

CRITICAL ITEMS LIST

PROJECT: SAMS
 ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1470-18-1

SHEET: _____

FMEA REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 2/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
3740	2	RIGIDIZATION MECHANISM PART OF 51140E1472 -18-3 QTY-1	<p>MODE: RIGIDIZE BRAKE SLIPS OR DISENGAGED.</p> <p>CAUSE(S): (1) STRUCTURAL FAILURE. (2) MECHANICAL FAILURE (GUIDE PIN AND SPRING). (3) FRICTION DEBRIS FROM EXCESSIVE BRAKE PAD WEAR.</p>	<p>WOM. SNARE BRAKE HOLDS SYSTEM.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNCOMMANDED RELEASE.</p> <p>REUNDANT PATHS REMAINING</p> <p>SNARE BRAKE</p>		<p>DESIGN FEATURES</p> <p>THE END EFFECTOR BRAKE IS A MAJOR BOUGHT-OUT PART WHICH IS SUPPLIED BY HONEYWELL SPERRY CORPORATION AND MEETS OR EXCEEDS THE REQUIREMENTS OF SPECIFICATION SPAR-SG.451 FOR P/N 51140D574 18-1 AND SPAR-SG.1091 FOR P/N 51140D2219-1.</p> <p>THE CALIPER BRAKE INCORPORATES MANY DESIGN FEATURES TO IMPROVE THE BRAKES CAPABILITY AND GIVE HIGHER RELIABILITY AS FOLLOWS:</p> <ul style="list-style-type: none"> - SLIP TORQUE CAPABILITY UP TO 85 OZ-IN. - TOTAL INTERNAL CONTAINMENT OF FRICTION DEBRIS WITH THE USE OF LABYRINTH PATHS AND THE PLACEMENT OF THE FRICTION DISKS ON THE OPPOSITE END OF THE BRAKE SHAFT FROM THE PINION GEAR. - MECHANICALLY REDUNDANT SLIDING SPLINES FOR THE CALIPER DISK. - MECHANICALLY REDUNDANT LOCATING PINS WITH VESPEL SLEEVES FOR DISK LOCATION. - BEARING LOADS ARE REDUCED BY A'S TO 1 FACTOR OVER THE ORIGINAL E/E SNARE BRAKE P/N 51140D574-3. - SLIDING SURFACES ARE LUBRICATED WITH MOLYBDENUM DISULFIDE. - BEARINGS ARE WET LUBRICATED WITH BRAYCOVE 3L-JOAP. - AIR GAP CAN BE ADJUSTED WITHOUT BRAKE DISASSEMBLY. <p>DESIGN STANDARDS REQUIRE AN ULTIMATE FACTOR OF SAFETY OF 1.4 FOR BRAKE MECHANICAL PARTS FOR DESIGN LIMIT LOADS. DESIGN DRIVERS ARE TYPICALLY BRAKE SEIZURE OR LAUNCH LOADS WHICH PROCURE LOADS 2 TO 3 TIMES OPERATING LOADS.</p> <p>THE BRAKE USES FOUR PINS PRESS FITTED INTO THE CORE TO HOLD THE ARMATURE FROM ROTATING AND TO ALLOW AXIAL SLIDING FOR ENGAGEMENT AND DISENGAGEMENT. THE FOLLOWING IS A LIST OF CHARACTERISTICS TO LIMIT THE POSSIBILITY OF THE BRAKE HANGING-UP DUE TO MECHANICAL BINDING BETWEEN THE PINS AND THE HOLES.</p> <p>THE HOLES IN THE ARMATURE AND BRAKE CORE ARE MATCH-BORED (JIG BORED) TO ASSURE GOOD ALIGNMENT.</p> <p>THE ARMATURE HOLES ARE 0.004 TO 0.005 INCH LARGER THAN THE CORE PINS TO ASSURE ADEQUATE CLEARANCE.</p> <p>MEASUREMENTS ARE PERFORMED TO CONFIRM A MINIMUM OF 0.002 INCH RADIAL PLAY BETWEEN THE TWO ASSEMBLED PARTS.</p> <p>THE UNIT IS TESTED A MINIMUM OF SEVEN TIMES DURING ACCEPTANCE TESTING FOR POTENTIAL BINDING. THE TEST CONSISTS OF APPLYING FULL RATED LOAD TORQUE WITH THE UNIT ENGAGED. A VOLTAGE IS THEN APPLIED TO DISENGAGE THE UNIT. THE TIME FROM APPLICATION OF VOLTAGE UNTIL FULL DISENGAGEMENT IS MEASURED. ANY BINDING OF THE ARMATURE WOULD EITHER PREVENT DISENGAGEMENT OR CAUSE AN EXCESSIVE TIME DELAY.</p> <p>THE PINS ARE LUBRICATED WITH MOLYBDENUM DISULFIDE.</p> <p>THE HEAVIEST AMOUNT OF FRICTION MATERIAL DEBRIS IS GENERATED DURING THE CALIBRATION RUN-IN OF THE UNIT. THE RUN-IN CONSISTS OF ROTATING THE UNIT IN ONE DIRECTION AT 50 RPM FOR A TOTAL OF 16 HOURS MINIMUM USING A DUTY CYCLE OF 10 SECONDS</p>

