| CARLO GAVAZZI SPACE SpA | AMS02 |
|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Tipo Doc.: *Doc.Type:* | TECHNICAL NOTE | | | N° DRD: *DRD N°:* | DEL 079 |
| N° Doc.: *Doc. N°:* | **AMSTCS-TN-CGS-014** | Ediz.: *Issue:* **1** | Data: *Date:* **31/03/2008** | Pagina *Page* **1** | Di *Of* **93** |
| Titolo : *Title :* | AMS-02 MLI DESCRIPTION REPORT | | | | |

| | Nome & Funzione *Name & Function* | Firma *Signature* | Data *Date* |
|---|---|---|---|
| Preparato da: *Prepared by:* | V. Latini | | |
| Approvato da: *Approved by:* | C. Vettore<br>L. Cremonesi<br>C. Cinquepalmi<br>M. Molina | Vettore<br>L. Cremonesi<br>C. Cinquepalmi<br>Molina | 31/03/08<br>31.03.08<br>31/3/08<br>31/3/2008 |
| Applicazione autorizzata da: *Application authorized by:* | M. Olivier | M. Olivier | 31.03.08 |
| Customer / Higher Level Contractor | | | |
| Accettato da: *Accepted by:* | | | |
| Approvato da: *Approved by:* | | | |

| LISTA DI DISTRIBUZIONE *DISTRIBUTION LIST* | N | A | I |
|---|---|---|---|
| Interna / *Internal* | | | |
| Esterna / *External* | | | |
| E. Russo (ASI) | 1 | X | |

N=Numero di copie A=Applicazione I=Informazione
*N=Number of copy A=Application I=Information*

| | | |
|---|---|---|
| Gestione documenti: *Data Management:* | Firma / *Signature* 31/03/08 Data / *Date* | File: AMSTCS-TN-CGS-014.doc |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA: Tutti i diritti sono riservati
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

| REGISTRAZIONE DELLE MODIFICHE / *CHANGE RECORD* | | | |
|---|---|---|---|
| EDIZIONE *ISSUE* | DATA *DATE* | AUTORIZZAZIONE *CHANGE AUTHORITY* | OGGETTO DELLA MODIFICA E SEZIONI AFFETTE *REASON FOR CHANGE AND AFFECTED SECTIONS* |
| 1 | 31-03-2008 | | |
| | | | |
| | | | |
| | | | |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

**LISTA DELLE PAGINE VALIDE / *LIST OF VALID PAGES***

| PAGINA *PAGE* | EDIZIONE *ISSUE* | PAGINA *PAGE* | EDIZIONE *ISSUE* | PAGINA *PAGE* | EDIZIONE *ISSUE* | PAGINA *PAGE* | EDIZIONE *ISSUE* | PAGINA *PAGE* | EDIZIONE *ISSUE* |
|---|---|---|---|---|---|---|---|---|---|
| 1 - 93 | 1 | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

TABLE OF CONTENT


1. SCOPE ..... 13

2. DOCUMENTS ..... 14

2.1 APPLICABLE DOCUMENTS ..... 14
2.2 REFERENCE DOCUMENTS ..... 15

3. COMMON MLI FEATURES ..... 16

3.1 BLANKET ASSEMBLY ..... 16
3.1.1 HOLDING TOGETHER OF INNER MLI PACKAGE ..... 16
3.1.2 EDGE CLOSING OF BLANKETS ..... 16
3.2 BLANKET ATTACHMENT ..... 17
3.2.1 STAND-OFF ATTACHMENT METHOD ..... 17
3.2.2 OVERLAP AND SLIT DESIGN ..... 17
3.2.3 LACING ATTACHMENT METHOD ..... 18
3.2.4 VELCRO ATTACHMENT METHOD ..... 18
3.2.5 CRACK STOPPERS ..... 18
3.3 ELECTRICAL BONDING OF MLI BLANKETS ..... 19
3.4 VENTING ..... 20
3.5 BLANKET LAY-UP ..... 21

4. TRACKER MLI ..... 25

4.1 TRACKER BOTTOM PLANE MLI ..... 25
4.1.1 BLANKET LAYUP ..... 26
4.2 WEIGHT ..... 26
4.3 CONSTRUCTION ..... 26
4.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 26
4.3.2 HOLES, SLOTS ETC. ..... 26
4.4 INTEGRATION ..... 26
4.4.1 MECHANICAL FIXATION POINTS ..... 26
4.4.2 GROUNDING POINTS ..... 26
4.4.3 IF WITH OTHER BLANKETS ..... 26
4.5 TRACKER COOLING TUBES MLI ..... 27
4.5.1 BLANKET LAYUP ..... 27
4.6 WEIGHT ..... 27
4.7 CONSTRUCTION ..... 27
4.7.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 27
4.7.2 HOLES, SLOTS ETC. ..... 27
4.8 INTEGRATION ..... 27
4.8.1 MECHANICAL FIXATION POINTS ..... 27
4.8.2 GROUNDING POINTS ..... 27
4.8.3 IF WITH OTHER BLANKETS ..... 27
4.9 TRACKER RAD RODS MLI ..... 28
4.9.1 BLANKET LAYUP ..... 28
4.10 WEIGHT ..... 28
4.11 CONSTRUCTION ..... 28
4.11.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 28
4.11.2 HOLES, SLOTS ETC. ..... 28
4.12 INTEGRATION ..... 28
4.12.1 MECHANICAL FIXATION POINTS ..... 28
4.12.2 GROUNDING POINTS ..... 28
4.12.3 IF WITH OTHER BLANKETS ..... 28

5. VACUUM CASE MLI ..... 29

5.1 VC LOWER CONICAL FLANGE OUTER RING MLI ..... 29
5.1.1 BLANKET LAYUP ..... 30


Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

5.2 WEIGHT ..... 30
5.3 CONSTRUCTION ..... 30
5.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 30
5.3.2 HOLES, SLOTS ETC. ..... 30
5.4 INTEGRATION ..... 30
5.4.1 MECHANICAL FIXATION POINTS ..... 30
5.4.2 GROUNDING POINTS ..... 30
5.4.3 IF WITH OTHER BLANKETS ..... 30
5.5 VC RAM AND WAKE SIDE OUTER SHELL MLI ..... 31
5.5.1 BLANKET LAYUP ..... 31
5.6 WEIGHT ..... 31
5.7 CONSTRUCTION ..... 32
5.7.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 32
5.7.2 HOLES, SLOTS ETC. ..... 32
5.8 INTEGRATION ..... 32
5.8.1 MECHANICAL FIXATION POINTS ..... 32
5.8.2 GROUNDING POINTS ..... 32
5.8.3 IF WITH OTHER BLANKETS ..... 32
5.9 VC SUPPORT RINGS MLI (UPPER AND LOWER) ..... 33
5.9.1 VC UPPER SUPPORT RING MLI ..... 34
5.9.2 BLANKET LAYUP ..... 34
5.10 WEIGHT ..... 34
5.11 CONSTRUCTION ..... 34
5.11.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 34
5.11.2 HOLES, SLOTS ETC. ..... 34
5.12 INTEGRATION ..... 34
5.12.1 MECHANICAL FIXATION POINTS ..... 34
5.12.2 GROUNDING POINTS ..... 34
5.12.3 IF WITH OTHER BLANKETS ..... 34
5.12.4 VC LOWER SUPPORT RING MLI ..... 35
5.12.5 BLANKET LAYUP ..... 35
5.13 WEIGHT ..... 35
5.14 CONSTRUCTION ..... 35
5.14.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 35
5.14.2 HOLES, SLOTS ETC. ..... 35
5.15 INTEGRATION ..... 35
5.15.1 MECHANICAL FIXATION POINTS ..... 35
5.15.2 GROUNDING POINTS ..... 35
5.15.3 IF WITH OTHER BLANKETS ..... 35
5.16 VC UPPER SKIRT MLI ..... 36
5.16.1 BLANKET LAYUP ..... 36
5.17 WEIGHT ..... 37
5.18 CONSTRUCTION ..... 37
5.18.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 37
5.18.2 HOLES, SLOTS ETC. ..... 37
5.19 INTEGRATION ..... 37
5.19.1 MECHANICAL FIXATION POINTS ..... 37
5.19.2 GROUNDING POINTS ..... 37
5.19.3 IF WITH OTHER BLANKETS ..... 37

**6. USS PARTS MLI ..... 38**

6.1 DESCRIPTION ..... 38
6.1.1 BLANKET LAY-UP ..... 43
6.2 WEIGHT ..... 44
6.3 CONSTRUCTION ..... 44
6.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 44
6.3.2 HOLES, SLOTS ETC. ..... 44
6.4 INTEGRATION ..... 44

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

6.4.1 MECHANICAL FIXATION POINTS ..... 44
6.4.2 GROUNDING POINTS ..... 44
6.4.3 IF WITH OTHER BLANKETS ..... 44

**7. RICH AND L-TOF MLI ..... 45**

7.1 DESCRIPTION ..... 45
7.1.1 BLANKET LAYUP ..... 45
7.2 WEIGHT ..... 45
7.3 CONSTRUCTION ..... 45
7.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 46
7.3.2 HOLES, SLOTS ETC. ..... 46
7.4 INTEGRATION ..... 46
7.4.1 MECHANICAL FIXATION POINTS ..... 46
7.4.2 GROUNDING POINTS ..... 46
7.4.3 IF WITH OTHER BLANKETS ..... 46

**8. RICH BOTTOM MLI ..... 47**

8.1 DESCRIPTION ..... 47
8.1.1 BLANKET LAYUP ..... 47
8.2 WEIGHT ..... 47
8.3 CONSTRUCTION ..... 47
8.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 48
8.3.2 HOLES, SLOTS ETC. ..... 48
8.4 INTEGRATION ..... 48
8.4.1 MECHANICAL FIXATION POINTS ..... 48
8.4.2 GROUNDING POINTS ..... 48
8.4.3 IF WITH OTHER BLANKETS ..... 48

**9. ECAL MLI ..... 49**

9.1 ECAL MLI ..... 49
9.1.1 DESCRIPTION ..... 49
9.1.2 BLANKET LAYUP ..... 49
9.2 WEIGHT ..... 49
9.2.1 CONSTRUCTION ..... 50
9.2.2 INTEGRATION ..... 50
9.2.3 GROUNDING POINTS ..... 50
9.2.4 IF WITH OTHER BLANKETS ..... 50
9.3 ECAL BRACKETS MLI ..... 51
9.3.1 DESCRIPTION ..... 51
9.3.2 BLANKET LAYUP ..... 51
9.4 WEIGHT ..... 52
9.4.1 CONSTRUCTION ..... 52
9.4.2 INTEGRATION ..... 52
9.4.3 GROUNDING POINTS ..... 52
9.4.4 IF WITH OTHER BLANKETS ..... 52

**10. TRD GAS BOX MLI ENCLOSURE ..... 53**

10.1 DESCRIPTION ..... 53
10.1.1 BLANKET LAYUP ..... 53
10.2 WEIGHT ..... 53
10.3 CONSTRUCTION ..... 54
10.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 54
10.3.2 HOLES, SLOTS ETC. ..... 54
10.4 INTEGRATION ..... 54
10.4.1 MECHANICAL FIXATION POINTS ..... 54
10.4.2 GROUNDING POINTS ..... 54
10.4.3 IF WITH OTHER BLANKETS ..... 54

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

**11. UPS MLI ..... 55**
11.1 DESCRIPTION ..... 55
11.1.1 BLANKET LAYUP ..... 55
11.2 WEIGHT ..... 55
11.3 CONSTRUCTION ..... 55
11.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 56
11.3.2 HOLES, SLOTS ETC. ..... 56
11.4 INTEGRATION ..... 56
11.4.1 MECHANICAL FIXATION POINTS ..... 56
11.4.2 GROUNDING POINTS ..... 56
11.4.3 IF WITH OTHER BLANKETS ..... 56
**12. TTCB-PORT AND STARBOARD MLI ..... 57**
12.1 DESCRIPTION ..... 57
12.1.1 BLANKET LAYUP ..... 57
12.2 WEIGHT ..... 57
12.3 CONSTRUCTION ..... 58
12.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 58
12.3.2 HOLES, SLOTS ETC. ..... 58
12.4 INTEGRATION ..... 58
12.4.1 MECHANICAL FIXATION POINTS ..... 58
12.4.2 GROUNDING POINTS ..... 58
12.4.3 IF WITH OTHER BLANKETS ..... 58
**13. RAM AND WAKE TRACKER RADIATOR MLI ..... 59**
13.1.1 BLANKET LAYUP ..... 59
13.2 WEIGHT ..... 59
13.3 CONSTRUCTION ..... 59
13.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 59
13.3.2 HOLES, SLOTS ETC. ..... 59
13.4 INTEGRATION ..... 60
13.4.1 MECHANICAL FIXATION POINTS ..... 60
13.4.2 GROUNDING POINTS ..... 60
13.4.3 IF WITH OTHER BLANKETS ..... 60
**14. CRATES MLI ..... 61**
14.1 UPPER WAKE CRATE MLI ..... 61
14.1.1 DESCRIPTION ..... 61
14.1.2 BLANKET LAYUP ..... 61
14.2 WEIGHT ..... 61
14.2.1 CONSTRUCTION ..... 61
14.2.2 INTEGRATION ..... 62
14.2.3 GROUNDING POINTS ..... 62
14.2.4 IF WITH OTHER BLANKETS ..... 62
14.3 LOWER WAKE CRATE MLI ..... 63
14.3.1 DESCRIPTION ..... 63
14.3.2 BLANKET LAYUP ..... 63
14.4 WEIGHT ..... 63
14.4.1 CONSTRUCTION ..... 63
14.4.2 INTEGRATION ..... 64
14.4.3 GROUNDING POINTS ..... 64
14.4.4 IF WITH OTHER BLANKETS ..... 64
14.5 UPPER RAM CRATE MLI ..... 65
14.5.1 DESCRIPTION ..... 65
14.5.2 BLANKET LAYUP ..... 65
14.6 WEIGHT ..... 65
14.6.1 CONSTRUCTION ..... 65

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

14.6.2 INTEGRATION ..... 66
14.6.3 GROUNDING POINTS ..... 66
14.6.4 IF WITH OTHER BLANKETS ..... 66
14.7 LOWER RAM CRATE MLI ..... 67
14.7.1 DESCRIPTION ..... 67
14.7.2 BLANKET LAYUP ..... 67
14.8 WEIGHT ..... 67
14.8.1 CONSTRUCTION ..... 67
14.8.2 INTEGRATION ..... 68
14.8.3 GROUNDING POINTS ..... 68
14.8.4 IF WITH OTHER BLANKETS ..... 68

**15. XPD MLI ..... 69**

15.1 DESCRIPTION ..... 69
15.1.1 BLANKET LAYUP ..... 70
15.2 WEIGHT ..... 70
15.3 CONSTRUCTION ..... 70
15.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 70
15.3.2 HOLES, SLOTS ETC. ..... 70
15.4 INTEGRATION ..... 70
15.4.1 MECHANICAL FIXATION POINTS ..... 70
15.4.2 GROUNDING POINTS ..... 70
15.4.3 IF WITH OTHER BLANKETS ..... 70

**16. CAB LHP MLI ..... 71**

16.1 DESCRIPTION ..... 71
16.1.1 BLANKET LAYUP ..... 71
16.2 WEIGHT ..... 71
16.3 CONSTRUCTION ..... 71
16.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 71
16.3.2 HOLES, SLOTS ETC. ..... 72
16.4 INTEGRATION ..... 72
16.4.1 MECHANICAL FIXATION POINTS ..... 72
16.4.2 GROUNDING POINTS ..... 72
16.4.3 IF WITH OTHER BLANKETS ..... 72

**17. HV BRICKS MLI ..... 73**

17.1 DESCRIPTION ..... 74
17.1.1 BLANKET LAYUP ..... 74
17.2 WEIGHT ..... 74
17.3 CONSTRUCTION ..... 74
17.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 74
17.3.2 HOLES, SLOTS ETC. ..... 74
17.4 INTEGRATION ..... 74
17.4.1 MECHANICAL FIXATION POINTS ..... 74
17.4.2 GROUNDING POINTS ..... 74
17.4.3 IF WITH OTHER BLANKETS ..... 74

**18. PORT/STARBOARD STAR TRACKER SUPPORT MLI AND BAFFLE SUPPORT MLI ..... 75**

18.1 DESCRIPTION ..... 76
18.1.1 BLANKET LAYUP ..... 76
18.2 WEIGHT ..... 76
18.3 CONSTRUCTION ..... 76
18.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 76
18.3.2 HOLES, SLOTS ETC. ..... 76
18.4 INTEGRATION ..... 76
18.4.1 MECHANICAL FIXATION POINTS ..... 76
18.4.2 GROUNDING POINTS ..... 76

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

18.4.3 IF WITH OTHER BLANKETS ..... 76

**19. RAM/WAKE/PORT/STARBOARD CRYO COOLERS MLI ..... 77**

19.1 DESCRIPTION ..... 77
19.1.1 BLANKET LAYUP ..... 78
19.2 WEIGHT ..... 78
19.3 CONSTRUCTION ..... 78
19.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 78
19.3.2 HOLES, SLOTS ETC. ..... 78
19.3.3 MECHANICAL FIXATION POINTS ..... 79
19.3.4 GROUNDING POINTS ..... 79
19.3.5 IF WITH OTHER BLANKETS ..... 79

**20. CVB MLI ..... 80**

20.1 DESCRIPTION ..... 80
20.1.1 BLANKET LAYUP ..... 80
20.2 WEIGHT ..... 80
20.3 CONSTRUCTION ..... 80
20.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 81
20.3.2 HOLES, SLOTS ETC. ..... 81
20.4 INTEGRATION ..... 81
20.4.1 MECHANICAL FIXATION POINTS ..... 81
20.4.2 GROUNDING POINTS ..... 81
20.4.3 IF WITH OTHER BLANKETS ..... 81

**21. CRYOCOOLER LHP LINES MLI ..... 82**

21.1 DESCRIPTION ..... 82
21.1.1 BLANKET LAYUP ..... 82
21.2 WEIGHT ..... 82
21.3 CONSTRUCTION ..... 82
21.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 82
21.3.2 HOLES, SLOTS ETC. ..... 83
21.4 MECHANICAL FIXATION POINTS ..... 83
21.4.1 GROUNDING POINTS ..... 83
21.4.2 IF WITH OTHER BLANKETS ..... 83

**22. TRD + UTOF MLI ENCLOSURE ..... 84**

22.1 TRD - UTOF MLI ..... 84
22.1.1 DESCRIPTION ..... 84
22.1.2 BLANKET LAYUP ..... 84
22.2 WEIGHT ..... 84
22.3 CONSTRUCTION ..... 84
22.3.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 85
22.3.2 HOLES, SLOTS ETC. ..... 85
22.4 INTEGRATION ..... 85
22.4.1 MECHANICAL FIXATION POINTS ..... 85
22.4.2 GROUNDING POINTS ..... 85
22.4.3 IF WITH OTHER BLANKETS ..... 85
22.5 TRD TOP MLI ..... 86
22.5.1 DESCRIPTION ..... 86
22.5.2 BLANKET LAYUP ..... 86
22.6 WEIGHT ..... 86
22.7 CONSTRUCTION ..... 86
22.7.1 HARDWARE NEEDED FOR CUT-TO-FIT ..... 86
22.7.2 HOLES, SLOTS ETC. ..... 87
22.8 INTEGRATION ..... 87
22.8.1 MECHANICAL FIXATION POINTS ..... 87
22.8.2 GROUNDING POINTS ..... 87

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

22.8.3 IF WITH OTHER BLANKETS ..... 87

**23. PDS MLI ..... 88**

23.1.1 DESCRIPTION ..... 88
23.1.2 BLANKET LAYUP ..... 88
23.2 WEIGHT ..... 88
23.2.1 CONSTRUCTION ..... 88
23.2.2 INTEGRATION ..... 89
23.2.3 GROUNDING POINTS ..... 89
23.2.4 IF WITH OTHER BLANKETS ..... 89

**24. MLI ON AMS-02 SURFACES SUMMARY ..... 90**

24.1 AMS-02 MLI BLANKETS INCLUDE ..... 90

**25. MLI MODELLING ..... 92**

**26. MLI MASS BUDGET ..... 93**

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## LIST OF TABLES

Table 3-1: Number of grounding pints vs blanket surface area ..... 19
Table 3-2 Alpha Magnetic Spectrometer – 02 blanket lay-up ..... 24
Table 4-1 TRACKER BOTTOM PLANE MLI summary table ..... 26
Table 4-2 TRACKER Cooling tubes MLI summary table ..... 27
Table 4-3 TRACKER RAD RODS MLI summary table ..... 28
Table 5-1 VC Lower Conical flange MLI summary table ..... 30
Table 5-2 VC Ram and Wake side outer shell MLI summary table ..... 31
Table 5-3 VC Upper Support Ring MLI summary table ..... 34
Table 5-4 VC Lower Support Ring MLI summary table ..... 35
Table 5-5 VC Upper Skirt MLI summary table ..... 37
Table 6-1 USS MLI blankets Lay-up ..... 43
Table 6-2 USS MLI summary table ..... 44
Table 7-1 LTOF and RICH LAT MLI summary table ..... 45
Table 8-1 RICH BOTTOM MLI summary table ..... 47
Table 9-1 ECAL BOTTOM MLI summary table ..... 49
Table 9-2 ECAL BRACKETS MLI summary table ..... 52
Table 10-1 TRD GAS BOX MLI enclosure summary table ..... 53
Table 11-1 UPS MLI summary table ..... 55
Table 12-1 TTCB-P & S MLI summary table ..... 57
Table 13-1 Tracker radiator MLI summary table ..... 59
Table 14-1 Upper wake crates MLI summary table ..... 61
Table 14-2 Lower wake crates MLI summary table ..... 63
Table 14-3 Upper ram crates MLI summary table ..... 65
Table 14-4 Lower ram crates MLI summary table ..... 67
Table 15-1 XPD crates MLI summary table ..... 70
Table 16-1 CAB LHP MLI summary table ..... 71
Table 17-1 HV Bricks MLI summary table ..... 74
Table 18-1 ASTC MLI summary table ..... 76
Table 19-1 Crycooler MLI summary table ..... 78
Table 20-1 CVB MLI summary table ..... 80
Table 21-1 Crycooler LHP lines MLI summary table ..... 82
Table 22-1 TRD – UTOF MLI summary table ..... 84
Table 22-2 TRD TOP MLI summary table ..... 86
Table 23-1 PDS MLI summary table ..... 88
Table 24-1 AMS-02 MLI covered surface ..... 91
Table 25-1 MLI 20 layers HTC ..... 92
Table 25-2 MLI 20 layers effective emissivity ..... 92
Table 25-3 MLI thermal modelling parameters ..... 92
Table 26-1 MLI Mass Budget. ..... 93

## LIST OF FIGURES

Figure 3-1 Attachment of outer layers ..... 16
Figure 3-2 Blanket Edge Closure in areas with insufficient outer layer material ..... 16
Figure 3-3 Stand-Off/Clip Washer Attachment Method ..... 17
Figure 3-4 MLI to MLI Stand-Off ..... 17
Figure 3-5 Overlapping design ..... 18
Figure 3-6 Grounding of Foils ..... 19
Figure 3-7 Enlarged stand off for venting ..... 20
Figure 3-8 AMS02 blanket lay-up, type:INT ..... 21
Figure 3-9 AMS02 blanket lay-up, type:RTE ..... 21
Figure 3-10 AMS02 blanket lay-up, type:EXT ..... 21
Figure 3-11 AMS02 blanket lay-up, type:SL ..... 22
Figure 3-12 AMS02 blanket lay-up, NASA TRD_GB_booties. ..... 22
Figure 3-13 AMS02 blanket lay-up, NASA TRD_Top. ..... 22
Figure 3-14 AMS02 blanket lay-up, NASA TRD_Edge. ..... 22

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

Figure 3-15 AMS02 blanket lay-up, NASA TRD_Side. ..... 22
Figure 3-16 AMS02 blanket lay-up, NASA TRD_Bottom. ..... 23
Figure 3-17 AMS02 blanket lay-up, NASA VC_ECAL ..... 23
Figure 4-1 Tracker Geometrical Mathematical Model into AMS-02 system model without MLI ..... 25
Figure 4-2. TRACKER BOTTOM PLANE MLI coverage (red surface). LOWER VC CONICAL FLANGE OUTER RING MLI(magenta surface) ..... 25
Figure 5-1 VC LOWER CONICAL FLANGE OUTER RING MLI (magenta surface). TRACKER BOTTOM PLANE MLI coverage (red surface) ..... 29
Figure 5-2 VC RAM AND WAKE SIDE OUTER SHELL MLI coverage. ..... 31
Figure 5-3 VC SUPPORT RINGS (UPPER AND LOWER) MLI coverage ..... 33
Figure 5-4 VC UPPER SKIRT MLI coverage. ..... 36
Figure 6-1 USS GMM with the different parts highlighted ..... 38
Figure 6-2 USS-02 parts coverage: Upper and Lower VC I/F Joints (#1,#2,#3,#4), Upper trunnion bridges (#1,#2,#3,#4), Upper sill trunnion joint (#1,#2,#3,#4)are Beta Cloth ..... 39
Figure 6-3 USS-02 parts coverage: MLI on WAKE side sill tube and sill tube joint (#3,#4) and cross bars. 10mil silver Teflon on wake side lower trunnion bridge (#3 partial, #4) and RAM side sill tube and sill tube joint( #1,#2). ..... 40
Figure 6-4 USS-02 parts coverage: Anodized Aluminum covers the entire RAM side lower trunnion bridge (#1#2), and 10 mil Silver Teflon covers entire Lower Diagonals (#1 #2 #3 #4). ..... 41
Figure 6-5 Center Body (CB) MLI/Silver tape coverage. MLI is on all Center Body joints (#1,#2,#3,#4) and 10mil Silver Teflon is on entire Center Body. ..... 42
Figure 6-6 Debris protection plate in WAKE side and the contact facets with TRD+U_TOF covered with Beta-Cloth ..... 43
Figure 7-1 MLI wrapping LOWER TOF and RICH ..... 45
Figure 8-1 MLI between RICH and ECAL ..... 47
Figure 9-1 MLI at ECAL bottom (Zenith and Nadir) surface ..... 49
Figure 9-2 ECAL brackets MLI ..... 51
Figure 10-1 TRDGB-S MLI location and layout ..... 53
Figure 11-1 UPS location and entirely wrapped with MLI ..... 55
Figure 12-1 TTCB MLI ..... 57
Figure 13-1 Tracker radiator MLI (Type EXT) ..... 59
Figure 14-1 Upper wake crates MLI (Type: EXT) ..... 61
Figure 14-2 Lower WAKE crates MLI (Type: EXT) ..... 63
Figure 14-3 Upper RAM crates MLI (Type: EXT) ..... 65
Figure 14-4 Lower RAM Crates MLI (Type: EXT) ..... 67
Figure 15-1 WAKE Radiator XPDs MLI coverage ..... 69
Figure 15-2 RAM Radiator XPDs MLI coverage ..... 69
Figure 16-1 CAB LHP MLI coverage ..... 71
Figure 17-1 MLI on EHV and RHV bricks. ..... 73
Figure 17-2 MLI on SHV bricks ..... 73
Figure 18-1 Locations of Port/Starboard star tracker ..... 75
Figure 18-2 ASTC MLI (IF with TRD – UTOF MLI and VC-Upper skirt MLI) ..... 75
Figure 19-1 Crycoolers location ..... 77
Figure 19-2 Crycooler MLI (in red) ..... 78
Figure 20-1 CVB location ..... 80
Figure 21-1 *Crycooler LHP lines* ..... 82
Figure 22-1 TRD – UTOF MLI ..... 84
Figure 22-2 TRD TOP MLI location ..... 86
Figure 23-1 PDS MLI (Type: EXT) ..... 88
Figure 24-1 AMS-02 MLI Covered surfaces form GMM 4.1 ..... 90

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 1. SCOPE

This document contains the description of AMS-02 MLI blankets.
After a general overview of the blankets features, each individual piece of MLI is characterized in terms of weight, construction, hardware needed to build it and mechanical interfaces.

