Application Note

Raytheon/Beechcraft 1900D

Propeller Balance

Part Number: 11-200-0299

AppNote Number: A-RA1900D-4040-PB (Rev. 3.00, Feb 2011)

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Application Note

Application Note Number	A-RA1900D-4040-PB
Revision	3.00 (From Airframe Rev dated 11/2009)
Function	Propeller Balance
Airframe	Raytheon/Beechcraft 1900D
Engine	PT6 Series
E-Setup Number	a-ra1900d-4040-pb.asf
ACES Systems Analyzer	Model 4040 Viper
Boot/App Version	3.xx/3.xx or later
Procedure	N/A

Introduction

This Application Note covers the required equipment, equipment installation, analyzer setup, data acquisition and solution process for using the ACES Systems Model 4040 with the Propeller Balance Performance Option to perform a Propeller balance on the Raytheon/Beechcraft 1900D. General instructions for the use of the Model 4040 can be found in the Model 4040 User Manual #4040-OM-01 (P/N 75-900-4040). All procedures for Propeller Balance and all adjustments should be made in accordance with the Aircraft Maintenance Manual.

A. Required Equipment

The following equipment is required to perform a Propeller Balance*:

Item	Quantity	Description	Part Number
1.	1	Analyzer, Model 4040CE	10-100-4040CE
2.	1	Cable, Inter, Beech/Dash 8 Bal - 2020/4040	10-320-0164
3.	1	Sensor, Velocity 7310 – One for each engine under test	69-100-7310
4.	1	Option, 4040 Propeller Balance	11-900-0007**

*This listing shows the latest design parts. It is acceptable to perform this task using previous designs with the appropriate accessories. For compatibility issues, contact ACES Systems.

** If the Main Menu of your 4040 does not display the “Propeller Balance” menu item, contact ACES Systems to learn about availability.

Optional Equipment

The following equipment may be used if both engines are balanced concurrently:

Item	Quantity	Description	Part Number
5.	1	Sensor, Velocity 7310 – One for each engine under test	69-100-7310

Miscellaneous Equipment

Tape or tie wraps to secure cables to airframe.

If adjustments are to be made to the Propeller Balance, use only hardware or balance weights that are specified in the applicable airframe maintenance manual.

B. Equipment Installation

1. Place the analyzer (Item 1) in the flight compartment. Follow the Maintenance Manual Procedure for positioning the aircraft for the balance runs.

NOTE

Secure and route cables as not to interfere with hot or rotating components and aircraft controls.

2. Remove the upper forward engine cowling.
3. Disconnect the cable from the dummy sensor connector on the bracket shown in Figure 1.
4. Remove the dummy sensor and retain for later reinstallation.
5. Replace the dummy vibration sensor with the 7310 Vibration Sensor, (Item 3 or Item 5). Install the Sensor on the bracket provided on the Tach generator pad as shown in Figure 1.
6. Connect the cable, previously disconnected from the dummy sensor, to the connector of the 7310 Sensor.
7. Reinstall the upper forward cowling assembly.
8. Connect the Beech Interface Cable (Item 2) to the receptacle for propeller balance located in the bulkhead behind the copilot's seat.
9. Connect the leads from the Interface Cable as follows:

LEFT VIBRATION – CHANNEL A	RIGHT VIBRATION – CHANNEL B
LEFT TACH – TACH 1	RIGHT TACH – TACH 2

Equipment Installation Diagram

Figure 1

Engine viewed from forward looking aft (FLA)

