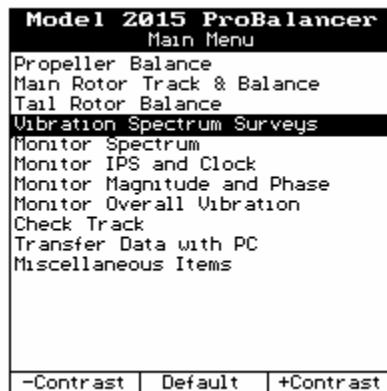

Chapter 7

Vibration Spectrum Surveys

(Revision 3, July 2007)

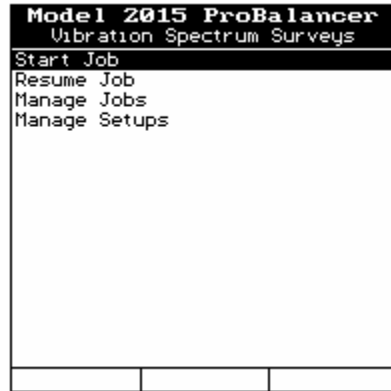
“Vibration Spectrum Surveys” is a function that is accessed from the ProBalancer’s Main Menu banner screen as shown in the illustration below. Selecting this function from the main menu brings up the “Vibration Spectrum Surveys” banner screen menu. Each of the listings on this banner screen menu is an option within the “Vibration Spectrum Surveys” function. Descriptions of each of these options follow, along with the information required to complete the menu screens within the options, and the steps necessary to perform the vibration spectrum surveys function.



The Vibration Spectrum Surveys option allows the user to rapidly complete and store vibration surveys using the “Setup” feature (described in section 7.1.1 below). With the setup feature you may complete surveys on several different components without manually entering the setup data between surveys. Each job is unique and very quick.

7.1 - Start Job

Selecting “Start Job” from the “Vibration Spectrum Surveys” banner screen allows you to begin a vibration spectrum survey. When you select this option, one of two screens will appear next depending on whether you are starting a job from scratch or whether an incomplete job still exists in the ProBalancer’s memory.



If you are starting a new job from scratch, the “Spectra Setup” banner screen appears or if you have previously saved setups stored in the ProBalancer’s memory, a screen displaying the list of setups will be displayed. You can then select a setup from this list. If you select from the list, you proceed to the “Customer Information” banner screen described in section 7.1.2. Instructions for completing the “Spectra Setup” banner screen appear in the following Section, 7.1.1.

If another job was in progress but was not completed, the “Incomplete Job” banner screen will be displayed to inform you of this. The ProBalancer will then display a message prompting you to verify that you want to complete the in-progress job or that you want to ignore it and begin a completely new job. This verification prevents you from accidentally erasing data from an in-progress job. The screen will display the message “The last job performed is incomplete. Finish it?” You must then choose a “Yes” or “No” answer by pressing the corresponding [F1] key, for “Yes,” or the [F3] key, for “No.” The “Yes” answer will return you to the point where the in-progress job was stopped and allow you to complete it. If you choose the “No” answer, the screen will then display the “Spectra Setup” banner screen so you can program a new setup or if you have previously-saved setups stored in the ProBalancer’s memory, a screen displaying the list of setups will be displayed. You can then select a setup from this list. If you select from the list, you proceed to the “Customer Information” banner screen described in section 7.1.2. Instructions for completing the “Spectra Setup” banner screen appear in the following Section, 7.1.1.

NOTE

The ProBalancer will store Setups as long as available memory remains. If you are attempting to store a survey that will exceed the ProBalancer’s memory capacity, the ProBalancer will display a message saying “You must delete an item before adding a new one.” Press the [BACKUP] key and select “Manage Setups” to delete the Setup of your choosing.

