



# Application Note

Application Note Number	E-PWPT6-1700-PB-1.0
Revision	1.1
Function	PT6, Propeller Balance
Airframe	All
Engine	PWC PT6
E-Setup Number	N/A
ACES Systems Analyzer	1700 / 1725
Firmware Version	2.08C or greater
Procedure	PT6 Vibration

## Introduction

This Application Note is recommended to perform a propeller balance on most airframes with various engine/propeller combinations. This Application Note describes the steps necessary to perform the physical set up of equipment (e.g., cabling, sensor mounting, etc.) and the execution of the steps in the analyzer procedure. For specific guidelines, refer to the aircraft Light Maintenance Manual and appropriate FAR.

## A. Required Equipment

The following ACES Systems' equipment is required.

Item	Quantity	Description	Part Number
1.	1EA	1700 Analyzer Plus	10-100-1700
2.	1EA	Card, Procedure, PT6 Vibration	11-100-0028
3.	1EA	Cable, Generic Tach, 25 Ft.	10-320-0153
4.	1EA	Cable, 991V, 25 Ft.	10-320-0197
5.	1EA	Sensor, Vibration, Velocity, 991V	69-100-0064
6.	1EA	Tachometer, Optical, Phototach	10-100-1773
7.	1EA	Tape, Reflective, Roll, 10 Ft.	10-400-0176

## Optional Equipment

To perform twin engine balance, the following *additional* items are required:

8.	1EA	Cable, Generic Tach, 25 Ft.	10-320-0153
----	-----	-----------------------------	-------------

9.	1EA	Cable, 991V, 25 Ft.	10-320-0197
10.	1EA	Sensor, Vibration, Velocity, 991V	69-100-0028
11.	1EA	Tachometer, Optical, Phototach	10-100-1773
12.	1EA	Package, Propeller Balancing	Z10-100-0446

Additionally, the following optional items may be used as alternates to the above equipment.

13.	1EA	Tachometer, Optical, Lasetach	10-100-1300
-----	-----	-------------------------------	-------------

Item 12 may be substituted for items 6 or 11 above.

14.	1EA	Cable, Generic Tach, 50 Ft.	10-320-0126
-----	-----	-----------------------------	-------------

Item 13 may be substituted for items 3 or 8 above.

15.	1EA	Cable, 991V, 50 Ft.	10-320-0190
-----	-----	---------------------	-------------

Item 14 may be substituted for items 4 or 9 above.

### Miscellaneous Equipment

Other items that may be required: Duct or Speed (aluminum) tape, Wire ties, inspection mirror, hand tools.

## B. Equipment Installation

1. Install the vibration sensor mount from the Balancing Package, item 12, as far forward and near the first support bearing aft of the propeller as possible. You may use the appropriate case bolt adapter as necessary for attaching the mount. Orient the mount so that the sensor will be vertical with the threaded mounting stud pointing toward the prop shaft.
2. Install the vibration sensor, item 5, on the vibration sensor mount installed in step 1 above. (See figure 1. below) Torque the sensor to 25 inch pounds.

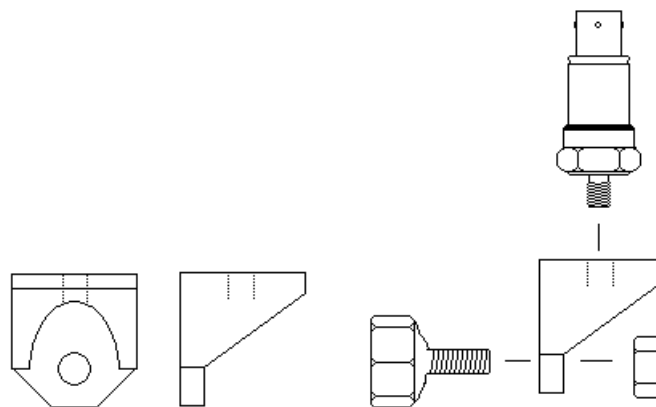


Figure 1

3. If you are installing the vibration sensor at the position of the dummy sensor on the engine, remove the dummy sensor and replace it with the 991V sensor, item 5. (See figure 2 below). NOTE: A sensor mounted as shown below is considered to be at the 7:00 position relative to the prop shaft.

