

Entry Checklist

STS-109 Flight Supplement

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

**Final
July 16, 2001**

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas



Verify this is the correct version for the pending operation (training, simulation or flight).
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JSC-48020-109

MISSION OPERATIONS DIRECTORATE

**ENTRY CHECKLIST
STS-109 FLIGHT SUPPLEMENT**

FINAL
July 16, 2001

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This document is under the configuration control of the Crew Procedures Control Board (CPCB). All proposed changes must be submitted on JSC Form 482 to DO3/FDF Manager.

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ENT/109/FIN

Incorporates the following:
482#: NONE – Establishes baseline

AREAS OF TECHNICAL RESPONSIBILITY

Book Manager	DM43/M. Trump	281-483-8029
Deorbit Burn to Entry Interface	DM43/J. Patterson	281-483-1987
Contingency Procedures and Entry Interface thru Rollout	DM43/J. Patterson	281-483-1987

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-109 FLIGHT SUPPLEMENT

LIST OF EFFECTIVE PAGES

FINAL 07/16/01
PCN-1 01/25/02

Sign Off	* generic	3-7	generic
ii	* generic	3-8	generic
Sign Off	* 109/FIN	3-9	generic
FS iv	* 109/FIN	3-10	generic
v	* generic	3-11	generic
vi	* generic	3-12	generic
vii	* generic	3-13	generic
viii	* generic	3-14	generic
ix	* generic	3-15	generic
x	* generic	3-16	generic
FS xi	* 109/FIN 1	3-17	generic
FS xii	* 109/FIN 1	3-18	generic
FS xiii	* 109/FIN 1	3-19	generic
FS xiv	* 109/FIN	3-20	generic
xv	generic	3-21	generic
xvi	generic	3-22	generic
1-1 (3 pgs)	† generic	3-23	generic
1-2 (3 pgs)	† generic	3-24	generic
2-1	generic	3-25	generic
2-2 (6 pgs)	† generic	3-26	generic
2-3 (6 pgs)	† generic	3-27	generic
2-4	generic	3-28	generic
FS 2-5	109/FIN	FS 3-29	109/FIN
FS 2-6	109/FIN	FS 3-30	109/FIN
FS 3-1	109/FIN	3-31	generic
FS 3-2	109/FIN	3-32	generic
FS 3-3	109/FIN	FS 3-33	109/FIN
FS 3-4	109/FIN	FS 3-34	109/FIN
3-5	generic	3-35	generic
3-6	generic	3-36	generic

* - Omit from flight book
† - Extra pages in crew copy only

FS xi

ENT/109/FIN 1

3-37	generic	5-16	generic
3-38	generic	5-17	generic
3-39	generic	5-18	generic
3-40	generic	FS 5-19	109/FIN 1
3-41	generic	FS 5-20	109/FIN
3-42	generic	5-21	generic
3-43	generic	5-22	generic
3-44	generic	5-23	generic
4-1	generic	5-24	generic
4-2	generic	6-1	generic
4-3	generic	6-2	generic
4-4	generic	6-3	generic
4-5	generic	6-4	generic
4-6	generic	7-1	* generic
FS 4-7	109/FIN	7-2	* generic
FS 4-8	109/FIN	7-3	* generic
4-9	generic	7-4	* generic
4-10	generic	7-5	* generic
FS 4-11	109/FIN	7-6	* generic
FS 4-12	109/FIN	7-7	* generic
4-13	generic	7-8	* generic
4-14	generic	7-9	* generic
4-15	generic	7-10	* generic
4-16	generic	8-1	* generic
5-1	generic	CC 8-2	* generic
5-2	generic	CC 8-3	* generic
5-3	generic	CC 8-4	* generic
5-4	generic	CC 8-5	* generic
5-5	generic	CC 8-6	* generic
5-6	generic	CC 8-7	* generic
5-7	generic	CC 8-8	* generic
5-8	generic	CC 8-9	* generic
5-9	generic	CC 8-10	* generic
5-10	generic	CC 8-11	* generic
5-11	generic	CC 8-12	* generic
5-12	generic	CC 8-13	* generic
5-13	generic	CC 8-14	* generic
5-14	generic	CC 8-15	* generic
5-15	generic	CC 8-16	* generic

* – Omit from flight book

CC 8-17 * generic
CC 8-18 * generic
CC 8-19 * generic
CC 8-20 * generic
CC 8-21 * generic
8-22 * generic
FS CC 8-23 ... * 109/FIN
FS CC 8-24 ... * 109/FIN