7.1.1 - Spectra Setup

The “Spectra Setup” banner screen allows you to define and store a vibration spectrum survey setup. As shown in the figure below, some fields in this screen have default values that appear automatically. You can use this information if appropriate or input your own specific setup information using the keypad. (Refer to Chapter 3, “Using the Model 2015 ProBalancer” if you are unfamiliar with using the keypad.) The ProBalancer will display the “Spectra Setup” banner with default values or values entered from the previous job such as those shown in the figure below.

| Model 2015 ProBalancer | |
|------------------------|----------------|
| Spectra Setup | |
| Name: | 310 GENERATORS |
| Min Frequency: | 0.0 |
| Max Frequency: | 60000.0 (RPM) |
| Resolution: | 200 lines |
| Average Type: | Normal |
| Blocks in Avg: | 4 |
| Measure Inputs: | A |
| Channel A Desc: | GEN #1 |
| Channel B Desc: | GEN #2 |
| Vibration: | IPS Mod: Peak |
| Full Scale Vibration: | 1.00 |
| Sensor: | 991U |
| Edit Conds | |

To complete the “Spectra Setup” banner screen, do the following:

1. Using the keypad, enter a name for the vibration spectra survey job. (Refer to Chapter 3, “Using the Model 2015 ProBalancer” if you are unfamiliar with using the keypad.)

“Name,” “Channel A Desc,” and “Channel B Desc” are optional fields that do not need to be filled in to use the Vibration Spectrum Survey function; however, this information will aid you in differentiating this spectra from other stored spectra should you choose to review or print it at a later time. The “Name” field should be one of your choosing which you will easily recognize and associate with this job. The Channel A and Channel B descriptions likewise should be a description of your choosing which you and your co-workers easily understand, such as “LAT,” “VERT,” or “GEN #1” and “GEN #2”. All other fields must be selected or filled in.

2. Using the [↓] key, move to the “Min Frequency” and “Max Frequency” fields. Using the keypad, enter the minimum and maximum frequency requirements for the job. The maximum acceptable entry is 600,000 RPM (10 kHz).

For instance, if the frequency of interest is 18,000 RPM (300 Hz), choose a minimum and maximum frequency that will place the 18,000 RPM (300 Hz) in the center of the range. The minimum could be 15,000 RPM (250 Hz) and the maximum 21,000 RPM (350 Hz) for example.

You should also consider other factors such as Harmonics. If you want multiples of the fundamental frequency included in the frequency range, determine to what extent that need is (1X, 2X, 3X, and so on) then extend the frequency range to include it. For

example, 18,000 RPM (300 Hz) is the frequency of interest, the fundamental frequency. If you want 3X harmonics included in the frequency range you must multiply the fundamental frequency 18,000 RPM (300 Hz) times the harmonic range (3X) and arrive at an upper range of 54,000 RPM (900 Hz).

3. Use the [↓] key to move to the “RPM” field. Determine if the required frequency units are revolutions per minute (RPM) or cycles per second (Hz), use the [⇒] key to “toggle” between the two selections in this field.
4. Move to the “Resolution” field using the [↓] key. Complete the field by setting the resolution as required at 100, 200, 400, or 800 lines by pressing the [⇒] key until the desired resolution is displayed.

Unless you are attempting to separate two frequencies that are within close proximity to one another, 100 or 200 lines should suffice for general analysis. Higher resolutions will provide a much sharper image of the specified frequency band, but also require more time and more memory for acquisition and should only be used when needed.

5. Move to the “Average Type” field using the [↓] key. Select the “Average Type” by toggling between the fields using the [⇒] key.

The two available options are “Normal” and “Peak.” Normal averaging displays an exponential running average of the last specified number of blocks of data. This means the amplitudes most likely will change (either increase or decrease) as the average is calculated. Peak averaging plots the highest, or worst case, amplitude for all frequencies and holds that value on the display until a higher value is acquired. The displayed amplitude will not decrease thus the term “peak hold.” Consult your aircraft’s equipment maintenance manual for specific requirements of a vibration survey or for analysis guidelines.

6. Use the [↓] key to move to the “Blocks in Avg” field. Using the keypad, enter the number of data blocks you wish to be used in the calculations. The default is 4. The valid range is 0 to 999. Remember that higher numbers of averaging, while providing more reliable data, also require more time. The default of 4 is sufficient for most applications.

CAUTION

Sensors connected to Channel A and Channel B must be of the same type. Using different sensors during the same job will cause erroneous readings and problems achieving good balance results.

