



Application Note

Application Note Number	E-GE-CF6-1725-FB-3.20
Revision	1
Function	Fan Trim Balance
Airframe	Multiple
Engine	General Electric CF6
Other Application Notes Required	NONE
ACES Systems Analyzer	1725 Trim TEC
Firmware Version	2.04 or greater
Procedure Cards	CF6 Engine Balancing

Introduction

This Application Note contains specific directions on how to perform a single engine fan trim balance on aircraft equipped with General Electric CF6 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 the 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	Cable, Tachometer Input	As Required for airframe
3.	2 EA.	Cable, Vibration Input	As Required for airframe
4.	1 EA.	Procedure, General Electric CF6 Balancing	11-100-0086

Optional Equipment

As required for the airframe

B. Equipment Installation

1. **Vibration:** Connect the vibration source cable to the analyzer at one of the four vibration inputs. These inputs are 6 pin socket connectors and marked “Engine 1 A and B” and “Engine 2, A and B”. Make note of the sensitivity of the vibration source. This is normally expressed in millivolts per engineering unit, such as 1000 mV/IPS. Consult the airframe or engine manual for this value.
2. **Tachometer:** Connect the vibration source cable to the analyzer at one of the two tachometer inputs. These inputs are 3 pin socket connectors and marked “Tach 1” and “Tach 2”.
3. **Procedure Card:** If the procedure for the CF6 has not be installed on the analyzer, or if it has be removed, install the procedure as follows.
 - a. With power to the analyzer OFF, insert the card into the procedure card slot on the right side of the analyzer.
 - b. Make sure the card is securely seated on the pins by pushing the card firmly into the slot.
 - c. Turn the analyzer ON by pressing the ON/OFF key.
 - d. The analyzer screen will display the first procedure loaded on the card. If this is not CF6 Engine Balancing, press the down arrow key until the screen reads CF6 Engine Balancing. When the CF6 Engine Balancing procedure is displayed, press ENTER.
 - e. When the screen returns to the “Operation Options” menu screen, turn the analyzer OFF by pressing the ON/OFF key. Remove the card from the analyzer.

Equipment Installation Diagram

See Airframe Specific Appnote

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 “CF6 Engine Balancing”. Press [ENTER] to accept and continue.

```

----- Mon 11Jun2001 14:31 89Kb
TrimTEC Analyzer
Operation Options
1--RB211 Balancing v3.22
2--CF6 Engine Balancing v3.208

Select Function Using ↑↓.

```

- After the “DO NOT EXCEED...” and battery self test information screens extinguish the “Select Model Type” screen is displayed. Use the [RIGHT ARROW] key to scroll through the model numbers until the line matches the engine model you are about to balance. Press [ENTER] to accept and continue.

```

----- || Mon 11Jun2001 14:39 88Kb
WARNING !

DO NOT Exceed ANY
Flight Manual or
Maintenance Manual Limits

```

```

----- || Mon 11Jun2001 14:39 88Kb
+ DEMO CF6-80A +

Select Model Type

Model: CF6-80A

Use ← → Keys To See Models

```

- From the MAIN MENU banner screen, select “1BBalance Fan” and press [ENTER].

NOTE

If conducting a normal balance job, line 3 on this menu should read “Enter Demo Mode” and the banner at the top of the screen should appear as shown below. If the banner indicates “DEMO” line 3 will read “Enter Normal Mode”. If this is the case, select line 3 and press ENTER. If the banner at the top of this screen reads “DEMO”, the analyzer is configured for training and will not perform the balance job.

```

-----|| Mon 11Jun2001 14:35 88Kb
+ DEMO CPG-80A +
      Main Menu
1--Balance Fan
2--Select Model
3--Enter Normal Mode
4--Change Global Settings
5--Exit
Select Operation to Perform.

```

```

-----| Mon 11Jun2001 14:34 88Kb
      CPG-80A
      Main Menu
1--Balance Fan
2--Select Model
3--Enter Demo Mode
4--Change Global Settings
5--Exit
Select Operation to Perform.