* – Omit from flight book

ENTRY CUE CARDS

<u>Title</u>	<u>Ref. Page</u>	<u>Card No.</u>
Deorbit Burn Flight		
Rules (Front)	CC 8-2	generic
(Back)	CC 8-3	generic
Deorbit Burn (RCS)		
(Front)	CC 8-4	generic
(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)	CC 8-17	generic
Entry NO-GO Checklist		
(Front)	CC 8-18	generic
ADTA Mgmt (Back)	CC 8-19	generic
Mach α		
(Front)	CC 8-20	generic
(Back)	CC 8-20	generic
Entry Control		
(Front)	CC 8-21	generic
(Back)	CC 8-22	generic
Deorbit Burn Monitor		
(Front)	FS CC 8-23	ENT-2a/109/A,O,D,E/A
OMS Failures (Back)	FS CC 8-24	ENT-2b/109/A,O,D,E/A

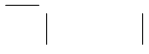


OMS/
RCS ΔV

OMS/RCS ΔV

FS 2-5

ENT/109/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	3420	253	210	7:20
40	3020	198	165	5:44
38	2940	187	156	5:24
36	2860	176	147	5:05
34	2780	165	137	4:46
32	2700	154	128	4:27
30	2620	143	119	4:08
28	2540	131	110	3:48
26	2460	120	101	3:29
24	2380	109	92	3:10
22	2300	98	82	2:51
20	2220	87	73	2:32
18	2140	76	64	2:12
16	2060	64	54	1:53
14	1980	53	45	1:33
12	1900	42	35	1:13
10	1820	31	26	0:54
8	1740	19	16	0:34
6	1660	8	7	0:14
5	1620	2	2	0:04

* He pressure not valid until 1 hr after last burn

ΔV CAPABILITY	
ARCS Δ V fps =	$0.8 \times [L\% + R\% - \text{AFT QTY } 1]$
FRCS Δ V fps =	$0.9 \times \text{FRCS } \%$
OMS Δ V fps =	$5.5 \times \text{OMS } \%$

NOTE: Uses assumed vehicle weight of 237,566 lb

DEORBIT BURN

DEORBIT
BURN

FS 3-1

ENT/109/FIN

**STS-109
LANDING SITE TABLE
(OPS 1/6/3)
(28.45° to 30.9° INCLINATION)**

**DEORBIT
BURN**

SITE	LOCATION	RWY	TACANS		MLS CH	LG
				ITEM 5		
1	KSC	KSC 15 KSC 33	TTS 59Y	OMN 73	8 6	15000 15000
2	BEN GUERIR	BEN 36 BEN 18	◆BEN 108	MAK 80 (DME)	◆6 -	13720 12720
3	MORON	MRN 20 MRN 02	MRN 100	AOG 23	◆6 -	11929 11729
4	DAKAR	OOY 36 OOY 18	◆BYD 121	YF 78 (DME)	- -	10647 10647
5	BANJUL	BYD 32 BYD 14	◆BYD 121	BJ 76 (DME)	◆6 -	12016 11816
6	BERMUDA	BDA 30 BDA 12	BDA 86 (DME)	BDA 86 (DME)	- -	8892 9212
7	AMILCAR CABRAL	AML 01 AML 19	CVS 100 (DME)	CVS 100 (DME)	- -	9728 9728
8	LAS PALMAS MONROVIA	GDV 03L LRB 04	TGN 103 -	- ROB 85 (DME)	- -	9827 10000
9	KINSHASA	KIN 24 KIN 06	BZ 78 (DME)	BZ 78 (DME)	- -	14422 11812
10	HOEDSPRUIT	AHS 18 AHS 36	HSV 87	HSV 87	- -	12256 12821
11	*BEN GUERIR TAMANRASSET	BEN 36 AAT 02	◆BEN 108 -	- TMS 72 (DME)	◆6 -	13720 10870
12	*BANJUL SOUDA	BYD 32 GSA 29	◆BYD 121 -	- RKL 20	◆6 -	12016 11786
13	*MORON ORLANDO	MRN 20 MCO 18R	MRN 100 -	- TTS 59Y	◆6 -	11929 11204

