Application Note

Aircraft Type: Falcon 2000

Procedure: CFE738 Vibration

Part Number: 11-200-0150

AppNote Number: E-CFE-738-1725-FB

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Application Note

Application Note Number	E-CFE-738-1725-FB
Revision	2
Function	Fan Trim Balance
Airframe	Falcon 2000
Engine	CFE738
Other Application Notes Required	NONE
ACES Systems Analyzer	1725 Trim TEC
Firmware Version	2.08C or greater
Procedure Cards	CFE-738 Vibration V3.30

Introduction

This Application Note contains specific directions on how to perform a single engine fan survey, and fan trim balance on CFE-738 engines. This Application Note describes the steps necessary to perform the physical set up of equipment, (analyzer, cabling, sensor mounting, etc.) and the steps necessary to perform each of the tasks.

A. Required Equipment

The following ACES Systems' equipment is required.

Item	Quantity	Description	Part Number
1.	1EA	Analyzer, 1725 Trim TEC	1725-110V
2.	1EA	Mount, Lasetach, Swivel	10-100-0369
3.	1EA	Tachometer, Lasetach, Model 299	10-100-1300
4.	1EA	Cable, Tachometer, Generic 50 ft.	10-320-0126
5.	2EA	Mount, Isolator	10-400-2986
6.	2EA	Accelerometer, B&K 4382	69-100-0033
7.	2 EA.	Microdot-to-BNC Cable, 3 Ft.	75-200-0031
8.	2 EA.	Converter, Charge, ACES Model 510-2	10-100-1502
9.	2 EA.	Cable, Interface , 991V	10-320-0142
10.	2 EA.	Cable, Vibration, Generic 50 FT.	10-320-0127

11.	1 EA.	Procedure, CFE738 Vibration	11-100-0072

Optional Equipment

12.	2 EA.	B&K 4383 Accelerometer (Same specification as 4382 Model but with side mounted connector)	69-100-0034
13.	1EA.	Phototach Optical Tachometer .	10-100-1773
14.	1EA	Cable, Interface, Falcon 2000 – 1725, LEFT	10-320-0255
15.	1EA.	Cable, Interface, Falcon 2000 – 1725, RIGHT	10-320-0256

Miscellaneous Equipment.

Trim Balance Class weight set for CFE-738

B. Equipment Installation

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.

1. Vibration sensors:
   a. Remove the onboard vibration sensor from the engine installed mount. Install the isolator mount, item 5., on the engine installed mount where the onboard vibration sensor was removed. Torque the isolator to 18 inch pounds.
   b. Install the 4382 accelerometer, item 6, or optionally the 4383 accelerometer, item 12, on the isolator mount, item 5, by threading the stud of the isolatorr into the 10/32 threaded hole in the sensor. NOTE: If a mounting stud is installed on the sensor, it will be necessary to remove it.
   c. Connect the Microdot connector end of the Microdot-to-BNC cable, item 7, to the connector of the 4382 accelerometer, item 6 or optional 4383 accelerometer, item 12.
   d. Connect the BNC end of the Microdot-to-BNC cable, item 7, to the BNC input side of the 510-2 charge converter, item 8.
   d. Connect the 991V interface cable, item 9, to the four-pin MS connector side of the 510-2 charge converter, item 8.
   e. Connect the six-pin end of the 991V interface cable, item 9, to the bulkhead socket connector of the Generic 50 Ft. Vibration Cable, item 10.
   f. Repeat steps 1 through 6 for the second vibration input. If using two sensors, one should be mounted at the 12:00 o'clock position and one at the 9:00 o'clock for the right (#2) engine, or 3:00 o'clock position for the left (#1) engine.
   g. Route all cables away from hot areas and high voltage wiring. Secure the cables with tie wraps or tape to prevent chaffing or ingestion into the engine. Route cables along the

fuselage to the passenger door, securing them to the fuselage with tape every six to eight feet. Route the cable through the lower aft corner of the door.

h. Place the 1725 Trim TEC analyzer, item 1, in the aircraft where it will be used. Route the Generic vibration cables item 4, to the analyzer and connect them to the vibration inputs you intend to use for the procedure (Eng. 1A, 1B or Eng. 2A, 2B).

NOTE

The following steps are for installation of the Lasetach and Phototach (optical tachometers) and are only necessary if you are conducting the Fan Vibration Survey and/or Fan Trim Balance portion of the procedure.

2. Lasetach:

   a. Assemble the Lasetach, item 3, and the Lasetach Mounting Bracket, item 2.

   b. Attach the base of the Lasetach Mounting Bracket, item 2, to the top surface of the wing near the leading edge or on the fuselage just aft of the main entry way with duct tape or aluminum speed tape across all four sides of the base.

   c. Connect the bulkhead socket connector end of the 50-ft. Generic Tachometer Cable, item 4, to the connector of the Lasetach, item 3. Route the opposite end of the cable to the lower aft corner of the main entry way then to the location of the analyzer and connect the three pin connector to the 1725 Analyzer, item 1, at the TACH 1 or TACH 2 input corresponding to the input you intend to use.

   d. Refer to Figure 4 of the Equipment Installation Diagram section for the following steps. Select a bolthole to be designated as the number 1 hole. . The photograph shows the approximate location for both the Lasetach application, near the point of the spinner, and the Phototach application, near the fringe of the spinner body. Select the appropriate location and clean the area thoroughly to remove dirt, grease and oil residue.

   e. Cut a two-inch length of tape and leave the backing in place. Draw an imaginary line from the point of the spinner to the center of the bolt hole you will designate as hole number 1. (See Figure 4 in the Equipment Installation section.) Remove the backing from the tape. Carefully apply the tape with the leading edge of the two-inch side aligned along the imaginary line. Insure that there are no air bubbles under the tape and that the edges are firmly attached. Bubbles and loose edges will act as an airfoil at high speed and cause the tape to separate from the spinner.

   f. Rotate the fan until the tape is in a position most nearly in a direct line to the Lasetach as viewed from forward looking aft.

   g. Turn the analyzer ON by pressing the ON/OFF key. Remove the protective cap from the Lasetach aperture Turn the LASER switch, located on top of the Lasetach, to the ON position.