The document corresponds to contract deliverable DEL 079.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 2. DOCUMENTS

Documents here below identified are applicable and/or reference for the activities described in the present document and are considered part of it to the extent specified herein.

## 2.1 APPLICABLE DOCUMENTS

The documents listed here below are applicable to the present proposal for the extent recalled on it:

CONTRACTUAL

AD1 Capitolato generale ASI, available on http://www.asi.it/html/norme/cap_gen.pdf

AD2 Richiesta d'offerta per Programma AMS, attività di Fase C/D – Prot. ASI 006194 – 25/07/2007

AD2bis CapitolatoTecnico "Progetto: AMS Attività di fase C/D" Doc. N. DC-IPC-2007-062

AD3 Tailoring di primo livello delle norme ECSS, serie M-E-Q – Progetto AMS attività di fase C/D- Doc. n° DC-IPC-2007-063 Rev. A

MANAGEMENT

AD4 "ECSS Glossary" – Doc. ECSS-P-001 Rev. B

PRODUCT ASSURANCE

AD5 "Product Assurance Requirements - Progetto AMS attività di fase C/D "-Doc. n° DC-IPC-2007-064 Rev. A

AD6 "Istruzione Operativa "Norme per la redazione del Piano di Assicurazione del Prodotto (PA Plan)", Doc. OP-IPC-2005-008

AD7 "Sistemi di Gestione per la Qualità", doc. UNI EN ISO 9001:2000

AD8 "Quality Management Plan for the Alpha Magnetic Spectrometer 02 (AMS-02) Experiment", Doc. JSC63164, Basic Version, 09/21/2005

AD9 "Master Verification Plan (MVP)", Doc. JSC 29788, Iss. Draft, 8/21/2006

AD10 "PA REQUIREMENTS DC-IPC-2007-064 RevA Conformity",doc AMSCD-RQ-CGS-001 issue 1

ENGINEERING AND TECHNICAL

AD11 "Multi-Layer Insulation for the Alpha Magnetic Spectrometer Guidelines", Doc. CTSD-SH-1782, 9/30/2005

AD12 "AMS-02 Structural Verification Plan for the Space Transportation System and the International Space Station", Doc. JSC28792, Iss.D, March 2005

AD13 "Experiment/Payload Integration Hardware Interfaces - Part I", Doc. JSC29095, Iss.A, 06/01/2002

AD14 "Experiment/Payload Integration Hardware Interfaces - Part II", Doc. JSC29095, Iss.A, August 2004

AD15 "Experiment/Vacuum Case Payload Integration Hardware Interface", Doc. JSC29202, Iss.C, March 2005

AD16 "AMS-02 Thermal Control Requirements", Doc. AMS-RQ-CGS-001, Iss.1, April 2007

AD17 "Attached Payload Interface Requirements Document , Doc. SSP 57003, Iss. B, 17/06/03

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

AD18 "Attached Payload Hardware Interface Control Document, Doc. SSP 57004, Iss. B, 13/06/03

AD19 "AMSPDS-RP-CGS-001", Doc. PDS Design Description, Iss.2, July 05

AD20 "AmsE-PPL", AMS Electronics Preferred Parts List, available on

(http://ams.cern.ch/AMS/Electronics/Parts/), Iss.1, Nov 01 configured on doc PDS-LI-CGS-006 iss 1

AD21 "PDS ICD - Interface Control Document", Doc. AMSPDS-IC-CGS-001, Iss.3, July 05

AD22 "PDS Specifications", Doc. AMS-RQ-CGS-002, Iss.1, April 07

## 2.2 REFERENCE DOCUMENTS

[DR 1] Phase II Flight Safety Data Package for the Alpha Magnetic Spectrometer - 02 (AMS-02) Version Basic JSC49978 , 2006

[DR 2] Alpha Magnetic Spectrometer – 02 Assembly and Testing Integration Plan, Version A, JSC63123, 28-11-2005

[DR 3] Dichiarazione INFN sulla consegna di componenti – lettera del 20 maggio 2007 (prot. ASI n. 0009869)

[DR 4] Capitolato gestionale ASI OP-IPC-2005-010-E

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 3. COMMON MLI FEATURES

## 3.1 BLANKET ASSEMBLY

### 3.1.1 HOLDING TOGETHER OF INNER MLI PACKAGE

During manufacturing of the MLI blankets, the movement of layers relative to each other is avoided by the application of the grounding points. The closing of the blanket edges at the outer contours, around holes and slits hold the MLI together during storage. Once the MLI blankets have been integrated to the spacecraft, the attachment elements (stand-offs, lacing or velcro) additionally hold the foil package together. Thus the mechanical requirements can be fulfilled with improved thermal performance (fewer discontinuities).

### 3.1.2 EDGE CLOSING OF BLANKETS

External Blankets outer layers are attached by leaving flaps on their edges, folding these flaps around the blanket edge and bonding them to the inner cover foil using PSA 966 (3M) or PSA 9460 (3M) or PSA 9703 (3M).
Alternatively , flaps of the outer layer can be attached to the MLI innermost layer with Kapton tape as depicted in the next figure:

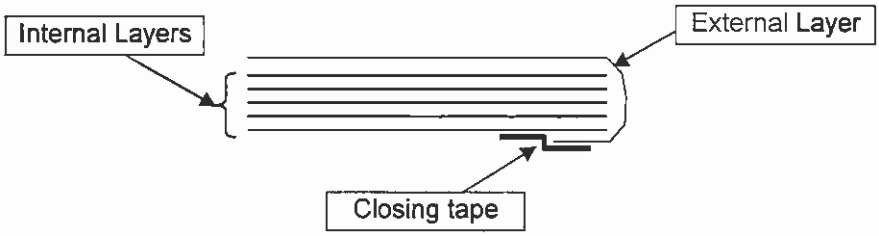


*Figure 3-1* Attachment of outer layers

For slits, small holes etc. where sufficient outer material is not available to provide edge flaps, additional strips are bonded to the outer foil and taped around the edge to the inside of the blanket:

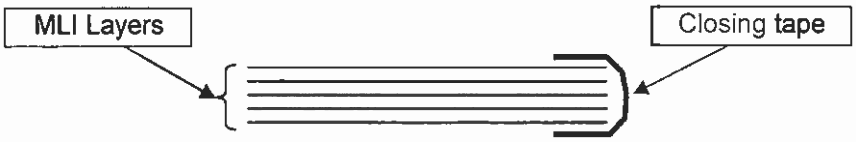


*Figure 3-2* Blanket Edge Closure in areas with insufficient outer layer material

All slits and cut-outs are protected against tearing in corners by cutting a ∅ 3 mm hole at the end of the slit or the corner of the cut out.

The closure tape shall have either the same thermo-optical properties as the outermost layer or shall be bonded underneath the outermost layer.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 3.2 BLANKET ATTACHMENT

The standard attachment method for MLI blankets to the structure or to each other is by Stand-Off / Pin assembly. The use of lacing and velcro is adopted for AMS02 MLI blankets.

### 3.2.1 STAND-OFF ATTACHMENT METHOD

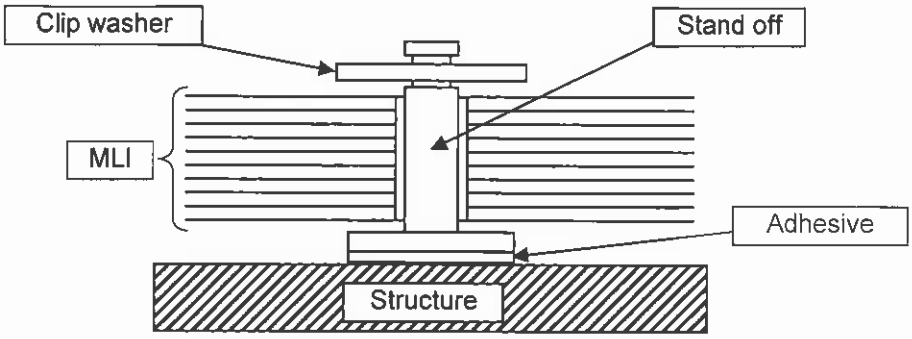


*Figure 3-3* Stand-Off/Clip Washer Attachment Method

The following materials are used:

Stand-offs: Aluminium or Vespel SP1
Clipwashers: Vespel SP1
Adhesive: Hysol EA 9321i

Stand-offs can also be used as a "floating" stand-off (i.e. not being rigidly bonded to the structure but attaching two overlapping blankets to each other). If access from underneath is difficult, two clip washers on one of this stand-off are needed (see next picture).

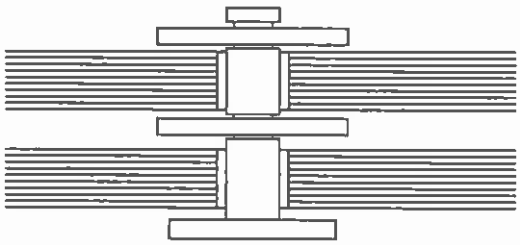

*Figure 3-4* MLI to MLI Stand-Off

Depending on the type of outer layer material, local reinforcement of stand-off holes with Kapton tape is foreseen. Stand-Off holes are cut by laser or punched using a hollow punch with cylindrical outer shape which prevents damaging of the foils around the holes.

### 3.2.2 OVERLAP AND SLIT DESIGN

For a good thermal performance of MLI blankets and to avoid undesired solar trapping, the detailed design of the interfaces (overlaps) between the single pieces of MLI is very important, as well as the closing of slits.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

In general for each slit longer than 150 mm and for each overlap between blankets a row of stand-offs is needed for mechanical and thermal reasons (i.e.: for retaining the respective blanket area to the structure). The baseline overlap design is shown in following sketch:

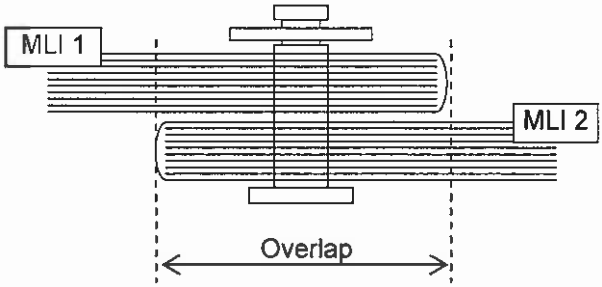


*Figure 3-5 Overlapping design*

Normally, the width of the overlap area is 50 mm but may vary depending on the local geometry of the S/C and on thermal critical areas.

### 3.2.3 LACING ATTACHMENT METHOD

In AMS02 some blankets must be attached to each other or the structure by lacing. Laces should be taut, with no slack that would let the blanket shift and expose protected areas or break away.
However they should not be pulled so tight as to cause the blanket to bunch or pucker. The laces should be tied off in a double knot (a square knot with an extra twist), also known as the Surgeon's knot.

### 3.2.4 VELCRO ATTACHMENT METHOD

Each Velcro attachment element consists of a loop part, which is already attached to the MLI blanket, and a hook part, which is to be bonded to the structure.
The position where velcros shall adhere must be marked on the structure. This performed using an approved pen or a very light abrading at the position according to applicable documents

### 3.2.5 CRACK STOPPERS

The foils of an MLI blanket are sensitive to tearing. Therefore all slits and cut-outs are finished with a D= 3mm hole to prevent tearing. These holes are cut by laser cutting made during MLI layers cut-to-shape.

If local repair of tears were necessary, these tears shall also be finished with a "crack stopper" prior to repairing with Kapton tape. In this case, these holes are punched with a hollow punch. On customer request these holes can be reinforced using 1 mil clear Kapton tapes on both external sides of the blanket.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 3.3 ELECTRICAL BONDING OF MLI BLANKETS

Each blanket is equipped with at least 2 bonding leads. At the blanket sided end of each bonding lead all foils are grounded to the respective bonding lead as follows:

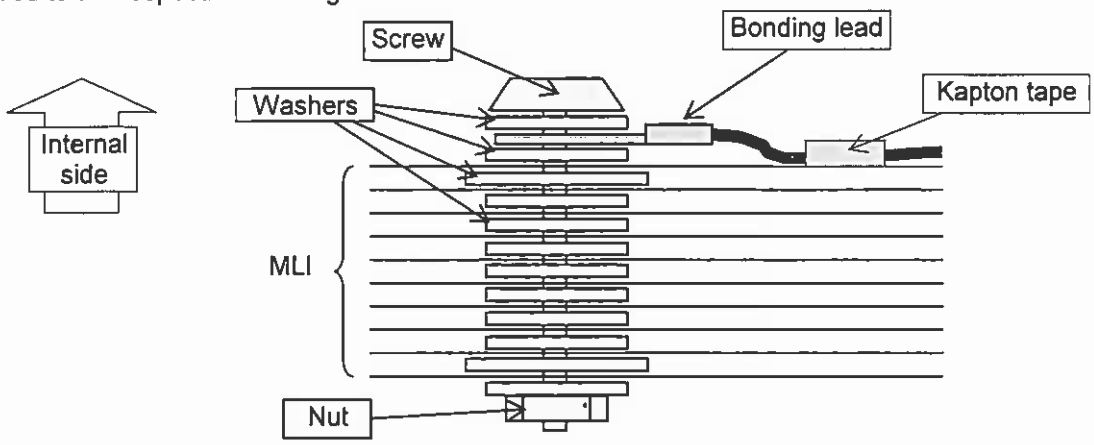


*Figure 3-6* Grounding of Foils

The bonding lead is secured on the innermost layer of the blanket by Kapton tape pieces.

The structural interface for attachment of the bonding leads to structure ground shall be M4 threaded bonding studs.
Sufficient grounding points shall be available on the structure (locations to be agreed mostly on the USS).
The standard number of bonding points per MLI blanket is given the following table:

| Blanket surface | Bonding points |
|---|---|
| Area < 100cm$^2$ | no grounding |
| 100cm$^2$<area<4m$^2$ | 2 |
| Area >4m$^2$ | >2 |

*Table 3-1: Number of grounding pints vs blanket surface area*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 3.4 VENTING

All the layers of the blankets will be perforated to allow the venting of the blanket itself. The perforation pattern of these foils will be chosen in order to provide an appropriate open.

To ensure venting of the air enclosed underneath the blankets venting direction will be defined.
In these locations, enlarged stand-off will be used where an extra gap is set between the two MLI to allow the gas escape.
Special care will be taken in the design of these areas to avoid solar trapping.

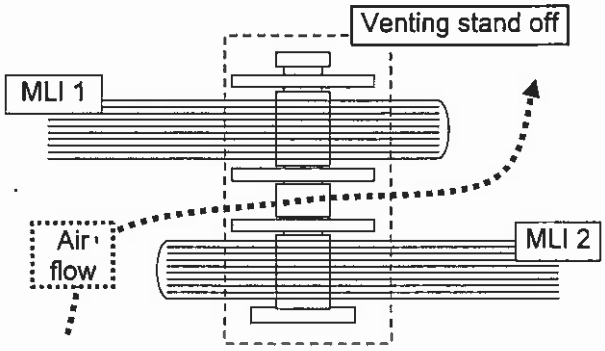


*Figure 3-7* Enlarged stand off for venting

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 3.5 BLANKET LAY-UP

Blanket lay-up for Alpha Magnetic Spectrometer – 02 (AMS-02) are summarized in the following 5 tipes:

1) Type INT;
2) Type RTE;
3) Type EXT;
4) Type SL;
5) NASA: TRD_GB_booties;
6) NASA: TRD_Top;
7) NASA: TRD_Edge;
8) NASA: TRD_Side;
9) NASA: TRD_Bottom;
10) NASA: VC_ECAL

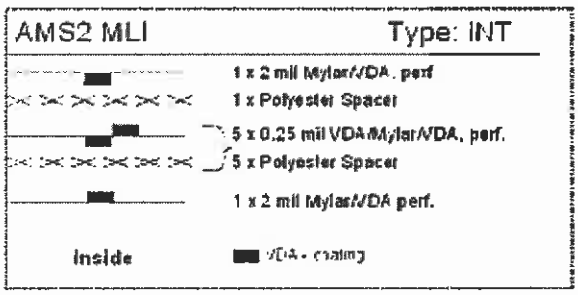


Figure 3-8 AMS02 blanket lay-up, type:INT

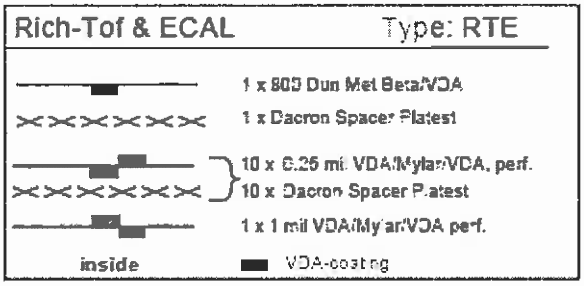


Figure 3-9 AMS02 blanket lay-up, type:RTE

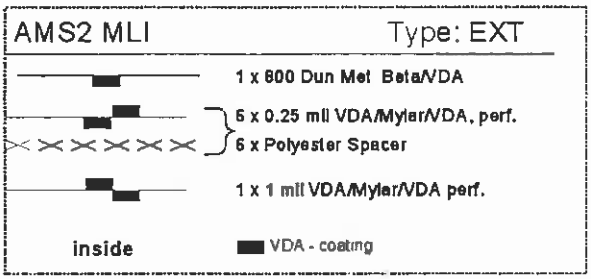


Figure 3-10 AMS02 blanket lay-up, type:EXT

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

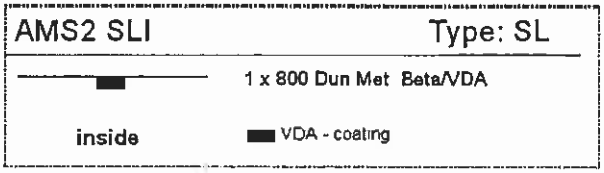


Figure 3-11 AMS02 blanket lay-up, type:SL

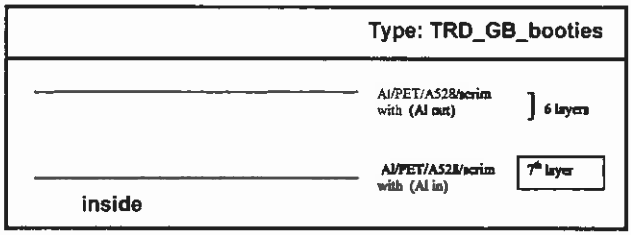


Figure 3-12 AMS02 blanket lay-up, NASA TRD_GB_booties.

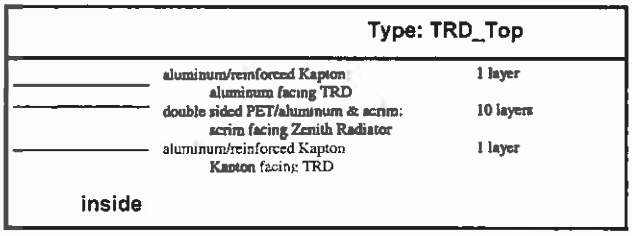


Figure 3-13 AMS02 blanket lay-up, NASA TRD_Top.

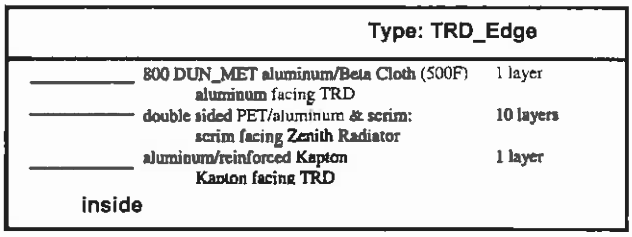


Figure 3-14 AMS02 blanket lay-up, NASA TRD_Edge.

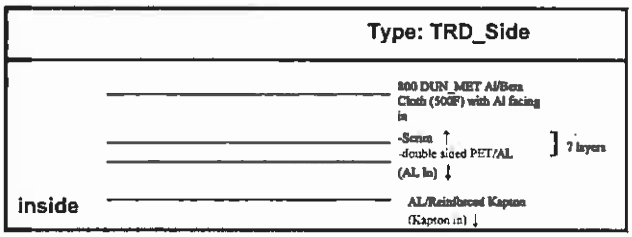


Figure 3-15 AMS02 blanket lay-up, NASA TRD_Side.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

| Type: TRD_Bottom | | |
|---|---|---|
| | aluminum/reinforced Kapton: aluminum facing TRD | 1 layer |
| | double sided PET/aluminum & scrim: scrim facing away from TRD | 7 layers |
| | aluminum/reinforced Kapton Kapton facing TRD | 1 layer |
| inside | | |

Figure 3-16 AMS02 blanket lay-up, NASA TRD_Bottom.

| Type: VC_ECAL | | |
|---|---|---|
| | Beta Cloth Al-Kapton (Al side facing down) | 1 layer |
| | Al-Mylar (with PET Scrim on one side, facing up) | 7 layers |
| | Al-Kapton, reinforced with PET mesh (Al side facing up) | 1 layer |
| inside | | |

Figure 3-17 AMS02 blanket lay-up, NASA VC_ECAL.

