ELEMENTAL COMPOSITION OF SSME ALLOYS IN WEIGHT PERCENTAGE

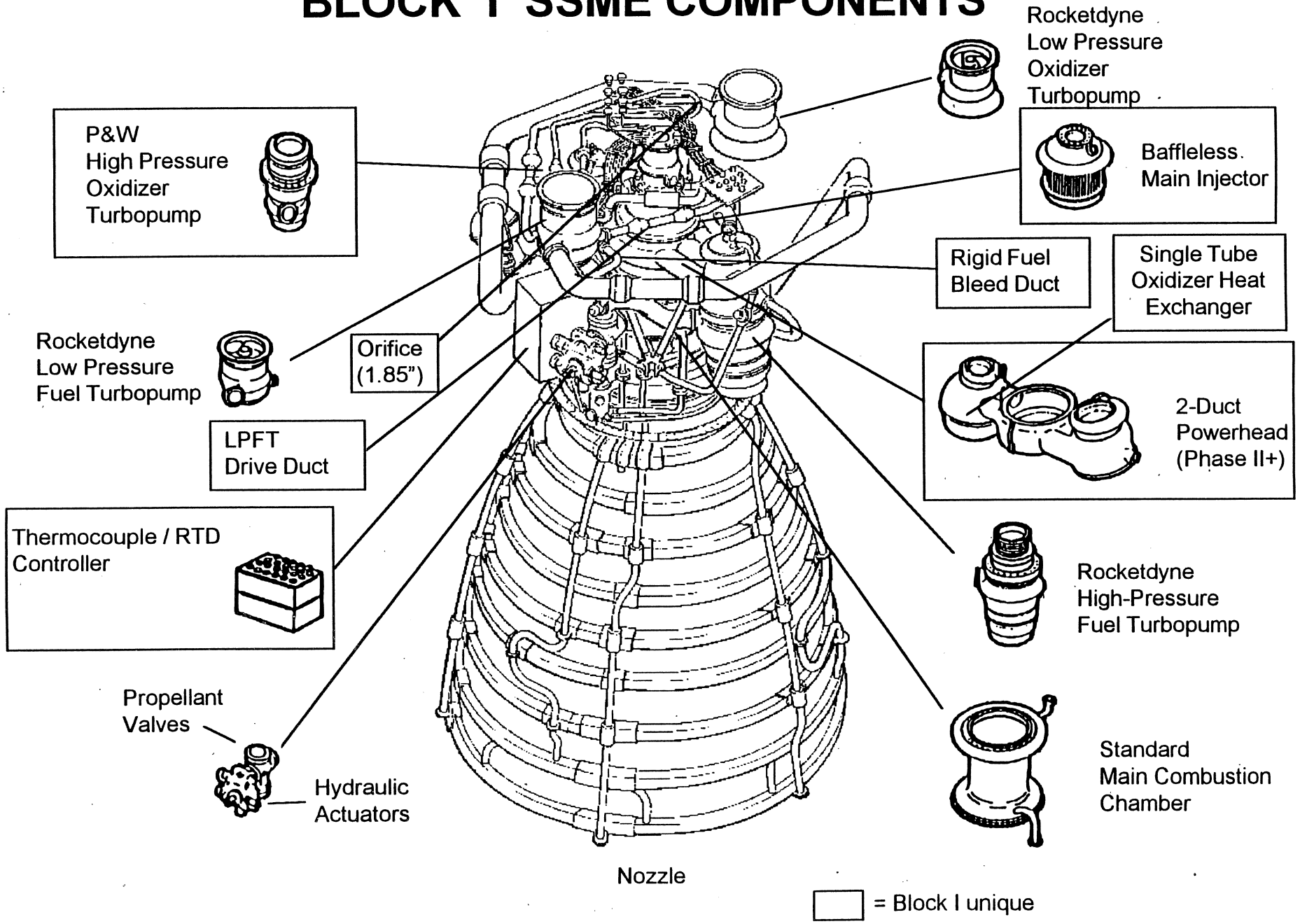
	Fe	Ni	Cr	Mn	Si	Al	Mo	Ti	C	Co	Cu	Mg	W	Nb	V	Be	Sn	S	Others
301 CRES	~72.85	7.0	17.0	2.0a	1.0a				0.15a										
302 CRES	~69.9	9.0	18.0	2.0a	1.0a				0.1										
303 CRES	~68.9	9.0	18.0	2.0a	1.0a		0.6b		0.15a									0.15c	0.2d
304 CRES	~68.7	9.2	19.0	2.0a	1.0a				0.1a										
304L CRES	~68.0	10.0	19.0	2.0a	1.0a														
316L CRES	~65.5	12.0	17.0	2.0a	1.0a		2.5												
321 CRES	~68.5	10.5	18.0	2.0a	1.0a														
347 CRES	~67.4	10.5	18.0	2.0a	1.0a				0.1a										10xCe
420 CRES	~84.85		13.0	1.0a	1.0a				0.15c										
2024 Aluminum	0.5a		0.1a	0.6		~92.5		0.15a			4.4	1.5							0.25a,f
6061 Aluminum	0.7a		0.2	0.15a	0.6	~96.67		0.15a			0.28	1.0							0.25a,f
A-286	55.0	26.0	15.0			0.3	1.3	2.0							0.3				
A356 Aluminum	0.2a			0.1a	7.0	~92.05					0.2a	0.35							0.1a,f
AISI 440C	80.2	0.2	16.9	0.5	0.6		0.5		1.0		0.1								
Armco 21-6-9	~62.8	6.5	20.3	9.0	1.0														0.4a,g
Beryllium Copper		0.38									97.37					2.25			
Elgiloy	15.31	15.5	20.0	2.0			7.0		0.15	40.0						0.04			
Hastelloy B	5.5	60.6	1.0	1.0	1.0		28.0			2.5					0.4				
Hastelloy B-2	2.0	65.4	1.0	1.0	0.1		28.0			2.5	0.02								
Hastelloy X	18.5	~46.3	22.0	1.0a	1.0a		9.0		0.1	1.5			0.6						
Haynes 188	3.0a	22.0	22.0	1.3a	0.3				0.1	~37.2			14.0						0.1h
Incoloy 625	2.5	~61.6	21.5	0.2	0.2	0.2	9.0	0.2		1.0a									3.6i
Incoloy 903	40.0	38.0				1.0		1.0+		15.0									3.0i
Inconel 600	8.2	75.6	15.5	0.5	0.2														
Inconel 718	18.0	52.9	19.0	0.2	0.2	0.6	3.0	0.8						5.2					
Inconel X-750	6.5	73.55	15.0	0.5	0.2	0.6		2.4		0.4				0.85					
K-Monel	0.9	66.0			0.5	2.7	0.7	0.5	0.1		29.0								
MAR-M 246+Hf		58.0	9.0			5.5	2.5	1.5	0.1	10.0			10.0						1.5j, 1.7k
NARloy A											96.0								3.0+l
Nickel 200	0.15	99.5		0.25	0.05				0.06		0.05								
Nitriding Steel	~95.99		1.35	0.55		1.12	0.37		0.32					0.3a					
Rene 41		55.5	19.0			1.5	9.6	3.2	0.1	11.0									
Tens-50 Aluminum					8.0	91.00		0.2				0.5				0.3			
Ti-5Al-2.5Sn ELI	0.17					5.0		92.25									2.5		0.08m
Ti-6Al-6V-2Sn	0.6					5.5		85.63			0.6				5.5		2.0		0.17m
Waspaloy	1.0	~56.5	19.5	0.5	0.4	1.2	4.2	3.0		13.5	0.1a								0.1n
Waspaloy X	2.0a	~55.95	19.5	0.1a	0.15a	1.4	4.25	3.0		13.5	0.1a								0.05n

Al: Aluminum Be: Beryllium C: Carbon Co: Cobalt Cr: Chromium Cu: Copper Fe: Iron Mg: Magnesium Mn: Manganese Mo: Molybdenum Nb: Niobium Ni: Nickel S: Sulphur Si: Silicon Sn: Tin Ta: Tantelum Ti: Titanium V: Vanadium W: Tungsten a: maximum b: optional c: minimum d: Phosphorus e: minimum Nb+Ta f: Zinc g: Nitrogen h: Lanthanum i:Nb+Ta j: Ta k: Halfnium l: Silver m: Oxygen n: Zirconium

BLOCK I SSME
DEFINITION

- **2-DUCT POWERHEAD (WAS 3-DUCT)**
  - 24 ADDITIONAL CHANGES TO SYSTEM HARDWARE DUE TO POWERHEAD ENVELOPE CHANGE
  - REMOVED MAIN INJECTOR BAFFLES
- **SINGLE TUBE OXIDIZER HEAT EXCHANGER**
- **RIGID FUEL BLEED DUCT**
- **ALTERNATE OXIDIZER TURBOPUMP**
  - 5 ADDITIONAL CHANGES TO SYSTEM HARDWARE TO SUPPORT PUMP INSTALLATION
- **ASSOCIATED GROUND SUPPORT EQUIPMENT**

BLOCK I SSME COMPONENTS



BLOCK I SSME
MAJOR DESIGN CHANGES

ECP	COMPONENT	BENEFITS	DEV. TEST HISTORY
1177	2-DUCT POWERHEAD (PHASE II+)	• INCREASED OPERATING MARGIN • REDUCED MAINTENANCE • IMPROVED PRODUCIBILITY	6 UNITS / 207 STARTS/95,419 SECS
1177	BAFFLELESS MAIN INJECTOR	• INCREASED PERFORMANCE • EXTENDED MCC LIFE	4 UNITS / 151 STARTS/72,131 SECS
1150	SINGLE TUBE OXIDIZER HEAT EXCHANGER	• ELIMINATES 7 INTERPROPELLANT (CRIT 1) WELDS • INCREASED MARGIN FOR TUBE WEAR • REDUCED MAINTENANCE AND POST FLIGHT INSPECTION	4 UNITS/ 151 STARTS/72,131 SECS
1200	RIGID FUEL BLEED DUCT	• IMPROVED CORROSION RESISTANCE	2 UNITS/ 42 STARTS/ 20,450 SECS
P&W	ALTERNATE OXIDIZER TURBOPUMP ECP NO. 94W142R1	• INCREASED SERVICE LIFE • DECREASED MAINTENANCE • ELIMINATE ALL UNINSPECTABLE WELDS (250 TO NONE) • MINIMIZE WELDS THROUGH FINE GRAIN CASTINGS (300 TO 7)	7 UNITS/183 STARTS/79,664 SECS 2 UNITS COMPLETED CERT. 43 STARTS/22,004 SECONDS

BLOCK I SSME
INTEGRATION DESIGN CHANGES

ECP	COMPONENT	BENEFITS	DEV. TEST HISTORY
1258 1150	CUT-BACK AND THICK TURNING VANE	• ELIMINATE CRACKING OF THE STHEX TURNING VANE ON BLOCK I ENGINES	3 UNITS / 113 STARTS/ 56,600 SECS THICK IN CERT. TEST
1258	HEX INLET SUPPLY LINE	• RE-ROUTED TO ACCOMMODATE LARGER PREBURNER DIAMETER OF THE HPOTP/AT	6 UNITS / 207 STARTS/ 95,419 SECS
1258	HPOTP/AT BEARING PURGE LINE	• NEW LINE REQUIRED TO SUPPORT HPOTP/AT BEARING PURGE REQUIREMENTS	6 UNITS / 207 STARTS/ 95,419 SECS
1258	MCC DRYING PURGE AND COVER PLATE	• CHANGE REQUIRED TO ELIMINATE MCC PURGE LINE AND INCORPORATE HPOTP/AT BEARING PURGE	6 UNITS / 207 STARTS/ 95,419 SECS
1258	JOINT 05 ORIFICE	• REQUIRED TO MAINTAIN NOMINAL LPOTP SPEED WITH THE HPOTP/AT	6 UNITS / 207 STARTS/ 95,419 SECS
1258	THICK F7 ORIFICE	• REQUIRED TO INCREASE THE CLEARANCE BETWEEN THE FTDD AND FPB IGNITER	2 UNITS / IN TEST

