ALPHA MAGNETIC SPECTROMETER - 02 (AMS-02) ASSEMBLY AND TESTING INTEGRATION PLAN

Engineering Directorate

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Alpha Magnetic Spectrometer – 02 Assembly and Testing Integration Plan

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Change Record

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Draft	2/21/06	M. Rucker/x45569 T. Martin/x33296	Draft
A	2/3/09	M. Fohey/ESCG/ 281-461-5684	Added AMS Collaboration documentation requirements for ground operations at CERN and ESTEC Added AMS Task Sheet (ATS) Instructions as Appendix B

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1.0 PURPOSE

This plan documents the roles, responsibilities, and authorities required to integrate and test collaborator-provided items into the Alpha Magnetic Spectrometer (AMS)-02 payload assembly. These activities will occur at several locations throughout Europe with the primary integration taking place at CERN in Geneva. This Integration Plan does not cover integration at the NASA Kennedy Space Center. All requirements associated with KSC are documented as part of the KSC Technical Requirements Dataset and KSC Support Requirements Dataset of the Payload Data Library.

2.0 SCOPE

This document defines the management roles and responsibilities, the technical activities, interfaces, list of deliverables, and schedule requirements to complete AMS payload integration and testing.

This plan covers Structural Test Article (STA) integration and testing, as well as payload final assembly, integration, testing, and delivery.

3.0 APPLICABLE DOCUMENTS

All applicable documents for the AMS project can be found in Section 3.0 of the AMS-02 Project Plan (JSC-27296).

4.0 DEFINITIONS

The following definitions are unique to this document and do not supersede definitions provided in other procedures or documents. Refer to Appendix A for a list of the acronyms used within this document.

- **Concur:** Agreement with the content, preferably via e-mail or other written communication, of hardware/service provider presentations, review packages, etc. Concurrence does not imply signature authority.
- **Collaborator:** Organization responsible for providing a product (such as hardware or software), service (such as design, test, or analysis), or funding to the AMS Project.
- **AMS Payload:** The flight hardware is referred to as the “AMS Payload” and is comprised of two parts: the “AMS Experiment” provided by the international AMS Experiment Collaboration and the “AMS Payload Integration Hardware (PIH)” provided by the National Aeronautics and Space Administration (NASA).

- **Insight:** Insight constitutes surveillance/screening of hardware/service provider-managed tasks. Surveillance and screening of tasks provides accurate assessments of the hardware/service provider's activities and overall performance to ensure process capability, product quality, and end-item effectiveness. Insight relies on gathering a minimum set of product or process data to provide adequate visibility into the integrity of the product or process. This data may be acquired from hardware/service provider's records, usually in a non-intrusive, parallel method.

- **Oversight:** Oversight constitutes managing and directing day-to-day tasks.

5.0 PAYLOAD OVERVIEW

5.1 Payload Description

The AMS payload is a state-of-the-art particle physics detector containing a large, cryogenic superfluid helium, superconducting magnet. The AMS payload will use the unique environment of space to advance knowledge of the universe and potentially lead to a clearer understanding of the universe's origin. Specifically, the science objectives of the AMS are to search for cosmic sources of antimatter, dark matter, and dark energy.

5.2 AMS-02 Payload Configuration

The AMS-02 payload configuration is fully defined in JSC-29095 (Experiment/Payload Integration Hardware Interface Control Document). The payload is comprised of 6 major detectors:

1) Transition Radiation Detector and associated Gas System,

2) Time of Flight Counters,

3) Tracker,

4) Ring Imaging Cerenkov Counter,

5) Electromagnetic Calorimeter, and the

6) Anti-Coincidence Counters.

The payload also includes several small subsystems that will be integrated during the installation of the major detectors. They include the Star Trackers and the Global Positioning System. The payload includes several large subsystems that support the major detectors. They include:

1) Experiment Electronics,

2) Thermal Control System, and the

3) Superconducting Cryogenic Magnet.

