



ET12-100
DRAFT Revision: F
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ORGANIZATION ISSUANCE

EXPERIMENTAL FLUID DYNAMICS GROUP

ET12

Experimental Test Project Process

DRAFT Revision F

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DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Revision	A	02/20/1998	Section 2: Applicable Document list simplified. section 3: added more definitions. 4.10.11: Added ED31 specific calibration procedures. 4.10.13: modified to include handling of test anomalies. 4.10.14: added references to new CWIs. Section 8: Quality Record list was updated to reflect additional quality records and custodians.
Revision	B	02/23/1998	Section 3: modified definitions to refer to appropriate MSP's.
Revision	C	07/12/1999	Revised to reflect the reorganization: Document number changed from OWI-ED31-ORG-001 to ET12-100. ED31 changed to ET12 throughout document. Approval authority changed. Changed document numbers for applicable documents which changed.
Revision	D	09/08/2000	Revised to reflect the operation of the new ET12 organization and to incorporate changes made in the new ET10 department as a result of the reorganization. The document has undergone major revisions in most sections.
Revision	E	09/08/2004	Updated due to CAITS 04-DA01-0387.
Revision	F	09/19/2005	Updated due to Reorg (Feb 18, 2005), and updated to reflect current procedures (Aug, 2005).

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Experimental Test Project Process

1.0 SCOPE

1.1 Scope: This document defines the standard process required to conduct an research/experimental test project with the Experimental Fluid Dynamics Group/ET12 including all steps from initial Test Scope of Work through delivery of final test reports and other deliverables.

1.2 Purpose: The purpose of this document is to guide the implementation of a test project conducted within the purview of the Experimental Fluid Dynamics Group/ET12 of the Test Laboratory/ET01 within the Engineering Directorate of NASA MSFC.

2.0 APPLICABILITY

This document defines the standard process to be implemented on Category 3 Research/Experimental per ET10-003 “Test Preparation Sheet (TPS) Instructions” as conducted by the Experimental Fluid Dynamics Group/ET12 at MSFC. This document applies to testing conducted solely by ET12 or in partnership with another organization. Implementation can deviate from these guidelines only if properly documented and approved in the Test Requirements Document and the Test Implementation Plan.

3.0 APPLICABLE DOCUMENTS

MPR 8730.5	Control of Inspection, Measuring, and Test Equipment
MPR 8715.1	Marshall Safety, Health, and Environmental (SHE) Program
MWI 8621.1	Close Call and Mishap Reporting and Investigation Program
QD10-QA-003	Quality Assurance Guidelines for Test Activities
QD10-QA-006	Baselining and Certifying Test Facilities/Systems
OI ET10-003	Test Preparation Sheet (TPS) Instruction
OI ET10-004	Test Procedure Instructions
OI ET10-007	Facility Nonconformance Reporting System for the Technology Evaluation Department

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OI ET10-008 Test and Evaluation Dept. Facility Inspection Requirements

OI ET10-013 Test Project Records Retention Process

4.0 DEFINITIONS

NOTE: The following definitions pertain to the ET12 Group and may not be consistent with definitions found in other documents.

4.1 Test Facility Team: The team of ET12 personnel assigned to the Test Project. The team consists of:

- Test Facility Engineer/Test Conductor
- Control and Power Systems Engineer
- Instrumentation Systems Engineer
- Data Acquisition Systems Engineer
- Test Support Technicians

4.2 Test Facility Engineer: Designated ET12 engineer (typically the mechanical systems engineer) assigned responsibility for coordinating and implementing all test facility/support system work required to support the execution of the test project on a specific, assigned ET12 test facility.

4.3 Test Conductor: Designated individual with responsibility to direct all run-day test support activities involved in executing test operations for a specific test. This function is typically a ET12 duty/responsibility of the Test Facility Engineer and/or the assigned Test Facility Mechanical Technician.

4.4 Systems Engineer(s): Designated ET12 engineer(s) assigned responsibility for specific facility systems or subsystems in support of one or more test projects. Systems engineers typically fall within a given functional area (i.e. Mechanical, Electrical, Control, Data Acquisition) as determined by the discipline of the engineer's education and background, as well as the organizational structure within the Experimental Fluid Dynamics Group/ET12.

4.5 Test Support Team: The team of NASA and contractor personnel who support test ET12 test operations. The team typically consists of:

- Test Support Technicians
- STE Fabrication Technicians
- Data Systems Operations Personnel
- Industrial Safety (as required)
- Quality Assurance (as required)

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4.6 Test Requester: The individual who is, or is representing or acting on behalf of a customer (i.e. owners of the test article and desiring the test data). The Test Requester may consist of a NASA organization, private company, another government agency, or a combination of these.

4.7 Test Agreement: An agreement between the Experimental Fluid Dynamics Group/ET12 and the Test Requester that describes each of these two party's obligations in performing a specified Experimental Test Project. The terms of this agreement might be outlined on a Task Agreement, Space Act Agreement, Cooperative Agreement, Memorandum Of Understanding, Collaborative Work Commitment (CWC) or other document that is signed by both the Test Requester and ET12 Group management.

4.8 Test Article: The hardware component or assembly that is to be monitored during the Test Project.

4.9 Test Scope of Work (TSOW): A document authored by the Test Requester, which adequately defines the requirements of a proposed test project to allow ET12 to develop preliminary cost/manpower and execution schedule estimates. It is written in accordance with the "Test Scope of Work Guidelines" (See Appendix A).

4.10 Test Requirements Document (TRD): A document authored by the Test Requester that defines the requirements for completing a test project and includes test article characteristics, limitations, and handling instructions as necessary. It is written in accordance with the "Test Requirements Document Guidelines" (See Appendix B) and contains detailed requirements sufficient to support an accurate test project cost and execution schedule determination necessary for a Test Agreement.

4.11 Test Implementation Plan (TIP): A TIP document defines the planned actions necessary to; 1) ready the test facility including all ancillary subsystems for conduction of the test, and 2) conduct the test. The TIP document is authored by the ET12 Test Facility Engineer in response to the TRD and with input (such as the instrumentation hookup sheet) from the ET12 Test Team. The generation of this document is optional depending on the extent and complexity of the test scope/preparation activities required. The TIP is written in accordance with the "Test Implementation Plan Guidelines" (See Appendix C).

4.12 Pretest Meeting(s): Informal meeting(s) held between the ET12 Test Facility Team and the Test Requester to enhance the communication/exchange of information during the test readiness planning and implementation phase as the test project matures. The occurrence frequency of these meetings is at the discretion of the parties involved, but will usually require at least two pretest meetings: a kickoff meeting (5.2) and a Test Readiness Review (4.13).

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4.13 Test Readiness Review (TRR): A pretest review to assure equipment and personnel are ready to begin testing. Topics to be addressed are outlined in “Test Readiness Review Guidelines” (See Appendix D).

4.14 Test Completion Report (TCR): A document compiled by the ET12 Test Facility Engineer and released to the Test Requester within 30 days following the completion of the Test Project. The format/contents of this document is in accordance with the “Test Completion Report Guidelines” (See Appendix E). The TCR should be stored as a quality record in WATS.

4.15 Record: Any record including data which furnishes objective evidence of activities performed or results achieved to substantiate the fulfillment of test requirements or effectiveness of test operations, or to demonstrate compliance with the established quality system. Refer to Section 8.0 for a listing of records specific to the test process described by this instruction.