WARNING

Do not look into the aperture of the Lasetach as permanent eye damage can occur.

   h. Verify that the laser is powered by placing an object in front of the laser aperture and observing the red laser being projected onto the object. (It will appear as a small red dot.)

i. Loosen the locking handle of the Lasetach swivel mount, item 2., just enough to enable movement of the Lasetach with some resistance. Use a "gunsight" method of looking across the top of the Lasetach body and align the laser beam on the center of the reflective tape attached to the spinner. You may safely project the laser beam onto your finger to assist in alignment during daylight when the laser is difficult to see. When the laser is aligned correctly and strikes the reflective tape, the reflection of the laser beam will glow brightly and be very apparent.

j. When the laser is aligned, tighten the locking handle of the Lasetach swivel mount, item 2., and recheck the alignment with hands off the assembly. Readjust if necessary using small movements.

k. When satisfied with the alignment, have an assistant rotate the fan. Check to insure that the green GATE light, adjacent to the ON/OFF switch of the Lasetach, flashes as the reflective tape passes through the laser beam projected on the spinner. When alignment and gate are verified, leave the laser power switch of the Lasetach in the ON position. Turn the analyzer OFF until ready to begin the survey or balance procedure to conserve battery power.

3. Phototach:

a. Assemble the Phototach, item 14, and the Phototach Mounting Bracket if necessary.

b. Remove the inlet pressure and temperature sensor mounting bolts, sensor and gasket from the mounting boss on the fan inlet duct. Do not disconnect the sensor from the engine wiring harness. Secure the sensor to the fan inlet duct with tape. Install the Phototach Mounting Bracket to the mounting boss on the fan inlet duct using one of the bolts removed from the sensor.

c. Connect the bulkhead socket connector end of the 50-ft. Generic Tachometer Cable, item 4, to the connector of the Phototach, item 13. Route the opposite end of the cable to the location of the analyzer and connect the three pin connector to the 1725 Analyzer, item 1, at the TACH 1 or TACH 2 input corresponding to the input you intend to use.

d. Refer to Figure 4 of the Equipment Installation Diagram section for the following steps. Select a bolthole to be designated as the number 1 hole. . The photograph shows the approximate tape location for using both the Lasetach, near the point of the spinner, and the Phototach, near the fringe of the spinner body. Select the appropriate location and clean the area thoroughly to remove dirt, grease and oil residue.

e. Cut a two-inch length of tape and leave the backing in place. Draw an imaginary line from the center of the bolt hole you will designate as hole number 1 to the aft edge of the spinner body. (See Figure 4 in the Equipment Installation section.) Remove the backing from the tape. Carefully apply the tape with the leading edge of the 1-inch side aligned along the imaginary line approximately half way between the bolt hole and the aft edge of the spinner body. Insure that there are no air bubbles under the tape and that the edges are firmly attached. Bubbles and loose edges will act as an airfoil at high speed and cause the tape to separate from the spinner.

f. Rotate the fan until the tape is directly under the Phototach.

g. Turn the analyzer ON by pressing the ON/OFF key.

h. Verify that the Phototach is powered by placing an object in front of the lens and observing that the red light is being projected from the lens.

i. When the Phototach is aligned correctly with the reflective tape the red LED on the aft end of the Phototach will illuminate and remain illuminated as long as the projected light from the Phototach is being reflected from the tape and being received back at the Phototach. Insure the LED remains illuminated as you slowly rotate the fan enough to pass the entire length of tape through the light beam. If necessary, adjust the position of the Phototach or replace the tape.

j. Rotate the fan by hand for several revolutions. Check to insure that the red gate indicator on the aft end of the Phototach flashes as the reflective tape passes the point where the light beam strikes the spinner. When alignment and gate are verified, turn the analyzer OFF until ready to begin the balance procedure.

Equipment Installation Diagram

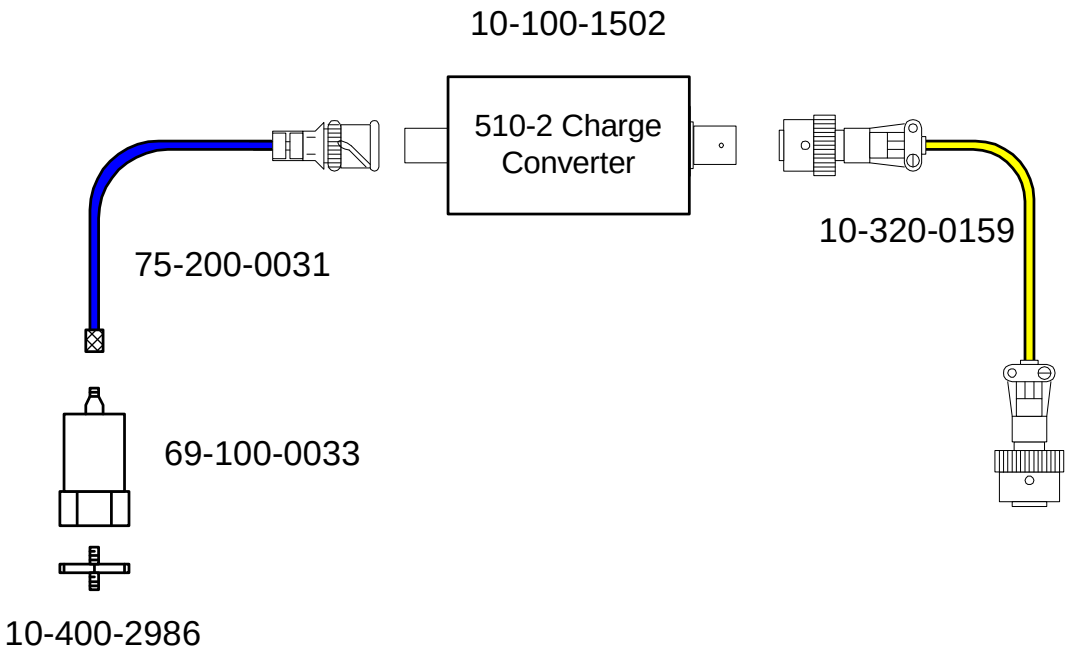


Figure 1. Equipment Installation Diagram

Figure 1, above, illustrates how each of the components of a vibration pickup assembly are placed in reference to the other components.