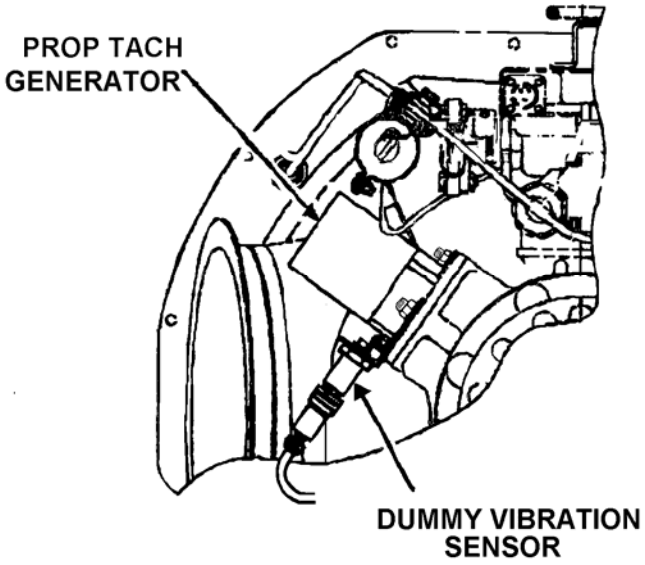
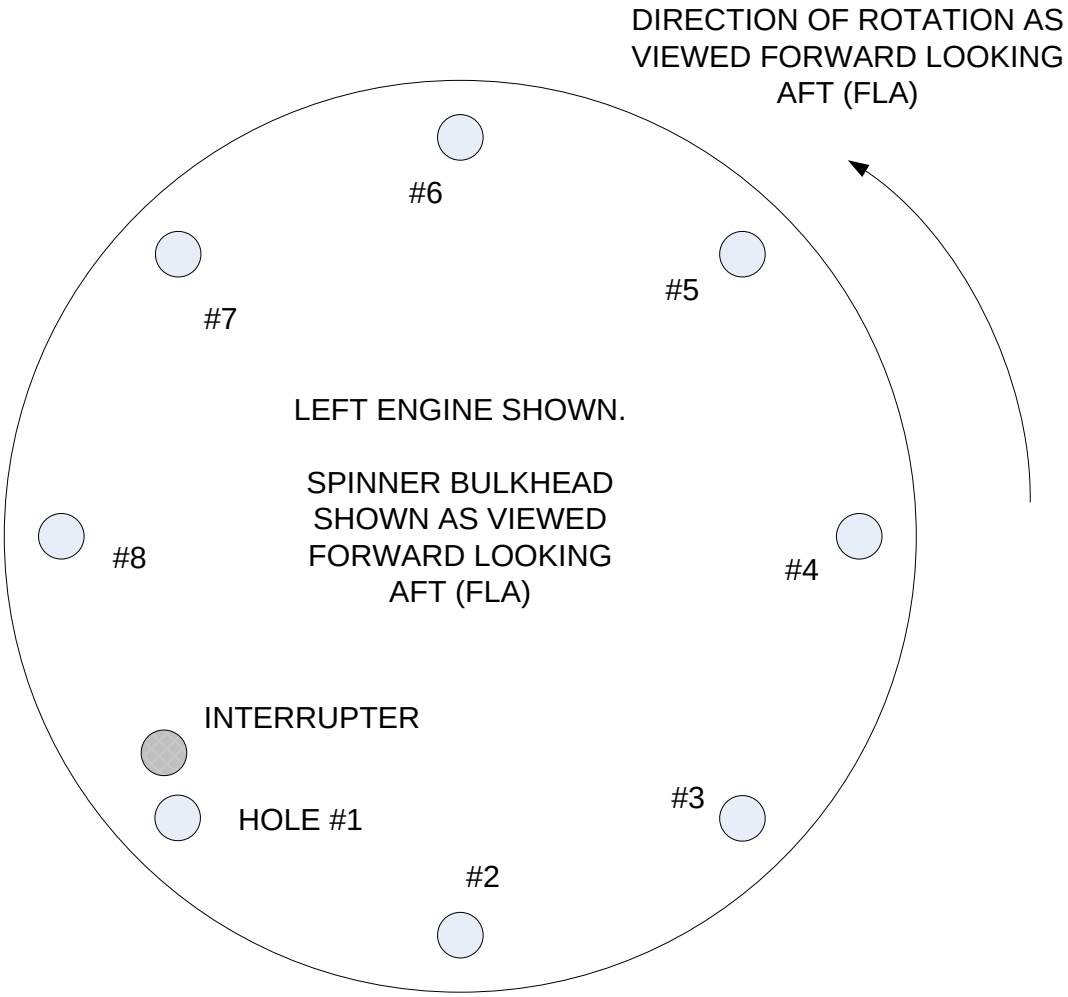
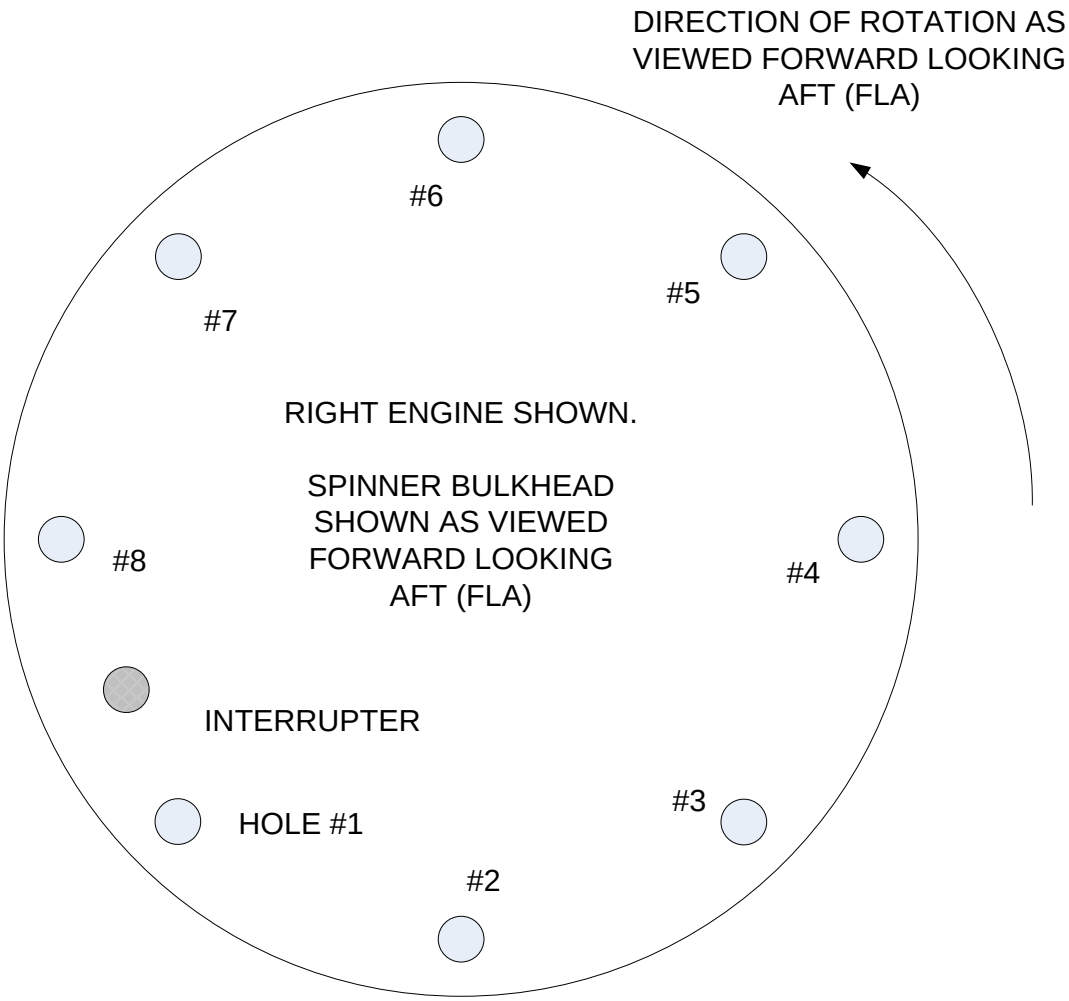


