60ABC-1

NAVWEPS 01-60ABC-1

NATOPS Flight Manual

NAVY MODEL

RA-5C AIRCRAFT

THIS PUBLICATION SUPERSEDES NAVWEPS 01-60ABC-1
DATED 1 JUNE 1964

THIS PUBLICATION TO BE USED IN CONJUNCTION WITH
SUPPLEMENTAL NATOPS FLIGHT MANUAL NAVWEPS 01-60ABC-1A
FOR NAVY MODEL RA-5C AIRCRAFT

PUBLISHED BY DIRECTION OF
THE CHIEF OF NAVAL OPERATIONS

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15 January 1965
Changed 15 August 1965

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Page No.	*Date of Latest Change*	*Page No.*	*Date of Latest Change*	*Page No.*	*Date of Latest Change*
B	15 August 1965	62B	15 August 1965	149	15 August 1965
C	15 August 1965	64	15 August 1965	150	15 August 1965
Flyleaf 1	15 August 1965	66	15 August 1965	152	15 August 1965
Flyleaf 2	15 August 1965	67	15 August 1965	153	15 August 1965
i	15 August 1965	68	15 August 1965	154	15 August 1965
ii	15 August 1965	73	15 August 1965	155	15 August 1965
iii	15 August 1965	78	15 August 1965	156	15 August 1965
1	15 August 1965	78A	15 August 1965	157	15 August 1965
2	15 August 1965	78B	15 August 1965	158	15 August 1965
3	15 August 1965	79	15 August 1965	161	15 August 1965
4	15 August 1965	81	15 August 1965	166	15 August 1965
4A	15 August 1965	82	15 August 1965	166A	15 August 1965
4B	15 August 1965	83	15 August 1965	166B	15 August 1965
5	15 August 1965	86	15 August 1965	167	15 August 1965
9	15 August 1965	87	15 August 1965	172	15 August 1965
15	15 August 1965	88	15 August 1965	176	15 August 1965
16	15 August 1965	90	15 August 1965	179	15 August 1965
18	15 August 1965	93	15 August 1965	180	15 August 1965
19	15 August 1965	95	15 August 1965	180A	15 August 1965
20	15 August 1965	96	15 August 1965	180B	15 August 1965
23	15 August 1965	97	15 August 1965	182	15 August 1965
26	15 August 1965	98	15 August 1965	183	15 August 1965
28	15 August 1965	104	15 August 1965	184	15 August 1965
29	15 August 1965	104A	15 August 1965	185	15 August 1965
30	15 August 1965	104B	15 August 1965	186	15 August 1965
34	15 August 1965	109	15 August 1965	187	15 August 1965
35	15 August 1965	110	15 August 1965	189	15 August 1965
36	15 August 1965	111	15 August 1965	190	15 August 1965
36A	15 August 1965	113	15 August 1965	190A	15 August 1965
36B	15 August 1965	115	15 August 1965	190B	15 August 1965
38	15 August 1965	116	15 August 1965	190C	15 August 1965
38A	15 August 1965	118	15 August 1965	190D	15 August 1965
38B	15 August 1965	118A	15 August 1965	191	15 August 1965
39	15 August 1965	118B	15 August 1965	192	15 August 1965
40	15 August 1965	119	15 August 1965	193	15 August 1965
41	15 August 1965	120	15 August 1965	195	15 August 1965
42	15 August 1965	121	15 August 1965	196	15 August 1965
43	15 August 1965	125	15 August 1965	196A	15 August 1965
44	15 August 1965	126	15 August 1965	196B	15 August 1965
44A	15 August 1965	127	15 August 1965	197	15 August 1965
44B	15 August 1965	128	15 August 1965	198	15 August 1965
45	15 August 1965	131	15 August 1965	199	15 August 1965
46	15 August 1965	132	15 August 1965	200	15 August 1965
47	15 August 1965	133	15 August 1965	201	15 August 1965
48	15 August 1965	134	15 August 1965	202	15 August 1965
48A	15 August 1965	135	15 August 1965	203	15 August 1965
48B	15 August 1965	138	15 August 1965	205	15 August 1965
50	15 August 1965	140	15 August 1965	206	15 August 1965
51	15 August 1965	141	15 August 1965	211	15 August 1965
53	15 August 1965	143	15 August 1965	213	15 August 1965
54	15 August 1965	144	15 August 1965	218	15 August 1965
55	15 August 1965	145	15 August 1965	225	15 August 1965
57	15 August 1965	146	15 August 1965	226	15 August 1965
62A	15 August 1965	148	15 August 1965	227	15 August 1965

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS: BuWeps

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Page No.	*Date of Latest Change*
228	15 August 1965
229	15 August 1965
230	15 August 1965
231 Deleted	15 August 1965
232 Deleted	15 August 1965
233	15 August 1965
234	15 August 1965
235	15 August 1965
237	15 August 1965
238	15 August 1965
239	15 August 1965
240	15 August 1965
246	15 August 1965
247	15 August 1965
248	15 August 1965
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262	15 August 1965
263	15 August 1965
264	15 August 1965
265	15 August 1965
266	15 August 1965
267	15 August 1965
268	15 August 1965
269	15 August 1965
270	15 August 1965
271	15 August 1965
272	15 August 1965
273	15 August 1965
274	15 August 1965

BuWeps

INTERIM CHANGE SUMMARY

The following Interim Changes have been either canceled or incorporated in this NATOPS Flight Manual:

Canceled or Previously Incorporated

No. 1
No. 2
No. 3
No. 4
No. 5

Incorporated in This Change on Pages Indicated

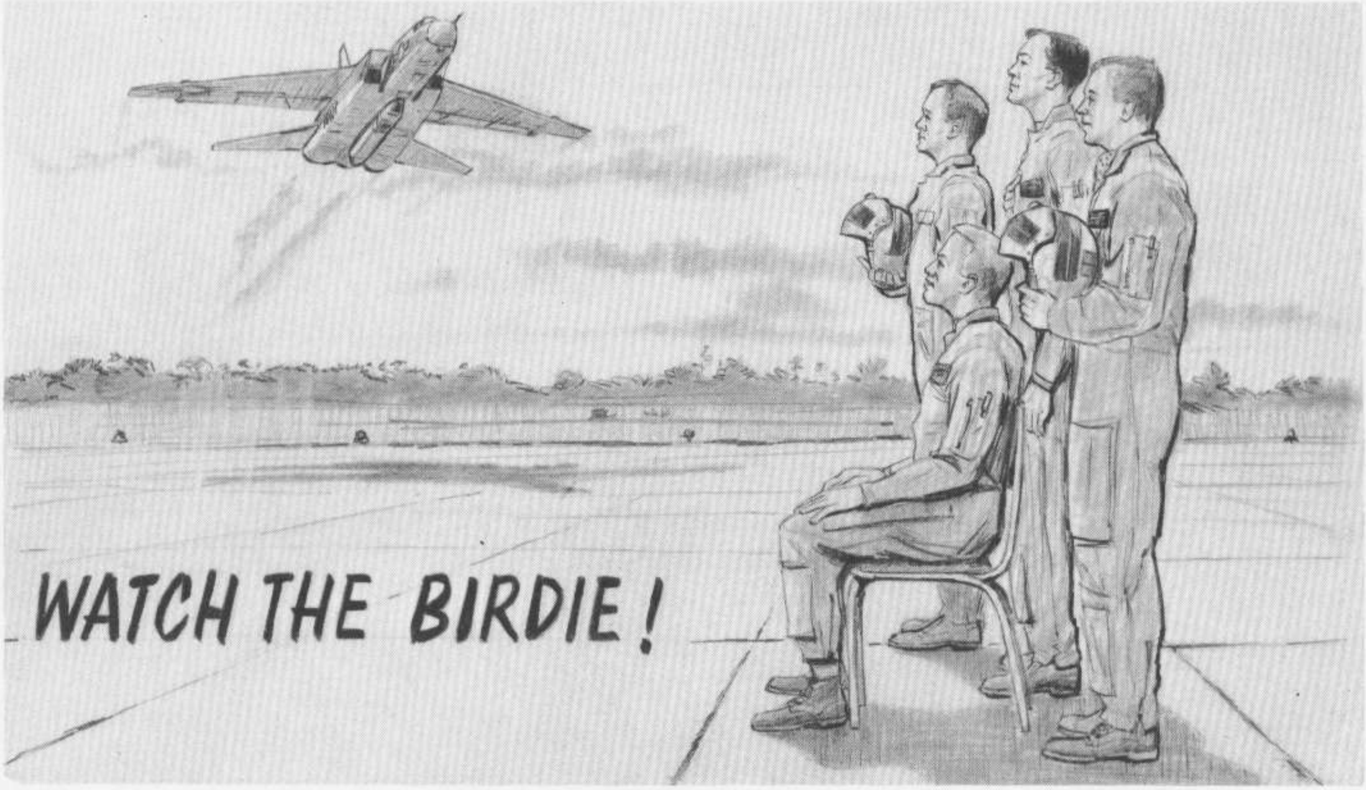
No. 6	Pages 183, 185
No. 7	Pages 57, 196

INTERIM CHANGES OUTSTANDING: (to be maintained by custodian of NATOPS Flight Manual)

Number	*Date*	*Purpose*
8	28 April 1965	CG data location change

TABLE OF CONTENTS

*Also refer to the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A)



SCOPE

This NATOPS Flight Manual (NAVWEPS 01-60ABC-1) and the classified Confidential Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A), along with the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C), contain information and procedures (based on the latest available data) necessary for safe and efficient operation of RA-5C aircraft.

Each issue of the NATOPS Flight Manual will be reviewed by the Model Manager concerned. Suggested changes should be sent to him or to your Evaluators for coordination.

The Pilot's NATOPS Check List (NAVWEPS 01-60ABC-1B) reflects official NATOPS procedures and is arranged as a ready reference to operating procedures, servicing requirements, and essential performance data. Check list arrangement is as follows:

EMERGENCY PROCEDURES
REFERENCE DATA
SPECIAL PROCEDURES
NORMAL PROCEDURES

Emergency/divert criteria has been placed at the end of EMERGENCY PROCEDURES. Procedures for the systems operator's reference have been incorporated in the Systems Operator's NATOPS Check List (NAVWEPS 01-60ABC-1D).

CHANGES

Changes to these publications are published as directed by the Chief of Naval Operations. Change stripes (heavy vertical lines in margins) indicate specific changes to text material. Flight crews must be cognizant of all pertinent technical directives, since these may cover critical flight restrictions or new procedures not yet incorporated by change.

NATOPS Changes or BuWeps Interim Changes, which point out safety-of-flight items, should be placed at the front of this manual until the Interim Change Summary (flyleaf preceding the Table of Contents) indicates that the information has been incorporated by change. This means that the flyleaf must always be consulted before using the manual.

To determine whether your copy of the manual is the latest issue or contains the latest changes, consult NavSandA Publication 2002, Section VIII, Part C.

A NATOPS Manual/NATOPS Flight Manual/Flight Manual Change Recommendation Form (OPNAV Form 3500-22) is included in the front of this manual. Change suggestions should be written on this form and forwarded to your NATOPS Evaluator or Model Manager for further attention.

MANUAL ARRANGEMENT

In addition to the Table of Contents preceding this Foreword, an Alphabetical Index is provided at the end of both the NATOPS Flight Manual and the Supplemental NATOPS Flight Manual for referencing specific subjects and illustrations. An understanding of the general contents of each section will simplify locating the information you desire.

SECTION I — THE AIRCRAFT

Part 1, General Description — An introduction to the aircraft.

Part 2, Systems—Description and operation of all major systems, including normal and emergency operation.

Part 3, Aircraft Servicing — Description and operating procedures for complete servicing, including starting units, danger areas, and turning radius.

Part 4, Aircraft Operating Limitations — Restrictions for operation of the aircraft, engines, and systems which must be observed for safe flight.

SECTION II — INDOCTRINATION

A resumé of required training and equipment for compliance with the NATOPS program.

SECTION III — NORMAL PROCEDURES

Part 1, Briefing and Debriefing — A general outline of requirements.

Part 2, Mission Planning — A guide to effective planning, including definition of responsibilities.

Part 3, Shore-based Procedures — Standard normal procedures used to conduct VFR nontactical flight from an on-shore station.

Part 4, Carrier-based Procedures — Standard normal procedures used to conduct VFR nontactical flight from a carrier.

SECTION IV — FLIGHT PROCEDURES

A summary of standard in-flight procedures, and the latest available data concerning aircraft characteristics throughout all phases of flight.

SECTION V — EMERGENCY PROCEDURES

Standard procedures to be followed during any emergency which could reasonably be expected.

SECTION VI — ALL-WEATHER OPERATION

Additional information and procedures required for flight under all weather conditions.

SECTION VII — COMMUNICATIONS PROCEDURES

Procedures utilized to standardize all forms of communications, including the use of electronic navigation equipment.

SECTION VIII — WEAPONS SYSTEMS

Operational procedures for effective utilization of the aircraft armament system in all modes, plus information on store loading and practice bombing.

SECTION IX — FLIGHT CREW COORDINATION

Complete operating procedures and check lists for the pilot and the systems operator, covering all phases of weapon delivery operation, are presented in the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

SECTION X — STANDARDIZATION EVALUATION

Part 1, Standardization Evaluation Program — The concept, applicability, definitions, and outlines of grading criteria for the RA-5C Standardization Evaluation Program.

Part 2, Standardization Evaluation Form

Part 3, Pilot Standardization Evaluation Worksheets

SECTION XI — PERFORMANCE DATA

Graphic and tabular data of aircraft performance to be used for effective mission planning.

AIRCRAFT BUREAU NUMBERS

Each aircraft has its Bureau Number painted on the vertical stabilizer. The Model designation and the Bureau Number are presented on the aft fuselage forward of the horizontal stabilizer. RA-5C aircraft are designated as follows:

MODEL DESIGNATION	NH BLOCK	BUREAU NUMBERS
JRA-5C	01	150823, 150824
JRA-5C	02	150825
RA-5C	01	150826 through 150829
JRA-5C	03	150830
RA-5C	01	150831
JRA-5C	04	150832
RA-5C	01	150833 through 150837
JRA-5C	05	150838
RA-5C	10	150839 through 150842
RA-5C	15	149300 through 149317
RA-5C	20	151615 through 151728
RA-5C	25	Converted A-5A's: 145157, 146695, 146696, 146698, 146701, 146702, 147850, 147858, 148925, 148932, 148933, 149276 through 149281, 149283 through 149289, 149291, 149293, 149294

WARNINGS, CAUTIONS, AND NOTES

Three types of attention-gaining devices are employed in the NATOPS Flight Manual. The type of device used depends upon the degree of hazard involved should crew members disregard or fail to perform the procedure. A functional interpretation of each type is as follows:

WARNING

Operating information which, if ignored, can result in personal injury or loss of life.

CAUTION

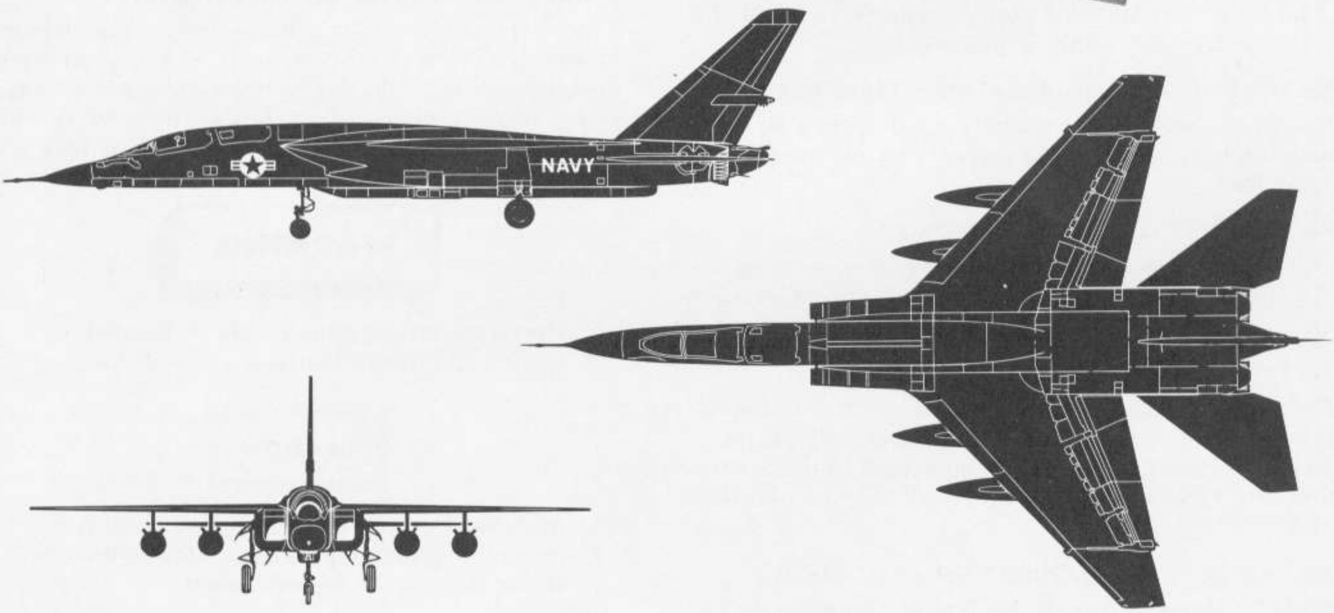
Additional operating information which is important in preventing damage to or destruction of the aircraft or its equipment.

Note

An operating procedure or information which is included for a more complete understanding.

MODEL RA-5C AIRCRAFT

VIGILANTE



A-5C-1-00-1

Figure 1-1

the aircraft
Section I

TABLE OF CONTENTS

PART 1 — GENERAL DESCRIPTION

THE AIRCRAFT

The RA-5C is a two-place, two-engine reconnaissance/attack aircraft designed for carrier-based or land-based operation. The aircraft is capable of all-weather, high- or low-altitude, tactical reconnaissance and delivery of special and conventional weapons. Basic appearance includes a long, slightly humpbacked fuselage, a sharply swept, shoulder-mounted wing, large, swept empennage surfaces, and side-mounted, rectangular air intakes. The vertical stabilizer, wings, and radome may be folded for aircraft storage. The wing center sections contain a spoiler-deflector lateral control system and slotted full-span wing flaps extending from the fuselage to the fold line. The wings also incorporate complete-span droopable leading edges with a boundary layer airflow control system. Armament is carried on four underwing external store stations and in a linear bomb bay. Empty weight without reconnaissance pod or external stores is approximately 40,000 pounds. Refer to AIRCRAFT LOADING, in this section.

MISSION

The primary mission of the RA-5C is tactical reconnaissance. The aircraft and its systems comprise one-half of the US Navy Integrated Operational Intelligence System (IOIS). The airborne systems counterpart is the ship- or ground-based Integrated Operational Intelligence Center (IOIC). This system is designed to provide tactical commanders with the full and up-to-the-minute intelligence picture on any target area. This information is comprised of photographic coverage, radar coverage, and Electronic Order of Battle (EOB) data.

AIRCRAFT DIMENSIONS

Overall static dimensions of the aircraft are as follows:

Wing Span .... 53.04 feet
wings folded .... 42.00 feet
Length .... 76.55 feet
vertical stabilizer and radome folded .... 65.57 feet
Height
vertical stabilizer folded .... 15.50 feet

AIRCRAFT LOADING

The following tables and figure 1-1A provide a simplified method of calculating aircraft gross weight and center-of-gravity location. Procedures consist of adding the weights of all items carried to the average basic weight and algebraically adding load item incremental cg index values to the basic weight index. Final index is then used with take-off gross weight to determine cg location in percent MAC.

- Average Basic Weight—38,500 pounds.
- Arm—511.50.
- Basic Index—69.5.

Note

Basic weight is typical average from Chart C of the Handbook of Weight and Balance Data (NAVWEPS 01-1B-40) for delivered aircraft and includes:

- Trapped fuel.
- Trapped and operating engine oil.
- Full oxygen service and emergency controllers.
- Seat kits, including parakits, pans, and parachutes.

INTERNAL LOAD ITEMS

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Pilot	200	−3.6
Systems Operator	200	−2.9
Forward Can (empty)	175	+0.2
Mid Can (empty)	175	+1.1
Aft Can (empty)	175	+2.0
Carriage (2 cans, no store)	70	+0.5
Carriage (3 cans)	89	+0.6
Carriage (2 cans, with store)	53	+0.5
Stabilizing Fins (store train)	92	+1.3
Tail Cone	117	+1.7
MK 28 Internal Store	1914	+3.9
Carriage (MK 28 store)	92	+0.3
MK 43 Internal Store (retarded)	1868	+2.8
Carriage and Chute (MK 43 store)	320	+0.9
Gun (store ejection)	159	+0.1
Mount (ejection gun)	22	Negligible
Fuselage Panel (bomb bay)*	92	−0.1
Fuselage Panels (miscellaneous)*	15	−0.1
Bomb Bay Rails (removable)	43	−0.1

*Used only when lower fairing is removed

LANDING GEAR RETRACTION/ EXTENSION EFFECT

OPERATION	INCREMENTAL CG INDEX
DOWN to UP	−3.2
UP to DOWN	+3.2

EXTERNAL LOAD ITEMS

INBOARD STATIONS (STATION 110)

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Pylon (inboard)	475	−0.5
Flasher Pod	347	+0.6
Drop Tank (inboard)	260	−0.4
MK 28 External Store (free-fall)	2037	−4.4
MK 43 External Store	2065	−4.9
MK 57 External Store	485	−1.2
MK 82 General Purpose	532	−1.4
MK 83 General Purpose	1000	−2.5
MK 84 General Purpose	2000	−4.6
Aero 8A PBC (empty)	380	−0.7
A/A37B-3 PMBR	163	−0.3
MK 76 (4)	100	−0.2
MK 89 (4)	224	−0.5
MK 106 (4)	18	Negligible

OUTBOARD STATIONS (STATION 175)

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Pylon (outboard)	440	+0.5
Drop Tank (outboard)	260	+0.2
MK 28 External Store (free-fall)	2037	+0.4
MK 43 External Store	2065	Negligible
MK 57 External Store	485	−0.1
MK 82 General Purpose	532	−0.1
MK 83 General Purpose	1000	−0.1
MK 84 General Purpose	2000	+0.1
Aero 8A PBC (empty)	380	+0.2
A/A37B-3 PMBR	163	+0.1
MK 76 (4)	100	Negligible
MK 89 (4)	224	Negligible
MK 106 (4)	18	Negligible

RECONNAISSANCE EQUIPMENT

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Miscellaneous Fuselage (PECM antennas), Viewfinder, Hoists, Electrical and Conditioning Equipment	446	−3.5
Sensor Station 1	112	−0.9
Sensor Station 2	141	−1.0
Sensor Station 3		
Basic Recon	138	−0.7
With PECM	178	−1.0
Sensor Station 3A	9	+0.1
Sensor Station 4		
Module 1—two side obliques	446	−1.3
—two obliques, 3-inch pan	836	−2.0
Module 2—18-inch pan	1081	−3.3
—18- and 3-inch pans	1408	−3.9
Module 3—forward	504	−1.5
—aft	504	−1.2
—both	736	−2.0
Attack Fairing	66	−0.2
Sensor Station 5		
Basic Recon	231	−0.6
Basic Recon and PECM	541	−1.4
Sensor Station 6	1116	+1.1
Sensor Station 8		
Basic Recon	728	+3.3
Basic Recon and PECM	924	+3.2
Sensor Station 9		
Flasher Pod (each)	347	+0.6

Note

Do not add flasher pods if pods were previously added under inboard external stores.

FUEL

FULL TANKS

TANK	WEIGHT (POUNDS — JP-5)	INCREMENTAL CG INDEX
Forward	3,094	−27.1
Sump	3,332	−20.3
Aft	884	+5.8
Wing	11,152	−5.2
Forward Can (bomb bay)	2,006	+2.8
Mid Can (bomb bay)	2,006	+12.6
Aft Can (bomb bay)	2,006	+22.6
Inboard Drop Tank (each)	2,720	−5.7
Outboard Drop Tank (each)	2,720	+0.7

PARTIAL FUEL LOAD DATA

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Wing Fuel	10,000	−2.2
	9,000	−0.0
	8,000	+1.7
	7,000	+3.0
	6,000	+3.8
	5,000	+4.2
	4,000	+4.2
	3,000	+3.9
	2,000	+3.0
	1,000	+1.7
Forward Tank	3,000	−26.3
	2,000	−17.5
	1,000	−8.8
	500	−4.4
Sump Tank	3,000	−18.3
	2,000	−12.2
	1,000	−6.1
	500	−3.1
Aft Tank	800	+5.2
	600	+3.9
	400	+2.6
	200	+1.3
Drop Tank (inboard)	2,000	−4.2
	1,500	−3.2
	1,000	−2.1
	500	−1.1
Drop Tank (outboard)	2,000	+0.5
	1,500	+0.4
	1,000	+0.2
	500	+0.1
Forward Can (bomb bay)	2,000	+2.8
	1,500	+2.1
	1,000	+1.4
	500	+0.7
Mid Can (bomb bay)	2,000	+12.6
	1,500	+9.4
	1,000	+6.3
	500	+3.1
Aft Can (bomb bay)	2,000	+22.5
	1,500	+16.9
	1,000	+11.2
	500	+5.6

Note

Weights and incremental cg index values are given for *single units*. If two are carried (e.g., pylons and drop tanks), double (or quadruple) given weight and index values.

CAUTION

The center-of-gravity location method presented should be used only as a check for small changes in configuration. For each *new* configuration (not previously calculated, and for which a Form F is not on file), the Handbook of Weight and Balance Data (NAVWEPS 01-1B-40) *must* be used.

COMPUTING GROSS WEIGHT AND CG

1. Add weights of all load items for the desired configuration to the average basic weight provided. Total is take-off gross weight.
2. Note basic weight cg index number (69.5). Add (algebraically, using the given sign convention), the incremental index numbers for all load items in the desired configuration to this value. Final sum is take-off gross weight cg index.
3. Enter the cg locator (figure 1-1A) with take-off gross weight and final cg index. Project gross weight horizontally and index number vertically. The meeting point may be read in cg, percent MAC. Be certain this point falls within a useful area on the chart.
4. Even though the take-off cg may be within prescribed limits, a comparison with a similar loading presented in the Handbook of Weight and Balance Data (NAVWEPS 01-1B-40) should be made to assure that the cg will not exceed specified limits during flight.

Note

- A detailed discussion on the gross weight index method is presented in Section VII of Basic Technical Order, Weight and Balance (T.O. 1-1B-50).
- If a specific aircraft weight from Chart C of the Handbook of Weight and Balance Data (NAVWEPS 01-1B-40) is used in lieu of the average shown, the following formula should be used to arrive at basic cg index:

$$\text{Index} = 63 - \frac{\text{Basic Weight} \times (508.11 - \text{Basic Arm})}{20{,}000}$$

- For items not listed, the following formula should be used to arrive at incremental cg index number:

$$\text{Increment} = (-)\left(\frac{\text{Item Weight} \times [508.11 - \text{Item Arm}]}{20{,}000}\right)$$

- *Arms* are locations in terms of fuselage station reference, and are shown in Charts A and E of the Handbook of Weight and Balance Data (NAVWEPS 01-1B-40).

EXAMPLE:

Find take-off gross weight and cg location for the high- or low-altitude general reconnaissance configuration.

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Average Basic Weight	38,500	69.5
Pilot	200	−3.6
Systems Operator	200	−2.9
Mid Can (bomb bay)	175	+1.1
Aft Can (bomb bay)	175	+2.0
Carriage (2 cans, no store)	70	+0.5
Tail Cone	117	+1.7
Recon (miscellaneous installations)	446	−3.5
Sensor Station 1	112	−0.9
Sensor Station 2	141	−1.0
Sensor Station 3	178	−1.0
Sensor Station 3A	9	+0.1
Sensor Station 4		
Module 2 (18- and 3-inch pans)	1,408	−3.9
Sensor Station 5		
Basic Recon and PECM	541	−1.4
Sensor Station 6	1,116	+1.1
Sensor Station 8		
Basic Recon and PECM	924	+3.2
Fuel (JP-5)		
Forward Tank	3,094	−27.1
Sump Tank	3,332	−20.3
Wing Tank	11,152	−5.2
Aft Tank	884	+5.8
Mid Can (bomb bay)	2,006	+12.6
Aft Can (bomb bay)	2,006	+22.6
Take-off Gross Weight	66,786	
Take-off CG Index		49.4

Enter figure 1-1A to determine cg in percent MAC.

Take-off cg location = 28.8 percent MAC.

AIRCRAFT SERVICE/AIRFRAME CHANGES LISTING

Past changes to aircraft, after delivery to the Navy, have been known as Aircraft Service Changes (ASC's). Future changes to the aircraft will be known as Airframe Changes (AFC's), beginning with A-5 Airframe Change 86, as directed by BuWeps Instruction 5215.8, dated 30 January 1963. The Aircraft Service Changes and Airframe Changes listing contains ASC's and AFC's applicable to RA-5C aircraft, and includes only those changes affecting procedures or systems description which are considered necessary information for pilot and systems operator operation of the aircraft. Each change is listed along with the affected aircraft (by Bureau Number), its purpose, and the degree of urgency (category). A complete listing and summary of Aircraft Service Changes and Airframe Changes applicable to the aircraft can be found in the NavSandA Publications 2002, Section VIII, Parts C and D.

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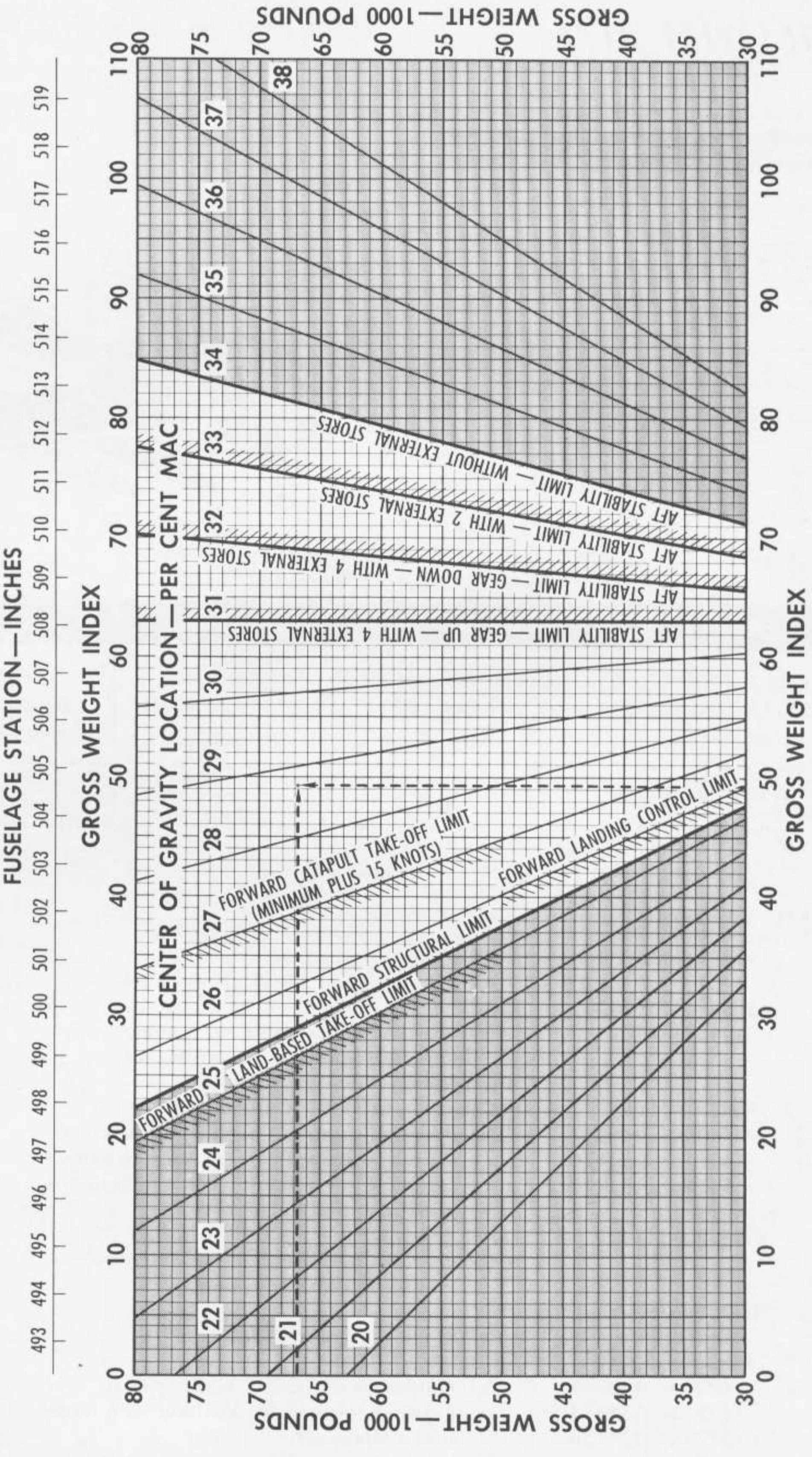


CG LOCATOR

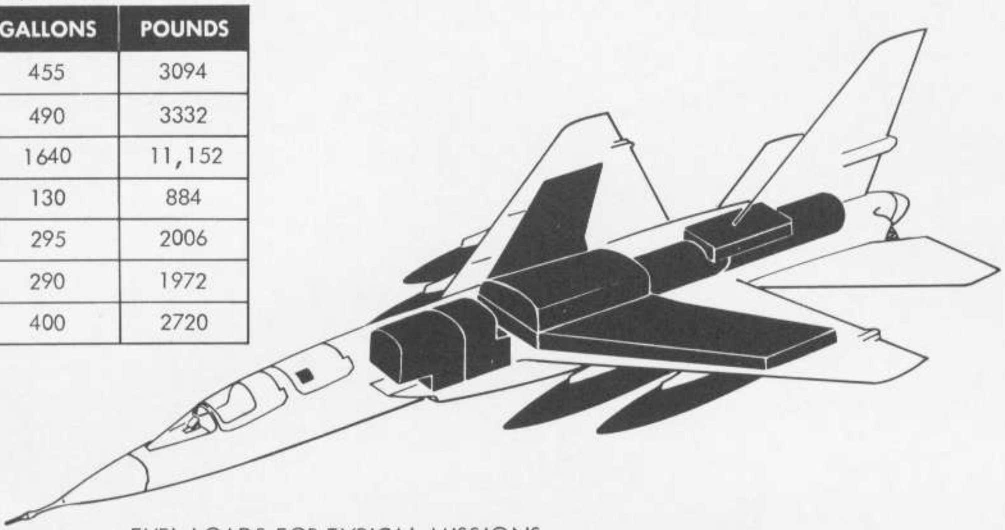
Figure 1-1A

FUEL QUANTITY DATA

JP-5 FUEL (6.8 POUNDS/GAL STANDARD DAY ONLY)
FOR JP-4 FUEL USE 6.5 POUNDS/GAL FOR STANDARD DAY

TANK CAPACITIES (USABLE)

TANK	GALLONS	POUNDS
FORWARD	455	3094
SUMP	490	3332
WING (AND OVERWING)	1640	11,152
AFT (SADDLE)	130	884
BOMB BAY CAN (EACH)	295	2006
BUDDY TANK	290	1972
DROP TANK (EACH)	400	2720



FUEL LOADS FOR TYPICAL MISSIONS

CLEAN		2 DROP TANKS		4 DROP TANKS		LONG RANGE	
FULL INTERNAL BOMB BAY CANS (2)		FULL INTERNAL BOMB BAY CANS (2) DROP TANKS (2)		FULL INTERNAL BOMB BAY CANS (2) DROP TANKS (4)		FULL INTERNAL BOMB BAY CANS (3) DROP TANKS (4)	
GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS
3305	22,474	4105	27,914	4905	33,354	5200	35,360

A-5C-1A-48-1

Figure 1-2

SERVICE/AIRFRAME CHANGE NO.	AIRCRAFT AFFECTED (BUREAU NO.)	SUBJECT AND PURPOSE	CATEGORY
11	150823—150842	**AVIONICS** (a) Installation of AN/ALQ-55 DECM	Record
101	150823—150842, 149306—149317	**CANOPY** (a) Provides a two-position, automatically operated uplock mechanism and improved canopy manual release.	Urgent
117	150823—150842, 149300—149317, 151615—151634, 151726—151728	**INCREASED CARRIER CAPABILITY** (a) Provides changed metering orifice, increased strength wheel bearing carrier, servicing instructions, increased main tire pressures, and airframe changes.	Urgent
118	150823—151630	**FLAPS** (a) Provides a 40-degree flap detent to replace the HOLD position.	Urgent
120	None (customer selected kits only)	**PPDI** (a) Provides folding capability.	
126	150823—150842, 149300—149317, 151615—151634, 151726—151728	**FLIGHT CONTROLS** (a) Reinforces horizontal leading edge. (b) Provides lateral trim washout with large stick deflections. (c) Limits spoiler deflection to 55 degrees, speed brakes extended.	Urgent

SERVICE/AIRFRAME CHANGE NO.	AIRCRAFT AFFECTED (BUREAU NO.)	SUBJECT AND PURPOSE	CATEGORY
129	149300—149317, 150823—151728	NOSE GEAR STEERING (a) Provides nose gear steering with aircraft weight on either main landing gear.	Urgent
137	149300—149317, 150823—151728	HYDRAULIC SYSTEM (a) Provides SLR pressure source downstream of the float-operated isolation valve.	Urgent
146	Converted aircraft: 146702, 147850, 147858, 148925, 148932, 148933, 149276—149283 RA-5C aircraft: 149300—149317, 150823—150842, 151615—151728	AVIONICS (a) Provides provisions for IFF/SIF installation in pilot's cockpit.	Urgent
150	149300—149317, 150823—151622	YAW AUGMENTATION (a) Addition of a 2-second time delay relay to prevent system transients from monitoring yaw augmentation off during flap retraction.	Urgent

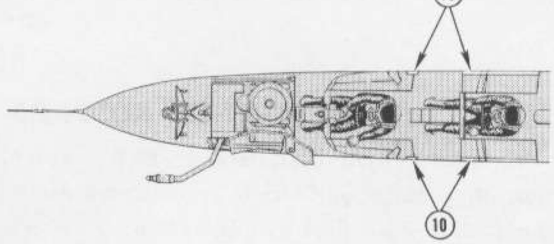
PRODUCT CONFIGURATION RECORDS

The Product Configuration Record (PCR) is a means of controlling the modification of delivered aircraft to the final approved fleet configuration. Kits released against aircraft by PCR may be incorporated by the contractor or a fleet facility, as determined by BuWeps. Removal of PCR coverage from the manual will be accomplished following receipt of certificates of compliance covering all aircraft concerned. The following table is a resumé of outstanding PCR's of interest to flight crews:

PCR	SUBJECT	PRODUCTION EFFECTIVITY
12 and 74	Replaces cable isolators with hard mounts and changes forward oblique depression angle to 11.5 degrees from the FRL	150842 and subsequent
46C	Conditioning system modification: orifice change, turbine cutout (flaps extended), RECON COOL caution light	151629 and subsequent
85H	Replacement of fuel can disconnect fitting and sensing line	150842 and subsequent
125	Relocation of lateral accelerometers	150842 and subsequent
211	Oblique camera sight marks	150842 and subsequent
304	Pitch trim amplifier	149300 through 149305, 151615 and subsequent

GENERAL ARRANGEMENT

1. PITOT STATIC BOOM
2. AIR REFUELING PROBE (RETRACTABLE)
3. RADAR ANTENNA (AN/ASB-12)
4. AIR REFUELING PROBE LIGHT
5. FORWARD ELECTRONIC COMPARTMENT (BOMB DIRECTING SET)
6. WINDSCREEN RADIATION SHIELD
7. PROJECTED DISPLAY INDICATOR (BOMB DIRECTING SET)
8. OPTICAL VIEWFINDER
9. LIQUID OXYGEN BOTTLES
10. ECM ANTENNAS
11. MAIN ELECTRONICS BAY
12. IFF-SIF ANTENNA
13. FORWARD FUSELAGE FUEL TANK
14. FUSELAGE SUMP FUEL TANK
15. TOP CAP FUEL TANK
16. INTEGRAL WING FUEL TANK
17. ANTI-COLLISION BEACON
18. AFT FUSELAGE (SADDLE) FUEL TANK
19. FUSELAGE FORMATION LIGHT
20. TACAN-COMM DUPLEX ANTENNA
21. TAIL POSITION LIGHT — BUDDY TANKER LIGHTS
22. FUEL SYSTEM VENT OUTLET
23. ECM TAIL BOOM ANTENNA ASSEMBLY
24. EXPENDABLE TAIL CONE
25. FUEL DUMP TUBE (EXTENDED)
26. ARRESTING HOOK BUMPER
27. CATAPULT HOLD BACK
28. ARRESTING HOOK
29. ENGINE STARTING CONNECTION
30. AFT REFUELING RECEPTACLE
31. EMERGENCY RAM-AIR TURBINE
32. CATAPULT HOOKS
33. EXTERNAL ELECTRICAL POWER AND CONDITIONING AIR ACCESS (AIR ON BOTH SIDES)
34. FORWARD REFUELING RECEPTACLE
35. RECONNAISSANCE FAIRING
36. IFF-SIF ANTENNA
37. RADAR ALTIMETER
38. UHF COMM ANTENNA
39. BOMBING COMPUTER
40. ADF ANTENNA
41. TACAN ANTENNA



42. TELEVISION OPTICAL SIGHT (BOMB DIRECTING SET)
43. LEADING EDGE BLC DUCT
44. WING TIP POSITION LIGHT
45. WING TIP FORMATION LIGHT
46. 400-GALLON DROP TANKS
47. STORE AND EJECTION GUN OR PECM
48. EXPENDABLE BOMB BAY FUEL CANS

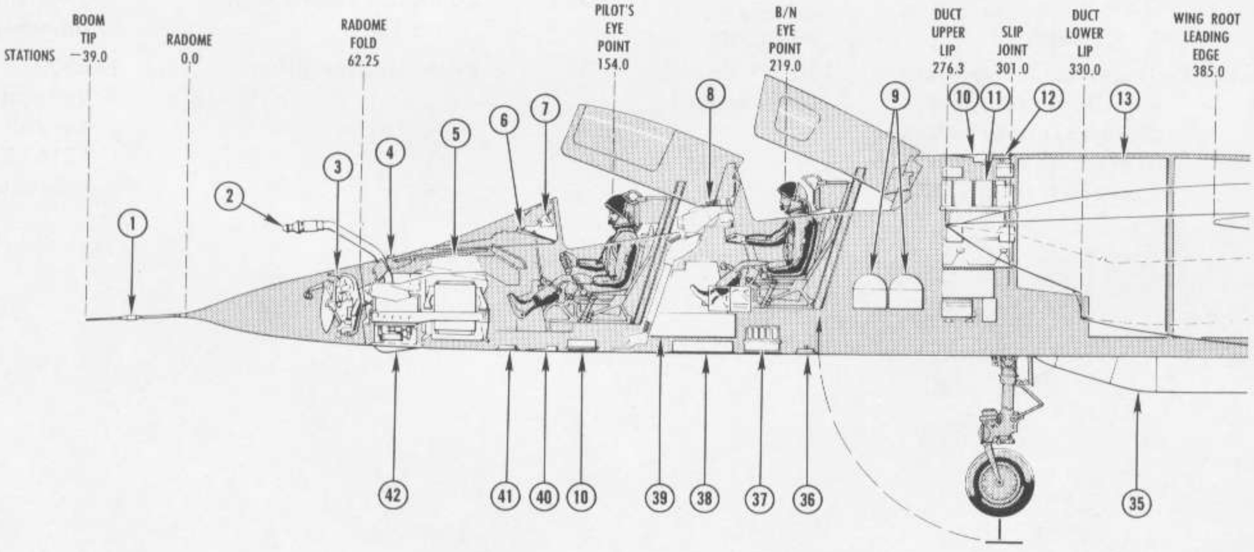


Figure 1-3 (Sheet 1)

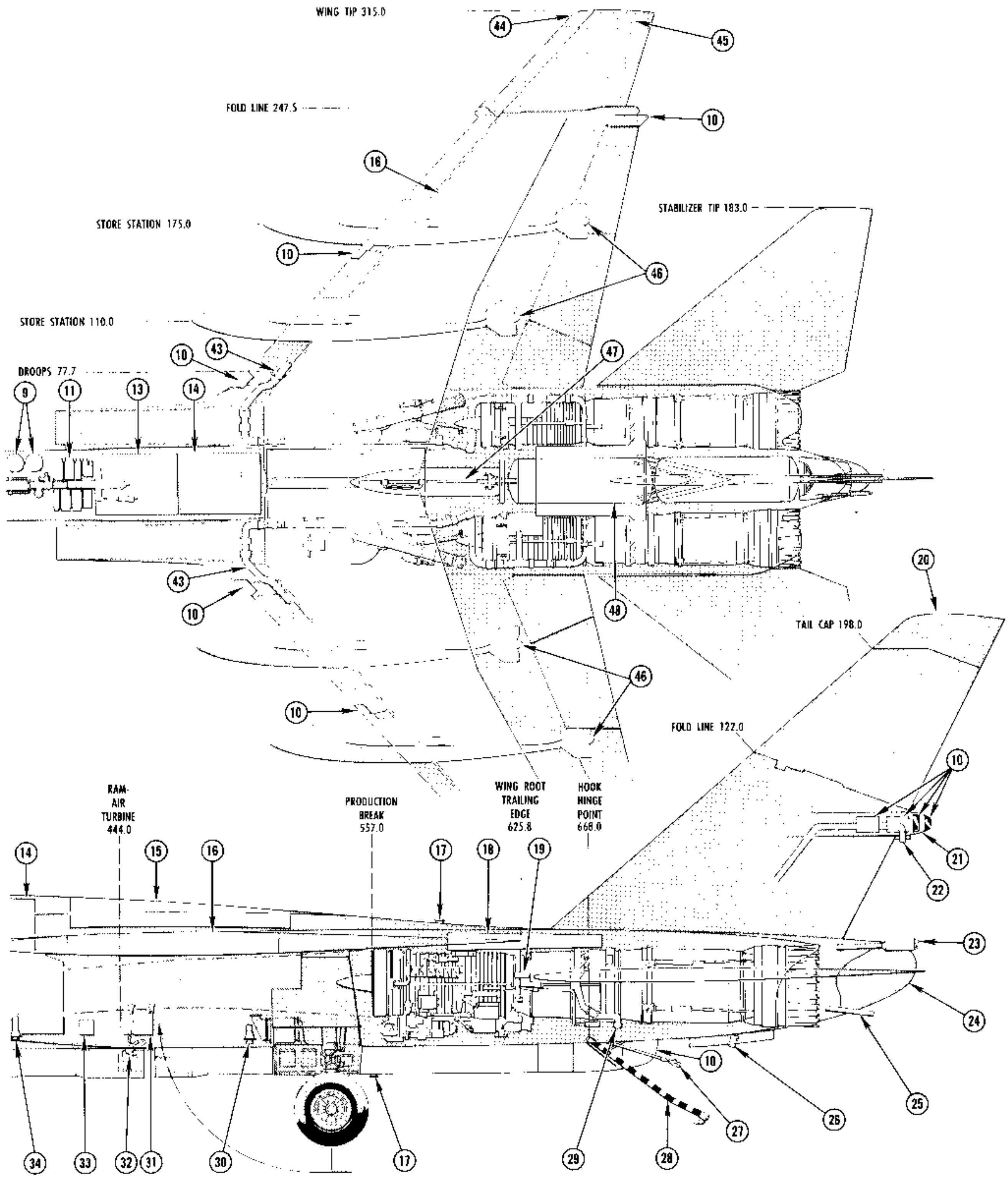


Figure 1-3 (Sheet 2)

PILOT'S COCKPIT

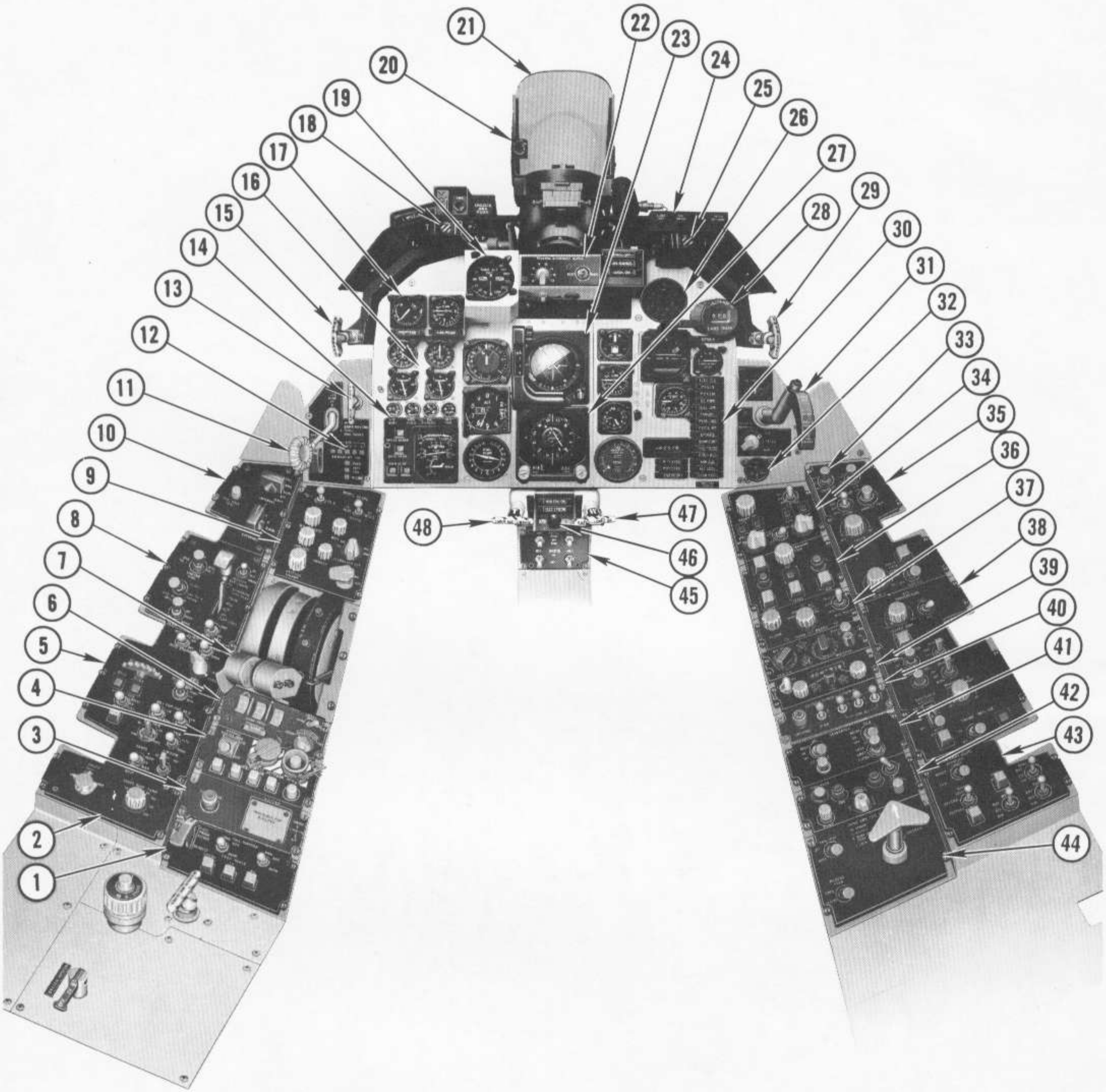


Figure 1-4 (Sheet 1)

1. FUEL TRANSFER PANEL
2. SUIT PANEL
3. BULLPUP PANEL (PROVISIONS)
4. WEAPONS PANEL
5. FLIGHT CONTROL AND AFCS PANEL
6. UHF COMM PANEL
7. THROTTLES
8. FLAP-DROOP PANEL
9. SCOPE PANEL (PPDI)
10. FUEL QUANTITY PANEL
11. LANDING GEAR HANDLE
12. ARMAMENT INDICATORS
13. FUEL DUMP HANDLE
14. GEAR, SPEEDBRAKE, DROOP-FLAP-TRIM INDICATORS
15. EMERGENCY BRAKE HANDLE
16. ENGINE INDICATORS
17. ANGLE OF ATTACK INDICATOR
18. MASTER WARNING LIGHT
19. RADAR ALTIMETER (LOW)
20. RADAR LOW ALTITUDE WARN LIGHT
21. PROJECTED DISPLAY INDICATOR (PPDI)*
22. T/A ALPHA PANEL
23. ALL-ATTITUDE INDICATOR (AAI)
24. AFCS INDICATORS
25. MASTER CAUTION LIGHT
26. DECM INDICATOR
27. HORIZONTAL SITUATION INDICATOR (HSI)
28. LABS TIMER
29. CANOPY JETTISON HANDLE
30. CAUTION LIGHT PANEL
31. ARRESTING HOOK HANDLE
32. INLET AIR TEMP INDICATOR
33. EMERGENCY IFF SWITCH
34. DECM PANEL
35. INTERIOR LIGHTS PANEL
36. AUDIO SELECT PANEL
37. INTERCOM PANEL
38. AIR TEMP AND ANTI-ICE PANEL
39. TACAN PANEL
40. CAMERA PANEL (PROVISIONS FOR T-375 OR AN/AWW-1)
41. ELECTRICAL SYSTEM PANEL
42. COMPASS PANEL
43. EXTERIOR LIGHTS PANEL
44. FOLD CONTROL PANEL
45. ENGINE START PANEL
46. RAT RETRACT BUTTON
47. LANDING GEAR EMER HANDLE
48. RAT RELEASE HANDLE

*AIRCRAFT WITH AFC 120 HAVE FOLDING PPD1

A-5C-1C-00-2B

Figure 1-4 (Sheet 2)

SYSTEMS OPERATOR'S COCKPIT

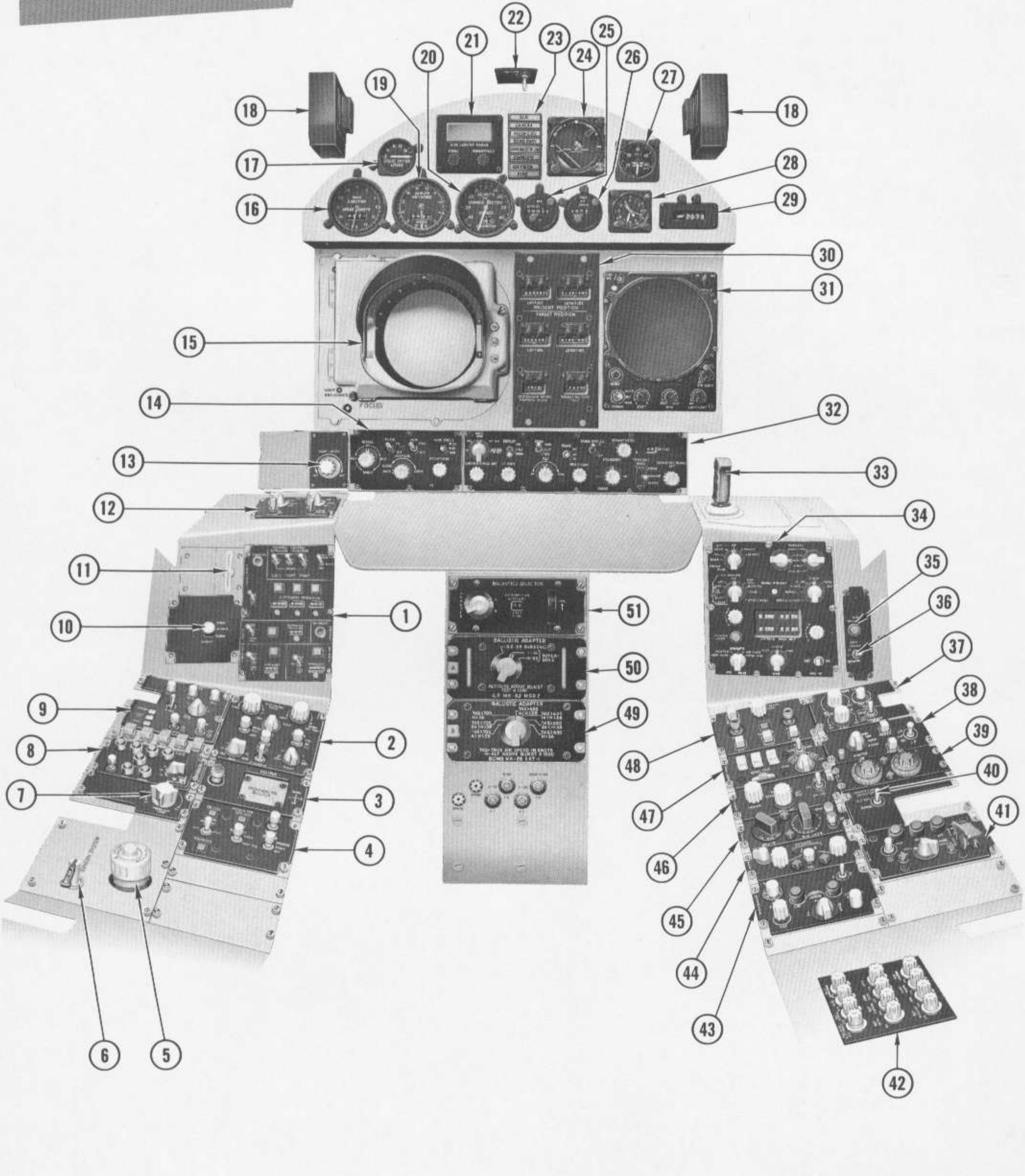


Figure 1-5 (Sheet 1)

1. CAMERA CONTROL PANEL
2. SIDE LOOKING RADAR PANEL
3. BULLPUP CONTROL PANEL (PROVISIONS)
4. AN/ALQ-61 CONTROL PANEL
5. ANTI-G VALVE
6. OXYGEN VALVE
7. SUIT FLOW KNOB
8. T-375 OR AN/AWW-1 PANEL
9. ARMAMENT RELEASE PANEL
10. CANOPY TOGGLE
11. CANOPY JETTISON HANDLE
12. INSTRUMENT CONTROL PANEL
13. MAP LIGHTS KNOB
14. TV CONTROL PANEL
15. RADAR TV INDICATOR
16. WIND SPEED/DIRECTION INDICATOR *
17. OXYGEN QUANTITY INDICATOR
18. COMPARTMENT FLOOD LIGHT
19. AZIMUTH AND RANGE INDICATOR (ARI)
20. TV SCAN INDICATOR *
21. SLR MONITOR SCOPE
22. RED FLOOD LIGHTS SWITCH
23. WARNING/CAUTION LIGHTS
24. ATTITUDE INDICATOR
25. RADAR/BAROMETRIC ALTIMETER
26. TRUE AIRSPEED/GROUND SPEED INDICATOR
27. COCKPIT ALTIMETER
28. CLOCK
29. CHANNEL/FREQUENCY INDICATOR
30. POSITION AND DESTINATION INDICATOR
31. OPTICAL VIEWFINDER
32. RADAR CONTROL PANEL
33. CURSOR CONTROL HANDLE
34. B/N CONTROL PANEL
35. B/N WARMUP LIGHT
36. SEAT ADJUST SWITCH
37. INTERIOR LIGHTS PANEL
38. IFF PANEL
39. SIF PANEL
40. COURSELINE NAV SWITCH
41. ECM PANEL (AN/ALQ-55)
42. FUSE PANEL
43. COMPASS PANEL
44. TACAN PANEL
45. AUX UHF PANEL
46. INTERCOM PANEL
47. UHF COMM PANEL
48. AUDIO SELECT PANEL
49. BALLISTIC ADAPTER B
50. BALLISTIC ADAPTER A
51. BALLISTICS CONTROL PANEL

*** LOCATION SHOWN FOR AIRCRAFT 151615 AND SUBSEQUENT**

A-5C-1A-00-3B

Figure 1-5 (Sheet 2)

ENGINE FUEL SYSTEM

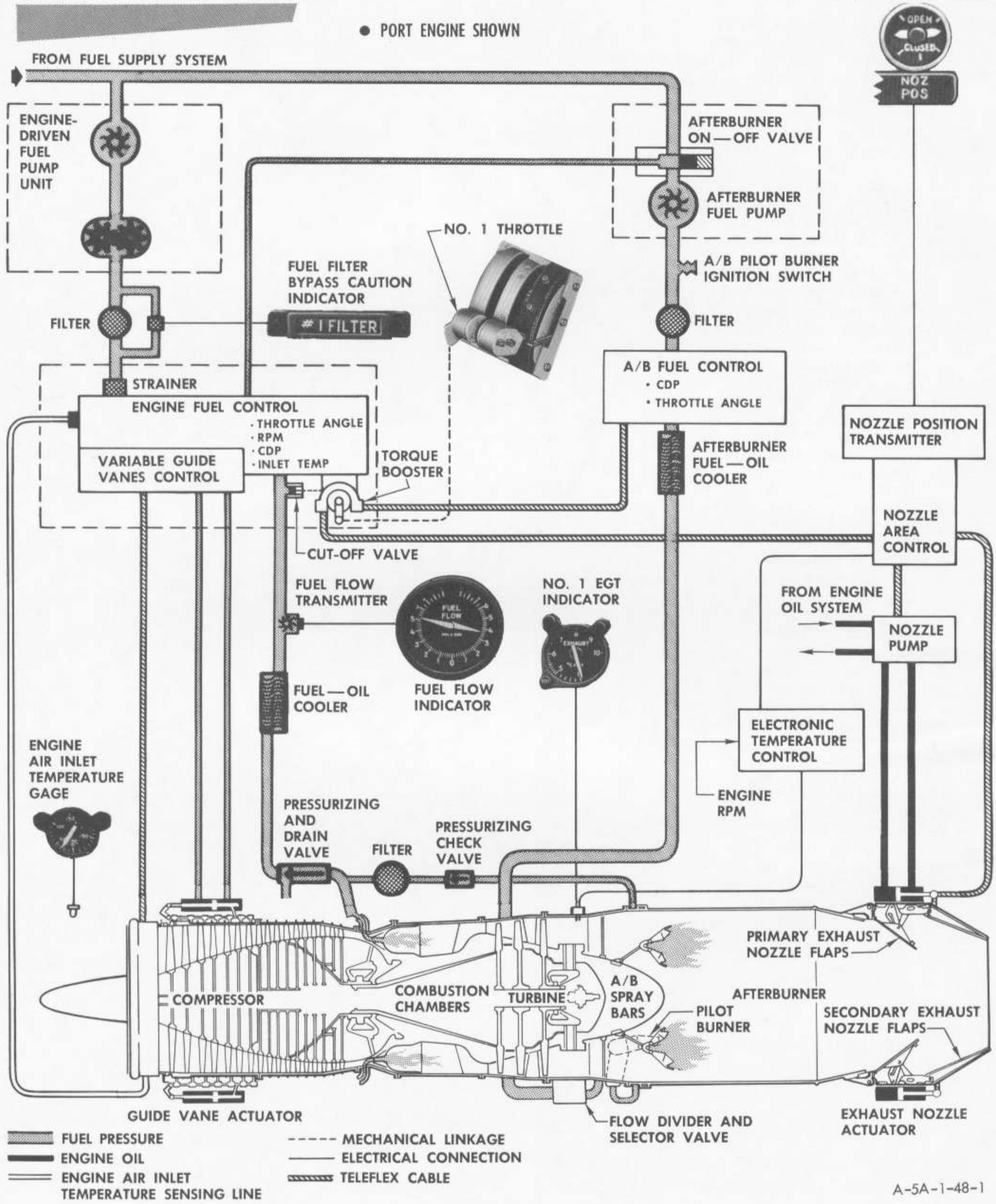


Figure 1-6

PART 2 — SYSTEMS

ENGINES

The aircraft is powered by two J79-GE-8A axial-flow, turbojet engines, each developing a maximum uninstalled thrust of approximately 17,000 pounds in full afterburner at 100% rpm (7685 rpm) under sea level conditions. The uninstalled Military Thrust rating is 10,900 pounds. Engine components include variable inlet guide vanes (heated for anti-icing), variable stator vanes in the first six stages of the 17-stage compressor, a three-stage turbine, and 10 annular-flow combustion chambers. Variable-thrust afterburning and a hydromechanically controlled, converging/diverging aerodynamic exhaust nozzle are also incorporated.

ENGINE FUEL SYSTEMS

Fuel flow to the engine-driven pumps, fuel control, and the combustion chambers is controlled to establish and maintain desired rpm under various engine operating conditions. The main fuel controls combine inputs of throttle position, compressor inlet temperature, engine speed, and compressor discharge pressure in metering fuel for combustion. They also position the variable stator vanes for optimum compressor performance. Throttle linkage simultaneously provides coordinated signals to the main fuel control, nozzle area control, and afterburner control. Fuel flows from the main fuel manifold through a flowmeter and an oil cooler into the pressurizing and drain valve, then to the 10 fuel nozzles for spray injection. See figure 1-6. As engine operating power is selected by the throttles, fuel is regulated for changes in compressor inlet temperature and discharge pressure. A fuel cutoff valve within the fuel control unit stops fuel flow to the combustion chambers when the throttles are retarded to OFF.

ENGINE-DRIVEN FUEL PUMPS

Before entering the main fuel control, the low-pressure fuel supply is boosted to high pressure by an engine-driven pump located on the bottom of each engine accessory section. This pump is composed of an impeller-type booster element and single positive displacement, gear-type pumping elements.

MAIN FUEL CONTROLS

Independent hydromechanical fuel control units meter fuel flow to establish and maintain engine rpm. They also initiate afterburner operation, and regulate servo pressure to control the inlet vanes and variable stator blades for optimum engine compressor performance. During steady-state operation, fuel metering is controlled by a governor in response to throttle position. The fuel control units limit engine maximum rpm at low compressor inlet temperatures and raise engine minimum rpm at high compressor inlet temperatures.

OIL COOLERS

Each engine is equipped with a main oil cooler and an afterburner oil cooler to reduce and control the temperature of scavenged oil. This is accomplished by using the fuel supply as a coolant. During cold engine operation, the coolers bypass scavenged oil until oil temperature reaches normal operating limits. The coolers also bypass scavenged oil when oil inlet/outlet differential pressure exceeds maximum limits and when fuel temperature exceeds a maximum limit. The afterburner cooler bypasses fuel when the fuel inlet/outlet differential pressure exceeds a maximum limit; however, the main cooler does not bypass fuel under any conditions.

FUEL FILTERS

Two filters are mounted on the engine, upstream of the fuel control unit. Should the main engine filter become clogged, a pressure drop of approximately 25 psi will cause the fuel filter pressure switch to actuate. A filter caution light is provided as an indication that the filter has clogged and that bypass will occur if the differential pressure continues to rise. The high-pressure fuel filter is provided with a bypass but no warning light. Two fuel filter caution indicators (figure 1-7) are installed on the instrument panel in the pilot's cockpit. An indication of impending fuel filter bypass is provided by differential pressure sensing switches which are set to energize their respective caution indicators before sufficient pressure drop occurs to cause opening of the bypass valve. Should illumination of a FILTER caution indicator be accompanied by fuel flow fluctuations exceeding ±300 pounds per hour, the flight should be discontinued, the fuel filter inspected, and corrective action taken prior to the next flight.

OIL SUPPLY SYSTEMS

Each engine is provided with a pressure-type oil supply system. In addition to providing necessary lubrication, the system also supplies oil to the constant-speed drive units and to the variable exhaust nozzle system. An oil tank is mounted on the compressor housing of each engine. Each engine oil tank has a usable capacity of 5.2 gallons. This supply is sufficient for an 8-hour air refueling mission. The tanks are designed so that failure or leakage of a constant-speed drive unit will not cause engine oil starvation. The oil scavenge systems filter and

ENGINE CONTROLS AND INDICATORS

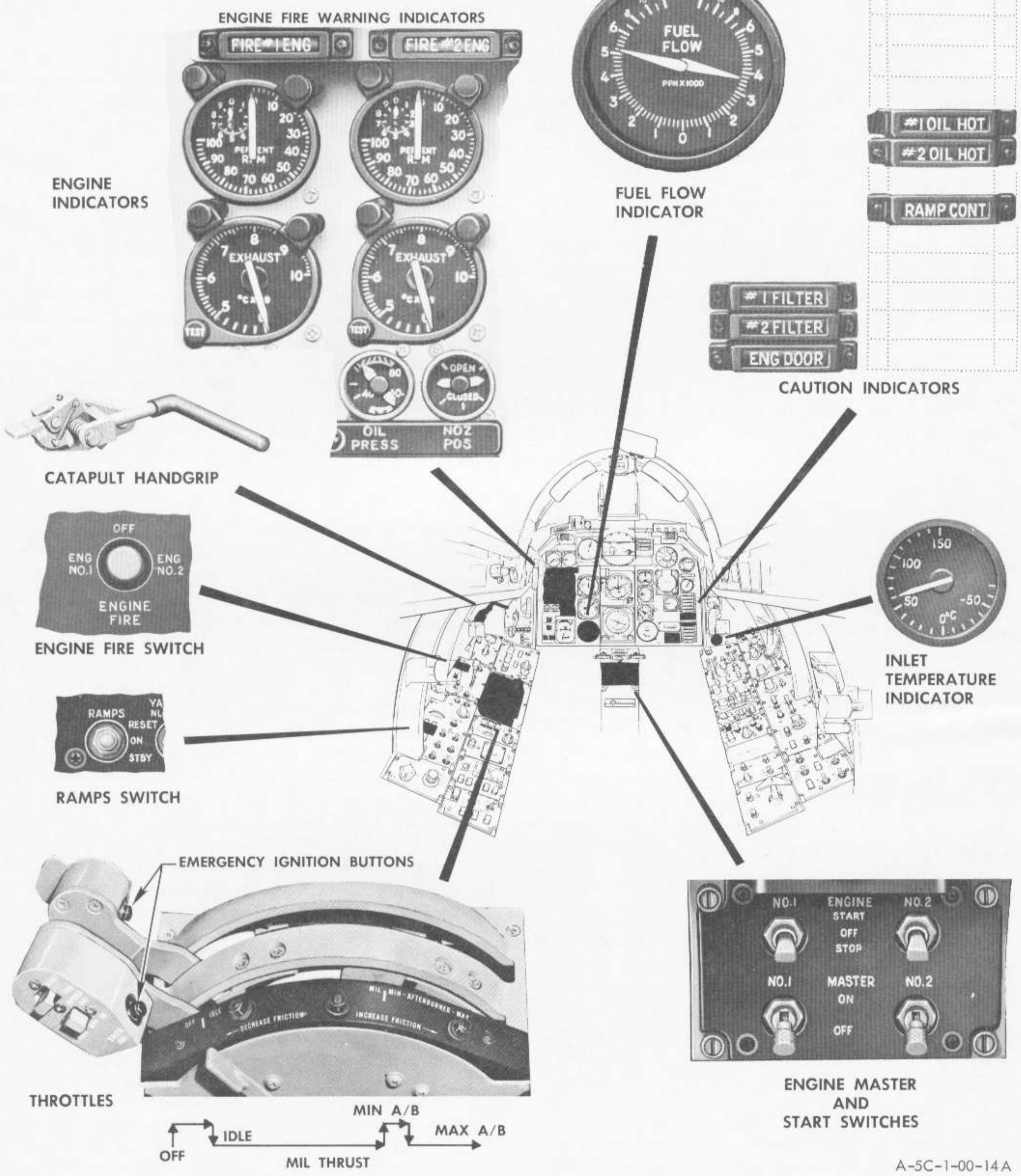


Figure 1-7

cool oil from the lubrication, engine hydraulic, and constant-speed drive systems and return the oil to the tanks for re-use. After scavenged oil passes through the engine filter, it flows through the afterburner oil cooler and then through the main oil cooler. If the temperature in the oil tank reaches 295°F, an overheat thermoswitch turns on the applicable OIL HOT caution indicator (figure 1-7) on the pilot's instrument panel. The main and afterburner oil coolers transfer oil heat to the fuel passing through the coolers. The oil tanks, gear cases, and sumps are interconnected and vented to a common overboard vent through a pressurizing valve which maintains approximately 4 to 5 psi above ambient pressure at any altitude.

AFTERBURNERS

A variable-thrust afterburner is installed on each engine. The afterburners are self-igniting and self-controlled by separate pilot burners, afterburner fuel pumps, and fuel control units. When afterburner power is selected by moving the throttles to the MIN AFTERBURNER position or beyond, fuel is pumped under high pressure to the afterburner fuel controls, which schedule fuel to the afterburner manifolds and sectors through flow dividers. Afterburning fuel flow is divided into core and annulus flows. Core flow is injected in a small area near the center of the exhaust gas system. As fuel flow increases, the manifold flow control schedules the additional fuel to the annular area around this central core. As afterburning is selected, the afterburner ignition units supply ignition to the pilot burners, which, in turn, ignite the fuel spray. Afterburner thrust may be varied between MIN and MAX for both engines or for either engine independently.

VARIABLE AREA EXHAUST NOZZLES

The variable area exhaust nozzles control engine exhaust area in order to maintain exhaust gas temperature and engine thrust at optimum within design limits. This feature is primarily important for efficient engine operation at military power and in the afterburner power range. The variable exhaust nozzle control systems utilize engine oil for hydraulic power to position the nozzle actuators. The nozzles are approximately full open during starting and at idle rpm. As engine speed increases above idle, nozzle area is reduced mechanically by throttle position until, at approximately 87% rpm, the nozzle stops closing. The nozzle is modulated according to EGT and rpm requirements while rpm is increased in the cruise power range. After reaching 100% rpm, continued throttle advance opens the nozzle until the maximum operating EGT (Military Thrust) is reached. The nozzle area is then modulated to maintain this temperature by amplified signals from the EGT thermocouple harness whenever rpm exceeds approximately 95%. At AB light-off, rpm drop (rollback) starts. The nozzles are opened further by increasing EGT (temperature limiting) and modulated to maintain maximum operating EGT. Exhaust temperature and rpm signals electronically control the nozzle for maximum performance during rapid throttle movements.

VARIABLE STATORS AND INLET GUIDE VANES

The engine inlet guide vanes and the first six stages of stator vanes are variable. The system is linked mechanically and is controlled by the main fuel control unit. It is powered by actuators using fuel as the hydraulic medium. The system acts to position the stator and guide vanes as a function of rpm and compressor inlet temperature. This provides maximum compressor efficiency and stall-free acceleration and deceleration.

STARTING SYSTEM

Turbine impingement starting provisions are incorporated. The starting air receptacles are located on the outboard sides of the aft fuselage. See figure 1-51. A manifold supplies external air through seven ports to impinge directly upon the second-stage turbine wheel, providing starting torque to the engine rotor assembly. The starting system provides a connection for automatic shutoff of external air and engine ignition; however, the normal procedure includes the pilot signaling for starting air shutoff as the engine speed reaches approximately 45% rpm. With external electrical power connected and the desired engine MASTER switch positioned to ON, momentarily moving the corresponding engine START switch to START completes a circuit to the external starting air cart, providing air for engine rotation. Movement of the throttle from OFF to IDLE energizes the ignition system and opens the fuel control unit cutoff valve. Light-off occurs at approximately 10% rpm, but starting air aids in developing higher engine speed. When engine rpm reaches approximately 45% rpm, the centrifugal switch mounted on the rear gearbox opens, shutting off external air and engine ignition.

ENGINE MASTER SWITCHES

The engine MASTER switches (figure 1-7) are located on the pilot's center pedestal. With external electrical power connected, moving either switch to ON completes circuits which energize the transfer pump in the forward cell and the boost pumps in the sump tanks. Subsequent movement of the throttle from OFF to IDLE initiates operation of the engine ignition system.

ENGINE START SWITCHES

The engine START switches (figure 1-7) are located on the center pedestal. Momentarily placing either START switch to START, with the corresponding engine MASTER switch ON, completes electrical circuits to supply air to the starting system and energizes the engine ignition system. This circuit remains energized until the engine attains approximately 45% rpm, at which time a speed-sensing switch cuts off the external starting air supply. An engine start may be aborted at any time by moving the throttle to OFF and momentarily moving the engine START switch to STOP, when engine is clear of fuel.

ENGINE FIRE SWITCH

The ENGINE FIRE switch (figure 1-7) operates engine bay fuel and hydraulic shutoff valves. The firewall shutoff valves are powered through the engine MASTER switch circuits.

Note

Use of the ENGINE FIRE switch may cause cavitation damage to engine-driven fuel and hydraulic pumps. If the ENGINE FIRE switch is used, it should be left in the selected position (ENG. NO. 1 or ENG. NO. 2) and the corresponding engine MASTER switch moved to OFF. Ground inspection of all engine systems will be required.

THROTTLES

The engines are controlled by separate throttles (figure 1-7), located in a quadrant on the left console. The No. 1 throttle grip incorporates a plate-type handguard. Throttle stops are provided for positive control of engine power setting and to prevent inadvertent engine shutdown. Throttle stops provided are OFF, IDLE, MIL (military), MIN AFTERBURNER (minimum afterburner), and MAX AFTERBURNER (maximum power). A throttle friction lever (figure 1-7) is mounted on the inboard side of the throttle quadrant for use as a throttle lock and force control. The No. 2 throttle grip contains a radio and ICS microphone switch and a speed brake switch.

EMERGENCY IGNITION BUTTONS

An emergency ignition button (EMER IGN, 19, figure 1-9) is installed in the forward face of each throttle grip. These buttons provide engine ignition system operation for air starts. Providing essential a-c bus power is available and the respective engine MASTER switches are ON, the system is energized when the EMER IGN buttons are depressed and held and the throttles are positioned forward of OFF. The ram-air turbine-powered emergency power unit can provide the essential a-c bus electrical power for ignition if both generators are inoperative.

CATAPULT HANDGRIP

An adjustable catapult handgrip (figure 1-7) is mounted on the cockpit bulkhead above and forward of the throttle quadrant. It is spring-loaded to the stowed position and is pulled down and aft to aid in holding the throttles at the MIL or MAX AFTERBURNER power setting during catapulting.

EGT INDICATORS

An exhaust gas temperature indicator for each engine (figure 1-7) is located on the instrument panel. A press TEST button is provided on each indicator. Depressing the button causes temperature indication to increase to a stop above 1000°C. Upon releasing the button, the needle should return to its original indication. Electrical power for operation of the EGT indicators is supplied by the essential a-c bus. No power-off warning is provided; however, the indicators "freeze" upon power failure. For maximum exhaust gas temperatures, refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

TACHOMETERS

A tachometer for each engine (figure 1-7) is located on the instrument panel. They are calibrated in percent of engine speed in rpm and are powered by their respective engine tachometer generators. Engine top speed (100%) corresponds to 7685 rpm. Failure of a tachometer generator results in failure of the indicator, the rpm reading falling to zero.

NOZZLE POSITION INDICATOR

A single miniature indicator located on the instrument panel (figure 1-7) reflects the position of both afterburner nozzles. The indicators are powered by the essential d-c bus and receive electrical position signals from the nozzle area controllers, indicating nozzle position from fully closed to fully open.

FUEL FLOW INDICATOR

A fuel flow indicator (figure 1-7) is located on the instrument panel. This dual-needle instrument indicates engine fuel consumption in thousands of pounds per hour flow and is scaled in varying increments from 0 to 12. The indicator is powered by the essential instrument a-c bus. Interruption of electrical power freezes the indication.

Note

Fuel flow to the afterburners is not indicated.

OIL PRESSURE INDICATOR

The oil pressure indicator (figure 1-7) is an electrically operated, dual-needle instrument, receiving electrical inputs from two direct, engine-mounted oil pressure transmitters. The indicator is powered by the essential instrument a-c bus. Loss of electrical power causes the indicator needles to remain at their last position. For engine oil pressure limits, refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

RAMPS SWITCH

The RAMPS switch (figure 1-7) is located on the left console and is used to start or restore normal variable ramp operation. After engine start, this switch should be held in RESET until the RAMP CONT caution indicator goes out. If the ramp control system cannot be reset, the

RAMPS switch should be left in STBY. Flight with inoperative inlet control must be conducted at reduced Mach number. Refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

RAMP CONTROL CAUTION INDICATOR

The ramp control caution indicator (RAMP CONT, figure 1-7) is located on the pilot's instrument panel. Illumination indicates a failure of the hydraulic or the electrical control system, or both. If the malfunction is transient, the RAMPS switch may be used to restore normal system operation.

ENGINE CHARACTERISTICS

The J79-GE-8A engine displays positive control characteristics over its entire range of thrust. At all power settings above approximately 79% rpm, variable area exhaust nozzle is automatically controlled as a function of EGT and throttle position, except during accelerations. At lower power settings, nozzle area is a direct function of throttle position. Normal Thrust is reached at 96% rpm. This is the highest continuous (nonlimited) setting. Military Thrust is reached at maximum sustained EGT and fuel flow at 100% rpm (above approximately 40°F compressor inlet temperature), and is marked at MIL on the quadrant.

ACCELERATION

During normal operation, engine accelerations can be made from any power setting without encountering compressor stall or exceeding EGT limits. For slow accelerations, the exhaust nozzle closes directly with throttle advance until maximum operating EGT is reached. For "burst" accelerations, closure of the nozzle is limited by combined signals of engine rpm and EGT in the nozzle controller ("speed derivative control"). Time to accelerate from IDLE to MIL averages 7 to 9 seconds (BLC off), and may increase to approximately 12 seconds with BLC operating, depending upon initial airspeed. For accelerations, the exhaust nozzle control system overrides the throttle mechanical schedule at engine speeds as low as 79% rpm, modulating the area larger or smaller to control EGT. Maximum engine speed and ground idle speed are ground adjusted at the engine main fuel control unit.

GOVERNOR OVERRIDE

The main fuel control unit senses compressor inlet temperature to override governor maximum speed and flight idle schedules under varying inlet temperature conditions.

RPM/EGT Cutback

At ambient temperatures less than approximately 40°F, the maximum engine mass airflow rating may be exceeded at 100% rpm. Mass airflow is limited, therefore, by lowering engine maximum rpm below this temperature. As compressor inlet temperature (CIT) decreases from approximately 6° to −54°C, engine top speed decreases from 100% to 92%. EGT decreases as rpm drops below approximately 98%. As a typical example, −27°C CIT (approximately 21,000 feet under standard conditions) results in a cutback from 100% rpm and 625°C EGT to about 96% rpm and 590°C EGT.

Flight Idle Reset

To reduce the effects of insufficient engine airflow on reduction of throttle setting at supersonic speeds, the minimum idle rpm schedule of the main fuel control unit is reset by the governor override. As CIT increases from 57° to 110°C, minimum idle rpm increases from 65% to 100%. Once reset has occurred, rpm cannot be throttle-reduced until CIT is reduced.

AFTERBURNERS

The afterburners should light off with a maximum of 3 seconds after the throttles are moved outboard of the MIL detent and forward into afterburner range. Lights should be obtained at any engine rpm above approximately 98%, and any "hard" or late light should not be accepted as normal. As the throttles are advanced in afterburner range, thrust increase should be smooth and positive, displaying direct control with the throttles. Fuel flow to the afterburners is not indicated. However, combined engine and afterburner fuel flow at MAX AFTERBURNER is approximately four times that of the engine at Military Thrust.

Variable Nozzles

The variable area exhaust nozzle system schedules engine nozzle area to obtain optimum thrust while maintaining EGT within design limits. During throttle bursts, speed derivative signals (engine speed and EGT) cause the nozzle amplifier to compare rates of rpm and EGT change, scheduling nozzle opening accordingly. As the engine accelerates to near the Military Thrust limit, the nozzle area controller opens and modulates nozzle area, maintaining EGT within steady-state limits. A malfunction in the nozzle hydraulic (engine oil) system causes the nozzle to freeze or drift open, resulting in excessive EGT or loss of EGT and thrust.

ENGINE ICING

ENGINE ANTI-ICE SWITCH

The ENGINE ANTI-ICE switch (9, figure 1-37), a two-position switch (ON/OFF) located on the pilot's right console, controls anti-ice airflow to the engine. Selecting the ON position opens a solenoid-operated valve which regulates the flow of hot air internally through the struts and guide vanes. On some engines,* the air is ported through the accessory bullet nose for gearbox anti-icing purposes. The air is discharged from the trailing edge of the guide vanes and the bullet nose into the engine.

***Aircraft having Engine Bulletin 126 complied with**

ENGINE ANTI-ICE INDICATOR

The engine anti-ice indicator (8, figure 1-37), displays "ON"* when the ENGINE ANTI-ICE switch is ON, both engine anti-ice air valves have opened, and air is flowing as required. Lack of an "ON" indication* shows a valve malfunction, loss of power to the indicator, or pressure switch failure.

AIR INDUCTION SYSTEM

The air induction system (figure 1-8) provides a stable air supply at sufficient total pressure and controlled velocity to ensure maximum engine efficiency under varying flight conditions. Inlet air pressure recovery is accomplished through controlled velocity reduction by variable ramps. Each inlet duct contains three ramps. The first ramp is a fixed, 8.5-degree wedge. The second ramp has a slotted surface for bleeding turbulent boundary layer air and is hydraulically variable from 0 to 21.5 degrees down. The third ramp is separated from the second ramp by a slot and moves with the second ramp to form a variable geometric inlet. The ramp system reduces duct air velocity and provides satisfactory pressure recovery through creation of a series of shock waves in the air stream ahead of the duct lip. To match engine demand with duct supply, an electrically driven, modulating bypass gap is mounted around the front frame of each engine. The gaps pass excess duct airflow around the engines, through the engine compartments, and out the afterburner ejector nozzles. The excess air provides the secondary airflow for engine compartment and engine cooling. The ramps and gaps are automatically scheduled and controlled by an electrical inlet control system. An rpm sensing override circuit provides ramp and duct overload protection in the event of rpm reduction at high supersonic speeds.

SECONDARY AIRFLOW

The air induction system provides air for cooling the engines and engine compartments and supplies air to the variable area exhaust nozzles. During flight, inlet duct air in excess of that required for efficient engine operation is guided around the compressor inlets and into the engine compartments. This airflow cools the engine compartments and flows overboard between the primary and secondary exhaust nozzle flaps. The air creates an aerodynamic convergent/divergent nozzle for the engine primary exhaust flow. During ground operation and with the flaps or landing gear extended, engine compartment cooling air is provided by the engine cooling and overpressure doors, which also provide engine primary air through reverse airflow.

ENGINE PRESSURE RELIEF DOORS

A motor-operated, bungee-loaded door is installed on the bottom center section of each engine compartment. During ground or in-flight operation with flaps extended 25 degrees or more or with landing gear extended, the doors open to provide outside air for engine compartment cooling and additional primary air for engine operation. Should engine compartment pressure exceed ambient by 8 psia or more, the pressure opens the door, because of the off-center mounting of its hinge, far enough to allow bungee action to complete full opening. The doors are then automatically closed electrically when engine compartment pressure is reduced to less than 7 psia above ambient. If the doors remain open (caution indicator on) after reducing power or airspeed, the remainder of the flight should be conducted at subsonic speeds and below 35,000 feet. On the ground, the doors can be opened by turning on an engine MASTER switch if a source of electrical power is provided.

CAUTION

If a fire warning light illuminates, the engine compartment temperature may be lowered by reducing power setting and/or altitude.

ENGINE DOOR CAUTION INDICATOR

The engine door caution indicator (ENG DOOR, figure 1-7) is illuminated whenever either engine compartment cooling and overpressure door is open. Illumination on the ground is normal. Illumination during flight with the landing gear and flaps retracted indicates engine compartment overpressure due to incorrect scheduling of the secondary air gaps or a mechanical malfunction. Should this occur, operation should be restricted to subsonic speeds and nonafterburning operation.

AIR INDUCTION SYSTEM OPERATION

The air induction system is designed to provide an air supply to the engine at high-pressure recovery with low inlet drag. The system includes variable geometry inlets, variable secondary air bypass gaps, and an automatic control system. The inlet control system is composed of amplifiers which combine electronic signal inputs of duct static pressure, ambient pressure, and aircraft Mach number to control the variable inlet ramps and bypass gaps. Portions of both the forward and aft variable ramps are slotted and separated by an additional slot for removing ramp turbulent boundary layer airflow. This air is directed into plenum chambers above the ramps. The aft plenum air is routed into the bomb bay for cooling and purging; forward and mid plenum air passes overboard through vents at the top of each duct. A cooling and overpressure relief door, located on the underside of each engine compartment, provides engine compartment overpressure relief as necessary under high "Q" conditions, and cooling air and engine supplementary air during low-speed and ground operation. Refer to ENGINE PRESSURE RELIEF DOORS, in this section.

INLET CONTROL

Protection against duct airflow instability is required for the air induction system at high Mach numbers during power reductions and in the event of engine or fuel control failure. To prevent severe inlet buzz, the affected

***Aircraft having Engine Bulletins 126 and 170 complied with**

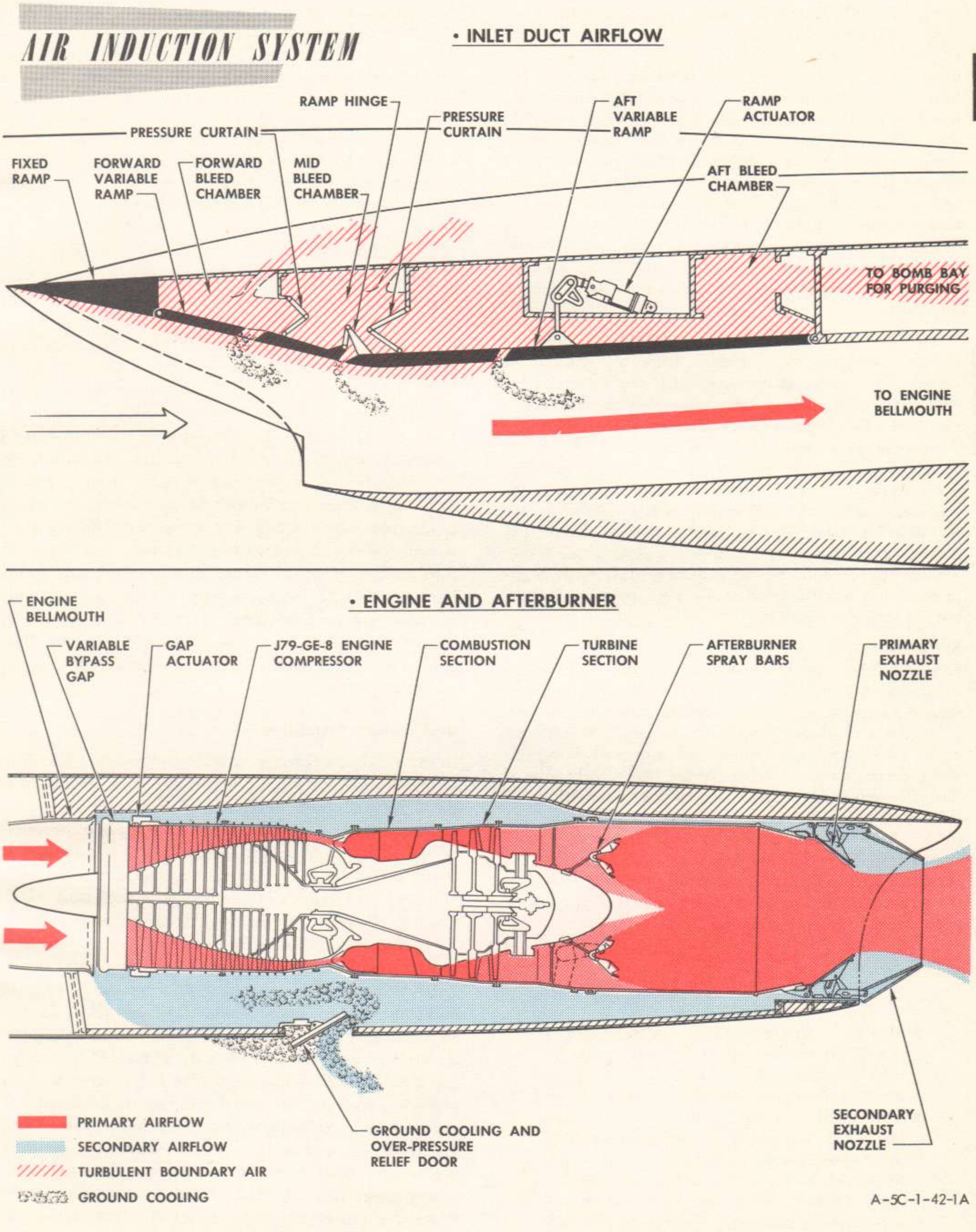

AIR INDUCTION SYSTEM
• INLET DUCT AIRFLOW
RAMP HINGE
PRESSURE CURTAIN
PRESSURE CURTAIN
AFT VARIABLE RAMP
RAMP ACTUATOR
FIXED RAMP
FORWARD VARIABLE RAMP
FORWARD BLEED CHAMBER
MID BLEED CHAMBER
AFT BLEED CHAMBER
TO BOMB BAY FOR PURGING
TO ENGINE BELLMOUTH
• ENGINE AND AFTERBURNER
ENGINE BELLMOUTH
VARIABLE BYPASS GAP
GAP ACTUATOR
J79-GE-8 ENGINE COMPRESSOR
COMBUSTION SECTION
TURBINE SECTION
AFTERBURNER SPRAY BARS
PRIMARY EXHAUST NOZZLE
PRIMARY AIRFLOW
SECONDARY AIRFLOW
TURBULENT BOUNDARY AIR
GROUND COOLING
GROUND COOLING AND OVER-PRESSURE RELIEF DOOR
SECONDARY EXHAUST NOZZLE
A-5C-1-42-1A

Figure 1-8

ramp will fully extend to the 21.5-degree (down) position whenever the airspeed is above 1.3 Mach and the engine rpm drops below approximately 94.5%, either by pilot action or a failure. This will not illuminate the RAMP CONT caution indicator, since the monitor circuit, which normally indicates failure if the ramps are more than 3 degrees apart, is bypassed in this case. When speed drops below 1.3 indicated Mach or rpm is increased above approximately 94.5%, the monitor circuit will be reactivated and will indicate failure. Holding the RAMPS switch in RESET until the RAMP CONT caution indicator goes out will then reset the ramp to the normal schedule. Should this indicator not extinguish, the ramps must be observed externally to determine their relative positions.

VARIABLE RAMPS

Below 0.3 Mach, the variable ramps are maintained in the fully retracted position with the inlet control system reset in normal operation. Between 0.3 Mach and 0.95 Mach, the system maintains a 4-degree ramp down position on normal schedule. Above 0.95 Mach, the variable ramps are automatically positioned by hydraulic actuators in accordance with a programed schedule, increasing to about 16.5 degrees down at maximum speed. At high supersonic speeds, inlet airflow is decelerated through two oblique waves and a normal shock wave. The ramp schedule provides duct airflow with high-pressure recovery for good engine performance throughout the airspeed envelope.

Ramp Monitor

Should a failure occur which results in the inlet control system driving the ramps to positions differing by more than 3 degrees, the control system will monitor off, providing a "fail-safe" mode of operation. Should this occur, the RAMP CONT caution indicator will illuminate and the ramps will be driven by air load slowly toward the fully retracted position. Under these conditions, if the system cannot be reset, flight speed should be limited to 1.3 indicated Mach. To provide improved single-engine efficiency, turning off the windmilling engine MASTER switch will bypass the monitor circuit and drive the respective ramp to the 21.5-degree extended (down) position, reducing windmilling drag.

CAUTION

- Moving an engine MASTER switch to OFF at any Mach number above 0.3 will cause the corresponding ramp to extend (down) regardless of engine operation or rpm.
- Subsequent to ramp control system failure, DO NOT repeatedly or continuously hold the RAMPS switch in RESET if reset is not successful. The RESET position overrides the ramp monitor circuit and hydraulic shutoff to the ramp actuators. This condition may cause the ramps to be driven full down, resulting in a large loss of thrust.

To protect the aircraft from a failure of one of these override circuits at low speed, neither ramp will extend to the full down position when the aircraft speed is below 0.3 Mach regardless of other conditions. If speed is reduced below 0.3 Mach when one ramp is extended, the RAMP CONT caution indicator will illuminate. The ramps should then be reset, returning the extended ramp to schedule. If the RAMP CONT caution indicator cannot be extinguished by resetting the ramps, the ramp will move slowly to the fully retracted position.

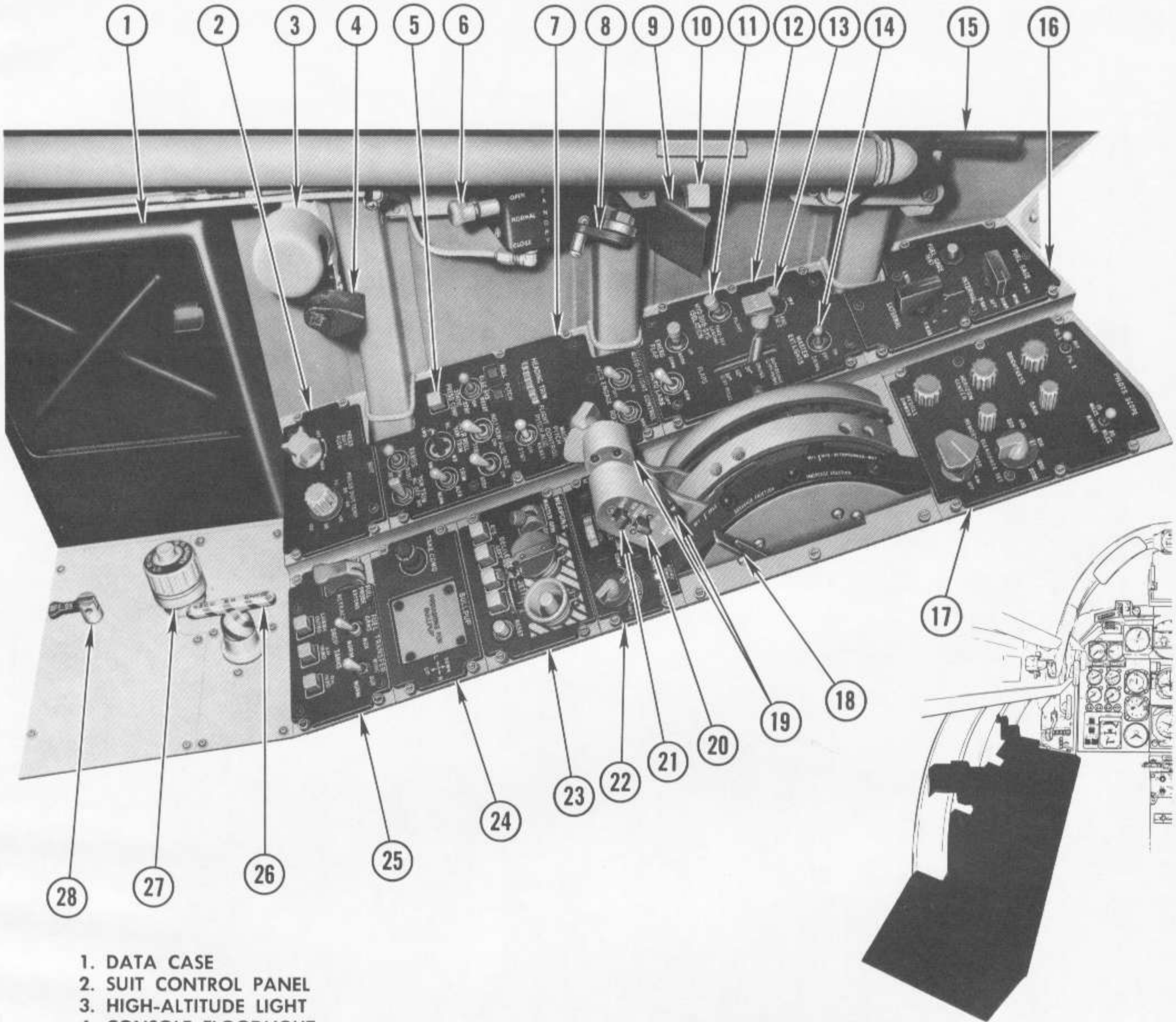
BYPASS GAPS

A variable area secondary air gap, located around each engine immediately ahead of the compressor inlet, acts to properly match engine airflow demand and inlet duct supply. These gaps, which are actuated by electrically powered rotary actuators, can modulate from a maximum of 80 square inches opening to a minimum of 30 square inches. Below 1.3 Mach, there is no requirement to decrease the bypass area, and the gaps are maintained at 80 square inches. Above 1.3 Mach, the gaps decrease to 30 square inches as a function of duct static pressure, ambient pressure, and aircraft Mach number. Air which is directed into the engine compartments by the gaps is used for engine and structural cooling and is ejected through the secondary nozzle of the variable area afterburner. Utilizing the bypass air in this manner forms an aerodynamic convergent/divergent exhaust nozzle, increasing engine thrust as much as 5 percent. The gaps also serve to minimize inlet drag and match engine and inlet airflow.

Duct Airflow Instability

In the event of improper variable ramp angle scheduling at speeds above 1.3 Mach, the position of the duct normal shock wave becomes unstable and may alternately enter and leave the duct, causing rapid fluctuations in pressure. If caused by faulty ramp scheduling, this instability is characterized by a low amplitude, moderate frequency buffet which increases in intensity with increasing Mach number. If caused by structural failure of an inlet ramp or failure of an engine rpm sensing switch during a power reduction, fully developed inlet buzz may occur. Refer to Section IV. Should airflow instability or buzz onset occur, Mach number should be reduced as quickly as possible by extending speed brakes and retarding the throttles to not less than Military Thrust. If this buffet coincides with illumination of the RAMP CONT caution indicator, reset should also be attempted. Normally, if engine rpm is reduced to less than 94.5% rpm above 1.3 Mach, the engine rpm switch extends the ramp of the affected inlet to the full down position (21.5 degrees) to preclude inlet buzz. When rpm is reestablished above the rpm switch limit, the RAMP CONT caution indicator will illuminate and the ramp control system should be reset.

LEFT CONSOLE



1. DATA CASE
2. SUIT CONTROL PANEL
3. HIGH-ALTITUDE LIGHT
4. CONSOLE FLOODLIGHT
5. STATIC PRESSURE COMPENSATOR BUTTON
6. CANOPY TOGGLE VALVE
7. AUTOFLIGHT AND FLIGHT CONTROL PANELS
8. EMERGENCY PITCH TRIM CRANK
9. INSTRUMENT PANEL FLOODLIGHT
10. VENTILATION AIR CONTROL
11. HYDRAULIC SUB-SYSTEMS ISOLATION SWITCH
12. FLAP CONTROL PANEL
13. ENGINE FIRE SWITCH
14. EXTERIOR LIGHTS MASTER SWITCH
15. CATAPULT HANDGRIP
16. FUEL QUANTITY INDICATOR CONTROL PANEL
17. SCOPE (PPDI) CONTROL PANEL
18. THROTTLE FRICTION LEVER
19. EMERGENCY IGNITION BUTTONS
20. SPEED BRAKE SWITCH
21. INTERCOM-TRANSMIT SWITCH
22. UHF COMM CONTROL PANEL
23. WEAPONS AND JETTISON CONTROL PANEL *
24. BULLPUP CONTROL PANEL (PROVISIONS) *
25. FUEL TRANSFER PANEL
26. SPEED BRAKE DUMP HANDLE
27. ANTI-G VALVE
28. OXYGEN SUPPLY LEVER

* Aircraft 150842 and subsequent and aircraft having PCR 215 complied with.

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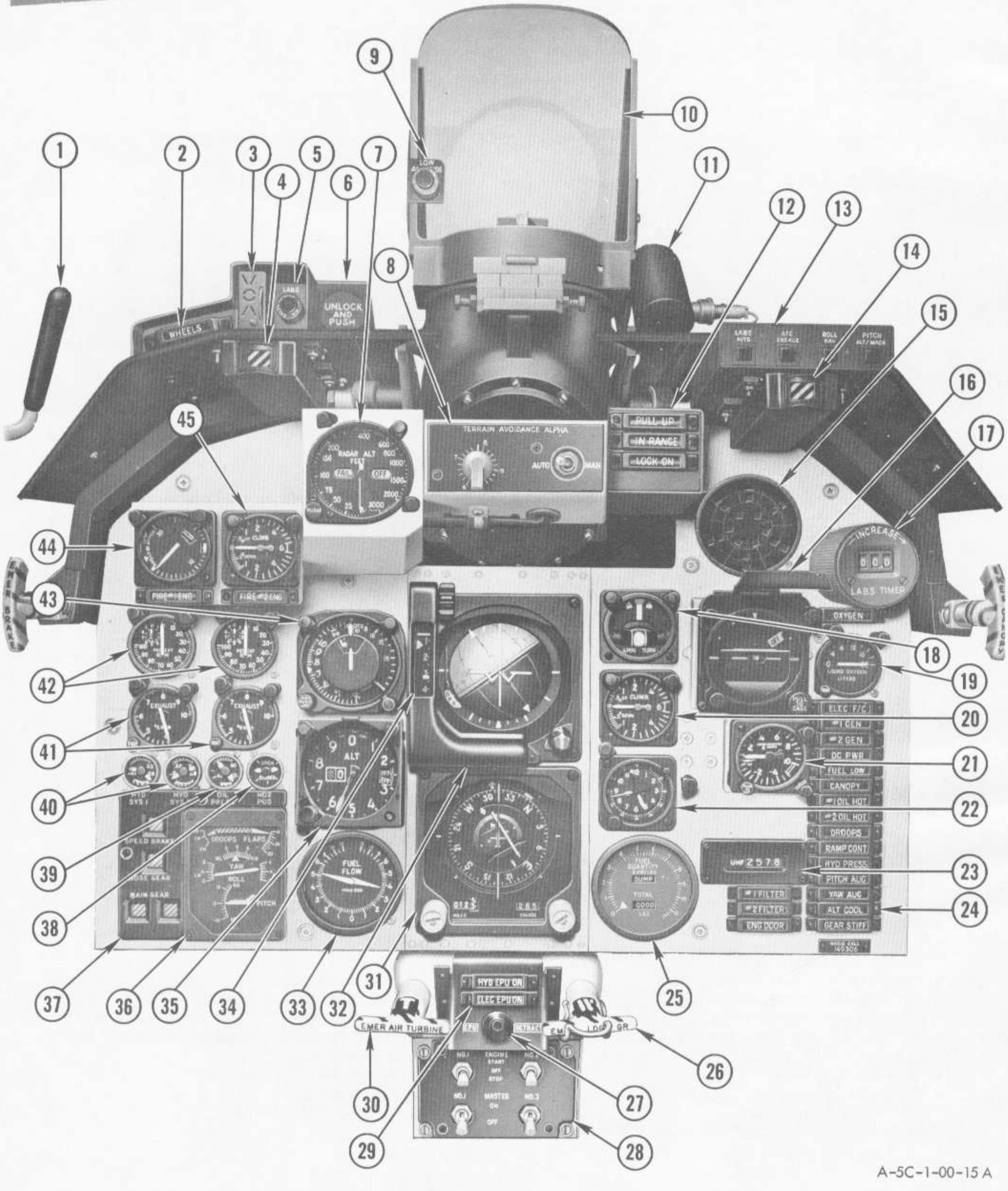
Figure 1-9

INSTRUMENT PANEL



A-5C-1-00-15 A

Figure 1-10 (Sheet 1)

1. RADIATION CURTAIN HANDLE
2. WHEELS WARNING INDICATOR
3. APPROACH INDEXER
4. MASTER WARNING INDICATOR
5. LABS PULLUP LIGHT
6. RADIATION CURTAIN RELEASE KNOB
7. RADAR ALTIMETER
8. TERRAIN AVOIDANCE ALPHA PANEL
9. LOW ALTITUDE WARNING LIGHT
10. PROJECTED DISPLAY INDICATOR (PPDI) *
11. PPDI TILT SOLENOID
12. RADAR ADVISORY LIGHTS
13. AFCS MODE INDICATORS
14. MASTER CAUTION INDICATOR
15. ECM INDICATOR
16. STANDBY ATTITUDE INDICATOR
17. LABS TIMER
18. TURN AND SLIP INDICATOR
19. OXYGEN QUANTITY INDICATOR
20. VERTICAL SPEED INDICATOR
21. ACCELEROMETER
22. CLOCK
23. UHF CHAN/FREQ INDICATOR
24. CAUTION INDICATORS
25. FUEL QUANTITY INDICATOR
26. LANDING GEAR EMERGENCY RELEASE HANDLE
27. EPU (RAT) RETRACT BUTTON
28. ENGINE MASTER AND START SWITCHES
29. EPU ADVISORY INDICATORS
30. RAT RELEASE HANDLE
31. HORIZONTAL SITUATION INDICATOR
32. ALL-ATTITUDE INDICATOR
33. FUEL FLOW INDICATOR
34. G-PROGRAMMER
35. ALTIMETER
36. DROOP-FLAP-TRIM INDICATOR
37. SPEED BRAKE, GEAR INDICATOR
38. NOZZLE POSITION INDICATOR
39. OIL PRESSURE INDICATOR
40. HYDRAULIC PRESSURE
41. EGT INDICATORS
42. RPM INDICATORS
43. AIRSPEED/MACH INDICATOR
44. ANGLE OF ATTACK INDICATOR
45. VERTICAL SPEED INDICATOR (PRIMARY T/A)

NOTE: CAUTION AND ADVISORY INDICATORS SHOWN ENERGIZED FOR INFORMATION PURPOSES.