6.0 ROLES

6.1 National Aeronautics and Space Administration (NASA)

In addition to providing the Payload Integration Hardware defined in JSC-29095, NASA serves as the overall payload integration authority. Additionally, NASA/Johnson Space Center (JSC) will serve as the overall flight and ground safety certification authority at the all NASA facilities. NASA will provide flight safety certification and specify/inspect for all requirements that impact flight safety at all Collaborator facilities. Although not covered by this document, the NASA/Kennedy Space Center (KSC) will provide specialized test facilities, support equipment, and personnel to integrate the payload into the Shuttle Orbiter payload bay at KSC.

NASA JSC will also provide some of the specialized ground support or test equipment to CERN and test sites as defined in JSC-29095.

6.2 European Organization of Nuclear Research (CERN)

CERN, together with the Other Collaborators listed in Section 6.7, will provide the specialized facilities, support equipment, and personnel to support final payload assembly and integration testing. This will include local facility safety, security, configuration management, quality control and assurance, and test planning and conducting.

6.3 European Space Agency (ESA)

ESA will provide specialized test facilities, support equipment, and personnel to support the structural test article magnet acoustic test, assembled payload thermal vacuum testing, and assembled payload Electromagnetic Interference/Electromagnetic Compatibility (EMI/EMC) testing. Testing will be conducted in the European Research and Technology Center (ESTEC) in Noordwijk, the Netherlands.

6.4 Industrieanlagen-Betriebsgesellschaft (IABG)

IABG will provide specialized test facilities, support equipment, and personnel to support the integrated modal and static testing of the Structural Test Article. Testing will be conducted in Munich, Germany.

6.5 Space Cryomagnetics Limited (SCL)

SCL will provide specialized facilities, support equipment, and personnel to support the integration of the magnet system into the payload assembly. Integration will be conducted in Culham, England.

6.6 Istituto Nazionale di Fisica Nucleare (INFN) Perugia

INFN will provide specialized facilities, support equipment, and personnel to support the sine-sweep test of the Structural Test Article magnet. Testing will be conducted in Terni, Italy.

6.7 Other Collaborators

The following collaborators support the project by providing payload hardware and/or funding, per established agreements:

- I. Physikalisches Institu Bt., RWTH Aachen – Germany
- III. Physikalisches Institu, RWTH Aachen - Germany
- University of Aarhus - Denmark
- National Institute for Nuclear Physics and High Energy Physics – The Netherlands
- Laboratoire d'Annecy-le-Vieux de Physique des Particules - France
- Johns Hopkins University - USA
- Beijing Institute of Spacecraft Environment Engineering - China
- Institute of Electrical Engineering - China
- Institute of High Energy Physics - China
- Universita di Bologna & INFN-Sezione di Bologna - Italy
- Institute of Microtechnology, Institute for Space Science and University of Bucharest - Romania
- Massachusetts Institute of Technology - USA
- National Central University - Taiwan
- University of Maryland - USA
- Kyungpook National University – South Korea

- National Aerospace Laboratory – The Netherlands
- Instituto di Ricerca sulle Onde Elettromagnetiche – Italy
- Max-Planck Institut fur Extraterrestrische Physik – Germany
- Universite de Geneve – Switzerland
- NASA Goddard Space Flight Center – USA
- Laboratoire de Physique Subatomique et de Cosmologie & Universite J. Fourier – France
- Sun Yet-sen University – China
- National Space Program Office – Taiwan
- Shandong University – China
- Universitat Karlsruhe – Germany
- Helsinki University of Technology – Finland
- Laboratorio de Instrumentacao e Fisica Experimental de Particulas – Portugal
- Chung-Shan Institute of Science and Technology – Taiwan
- Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas – Spain
- Universidad Nacional Autonoma de Mexico – Mexico
- Universita di Milano-Bicocca & INFN-Sezione di Milano – Italy
- Universite Montpellier – France
- Institute of Theoretical and Experimental Physics – Russia
- Institute for Space Research – Russia
- Kurchatov Institute – Russia
- Lomonosov Moscow State University – Russia
- Southeast University – China
- Yale University – USA