Figure 2



ALIGN THE MAGNETIC PICKUP AND INTERRUPTER. WHILE STANDING IN FRONT OF THE PROPELLER, PLACE THE PROPELLER PROTRACTOR OVER THE SPINNER WITH THE "DIRECTION OF ROTATION" ARROW POINTING IN THE DIRECTION OF PROPELLER ROTATION, COUNTERCLOCKWISE. THE ZERO DEGREE MARKING ON THE PROPELLER PROTRACTOR SHOULD BE AT THE 12:00 LOCATION. MEASURE THE HOLE ANGLES, FROM FORWARD OF THE PROPELLER LOOKING AFT, TO THE LOCATION OF THE NUMBER 1 HOLE. THIS WILL BE AT APPROXIMATELY THE 270 DEGREE LOCATION.

Figure 3



ALIGN THE MAGNETIC PICKUP AND INTERRUPTER. WHILE STANDING IN FRONT OF THE PROPELLER, PLACE THE PROPELLER PROTRACTOR OVER THE SPINNER WITH THE "DIRECTION OF ROTATION" ARROW POINTING IN THE DIRECTION OF PROPELLER ROTATION, COUNTERCLOCKWISE. THE ZERO DEGREE MARKING ON THE PROPELLER PROTRACTOR SHOULD BE AT THE 12:00 LOCATION. MEASURE THE HOLE ANGLES, FROM FORWARD OF THE PROPELLER LOOKING AFT, TO THE LOCATION OF THE NUMBER 1 HOLE. THIS WILL BE AT APPROXIMATELY THE 240 DEGREE LOCATION.

C. Analyzer Set Up

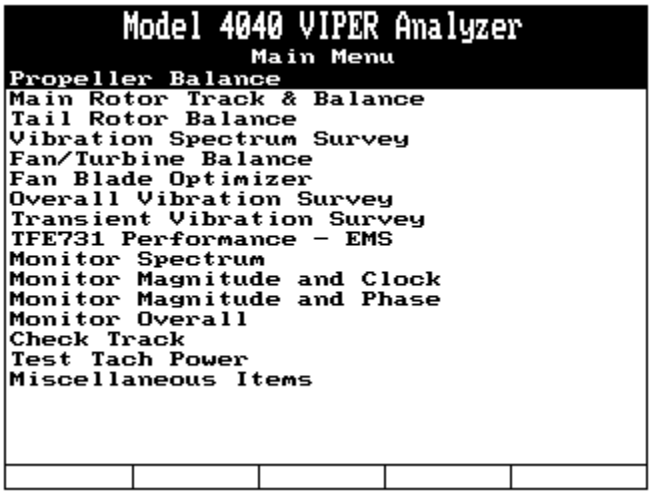
NOTE

It is strongly recommended that two separate setups be completed, one for each engine. This is because the Magnetic Pickup and Interrupter align at slightly different locations on the Spinner Bulkhead. By creating individual seutps, the analyzer can correct each setup for the minor change in location and provide better solutions for each engine.

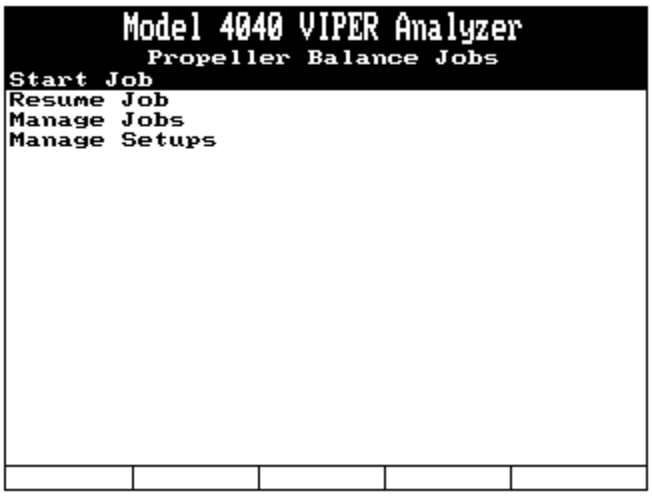
1. Insure the analyzer battery is charged prior to starting the job. See the Model 4040 User Manual #4040-OM-01 (P/N 75-900-4040) Chapter 2 for detailed instructions on battery charging.
2. Turn the analyzer ON by pressing the **[ON/OFF]** key.
3. From the Main Menu, select "Propeller Balance" and press the **[ENTER]** key.

NOTE

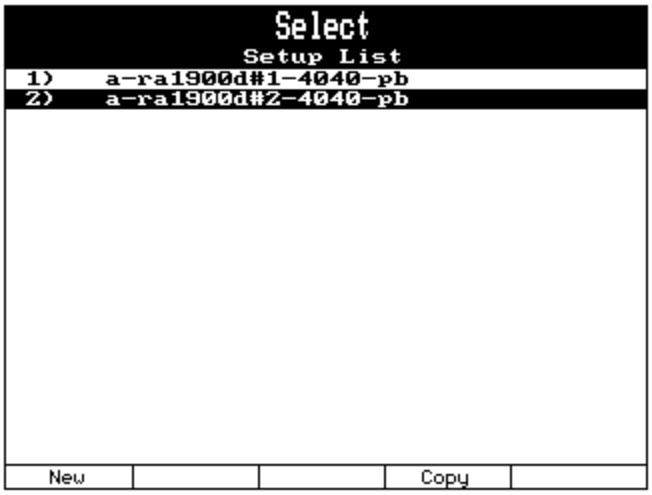
The menu may look slightly different from the one presented below. The individual menu items are individually licensed. Only the menu items licensed to your specific 4040 will be present. If you do not have a menu item for Propeller Balance, please contact ACES Systems for information on obtaining a license.



