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Organization Procedure No. GRC-P7600.004

Revision G.2

## **7630/7640 Organization Procedure**

# **Space Test Engineering**

Approved by:

Chief, Research Testing Division/7600

**NASA - Glenn Research Center  
Cleveland, OH 44135**

<b>Glenn Research Center Organization Procedure</b>	<b>Title: Space Test Engineering</b>	
	<b>Document No.: GRC-P7600.004</b>	<b>Rev.: G.2</b>

### Change Record

<b>Rev.</b>	<b>Effective Date</b>	<b>Description</b>
Basic	04/09/1999	Initial Issue
A	08/05/1999	Corrections to paragraphs 2.2.3 and 2.2.4, FCR1999-1062
B	11/15/1999	Clarifications of “Records and Forms” and “Test Request”, FCR1999-1139
C	04/21/2000	Correct records list, FCR2000-1189
D	02/01/2001	Corrections to reflect changes in the BMS and other organization procedures, FCR2000-1236
E	03/23/2001	General Revisions, FCR2001-1312
F	10/22/2001	Revisions to incorporate Test Engineering Non-Conformance Identification and Reporting System (GRC-W7500.077), FCR2001-1408
F.1	04/24/2003	Edited Title of reference document P3.9.1 to agree with title change
F.2	05/19/2003	Edited Title of reference document P3.11.1 to agree with actual title
G	11/04/2003	Document Number Changed from 7500.026 to 7600.004 General numbering and reference changes related to directorate re-organization and document re-numbering. FCR2003-1654
G.1	01/20/2004	Corrected Errors in referenced document names/numbers and Visio translated flow diagrams.
G.2	01/29/2004	Annual Review – No Changes Required.

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## 1.0 INTRODUCTION

This procedure describes the process for the accomplishment of test engineering by the Space Power Test Engineering Branch (7630) and the Combustion & Microgravity Test Engineering Branch (7640).

### 1.1 Purpose

To clearly define the test engineering process in order to effectively meet the overall program/project objectives, fully satisfy the *customer's* needs, effectively execute an efficient test engineering effort, and to maximize the quality of the results.

### 1.2 Scope

This procedure applies to all test engineering conducted by the Space Power Test Engineering Branch (7630) and the Combustion & Microgravity Test Engineering Branch (7640).

## 2.0 REFERENCES

### 2.1 Applicable Documents

<b>Document Number</b>	<b>Document Title</b>
GRC-P2.2.1	Internal Customer Agreements
GRC-P2.6.1	Implementation – Experimental Testing
GRC-P3.4	Facilities Management
GRC-P3.9	Acquisition Process
GRC-P3.9.1	Purchase Requisition (PR) Process
GRC-P3.11.1	Control of Inspection, Measuring and Test Equipment
GRC-P4.4	Control of Nonconforming Product
GRC-P4.7	Corrective and Preventative Action
GRC-P7100.002	Data Systems Service Request
GRC-P7600.009	Work Management System 7i
GRC-P7600.010	Qualified Operators
GRC-P7780/7790.001	7780/7790 Task Completion Process
GRC-P7300.002	Work Control Office - Work Order Processing
GRC-P7600.001	Research Facility Management
GRC-P7700.002	7700/7800 Task Initiation and Resource Management Procedure
GRC-W0620.3.11.1.003	Calibration Laboratory Calibration Process
GRC-W7600.005	IMTE for 7610, 7620, 7630, 7640, 7660 (Direct Link)
GRC-W7600.007	Test Engineering Non-Conformance Identification and Reporting System
	Glenn Safety Manual
TM-1999-209641	Zero Gravity Research Facility User's Guide
JSC 22803	JSC Reduced Gravity Program User's Guide

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## 7600 Records Retention List (Posted on LiveLink)

### 2.2 Records and Forms

F7600.008 Space Test Engineering Test Request  
 NASA C-919 Safety Permit Package  
 F7600.005 Test Readiness Verification Form  
 F7600.006 Quality and Safety List  
 Calibration Records  
 Task Orders  
 Work Requests

