



# Application Note

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**ATR 42/72**

**Propeller Balance**

**Part Number: 11-200-0235**

**AppNote Number: A-ATR42-4040-PB (Rev. 2.1, Jun 2007)**

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# Application Note

Application Note Number	A-ATR42-4040-PB
Revision	2.1
Function	Propeller Balance
Airframe	ATR 42/72
Engine	PW100
E-Setup Number	a-atr42-4040-pb.asf
ACES Systems Analyzer	Model 4040
Firmware Version	1.09/2.04b
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 airframe listed above. 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 ACES Systems equipment is required\*:

Item	Quantity	Description	Part Number
1.	1	Analyzer, Model 4040	10-100-4040
2.	1	Cable, Interface, 991V to ATR 42/72	10-320-0294
3.	1	Cable, Interface, ATR 42/72 to 4040	10-320-0185
4.	1	Sensor, Vibe, Velo, 991V	69-100-0064
5.	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.



## Optional Equipment

The following ACES Systems equipment is necessary to balance both engines during a single run:

Item	Quantity	Description	Part Number
6.	1	Cable, Interface, 991V to ATR 42/72	10-320-0294
7.	1	Sensor, Vibe, Velo, 991V	69-100-0064

## Miscellaneous Equipment

Standard AN washers for balance weights (see maintenance manual for ACES Guide to Propeller Balancing for acceptable hardware).

## B. Equipment Installation

1. Place analyzer (Item 1) in flight compartment.
2. Obtain access to the engine mounted vibration sensor (or dummy sensor) mounted on the gearbox.

