



EASEP
Crew Systems & Operations
Deployment Task/Time Sequence
Analyses for LRRR & PSEP

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This EATM presents the EASEP deployment task/time sequence analyses for the Laser Ranging Retro-Reflector (LRRR) and the Passive Seismic Experiment Package (PSEP). Separate and combined task/time deployment sequences for the LRRR and PSEP are included. The assumptions for the development of these task/time deployment sequences are based on current design.

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1.0 ASSUMPTIONS

In performing the analyses reported herein, certain assumptions were made, as follows:

1. The slope at all landing sites is no greater than 2° .
2. EASEP (LRRR and PSEP) deployment does not include Lunar Module (LM) Scientific Equipment Bay (SEQ) Door operations, but does include all boom assembly operations.
3. No time has been allocated for the astronaut to level the deployment site using his Extravehicular Mobility Unit (EMU) boot.
4. No rest periods have been programmed in these sequences.
5. The astronaut takes the most direct route to the deployment site as shown in Figure No. 1.
6. The nominal walking rate for the EMU-suited astronaut operating at 1/6G is 1.5 feet per second.
7. There is no time allocated for leveling the LRRR or the PSEP.
8. There is no time allocated for communication of data between the astronaut and MCC.
9. These sequences describe one-man deployment of the EASEP.
10. The Lunar Module is oriented on the lunar surface with the SEQ (Quadrant II) facing the sun (lunar east).
11. The Commander, who remains inside the LM, maintains constant voice contact with the LM Pilot while the LM Pilot is deploying EASEP.
12. The voice link between the LM Pilot and MCC, during EASEP deployment, is through the LM directly to MCC.
13. The LM Pilot is pressurized to 3.75 psi in the EMU during EASEP deployment.

