Application Note

ACES SYSTEMS

Bombardier Regional Jet

Fan Balance / CF34

Part Number: 11-200-0159

AppNote Number: A-BBRJ-4040-FB

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Application Note

Application Note Number	A-BA-CRJ200-4040-FB
Revision	1.05
Function	Fan Trim Balance
Airframe	Bombardier Regional Jet
Engine	CF34-3B1
Other Application Notes Required	N/A
ACES Systems Analyzer	ACES 4040 Viper Analyzer
Firmware Version	1.04 or higher / App 1.07g5 or greater
Procedure Cards	NA

Introduction

This Application Note contains specific directions on how to perform a vibration survey and fan trim balance on Bombardier Regional Jets (CRJ) 200 aircraft with General Electric CF34-3B1engines. This Application Note describes the steps necessary to perform the physical set up of equipment (e.g., analyzer, cabling, sensor mounting, etc.) and the steps necessary to perform the vibration surveys and balance procedures.

A. Required Equipment

The following ACES Systems' equipment is required.

Item	Quantity	Description	Part Number
1.	1EA	4040 Viper Analyzer	10-100-4040
2.	1EA	Interface, Challenger/RJ Vibration WB (Wide Band) 4040	10-320-0292
3.	1EA	Lasetach, Model 299	10-100-1300
4.	1EA	Mount, Lasetach	10-100-0369
5.	2EA	Cable data acquisition, Generic 50 ft.	10-320-0127
6.	2EA	Cable, tachometer, Generic 50 ft.	10-320-0126

Optional Equipment

7.	1EA	Lasetach, Model 299 (for 2 eng Balance)	10-100-1300
8.	1EA	Cable data acquisition, Generic 50 ft.	10-320-0127
9.	1EA	Cable, tachometer, Generic 50 foot (additional for 2 eng. Bal)	10-320-0126

10.	1EA	Interface, Tachometer, Challenger/RJ (used to collect speed and phase data directly from the tach output of the engine) This application will also require two 50 foot tachometer cables PN 10-320-0126 for each engine being connected to the analyzer.	10-320-0147
11.	1EA	Interface, 797V Vibration sensor (used to connect an external sensor (797V) for backup if onboard sensor fails.	10-320-0134
12.	1EA	Sensor, Velocity, 797V (used as a backup for onboard sensor)	69-100-0074
13.	1EA	Battery Charger, 220V (for use where 220V power is standard)	10-100-0414
14.	1EA	Interface, Challenger/RJ Vibration NB (Narrow Band)*	10-320-0253

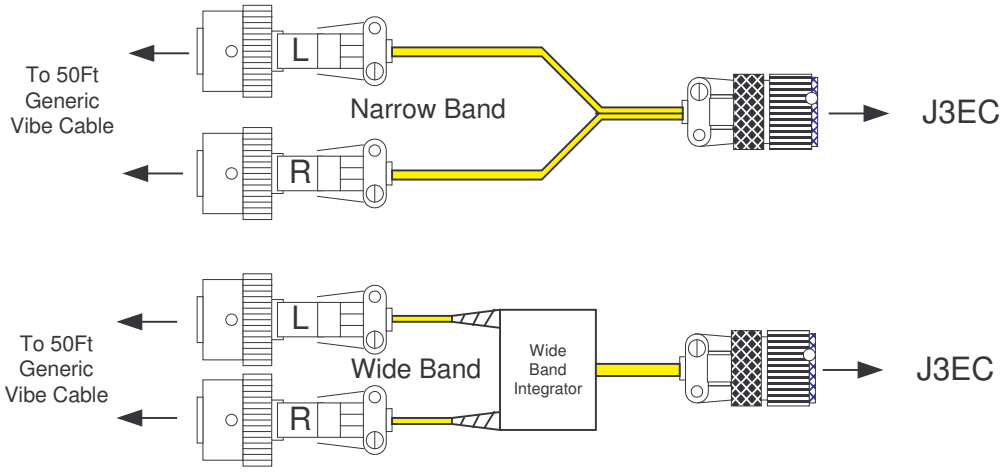
*** The Challenger/RJ Wide Band Interface will collect data for both vibration surveys and fan trim balance. The Challenger/RJ Narrow Band Interface will collect data for fan surveys and fan trim balance only. Dependent on the serial number of the aircraft, these outputs from the test connector may not match those from the cockpit vibration indicator without the correct combination of cable and selected sensor. Call ACES Systems for details. RJ Serial numbers 5135 and higher are wired so that the NARROW BAND (NB) is indicated in the cockpit. Serial numbers 5134 and lower are wired so that the WIDE BAND (WB) is indicated in the cockpit.**

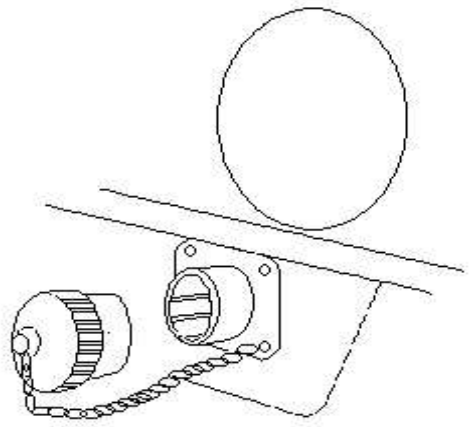
Miscellaneous Equipment

15.	1EA	Socket head screw weights (General Electric Part Numbers) Use only one Part Number when balancing. DO NOT MIX SCREW WEIGHTS OF DIFFERENT PART NUMBERS.	4096T45, or 3024T53, or 9111M35

B. Equipment Installation

1. If connecting to the onboard vibration monitoring system, gain access to the under-floor electronics equipment compartment through the access hatch on the bottom of the fuselage.
2. Connect the RJ interface, (Item 2 or 14 as appropriate) pictured below, to the J3EC test connector of the EVM system. The connector location varies with the series of the aircraft but is generally on the left side of the compartment and slightly forward of the access hatch.





J3EC Test Connector (Typical)

3. Remove the cover from an unused radio equipment position in the center pedestal or remove the floor panel just aft of the center pedestal and between the pilot and copilot seats in the cockpit.
4. Route the socket end of a 50 foot generic vibe cables, (Item 6), down through the open radio panel or floor panel and toward the rear of the aircraft to the J3EC test connector location.

(You may alternately route the 50 foot generic data acquisition cables, item 5, from the RJ interface, out the ground access hatch, along the fuselage, and in the over wing escape hatch latching door.)

NOTE

When using two cable sets, for two engine balance or vibe survey, it is advisable to identify one of the two cables as the #1 (left) with a wrap of electrical tape or a wire tie at each end. As both cables are otherwise identical, this will avoid confusion when connecting to the analyzer.

5. Connect the 50-foot vibe cable identified as the Number 1 engine cable to the interface connector (item 3) marked as number 1, left engine. If you are completing a two-engine task, repeat steps 4 and 5 of this procedure for the number 2 right engine.

6. If using the Lasetach, assemble the ACES Model 299 Lasetach (item 4) and swivel mount (item 5). Position the Lasetach assembly on the side of the fuselage between the second and third windows aft of the over wing escape hatch. Secure the base of the swivel bracket to the fuselage with duct tape or aluminum speed tape.