4.16 Record Custodian: The designated individual (named by group management) who is responsible for the control, storage, retrieval and disposition of records.

4.17 Run Log: A Run Log is kept to document each test performance (run) in lieu of an “as-run” test procedure. For each run, entries including the time/date, unique run number, test-specific facility parameter set points, anomalous events and facility operator initials are required as a minimum. These logs also serve as an historical record on the use/run time of ET12 Facilities and aid in the analysis of data after the tests have been completed. Each facility’s operation Run Log is and retained by the assigned Test Facility System Engineer for a period of 10 (ten) years.

4.18 Calibration Discrepancy Report: A report to notify the test requestor that a piece of calibrated equipment which was used on the test has returned from calibration with a discrepancy tag which indicates that the quality of the data acquired by the device is questionable. The calibration discrepancy report (CDR) is stored as quality record in WATS along with the TCR. The CDR is sent to the same distribution as the TCR to which it is attached.

4.19 Anomalous Event: Any event that occurs during testing which might impact the quality of data. For example, improperly configured test article for the test condition indicated in the run matrix.

4.20 Experiment: A short one-of-a-kind test that typically requires less than 40 hours of labor and/or less than \$10,000 in material and fabrication. A TPS in WATS suffices for recording the ET12 support for an experiment.

5.0 INSTRUCTIONS

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The steps identified in the following process discussion correspond to those of Flow Diagram #1 – Experimental Test Project Process. Not all of these steps are required for conducting an experiment, which typically requires less than 40 hours of labor and or less than \$10,000 in materials/fabrication cost

5.1 Initiation:

5.1.Step 1: Upon initial inquiry, the Experimental Fluid Dynamics Group/ET12 shall supply a copy of this document, ET12-100, “Experimental Test Project Process” to the Test Requester. The Test Requester communicates a test concept to the Experimental Fluid Dynamics Group/ET12 management. The Test Requester shall describe the general nature of desired testing to be performed. This initial communication of testing concept can be done verbally but is preferred in writing.

5.1.Step 2: ET12 Group Lead shall consult the appropriate Test Facility Engineer(s) to assess the feasibility of performing the test considering ET12 facility capabilities and schedule commitments. At this point it can be possible to determine if the request can be satisfied as an experiment or if the full experimental test process is required.

5.1.Step 3: If testing is deemed feasible, the ET12 Group Lead shall contact the Test Requester to submit a Test Scope of Work to per the “Test Scope of Work Guidelines”. This document shall contain sufficient definition of the scope of testing to allow a rough order of magnitude (ROM) Cost Estimate and projected execution schedule to be generated.

5.1.Step 4: The ET12 Group Lead shall task a Test Facility Team, which is led by the appropriate ET12 Test Facility (Mechanical Systems) Engineer, to review the Test Scope Of Work and produce a ROM Cost Estimate and execution schedule as influenced by the following requirements:

- Costs of procuring consumables and hardware
- Costs of preparing the test facility
- Manpower to accomplish the Test Project
- Schedule for facility modifications and test operations

5.1.Step 5: The Test Requester shall use the ET12-generated ROM cost and execution schedule estimate for project planning. If the Test Requester accepts the ET12-estimated cost and schedule, then a Test Agreement shall be formalized defining the responsibilities and obligations of both parties. The Test Agreement is documented (Memorandum, Collaborative Work Commitment (CWC), Space Act Agreement, etc) and references the TSOW, the ET12 cost/schedule estimates and the test project funding code. Any subsequent changes to the test scope/requirements shall re-negotiate the Test Agreement. The ET12 Group shall

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estimate cost and schedule impacts for any proposed increase in scope, but shall not be bound to perform any testing not covered in scope by a valid, signed Test Agreement.

5.2 Definition Phase

5.2.Step 6: The ET12 Group Leader shall designate/assign the ET12 Test Facility Team responsible for the implementation/performance of the Test Project.

5.2.Step 7: The Test Requester and the assigned Test Facility Team Leader shall conduct a Test Project kickoff meeting to initiate the process of planning test implementation and refining the necessary documents. It is advisable that all members of the Test Facility Team attend this meeting. It is advisable that additional pretest meetings are conducted as appropriate during the test planning and test facility preparation phase to enhance communication and resolve issues expediently.

5.2.Step 8: The Test Requester shall prepare the Test Requirements Document (TRD) and shall submit it to the Test Facility Engineer. This document is written in accordance with the "Test Requirements Document Guidelines". The TSOW, previously generated by Test Requester, can be expanded/supplemented to become the TRD that contains all detailed test/test article requirements.

5.2.Step 9: The Test Requester shall arrange for funding to be available to accomplish the test project. The Test Requester shall provide the appropriate charge code to the Test Facility Engineer via the Test Agreement. The Test Facility Engineer shall acquire a project number, which shall be used along with the facility's three-letter acronym to uniquely identify the test in all subsequent documentation, scheduling, and for data storage.

5.3 Design and Analysis

5.3.Step 10: The Test Facility Engineer shall ensure that the TRD requirements are properly addressed in the planning of necessary facility readiness actions including modifications. The Test Facility Engineer can document the planned implementation actions in the Test Implementation Plan (TIP). The TIP is developed when necessary and with the assistance/input of all Test Facility Team members and in accordance with the Test Implementation Plan Guidelines (Appendix C). During the plan's development, the Test Facility Engineer is responsible for working jointly with the Test Requester to ensure that all requirements are adequately addressed. A TIP is generally required for complex tests that involve extensive facility preparation/modification activity.

5.3.Step 11: The Test Facility Team shall initiate facility-specific procurements (for both services and products) as required for preparing the facility for test.

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NOTE: At the discretion of the ET12 Group Leader and based upon the extent of facility modification and/or hazards associated with the testing planned, a Safety Review Team (SRT) or an Operational Readiness Inspection Committee (ORIC) can be warranted and activated. These teams shall operate in accordance with “MPR 8715.1 “Marshall Safety, Health and Environment (SHE) Program” and become a part of the Test Support Team.

5.3.Step 12: Upon completion of the TIP (if required), the Test Facility Engineer shall conduct a meeting to review the TIP with the Test Requester and all members of the Test Facility and Support Teams. The TIP shall be signed-off by the Test Requester and Test Facility Engineer if deemed acceptable, otherwise revisions are made until the TIP is approved. Since the TIP is a living document, revisions can be required throughout the test project. After approval, the same parties who signed the baseline shall always approve any significant TIP changes.

5.4 Facility Preparations

5.4.Step 13: The Test Facility Team shall direct/assist the Test Support Team in the preparation and checkout of the test facility in accordance with the implementation plan developed by the Test Facility Engineer. Work authorization documents are generated to prepare the facility, and shall perform checkout operations in accordance with ET10-003 “Test Preparation Sheet (TPS) Instructions” for Category C Research/Experimental Test Projects.

5.4.Step 14:

- A) At the discretion of the ET12 Group Leader, the Test Requestor shall provide a stress analysis report that demonstrates the test article’s ability to withstand the test conditions of the facility.
- B) The Test Facility Team shall be responsible for the installation/integration of the test article into the test facility. The Test Requester is expected to provide any specific instructions pertinent to the proper execution of this operation. The Test Requester shall maintain control of the configuration of test article. The Test Requester shall approve any work that affects the test articles, whether performed by the test requesting organization or ET12 personnel. If work is performed by ET12 personnel, the work shall be documented by a TPS in WATS.