7. Use the [↓] key to move to the “Measure Inputs” field. Select from the choices by using [⇒] key. The selection identifies which Channel input port on the ProBalancer you have selected to acquire vibration data. The available choices are Channel(s) “A”, “B”, or “A+B”. “A+B” indicates you will acquire from both channels however, the acquisition will not be simultaneous. You will be queued by the ProBalancer when you are about to acquire from each channel.
8. Use the [↓] key to move to the “Channel A Desc” and “Channel B Desc” fields. As described in step 1 above, these fields are optional. The available field length is 6 characters. Use the keypad to complete these fields.

9. Use the [↓] key to move to the “Vibration” field. The “Vibration” field determines the engineering units in which the amplitude or “Y” axis of the spectra will be displayed. Consult your ship’s equipment maintenance manual for specific requirements of a vibration survey or for analysis guidelines. Use the [⇒] key to select either IPS (Inches Per Second), mm/sec (millimeters per second), cm/sec (centimeters per second), Mils (1/1000th of an inch), Microns (1/1000000th of a meter), or G’s (equivalent gravities).
10. Move to the “Mod” field using the [↓] key. “Mod” is an abbreviation for unit Modifiers relevant to the engineering units specified in step 9 above. Use the [⇒] key to select either “Peak”, “Pk – Pk” (Peak to Peak), “Avg” (Average) or “RMS” (Root Mean Square). Consult the appropriate equipment maintenance manual for specific requirements of a vibration survey or for analysis guidelines.
11. Use the [↓] key to move to the “Full Scale Vibration” field. Toggle between the possible selections by using [⇒] key. The full scale indicates the maximum amplitude you expect to acquire or the maximum amplitude of interest. You should choose an amplitude that will adequately display the full amplitude of any specified limit. If you do not expect amplitudes in excess of what would normally be experienced for the equipment application, set this field as low as possible while still allowing sufficient space to display the maximum limitations as stated above.

NOTE

Encountered amplitudes above this setting may cause the ProBalancer to overload. It is best to set the “Full Scale Vibration” higher than needed as opposed to lower than needed for this reason. The overload does not cause a fatal error. You can recover from the overload by pressing the [MAIN MENU] key and starting the process again from the beginning. However, avoiding an overload will save you time in the process.

The available selections are: 0.01, 0.02, 0.05, 0.10, 0.20, 0.50, 1.00, 2.00, 5.00, 10.0, 20.0, 50.0, 100, 200, 500, 1000, 2000, and 5000. This scale refers to the number of engineering units of vibration amplitude specified in step 9 above.

12. Move to the “Sensor” field using the [↓] key. Use the [⇒] key to toggle between the options and select a sensor.

NOTE

See the Chapter 15, Equipment and Accessory Setup and Troubleshooting, for additional information on installing accessory equipment such as vibration sensors and tachometers.

7.1.1.1 – Edit Conditions

The “Edit Conds” (which corresponds to the [F1] key) selection appears at the bottom left of the “Spectra Setup” banner screen. Press the [F1] key if you wish to define conditions for the survey. If you choose this option, the following “Spectra Conditions” banner screen is displayed.

| Model 2015 Balancer | |
|---------------------|------------|
| Spectra Conditions | |
| | Condition |
| 1) | GROUND IDL |
| 2) | HOVER |
| 3) | 60 KTS |
| 4) | 80 KTS |
| 5) | 100 KTS |
| 6) | |
| 7) | |
| 8) | |
| 9) | |
| 10) | |

To input conditions, do the following:

1. Use the [↑] and [↓] keys to navigate the screen and input conditions' data using the keypad.
2. In the "Condition" column, use the ProBalancer keypad to enter a descriptive name for up to ten conditions. You may define up to ten individual points at which you collect and optionally store data. When defined, these conditions are stored with the setup and are accessed when the setup is selected.
3. When the conditions are completed per your requirements, press [ENTER] to accept and exit back to the "Spectra Setup" screen.
4. Press [ENTER] again and an information screen will ask, "Store this new setup?" Press [F1] to answer "Yes" and continue, or [F3] to answer "No" and continue.

7.1.2 - Customer Information

| Model 2015 ProBalancer | |
|--|---------------|
| Customer Information | |
| Enter the following optional Customer Information. | |
| Name: | AS350 GEARBOX |
| A/C Registration: | |
| A/C Total Time: | 0 |
| Press ENTER to continue. | |
| Names | |

The next screen displayed is the "Customer Information" banner screen shown in the following illustration. All information on this screen is optional; however we highly recommend you fill in as much information as possible to ease the task of storage and retrieval of surveys. If you have other customer information stored, you may press the [F1]

key to select from a list of stored customer names, which will then be entered into the “Name” field. When all fields are completed as desired, press [ENTER] to continue.

