

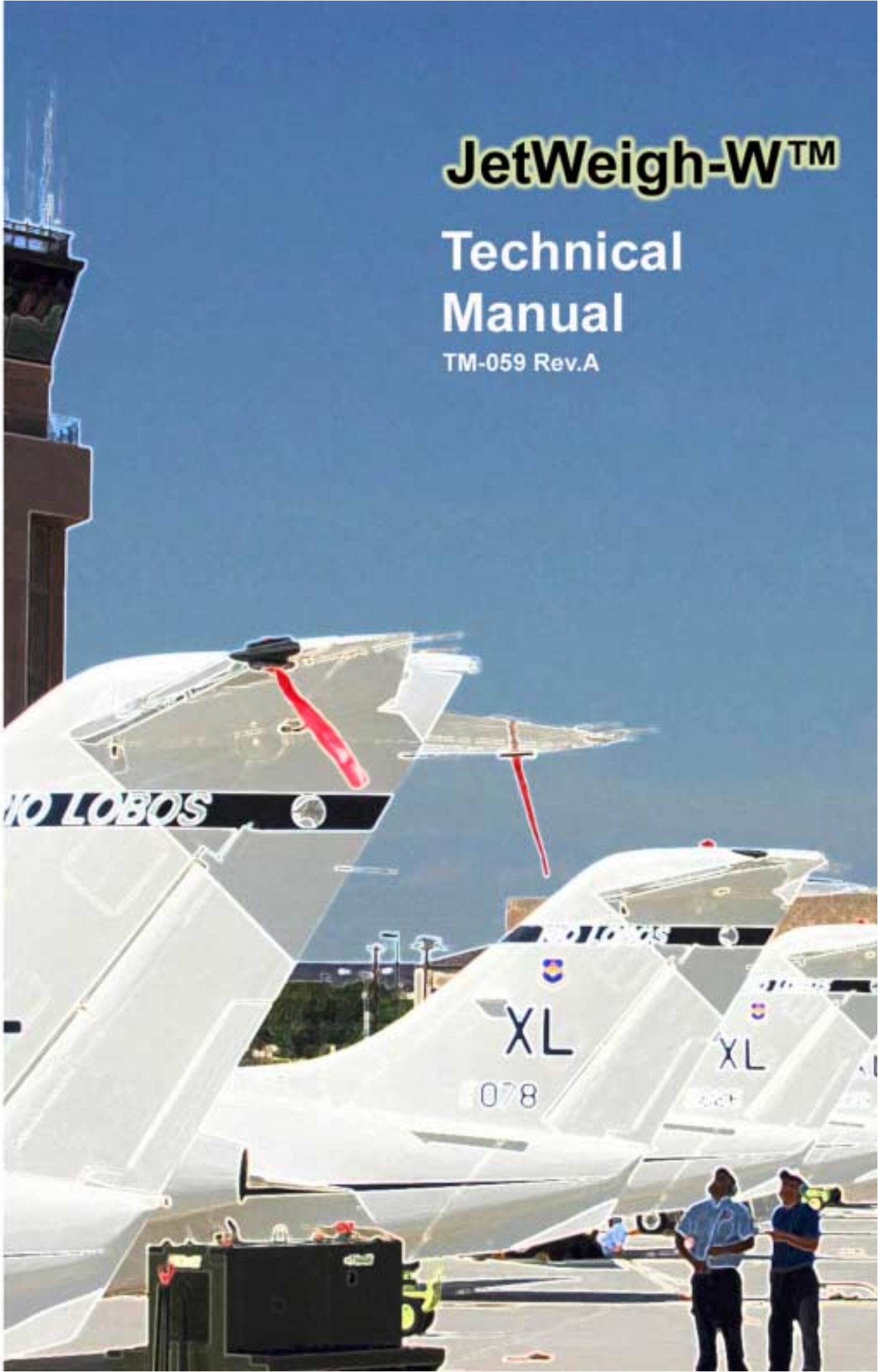


Wireless Aircraft Weighing Systems

JetWeigh-W™

Technical Manual

TM-059 Rev.A



Important Notices:

(1). This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

(2). Changes or modifications to this equipment not expressly approved by the party responsible for compliance (Vishay Israel Ltd.) could void the user's authority to operate the equipment.

(3). The antenna used for the load cell transmitter must be installed to normally provide minimum separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

The handheld terminal is portable but restricted to occupational/controlled use only. It is not authorized for consumer or general population use. Personnel using the terminal must be trained regarding RF exposure and its control.

