

Entry Checklist

STS-134 Flight Supplement

**Mission Operations Directorate
Flight Design and Dynamics Division**

**Final
May 20, 2010**

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas



MISSION OPERATIONS DIRECTORATE

**ENTRY CHECKLIST
STS-134 FLIGHT SUPPLEMENT**

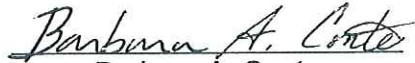
FINAL
May 20, 2010

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This document is under the configuration control of the Crew Procedures Control Board (CPCB). All proposed changes must be submitted via Change Request Workflow (CRW) to DO3/FDF Manager.

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AREAS OF TECHNICAL RESPONSIBILITY

Book Manager	DM43/G. Jordan-Moore	281-483-1261
Deorbit Burn to Entry Interface	DM43/G. Pogue	281-483-8067
Contingency Procedures and Entry Interface thru Rollout	DM43/G. Pogue	281-483-8067

NOTE

This Flight Supplement must be integrated into the generic Entry Checklist to have a complete document for flight. Insert the Flight Supplement (FS) pages in the proper numerical order in the generic Entry Checklist by using the List of Effective Pages (LOEP) which provides the sequence for merging pages to create a complete Entry Checklist.

ENTRY CHECKLIST
STS-134 FLIGHT SUPPLEMENT

LIST OF EFFECTIVE PAGES

FINAL 05/20/10

Sign Off	* generic	3-9	generic
ii	* generic	3-10	generic
Sign Off	* 134/FIN	3-11	generic
FS iv	* 134/FIN	3-12	generic
v	* generic	3-13	generic
vi	* generic	3-14	generic
vii	* generic	FS 3-15	134/FIN
viii	* generic	FS 3-16	134/FIN
ix	* generic	FS 3-17	134/FIN
x	* generic	FS 3-18	134/FIN
FS xi	* 134/FIN	3-19	generic
FS xii	* 134/FIN	3-20	generic
FS xiii	* 134/FIN	3-21	generic
FS xiv	* 134/FIN	3-22	generic
xv	generic	3-23	generic
xvi	generic	3-24	generic
1-1 (3 pgs)	† generic	3-25	generic
1-2 (3 pgs)	† generic	3-26	generic
2-1	generic	3-27	generic
2-2 (6 pgs)	† generic	3-28	generic
2-3 (6 pgs)	† generic	FS 3-29	134/FIN
2-4	generic	FS 3-30	134/FIN
FS 2-5	134/FIN	3-31	generic
FS 2-6	134/FIN	3-32	generic
FS 3-1	134/FIN	FS 3-33	134/FIN
FS 3-2	134/FIN	FS 3-34	134/FIN
FS 3-3	134/FIN	3-35	generic
FS 3-4	134/FIN	3-36	generic
3-5	generic	3-37	generic
3-6	generic	3-38	generic
FS 3-7	134/FIN	3-39	generic
FS 3-8	134/FIN	3-40	generic

* – Omit from flight book

† – Extra pages in crew copy only

3-41.....	generic	5-23.....	generic
3-42.....	generic	5-24.....	generic
3-43.....	generic	6-1.....	generic
3-44.....	generic	6-2.....	generic
4-1.....	generic	6-3.....	generic
4-2.....	generic	6-4.....	generic
4-3.....	generic	7-1.....*	generic
4-4.....	generic	7-2.....*	generic
FS 4-5.....	134/FIN	FS 8-1.....*	134/FIN
FS 4-6.....	134/FIN	FS CC 8-2.....*	134/FIN
FS 4-7.....	134/FIN	FS CC 8-3.....*	134/FIN
FS 4-8.....	134/FIN	FS CC 8-4.....*	134/FIN
FS 4-9.....	134/FIN	CC 8-5.....*	generic
FS 4-10.....	134/FIN	CC 8-6.....*	generic
4-11.....	generic	CC 8-7.....*	generic
4-12.....	generic	CC 8-8.....*	generic
5-1.....	generic	CC 8-9.....*	generic
5-2.....	generic	CC 8-10.....*	generic
5-3.....	generic	CC 8-11.....*	generic
5-4.....	generic	CC 8-12.....*	generic
5-5.....	generic	CC 8-13.....*	generic
5-6.....	generic	CC 8-14.....*	generic
5-7.....	generic	CC 8-15.....*	generic
5-8.....	generic	CC 8-16.....*	generic
5-9.....	generic	FS CC 8-17.....*	134/FIN
5-10.....	generic	FS CC 8-18.....*	134/FIN
5-11.....	generic	CC 8-19.....*	generic
5-12.....	generic	8-20.....*	generic
5-13.....	generic	CC 8-21.....*	generic
5-14.....	generic	CC 8-22.....*	generic
5-15.....	generic	FS CC 8-23.....*	134/FIN
5-16.....	generic	FS CC 8-24.....*	134/FIN
5-17.....	generic		
5-18.....	generic		
FS 5-19.....	134/FIN		
FS 5-20.....	134/FIN		
5-21.....	generic		
5-22.....	generic		

* – Omit from flight book

ENTRY CUE CARDS

<u>Title</u>	<u>Ref. Page</u>	<u>Card No.</u>
DEORBIT BURN FLIGHT		
RULES (Front).....	FS CC 8-2	ENT-1a/134/D/A
(Back).....	FS CC 8-3	ENT-1b/134/D/A
DEORBIT BURN (RCS)		
(Front)	FS CC 8-4	ENT-3a/D/L
(Back).....	CC 8-6	generic
DEORBIT BURN (2 ENG)		
(Front)	CC 8-8	generic
DEORBIT BURN (1 ENG)		
(Back).....	CC 8-10	generic
UNBALANCED PRPLT		
DEORBIT BURN		
(Front)	CC 8-12	generic
DEORBIT BURN (MIXED		
XFEED) (Back).....	CC 8-14	generic
ENTRY MANEUVERS		
(Front)	CC 8-16	generic
(Back).....	FS CC 8-17	ENT-6b/134/E/A
ENTRY NO-GO CHECKLIST		
(Front)	FS CC 8-18	ENT-7a/E/K
EMERGENCY EGRESS		
(Back).....	CC 8-19	generic
ENTRY CONTROL		
(Front)	CC 8-21	generic
(Back).....	CC 8-22	generic
DEORBIT BURN MONITOR		
(Front)	FS CC 8-23	ENT-2a/134/A,O,D,E/A
OMS FAILURES (Back)....	FS CC 8-24	ENT-2b/134/A,O,D,E/A



