

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER	REVISION
	REPORT ORDER		PS-0032	C
TITLE FRDS GENII Dump Pit Calibration	BY	CHK'D	MODEL	
	Victor Trotter	CG	FRDS Gen II	
	DATE		SERIAL	
	01/11/10		ALL	
		PAGE	OF	
		1	8	

Overview

This document provides detailed instructions for calibrating the Leakage Table in "LEARN" mode during dump-pit water flow calibration of the second generation (GEN II) FRDS system installed on Air Tractor firefighting aircraft.

Objectives

To provide a procedure for calibration of the Leakage Table using LEARN mode during dump-pit calibration of the second generation (GEN II) FRDS system installed on Air Tractor firefighting aircraft.

Background

The leakage table consists of a two-dimensional table of cells, each cell containing a leakage correction (in gallons) for a specified "coverage level" (row value) and "gallons to dump" (column value).

The leakage correction (calibrated in this process specification) is used by the system to apply gate timing corrections based on known errors ("leakage") which are measured during this calibration procedure.

Each cell in the table is calibrated using a "successive approximation" method, where each subsequent "test dump" calculates a leakage correction value that is closer to the "correct" leakage value than the value from the previous "test dump". When the leakage value calculated from a test dump is the same (or close to) the value calculated from a previous test dump, the cell is considered to be calibrated.

After every cell in the Leakage Table is calibrated, the Leakage Table is considered to be calibrated.

The Leakage Table has positions for "gallons to dump" of 200, 400, and 600 gallons (and 800 gallons in the case of an AT-1002), and positions for "coverage level" of 0.5, 1, 2, 3, 4, and "Max" (4.5).

Prerequisite Conditions

The following items must be verified before dump pit calibration of the system:

1. The hopper gallons sensor offset has been set and the hopper gallonage is correctly per Trotter Controls PS0031.
2. The gatebox door angle sensor offset has been set so that the voltage with a closed door is 4.00 (± 0.01) when looking at the gate angle sensor analog input in maintenance mode per Trotter Controls PS0031.
3. The hopper float has been verified to operate correctly without binding or obstructions over the entire range of operation and the hopper sensor has been set per Trotter Controls PS0031.
4. The hopper vent control arm is connected and the vent is operating correctly when the doors are opened.
5. Hydraulic oil is present in the system.
6. The hydraulic system pressure is 2800 to 3100 PSI before each delivery.

Successive Approximation Learning

The "successive approximation" method calculates a new correction value for the cell based on the "previous" correction value and the newly measured correction value. The algorithm currently being used calculates (and stores) a value that is midway between (the average of) the previous value and the newly measured value, which allows each subsequent test dump to get closer and closer to a "correct" cell value.

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER PS-0032	REVISION C
	REPORT ORDER		<input checked="" type="checkbox"/>	
TITLE FRDS GENII Dump Pit Calibration	BY Victor Trotter	CHK'D CG	MODEL FRDS Gen II	
	DATE 01/11/10		SERIAL ALL	
			PAGE 2	OF 8

To allow for faster calibration of a completely uninitialized Leakage Table, a “fast learn” facility is supported to bypass the “successive approximation” method once for each cell, allowing the new cell value to be set immediately from a single test dump, without averaging the previous value of the cell. This allows the first “guess” for each cell to be set immediately closer to the correct value, rather than using multiple “successive approximation” iterations.

Initial Preparation

Before performing the individual steps for each cell to be calibrated, set up the system by performing the following steps:

1. Power-up the system. (Turn on the master power to the aircraft)
2. Set the “MODE” switch to “AUTO”
3. Press the “MENU” panel switch to enter the main system menu.
4. Use the rotary knob to Select “Maint” and push the selector knob to enter the maintenance menu.
5. Select “Leakage Table” and push the selector knob to display the Leakage Table.
6. Use the twist knob to scroll through the Leakage Table to determine which, if any, cells are already calibrated.
 - a. Cells that are set to factory values are shown in “normal” text. Cells that are **different** than factory values are highlighted in “inverse” text.
 - b. Pressing the “YES” panel switch will toggle the display between “active” values and “factory” values. The factory values are for reference only
7. Press the “NO” panel switch (or press the selector knob) to exit Leakage Table display.
8. Press the “MENU” panel switch to enter the main system menu.
9. Select “Config” and push the selector knob to enter the configuration menu.
10. Confirm that the proper aircraft is selected, and if not, select the aircraft you are calibrating.
11. Select the line beginning with “Learn” and push the selector knob.
12. **Only if it is desired to erase the existing leakage table and set it to factory values**, select “Reset Factory Leakage” and push the selector knob twice. This would typically be performed only if the leakage information has been severely corrupted or lost.
13. Select the item “Learn” (to activate Learn mode) and push the selector knob.
14. Confirm that Learn mode is activated (the display should show “Learn:Learn”).
15. Press the “NO” panel switch to exit the configuration menu.
16. Confirm that two integer values separated by a hyphen (initially “999-999”) are displayed immediately below the Hopper (gallons) entry.

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER	REVISION
	REPORT ORDER		PS-0032	C
TITLE FRDS GENII Dump Pit Calibration	BY	CHK'D	MODEL	
	Victor Trotter	CG	FRDS Gen II	
	DATE		SERIAL	
	01/11/10		ALL	
			PAGE	OF
			3	8

17. Set the HYD POWER switch to the “ON” position. This switch must be ON to display and allow changing the values for “coverage level” and “gallons to dump”.

18. Set the ARMED switch to “ON” (“up” position) to enable the “DUMP” switch for auto-dump operation.

Note that “LEARN” mode is active only for the duration of the current system run. If the system is restarted for any reason, these steps need to be repeated.

Process Steps for each Calibration Point

The setting for the coverage level, the gallons to dump, and the initial gallons that should be contained in the aircraft hopper are shown in Tables 1 & 2.

NOTE: The calibration sequence for a specific cell should be repeated until the actual gallons remaining in the hopper (after the delivery is complete) is within the following tolerances:

- Coverage level 0.5 ~ 2.0: Remaining gallons after dump is within 10 ~ 15 gallons of the expected amount.
- Coverage level greater than 2.0: Remaining gallons after dump is within 15 ~ 20 gallons of the expected amount.

Table 1 ~ Calibration points for AT802F aircraft (GEN II FRDS systems only)

AT802F Calibration Points			
Initial Gallons in Hopper	800	800	800
Coverage Level	Gallons to Dump	Gallons to Dump	Gallons to Dump
Coverage Level 0.5	600	400	200
Coverage Level 1.0	600	400	200
Coverage Level 2.0	600	400	200
Coverage Level 3.0	600	400	200
Coverage Level 4.0	600	400	200
Coverage Level 4.5	600	400	200

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER PS-0032	REVISION C
	REPORT ORDER		<input checked="" type="checkbox"/>	
TITLE FRDS GENII Dump Pit Calibration	BY Victor Trotter	CHK'D CG	MODEL FRDS Gen II	
	DATE 01/11/10		SERIAL ALL	
			PAGE 4	OF 8

Table 2 ~ Calibration points for AT1002F aircraft (GEN II FRDS systems only)

AT1002F Calibration Points				
Initial Gallons in Hopper	1000	1000	1000	1000
Coverage Level	Gallons to Dump	Gallons to Dump	Gallons to Dump	Gallons to Dump
Coverage Level 0.5	800	600	400	200
Coverage Level 1.0	800	600	400	200
Coverage Level 2.0	800	600	400	200
Coverage Level 3.0	800	600	400	200
Coverage Level 4.0	800	600	400	200
Coverage Level 4.5	800	600	400	200
Coverage Level 5.0	800	600	400	200
Coverage Level 6.0	800	600	400	200
Coverage Level 6.5	800	600	400	200

For each cell in the Leakage Table above, perform the following steps:

1. Fill the hopper with water until the hopper gauge (side-loader gauge) reads 800 gallons \pm 5 gallons (full tank).
2. On the main display, use the twist knob to select a "coverage level" value and a "gallons to dump" value to be calibrated ("learned"). Values for coverage level are 0.5, 1, 2, 3, 4, and "Max". Values for "gallons to dump" should be set to 200, 400, or 600 gallons.
3. After selecting a "coverage level" value and a "gallons to dump" value to be "learned", confirm that the dump area is clear and press the "DUMP" switch to activate the dump.
4. After the dump operation is complete, the gate doors will close, the system will wait a short delay for the water level to stabilize, and then the system will measure the actual amount of water in the tank and compare it to the expected amount of water in the tank. The appropriate cell in the Leakage Table will be adjusted accordingly, and the entire Leakage Table will be saved to EEPROM.
5. The two integer values (separated by a hyphen) immediately below the "hopper (gallons)" display will show the number of gallons in the hopper before and after the dump.
6. Wait for the bottom line of the pilot interface to briefly display: "**LeakageUpdate**".
7. This indicates that the current leakage value has been saved and it's OK to fill the hopper again and test the next point.
8. **LEARN mode should be turned OFF at the end of the calibration process to avoid data corruption. This must be done by entering the "Config" menu and resetting "Learn" mode to "Normal".**

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER	REVISION
	REPORT ORDER		PS-0032	C
TITLE FRDS GENII Dump Pit Calibration	<input checked="" type="checkbox"/>		MODEL	
	BY	CHK'D	FRDS Gen II	
	Victor Trotter	CG	SERIAL	
	DATE		ALL	
	01/11/10		PAGE	OF
			5	8

Conclusion

Calibration Leakage Table

Once the aircraft has been calibrated, record the leakage values in Table 3. This is important since this data can be used to re-construct the leakage data for a given aircraft in the event that the data is lost. Use the maintenance menu to display the leakage table and write the leakage table values down as displayed on the pilot interface. Perform the following steps:

1. Press the "MENU" panel switch to enter the main system menu.
2. Select "Maint" and push the selector knob to enter the maintenance menu.
3. Select "Leakage Table" and push the selector knob to display the Leakage Table.
4. Use the twist knob to display the Leakage Table. Cells that are set to factory values are shown in "normal" text. Cells that are **different** than factory values are highlighted in "inverse" text. Pressing the "YES" panel switch will toggle the display between "active" values and "factory" values.
5. Press the "NO" panel switch (or press the selector knob) to exit Leakage Table display.
6. Record the leakage values in Table 3 for the corresponding aircraft

Calibration Analog Data

Once the aircraft has been calibrated, record the analog calibration values in Table 4. This is important since this data can be used to restore analog calibration data for a given aircraft in the event that the data is lost.

Use "Tweak Parameters" from the "Maint" menu to read and record this data. In tweak mode, this data must be viewed in "word" mode (tweak 0 contains value of 2, and tweak numbers increments by 2 are shown, Ex., 0, 2, 4, 6...100, 102.., tweak 100 also contains the counts for 101, and 102 also contains the values for 103 and so on). If the tweak numbers are not shown in increments of 2, press the LAMP TEST switch until the numbers do show as increments of 2 as explained previously.

Note that these values can also be read using "Analog Calibrate" from the "Maint" menu, and recording the two numeric values under the column heading "Count" for each of the analog devices.

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER	REVISION
	REPORT ORDER	<input checked="" type="checkbox"/>	PS-0032	C
TITLE FRDS GENII Dump Pit Calibration	BY	CHK'D	MODEL	
	Victor Trotter	CG	FRDS Gen II	
	DATE		SERIAL	
	01/11/10		ALL	
			PAGE	OF
			6	8

Calibration Fingerprint Data

Once the aircraft has been calibrated, record the fingerprint values in the table below. This is extremely important since this data can be used to quickly verify the leakage and analog calibration data for a given aircraft in the event that it is lost. Since this data is exclusively specific to each aircraft it can be considered like a fingerprint.

1. Press the "MENU" panel switch to enter the main system menu.
2. Select "Maint" and push the selector knob to enter the maintenance menu.
3. Select "Logo/Version" and push the selector knob to display the Logo, Version, and Version Date.