### 2.3 Definitions

<b>Calibration</b>	The set of operations that establishes, under specified conditions, the relationship between values indicated by a measuring or generating instrument or system and the corresponding standard or known values derived from the standard. This definition may also be broadened to describe the performance or attributes of a collection of measuring and generating instruments acting together, such as a testing facility.
<b>Customer</b>	The person or organization that requested the test, either internal, or external to GRC.
<b>Facility Manager</b>	The individual responsible for coordinating all activities at a <i>test facility</i> .
<b>IMTE</b>	Inspection, Measuring, and Test Equipment
<b>Lead Engineer</b>	The individual in 7630/7640, appointed by the branch chief, who serves as the primary contact between 7630/7640 and the <i>customer</i> .
<b>Outside Engineering</b>	Engineering organizations that are internal to GRC but outside of 7630/7640. These organizations provide specialized design, analysis or data acquisition services.
<b>Safety Permit</b>	A license to operate a <i>test facility</i> within the constraints listed on the Permit to avoid potential safety hazards.
<b>Test Article</b>	The material, hardware, software, or system that is being tested.
<b>Test Conductor</b>	The person(s) or organization(s) responsible for implementing the various phases of the test. Can be the same person as the <i>customer</i> .
<b>Test Facility</b>	The place where the test is performed. This can be of any size from a single piece of equipment up to a large vacuum facility.
<b>Test Fixtures</b>	<i>Test article</i> support systems such as mechanical mounting, instrumentation connections, and controls.
<b>Test Procedure</b>	How the test is performed. Typically contains the conditions and actions to be performed by the <i>test conductor</i> .
<b>Test Request</b>	Contains descriptions of the technical, schedule, and other resource requirements for the experimental testing activity. In the event that undefined requirements are presented (items TBD or TBR) at the time of <i>test request</i> submittal, these items must be finalized prior to the approval of the test readiness verification form. This will be indicated by a check mark in the Research Requirements complete box. The <i>test request</i>

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document shall be revised to indicate resolution of TBDs and TBRs as they are resolved.

## 3.0 RESPONSIBILITIES

### 3.1 Customer

All *customers* are responsible for defining the scope and objectives of an experimental test and providing or arranging for: resources needed to carry out the test; the *test article*; the *test procedure*; data analysis; and the final reporting of the data in compliance with this procedure. The *customer* is also responsible for the tracking of *test articles* or other items provided by external groups while said items are on the premises.

### 3.2 Space Power Test Engineering Branch (7630) and the Combustion & Microgravity Test Engineering Branch (7640).

The 7630/7640 branches are responsible for determining if and how the *test request* can be met, scheduling resources, working with the appropriate *Facility Manager* to schedule the *test facility*, performing the test preparation, and, as needed, conducting the test. All designs and test procedures will be developed in accordance with the NASA Glenn Safety Manual. The test engineer will be responsible for the control of *test request* data, experimental data, documents, and *test article(s)* while they are within the scope of the experimental testing activity. In the event of damage to a *test article*, 7630/7640 personnel shall document and report the damage to the *customer* immediately as a non-conformance by following Test Engineering Non-Conformance Identification and Reporting System (GRC-W7600.007). 7630/7640 management is responsible for maintaining a list of *lead engineers*.

### 3.3 Facility Manager

The *Facility Manager* is responsible for interfacing with *customers* and 7630/7640 to plan for a test. This person will utilize all pertinent information provided by both groups to determine whether a test can be performed at a particular *test facility*. If all parties agree, then the *Facility Manager* provides approval to schedule the *test facility* and resources.

### 3.4 Outside Engineering

Outside Engineering are organizations within the Engineering Development Division (EDD) and Information Services Division (ISD) that are responsible for providing specialized design, analysis or data acquisition services.

### 3.5 Procurement Division

The Procurement Division is responsible for providing support to purchase equipment, supplies and services.

### 3.6 Calibration Lab

The Calibration Lab is responsible for the *calibration* of *IMTE* (e.g., voltmeters, oscilloscopes, accelerometers, flow meters, etc.) that are used in a *test facility*.

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### 3.7 Engineering Development Division (EDD)

EDD is responsible for providing manufacturing engineering, technical consulting pursuant to manufacturing processes, fabrication of in-house mechanical and instrumentation systems, and procurement of out-sourced mechanical systems.

### 3.8 Area Safety Committee

The Area Safety Committee is responsible for reviewing the *Safety Permit* request submitted by 7630/7640 to insure that a *test facility* conforms to the NASA Glenn Safety Manual. A *Safety Permit* is issued when all safety concerns are satisfied.

### 3.9 Research Testing Division (RTD)

RTD is responsible for performing mechanical, electrical or electronic tasks to build up and/or operate a *test facility*.

