

IBM 9020D/E SYSTEM
ACCEPTANCE TEST CHECK LIST

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INTRODUCTION

This document contains the check list of recommended acceptance tests, descriptions, and data to be taken, for the IBM 9020D/E System.

The following terms are unique to the 9020D/E System, and definitions are presented below:

Active Elements and/or Units - elements and/or units which are performing the operating program's functions.

Diagnostic Monitor - The supervisory program used to control test programs and reconfiguration programs, and to handle the interrupt system, input/output facilities, and communication requirements of the IBM 9020D or 9020E System.

Malfunction - an error which recurs upon the next repeated runs of the same routine.

Redundant Elements and/or Units - elements and/or units which are free of malfunctions and available for program assignment.

State Zero - a state in which the test switch is operative and, therefore, when turned on, all manual controls may be used.

Transient Failure - an error which does not recur upon repeated runs of the same routine.

1.0 GENERAL

This check list defines the acceptance procedures and tests to be conducted by the International Business Machines Corporation for the Federal Aviation Administration on the IBM 9020D/E System.

The purpose of the acceptance test will be to establish that the equipment, in accordance with the procedures outlined herein, meets the requirements of applicable sections of specification FAA ER-606-063 and applicable amendments, thereof, specification FAA-ER-NS-100-1, and Contract No. FA64WA-5223.

The Factory Acceptance Test will be conducted at the IBM Systems Manufacturing Division facility in Kingston, New York. The Field Acceptance Test will be conducted after field installation.

2.0 REQUIREMENTS (Ref. ER063-4.1)

The procedures and tests outlined in this check list will be developed and performed by IBM personnel and approved by the FAA. The IBM Acceptance Test Group will assist the FAA observer(s) in the interpretation of test results and answer FAA questions.

2.1 Quality Inspection (Ref. ER 063-4.2.2 and 4.2.2.1)

All 9020D/E equipment and field location cables to be tested shall have been inspected and certified by IBM Quality Control prior to the Factory Acceptance Test. No extensive period of time for a FAA Quality Control inspection has been included in the 9020D/E System Acceptance test schedule. Certified IBM Quality Control reports should fulfill the Acceptance Test Quality Control requirements. However, the FAA may perform an inspection if so desired after system power has dropped in the System EPO test, Section 7.6. Quality Control personnel upon request from the FAA, will make available for review at our Kingston plant information regarding the quality status and/or specifications relating to the IBM 9020D/E System.

2.2 Test Program Documentation (Ref. ER 063-4.2.4)

Test programs used in the acceptance test will be documented with the following information:

- a. An English language description of each program and its purpose.
- b. An annotated symbolic listing of each program.
- c. Loading and operating instructions.
- d. Success and/or failure indication.
- e. Flow diagrams.
- f. Approximate running time.

All programs will be provided on magnetic tape except for Special System Tests which may be provided on punched cards.

2.3 Test Recording (Ref. ER 063-4.2.6)

A detailed procedure for recording test data, including the appropriate forms, will be provided by IBM.

2.4 Test Procedure Changes

The FAA shall have the right of approval of all acceptance test procedure changes. Approval of such changes is requested within two weeks after receipt of the change notice.

2.5 Maintenance (Ref. ER 063-3.8.2.2.2.1) and NS 100-3.0(5))

Normal routine maintenance will be permitted on tape drives and other peripheral equipment requiring periodic cleaning and/or adjusting.

Normal preventive maintenance will be allowable on the equipment during the acceptance test.

Corrective maintenance on equipment, which is not part of the active test configuration, will be performed when required. Redundant elements and/or units may be needed to assist in performing this corrective maintenance.

Program corrective maintenance will be allowed during the acceptance tests. Scheduling of necessary time and equipment will be mutually agreed to by IBM and FAA personnel.

2.6 Acceptance Test Report (Ref. ER 063-3.11.9)

The acceptance test report derived from the test data sheets will be submitted to the FAA within 30 days after completion of tests.

3.0 SCOPE OF ACCEPTANCE TEST

The 9020D/E System Acceptance Tests will be preceded by a familiarization and orientation period to review with the FAA observers the test specification procedures and agreements, and to become acquainted with the test facility, equipment layout, and IBM test personnel.

Equipment test set-up and operating procedures, common to most of the acceptance tests, will be described in the acceptance test specification to standardize the initial switch settings, panel indications, and Diagnostic Monitor initialization.

The Acceptance Test Specification will also contain appendices to supplement the various test procedures, and to supply required lists and drawings.

The recommended acceptance tests are briefly described in this section and further defined in Section 5.0 through 8.1.

For acceptance test purposes, the defined minimum system configuration is as follows:

9020D

- 1 Compute Element
- 1 Storage Element
- 1 I/O Control Element
- 1 Peripheral Adapter Module with 1052 Printer Keyboard
- 1 Tape Control Unit with Tape Drives
- 1 Storage Control Unit with Disk Storage Unit

9020E

- 1 Compute Element with 1052 Printer Keyboard
- 1 Storage Element
- 1 Display Element
- 1 I/O Control Element
- 1 Tape Control Unit with Tape Drive
- 1 DAU
- 1 RCU

The defined minimum configuration does not include the redundant elements and units, System Console (9020D), Configuration Console (9020E) with 1052 Printer Keyboard, and 2821 Control Unit and Read/Punch and Printer, but these elements and units are used with the configuration as required.

3.1 Subsystem Functional Tests

These tests will be a demonstration of element or unit operation under control of the Diagnostic Monitor, maintenance and operator panels, as listed in Section 5 of this document.

3.2 System Functional Tests

These tests will be a demonstration of:

- a. A 9020D/E System reconfiguration capabilities under program control (Manual reconfiguration will be utilized at all other times to alter a system configuration).
- b. 9020D/E integrated system operation using the System Evaluation Program (SEVA).
- c. Instruction timings verification, practical FLT application and System/360 - 9020D/E System compatibility.

3.3 Battery and Power

These tests will be a demonstration of element power loss, power return and battery operation.

3.4 Factory Acceptance Exercise (Ref. ER063-4.2.2.4)

This test will be a demonstration of System operation for a 48-to 120-hour period. For portions of this period, predetermined marginal check voltages will be applied to elements and units.

