

Capability Guidelines for Computer Controlled Test  
Equipment for Hydraulic Components

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### 1. SCOPE:

#### 1.1 Scope:

This SAE Aerospace Recommended Practice (ARP) establishes software capability guidelines for computer controlled test equipment, hereinafter referred to as automatic test equipment (ATE), for testing hydraulic components. A typical ATE system is shown in Figure 1. The items herein have been selected as potential features which may or may not be applicable to a particular application. This document does not address software development requirements, qualification procedures, or hardware design requirements, but encourages users to refer to existing documents, defined in 2.1.1, for guidance on such issues.

#### 1.2 Field of Application:

It is anticipated that this document will be used as an aid and/or guideline for aerospace support equipment engineers, who are either designing ATE for hydraulic components or preparing design/procurement specifications for such equipment. In this document, "shall" denotes a requirement while "may" denotes a typical implementation. Because of the interdependency between system software and hardware and software requirements, it is anticipated that users of this document will separately establish the ATE hardware requirements.

NOTE: Hardware specification should specify operator input/output (I/O) devices, such as, but not limited to, graphics compatible printer, plotter, high resolution monitor, touchscreen, sealed keypad, floppy disk drive, RS-232 or IEEE-488 I/O ports. Such hardware features affect software requirements.)

### 2. REFERENCES:

#### 2.1 Applicable Documents:

The following publications form a part of this specification to the extent specified herein. The applicable issue shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. Users of this document are encouraged to review and reference the appropriate sections of the following documents, as appropriate to the specific applications.

#### 2.1.1 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2165	Testability Program for Electronic Systems and Equipment
DOD-STD-2167	Defense Systems Software Development
DOD-STD-2168	Defense Software Quality Assurance
MIL-HDBK-287	Defense System Software Development Handbook