### 3.10 Institutional Support Branches

The Institutional Support Branches are organizations within the Facilities Division (FD) that are responsible for performing maintenance, repair, rehabilitation, modification, or new construction of building mechanical and electrical systems to support the *test facilities*.

## 4.0 PROCEDURE

### Responsible Person or Organization

### Block No.

### Activity

*Customer*

4.1

#### **Test Request**

The *customer* establishes contact with 7630/7640, either through a *Facility Manager* or directly (if a *Facility Manager* does not exist for a particular *test facility*). 7630/7640 will assign a *lead engineer* for the project. The *lead engineer* will provide the *customer* with any applicable facility user's guides and inform the *customer* of the level of detail required in the *test request*. The *customer* will then provide the required information for the test, which can be verbal or written. Changes to the *test request* which result in more than three working days of schedule delay must be approved as a revision to the *test request* by the signers of the original *test request*.

*Facility Manager*  
and/or 7630/7640

4.2

#### **Resources & Capabilities?**

7630/7640 evaluates the *test request* and determines the technical complexity, the scope of the effort, and the resources required to fulfill the *test request*. If the resources required are available and within the scope of the *customer's* effort, then the *Facility Manager* or the *lead engineer* (if a *Facility Manager* does not exist for a particular *test facility*) will schedule the test. For external *customers*, these *test*

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**Responsible Person or  
Organization**

**Block No.**

**Activity**

		<i>requests</i> are written as part of formal agreements. If the resources required are not available, then 7630/7640 will negotiate a revised <i>test request</i> with the <i>customer</i> .
<i>Customer</i>	<b>4.3</b>	<b>Revised or New Test Request?</b> The <i>customer</i> decides whether to revise the test objectives, requirements, or resources; to formulate a new <i>test request</i> ; or to cancel the <i>test request</i> .
<i>Facility Manager</i> and/or 7630/7640	<b>4.4</b>	<b>Schedule Test</b> The <i>Facility Manager</i> or the <i>lead engineer</i> (if a <i>Facility Manager</i> does not exist for a particular <i>test facility</i> ) schedules the test and resources for the appropriate <i>test facility</i> . The <i>Facility Manager</i> (if appropriate) and the 7630/7640 Branch Chief(s) (or their designees) will approve the <i>test request</i> .
7630/7640	<b>4.5</b>	<b>Test Facility Preparation Sub-Process</b> This sub-process occurs after the <i>customer</i> and 7630/7640 agree to proceed with a test. This includes all the design and implementation work that is required to achieve the test requirements.
7630/7640	<b>4.5.1</b>	<b>Field Engineering</b> Review the <i>test request</i> and design the <i>test facility</i> and <i>test fixtures</i> needed to fulfill the <i>test request</i> . Determine if the services of external organizations are needed and contact the appropriate organizations to initiate services.
7630/7640	<b>4.5.2</b>	<b>Documentation</b> The documentation required for any given test shall be maintained per customer requirements as outlined in the <i>test request</i> . Documentation shall be generated as required when interfacing with other organizations. Work in progress drawings for a given test shall be controlled at the individual facilities.
7630/7640	<b>4.5.3</b>	<b>Outside Engineering Services Required?</b> If 7630/7640 determines that <i>outside engineering</i> services are required, then the appropriate organization is contacted, per GRC-P7700.002 and GRC-P7100.002.
Outside Engineering	<b>4.5.4</b>	<b>Outside Engineering Provides Service</b> After receiving the request for services, the <i>outside engineering</i> organizations perform the required work.
7630/7640	<b>4.5.5</b>	<b>New Hardware/Software Required?</b> If 7630/7640 determines that commercial off-the-shelf (COTS) hardware or software is required, then a purchase request is submitted to initiate the Procurement Process.
Procurement Division	<b>4.5.6</b>	<b>Procurement Process</b>

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**Responsible Person or  
Organization**