3.5 Test Schedule

The test schedules listed in Section 9.0 will be changed to permit a continuous sequence of testing when the next scheduled test, or portion thereof, must be delayed due to the temporary unavailability of the equipment to be tested.

The time allocated for each test in the acceptance test specification schedule, should be observed to prevent undue expansion of the acceptance test period; however, the expiration of a test's allocated time period does not necessarily constitute satisfactory completion of the test. For this reason, test rerun periods have been placed in the acceptance test schedules to allow for any required test reruns and/or test completions.

4.0 TEST ACCEPTANCE

The criteria for test acceptance or rejection shall be determined by the conditions and/or indications of each test. Upon successful completion of each subsystem or system test, the FAA observer will certify the results of that test. FAA and IBM, by mutual agreement, may discontinue testing.

4.1 Failure - Non - Deliverable Items (Ref. ER 063-3.2.2.1.2 and NS 100-3.8.5.1.2)

In the event of a failure of any of the following items the determination of whether or not the non-deliverable item caused the failure will be mutually agreed to by the FAA and IBM.

Failures determined to be caused by any of the following items will not constitute failure of the 9020D or E Systems.

- a. External equipment or facilities (power, simulators or environment).
- b. Supply items (magnetic tape, card, etc.).
- c. Those resulting from operator error, configuration error due to a manually initiated system set-up operation, or program set-up error.
- d. Non-deliverable cables used in the Factory Acceptance Test.
- e. Central Computer Complex equipment provided by the FAA.

4.2 Program Failures.

Program failures will not constitute a failure of an IBM 9020 D/E System Acceptance Test. However, the acceptance of the associated test will be dependent upon correction of the program failure and the successful demonstration of that test on the IBM 9020D/E Systems.

4.3 Recurring Transient Failures

Related transient failures which recur several times during the acceptance tests, and show a definite trend, will be classified as a recurring transient failure upon the mutual agreement of IBM and the FAA. IBM will submit for FAA approval, their recommended action to resolve the condition.

5.0 SUBSYSTEM FUNCTIONAL TESTS (Ref. ER 063-4.2.2.2 (b))

These tests will consist of test programs that check technical features, logic blocks, computer commands, and data transfer paths of individual elements or units. A single successful pass of a test program shall be considered an acceptable demonstration; however, if several transient failures are detected during a given test, the cause of such failures will be analyzed and reported to the FAA observer, and the tests rerun at his option.

In the event that a test program or a certain routine of a test program encounters a failure caused by the element or unit being tested, that test program or routine shall be rerun immediately.

If an error does not recur upon repeated runs of the same routine, the failure shall be classified a transient failure and the test shall be considered acceptable.

If an error recurs upon the next repeated run of the same routine, the failure shall be classified a malfunction and necessary corrective action shall be initiated. Testing of other elements or units may proceed while repairs are accomplished on the failing element or unit. Further testing of the element or unit that failed, including a rerun of the test program or routine that encountered the failure, will be completed during the time period allocated for such reruns. Several passes of the affected program shall be made for each rerun.

The failure of an element or unit in the required configuration, other than the element or unit being tested, shall require that a redundant element or unit be substituted for the failing element or unit, and testing resumed. The incident and the substitution shall be recorded in the test log.

5.1 Manual Functional Tests

5.1.1 Compute Element (CE) 7201-02 . This test will consist of a manual demonstration of the switches, controls and indicators on the CE control panel.

5.1.2 I/O Control Element (IOCE) 7231-02. This test will consist of a manual demonstration of the switches, controls and indicators on the IOCE control panel.

5.1.3 Storage Element (SE) 7251-09. This test will consist of a manual demonstration of the switches, controls and indicators on the SE test panel.

5.1.4 Storage Timing and Access Demonstration. A scoping demonstration will be given to verify the following:

- a. The time between selects while interleaving storage is no greater than 400 nanoseconds.
- b. The storage cycle time does not exceed 800 nanoseconds.

The demonstration will be considered acceptable when the above stated timings have been verified on a calibrated oscilloscope for all Storage Elements.

5.1.5 Display Element (DE) 7289-04. This test will consist of a manual demonstration of the switches, controls and indicators on the DE test panel.

5.1.6 Display Element Timing Demonstration. A scoping demonstration will be given to verify the following:

- a. The time between Selects while interleaving storage is no greater than 400 nanoseconds.
- b. The storage cycle time does not exceed 800 nanoseconds.
- c. The time between Refresh pulses is 18.2 milliseconds (55 Hz Refresh Rate).
- d. While processing images of greater than 18.2 milliseconds, the image will be restarted within 21.6 microseconds.
- e. A quadword access is made available to each CVG once every 21.6 microseconds.

The demonstration will be considered acceptable when the above stated timings have been verified on a calibrated oscilloscope for all Display Elements.

5.1.7 System Console (SC) 7265-02. This test will consist of a manual demonstration of the switches, controls and indicators on the SC test panel and a manual demonstration of the SC/SMMC Interface.

5.1.8 Configuration Console (CC) 7265-03. This test will consist of a manual demonstration of the switches, controls and indicators on the RCU and SCCU test panels and a manual demonstration of the CC/SMMC Interface.

5.1.9 Peripheral Adapter Module (PAM) 7289-02. This test will consist of a manual demonstration of the switches, controls and indicators on the PAM test panel.

5.1.10 Storage Control Unit (SCU) 2314 and Associated Disk Storage Units. This test will consist of a manual demonstration of the switches, controls and indicators on the SCU Operator's Panel and Unit Test Panel.

5.1.11 Tape Control Unit (TCU) 2803-1 and Associated Tape Drives. This test will consist of a manual demonstration of the switches, controls and indicators on the TCU test panel.

5.1.12 Integrated Control Unit - Read/Punch and Printer. This test will consist of a manual demonstration of the 2540 Read/Punch and the 1403 Printer using the I/O Tester.

5.1.13 Printer Keyboard (1052). This test will consist of a manual demonstration of the switches, controls and indicators on the 1052 test panel.

5.1.14 Data Adapter Unit (DAU) 2701. This test will consist of a manual demonstration of the 2701 Data Adapter Unit using the I/O Tester.

