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ROCKWELL INTERNATIONAL EL SEGUNDO CA NORTH AMERICAN --ETC F/6 1/3
UNIVERSAL ALIGNMENT EQUIPMENT STUDY RESULTS.(U)

APR 80

F33657-79-C-0783

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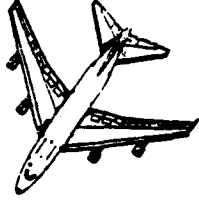
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UNIVERSAL ALIGNMENT EQUIPMENT

STUDY RESULTS



Rockwell International

North American Aircraft Division

CONTRACT NO F33657-79-C-0783

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APR 22 1980

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DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

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UNIVERSAL ALIGNMENT EQUIPMENT
STUDY RESULTS



Rockwell International

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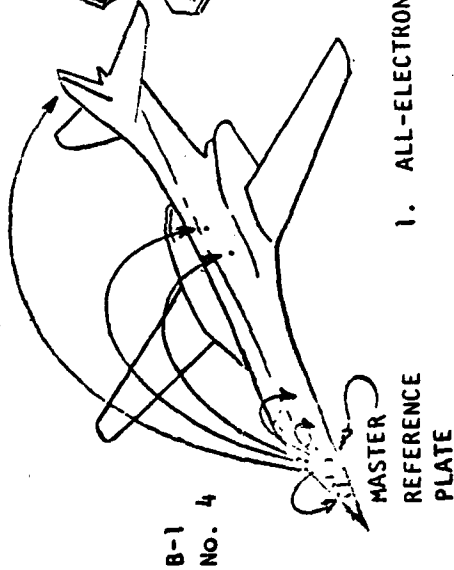
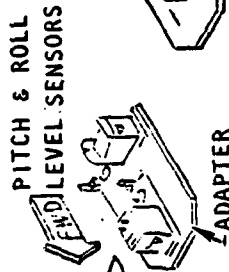
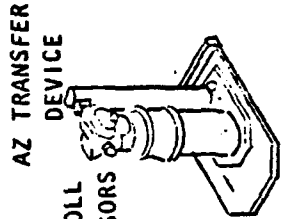
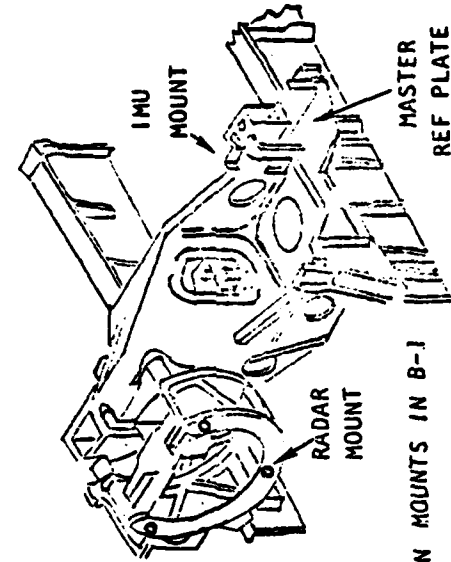
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OUTLINE:

- BACKGROUND;
- UNIVERSAL INSTRUMENTS;
- ELIMINATION OF ADAPTERS;
- INSTRUMENT TECHNOLOGY SURVEY;
- APPLICATIONS TO PRESENT, NEW AIRCRAFT;
- COST EFFECTIVENESS;
- CONCLUSIONS & RECOMMENDATIONS. R

BACKGROUND

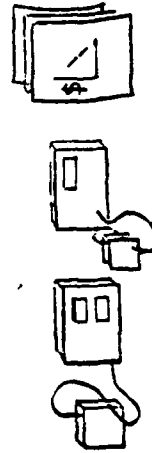


1. ALL-ELECTRONIC ALIGNMENT METHOD USED TO ALIGN MOUNTS IN B-1

2. PROPOSAL TO STUDY IMPROVED, UNIVERSAL ALIGNMENT METHOD



1979	1980
S O N D J F M A	
6 MOS STUDY	



3. OBJECTIVES:
 DEFINE AND JUSTIFY
 UNIVERSAL INSTRUMENTS &
 COMPATIBLE MOUNTS.

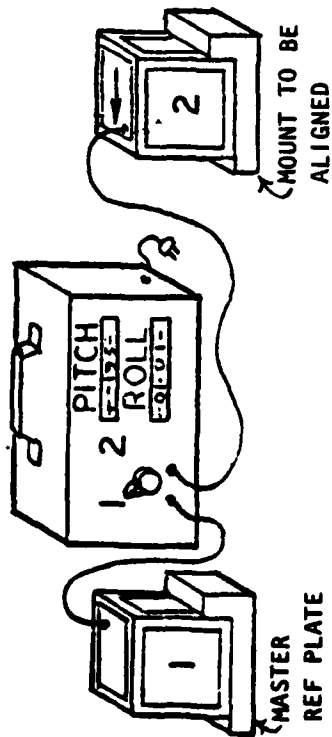
4. STUDY APPROACH:

- DEFINE REQUIREMENTS
- CONDUCT INSTRUMENT SURVEY
- ANALYZE OPTICAL VS ELECTRONIC ALIGNMENT ON NEW AIRCRAFT, ON F-15, A-10, B-52 OAS
- CONDUCT COST EFFECTIVENESS EVALUATION
- PREPARE SPEC FOR NEW MOUNTS

DESIRED IMPROVEMENTS

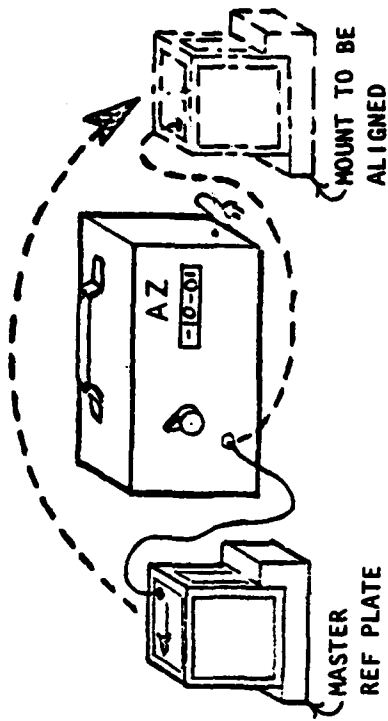
- ELIMINATE ALIGNMENT ADAPTERS AND FIXTURES
- SIMPLIFY ALIGNMENT OPERATIONS
 - PROVIDE DIRECT, INSTANT READOUTS OF ALIGNMENT
 - AVOID NEED TO MOVE OR STABILIZE AIRCRAFT