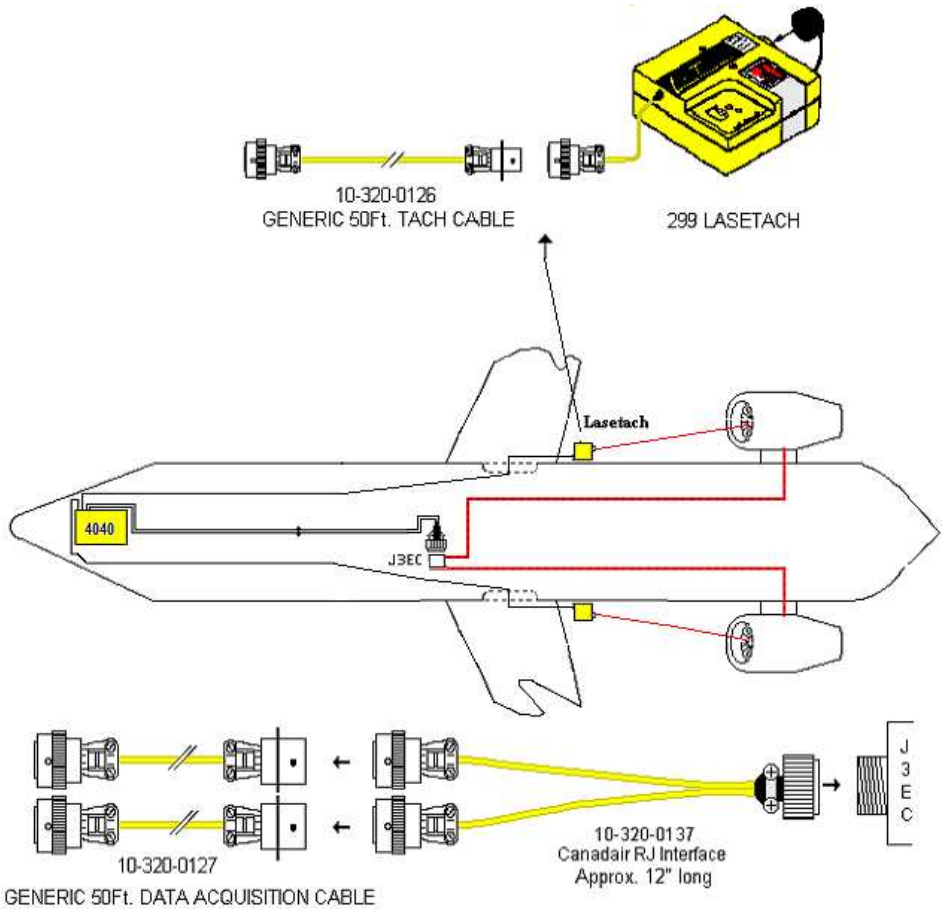
6.1. If you are using the output from the engine as a speed and phase reference source for balancing, access the N1 / N2 AMPLIFIER unit at fuselage station 682 for the left or right engine as required from the ground access door of the aft electronics (APU) bay. Disconnect the 1P1KH connector for number 1 engine or 2P1KH connector for number 2 engine tach output and connect the Challenger/RJ tach interface, item 10, in its place. Connect the previously disconnected 1P1KH or 2P1KH to the Challenger/RJ tach interface, item 10, to maintain cockpit indications.

7. Attach a 50 Ft. TACH CABLE, item 6, to the Lasetach (item 4) or to the N1 connector of the RJ Tach Interface, item 10, according to which tach source you are using. If using the RJ tach interface, make the connection to the lead labeled N1. (See Figure(s) below) and route the cable through the louvers in the ground access hatch and forward to a second tach cable, item 6, which must be connected in series to the end of the first cable to reach the cockpit.

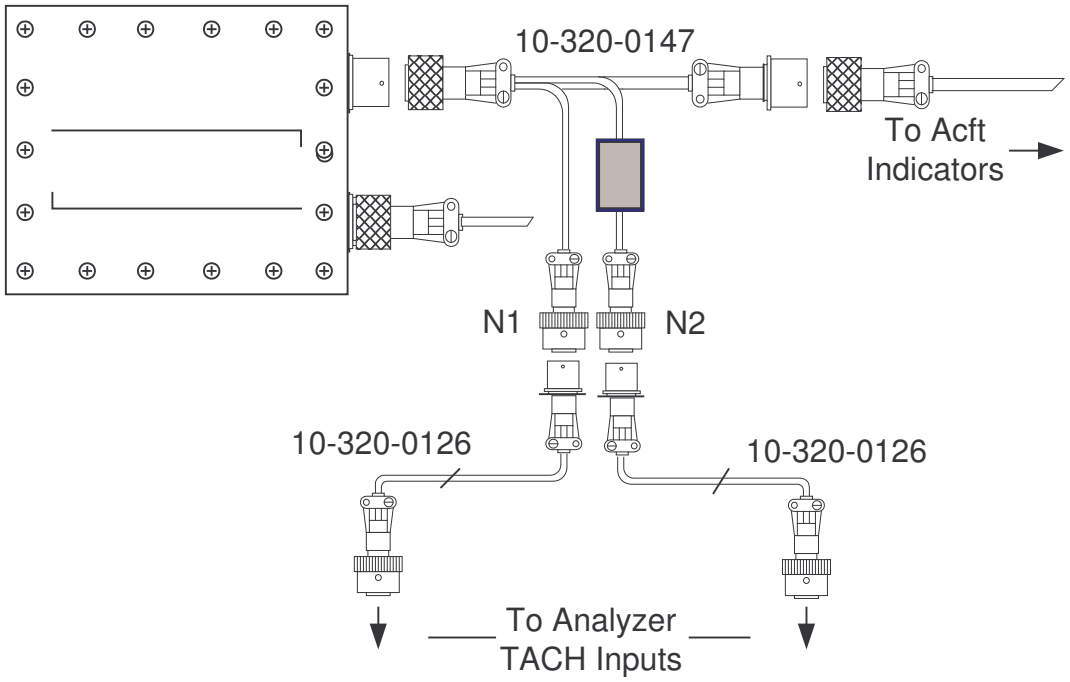
NOTE

When using two cable sets, for two engine balance or vibe survey, it is advisable to identify one of the two sets as the #1 with a wrap of electrical tape at each end. As both cables are otherwise identical, this will avoid confusion when connecting to the analyzer.

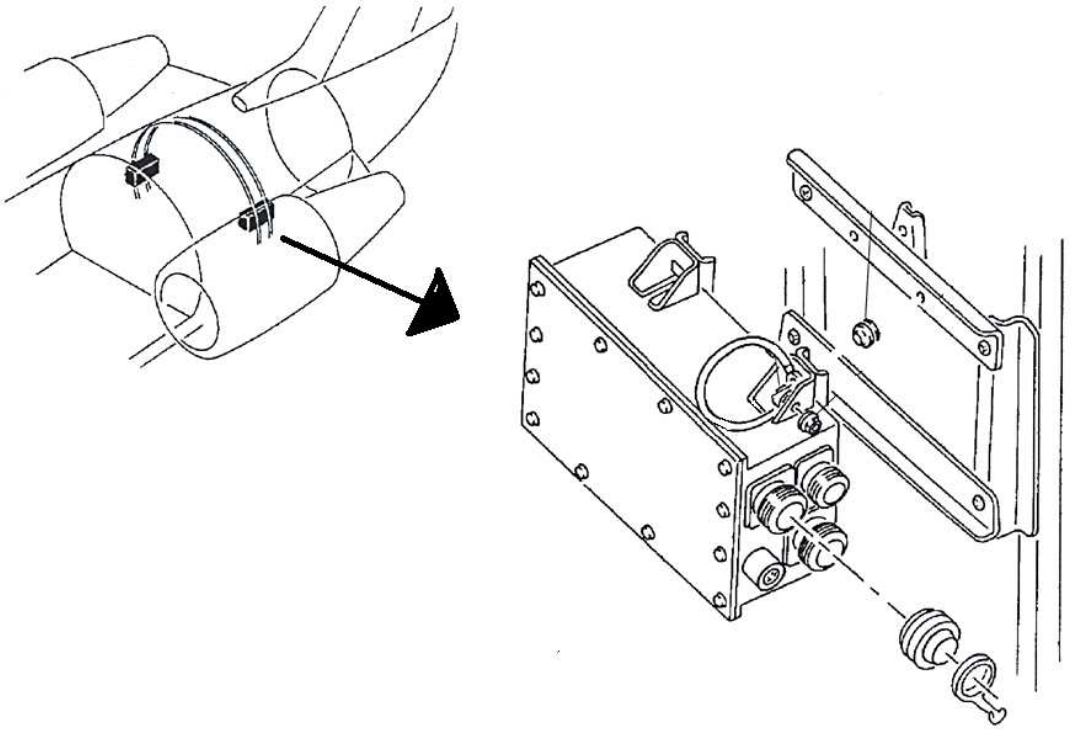
Equipment Installation Diagram



Hookup using vibration output from engine installed sensor and Lasetach optical tachometer for speed and phase measurements.