5.2 Program Functional Tests

5.2.1 Compute Element (CE) 7201-02 (Ref. ER 063-4.2.2.2). Configuration will be set for the defined minimum system. The Diagnostic Monitor will be loaded from tape and initialized for the CE tests.

The test programs will be run sequentially.

5.2.1.1 Functions Tested. Upon completion of the test, the CE will have been checked for:

- a. Proper execution of computer instructions.
- b. Proper operation of CE control logic.
- c. Ability to load, set and translate its Address Translation Register.
- d. Ability to load, set and test the Address Translation Register of the IOCE.
- e. Ability to communicate with all storage and display elements.
- f. Ability to control interrupts from the IOCE.

5.2.1.2 Functions Not Tested. Upon completion of the test, the CE will not have been checked for:

- a. Ability to communicate with other CE's.
- b. Ability to communicate with PAM's, SCU's, TCU's and RCU's.
- c. Ability to control all IOCE's.

All items listed as not tested during the Subsystem Test of the CE's will be checked by System Functional Test (6.0).

Each CE in turn will be configured into the system and tested as specified above.

5.2.2 I/O Control Element (7231-02) Selector Channels, Channel-To-Channel Adapter (CTC), Storage Control Unit/Disk Storage Units (2314/2312), Tape Control Units/Tape Drives (2803/2401) (Ref. ER 063-4.2.2.2). The configuration will be set for the defined minimum system.

The Diagnostic Monitor will be loaded from tape and prepared for tests of the IOCE selector channels, CTC Adapter, SCU's and DSU's, TCU's and Tape Drives.

The test programs will be run sequentially.

5.2.2.1 Functions Tested. Upon completion of these tests, the following items will have been checked:

- a. Proper operation of the Selector Channels.
- b. The ability of the IOCE to communicate with a CE.
- c. The ability of the IOCE to communicate with a SE.
- d. The ability of the IOCE to communicate with a Storage Control Unit and Associated Disk Storage Units.
- e. The ability of the IOCE to communicate with a TCU and associated tape drives.
- f. Proper operation of I/O instructions and commands associated with selector channels.
- g. Proper operation of SCU's, including dual interface.
- h. Proper operation of DSU's.
- i. Proper operation of TCU's, including dual interface.
- j. Proper operation of Tape Drives.
- k. Proper operation of Channel-To-Channel Adapters.

5.2.2.2 Functions Not Tested. Upon completion of these tests, the following items will not have been checked:

- a. The ability of each IOCE to communicate with each SE.
- b. The ability of each IOCE to be controlled by each CE.
- c. The ability of the IOCE's to communicate with PAM's DAU's and RCU's.
- d. Proper operation of the IOCE Multiplexor Channel.

Each IOCE and each SCU and its associated DSU's and TCU and its tape drives will be tested as specified above. Items a and b will be checked by System Functional Tests (6.0).

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Items c and d will be checked by subsystem tests of PAM (5.2.8), DAU (5.2.11), RCU (5.2.7) and Multiplexor Chan. (5.2.3).

5.2.3 I/O Control Element (7231-02) Multiplexor Channel. Configuration will be set for the defined minimum system. The Diagnostic Monitor will be loaded from tape and prepared for tests of the IOCE Multiplexor Channel.

The test programs will be run sequentially.

5.2.3.1 Functions Tested. Upon completion of these tests, the following items will have been checked.

- a. Proper operation of the Multiplexor Channel.
- b. The ability of the IOCE to communicate with an I/O device attached to the Multiplexor Channel.
- c. Proper operation of I/O instructions and commands associated with the Multiplexor Channel.

5.2.3.2 Function not Tested. Upon completion of this test, the IOCE will not have been checked for:

- a. Ability to communicate with a PAM, DAU and RCU.

The item listed as not tested during Subsystem Tests of the IOCE's will be checked by Subsystem Tests of PAM (5.2.8), DAU (5.2.11) and RCU (5.2.7.2).

5.2.4 Storage Element (SE) 7251-09 (Ref. ER 063-4.2.2.2). Configuration will be set for the defined minimum system. The Diagnostic Monitor will be loaded from tape and prepared for the SE test. The SE test programs will be run sequentially.

5.2.4.1 Functions Tested. Upon completion of the tests, the SE will have been checked for:

- a. Ability to access each storage address of the SE.
- b. Ability to store and retrieve data.
- c. Ability to communicate with a CE and IOCE.
- d. Proper operation of the storage protection function.

5.2.4.2 Functions Not Tested. Upon completion of the tests, the SE will not have been checked for:

- a. Ability to communicate with all IOCE's and CE's.

The item listed as not tested during Subsystem Tests of the SE's will be checked by the System Functional Tests (6.0).

Each SE in turn will be configured into the system and tested as specified above.

5.2.5 Display Element (DE) 7289-04 (Ref. ER 063-4.2.2.2). Configuration will be set for the defined minimum system. The Diagnostic Monitor will be loaded from tape and prepared for the DE Test. The DE test programs will be run sequentially.

5.2.5.1 Functions Tested. Upon completion of the tests, the DE will have been checked for:

- a. Ability to access each storage address of the Display Element.
- b. Ability to store and retrieve data.
- c. Ability to communicate with a CE.
- d. Proper operation of the storage protection function.
- e. Ability to communicate with a CE via the Wrap operation.

5.2.5.2 Functions Not Tested. Upon completion of the tests, the DE will not have been checked for:

- a. Ability to communicate with all CE's.

The item listed as not tested during Subsystem Tests of the DE's will be checked by the System Functional Tests (6.0).

5.2.6 System Console (SC) 7265-02 (Ref. ER 063-4.2.2.2). The system configuration will consist of all available elements and units. These elements and units will not be functionally checked at this time, but will provide status, configuration, and logic check indications while running the System Console test program.

The Diagnostic Monitor will be loaded from tape and prepared for the console check.

The console test program will be run sequentially from each CE with operator interventions required.

Since parts of the System Console test program will not be self-checking, a visual comparison of the console indicators against the program listing or output printout will be necessary to insure a successful pass.

5.2.6.1 Functions Tested. Upon completion of the above tests, the following console functions will have been checked:

- a. Initial program loading.
- b. Manual entry and display of data in main and local storage, utilizing console keys and switches.