*AIRCRAFT WITH AFC 120 HAVE FOLDING PPDI

A-5C-1-00-16B

Figure 1-10 (Sheet 2)

ENGINE OPERATION

ENGINE STARTING

Engine ground starting requires both external a-c electrical power and engine starting air. Normal starts may be made with or without automatic shutoff of the air source, using the RCPP-105-1 pod or RCPT-105-3 unit. When using the automatic feature (electrical connection from aircraft to air unit), flow of start air begins when the engine START switch is moved to START, ignition operation is automatic, and start air is shut off automatically when an engine rpm of about 45% is reached. During pilot-controlled starts (electrical connection not used), the pilot must signal for airflow, depress the EMER IGN button or use engine START switch to obtain ignition, and signal for airflow shutoff at about 45% rpm. During pilot-controlled starts, the engine START switches need not be used, since airflow is direct to the impingement starting ducts. For complete engine operating procedures, refer to Sections III and IV.

CAUTION

Engine start should not be attempted with droops extended. Engine compressor loss due to BLC flow may cause hot starts. If droops are extended, move the flap control switch to CRUISE or SUPERSONIC, move the engine START switch to START or signal for airflow, and delay moving the throttle to IDLE until the droops have retracted to less than 25 degrees.

During starts with autonavigator alined, engine operations with droops down are restricted. Do not exceed 2 minutes at idle with droops down if bomb directing set alinement is to be maintained.

COMPRESSOR STALLS

Compressor stall is a breakdown of airflow in the engine compressor due to separation of airflow from the compressor blades, similar to the separation from a wing during an aircraft stall. Such stalls usually result from an inlet control or engine fuel control unit malfunction or compressor blade damage. Compressor stalls are recognized by (1) loss of rpm or "hanging" acceleration, (2) rise in EGT and abnormal change in nozzle area, or (3) a pulsating, explosive sound, possibly accompanied by light to severe vibration. During normal operation, the main fuel control unit automatically controls compressor stator vane angle by servo fuel pressure. Vane angle is modulated to regulate airflow rate and pattern through the early stages of compression to reduce the possibility of stall. The main fuel control unit also schedules engine rpm as a function of CIT and inlet guide vane angle to maintain adequate compressor stall margin. Refer to Section V for emergency procedures.

AIR STARTS

Best conditions for air start are found below 45,000 feet at less than 1.0 indicated Mach. The areas of positive and probable air start capability, as well as the operational limits of the engine, can be determined from figure 5-2. It should be noted that not all engines will perform exactly as depicted. Some engines will exceed these factors; some will fall short. The area of the afterburner blowout boundary may be preceded by an area of cyclic afterburner operation prior to final blowout. Should dual flame-out occur in a zoom climb, the aircraft should be returned to the area of probable air start before attempting a relight. For complete procedures and air start envelope, refer to Section V and see figure 5-2.

Note

If both engines are below 36% rpm, it is necessary to extend the RAT to obtain flight control hydraulic pressure and electrical power for air start.

AIRCRAFT FUEL SUPPLY SYSTEM

The aircraft fuel supply system includes internal tanks in the fuselage and wings, and provisions for additional fuel in the bomb bay and at four wing external store stations. Normal system transfer is automatic, except for transfer of drop tank fuel which must be selected by the pilot. In flight, all internal tanks are automatically pressurized to 5.5 psi by the air conditioning system. This pressure minimizes fuel loss due to altitude "boil-off" and improves the performance of transfer and boost pumps. For a system functional diagram, see figure 1-12. For tank and total quantities, see figure 1-2.

INTERNAL TANKS

FORWARD TANK

The forward tank is located aft of the main electronics bay. This tank contains a single low-duty transfer pump and provisions for refueling from the forward pressure refueling receptacle and the air refueling probe. Should the forward tank transfer pump fail, fuel will gravity-feed into the sump tank through a gravity-flow check valve which maintains an even level in the two tanks, and prevents flow from the sump back to the forward tank.

SUMP TANK

The sump tank is located directly aft of the forward tank. All fuel is directed into this tank for distribution to the engine fuel systems. The sump tank is connected to the forward tank and receives fuel from the forward tank transfer pump or by gravity. Sump tank fuel is forced into the engine supply lines through a manifold by two dual-speed boost pumps. With both generators operating, selection of afterburning switches both pumps to high-speed operation. For single-generator operation, the sump tank boost pumps remain on low duty during afterburner operation. The two pumps incorporate standpipes which provide in excess of 30 seconds of inverted flight fuel supply at all power settings under negative "g" conditions.

WING TANKS

The wing fuel tank complex is composed of an overwing (top cap) tank and integral wing tanks. Top cap fuel gravity-feeds directly into the wing tanks. The integral tanks contain a two-speed transfer pump and a scavenge pump in each wing section. These pumps operate only when wing and overwing fuel is transferred to the sump in the normal sequence or when auxiliary transfer operation is selected. With both generators operating, the transfer pumps switch to high-speed operation on selection of afterburning, or WING AUX transfer, and during wing fuel dumping. The scavenge pumps, located on the outer portion of the main wing tanks, ensure movement of fuel to the central portion and the transfer pumps.

CAUTION

Low-duty wing transfer pump pressure with single-generator operation may result in sump tank depletion under maximum afterburner fuel flow conditions below 18,000 feet.

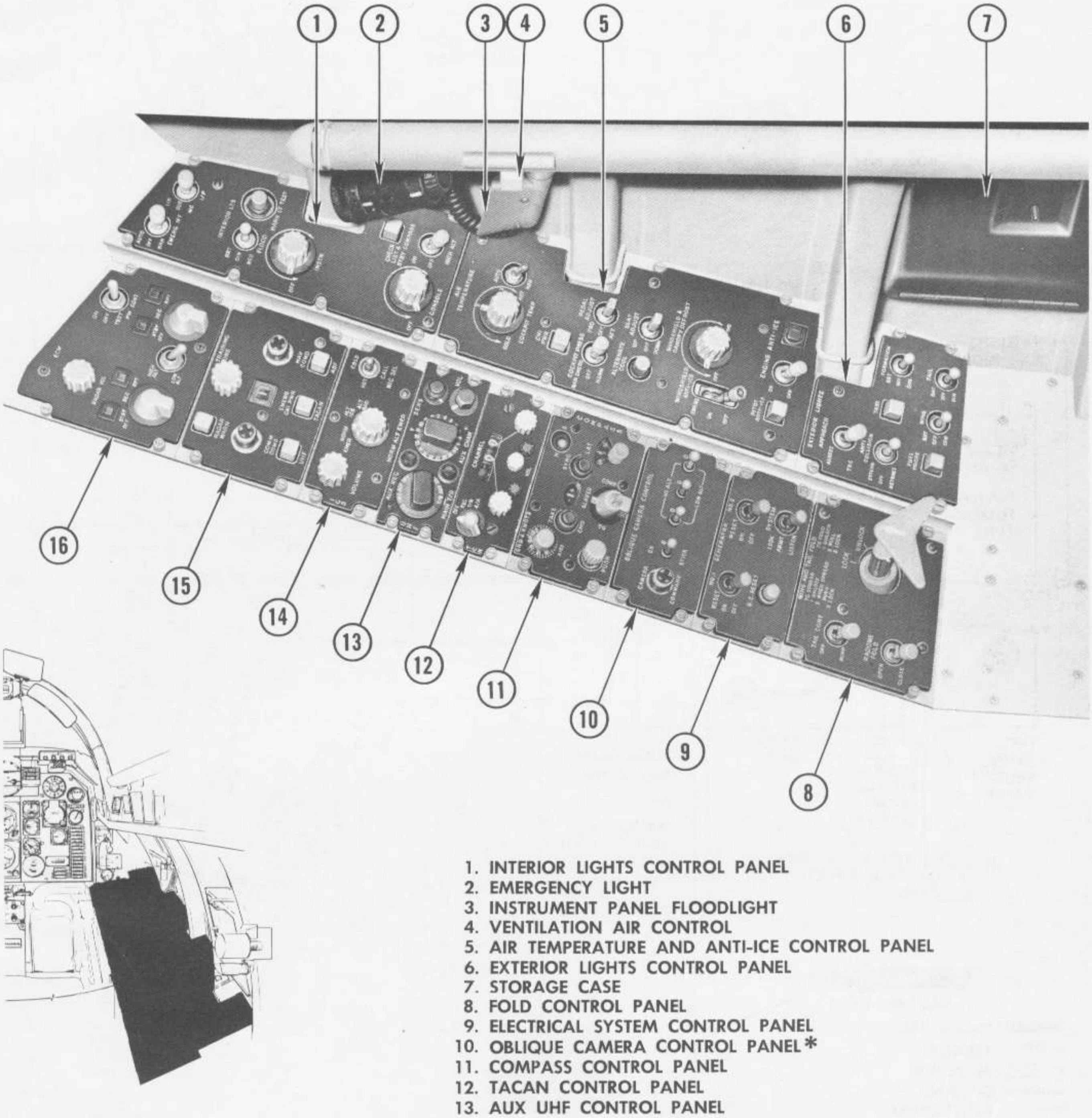
AFT TANK

The saddle-shaped aft fuselage tank is located above the bomb bay, forward of the vertical stabilizer. Fuel from the aft tank is transferred to the sump tank through the wing fuel transfer lines by three single-speed, low-pressure transfer pumps. Under normal (automatic) sequencing, aft tank pumps are activated concurrently with wing pumps, and fuel begins transfer to the sump tank when approximately 400 to 700 pounds of wing tank fuel remain. This sequence may be initiated manually by moving the WING switch to AUX with the bomb bay cans empty or depressurized (arresting hook down, refueling probe out, or weight of the aircraft on landing gear). During wing fuel dumping, aft tank fuel is dumped concurrently.

BOMB BAY FUEL CANS

Two or three 295-gallon fuel cans may be installed in the linear bomb bay. Can fuel is transferred directly to the sump tank by pressure from the air conditioning system. Under normal conditions, bomb bay fuel will be transferred automatically upon lifting of aircraft

RIGHT CONSOLE



1. INTERIOR LIGHTS CONTROL PANEL
2. EMERGENCY LIGHT
3. INSTRUMENT PANEL FLOODLIGHT
4. VENTILATION AIR CONTROL
5. AIR TEMPERATURE AND ANTI-ICE CONTROL PANEL
6. EXTERIOR LIGHTS CONTROL PANEL
7. STORAGE CASE
8. FOLD CONTROL PANEL
9. ELECTRICAL SYSTEM CONTROL PANEL
10. OBLIQUE CAMERA CONTROL PANEL*
11. COMPASS CONTROL PANEL
12. TACAN CONTROL PANEL
13. AUX UHF CONTROL PANEL
14. INTERCOM CONTROL PANEL
15. AUDIO SELECT PANEL
16. ECM CONTROL PANEL

*INTERCHANGEABLE WITH T-375 AMAC OR AN/AWW-1 FFC CONTROL PANELS

A-5C-1-00-8C

Figure 1-11

AIRCRAFT FUEL SUPPLY SYSTEM

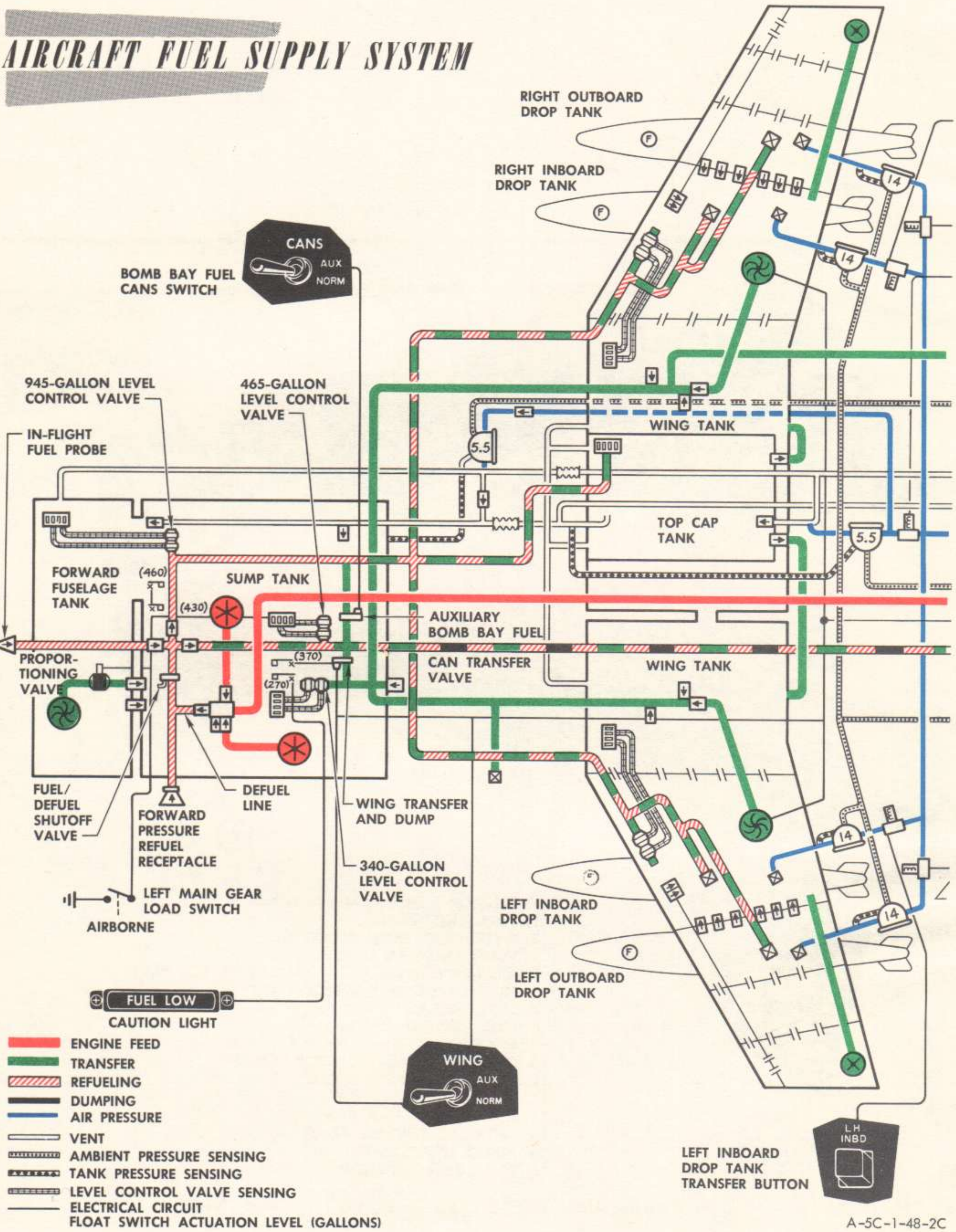


Figure 1-12 (Sheet 1)

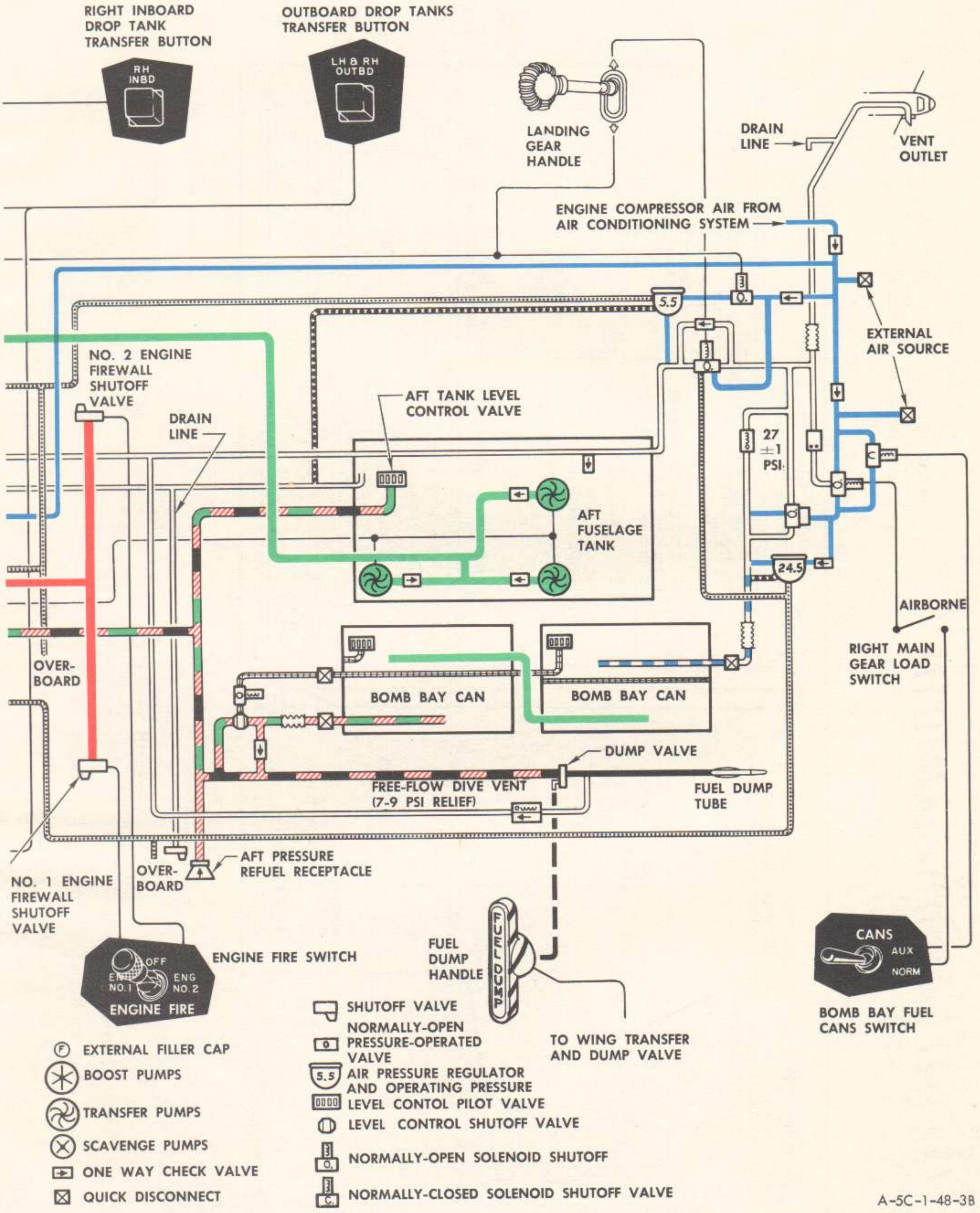


Figure 1-12 (Sheet 2)

SUMP FUEL SEQUENCING COMPONENTS

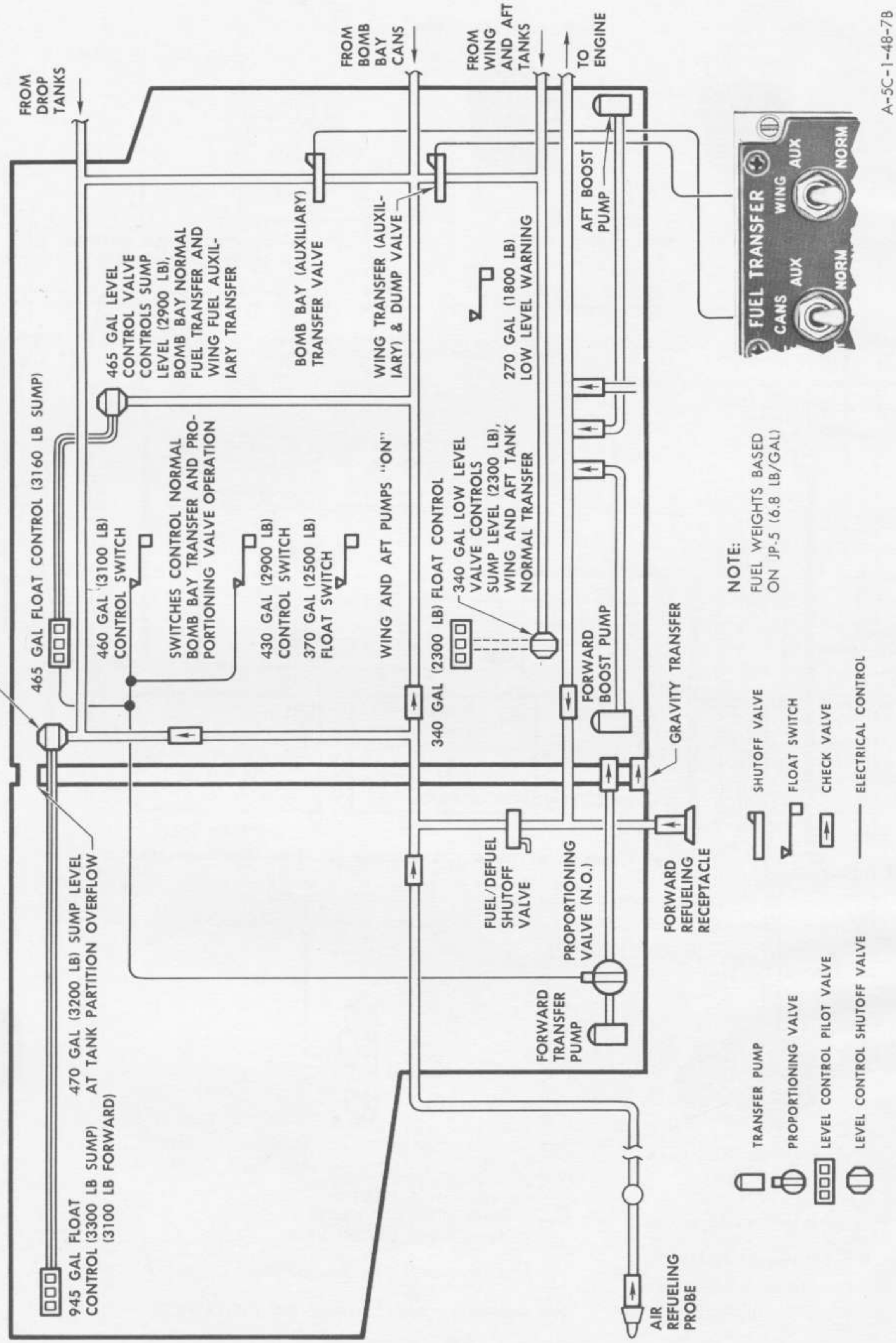


Figure 1-13

weight from the landing gear (after drop tank fuel depletion), when sump fuel level drops to approximately 2700 to 2900 pounds. The bomb bay cans are automatically depressurized on landing touchdown, when the arresting hook is extended, the refueling probe is extended, when can fuel is exhausted, or when wing dump is selected.

EXTERNAL FUEL TANKS

Four 400-gallon drop tanks can be installed at wing external store stations. When drop tank fuel transfer is selected, the tanks are pressurized by the air conditioning system, forcing fuel directly into the sump and wing tanks. If necessary, the tanks can be jettisoned, or released normally through the armament system. Emergency jettison releases the tanks by gravity through pyrotechnic retraction of retaining hooks. Normal release through the armament system retracts the hooks and force-ejects the tanks from the pylons. Refer to ARMAMENT SYSTEM, in Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

WARNING

When stores (including drop tanks, empty or full) are retained on three or four external stations, move the WING switch to AUX as soon as bomb bay cans are empty (when sump level begins to fall below 2600 pounds) to avoid exceeding aft stability limits.

FUEL QUANTITY DATA

For fuel quantity data, see figure 1-2. Due to inherent gaging and fuel system characteristics, a 1.5 percent difference exists between the actual JP fuel dielectric constant/density relationship and the design value required by specification. In addition, approximately 300 pounds of usable fuel that is not gaged exists in the lines and tanks when the total fuel remaining exceeds approximately 10,000 pounds. It is recommended that the following conversion formula be used to compensate for this difference when planning a mission:

$$\text{Total Actual Fuel} = \frac{\text{Total Reading}}{0.985} + 300$$

FUEL TRANSFER

The forward tank transfer pump and sump tank boost pumps operate with electrical power available and either engine MASTER switch positioned to ON. With drop tanks installed and the transfer buttons depressed, transfer of drop tank fuel maintains the forward and sump tanks full until drop tank fuel is depleted. With no external tanks installed, forward tank and bomb bay can fuel transfers through the proportioning system to the sump 2700- to 2900-pound level until depleted. Forward tank fuel and bomb bay can fuel is concurrently transferred to the sump to maintain center of gravity within specified limits. Wing tank (and top cap) fuel transfers automatically when sump quantity falls to approximately 2300 pounds. As wing fuel is exhausted, the aft tank transfers to the sump until empty. When total fuel remaining drops below 3000 pounds, transfer volume is reduced and extended AB operation should be avoided.

WARNING

Whenever the hook is in the down position, the air refueling probe is extended, or weight of the aircraft is on the landing gear, bomb bay can fuel will not transfer. This may result in increased longitudinal control sensitivity due to an aft center of gravity and/or a dangerously low sump fuel condition. If the FUEL PROBE switch is in EXTEND position, or arresting hook is extended and cannot be retracted, bomb bay fuel may be transferred by holding the CANS switch in AUX.

Note

- When the forward tank is completely empty, the bomb bay cans should contain 0 to 600 pounds (two cans) or 1800 to 2600 pounds (three cans). This fuel should be next to transfer to the sump tank.
- During wing fuel transfer, the sump should be maintained at 2200 to 2300 pounds. Under level flight conditions, aft tank fuel is normally last to transfer to the sump, occurring usually when about 700 pounds wing fuel remains. Under maneuvering conditions (LABS, air-to-ground, afterburner operation, etc), transfer of aft tank fuel may occur earlier.

FUEL DUMPING

Wing and bomb bay can fuel may be dumped through a tube at the aft end of the fuselage. Refer to FUEL DUMP HANDLE, in this section. Bomb bay can fuel is forced through the dump line by air pressure in approximately 3 minutes (two cans) or 5 minutes (three cans). At normal (nose high) flight attitudes, wing (and top cap) tank fuel is pumped through the dump line in excess of 1020 pounds per minute by the wing transfer and scavenge pumps.

CAUTION

- Due to fire hazard, fuel dumping is not to be accomplished during afterburner operation, except in an emergency.
- CANS and WING switches should be in NORM during dump operations.

CONTROLS AND INDICATORS

CANS SWITCH

The CANS switch (figure 1-14) is located on the FUEL TRANSFER panel. This solenoid-held switch is spring-loaded to NORM, and held electrically in AUX if selected in flight. After the aircraft is airborne, the cans pressurize and the fuel transfers on depletion of drop tank fuel, if tanks are installed and selected for transfer. Use of the AUX position allows bomb bay can pressurization at any time, and permits immediate transfer of bomb bay fuel to the sump tank.

Note

- To obtain pressurization of bomb bay cans on the ground, the CANS switch must be manually held in AUX. On release, the cans will be depressurized and vented.
- The CANS switch automatically returns from AUX to NORM when can fuel is exhausted, the arresting hook is extended, or when wing fuel dumping is selected.

DROP TANK TRANSFER BUTTONS

The drop tank transfer buttons (figure 1-14) are depressed to select fuel transfer from either inboard tank or both outboard tanks. Fuel transfer may be stopped at any time by momentarily depressing the drop tank transfer buttons. This depressurizes the selected tanks.

Note

It is recommended that outboard tank fuel be transferred prior to transfer from the inboard tanks.

WING SWITCH

The WING switch (figure 1-14) is used to select normal or auxiliary transfer of wing and aft tank fuel. This solenoid-held switch is spring-loaded to NORM, and held electrically in AUX if selected in flight with the bomb bay cans depressurized. Placing the landing gear handle to the DOWN position returns the switch to NORM. The NORM position allows automatic transfer in the normal sequence, following depletion of the bomb bay can fuel. The AUX position should be selected in the event of failure of wing fuel to transfer. Auxiliary wing transfer switches the wing pumps to high duty and maintains sump level at 3000 pounds.

Note

- The WING switch must be held manually in AUX for ground checks of the wing transfer and scavenge pumps.
- The CANS switch must be at NORM while transferring wing fuel in AUX. If the CANS switch is at AUX, the AUX position of the WING switch is inoperative.
- Common transfer lines direct both aft tank and wing tank fuel to the sump tank. Aft tank and wing tank fuel can be transferred out of sequence only if bomb bay cans are depressurized by extending the arresting hook, extending the refueling probe, or when on the deck, by holding the WING switch in AUX.

FUEL PROBE SWITCH

The FUEL PROBE switch (figure 1-14) controls air refueling probe extension and retraction. Probe extension, which requires approximately 8 seconds, automatically dumps internal fuel tank and bomb bay can pressure. Retracting the probe restores fuel system pressurization and makes bomb bay can fuel transfer available.

Note

The FUEL PROBE switch guard provides switch protection in either the EXTEND or RETRACT position.

FUEL DUMP HANDLE

The FUEL DUMP handle (2, figure 1-29) is located on the left forward console. This handle has two fuel dumping positions. When the handle is pulled straight back, the bomb bay cans are pressurized and bomb bay fuel

FUEL TRANSFER CONTROLS

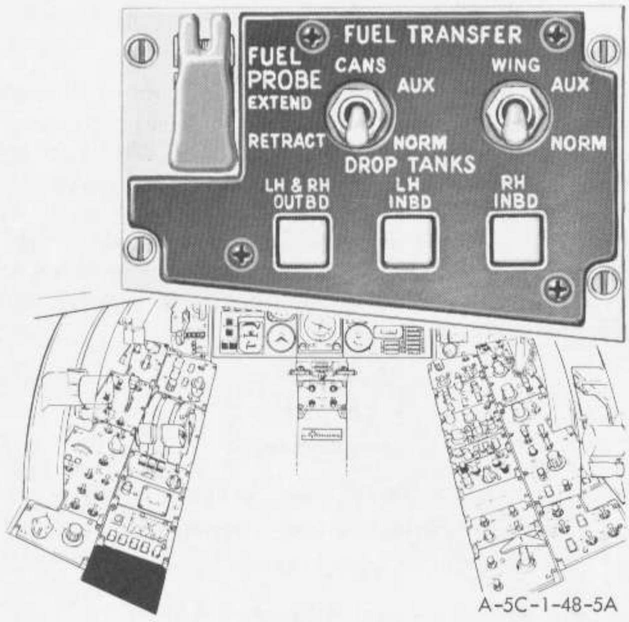


Figure 1-14

is dumped overboard. If the handle is further rotated 45 degrees to the right, the bomb bay cans are depressurized, the wing transfer and dump valve opens, the wing transfer pumps switch to high-speed operation, and wing fuel is pumped overboard via the dump tube. Primary bus a-c electrical power is required for operation of the wing transfer pumps; however, some dumping will occur because of the 5.5-psi differential pressure in the tanks. Dump rate is improved by maintaining a normal flight (nose-up) attitude.

Note

During bomb bay can fuel dumping, periodically check the fuel dump handle to ensure that it has not slipped out of the dump position.

FUEL QUANTITY INDICATOR

A FUEL QUANTITY indicator (25, figure 1-10) is installed on the instrument panel. By using the fuel quantity selectors, individual tank quantities may be checked. Total fuel quantity is indicated by a digital counter, calibrated in pounds remaining. During individual tank selections of either internal or external tanks, individual tank quantity is indicated by the triangular pointer, while the total fuel counter remains fixed at the indicator before selection. A window on the face of the indicator shows the tank selected for check. With the EXTERNAL selector held at any drop tank position, the symbol "DT" appears. For internal positions, the window display corresponds to selector position.

FUEL QUANTITY SELECTORS

Two fuel gage selector handles (figure 1-15) are installed on the forward portion of the left console. The INTERNAL selector is spring-loaded to the SUMP position, and switches the indicating system to read fuel remaining in the FWD (forward), WING, AFT, and B. BAY (bomb bay) tanks. The EXTERNAL selector is spring-loaded to a neutral (internal) position and, on selection, overrides the INTERNAL selector for indication of fuel remaining at external stations 1, 2, 3, and 4.

FUEL GAGE TEST BUTTON

The FUEL GAGE TEST button (figure 1-15) is located outboard of the fuel gage selectors. When depressed to test FUEL QUANTITY indicator, the fuel totalizer and tank quantity pointer should run toward zero. On release, the indicator window and pointer should return to their original readings.

FUEL LOW CAUTION INDICATOR

The fuel low caution indicator (FUEL LOW, figure 1-10) automatically illuminates when the fuel level in the sump tank drops to between 1600 and 1950 pounds.

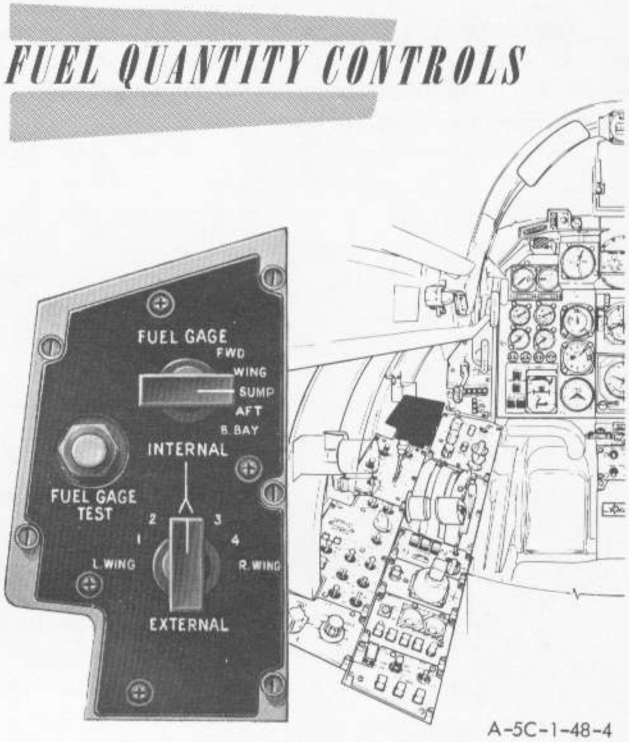


Figure 1-15

FUEL SYSTEM OPERATION

The normal transfer of bomb bay, forward, wing, and aft tank fuel to the sump tank is automatic. Drop tank fuel must be manually selected. With external electrical power connected, placing either engine MASTER switch to ON activates the forward tank transfer and sump tank boost pumps. Prior to take-off, the bomb bay CANS switch should be in NORM, and drop tank transfer buttons selected off. During ground operation, fuel from the forward tank will gravity-feed to the sump tank, as the proportioning valve remains closed until the aircraft is airborne. If take-off is delayed, the sump tank may be filled by ground transfer from the cans by holding the CANS switch in AUX. With normal load, this transfer should not exceed 2000 pounds. After the desired tank levels are attained, release the CANS switch to NORM.

CAUTION

If an empty drop tank is installed, selection of on-deck transfer of full tanks alone results in transfer of fuel into the empty tank.

FUEL TRANSFER SEQUENCE

The following table presents the normal transfer sequence without external tanks and with two bomb bay cans installed. (Indications are based on JP-5 fuel at 6.8 pounds per gallon on a Standard Day.) For fuel planning purposes, actual usable fuel aboard at the time of engine start may exceed the totalizer reading by as much as 600 pounds. This is due to an inherent gage error of 1.5 percent of the total, plus 300 pounds of usable, "ungaged" fuel existing in the fuel lines and tanks.

	NOMINAL GAGE READINGS				
SEQUENCE	FORWARD	SUMP	WING	AFT	BOMB BAY
Start	3100	3300	10,400 — 10,600	800 — 900	3900
Taxi, take-off	2500	2900	10,400	800 — 900	3900
Bomb bay transfer / Forward transfer	2300 — 0	2900*	10,400	800 — 900	3700 — 600
Bomb bay transfer (remainder)	—	2900	10,400	800 — 900	0 — 600
Sump transfer	—	2300	10,400	800 — 900	—
Wing transfer	—	2300	700†	400 — 800‡	—
Aft transfer	—	2300	—	—	—
FUEL LOW warning	—	1600 — 1950	—	—	—

***Sump cycles from 2900 to 2700 pounds as fuel is transferred from forward and bomb bay**
†Aft tank positive transfer starts with approximately 700 pounds in wing
‡Some aft tank fuel will transfer concurrently with wing fuel transfer in maneuvering flight

Pressurization of the bomb bay cans cannot occur until the weight of the aircraft is off the landing gear to energize the ground safety switch; internal fuel tanks are pressurized when the landing gear handle is raised to the UP position. Drop tank fuel transfer is manually selected after take-off. Under normal conditions, the drop tanks will keep the forward and sump tanks full (3100 and 3300 pounds) until drop tank fuel is exhausted.

CAUTION

The WING and CANS switches should be held in AUX prior to take-off to check for positive transfer. If bomb bay fuel fails to transfer after take-off, move the CANS switch to AUX and recheck. Failure to transfer bomb bay can fuel results in an aft center-of-gravity condition, seriously affecting pitch control during a landing approach.

Normal consumption will drop the sump tank level to approximately 2300 pounds when wing tank transfer begins. If normal sequencing fails, WING AUX should be selected. Electric power for wing AUX transfer sequence depends upon hook and probe position and action of the bomb bay cans low-level float switch. Alternate transfer procedures are described in Section V under WING FUEL TRANSFER FAILURE. Aft tank transfer will maintain approximately 2000 pounds sump level (at cruise power settings) until exhausted. The FUEL LOW caution indicator will be illuminated when the remaining fuel reaches approximately 1600 to 1950 pounds.

INVERTED FLIGHT

The fuel system incorporates boost pump inverted flight standpipes controlled by gravity-sensitive valves. During negative-g flight, essentially all sump tank fuel is available for continuous flow to the engines. Refer to ACCELERATION LIMITATIONS, in Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

FUEL SYSTEM VENTING

All internal fuel tanks are pressurized and climb/dive vented. The wing, aft, and sump tanks vent through the forward tank and into the normally open main vent valve and vent outlet pipe. The main vent valve is electrically energized (closed) when the landing gear is retracted, and relieves vent pressure at approximately 6.5 psi differential. A negative/positive relief valve is also provided in a line between the vent line and dump tube vent line (negative relief during defueling and positive relief for a clogged overboard vent). The bomb bay cans vent directly through a separate line, containing a pneumatically operated vent shutoff valve, to the vent outlet pipe. The shutoff valve is open for can venting and closed when the cans are pressurized. A bomb bay can relief valve bypasses any overpressurization to the vent outlet. A drop tank pressure vacuum relief valve will vent excessive air pressure overboard and relieve drop tank vacuum during descents.

REFUELING

All internal tanks may be refueled in approximately 7 minutes through two pressure refueling receptacles. The forward receptacle is located aft and slightly left of the nose gear well and the aft receptacle is located aft of the left main landing gear well. Aircraft with four drop tanks can be refueled in approximately 15 minutes. External a-c electrical power is required for refueling the drop tanks and level control valve testing. During FMLP, etc, the aft refueling receptacle can be used to fill only the aft tank and the bomb bay cans and to fill the sump tank to the 3200-pound level. If the forward receptacle is used alone, complete refueling may require up to 30 minutes. The drop tanks may be separately hose-fueled, if desired. Refer to Section I, Part 3.

Note

- After refueling, the push-pull refuel-defuel select lever, located in the forward receptacle access, must be pushed upward to the FLIGHT AND DEFUELING position.
- Should operational requirements dictate refueling with the engines running, the air refueling probe must be extended to allow complete refueling.

FUEL SYSTEM FAILURES

Failure of fuel system boost or transfer pumps is not apparent using JP-5 fuel with the system pressurized. However, dropping fuel flow, erratic or subnormal engine operation (i.e. 80% rpm with throttles at MIL detent), or abnormal depletion of forward or sump tank fuel level should be sufficient reason to reduce throttle settings and maintain as high an altitude as possible where transfer rate meets engine demand. Failure of the 5.5-psi internal tanks pressurization feature together with boost or transfer pump failure may require descent to as low as 25,000 feet before Military Thrust can be obtained. The level of fuel in the sump tank is normally continuously indicated, and serves as the main guide to checking system operation and sequencing. Any radical change in sump level during the transfer sequence from that shown under FUEL TRANSFER SEQUENCE should be noted on the "yellow sheet" for maintenance investigation and/or corrective action. Failure of drop tanks to transfer is readily apparent, since bomb bay can and forward tank transfer will start prematurely and the sump will fall to between 2700 to 2900 pounds, instead of being maintained at the normal 3200-pound level. Attempt to regain drop tank transfer by cycling the transfer buttons off and on, allowing at least 2 minutes in each position. Extending the RAT and turning off both generators may cause drop tank transfer.

Note

- Carrier arrestments are not permitted with fuel in external tanks.
- For landing with one full external tank on an inboard station, use *full opposite lateral trim*. Do not attempt landing with a full drop tank on an outboard station.

Failure of bomb bay can fuel to transfer poses a potentially more serious problem than drop tank failure, since two full cans provide approximately 3700 to 3900 pounds contribution to aft center-of-gravity problems. Sump level drops to about 2300 pounds (after forward tank transfer), and wing tank fuel depletion will begin. Recommended procedure is to maintain economical altitude and power settings while allowing normal wing fuel transfer and to attempt to regain can transfer by moving the CANS switch to AUX. If unsuccessful, rock and porpoise the aircraft to check for a sticking level control valve. Pull the ESS FUEL circuit breaker to cut power to the can pressure valve (held closed electrically). If sump fuel level rises, transfer can be controlled by alternately pulling and resetting the breaker until can fuel is exhausted. If all attempts to transfer bomb bay can fuel fail, pull the FUEL DUMP handle to the first detent and check the fuel quantity indicator for dump reaction.

ELECTRICAL POWER SUPPLY SYSTEMS

See figure 1-16 for schematic of electrical power supply systems.

A-C POWER SYSTEM

The basic power supply is a 400-cycle, constant-frequency, alternating-current system supplying three-phase power at 115 volts per phase. Voltage measured across any two phases is 200 volts. Normal a-c power is provided by two engine-driven generators. Essential a-c bus power can be provided by an emergency power unit which is driven by a dropout ram-air turbine.

GENERATORS

The aircraft is provided with two 42-kva a-c generators, providing a total system capacity of 84 kva. The generators are powered by independent, engine-driven, constant-speed drives which are cooled by passing oil from the engine oil tank through the frame and shaft of each generator. The constant-speed drives are hydromechanical transmissions which, by differential action,

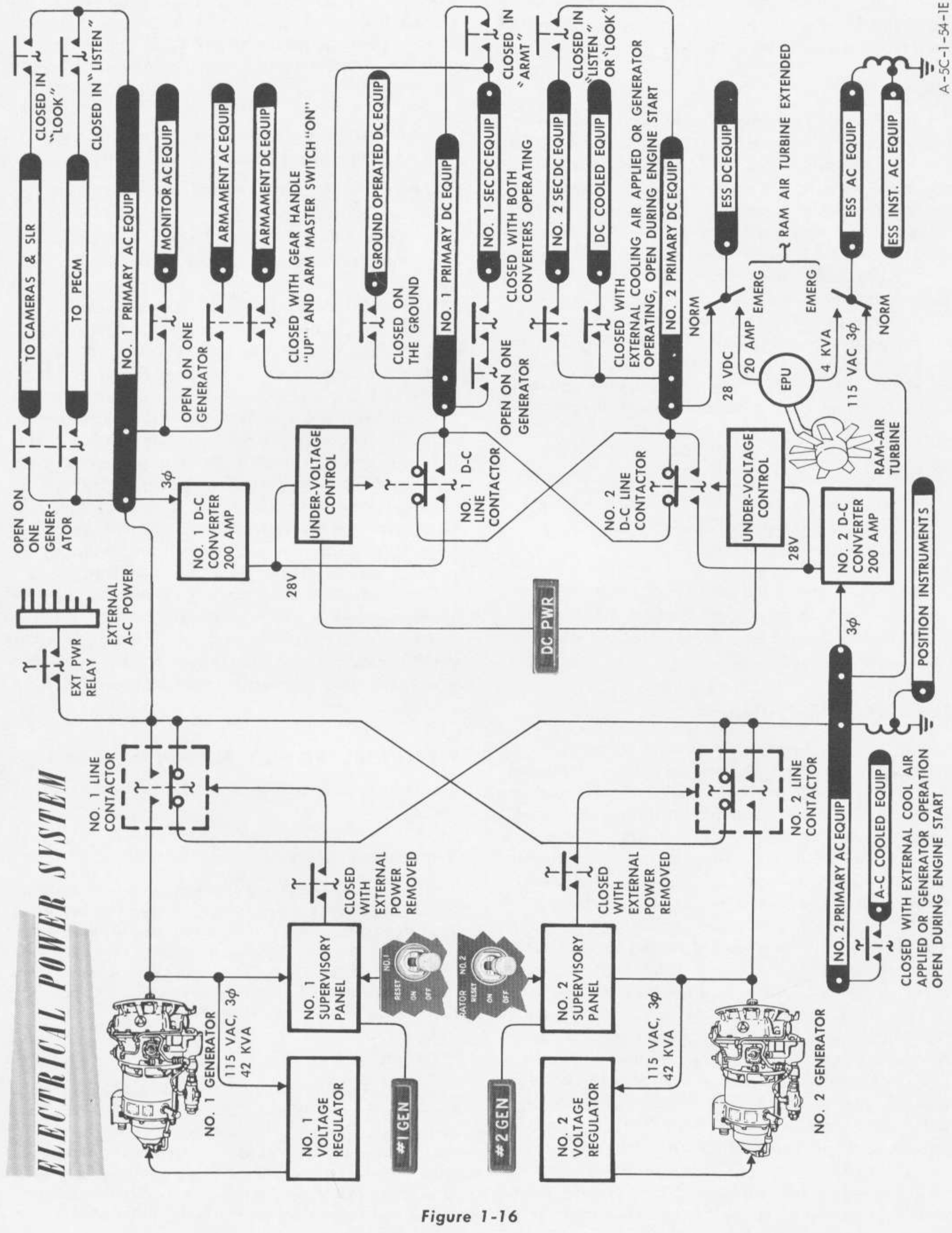

ELECTRICAL POWER SYSTEM
TO CAMERAS & SLR
TO PECM
CLOSED IN "LOOK"
CLOSED IN "LISTEN"
OPEN ON ONE GENERATOR
NO. 1 PRIMARY AC EQUIP
MONITOR AC EQUIP
ARMAMENT AC EQUIP
ARMAMENT DC EQUIP
CLOSED WITH GEAR HANDLE "UP" AND ARM MASTER SWITCH "ON"
GROUND OPERATED DC EQUIP
CLOSED ON THE GROUND
NO. 1 PRIMARY DC EQUIP
NO. 1 SEC DC EQUIP
CLOSED IN "ARMT"
CLOSED WITH BOTH CONVERTERS OPERATING
OPEN ON ONE GENERATOR
NO. 2 SEC DC EQUIP
DC COOLED EQUIP
CLOSED IN "LISTEN" OR "LOOK"
CLOSED WITH EXTERNAL COOLING AIR APPLIED OR GENERATOR OPERATING, OPEN DURING ENGINE START
NO. 2 PRIMARY DC EQUIP
ESS DC EQUIP
NORM
EMERG
RAM AIR TURBINE EXTENDED
28 VDC
20 AMP
EPU
4 KVA
115 VAC 3φ
ESS AC EQUIP
ESS INST. AC EQUIP
A-5C-1-54-1E
3φ
NO. 1 D-C CONVERTER 200 AMP
28V
UNDER-VOLTAGE CONTROL
NO. 1 D-C LINE CONTACTOR
NO. 2 D-C LINE CONTACTOR
NO. 2 D-C CONVERTER 200 AMP
RAM-AIR TURBINE
POSITION INSTRUMENTS
DC PWR
EXTERNAL A-C POWER
EXT PWR RELAY
NO. 1 LINE CONTACTOR
NO. 2 LINE CONTACTOR
CLOSED WITH EXTERNAL POWER REMOVED
NO. 2 PRIMARY AC EQUIP
A-C COOLED EQUIP
CLOSED WITH EXTERNAL COOL AIR APPLIED OR GENERATOR OPERATION OPEN DURING ENGINE START
NO. 1 SUPERVISORY PANEL
NO. 2 SUPERVISORY PANEL
RESET
ON
OFF
NO. 1 GENERATOR
NO. 2 GENERATOR
115 VAC, 3φ
42 KVA
NO. 1 VOLTAGE REGULATOR
NO. 2 VOLTAGE REGULATOR
#1 GEN
#2 GEN

Figure 1-16

POWER DISTRIBUTION

NO. 1 PRIMARY AC BUS

AIR DATA
ARMAMENT MASTER
AN/AWW-1
BUDDY TRANSFER
B/N
BULLPUP & SHRIKE
DATA CONVERTER
DIGITAL DATA SYSTEM
ENGINE ANTI-ICE
EXT LIGHTS DIM
FORWARD BOOST PUMP
GENERAL EXT LIGHTS
GENERAL LIGHTS TRANSFORMER
GROUND SAFETY
LH WING TRANSFER PUMP
MODE RELEASE CONTROL
NAV FLOOD & MAP LIGHTS
NAV CONSOLE & INSTR LIGHTS
NAV RED FLOOD LIGHTS
NAV STANDBY GYRO HORIZON
NO. 1 AB IGNITION
NO. 1 AFT TANK PUMP
NO. 2 AFT TANK PUMP
NO. 1 DC CONVERTER
NO. 1 DC RESET
NO. 1 YAW AUG
PILOT CONSOLE LIGHTS
PILOT HI ALT & PROBE LIGHTS
PILOT INSTR LIGHTS
PRI HEAT EXCH JETPUMP
RADAR
RADAR ALTIMETER
SECONDARY BUS CONTROL
SECONDARY HEAT EXCH JETPUMP
TACAN
TANK & PYLON RELEASE
TAXI LIGHT
TRIGGER

NO. 2 PRIMARY AC BUS

AC MONITOR BUS CONTROL
AIR DATA
AN/ALQ-41
AN/ALQ-51
AN/ALQ-55
AN/ALQ-55 COOLING
AN/ALQ-55 HEAT EXCH AIR
AUTOFLIGHT
B/N
CNI—LESS TACAN
ELECTRIC FLIGHT CONTROL
FORWARD TANK TRANSFER PUMP
GAP ACTUATORS (1, 2)
HSI
INLET RAMPS
LATERAL & DIRECTIONAL TRIM
NO. 2 AB IGNITION
NO. 2 DC CONVERTER
NO. 2 DC RESET
NO. 2 YAW AUG
NO. 3 AFT TANK PUMP
PITCH AUG AIR DATA
POSITION INSTRUMENTS
RH WING TRANSFER PUMP
WING LIGHTS

NO. 1A SECONDARY AC BUS

AZIMUTH-CORRECTED CAMERA MOUNT
CAMERA CONTROL
LIQUID COOLING PUMP
MODULE NO. 1 & NO. 3 DEFROST
NO. 1 STABILIZED CAMERA MOUNT
NO. 2 STABILIZED CAMERA MOUNT
VACUUM PUMP
VIEWFINDER
SERIAL FRAME CAMERA
SLR
3-INCH SYSTEM
18-INCH SYSTEM

NO. 1B SECONDARY AC BUS

PECM

ESSENTIAL AC BUS

AFT BOOST PUMP
ALTERNATE COOLING
ALTERNATE INSTR POWER
ALTERNATE TRIM
CABIN COOLING
CABIN HEAT EXCH BYPASS
CENTER PEDESTAL AC
COCKPIT LIMITER (1, 2, 3)
CNI
  UHF COMM
  AUX REC
  IFF
EGT (1, 2)
ELECTRONICS COOLING
ELECTRONIC HEAT EXCH BYPASS
EQUIPMENT COOLING
FLAP-DROOP CONTROL
• FIRE DETECTOR (1, 2)
• FIRE SHUTOFF
FLAP-DROOP-TRIM INDICATOR
FLIGHT REFERENCE SET
FUEL LOW WARNING
FUEL QUANTITY INDICATOR (SUMP)
FUEL QUANTITY INDICATOR (TOTAL)
• FUEL SHUTOFF
INDICATING LIGHTS TEST
INTERNAL JETTISON (1, 2)
INSTRUMENT TRANSFORMER
J-8 GYRO
• NAV ESSENTIAL TRANSFORMER
OXYGEN QUANTITY
• PILOT ESSENTIAL TRANSFORMER
PILOT INSTR VIBRATOR
PITOT HEATER
RAM AIR
• START & IGNITION (1, 2)
SUIT TEMPERATURE
WARNING LIGHTS POWER

ESSENTIAL INST AC BUS

ENGINE OIL PRESSURE (1, 2)
FUEL FLOW (1, 2)
HYDRAULIC PRESSURE (1, 2)

MONITOR AC BUS

AFT SEAT ADJUST
ENGINE COOLING DOORS
FORWARD SEAT ADJUST
HIGH DUTY FUEL PUMP OPERATIONS
RADOME FOLD
PEDAL ADJUST
WING SCAVENGE PUMPS

ARMAMENT AC BUS

INTERNAL RELEASE (1, 2)

NO. 1 PRIMARY DC BUS

AIR REFUELING PROBE LIGHT
ACCELERATION CUTOFF (ASN-26)
ALTERNATE SUPV POWER (GEN CONTROL)
ANGLE-OF-ATTACK
ANTI-COLLISION LIGHTS
AIR TEMPERATURE DETECTOR
B/N
BUDDY TANKER
DROP TANKS TRANSFER
EMERGENCY BUDDY TANKER
ECM PASSIVE WARNING
ENGINE OIL COOLING
FLAP SHUTOFF
FUEL SEQUENCE
HOOK & APPROACH LIGHT
MAPPING RADAR
NOSE WHEEL STEERING
NO. 1 YAW AUG
PNEUMATIC PRESSURE
WING & TAIL FOLD

NO. 2 PRIMARY DC BUS

AN/ALQ-41 & 51
AN/ALQ-55
AUTOFLIGHT CONTROL
CANOPY SEAL
CNI NO. 1
CNI NO. 2
DC SECONDARY BUS SELECT
ELECTRIC FLIGHT CONTROL
EMERGENCY ELEC POWER INDICATOR
FORWARD TRANSFER CONTROL
HYDRAULIC ISOLATION
INLET RAMPS
JET PUMP CONTROL
LANDING GEAR CONTROL
NO. 2 YAW AUG
PEDAL SHAKER & ACCELEROMETER
PITCH AUG
SECONDARY HEAT EXCH SHUTOFF
SPEED BRAKE
TURBINE RETRACT

NO. 1 SECONDARY DC BUS

ARMAMENT MASTER
BULLPUP POWER
BOMBS & BULLPUP
LABS
STORE-STATION MODE SELECT
TANK RELEASE (1, 2)
WEAPON CONTROL
WEAPON POWER (1, 2, 3)

NO. 2 SECONDARY DC BUS

AZIMUTH CORRECTED CAMERA MOUNT
DATA CONVERTER
DIGITAL DATA SYSTEM
MODULE NO. 1 & NO. 3 DEFROST
NO. 1 STABILIZED CAMERA MOUNT
NO. 2 STABILIZED CAMERA MOUNT
PECM
SERIAL FRAME CAMERA
SLR
SPECIAL SYSTEMS CONTROL
VIEWFINDER
WINDOW COVER RELEASE
 3 INCH SYSTEM
18 INCH SYSTEM

ESSENTIAL DC BUS

• AIRBORNE REFUEL
CABIN HEAT EXCH BYPASS
• CABIN PRESSURE
CNI ESSENTIAL
COCKPIT ESSENTIAL (1, 2, 3)
• DC ESSENTIAL (1, 2, 3)
ELECTRONICS HEAT EXCH BYPASS
• EMERGENCY FLAP
• ESSENTIAL FUEL
• EXTERNAL JETTISON (1)
• EXTERNAL JETTISON (2)
FLIGHT REFERENCE SET
• FUEL GAGE DC
• ICS RELAY POWER
• INDICATORS TEST (1)
• INDICATORS TEST (2)
LANDING GEAR INDICATOR
MASTER CAUTION
MASTER WARNING
NOZZLE POSITION INDICATOR
• NAV ICS
• PILOT ICS
TURN & SLIP INDICATOR
UHF COMM
• WINDSHIELD DEFROST & ANTI-ICE
WHEELS LIGHT

GROUND-OPERATED DC BUS

FLOOD LIGHTS
INDICATOR
REFUEL TEST & DEFUEL

ARMAMENT DC BUS

CONVENTIONAL STORE ARM
STORE RELEASE (1, 2)

• COCKPIT CIRCUIT BREAKERS

A-5C-1-54-6C

Figure 1-17

NO. 1 GENERATOR SYSTEM

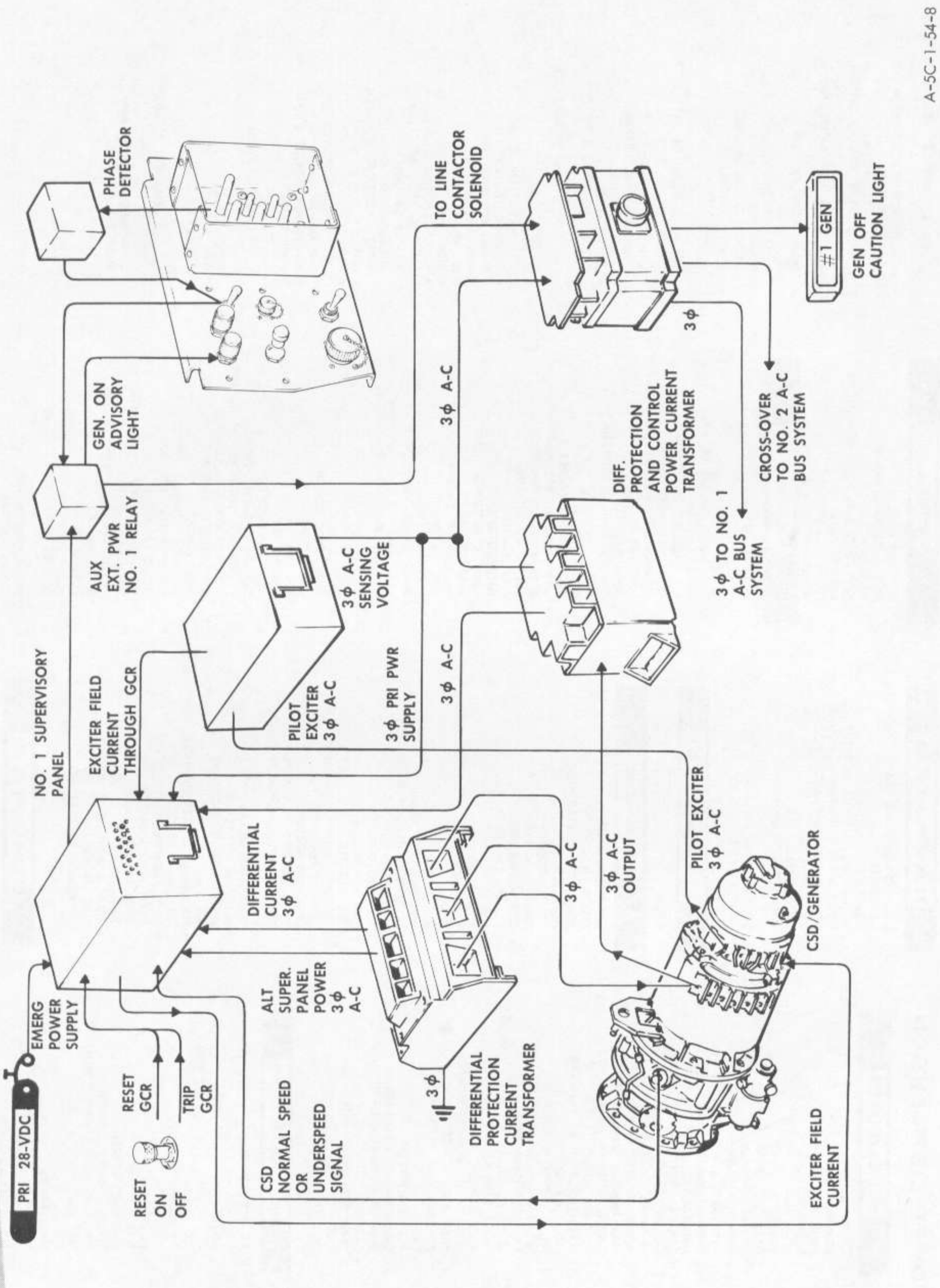


Figure 1-17A

D-C POWER SYSTEM

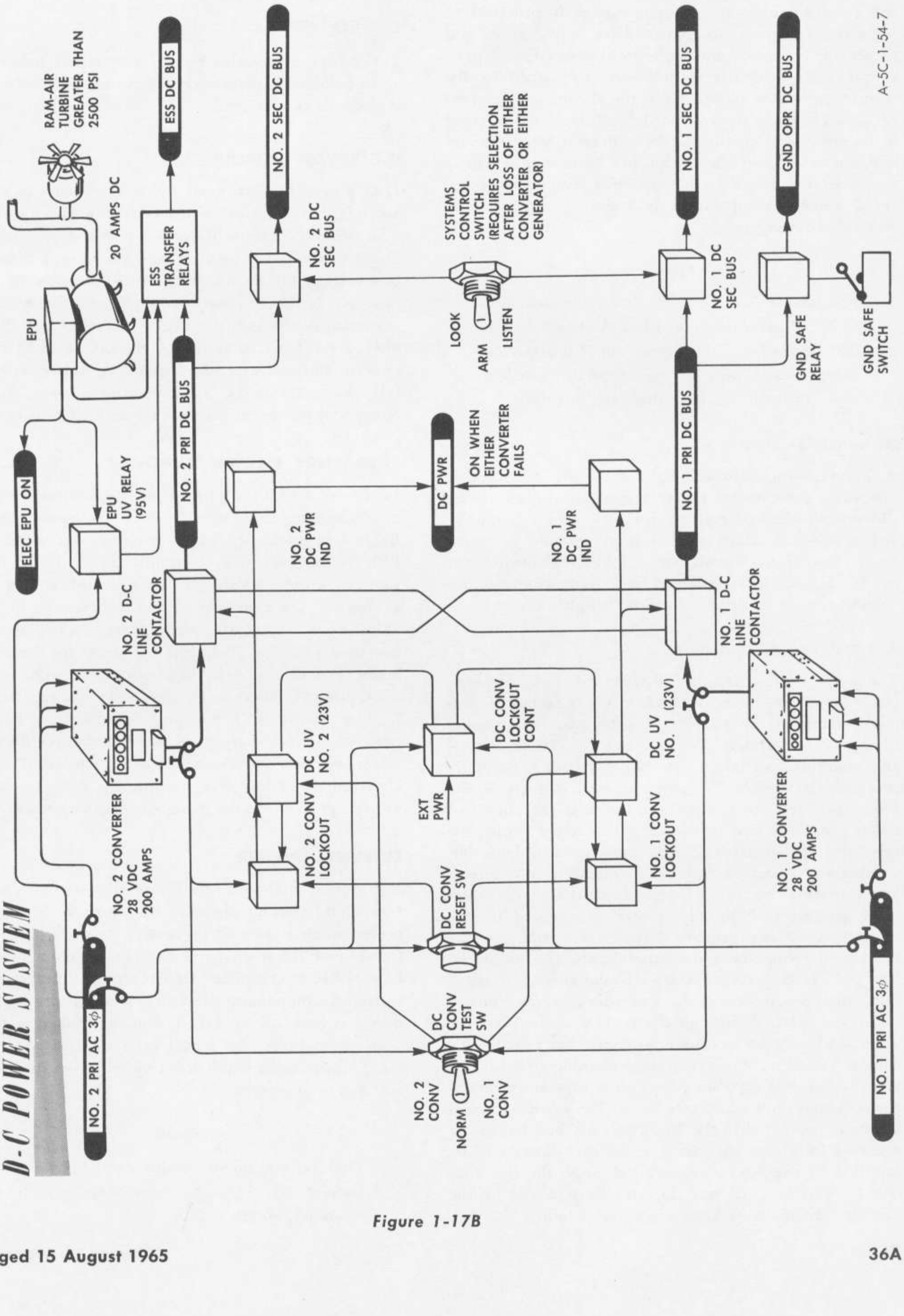


Figure 1-17B

convert variable engine speed to constant speed to drive the a-c generators. A governor system is provided to serve two functions: to control drive output speed and to provide overspeed and underspeed protection. A pressure-sensitive switch is included in each circuit to disconnect generator output from the system in the event of an underspeed or overspeed condition. In the event of an overspeed condition, the generator will trip and will not reset until the engine has been shut down. If the generator drops out because of a temporary underspeed condition, operation is regained automatically without requiring reset.

Note

The loss of No. 2 engine, and subsequent loss of No. 2 generator, may cause AAI tumble and HSI precession. Turning the NO. 2 GENERATOR switch to OFF prior to engine rundown below 36% rpm will preclude these malfunctions.

Generator-on Lights

A generator-on indicator light for each generator is located in the external power access. The lights will be illuminated when generator output is at proper frequency and voltage, at which time it is permissible to switch from external to aircraft power. Although switchover can be initiated when either of these lights come on, disconnect should be delayed until both lights are on.

A-C POWER DISTRIBUTION

The a-c power distribution is divided into two independent systems. See figure 1-17. The No. 1 system is normally energized by the No. 1 generator and consists of the No. 1 primary, No. 1A and No. 1B secondary, and monitored a-c buses. The No. 2 system is normally energized by the No. 2 generator and consists of the No. 2 primary and essential a-c buses. If the output of either generator falls below approximately 95 volts, the generator is automatically disconnected and both bus systems are connected through a crossover by means of line contactors to receive power from the proper operating generator. Normally, power is supplied by the generators to the primary buses which energize the monitored, secondary, and essential buses. The monitored bus (which supplies nonessential equipment, all high-duty fuel pump operation, and the two nonprimary systems as selected through the SYSTEM switch) are cut off when one generator or one engine has failed. This ensures sufficient a-c power to the remaining systems. The essential a-c bus supplies power to equipment essential to navigation and communications. The essential bus is normally connected to the No. 2 primary bus, but in the event of failure of the No. 2 generator, power will be supplied by the No. 1 generator through the line contactors. The essential bus can also be powered by the ram-air turbine-driven emergency power unit.

D-C POWER SYSTEM

D-C CONVERTERS

D-C power is provided by two 200-ampere transformer-rectifier units (converters) which direct 28 volts to the d-c distribution system.

D-C POWER DISTRIBUTION

D-C power is distributed by two primary buses, two secondary buses, and an essential bus. See figure 1-17. The primary buses will receive power from either the No. 1 or the No. 2 transformer-rectifier unit. Should d-c bus voltage fall to 24 volts for 30 seconds, or should bus voltage drop to zero for 6 seconds, the system will automatically switch the faulty converter off the line. Should the fault be transient, the unit may be reset to operate normally. If the remaining converter should fail, the essential d-c bus can receive power from the emergency power unit if the ram-air turbine is extended.

EMERGENCY ELECTRICAL POWER

In the event of a complete primary electrical power failure, emergency a-c and d-c power is obtained from the EPU, a hydraulically driven motor-generator unit. The EPU is supplied with hydraulic power by a dropout ram-air turbine which can be extended and retracted as desired. On extension of the turbine, the EPU provides 4-kva, 400-cycle, three-phase, 115/200-volt a-c power and 28-volt, 20-ampere d-c power for the essential buses. The EPU is capable of providing sufficient electrical power to effect an air start and make an emergency landing. If the RAT is supplying emergency hydraulic pressure as well as electrical power, excessive flight control movements may cause momentary shutoff of the EPU electrical generator, extinguishing the ELEC EPU ON advisory light and deenergizing the essential buses.

EXTERNAL POWER

For ground operation of all buses, external a-c electrical power and cooling air must be supplied. The external power access is located on the left side of the fuselage, forward of the main gear. Equipment cooling air must be supplied to complete external electrical power circuits to aircraft components. If autonavigator alinement procedure has been initiated, care should be taken to disconnect external electrical power prior to removing cooling air. This precludes bomb directing set power interruption and loss of alinement.

Note

The starting power source must be a 45-kva (minimum), 115-volt, three-phase (A, B, C rotation), 400-cycle unit.

GROUND COOLING

During ground operations with external electrical power applied to the aircraft, reconnaissance equipment and other electronic components require cooling air to prevent overheating. Electrical power to this equipment is controlled by relays and cooled component air temperature detectors. For normal ground operation of cooled equipment, cooling air temperature and flow rate must not exceed specified limits within the cooled components. In the event of insufficient cooling airflow, faulty hose connection, or abnormal air temperature, electrical power to the equipment is interrupted by the relays through the detectors.

Note

For external electrical power cooling air and engine starting units and requirements, refer to Section I, Part 3.

Aircraft Power Switch

The aircraft power switch is located on the external power access panel (figure 1-51). To apply external power to aircraft systems, this switch must be positioned to EXT with equipment cooling air applied. After engine start, the aircraft power switch is positioned to GEN by ground personnel, prior to removal of cooling air, to transfer the aircraft electrical system to generator output.

B/N ALINE Power Switch

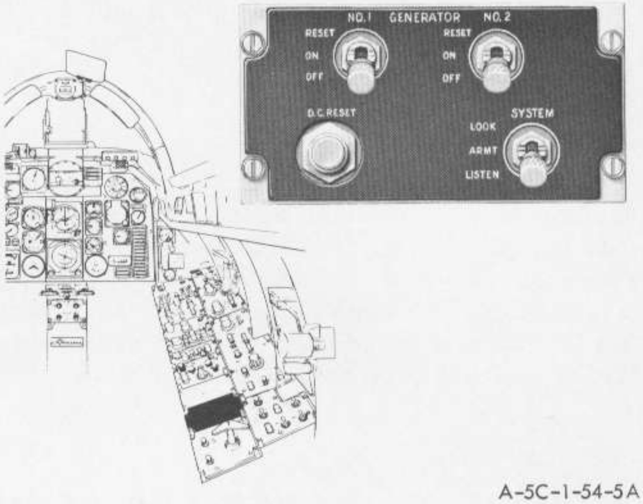
The B/N ALINE power switch is installed adjacent to the aircraft power switch on the external power panel. See figure 1-51. During autonavigator alinement with external power, the switch is positioned to EXT. After successful transfer of aircraft systems to generator power with the aircraft power switch, the alinement process may continue on external power as required. On completion of alinement, the B/N ALINE power switch is moved to GEN by ground personnel to complete transfer of the autonavigator to generator power without interruption.

CONTROLS AND INDICATORS

SYSTEM SELECT SWITCH

The SYSTEM select switch (figure 1-18) is used to provide all available a-c and d-c electrical power to the primary mission systems in the event of failure of a d-c converter or a-c generator. The switch is normally maintained in ARMT or the position briefed for the primary mission. During electrical system normal operation, all positions provide power to all systems as designated. In the event the DC PWR caution indicator or a generator caution indicator illuminates, and attempts to reset fail to restore normal operation, the LOOK or LISTEN position should be selected, depending upon aircraft configuration, assigned mission, and the tactical situation. Refer to Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

ELECTRICAL SYSTEM CONTROLS



A-5C-1-54-5A

Figure 1-18

GENERATOR SWITCHES

A control switch for each generator (figure 1-18) is located on the pilot's right console. The generator switches have three positions (OFF, ON, and RESET) and are maintained in either the ON or the OFF position. The a-c generators will assume the electrical load when external power is removed if the engines are up to idle speed and generator output voltage and frequency are within limits. Should the generator-on indicator lights at the external power receptacle remain extinguished after engine start is complete, the pilot will be advised and the generator switches should be held momentarily in RESET and released. If an attempt is made to reset the generator circuit while a fault still exists in the system, the circuit will reset and trip again. Additional reset attempts will result in no response.

Note

Properly operating generators will reset automatically as engine rpm builds. However, if the generator switches were placed at OFF prior to a previous engine shutdown, the generators must be reset after start. The aircraft power switch is not moved from EXT to GEN until both generators are "on the line" or reset.

GENERATOR-OUT CAUTION INDICATORS

Generator-out caution indicators (#1 GEN and #2 GEN, figure 1-10) are located on the pilot's instrument panel. Each indicator is automatically illuminated when its respective generator line contactor is not connected to the bus system. In the event of loss of both generators, all cockpit lights will extinguish, including the generator-out caution indicators, unless external power is applied or the emergency ram-air turbine is extended.

Note

> On engine shutdown with external power applied, check that the generator-out caution indicators illuminate at not less than 28% engine rpm. Illumination at lower rpm should be noted on the "yellow sheet" for maintenance corrective action.

D-C POWER CAUTION INDICATOR

A d-c power caution indicator (DC PWR, figure 1-10) is installed on the instrument panel. This a-c powered indicator signifies that either d-c converter is inoperative. Subsequent failure of the remaining d-c converter is indicated by the appearance of "power-off" warning flags in all d-c operated indicators, such as barber poles in the landing gear and speed brake position indicators.

D.C. RESET BUTTON

The D.C. RESET button (figure 1-18) is used to restore the output of a d-c converter in the event of dropout, or to obtain normal converter operation upon switchover from external a-c power. If the DC PWR caution indicator illuminates, this button should be momentarily depressed to restore both converters to normal operation.

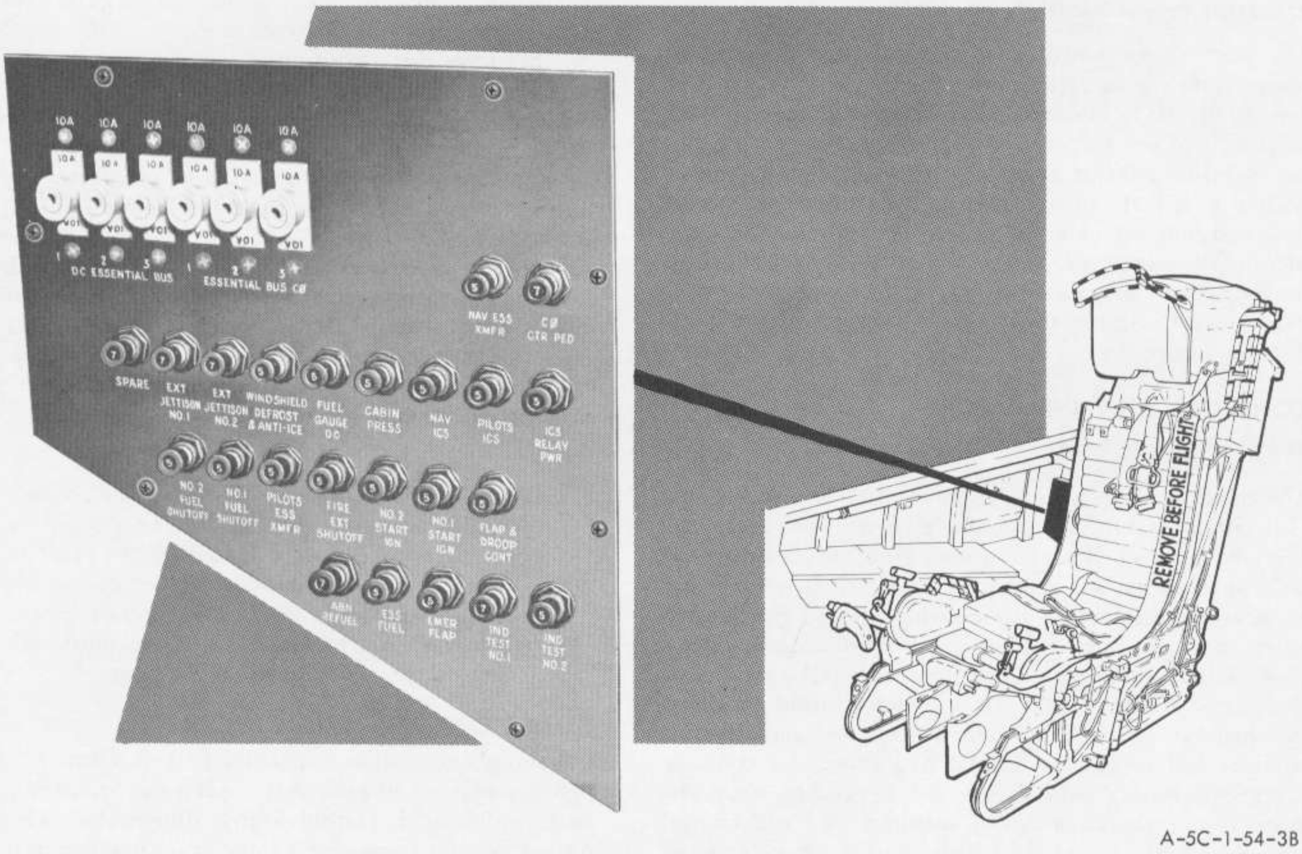
EMERGENCY ELECTRICAL ADVISORY LIGHT

An emergency electrical advisory light (ELEC EPU ON, figure 1-10) is installed on the pilot's center pedestal. This green light is illuminated when the RAT is extended and the emergency power unit is supplying the required a-c and d-c voltages. Proper operation of the emergency electrical system is indicated by restoration of power to essential indicators such as the landing gear and speed brake position indicators and AAI.

CIRCUIT PROTECTION

Aircraft electrical circuits are protected by circuit breakers, voltage limiters, and fuses. The pilot's circuit-breaker and limiter panel (figure 1-19) is located aft of the

CIRCUIT BREAKERS AND LIMITERS



A-5C-1-54-3B

Figure 1-19

right console. Voltage limiters located on this panel protect essential a-c and d-c bus components. Protection for the instrument and lighting circuits is provided by fuses in the center pedestal and on the systems operator's right console. The main bus distribution circuit-breaker panels are located in the electrical distribution bay above the nose wheel well and are not normally accessible to the flight crew for inspection.

RAM-AIR TURBINE OPERATION

SYSTEM CHECK

It is recommended that the emergency ram-air turbine be extended during the first flight of each week as follows:

1. Prior to entering landing pattern, pull EMER AIR TURBINE handle.
2. Check ELEC EPU ON and HYD EPU ON advisory lights illuminated and steady.
3. EPU RETRACT button—Depress and hold until approximately 4 seconds after advisory lights are extinguished.
4. During taxi back to line, pull EMER AIR TURBINE handle.

Note

A complete operational reliability flight check will be required if adequate periodic ground maintenance check is not available. Refer to FLIGHT TEST PROCEDURES, in Section IV.

HYDRAULIC POWER SUPPLY SYSTEMS

Hydraulic power is supplied by two separate systems. See figure 1-20. Both systems have two independent pumps, a reservoir, and separate lines, delivering a basic no-flow pressure of 2800 to 3250 psi. The reservoirs are pressurized to provide adequate fluid supply to the engine-driven pumps under all conditions. Both systems are used at full pressure to power the vertical stabilizer, horizontal stabilizers, spoiler-deflectors, and the droop leading edge. Operation of the flight control systems on one system produces no noticeable difference from two-system operation for normal low-rate control movements. Sudden, high-rate longitudinal or lateral stick movements can, however, drop single-system pressure sufficiently to cause momentary stiffness. Should operating pressure in either system fall below approximately 650 psi, a pressure-operated switch energizes the master and HYD PRESS caution indicators. With the engines at equal rpm, operating pressure of a pump in either system should be within 300 psi of the opposing pump at all times.

NO. 1 SYSTEM

The No. 1 system provides hydraulic power to all basic flight control actuators and the droop leading edge. The No. 1 system supplies pressure to the No. 1 yaw augmentation system. In the event of complete failure of both No. 1 system pumps and no indication of fluid loss, pressure may be restored in this system by the emergency ram-air turbine (RAT).

NO. 2 SYSTEM

The No. 2 system provides power to all basic flight control surface actuators, the droop leading edge, and all other hydraulically operated systems and components. No. 2 system pressure is reduced to approximately 1500 psi for use in the longitudinal and lateral flight control master actuators. No. 2 system pressure is also used to power the yaw augmentation (No. 2 yaw augmentation) system. No. 2 system pressure is used at full force to operate the SLR, landing gear, flap, arresting hook, nose wheel steering, wheel brake, fuel probe, pneumatic compressor, wing tail fold, inlet variable ramps, ram-air turbine retract, speed brake, and gear stiff systems. The No. 2 system incorporates two isolation valves downstream of components essential to the mission, such as the flight control system, ramp control system, and air refueling probe actuator. One isolation valve can be controlled by the pilot through the HYD SUB-SYS ISOLATION switch, and when actuated, removes hydraulic power from all nonessential systems. In addition, a 2200- to 2500-psi priority valve ensures pressure to the flight controls at all times. Both isolation valves are controlled electrically by a float level control switch in the hydraulic reservoir. In the event of loss of hydraulic fluid, both isolation valves close in order to maintain hydraulic pressure to essential hydraulic services. The SLR antenna system is upstream of the isolation valves and should be deenergized. On some aircraft,* the SLR system is located downstream of the reservoir float controlled isolation valve so that low No. 2 hydraulic system fluid level will isolate it.

CONTROLS AND INDICATORS

HYDRAULIC PRESSURE INDICATORS

Two miniature indicators are installed on the instrument panel (40, figure 1-10). The No. 1 and No. 2 system indicators each have two needles to provide pressure indications for both left and right engine pumps. No indication of emergency power unit hydraulic pressure is provided except for the HYD EPU ON advisory light on the center pedestal. The HYD PRESS caution indicator remains on if the ram-air turbine is the only source of power. The hydraulic pressure indicators receive power from the a-c essential instrument bus.

HYDRAULIC PRESSURE CAUTION INDICATOR

A HYD PRESS caution indicator on the instrument panel (figure 1-10) is provided to warn the pilot when hydraulic system output falls below a safe minimum. Loss of pressure from one pump does not illuminate the indicator, but the affected pressure indicator needle will

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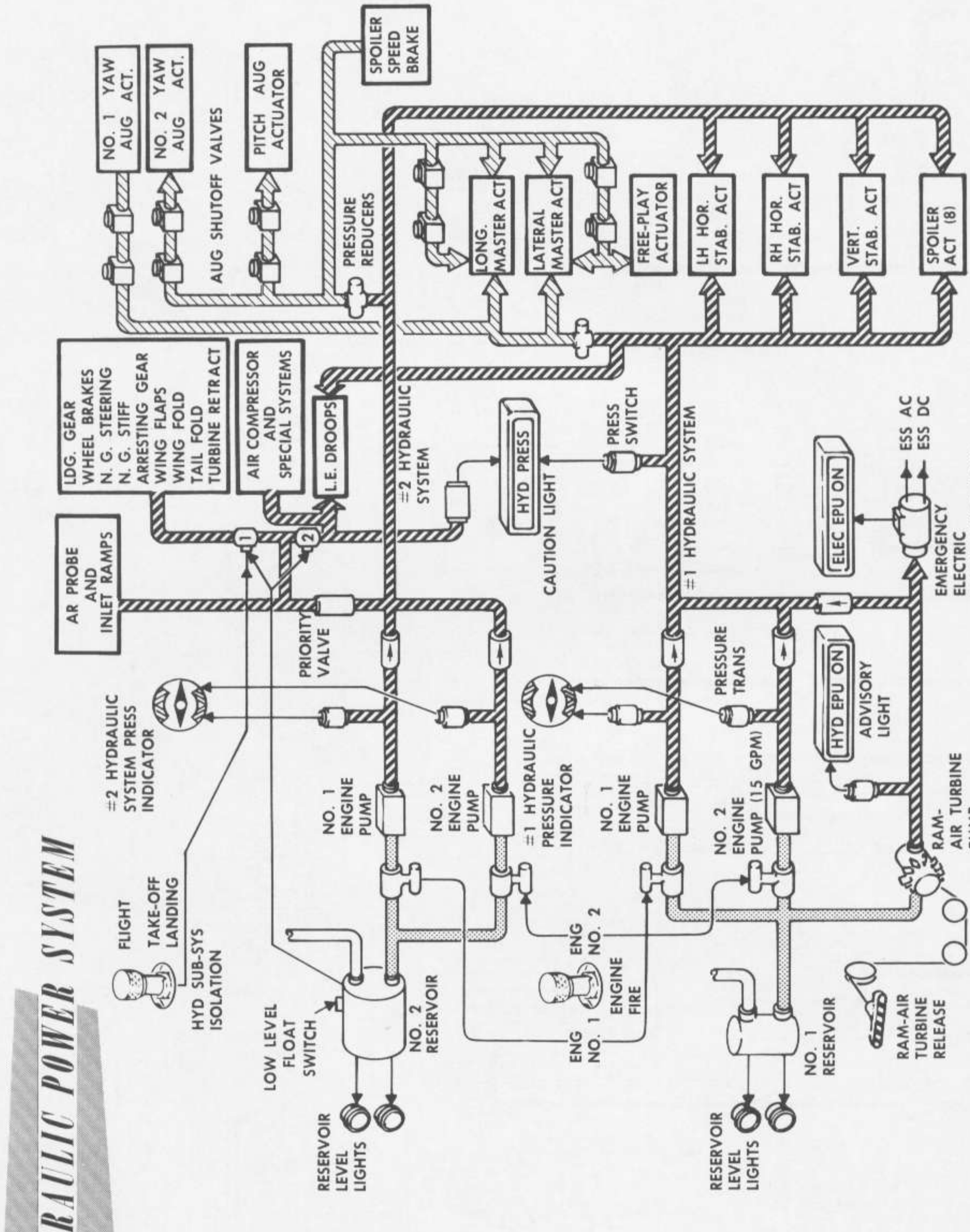

Figure 1-19A

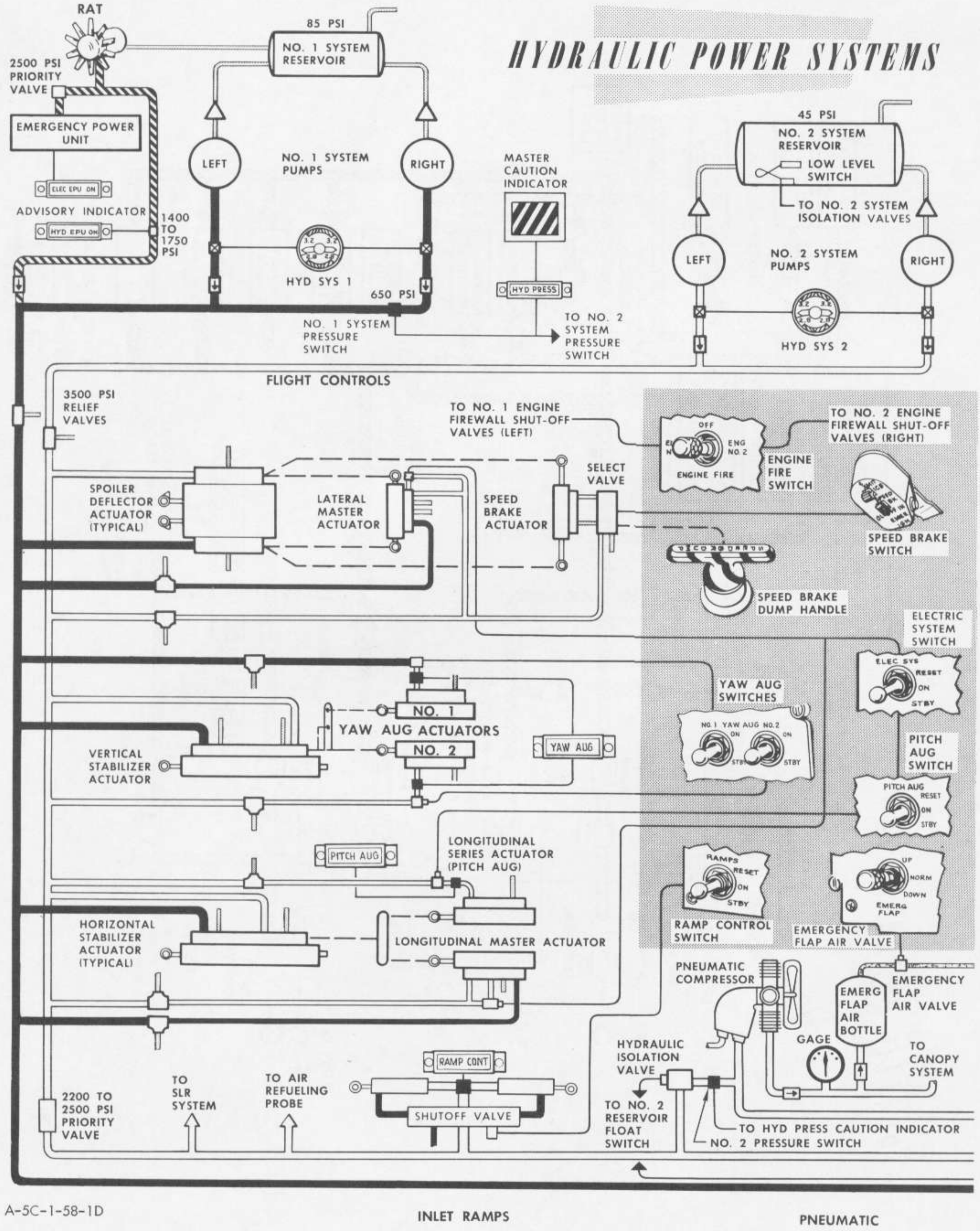

Figure 1-20 (Sheet 1)

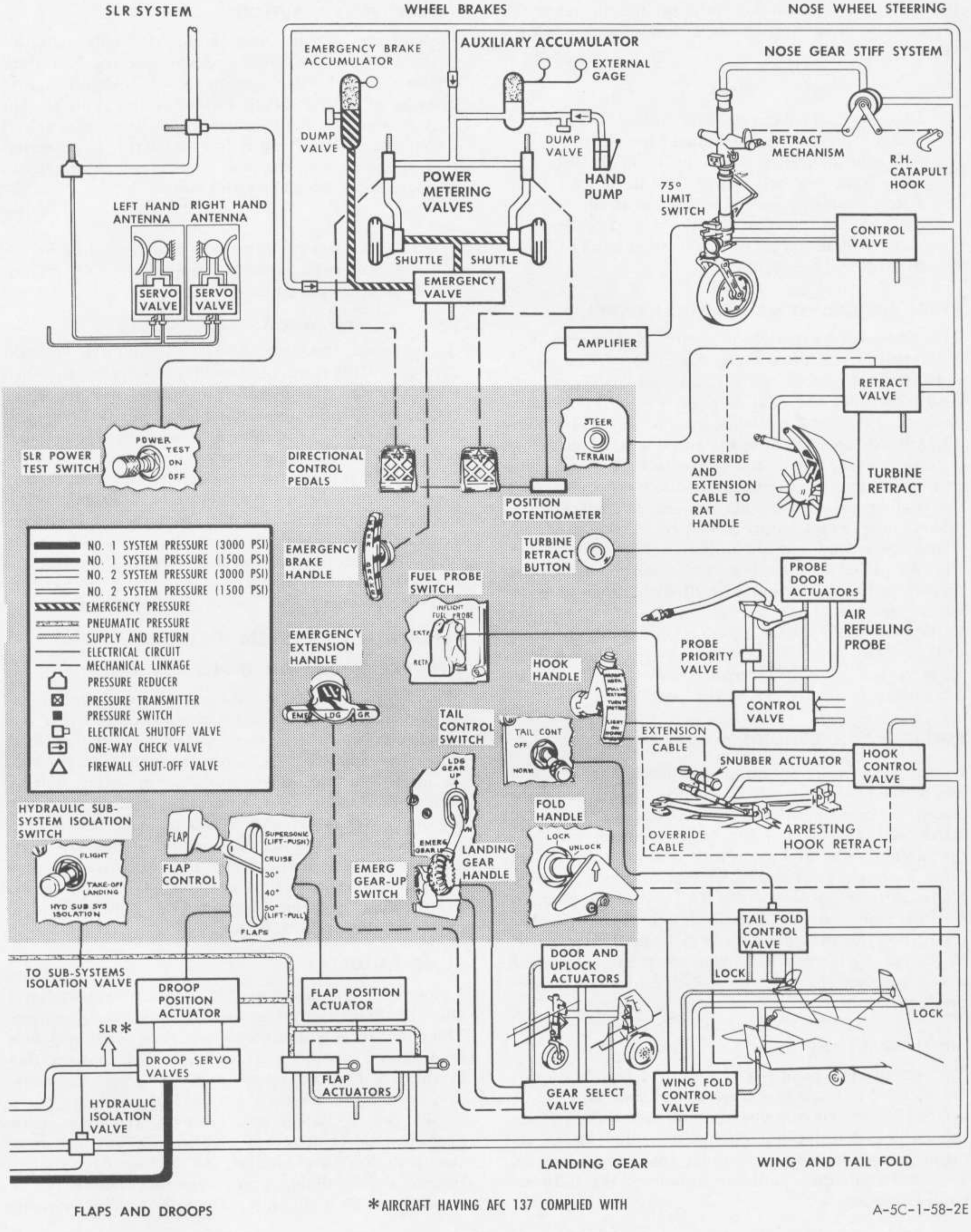

Figure 1-20 (Sheet 2)

show the loss. The caution indicator illuminates if the pressure in either system falls below approximately 650 psi.

Note

Illumination of the HYD PRESS caution indicator with no pressure drop indicated for either system is an indication that a hydraulic isolation valve has closed and loss of fluid in the No. 2 system reservoir has probably occurred, and that systems powered by the No. 2 system alone will be inoperative. On some aircraft,* the SLR will be inoperative.

HYDRAULIC SUBSYSTEMS ISOLATION SWITCH

The HYD SUB-SYS ISOLATION switch (11, figure 1-9) is located on the left console. This two-position switch is labeled TAKE-OFF/LANDING and FLIGHT. The FLIGHT position enables the pilot to close one of the isolation valves in the No. 2 hydraulic system. This valve shuts off hydraulic pressure to subsystems not required during normal cruising flight and prevents fluid loss in the event of system malfunction. Isolated systems include the landing gear, flaps, wheel brakes, emergency wheel brakes, nose wheel steering, tail fold, wing fold, arresting gear, and ram-air turbine retract. The switch must be placed in the TAKE-OFF/LANDING position for ram-air turbine retraction and all flight operations requiring the use of isolated subsystems. After returning to the TAKE-OFF/LANDING position, emergency operation of the isolated hydraulic subsystems may still be required. In the event a No. 2 hydraulic system leak does exist, a complete failure of the system may occur.

EMERGENCY HYDRAULIC POWER

If No. 1 hydraulic system pumps have failed without loss of fluid, pressure may be restored by extending the emergency ram-air turbine. At speeds at and above 150 KIAS, this turbine will supply sufficient pressure for operation of the flight controls at normal movement rates. Lateral control should be kept to minimum rates. Under normal operation, the RAT hydraulic pump is isolated from system pressure by check valves. The emergency electrical power unit is hydraulically driven by the ram-air turbine. Retraction of the ram-air turbine is accomplished through use of No. 2 hydraulic system pressure.

AIR TURBINE HANDLE

The air turbine handle (30, figure 1-10) is located on the left-hand side of the center pedestal. This handle is labeled EMER AIR TURBINE. Pulling the handle releases the turbine door-locking mechanism, allowing an actuator bungee to push the turbine into the air stream. The air stream then pulls the turbine to the fully extended position.

TURBINE RETRACT BUTTON

Pushing the turbine retract button (EPU RETRACT, 27, figure 1-10) on the center pedestal operates the turbine retract solenoid valve, causing No. 2 hydraulic system pressure to actuate the air turbine retract cylinder. The button must be held depressed for approximately 4 seconds or until turbine is fully retracted. Upon retraction of the turbine, the ELEC EPU ON and HYD EPU ON advisory lights should be extinguished.

Note

The HYD SUB-SYS ISOLATION switch must be in the TAKE-OFF/LANDING position before the air turbine can be retracted.

Emergency Hydraulic Advisory Light

An emergency hydraulic advisory light (HYD EPU ON, 29, figure 1-10) is installed on the center pedestal. When electric power is available from either or both of the engine-driven generators, this green light is illuminated if the hydraulic pressure generated by the ram-air turbine-driven emergency power unit exceeds approximately 1750 psi. This light will extinguish if emergency pressure drops below approximately 1450 psi. When no electric power is available from the engine-driven generators, the emergency hydraulic advisory light can only illuminate if the emergency electrical power unit is operating (above approximately 2500 psi). Refer to EMERGENCY ELECTRICAL POWER, in this section.

HYDRAULIC SYSTEM FAILURE

HYD PRESS CAUTION INDICATOR ON

Should the HYD PRESS caution indicator and master caution indicator illuminate with no accompanying loss of pressure in either system, a fluid leak in the No. 2 system is indicated. The most common failure would be located in one of the isolated secondary systems, such as the landing gear, nose wheel steering, or arresting hook retract cylinder. If no pressure loss or fluctuations occur following illumination of the HYD PRESS caution indicator, it is assumed that automatic isolation of the secondary systems has stopped the loss of hydraulic fluid, and emergency methods must be used to extend landing gear and flaps.

PUMP FAILURES

Failure of one pump in the No. 1 system has no adverse effect on flight control or secondary systems operation. The dual yaw augmentation system is powered by pumps from both hydraulic systems: No. 1 yaw augmentation by the No. 1 system pumps and No. 2 yaw augmentation by the No. 2 system pumps. Failure of one pump in the No. 2 system can, however, cause automatic pressure monitor shutoff of pitch and yaw augmentation, electric flight control systems, and the inlet ramp control system, should flight control demands reduce No. 2 system pressure sufficiently. The failure of a hydraulic

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pump will normally be indicated by a drop in pressure on the appropriate needle of the hydraulic pressure indicator. Should one pump fail on either system, the pilot may continue an operational mission. Failure of both pumps on either system shall be considered an emergency. Refer to Section V.

NO. 1 SYSTEM FAILURES

Complete failure of the system will be indicated by illumination of the master caution and HYD PRESS caution indicators, and an associated drop in pressure on the No. 1 system pressure indicators (below 650 psi on both needles). Under these conditions, the No. 2 system will provide hydraulic power with loss of approximately 50 percent of normal control surface hinge power. Adequate control will be available; however, rapid control movements should be avoided. With a normally operating No. 2 system, the RAT should not be extended if fluid loss from the No. 1 system is suspected. Without indications of system fluid loss, the RAT may be extended prior to descent. System fluid loss (or fluid loss associated with pump failure) can be suspected if the HYD PRESS caution indicator remains illuminated with RAT extension and the HYD EPU ON advisory light does not illuminate. Temporary extinguishment of the HYD PRESS caution indicator and illumination of the HYD EPU ON advisory light, followed by a return to the previously described condition of these lights, also indicates fluid loss. Dual pump failure can be assumed if system pressure is restored by RAT extension (indicated by illumination of the HYD EPU ON advisory light and extinguishment of the HYD PRESS caution indicator).

Note

Intermittent illumination of the HYD PRESS caution indicator will occur when large demands (especially lateral inputs) are placed on the system when a pump has failed, or when both pumps have failed and system pressure is being provided by the RAT.

NO. 2 SYSTEM FAILURES

Complete failure of the No. 2 system will be indicated by a pressure drop of the applicable pressure indicators and illumination of the master caution and HYD PRESS caution indicators. The following systems will be lost: electric flight control, pitch and No. 2 yaw augmentation, speed brakes, variable inlet ramp operation, air refueling probe retraction and extension, normal landing gear retraction and extension, normal wing flap and droop operation, unlimited normal power brake applications, RAT retraction, hook retraction, nose wheel steering, wing and tail fold, pneumatic air compressor operation, SLR antenna, and gear stiff. If a complete failure, or any indication of an impending failure of the system occurs, the "kill" button should be depressed in order to secure the electric flight control and pitch augmentation systems while under optimum flight conditions. The pilot will declare an emergency and the field arresting gear shall be utilized when readily available.

Note

In the event of a divert, the flaps/droops may be retracted by air load pressure by moving the EMERG FLAP switch to UP. Under this condition, ensure that the normal flap control switch is in the same position as the EMERG FLAP switch prior to landing. A second partial extension of the flaps/droops may be possible if sufficient pneumatic pressure is available.

DUAL HYDRAULIC SYSTEM FAILURES

Refer to HYDRAULIC FAILURES, in Section V.

PNEUMATIC POWER SUPPLY SYSTEM

The pneumatic power supply system provides high-pressure air for canopy normal operation, canopy emergency jettison, emergency flap extension, and emergency droop valve operation. Separate pressure storage bottles are provided for the canopy jettison and emergency flap extension system. The emergency flap bottle provides pressure for normal canopy operation when the aircraft is on the deck. The pneumatic system bottles are precharged to 3200 psi, prior to flight, through the pneumatic service panel under the aircraft, inboard of the right main landing gear. The panel also contains check switches for the emergency flap system isolation valve and the pneumatic compressor. During flight, a hydraulic motor-driven air compressor maintains the bottles at 3000 psi. The compressor is powered by the No. 2 hydraulic system. An oil servicing point for the compressor is located in the right main gear well. An internal and external canopy pneumatic control toggle valve and an internal canopy emergency jettison "T" handle are provided for each cockpit. Refer to CANOPIES, in this section and see figure 1-20A for pneumatic system schematic.