5.5 Pretest Review

5.5.Step 15: The Test Facility Engineer shall coordinate the scheduling of the Test Readiness Review (See Appendix E “Test Readiness Review Guidelines”). The TRR shall determine/verify the readiness of the test facility, ancillary systems and personnel to support

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the commencement of testing. The outcome results in either returning to Step 13 or continuing to Step 16. The TRR can authorize the Test Facility Team to proceed with testing contingent on the completion of certain “constraint-to-test” action items. Any failure to satisfy these actions or any changes to test implementation plans and/or test facility systems shall require the approval of the TRR at a delta-TRR meeting.

5.6 Test

5.6.Step 16: The Test Facility Team shall perform the test utilizing the appropriate facility Standard Operating Procedure(s) OI(s) with the support of the Test Requester and Test Support Team. During test operations, the Test Facility Engineer is responsible for the coordination/execution of all test activities and operations. A Facility Run Log shall be maintained throughout the test operation for each test project and shall document test run ID number, run time /date, run conditions (mach number, flow rate, pressure, temperature, etc.) and any anomalies occurring during each run. The Run Log is retained per Section 8, Records.

5.7 Post Test Review

5.7.Step 17: The Test Facility Team shall review the test data for integrity and shall release it to the Test Requester along with any disclaimers. Preliminary data can be viewed “real-time” in some cases or provided to the Test Requester for preliminary review immediately following a test run. The test data shall not, however, be authorized by ET12 as “official” test data until after completion of a data integrity review and the release of a Test Completion Report (per Step 20).

5.7.Step 18: The Test Requester shall review/analyze the test data and can request run condition changes for subsequent planned test runs or determine that additional tests are required. If so, then return to Step 16, otherwise go on to Step 19.

5.7.Step 19: When the test project has been completed, the Test Requester shall disposition the test article (disposition from the ET12 test area premises) within 30 days after it is removal from the test facility. Test articles shall not be stored within/around ET12 facilities without prior approval from ET12 Group Lead and documented in the Test Agreement.

5.8 Post Test Response

5.8.Step 20: The Test Facility Engineer shall be responsible for releasing a Test Completion Report (TCR) within 30 days Following test completion to the Test Requester. The contents of this report shall contain as a minimum:

- Test objective(s)

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- Test run matrices
- Test Facility Setup/Configuration Documentation
(i.e. dimensioned sketch(s) depicting facility instrumentation-to-model locations.
- Data integrity/validity verification statement
- Instrumentation/Measurement Devices Used/Field device Hookup Schematic (may refer to TPS#)
- Data file name/location

Reference Appendix E – Test Completion Report (TCR) Guideline

5.9.Step 21: The Test Facility Team receives assistance from the Test Support Team for the removal and disposition of the Test Article in accordance with the TIP and/or per the direction of the Test Requester/Project Engineer.

5.10.Step 22: ET12 Test Facility Engineer shall supply a Customer Satisfaction Survey (Appendix F) to the Test Requester. The Test Requester can complete and return the survey to ET12 Group Lead.

5.11.Step 23: The Test Facility Engineer shall receive assistance from the Test Facility Team to archive the Test Project information in accordance with Section 8, Records.

6. RESPONSIBILITIES

6.1 Test Requester shall be responsible for:

- Developing/Providing the TSOW.
- Negotiating the Test Agreement with the ET12.
- Providing funding as agreed upon in the Test Agreement.
- Developing/Providing the TRD.
- Delivery and post-test disposition of the test article with any special installation and/or removal instructions.
- Configuration control of the test article.
- Presentation/Participation in the TRR.
- Analyzing test data to verify that objectives have been satisfied.

6.2 Group Management, Experimental Fluid Dynamics (ET12) shall be responsible for:

- Determining testing feasibility considering capability and schedule.
- Assigning a Test Facility Team to the test project.
- Negotiating/Approving the Test Agreement with the Test Requester.

6.3 Test Facility Team:

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6.3.1 Test Facility Engineer shall be responsible for:

- Estimating ROM cost and execution schedule in response to the TRD.
- Developing/providing the TIP.
- Implementation/Authorization of facility test-readiness activities including modifications.
- Installation and removal of the test article with instructions from Requester as required.
- Conducting the TRR.
- Operation/maintenance of facility including equipment calibration as needed.
- Preparing the TCR, and notifying the Systems Engineers that the test is complete and the data is ready for harvesting and prep for release and archival.
- Coordinating the disposition of the Test Article and facility.
- Closeout of Run log and other test records.

6.3.2 Systems Engineers shall be responsible for:

- The design, fabrication, integration and operation of facility subsystems (i.e. measurement, data acquisition, and control) utilized during the Test Project within their specific, designated discipline.
- Translating the requirements of the TRD into functional subsystems that demonstrate the ability to meet the objectives.
- Performing data system operations task and equipment calibration such as database buildup, operating data recording and display systems during real-time test operations, post-test processing data files and generating “quick-look” plots, etc.
- Maintaining data acquisition (DAQ) and control systems in an operational state with on-site, real-time support during critical test operations.
- Developing and maintaining custom test support software for data acquisition and control systems.
- Providing the officially released version of the data, and copies of the DAQ software used to the DataBase Manager following each test.
- Providing the Database Manager a copy of a user manual in electronic form for new or special purpose DAQ software.
- Directing the Test Support Team by generating work authorization documents and procedures.

6.4 Test Support Team:

6.4.1 Industrial Safety Office: This organization shall be responsible for the effective implementation of the MSFC safety program and for assuring compliance with applicable safety policies, regulations, and standards in accordance with “MPR 8715.1 Marshall Safety, Health and Environment (SHE) Program”.

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6.4.2 Quality Assurance Office: At the discretion of the ET12 Division Chief or by request of the Test Requestor, this organization shall provide the following in accordance with the appropriate guidelines/procedures:

- Surveillance of facility modification, activation, operation, test and checkout operations.
- Inspection and Quality Engineering Services
- Review and change control of test procedures and work authorization documents.
- Documenting and processing of non-conformances Documenting of trouble-shooting procedures
- Documenting of test anomalies

6.4.5 Test Support Technicians: These personnel shall assist the Test Facility Engineer in the preparation, operation and maintenance of the test facility in support of the Test Project. This work is authorized, documented and performed in accordance with ET10-003 “Test Preparation Sheet (TPS) Implementation Instruction”. Some examples of this type of work are: Mechanical system assembly/configuration, pneumatic and/or hydraulic control system setup, instrumentation installation, electronic adjustments and verification, network systems checkouts and operations, and test hardware installation

6.4.6 Test Quality Inspectors: When required by ET10-008 “Technology Evaluation Department Facility Inspection Requirements” as determined by the ET12 Group Lead, these personnel shall witness/inspect test facility preparations, activation and verification activities, as well as test.