PREPARED BY: RMG

SUPERCEDING DATE: 06 OCT 87

APPROVED BY: _____

DATE: _____



CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1470-1B

SHEET: 2

P/N REF.	REV.	PART QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOW / FUNC. 2/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
3740	2	RIGIDIZATION MECHANISM PART OF 51140E1472 -1B-3 QTY-1	<p>MODE: RIGIDIZE BRAKE SLIPS OR DISENGAGED.</p> <p>CAUSE(S): (1) STRUCTURAL FAILURE. (2) MECHANICAL FAILURE (GUIDE PIN AND SPRING). (3) FRICTION DEBRIS FROM EXCESSIVE BRAKE PAD WEAR.</p>	<p>WOMEN. SHARE BRAKE HOLDS SYSTEM.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNCOMMANDED RELEASE.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SHARE BRAKE</p>		<p>ENGAGED AND THEN 10 SECONDS DISENGAGED. THE UNITS RECEIVE A VERY LIMITED AMOUNT OF SLIPPING DURING ON MISSION USAGE. DEBRIS IS PREVENTED FROM ESCAPING FROM THE -3 CLUTCH USED IN THE 51140E1470 1 END EFFECTOR WITH A LABYRINTH NETWORK.</p> <p>THE AIR GAP OF THE UNIT IS VERIFIED TO MEET A MINIMUM VALUE BY THE END PLAY TEST (LARGEST APPLIED LOAD) DURING ACCEPTANCE TESTING.</p> <p>THE STRIPDOWN AND INSPECTION OF FLIGHT HARDWARE RETURNED FOR REFURBISHMENT HAS REVEALED THAT A SIGNIFICANT AMOUNT OF FRICTION MATERIAL DEBRIS MAY HAVE ACCUMULATED AT THE UNIT END OF LIFE. IT IS VERY UNLIKELY; HOWEVER, THAT SUFFICIENT FRICTION DEBRIS COULD ACCUMULATE BEHIND THE ARMATURE OR BETWEEN THE FRICTION SURFACES, SO AS TO AFFECT THE UNITS PERFORMANCE</p>

CRITICAL ITEMS LIST

PROJECT: SRMS
 ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1470-1B-1

SHEET: 3

P/N REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HWMR / FUNC. 2/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
3740	2	RIGIDIZATION MECHANISM PART OF 51140E1472 -1B-1 QTY-1	MODE: RIGIDIZE BRAKE SLIPS OR DISENGAGED. CAUSE(S): (1) STRUCTURAL FAILURE. (2) MECHANICAL FAILURE (GUIDE PIN AND SPRING). (3) FRICTION DEBRIS FROM EXCESSIVE BRAKE PAD WEAR.	NONE. SNARE BRAKE HOLDS SYSTEM. WORST CASE LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNCOMMANDED RELEASE. REDUNDANT PATHS REMAINING SNARE BRAKE		ACCEPTANCE TESTS ----- THE EE ASSEMBLY IS TESTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTS: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 7 O THERMAL VACUUM: +70 DEGREES C TO -25 DEGREES C (1 1/2 CYCLES) 1 X 10**6 TORR THE EE ASSEMBLY IS FURTHER TESTED IN THE IN THE RMS SYSTEM TEST (TP510 RMS STRONGBACK AND TP552 FLAT FLOOR TESTS) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE. QUALIFICATION TESTS ----- THE EE ASSEMBLY QUALIFICATION TESTING CONSISTED OF THE FOLLOWING ENVIRONMENTS: O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 7 O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS) O THERMAL VACUUM: +81 DEGREES C TO -36 DEGREES C (6 CYCLES) 1 X 10**6 TORR O HUMIDITY: 95% RH (65 DEGREES C MAINTAINED FOR 6 HRS) (65 DEGREES C TO 30 DEGREES C IN 16 HRS) 10 CYCLES 240 HRS. O EMC: MIL-STD-461A AS MODIFIED BY SL-E-0002 (TEST CE01, CE03, CS01, CS02, CS06, RE02 (M/B)) O STRUCTURAL STIFFNESS AND LOAD TEST FLIGHT CHECKOUT ----- PDMS OPS CHECKLIST (ALL VEHICLES) JSC 16907

