

# Rendezvous

## STS-103

HST

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

**Final  
August 27, 1999**

National Aeronautics and  
Space Administration

**Lyndon B. Johnson Space Center**  
Houston, Texas



MISSION OPERATIONS DIRECTORATE

**RENDEZVOUS  
STS-103**

FINAL  
August 27, 1999

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## NOTE

This checklist is the controlling crew document for HST rendezvous and retrieval operations. The Rendezvous timeline begins at Ti-4.5 hours and continues through grapple.

Timeline pages assume rendezvous and grapple on FD3. Lighting is based on planned rendezvous altitude of 324 nmi. Targeting I-loads are based on 310 nmi.

## ACRONYMS

AZ, AZM	Azimuth
D/N	Day/Night
EL, ELEV	Elevation
IAH	Inertial Attitude Hold
INRTL	Inertial
LOS	Line of Sight
LVLH	Local Vertical, Local Horizontal
R	Range
$\dot{R}$ , RDOT	Range Rate
$\bar{R}$ , RBAR	Radius Vector (toward Earth)
RNDZ	Rendezvous
RR	Rendezvous Radar
SK	Stationkeep
ST, STRK	Star Tracker
$\bar{V}$ , VBAR	Velocity Vector (direction of orbital travel)
$\pm X, Y, ZLV$	$\pm X, Y, \text{ or } Z$ Local Vertical ( $\pm X, Y, \text{ or } Z$ toward Earth)
X, Y, ZPOP	X, Y, or Z orbiter body axis Perpendicular to Orbit Plane (aligned with the angular momentum vector)
$\pm X, Y, ZVV$	$\pm X, Y, \text{ or } Z$ orbiter body axis along the LVLH Velocity Vector

RENDEZVOUS  
STS-103 HST

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4-4 .....		103/FIN	5-9 .....	103/FIN
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4-9 .....		103/FIN	5-14 .....	103/FIN
4-10 .....		103/FIN	5-15 .....	103/FIN
4-11 .....		103/FIN	5-16 .....	103/FIN
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\* - Omit from flight book

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\* - Omit from flight book

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FLIGHT RULES SUMMARY

**FLIGHT RULES SUMMARY**

**RNDZ BREAKOUT PROCEDURES OVERVIEW**

TIME BREAKOUT REQD	BREAKOUT PROCEDURE
Prior to Ti	Discontinue RNDZ burns; specific breakout only on MCC call
Between Ti and stable at 500 ft on the +RBAR	3 fps retrograde see RNDZ BREAKOUT (CONTINGENCY OPERATIONS), 5-16
In PROX OPS: If between 500 ft and INERTIAL ALIGNMENT FLYAROUND	3 fps posigrade or retrograde (MCC call). See HST RBAR BREAKOUT (CONTINGENCY OPERATIONS), 5-13
----- If between INERTIAL ALIGNMENT FLYAROUND and 10 ft	1.7 fps -X burn, manual pitch, 2 fps out-of-plane, 3.5 fps posigrade or retrograde (MCC call). See HST FLYAROUND/LOSS OF LO Z BREAKOUT (CONTINGENCY OPERATIONS), 5-14
----- If inside 10 ft	Maintain LO Z backout to > 10 ft then 1.7 fps -X burn, manual pitch, 2 fps out-of-plane, 3.5 fps posigrade or retrograde (MCC call). See HST FLYAROUND/LOSS OF LO Z BREAKOUT (CONTINGENCY OPERATIONS), 5-14

**RNDZ BURN SOLUTION SELECTION GUIDELINES**

BURN	SOLUTION PRIORITY
All burns prior to, but not including, NCC	1) Ground solution
NCC & Ti	1) Onboard FLTR solution if STRK or RR NAV converged* (for COAS, use step 2 below) 2) Onboard FLTR solution if it agrees with ground solution** 3) Onboard PROP solution if it agrees with ground solution 4) Ground solution
Post-Ti midcourse corrections	1) Onboard solution

\*For the purpose of burn solution selection NAV is converged if, for the present sensor in acquisition (RR or STRK), at least 40 marks have been accepted with state vector position update of less than 0.5 Kft for at least the last 4 marks; or if state vector updates are small and stable. This criteria does not apply to COAS NAV

\*\*Burn solutions are considered to be in agreement if delta Vs differ by no more than the 'final-ground' limits for each axis

## RNDZ BURN ENGINE SELECTION GUIDELINES (Cont)

DELTA V	ENGINE
< 4 fps	RCS – Primary technique is multi-axis
4 to 6 fps	RCS – Primary technique is +X
> 6 fps	OMS – Single engine

### RNDZ FAILURE/RESPONSE SUMMARY

FAILURE	RESPONSE
No sensor data (RR, STRK, or COAS) during RNDZ, and no visual acquisition	Breakout by MC2 + 20 min
Good sensor data (RR, STRK, or COAS) during RNDZ, and no visual acquisition	Breakout by MC2 + 24 min
Target > 30 deg from COAS horizontal at start of radar fail correction	Breakout ASAP; use RNDZ BREAKOUT ( <u>CONTINGENCY OPERATIONS</u> ), 5–16, until RBAR arrival
Prop quantities violate bingo numbers on <u>RNDZ PRPLT PAD</u> Cue Card or Orbiter systems malfunctions require breakout	Breakout per overview on previous page
<b>SYSTEMS:</b> DPS: < 2 GNC GPCs	2 GNC GPCs reqd for Ti and PROX OPS within 250 ft. Loss of GNC GPC inside 250 ft requires backout to 250 ft and stationkeep until reconfiguration to a 2 GNC redundant set is complete
GNC: Loss of redundant + Z Trans or PRCS TRANS, any axis ↓ or PRCS ROT, any axis ↓ or AFT THC (–Z sense), > 1 TX contact ↓, all TY contacts ↓, all TZ contacts ↓ or AFT RHC, all channels, any axis ↓ or < 2 IMUs	PROX OPS within 250 ft not permitted
Degraded LO Z: (loss of 2 –X jets):	Approach attempt allowable
Loss of LO Z Braking:	Breakout per LOSS OF LOW Z BRAKING ( <u>CONTINGENCY OPERATIONS</u> ), 5–22
MECH: 1 KU ANTENNA STOW MOTOR ↓	Normal ops

## HST RENDEZVOUS GO/NO-GO SUMMARY

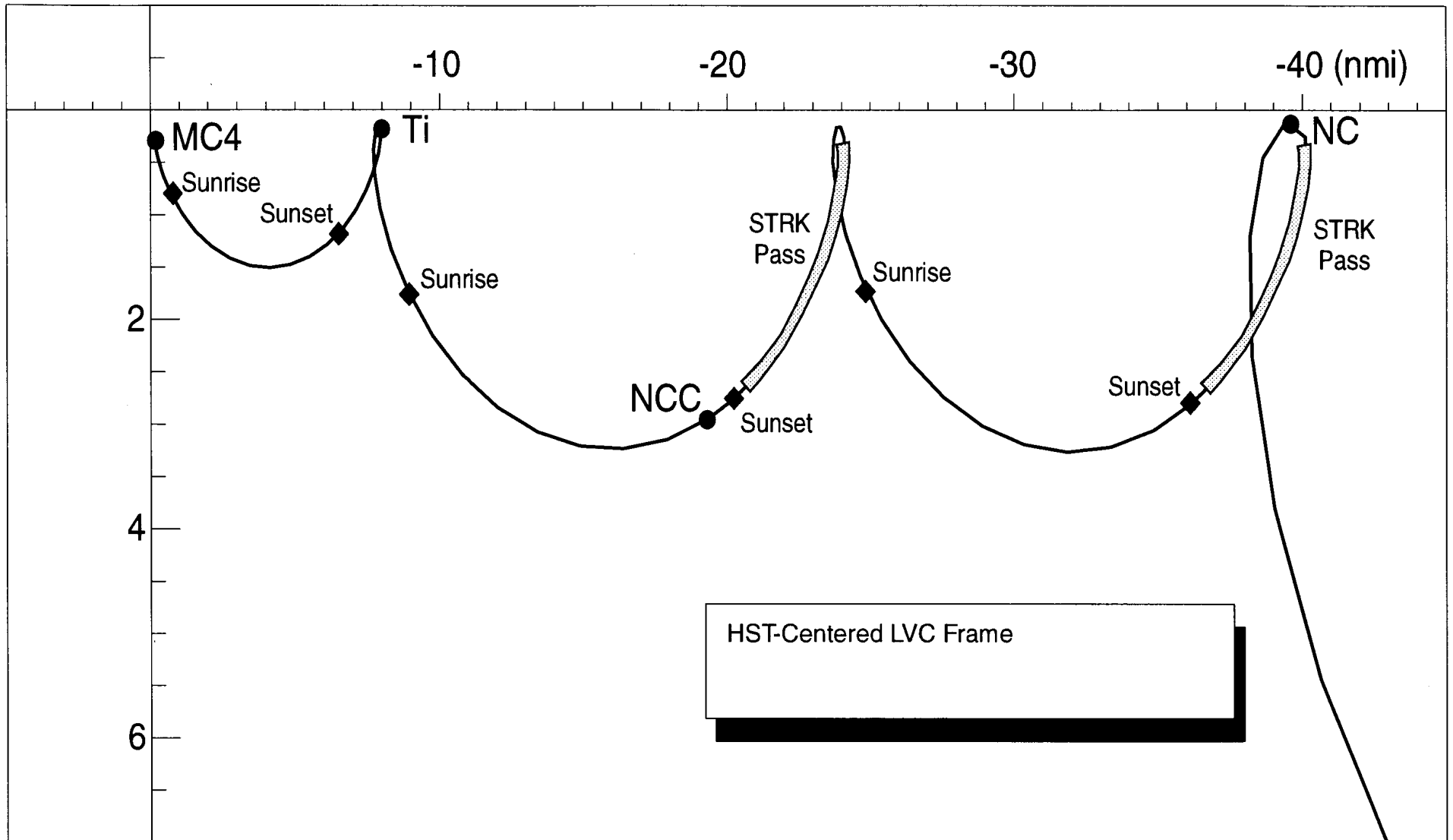
SYSTEM	FAILURE	NC FINAL	TI [12]	PROXOPS, R< 250 FT [14]
HST	AD NOT CLOSED SA NOT SLEWED TO 90 ± 3.5 COMM ↓ PCS NORMAL POINTING MODE ↓ NO 30 DEG PITCH BIAS BODY RATES > 0.1 DEG/SEC	GO [11] GO GO GO GO GO	GO [11] GO NO GO GO GO NO GO	GO [11] GO [12] GO GO GO GO
PROP RCS	VRCS PRCS ROT, ANY AXIS ↓ PRCS TRANS, X OR Y AXIS OR -Z PRCS TRANS, LOSS OF +Z REDUNDANCY PRCS TRANS, LOSS OF LO -Z +Z (BRAKING) [18] RCS LEAK FRCS ↓ LOW Z ATTITUDE CONTROL ↓	GO [1] GO [2] GO [2] GO [3] GO [13] GO [4] NO-GO GO [13]	GO [1] GO [2] GO [2] GO [3] GO [13] GO [4] NO-GO GO [13]	GO [1] NO-GO NO-GO NO-GO GO [10] NO-GO [6] NO-GO NO-GO
PROP OMS	1 OME ↓ (2 DEORBIT SYS REMAINING) 2 OME ↓ 1 HE TK LEAK/FAIL PROP TK LEAK/FAIL	NO-GO [5] NO-GO NO-GO NO-GO	NO-GO [5] NO-GO NO-GO NO-GO	NO-GO [5] NO-GO NO-GO NO-GO
GNC IMUs AFT THC CONTACTS FWD AND AFT THC CONTACTS AFT RHC CHANNELS STAR TRACKER RNDZ RADAR COAS/HUD	2 ↓ 3 ± X ↓ OR 3 ± Y ↓ OR 2 -Z ↓ 2 -Z FWD AND 2-Z AFT ↓ 4 + Z ↓ 3 ↓ ANY AXIS 2 ↓ 1 ↓ 1 ↓	NO-GO GO [2] GO [3] GO GO [3] GO GO GO	NO-GO GO [2] GO [3] GO GO [3] GO GO GO	NO-GO NO-GO NO-GO NO-GO [9] NO-GO GO GO (IF VIS) GO
PDRS	RMS ↓ MCIU ↓ EE ↓	NO-GO GO NO-GO	NO-GO NO-GO [15] NO-GO	NO-GO GO [16] NO-GO
DPS 1 OF 3 GNC GPCs 1 OF 2 GNC GPCs SM GPC ANY GPCs MDM (FF, FA, PL)	1 ↓ 1 ↓ 1 ↓ 2 ↓ (OR RS SPLIT) 1 ↓	GO [7] GO GO [8] NO-GO GO	GO [7] NO-GO GO [8] NO-GO GO	GO [7] NO-GO [17] GO [8] NO-GO GO

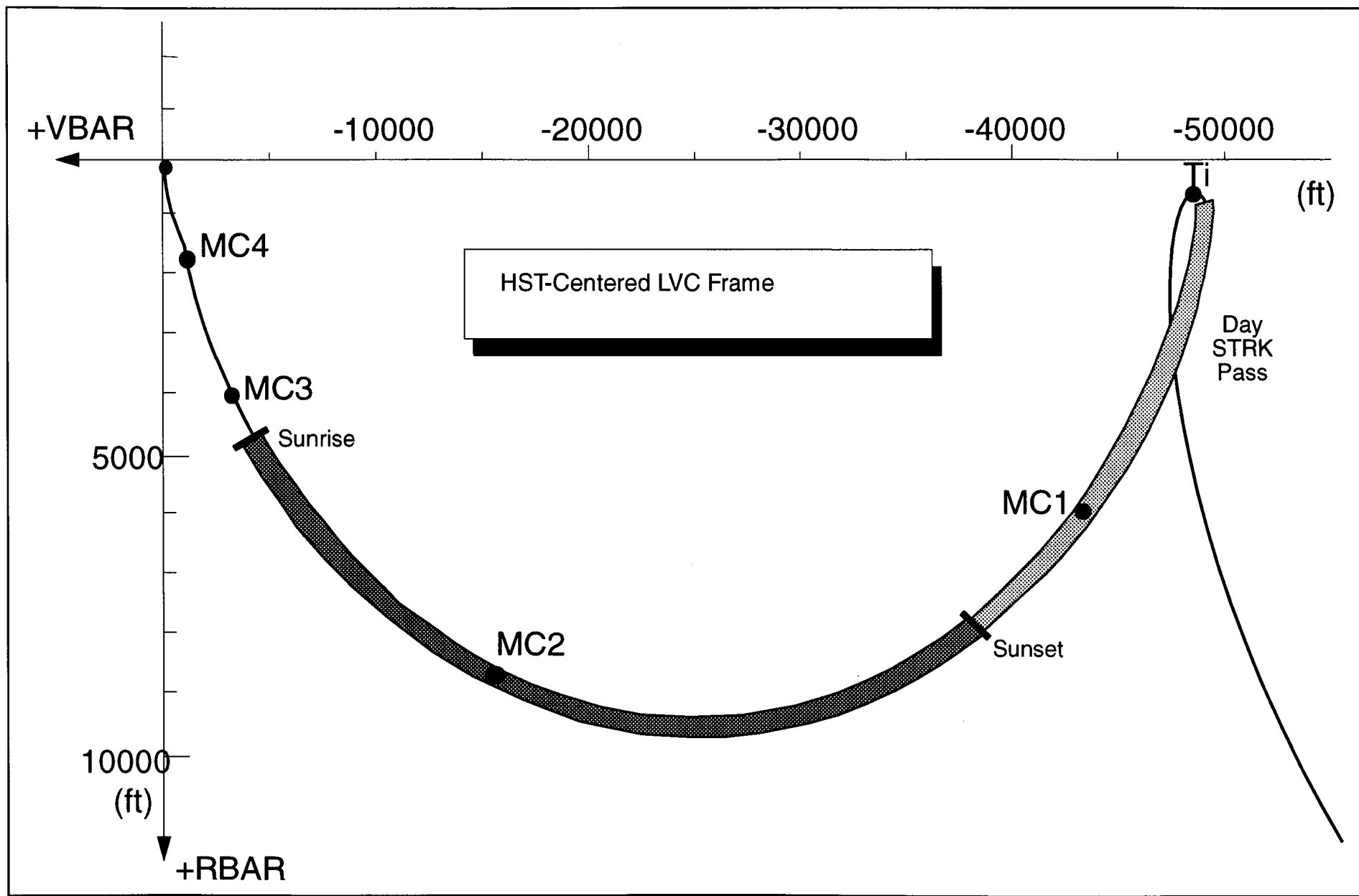
**NOTES:**

- [1] NOSE-TAIL CONTROL REQD AFTER NCC
- [2] IF RECOVERABLE PRIOR TO 250 FT
- [3] INCLUDES STRINGING. IF REDUNDANCY RECOVERABLE PRIOR TO 250 FT
- [4] IF LEAK CAN BE ISOLATED
- [5] GO IF RCS STEEP DEORBIT AVAILABLE
- [6] BACK OUT TO 120 FT. GO IF LEAK CAN BE ISOLATED
- [7] WHEN POSSIBLE, RESTRING TO REMAINING 2 GNC GPCs
- [8] WHEN POSSIBLE, GIVE UP 1 OF 3 GNC GPCs AND FORM A NEW SM GPC
- [9] GO IF EACH THC HAS ONE CONTACT REMAINING
- [10] NO NORM Z BRAKING WITHIN 1500 FT. APPROACH MAY CONTINUE TO 120 FT FOR TROUBLESHOOTING IF ATTITUDE CONTROL AND -X TRANSLATION IS AVAILABLE IN LO Z. BREAKOUT IF FAILURE OCCURS WITHIN 150 FT
- [11] INERTIAL APPROACH REQD
- [12] IF TI IS NO-GO AND THERE IS A POSSIBILITY OF RECOVERING THE FAILURE, PERFORM TI DELALY
- [13] GO IF RECOVERABLE PRIOR TO 1500 FT
- [14] IF RANGE <250 FT, PERFORM BACKOUT TO 250 FT
- [15] PERFORM TI DELAY AND MCIU IFM IF PROP MARGINS SUPPORT. ELSE CONTINUE WITH BEST EFFORT USING SINGLE JOINT CAPTURE
- [16] CONTINUE RETRIEVAL OPS USING SINGLE JOINT UNTIL CAPTURE
- [17] IF IN PROX OPS, BACK OUT TO 250 FT, GO WHEN RECONFIGURED TO 2 GNC GPCs
- [18] LOSS OF LO Z BRAKING IS DEFINED AS FAILURE OF BOTH AFT FIRING JETS FROM THE SAME POD, OR LOSS OF ALL THREE FORWARD FIRING JETS ((A2.1.3-18} RNDZ/PROX OPS GNC SYSTEMS MANAGEMENT). LOSS OF TWO FORWARD FIRING JETS RESULTS IN DEGRADED LOW Z BRAKING. DEGRADED LOW Z IS CONSIDERED ACCEPTABLE WITH INCREASED RISK OF REQUIRING SOME NORM Z BRAKING IN CLOSE. IF A SUBSEQUENT FAILURE COULD RESULT IN LOSS OF THE REMAINING FORWARD FIRING JET AND LOSS OF +Z NORM Z TRANSLATIONAL CAPABILITY, THE APPROACH MUST BE DISCONTINUED SINCE REDUNDANT +Z TRANSLATION IS REQUIRED (REF RULE {X2.1.6-1.D}, RENDEZVOUS REQUIREMENTS)

FLIGHT PROFILE

# FLIGHT PROFILE

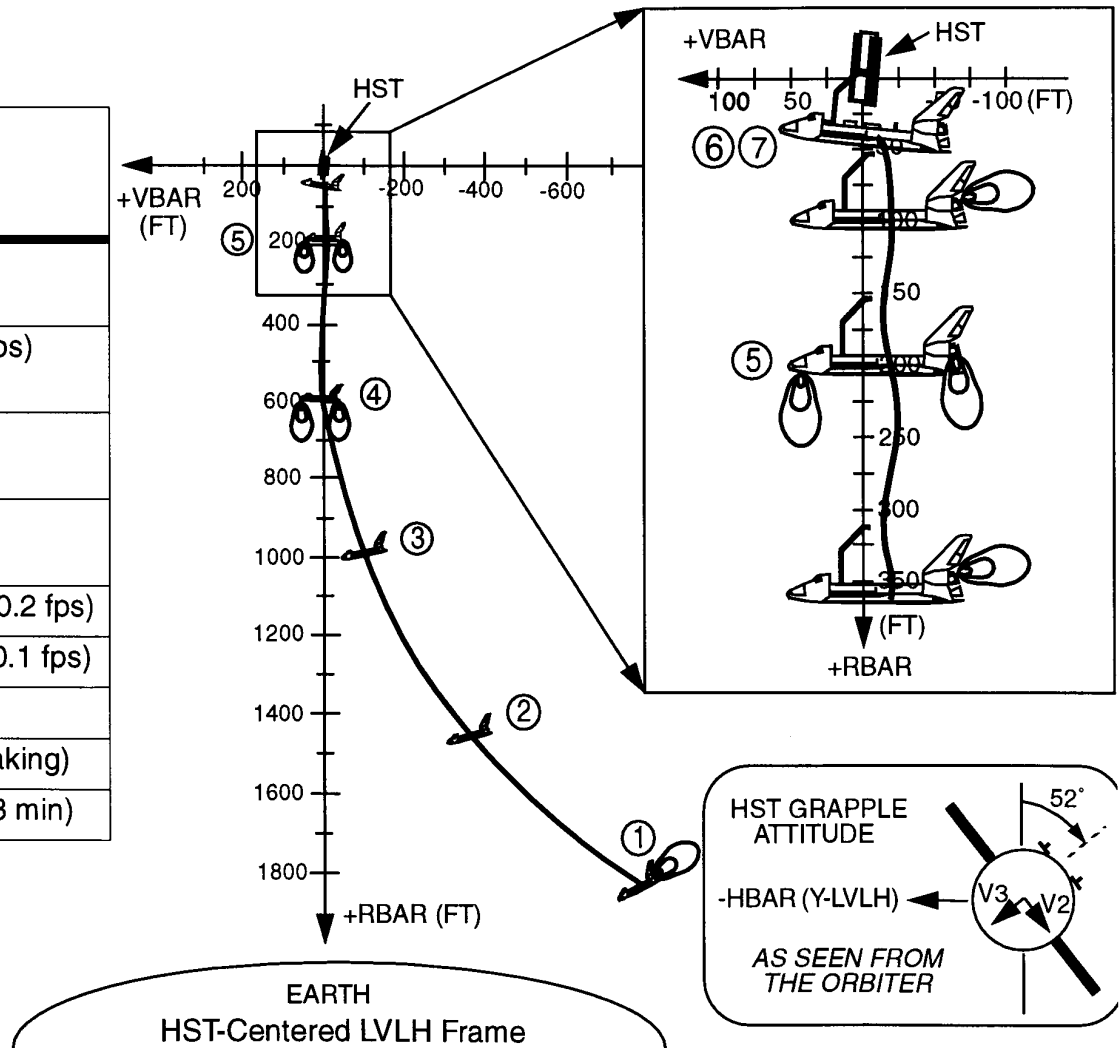






# MANUAL PHASE RBAR APPROACH AND INERTIAL GRAPPLE

	APPROX. PET (min)	EVENT
1	0	MANUAL PHASE TAKEOVER AT MC4 (Rdot = -3.0 fps)
2	3	1500 FT BRAKING GATE (Rdot = -2.3 fps) <b>SWITCH TO LOWZ</b>
3	8	1000 FT LOWZ BRAKING GATE (Rdot = -1.5 fps)
4	13	600 FT GATE (Rdot = -0.8 fps) Allow Rdot to drop to -R/1000
5	31	200 FT GATE (Maintain Rdot = -0.2 fps)
	38	120 FT GATE (Let Rdot drop to -0.1 fps)
6	50	<b>INRTL</b> When Aligned
	50	35 FT Grapple Position (Final LOWZ Braking)
7	52	Stabilize and Grapple (Sunset+3 min)



DEPLOY

See HST Deploy for detailed procedures.