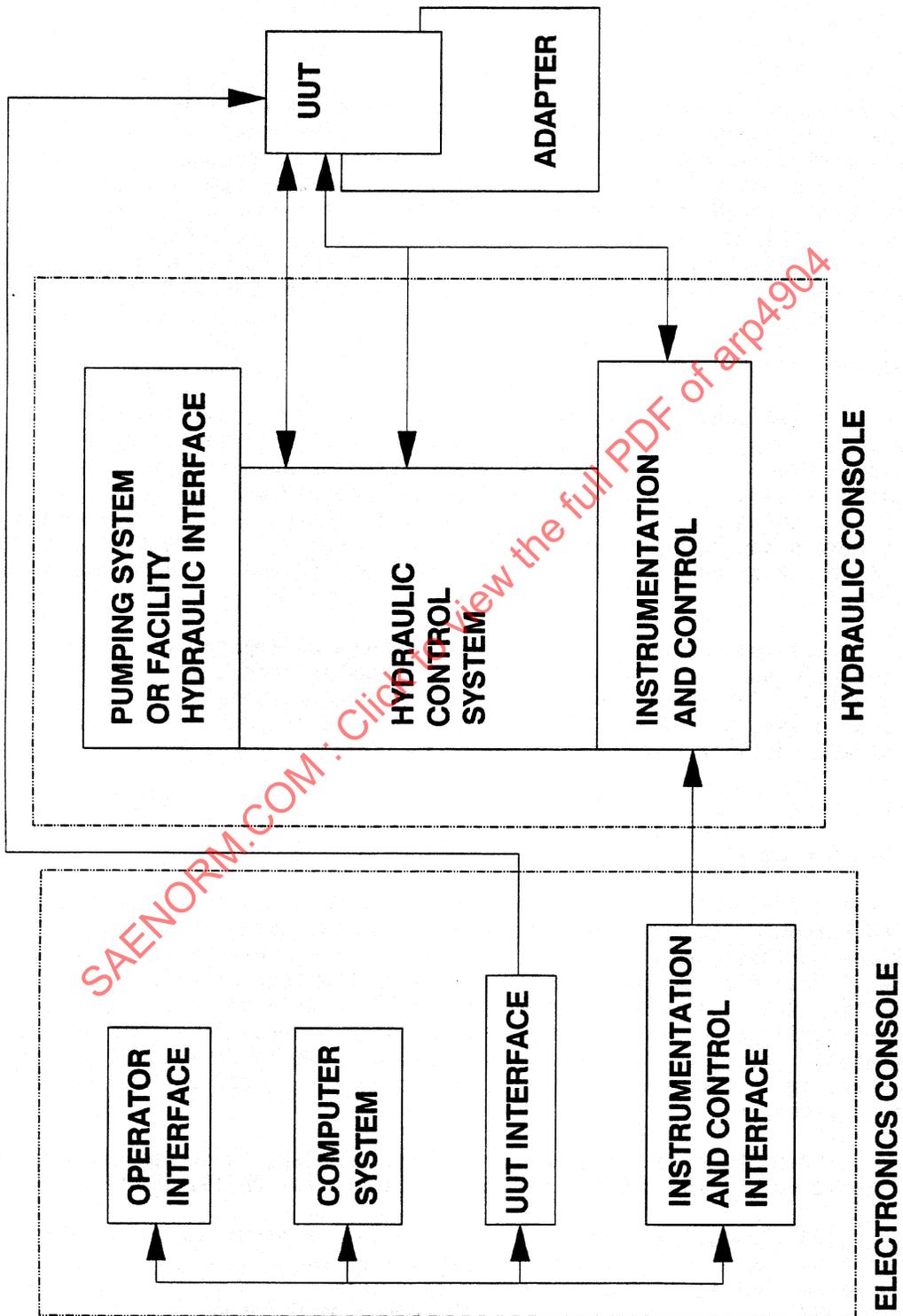


FIGURE 1 - Typical ATE System Diagram

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### 2.2 Definitions:

- 2.2.1 **UNIT UNDER TEST (UUT):** UUT is defined as a component tested on the ATE. UUT testing may require the use of electrical, mechanical and/or hydraulic adapters in order to interface the UUT to the ATE.
- 2.2.2 **AUTOMATIC MODE:** The automatic mode is defined as that mode in which the operator can test a UUT from start to finish, by initiating a preprogrammed test sequence. Any interruptions in this mode, which require operator intervention (i.e., external leakage measurement, etc.), shall be minimized and should be approved by the customer.
- 2.2.3 **SEMIAUTOMATIC MODE:** The semiautomatic mode is defined as that mode in which the operator is able to select and initiate a subset of the automatic mode tests. The semiautomatic mode provides the operator with the flexibility to perform portions of the preprogrammed test sequences as desired by the user.
- 2.2.4 **MANUAL MODE:** Manual Mode is defined as that mode in which the operator is able to command, control, and communicate with the ATE system devices and the UUT, through the computer via an operator interface system. The manual mode enables the operator to directly control, configure and acquire data from any system device (i.e., transducers, solenoids, servovalves, latches, I/O devices, etc.), independent of the automatic or semiautomatic operation. Manual mode allows the creation of unique UUT test programs in which the operator may select various equipment configurations and test parameters.
- 2.2.5 **UUT PERFORMANCE VERIFICATION (PV) TEST:** Performance verification test is defined as the sequence of UUT individual tests, the results of which verify that the UUT is fully operational and meets all of its performance requirements.
- 2.2.6 **UUT INDIVIDUAL TEST:** An individual test is defined as a sequence of operations which verify either a single UUT performance requirement or a set of similar UUT performance requirements. To maximize utilization of acquired data and reduce test time, it may be advantageous to perform several UUT individual tests simultaneously. In such cases, tests can be combined into a single test module, which can be initiated by the operator. This type of module is also called an individual test. An example is a linear variable differential transformer (LVDT) test module, which performs specific individual tests to determine several performance parameters, including Null voltage, scalefactor, linearity and tracking, based on a single set of acquired data.
- 2.2.7 **UUT DIAGNOSTIC FAULT ISOLATION (DFI) TEST:** DFI test is defined as the sequence of UUT individual tests, the results of which identify failed component(s) in the UUT.
- 2.2.8 **APPLICATION SOFTWARE:** Application software is defined as those high-level software programs which accomplish ATE functional tasks. Examples include self-test, calibration, and UUT tests. In the scope of this document, the computer processor operating system is not considered application software.