4. From the Propeller Balance Menu, select "Start Job" and press the **[ENTER]** key.

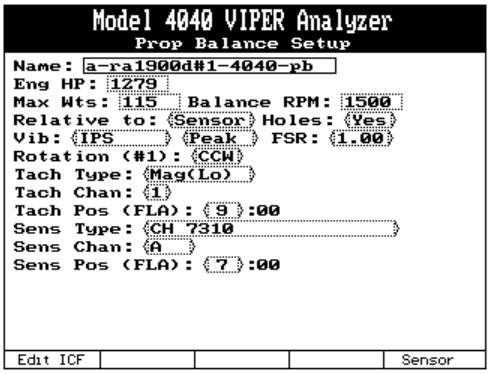


5. If the setup for the Raytheon/Beechcraft 1900D is listed in the Setup List, select it using the **[⇓]** key, press **[ENTER]** and go to Section D below. If the setup for the Raytheon/Beechcraft 1900D is not in the Setup List, press the **[F1]**, "New" key and go to Step 6 below.

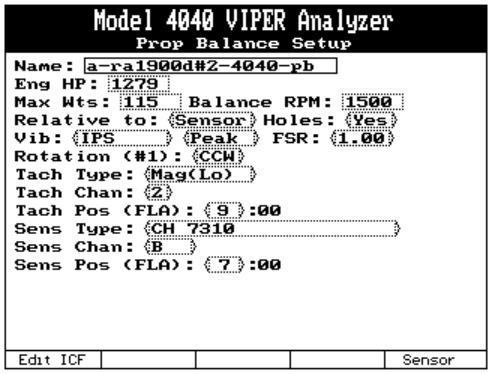


6. Complete the Prop Balance Setup screen per the illustration screen below.

Number 1 Engine



Number 2 Engine



6.1 In the “Name:” field, use the analyzer keypad to enter “Raytheon/Beechcraft 1900D”. You may use any name that is convenient for locating the setup in the future. Press the **[⇓]** key to move to the next field.

6.2 In the “Eng HP:” (Engine Horsepower) field, use the analyzer keypad to enter “1279”. Press the **[⇓]** key to move to the next field.

6.3 In the “Max Wts:” field, use the analyzer keypad to enter “115”. This is the maximum total amount of balance weights that may be added to the propeller assembly to accomplish the job. You will enter a maximum amount per hole in another screen. Press the **[⇓]** key to move to the next field.

6.4 In the “Balancing RPM:” use the analyzer keypad to enter “1500”. Press the **[⇓]** key to move to the next field.

6.5 In the “Wts relative to:” field, press the **[⇒]** key until the field reads “Sensor”. This indicates the angle to each of the holes is measured from the 12:00 position with the Magnetic Pickup and Interrupter aligned. Press the **[⇓]** key to move to the next field.

6.6 In the “Holes:” field, press the **[⇒]** key until the field reads “Yes” to indicate there are pre existing holes where balance weights are added that must be defined. Press the **[⇓]** key to move to the next field.

6.7 In the “Vib:” press the **[⇒]** key until the field reads “IPS” to indicate you intend to read vibration in IPS. Press the **[⇓]** key to move to the next field.

6.8 In the next field press the **[⇒]** key until the field reads “Peak” to indicate you intend to read Peak vibration. Press the **[⇓]** key to move to the next field.

6.9 In the “FSR:” (Full Scale Range” field, press the **[⇒]** key until the field reads “1.00” to select a Full Scale Range of 1.00 IPS Peak. Press the **[⇓]** key to move to the next field.

6.10 In the “Rotation (#1):” field, press the **[⇒]** key until the field reads “CCW” for counterclockwise. Press the **[⇓]** key to move to the next field.

6.11 In the “Tach Type:” field, press the **[⇒]** key until the field reads “Mag (Lo)” indicating you will use the onboard Magnetic Pickup. Press the **[⇓]** key to move to the next field.

6.12 In the “Tach Chan:” field press the **[⇒]** key until the field reads “1” indicating you will use TACH 1 on the analyzer. For the Number 2 Engine it is acceptable to select “2”

indicating TACH 2. This will allow simultaneous connection of all of the sensor cables to perform the balance on both engines at the same time. Press the **[⇓]** key to move to the next field.

6.13 In the "Tach Pos" (FLA): field, press the **[⇒]** key until the field reads "9:00". This indicates the clock position where the Magnetic Pickup is triggered by the passage of the Interrupter, as viewed from forward of the engine looking aft toward the tail of the aircraft. Press the **[⇓]** key to move to the next field.

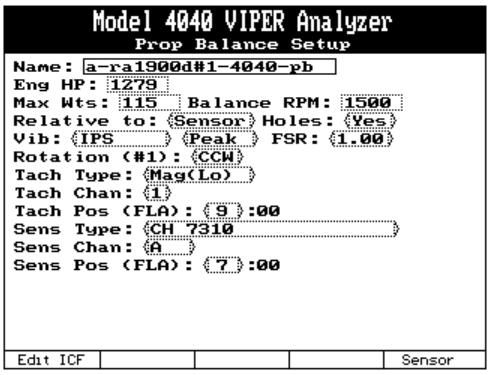
6.14 In the "Sens Chan:" field press the **[⇒]** key until the field reads "A" indicating you will use CHANNEL A on the analyzer. For the Number 2 Engine it is acceptable to select "B" indicating CHANNEL B. This will allow simultaneous connection of all of the sensor cables to perform the balance on both engines at the same time. Press the **[⇓]** key to move to the next field.

6.15 In the "Sens Type:" field, press the **[⇒]** key until the field reads "CH7310". Press the **[⇓]** key to move to the next field.

