



# Application Note

Application Note Number	E-RRRB211-1725-FB-3.22
Revision	0
Function	Fan Trim Balance
Airframe	Multiple
Engine	Rolls-Royce RB211
Other Application Notes Required	NONE
ACES Systems Analyzer	1725
Firmware Version	2.04 or greater
Procedure Cards	RB211 Balancing

## Introduction

This Application Note contains specific directions on how to perform a single engine fan trim balance on aircraft equipped with Rolls-Royce RB211 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
4.	1EA	Cable, Tachometer Input	As Required for airframe
10.	2 EA.	Cable, Vibration Input	As Required for airframe
11.	1 EA.	Procedure, RB211 Balancing	11-100-0032

## Optional Equipment

As required for the airframe

## B. Equipment Installation

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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 RB211 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 RB211 Balancing, press the down arrow key until the screen reads RB211 Balancing. When the RB211 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

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See Airframe Specific Appnote

## C. Analyzer Set Up

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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 “RB211 Balancing”. Press [ENTER] to accept and continue.

```

----- Mon 25Mar1996 00:39 3293Kb
TrimTEC Analyzer
Operation Options
Page 1 of 2
1--RB211 Balancing v3.22
2--ALF 502/507 Test Cell v3.368
3--CFE738 Vibration v3.368
4--TFE731/ATF3 Vibration v3.368
5--AS900 Vibration v3.368
6--GE CF34 Vibration v3.26
[More]
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 25Mar1996 00:50 3293Kb
RB211-535

Select Model Type

Model: RB211-535

Use ← → Keys To See Models

```

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

#### NOTE

**I 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 25Mar1996 00:52 3293Kb
RB211-535
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.

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

```

----- Mon 25Mar1996 00:51 3293Kb
          RB211-535
          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 25Mar1996 00:51 3293Kb
          RB211-535
          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 25Mar1996 17:15 3291Kb
          RB211-535
          Balance Information
          Power to Tach 1 Light is ON
          Num Of Engines : 1
          Vib. Source   : CUSTOM
          Engine S/N    :
          Engine Cycles :
          Engine Hours  : 0.0000
          Enter Num of Engines to Balance

```

**Num Of Engines** : (1 or 2) This indicates the number of engines you will balance during this procedure. This is a toggle selection.

**Vib Source** : (Custom, Microtrac I, Microtrac II, or 991V) This is the sensitivity setting for the vibration input. If using this procedure on Boeing 757 with Microtrac I or II EVM systems, the vibe signal can be taken from that unit by selecting the type unit (Microtrac I or II) from this list. The 991 is a common velocity sensor. 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.

- If you chose one of the preset Vib. Sources, go to item 8. If you chose “CUSTOM” in the “Vib. Source” field, the screen below will be displayed. Move between fields using the [UP ARROW] and [DOWN ARROW] keys. Change the value of the field by scrolling through the selections using the [RIGHT ARROW] key or enter the desired value from the keypad.

```

----- Mon 25Mar1996 19:21 3291Kb
RB211-535
Setup Custom Sensor

Accelerometer Power: OFF
Probe Type :
    Velocity Probe
Probe Sensitivity : +1000

Enter Sens (mV/in/sec)
  
```

If the vibration source is supplied from an ONBOARD EVM SYSTEM, the Accelerometer Power field should read “OFF”.

The **Probe Type** : is a scroll selection. Choose the Probe type according to the type of sensor being used. You may choose to have the analyzer do conversions and present the vibration in other engineering units if desired, such as “Velocity from Acceleration” or “Displacement from Velocity” if your requirements so dictate.

The **Probe Sensitivity** : is the voltage output (in mV) of the sensor per engineering unit of vibration. If using the EVM system from the airframe, refer to the aircraft maintenance manual for the output of the EVM.

- 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.

```

----- Mon 25Mar1996 20:57 3291Kb
----- RB211-535
----- Channels Selection
-----
Eng      Sensor      Tach
 1      Eng 1a      Tach 1

CURSOR HERE WHEN DONE
Power to Tach 1 Light is ON
Select Vibration Signal Channel

```

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.

- The next screen to be displayed is the "Define Influence Coefficient" banner screen shown below. There are three choices on this screen "1—Influence From: Default, 2—Influence From : Previous" and "3—Influence From Editing." The 1725 is a learning system that calculates and stores influence coefficients. Reasoning for each choice is as follows:

```

----- Mon 25Mar1996 20:52 3291Kb
----- RB211-535
----- Define Influence Coefficient
-----
1--Influence From: Default
2--Influence From: Previous
3--Influence From: Editing

Select Operation to Perform.

```

**1—Influence From : Default** Use this selection if you do not know the influence coefficient for the engine you are about to balance *and* this is the first run for this model of the RB211 since installing the procedure card in the analyzer. This "Default" value is one taken from test cell balance jobs and will give you a good starting point in the absence of a more accurate influence. Use

**2—Influence From : Previous** Use this selection for the second and all subsequent runs for this model of the RB211. Previous means that the influence calculated and stored for the previous balance job will be used for this balance run. With each use the influence is refined and more accurate for fleet type use. If using this influence on a single engine it will shorten the total runs to one in most cases. For fleet use the average should be about 1.7 runs to balance.