◆Available for TAL Only

FADS version 002

*Reduced Crossrange TAL Site

**STS-109
LANDING SITE TABLE
(OPS 1/6/3)
(28.45° to 30.9° INCLINATION)**

S I T E	LOCATION	RWY	TACANS		MLS CH	LG
				ITEM 5		
14	KING KHALID DIEGO GARCIA	KKI 15R JDG 31	RIY 92	-	-	13164
			-	NKW 57	-	12003
15	AMBERLEY TINDAL	AMB 15 PTN 14	AMB 94	-	-	9200
			-	TDL 70	-	9003
16	ANDERSEN HAO	GUA 06L HAO 12	UAM 54	-	-	10555
			-	HAO 85 (DME)	-	10089
17	HONOLULU	HNL 08R HNL 26L	HNL 95	CKH 86	-	11000
					-	11000
18	DYESS	DYS 16 DYS 34	ABI 84	MQP 124	-	13500
					-	13500
19	NASSAU	YNN 14 YNN 32	ZQA 74 (DME)	ZQA 74 (DME)	-	10293
					-	10230
20	NORTHROP	NOR 17 NOR 23	SNG 121Y	HMN 92	6	15000
					6	15000
21	NORTHROP	NOR 05 NOR 35	SNG 121Y	HMN 92	-	15000
					-	15000
22	EDWARDS	EDW 15 EDW 33	EDW 111	LHS 21	6	16300
					#	16300
23	EDWARDS	EDW 22 EDW 04	EDW 111	LHS 21	8/†	14995
					6	13995
24	EDWARDS	EDW 23L EDW 18L	EDW 111	LHS 21	#	15000
					#	15000
25	KSC	KSC 15 KSC 33	COF 97	LAL 107	8	15000
					6	15000

MSBLS Jr. Channel 6 - Requires Uplink FADS version O02
† MSBLS Jr. Channel 8 - Requires Uplink

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FS 3–4

ENT/109/FIN

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DEORBIT BURN MONITOR

OMS TEMP* FU IN P ≥ <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td style="width: 20px; text-align: center;">L</td><td style="width: 20px; text-align: center;">R</td></tr> <tr><td style="text-align: center;">225</td><td style="text-align: center;">221</td></tr> <tr><td style="text-align: center;">211</td><td style="text-align: center;">200</td></tr> </table> ≤ <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td style="width: 20px; text-align: center;">L</td><td style="width: 20px; text-align: center;">R</td></tr> <tr><td style="text-align: center;">211</td><td style="text-align: center;">200</td></tr> </table> or No FU IN P	L	R	225	221	211	200	L	R	211	200	OMS ENG FAIL OMS PRPLT FAIL
L	R										
225	221										
211	200										
L	R										
211	200										
OMS PC* & OMS ↓ (BFS: √accel) ENG VLV 1 or 2 < 70 or OX IN P > 227 OX IN P ≤ 227 or No OX IN P	OMS ENG FAIL OMS PRPLT FAIL										
OMS OX/FU TK P (√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 (twice) 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 (twice) If high RCS usage: OMS ENG FAIL √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 √MAN SHUTDN										
BCE STRG D 1(4)	I/O RESET (if recov: >>) If high RCS usage: L(R) OMS GMBL – SEC (twice)										
RM DLMA IMU or GPC SET SPLIT or 2 MN BUSES ABOVE SAFE HP ⇒ <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> BELOW SAFE HP ⇒			STOP BURN: OMS ENG(s) – OFF >> IMU DLMA: After C/O: √timer <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td style="width: 20px; text-align: center;">G21</td></tr> </table> If any IMU ACC > 0.03: aff IMU – desel I'cnct OMS to RCS (√RCS Burn Time) THC +X to TGT HP (EOM) or 3.5 x timer at C/O (AOA) SET SPLIT: Go to "GPC" above	G21							
G21											
I/O ERROR PCM	OI PCMMU PWR – 2(1)										