7.1.3 – Engine Information

The “Engine Information” banner screen is displayed as shown below. A serial number (“S/N”) and “Type” field are available for both an engine and a propeller so that stored surveys can be traced by either component of the powertrain system. All fields are optional but we highly recommend you fill in as much information as possible for ease of use in trending, recall, and storage.

Navigate (move) between the fields using the [↓] and [↑] keys. All fields are entered from the keypad with the exception of the “Pos” (Position) field, which is a selection field. The position indicates the position on the airplane of the engine, propeller or subcomponent. Using the [⇒] key, select positions from 1 through 4. The “TSO” and “TSN” fields for “Time Since New” and “Time Since Overhaul” are optional fields. When all fields are filled as required, press [ENTER] to continue.

| Model 2015 ProBalancer | |
|------------------------|-------------|
| Engine Information | |
| Engine 1 Info | Prop 1 Info |
| S/N: A42784 | |
| Type: | |
| Pos: (1) | |
| TSO: 0 | |
| TSN: 0 | |
| Serial Nos | |

7.1.4 – Select Aircraft Condition

The “Select Aircraft Condition” banner screen is displayed. The conditions are those defined in the “Edit Conditions” screen (see section 7.1.1.1).

Use the [↑] or [↓] keys to select the condition you wish to collect. When your choice is highlighted, press [ENTER] to begin collecting data.

7.1.5 – Start Component

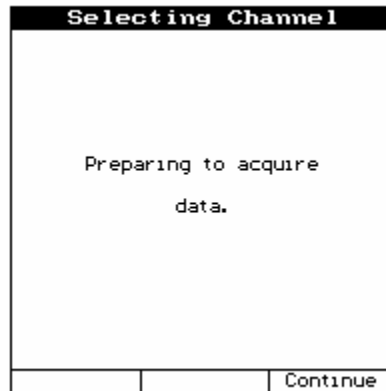
Start the component you are checking (engine, generator, gearbox, etc.). When the component reaches the desired operating condition (speed, temp, etc.), press the [ENTER] key to begin acquiring data.

NOTE

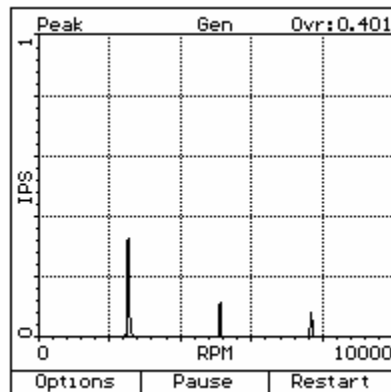
When the spectra is displayed on screen, you may press the [⇒] key to produce a **NORMAL CURSOR** immediately at the highest displayed amplitude frequency. The [↑] and [↓] keys may also be used immediately to **EXPAND** or **SHRINK** the Y scale.

7.1.6 - Collecting Data

The ProBalancer will display the following message. Press [F1] “Continue” to display the first spectral plot.

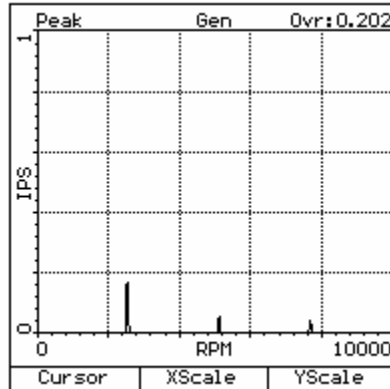


When the spectra is displayed, you will also see three function boxes at the bottom of the screen (see following figure) corresponding to the position of the [F1], [F2], and [F3] keys directly below them. The boxes read “Options,” “Pause,” and “Restart.”