RECOMMENDED REQUIREMENTS FOR UNIVERSAL
ALIGNMENT INSTRUMENTS



2 - AXIS DIFFERENTIAL LEVEL SENSOR SYSTEM

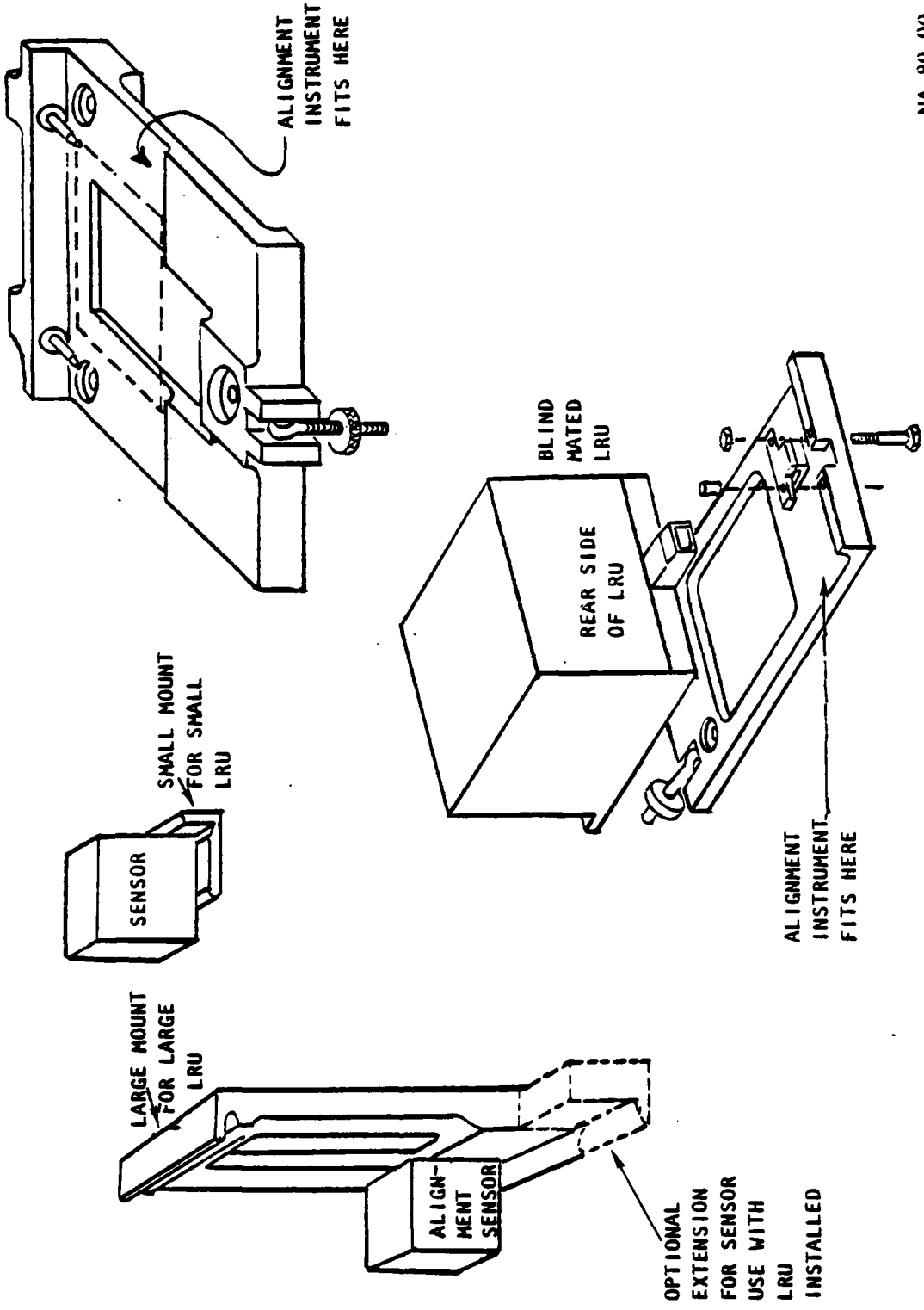
+0.10 MRAD PITCH & ROLL TRANSFER ACCY
CONTINUOUS READOUTS: 1 SEC SETTling TIME
SAME SIZE SENSOR MODULE AS AZ XFR DEVICE
OPERABLE BY UNTRAINED PERSONNEL
WEIGHT GOAL: UNDER 10 LB TOTAL
RDT&E LIMIT: \$100K
COST GOAL: UNDER \$15K



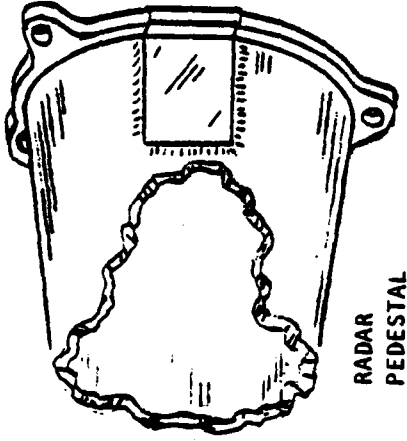
AZ DIRECTIONAL GYRO TRANSFER DEVICE

+0.10 MRAD TRANSFER ACCY FOR 0.1 HR
+0.50 ACCY FOR 0.5 HR DRIFT TIME
5 INCH CUBICAL SENSOR MODULE
OPERABLE BY UNTRAINED PERSONNEL
WEIGHT GOAL: UNDER 20 LB TOTAL
RDT&E LIMIT: \$500K
COST GOAL: UNDER \$50K

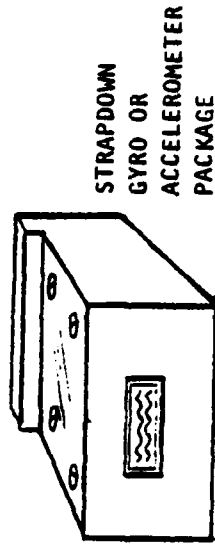
EXAMPLES OF MOUNTS WHICH REQUIRE NO
ALIGNMENT ADAPTERS FOR
UNIVERSAL ALIGNMENT INSTRUMENTS