6.4.7 Others: Other MSFC organizations and contractors frequently support the ET12 Group test operations. Some examples are:

- Design and analysis of piping systems and other special test equipment
- Fabrication of piping systems and other special test equipment
- Failure, stress, and material analysis
- Cleaning and servicing of valves and piping components
- Sampling of facility propellants and pressure systems for contaminants, etc.
- Heavy lift/Program Critical Equipment Operators
- Hazardous Waste Management
- Facility modifications and construction
- MSFC Calibration Facility

7.0 SAFETY PRECAUTIONS AND WARNING NOTES

7.1 Anomalous Events

The handling of anomalous events, which result in personal injury or equipment damage in excess of \$1,000, shall be in accordance with MWI 8621.1, “Close Call and Mishap Reporting and Investigation Program.”

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8.0 APPENDICES, DATA, REPORTS, AND FORMS

- 8.1 Appendix A - Test Scope of Work Guidelines (TSOW)
- Appendix B - Test Requirements Document Guidelines (TRD)
- Appendix C - Test Implementation Plan Guidelines (TIP)
- Appendix D - Test Readiness Review Guidelines (TRR)
- Appendix E - Test Completion Report Guidelines (TCR)
- Appendix F - Customer Satisfaction Survey

8.2 Data is acquired in several forms, but only the steady- state data is archived by ET12. Unsteady or Dynamic data is not archived by ET12. Flow Visualization data in video, film, or digital stills are provided to and become the responsibility of the test requestor. Steady State Data shall be provided to the ET12 Database Manager at the end of each test.

9.0 RECORDS

9.1 Record Retention:

The table on the next page lists the retention period for each type of Record. When the Records reach expiration they can be either destroyed or saved as historical or reference at the discretion of the custodian and/or OPR Lead.

9.2 The Following documents typically are considered/controlled as Records pertinent to the Experimental Test Project Process. The Test Facility Engineer shall be responsible to obtain and maintain finalized, approved copies of the following documents as required for each test.

- 1 Test Agreement Document.
- 2 Minutes of Test Project Kickoff meeting.
- 3 Test Requirement Document.
- 4 Test Implementation Plan (as necessary).
- 5 Minutes of tabletop meeting to finalize the Test Implementation Plan.
- 6 Minutes of tabletop meeting to assess readiness to integrate test. article into facility (As Required)
- 7 Minutes of Test Readiness Review with Authorization.
- 8 Minutes of post-test data review meeting.
- 9 Test Completion Report.
- 10 "As Built" Drawings for test facility configurations.
- 11 Hazard Analysis as required for facility and test configuration

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The Test Facility Engineer shall be responsible to provide copies of the above documents to the appropriate record custodian (see table below). All Records for a given test project shall be maintained for a period of not less than 3 years from the date of the Test Completion Report. These Records can be stored in paper or electronic form. The environment shall always be suitable to preclude degradation of the documents and the documents shall always be readily accessible for review.

The Following types of data records are also Records. The appropriate Test Facility or Systems Engineer shall be responsible to produce and archive the following:

- 1 "As Built" Drawings for test facility subsystem configurations
- 2 Facility Checkout data files
- 3 Facility Run Logs

Per section 8 the steady state Test data files shall be provided to the ET12 Database Manager at the end of the test, and shall be kept as Records by the ET12 Database Manager.

The OPR Records Custodians identified below shall maintain a marked secure file of the following Records:

Record Type	Who Generates it	Who/Where is it kept (custodian/location)	Retention Time
Memorandums	OPR personnel	OPR Secretary -- memo file	3 yr
calibration QR (Cat IV or V)	Outside vendor or in-house	ULO decides either Calibration Facility or the Cal Contact	min of 1 cal for LOE + 1yr
Cal Usage Logs	Cal Contact	Cal Contact	next successful cal
Cal Disposition Record	Cal Contact	WATS	3yr
Hookup Sheet	Data Acq Engr.	WATS/TPS attachment	See ET10-003
Facility Run Logs	Facility Operator	Facility Engineer	10 yr
TCR	Facility Engineer	WATS	
TRR	Facility Engineer	WATS	
TIP	Facility Engineer	WATS	

TABLE 1: Records

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10.0 TOOLS, EQUIPMENT, AND MATERIALS

10.1 Control of Inspection, Measuring, and Test Equipment

10.1.1 The calibration contacts are responsible for individual pieces of equipment and for getting them calibrated. Calibrations can be done by the MSFC Calibration Facility, a third party vendor, or by the User Line Organization (i.e ET12). Calibration Contacts shall be familiar with and follow MPG 8730.5.

10.1.2 ET12 and Third Party Calibration Records: Any equipment that is calibrated by either a third party vendor or by ET12 shall have calibration records which shall always either be maintained by the Calibration Contact as a Record or submitted to the MSFC Calibration Facility for maintaining as a Record. For example, wind tunnel balances require specialized equipment for calibration and therefore require a third party vendor to perform the calibration. The calibration records for the wind tunnel balances are kept by the ET12 calibration contact as Records.

10.1.3 Calibration Usage Log: For calibrated equipment that can be used or shared among facilities the calibration contact shall always track where the equipment is used via a calibration usage log. Calibrated equipment that is used in primarily a single facility can be tracked by hookup sheets, which are attached to the TPS for each test where the equipment is used. The log or the hookup sheets can be used to notify the appropriate Test Requestor if an item returns from calibration with a disposition tag indicating that the data acquired with the equipment is suspect.

11.0 PERSONNEL TRAINING AND CERTIFICATION

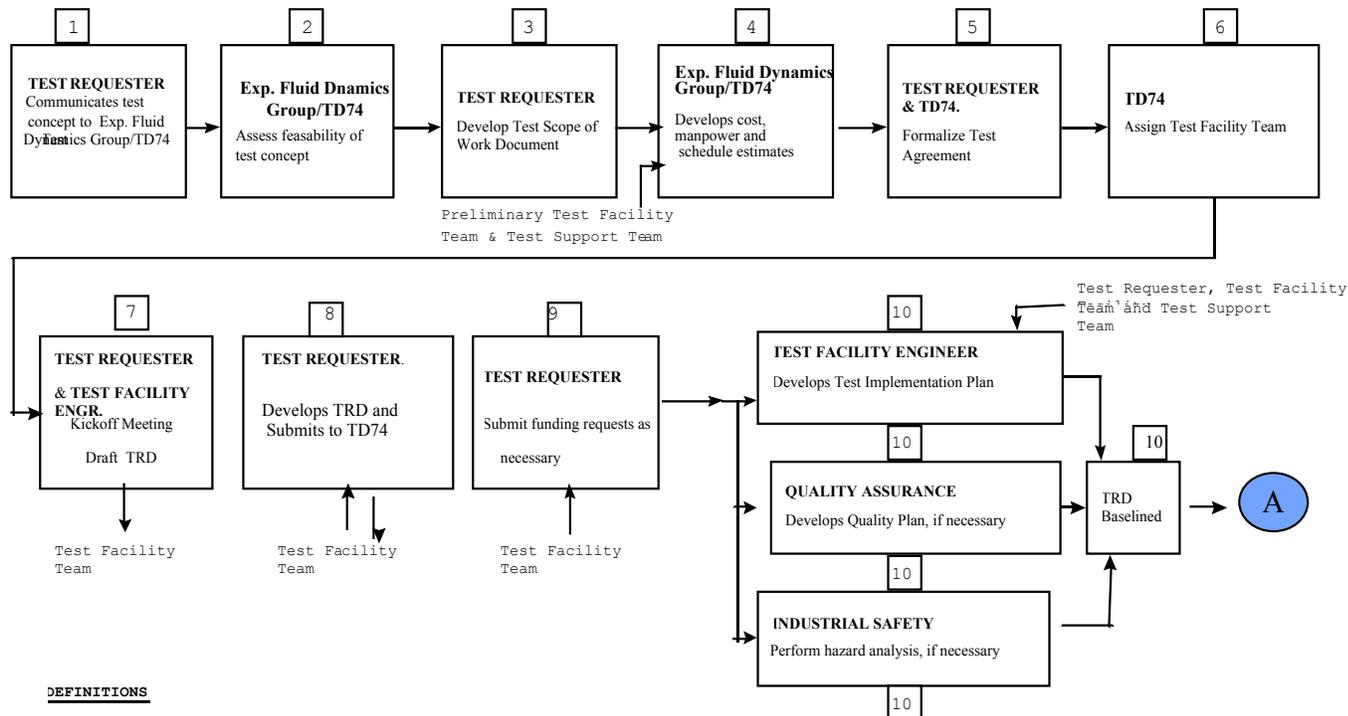
Personnel who operate ET12 test facilities can require operator and/or specific safety-related training/certification as warranted by facility complexity, hazard analysis, etc. Reference individual ET12 test facility standard operating procedure OWI for training/certification requirements as applicable to that facility. Qualified/trained facility operators shall be identified/documented via Memorandum of Record issued by the ET12 Group Lead. The Test Facility Engineer shall be responsible for making test personnel aware of the hazards associated with the operation of a facility and location/use Personnel Protective Equipment (PPE) in the performance of a test project.

