
Chapter 8

TFE731 Performance

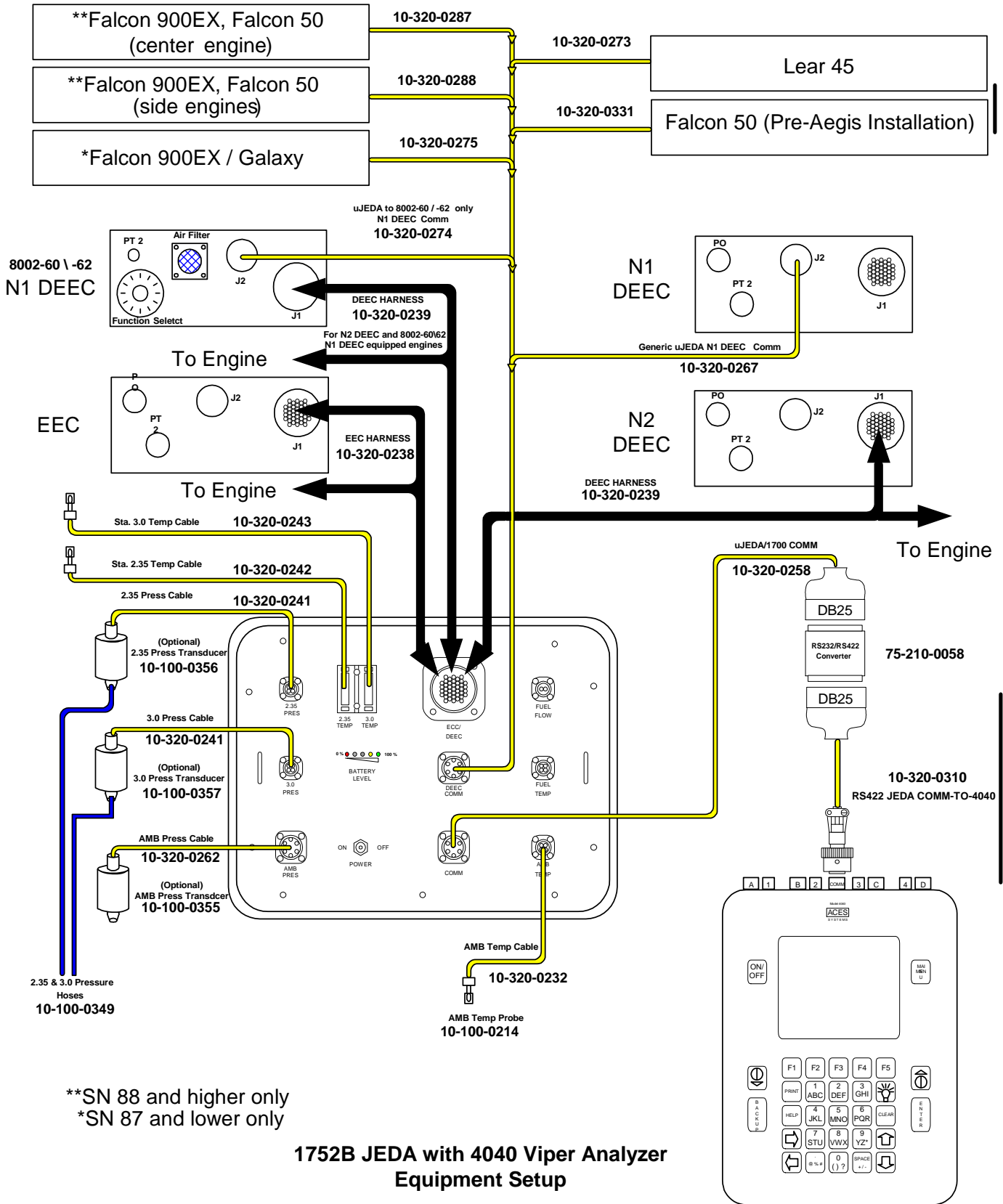
(Revision 2, Aug 2007)

TFE731 Performance EMS is the function that makes the Viper the controller for the ACES1752B, and 1754 JEDA units. The 1750 and 1752 JEDA will collect performance data on all TFE731 engine models *not* equipped with N1 DEEC computers and currently requires the use of the 17XX series analyzer acting as a controller. The 1752B will collect performance data on all TFE731 engine models regardless of the engine computer type and the 1754 will collect performance data only from TFE731 engine models with N1 DEEC computers. The 1752B and 1754 JEDA models can be controlled with either a 17XX analyzer or the 4040 Viper.

The TFE731 Performance EMS function is used exclusively with the model 1752B Mini JEDA and 1754 Micro JEDA models. The EMS function is included as part of the 4040 Viper Main Menu. The EMS function cannot be intermixed as controller for 1750 and 1752 JEDA equipment and will not perform as described here. If you are not sure what performance equipment and accessories you currently have, contact ACES Systems. To conduct a performance run using EMS, refer to section 8.1 below.