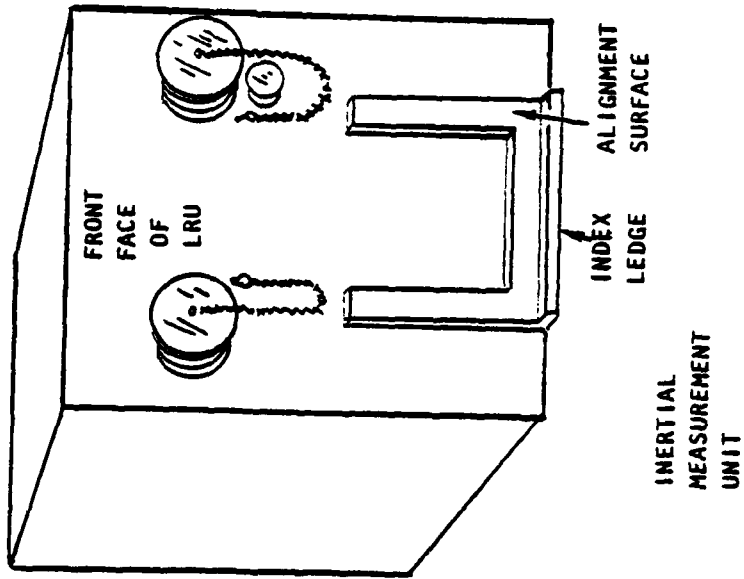
EXAMPLES OF LRU'S WHICH ARE DIRECTLY
COMPATIBLE WITH ALIGNMENT INSTRUMENTS



RADAR
PEDESTAL

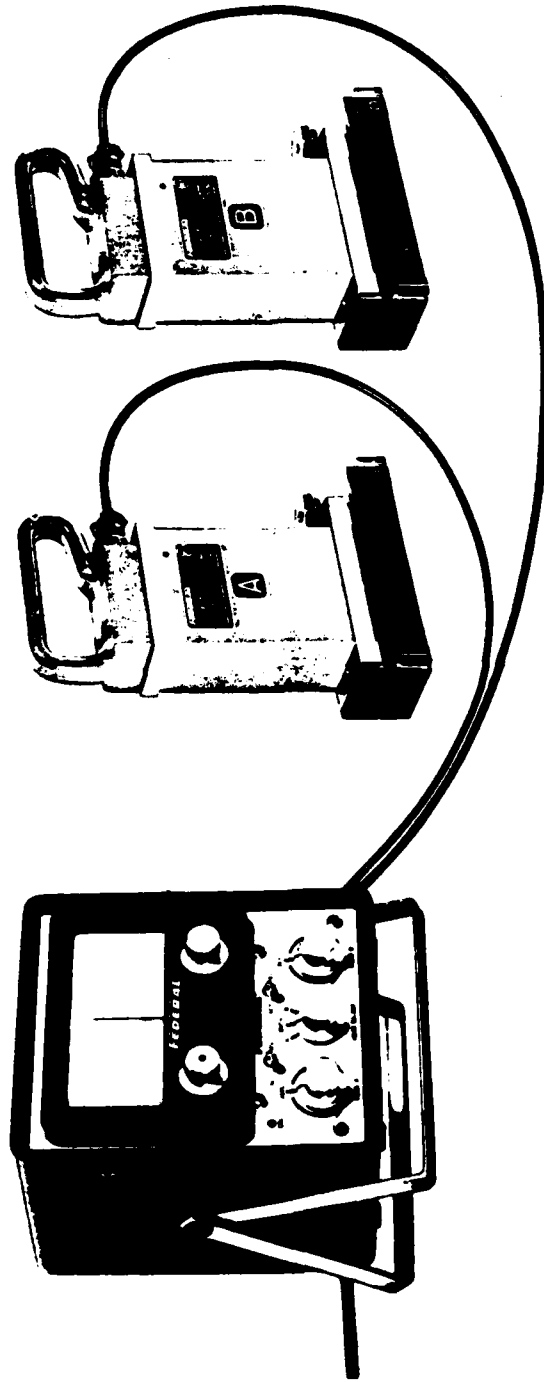


STRAPDOWN
GYRO OR
ACCELEROMETER
PACKAGE



INERTIAL
MEASUREMENT
UNIT

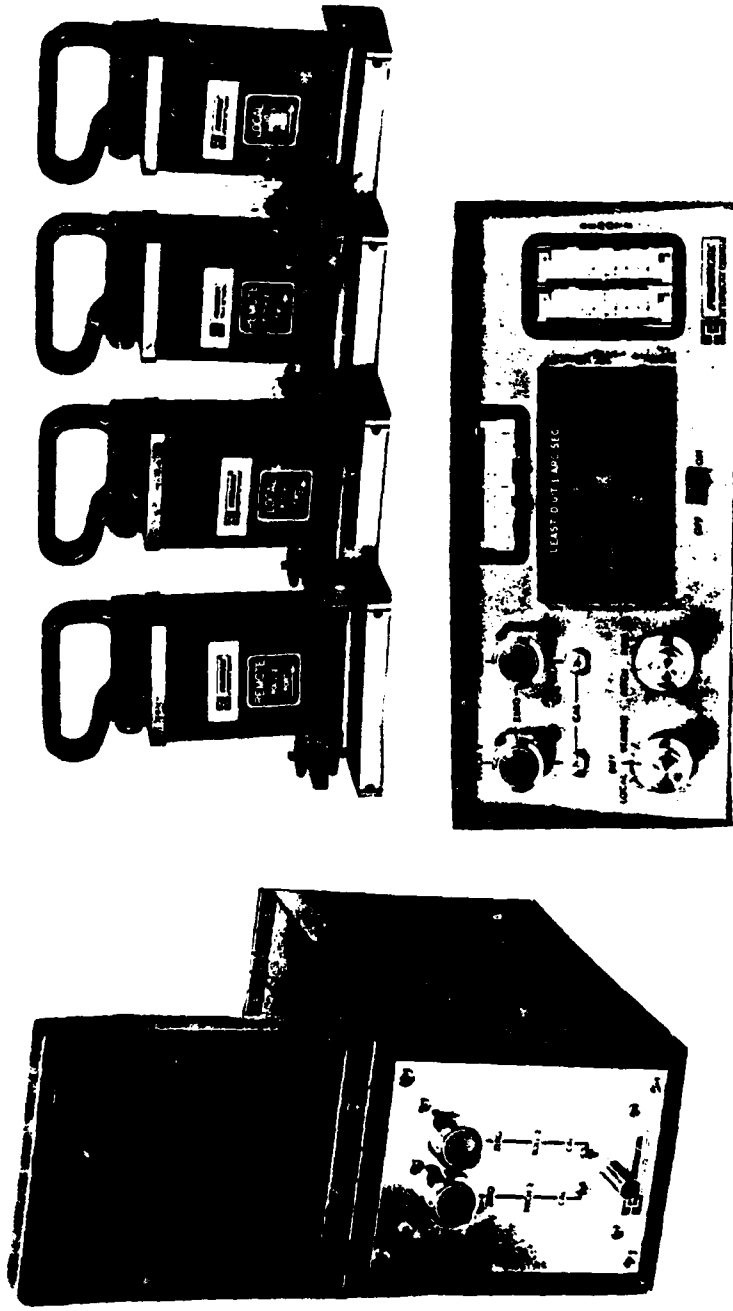
EXAMPLE OF OFF-SHELF LEVEL SENSORS



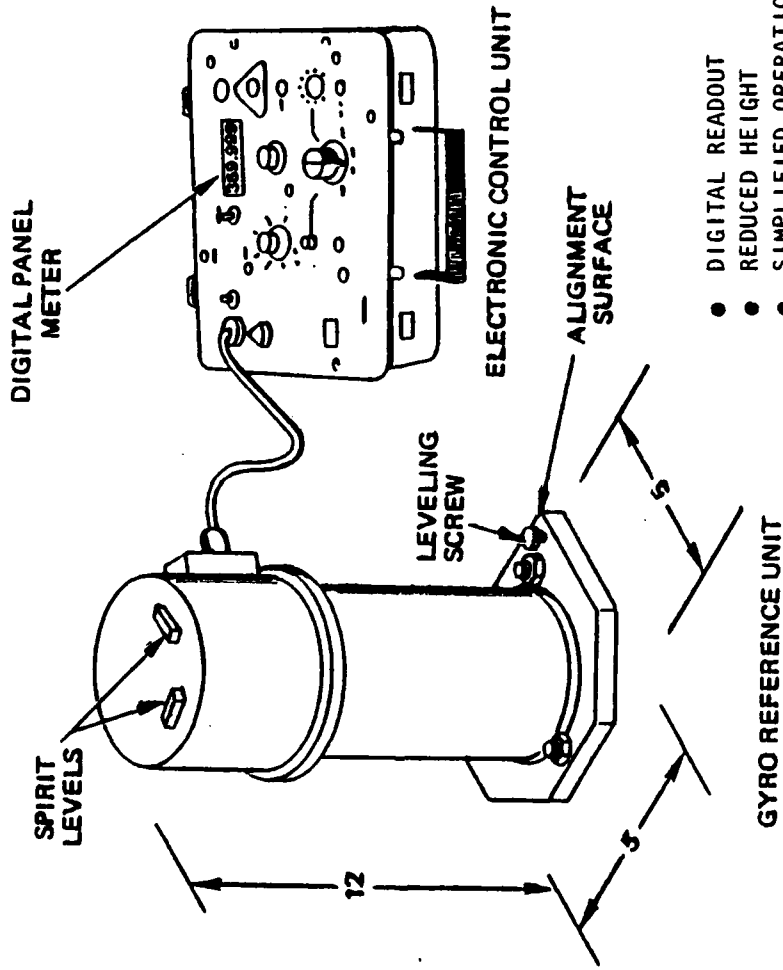
- 5 SCALES
- ADJUSTABLE BASES
- 1 ARC SEC ACCY