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OMS/
RCS ΔV

OMS/RCS ΔV

FS 2-5

ENT/134/FIN



OMS He PRESS/ Δ V/BURN TIME

OMS/
RCS Δ V

OMS% GAGE	OMS He Press *	OMS Δ V	RCS Δ V	RCS BURN MIN:SEC
50	3210	278	231	7:18
40	2810	217	181	5:42
38	2730	205	171	5:23
36	2650	193	161	5:04
34	2570	180	151	4:45
32	2490	168	141	4:26
30	2410	156	131	4:07
28	2330	144	121	3:48
26	2250	132	111	3:28
24	2170	119	101	3:09
22	2090	107	90	2:50
20	2010	95	80	2:31
18	1930	82	70	2:12
16	1850	70	60	1:52
14	1770	58	49	1:33
12	1690	45	39	1:13
10	1610	33	28	0:53
8	1530	21	18	0:34
6	1450	8	7	0:14
5	1410	2	2	0:04

* He pressure not valid until 1 hr after last burn

ΔV CAPABILITY	
ARCS Δ V fps =	$\boxed{0.9} \times [L\% + R\% - \text{AFT QTY } 1]$
FRCS Δ V fps =	$\boxed{0.9} \times \text{FRCS } \%$
OMS Δ V fps =	$\boxed{6.1} \times \text{OMS } \%$

NOTE: Uses assumed vehicle weight of 215,625 lb



DEORBIT BURN

DEORBIT
BURN



FS 3-1

ENT/134/FIN

DEORBIT
BURN

**STS-134 LANDING SITE TABLE
(50° to 63.5° INCLINATION)**

S I T E	LOCATION	RWY	MLS CH	LG	+ OVR RUN
1	KSC	KSC 15 KSC 33	8 6	15000 15000	1000 1000
2	BEN GUERIR	BEN 36 BEN 18	- -	13720 13220	0 1000
3	MORON AB	MRN 20 MRN 02	◆6 -	11730 11730	1000 1000
4	ZARAGOZA	ZZA 30L ZZA 12R	◆6 -	12200 12200	1000 1010
5	MYRTLE BEACH	MYR 36 MYR 18	- -	9500 9500	1000 1000
6	WILMINGTON	ILM 06 ILM 24	- -	7500 7500	0 0
7	CHERRY POINT	NKT 32L NKT 23R	- -	7110 7100	800 880
8	OCEANA NAS	NTU 32R NTU 23L	- -	7500 11500	0 0
9	WALLOPS	WAL 28 WAL 04	- -	7510 8750	0 0
10	DOVER AFB	DOV 32 DOV 19	- -	12400 9100	0 0
11	ATLANTIC CITY	ACY 31 ACY 13	- -	9500 9500	0 0
12	BEN GUERIR	BEN 36 BEN 18	- -	13720 13220	0 1000
13	*MORON AB	MRN 20 MRN 02	◆6 -	11730 11730	1000 1000
14	*ZARAGOZA	ZZA 30L ZZA 12R	◆6 -	12200 12200	1000 1010
15	GABRESKI	FOK 06 FOK 24	- -	8500 8500	1000 1000

◆ Available for TAL Only

* LO XRNG TAL Site **Length** after displaced threshold

**STS-134 LANDING SITE TABLE
(50° to 63.5° INCLINATION)**

S I T E	LOCATION	RWY	MLS CH	LG	+ OVR RUN
16	CAPE COD CGAS	FMH 32	-	9000	0
		FMH 23	-	7500	0
17	PEASE INT'L	PSM 34	-	10020	0
		PSM 16	-	10020	0
18	HALIFAX INT'L	YHZ 23	-	8800	0
		YHZ 32	-	7700	0
19	STEPHENVILLE	YJT 09	-	9500	0
		YJT 27	-	9500	0
20	ST JOHNS INT'L	YYT 29	-	8500	0
		YYT 11	-	8500	0
21	GANDER INT'L	YQX 21	-	9700	0
		YQX 31	-	8900	0
22	GOOSE BAY	YYR 26	-	10550	0
		YYR 34	-	9080	0
23	LAJES AB	LAJ 15	-	10870	970
		LAJ 33	-	10870	990
24	BEJA AB	BEJ 01L	-	10820	0
		BEJ 19R	-	10820	900
25	KEFLAVIK INT'L	IKF 20	-	9520	0
		IKF 29	-	9560	0
26	SHANNON	INN 06	-	9540	0
		INN 24	-	9540	0
27	FAIRFORD	FFA 27	-	9490	990
		FFA 09	-	9490	970
28	KOLN-BONN	KBO 14L	-	12020	0
		KBO 32R	-	12020	0
29	ISTRES AB	FMI 33	◆6	11300	3960
		FMI 15	-	12300	0
30	ESENBOGA	ESN 03R	-	11800	0
		ESN 21L	-	11800	0

◆ Available for TAL Only

Length after displaced threshold

**STS-134 LANDING SITE TABLE
(50° to 63.5° INCLINATION)**

S I T E	LOCATION	RWY	MLS CH	LG	+ OVR RUN
31	KING KHALED	KKI 15R KKI 33L	- -	13300 13300	0 0
32	DIEGO GARCIA	JDG 31 JDG 13	- -	12000 12000	950 950
33	AMBERLEY TINDAL RAAF	AMB 15 PTN 14	- -	9500 8500	0 0
34	YOKOTA AB	JTY 36 JTY 18	- -	11000 11000	1000 1000
35	ANDERSEN AFB	GUA 06L GUA 24R	- -	10560 10560	1050 1000
36	WAKE ISLAND	WAK 28 WAK 10	- -	9340 9340	0 0
37	HONOLULU	HNL 08R HNL 26L	- -	11500 11500	0 0
38	ELMENDORF	EDF 24 EDF 06	- -	9500 9500	0 0
39	HAO ATOLL	HAO 12 HAO 30	- -	10690 10690	0 0
40	EDW TEMP	EDT 22R EDT 04L	8 6	12000 12000	1000 1000
41	ASCENSION	HAW 13 HAW 31	- -	9520 9520	0 0
42	NORTHROP	NOR 17 NOR 23	6 6	15000 15000	Lkbd Lkbd
43	NORTHROP	NOR 05 NOR 35	- -	15000 15000	Lkbd Lkbd
44	EDWARDS AFB	EDW 15 EDW 18L	- -	16300 15000	Lkbd Lkbd
45	EDWARDS AFB	EDW 22 EDW 04	8/† 6	15020 14020	0 1800

† MSBLS Jr. Ch 8 - Requires Uplink

Length after displaced threshold

1: GNC DEORB MNVR COAST	2: GNC 50 HORIZ SIT
3: BFS, GNC 50 HORIZ SIT	

HORIZ SIT CONFIG

ALTM – ITEM 9 + .