12.0 Flowcharts

The flowcharts for this procedure are on the following pages.

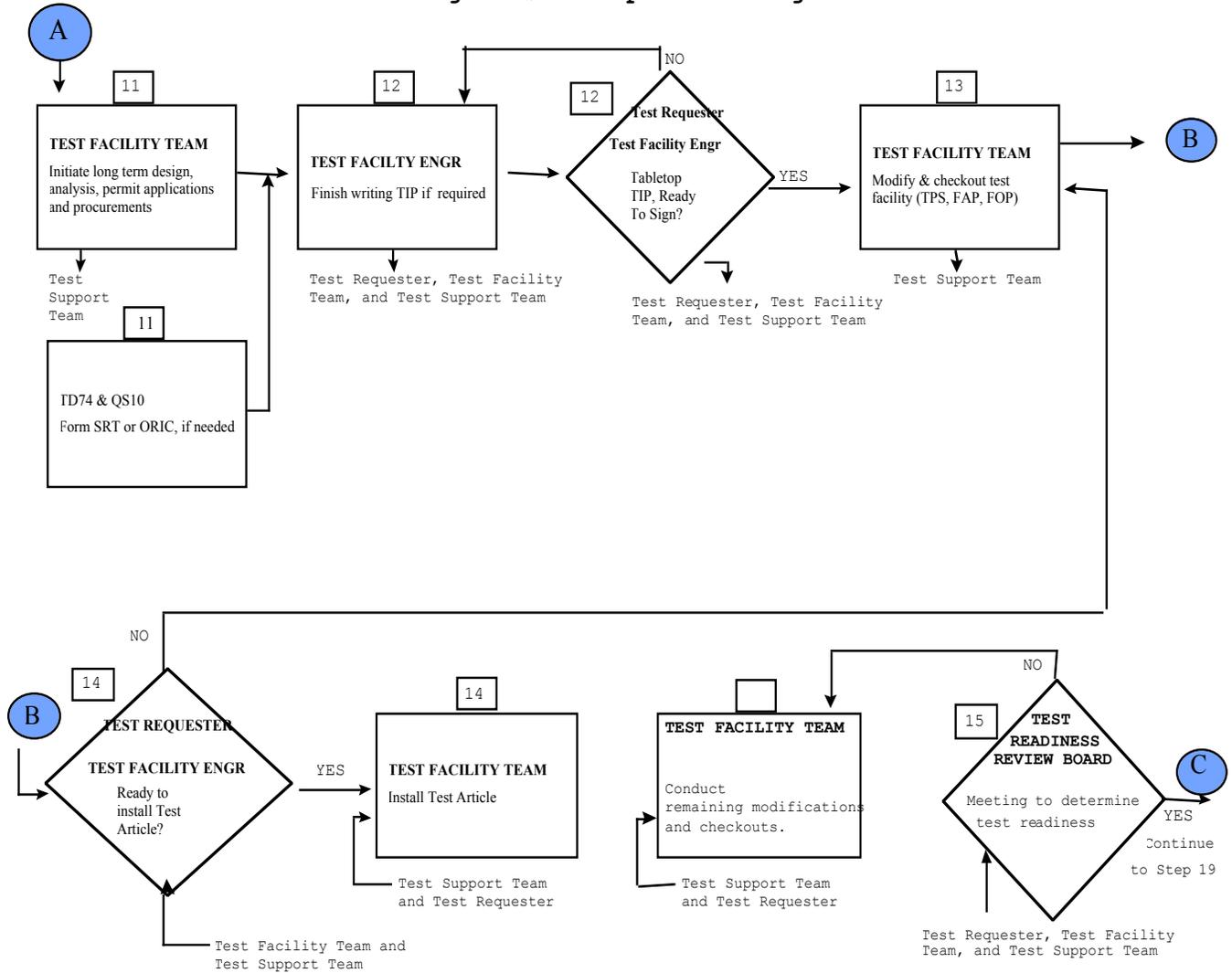
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Flow Diagram #1 - Exp. Test Project Process



