



Application Note

Antonov AN38

Propeller Balance

Part Number: 11-200-0250

AppNote Number: A-AN38-2020-PB (Rev. 5.0, Aug 2008)

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Application Note

Application Note Number	A-AN38-2020-PB
Revision	5.0 (From Customer data provided 9/2007)
Function	Propeller Balance
Airframe	Antonov AN38
Engine	Honeywell TPE 331
E-Setup Number	a-an38-2020-pb.asf
ACES Systems Analyzer	Model 2020
Firmware Version	5.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 2020 with the Propeller Enhanced Performance Software (EPS) option to perform a Propeller balance on the Antonov AN38. General instructions for the use of the Model 2020 can be found in the Model 2020 User Manual #2020-OM-01 (P/N 75-900-2020). 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 2020	10-100-2020
2.	1	Mount, Assy, Phototach Cowling	10-100-0196
3.	1	Tachometer, Optical, Phototach (New)	10-100-1773
4.	1	Cable, Tach, Generic, 50'	10-320-0126
5.	1	Cable, Sensor 991D-1, 50'	10-320-0163
6.	1	Tape, Reflective, Roll, 10'	10-400-0176
7.	1	Mount, ¼X28 Sensor, Vibe ¼" Hole	22-430-0056
8.	1	Sensor, Vibe, Accel, 991D-1	69-100-0075
9.	1	Option, 2020 Enhanced Propeller	11-900-0001**

*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.



**Using the Enhanced Propeller Option will require entries on screens not found in the standard 2020 software. If your 2020 does not display all of the following screens, contact ACES Systems to learn about the benefits and availability of EPS.

Optional Equipment

If both engines are going to be balanced at the same time the following optional equipment will also be needed:

Item	Quantity	Description	Part Number
10.	1	Mount, Assy, PhotoTach Cowling	10-100-0196
11.	1	Tachometer, Optical, PhotoTach (New)	10-100-1773
12.	1	Cable, Tach, Generic, 50'	10-320-0126
13.	1	Cable, Sensor 991D-1, 50'	10-320-0163
14.	1	Mount, ¼X28 Sensor, Vibe ¼" Hole	22-430-0056
15.	1	Sensor, Vibe, Accel, 991D-1	69-100-0075

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 analyzer (Item 1) in flight compartment.
2. Obtain access to the engine compartment.

NOTE

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

3. Install the 991D-1 Vibe Sensor (Item 8 or Item 15 for #2 engine) into the Vibe Sensor Mount with ¼" Hole (Item 7 or Item 14 for #2 engine). Attach the Vibe Sensor and Mount assembly to the stud on the right-hand side of the accessory case. The vibration sensor should be installed with the electrical connector pointing toward the 9 o'clock position. (Figure 1)
4. Connect the 50' 991D-1 Sensor Cable (Item 5 or Item 13 for #2 engine) to the Sensor and route to the analyzer. Connect Cable to "CHANNEL A" of the analyzer for #1 Engine. Connect Cable to "CHANNEL B" of the analyzer for the #2 Engine.
5. Reinstall any previously removed engine cowlings.

NOTE

See Paragraph D.4 for additional installation instructions of PhotoTach and Tape.

6. Secure PhotoTach (Item 3 or Item 11 for #2 engine) and Mount (Item 2 or Item 10 for #2 engine) to top of engine cowling. Insure that PhotoTach will withstand propeller slipstream. (Figure 2)

7. Connect the 50' Generic Tach Cable (Item 4 or Item 12 for the #2 engine) to the PhotoTach and route the Cable to the analyzer. Connect Cable to "TACH 1" of the analyzer for the #1 engine. Connect Cable to "TACH 2" for the #2 engine.
8. Install the equipment on the second engine as required using Items 10 thru 15 and following steps 2 thru 7