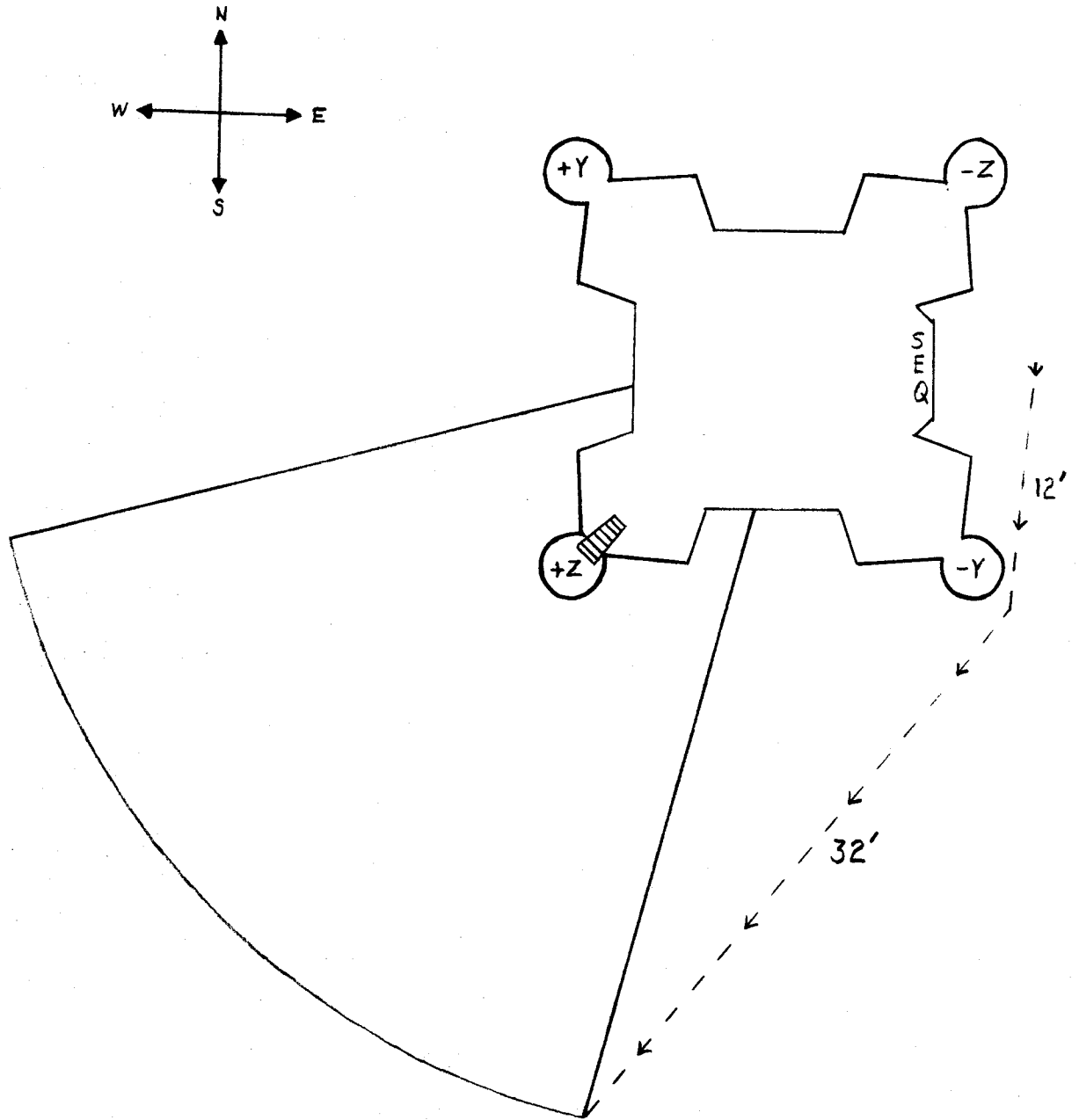


FIGURE NO. 1 - TRAVERSE TO DEPLOYMENT SITE



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14. The times, in minutes and seconds, are based on part-task tests conducted with Crew Systems and Operations mockups. A whole task/time sequence deployment test is required to validate these analyses.



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LRRR
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	<u>Task Time</u>	<u>Cumulative Time</u>
1.0 <u>REMOVE EASEP PACKAGE NO. 2</u> (Total Time = 1:53)		
1.1 Open SEQ Bay Door.	00:00	00:00
1.2 Retrieve EASEP Package No. 2 deployment lanyard.	00:10	00:10
1.3 Walk 10 feet from LM, deploying lanyard.	00:07	00:17
1.4 Pull EASEP Package No. 2 deployment lanyard to release Package No. 2 tie-downs, extend boom assembly, and to lower Package No. 2 to the lunar surface.	00:25	00:42
1.5 Discard EASEP Package No. 2 deployment lanyard.	00:02	00:44
1.6 Walk to EASEP Package No. 2.	00:04	00:48
1.7 Use two hands to pull in opposite directions to release deployment lanyard from EASEP Package No. 2.	00:10	00:58
1.8 Remove boom assembly pull pin to separate EASEP Package No. 2 from boom attachment assembly and discard pull pin.	00:05	01:03
1.9 Retrieve EASEP Package No. 2 deployment lanyard.	00:05	01:08
1.10 Walk 5 feet back from EASEP Package No. 2, deploying lanyard.	00:04	01:12
1.11 Pull EASEP Package No. 2 deployment lanyard to restow boom assembly.	00:20	01:32
1.12 Walk to SEQ Bay Compartment II.	00:07	01:39
1.13 Restow EASEP Package No. 2 deployment lanyard.	00:10	01:49
1.14 Close SEQ Bay Door.	00:00	01:49
1.15 Walk to EASEP Package No. 2.	00:04	01:53
2.0 <u>TRAVERSE TO DEPLOYMENT SITE</u> (Total Time = 0:55)		
2.1 Use carry handle to lift EASEP Package No. 2 from lunar surface.	00:05	01:58
2.2 Walk to -Y landing gear pad.	00:08	02:06
2.3 Survey lunar surface to select suitable EASEP Package No. 2 deployment site.	00:10	02:16
2.4 Walk approximately 32 feet from LM to selected EASEP Package No. 2 deployment site.	00:22	02:38