Experimental Test Project Process Flowchart

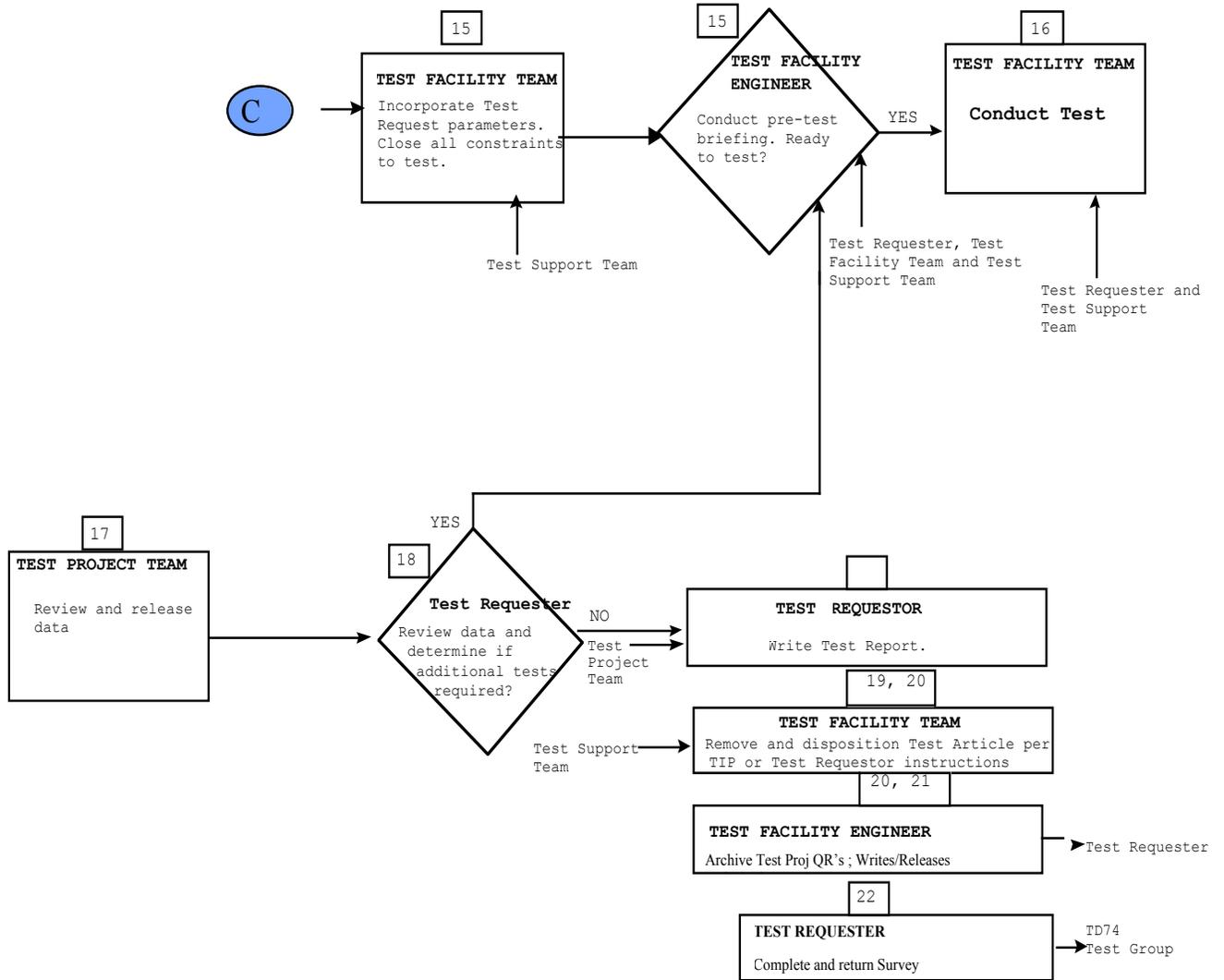
Flow Diagram #1 - Exp. Test Project Process



Experimental Test Project Process Flowchart

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Flow Diagram #1 - Exp. Test Project Process



Experimental Test Project Process Flowchart

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APPENDIX A - TEST SCOPE OF WORK GUIDELINES

This document is intended as a guide for use in preparing a Test Scope of Work (TSOW). The purpose of the TSOW is to provide a vehicle for communicating certain key parameters concerning a proposed Test Project. This information is used by ET12, Experimental Fluid Dynamics Group in formulating a cost and manpower estimate for the test project under consideration. The expected content of the TSOW is outlined below, with questions and/or statements that are intended to communicate the type of information to be included in each section along with possible options for each requirement. While much of this information is not known at the early stages of the test project, it is important that the test requester specify as much as possible. Any information that is not known at this time can be indicated as TBD.

A.1 TEST PROJECT DESCRIPTION

In general terms, what will be tested and how?

A.2 TEST REQUIREMENTS MATRIX

Specify conditions for each individual test required.

A.3 CUSTOMER SUPPLIED HARDWARE

List any hardware, to be supplied by customer (mechanical and electrical), as well as any special test equipment.

A.4 TEST FACILITY SUPPLIED HARDWARE

List hardware to be supplied by test facility (mechanical and electrical), as well as any special test equipment.

A.5 FLUID/GAS REQUIREMENTS

A.5.1 Test article flow media:

List fluids/gases used with flowrates, temperatures and pressures

A.5.2 Test article run tanks:

List required tank volumes, working pressures, fill rates, and pressurization gases

A.5.3 Purge requirements for test article

Pretest, posttest, during test, flowrates, media

A.5.4 Facility tanking/feed requirements

Specific requirements for facility storage tanks or feed systems.

A.6 GENERAL ELECTRICAL INTERFACE REQUIREMENTS

A.6.1 Connections

A.6.1.1.1 Electrical interface panels?

A.6.1.1.2 Mating connectors provided?

A.6.2 Calibrations

Any special calibrations to be performed at the test facility

A.6.3 Other special electrical requirements

A.7 MEASUREMENT REQUIREMENTS

A.7.1 Parameter Type (i.e. pressure, temperature, etc.)

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APPENDIX A -TEST SCOPE OF WORK GUIDELINES (CONTINUED)

A.7.2 Amplitude Range (i.e. 0-100 PSIG)

A.7.3 Required Frequency Range (i.e. 0-500 Hz)

A.7.4 Allowable Experimental Error Tolerance

(Note: Greater accuracy costs more time and money)

A.7.5 Special Sensor Environments Required

A.8 CUSTOMER SUPPLIED INSTRUMENTATION

Will transducers or special conditioning equipment be supplied as part of the test article? If so, list the type and quantity.

A.9 DATA REQUIREMENTS

What are the sample rates required?

What are the data display and/or data processing requirements?

A.10 TEST CONTROL REQUIREMENTS

A.10.1 Test Article Control System

Will the test article include an independent control system? If so, who will operate (test requester or testing organization)?

A.10.2 Facility Control System

Will facility control system control the test article? If so, what parameters will the facility system be required to control? Describe each.

A.10.3 Redline Limit Requirements

Quantity, type, parameter, response rates and required actions?

A.10.4 Pressurization/Vent Systems

Will facility systems be required to control pressurization and/or venting of test article tanks or vessels?

A.11 PHOTO/VIDEO/HIGH SPEED FILM REQUIREMENTS

A.11.1 Still photography

A.11.2 High-speed film recording (slow motion playback/freeze-frame)

A.11.3 Regular video recording

A.11.4 Other special requests

A.12 ENVIRONMENTAL CONDITIONS TEST REQUIREMENTS

Fully describe any environmental conditions or launch profile simulations to which the test article is to be subjected.

A.12.1 Temperature

A.12.2 Heat Load

A.12.3 Pressure

A.13 TEST OPERATIONS REQUIREMENTS

A.13.1 Pre Test Operations/Checkouts

A.13.2 Facility/Test Article Integrated Checkouts

A.13.3 Test Conduct

A.13.4 Post Test Operations

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APPENDIX A -TEST SCOPE OF WORK GUIDELINES
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A.14 TEST PROJECT SCHEDULE REQUIREMENTS

A.14.1 Expected Test Article Delivery Date

A.14.2 Required Test Frequency (including time for data analysis)

A.14.3 Test Completion Deadlines

A.15 APPENDICES

A.15.1 Test Article Drawings

A.15.2 Customer Reference Drawings

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APPENDIX B - TEST REQUIREMENTS DOCUMENT GUIDELINES

This document is intended as a guide for use in preparing a Test Requirements Document (TRD). The expected content of the TRD is outlined below, with questions and/or statements that are intended to communicate the type of information to be included in each section along with possible options for each requirement. While much of this information requires an ongoing technical interchange between the test requester and the testing organization, it is ultimately the responsibility of the test requester to define the requirement as outlined below. This information can be contained within another document of larger scope or with a different name. If so, please reference the name of the document, which provides the required information.

B.1 INTRODUCTION

Program Overview

Describe the big-picture view of the overall program that this Test Project will support.

Test Project Purpose

Is this program intended to provide R&D data, prototype verification or flight qualification data?