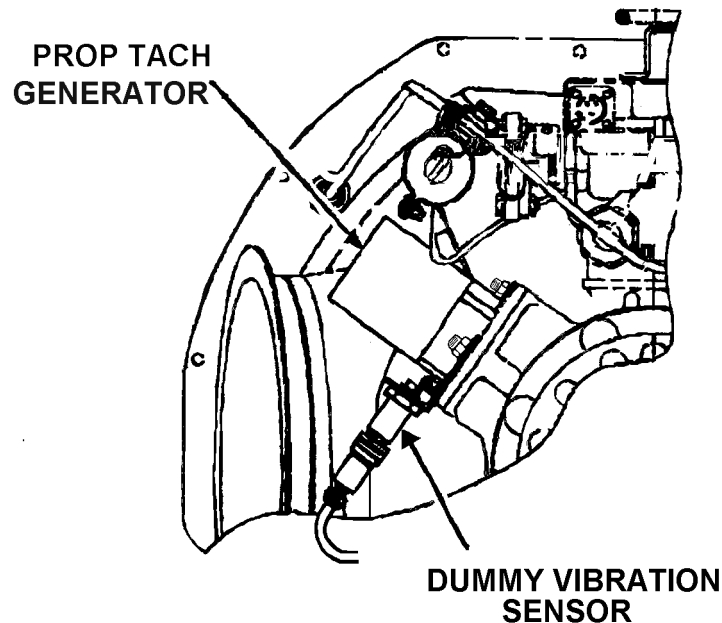


Figure 2

4. Attach the 991V cable to the 991V sensor. Route the cable to the analyzer avoiding hot areas and moving components. Secure the cable to the cowling, wing, and fuselage with duct tape, speed (aluminum) tape, or wire ties as necessary to prevent movement and possible injection into the engine intake or propeller.
5. Place the analyzer in the cockpit or in the location where it will be operated. Connect the 991V cable to the 1700 Velocity input, or to the selected vibration channel input of the 1725.
6. Mount the Phototach and Phototach mount assembly 12 to 18 inches aft of the propeller on the cowling of the engine. Secure the assembly base to the cowling surface with duct or speed tape. It is best to mount the Phototach at a slight angle (approximately 5 to 10 degrees) to the back of the propeller blades rather than perfectly perpendicular. You must estimate this angle based on the pitch of the propeller AFTER it comes out of the feather position. See Figure 3 below.
7. Attach the Phototach cable to the Phototach. Route the cable to the analyzer avoiding hot areas and moving components. Secure the cable to the cowling, wing, and fuselage with duct tape, speed (aluminum) tape, or wire ties as necessary to prevent movement and possible injection into the engine intake or propeller.
8. Sight along the top of the Phototach to estimate where the light beam will strike the back of the propeller blade. Clean that area of the propeller blade with a quality solvent that will clean the area thoroughly and not leave a residue. Cut a two to three inch length of 1 inch wide

7610 reflective tape. Remove the backing and center the tape, running lengthwise toward the blade tip, at the point where the Phototach beam is estimated to strike the propeller blade.