Hookup using tach output from engine for speed and phase measurements. NOTE: The N2 output is not required for Fan Balance but may be used in transient (tracked) vibration analysis if desired.



8. Route the Tachometer Cables, item 6, along the fuselage to the over wing escape hatch, and through the passenger compartment toward the cockpit or location where the analyzer will be used. Take care not to pinch the cables in doors or hatches. Secure the cables to the fuselage every 36 inches to prevent movement or possible ingestion into the engine. Repeat steps 6, 7, and 8 for the second engine if conducting a two-engine task.

NOTE

When using two cable sets, for two engine balance or vibe survey, it is advisable to identify one of the two sets as the #1 with a wrap of electrical tape at each end. As both cables are otherwise identical, this will avoid confusion when connecting to the analyzer.

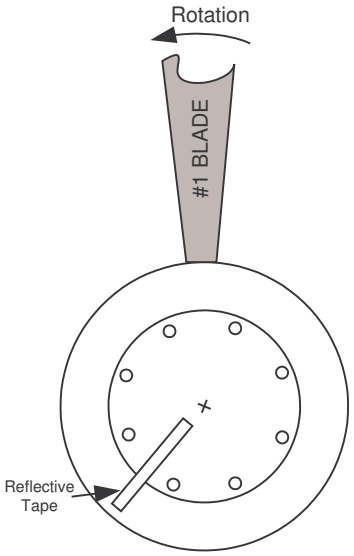
9. Place the analyzer, item 1, in the cockpit or locate it where it will be used if the technician running the engines will not also conduct the procedure. Connect the various cables for either a one or two engine application as follows:

- Left Engine Data Acquisition Cable (item 5) marked as the **#1 or left engine** to the six pin connector marked "CHANNEL A"
- Left Engine Tach Cable (item 8) marked as the **#1 or left engine** to the three pin connector marked "TACH 1"
- Right Engine Data Acquisition Cable (item 5) marked as the **#2 or right engine** to the six pin connector marked "CHANNEL B"
- Right Engine Tach Cable (item 6) marked as the **#2 or right engine** to the three-pin connector marked "TACH 2"

NOTE

Steps 10 and 11 are not required if you are using the onboard tach interface cable, item 10. Reflective quality is not the same for all reflective tape. Use only 3M brand, #7610 reflective tape for best results if using an optical sensor such as the Lasetach or Phototach.

10. Position the fan so that #1 blade is at the 12:00 o'clock position (As viewed from forward looking aft into the intake.)
11. With the fan in this position, clean the surface of the spinner at the 7:30 clock position with a degreaser (MEK) and dry thoroughly. Remove the protective backing from a two-inch strip of reflective tape and apply the tape at the cleaned (7:30 clock) location. (See Figure below.) Alignment of the laser will be accomplished later in this procedure.



C. Analyzer Set Up

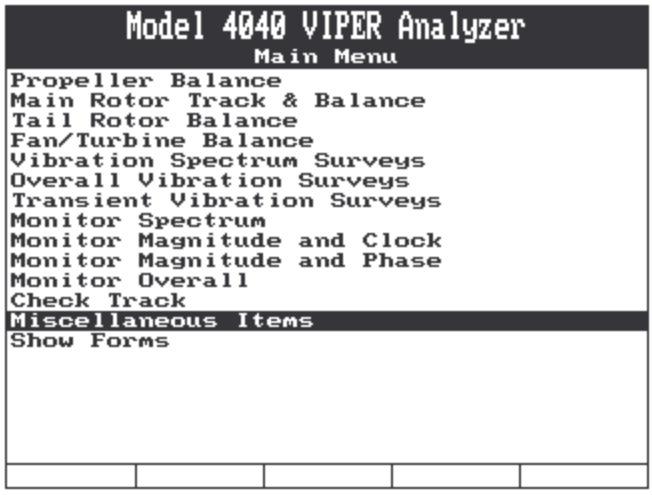
12. Fan Balance Setup.

12.1 This section will provide you with the steps to enter the Setup into the Viper Analyzer. If the setup has been previously entered, you need not repeat this step. If the setup is available, go to section C. Data Acquisition. Otherwise proceed to item 14 below.

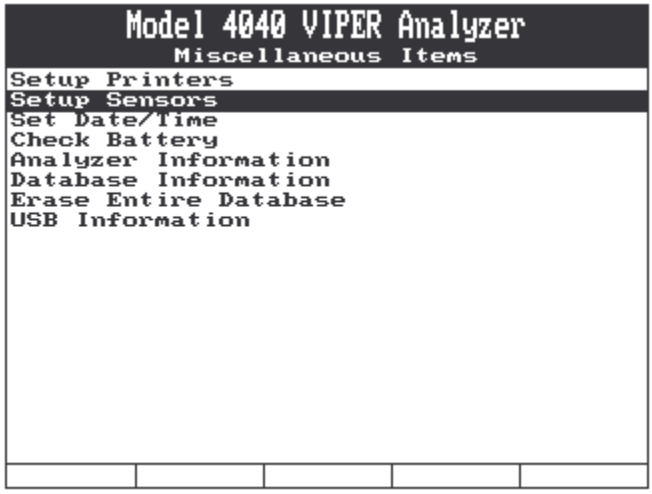
12.2 Turn the analyzer on by pressing the ON/OFF key.

12.3 The analyzer has several default sensors already in memory. Other sensors may have also been programmed into the analyzer. To view the list of sensors already stored in the analyzers memory, do the following:

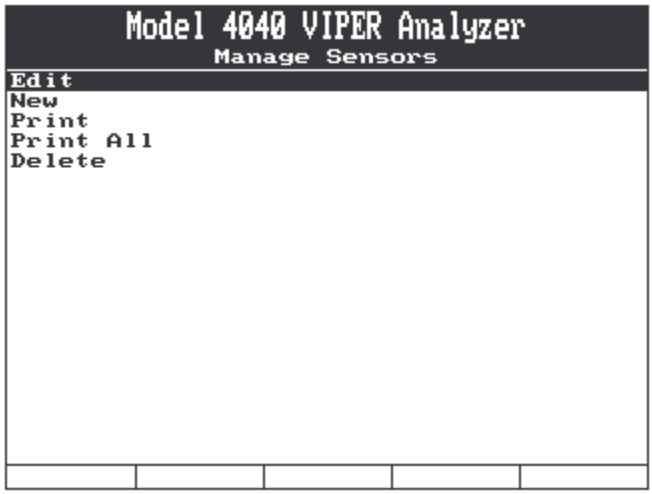
12.4 From the Main Menu, select Miscellaneous Items.



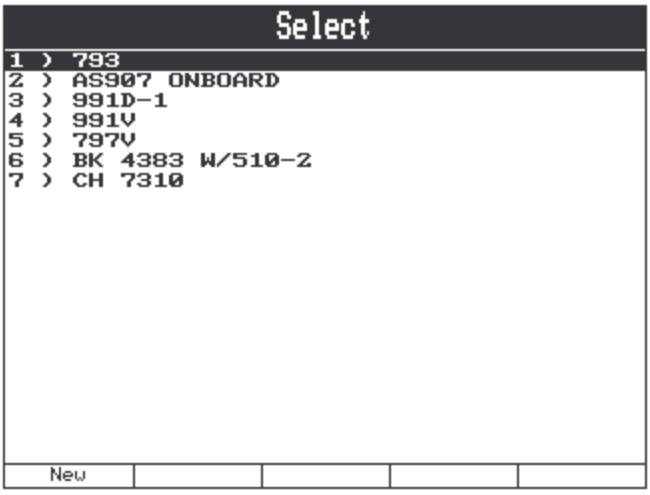
12.5 From the Miscellaneous items menu, select Setup Sensors, then press [ENTER].