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- 2.2.9 **ON-LINE HELP:** On-line help is defined as a function, that is available to the operator during ATE operation, which provides the operator with additional informative and instructional messages to facilitate ATE operation and maintenance.
- 2.2.10 **USER-SELECTABLE:** User-selectable is defined as a function descriptor which requires that the system provide the operator with a predefined set of options, within the ATE hardware constraints, for that function. An example would be allowing the operator to select the state (ON/OFF) of a solenoid.
- 2.2.11 **USER-SPECIFIABLE:** User-specifiable is defined as a function descriptor which requires that the system allow the operator to specify a particular parameter, within the ATE hardware constraints, for that function. An example would be allowing the operator to specify the pressure regulation set point for a hydraulic port.
- 2.2.12 **OPERATOR:** Operator is defined as that individual who is selecting, initiating and executing ATE functions relating to UUT test.
- 2.2.13 **USER INTERFACE:** User Interface is defined as the means by which the operator communicates with the ATE and the UUT. User interface comprises both the hardware (including monitor, plasma tube, keypad, keyboard, function buttons, printer, plotter, touchscreen, audible alarms, and annunciator lights as appropriate for the application) and software (including software for prompting, selecting menus and displaying and formatting of test results).
- 2.2.14 **CONFIDENCE TEST:** Confidence test is defined as a brief ATE self-test performed during ATE initialization. Confidence test shall include a gross check of all ATE power supplies and digital/analog instrumentation for reasonable values and a verification that all I/O devices have been properly initialized. Specific conditions which may be checked during the confidence test include excessive analog instrumentation offsets, shorts, grounds, and opens. As a design goal, the system should be able to perform a confidence test with the UUT connected to the test system.
- 2.2.15 **PRIMARY FAILURE:** Primary failure is defined as a failure, reported by the system software, that is related to a fault in the ATE which could result in damage to the ATE, UUT or operator.
- 2.2.16 **RUN-TIME FAILURE:** Run-time failure is defined as a software event which occurs during the execution of an application program whenever the program attempts to perform an operation which is outside the realm of anticipated operation. Examples of run-time failures include divide, case, arithmetic, heap and string overflows, and range errors. In many instances, such errors result from the processing of ill-conditioned or faulty test data.
- 2.2.17 **USER:** User is defined as that group who operates the ATE. Users include operators, maintainers, calibration technicians, and software development engineers. Specific users may be limited in terms of their ability to access certain ATE capabilities. For example, a UUT test operator may be unable to access calibration applications.

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2.2.18 IDLE MODE: Idle mode is defined as that mode of operation in which the ATE system remains in its last commanded configuration state. The only operations which the ATE system shall perform in the idle mode shall be fault monitoring and the operation of parameter displays. User input shall be required to exit from the idle mode. The Idle mode may also remove power and vent trapped pressure from the hydraulic system as an additional safety feature, if appropriate.

### 2.3 Acronyms:

ARP	Aerospace Recommended Practice
ATE	Automatic Test Equipment
ATP	Acceptance Test Procedure
BIT	Built-In-Test
CPU	Central Processing Unit
DFI	Diagnostic Fault Isolation
IEEE	Institute of Electrical and Electronic Engineers
I/O	Input/Output
LVDT	Linear Variable Differential Transformer
NIST	National Institute of Standards and Technology
PV	Performance Verification
P/N	Part Number
UUT	Unit Under Test

### 3. TECHNICAL REQUIREMENTS:

#### 3.1 General Requirements:

The application software shall provide the computer control capability to support UUT testing and system maintenance. A typical software system is illustrated by Figure 2. The application software shall include the following:

##### a. System Control

- (1) User Interface
- (2) System Boot/Initialization
- (3) Generic Driver Programs
- (4) Failure Monitors
- (5) Runtime Options

##### b. System Support

- (1) Self-test
- (2) Calibration
- (3) Utilities
- (4) Manual Mode
- (5) Software Support and Development Programs