- c. Modification of data in main or local storage, CE configuration control register (SCON bits) and instruction address register utilizing console keys and switches.
- d. I/O Select switches for Read/Punch, Printer and Printer/Keyboard.
- e. Audible alarms.
- f. Indicators as follows:
 - 1. Unit Status
 - 2. CE Manual Status
 - 3. CE Wait Status
 - 4. Configuration Register
 - 5. Storage Data Register
 - 6. Instruction Address Register
 - 7. Invalid Selection
 - 8. Mode of Operation

5.2.7 Configuration Console (CC) 7265-03 (Ref. ER 063-4.2.2.2).

5.2.7.1 System Console Control Unit. The system configuration will consist of all available elements and units. These elements will not be functionally checked at this time, but will provide status, logic check, and configuration indications while running the System Console test program.

The Diagnostic Monitor will be loaded from tape and prepared for console check.

The console test program will be run sequentially from each CE with operator interventions required.

Since parts of the System Console test program will not be self-checking, a visual comparison of the console indicators against the output printout will be necessary to insure a successful pass.

5.2.7.1.1 Functions Tested. Upon completion of the above tests, the following functions will have been checked:

- a. Initial Program Loading.
- b. Manual entry of data in main or local storage, utilizing console keys and switches.
- c. Modification of data in main or local storage, CE configuration control register (SCON bits) and instruction address register utilizing console keys and switches.
- d. I/O Select switch for Read/Punch and Printer.
- e. I/O Interface Enable/Disable switch.

- f. Audible Alarms.
- g. Indicators as follows:
 1. Unit Status
 2. CE Manual Status
 3. CE Wait Status
 4. Configuration Register
 5. Storage Data Register
 6. Instruction Address Register
 7. Invalid Selection
 8. Mode of Operation

5.2.7.2 Reconfiguration Control Unit. Configuration will be set for the defined minimum system.

The Diagnostic Monitor will be loaded from tape and prepared for the RCU check.

The RCU test program will be run sequentially from each CE.

5.2.7.2.1 Functions Tested. Upon completion of the above tests, the following functions will have been checked:

- a. A pseudo-check of all RCU external interfaces.
- b. Read/Write Configuration.
- c. Handling of forced parity errors.
- d. Enabling masks.

5.2.7.2.2 Functions Not Tested. Upon completion of the tests, the RCU will not have been checked for:

- a. Ability of the RCU to communicate with all CE's.

The item listed as not tested during Subsystem Tests of the RCU's will be checked by the System Functional Tests (6.0).

5.2.8 Peripheral Adapter Module (PAM) 7289-02 (Ref. ER 063-4.2.2.2). Configuration will be set for the defined minimum system.

The Diagnostic Monitor will be loaded from tape and prepared for tests of the Peripheral Adapter Module.

5.2.8.1 Functions Tested. Upon completion of these tests, the following functions will have been checked:

- a. The ability of the IOCE to communicate with a PAM.
- b. Proper operation of PAM common circuitry.

- c. Proper operation of the Test and Monitor adapter.
- d. Proper operation of other adapters using the Test and Monitor adapter.
- e. Proper operation of test and error forcing commands.

5.2.8.2 PAM Dual Interface Test. The configuration will be set for the defined minimum system plus one additional PAM. This test will check the Pass Address feature of the PAM's and the IOCE's ability to communicate with both its primary and secondary PAM's.

5.2.8.3 Functions Not Tested.

- a. PAM's ability to communicate with all CE's.
- b. System oriented peripheral devices will not be tested.

Each IOCE and each PAM and its adapters will be tested as specified above.

5.2.9 Control Unit (2821), Read/Punch (2540) and Printer (1403) (Ref. ER 063-4.2.2.2). Configuration will be set for the defined minimum system with the I/O device under test enabled to the configured IOCE.

The Diagnostic Monitor will be loaded from tape and prepared for the I/O devices tested.

Test programs will run sequentially on the Control Unit, Read/Punch and Printer.

Since print programs are not self-checking, a comparison of the printout against the program listing, will be necessary to insure a successful pass.

5.2.9.1 Functions Tested. Upon completion of the above tests, the following functions will have been checked:

- a. Proper operation of data paths, clocks, and counters in the 2821 Control Unit.
- b. Functional operation of 2540 Read/Punch.
- c. Functional operation of 1403 Printer.
- d. Interface lines between the System Console/ Configuration Console and the 2821 Control Unit.

5.2.9.2 Additional Tests for 2821 with a Two Channel Switch. The configuration will be set for the defined minimum system with the addition of a second IOCE.

The test program for the two channel switch feature will be run.

An additional test will be run to demonstrate the ability to drop power on the 2821 without the loss of data on the channel interface.

5.2.10 1052 Printer Keyboard (Ref. ER 063-4.2.2.2). Configuration will be set for the defined minimum system.

The Diagnostic Monitor will be loaded from tape and prepared for the printer keyboard tests.

Test programs will be run sequentially on all procured 1052's as part of the IBM 9020D/E System. Upon completion of these tests, the Patch Panel feature will be tested.

Since print programs are not self-checking, a comparison of the printout against the program will be necessary to insure a successful pass.

5.2.10.1 Functions Tested. Upon completion of the above tests, the following will have been checked:

- a. Proper operation of the associated 1052 adapters in the CE's or PAM's and the 1052 Control Unit in the System Console.
- b. Functional operation of the 1052 printer keyboards.

5.2.11 Data Adapter Unit (DAU) 2701 (Ref. ER 063-4.2.2.2). Configuration will be set for the defined minimum system. The Diagnostic Monitor will be loaded from tape and prepared for the DAU tests. The DAU test programs will be run sequentially.

5.2.11.1 Functions Tested. Upon completion of these tests, the following functions will have been checked:

- a. The ability of the IOCE to communicate with a DAU.
- b. Rejection of illegal commands.
- c. Reformatting of all valid DAU/RKM commands.

5.2.11.1 Functions Not Tested.

- a. Reconfiguration

The item listed as not tested during Subsystem Tests will be checked by the System Functional Tests (6.0).

5.2.11.2 Data Adapter Unit Two Processor Switch Test. The configuration will be set for the defined minimum system plus the second IOCE associated with the configured DAU. This test will check the ability of either IOCE to communicate with the DAU.