8.1. TFE731 Performance EMS

- 8.1.1. Necessary Equipment. In order to use the EMS function of the Viper 4040 analyzer you must first have the EMS function active on your analyzer. There is no charge for the EMS function to be activated on the analyzer. If “TFE731 Performance - EMS” does not appear on your main menu screen, contact ACES Systems for information on how to activate this function. In addition to the EMS function being active, you must have the necessary data logger (Jet Engine Data Acquisition, or JEDA) plus accessories required for the TFE731 engine model that you intend to conduct the performance calibration run on. The following is a list and short explanation of each.



**SN 88 and higher only
 *SN 87 and lower only

- 8.1.1.1. Datalogger (JEDA): There are two possible selections for the JEDA unit required. 1.) The Model 1752 Mini JEDA is a compact designed data logger, which enables you to collect data from any TFE731 engine model, regardless of the computer type (EEC, N2 DEEC, or N1 DEEC) and 2.) The Model 1754 Micro JEDA is a super compact designed data logger that enables you to collect data from only TFE731 engine models equipped with N1 DEEC computers.
- 8.1.1.2. ACES AvTrend Software: ACES AvTrend is the companion software provided with the purchase of the Viper 4040 analyzer. AvTrend allows you to dump and store all Jobs completed with your Viper 4040 to your computer. This includes TFE731 performance calibration runs. AvTrend directs the logger files to the MEDRA Logger Directory where it is stored until the data is reduced by MEDRA.
- 8.1.1.3. RS232-to-RS422 Communications Cable: This is the communications cable that enables the Viper 4040 to control the JEDA unit via a serial communications link. The communications cable between the Viper 4040 and the JEDA unit includes a RS232-to-RS422 converter and is approximately 70 feet long to accommodate all known airframe applications. The RS232-to-RS422 converter is attached in line at the Viper 4040 end of the cable to the DB25 connector. The converter connects directly to the DB25 end of the Serial Comm cable, which is included with the Viper 4040 analyzer. The Serial Comm cable then connects to the analyzer via a 6 pin MS connector and the AUX COMM port
- 8.1.1.4. EEC, N2 DEEC, and N1 DEEC Comm Cable(s): The EMS software will accommodate all TFE731 engine types. The EEC harness is connected to the engine EEC computer and to the JEDA unit. The connection at the computer also passes the signals through to the engine normally except for the T5 connection, which is opened by the JEDA unit. For this reason, the EEC or DEEC harness must never be attached independently to the engine computer (that is without also being connected to the JEDA unit) to prevent torching and overheating during engine start. The N2 DEEC harness is used in the same fashion as the EEC harness. Both the EEC and DEEC harness are the only cables required to be connected to EEC and N2 DEEC computers to collect the calibration data. There are several N1 DEEC Comm cables available as of this writing. You may expect that others will become available as new airframe/engine combinations are designed and as older N2 DEEC equipped engines are upgraded to the newer N1 DEEC computers. The Standard N1 DEEC Comm cable is a generic design that connects directly to the J2 connection of the N1 computer, where possible. Engine/airframe specific cables are necessary for access to the computer where other means of communicating with the computer are not available. There are specific designs for the Falcon 900EX, Falcon 50 (Side and Center Engine), Lear 45, ASTRA SPX/Galaxy, and for the 8002-60 and

8002-62 N1 computers. When collecting data from either the 8002-60 or 8002-62 computers, you must also use the N2 DEEC harness cable (10-320-0239) in conjunction with the -60/-62 N1 DEEC comm cable, 10-320-0274. The two cables are necessary to: 1) control the computer (-60/-62 N1 DEEC Comm Cable) and 2) to facilitate a faster acquisition speed (N2 DEEC breakout cable) from these older design N1 Computers.

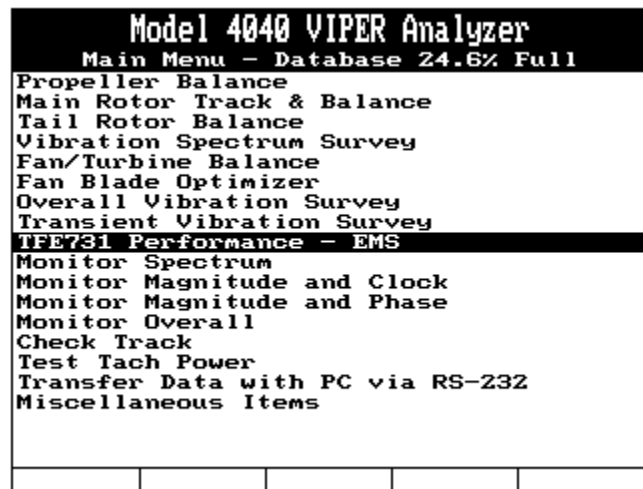
8.1.1.5. Ambient Temperature Probe and Cable: The EMS software design dictates that you must have an ambient temperature sensor and connecting cable installed for all EMS performance runs. The ambient temperature sensor is placed in a shaded area near the engine and secured to prevent ingestion into the engine or damage due to movement caused by jet blast or wind. The cable then connects the sensor to the JEDA unit.