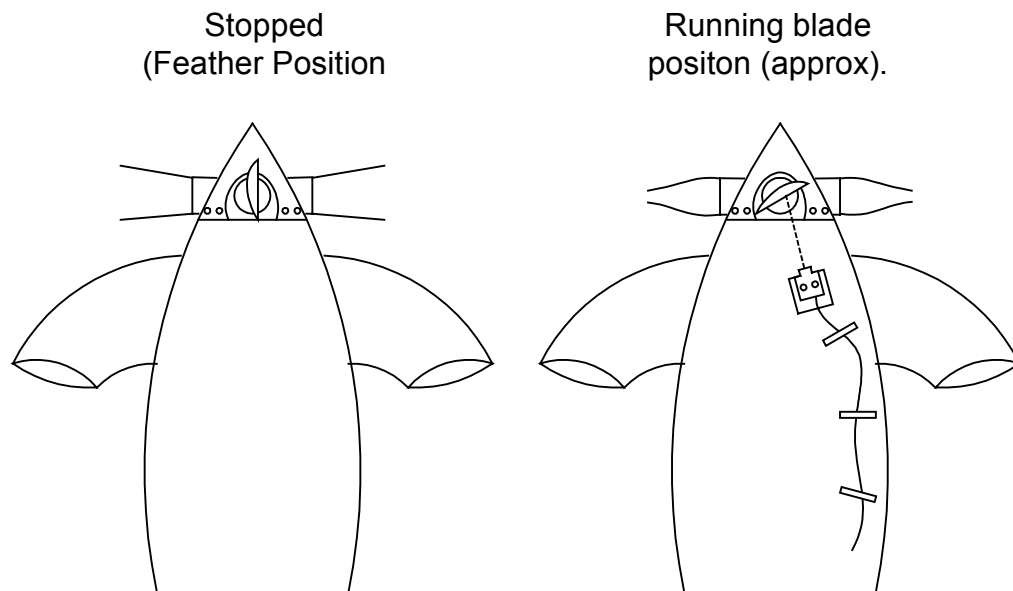


Figure 3

### C. Analyzer Set Up

1. Turn the analyzer ON by pressing the ON/OFF key. When the Operation Options menu screen is displayed, use the [DOWN ARROW] key to select P&W PT6 and press [ENTER].

```

-----
Fri 09Aug2002 16:16 4239Kb
TrimTEC Analyzer
  Operation Options
-----
1--P&W PT6                               v3.21
-----
Select Function Using ↑↓.

```

2. A series of information screens such as Battery Check and the DO NOT Exceed screen shown below will be momentarily displayed and extinguished automatically. Some of these screens will be dependent on the amount of time the analyzer has been idle. You are not required to take any action but only to note the information presented on these screens.

```

----- Fri 09Aug2002 16:18 4239Kb
-----
WARNING!

DO NOT Exceed ANY
Flight Manual or
Maintenance Manual Limits

```

- When the Main Menu banner screen is displayed, use the [DOWN ARROW] key to select “2—Balance Propeller” and press [ENTER].

```

----- Fri 09Aug2002 16:18 4239Kb
-----
PTG
Main Menu

1--Perform Engine Survey
2--Balance Propeller
3--Enter Demo Mode
4--Change Global Settings
5--Exit

Select Operation to Perform.

```

- From the Balance banner screen, use the [DOWN ARROW] key to select “1—Start Balance Procedure” and press [ENTER].

```

----- Fri 09Aug2002 16:18 4239Kb
-----
PTG
Balance

1--Start Balance Procedure
2--Review Balance Job
3--Resume Balance Job
4--Equipment Setup
5--Exit

Select Operation to Perform.

```

- When the Balance Information banner screen is displayed, the first line will display the message “Power to Tach 1 Light is ON”. This indicates that power is being provided to the optical tachometer (Phototach or Lasetach) so that alignment of the tachometer and tape may be accomplished. Since the pitch of the propeller makes this impossible to do with the engine shutdown, you must assume the alignment is sufficient for a reliable tachometer signal and continue. Complete the remainder of the screen as follows:

**Engines:** This is a toggle, 1 or 2, field to indicate the number of engines you will balance during this procedure. Use the [RIGHT ARROW] key to toggle the answer to the appropriate number. If you choose 2, the screen will change, as illustrated in the second screen below, to

accommodate 2-engine information. Press the [DOWN ARROW] key to move to the next field.

**Sensors:** This is a toggle, 1 or 2, field to indicate the number of sensors you will use to conduct the propeller balance. Only one sensor is required for the balance. Select 1, then press the [DOWN ARROW] key to move to the next field.

**Vibe Source:** Is the sensor you are using to conduct the balance job. Use the [RIGHT ARROW] key to scroll through the list of available selections until the sensor you are using is displayed. If your sensor is not contained in the list, select CUSTOM. A follow on screen will be provide where you will define the characteristics of the sensor. . Press the [DOWN ARROW] key to move to the next field.

**Engine S/N:** The Engine Serial Number filed is an optional field. If you choose to use the field, enter the numeric Serial Number of the Engine using the analyzer keypad. Press the [DOWN ARROW] key to move to the next field.

**Engine Cycles:** Likewise, the Engine Cycles is an optional filed to indicate the number of cycles currently on the engine. Enter the numeric value from the analyzer keypad. . Press the [DOWN ARROW] key to move to the next field.