- ABSOLUTE OR DIFFERENTIAL READINGS
- \$4 K
- FEDERAL PRODUCTS CORP

OFF-SHELF DIGITAL DIFFERENTIAL LEVEL SENSOR SYSTEM

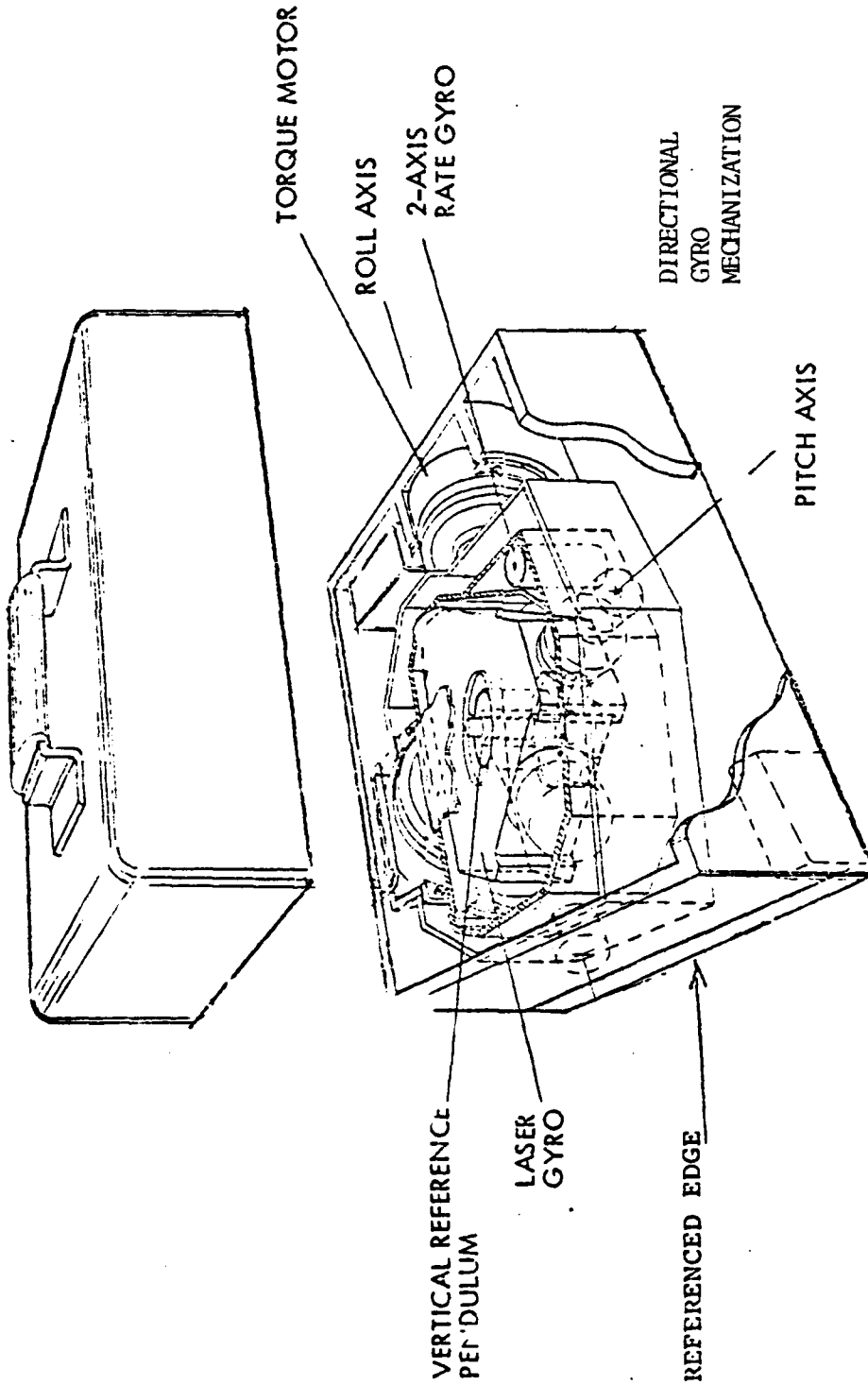


IMPROVED VERSION OF AZ TRANSFER DEVICE USED ON B-1



- DIGITAL READOUT
- REDUCED HEIGHT
- SIMPLIFIED OPERATION
- FASTER SETTling
- LESS VIBRATION SENSITIVITY
- \$250 K - 350 K RDT&E
- \$150 K TOOLING
- \$32 - 33 K EACH

AZ GYRO TRANSFER DEVICE PROPOSED BY RAYTHEON



REMOTE ELECTRONICS
UNIT NOT SHOWN

INSTRUMENT SURVEY RESULTS

- DIGITAL DIFFERENTIAL LEVEL SENSOR SYSTEM CAN BE DEVELOPED TO REQUIREMENTS IN 10-12 MONTHS WITH LOW RISK

	<u>RDT&E*</u>	<u>PRODUCTION</u>
AUTONETICS REPACKAGED TILTMETER	\$ 95 K	\$15 K
REPACKAGED FED PROD CORP QUAD SENSOR	UNK	\$17 K NOW
GOALS: \$100 K MAX \$15 K MAX		