	<u>PASS ITEM</u>		<u>BFS ITEM</u>	
PTI	INH	√1		
LAND SITE (DEL PAD)		√41		√41
RWY (DEL PAD)		√3		√3
		√4		√4
TAEM TGT				
G&N	OVHD	√6	blank	
HSI	blank		blank	
XEP	NEP	√7	NEP	√7
AIM (DEL PAD)	NOM	√8	NOM	√8
	(or CLSE)		or (CLSE)	
SPDBK	NOM	√39		
NAV				
GPS	INH	√43	INH	√43
DRAG H	AUT	√22	AUT	√22
ADTA H	INH	√26	INH	√26
MLS	AUT	√50		
G&C				
GPS	INH	√48		
ADTA	INH	√29	AUT	√28

- * If BFS engaged: *
- * Set BFS HSD ITEMS to PASS config *

G51 SEL ATMOSPHERE:
 incl ≤ 50° ITEM 22 EXEC
 incl > 50° SEL ITEM NR (table)

Hemi	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N Desc	23	23	23	23	22	24	24	24	22	23	23	23
S Asc	24	24	22	23	23	23	23	23	23	23	22	24
N Asc	22											
S Desc	22											

1: GNC DEORB MNVR COAST | 2: GNC 50 HORIZ SIT

3: GNC 51 OVERRIDE

- √ELEVON AUTO – ITEM 17 (*)
- √SSME REPOS – ITEM 19 (ENA)
- √WRAP MODE – ITEM 45 (ENA)
- If PLB holding > 10K lb:
 - FILTER ALT – ITEM 21 EXEC (*)

3: BFS, GNC 51 OVERRIDE

- √ELEVON AUTO – ITEM 17 (*)
- √SSME REPOS – ITEM 19 (ENA)
- √WRAP MODE – ITEM 45 (ENA)
- If PLB holding > 10K lb:
 - √FILTER ALT – ITEM 21 (*)

- * DES any failed/comm faulted *
- * IMU, RGA, AA, or SURF feedback *

2: GNC DEORB MNVR COAST

3: BFS, GNC DEORB MNVR COAST

- √BFS GMBL sel config same as PASS GMBL sel config



DEORBIT BURN CARDS

**BURN
CARDS**

MS ONLY

FS 3-15

ENT/134/FIN



DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE AVAILABLE ENT-1a/134/D/A

BURN CARDS

FAILURE	PRE TIG		POST TIG
	Delay (max)		Stop Burn, > Safe HP
	One Orbit	One Day	
APU/HYD			
1 No APU operating .....	... X ...	.....
DPS			
2 RDNT fail, Split.....	.....	...X...	.....X
3 1 GPC.....	... X ...	.....
4 BFS .....	.....	...X...	
5 GPC BITE (Multiple GPCs).....	.....	...X...	
ECLS			
6 2 Av Bay Fans in Bay 3.....	... X ...	.....
7 2 Av Bay Fans in Bay 1 or 2.....	.....	...X...	
ELEC			
8 H2 Manf or TK leak (not in depleted tk(s) .....	... X ...	.....
9 2 MN Buses.....	.....	...X...	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	.....	...X...	
11 Multi Φ AC BUS (unshorted).....	... X ...	.....
GNC			
12 1 MLS (if reqd), IMU, or GPS (C-band not avail).....	... X ...	.....
13 IMU Dilemma.....	.....	...X...	.....X
14 RHC Dilemma .....	... X ...	.....
15 2 IMUs (Not targeting EDW/NOR).....	.....	...X...	
16 2 ADTAs (Winds>80kts or Dynamic Wx).....	... X ...	.....
HOOK VELCRO			HOOK VELCRO
17 2 FCS Channels (same surface) (Not targeting NOR/EDW).....	... X ...	.....
18 2 AAs, RGAs (Not targeting EDW/NOR).....	... X ...	.....
OMS			
19 Prplt Tank .....	... X ...	.....	.....X ①
20 Ignition (neither eng ignites).....	... X ...	.....	.....X ②
21 Both OMS Eng fail.....	.....	.....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust	.....
AFT RCS			
23 2 jets, same direction, same pod .....	... X ...	.....
24 Prplt Lk after LAST LOS.....	... X ...	.....
25 1 AFT RCS PROP TK fail .....	... X ...	.....
COMM			
26 MCC GO for DEORBIT not rcvd .....	.....	...X...	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)
 ② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE NOT AVAILABLE ENT-1b/134/D/A

FAILURE	PRE TIG	POST TIG
	Delay (max)	Stop Burn, > Safe HP
	One Day	
APU/HYD		
1 No APU operating .....	..... X	
DPS		
2 RDNT fail, Split.....	..... X .....	.....X
3 1 GPC.....	..... X	
4 BFS .....	..... X	
5 GPC BITE (Multiple GPCs) .....	..... X	
ECLS		
6 2 Av Bay Fans in Bay 3 .....	..... X	
7 2 Av Bay Fans in Bay 1 or 2.....	..... X	
ELEC		
8 H2 Manf or TK leak (not in depleted tk(s) .....	..... X	
9 2 MN Buses.....	..... X .....	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	..... X	
11 Multi Φ AC BUS (unshorted) .....	..... X	
GNC		
12 1 MLS (if reqd), IMU, or GPS (C-band not avail).....	..... X	
13 IMU Dilemma.....	..... X .....	.....X
14 RHC Dilemma .....	..... X	
15 2 IMUs (Not targeting EDW/NOR) .....	..... X	
16 2 ADTAs (Winds>80kts or Dynamic Wx) .....	..... X	
HOOK VELCRO		HOOK VELCRO
17 2 FCS Channels (same surface) (Not targeting NOR/EDW) .....	..... X	
18 2 AAs, RGAs (Not targeting EDW/NOR) .....	..... X	
OMS		
19 Prplt Tank .....	..... X .....	.....X ①
20 Ignition (neither eng ignites).....	..... X	
21 Both OMS Eng fail.....	..... X .....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust	
AFT RCS		
23 2 jets, same direction, same pod .....	..... X	
24 Prplt Lk after LAST LOS.....	..... X	
25 1 AFT RCS PROP TK fail .....	..... X	
COMM		
26 MCC GO for DEORBIT not rcvd .....	..... X	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)
 ② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