FLIGHT CONTROL SYSTEMS

For schematic diagrams of the flight control systems, see figures 1-21, 1-23, 1-24, and 1-25. Longitudinal and directional control is provided by one-piece slabs and a spoiler-deflector system is provided for lateral control. The flight control systems are hydraulically powered and irreversible. Control forces are simulated by artificial feel bungees installed in the mechanical linkage. Control of the longitudinal and lateral systems

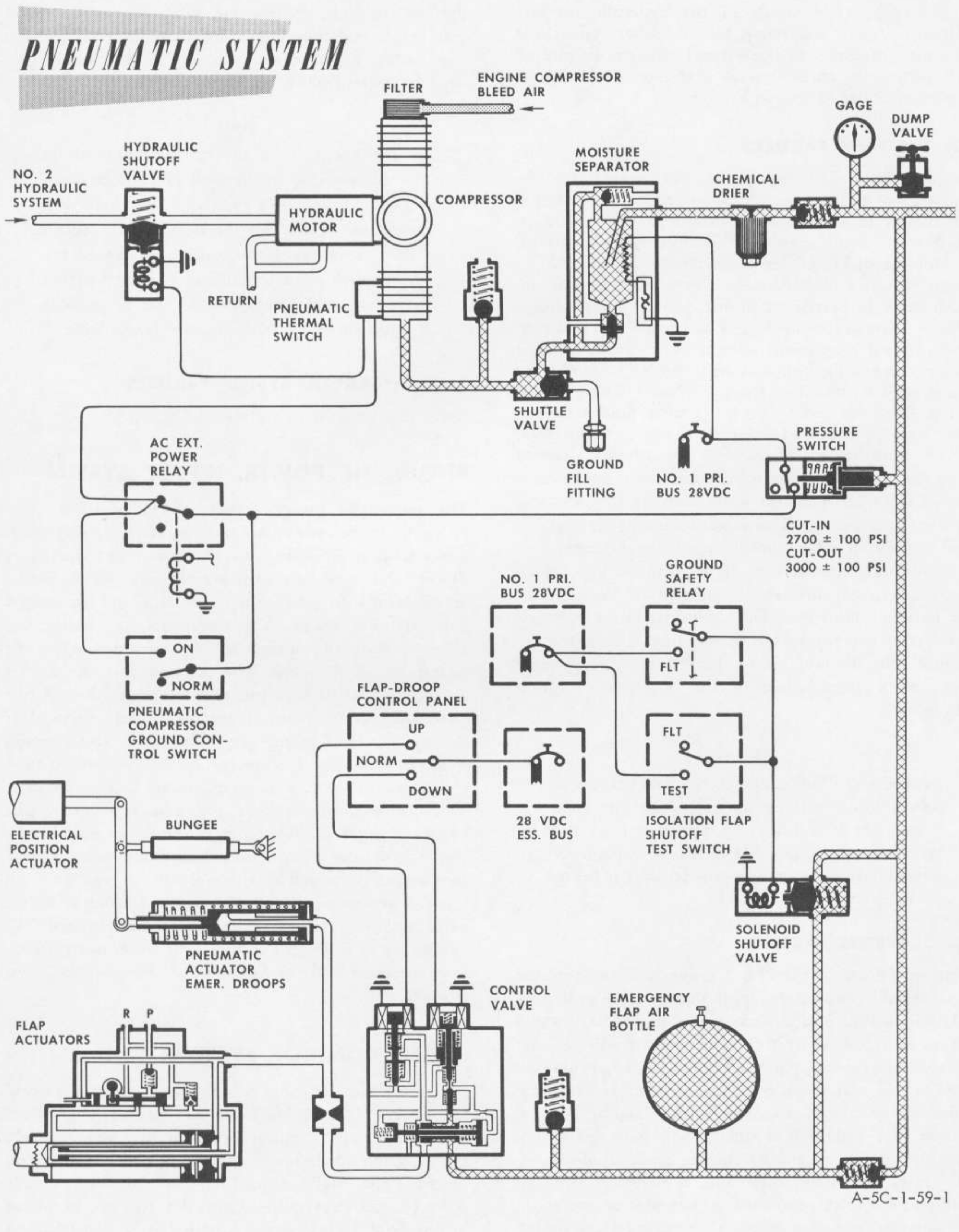


Figure 1-20A (Sheet 1)

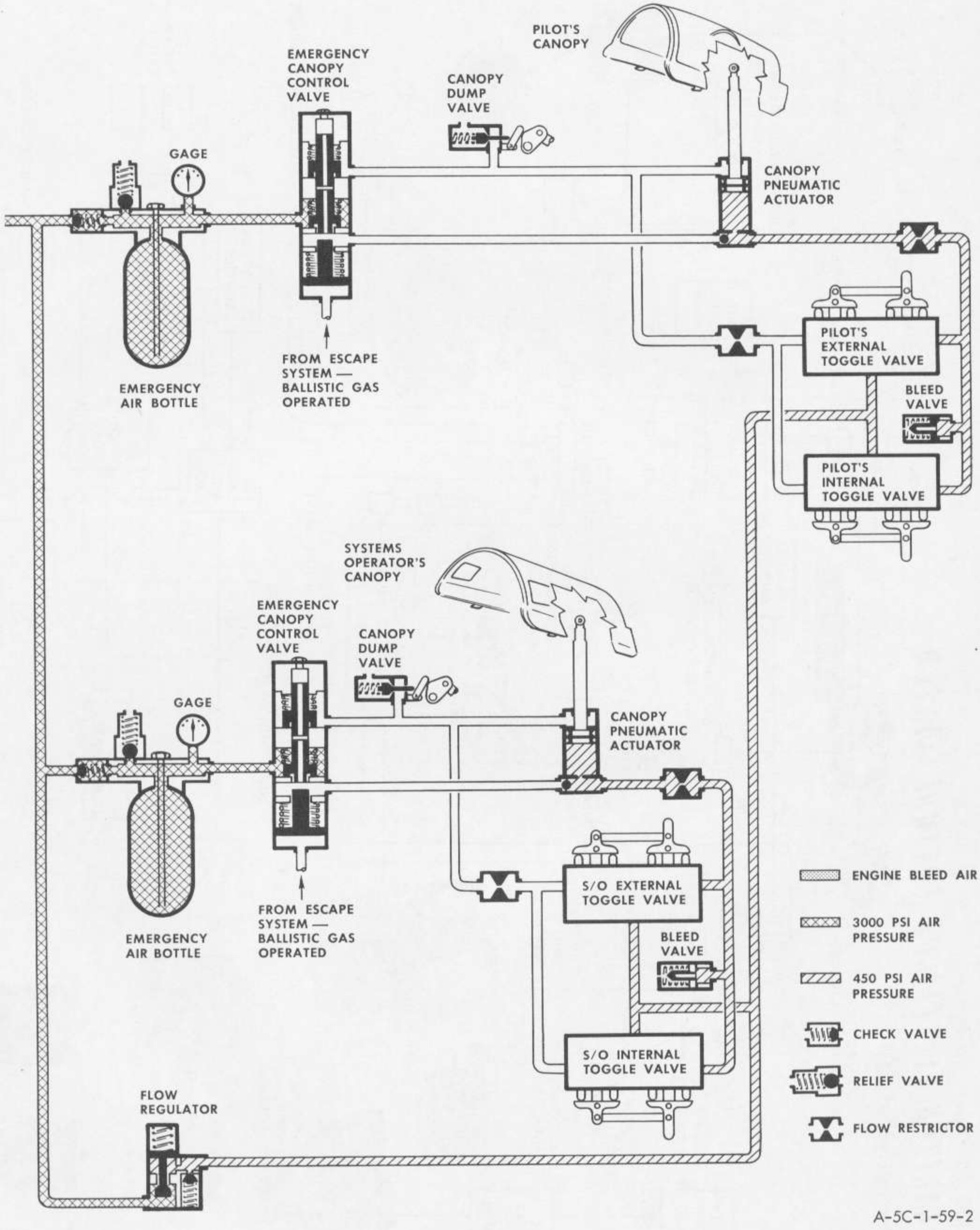


Figure 1-20A (Sheet 2)

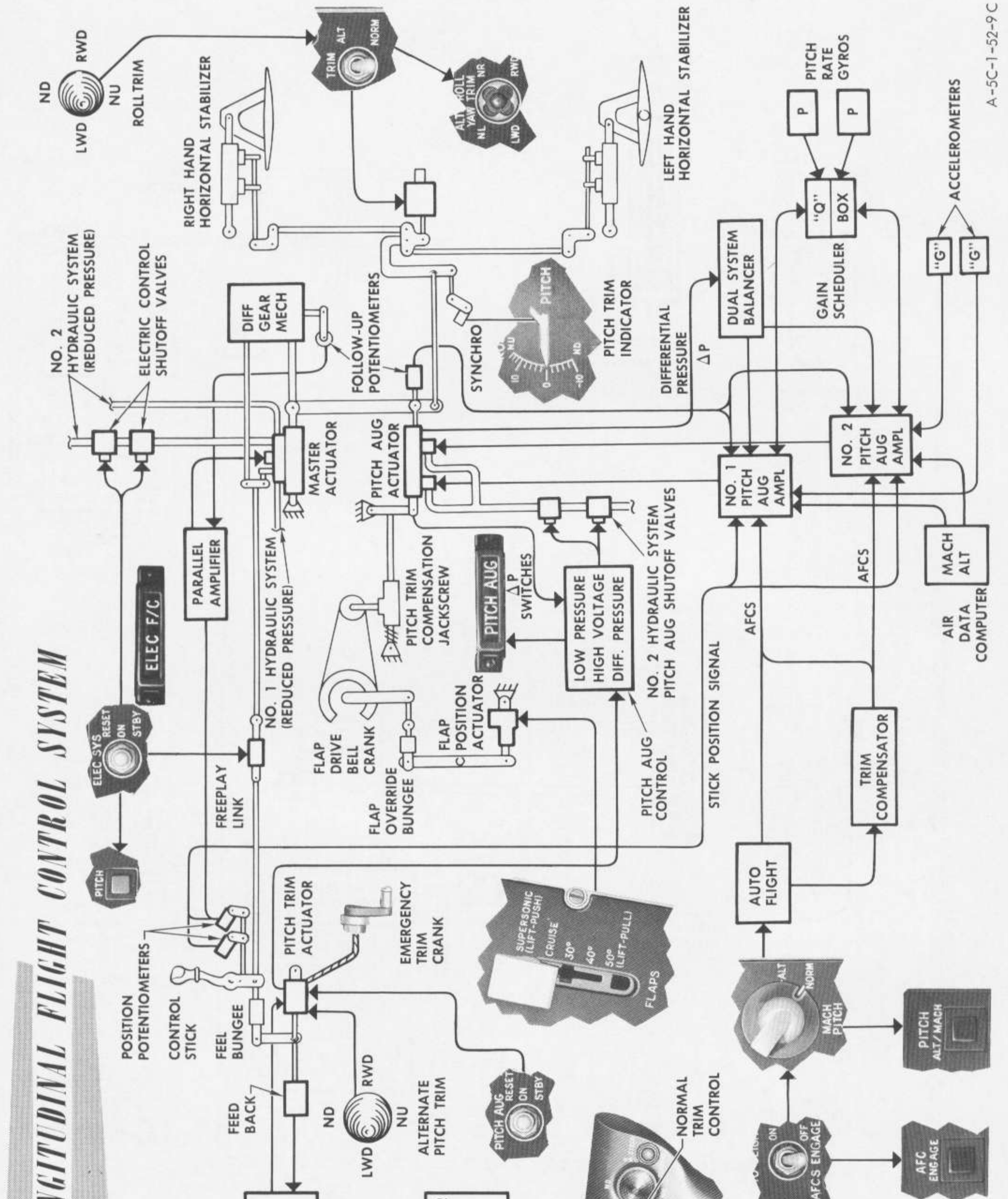

LONGITUDINAL FLIGHT CONTROL SYSTEM
A-5C-1-52-9C
ND
RWD
LWD
NU
ROLL TRIM
TRIM
ALT
NORM
ROLL
YAW TRIM
NR
NL
LWD
RWD
RIGHT HAND HORIZONTAL STABILIZER
LEFT HAND HORIZONTAL STABILIZER
PITCH RATE GYROS
P
P
"Q" BOX
ACCELEROMETERS
"G"
"G"
GAIN SCHEDULER
DUAL SYSTEM BALANCER
DIFFERENTIAL PRESSURE ΔP
PITCH TRIM INDICATOR
PITCH
SYNCHRO
FOLLOW-UP POTENTIOMETERS
DIFF GEAR MECH
NO. 2 HYDRAULIC SYSTEM (REDUCED PRESSURE)
ELECTRIC CONTROL SHUTOFF VALVES
MASTER ACTUATOR
PITCH AUG ACTUATOR
NO. 2 PITCH AUG AMPL
NO. 1 PITCH AUG AMPL
MACH ALT
AIR DATA COMPUTER
AFCS
AFCS
NO. 2 HYDRAULIC SYSTEM PITCH AUG SHUTOFF VALVES
LOW PRESSURE
HIGH VOLTAGE
DIFF. PRESSURE
ΔP SWITCHES
PITCH AUG
PITCH TRIM COMPENSATION JACKSCREW
PARALLEL AMPLIFIER
ELEC F/C
NO. 1 HYDRAULIC SYSTEM (REDUCED PRESSURE)
ELEC SYS
RESET
ON
STBY
FREEPLAY LINK
FLAP DRIVE BELL CRANK
FLAP POSITION ACTUATOR
FLAP OVERRIDE BUNGEE
PITCH AUG CONTROL
STICK POSITION SIGNAL
TRIM COMPENSATOR
PITCH
AUTO FLIGHT
SUPERSONIC (LIFT-PUSH)
CRUISE
30°
40°
50° (LIFT-PULL)
FLAPS
PITCH TRIM ACTUATOR
EMERGENCY TRIM CRANK
POSITION POTENTIOMETERS
CONTROL STICK
FEEL BUNGEE
FEED BACK
ND
RWD
LWD
NU
ALTERNATE PITCH TRIM
PITCH AUG
RESET
ON
STBY
MACH PITCH
PITCH ALT/MACH
NORMAL TRIM CONTROL
AFCS ENGAGE
ON
OFF
AFC ENGAGE
STICK TRIM AMPL
NO. 2 PITCH AUG AMPL

Figure 1-21

is through master actuators and mechanical linkage, which, in turn, operates full-powered hydraulic surface actuators. The directional control system is a direct, mechanically controlled, hydraulically powered system. The longitudinal and directional systems are augmented for optimum control characteristics at various altitudes and airspeeds. A priority valve in the No. 2 hydraulic system prevents pressure from being directed to other than the flight control surface actuators if the system drops below 2200 psi. The hydromechanical system consists of the control stick and directional control pedals, connecting mechanical linkage, the control surfaces, the tandem master and control surface actuators, and associated flight control hydraulic systems. Normal pilot control inputs are electrically transmitted to the master actuators (when the electric flight control system is engaged) but the basic mechanical system operates in parallel with the electric system and will automatically take over to transmit stick inputs to the master actuator if the electric flight control system should fail or is not used. When pitch augmentation is engaged, horizontal stabilizer displacement is varied by a series actuator at a mechanical summing point for near-constant aircraft response to control stick inputs at all altitudes and at airspeeds above 0.55 Mach.

HORIZONTAL STABILIZERS

The horizontal stabilizers, constructed in two one-piece slabs, are attached to spindles on the aft fuselage. The authority of the horizontal stabilizers is increased for positive aircraft nose-up control in the landing (flaps extended) configuration. See figure 1-22. The following table summarizes horizontal stabilizer travel in relation to flap position and pitch augmentation system operation.

PITCH AUG	FLAPS	DEGREES AT LEADING EDGE UP (FORWARD STICK)	DEGREES AT LEADING EDGE DOWN (AFT STICK)
STBY	Up	8	16
ON	Up	8	21
STBY	50°	2.5*/7.8†	21
ON	50°	8	21

*Free-play link not centered
†Free-play link centered

VERTICAL STABILIZER

The vertical stabilizer is also constructed as an all-movable, one-piece surface. Maximum travel is 8 degrees left and right of center with full pedal applied and with the flaps extended. With flaps retracted, travel is restricted to 2 degrees left and right to prevent overcontrolling at high speeds. As the flaps extend to approximately 30 degrees, a mechanical interconnect applies coordinated vertical stabilizer movement during lateral stick movement. Refer to LATERAL/DIRECTIONAL INTERCONNECT, in this section. A position light, buddy

PITCH CONTROL AUTHORITY

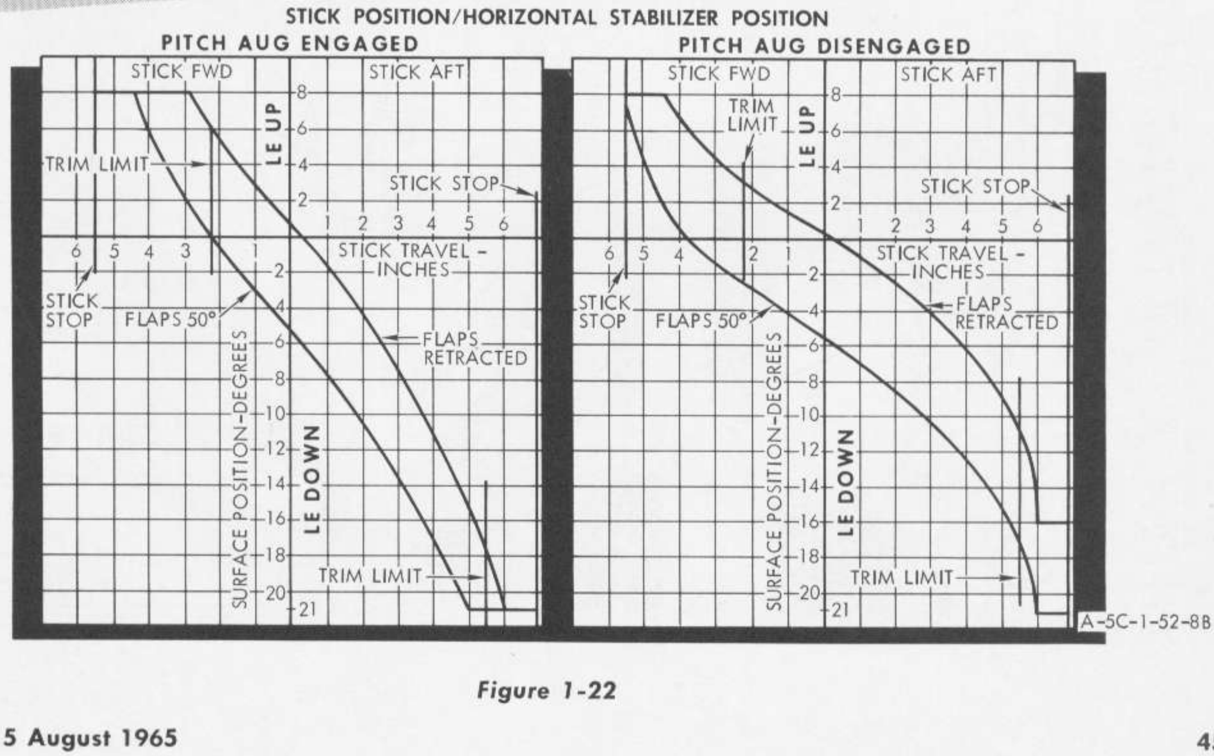


Figure 1-22

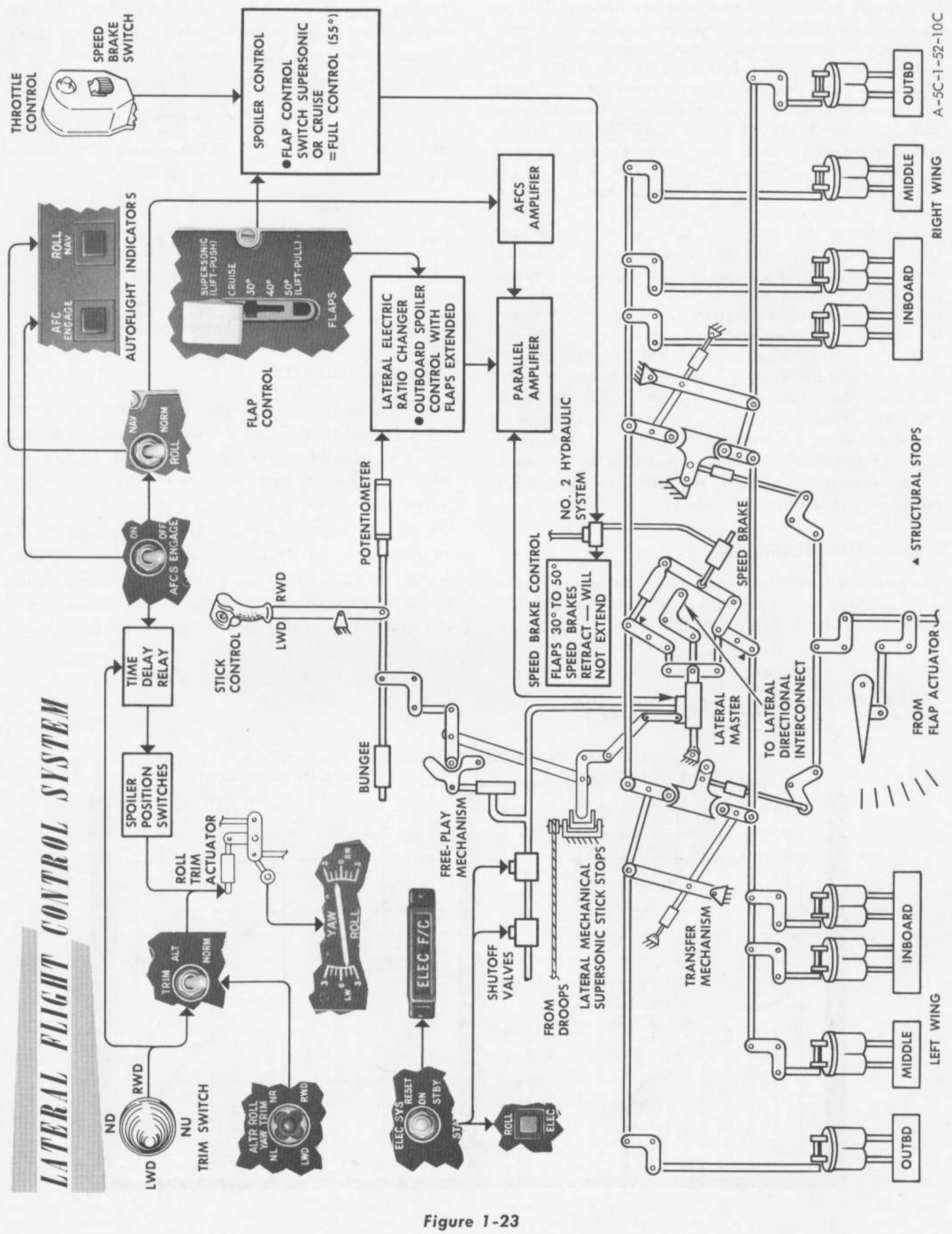

LATERAL FLIGHT CONTROL SYSTEM
THROTTLE CONTROL
SPEED BRAKE SWITCH
SPOILER CONTROL
●FLAP CONTROL SWITCH SUPERSONIC OR CRUISE =FULL CONTROL (55°)
AUTOFLIGHT INDICATORS
AFC ENGAGE
ROLL NAV
SUPERSONIC (LIFT-PUSH)
CRUISE
30°
40°
50° (LIFT-PULL)
FLAPS
FLAP CONTROL
AFCS AMPLIFIER
LATERAL ELECTRIC RATIO CHANGER
●OUTBOARD SPOILER CONTROL WITH FLAPS EXTENDED
PARALLEL AMPLIFIER
NAV
NORM
ROLL
ON
OFF
AFCS ENGAGE
POTENTIOMETER
NO. 2 HYDRAULIC SYSTEM
SPEED BRAKE CONTROL
FLAPS 30° TO 50° SPEED BRAKES RETRACT — WILL NOT EXTEND
SPEED BRAKE
▲ STRUCTURAL STOPS
TIME DELAY RELAY
STICK CONTROL
LWD
RWD
BUNGEE
LATERAL MASTER
TO LATERAL DIRECTIONAL INTERCONNECT
FROM FLAP ACTUATOR
SPOILER POSITION SWITCHES
ROLL TRIM ACTUATOR
FREE-PLAY MECHANISM
TRIM
ALT
NORM
YAW
ROLL
ELEC F/C
SHUTOFF VALVES
FROM DROOPS
LATERAL MECHANICAL SUPERSONIC STICK STOPS
TRANSFER MECHANISM
ND
RWD
LWD
NU
TRIM SWITCH
ALTR ROLL YAW TRIM
NL
NR
RWD
LWD
ELEC SYS
RESET
ON
STBY
ROLL
ELEC
OUTBD
MIDDLE
INBOARD
RIGHT WING
INBOARD
INBOARD
MIDDLE
OUTBD
LEFT WING
A-5C-1-52-10C

Figure 1-23

tanker signal lights, and the fuel system overboard vent are installed on the trailing edge fairing. The vertical stabilizer folds 70 degrees to port for hangar deck storage.

SPOILER-DEFLECTORS

Lateral control is provided by an arrangement of conventional and inverted spoilers and deflectors located on the inboard wing panels. The conventional spoilers, located at the mid and inboard positions, open a maximum of 70 degrees. The deflectors, located on the lower surfaces under the conventional spoilers, open a maximum of 35 degrees. The outboard spoilers and deflectors are inverted, the spoilers being on the lower surfaces and the deflectors on the upper surfaces. The inverted spoilers open a maximum of 70 degrees. With the droop leading edge fully retracted (SUPERSONIC) outboard spoiler-deflector opening is reduced to 48 degrees and mid and inboard spoilers to 40 degrees. With the flap control switch at CRUISE or lower (droops extended), full spoiler-deflector authority is regained. The deflectors and spoilers are mechanically interconnected so that hydraulically powered movement of the spoilers results in movement of the deflectors. During rolling maneuvers with the flaps retracted, the inverted spoiler and deflector on the outside wing induce drag, offsetting the yaw effect of the mid and inboard spoilers on the inside wing. With flaps extended, the inboard, mid, and inverted spoiler-deflectors on the same wing operate together. A series of override bungees is installed in the mechanical linkage to the spoiler actuators, and consists of one bungee for each inverted spoiler and one for each set of inboard and mid spoilers. These bungees allow full control of the lateral system in the event one set of actuators should fail. The spoiler-deflectors are also used for speed brakes. Refer to SPEED BRAKES, in this section.

ELECTRIC FLIGHT CONTROL SYSTEMS

The longitudinal and lateral electric systems are designed to provide control for the corresponding hydromechanical systems. Electrical operation eliminates mechanical system friction and provides reduced breakout force for longitudinal and lateral control. The parallel actuator servo valves require No. 2 hydraulic system pressure for operation.

Note

> If both the No. 2 hydraulic pressure indicators are below 1000 psi, disengaging the electric flight control system will prevent lateral trim shifts resulting from abnormally low hydraulic pressures.

The master actuator servo valves for both systems are capable of accepting either mechanical commands through the control stick linkage, or electrical commands through amplifiers from control stick position potentiometers. During electrical operation, stick movement produces a signal from the potentiometers which is amplified and fed into the lateral and longitudinal master actuators. The master actuators respond to the command signals, mechanically positioning the control valves of the horizontal stabilizer and spoiler actuators. Follow-up potentiometers, mounted in the master actuator linkage, send a position signal back to the amplifier, nullifying the command signal when the proper control surface position is reached. Longitudinal and lateral electric system operation independent of the mechanical system is maintained by a free-play mechanism which acts as a clutch in the mechanical linkage. This free-play mechanism is disengaged during electrical operation and the mechanical linkage aft of the free-play mechanism is forced to follow movements of the control stick through master actuator movements.

Note

> Should a control malfunction occur, the pilot can return the system to mechanical control by (1) depressing the "kill" button on the stick grip, (2) restraining the control stick (hard-over condition) or applying a stick force to oppose the control movement, or (3) selecting the stand-by position of the electric system switch.

PITCH CONTROL

LONGITUDINAL INTERCONNECT

The position of the horizontal stabilizers is changed automatically to offset pitch changes due to flap movement. The automatic pitch trim correction during extension or retraction of flaps is provided by a mechanical interconnect between the flaps and the longitudinal series actuator. This mechanism moves the series actuator assembly a distance proportional to flap deflection, compensating for the trim change resulting from the extension and from the effect of boundary layer control. For a 50-degree flap extension, 6 degrees aircraft nose-up stabilizer (surface leading edge down) trim change is provided without changing the trimmed-neutral position of the control stick. Since the interconnect is mechanical, it operates during all modes of operation: electric flight control system and pitch augmentation system engaged or stand-by.

LONGITUDINAL FREE-PLAY LINK

The control stick is mechanically connected to the longitudinal master actuator through a free-play inducing link (solenoid clutch) installed in the linkage. With the electric flight control system engaged, this link allows the longitudinal system to operate in the electric mode without the friction of the control linkage. In the mechanical mode (electric systems disabled), the link is engaged, forming the control stick linkage into a solid, continuous connection with the master actuator.

LATERAL CONTROL

LATERAL FREE-PLAY MECHANISM

The lateral free-play mechanism is a hydromechanical device consisting of a hydraulically extended, spring-retracted actuator and associated linkages. No. 2 hydraulic system pressure to operate the actuator is provided from the lateral master actuator shutoff valves. When the electric system is operative, hydraulic pressure extends the actuator and unlocks the mechanical movement from the cable system. If the electric system is switched off or fails, the solenoid-operated shutoff valves close off hydraulic power and the spring returns the free-play mechanism into mechanical engagement.

LATERAL CONTROL TRANSFER

To increase lateral control ability at low speeds, a lateral control transfer mechanism is installed. With flaps extending toward 30 degrees, lateral system transitions from "upwing inverted spoiler" to simultaneously open all three sets of spoilers and deflectors on the "down" wing. With flaps less than 30 degrees and retracting, the lateral system transitions from the "all spoilers on down wing" configuration to the normal "up wing inverted spoiler" operation.

LATERAL RATIO CHANGER

To reduce lateral control sensitivity and prevent excessive roll rates at high speed, the flap control switch provides for an electrical or mechanical change in control stick-to-spoiler ratio through the flap control system. With the flap control switch at CRUISE or below (flaps extended), the lateral system operates at full deflection ratio. With the flap control switch at SUPERSONIC, the spoilers are restricted. Degrees of spoiler and deflector are shown in the following table:

	FLAP POSITION	
	SUPERSONIC	CRUISE
Inboard		
Spoiler	40	70
Deflector	20	35
Mid		
Spoiler	40	70
Deflector	21.5	35
Outboard		
Spoiler	48	70
Deflector	26	39

LATERAL/DIRECTIONAL INTERCONNECT

To improve roll characteristics at low speeds, lateral stick movements exceeding 1 inch from center provide coordinated displacement of the vertical stabilizer up to ±4 degrees if the flaps are extended 30 degrees or more. See figure 1-24. Though this system provides proper coordination when rolling into a bank, some input may be required with opposing directional control as the stick is centered at the desired angle of bank, depending upon rate of roll.

DIRECTIONAL CONTROL

DIRECTIONAL RATIO CHANGER

To prevent high-speed overcontrol, the authority of the vertical stabilizer is controlled by the flap mechanical interconnect. With flaps retracted, full pedal travel results in 2 degrees stabilizer deflection. As flaps are extended to 30 degrees, full pedal travel deflection is proportionally increased to 8 degrees. This ratio mechanism affects yaw trim equally. With flaps retracted (SUPERSONIC or CRUISE), trim is restricted to $1\frac{1}{2}$ degrees left or right. As flaps extend, trim authority increases to the full 7.5 degrees travel. To prevent radical trim change during flap extension, the yaw trim actuator incorporates centering switches which return the vertical stabilizer and the control pedals toward neutral during the ratio change.

Note

For a complete listing of flap system functions, see figure 1-28.

PITCH AUGMENTATION SYSTEM

The pitch augmentation system provides relatively constant pitch control characteristics over the entire range of speed and altitude attainable. The system provides constant "feel" (stick movement and force requirements), and accepts control signals from the pitch axis of the automatic flight control system (AFCS). The system provides direct, nonlinear horizontal stabilizer position control below 0.25 Mach, pitch damping above 0.3 Mach, and "g" control with pitch damping above 0.55 Mach. All components are dual for fail safety, and include pitch rate gyro, normal pitch accelerometers, electronic (series) amplifiers, and a hydraulic (series) servo actuator in series with the mechanical (pilot-controlled) system. The series actuator, acting through independent linkage, operates the horizontal stabilizer actuators, adding to or subtracting from the control authority of the pilot's electrical or mechanical input. A differential pressure transducer in the series actuator constantly compares the operating pressures of the dual pistons of the series actuator, providing a signal proportional to the unbalance. The balancer corrects the signal to the servo valves, resulting in equal piston pressures. Differential pressure switches in the actuator will shut off the system in the event of an unbalance beyond balancer capability. A failure of the No. 2 hydraulic system will also shut off the system through operation of the hydraulic pressure switches.

CAUTION

Pitch augmentation malfunctions can occur which will not monitor the pitch augmentation system off or illuminate the PITCH AUG caution indicator.

WARNING

A malfunctioning pitch augmentation system cannot be monitored off by the use of opposing control stick forces. Disable pitch augmentation as follows:

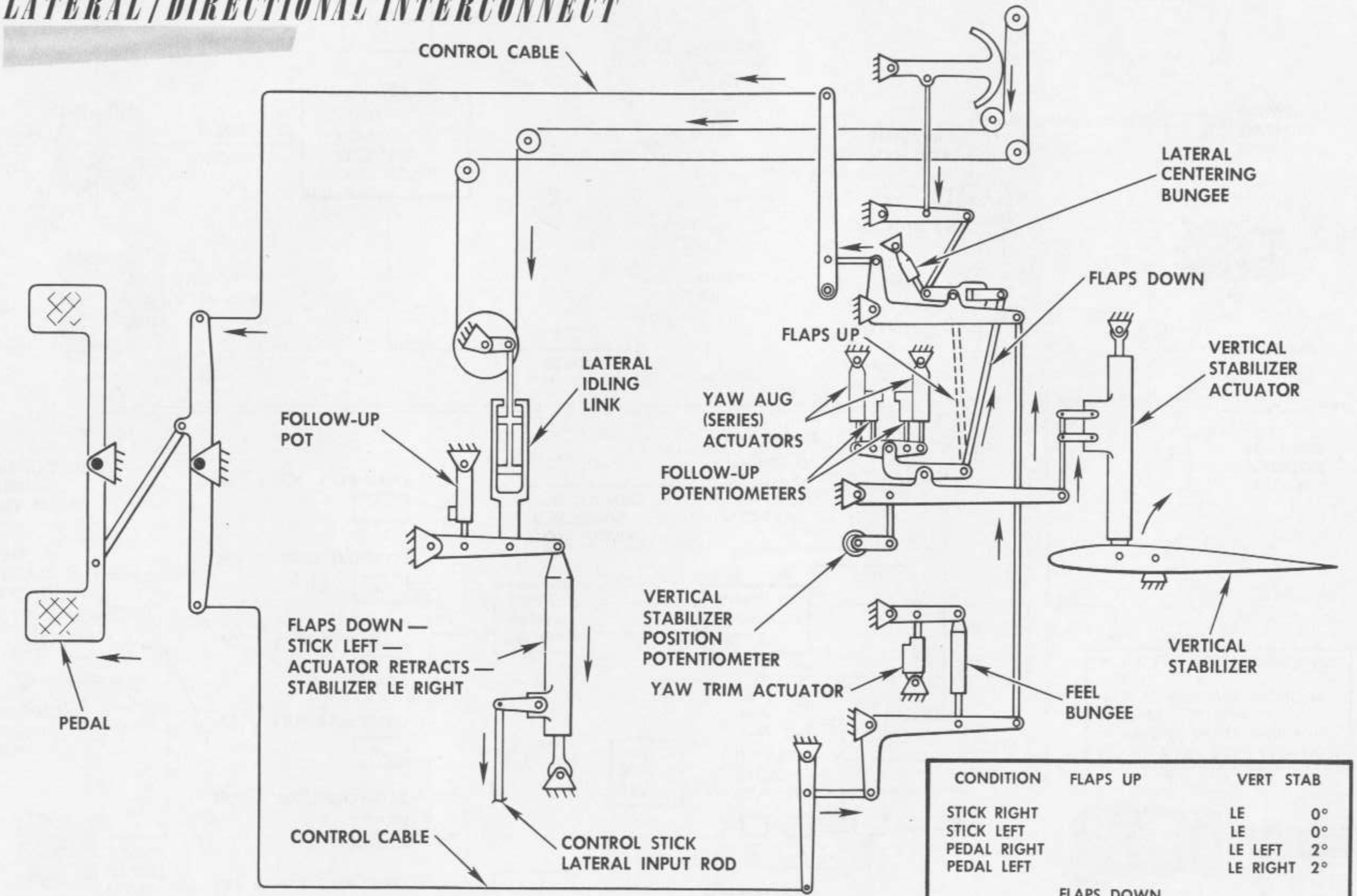
(a) "Kill" button—Depress.

(b) PITCH AUG switch—STBY.

Note

The pitch augmentation system must be allowed to warm up for 1½ minutes and flight control hydraulic pressure must be within normal limits before the system can be reset for operation.

LATERAL/DIRECTIONAL INTERCONNECT



CONDITION	VERT STAB	
FLAPS UP		
STICK RIGHT	LE	0°
STICK LEFT	LE	0°
PEDAL RIGHT	LE LEFT	2°
PEDAL LEFT	LE RIGHT	2°
FLAPS DOWN		
STICK RIGHT	LE LEFT	4°
STICK LEFT	LE RIGHT	4°
PEDAL RIGHT	LE LEFT	8°
PEDAL LEFT	LE RIGHT	8°
STICK RIGHT AND PEDAL LEFT	LE RIGHT	6°
STICK LEFT AND PEDAL RIGHT	LE LEFT	6°

A-5C-1-52-13

Figure 1-24

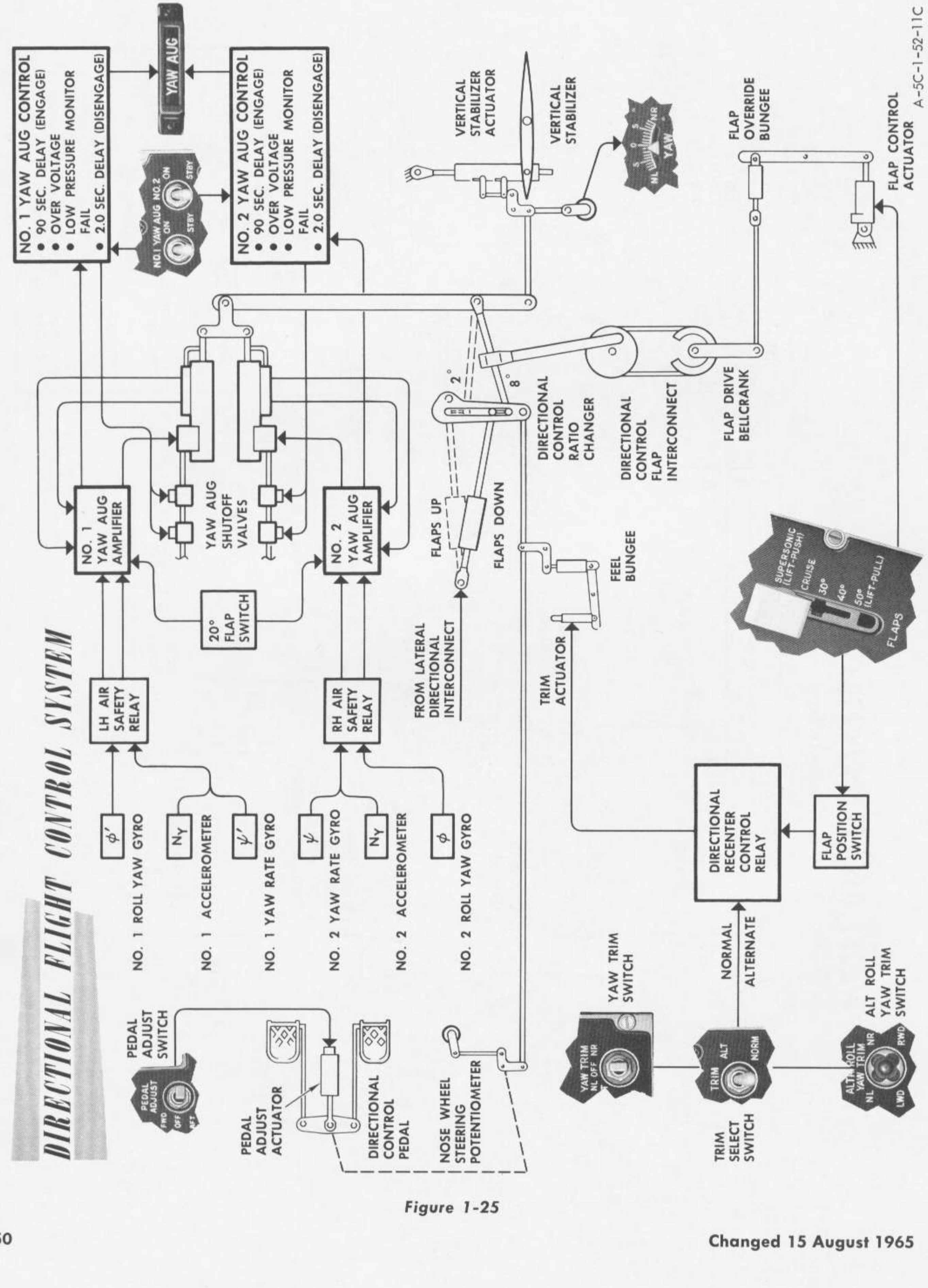

DIRECTIONAL FLIGHT CONTROL SYSTEM
A-5C-1-52-11C
NO. 1 YAW AUG CONTROL
● 90 SEC. DELAY (ENGAGE)
● OVER VOLTAGE
● LOW PRESSURE MONITOR FAIL
● 2.0 SEC. DELAY (DISENGAGE)
NO. 2 YAW AUG CONTROL
● 90 SEC. DELAY (ENGAGE)
● OVER VOLTAGE
● LOW PRESSURE MONITOR FAIL
● 2.0 SEC. DELAY (DISENGAGE)
YAW AUG
NO.1 YAW AUG NO.2
ON
STBY
VERTICAL STABILIZER ACTUATOR
VERTICAL STABILIZER
NL
NR
YAW
FLAP OVERRIDE BUNGEE
FLAP CONTROL ACTUATOR
YAW AUG SHUTOFF VALVES
NO. 1 YAW AUG AMPLIFIER
NO. 2 YAW AUG AMPLIFIER
20° FLAP SWITCH
LH AIR SAFETY RELAY
RH AIR SAFETY RELAY
2°
8°
DIRECTIONAL CONTROL RATIO CHANGER
DIRECTIONAL CONTROL FLAP INTERCONNECT
FLAP DRIVE BELLCRANK
FLAPS UP
FLAPS DOWN
FEEL BUNGEE
FROM LATERAL DIRECTIONAL INTERCONNECT
TRIM ACTUATOR
SUPERSONIC (LIFT-PUSH)
CRUISE
30°
40°
50° (LIFT-PULL)
FLAPS
NO. 1 ROLL YAW GYRO
NO. 1 ACCELEROMETER
NO. 1 YAW RATE GYRO
NO. 2 YAW RATE GYRO
NO. 2 ACCELEROMETER
NO. 2 ROLL YAW GYRO
DIRECTIONAL RECENTER CONTROL RELAY
FLAP POSITION SWITCH
PEDAL ADJUST SWITCH
PEDAL ADJUST
FWD
OFF
AFT
PEDAL ADJUST ACTUATOR
DIRECTIONAL CONTROL PEDAL
NOSE WHEEL STEERING POTENTIOMETER
YAW TRIM SWITCH
YAW TRIM
NL OFF NR
NORMAL
ALTERNATE
TRIM
ALT
NORM
TRIM SELECT SWITCH
ALT ROLL YAW TRIM SWITCH
ALT ROLL YAW TRIM
RWD
LWD

Figure 1-25

CONSTANT CONTROL FEEL

The pitch augmentation system provides desirable longitudinal control system feel at all airspeeds and altitudes. At low speeds (below 0.25 Mach), the pilot has a direct, stick-to-stabilizer ratio for positive control of pitch attitude. As airspeed increases above 0.25 Mach, air data computer inputs increase, providing a combination of direct stick-to-stabilizer control and direct command of normal acceleration ("g") through the augmentation system. Above 0.55 Mach, the system has transitioned to a "g" command system with pitch damping, producing a requirement for constant stick force and stick displacement per change in "g." Refer to PITCH AUGMENTATION operation, in this section.

Note

Automatic horizontal stabilizer modulation by the pitch augmentation system is not followed by the control stick. All pitch trim changes accomplished through the normal trim control do, however, change the trimmed stick position and reduce control pressures.

PITCH DAMPING

Above 0.3 Mach, the pitch augmentation system provides pitch damping, stabilizing the aircraft during short-term pitch oscillations. Should longitudinal oscillations occur because of pilot input or turbulence, the pitch rate gyros and accelerometers detect the motion and convert it into an electrical signal. The signal is then fed to the series amplifiers, which control the longitudinal series actuator, acting to damp out the oscillations.

YAW AUGMENTATION SYSTEM

A dual yaw augmentation system comprised of two independent matched systems, is installed. Each system provides half the total vertical stabilizer movement authority of full dual system force. These systems provide fail-safe directional stability and damp out short duration yaw oscillations. With the flaps extended more than 30 degrees, the yaw rate and acceleration signals are cut off, and the yaw augmentation systems receive signals from roll/yaw rate sensing gyros, allowing the system to provide "dutch roll" damping. On some aircraft,* a 2-second time delay relay prevents system transients from causing nuisance shut-offs during flap retraction. The high-speed system consists of yaw rate gyros, yaw accelerometers, two yaw amplifiers, and two hydraulic servo actuators (directional series) installed in the mechanical system. The directional series actuators control the vertical stabilizer actuator without affecting control pedal position. A yaw motion results in a signal from the accelerometers. The signal is then fed to the yaw amplifiers, which boost the signal and relay it to the directional series actuators. The series actuators then cause the vertical stabilizer actuator to move, stabilizing the aircraft at zero yaw rate and acceleration about the yaw axis. The output signal of the accelerometers and gyros is fed to the yaw amplifiers through contacts of the ground safety relay. When the weight of the aircraft is on the extended landing gear, the system is rendered insensitive to input, eliminating spurious vertical stabilizer movements during ground operation. The authority of the augmentation system is limited to ±2 degrees of vertical stabilizer travel. This limited travel feature prevents yaw augmentation malfunctions from damaging the aircraft.

CAUTION

If a rapid, undamped oscillation of the vertical stabilizer is encountered during taxi or other ground operation, indicating a ground safety relay failure, move both YAW AUG switches to STBY immediately. Abrupt rudder pedal inputs or rough terrain may result in rapid, self-sustaining oscillations through ±2 degrees at a maximum rate of 10 degrees per second. A ground safety relay failure will have no effect on airborne performance; however, if a known failure exists, yaw augmentation should be disengaged during landing rollout.

FLIGHT CONTROLS AND INDICATORS

CONTROL STICK

The control stick (figure 1-26) incorporates a normal pitch trim control, a five-position pulse trim button, a STEER/TERRAIN button, a flight control systems off button, and an armament initiation trigger. Full stick travel is 5.5 inches forward, 7 inches aft, and 3.37 and 3.42 inches left and right of neutral, respectively. With pitch augmentation engaged, apparent longitudinal stick stops may be felt because of bottoming surface actuators before reaching stick travel limits. For a description of the trim controls on the stick grip and flight control panel, refer to TRIM SYSTEMS, in this section.

DIRECTIONAL CONTROL PEDALS

The conventional style directional control pedals are electrically adjustable for leg length over a 4-inch range. When angle of attack exceeds 19 units, a vibrator on the right pedal is actuated as a stall warning device. The nose wheel steering system is operated through the directional control pedals in conjunction with the STEER/TERRAIN button on the control stick grip. Total pedal travel is 3.25 inches forward and aft of center with directional trim at neutral.

ELECTRIC SYSTEM SWITCH

The electric system switch (ELEC SYS) is located on the flight control panel (figure 1-26). This three-position (STBY, RESET, ON), spring-loaded switch controls the longitudinal and lateral electric systems. To place the systems in operation, hold this switch in RESET until

***Aircraft 151623 and subsequent and aircraft having AFC 150 complied with**

FLIGHT CONTROLS AND INDICATORS

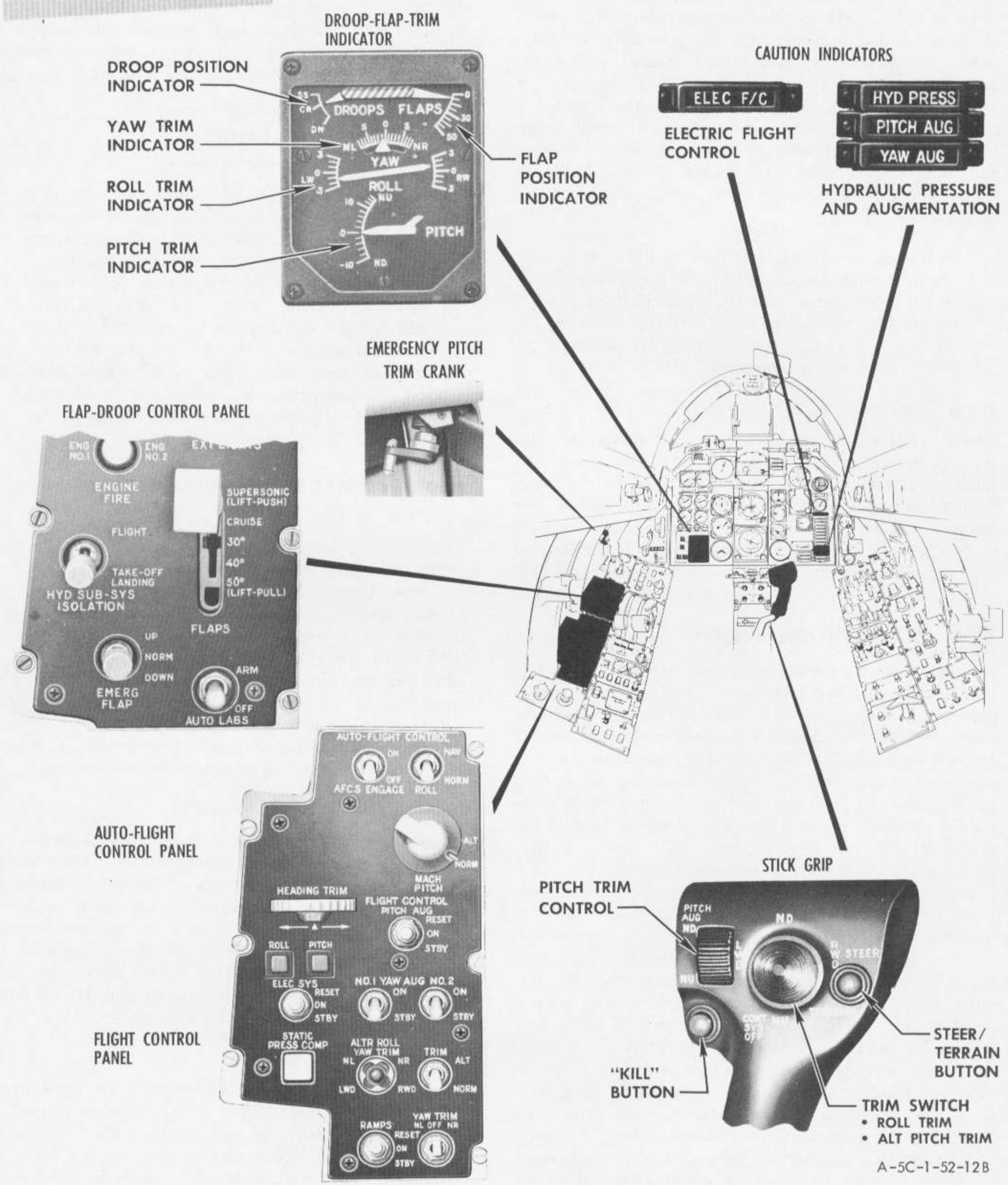


Figure 1-26

both the PITCH and ROLL axis indicators show "ON" and the ELEC F/C caution indicator goes out; then release the switch to the ON position. This operation disengages the free-play links in the mechanical systems, energizes the lateral and longitudinal master actuators in the electric mode of operation, and completes the circuit to the PITCH and ROLL axis electrical indicators.

Note

The electric system switch may be used to reset one system even though the other system will not remain engaged. A transient may occur in the failed system.

ROLL and PITCH Indicators

The electric system ROLL and PITCH indicators (figure 1-26) are located on the flight control panel, adjacent to the electric system switch. These windows show a blank if the mechanical control system is in operation. During electrical operation, these windows display "ON."

ELEC F/C Caution Indicator

The ELEC F/C caution indicator (figure 1-26) is illuminated when either the longitudinal or lateral electric system is disengaged.

CONTROL SYSTEMS DISABLE ("KILL") BUTTON

Depressing the "kill" button (figure 1-26) disengages the electric flight control, pitch augmentation, and automatic flight control systems. The normal pitch trim system is also disabled as long as the "kill" button is held down, but the alternate trim system is available. Aircraft control is then accomplished through the mechanical flight control system. Electric systems may be re-engaged at any time after "kill" button use by resetting individual control switches.

CAUTION

When depressing the "kill" button, the pilot should be prepared to compensate for any pitch trim changes associated with pitch augmentation disengagement.

Note

Depressing the "kill" button will not disable yaw augmentation.

PITCH AUGMENTATION SWITCH

The pitch augmentation switch (PITCH AUG, figure 1-26) is located on the flight control panel. This switch has three positions: STBY, RESET, and ON. When the system is disengaged, the PITCH AUG caution indicator is on. To engage, hold the switch in RESET until the PITCH AUG caution indicator goes out, then release the switch to the ON position. This action moves the stick to a neutral position by centering the pitch trim actuator, energizes the pitch augmentation hydraulic shutoff valves, and energizes a holding circuit for system operation, extinguishing the PITCH AUG caution indicator.

Note

The pitch augmentation system cannot be reset with the TRIM select switch at ALTR.

PITCH AUG Caution Indicator

The pitch augmentation caution indicator (PITCH AUG, figure 1-26) is located on the instrument panel. This indicator will be illuminated until the system is reset to operate and at any time the system shuts off in flight. The PITCH AUG caution indicator will not extinguish and the system will not remain engaged until the switch has been held in RESET a sufficient time to allow centering of the stick by the pitch trim actuator.

Note

Failure of the pitch augmentation system will be followed by a slight change in pitch trim. Continued use of the pitch trim control will trim out the associated force.

YAW AUGMENTATION SWITCHES

The YAW AUG NO. 1 and YAW AUG NO. 2 switches (figure 1-26) have two positions: STBY and ON. With either or both systems inoperative, the YAW AUG caution indicator will be on. To place the systems in operation, move each switch to ON. This action opens hydraulic shutoff valves and energizes a holding circuit for system operation. The YAW AUG caution indicator should go out on successful engagement of the second system, engaged in either order.

YAW AUG Caution Indicator

The yaw augmentation caution indicator (YAW AUG, figure 1-26) is installed on the instrument panel. This indicator will be illuminated whenever the aircraft electrical system is energized and one or both yaw augmentation systems are not engaged.

TRIM SYSTEMS

PITCH TRIM

Pitch trim is adjusted by moving the horizontal stabilizers. Normal pitch trim is continuous, pitch augmentation engaged, or stand-by. An alternate pitch trim system allows control of trim should normal trim fail. In the event of failure of both generators, the alternate trim system may receive power from the RAT. Emergency (mechanical) pitch trim is also provided. Pitch trim authority is increased with horizontal stabilizer travel increase in the landing (flaps extended) configuration. The following table summarizes pitch trim authority (all modes) in relation to flap position and pitch augmentation.

		DEGREES AT LEADING EDGE	
PITCH AUG	FLAPS	UP (NOSE DOWN)	DOWN (NOSE UP)
STBY	Up	3.5	11
ON	Up	6	17
STBY	50°	—	2 to 16
ON	30°, 40°, 50°	0	21

Pitch Augmentation Engaged

With the pitch augmentation system engaged, command signals for trim are provided by the No. 2 pitch augmentation and stick trim amplifiers. Pitch trim control is provided by movement of the longitudinal master actuator with a corresponding reference movement of the pitch augmentation actuator. The control stick follows normally during trim control rotation. At speeds below 0.25 Mach, the pitch trim control functions as a position trim control, removing stick forces by positioning the stick and horizontal stabilizers as required. Above 0.55 Mach, the pitch trim control acts as a "g" trimming control. The desired "g" (trim control rotation or stick position) is automatically maintained by changes in horizontal stabilizer position. On some aircraft,* alternate pitch trim should be selected after pitch augmentation engagement, to avoid possible runaway trim.

Pitch Augmentation Disengaged

With pitch augmentation disengaged or failed, control of pitch trim continues normally through the pitch trim control and the longitudinal trim amplifier. Trim signals in this mode are not shaped by the air data computer, and large changes in required stick forces and trim adjustment can be expected over the speed range of the aircraft.

ALTERNATE PITCH TRIM

An alternate pitch trim system (pulse trim) is provided for pitch trim control in the event that normal pitch trim fails. In the event of a complete failure of primary electrical power, the alternate pitch trim system operates on RAT emergency electrical power. This system trims longitudinal stick forces by changing the "no-load" position of the stick artificial feel bungee. The pulse trim switch on the stick grip may be used to control pitch trim. The TRIM select switch must first be moved to ALTR to provide a-c essential bus power to the alternate pitch trim circuit. This system may be powered by the ram-air turbine-powered emergency unit in the event both generators fail.

EMERGENCY PITCH TRIM

An emergency pitch trim system is installed. Manual operation of the alternate pitch trim actuator, in the event of complete failure of normal and alternate pitch trim, is accomplished through a flex shaft to a cockpit emergency pitch trim crank. Refer to EMERGENCY PITCH TRIM CRANK, in this section.

ROLL TRIM

Normal roll (lateral) trim is provided through differential displacement of the horizontal stabilizers. An electrical actuator is connected through reversing linkage to the control valves of the horizontal stabilizer actuators. When the lateral trim switch is moved, the electrical trim actuator causes differential displacement of the horizontal stabilizers, trimming the aircraft about the roll axis.

Note

An override bungee is provided in the lateral trim linkage to allow any lateral trim to be removed if full nose-up or nose-down longitudinal control displacement is required. The lateral trim will automatically return when the control stick is returned toward neutral.

YAW TRIM

The aircraft is trimmed about the yaw axis by changing the "no load" position of the directional artificial feel bungee. As the YAW TRIM switch is moved, the directional control pedals assume a new "no load" position, and the vertical stabilizer is displaced, trimming the aircraft about the yaw axis. The authority of the directional trim system and the total travel of the vertical stabilizer are controlled through the flap mechanical ratio changer. With the flaps extended more than 30 degrees, 7.5 degrees of left or right trim can be obtained. With the flaps retracted (SUPERSONIC or CRUISE), trim is restricted to 1½ degrees of left or right travel.

ALTERNATE ROLL/YAW TRIM

When selected, the alternate roll/yaw trim system will assume operation of lateral and directional trim in the event of normal trim switch or electric system failure. This system is powered by the essential a-c bus and, if necessary, may be operated on power supplied by the emergency ram-air turbine.

AUTOMATIC TRIM FEATURES

Flap Compensation

The flap/longitudinal interconnect provides 6 degrees aircraft nose-up (stabilizer leading edge down) stabilizer shift for 50 degrees flap extension to offset pitch trim change.

Directional Trim Centering

To prevent a radical trim change during flap extension, the yaw trim actuator incorporates a centering feature which returns stabilizer trim toward neutral during the ratio change.

TRIM CONTROLS AND INDICATORS

TRIM Select Switch

The trim select switch (TRIM, figure 1-26) is located at the rear of the flight control panel. This switch has two positions: NORM and ALTR. In the NORM position, primary a-c bus power is supplied to all normal trim

***Aircraft 150823 through 150842 and aircraft 149306 through 149317 not having PCR 304 complied with**

circuits. The ALTR position is used in the event of electrical system failure or normal trim failure to transfer control to the alternate roll/yaw and pitch trim switches and to shift the electrical power supply for all trim circuits to the essential a-c bus.

Note

The TRIM select switch should be at NORM in order to engage pitch augmentation, but pitch augmentation may be engaged with the TRIM select switch at ALTR if the PITCH AUG switch is held in RESET and trim is moved to neutral.

Pitch Trim Control

Normal pitch trim is adjusted through a rotary synchro-type control (figure 1-26) installed on the face of the control stick grip. This control [NU (nose up), ND (nose down)] enables the pilot to neutralize stick forces through normal trim or to command aircraft normal acceleration ("g") through the pitch augmentation system. With pitch augmentation engaged below 0.25 Mach, the pitch trim control is used to trim horizontal stabilizer position, relieving control stick loads during take-off and landing. Above 0.55 Mach, the pitch trim control is a means of trimming normal acceleration ("g"). Trim control rotation changes the "no load" position of the stick, which changes the output voltage of the stick position potentiometer. Summing circuits in the amplifier compare the reference signal with acceleration signals from the normal accelerometers. The result is an error signal which is sent to the series actuator, causing the aircraft to nose up or down, seeking the trimmed condition.

Pulse Trim Switch

The pulse trim switch (figure 1-26) is located on the control stick grip, to the right of the normal pitch trim control. This switch is spring-loaded to neutral (off) from four trimming positions. The lateral positions are LWD (left wing down) and RWD (right wing down). These positions control normal lateral trim through differential displacement of the horizontal stabilizers. The vertical positions (alternate pitch trim) are NU (nose up) and ND (nose down). These positions may be used to trim out longitudinal stick force with normal pitch trim inoperative.

Emergency Pitch Trim Crank

The emergency pitch trim crank (figure 1-26) is used to mechanically drive the alternate pitch trim actuator in the event of complete electrical pitch trim failure. This crank is located above the left console. Nose-down control stick loads may be removed by rotating the crank counterclockwise, or nose-up loads may be removed by rotating the crank clockwise. Each revolution of the crank displaces the horizontal stabilizers approximately 0.14 degree (seven revolutions per degree surface travel). The crank may be used at any time; however, if rotated during normal trim operation (TRIM select switch at NORM), all manual input is removed automatically.

YAW TRIM Switch

The YAW TRIM switch (figure 1-26) is located on the flight control panel. Yaw trim is controlled by holding this switch to NL (nose left) or NR (nose right) until the undesirable load is removed from the control pedals.

ALTR ROLL/YAW TRIM Switch

The ALTR ROLL/YAW TRIM switch (figure 1-26) provides control of roll and yaw trim with the TRIM select switch at ALTR. In the event of failure of the normal roll or yaw trim circuits, undesirable stick loads or yawed flight can be corrected by using this switch as desired.

Droop, Flap, and Trim Indicator

All trim positions and droop and flap positions are indicated by a single unit (figure 1-26) installed on the instrument panel. Droop position is indicated at the SS (supersonic), CR (cruise), or DN (down) positions. Flap position is indicated from 0 to 50 degrees. Vertical stabilizer trim is indicated from 0 to 8 units nose left and nose right. Horizontal stabilizer differential displacement (roll trim) is indicated from 0 to 3 units wing up or down for either wing. Horizontal stabilizer position is indicated from 0 to 16 units nose up and from 0 to 10 units nose down. The pitch needle is a miniature aircraft, indicating the resulting aircraft attitude reaction to a given trim setting.

FLIGHT CONTROL SYSTEMS OPERATION

PITCH AUGMENTATION

The pitch augmentation system consists of an electrically controlled, tandem piston hydraulic actuator, effectively in series with the longitudinal master actuator (parallel system). Augmented system operation provides relatively constant stick force and displacement per change in "g," position trim at low speeds, "g" command at high speeds, and pitch damping at speeds greater than 0.3 Mach. The augmentation system controls the movements of the series actuator, which is attached to a mixer bell crank in the longitudinal control linkage. The final mixer bell crank output to the surface actuators is the algebraic sum of movements of both the master actuator (parallel system) and the series actuator (augmentation system). Each half of the tandem series actuator is controlled by a separate servo valve which accepts inputs from one-half of the dual electronic systems. The output of these valves is constantly measured and a dual system balancer acts to equalize the output of the series amplifiers. Should an unbalance in signal beyond the capability of the balancer exist for more than 2 seconds, differential pressure switches in the servo valve disable the system, allowing the series actuator to center and illuminate the PITCH AUG caution indicator. If the condition which caused the unbalance is transient, the system may be reset by using the PITCH AUG switch.

Low Speed

At speeds less than 0.25 Mach, stick movement produces direct stabilizer response for precise control of pitch attitude during take-off or landing. Normally, position trim is provided at low speeds through the pitch trim control on the stick grip. The trim control synchro output is directed to a pitch trim amplifier, commanding a stabilizer position change equivalent to trim control rotation. Position trim follow-up signals are fed back through the pitch trim amplifier to drive the pitch trim feel device (alternate trim actuator), forcing the stick to follow the trim signal.

Pitch Damping

Above 0.3 Mach, the system provides damping of short-period pitch oscillations. This feature is provided by using pitch rate and acceleration signals from a pitch rate sensing gyro and accelerometer. The pitch signal is washed out to eliminate the steady-state signal such as that produced during a pull-up and/or a stabilized turn, and to allow only changes in the pitch rate and acceleration signals to pass through. The pitch signals are summed with other inputs in the series amplifiers, and stabilizer position is modulated independent of stick position to maintain an effective zero pitch rate change.

High Speed

At high speeds (above 0.55 Mach), the stick position potentiometer output functions as a "g" command. This is accomplished by transition from series actuator follow-up (position system) to a "g" command system. During this mode of operation, the pitch trim control acts as a "g" trim control, allowing the pilot to trim normal acceleration number as desired. Trim synchronizers in the series amplifiers maintain "g" error at zero when the system is disengaged and maintain the aircraft at the trimmed "g" state once the trimmed setting is established. Stick position potentiometer output is transmitted to the series actuators as a "g" command at the rate of one additional "g" for each ¾ inch of stick travel. As the "g" change begins, pitch accelerometers send a signal into the series amplifiers, where the signal is compared with stick position input. Stabilizer position is varied by the resultant series amplifier signal, and "g" force is maintained at the value commanded by control stick input. Constant stick force per "g" is automatically provided above 0.55 Mach, as the artificial feel bungee in the control linkage exerts a 5.6-pound force for every ¾ inch of stick travel. When no acceleration change signal is present (no stick movement or trim control input), the series amplifier signal maintains the aircraft at steady-state acceleration, providing constant normal acceleration.

LATERAL CONTROL

With the spoiler-deflector system, adequate roll-rate capability is provided for low-speed flight. More than adequate roll rate is available to transonic speeds, where a slight decrease is noted. Maximum roll rate again increases at medium and high supersonic speeds.

Effectiveness

At low airspeeds, the aerodynamic effectiveness of the spoilers is considerably greater with flaps extended than with flaps retracted. In order to ensure adequate lateral control, flaps should not be retracted to less than 30 degrees at heavy gross weights, for asymmetrical store loadings, or possible engine failure until reaching 220 knots or 9 units angle of attack.

TRIM

Lateral/Directional Trim

Because of a trim interaction characteristic of this system, a large roll trim change may require a pitch trim adjustment. A change in yaw trim usually requires a slight change in roll trim.

Directional Trim Centering

To prevent a large magnification of any trim setting upon flap extension, the yaw trim actuator is returned toward neutral as the flaps extend to 25 degrees. During flap extension, the trim indicator follows the trim actuator toward zero. Directional retrimming may be required following flap extension.

Pitch Trim

The pitch trim system operates normally (continuously) through the pitch trim control synchro, pitch augmentation engaged or in stand-by. A "monitor" failure of pitch augmentation may cause a slight pitch trim change; however, normal pilot reaction and trim adjustment easily counters this effect. In the event of failure of normal trim, the TRIM select switch may be moved to ALTR and control regained through the alternate (pulse) trim switch, or trim may be controlled manually with the emergency pitch trim crank.

FLIGHT CONTROL SYSTEMS FAILURE

PITCH AUGMENTATION FAILURE

Failure of pitch augmentation may indicate loss of No. 2 hydraulic system pressure or electrical malfunction within the longitudinal series system. Should failure occur with the electrical and hydraulic systems operating normally, attempt to reset the system as desired.

CAUTION

- Should attempts to reset pitch augmentation result in an abrupt nose-up or nose-down pitch, move the PITCH AUG switch to STBY and do not make further reset attempts.
- Pitch augmentation malfunctions can occur which will not monitor the pitch augmentation system off or illuminate the PITCH AUG caution indicator.

WARNING

A malfunctioning pitch augmentation system cannot be monitored off by the use of opposing stick forces. Disable pitch augmentation as follows:

(a) "Kill" button—Depress.
(b) PITCH AUG switch—STBY.

Large changes in airspeed with pitch augmentation in STBY mode, require more adjustment of pitch trim than is required with pitch augmentation operating. In addition, flight in or through the transonic speed range is accompanied by stick force lightening or reversal. For landing, larger and heavier stick movement and force are required to correct pitch attitude. Firm, positive attitude corrections are required for glide path correction.

YAW AUGMENTATION FAILURE

Failure of yaw augmentation system may indicate loss of No. 1 or No. 2 hydraulic system pressure or electrical malfunction within the directional series system. Should failure occur at high speeds, speed should be reduced cautiously and roll rate should be restricted. The YAW AUG switches should then be checked to determine which system has failed. Landing in turbulence or cross wind with both systems inoperative may result in lateral/directional oscillation, requiring pilot control with directional control pedals.

TRIM FAILURE

Failure of the normal roll or yaw trim systems does not present a serious problem unless asymmetrical external loads are involved. Should one or both of these systems fail, the TRIM select switch should be moved to ALTR, and the ALTR ROLL/YAW TRIM switch should be used to remove control forces. If both generators are lost and the RAT is extended to regain electrical power, select ALTR position of the TRIM select switch and use pulse trim switch for trim control.

Note

- Normal pitch trim malfunction may be stopped by depressing *and holding* the control systems disable ("kill") button until the ALTR position of the TRIM switch can be selected.
- Failure of the roll or yaw trim *actuators* cannot be corrected by selecting alternate trim.

Failure of the alternate pitch trim circuit results in heavy, fatiguing stick forces if not relieved. Should both normal and alternate pitch trim fail, pitch trim must be adjusted through the emergency pitch trim crank.

Note

- Failure of the alternate pitch trim actuator is not corrected by selecting alternate trim.
- Selecting alternate trim for any trim axis requires that all axes be trimmed by the alternate method as long as the TRIM select switch is in ALTR.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The AFCS is designed to provide automatic control of the longitudinal and lateral flight control systems from touchdown speeds at sea level to 2.0 Mach at approximately 55,000 feet. Refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A) for current restrictions. During normal AFCS operation, the pilot can make control stick attitude corrections (stick-steering) within limits without disengaging the system. The AFCS acts through components of the longitudinal and the lateral flight control systems. Command signals to the system are heading, pitch, and roll synchro inputs generated by the flight reference set. Mach number or altitude signals from the air data computer, or steering error signals from the bomb directing set. These systems direct commands to the flight control system through the pitch augmentation (longitudinal series) and lateral electric system amplifiers. The AFCS provides NORM (hold bank, hold pitch, or hold heading), ALT (hold altitude), MACH (hold Mach), and NAV (autonavigation) modes of operation. In addition, the AFCS provides automatic LABS maneuvers as an alternate method of weapon delivery.

NORMAL MODE

Normal mode AFCS operation provides "hold pitch" control within 1 degree of the desired pitch attitude, and "hold heading" control within 1 degree of flight reference set heading output. Aircraft attitude limits in this mode are plus or minus 55 degrees of pitch and plus or minus 60 degrees of bank. Pilot stick-steering corrections to these limits may be initiated at any time in this mode without disengaging the system. For stick-steering, approximately 2.75 pounds maximum breakout force is required for pitch corrections and 2.25 pounds force is required for roll. Release of stick-steering breakout force at a bank angle of less than 5 degrees results in AFCS resumption or "hold heading" control. A stick-steering correction with stick centering at between 5 and 60 degrees of bank will switch the lateral system to "hold bank," resulting in a sustained, coordinated turn at the existing bank angle. This turn will be maintained until the aircraft is stick-steered to within 5 degrees of the wings level attitude and the control stick is centered, or until the NAV mode is selected. Should the pilot make a stick-steering correction in pitch, the longitudinal system will revert to "hold pitch" and will maintain the pitch angle at stick release, up to the 55-degree limit. A pilot-initiated correction of more than 55-degree pitch or 60-degree bank will disengage the autoflight system.

ALTITUDE MODE

The altitude mode of operation is a function of the longitudinal control system, utilizing true pressure altitude signals from the air data computer. Altitude should be maintained within plus or minus 50 feet (or 0.2 percent, whichever is greater) above 10,000 feet, and plus or minus 30 feet below 10,000 feet. A longitudinal stick-steering correction reverts the system to "hold pitch." After the aircraft has been leveled at the new altitude, the ALT mode may be reselected. A load factor limiting device prevents AFCS pitch corrections from exceeding plus or minus 1 "g" from the load factor existing prior to correction.

CAUTION

Changing SPC mode while in hold altitude (ALT), at subsonic speeds, will cause aircraft pitch response, with severity depending on altitude and Mach number at time of change.

MACH MODE

The MACH (hold Mach number) mode is a function of the longitudinal control system, utilizing Mach number signal output of the air data computer. This mode should modulate aircraft pitch attitude to maintain true Mach number within 0.01 Mach of that present at time of mode selection.

CAUTION

- Do not change SPC mode while in hold MACH.
- Do not engage MACH mode while at low altitude or in rough air.

NAV MODE

The ROLL switch may be placed to NAV as soon as desired after the AFCS is engaged. The aircraft will turn on course for the selected destination. The longitudinal system will continue to operate in the selected mode. Refer to BOMB DIRECTING SET, AN/ASB-12, in Section I, Part 2, of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

AUTO-LABS

Refer to LOW-ALTITUDE BOMBING SYSTEM (LABS), in Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

AFCS CONTROLS AND INDICATORS

AFCS ENGAGE SWITCH

The AFCS ENGAGE switch (2, figure 1-27) has two positions: OFF and ON. The electronic components of the AFCS are energized and warmed up when external or aircraft electrical power and cooling air are applied. After the electric flight control and pitch augmentation systems are engaged, placing this switch to ON, during flight within AFCS attitude limits, places the AFCS in operation. Should these limits be exceeded while stick-steering, the system will automatically disengage and the AFCS ENGAGE switch will return to the OFF position.

AUTOFLIGHT INDICATORS

The autoflight indicators (6, 7, 8, 9, figure 1-27) are mounted directly above the master caution indicator on the instrument panel shroud. During flight with the AFCS ENGAGE switch at OFF, these indicators are blank. With the AFCS ENGAGE switch at ON, the AFC ENGAGE indicator shows "ON." The ROLL NAV indicator displays "ON" only with the AFCS engaged and the ROLL switch positioned to NAV. The PITCH ALT/MACH indicator displays "ON" with the PITCH knob at ALT or MACH for the hold altitude or MACH mode. For a description of the LABS AUTO indicator, refer to LOW-ALTITUDE BOMBING SYSTEM (LABS), in Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

PITCH KNOB

The PITCH knob (5, figure 1-27) is a three-position rotary selector, with ALT (hold altitude), NORM (hold pitch), and MACH (hold Mach number) positions. After

AUTOFLIGHT SYSTEM CONTROLS AND INDICATORS

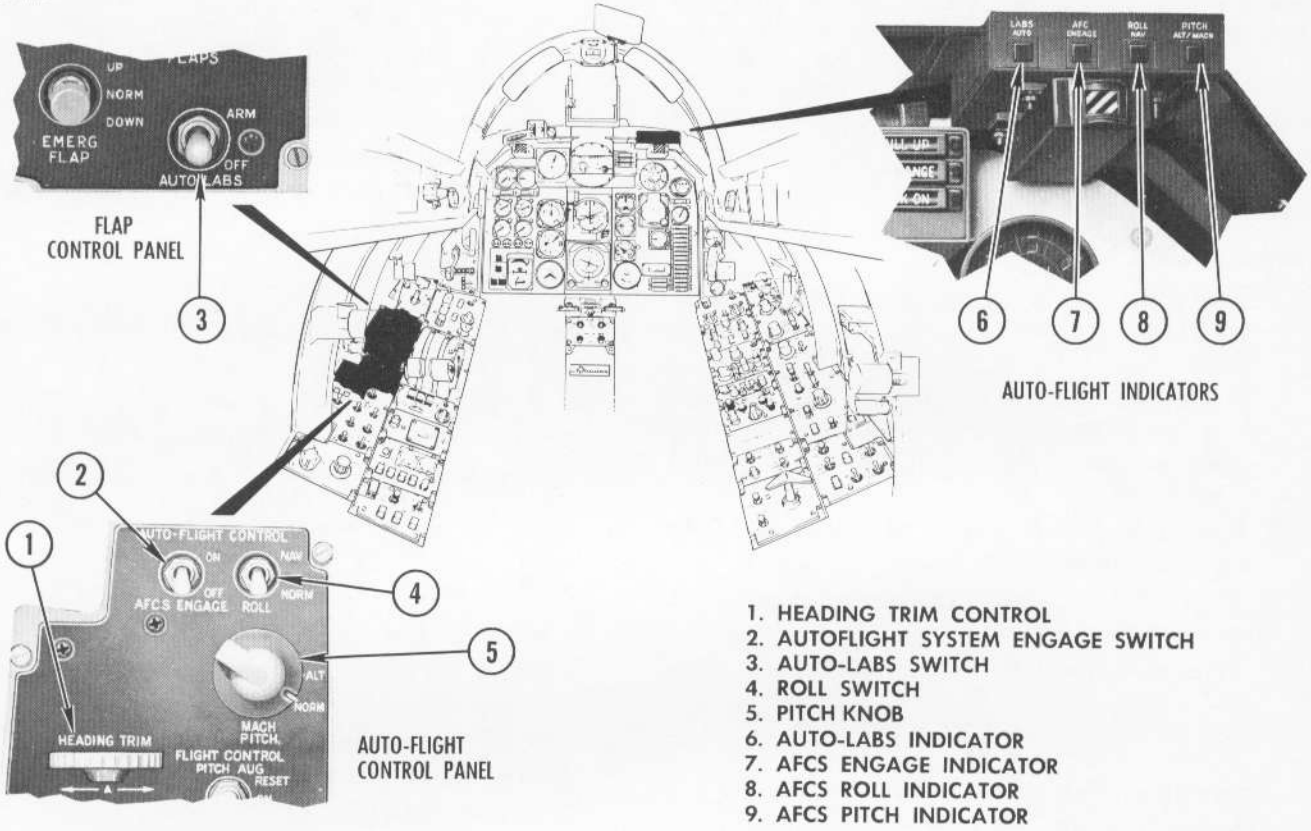


Figure 1-27

the AFCS has been engaged in the NORM mode and the aircraft is flying at the desired altitude, the PITCH knob may be moved to the ALT position. A stick-steering pitch correction moves the knob from ALT to NORM. Once the correction is concluded and breakout force is relieved from the control stick, the knob may be repositioned as desired.

ROLL SWITCH

The ROLL switch (4, figure 1-27) has two positions: NORM and NAV. The NORM position provides "hold heading" or "hold bank" control and provides heading trim. Refer to HEADING TRIM CONTROL, in this section. With the ROLL switch in NORM, stick-steering is available. Steering corrections will revert the system to "hold bank" if the control breakout force is relieved at more than a 5-degree bank angle. The AFCS will then maintain a coordinated turn at the bank angle existing at stick release. To return to "hold heading," the aircraft must be stick-steered to a bank angle of less than 5 degrees and the control stick centered. The NAV position locks out the heading input of the flight reference set and supplies a steering signal from the bomb directing set. The use of stick-steering for heading corrections causes the lateral system to revert from NAV to NORM mode operation.

AUTO LABS SWITCH

Refer to LOW-ALTITUDE BOMBING SYSTEM (LABS), in Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

HEADING TRIM CONTROL

The HEADING TRIM control (1, figure 1-27) provides vernier-type trim control of aircraft heading in the roll NORM (hold heading) mode. Should a heading change be desired, the pilot may roll this control toward the desired direction of heading correction (1 degree per click). The aircraft will roll into a coordinated turn and roll out when the selected number of degrees of heading has been passed.

CONTROL SYSTEMS DISABLE ("KILL") BUTTON

A "kill" button (figure 1-26) is provided on the lower left portion of the control stick grip face. Should a malfunction occur in the AFCS, the pitch augmentation system, or the pitch or roll electric systems, all systems may be disabled by depressing this button. This action will position the AFCS ENGAGE switch to OFF, disengage the electric flight control and pitch augmentation systems, and disable the normal pitch trim circuit until the button is released.

AFCS OPERATION

NORMAL MODE

1. Above 500 feet, check the PITCH knob and ROLL switch at NORM and move the AFCS ENGAGE switch to ON.

   Note the AFC ENGAGE indicator "ON." If the system is engaged in a turn, the aircraft will hold existing bank angle until changed by control stick steering.
2. Control climb Mach number by stick-steering pitch attitude as desired.
3. Make all fine heading changes by rotating the HEADING TRIM control.
4. Turns are accomplished by stick-steering the roll-in and rollout.

Note

The normal pitch trim control serves no useful purpose in the AFCS NORM mode. Trim control rotation causes aircraft response; however, the effect is removed within a maximum of 15 seconds, depending upon the amount of trim input.

CAUTION

Failure of the pitch augmentation or lateral and longitudinal electric flight control systems results in loss of AFCS operation.

ALTITUDE MODE

1. When the desired altitude is reached, stick-steer the aircraft to a level attitude and move the PITCH knob to ALT.
2. Check PITCH ALT/MACH indicator "ON."
3. When accelerating or decelerating through the transonic speed range, a transient pitch effect may occur due to compressibility effects of the transonic speed range on the air data computer pressure sensing and compensation system. If this transient effect is considered objectionable, the NORM (hold pitch) mode of the AFCS can be selected. When above or below this speed range, the ALT mode of operation can then be reselected.

CAUTION

Altitude should not be trimmed through use of the normal pitch trim control. Use of trim will produce an out-of-synchronization condition, causing a transient pitch response upon AFCS mode change or when a stick-steering correction is initiated.

MACH MODE

1. With the AFCS engaged, establish Mach number as desired.
2. PITCH knob—MACH.
3. Check PITCH ALT/MACH indicator "ON."
4. Adjust power as required for altitude control.

CAUTION

Mach number should not be adjusted through use of the normal pitch trim control. Use of trim will produce an out-of-synchronization condition, causing a transient pitch response upon AFCS mode change or when a stick-steering correction is initiated.

NAV MODE

1. When desired after take-off, engage AFCS in the pitch and roll NORM mode.
2. Stick-steer the aircraft to approximate heading desired and move the ROLL switch to NAV.
3. Check ROLL NAV indicator "ON."

Note

The NAV mode is operable only when the bomb directing set is in operation.

4. If a stick-steering heading change is made, the ROLL switch will move to NORM and the ROLL NAV indicator will go blank. When the aircraft is returned to the desired course, return the ROLL switch to NAV to resume operation.

AUTO-LABS

The AFCS may be used in performing automatic LABS maneuvers on bomb directing set targets or on any target through the LABS system. Refer to Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

SPEED BRAKES

Deceleration control is provided through the lateral flight control surfaces by opening all spoilers and deflectors simultaneously. The spoiler speed brake system is electrically controlled and operated by the No. 2 hydraulic system. When the speed brake switch is moved to OUT, hydraulic pressure is ported to a spring-loaded speed brake actuator, which positions the lateral system mechanical linkage to obtain any desired position to a maximum deflection of 55 degrees.

Note

Due to design air load limits, the inverted spoilers will not extend fully at speeds above approximately 500 KIAS.

Lateral control is provided with the speed brake in any position through differential movement of the spoiler-deflectors from their extended (speed brake) position. An interconnect is provided which retracts and deenergizes the spoiler speed brake when the flap control switch is moved from SUPERSONIC or CRUISE to any position calling for extended flaps.

CONTROLS AND INDICATORS

SPEED BRAKE SWITCH

A speed brake switch (20, figure 1-9) is located on the No. 2 throttle grip. This thumb-actuated switch has three positions: OUT (aft), IN (forward), and OFF (center). The switch is spring-loaded to OFF (neutral) from the OUT position.

SPEED BRAKE DUMP HANDLE

A speed brake dump handle (26, figure 1-9) is located at the rear of the left console. This handle permits manual dumping of hydraulic pressure in the speed brake selector valve to return in the event of electrical or No. 2 hydraulic system failure. This allows the spring-loaded speed brake actuator to move the spoiler-deflector control linkage to the closed position. This handle is held in the dump position by a ratchet incorporated in the handle shaft. To return the handle to the down position, the handle must be twisted clockwise. Spring action will return the handle to the console.

SPEED BRAKE INDICATOR

A speed brake indicator (37, figure 1-10) is located on the instrument panel. The indicator shows the open ("OUT") and closed ("IN") positions of the speed brake and displays a barber pole during speed brake movement, during the absence of electrical power, and whenever the speed brake is stopped in an intermediate position.

SPEED BRAKE OPERATION

Refer to Section III, Part 3.

CHARACTERISTICS

Speed brake extension at subsonic speeds is accompanied by an easily controlled nose-down pitch and moderate airframe buffet. Extension at supersonic speeds is characterized by high deceleration forces and speed brakes should be extended in increments. When decelerating through 1.0 Mach, pitch trim may reverse and pilot-induced oscillation may be encountered, particularly with pitch augmentation inoperative.

Note

- The inverted spoilers will not extend fully at speeds above approximately 500 KIAS.
- A slight increase in roll sensitivity may be noted as the speed brakes open and close.

HIGH-LIFT SYSTEMS

FLAPS

The semi-full-span, slotted, double section flaps are electrically controlled and powered by the No. 2 hydraulic system. Normal no-load extension through the full 50 degrees of travel requires approximately 8 seconds and no-load retraction requires approximately 11 seconds.

CAUTION

Extension of the flaps with the forward engine access doors open will result in damage to the flaps, the access door, or both.

DROOP LEADING EDGE

Complete-span droop leading edges are installed on each wing. Each wing droop leading edge consists of three hydraulically powered mechanically operated sections. The middle and outboard sections extend a maximum of 50 degrees, while the inboard section extends to 28.5 degrees maximum. The droops are operated through a series of hydraulic rotary actuators, driven by both the No. 1 and No. 2 hydraulic systems. Droop leading edge operation continues normally in the event of failure of a single hydraulic system. The combined change in airfoil resulting from lowered flaps and drooped leading edge sections increases lift and decreases stall speeds. For flight at less than transonic speeds, the CRUISE position provides best performance. In this position, the middle and outboard droop leading edge sections are lowered to 5 degrees and the inboard section to 3 degrees. For high-speed flight, the leading edges are fully retracted by placing the flap control switch in SUPERSONIC. Beyond the CRUISE position, droop operation lags flap movement slightly.

BOUNDARY LAYER CONTROL

Overwing leading edge boundary layer control is provided to increase the lift available for take-off and landing. BLC is automatically coordinated with droop leading edge operation. A BLC valve, installed in the compressor bleed line from each engine, directs high-velocity air over the wings, beginning when the droops leave the CRUISE position. Flow reaches maximum when the outboard and middle droop sections are extended approximately 40 degrees. This high-velocity flow effectively increases lift available for landing and take-off. Operation of the droop leading edge BLC valves is monitored to provide indication of proper operation. Operation of the valves during both opening and closing (droop extension and retraction) is indicated through the DROOPS caution indicator. Refer to DROOPS CAUTION INDICATOR, in this section.

FLAP/DROOP CONTROLS AND INDICATORS

FLAP CONTROL SWITCH

The flap control switch (1, figure 1-28) is located outboard of the throttle quadrant on the left console. Operation of the wing flaps and droop leading edge, plus various automatic features, is coordinated through the use of this multiple lever-lock switch. The flap control switch has 50°, 40°, 30°, CRUISE, and SUPERSONIC positions. On aircraft not having the 40° position,* a HOLD position is incorporated. For flap control functions, see figure 1-28. The flap control switch may be moved directly between the 40°, 30°, and CRUISE positions, but must be lifted and moved into the 50° position, and lifted and moved into and out of SUPERSONIC. The control switch may be pushed directly from 50° to 40°; however, if lifted while in the 50° position, a mechanical stop prevents movement to 30° (HOLD*) or CRUISE. See figure 1-28.

Note

- To prevent inadvertent movement directly from SUPERSONIC to 30° (HOLD*) at high speeds, the flap control switch must be dropped into CRUISE before 30° (HOLD*) can be selected. This provision prevents inadvertent deactivation of speed brakes.
- On some aircraft,* moving the flap control switch to HOLD after selecting 30-degree flaps results in full 50-degree droops extension. Do not select HOLD from the 30° position, since full droops result in excessive BLC air bleed and increased drag.

FLAP/DROOP POSITION INDICATORS

Refer to DROOP, FLAP, AND TRIM INDICATOR, in this section.

DROOPS CAUTION INDICATOR

The DROOPS caution indicator (figure 1-10) indicates to the pilot that further increase in airspeed with the droop leading edge at CRUISE will result in increased drag and fuel consumption and decreased acceleration performance, and provides a monitor of proper operation of the leading edge BLC valves. Speed warning consists of indicator illumination at approximately 590 KIAS or 1.3 IMN and above, with the flap control switch at CRUISE. Moving the switch to SUPERSONIC or slowing to less than 590 KIAS or 1.3 IMN will extinguish the indicator. Failure of the leading edge BLC valves to open or close properly is indicated by illumination of the DROOPS caution indicator as the droops pass the 10-degree position. No indication is available with the droops at 25 degrees.

CAUTION

DROOPS caution indicator illumination on extension or retraction indicates faulty valve operation, which can cause dangerous loss of lift or structural damage from high-temperature/high-velocity airflow.

EMERGENCY FLAP SWITCH

The EMERG FLAP switch (2, figure 1-28) operates the flap emergency pneumatic subsystem. This lever-lock switch has NORM, UP, and DOWN positions. In the event of failure of the No. 2 hydraulic system, or failure of the flap and droop control electrical circuit, moving this switch to DOWN extends the flaps by pneumatic power and the droops by movement of the droop position actuator. Air/hydraulic separation during use of the emergency system is provided by floating pistons in the flap actuators which are inactive during normal operation. If the switch is returned to NORM after emergency extension, the flaps are locked down.

Note

- Emergency extension results in full flap and droop deflection regardless of flap control switch position.
- Loss of all electrical power after emergency extension does not affect flap/droop position.

***Aircraft 150823 through 151630 not having AFC 118 complied with**

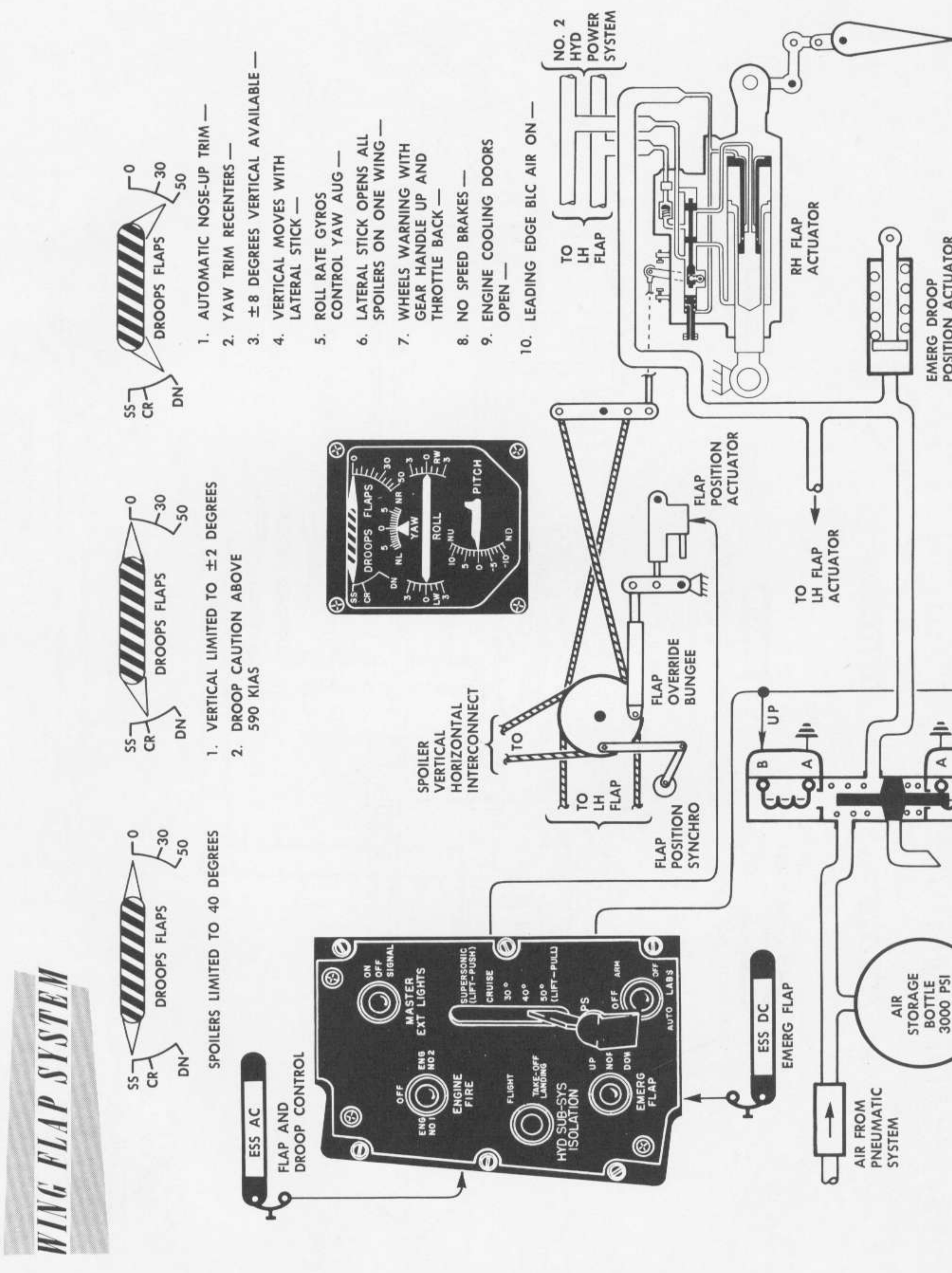

WING FLAP SYSTEM
SS
CR
DN
DROOPS FLAPS
0
30
50
SPOILERS LIMITED TO 40 DEGREES
1. VERTICAL LIMITED TO ±2 DEGREES
2. DROOP CAUTION ABOVE 590 KIAS
1. AUTOMATIC NOSE-UP TRIM —
2. YAW TRIM RECENTERS —
3. ±8 DEGREES VERTICAL AVAILABLE —
4. VERTICAL MOVES WITH LATERAL STICK —
5. ROLL RATE GYROS CONTROL YAW AUG —
6. LATERAL STICK OPENS ALL SPOILERS ON ONE WING —
7. WHEELS WARNING WITH GEAR HANDLE UP AND THROTTLE BACK —
8. NO SPEED BRAKES —
9. ENGINE COOLING DOORS OPEN —
10. LEADING EDGE BLC AIR ON —
ESS AC
FLAP AND DROOP CONTROL
MASTER EXT LIGHTS
ON
OFF
SIGNAL
SUPERSONIC (LIFT-PUSH)
CRUISE
30°
40°
50° (LIFT-PULL)
PS
OFF
ARM
AUTO LABS
ENGINE FIRE
ENG NO1
ENG NO2
HYD SUB-SYS ISOLATION
FLIGHT
TAKE-OFF LANDING
EMERG FLAP
UP
NOF
DOW
ESS DC
EMERG FLAP
PITCH
ROLL
YAW
NL
NR
NU
ND
LW
RW
SPOILER VERTICAL HORIZONTAL INTERCONNECT
TO
TO LH FLAP
FLAP POSITION SYNCHRO
FLAP OVERRIDE BUNGEE
FLAP POSITION ACTUATOR
TO LH FLAP ACTUATOR
NO. 2 HYD POWER SYSTEM
RH FLAP ACTUATOR
EMERG DROOP POSITION ACTUATOR
UP
DN
B
A
C
EMERGENCY FLAP VALVE
AIR STORAGE BOTTLE 3000 PSI
AIR FROM PNEUMATIC SYSTEM
A-5C-1-52-14

Figure 1-27A

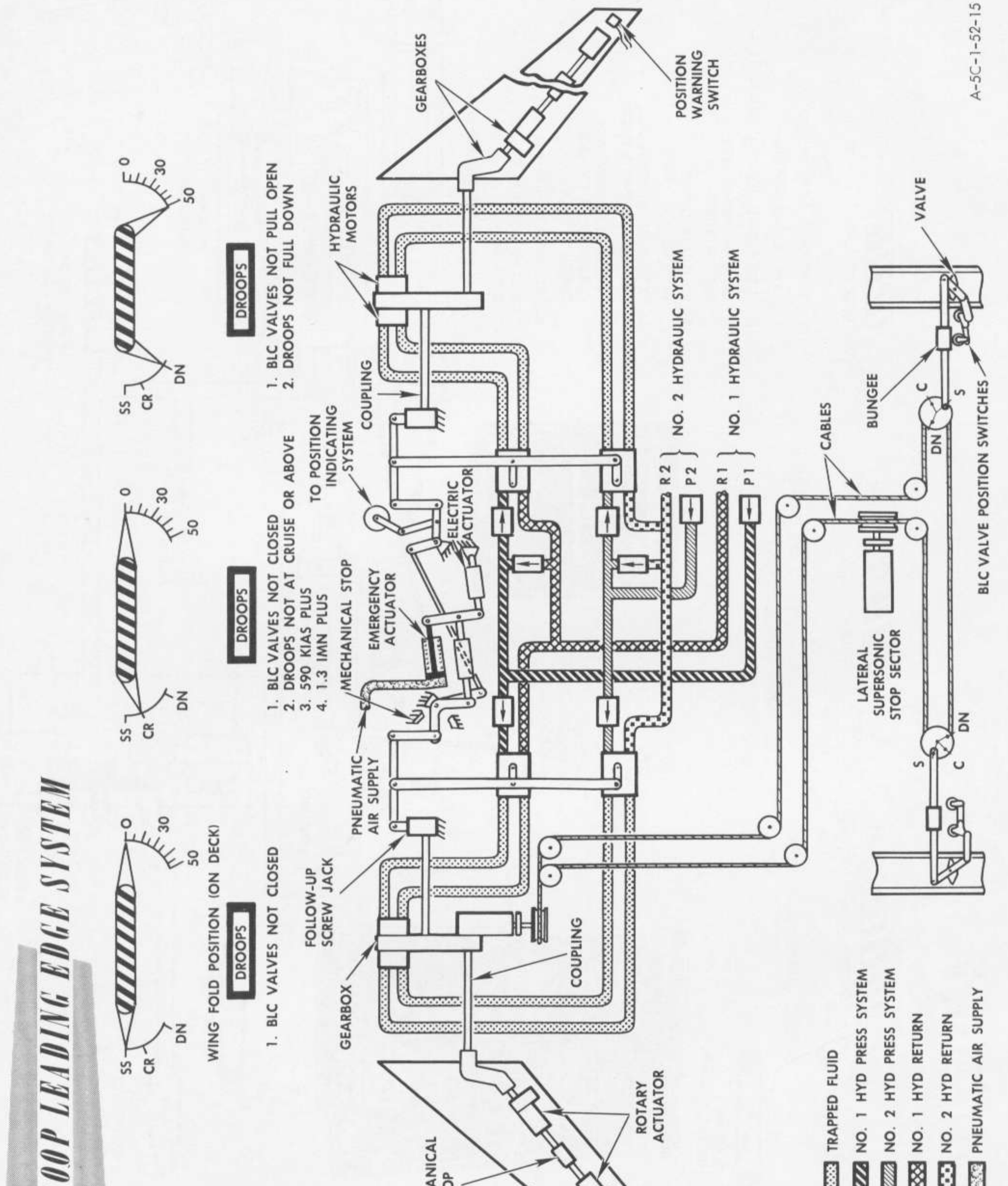
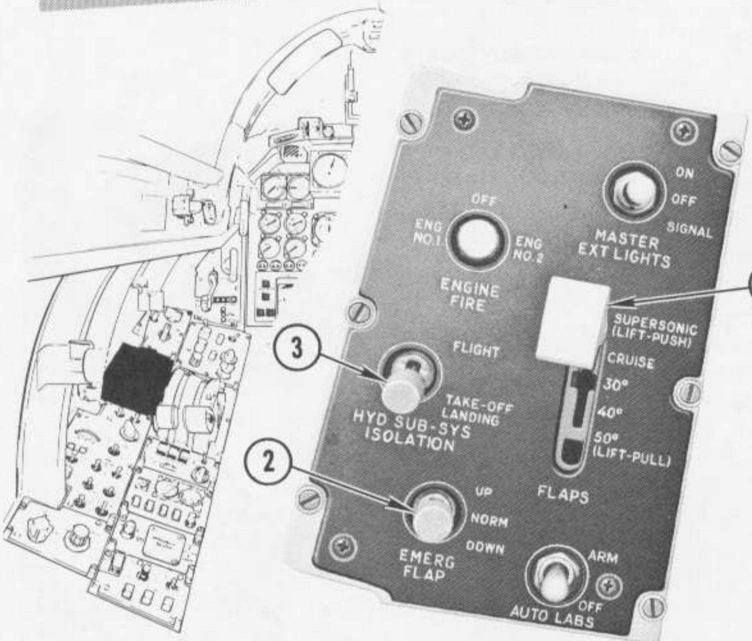

DROOP LEADING EDGE SYSTEM
SS
CR
DN
0
30
50
DROOPS
WING FOLD POSITION (ON DECK)
1. BLC VALVES NOT CLOSED
1. BLC VALVES NOT CLOSED
2. DROOPS NOT AT CRUISE OR ABOVE
3. 590 KIAS PLUS
4. 1.3 IMN PLUS
1. BLC VALVES NOT PULL OPEN
2. DROOPS NOT FULL DOWN
GEARBOXES
POSITION WARNING SWITCH
A-5C-1-52-15
HYDRAULIC MOTORS
COUPLING
TO POSITION INDICATING SYSTEM
ELECTRIC ACTUATOR
EMERGENCY ACTUATOR
MECHANICAL STOP
PNEUMATIC AIR SUPPLY
FOLLOW-UP SCREW JACK
GEARBOX
COUPLING
ROTARY ACTUATOR
MECHANICAL STOP
R 2
P 2
NO. 2 HYDRAULIC SYSTEM
R 1
P 1
NO. 1 HYDRAULIC SYSTEM
CABLES
BUNGEE
VALVE
C
S
DN
BLC VALVE POSITION SWITCHES
LATERAL SUPERSONIC STOP SECTOR
TRAPPED FLUID
NO. 1 HYD PRESS SYSTEM
NO. 2 HYD PRESS SYSTEM
NO. 1 HYD RETURN
NO. 2 HYD RETURN
PNEUMATIC AIR SUPPLY

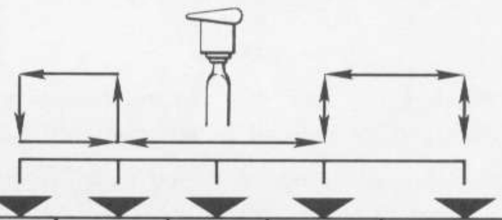
Figure 1-27B

FLAP AND DROOP CONTROLS



1. FLAP AND DROOP CONTROL SWITCH
2. EMERGENCY FLAP SWITCH
3. HYDRAULIC SUB-SYSTEMS ISOLATION SWITCH

FLAP CONTROL SWITCH OPERATION



	50°	40°	30°	CRUISE	SUPERSONIC
TRAILING EDGE FLAPS	50°	40°	30°	0°	0°
DROOPS — INBOARD	28.5°	28.5°	15.5°	3°	0°
MID/OUT	50°	50°	25°	5°	0°
AVAILABLE SPEED BRAKE	0	0	0	55°	55°

FLAP CONTROL FUNCTIONS

FLAP POSITION	FLAP SWITCH POSITION	DROOP POSITION INBD	DROOP POSITION MID/OUT	FUNCTION
0°	SUPERSONIC	0°	0°	Spoiler-deflector travel mechanically limited to 40 degrees inboard/ 48 degrees outboard.
	CRUISE	3°	5°	Spoiler-deflector travel unlimited (70 degrees).
30°	30°	15.5°	25°	Directional ratio change and trim centering-speed brake automatic retraction and deactivation. Lateral control transfer—0° to 30° flaps.
0°—50°	40° OR 50°	28.5°	50°	Boundary layer control—outboard droops down 10° or more. Wheels warning light—flaps down 25° or more with either throttle retarded below position for approximately 85 to 90% engine rpm. Pitch trim compensation of horizontal stabilizers throughout flap range.

A-5C-1-52-6D

Figure 1-28

FLAP EMERGENCY EXTENSION PROCEDURE

Pneumatic system pressure is used to extend the flaps in the event of failure of the flap control electric circuit and/or the No. 2 hydraulic system. In the event of a failure in the primary electrical system, selection of emergency flaps will position the flap control valve and No. 2 hydraulic system pressure will extend the flaps. In the event of No. 2 hydraulic system failure, selection of emergency flaps results in extension by pneumatic pressure. Flap emergency extension pneumatically operates the droop leading edge electrical position actuator. In the event of droop electrical failure, and/or failure of the No. 2 hydraulic system, use of the emergency flap switch results in droop extension. The lateral control transfer system (outboard spoiler operation) operates on emergency flap extension prior to reaching the 30-degree position. To extend the flaps by the emergency method, reduce speed to less than 190 KIAS, move the EMERG FLAP switch to DOWN, and place the flap control switch to 50°.

Note

- Full (50°) flaps may not be obtained until airspeed is reduced to less than 170 KIAS.
- Failure of droops to extend with flap emergency extension, after No. 1 hydraulic system failure, indicates No. 2 hydraulic system isolation. Prepare to make a no-droops landing approach.

LANDING GEAR

The retractable tricycle landing gear is electrically controlled and hydraulically operated. The landing gear swings forward on retraction, the main gear rotating 90 degrees and locking into the fuselage. Normal retraction requires 7 to 9 seconds. In the event of hydraulic failure, the forward retraction feature allows the gear to be extended by gravity and air load by pulling the emergency landing gear handle. The wheel well and fairing doors are electrically sequenced so that they are open whenever the gear is in any unlocked position.

Note

The gear fairing and wheel well doors do not close after landing gear emergency extension.

CONTROLS AND INDICATORS

LANDING GEAR HANDLE

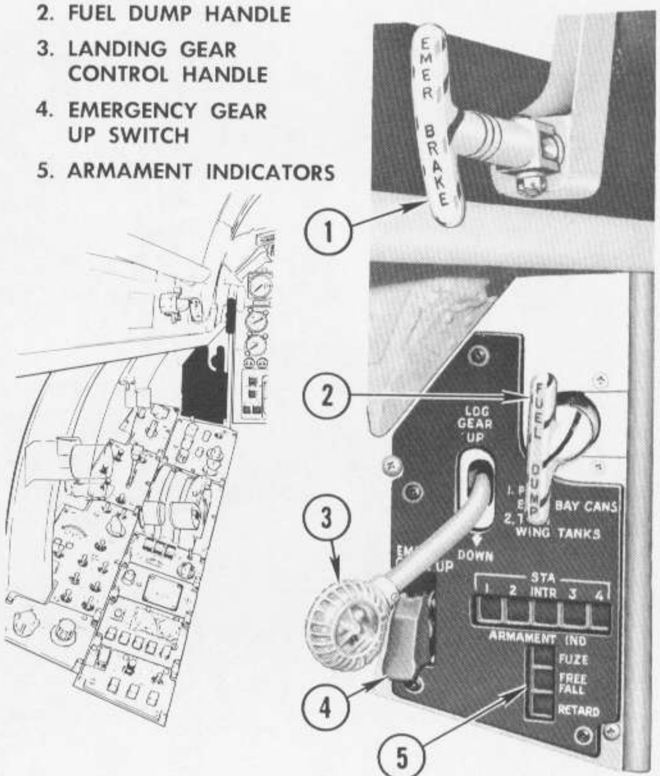
The landing gear handle (3, figure 1-29) is located on the left forward console in the pilot's cockpit.

LANDING GEAR WARNING LIGHT

The landing gear handle (3, figure 1-29) contains a red warning light. This light will illuminate during normal operation whenever the landing gear is not locked in the position called for by the landing gear handle. After gear retraction, the light remains on if any gear or door does not lock in the retracted position. After extending, the light stays on if the gear fails to lock down. The warning light will not be illuminated should the gear doors and fairing doors fail to close with the gear locked down. Turning the instrument lights knob out of OFF connects this light to a reduced power source for dim lighting.

LEFT FORWARD CONSOLE

1. EMERGENCY BRAKE HANDLE
2. FUEL DUMP HANDLE
3. LANDING GEAR CONTROL HANDLE
4. EMERGENCY GEAR UP SWITCH
5. ARMAMENT INDICATORS



A-5C-1-00-5A

Figure 1-29

EMERGENCY GEAR UP SWITCH

A guarded emergency gear up switch (EMERG GEAR UP, 4, figure 1-29) is installed on the left forward console in the pilot's cockpit. This switch is provided for retracting the landing gear in the event of control switch or circuit-breaker malfunction. Should emergency retraction in flight be necessary, the switch may be moved to the up position to retract the gear. With essential bus and No. 2 hydraulic system power available, the landing gear will retract regardless of landing gear handle position if the weight of the aircraft is off the extended landing gear.

WARNING

With electrical and hydraulic power available, moving the emergency gear up switch to the up position bypasses the normal gear retraction circuit, unlocks the gear door uplocks and landing gear downlocks, and sequences the landing gear system to retract. Should a failure in landing gear ground safety circuit or loss of power in the normal landing gear control (handle) circuit occur, retraction may occur with the weight of the aircraft on the gear.

Note

If the emergency gear up switch is used, gear extension for landing requires placing the switch to normal (down) and using normal extension procedure.

LANDING GEAR POSITION INDICATOR

A landing gear position indicator (37, figure 1-10) is installed on the instrument panel. This indicator contains a window for each landing gear, indicating "UP," "DN," or a barber pole for an unsafe condition or the absence of electrical power.

WHEELS WARNING INDICATOR

The WHEELS warning indicator (2, figure 1-10) is installed on the instrument panel shroud. This indicator is illuminated and the master warning indicator will flash whenever either throttle is retarded to a position corresponding to approximately 85% to 90% engine rpm and the landing flaps are extended 25 degrees or more, if the landing gear handle is *not down*. There is no dimming feature for this indicator. The WHEELS warning indicator is powered by the essential d-c bus and can operate on emergency electrical power from the ram-air turbine-powered emergency power unit.