- AZ GYRO TRANSFER DEVICE TECHNICALLY FEASIBLE: SOME COST RISK

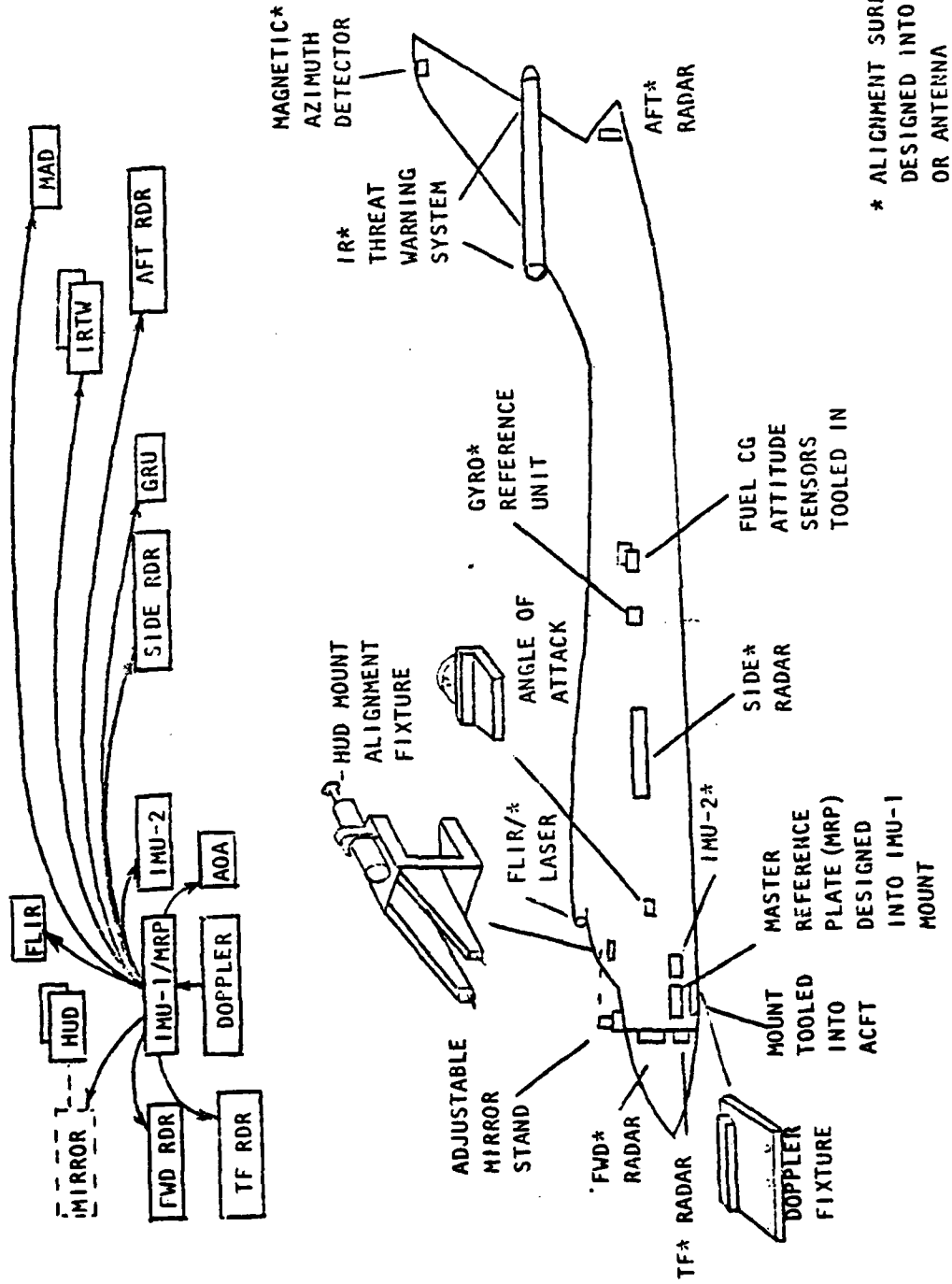
- 12-15 MONTHS DEVELOPMENT TIME
- DIRECTIONAL GYRO MECHANICATION PREFERRED, OBTAINABLE
- 5 INCH SENSOR CUBE (APPROX) OBTAINABLE
- 0.1 MRAD/0.1 HR & 0.5 MRAD/0.5 HR ACCY OK

	<u>RDT&E*</u>	<u>PRODUCTION</u>
RAYTHEON RING LASER GYRO DG MECH	\$500 K	\$ 45 K
LEAR SIEGLER STRAPDOWN DG MECH	\$440 K	\$ 45 K
LITTON LR-80 STRAPDOWN GYRO MOD	\$540 K	\$190
GOALS: \$500 K MAX \$ 50 K MAX		

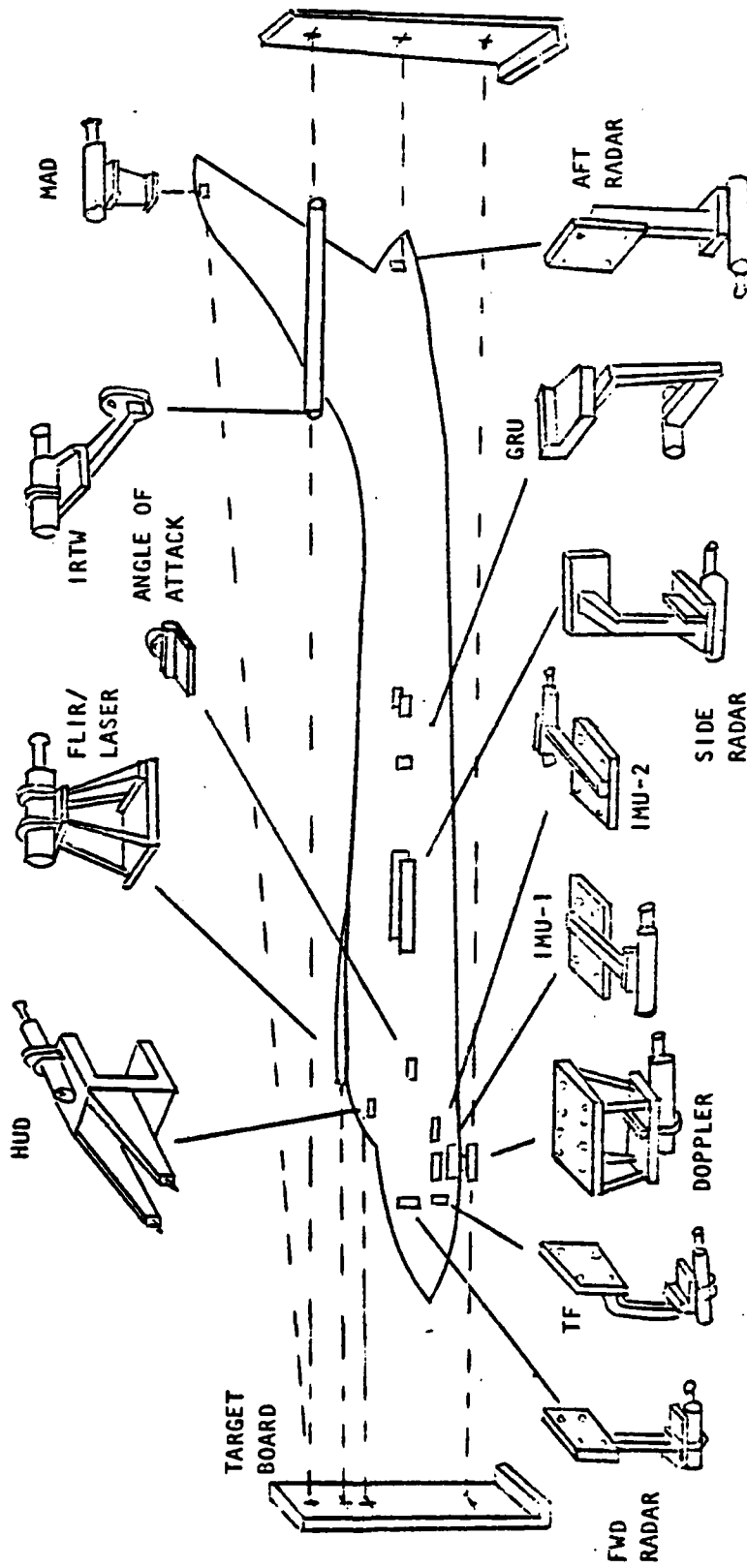
- MONITOR NAVY EFFORT TO AVOID DUPLICATION