Equipment Installation Diagram

Figure 1

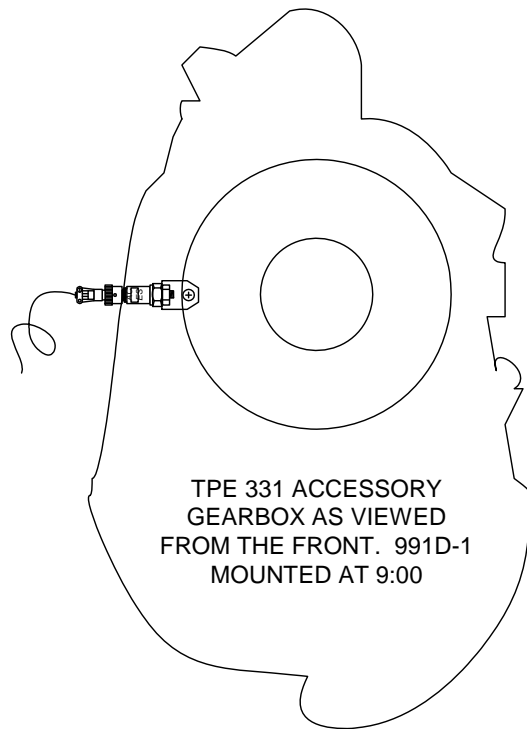


Figure 2

**Running blade
position (approx).**

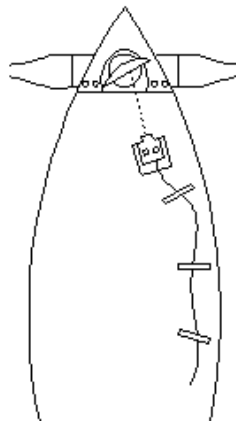
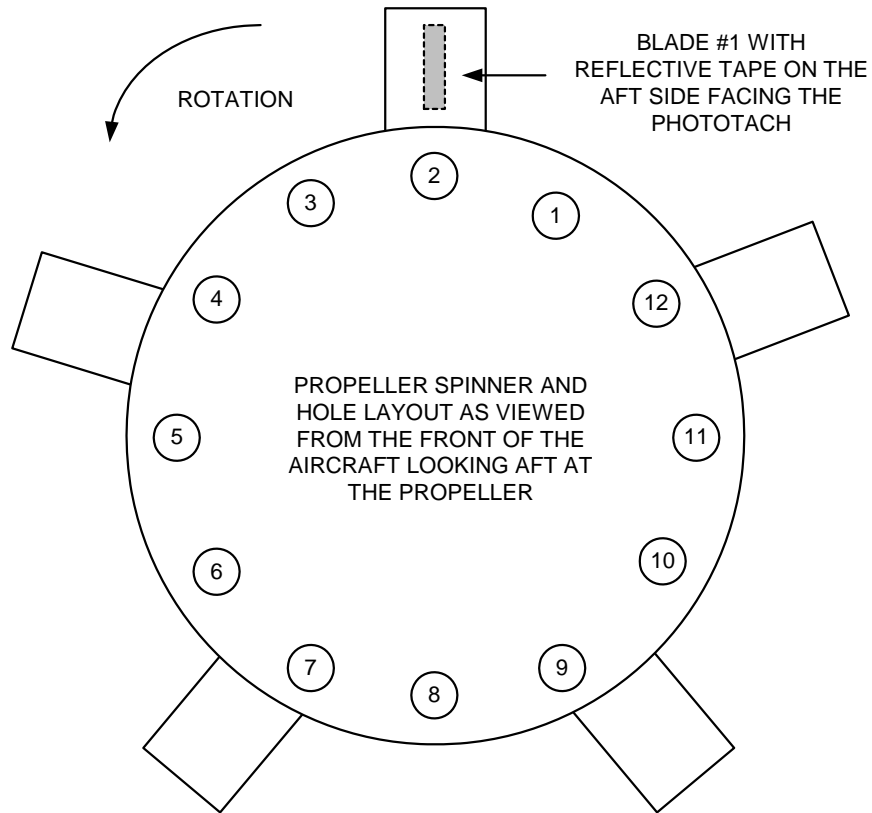
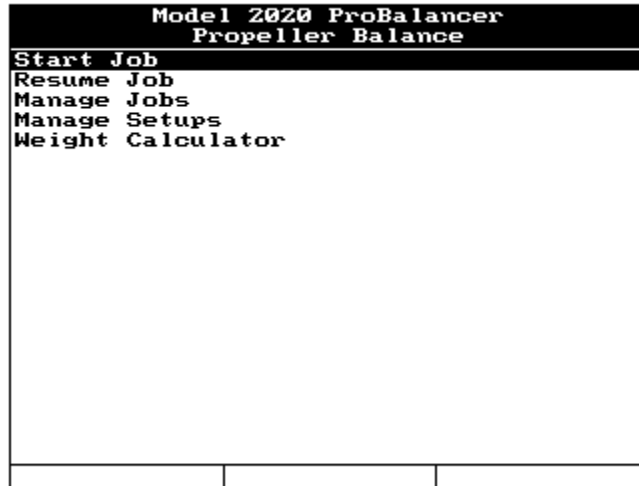