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1.1 INTRODUCTION

This manual provides information on the operation of JetWeigh-W™ Wireless Aircraft Weighing System series aircraft electronic weighing kits manufactured by Vishay SI Technologies. JetWeigh-W™ Wireless Aircraft Weighing Systems (Figure 1-1) integrate state-of-the-art wireless communication, digital weight processing, and high-accuracy hermetically sealed load cells. Combined technologies from Vishay Revere Transducers and Vishay RFWaves results in an accurate, high-reliability, robust, and easy to use Wireless Aircraft Weighing System.

JetWeigh-W kits are designed primarily for the weighing of aircraft and aerospace vehicles, but can be used for other precision weighing applications, as well as for the calibration of force generating machines. The kits have been calibrated using dead weight machines. These machines are maintained to better than $\pm 0.001\%$ with respect to the nominal weight value. The degree of uncertainty for all of the individual weights is approximately $\pm 0.005\%$ with respect to true values. All readings are corrected to standard gravity factor "g" as required by MIL-W-7327C.

High capacity JetWeigh-W kits with load cell capacities of 200,000 lb are calibrated on Vishay Revere's high capacity precision hydraulic transfer standard.

On completion of this calibration, the JetWeigh data is verified on the dead weight machine up to the 100,000-lb point. Maximum acceptable deviation between the transfer standard and dead weight data is $\pm 0.05\%$. Both the dead weight machine and the transfer standard are secondary standards and are directly traceable to NIST.

It is recommended that the kit be returned to the factory for routine calibration every twelve (12) months or sooner if trouble is observed or erroneous readings are suspected.

The load imposed on a load sensor produces an output signal directly proportional to the load applied. The signal is transmitted through a wireless channel to the JetWeigh handheld terminal where the measurement is processed. Analog load sensor signals are processed digitally to remove linearity errors, latitude and altitude effects. Presentation in pounds or kilograms is selectable by the operator. An integral printer provides a permanent record of all pertinent weighment information including any deviations that are accepted by the operator.



Figure 1-1. Typical JetWeigh-W™ Aircraft Weighing System

1.2 SYSTEM COMPONENT DESCRIPTIONS

Each kit contains the necessary equipment for weighing an aircraft with the exception of specialized jacks. Kit contents include 3 to 5 wireless load cells, a rugged handheld PC user terminal, a thermal printer, power adaptors and a power cord, a center of gravity accessory kit, and a rugged fiberglass carrying case.

1.2.1 Wireless Handheld Terminal

The wireless handheld PC terminal features a graphic color touch screen display, intuitive step-by-step operation, and advanced functions such as CG calculation, aircraft type library, weighing history, latitude and altitude adjustment. It communicates with up to 5 remote wireless load cells thereby eliminating cumbersome interconnecting cables.

Units operate in a world wide license-free band - 2400 MHz to 2483.5 MHz and comply with all FCC, CE, ETSI standards.

Synchronized sampling of all load cells ensures correct weighing even under severe vibration and oscillations conditions.

1.2.2 Wireless Load Cells

Each kit contains from 3 to 5 hermetically sealed wireless load cells. These cells are precision devices and will withstand 150% overload without damage. Dropping a load cell, however, could damage the electronic box, the diaphragm, or other components affecting its operation or accuracy.

Each cell has a tapped hole on the bottom to receive a plug or a ring jack adapter. The top surface has a $\frac{3}{4}$ " radius concave surface to receive either the spherical surface of an adapter or the aircraft jack pad directly.

NOTE: Load cells of identical capacity are interchangeable. However, load cells and spherical adapters are color coded as matched sets. When changing load cell locations, make sure that the spherical adapter/load cell combination remains intact.

1.2.3 Load Cell Adapters

For the purpose of mounting load cells under varying physical arrangements, several adapters are provided (See Figure 1-2):