*WITH FIRST UNIT

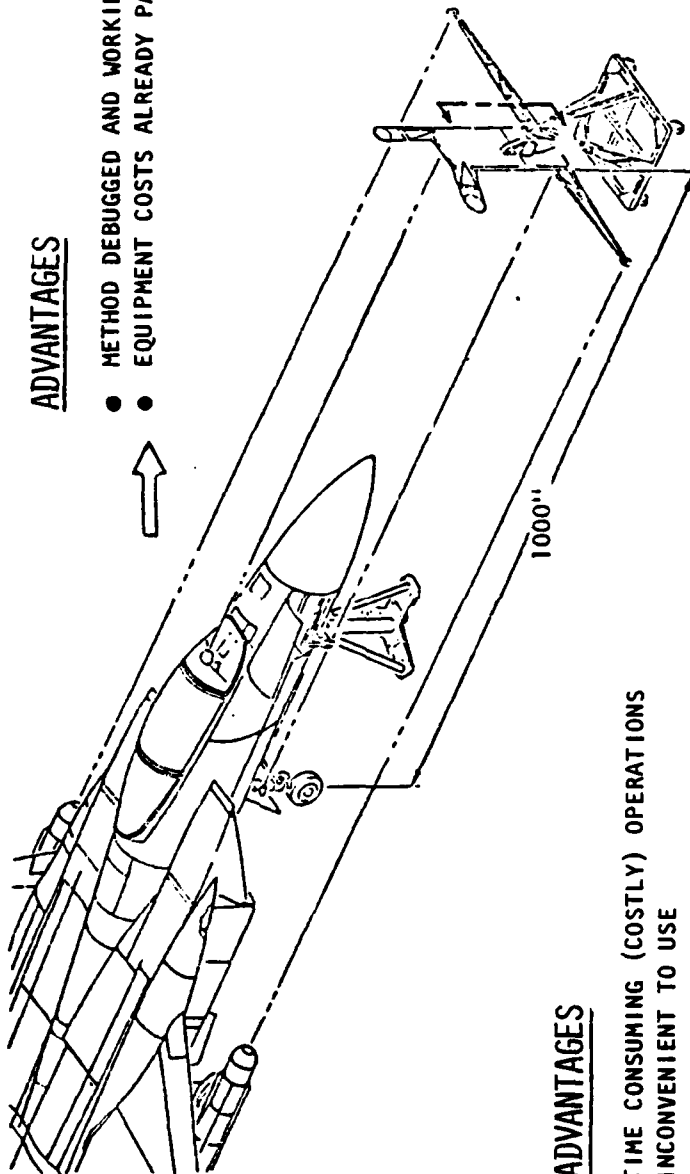
ELECTRONIC ALIGNMENT CONCEPT FOR HYPOTHETICAL NEW AIRCRAFT