##### c. UUT Testing

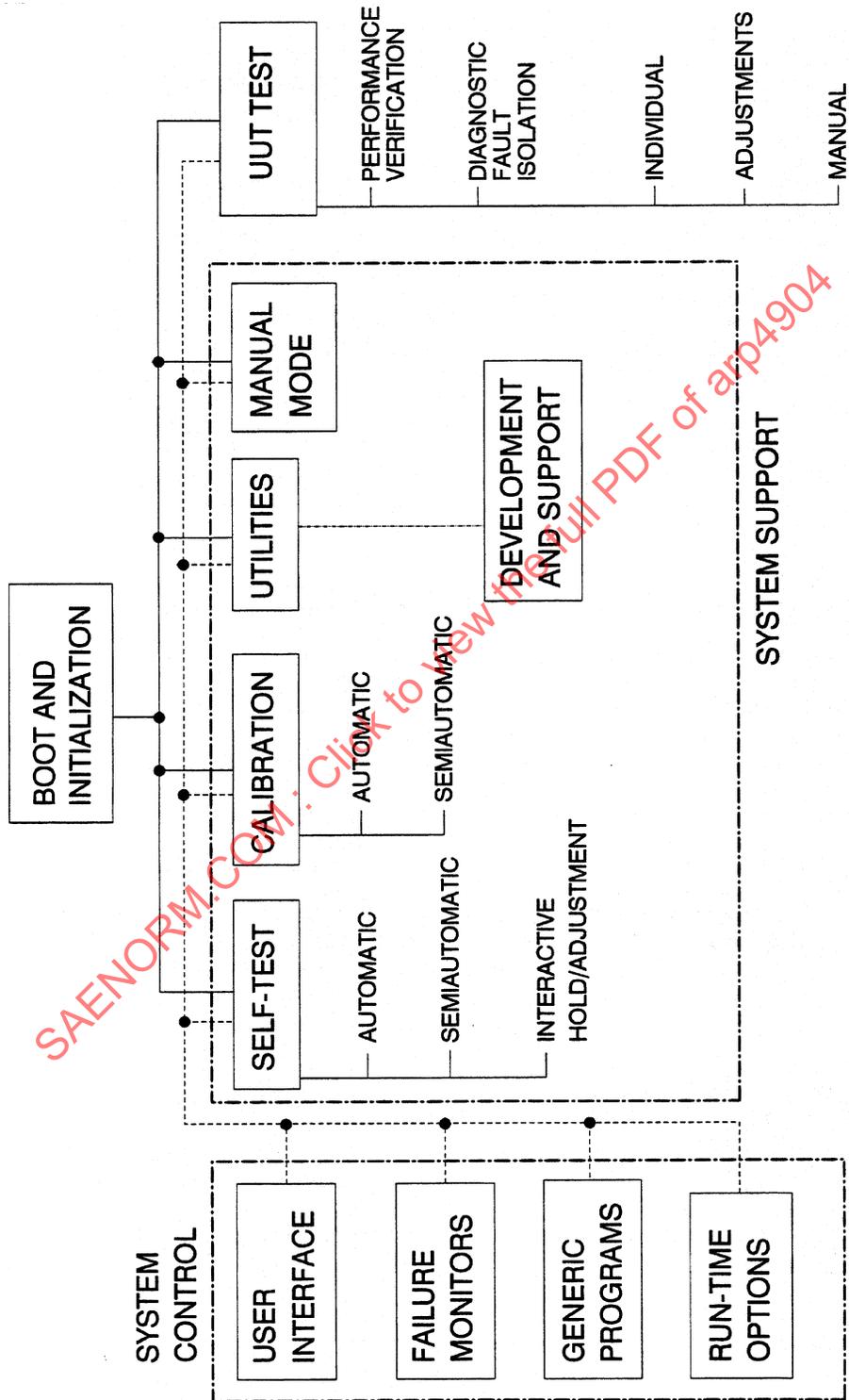


FIGURE 2 - Typical ATE Software Architecture

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### 3.2 System Control:

System control software shall include all software not discretely selected by the user (i.e., boot-up and initialization routines, generic drivers and failure monitors).