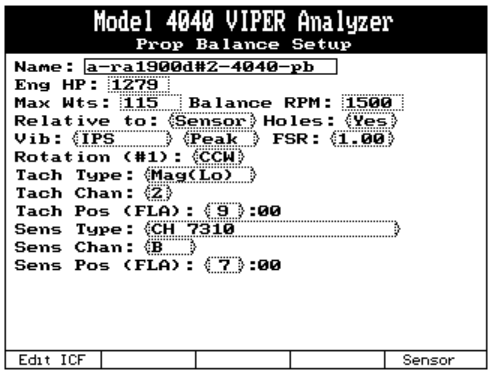
6.16 In the "Sens Posn (FLA):" field, press the **[⇒]** key until the field reads "7:00". This will define the sensing axis of the vibration sensor. You can find the sensing axis by determining the direction the electrical connector points as viewed from forward of the engine looking aft toward the tail of the aircraft. For example, if the sensor is off of the centerline of the engine, but the electrical connector is pointing toward the sky, the correct "Sens Posn" entry will be "12:00".

7. You can potentially reduce the number of runs required to balance the engine if you already know the ICF for the engine type being balanced. To define the ICF press the **[F1]** "Edit ICF" key from the "Prop Balance Setup" screen.

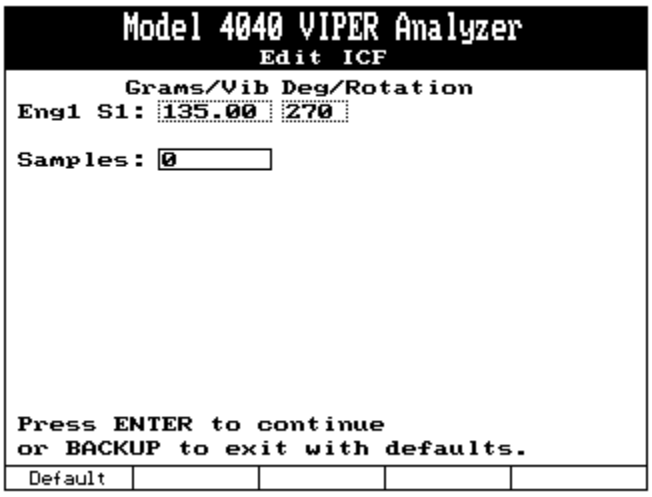
Number 1 Engine



Number 2 Engine



7.1 The "Edit ICF" screen will be displayed. Use the keypad to enter the correct "g/IPS" value in the field adjacent to the "Eng1 S1" text. This is the amount of weight, in grams required to offset a 1.0 IPS vibration on this application. Both engines will begin with the same ICF setting. The analyzer will update these settings during the job. Press the [⇓] key to move to the next field.

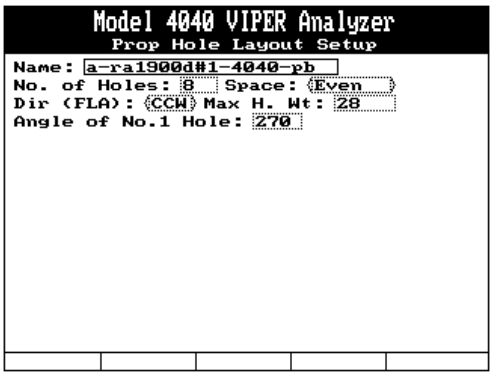


7.2 In the “Deg/Rotation” field use the keypad to enter the “Phase Lag” value for the ICF. This value will be displayed in prior ICF samples as stored in completed jobs. Press the **[⇓]** key to move to the next field.

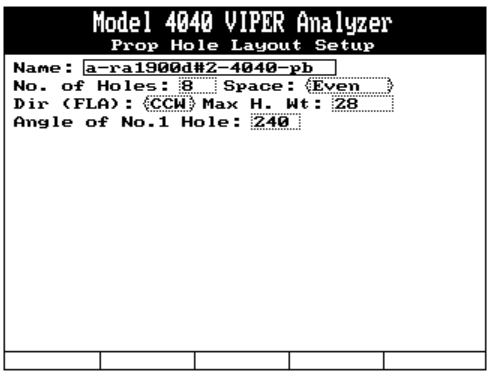
7.3 The “Samples” value will automatically update as the setup is used in future jobs. Leave the value set to zero and press the **[ENTER]** key to exit the screen and return to the “Prop Balance Setup” screen.

8. Press the **[ENTER]** key to exit the screen and display the “Prop Hole Layout Setup” screen as illustrated in the screens below. The “Name:” field will automatically be filled in from the previous screen above. Press the **[⇓]** key to move to the “No. of Holes:” field. Use the analyzer keypad to enter “8” in the field. Press the **[⇓]** key to move to the next field.

Number 1 Engine



Number 2 Engine



8.1 In the “Space:” field, press the **[⇒]** key until the field reads “Even”. The screen will immediately change to display the hole layout grid. Press the **[⇓]** key to move to the next field

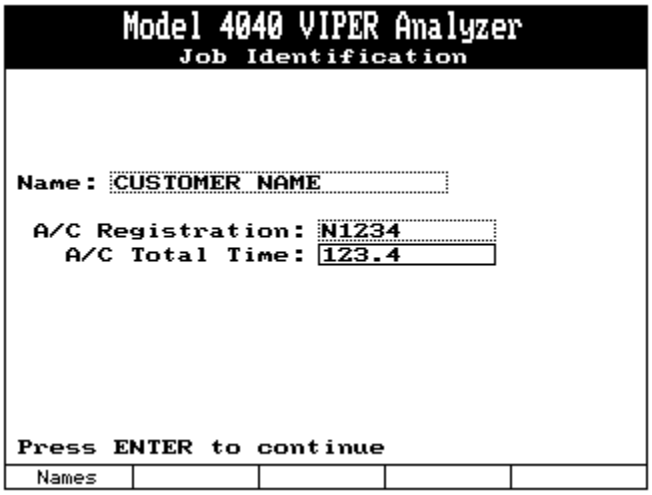
8.2 In the “Dir (FLA):” field, press the right arrow key until the field reads “CCW” for counterclockwise. This is the direction of the hole numbering sequence for the installation. This direction is independent of the method used to determine the location of hole #1 in Step 8.4 below. Press the **[⇓]** key to move to the next field.