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LRRR
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	Task Time	Cumulative Time
2.5 Lower EASEP Package No. 2 to lunar surface on E-W axis so that LRRR will be directed toward sub-earth point when EASEP Package No. 2 is in the deployed position.	00:10	02:48
3.0 <u>DEPLOY LRRR</u> (Total Time = 1:38)		
3.1 Grasp deployment handle and associated release ring to release deployment handle pull pin.	00:03	02:51
3.2 Pull deployment handle to extend deployment handle six inches to first detent position and to partially release LRRR array.	00:05	02:56
3.3 Discard deployment handle release ring and attached pull pin.	00:02	02:58
3.4 Regrasp deployment handle with left hand to steady EASEP Package No. 2 and, using right hand, grasp array tilting handle, pull outward, rotate handle 45°, and continue pulling array tilting handle outward to extend array tilting handle 9.5 inches to detent position and to complete release of LRRR array.	00:15	03:13
3.5 Observing array tilt angle indicator and pointer, use array tilting handle to set in array tilt angle for actual LM landing site, while using deployment handle to steady EASEP Package No. 2.	00:10	03:23
3.6 Partially release outward tension on array tilting handle and check to ensure that array is locked in place.	00:05	03:28
3.7 Release array tilting handle and allow array tilting handle to spring back into stowed position.	00:03	03:31
3.8 Regrasp deployment handle, depress trigger on deployment handle to release first detent, pull deployment handle to extend deployment handle an additional 27 inches, and use deployment handle to control descent of EASEP Package No. 2 as it rotates to the lunar surface.	00:15	03:46
3.9 Use deployment handle to embed EASEP Package No. 2 mounting tabs in lunar surface.	00:20	04:06



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LRRR
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	<u>Task Time</u>	<u>Cumulative Time</u>
3.10 Observing shadow cast by EASEP Package No. 2 gnomon on partial compass rose for actual LM landing site, use deployment handle to align EASEP Package No. 2 to within $\pm 5^\circ$ of LRRR centerline, and release deployment handle.	00:20	04:26
4.0 <u>TRAVERSE TO LM</u> (Total Time = 0:20)		
4.1 Return to LM.	00:20	04:46



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PSEP
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	<u>Task Time</u>	<u>Cumulative Time</u>
1.0 <u>REMOVE EASEP PACKAGE NO. 1</u> (Total Time = 2:03)		
1.1 Open SEQ Bay Door.	00:00	00:00
1.2 Retrieve EASEP Package No. 1 deployment lanyard.	00:10	00:10
1.3 Walk 10 feet from LM, deploying lanyard.	00:07	00:17
1.4 Pull EASEP Package No. 1 deployment lanyard to release Package No. 1 tie-downs, extend boom assembly, and to lower Package No. 1 to the lunar surface.	00:25	00:42
1.5 Discard EASEP Package No. 1 deployment lanyard.	00:02	00:44
1.6 Walk to EASEP Package No. 1.	00:04	00:48
1.7 Use two hands to pull in opposite directions to release deployment lanyard from EASEP Package No. 1.	00:10	00:58
1.8 Walk to rear of EASEP Package No. 1.	00:03	01:01
1.9 Remove boom assembly pull pin to release deployment handle, to release and rotate PSE gnomon, and to separate EASEP Package No. 1 boom attachment assembly from boom assembly.	00:07	01:08
1.10 Walk to front of EASEP Package No. 1.	00:03	01:11
1.11 Retrieve EASEP Package No. 1 deployment lanyard.	00:05	01:16
1.12 Walk 5 feet back from EASEP Package No. 1, deploying lanyard.	00:04	01:20
1.13 Pull EASEP Package No. 1 deployment lanyard to restow boom assembly.	00:20	01:40
1.14 Walk to SEQ Bay Compartment I.	00:07	01:47
1.15 Restow EASEP Package No. 1 deployment lanyard.	00:10	01:57
1.16 Close SEQ Bay Door.	00:00	01:57
1.17 Walk to EASEP Package No. 1.	00:06	02:03
2.0 <u>TRAVERSE TO DEPLOYMENT SITE</u> (Total Time = 0:55)		
2.1 Use carry handle to lift EASEP Package No. 1 from lunar surface.	00:05	02:08
2.2 Walk to -Y landing gear pad.	00:08	02:16