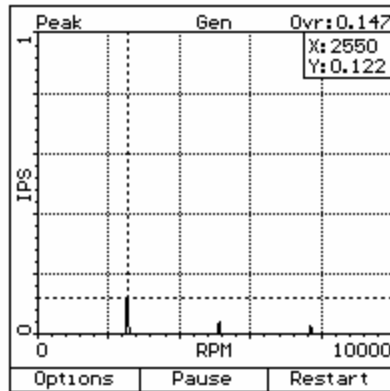


Once any of these “F” key options are selected, both the screen and the corresponding “F” key functions change. With each selection, the “F” keys offer different options (e.g., Expand, Shrink, X scale) for viewing the spectra. The “F” key functions for viewing spectra are described in the following steps.

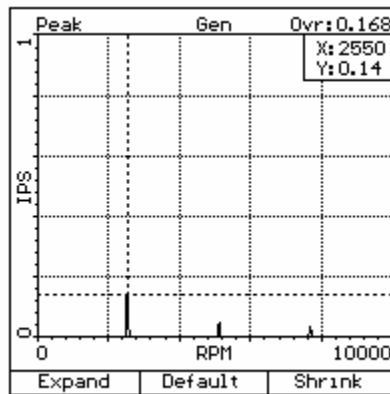
1. Pressing the [F1] (Options) key will change the [F1], [F2], and [F3] boxes to read "Cursor," "X scale," and "Y scale" respectively as shown in the figure below.
2. Pressing the [F1] (Cursor) key will change the [F1], [F2], and [F3] boxes to read "Normal," "Harmonic," and "None" respectively. The functions of the "F" keys will continue to change as the screens change.



3. Pressing the [F1] (Normal) key will produce a normal cursor on the screen accompanied by an X and Y scale value readout box in the upper right corner of each displayed spectra (see the figure in step 5). These X and Y values are relative to the current position of the cursor only. The cursor can be moved along the X (horizontal) axis of the spectra by pressing the [←] or [⇒] keys. Hold down the key for large and rapid incremental changes. The value of the X-axis (frequency) and Y-axis (amplitude) will be displayed for the current position of the cursor. Incremental values are determined by the number of lines of resolution specified in the setup screen.
4. Pressing the [F2] (Harmonic) key will produce multiple harmonic cursors according to the specified frequency range. When this key is pressed, cursors will appear to the right of the fundamental frequency identified by the leftmost cursor. For example, if the fundamental frequency is 18,000 RPM (300 Hz) cursors will be placed at 2X (36,000 RPM (600 Hz)) 3X (54,000 RPM (900 Hz)) 4x (72,000 RPM (1200 Hz)) and so on until the upper frequency limit of the screen is met. When the primary cursor (for the fundamental frequency) is moved, the multiple harmonic cursors will automatically follow the movement and position themselves at the new multiple of the fundamental frequency. To remove the harmonic cursors, repeat steps 1 to 3 above. At step 4, press either the [F1] (Normal) or [F3] (None) key and the multiple cursor will be replaced by your selection.
5. Pressing the [F3] (None) key will remove either a normal or harmonic cursor if currently displayed on screen. The three boxes above the [F1], [F2] and [F3] keys will return to "Options," "Pause," and "Restart" respectively. If no cursor is displayed when pressing this key, only the box nomenclature will change.



6. Pressing the [F1] (Options) then [F2] (X scale) key will change the [F1], [F2], and [F3] boxes to read “Expand,” “Default,” and “Shrink” respectively as shown in the following figure.
7. Pressing the [F1] (Expand) key will expand the X scale of the spectra, in effect enlarging the viewing area. You might think of this function as a “Zoom Out” feature. The center of the Expanded view will be the position of the cursor prior to pressing the [F1] key. If the view is already at the maximum range of the specified X scale range, no scaling change will occur. However, the cursor will be displayed and the X, Y, and “Ovr” (Overall) values will be shown in the upper right corner of the screen. The [F1], [F2] and [F3] boxes will return to the format described in step 5 above. If you wish to Expand the X scale even further, retrace the steps from that point as described in the text.



8. Pressing the [F2] (Default) key will return the X scale to the values specified in the setup. This is a quick and easy way to return the expanded or shrunken scale to that default value without the necessity of numerous keystrokes. If the X scale is already at the setup values when the [F2] Default key is pressed, the three function boxes will return to “Options,” “Pause,” and “Restart”. No other changes will occur.
9. Pressing the [F3] (Shrink) key will lower the X scale of the spectra, in effect shrinking the viewing area. You might think of this function as a “Zoom In” feature. If the view is already at the minimum of the specified X scale range, no scaling change will occur.

