



Application Note

Bombardier Challenger 300 (AS907)

Fan Trim Balance (with 1700)

Part Number: 11-200-0182

AppNote Number: A-BA-CH300-1700-FB

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Application Note

Application Note Number	A-BR-CH300-1700-FB
Version	1.1
Function	Fan Trim Balance
Airframe	Bombardier Challenger 300
Engine	Honeywell AS907
E-Setup Number	N/A
ACES Systems Analyzer	1700 Analyzer Plus
Firmware Version	1.04 or Higher
Procedure	N/A

Introduction

This Application Note describes the steps necessary to conduct a Fan Trim Balance procedure on the Bombardier Challenger 300 aircraft with AS907 engines using the ACES 1700 Analyzer Plus Analyzer.

A. Equipment Set Up

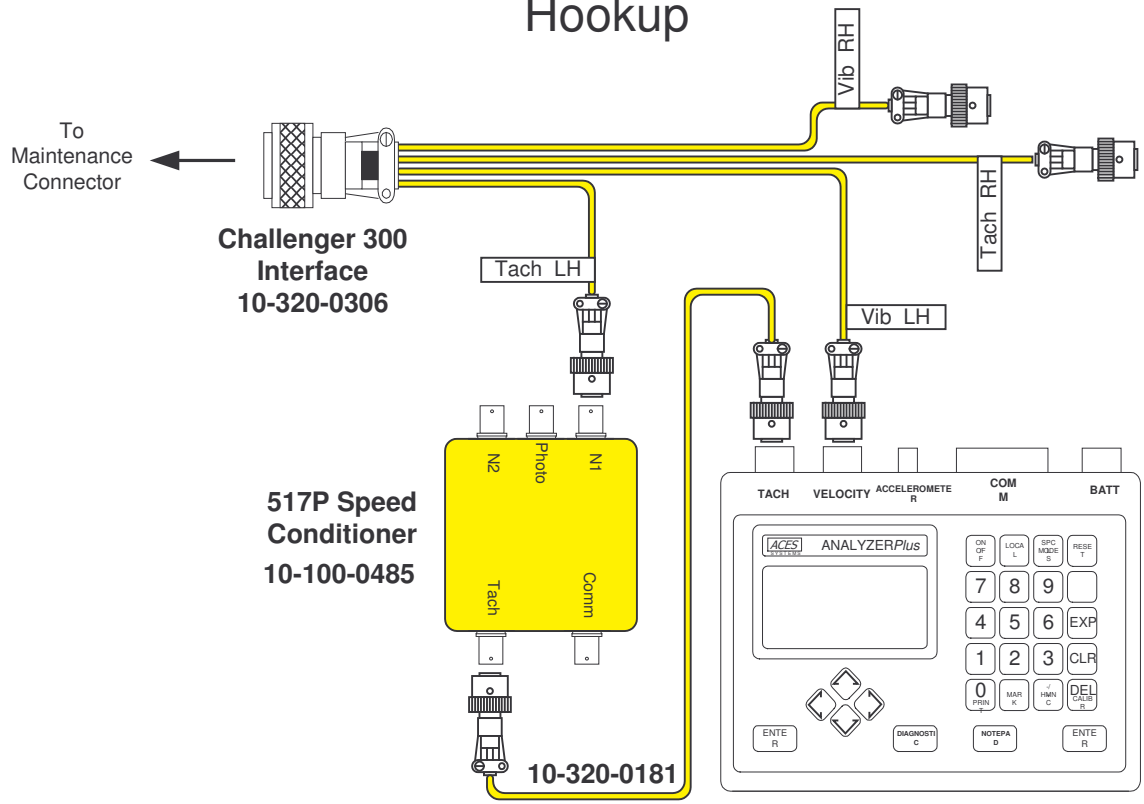
Required Equipment: The following equipment is required to accomplish a single engine fan trim balance.