**Engine Hours:** The Engine Hours is also an optional filed. Use the analyzer keypad to enter the total number of operating hours. When all field are complete, press [ENTER] to accept the values of each field

```

----- Fri 09Aug2002 16:19 4239Kb
          P T 6
          Balance Information
Power to Tach 1 Light is ON
Engines: 1 Sensors: 1
Vib. Source : 991V
Engine S/N :
Engine Cycles :
Engine Hours : 0.0000
Enter Num of Engines to Balance

```

```

----- Fri 09Aug2002 16:19 4239Kb
          P T 6
          Balance Information
Power to Tach 1 Light is ON
Engines : 2 Sensors: 1
Vib. Source: 991V
Eng S/N Cycles Hours
1
2
Enter Number of Sensors / Engine

```

- If you are using the 1725 Trim TEC analyzer, the Channels Selection screen will be displayed. Use the [DOWN ARROW] key to move from field to field and the [RIGHT ARROW] key to change the selection in the Sensor and Tach fields to match the connections you have made on the analyzer for those functions. When the settings are set correctly, use the [DOWN ARROW] key to move the dark highlight bar to “CURSOR HERE WHEN DONE” and press [ENTER] to accept the settings and continue.

```

----- Fri 09Aug2002 16:19 4239Kb
      PT6
    Channels Selection

    Eng      Sensor    Tach
    1         Eng 1A    Tach 1

    CURSOR HERE WHEN DONE

Power to Tach 1 Light is ON
Press ENTER if Done

```

7. The Define Influence Coefficient screen will be displayed with three options, Influence from: 1—Default, 2—Previous, and 3—Editing. Select one of the three as follows:

**Influence From: Default.** This is the influence you should choose if you do not know what the influence for the engine / propeller combination is or if you have not balanced a propeller with this procedure since it's installation in the analyzer. The Default value is a general default based on experience in a typical PT6 Propeller Balance scenario.

**Influence From: Previous.** If you have previously balanced a PT6 propeller with this procedure since it's installation in the analyzer, an influence for that balance job is stored in the analyzers memory. This selection uses that stored influence to calculate a solution for the propeller you are about to balance. This setting should be used only if the previous balance job was conducted on the same engine / propeller combination.

```

----- Fri 09Aug2002 16:19 4239Kb
      PT6
    Define Influence Coefficient

    1--Influence From: Default
    2--Influence From: Previous
    3--Influence From: Editing

Select Operation to Perform.

```

**Influence From: Editing.** This selection will produce the screen below where you may enter the actual influence calculated on the propeller you are about to balance. You may have this information stored in a balance report or recorded in a personal note. In any case, you may use this option to enter the actual Magnitude and Phase Lag for this propeller before you begin the balance job. This information may allow the analyzer to balance the propeller on the very first run but will reduce the total number of required runs in all cases. Press [ENTER] to accept the influence and continue.

```

----- Fri 09Aug2002 16:19 4239Kb
          P T 6
    Edit Influence Coefficient
Sensor 1 Infl Mag: 100.00
Sensor 1 Infl Lag: 270.00
          CURSOR HERE WHEN DONE
Press ENTER if Done

```

8. The Get Balance Speed banner screen will be displayed as shown below. Enter the propeller balance speed using the analyzer keypad. Press [ENTER] to accept and continue.

```

----- Fri 09Aug2002 16:23 4238Kb
          P T 6
    Get Balance Speed
          ENTER PROP BALANCE RPM
          +2000
Press ENTER to Continue

```

9. A verification screen will ask you to answer Yes or No to the question “OK to Balance at xxxxx RPM?” The default answer is Yes. If the displayed balance RPM is correct, simply press [ENTER] to continue. If you wish to change the balance RPM, press the right arrow key to toggle the answer field to No then press [ENTER]. The screen will revert to the screen above in item 8 where you may edit the RPM.

```

----- Fri 09Aug2002 16:23 4238Kb
          P T 6
    Get Balance Speed
          ENTER PROP BALANCE RPM
          2000.0
          OK to Balance at 2000 RPM ?
          YES
Use + + to select, then ENTER