Note

Extinguishing of the WHEELS warning indicator is not an indication that the gear is locked down.

LANDING GEAR EMERGENCY EXTENSION HANDLE

A landing gear emergency extension handle (26, figure 1-10) is installed on the right side of the center pedestal. When the retaining safety clip is pushed down and the handle is pulled outward and held at full travel (approximately 15 inches), all gear and fairing door uplocks are released, allowing gravity and air loads to extend the gear to the down and locked position.

GEAR STIFF CAUTION INDICATOR

The GEAR STIFF caution indicator (figure 1-10) is provided to indicate the hydraulically extended and stiffened, catapulting position of the nose gear strut. The nose gear strut stiffening system is designed to position the nose gear for catapult launch. On manual extension of the right-hand catapult hook, the nose gear strut is pressurized by the No. 2 hydraulic system, limiting strut stroke to 9 inches. After launch, retraction of the right-hand hook or the landing gear relieves the strut stiffening pressure.

LANDING GEAR OPERATION

Landing gear normal retraction occurs in three phases: (1) doors open, (2) gear retracts, and (3) doors close. Failure of either the gear to retract or the doors to close causes the landing gear warning light to remain illuminated and the position indicator to remain barber-poled. Landing gear normal extension occurs in reverse order to retraction.

Note

The landing gear fairing doors normally will be open for preflight inspection. During the walk-around, ensure that the GEAR DOOR switch (electrical power access panel) is positioned to NORMAL.

CAUTION

On engine start, the landing gear doors will close abruptly as No. 2 hydraulic system pressure builds. Ensure that all ground personnel are clear of the gear wheels prior to starting engines.

ARRESTING GEAR

The arresting hook is located on the aft lower fuselage and is hinged adjacent to the root of the horizontal stabilizer leading edges. The V-shaped arresting gear is faired into the fuselage by mechanically operated trunnion, hook point doors, and beam fairing doors. The hook extends to 55 degrees from vertical. The hook is extended and retracted by operation of a snubber actuator that has an integral piston-type hydraulic air accumulator. Retraction utilizes No. 2 hydraulic system pressure while extension is accomplished by gravity and precharged air pressure in the accumulator portion of the snubber actuator. While the hook is extended, the snubber actuator acts to snub hook bounce to prevent arresting wire skip. Hook point doors are installed to cover the hook point when the arresting gear is retracted. These doors are opened and closed mechanically by the hook during the cycle. An air/oil hook bumper unit prevents the hook from bouncing into the access well during arrested landings and retracts before the hook is retracted.

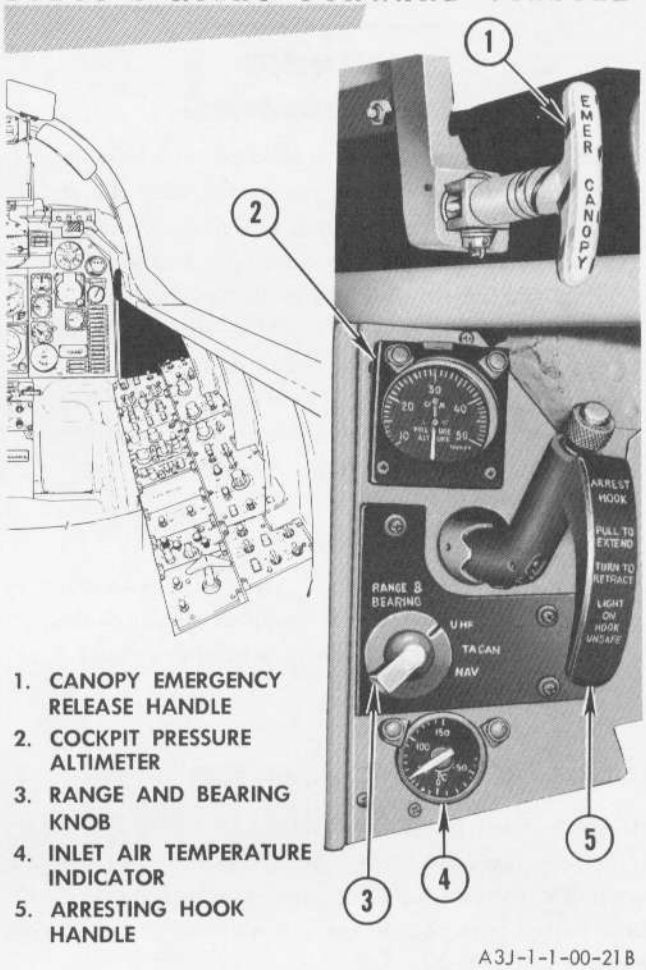
ARRESTING HOOK HANDLE

An arresting hook handle (5, figure 1-30) is located on the pilot's right forward console. The hook is extended by pulling the handle aft approximately 5 inches. This unlocks the doors, releases the hook uplock, and allows the hook to drop by gravity, assisted by air pressure in a snubber actuator. The hook may not reach the fully extended position until airspeed is reduced to the point at which gravity and precharged snubber actuator air pressure can overcome the force of the air stream. The arresting gear may be retracted by turning the handle counterclockwise and allowing it to return to the stowed position. This allows No. 2 hydraulic system pressure to act upon the bottom of the actuator, retracting the hook. Hook extension is not dependent upon hydraulic system pressure or electrical power; therefore, no separate emergency system is provided. Should the control valve stick in the "hook up" position, a mechanical override linkage forces the valve to the "hook down" position.

HOOK WARNING LIGHT

The hook warning light is located on top of the arresting hook handle. This red light will come on any time the arresting hook is not in the position selected by the arresting hook handle. Should the control cable break between the handle and the control sector, the hook warning light will illuminate and the hook will extend, regardless of handle position. A control cable break between the sector and the emergency bungee causes the hook and doors to unlock, but the hook warning light will remain off and the hook will remain retracted until the handle is pulled.

PILOT'S RIGHT FORWARD CONSOLE



1. CANOPY EMERGENCY RELEASE HANDLE
2. COCKPIT PRESSURE ALTIMETER
3. RANGE AND BEARING KNOB
4. INLET AIR TEMPERATURE INDICATOR
5. ARRESTING HOOK HANDLE

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Figure 1-30

CAUTION

High-rate blinking of the hook warning light indicates an out-of-adjustment condition of the hook uplock switch mechanism, causing rapid extend/retract commands to the hook snubber actuator. This condition could result in hydraulic line or snubber actuator failure, loss of proper arresting hook action, and No. 2 hydraulic system failure. In the event of hook light blinking, place the HYD SUB-SYS ISOLATION switch to FLIGHT. This results in a steady illumination of the warning light.

NOSE WHEEL STEERING

Nose wheel steering authority to 75 (±5) degrees either side of center is provided through the control pedals when the STEER/TERRAIN button is depressed. When the button is not depressed, the nose wheel is in the damping, swiveling configuration which allows 360-degree swiveling of the nose wheel for ground handling purposes and unlimited steering deflection through differential braking. System design is such that, as the flaps are extending, the deflection of nose wheel steering is reduced gradually to a maximum of 35 percent. Differential braking will still produce unlimited steering. As a safety feature, the nose wheel steering system will operate only when the weight of the aircraft is on the left-hand main landing gear. On some aircraft,* the nose wheel steering is activated by the weight of the aircraft on either main landing gear.

Note

A yaw trim change during nose wheel steering operation repositions the control pedals, turning the nose wheel.

STEER/TERRAIN BUTTON

A momentary contact button labeled STEER/TERRAIN, is located on the control stick grip (figure 1-26). Nose wheel steering is activated by holding the button depressed, and control is maintained through movement of the directional control pedals. The STEER/TERRAIN button is also used as a radar mode control when the aircraft is in flight and, in addition, has several bomb directing set functions. Refer to BOMB DIRECTING SET, AN/ASB-12, in Section I, Part 2, of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

WHEEL BRAKES

The wheel brake system consists of two independent hydraulic systems: the normal brake system, with an auxiliary accumulator, and the emergency brake system. They are completely separate down to the shuttle valve at each main gear wheel. The normal system consists of two brake power metering valves, a brake auxiliary accumulator, and necessary connections. The power brake valves, one for each wheel, provide differential pressure at the wheel in proportion to the degree the pedals are depressed. Pressure from the No. 2 hydraulic system is metered from the valves to each brake unit. The hydraulic auxiliary brake accumulator in the normal system is capable of a minimum of three full brake applications and up to as many as 12 lesser applications of a magnitude necessary to stop a fully loaded aircraft during ground handling operations. An externally mounted brake accumulator pressure repeater gage is located on the left side of the forward fuselage, just ahead of the intake duct. This gage must indicate a precharge of 1000 psi at 40° to 90°F (or 3000 psi if the hydraulic system has been operating and pressure has not been bled) and is used to check that adequate auxiliary accumulator pressure is available for power-off braking.

BRAKE AUXILIARY HAND PUMP

A braking system auxiliary hand pump is located on the auxiliary brake accumulator service panel in the forward end of the nose wheel well. Prior to deck spotting or power-off braking, the auxiliary brake accumulator must be pumped to 3000 psi.

CAUTION

If pressure is depleted to 1250 psi, repumping to 3000 psi is required before further power-off braking can be accomplished.

EMERGENCY BRAKES

The emergency brake accumulator receives pressure from the No. 2 hydraulic system. The system is operated by an emergency brake handle located on the left forward console (1, figure 1-29), and provides equal pressure to both brake assemblies simultaneously in proportion to the extent the handle is pulled. Optimum emergency braking is obtained by slowly pulling outward on the handle, increasing braking force as speed decreases. The emergency brake accumulator provides a minimum of three full brake applications and up to as many as 12 lesser applications. On some aircraft,† a thermal relief valve protects the system against thermal expansion.

Note

For field landings utilizing emergency brake accumulator, it is recommended that the emergency brakes be used first to conserve auxiliary brake accumulator action for directional control of the last stages of landing rollout.

WHEEL BRAKE SYSTEMS OPERATION

The wheel brake systems are capable of stopping the aircraft under nearly all mission conditions. In addition to normal full power braking, limited duration braking is supplied by the auxiliary brake accumulator.

***Converted aircraft and aircraft 149300 through 149317, and 150823 through 151728 having AFC 129 complied with**

†Converted aircraft and aircraft 149300 through 149317, and 150823 through 151728 having AFC 137 complied with

NORMAL

Normal braking requires relatively light pedal forces and pedal deflection. Up to 85 pounds force is normally sufficient for field landing rollout braking at typical gross weights. Directional control is easily maintained in the event of nose wheel steering failure, and differential braking can be used to execute turns exceeding the 75-degree swivel of the nose wheel steering system.

Note

- A pedal force of about 100 pounds is required to hold the aircraft with both engines at Military Thrust.
- Provided gross weight is sufficient to prevent tire skidding, properly operating brakes will hold the aircraft at MIN AFTERBURNER.

For a discussion of optimum braking technique, refer to STOPPING THE AIRCRAFT, in Section III, Part 3.

EMERGENCY

Note

Upon first indication of any brake malfunction, the aircraft should be maneuvered off the duty runway and towed in. Should brake failure occur on the catapult, pull the emergency brake handle, signal the Catapult Officer, and down the aircraft.

In the event of failure of the No. 2 hydraulic system or during towing operations, the charge in the auxiliary brake accumulator may be used to obtain braking. If a single, increasing pressure application is used, sufficient power is available to stop. Approximately three "on and off" type applications are available with a fully charged auxiliary accumulator, and up to 12 lesser applications of the "towing and spotting" type. Auxiliary brake accumulator charge for ground operation is indicated by an auxiliary pressure gage on the left fuselage below the aft cockpit.

FOLD SYSTEMS

WING AND TAIL FOLD

Power folding of the wings and vertical stabilizer is accomplished by No. 2 hydraulic system pressure. A hydraulic lock valve is provided in the wing fold line to prevent inadvertent wing spreading in the event of hydraulic pressure loss during wing folding, and to maintain the folded position when hydraulic pressure is removed. A manual override lever is installed on the wing fold lock valve to permit manual spreading of the wings. A similar lever on the tail fold control valve (located on the bottom of the aft fuselage left of the arresting hook point doors) also allows manual folding and unfolding of the vertical stabilizer. Positive hydraulic sequencing actuates the lockpins upon completion of the wing spread cycle. Manually operated locks, actuated from the cockpit, secure the lockpins in position. Folding and unfolding of the wings and vertical stabilizer can be accomplished simultaneously by using the fold control handle. The wings can be cycled independently, if desired, by selecting the OFF position of the tail control switch.

Note

An electrical interlock between the droop position and the wing fold controls is designed to prevent folding of the wings with droops in any position but SUPERSONIC. Attempting to fold the wings with droops other than fully retracted (SUPERSONIC) may cause damage to leading edge BLC.

FOLD CONTROL HANDLE

Operation of the wing and tail fold system is controlled by the use of the fold control handle (figure 1-31), installed at the rear of the right console. With the wings folded, clockwise rotation of the handle to the UNLOCK position spreads the wings and extends the vertical stabilizer. The pilot should then pause for 10 seconds to ensure that the wing and tail lockpins have been sequenced into position. The handle should then be pushed down and twisted counterclockwise to the LOCK position. This action provides mechanical security for the wing

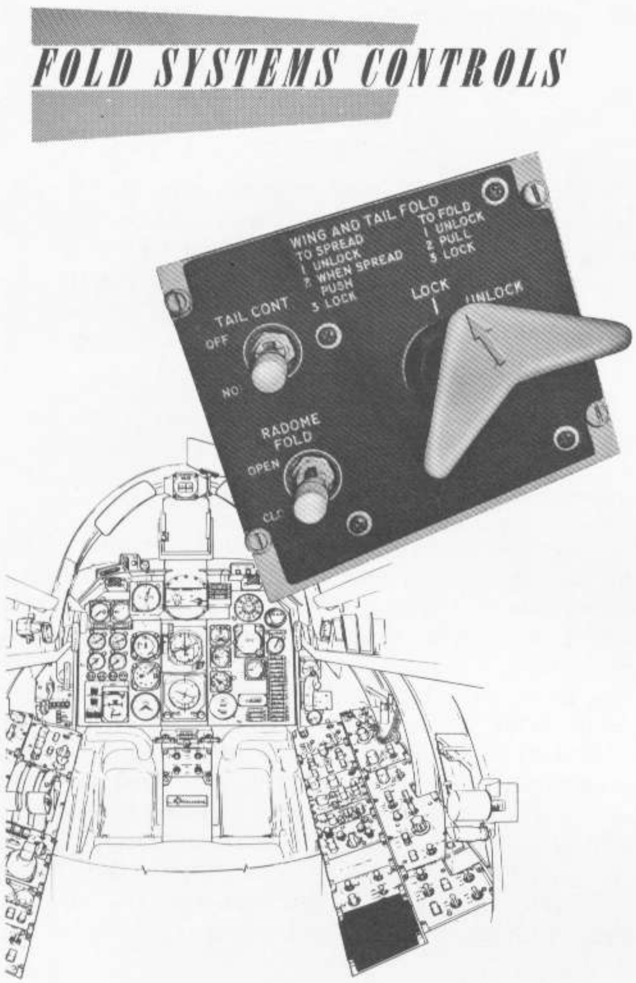

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Figure 1-31

and tail hydraulic lockpins. For wing and tail folding, this procedure is reversed.

Note

The handle must be lifted slightly before it can be moved to either the locked or unlocked position.

CAUTION

- If the wings are folded, check that the control handle is in the LOCK position prior to engine start.
- Ensure that the flap control switch is at SUPERSONIC before folding wings, as damage to the leading edge can occur at CRUISE or below.

TAIL CONT Switch

The TAIL CONT switch (figure 1-31) is used to select simultaneous folding of the outboard wing panels and the vertical stabilizer (NORM position), or folding of the outboard wing panels only (OFF position).

Wing and Tail Fold Warning Flags

Red warning flags are installed at the fold lines of the wings and vertical stabilizer. These flags extend on both sides of each folding surface when the fold control handle is pulled (unlocked) and retract when the handle is pushed in (locked).

RADOME FOLD

To permit access to the radar compartment and to facilitate handling, the radome can be opened and rotated upward and aft through operation of an electrical actuator. A warning flag protrudes on each side of the radome as an indication that the latches are not locked. An interlock relay prevents operation of the fold circuit unless the aircraft is on the ground and the radar antenna is in its stowed position.

RADOME FOLD SWITCH

Moving the two-position RADOME FOLD switch (figure 1-31) to OPEN supplies monitored bus a-c electrical power to a latch drive motor. When the latches are fully unlocked, the fold actuator extends, opening the radome. Moving the switch to CLOSE causes the actuator to retract the radome toward the closed position until a limit switch energizes the locking latches. This mechanically positions the warning flags flush with the radome exterior.

External Control Switch

An external radome fold control switch (interlock bypass) is installed inside the right jowl door aft of the radome. This switch is used to open or close the radome with the aircraft electrical system energized and the cockpit RADOME FOLD switch at OPEN.

Note

Should radome fold fail to operate when selected, check that the external control switch is positioned to CLOSE.

CANOPIES

Both cockpits are provided with separate jettisonable, clamshell canopies. The pilot's canopy is of conventional design. The aft canopy is primarily of metal construction with a small window on each side, restricting the amount of light in the cockpit for monitoring radar and television equipment. Both canopies are opened and closed by pneumatic cylinders, which are controlled by pneumatic toggle valves on the left forward fuselage. Internal and external manual release is also provided. Power for canopy operation is supplied by the aircraft pneumatic compressor system. Canopy operation does not require electrical power. Sufficient air is stored to provide approximately 25 canopy cycles. An emergency air bottle is also provided for each canopy, supplying 3000 psi air for emergency jettison. When normal opening is initiated, the canopies move rearward approximately 1 inch to unlock, then swing upward 33 degrees to the fully open position. Normal opening or closing time is 8 to 14 seconds.

Note

During the closing or opening cycle, the canopy may "bounce" slightly. This is not an abnormal condition.

CANOPY CONTROLS AND INDICATORS

CANOPY TOGGLE VALVE

The canopy toggle valve (6, figure 1-9) is located above the left console. This three-position pneumatic valve has CLOSE, NORMAL, and OPEN positions and is spring-loaded to NORMAL. Prior to actuating the canopy, hold toggle valve in same position as canopy to prevent possible rough operation.

CAUTION

Should the canopy toggle valve be held momentarily to OPEN at any time after the canopy is closed (before take-off), ensure that the canopy is locked by holding the toggle valve in CLOSED. This will prevent possible in-flight loss of the canopy due to movement of the locking overcenter linkage.

EXTERNAL TOGGLE VALVES

A toggle valve for each canopy is installed in a canopy control access below the pilot's left-hand canopy skirt. These toggles are used for normal external opening or closing of either canopy and utilize the canopy pneumatic system.

CANOPY JETTISON HANDLE

The canopy jettison handle (1, figure 1-30) is located above the right forward console above the cockpit pressure altimeter. The canopy jettison handle in the aft cockpit is located on the left forward console inboard of the canopy toggle valve. Pulling these handles will jettison the canopies without arming the ejection seats.

CAUTION

Canopies should not be jettisoned when the aircraft is stationary, since canopy trajectory is greatly dependent upon wind. Under no-wind conditions, the forward canopy will fall directly on the aft cockpit. Manual canopy release should be used when aircraft is stationary, except in extreme emergencies.

CANOPY MANUAL RELEASE HANDLES

External Release Handles

Two external manual release handles are installed on each canopy, one on each side. A square push button, located just aft of each handle, must be depressed to release the handle. Once the handle springs out, it should be pulled full forward to a latched position. By using both external handles, two men can remove either canopy. This is accomplished by pushing the latched handles aft with sufficient force to move the canopy aft about 1 inch. The canopy may then be lifted about its pivot point. If the canopy is opened manually, the mechanical uplock must be set to allow the canopy to remain in position. On some aircraft,* when the canopy is manually opened, a ratchet arrangement allows the canopy to hold in one of three positions as selected.

Note

- The canopy is physically disconnected from the actuator when the manual release handles are used. Raise the canopy just enough to allow rotation of the uplock handle. Should the canopy rollers come out of the tracks, the canopy may jam.
- No canopy external jettison provisions are installed.

Internal Release Handle

Both canopies are equipped with an internal release handle on the left side of the skirt. These handles operate the same linkage as the external release handles. To operate, the handle lock is pushed forward, allowing the handle to spring out and downward. Approximately 100 (50*) pounds aft force on the handle may be required to unlock the overcenter linkage and move the canopy aft 1 inch. Manual operation in unmodified aircraft may

***Aircraft 151615 and subsequent and aircraft having AFC 101 complied with**

prove extremely difficult. For in-flight manual operation, the canopy should release when unlocking of the over-center linkage occurs. After manually opening the canopy on the ground, the actuator must be reconnected and pressurized to the up position for normal operation. On some aircraft,* the automatic uplock pawl must be stowed for normal operation.

WARNING

When attempting in-flight manual release, grasp the handle PALM UP, with the thumb TUCKED IN, as serious injury can occur as the canopy departs. The handle should be operated in as close to the vertical position as possible.

Disconnect Override Handles

Both canopies are equipped with an actuator disconnect override handle under an access door on the left rear portion of the frame. When rotated counterclockwise, these handles prevent disconnection of the canopy manual release mechanism from the canopy actuators. If manual access to the cockpits is required under high wind conditions, using these override handles will prevent inadvertent canopy loss. To assure disconnection of the canopy actuator rod end, the handle must be in the down position immediately prior to raising the canopy after the canopy has moved aft. The canopy should then be raised to a minimum height sufficient to allow engaging the canopy uplocks. If the canopy is raised too high, the canopy guide rollers will separate from the guide rails.

MANUAL UPLOCK HANDLE

Each canopy is provided with a manual uplock and handle. These handles are located directly aft of the ejection seat headrests and are a part of the canopy operating mechanism. If the canopies are opened and it is desired that they remain open for a prolonged period, the manual uplocks should be engaged by rotating the manual uplock handles aft until the indicator flag reads "UPLOCK ENGAGED." To unlock the canopies, rotate the handles forward until the forward lock indicator reads "UPLOCK DISENGAGED," and the aft indicator retracts from sight.

Note

To relieve binding of the canopy manual uplocks, pressurize the top side of the canopy actuators by holding the canopy toggle valves to OPEN for at least 5 seconds before disengaging.

CANOPY CAUTION INDICATOR

Each cockpit is provided with a CANOPY caution indicator. These indicators are located in the caution indicator bank on the main instrument panel in the front cockpit and on the top center portion of the display panel in the rear cockpit. The pilot's caution indicator is a flip-shutter type which is energized when one or both canopies are unlocked and electrical power is applied to the circuit from the generators or external power units. The systems operator's caution light will come on only when his canopy is unlocked. An electrical interconnect between the two canopies requires that both canopies be closed and locked before the pilot's indicator will go out.

ESCAPE SYSTEM

The escape system provides safe emergency egress from the aircraft under nearly all flight conditions. If aircraft attitude and rate of sink are within seat recovery capability, escape is possible at ground level at speeds as low as approximately 100 knots.

Note

Ejection of the aft seat can be initiated by the pilot or the systems operator. Refer to EJECTION INTERCONNECT, in this section.

EJECTION SEATS

The ejection seats (figure 1-32) are designed to provide integrated crew environmental services (personal disconnect), as well as safe escape under nearly all flight conditions. The seat bucket is electrically adjustable through a vertical range of 5 inches, while the headrest remains stationary. The seat is equipped with an NB-7E personnel parachute, requiring use of the standard integrated harness garment.

Note

Crew members will personally connect parachute riser and lap strap "Rocket-Jet" fittings when entering, and disconnect when leaving, the aircraft to maintain skill and check for proper operation.

Seat ejection is initiated by pulling the face curtain handle forward and down sharply to full travel, or by turning (unlocking) and pulling either alternate ejection knob. After ejection is initiated, the crewman is automatically positioned in the proper ejection posture by ballistic prepositioning devices. Postejection sequencing provides automatic seat trajectory stabilization and descent to below 13,000 feet, crew member/seat separation, and automatic parachute deployment. Escape from

*Aircraft 151615 and subsequent and aircraft having AFC 101 complied with

EJECTION SEAT

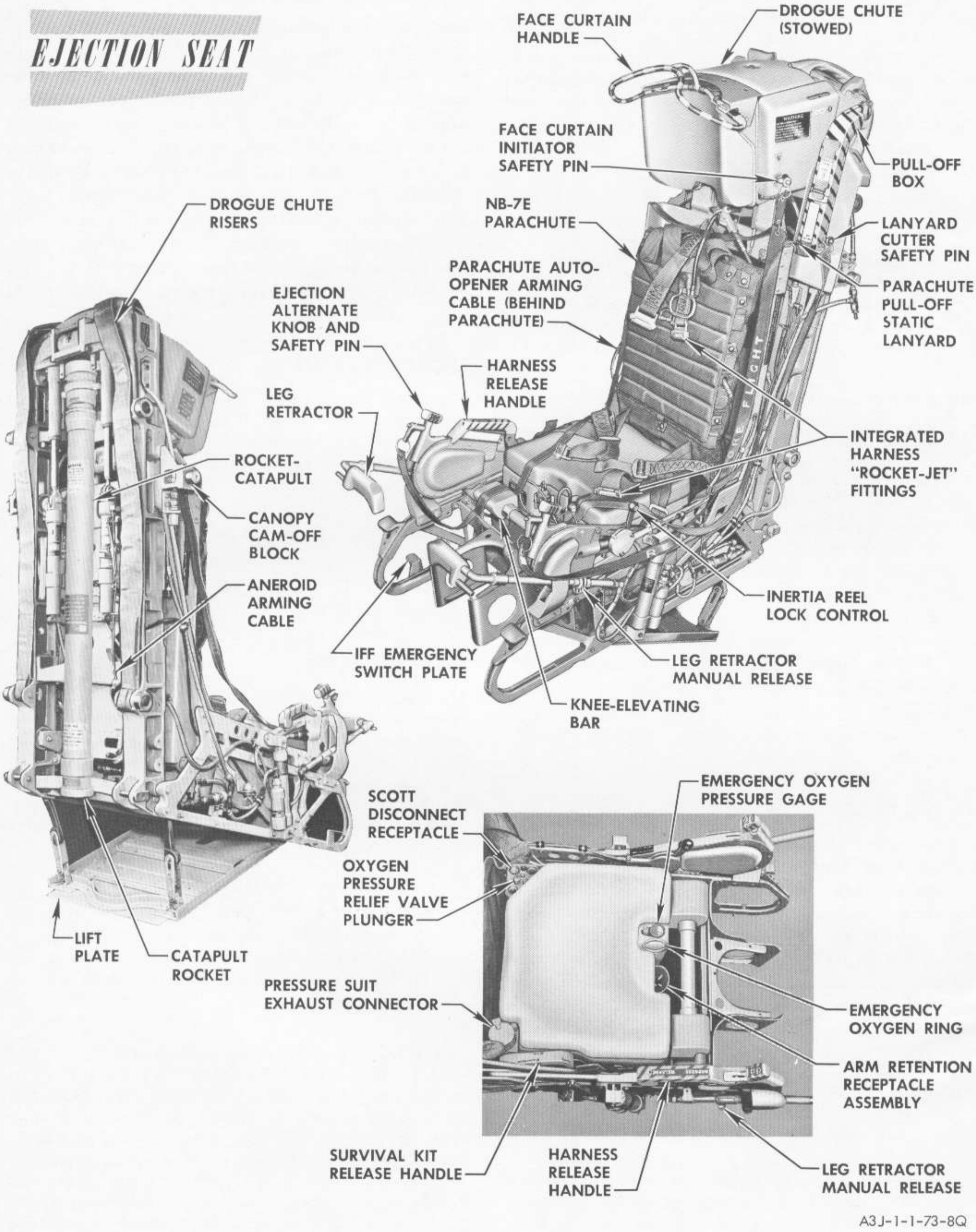


Figure 1-32

the seat in the event of ditching or crash landing is provided by a single handle, which severs or releases all connections to the seat except the Scott disconnect, which separates automatically when the crewman stands up during egress. A hinged lift plate, attached to the bottom of the seat, is opened as the seat rises on ejection. This plate provides additional aerodynamic lift and stability as the seat enters the air stream.

Note

For low-altitude ejections, use of the left-hand alternate ejection pull-knob while maintaining altitude control with the right-hand on the stick, is recommended.

CATAPULT ROCKETS

Seat ejection thrust is provided by a single unit catapult rocket. When actuated, the catapult portion fires, thrusting the seat up the rails and clear of the cockpit. As the seat leaves the rails, the rocket portion ignites, providing a directionally and longitudinally stable thrust. This force is sufficient to propel the seat to a height of approximately 125 feet above the aircraft flight path at average cruise speeds, providing ample height for separation and deployment.

DROGUE PARACHUTES

A 52-inch diameter, stabilizing drogue parachute is installed in each headrest. Approximately 0.5 second after seat begins to move, the drogue chute is deployed by a thruster actuated by a lanyard which is pulled as the seat ascends the rails. For ejections at high altitudes (above 13,000 feet), the drogue chute remains attached to the seat, providing stabilized crewman/seat free-fall to 13,000 feet, where automatic crewman separation and personnel parachute deployment sequencing takes place. Upon seat/man separation, the drogue lower riser attachments are released, allowing the seat to rotate forward about the upper riser attach points simultaneously with separation bladder inflation. As the crewman leaves the seat, the parachute "pulloff" lanyard extends to its full 14-foot length. The drogue upper attachments are then released from the seat, allowing the drogue to deploy the main chute canopy. After approximately 0.5 second of lanyard tension, a small ballistic cutter separates the drogue from the main parachute.

INERTIA REEL

A ballistically operated inertia reel provides crew member retention in an upright position during maneuvering, deceleration, and ejection. The reel may be manually locked and unlocked during normal use by the shoulder harness lock handle. The reel mechanism is attached to the upper portion of the personnel parachute by a strap which, when in the unlocked condition of the reel, allows the crew member to lean forward as desired. When locked by the handle or a 2- to 3-g deceleration, the reel prevents any further play-out. On ejection, the inertia reel ballistic device is actuated, winding in the strap and restraining the crew member in the retracted position in the seat.

KNEE BAR AND FOOT RETRACTORS

During the initial phase of seat ejection, leg positioning and restraint and positioning of the lower torso are accomplished by lowering the seat bucket to bottom, lifting the knees, and locking the feet in foot wells. The knee-raising bar contacts the legs behind the knees. As the knees are lifted, the feet fall into foot wells, and the wells are closed by hooks. If acceleration is being experienced, such that the feet will not fall into the wells, the hooks contact the lower legs and push the feet into the wells. On automatic crewman/seat separation, the foot retractors are ballistically ejected from their housing rods. The knee bar is ballistically rotated through 90 percent of its travel and the crewman's weight shifting forward completes the travel for release from open slots. The foot retractors can be manually spring-ejected by placing the thumb and forefinger behind a release on each retractor rod and pushing down and forward, parallel to the rod. The knee bar may be manually released by pushing forward and down.

SEPARATION SYSTEM

The automatic seat/man separation system consists of a preset aneroid, a ballistic thruster, and ballistically operated mechanical release devices or cutters. The seat remains in the stabilized attitude until it has decelerated to separation velocity and descended below a pressure altitude of 13,000 feet. Then, simultaneously, the lower drogue chute risers, leg hooks, and harness release attachments are released, and separation bladders, located under the survival kit and behind the personnel parachute, are inflated. Refer to ESCAPE SYSTEM OPERATION, in this section.

Separation Aneroid Indicator

The separation aneroid indicator is installed behind an inspection hole in the back of the seat. The indicator is viewed by unlocking the shoulder harness, leaning the parachute forward, and moving the seat back separation bladder to one side. A satisfactory aneroid is indicated if only white can be seen in the inspection window.

Note

At field elevations of 5000 feet and higher, it is acceptable for a small portion of red to be visible in the inspection window.

SURVIVAL KIT

A land and water survival kit is installed in the seat bucket. This kit contains the emergency high-pressure oxygen supply and a standard PK-2 life raft and survival package. The pressure gage for the emergency oxygen system, along with its emergency pull-ring, is located on the left forward portion of the kit as viewed by the seated crew member.

WARNING

Do not use supplemental seat cushions on top of the survival kit. Serious injury can result on ejection due to cushion compression and seat center-of-gravity movement.

Note

During the ejection sequence, the emergency oxygen system is automatically operated. If the crew member is wearing a full-pressure suit, emergency pressurization of the suit is provided above 35,000 feet during seat/man free-fall.

After crewman/seat separation and parachute deployment, the survival kit and raft are manually deployed for water landing by pulling a yellow handle on the right side of the kit. As the raft and equipment package falls to the full length of its retaining lanyard (about 15 feet), the life raft is automatically inflated by its integral CO_2 bottle. A retractable knife for emergency cutting of parachute shroud lines is located in the kit release handle.

SEAT ADJUST SWITCH

The SEAT ADJUST switch (5, figure 1-11) is located on the right console. This switch provides electrically operated seat height adjustment. The seat adjust circuit is inoperative with one generator inoperative.

HARNESS LOCK HANDLE

The harness lock handle (figure 1-32) is located on the left side of the seat. Moving the handle to the LOCK (forward) position prevents the crew member from leaning forward by locking the inertia reel. The reel may be unlocked by leaning back to remove tension from the reel and moving the handle back to UNLOCK. If the reel is locked automatically, the reel may be unlocked by cycling the handle.

EJECTION INTERCONNECT

The ejection seats are connected by a system of ballistic lines and a delay device to allow the pilot to operate the escape sequence in both cockpits. This interconnect does not allow the systems operator to eject the pilot, nor does it in any way affect the systems operator's ability to initiate his own ejection. In the event of an emergency, initiation of ejection by the pilot jettisons both canopies. The aft seat is then automatically ejected, followed approximately 0.75 second later by the forward seat. This sequence provides safe separation from the canopies and ensures crew member separation.

WARNING

On being warned of emergency ejection by the pilot, the systems operator must make every effort to assume the appropriate position for ejection.

HARNESS RELEASE HANDLE

The harness release (ditching) handle (figure 1-32) allows complete crew member separation from the seat through the action of this single handle. When pulled up through full travel, this handle releases the following:

1. Survival kit hold-down attachments.
2. Parachute static "pulloff" lanyard.
3. Shoulder harness and lap belt attach points.
4. Parachute automatic opener (if seat is NOT ejected).

WARNING

- After ejection, the harness release handle may be used, if desired, to override the automatic separation and chute deployment sequence. The parachute automatic opener is armed on separation from the seat. If, however, the harness release handle is used to obtain freedom from the seat for *unejected bail-out*, the automatic opener cable is *released* and the *manual "D" ring* must be pulled to obtain parachute deployment.
- Manual separation at high altitudes can result in severe tumbling or spinning, causing possible injury or death.

FACE CURTAIN

The face curtain is stowed in the seat headrest. The curtain "B" handle, in the event ejection is to be initiated, should be gripped firmly with both hands and pulled sharply outward and down over the head in one continuous motion (approximately 18 inches).

ALTERNATE EJECTION PULL-KNOBS

The alternate ejection pull-knobs are located on each side of the seat frame at the knee position. To operate, either knob must be turned inward to unlock (about 40 pounds force), then pulled upward ¾ inch with a force of about 30 pounds to initiate ejection.

ESCAPE SYSTEM OPERATION

Once initiated, operation of the ejection and escape sequence is entirely automatic. For minimum safe ejection altitudes, see figure 1-33. Figure 1-34 illustrates the escape system trajectory. The following table is a chronology of a pilot-initiated, ground-level ejection (100 KEAS), with escape and recovery of both crew members.

AFT SEAT	TIME IN SECONDS (CUMULATIVE)	FRONT SEAT
—	Zero	Initiation
Canopy jettisoned	0.10	Canopy jettisoned
Seat bottomed, S/O restrained	0.20	Seat bottomed, pilot restrained
Front canopy clear	0.30	↑
Catapult fired	0.40	
Separation aneroid armed	0.50	(0.75-second delay)
Drogue chute deployed	0.52	
Seat clear of cockpit	0.57	
Drogue chute inflated	0.58	
Rocket burnout	0.78	↓
↑	1.15	Catapult fired
	1.25	Separation aneroid armed
(Stabilized ascent)	1.27	Drogue chute deployed
	1.32	Seat clear of cockpit
	1.33	Drogue chute inflated
↓	1.53	Rocket burnout
Seat/man separation	1.95	(Stabilized ascent)
Separation complete	2.26	—
Parachute deployed	2.70	Seat/man separation
—	3.01	Separation complete
—	3.45	Parachute deployed
Parachute inflated	5.00	—
—	7.30	Parachute inflated

AIR CONDITIONING SYSTEM

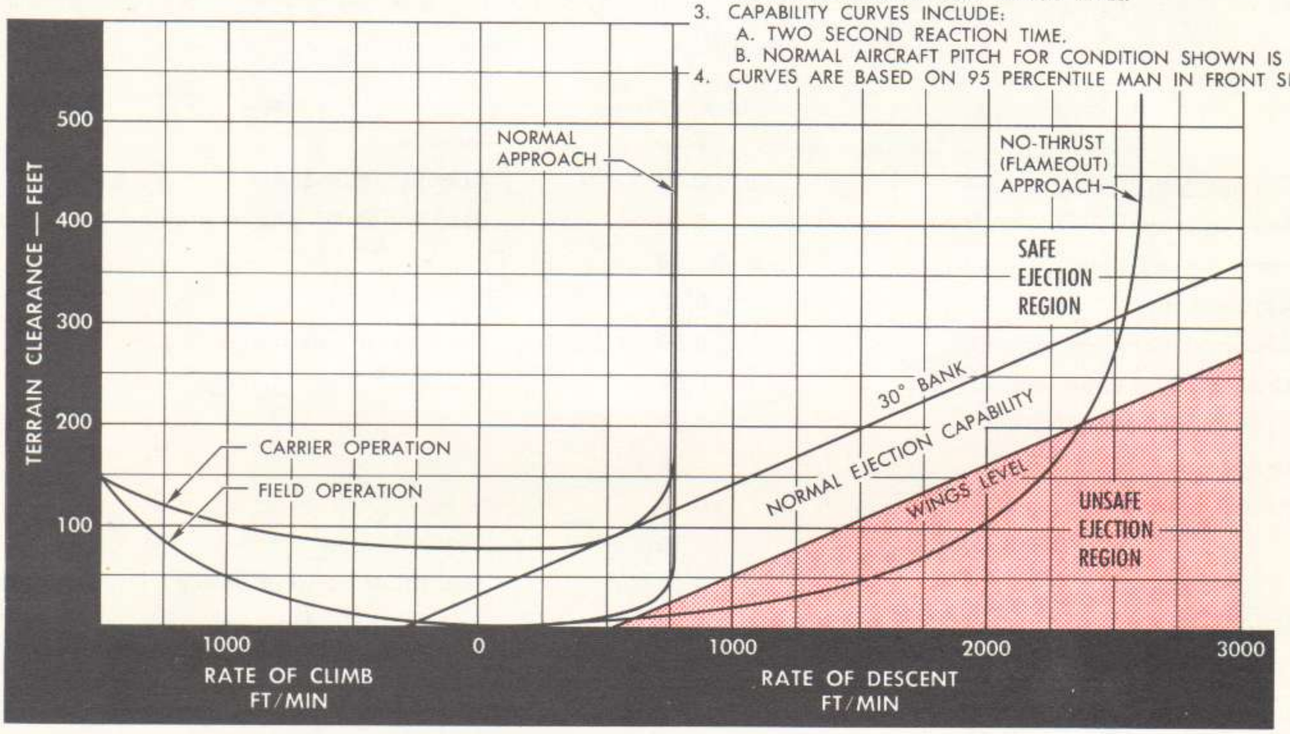
The air conditioning system performs the following functions:

1. Cockpit and pressure suit conditioning and pressurization.
2. Equipment conditioning and pressurization.
3. Anti-G suit operation.
4. Windshield and canopy defrosting, windshield anti-icing, and rain removal.

The final stage of each engine compressor is tapped at four points to supply hot, high-pressure air. The compressor air is routed to the right-hand (cockpit and equipment) heat exchanger, where it is cooled and modulated to approximately 300°F, and to the left-hand (equipment) heat exchanger, where it is cooled and modulated to approximately 150°F, by ram air from the engine intake ducts. The compressor bleed air lines to the heat exchangers are cross-connected for single-engine operation and are equipped with check valves to prevent backflow in the event of engine failure. Between the check valves and heat exchangers, air is tapped off to supply the boundary layer control system. Turbine compressor refrigeration units and secondary heat exchangers modify the air supply as required for system operation. Cooling airflow through the primary and secondary heat exchangers is increased, when required, by the use of jet pumps to offset the effect of slow speeds, with the resulting low ram cooling airflow. The jet pumps, using engine compressor bleed air, create low

MINIMUM SAFE EJECTION ALTITUDES

NOTE:
1. FOR 90° BANK ADD 400 FEET TO TERRAIN CLEARANCE REQUIRED FOR WINGS LEVEL.
2. FOR INVERTED FLIGHT ADD 700 FEET TO TERRAIN CLEARANCE REQUIRED FOR WINGS LEVEL.
3. CAPABILITY CURVES INCLUDE:
   A. TWO SECOND REACTION TIME.
   B. NORMAL AIRCRAFT PITCH FOR CONDITION SHOWN IS ±15°.
4. CURVES ARE BASED ON 95 PERCENTILE MAN IN FRONT SEAT.



NOTE:
1. CURVES INCLUDE 2 SECOND PILOT REACTION TIME.
2. CURVES ARE BASED ON WINGS LEVEL DIVE ATTITUDE AND APPROPRIATE ANGLE OF ATTACK.
3. TERRAIN CLEARANCE REQUIRED IS BASED ON 5000 FOOT TERRAIN AND IS CONSERVATIVE FOR LOWER TERRAIN.
4. CURVES ARE BASED ON 95 PERCENTILE MAN IN FRONT SEAT.

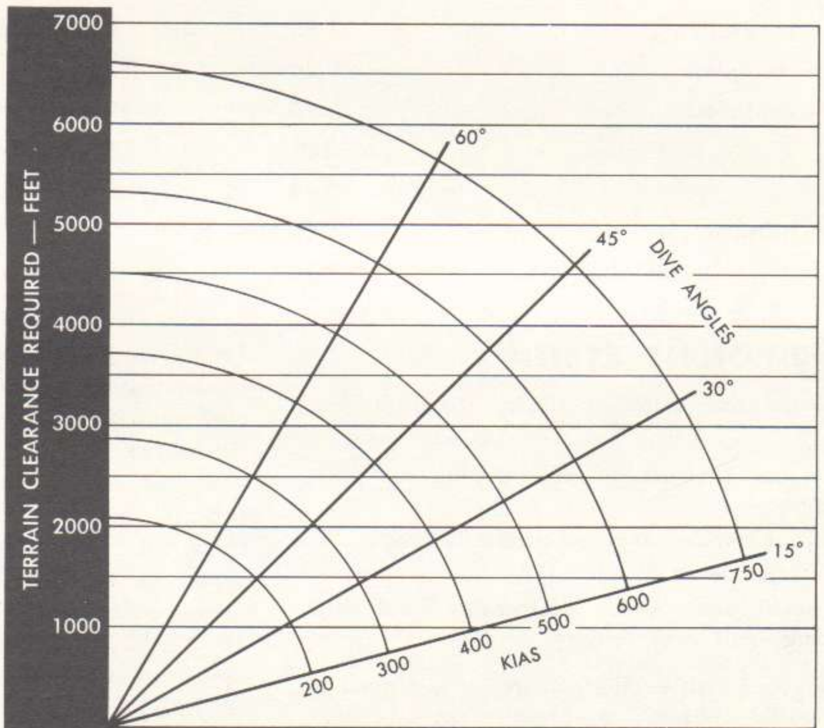


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Figure 1-33

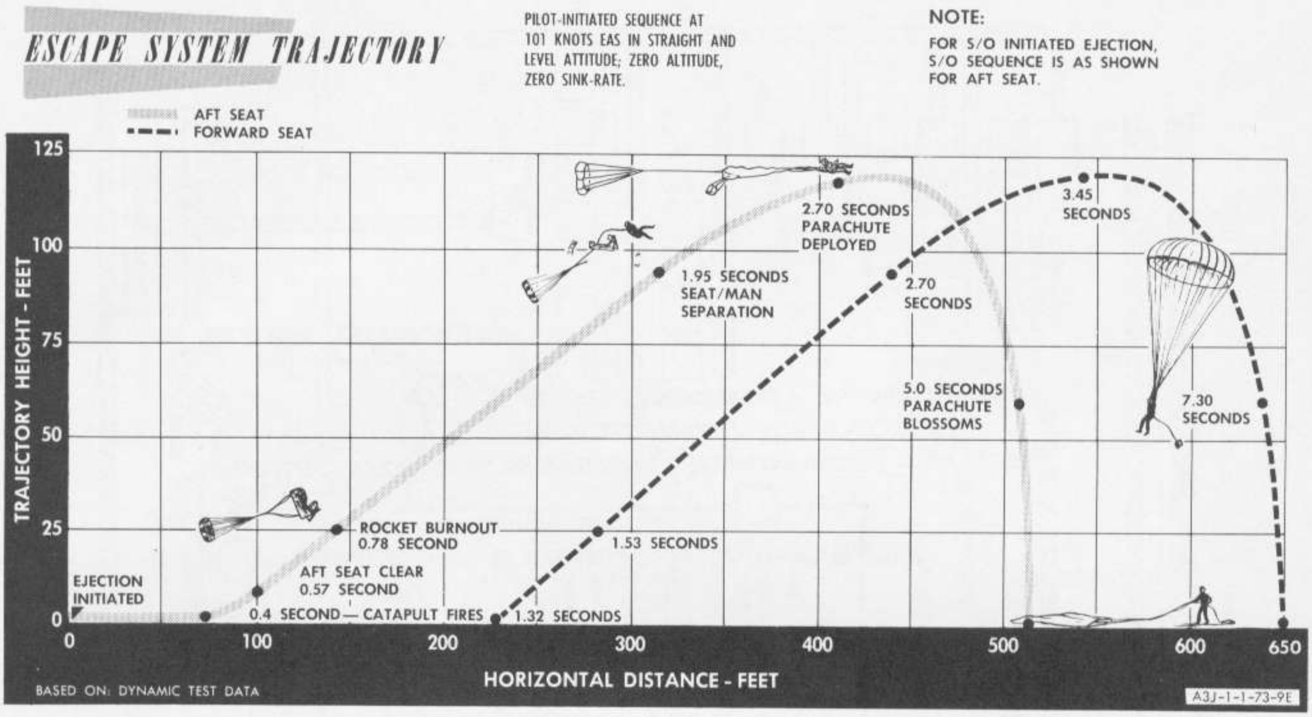


Figure 1-34

pressure at the heat exchanger outlets, causing an increase in airflow through the units. During normal flight (flaps retracted), the four heat exchanger jet pump valves are opened and closed on demand by an automatic supply air temperature control system. During flight with flaps extended, the primary jet pumps are shut off to decrease total engine bleed air requirements. During ground operations, the primary jet pump valves are opened automatically below 80% engine rpm to supplement cooling airflow for equipment and shut off automatically at 80% engine rpm, or above. The secondary jet pumps are maintained in operation with the gear extended on the ground or in flight. See figure 1-35.

COCKPIT CONDITIONING

The air conditioning system provides a regulated air supply for cockpit temperature control, cockpit pressurization, windshield and canopy defrosting, and windshield anti-icing and rain removal. In addition, this system provides a source of pressurized air for the canopy seals, air data computer, ECM waveguide, radar, inertial autonavigator platform, aircraft fuel supply system, and hydraulic reservoirs, and provides air supply to the pneumatic system compressor. Cockpit air conditioning is accomplished by manual or automatic mixing of warm air from the 300°F modulating valve with cold air from the No. 4 refrigeration turbine outlet.

With flaps extended 25 degrees or more, the No. 2 and No. 3 refrigeration turbine compressor units are shut down to reduce total engine compressor bleed air requirements. Cockpit cooling airflow is available from the No. 4 turbine. Defrost air remains available directly from the right-hand primary heat exchanger. On some aircraft,* with flaps extended 25 degrees or more, No. 3 and No. 4 turbine compressor units are shut down. Under these conditions, cockpit cooling airflow is reduced by approximately 60 percent.

COCKPIT TEMPERATURE KNOB

The COCKPIT TEMP knob (5, figure 1-37) is operated in conjunction with the AUTO/MAN switch in controlling cockpit air temperature. With the AUTO/MAN switch in MAN, the COCKPIT TEMP knob directly controls cockpit

***Aircraft not having PCR 46C complied with**

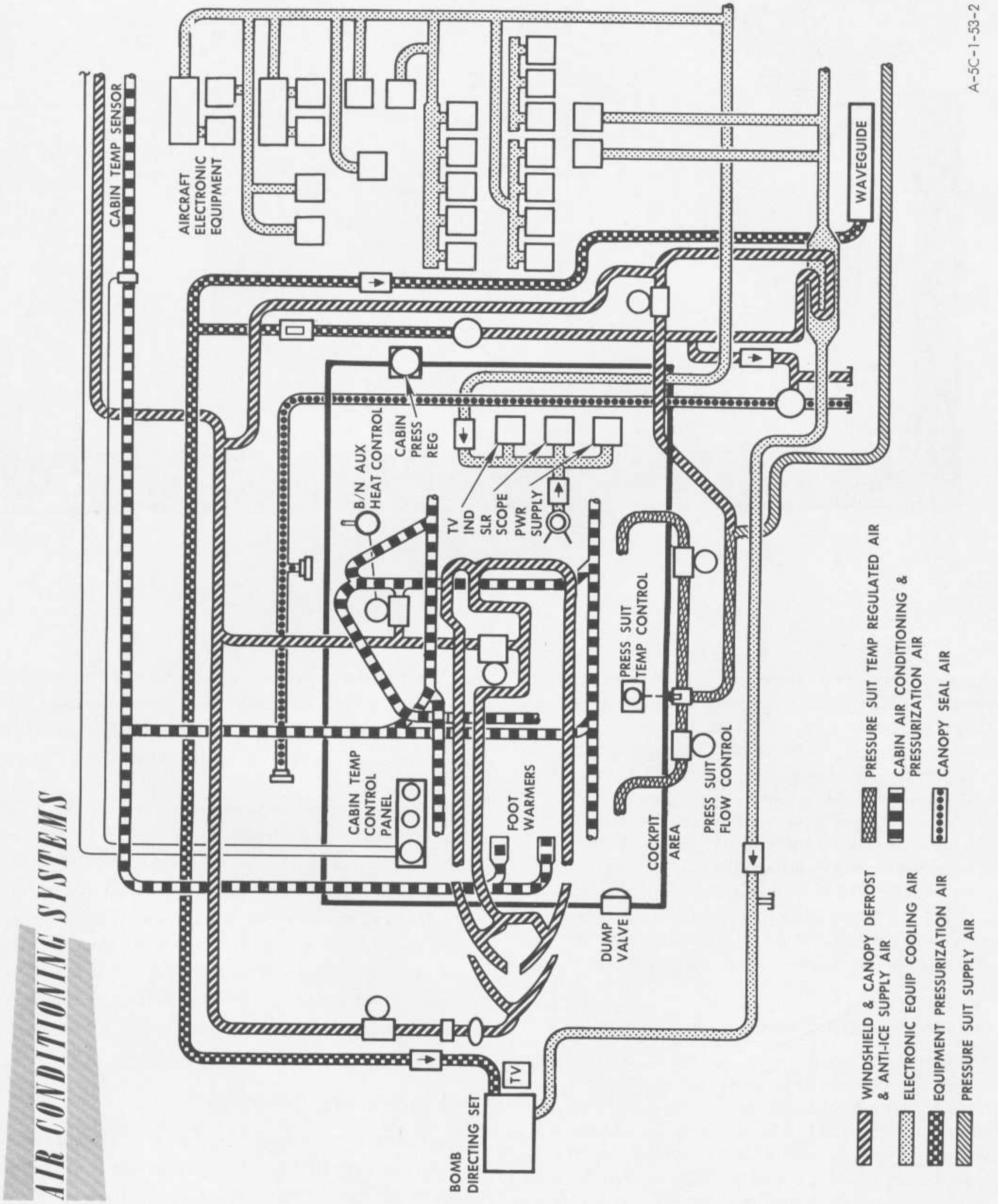


Figure 1-35 (Sheet 1)

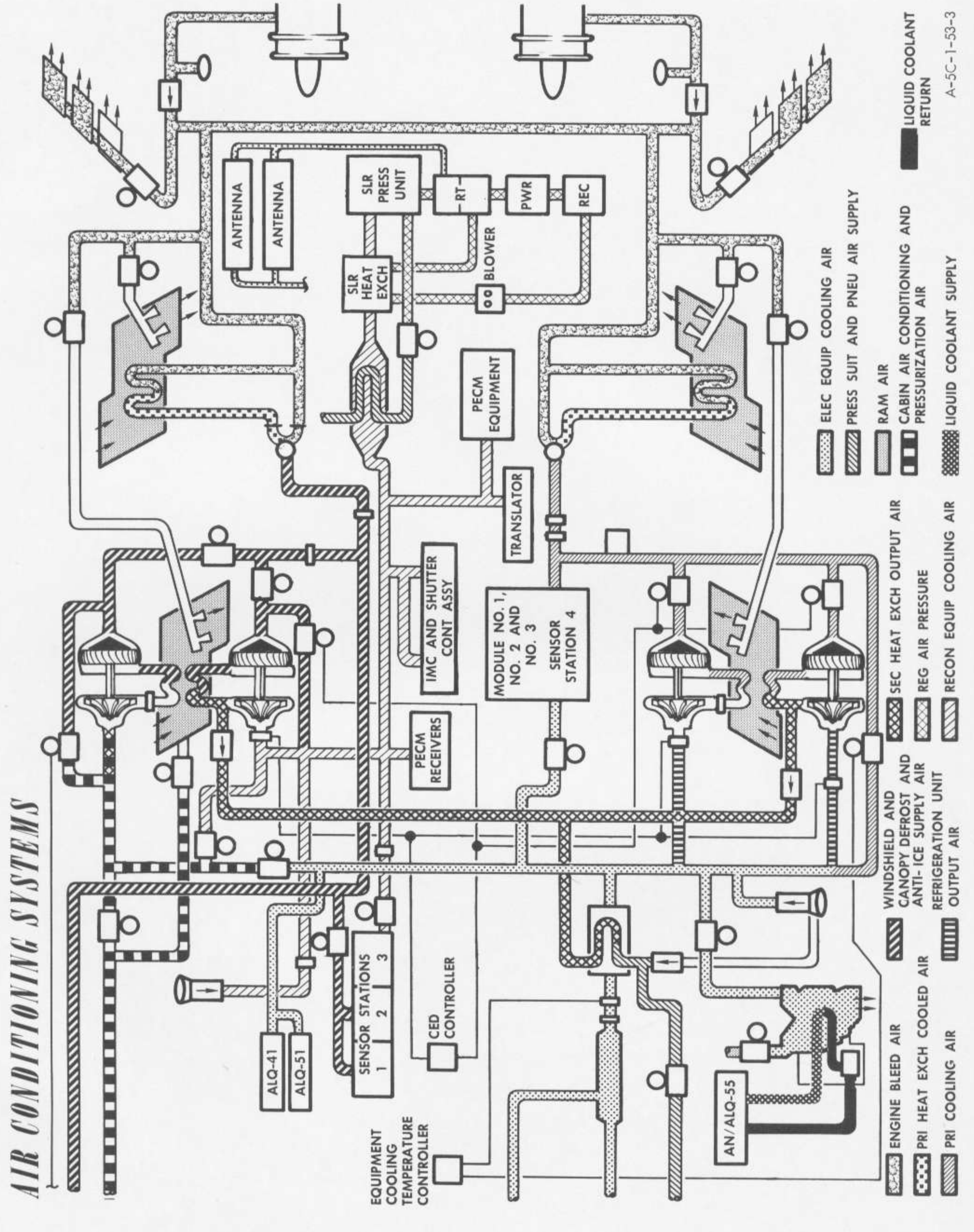


Figure 1-35 (Sheet 2)

COCKPIT PRESSURIZATION SCHEDULE

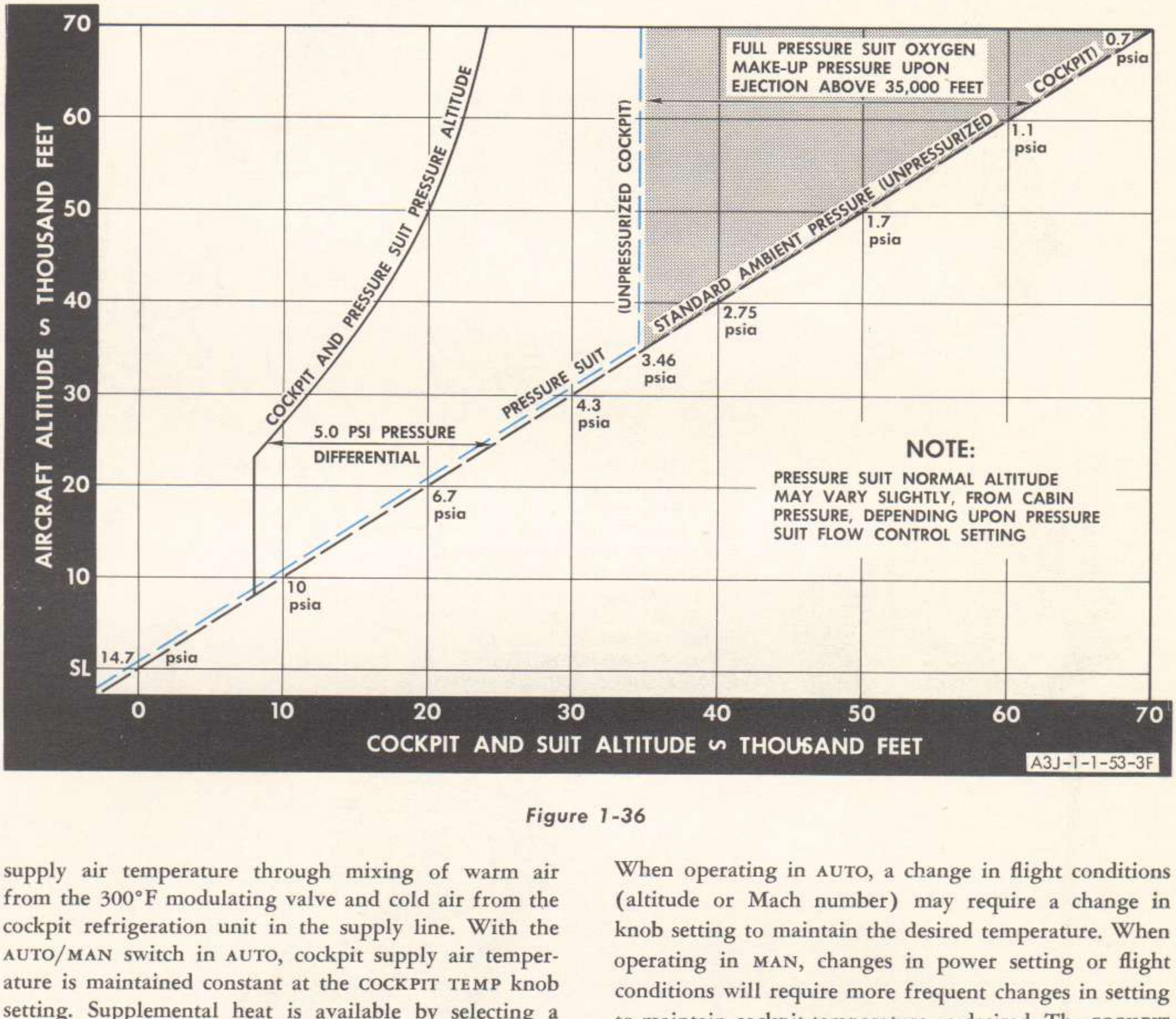


Figure 1-36

supply air temperature through mixing of warm air from the 300°F modulating valve and cold air from the cockpit refrigeration unit in the supply line. With the AUTO/MAN switch in AUTO, cockpit supply air temperature is maintained constant at the COCKPIT TEMP knob setting. Supplemental heat is available by selecting a desired amount of defrost airflow.

CAUTION

Before taking off in humid weather, the COCKPIT TEMP knob should be set at "2" or RAM EMERG to preclude formation of cockpit fog. Under high-humidity conditions, turning the knob toward COLD will increase the intensity of fog formation and can cause frosting of the canopy and instruments.

When operating in AUTO, a change in flight conditions (altitude or Mach number) may require a change in knob setting to maintain the desired temperature. When operating in MAN, changes in power setting or flight conditions will require more frequent changes in setting to maintain cockpit temperature as desired. The COCKPIT TEMP knob can be used to modify uncomfortable cockpit temperatures caused by defrost system operation.

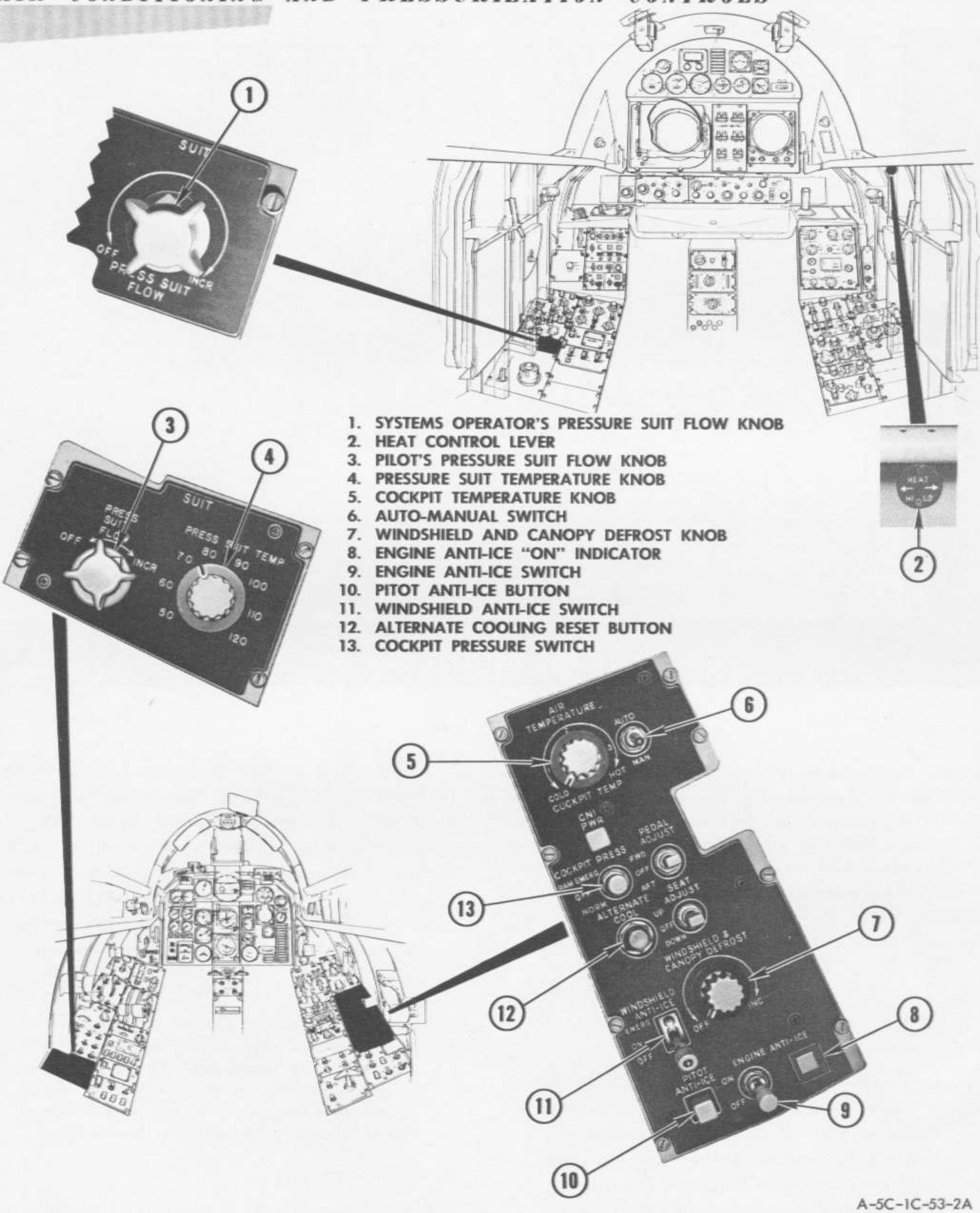
Note

The temperature of the aft cockpit is varied by an airflow control lever which ports defrost system flow to the cockpit. Under some conditions, changing the position of the cockpit temperature knob and varying the position of the aft cockpit heat lever may be required.

AUTO/MAN SWITCH

The AUTO/MAN switch (6, figure 1-37) provides automatic or manual control of cockpit air temperature. The

AIR CONDITIONING AND PRESSURIZATION CONTROLS



1. SYSTEMS OPERATOR'S PRESSURE SUIT FLOW KNOB
2. HEAT CONTROL LEVER
3. PILOT'S PRESSURE SUIT FLOW KNOB
4. PRESSURE SUIT TEMPERATURE KNOB
5. COCKPIT TEMPERATURE KNOB
6. AUTO-MANUAL SWITCH
7. WINDSHIELD AND CANOPY DEFROST KNOB
8. ENGINE ANTI-ICE "ON" INDICATOR
9. ENGINE ANTI-ICE SWITCH
10. PITOT ANTI-ICE BUTTON
11. WINDSHIELD ANTI-ICE SWITCH
12. ALTERNATE COOLING RESET BUTTON
13. COCKPIT PRESSURE SWITCH

Figure 1-37

AUTO position allows the temperature control unit to maintain cockpit supply air temperature automatically at the preset position of the COCKPIT TEMP knob. Should cockpit temperature become uncontrollable because of system malfunction, the switch should be placed in MAN and cockpit temperature controlled manually with the COCKPIT TEMP knob. Should an extreme temperature malfunction occur when the pressure suit is being worn, the effect may be offset by manually changing suit temperature. It may be desirable to move the COCKPIT PRESS switch to RAM EMERG for cooling or to operate defrost for additional heat as applicable.

VENTILATION OUTLETS

Cockpit ventilation is provided by footwarmers and air distribution tubes, located below the canopy rails on both sides of each cockpit. Airflow direction is controlled through manual rotation of the ventilation tubes.

SYSTEMS OPERATOR'S HEAT LEVER

The systems operator's heat lever (2, figure 1-37) controls the flow of additional hot air to the rear cockpit. This air is ducted through a variable control valve from the defrosting system to supplement normal cockpit air conditioning and compensate for the temperature difference between cockpits.

COCKPIT CONDITIONING OPERATION

To operate the cockpit conditioning system, proceed as follows:

1. AUTO/MAN switch—AUTO.
2. COCKPIT TEMP knob—midposition (2).
3. COCKPIT PRESS switch—NORM.
4. Systems operator's heat lever—midposition.
5. WINDSHIELD & CANOPY DEFROST knob—on as desired.

   Some defrost flow should be maintained during all pressure suit operations to ensure adequate warmth for the pressure suit conditioning lines.

6. The pilot controls cockpit temperature by rotating the COCKPIT TEMP knob toward HOT or COLD as desired.

   If additional heat is required, move the WINDSHIELD & CANOPY DEFROST knob toward INC as necessary.

7. If formation of cockpit fog is anticipated during take-off or approach, it is recommended that the COCKPIT PRESS switch be positioned to OFF and that canopy defrost be operated at maximum.

Note

Excessive cockpit heat resulting from defrost airflow can be modified by use of the COCKPIT TEMP knob.

8. Aft cockpit temperature is controlled by moving the heat lever toward LO (aft) or HI (forward).
9. If automatic temperature control fails, move the AUTO/MAN switch to MAN and control temperature directly with the COCKPIT TEMP knob.

Note

Should temperature controller failure during flight cause fog formation in the cockpit, the best corrective action is to utilize windshield and canopy defrost airflow as required. Turning the COCKPIT PRESS switch OFF also aids fog dissipation, if pressurization is not required.

10. If emergency cockpit cooling is mandatory, check the WINDSHIELD & CANOPY DEFROST knob OFF and move the COCKPIT PRESS switch to RAM EMERG.

    A reduction in airspeed may also be required.

ABNORMAL COCKPIT TEMPERATURE

COCKPIT TEMPERATURE CONTROL FAILURE

1. Check AUTO/MAN switch—AUTO.
2. COCKPIT TEMP knob—as desired.
3. Select AUTO/MAN switch—MAN.
4. COCKPIT TEMP knob—as desired.
5. COCKPIT PRESS switch—OFF (if too hot).
6. WINDSHIELD & CANOPY DEFROST knob—ON (if too cold).

WINDSHIELD AND CANOPY DEFROST FAILED ON

1. Check AUTO/MAN switch—MAN.
2. COCKPIT TEMP knob—full cold.
3. Ventilation air control tubes—full up.
4. WINDSHIELD ANTI-ICE switch—ON if necessary.
5. If heat is intolerable, descend and jettison canopy.
6. Land as soon as possible.

CAUTION

Turn WINDSHIELD ANTI-ICE switch OFF after landing.

COCKPIT PRESSURIZATION

The cockpit pressurization system pressurizes and ventilates the cockpits. A cockpit pressure regulator, mounted aft of the systems operator's left console, maintains the following pressure schedule. See figure 1-36.

1. An unpressurized cockpit to 8000 feet MSL.
2. A constant 8000-foot level pressure from 8000 to approximately 23,400 feet MSL.
3. A constant 5.0-psi differential pressure at all altitudes above approximately 23,400 feet MSL.

In the event of pressure regulator failure, a combination dump/vacuum pressure relief valve prevents cockpit pressure differential from exceeding approximately 5.5 psi. The vacuum relief function of this valve prevents cockpit pressure from falling below a pressure level 0.25 psi less than atmospheric pressure, thus avoiding possible canopy or cockpit structural collapse. Cockpit ventilation is achieved by exhausting cockpit air through the cockpit pressure regulator into the main electronics bay and through the combination dump/vacuum pressure relief valve into the forward electronics bay.

COCKPIT PRESSURE SWITCH

The COCKPIT PRESS switch (13, figure 1-37), located on the AIR TEMPERATURE control panel, has three positions: NORM, OFF, and RAM EMERG. In the OFF position, there is no cockpit pressurization or ventilation. In the NORM position, automatic cockpit pressurization and ventilation are provided according to the schedule shown in figure 1-36. If cockpit air is contaminated by smoke or fumes, placing the COCKPIT PRESS switch to RAM EMERG will ventilate the cockpits.

Note

In the OFF and RAM EMERG positions of the COCKPIT PRESS switch, crew member environment may be modified with the pressure suit controls or by turning on the windshield and canopy defrost system.

COCKPIT PRESSURE ALTIMETER

The cockpit pressure altimeter (2, figure 1-30) indicates cockpit pressure altitude in feet. When the full pressure suit is worn, suit altitude is indicated by a suit-mounted altimeter.

COCKPIT PRESSURIZATION OPERATION

The cockpit pressurization system operates automatically when the engines are operating and the canopies are closed to maintain the schedule shown in figure 1-36. To initiate and monitor system operation, proceed as follows:

1. COCKPIT PRESS switch—NORM.
2. Canopy—closed (CANOPY caution indicator out).
3. Check cockpit pressure altimeter for normal schedule.

Note

In the event of equipment conditioning air overtemperature in normal flight (flaps retracted), initiation of alternate cooling causes diversion of cockpit pressurization and cooling airflow to the equipment cooling system. Should this occur, the ALT COOL caution indicator comes on and cockpit altitude rises rapidly to ambient pressure level.

4. If normal operation cannot be obtained through use of the ALTERNATE COOL reset button, reduce altitude as necessary for safe flight.
5. If ram-air ventilation is desired, move the COCKPIT PRESS switch to RAM EMERG.

CAUTION

If a crack should develop in the windshield, move the COCKPIT PRESS switch to OFF, descend, reduce airspeed to minimum, and land as soon as possible.

EQUIPMENT CONDITIONING

Electronic equipment is conditioned by air from both primary and secondary heat exchangers and turbine compressor refrigeration units No. 1, No. 2, and No. 3. Equipment cooling air controls the environment of components such as the a-c power supervisory panels, voltage regulators, autoflight control system, bomb directing set, and camera systems. These components and equipment must be supplied with cooling air during ground operation prior to and during engine starting. This is accomplished by a combination electrical and air conditioning ground handling unit. The cooling air must be supplied to the equipment whenever external electrical power is supplied to the components. With reconnaissance systems installed, two cooling air units are used, one supplying the requirements for equipment in the reconnaissance pod. See figure 1-51 for usable equipment and system requirements.

Note

With flaps retracted, the equipment conditioning system has priority over the cockpit conditioning and pressurization systems in the event of a malfunction of the No. 3 refrigeration turbine compressor unit.

ALTERNATE COOLING

The equipment and cockpit conditioning systems are interconnected to increase total system reliability. If the equipment refrigeration capacity becomes inadequate, a cooling effect detector, located in the equipment refrigeration unit discharge line, energizes relays. These relays accomplish the switching required to supply equipment cooling air from the No. 4 turbine compressor refrigeration unit. If the overheat condition is eliminated, normal cooling system operation may be restored by depressing the ALTERNATE COOL reset button.

ALTERNATE COOL Reset Button

The ALTERNATE COOL reset button (12, figure 1-37) is located on the AIR TEMPERATURE control panel. This button is used to regain normal equipment conditioning flow if the overheat condition or malfunction of systems 1, 2, or 3 has passed.

ALT COOL Caution Indicator

The alternate cooling caution indicator (ALT COOL, figure 1-10) is located on the instrument panel. This indicator will come on if cockpit conditioning air has been diverted to the equipment conditioning system.

Note

Operation of pressure suit conditioning and pressurization is not affected during alternate cooling operation; however, if the pressure suit is worn, utilization of the defrost system airflow for crew member warmth may be required during extended high-altitude operation.

RECON COOL Caution Light*

A RECON COOL caution light on the systems operator's display panel illuminates on lift-off (with flaps extended more than 25 degrees), and remains illuminated until approximately 1 minute after flap retraction. Flight operations (with flaps extended more than 25 degrees) for a period exceeding 2 minutes will require that reconnaissance systems POWER switches be turned OFF.

EQUIPMENT CONDITIONING OPERATION

Normal operation of the equipment conditioning system is entirely automatic. If the ALT COOL caution indicator is illuminated prior to take-off, proceed as follows:

1. Increase engine speed to 80% rpm or higher.
2. Depress the ALTERNATE COOL reset button until the ALT COOL caution indicator extinguishes.
3. If the ALT COOL indicator illuminates after button release, it can be assumed that the equipment conditioning system has failed and cockpit conditioning and pressurization will not be available.

If the ALT COOL caution indicator illuminates in flight, proceed as follows:

1. Depress the ALTERNATE COOL reset button.
2. If the indicator illuminates after 15 seconds, increase engine rpm and airspeed and again attempt reset.
3. If the indicator still illuminates after button release, it can be assumed that the equipment conditioning system has failed.

Note

- Do not exceed 2 minutes at IDLE rpm with flaps extended.
- All camera systems are disabled on the ground until cooling air is applied to the right-hand receptacle.

PRESSURE SUIT CONDITIONING

Hot air from the No. 1 and No. 3 conditioning turbine inlets is cooled by air from turbines No. 1 and No. 2 and the equipment cooling refrigeration unit in the pressure suit heat exchanger. This moderate temperature air, and warm air from the defrost and anti-ice ducts, is directed to the pressure suit controller, where it is mixed for use in pressure suit ventilation and temperature control. Suit conditioning airflow is directed through the composite disconnects approximately 3.0 psi above cockpit pressure. The pressure schedule is shown in figure 1-36.

SUIT TEMPERATURE KNOB

The PRESS SUIT TEMP knob (4, figure 1-37) is located on the SUIT control panel in the pilot's cockpit and controls the temperature of both crew member's suits. Pressure suit temperature may be controlled from 70° to 120°F.

SUIT FLOW KNOBS

The PRESS SUIT FLOW knobs (1, 3, figure 1-37) are located on the left console in both cockpits. The pilot's PRESS SUIT FLOW knob must be turned more than 5 degrees from the OFF position so that the PRESS SUIT TEMP knob can be used to control the temperature of the air flowing into the suits.

PRESSURE SUIT OPERATION

Prior to starting engines, the crew members' pressure suits are ventilated from the external cooling air source. See figure 1-51. The crew members may regulate external pressure suit airflow by using the PRESS SUIT FLOW

*Aircraft 150823 through 151628 having PCR 46C complied with knobs on the SUIT panels in each cockpit. Temperature of the pressure suit air is controlled by the pilot's PRESS SUIT TEMP knob; however, temperature control can also be achieved through flow adjustment. It is recommended that defrost system airflow be utilized to ensure adequate heat for pressure suit airflow. Above 35,000 feet cockpit altitude, a suit pressure corresponding to approximately 34,500 feet is maintained in the event of loss of cockpit pressurization. The liquid oxygen system provides suit pressurization automatically in the event both the normal and alternate systems fail due to a system malfunction or a dual flame-out. Refer to OXYGEN SYSTEMS, in this section. If extreme suit temperature cannot be controlled normally, the PRESS SUIT FLOW knob should be turned off, initiating automatic emergency operation through the oxygen system. Cockpit temperature should be maintained high enough to reduce faceplate fogging.

Note

- If pressure suit flight is made following an overnight cold soak of the aircraft below 32°F, move the PRESS SUIT FLOW knobs to the full INCR position, with the pilot's PRESS SUIT TEMP knob at 70° for about 5 minutes prior to take-off. This procedure will preclude possible ice-up of the pressure suit flow controller in the personnel disconnect.
- To preclude possible suit inflation and crew member incapacitation due to a malfunction during take-off, the PRESS SUIT FLOW knobs should be left OFF and one glove left open until the aircraft is airborne.

ANTI-G SUIT OPERATION

The defrost, anti-ice, and rain removal line of the cockpit conditioning system is tapped as a source of pressurized air for anti-G suit operation. G-suit air is routed to an anti-G valve on the left console in both cockpits. On demand, the air flows into the suits through the composite disconnects.

ANTI-G SUIT VALVES

The anti-G valves each consist of a spring-balanced valve which is opened when positive "g" force is sufficient to overcome valve spring tension. The top of each valve may be turned to select a HI (1.5 psi per "g") or LO (1.0 psi per "g") suit pressure during accelerations. A manual operation button is incorporated for checking valve operation. Anti-G suit operation is entirely automatic. To ease discomfort caused by long-duration flight, the anti-G valve manual button can be depressed to provide changes in suit pressure.

Note

To remove any moisture from the system, the anti-G valve should be operated manually prior to connecting the anti-G suit.

DEFROST AND ANTI-ICE SYSTEMS

Hot air from the cockpit conditioning primary heat exchanger modulating valve provides windshield and canopy defrosting and windshield external anti-ice and rain removal. When the pilot's canopy is closed, 300°F air is available to the defrost and anti-ice valves for system operation.

WINDSHIELD AND CANOPY DEFROST KNOB

A WINDSHIELD & CANOPY DEFROST knob is provided (7, figure 1-37). With this knob, a flow of windshield and canopy defrost air is routed through perforated tubing around the lower inside surfaces of the windshield and canopy. This knob should be turned on well in advance of descent from high altitudes so that the large area of the canopy may be warmed thoroughly before being exposed to warm, moist air at lower altitudes. During adverse flying weather, it may be necessary to maintain continuous defrost flow to keep the windshield and canopy clear. Defrost flow is turned on and increased as desired by turning the WINDSHIELD & CANOPY DEFROST knob clockwise from the OFF position.

WINDSHIELD ANTI-ICE AND RAIN REMOVAL SWITCH

The WINDSHIELD ANTI-ICE switch (11, figure 1-37) is located on the right console. This switch has three positions: OFF, ON, and EMERG. During flight in adverse weather, especially during precision instrument approaches in icing conditions or precipitation, this switch should be in the ON position. High-velocity, hot air is directed onto the outer surface of the windshield to remove rain droplets or ice crystals for improvement of pilot visibility. A safety provision for overpressure and/or overtemperature is built into the anti-icing and rain removal system. Should anti-icing air temperature exceed 360°F or nozzle pressure exceed 50 psi, a sensing circuit returns the switch to the OFF position. Should airflow be needed for flight safety under these conditions, the switch can be lifted and moved from ON into the EMERG position, where a detent holds it in place and overrides the safety features.

CAUTION

The windshield anti-icing and rain removal system should be operated in the EMERG position only when absolutely essential, as the airflow temperature and pressure safety devices are overridden. The EMERG position should never be used on the ground except for take-off, and then only if absolutely necessary. If used on the ground, select EMERG *for a maximum of 5 seconds,* then select OFF for at least 60 seconds before reselecting EMERG.

Note

Any time the EMERG position has been used, a notation should be made on the yellow sheet, and the windshield should be inspected for overtemperature damage.

PITOT ANTI-ICE BUTTON

When depressed, the PITOT ANTI-ICE button (10, figure 1-37) provides essential a-c bus power to heater elements in the airstream direction detector probe and in the pitot-static boom.

ENGINE ANTI-ICE SWITCH

Engine anti-ice airflow is controlled by the ENGINE ANTI-ICE switch (9, figure 1-37), a two-position switch (ON/OFF) located on the pilot's right console. Moving this switch to ON opens a solenoid-operated valve which regulates the flow of hot air internally through the struts and guide vanes. This switch also controls flow of anti-icing air to the engine accessory bullet nose.* The air is discharged from the trailing edge of the guide vanes and from the engine bullet nose into the engine.

ENGINE ANTI-ICE Indicator

The ENGINE ANTI-ICE indicator (8, figure 1-37) displays "ON"† when the ENGINE ANTI-ICE switch is ON, both engine anti-ice air valves have opened, and air is flowing as required. Lack of an "ON" indication means either a valve malfunction, loss of power to the indicator, or pressure switch failure.

DEFROST AND ANTI-ICE OPERATION

For flight under adverse weather conditions, set the defrost and anti-ice controls as follows:

1. WINDSHIELD & CANOPY DEFROST knob— as desired. For warm, humid conditions, a defrost setting of about one-half is recommended. The COCKPIT TEMP knob can be used to modify the temperature, if necessary.

2. WINDSHIELD ANTI-ICE switch—as desired. If precipitation limits visibility, move this switch to ON.

3. PITOT ANTI-ICE button—Depress.

4. ENGINE ANTI-ICE switch—ON as desired.

   The ENGINE ANTI-ICE switch should be moved to ON whenever visible moisture is encountered and ambient temperature is at or near the freezing point.

CAUTION

The only cockpit indications of failure of the pitot anti-icing system are abnormal pitot-static instrument readings. Should failure occur under icing conditions, pitot-static boom ice can cause erroneous airspeed/Mach and altitude readings, as well as undesired changes in inlet ramp operation. If such icing should occur at low or cruising airspeeds, placing the RAMPS switch to STBY will prevent the inlet ramps from being driven toward the minimum opening position and causing loss of engine airflow and possible flame-out.

OXYGEN SYSTEMS

Two independent oxygen systems are installed. The normal breathing oxygen supply is provided by a liquid oxygen conversion system. An emergency oxygen supply is incorporated into the survival kit in each seat, providing emergency breathing supply and emergency pressure suit inflation when actuated. The seat composite disconnect provides connection to both normal and emergency oxygen systems.

Note

The Scott composite disconnect block should be checked immediately for connection in the event of oxygen interruption.

NORMAL OXYGEN SYSTEM

A 20-liter liquid oxygen system is installed, which is supplied by separate 10-liter converters. Liquid oxygen is evaporated under controlled pressure and routed at 70 psi to the cockpit supply valves. The oxygen conversion system is located in the forward portion of the nose wheel well, above the well cover. See figure 1-38 for oxygen system duration.

Note

The forward converter must be installed to obtain an operational system. If the aft converter is removed, a dummy capacitor must be installed to obtain oxygen quantity indication. The dummy disconnects must be connected to prevent liquid oxygen spillage into the electronics bay.

OXYGEN SUPPLY VALVES

An oxygen system supply ON/OFF valve (28, figure 1-9) is provided on the left console. To obtain oxygen pressure at the composite disconnect, the valve control lever is moved to the ON (forward) position.

***Aircraft having Engine Bulletin 126 complied with**
†Aircraft having Engine Bulletins 126 and 170 complied with

OXYGEN DURATION

AIRCRAFT ALTITUDE		COCKPIT ALTITUDE			OXYGEN QUANTITY ∽ LITERS						
FEETX1000	PSIA	FEETX1000	PSIA	HOURS ∽ TWO CREW MEMBERS	20	16	12	8	4	2	LESS THAN 0.8
70	0.65	24.2	5.65		20.5	16.4	12.3	8.2	4.1	2.0	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
60	1.05	22.6	6.05		19.1	15.3	11.5	7.6	3.8	1.9	
50	1.69	20.3	6.69		17.2	13.7	10.3	6.9	3.4	1.7	
45	2.14	18.6	7.14		15.9	12.7	9.5	6.4	3.2	1.6	
40	2.72	16.8	7.72		14.6	11.7	8.8	5.8	2.9	1.5	
35	3.46	14.6	8.46		13.1	10.5	7.9	5.2	2.6	1.3	
30	4.36	12.0	9.36		11.6	9.3	7.0	4.7	2.3	1.2	
25	5.45	9.2	10.45		10.4	8.3	6.2	4.1	2.1	1.0	
20	6.75	8.0	10.91		9.9	7.9	5.9	4.0	2.0	.9	
8	10.91	8.0	10.91		9.9	7.9	5.9	4.0	2.0	.9	
5	12.23	5.0	12.23		8.9	7.1	5.3	3.6	1.8	.8	
SEA LEVEL	14.70	SEA LEVEL	14.70		7.5	6.0	4.5	3.0	1.5	.7	A-5C-1-73-4

Figure 1-38

OXYGEN QUANTITY INDICATORS

An oxygen quantity indicator (19, figure 1-10) is installed in both cockpits. The forward cockpit indicator contains an amplifier which receives power from the essential a-c electrical bus. The aft cockpit indicator is a repeater instrument, connected to the forward indicator. Up to 20 liters is indicated in increments of 1 liter. An indicator TEST button is located on the pilot's indicator.

OXYGEN WARNING INDICATORS

An OXYGEN warning indicator is mounted on the instrument panel in both cockpits. These red warning indicators come on if the liquid quantity in the system drops below 0.8 liter or if total gas pressure falls below 45 psi in the systems operator's system. The pilot's indicator incorporates a 4-second delay to prevent nuisance flashing. The warning light circuit may be checked by use of the WARN LT TEST button (2, figure 1-42).

EMERGENCY OXYGEN SYSTEM

A high-pressure (1800 psi), gaseous emergency oxygen supply bottle is installed in each of the seat-mounted survival kits. Utilization of this supply is automatic upon initiation of ejection. A manual ring is provided on each survival kit for obtaining emergency oxygen flow. If used as an emergency breathing supply with the standard mask, approximately 20 minutes normal breathing is available. If used to supply both emergency breathing and pressure suit, time available is less than 20 minutes but the supply is sufficient to permit emergency seat/man free-fall descent to a safe altitude.

Note

With a good pressure suit, there is no decrease in time available on emergency oxygen pressurization, since minor leakage is made up by air which is exhaled into the suit.

EMERGENCY OXYGEN PRESSURE GAGES

An emergency oxygen supply pressure gage is installed in each survival kit. For all flights, this gage should read a minimum of 1800 psi and a maximum of 2200 psi.

EMERGENCY OXYGEN RINGS

An emergency oxygen manual actuator ring is installed on the survival kits near the pressure gage. If emergency oxygen flow is required, this ring should be pulled sharply upward, separating it from the survival kit.

PERSONAL COMPOSITE DISCONNECT

A Scott composite disconnect is installed at the left rear corner of the ejection seat. The composite disconnect consists of three separate blocks. These three blocks (upper, intermediate, and lower) are joined together to form the junction for the personal leads from the crewman to the aircraft. The lower disconnect block is attached to the cockpit floor with a cable, which remains in the aircraft at all times. The intermediate block is fastened to the survival kit as a permanent part and has an oxygen port connected to the emergency oxygen bottle in the survival kit. Lanyards are routed to the intermediate block for actuation of the pressure suit exhaust disconnect and the emergency oxygen supply valve. On ejection, the lower block (attached to the cockpit floor by a lanyard) separates from the intermediate block, leaving the intermediate and upper blocks connected. This connection provides emergency oxygen flow to the crewman upon descent. The upper block is attached to the intermediate block after entering the cockpit. The upper block is available in four configurations. They are the standard garment personal lead and the short, medium, and long full pressure suit personal leads. All four configurations have a manual release handle cable assembly (yellow pear). This manual release assembly is used to cock the upper block mechanism for connecting with the intermediate block and to release the upper block prior to leaving the cockpit. The standard garment personal lead assembly (upper block) is used with conventional nonpressurized flying garments. The upper block is composed of an anti-G suit hose, oxygen hose, and a communications cable assembly.

SUIT EMERGENCY PRESSURIZATION

The oxygen system supplies suit pressurization in the event of complete failure of the aircraft air conditioning and pressurization system above 35,000 feet. The sequence of events which results in the aircraft oxygen system being used for suit pressurization is completely automatic and requires no attention from the crew members. With the pressure suit, oxygen system pressure will adequately protect the crew members for descent and landing from any altitude.

INTERCOMMUNICATIONS SYSTEM (ICS)

The ICS provides communication between cockpits, serves as a selector station and audio amplifier for ECM and CNI subsystems, and provides communication between the cockpits and ground crew. The system incorporates a basic control unit installed in each cockpit, consisting of two transistorized amplifiers, their controls, and a panel of selector switches. Two remote ICS stations, one located in the external canopy control access and another near the external electrical power receptacle, may be utilized by the ground crew members for aircraft preflight and starting checks or during bomb directing set preflight operations. The ICS is powered by the essential d-c bus and is thus operative through the emergency ram-air turbine power unit in the event of dual generator failure. Other electronic equipment is listed in figure 1-39.

MICROPHONE SWITCH

The pilot's microphone switch is located on the No. 2 throttle grip. The microphone switch has two positions: ICS and XMIT. The ICS position (down) is used for intercommunication with the aft cockpit or the external ground stations. The XMIT position (up) actuates the main communications transmitter. For aft cockpit communications, a foot-operated microphone switch is provided on the right footrest. The ICS position of the microphone switch and the aft cockpit foot-operated ICS switch duplicate the function of the ICS CALL position of the microphone select switch.

ICS CONTROLS

ICS FUNCTION SELECTOR

The ICS function selector (C2, figure 1-40) has four positions: EMER, NORM, ALT ICS, and ALT RAD. These positions function as follows:

POSITION	FUNCTION
NORM	NORMAL ICS OPERATION. The ICS and radio isolation amplifiers are operative.
ALT RAD	USED IF RADIO AMPLIFIER FAILS. ICS amplifier handles ICS output as well as all incoming signals.
ALT ICS	USED IF ICS AMPLIFIER FAILS. Radio amplifier handles ICS output as well as all incoming signals.

TABLE OF ELECTRONIC EQUIPMENT

EQUIPMENT	FUNCTION	CHARACTERISTICS	CONTROL PILOT	CONTROL SYSTEMS OPER
COMMUNICATIONS — NAVIGATION — IDENTIFICATION SYSTEM, AN/ASQ-56				
UHF COMM unit	Voice communication	1750 frequencies	X	X
AUX UHF unit	Reception, ADF	20 preset channels	X	X
TACAN unit	Station range, bearing Airborne ranging *	126 channels	X	X
IFF-SIF units	Radar identification	Mode 1-32 codes Mode 3-64 codes	Emerg. Only	X
MISCELLANEOUS ELECTRONIC EQUIPMENT				
ICS	Intercommunications	Cockpit/External	X	X
AN/APN-120	Radar Altimeter	Low system-0 to 3000 feet	X	
		High System-500 to 75,000 feet		X
AN/ASN-26	Flight Reference Set	Provides attitude reference, compass and LABS	X	compass
BOMB DIRECTING SET, AN/ASB-12				
Refer to SYSTEMS OPERATOR'S NATOPS MANUAL NAVWEPS 01-60ABC-IC				
ELECTRONIC COUNTERMEASURES EQUIPMENT				
Refer to SYSTEMS OPERATOR'S NATOPS MANUAL NAVWEPS 01-60ABC-IC				
RECONNAISSANCE EQUIPMENT				
Aerial Photo System	Still Picture Photography			
KA-51A	Forward Oblique Camera	6-Inch Focal Length	X	X
KA-51A	Side Oblique Cameras	6-Inch Focal Length	X	X
KA-50A, KA-51A	Stabilized Vertical Cameras	1¾, 6-Inch Focal Length		X
KS-68A, KS-69A	Panoramic Cameras	3-Inch, 18-Inch Focal Length		X
AN/APD-7	Side-Looking Radar	Oblique Pattern Recording		X
ELECTRONIC DATA COLLECTION EQUIPMENT				
Refer to SYSTEMS OPERATOR'S NATOPS MANUAL NAVWEPS 01-60ABC-IC				

* AIRCRAFT 151615 AND SUBSEQUENT

A-5C-1-73-6B

Figure 1-39

POSITION	FUNCTION
EMER	**EMERGENCY COMMUNICATIONS.** Used if both amplifiers in either control unit fail. Provides UHF communications, TACAN, and ADF signals direct to the headphones, plus intercom through UHF communications sidetone. (AN/APR-18 audio is not provided.)

ICS VOLUME KNOB

The VOLUME knob (C1, figure 1-40) controls ICS audio level without affecting the level of selected receivers.

MICROPHONE SELECT SWITCH

The microphone select switch (MIC SEL, C3, figure 1-40) is independent of the ICS function selector and has three positions: COLD, HOT, and CALL. If the MIC SEL switches in both cockpits are not in the same position, the momentary CALL position may be used, or the microphone switch on the throttle held in ICS.

AUDIO SELECT BUTTONS

Audio select buttons (B1, B4, B5, B6, figure 1-40) are positioned immediately forward of the UHF COMM panel. These buttons may be depressed to monitor the audio output from the communications, navigation, and ECM systems receivers. All receivers, or as many as desired for monitoring, can be selected. Audio monitoring of the following components is controlled by these buttons.

BUTTON	COMPONENT
UHF	UHF communications radio
TACAN	UHF navigation
ADF	Auxiliary receiver
RADAR WARN	Radar passive warning receiver

ICS OPERATION

The ICS is operative when the aircraft electrical system is energized by external or generator power. With the ICS function selector in the NORM position, reception of main UHF signals and any other selected receiver signals is available, provided the selected receivers are energized. Simultaneous monitoring of navigation and ECM equipment is accomplished through the associated audio select buttons by controlling the volume through the individual UHF, TACAN, and ECM system volume controls. To operate the ICS, proceed as follows:

NORMAL

1. ICS function selector—NORM.
2. Adjust ICS volume as desired.
3. MIC SEL switch—COLD.
   Check ICS operation, using microphone switch ICS position.
4. Recheck the ICS.
   MIC SEL switch—as desired.

EXTERNAL STATIONS

For communication with the Plane Captain or crewman during starting or postflight procedure, use the ICS as follows:

1. ICS function selectors—NORM (both cockpits).
2. MIC SEL switches—HOT (both cockpits).
3. Increase ICS volume as required.
4. Establish communication with external stations.

LOSS OF NORMAL MODE

If a crew member loses ICS contact, proceed as follows:

1. ICS function selector—ALT ICS.
2. Check intercommunication as in normal operation.

If selected receiver signals fail:

1. ICS function selector—ALT RAD.
2. If signals are regained, the ICS intercom amplifier has assumed the function of the failed intercom radio amplifier.

LOSS OF ALTERNATE MODE

Should NORM and ALT ICS fail, intercommunications may be regained as follows:

1. ICS function selector—EMER.
2. Systems operator's TRANSMIT CONT switch—RADIO.
3. UHF audio select button—Depress.
4. COMM VOL control—maximum.
5. Proceed as for normal radio communications.

COMMUNICATIONS-NAVIGATION-IDENTIFICATION SYSTEM (CNI)

CNI POWER BUTTON

The CNI PWR button (figure 1-11) is located on the right console, forward of the COCKPIT PRESS switch. With external electrical power and cooling air applied, depressing the CNI PWR button supplies power to the auxiliary UHF receiver power supply, which turns on the auxiliary UHF receiver and supplies warm-up power to the IFF/SIF unit.

Note

Operation of CNI system components should be delayed at least 90 seconds to allow warm-up.

EMERGENCY CNI POWER INDICATOR

The EMER CNI PWR indicator (B7, figure 1-40), normally blank, will flip to "ON" if a CNI power supply malfunction occurs. An "ON" indication denotes that the main communications transmitter is operating on reduced power. In this event, the AN/ASQ-56 TACAN unit is inoperative and IFF and SIF may also be inoperative, depending on the extent and type of malfunction. This indicator does not reveal the operating status of the auxiliary UHF receiver unit. An "ON" indication does not necessarily reflect inoperative status of the AN/ARN-52(V) TACAN in modified aircraft, except on loss of monitored a-c power.

UHF COMMUNICATIONS UNIT

The UHF communications unit (UHF COMM) transmits and receives AM signals in the frequency range from 225.0 to 399.9 megacycles. Through this unit, either crew member may select any of 20 preset channels, standard military emergency frequency, or manually tune to any of 1750 transmitter-receiver frequencies.

CONTROLS AND INDICATOR

COMM COMD Button

The COMM COMD button (B8, figure 1-40) is used to assume command of the main and auxiliary UHF communications units. The button contains a dimmable green indicating light. The button in the cockpit having command is illuminated.

Mode Selector

The communications mode selector (COMM/AUX, H2, figure 1-40) is used to control the operation of both the main and auxiliary UHF communications units. With this selector, the main unit can be operated as a transmitter-receiver, with or without monitoring of the military emergency (GUARD) frequency, or as an ADF receiver for navigation purposes. The auxiliary receiver can be used as an ADF receiver or to monitor the military emergency frequency.

Volume Control

With CNI power on, the COMM VOL control (H4, figure 1-40) is used to turn on the main UHF communications unit and to control main UHF receiver volume.

Function Control Switch

The function control switch (H1, figure 1-40) is used to select the transmitter frequency option of the main UHF unit. The function control switch operates as follows:

POSITION	FUNCTION
CHAN	Operation in mode preset channel (using the left-hand UHF slewing switch).
GUARD XMIT	Main unit is automatically tuned to military emergency frequency (243.0 mc).
FREQ	Operation in manual tuning mode (any of 1750 frequencies using all three UHF slewing switches).

Channel/Frequency Slew Switches

The channel/frequency slew switches (H3, H5, figure 1-40) are used to select operating frequency or channel of the main UHF unit through touch-tuning. With the function control switch in CHAN, the left switch is used to select the desired channel (1 through 20). With the function control switch in FREQ, all three switches are used to select frequency between 225.0 and 399.9 megacycles. When the function control switch is in the GUARD XMIT position, the touch-tuning circuits are inoperative.

Channel/Frequency Indicator

A channel/frequency remote indicator (F, figure 1-40) is installed in both cockpits. This indicator reads the operating channel (1 through 20 or GUARD) or the selected frequency between 225.0 and 399.9 megacycles. When the slewing switches are operated, the indicator changes reading in pulses at a rate of approximately three digits per second.

AUXILIARY UHF RECEIVER UNIT

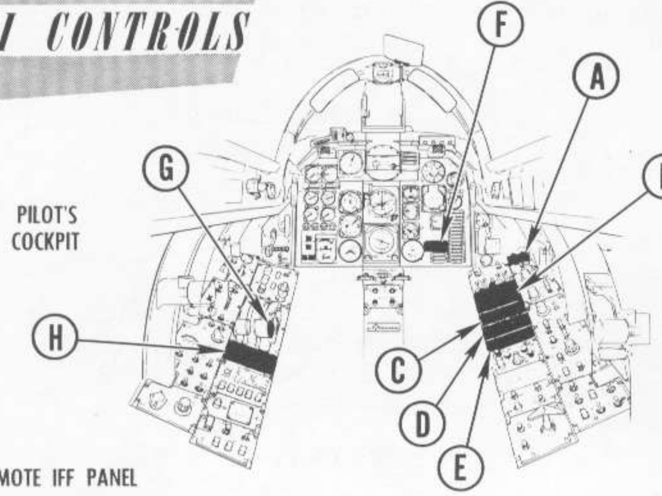
The auxiliary UHF receiver unit provides ADF operation and emergency reception of 20 preset channels between 265.0 and 284.9 megacycles or emergency reception on a fixed GUARD frequency. The auxiliary receiver is controlled through the lower row of functions of the COMM/AUX selector on the main UHF control panel. Auxiliary receiver channels are selected with the AUX CHAN knob on the auxiliary receiver control panel.

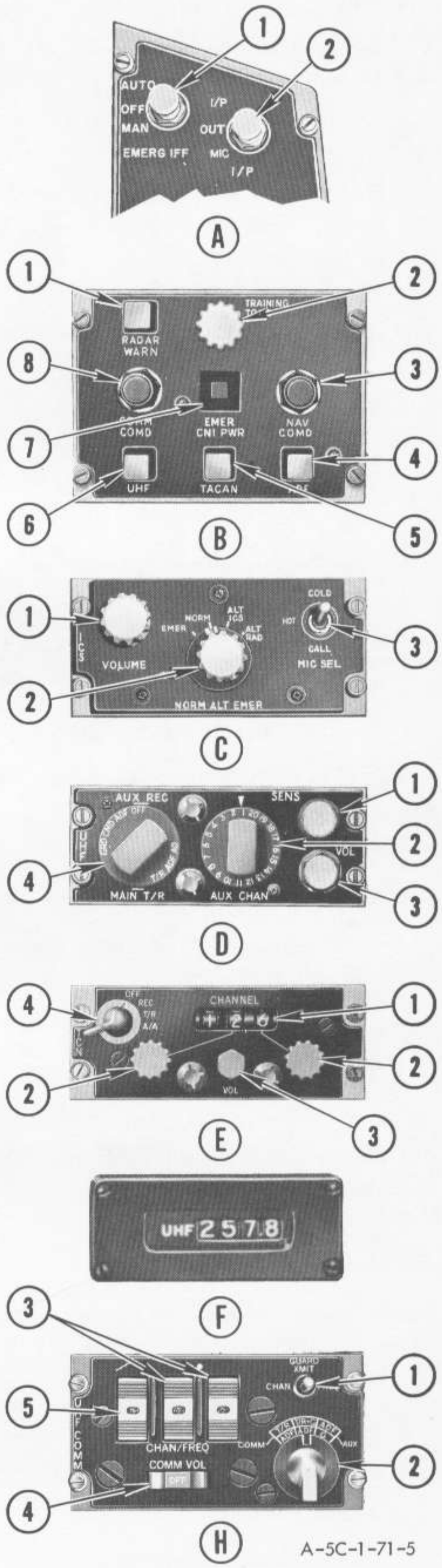
CONTROLS

AUX CHAN Knob

The AUX CHAN knob (D2, figure 1-40) selects any of the 20 preset auxiliary receiver channels.

ICS-CNI CONTROLS





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(A) REMOTE IFF PANEL

1. EMERGENCY IFF SWITCH
2. I/P SWITCH

(B) ICS AUDIO SELECT PANEL

1. RADAR WARNING RECEIVE BUTTON
2. TRAINING TONE VOLUME KNOB
3. NAV COMMAND BUTTON
4. ADF RECEIVE BUTTON
5. TACAN RECEIVE BUTTON
6. UHF RECEIVE BUTTON
7. EMERGENCY POWER INDICATOR
8. COMM COMMAND BUTTON

(C) ICS CONTROL PANEL

1. ICS VOLUME KNOB
2. ICS FUNCTION SELECTOR
3. MICROPHONE SELECT SWITCH

(D) AUX UHF RECEIVER PANEL

1. SENSITIVITY CONTROL (INOPERATIVE)
2. CHANNEL SELECTOR
3. VOLUME CONTROL
4. FUNCTION SELECTOR (INOPERATIVE)

(E) TACAN CONTROL PANEL

1. CHANNEL INDICATOR
2. CHANNEL SELECT KNOBS
3. VOLUME CONTROL
4. FUNCTION SELECTOR *

(F) UHF CHANNEL/FREQUENCY INDICATOR

(G) TRANSMIT SWITCH

(H) UHF COMM PANEL

1. FUNCTION CONTROL SWITCH
2. MODE SELECTOR
3. FREQUENCY SLEW SWITCHES
4. VOLUME KNOB
5. CHANNEL/FREQUENCY SLEW SWITCH

* A/A POSITION — AIRCRAFT 151615 AND SUBSEQUENT

Figure 1-40

VOL Knob

The auxiliary receiver VOL knob (D3, figure 1-40) is used to control auxiliary receiver volume level.

Note

The AUX REC function selector and sensitivity (SENS) knob are not operational in this installation.

UHF COMMUNICATIONS OPERATION

Note

If UHF equipment is to be operated prior to engine start, external equipment cooling air and electrical power must be connected.

1. CNI PWR button—Depress.
2. COMM VOL—Rotate to right as desired.
3. Mode (COMM/AUX) selector—T/R—ADF or T/R + G—ADF.
4. Function control switch—CHAN.
5. COMM COMD button—Depress; check illuminated.
6. UHF audio select button—Depress.
7. Operate channel (left) slewing switch, setting desired channel into channel/frequency indicator.
8. After allowing 90 seconds for warm-up, check communications as desired.
9. To select a manual frequency, move the function control switch to FREQ and, using the slewing switches, set desired frequency in channel/frequency indicator.
10. To secure the main UHF unit, rotate the COMM VOL control left to OFF.

AUXILIARY RECEIVER

The auxiliary receiver may be used to monitor military emergency frequency while using the main receiver in the ADF mode. Proceed as follows:

1. Mode (COMM/AUX) selector—ADF—G.
2. UHF audio select button—Depress.
3. RANGE & BEARING knob—UHF.
4. Auxiliary volume—as desired.

MAIN UHF/ADF

For main receiver ADF operation, proceed as follows:

1. Function control switch—CHAN or FREQ.
2. Set desired channel or frequency into channel/frequency indicator.
3. Mode (COMM/AUX) selector—ADF—G.
4. RANGE & BEARING knob—UHF.
5. Observe bearing to selected facility indicated on the horizontal situation indicator.

AUXILIARY UHF/ADF

For navigation purposes, the auxiliary receiver is used in the ADF mode as follows:

1. Mode (COMM/AUX) selector—T/R—ADF or T/R + G—ADF.
2. ADF audio select button—Depress if desired and adjust auxiliary volume.
3. AUX CHAN knob—desired channel.
4. RANGE & BEARING knob—UHF.
5. Observe bearing to facility on the horizontal situation indicator.