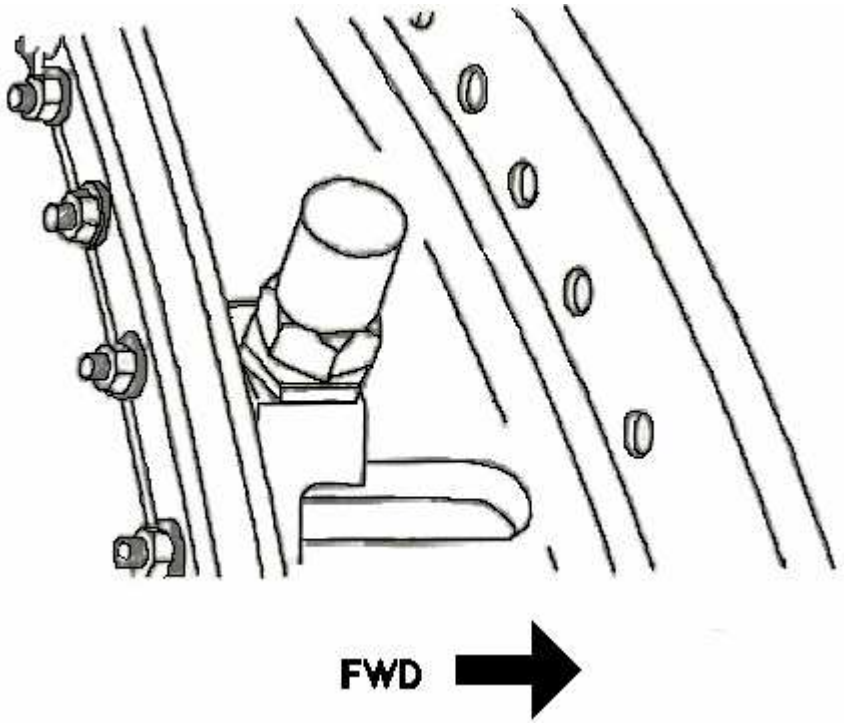


Figure 2. Equipment Installation Diagram

Figure 2. above illustrates a typical installation of the vibration sensor mounted on its TFE731-60 sensor mount. The mount is bolted to the fwd side of the flange at 12 o'clock and 9 o'clock if using two sensors or 12 o'clock and 3 o'clock depending on the mounted position of the engine.

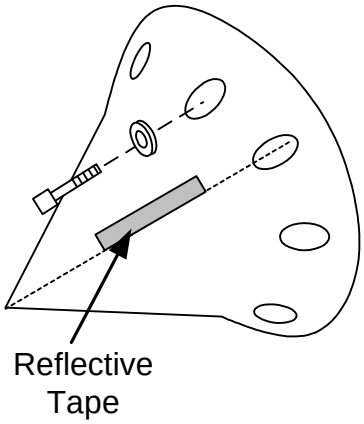


Figure 3. Equipment Installation Diagram

Figure 3, above, illustrated the positioning of reflective tape for use with the Lasetach, near the point of the spinner. The hole aligned with the tape is designated as hole #1..

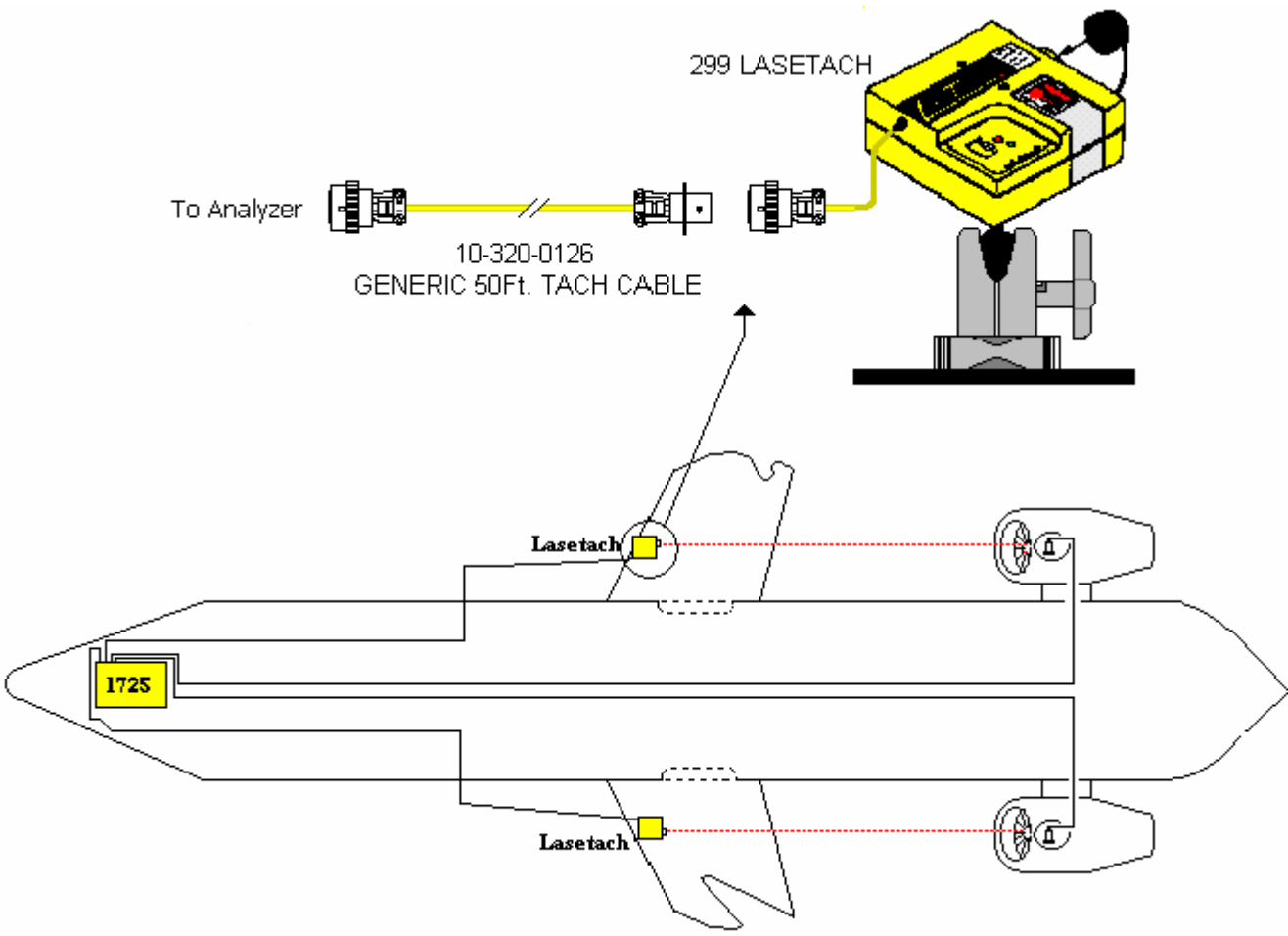
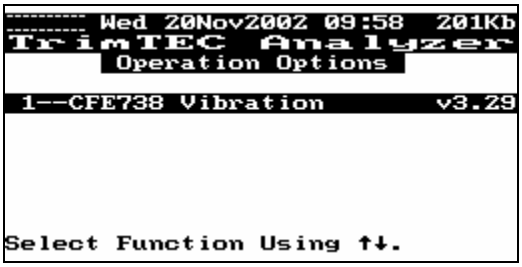


Figure 5. Equipment Installation Diagram

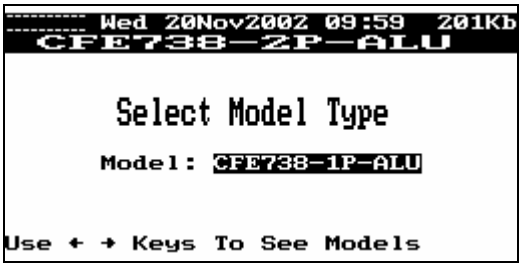
Figure 5. above illustrates the approximate positioning of the Lasetach(s) on the wing. If the angle to the spinner is too great for the laser beam to clear the engine intake, you may position the Lasetach on the side of the fuselage.