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	Task Time	Cumulative Time
2.3 Survey lunar surface to select suitable EASEP Package No. 1 deployment site.	00:10	02:26
2.4 Walk approximately 32 feet from LM to selected EASEP Package No. 1 deployment site.	00:22	02:48
2.5 Lower EASEP Package No. 1 to lunar surface on E-W axis.	00:10	02:58
3.0 <u>DEPLOY PSEP</u> (Total Time = 3:21)		
3.1 Walk to rear of EASEP Package No. 1.	00:03	03:01
3.2 Grasp deployment handle, pull to extend handle to 30 inch working height, and rotate handle 90° to lock it in place.	00:10	03:11
3.3 Walk to front of EASEP Package No. 1.	00:03	03:14
3.4 Grasp carry handle with left hand.	00:03	03:17
3.5 Use right hand to remove and discard first solar panel-restraining pull pin.	00:10	03:27
3.6 Remove and discard first solar panel support bracket-restraining pull pin.	00:05	03:32
3.7 Grasp first solar panel support bracket, rotate bracket forward, lift bracket upward to release and remove first rear support bracket pull pin, and discard bracket/lanyard/pull pin.	00:20	03:52
3.8 Grasp carry handle with right hand.	00:03	03:55
3.9 Use left hand to remove and discard second solar panel-restraining pull pin.	00:10	04:05
3.10 Remove and discard second solar panel support bracket-restraining pull pin.	00:05	04:10
3.11 Grasp second solar panel support bracket, rotate bracket forward, lift bracket upward to release and remove second rear support bracket pull pin, and discard bracket/lanyard/pull pin.	00:20	04:30
3.12 Use carry handle to rotate EASEP Package No. 1 to the lunar surface.	00:10	04:40
3.13 Use deployment handle to embed EASEP Package No. 1 mounting tabs in lunar surface.	00:20	05:00



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	<u>Task Time</u>	<u>Cumulative Time</u>
3.14 Observing shadow cast by PSE gnomon on compass rose, use deployment handle to align EASEP Package No. 1 to within $\pm 5^\circ$ of PSEP centerline.	00:20	05:20
3.15 Release velcroed antenna release lanyard from deployment handle.	00:05	05:25
3.16 Pull antenna release lanyard to remove antenna pull pin, and release and rotate antenna. (Steady EASEP Package No. 1 by holding handle with left hand.)	00:10	05:35
3.17 Discard antenna release lanyard.	00:02	05:37
3.18 Release velcroed solar panel deployment lanyard from deployment handle.	00:05	05:42
3.19 Pull solar panel deployment lanyard to rotate solar panels. (Steady EASEP Package No. 1 by holding deployment handle with left hand and monitor solar panel deployment.)	00:20	06:02
3.20 Discard solar panel deployment lanyard.	00:02	06:04
3.21 Grasp antenna, observe antenna tilt angle indicator and pointer, rotate antenna to elevation offset for actual LM landing site, and release antenna.	00:15	06:19
4.0 <u>TRAVERSE TO LM</u> (Total Time = 0:20)		
4.1 Return to LM.	00:20	06:39