MANEUVER PADS

**MINVR PADS**

# MNVR PADS

## PRELIMINARY ORBITAL MANEUVER PAD FOR NC

OMS BOTH 1

L 2

R 3

RCS SEL 4

+X

-X

MULTI-AXIS

TV ROLL 5

TRIM LOAD

P 6

LY 7

RY 8

WT 9

TIG 10

TGT PEG 7

$\Delta V_X$  19

$\Delta V_Y$  20

$\Delta V_Z$  21

BURN ATT

R 24

P 25

Y 26

$\Delta V_{TOT}$

TGO

VGO X

VGO Y

VGO Z

HA

HP

TGT

NOTES

OMS GMBL CK:

	PRE	POST-BURN
L PRI	<input type="text"/>	<input type="text"/>
L SEC	<input type="text"/>	<input type="text"/>
R PRI	<input type="text"/>	<input type="text"/>
R SEC	<input type="text"/>	<input type="text"/>

RCS I'CNCT:

L OMS → RCS

R OMS → RCS

NONE

DOWN MODE OPTIONS:

2 OMS → 1 OMS → RCS

2 OMS → 1 OMS

1 OMS → RCS

NONE

OMS HE REG TEST:  
L,R OMS HE P/VAP ISOL

	GPC	OP	CL
A	<input type="text"/>	<input type="text"/>	<input type="text"/>
B	<input type="text"/>	<input type="text"/>	<input type="text"/>

-X RCS BURNS:

	BURN ATT	LVLH ATT
P 15	<input type="text"/>	R <input type="text"/>
Y 16	<input type="text"/>	P <input type="text"/>
OM 17	<input type="text"/>	Y <input type="text"/>

### FINAL ORBITAL MANEUVER PAD FOR NC

OMS BOTH	1		<table style="border-collapse: collapse;"> <tr> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="padding-left: 5px;">+X</td> </tr> <tr> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="padding-left: 5px;">-X</td> </tr> <tr> <td style="border: 1px solid black; width: 20px; height: 20px;"></td> <td style="padding-left: 5px;">MULTI-AXIS</td> </tr> </table>		+X		-X		MULTI-AXIS
	+X								
	-X								
	MULTI-AXIS								
L	2								
R	3								
RCS SEL	4								

TV ROLL	5			
---------	---	--	--	--

**TRIM LOAD**

P	6					
LY	7					
RY	8					

WT	9								
----	---	--	--	--	--	--	--	--	--

TIG	10																		
-----	----	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**TGT PEG 7**

$\Delta V_X$	19						
$\Delta V_Y$	20						
$\Delta V_Z$	21						

**BURN ATT**

R	24			
P	25			
Y	26			

$\Delta V_{TOT}$							
TGO							

VGO	X							
VGO	Y							
VGO	Z							

HA                      HP

TGT									
-----	--	--	--	--	--	--	--	--	--

NOTES

**OMS GMBL CK:**

	PRE	POST-BURN
L PRI		
L SEC		
R PRI		
R SEC		

**RCS I'CNCT:**

	L OMS → RCS
	R OMS → RCS
	NONE

**DOWN MODE OPTIONS:**

	2 OMS → 1 OMS → RCS
	2 OMS → 1 OMS
	1 OMS → RCS
	NONE

**OMS HE REG TEST:  
L,R OMS HE P/VAP ISOL**

	GPC	OP	CL
A			
B			

**-X RCS BURNS:**

	BURN ATT	LVLH ATT
P 15		
Y 16		
OM 17		

## PRELIMINARY ORBITAL MANEUVER PAD FOR NH

OMS BOTH	1	<input style="width: 100%;" type="text"/>	
L	2	<input style="width: 100%;" type="text"/>	
R	3	<input style="width: 100%;" type="text"/>	
RCS SEL	4	<input style="width: 100%;" type="text"/>	
TV ROLL	5	<input style="width: 100%;" type="text"/>	
<b>TRIM LOAD</b>			
P	6	<input style="width: 100%;" type="text"/>	
LY	7	<input style="width: 100%;" type="text"/>	
RY	8	<input style="width: 100%;" type="text"/>	
WT	9	<input style="width: 100%;" type="text"/>	
TIG	10	<input style="width: 100%;" type="text"/>	
<b>TGT PEG 7</b>			
$\Delta V_X$	19	<input style="width: 100%;" type="text"/>	
$\Delta V_Y$	20	<input style="width: 100%;" type="text"/>	
$\Delta V_Z$	21	<input style="width: 100%;" type="text"/>	

<b>BURN ATT</b>	
R	24 <input style="width: 100%;" type="text"/>
P	25 <input style="width: 100%;" type="text"/>
Y	26 <input style="width: 100%;" type="text"/>

$\Delta V_{TOT}$	<input style="width: 100%;" type="text"/>
TGO	<input style="width: 100%;" type="text"/>
VGO X	<input style="width: 100%;" type="text"/>
VGO Y	<input style="width: 100%;" type="text"/>
VGO Z	<input style="width: 100%;" type="text"/>
HA	<input style="width: 100%;" type="text"/>
HP	<input style="width: 100%;" type="text"/>
TGT	<input style="width: 100%;" type="text"/>

NOTES																															
<p><b>OMS GMBL CK:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">PRE</td> <td style="text-align: center;">POST-BURN</td> </tr> <tr> <td>L PRI</td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> </tr> <tr> <td>L SEC</td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> </tr> <tr> <td>R PRI</td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> </tr> <tr> <td>R SEC</td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> </tr> </table>		PRE	POST-BURN	L PRI	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	L SEC	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	R PRI	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	R SEC	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<p><b>RCS I'CNCT:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td><input style="width: 100%;" type="text"/></td> <td>L OMS → RCS</td> </tr> <tr> <td><input style="width: 100%;" type="text"/></td> <td>R OMS → RCS</td> </tr> <tr> <td><input style="width: 100%;" type="text"/></td> <td>NONE</td> </tr> </table>	<input style="width: 100%;" type="text"/>	L OMS → RCS	<input style="width: 100%;" type="text"/>	R OMS → RCS	<input style="width: 100%;" type="text"/>	NONE	<p><b>DOWN MODE OPTIONS:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td><input style="width: 100%;" type="text"/></td> <td>2 OMS → 1 OMS → RCS</td> </tr> <tr> <td><input style="width: 100%;" type="text"/></td> <td>2 OMS → 1 OMS</td> </tr> <tr> <td><input style="width: 100%;" type="text"/></td> <td>1 OMS → RCS</td> </tr> <tr> <td><input style="width: 100%;" type="text"/></td> <td>NONE</td> </tr> </table>	<input style="width: 100%;" type="text"/>	2 OMS → 1 OMS → RCS	<input style="width: 100%;" type="text"/>	2 OMS → 1 OMS	<input style="width: 100%;" type="text"/>	1 OMS → RCS	<input style="width: 100%;" type="text"/>	NONE
	PRE	POST-BURN																													
L PRI	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>																													
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<input style="width: 100%;" type="text"/>	R OMS → RCS																														
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<p><b>OMS HE REG TEST:</b> L,R OMS HE P/VAP ISOL</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">GPC</td> <td style="text-align: center;">OP</td> <td style="text-align: center;">CL</td> </tr> <tr> <td>A</td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> </tr> <tr> <td>B</td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> <td><input style="width: 100%;" type="text"/></td> </tr> </table>		GPC	OP	CL	A	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	B	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<p><b>-X RCS BURNS:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">BURN ATT</td> <td style="text-align: center;">LVLH ATT</td> </tr> <tr> <td>P</td> <td>15 <input style="width: 100%;" type="text"/></td> <td>R <input style="width: 100%;" type="text"/></td> </tr> <tr> <td>Y</td> <td>16 <input style="width: 100%;" type="text"/></td> <td>P <input style="width: 100%;" type="text"/></td> </tr> <tr> <td>OM</td> <td>17 <input style="width: 100%;" type="text"/></td> <td>Y <input style="width: 100%;" type="text"/></td> </tr> </table>		BURN ATT	LVLH ATT	P	15 <input style="width: 100%;" type="text"/>	R <input style="width: 100%;" type="text"/>	Y	16 <input style="width: 100%;" type="text"/>	P <input style="width: 100%;" type="text"/>	OM	17 <input style="width: 100%;" type="text"/>	Y <input style="width: 100%;" type="text"/>						
	GPC	OP	CL																												
A	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>																												
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P	15 <input style="width: 100%;" type="text"/>	R <input style="width: 100%;" type="text"/>																													
Y	16 <input style="width: 100%;" type="text"/>	P <input style="width: 100%;" type="text"/>																													
OM	17 <input style="width: 100%;" type="text"/>	Y <input style="width: 100%;" type="text"/>																													

FINAL ORBITAL MANEUVER PAD FOR NH

OMS BOTH 1

L 2

R 3

RCS SEL 4

<input type="text"/>	+X
<input type="text"/>	-X
<input type="text"/>	MULTI-AXIS

TV ROLL 5

TRIM LOAD

P 6 

( )		.	
( )		.	
( )		.	

LY 7

RY 8

WT 9

TIG 10  /  :  :  .

TGT PEG 7

$\Delta V_X$  19 

( )		.	
( )		.	
( )		.	

$\Delta V_Y$  20

$\Delta V_Z$  21

BURN ATT

R 24 

<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

P 25

Y 26

$\Delta V_{TOT}$ 

<input type="text"/>	<input type="text"/>	<input type="text"/>	.	<input type="text"/>
<input type="text"/>	<input type="text"/>	:	<input type="text"/>	<input type="text"/>

TGO 

<input type="text"/>	<input type="text"/>	:	<input type="text"/>	<input type="text"/>
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VGO X 

( )		.	
( )		.	
( )		.	

VGO Y

VGO Z

HA

HP

TGT 

<input type="text"/>	<input type="text"/>	( )	<input type="text"/>	<input type="text"/>
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NOTES

OMS GMBL CK:

	PRE	POST-BURN
L PRI	<input type="text"/>	<input type="text"/>
L SEC	<input type="text"/>	<input type="text"/>
R PRI	<input type="text"/>	<input type="text"/>
R SEC	<input type="text"/>	<input type="text"/>

RCS I'CNCT:

<input type="text"/>	L OMS $\rightarrow$ RCS
<input type="text"/>	R OMS $\rightarrow$ RCS
<input type="text"/>	NONE

DOWN MODE OPTIONS:

<input type="text"/>	2 OMS $\rightarrow$ 1 OMS $\rightarrow$ RCS
<input type="text"/>	2 OMS $\rightarrow$ 1 OMS
<input type="text"/>	1 OMS $\rightarrow$ RCS
<input type="text"/>	NONE

OMS HE REG TEST:  
L,R OMS HE P/VAP ISOL

	GPC	OP	CL
A	<input type="text"/>	<input type="text"/>	<input type="text"/>
B	<input type="text"/>	<input type="text"/>	<input type="text"/>

-X RCS BURNS:

	BURN ATT	LVLH ATT						
P 15	<table border="1"><tr><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr></table>	<input type="text"/>	<input type="text"/>	<input type="text"/>	R <table border="1"><tr><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr></table>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>						
<input type="text"/>	<input type="text"/>	<input type="text"/>						
Y 16	<table border="1"><tr><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr></table>	<input type="text"/>	<input type="text"/>	<input type="text"/>	P <table border="1"><tr><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr></table>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>						
<input type="text"/>	<input type="text"/>	<input type="text"/>						
OM 17	<table border="1"><tr><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr></table>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Y <table border="1"><tr><td><input type="text"/></td><td><input type="text"/></td><td><input type="text"/></td></tr></table>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>						
<input type="text"/>	<input type="text"/>	<input type="text"/>						



## PRELIMINARY ORBITAL MANEUVER PAD FOR Ti

OMS BOTH	1	<input type="text"/>		
L	2	<input type="text"/>		
R	3	<input type="text"/>		
RCS SEL	4	<input type="text"/>	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; border-bottom: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> <div style="border-left: 1px solid black; border-right: 1px solid black; border-bottom: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> <div style="border-left: 1px solid black; border-right: 1px solid black; border-bottom: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="margin-left: 10px;">             +X -X MULTI-AXIS           </div>	
TV ROLL	5	<input type="text"/>		
TRIM LOAD				
P	6	<input type="text"/>	<input type="text"/>	<input type="text"/>
LY	7	<input type="text"/>	<input type="text"/>	<input type="text"/>
RY	8	<input type="text"/>	<input type="text"/>	<input type="text"/>
WT	9	<input type="text"/>	<input type="text"/>	<input type="text"/>
TIG	10	<input type="text"/>	<input type="text"/>	<input type="text"/>
TGT PEG 7		<input type="text"/>	<input type="text"/>	<input type="text"/>
$\Delta V_X$	19	<input type="text"/>	<input type="text"/>	<input type="text"/>
$\Delta V_Y$	20	<input type="text"/>	<input type="text"/>	<input type="text"/>
$\Delta V_Z$	21	<input type="text"/>	<input type="text"/>	<input type="text"/>

BURN ATT		<input type="text"/>	<input type="text"/>	<input type="text"/>
R	24	<input type="text"/>	<input type="text"/>	<input type="text"/>
P	25	<input type="text"/>	<input type="text"/>	<input type="text"/>
Y	26	<input type="text"/>	<input type="text"/>	<input type="text"/>

$\Delta V_{TOT}$	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
TGO	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

VGO	X	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
VGO	Y	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
VGO	Z	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

	HA	<input type="text"/>	HP	<input type="text"/>
TGT	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

NOTES																															
<p>OMS GMBL CK:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">PRE</td> <td style="text-align: center;">POST-BURN</td> </tr> <tr> <td>L PRI</td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>L SEC</td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>R PRI</td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>R SEC</td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> </table>		PRE	POST-BURN	L PRI	<input type="text"/>	<input type="text"/>	L SEC	<input type="text"/>	<input type="text"/>	R PRI	<input type="text"/>	<input type="text"/>	R SEC	<input type="text"/>	<input type="text"/>	<p>RCS I'CNCT:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td><input type="text"/></td> <td>L OMS → RCS</td> </tr> <tr> <td><input type="text"/></td> <td>R OMS → RCS</td> </tr> <tr> <td><input type="text"/></td> <td>NONE</td> </tr> </table>	<input type="text"/>	L OMS → RCS	<input type="text"/>	R OMS → RCS	<input type="text"/>	NONE	<p>DOWN MODE OPTIONS:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td><input type="text"/></td> <td>2 OMS → 1 OMS → RCS</td> </tr> <tr> <td><input type="text"/></td> <td>2 OMS → 1 OMS</td> </tr> <tr> <td><input type="text"/></td> <td>1 OMS → RCS</td> </tr> <tr> <td><input type="text"/></td> <td>NONE</td> </tr> </table>	<input type="text"/>	2 OMS → 1 OMS → RCS	<input type="text"/>	2 OMS → 1 OMS	<input type="text"/>	1 OMS → RCS	<input type="text"/>	NONE
	PRE	POST-BURN																													
L PRI	<input type="text"/>	<input type="text"/>																													
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	GPC	OP	CL																												
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	BURN ATT	LVLH ATT																													
P 15	<input type="text"/>	R <input type="text"/>																													
Y 16	<input type="text"/>	P <input type="text"/>																													
OM 17	<input type="text"/>	Y <input type="text"/>																													

# FINAL ORBITAL MANEUVER PAD FOR Ti

OMS BOTH	1	<input style="width: 20px; height: 20px;" type="text"/>		
L	2	<input style="width: 20px; height: 20px;" type="text"/>		
R	3	<input style="width: 20px; height: 20px;" type="text"/>		
RCS SEL	4	<input style="width: 20px; height: 20px;" type="text"/>		

+X
-X
MULTI-AXIS

TV ROLL	5	<input style="width: 30px; height: 20px;" type="text"/>
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TRIM LOAD		
P	6	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
LY	7	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
RY	8	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>

WT	9	<input style="width: 20px; height: 20px;" type="text"/>
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TIG	10	<input style="width: 20px; height: 20px;" type="text"/> / <input style="width: 20px; height: 20px;" type="text"/> : <input style="width: 20px; height: 20px;" type="text"/> : <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
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TGT PEG 7		
ΔVX	19	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
ΔVY	20	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
ΔVZ	21	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>

BURN ATT		
R	24	<input style="width: 20px; height: 20px;" type="text"/>
P	25	<input style="width: 20px; height: 20px;" type="text"/>
Y	26	<input style="width: 20px; height: 20px;" type="text"/>

ΔVTOT		<input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
TGO		<input style="width: 20px; height: 20px;" type="text"/> : <input style="width: 20px; height: 20px;" type="text"/>

VGO	X	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
VGO	Y	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>
VGO	Z	<input style="width: 20px; height: 20px;" type="text"/> ( ) <input style="width: 20px; height: 20px;" type="text"/> . <input style="width: 20px; height: 20px;" type="text"/>

TGT		<input style="width: 20px; height: 20px;" type="text"/> HA <input style="width: 20px; height: 20px;" type="text"/> HP <input style="width: 20px; height: 20px;" type="text"/>
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NOTES																															
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### Ti DELAY PAD

OMS BOTH	1	<input type="text"/>
L	2	<input type="text"/>
R	3	<input type="text"/>
RCS SEL	4	<input type="text"/>

+X

-X

MULTI-AXIS

TV ROLL	5	<input type="text"/>	<input type="text"/>	<input type="text"/>
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TRIM LOAD

P	6	( )	<input type="text"/>	.	<input type="text"/>
LY	7	( )	<input type="text"/>	.	<input type="text"/>
RY	8	( )	<input type="text"/>	.	<input type="text"/>

WT	9	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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TIG	10	<input type="text"/>	<input type="text"/>	/	<input type="text"/>	<input type="text"/>	:	<input type="text"/>	<input type="text"/>	:	<input type="text"/>	.	<input type="text"/>
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TGT PEG 7

$\Delta V X$	19	( )	<input type="text"/>	<input type="text"/>	.	<input type="text"/>
$\Delta V Y$	20	( )	<input type="text"/>	<input type="text"/>	.	<input type="text"/>
$\Delta V Z$	21	( )	<input type="text"/>	<input type="text"/>	.	<input type="text"/>

OMS BOTH	1	<input type="text"/>
L	2	<input type="text"/>
R	3	<input type="text"/>
RCS SEL	4	<input type="text"/>

+X

-X

MULTI-AXIS

TV ROLL	5	<input type="text"/>	<input type="text"/>	<input type="text"/>
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TRIM LOAD

P	6	( )	<input type="text"/>	.	<input type="text"/>
LY	7	( )	<input type="text"/>	.	<input type="text"/>
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----	---	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

TIG	10	<input type="text"/>	<input type="text"/>	/	<input type="text"/>	<input type="text"/>	:	<input type="text"/>	<input type="text"/>	:	<input type="text"/>	.	<input type="text"/>
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$\Delta V Z$	21	( )	<input type="text"/>	<input type="text"/>	.	<input type="text"/>

# ORBITAL MANEUVER PAD FOR \_\_\_\_\_

OMS BOTH 1

L 2

R 3

RCS SEL 4

+X

-X

MULTI-AXIS

BURN ATT

R 24

P 25

Y 26

$\Delta$ VTOT

TGO

VGO X

VGO Y

VGO Z

TV ROLL 5

**TRIM LOAD**

P 6

LY 7

RY 8

WT 9

TIG 10

**TGT PEG 7**

$\Delta$ VX 19

$\Delta$ VY 20

$\Delta$ VZ 21

HA

HP

TGT

**NOTES**

**OMS GMBL CK:**

	PRE	POST-BURN
L PRI	<input type="text"/>	<input type="text"/>
L SEC	<input type="text"/>	<input type="text"/>
R PRI	<input type="text"/>	<input type="text"/>
R SEC	<input type="text"/>	<input type="text"/>

**RCS I'CNCT:**

L OMS → RCS

R OMS → RCS

NONE

**DOWN MODE OPTIONS:**

2 OMS → 1 OMS → RCS

2 OMS → 1 OMS

1 OMS → RCS

NONE

**OMS HE REG TEST:**  
L,R OMS HE P/VAP ISOL

	GPC	OP	CL
A	<input type="text"/>	<input type="text"/>	<input type="text"/>
B	<input type="text"/>	<input type="text"/>	<input type="text"/>

**-X RCS BURNS:**

	BURN ATT	LVLH ATT
P 15	<input type="text"/>	R <input type="text"/>
Y 16	<input type="text"/>	P <input type="text"/>
OM 17	<input type="text"/>	Y <input type="text"/>

# ORBITAL MANEUVER PAD FOR \_\_\_\_\_

OMS BOTH 1

L 2

R 3

RCS SEL 4

+X

-X

MULTI-AXIS

BURN ATT

R 24

P 25

Y 26

$\Delta$ VTOT

TGO

VGO X

VGO Y

VGO Z

TV ROLL 5

**TRIM LOAD**

P 6

LY 7

RY 8

WT 9

TIG 10

**TGT PEG 7**

$\Delta$ VX 19

$\Delta$ VY 20

$\Delta$ VZ 21

HA

HP

TGT

**NOTES**

**OMS GMBL CK:**

	PRE	POST-BURN
L PRI	<input type="text"/>	<input type="text"/>
L SEC	<input type="text"/>	<input type="text"/>
R PRI	<input type="text"/>	<input type="text"/>
R SEC	<input type="text"/>	<input type="text"/>

**RCS I'CNCT:**

L OMS → RCS

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2 OMS → 1 OMS → RCS

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NONE

**OMS HE REG TEST:**  
L,R OMS HE P/VAP ISOL

	GPC	OP	CL
A	<input type="text"/>	<input type="text"/>	<input type="text"/>
B	<input type="text"/>	<input type="text"/>	<input type="text"/>

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	BURN ATT	LVLH ATT
P 15	<input type="text"/>	R <input type="text"/>
Y 16	<input type="text"/>	P <input type="text"/>
OM 17	<input type="text"/>	Y <input type="text"/>

# ORBITAL MANEUVER PAD FOR \_\_\_\_\_

OMS BOTH 1

L 2

R 3

RCS SEL 4

+X

-X

MULTI-AXIS

TV ROLL 5

**TRIM LOAD**

P 6  ( )   .

LY 7  ( )   .

RY 8  ( )   .

WT 9

TIG 10   /   :   :   .

**TGT PEG 7**

$\Delta V_X$  19  ( )    .

$\Delta V_Y$  20  ( )    .

$\Delta V_Z$  21  ( )    .

BURN ATT

R 24

P 25

Y 26

$\Delta V_{TOT}$     .

TGO   :

VGO X  ( )    .

VGO Y  ( )    .

VGO Z  ( )    .

HA HP

TGT    ( )

NOTES

**OMS GMBL CK:**

	PRE	POST-BURN
L PRI	<input type="text"/>	<input type="text"/>
L SEC	<input type="text"/>	<input type="text"/>
R PRI	<input type="text"/>	<input type="text"/>
R SEC	<input type="text"/>	<input type="text"/>

**RCS I'CNCT:**

L OMS → RCS

R OMS → RCS

NONE

**DOWN MODE OPTIONS:**

2 OMS → 1 OMS → RCS

2 OMS → 1 OMS

1 OMS → RCS

NONE

**OMS HE REG TEST:**  
L,R OMS HE P/VAP ISOL

	GPC	OP	CL
A	<input type="text"/>	<input type="text"/>	<input type="text"/>
B	<input type="text"/>	<input type="text"/>	<input type="text"/>

**-X RCS BURNS:**

	BURN ATT	LVLH ATT
P 15	<input type="text"/> <input type="text"/> <input type="text"/>	R <input type="text"/> <input type="text"/> <input type="text"/>
Y 16	<input type="text"/> <input type="text"/> <input type="text"/>	P <input type="text"/> <input type="text"/> <input type="text"/>
OM 17	<input type="text"/> <input type="text"/> <input type="text"/>	Y <input type="text"/> <input type="text"/> <input type="text"/>

# ORBITAL MANEUVER PAD FOR \_\_\_\_\_

OMS BOTH 1

L 2

R 3

RCS SEL 4

+X

-X

MULTI-AXIS

TV ROLL 5

**TRIM LOAD**

P 6  ( )   .

LY 7  ( )   .

RY 8  ( )   .

WT 9

TIG 10   /   :   :   .

**TGT PEG 7**

$\Delta V_X$  19  ( )    .

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$\Delta V_Z$  21  ( )    .

BURN ATT

R 24

P 25

Y 26

$\Delta V_{TOT}$     .

TGO   :

VGO X  ( )    .

VGO Y  ( )    .

VGO Z  ( )    .