```

If you wish to review or change the Global Settings, see Global Settings on page 13 of this document.

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

```

-----|| Mon 11Jun2001 14:41 88Kb
      CPG-80A
      Balance
1--Start Balance Procedure
2--Review Balance Job
3--Resume Balance Job
4--Equipment Setup
5--Exit
Select Operation to Perform.

```

6. The “Balance” banner screen will display the screen below if a balance job is currently in progress. Notice that the answer field to the question at the bottom of the screen “O.K. to Proceed?” reads NO. The NO answer indicates that you DO NOT want to start a new job, but rather continue with the in progress job already started. If this is the case, press ENTER while the NO answer is showing. If, on the other hand, you wish to discard the in progress job and start a new job, press the [RIGHT ARROW] key to toggle the answer to YES, then press [ENTER].

```

Mon 11Jun2001 14:59 84Kb
CF6-80A
Balance
New Balance Job
Will Terminate Current Job,
(Use Resume to Restart).
O.K. to Proceed? NO

```

6. The Balance information screen below will be displayed. Use the [UP ARROW] or [DOWN ARROW] keys to move between fields and [RIGHT ARROW] key to toggle between selections where applicable. The first line reads “Power to Tach 1 Light is ON.” This indicates that power is available to the laser tachometer if being used. If you are not using the Lasetach, disregard this line. Set the fields according to your requirements as follows:

```

Mon 11Jun2001 14:53 88Kb
CF6-80A
Balance Information
Power to Tach 1 Light is ON
Num Of Engines : 1
Sensor Type : CUSTOM
Engine S/N :
Engine Cycles :
Engine Hours : 0.0000
Define Sensor in Global Settings

```

Num Of Engines : (1, 2, 3, or 4) This indicates the number of engines you will balance during this procedure. If you choose a number of engines higher than 1, the screen will change to provide information fields for all engines as shown in the example below.

```

Mon 11Jun2001 15:42 66Kb
CF6-80A
Balance Information
Power to Tach 1 Light is ON
Engs: 2 Sens Type: CUSTOM
Eng S/N Cycles Hours
1 0.0000
2 0.0000
Enter Num of Engines to Balance

```

Sensor Type : (Custom, or AAL) This is the sensitivity setting for the vibration input. If using this procedure on Boeing 767 with Microtrac II EVM systems, the vibe signal can be taken from that unit by selecting the type AAL from this list. If you are using other sources of vibration signals, select “CUSTOM”. From this screen you will be provided a second screen where you will enter the information for your CUSTOM vibration input.

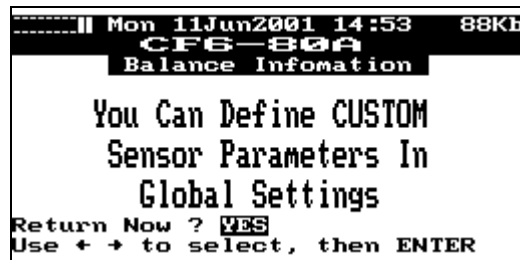
Engine S/N : This optional field is used to record the serial number (S/N) for the engine being balanced. Use the numeric keypad to enter the number is desired.

Engine Cycles : This optional field is used to record the number of cycles for the engine being balanced. Use the numeric keypad to enter this number if desired.

Engine Hours : This optional field is used to record the total hours for the engine being balanced. Use the numeric keypad to enter this number if desired.

When all fields are completed as required, press **[ENTER]** to accept all inputs and continue.

7. If you chose one of the preset Sensor Types, go to item 8. If you chose “CUSTOM” in the “Sensor Type” field, the screen below will be displayed. Near the bottom of the screen, there is the question “Return Now?” followed by a toggle answer field “YES” or “NO”. Change the value of the answer field by using the **[RIGHT ARROW]** key. A “YES” in the answer field will return you to the Balance banner screen as shown above in item 5. From this screen you must press the **[BACKUP]** key one time to return to the Main Menu screen. From the Main Menu screen, select “4—Change Global Settings” to define a custom sensor. Go to page 13 of this document for additional information to Change Global Settings. Selecting the “NO” answer will continue to the next screen, as shown in item 8, and leave the sensor defined per the last sensor definition entered in the Global Settings screen.