Item	Quantity	Description	Part Number
1.	1EA	Analyzer, 1700	10-100-1700
2.	1EA	Cable, Interface, Challenger 300 (AS907) to 1700 w 517	10-320-0307
3.	1EA	Conditioner, Speed, Model 517P	10-100-0485
4.	1EA	Cable, Tach, 517P to 1700	10-320-0181

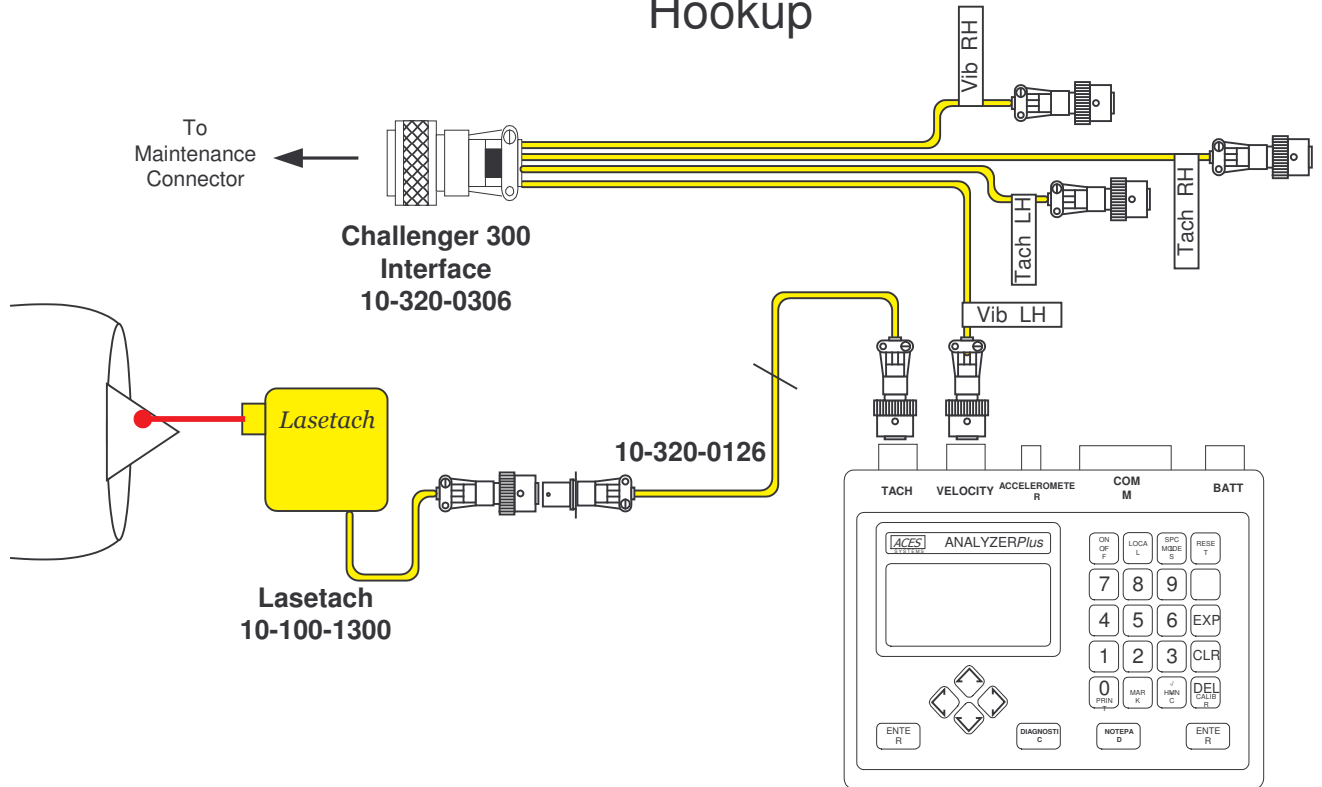
Optional Equipment: The following items are optional and are required only if you are conducting a balance job and not using the wide tooth output from the engine as a once-per-rev/speed signal.

5.	1EA	Tachometer, Lasetach II, 299 (Reflective tape included)	10-100-1300
6.	1EA	Mount, Lasetach Swivel	10-100-0369
7.	1EA	Cable, Tachometer, Generic, 50 Ft.	10-320-0126

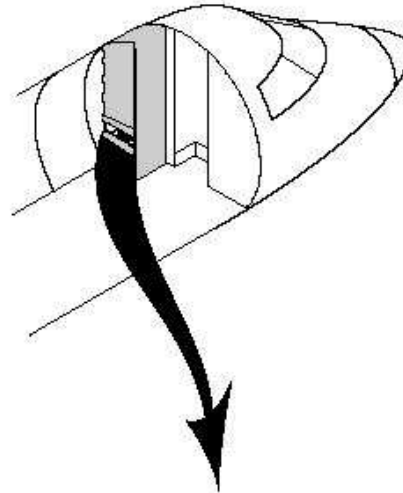
Challenger 300 Installation Single Fan Trim Balancing Hookup



Challenger 300 Installation Single Fan Trim Balancing Hookup



1. Install the Challenger 300 (AS 907) interface cable, item 2, to the forward maintenance panel connector adjacent to the aircraft entrance door.