PREPARED BY: WMC SUPERSEDING DATE: 06 OCT 07 APPROVED BY: _____

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1470-18-3

SHEET: 4

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 2/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
3740	2	RIGIDIZATION MECHANISM PART OF 51140E1472 -18-3 QTY-1	<p>MODE: RIGIDIZE BRAKE SLIPS OR DISENGAGED.</p> <p>CAUSE(S): (1) STRUCTURAL FAILURE. (2) MECHANICAL FAILURE (GUIDE PIN AND SPRING). (3) FRICTION DEBRIS FROM EXCESSIVE BRAKE PAD WEAR.</p>	<p>NONE. SNARE BRAKE HOLDS SYSTEM.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNCOMMANDED RELEASE.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SNARE BRAKE</p>		<p>QA/INSPECTIONS</p> <p>UNITS ARE MANUFACTURED UNDER DOCUMENTED QUALITY CONTROLS. THESE CONTROLS ARE EXERCISED THROUGHOUT DESIGN PROCUREMENT, PLANNING, RECEIVING, PROCESSING, FABRICATION, ASSEMBLY, TESTING AND SHIPPING OF THE UNITS. MANDATORY INSPECTION POINTS ARE EMPLOYED AT VARIOUS STAGES OF FABRICATION ASSEMBLY AND TEST. GOVERNMENT SOURCE INSPECTION IS INVOKED AT VARIOUS CONTROL LEVELS.</p> <p>RECEIVING INSPECTION VERIFIES THAT THE HARDWARE RECEIVED IS AS IDENTIFIED IN THE PROCUREMENT DOCUMENTS, THAT NO DAMAGE HAS OCCURRED DURING SHIPMENT, AND THAT APPROPRIATE DATA HAS BEEN RECEIVED WHICH PROVIDES ADEQUATE TRACEABILITY INFORMATION AND IDENTIFIES ACCEPTABLE PARTS.</p> <p>PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE:</p> <p>FOLLOWING HEAT TREATMENT, STEEL PARTS (E.G. GEARS) ARE SUBJECTED TO A MAGNETIC PARTICLE INSPECTION FOR CRACKS OR IN THE CASE OF ALUMINUM PARTS (E.G. HOUSINGS) ARE DYE PENETRANT INSPECTED USING GROUP V PENETRANTS. WELDING OF GEARS OR HOUSINGS IS SUBJECTED TO DYE PENETRANT (GROUP V) AND RADIOGRAPHIC INSPECTION ON COMPLETION OF STRESS RELIEF TO CHECK FOR CRACKS. QUALIFICATION WELDING TEST SAMPLES FOR STRUCTURAL WELDS ARE SUBJECTED TO DESTRUCTIVE TESTING WHERE POSSIBLE (TENSILE AND BENDING) AS WELL AS METALLAGRAPHIC ANALYSIS TO ENSURE DEFECT FREE WELDS.</p> <p>FRACTURE CRITICAL COMPONENTS ARE INSPECTED TO THE APPLICABLE PROCESS CONTROL PROCEDURE, USING SPECIAL NDT METHODS, BY TRAINED AND CERTIFIED INSPECTORS.</p> <p>BEARINGS RECEIVE DIMENSIONAL INSPECTION AT THE SUPPLIER AND VERIFICATION BY SPAR RECEIVING INSPECTION. PRE-ASSEMBLY INSPECTION VERIFIES CIRCULARITY OF BALL TRACKS AND INNER/OUTER RACE DIAMETERS. AFTER ASSEMBLY PRIOR TO LUBRICATION, RADIAL CLEARANCE MEASUREMENTS ARE TAKEN. FOLLOWING LUBRICATION, RUN-IN/BURNISHING AND CLEANING OF OAT LUBE BEARINGS, SPECIALIZED BEARING INSPECTION EQUIPMENT AT SPAR IS USED TO VERIFY QUALITY AND STICTION LEVELS THROUGH STRIP CHART RECORDING OF TORQUE TRACES. BEARINGS ARE THEN RETURNED TO THE SUPPLIER FOR FINAL RADIAL CLEARANCE MEASUREMENTS. GOVERNMENT SOURCE INSPECTION IS INVOKED ON ALL BEARING PROCUREMENTS.</p> <p>INSPECTION VERIFIES THAT KITTED PARTS ARE CORRECT PRIOR TO ASSEMBLY AND TRACEABILITY INFORMATION RECORDED.</p> <p>INSPECTION TO DRAWING IS CONDUCTED THROUGHOUT THE ASSEMBLY PROCESS, INCLUDING INSPECTION OF LOCKING, WITNESSING OF TORQUING AND APPLICATION OF TORQUE STRIPING.</p> <p>PRE-ACCEPTANCE TEST INSPECTION, WHICH INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC., (MANDATORY INSPECTION POINT).</p>