DEORBIT BURN MONITOR

OMS TEMP* FU IN P \geq <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td style="padding: 2px;">L</td><td style="padding: 2px;">R</td></tr> <tr><td style="padding: 2px;">219</td><td style="padding: 2px;">220</td></tr> <tr><td style="padding: 2px;">201</td><td style="padding: 2px;">208</td></tr> </table> or No FU IN P	L	R	219	220	201	208	OMS ENG FAIL OMS PRPLT FAIL
L	R						
219	220						
201	208						
OMS PC* & OMS ↓ (BFS: $\sqrt{\text{accel}}$) ENG VLV 1 or 2 < 70 or OX IN P > 227 OX IN P \leq 227 or No OX IN P	OMS ENG FAIL OMS PRPLT FAIL						
OMS OX/FU TK P ($\sqrt{\text{ENG IN P}}$) OX/FU LOW OX & FU HIGH	He PRESS/VAP ISOL (two) – OP If aff TK P not incr: He PRESS/VAP ISOL (two) – CL At PC < 72 or OMS TEMP: OMS PRPLT FAIL He PRESS/VAP ISOL (two) – CL Cycle He A(B) to maintain TK P 234-284						
OMS GMBL PRI fail SEC fail	L(R) OMS GMBL – SEC If high RCS usage: OMS ENG FAIL						
GPC 1(4) & Burning OMS aff SEC GMBL lost 2 FAs lost	aff GPC PWR – OFF If SEC GMBL avail: aff MDM FF 1(4) – OFF, ON L(R) OMS GMBL – SEC If high RCS usage: OMS ENG FAIL $\sqrt{\text{MAN SHUTDN}}$						
I/O ERROR FA 1(4) 2 FAs lost	L(R) OMS GMBL – SEC ♦ I/O RESET (if recov: BFS I/O RESET) If high RCS usage: OMS ENG FAIL $\sqrt{\text{MAN SHUTDN}}$						
BCE STRG D 1(4)	I/O RESET (if recov: >>) If high RCS usage: L(R) OMS GMBL – SEC						
RM DLMA IMU or ABOVE SAFE HP \Rightarrow <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td style="width: 20px; height: 15px;"></td><td style="width: 20px; height: 15px;"></td></tr> </table> GPC SET SPLIT or 2 MN BUSES BELOW SAFE HP \Rightarrow			STOP BURN: OMS ENG(s) – OFF >> IMU DLMA: After C/O: $\sqrt{\text{timer}}$ G21 If any IMU ACC > 0.03: aff IMU – desel I'cnct OMS to RCS ($\sqrt{\text{RCS Burn Time}}$) THC +X to TGT HP (EOM) or 3.5 x timer at C/O (AOA) SET SPLIT: Go to "GPC" above				
I/O ERROR PCM	OI PCMMU PWR – 2(1)						

*If XFD, BLDN, or sensor fail, monitor ENG IN P for off-nominal performance

ENT-2a/134/A,O,D,E/A

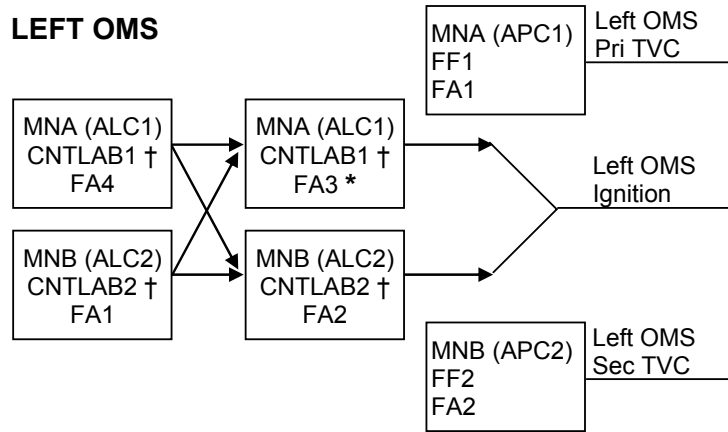
MS ONLY

FS 3-29

ENT/134/FIN

OMS FAILURES

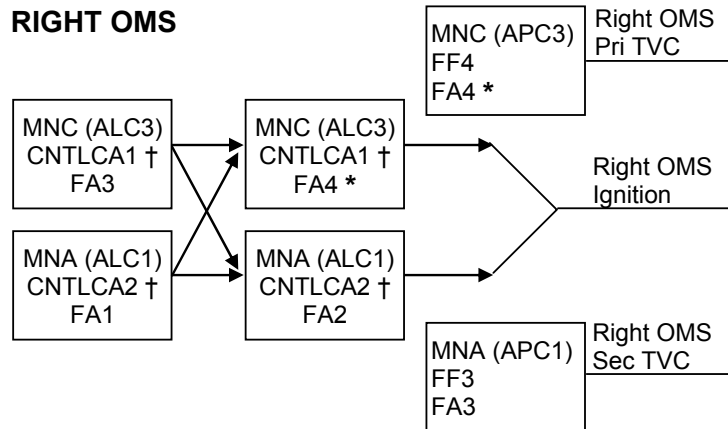
LEFT OMS



† If CNTL AB1 or AB2 (CA1 or CA2) failed and ign path still exists at OMS fail, assume L(R) OMS ↓ is PRPLT FAIL

* If L(R) P_C failed high during burn, or FA3(4) failed, at L(R) OMS fail, no guidance downmode after L(R) OMS ENG switch OFF (TGO slow, ADI needles in error, 6 ft/s underburn)

RIGHT OMS



If two FA MDMs lost		
MDMs	Preburn: ENG – OFF	During burn: MAN SHUTDN
1,2	LEFT (TVC)	BOTH
1,3	RIGHT (IGN)	LEFT
1,4	LEFT (IGN)	RIGHT
2,3	LEFT (IGN)	RIGHT
2,4	RIGHT (IGN)	LEFT
3,4	RIGHT (TVC)	BOTH

ENT-2b/134/A,O,D,E/A

MS ONLY

FS 3-30

ENT/134/FIN

1: GNC DEORB MNVR EXEC	2: GNC DEORB MNVR EXEC
3: BFS, GNC SYS SUMM 2	

- * **UNDERBURN** *
- * Determine ΔHP (CUR HP – TGT HP) *
- * Record prebank on ENTRY MANEUVERS Cue Card *