- a) *Plug and ring adapters for securing the cell to the hydraulic jack.*

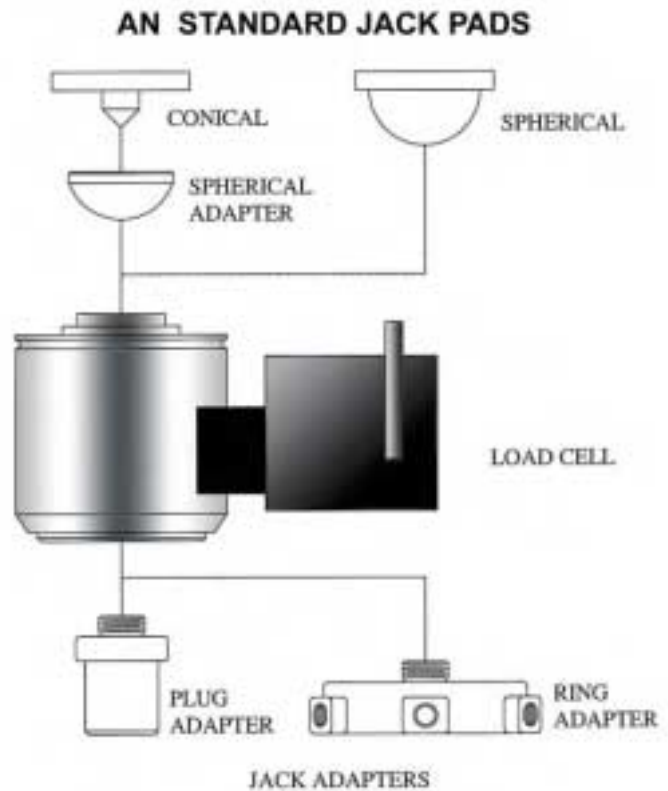


Figure 1-2. Jack Adapters

- b) *Spherical adapters to allow interfacing transition between the cells and conical jack pads or flat surfaces*
- c) *Axle adapters which allow transition from the cell to the cylindrical surface of the axle.*

1.2.4 Thermal Printer

JetWeigh-W systems ship with a high speed thermal printer. At the end of each weighment, aircraft specifications, resultant weight data, and all other calculations can be printed and stored for future reference.

The printer is compact, easy to install, and require minimal maintenance. A complete reference manual for the printer is included with the kit.

Section II - Pre-Operation

2.1 PRE-OPERATIONAL PROCEDURES

Section II presents all procedures that must be performed prior to actual aircraft weighment. Since the JetWeigh-W system is completely wireless, no cable connection/ installation procedures are required. With an operating range of 220 feet (70 meters), it should be easy to locate all load cells and the handheld terminal in functional proximity to one another.

2.1.1 Load Cell Jack Point Configuration

JetWeigh-W Systems accommodate jack point configurations for 3-point, 4-point (helicopter or fixed wing) and 5-point aircraft. Recommended deployment of the load cells is shown in Table 2-1. Make sure to match the load cells and the mechanical adapters to ensure good repeatability of weighments.

2.1.2 Preparation for Aircraft Weighing

1. Review the Equipment List of the aircraft being weighed. Update the list as required. Make sure the particular equipment, which will normally be installed, but is missing at the time of the weighing, is added in the later calculations.
2. Remove all equipment, which will not be included in the above list.
3. Clean the aircraft to remove accumulated dirt, grease and trapped water.
4. Fill the oil tanks to a known quantity. Fill all reservoirs, such as anti-icing fluid, to capacity.
5. Drain fuel tanks. If draining is not practical, fill the tanks to capacity. Add or account for unusable fuel.
6. Determine the unit weight of fuel. Obtain a sample from the fuel tank with the supplied fuel dipper (CG kit) and pour the sample into the test tube. Using the hydrometers (CG kit), the weight of fuel in pounds per gallon can be observed. Variations in fuel weight, particularly in the case of jet aircraft, can cause appreciable difference in the final empty weight and CG determinations. Be alert for partially filled non-symmetrical fuel tanks.
7. With tricycle gear aircraft, it is often desirable to level the aircraft as closely as possible before lifting on the jacks. Changing oleo strut extensions can do this.
8. A stabilizing period of 20 minutes running concurrently with warm-up period is advisable. When using jack adapters, be sure the adapter is fully threaded into the cell. With ring adapters, make sure it is centered flush on the ram before tightening the set screws.

CAUTION

Use proper adapters to prevent jacks from slipping or buckling. Damage to the aircraft or inaccurate weight readings may result if improper adapters are used. Never apply load to the rim of the cell.

Color coded spherical adapters must be used in conjunction with color coded load cells.

9. It is recommended that the load sensors be exercised prior to performing an actual weighment. Exercise the load sensors 2 – 3 times by lifting the aircraft with the load sensors and jacking system in place.
10. The JetWeigh-W is programmed to identify left, right, nose, or the sum of both sensors on a bogie. This requires that specific channels (load cells) be dedicated to a specific location when preparing for a weighment. These location identifiers will normally appear on the printout. However, they will not appear during 1 and 2 channel operation. Table 2-1 shows the recommended layout for various configurations.