8.3 In the “Max H. Wt:” (Maximum Hole Weight) field, use the analyzer keypad to enter “28”. Press the **[⇓]** key to move to the next field

8.4 In the “Ang of First Hole” field, use the keypad to enter “270” for the Number 1 Engine. This indicates that hole #1 on the Number 1 Engine is located at 270 degrees, measured in a clockwise direction as viewed from the front as counted from the 12:00 position. Enter “240” for the Number 2 Engine. See Section B Figure 2 or Figure 3 above for more information. This measurement is independent of the direction of increasing hole numbers set in Step 8.2 above. When complete, press the **[ENTER]** key to accept and continue.

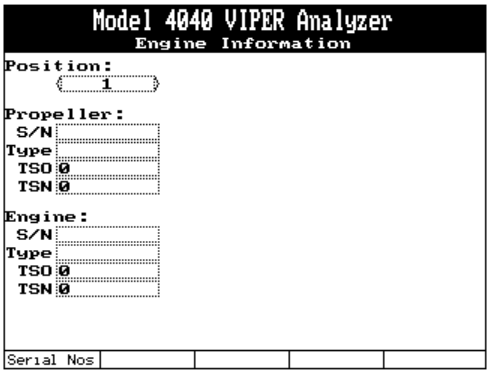
D. Data Acquisition

1. The “Job Identification” screen will be displayed, as shown below. Use the analyzer keypad to enter a customer name in the “Name:” field. The analyzer will maintain a list of customer names as new names are entered. If names have been previously entered into this analyzer, you may press the **[F1]** “Names” key and select a customers name from the provided list. Press the **[⇓]** key to move to the next field and use the analyzer keypad to enter the optional aircraft registration and aircraft total time as required. When all fields are complete, press the **[ENTER]** key to accept and continue.

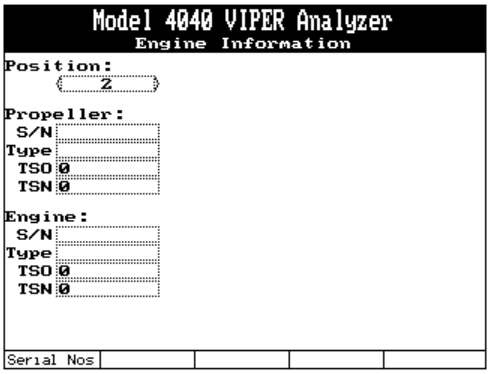


2. The next screen to be displayed is the “Engine Information” screen, as shown below. While all these fields are optional, we highly recommend you fill in as much information as possible to provide better record keeping and search functions in AvTrend. Use the key pad and the arrow keys to complete the fields for the engine. S/N = Serial Number. In the serial number field, you may press the **[F1]** “Serial Nos” key to select the serial number from a list if this number has previously been entered in this analyzer. Type = Type engine or prop. Pos = position (1 or 2). TSO = Time since overhaul and TSN = Time since new. All fields are filled in using the analyzer keypad except the Pos: field which is selected using the **[⇒]** key. When all fields are complete, press the **[ENTER]** key to continue.

Number 1 Engine

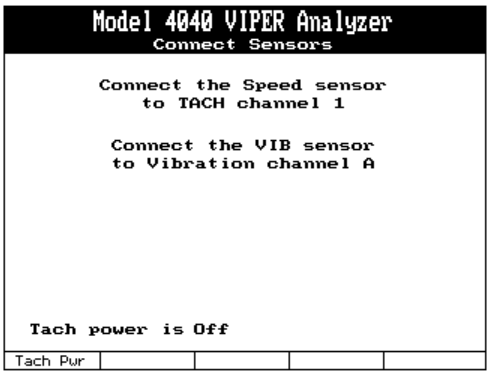


Number 2 Engine

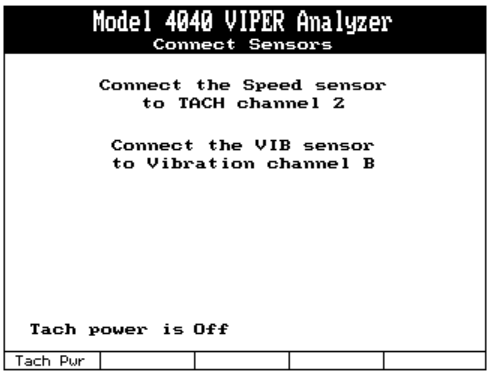


3. The next screen to be displayed will be the Connect Sensors screen as illustrated below. This screen gives instructions on installing sensors and cables. The **[F1]** "Tach Pwr" key supplies power to the optical tachometer for checking alignment with the reflective tape and is not required when using this procedure.