* PREBANK TABLE EDW (HA = 202 NM) *											
* EDW *											
ΔHP	0	4	8	12	REDES.	13	14	(15)	REDES.		
PREBANK	0	80	105	125	NOR ELS	140	155	170	YYR		
* NOR *					IF NOR NOGO						
* <u>G50</u> ITEM 41 + <u>4</u> <u>2</u> , √RWY 17 *											
ΔHP			10	11	13	14	15	16	(17)	REDES.	
PREBANK			105	110	120	130	145	155	175	YYR	
* YYR *											
* <u>G50</u> ITEM 41 + <u>2</u> <u>2</u> , √RWY 26 *											
ΔHP						16	18	20	24	(26)	28
PREBANK						75	85	95	125	145	180
* PREBANK TABLE KSC (HA = 203 NM) *											
* KSC *											
ΔHP	0	2	4	7	9	12	14	(15)	REDES.		
PREBANK	0	50	80	100	110	130	155	175	YQX		
* YQX *											
* <u>G50</u> ITEM 41 + <u>2</u> <u>1</u> , √RWY 21 *											
ΔHP							16	22	(25)	RED.	
PREBANK							95	135	170	INN	
* INN *											
* <u>G50</u> ITEM 41 + <u>2</u> <u>6</u> , √RWY 06 *											
ΔHP									26	28	
PREBANK									135	180	

134 oct

1: GNC DEORB MNVR EXEC	2: GNC DEORB MNVR EXEC
3: BFS, GNC SYS SUMM 2	

C CRT1 **GNC, OPS 303 PRO**

1: GNC DEORB MNVR COAST	2: GNC DEORB MNVR COAST
-------------------------	-------------------------

C CRT1 √Uplinked INRTL EI-5 MM303 ATT with DEL PAD

- * If no deorbit TGT uplink, enter INRTL EI-5 *
- * MM303 ATT from DEL PAD *
- * R – ITEM 24 + _____ *
- * P – ITEM 25 + _____ *
- * Y – ITEM 26 + _____ *

Mnvr to EI-5 ATT – ITEM 27 EXEC (*)	TIME to EI (min)	LVLH PITCH (deg)
	20	339
		343
		347
* If UNDERBURN or no *		351
* DEL PAD, manually *		355
* mnvr to LVLH R 001, *	15	359
* Y 358, P per table *		3
		7
		11
		15
	10	19
		23
		27
		31
		35
	5	39

C **OMS GMBL PWRDN (PASS ONLY)**

CRT1 Verify GMBL positions:

	<u>L</u>	<u>R</u>
P	+5.9	+5.9
Y	+6.4	-6.4

GMBL OFF – ITEM 32 EXEC
 – ITEM 33 EXEC

FLIGHT CONDITIONS	MANEUVER
V = 7K	G50 √GPS, INCORPORATE * If ELS: UHF MODE – G T/R *
V = 5K	ADTA PROBES – DEPLOY (√HEAT) Begin AIL and RUD trim monitoring
M = 3.5	If previous OMS OX TK, He TK, or RCS OX TK leak: G51 VENT DOOR CNTL OPEN – ITEM 43 EXEC
M = 2.7	√APUs HUD PWR (two) – ON
* If M < 2.5; P CSS for ADTA to G&C incorp *	
M = 2.0	Ensure ADTA to G&C else √Theta limits
M < 1.0	√R FLT CNTLR – ON P,R/Y – CSS as reqd √SPDBK CMD vs POS MAX N _z <input type="text"/> . <input type="text"/> √NWS – 1 Lock Inertia Reels
M = 0.7	√LG EXTD ISO VLV – OP
h = 15K	√MLS
h = 10K	√A/L (KSC – Tabs, Visors, Suit O2)
h = 2K	LDG GEAR ARM pb – push (ARM It on)
h = 300	LDG GEAR DN pb – push (DN It on)
MAIN GEAR TD	√SPDBK – 100%
V = 195 KEAS	DRAG CHUTE ARM, DPY pb (two) – push (simo) (All Its on)
V = 185 KEAS	DEROTATE
NOSE GEAR TD	SRB SEP – MAN/AUTO and depress pb √Auto Load Relief √HYD BK ISOL VLV (three) – OP
V < 120 KGS or 5K' remaining	BRAKE as required (8-10 fps ² , -0.25 to -0.3G)
* If 5K' remaining and V > 140 KGS – MAX BRAKING *	
V = 60 KGS	DRAG CHUTE JETT pb – push (JETT1,JETT2 It on)
V = 40 KGS	BRAKE < 6 fps ² (-0.2G) (Antiskid cutout)
WHEEL STOP	Go to ENT C/L, <u>POST LANDING PROCEDURES</u>

ENT-6b/134/E/A
(Partial)

MS ONLY

FS 4-5

ENT/134/FIN



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MS ONLY

FS 4-6

ENT/134/FIN



DRAG CHUTE DEPLOY

MCC Call	Flight Condition
Early	Main Gear TD
NOMINAL	195 KEAS
Late	Post-Nose Gear TD Xwind DTO
Emergency Only	No Deploy Except CDR call
NO DEPLOY prior to MGTD > 230 KEAS < 80 KGS Xwind > 15 kts	

FAILED TIRE TECHNIQUE

Post-MGTD	P – AUTO
185 KEAS	Deploy drag chute
180 KEAS	√Auto derotation
NGTD	Max RHC roll away from failed tire

50K	/
38K	/
28K	/
20K	/
12K	/
7K	/
3K	/
1K	/
SURF	/

ENT-6b/134/E/A
(Partial)

ENTRY
MISC

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MS ONLY

FS 4-8

ENT/134/FIN

ENTRY ALPHA

VR	α	ref	R	H	Href	Rref
25	HI	40 LO	4314	400		
24	HI	40 LO	2558	247	-48	L79
23	43	40 37	2123	239	-65	69
22	43	40 37	1782	233	-84	63
21	43	40 37	1508	227	-106	60
20	43	40 37	1296	220	-122	59
19	43	40 37	1124	214	-144	59
18	43	40 37	982	207	-166	60
17	43	40 37	864	200	-184	61
16	43	40 37	767	194	-193	62

KSC 15

MAX L/D	
M	α
3	17
2	15
1	12

(134 OCF CY)

HOOK
VELCRO

ASC-14b/134/A,E/A

HOOK
VELCRO

HOOK
VELCRO

15	43	40 37	685	188	-205	63
14	43	40 37	613	183	-127	61
13	43	40 37	545	180	-136	58
12	43	40 37	482	175	-153	56
11	42	39 36	424	170	-195	54
10	41	38 35	372	165	-174	R51
9	39	36 33	322	160	-209	46
8	37	34 31	274	152	-242	43
7	33	30 27	227	142	-272	42
6	30	27 24	182	130	-276	42
5	26	23 20	143	120	-274	L42
4	22	19 18	105	105	-263	43
3	19	16 15	75	91	-249	R35
2.5	14		61	84	-285	
2	12		50	78	-261	
1.5	9		38	68	-317	
1	8		28	53	-263	