12.6 From the Manage Sensors menu, select Edit, then press [ENTER].

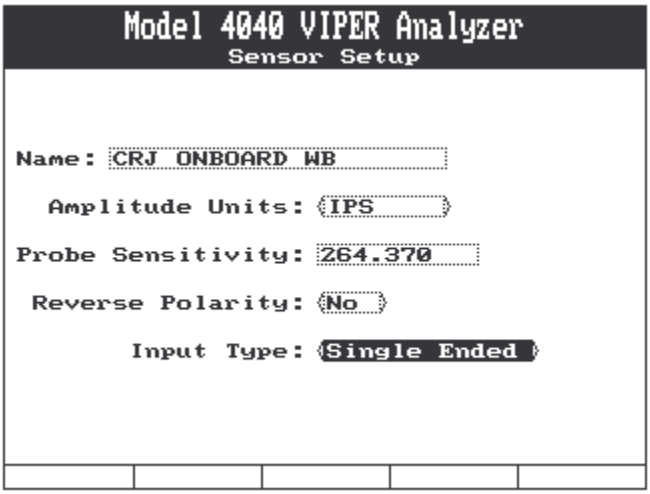


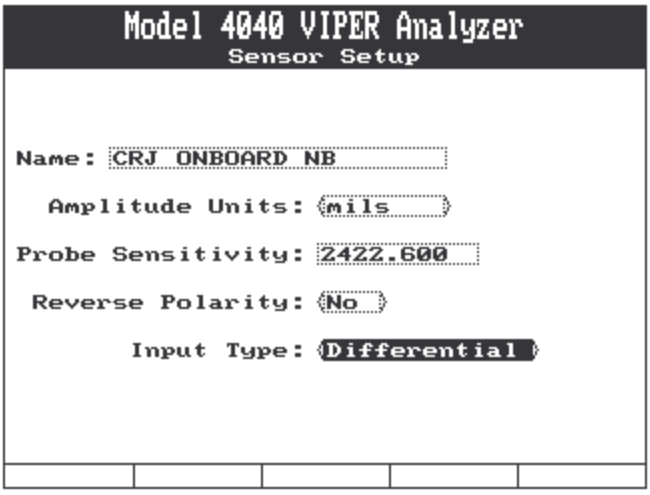
12.7 The Select menu will be displayed which lists all sensors currently programmed into the analyzer memory. If the sensor you are using is listed, you need not re-enter it. Go to item 22, otherwise press the [BACKUP] key, select New from the Manage Sensors menu and proceed with item 21 below.



12.8 Complete the Sensor Setup screen, shown below, as follows:

In the **Name:** field, enter the sensor name such as CRJ ONBOARD WB for instance. Press the ⇓ key to move to the next field.





NOTE

The examples above show the setups for the engine-mounted sensor, wide band and narrow band output, respectively, from the J3EC test connector.

In the **Amplitude Units:** field, use the ⇒ key to select units for the sensor. This is the engineering unit of output for the sensor. Enter the information for both sensors as shown above. Press the ⇓ key to move to the next field.

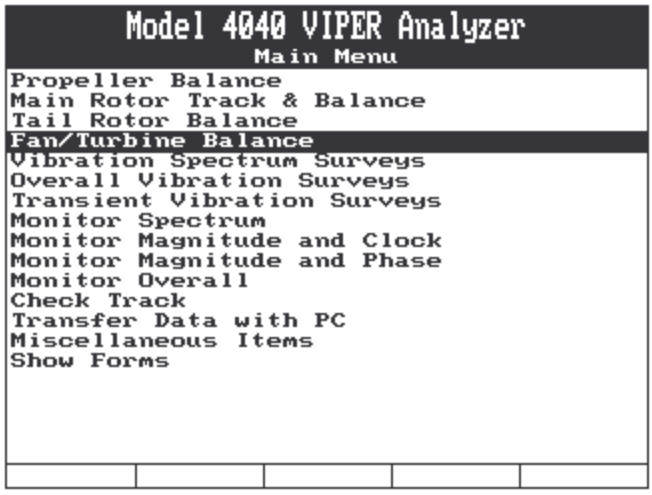
In the **Probe Sensitivity:** field, enter the mV per engineering unit as specified on the data sheet for the sensor you are using, The ONBOARD WB sensitivity is 264.37 mV/IPS. The sensitivity for the ONBOARD NB is 2422.6 mV/Mil. Press the ⇓ key to move to the next field.

In the **Reverse Polarity:** field, use the ⇒ key, if necessary, to select "Yes or No" as appropriate for the sensor you are using. This will be "No" for the ONBOARD WB and ONBOARD NB sensor settings indicating the sensor polarity is not reversed. Press the ⇓ key to move to the next field.

In the **Input Type:** field, use the ⇒ key, as necessary, to select "Differential or Single Ended" indicating the type input to the sensor. This will be "Single Ended" for the ONBOARD WB and the ONBOARD NB will be "Differential".

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.

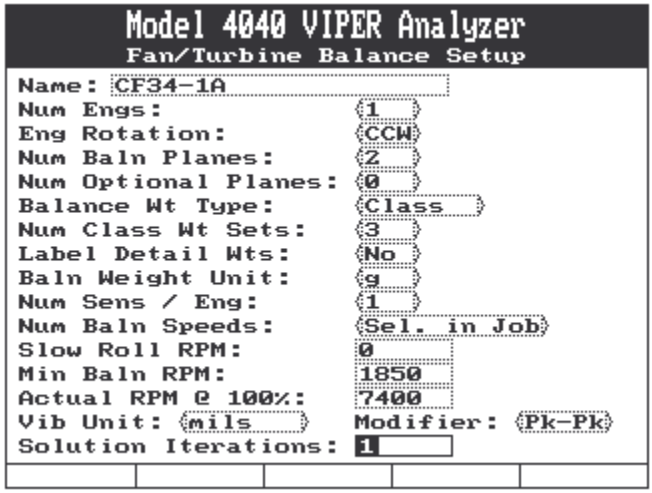
21. From the Main Menu, select "Fan / Turbine Balance"



22. 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:

23. Complete the Fan/Turbine Balance Setup screen as follows:

24.1 Use the keypad to enter "CF34-1A (or appropriate model)" in the **Name:** field. Press the ⇓ key to move to the next field.



24.2 In the **Num Engs:** (number of engines) field, use the use the ⇒ key to select a number that indicates the number of engines that will be balanced using this setup. This is typically "1". Press the ⇓ key to move to the next field.

24.3 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

24.5 In the **Num Baln Planes:** (number of balance planes) field, use the ⇒ key to select "2". Press the ⇓ key to move to the next field.

24.6 In the **Num Optional Planes:** (number of optional planes), use the ⇒ key to select “0”.

24.7 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.

24.8 In the **Num Class Wt Sets:** (number of class weight sets), use the ⇒ key to select “3”. The CF34 has three sets of class weights that may be used to trim balance the engine. You may choose any one of the sets individually or up to all three. It is important not to mix individual weights of different class weight sets when balancing. The part numbers are stamped on the head of each socket head screw weight. See step 25 below to identify the three individual class weight sets. Press the ⇓ key to move to the next field.

24.9 In the **Label Detail Wts:** field, use the ⇒ key to select “No”. Detail weights are those weights which cannot be removed and occupy holes normally used for adding trim balance weights. If the answer is yes in this field, the analyzer will optimize the balance solution on available holes only. Press the ⇓ key to move to the next field.

24.10 In the **Baln Weight Units:** field, use the ⇒ key to select “g’ for grams. The class weights for the CF34 are measured in grams. Press the ⇓ key to move to the next field.

24.11 In the **Num Sens / Eng:** field, use the ⇒ key to select 1. Press the ⇓ key to move to the next field.

24.12 In the **Num Baln Speeds:** field, use the ⇒ key to select the total number of speeds (up to 9) you will use for this setup. Optionally, you may choose “Select in Job” which will allow you to specify the number of balance speeds with each new job rather than defaulting to a number you select here in the setup. ACES recommends three speeds for balancing the CF34. Press the ⇓ key to move to the next field.