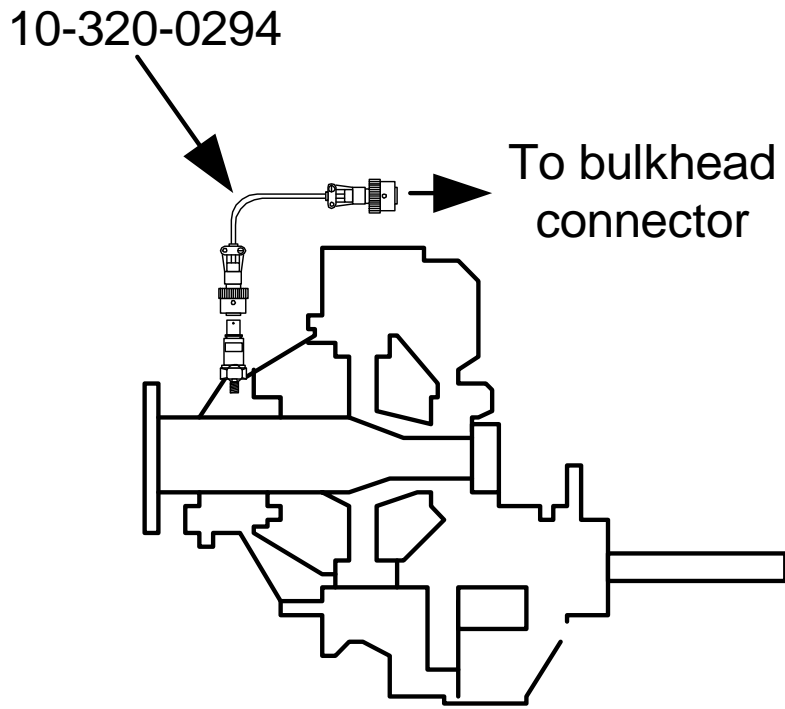
### NOTE

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

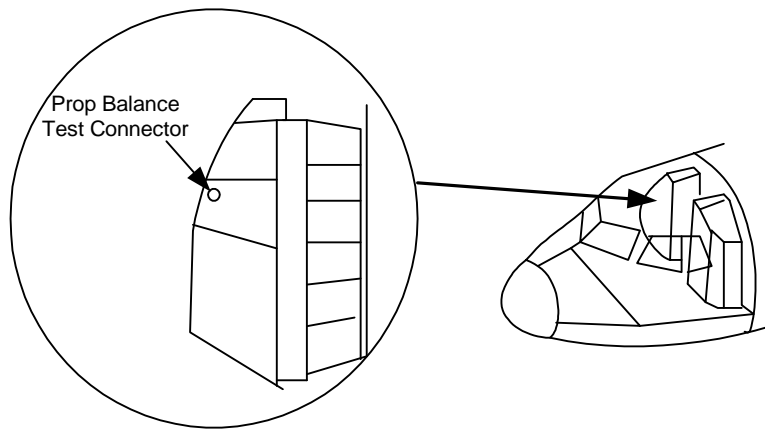
3. Disconnect the sensor cable from the installed sensor (or dummy sensor) and from the bulkhead. Install the 991V to ATR42/72 Interface Cable, (Item 2), to the bulkhead where the previously installed cable was attached. (Figure 1) To configure the second engine for balancing during the same run, install a second Interface Cable (Item 6) as described above.
4. Remove the installed sensor (if not a functional 991V sensor) and install the 991V Vibe Sensor (Item 4) into the mounting hole. Connect the 991V to ATR42/72 Interface Cable (Item 2) to the now installed 991V vibration sensor. (Figure 1) Install a second vibration sensor (Item 7) on the second engine being balanced.
5. Reinstall any previously removed engine cowlings.
6. Connect the ATR-42 to 4040 Interface Cable (Item 3) to the Prop Balance test connector located on the bulkhead behind the co-pilots seat. (Figure 2)
7. Connect the six pin vibration connectors of the ATR42/72 Interface Cable, marked L (left) and R (right) or 1 and 2 to the six pin vibration inputs of the 4040 analyzer as required. The left (#1 engine) connection should go to CHANNEL A and the right (#2 engine) connection should go to CHANNEL B.
8. Connect the three pin tachometer connectors for the ATR42/72 Interface Cable, marked L (left) and R (right) or 1 and 2, to the three pin TACH connectors of the 4040 analyzer as required. The left (#1 engine) connection should go to TACH 1 and the right (#2 engine) connection should go to CHANNEL B.

**Equipment Installation Diagram**

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**Figure 1**



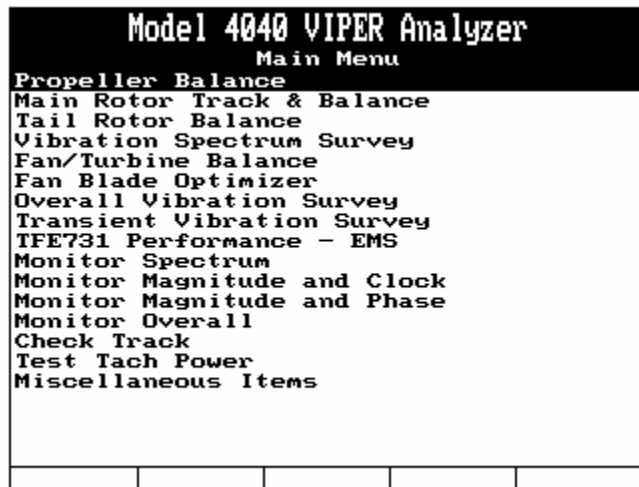
**Figure 2**



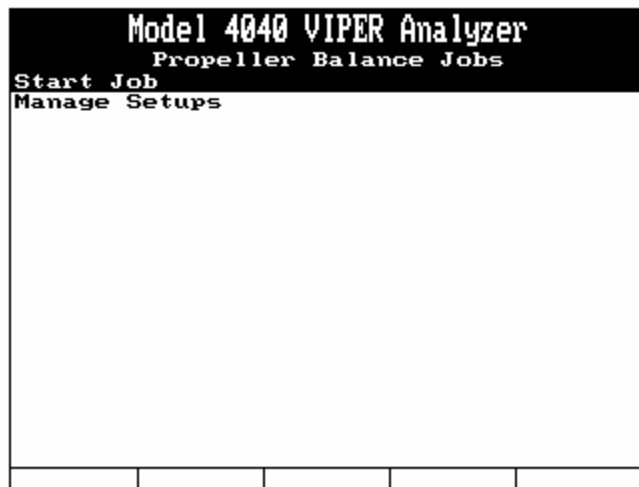
## C. Analyzer Set Up

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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.