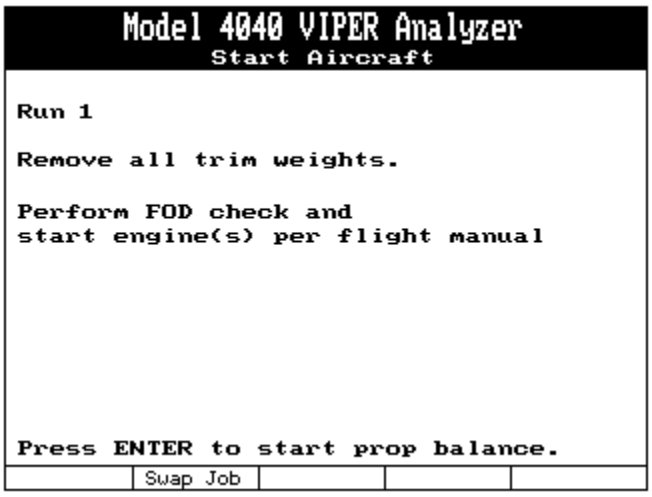
Number 1 Engine



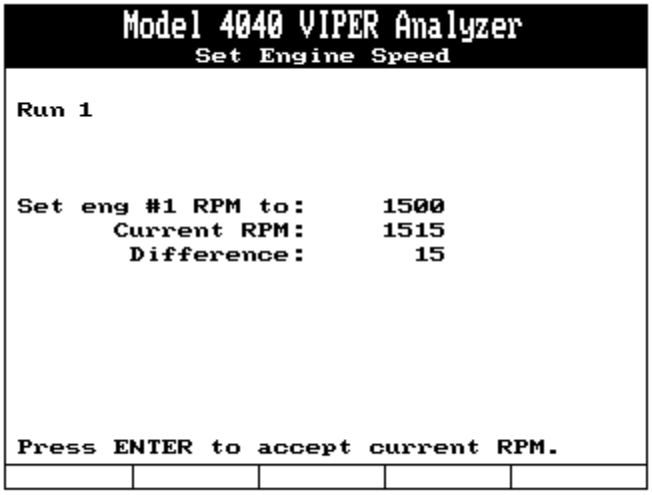
Number 2 Engine



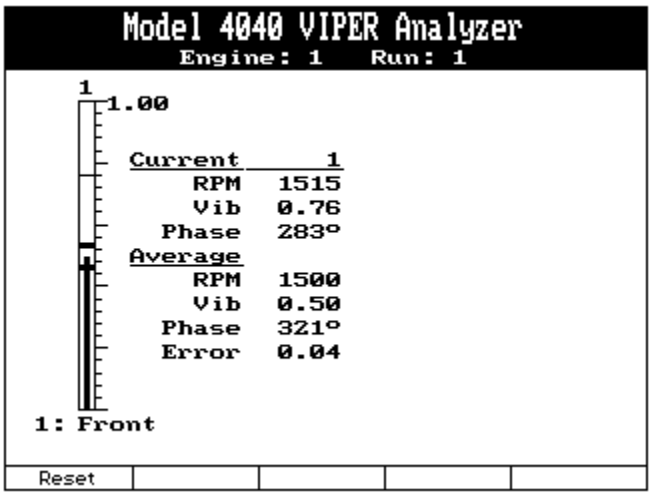
4. The "Start Aircraft" screen will be displayed with instruction to "Remove all trim weights". Remove all previously installed trim balance weights from all hole locations to begin the balance with a clean slate. You can use the **[F2]** "Swap Job" key to return directly to the Main Menu. This can be useful when Swapping Jobs between engines. When you have verified that all weights are removed, press the **[ENTER]** key to continue.



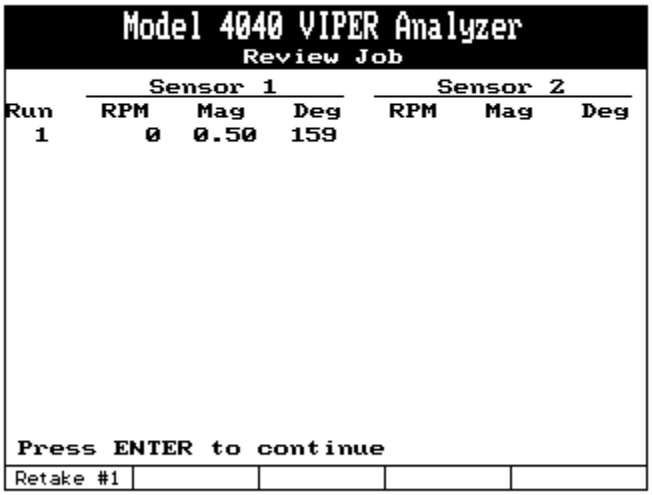
5. The “Set Engine Speed” screen will appear and provide instructions on how to set the throttle to take vibration readings on the test engine. When the test engine RPM is stable and within range of the balance RPM, press the **[ENTER]** key to continue.



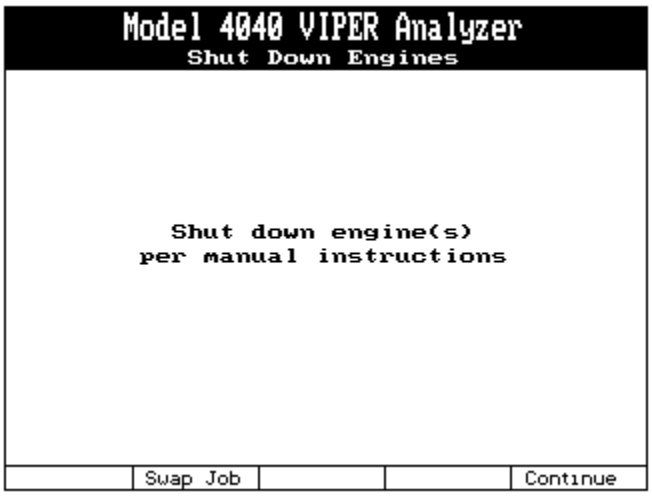
6. The analyzer will display the Engine 1, Run 1 screen similar to the one below. Chapter 20 of the Model 4040 User’s Manual #4040-OM-01 (P/N 75-900-4040) gives detailed instructions on how to read the converging scale if you are not familiar with it. Increase RPM on the engine to a low cruise setting and allow the analyzer to collect data for approximately 10 to 15 seconds. The “Err:” (Error) indication at the bottom of the text portion of the screen should be as steady as possible with very little change before you press **[ENTER]** to stop acquisition. If the Err is not “0”, this is not an indication of failure or fault, only that the vibration averaging errors cannot be resolved below the displayed level. This Err value will typically be higher as the balancing process reduces the vibration amplitude.