8.1.1.6. Optional sensors and cables: Optional Sensors include the Station 3.0 Temperature cable, the Station 2.35 Temperature cable, the Station 2.35, and 3.0 pressure sensors and connecting cables and the pressure hoses to connect the Station 2.35 and Station 3.0 pressure sensors to the engine. The Ambient Pressure sensor and cable are also optional but recommended for data quality.

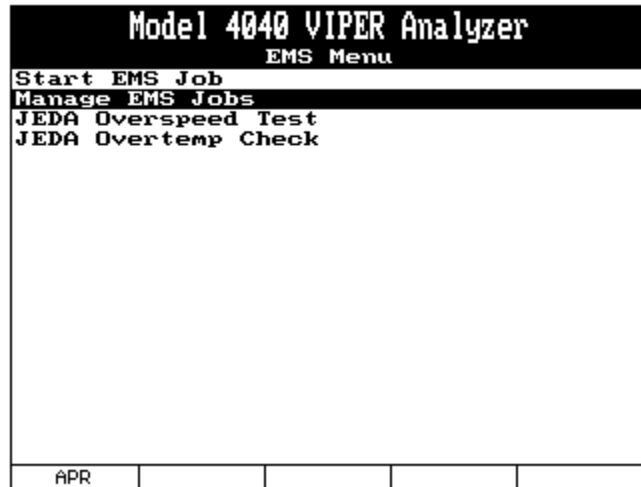
8.1.2. Analyzer Operation

8.1.2.1. Turn the analyzer ON by pressing the ON/OFF key.

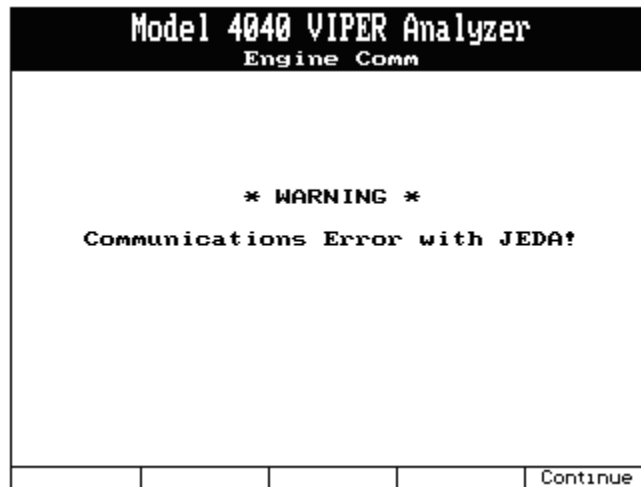
8.1.2.2. From the Main Menu, shown below, use the [UP ARROW] or [DOWN ARROW] key to select “TFE731 Performance – EMS” and press [ENTER].



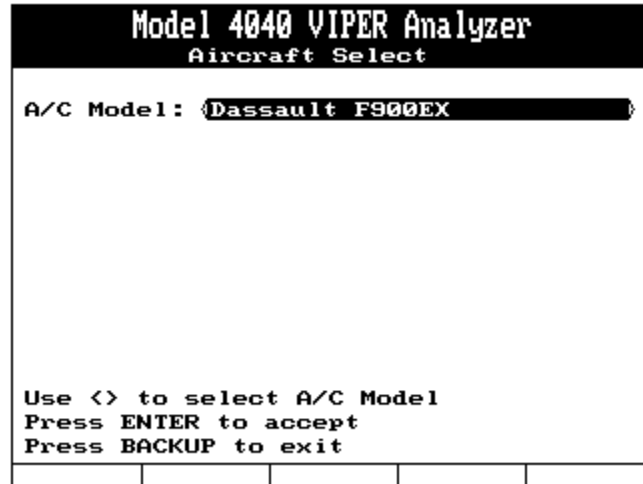
- 8.1.2.3. From the EMS Menu, select “Start EMS Job” and press [ENTER].



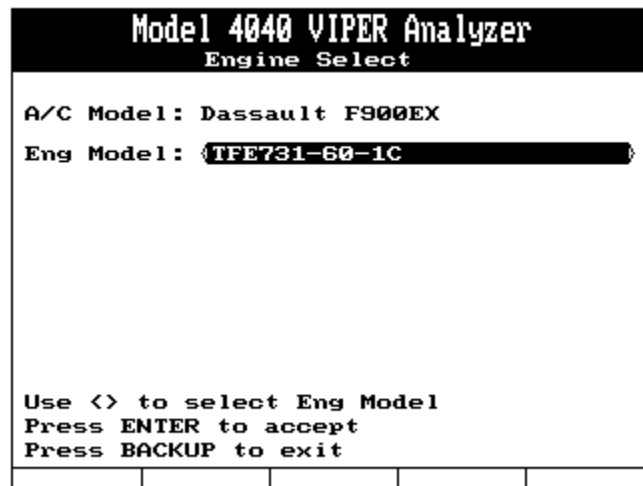
- 8.1.2.4. The analyzer will perform a communications check with the JEDA unit and the aircraft computer. If an error is encountered, the information screen below will be displayed. Check all cable connections and attempt to start the job again. Press the [F5] “Continue” key to acknowledge the warning and continue.