Figure 3

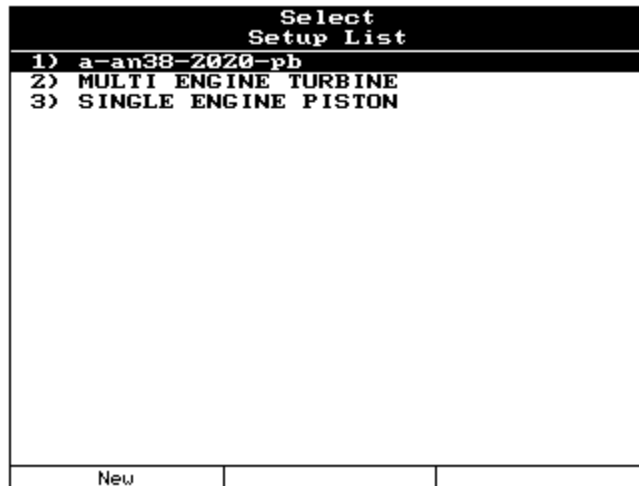


C. Analyzer Set Up

1. Insure the analyzer battery is charged prior to starting the job. See the Model 2020 User Manual #2020-OM-01 (P/N 75-900-2020) 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 Antonov AN38 is listed in the Setup List, select it using the [↓] key, press [ENTER] and go to Paragraph D.1 below. If the Antonov AN38 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 2020 ProBalancer Prop Balance Setup		
Name :	a-an38-2020-pb	
Eng HP :	1400	Num of Engs : 2
Balancing RPM :	1475	
Max Baln. Wts :	200	Holes : Yes
Wts relative to :	Tape	
Rotation (#1) :	CCW	(#2) : CCW
Tach Type :	Optical	
	Eng 1	Eng 2
Tach Pos (FLA) :	12 :00	12 :00
Sens Type :	991D-1	
	Eng 1	Eng 2
Sens Pos (FLA) :	9 :00	9 :00
Edit ICF		Sensor

- 6.1 In the “Name:” field, use the analyzer keypad to enter “Antonov AN38”. Press the [↓] key to move to the next field.
- 6.2 In the “Eng HP:” (Engine Horsepower) field, use the analyzer keypad to enter “1400”. Press the [↓] key to move to the next field.
- 6.3 In the “Num of Engs:” field, press the [⇒] key until the field reads “2”. Press the [↓] key to move to the next field.
- 6.4 In the “Balancing RPM:” use the analyzer keypad to enter “1475”. Press the [↓] key to move to the next field.
- 6.5 In the “Max Baln. Wts:” field; use the analyzer keypad to enter “200”. 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.
- 6.6 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 “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.
- 6.8 In the “Rotation (#1):” field, press the [⇒] key until the field reads “CCW” for counterclockwise. Press the [↓] key to move to the next field.
- 6.9 In the “Tach Type:” field, press the [⇒] key until the field reads “Optical” indicating you will use the optical PhotoTach. Press the [↓] key to move to the next field.
- 6.10 In the “Tach Pos” (FLA): field, press the [⇒] key until the field reads “12:00”. 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.