7. After pressing **[ENTER]** the review screen will be displayed as shown in the example below. This is the amplitude and phase angle reading for each engine. You may retake engine #1 data by pressing the **[F1]** "Retake #1" function key. When satisfied with the acquired data, press the **[ENTER]** key to accept and continue.

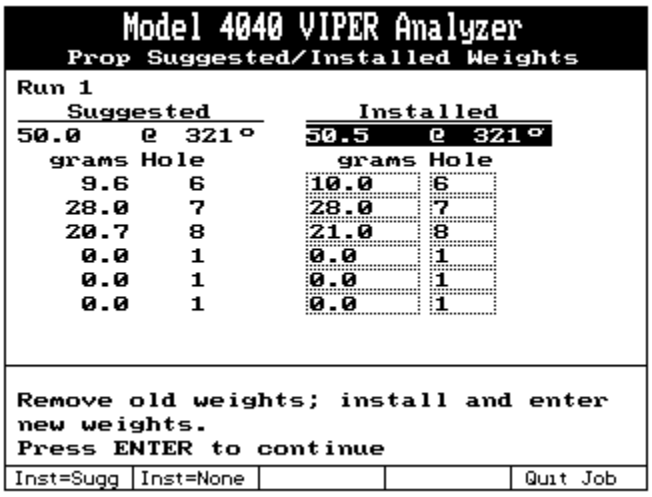


8. The "Shutdown Aircraft" instruction screen will be displayed as shown in the example below. Shut down the engine(s) using normal shutdown procedures. You can use the **[F2]** "Swap Job" key to return directly to the Main Menu. This can be useful when Swapping Jobs between engines. When all shutdown tasks are complete, press the **[F3]** "Continue" key.



9. The “Prop Suggested/Installed Weights” screen for Run 1 shown below will be displayed. At the top of the screen you will see the Run number. The left side of the screen shows the Suggested weight installation by actual weight and phase angle. Directly below the raw solution you will see a specific weight (in grams) in the left column and a corresponding hole number(s) in the right column where that weight should be installed. The Installed column at the right side of the screen is where you must enter the actual weight and hole number(s) where that weight was installed. Be as accurate as possible with the installed weight as the analyzer will use this information to calculate the follow on influence for the next solution (if required). Notice at the bottom of the screen the instructions: “Remove old, install & enter new weight.” This means that ALL previously installed weights must be removed with each new weight installation. At the bottom of the screen, the three function keys are defined as: **[F1]**, “Inst=Sugg”, press this key to default the Installed columns to the values displayed in the Suggested column. **[F2]**, “Inst=None”, press this key to zero out all weight in the Installed column. **[F3]**, Quit Job, press this key if you are satisfied with the current vibration levels and wish to terminate the balance job, leaving the previously installed weights in place. After the screen is complete per your actions, press the **[ENTER]** key to continue.

   In the example below, the “Suggested” weight correction is shown in the left-hand column. This value is achieved using the “Suggested” weight combinations listed below the effective weight value. Use the keypad to enter the “Implemented” values under the right-hand column. If you are not able to match the suggested value exactly, simply enter the value that you can install. As you enter values in the right-hand column, the effective weight at the top of the column, shown highlighted in black below, will update to reflect the new effective weight. When you have entered the value for each hole, review the effective weight. If the Implemented effective weight value does not closely match the Suggested value, you can try to re-weigh one or more holes under the Implemented solution column. In any case, be as honest as possible when entering the values in the Implemented column as the analyzer uses these values to predict future solutions.



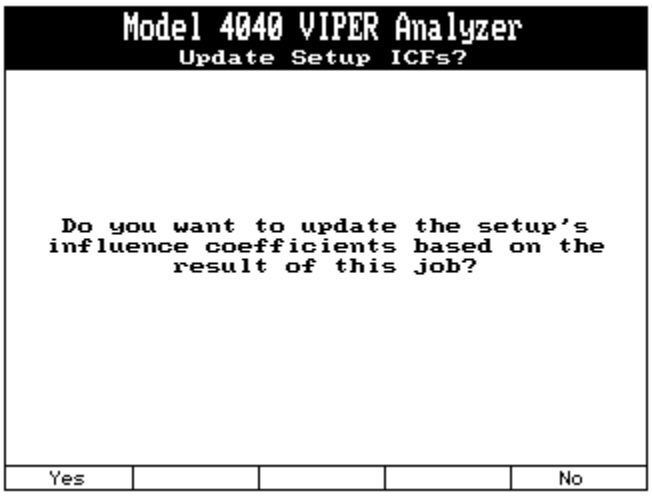
CAUTION

At no point should a correction be made that contradicts information in the maintenance manual. The analyzer will attempt to resolve the vibration and/or track level to 0.00. This may require adjustments that are not practical to duplicate. The technician must determine the closest possible match to the suggestion.

10. If you chose to continue the job, the screen below will be displayed indicating you are ready to start the engine for the next run. Steps D.4 through 9 above will be repeated until the vibration amplitude has been reduced to a satisfactory level, usually three runs total.

E. Quit Job

1. If you selected **[F3]** "Quit Job" in Paragraph D.9 above you will be presented with the following screen. Press **[F1]** "Yes" if the job went as expected. It is possible to update and store the calculated ICF in the setup. This allows you to refine the ICF and potentially reduce the number of runs required in future jobs using this same setup. Select **[F2]** "No" if the balance job did not go as expected. This will keep mistakes or poor mechanical condition from influencing the setup causing unnecessary runs when using the same setup in the future.



2. Remove all test equipment and return aircraft to airworthy condition. Insure only permanent weights are mounted on the propeller and that they are mounted in accordance with the manufacturer's instructions or the *ACES Guide to Propeller Balance* as applicable.