24.13 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.

24.14 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 flight range but never less than idle RPM. Press the ⇓ key to move to the next field.

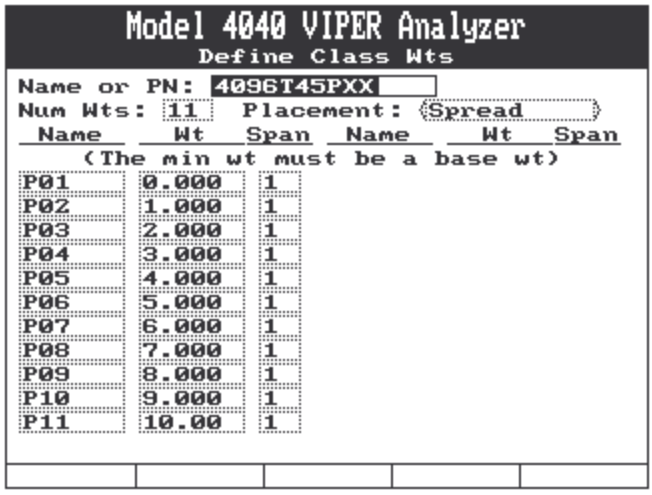
24.15 In the **Actual RPM @ 100%:** field, use the keypad to enter the speed of the fan at 100% rpm. For the CF34, this speed is 7400 RPM. Press the ⇓ key to move to the next field.

24.16 In the **Vib Unit:** field, use the ⇒ key to select “Mils”. The CF34 engine is balanced using displacement units. Press the ⇓ key to move to the next field.

24.17 In the **Modifier:** field, use the ⇒ key to select “Pk - Pk”. When all fields are complete, press [ENTER] to accept and continue.

25. The Define Class Weights banner screen will be displayed where each of the class weights used for the CF34 fan trim balance will be added to the setup. Complete each field in the screen as follows:

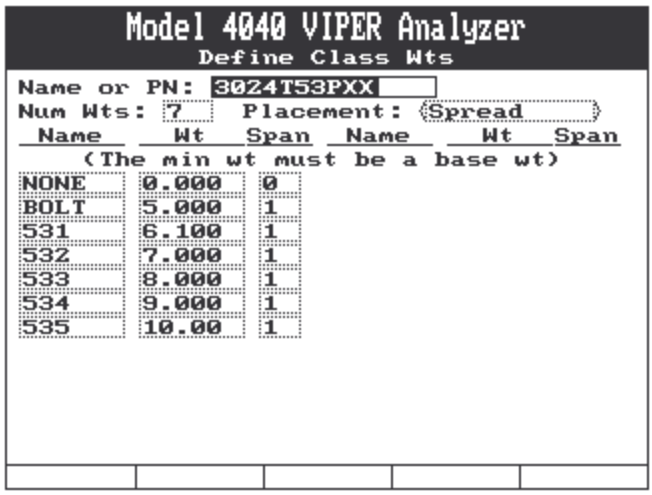
25.1 In the **Name or PN:** field, use the keypad to enter a commonly known name, such as P0 WEIGHTS or the actual part number of the class weight set. There are three part numbers that identify the class weight sets used for the CF34. You may choose to enter all or only the one you routinely use. The three part numbers are listed in the name field for each of the three sets in the following screens. The 3024T53PXX set is the weights used on the forward spinner, the secondary balance plane.



Model 4040 VIPER Analyzer
Define Class Wts

Name or PN: 4096T45PXX
Num Wts: 11 Placement: Spread

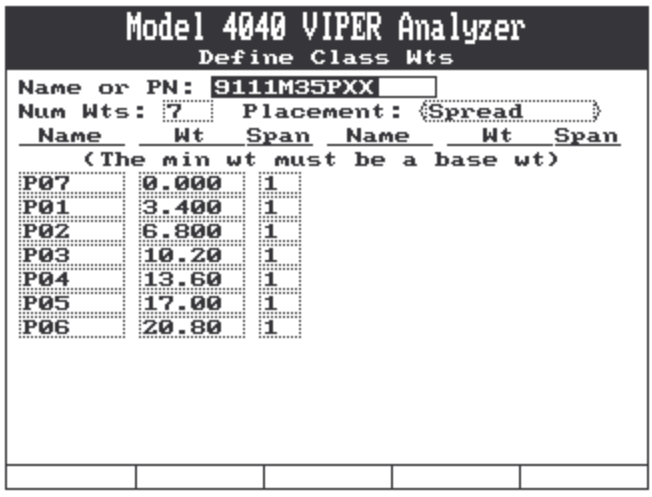
Name	Wt	Span	Name	Wt	Span
(The min wt must be a base wt)					
P01	0.000	1			
P02	1.000	1			
P03	2.000	1			
P04	3.000	1			
P05	4.000	1			
P06	5.000	1			
P07	6.000	1			
P08	7.000	1			
P09	8.000	1			
P10	9.000	1			
P11	10.00	1			



Model 4040 VIPER Analyzer
Define Class Wts

Name or PN: 3024T53PXX
Num Wts: 7 Placement: Spread

Name	Wt	Span	Name	Wt	Span
(The min wt must be a base wt)					
NONE	0.000	0			
BOLT	5.000	1			
531	6.100	1			
532	7.000	1			
533	8.000	1			
534	9.000	1			
535	10.00	1			



Model 4040 VIPER Analyzer
Define Class Wts

Name or PN: 9111M35PXX
Num Wts: 7 Placement: Spread

Name	Wt	Span	Name	Wt	Span
(The min wt must be a base wt)					
P07	0.000	1			
P01	3.400	1			
P02	6.800	1			
P03	10.20	1			
P04	13.60	1			
P05	17.00	1			
P06	20.80	1			

25.2 In the **Num Wts:** field, use the keypad to enter a total number of weights in this class weight set, either 11 or 7 according to the class weights you are entering. Press the ⇓ key to move to the next field.

25.3 In the **Placement:** field, use the ⇒ key to select "Spread". There are two selections, Continuous or Spread. Continuous dictates that all added weights must be installed in a continuous pattern (of usable holes). Spread allows the weights to be placed at intervals or spread among available holes, including a continuous pattern to facilitate the balance. Press the ⇓ key to move to the next field.

25.4 In the **Name, Wt,** and **Span** columns, enter the information as shown in the illustrations above for the class weights. The name will be the PXX number of the individual weights, the weight, as measured in grams, for each individual class weight and the span is the number of holes each individual weight covers when installed.

25.5 When all information is completed, press [ENTER] to accept and continue. If you selected more than 1 class weight set above in step 24.8, another "Define Class Wts" screen will be displayed. Repeat steps 25 through 25.4 for each additional class weight set.

26. The Balance Plane information screen, shown below, will be displayed. Complete each field in the screen as follows:

26.1 In the **Plane ID:** field, use the ⇒ key to select the plane identification number (if optional planes were selected). Press the ⇓ key to move to the next field.

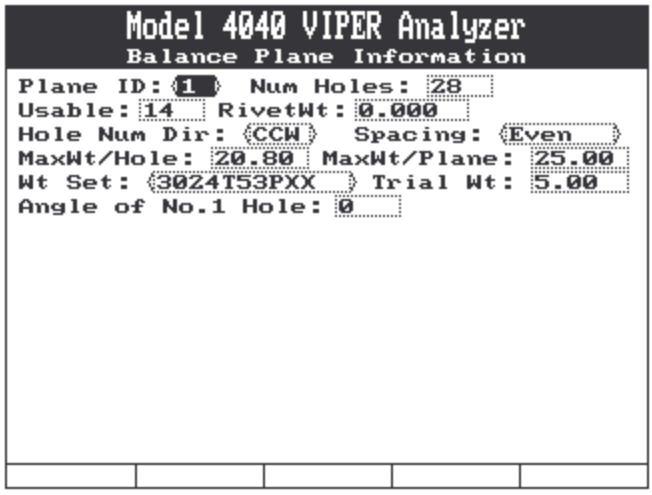
26.2 In the **Num Holes:** field, use the keypad to enter "28" for CF34-1A, -3A, -3A1, -3B or –3B1. Press the ⇓ key to move to the next field.