HA HP

TGT    ( )

NOTES

**OMS GMBL CK:**

	PRE	POST-BURN
L PRI	<input type="text"/>	<input type="text"/>
L SEC	<input type="text"/>	<input type="text"/>
R PRI	<input type="text"/>	<input type="text"/>
R SEC	<input type="text"/>	<input type="text"/>

**RCS I'CNCT:**

L OMS → RCS

R OMS → RCS

NONE

**DOWN MODE OPTIONS:**

2 OMS → 1 OMS → RCS

2 OMS → 1 OMS

1 OMS → RCS

NONE

**OMS HE REG TEST:**  
L,R OMS HE P/VAP ISOL

	GPC	OP	CL
A	<input type="text"/>	<input type="text"/>	<input type="text"/>
B	<input type="text"/>	<input type="text"/>	<input type="text"/>

**-X RCS BURNS:**

	BURN ATT	LVLH ATT
P 15	<input type="text"/> <input type="text"/> <input type="text"/>	R <input type="text"/> <input type="text"/> <input type="text"/>
Y 16	<input type="text"/> <input type="text"/> <input type="text"/>	P <input type="text"/> <input type="text"/> <input type="text"/>
OM 17	<input type="text"/> <input type="text"/> <input type="text"/>	Y <input type="text"/> <input type="text"/> <input type="text"/>

RENDEZVOUS TIMELINE

RENDEZVOUS  
TIMELINE



AFT FLT STATION CONFIG FOR RNDZ [2A]

O14,16:E √cb MNA,C DDU AFT (two) - cl

A6U ADI ATT - LVLH  
ERR - MED  
RATE - LO  
SENSE - minus Z

R13 √KU ANT - GND  
A1U √PWR - ON  
sel - MAN SLEW  
MODE - RDR PASSIVE  
RADAR OUTPUT - HI  
CNTL - PNL  
SIG STRENGTH sel - KU  
SLEW RATE - as reqd

A2 DIGI-DIS sel - R/RDOT  
X-PNTR SCALE - X1

[SM\_ANTENNA]  
CRT SELF TEST - ITEM 7 EXEC (\*)

NOTE  
SELF TEST runs about 3 min

A1U √KU SCAN WARN tb - gray  
√TRACK tb - gray  
√SEARCH tb - gray

A2 √RANGE - 888.8  
DIGI-DIS sel - EL/AZ

CRT SELF TEST - ITEM 7 EXEC (no \*)

A1U KU MODE - COMM  
sel - GPC  
CNTL - CMD

Install:  
-Z COAS  
RCS BURN Cue Card  
KU OPS Cue Card

MET: 01:17:51

PET

-04:30 MS AFT FLT STATION CONFIG FOR RNDZ [2A]  
 A1(B6) PLT RNDZ OPS INITIALIZATION [3A]  
 A7(B7)  
 PLT ENABLE RENDEZVOUS NAV [3B]

MCC UPLINK  
TGT SV  
ORB SV

-04:25

MCC UPDATE  
Final NH burn PAD, 3-5

-04:20

CDR If -X RCS, Perform PERFORM -X RCS NH BURN [3C]  
If +X RCS, Perform RCS BURN, steps 1 thru 5 (Cue Card)  
IF OMS, Perform RNDZ OMS BURN, steps 1 thru 4 (CONTINGENCY OPERATIONS) 5-3

-04:15

-04:10

← TIG - 3 min

-04:05

← [\_NH\_TIG]  
Post burn, DAP: A/LVLH/VERN(ALT)

-04:00

RNDZ OPS INITIALIZATION [3A]

√DPS Config for Rndz Ops - String 1233  
 [SM\_2\_TIME]  
 Set SM TIMER counting to Ti TIG per Burn Pad, 3-6  
 Config DAP A,B to A7,B7  
 Record nominal TIGs in burn solution blocks per Execute Package:  
 NCC TIG pg (4-15)  
 MC1 TIG pg (4-21)  
 MC2 TIG pg (4-22)  
 [GNC\_55\_GPS\_STATUS]  
 √INH GPS to G&C, ITEM 33 - (\*)  
 NAV, ITEM 36 - (\*)

ENABLE RENDEZVOUS NAV [3B]

CRT 1. [GNC\_33\_REL\_NAV]  
 RNDZ NAV ENA - ITEM 1 EXEC (\*)  
 √SV SEL, ITEM 4 - PROP  
 √INH RNG, ITEM 18 - (\*)  
 RDOT, ITEM 21 - (\*)  
 Angles, ITEM 24 - (\*)  
 √S TRK, ITEM 12 - (\*)  
 2. [GNC\_34\_ORBIT\_TGT]  
 TGT NO - ITEM 1 +1 EXEC  
 Set BASE TIME to Ti TIG, (Ti Burn Pad, 3-6)  
 LOAD - ITEM 26 EXEC

PERFORM -X RCS NH BURN [3C]

[GNC\_UNIV\_PTG]  
 CRT TGT ID +2  
 BODY VECT +5  

	Per PAD	Ref Values for NH
P	—	+100
Y	—	+0
OM	—	+0

C3 TRK - ITEM 19 EXEC (CUR - \*)  
 DAP: A/AUTO/ALT (B/ALT as reqd)  
 When in burn attitude,  
 Perform RCS BURN, steps 1 thru 5 (Cue Card)

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MET: 01:18:21

PET

-04:00

A7(B7)

-03:55

MS PGSC SETUP (RENDEZVOUS TOOLS), 7-2  
PCDECOM OPERATIONS (ORBIT OPS, PCDECOM OPERATIONS)  
RPOP INITIALIZATION (RENDEZVOUS TOOLS), 7-7  
HHL CHECKOUT (2) (RENDEZVOUS TOOLS), 7-5  
RPOP OPERATIONS (RENDEZVOUS TOOLS), 7-8

-03:50

-03:45

MS Perform PI CONFIG (PL OPS, RETRIEVAL OPS)

-03:40

-03:35

CDR LOAD TARGET TRACK [5A]

-03:30

MCC UPDATE  
Final NC burn PAD, 3-3

LOAD TARGET TRACK [5A]

√DAP: A/LVLH/VERN(ALT)  
[GNC\_UNIV\_PTG]  
CRT CNCL - ITEM 21 EXEC  
TGT ID +1

	<u>-Z AXIS</u>	<u>-Y STRK</u>
BODY VECT	+3 (-Z)	+4
P	√+90	√+0
Y	√+0	√+280.57
OM	+0	+90

Do not INITIATE TARGET TRACK [7B] until post NC

STAR TRACKER NAV [6A]

1. CONFIG FOR STRK NAV

√DAP: A/AUTO/VERN(ALT)

Turn down cabin lights to optimize target viewing through -Z COAS/overhead window

IMU for Deselect \_\_\_\_ (If no comm, use IMU 1 for deselect)

[GNC\_21\_\_IMU\_ALIGN]

CRT IMU DES - ITEM 7(8,9) EXEC (\*)

√MCC for NAV selected IMU \_\_\_\_

[GNC\_33\_\_REL\_NAV]

If first NAV pass,

| √SV SEL, ITEM 4 - PROP

If previous NAV,

√SV SEL, ITEM 4 - FLTR

√INH Angles, ITEM 24 - (\*)

√S TRK, ITEM 12 - (\*)

[GNC\_22\_\_S\_TRK/COAS\_CNTL]

-Z (-Y) TGT TRK - ITEM 6(5) EXEC (\*)

√STATUS - blank

√SHUTTER - op

2. INITIAL MEASUREMENT EVALUATION

[GNC\_22\_\_S\_TRK/COAS\_CNTL]

When S PRES - (\*), continue

[GNC\_33\_\_REL\_NAV]

Monitor RESID V and H each NAV cycle for at least  
four consecutive cycles (~30 sec)

Record init RESID V = \_\_\_\_\_

H = \_\_\_\_\_

If RESID V or H changes by > 0.05 each cycle:

| [GNC\_22\_\_S\_TRK/COAS\_CNTL]

| -Z(-Y) BREAK TRK - ITEM 8(7) EXEC

| Repeat Step 2

If RESID V or H > 0.6:

[GNC\_22\_\_S\_TRK/COAS\_CNTL]

-Z(-Y) BREAK TRK - ITEM 8(7) EXEC

When S PRES - (\*), if RESID V or H still > 0.6 and stable:

Perform S TRK NAV - HIGH INITIAL RESID (CONTINGENCY OPS), 5-8

3. INCORPORATE DATA INTO NAV

If SV SEL = PROP:

AUTO Angles - ITEM 23 EXEC (\*)

Record 1st SV UPDATE POS = \_\_\_\_\_

When SV UPDATE POS < 1.0 and Angle ACPT > 9:

SV SEL - ITEM 4 EXEC (FLTR) >>

If SV = FLTR:

FLTR TO PROP - ITEM 8 EXEC

AUTO Angles - ITEM 23 EXEC (\*)

Record 1st SV UPDATE POS = \_\_\_\_\_

\* If FLTR MINUS PROP changes by more than 8 kft within a S TRK pass: \*

\* Perform S TRK NAV - HIGH FLTR MINUS PROP (CONTINGENCY OPS), 5-9 \*

MET: 01:18:51

PET

-03:30

A7(B7)

CDR If -X RCS, Perform PERFORM -X RCS NC BURN [7A]  
If +X RCS, Perform RCS BURN (Cue Card)  
IF OMS, Perform RNDZ OMS BURN (CONTINGENCY OPERATIONS) 5-3

-03:25

MCC UPDATE  
STRK NAV  
IMU DES \_\_\_ [6A]

-03:20

← TIG - 3 min

-03:15

← [\_NC\_TIG]

CDR INITIATE TARGET TRACK [7B]

-03:10

PLT STAR TRACKER NAV [6A]

MCC UPDATE  
Nav Selected  
IMU \_\_\_

-03:05

-03:00

PERFORM -X RCS NC BURN [7A]

[GNC\_UNIV\_PTG]  
CRT TGT ID +2  
BODY VECT +5  
Per PAD Ref Values for NC  
P \_\_\_ +100  
Y \_\_\_ +0  
OM \_\_\_ +0

C3 TRK - ITEM 19 EXEC (CUR - \*)  
DAP: A/AUTO/ALT (B/ALT as reqd)

When in burn attitude,  
Perform RCS BURN, steps 1 thru 5 (Cue Card)

[GNC\_UNIV\_PTG]  
CRT TGT ID +1  
-Z AXIS -Y STRK  
BODY VECT +3 (-Z) +4  
P √+90 √+0  
Y √+0 √+280.57  
OM +0 +90

INITIATE TARGET TRACK [7B]

[GNC\_UNIV\_PTG]  
TRK - ITEM 19 EXEC (CUR - \*)  
DAP: B/AUTO/ALT  
When MNVR cmpit,  
DAP: A/AUTO/VERN(ALT)

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-03:00

A7(B7)

-02:55

-02:50

-02:45

PLT END S TRK NAV [9A]

-02:40

CDR If NH reqd.  
Perform RCS BURN (Cue Card)  
If OMS, perform RNDZ OMS BURN (CONTINGENCY OPERATIONS), 5-3

-02:35

-02:30

END S TRK NAV [9A]

[GNC\_33\_\_REL\_NAV]  
CRT INH Angles - ITEM 24 EXEC (\*)  
  
[GNC\_21\_\_IMU\_ALIGN]  
IMU DES - ITEM 7(8,9) EXEC (no \*)

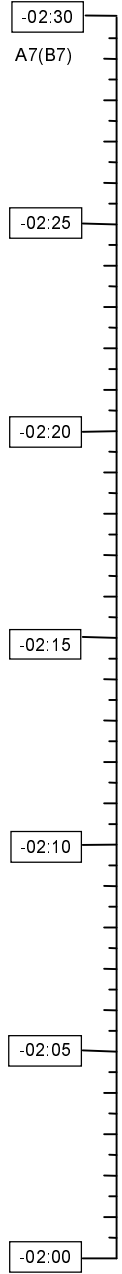
If reqd.  
MCC UPDATE  
Final NH burn PAD, 3-5



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A7(B7)

-02:25



IF REQD,  
[NH\_TIG]

-02:20

-02:15

-02:10

-02:05

-02:00

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-02:00

A7(B7)

When:  
[GNC\_33\_REL\_NAV]  
NAV RNG < 150 KFT,  
PLT KU OPS, step 1 (cue card)

-01:55

NOTE  
If next S TRK uses -Y S TRK, delay  
until after -Z AXIS TARGET TRACK [17A], 4-17

MCC UPDATE  
 $\beta$  only 0°

-01:50

-01:45

CDR TARGET NCC BURN [13A] (Preliminary solution)

-01:40

MCC UPDATE  
STAR TRACKER NAV  
IMU DES \_\_\_ [14A]

-01:35

PLT STAR TRACKER NAV [14A]

-01:30

TARGET NCC BURN [13A] (preliminary solution)

CRT  $\sqrt$ SV SEL correct  
[GNC\_34\_\_ORBIT\_TGT]  
TGT NO - ITEM 1+9 EXEC  
 $\sqrt$ TGT Set data:  
T1 TIG = NCC BURN SOLUTION TIG  
EL +0  
 $\Delta$ T +60.1  
 $\Delta$ X -48.6  
 $\Delta$ Y +0.0  
 $\Delta$ Z +1.2  
COMPUTE T1 - ITEM 28 EXEC  
Record solution in PAD

START TRACKER NAV [14A]

1. CONFIG FOR STRK NAV

√DAP: A/AUTO/VERN(ALT)

Turn down cabin lights to optimize target viewing through -Z COAS/overhead window

IMU for Deselect \_\_\_\_\_ (If no comm, use IMU 1 for deselect)

[GNC\_21\_\_IMU\_ALIGN]

CRT IMU DES - ITEM 7(8,9) EXEC (\*)

√MCC for NAV selected IMU \_\_\_\_\_

[GNC\_33\_\_REL\_NAV]

If first NAV pass,

| √SV SEL, ITEM 4 - PROP

If previous NAV,

| √SV SEL, ITEM 4 - FLTR

√INH Angles, ITEM 24 - (\*)

√S TRK, ITEM 12 - (\*)

[GNC\_22\_\_S\_TRK/COAS\_CNTL]

-Z (-Y) TGT TRK - ITEM 6(5) EXEC (\*)

√STATUS - blank

√SHUTTER - op

2. INITIAL MEASUREMENT EVALUATION

[GNC\_22\_\_S\_TRK/COAS\_CNTL]

When S PRES - (\*), continue

[GNC\_33\_\_REL\_NAV]

Monitor RESID V and H each NAV cycle for at least  
four consecutive cycles (~30 sec)

Record init RESID V = \_\_\_\_\_

H = \_\_\_\_\_

If RESID V or H changes by > 0.05 each cycle:

| [GNC\_22\_\_S\_TRK/COAS\_CNTL]

| -Z(-Y) BREAK TRK - ITEM 8(7) EXEC

| Repeat Step 2

If RESID V or H > 0.6:

[GNC\_22\_\_S\_TRK/COAS\_CNTL]

-Z(-Y) BREAK TRK - ITEM 8(7) EXEC

When S PRES - (\*), if RESID V or H still > 0.6 and stable:

Perform S TRK NAV - HIGH INITIAL RESID (CONTINGENCY OPS), 5-8

3. INCORPORATE DATA INTO NAV

If SV SEL = PROP:

AUTO Angles - ITEM 23 EXEC (\*)

Record 1st SV UPDATE POS = \_\_\_\_\_

When SV UPDATE POS < 1.0 and Angle ACPT > 9:

SV SEL - ITEM 4 EXEC (FLTR) >>

If SV = FLTR:

FLTR TO PROP - ITEM 8 EXEC

AUTO Angles - ITEM 23 EXEC (\*)

Record 1st SV UPDATE POS = \_\_\_\_\_

\* If FLTR MINUS PROP changes by more than 8 kft within a S TRK pass: \*

\* Perform S TRK NAV - HIGH FLTR MINUS PROP (CONTINGENCY OPS), 5-9 \*

END S TRK NAV [14B]

[GNC\_33\_\_REL\_NAV]

CRT INH Angles - ITEM 24 EXEC (\*)

[GNC\_21\_\_IMU\_ALIGN]

IMU DES - ITEM 7(8,9) EXEC (no \*)

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PET

-01:30

-01:25

-01:20

-01:15

-01:10

-01:05

-01:00

CDR

When NAV converged, (SV UPDATES small and stable)  
TARGET NCC BURN [15A] (Intermediate)

√MCC for burn type. If no comm:  
If  $\Delta VT > 6$ , at TIG -5:00 perform RNDZ OMS BURN (CONTINGENCY OPERATIONS) 5-3  
If  $4 \leq \Delta VT \leq 6$ , at TIG -5:00 perform +X RCS burn, RCS BURN (Cue Card)  
If  $\Delta VT < 4$ , at TIG -5:00 perform multi-axis RCS burn, RCS BURN (Cue Card)

← TIG - 15:00

MS A8L PORT RMS HTR (two) - AUTO  
L17 Check MCIU filter screen

PLT END S TRK NAV [14B]

← TIG -05:00  
CDR TARGET NCC BURN [15A] (Final solution)  
Perform RCS BURN (Cue Card)

← [NCC\_TIG]

MCC UPDATE  
Ground NCC  
Burn Solution

TARGET NCC BURN [15A]

**FINAL SOLUTION**

OPS 202 PRO  
[GNC\_ORBIT\_MNVR\_EXEC]  
√Eng Sel CORRECT

CRT

√SV SEL correct  
[GNC\_34\_\_ORBIT\_TGT]  
TGT NO - ITEM 1+9 EXEC  
√TGT Set data:  
T1 TIG = NCC BURN SOLUTION TIG  
EL +0  
 $\Delta T$  +60.1  
 $\Delta X$  -48.6  
 $\Delta Y$  +0.0  
 $\Delta Z$  +1.2  
COMPUTE T1 - ITEM 28 EXEC  
Record solution in PAD

**FINAL SOLUTION**

If > 40 marks in current sensor pass and  
SV UPDATE POS < 0.5 for the last 4 marks:  
| Burn FLTR soln  
If FLTR within ground solution limits:  
| Burn FLTR soln  
If PROP within ground solution limits:  
| Burn PROP soln  
If none of the above:  
Burn ground soln EXT  $\Delta V$ s

**NCC BURN SOLUTION**

TIG [ ] [ ] [ ] / [ ] [ ] : [ ] [ ] : [ ] [ ]

**PRELIMINARY**

$\Delta VX$	( )			.	
$\Delta VY$	( )			.	
$\Delta VZ$	( )			.	
$\Delta VT$				.	

**INTERMEDIATE**

$\Delta VX$	( )			.	
$\Delta VY$	( )			.	
$\Delta VZ$	( )			.	
$\Delta VT$				.	

**FINAL**

$\Delta VX$	( )			.	
$\Delta VY$	( )			.	
$\Delta VZ$	( )			.	
$\Delta VT$				.	

**GROUND**

$\Delta VX$	( )			.	
$\Delta VY$	( )			.	
$\Delta VZ$	( )			.	
$\Delta VT$				.	

**FINAL - GROUND LIMITS**  
(1.2)  
(4.1)  
(4.5)

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PET

-01:00  
A7(B7)

**IF Y S TRK TRACK**  
-Z AXIS TARGET TRACK [17A]

MCC UPDATE  
RNDZ PRPLT Pad

CDR TARGET Ti BURN [17B] (Preliminary)

-00:55

When:  
[GNC\_33\_REL\_NAV]  
RR RNG < 135 KFT,  
PLT RR NAVIGATION [17C]

-00:50

-00:45

When NAV converged (SV UPDATES small and stable):  
CDR TARGET Ti BURN [17B] (Intermediate)

√MCC for burn type. If no comm:  
If  $\Delta VT > 6$ , at TIG -17:00 perform RNDZ OMS BURN (CONTINGENCY OPERATIONS) 5-3  
If  $4 \leq \Delta VT \leq 6$ , at TIG -17:00 perform +X RCS burn, RCS BURN (Cue Card)  
If  $\Delta VT < 4$ , at TIG -5:00 perform multi-axis RCS burn, RCS BURN (Cue Card)

-00:40

MS RMS PWRUP ( PDRS OPS, RMS PWRUP)

-00:35

-00:30

-Z AXIS TARGET TRACK [17A]

[GNC\_UNIV\_PTG]  
CRT √TGT ID +1  
BODY VECT +3 (-Z)  
OM +0  
C3 DAP: B/AUTO/ALT  
CRT TRK - ITEM 19 EXEC (CUR - \*)

When MNVR cmlpt,  
DAP: A/AUTO/VERN(ALT)

TARGET Ti BURN [17B]

CRT √SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 +1\_0 EXEC  
√TGT Set data:  
T1 TIG = BASE TIME  
EL +0  
 $\Delta T$  +80.1  
 $\Delta X$  -0.9  
 $\Delta Y$  +0  
 $\Delta Z$  +1.8  
COMPUTE T1 - ITEM 28 EXEC  
Note solution in PAD

RR NAVIGATION [17C]

[GNC\_33\_REL\_NAV]  
CRT RR - ITEM 13 EXEC (\*)  
√Elev, Az approx 0

Record Initial RESID RANGE = \_\_\_\_\_  
RDOT = \_\_\_\_\_

**IF RESID RANGE > 5.0 or  
RDOT > 3.0**

SV SEL - ITEM 4 EXEC (PROP)  
Proceed with taking data and contact MCC  
as soon as practical

FLTR TO PROP - ITEM 8 EXEC  
AUTO RNG - ITEM 17 EXEC (\*)  
RDOT - ITEM 20 EXEC (\*)  
Angles - ITEM 23 EXEC (\*)

Record 1st SV UPDATE POS = \_\_\_\_\_

**IF SV SEL = PROP**

When SV UPDATE POS < 0.3 and MARK ACPT > 9:  
SV SEL - ITEM 4 EXEC (FLTR)



PREL FLTR

( )			.	
( )			.	
( )			.	
			.	

INTER FLTR

( )			.	
( )			.	
( )			.	
			.	

FINAL FLTR

( )			.	
( )			.	
( )			.	
			.	

GND

( )			.	
( )			.	
( )			.	
			.	

PROP  
(If Reqd)

( )			.	
( )			.	
( )			.	
			.	

FINAL - GROUND  
LIMITS

$\Delta V_X$  (1.1)  
 $\Delta V_Y$  (2.6)  
 $\Delta V_Z$  (1.2)

FINAL Ti Burn Pad, 3-7

MET: 01:21:51

PET

-00:30

-00:25

-00:20

-00:15

-00:10

-00:05

00:00

If no lock-on by:  
[GNC\_33\_REL\_NAV]  
NAV RNG = 60 KFT  
PLT KU OPS, step 2 (Cue Card)

**If RNDZ DELAY**  
CDR Perform Ti DELAY (CONTINGENCY OPERATIONS), 5-17

← TIG - 17:00 (If multi-axis, delay final targeting until TIG - 05:00)  
CDR TARGET Ti BURN [19A] (Final)

CDR If Ti is +X RCS burn:  
Perform RCS BURN (Cue Card)  
If Ti is OMS BURN:  
Perform RNDZ OMS BURN (CONTINGENCY OPERATIONS), 5-3

← TIG - 5:00  
CDR If Ti is multi-axis burn:  
Perform RCS BURN (Cue Card)

**If HST Door Open, go to**  
CDR CONTINGENCY INERTIAL APPROACH TIMELINE, 4-33

← [Ti\_TIG]

MCC UPDATE  
Ti Final Ground Soln, 3-7  
Ti DELAY BURN PAD, 3-8

MCC UPDATE  
Go for Ti

TARGET Ti BURN [19A] (Final)

CRT OPS 202 PRO  
[GNC\_ORBIT\_MNVR\_EXEC]  
Load Eng Sel, TVR, WT and Trims for Ti per Final Ti Burn Pad  
LOAD - ITEM 22 EXEC  
[GNC\_33\_REL\_NAV]  
√SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 +1 0 EXEC  
√TGT Set data:  
T1 TIG = BASE TIME  
EL +0  
ΔT +80.1  
ΔX -0.9  
ΔY +0  
ΔZ +1.8  
COMPUTE T1 - ITEM 28 EXEC

Record solution in PAD

**FINAL SOLUTION**

If > 40 marks in current sensor pass and  
SV UPDATE POS < 0.5 for the last 4 marks:  
| Burn FLTR soln  
If FLTR within ground solution limits:  
| Burn FLTR soln  
If PROP within ground solution limits:  
| Burn PROP soln  
If none of the above:  
Burn ground soln EXT ΔVs

TARGET MC 1 [20A]

CRT   √SV SEL correct  
      [GNC\_34\_\_ORBIT\_TGT]  
      TGT NO - ITEM 1 +1 1 EXEC  
      √TGT Set data:  
          T1 TIG = MC1 BURN SOLUTION TIG  
          EL       +0  
          ΔT       +60.1  
          ΔX       -0.9  
          ΔY       +0  
          ΔZ       +1.8  
      COMPUTE T1 - ITEM 28 EXEC  
      Note solution in PAD

POST T1 NAV [20B]

A6U   √DAP: A/AUTO/VERN(ALT)  
A1U   √KU sel - GPC

[GNC\_33\_REL\_NAV]  
IF SV SEL = FLTR:  
    FLTR TO PROP - ITEM 8 EXEC (\*)  
    √AUTO Angles - ITEM 23 EXEC (\*)  
If RR NOT Tracking TGT:  
  √Inhibit Data  
    Perform KU OPS, steps 2 and 3 (Cue Card)  
    If still no RR ACQ, assume RR Fail

CRT   [GNC\_22\_\_S\_TRK/COAS\_CNTL]  
      √Z TGT TRK - ITEM 6 EXEC (\*)  
      -Z THOLD - ITEM 14 +3 EXEC

**IF RR FAIL**

If -Z Star Tracker:  
  | √-Z TGT TRK ATT, then:  
  |   Perform STAR TRACKER NAV [14A]  
If COAS NAV:  
  | √-Z TGT TRK ATT, then:  
  |   Perform COAS NAVIGATION (CONTINGENCY OPS), 5-10  
If -Y Star Tracker:  
  [GNC\_22\_\_S\_TRK/COAS\_CNTL]  
  √-Y THOLD - ITEM 13 +0 EXEC  
  [GNC\_UNIV\_PTG]  
  TGT ID    +1  
  BODY VECT +4  
  P         √+0  
  Y         √+280.57  
  OM        +90  
  DAP: B/AUTO/ALT  
  TRK - ITEM 19 EXEC  
  When MNVR cmlpt:  
    DAP: A/AUTO/VERN(ALT)  
    Perform STAR TRACKER NAV [14A]

TARGET MC 2 [20C] (Preliminary)

CRT   √SV SEL correct  
      [GNC\_34\_\_ORBIT\_TGT]  
      TGT NO - ITEM 1 +1 2 EXEC  
      √TGT Set data:  
          T1 TIG = MC2 BURN SOLUTION TIG  
          EL       +30.25  
          ΔT       +27.0  
          ΔX       -0.9  
          ΔY       +0  
          ΔZ       +1.8  
      COMPUTE T1 - ITEM 28 EXEC

NOTE

If TGT EL ANG Alarm,  
  ΔV still valid for current TIG,  
  TIG slip limits still apply

Note solution in PAD

MET:01:22:21

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00:00 CDR TARGET MC 1 [20A] (Preliminary)  
A7(B7)

CDR When mnvr to att complete,  
POST TI NAV [20B]

00:05 MS1 HST POISE FOR CAPTURE (PDRS OPS, HST RETRIEVE)

MCC UPLINK  
PROX OPS  
COV MATRIX

00:10 CDR When NAV converged, (SV UPDATES small and stable)  
TARGET MC 1 [20A] (Intermediate)

00:15 √FOR TIME OF OOP NULL

TIG -03:00  
CDR TARGET MC 1 [20A] (Final)  
Perform RCS BURN (cue card)

MCC  
ESTABLISH  
PI COMM

00:20 ← MC 1 TIG

CDR TARGET MC 2 [20C] (Preliminary)

00:25 CDR When Y = 0  
MANUAL OUT-OF-PLANE NULL [21A]

At sunset,  
If RR NAV  
| [GNC\_22\_STRK/COAS\_CNTL]  
| -Z STAR TRK - ITEM 4 EXEC (\*)  
If S TRK NAV,  
END S TRK NAV [21B]

00:30

### MC 1 BURN SOLUTION

TIG [ ] [ ] [ ] / [ ] [ ] : [ ] [ ] : [ ] [ ]

#### PRELIMINARY

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

#### INTERMEDIATE

( )				.	
( )				.	
( )				.	
				.	