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

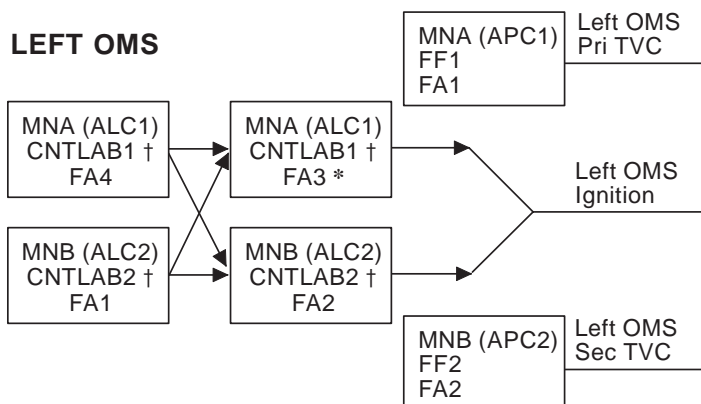
ENT–2a/109/A,O,D,E/A

MS ONLY

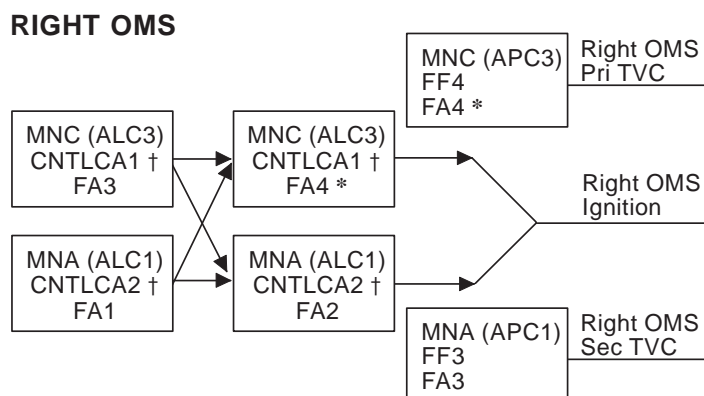
FS 3–29

ENT/109/FIN

OMS FAILURES



† 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) Pc 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/109/A,O,D,E/A

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

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

* **PREBANK TABLE EDW (HA = 319 NM)** *

Δ HP	0	3	(6)	RED	8	9	10	11	12
PREBANK	0	80	105	NOR	110	120	130	145	170
NOR NOT AVAIL.									



Δ HP	7	9	11	(13)	14	15
PREBANK	95	105	115	135	155	175
<u>G50</u> ITEM41 + <u>20</u> , \sqrt RWY 17 SET TACAN tw (three) 121Y						

* **PREBANK TABLE KSC (HA = 321 NM)** *

Δ HP	0	2	5	(7)	8	10	11	12	13
PREBANK	0	65	95	105	110	125	140	155	180
Set TACAN tw (three) 59Y									

Δ HP									
PREBANK									

POST BURN STATUS

NOMINAL

Δ TIG

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

If non-MEDS vehicle:

C F6 INST PWR – FLT/MPS
P F7 MPS PRESS He Sel – REG

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
		351
		355
	15	359
		3
		7
		11
		15
	10	19
		23
		27
		31
		35
	5	39

* If UNDERBURN or no *
* DEL PAD, manually *
* mnvr to LVLH R 001; *
* Y 358, P per table *

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

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MS ONLY

FS 4–7

ENT/109/FIN

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MS ONLY

FS 4–8

ENT/109/FIN

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ENTRY ALPHA

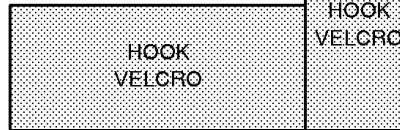
VR	α_{ref}	R	H	H _{ref}	R _{ref}
25	40	4296	400		
24	HI 40 LO	2762	247	-43	R85
23	43 40 37	2255	238	-59	74
22	43 40 37	1871	231	-77	67
21	43 40 37	1572	226	-98	L62
20	43 40 37	1339	218	-114	61
19	43 40 37	1153	211	-134	61
18	43 40 37	999	204	-156	61
17	43 40 37	874	197	-174	62
16	43 40 37	771	191	-184	63

KSC 15

MAX L/D	
M	α
3	17
2	15
1	12

(109 OCF CY)

ASC-14b/109/A,E/A



15	43 40 37	688	185	-198	64
14	43 40 37	615	179	-126	63
13	43 40 37	547	175	-136	61
12	43 40 37	484	171	-151	58
11	42 39 36	424	165	-196	56
10	41 38 35	374	161	-174	R50
9	39 36 33	325	156	-206	43
8	37 34 31	276	148	-239	39
7	33 30 27	230	139	-267	38
6	30 27 24	183	128	-273	39
5	26 23 20	142	115	-275	41
4	23 20 18	107	103	-263	L39
3	19 16 15	74	88	-248	35
2.5	14	61	81	-242	
2	13	50	74	-273	
1.5	10	39	65	-321	
1	8	27	50	-268	

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MS ONLY

FS 4–12

ENT/109/FIN

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1:	2:
3:	