TACAN UNIT

The TACAN unit (Tactical Air Navigation) operates with ground- or ship-based beacons in the UHF band between 962 and 1213 megacycles. This band is divided into 126 operating channels. The TACAN unit provides displays of magnetic bearing to station, deviation from selected inbound or outbound course, and slant-range distance to selected station. Bearing, course, and distance are displayed to the pilot by the horizontal situation indicator. Bearing and distance are displayed to the systems operator by the azimuth and range indicator. On some aircraft,* the TACAN incorporates an air-to-air ranging function, capable of displaying line-of-sight distance to a suitably equipped aircraft for purposes such as air refueling rendezvous.

TACAN CONTROLS

A TACAN control panel (E, figure 1-40) is installed on the right console in both cockpits. Control of the system is assumed by depressing the NAV COMD button on the ICS audio select panel (B3, figure 1-40).

Function Selector

The TACAN function selector (E4, figure 1-40) controls operation and mode. The selector has OFF, REC, T/R,

*Aircraft 151615 and subsequent

and A/A* positions. Function selector positions operate TACAN as follows:

POSITION	FUNCTION
OFF	System secured.
REC (Receive)	System receives and indicates magnetic bearing only to selected station.
T/R (Transmit/ Receive)	System receives and indicates magnetic bearing and slant-range distance in nautical miles to selected station.
A/A* (Air-to-air)	System transmits and receives slant-range distance in nautical miles to selected airborne beacon.

Channel Knobs

The TACAN channel knobs (E2, figure 1-40) are used to select operating channels 001 through 126. Channels 127, 128, and 129 may be selected but are inoperative. After the initial 90-second warm-up period, up to 12 seconds are normally required to achieve lock-on after changing channels.

VOL Knob

The VOL knob (E3, figure 1-40) allows control of station identification audio signals as selected by depressing the TACAN audio select button on the ICS audio select panel. Ground- or ship-based stations transmit a Morse-coded identification signal every 38 seconds. No identification signal is present during the absence of station lock-on and in the A/A mode.*

TACAN OPERATION

Ground- or Ship-based Beacons

The TACAN unit presents precision displays of bearing, course deviation, and distance. Bearing is accurate to within an average of ±1 degree. Distance is accurate to within 0.1 nautical mile at less than 50 miles, and to 0.2 nautical mile from 50 to 196 miles, the maximum obtainable. Bearing and distance memory circuits allow continuous indications and lock-on retention during mild maneuvers or spurious signal operation. The bearing indication holds for 3 to 8 seconds, and the distance indication will hold for 8 to 15 seconds. The unit is capable of maintaining bearing track during turns of up to 20 degrees per second, depending upon clear line-of-sight access to the station.

Audio Identifier

In the REC or T/R modes, a garbled or unreadable station identifier is an indication of malfunction of the aircraft unit or the surface station. Unless confirmed by known landmarks or ship sighting, range and bearing displays accompanied by an unreadable identifier should not be trusted.

False Bearing

TACAN will occasionally lock on to a false bearing which will be 40 degrees, or any multiple of 40 degrees, in error on either side of the correct bearing. Switching to another channel and then returning to the desired channel should recycle the search mode. This deficiency does not affect the distance indication provided by the TACAN unit.

Air-to-air Ranging*

TACAN airborne ranging provides line-of-sight distance indication up to 300 nautical miles between any suitably equipped transponder (tanker or aircraft acting as the station) and up to five suitably equipped interrogator (homing) aircraft. A/A mode mechanization requires that the transponder and interrogator systems be set 63 channels apart. Use of the A/A mode requires prearrangement and preflight or in-flight briefing as necessary. The following table is a partial listing of compatible channel combinations.

Note

Although the AN/ARN-52(V) TACAN system is capable of 300 nautical miles line-of-sight ranging, the pilot's HSI is unlimited for readout, altitude permitting, but the systems operator's ARI is limited to 186 nautical miles.

TRANSPONDER CHANNEL	INTERROGATOR CHANNEL	TRANSPONDER CHANNEL	INTERROGATOR CHANNEL
001	064	064	001
020	083	083	020
100	037	037	100
120	057	057	120
126	063	063	126

Note

- When transponding to more than one interrogator, the distance displayed in the transponder aircraft will probably be to the closest interrogator beyond 0.1 nautical mile. With two or more interrogators at approximately the same distance, it is unknown which interrogator distance is being displayed.
- During A/A mode operation, the HSI bearing pointer searches (no bearing is displayed). The ADF function of the UHF COMM unit or the auxiliary receiver must be set and used periodically to determine bearing between transponder and interrogator.

TACAN PROCEDURES

Ground- or Ship-based Beacons

1. CNI power—on.
2. TACAN audio select button—Depress.
3. Function selector—REC.

*Aircraft 151615 and subsequent

4. NAV COMD button—Depress.
   Check light on.
5. RANGE & BEARING knob—TACAN.
6. Select desired station channel.
7. After lock-on, adjust volume and identify station.
8. Function selector—T/R.
9. Observe bearing and distance on HSI.
10. To secure TACAN, move function selector to OFF.

Air-to-air Ranging*

Interrogator (Homing Procedure).

1. Normal T/R mode operation—check.
2. Function selector—A/A.
3. Prebriefed channel—Select.
4. UHF COMM unit or auxiliary receiver channel—as desired (ADF function).
5. Note distance to transponder on HSI.
6. To determine bearing to transponder, move RANGE & BEARING knob to UHF, request transmission, and note HSI bearing indication.
7. With transponder in sight and confirmed, move function selector to T/R, REC, or OFF, as briefed.

Transponder (Homer Procedure).

1. Normal T/R mode operation—check.
2. Function selector—A/A.
3. Prebriefed channel—Select.
4. UHF COMM unit or auxiliary receiver channel—as desired (ADF function).
5. Note distance to interrogator on HSI.

RANGE AND BEARING KNOBS

A RANGE & BEARING knob (3, figure 1-30) is installed in each cockpit to provide selection of signal source from the UHF communications system, TACAN, or the bomb directing set (NAV) for navigation display. The knobs are independent so that each crew member can select a separate source. In the UHF position, the bearing pointer of the horizontal situation indicator or the systems operator's azimuth and range indicator displays magnetic bearing to the selected radio facility. In TACAN, these indicators display magnetic bearing and distance (as selected) to the TACAN beacon. In NAV, the horizontal situation indicator or the systems operator's azimuth and range indicator displays bearing and distance to selected bomb directing set navigation checkpoint or target. Refer to Section I, Part 2, of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

HORIZONTAL SITUATION INDICATOR (HSI)

The horizontal situation indicator (figure 1-41) provides selected radio and bomb directing set navigation displays. Within 46.5 nautical miles of target with the bomb directing set operating in the BOMB mode, the indicator shows magnetic bearing and distance to the weapon release point. The compass ring (4, figure 1-41) is controlled by the flight reference set, duplicating the heading indication of the all-attitude indicator. The bearing pointer (2) indicates magnetic bearing to station or destination. The heading marker (5) indicates desired heading as adjusted with the HEADING SET knob (14). During TACAN operation, the course pointer, the course deviation bar, and the reciprocal course pointer (8, 1, 15) form a single arrow when flight path is on the selected course. The deviation bar (1) is deflected when the flight is off the selected course. Selection of the desired inbound or outbound course is made by setting the desired course into the course setting indicator (12) with the COURSE SET knob (11). Mode of operation indicator lights are provided on the face of the instrument.

Note

Failure of the No. 2 engine or No. 2 generator, and subsequent undervoltage due to rpm decrease, may cause HSI precession prior to switchover to No. 1 electrical system. Placing the NO. 2 GENERATOR switch to OFF before No. 2 engine rpm reaches 36% will prevent precession.

ADF MODE

When homing on a selected UHF facility (RANGE & BEARING knob at UHF), the UHF light (10, figure 1-41) appears. The course deviation bar (1) is locked at center and the distance indicating window (13) is covered by a shutter. Magnetic bearing to the selected station is indicated by the bearing pointer (2).

TACAN MODE

With TACAN operating and the RANGE & BEARING knob at TACAN, magnetic bearing to selected station is indicated by the bearing pointer (2, figure 1-41), and the TAC light (6) is visible in the upper right corner of the instrument. "TO/FROM" indication is provided by an arrow (9) which appears near the center of the instrument. Depending on position of the aircraft relative to selected course, the head of this arrow will appear near either end of the course deviation bar. The deviation bar (1) slides to either side to indicate displacement from selected course (12). Each deviation dot under the bar indicates $2\frac{1}{2}$ degrees displacement. The distance indicating window (13) displays TACAN range up to 196 nautical miles (T/R) and the 1000 digit is hidden by

*Aircraft 151615 and subsequent

HORIZONTAL SITUATION INDICATOR

1. COURSE DEVIATION BAR
2. BEARING POINTER
3. LUBBER LINE
4. COMPASS CARD
5. HEADING MARKER
6. TACAN MODE LIGHT
7. BOMB MODE LIGHT
8. COURSE POINTER
9. TO/FROM POINTER
10. UHF MODE LIGHT
11. COURSE SET KNOB
12. COURSE SETTING READOUT
13. DISTANCE READOUT
14. HEADING SET KNOB
15. RECIPROCAL COURSE POINTER
16. NAV MODE LIGHT

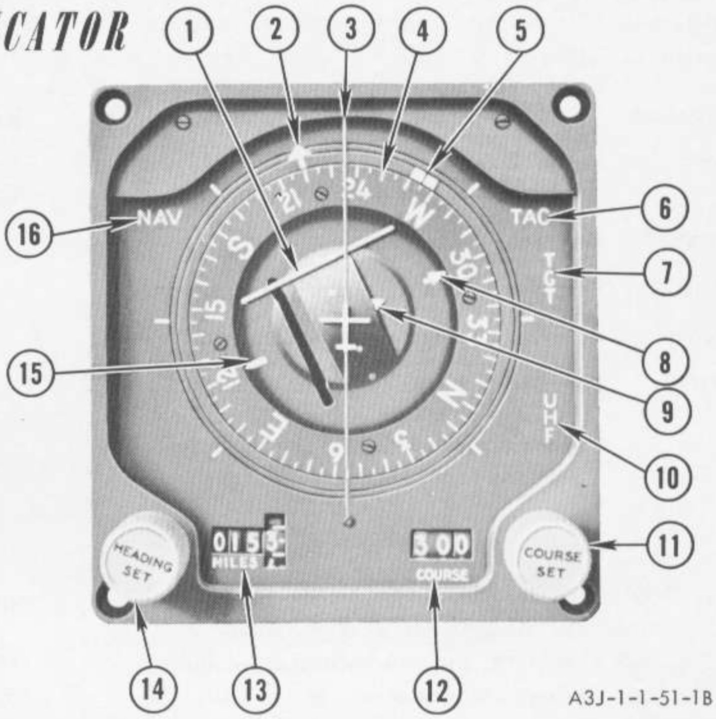


Figure 1-41

a shutter. If the TACAN is switched from T/R to REC, the entire window is covered.

Note

When changing TACAN channel (RANGE & BEARING knob at TACAN), the course deviation bar centers, the bearing pointer searches, and the distance window flag appears until lock-on is achieved.

NAV AND BOMB MODES

Refer to Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

IDENTIFICATION UNITS (IFF AND SIF)

The IFF/SIF transponder units provide coded display responses, along with the basic video return of the aircraft, on the scope of any properly equipped and interrogating air or surface radar. The IFF unit (Identification, Friend or Foe) supplies a basic reply pulse in any of three modes. The SIF unit (Selective Identification Feature) provides coded response for the three basic modes. In-flight selection of 32 codes is available for MODE 1, and 64 codes are available for MODE 3. MODE 2, the classified military identification mode, is preset by maintenance personnel, and is not available for in-flight SIF code selection. In addition to the military identification applications, navigation assistance, traffic separation, and distress identification are available through the IFF/SIF system. If preselected by the pilot, the IFF automatically responds in the emergency mode upon ejection of either crew member.

Note

- Operation of SIF requires that the NORM/MOD switch on the SIF unit in the electronics bay be set to MOD. NORM position results in a basic IFF response (no SIF). Ground stations equipped with SIF are not capable of receiving unmodified IFF signals.
- Master controls for the IFF and SIF units are installed in the aft cockpit only. Flight in positive control areas is not normally permitted without operational SIF.
- An emergency IFF mode switch is located on the pilot's right-hand console and an emergency IFF switch is under each crew member's seat. Refer to EMERG IFF SWITCH, in this section.

IFF/SIF CONTROLS

MASTER Function Selector

The MASTER function selector (aft cockpit) controls operation of the IFF/SIF system in any or all selected modes. With the SIF unit NORM/MOD switch at MOD, the MASTER function selector supplies power for SIF operation. The MASTER function selector operates the system as follows:

POSITION	OPERATION
OFF	Partial filament power (90 seconds after CNI power is turned on).
STBY	Warmed up and ready.
LOW	Receiver on low sensitivity in all modes.
NORM	Receiver on normal sensitivity in all modes.
EMERG (SIF)	Four Mode 1 replies, a single Mode 2 reply, two Mode 3, Code 77 replies (plus a partial third Mode 3, Code 77 reply in modified aircraft).

Note

- Pilot selection of MAN (EMERG IFF switch) overrides all positions of the systems operator's MASTER function selector, including OFF. Direct selection of MAN with the MASTER function selector at OFF requires no delay before response is available if CNI power has been on for at least 90 seconds.
- Aircraft modified by Avionics Change 170 respond automatically in Mode 3, Code 77, during emergency operation. The MODE 3 button need *not* be depressed to obtain this feature.

MODE 2 and MODE 3 Buttons

The MODE 2 and MODE 3 buttons (aft cockpit) provide selection of transponder operation in two additional modes. MODE 2 is the classified military mode of identification. MODE 3 is used in conjunction with civilian and some military agencies, such as FAA Air Traffic Control Centers and GCA or CCA. MODE 2 and MODE 3 can be selected separately or simultaneously, and are initiated in the LOW or NORM positions of the MASTER function selector.

Identify Position (I/P) Switch

The I/P switch (both cockpits) allows a radar agency to single out, by radio request, an individual aircraft in a high-density traffic area. A momentary I/P or a permanent MIC position may be selected. Upon holding the switch momentarily in I/P, or selecting MIC and depressing the microphone switch, a 30-second I/P response is activated, after which normal response returns.

The I/P function operates in the various modes as follows:

NORM/MOD SWITCH POSITION	MODE 1	MODE 2	MODE 3	RESPONSE
MOD	Double reply	Normal reply	Double reply*	IFF/SIF
NORM	Normal reply	Normal reply†	Normal reply	IFF only

*On aircraft having Avionics Bulletin 46 complied with, the IFF is capable of transmitting an I/P response in Mode 3. Without this modification, positive identification with some FAA Centers may require momentary selection of STBY or making identifying turns

†With Mode 2 out, a 30-second reply

SIF MODE 1 and MODE 3 Code Dials

The MODE 1 and MODE 3 code dials are two concentric-type switches. The outer dial sets the first digit of the MODE 1 or MODE 3 codes, while the inner dial sets the second digit.

EMERG IFF Switch

The EMERG IFF switch (A1, figure 1-40) is used to select IFF emergency response. The EMERG IFF switch has three positions: MAN, OFF, and AUTO. In OFF, the IFF emergency mode is deenergized and control is maintained at the systems operator's IFF control panel. The MAN (manual) position is used to select emergency IFF response, overriding the systems operator's MASTER function selector. The AUTO position is selected to prepare the system to respond in the emergency mode in the event of ejection. Automatic IFF emergency response will not occur with the switch in the OFF position, which may be used over territory where the emergency transmission would be considered undesirable.

IFF/SIF OPERATION (SYSTEMS OPERATOR)

1. MASTER function selector—STBY.
2. Position MODE 1 and MODE 3 SIF code dials to desired codes.

   The outer dial selects "tens," the inner dial selects units.

3. I/P switch—OUT.
4. MASTER function selector—NORM, when desired.

5. Rotate MASTER function selector to LOW (partial sensitivity) when requested to do so by properly identified surface or air challenger.

   This position is utilized for surface tracking when close to the challenging radar.

6. Set MODE 2 and MODE 3 buttons as requested.

7. For emergency operation, press dial stop and rotate MASTER function selector to EMERG.

   The IFF will automatically transmit an emergency response when interrogated.

WARNING

Most civilian agencies do not interrogate IFF Mode 1 until all aircraft are modified by AVC 170, and when time permits, select Code 77 on MODE 3 to ensure that all interested agencies will be made aware of an emergency.

8. For "Ident" or "Squawk Flash" requests, hold I/P switch momentarily in I/P, or move I/P switch to MIC and momentarily depress the microphone switch.

9. To secure the IFF/SIF, rotate MASTER function selector to OFF.

PILOT'S IFF PROCEDURES

1. EMERG IFF switch—AUTO for normal operations (or OFF only if no automatic emergency IFF response is desired for tactical reasons).

2. For "Squawk Flash" or "Ident" requests, hold I/P switch momentarily in I/P as directed, or place I/P switch in MIC and actuate the microphone switch in XMIT, as desired. Either action will activate a 30-second I/P response, after which normal response returns.

Note

- On aircraft not having Avionics Bulletin 46 complied with, the I/P function in MODE 3 is not available.
- The MAN position of the EMERG IFF switch overrides any position of the systems operator's MASTER function selector, including OFF.
- Prior to flight with the aft cockpit unoccupied, ensure that the IFF MASTER function selector is positioned to NORM, the MODE 3 button is depressed, the I/P switch (aft cockpit) is at OUT, and the desired MODE 3 SIF code is selected.

LIGHTING SYSTEMS

EXTERIOR LIGHTS

Exterior lighting equipment consists of wing and tail position lights, low-intensity formation lights, retractable, rotating anticollision lights, a taxi light, and approach lights.

POSITION LIGHTS

Position lights are located on the wing tips and the vertical stabilizer. Controls for the position lights are located on the exterior lighting panel on the right console.

ANTICOLLISION LIGHTS

Retractable, rotating anticollision lights are installed on the top of the fuselage and on the bottom aft of the cockpit section. The anticollision lights can be utilized as steady, white fuselage position lights by placing the MASTER EXT LIGHTS switch to ON with the ANTICOLLISION switch at RETRACT. There are no speed limitations for operation of the anticollision lights.

TAXI LIGHT

A single taxi light is located on the nose wheel landing gear.

FORMATION LIGHTS

The aircraft is equipped with wing tip and fuselage low-intensity formation lights. The fuselage formation lights are installed aft of each wing trailing edge. The wing tip formation lights are single units with lenses on both the upper and lower surfaces, permitting the lights to be viewed from positions above and below the lead aircraft.

FUEL PROBE LIGHT

A retractable, red-lensed light is installed in the upper nose section forward of the windshield for illumination of the fuel probe. This light is controlled by the FUEL PROBE light button. On some aircraft,* the light is a fixed installation.

APPROACH LIGHTS

Refer to ANGLE-OF-ATTACK SYSTEM, in this section.

EXTERIOR LIGHTS CONTROLS

MASTER EXT LIGHTS Switch

The MASTER EXT LIGHTS switch (1, figure 1-42) is located on the left console immediately forward of the flap control switch. This toggle switch has ON, OFF, and SIGNAL positions. The MASTER EXT LIGHTS switch must be moved from the OFF position before the anticollision

*Converted aircraft and aircraft 149300 through 149317, and 150823 through 151728 having AFC 155 complied with or position lights can be illuminated. The purpose of the switch is to enable the pilot to signal for night catapult and to extinguish the exterior lights after a night carrier landing. When the switch is positioned to ON, all position lights will be illuminated if their individual switches are at BRT or DIM and the ANTICOLLISION switch is at RETRACT. When the switch is *held* in the SIGNAL position, it will perform the same function as it does when in the ON position. If one or both of the WING or TAIL light switches is positioned to BRT or DIM, the corresponding position lights will be illuminated as long as the MASTER EXT LIGHTS switch is held in SIGNAL. The taxi light and the approach lights system are not part of the exterior lights master circuit.

Note

> At least one of the position light switches must be in the BRT or DIM position for a signal application.

WING and TAIL Light Switches

The function and brightness of the wing and tail position lights are controlled by two selector switches (TAIL, 11, and WING, 12, figure 1-42) on the exterior lights control panel.

ANTICOLLISION Lights Switch

The ANTICOLLISION lights switch (14, figure 1-42) controls the retractable anticollision lights. Extension, retraction, and illumination power is supplied by the MASTER EXT LIGHTS switch. With the MASTER EXT LIGHTS switch in ON or SIGNAL, the ANTICOLLISION lights switch will illuminate the lights when moved from the OFF position: EXTEND causing them to extend and rotate as anticollision lights, RETRACT causing them to remain in or retract into the fuselage and act as position lights.

FORMATION Lights Switch

A FORMATION lights switch (10, figure 1-42) is installed on the exterior lights control panel. This switch has BRT, DIM, and OFF positions.

FUEL PROBE Light Button

The FUEL PROBE light button (13, figure 1-42) is provided for control of night illumination of the extended air refueling probe. Depressing the button extends and illuminates the light. Redepressing and releasing the button turns out the light and retracts the assembly.

APPROACH Lights Switch

The flashing function of the approach lights and approach indexer may be bypassed for field carrier landing practice or carrier touch-and-go by selecting the T & G position of the APPROACH lights switch (8, figure 1-42), located on the exterior lights control panel.

TAXI Light Button

The TAXI light button (9, figure 1-42) is located on the exterior lights panel. During night operations, the taxi light is illuminated by depressing the button and is extinguished by redepressing and releasing the button. If the light is on when the landing gear is retracted, the light will extinguish, and will illuminate on extension if the button is left depressed.

INTERIOR LIGHTS

The following interior cockpit lighting is installed:

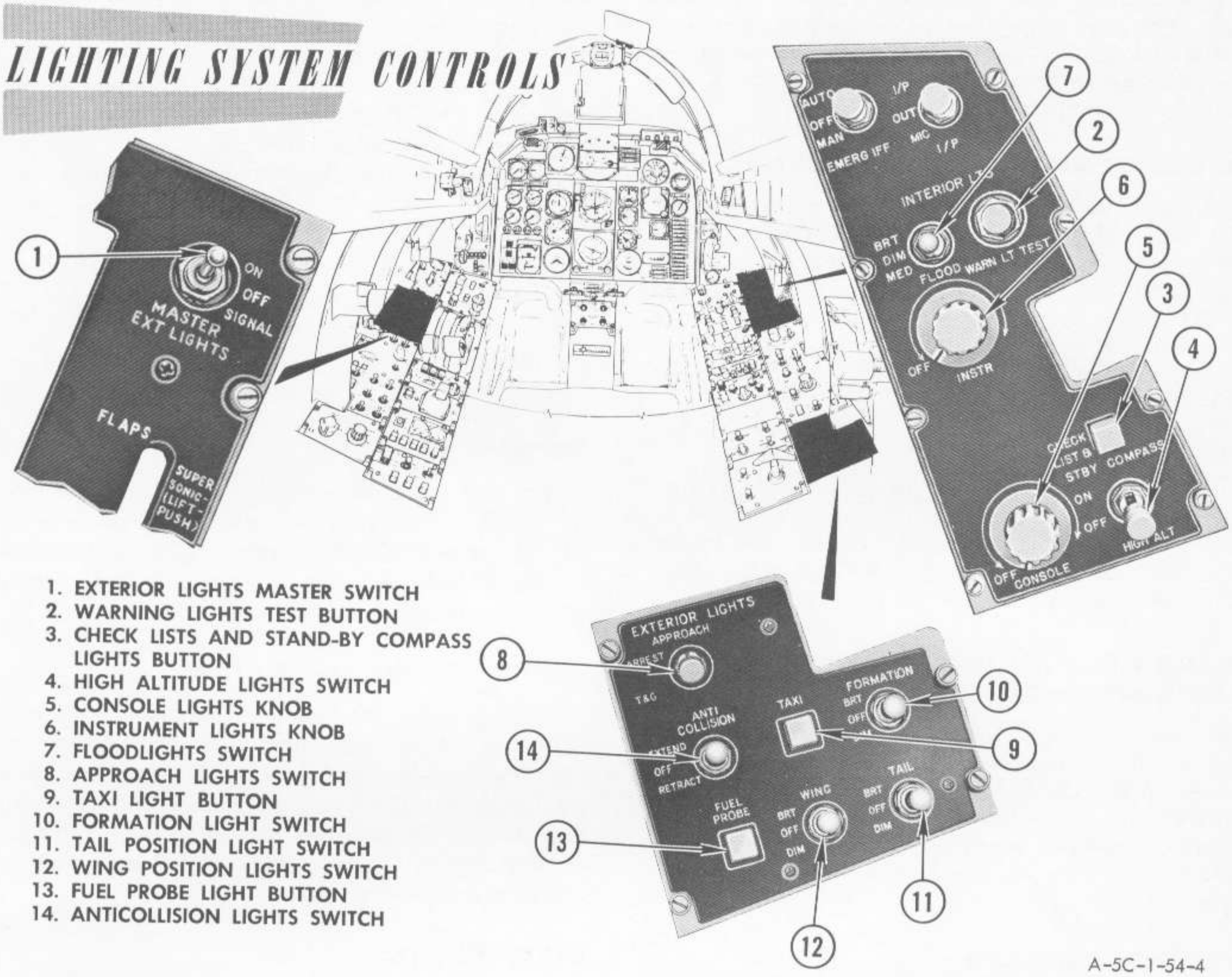
1. Right and left console red floodlights.
2. Right and left console white high-altitude lights.
3. Console refractor panels red lights (indirect).
4. Individual red instrument lighting (instrument panel).
5. Indirect red lighting for checkoff lists and stand-by compass.
6. Warning, caution, and advisory lights.
7. Left and right emergency lights.

INTERIOR LIGHTS CONTROLS

FLOOD Switch

The intensity of console red floodlighting is controlled by the FLOOD switch (7, figure 1-42). On/off selection is made through the CONSOLE lights knob. The FLOOD switch allows BRT, DIM, or MED selection.

LIGHTING SYSTEM CONTROLS



1. EXTERIOR LIGHTS MASTER SWITCH
2. WARNING LIGHTS TEST BUTTON
3. CHECK LISTS AND STAND-BY COMPASS LIGHTS BUTTON
4. HIGH ALTITUDE LIGHTS SWITCH
5. CONSOLE LIGHTS KNOB
6. INSTRUMENT LIGHTS KNOB
7. FLOODLIGHTS SWITCH
8. APPROACH LIGHTS SWITCH
9. TAXI LIGHT BUTTON
10. FORMATION LIGHT SWITCH
11. TAIL POSITION LIGHT SWITCH
12. WING POSITION LIGHTS SWITCH
13. FUEL PROBE LIGHT BUTTON
14. ANTICOLLISION LIGHTS SWITCH

A-5C-1-54-4

Figure 1-42

INSTR Lights Knob

The brightness of individual instrument lights and checkoff lists lights is controlled by the INSTR knob (6, figure 1-42). When the knob is turned clockwise from the OFF position for night operation, the following lights are automatically dimmed: landing gear warning light, hook warning light, compass SYNC and TAKE CMD lights, HSI function lights, LABS light, radar advisory lights, and the master warning and caution indicators.

CONSOLE Lights Knob

The console lights intensity is controlled by the CONSOLE knob (5, figure 1-42).

HIGH ALT Lights Switch

The high-altitude lights are selected through the HIGH ALT switch (4, figure 1-42).

CHECK LIST & STBY COMPASS Button

Lighting of the take-off and landing check lists and stand-by compass is controlled through the CHECK LIST & STBY COMPASS button (3, figure 1-42). The check lists lights intensity is dependent upon CONSOLE knob position.

WARN LT TEST Button

The WARN LT TEST button (2, figure 1-42) provides an operational check of all cockpit warning, caution, and advisory indicators.

Emergency Light

The cockpit emergency light (2, figure 1-11) provides mobile utility or emergency white or red light. Illumination and brightness are controlled by a rheostat on the back of the light. A small button, located on the rheostat, provides momentary full bright intensity. The lens at the front of the light may be rotated to provide four light patterns: white spot, white flood, red spot, and red flood. This light is provided by the essential d-c bus and may be operated with power supplied by the RAT-driven emergency unit.

SYSTEMS OPERATOR'S INTERIOR LIGHTS

Lighting of the systems operator's cockpit is provided by white floodlights, indirect instrument (red) lighting, white map (chartboard) lights, and red flood (boarding) lights. Controls for the interior lights are located on the interior lights panel on the right console, for the map lights on the map lights panel on the left forward console, and for the red floodlights on the under side of the instrument panel shroud.

MISCELLANEOUS LIGHTING

Interior lighting of the bomb bay is provided by four dome lights. The electronics compartment is lighted by a single floodlight. These lights are controlled by the BOMB BAY LTS switch, located in the right aft portion of the nose wheel well. See figure 1-51.

WARNING, CAUTION, AND ADVISORY INDICATORS

The warning, caution, and advisory indicator system consists of yellow caution indicators, red warning indicators, and green and yellow advisory lights. All indicators are automatically dimmed when the instrument lights are turned on for night operations. The warning and caution indicators are of a flip-shutter design, appearing black until energized.

WARNING INDICATORS

The red FIRE #1 ENG and FIRE #2 ENG warning indicators are installed on the upper left portion of the pilot's instrument panel. The red OXYGEN warning indicator is located on the upper right of the instrument panel. Single FIRE and OXYGEN warning lights are installed on the systems operator's display panel. Three additional warning indicators are installed on the pilot's instrument panel: the WHEELS warning indicator, the illuminated landing gear handle, and the hook handle-mounted warning light. The landing gear handle and hook handle warning lights are not on the master warning circuit.

CAUTION INDICATORS

A bank of yellow caution indicators is installed on the lower right portion of the pilot's instrument panel. A single caution light (CANOPY) is installed on the systems operator's display panel.

MASTER WARNING AND MASTER CAUTION INDICATORS

A master warning and a master caution indicator are installed under the instrument panel shroud. These barber-poled, rotating lights are designed to draw the pilot's attention to a warning or caution indicator which might otherwise be missed. The master warning and caution indicators are turned off by depressing and releasing the face of the light assemblies. The potential brightness of the master warning and caution indicators is reduced by moving the INSTR lights knob from OFF.

Note

The master warning indicator is energized by the FIRE #1 ENG, FIRE #2 ENG, OXYGEN, and WHEELS warning indicator circuits only. Landing gear handle and hook handle warning lights are not on the master warning circuit.

ADVISORY LIGHTS

Yellow and green advisory lights are installed on the consoles in both cockpits and on the pilot's center pedestal. The console-mounted advisory lights indicate the operational status and cockpit in command of the various communications and navigation equipment.

WARNING LIGHTS TEST BUTTONS

A warning lights test button is installed on the right console in each cockpit. The crew members can depress their respective buttons to test operation of the indicating lights. In addition to testing the lights, depressing these buttons also provides functional checks of the fire warning system, armament indicating circuits, and the CNI emergency power indicator.

INSTRUMENTS

A standard group of pitot-static instruments is provided: airspeed/Mach indicator, counter-pointer altimeter, and vertical speed indicators. The pitot-static system receives pitot (total) and static pressure through the radome-mounted pitot boom. The pitot-static instruments receive a corrected static pressure input from a pressure compensator in the air data computer. This corrected static pressure feature may be disabled by the pilot in the event of a suspected malfunction in the air data computer. In addition to the pitot-static group, other flight instruments include an all-attitude indicator, an angle-of-attack indicator, an accelerometer, a turn-and-bank indicator, and a stand-by attitude indicator for use in the event of failure of the all-attitude indicator. The pilot's navigation instruments include a horizontal situation indicator (HSI), a stand-by magnetic compass, and a clock. The systems operator's cockpit is provided with an azimuth and range indicator, a clock, wind speed and direction, true airspeed/ground speed, and radar/barometric altitude indicators. Engine instruments and other system indicators are described with their applicable systems in this section.

AIR DATA COMPUTER

The air data computer is an analog device which receives static and pitot pressures from the pitot-static boom, indicated angle of attack from the airstream direction detector (right forward fuselage), and total temperature from a probe mounted in the right inlet duct. An electrical output of altitude is provided to the inlet duct control system and flight control augmentation systems, and is displayed on the systems operator's radar/barometric altimeter as selected. A pneumatic output of altitude is provided for the pilot's altimeter, airspeed, Mach, and vertical speed indicators. Mach number is computed from the ratio of static and pitot pressures, and electrical outputs are provided for pitch augmentation, inlet duct and autoflight control systems, and for special reconnaissance systems if installed. True airspeed is computed from Mach number and total temperature, and electrical outputs are provided to the bomb directing set and flight reference set and displayed in the systems operator's cockpit. True angle of attack is computed from indicated angle of attack and Mach number, and electrical outputs are provided to the AN/ASB-12 radar antenna (in the alpha AUTO mode of terrain avoidance) and to the bombing computer. Normal velocity is computed from TAS and true angle of attack for the bombing computer.

STATIC PRESSURE COMPENSATOR (SPC)

Indicated static pressure is corrected for position error by a static pressure compensator (pneumatic generator) in the air data computer. The output pressure, controlled by Mach number, is supplied to the pilot's flight instruments (airspeed, altitude, and vertical speed) and is converted to electrical outputs which are provided for the pitch augmentation, inlet duct, and autoflight control systems. Electrical outputs which can be corrected for local atmospheric pressure variation from standard conditions are supplied to the bomb directing set and displayed in the systems operator's cockpit. The correction is made by the systems operator's setting in known terrain elevation and selecting the BARO CAL mode, which uses the radar altimeter.

SPC BUTTON

Some malfunctions of the SPC mechanism which cause erroneous output will initiate a fail-safe condition. In order to attain the next most accurate static pressure, the SPC is automatically bypassed and indicated static pressure is routed to the pilot's pressure-operated instruments and to the altitude computing portions of the air data computer. A barber pole will show in the systems operator's radar/barometric altimeter when operating in the BARO mode. Because some inert failures cannot be detected by this fail-safe feature, cockpit control is provided. Depressing the SPC button (5, figure 1-9) routes the output of the SPC to the instruments. A second depression and release of the button (away from the panel) routes indicated static pressure from the pitot-static boom directly to the instruments. The resulting display will be lower than actual altitude and airspeed. See figure 11-1 of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A). The SPC button will have no effect on the true airspeed display in the systems operator's cockpit.

Note

The error which can be introduced by the SPC is nearly equal to the amount of error present at landing touchdown speeds. Because of this, and due to the possibility of a failure at a critical time, it is recommended that the SPC be turned off for landings.

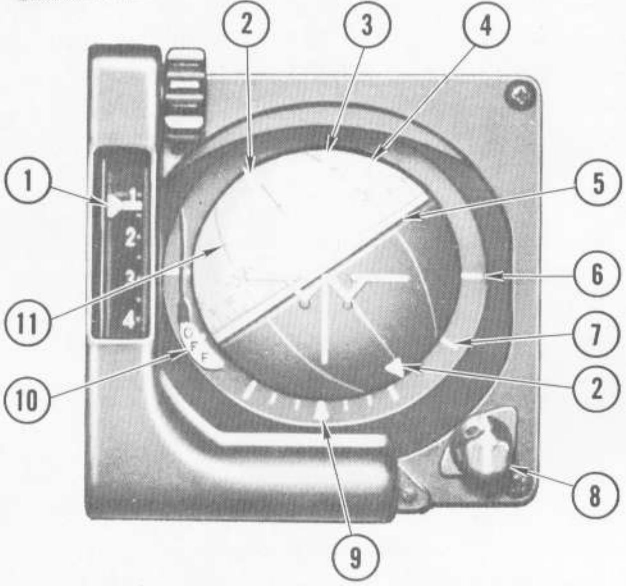
CAUTION

With the SPC turned off during a catapult launch, rate of descent and loss of altitude may be indicated on the cockpit instruments as a transient condition, due to increased position error in the airspeed system as airspeed increases.

ALL-ATTITUDE INDICATOR

The all-attitude indicator (figure 1-43) is an electrically operated servodriven instrument which displays aircraft attitude and heading 360 degrees about all axes. Basically, the indicator consists of a 3¾-inch sphere suspended in a sealed case. The sphere is capable of unrestricted movement around three axes, representing the relative movement of the earth and sky as viewed from the cockpit. A trim knob in the lower right-hand corner of the instrument rotates the sphere for change in zero pitch reference. Aircraft roll while in a vertical pitch attitude results in a heading change indication. The heading numerals are inverted during inverted flight. A vertical pointer is provided which indicates errors in lateral steering for the NAV or BOMB modes of the bomb directing set. The pointer indicates linear steering error left or right of the true run-in course. The pointer also provides roll/yaw deviation error during alternate LABS pull-ups. The vertical indices are equivalent to 5 degrees from the true run-in course. The indicator receives power through its own amplifier from the flight reference set, which in turn is powered by the essential a-c bus. A red "OFF" flag becomes visible at

ALL-ATTITUDE INDICATOR



1. LABS "G"-PROGRAMMER (REFER TO NATOPS SUPPLEMENTAL FLIGHT MANUAL)
2. ROLL POINTER
3. LATERAL STEERING AND ROLL-YAW POINTER
4. 5-DEGREE STEERING MARKS
5. HORIZON LINE AND HEADING SCALE
6. 90-DEGREE BANK MARKER
7. 60-DEGREE BANK MARKER
8. PITCH TRIM KNOB
9. BANK SCALE (0, 10, 20, 30 DEGREES)
10. OFF FLAG
11. PITCH REFERENCE MARKS (30 DEGREES)

A-5A-1-51-1

Figure 1-43

the lower left of the sphere when the indicator is not receiving the proper voltage inputs.

CAUTION

- If the No. 2 engine fails, undervoltage resulting from rpm decrease may cause the all-attitude indicator to tumble prior to electrical system switchover to engine No. 1. Placing the NO. 2 GENERATOR switch to OFF before No. 2 engine rpm reaches 36% will prevent AAI tumble.
- Should the "OFF" flag of the all-attitude indicator appear in flight, the instrument is *immediately* unreliable. If necessary, refer to the stand-by attitude indicator on the instrument panel.

During flight under instrument conditions, a periodic cross-check between the all-attitude indicator and the stand-by attitude indicator is recommended. Under stabilized flight conditions, the gyro platform corrects transient wing-down indications at a rate of approximately 5 degrees per minute.

G-PROGRAMMER

A G-programmer is mounted on the left side of the instrument bezel of the all-attitude indicator. This indicator is used during loft or toss bombing maneuvers. The desired "g" index may be alined with the horizon bar of the all-attitude indicator by means of a knob at the top of the instrument. Upon activation by the pull-up signal from the bomb directing set, weapon initiation trigger, or LABS timer, a motor-driven pointer moves down scale at a predetermined rate. During manual pull-ups, keeping the pointer alined with the moving reference pointer by steadily increasing control stick back pressure assures proper entry into the weapon delivery maneuver. The programmer is inoperative when the auto-flight control system is engaged.

STANDARD INSTRUMENTS

STAND-BY ATTITUDE INDICATOR

A stand-by attitude indicator (16, figure 1-10) is provided for the pilot's emergency use in case of malfunction of the flight reference set or the all-attitude indicator. The indicator is electrically operated and will permit rolls and loops without tumbling the gyro. If a malfunction occurs as a result of a power failure, a warning flag becomes visible, indicating "OFF." When not in use, the indicator face is obscured from view by a spring-loaded cover.

AIRSPEED/MACH INDICATOR

The airspeed/Mach indicator (43, figure 1-10) is a pressure-operated instrument which presents calibrated Mach number and airspeed in knots to the pilot. The instrument receives total pressure from the pitot-static boom and true static pressure from the air data computer. Should the static pressure compensator fail, or if the SPC button is released to the off position because of unreliable airspeed or altitude instrument readings, the indications will read IAS, IMN, and indicated altitude (with no correction for static pressure system error). The instrument provides indicated airspeed readings from 80 to 850 knots on a fixed dial and from 0.4 to 2.5 Mach on a moving scale.

INLET AIR TEMPERATURE INDICATOR

An inlet air temperature indicator (4, figure 1-30) is installed on the pilot's right forward console. This indicator (−70° to 150°C) presents the free air stream total temperature, measured at the engine inlet duct. This temperature can be used to determine ambient air temperature effects on flight performance by considering aircraft Mach number. Refer to Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

ALTIMETER

A standard counter-pointer altimeter (35, figure 1-10) is installed.

VERTICAL SPEED INDICATORS

Two standard vertical speed indicators are installed. The uppermost indicator (45, figure 1-10) is used as a cross-check indicator for terrain avoidance flight.

CLOCK

A standard 8-day clock (22, figure 1-10) with a 12-hour dial is located on the instrument panel. An elapsed time mechanism is provided and is set by the use of a button on the upper right corner of the face rim.

ANGLE-OF-ATTACK SYSTEM

The angle-of-attack system consists of an airstream direction detector and an angle-of-attack indicator which controls the approach lights on the nose landing gear and the pilot's approach indexer. Refer to APPROACH LIGHTS, in this section. The airstream direction detector is located on the right side of the fuselage, forward of the right intake duct. The detector alines with the direction of the local air stream and sends a resultant signal voltage to the angle-of-attack indicator. The detector probe is electrically heated through the pitot anti-ice circuit.

ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator (44, figure 1-10) displays aircraft local angle of attack as sensed by the airstream direction detector. This indicator operates whenever d-c electrical power is available (d-c converter operating), and requires no control initiation by the pilot. The face of the indicator is adjusted to place the nominal approach angle of attack (15 units) under an index at the 3-o'clock position. An "OFF" flag, located near the center of the indicator, appears in the event of failure. In the event of failure or when not powered, the indicator pointer rests at zero. A system of cam-operated switches within the indicator operates the approach lights and approach indexer.

APPROACH INDEXER

The approach lights system is supplemented by the approach indexer (3, figure 1-10). The indexer is illuminated under the same conditions as the approach lights, since operation is also controlled by the position of the landing gear and arresting hook. The indexer is also controlled by the hook bypass relay and will flash if the landing gear is locked down and the hook is up or unlocked (with the APPROACH lights switch in ARREST). The red-lighted approach indexer is located on the instrument panel shroud and is a visual aid to the pilot in determining the optimum landing approach attitude. A press-to-test button and a mechanical dimmer controlled by a knurled wheel are incorporated. The wheel may be rotated upward to provide dimming, as desired, through rotation of polaroid lenses on each indexer lamp. No control action is required from the pilot to utilize the approach lights and approach indexer systems. For indications of the angle-of-attack system, see figure 1-44.

APPROACH LIGHTS

The approach lights, installed on the nose gear strut, aid the Landing Signal Officer in determining aircraft landing approach attitude. These lights signify fast (red), "Roger" (amber), and slow (green) approach attitudes, respectively, as viewed by the Landing Signal Officer. The approach lights system is automatic. It is activated when the landing gear is down and locked and is controlled by the angle-of-attack indicator. Refer to ANGLE-OF-ATTACK INDICATOR, in this section. When the landing gear and arresting hook are down, the applicable approach light is on "steady." If the landing gear is down and the hook is retracted, the applicable approach light is on "steady" or flashing, as controlled by the APPROACH lights switch. The approach lights system is dimmed for night operations by placing the MASTER EXT LIGHTS switch to ON. The approach lights are extinguished when the weight of the aircraft compresses the landing gear struts.

PEDAL SHAKER (SPEED WARNING)

A vibration motor is mounted on the back side of the right-hand control pedal to produce a stall warning. It receives signals from the angle-of-attack system and will actuate when angle of attack reaches or exceeds 19 units.

GYROCOMPASS SYSTEM

The flight reference set, AN/ASN-26, provides precision heading information regardless of aircraft geographic latitude and flight attitude. Three modes of compass operation are available to the crew members in each cockpit. The normal mode of compass operation is designated the SLAVED mode and provides a gyro-stabilized magnetic heading indication. An alternate mode of operation is the directional gyro (DG) mode which is used during operation in high latitudes and during failure of the SLAVED mode. For emergency compass operation, a magnetic induction compass reference is used and is designated the compass (COMP) mode.

CONTROLS AND INDICATORS

COMMAND BUTTONS

The compass control panels are equipped with a TAKE CMD (take command) button (2, figure 1-45). Either

ANGLE-OF-ATTACK INDICATIONS

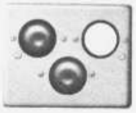
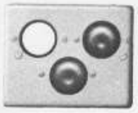
ANGLE-OF-ATTACK UNITS INCREASING A/A	ANGLE-OF-ATTACK UNITS DECREASING A/A	APPROACH LIGHTS	APPROACH INDEXER	CONDITION
14¼	13¾			NOSE LOW (FAST)
14¼ — 14¾	14¼ — 13¾			SLIGHTLY NOSE LOW
14¾ — 15¾	15¼ — 14¼			"ON SPEED"
15¾ — 16¼	15¾ — 15¼			SLIGHTLY NOSE HIGH
16¼ — MAX	MAX — 15¾			NOSE HIGH (SLOW)
19¼ ▼	18¾ ▲			PEDAL SHAKER OPERATES

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Figure 1-44

crew member can take command of the compass system by momentarily depressing the TAKE CMD button. Command of the system is indicated by steady illumination of a dimmable green light within the button.

HEMISPHERE SWITCH

The hemisphere switch (5, figure 1-45) provides controlled reversal of the correction voltages from the ground speed and latitude dials for the hemisphere (north or south) in which flight is being conducted.

MODE SELECTOR

The compass mode selector (7, figure 1-45) is used to select compass modes of operation. Three modes of operation are available: DG (directional gyro), SLAVED, and COMP (compass).

SYNCHRONIZING BUTTON

The SYNC button (4, figure 1-45) activates a fast servo loop which overrides the normal compass slaving rate of 2 degrees per minute, thus providing synchronization of heading presentation with magnetic heading in 10 seconds maximum during SLAVED mode operation. Synchronization is accomplished automatically on initial turn-on or re-selection of the SLAVED mode, but may be initiated as desired by depressing the button momentarily. An amber light, which may be dimmed for night operation, is incorporated within the button. During synchronization, the light should come on, indicating continuity of electrical power to the fast slave servo. The annunciator needle should center and the SYNC button indicator light should extinguish when synchronization is achieved.

Note

The SYNC light illuminates momentarily when compass mode is changed, and when the TAKE CMD button is depressed.

APPROACH LIGHT AND ANGLE OF ATTACK SYSTEMS

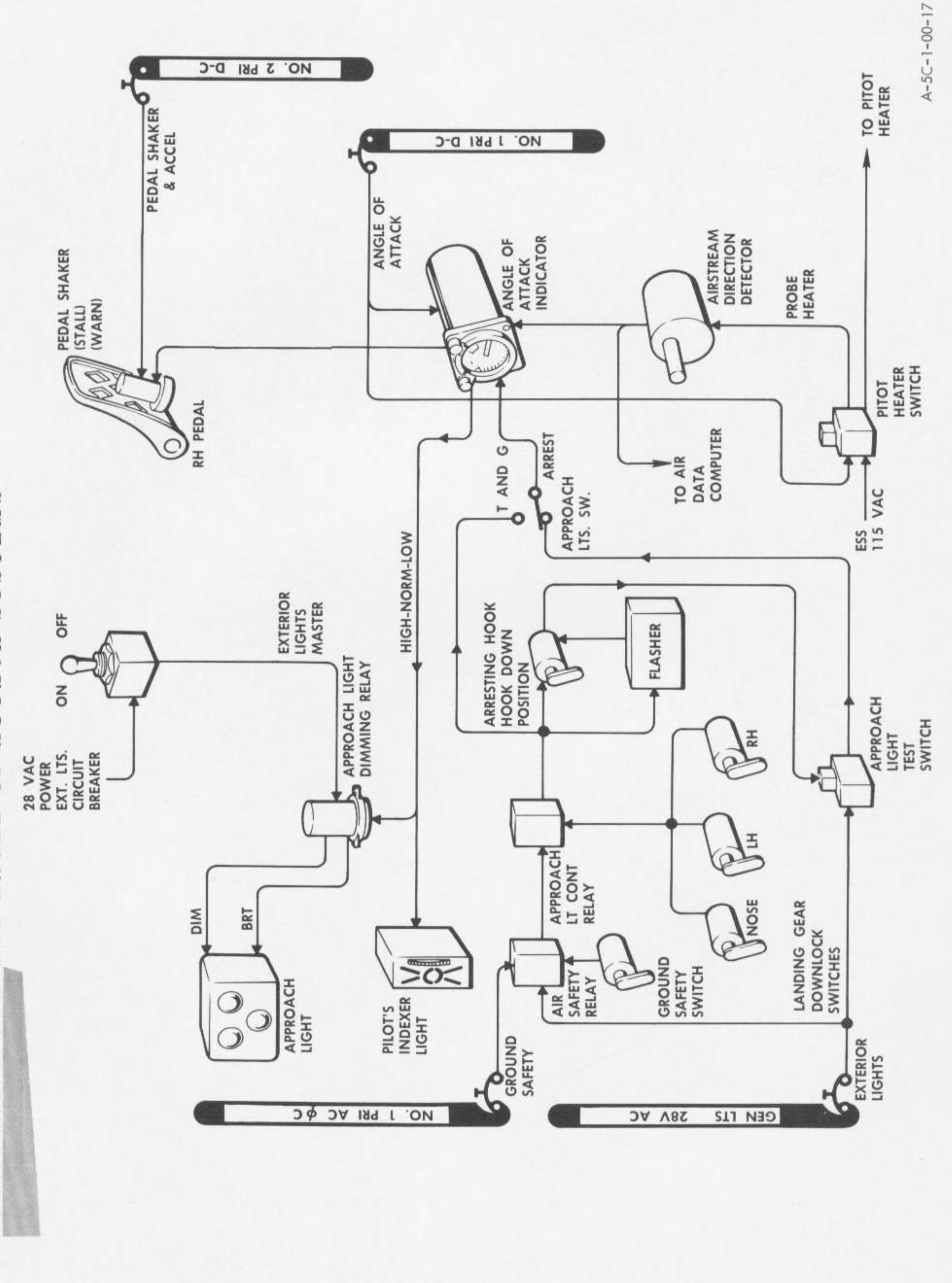
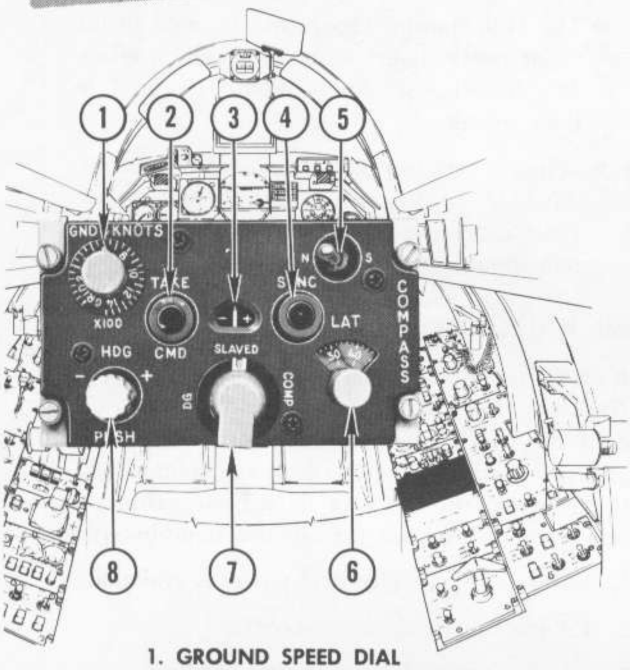


Figure 1-44A

COMPASS CONTROL PANEL



1. GROUND SPEED DIAL
2. COMPASS COMMAND BUTTON
3. ANNUNCIATOR
4. SYNCHRONIZING BUTTON
5. HEMISPHERE SWITCH
6. LATITUDE DIAL
7. COMPASS MODE SELECTOR
8. HEADING SET KNOB

A-5C-1-71-4

Figure 1-45

GROUND SPEED DIAL

The ground speed dial (1, figure 1-45) introduces the proper correction for system drift caused by the east-west component of aircraft velocity. When setting this dial, the compass mode selector should be in the DG or SLAVED position.

LATITUDE DIAL

The LAT dial (6, figure 1-45) is used to manually set known flight latitude to the heading compensator, in conjunction with ground speed, when operating in the DG mode. The LAT dial should be manually adjusted upon each 5-degree change of latitude in DG mode.

ANNUNCIATOR

The annunciator (3, figure 1-45) provides visual indication of the error in synchronization existing between the signals from the magnetic induction compass transmitter and the gyro-stabilized platform (directional gyro) heading indication. With the annunciator indicating minus or plus, the heading indications of all instruments are in corresponding error in the SLAVED mode.

HEADING SET KNOB

The heading set knob (HDG, 8, figure 1-45) is used, in conjunction with the DG and SLAVED modes of compass operation, to manually synchronize heading signals from the induction compass transmitter and the gyro-stabilized platform. The heading set knob is provided for manually changing, left or right, the heading indications of the all-attitude indicator, the azimuth and range indicator, and the magnetic heading pointer of the course deviation indicator. Synchronization is achieved by turning the knob left or right (— and + directions) until the annunciator needle is centered.

HEADING INDICATORS

ALL-ATTITUDE INDICATOR

Aircraft heading is displayed by the sphere of the AAI in all modes of compass system operation. Refer to INSTRUMENTS, in this section.

HORIZONTAL SITUATION INDICATOR

The compass ring of the HSI is driven by the compass system in all modes of operation.

Note

Heading indications of the AAI, HSI, and the aft cockpit azimuth and range indicator should agree at all times, unless the flight reference set gyro has tumbled due to engine or generator failure.

COMPASS SYSTEM OPERATION

Compass components of the flight reference set receive electrical power when external power is applied or when the engine-driven generators are producing proper voltage. In the event that one or both engine-driven generators fail, the compass system is fully operational with electrical power from one generator or from the ram-air turbine. On initial application of electrical power, the compass control in the forward cockpit is in command of the compass system. It is recommended that before command is transferred, the crew member taking command select compass mode to coincide with the control presently in command.

SLAVED (NORMAL)

The SLAVED mode is normally used during all flights at latitudes where magnetic induction compass sensing is reliable. In this mode, signals from the flight reference set gyro-stabilized platform and the induction compass transmitter are integrated in the heading compensator. Heading compensator output is then fed to the AAI, HSI, and the aft cockpit azimuth and range indicator.

Should gyro heading differ from magnetic, as will normally be the case when selecting the SLAVED mode, the control will synchronize the AAI sphere and the azimuth and range indicator to aircraft magnetic heading at the rate of approximately 18 degrees per second. Should this "fast slaving" be desired, the crew member in command of the compass system may depress his SYNC button momentarily and observe the annunciator and the amber light within the button. When synchronization is accomplished, the annunciator needle will be centered between the minus and plus signs and the amber light will be extinguished.

1. After the AAI erects, check that the compass mode selector is in the SLAVED position.
2. Check the annunciator needle and depress the SYNC button if the needle is not centered.

Note

- Do not depress the SYNC button until the wings are spread and locked.
- Synchronization should NOT be attempted during turns or radial maneuvers, or in conditions of extreme turbulence. Erratic indications may result from the turn and acceleration errors may be imposed upon the magnetic induction compass transmitter.
- The SYNC button should not be *held* down, as the fast slave circuit is operated by a thermal time-delay relay. Slaving synchronization should be achieved within 10 seconds after the button is momentarily depressed.

DG (ALTERNATE)

If the compass SLAVED mode fails to operate properly, the DG mode should be selected. In addition, at high latitudes (usually above 60 degrees) where magnetic heading is unreliable, the output of the magnetic induction compass transmitter should be cut out by selecting the DG mode. In this mode, the flight reference gyro alone transmits electrical signals through the heading compensator to the heading indicating instruments, and provides radar antenna gyro stabilization in the STBY-NAV position of the A/N MODE knob. Automatic correction for apparent drift and east-west ground speed is accomplished by adjusting the ground speed dial for each major speed change and adjusting the LAT dial upon each 5 degrees of change in latitude.

1. Compass mode selector—DG.
2. Hemisphere switch—as applicable.
3. LAT dial—local.
4. When established at stabilized climb, cruise, or descent ground speeds, set computed ground speed into the ground speed dial.
   Average ground speed settings may be desired during climbs and descents.
5. Correct heading indication with the heading set knob as desired.

Note

- The SYNC button should not be used in the DG or COMP modes as it will have no effect. The heading set knob should be used in these modes.
- When operating the bomb directing set, AN/ASB-12, in the STBY-NAV mode at latitudes exceeding 60 degrees, the compass system should be set in DG mode.

COMP (EMERGENCY)

The COMP mode of operation is used in the event of malfunction of both the SLAVED and DG modes. Selection of the COMP mode utilizes the unstabilized signal of the magnetic induction compass transmitter. The heading presentation is that of a basic earth inductor compass and is provided for use as a stand-by system.

1. Ensure adequate electrical power is available.
2. Compass mode selector—COMP.
3. Observe unstabilized magnetic heading.
4. Periodically cross-reference the stand-by magnetic compass.

CAUTION

The COMP mode of operation should only be used in the event of component damage or malfunction. The COMP mode is subject to turning and acceleration errors associated with all induction compass transmitters and magnetic compasses, and is also affected by local magnetic variations. During operation in the COMP mode, do not exceed 20 degrees of bank angle if minimum turn error is desired.

STAND-BY MAGNETIC COMPASS

A common Air Path stand-by magnetic compass is installed with the sunvisor on the canopy bow.

RADAR ALTIMETER

The radar altimeter, which is part of the electronic altimeter set, AN/APN-120, furnishes accurate altitude calibration data to the air data computer for correction of barometric altitude factor used by the bomb directing set. In addition, the set furnishes precision height-above-terrain data from terrain level to 75,000 feet to the crew members. The set consists of two independent sections: a low system and a high system, operating from a common power supply.

Note

Accurate radar altimeter indication is dependent upon level aircraft attitude.

LOW-ALTITUDE SYSTEM

The low-altitude system measures aircraft height above terrain from ground level to 3000 feet. An automatic turn-on signal from the high system (in RADAR mode) energizes the pilot's low-altitude indicator below approximately 4000 (+500/−700) feet above terrain. If the high system is in BARO, the barometric altitude shaft of the air data computer causes automatic low system turn-on at approximately 4000 (+500/−700) feet above mean sea level. The low system utilizes a frequency-modulated, continuous-wave (FM-CW) radio transmission at a frequency of 4300 megacycles, by which the measure of altitude is accomplished through monitoring of frequency differential between transmitted and received signal. In the event automatic turn-on does not occur, as indicated by appearance of the "FAIL" flag when the aircraft is below 3000 feet, the pilot can obtain low system operation through an override button located on the indicator. The LOW ALTITUDE warning light and the systems operator's radar/barometric altimeter are operated by the low system below 500 feet above the terrain.

HIGH-ALTITUDE SYSTEM (SYSTEMS OPERATOR)

The high-altitude system measures aircraft altitude from 500 to approximately 75,000 feet, within pitch and bank attitude limits of approximately 30 degrees. A signal from the high-altitude system is transmitted to the systems operator's radar/barometric altimeter when a radar mode of operation is selected. The high system operates on the pulse propagation principle at a frequency of 4225 megacycles. Time delay between pulse transmission and reception is converted into aircraft altitude above the terrain. Below 500 feet, the high-altitude system switches to input from the low-altitude system. The high system continues to transmit, but all radar altitude signals are generated by the FM-CW (low) system. Operational tolerance of the high-altitude system (above 500 feet) is ±22 feet.

MODE AND CALIBRATION CONTROLS (SYSTEMS OPERATOR)

ALTITUDE MODE KNOB

The ALTITUDE mode knob (8, figure 1-46) has four positions: RADAR CAL, RADAR, BARO, and BARO CAL. These positions function as follows:

POSITION	FUNCTION
RADAR CAL (Radar Calibrate)	Used during ground test by maintenance personnel, with an rf energy-absorbing hat under the system antenna, or in flight to determine high system operation and calibration accuracy. Proper operation and calibration is indicated by a 00000 (±22) -foot indication on the systems operator's radar/barometric altimeter.

Note

Radar calibration at high altitudes is impractical because of the time required to complete the slewing operation.

POSITION	FUNCTION
RADAR	The electronic altimeter energizes the systems operator's radar/barometric altimeter and the "RDR" mode flag is displayed.

Note

Failure of the high system above 500 feet results in BARO mode operation.

POSITION	FUNCTION
BARO (Barometric)	Corrected barometric altitude is displayed in the systems operator's radar/barometric altimeter and the "BAR" mode flag is displayed. A barber pole is displayed in the systems operator's radar/barometric altimeter if the SPC is OFF or failed.
BARO CAL (Barometric Calibrate)	Selected to correct indicated barometric altitude by correcting the air data computer with radar height plus a preflight set-in of calibration point terrain elevation.

Note

On aircraft not having bomb directing set, AN/ASB-12, installed, BARO CAL mode is inoperative.

RADAR ALTIMETER CONTROLS AND INDICATORS

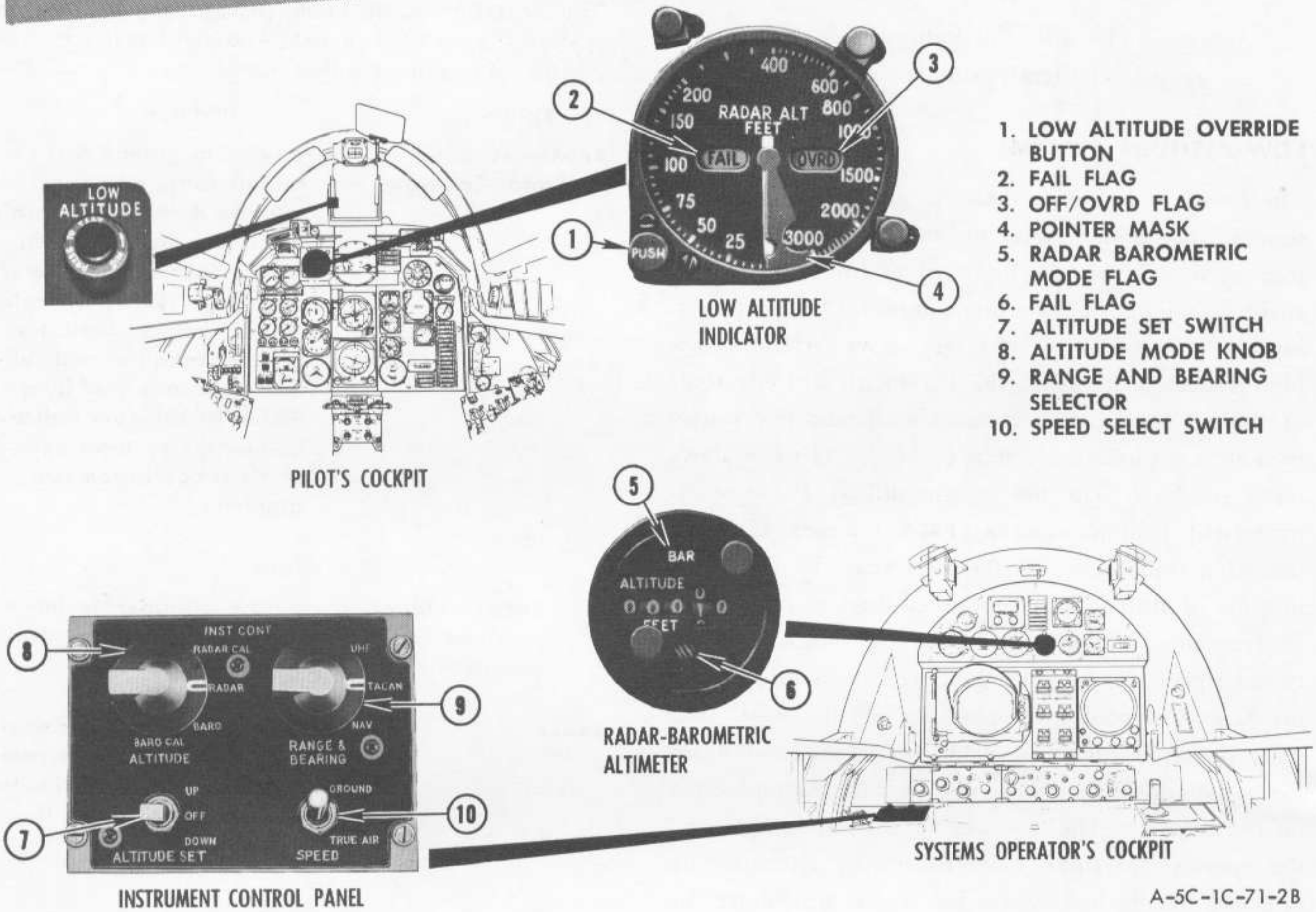


Figure 1-46

ALTITUDE SET SWITCH

The ALTITUDE SET switch (7, figure 1-46) is used by the systems operator to correct the radar/barometric altimeter in the BARO mode. Prior to take-off, desired elevation may be set into the altimeter by holding the switch in UP or DOWN and releasing at the desired indication.

LOW-ALTITUDE INDICATOR

The low-altitude indicator (figure 1-46) provides an indication of height above terrain from approximately 3000 feet to ground level (ground level, or zero, corresponds to a point 10 feet above the terrain). The indicator face contains a "FAIL" indicating window (2, figure 1-46) and an "OFF/OVRD" (override) indicating window (3, figure 1-46). During normal operation below 3000 feet above the terrain, both windows display a blank (black) space. In the event of low system failure, the "FAIL" flag is displayed and the indicating pointer retreats behind a mask (4, figure 1-46).

OVERRIDE BUTTON

An override push button on the face of indicator (1, figure 1-46) is used to activate the low system transmitter on descent in the event the "OFF" flag fails to disappear automatically at approximately 3300 feet above the ground. When low system transmitter operation is initiated through depressing the button, the "OVRD" flag is displayed. When altitude is regained, the button should again be depressed in order to shut off the low-altitude system and return to automatic operation; otherwise, sensitivity of the system operator's high-altitude system is reduced.

Note

In override mode above 5000 feet, the low-altitude indicator may display a momentary erroneous reading (with a "FAIL" flag showing) of 1500 feet if the systems operator shifts from RADAR to the BARO mode. The indicator then returns to the proper reading.

LOW-ALTITUDE WARNING LIGHT

The LOW ALTITUDE warning light is installed on the left side of the PPDI. This red light, used during terrain avoidance, low-altitude flight, illuminates whenever aircraft clearance above the terrain is less than 400 feet. Operation of this light depends on proper function of the low-altitude portion of the electronic altimeter. Refer to TERRAIN AVOIDANCE, in Section I, Part 2, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

HIGH SYSTEM OPERATION

The systems operator's radar/barometric altimeter provides a direct, digital read-out of aircraft height above the terrain in feet. Prior to reaching a target or checkpoint, the systems operator calibrates the air data computer for radar height by holding the ALTITUDE mode knob momentarily in BARO CAL over an area of flat terrain or over water. This procedure increases the accuracy of altitude input to the bomb directing set. Failure of the high-altitude system, with the ALTITUDE mode knob in RADAR, results in a radar/barometric altimeter indication of barometric altitude minus set-in target or checkpoint elevation, plus a "FAIL" flag. For high-altitude system operating procedures, refer to the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

LOW SYSTEM OPERATION

Prior to take-off, the indicator should read 0 feet. During climb-out above 3300 feet, the "OFF" and "FAIL" flags appear and the pointer is driven behind the mask. As altitude is decreased to 4000 (+500/—700) feet, the "OFF" flag should disappear. Below 3000 feet, radar altitude is indicated. If the pointer should remain masked and the "OFF" flag is displayed below an estimated 3000 feet above the terrain, depress the override button. Radar altitude is then displayed and the "OVRD" flag is visible.

CAUTION

When penetrating near mountainous terrain, the override button should be depressed on departing cruising or holding altitude. This procedure allows the low-altitude system to energize as radar altitude decreases to approximately 4000 feet, regardless of high system mode selection.

Note

The low-altitude indicator should NOT be operated in override (with "OVRD" flag displayed) above 4000 (+500/—700) feet above the terrain during SLR and photographic systems operation.

RECONNAISSANCE SYSTEMS

INTEGRATED OPERATIONAL INTELLIGENCE CENTER

The integrated operational intelligence center (IOIC) provides a rapid method of obtaining finished intelligence data from exposed film and magnetic tape recorded by the RA-5C multisensor reconnaissance systems. This includes fast photographic processing, interpretation, and analysis; PECM tape interpretation and analysis; SLR film processing, interpretation, and analysis; and data storage. The IOIC has the capability to receive raw data, process it to usable form, and analyze, interpret, correlate, store, retrieve, and formulate data into usable reports. The IOIC also handles data collected by other reconnaissance aircraft, and is geared to store, retrieve, and utilize information from other intelligence agencies. Through data generated by the aircraft sensors (both image-forming and non-image-forming), plus navigational data generated and recorded by the digital data system, the intelligence environment of target areas can be formulated.

DIGITAL DATA SYSTEM

The digital data system, integrated with the aircraft multisensor reconnaissance systems, receives signals from the bomb directing set, the radar altimeter, the air data computer, and preset identification data. These data are processed in a signal data converter and a data translator, and are directed to the various reconnaissance systems in the form of stabilization and control signals and aircraft location (flight data). These combined data are recorded on all photographic exposures and the SLR film by miniature cathode-ray tubes in the form of a coded digital data matrix. Similar data are recorded on the PECM tape on a time-sharing basis. These data matrix blocks and taped data, when correlated with the sensor data processed and recorded in the IOIC, provide exact location data of targets, an important factor in the planning of subsequent missions.

AERIAL PHOTOGRAPHIC SYSTEM

The aerial photographic system is capable of obtaining day or night, high- or low-altitude coverage. The system includes a maximum of five cameras, mounted in the special systems ventral pod. An air-driven flasher pod may be installed at each wing inboard store station for night operation. The cameras are controlled primarily by the systems operator; however, the pilot may assume command of, and operate, the oblique cameras. For camera coverage limits, oblique camera coverage, and recon systems integration, see figures 1-48, 1-49, and 1-50.

OBLIQUE CAMERAS

FORWARD OBLIQUE CAMERA

The forward oblique camera, KA-51A, is permanently installed in the bow of the ventral fairing. This 6-inch focal length camera is oriented with its optic axis fixed at 9.5 degrees depressed to the fuselage reference line. This camera carries 100 feet of 5-inch film. Total optical coverage is 41 degrees, and frame overlap provides film coverage of 50 percent of the foreground distance on each exposure.

SIDE OBLIQUE CAMERAS

A 6-inch focal length camera, KA-51A, may be installed at each side of the ventral fairing. Adjustable, fixed depression angles of 5 or 19.75 degrees are available.

OBLIQUE CAMERA SIGHT MARKERS

On some aircraft,* a side oblique camera alinement (sight) marker is installed on both sides of the wind screen radiation shield seal. These markers are used to aline the side oblique cameras with targets. The top marking corresponds to the 5-degree preset depression; the lower marking to the 19.75-degree preset depression. The desired marker should be alined to fly through the intended target in order to obtain centered photos of the target.

VERTICAL CAMERAS

Three vertical cameras are available: an azimuth (drift) stabilized camera, and one or two fully stabilized cameras. The drift-stabilized camera has a 1.75-inch focal length lens and its mounts are stabilized to aircraft flight path. The fully stabilized cameras (roll, pitch, and yaw) may be either 1.75- or 6-inch focal length. These cameras are used for direct overhead photography and are operated only by the systems operator.

PANORAMIC CAMERAS

A 3-inch, KS-68A, and/or an 18-inch, KS-69A, focal length panoramic camera may be installed in the ventral fairing center section. These cameras provide 180-degree, horizon-to-horizon coverage on two film frames. The panoramic cameras are fully stabilized to limits of 5 degrees in roll, pitch, and yaw at a maximum correction rate of 10 degrees per second.

FLASHER PODS

For night photography, a flasher pod is installed at each wing inboard store station. The pods incorporate an air-driven generator, capacitors, flash synchronization mechanism, and three independent flasher elements. These units are capable of providing a maximum of three separate flash impulses per second at a brightness level approximately 40 times that of a typical camera flashbulb. The flasher pulsing system is synchronized with camera speed and is adjusted for speed and altitude. The entire pod unit may be released through the armament normal release system as a store, or jettisoned while airborne, if necessary. Mode of operation (SIMULTANEOUS or ALTERNATE) is preset through a switch in the aft end of both pods. Proper flasher setting is determined prior to each mission. For additional information, refer to FLASHER CAPABILITY, in Section XI of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C). For aircraft operating limits with pods aboard, refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

WARNING

- The flasher pod capacitor system operates at 2600 volts. Remain clear of the flash units for 10 minutes after use, as residual capacitor charge requires this amount of time to bleed off.
- The brightness of the flash units subjects any person within direct viewing range to DANGER OF PERMANENT BLINDNESS. DO NOT LOOK DIRECTLY AT THE UNITS DURING PREFLIGHT TEST PROCEDURES.

CAMERA CONTROLS

Controls for the oblique cameras are located on the right console. The oblique camera panel is an alternate for either the T-375 armament monitor and control panel, or the AN/AWW-1 fuze function control panel.

COMMAND BUTTON

Command of the oblique cameras is assumed by depressing the CAMERA COMMAND button (figure 1-47). Command is indicated by a green light within the button. In order to assume command, the flaps must be retracted

*Aircraft 150842 and subsequent and aircraft having PCR 211 complied with

CAMERA CONTROL PANEL

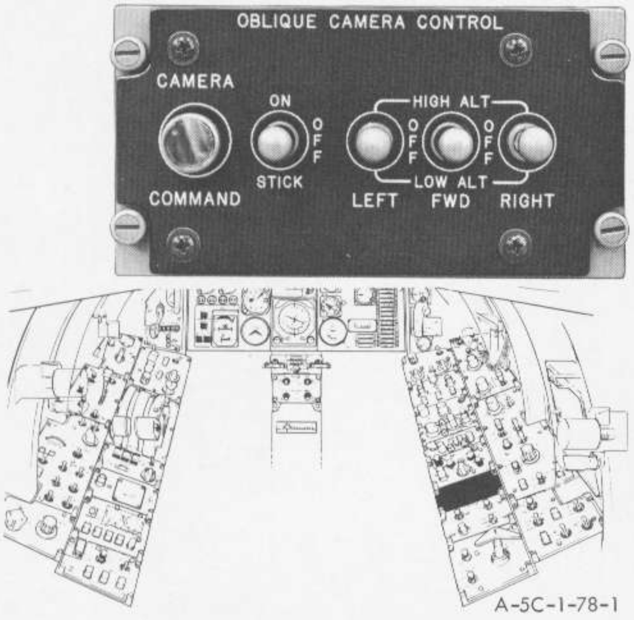


Figure 1-47

and the systems operator's camera master POWER switch must be in READY or OPERATE.

CAMERA CONTROL SWITCH

The camera control switch (ON, OFF, STICK, figure 1-47) allows selection of continuous operation (ON), selective operation through the stick trigger (STICK), or deenergizing of the oblique cameras while in command.

CAUTION

To prevent inadvertent updating of the autonavigator during STICK mode camera operation, check the weapons control panel B/N SYS button is in the UP position.

CAMERA ALTITUDE MODE SWITCHES

The camera altitude mode switches (LEFT, FWD, RIGHT, figure 1-47) allow mode selection for the oblique cameras. At HIGH ALT, the cameras operate in the normal mode without IMC (image motion compensation). At LOW ALT, the cameras operate with IMC.

Note

- LOW ALT should be selected for all operations except for air-to-air photography or for special targets of opportunity.
- The systems operator's camera POWER switch must be at READY or OPERATE for the pilot's controls to be operative.

CAMERA OPERATION

1. Ensure systems operator's camera master POWER switch is in READY prior to take-off.
2. If command is desired, depress CAMERA COMMAND button.
3. Set camera altitude mode switches as desired.
4. To operate, move camera control switch ON or depress and hold trigger, as applicable.
5. After photo run, move camera control switch OFF.

Note

- Do not change camera altitude mode switch positions (HIGH ALT/LOW ALT) during oblique camera operation (ON, or STICK with trigger depressed). To avoid possible damage, release the trigger (STICK mode) or select OFF, change altitude mode, and then resume operation as desired.
- For detailed coverage of the aerial photographic system, including systems operator procedures, refer to Section I, Part 2, and Section IX of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

SIDE-LOOKING RADAR

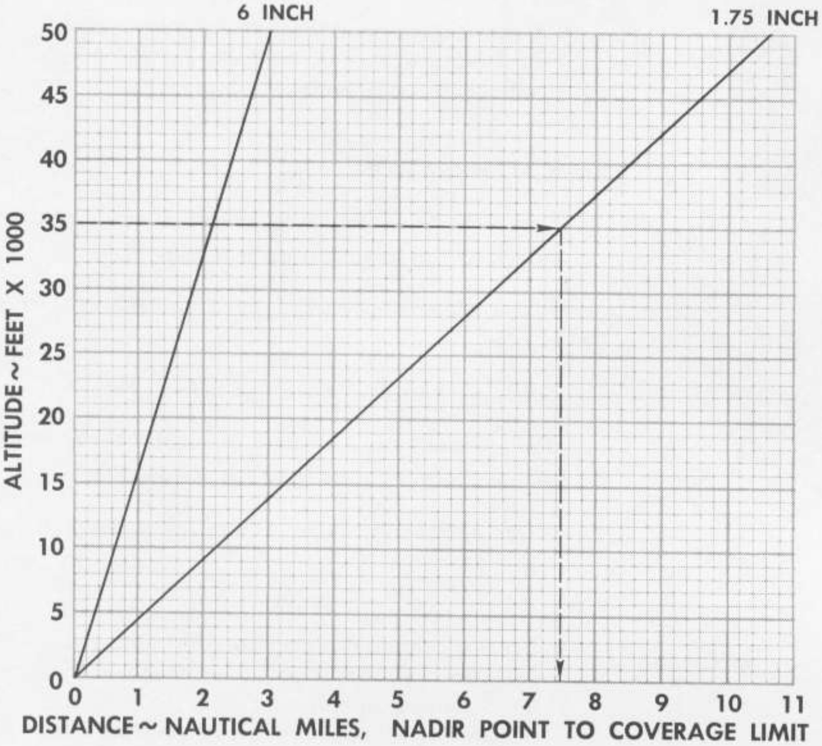
Refer to the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

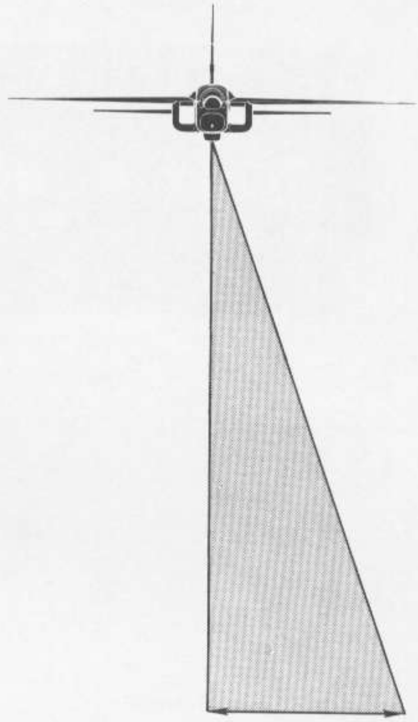
ELECTRONIC RECONNAISSANCE SYSTEM

For coverage of PECM, refer to the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

CAMERA COVERAGE LIMITS

STABILIZED VERTICAL CAMERAS

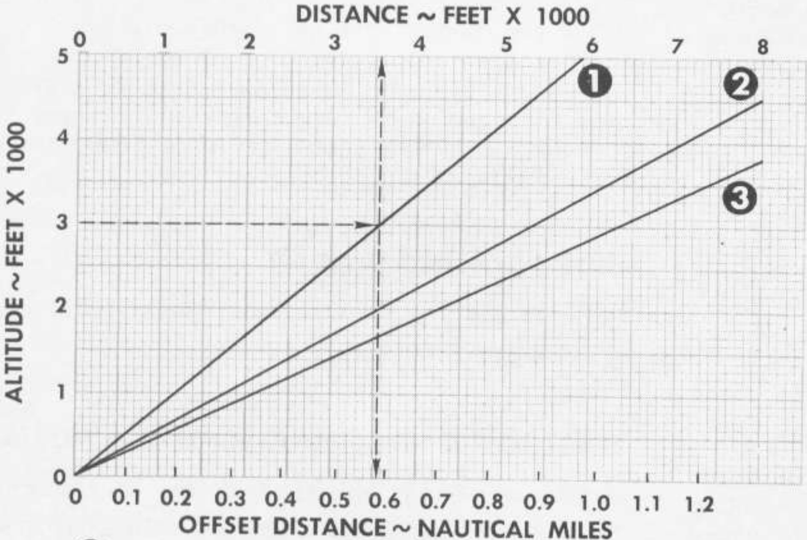


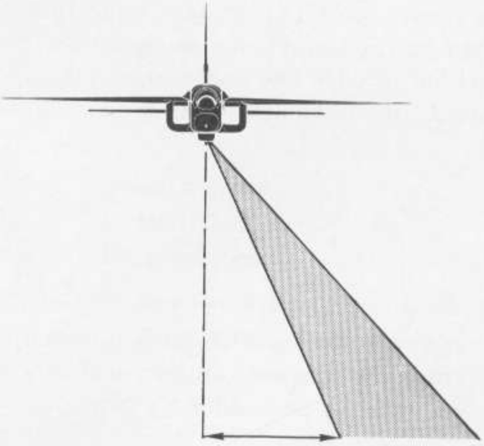


NOTE:

Double distance shown to obtain total coverage.

OBLIQUE CAMERAS





NOTE:

Distance shown is minimum offset.

❶ SIDE OBLIQUES - DISTANCE FROM NADIR TO START OF COVERAGE (19.75° DEPRESSION)

❷ FORWARD OBLIQUE - DISTANCE AHEAD TO START OF COVERAGE (AT 2.25° ANGLE-OF-ATTACK)

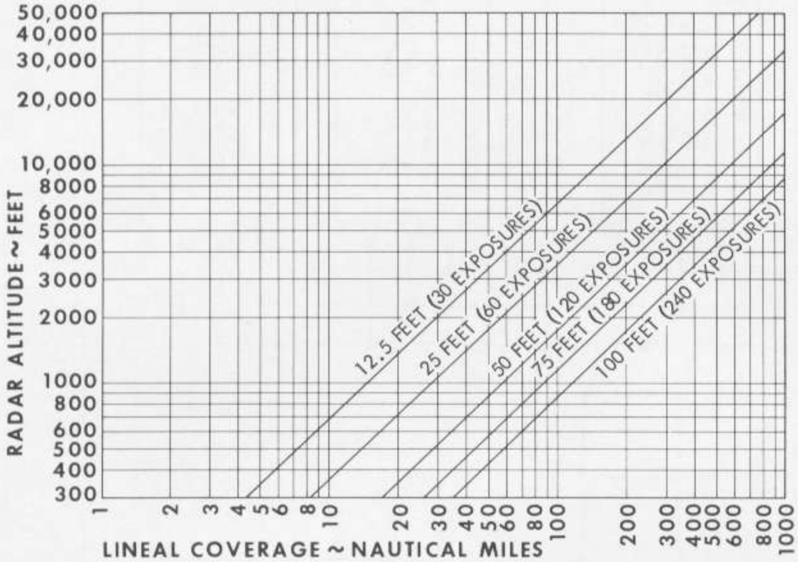
❸ SIDE OBLIQUES - DISTANCE FROM NADIR TO START OF COVERAGE (5° DEPRESSION)

A-5C-1C-78-12A

Figure 1-48

OBLIQUE CAMERA COVERAGE

FILM REQUIRED



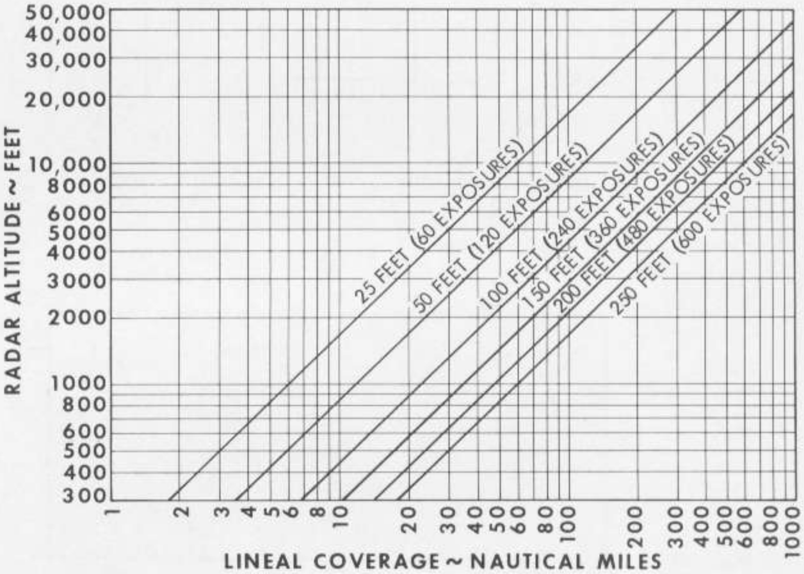
FORWARD

- 6" FOCAL LENGTH
- 9.5° DEPRESSION PLUS (2° ANGLE-OF-ATTACK) 11.5° TOTAL
- 41° X 41° FIELD
- 4.5" X 4.5" FORMAT
- 50% OVERLAP
- 100 FEET OF FILM (240 EXPOSURES)

SIDE

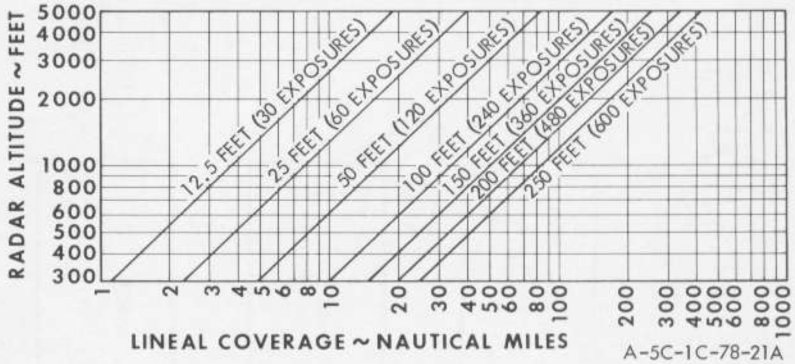
DEPRESSION 19.75°

- 6" FOCAL LENGTH
- 41° X 41° FIELD
- 4.5" X 4.5" FORMAT
- 60% OVERLAP
- 250 FEET OF FILM (600 EXPOSURES)



SIDE

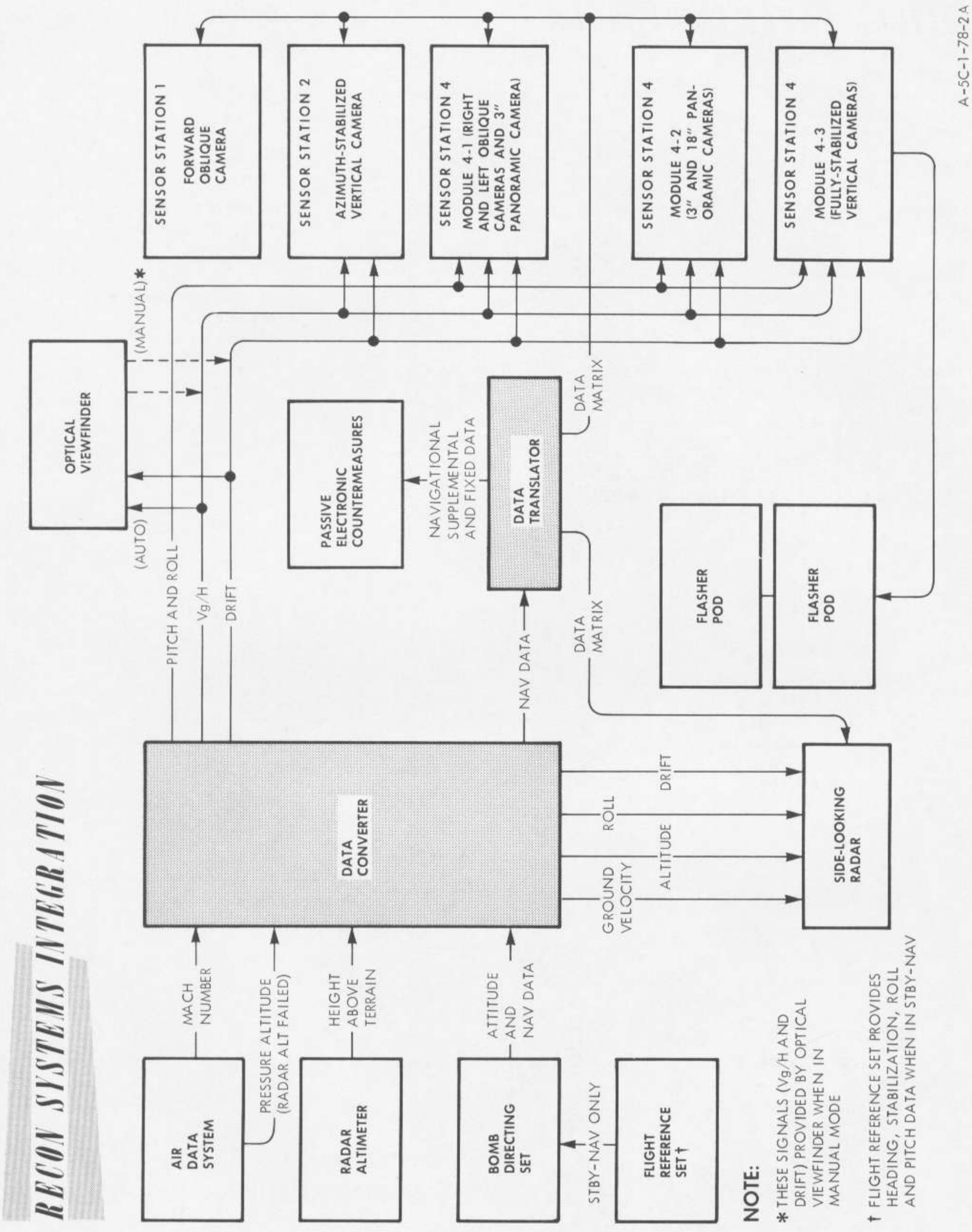
DEPRESSION 5°



A-5C-1C-78-21A

Figure 1-49

RECON SYSTEMS INTEGRATION



NOTE:

* THESE SIGNALS (Vg/H AND DRIFT) PROVIDED BY OPTICAL VIEWFINDER WHEN IN MANUAL MODE

† FLIGHT REFERENCE SET PROVIDES HEADING, STABILIZATION, ROLL AND PITCH DATA WHEN IN STBY-NAV

Figure 1-50

PART 3 — AIRCRAFT SERVICING

Normally, the aircraft will be serviced by qualified maintenance personnel and servicing will not require flight crew supervision. However, navigation flights, diversions, weather alternates, and NATO operations may require the use of various bases. Therefore, the flight crew must have a knowledge of aircraft servicing procedures, sufficient to accomplish normal aircraft turnaround-type servicing. Reference to the following procedures and figure 1-51, or the Pilot's NATOPS Check List (NAVWEPS 01-60ABC-1B), should be sufficient to ensure proper aircraft servicing by transient maintenance personnel under the supervision of the flight crew.

EXTERNAL POWER AND AIR REQUIREMENTS

The aircraft requires external electrical power, cooling air, and engine starting air. For a list of acceptable external power and conditioned air units, refer to EXTERNAL POWER UNITS, in this section.

ELECTRICAL

For ground operation of all buses, external a-c electrical power must be applied. The external power receptacle is located on the left side of the fuselage, forward of the main gear, at access number 74. Electrical power required is 115 volts, 400 cycles, three-phase (A, B, C rotation), ac, 45 kva. Two indicator lights (green) are mounted beside the external power receptacles and will come on when the generators are operating and ready to assume operation of the system. Although external power may be removed when either of these lights illuminates, the disconnect should be delayed until both lights are on and the aircraft power switch has been moved to GEN.

CONDITIONED AIR

An external cooling air supply is required for ground operation of electrical equipment. The main cooling supply nozzle is connected in the external power receptacle at access number 74. A cooling effect detector disables electrical circuits until sufficient cooling air is available. If autonavigator alinement has been initiated, care should be taken to disconnect external electrical power after aircraft generators are operating. This precludes bomb directing set power interruption and loss of alinement. An external cooling air receptacle for special systems is located in the right fuselage at access number 189:1. For conditioned air requirements, refer to EXTERNAL POWER UNITS, in this section.

ENGINE STARTING AIR

The aircraft engines have an impingement starting system requiring 180 pounds per minute, 75 psia (5:1) airflow. Engine starting air connections are located on the lower left side of each engine at access numbers 109:1 and 155:1 on the aft engine access doors.

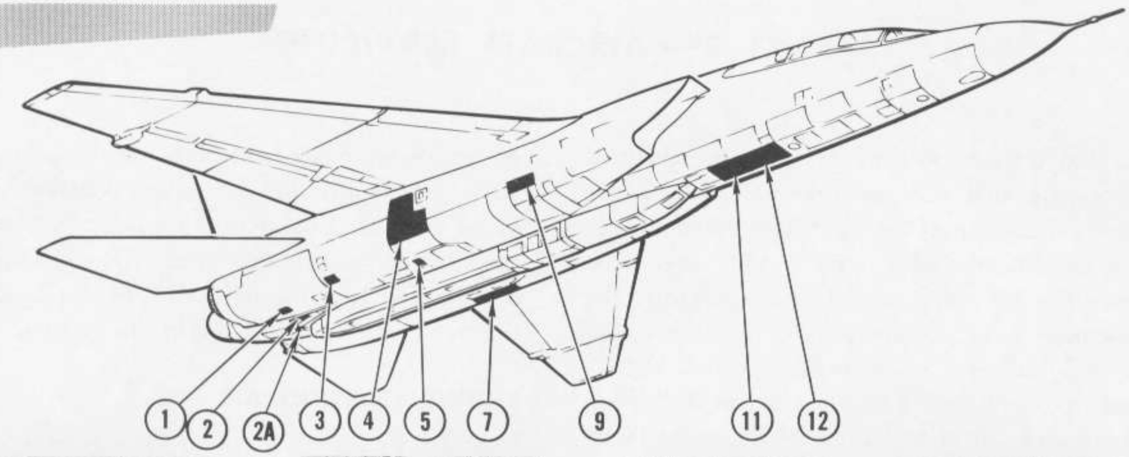
POWER UNITS (RCPP-105-1 AND RCPT-105-3)

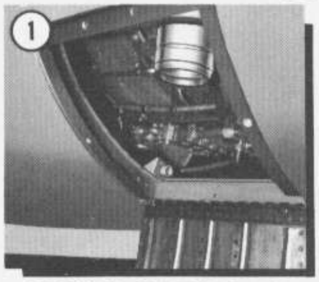
The RCPP-105-1 power unit is a streamlined, self-contained, air-transportable ground support pod. The RCPT-105-3 power unit is a trailerized, non-air-transportable version of the RCPP-105-1 unit. Internal components include a gas turbine compressor, a 60-kva a-c generator, a turbine refrigeration unit, the required fuel and oil supply, and controls. The pod provides refrigerated air for conditioned systems, engine starting air, and a-c power. Cooling air output temperature may be varied from 50° to 180°F, depending on ambient air temperature. Engine starting air output can be set to 3.6:1 for air turbine start systems, or to 5:1 for turbine impingement starting, as used on this aircraft. For ground aircraft systems operation, 60-kva, 400-cycle a-c electrical power is provided. The power pod can be carried on either inboard wing station, although it is normally transported on the left since the pod refueling receptacle is located on the left fuselage above the main gear wheel door. The pod can be refueled on the ground from the aircraft supply, either by gravity flow or under pressure from the wing transfer pumps. In emergencies, the pod may be jettisoned by the pilot through use of the external jettison button.

B/N AUXILIARY POWER UNIT

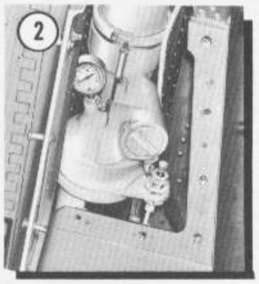
The E7488 B/N auxiliary power unit ("chin package") is a self-contained power unit, designed to be attached to the lower forward fuselage. Internal components include an internal combustion engine, an a-c generator,

SERVICING

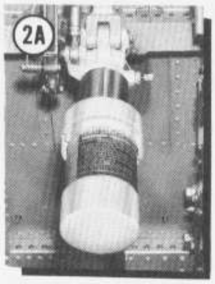




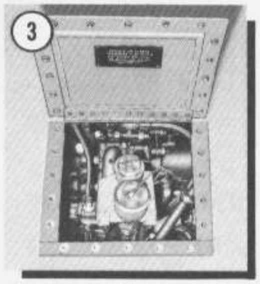
GROUND STARTING AIR CONNECTION (RIGHT SIDE SHOWN)



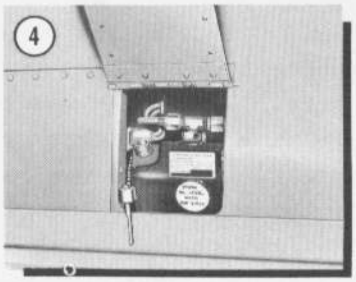
ARRESTING GEAR SNUBBER



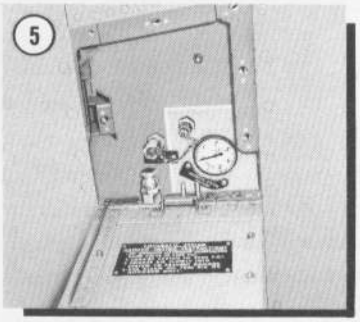
ARRESTING GEAR BUMPER
25 PSI AIR



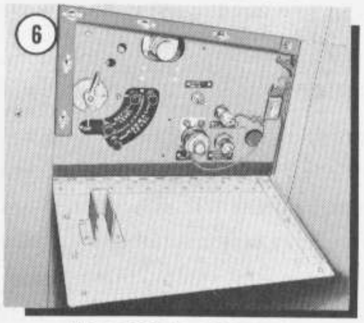
OIL TANK FILLER ACCESS (ON EACH SIDE)
TOTAL FILL CAPACITY — 5.2 GAL



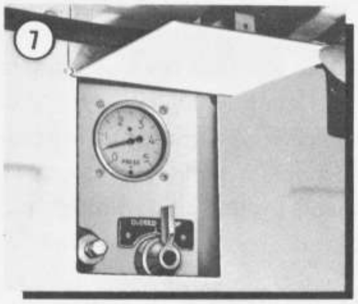
PNEUMATIC COMPRESSOR RESERVOIR



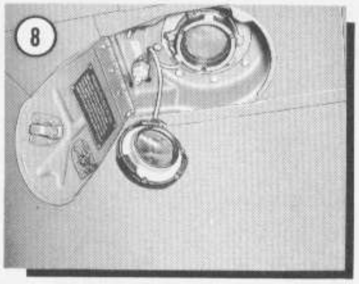
PNEUMATIC SYSTEM SERVICE PANEL
PRECHARGE — 2800-3200 PSI



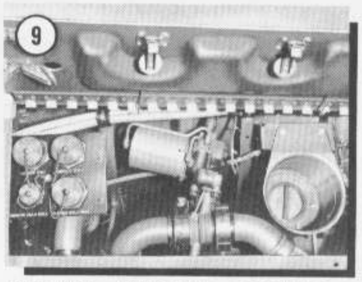
HYDRAULIC SYSTEMS SERVICE PANEL
NO. 1 RES — 2.3 GA
NO. 2 RES — 5.67 GAL



EMERGENCY BRAKE ACCUMULATOR SERVICE PANEL (LEFT GEAR WELL)
PRECHARGE — 1000 PSI



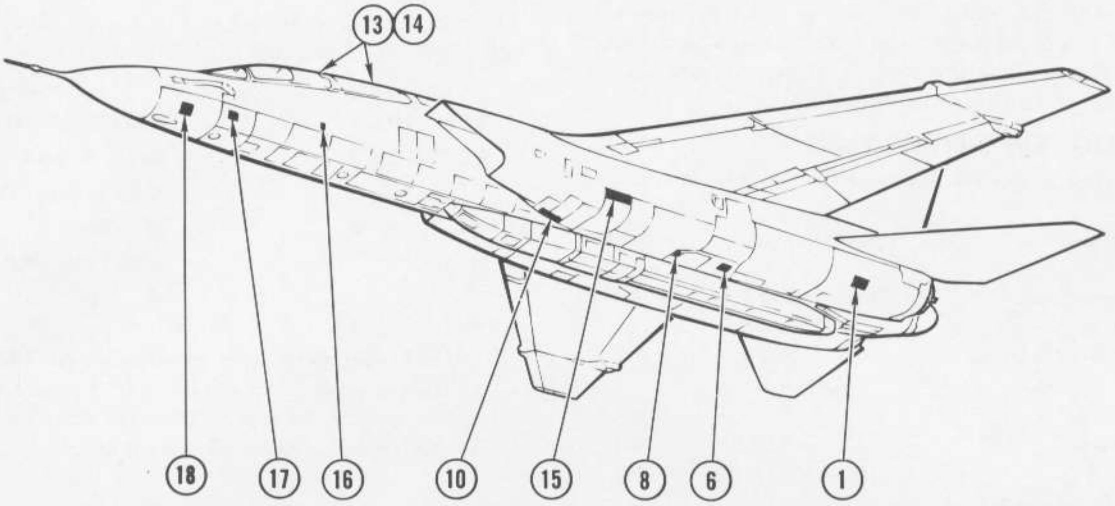
AFT REFUELING RECEPTACLE

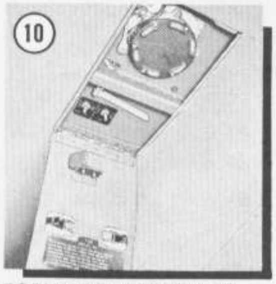


SPECIAL SYSTEMS COOLING AIR ACCESS

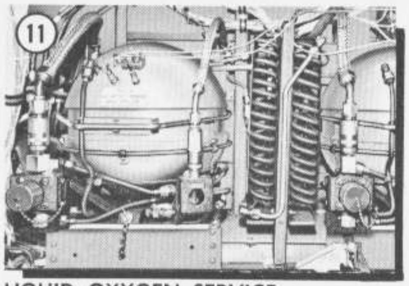
A-5C-1-00-11C

Figure 1-51 (Sheet 1)

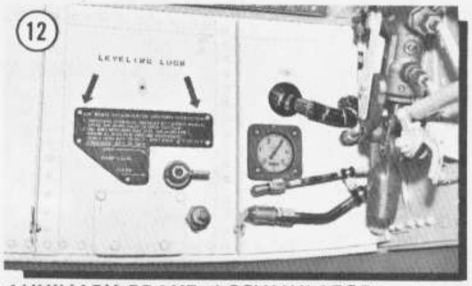




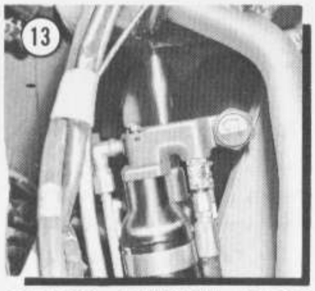
FORWARD REFUELING RECEPTACLE
(ALL TANKS)



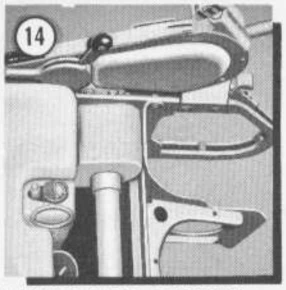
LIQUID OXYGEN SERVICE
(TWO 10 LITER BOTTLES)



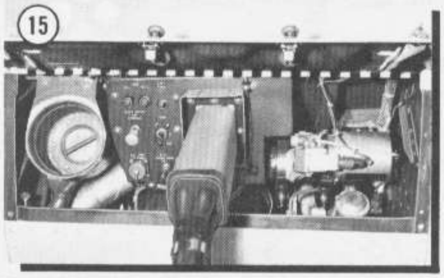
AUXILIARY BRAKE ACCUMULATOR SERVICE PANEL (PRECHARGE — 1000 PSI)
- BRAKE HANDPUMP — RIGHT SIDE
- PUMP HANDLE — STOWED ON LEFT SIDE OF WELL



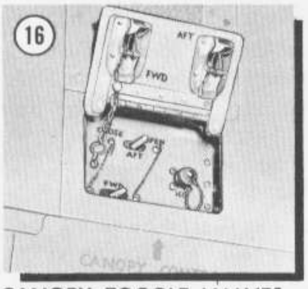
CANOPY JETTISON GAGES
PRECHARGE-2800 PSI



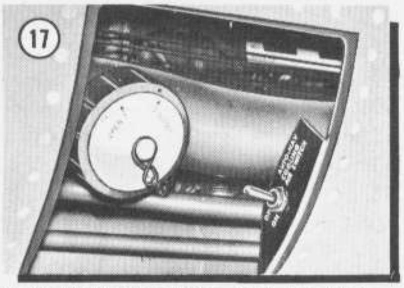
EMERGENCY OXYGEN
1800 TO 2200 PSI



EXTERNAL ELECTRICAL POWER AND EQUIPMENT COOLING RECEPTACLES



CANOPY TOGGLE VALVES



AUTONAV COOLING AIR ACCESS AND SWITCH

AUTO NAV (CHIN PACK) AIR AND PRE-HEAT SWITCH ACCESS
(AFC 112 COMPLIED WITH)

A-5C-1-00-12C

Figure 1-51 (Sheet 2)

refrigeration unit, required fuel supply, and necessary equipment for mounting. Its purpose is to provide uninterrupted electrical power and temperature-conditioned air to the bomb directing set for alinement operations prior to take-off and for turnaround missions.

SERVICING SPECIFICATIONS

The following materials are required to service the aircraft:

MATERIALS	MILITARY SPECIFICATIONS	NATO CODES
Fuel		
Primary—JP-5	MIL-J-5624 (UK-AvCat)	F-44
Alternate—JP-5	MIL-J-5624 (UK-AvTag)	F-40
Emergency		
—AVGAS	MIL-G-5572	F-22
—Jet A (U.S. Commercial)	UK-AVTUR 40	F-30
—Jet A-1 (U.S. Commercial)	UK-AVTUR 50	F-34
Hydraulic Fluid	MIL-H-5606	H-515
Engine Oil		
Primary	MIL-L-23699 (Wep)	None
Cold Alternate	MIL-L-7808	O-148
Lubricating Oil	MIL-L-6085	O-147
Dry Nitrogen	MIL-N-6011	None
Oxygen		
Gaseous (high pressure)	MIL-O-21749 (Wep), Type I	None
Liquid	MIL-O-21749 (Wep), Type II	None
Liquid or Gaseous (USAF)	MIL-O-27210 (USAF)	None

EXTERNAL POWER UNITS

ENGINE STARTING AIR

Airflow required for normal start is 180 pounds per minute, 75 psia.