Figure 1 - Logo / Version / Compile date

4. Figure 1 displays the Software version and the compile date.
5. Press the "Yes" panel switch twice more to enter the Fingerprint configuration display.

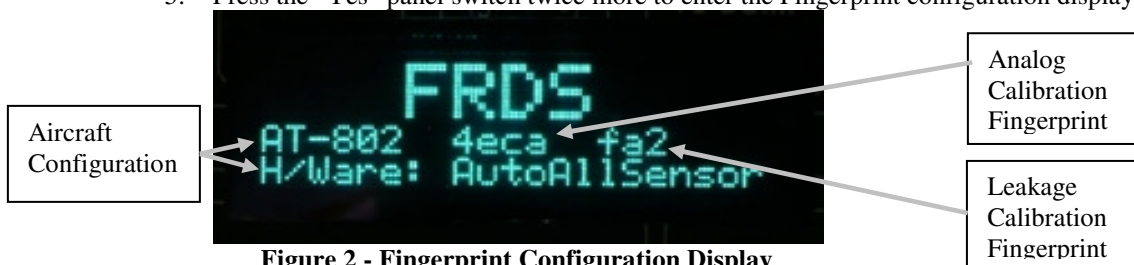


Figure 2 - Fingerprint Configuration Display

6. Figure 2 displays the Aircraft configuration and fingerprint info.
7. Record the analog and leakage values in Table 3 for the corresponding aircraft.
8. Archive the recorded values for possible future reference.
9. Keep Pressing and releasing the "Yes" panel switch until the main AUTO or TIMER display appears.

Note: Fingerprint information can also be viewed under Maint – Compare RAM/EE. It may be required to hold the "Run Pump" switch down and press the selector knob to skip down to the display shown below

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER	REVISION
	REPORT ORDER		PS-0032	C
TITLE FRDS GENII Dump Pit Calibration	BY	CHK'D	MODEL	
	Victor Trotter	CG	FRDS Gen II	
	DATE		SERIAL	
	01/11/10		ALL	
			PAGE	OF
			7	8

Calibration Data Quick Sheet – AIRCRAFT SPECIFIC

- After calibration is complete, record the values on the tables below and place inside the relay enclosure -

Figure 3 ~ Dump Cal Data table

PI S/N: _____		Analog Cal Fingerprint: _____		Leakage Cal Fingerprint: _____	
AT _____	F S/N _____	Date: _____	By: _____	(AT1002 ONLY)	
Gallons to Dump	200	400	600	800	
Coverage Level 0.5					
Coverage Level 1.0					
Coverage Level 2.0					
Coverage Level 3.0					
Coverage Level 4.0					
Coverage Level 4.5					
Coverage Level MAX				(N/A)	
(AT1002 ONLY)					
Coverage Level 5.0					
Coverage Level 6.0					
Coverage Level MAX					

Figure 4 ~ Analog Cal Data table

PI S/N _____		
Tweak number	Value	Description
100		Photo 0 volt calibration value
102		Photo 4.50 volt calibration value
112		Accel One, -1 G calibration value
114		Accel One, +1G calibration value
124		Accel Two, -1 G calibration value
126		Accel Two, +1G calibration value
136		Gate Angle 0 volt calibration value
138		Gate Angle 4.50 volt calibration value
148		Hopper Gallons 0 volt calibration value
150		Hopper Gallons 4.50 volt calibration value
160		Hyd. Pressure 0 volt calibration value
162		Hyd. Pressure 4.50 volt calibration value
172		Foam Gallons 0 volt calibration value
174		Foam Gallons 4.50 volt calibration value
184		15.00 volt calibration value
186		24.00 volt calibration value

TROTTER CONTROLS FORT WORTH, TEXAS	PROCESS SPECIFICATION		NUMBER	REVISION
	REPORT ORDER		PS-0032	C
TITLE FRDS GENII Dump Pit Calibration			MODEL	
	BY	CHK'D	FRDS Gen II	
	Victor Trotter	CG	SERIAL	
	DATE		ALL	
	01/11/10		PAGE	OF
			8	8

Notes:
