Gamma-ray Large Area Space Telescope (GLAST)
Large Area Telescope (LAT)
Integration and Test Subsystem

I&T Integration Sequence, MGSE, and Flight Work Instruction Development Plan
### Change History Log

<table>
<thead>
<tr>
<th>Revision</th>
<th>Effective Date</th>
<th>Description of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>04-22-02</td>
<td>Initial Draft</td>
</tr>
<tr>
<td>02</td>
<td>04-25-02</td>
<td>Updated Draft – Added sequence steps for final flight functional testing</td>
</tr>
</tbody>
</table>

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1. ABSTRACT

This purpose of this note is to delineate sequence of steps for LAT I&T, the plan for Flight Work Instruction development, and the schedule for MGSE production.

2. DEFINITIONS

LAT: Large Area Telescope, including partially complete stages during integration.
ACD: Anti-Coincidence Detector, including fully integrated and tested base electronics assembly.
NRL: Naval Research Laboratory, location of LAT environmental testing facility.
MGSE: Mechanical Ground Support Equipment is non-flight hardware, which are critical for handling, assembling, and testing of the LAT and Calibration Unit.
EM: Engineering Model
CU: Calibration Unit is a 1x4 array of integrated towers (2 flight, 1 qualified spare, 1 unqualified spare), which will be exposed in the SLAC Beam Test for calibration of the LAT.

3. FLIGHT UNIT I&T SEQUENCE AND CONFIGURATION

Note the following definitions regarding orientation of the LAT assembly: “upright” means tracker towers pointing upwards, “upside-down” means tracker towers pointing downwards, “sideways” means tracker towers pointing in a direction parallel to the ground.

F010 Flight Grid+Radiator Mount Brackets are mounted into the LAT Universal Handling Fixture.
F020 LAT Universal Handling Fixture is lifted with LAT Lifting Fixture and mounted into the LAT Mounting Stand.
F030 Flight Grid bay protective closeouts are mounted, purge lines are connected, and dry air purge started.
F040 LAT Ground Test Heat Exchanger integrated to +/- X sides of Flight Grid.