```

10. If you have proceeded with a balance RPM, the information screen below will be displayed advising you to “Remove All Trim Balance Weights”. Inspect the propeller and remove any previously installed trim balance weights. NOTE: Do not remove static balance weights installed by an authorized prop overhaul facility. Acknowledge and proceed by pressing [ENTER].

```
----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Balance Preparation
          Remove All
          Trim Balance Weights
          Press ENTER to Continue.
```

11. The information screen below will prompt you to Start the Engine Per Manual and Set To Idle. Follow the normal start sequence and allow the engine to stabilize and warm up at idle speed. Do not attempt to balance the propeller if operating temperatures are not in the normal range. When the engine is stable, press [ENTER] to proceed.

```
----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Balance Run 1
          Start Engine Per Manual
          Set To Idle
          Press ENTER to Continue.
```

12. The screen will display a Check Idle information page. This is only a check to make sure the tachometer is working correctly. If the analyzer is not acquiring a valid tachometer signal, the second screen below will be displayed. If you encounter the “PROBLEM Bad Tach” message, recheck reflective tape, tachometer alignment and all tachometer connections. Check the indicated Measured RPM for validity only at this point. Press [ENTER] to proceed in either case.

```
----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Balance Run 1
          Check Idle RPM
          Measured RPM: 1570
          Press ENTER to Continue.
```

```
----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          PROBLEM
          Bad Tach
          Press any key to continue.
```

13. If the tachometer signal was good, the next information screen will be displayed and prompt you to Set the Engine (propeller speed) to the RPM entered in step 8 above. When you are ready to set the power to balance speed, press [ENTER] to continue to the next screen.

```
----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Balance Run 1

          Set Engine To
          Desired RPM: 2000
          Monitor Speed on Next Screen

          Press ENTER to Continue.
```

14. The next screen will display a “Standby....” Screen while the tach signal is again being acquired. When a tach signal is acquired, the screen will automatically display the second screen below showing the “Desired RPM:” which is the target balance speed you should accelerate to, and the “Measured RPM:” which is the current RPM the propeller is turning. Begin the acceleration and match the Measured RPM as closely as possible with the Desired RPM. Allow the speed to stabilize for a few moments, then make minor adjustments if necessary. When the two speeds are matched as closely as possible, press [ENTER] to begin averaging the data. (NOTE: The data shown in the screens below is for illustration only and does not reflect actual data you might acquire.)

```
----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Balance Run 1

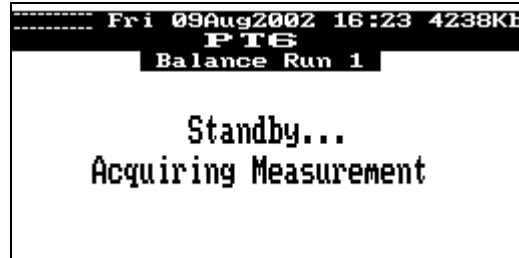
          Standby...
          Measuring Speed
```

```
----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Balance Run 1

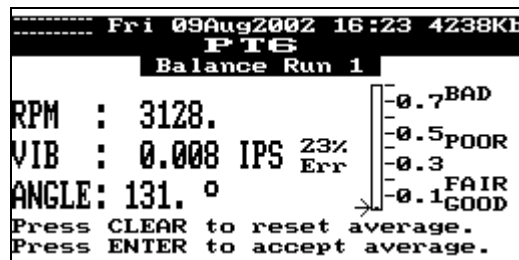
          Desired RPM: 2000
          Measured RPM: 3104

          Set to Desired, then Press ENTER
```

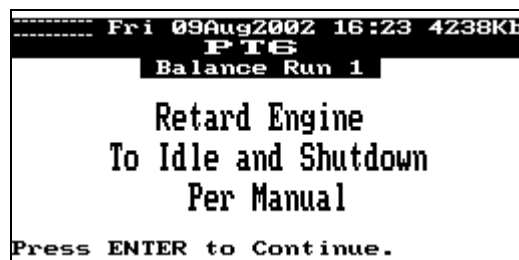
15. The “Standby..” screen will be displayed again while vibration and tachometer signals are being acquired. The screen will then automatically display the second screen below which shows the averaged data as well as the current data.