- 6.11 In the “Sens Type:” field, press the [⇒] key until the field reads “991D-1”. Press the [↓] key to move to the next field.
- 6.12 In the “Sens Pos: (FLA) field, press the [↓] key until the field reads “9:00”. This indicates the sensing axis relative to the center of the prop shaft is 9:00 and the connector points to the left as viewed from the front of the propeller.
7. The “Prop Hole Layout Setup” screen will be displayed as illustrated in the screen 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.
- 7.1 Use the analyzer keypad to enter “12” in the field. Press the [↓] key to move to the next field.

Model 2020 ProBalancer Prop Hole Layout Setup		
Name :	a-an38-2020-pb	
No. of Holes :	12	Space : Even
Dir (FLA) :	CCW	Max H. Wt : 40
	Angle of First Hole :	30

- 7.2 In the “Space:” field, press the [⇒] key until the field reads “Even”. The screen will immediately change to display the hole layout grid shown in Step 7 above. Press the [↓] key to move to the next field
- 7.3 In the “Dir (FLA):” field, press the right arrow key until the field reads “CCW” for counterclockwise. This is the direction the hole numbering sequence increases for the installation. This direction is independent of the method used to determine the location of hole #1 in Step 7.5 below. Press the [↓] key to move to the next field.
- 7.4 In the “Max H. Wt:” (Maximum Hole Weight) field, use the analyzer keypad to enter “40”. Press the [↓] key to move to the next field
- 7.5 In the “Ang of First Hole” field, use the keypad to enter “30”. This indicates that hole #1 is located at 30 degrees, measured in a clockwise direction as viewed from the front, relative to the reflective tape at the center of the #1 blade. This measurement is independent of the direction of increasing hole numbers set in Step 7.3 above. When complete, press the [ENTER] key to accept and continue. (Figure 3)

D. Data Acquisition

1. The Engine Selection screen will appear next as shown below. Use the [⇒] key to toggle between the selections, Both, Right or Left to accurately describe the engine(s) you are going to balance. To continue, press [ENTER] after you have made your selection.

```
Model 2020 ProBalancer
Engine Selection

You have selected a twin
engine setup. Which engines
do you wish to balance?

Engine selection: Both
```

2. The Customer Information 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 2020 ProBalancer
Customer Information

Enter the following optional
Customer Information.