- INFN-Sezione di Perugia & Universita degli Studi di Perugia – Italy
- INFN-Sezione di Pisa and Universita di Pisa – Italy
- Aganzia Spaziale Italiana – Italy
- INFN-Sezione di Roma and Universita di Roma – Italy
- Ewha Womens University – South Korea
- Shanghai Jiaotong University – China
- INFN-Sezione di Siena and Universita di Siena – Italy
- National Cheng Kung Univeristy – Taiwan
- Academia Sinica – Taiwan
- Florida A&M University – USA
- Instiuto de Astrofisica de Canarias – Spain
- Center for Advanced Research in Space Optics – Italy
- University of Turku – Finland
- Eidenossische Technische Hochschule – Switzerland
- Other Collaborators

7.0 RESPONSIBILITIES AND AUTHORITIES

Responsibility for assuring the definition, control, implementation, and accomplishment of the activities identified in this document is vested with the Collaborators as established in subsequent sections of this document. These Collaborators shall support integration activities and the scheduled completion dates of the items contained in Section 9.0. Overall responsibility for the preparation and configuration management of this Integration Plan lies in the NASA AMS Project Office.

7.1 Payload Integration and Test Manager (PIT Manager)

NASA JSC and/or the Collaboration, as assigned by a letter issued jointly by Prof. Ting and the NASA JSC APO, will provide a Payload Integration and Test (PIT) Manager to oversee the overall integration and testing process. The PIT Manager position may be filled by one person or a team of people. The PIT Manager is responsible to coordinate day-to-day operations during integration and testing and has final authority for all

operations that occur on the integrated payload and during integrated testing. The PIT Manager is also responsible to coordinate with the Experiment Integration and Test Manager as well as the Experiment component leads for all integration and testing issues that affect experiment components. The PIT Manager has final signature authority for all documentation developed or used during the assembly and testing process. The PIT Manager may choose to delegate this authority to assembly or test personnel as required for the particular circumstance. This delegation must be made in writing.

7.2 Experiment Integration and Test Manager (EIT Manager)

As part of the PIT Management team, the AMS Collaboration will provide an Experiment Integration and Test (EIT) Manager to coordinate with each of the Experiment Detector Organizations and other subsystem organizations to ensure that all integration and test activities meet that specific organizations needs.

7.3 Hardware Providers

Any organization that provides hardware to be integrated into the overall payload is considered a hardware provider. All hardware providers must coordinate all integration and integrated testing activities with the EIT Manager and PIT Manager to ensure that a properly scheduled, safe work environment is followed in the integration and test facilities. Each hardware provider must provide appropriate personnel to disposition discrepancy reports that will likely occur during the integration process.

7.4 Facility Manager

CERN, together with the Other Collaborators, or specific test facilities will provide a Facility Manager who is responsible for the overall facility operations. The Facility Manager is responsible to ensure that all procedures developed for Integration and Testing are safe and meet the requirements of CERN or the specific test facility.

7.5 Assembly Technicians

Both NASA and the AMS Collaboration will provide assembly technicians as required to support integrated activities. Scheduling of the technicians will be coordinated through the EIT and PIT Managers. All technicians will be required to go through a short training course prior to work in an integration facility. This training will include safety requirements, integration requirements, and roles and responsibilities.

7.6 Hardware and Software Specialists

Each collaboration organization will provide hardware and software specialists during the integration of their specific hardware. Scheduling of these specialists will be coordinated through the EIT and PIT Managers.

7.7 Test Technicians

NASA, the AMS Collaboration, and the test facilities will provide test technicians during integrated testing. Scheduling for these technicians will be coordinated through the EIT and PIT Managers.