Notice that the banner is showing “Balance Run 1” indicating this is run one of the balance job. This number will increase incrementally as subsequent runs are made. In the mid left section of the screen, the **RPM** (Averaged Propeller RPM), **VIB**, (Averaged Amplitude), and **ANGLE** (Averaged Phase Angle) are displayed. These values will continue to change as long as averaged corrections are being made. Take note of the two lines of text at the bottom of the screen. “Press CLEAR, the [CLR] key, to reset average, and Press ENTER to accept average. If you feel a wind gust, passing aircraft, or other outside influence has affected the quality of the averaged data up to this point, you may press the [CLR] key to delete the averaged data and begin a new averaging. The “% Err” to the immediate right of the VIB value is an indication of how much error is in the current averaged data. This value may start out high and reduce to or near 0% very rapidly if the amplitude of the vibration is high. As the vibration amplitude is reduced in the balancing process, the % Err value will be increasingly slow to reduce and, in fact, may stop at a value of 10 to 15% if the amplitude is below .1 IPS. The important indication is that the %Err value is stable and not changing at this point. The small arrow to the left side of the scale and indicator will indicate the current vibration amplitude relative to the scale. In the center of the “thermometer” scale, the averaged amplitude is shown relative to the scale. When the averaged data is stable, press [ENTER] to accept and continue.



16. The screen will display the message shown in the illustration below. Shutdown the engine using normal procedures. When the shutdown is complete, press [ENTER] to continue.



17. The Vib Summary : Run X banner screen will be displayed showing the Starting Level of vibration and the Current Level. If this is the Run 1 summary, the Starting and Current levels will be the same as no corrective action has been taken as yet. Review the condition and determine if the propeller requires balancing. If the vibration level is below .07 IPS, the “Continue to Balance?” answer field will default to No. If you still wish to balance, even if the vibration level is below .07, press the [RIGHT ARROW] key to toggle the answer field to Yes, then press [ENTER] to continue. In subsequent runs, if the vibration level is below .07 you must repeat this action. If you press [ENTER] with the No answer selected, the job will be terminated and there is no recovery path.

```

----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Vib Summary: Run 1
          Starting Level 0.007
          Current Level 0.007
          Continue to Balance ? YES
          Use ← → to select, then ENTER

```

18. If you chose to continue the balance, the solution for this run will be displayed as illustrated below. The Suggested Solution is presented as a weight in grams (0.7 G in the example below) and phase angle (20 Degrees in the example below). If you will install the suggested weight at the suggested phase angle, weigh the washers (see ACES Guide to propeller balancing for FAA approved hardware) before installing. If you are using the spinner attaching screws to attach test weights, you may need to exchange the screw for a longer screw to maintain minimum thread requirements. If so, be sure to add the delta between the original screw and the longer screw to the total weight applied. Always rotate the propeller so that the reflective tape is directly in line with the Phototach (or the interrupter is in line with the magnetic pickup) for the phase measurement. With the propeller in this position, use the location of the vibration sensor as the index point and measure from the index, opposite the direction of prop rotation, as viewed from *forward of the propeller looking toward the aft* of the propeller, to the phase angle in the suggested solution.

If you are unable to install the suggested weight at the suggested location due to a physical limitation or a single location weight limitation, you may Split the weights over two locations. To use this option, use the [RIGHT ARROW] key to toggle the Yes/No answer field to Yes in the “Split Weights?” line at the bottom of the screen, then press [ENTER].

```

----- Fri 09Aug2002 16:23 4238Kb
          P T 6
          Solution Run 1
          Suggested Solution:
          0.7 G At 20 Degrees
          Split Weights ? YES
          Use ← → to select, then ENTER

```

19. If you chose not to split the weight, go to step 20. If you chose to split the weights, the first screen below will be displayed. The suggested weight and angle are given at the top of the screen. There are two fields, Angle Above, and Angle Below, near the center of the screen. Use the [ARROW] keys to move between the fields and enter the two new angles from the analyzer keypad. The “Angle Above” must be a value greater than the suggested and the angle below must be less than the suggested angle. If your hole split exceeds 180 degrees, the new solution will be give as a negative number. Generally you should always use splits of less than 180 degrees unless you have the option of removing weight from the spinner.

```

----- Fri 09Aug2002 16:23 4238Kb
      P T E
      Split Weights
Split  0.7 G at  20 Deg.
      Available Angles
      Angle Above : 0
      Angle Below : 30
Enter Angle in Degrees