SERVICE	UNIT	POUNDS PER MINUTE	OUTPUT (PSIA)
USN	RCPP-105-1	186	75
USN	RCPT-105-3	186	75
USN	GTC-85-15*	110	50
USN	GTC-85-24*	120	50
USN	GTC-85-28*	122	52
USN	GTC-85-72†	150	50
USN	MA-1E*	(120 cfm)	45
USN	MD-3A†	(180 cfm)	75
USAF	CTC-0-105-2	236	78
USAF	MA-1 GTC*	115	50
USAF	MA-1A*	82	45
USAF	MA-2†	150	65
USAF	502-7D (Boeing)†	182	53
USAF	MA-1MP*	117	40
USAF	MA-2MP*	110	45
USAF	MA-3MP†	150	60

*Emergency only—Obtain maximum rpm before advancing throttle

†Alternate start—Modulate throttle to maintain EGT less than 700°C

ELECTRICAL

Electrical power required is 115 volts, 400 cycles, three-phase (A, B, C rotation), ac, 30 kva, four-wire.

USN UNITS	USAF UNITS
RCPP-105-1	AF/M32A-10
RCPT-105-3	B-10, B-10A, B-10B
NC-5, NC-6	MD-3, MD-3A
NC-7, NC-8	MD-3M
NC-10, NC-12	MA-1MP, MA-2MP

Note

USAF electrical units must have AN3430-2A cables, with jumper installed between pins "E" and "F." Refer to General Airframe Bulletin No. 2, dated 22 July 1963.

CONDITIONED AIR

Cooling air requirements are as follows:

RECEPTACLE	INPUT AIR TEMPERATURE 70°F	50°F
Main (left)	60.0 pm, 4.7 psig	43.0 pm, 3.0 psig
Recon (right)	27.0 pm, 3.0 psig	20.0 pm, 1.6 psig
A/N (forward)	11.5 pm, 2.8 psig	6.0 pm, 0.6 psig

USN UNITS	USAF UNITS
RCPP-105-1	MA-3, MA-7
RCPT-105-3	MA-8, A/M32C-6
NR-2, NR-3	555R
NR-4, NR-5	
NR-7, NR-8	
MD-3A	
E7488 (chin package)	

Note

Electrical power should always be removed before removing cooling air. Use conditioned air dump valve assembly (E7304) if available to regulate the cooling airflow and temperature at the input receptacles.

REFUELING

The aircraft may be refueled by deck edge hoses, trucks, or pits using standard hose couplings. Fuel flow rate desired is 40 to 50 psi and is not to exceed 60 psi. JP-5 fuel should be used if available; however, the alternate and emergency fuels previously listed may be used as necessary.

Note

If AVGAS is used, adjust the main and afterburner fuel control specific gravity to 0.72. If flight time exceeds 5 hours, a fuel nozzle and hot section inspection is required. Top engine speed may have to be adjusted, as lower fuel specific gravity may cause a slight drop in maximum rpm.

GROUND PRESSURE REFUELING

All internal tanks may be refueled in approximately 7 minutes through two pressure refueling receptacles. The forward receptacle is located aft and slightly left of the nose gear well, and the aft receptacle is located aft of the left main landing gear well. Aircraft with four drop tanks can be refueled in approximately 15 minutes. External a-c electrical power is required for refueling the drop tanks and level control valve testing. The aft refueling receptacle can be used to fill only the aft tank and the bomb bay cans, and to fill the sump tank to the 3200-pound level. If the forward receptacle is used alone, complete refueling may require up to 30 minutes. The drop tanks may be separately hose-fueled, if desired.

NORMAL PROCEDURE

For normal refueling, proceed as follows:

1. Check following for freedom from obstruction:
   (a) Main fuel vent outlet on vertical stabilizer.
   (b) Ambient sensing line outlets (forward corner of right-hand intermediate engine access door).
   (c) Drain line outlets (forward corner of right-hand intermediate engine access door).
   (d) Drop tank overboard vent lines (lower forward side of tanks).
2. Ground aircraft with suitable low-resistance ground wire.
3. Check following switches and controls in pilot's cockpit:
   (a) Engine MASTER switches—OFF.
   (b) FUEL PROBE switch—RETRACT.
   (c) Bomb bay CANS switch—NORM.
   (d) WING switch—NORM.
   (e) DROP TANKS switches—off.
   (f) FUEL DUMP handle—completely in.
   (g) ESS FUEL circuit breaker—in.
4. Apply external electrical power.
   Power must be connected and operating for level control valve shutoff test and drop tank refueling.
5. Aircraft power switch (external)—EXT.

6. Open forward refueling door (access number 66:5) and remove cap.
7. Rotate refuel valve handle down.
8. Attach refueling nozzle ground lead to the airframe and connect nozzle by pushing up and turning clockwise to the locked position.
9. Connect a second hose to the aft receptacle (access number 84) if faster refueling is desired.
10. Begin fuel transfer (40 to 50 psi normal and 60 psi maximum).

Note

If difficulty is encountered in attaching the hose, or if leakage is encountered, a spanner wrench adjustment to the nozzle may correct the situation.

11. During first few minutes of refueling, position REFUEL TEST switch to PRI. Fuel flow should become very low within 15 seconds. Repeat procedure with REFUEL TEST switch to SEC. If fuel flow does not become very low within 15 seconds, discontinue refueling operations.
12. Shut down refueling equipment immediately after step 11.
13. Rotate refuel valve handle up and inboard to the defuel and flight position.
14. Reapply refueling pressure to the forward receptacle. *The refueling equipment should show no fuel flow, indicating that the refueling/defueling selector valve is closing properly.*
15. Shut off refueling pressure and return the refuel valve handle to the ground refueling position (down and outboard).
16. Continue refueling until fuel flow stops automatically.
17. Check fuel quantity gage for desired servicing quantities.
18. Secure refueling operation:
    (a) Shut down refueling equipment.
    (b) Refuel valve handle—defuel and flight position (up, inboard).
    (c) Disconnect hoses.
    (d) Secure receptacle caps.
    (e) Close access doors.

REFUELING AIRCRAFT WITH ENGINES RUNNING

The operational need for refueling the aircraft with the engines running is of primary concern when aboard ship and participating in Carrier Qualifications. Also, occasions may arise when the necessary ground support equipment is not available for starting the engines (as in a divert situation), and refueling with engines running becomes necessary. The following procedures are primarily for shipboard operations and are slanted toward Carrier Qualifications, but they may be modified as the situation requires.

1. Use HOT mike or hand signals with ground crew.
2. Report fuel state, fuel required, and whether "carqual" or full load is required.
3. On signal, FUEL PROBE—EXTEND.
4. When ready, signal crew to start refueling. *Monitor fuel quantity indicator closely.* Warn ground crew when 1000 pounds short of desired total. Order "Stop fuel" when 200 pounds short of desired total.
5. Check all tanks for desired load. If satisfactory, report total fuel (and gross weight for "carqual") to the ground crew.
6. On signal, FUEL PROBE—RETRACT.
7. If overfueling or wrong tank fill occurs, and transfer is not feasible, report aircraft "down" to ground crew. Request instructions from tower.
8. Observe safety precautions:
    (a) Engine power—IDLE.
    (b) Ground crew—Watch for loose clothing, caps, etc, around air intake ducts.
    (c) Be familiar with aircraft gross weight limits (CAT, ARREST).
    (d) Check proper trim settings for fuel loads.

PARTIAL FUEL LOAD PROCEDURE

When a partial fuel load is desired, the aft refueling receptacle should be used, but the forward receptacle may be used if fuel gage quantities are monitored to prevent filling wings and drop tanks. To prevent an aft cg with partial fuel load, wing fuel and bomb bay can fuel transfer to the forward and sump tank may be accomplished by holding the WING switch or the CANS switch, as applicable, in the AUX position. See figure 1-1A for cg control with partial fuel load.

FUEL QUANTITIES AND LOADINGS

See figure 1-2.

SYSTEMS SERVICING

HYDRAULIC

The hydraulic systems are serviced with red hydraulic fluid (MIL-H-5606) at access number 90. The temperature of the fluid must be near ambient when checking the systems. The systems must be serviced if the red light is on or if the level in the reservoir sight gage is at or below REFILL. The sight gages may be checked through access numbers 103 and 168:2 on the top of the aft fuselage. The spoiler speed brakes must be closed during servicing. Servicing pressure should be 80 to 85 psig at 1.5 gpm flow rate. Do not exceed 120 psig or 1.5 gpm. After servicing, the reservoirs are to be pressurized to 80 to 120 psi with dry nitrogen (MIL-N-6011).

CAPACITIES	U.S. GAL	IMP. GAL	LITERS
No. 1 reservoir	2.30	1.92	8.71
No. 1 system	6.70	5.58	25.36
No. 2 reservoir	5.67	4.72	21.46
No. 2 system	16.80	14.00	63.60

A servicing instructions placard is located inside access number 90. The hydraulic system accumulators are pre-charged to 1000 (±50) psi with dry nitrogen. The auxiliary brake accumulator is serviced in the nose wheel well and the emergency brake accumulator is serviced in the left main gear well. Servicing instructions placards are located adjacent to the pressure gages.

ENGINE OIL

The engines are serviced with MIL-L-23699 (Wep) oil through access numbers 97:1 and 162. Servicing should be accomplished within 30 minutes after engine shut-down. If this time limit is exceeded, the engine transfer gearbox must be drained of excess oil. Fill capacity for each engine is 5.2 U.S. gallons, 4.34 Imperial gallons, or 19.7 liters. The servicing cart fill line is to be primed full before connection to the aircraft. The oil tank overflow line must drain into a graduated catch can. With the servicing cart set at zero, fill the tank until a minimum of 1 pint of oil overflows into the catch can. Subtract the amount of oil in the catch can from the amount serviced (as indicated on the oil cart quantity gage). Enter the amount of oil serviced and the date in the engine logbook.

Note

MIL-L-7808 oil should be used at starting ambient temperatures below −40°F.

ARRESTING GEAR SNUBBER AND BUMPER

Service the arresting gear snubber and bumper with hydraulic fluid (MIL-H-5606) and dry nitrogen (MIL-N-6011). The snubber is serviced at access number 154 and the gear must be lowered to service the bumper. Servicing instructions placards are located inside access number 154 and on the bumper.

LANDING GEAR STRUTS

The landing gear struts are serviced with hydraulic fluid (MIL-H-5606) and dry nitrogen (MIL-N-6011). For correct landing gear strut extension, refer to the servicing instructions placard on the upper part of the struts. Servicing instructions placards are located on each strut.

OXYGEN SYSTEMS

The liquid oxygen system [MIL-O-21749 (Wep), Type II] is serviced in the nose wheel well. Two 10-liter bottles are installed and may be removed from the aircraft for servicing if desired. A servicing instructions placard is located on the forward bulkhead of the nose wheel well. The emergency seat kit oxygen bottles are serviced in each cockpit. Fill to 1800 to 2200 psi (black area on the gage). Adapter 21000-T130 will be required.

PNEUMATIC SYSTEMS

The pneumatic system storage bottles are serviced to 2800 to 3200 psi with clean dry air or dry nitrogen (MIL-N-6011) at access number 177. Servicing instructions are located on the inside of access number 177. The pneumatic compressor reservoir is serviced in the right main gear well with MIL-L-6085 oil. The oil level is checked with a dip stick attached to the filler cap. Remove the cap, clean the dip stick, replace the cap finger-tight, and then remove again to check oil level. The cap is to be safety-wired after servicing is completed.

TIRES

All tires are serviced with dry air or dry nitrogen (MIL-N-6011). Tire pressure tolerance is ±5 psi.

TIRE	LAND (PSI)	CARRIER (PSI)
Main Gear, 36 x 11, Type VII, 24-ply	250	300
Nose Gear, 26 x 6.6, Type VII, 16-ply	275	325

PITOT-STATIC DRAINS

Pitot-static drains are located inside the radome fold and under access number 222. Remove the caps, drain any moisture, and replace the caps.

HIGH-PRESSURE AIR VALVES

The landing gear struts, arresting gear snubber, arresting hook bumper, hydraulic accumulators, and pneumatic system have high-pressure air valves. After servicing, these valves must be tightened and torqued. Torque values are:

Valve body ....100—110 inch-pounds
Valve swivel nut ....50—70 inch-pounds

DANGER AREAS

NOISE AREAS

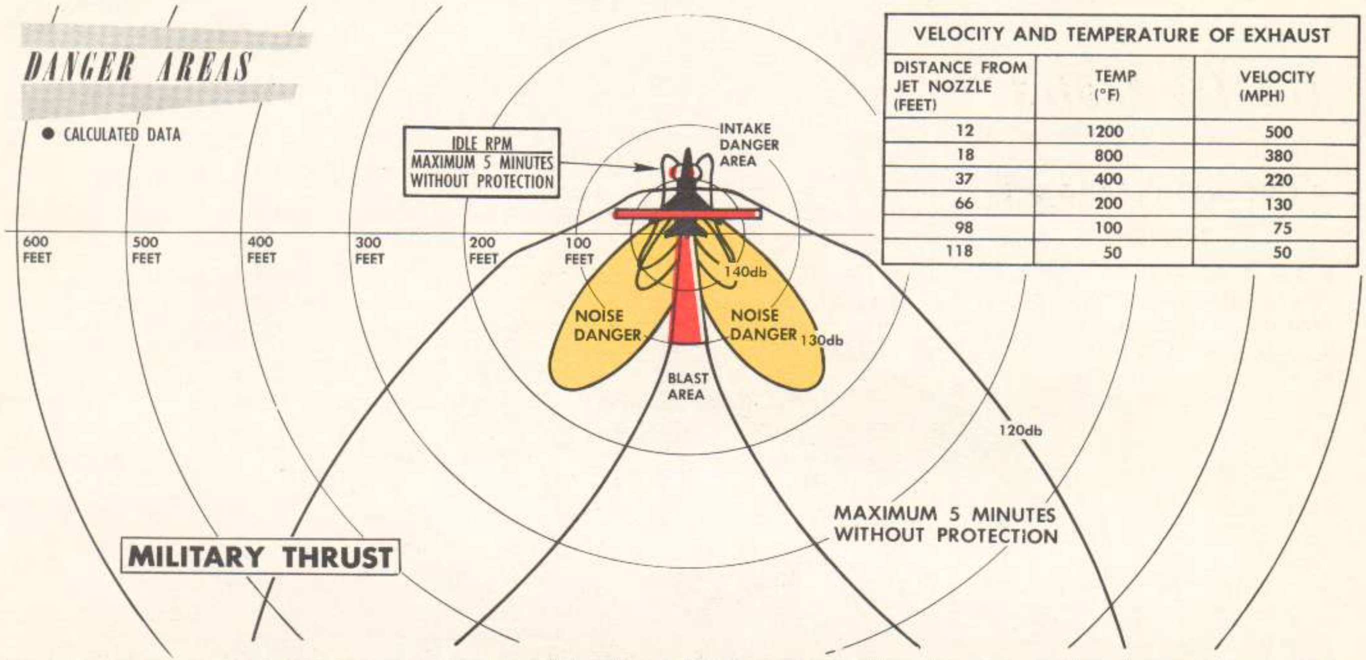
The aircraft engines produce noise and heat blast when operating. See figure 1-52. Danger areas are to be avoided and protective ear covering *must* be worn in noise danger areas. In addition, caution should be observed when near the wing fold BLC and nacelle jet pump exhaust ports.

MOVABLE SURFACES

When electrical and hydraulic power are applied to the aircraft, there are numerous surfaces which can cause injury to personnel and damage to the aircraft and equipment if these surfaces are inadvertently operated. Only *qualified* personnel should be permitted to be in the cockpits or to operate these surfaces.

DANGER AREAS

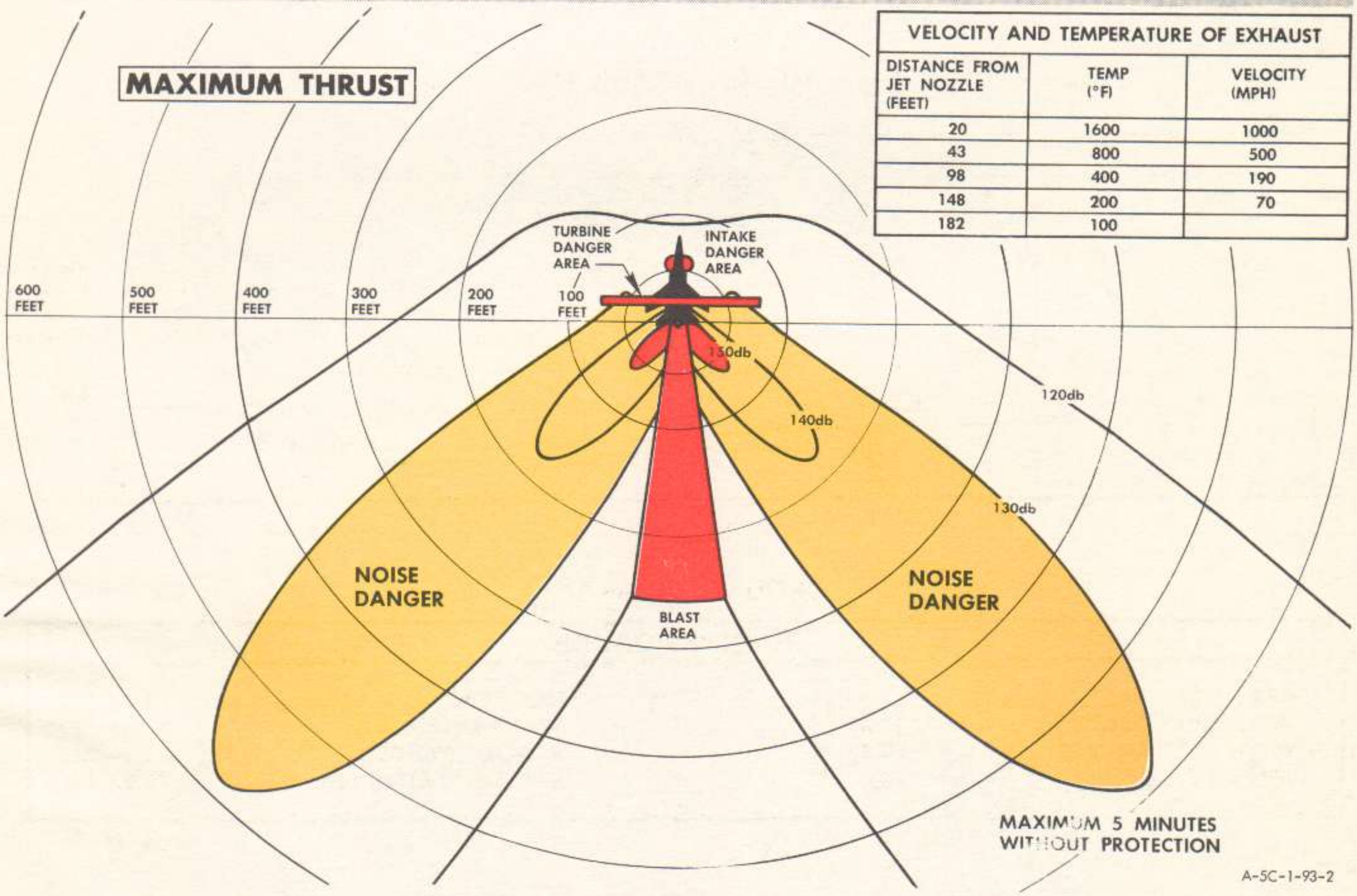
● CALCULATED DATA



VELOCITY AND TEMPERATURE OF EXHAUST		
DISTANCE FROM JET NOZZLE (FEET)	TEMP (°F)	VELOCITY (MPH)
12	1200	500
18	800	380
37	400	220
66	200	130
98	100	75
118	50	50

NOTE:

- WHEN FULL A/B RUN-UP IS MADE, PERSONNEL MUST REMAIN CLEAR OF ALL DANGER AREAS.
- IF BLAST DEFLECTOR IS USED, DANGER PATTERNS ARE DISTORTED DUE TO REFLECTION.
- PERSONNEL WITHOUT EAR PROTECTION MUST REMAIN CLEAR OF NOISE DANGER AREAS.
- WHEN DROOPS ARE EXTENDED WITH WINGS FOLDED, USE CAUTION TO AVOID HIGH VELOCITY, HIGH TEMPERATURE BOUNDARY LAYER CONTROL AIR FROM WING FOLD AREA.



VELOCITY AND TEMPERATURE OF EXHAUST		
DISTANCE FROM JET NOZZLE (FEET)	TEMP (°F)	VELOCITY (MPH)
20	1600	1000
43	800	500
98	400	190
148	200	70
182	100	

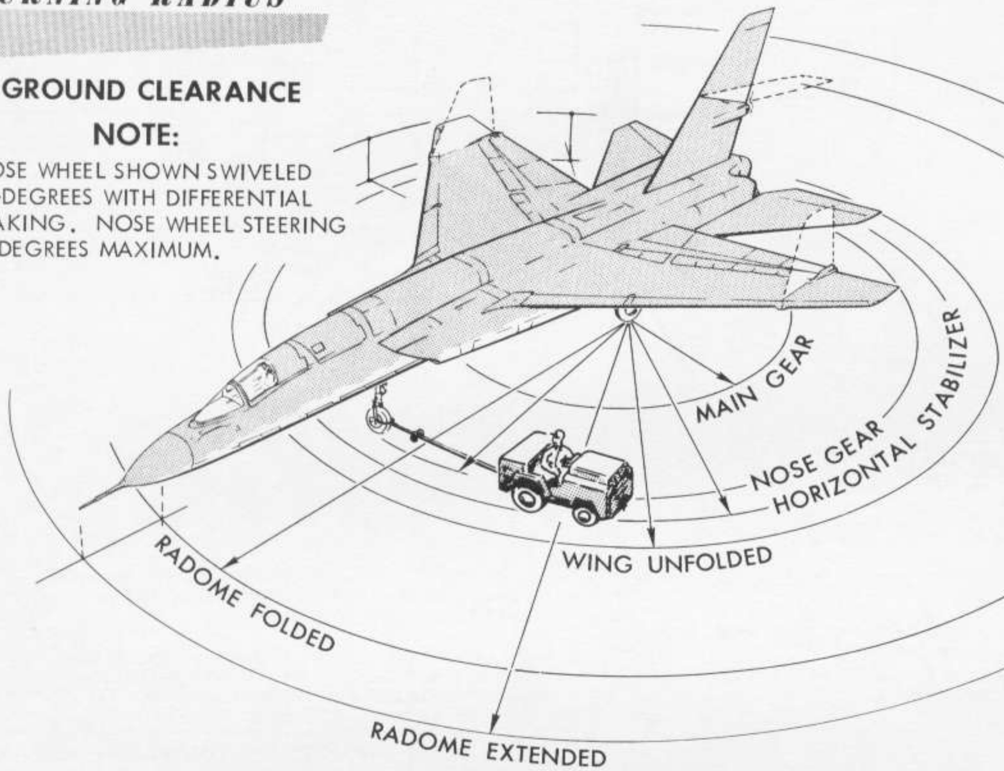
Figure 1-52

TURNING RADIUS

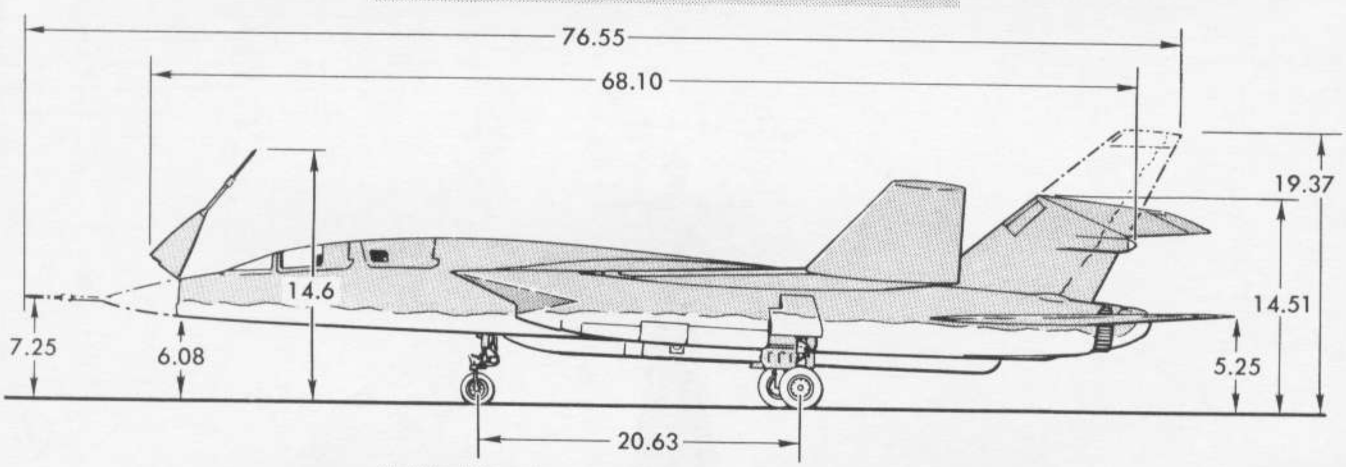
• GROUND CLEARANCE

NOTE:

NOSE WHEEL SHOWN SWIVELED 90-DEGREES WITH DIFFERENTIAL BRAKING. NOSE WHEEL STEERING 75 DEGREES MAXIMUM.



TURNING RADIUS



GROUND CLEARANCE

TURNING RADIUS			
MAIN GEAR TRACK	11.62 FT	HORIZONTAL STABILIZER	32.14 FT
NOSE GEAR TRACK	21.82 FT	WING UNFOLDED	34.86 FT
VERTICAL STABILIZER	19.40 FT	RADOME FOLDED	43.12 FT
WING FOLDED	28.00 FT	RADOME EXTENDED	49.83 FT

A-5C-1C-0-13

Figure 1-53

GROUND HANDLING

TURNING RADIUS

While being taxied, the nose wheel is steerable up to 75 (±5) degrees (flaps up) either side of center. The shortest turning radius is made by releasing the nose wheel steering button and using differential braking. For congested area movement, it is recommended that the aircraft be towed rather than taxied. See figure 1-53.

TOWING

For towing operations, the nose wheel is full swiveling. The aircraft can be towed by the nose gear, using a Navy universal tow bar (NT-2 Model 3 or similar) of suitable length. For towing operations, proceed as follows:

1. Ensure landing gear pins are installed.
2. Check auxiliary and emergency brake accumulators for proper charge (emergency—1000 psi, normal—1400 psi minimum). If auxiliary accumulator pressure is less than 1400 psi, charge to 3000 psi, using pump adjacent to gage in nose wheel well (repeater gage on left forward fuselage). Pump handle is stowed on the left side of the nose wheel well.
3. A qualified person should man the pilot's cockpit and be familiar with the aircraft brake system.

TABLE OF CONTENTS

INTRODUCTION

The standardized procedures in this manual are directed primarily to operational squadrons, but are also used as a basis for establishing procedures within the training squadrons. The assumption is made that flight crew members reporting to operational squadrons will have qualified in basic readiness training in a Reconnaissance/Attack Training Squadron. Training to attain final readiness is accomplished in the operational squadrons. It is important that all flight crews realize a maximum of training during each operational flight. The following requirements apply for pilot qualifications:

First flight—6 WST/OFT/CPT periods.

Night flight—10 hours.

FCLP—50 hours (15 night).

Carrier landings—8 day, 12 night FCLP periods.

Unit commanding officers are authorized to waive any of the minimum flight qualification or ground training requirements in writing if recent experience in similar aircraft models so warrants.

In the interest of brevity, reference is made within this manual to Naval Warfare Publications and other appropriate directives.

TRAINING

RECON/ATTACK PILOT COURSE

Following is the syllabus of ground and flight training required to achieve basic readiness:

BASIC TRAINING SECTION	GROUND HOURS	FLIGHT HOURS
Orientation	10.0	0.0
Navigation		
AN/ASB-12 Operational Training	15.0	0.0
Radar Target Identification		
Weapons	63.0	0.0
Air Intelligence	24.0	0.0
Basic Training Total	112.0	0.0

ADVANCED TRAINING SECTION	GROUND HOURS	FLIGHT HOURS
Aircraft Systems	109.0	0.0
Flight Familiarization	51.0	17.5
Flight Instruments	14.5	14.0
Tactics	68.5	15.0
Missions	112.5	46.5
Carrier Operations	80.5	38.0
Graduation	7.0	0.0
Advanced Training Total	443.0	131.0
TOTAL TRAINING HOURS	555.0	131.0

OPERATIONAL SQUADRON TRAINING

Each squadron will establish and maintain a ground and flight training syllabus in order to keep flight crew members current in all phases of training necessary to the maintenance of a high degree of combat readiness. In addition to the basic squadron training program, other specialized training required by various directives is specified in the following paragraphs.

Note

Training requirements, checkout procedures, evaluation procedures, and weather minimums for Ferry Squadrons are governed by the provisions contained in the OPNAVINST 3710.6 series.

WEAPONS SYSTEM, OPERATIONAL FLIGHT, OR COCKPIT PROCEDURES TRAINER

This trainer is available through the Carrier Readiness Air Wing (CRAW). Refresher periods on emergency procedures will be scheduled at least quarterly for each pilot. A WST/OFT/CPT period will be mandatory before flying a squadron aircraft if a pilot has not flown the RA-5C for the previous 30 days. The WST and/or OFT can be utilized for instrument training. If none of the previously mentioned trainers are available, the RA-5C pilot's cockpit may be utilized for reviewing emergency procedures.

LOW-PRESSURE CHAMBER

All personnel flying in jet aircraft are required to maintain current qualifications in a low-pressure chamber. All personnel will receive pressure suit indoctrination and checkout prior to conducting any flight over 50,000 feet.

EJECTION SEAT

An ejection seat trainer will be used to initially qualify/refresh flight crew members every 2 years. In addition, each crew member will receive basic instruction in the A-5 ejection seat while undergoing CRAW training. A review lecture and checkout will be given quarterly in the A-5 ejection system, utilizing the CRAW ejection seat trainer.

SURVIVAL TRAINING

Each crew member will qualify in the following phases of survival training:

1. Night vision—when reporting from nonoperational duty.
2. Dilbert Dunker—every 2 years.
3. Swimming tests—every 2 years.
4. Underwater breathing with oxygen mask—every 2 years.
5. Helicopter rescue—every 2 years.
6. Parachute harness release and drag—every 2 years.

Mobile Survival Training

A mobile survival trainer makes periodic visits to the local NAS. All crew members will be scheduled to attend every 2 years.

FLIGHT CREW REQUIREMENTS

The crew will normally consist of a pilot and a systems operator, both of whom will meet the requirement for basic readiness. A full flight crew will be used on all operational and training flights, including carrier qualifications. Crew composition for flights other than operational or training flights shall be at the discretion of the Commanding Officer, who shall ensure that minimum crews consistent with safe accomplishment of the mission are used for any flight involving an unusual degree of hazard. Duties of the flight crew members are as follows:

PILOT

1. Has complete responsibility for the aircraft and its assigned mission and for the performance of the S/O in his specified flight duties.
2. Ensures safe and proper operation of the aircraft in accordance with standard procedures.
3. Supervises adequate and continued training of the S/O.
4. Delegates duties to the S/O and ensures that all duties are properly understood.
5. Prepares and/or supervises and reviews mission planning.

SYSTEMS OPERATOR

1. Completes preparation for and execution of the weapons system reconnaissance and bombing problem.
2. Prepares for and properly conducts aircraft navigation.
3. Ensures that the navigation bag, with appropriate contents, is carried in the aircraft.
4. Inspects for security and condition of bomb load and/or reconnaissance systems.
5. Assists in the preflight preparation of the aircraft.
6. Gives a postflight debrief of systems operation.
7. Assists in other duties as directed by the pilot.

PERSONAL EQUIPMENT REQUIREMENTS

Flying equipment considered appropriate per OPNAVINST P3710.7 will be worn by all personnel flying in the aircraft. They will be familiar with the operation and use of all required survival equipment. All survival equipment will be secured in such a manner that it is easily accessible and will not be lost during an emergency. Equipment to be worn is listed in the following paragraph.

TEMPERATE CLIMATE (LOW AND MEDIUM ALTITUDE)

		WINTER	SUMMER
1.	MA-2 integrated torso harness with MK-3C life preserver (the MA-2P harness assembly with MK-IV life preserver will be worn only with the full pressure suit or MK 5/5A exposure suit)	x	x
2.	Antibuffet helmet, painted and rigged in accordance with latest survival bulletin	x	x
3.	An approved oxygen mask with appropriate retention fittings	x	x
4.	Flight suit	x	x
5.	Anti-G suit	x	x
6.	Approved survival knife and sheath	x	x
7.	Lace-up, ankle-length boots	x	x
8.	(Deleted.)		
9.	Flight gloves	x	x
10.	Identification tags	x	x
11.	Winter trousers or thermal underwear (when applicable)	x	
12.	.38-caliber pistol with tracer ammunition	x	x

Note

An approved signaling device is authorized as a substitute for the pistol when operational and/or security conditions warrant.

13.	Flashlight with red lens (night only)	x	x
14.	Personal survival kit	x	x

OVER-WATER FLIGHTS

The full pressure suit or anti-exposure suit will be worn on all over-water flights when the water temperature is 59°F or below, or outside air temperature is 32°F or below, or the combined air/water temperature is 120°F or below. During daylight, within gliding distance of land, the exposure suit need not be worn if water temperature is above 50°F. Operational Commanders may waive the requirement for wearing all types of anti-exposure suits if a possibility exists that high ambient cockpit temperature could cause extreme fatigue and dehydration.

HIGH-ALTITUDE/HIGH-SPEED FLIGHTS

For flights above 50,000 feet, both crew members will wear the full pressure suit with all approved accessories, in lieu of all other personal equipment.

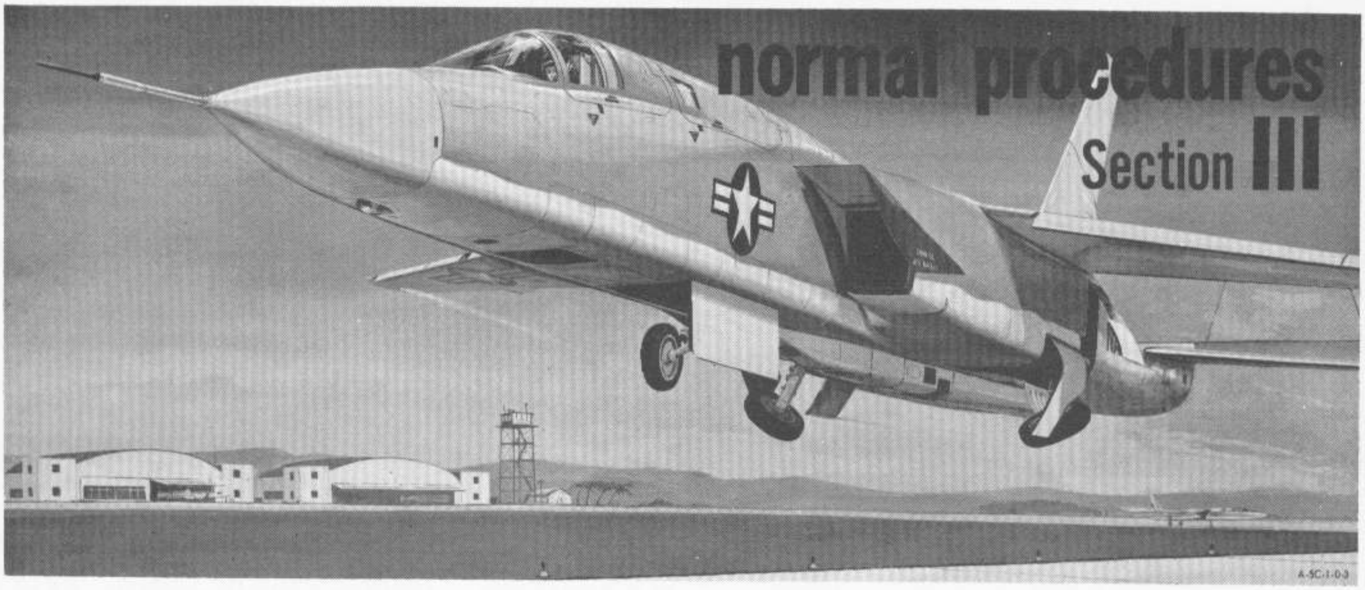


TABLE OF CONTENTS

PART 1 — BRIEFING AND DEBRIEFING

Successful execution of an assigned mission demands complete familiarity with its requirements. The nature of the assigned mission will determine briefing format and persons responsible for delivering the briefing. If possible, both crew members will attend all mission briefings. It is the responsibility of the Operations Officer to see that correct and complete briefings are conducted. Briefing duties will be assigned to specific individuals of the various squadron departments by the Operations Officer.

GENERAL BRIEFING

The general briefing applies to mission training flights, competitive exercises, operational readiness tests, and flight operations conducted in accordance with Operations Orders. The general briefing will be conducted as soon as possible after receiving the Operations Order; generally not later than 48 hours prior to launch time.

OPERATIONAL BRIEFINGS

TARGET BRIEFING

The target briefing encompasses all phases of flight planning and includes a thorough crew evaluation of all available intelligence information. Mission briefings will normally include the information noted in the following paragraphs.

MISSION PLANNING BRIEFINGS

OPERATIONAL MISSION PLANNING

1. Primary mission.
2. Secondary mission.
3. Operations area.
4. Control agency.
5. Communications.
6. TOT.

GENERAL OPERATIONS BRIEFING

1. Aircraft assignment.
2. Call signs.
3. Deck spot and launch order.

WEAPONS BRIEFING

1. Loading.
2. Safety.
3. Arming, dearming.
4. Duds/jettison procedure.
5. Special route assignments.

RECONNAISSANCE BRIEFING

1. Targets.
2. Required coverage and altitudes.
3. Aircraft systems configuration.
4. NAV checkpoints.
5. Target area weather.

INTELLIGENCE PLANNING/BRIEFING

1. Friendly/enemy forces.
2. Current intelligence.
3. Targeting (visual/radar).

NAVIGATION BRIEFING

1. Climb-out.
2. Cruise control, fuel, oxygen.
3. Marshal, penetration, GCA/CCA.
4. Recovery.

WEATHER BRIEFING

1. Local.
2. Destination, alternate.
3. Enroute.

FORMATION (FLIGHT LEADER'S BRIEFING)

When formation flying is scheduled, the designated leader or senior pilot, if no leader is assigned, will conduct the required briefing. This briefing will cover the following points:

1. Radio frequencies to be used.
2. Location and type rendezvous to be used.
3. Position of each aircraft in the formation.
4. Airspeed and altitude to be used for the rendezvous.
5. Alternate leaders, in case the designated leader fails to become airborne.
6. Type mission to be flown.
7. Lost communications procedure.

FINAL BRIEFING

The final briefing will take place just prior to manning aircraft. At this time, all other information needed by the crew in order to accomplish the flight will be available. This briefing will usually start 1½ hours before launch time. When attending this briefing, the crew will be in flight clothing (including pressure suit) appropriate to the mission.

DEBRIEFING

A thorough debriefing is necessary to obtain maximum value from tactical or training flights. The postflight debriefing will be conducted by the Air Intelligence Officer and/or his assistant, under the supervision of the Operations Officer. The debriefing will be conducted as soon as practicable following recovery of the flight. A standard debriefing form, tailored to meet the tactical mission, will be utilized in order to ensure that no items are overlooked.

PART 2 — MISSION PLANNING

The ease and success with which a mission is accomplished is directly affected by the preplanning process. Thorough, detailed planning is mandatory and is a crew function. Training will emphasize the necessity for coordination and delineation of responsibilities. Both crew members, pilot and systems operator, must be thoroughly acquainted with all aspects of the mission, and understand the manner in which each is to assist the other in performance of assigned tasks. All tactical missions should be planned so that an alternate visual approach can be made in the event of failure of the AN/ASB-12 bomb directing set.

SUBSONIC/SUPERSONIC MISSIONS

Subsonic missions will be planned, using the performance data in Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A), aerologic information, and weapons criteria. Missions requiring a supersonic dash will be planned in a similar manner, except that for the cruise control portion of the planning, a "canned" problem approach will be used. Refer to FUEL PLANNING, in this section.

RECONNAISSANCE MISSIONS

Equipment installed will depend upon the target and tactical situation. Planning for a reconnaissance mission requires special emphasis on radar-significant checkpoints and IP's for maintaining a proper track and desired ground coverage.

PLANNING RESPONSIBILITIES

PILOT AND SYSTEMS OPERATOR

1. Briefings.
2. Mission planning.
3. (Deleted.)

PILOT

1. Aircraft performance factors.
2. Fuel management and fuel control log.
3. Communications.
4. DD-175 or appropriate flight plan.
5. Target study/planning.

SYSTEMS OPERATOR

1. Target study/planning.
2. NAV/BOMB/RECON Log.
3. Pilot's JET NAV Log.
4. (Deleted.)
5. Navigation portion of DD-175.
6. NAVWEPS Special Weapons Check Lists.

Note

Use RA-5C Supplements to NWIP 41-3 and 41-4 for mission planning considerations.

OPERATIONAL MISSION PLANNING

When proper planning precedes the mission, the crew conducts the mission primarily by means of check lists and logs. The following items are required.

1. NAVWEPS Special Weapons Check Lists, if applicable.
2. (Deleted.)
3. NAV/BOMB/RECON Log.
4. Pilot's JET NAV Log.
5. Ballistics cards.

NAVIGATION PLANNING

FACTORS

Factors to be considered in navigation planning include:

1. Mission operational requirements.
2. Radar/visual checkpoints.
3. Range-to-target and/or total radius.
4. Weather, including wind, contrails, and cloud cover.

5. Recon targeting criteria.
6. TOT.
7. Enemy defense criteria.

CREW PLANNING REQUIREMENTS

1. Completeness of navigation bag. Refer to NAVIGATION BAG CHECK LIST (FLIGHT CREW), in this section.
2. Operational and weather briefings.
3. Preparation of two sets of suitable scale charts, depicting the intended flight path, diversionary fields, and other data as may be pertinent.
4. Preparation of NAV/BOMB/RECON Log.
5. Preparation of pilot's JET NAV Log.
6. Preparation of DD-175 or other required flight plan.
7. When ship-based, knowledge of PIM and condition of ship's navigational aids.
8. Ensuring that required code books and tables are aboard aircraft.
9. (Deleted.)

MINIMUM NAVIGATION REQUIREMENTS

1. Over land—a minimum of two fixes hourly.
2. Over water — a minimum of two DR positions hourly.
3. A running plot of autonavigator positions and winds shall be maintained as dictated by the mission.

FUEL PLANNING

The RA-5C fuel planning problem is complicated by a great variety of mission requirements, plus the capability of wide latitude in altitudes and airspeeds. A preflight fuel plan will be incorporated on the JET NAV Log for all flights. The latest REST computer will be used for the cruise control computations. If aircraft configuration makes their use impractical, the performance data in Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A) will be used.

All jet aircraft respond to certain performance parameters. The three most important of these, and the ones upon which specific range depends, are (1) gross weight, (2) pressure altitude, and (3) Mach number. The performance data in Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A) indicate range or specific range for various altitudes, weights, and Mach numbers. Also indicated are engine rpm, fuel flow, and TAS. These last, however, are dependent upon Standard Day conditions. For other than standard conditions, the first three factors (weight, altitude, and Mach number) are the controlling parameters. On a warmer-than-standard day, engine rpm, fuel flow, and TAS will all be higher than indicated in the curves; however, if proper Mach number is flown, specific range will be accurate.

Note

To obtain the specific range indicated, FLY MACH NUMBER. Do not fly power settings, fuel flow, or TAS. To do so will result in inaccuracies if the day is nonstandard.

SPEED

Missions fall into two categories: (1) entirely subsonic, and (2) partially supersonic. The planning for these two missions differs, and is covered separately as follows.

SUBSONIC MISSIONS

The subsonic mission will be planned using the performance data in Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A). Each mission will be planned separately, based upon requirements.

SUPERSONIC MISSIONS

Fuel consumption at high speeds is very high, and small errors in planning can result in gross errors in available fuel. In addition, temperature plays an important role in the overall range. Because of the difficulty in accurate planning, and the possibility of serious error, all supersonic missions will be based on "canned" profiles. Each squadron will develop as many representative profiles as required for the targets assigned, with alternate profiles for Hot and Cold days. For actual missions, the crew will select a profile which contains as much or more range than the mission, and this profile will be flown. The crews will provide themselves with alternate profiles to be used if the temperature at altitude proves to be hotter or colder than standard. Specifically, profiles for 10 degrees cold, 10 degrees hot, and 20 degrees hot will be carried on each supersonic mission. Enroute to the target, and within 10 minutes of selecting afterburning, the pilot will determine outside temperature from the inlet temperature gage. (At 0.9 Mach above 36,000 feet, the inlet temperature should read −21°C for a Standard Day.) At this time, the pilot will decide which profile will be used and delay or anticipate afterburning selection as indicated.

SINGLE-ENGINE FLIGHT

Single-engine specific fuel consumption indicates that "singling-up" will not result in an increase in range. Pilots will refrain from shutting down an engine in flight for this purpose.

FUEL CONTROL LOG

The pilot's JET NAV Log will include a fuel control log, indicating planned fuel remaining at each navigational checkpoint, the IP, and over the target. In addition, supersonic flights will include fuel remaining at the start of the supersonic run, at the end of each minute of afterburner operation, and at the end of the supersonic run. The crew will monitor fuel closely to determine whether the flight is proceeding as planned. *This is most important on supersonic missions, where an extra minute of afterburning can cost 60 nautical miles overall range.* Fuel computations will be based on forecast winds. However, in applying winds, *all* predicted head-wind factors, but only *half* of any tail-wind factor will be applied.

FUEL REQUIREMENTS

It is evident that the fuel requirements for a mission will be dependent upon the type of mission, the flight profile selected, the ordnance load assigned, and aircraft gross weight. A realistic determination of the fuel requirements can be established only after consideration of all the following elements:

1. Maximum fuel available based on configuration, ordnance/weapons load, basic operating weight of the aircraft, and maximum take-off gross weight.
2. Fuel required for ground operation, i.e., turnup and taxi to take-off position.
3. Fuel required for take-off and climb to cruise altitude.
4. Fuel required for cruise in accordance with the mission profile.
5. Fuel required for descent at destination.
6. Fuel required for the alternate, holding, and reserve.

Fuel requirements for field operations will be calculated to allow for the following amounts of fuel upon return:

1. VFR conditions—2500 pounds at the break.
2. IFR conditions—3000 pounds at filed alternate approach fix.

Note

For normal shipboard training operations, fuel planning must allow for landing approach to be made at maximum allowable gross weight for landing.

Pilots are responsible for adhering to the minimum fuel requirements as stated in current OPNAV Instructions. A reserve of 1500 pounds constitutes a low state.

BINGO FUEL

Bingo fuel may be defined as the fuel state required to enable the aircraft to proceed to a designated airfield and land with minimum safe fuel remaining. It is particularly applicable to shipboard operations within a reasonable range of a land mass, but may be applied to exercises conducted with an airfield as the operating base where the mission requires a maximum endurance on station. The Bingo data in the Pilot's NATOPS Check List (NAVWEPS 01-60ABC-1B) are based on starting at sea level and arriving at destination with 1500 pounds fuel remaining. Bingo fuel for IFR conditions should be increased to arrive over destination at 20,000 feet with 2500 pounds fuel remaining.

NAVIGATION BAG CHECK LIST (FLIGHT CREW)

ITEM	PILOT	SYSTEMS OPERATOR
1. Pilot's NATOPS Check List (NAVWEPS 01-60ABC-1B)	x	
2. Systems Operator's NATOPS Check List (NAVWEPS 01-60ABC-1D)		x
3. Flashlight with red lens (night only)	x	x
4. FLIP Enroute Supplement	x	x
5. Enroute High-altitude Charts	x	x
6. Enroute Low-altitude Charts	x	x
7. High-altitude Approach Procedures Booklets	x	x
8. Navigation Charts (area of flight)	x	x
9. Dividers, plotter, and computers		x

MISSION CHECK LIST

The following items will be used as a guide in preflight planning. Only those items applicable to the type mission flown need be considered.

NAVIGATION

1. PIM.
2. TAS/GS checks.
3. Pressure pattern D readings.
4. Checkpoint coordinates and elevations.
5. Bearings and distances enroute.*
6. Variation.*
7. Control lines and times.*
8. TOT.*

WEAPONS

1. Pre-take-off check.*
2. Post-take-off check.*
3. Arming check.
4. Pre-drop check.
5. Abort check.*

FUEL MANAGEMENT*

1. Climb, descent, and cruise data.
2. Pilot's JET NAV Log.

DETECTION

1. EW.*
2. GCI.
3. Aircraft or missile intercept point.*

BOMB SYSTEM

1. Computer ballistics.
2. Offsets.
3. Target coordinates and elevations.
   (a) Aimpoint/checkpoint coordinates and elevations.
4. Target intelligence (radar).
   (a) Target intelligence (TA/visual).
5. Altitude options.*

AIRCRAFT ARMAMENT*

1. Bomb release selectors and options.
   (a) Mode select.
   (b) Release select.
   (c) Arming.
   (d) Weapons monitor and control.
   (e) Jettison.
   (f) Primary/secondary options.

RECONNAISSANCE DATA

1. Tactical situation.*
2. Weather.*
3. Camera settings.
   (a) Exposure.
   (b) Flasher setting.
4. SLR.
   (a) Target.
   (b) Gain.
5. PECM.
   (a) Sector coverage.
   (b) Checkpoints.*
6. IP checkpoints.*
7. Altitudes.*
8. NAV (tracks).
9. Alternate target.*

TACTICAL

1. EMCON.*
   (a) Radar.
   (b) Communications and Navaids.
2. Radio signals.
3. Thermal shields.*
4. Bomb-safe line.*
5. Target defenses.*
6. DECM operation.
7. Abort procedures.*

REPORTS

1. ADIZ.
2. Tactical control.

*Primary interest to pilot

PART 3 — SHORE-BASED PROCEDURES

When based ashore, the squadrons are responsible through the local wing and/or fleet air commander to the appropriate type commander.

SCHEDULING

LONG-RANGE PLANNING SCHEDULES

Weekly and monthly flight planning schedules will be published to assist the orderly progress of training and the planning of maintenance.

DAILY FLIGHT SCHEDULE

The daily flight schedule will be prepared by the Flight Officer or Schedule Officer. When approved by the Commanding Officer, the daily flight schedule has the authority of a direct order of the Commanding Officer. The daily flight schedule will include the following information:

1. Name of the Operations Duty Officer.
2. Time of sunrise and sunset.
3. Water temperature, if applicable.
4. Schedule of flights, to include:
   (a) Briefing times.
   (b) Take-off times.
   (c) Flight duration.
   (d) Flight crews.
   (e) Aircraft, fuel load, and configuration.
   (f) Mission.
   (g) Flight leaders (when appropriate).

LINE OPERATIONS

MANNING AIRCRAFT

Following the final briefing (and filing of flight plans, if required), the pilot will review previous aircraft discrepancies and sign the yellow sheet. The systems operator will review previous weapons system discrepancies. A thorough preflight inspection and an orderly, methodical, prestart check will be made.

BEFORE ENTERING AIRCRAFT

1. Conduct aircraft exterior inspection. See figure 3-1.
2. External units—connected and operating.
   An RCPT/RCPP-105 or equivalent unit, and a 400-cycle, three-phase (A, B, C rotation), 120-volt, 45-kva electrical unit is required. If the bomb directing set is to be alined, cooling air is also required.

AFT COCKPIT CHECK (SOLO FLIGHT)

1. Oxygen—OFF.
2. IFF/SIF—NORM/as desired.
3. Seat and parachute—secured.
4. Loose gear—stowed.
5. AN POWER switch—OFF.
6. Canopy (listen for "pop")—closed.

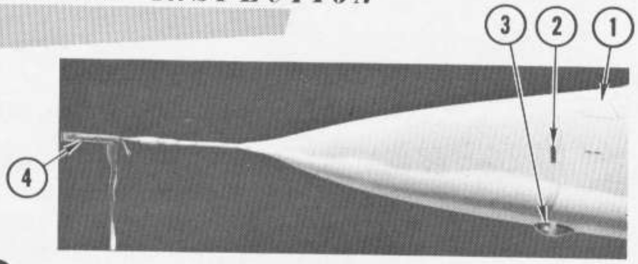
ENTERING AIRCRAFT

1. Inspect seat and canopy (figure 3-2).
2. Canopy uplock—ENGAGED.
3. Canopy emergency air bottle — 2800 psi (minimum).
4. Emergency oxygen—1800 psi (minimum).
5. Seat quick-disconnects—fastened/safetied.
6. Disconnect block—Fasten/check.
7. Oxygen—OFF.
8. Relief plunger—Depress.
9. Yellow knob—Pull.
10. Disconnect block—Mate.
11. Oxygen—ON.
12. Lines—Pull to check.
13. Harness—Fasten/Adjust.

Note

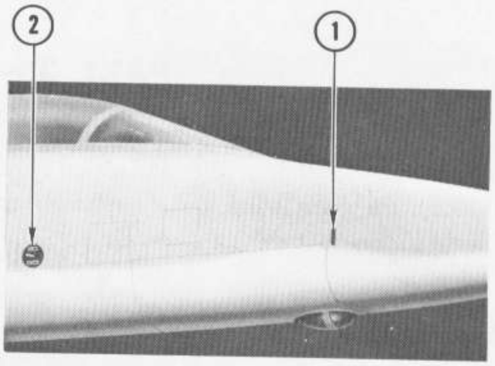
Crew members will personally fasten and become proficient at fastening and releasing the "Rocket-Jet" fittings and adjusting the integrated harness.

EXTERIOR INSPECTION



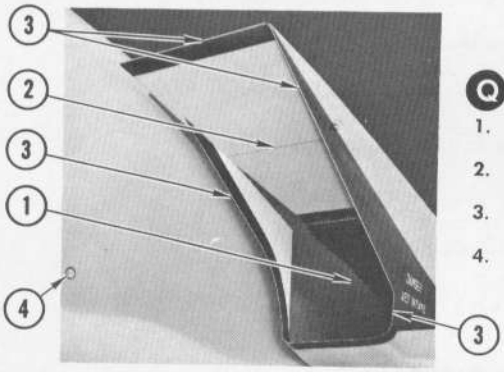
A LEFT NOSE

1. Air refueling probe — RETRACTED. Check all doors flush.
2. Radome — SECURE. Check lock flag flush if closed.
3. TV scanner condition — CHECK.
4. Pitot boom cover — REMOVED. Check pitot boom condition.



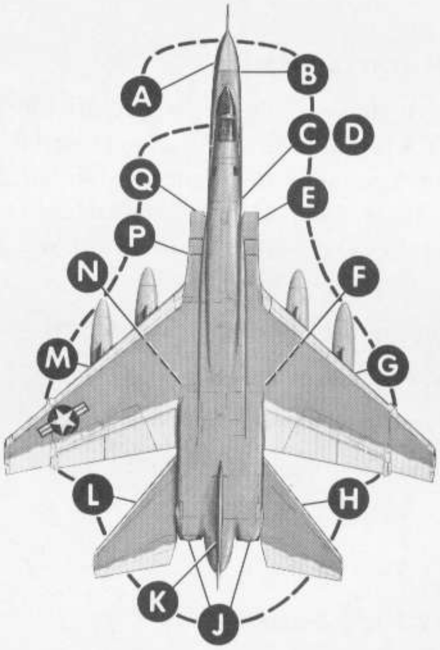
B RIGHT NOSE

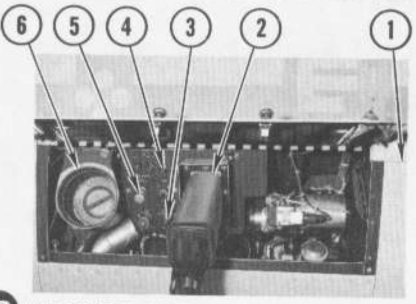
1. Radome lock flag flush, if closed.
2. Angle-of-attack probe cover — REMOVED. Check probe condition.



Q LEFT INTAKE

1. Duct cover — REMOVED. Duct — CLEAR.
2. Ramp — RETRACTED. Check condition.
3. Condition of leading edges — CHECK.
4. Normal brake accumulator repeater gage — 1100 psi



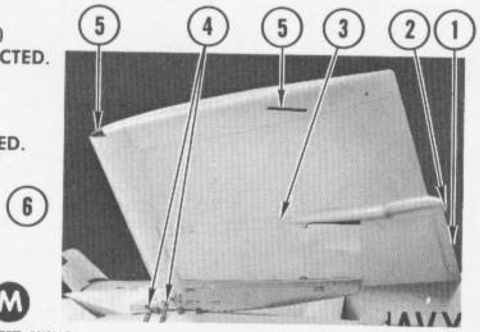


P LEFT-FORWARD FUSELAGE

1. Ram-air turbine — RETRACTED. (Check lock pin flush with fuselage.)
2. External electrical power — CONNECTED.
3. B/N ALIGN PWR switch — EXT.
4. ACFT PWR switch — EXT.
5. GEAR DOOR switch — NORMAL.
6. Equipment cooling air — CONNECTED.

N LEFT MAIN GEAR (SEE F)

1. Tire condition — CHECK.
2. Brake back-up plate — FREE. Check for ⅜ inch rotational freedom.
3. Strut extension — 3 to 4 inches.
4. Door condition — CHECK.
5. Emergency brake accumulator — 1000 psi. (Under pull-out door on inner bulkhead)
6. Ground safety lock — REMOVED.



M LEFT WING

1. Flap guards — REMOVED.
2. ECM antenna condition — CHECK.
3. Wing fold area for leaks — CHECK.
4. If installed, drop tank and pylon safety pins — REMOVED.
5. Position and formation lights condition — CHECK.
6. Droops, spoilers for hydraulic leaks — CHECK.

GENERAL CHECK

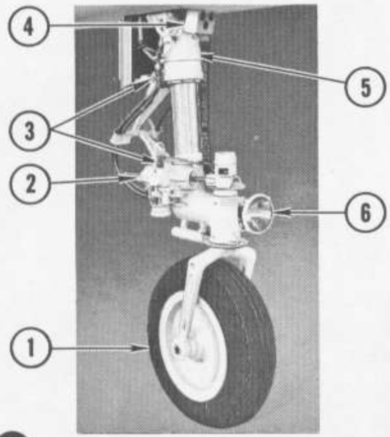
1. All covers, jury struts — REMOVED.
2. Chocks — IN PLACE.
3. Doors, fasteners, exposed lines — SECURED.
4. IFF/TACAN lobing switches — ON.
5. Radome lock flags — RETRACTED.
6. Inlet ramps — RETRACTED.
7. Inlet ducts — CLEAR.
8. Tires/Brake stacks — CHECK/FREE.
9. RAT — RETRACTED.

L LEFT STABILIZER AND AFT FUSELAGE (SEE H)

1. Trailing edge guard — REMOVED.
2. Stabilizer condition — CHECK.
3. Engine access doors — SECURE, Check fasteners flush with surface.
4. Fuselage formation light condition — CHECK.

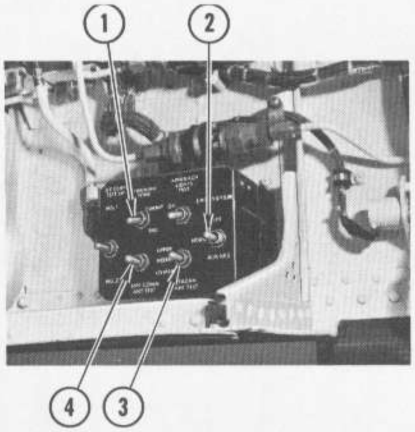
A-5C-1-00-9

Figure 3-1 (Sheet 1)



C NOSE GEAR

1. Tire condition — CHECK.
2. Steer-damp unit condition — CHECK.
3. Strut extension — 8 to 9 inches. (Between upper and lower torque arm pins.)
4. Approach lights condition — CHECK.
5. Ground safety lock — REMOVED.
6. Taxi light condition — CHECK.

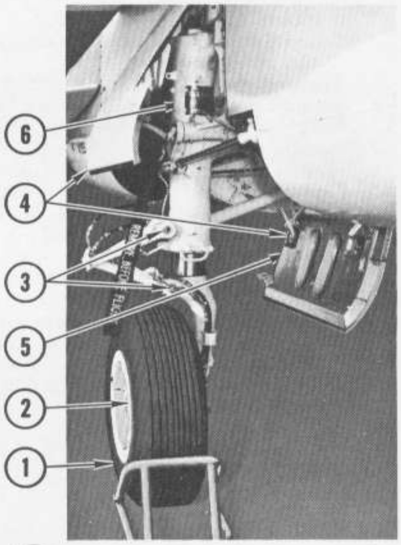


D NOSE WHEEL WELL

1. Training tone switch — AS DESIRED.
2. CNI antenna switch — NORM.
3. TACAN ANT TEST switch — NORM.
4. UHF COMM ANT TEST switch — NORM.
5. Normal brake accumulator — 1100 psi (right bulkhead)

E RIGHT INTAKE (SEE Q)

1. Duct cover — REMOVED. Duct — CLEAR.
2. Ramp — RETRACTED. Check condition.
3. Condition of leading edges — CHECK.

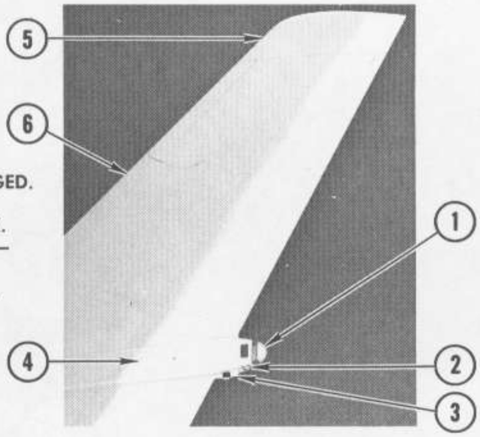


F RIGHT MAIN GEAR

1. Tire condition — CHECK.
2. Brake back-up plate — FREE. Check for ⅜ inch rotational freedom.
3. Strut extensions — 3 to 4 inches. (Between torque arm connector pins.)
4. Door condition — CHECK.
5. Emergency flap pneumatic pressure — 2600-3100 psi (Inboard of right main gear door)
6. Ground safety lock — REMOVED.

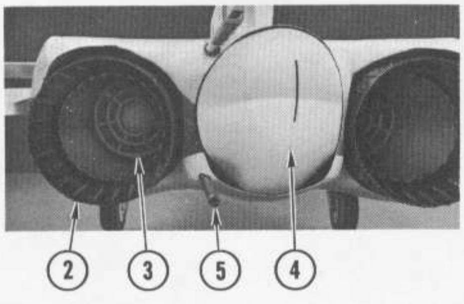
K VERTICAL STABILIZER

1. Position light condition — CHECK.
2. Buddy tanker lights condition — CHECK.
3. Fuel overboard vent — UNDAMAGED. Check for fuel drainage.
4. ECM antennas condition — CHECK.
5. Tail cap antenna cover condition — CHECK.
6. Leading edge condition — CHECK.



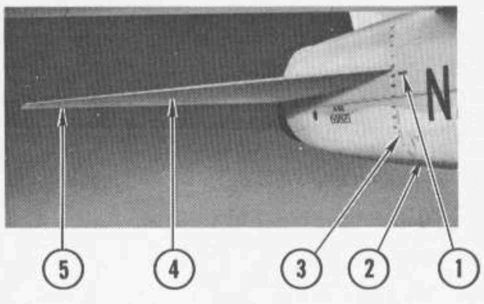
J ENGINE OUTLETS

1. Exhaust nozzle covers — REMOVED.
2. Afterburner nozzle flaps — UNDAMAGED. Check for freedom of movement.
3. Spray bars — CHECK. Check for signs of warpage or breaks.
4. Tail cone — SECURE.
5. Fuel dump tube — RETRACTED.



H RIGHT STABILIZER AND AFT FUSELAGE

1. Fuselage formation light condition — CHECK.
2. Arresting hook fairing doors — CLOSED.
3. Engine access doors — SECURE. (Check fasteners flush with surface.)
4. Stabilizer condition — CHECK.
5. Trailing edge guard — REMOVED.



G RIGHT WING (SEE M)

1. Droops and spoilers for hydraulic leaks — CHECK.
2. If installed, drop tank and pylon safety pins — REMOVED.
3. ECM antenna condition — CHECK.
4. Wing fold area for leaks — CHECK.
5. Position and formation light condition — CHECK.
6. Flap guards — REMOVED.

A-5C-1-00-10 A

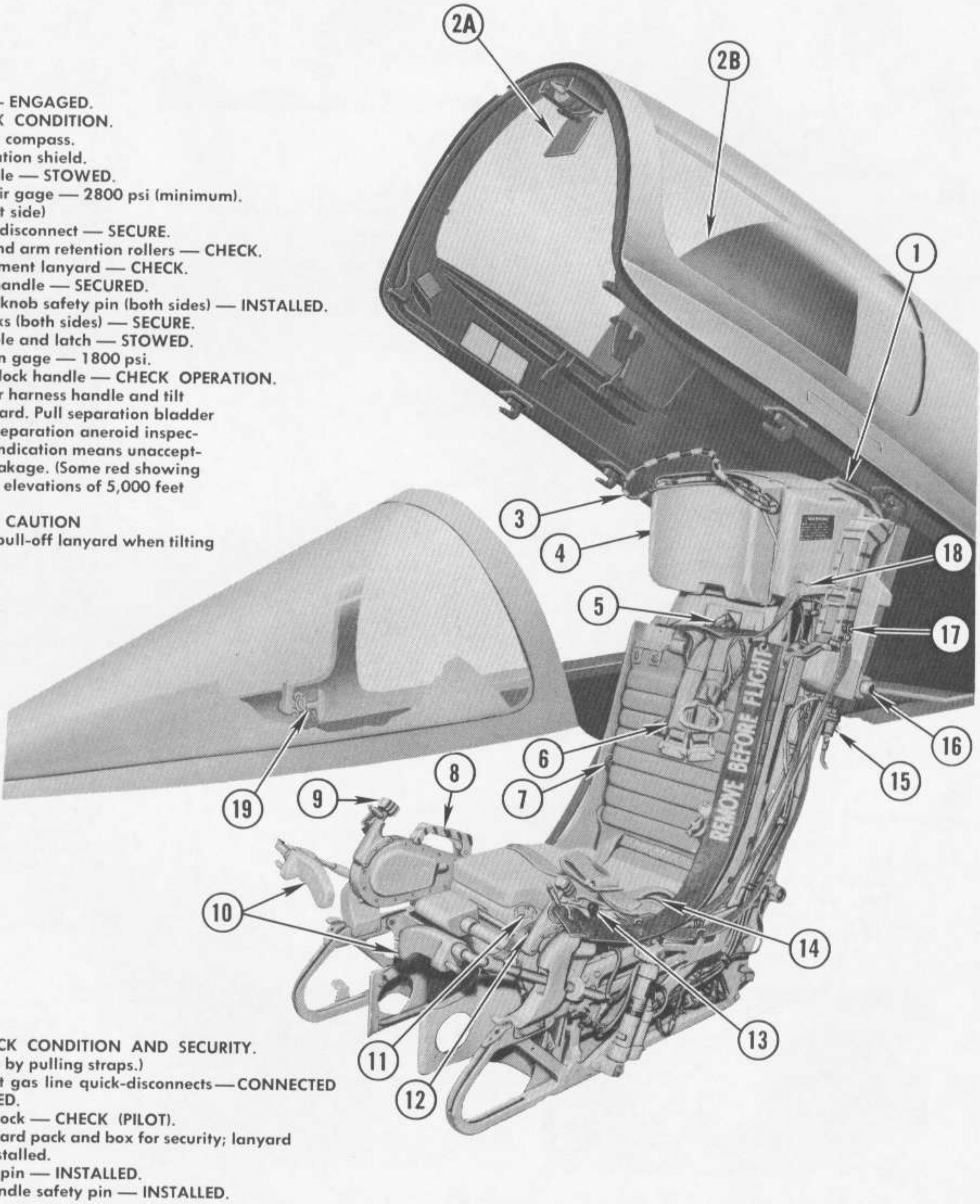
Figure 3-1 (Sheet 2)

CANOPY AND SEAT INSPECTION

1. Canopy uplock — ENGAGED.
2. Canopy — CHECK CONDITION.
   (a) Sun visor and compass.
   (b) Thermal radiation shield.
3. Face curtain handle — STOWED.
4. Canopy jettison air gage — 2800 psi (minimum). (Visible from right side)
5. Shoulder harness disconnect — SECURE.
6. Shoulder straps and arm retention rollers — CHECK.
7. Parachute deployment lanyard — CHECK.
8. Harness release handle — SECURED.
9. Ejection alternate knob safety pin (both sides) — INSTALLED.
10. Leg retention hooks (both sides) — SECURE.
11. Arm retention cable and latch — STOWED.
12. Emergency oxygen gage — 1800 psi.
13. Shoulder harness lock handle — CHECK OPERATION. Unlock shoulder harness handle and tilt parachute forward. Pull separation bladder aside to check separation aneroid inspection hold. Red indication means unacceptable aneroid leakage. (Some red showing is acceptable at elevations of 5,000 feet and higher.)

   CAUTION

   Do not actuate pull-off lanyard when tilting chute forward.



14. Lap straps — CHECK CONDITION AND SECURITY. (Check kit retention by pulling straps.)
15. Check left and right gas line quick-disconnects — CONNECTED AND SAFETY-WIRED.
16. Canopy cam-off block — CHECK (PILOT).
17. Check pull-off lanyard pack and box for security; lanyard cutter safety pin installed.
18. Face curtain safety pin — INSTALLED.
19. Canopy jettison handle safety pin — INSTALLED.

A-5C-1-73-2B

Figure 3-2

OXYGEN SYSTEMS OPERATION

Normal operation of the oxygen system is fully automatic, requiring only that the crew members be properly connected and that the supply valves be positioned to ON. In either the standard mask or full pressure suit configuration, 100 percent oxygen is supplied to the crew when the oxygen supply ON/OFF valves are in the ON position. Ensure the position of the emergency oxygen bottle manual actuation ring on the survival kit. Check the operation of the warning system with the warning lights test button.

PREFLIGHT

Before each flight, inspect the oxygen system components as follows:

1. Check survival kit emergency oxygen pressure—1800 to 2200 psi.
2. Check liquid oxygen quantity indicator—20 liters.
3. Press the oxygen TEST button on gage. Check needle rundown. During the test, when the indication is 0.8 liter and below, the OXYGEN warning indicator should illuminate. Upon releasing the TEST button, the needle should continue to its original setting and the OXYGEN warning indicator should extinguish.

WARNING

If preflight inspection reveals that the system has been empty for several hours or if the system has been left open because of replacement of parts, without all lines and components having been capped or plugged, complete system purge and refilling is mandatory before flight.

PRESTART CHECK

1. Seat/canopy safety pins (four)—removed (after entry).
2. Canopy uplock—disengaged (Plane Captain).
3. SPEED BR DUMP handle—down.
4. DROP TANKS transfer buttons—up.
5. FUEL PROBE switch—RETRACT.
   Lift guard to check.
6. MASTER ARM switch—OFF.
7. SPC button—up (OFF).
8. AFCS ENGAGE switch—OFF.
9. UHF selector—as desired.
   Rotate COMM VOL control right to approximate volume desired.
10. FLAPS—SUPERSONIC.
11. EMERG FLAP switch—NORM.
12. HYD SUB-SYS ISOLATION switch—TAKE-OFF/LANDING.
13. ENGINE FIRE switch—OFF.
14. Fuel quantity—check.
    Check total and individual tank quantities.
15. FUEL GAGE TEST button—Test (Press).
    Check gage for rundown and return.
16. LDG GEAR control handle—DOWN.
17. EMERG GEAR UP switch—NORM.
    Lift guard to check.
18. FUEL DUMP handle—IN.
19. EGT indicator TEST buttons—Depress.
20. EMER AIR TURBINE handle (RAT)—in.
21. EMER LDG GR handle—in and guarded.
22. EMER CANOPY jettison handle—in.
23. ARREST HOOK handle—in.
24. Oxygen quantity gage—check, Test.
    Check gage for rundown and return.
25. CNI PWR button—ON (Depress).
26. TAIL CONT switch—same position as tail.
27. WING AND TAIL FOLD handle—same position as wings.
28. EMERG IFF switch—AUTO.
29. WARN LT TEST button—Press, Test.
30. COCKPIT TEMP knob—2.
31. COCKPIT PRESS switch—NORM.
32. WINDSHIELD & CANOPY DEFROST knob—OFF.
33. WINDSHIELD ANTI-ICE switch—OFF.
34. PITOT and ENGINE ANTI-ICE switches—OFF.
35. NAV COMD button—as desired.
36. COMM COMD button—as desired.
37. Circuit breakers—in.
38. Interior lights—as desired.
39. Exterior lights—as desired.

STARTING ENGINES (WITH RCPP-105 ELECTRICAL CONNECTION)

Note

Either engine may be started first.

1. Throttles—OFF.
2. Engine MASTER switches—ON.
3. NO. 2 START switch—START.
   Check starting air ready and signal before starting.
4. 10% rpm—throttle to IDLE.
   Check engine instruments for normal start.
5. At 45% rpm, NO. 2 START switch—STOP.
6. NO. 2 GENERATOR switch—RESET.
7. Repeat steps 3 through 6 for No. 1 engine.
8. External power and air—check with S/O (Disconnect when ready).
   Disconnect electrical power before disconnecting cooling air.
9. HYD SYS 1, HYD SYS 2 pressure indicators—3000 (±250) psi.

STARTING ENGINES (WITHOUT RCPP-105 ELECTRICAL CONNECTION)

1. Throttles—OFF.
2. Engine MASTER switches—ON.
3. Signal crewman to start air (connected engine should start motoring).
4. 10% rpm—Depress/Hold EMER IGN (or Move START switch to START), Move No. 2 throttle to IDLE.
   While holding EMER IGN, move throttle to IDLE, and hold button down until engine light-off definitely occurs.
5. At 45% rpm—Signal crewman to secure air, Move START switch to STOP.
6. NO. 2 GENERATOR switch—RESET.
7. Repeat steps 3 through 6 for No. 1 engine.
8. External power and air—check with S/O (Disconnect when ready).
   Disconnect electrical power before disconnecting cooling air.
9. HYD SYS 1, HYD SYS 2 pressure indicators—3000 (±250) psi.

FLIGHT CONTROL AND PRETAXI CHECK (ABBREVIATED)

Check control positions in rearview mirror.

1. Canopy—closed (Listen for "pop").
2. RAMPS switch—RESET.
3. TRIM select switch—ALTR.
   Check roll, yaw, and pitch in both directions.
4. Emergency pitch trim—check.
5. TRIM select switch—NORM.
   Check roll, yaw, and pitch in both directions.
6. YAW AUG NO. 1 and YAW AUG NO. 2 switches—ON.
7. ELEC SYS (flight control) switch—RESET.
8. PITCH AUG switch (ON SIGNAL ONLY)—RESET.
   Position trim to 10 units nose-up.
9. PITCH AUG switch—STBY.
   (a) Observe longitudinal centering (pitch trim indicator) 5 to 6 units nose-up.
10. Speed brake switch—OUT.
    Check spoiler action.
11. Flap control switch—50°.
    (a) Check spoiler action and vertical stabilizer interconnect.
    (b) Pitch trim indicator 11.5 units nose-up.
12. Flap control switch—40°.
    (a) Check spoiler action.
    (b) Pitch trim 10.2 units nose-up.
13. Flap control switch—30°.
    (a) Check spoiler action.
    (b) Pitch trim 9.1 units nose-up.
14. Flap control switch—CRUISE.
    Check flaps 0/droops 5 degrees.
15. Flap control switch—SUPERSONIC.
    Check flaps 0/droops 0 degrees.
16. PITCH AUG switch—RESET.

17. Vertical/horizontal stabilizers (ON SIGNAL)—check full travel (8 units nose-down, 21 units nose-up).

18. Move stick rapidly forward, then full left and rapidly right.
    (a) Check ELEC F/C caution indicator on and PITCH, ROLL indicators blank.
    (b) ELEC SYS switch—RESET.

19. Move stick rapidly aft, then full right and rapidly left.
    (a) Check ELEC F/C caution indicator on and PITCH, ROLL indicators blank.
    (b) ELEC SYS switch—RESET.

20. Emergency disable ("kill") button—Depress.
    (a) Check PITCH AUG and ELEC F/C caution indicators on.
    (b) Check PITCH AUG and ELEC SYS—STBY.

21. Operate all flight controls—check normal and full travel of spoiler, deflectors, and stabilizers (8 units nose-down, 16 units nose-up).

22. PITCH AUG and ELEC SYS switches—RESET, if desired.

23. Air refueling probe—check.

24. Jet pump operation—check (do not exceed 85 percent).

25. CNI command lights—as desired.

26. Compass—set and SLAVED.

27. External power and cooling air—removed.

28. Wing and bomb bay auxiliary transfer—check.

29. Canopy defrost and windshield anti-ice systems—check.

30. Wings and tail (ON SIGNAL)—SPREAD and LOCKED.

Note

For complete flight control check procedures, refer to FLIGHT TEST PROCEDURES, in Section IV.

WARNING

- For flight with partial fuel load (bomb bay full, forward tank empty), hold CANS switch in AUX until 2000 pounds fuel has transferred from the bomb bay to the forward tank to move center of gravity forward of the aft limit.
- Nose wheel lift-off and take-off speeds must be increased 4 KIAS and take-off distances 250 feet for each percent MAC of center-of-gravity movement forward of 25 percent.

TAXI, TAKE-OFF, AND LANDING

TAXI PROCEDURES

1. When taxiing in close quarters (within 10 feet of obstructions), there shall be a director in front and a wing tip walker at each wing to ensure safe clearance of obstructions. The crew shall be alert to spot any obstructions which the aircraft might strike.
2. Check the brakes before getting into close quarters. Once clear of close quarters, check emergency brake operation.
3. The aircraft can be taxied using minimum power and nose wheel steering. To start, it is usually necessary to increase rpm to about 85%. Once moving, retard throttles as appropriate. If excess power is required to taxi, check for dragging brakes.

Note

If brakes are dragging, down the aircraft.

4. Do not brake against nose wheel steering. Center the nose wheel before stopping.

AIR CONDITIONING/DEFROST PROCEDURE

1. Pressurization should not be used during take-off when high humidity exists.
2. Prior to take-off, operate canopy defrost, cockpit ventilation, and windshield anti-ice systems to blow any possible water out of the air vents.

Note

For bomb directing set/reconnaissance flights, do not operate the engines at less than 80% rpm with flaps extended for more than 2 minutes when ambient temperature exceeds 100°F. With flaps extended, advancing power above 80% rpm will ensure adequate system cooling.

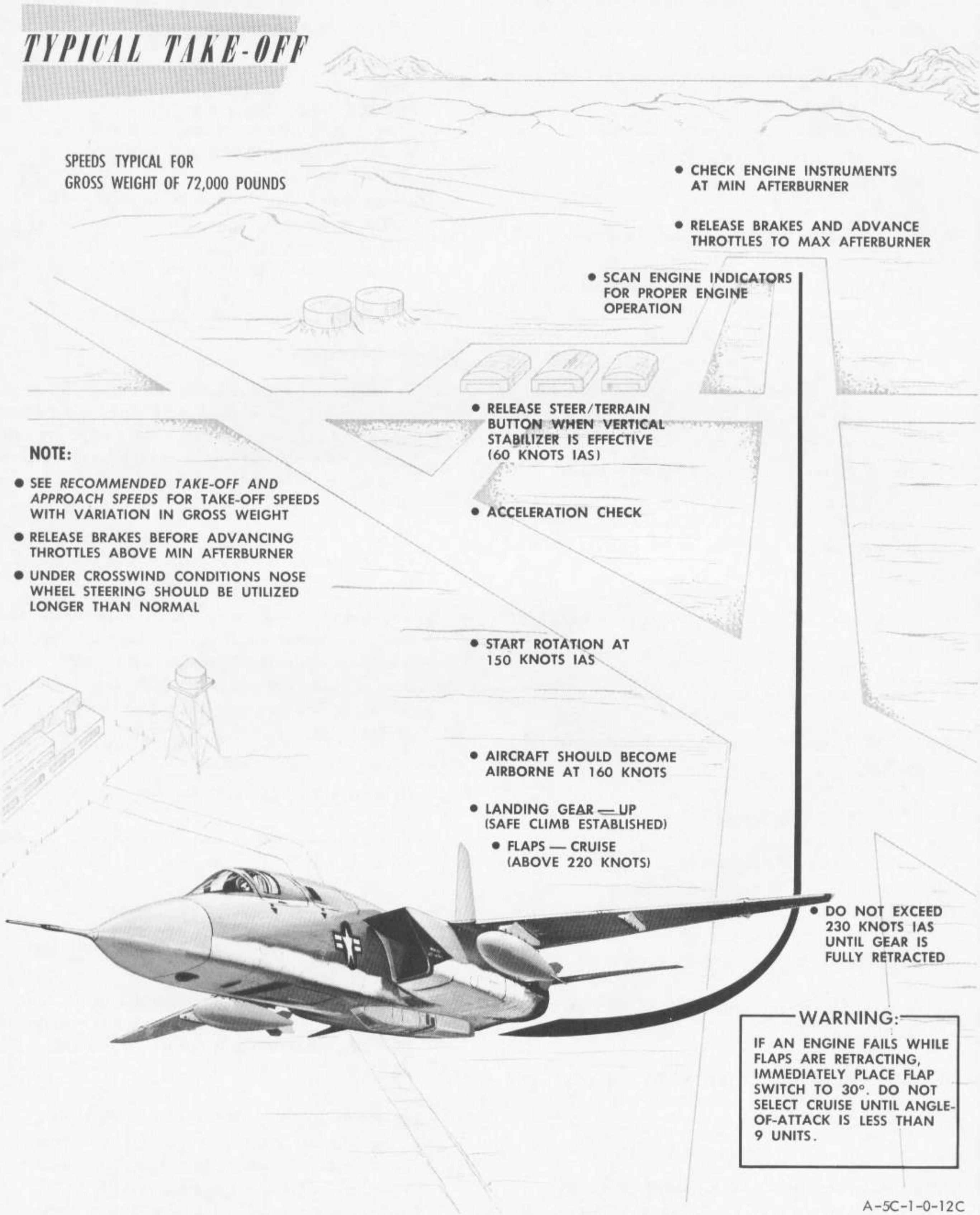

TYPICAL TAKE-OFF
SPEEDS TYPICAL FOR GROSS WEIGHT OF 72,000 POUNDS
NOTE:
• SEE RECOMMENDED TAKE-OFF AND APPROACH SPEEDS FOR TAKE-OFF SPEEDS WITH VARIATION IN GROSS WEIGHT
• RELEASE BRAKES BEFORE ADVANCING THROTTLES ABOVE MIN AFTERBURNER
• UNDER CROSSWIND CONDITIONS NOSE WHEEL STEERING SHOULD BE UTILIZED LONGER THAN NORMAL
• CHECK ENGINE INSTRUMENTS AT MIN AFTERBURNER
• RELEASE BRAKES AND ADVANCE THROTTLES TO MAX AFTERBURNER
• SCAN ENGINE INDICATORS FOR PROPER ENGINE OPERATION
• RELEASE STEER/TERRAIN BUTTON WHEN VERTICAL STABILIZER IS EFFECTIVE (60 KNOTS IAS)
• ACCELERATION CHECK
• START ROTATION AT 150 KNOTS IAS
• AIRCRAFT SHOULD BECOME AIRBORNE AT 160 KNOTS
• LANDING GEAR — UP (SAFE CLIMB ESTABLISHED)
• FLAPS — CRUISE (ABOVE 220 KNOTS)
• DO NOT EXCEED 230 KNOTS IAS UNTIL GEAR IS FULLY RETRACTED
WARNING:
IF AN ENGINE FAILS WHILE FLAPS ARE RETRACTING, IMMEDIATELY PLACE FLAP SWITCH TO 30°. DO NOT SELECT CRUISE UNTIL ANGLE-OF-ATTACK IS LESS THAN 9 UNITS.
A-5C-1-0-12C

Figure 3-3

FUEL CONSERVATION

While taxiing to take-off position, the take-off check list shall be completed. On long-range flights or where a delay in obtaining IFR clearance is expected, the clearance should be obtained prior to starting engines. It is necessary to use cooling air to operate the radios without engines.

CHECKOFF LIST

1. The pilot will ensure that all items have been accomplished prior to take-off.
2. The systems operator will ensure that the weapons system check lists have been accomplished and so inform the pilot prior to take-off.

BEFORE TAXIING INTO POSITION

1. COCKPIT PRESS switch—NORM (RAM EMERG if high humidity exists).
2. COCKPIT TEMP knob—position 2 (increase if fogging).
3. Caution indicators—OUT, except ENG DOOR (ELEC F/C, PITCH AUG if desired).
4. Harness—LOCKED.
5. Speed brakes—IN.
6. (Deleted.)
7. Flap control switch—30°.
8. Pitch trim—6 units NU.

Note

Trim required for field take-off varies from 5 units at light take-off gross weights to 8 units at heavy weights.

9. PRESS SUIT FLOW knob—OFF.

Note

Under conditions where the aircraft has been subjected to heavy precipitation prior to flight, the windshield and canopy defrost system should be turned on at full flow, and the engines operated at 85% rpm for at least 20 seconds to purge water from the air conditioning system. If a 20-second run-up is not feasible, move the COCKPIT PRESS switch to RAM EMERG.

10. MIC SEL switch—HOT.

TAKE-OFF PROCEDURES

Maximum Thrust is recommended for all take-offs under normal conditions. At gross weights above 56,000 pounds, Maximum Thrust is required for safe take-off. The take-off roll will not be initiated until the approved take-off check list, posted on the canopy molding, has been completed. Flaps will be set at 30 degrees for all normal take-offs. Take-off distance and airspeed will be determined prior to each take-off.

1. After assuming the take-off position and ensuring that the nose wheel is straight, apply brakes and advance throttles to MIL.

   Check for bleed duct air leaks by timing the acceleration of both engines simultaneously from idle to Military Thrust, as indicated by fuel flow cutbacks. If the acceleration requires more than 10 seconds with 25-degree droops (30-degree flap position), or more than 13 seconds with 50-degree droops (40-degree flap position), the aircraft should be noted for correction of bleed duct air leaks (downstream of the engine). If the previous acceleration limits are not met, another check should be made with 0-degree droops (supersonic flap position) and the aircraft should be rejected if acceleration is not within the 7- to 9-second engine limitation.
2. Check:

   RPM—100 (±0.5) % (at 5°C and above)
   EGT—625 (±10) °C
   Oil pressure—35 to 60 psi (27 to 57 psi*) MIL-L-7808
   —45 to 70 psi (37 to 67 psi*) MIL-L-23699 (Wep)
   Nozzles—one-fourth open
   Fuel flow—7000 to 10,000 pph

MILITARY THRUST RPM vs AMBIENT TEMPERATURE (INLET AIR TEMPERATURE INDICATOR — STATIC CONDITIONS)

OAT (°C)	% (RPM)
5 and higher	100 (±0.5)
0	99 (±0.5)
−10	98 (±0.5)
−20	96.5 (±0.5)
−30	95 (±0.5)

3. Select MIN AFTERBURNER and determine that both afterburners light off (3 seconds maximum from MIL).

Note

If aircraft gross weight is insufficient, tire skidding may be experienced.

4. Check nozzles—three-fourths open.
5. Engage nose wheel steering.
6. Release brakes.
7. Advance throttles to MAX AFTERBURNER.
8. Check:

   EGT—625 (±10) °C
   Nozzles—full open and steady

TAKE-OFF TECHNIQUE

1. Use Maximum Thrust (full afterburner) for all take-offs and acceleration to best climb speed.

   Acceleration at MAX AFTERBURNER is quite rapid at all gross weights.

*Aircraft not having Engine Bulletin 104 complied with

2. Use nose wheel steering until rudder control is effective (about 60 KIAS).
   Do not hold the control stick aft until ready for nose wheel lift-off, as early rotation will increase take-off distance.
3. Rotate the aircraft to take-off attitude (15 units angle of attack) as IAS reaches 10 to 15 knots below take-off speed. See figure 3-4.

CAUTION

Although a definite rotation is required for lift-off, avoid overrotation which could result in increased take-off distance and possible damage from aft section contact with the runway.

4. Utilize straight and level lift-off prior to gear retraction whenever possible to prevent possible off-center nose gear retraction.
5. Establish a positive rate of climb, then raise the landing gear.
6. If power reduction is desired, use the following procedure:
   (a) After gear retraction, select MIN AFTERBURNER.
   (b) Retard throttles separately to MIL.
   This is a precaution against possible nozzle failure.
7. Raise the flaps at 9 units A/A (220 to 250 KIAS, depending on gross weight) and 200 feet (VFR), or 1000 feet (night/IFR).
   Ensure that landing gear is retracted prior to exceeding 230 KIAS.

CAUTION

Severe cross-wind conditions may require longer use of nose wheel steering and higher take-off speeds.

AFTER TAKE-OFF

1. SPC—ON (Depress).
2. HYD SUB-SYS ISOLATION switch—FLIGHT.
3. COCKPIT PRESS switch—NORM.
4. DROP TANKS transfer buttons—ON (Depress).
5. PRESS SUIT FLOW knob—ON (as desired).
6. MIC SEL switch—as desired.

PENETRATION AND LANDING

COMMENCING DESCENT

1. SPC button—OFF (Depress; Release up).
2. HYD SUB-SYS ISOLATION switch—TAKE-OFF/LANDING.
3. Defrost—as required.
4. Pilot's radar altimeter—Override.
5. Harness—Lock and Tighten.
6. MIC SEL switch—HOT.

NORMAL APPROACH AND LANDING

1. Enter the landing pattern for break at 250 KIAS (SPC OFF) and at the specified break altitude for the field. See figure 3-5. At the break, establish brake angle, open speed brakes, and reduce power to approximately 80% rpm. Below 255 KIAS, lower flaps to 40 degrees and, below 230 KIAS, extend the landing gear. Check speed brakes automatically retracted. Adjust upwind turn to place the downwind leg $1\frac{1}{2}$ miles abeam.
2. On the downwind leg, when the aircraft is level, complete the landing check list.
   (a) Flaps/droops—down.
   (b) Wheels—down.
   (c) Hook—as required.
   (d) PRESS SUIT FLOW knob—OFF.
3. Plan the base leg to allow for a $1\frac{1}{2}$-mile final. Altitude at the 90-degree position should be 600 to 800 feet, with airspeed stabilized at 15 units A/A. Maintain 15 units A/A throughout the remainder of the approach. Stabilize rate of descent with power and hold 15 units A/A until touchdown.
4. Fly the aircraft onto the runway, holding approach speed and attitude.
5. Touchdown should be made in the first 500 feet of runway or on the designated GCA or mirror touchdown point.
   Do not attempt to salvage a bad approach.

CAUTION

In the event the landing looks long or a porpoise occurs, the correct course of action is to take a wave-off.

6. On touchdown, retard throttles to IDLE and commence aerodynamic braking.
7. Continue aerodynamic braking until:
   (a) The nose drops through at about 115 KIAS, or
   (b) Only 4000 feet of runway remain, whichever occurs first.
8. With all three wheels on deck, continue holding the stick full aft and commence steady braking.

RECOMMENDED TAKE-OFF AND APPROACH SPEEDS

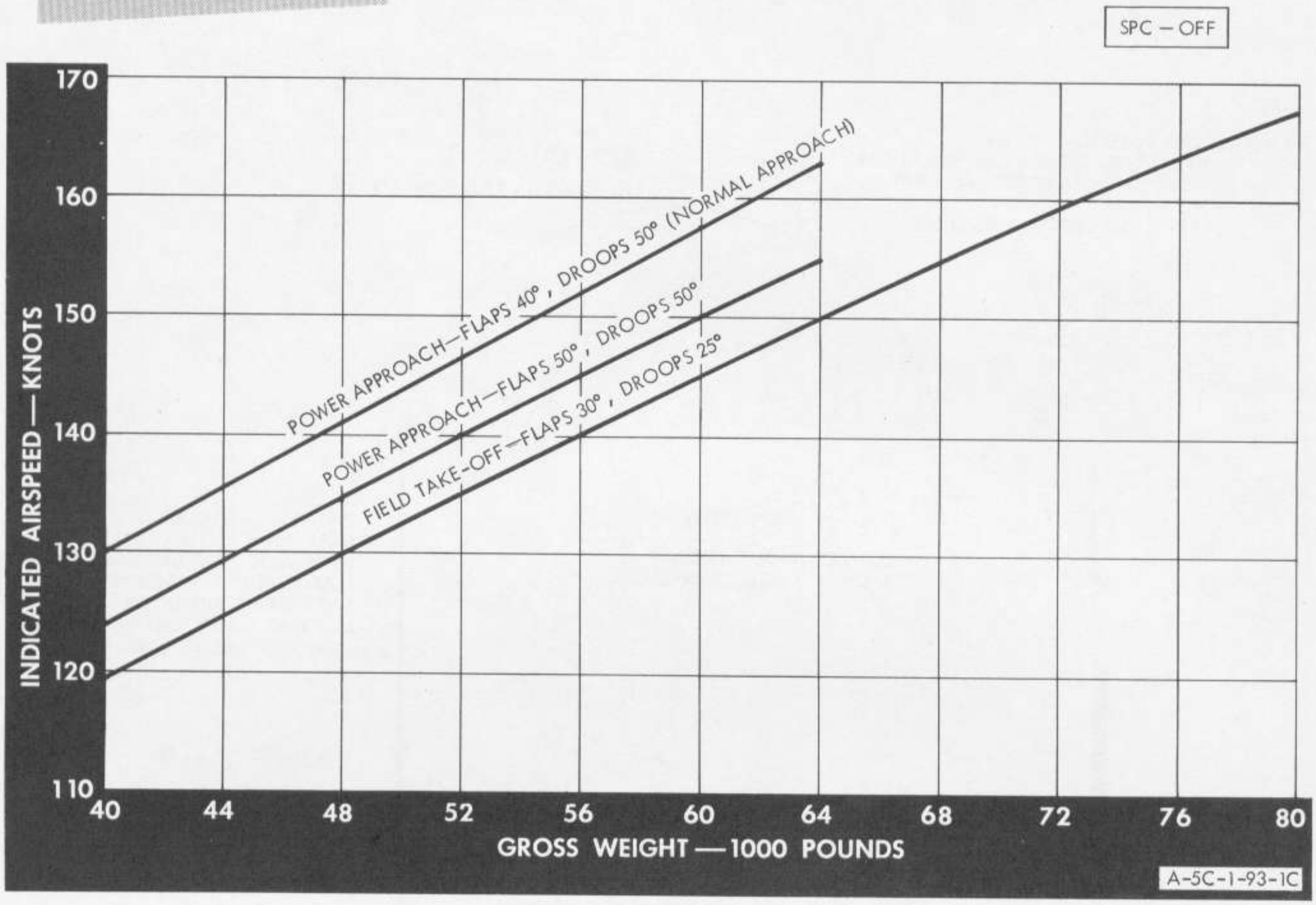


Figure 3-4

9. Maintain directional control with rudder and differential braking. Be prepared to use nose wheel steering if any evidence of a directional control problem exists.

CAUTION

- Center pedals before engaging nose wheel steering.
- Braking on slippery runways must be commenced lightly and with caution, increasing in amplitude as the aircraft decelerates. Otherwise, a blown tire may result. Should this occur, it is *most important* to maintain directional control with nose wheel steering.

10. Check for normal braking prior to reaching runway abort gear. If normal braking is not available, LOWER THE ARRESTING HOOK. Emergency brakes should then be checked.

Note

Allow 3 to 5 seconds for hook extension.

LANDING TECHNIQUE

The constant rate of descent to touchdown landing technique shall normally be employed for all landings. If the aircraft is "on" angle of attack, thus having the correct speed for a given gross weight, and pitch attitude is not undergoing any transition at the moment of touchdown, the aircraft will touch down comfortably on the main wheels, rock forward on the nose wheel, and exhibit no tendency to bounce. A bounce or porpoise can be initiated by landing nose wheel first or pushing the nose down at touchdown, and should be avoided. If a porpoise develops, take an immediate wave-off. The possibility of a lateral oscillation (duck waddle) exists if the aircraft is landed one wheel first. This oscillation may be aggravated by pilot attempts to make corrections by rapid lateral control inputs. If the oscillation is severe, a wave-off should be executed.

TYPICAL FIELD LANDING

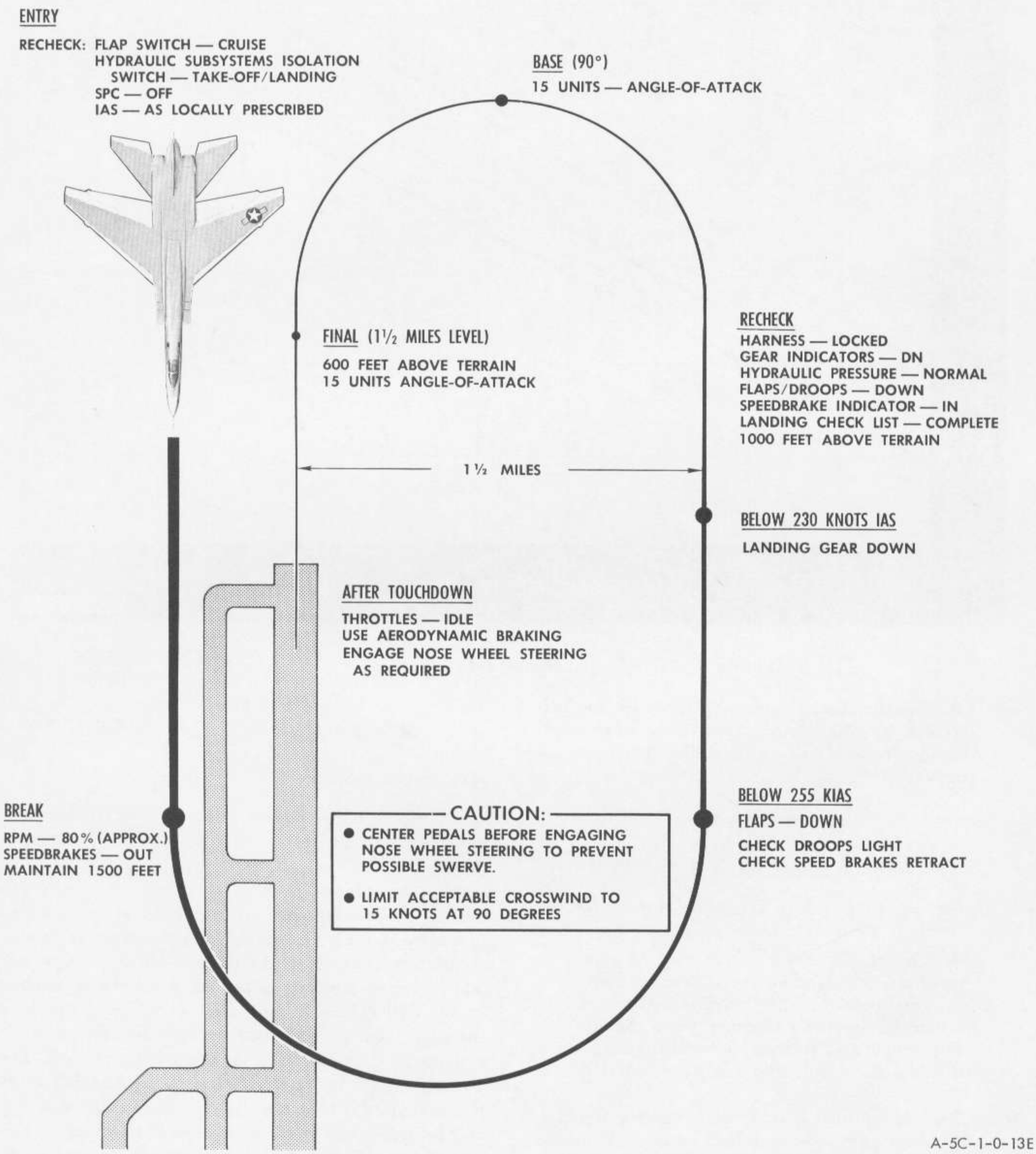


Figure 3-5

CROSS-WIND LANDINGS

Normally, no serious problems are to be expected when landing in cross-wind components up to a maximum of 15 knots. If the 90-degree component exceeds 15 knots, change runways or go to an alternate airfield (if available) where acceptable wind conditions prevail. A combined crabbing and wing-down technique may be used. Lower the nose shortly after touchdown (nose-high aerodynamic braking is not recommended if the component exceeds 10 knots) and utilize nose wheel steering as necessary to maintain directional control. Lateral correction should be used during the rollout. At about 80 knots, the aircraft may tend to "heel" with the wind; however, directional control available is more than adequate. Full stick into the wind is effective.

1. Make a wing-down approach.
2. Immediately upon touchdown, retard to idle power.
3. Use aerodynamic braking judiciously.
4. With all three wheels on deck, commence steady braking.
5. Maintain the lateral correction during rollout, stick into the wind.
6. Center pedals and use nose wheel steering to maintain directional control if necessary.

WAVE-OFF

The optimum wave-off technique is as follows:

1. Throttles—MIL.
2. Rotate smoothly to 19 units A/A (pedal shaker).
3. Minimize lateral control inputs if possible.
4. When climb rate is obtained, select MAX AFTERBURNER, as required, and reduce angle of attack to value required for climb.
5. Reduce power as desired when safe.

TOUCH-AND-GO PRACTICE

Touch-and-go landing practice will be accomplished using the same technique as described in NORMAL APPROACH AND LANDING, in this section. After landing, retard the throttles to IDLE and allow the aircraft to settle down on a short runout prior to applying power for the take-off. Leave flaps at 50 degrees as take-off power is applied. Be alert for yaw in case the engines do not accelerate evenly. The landing gear and flaps will not normally be retracted after a touch-and-go landing.

NIGHT LANDINGS

Night landings will employ the same techniques described for day landings (power-on approach using a constant rate of descent to touchdown). The taxi light may be used on final approach during shore-based operations only if the pilot keeps the following points in mind:

1. Use of the light is recommended when doubt exists as to construction clearance, lineup, etc.
2. Switching on the light may cause radical readjustment of depth perception at a critical point.
3. Ground personnel, such as runway watches, may be temporarily blinded and unable to perform their duties.
4. Use of the light is prohibited aboard ship; its use ashore should be minimized.

STOPPING THE AIRCRAFT

In-flight performance and handling qualities of this aircraft tend to mask its size and gross weight. It is extremely important, therefore, to know the proper braking techniques and limitations in order that all landings may be safely accomplished.

TOUCHDOWN SPEED

To stay within its capabilities, the brake system must be given the advantage of a properly executed approach with touchdown at the optimum speed for gross weight. A touchdown above recommended speed creates greatly increased kinetic energy over that created by a landing at the correct speed. This energy must be absorbed by the brakes in the form of heat. The hotter brakes become, the less effective they are.

AERODYNAMIC BRAKING

In order to gain the most effective use of the energy-absorbing capabilities of the brakes, aerodynamic braking must be used to decrease the kinetic energy present at touchdown.

Nose-high Method

Optimum aerodynamic braking is obtained by raising the nose after touchdown, keeping the main wheels lightly on the runway. Aft stick travel is increased steadily as speed decreases until full aft stick is attained. The drag rise in this attitude, with flaps extended, results in noticeable deceleration. The nose will fall through at approximately 115 knots with normal internal fuel remaining, but the stick should be held aft to obtain the drag of the displaced horizontal stabilizers.

Note

> Flaps should be left extended for aborted take-offs and for landing rollout, since the total deceleration of full aft stick and extended flaps decreases ground roll distance more than if flaps are retracted and wheel braking is started early.

Three-point Method

An alternate method of aerodynamic braking is to lower the nose immediately on touchdown and steadily increase aft stick travel, leaving the nose wheel on the runway. *This method is about 80 percent as effective* as the nose-high method, but is effective at high gross weights and safer for use in strong cross winds.

WHEEL BRAKE CAPABILITY

Approximately 51 million foot-pounds of energy may be absorbed before brake fading occurs. This figure is much lower if brakes are hot from previous use. Up to 7 million pounds of energy are absorbed during normal taxiing to the runway with no external stores at average taxi speeds. For an aborted take-off, total capacity is then far less than design. It is, therefore, important that taxiing be accomplished at speeds requiring minimum use of brakes. The following table shows recommended wheel braking initiation speed to obtain 80 and 100 percent of the energy-absorbing capacity of a set of NEW brakes:

GROSS WEIGHT (Pounds)	MAXIMUM SPEED FOR BRAKING INITIATION IN KNOTS (SPC — OFF) 80% CAPACITY (20% remaining when stopped)	100% CAPACITY (Faded when stopped)
44,000	—	—
48,000	130	—
56,000	125	140
60,000	121	135
64,000	117	131
68,000	113	127
72,000	110	123
76,000	107	120
80,000	105	117

Note

During aborted take-offs or landings at high gross weights, constant wheel braking should not be commenced until speed is approximately 110 knots. Intermittent braking may be used if speed is below that shown in the 80 percent column of the table. Refer to BRAKING TECHNIQUE, in this section.

Initiation of constant braking at the speeds shown in the 100 percent column of the table results in brake fade to zero capability as speed approaches zero. The 80 percent capacity speeds assume use of the three-point method of aerodynamic braking from touchdown to stop. The speeds shown are all 105 knots or above; however, it must be remembered that these figures correspond to a set of new brakes with full design capacity.

Note

A speed of 100 knots is considered adequate for initiation of wheel braking for all conditions and will provide a safe margin for old or slightly heated brakes.

BRAKING TECHNIQUE

After using aerodynamic braking to the recommended initiation speed (or light intermittent braking at high gross weights), and with all three wheels on the runway, brake pressure should be applied gently until the pedals feel "solid." Firm pressure should then be applied and held, increasing pressure as speed decreases until the aircraft is stopped or taxi speed is reached. Exercise care, however, since it is difficult to detect tire skidding, even on dry runway.

Intermittent Braking

It has been established that very little effective brake cooling is gained through intermittent braking. However, chances of skidding or blowout, due to excess brake pressure, are reduced. Calculations reveal that landing rollout distance is considerably increased by intermittent braking, inasmuch as there are short periods of zero braking effect. As much as 400 feet may pass between applications of pressure if released for 2 seconds.

Note

Since no significant cooling results from intermittent braking, it is recommended that constant brake pressure be used for normal landings. Above 100 knots, light, steady braking should be used if required. As speed decreases, pedal pressure should steadily increase.

FIELD ARRESTMENTS

Field arrested landings will be made when the aircraft has suffered physical damage which might have rendered braking ineffective (e.g., a blown tire). When available, fly-in type arresting gear will be used for emergency arrested landings. Refer to FIELD ARRESTMENT in Section V.

AFTER LANDING

When clear of the runway:

1. Flap control switch—SUPERSONIC.
2. Anti-ice switches—OFF.
3. Trim—neutral.
4. Canopy—as desired.
5. Wings, tail—Fold as required.

CAUTION

Ensure that the droops are in SUPERSONIC prior to folding the wings.