Blanket lay-up is summarized for each Alpha Magnetic Spectrometer – 02 blanket.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

| Row ID | SUBSYSTEM | description | Number of blankets | Lay-up |
|---|---|---|---|---|
| 1 | TRACKER | TRACKER BOTTOM Plane MLI | 2 | INT |
| 2 | TRACKER | TRACKER COOLING TUBES MLI | 2 | EXT |
| 3 | TRACKER | Tracker rad rods MLI | 16 | SL |
| 4 | VC | VC LOWER CONICAL FLANGE OUTER RING MLI | 4 | EXT |
| 5 | VC | VC RAM AND WAKE SIDE OUTER SHELL MLI | 2 | NASA VC-ECAL |
| 6 | VC | VC Upper Support Ring (USR) MLI | 6 TBC | EXT |
| 7 | VC | VC Lower Support Ring (LSR) MLI | 8 TBC | EXT |
| 8 | VC | VC UPPER SKIRT MLI | 4 | EXT |
| 9 | USS | USS02 Upper Trunion Bridges - Ram side - MLI | 2 | SL |
| 10 | USS | USS02 Upper Trunion Bridges - Wake side - MLI | 2 | EXT |
| 11 | USS | USS02 Upper VC IF joints MLI | 4 | EXT |
| 12 | USS | USS02 sill trunnion joints RAM & WAKE MLI | 4 | SL |
| 13 | USS | USS02 WAKE sill tube joints MLI | 2 | SL |
| 14 | USS | USS02 WAKE sill tube MLI | 1 | SL |
| 15 | USS | Cross bar MLI | 2 | SL |
| 16 | USS | USS02 lower VC IF joints MLI | 4 | SL |
| 17 | USS | USS02 center body joints MLI | 4 | SL |
| 18 | RICH and L-TOF | L-TOF MLI | 4 | RTE |
| 19 | RICH and L-TOF | RICH LAT MLI | 4 | RTE |
| 20 | RICH and L-TOF | RICH BOTTOM MLI | 2 | RTE |
| 21 | ECAL | ECAL BOTTOM MLI | 1 | NASA VC-ECAL |
| 22 | ECAL | ECAL BRACKETS MLI | 8 | RTE |
| 23 | TRDGB | TRD GAS BOX MLI ENCLOSURE | TBD | NASA TRD_GB_booties<br>NASA TRD_Side |
| 24 | UPS | UPS MLI | TBD | EXT |
| 25 | TTCB | TTCB-PORT AND STRB MLI | TBD | EXT |
| 26 | TRACKER | RAM AND WAKE TRACKER RADIATOR MLI | 2 | EXT |
| 27 | CRATES | UPPER WAKE CRATE MLI | TBD | EXT |
| 28 | CRATES | LOWER WAKE CRATE MLI | TBD | EXT |
| 29 | CRATES | UPPER RAM CRATE MLI | TBD | EXT |
| 30 | CRATES | LOWER RAM CRATE MLI | TBD | EXT |
| 31 | XPD | XPD MLI | TBD | EXT |
| 32 | CAB | CAB LHP lines | TBD | EXT |
| 33 | HV BRICKS | HV BRICKS MLI:<br>4SHV (2 on WAKE and 2 on RAM main radiator)<br>6EHV (L-USS diagonal) + 4RHV (L-USS diagonal) | TBD | EXT |
| 34 | ASTC | ASTC MLI<br>(STAR TRACKER SUPPORT MLI AND BAFFLE SUPPORT MLI) | 2 | EXT |
| 35 | CRYO COOLERS | CRYO COOLERS MLI | 4 | EXT |
| 36 | CVB | CVB MLI | TBD | EXT |
| 37 | CRYO COOLERS | CRYO LHP LINES MLI | 4 | EXT |
| 38 | TRD - UTOF | TRD - UTOF MLI | 1 | NASA TRD_Top<br>NASA TRD_Edge |
| 39 | TRD | TRD TOP MLI | 1 | NASA TRD_Side<br>NASA TRD_Bottom |
| 40 | PDS | PDS MLI | TBD | EXT |

*Table 3-2 Alpha Magnetic Spectrometer – 02 blanket lay-up*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 4. TRACKER MLI

## 4.1 TRACKER BOTTOM PLANE MLI

In order to provide an overview of the TRACKER subsystem the geometrical mathematical model without MLI has been presented in the following Fig.3-1. The figure provide also the location and name of tracker different parts.

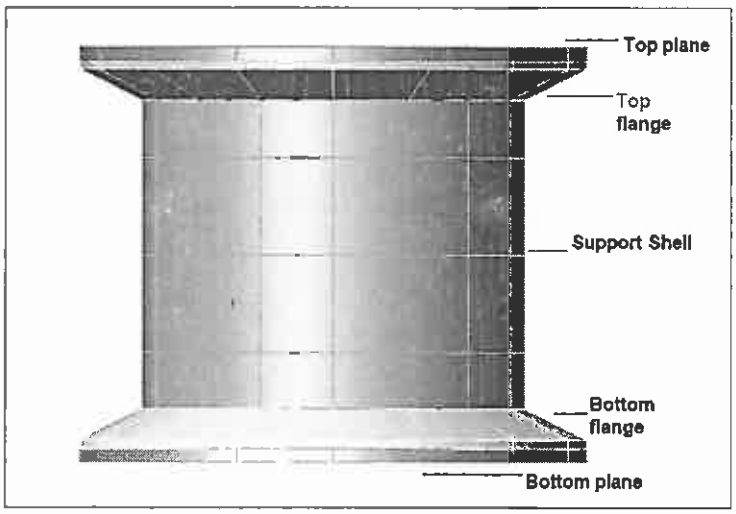


*Figure 4-1 Tracker Geometrical Mathematical Model into AMS-02 system model without MLI*

The TRACKER BOTTOM PLANE MLI cover the bottom surface as showed in Fig.3-2.

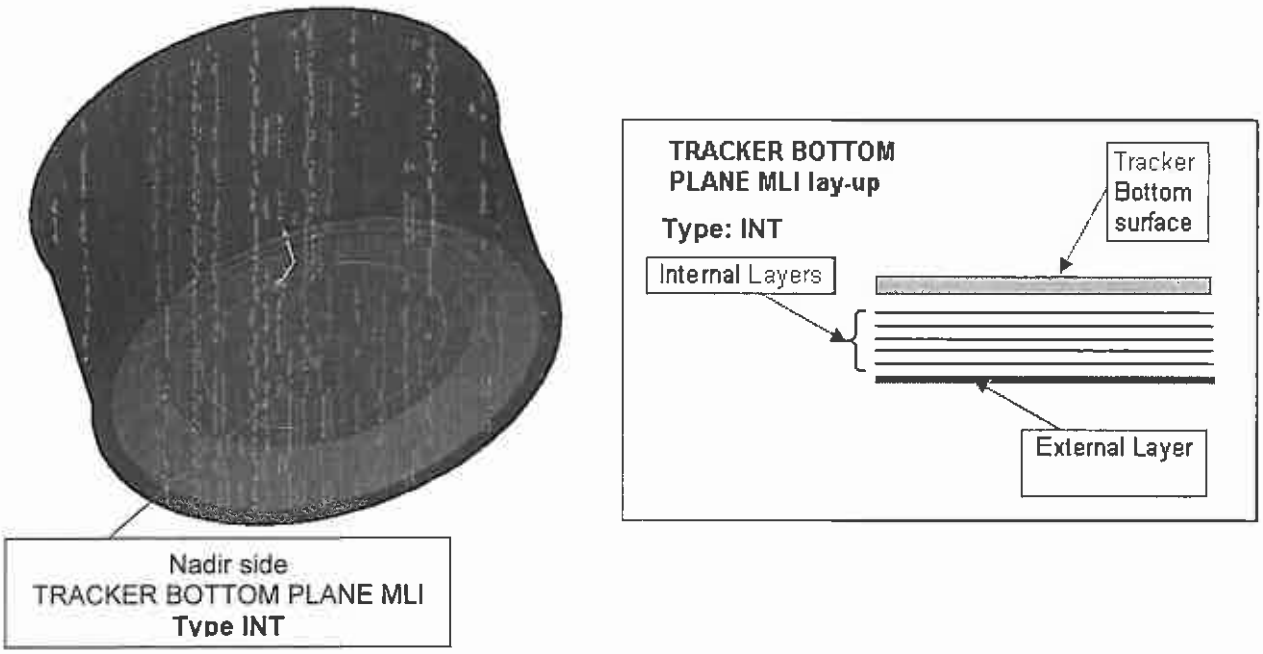


*Figure 4-2. TRACKER BOTTOM PLANE MLI coverage (*red surface*). LOWER VC CONICAL FLANGE OUTER RING MLI(*magenta surface*).*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 4.1.1 BLANKET LAYUP

The blanket Lay-up is INT

## 4.2 WEIGHT

Details are shown in Table 4-1

*Table 4-1 TRACKER BOTTOM PLANE MLI summary table*

| Blanket ID | nr parts | Area [$m^2$] | Weight [Kg] |
|---|---|---|---|
| Blanket Tracker Bottom plane YP | 1 | 0.841 | 0.23 |
| Blanket Tracker Bottom plane YN | 1 | 0.841 | 0.23 |
| **TOTAL** | **2** | **1.682** | **0.46** |

## 4.3 CONSTRUCTION

The blanket is cut on the basis of Tracker CAD model.

### 4.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

Tracker bottom plane, Tracker harness, Optical Fibres.

### 4.3.2 HOLES, SLOTS ETC.

No cut-outs are needed.

## 4.4 INTEGRATION

After Tracker installation.

### 4.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by means of fixed aluminium stand-offs located on Tracker Bottom Plane.

### 4.4.2 GROUNDING POINTS

4 grounding points located on tracker bottom plane (+ 2 spare)

### 4.4.3 IF WITH OTHER BLANKETS

IF with Lower Conical Flange MLI through shared stand-offs.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 4.5 TRACKER COOLING TUBES MLI

This blanket covers the tubes of the TTCS from TTCB to Tracker radiator.
TTCS tubes will be mounted inside VSB1 (wake-port side) and VSB2 (wake-stb side).

### 4.5.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 4.6 WEIGHT

Details are shown in Table 4-2.

*Table 4-2 TRACKER Cooling tubes MLI summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Blanket covering TTCS tubes – | 2 | TBD | in TTCS mass budget |
| **TOTAL** | **2** | **TBD** | ***in TTCS mass budget*** |

## 4.7 CONSTRUCTION

The blanket is cut to fit directly on TTCS plumbing inside VSB.

### 4.7.1 HARDWARE NEEDED FOR CUT-TO-FIT

TTCS plumbing and VSB assembled on AMS-02

### 4.7.2 HOLES, SLOTS ETC.

Cut-outs are needed for IF with LHP

## 4.8 INTEGRATION

After Magnet installation.

### 4.8.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by means of lacing or velcro on Upper and Lower Support Ring hardware and around VSB.

### 4.8.2 GROUNDING POINTS

VC (TBC)

### 4.8.3 IF WITH OTHER BLANKETS

IF with TTCB units MLI, Upper USS, Upper and Lower Support Ring MLI.
The blanket could merge with Cryocoolers LHP MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 4.9 TRACKER RAD RODS MLI

This blanket covers the Tracker radiator rods.

### 4.9.1 BLANKET LAYUP

The blanket Lay-up is SL

## 4.10 WEIGHT

Details are shown in Table 4-3.

*Table 4-3 TRACKER RAD RODS MLI summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Blanket on Tracker rad Rods – Ram side | 8 | 0.8 | 0.455 |
| Blanket on Tracker rad Rods – Wake side | 8 | 0.8 | 0.455 |
| **TOTAL** | **16** | **1.6** | **0.91** |

## 4.11 CONSTRUCTION

The blanket is cut on the basis of Tracker Rods CAD model.

### 4.11.1 HARDWARE NEEDED FOR CUT-TO-FIT

Tracker radiator rods, Upper USS, Tracker radiator.

### 4.11.2 HOLES, SLOTS ETC.

No cut-outs are needed.

## 4.12 INTEGRATION

Before Tracker radiator installation.

### 4.12.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing or Velcro on Tracker radiator rods (TBC).

### 4.12.2 GROUNDING POINTS

on tracker radiator (TBC)

### 4.12.3 IF WITH OTHER BLANKETS

IF with USS VC Upper IF Joint MLI, Tracker radiator MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 5. VACUUM CASE MLI

## 5.1 VC LOWER CONICAL FLANGE OUTER RING MLI

The VC LOWER conical flange OUTER ring is covered with MLI blanket (type: EXT), which is shown in Figure 4-1.

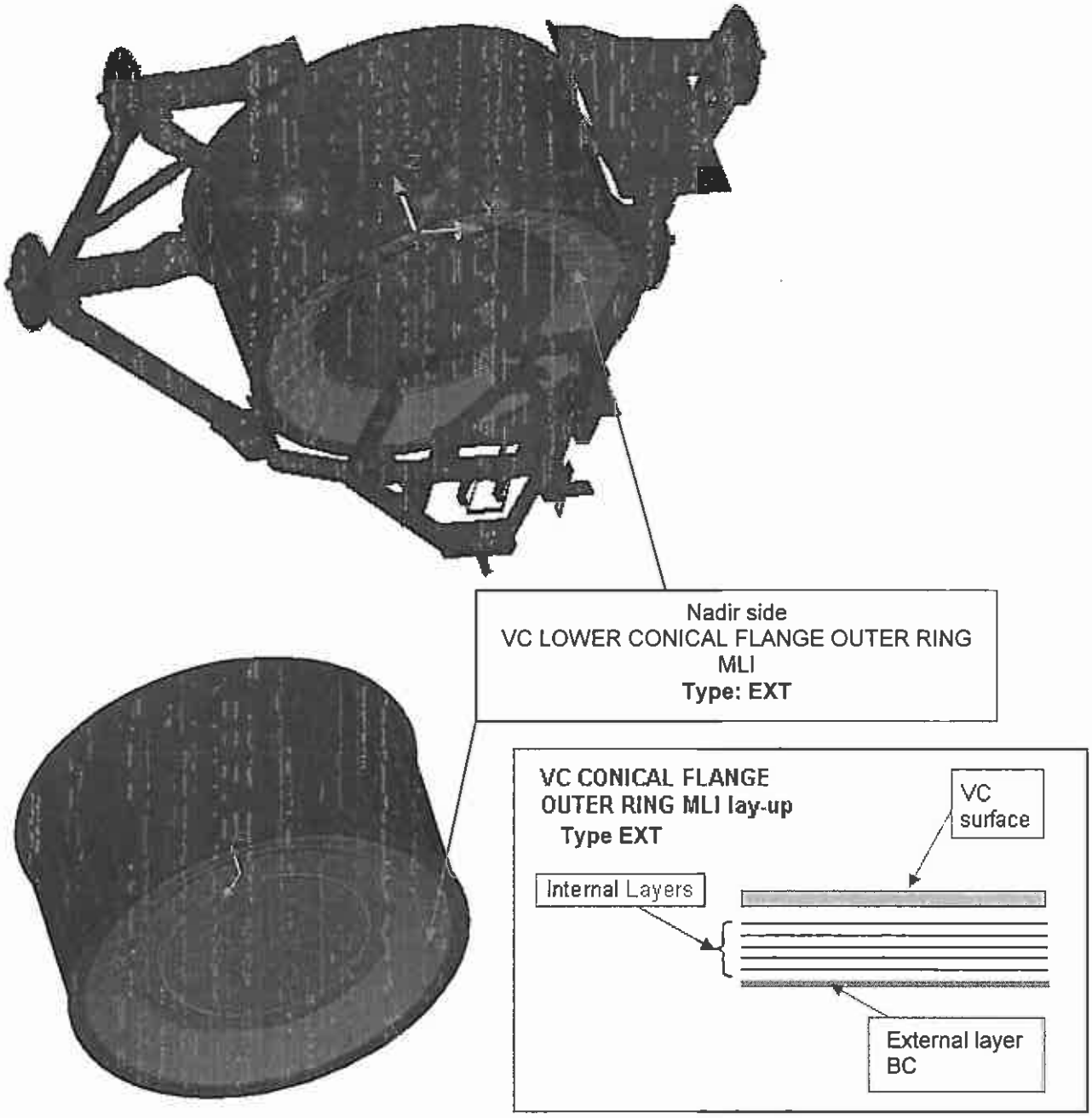


*Figure 5-1 VC LOWER CONICAL FLANGE OUTER RING MLI* (magenta surface). *TRACKER BOTTOM PLANE MLI coverage* (red surface).

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 5.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 5.2 WEIGHT

Details are shown in Table 5-1.

*Table 5-1* VC Lower Conical flange *MLI summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| VC Lower Conical flange MLI | 4 | 3.43 | 2.29 |
| **TOTAL** | **4** | **3.43** | **2.29** |

## 5.3 CONSTRUCTION

The blanket is cut on the basis of VC CAD model. Fit-check activity is foreseen.

### 5.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

Tracker bottom plane, Tracker harness, VC.

### 5.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for lacing to VC.

## 5.4 INTEGRATION

After Tracker installation.

### 5.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to VC and by stand-offs to Tracker bottom plane. Velcro or lacing can be applied to IF with LTOF MLI and Lower Support Ring MLI.

### 5.4.2 GROUNDING POINTS

Grounding points shared with Tracker Bottom MLI, located on tracker bottom plane.

### 5.4.3 IF WITH OTHER BLANKETS

IF with Lower Conical Flange MLI through shared stand-offs.
Velcro or lacing can be applied to IF with LTOF MLI and Lower Support Ring MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 5.5 VC RAM AND WAKE SIDE OUTER SHELL MLI

Vacuum case outer shell is covered with MLI blanket on Wake and Ram sides facing crates on radiator, as shown in Figure 5-2.

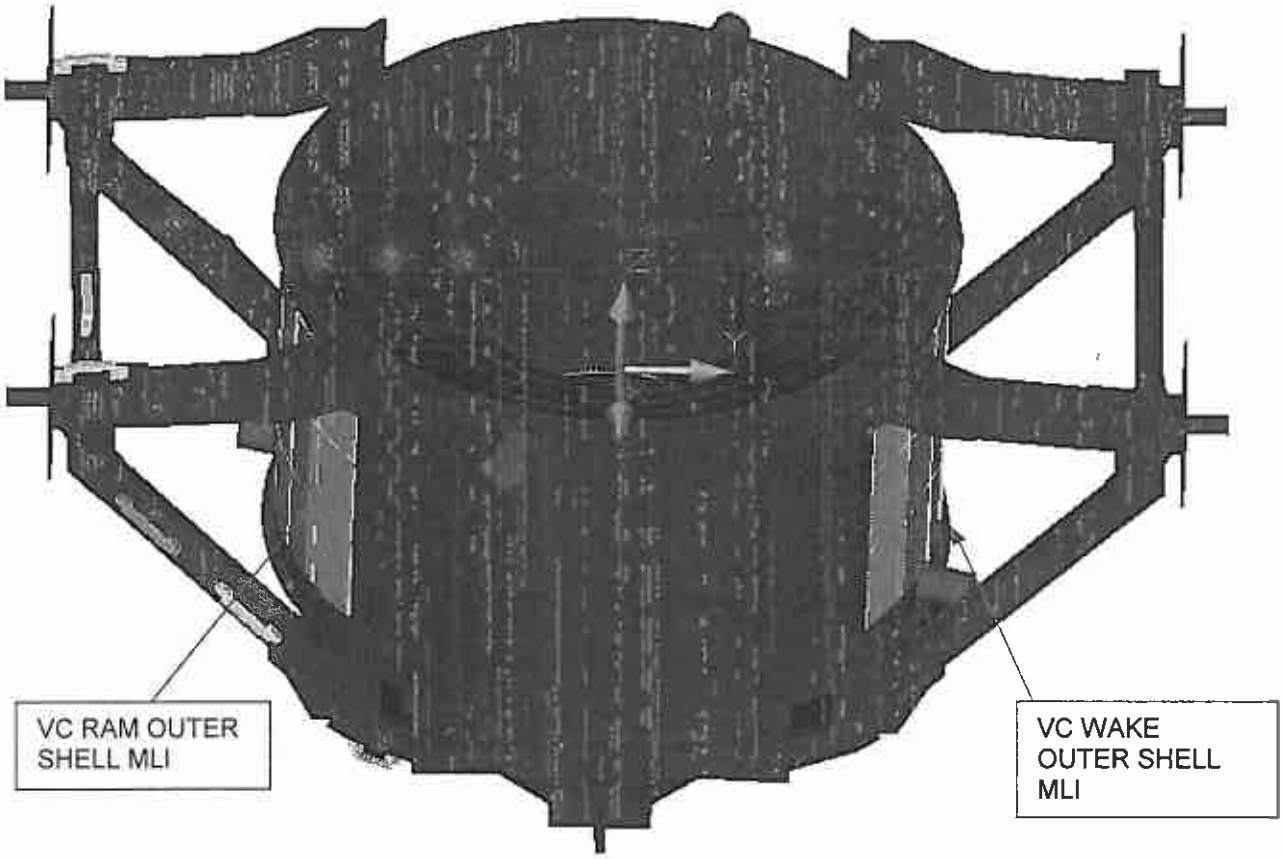


*Figure 5-2 VC RAM AND WAKE SIDE OUTER SHELL MLI coverage.*

### 5.5.1 BLANKET LAYUP

The blanket Lay-up is NASA VC_ECAL.

## 5.6 WEIGHT

Details are shown in Table 5-2.

*Table 5-2* VC Ram and Wake side outer shell MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| VC Ram side outer shell MLI | 1 | 2.6 | 1.17 |
| VC Ram side outer shell MLI | 1 | 2.6 | 1.17 |
| **TOTAL** | **2** | **5.2** | **2.34** |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 5.7 CONSTRUCTION

The blanket is cut on the basis of VC CAD model.

### 5.7.1 HARDWARE NEEDED FOR CUT-TO-FIT

VC, Upper USS, VC harness

### 5.7.2 HOLES, SLOTS ETC.

Cut-outs are needed for lacing to VC and for Cryo-coolers and VSB.

## 5.8 INTEGRATION

After VC installation.

### 5.8.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to VC.

### 5.8.2 GROUNDING POINTS

Grounding points located on VC Upper Support Ring.

### 5.8.3 IF WITH OTHER BLANKETS

Possible IF with VSB MLI and U and L SR MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 5.9 VC SUPPORT RINGS MLI (UPPER AND LOWER)

These two blankets cover the Upper and the Lower vacuum case Support Rings (U and L SR).

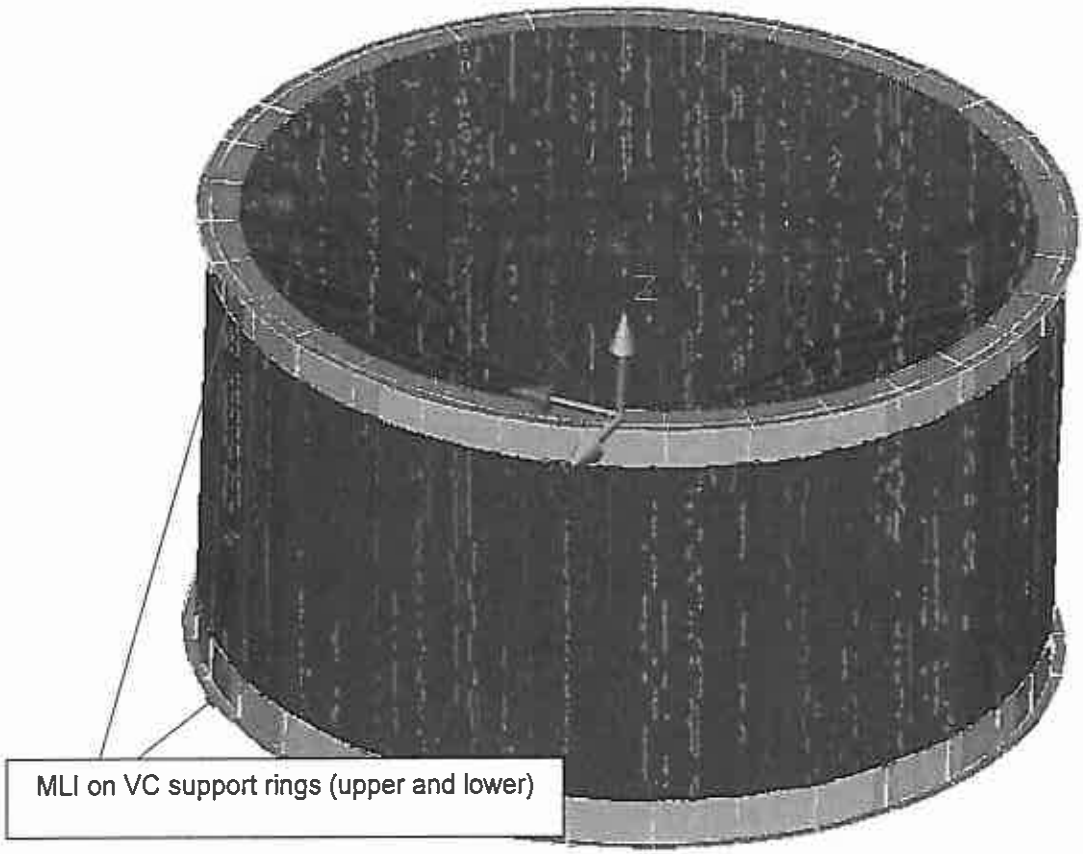


*Figure 5-3 VC SUPPORT RINGS (UPPER AND LOWER) MLI coverage*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 5.9.1 VC UPPER SUPPORT RING MLI

### 5.9.2 BLANKET LAYUP

The blanket Lay-up is EXT

## 5.10 WEIGHT

Details are shown in Table 5-3.

*Table 5-3* VC Upper Support Ring MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| VC Upper Support Ring MLI | 6 TBC | 1.85 | 1.48 |
| **TOTAL** | **6 TBC** | **1.85** | **1.48** |

## 5.11 CONSTRUCTION

The blanket is cut on the basis of VC U SR CAD model. Fit-check activity is recommended

### 5.11.1 HARDWARE NEEDED FOR CUT-TO-FIT

VC hardware, Upper USS, VC harness, VC piping lines, Bipod structure, VSB

### 5.11.2 HOLES, SLOTS ETC.

Cut-outs, holes and flaps are needed for VC hardware, Upper USS, VC harness, VC piping lines, Bipod structure

## 5.12 INTEGRATION

After VC hardware installation.

### 5.12.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing or velcro to VC Upper support ring.

### 5.12.2 GROUNDING POINTS

Grounding points located on VC U Support Ring (to be shared with VC ram and wake side outer shell MLI) (TBC)

### 5.12.3 IF WITH OTHER BLANKETS

IF with VC Ram and Wake outer shell MLI, VC Upper skirt MLI, Cryocoolers LHP MLI/VSB, Upper I/F Joints MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 5.12.4 VC LOWER SUPPORT RING MLI

### 5.12.5 BLANKET LAYUP

The blanket Lay-up is EXT

## 5.13 WEIGHT

Details are shown in Table 5-4.