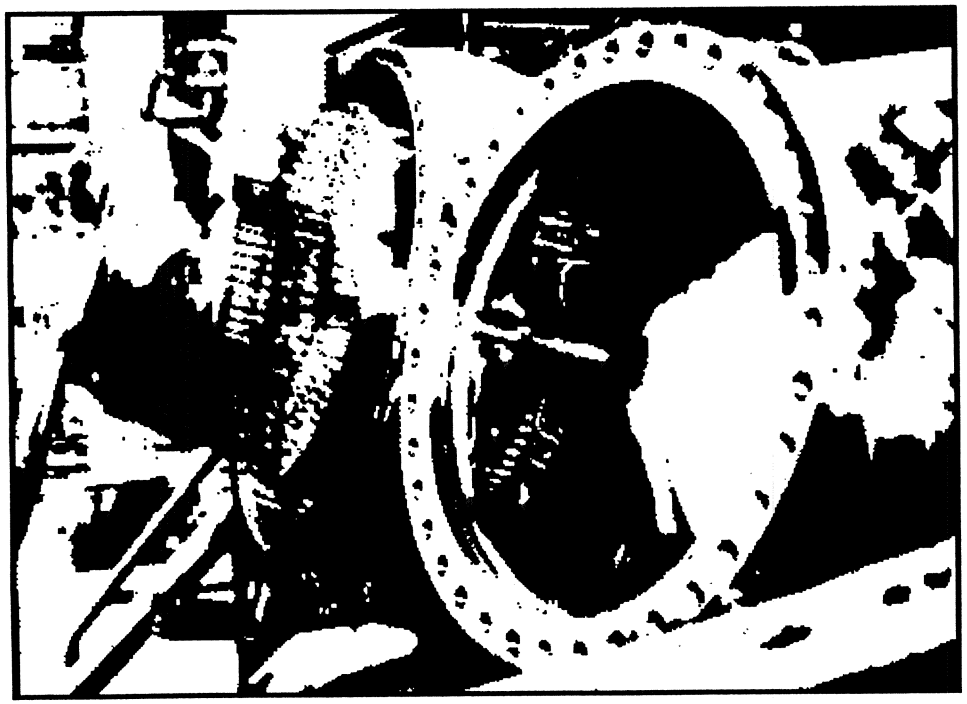
BLOCK I SSME
ADDITIONAL DESIGN CHANGES

ECP	COMPONENT	BENEFITS	DEV. TEST HISTORY
1247	PNEUMATIC VENT FLANGE	• ADD PNEUMATIC VENT FLANGE TO ELIMINATE TRAPPED PNEUMATIC PRESSURE WHICH INHIBITS PNEUMATIC SHUTDOWN CAPABILITY	2 SETS / 2 ENGINES / 10 TESTS / 5000 SECS. VCR COMPLETE
1259	CONTROLLER & HARNESS FOR THERMO. / RTD	• REQUIRED MODIFICATION TO SUPPORT THERMOCOUPLES OR RTD's	CONT./ HARNESS 2 UNITS / 10 STARTS/ WITH RTD 2 STARTS
1273	RTD's WITH PLUGGED VENT HOLES	• LASER WELDED OR BRAZED TO REDUCE INFLUENCE OF COOLANT LEAKAGE ON MEASUREMENT	2 UNITS/ IN TEST ENGINE 0422 & ENGINE 0423
1138	ELIMINATE WELD 1 & 2 ON NOZZLE FEED LINE	• IMPROVED DESIGN • ELIMINATE CRITICAL WELDS	3 UNITS / 7 STARTS / 2858 SECS.
1223	POGO Z-BAFFLE	• IMPROVED DESIGN TO ELIMINATE CRACKING	2 UNITS / 24 STARTS / 11604 SECS.
1249	CO2 BLOWN FOAM FOR FUEL HARDWARE	• INCORPORATE ENVIRONMENTALLY APPROVED CO2 FOAM FOR FUEL HARDWARE	VARIOUS UNITS AND TESTS

BLOCK I SSME
2 - DUCT HOT GAS MANIFOLD
DESIGN EVOLUTION

- **1972-1985 - THREE TUBE (PHASE I & II) DEVELOPMENT PERIOD**
  - SEVERE HOT GAS FLOW ENVIRONMENT IDENTIFIED
    - RESULTED IN TRANSFER TUBES & MAIN INJECTOR COMPONENT FAILURES
  - MODIFICATIONS MADE TO IMPROVE HARDWARE LIFE
- **1982-1992 - TWO TUBE DEVELOPMENT PERIOD**
  - 2-DUCT HOT GAS MANIFOLD DESIGNED TO IMPROVE FLOW PATH
    - IMPROVED MANIFOLD PERFORMANCE & PRODUCIBILITY
      - REDUCE NUMBER OF WELDS
    - SEVERAL HARDWARE MODIFICATIONS MADE AS RESULT OF DEVELOPMENT TESTING

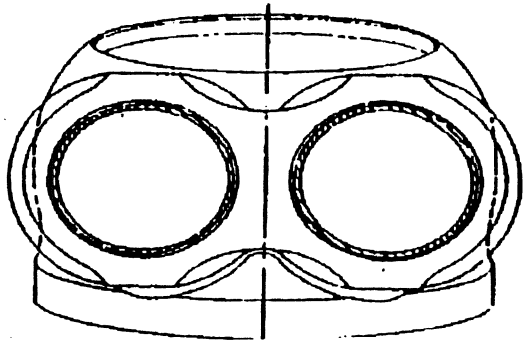
BLOCK I SSME
TWO-DUCT HOT GAS MANIFOLD



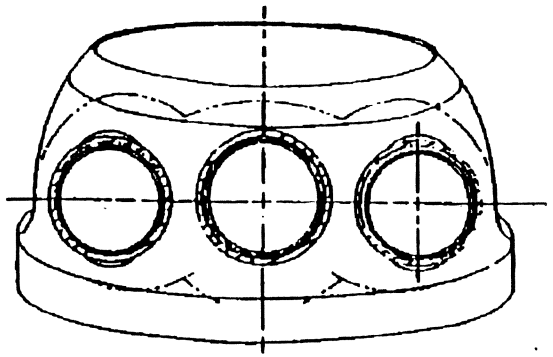
- 6 UNITS
- 207 STARTS/ 95,419 SECS

- **INCREASED MARGIN**
  - REDUCES FLOW VELOCITY & FLUCTUATING PRESSURE (75% AT MAIN INJECTOR)
  - REDUCED TURBINE TRANSVERSE DELTA P (60% AT HPFTP TURBINE EXIT)
- **REDUCED MAINTENANCE**
  - NO PREBURNER SUPPORT PINS
- **IMPROVED PRODUCIBILITY**
  - 74 WELDS ELIMINATED (24%)
  - SIX, 903 OVERLAYS ELIMINATED
  - PART COUNT REDUCED BY 52
- **MCC LIFE EXTENDED - REDUCED BLANCHING**

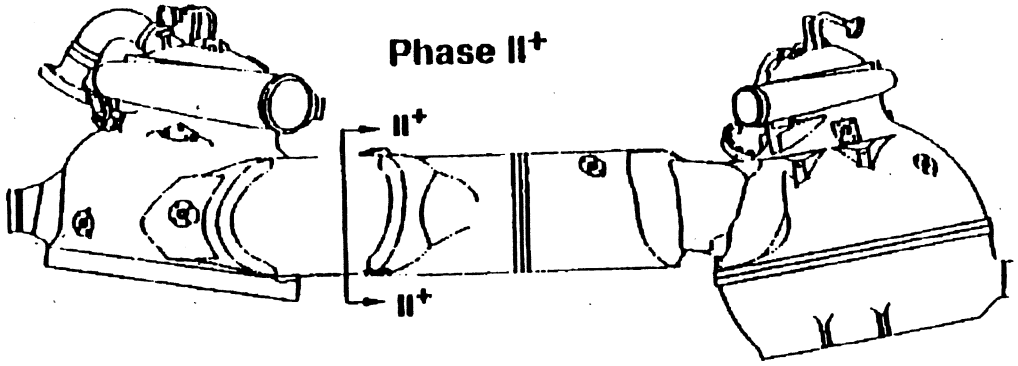
PHASE II+ POWERHEAD
MANIFOLD COMPARISON

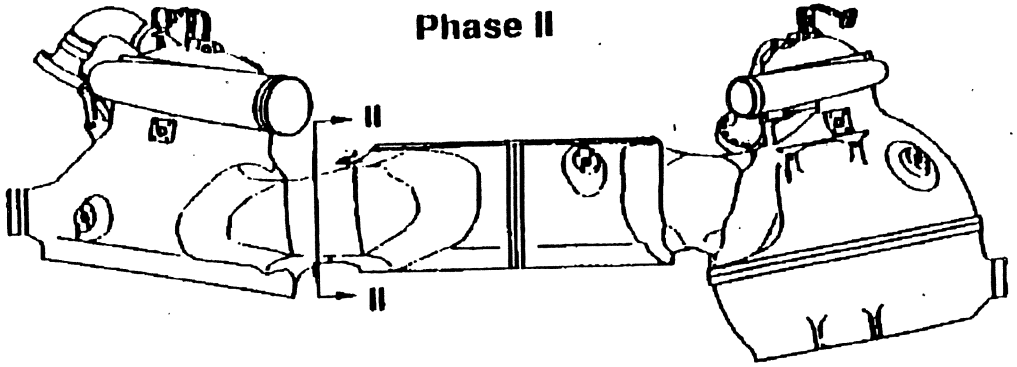


Sec II+ - II+



Sec II - II



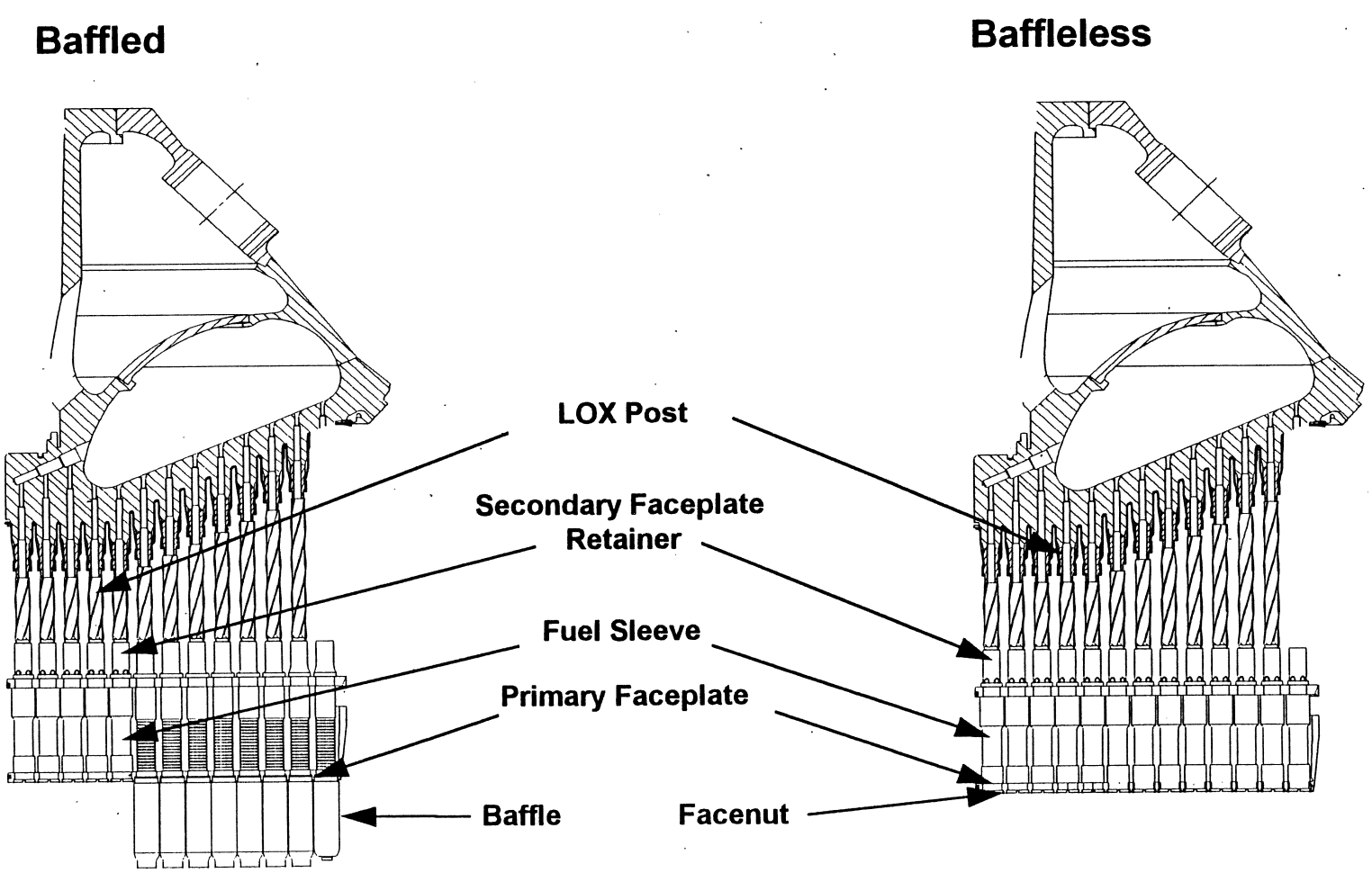


HOT GAS FLOW AREA INCREASED FROM 37/51 TO 66 IN^2 CONSTANT

BLOCK I SSME
BAFFLELESS MAIN INJECTOR

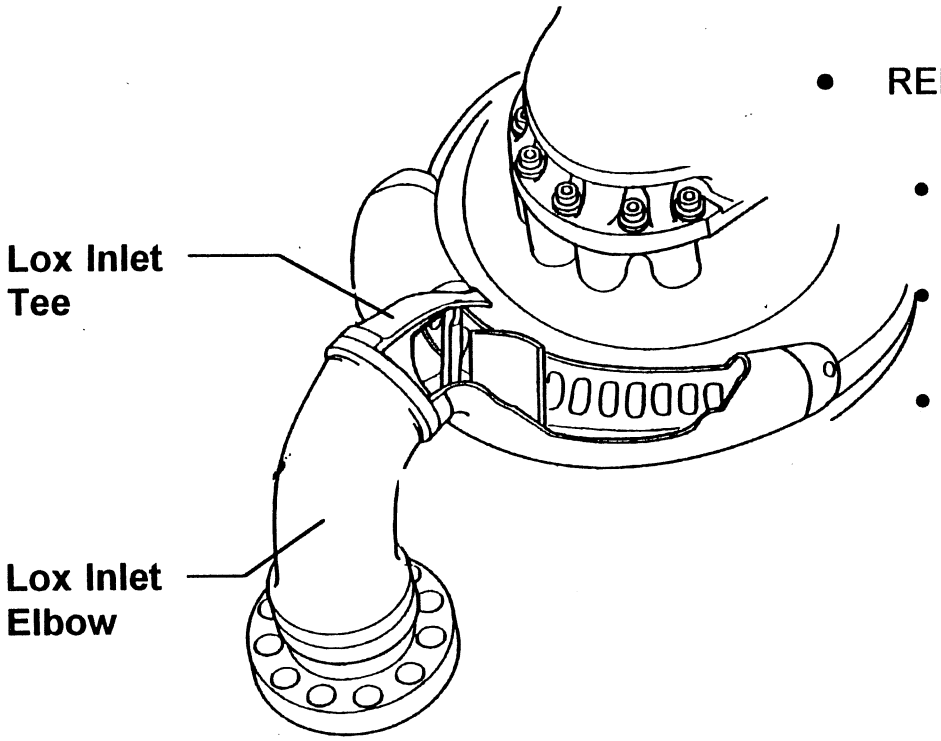
- **BACKGROUND**
  - BAFFLES INCORPORATED IN ORIGINAL SSME DESIGN TO ENSURE NO COMBUSTION STABILITY PROBLEMS ON THE ENGINE
    - BAFFLES COMPARTMENTALIZE THE COMBUSTION ZONE & DAMP OUT HIGH FREQUENCY PRESSURE OSCILLATIONS
- **RATIONALE FOR REMOVING BAFFLES**
  - COAXIAL INJECTION ELEMENTS INHERENTLY STABLE
  - COMBUSTION STABILITY VERIFIED BY TESTING ON 2 ENGINES
    - BOMB TESTS CONDUCTED (2 BOMBS/TEST) - NO SUSTAINED INSTABILITY
- **REMOVAL OF THE MAIN INJECTOR BAFFLES RESULTS IN THE FOLLOWING BENEFITS**
  - INCREASE Isp (EXPECTED MINIMUM OF 1.0 SECONDS)
  - ADDITIONAL HYDROGEN AVAILABLE FOR IMPROVED MCC BOUNDARY LAYER COOLING
  - ELIMINATION OF BAFFLE EROSION CONCERNS