- 3.2.1 User Interface: The user interface routines provide the ATE system with the means to communicate with the operator via the ATE hardware devices. User interface routines may be menu driven.
  - 3.2.1.1 Menu System: The menu system shall enable the operator to conveniently access all system functions. Each menu shall have provisions to return to the highest level menu and to return to the previous menu. Each menu shall have a unique reference identifier, to facilitate documentation references.
  - 3.2.1.2 Discrete Function Keys: Routines to support discrete function keys shall be provided for those functions frequently used by the operator. In addition to specific function keys which may be required for specific applications, function keys may include the following: numeric keys (0-9), decimal point, minus, SHIFT, directional arrow keys, ENTER, TAB, ESCAPE, DELETE, BACKSPACE, SPACE, PAGE UP, PAGE DOWN. Capabilities for alphanumeric input shall be defined, if required.
  - 3.2.1.3 Warnings: The system shall support the use of audio and visual warnings on critical primary faults. The type of warning shall be compatible with the ATE operating environment. Visual warnings, such as a flashing display with emphasized characters, should be used in high noise areas. Specific characteristics of the warnings shall be approved by the user.
  - 3.2.1.4 Test Result Output: The system shall provide the operator with a display of all test results and a hard copy output option.
  - 3.2.1.5 Test-In-Progress Status Indicators: User interface software shall provide test-in-progress status indicators, to reflect program execution status. These indicators may either be descriptive or functional in nature.
    - 3.2.1.5.1 Descriptive Status Indicators: Descriptive indicators shall provide descriptive data to the operator regarding the program running on the ATE. These indicators may range from simple displays of the name of the UUT being tested and the test in progress to more complex displays which additionally display data to identify that portion of the test program currently being executed (in order to support troubleshooting, as required).
    - 3.2.1.5.2 Functional Status Indicators: Functional indicators shall provide a functional message to the operator regarding the operational status of the ATE. These indicators shall, as a design goal, enable the operator to delineate when the system is temporarily unable to respond to operator control (i.e., when ATE is locked-up).

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- 3.2.1.6 Parameter Displays: The user interface shall support permanent continuously updated parameter displays on those parameters deemed critical to ATE operation. An example of this would be a continually updating display of pressures, flow rates or temperatures in the UUT or ATE. Parameter display software may support a user-selectable parameter display capability. Display formats may be either digital or analog. Analog display formats (such as bar graphs or arrows) may be preferable for indicating direction and rate of parameter change.
- 3.2.2 System Boot and Initialization: The system boot/Initialization routines shall include all programs which configure the ATE after power-up until the operator is prompted for input. These routines shall not require operator input. Initialization shall conclude with the display of the main system menu. The routines shall perform the following tasks:
- a. Initialization of computer/CPU
  - b. Verification of memory integrity
  - c. Initialization of computer/CPU interrupt system
  - d. Initialization of I/O devices and system clocks
  - e. Initialization of failure monitors
  - f. Load main program into memory (if applicable)
  - g. Initialize operator interface
  - h. Run confidence test
- 3.2.2.1 Initialization Fault Processing: Faults detected during initialization shall be communicated to the operator in sufficient detail to support failure diagnostics. After processing a detected fault, the initialization routine shall continue to completion of initialization. As a design goal, the initialization routine shall support detection, prioritization and processing of multiple faults.
- 3.2.3 Generic Program: Generic Programs shall include all routines, procedures, and functions which are externally accessible by other software programs and have utility to other procedures. Generic programs shall make extensive use of low level hardware driver routines and common procedures. Generic programs are considered to be system resident programs, which are considered permanent and of general usage. Generic programs shall perform the following tasks:
- a. Control/configure discrete systems, I/O and devices
  - b. Control data acquisition functions
  - c. Numerical analysis routines
- 3.2.4 Failure Monitors: Failure monitors shall provide the system with ATE failure detection of both hardware and software (run-time) faults. As a design goal, this failure detection shall be provided in real time. The detection of primary failures shall immediately reset the system to a safe state, without operator intervention. Failure monitor software shall facilitate prioritization of failures and handle simultaneous failures. Failure monitors shall be structured so that each individual monitor may perform a particular procedure upon detection of that failure. All monitors shall, as a minimum, provide the operator with a positive identification of the failure. The customer shall approve and may define failure monitor conditions, their priority, detection time, and course-of-action upon detection of the condition.