C. Analyzer Set Up

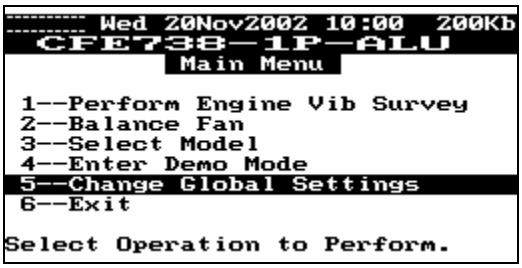
1. Turn the Analyzer power ON by pressing the ON/OFF key.
2. When the main menu screen is displayed, use the **[UP ARROW]** or **[DOWN ARROW]** key to select CFE738 Vibration. Press **[ENTER]** to accept and continue.



3. After the “DO NOT EXCEED....” and battery self test information screens extinguish the “Select Model Type” screen will be displayed. Use the **[RIGHT ARROW]** key to scroll through the description of the spinner type on the model you are balancing, 1 piece aluminum, 1 piece composite, or 2 piece aluminum . Press **[ENTER]** to accept and continue.



4. Prior to proceeding tot he actual balance job, you should check, and if necessary edit the Global Settings page. To access the Global Settings from the Main Menu shown below, select “5—Change Global Settings” and press ENTER.



5. The Global Settings screen, shown below, will be displayed. Use the [UP ARROW] or [DOWN ARROW] keys to move from field to field and the [LEFT ARROW] and [RIGHT ARROW] keys to select from selection fields or use the analyzer keypad to enter values in a field. The fields are as follows"

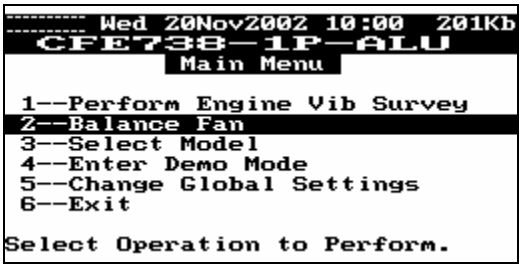
- **Freq Unit** : This is a selection field with options of RPM or Hz as desired. This is the units of speed that will be shown for the vibe survey and balance job.
- **Spds** : This is the number of balance speeds selection field. You may choose a number of speeds between 1 and 3. ACES recommends three speeds for balancing.
- **Balance Band Width** : This is the total band width (Fan speed – and + the displayed values) of the tracked fan speed. For instance, if the fan is currently stable at 10,000 RPM and this band width is set at .98 – 1.02, the total band width where vibration data is being collected would be from 9,800 to 10,200 RPM. This band width can be set to several predetermined settings. A more narrow band width dictates a closer adherence to a slow steady acceleration from idle to max power in not less than one minute (60 seconds).
- **Baln Job Minimizes** : This is a toggle selection, *Peak Vibe* or *Average Vibe*. The selection of Peak Vibe will target the peak vibration as determined by a vibration survey or user entered speed and attempt to reduce that peak without regard to how it may affect vibration peaks at other speeds. The selection of Average Vibe will attempt to reduce the vibration over several peaks from different speeds while not increasing any single peak in order to reduce another. The result of the Average Vibe selection is that vibration over a given speed range (cruise through max power for instance) will be relatively stable but may not be reduced to the lowest possible vibration at any single speed.

- **Too Type** : This selection sets the tach input type for the smart tach processor. If you are using the low tooth tach output directly from the engine, you should select "Low" or "Offset". If you are using an external lasetach or phototach, select NONE.
- **Print ACES Header** : This is a YES or NO toggle field. If you select YES the ACES header will be printed for jobs printed directly from the analyzer to a printer. The NO select will print the job without the ACES header.
- **Influence From** : This selection determines what influence coefficient will be used for the balance job. There are three possible selections:
  - **Default** : This selects the influence stored as the default setting in the balance program. It was derived from an average of numerous test cell balanced engines.
  - **Previous** : This selection will use the influence calculated by the analyzer for the previously balanced engine using the same analyzer and engine model. If the analyzer has been reinitialized or the battery has been allowed to go dead, there may be no influence stored in this selection. It will automatically use the default setting in either of these cases.
  - **Editing** : This selection will produce a screen where you may enter an influence into the analyzer for this job. This selection is most useful when attempting to balance an engine for which you have a known influence recorded from a previous balance job. It is also useful when balancing an engine which has historically not reacted in a typical manner during previous balance attempts.
- **Split Wt. @ 1st Run :** This is a toggle, YES or NO, answer field. If you select YES, the analyzer will provide a split weight (spread over multiple holes) solution as the first solution in an effort to balance. The YES answer should be selected when you have a known good influence coefficient (from editing or from previous). The NO answer will provide a single hole solution on the first run which is then used to calculated an influence from the single weight placement and provide a balance solution spread over several holes after the second run.
- **Vibe Err for AutoAcq:** This setting allows the analyzer to decide when the acquired data is sufficient to accurately calculate an influence coefficient and automatically stop taking data. The Vibe error level you enter determines when the auto acquire will stop collecting data. The default is 0.1 IPS and is normally sufficient for accurate data gathering. If you set the level to "0.0" the analyzer will continue to gather data until you manually stop it by pressing ENTER.

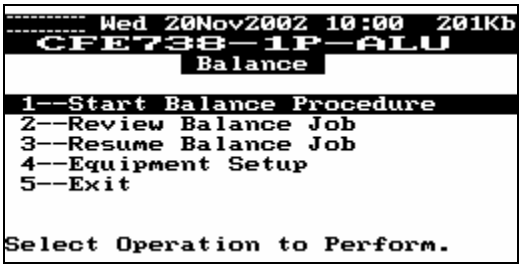
When all fields are set according to your requirements, press **[ENTER]** to accept the settings and continue.