PHASE II+ POWERHEAD
BAFFLELESS MAIN INJECTOR



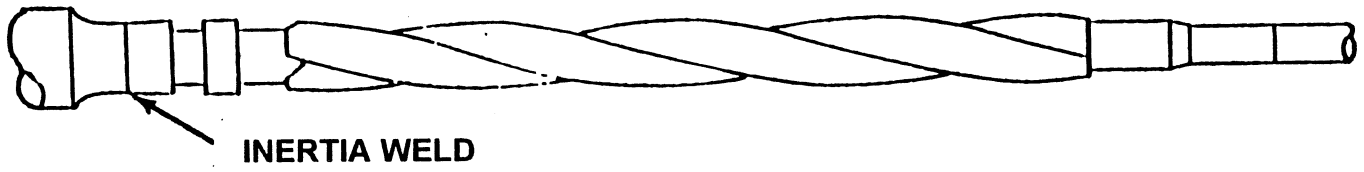
BLOCK I SSME
MAIN INJECTOR OXIDIZER INLET

INLET MANIFOLD WELDS ARE CRITICAL LIFE LIMIT ON POWERHEADS



- REPLACED CAST TEE AND ELBOW WITH FORGING
  - IMPROVED MATERIAL PROPERTIES
  - INCREASED MARGINS ON HCF & LCF
  - IMPROVED WELDABILITY

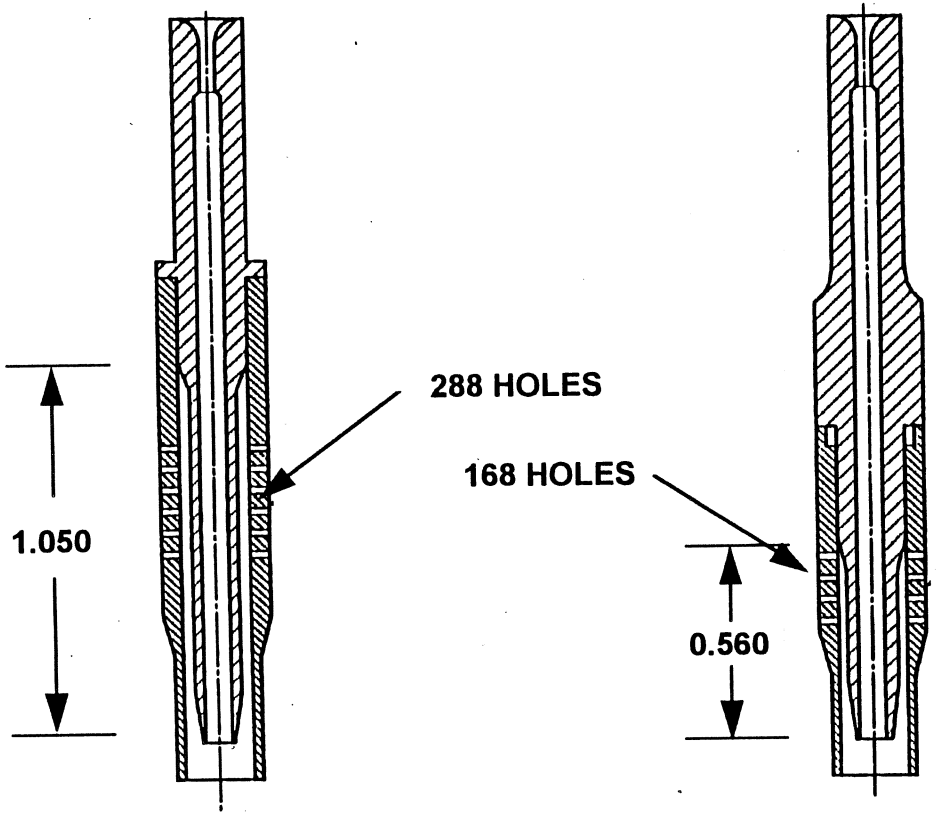
BLOCK I SSME
MAIN INJECTOR LOX POSTS



- **MAIN INJECTOR LOX POST MARGIN IMPROVEMENT**
  - DYNAMIC FLOW ENVIRONMENT REDUCED 16% IN CRICAL AREA
  - HIGH CYCLE FATIGUE LIFE AT INERTIA WELD INCREASED TO INFINITE LIFE

BLOCK I SSME
PREBURNER INJECTOR ELEMENTS

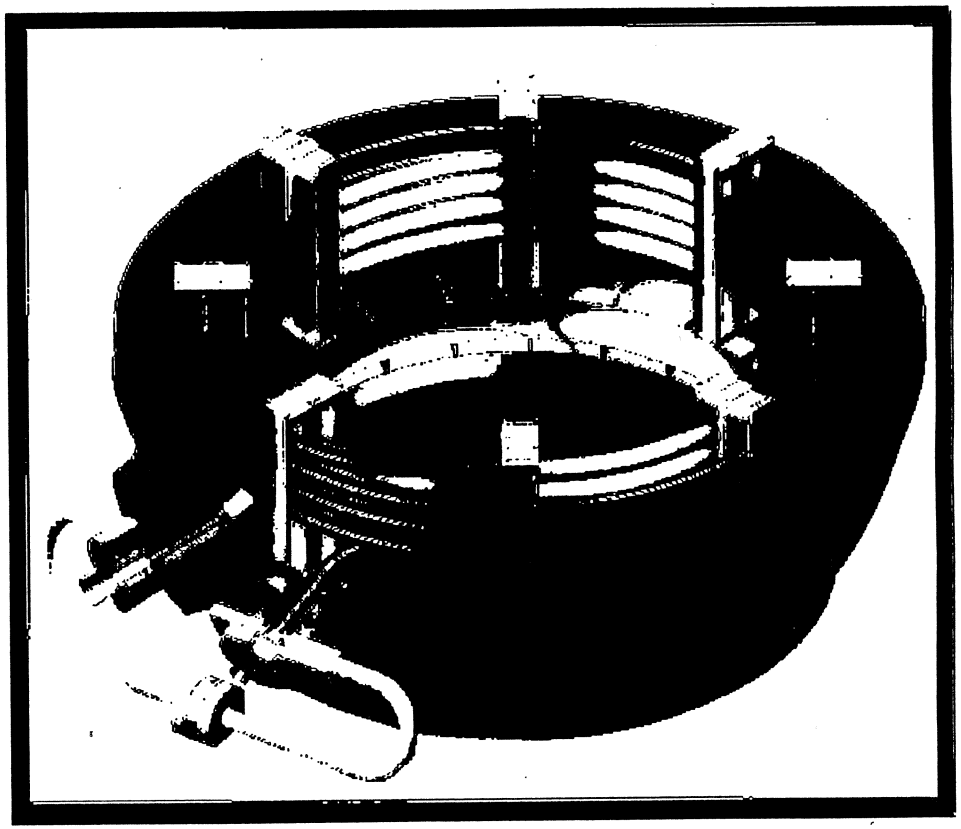
REDESIGNED FUEL AND OXIDIZER ELEMENTS TO INCREASE STRENGTH & REDUCE MAINTENANCE



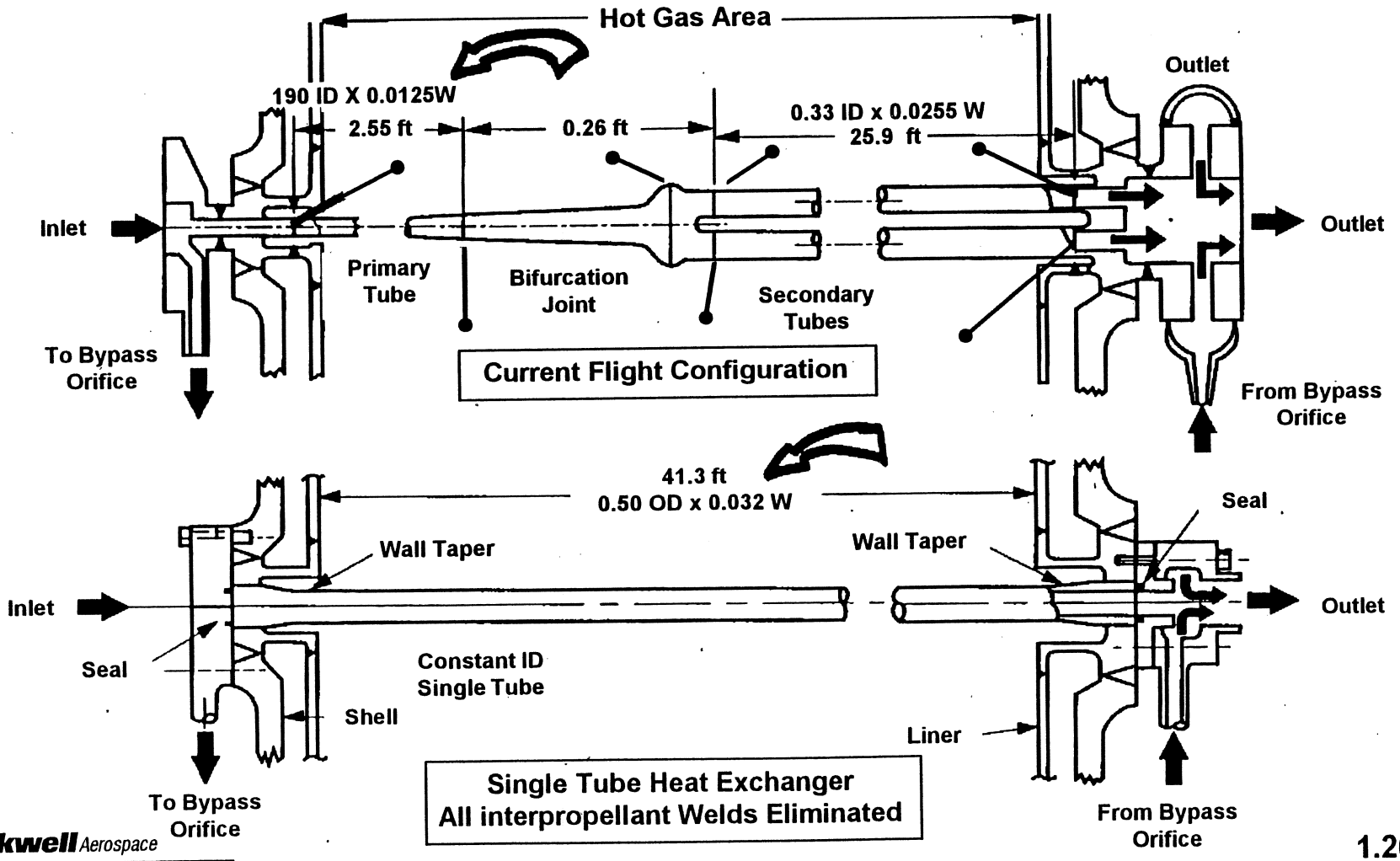
- ELIMINATED STRUCTURAL NEED FOR SUPPORT PINS
- ENHANCED ELEMENT MAINTENANCE
  - ELIMINATED LOX POST SUPPORT PIN INSTALLATION & INSPECTION
  - IMPROVED FUEL ANNULUS INSPECTABILITY
  - LOX POST CONCENTRICITY ENHANCE
- ELIMINATES EDDY CURRENT INSPECTION REQUIREMENTS

BLOCK I SSME
SINGLE TUBE OXIDIZER HEAT EXCHANGER

- **TOTAL OF 30 WELD JOINTS ELIMINATED FROM SINGLE TUBE HEAT EXCHANGER ASSEMBLY**
  - 7 INTERPROPELLANT COIL WELDS
  - 15 BYPASS ASSEMBLY WELDS & 4 OUTLET DUCT WELDS
  - 2 FITTING-TO-SLEEVE WELDS PLUS 2 SLEEVE OVERLAYS
- **THICK TUBE WALL INCREASE MARGIN FOR TUBE WEAR AND DAMAGE**
  - 0.032 IN WALL WAS 0.0125 IN WALL
- **REDESIGNED WELD JOINTS TO OBTAIN 100% INSPECTABILITY**
  - VERIFIED CRITICAL INITIAL FLAW SIZES COULD BE DETECTED BY INSPECTION TECHNIQUES
- **REDUCES MAINTENANCE/POST FLIGHT INSPECTION**
- **DEMONSTRATED TEST EXPERIENCE**
  - 4 UNITS / 151STARTS / 72,131 SECONDS

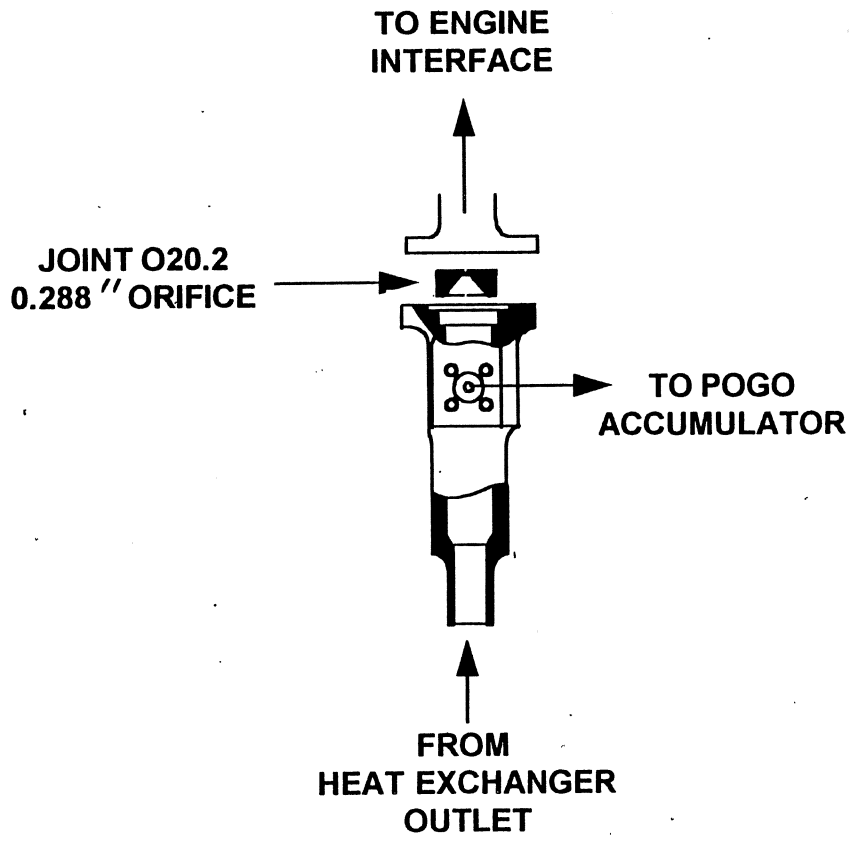


BLOCK I SSME
SINGLE TUBE HEAT EXCHANGER COMPARED TO CURRENT FLIGHT



BLOCK I SSME
SINGLE TUBE HEX DISCHARGE ORIFICE

- ORIFICE ADDED TO HEX OUTLET TO MAINTAIN ORBITER INTERFACE PRESSURE
- ICD CONDITIONS VERIFIED DURING GROUND TEST/CERTIFICATION
- INCREASES GOX FLOW TO POGO ACCUMULATOR 10%
- ACCUMULATOR LIQUID LEVEL MAINTAINED BY POGO STAND PIPE ORIFICES
- ZERO G TESTING DEMONSTRATED NO GAS INGESTION

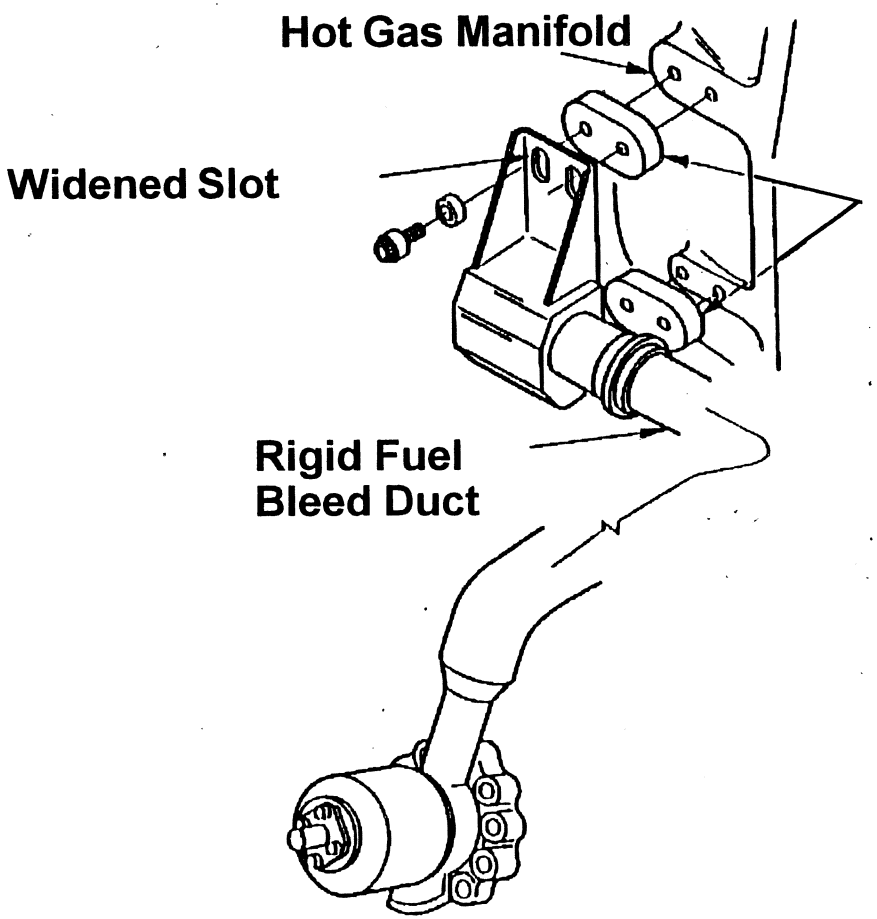


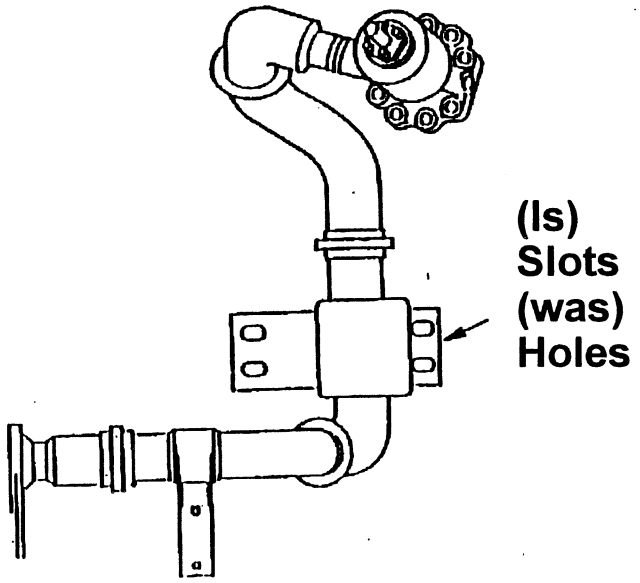
SSME BLOCK I DESIGN CERTIFICATION REVIEW
RIGID FUEL BLEED DUCT
ECP 1200

MATERIAL CHANGE

FROM 21-6-9 CRES TO INCONEL 625

- IMPROVED RESISTANCE TO CORROSION
- ELIMINATES NEED FOR CORROSION INHIBITOR PAINT

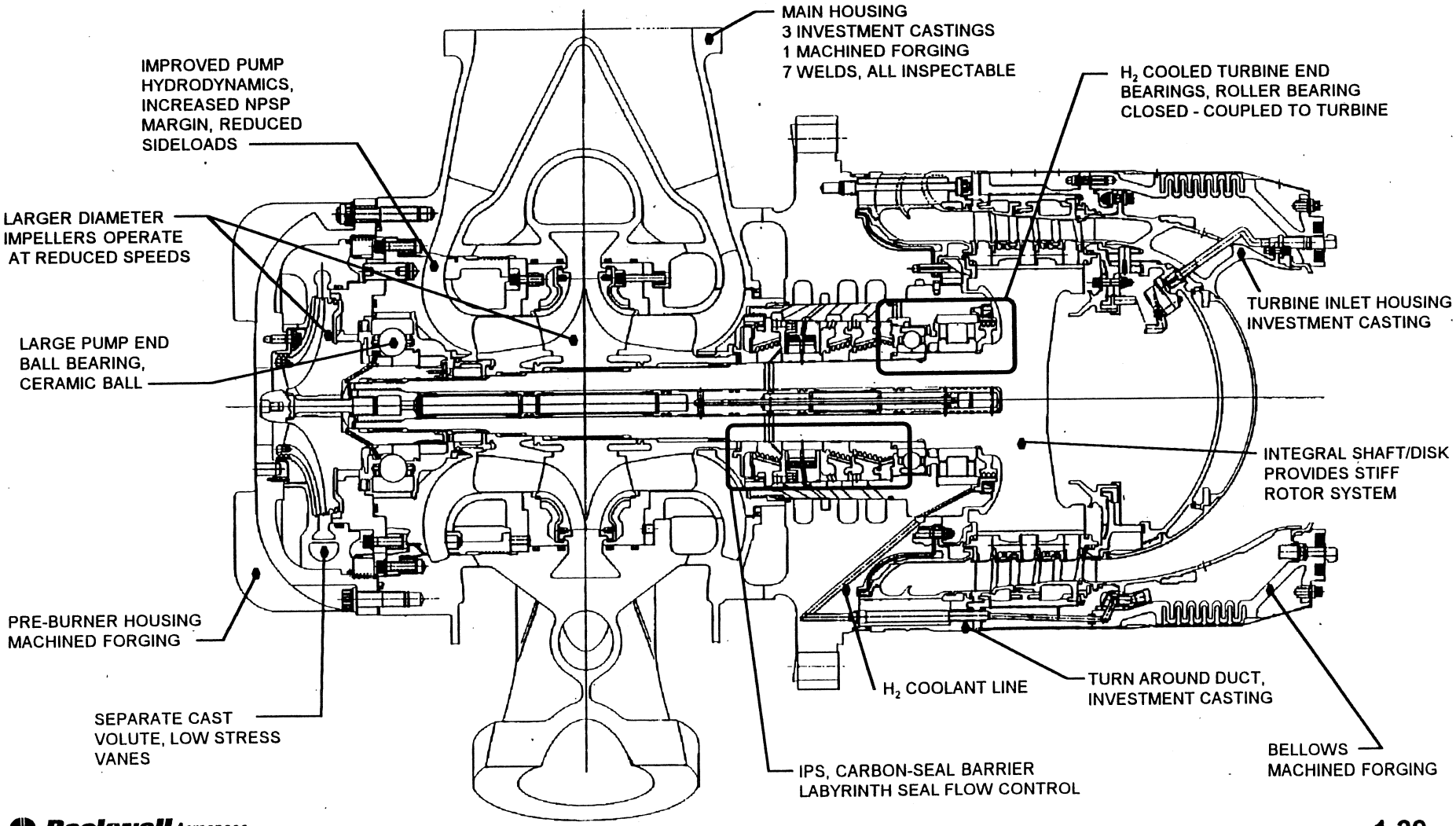




BLOCK I SSME
AT HIGH PRESSURE OXIDIZER TURBOPUMP DESIGN FEATURES

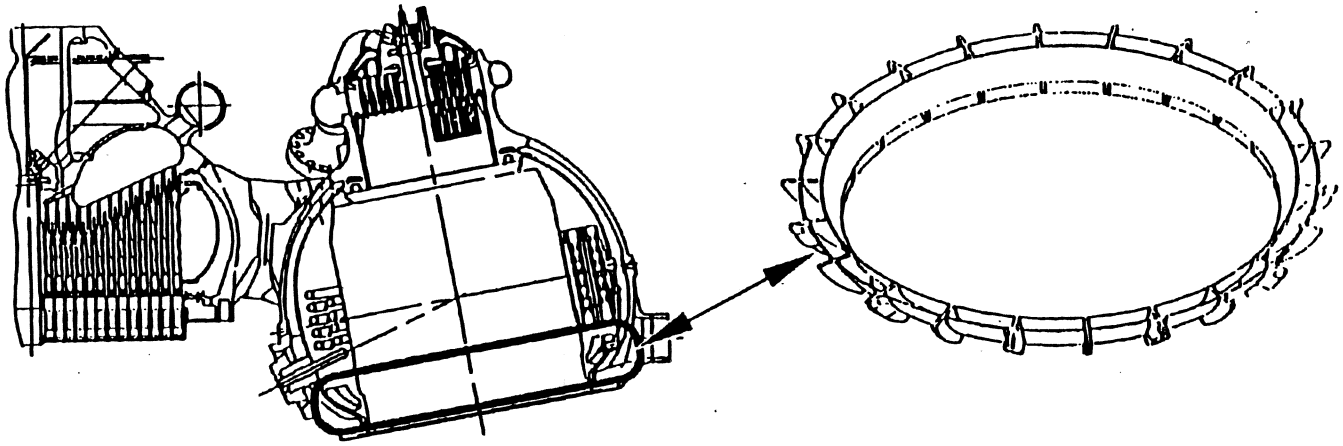
- THE USE OF CASTINGS VS WELDED STRUCTURES RESULTS IN FEWER WELDS, WITH ALL OF THEM INSPECTABLE (7 WELDS TOTAL)
- EXTENSIVE USE OF LABYRINTH SEALS IN THE INTERMEDIATE SEAL REDUCES THE COMPLEXITY OF MULTI CARBON SEALS
- REDUCED INTERMEDIATE SEAL MAINSTAGE REDLINES - PUMP REQUIRES ONLY HELIUM SOURCE PRESSURE REDLINE - NO SECONDARY SEAL REDLINE
- THE USE OF A SINGLE PIECE TURBINE DISK AND SHAFT REDUCES THE COMPLEXITY OF A BOLTED DESIGN AND IMPROVES THE ROTORDYNAMIC CHARACTERISTICS
- THE TURBINE BLADE AND VANE DESIGN IMPROVES THERMAL RESPONSE FOR IMPROVED DURABILITY WITHOUT COATINGS
- REDUCED OPERATING SPEED REDUCES BEARING WEAR AND ALLOWS SHAFT SUB-CRITICAL SPEED OPERATION
- STREAMLINED INLET DESIGN INCREASES CAVITATION MARGIN
- HYDROGEN COOLED-CLOSE COUPLED ROLLER BEARING INCREASES ROTOR SUPPORT STIFFNESS FOR IMPROVED ROTORDYNAMIC CHARACTERISTICS
- SINGLE HYBRID Si_3N_4 PUMP END BALL BEARING PROVIDES EXCELLENT RESISTANCE TO WEAR IN LOX ENVIRONMENT