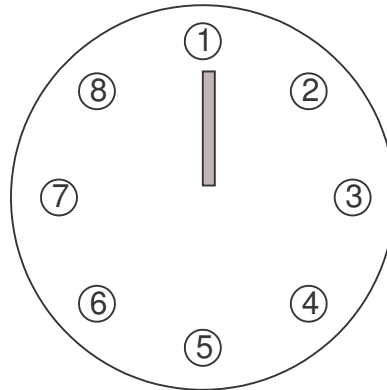


Forward Maintenance Panel



2. Route the cable to the cockpit or location where the analyzer will be used. Connect the three-pin cable end market TACH LH or TACH RH (according to which engine you are balancing) to the N1 input of the 517P.
3. Connect the 517-to-1700 tach cable, item 4, to the TACH output of the 517 Speed conditioner and to the 1700 TACH input.
4. Connect the four-pin cable end of the Challenger 300 interface cable, item 2, marked VIBE LH or VIBE RH (according to which engine you are balancing) to the Velocity input of the 1700 analyzer.
5. **Optional Lasetach Setup** (only if **not** using the once per rev output from the forward maintenance connector via the 517 speed interface).
 - a. Assemble the Lasetach, item 5, and the Lasetach Mounting Bracket, item 6.
 - b. If necessary, assemble the Lasetach and Lasetach mount. Attach the base of the Lasetach Mounting Bracket, item 6, to the top surface of the wing near the leading edge 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 7, to the connector of the Lasetach, item 5. Route the opposite end of the cable to the location of the analyzer and connect the three-pin connector to the 1700 Analyzer, item 1, at the TACH input.

- d. Refer to the diagram below for the following steps. Locate the number 1 hole. This will be the bolt nearest to the fan blade marked with a '*'. The reflective tape should be attached along an imaginary line between the tip of the spinner and the center of the number 1 bolt hole. Select the appropriate location for the reflective tape and clean the spinner surface area thoroughly to remove dirt, grease and oil residue.



- e. Cut a two-inch length of tape and leave the backing in place. Fit the tape along a line directly between the tip of the spinner and the number 1 hole. 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 in the direction of normal rotation until the tape is in the 6 o'clock position 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 power to the laser on by positioning the LASER switch, located on top of the Lasetach, to the ON position. Turn the analyzer ON and select TEST TACH POWER from the main menu.

WARNING

Do not look into the aperture of the Lasetach as permanent eye damage may 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 6., 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 4., 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 on top 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.
6. If not loaded already, load the AS 900 Vibration procedure into the analyzer. See the users manual for instruction on Loading a Procedure from a Procedure Card.
 7. Turn the analyzer ON by pressing the ON/OFF key.
 8. After a series of self-checks, the analyzer will display the main menu, shown below. Select the AS900 Vibration procedure.

```

----- Fri 12Apr2002 12:44 2963Kb
TrimTEC Analyzer
Operation Options
Page 1 of 2
1--GE CF34 Vibration          v3.27
2--PW300 Series TestCell v2.71
3--BMW Rolls BMR700          v3.24
4--RR Tay Balancing          v3.21
5--CFE738 Vibration          v3.29
6--AS900 Vibration           v3.248
[More]
Select Function Using ↑↓.

```

8. The WARNING screen shown below will be displayed temporarily then automatically change to....

```

----- Fri 12Apr2002 12:53 2963Kb
WARNING ?

DO NOT Exceed ANY
Flight Manual or
Maintenance Manual Limits

```

.....the Select Model screen. Use the [RIGHT ARROW] key to scroll through the selections until “AS907” is displayed in the field. Press [ENTER] to continue.

```

----- Fri 12Apr2002 12:53 2963Kb
----- AS900-LP
-----
Select Model Type
-----
Model: AS907
-----
Use ← → Keys To See Models

```

9. The AS907 Main Menu screen, shown below, will be displayed. Before you proceed with the balance procedure, select “5—Change Global Setting” to insure all parameters are set per your requirements as follows:

```

----- Fri 12Apr2002 13:00 2963Kb
----- AS907
----- Main Menu
-----
1--Perform Engine Vib Survey
2--Balance Fan
3--Select Model
4--Enter Demo Mode
5--Change Global Settings
6--Exit
-----
Select Operation to Perform.

