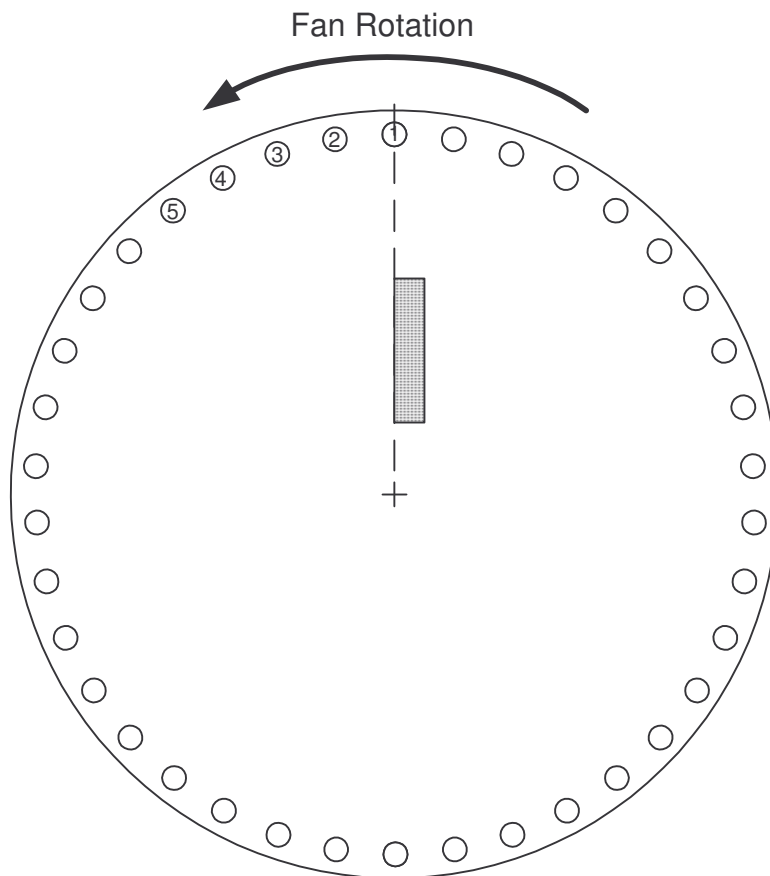
## A. Equipment Set Up

1. Install the vibration sensor and interface (including high temp cable and charge converter if required) on the engine.
2. Connect the Generic 50 foot Vibration cable, item 3, to the vibration sensor interface being used with the sensor for the balance.

### NOTE

If both engines are being balanced, identify the #1 (LH) engine with a wrap of tape around both ends of the generic 50 foot vibration cables, item 3, and the generic tachometer cables, item 4, to distinguish them from the #2 (RH) engine during cable connections.

3. Connect the six pin vibration cable for engine #1 to the Channel A input of the analyzer, item 1. Route the cable back to the analyzer in the cockpit, securing it every thirty six inches with aluminum speed tape to prevent movement or possible injection into the engine.



The leading edge of the reflective tape is placed along a line between the #1 hole and the center of the spinner cone as shown in the drawing above.

Figure 1. Installation of reflective tape on the spinner.

4. Locate #1 hole on the spinner. The hole may have a green patch to its right side as viewed from forward of the engine looking aft. If you are not sure where the #1 hole is located, pick any hole and designate it as #1. Draw an imaginary line directly from the center of the nose of the spinner then aft and through the center of the #1 hole. With the fan rotated with #1 hole at the 12:00 position, clean the area immediately to the right (trailing edge) side of the imaginary line (see figure 1.). Cut a 3" to 5" strip of 7310 reflective tape (supplied with the LaseTach), then remove the protective backing and apply the tape in the cleaned area with the leading edge of the tape parallel to the imaginary line. The tape should be applied so that it begins approximately 6" from the center point of the spinner then trails aft from that point toward the fan. Make sure there are no bubbles under the tape and that all edges are pressed down and adhered firmly to the spinner.
5. Assemble the LaseTach (item 2) and LaseTach swivel mount (item 5) as necessary. Mount the LaseTach swivel mount to the side of the fuselage, not more than 30 feet from the spinner, by taping the base of the mount on all four sides to the fuselage, using aluminum speed tape. Connect the generic 50 foot tachometer cable to the LaseTach and route the cable back to the analyzer, securing it along the fuselage every 36 inches with speed tape. The laser alignment will be completed later in this application note.