*Table 5-4* VC Lower Support Ring MLI *summary table*

| Blanket ID | nr parts | Area [$m^2$] | Weight [Kg] |
|---|---|---|---|
| VC Lower Support Ring MLI | 8 TBC | 1.85 | 1.48 |
| **TOTAL** | **8 TBC** | **1.85** | **1.48** |

## 5.14 CONSTRUCTION

The blanket is cut on the basis of VC L SR CAD model. Fit-check activity is recommended

### 5.14.1 HARDWARE NEEDED FOR CUT-TO-FIT

VC hardware, Lower USS, VC harness, VC piping lines, Bipod structure, VSB

### 5.14.2 HOLES, SLOTS ETC.

Cut-outs, holes and flaps are needed for VC hardware, Lower USS, VC harness, VC piping lines, Bipod structure

## 5.15 INTEGRATION

After VC hardware installation.

### 5.15.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing or velcro to VC Lower support ring.

### 5.15.2 GROUNDING POINTS

Grounding points located on VC L Support Ring (TBC)

### 5.15.3 IF WITH OTHER BLANKETS

IF with VC Lower conical flange MLI; LTOF MLI; Cryocoolers LHP/VSB MLI, Lower I/F Joints MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 5.16 VC UPPER SKIRT MLI

The VC UPPER SKIRT MLI between TRD and VC is used to protect the Tracker top plane from external fluxes. Figure 5-4 shows the location of the Upper Skirt MLI. Please note the I/F between the blanket and the 2 star trackers.

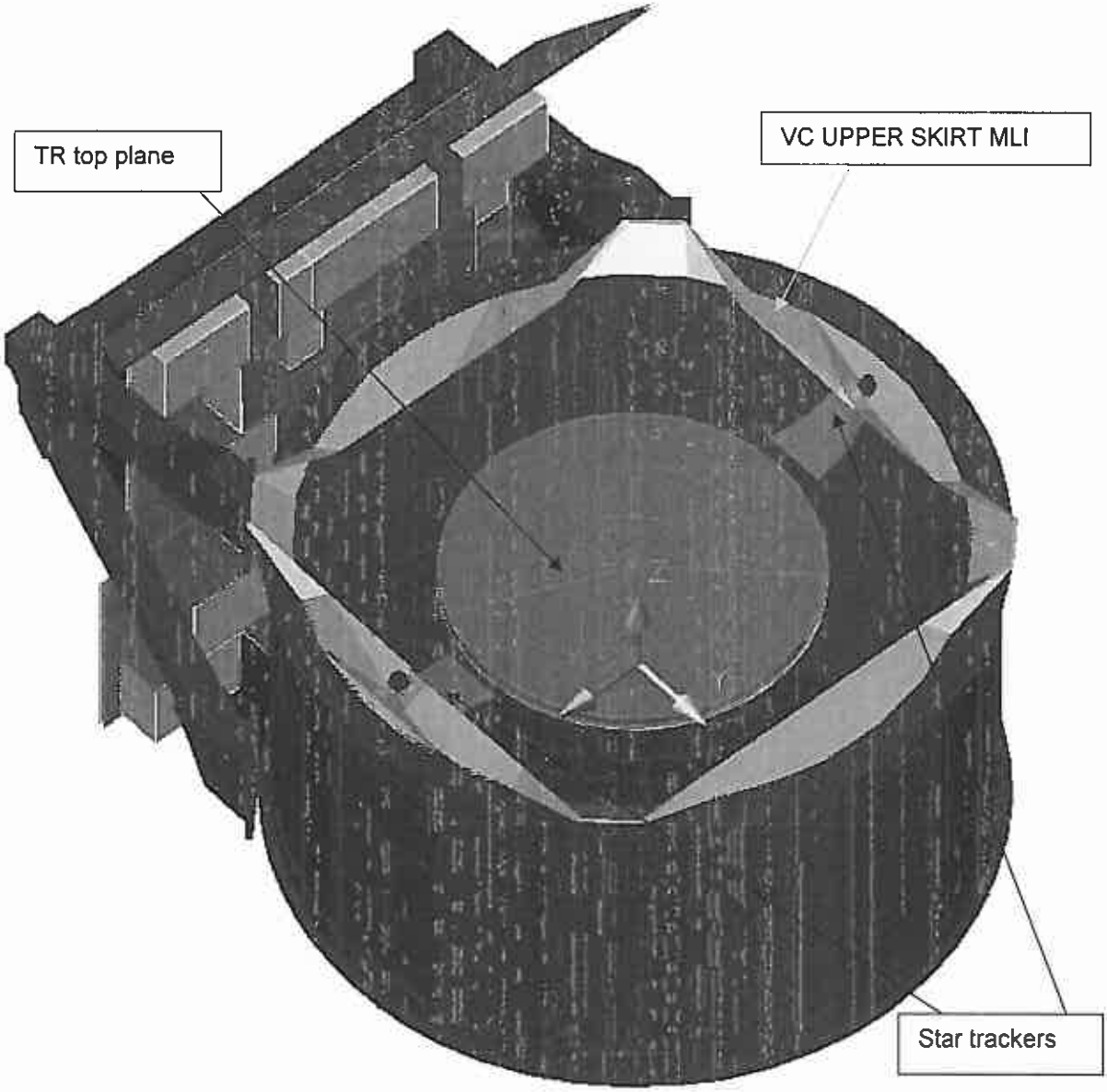


*Figure 5-4 VC UPPER SKIRT MLI coverage.*

### 5.16.1 BLANKET LAYUP

The blanket Lay-up is EXT

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 5.17 WEIGHT

Details are shown in Table 5-5.

*Table 5-5* VC Upper Skirt MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| VC Upper Skirt MLI | 4 | 2.6 | 1.9 |
| **TOTAL** | **4** | **2.6** | **1.9** |

## 5.18 CONSTRUCTION

The blanket is cut on the basis of VC CAD model.

### 5.18.1 HARDWARE NEEDED FOR CUT-TO-FIT

VC hardware, TRD, Upper USS, U-TOF, Star trackers

### 5.18.2 HOLES, SLOTS ETC.

Cut-outs are needed for IF with Star Tracker MLI.

## 5.19 INTEGRATION

After VC and TRD installation.

### 5.19.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to VC.

### 5.19.2 GROUNDING POINTS

Grounding points shared with TRD MLI.

### 5.19.3 IF WITH OTHER BLANKETS

IF with VC Upper Support Ring MLI, TRD + UTOF MLI, Star Tracker MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 6. USS PARTS MLI

## 6.1 DESCRIPTION

The locations and general descriptions of USS different parts are indicated in Figure 6-1.

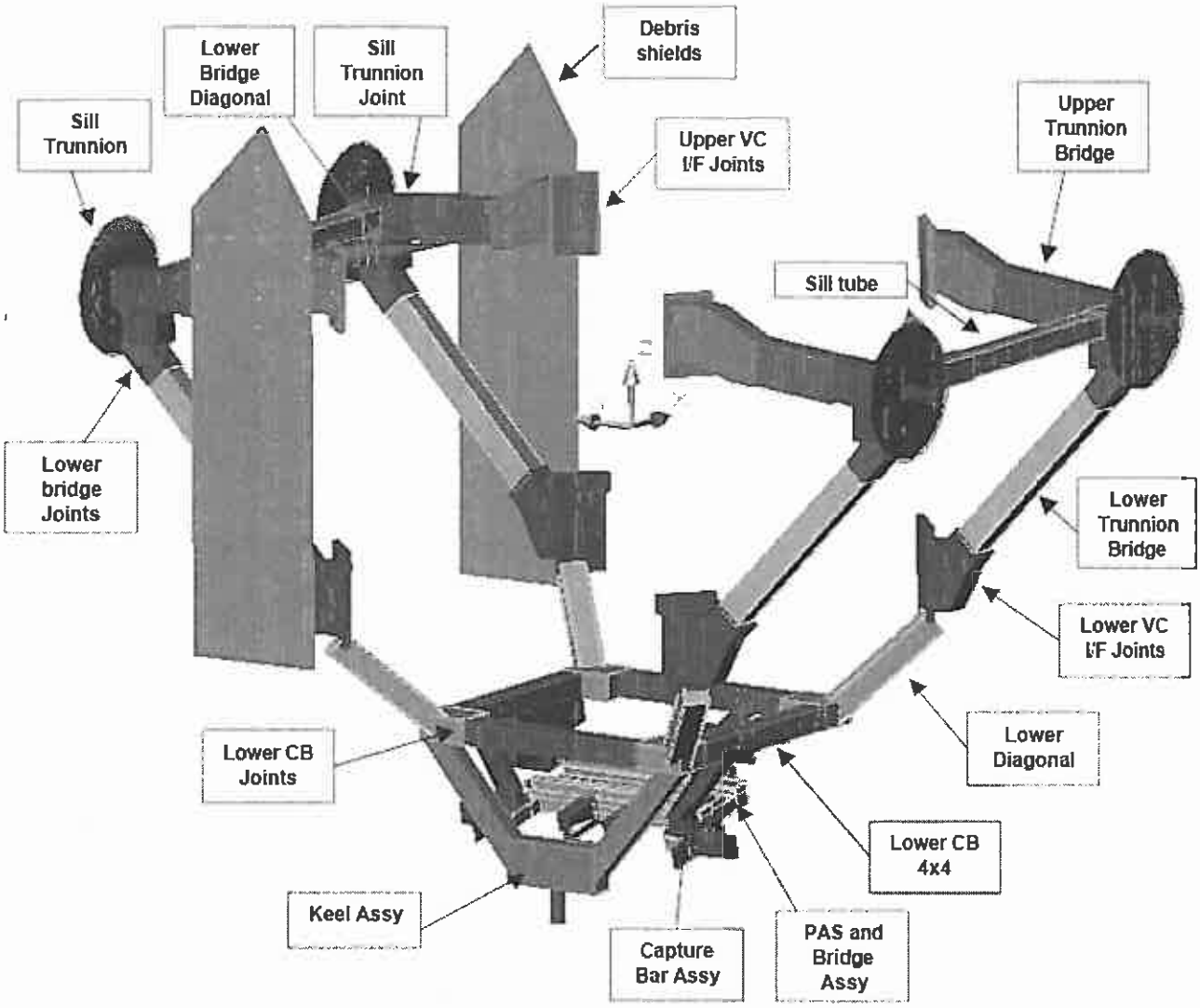


*Figure 6-1 USS GMM with the different parts highlighted*

The following pictures show the USS parts covered by MLI and provide information about the coating/taping of the others.
All the parts are numbered according to the following rule (clockwise, looking from zenith):
#1: RAM-PORT corner , +X+Y in AMS coordinate system
#2: RAM-STARBOARD corner, +X-Y in AMS coordinate system
#3: WAKE-STARBOARD corner, -X-Y in AMS coordinate system
#4: WAKE-PORT corner, -X+Y in AMS coordinate system.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

ALL the surfaces covered by MLI, in Figure 6-2, are highlighted using the yellow colour (for Beta cloth) and light green (for Silver Teflon).

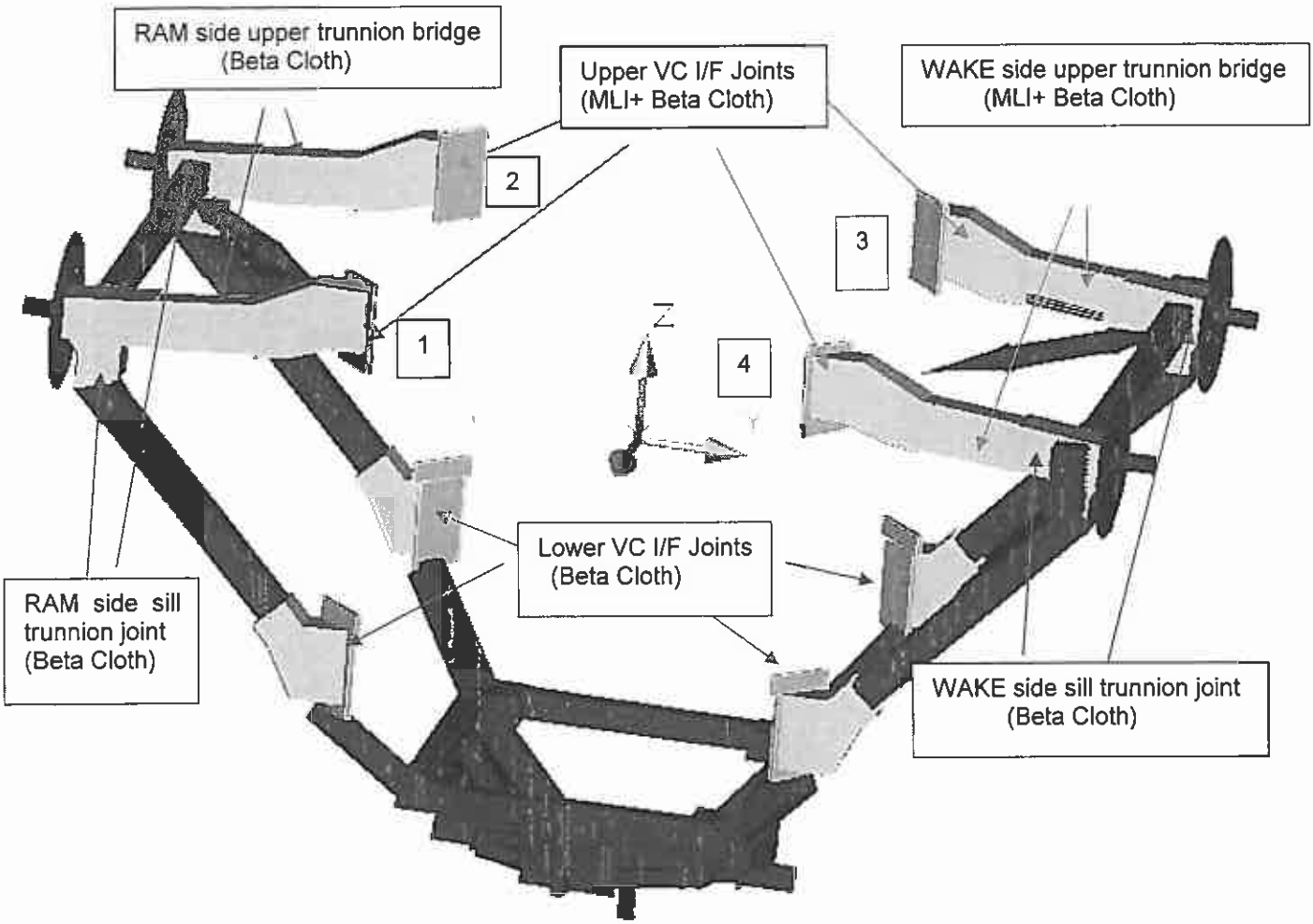


*Figure 6-2* USS-02 parts coverage: Upper and Lower VC I/F Joints (#1,#2,#3,#4), Upper trunnion bridges (#1,#2,#3,#4), Upper sill trunnion joint (#1,#2,#3,#4)are Beta Cloth.

Upper VC I/F Joints and Wake side upper trunnion bridge are covered by MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

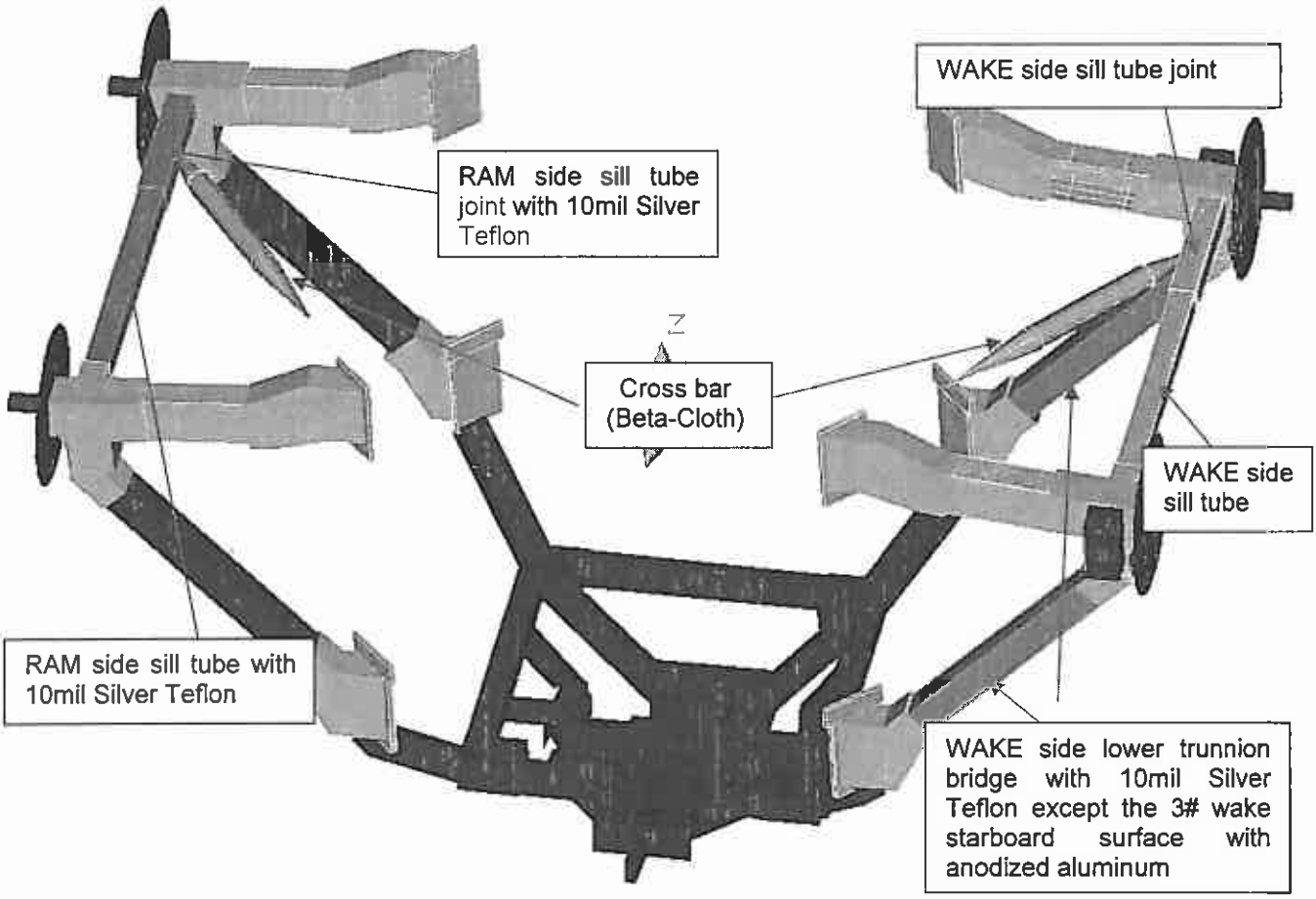


*Figure 6-3 USS-02 parts coverage: MLI on WAKE side sill tube and sill tube joint (#3,#4) and cross bars. 10mil silver Teflon on wake side lower trunnion bridge (#3 partial, #4) and RAM side sill tube and sill tube joint( #1,#2).*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

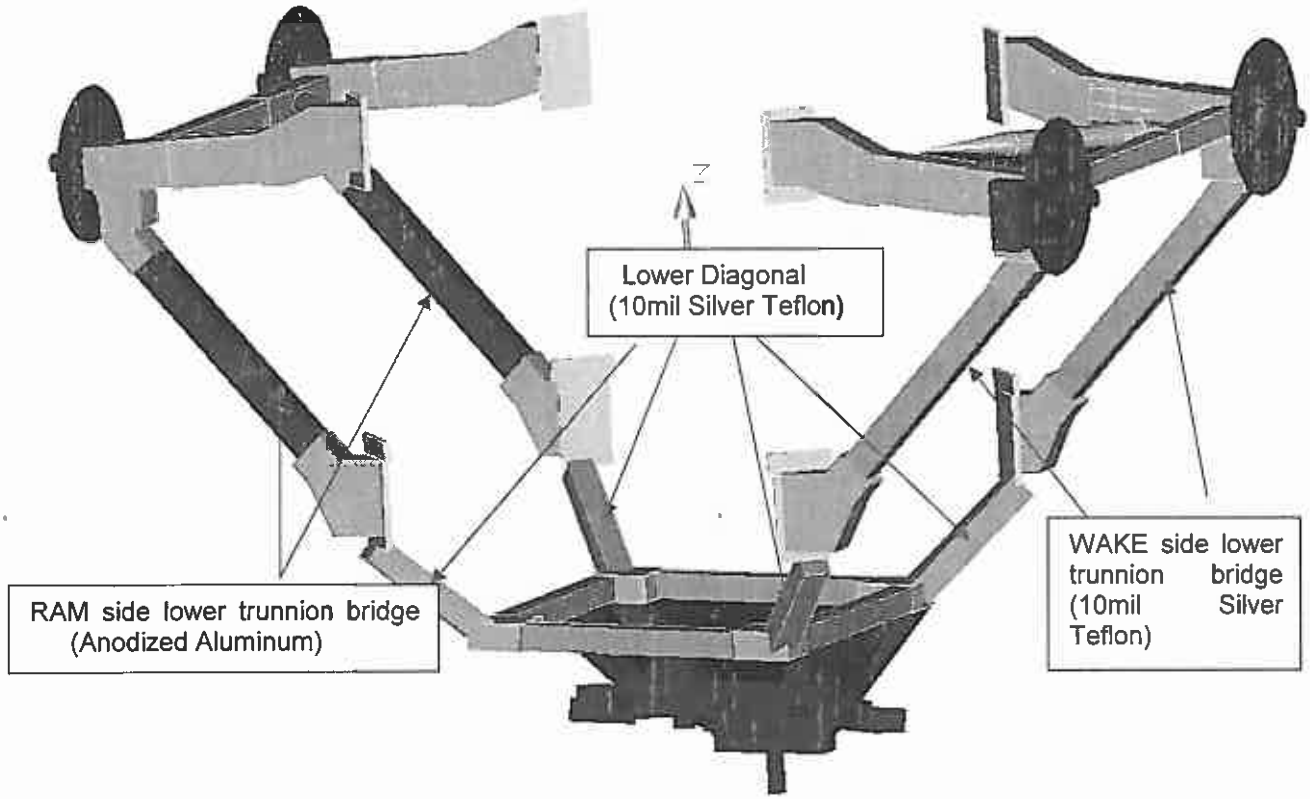


*Figure 6-4* USS-02 parts coverage: Anodized Aluminum covers the entire RAM side lower trunnion bridge (#1#2), and 10 mil Silver Teflon covers entire Lower Diagonals (#1 #2 #3 #4).