```

```

----- Fri 12Apr2002 13:00 2963Kb
----- AS907
----- Global Settings
-----
Freq Unit: RPM   Baln Spds: 2
Balance Band Width : .98-1.02
Baln Job Minimizes : Peak Vib
Tooth Type       : None
Print ACES Header : NO
Influence From   : Default
Split Wt. @ 1st Run: YES
Vib Err for AutoAcq: 0.0000
-----
Use ← → keys to select unit

```

Use the [DOWN ARROW] key to move from field to field and the [RIGHT ARROW] key to select within the fields. Use the numeric keypad to enter the value for the “Vibe Err for AutoAcq” field.

- A. In the “Freq Unit:” field, select either RPM or Hz for a speed indication.
- B. In the “Baln Spds:” select the number of speeds you will use to balance the engine. The recommend number is three (3).
- C. In the “Balance Band Width:” field, select the total band width for data acquisition. The band width will be set at the fan speed plus and minus the lower and plus the upper frequency selected in this setting.
- D. In the “Balan Job Minimizes:” field, select whether you wish to reduce the Peak vibration or the Average vibration.

- E. In the “Tooth Type” field, accept the default **None** as this field is not an option in the 1700 analyzer.
- F. In the “Print ACES Header” field, select YES or NO according to your preference.
- G. In the “Influence From:” field, you may choose to use the **Default** influence which is coded into the procedure, the **Previous** influence which was calculated from the previous balance job conducted with this analyzer (but not necessarily this engine), or **Editing**, where you enter the influence you wish to use for this balance job.
- H. In the “Split Wt. @ 1st Run:” field, select YES or NO to set the procedure to either attempt a balance from the first run (YES) or to add a trial weight and calculate an influence coefficient based on the resulting change in amplitude and phase angle.
- I. In the “Vibe Err for AutoAcq” use the numeric keypad to enter a value. This value will determine at what % of error in averaging the analyzer will terminate data acquisition. If you do not wish to use the Auto Acquire function, enter all 0s. (0.0000). If you enter a number, the acquisition will cease when the error in averaging matches your setting. For initial runs, 0.100 is a reasonable setting.
- J. When all settings are made per your requirements, press [ENTER] to accept and continue. The analyzer will return to the AS907 Main Menu screen shown above in item 8. From that screen, select “2—Balance Fan” and go to item 9 below.

9. When the Balance menu is displayed, select “1—Start Balance Procedure”.

```

----- Fri 12Apr2002 13:00 2963Kb
----- AS907
----- Balance
-----
1--Start Balance Procedure
2--Review Balance Job
3--Resume Balance Job
4--Equipment Setup
5--Exit

Select Operation to Perform.

```

10. The information screen below will be displayed. If you are not using the Trig-TEK Charge amplifier for this balance, ignore this screen and press ENTER to continue.

```

----- Fri 12Apr2002 13:00 2963Kb
----- AS907
----- Balance
-----
Set Trig-TEK Charge Amplifier
High Pass Filter to Low
Before Starting Balance

Press ENTER to Continue.

```

11. The Information screen will be displayed to indicated there may be a previously started job still in progress (not complete) and that starting a new job will terminate that in progress job.

If you want to resume the in progress job, use the [RIGHT ARROW] key to toggle the YES or NO answer field to NO and press ENTER. You will be returned to the Balance Menu screen where you may select “3—Resume Balance Job” (see item 9 above) and continue that job. If you wish to terminate the old job and begin a new one, toggle the YES or NO answer field to YES and press ENTER.

```

-----| Fri 12Apr2002 14:07 2960Kb
AS907
Balance

New Balance Job
Will Terminate Current Job,
(Use Resume to Restart).

O.K. to Proceed? YES