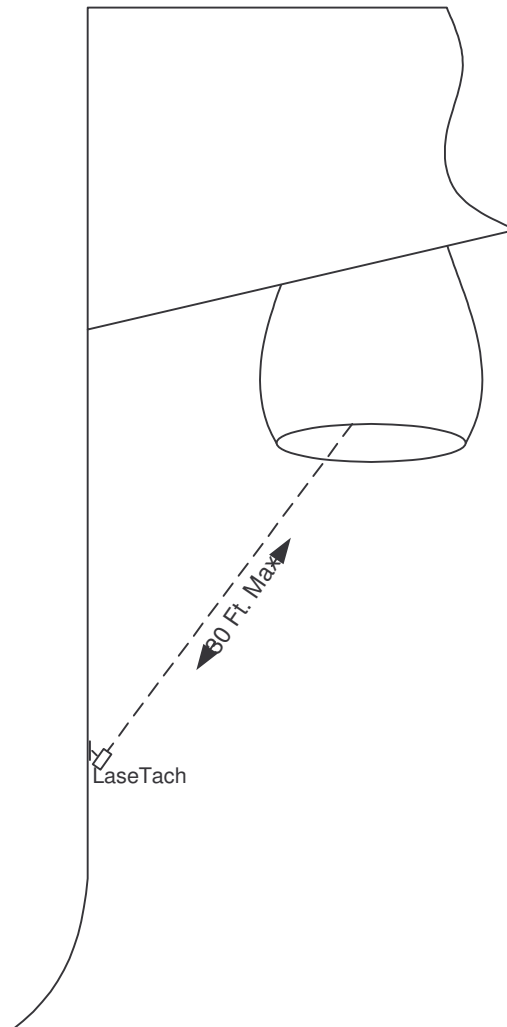


Figure 2. LaseTach Installation



Model 4040 VIPER Analyzer				
Sensor Setup				
Name :	CF6-50 ONBOARD			
Amplitude Units :	IPS			
Probe Sensitivity :	500.000			
Reverse Polarity :	No			
Input Type :	Single Ended			

- 10.3 In the **Reverse Polarity:** field, use the ⇨ key, if necessary, to select “No” indicating the sensor polarity is not reversed. If you are not sure about this setting, always use NO. Press the ↓ key to move to the next field.
- 10.4 In the **Input Type:** field, use the ⇨ key, as necessary, to select “Single Ended” or “Differential” indicating the type input from the sensor.
- 10.5 When all fields are complete, press [ENTER] to accept and save. The screen will return to the “Manage Sensors” screen. From that screen, press [BACKUP] repeatedly until the Main Menu is again displayed.
11. From the Main Menu, select “Fan / Turbine Balance”

Model 4040 VIPER Analyzer				
Main Menu				
Propeller Balance				
Main Rotor Track & Balance				
Tail Rotor Balance				
Fan/Turbine Balance				
Vibration Spectrum Surveys				
Overall Vibration Surveys				
Transient Vibration Surveys				
Monitor Spectrum				
Monitor Magnitude and Clock				
Monitor Magnitude and Phase				
Monitor Overall				
Check Track				
Transfer Data with PC				
Miscellaneous Items				
Show Forms				

- 11.1 If there are other setups already in the analyzer, the Setup List banner screen will be displayed. From that screen, press the [F1] “New” key. If no setups are in the analyzer, the “Fan / Turbine Balance Setup” screen will be displayed. Complete the Balance Setup screen as follows:



- 11.1.2 In the **Eng Rotation:** field, use the ⇨ key to select “CCW” indicating the fan rotates counter-clockwise as viewed from the front looking into the intake. Press the ⏴ key to move to the next field.
- 11.1.3 In the **Num Balan Planes:** (number of balance planes) field, use the ⇨ key to select “1”. Press the ⏴ key to move to the next field.
- 11.1.4 In the **Num Optional Planes:** (number of optional balance planes), use the ⇨ key to select “0”. Press the ⏴ key to move to the next field.
- 11.1.5 In the **Balance Wt Type:** field, use the ⇨ key to select “Class”. The class weights will be defined on another page. Press the ⏴ key to move to the next field.
- 11.1.6 In the **Num Class Wt Sets:** (number of class weight sets), use the ⇨ key to select “1”. The BR710 has two one weight set that may be used to trim balance the engine. Press the ⏴ key to move to the next field.
- 11.1.7 In the **Label Detail Wts:** field, use the ⇨ key to select “No”. Press the ⏴ key to move to the next field.
- 11.1.8 In the **Baln Weight Units:** field, use the ⇨ key to select “g” for grams. The class weights for the BR710 are measured in grams. Press the ⏴ key to move to the next field.
- 11.1.9 In the **Num Sens / Eng:** field, use the ⇨ key to select 1. Press the ⏴ key to move to the next field.
- 11.1.10 In the **Num Baln Speeds:** field, use the ⇨ key to select the total number of speeds (3) you will use for this setup. Three speeds are recommended for balancing the CF6. Press the ⏴ key to move to the next field.
- 11.1.11 In the **Slow Roll RPM:** field, use the keypad to enter “0”. Slow roll is a compensating RPM for use in engine applications where proximity probes are used and does not apply to this engine. Press the ⏴ key to move to the next field.
- 11.1.12 In the **Min Baln RPM:** field, use the keypad to enter the minimum speed at which this engine can be balanced. This speed will normally be a speed in the low flight range or just above idle. Press the ⏴ key to move to the next field.
- 11.1.13 In the **Actual RPM @ 100%:** field, use the keypad to enter the speed of the fan at 100% rpm. For the CF6-50, this is 3432. Press the ⏴ key to move to the next field.
- 11.1.14 In the **Vib Unit:** field, use the ⇨ key to select “mils”. The CF6-50 engine is balanced using displacement units of mils. Press the ⏴ key to move to the next field.
- 11.1.15 In the **Modifier:** field, use the ⇨ key to select “Pk-Pk” for Peak-to-Peak. When all fields are complete, press [ENTER] to accept and continue.
- 11.2 The Fan/Turbine Balance Speeds screen will be displayed. Select “No” to answer the question “Balance Relative to Defined Peak Speed?”. Use the analyzer keypad to enter the three balance speeds of 85%, 82.5% and 65% as shown below in the example. The line at the bottom of the screen should read “Use These Speeds for All Runs”. If it does not, press the ⏴ key to move to the field, and then press the ⇨ key to select the option. Press [ENTER] to accept your entries and continue.

**Model 4040 VIPER Analyzer**  
Fan/Turbine Balance Speeds

Num Balance Speeds: 3

Balance Relative to Defined Peak Speed?  
(No)

Enter Speeds As N% or Defined RPM

Spd All Sensors

1	85.0
2	82.5
3	65.0

**Use These Speeds for ALL Runs**

11.3 The Define Class Weights banner screen will be displayed where each of the class weights used for the CF6-50 fan trim balance will be added to the setup.

11.4 Complete each field in the screen as follows:

11.4.1 In the **Name or PN:** field, use the keypad to enter “9111M35P0XX”. Press the ↓ key to move to the next field. The MaxErr (maximum error) defaults to 0.1. If your maximum error for weight placement is less than this, enter the value using the keypad. Press the ↓ key to move to the next field.

**Model 4040 VIPER Analyzer**  
Define Class Wts

Set ID: 9111M35P0XX MaxErr: 0.10

Num Wts: 7 Placement: Spread

Name	Wt	Span	Name	Wt	Span
(The min wt must be a base wt)					
P07	0.000	1			
P01	3.100	1			
P02	6.200	1			
P03	9.200	1			
P04	12.00	1			
P05	14.70	1			
P06	17.30	1			

11.7.1 In the **Num Wts:** field, use the keypad to enter a total number of weights in this class weight set, 7. Press the ↓ key to move to the next field.

11.7.2 In the **Placement** field, press the ⇒ key to select “Spread”. Press the ↓ key to move to the next field.

11.7.3 In the **Name, Wt,** and **Span** columns, enter the information as shown in the illustration above for the 7 class weights. The name will be the alpha numeric combinations of the various weights, the weight is measured in grams for each class weights and the span is the number of holes each combination weight covers when installed, 1 in all cases. When all information is entered as shown for the first 7 weights, press [ENTER] to accept and continue.

11.8 The Balance Plane Information screen will be displayed. Complete the screen as follows:

Model 4040 VIPER Analyzer				
Balance Plane Information				
Plane:	(1)			
Posn Type:	(Hole)			
Num Holes:	38			
Num Usable:	20			
RivetWt:	0.000			
Spacing:	(Even)			
Hole Num Dir:	(CW)	from	(FLA)	
MaxWt/Hole:	17.30			
MaxWt/Plane:	328.7			
Wt Set:	9111M35P0XX			
Trial Wt:	9.20			
Angle of #1 Hole:	0			