6. When the Main Menu banner screen is again displayed, check to be sure the banner does not show the " + DEMO CFE738 +" banner. If the screen does display the DEMO banner, the procedure will not collect data in an actual balance or survey job. Notice that line 4 in the menu screen below reads "4—Enter Demo Mode". This indicates that the analyzer is currently in the NORMAL mode. To place the analyzer to the DEMO Mode, select "4—Enter DEMO Mode" and press **[ENTER].** The screen will revert to DEMO Mode and display the screen indicating DEMO in the banner.

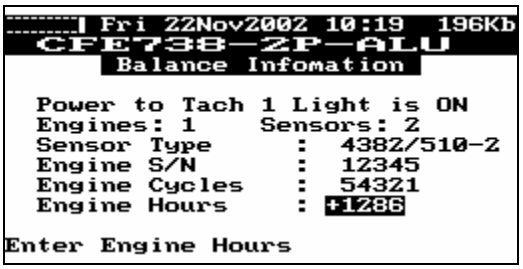
7. From the MAIN MENU banner screen, select “2--Balance Fan” and press **[ENTER].**



8. From the “Balance” banner screen, select “1-Start Balance Procedure” and press **[ENTER]**.



9. The Balance Information screen will be displayed. Use the **[UP ARROW]** or **[DOWN ARROW]** key to move between the fields and complete the screen as follows:

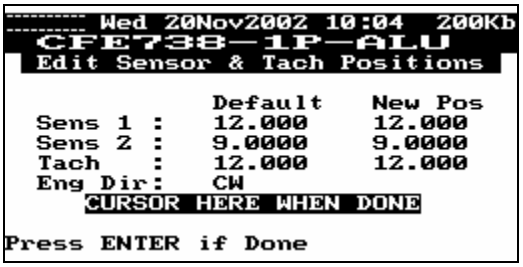


- **Power to Tach 1 Light is ON** : This indicates that power is available to the Phototach or Lasetach for conducting the alignment checks.
- **Engines :** This is a toggle selection field, 1 or 2, to indicate how many engines you are balancing during this job. Use the [RIGHT ARROW] key to toggle the selection.
- **Sensors :** This is the number of sensors attached to the engine for use with this balance job. This is a toggle, 1 or 2, field. Use the [RIGHT ARROW] key to toggle the selection.

- **Sensor Type :** This is a select field which indicates the type sensor you will use for this balance job. Use the [RIGHT ARROW] key to scroll through the list of available sensors. One of the selections is "FALCON 2000" which indicates you are using the onboard vibration sensor to balance. This is acceptable for balance only but not for a pass-fails vibration survey because the onboard sensor is not routinely calibrated. NOTE – Selection of this sensor requires that you use the Falcon 2000 Interface cable, item 14 or 15.
- **Engine S/N :** Enter the engine serial number from the analyzer keypad. This is an optional field and need not be completed to continue.
- **Engine Cycles :** Enter the number of engines cycles from the analyzer keypad. This is an optional field and need not be completed to continue.
- **Engine Hours :** Enter the total engine hours from the analyzer keypad. This is an optional field and need not be completed to continue.

Press **[ENTER]** to accept the values in all fields and continue.

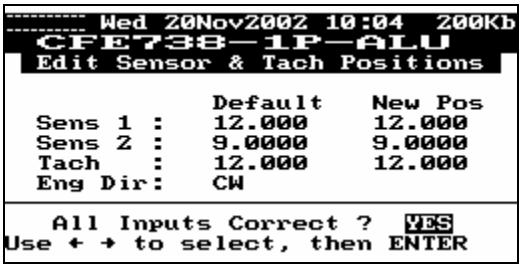
10. The "Edit Sensor & Tach Positions" banner screen will be displayed. Use the **[UP ARROW]** or **[DOWN ARROW]** keys to navigate between the fields. Accuracy of these positions will shorten the number of runs necessary to balance the fan. If they are incorrect, the balance job should still be successful but may require additional runs. Complete the fields as follows:



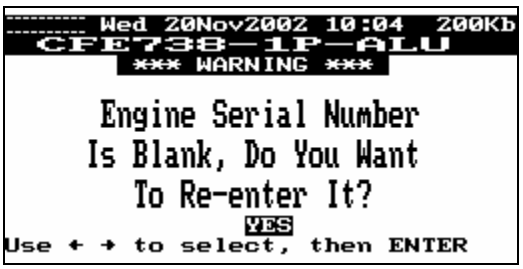
Sens 1: Indicates the position of the sensor designated as "1". Notice that the Default position is 12.00 indicating twelve o'clock. This clock position is established from a viewpoint of standing Forward of the engine Looking Aft (FLA) into the intake of the engine. Number 1 sensor should always be at the 12:00 position if possible. If you must change the position, place the cursor in this field and enter the new position in hours and minutes, separated by a decimal (".") which is inserted using the ". MARK" key. The tachometer position is determined by the relative clock angle where the Phototach or Lasetach light beam is projected onto the fan assembly. When you have entered and verified the position of both sensors (if two sensors are being used) and the tachometer device, move the cursor to "CURSOR HERE WHEN DONE" and press **[ENTER]** to accept your inputs and continue.

11. The screen will display a verification statement "All Inputs Correct?" followed by a toggle "YES" or "NO" answer. Recheck the positions and use the **[RIGHT ARROW]** key to indicate your response. A "YES" response will allow you to continue with the balance

procedure. A “NO” response will return you to the previous screen where you may make corrections as necessary.

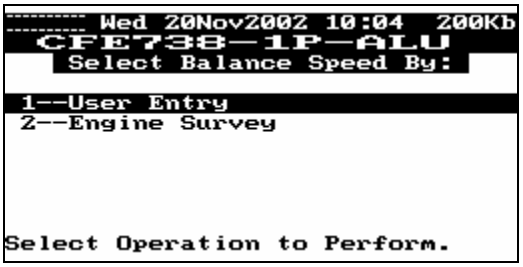


12. If you did not enter an Engine Serial Number in item 9 above, the WARNING screen below will be displayed. At this point you must verify that you do or do not wish to enter the number by selected “YES” to enter the number or “NO” to ignore the warning and proceed. Use the **[RIGHT ARROW]** or **[LEFT ARROW]** keys to change the selection and press **[ENTER]** to execute your choice. If you choose “YES” the screen will return to the information screen view where you may enter the Serial Number.