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

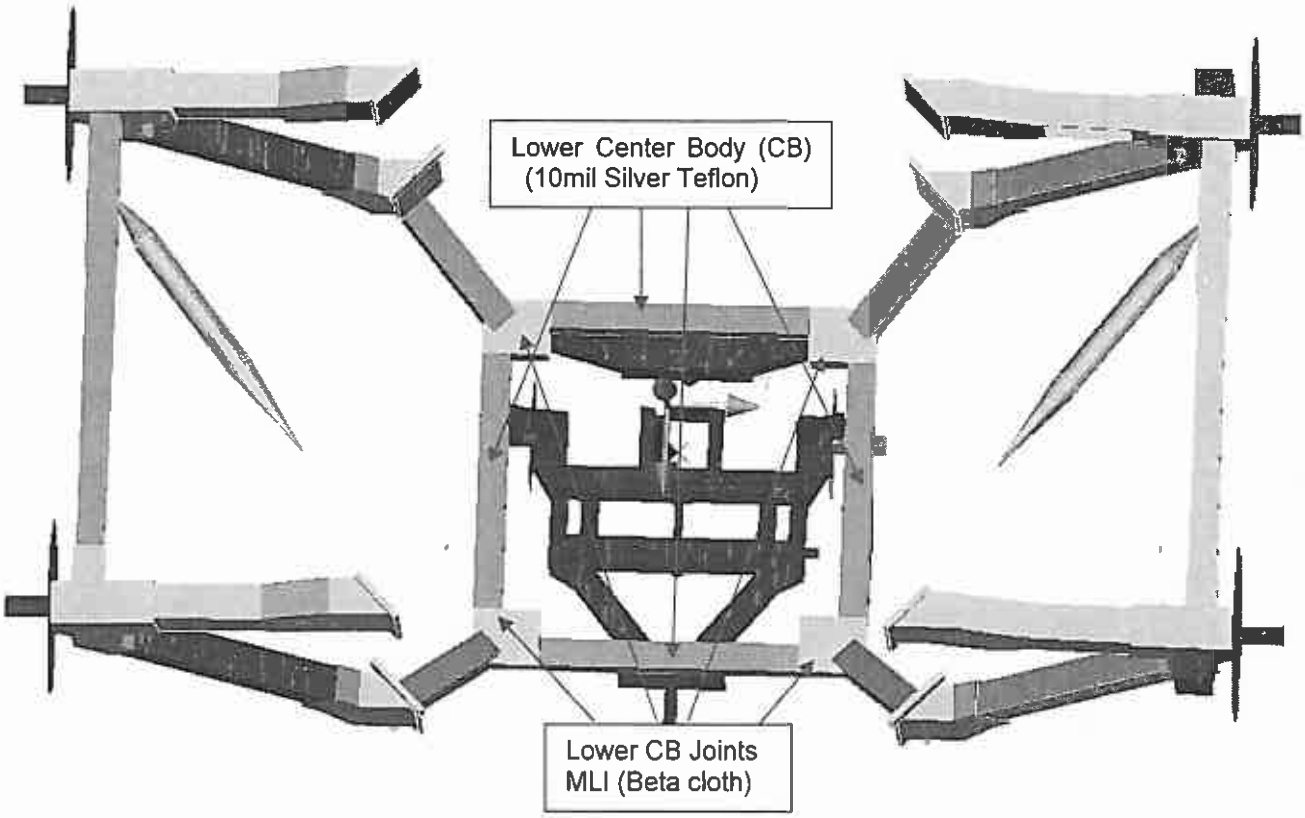


*Figure 6-5 Center Body (CB) MLI/Silver tape coverage. MLI is on all Center Body joints (#1,#2,#3,#4) and 10mil Silver Teflon is on entire Center Body.*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

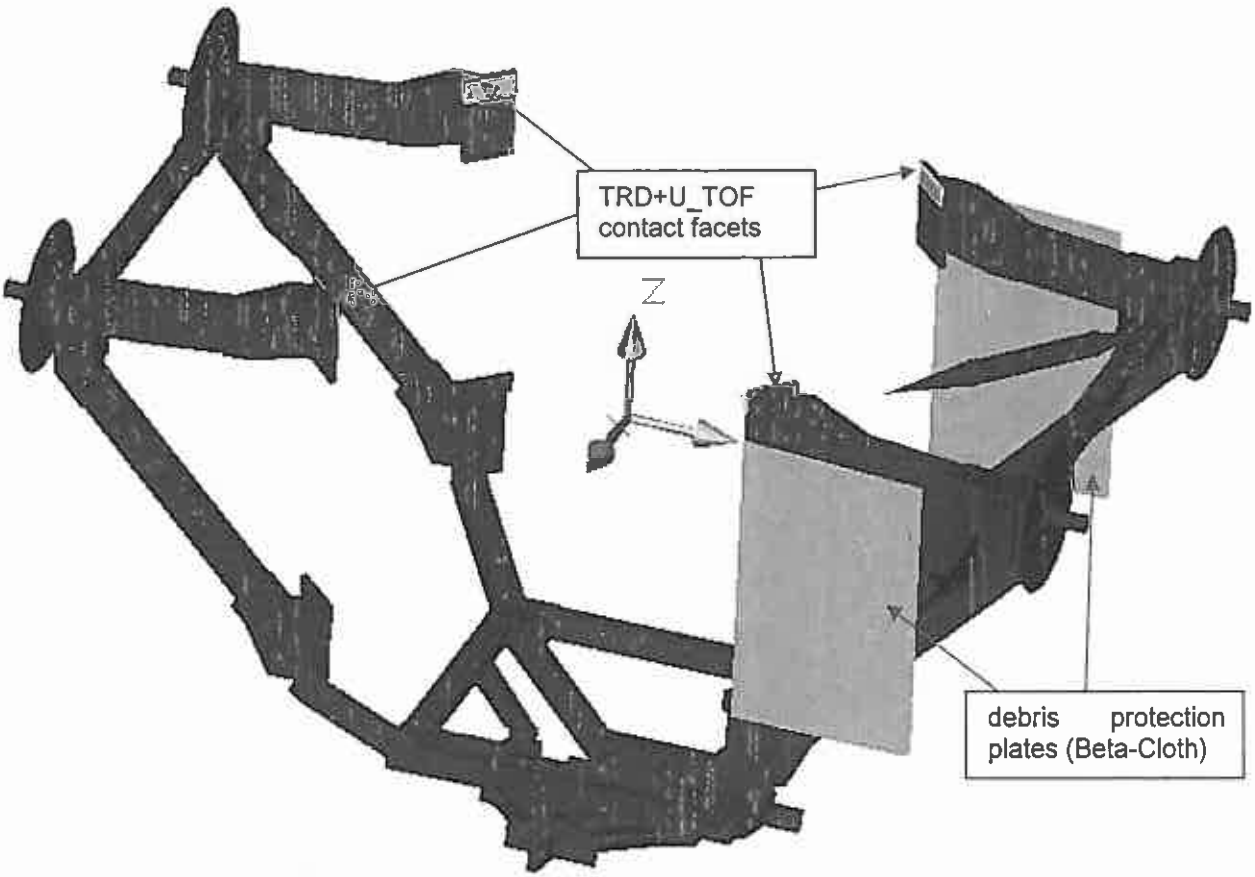


*Figure 6-6 Debris protection plate in WAKE side and the contact facets with TRD+U_TOF covered with Beta-Cloth*

### 6.1.1 BLANKET LAY-UP

The blanket type is summarized in Table 6-1

*Table 6-1 USS MLI blankets Lay-up*

| Blanket ID | nr parts | LAY-UP |
|---|---|---|
| Upper trunnion bridges (#1,#2) – Ram side | 2 | SL |
| Upper trunnion bridges (3,#4) – WAKE side | 2 | EXT |
| Sill tube(WAKE) | 1 | SL |
| Upper Vacuum case I/F joints (#1,#2,#3,#4) | 4 | EXT |
| Lower Vacuum case I/F joints (#1,#2,#3,#4) | 4 | SL |
| Sill trunnion joints (#1,#2,#3,#4) | 4 | SL |
| Sill tube joint (WAKE) | 2 | SL |
| Cross bar (both RAM and WAKE) | 2 | SL |
| Center Body joints (#1,#2,#3,#4) | 4 | SL |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 6.2 WEIGHT

Details are shown in Table 6-2.

*Table 6-2 USS MLI summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Upper trunnion bridges (#1,#2) – Ram side | 2 | 0.6 | 0.35 |
| Upper trunnion bridges (#3,#4) – WAKE side | 2 | 0.6 | 0.35 |
| Sill tube(WAKE) | 1 | TDB | TBD |
| Upper Vacuum case I/F joints (#1,#2,#3,#4) | 4 | 2.2 | 1.6 |
| Lower Vacuum case I/F joints (#1,#2,#3,#4) | 4 | 2.2 | 1.1 |
| Sill trunnion joints (#1,#2,#3,#4) | 4 | 1.5 | 0.6 |
| Sill tube joint (WAKE) | 2 | 0.8 | 0.4 |
| Cross bar (both RAM and WAKE) | 2 | 0.8 | 0.4 |
| Center Body joints (#1,#2,#3,#4) | 4 | 0.8 | 0.4 |
| **TOTAL** | **25** | **9.5** | **5.2** |

## 6.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model after hardware is installed on the USS.

### 6.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

TRD + UPPER TOF + USS flight H/W + MAIN AND TRACKER RADIATORS + CAB + TRD GB + UPS + TTCS + all items mounted on upper and lower trunnion bridges.

### 6.3.2 HOLES, SLOTS ETC.

Cut outs are needed in order to interface the MLI on USS with the Top-Middle-Lower bracket MLI, T-crate MLI.
Cut outs are needed for Tracker radiator rods.

## 6.4 INTEGRATION

After Main and Tracker installation.
Top bracket shall be covered by MLI blanket as well.

### 6.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by means of lacing on the USS itself.

### 6.4.2 GROUNDING POINTS

Grounding points on USS (#10 IF)
No grounding for SL lay-up - blankets

### 6.4.3 IF WITH OTHER BLANKETS

IF with VC Upper and Lower Support Ring MLI, Upper Skirt MLI, Top-Middle-Lower bracket MLI, T-crates MLI, LTOF MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 7. RICH AND L-TOF MLI

## 7.1 DESCRIPTION

The following parts shall be covered: LOWER TOF + RICH Optical seal.
This MLI enclosure will wrap the LOWER TOF (LTOF) and RICH lateral (RICH LAT) wall wholly instead of covering them individually.

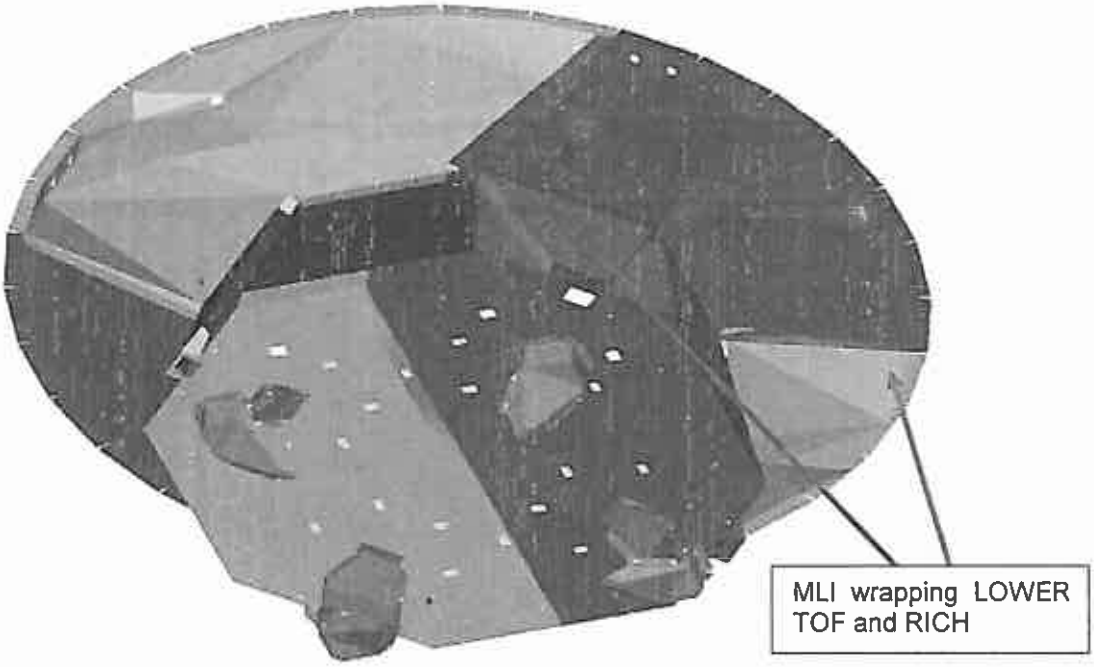


*Figure 7-1 MLI wrapping LOWER TOF and RICH*

### 7.1.1 BLANKET LAYUP

The blanket Lay-up is RTE

## 7.2 WEIGHT

Details are shown in Table 7-1.

*Table 7-1* LTOF and RICH LAT MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| LTOF MLI | 4 | 3.4 | 1.8 |
| RICH LAT MLI | 4 | 3 | 1.61 |
| **TOTAL** | **8** | **6.4** | **3.41** |

## 7.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model, after RICH and TOF integration.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 7.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

RICH panels/debris shield flight H/W,LOWERTOF flight H/W.

### 7.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for:
- TOF legs
- RICH cables coming out from the patch-panel
- TOF cables
- Tracker cables

## 7.4 INTEGRATION

After RICH and LOW-TOF are in place.

### 7.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by Velcro loops on TOF legs and by lacing to TOF structure

### 7.4.2 GROUNDING POINTS

RICH LAT MLI: shared grounding points with RICH BOTTOM MLI on L-USS
LTOF MLI: grounding on VC/TOF (TBC)

### 7.4.3 IF WITH OTHER BLANKETS

LTOF MLI blanket shall be interfaced with the Lower conical flange MLI and the Lower Support Ring MLI.
RICH LAT MLI shall be interfaced with RICH BOTTOM MLI through lacing.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 8. RICH BOTTOM MLI

The MLI between RICH and ECAL is to separate these two subdetector in order to avoid heat transfer between them.

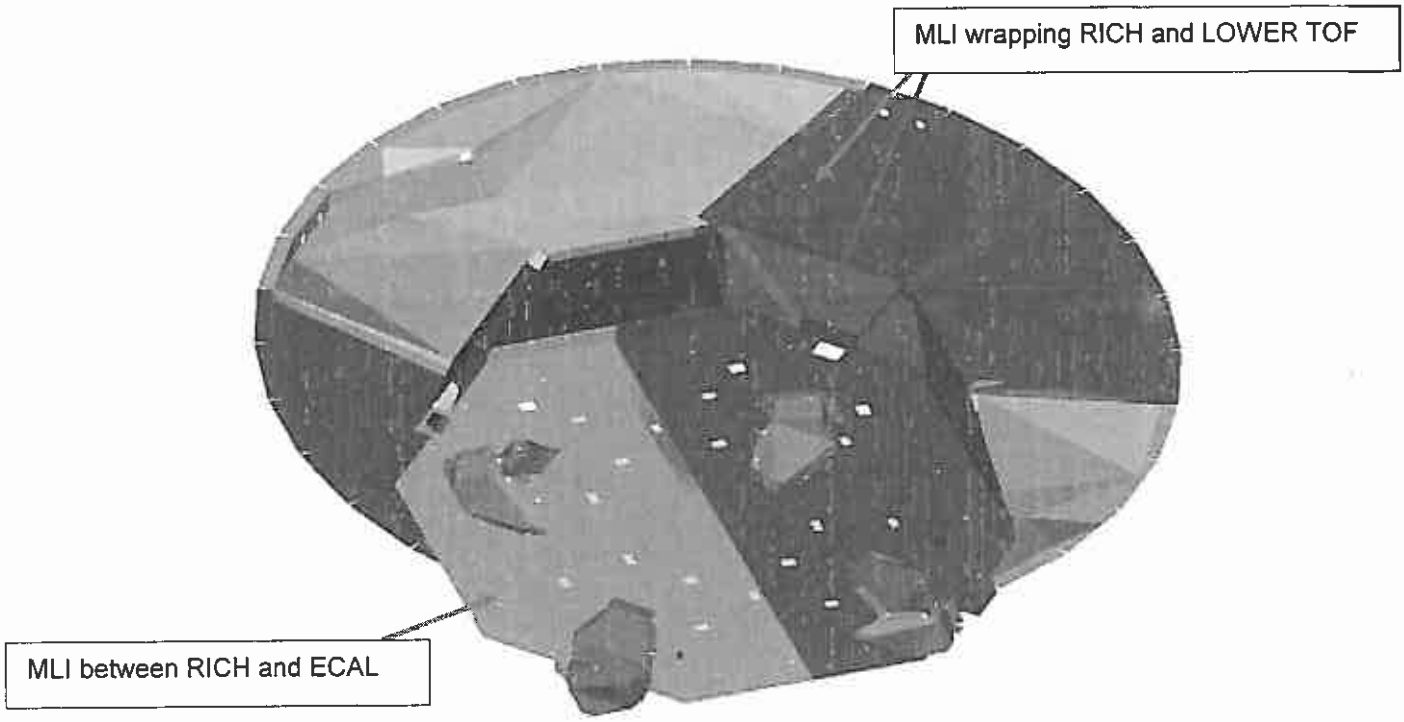


*Figure 8-1* MLI between RICH and ECAL

## 8.1 DESCRIPTION

### 8.1.1 BLANKET LAYUP

The blanket Lay-up is RTE

## 8.2 WEIGHT

Details are shown in Table 8-1.

*Table 8-1* RICH BOTTOM MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| RICH BOTTOM MLI | 2 | 2.5 | 1.3 |
| **TOTAL** | **2** | **2.5** | **1.3** |

## 8.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 8.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

Cut-to-fit design to flight Hardware

### 8.3.2 HOLES, SLOTS ETC.

Feed through for TOF and RICH harness routing.

## 8.4 INTEGRATION

In between RICH and ECAL integration.

### 8.4.1 MECHANICAL FIXATION POINTS

Velcro patch bonding on RICH panel.
Stand-off on Lower USS

### 8.4.2 GROUNDING POINTS

grounding points on L-USS to be shared with RICH LAT MLI (#10 IF).

### 8.4.3 IF WITH OTHER BLANKETS

RICH BOTTOM MLI shall be interfaced with RICH LAT MLI through lacing.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 9. ECAL MLI

## 9.1 ECAL MLI

### 9.1.1 DESCRIPTION

ECAL bottom (nadir) panel is covered by MLI shown in Figure 9-1.

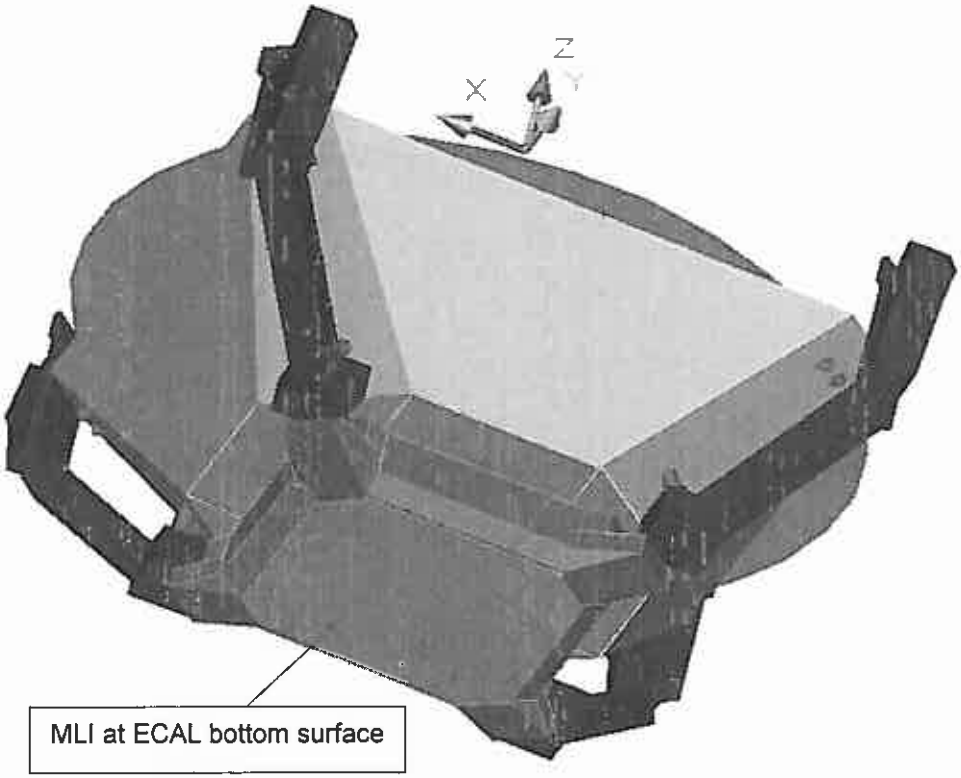


*Figure 9-1* MLI at ECAL bottom (Zenith and Nadir) surface

### 9.1.2 BLANKET LAYUP

The blanket Lay-up is NASA

## 9.2 WEIGHT

Details are shown in Table 9-1.

*Table 9-1* ECAL BOTTOM MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| ECAL BOTTOM MLI | 1 | 0.57 | 0.35 |
| **TOTAL** | **1** | **0.57** | **0.35** |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 9.2.1 CONSTRUCTION

The blanket is cut on the basis of ECAL assembly drawings.

#### 9.2.1.1 HARDWARE NEEDED FOR CUT-TO-FIT

NONE

#### 9.2.1.2 HOLES, SLOTS ETC.

No cut outs are needed.

### 9.2.2 INTEGRATION

This MLI blanket can be mounted After installing ECAL.

#### 9.2.2.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by velcro to the lower ECAL h/c plate.

### 9.2.3 GROUNDING POINTS

On ECAL corners.

### 9.2.4 IF WITH OTHER BLANKETS

N/A

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 9.3 ECAL BRACKETS MLI

### 9.3.1 DESCRIPTION

The sides of every ECAL brackets are covered with different optical property materials.
Details are shown in Figure 9-2.

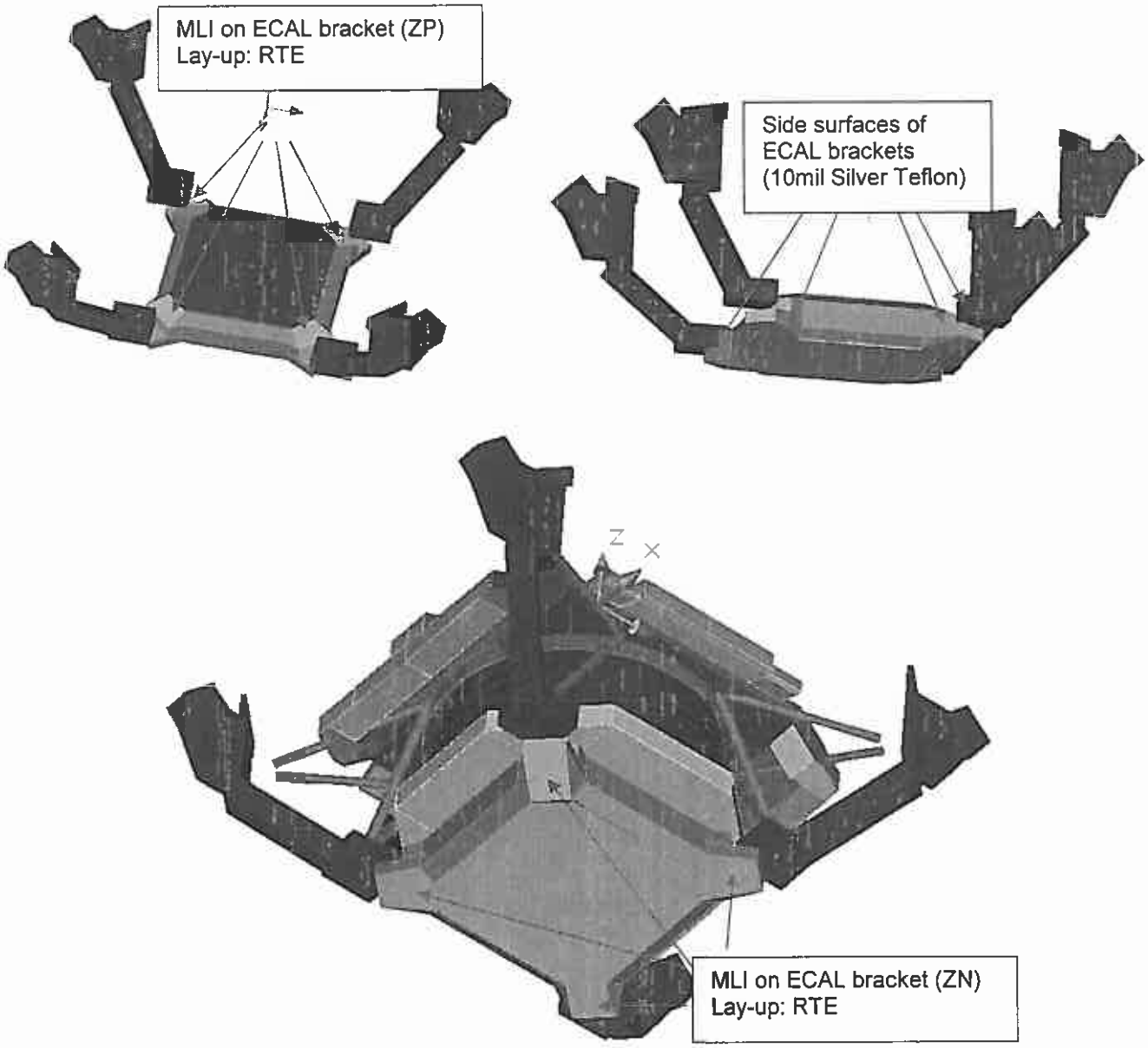


*Figure 9-2* ECAL brackets MLI

### 9.3.2 BLANKET LAYUP

The blanket Lay-up is RTE

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 9.4 WEIGHT

Details are shown in Table 9-2.

*Table 9-2* ECAL BRACKETS MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| ECAL BRACKET MLI - ZP | 4 | 0.35 | 0.24 |
| ECAL BRACKET MLI - ZN | 4 | 0.33 | 0.19 |
| **TOTAL** | **8** | **0.68** | **0.43** |

### 9.4.1 CONSTRUCTION

The blanket is cut on the basis of ECAL assembly drawings.

#### 9.4.1.1 HARDWARE NEEDED FOR CUT-TO-FIT

N/A

#### 9.4.1.2 HOLES, SLOTS ETC.

For cable routing purposes.

### 9.4.2 INTEGRATION

After ECAL integration on AMS.

#### 9.4.2.1 MECHANICAL FIXATION POINTS

Stand-offs located ECAL radiators.

### 9.4.3 GROUNDING POINTS

Grounding points located on Ecal Brackets (M4 IF)

### 9.4.4 IF WITH OTHER BLANKETS

ECAL BRACKET MLI – ZP and ZN will IF trough 4 floating stand-offs.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 10.TRD GAS BOX MLI ENCLOSURE

## 10.1 DESCRIPTION

The TRDGB is wrapped with MLI, and is mechanically mounted on the USS, in the wake/port side.