Test Project Scope

What will be the scope of this Test Project? In general terms, what will be tested and how? (This scope should match what was specified in the Task Agreement. Any changes must be submitted through the formal process for Task Agreement changes with resulting re-negotiation of cost.)

B.2 TEST OBJECTIVES

Primary/Secondary Objectives

What will be learned from the data?

How will the data be used?

Spectrum Analysis

Transient Analysis

Modal Analysis

Signature Analysis

Thermal Analysis

Mathematical Analysis

Thumbprint Analysis

Static Load Analysis

Success Criteria

What will constitute a successful test vs. a non-successful test?

Specify the pass/fail criteria for the test article?

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APPENDIX B - TEST REQUIREMENTS DOCUMENT GUIDELINES
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B.3 OVERALL TEST REQUIREMENTS

Test Matrix

Specify conditions for each test required

Test Profiles

Specify all profiles for each test

Flow chart of typical test sequence

Summarize a sequence of any testing events required

B.4 CUSTOMER SUPPLIED HARDWARE

Test Article Description

Overall description of the entire test article hardware to be supplied by customer including all mechanical, instrumentation and control equipment.

Special Test Equipment

Describe any special test equipment that is supplied by the customer, such as special interface hardware, fittings or adapters.

Other Available Hardware

Describe any additional hardware that will be available to the test organization, such as test article installer hardware or test article mockup for use in fabricating and configuring facility interface hardware.

B.5 TEST CONFIGURATION REQUIREMENTS

Test Article/Facility Configuration Requirements

Include copies of the test article configuration where this is necessary to illustrate facility interface or configuration requirements unique to this Test Project.

B.6 TEST ARTICLE PREPARATION REQUIREMENTS

Handling

List any requirements for handling flight hardware?

List any requirements for handling Program Critical Hardware?

Cleanliness

Instrumentation

Installation

Removal and Disposition

B.7 TEST FACILITY REQUIREMENTS

For the following types of systems specify all required interfaces (including type, size, connections, etc.):

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APPENDIX B - TEST REQUIREMENTS DOCUMENT GUIDELINES
(CONTINUED)

Structural Requirements

Gas Systems

Water Systems

Hydraulic Systems

GSE Requirements

Certification Requirements for GSE, facility systems, etc.

Other Test Facility Requirements

B.8 TEST ARTICLE ELECTRICAL INTERFACE/POWER REQUIREMENTS

Specify voltage, current and frequency of power requirement, as well as connector type, for each electrical interface listed below:

Valves (EHV, EMA and Pneumatic)

Motors

Heaters

Test Article Control System

Test Article Power Supply

Other Control Parameters

B.9 GENERAL ELECTRICAL INTERFACE REQUIREMENTS

Connections

How will electrical connections to test article be achieved? Describe any electrical interface or standard connector panels that test facility wiring must adapt to.

Will mating connectors and pin-out information be provided for all electrical interface points?

Does this Test Project require any special cable fabrication from the test facility?

Grounding

List any specific requirements for electrical grounding schemes required for interconnections with the test article. (Absent any specific requirements, standard test facility grounding schemes will be utilized.)

Calibrations

Does the Test Project require any special electrical calibrations to be performed by our facility?

Other special electrical requirements

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APPENDIX B - TEST REQUIREMENTS DOCUMENT GUIDELINES (CONTINUED)

B.10 MEASUREMENT REQUIREMENTS

Parameter Type (i.e. pressure, temperature, etc.)

Amplitude Range (e.g. 0-100 PSIG)

Required Frequency Range (e.g. 0-500 Hz)

Allowable Experimental Error Tolerance

(Note: Greater accuracy costs more time and money)

Calibration Requirements (**for test article measurements**)

Sensor Environment

Critical measurements

List all critical measurements required to proceed with testing

B.11 DATA REQUIREMENTS

Required sample rates

High frequency data requirements

Time-domain data required?

Frequency-domain data required?

Real time display requirements

Processing requirements

Access requirements

- Preferred media for data delivery/access (i.e. download from server, floppy disk or hard copy plot)

- Preferred file format for data delivery/access

Data analysis - Describe any post test data processing to be performed by the testing organization, such as spectrum analysis, waterfall plots, etc.

B.12 TEST CONTROL REQUIREMENTS

Test Article Control System

Will the test article include an independent control system?

If so, what interface signals will be required between the test article controller and the facility automated control systems?

What safety override functions or actions are required of the facility control systems in the event of failure of the test article control system?

Who will be responsible to operate the test article control system, test requester or testing organization?

Facility Control System

Will the facility control system implement control of the test article?

If so, what type of logic will be required of the facility control systems? Describe any safety interlocks, ladder logic, etc.

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How many test article parameters will the facility system be required to control?

Describe each.

What type of automatic redline shutdowns are required for this Test Project? (i.e., Absolute limits, timed activation of limits, rate-of-change limits or allowed variation around a dynamic limit.)

What types of parameters will be monitored for redline limits? (i.e. temperature, pressure, vibration, accelerometer, calculated parameters, etc.)

What response rates are required for redline shutdowns?

What actions are required as a result of redline limit violations?

Approximately how many redline parameters will be required?

Checkout/Verification

What type checkout/simulation capability will be required to verify automated control capabilities? For the test article control system? For the facility control system?

B.13 PHOTO/HIGH SPEED FILM REQUIREMENTS

Still photography

Locations to be photographed

Number of copies

Media (Prints or on-disk for presentations, etc.)

High-speed film (for slow motion or freeze-frame playback)

Specific locations or operations to be filmed

Frames per second on high speed film

IRIG Timing

Media for delivery and number of copies

Other special requests

B.14 VIDEO RECORDING REQUIREMENTS

Type of recording

Infrared camera

Normal video recording

Sound recording

Specifics of requirement

Specific locations or operations to be filmed

IRIG Timing

Media for delivery and number of copies

B.15 ENVIRONMENTAL CONDITIONS TEST REQUIREMENTS

Fully describe any environmental conditions to which the test article is to be subjected.

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APPENDIX B - TEST REQUIREMENTS DOCUMENT GUIDELINES
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Temperature

What environmental heating or cooling conditions are required? Fully describe these, including required temperature distribution or gradients, rate of change, duration and sequences.

If heating is required, is radiant heat or convection heating required?

Heat Load

Fully describe any heat transfer requirements, including heat flux rates, etc.

Pressure

Required rate of change, duration and sequences.

B.16 TEST OPERATIONS REQUIREMENTS

Pre Test Operations/Checkouts

Facility/Test Article Integrated Checkouts

Test Conduct

Test Requester Roles/Responsibilities

Test Conductor Authority

Control Room Protocol Requirements

Post Test Operations

Required inspections

Required operations

B.17 TEST PROJECT SCHEDULE REQUIREMENTS

Expected Test Article Delivery Date

Required Test Frequency (including time for data analysis)

Test Completion Deadlines

Desired completion date

“Must have” completion date

B.18 QUALITY ASSURANCE/SAFETY REQUIREMENTS

Certification

Certification requirements for test area personnel

Certification requirements for test facility GSE or special handling equipment

Quality

Test requester approval of work

Special anomaly resolution system requirements

Approval authority to proceed with testing

Security

List any special security requirements for this Test Project, such as limited access to test hardware or test data, etc.