Name: CUSTOMER NAME
A/C Registration: N1234
A/C Total Time: 123.4

Press ENTER to continue.
```

3. 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.

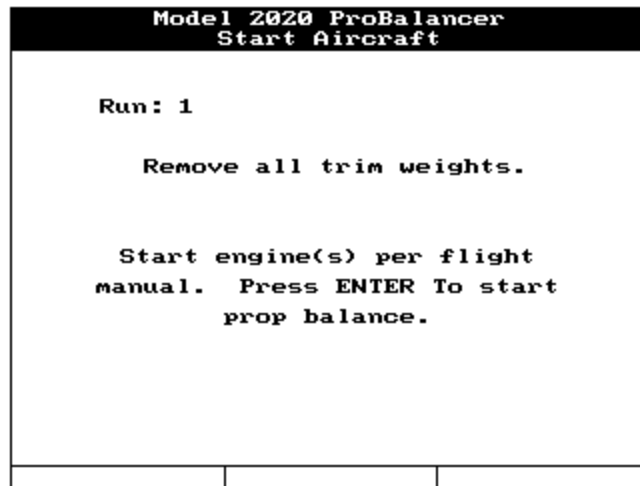
Model 2020 ProBalancer Engine Information	
Engine 1 Info	Prop 1 Info
S/N: 1234	1234
Type: SAMPLE	DEMO
Pos: 1	
TSO: 123	
TSN: 123	
Engine 2 Info	Prop 2 Info
S/N: 2234	2234
Type: SAMPLE	DEMO
Pos: 2	
TSO: 223	
TSN: 223	
Serial Nos	

4. The next screen to be displayed will be the Prop Balance Equipment Setup screen as illustrated below. This screen gives instructions on installing sensors and cables. You may also check the Phototach alignment by pressing the [F1] “Tach Pwr” key which supplies power to the optical tachometer for checking alignment with the reflective tape.

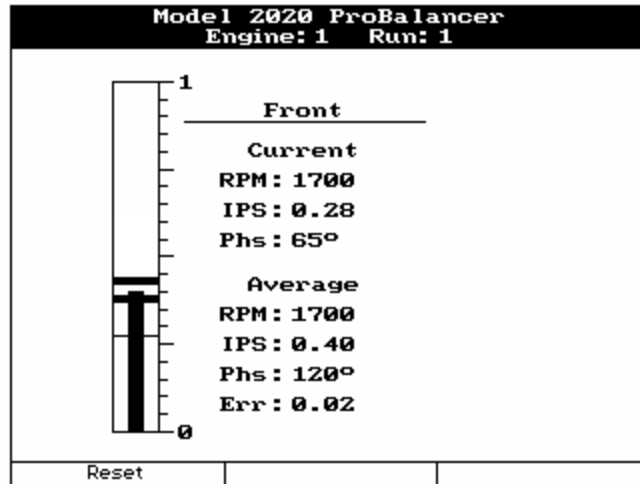
Model 2020 ProBalancer Connect Sensors	
Connect Left Speed sensor to TACH channel 1	
Connect Right Speed sensor to TACH channel 2	
Connect Left VIB sensor to Vibration channel A	
Connect Right VIB sensor to Vibration channel B	
Tach power is Off	
Tach Pwr	

- 4.1 Install and align reflective tape (Item 6) with Phototach as follows:
- 4.2 Press [F1] “Tach Pwr”. Position one blade at the 12:00 o’clock position as viewed from the front.
- 4.3 Hold a 2-inch piece of reflective tape, reflective surface facing the Phototach, against the back side of the propeller. Do not remove backing at this point.

- 4.4 The red “Gate” light on the back of the Phototach should illuminate as the reflective tape is properly aligned in front of the LED. Clean an area of the propeller in preparation for mounting the reflective tape.
- 4.5 Remove the backing and install the reflective tape on the clean propeller surface.
- 4.6 If possible, adjust the PhotoTach to obtain an angle of approximately 5 degrees from perpendicular to the reflective tape. This will produce the best results when reading RPM.
- 4.7 Press **[ENTER]** when finished with Tape installation.
5. 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. When you have verified that all weights are removed, press the **[ENTER]** key to continue.