5.2.12 IOCE Diagnostic Mode Functional Demonstration. This test will demonstrate the ability of each IOCE to operate diagnostic programs.

Equipment required for this test will be:

- 1. IOCE
- 1 TCU
- 1 Tape Drive
- 1 1052

The Subsystem Diagnostic Monitor will be loaded from tape to run the diagnostic mode programs.

5.2.13 IOCE Processor Operation. Configuration will be set for the defined minimum system. The Diagnostic Monitor will be loaded from tape prepared for IOCE Processor Operation.

5.2.13.1 Functions Tested. Upon completion of the above test, the IOCE will have been checked:

- a. Ability to operate functional programs in IOCE Processor mode under the control of a CE.

5.2.14 Log-Out Demonstration. Configuration will be set for the defined minimum system.

The Diagnostic Monitor will be loaded from tape and a selected program operated. A log-out will be initiated by the LOG-OUT pushbutton and/or by an induced machine check. MDM will give a hard copy printout of the log-out data.

Since this test is not self-checking, a comparison of the expected results will be compared with the actual results to insure that correct log-out data was obtained.

5.2.15 FLT Functional Test. This test will check each CE's and IOCE's ability to functionally execute its Fault Locating Tests.

Equipment required for the IOCE tests will be:

- 1 IOCE
- 1 TCU
- 1 Tape Drive

Equipment required for the CE tests will be:

- 1 CE
- 1 SE
- 1 IOCE
- 1 TCU
- 1 Tape Drive

The FLT tests will be run on each CE and IOCE.

6.0 SYSTEM FUNCTIONAL TESTS (Ref. ER 063-4.2.2.2)

The system functional tests will consists of reconfiguration tests, integrated system operation tests using the system evaluation program, and special system tests.

6.1 Reconfiguration

Reconfiguration capability of the 9020D/E System will be demonstrated by the following four tests: (Ref. ER 063-4.2.2.4.2)

Test A CCR Operation and Signal Gating

Test B DAR/DMR External Interrupt Checks

Test C Input Message Reconfiguration Control

Test D Failure Detection Reconfiguration Control

6.1.1 Reconfiguration - Test A. The purpose of the Reconfiguration Test A program will be to demonstrate, under program control, the reconfiguration ability of all elements and units. This program will assure that communication can only be made between configured interfaces.

The configuration will be set to include all available elements and units of the 9020D/E System. This will avoid repeated program runs, and provide a better check of the various configuration combinations.

The Diagnostic Monitor will be loaded from tape and prepared for the Reconfiguration Test A program.

The reconfiguration ability of each element and unit will be checked by reconfiguring each element and unit both into and out of the active system.

Printout information will be matrix format printout indicating the results of reconfiguration tests.

The Reconfiguration Test A program will be considered acceptable upon completion of a single successful program pass, which may be indicated by either a success typeout or a program halt at the correct indicated location.

6.1.2 Reconfiguration - Test B. The purpose of the Reconfiguration Test B program will be to check the Diagnose Accessible Register (DAR) for proper bit setting of hardware generated external interrupts, and the DAR Mask Register (DMR) for proper masking of the interrupts.

The test configuration will include all available elements and units in State Zero Test switch "Off". The Diagnostic Monitor will be loaded from tape, and the DAR/DMR program loaded and run on the configured system. After the program has checked all available elements and units for proper storing and identifying of external interrupts, it will test OBS and/or OTC signals as they are manually caused in each element and unit.

Printout information will consist of any errors detected in either part of the program.

Reconfiguration Test B will be considered acceptable after each element and unit has successfully passed the automatic and manual intervention portions of the test.

6.1.3 Reconfiguration - Test C. The purpose of the Reconfiguration Test C program will be to demonstrate the ability of the system to reconfigure upon manual request. The configuration will be the defined minimum system. The Diagnostic Monitor will be loaded from a special system tape prepared for the Reconfiguration Test C.

After the program has completed a communication check of the configured interfaces, a reconfiguration request will be issued to the program by IBM personnel as directed by the FAA observer(s). Elements and units may be reconfigured into and out of the active system in any order; however, at no time during this test may the active system be less than the specified system. To assure that reconfiguration was successful, the program will attempt to communicate with the newly active elements and units.

Printout information will include the elements or units which become active, elements and units which become redundant, results of the communication checks, and the time required to reconfigure.

Reconfiguration Test C will be considered acceptable when each element and unit of each type has been successfully reconfigured into the active system. This test will be terminated at the end of the scheduled time period, provided successful reconfiguration of each element and unit has been accomplished. However, the FAA observer may stop the test sooner, at his discretion.

6.1.4 Reconfiguration - Test D. The purpose of the Reconfiguration Test D program will be to demonstrate, under program control, the ability of the system to reconfigure upon detection of a failing element. The configuration will be defined minimum system. The Diagnostic Monitor will be loaded from tape and prepared for the Reconfiguration Test D program.

The program will detect a simulated malfunction, isolate the malfunction to the failing element, reconfigure a redundant element into the active system, reconfigure the failing element into State Zero, and attempt to communicate with the newly active elements. At no time during this test may the configuration be less than the specified system.

Printout information will include the type of error, the element made active, the element that failed, and results of the communication check.

Reconfiguration Test D will be considered acceptable when an element of each type has been successfully reconfigured out of the active system upon detection of the simulated malfunction in that element, and redundant element reconfigured in its place.

6.2 Integrated System Tests (Field Only)

6.2.1 System Evaluation (SEVA) (Ref. ER 063-4.2.2.2). The purpose of this integrated system program is to exercise and test elements, units and computer oriented peripheral equipment in the maximum system configuration under control of the Diagnostic Monitor. Redundant elements and units will be available for manual reconfiguration as required.

The Diagnostic Monitor, in the maximum system configuration, will function as a cyclic program to control and operate SEVA test programs in a multiprogramming, multiprocessing mode. Periodic program results will be provided to record pass complete message, error data, and other pertinent information.

The maximum system configuration will be exercised for a duration type run. Therefore, it is recommended that at a fixed interval the program be stopped so that units designated as redundant may be substituted into the active system. In this manner, all system elements and units will operate as part of the system for a portion of the run.