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



5. If the ATR 42/72 is listed in the Setup List, select it using the [↓] key, press [ENTER] and go to Section D Paragraph 1 below. If the ATR 42/72 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.

Model 4040 VIPER Analyzer				
Prop Balance Setup				
Name:	a-atr42#1-2020-pb			
Eng HP:	1000			
Max Wts:	650	Balance RPM:	850	
Relative to:	Tape	Holes:	Yes	
Vib:	IPS	Peak	FSR: 1.00	
Rotation (#1):	CCW			
Tach Type:	Mag(H1)			
Tach Chan:	1			
Tach Pos (FLA):	9:00			
Sens Type:	991V			
Sens Chan:	A			
Sens Pos (FLA):	12:00			
Edit ICF				Sensor

- 6.1. In the “Name:” field, use the analyzer keypad to enter “ATR 42/72”. Identify the first setup as the #1 or Left engine setup. Create a second setup identified as #2 or Right for the right engine. This will allow you to store separate influence coefficients for each engine. Press the [↓] key to move to the next field.
- 6.2. In the “Eng HP:” (Engine Horsepower) field, use the analyzer keypad to enter “1000”. Press the [↓] key to move to the next field.
- 6.3. In the “Max Wts:” field, use the analyzer keypad to enter “650”. 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 “850”. Press the [↓] key to move to the next field.
- 6.5. In the “Wts relative to:” field, press the [⇒] key until the field reads “Tape”. This indicates the angle to each of the holes is measured relative to the position of the reflective tape on the propeller, which is used as an index point. 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:” field press the [⇒] key until the field reads “IPS” to indicate you are reading the vibration in Inches Per Second. 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 are using the peak modifier. Press the [↓] key to move to the next field.
- 6.9. In the “FSR:” field press the [⇒] key until the field reads “1.00” to indicate that the full scale range will be from 0 to 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 (Hi)” indicating you will use a magnetic pickup requiring Hi gain. Press the [↓] key to move to the next field.
  - 6.12. In the “Tach Chan:” field select “1” for the left engine. In the right engine setup, select “2” to facilitate balancing both engines during the same run without having to switch cables.
  - 6.13. In the “Tach Pos” (FLA): field, press the [⇒] key until the field reads “9:00”. This indicates the clock position where the PhotoTach is triggered by the passage of the reflective tape, 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 Type:” field, press the [⇒] key until the field reads “991V”. Press the [↓] key to move to the next field.
  - 6.15. In the “Sens Chan:” field select “A” for the left engine. In the right engine setup select “B” to facilitate balancing both engines during the same run without having to switch cables.
  - 6.16. In the “Sens Pos: (FLA) field, press the [↓] key until the field reads “12:00”. This indicates the mounted axis relative to the prop shaft. Even though the sensor is physically mounted at the 9:00 o’clock position, its alignment is a vertical position relative to the propeller shaft. Press the [ENTER] key to continue.
7. The Edit ICF screen shown below will be displayed. Use the analyzer keypad to enter the “g/IPS, Deg/Rotation and Samples as shown below for the ATR-42. When all fields are complete, press [ENTER] to accept and continue.