HOOK VELCRO

MS ONLY

FS 4-9

ENT/134/FIN



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MS ONLY

FS 4-10

ENT/134/FIN



1:	2:
3:	

POST LANDING PAYLOAD ACTIVITIES

N/A



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CUE CARD
CONFIG

ENTRY CUE CARD CONFIG

FAB USE ONLY

FS 8-1

ENT/134/FIN

DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE AVAILABLE ENT-1a/134/D/A

FAILURE	PRE TIG		POST TIG
	Delay (max)		Stop Burn, > Safe HP
	One Orbit	One Day	
APU/HYD			
1 No APU operating .....	... X ...	.....
DPS			
2 RDNT fail, Split.....	.....	...X...	.....X
3 1 GPC.....	... X ...	.....
4 BFS .....	.....	...X...	
5 GPC BITE (Multiple GPCs).....	.....	...X...	
ECLS			
6 2 Av Bay Fans in Bay 3.....	... X ...	.....
7 2 Av Bay Fans in Bay 1 or 2.....	.....	...X...	
ELEC			
8 H2 Manf or TK leak (not in depleted tk(s) .....	... X ...	.....
9 2 MN Buses.....	.....	...X...	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	.....	...X...	
11 Multi Φ AC BUS (unshorted).....	... X ...	.....
GNC			
12 1 MLS (if reqd), IMU, or GPS (C-band not avail).....	... X ...	.....
13 IMU Dilemma.....	.....	...X...	.....X
14 RHC Dilemma .....	... X ...	.....
15 2 IMUs (Not targeting EDW/NOR).....	.....	...X...	
16 2 ADTAs (Winds>80kts or Dynamic Wx).....	... X ...	.....
HOOK VELCRO			
17 2 FCS Channels (same surface) (Not targeting NOR/EDW).....	... X ...	.....
18 2 AAs, RGAs (Not targeting EDW/NOR).....	... X ...	.....
OMS			
19 Prplt Tank.....	... X ...	.....	.....X ①
20 Ignition (neither eng ignites).....	... X ...	.....
21 Both OMS Eng fail.....	.....	.....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust	.....
AFT RCS			
23 2 jets, same direction, same pod .....	... X ...	.....
24 Prplt Lk after LAST LOS.....	... X ...	.....
25 1 AFT RCS PROP TK fail .....	... X ...	.....
COMM			
26 MCC GO for DEORBIT not rcvd .....	.....	...X...	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)

② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

(reduced copy)

TOP
BACK OF 'DEORBIT BURN FLIGHT RULES'

DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE NOT AVAILABLE ENT-1b/134/D/A

FAILURE	PRE TIG	POST TIG
	Delay (max)	Stop Burn, > Safe HP
	One Day	
APU/HYD		
1 No APU operating .....	..... X	
DPS		
2 RDNT fail, Split.....	..... X .....	.....X
3 1 GPC.....	..... X	
4 BFS .....	..... X	
5 GPC BITE (Multiple GPCs).....	..... X	
ECLS		
6 2 Av Bay Fans in Bay 3.....	..... X	
7 2 Av Bay Fans in Bay 1 or 2.....	..... X	
ELEC		
8 H2 Manf or TK leak (not in depleted tk(s).....)	..... X	
9 2 MN Buses.....	..... X .....	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	..... X	
11 Multi Φ AC BUS (unshorted).....	..... X	
GNC		
12 1 MLS (if reqd), IMU, or GPS (C-band not avail).....	..... X	
13 IMU Dilemma.....	..... X .....	.....X
14 RHC Dilemma .....	..... X	
15 2 IMUs (Not targeting EDW/NOR).....	..... X	
16 2 ADTAs (Winds>80kts or Dynamic Wx).....	..... X	
HOOK VELCRO		HOOK VELCRO
17 2 FCS Channels (same surface) (Not targeting NOR/EDW).....	..... X	
18 2 AAs, RGAs (Not targeting EDW/NOR).....	..... X	
OMS		
19 Prplt Tank.....	..... X .....	.....X ①
20 Ignition (neither eng ignites).....	..... X	
21 Both OMS Eng fail.....	..... X .....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust	
AFT RCS		
23 2 jets, same direction, same pod .....	..... X	
24 Prplt Lk after LAST LOS.....	..... X	
25 1 AFT RCS PROP TK fail .....	..... X	
COMM		
26 MCC GO for DEORBIT not rcvd .....	..... X	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)

② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

(reduced copy)

FAB USE ONLY

FS CC 8-3

ENT/134/FIN

TOP

HOOK
VELCRO

DEORBIT
BURN
(RCS)

HOOK
VELCRO

√MM302 √RCS SEL
√RCS BURN CONFIG (L OMS I'CNCT)
L,R OMS He PRESS/VAP ISOL A (two) – OP
..... Wait 2 sec B (two) – OP
√DAP – INRTL/DISC
ADI – LVLH(REF)/MED/MED
FLT CNTLR PWR (two) – ON

TIG THC +X (No Deorbit > TIG + :)
Maintain PITCH ATT ERR ± 3°
Monitor ΔVTOT:
RCS I'CNCT TK SW at ΔVTOT =
R OMS XFEED (two) – OP
L OMS XFEED (two) – CL

OMS PRPLT LOW
AFT RCS RECONFIG AT ΔVTOT =
RCS COMPLETION

*** OMS PRPLT FAIL (MULTIPLE JETS FAIL OFF):**

*	Secure aff OMS	*
*		*
*	STOP BURN:	*
*	SAFE <input type="text"/> APU _s – SHUT DN	*
*	HP -----	*
*	CONTINUE BURN:	*
*	ITEM 18 +0 EXEC	*
*	<input type="text"/> Resel jets	*
*	Interconnect good OMS to RCS	*
*	THC +X (√OMS% vs RCS Burn Time)	*
*	AFT RCS RECONFIG	*
*	RCS COMPLETION	*
*	RCS +X JET FAIL OFF:	*
*	STOP BURN:	*
*	SAFE <input type="text"/> APU _s – SHUT DN	*
*	HP -----	*
*	CONTINUE BURN:	*
*	ITEM 18 +0 EXEC	*
*	<input type="text"/> Resel jets	*
*		*

ENT-3a/D/L

HINGE

(reduced copy)

FAB USE ONLY

FS CC 8-4

ENT/134/FIN

TOP
BACK OF 'ENTRY MANEUVERS'