**Block No.**

**Activity**

		Interface with Acquisition Process, per GRC-P3.9 and GRC 3.9.1.
7630/7640	<b>4.5.7</b>	<b>Calibrate Instruments?</b> If 7630/7640 determines that instruments to be used in the <i>test facility</i> need to be calibrated, per GRC-P3.11.1 and GRC-W7600.005, then the Calibration Lab is contacted to initiate the Calibration Process, or an in-situ <i>calibration</i> is performed. In the event that a non-calibrated instrument is used in the conduct of a test, a non-conformance shall be filed, per Test Engineering Non-Conformance Identification and Reporting System (GRC-W7600.007), with a “use as is” corrective action filed. The predicted worst case error for the instrument in question shall be documented in the non-conformance description.
Calibration Lab	<b>4.5.8</b>	<b>Calibration Process</b> All instruments shall be calibrated per GRC-P3.11.1. Interface with Calibration Process (GRC-W0620.3.11.1.003).
7630/7640	<b>4.5.9</b>	<b>Fabricate Parts?</b> If 7630/7640 determines that non-COTS hardware is required then the Engineering Development Division (EDD) is contacted to initiate the Fabrication Process.
EED	<b>4.5.10</b>	<b>Fabrication Process</b> Interface with 7780/7790 Task Completion Process (GRC-P7780/7790.001).
7630/7640	<b>4.5.11</b>	<b>Safety Permit Required?</b> If 7630/7640 determines that a new <i>Safety Permit</i> or a modification to an existing <i>Safety Permit</i> is required, then a <i>Safety Permit</i> request is submitted to initiate the Safety Permit Process.
Area Safety Committee	<b>4.5.12</b>	<b>Safety Permit Process</b> Interface with Safety Permit Process Glenn Safety Manual
7630/7640	<b>4.5.13</b>	<b>Trades Work Required?</b> If 7630/7640 determines that mechanical, electrical or electronic work needs to be performed then task order requests are submitted to the appropriate Research Testing Division (RTD) supervisor to initiate the RTD Process and/or work requests are submitted to the Work Control Office to initiate the Institutional Support Process.
RTD and/or Institutional Support Branches	<b>4.5.14</b>	<b>TID and/or Institutional Support Process</b> Interface with Work Management System 7i (GRC-P7600.009) and/or Work Order Processing (GRC-P7300.002).



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**Responsible Person or  
Organization**

**Block No.**

**Activity**

*Customer*

**4.5.15**

**Revised Test Request?**

If the *customer* wishes to modify the *test request* for any reason, then return to the *Test Request* phase (Box 4.1).

7630/7640

**4.5.16**

**Facility Verification**

The facility is checked out after all systems are installed. This includes the system verification of the instrumentation, control logic and hardware (including the *test article*). A test readiness form shall be filled out and approved as required on the form.

7630/7640 and  
*Customer*

**4.6**

**Test Operations Sub-Process**

This sub-process takes place after the *test facility* preparation is completed. This activity includes conducting the test, acquiring data and troubleshooting any *test facility* or *test article* problems.

7630/7640 and  
*Customer*

**4.6.1**

**Conduct Test**

After preparations for the test are completed, then the test is performed by following the *test procedure*. The *test conductor* verifies that the *test facility* is at the requested test conditions and that requested data is collected.

7630/7640 and  
*Customer*

**4.6.2**

**Data Acquisition**

The instrumentation gathers and records the requested data during the test runs. The data is reviewed for consistency with the *test request* and expected results. [Since this is an experiment, unexpected results could occur from the test and the *customer* may want the test repeated at the same or different test conditions and/or different data collected. If so, the test is repeated.] A continuous preliminary data analysis is conducted and expenditure of resources is monitored. Whether or not to interrupt the testing will be periodically explored considering the remaining resources, progress of the test, and results. In the event that the data have been determined to be corrupt, the permanent copies of these data shall be destroyed or clearly marked to prevent their use. In the event that the data errors were caused by faulty sensors or failure of equipment in the *test facility*, a non-conformance shall be filed, per Test Engineering Non-Conformance Identification and Reporting System (GRC-W7600.007).

7630/7640 and  
*Customer*

**4.6.3**

**Abort/Shutdown?**

An abort/shutdown is initiated manually or automatically if any test parameters exceed pre-established limits. If the abort/shutdown results in facility damage, necessitates a redesign of portions of the facility, or was caused by the failure of a system under the control of 7630/7640, a non-conformance shall be filed, per Test Engineering Non-

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**Responsible Person or  
Organization**