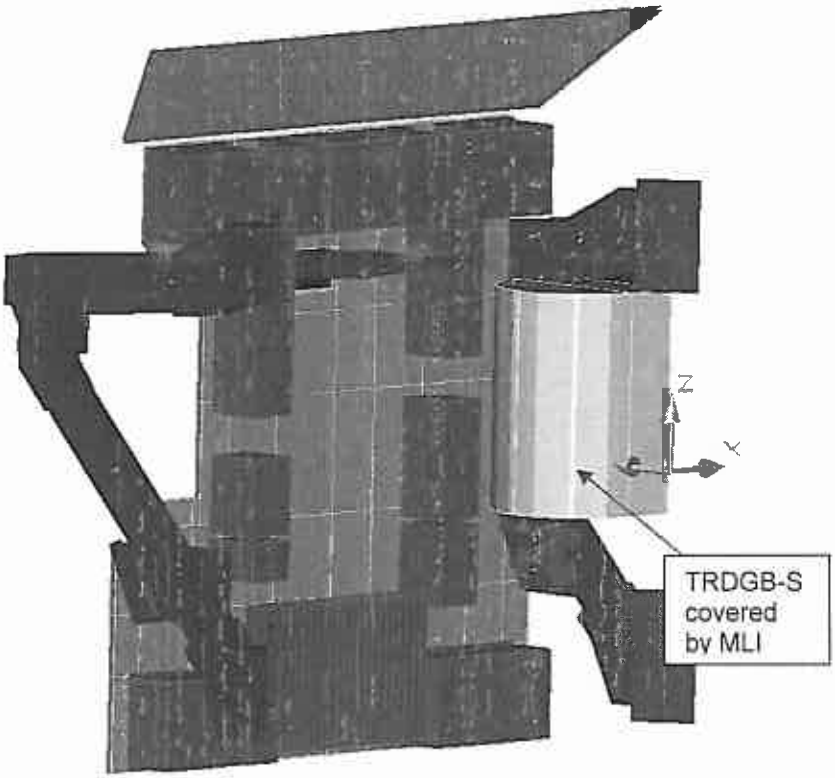


*Figure 10-1* TRDGB-S MLI location and layout

### 10.1.1 BLANKET LAYUP

The blanket Lay-up is:

- NASA TRD_GB_Booties for Gas Box Booties
- NASA TRD_Side for Gas Box Outer Cover

## 10.2 WEIGHT

Details are shown in Table 10-1.

*Table 10-1* TRD GAS BOX MLI *enclosure summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| TRD GSA BOX MLI enclosure | TBD | TBD | 1.16 (in TRD GB mass budget) |
| **TOTAL** | **TBD** | **TBD** | **1.16** |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 10.3 CONSTRUCTION

The blanket is cut-to-fit directly on TRDGB.

### 10.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

TRD GAS BOX.

### 10.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES and piping routing from TRD GB to TRD and relevant crates.

## 10.4 INTEGRATION

After TRDGB has been installed onto Upper USS.

### 10.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing (TBC by NASA/JACOBS) to the TRDGB and to the USS (TBC by NASA/Jacobs).

### 10.4.2 GROUNDING POINTS

defined by NASA/JACOBS

### 10.4.3 IF WITH OTHER BLANKETS

IF with Upper Joints MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 11.UPS MLI

## 11.1 DESCRIPTION

The two UPS box are entirely wrapped with MLI.

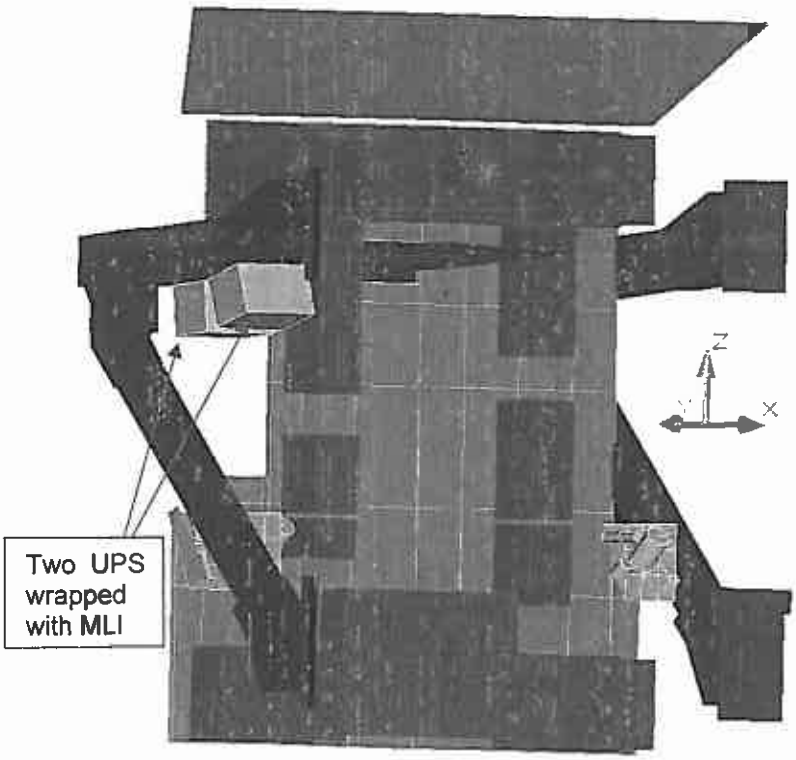


*Figure 11-1* UPS location and entirely wrapped with MLI

### 11.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 11.2 WEIGHT

Details are shown in Table 11-1.

*Table 11-1* UPS MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| UPS MLI | TBD | 0.6 | 0.4 (in UPS mass budget) |
| **TOTAL** | **TBD** | **0.6** | **0.4** |

## 11.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 11.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

UPS flight H/W or flight representative, U-USS

### 11.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

## 11.4 INTEGRATION

After UPS has been mounted on the USS.

### 11.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the UPS

### 11.4.2 GROUNDING POINTS

On the unit itself

### 11.4.3 IF WITH OTHER BLANKETS

IF with Wake-STB Upper Trunnion bridges MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 12.TTCB-PORT AND STARBOARD MLI

## 12.1 DESCRIPTION

The whole TTCB-S and TTCB-P are covered by MLI.
TTCS-P and TTCS-S box locations and MLI coverage are shows in Figure 12-1.

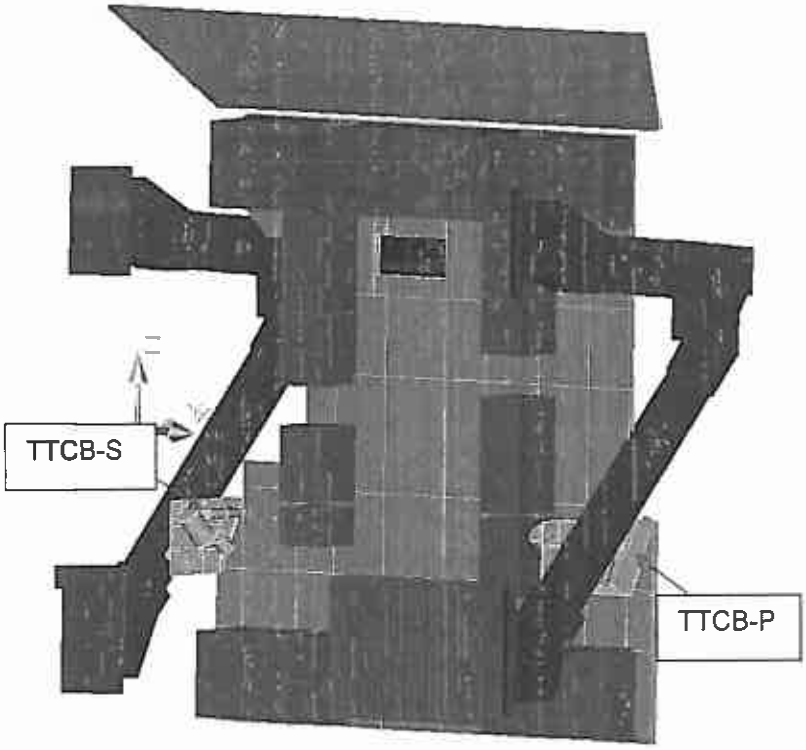


*Figure 12-1* TTCB MLI

### 12.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 12.2 WEIGHT

Details are shown in Table 12-1.

*Table 12-1* TTCB-P & S MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| TTCB-P MLI | TBD | TBD | in TTCS mass budget |
| TTCB-S MLI | TBD | TBD | in TTCS mass budget |
| **TOTAL** | **TBD** | **TBD** | in TTCS mass budget |

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 12.3 CONSTRUCTION

The blanket is cut-to-fit directly on TTCS box .

### 12.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

TTCS flight H/W or flight representative

### 12.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES and pipes routing.

## 12.4 INTEGRATION

After TTCS has been mounted.

### 12.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed lacing (TBC by TTCS team) to the TTCS box.

### 12.4.2 GROUNDING POINTS

On the unit itself

### 12.4.3 IF WITH OTHER BLANKETS

IF with Wake-Radiator MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 13.RAM AND WAKE TRACKER RADIATOR MLI

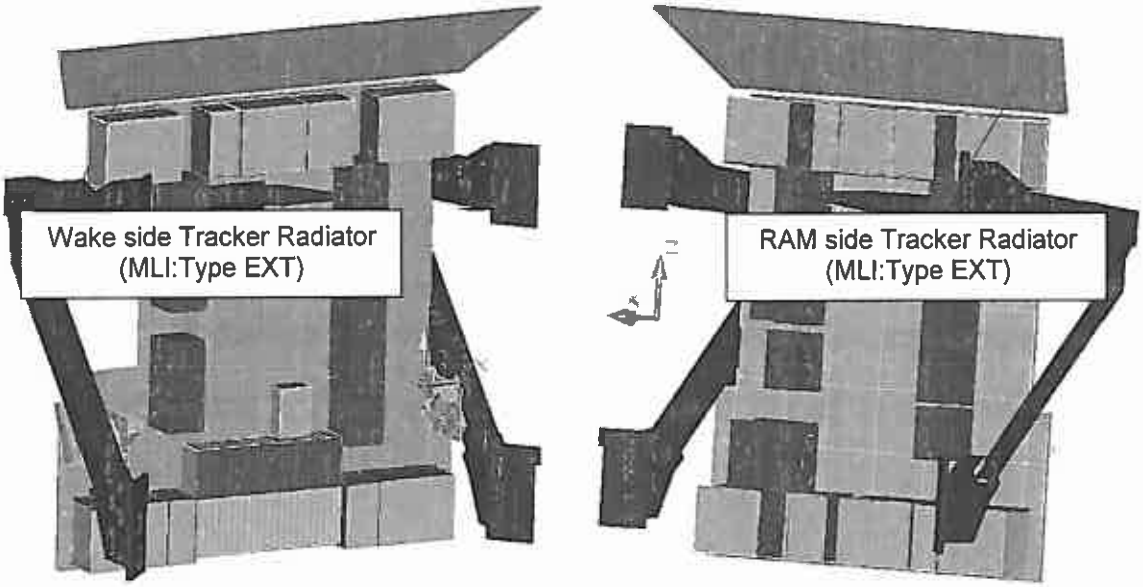


*Figure 13-1 Tracker radiator MLI (Type EXT)*

### 13.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 13.2 WEIGHT

Details are shown in Table 12-1.

*Table 13-1* Tracker radiator MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Tracker radiator MLI Ram side | 1 | 1.25 | 0.81 |
| Tracker radiator MLI Wake side | 1 | 1.25 | 0.81 |
| **TOTAL** | **2** | **2.5** | **1.62** |

## 13.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

### 13.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

Tracker radiator H/W, integrated on the USS with condenser mounted.

### 13.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for pipes routing and rods.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 13.4 INTEGRATION

After the condensers have been mounted onto the radiator

### 13.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing or velcro to the back side of the radiator

### 13.4.2 GROUNDING POINTS

On main radiator border

### 13.4.3 IF WITH OTHER BLANKETS

IF with Tracker radiator rods MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 14.CRATES MLI

Crates described here are referenced to the upper and lower rack crates both in RAM Radiator and WAKE Radiator, the MLI coverage of which is shown in the following pictures.

## 14.1 UPPER WAKE CRATE MLI

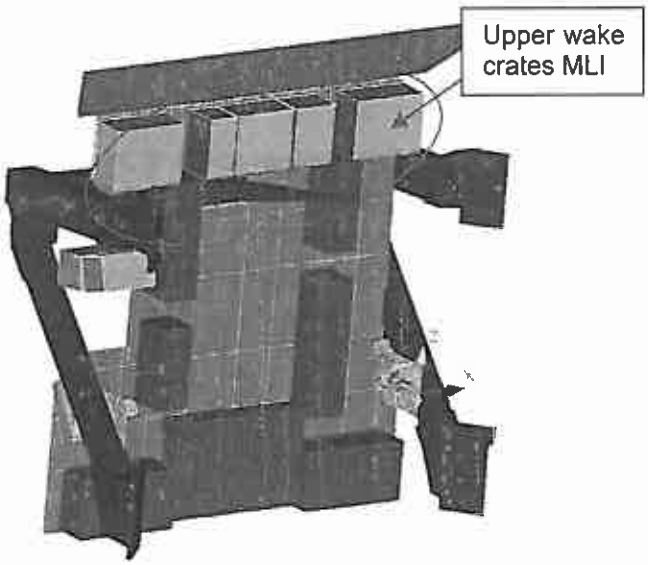


*Figure 14-1* Upper wake crates MLI (Type: EXT)

### 14.1.1 DESCRIPTION

- Crates (Radiator mounted)
- All zenith main wall covered by MLI.
- The walls facing outside also covered by MLI.

### 14.1.2 BLANKET LAYUP

The blanket Lay-up is EXT

## 14.2 WEIGHT

Details are shown in Table 14-1.

*Table 14-1* Upper wake crates MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Upper wake crates MLI | TBD | 0.6 | 0.7 |
| **TOTAL** | **TBD** | **0.6** | **0.7** |

### 14.2.1 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

#### 14.2.1.1 HARDWARE NEEDED FOR CUT-TO-FIT

Upper crates row with integration jig.

#### 14.2.1.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

### 14.2.2 INTEGRATION

After crates are integrated on Integration Jig and harness routing completed.

#### 14.2.2.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the crates boxes and brackets located on wake radiator.

### 14.2.3 GROUNDING POINTS

On the unit itself

### 14.2.4 IF WITH OTHER BLANKETS

IF with Top Bracket MLI, XPD MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 14.3 LOWER WAKE CRATE MLI

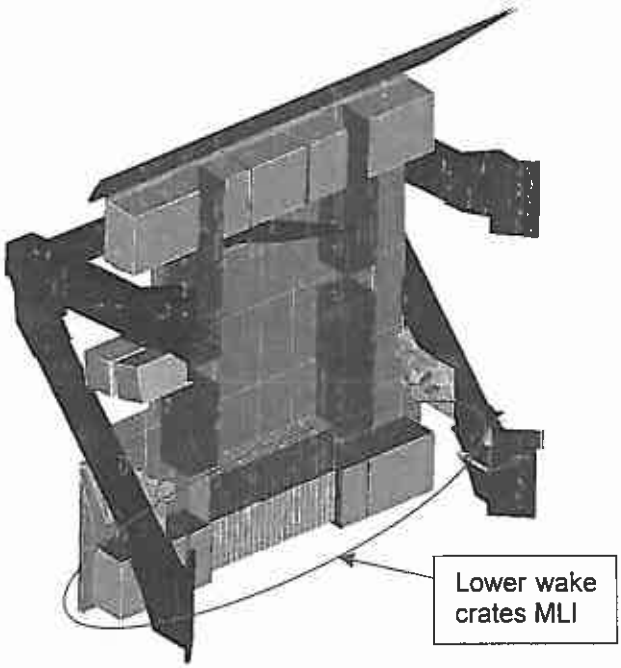


*Figure 14-2* Lower WAKE crates MLI (Type: EXT)

### 14.3.1 DESCRIPTION

- Crates (Radiator mounted)
- The nadir main walls are covered with MLI.
- The walls facing outside are covered with MLI.

### 14.3.2 BLANKET LAYUP

The blanket Lay-up is EXT

## 14.4 WEIGHT

Details are shown in Table 14-2.

*Table 14-2* Lower wake crates MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Lower wake crates MLI | TBD | 0.5 | 0.6 |
| **TOTAL** | **TBD** | **0.5** | **0.6** |

### 14.4.1 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

#### 14.4.1.1 HARDWARE NEEDED FOR CUT-TO-FIT

Cut-to-fit design to flight Hardware: crates integrated on Jig

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

#### 14.4.1.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

### 14.4.2 INTEGRATION

After crates are integrated on Integration Jig and harness routing completed.

#### 14.4.2.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the crates boxes and brackets located on wake radiator.

### 14.4.3 GROUNDING POINTS

On the unit itself

### 14.4.4 IF WITH OTHER BLANKETS

IF with Lower Bracket MLI, XPD MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 14.5 UPPER RAM CRATE MLI

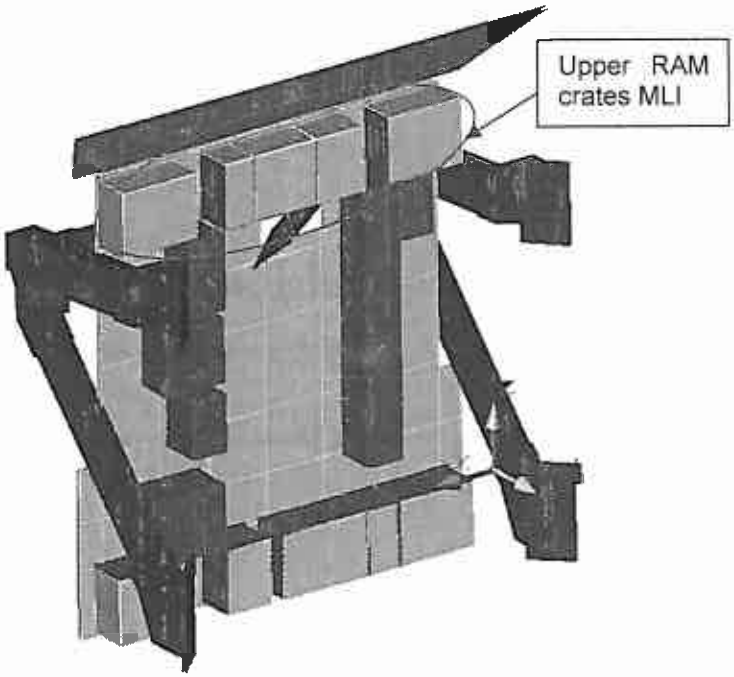


*Figure 14-3 Upper RAM crates MLI (Type: EXT)*

### 14.5.1 DESCRIPTION

- Crates (Radiator mounted)
- All zenith main wall covered by MLI.
- The walls facing outside also covered by MLI.

### 14.5.2 BLANKET LAYUP

The blanket Lay-up is EXT

## 14.6 WEIGHT

Details are shown in Table 14-1.

*Table 14-3* Upper ram crates MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Upper ram crates MLI | TBD | 0.6 | 0.7 |
| **TOTAL** | **TBD** | **0.6** | **0.7** |

### 14.6.1 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

#### 14.6.1.1 HARDWARE NEEDED FOR CUT-TO-FIT

Upper crates row with integration jig.

#### 14.6.1.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

### 14.6.2 INTEGRATION

After crates are integrated on Integration Jig and harness routing completed.

#### 14.6.2.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the crates boxes and brackets located on ram radiator.

### 14.6.3 GROUNDING POINTS

On the unit itself

### 14.6.4 IF WITH OTHER BLANKETS

IF with Top Bracket MLI, XPD MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 14.7 LOWER RAM CRATE MLI

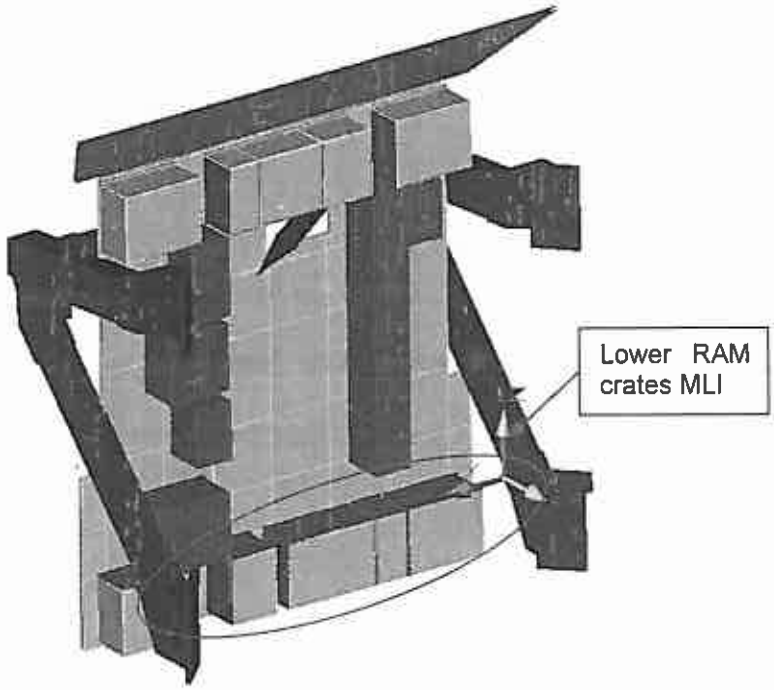


*Figure 14-4* Lower RAM Crates MLI (Type: EXT)

### 14.7.1 DESCRIPTION

- Crates (Radiator mounted)
- The nadir main walls are covered with MLI.
- The walls facing outside are covered with MLI

### 14.7.2 BLANKET LAYUP

The blanket Lay-up is EXT

## 14.8 WEIGHT

Details are shown in Table 14-4.

*Table 14-4* Lower ram crates MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Lower ram crates MLI | TBD | 0.5 | 0.6 |
| **TOTAL** | **TBD** | **0.5** | **0.6** |

### 14.8.1 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

#### 14.8.1.1 HARDWARE NEEDED FOR CUT-TO-FIT

Cut-to-fit design to flight Hardware.

#### 14.8.1.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

### 14.8.2 INTEGRATION

After crates are integrated on Integration Jig and harness routing completed.

#### 14.8.2.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the crates boxes and brackets located on ram radiator.

### 14.8.3 GROUNDING POINTS

On the unit itself

### 14.8.4 IF WITH OTHER BLANKETS

IF with Lower Bracket MLI, XPD MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 15.XPD MLI

## 15.1 DESCRIPTION

XPDs walls nearby the USS and facing outside shall be covered by MLI, which is indicated with arrows in the following figures.

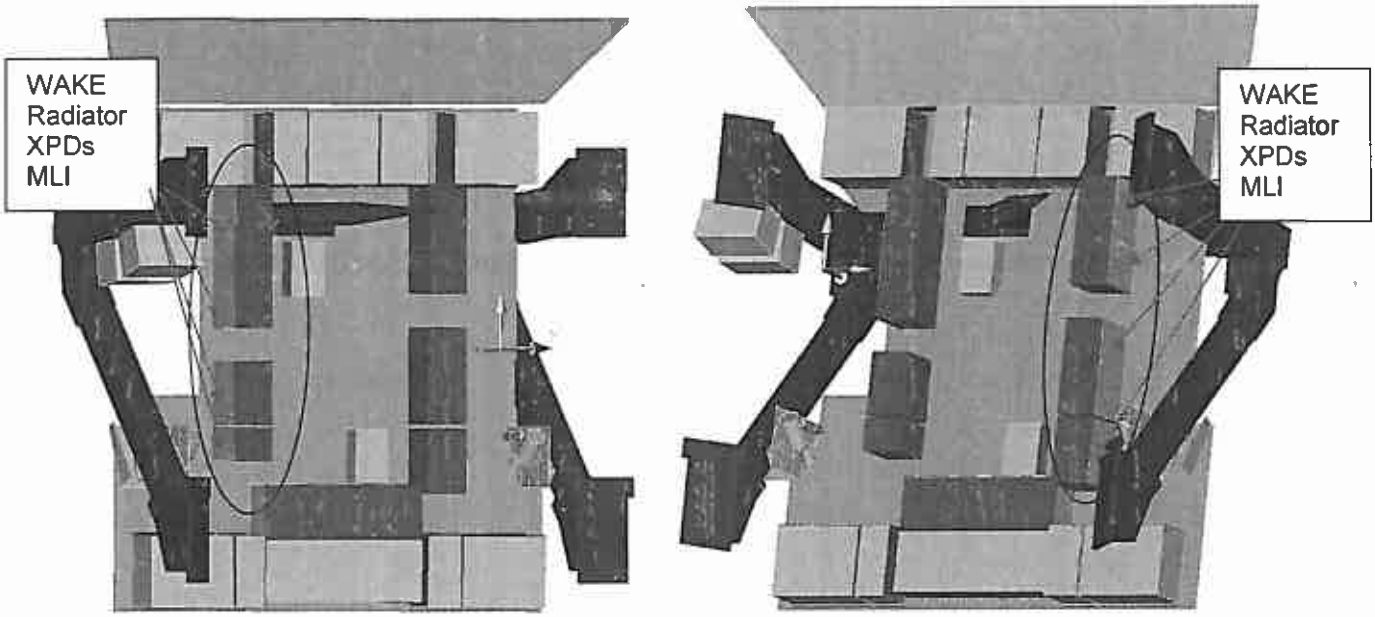


*Figure 15-1 WAKE Radiator XPDs MLI coverage*

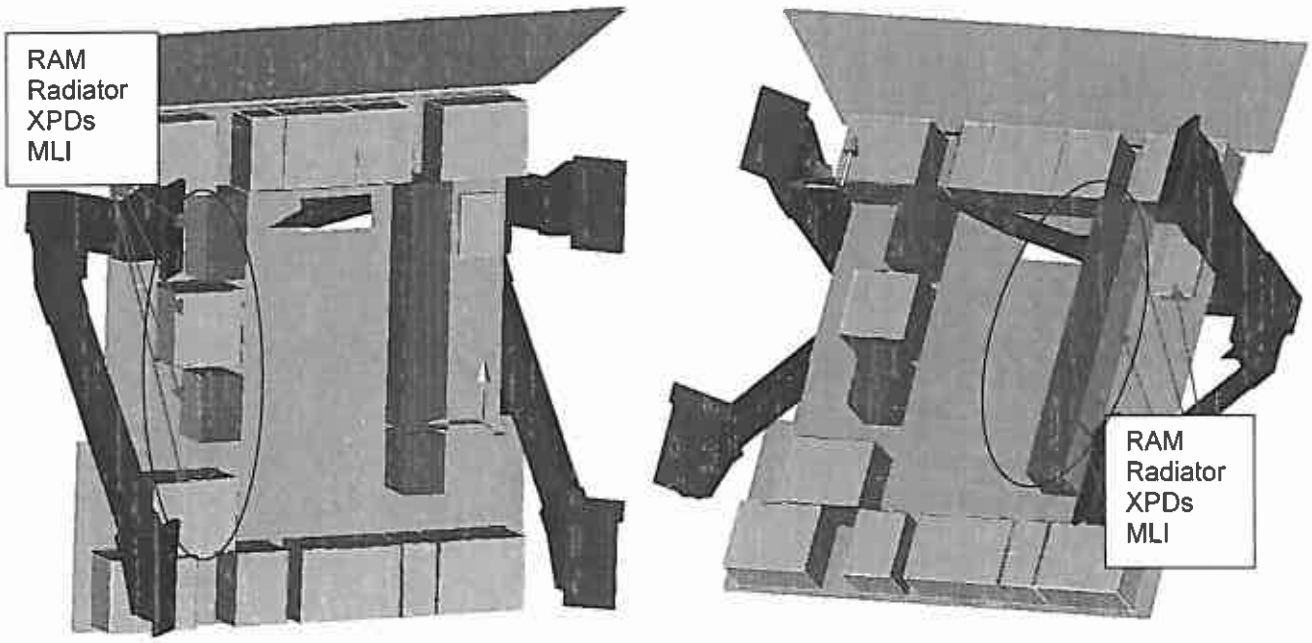


*Figure 15-2 RAM Radiator XPDs MLI coverage*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 15.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 15.2 WEIGHT

Details are shown in Table 15-1.