- 8.1.2.5. The Aircraft Select screen will be displayed. Use the [RIGHT ARROW] key to scroll through the list of available aircraft. When the name of the aircraft on which you are conducting the calibration run appears, press [ENTER] to accept and continue.



- 8.1.2.6. The Engine Select screen will be displayed. Use the [RIGHT ARROW] key to scroll through the list of available engine models. The list is restricted to those engine models that may be installed on the aircraft model selected in the Aircraft Selection screen above. Double check the engine model as an error in this selection can make significant differences in the reduced data. If the engine model installed on the selected aircraft is NOT AVAILABLE from the list, contact ACES Systems at the number listed in front of this manual. When you are ready to continue, press [ENTER] to accept your selection.



- 8.1.2.7. The Nozzle Select screen will be displayed. Use the [RIGHT ARROW] key to scroll through the list of available Nozzles that may be installed on the engine model and aircraft selected in paragraphs 8.1.2.7 and 8.1.2.8 above. Press [ENTER] to accept your selection and continue.

Model 4040 VIPER Analyzer				
Nozzle Select				
A/C Model: Dassault F900EX				
Eng Model: TFE731-60-1C				
Nozzle: Center T/R Nozzle				
Use <> to select Nozzle ID				
Press ENTER to accept				
Press BACKUP to exit				

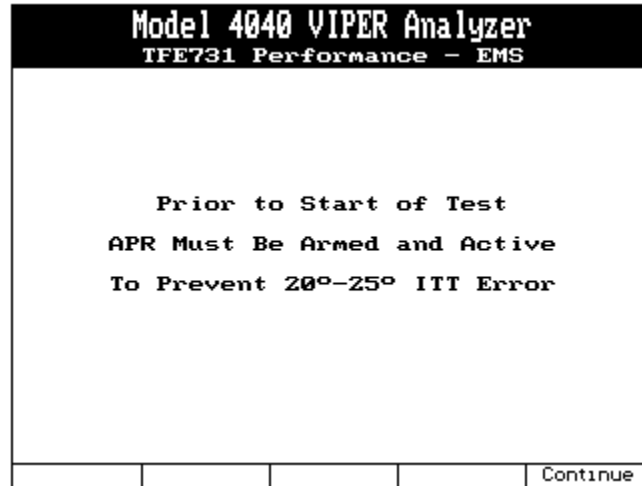
8.1.2.8. The Performance Calibration Setup screen, shown below, will be displayed. Complete this screen as follows:

- Customer Name:** Use the analyzer keypad to enter a customer name. Press the [DOWN ARROW] key to move to the next field.
- Aircraft S/N:** Use the analyzer keypad to enter the aircraft registration or serial number as required. Press the [DOWN ARROW] key to move to the next field.
- Fuel Spec Gravity:** If you are using a fuel flow meter, use the analyzer keypad to enter the Specific Gravity of the fuel at 60 degrees F (15.6 degrees C). NOTE: If you are not using a fuel flow meter, this entry is not required. Press the [DOWN ARROW] key to move to the next field.
- Fuel LHV(BTU/lbm):** If you are using a fuel flow meter, use the analyzer keypad to enter the Fuel Lower Heating Value. If you are not using a fuel flow meter, this entry is not required. Press the [DOWN ARROW] key to move to the next field.
- Temp Disp Units:** Use the [RIGHT ARROW] key to toggle the desired temperature display units between degrees C or degrees F. Press the [DOWN ARROW] key to move to the next field.
- N1 Delta (rpm):** Use the numeric keypad to enter the N1 Delta RPM. This is the allowable N1 speed drift from a stable speed, before the data logger will detect and store an invalid sample. The default is 100. If wind conditions dictate, this value may be set as high as 300 RPM, however; data quality may be questionable if taken in such extreme conditions as to require a 300 RPM delta. Press the [DOWN ARROW] key to continue.