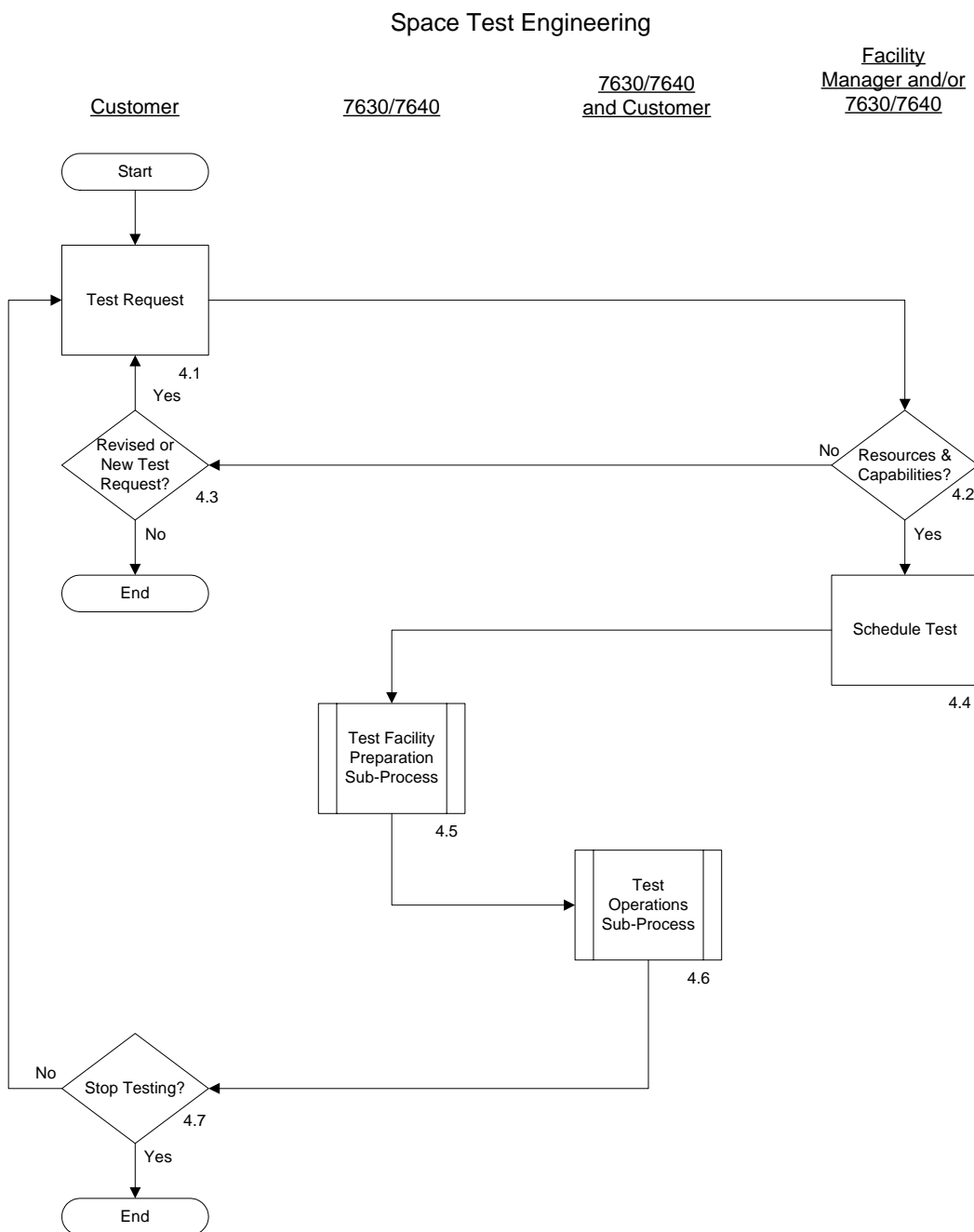
**Block No.**

**Activity**

		Conformance Identification and Reporting System, (GRC-W7600.007). Mishap reports shall also be filed if required by Glenn Safety Manual.
7630/7640	<b>4.6.4</b>	<b>Deliver Data</b> 7630/7640 delivers data to the <i>customer</i> as specified in the <i>test request</i> .
7630/7640 and <i>Customer</i>	<b>4.6.5</b>	<b>Correct Problem</b> The <i>test facility</i> and/or <i>test article</i> problem is analyzed and identified. Corrective actions are implemented to allow testing to resume. See 4.6.3 for the descriptions of the corrective action documentation
<i>Customer</i>	<b>4.7</b>	<b>Stop Testing?</b> The <i>customer</i> decides whether or not to terminate the testing. The amount and adequacy of the test data recorded will be considered. The test can be terminated for various reasons, including: <ul style="list-style-type: none"> <li>• the test objectives have been met;</li> <li>• the performance of the <i>test article</i> can not be improved further;</li> <li>• the <i>customer</i> has decided that further testing is not warranted;</li> <li>• the remaining resources are insufficient.</li> </ul> The <i>customer</i> may decide to return to the <i>Test Request</i> phase (Box 4.1) for one or more of the following reasons: <ul style="list-style-type: none"> <li>• to modify the test requirements</li> <li>• to modify the <i>test article</i></li> </ul>