ENGINE SHUTDOWN

The engines should be stabilized at IDLE for 2 to 3 minutes (including taxi time) to allow temperature stabilization.

1. External units—connected.
2. Chocks—in place.
3. CNI power—OFF.

3A. Pedals—full aft.

Note

Ensure that the RADAR/TV POWER switch is OFF (systems operator) at least 30 seconds before shutting down the engines.

4. Throttles—OFF.
5. Generator dropout (28% minimum)—check.
6. Engine rundown (120 seconds)—check.
7. Engine MASTER switches—OFF.

7A. Seat and canopy safety pins—installed.

8. Canopy uplock—ENGAGED.
9. Gear safety locks—check installed.
10. (Deleted.)
11. Discrepancies—Note on yellow sheet.

PART 4 — CARRIER-BASED PROCEDURES

COMMAND RESPONSIBILITY

When carrier-based, the squadron is under the administrative and operational control of the Air Wing Commander and the ship. All official reports or requests will be processed through the proper chain of command. It is reasonable to assume that operational procedures will vary between ships. For this reason, it is mandatory that the Command review standard ship operating procedures to determine, prior to the commencement of operations, that there are no variations which, in the opinion of the Command, are dangerous to the safe and orderly operation of squadron aircraft. Published NATOPS procedures will not be violated without the approval of the Commanding Officer or his duly authorized representative. The Operations Officer shall provide the ship's Air Officer and Air Operations Officer with all data required for the proper operation and employment of the RA-5C prior to embarkation.

SCHEDULING

FLIGHT SCHEDULING

The Air Operations Officer of the carrier is responsible to the ship's Operations Officer for the daily flight schedule (Air Plan). The schedule is normally published the evening before any scheduled air operations and includes all pertinent information, such as fuel loads, ordnance, mission, etc, for the entire air group. Squadrons will submit flight requirements to the Air Operations Officer. The squadron Operations Officer will assign tactical crews to the flight commitments assigned by the ship's Air Plan. Day and night flights normally will be equally divided among crews. A day flight normally will be scheduled prior to a night flight after long "in port" periods. The flight assignments will be indicated on the ready room scheduling board. At the end of each operating day, the completed commitments shall be transcribed to a daily corrected flight schedule. It shall be the responsibility of the squadron Operations Officer to keep Air Operations advised as to aircraft and crew lineup for each scheduled sortie. Air Operations will be notified promptly of any changes.

GROUND TRAINING SCHEDULES

1. Weekly ground training requirements will be determined and published in order to allow time for those affected to make adequate preparation.
2. Daily ground training schedules will cover the events listed on the weekly schedule and will be posted with the daily flight schedule.
3. In port, the daily ground training schedule will be posted in lieu of a flight schedule.

BRIEFING

Briefings will be in accordance with Part 1 of this section.

MANNING READY ROOM

Though this topic is generally given little formal consideration, flight efficiency begins in the ready room. Flights are often delayed because crews do not man the ready room in time for adequate briefing. Such procedure can result in failure of the mission. Therefore, it is mandatory that the ready room be manned at least 1 hour prior to scheduled launch time when operating aboard. In the event of multiplane flights, all pilots and crews shall ensure that they are briefed thoroughly on all phases of the mission.

"Tail-end Charlie" may find himself leading the entire flight and, if he is not properly briefed, the resulting confusion may prove to be more than embarrassing. At the completion of the briefing, all crew members will man their aircraft when directed by Air Operations.

FLIGHT OPERATIONS

Note

Only those procedures which differ from shore-based procedures are described in the following paragraphs.

TOWING

Whenever the aircraft is towed without external hydraulic pressure applied, braking is dependent upon the two accumulators. Towing will not be started unless the auxiliary brake accumulator has at least 1400 psi and emergency 1000 psi. Whenever the auxiliary brake accumulator is exhausted, pull the emergency brake handle and do not move the aircraft further until both accumulators are recharged. The auxiliary accumulator may be recharged by a hand pump in the nose wheel well.

MANNING AIRCRAFT

Aircraft will be manned as directed by Air Operations; however, pilots shall man their aircraft in sufficient time to ensure an adequate preflight inspection. Normally, 25 minutes before scheduled launch should be adequate. Crew members will man their aircraft in a smart, expeditious manner. Helmets will not be worn on the flight deck until after manning the aircraft. The Plane Captain will meet the pilot and accompany him throughout the preflight inspection. Double-check aircraft gross weight written on the side of the fuselage.

PRESSURE SUITS

If the pressure suit is worn, the helmet may be worn, if desired, but, under such conditions, the crewman will be accompanied by another person without a helmet. The aircraft may be preflighted by the Plane Captain and a qualified crew other than the flight crew. The aircraft will be ready for manning upon arrival of the flight crew. When pressure suits are used, or on any flight using the AN/ASB-12 bomb directing set, external cooling air will be required. For other flights, cooling air is optional; however, the ship must know that, without cooling air, no radio communication with the aircraft is possible until engines are started.

SYSTEMS OPERATOR (S/O)

The systems operator is responsible for checking the ready status of all photographic and other special systems. He shall ascertain that all systems are ready as briefed. The S/O shall also ascertain the status of inertial platform alinement prior to manning aircraft and complete such alinement procedures as may remain. The aircraft should not be moved during alinement. If such movement is unavoidable, the S/O shall advise the pilot of probable effect on systems and possible compensation effects available with regard to overall mission capability. If the mission will be compromised, the facts shall be reported to the ship's Operations Officer prior to launch.

Note

Accuracy of the autonavigator is dependent on accuracy of the initial alinement, and hence on the quality of the initial inputs, as well as on the time duration of alinement. If ship-based, it is also dependent on the maneuvers of the ship during alinement. For best results, a 30-minute alinement is required.

STARTING AND POSTSTART PROCEDURES

1. Engines will be started on order from Pri-Fly.
2. A 5-minute warm-up of all systems (other than the bomb directing set and reconnaissance systems) is required after engine start.
3. Complete all items of the check list except flap setting, pitch trim setting, compass synchronization, and wing spread, prior to taxiing.
   A complete flight control system check is mandatory—do not allow yourself to be rushed. Make all checks in a thorough and expeditious manner.
4. When the Yellow Shirt director holds a thumb "up" to determine whether or not you are ready to pull tie-downs, do not answer (thumb up) unless ready to taxi in all respects. If not ready, hold your hand up, palm out, as a signal to stand by.
5. When an aircraft is determined to be "down," the pilot will immediately indicate this to the Plane Captain, the Plane Director, and to Pri-Fly Control by radio, if conditions of radio silence are not in effect.

   It is important that discrepancies which will down an aircraft be discovered as soon as possible and communicated to Flight Deck Control in order to avoid interfering with the launch. For this reason, it is paramount that every effort be made to determine the status of the aircraft prior to taxi from the spot position. If the aircraft is determined to be "down," the crew will remain in the cockpit until relieved by the Plane Captain or the aircraft has been chocked and tied down.

CAUTION

On a carrier deck, the exhaust from other aircraft can affect inlet duct temperature, resulting in higher than expected engine power because of the rpm schedule reset feature. Monitor the inlet temperature gage and be prepared for engine speed reset when more than 110 degrees are indicated.

TAXI PROCEDURES

Taxiing on a carrier flight deck, which often may be wet, pitching, rolling, or heaving, calls for extreme care on the part of all pilots. The Plane Director's signals must be followed religiously. Know your signals and answer them without delay. Taxi speeds shall be restricted to a fast walk. Keep the director in sight at all times. If the signal is not understood or you lose sight of the director—STOP.

1. Use only as much power as is required to taxi.
2. Use nose wheel steering and differential braking as required for taxi.
3. Spread wings, aline compass, and set pitch trim in accordance with current Catapult Launching Bulletins (approximately 11 units nose-up) prior to taxiing onto the catapult.

CAUTION

Ship's magnetism may cause compass errors. Recheck compass after launch and synchronize if necessary.

4. Prior to crossing the shuttle, check:
   (a) Altimeter—set.
   (b) Wings—spread and locked.
   (c) Flaps—down.
   (d) Trim—pitch trim set/roll and yaw centered.
   (e) Speed brakes—IN.
   (f) Harness—LOCKED.

5. Taxiing onto the catapult is a relatively simple maneuver if the director's signals are followed explicitly. After taxiing into the holdback and until the Catapult Director gives the "tension" signal, maintain sufficient power to prevent slack in the holdback cable. Crossing the shuttle, the starboard catapult hook will be extended, illuminating the GEAR STIFF caution indicator.

CAUTION

After tensioning, recheck GEAR STIFF caution indicator. If not on, check No. 2 hydraulic system pressure. If pressure is normal, launch may be accomplished, provided catapult end speed and WOD requirements have been set up with at least 5 knots excess above minimum airspeed requirements. Expect greater than normal aircraft sink off the bow and nose rotation requirements under these conditions.

Note

For procedures required if landing with the GEAR STIFF caution indicator on, refer to Section V.

LAUNCH PROCEDURE

CAUTION

Never launch with a partial wing fuel load between 1200 and 9000 pounds, as a swerve during the catapult power stroke may result. For partial fuel launches such as carquals, fuel only the forward, sump, and aft tanks and the bomb bay cans. Leave the wing tanks empty.

1. On the tension signal, advance throttles to full Military Thrust and allow the engines to stabilize. Recheck caution indicators and trim and flap settings and note the stabilized fuel flow, EGT, rpm, hydraulic pressure, oil pressure, and nozzle indications. On signal from the Catapult Officer, advance the throttles to MAX AFTERBURNER and note the stabilized engine indicators. When satisfied the aircraft is ready, position the body properly with head against the headrest, signal the Catapult Officer and alert the systems operator.

2. If, after the salute (or MASTER LIGHTS switch ON) signal, the aircraft goes down, transmit "SUSPEND-SUSPEND." This signal will be heard in Pri-Fly and the suspend button may be pushed in time to hold the launch. Maintain maximum power until the Catapult Officer walks in front of the aircraft and signals to throttle back.

3. After signaling the Catapult Officer, recheck body position and either back up the throttles or use the catapult handgrip to avoid inadvertent retarding of power. Hold the stick near the neutral position, or slightly aft if high sink rate is anticipated. If longitudinal trim has been properly set, the aircraft will upon bridle release, fly smoothly off the bow with a slight rate of sink. Positive rotation to approximately 19 units angle of attack will arrest sink rate.

4. After launch, establish a positive rate of climb on the AAI, cross-checking the stand-by gyro and radar altimeter for a positive rate of climb. Maintain 19 units A/A as necessary to stop a sink on a slow shot. During the latter phase of the power stroke and immediately after becoming airborne, the static pressure instruments will temporarily indicate erroneously (rate of climb as much as 1000 fpm down, pressure altimeter at or below zero altitudes). For this reason, maintain a scan of both gyros, the radar altimeter, and the angle-of-attack indicator to establish a wings-level climb off the catapult. Every catapult, day or night, with or without a horizon, should be made on instruments as drill for a time when there will be no choice.

5. When a positive rate of climb is established, retract the gear and, at 14 units A/A (150 to 170 KIAS), place the flap control switch in the 40-degree position and then to the 30-degree position.

WARNING

Exercise caution to prevent passing the 30° detent and inadvertently placing the flaps in CRUISE position.

6. Recheck the gear up and at 220 KIAS and 200 feet (VFR), or 1000 feet (night and/or IFR), retract the flaps to the CRUISE position. Maintain afterburner until flaps are fully retracted.
7. Avoid excessive use of lateral control immediately after launch, as drag increases markedly with large lateral inputs. If turbulence is experienced immediately after the launch, try only to level the wings; do not attempt to return to course until speed builds up and the increased drag due to lateral inputs is less critical.

RENDEZVOUS AND DEPARTURE

Rendezvous and departure will be in accordance with Section IV and NWIP 41-3, Chapter 8.

RECOVERY

BINGO FUEL

Bingo fuel is that fuel required to reach the break at a diversionary field (not nearest land) under VFR conditions with 1500 pounds remaining. In addition, sufficient fuel shall be computed to complete a standard jet penetration unless the weather at the diversionary field is 5000 feet and 5 miles or more and forecast to remain so for 1 hour after estimated arrival time. Know the Bingo fuel and be prepared to advise the ship of DOG time remaining or the number of passes that can be made before reaching Bingo fuel (a tight pass requires approximately 600 pounds of fuel). "Low state" will be declared at any point in the pattern or during the approach when usable fuel remaining reaches "Bingo." Should the pilot be confronted with a low fuel state, he will either be given priority in the pattern, directed to the emergency tanker, or diverted. Bingo data is contained in the Pilot's NATOPS Check List (NAVWEPS 01-60ABC-1B). Normally, all flights shall be planned to arrive over the ramp at maximum landing weight. In this case, "low state" shall be declared any time usable fuel remaining reaches 1500 pounds. This fuel quantity should be adequate for three tight passes. A *minimum* of 500 pounds of fuel at the 180-degree position is needed to commence the final pass. The decision to use the barricade will be made by the Commanding Officer of the ship.

MARSHAL

1. The flight operating sectors for a formation of two or more carriers are set forth in ATP-1(A).
2. Returning aircraft will normally call for marshaling instructions 20 minutes prior to the scheduled recovery time, reporting position and fuel state. A Marshal altitude and sector will be assigned by the ship. While proceeding to the assigned Marshal point, do not approach the ship any closer than the assigned Marshal distance, except under positive control of the ship.
3. On arrival at the assigned Marshal point (usually 10 minutes to the scheduled recovery time), aircraft will report arrival and fuel state and commence rendezvous with the remainder of the flight, if scheduled and if weather permits.
4. When rendezvoused, fuel permitting, extend arresting hooks and conduct visual inspection. Limit airspeed to 250 KIAS for extension.

APPROACH

Control and recovery of aircraft from the Marshal point will be in accordance with the individual ship's operating procedures. Generally, aircraft will penetrate as a division at 250 KIAS down to breakout. Flight leaders will report "see you" after passing the 10-mile Gate. At this time, the flight will switch to the recovery frequency and enter the landing pattern.

LANDING PATTERN

1. Generally, the landing pattern (figure 3-6) is entered at 800 feet, 250 KIAS, by flying in right echelon, parallel to the ship's course, close aboard the starboard side.
2. If the pattern is full, the flight should go around and reenter to avoid extending the landing pattern too far ahead of the ship. The tower should be advised of the go-around and the flight should climb to 1500 feet until passing the abeam position.
3. The leader will break, as necessary, to maintain a proper interval (40 seconds at the ramp) on the last aircraft upwind.
4. Break smartly (14-second interval), extend speed brakes, reduce power to 80%, slow to 230 KIAS, lower gear and flaps, check SPC—OFF.
5. On the downwind leg, descend to 600 feet, distance abeam 1½ miles. Complete the landing checkoff list and assume appropriate speed to maintain landing interval, decelerating to 15 units angle of attack by the 180-degree position.
6. Turn abeam the stern of the ship. A consistent pattern must be flown to realize a proper landing interval. Do not vary the pattern to make amends for the aircraft ahead at the expense of those behind. Generally, aircraft that are long in the groove will be waved off.
7. A report to the tower will be made when intercepting the OLS. The report will include side number, fuel state, and type aircraft.

TYPICAL CARRIER LANDING

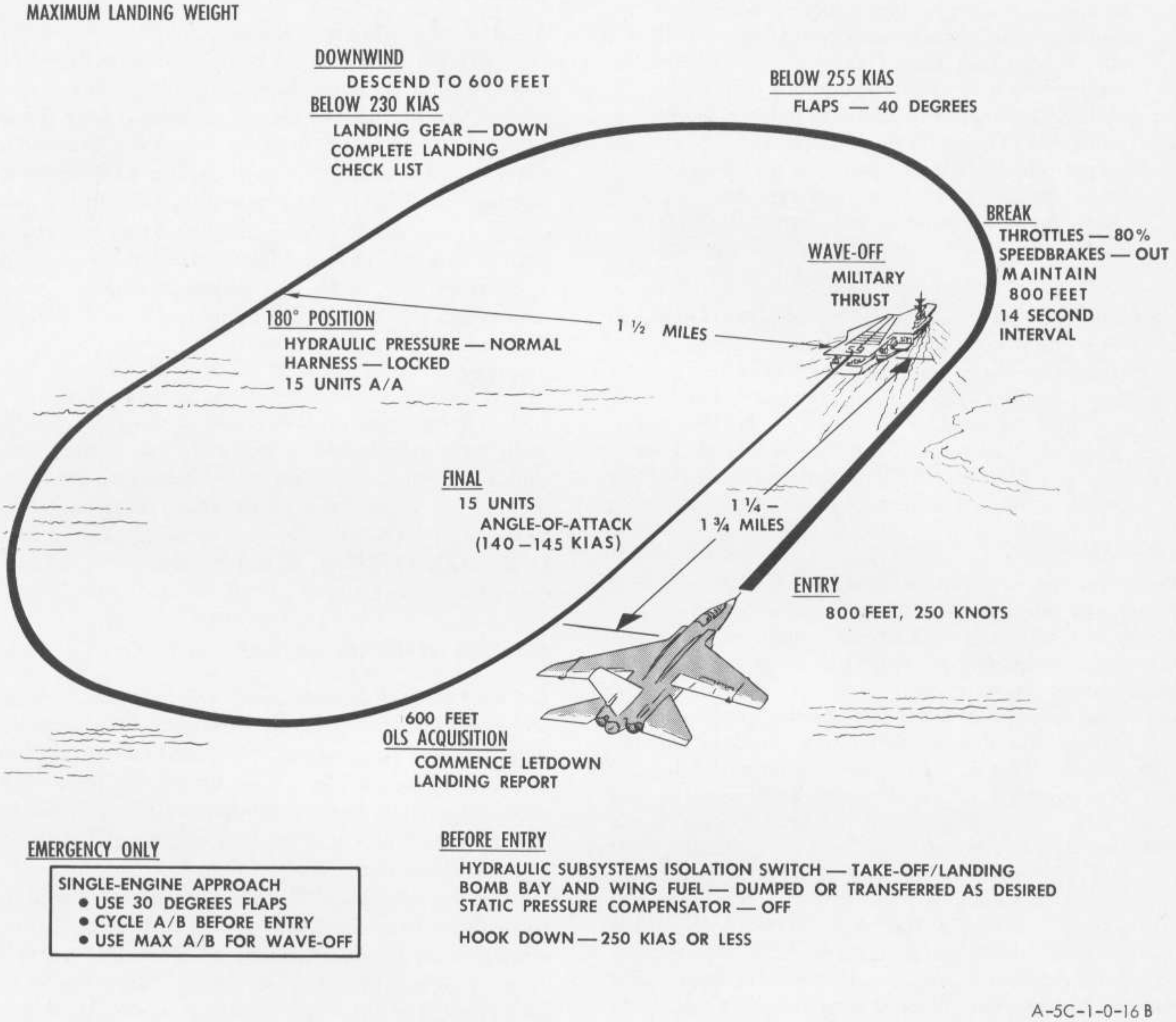


Figure 3-6

8. The current maximum landing weight is 50,000 pounds. Configuration (pylons, drop tanks, bomb bay cans, special systems, etc) must be considered when computing maximum allowable fuel remaining for landing. Drop tanks will be empty and bomb bay cans will have a maximum of 2000 pounds fuel for an arrested landing. Plan fuel to be at or below maximum landing weight prior to reaching the abeam position.

CARRIER APPROACH

1. During the approach, aircraft response is adequate if proper speed is maintained. The lateral control system, by means of spoiler/deflectors, is adequate if speed is maintained; however, if speed is allowed to drop below that required for 16 units angle

of attack, lateral control becomes marginal and over-nose vision is limited.

CAUTION

At approach speeds, large spoiler deflections resulting from lateral control movements will cause a high sink rate. This condition will be amplified in a slow or decelerating approach, particularly when any ramp turbulence is encountered. This condition is extremely difficult for the pilot or LSO to detect at night, and a dangerous low-at-the-ramp situation may develop. Ramp turbulence and burble increase sharply when wind over the deck optimums are exceeded.

2. Each pilot is expected to fly his own approach. The LSO will offer advisory comments as he deems necessary; however, the wave-off is mandatory. A pilot may take a voluntary wave-off at any time he considers an unsafe condition exists; however, late wave-offs are extremely dangerous as thrust is slow to increase and a nose-up rotation to 19 units A/A is required to arrest sink rate.

ARRESTMENT

Treat every carrier landing as a touch-and-go. As soon as the gear touches the deck, advance throttles to MIL thrust and hold until all forward motion stops. As the runout is completed, sharply reduce power to IDLE, engage nose wheel steering, stay off the brakes, and allow the aircraft to roll back. As the pendant clears the tail hook, the director will give a "hook up" signal, then retract the hook. As the hook retracts, the director will give a series of rapid come-ahead signals. Add power and taxi smartly out of the gear and across the foul line. Once clear of the foul line, retard power and check for brake action. If none is available, use the emergency system and advise Primary of the loss of braking and that a tow will be required. While taxiing, move the flap control switch to SUPERSONIC, then fold the wings and remain alert for nose wheel steering malfunctions. Should a malfunction occur, release the nose wheel steering button, and use normal braking for directional control. If the aircraft is to be struck below, the radome must be folded. Do not initiate the radome folding cycle until spotted on the elevator, due to restricted forward vision.

CAUTION

- To prevent droop damage, do not fold wings until the droop leading edges are fully retracted.
- The pilot must ensure that the systems operator has properly secured the bomb directing set prior to folding the radome.

Should the aircraft hang up in the gear and it becomes necessary to pull it back with the arresting gear engine, ensure that nose wheel steering is engaged to prevent the nose wheel from swiveling.

WAVE-OFF TECHNIQUE

At maximum allowable landing weight, the need for early decision in taking a wave-off cannot be overemphasized. Lateral stick inputs to correct for "island burble" are detrimental due to increased drag (spoiler effect). If a wave-off becomes necessary, immediately advance the throttles to MIL thrust, while smoothly rotating the aircraft nose-up until stall warning pedal shaker action is felt (19 units A/A). Hold this attitude until a definite rate of climb is attained. Do not start a clearing turn until safe speed is attained, as the semistalled condition may be aggravated.

BOLTERS

If the aircraft bolts the deck, allow it to fly off smoothly, while advancing power as required, then rotate nose up slightly as the round-down is cleared to establish a positive rate of climb. After the climb is established and comfortably airborne, take up a heading parallel to the FOXTROT CORPEN. Reenter downwind, taking a normal interval to other aircraft in the pattern.

BROKEN WIRE OR HOOK

If a wire or hook breaks during an arrestment, it will be felt as an initial deceleration, followed by a sudden release. At this time, select MAX AFTERBURNER on both engines. Allow the aircraft to fly off the round-down, then deliberately, but not too hurriedly, rotate the nose up. In an emergency, at landing weights and with MAX AFTERBURNER, the aircraft can be flown in excess of 25 units angle of attack. Under these conditions, lateral control will be virtually nonexistent, but the aircraft should accelerate and climb. The aircraft has been flown as slow as 95 KIAS under test conditions. Flight under such emergency conditions, although very uncomfortable and even dangerous, is still better than hitting the water. Under most conditions of broken wires or hooks, the aircraft will still have 90 or more knots airspeed, and with proper pilot techniques and MAX AFTERBURNER, should accelerate sufficiently so that the situation can be saved.

SINGLE-ENGINE CARRIER LANDINGS

Note

Single-engine carrier landings are normally not permitted except under emergency conditions which preclude divert.

1. External stores—JETTISON.

2. Reduce gross weight to less than 50,000 pounds Standard Day; 47,000 pounds 73° F (+23° C); or 45,000 pounds 90°F (+30°C).

3. Cycle afterburner to ensure rapid light-off when needed.

4. Flaps/droops—30/25 degrees.

5. Landing gear—DOWN.

Note

Retrim as required to attain zero spoiler deflection. Zero spoiler deflection reduces thrust required.

6. Use a straight-in approach if practicable.
   A normal approach may be made starting 2 miles abeam at 800 to 1000 feet. For a circling approach, power setting up to Military Thrust may be required.

7. Maintain 14 units A/A (approximately 88% to 90% rpm) on final.
   Above 40° F, required power setting increases significantly.

8. On touchdown, select MAX AFTERBURNER to ensure sufficient thrust in the event of a bolter.

SINGLE-ENGINE CARRIER WAVE-OFF

CAUTION

A low, slow, decelerating approach cannot be safely accomplished. On recognition, select MAX AFTERBURNER and wave off immediately.

1. Throttles—Select MAX AFTERBURNER and rotate aircraft to 17 units A/A.

2. If leaving pattern, retract flaps above 220 KIAS.

CARRIER INSTRUMENT PROCEDURES

The following is a description of typical carrier instrument procedures.

CLIMB-OUT AND RENDEZVOUS

Carrier Air Traffic Control Center (CATCC) information will be furnished for ready room briefings and will contain detailed information to meet the changing tactical situation. However, the following mandatory evaluations and criteria will be met under IFR conditions:

1. Prior to launch, each aircraft shall have positive radio communications with, and remain on, the assigned control frequency until directed to shift to another control agency.

2. The Air Officer will broadcast any necessary prelaunch information to aircraft on deck on their assigned frequency.

3. Pilots will not change radio frequencies after launch until at least a 2500-foot altitude has been reached and the aircraft is in a climbing, wings-level attitude. Those aircraft assigned operating altitudes below 2500 feet will not change frequencies until level attitude and cruise configuration have been attained at assigned altitude. The systems operator may perform these functions below 2500 feet when directed to do so by the pilot.

4. An expected approach clearance (EAC) and alternate Marshal will be assigned each aircraft, and preflight briefings will include procedures to be followed in the event of radio or navigational aid failure.

5. The instrument climb-out should be accomplished, using the following procedures:
   (a) Retract the landing gear when safely airborne; maintain wings level and a positive rate of climb. Climb on launch heading, maintaining a sufficiently nose-high attitude to ensure that airspeed does not exceed 230 KIAS until the landing gear is fully retracted.
   (b) At 1000 feet of altitude, 220 KIAS, retract the flaps.
   (c) Accelerate to climb schedule airspeed and commence a 30-degree maximum bank turn to intercept the assigned climb-out radial.
   (d) Maintain climb schedule and climb-out radial to assigned altitude or "on top."

CCA

All recoveries during instrument conditions (IFR) will be under positive control. IFR weather for shipboard operation is defined as ceiling of 1500 feet or less and forward flight visibility of 3 miles or less. Marshal, expected approach clearance (EAC), and jet emergency marshal (JEM) information will be given prior to the launch. Pilots will check in with Center 20 minutes prior to assigned EAC and plan their flight to arrive at Marshal 10 minutes prior to EAC. After check-in, the Center will confirm Marshal, altimeter setting, EAC, final controller frequency, expected final bearing, and time check.

PENETRATION

Holding will be accomplished at the assigned altitude in a left-hand, 6-minute, race track pattern at 250 KIAS. Plan the pattern in order to reach the holding fix inbound at the assigned EAC. The EAC is not a clearance to commence an approach until verified by Approach Control. Report commencing approach. It is very important that pilots commence the approach on the second, but if this is not possible, report the actual deviation ("departing Marshal 20 seconds late") to Approach Control.

Prior to commencing the penetration, depress the radar altimeter override button, depress and release the SPC button (OFF), HYD SUB-SYS ISOLATION switch TAKE-OFF/LANDING, and turn on the windshield and canopy defrost in order to prevent fogging at lower altitudes. Execute the entire approach with the pilot's radar altimeter in the override mode. Plan the rate of descent to arrive at Platform at 5000 feet and 18 miles. Proper altitude versus distance from the ship may be determined readily by applying a simple rule of thumb. The distance of Marshal from the ship is equal to 1 mile for every 1000 feet of altitude, plus 15 miles (Angels plus 15). The pilot can, accordingly, quickly determine proper altitude during the penetration, provided that aircraft is proceeding directly toward the ship, by applying "Angels plus 15." For example, at 30,000 feet the distance should be 45 miles, at 25,000 feet—40 miles, at 20,000 feet—35 miles, and at 10,000 feet—25 miles. Rate of descent may be regulated to arrive at these checkpoints (4000 to 6000 fpm is a good rate under normal operating conditions). It is mandatory that the pilot execute the entire penetration to the 10-mile Gate at 250 KIAS. This may be accomplished by selecting 80% rpm on both engines and regulating airspeed and rate of descent with speed brakes.

On reaching Platform, reduce rate of descent to 2000 fpm, but maintain 250 KIAS. Adjust the speed brakes to maintain the desired rate of descent. A mandatory report will be made upon reaching Platform. Continue the penetration at 2000 fpm and 250 KIAS to the 10-mile Gate, to reach the gate in level flight at 1000 feet and 250 KIAS. Report reaching the 10-mile Gate. After passing the 10-mile Gate, slow the aircraft, extend the landing gear and flaps, and complete the landing check list prior to reaching the 6-mile Gate. Report reaching the 6-mile Gate. All requirements preparatory to landing shall be accomplished prior to passing the 6-mile Gate. A gradual descent to 600 feet will be commenced departing the 6-mile Gate. CCA will vector the aircraft to intercept the meatball at 600 feet, approximately 1¼ miles from ship. The requirement for calling fuel state will vary between ships; however, a fuel state report is normally mandatory on departing Marshal and reporting the 6-mile Gate.

CCA WAVE-OFF/BOLTER PATTERN

In the event of a bolter or wave-off, Bolter/Wave-off Control will supply immediate instructions, and vector you downwind. If other aircraft are in the pattern, you will normally be vectored out ahead of the ship, prior to turning downwind. If you are alone in the pattern, you will normally be cleared to turn downwind upon reaching a safe altitude. Climb to a minimum of 500 feet prior to commencing a turn downwind during bolters or wave-offs at night, or when ceilings are less than 600 feet. After turning downwind, you will be vectored around the pattern for another approach.

NIGHT CARRIER OPERATIONS

Night operations begin in the ready room. All crews will be thoroughly briefed with regard to their assigned mission. Each crew member will be completely night-adapted prior to manning his aircraft (normally, 30 minutes of adaptation will be satisfactory). Ready room lighting shall be governed accordingly.

LIGHTS

1. Exterior lights will be kept OFF on deck. The exterior lights panel should be set up prior to taxiing, with the wing and tail light switches at DIM and the fuselage light and the exterior lights master switches OFF.
2. The status (up/down) of the aircraft is signaled by waving a red-lensed flashlight as follows:
   Up—vertically, up and down.
   Down—horizontally, fore and aft.

SIGNALS

Standard wand signals, as prescribed in NWP 41(A), will be used on the flight deck. All pilots are required to receive a night catapult signals lecture, by the ship's Catapult Officer, prior to operating from any carrier during the hours of darkness. This is a one-time requirement and will normally be met prior to commencement of initial night operations. Pilots are, however, charged with the responsibility of remaining familiar with all flight deck signals.

RECOVERY

All night recoveries will be under CATCC control. Under normal conditions a complete penetration, with CCA to final approach bearing and interception of the glide path (meatball), will be accomplished. Position lights (wings and tail only) will be turned on bright upon departing Marshal. Pilots may use additional external lights, including Grimes lights, if they desire, but additional lights shall be turned off prior to departing the 6-mile Gate. Pilots are reminded that they should fly the penetration, approach, and the wave-off/bolter pattern strictly on instruments until they are on final bearing and have visually acquired the meatball. After arrestment, move the exterior lights master switch OFF.

Note

Use of the taxi light is prohibited aboard ship.

LOST COMMUNICATIONS

In the event of lost communications, prior to reaching Marshal, the pilot will proceed to emergency Marshal at the assigned Marshal altitude and enter the normal left-hand, 6-minute holding pattern. Another aircraft will be dispatched to the emergency holding fix to lead you through the penetration. Should lost communications occur after commencement of holding at Marshal, a penetration will be initiated at last *acknowledged* EAC. Should communications failure be experienced after initiation of the penetration, the pilot will continue a normal approach on TACAN or UHF homing. If lost communications occur in the wave-off/bolter pattern while proceeding upwind, the pilot will climb to 600 feet, proceed to a point 2 miles ahead of the ship, and turn downwind. If the failure occurs while proceeding downwind, the pilot will proceed to a point 4 miles astern of the ship and turn cross-wind. In both instances, the subsequent turn to final will be accomplished with TACAN or UHF homing.

COMMUNICATIONS EMERGENCIES

Additional lost communication procedures are as follows:

1. Lost aircraft with no navigational aids available—pilot must navigate to recovery position by dead reckoning.
2. Lost aircraft with radio receiver—Fly right-hand triangular pattern, 1-minute legs, maintain altitude, and conserve fuel. Squawk Mode 2, and await recovery instructions. Be alert for aircraft vectored to join you.
3. Lost aircraft without radio receiver—Fly left-hand triangular pattern, 1-minute legs, conserve fuel, and fly highest possible altitude consistent with the situation to facilitate radar acquisition. Squawk Mode 2 and be alert for aircraft vectored to join. After being intercepted, inform lead aircraft of all emergency conditions with appropriate hand signals in order to reduce the possibility of separation during penetration or letdown. Use auxiliary receiver or monitor GUARD as a stand-by receiver.

EMERGENCY SIGNALS

For emergency communications procedures, refer to NWP 41(A).

TABLE OF CONTENTS

FAMILIARIZATION AND TRANSITION

Familiarization and transition will be accomplished in the replacement training squadron. The ground training and flying training accomplished will be in accordance with current directives. Refer to Section II.

GENERAL FLIGHT PROCEDURES

The professional approach to flying is mandatory. All phases of any mission will be thoroughly planned. Each crew must know the aircraft systems, planning, and in-flight procedures thoroughly.

1. The following procedures are common to all flights:
   - Use NATOPS and applicable NAVWEPS check lists.
   - Maintain an alert watch for other aircraft.
   - Both crew members will remain on oxygen at all times. In the event either crew member fails to receive oxygen, descend to 10,000 feet of cockpit altitude if sufficient fuel is available to land safely when flying at this lower altitude. If the fuel situation prohibits this action, and it is necessary to fly in excess of 10,000 feet of cockpit altitude for more than 15 minutes without oxygen, the emergency oxygen system will be actuated 5 minutes prior to landing.
   - The maximum allowable 90-degree crosswind component for take-off or landing is 15 knots.
2. Simulate and review emergency procedures regularly.
3. Check all radio equipment.
4. For procedures to be followed in the event of intercom loss, refer to INTERCOMMUNICATIONS SYSTEM FAILURE, in Section VII, and LOST AIRCRAFT PROCEDURES, in Section V.
5. Whenever crew members are wearing full pressure suits, pressure suit air shall be secured and one glove opened for take-off and landing.

NAVIGATION

METHODS OF NAVIGATION

INERTIAL AUTONAVIGATOR

The primary mode of navigation will be by the full use of the N5H inertial autonavigator (A/N). Except when specifically restricted, the AN/ASB-12 radar or television will be used to improve the accuracy of the autonavigator. The autonavigator, using the inertial gyro platform, will be used on all flights on which it is operating normally. The stand-by navigation mode, utilizing the flight reference set gyro platform, will be used when the inertial gyro platform fails. Present position, winds, and time will be recorded and plotted at least every 15 minutes on a navigation flight.

DEAD RECKONING

Dead reckoning (DR) navigation is the most basic tool available to the systems operator. He shall keep a complete DR plot throughout any navigation flight. This plot shall consist of standard textbook symbols for fixes, courses, positions, etc, and will include a DR position and an air plot and wind vector for each navigation leg. The DR plot normally will not be started anew from a plot of present position, except immediately following correction of present position (A/N) on some known point.

DR navigation is only as good as the information used. To get good information, the crew must use proper navigation procedures. The systems operator may judge the adequacy of his DR plot by his ability to show: (1) present position, (2) heading to the next checkpoint, and (3) ETA at that point, at any time.

RADAR

The AN/ASB-12 radar may be used as a secondary mode of navigation in the event of complete auto-navigator failure. Following an A/N failure, a fully stabilized radar picture normally remains. Using the fixed range circles, relative bearing scale, and aircraft compass, the systems operator has all the information necessary to obtain navigation fixes, ground speed, and track information.

RADIO

Radio navigation (TACAN) will be used on all airways flights, scoring, or navigation flights to check auto-navigator accuracy.

LOW LEVEL

Low-level navigation flights may use either radar or visual fixes. Training flights will normally be limited to radar fixes in order to further operator training. In the event of loss of radar, or radar silence conditions, the pilot may use visual fixes to correct the A/N. In addition to using radar to obtain fixes, the pilot may use terrain avoidance radar, or the systems operator may use contour-mapping radar, to control aircraft altitude above the terrain. A plot of present position or a fix is required once each minute. Low-level flights shall be conducted only over approved low-level routes.

CARRIER-BASED NAVIGATION

In general, carrier-based navigation is the same as land-based navigation; the extra variable is the mobility of the launch point and the return point. The systems operator must know the ship's intended movement (PIM) to know the ship's position at the time of his return. A dead reckoning plot will be maintained on every flight from the carrier.

NAVIGATIONAL PLANNING

Complete navigational preplanning is required for all flights. Refer to Section III, Part 2. In addition to thorough route planning, careful attention will be given to airspace reservations, Air Defense Zones, high-altitude routing, and cruising altitudes. NOTAMS shall be checked, enroute frequencies verified, and destination and alternate fields checked for current status.

SYSTEMS OPERATOR RESPONSIBILITIES

The systems operator will be thoroughly versed in the use of navigational charts, publications, and procedures associated with airways navigation, as well as operational use of available electronic aids. He shall be familiar with applicable VFR/IFR flight rules under routine and special conditions and have sufficient knowledge of instrument approach and GCA/CCA procedures to monitor the approach and render assistance to the pilot as required. The systems operator shall be capable of making all position reports and taking flight clearance reports.

CRUISE CONTROL

PREFLIGHT

As much of the checkoff list shall be completed prior to turnup as possible to minimize engine ground operation and ground fuel consumption. On IFR flights, a fairly substantial saving of fuel can be realized by using external power and delaying starting of engines until such time as the IFR clearance has actually been received from ATC. An accurate fuel check shall also be made prior to starting engines, as required by the prestart check list. If proper techniques are employed, a minimum amount of fuel will be expended during ground operation.

TAKE-OFF AND CLIMB

After the aircraft has been positioned for take-off and Military Thrust applied, the systems operator shall record total fuel aboard prior to commencement of the take-off roll.

CRUISE

Optimum performance figures for all profiles and configurations are included in the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A). It is the responsibility of the pilot to exploit every means to obtain the maximum performance from his aircraft, consistent with the assigned mission.

The aircraft is capable of a wide range of altitude/speed combinations. This demands that each flight be thoroughly preplanned, utilizing the latest available fuel planning data for cruise control. This planning must consider the portions of the profile at high, low, and medium altitudes, as well as acceleration schedules and supersonic flight.

When flights are scheduled utilizing point-to-point navigation which will permit positive electronic fixes, a normal route card fuel log will suffice for cruise control purposes. This will provide an instantaneous evaluation of the progress of the flight and will enable the pilot or systems operator to extrapolate actual fuel consumption to predict the progress of the remainder of the flight.

DESCENT AND LETDOWN

The procedures to be employed in descent and letdown are categorized as follows:

1. Standard Instrument Penetration—The standard penetration is flown at 250 KIAS (SPC OFF) with approximately 80% rpm and a 4000 to 6000 feet per minute rate of descent. Speed brakes are adjusted to attain the desired rate of descent. From commencement of penetration, a fuel state of 6000 pounds will permit completion of the penetration to a wave-off, a 150-nautical-mile flight to an alternate (optimum altitude), and an arrival over the alternate approach fix with 2000 pounds of fuel remaining.
2. Maximum Range Descent—The maximum range descent can be used in a descent from high cruising altitudes to the initial approach altitude, or during descent on a high/low profile. The aircraft configuration is throttles at IDLE speed brakes IN, flap control switch in CRUISE, and 250 KIAS. For planning purposes, the maximum range descent charts in the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A) may be used.
3. Maximum Rate of Descent—This type of descent would most probably be required during carrier operations when it is necessary to meet a specified recovery time after a period of operation in the DOG circle, or in an emergency situation when immediate descent is mandatory. Maximum rate of descent is obtained by placing throttles at IDLE, extending speed brakes, and maintaining maximum allowable airspeed consistent with visibility, possible turbulence, and altitude.

FUEL MANAGEMENT

Pilots shall thoroughly plan all flights and ensure that the proper fuel load is aboard prior to manning their aircraft. The fuel system is essentially automatic; however, the pilot must periodically monitor individual fuel tank quantities in flight to determine whether the system is functioning properly. When drop tanks are employed, it is prudent to ensure that all tanks will transfer (drop tank fuel should be used as early as possible during the flight). Failure of forward tank fuel to transfer is the first indication of a fuel sequencing failure. Should this occur, check the ESS FUEL circuit breaker. Should a fuel sequencing failure occur, avoid flight regimes that will require high fuel flow, and closely monitor sump and forward tank fuel. When carrier-based, pilots will hold any excess fuel until assured of getting into the landing pattern; however, during night or instrument conditions, pilots will be down to authorized landing weight prior to departing the 6-mile Gate. Dump rates are approximately 1200 pounds per minute.

EXTERNAL TANKS

When three or four 400-gallon drop tanks are carried, or two 400-gallon drop tanks are carried in combination with any two other external stores, attempt to maintain a forward center of gravity by using WING AUX fuel sequencing. WING AUX sequencing maintains sump and forward tank level higher than normal sequencing, maintaining cg in a more favorable forward range.

FORMATION FLIGHT

Formation tactics will normally be conducted in accordance with NWIP 41-3, Chapter 8, and as discussed in the following paragraphs.

GENERAL

Most tactical missions of the Reconnaissance/Attack Squadron will be single aircraft; however, carrier operations require a considerable amount of formation flying in the vicinity of the ship and it is essential that each pilot be adept in these procedures. A thorough and specific briefing shall be accomplished prior to conducting a formation flight.

A formation is designed to afford tactical concentration, ease of control, and mutual defense. The governing factors are:

1. It must be maneuverable.
2. It must be flexible enough to meet any situation.
3. It must be simple and arranged so that the flight leader can see all elements of the flight.

BASIC FORMATIONS

PARADE

Parade formation will be used when passing in review, orbiting the ship or station (shore-based), or when participating in aerial demonstrations.

Maneuvers performed in parade formation are relative to the leader, and the wingman maintains a fixed wing position on the leader. On turns into the wingman, he will rotate about the leader's longitudinal axis. On turns away from the wingman, he will rotate about his own axis while maintaining a safe stepped-down position.

Parade formations are flown in section, division, or squadron strength.

CRUISE

Cruise formation is used during cross-country navigation and, at other times, to reduce pilot fatigue and to conserve fuel. Cruise formation provides maximum maneuverability.

ECHELON

Echelon is normally used prior to breakup and during rendezvous. Echelon to the right or left will be signaled by the leader. If the leader's wingman is on the same side as the echelon to be formed, the second section will cross under and join on him. If the second section is on the side to which the echelon will be formed, it will move out to make room for the wingman. Turns into an echelon will be avoided.

FORMATION ELEMENTS

The section, consisting of two aircraft, is the basic formation unit from which other elements are formed. The division consists of four aircraft formed from two sections: a division leader with his wingman in the No. 2 position, and the second section leader in the No. 3 position, with his wingman in the No. 4 position.

PARADE AND ECHELON

In these two basic formations, the wingmen position themselves on a line slightly ahead of the leader's wing, 45 degrees relative to the longitudinal axis of the lead aircraft, and stepped down sufficiently to allow clearance between the tip of their vertical stabilizer and the bottom of the leader's fuselage. This position may be maintained by lining up the outboard leading edge of the engine inlet duct with the aft upper area of the rear canopy. Lateral separation is approximately 10 feet between wing tips.

CRUISE

In cruise formation, the wingmen position themselves on a 60-degree relative bearing, extended laterally sufficiently to provide 20 feet of clearance between the nose of their aircraft and the tail of the preceding aircraft. This position leaves one space between each aircraft. When maneuvering, the wingmen may slide as necessary to maintain the same nose-to-tail distance between aircraft.

SQUADRON FORMATION

The squadron formation shall consist of three four-plane divisions with the second section of each division outboard from the formation leader. Sufficient space shall be left between the first and third divisions for the second division to maneuver.

BRIEFING

When formation flying is scheduled, the designated leader, or senior pilot if no leader is designated, will conduct the required briefing. The briefing will cover the following points:

1. Radio frequencies.
2. Location, altitude, airspeed, and type of rendezvous.
3. Position of each aircraft in the formation.
4. Alternate leaders.
5. Type of mission to be flown.
6. Lost communication procedures.

RENDEZVOUS AND DEPARTURE PATTERN (SHORE-BASED)

NORMAL RENDEZVOUS

1. The purpose of the rendezvous is to join a formation in a minimum amount of time and proceed on an assigned mission. The 180-degree rendezvous is the basic type.
2. Prior to leaving the line, the flight will check in with the leader on squadron frequency with side number and aircraft status. All aircraft will then switch to ground control frequency, and the leader will call for taxi for the entire flight. The aircraft will leave the line in order and taxi to the head of the runway in column, maintaining sufficient taxi interval to preclude FOD.
3. After switching to tower frequency and receiving appropriate take-off clearance, two aircraft will spot on the runway at a time.
4. The take-off interval shall be 30 seconds, or as briefed, and after take-off, all aircraft shall conform to the leader's flight path.
5. After take-off, the leader will climb straight ahead at 300 KIAS (SPC ON) with 90% rpm. The leader will allow 20 seconds (30 seconds if less than four) for each aircraft in the flight before commencing the rendezvous turn.
6. At the proper time, the leader will commence a 30-degree banked turn and continue climb to briefed altitude.
7. Once the leader commences the rendezvous turn, the succeeding aircraft shall hold a straight course until the leader bears 20 degrees to left or right, at which time a 45-degree banked turn will be executed to establish the relative rendezvous bearing. Once established, the bank angle should be decreased.
8. In joining, the wingman should concentrate on working in the rendezvous cone, which is generally considered to be an imaginary cone 225 to 255 degrees relative to the leader. When there is considerable distance between aircraft, the relative bearing should be further forward; as the distance decreases, the bearing should approach to optimum 225 degrees. Maintaining this rendezvous cone will give a steady closing rate. Each aircraft should stay inside of the leader's turn until joined up, and then cross under to their assigned position. Do not tail chase in the rendezvous turn.

9. After completing 180 degrees of the turn, depending on whether all aircraft have joined, the leader will proceed on course, accelerating to climb schedule speed, or return to the departure point, leveling off at the briefed altitude at 300 KIAS.

RUNNING RENDEZVOUS

1. A running rendezvous may be accomplished at the discretion of the flight leader when time and fuel are critical.
2. After take-off, the leader will immediately turn to the briefed departure heading, maintaining 300 KIAS and 90% rpm.
3. Each succeeding aircraft shall take off with a 30-second interval and conform to the leader's flight path.
4. Speed differential will be utilized to close the distance between aircraft. As the distance is reduced, the speed differential should be reduced accordingly. A speed differential in excess of 20 knots can be dangerous when in close proximity to another aircraft.
5. Wingman will join on the left side of the leader, then cross under to the assigned position.

RENDEZVOUS AND DEPARTURE (CARRIER-BASED)

NORMAL RENDEZVOUS

The rendezvous sector will be changed with respect to the number of carriers and the relative position of the specific carrier in the formation. For single carrier operations, the rendezvous area for RA-5C aircraft is normally forward of the carrier and outside of the recovery pattern. On launch, the leader will execute his clearing turn and proceed straight out at 300 KIAS until all aircraft are airborne. Departure Control will give you an off count and clear you to controller or tactical frequency. The lead aircraft shall then proceed to a point 10 miles ahead of the ship and commence a 180-degree, 30-degree banked, climbing turn accelerating to 350 KIAS. When all aircraft are joined, the leader shall accelerate to climb schedule and proceed with the assigned mission. After each frequency shift, the flight shall count off, "one up, two up, etc." Lead pilots shall ensure that their flight remains clear of Marshal points and penetration courses.

RUNNING RENDEZVOUS

After launch, the leader will maintain 300 KIAS and climb out on the assigned departure radial. Following aircraft will join, using power settings as required. On completion of the join-up, the leader will accelerate to climb schedule and proceed with the mission.

FORMATION BREAKUP

1. The formation will always break from an appropriate echelon and signal from the flight leader.
2. All breaks will be executed in a 60-degree banked level turn or as briefed.
3. Breaks into a landing pattern shall normally consist of 14 seconds when shipboard (40-second landing interval), and 20 seconds when shore-based, to allow sufficient time for the aircraft ahead to clear the runway.
4. In order to avoid extension of the landing pattern, do not break more than one division at a time. Succeeding divisions shall circle 500 feet above preceding divisions, entering the break in order.

FORMATION IN CLOUDS

1. Should a formation enter clouds, it can be kept intact if proper wing positions are maintained. Wingmen should maintain the same relative position during all turns, i.e., roll about the leader's axis for both turns into and away from the wingmen.
2. Should an aircraft lose sight of a preceding aircraft, an easy turn away will be in accordance with the following rules: first aircraft to the right of the leader turns 10 degrees right, second aircraft to the right of the leader turns 20 degrees right. Aircraft to the left make similar left turns. These headings will be held for 1 minute, then return to base course. The leader will maintain base course.

NIGHT FORMATION

1. The same general rules for day formations apply to night formations.
2. It is difficult to determine relative motion at night; therefore, no abrupt maneuvers should be attempted and changes in formation should be kept to a minimum. Rendezvous should be accomplished with low closing speeds.
3. While in formation, all aircraft, except the last, should set wing and tail lights DIM, formation lights ON, and anticollision lights OFF. The last aircraft shall have all lights on bright and the anticollision lights ON. When not in formation, all aircraft shall keep lights on bright and the anticollision lights ON.
4. Cockpit lights shall be dimmed to improve exterior visibility.
5. Night breakup will be signaled by flashing position lights and by radio, if radio silence is not imposed. Position lights of all aircraft will be turned on bright following the break.

BASIC FORMATION RULES

1. Rendezvous as briefed.
2. Never lose sight of the aircraft ahead. If a preceding aircraft gets "sucked" in a rendezvous, all succeeding aircraft will drop back.
3. Never pass an aircraft during the rendezvous.
4. In the event an unsatisfactory join-up occurs due to an excessive closure rate, level your wings and go to the outside. Never throw a wing up to stop an excessive closure rate.
5. Do not join another aircraft or formation of aircraft without prior approval of the flight leader.
6. When maneuvering a parade and echelon formation, the leader should be smooth, avoid rapid roll rates and steep bank angles, and maintain constant power settings where possible.
7. Leaders should not use MAX AFTERBURNER, military, or IDLE power settings, thus allowing maneuvering power for the rest of the formation.
8. The flight should always be warned prior to using afterburner, speed brakes, and changing configuration, i.e., gear, flaps, etc.

AIR REFUELING

RECEIVER PROCEDURE

Any planned air refueling will be thoroughly prebriefed. Prior to refueling, tanker/receiver equipment compatibility must be definitely determined. For operational limits with the probe extended, refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A). Drop tank transfer, pitch augmentation, and the electric flight control system will be secured prior to hookup attempts. Caution must be exercised to avoid high-rate closure or departure on the trailed drogue to prevent possible FOD from damaged drogue canopies. For night refueling, complete familiarity with tanker signal lights is required. These lights are color-coded as follows: amber—drogue at full trail; green—fuel on (transferring). To successfully complete an air refueling hookup, the following procedure is recommended:

Note

Normal airspeed range for refueling is between 250 and 280 KIAS.

1. Below probe limit airspeed, place the FUEL PROBE switch to EXTEND. For probe airspeed limits at varying altitudes, refer to Section I, Part 4 of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).
2. Flap control switch—CRUISE.
3. Drop tank transfer—off.

3A. CANS switch—NORM.

4. PITCH AUG switch—STBY.

   Extinguish master caution indicator and trim aircraft as required.
5. Approach the tanker aircraft from the rear and below. Line up with the left edge of the drogue, stabilize aircraft position, and retrim slightly below and approximately 10 to 15 feet astern.
6. Increase power and maintain an even rate of closure.

   Maximum rate of closure recommended is 5 to 8 feet per second (3 to 5 knots). Do not hesitate; drive the probe directly into the drogue. If engagement is missed, retard the throttles and attempt a second engagement.

CAUTION

- A rapid rate of closure will move the drogue forward too fast for proper reel action, causing slack in the hose. This may result in a violent whipping action which could cause structural damage to the probe or drogue.
- If the hose loops on initial contact, or will not retract, a malfunction in the tanker exists. DO NOT ATTEMPT FURTHER ENGAGEMENTS unless an emergency exists.
- If the hose or drogue fouls on the probe, back out very slowly.

7. After hookup is accomplished, push about 10 to 15 feet of hose into the reel. Reduce speed to that of the tanker and maintain the required position during fuel transfer operations.

Note

When the drogue has extended the proper distance, an amber light is illuminated on the tanker aircraft. After contact is made, movement of the drogue inward approximately 6 feet automatically starts fuel transfer from the tanker. This is indicated by a green light on the tanker. When the green light comes on, the yellow light will go out. The sequence is reversed when the receiving aircraft moves the drogue back to full trail to break contact.

8. Note progress during fuel transfer by observing the fuel quantity indicator.

   A steady increase in power will be required as fuel transfer progresses.

9. When the refueling is complete, reduce power slightly to pull the hose out at 2 to 3 knots to full trail, disengaging the probe from the drogue reception coupling.

CAUTION

High rates of separation should be avoided when breaking contact. Sudden separation may damage the probe. If the drogue and/or parts of the hose break off and become entangled on the probe, do not retract the probe. Land as soon as possible.

WARNING

Broken parts or pieces may enter the port engine duct. Anticipate reduced power or erratic performance from the port engine due to foreign object damage.

10. FUEL PROBE switch—RETRACT.

FLIGHT TEST PROCEDURES

Pilots assigned for flight testing must be designated, in writing, by the Commanding Officer. Fuel loadings and crew requirements will be determined by the Commanding Officer or his designated representative and will take into account safety of flight and the purpose for which the test flight is conducted.

FLIGHT CONTROL, TRIM, AND PRETAXI CHECK (COMPLETE)

Check control positions in rearview mirror.

1. Canopy—closed (Listen for "pop").
2. Flap control switch—SUPERSONIC.
3. Check surface travels:
   (a) Horizontal stabilizer—8 degrees nose down, 16 degrees nose up.
   (b) Spoilers—40 degrees inboard and mid, 48 degrees outboard.
   (c) Vertical stabilizer—2 degrees left and right.
4. TRIM select switch—ALTR.
5. Emergency pitch trim crank—check trim in each direction.
6. ALTR ROLL/YAW TRIM switch—check trim in each direction. Trim indicator:
   (a) ROLL—3 units left wing down and right wing down; return to neutral.
   (b) YAW—$1\frac{1}{2}$ units left and right.
7. Alternate pitch trim—check full nose-up and nose-down. Trim indicator:
   (a) ND—3.5 units.
   (b) NU—11 units.
8. TRIM select switch—NORM.
9. Roll trim—check travel in both directions, return to zero.
10. Yaw trim—check travel in both directions.
    (a) Leave trimmed full out.
11. Normal pitch trim—check travel in both directions.
    (a) Leave at 3.5 units ND.
12. YAW AUG NO. 1 and YAW AUG NO. 2 switches—ON.
    (a) Move YAW AUG switches to ON in either order.
    (b) YAW AUG caution indicator should go out on engagement of second system.
13. RAMPS switch—RESET.
14. ELEC SYS switch—RESET.
    (a) Hold ELEC SYS switch in RESET until ELEC F/C caution indicator goes out.
    (b) Check PITCH and ROLL indicators—"ON."
15. Hold stick full left or right.
    (a) Check spoilers partly open 40 degrees.
16. Flap control switch—CRUISE (Hold stick).
    (a) Check spoilers full open 70 degrees.
    (b) Check spoilers with full opposite stick.
17. Speed brake switch—OUT.
    (a) Check spoilers open to 55 degrees.
18. PITCH AUG switch—RESET.
    (a) Hold switch in RESET until PITCH AUG caution indicator goes out.
    (b) Control stick should move to center.
    (c) Pitch trim—check indicator moves to 0.5 unit ND.
19. Stick—full forward and aft.
    (a) Check horizontal stabilizer—8 degrees aircraft nose-down, 21 degrees aircraft nose-up.
20. Pitch trim—check friction and travel.
    (a) Return to 10 units nose-up.
21. PITCH AUG switch—STBY.
    (a) Check pitch trim 5 to 6 units NU.

22. Move stick rapidly forward, then full left, then rapidly right.
    (a) Check ELEC F/C caution indicator on and PITCH and ROLL indicators blank.
    (b) ELEC SYS switch—RESET.
23. Move stick rapidly aft, then full right, then rapidly left.
    (a) Check ELEC F/C caution indicator on and PITCH and ROLL indicators blank.
    (b) ELEC SYS switch—RESET.
24. HYD SUB-SYS ISOLATION switch—FLIGHT.
25. Flap control switch—50°.
    (a) Note flaps do not extend.
    (b) Yaw trim centers.
    (c) Check speed brakes full retracted.
26. HYD SUB-SYS ISOLATION switch — TAKE-OFF/LANDING.
    (a) Check flaps extend to 50 degrees.
    (b) Check droop extension (inboard—30 degrees/outboard—50 degrees).
27. Move stick full left and right.
    (a) Check spoilers for full 70 degrees travel.
    (b) Check vertical stabilizer interconnect 4 degrees left and right.
28. Directional control pedals full left and right.
    (a) Check for 8 degrees travel.
29. PITCH AUG switch—RESET.
30. Disable "kill" button—Press/Push stick full forward and Hold.
    (a) Check pitch trim indicator reaches at least 2.5 units ND with free-play link not centered and 7.0 to 8.0 units ND with free-play link centered.
31. PITCH AUG and ELEC SYS switches—RESET.
32. Push stick full forward and press disable "kill" button. IMMEDIATELY pull stick full aft and hold.
    (a) Check PITCH trim indicator reaches 15.5 units NU RAPIDLY and observe centering to 21 units NU.
    (b) Check PITCH AUG, ELEC F/C caution indicators on.
    (c) Check PITCH and ROLL indicators blank.
33. Flap control switch—CRUISE.
    (a) Check flaps retract, droops stop at CR.
    (b) Pitch trim indicator—check 0.5 unit ND.
34. PITCH AUG and ELEC SYS switches—RESET.
35. Disable "kill" button—Depress and Hold.
    (a) Check for operation of normal trim—There should be no indications of movement of the horizontal stabilizers.
    (b) Alternate trim should operate with "kill" button depressed.
36. Operate all flight controls—check normal and full travel.
37. PITCH AUG, YAW AUG and ELEC SYS switches—RESET, if desired.
38. Air refueling probe—check.
39. Jet pump operation—check (do not exceed 85 percent).
40. CNI command lights—as desired.
41. Compass—Set and SLAVED.
42. External power and cooling air—removed.
43. Wing and bomb bay auxiliary transfer—check.
44. Canopy defrost and windshield anti-ice systems—check.
45. Wing and tail (ON SIGNAL)—SPREAD and LOCKED.

RAM-AIR TURBINE OPERATIONAL CHECK

1. Visually inspect and actuate RAT during preflight.
2. Check that both hydraulic systems are operating normally and within pressure limits.
3. HYD SUB-SYS ISOLATION switch—FLIGHT.
4. Airspeed—200 to 400 KIAS.
5. PITCH AUG, YAW AUG, and ELEC SYS switches—STBY.
6. SLR POWER switch—OFF.
7. TRIM select switch—ALTR.
8. Extend RAT.
   Check HYD EPU ON and ELEC EPU ON advisory lights on.
9. Reduce speed to less than 230 KIAS.
10. HYD SUB-SYS ISOLATION switch—TAKE-OFF/LANDING.
11. Flaps and landing gear — Extend.
12. Check generators individually for proper reset.
13. Trim aircraft for 150 KIAS and move both generator switches to OFF.
    Check for proper operation of essential a-c and d-c systems.

Note

The HYD PRESS caution indicator will illuminate with both generators off and ELEC EPU ON light illuminated.

14. Check all flight and engine instruments for normal operation (except HSI and angle-of-attack indicator).

    Check UHF EMER CNI PWR indicator on, and check transmitter for operation.

15. NO. 1, NO. 2 GENERATOR switches—RESET/ON.

Note

Properly operating generators will not require power for reset.

15A. D.C. RESET button—Push.

16. TRIM select switch—NORM.

17. ELEC SYS, PITCH AUG and YAW AUG switches—RESET.

18. Retract RAT.

WEAPON DELIVERY TACTICS

Refer to Section VIII of this manual and to Section IX of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

FLIGHT CHARACTERISTICS

STABILITY

Stability and control are good throughout the normal envelope of operation. The thin, 43-degree sweptback wing and 52-degree sweptback tail surfaces provide excellent high-speed flight characteristics. The droop leading edges decrease drag, provide improved maneuverability at cruising speed, and lower stall speeds.

HIGH-LIFT DEVICES

Wing trailing edge flaps and leading edge droops with boundary layer control (BLC) on the droops provide high lift for carrier take-off and field and carrier approaches. The high-lift devices provide aircraft capability for catapult at high gross weights and for controllability about all axes.

FLIGHT CONTROLS

Positive control about all three axes is provided by the all-movable vertical and horizontal stabilizers and the spoiler-deflectors. The spoiler-deflector system of lateral control provides effective roll-rate capability at all flight speeds, including the low-altitude, high-speed region where conventional aileron effectiveness is low.

All control surfaces are hydraulically powered and are provided with artificial feel. The directional control system includes dual yaw augmentation, which provides effective directional stability for all flight conditions. The longitudinal control system with pitch augmentation provides pitch damping, "g" trim, relatively constant stick force and displacement per "g" above 0.55 Mach, and a positive, nonlinear mode of control with position trim for take-off and landing. Refer to LONGITUDINAL CONTROL, in this section.

MACH EFFECT

For ease of reference, many speeds in this section are given in terms of Mach number instead of indicated airspeed. An aircraft handling characteristic or aircraft tendency will occur at the same Mach number regardless of altitude. The intensity of a characteristic will, however, vary in proportion to indicated airspeed. The lower the altitude, the higher the indicated airspeed will be for a given Mach number. Increasing indicated airspeed is an indication of increasing dynamic pressure forces on the aircraft. Consequently, you will notice that although a specific handling quality will occur at the same Mach number at all altitudes, the effect on aircraft control may be more pronounced at low altitudes.

LONGITUDINAL CONTROL

The longitudinal system is augmented to provide ease of control throughout the entire speed and altitude range of operation. Below 0.25 Mach, the system provides positive horizontal stabilizer position response to control stick movements for take-off and landing. As airspeed is increased above 0.25 Mach, a transition begins which changes the system from a "position" system to a "rate" system at 0.55 Mach. Pitch damping is operative at all speeds above 0.3 Mach. Above 0.55 Mach, control stick deflection commands a "g" force rather than a set stabilizer position. During normal operation with pitch augmentation, a stick force of 5.6 pounds commands 1 "g" of additional acceleration. These control force and deflection characteristics are constant above 0.55 Mach over the entire operating range of speed and altitude. By moving the control stick and then holding it fixed, the pilot generates a "g" command signal proportional to stick movement. The pitch augmentation system holds aircraft acceleration at the "g" commanded by comparing the command signal with detected acceleration signal.

UNAUGMENTED CONTROL

With pitch augmentation disengaged or inoperative, variations in airspeed and altitude result in changing requirements for control stick movement and force, and the aircraft handles in a manner similar to that of slower, transonic aircraft not having augmented flight controls. At low altitudes, loss of pitch damping requires cautious handling and trimming in the transonic speed range to prevent pilot-induced oscillations. Available horizontal stabilizer aircraft nose-up displacement is reduced approximately 5 degrees and pitch corrections at low speeds require larger stick movements than when operating with pitch augmentation engaged. Refer to LOW-SPEED FLIGHT, in this section.

AUGMENTED CONTROL

With pitch augmentation operating, stick displacement required remains approximately constant above 0.55 Mach. For better control and safety, pitch augmentation should be disengaged during air refueling operations. During rolling maneuvers at speeds less than 250 KIAS, forward stick pressure is required to hold pitch attitude as inverted flight is approached. This is due to the 1-g reference used by pitch augmentation. If a correction is not anticipated, altitude will be lost during low-speed rolls.

CAUTION

> Pitch augmentation dropout during high-g maneuvers may cause the aircraft to pitch up or "dig in," requiring a change in stick force at a moderate rate. If dropout occurs during transonic turns or pull-ups, the resultant change in "g" (±1.5 "g's" without pilot correction) could exceed structural limits. Upon illumination of the PITCH AUG and master caution indicators, be alert to trim out the forces which may be produced.

LATERAL CONTROL

Lateral control is provided by a combination of conventional and inverted spoiler-deflectors. With this system, adequate roll control is provided for all configurations (power approach, cruise, and supersonic).

MECHANICAL LATERAL STOPS

A mechanical stop mechanism controlled by the flap control system provides 70 degrees spoiler-deflector throw for full stick displacement with the flap control switch at CRUISE, 30°, 40°, and 50°. It also provides 40 degrees inboard/48 degrees outboard spoiler-deflectors throw at SUPERSONIC. This reduction in spoiler deflection prevents excessive roll rates and provides a more favorable balance of yaw during rolls at high speeds. The ratio change is initiated mechanically through movement of the droops. Moving the flap control switch from CRUISE to SUPERSONIC limits the deflection to 40—48 degrees.

LATERAL/DIRECTIONAL INTERCONNECT

With flaps extended, a mechanical lateral/directional interconnect is employed to reduce adverse sideslip during large control deflection rolls. The interconnect provides 4 degrees of coordinating vertical stabilizer deflection for 70 degrees of spoiler deflection. The interconnect system is designed to allow ±15 degrees of spoiler deflection before actuating the vertical stabilizer, to minimize cross control required during crosswind take-offs and landings.

LATERAL CONTROL EFFECTIVENESS

At low airspeeds, the aerodynamic effectiveness of the spoilers is considerably greater with flaps extended than with flaps retracted. To ensure adequate lateral control for asymmetrical store loadings or possible engine failure, flaps should not be retracted to less than 30 degrees at angle-of-attack indications greater than 9 units or airspeeds below 220 KIAS. At approach airspeeds, large lateral stick deflections may produce cyclic roll response due to adverse yaw at high angles of attack. In order to minimize this effect, large stick deflections must be accompanied by application of coordinating rudder.

SPOILER SPEED BRAKES

The spoiler-deflector system is used as a speed brake by extending all surfaces simultaneously. Speed brake extension at subsonic speeds is accompanied by an easily controlled nose-down pitch and moderate airframe buffet. Extension at supersonic speeds is characterized by high deceleration forces, and speed brakes should be extended in increments.

Note

- With pitch augmentation inoperative, care should be taken when decelerating through 1.0 Mach at low altitudes. Pitch trim may reverse and pilot-induced oscillation tendency may be encountered.
- Speed brake extension at low altitudes and high speeds with pitch augmentation off is accompanied by a definite pitch-down reaction.

DIRECTIONAL CONTROL

The all-movable, hydraulically powered vertical stabilizer provides excellent directional control throughout the aircraft operational envelope.

DIRECTIONAL RATIO CHANGER

The change in vertical stabilizer deflection ratio flaps up to flaps down is accomplished through a ratio-changing mechanism, operated by mechanical linkage attached to the flap actuating linkage. The directional shift begins at 0 degrees, and the shift is complete when the flaps reach 30 degrees. The vertical stabilizer ratio mechanism has no effect on directional control pedal travel.

WARNING

To avoid any danger of overloading the vertical stabilizer, abrupt control pedal movements should be avoided at airspeeds above 450 KIAS or 1.2 IMN, whichever is less.

YAW AUGMENTATION

At high altitudes, the aircraft may be flown with one or both yaw augmentation systems inoperative up to 1.7 Mach, as long as lateral or directional control inputs are limited. Refer to SUPERSONIC FLIGHT, in this section, and to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A). With one system inoperative, no difference in yaw damping characteristics should be noted.

TRIM

PITCH TRIM

NORMAL

The normal pitch trim control is through the PITCH AUG trim wheel on the control stick. It may be used with pitch augmentation either engaged or disengaged. In either case, stick position will follow trim changes. With pitch augmentation engaged, the pitch trim functions as a position trim control below 0.25 Mach and as a "g" trim control above 0.55 Mach. Pitch augmentation will only engage if the TRIM select switch is in the NORM position. With pitch augmentation disengaged, the pitch trim wheel functions as a position trim control.

ALTERNATE

Pitch trim with the normal system inoperative is provided by the alternate pitch trim pulse switch on the control stick. The alternate trim system functions in the same manner as the normal trim system by repositioning the no-load position of the artificial feel bungee.

EMERGENCY

Should both the normal and alternate pitch trim circuits fail, the emergency pitch trim system must be used. The emergency pitch trim crank mechanically operates the normal pitch trim actuator, repositioning the stick through the artificial feel bungee.

LATERAL TRIM

Lateral trim is provided by differential deflection of the horizontal stabilizers. Full lateral trim displaces each surface of the stabilizer 3 degrees in opposite directions. The lateral trim switch must be held to the desired position while the control stick is centered. Because of a trim interaction characteristic of this system, a large lateral trim change may require some directional trim change.

DIRECTIONAL TRIM

The directional (YAW TRIM) trim switch is located on the pilot's left-hand console. Directional trim is provided by adjusting the no-load position of the directional system artificial feel bungee (control pedals). This action repositions the control pedals and linkage, moving the vertical stabilizer actuator to a new trim position.

Through the directional control ratio changing mechanism, a maximum 7.5 degrees of directional trim is provided with the flaps extended, and 1.5 degrees with the flaps retracted. Because of trim interaction, a change in directional trim usually requires a change in lateral trim.

DIRECTIONAL TRIM CENTERING

To prevent a large magnification of any trim setting upon flap extension, the vertical stabilizer trim actuator is returned toward neutral as the flaps extend to 25 degrees. During flap extension, the trim indicator follows the trim actuator toward zero. Directional retrimming may be required following flap extension.

Note

During flap retraction, the yaw trim indicator will move if a trim input has been made. Trim will be reduced to approximately one-quarter of the original input. When the stabilizer shift occurs, the indicator will move, since the indicator reflects the actual surface position.

SUBSONIC FLIGHT

Subsonically, the aircraft is highly maneuverable. The augmentation systems provide good damping and control characteristics. Operation with the electric flight control system engaged results in reduced control stick forces and improved lateral and longitudinal control. Low-altitude operation in the transonic speed range, with pitch augmentation inoperative, results in increased pitch sensitivity. High-altitude subsonic maneuvering flight may produce buffet which limits maneuvering capability.

SUPERSONIC FLIGHT

The aircraft has good supersonic stability and control characteristics about all axes with the pitch and yaw augmentation systems operating. At Mach numbers above 1.7, or speeds in excess of 650 KIAS, directional stability is weakened, and maneuvering above this speed is limited. Refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A). High-speed buffet may be encountered just under limit airspeed at some altitudes.

MANEUVERING FLIGHT

The aircraft is easily handled in maneuvering flight and good low-speed maneuverability is available. When fully operative under normal conditions, the pitch augmentation and yaw damper systems produce desirable flight characteristics in all phases of flight.

PILOT-INDUCED OSCILLATIONS

Pilot-induced oscillations are rapid up and down pitching motions caused by inadvertent overcontrol. Caution should be exercised in the transonic speed region at low altitudes with pitch augmentation inoperative, as the aircraft is responsive and sensitive to control movement. The pitch augmentation system will reduce any pronounced pitch oscillations. The best method for correcting a pilot-induced oscillatory condition is to relax pressure on the control stick, allowing the aircraft to fly itself out of the condition.

CAUTION

DO NOT attempt to stop pilot-induced oscillation by pushing and pulling fore and aft on the control stick in opposition to aircraft motion. Pilot reaction time, coupled with pilot body motions, make it almost impossible to apply corrective action in relation to oscillation phases.

ALTITUDE LOSS IN DIVE RECOVERY

Altitude loss in dive recovery is dependent upon angle of dive, altitude and airspeed at start of pull-out, speed brake position, load factor, and power setting maintained during pull-out. These factors must be considered collectively in estimating the altitude required for recovery from any dive. Buffet may be encountered in pull-outs at Mach numbers less than 1.0. High-speed, high-angle dives should never be attempted below 25,000 feet until the pilot is completely familiar with the aircraft. Refer to Section IV of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

ANGLE-OF-ATTACK RELATIONSHIP

Angle-of-attack data are presented in Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

LOW-SPEED FLIGHT

TAKE-OFF

Take-off characteristics are noticeably affected by the high-lift wing with leading edge BLC and semi-full-span flaps. Pitch trim for take-off is 5 to 6 units aircraft nose-up for normal loadings and 8 units for heavy weights. Ground effect during field take-off significantly increases the stabilizer deflection required for nose wheel lift-off. Nearly full nose-up stabilizer deflection is required to rotate the aircraft to take-off attitude at minimum take-off speed. Following aircraft lift-off, the required stabilizer deflection decreases rapidly as speed increases. After take-off, the landing gear should be retracted as soon as practicable. However, in order to provide adequate directional control for all emergencies, the flaps should not be retracted until angle of attack is 9 units or less. For heavy external loads, the flaps should be retracted in increments at speeds corresponding to 9 units angle of attack or less.

TAKE-OFF WITH FORWARD CG

Take-offs can be accomplished with the center of gravity ahead of the nose wheel lift-off limit of 25 percent of the mean aerodynamic chord. It should be noted, however, that nose wheel lift-off speed will increase 4 knots for each one percent of forward movement ahead of this center-of-gravity limit, and take-off distance increases approximately 250 feet for each one percent of center-of-gravity travel. Pitch trim should be increased 1 unit aircraft nose-up for each percent of cg forward movement. Full aft stick will be required to initiate aircraft rotation at nose wheel lift-off speed; however, aircraft nose-up stabilizer travel required following lift-off will decrease rapidly. For catapult end airspeed requirements at forward cg conditions, refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

APPROACH TO STALL (CLEAN)

Low-speed flight characteristics are similar to those of other high-performance aircraft. With the droops in the SUPERSONIC (retracted) position at 45,000 to 48,000 pounds gross weight, light buffet commences at 200 to 220 KIAS, depending on altitude. With the droops in the CRUISE position (5 degrees), buffet commences at 170 to 190 KIAS. As speed is decreased, buffet intensity increases, becoming moderate at about 160 KIAS. After moderate buffet is noticed, lateral control deterioration begins and, as speed is further decreased, full lateral stick deflections are required to maintain wings level.

Note

Minimum control speed, defined as the speed where both lateral and directional control requirements to maintain level flight become excessive, is presented under MINIMUM CONTROL SPEEDS, in this section. Spoiler effectiveness deteriorates at airspeeds *higher* than those shown, but proper use of directional control will pick up a wing after lateral effectiveness is lost.

CAUTION

The aircraft should not be flown at speeds lower than those corresponding to 20 units angle of attack unless ample altitude is available for recovery from an unusual attitude.

At approximately 16.5 units angle of attack, lateral control deteriorates and the pedal shaker operates at approximately 19 units as an artificial stall warning. As speed is further decreased, buffet becomes heavy in intensity, increasing difficulty is encountered in longitudinal and directional control, and rate of sink starts to build up. The aircraft is considered stalled at 22.6 units angle of attack, even though it is possible to maintain controlled wings level flight in a high sink condition until the stabilizer reaches its full leading edge down position. Complete loss of control occurs at approximately 25 units angle of attack, or approximately 100 KIAS at 43,000 pounds gross weight. Similar characteristics are experienced and commensurate warnings are provided in accelerated stall approaches. During maneuvering flight while decelerating from supersonic to subsonic Mach numbers (particularly in the speed range around 0.92 IMN), a very slight tendency for the aircraft to "pitch up" may be noted. This tendency is easily controlled but caution should be exercised. With pitch augmentation off, or in the event of a pitch augmentation failure, a push force will be required to keep from increasing "g" when decelerating through this speed range. Because of the design characteristics of the pitch augmentation system, full leading edge down horizontal stabilizer is reached somewhat before the stick is full aft with pitch augmentation engaged. Thus, stick position is not always a good indication of stabilizer position. With pitch augmentation disengaged, full aft stick is required to obtain full leading edge down horizontal stabilizer.

WARNING

Avoid abrupt, large magnitude, longitudinal control motions in maneuvering flight. If the stall warnings of lateral control deterioration, moderate-to-heavy aircraft buffet, and rudder pedal shaker actuation are ignored, or if extreme control motions cause the aircraft to depart abruptly from controlled flight, the aircraft may enter a developed spin from which recovery is highly unlikely.

APPROACH TO STALL (FLAPS AND GEAR EXTENDED)

At 18 units angle of attack, natural stall buffet begins. The pedal shaker operates at 19 units angle of attack. Lateral and directional control remains effective throughout the stall approach to the minimum speed attainable with full aft stick. The aircraft is considered stalled at 28 units angle of attack. Recovery from the stall approach can be easily executed by reducing back pressure on the stick and allowing the nose to lower to approach attitude. The characteristics of landing stalls (power off) are similar, with a noticeable loss in lateral control at angles of attack above 17 units. Roll attitude is controllable, however, above 17 units, with directional control input.

Note

With less than 4000, or with 13,000 to 19,000 pounds fuel remaining, the forward cg limits longitudinal control availability to approximately 22 units angle of attack during slow approaches to stall. Full 28-unit stalls can be obtained in dynamic maneuvers.

Note

- At Military Thrust in the take-off configuration (30-degree flaps/25-degree droops), stall occurs at approximately 21 units.
- In some cases, when the aircraft is flown at angles of attack exceeding 10 units during transfer of wing fuel, an asymmetrical condition can result. This condition is caused by unequal distribution of fuel in the wings. Under such conditions, one wing may drop during a stall approach. However, recovery may be effected as noted.

POWER APPROACH AND LANDING

Low-speed flight with the landing gear and flaps extended results in good aircraft control. The aircraft control in this configuration remains "solid" down to the minimum speed. Flap buffet is light to moderate above 140 KIAS, but this buffet becomes generally unnoticeable below 140 KIAS.

Normal approach speed and attitude correspond to 15 units angle of attack. Controllability is adequate, however, to allow approach speeds corresponding to 16 units angle of attack. With flaps extended, lateral/directional ("Dutch Roll") damping is provided by the yaw augmentation systems through a tilted, rate-measuring gyro which senses both yaw rate and roll rate. In addition, a lateral/directional interconnect between the lateral control system and the vertical stabilizer reduces adverse yaw during roll maneuvers.

CAUTION

If a minimum-rate-of-descent landing is executed, do not rotate to more than 20 units angle of attack. Touchdown at more than 20 units may cause the fuel dump tube or aft fuselage to strike the runway.

WAVE-OFF TECHNIQUE

At normal landing gross weights and ambient temperatures, Military Thrust is sufficient to execute a wave-off. At gross weights up to maximum landing weight, or at high ambient temperatures, afterburner thrust is definitely required. At all gross weights, positive pitch rotation is required in addition to power increase in order to stop rate of sink and to establish a rate of climb. During carrier approaches, lateral control corrections made to offset "island burble" may prove detrimental due to increased drag (spoiler effect). Immediate selection of power in the afterburner range may also prove detrimental in that a pause occurs between throttle advance and aircraft response to thrust increase, due to rpm rollback. At maximum landing weights, the need for early decision and action in taking a wave-off cannot be overemphasized. To obtain optimum aircraft response, the following wave-off procedure should be used.

1. Advance throttles to MIL while smoothly rotating the aircraft to 19 units A/A, or until pedal shaker action initiates.
2. Hold this attitude, maintaining wings level, until descent rate is broken and altitude is maintained or allowed to increase.
3. Reduce angle of attack slightly and select afterburner power, if required, to attain a desired rate of climb, or maintain safe speed as desired.

BOUNDARY LAYER CONTROL (BLC)

BLC effectiveness varies with engine rpm. During final approach, retarding the throttle below approach power results in a decrease in BLC flow. The aircraft will be slightly less stable with the reduced BLC and a slight nose-up pitch tendency will be experienced. The pitch-up tendency is easily controlled. During all approaches, it is recommended that normal approach power (82% to 88% rpm) be maintained until touchdown, at which time the throttles may be retarded to IDLE.

BLC VALVE FAILURES

Should failure of a BLC valve occur on droop extension for take-off (DROOPS caution indicator remains on), catapult launch should *not* be attempted. The 30-degree flaps/25-degree droops field take-off position is not guarded by the DROOPS caution indicator. Field take-off characteristics with 25-degree droops/30-degree flaps will be essentially unchanged if a BLC valve has failed closed. In the event of a valve-closed failure prior to landing, stall buffet is noted at higher than normal speed, accompanied by a tendency to roll uncontrollably toward the failed valve at speeds well above those presented under MINIMUM CONTROL SPEEDS. If characteristics near approach speed are poor, utilize the emergency single-engine approach configuration (30-degree flaps).

MINIMUM CONTROL SPEEDS

The following table presents minimum control speeds in KIAS (SPC OFF) for various configurations, gross weights, and power settings.

TAKE-OFF (Flaps 30 degrees/Droops 25 degrees — Gear Down — Power On)

GROSS WEIGHT — POUNDS 48,000	60,000	64,000	72,000	80,000	BANK ANGLE (DEGREES)	"G"
115	129	133	140	148	0	1.0
126	141	147	154	163	30	1.2
136	152	158	167	176	45	1.4
163	182	188	204	210	60	2.0

CRUISE (Droops 5 degrees — Gear Up — Power On)

GROSS WEIGHT — POUNDS 48,000	60,000	64,000	72,000	80,000	BANK ANGLE (DEGREES)	"G"
139	151	161	171	181	0	1.0
152	165	176	187	198	30	1.2
164	179	190	203	214	45	1.4
197	215	229	243	257	60	2.0

LANDING (Flaps 40 or 50 degrees — Gear Down — RPM 82% and Above)

GROSS WEIGHT — POUNDS 40,000	44,000	48,000	52,000	56,000	BANK ANGLE (DEGREES)	"G"
95	100	104	109	113	0	1.0
104	109	114	119	124	30	1.2
113	119	123	129	134	45	1.4
135	142	148	155	161	60	2.0

LANDING (Flaps 40 or 50 degrees — Gear Down — Idle RPM)

GROSS WEIGHT — POUNDS 40,000	44,000	48,000	52,000	56,000	BANK ANGLE (DEGREES)	"G"
116	122	127	132	137	0	1.0
125	134	139	145	150	30	1.2
138	145	151	157	163	45	1.4
164	173	180	187	194	60	2.0

STALLS

WARNING

There is no tactical necessity for fully stalled flight. Stalls in power approach and wave-off configurations may be beneficial for training purposes and are permitted. *Stalls in the take-off (30-degree flaps / 25-degree droops) and cruise configurations may result in loss of control if improper stall recovery procedures are used and are, therefore prohibited.*

TAKE-OFF

The 1-g stall approach with no external stores and the flap control switch at 30° (30-degree flaps/25-degree droops configuration*) with Military Thrust is characterized by buffet onset at 18 units angle of attack, a slight rolling tendency between 19.5 and 20.5 units, light pitch-up at 23 to 24 units, and lateral control ineffectiveness above 25 units. An aerodynamic stall occurs at 27 to 27.5 units angle of attack, generally characterized by sideslip and roll excursions to the left. Large departures from controlled flight can result from deep stall penetrations. The addition of external wing stores and/or pylons may decrease the severity of the sideslip and roll excursions at stall.

***Aircraft having PCR 216 complied with**

CRUISE

1-g Stall

At the point in a 1-g stall approach (droops at CRUISE or SUPERSONIC), when the horizontal stabilizers reach full leading edge down, the aircraft loses directional stability rather abruptly, and will generally yaw left or right, depending on asymmetry or trim. Lateral control is relatively ineffective for holding wings level prior to reaching minimum speed.

Accelerated Stalls

In accelerated stalls, the aircraft will generally slow down to a speed where less than 2 "g's" result with the stick full aft before it yaws. If the stick is moved to a "neutral" position when the yaw begins, the aircraft will probably recover in one-fourth to one-half turn.

Note

- "Neutral" stick is defined as that position resulting in approximately zero horizontal stabilizer angle.
- The more quickly the stick is allowed to return to approximately trim neutral position, the better are the chances of a quick recovery.

POWER APPROACH

The stall approach and 1-g stall characteristics with landing gear down, flaps at 40°, and approach power are relatively mild. Natural stall buffet commences between 17 to 18 units A/A and the pedal shaker operates at 19 units. Lateral and directional control remain good down to stall. The stall is defined as either an aerodynamic wing stall (sudden wing drop) or a minimum speed attainable with full aft stick. Aerodynamic wing stall will occur only with relatively aft cg positions. Angle of attack will be 28 to 29 units. At more forward cg positions, full aft stick will not be sufficient to rotate the aircraft to this angle of attack in 1-g flight and the stall becomes a minimum flying speed. The maximum attainable angle of attack decreases as cg moves forward, and only 20 to 22 units may be attained near the forward cg limit.

Wave-off

Stalls with Military Thrust (wave-off) are similar to the stalls described under POWER APPROACH. The characteristics of landing stalls (idle power) are also similar except lateral control power decays above 17 units angle of attack and lateral control is completely ineffective above 25 units A/A.

POSTSTALL GYRATIONS

The characteristics of the pitch augmentation system, which provides light stick forces and high maneuverability, tend to mask the fact that the aircraft is relatively large and heavy. During the stall and poststall phases of flight, the aircraft behaves as a heavy aircraft would be expected to behave. It is reluctant to enter the poststall condition, but once it has entered, it is somewhat reluctant to recover rapidly. The poststall gyration is not physically uncomfortable to the pilot, but the lack of immediate response to recovery controls is disconcerting. Depending on gross weight, individual aircraft asymmetry, and other variables, the aircraft will continue to yaw in an uneven manner in the initial direction or may possibly reverse direction.

Note

It is important to remember that there is nothing that can be done to speed up the recovery and the pilot should continue to hold neutral stick until the aircraft begins flying.

Aircraft pitch attitude varies from nose-down past vertical to above the horizon, and yaw rate decreases at the minimum and maximum pitch attitudes. Indicated airspeed oscillates from 0 to about 100 KIAS. IAS increase above 100 knots is an indication that recovery is occurring. As airspeed reaches approximately 150 to 160 KIAS, the aircraft may be flown normally.

INVERTED ATTITUDE

Inverted stall characteristics are straight forward. Directional stability is quite high during inverted flight and any rotation which develops can be stopped immediately with opposing directional control. The aircraft may be flown out of the inverted stall condition by applying opposite directional control pedal to stop any rotation and pulling back on the stick to increase "g."

VERTICAL ATTITUDE

Vertical entries usually result in upright poststall gyrations similar to those previously described. The more nearly vertical the attitude, the more abruptly the aircraft "swaps ends." If the nose falls backward from a near vertical entry, the aircraft will continue to rotate approximately 270 degrees in pitch to an upright attitude and enter an upright poststall gyration from that point. If the nose falls forward from a near vertical attitude, the aircraft will again rotate approximately 270 degrees to an inverted attitude, hesitate, rotate in the opposite direction until it assumes approximately an upright attitude, from which it will enter a poststall gyration.

WARNING

By establishing an upright pitch attitude of approximately 60 degrees and leaving hands off the controls, it is possible to enter a developed spin from which *recovery is highly unlikely.*

A stall entry in the 60-degree attitude allows the aircraft to arc over-the-top in such a way that the angle of attack does not exceed approximately 45 degrees. The aircraft then begins a yaw rotation in one direction or the other as it descends vertically. With an attitude steeper than 60 degrees, the angle of attack reaches values well above 90 degrees as the aircraft "backs down." When it abruptly "swaps ends," a dynamic pitching moment is provided, allowing the aircraft to recover "hands off." At upright pitch attitudes below 60 degrees, angle of attack is lower and the aircraft will fly out in a normal manner.

RECOVERY FROM POSTSTALL GYRATIONS

As previously noted, neutralizing all controls provides recovery from most poststall gyrations. However, in order to improve the possibility of recovery from certain vertical entries and still maintain a standardized technique, a single procedure is required. When it is recognized that the aircraft is no longer responding normally to longitudinal control inputs:

1. Stick—FULL AFT.
2. When the nose drops below the horizon with the aircraft in an upright attitude, depress the flight control "kill" button (on the stick grip) to disengage pitch augmentation.
3. Immediately allow the stick to center longitudinally and LEAVE IT THERE.
4. Throttles—IDLE (to prevent excessive altitude loss in recovery).

For 1-g and accelerated entries, the horizontal stabilizer has to be full leading edge down before an out-of-control condition can be attained, so it is merely necessary to hold full aft stick until the nose drops below the horizon. For vertical entries, holding aft stick decreases the possibility of entering a developed spin from certain attitudes. If the aircraft pitches nose-backward from a near vertical entry, the stick should be held aft until the aircraft is upright and the nose is below the horizon and dropping.

GENERAL

During some of the recoveries in the A-5A spin test program, the pitch augmentation system produced undesirable inputs just as the aircraft commenced flying in the recovery. These pitch inputs are caused by system characteristics in response to pitch rate or "g" at the initiation of recovery. At times, pitch augmentation would cause a rather abrupt pitch-up, which tended to cause a secondary stall. At other times, pitch augmentation would cause a fairly violent pitch-down, which was uncomfortable and disconcerting. Due to these inputs, and to definitely establish neutral longitudinal control, pitch augmentation should be disabled by depressing the flight control disable button (on the stick grip). The stick should be allowed to center longitudinally as noted. The average altitude lost in recovery during the spin test program was approximately 13,000 feet and was never less than 8000 feet.

WARNING

If the aircraft is not under control at 15,000 feet above the terrain, EJECT.

UNUSUAL ATTITUDE RECOVERY

As noted, directional stability is high during inverted stalls. Any rotation in yaw which exists will be low rate and easily stopped with opposite directional control. Application of aft stick will result in a positive load factor and the aircraft will commence flying. In the event the aircraft is at low speed in a nearly vertical attitude, the following technique should be employed:

1. The aircraft should be rotated to the nearest horizon, using longitudinal control.
   (a) If pitch attitude is past vertical as noted on the attitude indicator, the stick should be pulled aft to achieve an inverted attitude.
   (b) If pitch attitude is short of vertical, the stick should be pushed forward to achieve an upright attitude.
   (c) If pitch attitude is so nearly vertical that there is no real choice, forward stick should be applied, as forward stick is much more effective in rotating the aircraft than is aft stick.

Note

With an airspeed of 100 KIAS in a vertical attitude, the aircraft can be rotated to an upright level attitude with forward stick.

2. Once the aircraft stops responding normally to longitudinal control application, the recovery procedures previously covered under RECOVERY FROM POSTSTALL GYRATIONS should be used.

SPINS

WARNING

INTENTIONAL SPINS ARE PROHIBITED. During the A-5A spin test program, a spin mode was encountered from which no satisfactory recovery, using the production design control systems, was possible.

INCIPIENT SPINS

For all entries except vertical entries, more than adequate aerodynamic stall warning is provided. The recovery procedures described are satisfactory for an incipient spin or poststall gyration. From a vertical entry, it is possible to recover from the steep attitude at a relatively low airspeed. Once normal longitudinal control is lost, chances are good that the recovery procedure described will enable the aircraft to recover from the worst vertical entry condition. *It must be remembered, however, that any time the aircraft is fully stalled or flown vertically to a low airspeed, there is a definite possibility that a developed spin will be entered, from which recovery is highly unlikely.*

DEVELOPED SPIN

The developed spin is characterized by higher yaw rate (rotation) and less pitching oscillation than is encountered in an incipient spin or poststall gyration. Pitch attitude is from 40 to 60 degrees nosedown and steady. There are some generally diminished roll and yaw rate oscillations. There may be some transverse (back-to-front) "g" imposed upon the crew members, which is quite uncomfortable.

WARNING

In the event the poststall gyration progresses to a fully developed spin, it is highly unlikely that recovery can be effected.

Should a developed spin be encountered at high altitude, the best control positions are:

1. Control stick—FULL AFT and laterally FULL IN DIRECTION OF SPIN.
2. Directional control pedals—FULL AGAINST SPIN.
3. Controls neutralized as yaw rate (turn needle) approaches zero.

During the contractor's A-5A spin test program, insufficient altitude was available to determine the number of turns required for the described control combination to effect recovery. Tests determined that this combination will possibly effect recovery from a low yaw rate developed spin if initial altitude is high enough.

WARNING

EJECT IMMEDIATELY on reaching 15,000 feet above the terrain if the aircraft is not under control.

LANDING APPROACH WITH FORWARD CG

Landing approaches with the center of gravity ahead of the forward landing limit of 27 percent MAC (27.5 with 50-degree flaps) can be made satisfactorily. However, to ensure adequate control for all emergencies, the minimum approach speed should be increased 6 knots for each percent forward movement ahead of 27 percent MAC (27.5 with 50-degree flaps). As a guide, approach angle of attack should be decreased 1.5 units for each percent forward of 27 percent MAC (27.5 with 50-degree flaps).

LANDING APPROACH WITH AFT CG

Under normal operating conditions, approaches and landings, as described in Sections I and VI, can be accomplished with two full bomb bay cans and empty wing tanks. However, flight tests show that the static longitudinal stability of the aircraft at an aft center of gravity becomes weak, which provides poor flying qualities during a landing approach, particularly in turbulent air. The flying qualities are further aggravated when the pitch augmentation system is disengaged, as evidenced by a requirement for larger control corrections, especially in turbulent air.

TECHNIQUE

Adequate longitudinal control authority is available under all conditions for landing at centers of gravity well aft of the limit for power approach. Landing approaches with the cg aft of the aft limit should be made at 14 units angle of attack to improve control characteristics. Speed control will not be precise, although the aircraft will respond satisfactorily with coordinated use of both pitch and power corrections. Due to the cg location, pitch control sensitivity to power changes is increased by action of the throttle/stabilizer interconnect. Concentrate on maintaining attitude prior to touchdown and ease the aircraft onto the runway by addition of power, not by attempting to abruptly flare with aft stick. If a bad bounce should occur, corrective action would be the addition of power for a complete wave-off. It is emphasized that adequate control authority is available under all conditions to safely counteract any pitch change due to thrust increase. However, remember that initial longitudinal response will be slow and no abrupt large magnitude longitudinal stick inputs should be applied in attempting to correct for a bad bounce. Admit to yourself that a bad landing was made and wave off. Utilize the same technique following a carrier landing bolter, add power as necessary for a wave-off, and avoid abrupt, large magnitude longitudinal stick inputs.

AIR INDUCTION SYSTEM

INLET BUZZ

Inlet shock wave instability and rapid cyclic oscillation constitute a phenomenon known as "inlet buzz." This may occur above 1.4 Mach when engine airflow demand is suddenly reduced by an abrupt change in rpm, flame-out, or compressor stall. At high Mach numbers, inlet buzz can occur below 95% rpm, as well as at low engine airflow (idle rpm or windmilling) conditions. It is characterized by extremely heavy airframe buffet combined with aircraft lateral/directional oscillations of low amplitude and high frequency. This phenomenon is violent and abrupt, calling for immediate pilot action to slow the aircraft to 1.4 Mach by extending the speed brakes and retarding the throttles to Military Thrust. Fully developed inlet buzz is considered unlikely to occur unless the ramps or rpm sensing switches should fail in conjunction with a throttle chop at high supersonic speed. If fully developed buzz is initiated by a throttle reduction with a malfunction of rpm sensing switches, the buzz can be eliminated by advancing the throttles to Military Thrust, while slowing by use of the speed brakes.

INLET BUFFET

Inlet duct flow instability or roughness can occur at Mach numbers greater than 1.6. This disturbance begins as a low-amplitude, light airframe buffet at 1.6 to 1.7 Mach. This buffet increases to mild or moderate levels at 1.95 Mach and varies at a constant level to V_L. This flow instability is primarily the result of inlet shock wave boundary layer interaction. This interaction is aggravated by inlet ramp mis-scheduling, secondary airflow modulation gap control malfunction, or colder than standard ambient air temperatures. There is no degradation in aircraft flying qualities such as that occurring during inlet buzz. No corrective action by the pilot is required. The buffet intensity can be reduced by climbing to altitudes above 45,000 feet.

Note

- When inlet ramps are fully extended, either by the rpm switch above 1.3 Mach, or by turning the engine MASTER switch to OFF above 0.3 Mach, rapid engine acceleration to high rpm may cause compressor stall.
- To avoid compressor stall below 1.3 Mach with ramps extended, inlet ramp control should be reset prior to rapid throttle movements.
- Above 1.3 Mach, inlet ramps will extend full down whenever engine speed decreases below 95% rpm. Compressor stall can be avoided by accelerating to this engine rpm limit. When the RAMP CONT caution indicator illuminates, reset the inlet ramp control and continue engine acceleration.
- Resetting the ramp control system is unnecessary if engine rpm is maintained at 100% rpm above 1.3 Mach.

ENGINE COMPARTMENT OVERPRESSURE

If the engine compartment pressure exceeds 8 psi differential, the overpressure relief doors will open and the ENG DOOR caution indicator will be illuminated. The relief doors will automatically close when the compartment pressure decreases to less than 7 psi differential. If the light remains on, high airspeed, altitude, and power settings should be avoided in order to prevent engine compartment overheat and possible fire.

TABLE OF CONTENTS

ENGINE START MALFUNCTIONS

FALSE START

Should an engine fail to light off within 30 seconds after the throttle is moved to IDLE, proceed as follows:

1. Throttle—OFF.
2. Allow engine to crank for 40 seconds.
3. Start ignition circuit breaker—check.
4. Engine MASTER switch—check.
5. START switch—STOP.
6. Inspect engine.
7. Commence restart.
8. Depress EMER IGN button and advance throttle to idle, continuing to hold button down.
   If EMER IGN was used on first attempt, try manual (normal) start.
9. If engine fails to light-off, move throttle to OFF and down the aircraft for investigation.

HOT OR HUNG START

Should starting EGT exceed limits, down the aircraft for engine inspection. Should rpm build up, then hang short of normal idle, proceed as follows:

1. Throttle—OFF.
2. Allow engine to crank for 40 seconds.
3. Instruct Plane Captain to check start air and electrical connections.
4. Attempt additional start only if the cause is determined to be other than an engine malfunction.

CAUTION

Do not attempt additional starts if EGT limits have been exceeded.

AUTOACCELERATION

If an engine autoaccelerates above idle rpm, proceed as follows:

1. Throttle—OFF.
2. If engine operation continues, ENGINE FIRE switch—TOWARD AFFECTED ENGINE.

Note

- If the ENGINE FIRE switch is used, it should be left in the selected position and the corresponding engine MASTER switch should then be turned to OFF to prevent reopening of the firewall shutoff valve. Ground inspection of all engine systems is required before any further start attempts are made.
- Engine shutdown is not necessary if exhaust gas from other aircraft has caused inlet temperature as high as 60°C since the engine rpm increase is caused by the idle speed reset function. A slight change in heading should correct this condition.

ENGINE FIRE DURING START

If a fire warning indicator comes on during a start, or if there are other indications of fire, the following procedures are recommended.

TAIL-PIPE FIRE

If a tail-pipe fire should occur during a start, the condition will probably be detected by the ground crew rather than by illumination of a fire warning indicator. If a tail-pipe fire exists, the pilot should proceed as follows:

1. Both throttles—OFF.
   Maintain starting air supply.
2. Appropriate START switch—START.
   Motor engine until the ground crew signals fire is out.
3. If fire is not extinguished by motoring, instruct ground crew to direct a stream of CO_2 agent into the tail pipe.
4. Evacuate the aircraft as soon as possible and have the ground crew disconnect external electrical power and cooling air.

OTHER THAN TAIL-PIPE FIRES

Should a fire occur other than in the tail pipe during starting, it normally will be indicated by illumination of a fire warning indicator. Should a fire warning indicator illuminate, the pilot should proceed as follows:

1. Both throttles—OFF.
2. ENGINE FIRE switch—TOWARD FIRE.

2A. Instruct ground crew to direct a stream of CO_2 agent into the fire door on the outboard side of the forward engine door.

Note

Opening the fire door requires a sharp rap with the fire extinguisher nozzle.

3. Instruct ground crew to disconnect external power and cooling air.
4. Leave the aircraft immediately.

TAKE-OFF EMERGENCIES

ABORTED TAKE-OFF

Should take-off abort prove necessary, proceed as follows:

1. Throttles—OFF.
2. Hold stick full aft for optimum effect while decelerating to MSBI.
3. Hook—DOWN.
4. At MSBI—Use MAXIMUM BRAKING.

WARNING

Applying brakes at speeds above MSBI can result in faded brakes. If no loss of thrust is involved, no arresting gear is available, and speed is above MSBI, CONTINUE TAKE-OFF.

CAUTION

Relax wheel brake pressure before engaging arresting gear.

Note

During aborted take-offs at high gross weights, steady wheel braking should not be commenced until airspeed is reduced to predetermined maximum speed for braking initiation or 4000 feet of runway remains, whichever occurs first. Refer to WHEEL BRAKE CAPABILITY, in Section III, Part 3.

TAKE-OFF ABORT FACTORS

Aborted take-offs must be planned and executed prior to reaching refusal speed if they are to be accomplished successfully. The most important considerations are; (1) a quick, positive decision, and (2) immediate action. Decision to abort is critical near refusal speed at high gross weight, since *stores cannot be jettisoned* with aircraft weight on the landing gear. In the event of an abort, total braking capacity is realistically only about 80 percent of normal total capacity, since approximately 20 percent is used in taxiing. The aircraft should be allowed to continue rolling until clear of the runway, as the brakes may "fuze" on coming to a stop.

Should aerodynamic braking prove only marginally effective and runway remaining become critical, light braking may be used to the recommended maximum speed for braking initiation (MSBI). If arresting gear is available, extend arresting hook.

Where no field arrestment gear is available, nearly all aborted take-offs starting above refusal speed result in accidents of varying degrees of seriousness. The refusal speed charts in Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A) should be consulted and a refusal speed computed prior to every take-off. For additional information, refer to STOPPING THE AIRCRAFT, in Section III, Part 3. For a discussion of landing on wet or icy runways, refer to Section VI.

ENGINE FAILURE ON TAKE-OFF

BELOW REFUSAL SPEED

ABORT. Refer to ABORTED TAKE-OFF, in this section.

ABOVE REFUSAL SPEED

If power loss is encountered after reaching refusal speed at high gross weights, lift-off should not be attempted and:

1. If conditions permit—ABORT.
2. If abort is not feasible—EJECT.

Note

At speeds above 100 knots, ground ejection is feasible.

ENGINE FAILURE AFTER TAKE-OFF

Note

During maximum afterburner operations or prolonged Military Thrust operations in the 165- to 180-knot speed range, a strong probability exists of encountering a fire warning indication due to engine bay overheat.

Should one engine fail immediately after take-off (flaps retracted or retracting), the marked tendency of the aircraft to roll and yaw into the failed engine is accentuated by reduced rudder effectiveness due to the directional ratio changer. Proceed as follows:

1. Throttles—MAX AFTERBURNER.
2. Flaps/droops—30/25 degrees. DO NOT RETRACT.
3. External stores—JETTISON, if required.

WARNING

Maintain speed above 160 KIAS with flaps at 30 degrees and above 220 KIAS with flaps at CRUISE (5 degrees droops).

4. Landing gear—UP (positive rate of climb established).
5. Raise the flaps to cruise at 9 units A/A (200 to 250 KIAS, depending on gross weight).
   Ensure that landing gear is retracted prior to exceeding 230 KIAS.

6. Throttle of inoperative engine—OFF.
7. If nature of failure permits, attempt air start.
8. If rate of climb after lift-off is marginal, dump fuel as required to reduce weight.

WARNING

With flaps retracted (low vertical stabilizer deflection) sufficient control for safe flight may not be available below 9 units A/A.

AFTERBURNER BLOWOUT

Afterburner blowout may or may not cause an emergency situation, depending upon phase of flight at time of blowout. In flight, afterburner blowout is recognized by a distinct loss of thrust or rate of acceleration, unexpected change in nozzle position, slight yawing, and a trail of fuel vapor. Should afterburner blowout occur on take-off a safe take-off can be accomplished with Military Thrust (MIL) on the failed afterburner engine and MAX AFTERBURNER on the other engine. If refusal speed is passed and take-off cannot be safely accomplished, the decision to use field arrestment gear must be weighed against ejection. Refer to ABORTED TAKE-OFFS, in this section.

Note

At speeds above 100 knots, ground ejection is feasible.

EXHAUST NOZZLE FAILURES

Nozzle Fluctuation (MIL and AB)

An oversensitive nozzle control system can cause nozzle fluctuations at MIL and afterburner power settings. To stabilize exhaust nozzle position, retard the throttle below MIL to obtain mechanically scheduled nozzle area control. Should each advance to MIL cause fluctuations, plan to land as soon as practicable.

Both Nozzles Full Open

If both nozzle systems fail in the fully open position, engine thrust may be extremely marginal at throttle settings up to MAX AFTERBURNER. Afterburner light-off is very unreliable with the nozzle in the full open position, the most probable light-off being at the MAX AFTERBURNER throttle setting. In addition, an afterburner operating at MIN AFTERBURNER will probably blow out when the nozzle opens. Should both nozzles fail open, select Military Thrust.

WARNING

Should both nozzles fail open below 150 knots during a MIN AFTERBURNER take-off, insufficient power remains below MAX AFTERBURNER for safe flight.

With *both* nozzles failed open under Standard Day conditions in CRUISE configuration at Military Thrust (flaps retracted, droops 5 degrees), 20,000 feet can be maintained at gross weights up to 56,000 pounds. With flaps at 30 degrees, landing gear down at weights up to 50,000 pounds, only 2500 feet can be maintained at Military Thrust. Therefore, under these conditions, the *landing gear should not be extended until the final approach*. Normal field approach and landing should be made with 30-degree flaps with both nozzles open if gross weight is reduced to approximately 48,000 pounds or less at temperatures up to standard. At weights over 48,000 pounds or temperatures above standard, sufficient thrust may not be available for a safe landing.

WARNING

Careful monitor of speed control and drag is required to avoid operation on the back side of the power curve. Jettison external stores and/or dump fuel if safe altitude or airspeed cannot be maintained. If power is still dangerously marginal, ejection is recommended rather than an attempt to land.

For performance capabilities with exhaust nozzle full open, refer to Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A).

Nozzle Full Closed

Serious engine overtemperature can result from a failure of the EGT regulating system, causing the nozzle area to be reduced to the minimum mechanically scheduled condition. If the EGT limitations are exceeded, retard the throttle to below MIL and regulate EGT manually with the throttle. Power settings of MIL or above must be avoided to prevent further engine overtemperatures.

LANDING GEAR EMERGENCY RETRACTION

Should the gear fail to retract after take-off, lift the red guard from the EMERG GEAR UP switch and raise the switch to the up position. This action bypasses the landing gear handle. If the malfunction is electrical, this action should result in normal gear retraction.

ENGINE FIRE ON TAKE-OFF

BELOW REFUSAL SPEED

Should a fire warning indicator illuminate or a fire be otherwise confirmed during take-off below refusal speed, ABORT. Refer to ABORTED TAKE-OFF, in this section.