#### FINAL

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

#### MEAN ± (3σ VARIATION)

+0.0 ± (0.4)

+0.0 ± (0.7)

-0.1 ± (1.2)

### MANUAL OUT-OF-PLANE NULL [21A]

[GNC\_33\_REL\_NAV]  
CRT When Y = 0:  
F7 FLT CNTLR PWR - ON  
DAP: A/AUTO/PRI  
DAP TRANS: as reqd  
THC: Null YDOT  
If -Z AXIS TRACK,  
+YDOT = FWD THC left  
AFT THC right  
If -Y S TRK TRACK,  
+YDOT = FWD THC down  
AFT THC out  
F7 FLT CNTLR PWR - OFF  
DAP: A/AUTO/ALT  
When rates nulled:  
DAP: VERN(ALT)

### END S TRK NAV [21B]

[GNC\_33\_REL\_NAV]  
CRT INH Angles - ITEM 24 EXEC (\*)  
[GNC\_21\_IMU\_ALIGN]  
IMU DES - ITEM 7(8,9) EXEC (no \*)

TARGET MC 2 [22A] (Intermediate)

CRT [GNC\_34\_ORBIT\_TGT]  
 TGT NO - ITEM 1 +1 2 EXEC  
 COMPUTE T1 - ITEM 28 EXEC

Note solution in PAD

-Z AXIS TARGET TRACK [22B]

CRT [GNC\_UNIV\_PTG]  
 TGT ID +1  
 BODY VECT +3 (-Z)  
 OM +0  
 C3 DAP: B/AUTO/ALT  
 CRT TRK - ITEM 19 EXEC (CUR - \*)

When MNVR cmlpt.  
 DAP: A/AUTO/VERN(ALT)

MC2 BURN SOLUTION

PRELIMINARY

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

INTERMEDIATE

( )				.	
( )				.	
( )				.	
				.	

FINAL

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

MEAN ± (3σ VARIATION)

+0.0 ± (0.3)

+0.0 ± (0.3)

+0.1 ± (2.5)

TIG

TIG SLIP  
(COMPUTED-NOM)

PREL	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>
INTER	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>
FINAL	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>
NOMINAL	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>

MET: 01:22:51

PET

00:30  
A7(B7)

CDR When NAV converged, (SV UPDATE small and stable)  
TARGET MC 2 [22A] (Intermediate)

00:35

00:40

00:45

MC2 ET

-00:05

TIG -05:00  
CDR TARGET MC 2 [23A] (Final)

00:50

Perform RCS BURN (cue card)

00:00

← [MC\_2\_TIG]  
CDR TARGET MC 3 [23B] (Preliminary)

MCC  
LGA SWITCH  
AFT TO FWD

00:55

If -Y S TRK TRACK  
PLT -Z AXIS TARGET TRACK [22B]

IF INITIAL RR ACQUISITION POST MC2  
CDR Perform LATE RR NAV [24A]

00:05

IF NO RR INTO NAV  
CDR Go to RADAR FAIL PROCEDURE [24C]

01:00

TARGET MC 2 [23A] (Final)

CRT √SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 +1 2 EXEC  
COMPUTE T1 - ITEM 28 EXEC  
√TIG change

IF TIG CHANGE < -3 OR > +7 MIN

Set BASE TIME to (Nominal MC 2 TIG -3 or +7 min as appropriate)  
LOAD - ITEM 26 EXEC  
TGT NO - ITEM 1 +1 9 EXEC

√TGT Set data:

T1 TIG = BASE TIME  
EL +0  
ΔT +27.0  
ΔX -0.9  
ΔY +0  
ΔZ +1.8

COMPUTE T1 - ITEM 28 EXEC

Set EVENT TIMER counting to MC 2 TIG  
Note solution in PAD

[GNC\_33\_REL\_NAV]  
CRT FLTR TO PROP - ITEM 8 EXEC

TARGET MC 3 [23B]

CRT √SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 +1 3 EXEC  
√TGT Set data:  
T1 TIG = BASE TIME + 0/00:17:00  
EL +0  
ΔT +10.0  
ΔX -0.9  
ΔY +0  
ΔZ +1.8  
COMPUTE T1 - ITEM 28 EXEC  
Note solution in PAD

MC 3 BURN SOLUTION

TIG	[ ] [ ] [ ]		/	[ ] [ ]		:	[ ] [ ]		:	[ ] [ ]			
	PRELIMINARY						FINAL						MEAN ±
ΔVX	( )	[ ]	[ ]	.	[ ]	( )	[ ]	[ ]	.	[ ]	[ ]	+0.1 ± (1.4)	
ΔVY	( )	[ ]	[ ]	.	[ ]	( )	[ ]	[ ]	.	[ ]	[ ]	+0.0 ± (1.2)	
ΔVZ	( )	[ ]	[ ]	.	[ ]	( )	[ ]	[ ]	.	[ ]	[ ]	+0.1 ± (1.9)	
ΔVT	[ ]	[ ]	[ ]	.	[ ]	[ ]	[ ]	[ ]	.	[ ]	[ ]		

MC 4 BURN SOLUTION

TIG    /   :   :

	PRELIMINARY				FINAL				MEAN ± (3σ VARIATION)
ΔVX	( )			.	( )			.	+1.2 ± (2.7)
ΔVY	( )			.	( )			.	-0.0 ± (1.7)
ΔVZ	( )			.	( )			.	+0.8 ± (4.1)
ΔVT				.				.	

LATE RADAR NAV [24A]

[GNC\_33\_REL\_NAV]  
 CRT FLTR TO PROP - ITEM 8 EXEC  
 √SV SEL, ITEM 4 - PROP  
 √RR - ITEM 13 EXEC (\*)  
 AUTO RNG - ITEM 17 EXEC (\*)  
 RDOT - ITEM 20 EXEC (\*)  
 Angles - ITEM 23 EXEC (\*)  
 Go to RADAR FAIL PROCEDURE [24C]

CCTV CONFIG [24B]

A7U MON 1 - Camr A  
 MON 2 - Camr B  
 Aim A at B and B at A  
 PAN/TILT - RESET for both; aim  
 both at (or near) PAN 0, TILT 90  
 Repeat for Camr C & D

TARGET MC 3 [24D]

CRT √SV SEL correct  
 [GNC\_34\_ORBIT\_TGT]  
 TGT NO - ITEM 1 +1 3 EXEC  
 √TGT Set data:  
 T1 TIG = BASE TIME + 0/00:17:00  
 EL +0  
 ΔT +10.0  
 ΔX -0.9  
 ΔY +0  
 ΔZ +1.8  
 COMPUTE T1 - ITEM 28 EXEC  
 Note solution in PAD

RADAR FAIL PROCEDURE [24C]

Note: At sunrise, report TGT Tally-Ho to MCC

**IF TARGET > 30 DEG FROM COAS HORIZONTAL**  
 CDR Go to RNDZ BREAKOUT (CONTINGENCY OPS), 5-16 >>

- At MC2 TIG+14:00 (MC3 TIG-3:00):  
 PLT TARGET MC3 [24D] (final)  
 CDR Perform RCS BURN, steps 1 thru 5 (Cue Card), then:  
 DAP: A/AUTO/ALT
- At MC2 TIG + 19:00:  
 A6U FLT CNTLR PWR - ON  
 √SENSE - -Z  
 DAP: A/LVLH/PRI  
 √COAS for TGT vertical position  
 THC: +X (or -X) per COAS LOGIC:  
 If TGT = N deg high in COAS, perform 2N +X (up) pulses  
 If TGT = N deg low in COAS, perform 1N -X (down) pulses  
 DAP: A/LVLH/VERN(PRI)  
 Inform MCC of TGT vertical position in COAS and number of pulses performed  
 Following radar fail X correction,  
 THC: As reqd to maintain target within 15 deg of COAS horizontal axis,  
 control planar motion, and manage Rdot  
 Perform CONFIG FOR RBAR [25B]
- At MC2 TIG + 24:00 or 2000 ft, whichever comes first:  
 [GNC\_UNIV\_PTG]  
 CRT TRK - ITEM 19 EXEC (CUR - \*)  
 A6U DAP: A/AUTO/VERN (PRI)  
 THC: as reqd to get TGT moving towards COAS center, then:  
 THC: as reqd to maintain TGT in COAS.  
 When RANGE < 1500 ft  
 DAP: LO Z

Follow prescribed braking gates:

RNG	RDOT
2.0	-3.0
1.5	-2.3
1.0	-1.5

Resume RENDEZVOUS TIMELINE at MC2 ET +00:35, 4-25 (R = 1000 ft)

MET: 01:23:21

PET **MC2 ET**

IF NO VISUAL OR RR ACQUISITION AT MC2+18 (MC2+22 PER MCC CALL)  
CDR Go to RNDZ BREAKOUT (CONTINGENCY OPS), 5-16 >>

01:00  
A7(B7)

MS √ P/TV11 SETUP HST RETRIEVE/BERTH, SETUP cpit  
(PHOTO/TV FS, P/TV11 SCENES)  
CCTV CONFIG [24B]

00:10

01:05

TIG - 03:00  
CDR TARGET MC 3 [24D] (Final)  
Perform RCS BURN (Cue Card)

00:15

01:10

← [MC\_3\_TIG]  
CDR TARGET MC 4 [25A] (Preliminary)

PLT CONFIG FOR RBAR [25B]

00:20

01:15

MS Perform HHL OPS (RENDEZVOUS TOOLS), 7-6

TIG -03:00  
CDR TARGET MC 4 [25A] (Final)  
Perform RCS BURN, steps 1 thru 5 (Cue Card)

00:25

HHL REPORT TO  
MCC

01:20

← [MC\_4\_TIG]  
CDR ESTABLISH RBAR [25C]  
When RANGE < 1500 ft  
DAP: LO Z

### MANUAL TRAJECTORY CONTROL

Follow prescribed braking gates:

RNG	RDOT
2.0	-3.0
1.5	-2.3
1.0	-1.5
0.6	-0.8

#### NOTE

If RDOT falls below value for next gate:  
THC: -Z (in) as reqd to maintain RDOT

00:35

When RANGE < 1000 ft  
A1L S-BD PL XMTR PWR-LO

MCC  
PI to PWR-LO

01:30

#### TARGET MC 4 [25A]

CRT √SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 +14 EXEC  
√TGT Set data:  
T1 TIG = BASE TIME + 0/00:27:00  
EL +0  
ΔT +13.0  
ΔX +0  
ΔY +0  
ΔZ +0.6  
COMPUTE T1 - ITEM 28 EXEC  
Note solution in PAD

#### CONFIG FOR RBAR [25B]

Config DAP A,B to A13,B13

[GNC\_UNIV\_PTG]  
TGT ID +2  
BODY VECT +5  
P +270  
Y +0  
OM +0

√ERR TOT - ITEM 23 EXEC (\*)  
Do not initiate Target Track until ESTABLISH RBAR [25C]

#### ESTABLISH RBAR [25C]

A6U FLT CNTLR PWR - ON

[GNC\_UNIV\_PTG]  
CRT TRK - ITEM 19 EXEC (CUR - \*)  
DAP: A/AUTO/VERN(PRI)

THC: as reqd to get TGT moving towards COAS center, then:  
THC: as reqd to maintain TGT in COAS



**AUTO INERTIAL FLYAROUND ALIGNMENT [26A]**

(For flyaround greater than tbd deg)

**Note 1**

THC as required to keep center point of payload centered in keel camera

**Note 2**

Watch closure rate, maintain Range > 120 ft

1. Maintain Range and Range Rate:

R = 150 ft ± 30 ft  
-.3 ft/sec < Rdot < +.3 fps

2. Check Initial Config:

√Sense: -Z  
√DAP A8, B8  
√DAP TRANS: PULSE/PULSE/PULSE  
DAP: B/INRTL/VERN (PRI)  
√DAP ROT: DISC/DISC/DISC

3. Flyout Sequence - The Sox Sequence:

-Z Sense: Roll - align orbiter XZ plane with the HST V1  
Pitch - align orbiter -Z with the HST V1  
Roll - align orbiter camera view with end of HST  
Body Sense: Yaw - align orbiter XZ plane with the HST V1  
Pitch - align orbiter -Z with the HST V1  
Yaw - align orbiter camera view with end of HST

3a. Align -Z Sense Pitch (Orbiter Body Pitch)

To Start Rotation:  
[GNC\_UNIV\_PTG]  
Body Vect = 5  
P = 0  
For +Body pitch: Y = 90  
For - Body pitch: Y = 270  
ROT - ITEM 20 EXEC  
DAP: A/AUTO/PRI  
To stop rotation:  
DAP: A/INRTL/PRI

3b. Align -Z Yaw (Orbiter Body Roll)

To Start Rotation:  
[GNC\_UNIV\_PTG]  
For +Body Roll: BV(ITEM 14 + 1)  
For - Body Roll: BV(ITEM 14 + 2)  
ROT - ITEM 20 EXEC  
DAP: A/AUTO/PRI  
To stop rotation:  
DAP: A/INRTL/PRI

**Note 3**

Orbiter body roll rotations will require Orbiter body Y translations. In DAP: Lo Z, body Y's cause a relatively large closing rate which in turn costs prop to fly out.

3c. Align -Z Sense Roll (Orbiter Body Yaw)

To Start Rotation:  
[GNC\_UNIV\_PTG]  
Body Vect = 5  
For +Body yaw: P = 270  
For - Body yaw: P = 90  
Y=0  
ROT - ITEM 20 EXEC  
DAP: A/AUTO/PRI  
To stop rotation:  
DAP: A/INRTL/PRI

4. Check Final Config

[GNC\_UNIV\_PTG]  
CNCL - ITEM 21 EXEC  
√DAP: B/INRTL/VERN, LO Z

**RBAR YAW ALIGNMENT [26B]**

**Note 1:**

Complete RBAR YAW ALIGN prior to MATCH INERTIAL RATES [29A]

1. Check Initial Config

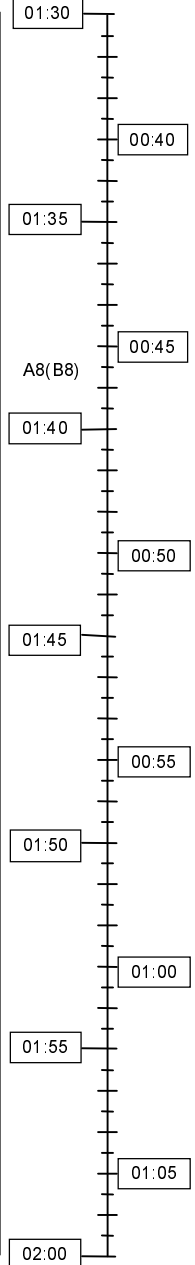
√Sense: -Z  
√DAP: A8, B8  
√DAP TRANS: PULSE/PULSE/PULSE  
  
DAP: A/LVLH/VERN (PRI)

2. Align -Z Sense Roll (Orbiter Body Yaw)

DAP ROT: PULSE/DISC/DISC  
RHC: Roll as reqd  
  
To Stop Rotation:  
DAP ROT: DISC/DISC/DISC

MET: 01:23:51

PET **MC2 ET**



Follow prescribed braking gates:

RNG	RDOT
1.0	-1.5
0.6	-0.8
0.5	-0.5
0.4	-0.4
0.3	-0.3
0.2	-0.2

**NOTE**  
 If RDOT falls below value for next gate:  
 THC: -Z (in) as reqd to maintain RDOT

Maintain -0.2 until 120 ft, then bleed to -0.1

**MCC UPDATE**  
 SUNPT TIMER EXP [29B]  
 MET = \_\_\_\_\_  
 PET = \_\_\_\_\_

PLT When RANGE < 400 ft  
 A1U KU OUTPUT - LO

Config DAP A,B to A8,B8

VISUAL SOLAR ARRAY DEFLECTION REPORT

When RANGE < 200 ft  
 ✓ HST IN CAPTURE ATTITUDE

**IF HST IN SUNPOINT MODE**  
 ✓ MCC for clearance to continue approach within 120 ft.

**MCC**  
 LGA SWITCH  
 FWD TO AFT

HHL REPORT

When RANGE = 150 ft  
 If HST not in nominal attitude,  
 Perform flyaround as reqd  
 RBAR YAW ALIGNMENT [26B]  
 or MANUAL INERTIAL FLYAROUND ALIGNMENT TRIM [27A]  
 or AUTO INERTIAL FLYAROUND [26A]

**MCC UPLINK**  
 TV Downlink

When RR breaks lock or range = 80 ft,  
 As time permits, CONFIG KU BAND FOR COMM  
 (Cue Card, KU OPS) step 4

**MANUAL INERTIAL FLYAROUND ALIGNMENT TRIM [27A]**  
 (For flyaround less than tbd deg)

**Note 1**

THC as required to keep center point of payload centered in keel camera

**Note 2**

Watch closure rate, maintain Range > 120 ft

1. Maintain Range and Range Rate:

R = 150 ft ± 30 ft  
 -3 ft/sec < Rdot < +3 fps

2. Check Initial Config:

✓ Sense: -Z  
 ✓ DAP A8, B8  
 ✓ DAP TRANS: PULSE/PULSE/PULSE  
 DAP: B/INRTL/VERN (PRI)

3. Flyout Sequence:

-Z Sense: Pitch/Yaw/Roll  
 Body Sense: Pitch/Roll/Yaw

3a. Align -Z Sense Pitch (Orbiter Body Pitch)

To Start Rotation:  
 DAP ROT: DISC/PULSE/DISC  
 RHC: Pitch as reqd

To Stop Rotation:  
 DAP ROT: DISC/DISC/DISC

3b. Align -Z Sense Yaw (Orbiter Body Roll)

To Start Rotation:  
 DAP ROT: DISC/DISC/PULSE  
 RHC: Yaw as reqd

To Stop Rotation:  
 DAP ROT: DISC/DISC/DISC

**Note 3**

Orbiter body roll rotations will require Orbiter body Y translations. In DAP: Lo Z, body Y's cause a relatively large closing rate which in turn costs prop to fly out.

3c. Align -Z Sense Roll (Orbiter Body Yaw)

To Start Rotation:  
 DAP ROT: PULSE/DISC/DISC  
 RHC: Roll as reqd

To Stop Rotation:  
 DAP ROT: DISC/DISC/DISC

4. Check Final Config

[GNC\_UNIV\_PTG]  
 CNCL ITEM 21 EXEC  
 ✓ DAP: B/INRTL/VERN (PRI), LO Z

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MET: 02:00:31

PET

02:00

When HST V1 axis in alignment with Orbiter Z axis,  
MATCH INERTIAL RATES [29A]

If capture within 5 min of HST sunpt mnvr,  
DISABLE SUNPT TIMER [29B]

02:05

When Target in EE Camera  
√DAP TRANS: LO Z  
THC: +Z (out) to null rates

02:10

When Target stable in EE Camera  
Perform HST CAPTURE (PDRS OPS, HST RETRIEVE)

02:15

HHL STOW (RENDEZVOUS TOOLS) 7-5  
RPOP OPERATIONS (RENDEZVOUS TOOLS) 7-8, step 10

DISABLE RENDEZVOUS NAV [29C]

02:20

GO TO FLIGHT PLAN

02:25

02:30

MATCH INERTIAL RATES [29A]

√DAP: LO Z  
DAP: A/INRTL/VERN (PRI)

THC: +X (up) as reqd to stabilize approach along HST V1 axis

[GNC\_UNIV\_PTG]  
CNCL - ITEM 21 EXEC

DISABLE SUNPT TIMER [29B]

180 MIN SUNPOINT TIMER EXPIRATION TIME:

MET = \_\_\_/\_\_\_:\_\_\_:\_\_\_  
PET = \_\_\_:\_\_\_:\_\_\_

[SM\_210\_HST\_SYS]

PCS SUNPT DIS - ITEM 7 +99 EXEC  
√DIS - YES

IF PCS SUNPT DIS - NO  
PCS SUNPT DIS - ITEM 7 +99 EXEC

IF PCS SUNPT DIS - NO  
Perform PROXIMITY OPERATIONS BACKOFF (CONT OPS) pg 5-12

DISABLE RENDEZVOUS NAV [29C]

A6U √FLT CNTLR PWR - OFF

[GNC\_33\_REL\_NAV]

CRT RNDZ NAV ENA - ITEM 1 EXEC (no \*)

[GNC\_22\_S\_TRK/COAS\_CNTL]

-Z(-Y) STAR TRK - ITEM 4(3) EXEC (\*)

[GNC\_20\_DAP\_CONFIG]

Modify DAP A7 for SEP:

EDIT DAP A7 - ITEM 3 +Z EXEC

A VERN ROT RATE - ITEM 63 +0.2 EXEC

LOAD - ITEM 5 EXEC

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## CONTINGENCY INERTIAL APPROACH TIMELINE

**NOTE:**

Perform nominal rendezvous timeline activities though PET 00:00.

For NCC targeting, use TGT NO - ITEM 1 +2 9 EXEC

For Ti targeting, use TGT NO - ITEM 1 +3 0 EXEC

For Ti and NCC targeting blocks,  $\sqrt{\text{TGT}}$  Set data per TARGETING DATA, 310 Inertial  
(REFERENCE DATA), 6-5.

TARGET MC 1 INERTIAL [32A]

CRT   √SV SEL correct  
      [GNC\_34\_\_ORBIT\_TGT]  
      TGT NO - ITEM 1 + 3 1 EXEC  
      √TGT Set data:  
          T1 TIG = MC1 BURN SOLUTION TIG  
          EL     +0  
          ΔT    +59.1  
          ΔX     +0  
          ΔY     +0  
          ΔZ     +0  
      COMPUTE T1 - ITEM 28 EXEC  
      Note solution in PAD

POST T1 NAV [32B]

A6U   √DAP: A/AUTO/VERN(ALT)  
A1U   √KU sel - GPC

[GNC\_33\_REL\_NAV]  
IF SV SEL = FLTR:  
   FLTR TO PROP - ITEM 8 EXEC (\*)  
   √AUTO Angles - ITEM 23 EXEC (\*)  
If RR NOT Tracking TGT:  
  √Inhibit Data  
   Perform KU OPS, steps 2 and 3 (Cue Card)  
   If still no RR ACQ, assume RR Fail

CRT   [GNC\_22\_\_S\_TRK/COAS\_CNTL]  
      √Z TGT TRK - ITEM 6 EXEC (\*)  
      -Z THOLD - ITEM 14 + 3 EXEC

**IF RR FAIL**

If -Z Star Tracker:  
  | √-Z TGT TRK ATT, then:  
  |   Perform STAR TRACKER NAV [14A]  
If COAS NAV:  
  | √-Z TGT TRK ATT, then:  
  |   Perform COAS NAVIGATION (CONTINGENCY OPS), 5-10  
If -Y Star Tracker:  
  [GNC\_22\_\_S\_TRK/COAS\_CNTL]  
  √-Y THOLD - ITEM 13 + 0 EXEC  
  [GNC\_UNIV\_PTG]  
  TGT ID    +1  
  BODY VECT +4  
  P         √+0  
  Y         √+280.57  
  OM        +90  
  DAP: B/AUTO/ALT  
  TRK - ITEM 19 EXEC  
  When MNVR cmlpt:  
    DAP: A/AUTO/VERN(ALT)  
    Perform STAR TRACKER NAV [14A]

TARGET MC 2 INERTIAL [32C] (Preliminary)

CRT   √SV SEL correct  
      [GNC\_34\_\_ORBIT\_TGT]  
      TGT NO - ITEM 1 + 3 2 EXEC  
      √TGT Set data:  
          T1 TIG = MC2 BURN SOLUTION TIG  
          EL     +29.49  
          ΔT    +32.7  
          ΔX     +0  
          ΔY     +0  
          ΔZ     +0  
      COMPUTE T1 - ITEM 28 EXEC

NOTE

If TGT EL ANG Alarm,  
  ΔV still valid for current TIG,  
  TIG slip limits still apply

Note solution in PAD

MET:01:22:21

PET

00:00

A7(B7)

CDR TARGET MC 1 INERTIAL [32A] (Preliminary)

When mnvr to att complete,  
POST Tl NAV [32B]

CDR

00:05

MS1 HST POISE FOR CAPTURE (PDRS OPS, HST RETRIEVE)

MCC UPLINK  
PROX OPS  
COV MATRIX

00:10

CDR When NAV converged, (SV UPDATES small and stable)  
TARGET MC 1 INERTIAL [32A] (Intermediate)

00:15

√FOR TIME OF OOP NULL

MCC  
ESTABLISH  
PI COMM

00:20

TIG -03:00  
CDR TARGET MC 1 INERTIAL [32A] (Final)

Perform RCS BURN (cue card)

00:25

← MC 1 TIG

CDR TARGET MC 2 INERTIAL [32C] (Preliminary)

00:30

CDR When Y = 0  
MANUAL OUT-OF-PLANE NULL [33A]

### MC 1 BURN SOLUTION

TIG [ ] [ ] [ ] / [ ] [ ] : [ ] [ ] : [ ] [ ]

#### PRELIMINARY

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

#### INTERMEDIATE

( )				.	
( )				.	
( )				.	
				.	

#### FINAL

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

### MANUAL OUT-OF-PLANE NULL [33A]

[GNC\_33\_REL\_NAV]  
 CRT When Y = 0:  
 F7 FLT CNTLR PWR - ON  
 DAP: A/AUTO/PRI  
 DAP TRANS: as reqd  
 THC: Null YDOT  
 If -Z AXIS TRACK,  
 +YDOT = FWD THC left  
 AFT THC right  
 If -Y S TRK TRACK,  
 +YDOT = FWD THC down  
 AFT THC out  
 F7 FLT CNTLR PWR - OFF  
 DAP: A/AUTO/ALT  
 When rates nulled:  
 DAP: VERN(ALT)

### END S TRK NAV [33B]

[GNC\_33\_REL\_NAV]  
 CRT INH Angles - ITEM 24 EXEC (\*)  
 [GNC\_21\_IMU\_ALIGN]  
 IMU DES - ITEM 7(8,9) EXEC (no \*)



TARGET MC 2 INERTIAL [34A] (Intermediate)

CRT [GNC\_34\_ORBIT\_TGT]  
 TGT NO - ITEM 1 +3 2 EXEC  
 COMPUTE T1 - ITEM 28 EXEC

Note solution in PAD

-Z AXIS TARGET TRACK [34B]

CRT [GNC\_UNIV\_PTG]  
 TGT ID +1  
 BODY VECT +3 (-Z)  
 OM +0  
 C3 DAP: B/AUTO/ALT  
 CRT TRK - ITEM 19 EXEC (CUR - \*)

When MNVR cmlpt  
 DAP: A/AUTO/VERN(ALT)

MC2 BURN SOLUTION

PRELIMINARY

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

INTERMEDIATE

( )				.	
( )				.	
( )				.	
				.	