8. 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 toggle 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 you are connected to 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”. If being used, the tach is powered at this time to facilitate laser alignment and tape placement.



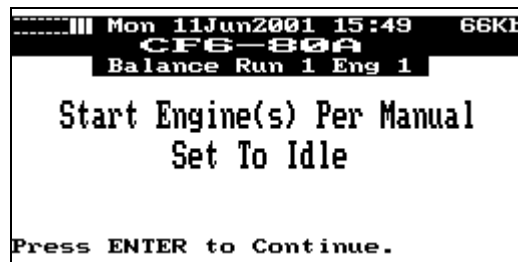
When selection is complete, use the **[DOWN ARROW]** key to move the dark cursor over the line reading “CURSOR HERE WHEN DONE” then press **[ENTER]** to accept your selection and continue.

D. Data Acquisition

NOTE

Data shown on the following screens is for illustration and training purposes only and does not reflect the actual values you should expect to see while actually using this procedure.

1. The Balance Run X Eng X banner will be displayed with the message “Start Engine(s) Per Manual Set To Idle”. X = (where X is the number of the run and engine number) When the engine is stable at Idle, press **[ENTER]** to continue.



2. The screen will show the “Check Idle RPM Standby.....” message until the analyzer acquires the tachometer signal. If a stable RPM signal is not acquired within approximately 30 seconds, the analyzer screen will automatically display the information screen below. Otherwise, go to item 3 of this section.



If you encounter the above screen, check tachometer input connections and equipment. When ready to make another attempt, press any key to continue. The screen will return to the Start Engines screen in item 1 of this section.

3. If the analyzer acquires a good tachometer signal, the screen will report the engine speed in both N1 percent (%) and in a raw fan RPM as shown in the screen below. If the speed is stable and you are ready to begin data acquisition, press [ENTER] to continue.

```
----- Wed 13Jun2001 09:56 64Kb
CF6-80A
Balance Run 1

Check Idle RPM

N1: 26% RPM: 892

Press ENTER to Continue.
```

4. The next screen will present the “Begin Accelerating Engine To” target speed (as shown in the screen below) in both N1 percent (%) and in a raw fan RPM. Make note of the target speed.

CAUTION

Allow the engine to warm up thoroughly 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.

Press [ENTER] to continue.

```
----- Sat 06Jan1996 19:04 209Kb
CF6-80A
Balance Run 1

Begin Accelerating Engine To
N1: 100% RPM: 3432
Monitor Speed on Next Screen

Press ENTER to Continue.
```

5. A momentary information screen, shown below, will be displayed, then automatically advance to the next screen when a speed signal is acquired.

```
----- Sat 06Jan1996 19:04 209Kb
CF6-80A
Balance Run 1

Standby...
Measuring Speed
```

6. Use the Balance Run 1 banner screen below to set the Measured engine speed to match the Desired speed. When the speeds match and are stable, press ENTER to continue.

```

-----|| Sat 06Jan1996 19:04 209Kb
          CF6-80A
          Balance Run 1

Item      N1      RPM
Desired : 100%   3432
Measured: 90 %   3100

Set to Desired, then Press ENTER

```

- A momentary information screen, below will be displayed then automatically proceed to the next screen when data is acquired.