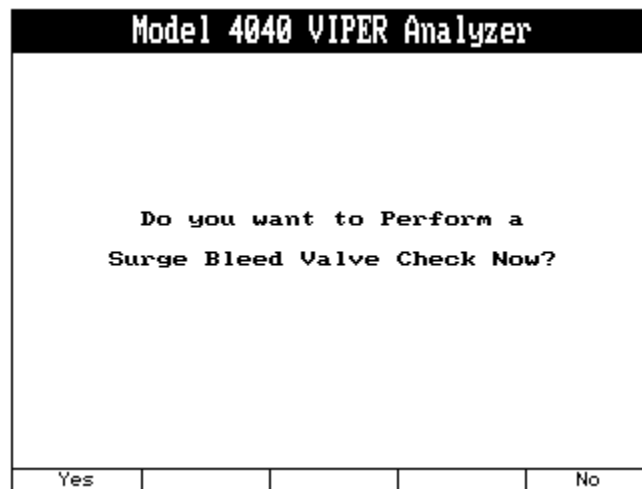
- Calib. Reason: Use the [RIGHT ARROW] key to scroll through the available selections for Calibration Reason. When the Reason you are conducting the calibration run is displayed, press the [DOWN ARROW] key to move to the next field.
- Engine Hours: Use the analyzer's numeric keypad to enter the total Engine Hours. Press the [DOWN ARROW] key to move to the next field.
- Engine Cycles: Use the analyzer's numeric keypad to enter the total Engine Cycles. Review all fields on this page for correct entry then press [ENTER] to accept your selections and entries and continue.

Model 4040 VIPER Analyzer	
Perf Calib Setup	
Customer Name :	RONALD BUMP
Aircraft S/N :	N534RB
Fuel Spec Gravity:	0.7
Fuel LHV(BTU/lbm):	14000
Temp Disp Units :	(°C)
N1 Delta(rpm):	100.00
Calib. Reason:	Rental Install
Engine Hours :	3654
Engine Cycles :	1263
Enter spec. gravity @ 60F/15.6C	
Press ENTER when done	

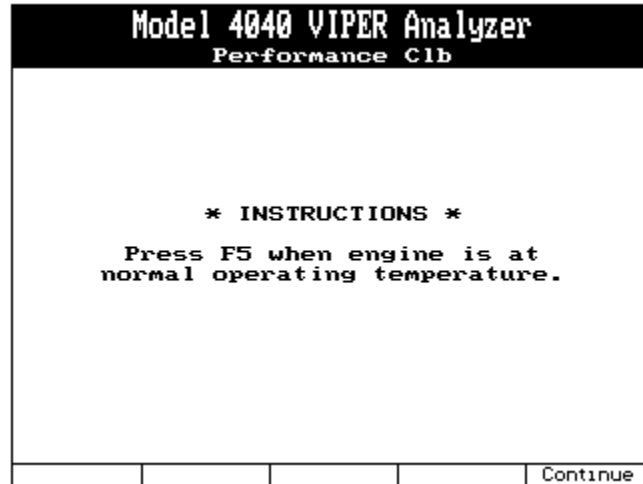
- 8.1.2.9. If the selected engine is APR equipped, the following information page will be displayed. The message varies according to the aircraft selected above. If APR equipped and aircraft is a Hawker with N1 DEEC 9020-3 or 9010-8000, the message "PRIOR TO START APR MUST BE TURNED OFF..." is given. If the selected aircraft is not a Hawker, the message "PRIOR TO START APR MUST BE ARMED AND ON." is given. Press the [F5] "Continue" key to acknowledge this information message and continue.



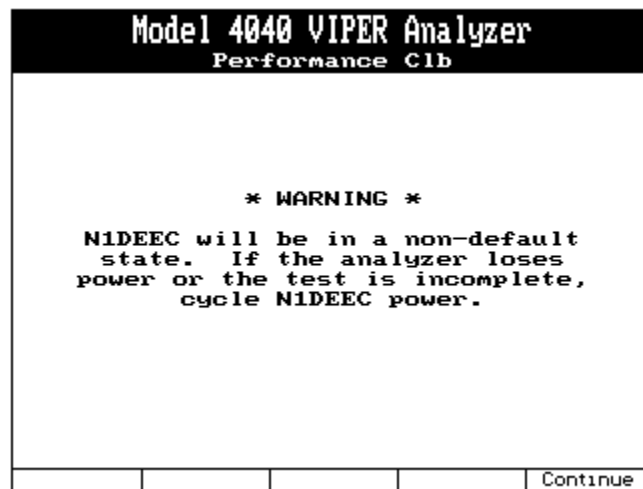
- 8.1.2.10. If the engine you are running is EEC or N2 DEEC equipped, the information message below will be displayed. Press [F1] “Yes” to conduct the bleed valve check or no to continue without conducting the check. NOTE: If the engine is N1 DEEC equipped, this message will not be seen as the Bleed Valve Check is not an option with N1 DEEC equipped engines. This is a limitation of the N1 DEEC design.



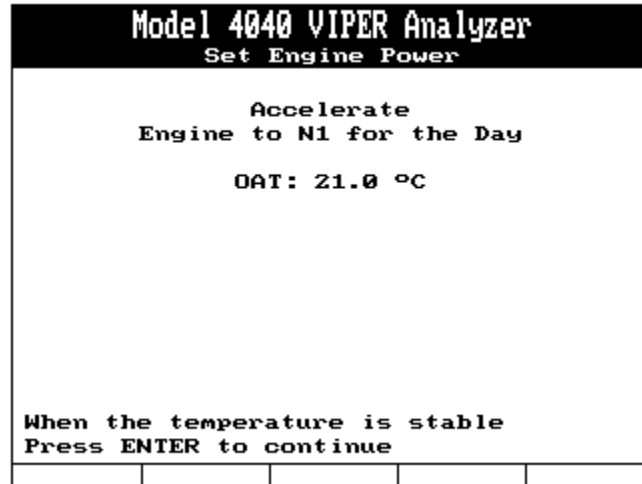
- 8.1.2.11. The information screen below will be displayed. Allow the engine to warm up to normal operating conditions. When normal operating conditions are attained, press the [F5] “Continue” key.