Table 2-1. Jack Point Configuration

3 Load Cells		
Channel 1	Red	Left
Channel 2	Yellow	Right
Channel 3	Blue	Nose

4 Load Cells	Helicopter	Fixed Wing
Channel 1 Red	Fwd Left	Left
Channel 2 Yel	Fwd Right	Right
Channel 3 Blue	Aft Left	Nose
Channel 4 Orng	Aft Right	Spare

5 Load Cells		
Channel 1	Red	Left (1)
Channel 2	Yellow	Right (1)
Channel 3	Blue	Left (2)
Channel 4	Green	Right (2)
Channel 5	White	Nose

2.2 TERMINAL SETUP

Figure 2-1 shows the default power up screen for the handheld terminal. Three primary function modes; Setup, Weighing, and System, are accessed by touching the associated soft keys at the bottom of this screen. In this Section, system setup is defined prior to actual aircraft weighing. Touch (with stylus - throughout) *setup* on the lower left corner of the screen to enter setup mode. Vishay recommends that setup be performed with the power adapter plugged in to conserve battery charge for actual wireless weighing.

NOTE: The Handheld Terminal will operate for approximately eight hours on battery power alone.



Figure 2-1. Initial Power Up Display

2.2.1 Setup Screen Options

Setup mode consists of four sub-menu selections located on the left side of the screen. Step through each sub-menu sequentially, starting with *Main* and proceeding to *Gravity*, *A/C*, and *Channel*. After entering valid parameters for each sub menu, the system is ready for "live" weighing operation.

NOTE: For screens that require data entry, touch the data entry box and an alphanumeric keypad will appear as shown in Figure 2-2.



Figure 2-2. Data Entry Keypad Displayed

2.2.2 Main

Touch "*Main*" on the left margin of the screen to enter fundamental system parameters (Figure 2-3).

- a). *Units* – use the drop-down menu to select *lb* (pounds) or *kg* (kilograms)
- b). *Date* – use the drop-down menu to set the correct date



Figure 2-3. Main Parameter Selections

- c). *Stability* – use the drop-down menu to select *Normal, Relaxed, or User*. Ambient air currents always affect weighments to some extent. If the aircraft is weighed indoors (hanger environment), select normal to compensate for minor air current uplift effects. If the plane is out of doors, select relaxed (twice normal) to achieve slightly more compensation. Selecting user allows specific time and amplitude values to be entered for precise compensation (see "d").
- d). "T" represents the duration period and "A" represents the amplitude of an interference that will not be considered as a change in weight. As long as the weight readings are within the rectangular TxA, weight readings are considered to be stable.
- e). *Averaging* - use the drop-down menu to select 1, 2, 5, 10, or 50 conversion averaging. Averaging applies a low-pass filter on the weight readings to eliminate the effect of vibrations.
- f). *Zero tracking* – touch the Zero Tracking check box to activate the zero tracking function. Zero tracking eliminates minor electronic variations around the calibrated zero value.

2.2.3 Gravity Factor Compensation

The Figure 2-4 *Gravity* menu consists of two grayed out text boxes that display the calibration location data, and two enabled text boxes for entry of the operation latitude and elevation. Enter the exact latitude and elevation of your installation location.



Figure 2-4. Gravity Parameter Selections

2.2.4 A/C

The *A/C* menu (Figure 2-5) allows users to choose from a predefined list of over 200 aircraft, or define the dimensions of a custom ("Other") aircraft. This menu also allows the entry of the aircraft serial number and the user's ID for printouts and future reference, if saved.



Figure 2-5. Aircraft (A/C) Parameter Selections

- a). Touch list and then model to view aircraft types and configurations.
- b). Touch the "Other" checkbox to activate entry of a new Manufacturer/Model combination. Key in the manufacturer and model number in the respective boxes beneath "Other".
- c). Use the A/C type drop-down menu to select the new aircraft type.
- d). Key in the serial number and user ID for the new aircraft configuration. All entered information will be included in the final weighment printout.

2.2.5 Channel

Touch the *Channel Selection* drop-down menu (Figure 2-6) to choose from one of five standard aircraft configurations. The selections are:

- a). 3 sensors (load cells – throughout)
- b). 4 sensors – helicopter
- c). 4 sensors – fixed wing aircraft
- d). 5 sensors

After selection, the configuration is displayed as a wheel-by-wheel, or jack point-by-jack point schematic diagram and the channel allocation table reflects exact placement locations. Double touching a channel ID number changes the channel allocation table and schematic to a new aircraft (based upon ID entry in segment “d” of paragraph 2.2.4).

After completing all sequential parameter entries, the JetWeigh-W System is ready for “live” weighing operation.



Figure 2-6. Load Cell Channel Configuration

2.2.6 Changing Channel ID and Location

To change logical channels, as shown in Figure 2-7, double click the ID field at the channel selection table. This opens an editable field at that ID, and a numeric keypad will pop up.