OPTICAL ALIGNMENT METHOD FOR HYPOTHETICAL NEW AIRCRAFT



OPTICAL ALIGNMENT METHOD IN USE ON F-15



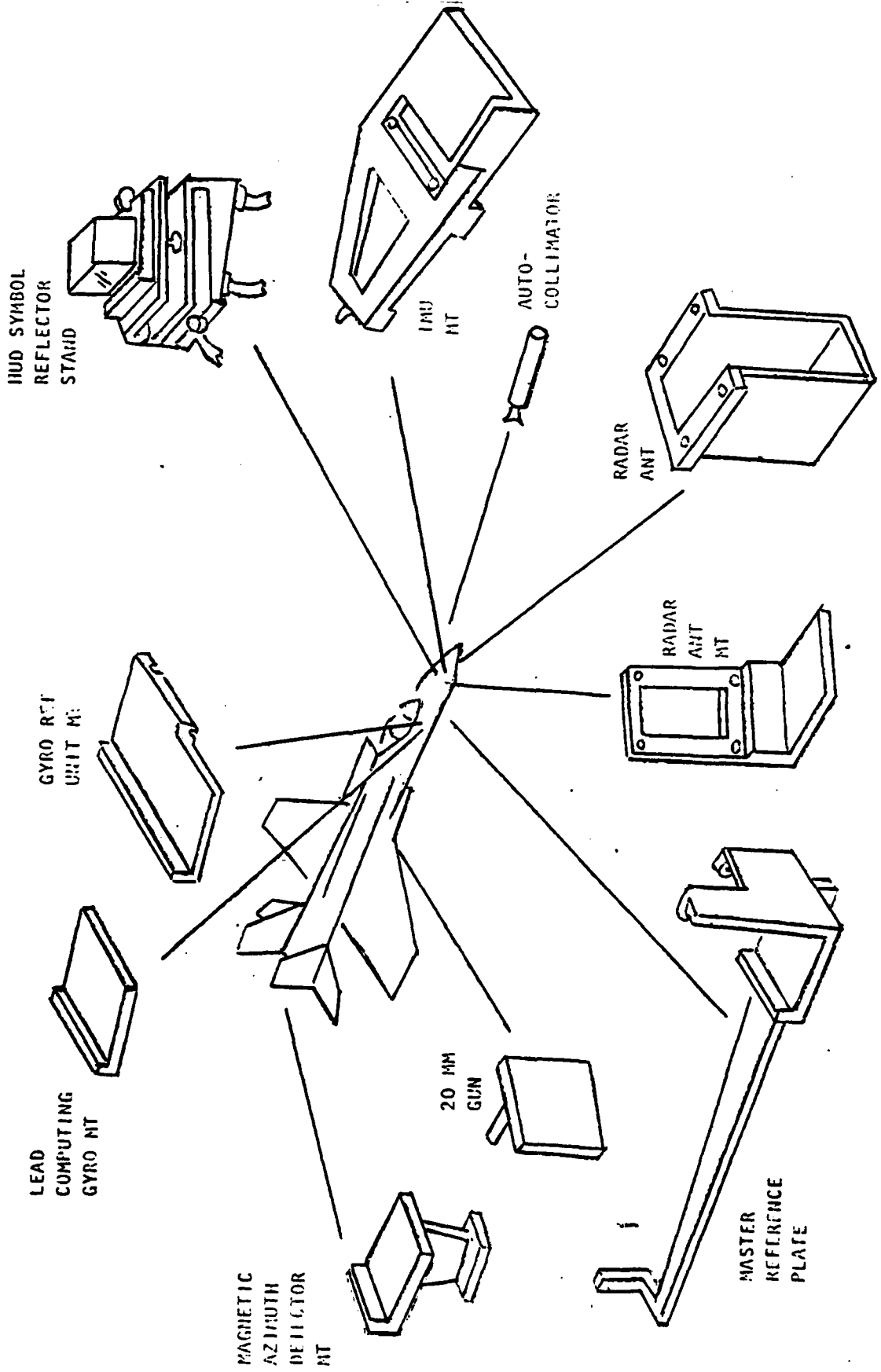
ADVANTAGES

- METHOD DEBUGGED AND WORKING WELL
- EQUIPMENT COSTS ALREADY PAID

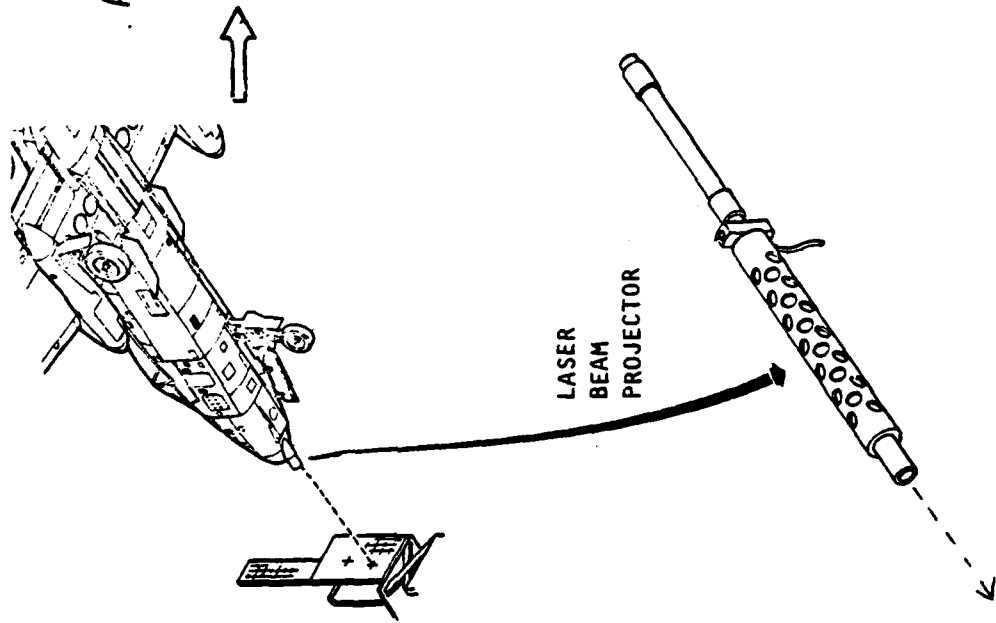
DISADVANTAGES

- TIME CONSUMING (COSTLY) OPERATIONS
- INCONVENIENT TO USE

ADAPTERS NEEDED FOR ELECTRONIC ALIGNMENT ON F-15



LASER ALIGNMENT METHOD PRESENTLY USED ON A-10



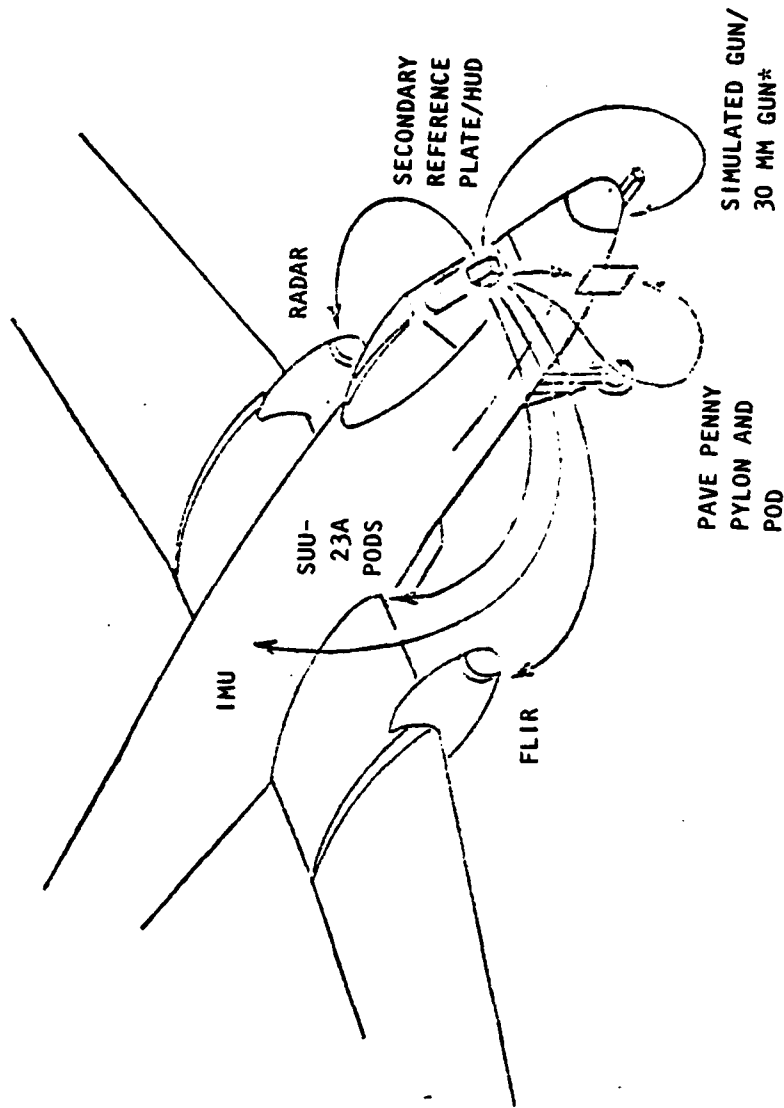
ADVANTAGES

- METHOD DEBUGGED AND WORKING WELL
- EQUIPMENT COSTS ALREADY PAID

DISADVANTAGES

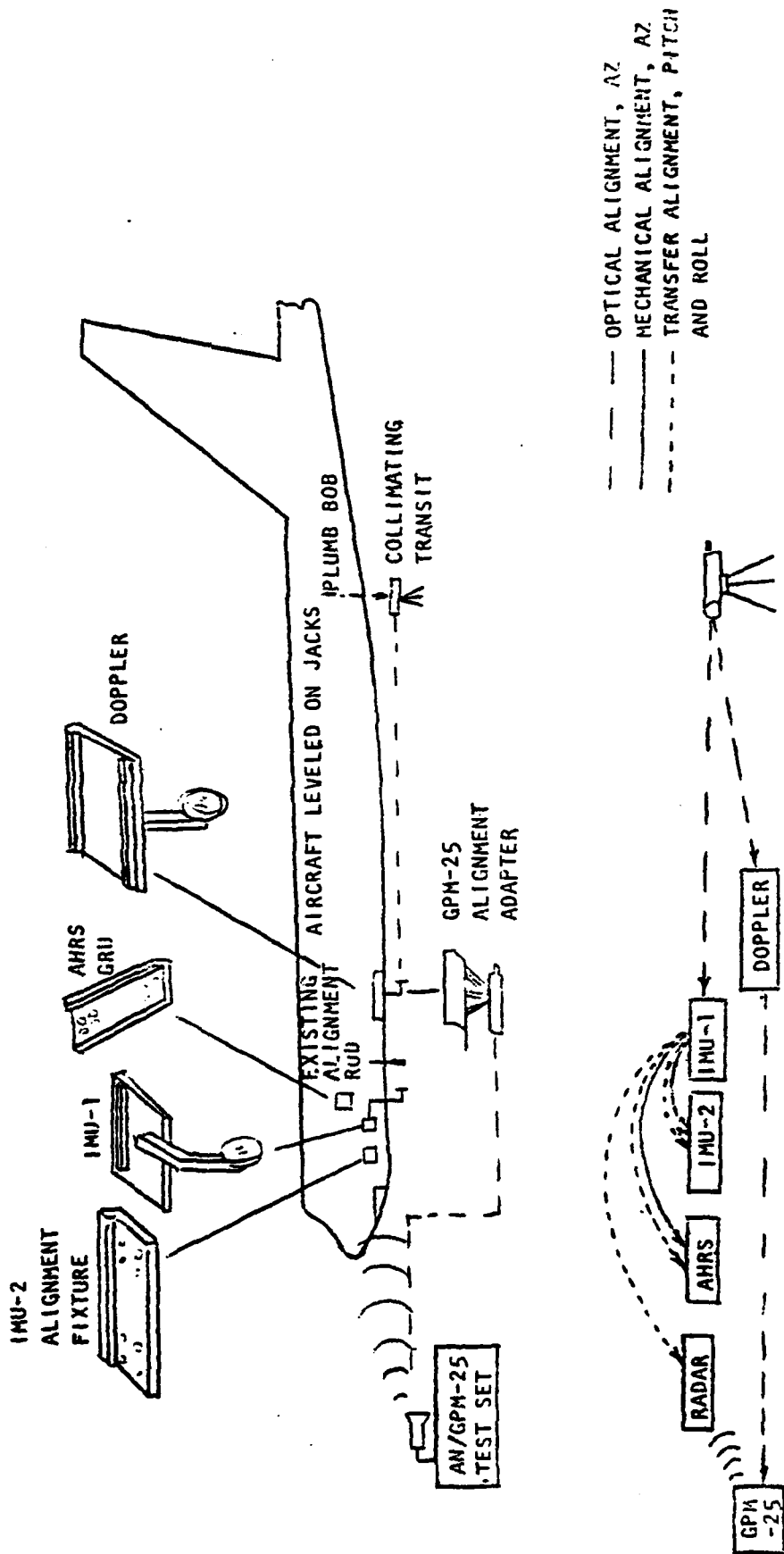
- LESS CONVENIENT THAN ELECTRONIC ALIGNMENT