	FLIGHT CONDITIONS	MANEUVER	MCC Call	Flight Condition
HOOK VELCRO	V = 7K	[G50] √GPS, INCORPORATE * If ELS: UHF MODE – G T/R *	Early	Main Gear TD
	V = 5K	ADTA PROBES – DEPLOY (√HEAT) Begin ALL and RUD trim monitoring	NOMINAL	195 KEAS
	M = 3.5	If previous OMS OX TK, He TK, or RCS OX TK leak: [G51] VENT DOOR CNTL OPEN – ITEM 43 EXEC	Late	Post-Nose Gear TD Xwind DTO
	M = 2.7	√APUs HUD PWR (two) – ON * If M < 2.5: P CSS for ADTA to G&C incorp *	Emergency Only	No Deploy Except CDR call
	M = 2.0	Ensure ADTA to G&C else √Theta limits	NO DEPLOY prior to MGTD > 230 KEAS < 80 KGS Xwind > 15 kts	
	M < 1.0	√R FLT CNTLR – ON P,R/Y – CSS as reqd √SPDBK CMD vs POS MAX Nz <input type="text"/> . <input type="text"/> √NWS – 1 Lock Inertia Reels	FAILED TIRE TECHNIQUE	
	M = 0.7	√LG EXTD ISO VLV – OP	Post-MGTD	P – AUTO
	h = 15K	√MLS	185 KEAS	Deploy drag chute
	h = 10K	√AL (KSC – Tabs, Visors, Suit O2)	180 KEAS	√Auto derotation
	h = 2K	LDG GEAR ARM pb – push (ARM It on)	NGTD	Max RHC roll away from failed tire
	h = 300	LDG GEAR DN pb – push (DN It on)		
	MAIN GEAR TD	√SPDBK – 100%		
	V = 195 KEAS	DRAG CHUTE ARM, DPY pb (two) – push (simo) (All Its on)	50K	/
	V = 185 KEAS	DEROTATE	38K	/
	NOSE GEAR TD	SRB SEP – MAN/AUTO and depress pb √Auto Load Relief √HYD BK ISOL VLV (three) – OP	28K	/
	V < 120 KGS or 5K' remaining	BRAKE as required (8-10 fps ² , -0.25 to -0.3G) * If 5K' remaining and V > 140 KGS – MAX BRAKING *	20K	/
	V = 60 KGS	DRAG CHUTE JETT pb – push (JETT1, JETT2 It on)	12K	/
	V = 40 KGS	BRAKE < 6 fps ² (-0.2G) (Antiskid cutout)	7K	/
	WHEEL STOP	Go to ENT C/L, <u>POST LANDING PROCEDURES</u>	3K	/
			1K	/
			SURF	/

ENT-6b/134/E/A

(reduced copy)

FAB USE ONLY

FS CC 8-17

ENT/134/FIN

TOP

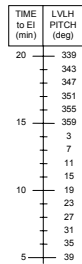
HOOK
VELCRO

HOOK
VELCRO

ENTRY NO-GO CHECKLIST

FAILURE OF:	AERO PTI DTO	AUTO FCS MODE	XWIND DTC ①
APU/HYD: 1 APU.....			X
2 APUs.....	X		X
DISPLAYS: 2 ADIs.....	X		
2 ADIs.....			X ②
CONTROLLERS: CDR HUD.....			X ②
RHC: IL.....			X
2L & 2R.....	X		X
RPTA: 2L or 2R.....	X		X
GNC: 2 AAs (LAT).....	X	X ③	X
2 AAs (NORM).....	X (M < 2.5)	X ③	X
2 RGS.....	X		X
2 R DDU PWR SPLY.....			X
2 IMU (or 1 IMU + BITE).....	X		X
2 ADTAs.....			X
ADTA NOT INCORP.....			X
OR OLMA.....	X (M < 2)		X
MLS NOT INCORP.....	X (< 6K ft)		X
DPS: 2 FCS CH (same surface).....	X		X
1 GPC (not restrung).....			X ④
2 GPC (restrung).....	X		X ④
2 GPC (not restrung).....	X	X ④	X ④
1 FF.....			X
2 FF.....	X	X ④	X
2 FA.....	X		X
RCS: LEAK (AFT - during ENT).....	X		X
2 YAW JETs (same side).....	X		X
MIN RCS QTY.....	X		X
TRIM: All > ± 2.0 deg.....	X		X
DOWNMODE: FCS problem.....	X	X	X
ADA.....	X		X
PLB: PLBD Latch Gang.....	X		X
LDG/DECEL: Tire Leak.....			X
HYD BRAKE ISOL VLV.....			X
< 100% Brake.....			X
NWS.....			X
ENERGY - OFF NOMINAL: Rot Ret Alert.....	X		
Above Upper Traj Line.....	X		
MCC GCA, or VEL & PSN.....			
update.....	X	X	
No AL by 6K ft.....	X		
DATA: SOLID STATE RECORDERS... X (LOS)			
XWIND: < 10 Knots Peak.....			X
> 15 Knots Peak.....			X
> 10 Knots Gust.....			X
GROUND SYSTEMS: No Runway Aim Point.....			X

- NOTES**
- ① Consider runway redesignation (M > 6) to avoid Xwind landing
 - ② GO if PAPI and BALL BAR available
 - ③ Pitch AUTO mode NO-GO for M < 2.5
 - ④ GO if only string 4 affected



HOOK
VELCRO

HOOK
VELCRO

HOOK
VELCRO

HOOK
VELCRO

HOOK
VELCRO

HOOK
VELCRO

ENT-7a/E/K

(reduced copy)