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- 3.2.4.1 Failure Monitor Override Provisions: Failure monitor software shall have provisions so that nonprimary failures can be overridden by the operator, by a method to be approved by the customer.
- 3.2.4.2 Monitor Conditions: The following is a list of potential candidates for failure monitoring:
- a. Servoamplifier overcurrent
  - b. LVDT excitation overcurrent
  - c. Solenoid overcurrent
  - d. Reservoir low level detection
  - e. Filter contamination (for each filter)
  - f. Pump motor overcurrent/phase dropout
  - g. Fluid overtemperature
  - h. Air overtemperature
  - i. Run-time errors (i.e., range errors, divide/case/arithmetic/heap/string overflows.)
  - j. Instrumentation problems (i.e., flowmeter overspeed)
  - k. Configuration setting problems (i.e., setting control loop gains, achieving set pressure points, etc.)
  - l. Catastrophic pressure loss
- 3.2.4.3 Failure Diagnostics: Failure detection shall result in the system providing the operator with sufficient data to support isolation of the particular failure. Upon failure detection, the system shall record pertinent test stand configuration (state) data to support failure analysis and troubleshooting. As a design goal, the failure diagnostics should isolate to the failed component (replaceable item).
- 3.2.4.3.1 Run-Time Failures Diagnostics: Software run-time failures shall provide the operator with additional data related to that software which initiated the failure, in order to support diagnostics or isolation of the particular failure. As a design goal, Run-time failure diagnostics shall identify the specific section of code and the contents of relevant variable in the test program which initiated the run-time failure.
- 3.2.5 Runtime Options: Runtime options shall be provided to enable the operator to select ATE output format and the ATE's mode of operation. Runtime options shall include the following:
- a. Parameter display
  - b. Data output
  - c. Interactive hold/adjustment mode
  - d. Test interruption capability
  - e. Test resumption capability
  - f. Automatic mode
  - g. Semiautomatic mode
- 3.2.5.1 Parameter Display: The system shall support creation and deletion of user-selectable real-time parameter display(s).

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- 3.2.5.2 Data Output: The system shall support operator selection of data output for all tests. Specific format definition shall be provided by the customer. These output options include the following:
- Print actual performance data and limits
  - Print PASS/FAIL test status
  - Print failed tests only
  - Print failed components only
  - Cancel print jobs; no print
  - Display output and provide operator with option to print
  - Store output to data archive
  - Print detailed test data, including "raw" unprocessed data
  - Set performance data print to tabular or graphical format
  - Set graphical performance data print to autoscaling (to record all data) or user-specified scales
- 3.2.5.3 Interactive/Hold Adjustment Option: This option shall allow the operator to initiate an individual test and place the system in an idle mode prior to data acquisition by the test program. The goal of this option shall be to facilitate lower level fault isolation (i.e., component on a circuit card). The actual test parameter, as measured by the ATE, shall be displayed and continually updated to the operator, in real time until the operator presses a predefined function key. In addition, the program shall display to the operator the units of measurement, the name of the test, the step in the test, test limits scaled to match the displayed test parameter, and any adjustment device identifiers as appropriate. Subsequent depression of this function key shall advance program execution to its next step until the program is completed. This program shall facilitate manual troubleshooting of the item being tested, including interactive adjustments on devices where appropriate (i.e., trimpots, relief valves, servovalves, LVDTs, etc.). At the conclusion of the test, detailed results shall be made available to the operator.
- 3.2.5.4 Test Interruption Capability: The system shall enable the operator to interrupt the test in progress and either shutdown the ATE in a controlled fashion or place the ATE into a safe idle mode. As a design goal, this capability shall be available to the operator at all times during ATE operation. This capability should be provided by an easily accessible and prominently marked hardware device (i.e., large red panic button or keyboard interrupt).
- 3.2.5.5 Test Resumption Capability: The system shall support a test resumption capability in the event that a test was previously interrupted. The application software shall store all status flags, which are required for failure diagnostics in the event of test resumption after an interruption with minimal loss of time. When a test sequence is resumed, this option shall additionally provide the operator with the option to either resume the test in which the interruption occurred or begin execution of the next test in the sequence.
- 3.2.5.6 Automatic Mode: The automatic mode enables the operator to initiate a complete test sequence on an item (i.e., UUT test, self-test, or calibration). The automatic mode may have provisions for nonvolatile memory utilization to enable resumption of testing without repeating previously completed tests if the test sequence was interrupted due to hardware malfunction.