```

When the two new angles are entered, press the [ENTER] key to accept and continue. The screen below will then display the new suggested weight for the two new available angles you entered. If, for any reason, you decide to change the angles, verify the “Re-Split Weights?” answer field reads “Yes” and press [ENTER]. The screen above will again be displayed so that you may enter the new angles. When the angles are correct, record the suggested weights and angles, then use the [RIGHT ARROW] key to toggle the answer field to No and press [ENTER] to continue.

```

----- Fri 09Aug2002 16:23 4238Kb
      P T E
      Split Weights
      Split Solution:
      0.2 Grams at  0 Degrees
      0.4 Grams at 30 Degrees
Re-Split Weights ? NO
Use + + to select, then ENTER

```

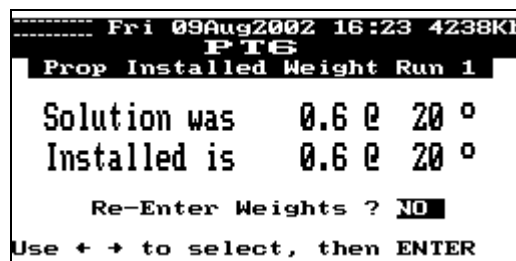
20. You may turn the analyzer off while adding the weights. After attaching the weights to the spinner, return to the analyzer and use the Resume function to continue the balance job (1—Balance Propeller | 3—Resume Balance Job). The screen below will prompt you to “Record The Weights Installed On The Prop Between Run 1 and Run 2”. Press [ENTER] to continue.



21. The “Prop Installed Weight Run X” screen, shown below will be displayed. The original solution will be displayed near the top of the screen with the split solution shown immediately below it. The diagram at the left of the screen shows the two split weight locations as darkened circles. These positions are shown relative to the sensor being mounted at the 12:00 o’clock (0 or 360 degrees) location as viewed from forward of the propeller looking aft. The arrow adjacent to the diagram indicates the direction of rotation of the propeller. If you did not install the exact weight as shown at the exact angle shown, use the [DOWN ARROW] key to move from field-to-field and use the analyzer keypad to enter the correct information. Notice to that you again have the opportunity to Resplit Weight by pressing the [EXP] key. If you choose to Resplit the weight, go to step 19 above. If you do not choose to Resplit the weight, recheck the displayed weights and angles for correct entry and press [ENTER] to continue.



22. The screen will display the “Solution Was XXX” and “Installed Solution XXX” to indicate any differences between the suggested solution and the solution you actually installed. If you do not agree with the Installed information, you may Re-enter Weights by toggling the Yes/No answer field to YES, then pressing [ENTER]. You will then be returned to the screen shown above in step 21. If the Installed is correct, toggle the answer field to NO and press [ENTER] to accept and continue.



22. The Start Engine information screen, shown below will again be displayed with the Balance Run number incremented by 1 in the banner. From this point, go to step 12 above. The steps from 12 through 22 will be repeated until the propeller vibration is reduced to an acceptable level.

```
----- Fri 09Aug2002 16:23 4238Kb
PT6
Balance Run 2

Start Engine Per Manual
Set To Idle

Use ← → to select, then ENTER
```

23. When the vibration level is reduced to an acceptable level, you must install the weight in a permanent manner. The spinner attaching screws must never be used for permanent balance weight installation. Some PT6 bulkheads are predrilled for adding balance weights. In this case, if those holes were used during the balance job, the weight may remain there for the permanent installation. If the bulkhead must be drilled for installation, refer to the ACES GUIDE TO PROP BALANCING for FAA approved methods and hardware. Do not forget to correct the weight for the change in arm from the spinner attaching screw to the position where the permanent weight will be installed.



# Application Note

---

**Aircraft Type: Various**

**Procedure: P&W PT6**

---

Part Number: 11-200-0143

AppNote Number: E-PWC-PT6-1700-PB

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.

Copyright © 2002, TEC Aviation Division. All rights reserved. This document is to be printed and reproduced for personal use only.