FINAL

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

TIG

TIG SLIP  
 (COMPUTED-NOM)

PREL	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>
INTER	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>
FINAL	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>
NOMINAL	<input type="text"/>	/	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>	:	<input type="text"/>

MET: 01:22:51

PET

00:30  
A7(B7)

At sunset,  
If RR NAV  
| [GNC\_22\_STRK/COAS\_CNTL]  
| -Z STAR TRK - ITEM 4 EXEC (\*)  
If S TRK NAV,  
| END S TRK NAV [33B]  
If no sensor data (RR,STRK,COAS) at any time during the RNDZ,  
Go to RNDZ BREAKOUT (CONTINGENCY OPERATIONS), 5-16

00:35

CDR When NAV converged, (SV UPDATE small and stable)  
TARGET MC 2 INERTIAL [34A] (Intermediate)

00:40

00:45

MC2 ET

-00:05

TIG -05:00  
CDR TARGET MC 2 INERTIAL [35A] (Final)

00:50

Perform RCS BURN (cue card)

MCC  
LGA SWITCH  
AFT TO FWD

00:00

← [MC\_2\_TIG]  
CDR TARGET MC 3 INERTIAL [35B] (Preliminary)

00:55

If -Y S TRK TRACK  
PLT -Z AXIS TARGET TRACK [34B]

00:05

IF NO POST-TI SENSOR DATA AND NO VISUAL (OR RR) ACQ BY MC2+20 MIN,  
OR  
IF POST-TI SENSOR DATA AVAILABLE, BUT NO VISUAL (OR RR) ACQ BY MC2+25 MIN:  
Go to RENDEZVOUS BREAKOUT (CONTINGENCY OPERATIONS), 5-16

01:00

TARGET MC 2 INERTIAL [35A] (Final)

CRT √SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 +3 2 EXEC  
COMPUTE T1 - ITEM 28 EXEC  
√TIG change

**IF TIG CHANGE < -3 OR > +7 MIN**

Set BASE TIME to (Nominal MC 2 TIG -3 or +7 min as appropriate)  
LOAD - ITEM 26 EXEC  
TGT NO - ITEM 1 +3 9 EXEC

√TGT Set data:

T1 TIG = BASE TIME  
EL +0  
ΔT +32.7  
ΔX +0  
ΔY +0  
ΔZ +0

COMPUTE T1 - ITEM 28 EXEC

Set EVENT TIMER counting to MC 2 TIG  
Note solution in PAD

[GNC\_33\_REL\_NAV]  
CRT FLTR TO PROP - ITEM 8 EXEC

TARGET MC 3 INERTIAL [35B]

CRT √SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 +3 3 EXEC  
√TGT Set data:  
T1 TIG = BASE TIME + 0/00:10:00  
EL +0  
ΔT +22.7  
ΔX +0  
ΔY +0  
ΔZ +0  
COMPUTE T1 - ITEM 28 EXEC  
Note solution in PAD

MC 3 BURN SOLUTION

TIG [ ] [ ] [ ] / [ ] [ ] : [ ] [ ] : [ ] [ ]

PRELIMINARY

FINAL

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

	( )			.	
	( )			.	
	( )			.	
				.	

MC 4 BURN SOLUTION

TIG    /   :   :

PRELIMINARY

FINAL

ΔVX	( )			.	
ΔVY	( )			.	
ΔVZ	( )			.	
ΔVT				.	

CCTV CONFIG [36A]

A7U MON 1 - Camr A  
 MON 2 - Camr B  
 Aim A at B and B at A  
 PAN/TILT - RESET for both; aim  
 both at (or near) PAN 0, TILT 90  
 Repeat for Camr C & D

TARGET MC 3 INERTIAL [36B]

CRT √SV SEL correct  
 [GNC\_34\_\_ORBIT\_TGT]  
 TGT NO - ITEM 1 +3\_3 EXEC  
 √TGT Set data:  
 T1 TIG = BASE TIME + 0/00:10:00  
 EL +0  
 ΔT +22.7  
 ΔX +0  
 ΔY +0  
 ΔZ +0  
 COMPUTE T1 - ITEM 28 EXEC  
 Note solution in PAD

MET: 01:23:21

PET **MC2 ET**

01:00  
A7(B7)  
00:10  
01:05  
00:15  
01:10  
00:20  
01:15  
00:25  
01:20  
00:30  
01:25  
00:35  
01:30

TIG - 03:00  
CDR TARGET MC 3 INERTIAL [36B] (Final)  
Perform RCS BURN (Cue Card)

← [MC\_3\_TIG]  
CDR TARGET MC 4 INERTIAL [37A] (Preliminary)

MS √P/TV11 SETUP HST RETRIEVE/BERTH, SETUP cpit  
(PHOTO/TV FS, P/TV11 SCENES)  
CCTV CONFIG [36A]

TIG -03:00  
CDR TARGET MC 4 INERTIAL [37A] (Final)  
Perform RCS BURN (Cue Card)

← [MC\_4\_TIG]

**MANUAL TRAJECTORY CONTROL**

CDR ESTABLISH INERTIAL LOS RATES [37B]  
MS Perform HHL OPS (RENDEZVOUS TOOLS), 7-6

When RANGE < 1500 ft  
DAP: LO Z

Follow prescribed braking gates:

RNG	RDOT
2.0	-4.0
1.5	-2.0
1.0	-1.0
0.9	-0.9
0.8	-0.8

When RANGE < 1000 ft  
A1L S-BD PL XMTR PWR-LO

HHL REPORT TO  
MCC

MCC  
PI to PWR-LO

**TARGET MC 4 INERTIAL** [37A]

CRT √SV SEL correct  
[GNC\_34\_ORBIT\_TGT]  
TGT NO - ITEM 1 - 34 EXEC  
√TGT Set data:  
T1 TIG = BASE TIME + 0/00:20:00  
EL +0  
ΔT +12.7  
ΔX +0  
ΔY +0  
ΔZ +0  
COMPUTE T1 - ITEM 28 EXEC  
Note solution in PAD

**ESTABLISH INERTIAL LOS RATES** [37B]

A6U √DAP TRANS: PULSE/PULSE/PULSE  
√SENSE - -Z  
FLT CNTLR PWR - ON

MC 2 +22:00  
DAP: A/INRTL/VERN(PRI)  
THC: ±X as reqd until  
EL LOS rate = 0 mrad/sec  
(TARGET stationary in COAS)

√ADI ATT - LVLH  
RHC: as reqd until Yaw = 0  
DAP: A/INRTL/VERN(PRI)

CRT [GNC\_UNIV\_PTG]  
CNCL - ITEM 21 EXEC  
ERR (TOT) DAP as desired - ITEM (23) 24 EXEC (\*)

AUTO INERTIAL FLYAROUND ALIGNMENT [38A]

(For flyaround greater than tbd deg)

**Note 1**

THC as required to keep center point of payload centered in keel camera

**Note 2**

Watch closure rate, maintain Range > 120 ft

1. Maintain Range and Range Rate:

R = 150 ft ± 30 ft

-.3 ft/sec < Rdot < +.3 fps

2. Check Initial Config:

√ Sense: -Z

√ DAP A8, B8

√ DAP TRANS: PULSE/PULSE/PULSE

√ DAP: B/INRTL/VERN (PRI)

√ DAP ROT: DISC/DISC/DISC

3. Flyout Sequence - The Sox Sequence:

-Z Sense: Roll - align orbiter XZ plane with the HST V1

Pitch - align orbiter -Z with the HST V1

Roll - align orbiter camera view with end of HST

Body Sense: Yaw - align orbiter XZ plane with the HST V1

Pitch - align orbiter -Z with the HST V1

Yaw - align orbiter camera view with end of HST

3a. Align -Z Sense Pitch (Orbiter Body Pitch)

To Start Rotation:

[GNC\_UNIV\_PTG]

Body Vect = 5

P = 0

For +Body pitch: Y = 90

For - Body pitch: Y = 270

ROT - ITEM 20 EXEC

DAP: A/AUTO/PRI

To stop rotation:

DAP: A/INRTL/PRI

3b. Align -Z Yaw (Orbiter Body Roll)

To Start Rotation:

[GNC\_UNIV\_PTG]

For +Body Roll: BV(ITEM 14 + 1)

For - Body Roll: BV(ITEM 14 + 2)

ROT - ITEM 20 EXEC

DAP: A/AUTO/PRI

To stop rotation:

DAP: A/INRTL/PRI

**Note 3**

Orbiter body roll rotations will require Orbiter body Y translations. In DAP: Lo Z, body Y's cause a relatively large closing rate which in turn costs prop to fly out.

3c. Align -Z Sense Roll (Orbiter Body Yaw)

To Start Rotation:

[GNC\_UNIV\_PTG]

Body Vect = 5

For +Body yaw: P = 270

For - Body yaw: P = 90

Y=0

ROT - ITEM 20 EXEC

DAP: A/AUTO/PRI

To stop rotation:

DAP: A/INRTL/PRI

4. Check Final Config

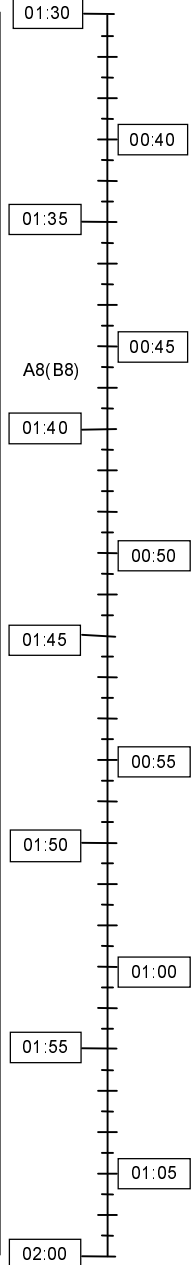
[GNC\_UNIV\_PTG]

CNCL - ITEM 21 EXEC

√ DAP: B/INRTL/VERN, LO Z

MET: 01:23:51

PET **MC2 ET**



Follow prescribed braking gates:

RNG	RDOT
0.7	-0.7
0.6	-0.6
0.5	-0.5
0.4	-0.4
0.3	-0.3
0.2	-0.2

Maintain -0.2 until 120 ft, then bleed to -0.1

PLT When RANGE < 400 ft  
A1U KU OUTPUT - LO  
Config DAP A,B to A8,B8

A8(B8)

VISUAL SOLAR ARRAY  
DEFLECTION REPORT

When RANGE < 200 ft  
√ HST IN CAPTURE ATTITUDE

**IF HST IN SUNPOINT MODE**

√ MCC for clearance to continue approach within 120 ft.

When RANGE = 150 ft  
If HST not in nominal attitude,  
Perform flyaround as reqd  
MANUAL INERTIAL FLYAROUND ALIGNMENT TRIM [39A]  
or AUTO INERTIAL FLYAROUND [38A]

When RR breaks lock or range = 80 ft,  
As time permits, CONFIG KU BAND FOR COMM  
(Cue Card, KU OPS) step 4

**MCC UPDATE**  
SUNPT TIMER EXP [41A]  
MET = \_\_\_\_\_  
PET = \_\_\_\_\_

**MCC**  
LGA SWITCH  
FWD TO AFT

HHL REPORT

**MCC UPLINK**  
TV Downlink

**MANUAL INERTIAL FLYAROUND ALIGNMENT TRIM [39A]**  
(For flyaround less than tbd deg)

**Note 1**

THC as required to keep center point of payload centered in keel camera

**Note 2**

Watch closure rate, maintain Range > 120 ft

1. **Maintain Range and Range Rate:**

R = 150 ft ± 30 ft  
-3 ft/sec < Rdot < +3 fps

2. **Check Initial Config:**

√ Sense: -Z  
√ DAP A8, B8  
√ DAP TRANS: PULSE/PULSE/PULSE  
DAP: B/INRTL/VERN (PRI)

3. **Flyout Sequence:**

-Z Sense: Pitch/Yaw/Roll  
Body Sense: Pitch/Roll/Yaw

3a. **Align -Z Sense Pitch (Orbiter Body Pitch)**

To Start Rotation:  
DAP ROT: DISC/PULSE/DISC  
RHC: Pitch as reqd

To Stop Rotation:  
DAP ROT: DISC/DISC/DISC

3b. **Align -Z Sense Yaw (Orbiter Body Roll)**

To Start Rotation:  
DAP ROT: DISC/DISC/PULSE  
RHC: Yaw as reqd

To Stop Rotation:  
DAP ROT: DISC/DISC/DISC

**Note 3**

Orbiter body roll rotations will require Orbiter body Y translations. In DAP: Lo Z, body Y's cause a relatively large closing rate which in turn costs prop to fly out.

3c. **Align -Z Sense Roll (Orbiter Body Yaw)**

To Start Rotation:  
DAP ROT: PULSE/DISC/DISC  
RHC: Roll as reqd

To Stop Rotation:  
DAP ROT: DISC/DISC/DISC

4. **Check Final Config**

[GNC\_UNIV\_PTG]  
CNCL ITEM 21 EXEC  
√ DAP: B/INRTL/VERN (PRI), LO Z

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MET: 02:00:21

PET

02:00

If capture within 5 minutes of HST sunpt mnvr,  
DISABLE SUNPT TIMER [41A]

02:05

When Target in EE Camera  
√DAP TRANS: LO Z  
THC: +Z (out) to null rates

02:10

When Target stable in EE Camera  
Perform HST CAPTURE (PDRS OPS, HST RETRIEVE)

02:15

HHL STOW (RENDEZVOUS TOOLS) 7-5  
RPOP OPERATIONS (RENDEZVOUS TOOLS) 7-8, step 10

DISABLE RENDEZVOUS NAV [41 B]

02:20

GO TO FLIGHT PLAN

02:25

02:30

DISABLE SUNPT TIMER [41A]

180 MIN SUNPOINT TIMER EXPIRATION TIME:

MET = \_\_\_/\_\_\_:\_\_\_:\_\_\_

PET = \_\_\_:\_\_\_:\_\_\_

[SM\_210\_HST\_SYS]

PCS SUNPT DIS - ITEM 7 + 99 EXEC

√DIS - YES

IF PCS SUNPT DIS - NO

PCS SUNPT DIS - ITEM 7 + 99 EXEC

IF PCS SUNPT DIS - NO

Perform PROXIMITY OPERATIONS BACKOFF (CONT OPS) pg 5-12

DISABLE RENDEZVOUS NAV [41B]

A6U √FLT CNTLR PWR - OFF

[GNC\_33\_REL\_NAV]

CRT RNDZ NAV ENA - ITEM 1 EXEC (no \*)

[GNC\_22\_S\_TRK/COAS\_CNTL]

-Z(-Y) STAR TRK - ITEM 4(3) EXEC (\*)

[GNC\_20\_DAP\_CONFIG]

Modify DAP A7 for SEP:

EDIT DAP A7 - ITEM 3 + Z EXEC

A VERN ROT RATE - ITEM 63 + 0.2 EXEC

LOAD - ITEM 5 EXEC



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## CONTINGENCY OPS

RNDZ OMS BURN .....	5-3
SENSOR FAIL .....	5-7
S TRK NAV – HIGH INITIAL RESID .....	5-8
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TGT ITER .....	5-23

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RNDZ OMS BURN

## RNDZ OMS BURN

RNDZ OMS  
BURN

1. OMS BURN PREP  
C2 Wedge Install OMS2/ORBIT OMS BURNS (Cue Cards) (two) and  
OMS BURN MONITOR (Cue Cards) (two) (F6,F8)

1: GNC 20 DAP CONFIG

- CRT1 ✓ DAP Config A7,B7  
GNC, OPS 202 PRO

1: GNC ORBIT MNVR EXEC

2: GNC SYS SUMM 2

2. LOAD TGT DATA

If onboard computed burn:

- ✓ Eng sel, TV ROLL, TRIM LOAD, and WT per Burn Pad
- ✓ TIG and TGT PEG 7  $\Delta$ Vs per Final ORBIT TGT solution
- ✓ Guidance option is LAMBERT

If ground computed burn:

- ✓ TGT data per Burn Pad (reload WT as reqd)

LOAD – ITEM 22 EXEC

TIMER – ITEM 23 EXEC

- ✓ Burn data

C3 DAP: A/AUTO/ALT(B/ALT as reqd)

CRT1 MNVR – ITEM 27 EXEC (\*)

If RR ops:

A1U KU sel – AUTO TRK

1: GNC 33 REL NAV

CRT1 INH Angles – ITEM 24 EXEC (\*)

1: GNC ORBIT MNVR EXEC

When mnvr to att complete:

C3 DAP: A/AUTO/ALT

3. PERFORM RNDZ OMS BURN

CAUTION

LAMBERT burn must be completed by  
T1 TIG + 1:30 to avoid guidance errors

- \* If start of LAMBERT burn delayed: \*
- \* Retarget burn, then go to step 2 \*

TIG-3 F7/F8 FLT CNTLR PWR (two) – ON  
Perform OMS2/ORBIT OMS BURNS (Cue Card)

Cont next page

4. OMS POST BURN RECONFIGURATION
- F7/F8  
O8      FLT CNTLR PWR (two) – OFF  
          L,R OMS He PRESS/VAP ISOL (four) – CL
- C3           DAP: B/INRTL/ALT  
              DAP TRANS: PULSE/PULSE/PULSE
- CRT1       RCS SEL – ITEM 4 EXEC (\*)  
              Perform OMS TVC GMBL CK per Burn Pad
- \* If down arrow(s) or M(s), \*  
\* select good GMBL           \*
- CRT1       GNC, OPS 201 PRO
5. MNVR TO POST BURN ATTITUDE
- 1: GNC UNIV PTG
- √Desired UNIV PTG load active
- C3           DAP: B/AUTO/ALT
- A1U           If RR ops, when ATT ERR < 30 deg:  
              KU sel – GPC  
              √KU TRACK tb – gray
- 1: GNC 33 REL NAV
- CRT1       AUTO Angles – ITEM 23 EXEC (\*)
- 1: GNC UNIV PTG
- C3           When in attitude and rates nulled:  
              DAP: A/AUTO/VERN(ALT)

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**SENSOR  
FAIL**

SENSOR FAIL



## S TRK NAV – HIGH INITIAL RESID

### 1. NAV SAFING

CRT1 1: GNC 33 RR REL NAV  
✓INH Angles – ITEM 24 EXEC (\*)

On MCC GO (if no comm, continue):

### 2. CHECK FOR S TRK FALSE LOCK

2: GNC 22 S TRK/COAS CNTL

If –Z S TRK, perform COAS visual check:

#### NOTE

GNC 33 REL NAV: COAS X (+up) and COAS Y (+left)  
provide approx TGT position in COAS based on –Z  
S TRK measurement

✓For debris near TGT position

If no debris near TGT position or TGT not visible:

Go to step 3

If debris near TGT position:

CRT2 –Z BREAK TRK – ITEM 8 EXEC

When S PRES – (\*):

CRT1 Monitor RESID V and H. Repeat BREAK TRK as reqd until  
stable lock-on

Go to STAR TRACKER NAV, step 2 6A

If –Y STRK, perform visual check through W1:

✓For debris near TGT line-of-sight

If no debris near TGT line-of-sight or TGT not visible:

Go to step 3

If debris near TGT line-of-sight:

CRT2 –Y BREAK TRK – ITEM 7 EXEC

When S PRES – (\*):

CRT1 Monitor RESID V and H. Repeat BREAK TRK as reqd until  
stable lock-on

Go to STAR TRACKER NAV, step 2 6A

### 3. CHECK IMU MISALIGNMENT

2: GNC 21 IMU ALIGN

CRT2 Nav sel IMU – des,sel (If Nav sel IMU unknown, pick one of two remaining  
IMUs)

CRT1 Record RESID V \_\_\_\_\_ and H \_\_\_\_\_

If RESID V and H < 0.6:

Go to STAR TRACKER NAV, step 3 6A

CRT2 Other IMU – des,sel

CRT1 Record RESID V \_\_\_\_\_ and H \_\_\_\_\_

### 4. RESUME PASS

Continue with pass per STAR TRACKER NAV, step 3 6A, then  
After S TRK pass, on MCC GO:

#### NOTE

SELF-TEST may false fail. ✓MCC for S TRK status

2: GNC 22 S TRK/COAS CNTL

CRT2 –Z(–Y) SELF-TEST – ITEM 2(1) EXEC (\*)

SENSOR  
FAIL

## S TRK NAV – HIGH FLTR MINUS PROP

### 1. NAV SAFING

CRT1 1: GNC 33 RR REL NAV  
INH Angles – ITEM 24 EXEC (\*)

On MCC GO (continue if no comm):

### 2. CHECK FOR S TRK FALSE LOCK

2: GNC 22 S TRK/COAS CNTL

If –Z S TRK, perform COAS visual check:

#### NOTE

GNC 33 REL NAV: COAS X (+up) and COAS Y (+left)  
provide approx TGT position in COAS based on –Z  
S TRK measurement

✓ For debris near TGT position

If no debris near TGT position or TGT not visible:

Go to step 3

If debris near TGT position:

SV SEL – ITEM 4 EXEC (PROP)

PROP TO FLTR – ITEM 9 EXEC

–Z BREAK TRK – ITEM 8 EXEC

When S PRES – (\*):

CRT1 Monitor RESID V and H. Repeat BREAK TRK as reqd until stable  
lock-on

Go to STAR TRACKER NAV, step 2 6A

If –Y STRK, perform visual check through W1:

✓ For debris near TGT line-of-sight

If no debris near TGT line-of-sight or TGT not visible:

Go to step 3

If debris near TGT line-of-sight:

SV SEL – ITEM 4 EXEC (PROP)

PROP TO FLTR – ITEM 9 EXEC

–Y BREAK TRK – ITEM 7 EXEC

When S PRES – (\*):

CRT1 Monitor RESID V and H. Repeat BREAK TRK as reqd until stable  
lock-on

Go to STAR TRACKER NAV, step 2 6A

### 3. RESUME PASS

AUTO Angles – ITEM 23 EXEC (\*)

Continue –Z S TRK pass

After S TRK pass, on MCC GO:

#### NOTE

SELF-TEST may false fail. ✓MCC for S TRK status

2: GNC 22 S TRK/COAS CNTL

CRT2 –Z(–Y) SELF-TEST – ITEM 2(1) EXEC (\*)

## COAS NAVIGATION

### NOTE

1. Do not execute MC1 or Out-Of-Plane null
2. Prior COAS cal reqd to perform COAS NAV
3. COAS Nav must be started within ~10 min of Ti to guarantee adequate geometry for nav convergence
4. Breakout – If tgt not visible at MC2+18, refer to 1–3 for breakout criteria

A6U 1. COAS NAV CONFIG  
✓SENSE: –Z  
✓DAP: B7/AUTO/VERN(PRI)

CRT GNC 22 STRK/COAS CNTL  
COAS: SIGHT MODE – ITEM 22 EXEC (\*)  
REQD ID – ITEM 21 +1 EXEC  
✓POS –Z: ITEM 27 (\*)

GNC 33 REL NAV  
INH Angles – ITEM 24 EXEC (\*)  
If TGT NOT in COAS FOV:  
| ✓MCC  
If TGT in COAS FOV:  
FLTR TO PROP – ITEM 8 EXEC  
COAS – ITEM 14 EXEC (\*)  
✓SV SEL, ITEM 4: FLTR

Upon MCC uplink of COVARIANCE MATRIX,  
COVAR REINIT – ITEM 16 EXEC

A6U 2. COAS MARKS  
FLT CNTLR PWR – ON  
DAP: B/FREE/PRI(VERN)  
RHC: As reqd to maintain TGT in COAS center and maintain BODY YAW  
ERR < 10 deg

When TGT centered in COAS, ATT REF pb – push

CRT GNC 33 REL NAV  
If X and Y RESID magnitudes  $\geq 1.0$ :  
| ✓MCC  
If X and Y RESID magnitudes < 1.0:  
FOR – ITEM 25 EXEC  
✓SV UPDATE – non-zero (within 8 sec), then  
– 0.0 (after 8 sec more)

Repeat step 2 per schedule:  
One mark every 10–20 sec until sunset Post-Ti

At sunset,

A6U 3. END COAS NAV  
DAP: A7/AUTO/VERN(ALT)

CRT GNC 22 STRK/COAS CNTL  
COAS: DES – ITEM 25 EXEC (\*)

Resume rendezvous timeline

BACKOFF/BREAKOUTS

**BACKOFF/  
BREAKOUTS**

# PROXIMITY OPS BACKOFF

## NOTE

Procedure assumes orbiter in target's plane

A6U

- ✓SENSE: -Z
- ✓ADI ATT - LVLH
- ✓DAP: LO Z as reqd

1. If immediate backoff reqd,  
THC +Z (out) - init 0.2 fps opening rate
2. If on +RBAR:
  - ✓DAP: A/AUTO/VERN(PRI)
  - THC as reqd to maintain opening rate and target over PLB (-Z axis)
  - Null opening rate at 250 ft
  - THC: as reqd to stationkeep >>
3. If not on +RBAR, + or - VBAR:
  - DAP: INRTL
  - THC as reqd to maintain target over PLB (-Z axis)
4. When + or - VBar reached (Aft ADI pitch = 180 or 0):
  - DAP: LVLH
  - Config UNIV PTG with tail or nose to Earth track as appropriate