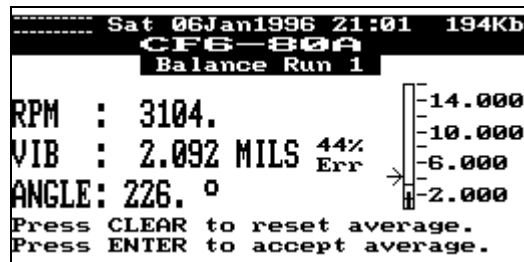
```

-----|| Sat 06Jan1996 19:04 209Kb
          CF6-80A
          Balance Run 1

          Standby...
          Acquiring Measurement

```

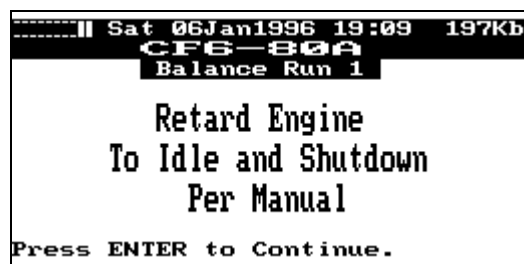
5. The screen will then display the RPM (fan speed), VIB (vibration amplitude), and the ANGLE, (phase angle of the out of balance mass). The screen will also show the average error (% Err) and a scale to indicate the current and average vibration level. The current vibration level is shown by the small arrow to the left side of the vertical scale and a running average of the vibration level is shown by the black portion which rises into the center of the scale as the average increases. As indicated at the bottom of the screen, you may "Press CLEAR ([CLR]) to reset averaging or ENTER ([ENTER]) to accept the average. The reset option ([CLR]) should be used in such cases as a passing aircraft affecting the fan speed by jet blast or where winds are gusting. If the VIB reading is above an acceptable level, you should allow the analyzer to continue collecting data until the "% Err" reading is as low as possible. This reading will continue to reduce as errors are averaged out. If the Err level stops reducing at a low number (less than 10%) you may press Enter to accept this average and continue with the balance job. The Err reading will reduce very quickly when vibration levels are higher because there is a wide margin for error but as the vibration level continues to be lowered by the balancing process, the error level may not go to 0 or even to a level below 10% because the margin for error is so reduced. If the error level will not reduce to a very low level when vibration amplitudes are at or below a maximum acceptable level, this should not be viewed as a defect in the engine or your equipment. It is not a fault but actually an indication that the vibration levels are being reduced.



If the target speed and current speed differ, the banner at the bottom of the screen below will automatically appear prompting you to “Stabilize Engine at xxxx RPM. Now is xxxx RPM, Diff x.x%” where x is equal to a numeric value. Adjust power lever as necessary to correct the speed. When speed is stable, press the [CLR] key to clear the averaging and begin a new collection period. When the Vibe reading is steady and the % Err level is as low as possible, press ENTER to accept the averaged data and proceed.



9. The screen (shown below) will display the informational message “Retard Engine To Idle and Shutdown Per Manual”. Complete the engine shutdown procedure and press [ENTER] to proceed to the solution phase of the balance.



10. The next screen will display the Starting Level of vibration amplitude and the Current Level. If this is the first run, the two levels will obviously be identical since no action has yet been taken to correct the vibration. In subsequent runs, this screen will display the same Starting Level, but will update the Current Level per corrections made following the previous run. If the Current Level is lower than the acceptable maximum level per the maintenance manual, the “Continue to Balance?” answer field near the bottom of the screen will default to the “NO” answer. If you press the [ENTER] key with the “NO” selection displayed, the job will

terminate. If you wish to reduce the Current Level to a lower amplitude, press the **[RIGHT ARROW]** key to toggle the answer field to “YES”. If you press the **[ENTER]** key With the answer field displaying “YES” the sequence of events for balancing will continue for with item 11 below.

```

-----|| Sat 06Jan1996 19:09 197Kb
          CFS-80A
          Vib Summary: Run 1

          Starting Level 1.826
          Current Level 1.826

          Continue to Balance ? NO
          Use + + to select, then ENTER
  
```

11. The Solution Run screen will display the Suggested Solution as illustrated in the screen below. The *raw* solution is the second line and reflects the actual calculated solution without regard to hole numbering or class weights. The third line reflects the Closest Hole number to the actual raw solution angle for adding weight and the fourth line reflects the optional hole for removal of weight if necessary. This is an information screen only and requires no action. Press **[ENTER]** to acknowledge the message and continue with the solution.

```

-----|| Sat 06Jan1996 19:09 197Kb
          CFS-80A
          Solution Run 1

          Suggested Solution After Run 1
          13.5 Grams @ 66 °
          Add Near Hole 32 or
          Remove Near Hole 13
          Press ENTER to Continue.
  