- However, the cursor will be displayed and the X, Y, and “Ovr” (Overall) values will be shown in the upper right corner of the screen. The [F1], [F2] and [F3] boxes will return to the format described in step 5 above. If you wish to Shrink the X scale even further, retrace the steps from that point as described in the text.
10. Pressing the [F1] (Options) then [F3] (Y scale) key changes the [F1], [F2], and [F3] boxes to read “Expand,” “Default,” and “Shrink” respectively (see above).
 11. Pressing the [F1] (Expand) key will expand the Y scale of the spectra, in effect enlarging the viewing area. You might think of this function as a “Zoom Out” feature. If the view is already at the maximum range of the specified Y scale range, no scaling change will occur. However, the cursor will be displayed and the X, Y, and Ovr: (Overall) values will be shown in the upper right corner of the screen. The [F1], [F2] and [F3] boxes will return to the format described in step 5 above. If you wish to Expand the Y scale even further, retrace the steps from that point as described in the text.
 12. Pressing the [F2] (Default) key will return the Y scale to the values specified in the setup. This is a quick and easy way to return the expanded or shrunken Y scale to that default value without the necessity of numerous keystrokes. If the Y scale is already at the setup values when the [F2] Default key is pressed, the three function boxes will return to “Options,” “Pause,” and “Restart.” No other changes will occur.
 13. Pressing the [F3] (Shrink) key will lower the Y scale of the spectra, in effect shrinking the viewing area. You might think of this function as a “Zoom In” feature. If the view is already at the minimum of the specified Y scale range, no scaling change will occur. However, the cursor will be displayed and the X, Y, and “Ovr” (Overall) values will be shown in the upper right corner of the screen. The [F1], [F2] and [F3] boxes will return to the format described in step 5 above. If you wish to shrink the Y scale even further, retrace the steps from that point as described in the text.
 14. Pressing the [F2] (PAUSE) key will stop data acquisition and freeze the screen with the latest displayed data. The [F1], [F2], and [F3] boxes will change to read [F1] (Blank), [F2] (Blank), and [F3] (Resume). Pressing the [F2] (Resume) key will restart the data acquisition and continue the data collection process with the latest data.

Anytime the spectrum is displayed on screen you may press [ENTER] to terminate data acquisition. If a second channel was selected for data acquisition in the initial setup, the analyzer will display the screen shown in paragraph 7.1.6 and collect data for the second channel. The same features and functions available for channel A will be available on channel B.

7.1.7 - Storing Data

Anytime the spectrum is displayed on screen you may press [ENTER] to terminate data acquisition. If this was the final channel selected for data acquisition, the ProBalancer then displays the screen shown below.

| Model 2015 ProBalancer | | |
|--------------------------|--------------------------------|----|
| Enter actual N1: | <input type="text" value="0"/> | |
| Enter actual N2: | <input type="text" value="0"/> | |
| Store the spectral data? | | |
| Yes | | No |

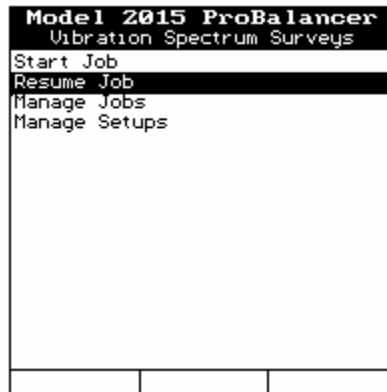
The two fields “Enter actual N1” and “Enter actual N2” are for user reference and are optional. We recommend you fill in as much information as possible as an identifying aid for recalling data. The last line on the screen reads “Store the spectral data?” The [F1] and [F3] keys are now designated “Yes” and “No” respectively. Press the key that corresponds to your choice. The “Select Aircraft Condition” banner screen is again displayed as shown in the following figure. Notice that the condition for which you just collected and stored data now has an “X” immediately to the left of the defined condition. This alerts the user that data has been collected and stored for this condition. This does not preclude you from selecting and acquiring new data for this condition. However, if you choose to store the data, the previously stored data will be written over and cannot be recovered.

At this point you may select a new condition and repeat the procedures starting from section 7.1.4 until all required data is collected.

To quit the job and return to the “Vibration Spectrum Surveys” banner screen, press [F3] for “Quit Job.”