*Table 15-1* XPD crates MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| XPD crates MLI | TBD | 0.9 | 1.1 |
| **TOTAL** | **TBD** | **0.9** | **1.1** |

## 15.3 CONSTRUCTION

The blanket is cut-to-fit directly on XPDs

### 15.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

XPDs mounted on their integration Jig

### 15.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

## 15.4 INTEGRATION

After XPDs are on Integration Jig and harness routing completed.

### 15.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the XPDs and brackets located on ram and wake radiators.

### 15.4.2 GROUNDING POINTS

On the unit itself

### 15.4.3 IF WITH OTHER BLANKETS

IF with Middle Bracket MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 16.CAB LHP MLI

## 16.1 DESCRIPTION

This MLI blanket protects the CAB LHP tubes in their free path from the source to the sink.

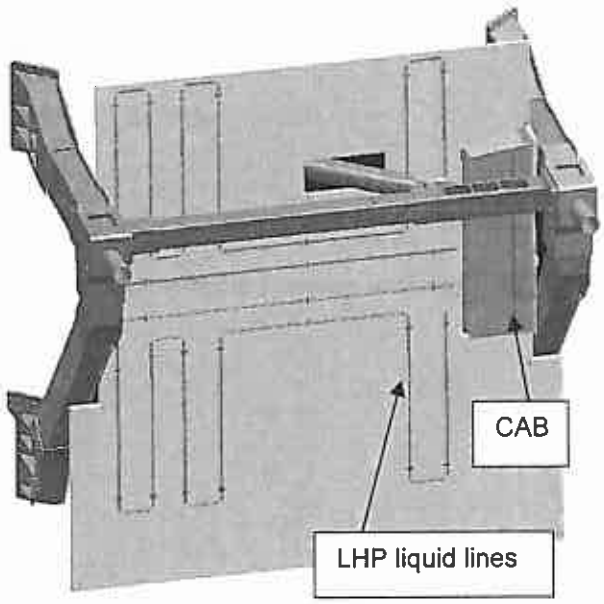


*Figure 16-1 CAB LHP MLI coverage*

### 16.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 16.2 WEIGHT

Details are shown in Table 16-1

*Table 16-1* CAB LHP MLI summary table

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| CAB LHP MLI | TBD | 2.2 | 1.4 |
| **TOTAL** | **TBD** | **2.2** | **1.4** |

## 16.3 CONSTRUCTION

The blanket is cut-to-fit directly on CAB flight model,

### 16.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

CAB integrated on the USS.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 16.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

## 16.4 INTEGRATION

After CAB has been installed on the USS.

### 16.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the wake radiator (TBC).

### 16.4.2 GROUNDING POINTS

To the wake radiator or CAB (TBC)

### 16.4.3 IF WITH OTHER BLANKETS

IF with UPS MLI (TBC)

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 17.HV BRICKS MLI

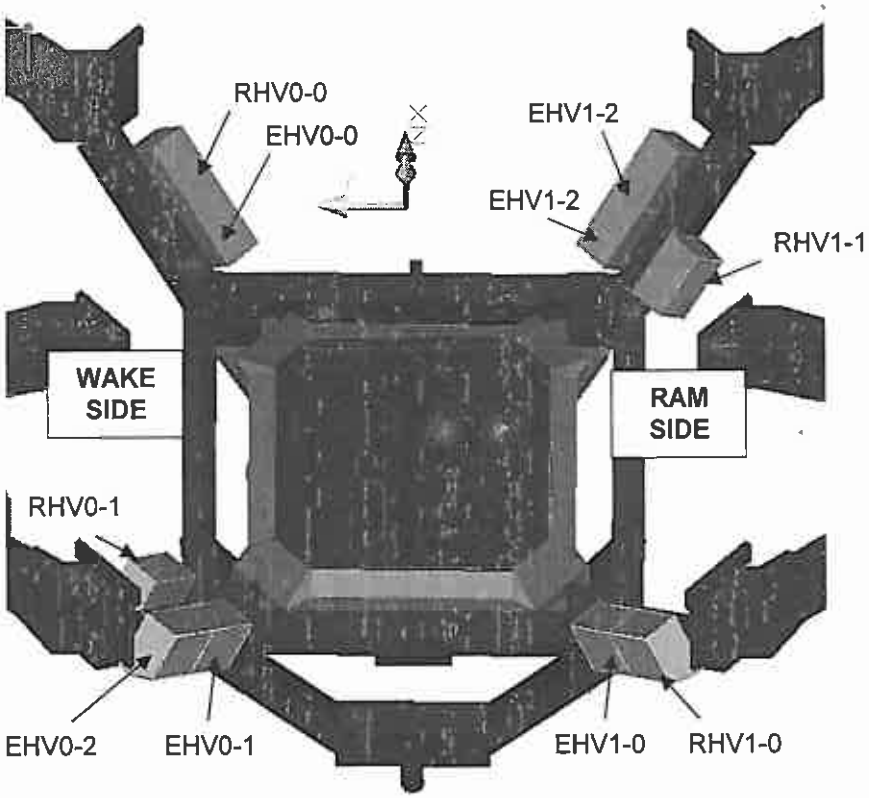


*Figure 17-1 MLI on EHV and RHV bricks.*

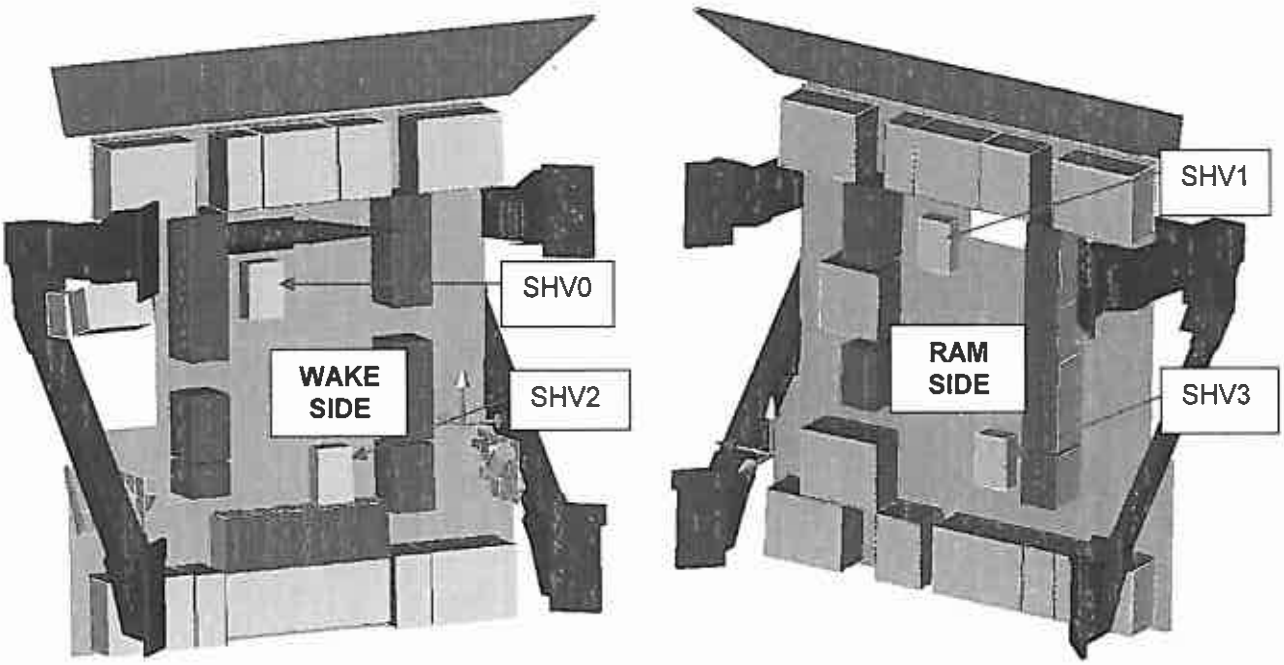


*Figure 17-2 MLI on SHV bricks*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 17.1 DESCRIPTION

The HV bricks described here are composed of three parts.
- The 6 high voltage bricks of ECAL (EHV), which are mounted on the USS lower diagonals.
- The 4 high voltage bricks of RICH (RHV), which are mounted on the USS lower diagonals.
- The 4 high voltage bricks of Scintillator subsystem (SHV), which are mounted on the wake and ram radiator respectively.

MLI covers parts of the HV bricks sides, according to their location on the USS. Figure 17-1 and Figure 17-2 provide the locations and MLI coverage of EHV / RHV and SHV respectively.

### 17.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 17.2 WEIGHT

Details are shown in Table 17-1.

*Table 17-1* HV Bricks MLI summary table

| Blanket ID | nr parts | Area [$m^2$] | Weight [Kg] |
|---|---|---|---|
| HV Bricks MLI | TBD | 0.8 | 1.0 |
| **TOTAL** | **TBD** | **0.8** | **1.0** |

## 17.3 CONSTRUCTION

The blanket is cut-to-fit directly on HV-bricks

### 17.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

HV bricks flight model

### 17.3.2 HOLES, SLOTS ETC.

Holes for mounting the units on L-USS

## 17.4 INTEGRATION

During HV bricks integration, and prior to put them on the USS.

### 17.4.1 MECHANICAL FIXATION POINTS

On HV bricks sides, with velcro.

### 17.4.2 GROUNDING POINTS

On the unit itself

### 17.4.3 IF WITH OTHER BLANKETS

No IF with other blankets are foreseen.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 18.PORT/STARBOARD STAR TRACKER SUPPORT MLI AND BAFFLE SUPPORT MLI

Two star trackers are mounted in opposite locations on the vacuum case upper flange, at PORT/ STARBOARD side (+X and –X).

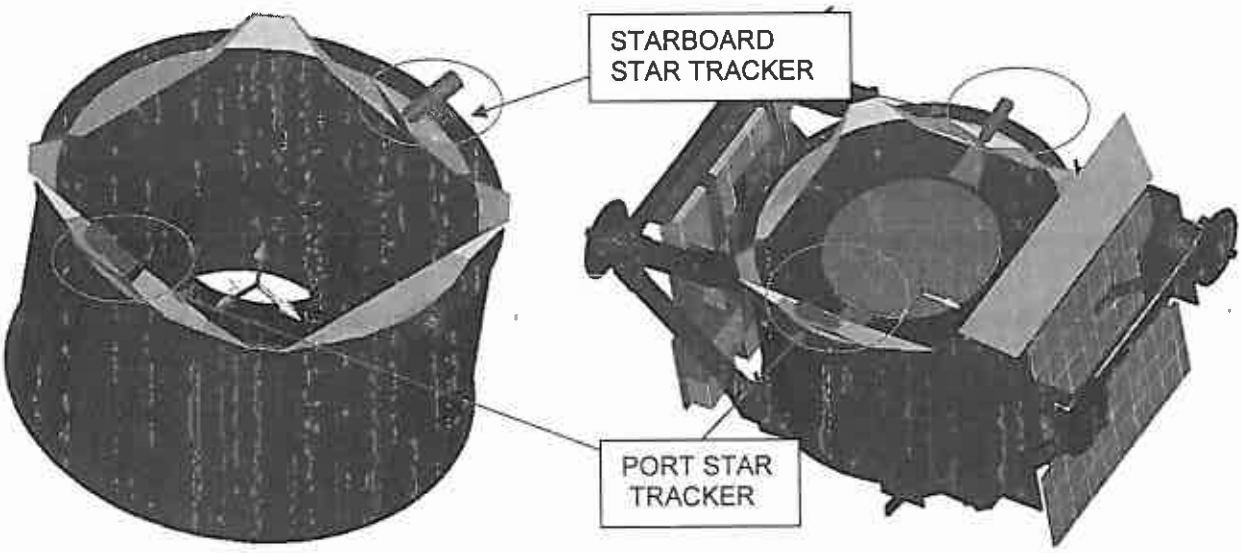


*Figure 18-1 Locations of Port/Starboard star tracker*

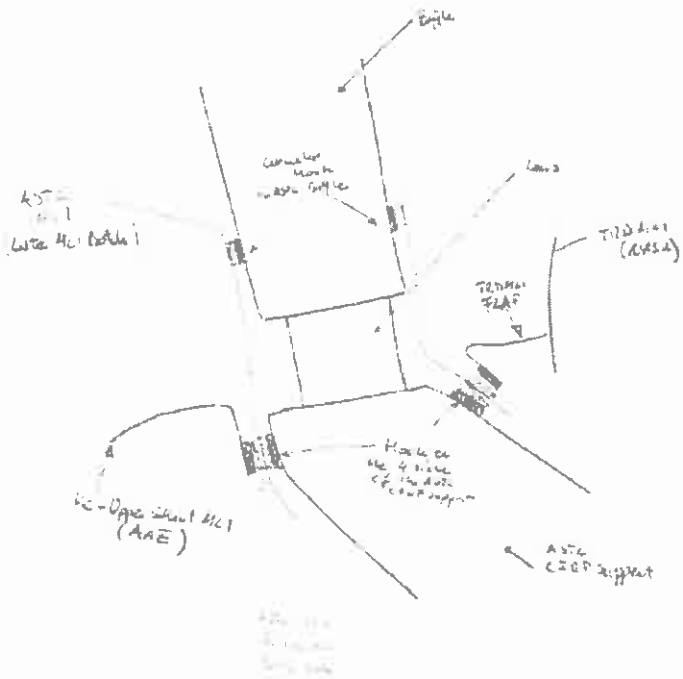

*Figure 18-2 ASTC MLI (IF with TRD – UTOF MLI and VC-Upper skirt MLI)*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 18.1 DESCRIPTION

ASTC MLI covers the Star Tracker baffle, as shown in Figure 18-2.
The VC Upper Skirt MLI will be attached to ASTC MLI on 3 sides: TRD - UTOF MLI flap will IF the 4th side with Velcro. The ASTC MLI will be fixed by means of a circular Velcro strip on the baffle and on the 4th side of the ASTC CFRP support by Velcro.
Velcro on the ASTC CFRP Support shall be glued off-line.

### 18.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 18.2 WEIGHT

Details are shown in Table 18-1.

*Table 18-1* ASTC MLI summary table

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| ASTC MLI | 2 | 0.5 | 0.3 |
| **TOTAL** | **2** | **0.5** | **0.3** |

## 18.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model after star tracker is installed

### 18.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

Star tracker baffle

### 18.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for star tracker aperture.

## 18.4 INTEGRATION

To be integrated with VC Upper Skirt MLI

### 18.4.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by a Velcro strip to the baffle itself and to the VC Upper skirt MLI.

### 18.4.2 GROUNDING POINTS

On the grounding point on the ASTC CFRP support.

### 18.4.3 IF WITH OTHER BLANKETS

IF with VC Upper Skirt MLI and TRD - UTOF MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 19.RAM/WAKE/PORT/STARBOARD CRYO COOLERS MLI

## 19.1 DESCRIPTION

Four Crycoolers are located at the upper and lower support rings of the vacuum case. Two of them are connect with upper support ring while the other two are located on the lower support ring, as shown in Figure 19-1.

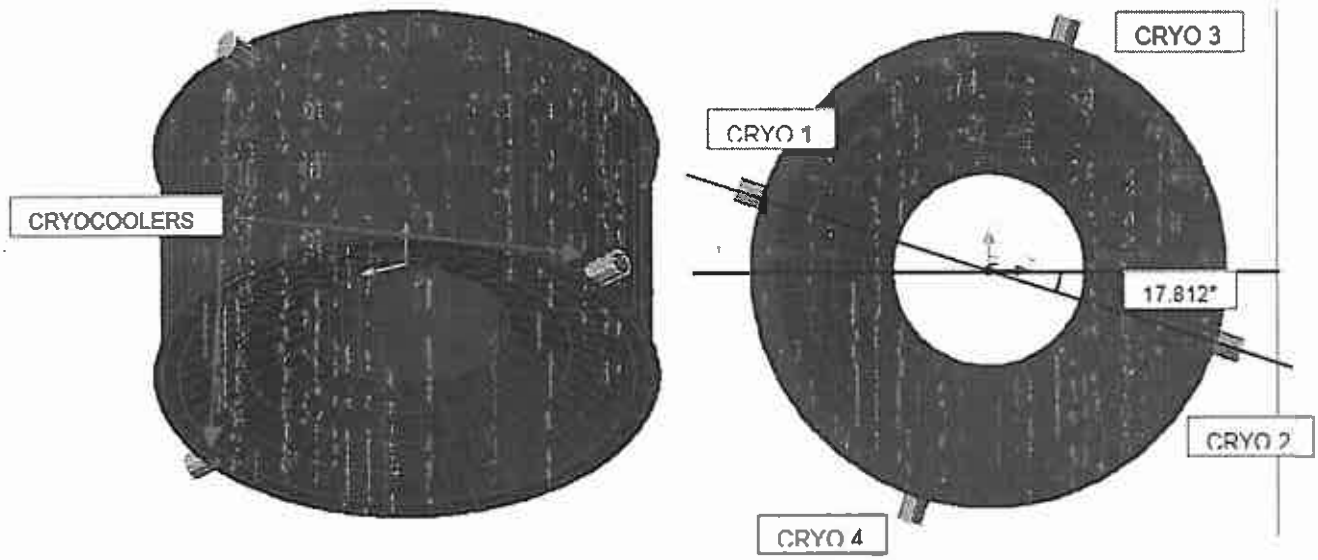


*Figure 19-1 Crycoolers location*

Figure 19-2 shows the coverage of Crycooler MLI. These four blankets cover the four cryocooler body and their bracket to the vacuum case.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

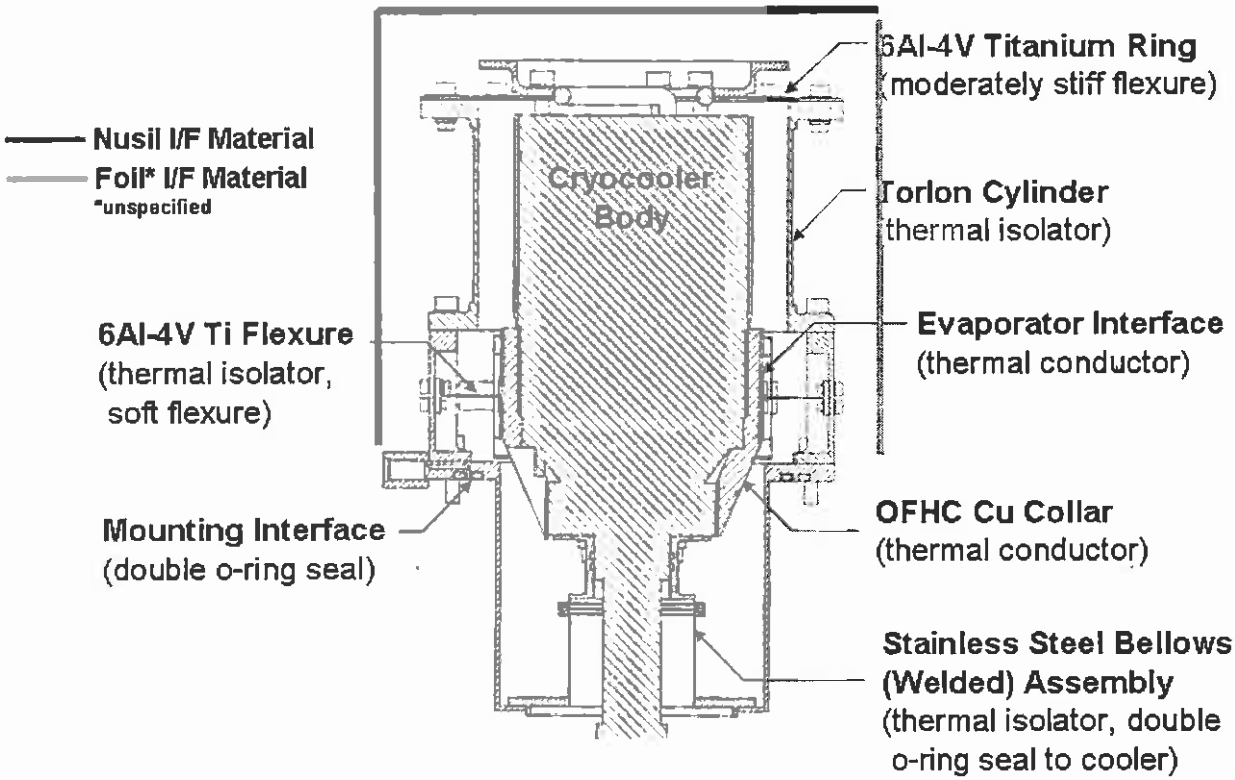


*Figure 19-2 Crycooler MLI (in red)*

### 19.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 19.2 WEIGHT

Details are shown in Table 19-1.

*Table 19-1* Crycooler MLI summary table

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Crycooler MLI | 4 | 0.3 | 0.3 |
| **TOTAL** | **4** | **0.3** | **0.3** |

## 19.3 CONSTRUCTION

The blanket is cut-to-fit directly on cryocoolers after their integration on AMS.
It could merge with U and L Support Ring MLI, with suitable flaps for late access.

### 19.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

Cryocoolers mounted on Upper and Lower Support Ring.

### 19.3.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing and LHP pipes routing.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 19.3.3 MECHANICAL FIXATION POINTS

The MLI shall be fixed by Velcro or lacing to the cryocooler body and to the vacuum case.

### 19.3.4 GROUNDING POINTS

On U and L Support Ring (TBC).

### 19.3.5 IF WITH OTHER BLANKETS

IF with VC Upper and Lower Support Ring MLI, Cryocoolers LHP/VSB MLI

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 20.CVB MLI

## 20.1 DESCRIPTION

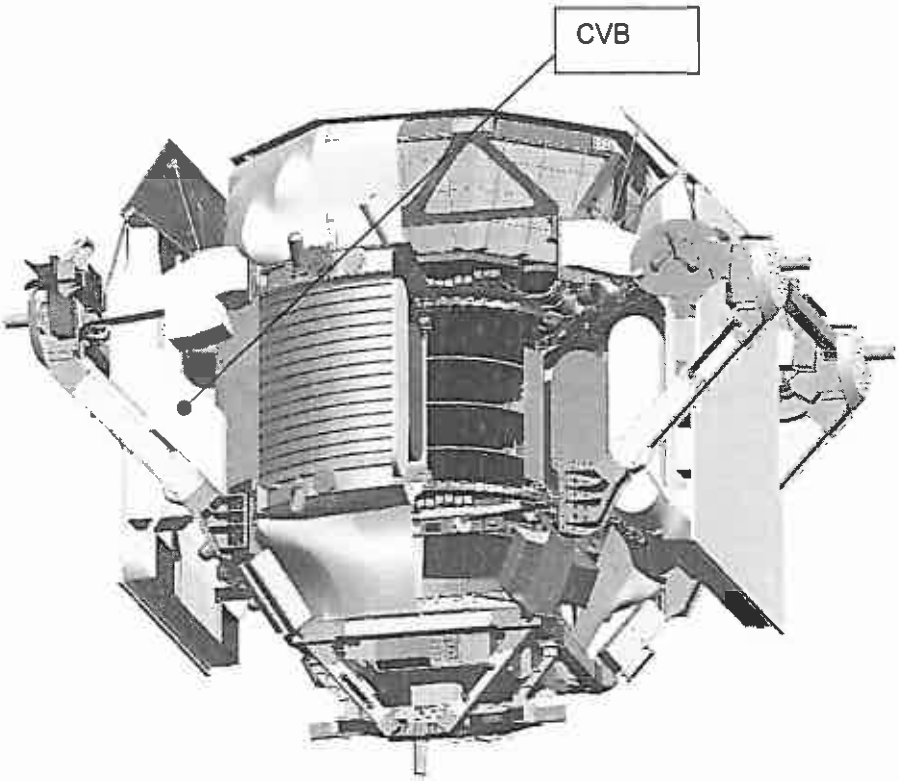


*Figure 20-1 CVB location*

### 20.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 20.2 WEIGHT

Details are shown in Table 20-1.