26.3 In the **Usable:** field, use the keypad to enter a number reflecting how many of the holes (entered in 26.2 above) are usable for adding weight for the purpose of a fan balance procedure. Press the ⇓ key to move to the next field.

26.4 In the **Rivet Wt:** field, use the keypad to enter "0". Some engines use a rivet or other attaching hardware to hold balance weights in place. This weight is in addition to the class weight values entered previously. The CF34 does not use attaching hardware and this field should be "0". Press the ⇓ key to move to the next field.

26.5 In the **R:** (for Radius) field, use the keypad to enter the radius, in inches, of this balance plane. This is the distance from the center of the Fan Disk to the location where the weights are added. For the Spinner Rear, this radius is 10 inches on the CF34.

26.6 In the **Hole Num Dir:** use the ⇒ key, if necessary, to toggle the field to read "CCW" for counter clockwise. This indicates the numbering direction of the weight holes is in a counter clockwise direction as viewed from forward of the engine looking into the intake. Press the ⇓ key to move to the next field.



26.7 In the **Spacing:** field, use the ⇒ key, if necessary, to toggle the field to read "Even" indicating that the 28 weight holes are evenly spaced. Press the ⇓ key to move to the next field.

26.8 In the **MaxWt/Hole:** field, use the keypad to enter a value equal to the maximum amount of weight from the class weight set being used that may be added to each hole. In this case, that value is the weight of the largest weight in the class weight set which is 10.00 grams for the P11 weight in the 4096T45PXX set. Press the ⇓ key to move to the next field. The maximum value for the 9111M35PXX set is the P06 at 20.8 grams. Entering the 20.8 grams will allow you to use the maximum from all weight sets but will not exceed the max total as define in Maximum Plane Weight below. Press the ⇓ key to move to the next field.

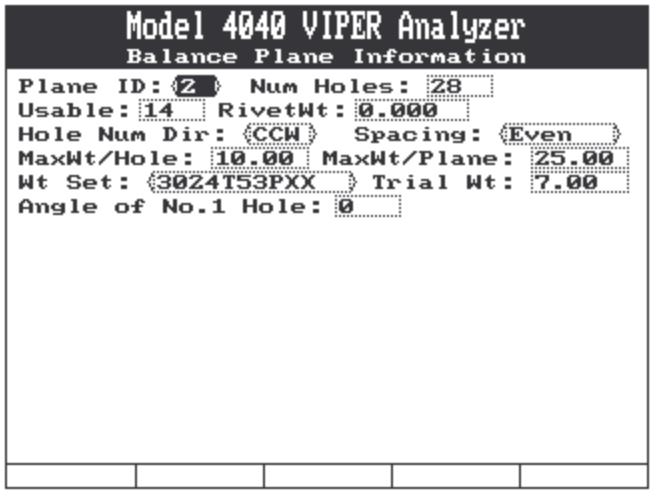
26.9 In the **MaxWt/Plane:** use the keypad to enter a value equal to the maximum total allowable for all weights on the plane. The maximum total weight for the CF34 on a single plane is 25 grams. Enter 25.00. Press the ⇓ key to move to the next field.

26.10 In the **Wt Set :** field, use the ⇒ key, if necessary, to toggle the field to read the name or part number of your chosen class weight set from the class weights defined earlier in step 25. Press the ⇓ key to move to the next field.

26.11 In the **Trial Wt:** field, use the analyzer keypad to enter the weight of a single class weight (from the class weight set being used) you wish to use as a trial weight. This weight is intended only to change the measured condition of the first run so that an influence calculation can be made for the fan based on the measured change induced by the addition of this weight. A class weight value in the mid range of the set is acceptable for this trial weight. Press the ⇓ key to move to the next field.

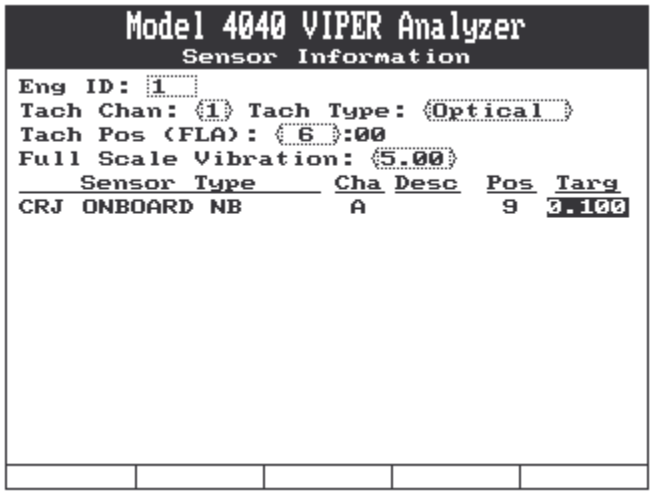
26.12 In the **Angle of No.1 Hole:** field, use the keypad to enter "0". This indicates the No. 1 hole is at 0 (360) degrees. Press [ENTER] to accept the settings and proceed.

26.13 The second Balance Plane Information screen (shown below) will be displayed. This is the forward spinner plane. Complete the screen with the information shown in the screen below using steps 26.1 through 26.12 as examples.



27. The Sensor Information screen will be displayed. Complete the screen as follows:

27.1 In the **Eng ID:** field, use the keypad to enter a single numeric value of 1 to 4, and indicating the position of the engine being balanced. If you defined the number of engines to be balanced with this setup as "1", that will be your only available selection in this field. Press the ⇓ key to move to the next field.



27.2 In the **Tach Chan:** field, use the use the ⇒ key to select the tach channel you wish to use. This must be the tach channel, 1, 2, 3, or 4, where you connect the tach input cable for this engine. Press the ⇓ key to move to the next field.

27.3 In the **Tach Type:** field, use the ⇒ key to select the type of tachometer you are using. If using a Lasetach or Phototach, select Optical. If you are using the direct output from the engine, select Lo Tth (Low Tooth). Press the ⇓ key to move to the next field.

27.4 In the **Tach Pos (FLA):** (tachometer position as viewed from forward looking aft), use the ⇒ key to select a clock position where the laser beam strikes the spinner when power to the laser is on. This should be approximately 6:00 for most applications. Press the ⇓ key to move to the next field.

27.5 In the **Full Scale Vibration:** field, use the ⇒ key to select the highest amplitude (in Mils Peak to Peak) you reasonably expect to experience for this balance job. This is typically 5. Press the ⇓ key to move to the next field.

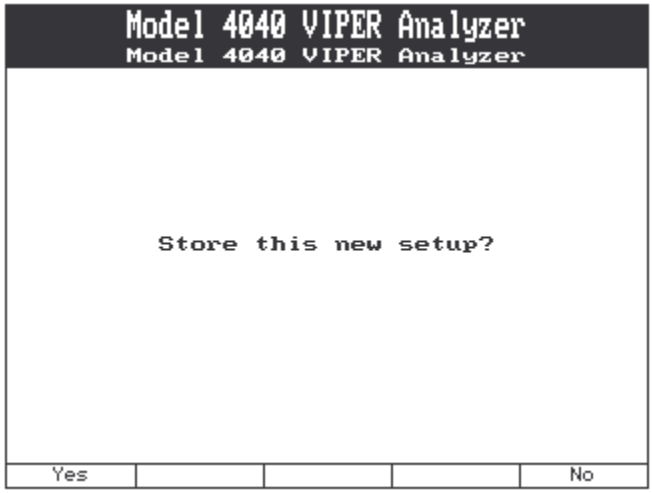
27.6 In the **Sensor Type** column, use the ⇒ key to select a sensor from those sensors programmed into your analyzer. Refer to the setup portion of this AppNote for additional information. Press the ⇓ key to move to the next field.