```

12. When the Balance Information screen, shown below, is displayed, move between fields using the [DOWN ARROW] key and complete each field as follows:
- The first line reads “Power to Tach 1 Light is ON” indicating you may align and check the Lasetach at this time if it is being used. Otherwise ignore this line.
 - The “Job:” field is a toggle On Wing/Test Cell field. Select the appropriate application using the [RIGHT ARROW] key.
 - The “Eng:” field is a toggle, 1 or 2, field to indicate the number of engines being balanced during this job. Select the appropriate number using the [RIGHT ARROW] key.
 - The “Sen:” is a toggle, 1 or 2, field to indicate the number of vibrations sensors being used for this job. If using a vertical and horizontal sensor, select 2. Select the appropriate number using the [RIGHT ARROW] key.
 - The “Sensor Type:” field is used to define the vibration sensor being used for this job. Use the [RIGHT ARROW] key to scroll through the list of available sensors until the sensor you are using is displayed. If your sensor is not in the list, select CUSTOM and you will be provided a screen to define the sensor when exiting this screen. **NOTE: If you are using the CEC4-130 velocity sensor, you may select CEC-105. The sensitivity for both these sensors is 105 ± 3 mV/IPS.**

```

-----| Fri 12Apr2002 14:16 2960Kb
AS907
Balance Information

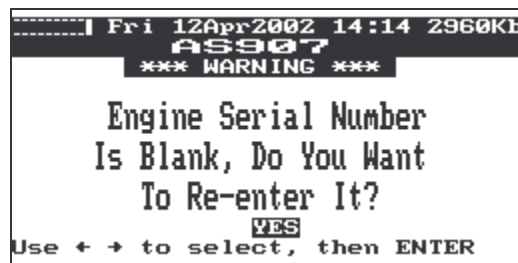
Power to Tach 1 Light is ON
Job: On Wing   Eng: 1  Sen: 1
Sensor Type   : CEC-105
Engine S/N    : P
Engine Cycles :
Engine Hours  : 0.0000

Enter Num of Engines to Balance

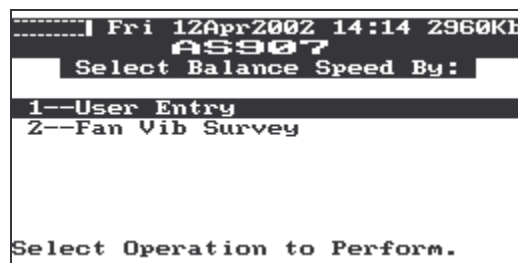
```

- In the “Engine S/N:” field, use the numeric keypad to complete the serial number. This is an optional field and may be left blank if desired.

- G. In the “Engine Cycles:” field, use the numeric keypad to enter the number of engine cycles for this engine. This is an optional field and may be left blank if desired.
- H. In the “Engine Hours:” field, use the numeric keypad to enter the number of hours for this engine. This is an optional field and may be left blank if desired.
- I. When all fields are complete per your requirements, press ENTER to accept your selections and continue.
13. If you did not enter an Engine Serial number in item 11.F above, the warning screen below will be displayed. If you wish to return to the screen in item 11 above and enter a number, be sure the YES/NO answer field is toggled to YES and press ENTER. If you wish to ignore the warning and continue without entering the number, press the [RIGHT ARROW] key to toggle the answer field to NO and press ENTER to continue.



14. The “Select Balance Speed By:” screen, shown below, will be displayed. If you have already established what the balance speeds will be, select 1—User Entry, and go to item 15 below. If you would like the analyzer to pick the balancing speeds for you, select 2—Fan Vibe Survey and go to item 16 below.



15. If you selected “1—User Entry” in the screen above in item 14, the screen below will be displayed. Use the [DOWN ARROW] key to move from field to field and the numeric keypad to enter a speed value in each of the fields provided. The screen will have a number of speed fields equal to the number of balance speeds you selected in Global Settings. If the screen does not have the number of speeds you intend to use, see item 11 above. You may enter the speed as an actual fan RPM or as a % of N1. The analyzer will accept either value as valid. As indicated at the bottom of the screen, pressing the [EXP] key, at the right side of the numeric keypad, will display the results of the last fan survey.

```
.....| Fri 12Apr2002 14:14 2960Kb
AS907
Get Balance Speed

Speed   Sensor 1
Speed 1: 87.000
Speed 2: 73.950
Speed 3: 69.600

Enter N1 % or RPM, or Press EXP
```

To verify the speeds as correct, the screen below will be displayed. Check to insure all speeds are correct. Toggle the YES/NO answer field as required and press ENTER to continue. If you select the NO answer, you will be returned to the screen above. The YES answer will continue the procedure. Go to the section **B. DATA ACQUISITION** portion of this document.