7.8 Safety

The PIT Manager will utilize the safety regulations set in place at each of the integration or test facilities. The PIT Manager has the authority to add any additional safety requirements required for safe integration and testing of the payload.

Note: Integrated hazards for flight and ground safety at KSC are completely defined in the ground and flight safety data packages and are not addressed as part of this integration plan.

7.9 Quality Control and Inspectors

Each Collaboration Organization is responsible for quality control and inspection until the hardware enters the integrated payload assembly area.

Quality Control and Inspection inside the integrated assembly area will be provided by NASA and the AMS Collaboration. On a periodic basis, NASA reserves the right to have an outside quality inspector audit the process and records. Procedures, processes, and schedules will be coordinated with the EIT and PIT Managers. Procedures must be in compliance with the Quality Management Plan for the AMS-02 Experiment (JSC-63164).

Each organization or institution should identify all pertinent data required to manufacture, fabricate, inspect, use or maintain its hardware or software in the flight configuration. These should include drawings, part lists, and specifications necessary for the approved configuration and design features. Also, information on materials, processes, type of manufacturing and assembly necessary for product conformity should be available to the entire team at the Assembly Facility.

Each organization or institution is responsible for the quality of ***all*** products purchased from suppliers *(or otherwise provided e.g. barter, agreement, trade, etc.)*. The organization or institution should have processes and procedures for inspection and/or testing of hardware or software upon receipt, method for documenting and tracking limited life items, or other activities to ensure that the products meets the specified requirements.

8.0 PROCESSES

8.1 Hardware Receiving

For all hardware that arrives at the Assembly Facility, a hardware receiving protocol will be established by the PIT Manager that ensures that all flight hardware is properly maintained in a controlled location. All movements of the hardware will be properly documented, authorized, and tracked via an electronic inventory system (Note: This can be as simple as a spreadsheet or database).

All non-flight hardware will also be tracked using a separate electronic inventory system, however, this hardware does not require controlled storage and may utilize a lower signature authorization level at the discretion of PIT Manager.

8.2 Assembly and Testing

8.2.1 Workmanship Standards

For all hardware that has entered the Assembly Facility, the PIT Manager, in coordination with the EIT Manager, will establish criteria for workmanship that are easily understood *(e.g., written standards, representative samples, or illustrations).*

8.2.2 Non-Conforming Materials

For all hardware that has entered the Assembly Facility, the PIT Manager, in coordination with the EIT Manager, will have detailed processes and procedures for identifying and controlling nonconforming products. Records of non-conformances and subsequent actions *(e. g., dispositions)* must be reported and documented. An appropriate Discrepancy Reporting system must be put in place.

8.2.3 Assembly Process

The Assembly Process will follow the Master Assembly Schedule that is developed as described in Section 9.1. All steps in the Assembly Process will follow written instructions. The written instructions, or build books, will be approved by the PIT manager and developed by the assembly team. The AMS Task Sheet (Form ATS-1225) shall be used to document all integration work performed. If the scope of the work changes during implementation or cannot be performed exactly as indicated on the ATS, an ATS Modification (Mod) Sheet must be written and approved by the NASA DV at CERN or by NASA QA. An ATS cannot be changed once approved.

Instructions for preparing the Form ATS-1225 and the ATS Mod Sheet are provided in Appendix B of this document.

A standard process will be implemented and each Hardware Provider will be required to provide the portions of the build books related to their hardware. This will assure that all personnel in the integration facility will be using the same process for assembly, quality control, safety and testing.

Once hardware has entered the Assembly Facility, the PIT Manager will take possession of the hardware and will control its movements within the facility and its integration into the overall payload per agreed procedures that have been coordinated with the EIT Manager and the specific collaboration organization that owns the hardware. The PIT Manager will assign assembly leads to act in his place should he not be available. This will ensure that a single point of contact will be controlling activities in the assembly facility at all times.