FAB USE ONLY

FS CC 8-18

ENT/134/FIN

TOP

HOOK
VELCRO

HOOK
VELCRO

**DEORBIT
BURN
MONITOR**

OMS TEMP*	<table border="1"> <tr> <td></td> <td>L</td> <td>R</td> </tr> <tr> <td>FU IN P</td> <td>≥ 219</td> <td>220</td> </tr> <tr> <td></td> <td>≤ 201</td> <td>208</td> </tr> </table>		L	R	FU IN P	≥ 219	220		≤ 201	208	<p>OMS ENG FAIL</p> <p>-----</p> <p>OMS PRPLT FAIL</p>
	L	R									
FU IN P	≥ 219	220									
	≤ 201	208									
or No FU IN P											
OMS PC* & OMS ↓ (BFS: √accel)	<p>ENG VLV 1 or 2 < 70</p> <p>or OX IN P > 227</p> <p>-----</p> <p>OX IN P ≤ 227</p> <p>or No OX IN P</p>	<p>OMS ENG FAIL</p> <p>-----</p> <p>OMS PRPLT FAIL</p>									
OMS OX/FU TK P (√ENG IN P)	OX/FU LOW	<p>He PRESS/VAP ISOL (two) – OP</p> <p>If aff TK P not incr:</p> <p>He PRESS/VAP ISOL (two) – CL</p> <p>At PC < 72 or OMS TEMP:</p> <p>OMS PRPLT FAIL</p> <p>-----</p> <p>OX & FU HIGH</p> <p>He PRESS/VAP ISOL (two) – CL</p> <p>Cycle He A(B) to maintain TK P 234-284</p>									
OMS GMBL	<p>PRI fail</p> <p>SEC fail</p>	<p>L(R) OMS GMBL – SEC</p> <p>-----</p> <p>If high RCS usage: OMS ENG FAIL</p>									
GPC	<p>1(4) &</p> <p>Burning OMS aff</p> <p>-----</p> <p>SEC GMBL lost</p> <p>2 FAs lost</p>	<p>aff GPC PWR – OFF</p> <p>If SEC GMBL avail:</p> <p>aff MDM FF 1(4) – OFF,ON</p> <p>L(R) OMS GMBL – SEC</p> <p>-----</p> <p>If high RCS usage: OMS ENG FAIL</p> <p>√MAN SHUTDN</p>									
I/O ERROR FA	1(4)	<p>L(R) OMS GMBL – SEC</p> <p>-----</p> <p>♦I/O RESET (if recov: BFS I/O RESET)</p> <p>If high RCS usage: OMS ENG FAIL</p> <p>-----</p> <p>2 FAs lost</p> <p>√MAN SHUTDN</p>									
BCE STRG D	1(4)	<p>I/O RESET (if recov: >>)</p> <p>-----</p> <p>If high RCS usage:</p> <p>L(R) OMS GMBL – SEC</p>									
RM DLMA IMU	ABOVE SAFE	<p>STOP BURN: OMS ENG(s) – OFF >></p> <p>-----</p> <p>IMU DLMA:</p> <p>After C/O: √timer G21</p> <p>If any IMU ACC > 0.03: aff IMU – desel</p> <p>I'cnct OMS to RCS (√RCS Burn Time)</p> <p>THC +X to TGT HP (EOM) or</p> <p>3.5 x timer at C/O (AOA)</p> <p>SET SPLIT: Go to "GPC" above</p>									
or	HP ⇒ <input type="checkbox"/> <input type="checkbox"/>										
GPC SET SPLIT											
or	BELOW SAFE										
2 MN BUSES	HP ⇒										
I/O ERROR PCM		OI PCMMU PWR – 2(1)									

*If XFD, BLDN, or sensor fail, monitor ENG IN P for off-nominal performance
ENT-2a/134/A,O,D,E/A

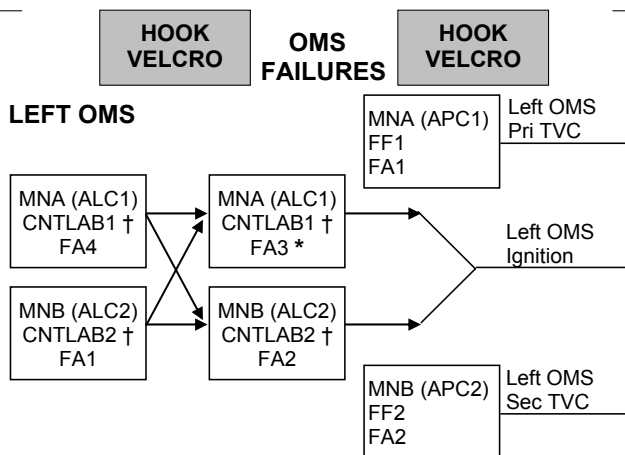
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FS CC 8-23

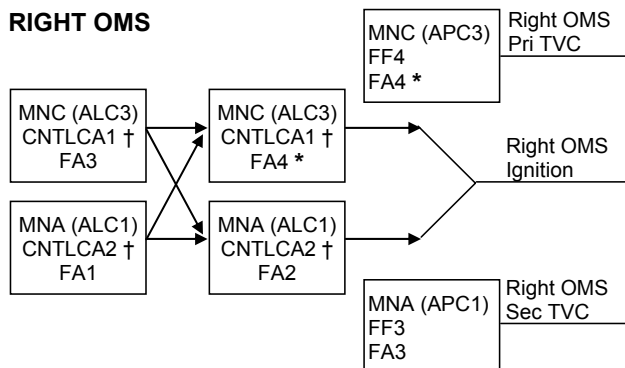
ENT/134/FIN

TOP
BACK OF 'DEORBIT BURN MONITOR'



† If CNTL AB1 or AB2 (CA1 or CA2) failed and ign path still exists at OMS fail, assume L(R) OMS ↓ is PRPLT FAIL

* If L(R) P_c failed high during burn, or FA3(4) failed, at L(R) OMS fail, no guidance downmode after L(R) OMS ENG switch OFF (TGO slow, ADI needles in error, 6 ft/s underburn)



If two FA MDMs lost		
MDMs	Preburn: ENG – OFF	During burn: MAN SHUTDN
1,2	LEFT (TVC)	BOTH
1,3	RIGHT (IGN)	LEFT
1,4	LEFT (IGN)	RIGHT
2,3	LEFT (IGN)	RIGHT
2,4	RIGHT (IGN)	LEFT
3,4	RIGHT (TVC)	BOTH

ENT-2b/134/A,O,D,E/A

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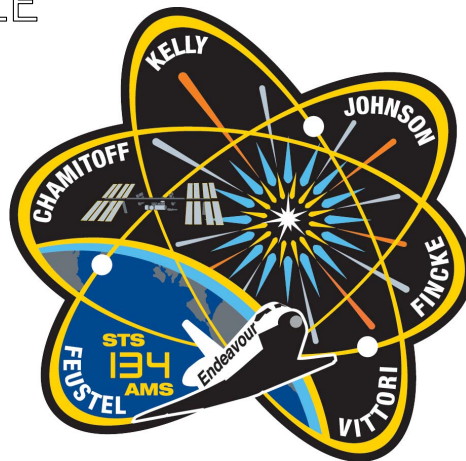
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FS CC 8-24

ENT/134/FIN

Space Shuttle Program
FLIGHT DATA FILE

JSC-48020-134
FINAL



ENTRY CHECKLIST

STS
134

Flight Cover (trim bottom to expose tabs)