Whenever a malfunction is detected in an active element or unit, the failing element or unit plus any additional system components deemed necessary for malfunction isolation and repair will be removed from the active configuration. IBM personnel will initiate corrective action on the element or unit that failed utilizing redundant elements for error diagnosis when necessary.

In the event that an active element fails, and an A-1 Equipment Mode cannot be maintained for the active configuration, the full system test will be interrupted. IBM personnel will diagnose, repair and check out a failed element before configuring the element into the active system, and resuming the test.

The maximum system configuration shall be exercised for a consecutive period of twelve (12) hours, of which 5 consecutive hours have been malfunction free.

6.3 Special System Tests

6.3.1 Eight Timed Sample Problem Test. The Eight Timed Sample Problems will be operated on a minimum system to verify that a 9020D/E Central Processor can adequately handle specific data-processing tasks at the required rates.

The Eight Timed Sample Problem Test will be considered acceptable if the true composite non-parallel CTAF, computed from the actual run time of the problems, does not substantially exceed the standard.

6.3.2 Display Instruction Performance Test (9020E System). The performance test for Convert and Sort Symbols, Convert Weather Lines, Repack Symbols and Load Chain instructions will be run to verify that these instructions will perform at the required rates.

6.3.3 FLT Practical Test. This test will demonstrate the ability of the One-Cycle FLT's to automatically diagnose a CE or IOCE failure and isolate the failure to a small number of circuit cards.

After an initial pass of the FLT's has been made to assure proper equipment operation, a single malfunction will be induced into a CE or an IOCE. The One-Cycle FLT's will then be repeated to diagnose and isolate the induced failure.

This test will be considered acceptable if the FLT's do isolate the failure and if the induced failure location appeared as a suspect in the FLT documentation.

6.3.4 System/360 - 9020D/E System Compatibility. This demonstration will utilize a System/360 Basic Assembler Program to assemble a symbolic deck and generate an object deck. The assembly and the object program execution will be performed on a 9020D/E Simplex System operating in 360 mode.

The compatibility demonstration will be considered acceptable if the expected results are obtained after executing the assembled program.

6.3.5 360 Mode Recall Test. An additional test will be included to demonstrate the ability of an active system to recall an element operating in 360 mode.

7.0 BATTERY AND POWER DEMONSTRATIONS (Ref. ER 063-3.2.2 and NS 100-3.8.1)

The battery and power demonstrations will consist of the following six tests.

Test A Normal Power On/Off Capabilities (Ref. ER 063-3.8.3.2 and NS 100-3.4.4, 3.8.1)

- a. Power Interlock Test
- b. Test State Power On/Off Test
- c. MPO Switch Test

Test B Abnormal Element Power Loss

Test C Thermal Warning and Protection

Test D Over Voltage/Over Current/Under Voltage Protection

Test E System Main Line Power Loss

Test F System Emergency Power Off

7.1 Test A - Normal Power On/Off

- a. Power Interlock Test

The test configuration will include all elements and units available.

The FAA observer(s) may direct IBM personnel to attempt to drop power by means of the Power On/Off switch on any active or redundant element or unit in the test configuration. The FAA observer(s) should check for proper program outputs and note that no actual or indicated power loss has occurred. Power interlocks will prevent power dropping unless an element or unit is configured State Zero - Test Switch "On". (There is no power interlock provided for the System Console or SCCU portion of the Configuration Console).

- b. Test State Power On/Off Test

After the power interlock capabilities of all available elements and units have been checked, the configuration will be changed to the defined minimum system with all other available elements and units in State Zero - Test Switch "On".

The Diagnostic Monitor will be reloaded from tape and prepared for power tests.

The FAA observer(s) may now direct IBM personnel to drop power by means of the Power On/Off switch on available State Zero-Test Switch "On", elements and units. The FAA observer(s) should check for proper program output information and correct System Console/Configuration Console indication after each element or unit is dropped.

The removal of power using the Power On/Off switch should not adversely affect program operations in the active system.

c. MPO Switch Test

With power down on the tested elements and units, their Element MPO Pull switch will be pulled and the attempt made to restore power with the Power On/Off switch. The FAA observer(s) should note that no power is restored. After the MPO switches are reset and power has been restored to all available State Zero elements and units, the program will be stopped and the active system reconfigured, substituting previously tested elements and units. The formerly active elements and units will now be configured State Zero-Test Switch "On". The program will then be reloaded and the remaining elements and units will be tested.

After all available elements and units have been tested for proper power interlock, Power On/Off and MPO capabilities, Test A will be terminated and considered successful.

7.2 Test B - Abnormal Element Power Loss.

a. Momentary Interrupt of Element Input Power

The configuration will be the defined minimum system set to State Zero - Test Switch Off. The Diagnostic Monitor will be loaded to operate a storage program for an SE and a DE, a tape functional program through an IOCE, or a CE functional program in a CE. The FAA observer will indicate which element line power is to be dropped on. The Diagnostic Monitor will then be initialized, the system configured to include the selected element and the element program operated.

Input power will then be dropped on the selected element to switch the element to battery power operation. As soon as the On Battery indication is observed, the main line power will be restored. The FAA observer(s) should note the continued program operation of the selected element. All SE's, DE's, CE's and IOCE's will be sequenced into the minimum system to perform the test on all battery powered elements.

b. Full Interrupt of Element Input Power

The above test will be repeated except that the elements will be allowed to continue program operation for their full set duration of battery power operation. The duration of battery operation will be measured by manual means.

In addition to the full interrupt tests, one element will be timed from the end of its battery operation to perform the following test.

c. Battery Recharge Demonstration

After the "Full Interrupt of Element Input Power" has been successfully demonstrated on the selected element, the batteries will be allowed to recharge for a minimum ratio of 300 to 1. When the minimum recharge period has been completed, the "Full Interrupt of Element Input Power" will be redemonstrated.

7.3 Test C - Thermal Warning and Protection

The thermal warning and protection facilities of all elements and units will be demonstrated by heating the thermal sensing circuit and observing the warning indicators and subsequent power drop. A heating device will be directed at the thermal sensing circuit to cause the over temperature condition. The FAA observer(s) should note the lighting of the Thermal Check indicator on the element or unit and the power Check indicator on the System Console or Configuration Console when the warning temperature is reached. Shortly after, the FAA observer(s) should note a power off sequence, as the thermal protection is reached.