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3.2.5.7 Semiautomatic Mode: The semiautomatic mode enables the operator to initiate a single or group of individual test(s). If a group of tests are selected, this mode shall perform the tests in a sequence defined by the operator.

### 3.3 System Support:

System support functions shall provide the ATE with the high level application programs required to support self-test, calibration, utilities, and development software. System support functions may be delineated from system control functions in that they can be directly initiated by the operator.

3.3.1 Self-Test: Self-test shall perform all of the functional and performance tests required to verify the integrity of the ATE. Self-test shall utilize quantitative PASS/FAIL parameters in order to provide the operator with the ATE status. Commercial self-test programs may be utilized for resident off-the-shelf components. Self-test software shall provide the interface required to execute any commercial self-test programs/diagnostics on the commercial components within the system. Self-test shall provide the operator with either a positive PASS indication or a list of failed components, by reference designator, with their detailed (FAIL) test results. Self-test shall exercise all ATE functional components, with any deviations requiring customer approval. Self-test program shall be structured so that the most important components in the ATE architecture are tested first, and components which rely upon the performance of those primary items shall be tested subsequently. If a component fails and it is used to test other items within the system, the program shall not test those impacted items. The customer shall define the allowable level of fault isolation and the percentage of both the system which shall be tested and the failures which the Self-test program must successfully isolate. Self-test may be partitioned into sections which require and do not require operator intervention. Self-test shall make maximum use of generic programs. Because of the interdependency of self-test capability and hardware design, users of this document are encouraged to consider self-test and testability features, as defined in MIL-STD-2165, in the hardware design.

3.3.2 Calibration: The calibration program shall provide the operator with an easy-to-use method to calibrate and/or align all system transducers and signal measurement hardware. Prior to calibration of such devices, the program shall automatically perform electronics self-test. The calibration program shall provide all of the prompting required for calibration of the specific devices. New scalefactors shall be computed by the calibration algorithm. The calibration program shall prompt the operator within a customer-defined time period prior to the expiration of the system calibration period. If calibration period expires, the system shall indicate on all data reports that the equipment is out of calibration.

3.3.2.1 Calibration Algorithm: Calibration algorithm shall have the system (or operator, as appropriate) exercise the device across its range and compare its results against a calibrated measurement standard, traceable to the National Institute of Standards Technology (NIST). Operator shall input parametric data from the calibrated standard to the system, via a system hardware I/O device such as a keypad, until the device has been exercised across its range. The program will compare system data with the standard data and recompute the physical scalefactors, which relate device output to engineering units, to minimize nonlinearity and hysteresis errors from the standard. After the new scalefactors have been computed, the system shall print the following results: parameter, device, standard data, system data (using new scalefactors), error at each

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### 3.3.2.1 (Continued):

point, maximum error and the new scalefactors. The new scalefactors shall then be checked for reasonableness against nominal values, and if acceptable, stored in memory. If the values are not reasonable, the operator shall be provided with a positive indication of such and given the option to either use the new values, manually enter values or use default values. At the completion of calibration, the program may provide the user with a PASS/FAIL indication for each calibrated device. The system shall have provisions for multistage scalefactor storage such that an overall parameter measurement scalefactor is the product of the individual scalefactors of the device, amplifier and data acquisition stages. Minimization of device recalibration is desired in the event of failures in the signal conditioning stages. If device signal conditioning stages are replaced, the calibration software shall compensate for differences in characteristics of the signal conditioning so that overall measurement accuracy is unchanged. The calibration software shall provide the operator with the ability to revise the temperature compensation factors and algorithms for devices within the system.

3.3.3 Utilities: Utility functions shall enable the operator to perform those miscellaneous tasks required to support ATE operation, which are not included in another category. These tasks may include the following:

3.3.3.1 Formatting Storage Media: The utilities shall enable the operator to format disks, tapes and/or other media as required.

3.3.3.2 Downloading/Reloading Memory: The utilities shall enable the operator to download/reload all or selected parts of memory as required.

3.3.3.2.1 Downloading System Archive: The utilities shall enable the operator to download system archive data to an appropriate peripheral system I/O device.