### GNC UNIV PTG

TGT ID: +2  
BODY VECT: +2 (tail to Earth: +VBar)  
                  +1 (nose to Earth: -VBar)  
OM: +0  
TRACK - ITEM 19 EXEC (CUR - \*)  
DAP: AUTO

THC: as reqd to maintain target over PLB  
(-Z axis) - low in COAS

5. If opening rate not established (step 1 not performed),  
THC: +Z (out) - init 0.2 fps opening rate
6. Null opening rate when safe range reached (standard range = 250 ft,  
flight specific as reqd),  
THC: as reqd to stationkeep

BACKOFF/  
BREAKOUTS

## HST RBAR BREAKOUT

### CAUTION

Constraints for use:

1. Orbiter on +Rbar in + XVV attitude
2. Range < 500 ft cg to cg
3. Tgt stable on Orbiter -Z axis

#### 1. AFT STATION CONFIG

- ✓ SENSE: -Z
- ✓ A/AUTO/VERN(PRI)
- ✓ DAP: LO Z

If RNG < 75 ft

#### 2. INITIATE BACKOUT

If RNG ≤ 75 ft:

- THC: +Z (out) as reqd to establish a +0.1 ft/sec opening rate
- Maintain lateral position within 8 deg of RBAR

When RNG > 75 ft

#### 3. PERFORM POSIGRADE/RETROGRADE BURN ON +RBAR

Config DAP A,B to A7,B7

- ✓ MCC for breakout direction

### NOTE

Posigrade burn will be performed if second rendezvous attempt is desired

DAP: A/AUTO/PRI

DAP TRANS: NORM/PULSE/PULSE

If Posigrade Sep:

THC: +X (up) for 12 sec (3.0 fps)

If Retrograde Sep:

THC: -X (down) for 12 sec (3.0 fps)

DAP TRANS: PULSE/PULSE/PULSE

FLT CNTLR PWR – OFF

DAP: A/INRTL/VERN(ALT)

Inform MCC when SEP complete

When RNG > 1500 ft

DAP: NO LO Z

# HST FLYAROUND/LOSS OF LO Z BREAKOUT

## CAUTION

Constraints for use:

1. HST near orbiter -Z axis
2. RNG > 10 ft (EE to grapple fixture)
3. RNG < 150 ft (nominal approach)  
or  
Post +Vbar crossing (inertial approach)

### 1. AFT STATION CONFIG

- ✓ SENSE: -Z
- ✓ DAP: LO Z

### 2. 1st BURN

DAP TRANS: NORM/PULSE/PULSE  
DAP: A/FREE/VERN(PRI)  
THC: -X (dn) for 7 sec (1.7 fps)

- \* If single fwd firing jet \*
- \* THC: -X (dn) for 14 sec \*

At TIG + 01:00,  
DAP: A/INRTL/PRI  
DAP TRANS: PULSE/PULSE/PULSE

### 3. PLACE AND MAINTAIN HST IN OH WINDOW

DAP: A/INTRL/VERN(PRI)  
DAP ROT: DISC/PULSE/DISC  
RHC: +/- PITCH as reqd to place HST in OH Window  
DAP ROT: DISC/DISC/DISC  
Repeat RHC: +/- PITCH as reqd to maintain HST in OH Window

### 4. 2nd BURN (Out-Of-Plane)

When RNG > 1500 ft:  
DAP: no LO Z  
GNC, OPS 202 PRO

GNC ORBIT MNVR EXEC

- ✓ RCS SEL - ITEM 4 EXEC (\*)

Set TIG to current time +1 min  
TGT PEG 7  $\Delta V_X$  - ITEM 19 +0 EXEC  
 $\Delta V_Y$  - ITEM 20 +2 EXEC  
 $\Delta V_Z$  - ITEM 21 +0 EXEC

LOAD - ITEM 22 EXEC  
TIMER - ITEM 23 EXEC

- ✓ VGO Z  $\geq$  0; if VGO Z < 0 then:

- \* TGT PEG 7  $\Delta V_Y$  - ITEM 20 -2 EXEC \*
- \* LOAD - ITEM 22 EXEC \*
- \* TIMER - ITEM 23 EXEC \*
- \* ✓ VGO Z  $\geq$  0 \*

Do not MNVR to BURN ATT

At TIG, deflect THC to null VGOs

Record 2nd Burn TIG \_\_\_/\_\_\_:\_\_:\_\_\_

5. 3rd BURN (Posigrade/Retrograde)

✓MCC for breakout direction

If Posigrade Sep:

If  $\Delta VY$  (step 3) +2:

TV ROLL – ITEM 5+2 7 0 EXEC

If  $\Delta VY$  (step 3) –2:

TV ROLL – ITEM 5+9 0 0 EXEC

Set TIG to 3rd Burn + 22 min:

TGT PEG 7  $\Delta VX$  – ITEM 19+3.5 EXEC

$\Delta VY$  – ITEM 20+0 EXEC

$\Delta VZ$  – ITEM 21+0 EXEC

If Retrograde Sep:

If  $\Delta VY$  (step 3) +2:

TV ROLL – ITEM 5+9 0 0 EXEC

If  $\Delta VY$  (step 3) –2:

TV ROLL – ITEM 5+2 7 0 EXEC

Set TIG to 3rd Burn + 22 min:

TGT PEG 7  $\Delta VX$  – ITEM 19–3.5 EXEC

$\Delta VY$  – ITEM 20+0 EXEC

$\Delta VZ$  – ITEM 21+0 EXEC

LOAD – ITEM 22 EXEC

TIMER – ITEM 23 EXEC

MNVR – ITEM 27 EXEC

DAP: B/AUTO/PRI

At TIG–0:30

DAP: A/INTRL/PRI

At TIG, deflect THC to null VGOs

FLT CNTLR PWR – OFF

DAP: A/INTRL/VERN(ALT)

GNC, OPS 201 PRO



# RNDZ BREAKOUT

## NOTE

This procedure may be performed anytime between Ti and 500 ft. For the contingency inertial approach, this procedure may be performed anytime between Ti and the +V bar crossing

1. BREAKOUT BURN PREP  
DAP: A/LVLH/PRI  
FLT CNTLR PWR – ON
  
  2. 3 FPS OUT OF PLANE (CONTINGENCY INERTIAL APPROACH RNDZ ONLY)  
DAP TRANS: PULSE/NORM/PULSE, NO LO Z  
GNC 33 REL NAV  
CRT If Y > 0:  
    FWD THC: +Y (right) 16 sec  
    (AFT THC: left)  
If Y < 0:  
    FWD THC: -Y (left) 16 sec  
    (AFT THC: right)  
DAP TRANS: PULSE/PULSE/PULSE
  
  3. 3 FPS RETROGRADE  
If RANGE < 1500 ft:  
    Config DAP B to B7  
    DAP: LO Z  
    DAP: B/AUTO/PRI  
    When in attitude:  
        DAP: A/LVLH/PRI
- CRT OPS 202 PRO  
GNC ORBIT MNVR EXEC  
✓ RCS SEL – ITEM 4 (\*)  
Set TIG to current time + 1:00  
If Contingency Inertial Approach Rndz:  
    Set TIG to current time + 15:00  
TGT PEG 7  $\Delta V_X$  – ITEM 19-3 EXEC  
     $\Delta V_Y$  – ITEM 20+0 EXEC  
     $\Delta V_Z$  – ITEM 21+0 EXEC  
LOAD – ITEM 22 EXEC  
TIMER – ITEM 23 EXEC  
DO NOT MNVR TO BURN ATT  
At TIG, deflect THC to null VGOs  
FLT CNTLR PWR – OFF
- CRT OPS 201 PRO  
DAP: A/AUTO/VERN

Ti DELAY BURN

**Ti DELAY BURN**

## Ti DELAY BURN

### 1. OPS 202 PRO

GNC ORBIT MNVR EXEC

Load Ti Delay Pad, 3–8

If RCS:

Perform RCS BURN (Cue Card), then go to step 2

If OMS:

Perform RNDZ OMS BURN, 5–3, then go to step 2

### 2. Reload new Basetime per MCC

GNC 34 ORBIT TGT

TGT NO – ITEM 1 +1 EXEC

Set BASETIME to new Ti TIG \_\_\_\_/\_\_\_\_:\_\_\_\_:\_\_\_\_

Load – ITEM 26 EXEC

Reset ET, SM timers to new Ti TIG

### 3. Perform Post Ti Nav [20B], 4–20, then

✓MCC for return to nominal timeline

✓If no NCC reqd,

Return to RENDEZVOUS TIMELINE at PET: –01:00, 4–17

If NCC reqd,

Return to RENDEZVOUS TIMELINE at PET: –01:20, 4–15

#### NOTE

Extra NCC Burn and Ti Onboard Solution pads, 5–19

Ti DELAY BURN

### NCC BURN SOLUTION

TIG

			/			:			:		
--	--	--	---	--	--	---	--	--	---	--	--

#### PRELIMINARY

#### INTERMEDIATE

ΔVX

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( )			.	
			.	

ΔVY

ΔVZ

ΔVT

#### FINAL

#### GROUND

#### FINAL-GROUND LIMITS

ΔVX

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(.)

(.)

(.)

ΔVY

ΔVZ

ΔVT

### Ti ONBOARD SOLUTIONS

#### PREL FLTR

#### 1ST INTER FLTR

#### 2ND INTER FLTR (IF REQD)

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#### FINAL FLTR

#### PROP (IF REQD)

#### FINAL - GROUND LIMITS

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FINAL Ti PAD (MNVR PADS)

# RNDZ NAV RECOVERY

CRT 1. If Recovery from OPS MODE RECALL:  
 (add/delete GPC to/from redundant set)

GNC 33 REL NAV

NOTE  
 Asterisks will not change until  
 RNDZ NAV enabled

Inhibit RNG – ITEM 18 EXEC  
 RDOT – ITEM 21 EXEC  
 Angles – ITEM 24 EXEC  
 RNDZ NAV ENA – ITEM 1 EXEC (\*)

GNC UNIV PTG

TRK – ITEM 19 (CUR – \*)  
 Go to step 3

2. If Recovery from OPS TRANSITION (G8/G3 to G2):

GNC 34 ORBIT TGT

TGT NO – ITEM 1 +1 EXEC  
 Set BASE TIME to Ti TIG (Ti Burn Pad, 3–6)  
 LOAD – ITEM 26 EXEC

GNC 33 REL NAV

Upon MCC uplink of TGT SV,  
 RNDZ NAV ENA – ITEM 1 EXEC (\*)

NOTE  
 If RNDZ NAV not enabled (no \*),  
**DO NOT PROCEED.** ✓MCC

Select appropriate target track attitude

	-Z	-Y (STRK)	+Y (RR)
TGT ID	+1	+1	+1
BODY VECT	+3	+4	+5
P	✓+90	✓+0	+0
Y	✓+0	✓+280.6	+90
OM	+0	+90	+180

TRK – ITEM 19 (CUR – \*)

C3 3. DAP: ALT  
 DAP: A/AUTO  
 DAP ROT: DISC/DISC/DISC

When in attitude:  
 DAP: VERN

If NAV sensor data available:  
 If STRK NAV:  
 Perform STAR TRACKER NAV 6A, 4–6 >>

If RR NAV:  
GNC 33 REL NAV  
 KU ANT ENA – ITEM 2 (\*)  
 GNC I/O RESET  
 Go to RR NAVIGATION 17C, 4–17

CRT

## LOSS OF VERNIERS

### NOTE

This procedure overrides LOSS OF VERNIERS  
(ORB OPS) during rendezvous ops

Use VERN fail downmodes (PRI/ALT) specified in parentheses and follow VERN fail starred blocks per Timeline. If VERN fail downmode not specified, use PRI Nose and Tail control

## LOSS OF LO Z BRAKING

During Approach:

If 2 -X jets ↓ (Degraded LO Z braking):

**CAUTION**

LO Z +Z translation with a single -X jet  
will couple strongly into +X translation

Maintain DAP: LO Z  
Minimize LO Z +Z translations  
Continue approach and attempt grapple >>

If 3 -X jets ↓ (Loss of LO Z Braking and/or -X translation not available):

If RNG > 150 ft:

Breakout 3 fps posigrade or retrograde per MCC

If RNG < 150 ft:

Breakout using ±Y translation or NORM Z braking as reqd to avoid collision

✓MCC for subsequent maneuvers >

If 2 +X jets ↓ in same pod (Loss of LO Z Braking):

If 150 < RNG < 1500 ft:

Maintain Rbar within 10 deg (do not initiate flyaround)

Maintain DAP: LO Z

If LO Z not recoverable:

If 500 < RNG < 1500

Perform RNDZ BREAKOUT, 5-16

If 150 < RNG < 500

Perform HST RBAR BREAKOUT, 5-13

If possibility of recovering LO Z:

Establish stationkeeping at 120 ft ± 10 ft

If RNG < 150 ft and range to grapple > 10 ft:

Perform HST FLYAROUND/LOSS OF LO Z BREAKOUT, 5-14

If Range to Grapple < 10 ft:

Proceed with NORM Z braking and perform grapple

Maintain DAP: LO Z when not braking

## TGT ITER

When in Lambert Targeting and TGT ITER occurs:

If PRED MATCH other than 999999 (all 9s):

✓MCC and read down PRED MATCH from SPEC 34 (MCC has delta Vs)

On MCC GO or if no comm:

Recall TGT set and recompute

If TGT ITER recurs and PRED MATCH less than 400:

Contact MCC and read down PRED MATCH from SPEC 34

On MCC GO or if no comm:

Load current delta Vs and execute as Lambert burn >>

If TGT ITER recurs and PRED MATCH greater than 400:

Contact MCC and read down PRED MATCH from SPEC 34

On MCC GO or if no comm:

Load ground solution and execute as EXT DV burn

(If MC burn, uplink of ground solution reqd) >>

If ground solution not available: No burn >>

If PRED MATCH 999999 (all 9s):

On MCC GO or if no comm:

Load ground solution and execute as EXT DV burn

(If MC burn, uplink of ground solution reqd) >>

If ground solution not available: No burn >>



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REFERENCE DATA

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POST Ti ..... 6-6  
    MC3 ..... 6-7  
COAS SUBTENDED ANGLE (DEG) VS RANGE (FEET) ..... 6-8

**REFERENCE  
DATA**

**STS-103 HST RNDZ OPS DAP CONFIGURATIONS**

	RNDZ		FLYAROUND		RBAR		SPEC 20 ITEM #	
	A7	B7	A8	B8	A13	B13	A	B
<b>PRI</b>								
ROT RATE	0.200	0.500	0.200	0.200	0.050	0.050	10	30
ATT DB	2.00	2.00	1.00	1.00	2.00	2.00	11	31
RATE DB	0.20	0.20	0.10	0.10	0.20	0.20	12	32
ROT PLS	0.10	0.04	0.10	0.04	0.10	0.04	13	33
COMP	.000	.000	.000	.000	.000	.000	14	34
P OPTION	ALL	ALL	TAIL	TAIL	ALL	ALL	15	35
Y OPTION	ALL	ALL	TAIL	TAIL	ALL	ALL	16	36
TRAN PLS	0.10	0.05	0.05	0.01	0.10	0.05	17	37
<b>ALT</b>								
RATE DB	0.100	0.100	0.200	0.200	0.100	0.100	18	38
JET OPT	ALL	ALL	ALL	ALL	ALL	ALL	19	39
# JETS	2	2	2	2	2	2	20	40
ON TIME	0.08	0.08	0.08	0.08	0.08	0.08	21	41
DELAY	0.00	0.00	0.00	0.00	0.00	0.00	22	42
<b>VERN</b>								
ROT RATE	0.0160	0.2000	0.2000	0.2000	0.0500	0.0500	23	43
ATT DB	1.000	1.000	1.000	1.000	1.000	1.000	24	44
RATE DB	.020	.020	.020	.020	.020	.020	25	45
ROT PLS	0.010	0.002	0.010	0.010	0.010	0.002	26	46
COMP	.000	.000	.000	.000	.000	.000	27	47
CNTL ACC	0	0	0	0	0	0	28	48

### TARGETING DATA

SPEC 34 ITEM NO	1			6	17	18	19	20		
TGT ALTITUDE	TGT NO	DESCRIPTION	T1 REL TO BASETIME	EL (DEG)	DT (MIN)	DX (KFT)	DY (KFT)	DZ (KFT)	NOTES	
130	9	NCC	-0/00:55:48	0	55.8	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	74.4	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	54.4	-0.9	0	+1.8		
		12	MC2	0/00:47:24	28.45	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
150	9	NCC	-0/00:56:18	0	56.3	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	75.1	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	55.1	-0.9	0	+1.8		
		12	MC2	0/00:48:06	28.46	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
170	9	NCC	-0/00:56:48	0	56.8	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	75.7	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	55.7	-0.9	0	+1.8		
		12	MC2	0/00:48:42	28.66	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
190	9	NCC	-0/00:57:12	0	57.2	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	76.3	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	56.3	-0.9	0	+1.8		
		12	MC2	0/00:49:18	28.85	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	

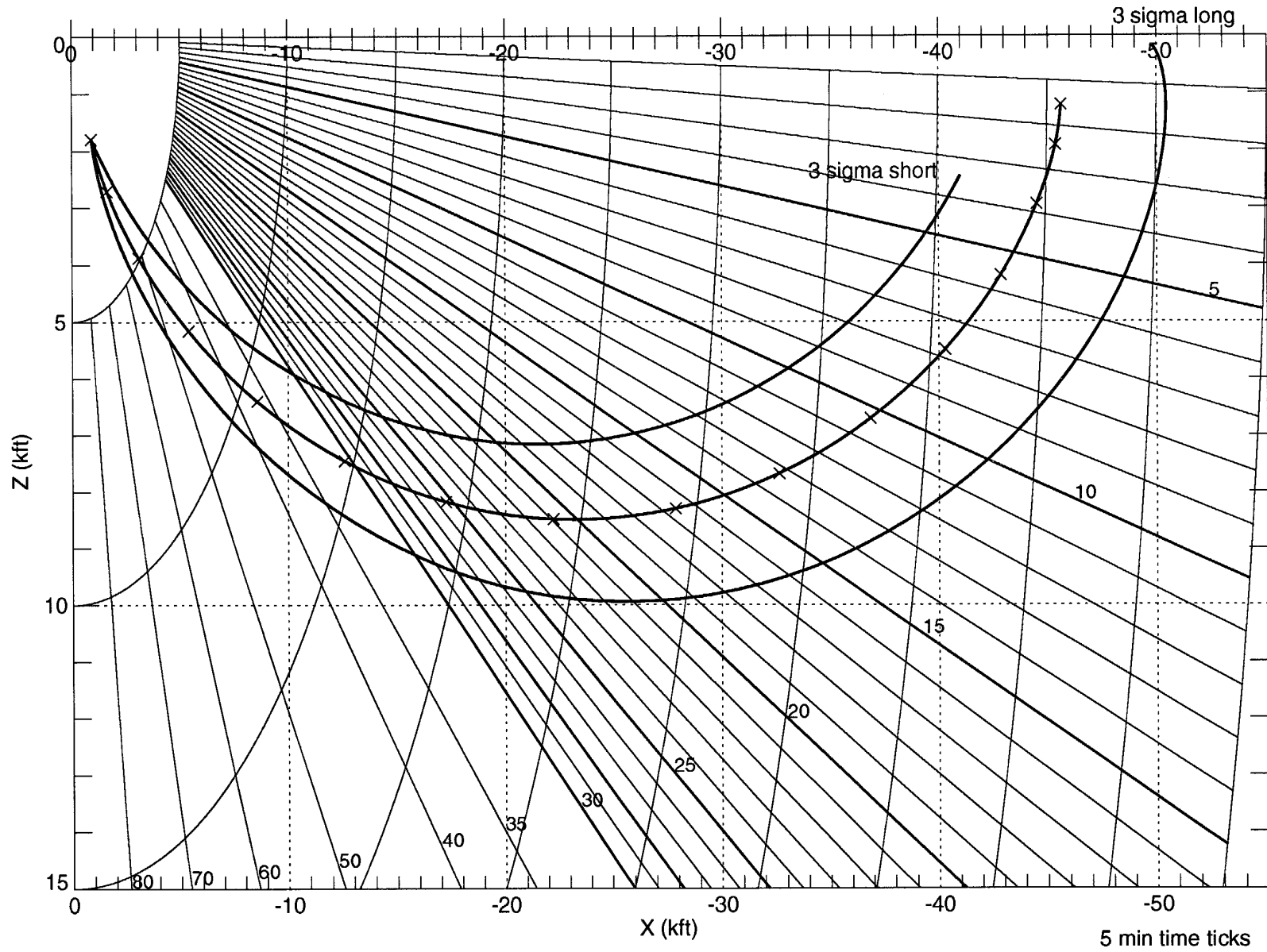
### TARGETING DATA (Cont)

SPEC 34 ITEM NO	1			6	17	18	19	20		
TGT ALTITUDE	TGT NO	DESCRIPTION	T1 REL TO BASETIME	EL (DEG)	DT (MIN)	DX (KFT)	DY (KFT)	DZ (KFT)	NOTES	
210	9	NCC	-0/00:57:42	0	57.7	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	76.9	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	56.9	-0.9	0	+1.8		
		12	MC2	0/00:49:54	29.07	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
230	9	NCC	-0/00:58:12	0	58.2	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	77.6	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	57.6	-0.9	0	+1.8		
		12	MC2	0/00:50:36	29.32	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
250	9	NCC	-0/00:58:42	0	58.7	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	78.2	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	58.2	-0.9	0	+1.8		
		12	MC2	0/00:51:12	29.55	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
270	9	NCC	-0/00:59:06	0	59.1	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	78.9	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	58.9	-0.9	0	+1.8		
		12	MC2	0/00:51:54	29.80	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	

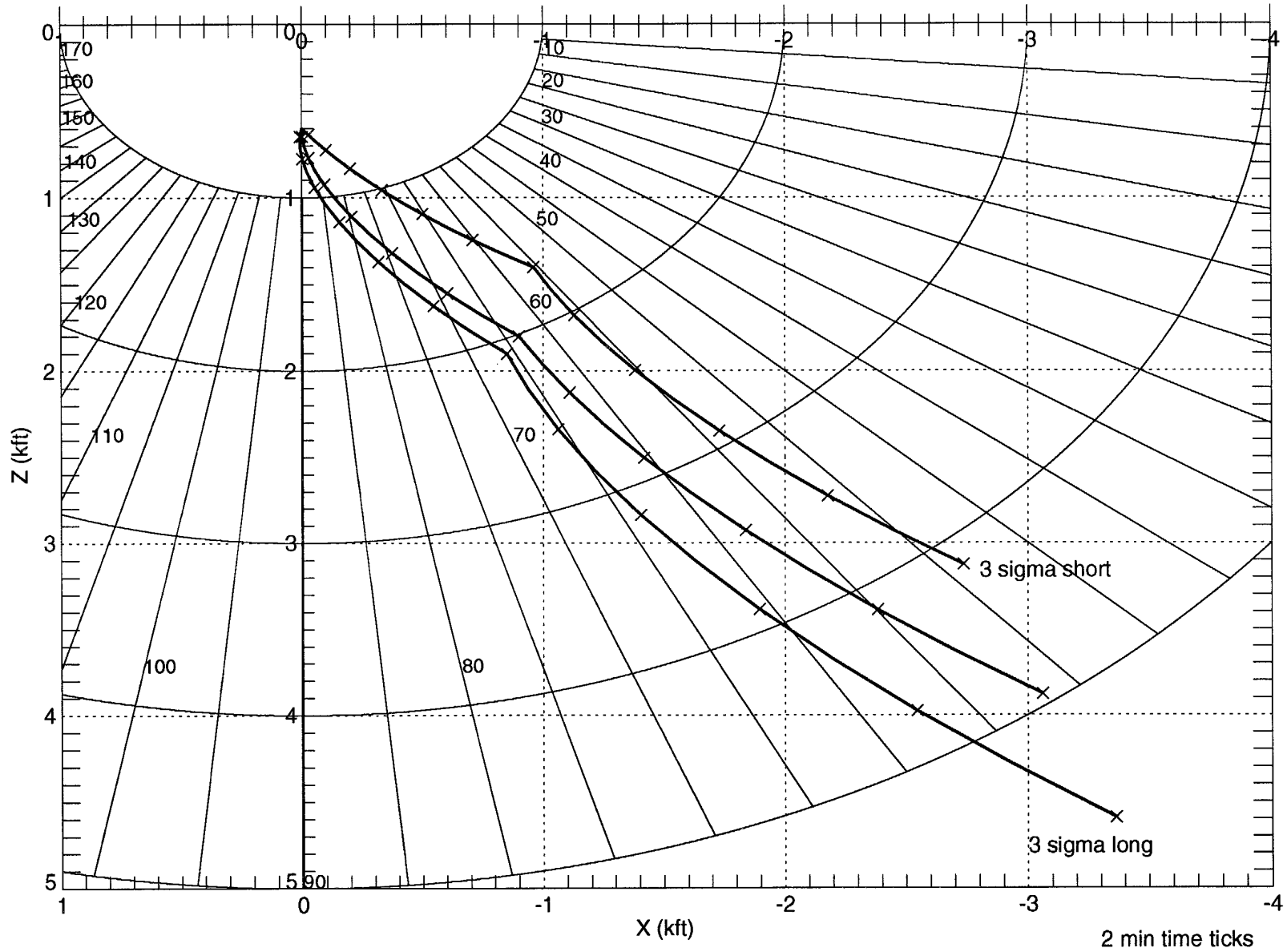
### TARGETING DATA (Cont)