Begin single tower integration sequence.
F050 Flight Grid bay protective closeout is de-mounted.
F060 LAT is oriented upright and leveled.
F070 Tracker module is lifted with Tracker Lifting Fixture, aligned and lowered onto Flight Grid Bay; Flight Mechanical Fastener Mates between Tracker and Flight Grid.
F080 Calorimeter module is lifted from underneath Flight Grid with Calorimeter Floor Lift, aligned and inserted into Flight Grid Bay; Flight Mechanical Fastener Mates between Calorimeter and Flight Grid.
F090 LAT is oriented sideways.
F100 Flight Mechanical Fastener Mates between Tower Electronics Modules and underside of Calorimeter module.
F110 Flight Cables between Tracker, Calorimeter, and Tower Electronics Modules are mechanically fastened.
F120 Flight Connector Mates for Flight Cables between Tracker, Calorimeter, and Tower Electronics Modules.
F130 Connector saver mates for cables between Electronic Ground Support Equipment and Tower Electronics Modules.
F140 Generate functional verification data packages for integrated single tower.
F150  Electronic Ground Support Equipment is de-connected from Tower Electronics Modules.
End single tower integration sequence.
F160  Repeat steps F050 through F150 for all 16 towers. Towers may be integrated in parallel
when possible.
F170  Heat Pipe Patch Plates and Downspout Heat Pipes are integrated to perimeter of Flight
Grid.
F180  LAT is oriented sideways and leveled.
F190  Test of thermal flight connections.
F200  Flight Mechanical Fastener Mates between Global Trigger-ACD-Signal Distribution Unit
and underside of LAT.
F210  Flight Cables between Global Trigger-ACD-Signal Distribution Unit and Tower Electronics Modules are mechanically fastened to LAT.
F230  Flight Mechanical Fastener Mates between Event Processor Units, Spacecraft Interface Unit, Power Distribution Unit and underside of LAT.
F240  Flight Cables between Event Processor Units, Spacecraft Interface Unit, Power Distribution Unit, and Global Trigger-ACD-Signal Distribution Unit are mechanically fastened to LAT.
F250  Flight Connector Mates for Flight Cables between Event Processor Units, Spacecraft Interface Unit, Power Distribution Unit, and Global Trigger-ACD-Signal Distribution Unit.
F260  Flight Cables to inside of Cross-LAT Box Bulkhead Connectors are mechanically fastened to LAT.
F270  Flight Connector Mates on inside of Cross-LAT Box Bulkhead Connectors.
F280  Connector saver mates for cables between Electronic Ground Support Equipment and Cross-LAT Box Bulkhead Connectors.
F290  Generate functional verification data packages for entire LAT without ACD.
F300  Electronic Ground Support Equipment is de-connected from connector savers outside of Cross-LAT Box Bulkhead Connectors.
F310  LAT is oriented upright and leveled.
F320  LAT is lowered so that top surface of tracker towers is at 4’4-5/16” (as per LAT-TD-00623-01).
F330  Survey tools are attached to Tracker Towers and Flight Grid.
F340  LAT is surveyed, including surveying of all 16 Tracker module tops and Flight Grid.
F350  Survey tools are removed.
F360  Accelerometers are attached to Tracker Towers and Flight Grid.
F370  Cosmic ray muon surveying run to establish baseline relative position of Tracker modules
F380  Auxiliary ACD installation tooling/guides are installed onto LAT Mounting Stand.
F390  Flight ACD is lifted with ACD Lifting Fixture, aligned, and lowered onto Flight Grid; Flight Mechanical Fastener Mates between ACD and Flight Grid.
F400  Auxiliary ACD installation tooling/guides are removed from LAT Mounting Stand.
F410  Flight Connector Mates between ACD and Cross-LAT Box Bulkhead Connectors.
F420  LAT oriented upside-down and leveled.
F430  Cross-LAT Thermal Plate is lifted with Cross-LAT Thermal Plate Lift Fixture, aligned, lowered onto and attached to Flight Grid.
F440  LAT is oriented sideways and leveled.
F450  Test of thermal flight connections.
F460 Connector saver mates for cables between Electronic Ground Support Equipment and Cross-LAT Box Bulkhead Connectors.

F470 LAT System Test Readiness Review at SLAC.

F480 LAT Reference Comprehensive Performance Test at SLAC.

F490 Pre-Environmental Test Readiness Review at SLAC.

F500 Electronic Ground Support Equipment is de-connected from Cross-LAT Box Bulkhead Connectors.

F510 LAT Ground Test Heat Exchanger is de-integrated from +/- X sides of Grid.

F520 LAT Lifting Fixture is attached to LAT Universal Handling Fixture.

F530 LAT Universal Handling Fixture is de-mounted from LAT Mounting Stand; LAT is lifted with LAT Lifting Fixture and mounted onto LAT Transport Box.

F540 Connector saver mates for cables between Electronic Ground Support Equipment and Cross-LAT Box Bulkhead Connectors.

F550 LAT Ground Test Heat Exchanger is integrated to +/- X sides of Grid.

F560 Purge line is detached and re-attached through LAT Transport Box bulkhead.

F570 LAT Transport Box is buttoned up and purged.

F580 SLAC to NRL pre-ship review.

F590 LAT Transport Box is shipped to NRL by airplane. Airborne Cosmic Test.

F600 Unpack and functional verification data package generation of LAT in Building A59 High Bay.

F610 LAT is de-mounted from LAT Transport Box; LAT assembly is lifted with LAT Lifting Fixture and attached to LAT Environmental Test Mounting Stand.

F620 LAT Environmental Test Mounting Stand is transported to NRL Anechoic Chamber.

F630 LAT is oriented upright, leveled, and raised 5’ off ground.

F640 EMI Test.

F650 LAT Environmental Test Mounting Stand is transported to NRL Shaker Room.

F660 LAT Universal Handling Fixture is de-attached from LAT Environmental Test Mounting Stand; LAT assembly is lifted with LAT Lifting Fixture, aligned and attached to Vibration Test Mount.

F670 LAT/Vibration Test Mount assembly with LAT Lifting Fixture, lowered and attached to NRL Vibration Table, and LAT Universal Handling Fixture is de-attached from Flight Grid.