Since the AMS Collaboration is spread across the globe, CERN/MIT will provide a system of web-based cameras which will be installed in the facility and broadcast over a secure internet site. This will allow collaboration members to keep informed of the progress of the integration work. This will also facilitate teleconferences with different facilities across the globe.

8.2.4 Testing Process

The test schedule for each test will be developed and maintained by the PIT Manager in coordination with the EIT Manager and the Test Facility Manager. All activities in the Test Facilities will be properly scheduled to ensure the most efficient and safe testing process. Late activities that will inevitably be added to the schedule must have the approval of the PIT Manager and Test Facility Manager before work can begin.

A Test Plan will be developed for each test and submitted for review by the testing team at least 30 days prior to the test. A Test Readiness Review will be performed for each test.

AMS payload requirements during the different test phases shall be properly documented by the AMS collaboration. The document shall report all AMS ground operations requirements as follows:

1. AMS ground operations requirements at CERN in the clean room during functional verification

2. AMS ground operations requirements at CERN during beam test

3. AMS ground operations requirements at ESTEC during EMI test

8.2.5 Quality Inspections

The PIT Manager in coordination with the EIT Manager will develop detailed plans for quality inspections during assembly and testing. These should state who will perform the inspections, where the inspections will be performed, and how frequently inspections are required. The PIT and EIT Managers will approve the quality inspection plans. NASA-JSC Quality will provide development support, review and concur on quality inspection plans.

8.2.6 Tools and Equipment

CERN, together with the Other Collaborators, will provide all standard tools required for assembly. All tools should be non-magnetic and both English & metric measurements where applicable. Tools that are magnetic should be stored in a location to ensure that no damage is done to the flight hardware during magnet operations. A detailed list of tools will be developed and maintained by the PIT Manager. An example list is shown below.

Mechanical Tools	Electrical Tools	Assembly Equipment and Tools	Cleaning Products	Other
Wrenches	Wire Strippers	Kapton Tape	Isopropyl alcohol	Lifting Equipment
Screw Drivers	Wire Cutters	Glass Tape	gloves	Scaffolding
Rubber Mallets	Digital Volt Meters	RTV	Lent free Cloths	Chem-film Alodine and brushes
Hammers	Continuity Testers	Magnifying glasses	Tech Wipes	Digital Camera
Pliers	Wire Crimping Tools	Inspection mirrors	Scotch-brite	Web-Cameras to monitor Assembly Facility
	Connector Pliers	Mechanical and magnetic extractors	Cleaning Swabs	
	Wire Ties	Flashlights & Worklights	Shop Vacuum	
	Wire Tie Cutting Tools	Dremel Tool with grinding wheel	Compressed Air Cans	
	Soldering Irons			
	Solder			
	Bench mounted positioning device for soldering			
	Crimp pull testers			

Any specialty tools must be provided by collaborators on an as-need basis. Specialty tools include welding equipment, cryogenic system tools, specialty gas system tools, torque wrenches (provided by NASA), EVA approved adhesive (provided by NASA), silvered Teflon for repairs, and any other item not specifically mentioned above.

CERN will also provide appropriate clean rooms, clean room procedures, and appropriate clean room materials like smocks, head-gear, safety shoes or booties, etc.

9.0 SCHEDULE

9.1 Assembly Schedule

The master assembly schedule will be developed and maintained by the PIT Manager in coordination with the EIT Manager. All activities in the CERN Assembly Facility will be properly scheduled to ensure the most efficient and safe integration process. Late activities that will inevitably be added to the schedule must have the approval of the PIT Manager before work can begin. At a minimum, the master assembly schedule should include the following items.

The master assembly schedule is considered a subordinate to the AMS Master Schedule defined in the Project Plan for the AMS (JSC-27296). Any modifications to the master assembly schedule that affect the AMS Master Schedule must be coordinated through the AMS CCB.