Power Test C will be considered acceptable when all elements and units have given the proper indication and dropped power due to the over temperature condition.

7.4 Test D - Over Voltage/Over Current/Under Voltage Protection

The over voltage and over current protection capability of all elements and units, except the SCU and TCU's will be demonstrated in this test. In addition, the under voltage protection of all CE's and IOCE's will be shown.

This test will be performed by causing a power supply to exceed its allowable limits. When the allowable limit is exceeded, the FAA observer(s) should note that power is removed from the element or unit and that a Power Check indication is provided at the System Console or Configuration Console and at the element or unit.

The test will be considered acceptable when all elements and units have demonstrated proper power removal and have provided proper indication.

7.5 Test E - System Main Line Power Loss

This test will demonstrate the proper safe storage of SE and CE registers, and orderly shutdown, upon a simulated main line power loss, and display the predicted safe store data upon restoration of power. The test configuration will be set for the defined minimum system in State Zero - Test Switch "Off", and all other elements and units in State Zero - Test Switch "On". This test will be performed on two additional CE and SE element configurations.

With the system configured, the selected registers stored, and Power Test E program cycling, IBM personnel will drop the

element main line power. The elements in State Zero - Test Switch Off will switch to battery power operation for their set durations, during which time the selected registers will be logged out into specific storage locations. System power will then be restored and the safe store data displayed.

7.6 Test F - System Emergency Power Off

After all other tests have been completed, the System Emergency Power Off circuitry will be tested to insure the removal of power from all elements and units within the system. (Note: For protection of tapes, unload tape drives before test is performed).

The System EPO switch on the System Console/Configuration Console will be pulled while power is applied to all elements and units. It should be noted that power and indication of power is removed from all elements and units.

Power will be restored to the system and, after a period of check-out, the SEVA program will be operated on an A-1 equipment configuration. Two complete passes of the program will be made to verify proper system operation.

Power Test F will be considered acceptable if power is removed from all elements and units and if, after power is restored, program checks do not show excessive system malfunctions.

8.0 FACTORY ACCEPTANCE EXERCISE (Ref. ER 063-4.2.2.4)

The 9020D/E System will be exercised for two to five consecutive 24 hour periods, each of which will cycle SEVA in the A-1 Equipment Mode for 21 hours, and in a scheduled Maintenance Equipment Mode of 3 hours. Refer to Appendix B for the equipment mode configuration requirements. The 48 to 120-hour period will include the time required to reconfigure the system for substituting elements and units during the exercise, marginal checking set up, and necessary malfunction reconfiguration. During this exercise, the upper workload capability and marginal voltage operation of the system equipment will be demonstrated. Available redundant elements and units will be used for reconfiguration as required throughout the exercise.

The SEVA program will be used to exercise the equipment under control of the Diagnostic Monitor. The Diagnostic Monitor in the maximum system exercise will function as a cyclic program that will control and operate SEVA test programs and routines in a logical sequence. Periodic program results will be provided to record the programs operated, error data, and other pertinent information.

The upper workload limit of high capacity capability of the 9020D/E System equipment will be demonstrated by operating the maximum system configuration with the multiprogramming, multiprocessing SEVA program, and controlling Diagnostic Monitor.

Redundant elements and units will be periodically configured into the system to replace active elements and units, so that each element and unit will be exercised for approximately the same length of time.

In the event that SEVA encounters a failure, a repeat of the failing pass of SEVA will determine if the failure is a malfunction or a transient failure.

If a malfunction occurs in the active system, and a redundant element or unit is available, it will be configured into the system to replace the failing element or unit. The failing element or unit will be configured State Zero, and IBM personnel will initiate the appropriate corrective action. As soon as the malfunction is corrected, and the element or unit is checked out off line, the element or unit will be made available for redundancy.

If a malfunction occurs in the active system, and a redundant element or unit is not available to maintain the scheduled equipment mode, the exercise will be interrupted. The exercise will be interrupted until the scheduled equipment mode can be restored.

8.1 Marginal Checking

The marginal voltage operation of the 9020D/E System will be demonstrated during the factory acceptance exercise on the active system in the A-1 equipment mode.

8.1.1 Test A - Positive Excursion. Operate the 9020D/E System for a total of 6 hours with a predetermined positive excursion of the (+) 6 M marginal voltages of the active elements and units.

8.1.2 Test B - Negative Excursion. Operate the 9020D/E System for a total of 6 hours with a predetermined negative excursion on the (+) 6 M marginal voltages of the active elements and units.

Failures during the marginal voltage tests will be handled as specified in Section 8.0, except Marginal Check excursions may be removed at any time at the option of IBM personnel.

9.0 SCHEDULES

The following schedules define the tests to be performed for the factory and field acceptance tests.

9.1 Factory Acceptance Tests

The factory acceptance tests will be scheduled in the following sequence.

- a. System Familiarization and Orientation
- b. Subsystem Manual Test
 1. Compute Element Switch Demonstration
 2. I/O Control Element Switch Demonstration
 3. Storage Element Switch Demonstration
 4. Storage Element Timing Demonstration
 5. Display Element Switch Demonstration (9020E only)
 6. Display Element Timing Demonstration (9020E only)
 7. System Console (9020D only) or Configuration Console (9020E only) Switch Demonstration
 8. Peripheral Adapter Module Switch Demonstration (9020D only)
 9. Storage Control Unit and Associated Disk Storage Units Switch Demonstration (9020D only)
 10. Tape Control Unit and Associated Tape Drives Switch Demonstration
 11. 2821 I/O Tester Switch Demonstration
 12. 1052 Switch Demonstration
 13. Data Adapter Unit I/O Tester Switch Demonstration (9020E only)
- c. Subsystem Program Tests
 1. Compute Element Functional Test
 2. I/O Control Element Selector Channel, Channel-To-Channel Adapter, Storage Control Unit/Disk Storage Unit, Control Unit/Tape Drives Functional Tests
 3. I/O Control Element Multiplexor Channel
 4. Storage Element Functional Test
 5. Display Element Functional Test (9020E only)
 6. System Console (9020D only) or Configuration Console (9020E only) Functional Tests
 7. Peripheral Adapter Module Functional Test (9020D only)
 8. Read/Punch, Printer and Control Unit Functional Tests
 9. Printer/Keyboard Functional Tests
 10. Data Adapter Unit Functional Test (9020E only)
 11. I/O Control Element Diagnostic Mode Functional Demonstration
 12. I/O Control Element Processor Operation Test
 13. Log-Out Demonstration
 14. FLT Functional Tests
- d. Rerun Period

- e. Reconfiguration
- f. Special System Tests
 - 1. Eight Timed Sample Problems
 - 2. Display Instruction Performance Test
 - 3. System/360-9020D/E System Compatibility
 - 4. 360 Mode Recall Test
- g. Power and Battery Demonstrations
- h. Maintenance Period
- i. Rerun Period
- j. 48-120 Hour Factory Acceptance Exercise
- k. System EPO Test
- l. Final Evaluation

9.2 Field Acceptance Tests

The Field Acceptance Tests will be scheduled in the following sequence.