F680 Vibration Table Shake Test.

F690 LAT Universal Handling Fixture is re-attached to Grid and Vibration Test Mount is de-attached from NRL Vibration Table.

F700 LAT/Vibration Test Mount assembly is lifted with LAT Lifting Fixture, and lowered onto floor.

F710 Vibration Test Mount is de-attached from LAT; LAT Universal Handling Fixture is lifted with LAT Lifting Fixture, aligned and attached to LAT Environmental Test Mounting Stand.

F720 LAT Environmental Test Mounting Stand is moved to NRL Building A59 High Bay.

F730 LAT is oriented sideways and leveled.

F740 Flight Radiators are attached to Flight Grid.

F750 LAT+Radiators is raised to 8’, oriented upright, and leveled.

F760 LAT Environmental Test Mounting Stand is moved into Acoustic Cell.

F770 Acoustic Vibration Test.

F780 LAT Environmental Test Mounting Stand is moved into NRL Building A59 High Bay.

F790 LAT is oriented sideways, and lowered.
F800 LAT Universal Handling Fixture is de-attached from LAT Environmental Test Mounting Stand, lifted with LAT Sideways Orientation Lifting Fixture, lowered and attached to Thermal Vacuum Test Equipment.

F810 LAT+Radiators/Thermal Vacuum Test Equipment assembly is lifted with LAT Sideways Orientation Lifting Fixture, aligned, and mounted onto NRL Large Thermal Vacuum Chamber Table.

F820 Thermal Balance Test.

F830 Thermal Vacuum Cycling Test.

F840 LAT+Radiators/Thermal Vacuum Test Equipment assembly is removed from NRL Large Thermal Vacuum Chamber, lifted with LAT Sideways Orientation Lifting Fixture and lowered onto floor.

F850 LAT Universal Handling Fixture is de-attached from Thermal Vacuum Test Equipment; LAT assembly is lifted with LAT Sideways Orientation Lifting Fixture and re-mounted in LAT Environmental Test Mounting Stand.

F860 Flight Radiators are removed from Flight Grid.

F870 LAT is oriented upright and leveled.

F880 LAT assembly is de-mounted from LAT Environmental Test Mounting Stand.

F890 LAT assembly is lifted with LAT Lifting Fixture, lowered and mounted onto LAT Transport Box.

F900 Purge line is detached and re-attached through LAT Transport Box bulkhead.

F910 LAT Transport Box is buttoned up and purged.

F920 LAT is oriented upright and leveled.

F930 LAT Transport Box is shipped by truck to SLAC.

F940 Unpack and functional verification data package generation of LAT in Building 33 High Bay.

F950 LAT is de-mounted from LAT Transport Box; LAT assembly is lifted with LAT Lifting Fixture and attached to LAT Mounting Stand.

F960 LAT is oriented upright and leveled.

F970 LAT is lowered so that top surface of tracker towers is at 4'4-5/16" (as per LAT-TD-00623-01).

F980 Flight Connector De-Mates between ACD and Cross-LAT Box Bulkhead Connectors.

F990 Auxiliary ACD installation tooling/guides are installed.

F1000 Flight Mechanical Fastener De-Mates between ACD and Flight Grid; Flight ACD is lifted with ACD Lifting Fixture and lowered onto staging table.

F1010 Accelerometers are de-attached from Tracker Towers and Flight Grid.

F1020 Survey tools are attached to Tracker Towers and Flight Grid.

F1030 LAT is surveyed, including surveying of all 16 Tracker module tops and Flight Grid.

F1040 LAT is surveyed, including surveying of all 16 Tracker module tops and Flight Grid.

F1050 Cosmic ray muon surveying run to establish final relative position of Tracker modules.

F1060 Flight ACD is lifted with ACD Lifting Fixture, aligned, and lowered onto Flight Grid; Flight Mechanical Fastener Mates between ACD and Flight Grid.

F1070 Auxiliary ACD installation tooling/guides are removed.

F1080 Flight Connector Mates between ACD and Cross-LAT Box Bulkhead Connectors.

F1090 LAT is oriented sideways and leveled.

F1100 LAT is de-mounted from LAT Transport Box Bulkhead Connectors.