- 11.8.1 If the Plane ID: field does not read < 1 >, press the ⇒ key to select “1”. Press the ↓ key to move to the next field. In the Posn (Position) Type, use the ⇒ key to select “Hole”. Press the ↓ key to move to the next field.
- 11.8.2 In the Num Holes: field; use the analyzer keypad to enter “38”. Press the ↓ key to move to the next field.
- 11.8.3 In the Num Usable: field; use the analyzer keypad to enter “20”. Press the ↓ key to move to the next field.
- 11.8.4 Skip the RivetWt: field and leave the selection at 0.000 as rivets are not used to fasten the balance weights. Press the ↓ key to move to the next field.
- 11.8.5 In the Spacing: field, use the ⇒ key to select “Even”. Press the ↓ key to move to the next field.
- 11.8.6 In the Hole Num Dir: field, use the ⇒ key to select CW (clockwise)
- 11.8.7 In the “from” field, use the ⇒ key to select FLA (forward looking aft). Press the ↓ key to move to the next field.
- 11.8.8 In the MaxWt/Hole: field, use the analyzer keypad to enter 17.3. Press the ↓ key to move to the next field.
- 11.8.8 In the MaxWt/Plane: field, use the analyzer keypad to enter 328.7. Press the ↓ key to move to the next field.
- 11.8.9 The Wt Set field will default to the BR710 set entered earlier. Press the ↓ key to move to the next field.
- 11.8.10 In the Trial Wt: field, use the analyzer keypad to enter 10.00. Press the ↓ key to move to the next field.
- 11.8.11 In the Angle of Hole #1 field, use the analyzer keypad to enter 0. Press [ENTER] to accept your entries and continue.
- 11.9 The Sensor Information screen will be displayed. Complete the screen as follows:
- 11.9.1 In the **Eng ID:** field; use the keypad to enter a single numeric character to identify this engine such 1 or 2. . Press the ↓ key to move to the next field.



Model 4040 VIPER Analyzer	
Define Fan/Turbine Balance ICFs	
Plane ID: 1	
All Speeds Use the Same ICF: <input type="checkbox"/> No	
Spd Sensor 1	
	<u>g/mm/se Deg</u>
1	<input type="text" value="0.00"/> <input type="text" value="0"/>
2	<input type="text" value="0.00"/> <input type="text" value="0"/>
3	<input type="text" value="0.00"/> <input type="text" value="0"/>

- 11.10.1 In the **g/mm/se** column, use the keypad to enter the influence in grams per mm/sec if you know the influence for this engine. If you do not know the influence, leave it at zero. The analyzer will require one extra run to automatically calculate an influence for the engine and update these fields automatically. Press the  $\downarrow$  key to move to the next field.
- 11.10.2 In the **Deg** field, use the keypad to enter the phase lag, if known. If you do not know the phase lag, leave this field at zero. The analyzer will calculate the phase lag automatically during the job. Repeat steps 11.10.1 and 11.10.2 for each of the three speeds then Press [ENTER] to accept your settings and proceed.
- 11.11 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	
Job Identification	
Name:	<input type="text" value="North Atlantic Oil"/>
A/C Registration:	<input type="text"/>
A/C Total Time:	<input type="text" value="0.0"/>
Press ENTER to continue	
Names	<input type="text"/>

- 11.11 The Engine Information screen will be displayed. Use the  $\Rightarrow$  key to select the engine Position: on the aircraft for the job you are about to begin. For the remainder of this screen, use the  $\downarrow$  key to move from field to field and use the analyzer keypad to enter the optional information for the Engine serial number (S/N), Type, TSO, TSN and Cycles (Cyc). When all fields are completed as required, press [ENTER] to accept your entries and continue.

Model 4040 VIPER Analyzer				
Engine Information				
Position:				
1				
Engine:				
S/N	RR1234			
Type				
TSO	0			
TSN	0			
Cyc	0			
Serial Nos				

- 11.12 The Label Detail Weight Holes screen will be displayed. Press the  $\downarrow$  key to move from field to field. Mark positions 1, 5, 9 and 13 with an “X” by pressing the  $\Rightarrow$  key when the dark cursor is covering each of these numbers. This will exclude consideration of these holes for use in adding trim weights during the balance job. Press [ENTER] to accept the settings and continue.
- 11.13 The Fan/Turb Balance Equipment Setup screen will be displayed with installation instructions as shown below. When the equipment is installed and your are ready to continue, press [ENTER].

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				

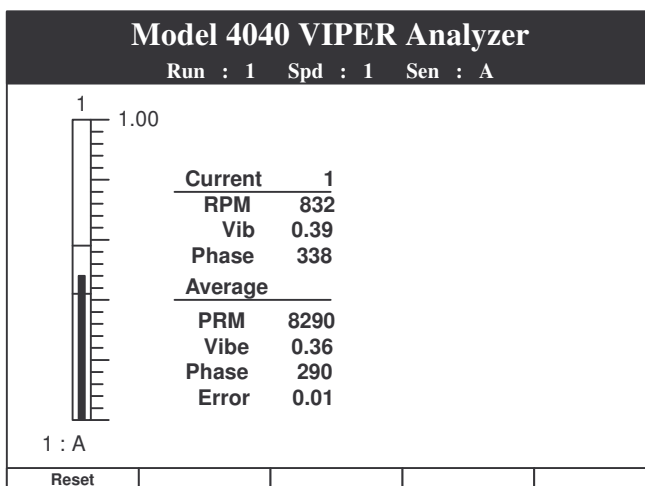
- 11.14 The Start Aircraft banner screen will be displayed. The Run number is indicated at the top left of the screen followed by the information message “Remove all trim weights.” Insure all previously installed trim balance weights have been removed. Start the engine(s) and watch for the Current RPM 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.				