Model 4040 VIPER Analyzer				
Edit ICF				
Grams/Vib		Deg/Rotation		
Eng 1A:	410.60	296		
Samples:	1			
Press ENTER to continue or BACKUP to exit with defaults.				
Default				

8. The “Prop Hole Layout Setup” screen will be displayed as illustrated in the screen below.

**Model 4040 VIPER Analyzer**  
Prop Hole Layout Setup

Name:

No. of Holes:  Space:

Dir (FLA):  Max H. Wt:

Ang No.	Ang No.	Ang No.	Ang No.
345 1	240 10	135 19	30 28
337 2	232 11	127 20	
330 3	225 12	120 21	
322 4	217 13	75 22	
315 5	210 14	67 23	
307 6	165 15	60 24	
300 7	157 16	52 25	
255 8	150 17	45 26	
247 9	142 18	37 27	

- 8.1. 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 “28” in the field. Press the [↓] key to move to the next field.
- 8.2. In the “Space:” field, press the [⇒] key until the field reads “Uneven”. The screen will immediately change to display the hole layout grid shown in step 8.5 below. Press the [↓] key to move to the next field
- 8.3. 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 8.5 below. Press the [↓] key to move to the next field.
- 8.4. In the “Max H. Wt:” (Maximum Hole Weight) field, use the analyzer keypad to enter “65”. This should be the most weight the maintenance manual allows you to place in a single hole. Press the [↓] key to move to the next field
- 8.5. In the “Ang” field, use the keypad to enter the angle of the default “No” number shown in the adjacent field. The default will be in order from 1 to 28. The #1 hole is located at 345 degrees, measured in a clockwise direction as viewed from the front, relative to the tachometer trigger. Check that each angle (Ang) matches the respective hole number (#) as shown in the screen above EXACTLY. This measurement is independent of the direction of increasing hole numbers set in Step 8.3 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.

Model 4040 VIPER Analyzer				
Job Identification				
Name: CUSTOMER NAME				
A/C Registration: N1234				
A/C Total Time: 123.4				
Press ENTER to continue				
Names				

- 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.

Model 4040 VIPER Analyzer				
Engine Information				
Position:				
1				
Propeller:				
S/N				
Type				
TSO 0				
TSN 0				
Engine:				
S/N				
Type				
TSO 0				
TSN 0				
Serial Nos				

- 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 screen below demonstrates the connections on the #1 engine. When balancing the #2 engine the TACH channel will be “2” and the Vibration channel will be “B”. Pressing the [F1] “Tach Pwr” key



is not required when using a Magnetic Pickup. Press [ENTER] to exit the screen and continue.

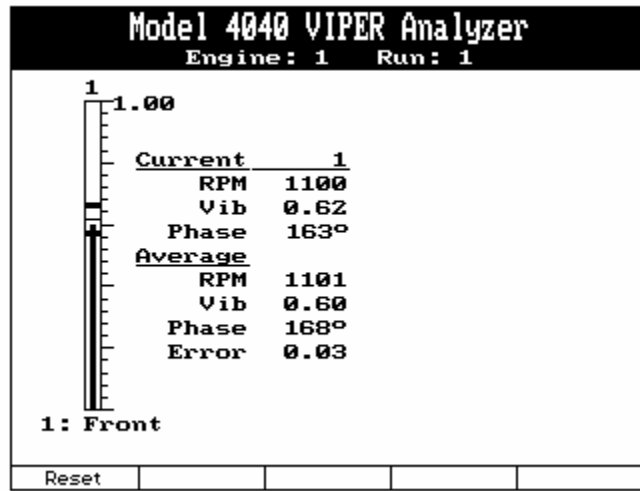
Model 4040 VIPER Analyzer				
Connect Sensors				
Connect the Speed sensor to TACH channel 1				
Connect the VIB sensor to Vibration channel A				
Tach power is Off				
Tach Pur				

- The “Start Aircraft” screen will be displayed with instruction to “Remove all trim weights. Perform FOD check and start engine(s) per flight manual”. Remove all previously installed trim balance weights from all hole locations to begin the balance with a clean slate. When you have verified that all weights are removed, press the [ENTER] key to continue. You can use the [F2] “Swap Job” key to return directly to the Main Menu without rebooting the analyzer.