F1110 Connector saver mates for cables between Electronic Ground Support Equipment and Cross-LAT Box Bulkhead Connectors.

F1120 LAT Final System Test Readiness Review at SLAC.

F1130 LAT Final Comprehensive Performance Test at SLAC.
Pre-S/C I&T Readiness Review at SLAC
Electronic Ground Support Equipment is de-connected from Cross-LAT Box Bulkhead Connectors.
LAT is oriented upright and leveled.
LAT Ground Test Heat Exchanger is de-integrated from +/- X sides of Grid.
LAT Lifting Fixture is attached to LAT Universal Handling Fixture.
LAT Universal Handling Fixture is de-mounted from LAT Mounting Stand; LAT is lifted with LAT Lifting Fixture and mounted onto LAT Transport Box.
Purge line is detached and re-attached through LAT Transport Box bulkhead.
LAT Transport Box is buttoned up and purged.
SLAC to Spacecraft Pre-Ship Review.
LAT Transport Box is shipped to Spacecraft I&T.

4. CALIBRATION UNIT I&T SEQUENCE AND CONFIGURATION

Note the following definitions regarding orientation of the CU assembly: “upright” means tracker towers pointing upwards, “upside-down” means tracker towers pointing downwards, “sideways” means tracker towers pointing in a direction parallel to the ground.

CU Grid is mounted into the CU Mounting Stand.

Begin calibration unit single tower integration sequence.

CU is oriented upright and leveled.
Tracker module is lifted with Tracker Lifting Fixture, aligned, lowered onto Flight Grid Bay; Mechanical Fastener Saver Mates between Tracker module and CU Grid Bay.
Calorimeter module is lifted from underneath CU Grid with Calorimeter Floor Lift, aligned, and inserted into CU Grid Bay; Mechanical Fastener Saver Mates between Calorimeter module and CU Grid Bay.
CU is oriented sideways.
Mechanical Fastener Saver Mates between Tower Electronics Modules and underside of Calorimeter module.
Flight Cables between Tracker, Calorimeter, and Tower Electronics Modules are mechanically fastened.
Connector Saver Mates for Flight Cables between Tracker, Calorimeter, and Tower Electronics Modules.
Connector saver mates for cables between Electronic Ground Support Equipment and Tower Electronics Modules.
Generate functional verification data packages for integrated single tower.
Electronic Ground Support Equipment is de-connected from Tower Electronics Modules.

End calibration unit single tower integration sequence.
Repeat steps C020 through C110 for Qualified Spare Tower, Un-Qualified Spare Tower, and two Flight Towers. Towers may be integrated in parallel when possible.
CU Grid is oriented upright and leveled.
CU ACD is lifted with CU ACD Lifting Fixture, aligned, lowered onto and attached to CU Grid.
CU Grid is leveled vertically.
CU EGSE is mechanically attached to CU Grid.
Connector saver mates for cables between CU Tower Electronics Modules and CU EGSE.
C180  CU Grid is de-mounted from CU Mounting Stand, lifted by 5-ton overhead crane, aligned, lowered and mounted onto CU Side Resting Plate.

C190  CU is lifted with CU Lifting Fixture, aligned, and mounted into CU Transport Equipment.

C200  CU Transport Equipment assembly is transported to SLAC End Station A.

C210  CU is de-attached from CU Transport Equipment assembly, lifted with CU Lifting Fixture, aligned, and mounted onto XY-Theta Table.

C220  SLAC Beam Test.

C230  CU is de-mounted from XY-Theta Table, lifted with CU Lifting Fixture, aligned, and mounted into CU Transport Equipment.

C240  CU Transport Equipment assembly is transported to LAT High Bay Integration Room.

C250  CU is de-attached from CU Transport Equipment, lifted with CU Lifting Fixture and lowered onto floor.

C260  CU Grid is de-attached from CU Side Resting Plate, lifted with CU Lifting Fixture, aligned, lowered onto and mounted to CU Mounting Stand.

C270  CU is oriented sideways.

C280  CU EGSE cables are de-attached from CU Tower Electronics Modules.

C290  CU EGSE is mechanically de-attached from CU Grid.