```

12. The screen below will be displayed instructing you to Record The Weights Installed On The Fan Between Run X and Run X. It is important that the exact class weight and the hole number be entered accurately for the analyzer to correctly calculate a new solution following the upcoming run. Make note of the weight and hole number, then press **[ENTER]** to continue.

```

-----|| Sat 06Jan1996 19:09 197Kb
          CFS-80A
          Fan Balance

          Record The Weights
          Installed On The Fan
          Between Run 1 and Run 2

          Press ENTER to Continue.
  
```

13. The Fan Installed Weight banner screen shown below will be displayed with the suggested weight (Des column) and hole numbers (Pos column) for placement of that weight. There is also a Previous (Prv column) weight and Current (Cur column) weight. If necessary you may change the weight as you wish by using the [UP ARROW] or [DOWN ARROW] keys to move the cursor between the fields. Use the [LEFT ARROW] or [RIGHT ARROW] to change the value of the weights adjacent to the Hole number field. When all weights and holes numbers are entered correctly, move the cursor to the "CURSOR HERE WHEN DONE" line and press [ENTER] to continue.

```

-----|| Sat 06Jan1996 19:09 197Kb
          CF6-80A
          Fan Installed Weight Run 1
          [More ↑]
Pos|Prv|Des|Cur|Desired
31|Unk|Unk|Unk|13.50 66.0
32|Unk|P05|Unk|Thus Far
33|Unk|Unk|Unk|0.00 0.0
34|Unk|Unk|Unk|Deviation
35|Unk|Unk|Unk|> 100. %
          REOPTIMIZE
          [More ↓]
          HERE if DONE
ENTER:Change Page, EXP:Summary

```

If you identify either the Prv or the Cur weights in the screen above, you must identify both. If you fail to do so, the screen below will be displayed. When you press ENTER to exit this screen you will be returned to the screen above. If you have identified both, as required, proceed to item 14 below.

```

----- Sat 06Jan1996 21:01 194Kb
          CF6-80A
          Warning Run 1

          If Either the Prv or the Cur
          Class Weight is Identified,
          Both Must be Specified.

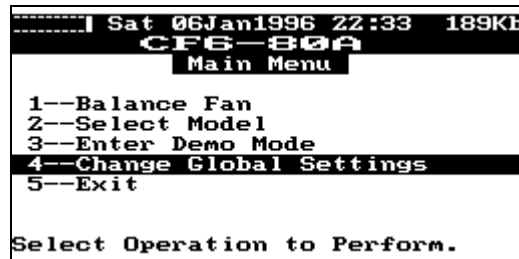
          Press ENTER to Continue.

```

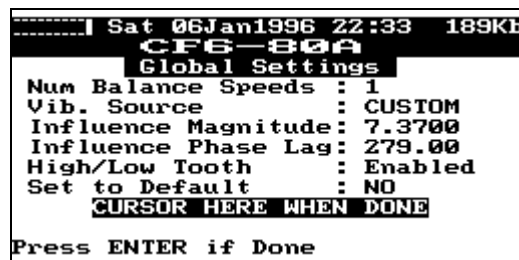
14. The screen will display the Start Engine information screen and the process will repeat from item 1 of this section until the vibration level is reduced to an acceptable lever (nominally 2 to 3 runs total).

Global Settings

- From the Main Menu screen, select “4—Change Global Settings” and press [ENTER].