- a. System Familiarization and Orientation
- b. Subsystem Manual Test
 - 1. Compute Element Switch Demonstration
 - 2. I/O Control Element Switch Demonstration
 - 3. Storage Element Switch Demonstration
 - 4. Storage Element Timing Demonstration
 - 5. Display Element Switch Demonstration (9020E only)
 - 6. Display Element Timing Demonstration (9020E only)
 - 7. System Console (9020D only) or Configuration Console (9020E only) Switch Demonstration
 - 8. Peripheral Adapter Module Switch Demonstration (9020D only)
 - 9. Storage Control Unit and Associated Disk Storage Units Switch Demonstration (9020D only)
 - 10. Tape Control Unit and Associated Tape Drives Switch Demonstration
 - 11. 2821 I/O Tester Switch Demonstration
 - 12. 1052 Switch Demonstration
 - 13. Data Adapter Unit I/O Tester Switch Demonstration (9020E only)
- c. Subsystem Program Tests
 - 1. Compute Element Functional Test
 - 2. I/O Control Element Selector Channel, Storage Control Unit/Disk Storage Unit, and Tape Control Unit/Tape Drives Functional Test

3. I/O Control Element Multiplexor Channel
4. Storage Element Functional Test
5. Display Element Functional Test (9020E only)
6. System Console (9020D only) or Configuration Console (9020E only) Functional Test
7. Peripheral Adapter Module Functional Test (9020D only)
8. Read/Punch, Printer and Control Unit Functional Tests
9. Printer/Keyboard Functional Tests
10. Data Adapter Unit Functional Test (9020E only)
11. I/O Control Element Diagnostic Mode Functional Demonstration
12. I/O Control Element Processor Operation Test
13. Log-Out Demonstration
14. FLT Functional Tests

d. Rerun Period

e. Reconfiguration

f. Special System Tests

1. Display Instruction Performance Test
2. FLT Practical Test

g. Power and Battery Demonstrations

h. Maintenance Period

i. Integrated System Test

j. Rerun Period

k. System EPO Test

l. Final Evaluation

APPENDIX A

List of Abbreviations

ATR	Address Translation Register
CE	Compute Element
CC	Configuration Console
CU	Control Unit
DAR	Diagnose Accessible Register
DASF	Direct Access Storage Facility
DAU	Data Adapter Unit
DSU	Disk Storage Unit
DE	Display Element
DMR	DAR Mask Register
EPO	Emergency Power Off
FLT	Fault Locating Test
IOCE	Input/Output Control Element
MPO	Master Power Off
OBS	On Battery Signal
OTC	Out of Tolerance Check
PAM	Peripheral Adapter Module
SC	System Console
SCON	Set Configuration
SCU	Storage Control Unit
SE	Storage Element
SEVA	System Evaluation
SMMC	System Maintenance Monitor Console
TCU	Tape Control Unit
CCS	Computer Complex Simplex

APPENDIX B

A-1 Equipment Mode (9020D)

<u>Element/Unit</u>	<u>Triplex Number</u>	<u>Duplex Number</u>	<u>Simplex Number</u>
CE	(C-1)	1	1
IOCE	2	1	1
SE	(S-2)**	(S-2)**	S
PAM	2	1*	1
SCU	2	1	1
DSU	1/3T	1/3T	1/3T
TCU	2	1	1
Tape Drives	1/3T	1/3T	1/3T

Where C = total no. of CE's
 S = total no. of SE's
 T = total no. of Tape Drives and Disk Storage Modules

A-1 Equipment Mode (9020E)

<u>Element/Unit</u>	<u>Triplex Number</u>	<u>Duplex Number</u>	<u>Simplex Number</u>
CE	C-1	1	1
IOCE	1	1	1
SE	(S-1)	(S-1)	S
DE	(D-1)	(D-1)	D
DAU	1	1	1
RCU	1	1	1

Where C = total no. of CE's
 S = total no. of SE's
 D = total no. of DE's

* On those system configurations containing three PAM's, a second PAM may be added at the Test Director's discretion provided that it is not required as part of a maintenance subsystem and an interface path exists to the IOCE in the A-1 mode.

** On those system configurations containing less than six Storage Elements, the number of on line Storage Elements will be (S-1). The minimum of on line Storage Elements shall not be less than 2.

Maintenance Equipment Mode (9020D)

<u>Element/Unit</u>	<u>Triplex Number</u>	<u>Duplex Number</u>	<u>Simplex Number</u>
CE	(C-2)	1	Not
IOCE	1	1	Applicable
SE	(S-4)**	(S-2)**	
PAM	1	1	
TCU	1*	1*	
Tape Drives	1/3 T	1/3 T	
SCU	1	1	
DSU's	1/3 T	1/3 T	

Maintenance Equipment Mode (9020E)

<u>Element/Unit</u>	<u>Triplex Number</u>	<u>Duplex Number</u>	<u>Simplex Number</u>
CE	C-2	1	Not
IOCE	1	1	Applicable
SE	(S-3)**	(S-2)**	
DE	(D-3)**	(D-2)**	
DAU	1	1	

* IBM has the option of using 2 TCU's with 2 tape drives each during the Maintenance Mode.

** On those configurations containing less than six Storage Elements/Display Elements, the minimum number of these elements on line during the Maintenance Mode shall not be less than half the number of these elements on that system.