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	<u>Task Time</u>	<u>Cumulative Time</u>
1.0 <u>REMOVE EASEP PACKAGE NO. 2</u> (Total Time = 1:51)		
1.1 Open SEQ Bay Door.	00:00	00:00
1.2 Retrieve EASEP Package No. 2 deployment lanyard.	00:10	00:10
1.3 Walk 10 feet from LM, deploying lanyard.	00:07	00:17
1.4 Pull EASEP Package No. 2 deployment lanyard to release Package No. 2 tie-downs, extend boom assembly, and to lower Package No. 2 to the lunar surface.	00:25	00:42
1.5 Discard EASEP Package No. 2 deployment lanyard.	00:02	00:44
1.6 Walk to EASEP Package No. 2.	00:04	00:48
1.7 Use two hands to pull in opposite directions to release deployment lanyard from EASEP Package No. 2.	00:10	00:58
1.8 Remove boom assembly pull pin to separate EASEP Package No. 2 from boom attachment assembly and discard pull pin.	00:05	01:03
1.9 Retrieve EASEP Package No. 2 deployment lanyard.	00:05	01:08
1.10 Walk 5 feet back from EASEP Package No. 2, deploying lanyard.	00:04	01:12
1.11 Pull EASEP Package No. 2 deployment lanyard to restow boom assembly.	00:20	01:32
1.12 Walk to SEQ Bay Compartment II.	00:07	01:39
1.13 Restow EASEP Package No. 2 deployment lanyard.	00:10	01:49
1.14 Walk to SEQ Bay Compartment I.	00:02	01:51
2.0 <u>REMOVE EASEP PACKAGE NO. 1</u> (Total Time = 2:01)		
2.1 Retrieve EASEP Package No. 1 deployment lanyard.	00:10	02:01
2.2 Walk 10 feet from LM, deploying lanyard.	00:07	02:08
2.3 Pull EASEP Package No. 1 deployment lanyard to release Package No. 1 tie-downs, extend boom assembly, and to lower Package No. 1 to the lunar surface.	00:25	02:33



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	Task Time	Cumulative Time
2.4 Discard EASEP Package No. 1 deployment lanyard.	00:02	02:35
2.5 Walk to EASEP Package No. 1.	00:04	02:39
2.6 Use two hands to pull in opposite directions to release deployment lanyard from EASEP Package No. 1.	00:10	02:49
2.7 Walk to rear of EASEP Package No. 1.	00:03	02:52
2.8 Remove boom assembly pull pin to release deployment handle, to release and rotate PSE gnomon, and to separate EASEP Package No. 1 boom attachment assembly from boom assembly.	00:07	02:59
2.9 Walk to front of EASEP Package No. 1.	00:03	03:02
2.10 Retrieve EASEP Package No. 1 deployment lanyard.	00:05	03:07
2.11 Walk 5 feet back from EASEP Package No. 1, deploying lanyard.	00:04	03:11
2.12 Pull EASEP Package No. 1 deployment lanyard to restow boom assembly.	00:20	03:31
2.13 Walk to SEQ Bay Compartment I.	00:07	03:38
2.14 Restow EASEP Package No. 1 deployment lanyard.	00:10	03:48
2.15 Close SEQ Bay Door.	00:00	03:48
2.16 Walk to EASEP Package No. 2.	00:04	03:52
3.0 <u>TRAVERSE TO DEPLOYMENT SITE</u> (Total Time = 1:02)		
3.1 Use carry handle to lift EASEP Package No. 2 from lunar surface.	00:05	03:57
3.2 Walk to EASEP Package No. 1.	00:02	03:59
3.3 Use carry handle to lift EASEP Package No. 1 from lunar surface.	00:05	04:04
3.4 Walk to -Y landing gear pad.	00:08	04:12
3.5 Survey lunar surface to select suitable EASEP deployment site.	00:10	04:22
3.6 Walk approximately 32 feet from LM to selected EASEP deployment site.	00:22	04:44
3.7 Lower EASEP Packages to lunar surface on N-S axis.	00:10	04:54



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	<u>Task Time</u>	<u>Cumulative Time</u>
4.0 <u>DEPLOY LRRR</u> (Total Time = 1:43)		
4.1 Position EASEP Package No. 2 on E-W axis so that LRRR will be directed toward subearth point when EASEP Package No. 2 is in the deployed position.	00:05	04:59
4.2 Grasp deployment handle and associated release ring to release deployment handle pull pin.	00:03	05:02
4.3 Pull deployment handle to extend deployment handle six inches to first detent position and to partially release LRRR array.	00:05	05:07
4.4 Discard deployment handle release ring and attached pull pin.	00:02	05:09
4.5 Regrasp deployment handle with left hand to steady EASEP Package No. 2 and, using right hand, grasp array tilting handle, pull outward, rotate handle 45°, and continue pulling array tilting handle outward to extend array tilting handle 9.5 inches to detent position and to complete release of LRRR array.	00:15	05:24
4.6 Observing array tilt angle indicator and pointer, use array tilting handle to set in array tilt angle for actual LM landing site, while using deployment handle to steady EASEP Package No. 2.	00:10	05:34
4.7 Partially release outward tension on array tilting handle and check to ensure that array is locked in place.	00:05	05:39
4.8 Release array tilting handle and allow array tilting handle to spring back into stowed position.	00:03	05:42
4.9 Regrasp deployment handle, depress trigger on deployment handle to release first detent, pull deployment handle to extend deployment handle an additional 27 inches, and use deployment handle to control descent of EASEP Package No. 2 as it rotates to the lunar surface.	00:15	05:57
4.10 Use deployment handle to embed EASEP Package No. 2 mounting tabs in lunar surface.	00:20	06:17