- When the Global Settings screen, shown below, is displayed, complete each field as follows:



- The “Num Balance Speeds” is the number of balance speed for this job. The CF6 is balanced at one speed and selections are not available. This field is locked at 1. Press the [DOWN ARROW] key to move to the next field.
- The “Vib. Source” field is the vibration data input source. This is a selection field containing only two selections, CUSTOM and AAL.. The AAL selection assumes you are using a Microtrack II EVM system as a vibe source. This signal is an accelerometer signal at 100 mV/g and displayed in Mils as engineering units of vibration. When the CUSTOM selection is made, a special screen will be provided where you may specify the Accelerometer Power to be on or off as required, the Probe Type you are using, the output modifier for the probe and the sensitivity. (See the screen below for an example).
- Influence Magnitude is entered from the keypad and is a value representing the number of inch grams per engineering unit of vibration required to balance the engine. This magnitude is calculated by the analyzer following each balance run and the final calculation printed on the balance report. The default value is stored in the procedure and is updated with each use of the procedure..
- The Influence Phase Lag is entered from the keypad and is a value representing the angular lag correction required to compute weight placement for balancing the engine. This phase lag is calculated by the analyzer following each balance run and the final calculation printed on the balance report.

- e. The High/Low Tooth refers to the modified tooth on a phonic gear which is used to generate a once-per-rev pulse to the engine indicating system. The 1725 analyzer has built in electronics which will detect the unique pulse from the modified tooth and use it as a phase reference for balancing as well as a speed indication. The selections are Enabled and Disabled. If you are using a non modified tooth signal, select Disabled. If you are using the once-per-rev signal from the engine, select Enable.
- f. The “Set to Default” field is used to return all fields described above to their Default values if you wish to do so. If you have changed the values of the above fields to meet your requirements, make sure this field reads “NO”. A “YES” answer in this field will revert all fields on this page to their default value when you exit the screen. Use the **[RIGHT ARROW]** key to toggle the answer between YES and NO.
- g. The CURSOR HERE WHEN DONE line tells the analyzer you are complete with the global settings and ready to exit this page. Use the **[DOWN ARROW]** key to move the dark cursor to this line then press **[ENTER]** to continue to the next page.
1. If you selected CUSTOM as the vibe source in item 2, above, the screen below will be displayed where you may define the CUSTOM sensor. Use the **[DOWN ARROW]** key to move from field to field and the **[RIGHT ARROW]** key to change selections in a field where available or the keypad to input a value.

```

-----| Sat 06Jan1996 22:33 189Kb
-----| CF6-80A
-----| Setup Sensor

Accelerometer Power: ON
Probe Type :
Displacement from Velocity
Probe Sensitivity : 1000.0

Select On or Off with + -.
```

- a. The “Accelerometer Power” is a select field ON or OFF. If you are powering an accelerometer with the analyzer this field should read “YES”. If you are receiving the vibration signal from an onboard source such as an EVM this field should read NO because power for the accelerometer is powered by installed vibration systems.
- b. The “Probe Type” is a selection field with various selections to meet your needs. Determine the type of signal being delivered to the analyzer input, such as Velocity, Acceleration, or Displacement. The CF6 is balanced with reference to Mils (1000th of an inch) engineering units of measure. The Probe Type should reflect that you are using the defined type of vibration signal (velocity, acceleration, or displacement) and if required, for velocity and acceleration signals, that it be displayed in Displacement. Therefore, the Probe type should reflect this, such as Displacement from Velocity as shown above in the example.
- c. The Probe Sensitivity is based on the voltage produced by the vibe source (sensor or EVM system) per unit of specified vibration (Gs, IPS, Mils). For instance, if using a velocity sensor with a sensitivity of 100 mV/IPS, and converting the readings to Mils for use of the balancing program, the sensitivity should read 100.

The analyzer will convert the signal from a velocity signal, as received, to a Mils display automatically.

Press ENTER to accept the settings in all fields and exit back to the CF6 Main Menu screen.



Application Note

GE CF6

Fan Balance

Part Number: 11-200-0064

AppNote Number: E-GE CF6-1725-FB-Rev 1

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