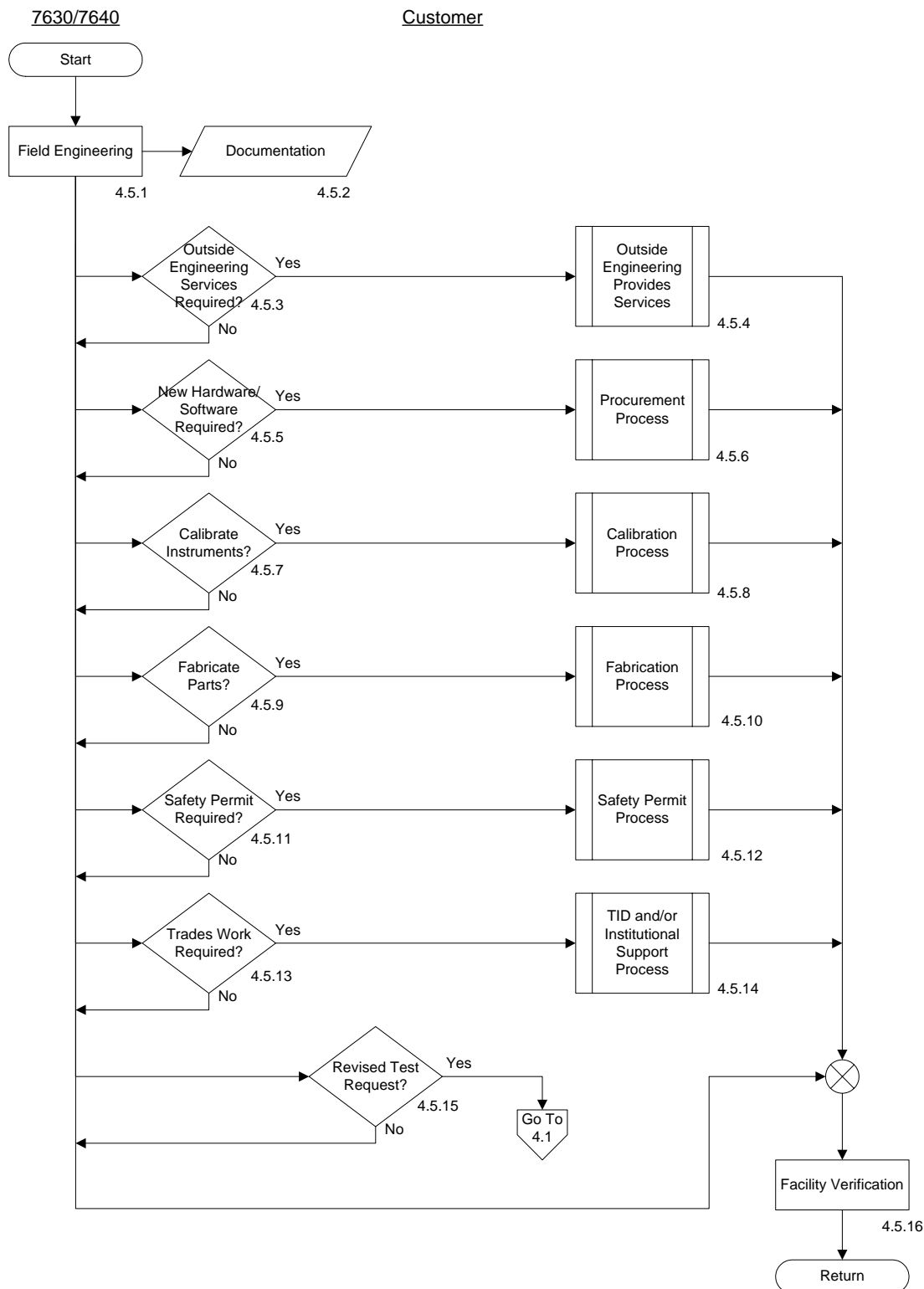
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## 5.0 FLOW DIAGRAMS



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### Test Facility Preparation Sub-Process



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## Test Operations Sub-Process

7630/7640 and Customer