ELECTRONIC ALIGNMENT CONCEPT FOR A-10
NIGHT/ADVERSE WEATHER VERSION

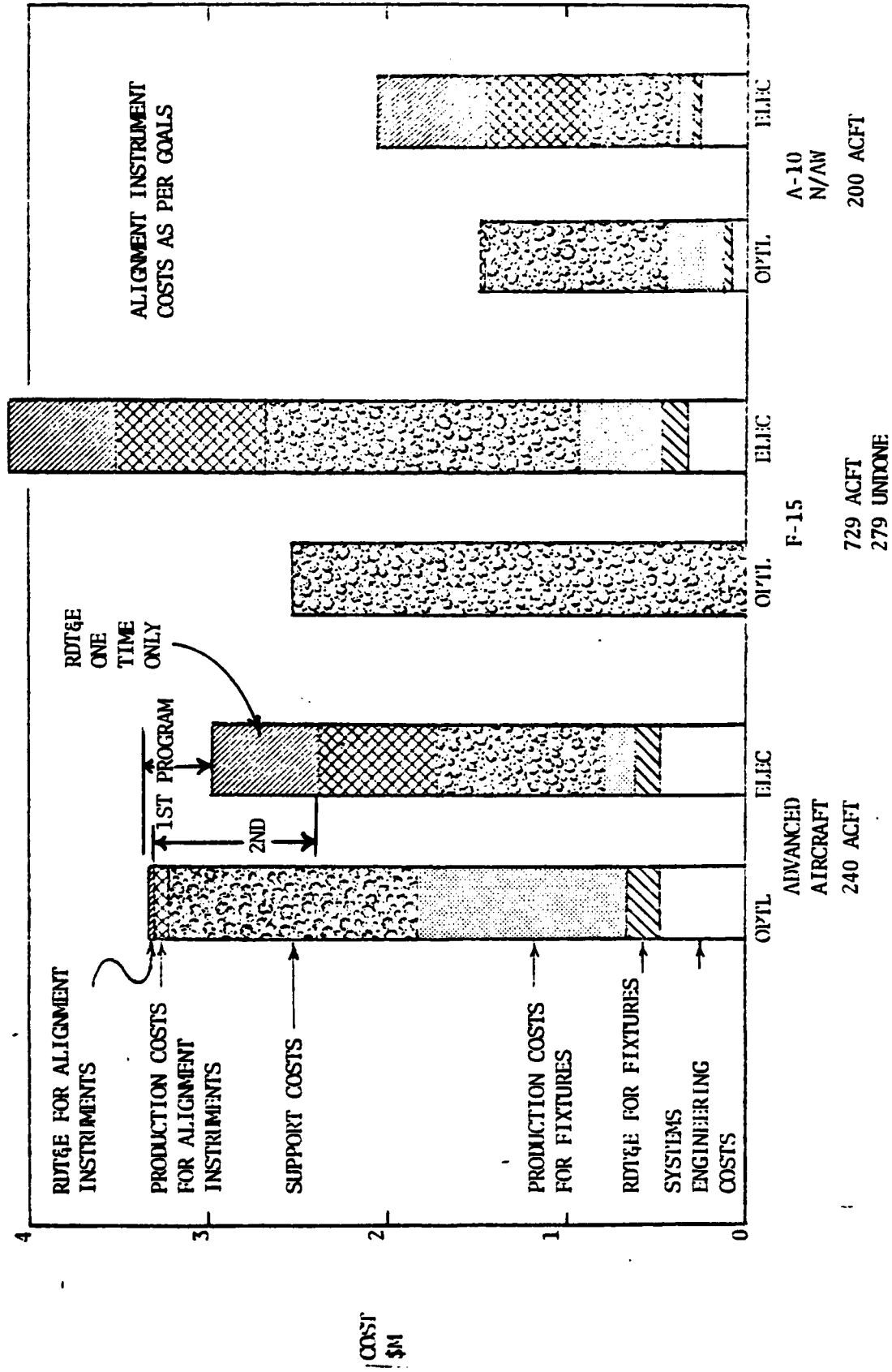


*ADAPTERS
REQUIRED,
BUT NOT
SHOWN HERE

BOEING B-52 OAS ALIGNMENT METHOD



MOUNT ALIGNMENT LIFE CYCLE COSTS



ADVANTAGES OF UNIVERSAL ALIGNMENT INSTRUMENTS

- NO/FEW ADAPTERS TO DESIGN AND PRODUCE FOR NEW AIRCRAFT
- NO DEDICATED WORK SPACE OR SCHEDULE TIME NEEDED
- NO AIRCRAFT STABILIZATION REQUIRED
- NO SPECIAL TRAINING
- INSTANT READOUT OF ALIGNMENT
- EASY ACCESS TO MOUNT ADJUSTMENTS
- HIGHLY ACCURATE
- ADAPTABLE TO ALIGNMENT CHECKS WITH LRU'S INSTALLED
- RE-USE OF INSTRUMENTS ON OTHER PROGRAMS

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

- WITHIN PRESCRIBED LIMITS, UNIVERSAL ALIGNMENT INSTRUMENTS ARE COST-EFFECTIVE (BREAK-EVEN ON 1ST PROGRAM, SAVE ON 2ND)
- INSTRUMENT PERFORMANCE REQUIREMENTS ARE PRACTICAL AND OBTAINABLE
- PRESCRIBED INSTRUMENT COST LIMITS APPEAR OBTAINABLE
- PRESENT AIRCRAFT SHOULD BE LEFT UNCHANGED

RECOMMENDATIONS

- PREPARE INSTRUMENT RFP'S
- PROCEED WITH DEVELOPMENT IF PROPOSALS SATISFY COST GOALS
- CONVERT MOUNT CRITICAL ITEM SPEC TO MIL-STD SPEC
- EMPLOY UNIVERSAL INSTRUMENTS ON NEXT AIRCRAFT PROGRAM