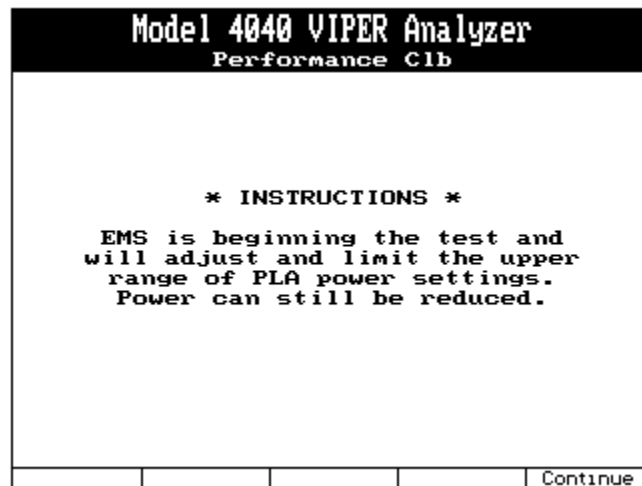
- 8.1.2.12. If the engine is N1 DEEC equipped, the WARNING message below will be displayed. The message indicates that the computer is not in the certified, factory default mode. If power to the analyzer is lost for any reason, the N1 DEEC control will not automatically return to its default, certified mode. In order to return the N1 DEEC computer to the default mode, you must cycle the N1 DEEC power switch any time power to the analyzer is lost during a calibration run. Press the [F5] key to acknowledge and continue.



- 8.1.2.13. The information screen below will be displayed. The OAT (outside air temperature) will be displayed on the screen. Use this temperature to calculate N1 for the day with the aircraft performance data. When the power setting is calculated, advance the power lever to N1 for the day. When the ITT is stable at N1 for the day, press [ENTER] to continue.



- 8.1.2.14. The information screen below will be displayed if you are running an N1 DEEC equipped engine. The message is to inform you that all power adjustment will be made automatically by the Viper 4040 analyzer. While you do not need to adjust power for the calibration run, you still have the ability to reduce the engine power using the PLA if necessary, such as in an emergency or because of airfield traffic. If power is reduced, the analyzer will afford you the opportunity to continue the run without returning to the beginning of the run. Press [F5] to acknowledge and continue.



- 8.1.2.15. The STABILIZATION screen, shown below, will be displayed. This screen will be displayed while the engine is in the stabilization mode and will automatically advance to the acquisition mode when the engine is thermodynamically stable. The length of time this screen is displayed will vary according to the quality of the data being collected. Note the P/Set: 1 indicates this is the first of the five power point settings.

Model 4040 VIPER Analyzer			
Stabilization			
P/Set : 1			
Time : 0:05			
Scans : 52			
N1	91.55	N2	89.09
Percent		Percent	
ITT	918.00	FuelFlow	220.00
Deg C		lb/hr	
PrsAlt	750.96	OAT	21.50
Feet		Deg C	
PLA	122.00	PT2	20.00
Deg		psia	
TT2	25.00		
Deg C			

When the analyzer switches to the Acquisition mode, the header at the top of the screen will indicate “Acquisition” and the data quality indications, ACCEPTABLE, QUESTIONABLE and UNRELIABLE will be shown to the right of the P/Set indication. The normal time required for acquiring each point is one minute. If data quality dictates, the scan period may be extended until the required number of acceptable data samples is acquired.

Model 4040 VIPER Analyzer			
Acquisition			
P/Set : 1		Acceptable : 2	
Time : 0:11		Questionable : 0	
Scans : 110		Unreliable : 0	
N1	91.55	N2	89.09
Percent		Percent	
ITT	918.00	FuelFlow	220.00
Deg C		lb/hr	
PrsAlt	750.96	P2.35	30.00
Feet		psig	
T2.35	28.00	P3	40.00
Deg C		psig	
T3	35.00	TFuel	21.50
Deg C		Deg C	

When acceptable data is acquired, the screen will automatically display the review screen shown below. As indicated at the bottom of the screen, use the [LEFT ARROW] and [RIGHT ARROW] keys to select data points. Press the [BACKUP] key to retake this power set point or press [ENTER] to accept this data and continue.