16. If you selected “2—Fan Vib Survey” above in item 14, the screen will display the information screen below. Remove all previously installed fan trim balance weights in preparation for the fan vibration survey run. When the weights are confirmed as removed, press ENTER to continue.

```
.....| Fri 12Apr2002 14:14 2960Kb
AS907
Fan Vib Survey

Remove All
Trim Balance Weights

Press ENTER to Continue.
```

17. The screen will display the Start Engine message shown below. At this time, start the engine per manual instructions and allow it to stabilize at idle RPM. While the engine is warming up, calculate the N1 for the day from the aircraft charts and record for later reference. Press ENTER to continue.

```
.....| Fri 12Apr2002 14:14 2960Kb
AS907
Fan Vib Survey

Start Engine Per Manual
Set To Idle

Press ENTER to Continue.
```

18. The information screen shown below will be displayed. The message indicates that you should NOT begin acceleration of the engine until a speed indication is displayed on screen. When the speed indication is seen, begin an acceleration from idle to N1 for the day (as calculated earlier) in NOT LESS THAN 60 seconds. A more rapid acceleration will not allow the analyzer sufficient time to acquire data at the differing speeds. A longer acceleration will not be detrimental to the data quality. When you are ready to begin the acceleration, press ENTER to continue.

```
-----| Fri 12Apr2002 14:14 2960Kb
AS907
Survey: Takeoff

After Speed Is
Displayed, Slowly Accelerate
Engine To N1 for the Day

Press ENTER to Continue.
```

18. A momentary STAND-BY screen, as shown below, will be displayed while the analyzer acquires the speed and vibration signals. DO NOT BEGING ACCELERATION until this screen is extinguished and the speed is indicated on screen. When the "Survey Takeoff" screen, the second screen below, is displayed it will indicate the current RPM as well as the Elapsed time since the analyzer began acquiring data. When this screen is visible begin your acceleration to N1 for the day in not less than 60 seconds. Use the Elapsed time indicator to pace your acceleration. NOTE: The Elapsed time is intended only to assist you in your acceleration pace and not to serve as an indication of completed requirements. The important thing to remember is to not accelerate from idle to max power in less than 60 seconds. As shown at the bottom of the screen, when you reach N1 for the Day, press ENTER to Stop.

```
-----| Fri 12Apr2002 14:14 2960Kb
AS907
Survey: Takeoff

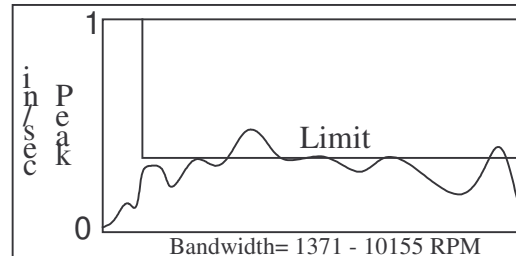
Standby...
Initializing For
This Survey
```

```
AS907
Survey: Takeoff

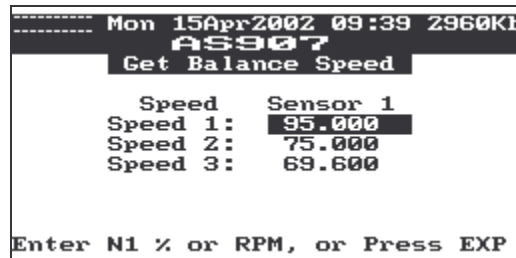
RPM      : 3101.2
Elapsed Time: 5.7 Sec.

Slowly Accel to N1 for the Day.
Press ENTER to Stop.
```

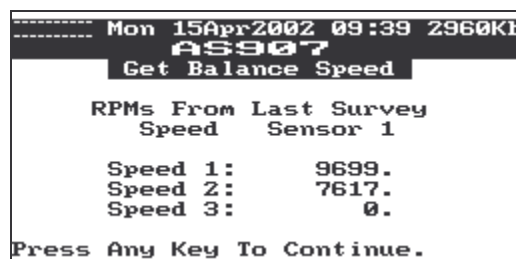
19. When you stop the survey, the survey graph, shown below will be displayed. If the amplitude line exceeds the Limit line anywhere along the length of the X (Frequency) axis, you should conduct a fan trim balance. To see the highest amplitude peak along the survey, press the [RIGHT ARROW] key one time. The cursor will go to the highest peak and the bottom of the screen will display the amplitude and frequency at that point. The speeds where the highest amplitudes occurred are stored in memory and you may review them in the next two items below. These are the speeds you will use for the balance procedure. Press ENTER to continue.