Integration Facility	System to be Integrated	Sub-system to be Integrated
SCL	STA Magnet System	STA VC
		STA Magnet
		STA SFHe Tank
		STA Straps
SCL	Flight Magnet System	Magnet Coils
		SFHe Tank
		Cryosystem including cold and warm valves
		Warm Helium System
		Vent Pump
IABG	STA Payload System	STA USS-02
		STA Magnet and External Magnet Component Mass Simulators
		TCS/Electronics Dynamic Simulators
		TRD M-structures and Mass Simulator
		TRD Gas Supply Mass Simulator
		TOF Mass Simulators (if required)
		ACC/Tracker Mass Simulators (if required)
		RICH Mass Simulator
		ECAL Mass Simulator
		Flight PAS (if required)
CERN	USS-02	PAS & EBCS
		Grapple Fixtures
		Handrails and WIF
		ROEU
		UMA
	Flight Magnet System	Flight Magnet
		SFHe Tank
		CAB including cable harnesses
		UPS including cable harnesses
		Charge Dump Diodes including cables
		Warm Helium System including plumbing and pilot valves
		Cryocoolers & Electronics
	TRD	TRD Electronic Crates & Cables
	TRD Gas Box	TRD Gas Box Electronics, Cables & Plumbing
	Upper TOF	TOF Electronics & Cables
	Lower TOF	TOF Electronics & Cables
	ACC	ACC Electronics & Cables
	Tracker	Tracker Electronic Crates & Cables
	TAS	Tracker Alignment System & Electronics
	RICH	RICH Electronic Crates & Cables
	ECAL	ECAL Electronic Crates & Cables
	Star Trackers	Star Tracker Cables
	GPS	
	TCS	Main Ram Radiator & Brackets
		Main Wake Radiator & Brackets
		Zenith Radiator with brackets, Cryocooler Loop Heat Pipes with Brackets
		Ram Tracker Radiator & Brackets
		Wake Tracker Radiator & Brackets
		CAB TCS
		Numerous Thermal Blankets and Silvered Teflon
	TTCS	TTCS Electronics
		TTCBs with pumps and valves
		Plumbing
		Manifolds
		Condensers
	Electronics	J-Crate & Cables
		PDS & Cables

9.2 Testing Schedules

Individual integrated test schedules will be developed and integrated into the AMS Master Schedule which is controlled by the AMS Project Office at JSC. The integrated AMS tests are shown below. The responsible organization should provide updates to the test schedules as they become available.

Integrated Test	Location	Responsible Organization
STA Magnet Acoustic Test	ESTEC - Noordwijk	NASA
STA Magnet Sine Sweep Test	INFN - Terni	NASA
STA Payload Modal Test	IABG - Munich	NASA
STA Payload Static Test	IABG - Munich	NASA
Flight Payload Beam Test	CERN	MIT
Flight Payload Thermal Vacuum Test	ESTEC – Noordwijk	MIT
Flight Payload EMI/EMC Test	ESTEC – Noordwijk	MIT

10.0 TRANSPORTATION AND DELIVERY

This section has been established to document transportation and delivery requirements for the payload. Each collaboration member is responsible for transportation coordination to the integrated payload assembly areas in Culham and CERN. Once the components have been integrated, there are numerous transports that must occur. The responsible organization will coordinate all transportation and delivery issues associated with the movement of the hardware. The main issues include transportation of pressurized systems, battery systems and cryogenic systems as well as customs concerns.