**3—Influence From : Editing** Use this selection to enter a known influence for an engine. Editing with a known influence should allow you to conduct a single run "one shot" balance if no major changes have been made in the condition of the fan. You may refer to printed balance jobs from previous runs to obtain this influence. Press [ENTER] to accept your choice.

If you have selected 3—Influence From : Editing, the screen below will be displayed. . Move between fields using the [UP ARROW] and [DOWN ARROW] keys. Using a previous balance job and its calculated influence as a reference, enter the new Influence Magnitude ;, and Influence Phase Lag: from the analyzer keypad. When complete, use the [DOWN ARROW] key to move the cursor over “CURSOR HERE WHEN DONE” and press [ENTER] to accept your inputs and continue.

```

----- Mon 25Mar1996 21:36 3291Kb
RB211-535
Edit Influence Coefficient

Influence Magnitude: 48.000
Influence Phase Lag: 270.00

CURSOR HERE WHEN DONE

Press ENTER if Done

```

- The next screen to be displayed is the “Balance Preparation” screen shown below. This is an information only screen and advises you to remove all previously installed trim balance weights. Press [ENTER] to acknowledge the message and continue.

```

----- Mon 25Mar1996 21:36 3291Kb
RB211-535
Balance Preparation

Remove All Inner
Trim Balance Weights

Press ENTER to Continue.

```

## D. Data Acquisition

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

```

----- Mon 25Mar1996 22:46 3291Kb
RB211-535
Balance Run 1 Spd 1

Start Engine Per Manual
Set To Idle

Press ENTER to Continue.

```

- The screen will show the “Check Idle RPM Standby.....” message until the analyzer acquires the tachometer signal.

```
----- Mon 25Mar1996 22:46 3291Kb
----- RB211-535
----- Balance Run 1 Spd 1
Check Idle RPM
Standby...
```

If a stable RPM signal is not acquired within approximately 35 seconds, the analyzer screen will automatically display the information screen below. Otherwise, go to item 3 of this section.

```
----- Mon 25Mar1996 22:46 3291Kb
----- RB211-535
PROBLEM
Bad Tach
Press any key to continue.
```

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.

- 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.

```
----- Mon 25Mar1996 23:38 3291Kb
----- RB211-535
----- Balance Run 1 Spd 1
Check Idle RPM
N1: 26% RPM: 1179
Press ENTER to Continue.
```

- The screen will present the target speed (as shown in the screen below) in both N1 percent (%) and in a raw fan RPM. Make note of the 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.

```

----- Mon 25Mar1996 23:38 3291Kb
          RB211-535
          Balance Run 1 Spd 1

          Set Engine To
          N1: 70%  RPM: 3150
          Monitor Speed on Next Screen

          Press ENTER to Continue.
  
```

- The next screen will show the Desired speed and the Measured (current) speed in both N1% and in a raw fan RPM. Advance the throttle until the N1% indications match. Use the RPM for fine adjustments and attempt to match the Measured speed as closely as possible to the Desired speed. Allow the speeds to stabilize with hands off the throttles, then press [ENTER] to continue.

```

----- Mon 25Mar1996 23:38 3291Kb
          RB211-535
          Balance Run 1 Spd 1

          Item      N1      RPM
          Desired :  70 %   3150
          Measured:  70 %   3129

          Press ENTER to Continue.
  
```

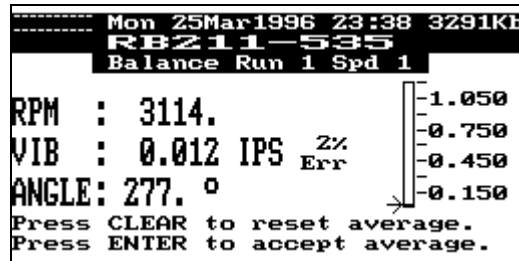
- A momentary information screen displaying the message “Standby...Acquiring Measurement” will be displayed. This screen will automatically change to the data screen when vibration and phase data is acquired.

```

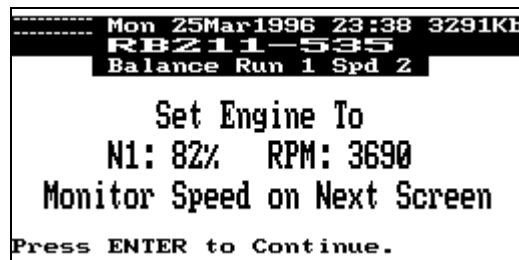
----- Mon 25Mar1996 23:38 3291Kb
          RB211-535
          Balance Run 1 Spd 1

          Standby...
          Acquiring Measurement
  
```

7. 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.