Using the numeric keypad, you can assign any channel to that location. Channel input termination is completed by touching the *enter* key on the numeric keypad.

NOTE: Users are responsible for maintaining the logical integrity of each assigned location (making sure that a single channel is allocated to a single location).



Figure 2-7. Changing Channel ID Information

Section III - Operation

3.1 LOAD CELL POWER UP

Place load cell equipped jacks in position beneath aircraft jack points as shown in Figure 3-1. Orient the load cell transmitter housing (rectangular box attached to the cylindrical cell) of each cell parallel to the neutral axis of the aircraft. Walk to each cell and press the power "ON" button. Check the green LED on each cell transmitter housing to see that it is illuminated and blinking at a rate of approximately one Hz (once per second).

NOTE: If the green LED is blinking at a rapid rate, this indicates that load cell internal battery capacity is low - approximately one hour of work is left (without charging). Recharge the cell battery as soon as possible.



Figure 3-1. Aircraft with Jacks Positioned

3.2 TERMINAL POWER UP

Figure 3-2 depicts the handheld terminal in its RF equipped carrying case. Press the terminal power button and observe the initial screen as depicted at right.

NOTE: The Operation LED should remain in the off state until actual weighing begins.

3.3 AIRCRAFT WEIGHING CYCLE

Prior to weighing, Vishay recommends that the aircraft be raised and lowered 2 or 3 times ("dry runs") to acclimate system load cells. Actual weighing is accomplished in six steps; Zeroing, Lifting, Weighing, Removing, Rezeroing, and Reporting using the weighing menu. Each step must be performed sequentially and successfully before proceeding to the next step. To begin, touch the *Weighing* menu block on the lower tool bar with the stylus and observe the *Zeroing* screen depicted in figure 3-3.

3.3.1 Zeroing

Under ideal conditions, with load cells powered up and in a no load condition (no jack contact with aircraft jack points) the reading for each channel should be zero. However, in reality, it is often necessary to "zero out" minor variances in any or all of the system cells. The zeroing screen (Figure 3-3) allows for individual or complete zeroing of any/all system cells.



Figure 3-2. Handheld Terminal Enclosure

During the zeroing process, the terminal retrieves calibration, serial number, and other critical data from each load cell. If data cannot be accessed, one of the Figure 3-4 error screens (next page) will appear. Any weighing which does not include all vital data from each cell will not be valid, so the user is prompted and given the choice/chance to try again.



Figure 3-3. Zeroing Screen/Menu

OPERATION

NOTE: A reading of NA for any valid channel indicates that the load cell is malfunctioning or in the “OFF” state. Zeroing is not valid. If the problem persists, refer to the Section IV - Troubleshooting.

NOTE: If a red “battery” symbol appears to the left of any channel ID, the load cell battery must be recharged and the zeroing process repeated.

NOTE: When a poor RF link conditions exists, a red antenna symbol will appear to the right of the channel ID of the cell experiencing the problem, as shown in Figure 3-5.

Once zero is established, touch Next> to advance to the lifting menu.