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	<u>Task Time</u>	<u>Cumulative Time</u>
4.11	Observing shadow cast by EASEP Package No. 2 gnomon on partial compass rose for actual LM landing site, use deployment handle to align EASEP Package No. 2 to within $+5^{\circ}$ of LRRR centerline, and release deployment handle.	00:20 06:37
5.0	<u>DEPLOY PSEP</u> (Total Time = 3:43)	
5.1	Use carry handle to lift EASEP Package No. 1 from lunar surface.	00:05 06:42
5.2	Walk 10 feet east of EASEP Package No. 2.	00:07 06:49
5.3	Lower EASEP Package No. 1 to lunar surface on E-W axis.	00:10 06:59
5.4	Walk to rear of EASEP Package No. 1.	00:03 07:02
5.5	Grasp deployment handle, pull to extend handle to 30 inch working height, and rotate handle 90° to lock it in place.	00:10 07:12
5.6	Walk to front of EASEP Package No. 1.	00:03 07:15
5.7	Grasp carry handle with left hand.	00:03 07:18
5.8	Use right hand to remove and discard first solar panel-restraining pull pin.	00:10 07:28
5.9	Remove and discard first solar panel support bracket-restraining pull pin.	00:05 07:33
5.10	Grasp first solar panel support bracket, rotate bracket forward, lift bracket upward to release and remove first rear support bracket pull pin, and dis- card bracket/lanyard/pull pin.	00:20 07:53
5.11	Grasp carry handle with right hand.	00:03 07:56
5.12	Use left hand to remove and discard second solar panel-restraining pull pin.	00:10 08:06
5.13	Remove and discard second solar panel support bracket-restraining pull pin.	00:05 08:11
5.14	Grasp second solar panel support bracket, rotate bracket forward, lift bracket upward to release and remove second rear support bracket pull pin, and dis- card bracket/lanyard/pull pin.	00:20 08:31



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	Task Time	Cumulative Time
5.15 Use carry handle to rotate EASEP Package No. 1 to the lunar surface.	00:10	08:41
5.16 Use deployment handle to embed EASEP Package No. 1 mounting tabs in lunar surface.	00:20	09:01
5.17 Observing shadow cast by PSE gnomon on compass rose, use deployment handle to align EASEP Package No. 1 to within $\pm 5^\circ$ of PSEP centerline.	00:20	09:21
5.18 Release velcroed antenna release lanyard from deployment handle.	00:05	09:26
5.19 Pull antenna release lanyard to remove antenna pull pin, and release and rotate antenna. (Steady EASEP Package No. 1 by holding handle with left hand.)	00:10	09:36
5.20 Discard antenna release lanyard.	00:02	09:38
5.21 Release velcroed solar panel deployment lanyard from deployment handle.	00:05	09:43
5.22 Pull solar panel deployment lanyard to rotate solar panels. (Steady EASEP Package No. 1 by holding deployment handle with left hand and monitor solar panel deployment.)	00:20	10:03
5.23 Discard solar panel deployment lanyard.	00:02	10:05
5.24 Grasp antenna, observe antenna tilt angle indicator and pointer, rotate antenna to elevation offset for actual LM landing site, and release antenna.	00:15	10:20
6.0 <u>TRAVERSE TO LM</u> (Total Time = 0:20)		
6.1 Return to LM.	00:20	10:40