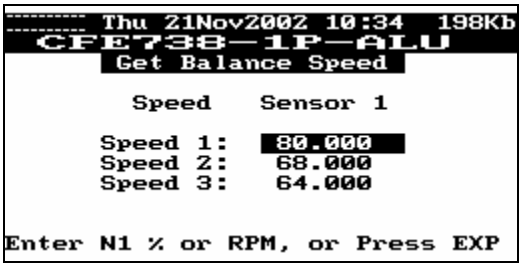


13. The “Channels Selection” banner screen will appear and display the default inputs for the engine(s). To the left is the “Eng.” number and to its right, the “Sensor” and “Tach” connector identification located at the rear of the analyzer. The “Sensor” and “Tach” are select fields and can be changed to Eng 1A, Eng 1B, Eng 2A, or Eng 2B for the Sensor field and Tach 1 or Tach 2 for the Tach field, as you desire. Use the **[RIGHT ARROW]** or **[LEFT ARROW]** keys to toggle between these selections. Your selection in this field must match the actual input at the rear of the analyzer for vibration and tach input. Notice that a message at the bottom of the screen indicates that “Power to Tach Light (1 or 2) is ON”. The tach connect to the indicated input is powered at this time to facilitate laser alignment and tape placement. If using two tachs, use the **[DOWN ARROW]** key to move the dark highlight bar to the opposite tach field and power it for alignment and tape placement. When complete, press the **[DOWN ARROW]** key to move the dark highlight bar to the “CURSOR HERE WHEN DONE” field, then press **[ENTER]** to continue.

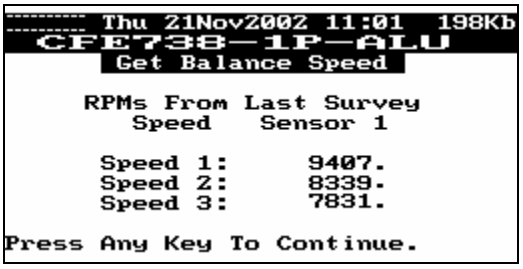
14. The “Select Balance Speed By:” screen will be displayed. The choices are “1—User Entry” or “2—Fan Vib Survey”. If you are attempting to resolved a reported condition at a specific speed, the User Entry will allow you to enter the actual speed of the complaint and balance the fan at that speed. If you are simply attempting to improve the general noise and vibration condition of the fan, it is best to let the analyzer determine, through a Fan Vib Survey, what speeds to use for balance. You might also wish to check the “Change Global Settings” in section “E. Change Global Settings” of this document for the number of balance speeds. Three balance speeds are best when attempting a general noise and vibration reduction throughout a power lever range. Press the **[DOWN ARROW]** key until the dark highlight bar is over your selection, then press **[ENTER]** to accept and continue.



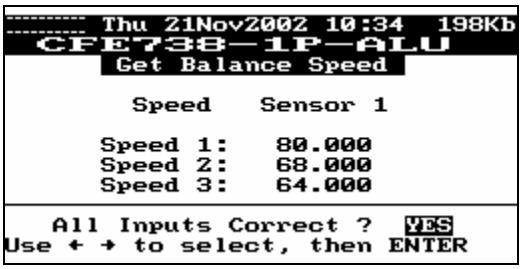
15. If you selected “1—User Entry” the analyzer will prompt you to enter the desired balance speeds for each sensor as shown in the screen below. Use the **[UP ARROW]** or **[DOWN ARROW]** to navigate between fields. Pressing either the **[RIGHT ARROW]** or **[LEFT ARROW]** keys will clear the current field and require you to input a speed. The speeds may be entered as either an N1% or an actual fan RPM. If the entered speed is 100 or less, the analyzer understands it to be a N1% and will automatically calculate the actual fan RPM. If the speed is above 100 the analyzer interprets the input to be an actual fan RPM.



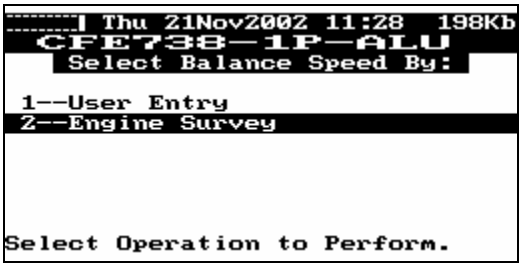
Pressing the **[EXP]** key, as an alternative will automatically enter the speeds from the last fan survey conducted as illustrated in the screen below. These speeds may not be desirable for the current balance job. To attain new speeds from a fan survey, go to item 17 below. From either of these two screens (above and below) press **[ENTER]** to accept the inputs and continue.



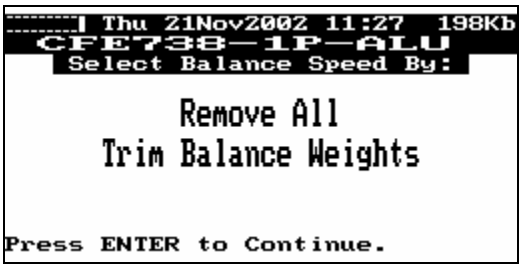
16. The screen will display the verification screen shown below to insure the speeds are correct. If the speeds are not correct, press the **[RIGHT ARROW]** key once to change the answer field to "NO", then press **[ENTER]**. The screen will return to that shown in item 15 above. If the speeds are correct, use the **[RIGHT ARROW]** key, if necessary, to change the answer field to "YES" then press **[ENTER]** to continue. For user entered speed proceed from this point to section "D. Data Acquisition". For speeds from Fan Vib Survey, go to item 16 below.



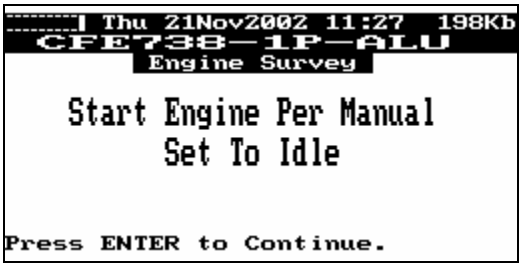
17. If you select "2—Fan Vib Survey", the analyzer will step you through the process to obtain these speeds as illustrated below.



18. The screen will display the Fan Vib Survey banner and the information message "Remove All Trim Balance Weights". Verify that all previously installed trim balance weights have been removed and press **[ENTER]** to continue.



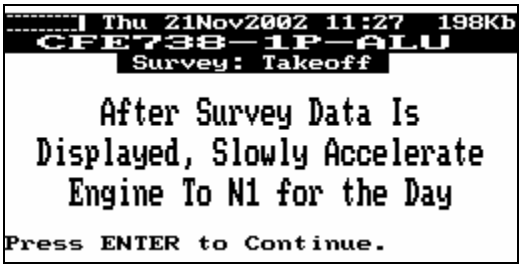
19. The screen will display the informational message “Start Engine Per Manual Set To Idle”. Acknowledge the message by pressing **[ENTER].**



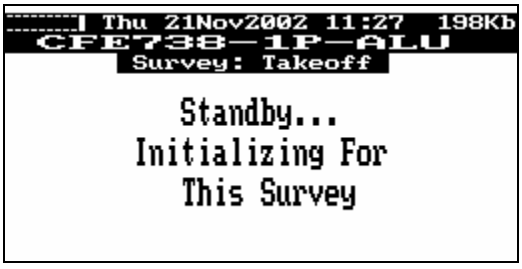
CAUTION

Allow the engine to warm up to normal operating temperatures before you continue the procedure. If the engine is operated at high power settings before the engine is allowed to warm up, abnormal vibrations may be indicated.