C300  CU is oriented upright and leveled.

C310  CU ACD is de-attached from CU Grid and removed with 5-ton crane.

C320  CU Grid is oriented sideways.

C330  Connector savers de-mated for Flight Cables between Tower Electronics Modules and Tracker/Calorimeter modules.

C340  CU oriented upright and leveled.

C350  Calorimeter Modules are de-attached and lowered out of CU Grid Bay with Calorimeter Floor Lift.

C360  Tracker Towers are de-attached and lifted off of CU Grid Bay with Tracker Lifting Fixture.

C370  Flight Towers and Qualified Spare Tower ready for integration in to Flight Unit.

5. SPARE TRACKER MODULE SWAP SEQUENCE AND CONFIGURATION

We assume the “worst case”: that a single Tracker Module must be swapped out of the LAT+Radiator assembly at NRL during Environmental Testing. Note the following definitions regarding orientation of the LAT assembly: “upright” means tracker towers pointing upwards, “upside-down” means tracker towers pointing downwards, “sideways” means tracker towers pointing in a direction parallel to the ground.

S010  TBD

6. MGSE DICTIONARY AND REQUIREMENTS

This dictionary is ordered by earliest step in which the MGSE appears in the integration sequence.

M010  LAT Universal Handling Fixture is a frame, which attaches to the Flight Grid and provides an area for support, lift, and rotation fixtures. The outer dimension must fit into the inner dimension of the Large Thermal Vacuum Chamber at Naval Research Lab. LAT
Universal Handling Fixture must allow integration and de-integration of the Radiators and ACD.

**M020** LAT Lifting Fixture is a crane fixture, which attaches to the LAT Universal Handling Fixture and allows safe lifting and translational motion of the LAT without rotation.

**M030** LAT Mounting Stand is a stand, which supports the full weight of the Flight Unit without radiators and allows vertical and rotational motion. Vertical motion will allow movement of the lower surface of the Cross-LAT Thermal Plate between 6” of the floor (defined by LAT-TD-00623-01) and 5’ (defined by convenient access to integration of Tracker Tower Flexures). Rotational motion requirements are summarized in the following table:

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Tracker</th>
<th>Calorimeter</th>
<th>Electronics</th>
<th>ACD</th>
<th>X-LAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sideways</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Upside down</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**M040** Tracker Lifting Fixture is a crane fixture, which attaches to the upper edges of the Tracker module and allows safe lifting and translational motion of the Tracker module without rotation.

**M050** Calorimeter Floor Lift is a stand for lifting and aligning a single Calorimeter Module in a Flight Grid Bay.

**M060** ACD Lifting Fixture is a crane fixture, which attaches to the lower edges of the ACD and allows safe lifting, translational motion, and alignment of the ACD module (relative to the Flight Grid) without rotation.

**M070** LAT Ground Test Heat Exchanger will be used for cooling during testing on the ground, as well as for the thermal driving test at SLAC.

**M080** LAT Transport Box is a temperature, humidity, and shock controlled shipping container for LAT+Radiators.

**M090** LAT Environmental Test Mounting Stand is a stand, which supports the full weight of the Flight Unit including radiators and allows vertical and rotational motion. Its main purpose will be to facilitate environmental testing, but it must also facilitate possible spare swap of a tracker module. Vertical motion will allow movement of the lower surface of the Cross-LAT Thermal Plate between 6” of the floor (defined by LAT-TD-00623-01) and a height which permits the Radiators to rotate freely without touching the floor. Rotational motion requirements are summarized in the following table:

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Tracker</th>
<th>Calorimeter</th>
<th>Electronics</th>
<th>ACD</th>
<th>X-LAT</th>
<th>Radiators</th>
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</thead>
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<tr>
<td>Upright</td>
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<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>Sideways</td>
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<td>X</td>
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<tr>
<td>Upside down</td>
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<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**M100** Vibration Test Mount is a mounting stand designed to hold Flight Unit in a sideways orientation and attach to the NRL Vibration Table.

**M110** LAT Sideways Orientation Lifting Fixture is a crane fixture, which attaches to the LAT Universal Handling Fixture and allows safe lifting and translational motion of the LAT+Radiators without rotation in a sideways orientation.