20. The “Get Balance Speed” screen will be displayed again with the last speeds entered. As indicated by the line at the bottom of the screen, ENTER an N1% or RPM, or Press EXP. Press the EXP key at the right side of the keypad to see the speeds collected for the just completed Fan Survey.



21. The speeds collected from the last survey will be displayed as shown below. NOTE: The speeds in this screen were generated in a lab environment and do not reflect typical speeds. Make note of the speeds and press any key to exit the screen and continue.



22. The screen will once again display the Get Balance Speed screen shown below. Use the [DOWN ARROW] key to move from field to field and enter the speeds taken from the screen above in the same order. When all speeds have been entered, check the answer field at the bottom of the page. If it does not read YES, press the [RIGHT ARROW] key to toggle the answer to YES then press ENTER to accept the entered speeds and continue.

```

----- Mon 15Apr2002 09:39 2960Kb
----- AS907
----- Get Balance Speed
-----
Speed  Sensor 1
Speed 1:  95.000
Speed 2:  75.000
Speed 3:  69.600
-----
All Inputs Correct ? YES
Use + + to select, then ENTER
  
```

23. The information screen below, will be displayed. If you have already verified that previously installed trim balance weights have been removed, press ENTER to continue.

```

----- Mon 15Apr2002 09:39 2960Kb
----- AS907
----- Balance Preparation
-----
Remove All
Trim Balance Weights
-----
Press ENTER to Continue.
  
```

24. The information screen below will be displayed. Start the engine or, if the engine is already running, press ENTER to continue. Allow the engine to warm up to normal operating temperature.

```

----- Mon 15Apr2002 09:39 2960Kb
----- AS907
----- Balance Run 1 Spd 1
-----
Start Engine Per Manual
Set To Idle
-----
Press ENTER to Continue.
  
```

B. Data Acquisition

25. The screen will display the Balance Run 1 Spd (speed) 1 screen as shown below. The current engine speed will be displayed in both N1 % as well as the actual FAN RPM. If the speed indication is correct and stable, press ENTER to continue.

NOTE

It may be necessary to advance the PLA to approximately 30% N1 for the signal strength of the tach circuit to be recognized by the ACES equipment.

```

----- Mon 15Apr2002 09:39 2960Kb
          AS907
----- Balance Run 1 Spd 1
          Check Idle RPM
          N1: 21%   RPM: 2108
          Press ENTER to Continue.
  
```

26. The information screen below will be displayed prompting you to Set the engine speed to the first balance speed entered previously. This is an information only screen and does not show current readings. Press [ENTER] when ready to advance power for data acquisition.

```

----- Mon 15Apr2002 09:39 2960Kb
          AS907
----- Balance Run 1 Spd 1
          Set Engine To
          N1: 95%   RPM: 9648
          Monitor Speed on Next Screen
          Press ENTER to Continue.
  
```

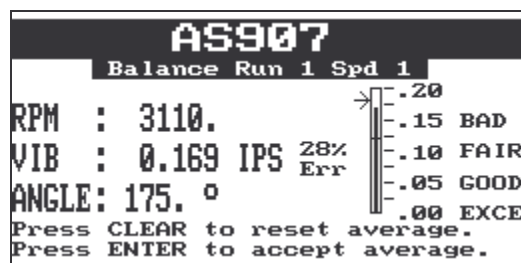
27. The speeds screen below will show the “Desired” speed, which is the first balance speed, and the current “Measured” speed. Advance the throttles until the Measured speed reads the same or as closely as possible to the Desired speed. Allow the engine to stabilize for a few moments to be sure it does not drift. Readjust if necessary and again allow it to stabilize. When you are satisfied the speed is set and stable, press [ENTER] to continue.

```

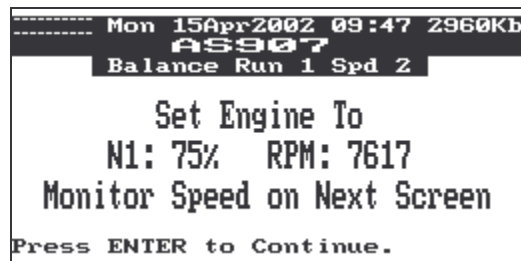
----- Mon 15Apr2002 09:39 2960Kb
          AS907
----- Balance Run 1 Spd 1
          Item           N1           RPM
          Desired :     95 %       9648
          Measured:     31 %       3103
          Set to Desired, then Press ENTER
  
```

27. The acquisition screen shown below will be displayed after a momentary pause. At the left center of the screen you will see the current averaged RPM, VIB (amplitude), and ANGLE, (phase angle). Immediately to the right of these averaged readings you will see the “Err”

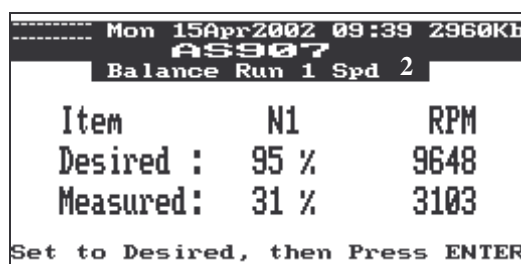
(error) as displayed in a %. This is the averaged error and should be decreasing as more data is acquired and averaged. To the immediate right of the Err %, you will see a thermometer type indicator with a scale to its right and a small arrow to its left. The scale indicates the condition, from EXCE (excellent) to BAD and corresponds to the vertical black bar rising up the center of the indicator. The arrow indicates the current unaveraged amplitude value, relative to the scale. You should allow the analyzer to take data until the RPM, VIB, and ANGLE readings are still changing due to updated averages. When satisfied that your data is acceptable, press ENTER to accept the averaged data and continue. NOTICE also, at the bottom of the screen, you may press the [CLR] or Clear key, to delete the averaged data and begin a new collection and averaging period. This feature is handy when you suspect that wind or the jet blast or propeller wash from a passing aircraft may have affected the quality of your data.



28. The Balance Run 1, Spd (speed) 2 screen will be displayed prompting you to set engine power to the second speed. Make note of the target speed and press ENTER when ready to adjust the speed.



29. The Desired and Measured Speed will be shown on the analyzer screen again. Advance the throttles until the Measured speed reads the same or as closely as possible to the Desired speed. Allow the engine to stabilize for a few moments to be sure it does not drift. Readjust if necessary and again allow it to stabilize. When you are satisfied the speed is set and stable, press ENTER to continue.



manual. You may still balance to even lower levels but you must press the [RIGHT ARROW] key to toggle the answer field to YES. If you press ENTER while the answer field reads NO, the job will be terminated and there is no means to correct this error and continue with the job.

```

----- Mon 15Apr2002 09:49 2960Kb
----- AS907
----- Vib Summary: Run 1
Starting Level 0.174
Current Level 0.174
Continue to Balance ? NO
Use + + to select, then ENTER

```

32. If you toggled the answer to YES indicating you wish to continue the balance, the Solution Run screen, shown below will be displayed. When the Optimizing is complete.....

```

----- Mon 15Apr2002 09:49 2960Kb
----- AS907
----- Solution Run 1
Standby...
Optimizing Weight Distribution

```

...the solution screen, shown below, will be displayed giving you the solution in class weight and hole numbers. Make note of the weights and press [ENTER] to continue.

```

----- Mon 15Apr2002 09:49 2960Kb
----- AS907
----- Solution Run 1
Attach Trial Weights:
-7 2.76 G In Hole #1
-5 1.74 G In Hole #3
To Attempt Solution of:
3.4 G At 31 Degrees
ENTER=Continue,EXP=Edit Class Wt

```

33. The information screen, shown below, will prompt you to record the weights you installed after the run and according to the solution provided. It is very important that you enter the exact weight and the exact hole number where you attached the weight. A mistake here could cause the balance job to take additional runs to compensate for the mistaken entry. When you have installed the weights, press [ENTER] to acknowledge the message and proceed to the Fan Installed Weight screen.


```
----- Mon 15Apr2002 09:49 2960Kb  
----- AS907  
----- Balance Run 2 Spd 1  
  
Start Engine Per Manual  
Set To Idle  
  
Press ENTER to Continue.
```