SPEC 34 ITEM NO	1			6	17	18	19	20		
TGT ALTITUDE	TGT NO	DESCRIPTION	T1 REL TO BASETIME	EL (DEG)	DT (MIN)	DX (KFT)	DY (KFT)	DZ (KFT)	NOTES	
290	9	NCC	-0/00:59:36	0	59.6	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	79.5	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	59.5	-0.9	0	+1.8		
		12	MC2	0/00:52:30	30.03	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
310	9	NCC	-0/00:60:06	0	60.1	-48.6	0	+1.2	BASETIME = Ti TIG	
	10	Ti	0/00:00:00	0	80.1	-0.9	0	+1.8		
	11	MC1	0/00:20:00	0	60.1	-0.9	0	+1.8		
		12	MC2	0/00:53:06	30.25	27.0	-0.9	0	+1.8	BASETIME = MC2 TIG
		13	MC3	0/00:17:00	0	10.0	-0.9	0	+1.8	
		14	MC4	0/00:27:00	0	13.0	0	0	+0.6	
		19	MC2 ON TIME	0/00:00:00	0	27.0	-0.9	0	+1.8	
310 INTRL APPROACH	29	NCC	-0/00:60:06	0	60.1	-48.6	0	-1.2	BASETIME = Ti TIG	
	30	Ti	0/00:00:00	0	85.5	0	0	0		
	31	MC1	0/00:26:24	0	59.1	0	0	0		
		32	MC2	0/00:52:48	29.49	32.7	0	0	0	BASETIME = MC2 TIG
		33	MC3	0/00:10:00	0	22.7	0	0	0	
		34	MC4	0/00:20:00	0	12.7	0	0	0	
		39	MC2 ON TIME	0/00:00:00	0	32.7	0	0	0	

POST Ti

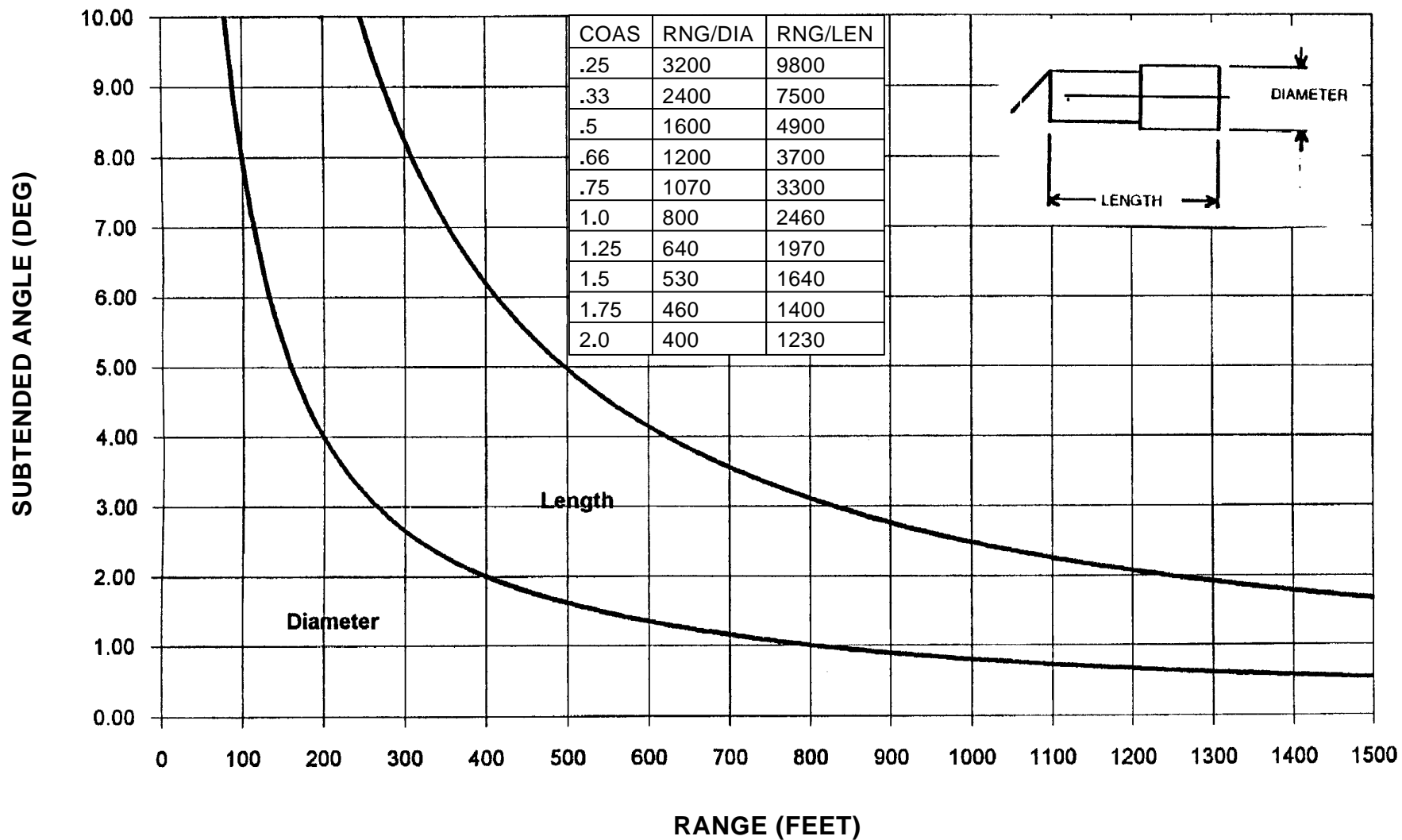


# POST MC3





### COAS SUBTENDED ANGLE (DEG) VS RANGE (FEET)

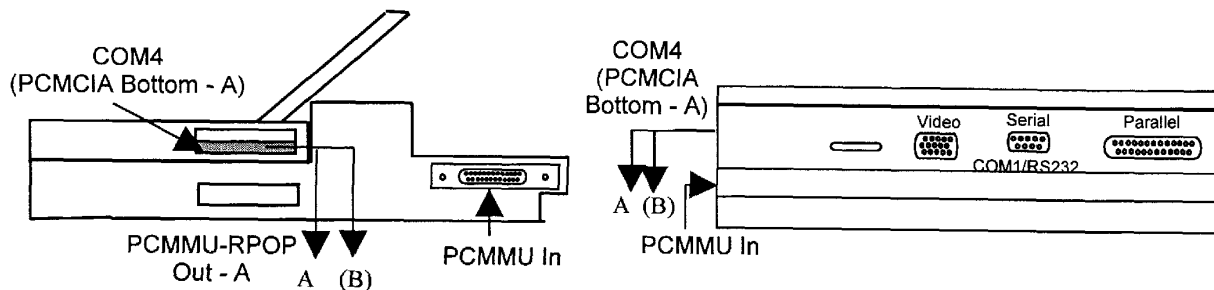


## RENDEZVOUS TOOLS

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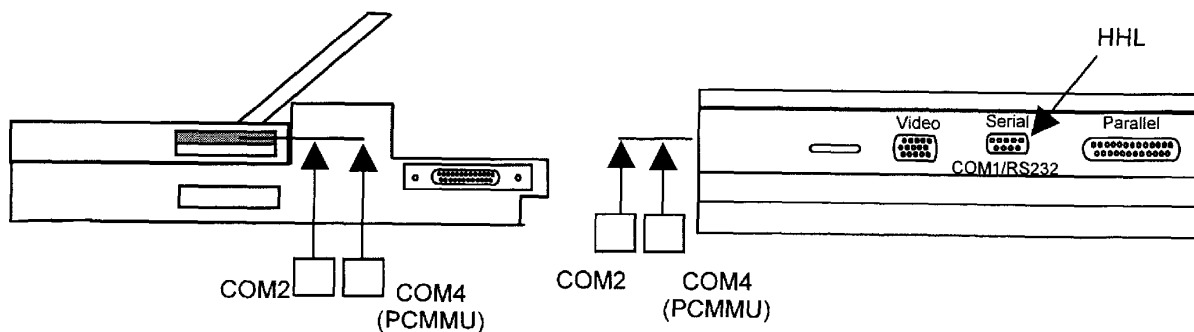
## PGSC SETUP

WINDECOM PGSC (STS-2) (Thinkpad 760XD with expansion chassis)



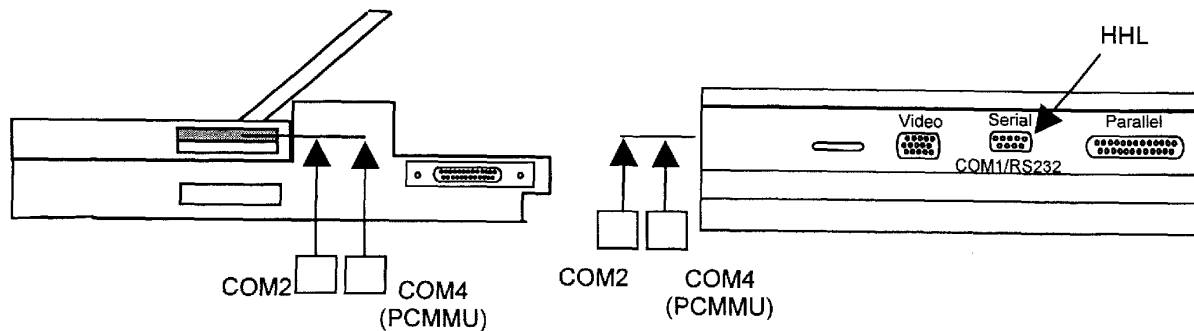
- Connect PCMMU Data Cable from pniO5 PCMMU to STS-2 PGSC PCMMU Port
- Connect RS422 Y Cable to STS-2 COM4 port (PCMCIA)

RPOP PGSC (STS-3) (Thinkpad 760XD with expansion chassis)



- Connect RS232 Y Data Cable from HHL to STS-3 COM1 port
- Connect RS422 Y Cable from STS-2 PGSC COM4 port (PCMCIA) to STS-3 PGSC COM4 port (PCMCIA)

RPOP2 PGSC (STS-4) (Thinkpad 760XD with expansion chassis)



- Connect RS232 Y Data Cable from HHL to STS-4 expansion chassis COM1 port
- Connect RS422 Y Cable from STS-2 PGSC COM4 port (PCMCIA) to STS-4 PGSC COM4 port (PCMCIA)

## RNDZ TOOLS CHECKOUT

1. ✓MCC uplink to TGT SV  
GNC 33 REL NAV  
RNDZ NAV ENA – ITEM 1 EXEC (\*)
2. ✓RNDZ TOOLS connected per PGSC SETUP
3. Perform PCDECOM OPS ACT (ORB OPS, PGSC)
4. Perform RPOP INITIALIZATION, steps 1 thru 6
5. Perform HAND–HELD LIDAR CHECKOUT  
✓HHL marks received by RPOP
6. When checkout complete:  
Exit RPOP – [SHIFT]/[F10], then  
HHL PWR SW – off, then  
Temp stow Rndz Tools as reqd
7. GNC 33 REL NAV  
RNDZ NAV ENA – ITEM 1 EXEC (no \*)

## **RNDZ TOOLS TROUBLESHOOTING**

Notify MCC then perform each step from appropriate procedure, one at a time, until functionality restored

### **PCDECOM NOT RECEIVING DATA**

1. ✓Cable securely connected to proper port
2. ✓Correct TFLs
3. ✓Correct PCDECOM config file selected
4. Reboot PCDECOM PGSC
5. Change out PCMMU Data cable
6. Try PCMMU 1 connection on middeck
7. Try alternate PCMMU and assoc port on Flight Deck (✓MCC prior to loading appropriate TFLs)
8. Swap PCDECOM PGSC and RPOP PGSC
9. ✓MCC

### **RPOP NOT RECEIVING PCMMU DATA**

1. ✓Cable securely connected to proper ports
2. ✓Correct RPOP port config in RPOP s/w
3. Quit and restart RPOP
4. Reboot aff PGSC and restart RPOP
5. Change out aff WinDecom RS422 Y cable
6. ✓MCC

### **RPOP NOT RECEIVING HHL DATA**

1. ✓Cable securely connected to proper ports
2. ✓Correct RPOP port config in RPOP s/w
3. Quit and restart RPOP
4. Reboot aff PGSC and restart RPOP
5. Change out RS232 HHL Data cable
6. Try alternate HHL unit
7. Swap PCDECOM PGSC and RPOP PGSC
8. ✓MCC

## HAND-HELD LIDAR CHECKOUT

1. Unstow HHL, Battery Pack(s), and RS232 cable

Connect RS232 cable from HHL to PGSC  
Plug Battery Pack into HHL

Verify RPOP program enabled per RPOP INITIALIZATION, 7-7

2. Perform HAND-HELD LIDAR OPS, 7-6

3. Take multiple (~10) Range and Velocity measurements using top center of aft PLB bulkhead as TGT

✓HHL data received by RPOP (HHL trajectory source must be selected)

Range check:

✓Range from aft port window to bulkhead = 60 ft

Velocity check:

Depress trigger for 5 sec

✓Velocity = 0.0 fps

Self-Test: Press and hold Test Mode button, ✓8.8.8.8. Select range

## HAND-HELD LIDAR STOW

Power sw – OFF

Remove RS232 cable  
Unplug Battery Pack

Stow HHL, Battery Pack(s), and RS232 cable

## HAND-HELD LIDAR OPS

Power sw – ON

### NOTE

If message 'LoB' or flashing 8888 on display or irregular tone emitted, replace battery

Display Intensity knob – Adjust intensity to minimum acceptable level

Select Range or Velocity decimal place by toggling RANGE/VELOCITY buttons

Range pb – 1 ft or 0.1 ft

Velocity pb – 0.1 fps or 0.01 fps

Center red dot on TGT

Depress trigger for each measurement

Hold trigger for velocity measurements

Raw HHL Velocity accuracy increases with trigger hold duration:

<u>Duration</u>	<u>Accuracy</u>
0.5	0.15
1.0	0.06
2.0	0.03
5.0	0.01

As reqd, mount HHL on multiuse arm, in port OVHD window

To verify lock-on (if desired):

1. Push Test Mode button
2. Center red dot on TGT
3. Depress and hold trigger; Pitch on tone proportional to received signal strength
4. Press Range or Velocity button to return to Operational Mode

Error Codes:

- EO1 Never acquired target because target was out of range or target was too close
- EO2 Excessive percentage of total laser pulses in measurement sample was unsatisfactory
- EO3 Excessive number of consecutive laser pulses in measurement sample was unsatisfactory

## RPOP INITIALIZATION

### NOTE

Do not connect RS232 or RS422 cables (with data flowing) to PGSC prior to PGSC powerup

1. Power on RPOP/TCS PGSCs
2. From Startup Menu, select appropriate expansion chassis config
3. From Windows95, open RPOP folder (resides within Shuttle Apps desktop folder), then select appropriate RPOP icon

RPOP logo display

RPOP Initialization

4. Enter MET of program startup:  
Days>\_\_\_\_/Hr>\_\_:Min>\_\_:Sec>\_\_\_\_  
  
Select appropriate Phase of Flight:  
\_\_\_ Rendezvous \_\_\_ Prox Ops \_\_\_ Deploy  
  
Click [OK] to continue

### NOTE

Time synchronized on [OK]

5. If Rendezvous Phase selected:

Rendezvous Initialization

Enter one of following times, as appropriate:

\_\_\_Ti TIG (in MET)> Days>\_/Hr>\_\_:Min>\_\_:Sec>\_\_  
\_\_\_Time Since MC2> Hr>\_\_:Min>\_\_:Sec>\_\_

### NOTE

If Time Since MC2 is not initialized,  
RPOP assumes MC2 at Ti + 50 min

Trajectory Display

6. ✓PCM selected – status displayed above F6 ([F6] to enable/disable)  
✓RPOP is receiving PCMMU data  
If no target state vector onboard, expect flashing error messages  
If target state vector, but rel nav not enabled, expect bad relative states

7. Update target LVLH attitude as reqd – [SHIFT]/[F6]

Enter Target Vehicle's LVLH Attitude

Pitch > \_\_\_\_\_ Yaw > \_\_\_\_\_ Roll > \_\_\_\_\_



## RPOP OPS

1. ✓RPOP SETUP complete:
  - ✓RPOP window title bar – verify mission specific scenario
  - In upper right corner of Trajectory Display:
    - ✓Time – counting as reqd
    - ✓Approach – as reqd
    - ✓RPOP configuration – as reqd (Pitch, Alt)
  
2. Begin processing trajectory data:
  - Configure/input trajectory data as needed per RPOP FUNCTION KEY SUMMARY (Trajectory Data Keys)
  
3. Update Time (as reqd):
  - [CNTL]/[F10]
  - 
  - Select [Update Time. . .] button
  - 
  - Update desired times and click [OK] when finished
  
4. Reconfig Serial Ports (as reqd):
  - [CNTL]/[F10]
  - 
  - Select [Comm Ports. . .] button
  - 
  - Reconfig desired com ports/DLL and click [OK] when finished
  
5. Reconfig TCS No./Reflector No. Settings (as reqd):
  - [CNTL]/[F10]
  - 
  - Select [TCS/Refl. . .] button
  - 
  - Reconfig desired TCS No. and/or Reflector No. and click [OK] when finished
  
6. Config Average RDOT guidance (as reqd):
  - Select Guid – [CTRL]/[F5]
  - 
  - Select [Average Rdot] button – [A]
  - 
  - Start timer – [OK]
  - 
  - Enter time until docking. Timer starts when OK pressed
    - Min > \_\_\_\_\_
    - Sec > \_\_\_\_\_

7. Config TCS NAV (as reqd):
  - Select the [Data] key for the TCS (CTRL row in columns F1 through F4)
  - If there is no [Data] key for TCS, reconfigure a data source for TCS
  - [F#]-TCS
  - Select Nav option – [N]
  - Click [OK] when finished
  
8. Config HHL NAV (as reqd):
  - Select the [Data] key for the HHL (CTRL row in columns F1 through F4)
  - If there is no [Data] key for HHL, reconfig a data source for HHL
  - [F#]-HHL
  - Select the [HHL Nav. . .] config button – [Alt]/[H]
  - HHL Nav Configuration
  - Enable HHL Nav (if unchecked) – [H]
  - Click [OK] to close HHL Nav dialog
  - Click [OK] or [Update Settings] to close HHL dialog
  
9. Change configuration and/or input data as reqd per RPOP FUNCTION KEY SUMMARY
  - Move axes or zoom in/out as desired per RPOP KEYSTROKE SUMMARY
  - Use [SPACEBAR] to toggle on–screen Function Key Menu ON/OFF
  - Use [F11] to cycle through declutter levels
  - Use [F12] to snap a range ruler mark; [SHIFT]/[F12] to clear it
  - Use [F10] for HELP
  
10. To exit RPOP program – [SHIFT]/[F10]

## RPOP FUNCTION KEY SUMMARY

### TRAJECTORY DATA KEYS (Columns F1 → F4)

---

- [F1 → F4]** PRIME KEY  
(SV, RR, HHL, CCTV or TCS)  
Make this Trajectory the Prime Trajectory
- Only one trajectory can be Prime at a time
  - Prime Trajectory has orbiter graphics, predictors, and color-coordinated digital data
- [SHIFT]/[F1 → F4]** SHOW/HIDE KEY  
(Show/Hide)  
Show or Hide this Trajectory (toggle)
- Prime Trajectory cannot be hidden
  - Background processing of trajectory continues even when hidden  
(Exception: HHL trajectory data will not prompt for user input when hidden)
- [CTRL]/[F1 → F4]** DATA KEY  
(Data)  
Configure/input data for the trajectory
- Allows user to configure specific Trajectory Data Source Options
  - Allows user to input manual data
  - Allows user to reconfigure function key to another Trajectory Data Source
  - Duplicate Trajectory Data Source configurations are permitted (e.g., HHL could be configured for both F3 and F4, if desired)

#### NOTE

Although duplicate data source configurations are permitted, duplicate automatic data modes (namely, State Vector, RR Auto, TCS Auto and TCS Nav) are not permitted. In such a situation, the duplicated auto mode option will simply be grayed out in Trajectory Data Source Options dialog box

## GENERAL FUNCTION KEYS (Columns F5 → F12)

---

**[F5]** Not used

**[SHIFT]/[F5]**  
(Orb Att) ORBITER ATTITUDE  
Update orbiter LVLH-to-ADI attitude (Pitch-Yaw-Roll in -Z sense)

**[CTRL]/[F5]**  
(Guid) GUIDANCE  
Select guidance cues on demand  
Available options are:  
Average Rdot – information for timed approach  
Radar Fail – do not use Radar Fail solution for ORBT Rendezvous Trajectory  
Approach Stabilization – burn solution to null orbiter Body Xdot at approach THETA

---

**[F6]**  
(PCMMU) PCMMU MODE  
No PCM mode (displays No PCM)  
Manual Data Entry With or Without -Z LVLH PITCH Assumptions:  
Enter data via Function Key command  
If -Z LVLH PITCH assumed (P Assmp selected)  
Initial -Z LVLH PITCH propagated at orbital rate until Final Approach pitch reached  
If -Z LVLH PITCH not assumed (No P Assmp selected)  
-Z LVLH PITCH input required with each data entry

PCM mode (displays PCM)  
Automatic Data Entry Without -Z LVLH PITCH Assumptions  
RR or SV data input automatically from PCMMU  
-Z LVLH PITCH input from PCMMU

**[SHIFT]/[F6]**  
(Tgt Att) TARGET ATTITUDE  
Update Target LVLH-to-Body attitude (Pitch-Yaw-Roll) and specify rate (LVLH Hold or Inertial)

**[CTRL]/[F6]**  
(Low Z) LOW Z  
Toggle jet-select between No Low Z and Low Z for making THC  
“What if” inputs  
Displays Low Z

---

**[F7]**  
(View) VIEW  
If Tgt-Centered LVLH, cycle through views: XZ, XY, YZ  
If Orb-Centered LVLH, cycle through views: XZ, XY, YZ, CAM  
View identification displayed upper left-hand corner of Trajectory Display

**[SHIFT]/[F7]**  
(Ovrlay) OVERLAY  
Cycle through displays of overlays

**[CTRL]/[F7]**  
(OvrOrgn) OVERLAY ORIGIN (*Available only if Overlay is enabled*)  
Toggle anchor-point of corridor overlay between Target vehicle attach point and orbiter attach point

---

**[F8]**  
(Tgt/Orb) REFERENCE FRAME  
Toggle display between Tgt-Centered LVLH plot and Orb-Centered LVLH plot

**[CTRL]/[F8]**  
(POR) POINT OF REFERENCE  
Cycle through pre-selected orbiter Point-Of-Reference to Target  
Point-Of-Reference sets (e.g., CG to CG, Dock Port to Dock Port)

## GENERAL FUNCTION KEYS (Columns F5 → F12, Cont)

---

<b>[F9]</b> (THC Clr)	THC CLEAR Clear THC “What if” inputs from the Prime Trajectory
<b>[SHIFT]/[F9]</b> (TrajClr)	TRAJECTORY CLEAR Clear Prime Trajectory history of all but 2 most recent data inputs
<b>[CTRL]/[F9]</b> (Back 1)	BACK 1 Delete last data input from the Prime Trajectory

---

**[F10]**  
(Help)                   HELP  
Access on–line help information

**[SHIFT]/[F10]**  
(Exit)                   EXIT  
Save output files and exit RPOP program

**[CTRL]/[F10]**  
(Config)               RPOP CONFIGURATION  
Config the following RPOP options:

Approach Type

Select final approach attitude:

+Vbar – Assumes –Z LVLH PITCH = 180

+Rbar – Assumes –Z LVLH PITCH = 90

–Rbar – Assumes –Z LVLH PITCH = 270

Other LVLH – Input desired –Z LVLH PITCH for approach

Inertial – No approach attitude required (–Z LVLH PITCH is propagated)

None – No approach attitude required (–Z LVLH PITCH held constant)

Assume Pitch (Available in No PCM mode only)

Toggle the option for RPOP to prompt for orbiter LVLH attitude

(Pitch–Yaw–Roll in –Z sense) with each manually–entered mark

Displays either P Assmp or No P A

Debug

Enable serial port I/O debug text to be displayed. Displays Debug

Data Freq...

Change frequency of automatic acceptance (plotting) of PCM data (SV or RR Auto) or TCS data (TCS Auto)

Predictors...

Change number and/or time increment of displayed predictors

Update Time...

Update MET, TI TIG (in MET), or Time Since MC2

Option also exists to toggle the display of Time Since MC2

Altitude...

Change altitude of target vehicle

Comm Ports...

Reconfig the serial ports and/or the DLL

TCS/Refl...

Select TCS ID number (1–2) and reflector ID number (1–6)

Views...

Enable/disable Tgt– and Orb–Centered views

NOTE

The currently displayed view (both Tgt– and Orb–Centered) cannot be disabled

**GENERAL FUNCTION KEYS (Columns F5 → F12, Cont)**

---

- [CTRL]/[F10]** (Config) RPOP CONFIGURATION (Cont)  
Configure the following RPOP options:  
THC “What if”...  
Select DAP setting (trans pulse size) to be used for THC “What if” inputs  
Options include: Rndz DAP, Prox Ops DAP, and a User-Configurable DAP
- [F11]** DECLUTTER  
Cycle RPOPs display through 3 different levels of declutter
- [F12]** RANGE RULER SNAP  
Computes range rate based on time between snaps and an assumed delta-range interval. Feature available only if I-loaded delta-range interval has non-zero value
- [SHIFT]/[F12]** RANGE RULER CLEAR  
Clears range ruler display from screen. Feature available only if I-loaded delta-range interval has non-zero value

## RPOP KEYSTROKE SUMMARY

[CTRL]/[←] or l            Move Vertical axis left  
[CTRL]/[→] or r            Move Vertical axis right  
[CTRL]/[↑] or u            Move Horizontal axis up  
[CTRL]/[↓] or d            Move Horizontal axis down

[CTRL]/[PGUP]            Zoom IN on Trajectory Display  
[CTRL]/[X]/[PGUP]        Zoom IN on X axis only  
[CTRL]/[Y]/[PGUP]        Zoom IN on Y axis only  
[CTRL]/[Z]/[PGUP]        Zoom IN on Z axis only

[CTRL]/[PGDN]            Zoom OUT on Trajectory Display  
[CTRL]/[X]/[PGDN]        Zoom OUT on X axis only  
[CTRL]/[Y]/[PGDN]        Zoom OUT on Y axis only  
[CTRL]/[Z]/[PGDN]        Zoom OUT on Z axis only

### NOTES

Use [SHIFT] in combination with any of above keystrokes in order to scale/move axes in finer increments.