Model 4040 VIPER Analyzer			
P/W Set 1 Pt 1			
Data Quality: Acceptable			
N1 %	: 91.31	TTZ	: 25.00
NZ %	: 89.09	N1StdDv	: 0.00
ITT	: 918	P2.35	: 30.00
OAT	: 21.50	T2.35	: 28.00
PrsAlt	: 751	P3.0	: 40.0
FuelFlw	: 220.0	T3.0	: 35.0
PLA	: 122.00	TFuel	: 21.50
PTZ	: 20.00		
Use <> to select data point			
Press BACKUP to retake power set			
Press ENTER to accept			

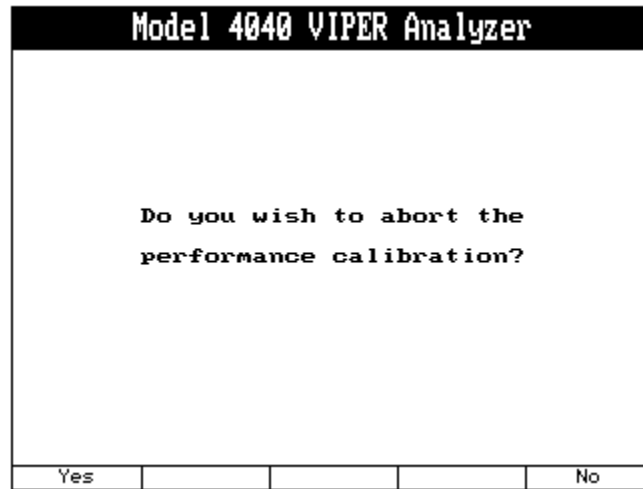
- 8.1.2.16. The Cockpit Readings screen, as shown in the example below, will be displayed. The fields immediately to the right of the N1, N2 and ITT names will be blank. Use the analyzer keypad to enter the values as indicated by the cockpit instruments. Use the [UP ARROW] or [DOWN ARROW] key to move between fields. When all fields are complete, press the [ENTER] key to accept and continue. The screen will then return to the acquisition screen shown above in 8.1.2.17 with the P/Set indicating the next sequential point number. The process then repeats for each of the five points until all data is collected.

Model 4040 VIPER Analyzer	
Cockpit Readings	
Cockpit N1 (% max)	: 91.50
Cockpit NZ (% max)	: 89.15
Cockpit ITT (Deg C)	: 922
Enter Cockpit readings	
Press ENTER to continue	

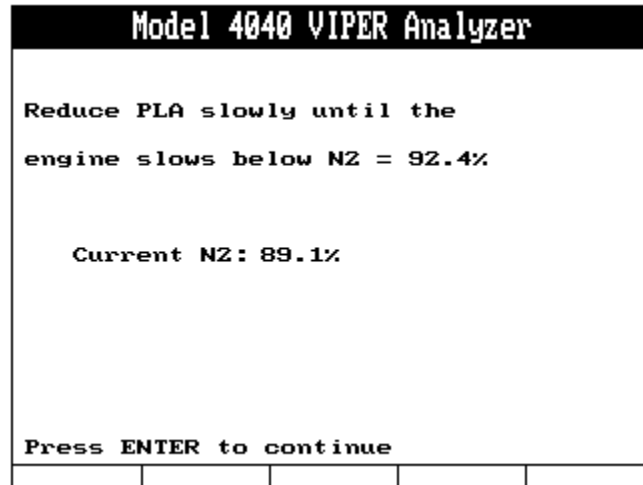
8.1.3. Information Screens

- 8.1.3.1. During data collection, you may encounter one or more of the screens shown below. Each screen is displayed if certain events occur. The first of these is "Do you wish to abort the performance calibration?" You will encounter this screen if the PLA is moved during the data acquisition phase; the PLA potentiometer is producing noise levels above the pre-set allowable level. In either case, there are

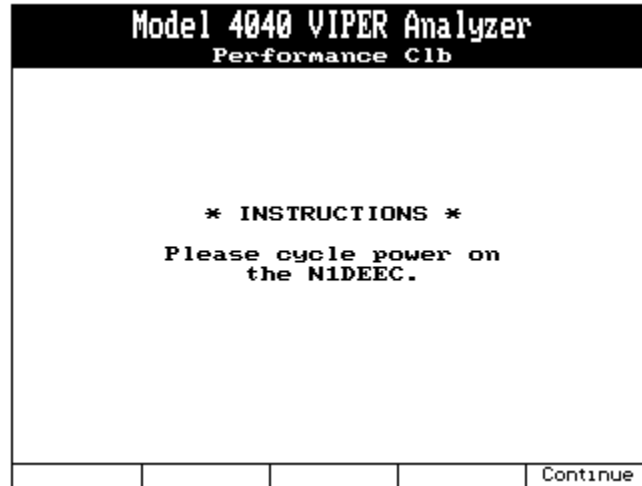
two possible answers “Yes” or “No” that may be selected by pressing either the [F1] or [F5] key, respectively.