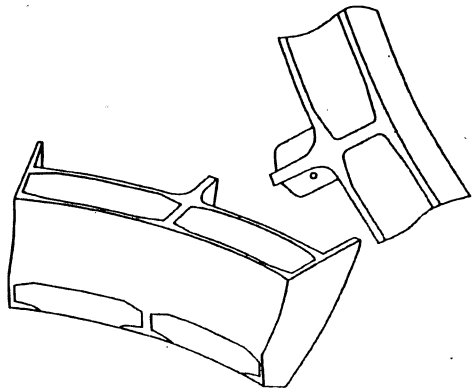
BLOCK I SSME
ALTERNATE HIGH PRESSURE TURBOPUMP



BLOCK I SSME

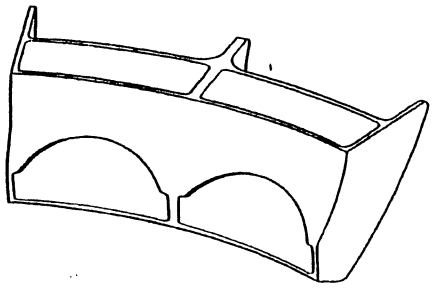
ECP 1258/1150 - STHEX TURNING VANE





Thick Vane Configuration

- 0.070" thick with tapered radius

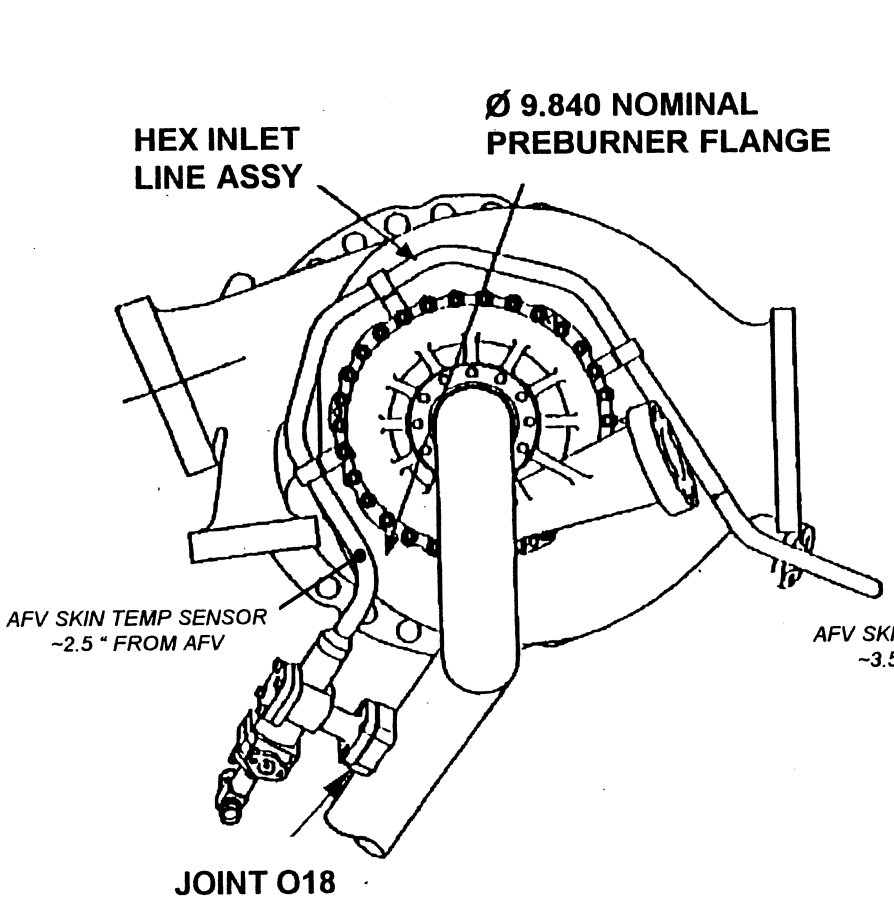


Cutback Vane Configuration

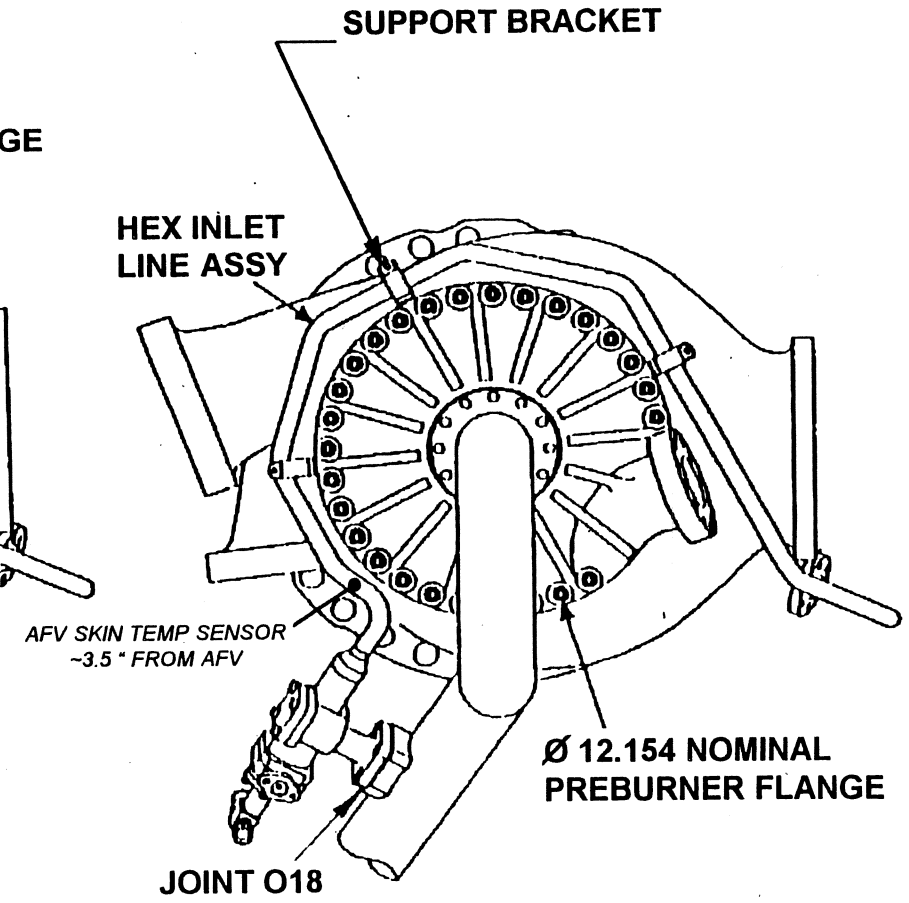
- Engine 2037 only
- 0.050" thick

BLOCK I SSME

ECP 1258 - HEAT EXCHANGER SUPPLY LINE CONFIGURATION

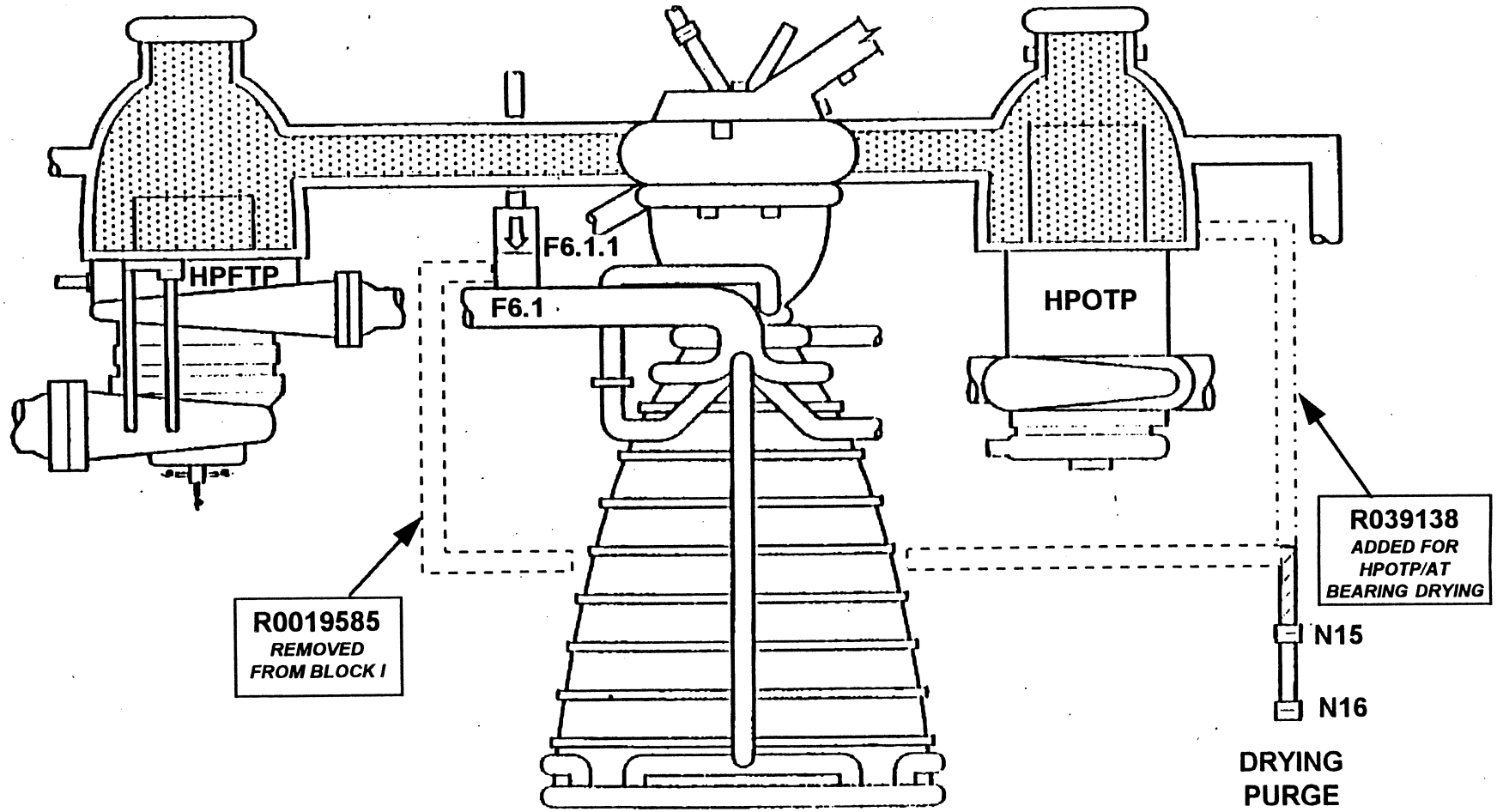


PHASE II



BLOCK I

BLOCK I SSME
ECP 1258 - DRYING PURGE CHANGES



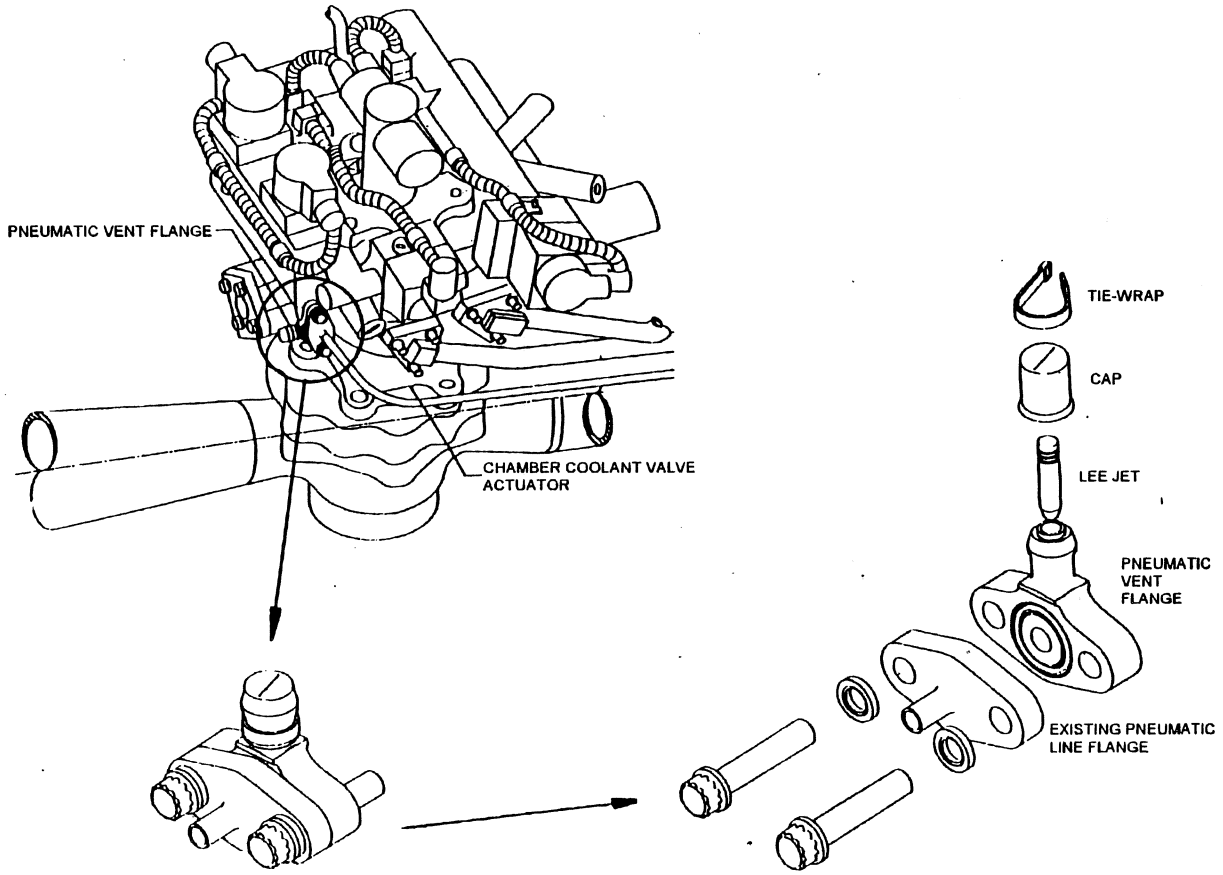
BLOCK I SSME

ECP 1247 - PNEUMATIC VENT FLANGE

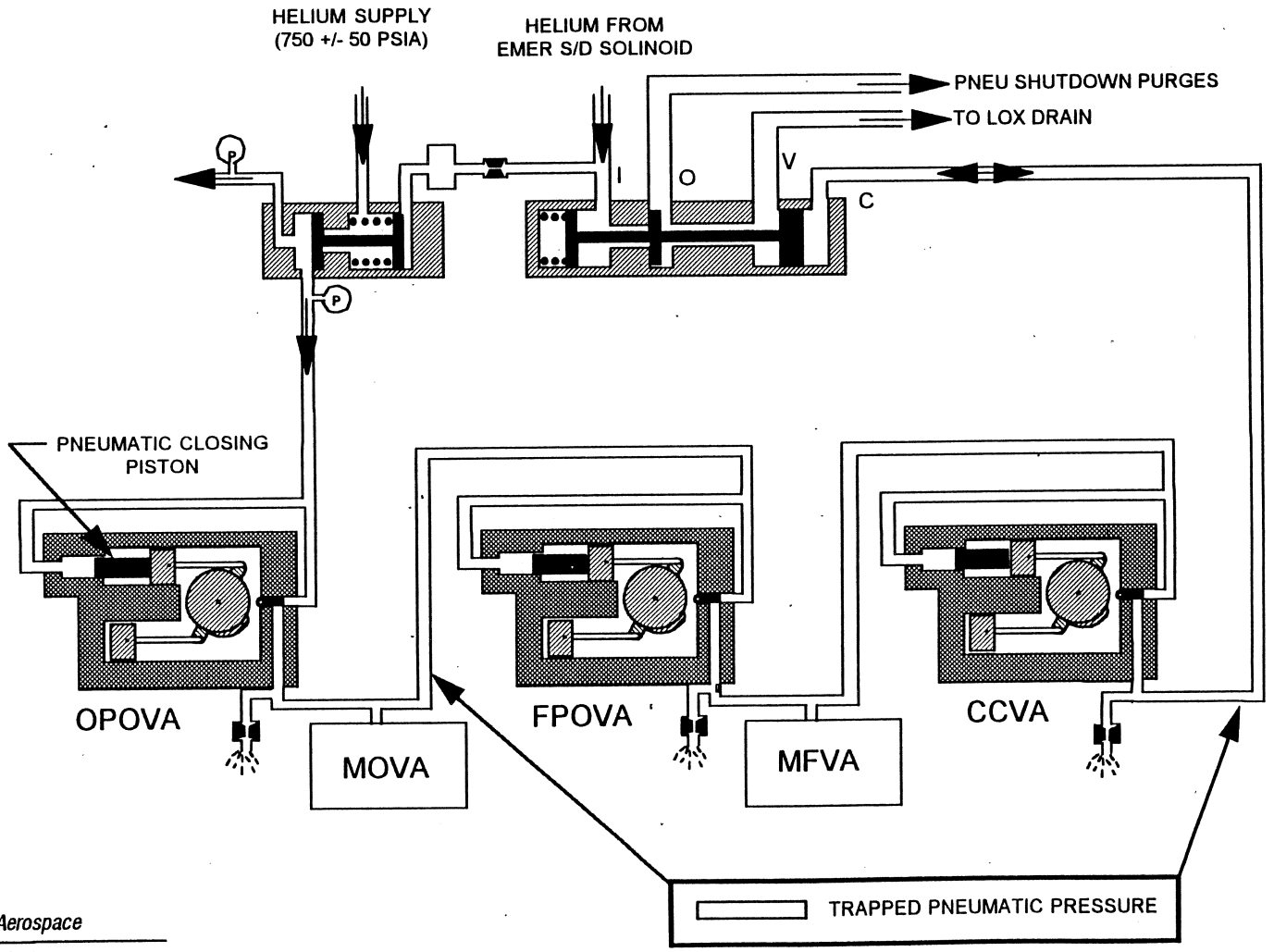
- **CHANGE**
  - INCORPORATE PNEUMATIC VENT FLANGE TO ASSURE FAIL-SAFE PNEUMATIC SHUTDOWN CAPABILITY
- **REASON FOR CHANGE**
  - SSME FAIL-SAFE PNEUMATIC SHUTDOWN CAPABILITY INHIBITED WITH HIGH ORBITER HYDRAULIC RETURN PRESSURE
    - ICD ALLOWS MAXIMUM RETURN PRESSURE OF 170 PSIG DURING PSN-4 TRANSITION PERIOD
    - SSME DEMONSTRATED SAFE PNEUMATIC SHUTDOWN CAPABILITY AT HYDRAULIC RETURN PRESSURE OF 140 PSIG
    - WAIVER CR S84737W APPROVED FOR 140 PSIG
  - PNEUMATIC VENTS RELIEVES TRAPPED HELIUM PRESSURE IN ACTUATOR CLOSING PISTONS AND PNEUMATIC SHUTDOWN ACTUATION VALVES
    - ASSURES PNEUMATIC SHUTDOWN CAPABILITY AT ICD REQUIREMENTS - **ELIMINATES WAIVER CONDITION**
    - REDUCES VALVE DRIFTS WITH ENGINE IN HYDRAULIC LOCKUP CONDITION

BLOCK I SSME
ECP 1247 - PNEUMATIC VENT FLANGE

PNEUMATIC VENT ASSEMBLY AND INSTALLATION



BLOCK I SSME
PURGE SEQUENCE 4 W/PNEUMATIC VENT FLANGE ASSEMBLIES

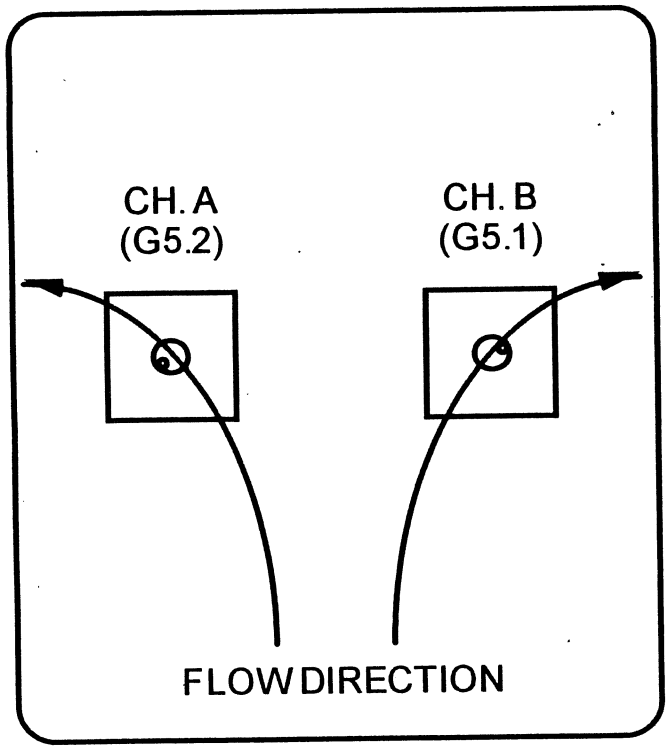


BLOCK I SSME
BLOCK II CONTROLLER MODIFIED FOR THERMOCOUPLES
ECP 1259

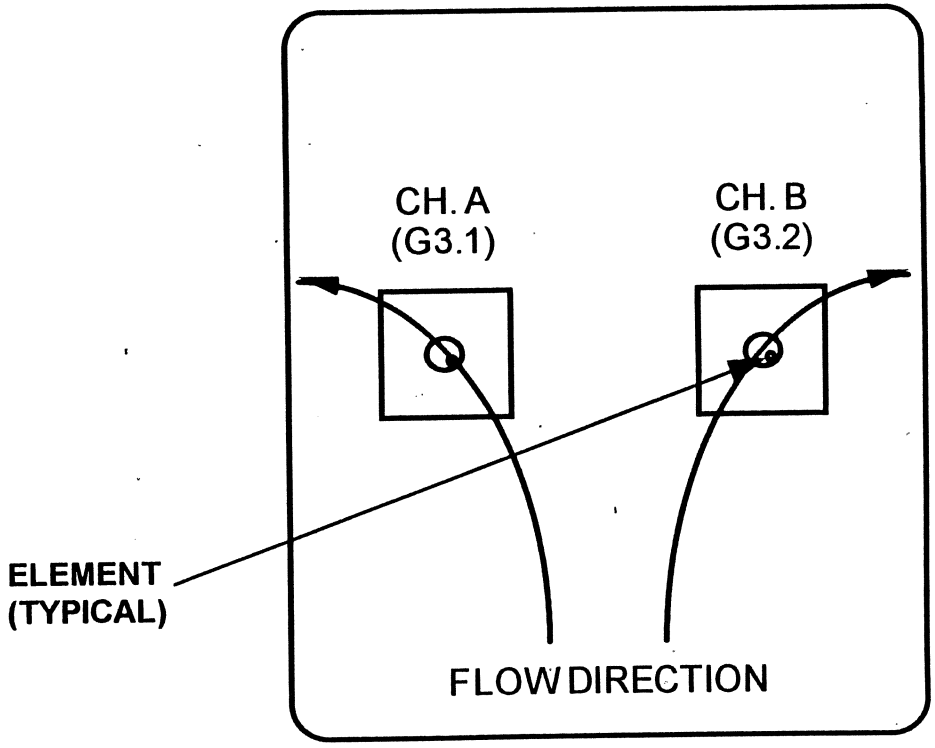
- **DESIGN CRITERIA**
  - MODIFY BLOCK II CONTROLLER AND SYSTEM TO BE COMPATIBLE WITH EITHER HOT GAS RTD's OR THERMOCOUPLES
    - BRAZED RTD's WILL BE USED FOR STS-70
- **SYSTEM MODIFICATIONS FOR STS-70**
  - BLOCK II CONTROLLER
    - SPARE CIRCUITS ON CONTROLLER IEI CARDS REPLACED BY THERMOCOUPLE INTERFACE CIRCUITS (8)
    - ADDED REFERENCE JUNCTION TEMPERATURE (2)
  - MODIFY HARNESSES (3) TO INCORPORATE THERMOCOUPLE MEASUREMENT
    - ADD 22 AWG WIRE AND CONNECTOR
  - CONNECTOR RE-CLOCKED TO LOCATE SENSOR ELEMENT UPSTREAM RELATIVE TO HOT GAS FLOW
    - NO EFFECT ON E2036 TURBINE TEMPERATURE PREDICTIONS