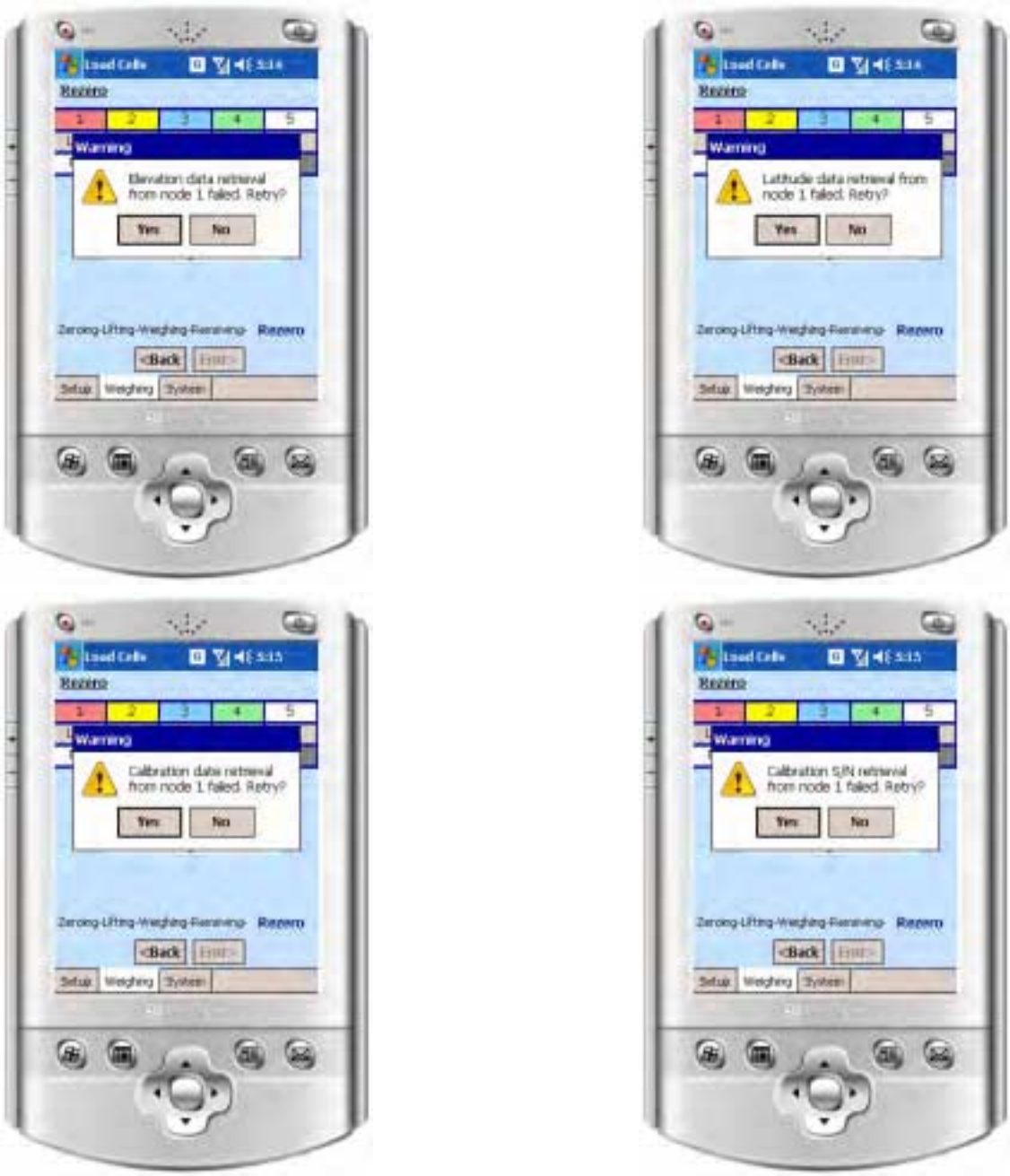


Figure 3-4. Load Cell Data Not Acquired Messages

3.3.2 Lifting

At this juncture, the aircraft must be jacked up so that it is resting exclusively on the load cell based jacks. Jacking should be done in accordance with aircraft manufacturer specifications, if provided. During the jacking or lifting phase, the Lifting menu (Figure 3-5) displays the successive measurements from all active channels and indicates the stability of the measurements. Once the aircraft is jacked up (Figure 3-6) and readings are stable, touch Next> to advance to the weighing screen.



Figure 3-6. Aircraft Fully Jacked



Figure 3-5. Screen Display During Lifting

If the weight readings are changing during lifting, a warning “UNSTABLE” appears at the bottom of the weights table. This is normal during the lifting process. After the aircraft was fully jacked up and all vibrations and oscillations ceased down this indication should change to “STABLE”.

Should the “STABLE” condition not be reached after a few minutes or in case of external causes (wind, etc.), the user can force the system to proceed to the WEIGHING stage by touching the NEXT> soft key. A warning message will appear on the screen as shown in Figure 3-7. To continue with forced operation touch the “YES” key.

NOTE: the unstable condition report will be included in the final report and in the printout of the weightment results.

NOTE: When a poor RF link conditions exists, a red antenna symbol will appear to the right of the channel ID of the cell experiencing the problem, as shown in Figure 3-5.

NOTE: If a red “battery” symbol appears to the left of any channel ID, the load cell battery must be recharged and the zeroing process repeated.

NOTE: If weight reading(s) for any channel(s) appear in a yellow box, less than 50% of the updates required for averaging have been received. If weight reading(s) for any channel(s) appear in a red box, this indicates that the load cell(s) is in low power mode. Turn off the terminal, recharge the low power cell(s), and restart the terminal to clear the red data indication.



Figure 3-7. Weighing Lift Warning

3.3.3 Weighing

Weighing (Figure 3-8) displays the current weight and percent of load readings for each channel (load cell). Weight values for each channel are recorded on the upper line with percentage equivalents directly beneath. With a stable reading displayed, touch Next> to record the weighment and advance to the Removing screen/ menu.



Figure 3-8. Channel Weight and Percentage Values

Should the “STABLE” condition not be reached after a few minutes or in case of external causes (wind, etc.), the user can force the system to proceed to the Removing stage by touching the NEXT> soft key. A warning message will appear on the screen as shown in Figure 3-9. To continue with forced operation touch the “YES” key.

NOTE:

The operator must be satisfied that the weighment is valid in addition to the instruments “stable” prompt. Operator acceptance takes into consideration factors such as: the aircraft is completely clear of the ground (floor) and all items aboard are accounted for, etc. The scale will enter the “stable” condition after an undisturbed period regardless of the amount of load applied. The operator is free to change the loading until a final weighment is acceptable on the display. Any outside force, wind on control surfaces, vibration, etc., may keep the scale from reaching a “stable” condition. It is important for the operator to exercise good judgment at this point. The scale can only recognize stability and has no way to confirm that loading is complete and acceptable.



Figure 3-9. Unstable Weighment Warning Screen

3.3.4 Removing

Removing is the reverse of lifting. At this time, lower the aircraft to its original resting position and make sure there is no contact between the load cells and the jack points. Touch Next> to advance to the rezeroing menu.

3.3.5 Rezeroing

The rezeroing menu displays the after-weighment zero reference for each cell. Ideally, all cells should return to their original no-load zero value.

NOTE: DO NOT REMOVE ANY INTERFACE HARDWARE. It is important that all load sensors are clear of the aircraft to provide a good zero return. The JetWeigh-W performs automatic checks to assure a good zero return (zero tracking if selected) and compensate for minor tolerance variations during zero return. If the return is not satisfactory for any reason, an error condition will result. The weighmaster must review all error messages and the data on the printout tape to decide if the weighment can be accepted or the aircraft must be re-weighed.

Touch Next> to view a complete report of the aircraft weighment cycle

3.3.6 Weighment Report

Figure 3-10 depicts the screen view of a typical aircraft weighment report. All calculations, aircraft identifiers, and weighment results are available for visual review and hard copy printout. Data may also be saved for future reference by touching the screen "Save" button.

If a data save is not desired/required, simply continue without touching the save button. A message will appear asking the operator to confirm that data is not being saved (Figure 3-11).

At this point, the weighment is complete. It is recommended that load cell batteries and the handheld terminal be recharged using the supplied power adapter cords. Once recharging is complete, the system may be readied for the next aircraft weighment or repacked in its storage case.



Figure 3-10. Typical Aircraft Weighing Report



Figure 3-11. Data Not Saved Warning Message

Section IV - Weighing History

4.1 RECALL A RECORD FROM THE HISTORY FILE

Access the “System” tab, and press “History” to get to the history page display shown in Figure 4-1. The upper table displays a list of past reports. These reports can be sorted by Time, by Aircraft ID, and by Serial Number, using the “Sort:” drop down list. This table also accesses reports belonging to a specific aircraft by entering its serial number at the “filter” field and touching the “Filter” button. To revert to the unfiltered state, clear the filter field and touch the filter button. The lower text box will display the report currently selected at the history table. To print an aircraft data report, connecting the handheld terminal to the printer and touch the “Print” button.

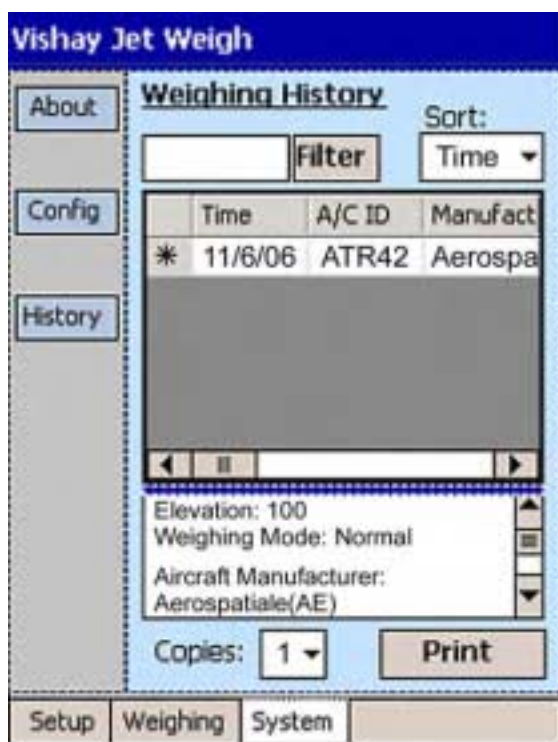


Figure 4-1. JetWeigh-W History Screen

4.2 RECALLING AIRCRAFT FROM THE LIBRARY.

Many standard aircraft configurations are recorded in the JetWeigh-W Library. To choose a configuration from the library, view the drop down list at the Setup/ Aircraft Data page, as shown in Figure 4-2.