20. The screen will display an informational message “After Survey Data Is Displayed, Slowly Accelerate Engine to N1 for the Day”. As indicated at the bottom of the screen, “Press **[ENTER]** to Continue” and exit this screen.

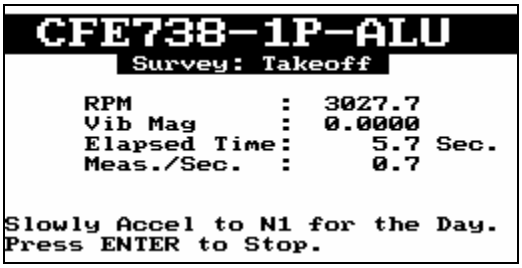


21. The next screen will display the message “Standby…..Initializing for This Survey”. You should remain at idle while this screen is displayed. When initialization is complete the screen will change to the one shown in item 22 in the Data Acquisition section below.

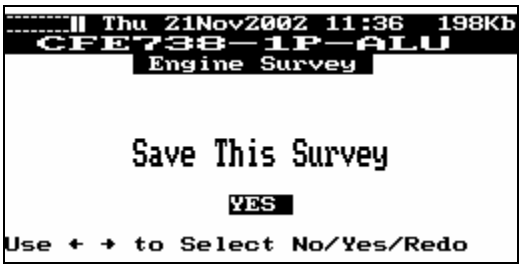


D. Data Acquisition

22. When initialization is complete, the screen below will be displayed. (NOTE: The data shown on the screen below is for illustration only and does not reflect what the actual data should or will be.) When the screen is displayed it should reflect the Current RPM, which should be idle at this point. As stated at the bottom of the screen “Slowly Accel to N1 for the Day.” At this time you should begin a slow, steady acceleration to N1 for the day. The acceleration should not be completed in less than 60 seconds to allow the analyzer time to gather data for the full operating range. An acceleration of more than 60 seconds is acceptable as long as the entire process is completed at a steady rate. An acceleration of more than 60 seconds is preferable over one of less than 60 seconds. You may the “Elapsed Time: “ line to estimate your progress. When you reach N1 for the day, allow the engine to stabilize for approximately ten seconds then, “Press ENTER to Stop”.



23. The analyzer will display a spectrum of the acceleration with an installed limit line as a quick reference to indicate whether LMM limits were exceeded. At this time you may press the [RIGHT ARROW] key one time to place the cursor on the highest peak amplitude encountered during the survey. Press **[ENTER]** to continue. An information screen will be displayed as shown below.

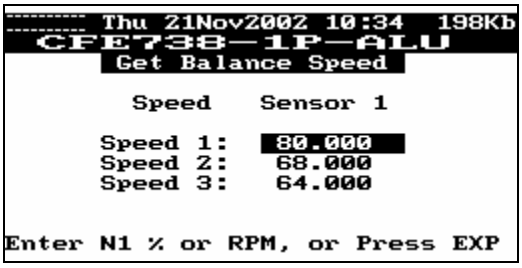


24. As indicated at the bottom of the screen, “Use the **[LEFT ARROW]** or **[RIGHT ARROW]** keys to change the answer field to “NO” if you do not wish to save this survey, “YES” if you do wish to save the survey, or “REDO” if you wish to discard this survey and acquire a new

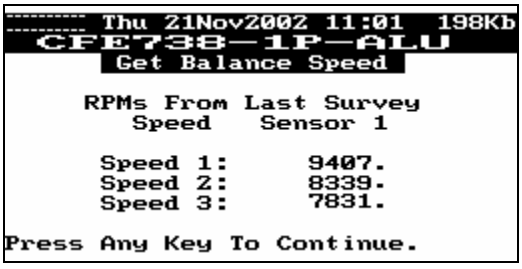
one. REDO will return you to the beginning of the data acquisition process. The sequence will then be repeated for sensor two.

The YES or NO answers following the sensor tow survey will proceed to the screen shown in item 4.

25. The “Get Balance Speed” banner screen, shown below will be displayed and indicate the speed(s) at which the highest fan vibration amplitude occurred during the acceleration. (NOTE: The DEMO mode was used to generate this example screen.) The screen is an example showing a three speed, two sensor balance. Notice at the bottom of this screen that you may enter an N1% or RPM, or Press EXP. Pressing the EXP key will produce the screen in Item 5 below. If you choose to edit the speeds on this screen, use the **[UP ARROW]** or **[DOWN ARROW]** key to move the highlight bar from speed to speed and enter the desired speed for each condition from the keypad. NOTE: This is not recommended as the analyzer has automatically chosen the best speeds for reducing noise and vibration. If you wish to accept those speeds acquired by the Fan Survey, or if you have changed the speeds and wish to accept them, simply press **[ENTER]** to continue and go to item 6 below.

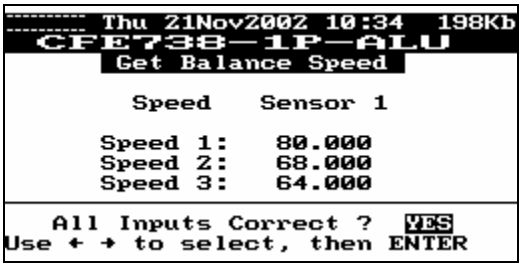


26. Pressing the EXP key from the screen above in item 3 will produce a “Get Balance Speed” screen showing the “RPMs From Last Survey” as illustrated below. Notice that in this case, there are no speeds for Speed 2 or 3 for either Sensor 1 or 2. This indicates the previous survey was taken with Global settings having been set to a single speed and a single sensor. As indicated at the bottom of the screen, Press Any Key To Continue. This action will return you to the previous Get Balance Speed screen.