POST LANDING PAYLOAD ACTIVITIES

(DTO 700-14 MAGR w/PGSC Option)

ASP MO13Q DC UTIL PWR MNB – OFF

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TOP

HOOK
VELCRO

**DEORBIT
BURN
MONITOR**

HOOK
VELCRO

OMS TEMP*	L R	
FU IN P \geq	225	221
	\leq	211 200
or No FU IN P		
		OMS ENG FAIL
		OMS PRPLT FAIL
OMS PC* & OMS \downarrow (BFS: \checkmark accel)		
ENG VLV 1 or 2 $<$ 70		OMS ENG FAIL
or OX IN P $>$ 227		
OX IN P \leq 227		OMS PRPLT FAIL
or No OX IN P		
OMS OX/FU TK P (\checkmark ENG IN P)		
OX/FU LOW		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
OX & FU HIGH		He PRESS/VAP ISOL (two) – CL
		Cycle He A(B) to maintain TK P 234–284
OMS GMBL	PRI fail	L(R) OMS GMBL – SEC (twice)
	SEC fail	If high RCS usage: OMS ENG FAIL
GPC	1(4) & Burning OMS aff	aff GPC PWR – OFF
		If SEC GMBL avail:
		aff MDM FF 1(4) – OFF, ON
		L(R) OMS GMBL – SEC (twice)
	SEC GMBL lost	If high RCS usage: OMS ENG FAIL
	2 FAs lost	\checkmark MAN SHUTDN
I/O ERROR FA	1(4)	L(R) OMS GMBL – SEC
		I/O RESET (if recov: BFS I/O RESET)
		If high RCS usage: OMS ENG FAIL
	2 FAs lost	\checkmark MAN SHUTDN
BCE STRG D	1(4)	I/O RESET (if recov: $>>$)
		If high RCS usage:
		L(R) OMS GMBL – SEC (twice)
RM DLMA IMU or GPC SET SPLIT or 2 MN BUSES	ABOVE SAFE HP \Rightarrow <input type="checkbox"/>	STOP BURN: OMS ENG(s) – OFF $>>$
	BELOW SAFE HP \Rightarrow	IMU DLMA: After C/O: \checkmark timer <input type="checkbox"/> G21 If any IMU ACC $>$ 0.03: aff IMU – desel I'ncnt OMS to RCS (\checkmark 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/109/A,O,D,E/A

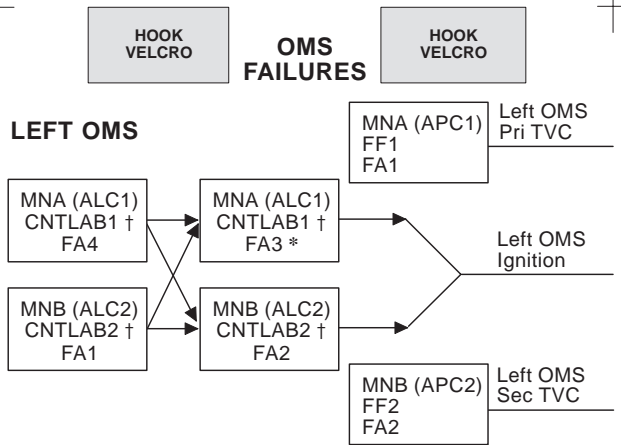
(reduced copy)

FAB USE ONLY

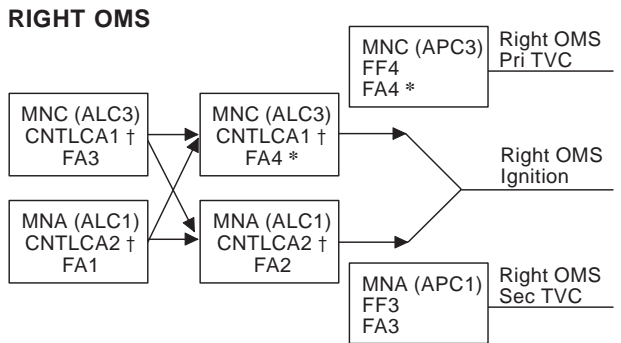
FS CC 8–23

ENT/109/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) Pc 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/109/A,O,D,E/A

(reduced copy)

FAB USE ONLY

FS CC 8-24

ENT/109/FIN

Space Shuttle Program
FLIGHT DATA FILE

JSC-48020-109
FINAL



ENTRY CHECKLIST

STS
109

Flight Cover (trim bottom to expose tabs)