**M120** Thermal Vacuum Test Equipment is a mounting stand designed to hold Flight Unit in a sideways orientation and attach to the NRL Large Thermal Vacuum Chamber.

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**M130** CU Grid is a frame designed to hold Calibration Unit Towers and provide mounting points for CU Mounting Stand, CU Side Resting Plate.

**M140** CU Mounting Stand is a stand, which supports the full weight of the Calibration Unit and allows vertical and rotational motion. Vertical motion will allow movement of the lower surface of the Calibration Unit Electronics between 6” of the floor and 5’ (defined by convenient access to integration of Tracker Tower Flexures). Rotational motion requirements are summarized in the following table:

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Tracker</th>
<th>Calorimeter</th>
<th>Electronics</th>
<th>CU Electronics</th>
<th>CU ACD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Sideways</td>
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<td>Upside-down</td>
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</table>

**M150** CU ACD Lifting Fixture is a crane fixture, which attaches to the CU ACD and allows safe lifting, translational motion, and alignment of the CU ACD module (relative to the CU Grid) without rotation.

**M160** CU Lifting Fixture is a crane fixture, which attaches to the CU Grid and allows safe lifting and transnational motion of the CU without rotation in a sideways orientation.

**M170** CU Side Resting Plate is a mounting stand designed to hold Calibration Unit in a CU Grid vertical orientation and attach to the XY-Theta Table.

**M180** CU Transport Equipment is a support assembly, which facilitates safe transport of Calibration Unit between Building 33 and End Station A on SLAC site.

**M190** XY-Theta Table is a table, which provides mounting points for CU Side Resting Plate, supports the full weight of the Calibration Unit, and allows vertical, horizontal, and vertical rotation. All motion is specified by the Particle Test Manager (GLAST LAT WBS 4.1.9.7.1).

### 7. FLIGHT WORK INSTRUCTION DEVELOPMENT PLAN AND SCHEDULE

The Flight Work Instruction Manager will document and update all Flight Work Instructions. The Flight Work Instructions Manager will document Quality Assurance Checkpoints in coordination with the QA Manager. Development of the Flight Work Instructions is a pre-condition for Flight Hardware assembly. Flight Work Instructions will be developed with exercise of the associated MGSE, EM, and other Models when possible. MGSE, EM, and other Models need dates are defined by when they are available from subsystems and/or needed for Flight Work Instructions development. The preparation of Flight Work Instructions will be broken down into 6 development periods, denoted A-F. Work Instruction development will be a continuous activity from November 1, 2002 until arrival of Flight Hardware. The dates for the development periods are given in the following table:

<table>
<thead>
<tr>
<th>Development Period</th>
<th>Dates</th>
<th>LAT Work Instructions</th>
<th>CU Work Instructions</th>
<th>Swap Work Instructions</th>
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<tr>
<td>B</td>
<td>Feb. 1 - May 31, 2003</td>
<td>F80-F150, F280-F300</td>
<td>C040-C110</td>
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<td>June 1 – July 31,</td>
<td>F200-F270, F410</td>
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<td>Development Period</td>
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<td>Need Date</td>
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<tr>
<td>A</td>
<td>EM Mounting Stand</td>
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<td>J. Broeder</td>
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<tr>
<td>A</td>
<td>EM LAT Universal Handling Fixture</td>
<td>November 1, 2002</td>
<td>J. Broeder</td>
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<td>A</td>
<td>EM LAT Lifting Fixture</td>
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<tr>
<td>A</td>
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<td>A</td>
<td>EM Grid 4x4 Extension</td>
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<tr>
<td>A</td>
<td>EM Tracker Mechanical Full Tower</td>
<td>December 1, 2002</td>
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<td>August 1, 2003</td>
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<td>MGSE Engineer</td>
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<td>Calorimeter Floor Lift</td>
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<td>MGSE Engineer</td>
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8. **EQUIPMENT NEED DATES**

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<tr>
<th>Column</th>
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<th>Responsible Party</th>
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<td>E</td>
<td>LAT Ground Test Heat Exchanger</td>
<td>November 1, 2003</td>
<td>M. Nordby</td>
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