## B. Data Acquisition

- 11.15 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 11.17.

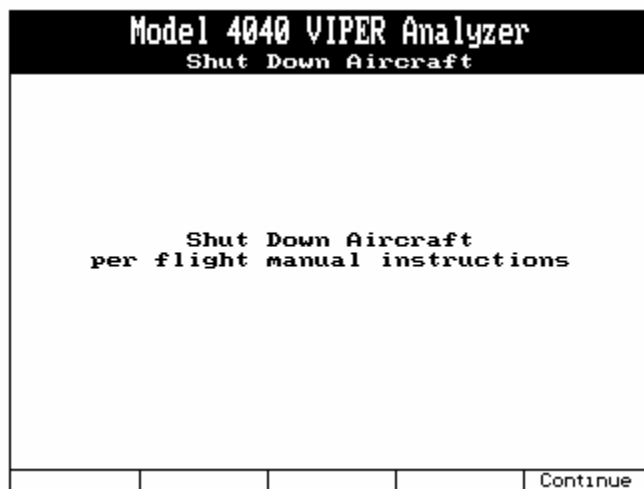


**CAUTION:** DO NOT LET THE ENGINE SPEED STABILIZE IN THE RANGE 66 TO 80 PERCENT N1 (FAN SPEED) (WHEN THE AIRCRAFT IS STABLE AND ENGINES IN FORWARD THRUST).

**CAUTION:** MAKE SURE ALL CHANGES IN ENGINE SPEED, BETWEEN 66 AND 80

PERCENT N1, ARE DONE IN 10 SECONDS OR LESS (WHEN THE AIRCRAFT IS STABLE AND ENGINES IN FORWARD THRUST ONLY)

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



- 11.17 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 ⇐ and ⇒ keys. Optionally you may use the [F1] and [F2] keys to Retake one or all data as required. When you are satisfied with the review, press [ENTER] to continue.

Model 4040 VIPER Analyzer				
Review Prior Run(s) Data				
Run 1				
Spd	Sensor 1			
	Rpm	Vib	Deg	
1	6316	1.20	22	
2	6093	1.10	35	
3	5945	1.30	27	
<> Run				
RetakeOne	RetakeAll			

- 11.19 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 for the 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 actually installed. Be sure the information in the Hole/Bld and Installed column are 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 key to navigate the matrix and indicate your exact installation.

This is very important in that the analyzer will use this information to calculate an influence for all subsequent runs. 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), and “Quit Job” When all fields are complete, press [ENTER] to accept and continue.

<b>Model 4040 VIPER Analyzer</b>			
<b>Fan/Turb Suggested/Installed Wts</b>			
<b>Run 2 Remove Old Wts, Inst. New Wts</b>			
<b>Name: Plane 1, 9111M35P0XX</b>			
<b>Hole</b>	<b>Suggested</b>	<b>Hole</b>	<b>Installed</b>
3	P01	3	P01
33	P01	33	P01
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
1	P07	1	P07
<b>Total: Soln =</b>		<b>4.672 @ 342</b>	
<b>Total: Inst =</b>		<b>4.886 @ 341</b>	
Inst=Sugg	Inst=None	Graph	Quit Job

**NOTE:** Before removing the nose cone to add trim weights, make a temporary mark on the nose cone and the nose cone fairing with an OMat Temporary marker felt/fibre tip to identify the angular position of the nose cone fairing and the nose cone. This is so that the fairing and cone can be installed back in to its initial position.

- 11.18 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 11.15 through 11.18 repeat until the fan vibration is reduced to an acceptable level. Normally this goal will be attained in one to three runs.

<b>Model 4040 VIPER Analyzer</b>			
<b>Start Aircraft</b>			
<b>Run 2</b>			
<b>Start engine(s) per flight manual</b>			
<b>Current RPM: NO IACH</b>			
<b>Desired RPM: 13746</b>			
<b>Difference :</b>			
<b>When speed is stable at desired speed, press ENTER to continue.</b>			