PREPARED BY: HEMC

SUPERSEDING DATE: 06 OCT 87

APPROVED BY:

DMS

CRITICAL ITEMS LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1470-1B-3 | SHEET: 5

P/N & REF.	REV.	NAME, QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	NDHM / FUNC. 2/IRAB CRITICALITY	RATIONALE FOR ACCEPTANCE
3740	2 -	RIGIDIZATION MECHANISM PART OF 51140E1472 -1B-3 QTY-1	<p>MODE: RIGIDIZE BRAKE SLIPS OR DISENGAGED.</p> <p>CAUSE(S): (1) STRUCTURAL FAILURE. (2) MECHANICAL FAILURE (GUIDE PIN AND SPRING). (3) FRICTION DEBRIS FROM EXCESSIVE BRAKE PAD WEAR.</p>	<p>NONE. SNARE BRAKE HOLDS SYSTEM.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNCOMMANDED RELEASE.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SNARE BRAKE</p>		<p>A TEST READINESS REVIEW (TRR) WHICH INCLUDES VERIFICATION OF TEST PERSONNEL, TEST DOCUMENTS, TEST EQUIPMENT CALIBRATION/ VALIDATION STATUS AND HARDWARE CONFIGURATION IS CONVENED BY QUALITY ASSURANCE IN CONJUNCTION WITH ENGINEERING, RELIABILITY, CONFIGURATION CONTROL, SUPPLIER AS APPLICABLE, AND THE GOVERNMENT REPRESENTATIVE, PRIOR TO THE START OF ANY FORMAL TESTING (ACCEPTANCE OR QUALIFICATION).</p> <p>ACCEPTANCE TESTING (ATP) INCLUDES AMBIENT, VIBRATION AND THERMAL VAC TESTING. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p> <p>SRMS SYSTEMS INTEGRATION. THE INTEGRATION OF MECHANICAL ARM SUBASSEMBLIES AND THE FLIGHT CABIN EQUIPMENT TO FORM THE SRMS. INSPECTIONS ARE PERFORMED AT EACH PHASE OF INTEGRATION WHICH INCLUDES GROUNDING CHECKS, THRU WIRING CHECKS, WIRING ROUTING, INTERFACE CONNECTORS FOR BENT OR PUSH BACK CONTACTS ETC.</p> <p>SRMS SYSTEMS TESTING - STRONGBACK AND FLAT FLOOR AMBIENT PERFORMANCE TEST. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p>

PREPARED BY: HWG SUPERSEDING DATE: 06 OCT 07 APPROVED BY: _____

CRITICAL ITEM LIST

PROJECT: SRMS
ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
ASS'Y P/N: 51140E1470-1B-3

SHEET: 6

P/N REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	RISK / FUNC. 2/1RAB CRITICALITY RATIONALE FOR ACCEPTANCE
3740	3	RIGIDIZATION MECHANISM PART OF 51140E1472-1B-3 QTY-1	<p>MODE: RIGIDIZE BRAKE SLIPS OR DISENGAGED.</p> <p>CAUSE(S): (1) STRUCTURAL FAILURE. (2) MECHANICAL FAILURE (GUIDE PIN AND SPRING). (3) FRICTION DEBRIS FROM EXCESSIVE BRAKE PAD WEAR.</p>	<p>NONE. SHARE BRAKE HOLDS SYSTEM.</p> <p>WORST CASE</p> <p>LOSS OF MISSION. SUBSEQUENT FAILURE MAY CAUSE UNCOMMANDED RELEASE.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SHARE BRAKE</p>	<p>FAILURE HISTORY</p> <p>THE FOLLOWING FAILURE ANALYSIS REPORT(S) ARE RELEVANT:</p> <p>FAR 2404: 5 UNITS (S/NS 301, 302, 303, 304, 305) E/E BRAKE AUG. 87</p> <p>DESCRIPTION</p> <p>ALL UNITS FAILED DROP-OUT & RELEASE TIME DUE TO A DESIGN ERROR</p> <p>CORRECTIVE ACTION</p> <p>MODIFIED DWG. TO ASSURE CORRECT GAP LENGTH. MODIFIED CALIBRATION PROCEDURE (WHICH SERVES AS A M.I.P.).</p>

PREPARED BY: MFVG

SUPERSEDING DATE: 12 OCT 89

APPROVED BY:

IE: _____

CRITICAL ITEMS LIST

PROJECT: SRMS
 ASS'Y NOMENCLATURE: END EFFECTOR

SYSTEM: MECHANICAL ARM SUBSYSTEM
 ASS'Y P/N: 51140E1470-1B SHEET: 1

PMA REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / TIME 2/1RAD CRITICALITY	RATIONALE FOR ACCEPTANCE
3740	2	RIGIDIZATION MECHANISM PART OF 51140E1472 -1B-1 QTY-1	MODE: RIGIDIZE BRAKE SLIPS OR DISENGAGED. CAUSE(S): (1) STRUCTURAL FAILURE. (2) MECHANICAL FAILURE (IGNITE PIN AND SPRING). (3) FRICTION DEBRIS FROM EXCESSIVE BRAKE PAD WEAR.	NONE. SNARE BRAKE HOLDS SYSTEM. WORST CASE ----- LOSS OF VISION. SUBSEQUENT FAILURE MAY CAUSE UNCOMMANDED RELEASE. REDUNDANT PATHS REMAINING ----- SNARE BRAKE		<p>OPERATIONAL EFFECTS -----</p> <p>NONE. FOR SUBSEQUENT FAILURE PAYLOAD WILL BE RELEASED WITH NO OPERATOR COMMAND. IF THIS OCCURS WHILE THE ARM IS BEING DRIVEN, THE PAYLOAD WILL TAKE AN UNEXPECTED TRAJECTORY.</p> <p>CREW ACTION -----</p> <p>MANEUVER ARM AND ORBITER AWAY FROM PAYLOAD.</p> <p>CREW TRAINING -----</p> <p>THE CREW WILL BE TRAINED TO MANEUVER THE ORBITER AWAY FROM A FREE PAYLOAD AT ANY TIME DURING ARM OPERATIONS.</p> <p>MISSION CONSTRAINT -----</p> <p>SPEC OPERATE UNDER VERNIER RATES WITHIN 10 FT OF STRUCTURE. THE OPERATOR MUST BE ABLE TO DETECT THAT THE ARM/PAYLOAD IS RESPONDING PROPERLY TO COMMANDS VIA WINDOW AND/OR CCTV VIEWS DURING ALL ARM OPERATIONS.</p> <p>SCREEN FAILURES -----</p> <p>A: EE OPERATES NORMALLY WITH LOSS OF REDUNDANCY. INDEPENDANT PATHS NOT INSTRUMENTED. B: SAME AS A.</p> <p>OWRSO OFFLINE -----</p> <p>NONE</p> <p>OWRSO ONLINE INSTALLATION -----</p> <p>NONE</p> <p>OWRSO ONLINE TURNAROUND -----</p> <p>NONE</p>

PREPARED BY: HEM

SUPERSEDING DATE: 04 OCT 87

APPROVED BY:

C: _____