SENSOR ORIENTATION IN FLOWSTREAM
ECP 1259

CURRENT CONFIGURATION



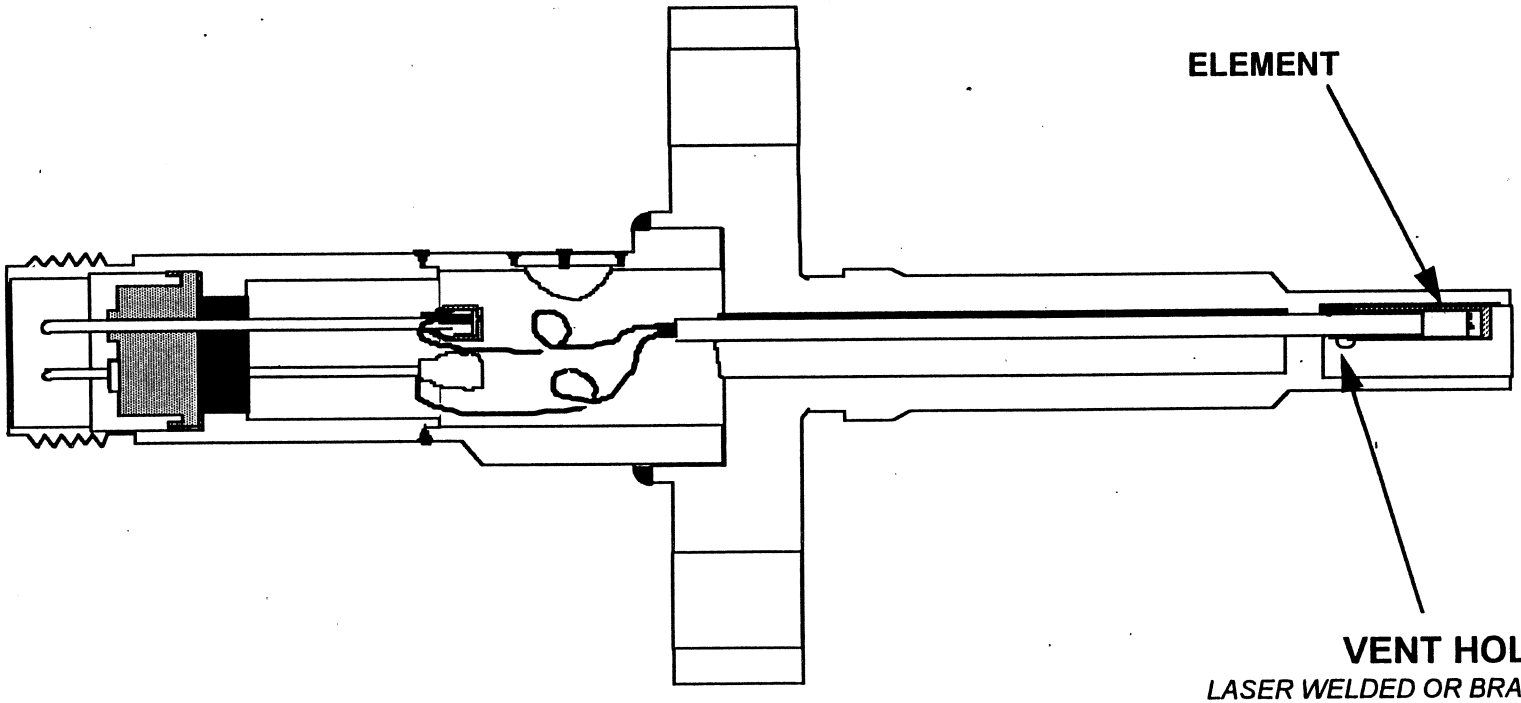
HPFTP SIDE



HPOTP SIDE

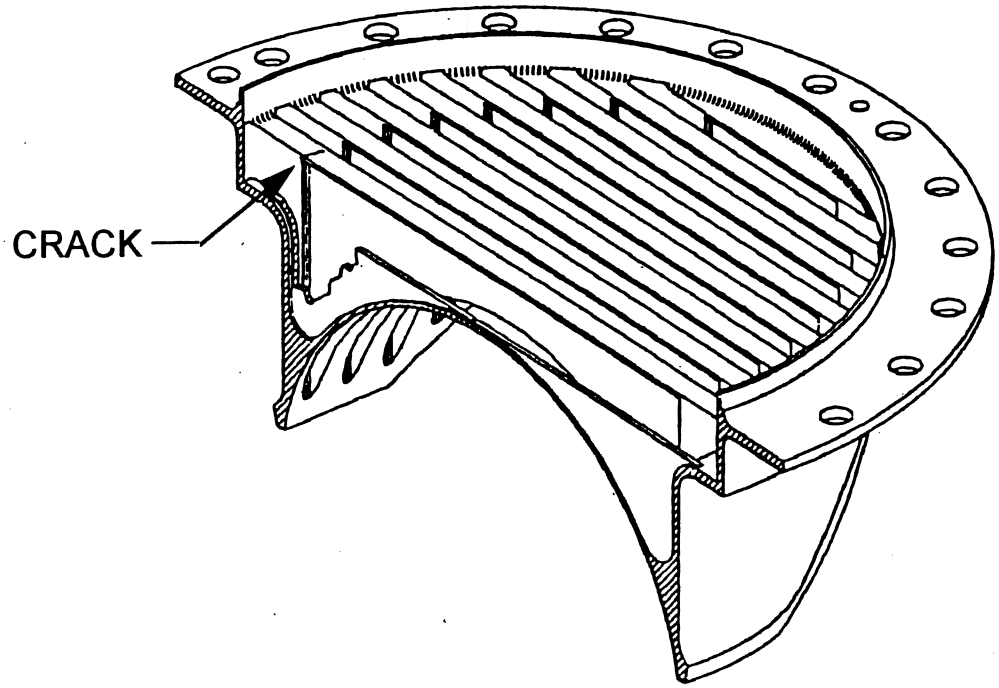
BLOCK I SSME

ECP 1273 - HOT GAS TEMPERATURE SENSOR CUTAWAY



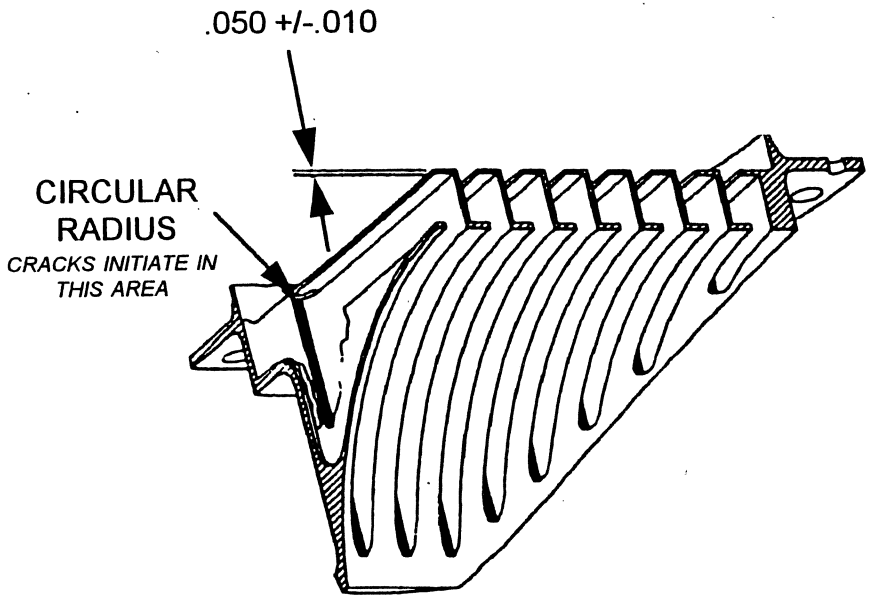
BLOCK I SSME
ECP 1223R1 - POGO Z-BAFFLE ASSEMBLY

- **POGO Z-BAFFLE REDESIGNED TO ELIMINATE HIGH CYCLE FATIGUE CRACKS**
  - CRACKS FOUND IN 13 POGO Z-BAFFLE ASSEMBLIES
  - CRACKS INITIATED IN VANE TRANSITION TO SHELL I.D.

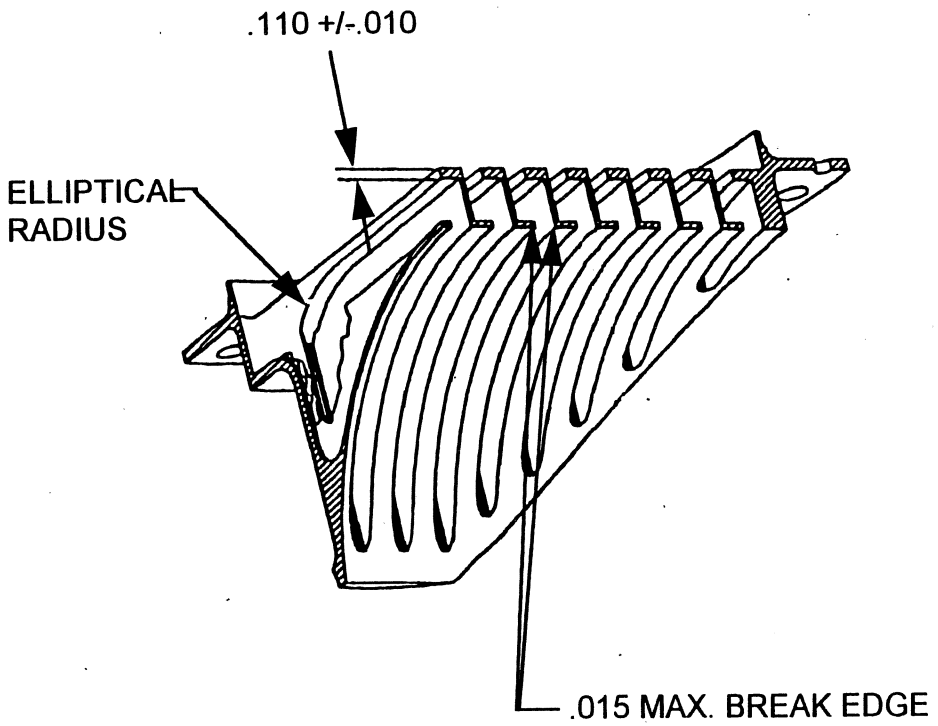


BLOCK I SSME

ECP 1223R1 - POGO Z-BAFFLE PLATE REDESIGN



PREVIOUS CONFIGURATION



RE-DESIGNED CONFIGURATION

BLOCK I SSME
ECP 1249 - CO_2 BLOWN FOAM

- **BACKGROUND**
  - ELIMINATION OF FREON BLOWN FOAM DUE TO FEDERAL ENVIRONMENTAL CONCERNS (CFC'S)
  - INSULATION USED ON LPFTP, LPFTP DISCH DUCT, HPFTP, HPFTP DISCH DUCT, ON MFV, AND RIGID FUEL BLEED DUCT
- **CLASSIFIED AS OPPORTUNITY MOD FOR ALL COMPONENTS**
- **CERTIFICATION COMPLETED**
- **AFFECTS ONLY THREE COMPONENTS ON ENGINE 2036**
  - LPFTP
  - LPFP DISCHARGE DUCT
  - RIGID FUEL BLEED DUCT

DISCOVERY STS-70

ECP 1246R4 & R5 - BLOCK II CONTROLLER FLIGHT SOFTWARE

- **STS 70 CHANGES**
  - **RCNs 6163 & 6144**
    - MODIFIED INTERRUPT PROCESSING LOGIC
      - INCORPORATES AN IMMEDIATE RETRY SOFTWARE FILTER TO DETECT AND REJECT TRANSIENT CONTROLLER INTERRUPTS
  - **RCN 6236**
    - PBP DISCHARGE TEMPERATURE SENSOR TIP INTEGRITY MONITOR LIMIT CHANGE
      - RAISES THE UPPER LIMIT IN START PREP, START, AND MAINSTAGE PHASES TO 230R (WAS 220R)
      - PROVIDES ADDITIONAL MARGIN FOR VALID READINGS DUE TO INCREASED MEASUREMENT RANGE CAPABILITY IN BLOCK II CONTOLLERS
  - **DCN 26181**
    - PRE-OPERATIONAL CONDITIONING CYCLE AND ACTUATOR EXERCISE SEQUENCE SEQUENCE DESIGN CHANGE
      - PROVIDES PROPER CHANNEL B COMMANDS UPON EXIT FROM THE SEQUENCE PRIOR TO NORMAL COMPLETION