27.7 In the **Cha** field, use the ⇒ key to select the channel you will connect the incoming vibration signal to, A, B, C, or D. Press the ⇓ key to move to the next field.

27.8 In the **Desc** field, use the keypad to enter a description of the channel-identified sensor such as #1, Fan or L. Press the ⇓ key to move to the next field.

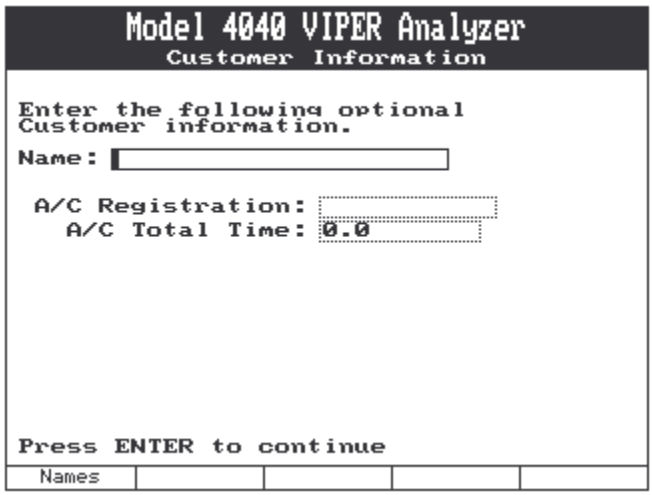
27.9 In the **Pos** (position) field, use the ⇒ key to select the approximate clock position of the vibration sensor on the engine as viewed from forward looking aft into the intake. If you are not sure of the position, select "UNK" for unknown. The analyzer will compensate for the unknown position and locate it automatically with one additional engine run. The onboard sensor for the CF34 is located at 9:00 FLA while the user installed 797 sensor may be at either the 10:00 or 2:00 position at the end of a strut. Press the ⇓ key to move to the next field.

27.10 In the **Targ** (target amplitude) field, use the keypad to input amplitude you wish to achieve as a maximum acceptable vibration using this setup. The analyzer will continue to provide solutions until this value is achieved. When all fields are complete, press [ENTER] to accept. The screen below will be displayed asking, "Store this new setup?" Press the [F1] "Yes" key to save or the [F5] "No" key to return to the setup.



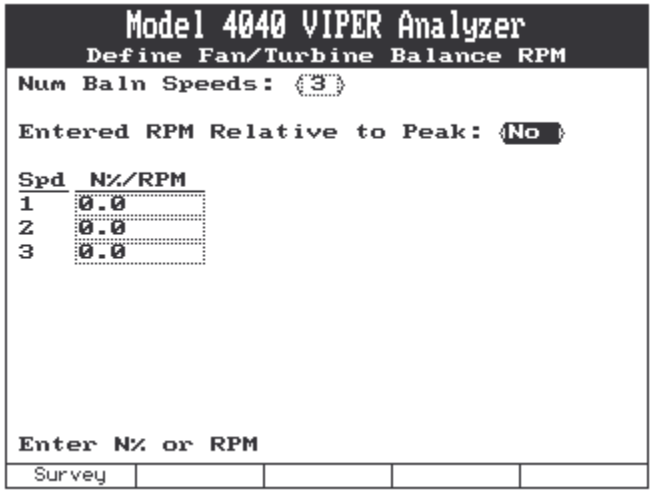
28. After the setup is stored you may turn the analyzer off or proceed to the balance procedure. If you continue with the balance, the customer information screen below will be displayed. The information on this screen is optional and need not be filled in to continue with the job, however; this information 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.



29. If you elected to Select Balance Speeds in the Job (see step 24.11 above) the "Define Fan/Turbine Balance RPM" banner, shown below, will be displayed. Complete the screen as follows:

29.1 In the **Num Baln Speeds:** field, use the ⇒ 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 CF34. Press the ⇓ key to move to the next field.



29.2 In the **Entered PRM Relative to Peak:** field, use the ⇒ key to toggle the answer field to Yes or No as appropriate indicating whether or not the speeds are relative to the peak vibration of a survey. "No" is normally the case unless the engine manufacturer specifies the balance speed as the Peak plus or minus a speed value. Select "No" for the CF34. Press the ⇓ key to move to the next field.

29.3 The **Peak Speed:** field will be displayed ONLY if you answered "YES" to the filed in step 29.2 above. This field should not normally be used for the CF34. Press the ⇓ key to move to the next field.

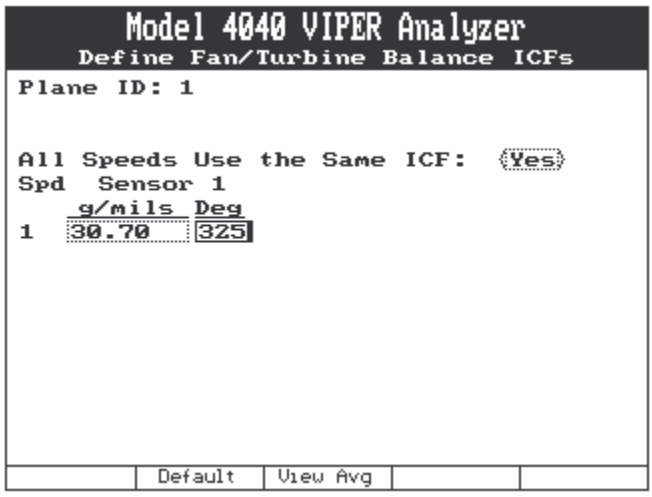
29.4 The **Spd** column will contain a number of rows relative to the number of balance speeds you specified in step 29.1 above. Immediately to the right of those numbers, in the **N%RPM** column, use the keypad to enter the balance speeds. If you wish to conduct a Fan Vibration Survey at this point to allow the analyzer to determine the 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.

30. The Define Fan / Turbine Balance ICFs banner screen will be displayed. Complete the screen as follows:

30.1 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.

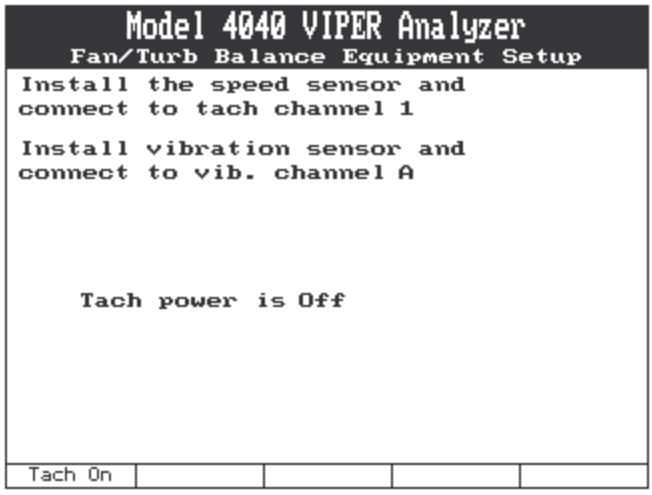
30.2 In the **1** row, and in the **g/IPS** (grams per Mil) column, enter "30.70" to indicate an influence of 30.7 grams per Mil. Press the ⇓ key to move to the next field.

30.3 In the **1** row, and in the **Deg** (Degrees) column, enter 325.

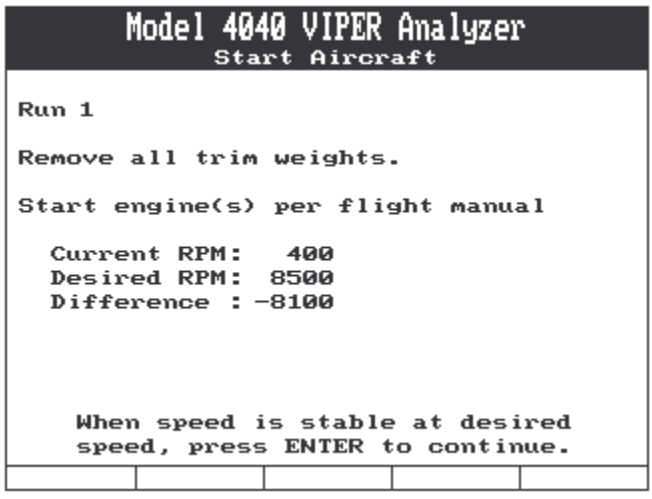


31 The Fan / Turb Balance Equipment Setup screen will be displayed. Follow the on screen instructions for installing and attaching sensors and cables. Notice that there is a message near the center of the screen reading "Tach power is off". This indicates the tachometer circuit is currently not powered 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 tot he LASER ALIGNMENT procedure on page 23 of this document. You may alternately complete the laser alignment by using the "Test Tach Power" option from the main menu. When the laser alignment is complete, return to this point and continue.