8. If you have selected a multiple speed balance in the Global Settings (Recommended) the analyzer screen will prompt you to set the next speed. As indicated on the screen, when you are ready to proceed, press [ENTER] to continue to the next screen where you may monitor the speeds. From this point the sequence of events is repeated for all speeds from item 5 through 7 of this section. When the last speed point data is taken, proceed to item 9 below.



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.

```

----- Mon 25Mar1996 23:38 3291Kb
RB211-535
Balance Run 1

Retard Engine
To Idle and Shutdown
Per Manual

Press ENTER to Continue.

```

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.

```

----- Mon 25Mar1996 23:38 3291Kb
RB211-535
Vib Summary: Run 1

Starting Level 0.013
Current Level 0.013

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 first line and reflects the actual calculated solution without regard to hole numbering or class weights. The second line reflects the Closest Hole number to the actual raw solution angle and the third line reflect the Angle Difference between the raw actual phase angle and the Closest Hole number. This is an information screen only and requires no action. Press [ENTER] to acknowledge the message and continue with the solution.

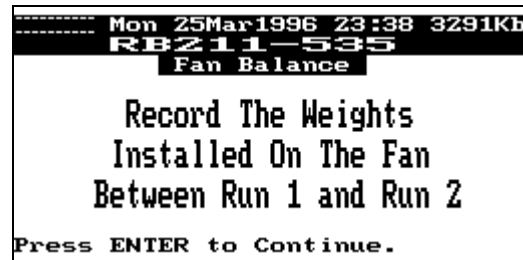
```

----- Mon 25Mar1996 23:38 3291Kb
RB211-535
Solution Run 1
Suggested Solution:
0.3 G At 83 Degrees
Closest Hole is #7
Angle Differs 3.8 °

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 amount of weight and the hole number be entered accurately for the analyzer to correctly calculate a new solution when required. Make note of the weight and hole number, then press **[ENTER]** to continue.



13. The Fan Installed Weight banner screen shown below will be displayed with the suggested weight and hole numbers. The screen will also show the relative location of the suggested hole number from a position Forward of the engine Looking Aft (FLA) and number 1 hole positioned at 12:00. If necessary you may change the weight or hole number 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 increase or decrease the Hole number field. Use the analyzer keypad to enter weight values in the Weight fields. When all weights and holes numbers are entered correctly, move the cursor to the "CURSOR HERE WHEN DONE" line and press **[ENTER]** to continue.



14. The screen will then display the suggested solution "Solution was" and the solution you applied "Installed is". If you note a discrepancy in the installed solution or if you choose to change it for any reason, press the **[RIGHT ARROW]** key to change the answer field for the question "Re-Enter Weights?" to YES and press **[ENTER]**. You will be returned to the screen shown in item 13 above where you may correct the solution. If the answer field is NO when the **[ENTER]** key is pressed, the balance run sequence will be repeated for items 1 thru 14 of this section.

```

----- Mon 25Mar1996 23:38 3291Kb
RB211-535
Fan Installed Weight Run 1
Solution was 0.3 @ 86 °
Installed is 0.3 @ 86 °
Re-Enter Weights ? NO
Use + + to select, then ENTER

```

## Global Settings

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

```

----- Mon 11Jun2001 11:16 90Kb
RB211-535
Main Menu
1--Balance Fan
2--Select Model
3--Enter Demo Mode
4--Change Global Settings
5--Exit
Select Operation to Perform.

```

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

```

----- Mon 11Jun2001 11:16 90Kb
RB211-535
Global Settings
Num Balance Speeds : 3
Vib. Source : CUSTOM
Influence Magnitude: 48.000
Influence Phase Lag: 270.00
Tooth Type : Low
Set to Default : NO
CURSOR HERE WHEN DONE
Press ENTER if Done

```

- The “Num Balance Speeds” is the number of balance speeds you wish to use for this job. The selections are from 1 to 3 speeds. Use the [RIGHT ARROW] key to change the selection until it reads the number of balance speeds you wish to use. 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 four selections, CUSTOM, 991V, Microtrack 1, and Microtrack II. The Microtrack I and II selections will set the sensitivity for the output of those

units. A 991V selection will set the sensitivity at 20 mV/IPS, and the CUSTOM selection will allow you, the user, to configure the analyzer to accept any sensor outside the other available selections. 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).

- c. 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 for the RB211 is 48 gram inches per IPS.
- d. 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. The default for the RB211 is 270 degrees.
- e. The Tooth Type 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 RB211 has a “low” tooth configuration. Selections are: Low, High, and Shifted.
- 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.



# Application Note

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## Rolls Royce RB211

### Fan Balance

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Part Number: 11-200-0038

AppNote Number: e-rrrb211-1725-fb-322

This Application Note is provided for information only and does not supercede the requirements or guidelines set forth in the applicable engine or airframe maintenance manual. Technology for Energy Corporation assumes no obligation or liability, either express or implied, to the Purchaser arising out of the use of this procedure.

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