Integrated Hardware	From	To	Responsible Organization
STA Magnet	Culham	Noordwijk	NASA
STA Magnet	Noordwijk	Terni	NASA
STA Magnet	Terni	Munich	NASA
STA Payload	Munich	Geneva	MIT
Flight Magnet	Culham	Geneva	MIT
AMS-02 Payload	Geneva	Noordwijk	MIT
AMS-02 Payload	Noordwijk	KSC	MIT

APPENDIX A
ACRONYMS

ACC	Anti-Coincidence Counter
AMS	Alpha Magnetic Spectrometer
AMS-02	AMS Operational Flight on the ISS
APO	AMS Project Office
CAB	Cryomagnet Avionics Box
CERN	Conseil Européen Pour la Recherche Nucléaire
EBCS	External Berthing Camera System
ECAL	Electromagnetic Calorimeter
EIT	Experiment Integration and Test
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESA	European Space Agency
ESTEC	European Research and Technology Center
ETH	Eidgenoessische Technische Hochschule
EVA	Extravehicular Activity
GPS	Global Positioning System
IABG	Industrieanlagen-Betriebsgesellschaft
INFN	Instituto Nazionale di Fisica Nucleare
ISS	International Space Station
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
PAS	Payload Attach System
PDS	Power Distribution System
PIH	Payload Integration Hardware
PIT	Payload Integration and Test
RICH	Ring Imaging Cerenkov Counter
ROEU	Remotely Operated Electrical Umbilical
RTV	Room Temperature Vulcanizing

RWTH	Rheinische Westfalisch Techische Hochschule
SCL	Space Cryomagnetics Limited (now Scientific Magnetics)
SFHe	Superfluid Helium
SM	Scientific Magnetics (formerly Space Cryomagnetics Limited)
STA	Structural Test Article
TCS	Thermal Control System
TOF	Time of Flight (Scintillator Counters)
TRD	Transition Radiation Detector
TTCS	Tracker Thermal Control System
UMA	Umbilical Mechanism Assembly
UPS	Uninterruptible Power Supply
USA	United States of America
USS	Unique Support Structure
VC	Vacuum Case
WIF	Worksite Interface Fixture

APPENDIX B
GENERAL RULES FOR THE AMS TASK SHEET (ATS)

(NON NASA TPS FORM)

1.1 HOW TO FILL OUT THE FORM ATS-1225.DOC

The form heading is based upon a simplified NASA TPS document. TPS stands for Task Performance Sheet. It is the acronym NASA uses for this type of document. ATS stands for AMS Task Sheet, to differentiate it from the "official" NASA TPS. Most of the NASA tracking information has been removed. Please fill in the form completely.

1. Project Code - SA-AMS (always).

2. JPIC Code - AMS (always).

3. Type. Most will be Type A and Permanent. The physical modification of a piece of equipment / software / etc. If it is a test fit or the piece of equipment is to be removed at the end of the TPS (the equipment is unchanged) then it isType A and Temporary. Most flight, Pre integration and STA assembly will be permanent since the TPS will close with the equipment attached. It is Type B if it is a test or equipment operation.

4. ATS #. Each detector group should serialize the TPSs they write. Each TPS must have a distinct traceable number. No revisions wil be allowed unless noted on the TPS as part of the number . ie. TRD070210-1, ECAL070224-1-R1 (different than ECAL070224-1-R2)

FORMAT:	GROUPDATE-SEQUENCE-REV
GROUP:	ECAL, TRD, ELEC, TWG, TTCS, etc.
DATE Written:	YYMMDD
SEQUENCE:	Group assigned number (unique)
REV:	Omit if no revision

6. MOD Sheets. If the ATS requires revision after it has been approved by QA, a MOD sheet must be attached to document the requested changes to the ATS. This MOD sheet and the original ATS must both be reviewed by NASA QA (or DV). On the original ATS, put a hand written note on the steps that were replaced stating "See M-(X)". These skipped steps do not get initials. The completion initials, and verification initials, go on the Mod. Remember to sign the Mod at the bottom. Hand

write a note on the Original ATS, in block 6 “M-(X)”, where (X) =1,2,3…. If there were other Mods done these would be “M-2”, M-3”...

1. Mod the ATS (see above)
2. Pass it by NASA QA for approval (before performing the work)
3. Do it.
4. Submit ATS and Mod with TPS for closure.