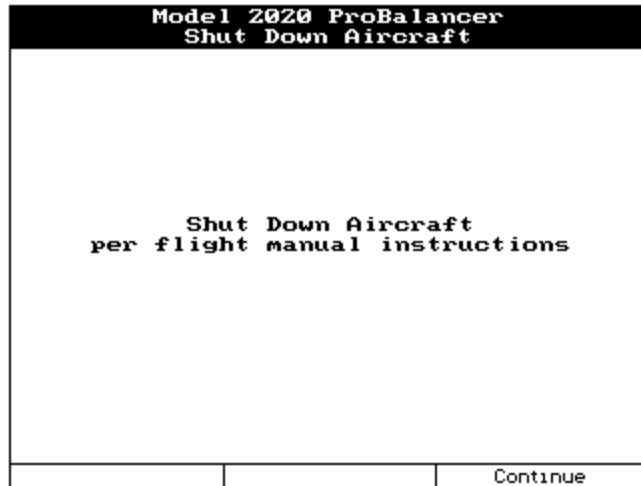
6. The analyzer will display the Engine 1, Run 1 screen similar to the one below. Chapter 16 of the Model 2020 User’s Manual gives detailed instructions on how to read the converging scale if you are not familiar with it. Increase RPM on the engine to a low cruise setting and allow the analyzer to collect data for approximately 10 to 15 seconds. The “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 the engine. You may retake the #1 engine data by pressing the [F1] “Retake #1” function key as indicated at the bottom of the screen. You may retake the #2 engine data by pressing the [F2] “Retake #2” function key as indicated at the bottom of the screen. You may retake data for both engines by pressing the [F3] “Retake All” function key as indicated at the bottom of the screen. When satisfied with the acquired data, press the [ENTER] key to accept and continue.

Model 2020 ProBalancer		
Review Job		
Run	Left Eng (IPS) DEG.	Right Eng (IPS) DEG.
1	0.40 100	0.40 150
Retake #1	Retake #2	Retake All

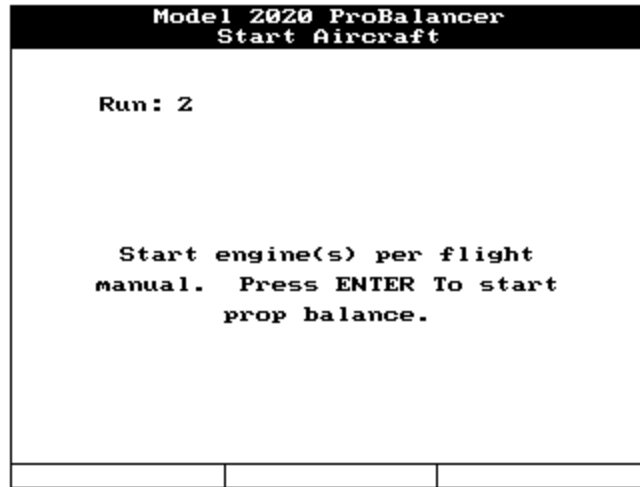
8. The “Shutdown Aircraft” instruction screen will be displayed as shown in the example below. Shut down the engine using normal shutdown procedures. When all shutdown tasks are complete, press the [F3] “Continue” key.



9. 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. **[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.

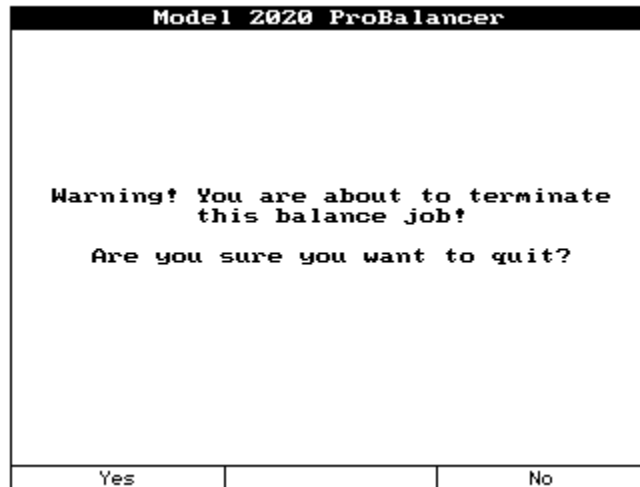
Model 2020 ProBalancer Prop Sugg. and Inst. Wts					
Run 1 - Left Engine					
Suggested			Implemented		
12.0	0	100°	11.6	0	100°
GMS	Hole		GMS	Hole	
4.2	9		4.0	9	
8.2	10		8.0	10	
0.0	0		0.0	1	
0.0	0		0.0	1	
0.0	0		0.0	1	
0.0	0		0.0	1	
Remove old, inst. & enter new wt ENTER to proceed to right eng.					
Inst=Sugg		Inst=None		Quit Job	

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 5 through 10 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 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.



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 2020 ProBalancer 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.