31.1 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.

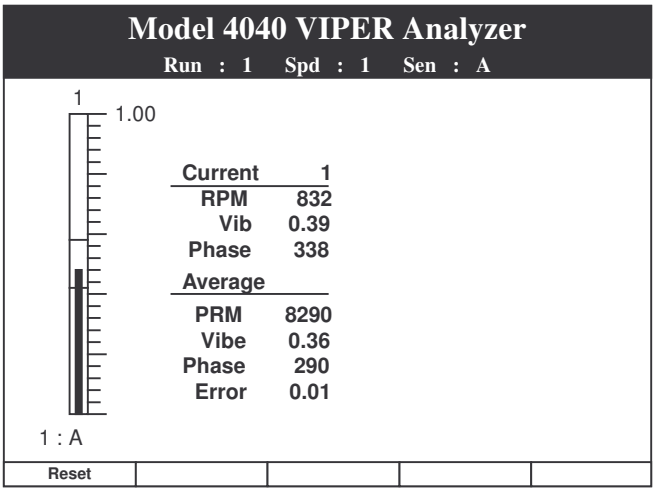


32 The Start Aircraft banner screen will be displayed. The Run number is indicated at the top left of the screen followed by the information message “Remove all trim weights.” Insure all previously installed trim balance weights have been removed. Start the engine(s) and watch for the Current RPM indication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

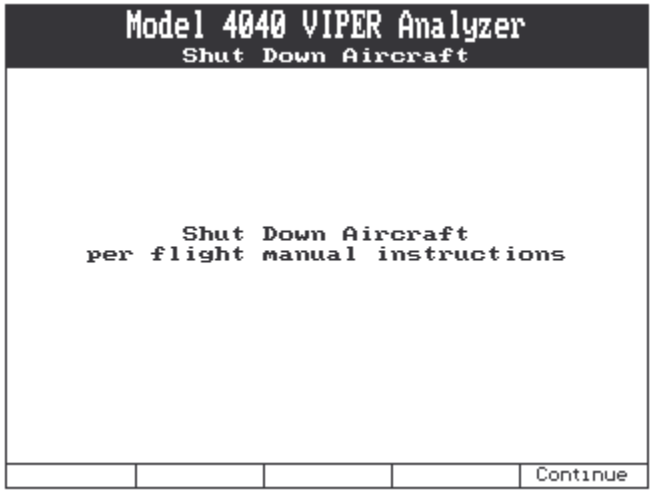


C. Data Acquisition

33. 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 angel 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 34.



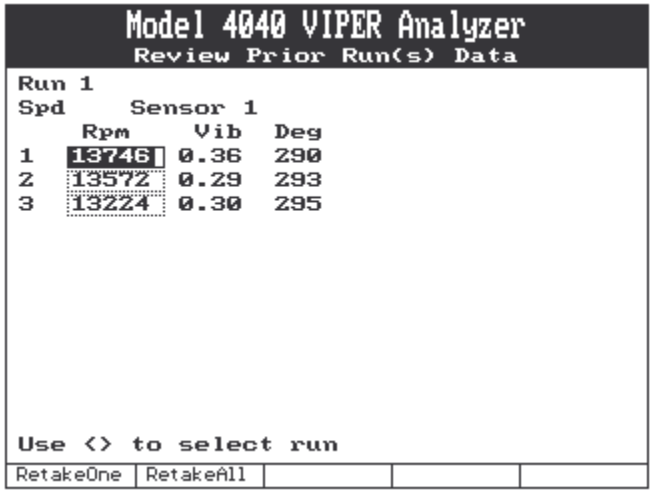
34. The Shutdown Aircraft message will be displayed. Press the [F5] “Continue” key to acknowledge and proceed with a normal engine shutdown procedure.



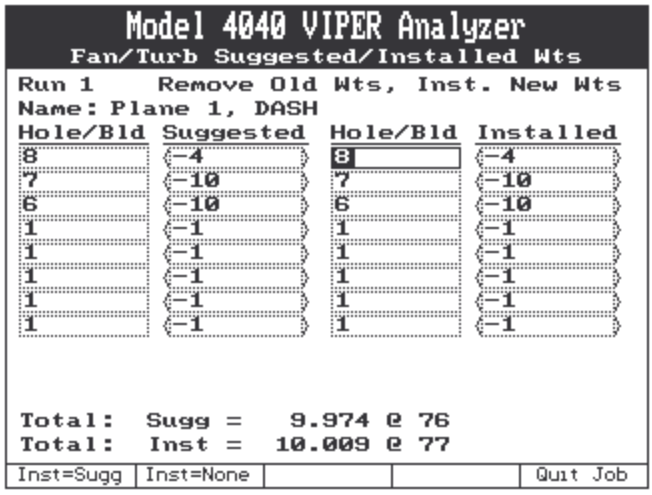
35. The Review Prior Run(s) Data will be displayed for your review of the data collected up to this point. You may view data from all runs by scrolling through the available run data using the ⇐ and ⇒ keys. Optionally you may use the [F1] and [F2] keys to Retake One or Retake All data as required. When 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 CF34 engine.



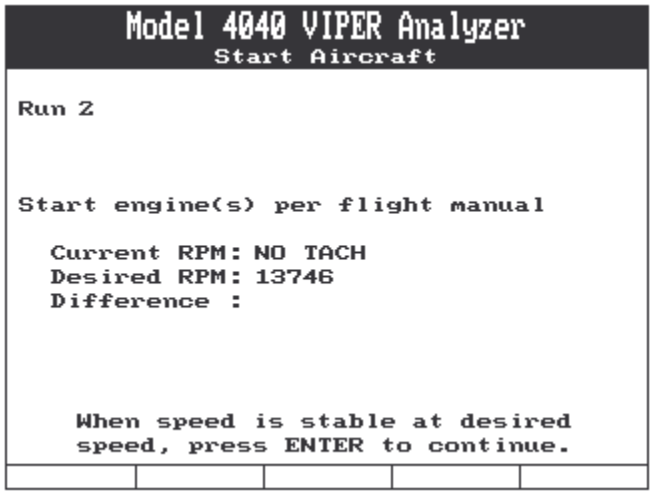
36. The Fan / Turb Suggested / Installed Wts screen will be displayed. Notice the first line of text in the screen shows the Run number and the message “Remove Old Wts, Inst. New Wts.” Remove all previously installed trim weights from any previous run and install the weights listed in the “Suggested” column into the hole numbers indicated to their immediate left. The right side of the screen reflects the suggested solution and changes to what you have actually installed only if you edit the solution shown. 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 matrix and indicate your exact installation. This action is very important in that the analyzer will use this information to calculate an influence for 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” If you enter a solution OTHER than the suggested, then decide to revert back to the suggested, you may press the [F1] “Inst=Sugg” key to automatically return all changed fields in the Installed section to the suggested solution shown at the left side of the screen, rather than changing it field by field. When all fields are complete, press [ENTER] to accept and continue.



36. 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 item 33 through item 36 will repeat until the fan vibration is reduced to an acceptable level. Normally this goal will be attained in from one to three runs.

NOTE

For best balance results, no more than 15 minutes should elapse between runs on the CF34 balance procedure. If three runs are completed and the balance is still not satisfactory, wait 5 hours to RESUME the balance job. This process reduces the bowing effect of the rotor due to heat build up.



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.