10. Part Name. The name of the item being worked on.

11. Sub Detector Name. Your group, even if not a subdetector.

12. Serial/ Lot #. If the part you are working on is serialized, note here.

14. Applicable Documents. Any document, drawing, process you reference or that is required to do this work, that is not included in the body of the ATS.

16. ATS Title. Short clear description of the work performed.

24. Originator. Person who wrote the ATS.

26. Project Engineer. Person who supervises the technician performing the work.

27. Quality Engineer. CERN or Collaboration Quality Representative).

28-31. Blank Signatory Spots. Anyone else in your chain of command who feels they should authorize work.

1.2 REQUIREMENTS FOR ATS PROCESS TEXT (BODY OF ATS-1225.DOC)

1. An ATS must be followed as written, unless authorized by a Mod sheet and QA approval. Proper care needs to be taken to ensure it is written clearly, succinctly, and with forethought to accommodate potential process issues.

2. All ATS (non NASA and NASA TPS) require 5 working days at NASA to review and QA before work can be done. This must be sent via email to JS project engineers. Please coordinate with JS prior to completion of ATS. The process to maintain traceability and review of all non-NASA ATS is:

3. A NASA TPS will be issued that will reference the non NASA ATS as an external document. This allows a fixed work order structure to document multiple groups and processes simultaneously. This means that non NASA ATS must be

coordinated with a NASA TPS to open and close it. The structure of this external reference in the NASA TPS is as follows.

1. Sub Procedure Start. Record the date the following procedure is opened _____. Review the procedure with onsite personnel to ensure MIP/DV compliance.
2. Work to be performed per ATS# _____.
3. Sub Procedure Closure. Record the date the above procedure is completed _____.

4. Add applicable work safety, personnel protection, and equipment protection notes to the beginning of the document. Also add reinforcing notes prior to the step.

5. Add a brief description of the work to be performed, 1 short paragraph.

6. The ATS should cover a specific process or task.

7. The ATS should not be open ended. It should have specific closure criteria. i.e. Close this ATS when the USS is installed in the RAS. NOT: Close this ATS when the VC arrives.

8. The ATS should not last longer than a week or two. It becomes too long to track properly and the QA process becomes unmanageable. Break the ATS into multiple ATS.

9. Provide sufficient pictures / drawings either in the body of the ATS or as references to clearly document the work. If external references are used, the document must be provided with the ATS for QA review.

10. Each numbered step in the ATS should clearly describe one specific task in the process.

11. Conditional statements may be used. i.e. If the battery is dead then do XXX else skip this section. These can be used for optional work as well. i.e. If the second unit is available, perform these steps. If not, proceed to next section.

12. All hardware should have part numbers and required quantities. When the part is used the part number should be called out, Lot numbers as well and serial numbers if assigned. It is good form to include a parts list at the front of the ATS.

13. Requirements to torque on an AMS02 fasteners.

14. All fasteners that are mounted to any AMS-02 Structure shall be final torqued to 1 percent accuracy using a calibrated torque wrench (AMS supplied Digital Torque Wrench) unless otherwise cleared by NASA/JS project engineers to do so.

15. Prior to using any torque wrench it shall verified by the acting NASA QA (or Designated Verifier) that the calibration sticker is up to date.

16. All Torque wrenches, digital or manual, shall be verified against an approved verifier tool once per shift? on the day of and prior to it's use.

17. All processes requiring the verification of torques, be it on a TPS, ATS, a DR, or per a work order that references a drawing shall document the following:

    1. The M# of the torque wrench. Calibration sticker identifier = M#
    2. The Part Number of the wrench
    3. The Cal Due Date.
    4. The run-in torque if applicable. (running torque)
    5. The final torque.

18. All documents, procedures, ATS, TPSs, drawings, or other controlling paper, that have been provided by a third party (other than ESCG or NASA) with the intention of interfacing flight or GSE hardware shall be fully reviewed for the above noted rules by cognizant ESCG/NASA project engineers prior to formally releasing the hardware for the specific task.