*Table 20-1* CVB MLI summary table

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| CVB MLI | TBD | TBD | in magnet mass budget |
| **TOTAL** | **TBD** | **TBD** | in **magnet mass** budget |

## 20.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 20.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

CVB

### 20.3.2 HOLES, SLOTS ETC.

Stay-out zones and late access zones to ACC PMTs , to TTCS H/W and to TRACKER cables connectors to be defined.

## 20.4 INTEGRATION

TBD

### 20.4.1 MECHANICAL FIXATION POINTS

On USS lower trunnion bridge.

### 20.4.2 GROUNDING POINTS

On the unit itself (TBC)

### 20.4.3 IF WITH OTHER BLANKETS

No IF with other blankets are foreseen.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 21.CRYOCOOLER LHP LINES MLI

## 21.1 DESCRIPTION

This MLI blanket protects the cryocoolers LHP in their free path from the source to the sink.

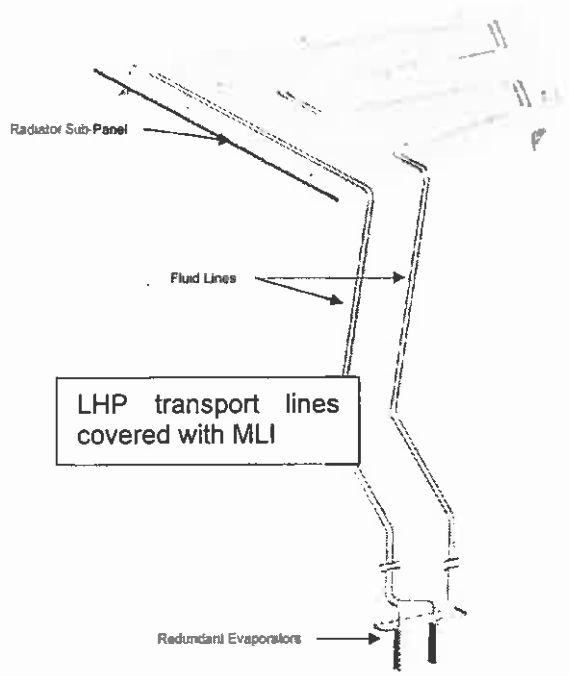


Figure 21-1 *Crycooler LHP lines*

### 21.1.1 BLANKET LAYUP

The blanket Lay-up is EXT

## 21.2 WEIGHT

Details are shown in Table 21-1.

*Table 21-1 Crycooler LHP lines* MLI summary table

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| Crycooler LHP lines MLI | 4 | TBD | 0.3 |
| **TOTAL** | **4** | **TBD** | **0.3** |

## 21.3 CONSTRUCTION

The blanket is cut-to-fit directly on LHP, after their integration on AMS on VSB.

### 21.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

LHP evaporator and condenser lines and VSB.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 21.3.2 HOLES, SLOTS ETC.

For IF with U and L Support Ring MLI

## 21.4 MECHANICAL FIXATION POINTS

The blanket is wrapped all around the VSB.

### 21.4.1 GROUNDING POINTS

VC

### 21.4.2 IF WITH OTHER BLANKETS

IF with U and L Support Ring MLI.
The blanket could merge with Tracker Cooling tubes MLI on wake side.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 22.TRD + UTOF MLI ENCLOSURE

These blankets enclose the TRD and the upper TOF.

## 22.1 TRD - UTOF MLI

### 22.1.1 DESCRIPTION

These blankets enclose the lower part of TRD and the Upper TOF (UTOF).

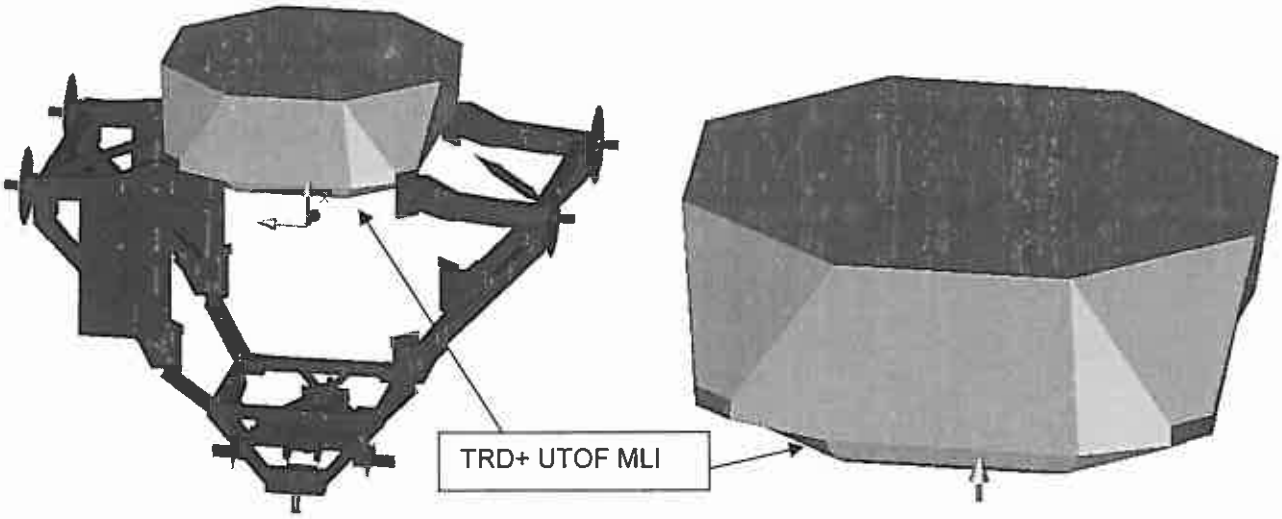


*Figure 22-1* TRD – UTOF MLI

### 22.1.2 BLANKET LAYUP

The blanket Lay-up is:

- NASA TRD_Side for lower part of TRD
- NASA TRD_Bottom for UTOF

## 22.2 WEIGHT

Details are shown in Table 22-1.

*Table 22-1* TRD – UTOF MLI summary table

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| TRD – UTOF MLI | 1 | TBD | 3.4 |
| **TOTAL** | **1** | **TBD** | **3.4** |

## 22.3 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 22.3.1 HARDWARE NEEDED FOR CUT-TO-FIT

(Cut-to-fit design to flight Hardware ). TRD + UPPER TOF Mock-up

### 22.3.2 HOLES, SLOTS ETC.

Stay-out zones and late access zones to TRD and UPPER TOF connectors to be defined.
Star Tracker baffle fixations to the M-structure.
LHP fixations to the M-structure.

## 22.4 INTEGRATION

After UPPER TOF and TRD installing.
After S-crate installing.
After TRD gas box installing.

### 22.4.1 MECHANICAL FIXATION POINTS

This MLI shall be overlapped in the lower part to the VC Upper skirt.
The upper part of the blanket shall be laced to the M-Structure.

### 22.4.2 GROUNDING POINTS

On M-Structure or VC U Support Ring (TBC)

### 22.4.3 IF WITH OTHER BLANKETS

IF with VC Upper skirt MLI and TRD TOP MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

## 22.5 TRD TOP MLI

### 22.5.1 DESCRIPTION

These blankets enclose the Upper part of TRD (TRD surface underneath the Zenith Radiator, and lateral TRD surface).

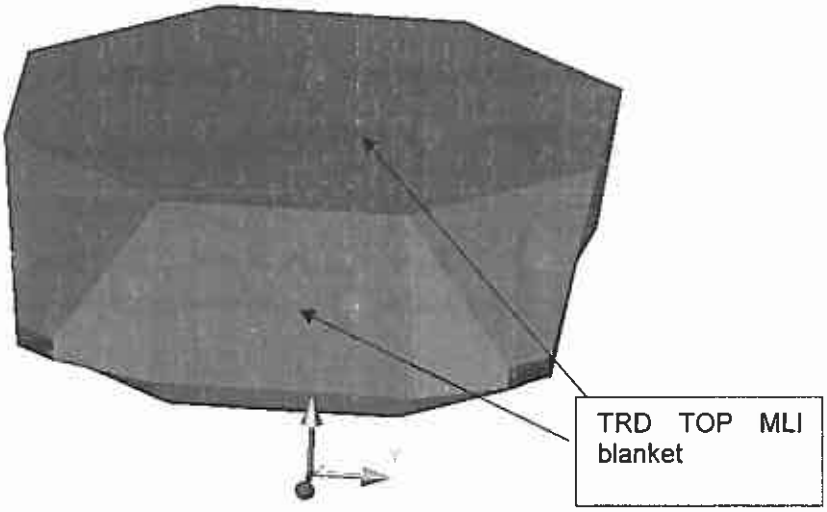


*Figure 22-2* TRD TOP MLI location

### 22.5.2 BLANKET LAYUP

The blanket Lay-up is:

- NASA TRD_Top for center of Top panel
- NASA TRD_Edge for 8 inch wide edge of top panel
- NASA TRD_Side for lateral surface of TRD

## 22.6 WEIGHT

Details are shown in Table 22-1.

*Table 22-2* TRD TOP MLI summary table

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| TRD TOP MLI | 1 | TBD | 5.2 |
| **TOTAL** | **1** | **TBD** | **5.2** |

## 22.7 CONSTRUCTION

The blanket is cut-to-fit directly on TRD mockup.

### 22.7.1 HARDWARE NEEDED FOR CUT-TO-FIT

TRD (including upper honeycomb panel and spokes).

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

### 22.7.2 HOLES, SLOTS ETC.

Cut-outs for the zenith radiator fixation (spokes and brackets)

## 22.8 INTEGRATION

After TRD Installation and before Zenith radiator integration.

### 22.8.1 MECHANICAL FIXATION POINTS

This MLI is fixed through spokes on the TRD H/C plane and laced to the M-Structure.

### 22.8.2 GROUNDING POINTS

On M-Structure

### 22.8.3 IF WITH OTHER BLANKETS

IF with TRD - UTOF MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 23.PDS MLI

MLI covers the PDS unit located on Wake side radiator.

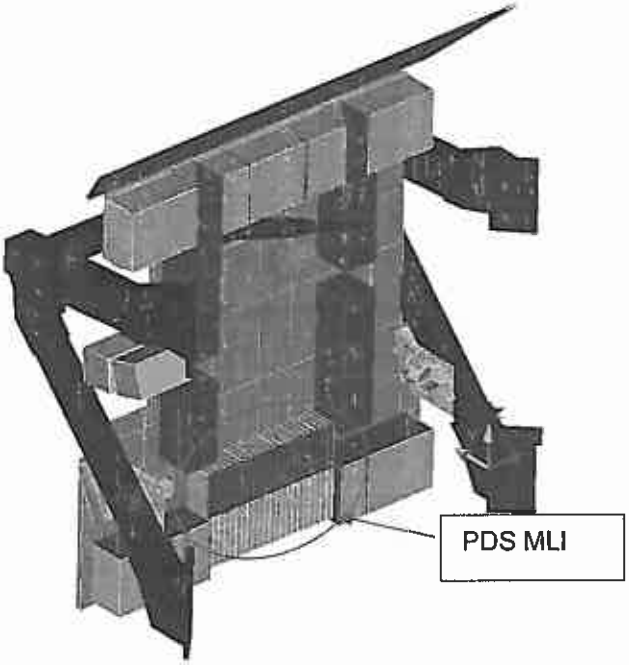


*Figure 23-1* PDS MLI (Type: EXT)

### 23.1.1 DESCRIPTION

- The Nadir wall is covered with MLI.
- The Zenith wall is covered with cables
- The walls facing outside are covered with MLI.
- Lower part of Wake wall is covered by MLI.

### 23.1.2 BLANKET LAYUP

The blanket Lay-up is EXT

## 23.2 WEIGHT

Details are shown in Table 23-1.

*Table 23-1* PDS MLI *summary table*

| Blanket ID | nr parts | Area [m$^2$] | Weight [Kg] |
|---|---|---|---|
| PDS MLI | TBD | 0.4 | 0.4 |
| **TOTAL** | **TBD** | **0.4** | **0.4** |

### 23.2.1 CONSTRUCTION

The blanket is cut-to-fit directly on AMS flight model

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

#### 23.2.1.1 HARDWARE NEEDED FOR CUT-TO-FIT

Cut-to-fit design to flight Hardware: PDS integrated on Jig

#### 23.2.1.2 HOLES, SLOTS ETC.

Cut-outs are needed for CABLES routing.

### 23.2.2 INTEGRATION

After crates are integrated on Integration Jig and harness routing completed.

#### 23.2.2.1 MECHANICAL FIXATION POINTS

The MLI shall be fixed by lacing to the unit itself and to the brackets located on wake radiator.

### 23.2.3 GROUNDING POINTS

On the unit itself

### 23.2.4 IF WITH OTHER BLANKETS

IF with Lower Wake crates MLI.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 24.MLI ON AMS-02 SURFACES SUMMARY

## 24.1 AMS-02 MLI BLANKETS INCLUDE

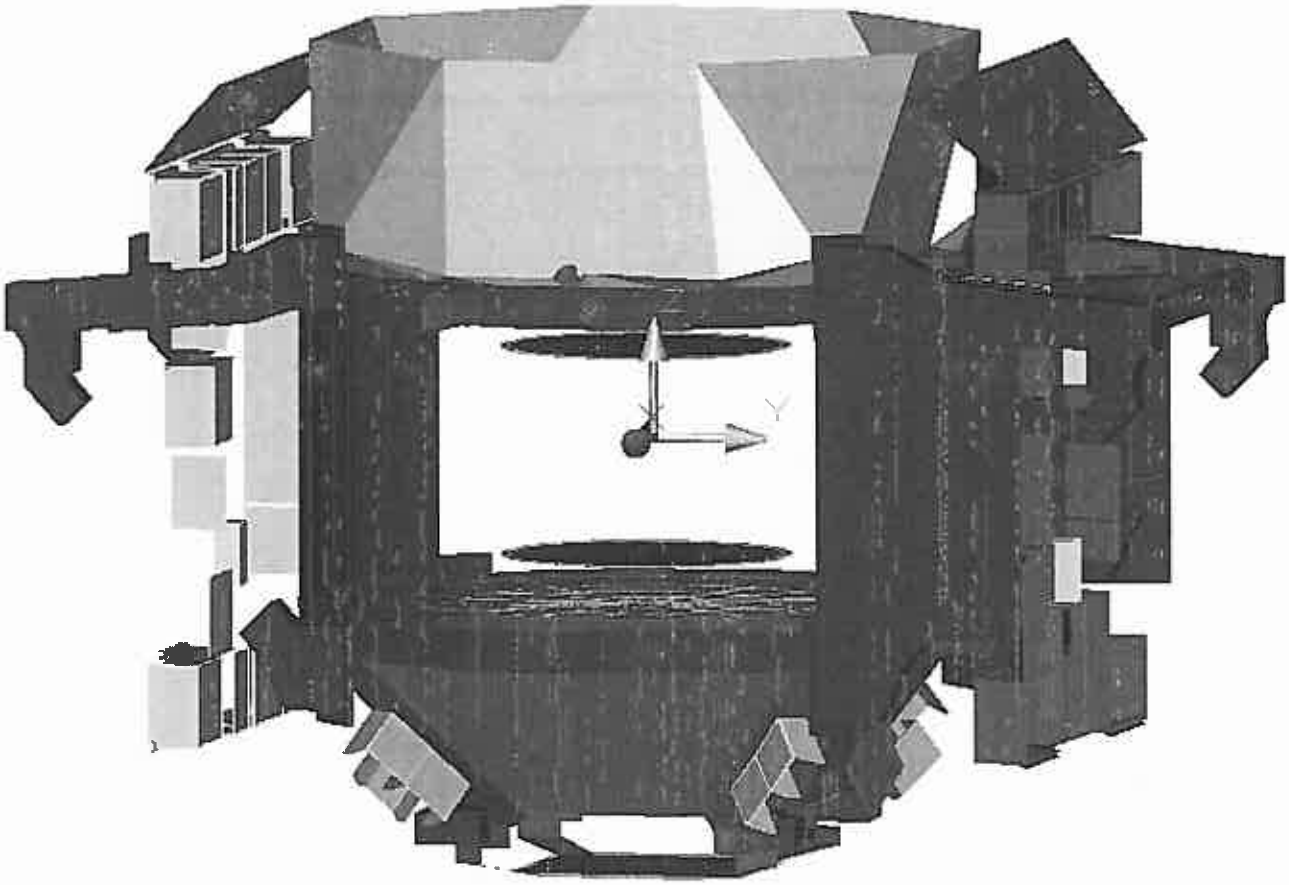

*Figure 24-1 AMS-02 MLI Covered surfaces form GMM 4.1*

The names of all the MLI surfaces showed in Figure 24-1 are listed in Table 24-1.

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

| | | |
|---|---|---|
| SUBMODEL | 1 | VACUUM CASE |
| | 1.1 | conical flange(lower,outer ring) |
| | 1.2 | outer shell(ram/wake side) |
| | 1.3 | support rings(upper/lower) |
| | 1.4 | upper skirt |
| | 2 | USS |
| | 1.1 | upper trunnion bridges(4) |
| | 1.2 | upper VC I/F Joints(4) |
| | 1.3 | lower VC I/F Joints(4) |
| | 1.4 | sill trunnion joints(4) |
| | 1.5 | sill tube wake side(1) |
| | 1.6 | sill tube joint wake side(1) |
| | 1.7 | cross bars(2) |
| | 1.8 | lower CB Joints |
| | 1.9 | debris protection plate+connect pads to TRD |
| | 3 | CRYCOOLER(upper/lower) |
| | 4 | CAB |
| | 5 | UPS |
| | 6 | L_TOF+RICH |
| | 7 | RICH/ECAL |
| | 8 | ECAL(bottom/brackets(4)) |
| | 9 | TRACKER(bottom plate+upper/lower rings) |
| | 10 | TRACKER Raditor(Inside face) |
| | 11 | CRATES |
| | 12 | XPDs |
| | 13 | HV bricks(HVE/HVR/SHV) |
| | 14 | TRDGB |
| | 15 | TRD+U_TOF |
| | 16 | TRD TOP |
| | 17 | Star Tracker(2) |
| | 18 | LHP LINE(crycooler/CAB) |
| | 19 | CVB |

*Table 24-1 AMS-02 MLI covered surface*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 25. MLI MODELLING

The following table shows the "ideal" performance of a 20 layers thermal blanket in terms of effective emissivity and conductance depending on the average temperature between the outer and inner blanket layer:

Heat Transfer Coefficient

| Average Temperature | W/m²K |
|---|---|
| -85 | $0,434 \times 10^{-2}$ |
| -45 | $0,954 \times 10^{-2}$ |
| 10 | $1,306 \times 10^{-2}$ |
| 50 | $2,057 \times 10^{-2}$ |
| 70,5 | $2,752 \times 10^{-2}$ |

*Table 25-1* MLI 20 layers HTC

Effective Emissivity

| Average Temperature | $\varepsilon_{eff}$ |
|---|---|
| -85 | $2,19 \times 10^{-3}$ |
| -45 | $2,52 \times 10^{-3}$ |
| 10 | $2,30 \times 10^{-3}$ |
| 50 | $2,62 \times 10^{-3}$ |
| 70,5 | $2,95 \times 10^{-3}$ |

*Table 25-2* MLI 20 layers effective emissivity

MLI thermal performance degradation factors between 2 and 10 are possible. As the degradation factor to be used largely depends on the geometrical configuration of the MLI blanket (e.g. cut-outs, shape, overlaps etc.) no standard degradation factor is possible but the degradation factor needs to be assigned for each blanket depending on the actual configuration.

The following table shows for the different parts of AMS MLI which are the modelling parameters used in the model.

| ITEM | Effective Emittance | Heat Transfer Coefficient | Remarks |
|---|---|---|---|
| USS MLI | 0.05 | N/A | |
| VC MLI | 0.05 | N/A | |
| TRD MLI | N/A | A degradation factor of 10 has been applied to the HTC array presented in **Errore. L'origine riferimento non è stata trovata.** | That corresponds to a nearly effective emittance of 0.02/0.03 |
| Other MLI | 0.05 | N/A | |

*Table 25-3* MLI thermal modelling parameters

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*

# 26.MLI MASS BUDGET

Table 26-1 summarizes MLI Mass Budget.

| Row ID | SUBSYSTEM | description | Number of blankets | Blanket weight [Kg] |
|---|---|---|---|---|
| 1 | TRACKER | TRACKER BOTTOM Plane MLI | 2 | 0.46 |
| 2 | TRACKER | TRACKER COOLING TUBES MLI | 2 | in TTCS mass budget |
| 3 | TRACKER | Tracker rad rods MLI | 16 | 0.91 |
| 4 | VC | VC LOWER CONICAL FLANGE OUTER RING MLI | 4 | 2.29 |
| 5 | VC | VC RAM AND WAKE SIDE OUTER SHELL MLI | 2 | 2.34 |
| 6 | VC | VC Upper Support Ring (USR) MLI | 6 TBC | 1.48 |
| 7 | VC | VC Lower Support Ring (LSR) MLI | 8 TBC | 1.48 |
| 8 | VC | VC UPPER SKIRT MLI | 4 | 1.9 |
| 9 | USS | USS02 Upper Trunion Bridges - Ram side - MLI | 2 | 0.35 |
| 10 | USS | USS02 Upper Trunion Bridges - Wake side - MLI | 2 | 0.35 |
| 11 | USS | USS02 Upper VC IF joints MLI | 4 | 1.6 |
| 12 | USS | USS02 sill trunnion joints RAM & WAKE MLI | 4 | 0.6 |
| 13 | USS | USS02 WAKE sill tube joints MLI | 2 | 0.4 |
| 14 | USS | USS02 WAKE sill tube MLI | 1 | TBD |
| 15 | USS | Cross bar MLI | 2 | 0.4 |
| 16 | USS | USS02 lower VC IF joints MLI | 4 | 1.1 |
| 17 | USS | USS02 center body joints MLI | 4 | 0.4 |
| 18 | RICH and L-TOF | L-TOF MLI | 4 | 1.8 |
| 19 | RICH and L-TOF | RICH LAT MLI | 4 | 1.61 |
| 20 | RICH and L-TOF | RICH BOTTOM MLI | 2 | 1.3 |
| 21 | ECAL | ECAL BOTTOM MLI | 1 | 0.35 |
| 22 | ECAL | ECAL BRACKETS MLI | 8 | 0.43 |
| 23 | TRDGB | TRD GAS BOX MLI ENCLOSURE | TBD | 1.16 (in TRD GB mass budget) |
| 24 | UPS | UPS MLI | TBD | 0.4 (in UPS mass budget) |
| 25 | TTCB | TTCB-PORT AND STRB MLI | TBD | in TTCS mass budget |
| 26 | TRACKER | RAM AND WAKE TRACKER RADIATOR MLI | 2 | 1.62 |
| 27 | CRATES | UPPER WAKE CRATE MLI | TBD | 0.7 |
| 28 | CRATES | LOWER WAKE CRATE MLI | TBD | 0.6 |
| 29 | CRATES | UPPER RAM CRATE MLI | TBD | 0.7 |
| 30 | CRATES | LOWER RAM CRATE MLI | TBD | 0.6 |
| 31 | XPD | XPD MLI | TBD | 1.1 |
| 32 | CAB | CAB LHP lines | TBD | 1.4 |
| 33 | HV BRICKS | HV BRICKS MLI: 4SHV (2 on WAKE and 2 on RAM main radiator) 6EHV (L-USS diagonal) + 4RHV (L-USS diagonal) | TBD | 1.0 |
| 34 | ASTC | ASTC MLI (STAR TRACKER SUPPORT MLI AND BAFFLE SUPPORT MLI) | 2 | 0.3 |
| 35 | CRYO COOLERS | CRYO COOLERS MLI | 4 | 0.3 |
| 36 | CVB | CVB MLI | TBD | in magnet mass budget |
| 37 | CRYO COOLERS | CRYO LHP LINES MLI | 4 | 0.3 |
| 38 | TRD - UTOF | TRD - UTOF MLI | 1 | 3.4 |
| 39 | TRD | TRD TOP MLI | 1 | 5.2 |
| 40 | PDS | PDS MLI | TBD | 0.4 |
| | | | Total Weight [Kg] | 39.17 |

*Table 26-1 MLI Mass Budget.*

Questo documento contiene informazioni di proprietà di CARLO GAVAZZI SPACE SpA. Tutti i diritti sono riservati.
*All information contained in this document are property of CARLO GAVAZZI SPACE SpA. All right reserved.*