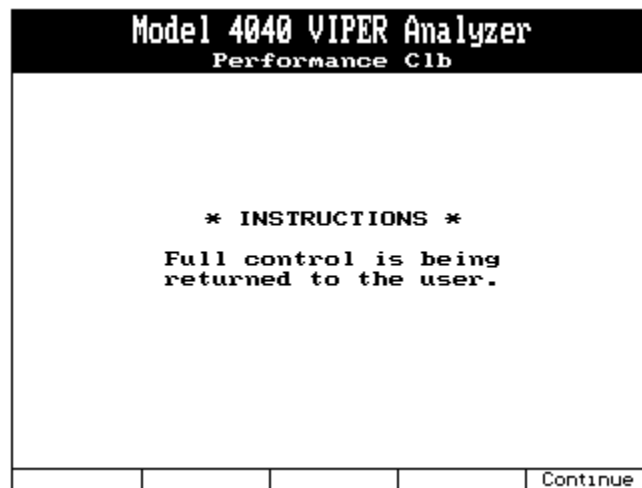
- 8.1.3.2. The Information screen below, “Reduce PLA slowly until the engine slows below N2 = XX.X%” indicates that you have either selected the [F1] “Yes” answer from the screen above, or you have completed data acquisition and terminating the job. This screen directs actions that are required in order to return normal control to the N1 DEEC computer. As indicated, the PLA must be reduced to a point equal to or less than an N2 indication of 92.4%. When the required speed is attained, press [ENTER] to continue the process.



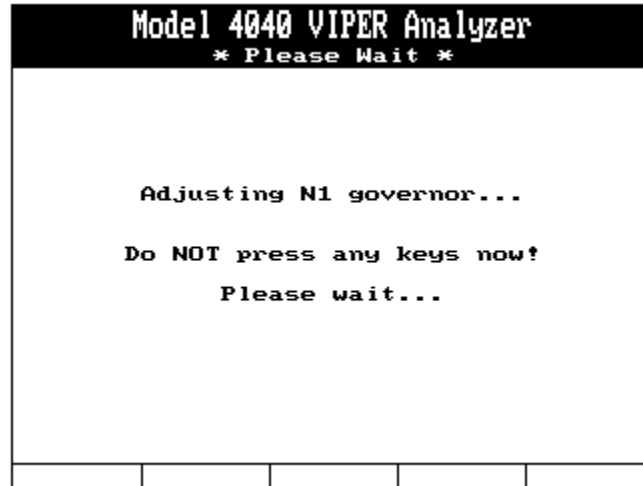
- 8.1.3.3. The screen below will be displayed as a last action to be completed for returning control of the engine to the N1 DEEC computer and the operator. As indicated, cycle the N1 DEEC power to complete the procedure. Press the [F5] “Continue” key to acknowledge and continue.



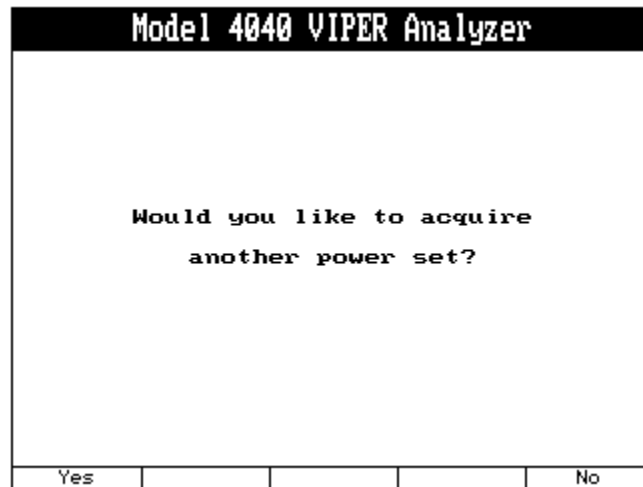
- 8.1.3.4. The information screen below confirms that control of the engine has been returned to the N1 DEEC computer and the operator.



- 8.1.3.5. The information screen below will be displayed each time the Viper 4040 is adjusting power for the next point. As stated in the message, you should not attempt to press any keys during this process. You should also not move the PLA, activate or deactivate any aircraft systems that would change the power setting of the engine. This screen is active only when conducting calibration runs on N1 DEEC equipped engines.



- 8.1.3.6. The information screen below will be displayed following the collection of data from the fifth point of a calibration run. A minimum of five points are required, however, the analyzer will allow you to acquire an additional seven points if you so desire. If you answer “YES” to the screen below, you must then define the parameters of the additional points and manually make power adjustment for the additional points, even when the engine computer is an N1 DEEC.



- 8.1.3.7. The information screen below will follow the screen above in paragraph 8.1.3.6 if you answer “Yes” in that screen. In this case, move the PLA to the desired power point and press the [F5] key to continue collecting data.



- 8.1.4. Getting the latest software. As modifications, additions, and changes are made to the EMS program, the Application running in your analyzer will change. To check the currency of your application software, contact ACES Systems or visit our web site at <http://www.acesystems.com/applications.htm> and look for the Viper 4040. You may download the latest application at this location. The site is updated during the first week of each month. The application software can also be delivered to you via E-mail or on CD in special cases.