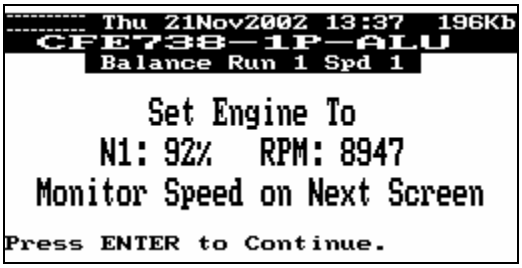


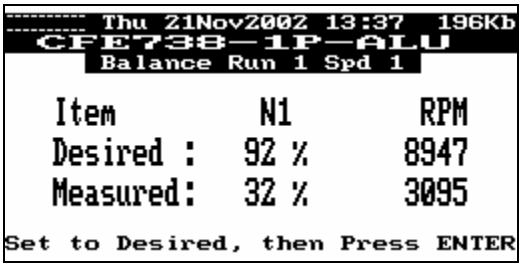
27. The screen below will be displayed to allow you to confirm these are the speeds you wish to use for the balance job. As shown at the bottom of this screen, you must confirm that you

agree “All Inputs Correct? (YES/NO). The default is YES and if you choose to accept these speeds, simply press **[ENTER]**. If the speeds do not reflect the speeds you wish to use, press the [RIGHT ARROW] key one time to toggle the answer field to NO and press **[ENTER]**. This action will return you to item 4 above.



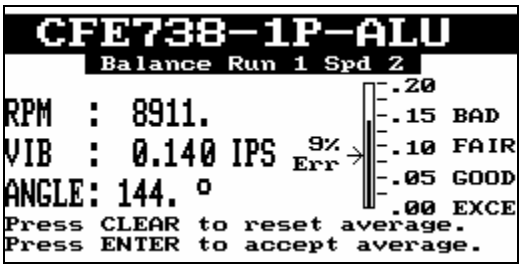
28. When the balance speeds have been confirmed the analyzer will proceed with the Fan Trim Balance procedure. As directed in the screen below, “Set Engine To N1 : xx%, RPM: xxxx” When ready to accelerate the engine to the indicated power setting, press **[ENTER]** to monitor the speed on the next screen. Match the indicated speed with the target speed.





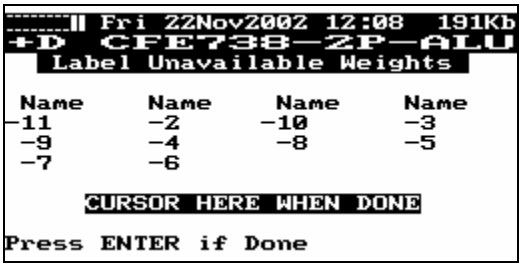
29. When the engine is set at the desired speed, press [ENTER] to begin acquiring data. The first screen below will be displayed then automatically change to the second screen below. DO NOT adjust the speed of the engine while the data acquisition is taking place. Allow the analyzer to collect data until the VIB: and ANGLE: readings are stable. The indicator at the right side of the screen, with the thermometer appearance, will also stabilize and remain relatively steady. The small arrow to the left of the thermometer will continue to move up and down as data is acquired. Another indication that the data is acceptable on the initial runs is the “% Err” indication just to the right of the VIB reading. If this number is relatively low,

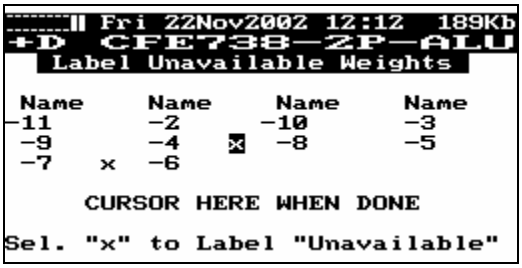
or at 0, press **[ENTER]** to stop data collection. (NOTE: This "% Err" reading may not drop to a very low readings if the vibration amplitude is also low, such as after the later runs of the job when vibration has already been reduced significantly. *This is not an indication of a fault.*



30. If you set the AUTO ACQUIRE function in GLOBAL SETTINGS, the analyzer will stop taking data automatically. If you set the AUTO ACQUIRE to 0.0, the analyzer will continue to acquire until you press the [ENTER] key on the analyzer to stop acquisition. In either case, the screen below will be displayed to indicate the analyzer is calculating the optimum weight placement for the balance solution. Do not press any keys while this screen is displayed. When the optimizing function is complete the analyzer will proceed to the next screen automatically.

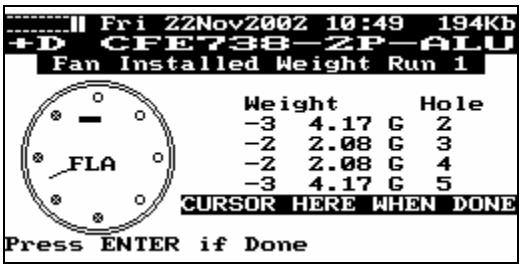
31. The next screen displayed will be the Solution Run screen. This screen displays the suggested weights and their individual hole placement. If you do not have a full set of balance weights, you may press the EXP key from this screen to edit the weight set and have the analyzer optimize a solution using only the weights you have available. (See the second and third screens below) If you do not wish to edit the class weight set, make note of the solution and proceed to the engine to install the weights.



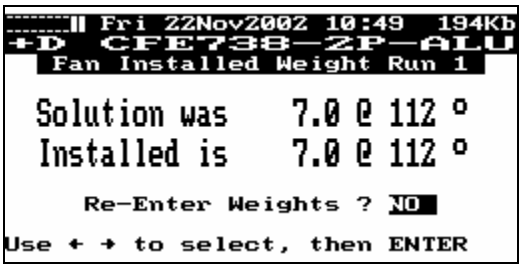


32. When the weights have been installed on the engine, return to the analyzer and press [ENTE] to continue. The information screen below will prompt you to Record The Weights Installed On The Fan Between Run X and Run X (where the first X is the run just completed and the second X is the run you are about to begin.) Press [ENTER] to proceed to the weight entry screen.

33. When the “Fan Installed Weight” banner screen, shown below, is displayed, use the [UP ARROW] and [DOWN ARROW] key to navigate between fields and the [LEFT ARROW] and [RIGHT ARROW] keys to scroll through the available choices for each Weight or Hole field. When the screen reflects the actual installed weights and hole numbers, move the cursor to the “CURSOR HERE WHEN DONE” line and press [ENTER] to accept the settings and continue.



34. The screen will display the suggested solution "Solution was" and the actual solution you installed "Installed is". A question reading "Re-Enter Weights?" followed by a toggle YES/NO answer field. If the displayed Installed solution is correct, you need only verify the NO answer is displayed and press [ENTER]. If the solution is not correct, use the [RIGHT ARROW] key to toggle the answer field to YES and press [ENTER]. You will be returned to the screen shown above in item 33 where you may correct the installed weight.



35. From this point the analyzer will direct you to Start Engines, and the process will repeat from step 28 above until the vibration is reduced to a satisfactory level.