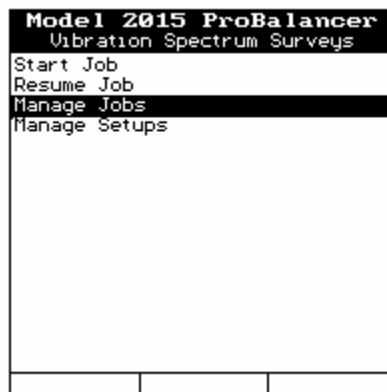
| Model 2015 Balancer | | |
|---------------------------|------------|----------|
| Select Aircraft Condition | | |
| [] | GROUND IDL | |
| [] | HOVER | |
| [x] | 60 KTS | |
| [] | 80 KTS | |
| [] | 100 KTS | |
| End Run | | Quit Job |

7.2 - Resume Job



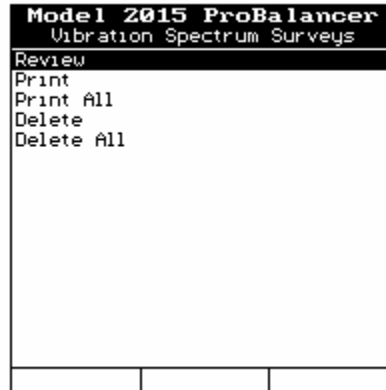
When you select “Resume Job” from the “Vibration Spectrum Surveys” banner screen menu, the “Incomplete Jobs” banner screen will be displayed. Incomplete jobs are listed by name, preceded by an asterisk. Select the job you wish to complete and the ProBalancer will return you to the point where the in-progress job was stopped, allowing you to complete it.

7.3 - Manage Jobs



Selecting “Manage Jobs” from the “Vibration Spectrum Surveys” banner screen menu presents several sub-menu choices to choose from. These choices allow you to “manage” previously completed job data you have stored in the ProBalancer.

7.3.1 - Review



Selecting the “Review” option presents a list of stored jobs on the “Job List” banner screen. You can select one job for on-screen viewing. When viewing is complete, press the [BACKUP] or [ENTER] key to exit the screen.

7.3.2 - Print

The “Print” option presents a list of stored jobs on the “Job List” banner screen. From the list, you may select one job for printing. See Chapter 14, “Printing” for a detailed explanation of how to set up the ProBalancer to print.

7.3.3 - Print All

The “Print All” option sends all currently stored jobs to the printer. When you select “Print All,” a message will appear on the ProBalancer’s “Print All Jobs” banner screen asking you to verify that you want to print all jobs. Answer the prompt, “Are you sure?” by pressing the [F1] key for “Yes” or the [F3] key for “No”. If you choose the “Yes” answer, ensure your printer is prepared (paper, print cartridge, etc.) to complete the number of jobs stored. The “Yes” answer will send *all* currently stored vibration survey jobs to the printer. The “No” answer will return you to the previous menu.

7.3.4 - Delete

The “Delete” option presents a list of stored jobs on the “Job List” banner screen. From the list, you may select one job for deletion. After making your selection, the “Delete Job” banner screen will appear, asking you to verify your intent to delete the selected job by pressing the [F1] key for “Yes” or the [F3] key for “No.” You may wish to print the job for reference or permanent record prior to deleting. Once deleted, the job cannot be retrieved from the ProBalancer.

7.4.4 - Print All

Selecting “Print All” sends all currently stored setups to the printer. When making this selection, you will be asked to verify “Are you sure?” by pressing the [F1] key for “Yes,” or the [F3] key for “No.” If choosing the “Yes” answer, ensure your printer is prepared (paper, print cartridge, etc.) to complete the number of jobs stored. The “Yes” answer will send *all* currently stored vibration survey setups to the printer. The “No” answer will return you to the previous menu.

7.4.5 - Delete

The “Delete” option presents you with a list of stored setups. From the list, you may select one setup for deletion. If you wish to delete all stored setups, you must delete them individually. After making your selection, you will be asked to verify your intent to delete the selected job by pressing the [F1] key for “Yes,” or the [F3] key for “No.” We highly recommend you print the setup for reference or permanent record prior to deleting them. Once deleted, the setups cannot be retrieved from the ProBalancer.