Safety

Special safety precautions pertaining to this Test Project

List hazardous operations required by this Test Project

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APPENDIX B - TEST REQUIREMENTS DOCUMENT GUIDELINES
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List any special safety reviews or test readiness reviews, etc. required for this Test Project.

Hazardous Materials

List any materials to be handled which will require a Material Safety Data Sheet.
List any effluents (along with levels or quantities expected) produced by the test article.

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APPENDIX C - TEST IMPLEMENTATION PLAN GUIDELINES

This document is intended as a guide for use in preparing a Test Implementation Plan (TIP) when warranted. The expected content of the TIP is outlined below, with questions and/or statements that are intended to communicate the type of information to be included in each section along with possible options for each requirement. In general, the TIP explains how each requirement in the TRD will be satisfied. It is important for the Test Project Engineer to write the TIP in his own words reflecting back his understanding of the requirements specified in the TRD

C.1 Test Project Description

Reference the appropriate Test Requirements Document. Describe what is to be included in the scope of this Test Project, with emphasis on any issues, impacts or concerns relative to test operations.

C.2 Test Execution Summary

This section will include a written summary of required test operations activities, including any multiphase testing, hardware change-outs, or intermediate data reviews that will effect the overall progress of test activities. This section will include a summary of major sequence of events and milestones for entire Test Project in a Gantt chart schedule format. For each pertinent task in the list below, this section will also include a description of the type of documentation required (work authorization document, facility operation procedures, etc.) as well as the responsible organization for each task specified.

- C.2.1 Facility design, fabrication and modification
- C.2.2 Special test equipment fabrication and integration
- C.2.3 Major procurements (data systems, thrust measurement systems etc.)
- C.2.4 Test article receipt and inspection
- C.2.5 Test article handling, transportation and processing
- C.2.6 Test article integration into test facility
- C.2.7 Systems installation and checkout/verification
- C.2.8 Test Readiness Reviews
- C.2.9 ORI or Safety Reviews
- C.2.10 Test operations
- C.2.11 Post-test activities
- C.2.12 Data reviews and analysis
- C.2.13 Test article removal and disposition
- C.2.14 Data and report deliveries

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APPENDIX C - TEST IMPLEMENTATION PLAN GUIDELINES
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C.3 Facility Systems Application/Modifications

Tell how the capabilities of existing facility systems will be applied or modified to meet specific requirements not obvious from the test execution details above. For example, we might utilize existing facility data system to provide data on certain parameters at a specified accuracy, or we might have to upgrade our existing facility PLC to provide a required response time in controlling a certain sequence of events.

C.4 Special Test Equipment Required

List and describe any special test equipment (STE) required. Specify who is responsible to design and fabricate STE. Describe how and where it will be integrated into existing facility systems, as well as any checkouts or verifications required to ensure its proper operation.

C.5 Deliverables

List deliverable items required to satisfy the TRD. Include a description of test data requirements (measurement parameters, file types, access requirements, plotted data requirements, etc.) as well as a description of any required test reports, summaries, etc.

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APPENDIX D – TEST Readiness Review GUIDELINES

Test Readiness Review will be conducted for tests prior to testing in ET12 facilities and shall typically address the following topics:

D.1 Test requirements and/or objective

Identify and review briefly the current test requirements. Satisfy that all prerequisite tests and analysis have been completed and/or acceptable waivers/deviations exist.

D.2 Pretest analysis status

Assess the proposed methods for compliance with objective, intent, and philosophy. Satisfy that all equipment utilized in performing the test meets specified requirements and is ready to support test.

D.3 Test Article Hardware status

The as built versus design configurations of the test article will be reviewed by evaluating all deviations and waivers.

D.4 Facility and Interface status

The requirements the test facility must meet will be reviewed and it must be shown that the facility has been configured to meet those requirements. Interface redlines which are imposed on the test configuration will be reviewed and assessed. The proper definition limits to be set, necessity of the redline, constraint or control of test operations and shutdown modes will be reviewed.

D.5 Test documentation status

Assess the test plan against current OWI Standard Operating Procedures. Assure that any changes have been reviewed and approved.

D.6 Test Staffing and/or certification status

Special personnel certification or training shall be reviewed during the TRR. Prior to start of testing, it must be shown that a full complement of certified test team personnel are available.

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APPENDIX D – TEST Readiness Review GUIDELINES
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D.7 Hazard analysis status

A summary report of applicable hazard analysis will be presented and reviewed for appropriate controls. Endorsement of the Safety Office for acceptability will be shown.

D.8 Safety Review committee status (as required)

D.9 Operational Readiness Inspection (as required)

D.10 Open Work status

All tests containing open work shall be reviewed. Schedules and procedures in place to assure satisfactory completion prior to test will be assessed for adequacy. Review any open work issues with tentative completion dates and Actionee assigned.

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Appendix E - Test Completion Report (TCR) GUIDELINE

The following is suggested content for a typical TCR. Actual report format/content may vary depending upon the test scope/complexity.

- INTRODUCTION
- TEST OBJECTIVE
- TEST ARTICLE DESCRIPTION
- TEST FACILITY/RIG/CONFIGURATION DESCRIPTION
- TEST INSTRUMENTATION/DATA ACQUISITION SYSTEM
- TEST OPERATION/PERFORMANCE w/ RUN MATRIX
- RESULTS/PRODUCT w/ any ANOMALIES
- LESSONS LEARNED
- References (OI's, Memos, etc.)
- TPS list
- Personnel (i.e. Test Support Team members)
- Calibration Discrepancy Reports (if any, usually an addendum)
- CUSTOMER FEEDBACK FORM (See Appendix F "CUSTOMER SATISFACTION SURVEY")

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APPENDIX F- CUSTOMER SATISFACTION SURVEY
NASA MFSC Experimental Fluid Dynamics/ET12

Please take the time to fill out the following survey so we may better serve you in the future. You may FAX your completed survey to George Gerry, Experimental Fluid Dynamics Group/ET12 at (256) 544-9388 or E-mail to George.B.Gerry@nasa.gov. --Thank You--

Please use the following numeric rating scale to score each:

<u>Excellent</u>	<u>Good</u>	<u>Average</u>	<u>Poor</u>	<u>Unsatisfactory</u>
5	4	3	2	1

Rating

_____ 1) How would you rate your overall experience with the Experimental Fluid Dynamics Group/ET12?

_____ 2) How well did ET12 test services meet your overall expectations?

_____ 3) How well did ET12 test services satisfy your overall requirements?

4) How would you judge the following attributes of ET12 personnel?

_____ A) Experience

_____ B) Knowledge

_____ C) Attitude

_____ D) Performance

5) How would you judge the following attributes of ET12 test facility(s)?

_____ A) Safe

_____ B) Efficient

_____ C) Well-maintained

_____ D) Adequacy in meeting requirements

_____ 6) Did the quality of the product meet your specifications?

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APPENDIX F-CUSTOMER SATISFACTION SURVEY
(CONTINUED)

- _____ 7) Was the product delivered on-schedule?
- _____ 8) How well did ET12 accommodate changes to your proposed schedule?
- _____ 9) In your judgement was the test service provided cost efficient?
- _____ 10) In your judgement was the test service provided time efficient?
- _____ 11) Based upon your recent experience, would you consider doing business with ET12 in the future?

YES or NO

What one thing should be addressed/changed to improve your experience with doing business with ET12?

We value your comments/improvement suggestions so that we may better serve the needs of our customers.