Figure 4-2. Recall Aircraft Screen

4.3 AIRCRAFT NOT RECORDED IN THE LIBRARY

In order to use aircraft not available on the drop down list, touch the “Other” check box, and input the aircraft parameters manually, as shown in Figure 4-3.



Figure 4-3. Input Aircraft Screen

Section V - Troubleshooting

Table 5-1. LED Status Indication

1.1 TROUBLESHOOTING OVERVIEW

Section V provides troubleshooting information for the JetWeigh-W system. In many cases, simple battery charging or recharging will resolve communication and operation problems.

1.2 LED STATUS INDICATORS

Many operational problems can be resolved by noting the LED status indicators on both the handheld terminal case and each individual load cell. Table 5-1 defines LED status indication for each device.

3.3 TYPICAL PROBLEMS AND SOLUTIONS

Table 5-2 presents typical JetWeigh-W problems and their simple solutions. As mentioned in paragraph 1.1, simply checking the battery status on all devices and recharging as needed resolves many JetWeigh-W problems.

System Status	Load Cell LED State	Handheld Terminal LED State
OFF	OFF	OFF
Standby	Blinks Every 1.5 Sec.	OFF
Weighing	Always On	Blinks Every 1.2 Sec.
Low Battery	Blinks Every 0.5 Sec.	Blinks Every 0.2 Sec.

Table 5-2. JetWeigh-W Problems and Solutions

Problem/Error	Cause	Solution
No weighing results received form a single load cell -1	Load cell is turned off	Turn the load cell on and verify that it is in standby mode
No weighing results received form a single load cell -2	Load cell battery needs recharging	a). Check for a low battery indication at the load cell and the terminal (see LED Status Table 5-1) b). Charge any/all low batteries
No weighing results received form a single load cell -3	Poor wireless link	a). Move terminal closer to the load cell b). Check the antenna connection on the load cell c). Change the RF channel in the terminal d). Improve the line-of-sight between the terminal and the failing cell e). Remove large metal objects from the load cell vicinity
No weighing results received form all load cells -1	Terminal is in low battery mode	a). Check for low battery indication at terminal b). Connect terminal to charger.
No weighing results received form all load cells -2	Poor wireless link conditions	a). Check the antenna connection on the terminal b). Change the RF channel in the terminal
A load cell doesn't turn on	Load cell battery is drained out	Connect the load cell to a charger
Handheld terminal doesn't turn on	IPAQ battery is drained out	Recharge IPAQ battery
Handheld terminal doesn't respond	IPAQ Windows fault	Remove the IPAQ from the case and perform a hardware reset using the stylus pen. The reset key is on the back of the IPAQ.

3.4 CHANGING RF CHANNELS

Communication problems are often resolved by switching to a different RF channel. Figure 5-1 shows the Switch Channel button. Touching this button toggles the label caption between channels. Save the optimal channel settings by touching the Save Settings button.

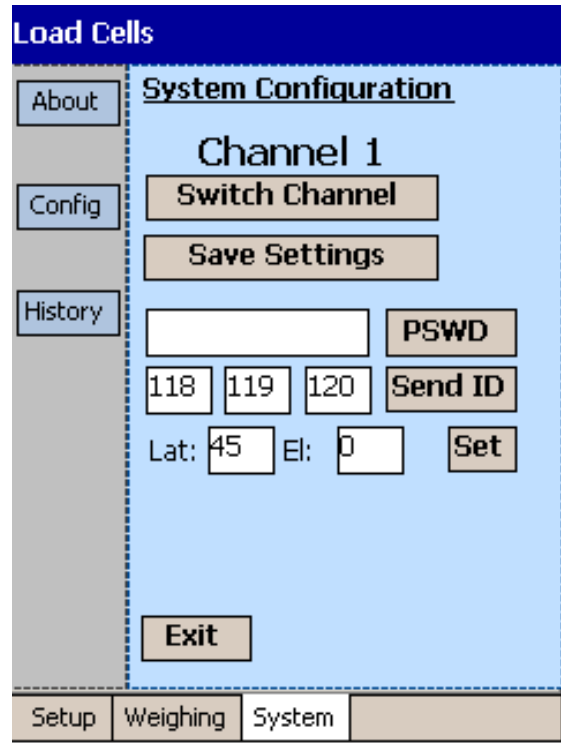


Figure 5-1. Changing RF Channels

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