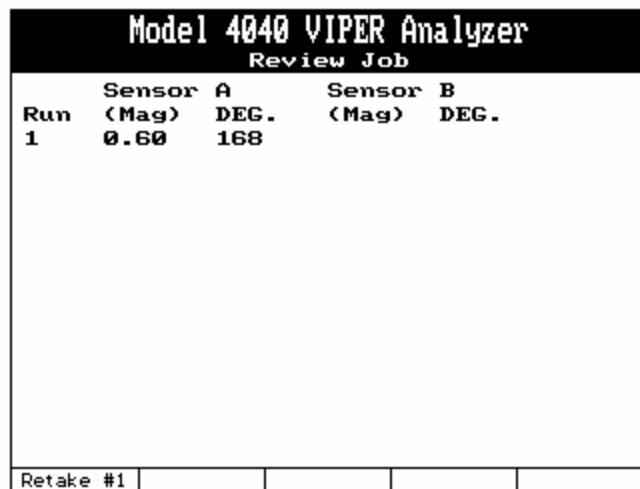
Model 4040 VIPER Analyzer				
Start Aircraft				
Run 1				
Remove all trim weights.				
Perform FOD check and start engine(s) per flight manual				
Press ENTER to start prop balance.				
	Swap Job			

- The analyzer will display the Engine 1, Run 1 screen similar to the one below. Chapter 20 of the Model 4040 User’s Manual 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 “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 Error 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 Error value will typically be higher as the balancing process reduces the vibration amplitude.



6. After pressing [ENTER] the “Review Job” screen will be displayed as shown in the example below. This is the amplitude and phase angle reading for the engine. You may retake the data by pressing the [F1] “Retake #1” function key as indicated at the bottom of the screen. When satisfied with the acquired data, press the [ENTER] key to accept and continue.



7. The “Shutdown Down Engines” instruction screen will be displayed as shown in the example below. You can use the [F2] “Swap Job” key to return directly to the Main Menu without rebooting the analyzer. This is a convenient way to “swap” from the left engine “job” to the right engine job. This method allows data to be gathered on both engines during a single run. Shut down the engine using normal shutdown procedures. When all shutdown tasks are complete, press the [F5] “Continue” key.

Model 4040 VIPER Analyzer			
Shut Down Engines			
Shut down engine(s) per manual instructions			
	Swap Job		Continue

8. The Prop Suggested and Installed Weights screen 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. [F5], 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.

Model 4040 VIPER Analyzer			
Prop Suggested/Installed Weights			
Run 1			
Suggested		Installed	
131.4	@ 144 °	132.5	@ 144 °
grams	Hole	grams	Hole
48.8	17	50.0	17
65.0	18	65.0	18
18.1	19	18.0	19
0.0	1	0.0	1
0.0	1	0.0	1
0.0	1	0.0	1
Remove old weights; install and enter new weights. Press ENTER to continue			
Inst=Sugg	Inst=None		Quit Job

9. 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. The [F2] “Swap Job” key on this page provides a place for you to “swap” between engines after placing the weight on one engine. Steps 4 through 9 will be repeated until the vibration amplitude has been reduced to a satisfactory level, usually three runs total.

Model 4040 VIPER Analyzer				
Start Aircraft				
Run 2				
Perform FOD check and start engine(s) per flight manual				
Press ENTER to start prop balance.				
	Swap Job			

## E. Quit Job

1. If you selected [F5] “Quit Job” from Section D paragraph 8 above you will be presented with the following confirmation screen. If you are certain you want to end the job press [F1] “Yes” and the job will be marked as completed. This choice will generate the message in step 2 below. Choosing [F2] “No” will take you back to the job in progress.

Model 4040 VIPER Analyzer				
Warning! You are about to terminate this balance job!				
Are you sure you want to quit?				
Yes				No

2. Selecting [F1] “Yes” from the screen shown in step 1 above will cause the following screen to be displayed. 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.

Model 4040 VIPER Analyzer				
Update Setup ICFs?				
Do you want to update the setup's influence coefficients based on the result of this job?				
Yes				No

3. 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.