3.3.3.2.2 System Backups: The utilities shall enable the operator to copy the system software in its entirety (backup).

3.3.3.3 Resetting System Calendar/Clock: The utilities shall enable the operator to reset the system clock and calendar.

3.3.3.4 Modifications To Test Parameters: This function shall enable the operator to modify the PASS/FAIL test limits and other system parameters, such as temperature compensation factors, proof pressure/external leakage test times or any other specific parameter defined by the customer.

3.3.3.4.1 Control of Modified Test Parameters: The customer shall specify the detailed control requirements for this function, including the following:

- a. Capability to permanently or temporarily modify parameters
- b. Capability to restore original parameters
- c. Method by which modified parameters are delineated to the operator
- d. Configuration control requirements for modified parameters

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- 3.3.3.5 Software Configuration Data: The system shall maintain and allow the operator to display software identification data on the application programs, in sufficient detail to uniquely identify those programs. The customer may define the specific software identification data (i.e., P/N, filename, version number, revision, release date, etc.) to be displayed by the system. The system shall also provide a software configuration verification method (i.e., checksum, cyclic redundancy code) that provides an audit vehicle to ensure that the software has not been modified.
- 3.3.3.6 System Input/Output Interface Characteristics: The system shall provide the operator with the means to reconfigure the hardware I/O interface, as defined by the hardware specification, to maximize interface flexibility. Typical I/O interfaces support communication with a network, printer, and/or modem.
- 3.3.3.7 Access to Operating System: The utilities shall enable the operator to exit the application programs to the operating system.
- 3.3.3.8 System Security: The utilities shall provide the means to prevent access to ATE capabilities. The utilities shall provide system security, as defined by the user, for each specified application. Protection criteria shall be controllable by the user.
- 3.3.3.9 On-line HELP: The utilities shall provide the operator with an on-line HELP function, which is accessible by the operator throughout the system software. The customer shall specify the scope of the on-line HELP support. On-line HELP functions may include the following:
- Instructional prompts for operator intervention tasks
  - Detailed Operating Instructions, including setup and teardown
  - Descriptive support data (detailed textual test descriptions and/or graphical schematic displays to reflect ATE configuration during testing)
  - Diagnostic data to support manual troubleshooting
  - Context sensitive electronic technical orders
  - On-line maintenance of the HELP database to reflect data developed through operator experience
- 3.3.4 Manual Mode: Manual mode shall provide the operator with the means to manually control all system devices. The manual mode shall enable the operator to control, configure and acquire data from any system device (i.e., transducers, solenoids, servovalves, latches, I/O devices, etc.). During data acquisition, manual mode shall enable the operator to acquire/display data continually, in real time, until a prescribed function key is pressed. The manual mode shall have provisions for controlling and testing a UUT.

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3.3.4.1 Manual Mode Features: Specific manual mode menu features shall include, but are not limited to, the following:

a. Hydraulic System Configuration

- (1) Subsystem configurations
  - (a) All functional/operational modes
- (2) Solenoid energization/deenergization
- (3) Pressure and flow servovalve control
  - (a) Step to set point
  - (b) Ramp to set point at specified rate
  - (c) Ramp input fixture position to set point
  - (d) Dynamic waveform definition for servovalve control

b. Measurement capabilities

- (1) Pressure transducers
- (2) Flowmeters
- (3) Temperature sensors
- (4) Force
- (5) Torque
- (6) Current
- (7) Voltage
- (8) Position
- (9) Velocity
- (10) Timebase

c. UUT Control Electronics Configuration

- (1) Command Generator: (all channels)
  - (a) Specify dynamic wave parameters (amplitude, frequency, DC offset) for sine, triangle and square waves. This should include options to run for a specified duration (number of cycles or time).
  - (b) Specify step or ramp parameters
- (2) LVDT Primary Function Generator: (all channels)
  - (a) Specify sine wave parameter (amplitude, frequency, maximum current).
- (3) Command attenuation setting
- (4) Channel selection (LVDT primary and EHV drive on/off)
- (5) Control loop closure (by feedback and by channel)
- (6) Solenoid channel energization/deenergization
- (7) Solenoid voltage level
- (8) Switching command signal to appropriate servoamplifier for closed loop operation
- (9) Forward path selection (DDV versus EHV)
- (10) Control loop gain characteristics