Each view may be independently scaled and/or auto-scaled

[CTRL]/[HOME]            Resume auto-scaling and reset scale  
[SPACEBAR]                Toggle on-screen Function Key Menu ON/OFF

### THC "What if" (-Z sense) Keystrokes (Prime Trajectory only)

	<u>DAP A8</u>	<u>DAP B8</u>
Z IN	[SHIFT]/[→]	[→]
Z OUT	[SHIFT]/[←]	[←]
X UP	[SHIFT]/[↑]	[↑]
X DOWN	[SHIFT]/[↓]	[↓]

## TRAJECTORY DATA SOURCE OPTIONS

**SV** STATE VECTOR  
*Options include:*  
State Vector – Enable automatic acceptance of the Onboard Nav states  
None – Turn State Vector processing off  
Config... – Reconfigure the Trajectory Data Source for this function key

**RR** RENDEZVOUS RADAR  
*Options include:*  
Manual – Manually enter Radar RNG, EL and AZ  
Auto – Enable automatic acceptance of Radar RNG, EL and AZ  
None – Turn Radar processing off  
Config... – Reconfigure the Trajectory Data Source for this function key

**HHL** HANDHELD LASER  
Manually select HHL Aim Point, Angle Source, and Angle Source Aim Point  
Manually enter HHL RNG and two Angle Source angles (an in-plane and out-of-plane)

*Options include:*  
Lock – Hold in-plane angle constant (locked) for each HHL mark  
Lock – Hold out-of-plane angle constant (locked) for each HHL mark  
Uppdate Settings – Accept config changes to Aim Points, Angle Source, and Lock option without incorporating a trajectory mark  
HHL Nav... – HHL Nav activation (on/off) and config (display resids & ratios, force measurements, re-initialize, length of trigger pull (short/long or long only))  
Config... – Reconfig Trajectory Data Source for this function key

*Angle Source options include:*  
Fwd CCTV, Aft CCTV, Dock Cam, COAS, Radar, TCS, *Other*, None

**Notes:**

- Manual inputs required for all angle sources except Radar, TCS and None
- If Radar or TCS selected, angles will be automatically snapped (if available)
- The *Other* camera is *optional*, and may be completely specified via I-load

*Aim Point options include:*

HHL Aim Pt, Tgt CG, *Point of Interest #1, Point of Interest #2, Point of Interest #3*

**Notes:**

- HHL Aim Pt is always available and may be completely specified via I-load
- Tgt CG is always available
- *Points of Interest 1–3* are *optional*, and may be completely specified via I-load
- For Angle Source Radar, the angle aim point is Tgt CG
- For Angle Source TCS, the angle aim point is the current reflector no

**CCTV** CLOSED CIRCUIT TELEVISION CAMERAS  
Manually enter FWD and AFT CCTV tilt angles  
*Options include:*  
Config... – Reconfigure the Trajectory Data Source for this function key



## TCS

### TRAJECTORY CONTROL SENSOR

*Options include:*

Manual – Manually enter TCS RNG, EL and AZ

Auto – Enable automatic acceptance of TCS RNG, EL and AZ

Nav – Enable TCS NAV (Kalman Filtering)

(display resids and ratios, force measurements, reinitialize)

None – Turn TCS processing off


Config – Reconfigure the Trajectory Data Source for this function key

CUE CARD CONFIGURATION

RCS BURN (+X, -X, Multi-axis) (Front) .....	CC 8-3
RENDEZVOUS PRPLT PAD (Back) .....	CC 8-4
KU OPS (Front) .....	CC 8-5
(Back) .....	CC 8-6
GPC/MDM FAILURE RESPONSE DURING RNDZ (Front) .....	CC 8-7
RNDZ REF DATA (Back) .....	CC 8-8
NOMINAL RADAR ANGLES AND CAMERA ANGLES RANGING CHART (Front) .....	CC 8-9
NOMINAL RADAR ANGLES AND CAMERA ANGLES RANGING CHART (Back) .....	CC 8-10
TOOL-CHASING (Front) .....	CC 8-11
(Back) .....	CC 8-12
KEEL CAMERA .....	CC 8-13

CUE CARD  
CONFIG

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HOOK VELCRO
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HOOK VELCRO
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**RCS BURN (+X, -X, Multi-axis)**

1. GNC, OPS 202 PRO  

GNC ORBIT MNVR EXEC
---------------------

  - ✓ RCS SEL, ITEM 4 – \*
2. If onboard computed burn:
  - ✓ TIG and TGT PEG 7 ΔVs per Final solution
  - ✓ Guidance option is LAMBERT
 If ground computed burn:
  - ✓ TGT data per Burn Pad (reload WT as reqd)
 LOAD – ITEM 22 EXEC  
 TIMER – ITEM 23 EXEC
3. If +X burn:
  - DAP: A/AUTO/ALT (B/ALT as reqd)
  - MNVR – ITEM 27 EXEC (\*)
  - If RR ops:
    - KU – AUTO TRK
    - |                |
|----------------|
| GNC 33 REL NAV |
|----------------|
    - INH Angles – ITEM 24 EXEC (\*)

**TIG-0:30**

4. FLT CNTLR PWR – ON  
 DAP TRANS: as reqd  
 If Multi-axis:  
 | DAP: A/LVLH/PRI  
 If +X or -X:  
 DAP: A/INRTL/PRI

**CAUTION**

LAMBERT burn must be completed by T1 TIG +1:30 to avoid guidance errors
--

- \* If start of LAMBERT burn delayed: \*
- \* Retarget burn, then go to step 2 \*

**TIG**

5. If VGO Z is neg, Z,X,Y seq;  
 otherwise, X,Y,Z  
 THC: Trim VGOs < 0.2 fps  
 FLT CNTLR PWR – OFF  
 DAP: ALT  
 If Multi-axis, when rates nulled:  
 DAP: VERN(ALT)  
 GNC, OPS 201 PRO
6. DAP: A/AUTO(B/AUTO/ALT as reqd)  
 DAP TRANS: PULSE/PULSE/PULSE
7. If RR ops and +X burn, when ATT ERR < 30 deg:  
 KU – GPC  
 ✓ KU TRACK tb – gray  

GNC 33 REL NAV
----------------

 AUTO Angles – ITEM 23 EXEC (\*)
8. When in attitude:  
 DAP: A/AUTO/VERN(ALT)

RNDZ-1a/103/O/A

(reduced copy)

TOP  
BACK OF 'RCS BURN (+X, -X, MULTI-AXIS)'

HOOK  
VELCRO

HOOK  
VELCRO

**RENDEZVOUS PRPLT PAD**

When L or R RCS QTY <  :

I'CNCT:  OMS to RCS (ORB PKT, RCS)

When G23  OMS/RCS QTY >  :

I'CNCT TK SWITCH: (ORB PKT, RCS)

When G23  OMS/RCS QTY >  :

I'CNCT RETURN (ORB PKT, RCS)

---

When L or R RCS QTY <  :

or when FRCS QTY <  :

DAP: NO LO Z

---

When L or R RCS QTY <  :

or when FRCS QTY <  :

If prior to Ti,  
Do not perform Ti

If after Ti, but prior to 500 ft:  
Perform RNDZ BREAKOUT (CONTINGENCY OPERATIONS), 5-16

If after 500 ft, but prior to INRTL ALIGNMENT  
FLYAROUND:  
Perform HST R-BAR BREAKOUT (CONTINGENCY OPERATIONS), 5-13

If after INRTL ALIGNMENT FLYAROUND, but prior to 10 ft:  
Perform HST FLYAROUND/LOSS OF LO Z  
BREAKOUT (CONTINGENCY OPERATIONS), 5-14

If inside 10 ft:  
Backout to 10 ft  
Perform HST FLYAROUND/LOSS OF LO Z  
BREAKOUT (CONTINGENCY OPERATIONS), 5-14

RNDZ-1b/103/O/A

(reduced copy)

TOP

HOOK  
VELCRO

**KU OPS**

1. CONFIGURE KU FOR RR TGT ACQ

GNC 33 REL NAV

- CRT ✓SV SEL, ITEM 4 – FLTR
- ✓INH RNG, ITEM 18 – (\*)
- RDOT, ITEM 21 – (\*)
- Angles, ITEM 24 – (\*)
- KU ANT ENA – ITEM 2 EXEC (\*)
- GNC I/O RESET
- A2 DIGI-DIS sel – R/RDOT
- A1U KU MODE – RDR PASSIVE
- ✓RDR OUTPUT – HI
- CNTL – PNL

KU sel – GPC >>

2. AUTO TRK ACQ

- KU sel – AUTO TRK
- SLEW – as reqd (as seen in COAS)
- ✓EL, AZ angles < 30 deg
- KU SEARCH – SEARCH (tb-gray)
- Repeat slew and search as reqd
- If acquisition not successful, ✓MCC >>

3. RR NAVIGATION

GNC 33 REL NAV

- CRT ✓RADAR, ITEM 13 – (\*)
- \* If RATIO > 1.0: \*
- \* ✓MCC \*
- FLTR TO PROP – ITEM 8 EXEC (\*)
- AUT RNG – ITEM 17 EXEC (\*)
- RDOT – ITEM 20 EXEC (\*)
- Angles – ITEM 23 EXEC (\*) >>

4. CONFIGURE KU FOR COMM

GNC 33 REL NAV

- CRT INH RNG – ITEM 18 (\*)
- RDOT – ITEM 21 (\*)
- Angles – ITEM 24 (\*)
- KU ANT ENA – ITEM 2 (no \*)
- A1U KU MODE – COMM
- ✓sel – GPC
- CNTL – CMD
- A2 DIGI-DIS sel – EL/AZ

HOOK  
VELCRO

RNDZ-2a/103/O/B

(reduced copy)

TOP  
BACK OF 'KU OPS'



**HOOK  
VELCRO**



**HOOK  
VELCRO**

RNDZ-2b/103/O/A



(reduced copy)

HOOK  
VEL-  
CRO

## GPC/MDM FAILURE RESPONSE DURING RNDZ

HOOK  
VEL-  
CRO

### NOTES

1. GPC assignments assume 1233 NBAT
2. Do NOT restrng for Non-Universal I/O Errors. Otherwise, a restrng for GPC 1,2,3 fails will recover everything (see expected restrng below)
3. If any GNC GPC fails, VERNs ↓
4. If IMUs not commfaulted, THCs are normally GO
5. Loss of FF2, FF4, FA3, and FA4 do not impact Rndz (unless other failures)

GPC	MDM	IMMEDIATE ACTION	MAJOR IMPACT
GPC1 (3232*)	FF1	1. If -Z ST NAV, INH ST to NAV 2. Work appropriate ORB PKT procedure 3. If not recovered: Use -Y ST, if reqd	1. C3 DAP lights latched (go out with MDM pwr fail) 2. -Z ST ↓
	FA1	Pre-MC4: DAP: ALT/AUTO Post-MC4: DAP: PRI/AUTO	VERNs ↓
GPC2 (1313*)	FA2	Pre-MC4: DAP: ALT/AUTO Post-MC4: DAP: PRI/AUTO	VERNs ↓
Man OMS Shutdown  GPC3 (1212*)  Loss of Aft DAP	FF3	1. Pre-MC4: DAP: ALT/AUTO Post-MC4: DAP: PRI/AUTO 2. If RR NAV, INH RR to NAV 3. If -Y ST NAV, INH ST to NAV 4. Work appropriate ORB PKT procedure 5. If not recovered: Work RR FAIL procedures	1. VERNs ↓ 2. RR→NAV/RPOP ↓ (Panel A2 OK) 3. A6 DAP lights latched (go out with MDM pwr fail) 4. -Y ST ↓ 5. Also for loss of GPC3: R OMS GMBL PRI/SEC ↓
GPC4 (1212*)	PL	If Ku breaks lock: KU sel - AUTO TRK	1. GPC Ku ptg ↓, slew in AUTO TRK if Ku breaks lock 2. No KU self-test

\* Expect this NBAT if GPC fail

MALFUNCTION	>>

RNDZ-3a/103/O/B

NOTE: Fabricate as a kneeboard (front)



TOP  
BACK OF 'GPC/MDM FAILURE RESPONSE DURING RNDZ'

HOOK  
VELCRO

**RNDZ REF DATA**

HOOK  
VELCRO

<p><b>FF1</b> FRCS MANF 1 JETS IMU 1 L OMS GMBL PRI SEL F,A THC contacts 1 L,A RHC channel 1 -Z STRK C3 DAP LTS FRCS OX QTY FRCS LOWEST QTY</p>	<p><b>FF2</b> FRCS MANF 2 JETS IMU 2 L OMS GMBL SEC SEL F,A THC contacts 2 L RHC channel 2 A RHC P,Y channel 2</p>	<p><b>FF3</b> FRCS MANF 4 JETS IMU 3 R OMS GMBL SEC SEL RR→NAV/RPOP F,A THC contacts 3 L,A RHC channel 3 VERNS -Y STRK A6 DAP LTS</p>	<p><b>FF4</b> FRCS MANF 3 JETS R OMS GMBL PRI SEL A RHC Roll channel 2</p>
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<p><b>FA1</b> ARCS MANF 1 JETS L OMS GMBL PRI L RCS MANF 5</p>	<p><b>FA2</b> ARCS MANF 3 JETS L OMS GMBL SEC R RCS MANF 5</p>	<p><b>FA3</b> ARCS MANF 2 JETS R OMS GMBL SEC</p>	<p><b>FA4</b> ARCS MANF 4 JETS R OMS GMBL PRI</p>
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**PL1**  
GPC KU PTG  
KU self-test

<p><b>CNTL AB1</b> PLB LTS (F,P BHD) L ADI ATT REF set cap</p>	<p><b>CNTL BC1</b> PLB LTS (FS, MID-P) R ADI ATT REF set cap VERNS</p>	<p><b>CNTL CA1</b> PLB LTS (AP, MID-S) OVHD DOCKING LIGHT</p>
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<p><b>CNTL AB2</b> L ADI ATT REF set cap L ADI: ATT, ERR, RATE set F MANF 1 JETS</p>	<p><b>CNTL BC2</b> R ADI ATT REF set cap R ADI: ATT, ERR, RATE set A6 DAP ROT, TRANS pbs</p>	<p><b>CNTL CA2</b> A ADI ATT REF set cap A ADI: ATT, ERR, RATE set F MANF 3 JETS A6 DAP ROT, TRANS pbs</p>
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<p><b>CNTL AB3</b> C3 DAP ROT, TRANS pbs</p>	<p><b>CNTL BC3</b> C3 DAP ROT, TRANS pbs</p>	<p><b>CNTL CA3</b> F MANF 4 JETS</p>
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<p><b>MAIN A</b> AC1B: RCS/OMS QTY gauges FWD EVENT TIMER APC1: L OMS GMBL PRI R OMS GMBL SEC L MANF 5 JETS FLC1: F MANF 1 JETS ALC1: L MANF 5 JETS OMS QTY GAUGING O14: -Z STRK L INST PWR AFT EVENT TIMER MPC1: OVHD DOCKING LTS AFT STB PLB LTS FWD PORT PLB LTS</p>	<p><b>MAIN B</b> MPC2: KU ANT HTRS 1 &amp; 2 FWD STB PLB LTS MID-PORT PLB LTS APC2: LOMS GMBL SEC R MANF 5 JETS ALC2: R MANF 5 JETS L OMS QTY GAUGE (single L OMS burns) O15: -Y STRK FWD EVENT TIMER R15: CCTV CAM-A CCTV MON-2 KU ANT ELEC 1 &amp; 2 (loss of KU comm &amp; RR) FLC2: F MANF 2 JETS</p>	<p><b>MAIN C</b> AC3A: COAS PWR FLC3: F MANF 4, 5 JETS APC3: R OMS GMBL PRI ALC3: R OMS QTY GAUGING (single R OMS burns) O16: PNL O3 OMS/RCS QTY R15: CCTV CAM-B CCTV KEEL CAMERA KU SIG PROC MPC3: AFT PORT PLB LTS MID-STBD PLB LTS</p>
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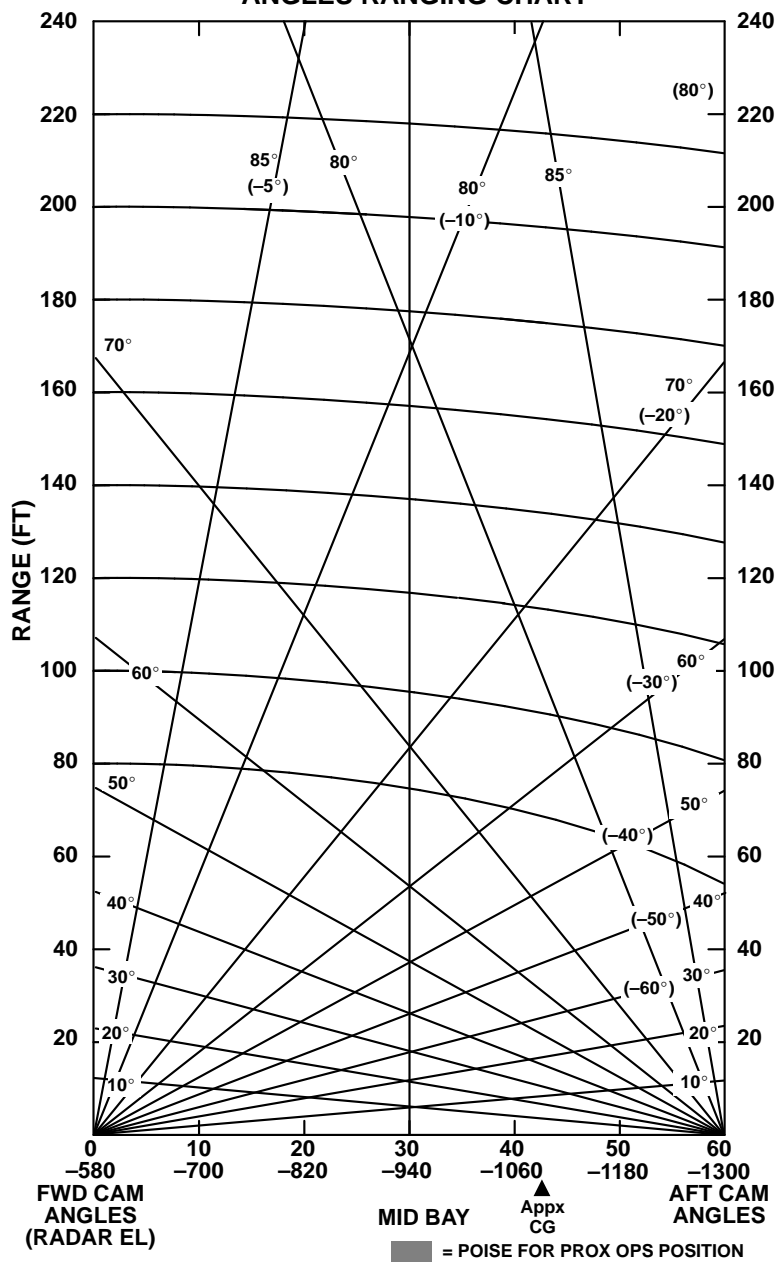
RNDZ-3b/103/O/B

NOTE: Fabricate as a kneeboard (back)

TOP

**HOOK  
VELCRO**

### NOMINAL RADAR ANGLES AND CAMERA ANGLES RANGING CHART



**HOOK  
VELCRO**

RNDZ-4a/103/O/A

(reduced copy)



BACK OF 'NOMINAL RADAR ANGLES AND CAMERA ANGLES RANGING CHART'



**HOOK  
VELCRO**



**HOOK  
VELCRO**

RNDZ-4b/103/O/A



TOP

**TOOL-CHASING**

1. ✓SENSE: -Z

**GNC 20 DAP CONFIG**

✓Dap A trans pulse size = .05 fps

✓DAP TRANS: PULSE/PULSE/PULSE, no LO Z

O14:E,  
O16:E  
O14:F,  
O15:F,  
O16:F

2. ✓cb DDU AFT (two) - cl

PRI RJD DRIVER, LOGIC (sixteen) - ON

DAP: A/LVLH/VERN(ALT)

FLT CNTLR PWR - ON

A6U

3. Tool-Chasing burns:

**CAUTION**

Maintain  $5 \pm 1$  sec between X pulses

Maintain  $5 \pm 1$  sec between Y pulses

Maintain  $5 \pm 1$  sec between Z pulses

Do not exceed 3 pulses

DAP: FREE

THC: As reqd

Record # of Pulses: (\_\_\_\_\_)

4. At TIG+5 min:

If additional pulses required:

Repeat step 3

If additional pulses not required:

FLT CNTLR PWR - OFF

A/AUTO/VERN(ALT 10)

cb DDU AFT (two) - as reqd

O14:E,  
O16:E  
O14:F,  
O15:F,  
O16:F

PRI RJD DRIVER, LOGIC (sixteen) - as reqd

RNDZ-5a/103/O/A

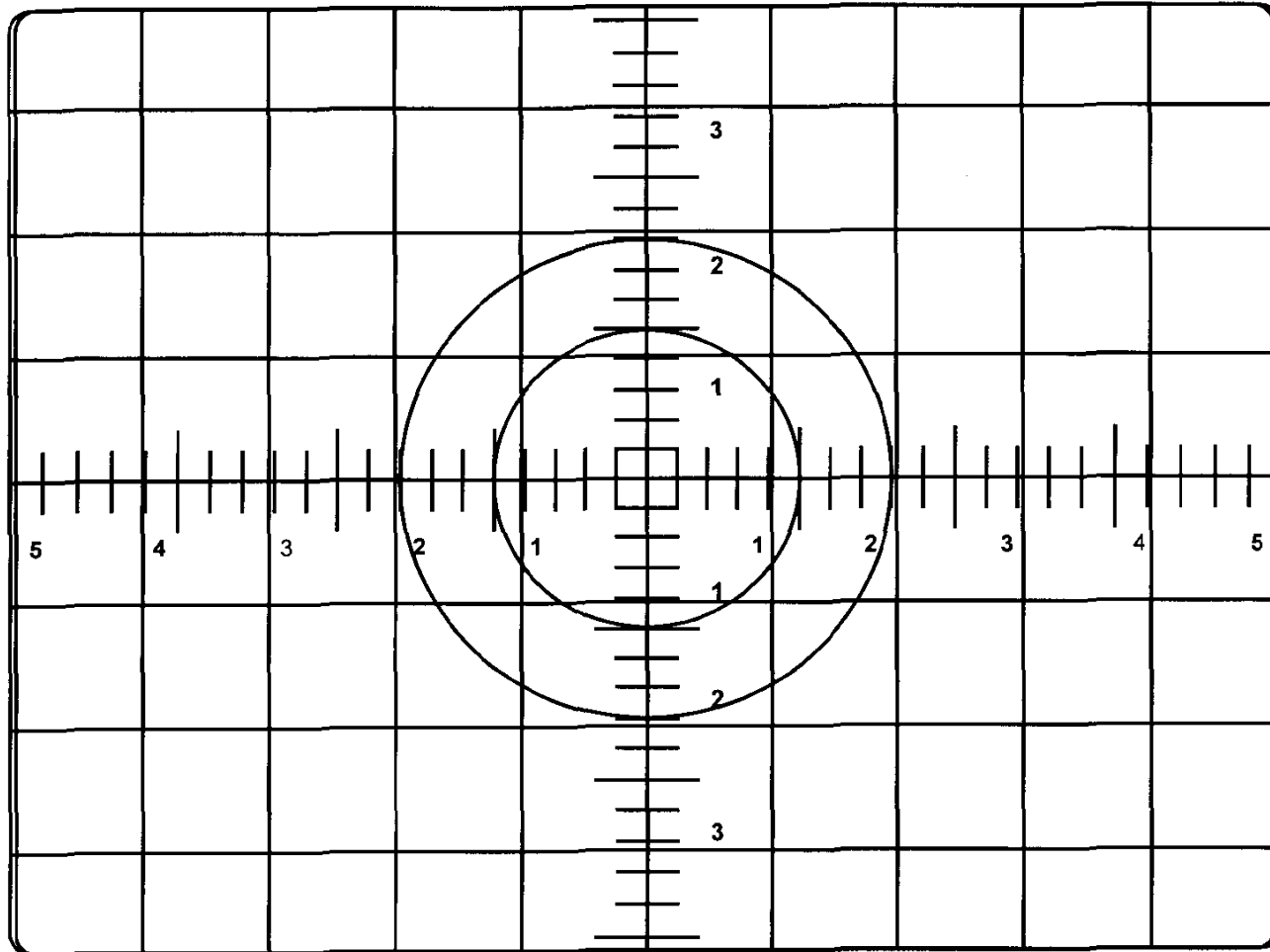
TOP  
BACK OF 'TOOL-CHASING'

**HOOK  
VELCRO**

RNDZ-5b/103/O/A

Note: Fabricate As Transparency

### KEEL CAMERA



40.0 DEG HFOV - TICK MARKS  
10.0 DEG HFOV - GRID

RNDZ-6a/103/O/A

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**RENDEZVOUS**

**STS  
103**