DISCOVERY STS-70

ECP 1246R4 & R5 - BLOCK II CONTROLLER FLIGHT SOFTWARE

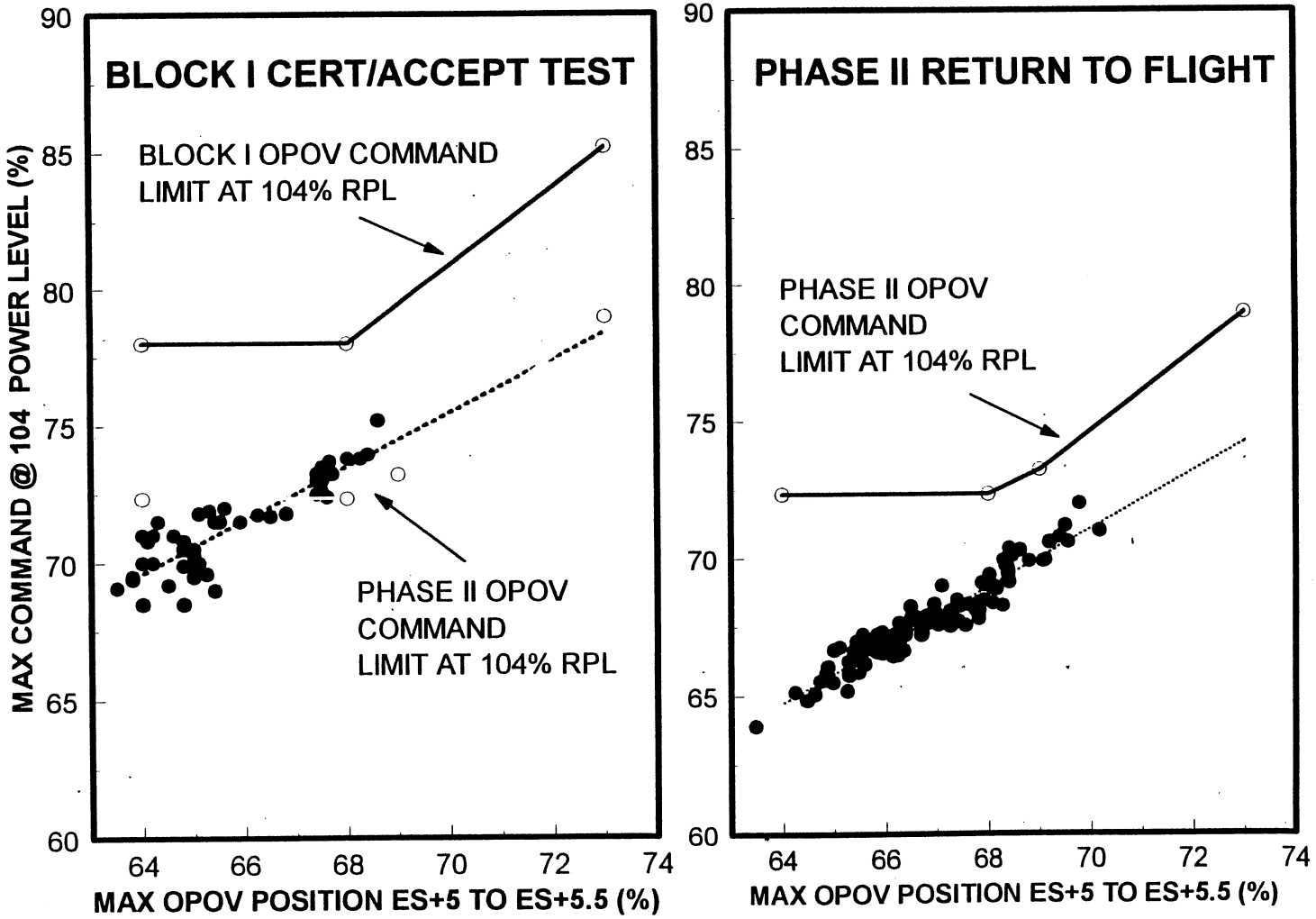
- **CERTIFICATION REQUIREMENTS**
  - **SOFTWARE VERIFICATION AT HSL**
    - VERIFICATION OF REQUIREMENT AND CODE CHANGES
    - RE-VERIFICATION OF CRITICAL ENGINE FUNCTIONS AFFECTED BY SOFTWARE CHANGES
    - STATUS - COMPLETED SATISFACTORILY 4/14/95
  - **HOT-FIRE VERIFICATION AT SSC**
    - TWO TESTS ON DIFFERENT ENGINES WITH DIFFERENT CONTROLLERS
      - ENGINE 2038/F57 TEST 902-611 COMPLETED 4/20/95
      - ENGINE 2015/F60 TEST 904-260 COMPLETED 4/26/95
  - **VERIFICATION COMPLETE REPORT**
    - REQUIRED AT COMPLETION OF TESTING
      - SUBMITTED 4/28/95

- **SOFTWARE DELIVERY SCHEDULE**
  - ENGINE INSTALLATION CHECKOUT - COMPLETED 4/19/95
  - FLIGHT AUTHORIZATION - **ECD** 5/~~10~~12/95

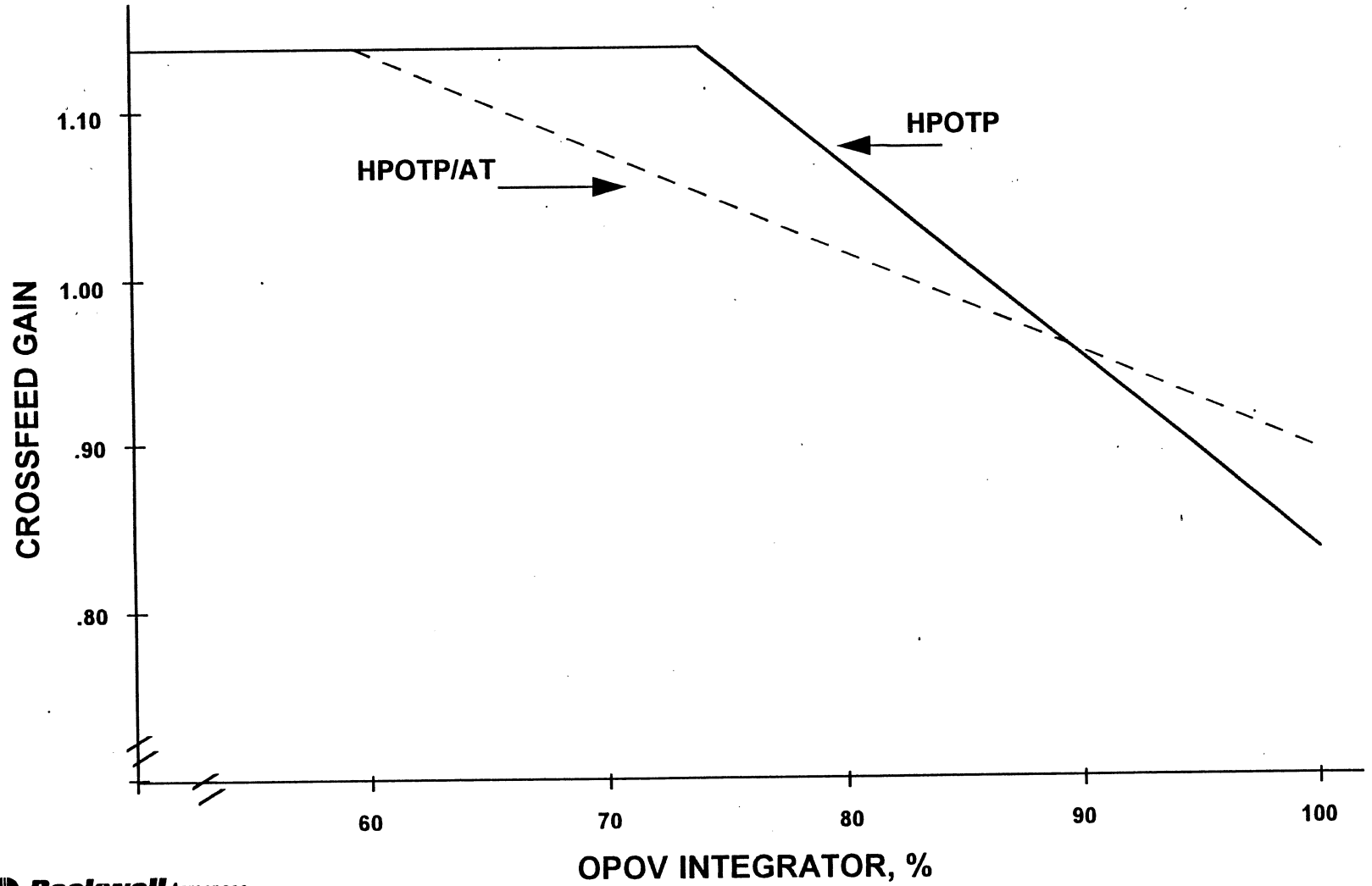
BLOCK I SSME
UNIQUE SOFTWARE CHANGES

- OPOV COMMAND LIMIT CURVE
- HPOTP INTERMEDIATE SEAL PRESSURE REDLINE LIMITS
- DELETE HPOTP SECONDARY SEAL PRESSURE REDLINE
- MODIFIED MAINSTAGE CROSSFEED GAIN VALUE
- ENGINE START MODIFICATIONS
- CHAMBER COOLANT VALVE (CCV) MAINSTAGE SCHEDULE CHANGE

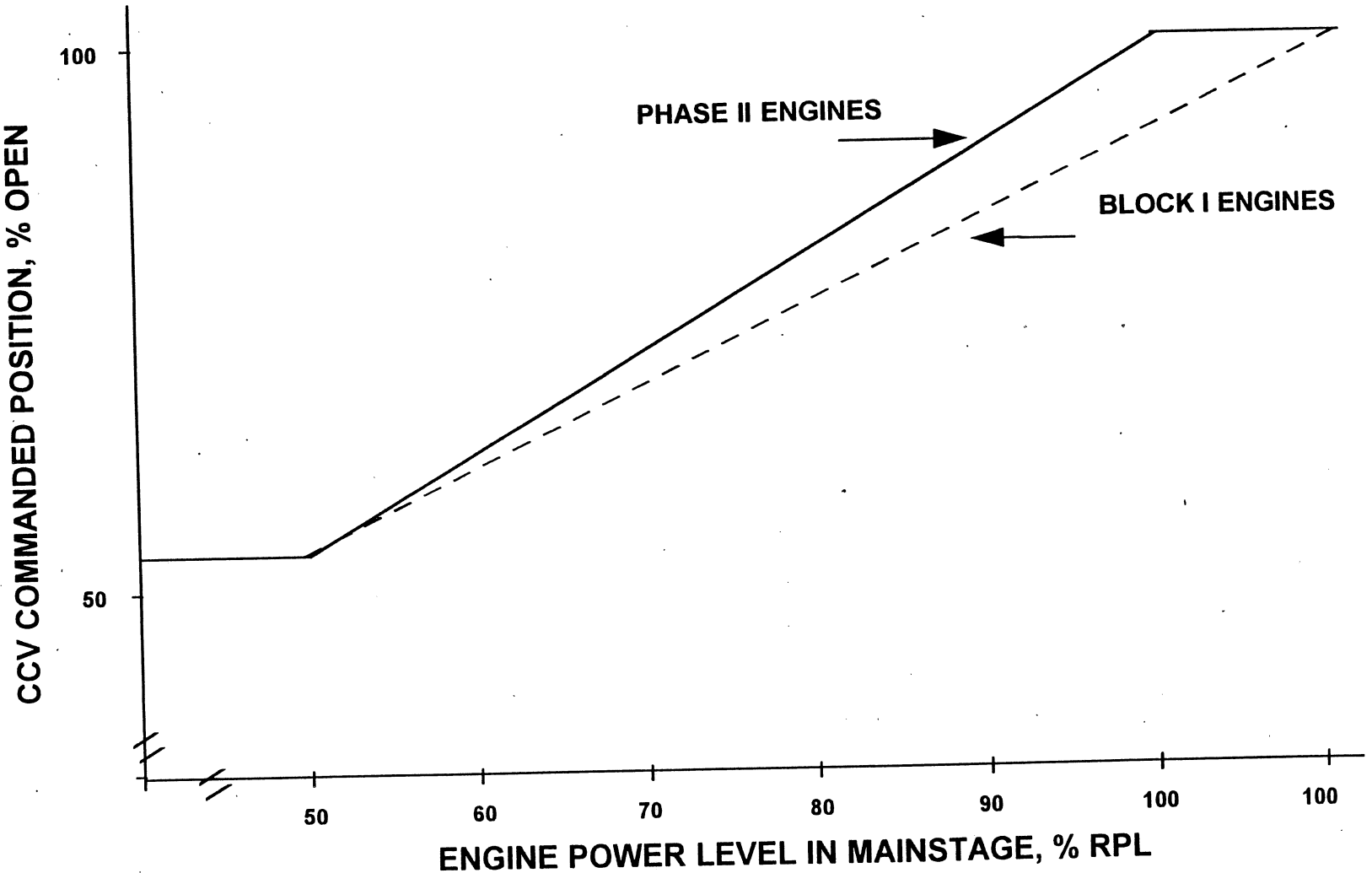
SSME CONTROLLER SOFTWARE
OPOV COMMAND LIMIT CHANGE



BLOCK I SSME
CONTROLLER SOFTWARE
MAINSTAGE CROSSFEED GAIN SCHEDULES



BLOCK I SSME
CONTROLLER SOFTWARE
CCV MAINSTAGE SCHEDULE CHANGE



DISCOVERY STS-70
SOFTWARE CHANGES

DESCRIPTION	ENGINE	REASON
LOGIC CHANGES		
• MODIFIED INTERUPT PROCESSING LOGIC	ALL	• INCORPORATE ECP 1246R4 AND R5
• PRE-OPERATIONAL CONDITIONING CYCLE AND ACTUATION EXRCISE SEQUENCE DESIGN CHANGE	ALL	• INCORPORATE ECP 1246R4 AND R5
OPERATIONAL/ADAPTATION DATA CHANGES		
• REDLINE CHANGES • HPOT DISCH TEMP CH A & CH B	2017	• RESET REDLINE (SET TO 1560R)
• PREBURNER PUMP DISCHARGE TEMPERTURE SENSOR TIP INTEGRITY MONITOR	ALL	• MADE COMPATIBLE WITH ENGINE READY LIMIT - LCC (CHANGED 220 TO 230) ECP 146R4
• BLOCK I SPECIFIC OPERATIONAL DATA	2036	• BLOCK I ENGINE COMPATABILITY
• SENSOR COEFFICIENTS • CRYOGENIC TEMPERATURE SENSORS	2019	• SENSORS REPLACED
• PRESSURE SENSOR CHANGES	2019 2036	• SCREENED SENSORS INSTALLED
• TURBINE DISCHARGE TEMPERATURE SENSORS	2036	• SENSORS WITH VENT HOLES PLUGGED WILL BE INSTALLED PRIOR TO FLIGHT