ABOVE REFUSAL SPEED

Should a fire warning indicator illuminate or a fire be otherwise confirmed during take-off above refusal speed (safe stop cannot be made), CONTINUE TAKE-OFF and proceed as follows:

1. Throttles—MAX AFTERBURNER.
2. Gear handle—UP.
3. External stores—JETTISON AFTER LIFT-OFF.

WARNING

External stores cannot be jettisoned until aircraft weight is off the landing gear.

4. Execute maximum climb (not below 160 KIAS).
5. Affected engine throttle—OFF.
6. ENGINE FIRE switch—TOWARD FIRE.
7. If fire persists and is confirmed, WARN S/O AND EJECT WITHOUT DELAY.
8. If fire goes out, land as soon as possible.

SINGLE-ENGINE RECOMMENDED SPEEDS

MINIMUM SAFE SPEED (KIAS, SEA LEVEL, GEAR UP OR DOWN)

GROSS WEIGHT (POUNDS)	FLAPS — 30° DROOPS — 25°	FLAPS — 0° DROOPS — 5° (CRUISE)
64,000	150	220
56,000	140	200
48,000	135	180
42,000	135	180

SPEED FOR MAXIMUM RATE OF CLIMB (KIAS, SEA LEVEL)

GROSS WEIGHT (POUNDS)	FLAPS — 30° DROOPS — 25°		FLAPS — 0° DROOPS — 5° (CRUISE)	
	GEAR UP	GEAR DOWN	GEAR UP	GEAR DOWN
72,000	205	195	260	—
64,000	200	190	255	230
56,000	195	185	250	220
48,000	190	180	245	210
42,000	185	175	240	200

NOSE WHEEL STEERING FAILURE

Should the aircraft fail in any way to respond normally to nose wheel steering, immediately release the STEER/TERRAIN button and use differential braking.

Note

In the event nose wheel steering malfunction is suspected, plan to engage fly-in gear. Runway foaming should be requested if available.

Where no field arrestment gear is available, nearly all aborted take-offs starting above refusal speed result in accidents of varying degrees of seriousness. The refusal speed charts in Section XI of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A) should be consulted and a refusal speed computed prior to every take-off. For additional information, refer to STOPPING THE AIRCRAFT, in Section III, Part 3. For a discussion of landing on wet or icy runways, refer to Section VI.

BOUNDARY LAYER CONTROL FAILURE ON

Should BLC fail on (DROOPS caution indicator illuminated after flap and droop retraction), proceed as follows:

1. Power settings—Reduce.
2. Airspeed—below 230 KIAS.
3. Droops—full DN.
4. "Burn down" and/or dump fuel.
5. Land as soon as practicable.

Note

- Failure of the BLC valves to close on droop retraction is indicated by illumination of the DROOPS caution indicator. At the 25-degree droop setting (flaps at 30 degrees for field take-off and single-engine emergency), the indicator circuit is bypassed and there is no indication of valve failure. Flying qualities and wing structural temperatures are not seriously affected with BLC failed on at 25-degree droops.
- If considerable time is required before landing can be accomplished, reduce power to maintain approximately 200 KIAS and move the flap control switch to 30° (droops 25 degrees).

EJECTION

CONTROLLED EJECTION

WARNING

At low altitude or in unusual attitudes, keep one hand on the stick for control of the aircraft and utilize an alternate ejection knob.

In the event controlled ejection is required and feasible, reduce airspeed to 250 KIAS. The pilot will accomplish as much of the following procedure as time permits:

1. Order systems operator to PREPARE FOR EJECTION. Both crew members will check the following:
   (a) Helmet—TIGHT.
   (b) Parachute lap and shoulder straps—TIGHT.
   (c) Oxygen mask—TIGHT.
   (d) Helmet visor—DOWN.
2. COCKPIT PRESS switch—RAM EMERG.
3. If the situation and time permit:
   (a) Obtain terrain clearance between 8000 and 10,000.
   (b) IFF—EMERGENCY.
   (c) Have systems operator transmit MAYDAY.
4. ORDER SYSTEMS OPERATOR TO EJECT.
5. Initiate ejection, using the face curtain or alternate knobs, keeping elbows in.

Note

In any ejection using the face curtain, be sure to "slam" the curtain out and forward rather than just pull. If ejection does not take place, either "bang" the curtain against the stops or use the alternate knobs.

6. After seat separation (below 10,000 feet), "D" ring—PULL HOUSING FREE OF RISER.
7. Inflate MK 3C life preserver (if over water).
8. Survival kit—RELEASE.
9. Mask/faceplate—OFF/UP (when oxygen is of no further use).

EMERGENCY EJECTION

WARNING

- It is ALWAYS preferable to eject rather than to attempt crash landing or ditching.
- At low altitude, keep one hand on stick for control and utilize an alternate ejection knob.

In an emergency situation requiring immediate ejection:

1. PILOT WILL ORDER SYSTEMS OPERATOR TO EJECT.
2. SYSTEMS OPERATOR WILL INITIATE HIS OWN EJECTION.

Note

Whenever possible, the systems operator should initiate his own ejection. This will ensure proper positioning. Use the face curtain, if possible, to ensure maximum protection from wind blast. Use of the face curtain will also tend to prevent arm flailing in the absence of arm retention. See figure 5-1 for ejection seat operation.

3. Complete steps 6 through 9 under CONTROLLED EJECTION.

EJECTION SEAT OPERATION

CONTROLLED EJECTION

① Prepare to Eject...

A. REDUCE SPEED TO 250 KNOTS OR ZOOM-CLIMB IF NECESSARY: INITIATE EJECTION BEFORE SINK-RATE CANCELS LOW ALTITUDE EJECTION CAPABILITY.

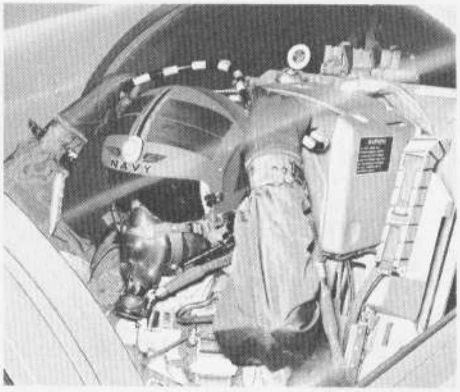
B. TRANSMIT MAYDAY AND TURN AIRCRAFT AWAY FROM POPULATED AREAS AS TIME PERMITS.

C. WARN CREW MEMBER TO PREPARE TO EJECT

D. ORDER CREW MEMBER TO EJECT

② Initiate Ejection

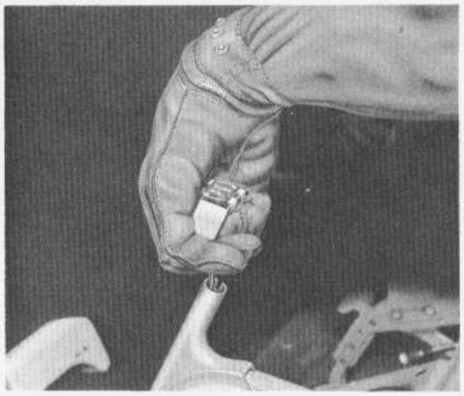
PULL FACE CURTAIN



- "SLAM" CURTAIN OUTWARD AND DOWN UNTIL REACHING FULL TRAVEL. BANG AGAINST STOPS IF REQUIRED

OR . . .

TURN AND PULL EITHER KNOB



1. SEAT INITIATORS FIRE.
   - CANOPY IS JETTISONED.
   - SEAT BUCKET IS BOTTOMED.
   - SHOULDER HARNESS IS RETRACTED.
   - RETENTION DEVICES ACTUATED.
2. CATAPULT-ROCKET FIRES.
   - EMERGENCY OXYGEN ACTUATED AS SEAT RISES.
   - IFF SWITCHED TO EMERGENCY (PROVIDED PILOT'S IFF SWITCH IS IN AUTO POSITION).
   - LIFT-PLATE IS EXTENDED.
3. DROGUE PARACHUTE DEPLOYED.

NOTE: IF PILOT INITIATES EJECTION, EJECTION OF PILOT'S SEAT IS AUTOMATICALLY DELAYED UNTIL 0.75 SECOND AFTER AFT SEAT EJECTS.

③ When Clear of Cockpit...

- IF ABOVE 13,000 FEET, RELEASE LEG RETRACTORS — PLACE THUMB AND FOREFINGER AROUND SLIDE RELEASE AND PUSH FORWARD.

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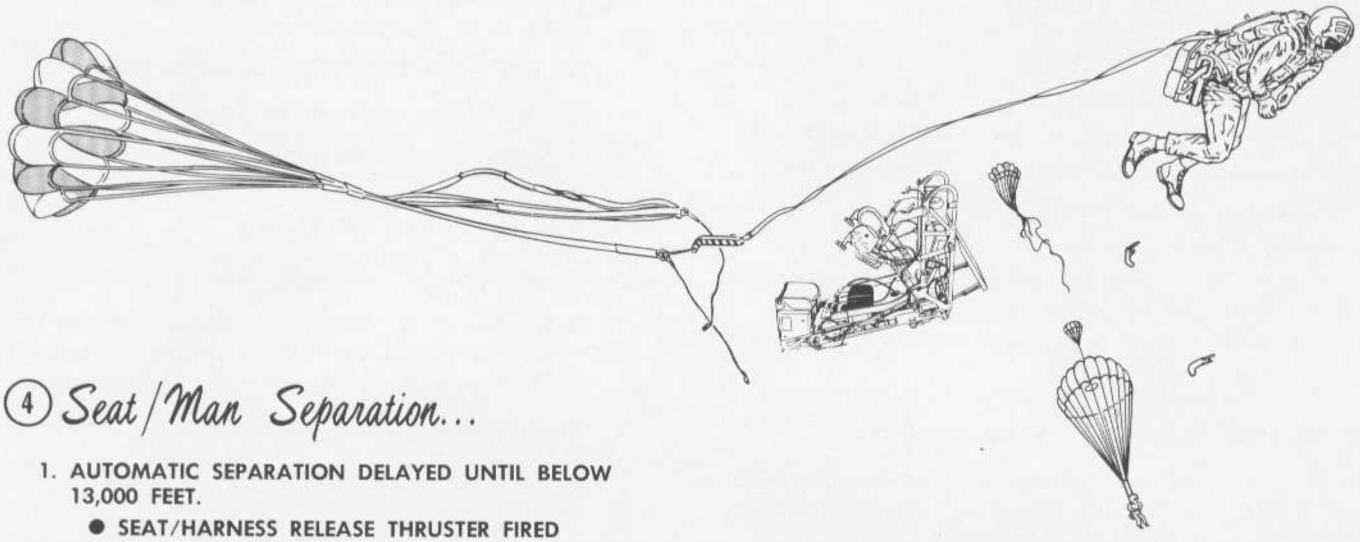
Figure 5-1 (Sheet 1)



④ Seat/Man Separation...

1. AUTOMATIC SEPARATION DELAYED UNTIL BELOW 13,000 FEET.
   - SEAT/HARNESS RELEASE THRUSTER FIRED
   - FACE CURTAIN CABLES CUT
   - LEG RETRACTORS JETTISONED
   - KNEE-BAR RELEASED
2. SEAT SEPARATION BLADDERS INFLATE, SEPARATING CREW MEMBER FROM SEAT AND KNOCKING KNEE BAR CLEAR.

IF AUTOMATIC SEPARATION FAILS:

1. LEG RETRACTORS — RELEASE SLIDES.
2. KNEE BAR — PUSH FORWARD AND DOWN.
3. HARNESS RELEASE HANDLE — PULL UP.
4. ROLL CLEAR OF SEAT; PARACHUTE WILL DEPLOY 0.75 SECOND AFTER SEPARATION IF BELOW 10,000 FEET.

⑤ Descent and Survival...

1. BEFORE GROUND OR WATER CONTACT, ENSURE THAT RIPCORD GRIP IS REMOVED FROM RETAINER CLIP POCKET AND SEPARATE FROM HARNESS/RISER STRAP. FAILURE TO DO THIS WILL RESULT IN FIXED ATTACHMENT BETWEEN PARACHUTE CONTAINER AND RISER EVEN WITH ROCKET-JET FITTINGS RELEASED
2. INFLATE MK-3C LIFE PRESERVER (OVER WATER)
3. PULL SURVIVAL KIT RELEASE HANDLE TO DEPLOY LIFE RAFT.

NOTE

- THE SURVIVAL KIT SHOULD BE DEPLOYED AT SUFFICIENT ALTITUDE TO ALLOW FULL EXTENSION OF THE KIT LANYARD, WHICH ACTIVATES THE CO_2 CYLINDER, INFLATING THE LIFE RAFT.
- DO NOT RELEASE EITHER LOWER ROCKET-JET FITTING PRIOR TO SURVIVAL KIT DEPLOYMENT AND WATER ENTRY.

4. OXYGEN MASK SHOULD BE REMOVED OR FULL PRESSURE SUIT FACEPLATE RAISED TO PREVENT SUFFOCATION ON EMERGENCY OXYGEN DEPLETION.
5. ON CONTACT, RELEASE SHOULDER-HARNESS ROCKET-JET FITTINGS TO SEPARATE FROM PARACHUTE.

A-5C-1-73-7

Figure 5-1 (Sheet 2)

EJECTION SEAT FAILURE

MANUAL SEPARATION

If automatic separation fails, proceed as follows:

1. Leg retainer release slides—PUSH FORWARD.
2. Knee bar—PUSH FORWARD AND DOWN.
3. Harness release handle—PULL.
4. Roll clear of seat.
   Parachute deploys 0.75 second after separation below 10,000 feet.
5. Complete steps 6 through 9 under CONTROLLED EJECTION.

EMERGENCY BAIL-OUT (SEAT FAILURE)

In the event the seat positioning devices operate but seat fails to eject or fails completely, use the following procedure as required to escape:

1. Emergency oxygen ring—PULL.
2. Leg retainer release slides—PUSH FORWARD.
3. Knee bar—PUSH FORWARD AND DOWN.
4. Canopy jettison handle—PULL (if not jettisoned).

Note

If at high altitude, move COCKPIT PRESS switch to RAM EMERG prior to jettisoning canopy.

5. Trim aircraft nose-down, roll inverted, and maintain positive "g."
6. Harness release handle—PULL/Push free of cockpit as required.
7. Complete steps 6 through 9 under CONTROLLED EJECTION.

WARNING

When emergency bail-out is accomplished without use of the ejection seat, automatic personal parachute deployment is NOT AVAILABLE. PULL THE "D" RING AT YOUR LEFT SHOULDER.

IN-FLIGHT EMERGENCIES

BOTH ENGINES FAILED AT HIGH ALTITUDE

Should both engines fail at high altitude, proceed as follows:

1. Emergency RAT—EXTEND.
2. If the nature of the failure permits, attempt immediate restart with the EMER IGN buttons.
3. If the engines do not respond, move both throttles to OFF.
4. Retrim as required and descend below 45,000 feet.
5. Attempt single air starts, using both emergency and manual ignition.
6. IFF/SIF—EMERGENCY (MODE 3, Code 77).
7. External stores—Jettison, if required.
8. If engines will not start, EJECT.

ONE ENGINE FAILED IN FLIGHT

Should one engine fail in flight, proceed as follows:

1. If the nature of the failure permits, attempt immediate restart using the EMER IGN button. If restart does not occur, perform the following steps.
2. Throttle of inoperative engine—OFF.
3. Retrim as required.
4. Attempt air start.
5. If engine does not start, land as soon as practicable.

Failure of one engine in cruising flight is accompanied by an easily controlled yaw and roll into the failed engine. Should failure occur at high Mach (above 1.4), these tendencies may be sharply increased. Cautious use of controls is required, especially if the yaw augmentation system is inoperative. Satisfactory single-engine cruise, with no external stores, may be obtained at altitudes up to approximately 20,000 feet. The drag of one inoperative engine may be simulated with the left engine at IDLE and the right engine at the required power setting.

Note

The AAI may "tumble" and the HSI "precess" of the right-hand engine fails or is shut down. This can be avoided by turning the NO. 2 GENERATOR switch OFF (before engine rpm falls below 36%) to gain automatic transfer of AAI power to the No. 1 generator.

AIR STARTS

Air starts may be attempted within a wide range of altitudes and airspeeds. See figure 5-2. Best conditions are found below 45,000 feet at less than 1.10 indicated Mach. Below 25,000 feet, optimum speed for air starts is 300 KIAS. Although in an emergency it is not expected that all engine limits will be observed, the EGT and windmill rpm limits stated in Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A) should be kept in mind.

If one or both engines flame out, depress the EMER IGN button(s) before too much engine rpm is lost.

If the engine(s) fails to start, use the following procedure:

1. Throttle(s)—OFF.
2. Hold 300 to 400 KIAS (12% to 30% rpm).

3. If both engines are out, pull the RAT handle and check that the ELEC EPU ON advisory light illuminates.

4. Depress and hold the EMER IGN button and advance the throttle above IDLE.

   If both engines are out, best procedure is to attempt start on one engine at a time.

5. If light-off does not occur within 30 seconds at IDLE while holding the EMER IGN button, continue holding the button and advance the throttle to MIL.

Note

Light-off is indicated primarily by increasing rpm and fuel flow. EGT may rise slowly until rpm increases to flight idle for that altitude.

6. If light-off is not indicated within 30 seconds, repeat steps 1 through 5.

7. After light-off, hold RAMPS switch in RESET, check RAMP CONT caution indicator out, then release.

CAUTION

Do not advance throttle beyond 95% rpm until ramps are reset to avoid compressor stall.

8. After light-off at speeds in excess of 1.3 Mach, advance throttle to approximately 95% rpm, or until RAMP CONT caution indicator comes on; then reset ramps prior to further rpm increase to prevent compressor stall.

WARNING

When using the RAT for electrical power, do not move the flight controls more than required to maintain wings-level flight while attempting air starts. The emergency hydraulic unit may take priority over the emergency electrical generator, preventing adequate electrical power for engine ignition.

NO-THRUST GLIDE

Maximum glide distance is obtained by jettisoning all external stores and maintaining 250 KIAS or 11 units A/A. The emergency ram-air turbine must be extended to obtain hydraulic power necessary to control the aircraft.

NO-THRUST GLIDE PERFORMANCE
NO WIND — 250 KIAS — STORES JETTISONED
(GEAR AND FLAPS UP/DROOPS SUPERSONIC)

ALTITUDE (X 1000 FEET)	DISTANCE (NMI)	TIME (MINUTES)
45	70	11
40	60	10
35	50	9
30	40	8
25	35	7
20	25	6
15	20	4
10	13	3
5	5	1.5

Note

Optimum glide distance and time with droops at cruise exceed the above performance by approximately 5 percent.

ENGINE OIL OVERHEAT

Overheating of an engine oil system (OIL HOT caution indicator on) may be accompanied by associated constant-speed drive and generator failure. Refer to ELECTRICAL SYSTEM FAILURES, in this section. Should an OIL HOT caution indicator come on, the following procedure is recommended.

1. Set throttle of affected engine at cruise power or higher.
2. If caution indicator remains on, place associated generator switch to OFF and descend to allow increased fuel flow through main fuel/oil cooler.
3. If caution indicator remains on, secure engines and land as soon as practicable.

OIL SYSTEM FAILURE

Early indications of oil system failure are exhaust nozzle failure, low or fluctuating oil pressure, and generator failure due to CSD oil starvation. Oil pressure fluctuations of more than 5 psi from the established pressure for a given engine speed should be investigated. For oil pressure limitations, refer to Section I, Part 4, of the Supplemental NATOPS Flight Manual (NAVWEPS 01-60ABC-1A). Excessive oil pressure fluctuations and generator failure are reason enough to make preparations for landing, but premature engine shutdown should be avoided. An engine need not be secured because of low oil pressure. It is recommended that the engine power setting not be reduced to less than cruise power; however, if continued engine operation appears dangerous because of oil pressure drop to zero or vibration,

ENGINE OPERATING ENVELOPE

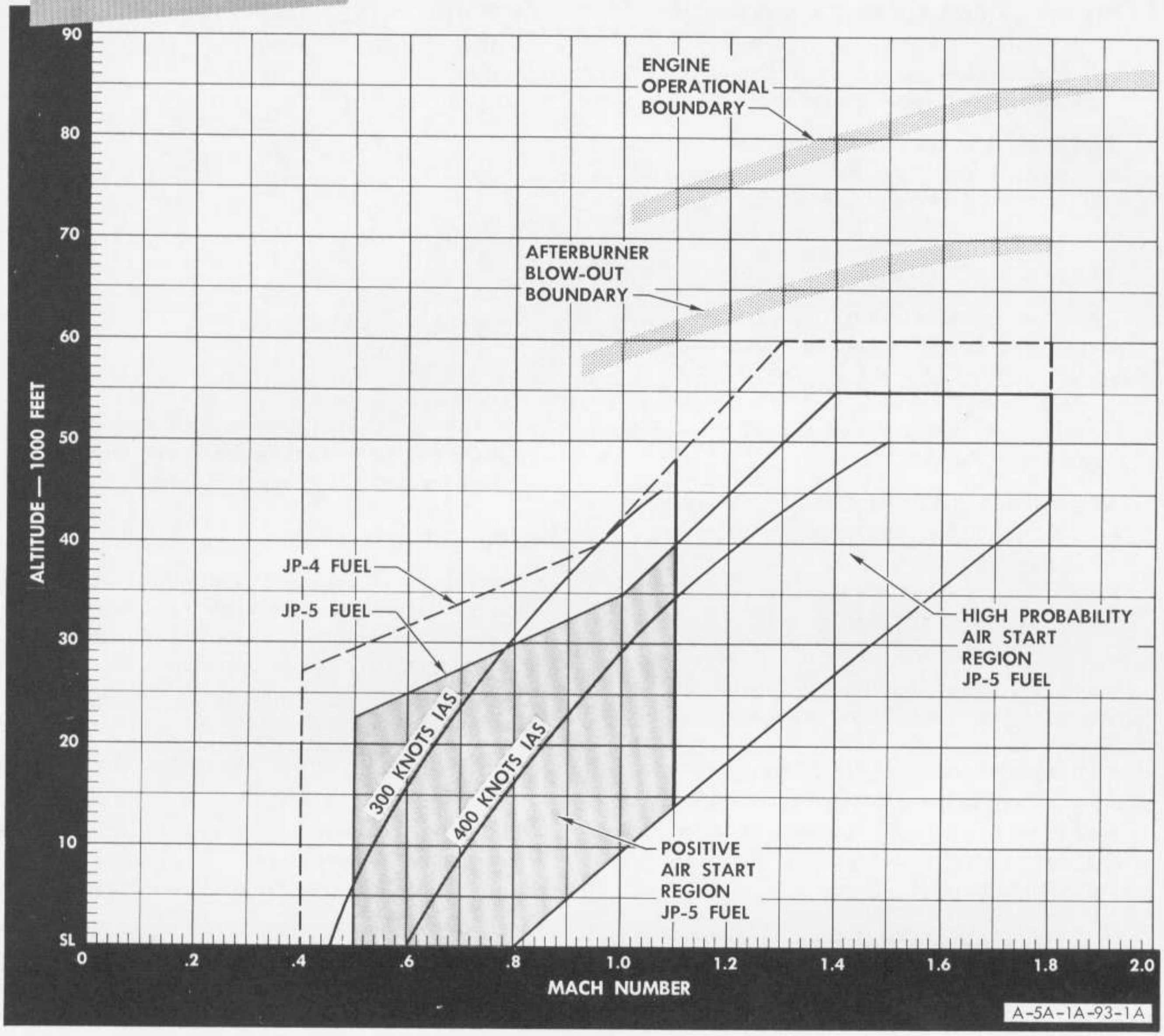


Figure 5-2

and if flight safety will not be compromised by the loss of thrust, engine shutdown can be accomplished in the normal manner. If the engine is secured, attempt to maintain windmill rpm above 7% since oil vapor accumulation in the oil sump may constitute a fire hazard if engine restart is attempted. In the event of oil system failure indications, proceed as follows:

1. Monitor oil pressure indications.

   If generator failure occurs (reset attempts fail), prepare to land as soon as practicable.

2. Periodically check the nozzle position indicator.

   If the nozzle should freeze in a closed position, EGT must be monitored during throttle movements to preclude overtemperature damage to the engine. Do not operate the engine in afterburner range.

3. Continue to utilize thrust from the affected engine until safe landing is assured, unless further operation appears hazardous.

CAUTION

Unless necessary for safe flight, air start of an engine after shutdown because of oil starvation is not recommended.

ENGINE FIRE DURING FLIGHT

Should a fire warning indicator illuminate and engine overheat is suspected, reduce power on the affected engine to IDLE and change speed to 300 KIAS, using the other engine as required. (If such conditions occur within 3 minutes of landing, complete the landing, securing the affected engine on touchdown.) Engine overheat is most probable in the speed range between 165 and 180 KIAS. If the fire warning indicator does not go out, shut down the affected engine and operate the ENGINE FIRE switch. If the indicator remains on, a serious emergency exists. If fire is confirmed, immediate ejection is recommended.

SMOKE AND FUMES

If smoke or fumes are detected in the cockpit, proceed as follows:

1. Throttles—Reduce power.
2. COCKPIT PRESS switch—RAM EMERG.

Note

Control of cockpit temperature is inoperative and, at altitudes above 8000 feet, cockpit pressure will be dumped.

3. Prepare for landing as soon as practicable, continuing to check for contaminants.
4. WINDSHIELD & CANOPY DEFROST knob—ON, as desired (if too cold).

ABNORMAL COCKPIT TEMPERATURE

COCKPIT TEMPERATURE CONTROL FAILURE

Should cockpit temperature become too hot or too cold, proceed as follows:

1. Check AUTO/MAN switch—AUTO.
2. Check temperature response to changing the setting of the COCKPIT TEMP knob.
3. (Deleted.)
4. If automatic control is inoperative, move AUTO/MAN switch to MAN.

4A. Check temperature response to changing the setting of the COCKPIT TEMP knob.

Should manual control respond properly, the temperature controller or temperature sensor may be inoperative.

5. If temperature remains too hot, descend and move COCKPIT PRESS switch to OFF.

WINDSHIELD DEFROST FAILED ON

Should windshield and canopy defrost air continue to flow with WINDSHIELD & CANOPY DEFROST knob turned OFF, proceed as follows:

1. AUTO/MAN switch—MAN.
2. COCKPIT TEMP knob—Full cold.
3. Ventilation air tubes—Turn full up.
4. WINDSHIELD ANTI-ICE switch—ON, if necessary.
5. If cockpit temperature becomes intolerably hot, descend and jettison the canopy.
6. Land as soon as possible.
7. Turn WINDSHIELD ANTI-ICE switch OFF as soon as possible after landing.

Note

Abnormal temperature of defrost and anti-ice air supply indicates an inoperative and/or frozen condition of the right-hand primary heat exchanger modulating bypass valve.

EMERGENCY OXYGEN

The first indication of oxygen supply exhaustion will be illumination of the OXYGEN warning indicator. If the warning light circuit is defective and the liquid oxygen quantity indicator is not periodically checked, system supply exhaustion will be indicated by a sudden onset of difficult inhalation. If this occurs, immediately pull the emergency oxygen supply ring and descend to an altitude where oxygen is not required.

WARNING

- Should the OXYGEN warning indicator illuminate in flight and more than 0.8 liter of oxygen is aboard, a system malfunction has occurred. Check connection of Scott composite disconnect. Descend to a safe cockpit altitude and be prepared to pull emergency oxygen supply ring upon noting a restriction to inhalation.
- Emergency oxygen is not available if Scott block assembly is disconnected.

SUIT EMERGENCY PRESSURIZATION

The oxygen system supplies suit pressurization in the event of complete failure of the aircraft air conditioning and pressurization system above 35,000 feet. The sequence of events which results in the aircraft oxygen system being used for suit pressurization is completely automatic and requires no attention from the crew members. With the pressure suit, oxygen system pressure will adequately protect the crew members for descent and landing from any altitude.

FUEL SYSTEM FAILURE

BOOST PUMP FAILURE

With JP-5 fuel and fuel system pressurization operating, engines will operate normally with both sump tank boost pumps inoperative. Should fuel system pressurization failure occur with both boost pumps inoperative, military power operation may not be obtainable above approximately 25,000 feet with JP-5 fuel (16,000 feet with JP-4).

Note

There is no direct indication of boost or transfer pump failure except for possible fuel flow fluctuations.

Should engine surging or partial power loss occur, proceed as follows:

1. Immediately reduce power and maintain the highest altitude at which satisfactory engine operation occurs.
2. ESS FUEL circuit breaker—check in.
3. Afterburner operation is not recommended.
4. Land as soon as practicable, avoiding excessive deceleration and steep descent angles.

CAUTION

If both sump tank boost pumps are inoperative, the forces produced by large decelerations and high angles of descent may cause the sump tank suction feed valve to become uncovered, resulting in flame-out.

FUEL FILTER BYPASS

Illumination of a low-pressure fuel filter caution indicator indicates impending fuel filter bypass. In this event, proceed as follows:

1. If fuel flow indications are normal (no fluctuations greater than ±300 pounds per hour), continue the mission, checking fuel flow periodically.
2. If the fuel flow indication fluctuates excessively, land as soon as practicable, or power loss may occur.

WING FUEL TRANSFER FAILURE

With the WING switch in the NORM position, failure of wing fuel to transfer is indicated by a drop in sump tank fuel to below 2000 pounds after transfer of all drop tank, bomb bay, and forward tank fuel. Aft tank transfer rate is not sufficient to maintain more than 8000 pounds per hour combined fuel flow. If wing fuel fails to transfer, proceed as follows:

1. WING switch—AUX.
2. If WING AUX fuel transfer does not occur, use procedure described under ALTERNATE METHODS, in this section.

Note

Bomb bay cans must be empty (or depressurized) for WING AUX to be operative. The WING switch returns from AUX to NORM on extension of the landing gear.

ALTERNATE METHODS

The following alternate procedures are recommended for obtaining wing fuel auxiliary transfer to eliminate the requirement for holding the WING switch in the AUX position and to bypass malfunctions in the fuel sequencing control circuits.

Wing Dump

To bypass bomb bay cans low-level switch, cans dump switch, and can connectors:

0. CANS switch—NORM.
1. FUEL DUMP handle — wing dump position.
2. WING switch—AUX.
3. FUEL DUMP handle—stowed.

Air Refueling Probe

If transfer does not occur with the wing dump method:

1. Reduce speed to less than 280 KIAS.
2. CANS switch—NORM.
3. FUEL PROBE switch—EXTEND.
4. WING switch—AUX.
5. FUEL PROBE switch—RETRACT.

Hook Down

If transfer still does not occur, the bomb bay cans low-level switch can be bypassed as follows:

1. Reduce speed to less than 250 KIAS.
2. Arresting hook—down.
3. WING switch—AUX.

3A. HYD SUB-SYS ISOLATION switch—TAKE-OFF/LANDING.

4. Arresting hook—up.
5. HYD SUB-SYS ISOLATION switch—FLIGHT.

OTHER FUEL MANAGEMENT PROCEDURES

Wing Fuel Transfer to Cans and Sump

1. CANS switch —NORM.
2. Reduce speed to less than 280 KIAS.
3. FUEL PROBE switch—EXTEND.
4. WING switch—AUX.
5. Monitor bomb bay can fuel.

Wing Gravity Transfer

1. If WING AUX fuel transfer does not occur using alternate methods, climb at Military Thrust to 30,000 feet, or until sump fuel indication falls to 1000 pounds (whichever is first).

   A cruise altitude of between 20,000 and 30,000 feet provides the best trade-off of long-range fuel flow vs aircraft attitude for gravity-flow fuel transfer to the sump tank.

2. Return to base at an angle of attack of 8 units, which requires an indicated speed of 0.1 Mach above best cruise speed. If angle-of-attack indication and airspeed are not available, approximately 87% rpm should be utilized.

Note

During gravity-flow fuel transfer at 8 units angle of attack, the sump tank indication reduces to approximately 800 pounds because gravity-flow rate cannot match engine demand until this level is reached. Aft tank fuel will not transfer by gravity and approximately 1400 pounds of wing fuel are trapped.

3. If range is not a consideration, or at the time the descent for landing is initiated, a nose-down pitch angle of 5 degrees allows the sump tank to fill to a maximum of 2200 pounds within 5 minutes. In the descent attitude all trapped wing fuel is also transferred to the sump tank.

Forward Fuel Cell Transfer to Sump

Failure of the 430-gallon (2700 pounds) sump control switch is indicated by lack of cans transfer and sump filling. A sump level of 3200 pounds can be maintained by pulling the ESS FUEL circuit breaker.

DROP TANK TRANSFER FAILURE

Should drop tank fuel fail to transfer, the level of fuel in the sump tank will drop to approximately 3000 pounds and be maintained at this level by transfer from the bomb bay cans and forward tank. Selection of quantity indication will show a drop in bomb bay level from that noted prior to engine start, with drop tank quantity remaining static. Transfer may be presented by a faulty drop tank air shutoff valve. In this event, the procedure covered in the following step 3 should result in complete recovery of drop tank fuel. However, electronic equipment operation is interrupted and autonavigator alinement is lost. Attempt to obtain drop tank fuel as follows:

1. DROP TANKS transfer buttons—Cycle OFF/ON.
2. Check sump and forward tanks for rising fuel level.
3. If transfer does not occur, warn the systems operator of intention to secure generators and extend RAT. When ELEC EPU ON indicator is illuminated, move generator switches to OFF and check for transfer after at least 2 minutes.
4. For landing with one full inboard tank, use full opposite wing down trim.

WARNING

Do not attempt to land with a single full outboard drop tank, as directional control may be lost after touchdown. If a single outboard drop tank fails to feed, it should be released.

BOMB BAY CAN TRANSFER FAILURE

If drop tanks are installed and full, failure of bomb bay can fuel to transfer will not be detected until all drop tank fuel has transferred. Should this occur, the level of fuel in the forward tank will decrease faster than normal. Should the forward tank be allowed to transfer completely, sump level will drop to 2300 pounds and transfer of wing fuel will begin. If this occurs, proceed as follows:

1. CANS switch—AUX.
2. Sump tank quantity—check.

   Rising level to approximately 3300 pounds in sump and 3100 pounds in forward tank indicates bomb bay fuel is transferring.
3. If can fuel does not transfer, pull ESS FUEL circuit breaker.
4. Fuel dump handle—Pull (first detent).
5. If fuel will not dump, move HYD SUB-SYS ISOLATION switch to FLIGHT.
6. Landing gear handle—DOWN.
7. CANS switch—NORM.
8. If fuel remains in bomb bay cans, reduce speed to less than 280 KIAS and extend probe, or to less than 250 KIAS and extend hook.
9. WING switch—AUX (Hold).
10. Check sump and forward tank levels for increase.
11. If transfer of wing fuel to sump tank does not occur, the resulting aft cg condition will require a final approach with 40-degree flaps at 14 units A/A.

    Refer to LANDING WITH AFT CG, in this section.

CAUTION

Under normal conditions, bomb bay CANS and WING switches should be in NORM when dumping.

BOMB BAY CANS REMOVED

With the bomb bay cans removed and all other internal tanks full, the center of gravity moves forward to approximately 22.0 percent MAC. Field take-off speeds should be increased 12 KIAS, take-off distances increased 750 feet, pitch trim set an additional 3 units nose-up, and maneuvering limited to that required for normal flying as defined by BUWEPSINST 3710.1, dated October 1960.

Note

Catapult launch shall not be attempted with bomb bay cans removed.

ELECTRICAL SYSTEM FAILURES

Failure of one generator should pose no serious problem if the d-c converters continue in operation. Several reset attempts may be made. However, if the generator will not reset after two attempts, it is recommended that the associated generator switch be moved to OFF and a landing be made as soon as practicable. On an operational mission, immediately ensure that the SYSTEM switch is positioned to provide power to the primary equipment.

CAUTION

During single generator operation, high engine power settings may deplete sump tank fuel. Under these conditions, sump level should be closely monitored.

Failure of both generators is unlikely. However, if dual failure does occur, immediate results, especially at night, may be startling. Since no battery is installed, dual generator failure results in complete failure of all electrically powered components and, at night, complete "blackout." All circuits essential to safe flight may be powered by extending the RAT (i.e., restoring communications, intercom, cockpit floodlighting, fuel sequencing, and boost pump control). Under these conditions, alternate roll and yaw trim must be used, and the alternate trim switch is used to control pitch trim. Altitude should be reduced to less than 39,000 feet to ensure sufficient gravity flow of wing tank fuel. If the RAT is used alone to obtain electrical power, extended speed brakes must be dumped prior to landing, and gear and flaps must be extended by emergency means. The arresting hook will extend normally when selected. Should both d-c converters fail, the RAT may be extended to power essential d-c bus items. However, even with both generators operating, failure of both d-c converters results in loss of normal operation of all following systems: (1) landing gear extension, (2) speed brake operation, (3) pitch and yaw augmentation, (4) electric flight control system, (5) nose wheel steering, (6) flaps operation, and (7) hydraulic subsystems with subsequent HYD PRESS caution indication. For detailed information on equipment lost on complete or partial a-c or d-c failures, refer to A-C ELECTRICAL FAILURE ANALYSIS and D-C ELECTRICAL FAILURE ANALYSIS, in this section.

CIRCUIT BREAKER LOSS LIST

Following is a resumé of losses encountered due to failure of circuits controlled through the pilot's cockpit circuit-breaker panel (figure 1-19).

CIRCUIT BREAKER	LOST	REMARKS
EXT JETTISON (NO. 1, NO. 2)	External jettison	Use normal manual release (MASTER ARM and trigger)
NAV ESS XMFR	In aft cockpit:	
	Chart lights	
	Utility lights	
	CNI command	Pilot has command
	Compass command	Pilot has command
	Warning lights	
	Caution lights	
Cϕ CTR PED	Stand-by attitude indicator	Cross-check. Turn-and-slip indicator may run sluggishly
FUEL GAUGE DC	Quantity selector	Total and sump operative. Trim pitch to neutral to check cans. Watch for roll with roll trim neutral to check drop tanks
WINDSHIELD DEFROST & ANTI-ICE	Canopy defrost knob WINDSHIELD ANTI-ICE switch (associated safety factors)	If failed on, reduce power and land. Not available if failed off
EMER FLAP	Emergency flap switch	If No. 2 hydraulic system has failed, reduce to minimum fuel and land no-flap
CABIN PRESS	Pressurization lost (dumped) ALTERNATE COOL reset inoperative	Land as soon as practicable
NAV ICS	Systems operator cannot receive or transmit, ICS or UHF COMM, in NORM, ALT ICS, or ALT RAD	Use UHF sidetone in ICS EMER mode
PILOTS ICS	Pilot cannot receive or transmit, ICS or UHF COMM, in NORM, ALT ICS, or ALT RAD	Use UHF sidetone in ICS EMER mode
ICS RELAY PWR	ICS completely dead in both cockpits in NORM, ALT ICS, ALT RAD	Use UHF sidetone in ICS EMER mode
NO. 1 FUEL SHUTOFF NO. 2 FUEL SHUTOFF	Applicable engine firewall valve will not close on operation of ENGINE FIRE switch	
PILOTS ESS XMFR	DC PWR caution indicator	
	ECM mode indicators	
	Indicating lights dimming	
	CNI emergency power indicator (light)	
	Armament indicator	Confirm verbally
	Hook warning light	Use TV (day)
	LABS advisory light	Use O/S mode

CIRCUIT BREAKER	LOST	REMARKS
	HSI mode lights	
	Emergency lights	
	Compass command	
	Anti-ice indicator	
	Electric flight control indicators	
	Floodlights	
	CNI command lights	Check channel change for control
	CNI command transfer	
	ECM indicator	
	Console lights	
	AFCS indicators	
NO. 1 START IGN NO. 2 START IGN	Applicable EMER IGN button inoperative (air start impossible)	
FIRE EXT SHUTOFF	ENGINE FIRE switch OFF position will not open valves	Firewall shutoff
FLAP & DROOP CONT	Normal flap/droop control	Use emergency
	Engine door control relays	
	Yaw trim recentering	Trim manually after flap emergency extension
ESS FUEL	Sump aft boost pump out	Fuel trapped
	Can pressure on (fail-safe)	
	Forward tank proportioning valve open (fail-safe)	Forward tank will gravity transfer
ABN REFUEL	Fuel system internal pressure vented	
	FUEL PROBE switch inoperative:	
	Probe extended	Normal transfer*
	Probe retracted	Normal transfer
IND TEST NO. 1	Fire warning system	
	Master warning indicator	
	Master caution indicator	
	Systems caution indicators	
	OXYGEN warning and test	
	WHEELS warning indicator	
IND TEST NO. 2	CNI emergency power indicator	
	LOW ALTITUDE warning light	
	Radar altimeter low-altitude override button	
	Landing gear advisory light	
	ECM indicators test	
	Armament indicator test	
	HYD EPU ON and ELEC EPU ON advisory lights test	
	Radar advisory lights test	
	Pilot's and systems operator's lights test	

***If *circuit* or *switch* fails with probe extended, bomb bay fuel may be transferred by selecting AUX or by pulling circuit breaker**

A-C ELECTRICAL FAILURE ANALYSIS

For analysis of a-c electrical failure, refer to the following table:

EQUIPMENT	FAILED
Monitored (Not available on one generator)	Wing Scavenge Pumps* Radome Fold Seat and Pedal Adjust Engine Cooling Doors (electrical operation) All high-duty fuel pump operation
Primary A-C (Not available with both generators inoperative; special systems inoperative with loss of primary a-c bus)	Fuel: Sump tank, wing transfer, forward boost, and forward tank pumps* Power Plant: Afterburner ignition Ramp and gap* Engine anti-ice Flight Controls: Pitch and yaw augmentation* Autoflight* Electric flight control* Normal trim Electronics: Air data, CNI* Bomb directing set, radar, radar altimeter* TACAN, HSI, ECM* Armament: Armament initiation Armament master circuit Tank and pylon release Mode release control Heat and Vent: Primary and secondary heat exchanger jet pumps* AN/ALQ-55 cooling Liquid heat exchanger air valves Miscellaneous: Interior and exterior lights S/O stand-by gyro Position instruments Ground safety and air safety
Essential A-C (Not available with both generators inoperative; available with ram-air turbine extended)	Heat and Vent: Cabin equipment and special systems temperature control Alternate cooling Suit temperature Ram-air control Oxygen quantity Fuel: Aft boost pump* Fuel firewall shutoff valves* Fuel flow Fuel quantity Power Plant: EGT, fire detectors, engine instruments Firewall shutoff Start and ignition system Flight Controls: Flap, droop, and trim indicator Flap and droop control Alternate trim Flight Instruments: Flight reference set (AAI, heading compensator, and three-gyro platform) Stand-by gyro horizon Communications: UHF communications (reduced power) IFF/SIF Miscellaneous: Internal jettison Pitot heater Indicator, warning, and caution lights Instrument vibrators

*D-C power required for control

D-C ELECTRICAL FAILURE ANALYSIS

For analysis of d-c electrical failure, refer to the following table:

EQUIPMENT	FAILED
Primary D-C (Not available with both converters inoperative)	Fuel: All pumps except sump tank aft boost pump* Wing and bomb bay can auxiliary transfer* Flight Control: Pitch and yaw augmentation* Inlet ramp* Autoflight* Electric flight control* Electronics: Bomb directing set, ECM, passive warning, CNI* Mapping radar* Heat and Vent: Primary and secondary heat exchanger jet pumps Power approach bleed reduction Canopy seal Miscellaneous: Air temperature detector Pneumatic compressor Nose wheel steering* Wing and tail fold Angle of attack Hydraulic subsystems isolation Pedal shaker and accelerometer Landing gear sequence
Essential D-C (Lost with both converters inoperative; available with ram-air turbine extended)	Indicators: Turn and slip Nozzle position Landing gear Fuel gage selector Indicator test (button) Pilot's caution and warning indicators Heat and vent: Defrost and anti-ice Cabin pressure Left- and right-hand primary heat exchanger bypass temperature control Fuel: Air refueling probe* Sump aft boost pump* Miscellaneous: Flight reference set, ICS, emergency flap UHF communications (reduced power) IFF/SIF External jettison
No. 1 Secondary D-C (Lost with one converter inoperative and SYSTEMS switch in LOOK or LISTEN; lost with one generator inoperative and SYSTEMS switch in LOOK or LISTEN)	Armament: All armament functions except jettison
No. 2 Secondary D-C (Lost with one converter inoperative and SYSTEMS switch in ARM)	Special Systems: All special systems

*D-C control. A-C power also required for operation

FAILURE OF BOTH GENERATORS

Failure of both generators is a rather remote possibility. However, if a complete electrical power failure should occur, or if for any reason it becomes necessary to turn off the generator switches, follow this procedure:

1. Extend ram-air turbine and return to base.

   With the ram-air turbine extended, power is supplied to the a-c and d-c essential buses and operation of the sump tank aft boost pump will be regained.

   Note

   Proper output from the emergency electrical power unit is indicated by illumination of the ELEC EPU ON advisory light.

2. To regain control of roll and yaw trim, move the TRIM select switch to ALTR.

   For trim, use the ALTR ROLL/YAW TRIM switch.

3. Use alternate pitch trim for the remainder of the flight for pitch trim changes.
4. If necessary, reduce altitude and/or engine rpm to maintain engine operation, as fuel flow may be impaired because of loss of fuel boost pressure at altitudes above 39,000 feet.
5. Dump bomb bay fuel prior to landing.

   Wing fuel cannot be dumped without generator operation since the wing transfer pumps are not powered by the essential bus.

6. For landing, the flaps can be extended by emergency air pressure from the pneumatic system and the hook will extend, when selected, by gravity and accumulator action.

   If extended, speed brakes must be dumped. The landing gear must also be extended by emergency means.

   Note

   If the ram-air turbine is providing both hydraulic and electrical power, electrical power may be temporarily cut off whenever hydraulic flight control power requirements take the full output of the ram-air turbine.

FAILURE OF ONE GENERATOR

Generator failure is indicated by illumination of a generator-out caution indicator located on the pilot's instrument panel. When this occurs, all selected bus loads are assumed by the remaining generator. If the SYSTEM switch is in ARMT (armament), loss of d-c power occurs in special reconnaissance systems (if installed). With the switch at LOOK or LISTEN, all arming and fuzing functions are lost. Proceed as follows:

1. SYSTEM switch—as desired.
2. Hold generator switch momentarily in RESET, then release.

   The caution indicator may extinguish momentarily with the switch in RESET, even though the fault may still exist. If the indicator remains extinguished, the temporary fault may have been due to overvoltage, undervoltage, open phase protection, or differential current protection.

3. SYSTEM switch—prefailure position.
4. If the indicator does not extinguish, the remaining generator will assume primary and essential electrical loads through the action of line contactors.

   If both generators fail, follow the procedures covered under FAILURE OF BOTH GENERATORS, in this section.

5. When operating on one generator, check sump tank fuel level during high power (AB) operation at low altitude. Reduce power as required to allow fuel transfer rate to maintain sump fuel at a safe level.

   Note

   If unable to reset a failed generator, leave the generator switch OFF. Operation of the wing fuel scavenge pumps, seat and pedal adjustment, all high-duty fuel pump operations, and operation of engine overpressure relief doors are lost.

D-C POWER FAILURE

The essential d-c bus provides the minimum requirements for d-c powered equipment. Illumination of the DC PWR caution indicator reflects failure of the primary d-c converter. The DC PWR caution indicator is powered by an a-c source so that, if both converters fail, the DC PWR caution indicator will be the only indicator illuminated and all d-c powered indicators will be inoperative. With both the primary and alternate d-c converters inoperative, electrical power can be supplied to the essential d-c bus by extending the ram-air turbine. With one converter out and the SYSTEM switch in LOOK or LISTEN, d-c power is provided to No. 2 secondary d-c bus components. *With both converters inoperative, the following systems remain inoperative with the ram-air turbine extended*: (1) normal landing gear operation, (2) speed brakes, (3) nose wheel steering, (4) pitch augmentation, (5) yaw augmentation, (6) electric flight control systems, (7) angle of attack and pedal shaker, (8) position lights, (9) cockpit pressurization, and (10) all fuel system pumps. If d-c power failure is caused through double generator loss, the ram-air turbine should be extended to provide power to the essential a-c and d-c buses for starting and ignition during air starts. After air start, when a-c generator output is restored, the ram-air turbine can be retracted by means of the EPU RETRACT button on the pilot's center pedestal (HYD SUB-SYS ISOLATION switch must be in TAKE-OFF/LANDING).

ELECTRICAL FIRE

1. Secure all electrical equipment switches except engine MASTER switches.
2. Land as soon as possible.

HYDRAULIC FAILURES

NO. 1 OR NO. 2 SYSTEM

Failure of both No. 1 or No. 2 system pumps is indicated by illumination of the HYD PRESS caution indicator and loss of pressure from the pumps and/or in the system to less than approximately 650 psi.

1. With one pump failed (one needle indicating zero), continue operational mission with caution.
2. Check HYD SUB-SYS ISOLATION switch—FLIGHT.
3. With complete loss of either hydraulic system, or low reservoir isolation (automatic) of No. 2 system, land as soon as practicable.
4. Reduce speed to less than 1.3 IMN.
5. "Kill" button—Depress.
6. YAW AUG NO. 1 and NO. 2 and RAMPS switches—STBY.
7. Speed brake dump handle—Pull, if necessary.
8. SLR antenna POWER switch—OFF.

CAUTION

- Do not operate SLR or extend air refueling probe unless absolutely required.
- Do not extend RAT if No. 1 system is operating normally, or if No. 1 system leakage is suspected. Do not retract the RAT once it is extended.

9. Extend flaps, using emergency procedure.

Note

- In the event of No. 1 system failure and low fluid level isolation of No. 2 system, droops may not extend. See figure 5-4 for emergency approach speeds with various flap/droop conditions.
- If No. 2 hydraulic failure occurs following normal flap extension, place EMERG FLAP switch in DOWN to prevent possible flap airload retraction during landing approach.

10. Extend landing gear, using emergency procedure.

CAUTION

Ensure that flap control switch is at 50° and landing gear handle is in the DOWN position.

11. Utilize short-field arresting gear *if immediately available.*
12. If short-field arresting gear is not utilized, use emergency brakes initially, saving auxiliary brake accumulator pressure for directional control.

    Normal braking and nose wheel steering will not be available.
13. Use runway abort gear, if necessary.

Note

- With No. 1 system failure, the HYD SUB-SYS ISOLATION switch can be returned to TAKE-OFF/LANDING after the aircraft is completely stopped, prior to taxiing.
- If failure involves No. 1 system only, and if crosswind conditions warrant the use of nose wheel steering, the HYD SUB-SYS ISOLATION switch should be moved to TAKE-OFF/LANDING at the short final approach position.
- If nose wheel steering is not available, do not attempt to taxi.

COMPLETE HYDRAULIC FAILURE

Complete failure of both hydraulic systems (four pumps) is an extremely remote possibility. In the event of complete failure, all hydraulically operated systems are lost, followed closely by "freezing" of all flight controls and complete loss of control of the aircraft. Proceed as follows:

1. RAT—EXTEND.
2. Check HYD EPU ON advisory light illuminates.

WARNING

If control stick action is not restored, EJECT IMMEDIATELY. Control is not possible without hydraulic pressure.

3. Prepare to land as soon as possible.

   Carrier landing should not be attempted.
4. Extend gear and flaps by emergency method.
5. Fly final approach at 160 KIAS, under optimum conditions, flaring prior to touchdown.

WARNING

- In order to ensure maximum RAT output under all conditions, approximately 160 KIAS should be maintained. This is especially important in turbulence. Control movements must be restricted to a minimum to avoid loss of pressure at a critical point during landing.
- Should emergency (RAT) hydraulic power fail when flight control power is obtained on the RAT alone, EJECT WITHOUT DELAY.

PITOT-STATIC SYSTEM FAILURE

The airspeed indicator will show characteristic reactions in the event of total pressure loss (such as might be caused by ice forming on the pitot boom) or static pressure loss (caused by water frozen in the static lines). Refer to ICE AND RAIN, in Section VI.

Note

If the airspeed indicator is suspected of inaccuracy for any reason, the landing gear can be safely extended at a 1-g stabilized angle of attack of 11 units.

CAUTION

Should the pitot anti-icing system fail, no positive cockpit indication is available. Pitot boom icing may cause the inlet ramps to be driven toward the down position, reducing duct airflow and possibly causing flame-out.

TOTAL PRESSURE SOURCE FAILURE

1. If the aircraft is in a climb, the indicated airspeed increases as the decreasing static pressure is sensed. Altimeter and vertical speed indications are not affected.
2. If the aircraft is in a descent, increasing static pressure is sensed, resulting in decreasing airspeed indications.

STATIC PRESSURE SOURCE FAILURE

1. Altimeter and vertical speed indications will be incorrect, since they tend to remain at their last indications before failure.
2. Airspeed indications will be low during a climb and high during descent.

FLIGHT CONTROL SYSTEMS MALFUNCTIONS

PITCH AUGMENTATION DISENGAGEMENT

1. "Kill" button—Depress.
2. If normal trim runaway, select alternate trim prior to releasing "kill" button.

WARNING

- Pitch augmentation malfunctions can occur which will not monitor the pitch augmentation system off or illuminate the PITCH AUG caution indicator.
- A malfunctioning pitch augmentation system cannot be monitored off by use of opposing control stick forces. Disable pitch augmentation as follows:

  (a) "Kill" button—Depress.

  (b) PITCH AUG switch—STBY.

ELECTRIC FLIGHT CONTROL DISENGAGEMENT

1. "Kill" button—Depress.
2. ELEC SYS switch—STBY.

FLIGHT CONTROL SYSTEMS FAILURES

PITCH AUGMENTATION FAILURE

Failure of pitch augmentation is indicated by illumination of the master and PITCH AUG caution indicators, followed by a slight change in pitch trim. Continued use of the normal (PITCH AUG) trim control will trim out the associated change. Proceed as follows:

1. Retrim as required.
2. Check No. 2 hydraulic system pressure.
3. Attempt reset if hydraulic and electrical systems are normal.

YAW AUGMENTATION FAILURE

Failure of yaw augmentation presents no serious problems at medium-to-low flight speeds under normal operating conditions. Without yaw damping, landing configuration power approaches in turbulent air may produce lateral/directional "wallowing." The frequency of this yawing is very low, allowing sufficient pilot damping. Failure of both systems during high-altitude, high-speed flight, or during the execution of high-roll-rate maneuvers will require cautious control handling to avoid excessive yawing. Yaw augmentation failure is usually indicated by a change in aircraft yaw damping tendencies and illumination of the YAW AUG caution indicator. Refer to Section I, Part 2. Proceed as follows:

1. Check positions of NO. 1 and NO. 2 YAW AUG switches.
2. Check No. 2 hydraulic system pressure.
3. Attempt reset.
4. If system will not reset, restrict speed and roll rate to safe limits.

WARNING

Should the YAW AUG caution indicator illuminate or large yaw excursions be noted at high Mach numbers, decelerate cautiously to a safe speed level and continue flight.

ELECTRICAL FLIGHT CONTROL SYSTEM FAILURE

Failure or "monitoring off" of the roll or pitch electric system has no effect on flight control operation. Should a "hard-over" failure be coupled with failure to automatically disengage, proceed as follows:

1. "Kill" button—Depress.
2. If trim runaway, move TRIM select switch to ALTR before releasing "kill" button.

TRIM SYSTEMS FAILURE

NORMAL PITCH TRIM FAILURE

Should the normal pitch trim control become inoperative with pitch augmentation engaged or disengaged, proceed as follows:

1. TRIM select switch—ALTR.

Note

Should pitch trim runaway occur, depress the "kill" button and hold until the TRIM select switch can be moved to ALTR.

2. Control pitch trim with alternate pulse trim switch or emergency trim crank.

ALTERNATE PITCH TRIM FAILURE

Should alternate pitch trim action fail, proceed as follows:

1. Oppose stick force manually.
2. Emergency pitch trim crank—Turn clockwise (nose down) or counterclockwise (nose up) to relieve control stick pressure.
3. Adjust trim with crank as required.

ROLL OR YAW TRIM FAILURE

Failure of the roll or yaw trim systems may place high control forces on the pilot upon changes of airspeed or configuration. Select the ALTR position of the TRIM select switch and attempt to regain trim control through the ALTR ROLL/YAW TRIM switch. Should the roll trim actuator fail in a "full travel" position, some of the lateral stick load may be relieved by adding yaw trim in the direction opposite to the load.

Note

In the event both generators fail and the RAT is the only source of electrical power, the TRIM select switch must be placed at ALTR to provide power for trim systems operation.

CAUTION

If the yaw trim actuator fails at "full travel," the vertical stabilizer will increase trim input from 1½ degrees to 7½ degrees when the flaps are extended. The only alternative is to use control pedal deflection to counteract yaw.

LOST AIRCRAFT PROCEDURES

Publications used for developing lost aircraft procedures are NWP 41(A), ACP 125B and 130, and FLIP, Enroute Supplement.

IF YOU ARE LOST

1. Admit to yourself that you are lost.
2. Use and cross-check all available navigation equipment.
3. CONSERVE fuel by flying at maximum endurance airspeed.
4. Select IFF EMERGENCY (SIF MODE 3, Code 77).

VOICE PROCEDURE

1. PAN, PAN, PAN.
   Use MAYDAY if immediate assistance is required.
2. Aircraft identification three times.
3. Type aircraft.
4. Estimated position and time.
5. Magnetic heading, true airspeed, and altitude.
6. Fuel remaining (hours and minutes).
7. Situation.
8. Intentions.
9. Assistance required.
10. COMPLY with instructions when contact is established.

ADDITIONAL PROCEDURES (SHORE-BASED)

To aid radar facilities, depending upon radio communications, proceed as follows:

1. With a radio receiver, fly right triangular patterns, using 120-degree turns, 1-minute legs.
2. Without a radio receiver, fly left triangular patterns, using 120-degree turns, 1-minute legs.
3. Fly two complete patterns before proceeding on course.
4. Repeat pattern every 20 minutes.
   Refer to FLIP, Enroute Supplement, for complete procedures.

ADDITIONAL PROCEDURES (CARRIER-BASED)

1. Lost procedures under EMCON conditions will be established during briefing.
2. When EMCON conditions allow, make radio report using procedures listed under VOICE PROCEDURE.
3. Select proper IFF/SIF mode/code.

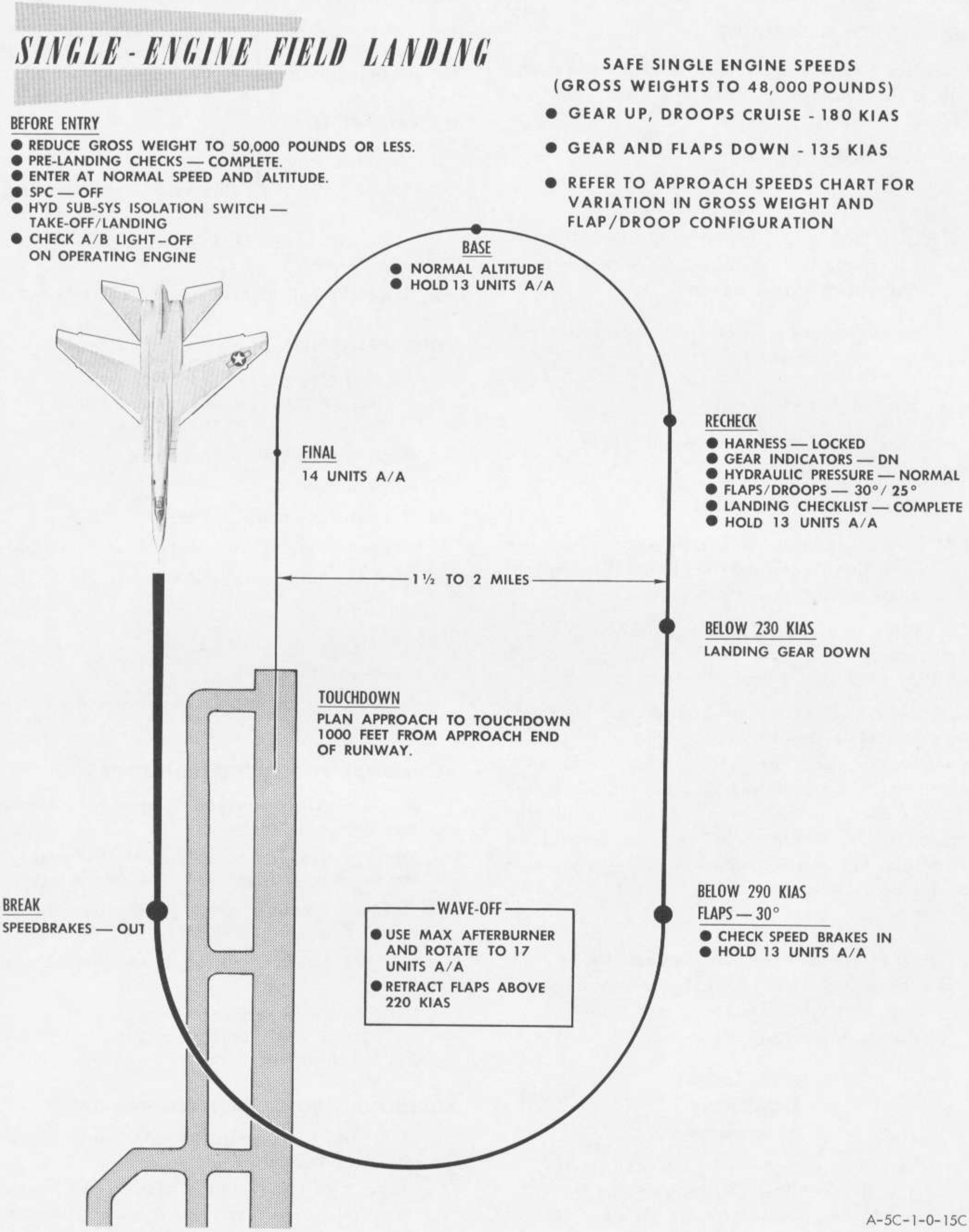

SINGLE-ENGINE FIELD LANDING
BEFORE ENTRY
● REDUCE GROSS WEIGHT TO 50,000 POUNDS OR LESS.
● PRE-LANDING CHECKS — COMPLETE.
● ENTER AT NORMAL SPEED AND ALTITUDE.
● SPC — OFF
● HYD SUB-SYS ISOLATION SWITCH — TAKE-OFF/LANDING
● CHECK A/B LIGHT – OFF ON OPERATING ENGINE
SAFE SINGLE ENGINE SPEEDS (GROSS WEIGHTS TO 48,000 POUNDS)
● GEAR UP, DROOPS CRUISE - 180 KIAS
● GEAR AND FLAPS DOWN - 135 KIAS
● REFER TO APPROACH SPEEDS CHART FOR VARIATION IN GROSS WEIGHT AND FLAP/DROOP CONFIGURATION
BASE
● NORMAL ALTITUDE
● HOLD 13 UNITS A/A
FINAL
14 UNITS A/A
RECHECK
● HARNESS — LOCKED
● GEAR INDICATORS — DN
● HYDRAULIC PRESSURE — NORMAL
● FLAPS/DROOPS — 30°/25°
● LANDING CHECKLIST — COMPLETE
● HOLD 13 UNITS A/A
1½ TO 2 MILES
BELOW 230 KIAS
LANDING GEAR DOWN
TOUCHDOWN
PLAN APPROACH TO TOUCHDOWN 1000 FEET FROM APPROACH END OF RUNWAY.
BREAK
SPEEDBRAKES — OUT
WAVE-OFF
● USE MAX AFTERBURNER AND ROTATE TO 17 UNITS A/A
● RETRACT FLAPS ABOVE 220 KIAS
BELOW 290 KIAS
FLAPS — 30°
● CHECK SPEED BRAKES IN
● HOLD 13 UNITS A/A
A-5C-1-0-15C

Figure 5-3

4. When over the carrier's estimated position, commence a square search, using left turns.
5. Use AN/ASB-12 radar, transmitting 1 minute and silent 1 minute.
6. If carrier is not located, land at a friendly field, fuel permitting.

DOWNED AIRCRAFT SURVEILLANCE

If two or more aircraft are present at the scene of an accident, the senior aviator present shall take immediate charge and carry out the following:

1. Instruct all aircraft at the scene to squawk MAYDAY.
2. Designate one aircraft to climb to altitude (if necessary), establish communications with a ground station, and act as relay. Transmit the following on GUARD frequency:
   (a) CRASH, CRASH, CRASH.
   (b) Identify yourself.
   (c) Position of crash.
   (d) Estimate of the situation.
   (e) Your intentions and endurance.
   (f) Request immediate coverage.
3. Designate one aircraft to remain on the scene and keep survivors in sight. This aircraft will:
   (a) Transmit any pertinent information to the relay plane.
   (b) Remain on station until aid arrives or as fuel permits.

DITCHING

WARNING

Rather than attempting to ditch and risking needless injury, ejection should be accomplished when feasible.

If conditions preclude ejection, the pilot must accomplish as much of the following procedure as time permits:

1. Notify systems operator.
2. Landing gear—UP.
3. RAT—Pull.
4. Flap control switch—40°.
5. Speed brakes—IN.
6. Stores—JETTISON.
7. EMERG IFF switch—EMERGENCY.
8. Harness—LOCKED.
9. Dump all possible fuel.
10. Canopies—JETTISON (front first).
11. Observe and use to best advantage the wind and/or sea state.
12. Emergency oxygen ring—PULL PRIOR TO TOUCHDOWN.

Note

- Do not pull Scott disconnect knob.
- The emergency oxygen system provides a 6- to 7-minute supply at sea level. If time precludes pulling the emergency oxygen ring, standing in the cockpit (pulling survival kit from seat) automatically actuates the system.

13. Maintain 160 KIAS until flare for touchdown.
14. Touch down at 100 fpm or less, in a nose-high attitude.
15. FLY THE AIRCRAFT UNTIL ALL FORWARD MOTION IS STOPPED.
16. Harness release handle—PULL.
17. Turn right and exit backwards over left side of cockpit.

DITCHING INFORMATION

If the sea is calm, land into the wind. If there is a swell running, touch down parallel to the swell crest or just after the crest has passed. In the event of high winds or a rough sea, land into the wind, touching down on the crest of a wave. Generally, the advantage gained from a slower touchdown speed will offset the disadvantage of a head-on impact with a wave crest. Rate of descent and airspeed at touchdown are the most important variables under the pilot's control. High touchdown speeds will greatly increase deceleration forces and increase the possibility of the flight crew being rendered unconscious. High rate-of-descent landings are likely to cause high impact forces and serious structural failures, resulting in a very short flotation period. A rate of descent of 100 feet per minute or less should be maintained at touchdown, if at all possible.

WARNING

If the aircraft is touched down in a flat attitude (less than 8 degrees), it may dive violently after contact. *Because of the shoulder wing mounting, the cockpits will be under water when forward motion stops.* If a properly adjusted mask is maintained, an underwater breathing supply is provided by the emergency oxygen system for approximately 5 minutes.

HELICOPTER WATER RESCUE

Prior to and during helicopter rescue after ditching or ejection over water, perform the following procedure:

1. Oxygen mask—OFF.
2. Upper "Rocket-Jets" and parachute "O" ring—RELEASE.
3. Scott disconnect yellow knob—PULL.
4. Lower rocket jets—RELEASE.
5. If the life raft lanyard has been tied to the torso garment—DISCONNECT.
6. Abandon life raft to avoid rotor wash.

CAUTION

Avoid high hand hold on rescue seat shank to preclude possible injury during hoisting and loading.

LANDING EMERGENCIES

SINGLE-ENGINE LANDING

For single-engine landing procedure, see figure 5-3. To avoid possible directional control difficulty after touchdown, check yaw trim set at 0 units and ensure that the control pedals are centered when engaging nose wheel steering.

WARNING

- Should final approach speed be allowed to reduce below 16 units A/A, sink rate may exceed safe limits.
- On some aircraft,* DO NOT move flap control switch to HOLD after selecting 30°. Loss of thrust will occur because droops extend to 50 degrees in HOLD, opening the BLC valves fully.

SINGLE-ENGINE WAVE-OFF

Use MAX AFTERBURNER on all single-engine bolters or wave-offs. A single-engine wave-off and landing pattern requires about 200 pounds more fuel than a normal pattern without afterburner. If leaving pattern, retract landing gear only when safe climb is established, as touchdown may be required in the event of a late wave-off. Retract flaps above 220 KIAS, when clear of all obstacles.

CAUTION

- Be prepared to counteract yaw as the flaps retract. Rudder effectiveness decreases with flap retraction.
- Reduce afterburner operations under the following conditions:
  (a) Double generator failure.
  (b) Fuel state 3000 pounds or less.

BOUNDARY LAYER CONTROL FAILURE OFF

Failure of one or both BLC valves to open as droops extend is indicated by illumination of the DROOPS caution indicator. Should this occur, add 10 KIAS to base leg and final approach speeds (decrease angle of attack 2 units) shown on figures 3-4 and 3-5.

ASYMMETRICAL BLC FAILURE

Should one BLC valve fail in the full closed or full open position, failure is indicated by illumination of the DROOPS caution indicator and a rolling and/or yawing tendency toward the no-flow wing during slow flight. For landing under these conditions, the following procedure is recommended:

1. Fly a normal pattern, adjusted as desired.
2. Apply full wing-down lateral trim as required.
3. Utilize 30-degree flaps and hold 14 units A/A during approach.
   In the event a 50-degree flap approach is required due to emergency flap extension, hold 13 units A/A.

TIRE FAILURE

In the event of a main gear tire failure, adequate directional control is available with nose wheel steering. During landings, brake disc temperature may exceed 1000°F. Most of this heat is dissipated into the atmosphere, but some is transmitted into the tire. Though the fusible plugs in the main wheels should deflate the tire of an overheated wheel, a tire blowout is possible for as long as 30 minutes after a brake has been used to capacity.

CAUTION

Allow sufficient time between flights or after an aborted take-off for adequate cooling. If operational necessity dictates immediate take-off, gear should be left extended as long as possible (at least 3 minutes) to permit maximum cooling, precluding possible wheel well explosion.

LANDING WITH TIRE FAILURE

For landing with any tire failure, use short-field arresting gear if available. Refer to SHORT-FIELD ARRESTMENT, in this section. In the event field arresting gear is not available, proceed as follows:

NOSE GEAR TIRE

1. Dump and consume fuel to minimum practical.
2. Make normal approach to center of runway with minimum sink touchdown.
3. Lower nose gently at 120 KIAS.
4. Stop aircraft straight ahead.
   Do not attempt taxi.

***Aircraft 150823 through 150842, 149306 through 149317, and 151615 through 151630 not having AFC 118 complied with**

APPROACH SPEEDS

APPROACH SPEED VARIATION FOR VARIOUS FLAP AND DROOP SETTINGS

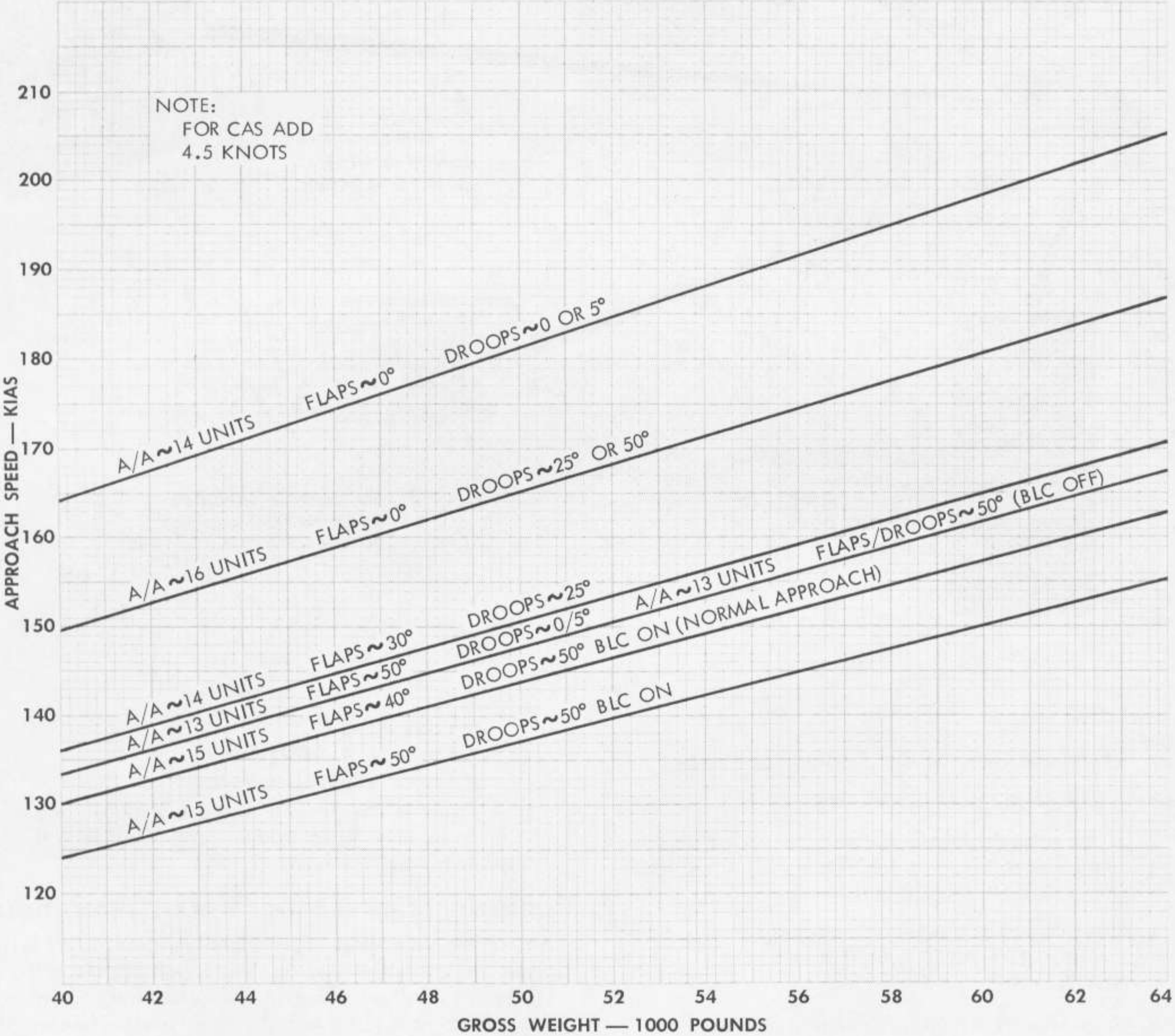


Figure 5-4

LANDING GEAR EMERGENCY EXTENSION

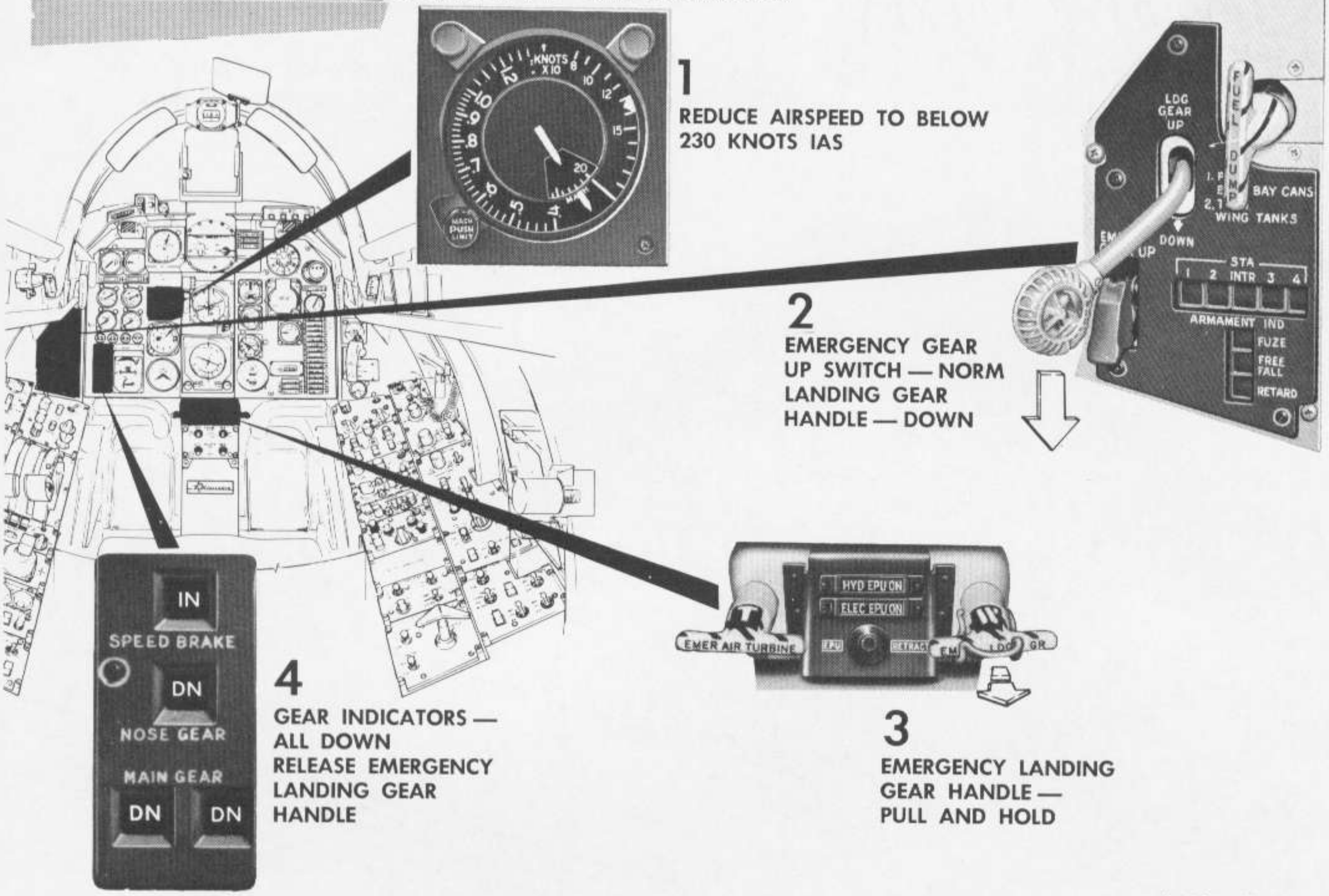


Figure 5-5

MAIN GEAR TIRE

1. Dump and consume fuel to minimum practical.

1A. Use arresting gear if available.

2. If not available, make normal approach with minimum sink touchdown. LAND ON SIDE OF RUNWAY NEAR GOOD TIRE.

3. Lower nose on touchdown and engage nose wheel steering. DO NOT USE BRAKE ON FAILED MAIN TIRE.

4. Stop aircraft straight ahead if possible.

NOSE GEAR STIFF

Should the GEAR STIFF caution indicator remain on after gear retraction, proceed as follows:

1. Recycle landing gear in an attempt to dump gear stiff system pressure.
2. If GEAR STIFF caution indicator remains on, land at a minimum rate of descent.

CAUTION

If divert is not possible and a carrier landing is made, nose wheel and/or strut damage will probably be sustained.

LANDING GEAR "DOWN" UNSAFE INDICATION

An unsafe indication of the landing gear may be the result of a malfunction of the landing gear selector valve, the hydraulic system, the electrical system, or the landing gear position indicating system. If an unsafe indication is encountered, proceed as follows:

1. Maintain airspeed below 230 KIAS.
2. Cycle landing gear handle twice.
3. If unsafe indication persists with gear handle down, pull EMER LDG GR handle and hold.
4. If gear is still unsafe, retract gear.
5. HYD SUB-SYS ISOLATION switch—FLIGHT.
6. Landing gear handle—DOWN.
7. EMER LDG GR handle—PULL and HOLD.
8. On safe indication—Return EMER LDG GR handle.

9. Remain in FLIGHT position and follow procedures under HYDRAULIC FAILURES for landing.
10. After landing, have downlock pins installed as soon as possible.

Note

If a safe indication cannot be obtained, use procedures described under LANDING WITH UNSAFE GEAR, in this section.

LANDING GEAR EMERGENCY EXTENSION

For landing gear emergency extension procedure, see figure 5-5.

CAUTION

Do not attempt to retract the landing gear after emergency extension because of failure of the No. 2 hydraulic system.

FLAP EMERGENCY EXTENSION

The wing flaps may be extended to 50 degrees by the pneumatic emergency system in the event of hydraulic or flap system electrical failure. Operation of the spoiler control lateral ratio changer is dual for fail-safe full spoiler-to-stick ratio with the flaps extended through either the normal or emergency system. Loss of power to the lateral ratio changer results in full (70-degree) spoiler authority without regard to the position of the flaps or the flap control switch. For flap emergency extension, proceed as follows:

1. Reduce airspeed to less than 190 KIAS.
2. HYD SUB-SYS ISOLATION switch—FLIGHT.
3. Flap control switch—50°.
4. EMERG FLAP switch—DOWN (if No. 2 system fails after flap extension).
5. Droop, flap, and trim indicator—check.
6. Speed brake operation—check; Dump if required.

Note

For recommended final approach speeds in various flap/droop configurations, see figure 5-4.

LANDING WITH UNSAFE GEAR

If the landing gear indicates unsafe after extension for landing and if fuel permits, every resource should be used to determine gear position before attempting to land or eject. Should fly-by for inspection prove the gear to be "cocked" or unsafe, the following factors must be considered:

1. Fuel state.
2. Crosswind effect.
3. Runway length.
4. Availability of field arresting gear.
5. Runway foam equipment capability.

WARNING

- Ejection is recommended unless combined landing factors are entirely favorable.
- In case of unsafe gear indication, do not retract the landing gear once a safe indication is obtained.

If the decision is made to land with unsafe or partially extended gear, proceed as follows:

1. Dump and consume excess fuel to minimum weight.
2. Loose gear—STOW.
3. Canopies—JETTISON.

WARNING

If making a fly-in arrestment with unsafe or retracted nose gear, DO NOT JETTISON CANOPIES.

4. Harness—LOCKED.
5. Make a normal approach.

   If a main gear is unsafe, land on the side of the runway nearest the good main gear. If the nose gear is unsafe, land in the center.

6. On touchdown, throttles—OFF.
7. Hold unsafe main gear off as long as possible.

Note

For unsafe nose gear, lower nose immediately after touchdown to minimize contact forces. Use take-off flap setting for better elevator effectiveness. As the nose touches, move the throttles to OFF.

8. Use rudder, nose wheel steering, or differential braking, as available, to control direction.
9. Abandon aircraft as soon as possible when all motion has stopped.

LANDING WITH AFT CG

Should bomb bay cans fail to transfer or dump, or alternate transfer methods fail, an excessively aft center of gravity exists. Proceed as follows:

1. Use 40-degree flaps for landing.
2. Hold 14 units angle of attack on final.

Note

- For arrested landing, the store train must be jettisoned if more than 2000 pounds can fuel remains and can dump fails.
- Arrested landing with the three fuel can configuration must not be made with more than 4000 pounds bomb bay can fuel remaining.
- The three-can bomb bay configuration *cannot be jettisoned*.

EMERGENCY ENTRANCE

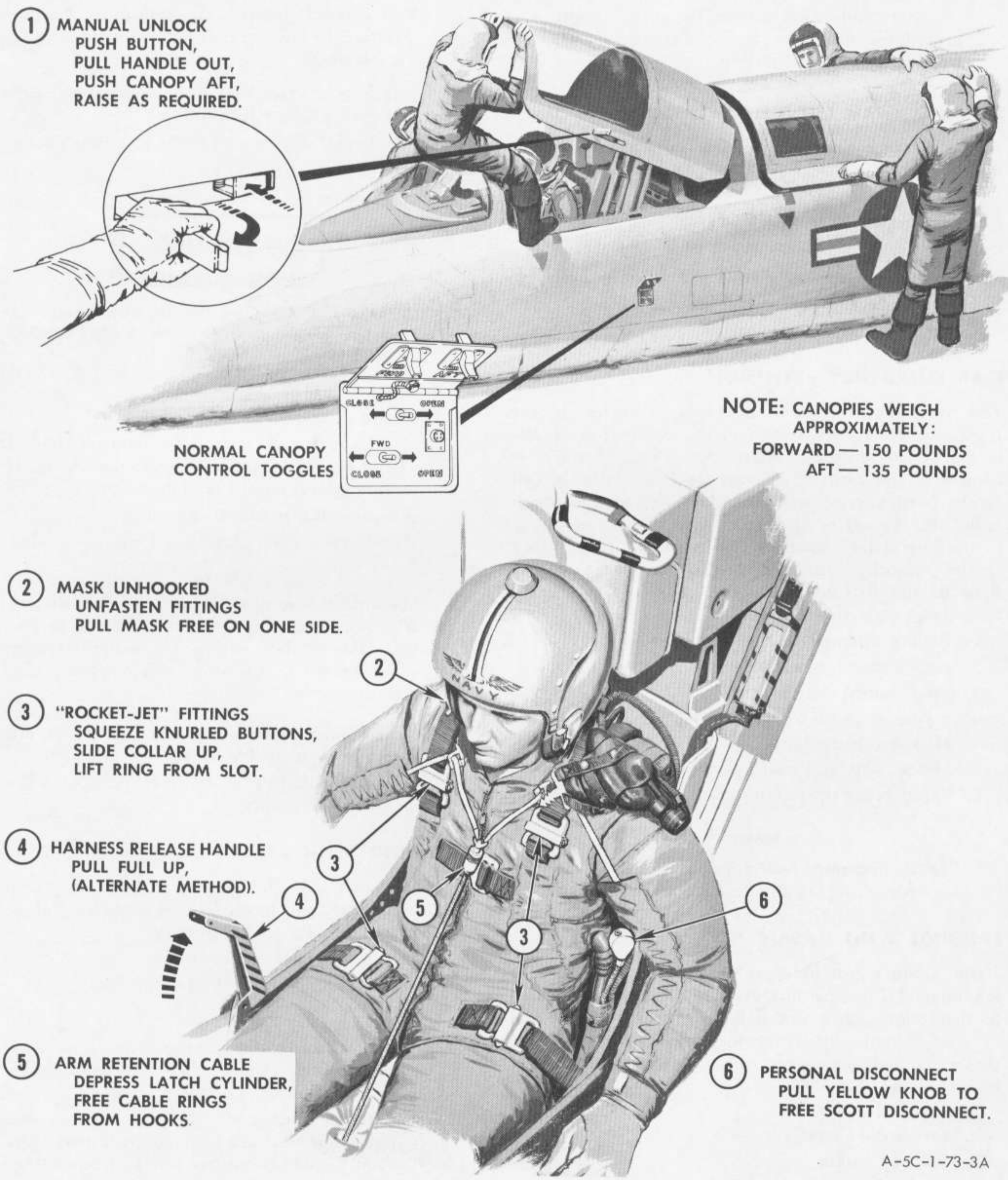


Figure 5-6

FIELD ARRESTMENT

Several types of field arrestment equipment are available. These types of arresting gear include the anchor chain/cable type, the aircraft brake/cable type, and/or water squeeze gear. At most USAF bases and many USN/USMC fields, some form of jet barrier is installed. It is imperative that all pilots be aware of the type, location, and load limitations of the gear in use. In general, the arresting gear is engaged on the centerline at as slow a speed as possible.

1. Reduce fuel aboard to minimum practical.
2. Obtain assistance of LSO, if possible.
3. Fly a low-angle pass, landing at minimum sink rate.

   Touch down between 500 and 1000 feet short of the cross-deck pendant and taxi into the gear in a slightly nose-high attitude. If the hook skips the wire, apply power and go around for another attempt.

SHORT-FIELD ARRESTMENT

When it is known that a directional control problem will exist or minimum rollout is desired, short-field arresting gear should be used. In addition, an LSO equipped with a radio should be stationed near the touchdown point to aid the pilot in landing. The hook should be lowered while airborne, and a positive hook check made. The aircraft is touched down just short of the arresting gear, with shoulder harness locked and the pilot's feet off the brakes, engaging the gear slightly nose-high. Be prepared for a wave-off if the gear is missed.

LONG-FIELD ARRESTMENT

This situation occurs when a stopping problem exists, such as failed brakes or failure of the No. 2 hydraulic system. Lower the hook in sufficient time for effective extension (normally 1000 to 2000 feet in front of the arresting gear). If arrestment is to be made at night, the pilot should request illumination of the arresting gear position. For normal long-field arrestment, proceed as follows:

1. Make a normal approach and landing.
2. Hook—down.
3. Use nose-high aerodynamic braking.
4. Direct the aircraft to enter the arresting gear as close to the center as possible, and attempt to engage the gear slightly nose-high.

FIELD BARRIER

If a field barrier is to be engaged, the aircraft should be in the three-point attitude and the engines secured prior to barrier engagement. For engagement of USAF BAK-6, BAK-9, or MA-1 type barriers, ensure that the hook is extended at least 1000 feet short of the barrier to prevent the possibility of the hook skipping over the cable.

BARRICADE ENGAGEMENT

If use of the barricade is required, the following procedures are recommended.

1. Lower hook if possible. The hook will assist the barricade in stopping the aircraft and will help keep the aircraft on deck at barricade entry.
2. Jettison stores if possible. Stores will not interfere with barricade engagement, but may be torn loose and present a hazard to the flight deck crew.
3. Fly a normal approach: on speed, centerline, and meatball.
4. Anticipate loss of meatball for a short period of time during the approach as barricade stanchions will obscure.

BRAKE FAILURE

In the event of any brake system malfunction, the aircraft should be maneuvered off the duty runway. Should brake failure be suspected before landing, use long- or short-field arresting gear, as applicable.

Note

For wheel brake failure accompanying failure of the No. 2 hydraulic system, use emergency braking for initial deceleration, saving the pressure in the auxiliary brake accumulator for terminal rollout directional control.

USE OF EMERGENCY BRAKES

The fully charged emergency brake accumulator provides approximately three full "on and off" applications of pressure of equal force to both brakes. Operation with the emergency brake handle is similar to that obtained through the pedals with the auxiliary accumulator, except that both brakes are operated simultaneously. A single application of emergency braking is normally sufficient to stop the aircraft if the handle is pulled gently until deceleration is felt, then pulled slowly outward, increasing force as speed decreases.

Note

When new brake assemblies are installed, it is recommended that the pilot be notified and that several applications of moderate braking be applied while taxiing out for flight. This procedure will wear off the metal protective primer, reducing smoking on landing rollout.

WARNING

A sudden pull on the emergency brake handle may lock the main wheels, causing tire failure and possible loss of directional control. Optimum technique is to slowly pull the emergency brake handle until deceleration is detected. Handle displacement can be increased as speed decreases.

EMERGENCY COCKPIT ENTRANCE AND ESCAPE

For emergency cockpit entrance and rescue information, see figure 5-6.

TABLE OF CONTENTS

INTRODUCTION

All-weather operation is discussed in this section for such conditions as instrument flight, ice and rain, turbulence, and temperature extremes. This material supplements the information contained in other sections of the manual and is not intended as a substitute for normal operating procedures. Procedures for simulated (hooded) instrument flight are also included.

INSTRUMENT FLIGHT

The capabilities of this aircraft make it highly adaptable for instrument flight. Mission accomplishment is enhanced by the effectiveness of the autoflight control system, CNI systems, and the bomb directing set. However, thorough preflight planning and current instrument proficiency are always necessary for successful instrument flight operations. Effective aircraft range may be reduced by air traffic control procedures and unexpected weather developments. The hazard of icing can be reduced by use of engine, windshield, and pitot anti-ice systems. Thunderstorms should be circumnavigated through the use of radar. Control of the UHF communications, IFF, ADF, and TACAN is available from either cockpit. Control of the SIF is available in the rear cockpit only. Flights in positive control areas cannot be accomplished without a crew member in the rear cockpit.

CAUTION

Should the right-hand engine fail or be shut down, move the NO. 2 GENERATOR switch to OFF before rpm reaches 36%. This procedure will prevent the all-attitude indicator from tumbling and the compass system (HSI and AAI) from precessing during power switchover to the No. 1 generator.

FUEL PLANNING

1. The following fuel reserves and allowances shall be used as a guide for instrument flight fuel planning on nonoperational flights:

Landing reserve	2000 pounds
Holding reserve	1500 pounds
GCA allowance	1000 pounds
Teardrop penetration	1000 pounds
Arcing penetration with extended low approach	1500 pounds

2. A departure fuel allowance must be provided if an adverse departure must be used.
3. All instrument flights shall be planned to arrive at the approach fix at cruising altitude. Enroute descent fuel savings shall not be planned.

TAKE-OFF

Normal operating procedures apply to preparation for instrument flight, with increased necessity for proper operation of the CNI and lighting systems. Before take-off, make the following additional checks:

CAUTION

To prevent the formation of fog and frost in the cockpit during take-off under conditions of high humidity, or to clear the cockpit anti-ice and defrost ducting system of moisture, set the COCKPIT TEMP knob at "3" (HOT) during ground engine operation and perform steps 1 and 2 of the following check. Any visible moisture will clear within 10 to 20 seconds.

1. Pitot anti-ice—ON.
2. Windshield and canopy defrost—ON (if required).
3. WINDSHIELD ANTI-ICE switch—as required.
4. PRESS SUIT FLOW knob—OFF.
5. Check stand-by gyro horizon.
6. Lighting controls—check.
7. Anticollision lights—ON.

If take-off is made under conditions of extremely reduced visibility, rotate the aircraft to approximately 10 degrees (16 units angle of attack) nose-up pitch attitude as lift-off speed is reached. When catapulted ITO's are made, the flight instruments must be carefully cross-checked for precession produced by the catapult acceleration. A wings level, 1000 fpm climb should be maintained during post-take-off transitions.

Note

After lift-off, an increase in pitch attitude may be required to limit airspeed until landing gear and flaps are retracted.

CLIMB

Under IFR conditions, or at night, it is recommended that 1000 feet of terrain clearance and 220 KIAS be attained before retracting flaps to CRUISE. Turns to departure heading should not be commenced until reaching 1000 feet and a minimum of 250 KIAS. This procedure will avoid low-level turns at changing airspeeds and altitudes. Since Maximum Thrust may result in excessively steep climb angle, Military Thrust is recommended during the instrument portion of departure climbs. The systems operator shall handle all frequency changes below 2500 feet, so that the pilot may devote his full attention to controlling the aircraft.

CRUISE

All instrument flights, except those involving an operational clearance, shall be conducted in accordance with current regulations. All radio traffic involving reports, requests, or acknowledgments, shall be clear and concise. Requests for weather and miscellaneous information shall be requested from Pilot-to-Forecaster Service (METRO) or Airways Communications Stations. Pilots shall monitor destination and alternate weather closely, especially when the weather at these two points is marginal. If the weather at the filed alternate station goes below authorized minimums, some other suitable alternate shall be requested or, lacking one, the destination shall be changed.

RADAR NAVIGATION

The AN/ASB-12 radar may be used as a secondary mode of navigation in the event of complete autonavigator failure. Following an autonavigator failure, a fully stabilized radar picture normally remains. Using the fixed range circles, relative bearing scale, and aircraft compass, the systems operator has all the information necessary to obtain navigation fixes, ground speed, and track information.

HOLDING

Holding airspeed is 200 to 275 KIAS, with the flap control switch at CRUISE (5-degree droops). Bank angles of more than 30 degrees may require added power to maintain altitude and airspeed. The following table may be used to determine recommended holding airspeed:

ALTITUDE (FEET)	FUEL REMAINING (LBS X 1000) 2	4	6	8	12
	KNOTS IAS				
Sea Level	200	205	210	215	220
10,000	205	210	215	220	230
20,000	215	220	225	230	240
30,000	230	235	240	245	260
40,000	235	240	245	255	275

DESCENT

Maximum-range enroute descent should be made at 80% rpm, holding 250 KIAS, speed brakes IN, flaps CRUISE. Rate of descent will average 3000 feet per minute.

PENETRATION

Prior to descent, pitot heat, engine anti-ice, windshield anti-ice, and canopy defrost should be checked ON. Airspeed and altitude control will be smoother if angle of bank is limited to 30 degrees. Normal penetrations will be the published jet penetration for the facility. Maintain 250 KIAS and 4000 feet per minute rate of descent with the speed brakes extended, when compatible with the published penetration. At 1000 feet above level-off, close speed brakes while maintaining 250 KIAS. The last 500 feet prior to level-off altitude should be used to slowly transition the aircraft to level flight. GCA pickup from the penetration point will be used whenever possible.

Note

If failure of the cockpit temperature controller causes fog to form in the cockpit upon descent, fog can be dissipated most rapidly by utilizing full windshield and canopy defrost airflow and turning the COCKPIT PRESS switch OFF.

Throughout the penetration, the systems operator should monitor both barometric and radar altitude, keeping the pilot informed of the lower indicated altitude at each 5000-foot level until reaching 5000 feet above terrain; then calling out each 1000-foot level until level-off. At start of descent, a fuel state of 6000 pounds will allow an instrument penetration, followed by a wave-off, 150-mile flight to a VFR alternate base, with 1000 pounds of fuel remaining at landing.

INSTRUMENT APPROACHES

With the use of TACAN for continuous bearing and distance reference and surface radar for approach and traffic control, the remaining factor in an instrument approach is control of altitude and airspeed. See figure 6-1 for suggested typical procedure.

CAUTION

Changes in airspeed exceeding 35 knots per minute during or before turns may cause the all-attitude indicator to display a transient, erroneous, wing-down bank attitude indication of up to 5 degrees.

AN/ASB-12 APPROACHES

The possibility of executing satisfactory instrument approaches with AN/ASB-12 equipment to land stations or to carriers is limited primarily by crew interest, effort, and experience in developing the necessary techniques. All practice and actual (weather) approaches should be executed with the AN/ASB-12 tracking the station being approached and, if possible, the runway being approached. AN/ASB-12 altitude, range, airspeed, and bearing information can provide the systems operator with aids to monitor the pilot's approach which might not otherwise be available. With experience and satisfactory equipment conditions, the AN/ASB-12 may be relied upon as the sole approach aid. The following factors and restrictions must be observed:

1. The AN/ASB-12 bomb directing set can be used to make an approach under actual instrument conditions or as a navigational aid in following a duly approved and published instrument approach pattern.
2. Measured and reported surface winds will be set into the system when commencing an approach using the stand-by navigation mode.
   This is necessary since automatic wind solution is not available in this mode.
3. The AAI steering signal is accurate only a few degrees either side of zero.
   For large corrections, the AAI should be cross-checked with the HSI.
4. The HSI needle may be used, as on a normal instrument approach, to maintain proper outbound track, and may also be used on an arcing approach to the station. The HSI or AAI may be used on the initial part of the inbound approach but, for the final approach, the AAI steering display is more sensitive and accurate.
5. In the AN/ASB-12 approach, it is not necessary that the radar aimpoint coincide with the approach end of the runway but, if an offset distance is used, it must be carefully measured prior to the flight.

Any AN/ASB-12 instrument approach depends on the accuracy of either the inertial autonavigator or the flight reference set gyro platform, and air data computer and wind inputs. This accuracy must be monitored and updated throughout the approach.

RECOMMENDED PROCEDURE

Refer to Section VI of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

LOW-VISIBILITY APPROACHES

The low-visibility approach procedure provides final approach alinement for landing, when misalinement existed at visual pickup. The procedure is essentially a close-in orientation to a circling approach and shall not be used in conditions less than those authorized for a circling approach.

EXECUTION

The aircraft should be in the power approach configuration.

1. Maintain contact with the ground; if lost, execute a missed approach.
2. Turn the shorter arc to fly the aircraft *over* the desired runway, parallel to it.

3. If proceeding upwind, immediately perform an 80- to 260-degree turn to proceed downwind *over* the desired runway.
4. Proceed downwind and, after passing over the approach end of the desired runway, perform an 80- to 260-degree turn. Commence descent to landing, coming out of the 260-degree turn with the runway in sight.

HAZARDS

The low-visibility approach is not an approved maneuver except as a form of circling approach. It is not a means of salvaging a missed approach to a straight-in approach. It is not an invitation to half-instrument and half-contact flight, nor should it be combined with the transition to landing configuration. Again, if contact flight with reference to the ground is not possible, a missed approach shall be executed.

GCA APPROACH

See figure 6-1 for suggested typical GCA procedure. IFF and bearing indicator equipment may be desirable for assistance in orientation and traffic control under adverse conditions. Check static pressure compensator button off before final approach. An angle-of-attack indication of 15 units should be used for final approach.

NIGHT FLIGHT

Night flight in this aircraft presents no additional problems. Both crew members should have a reliable flashlight and should be familiar with the location of all switches and controls. Aircraft lighting and flight instruments should be checked completely before take-off. The aircraft is not equipped with landing lights; however, the nose-gear-mounted taxi light is provided for night ground operation.

FLIGHT IN TURBULENCE

Flight in light to moderate turbulence presents no serious problems. Use of the AFCS will improve the damping of undesirable aircraft motions. In moderate to severe turbulence, however, use of the AFCS is not recommended, as it may monitor off abruptly due to severe gust loads. In instrument flight conditions, its loss can induce vertigo if the pilot is not holding the stick. The relatively long moment arm between the crew and the aircraft center of gravity aggravates the effects of severe turbulence, and the crew should keep shoulder harnesses locked to avoid injury. Instruments become blurred, making accurate interpretation impossible. Increasing airspeed increases the effects of turbulence; however, too slow an airspeed may result in engine compressor and/or aircraft stall, particularly at altitudes above 35,000 feet. The following subsonic airspeeds are recommended for flight through severe turbulence and thunderstorms:

Below 35,000 feet	250 to 300 KIAS
35,000 to 40,000 feet	270 KIAS to 0.92 IMN

Subsonic operations in severe turbulence above 40,000 feet are not recommended; supersonic operations in severe weather have not been evaluated at this time.

THUNDERSTORM PENETRATION

Whenever possible, flight through thunderstorms and areas of heavy precipitation should be avoided by alternate routing, vectoring by ground radar facilities, or in-flight use of the AN/ASB-12 radar. Attempting to climb above severe weather increases the possibility of compressor stall or aircraft stall at high altitudes and low airspeeds. If penetration is unavoidable, the pilot must prepare for the disorienting effects of severe turbulence, precipitation (in the forms of hail, ice, and rain), lightning strikes, and rapid fluctuation of pitot-static instruments. The following procedures are recommended prior to entry:

1. Stabilize on penetration altitude, airspeed, and attitude, using the speeds recommended for flight in severe turbulence.

   If necessary, use afterburner to maintain minimum speeds.
2. Turn on high-altitude lights.
3. Lower helmet visor.
4. Turn on engine and pitot anti-ice switches.
5. Lock shoulder harness.
6. Maintain heading and a level attitude by reference to the AAI, using the stand-by gyro horizon as a backup.

   Do not chase altitude and airspeed.
7. Do not extend landing gear or flaps as structural damage may result.

Note

- The stand-by compass may not be reliable if the aircraft is struck by lightning.
- Completion of a training mission does not warrant penetration of a known thunderstorm.

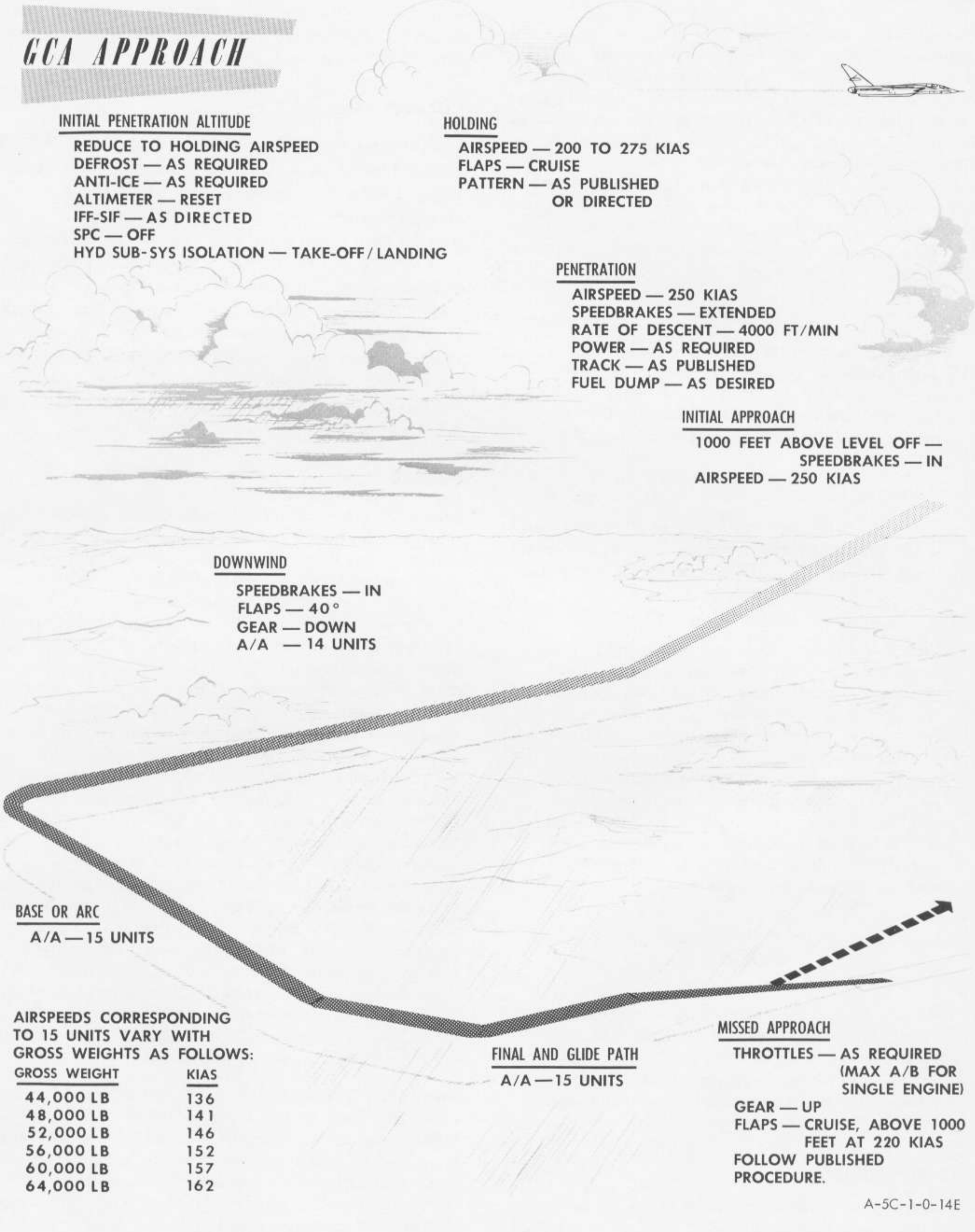

GCA APPROACH
INITIAL PENETRATION ALTITUDE
REDUCE TO HOLDING AIRSPEED
DEFROST — AS REQUIRED
ANTI-ICE — AS REQUIRED
ALTIMETER — RESET
IFF-SIF — AS DIRECTED
SPC — OFF
HYD SUB-SYS ISOLATION — TAKE-OFF / LANDING
HOLDING
AIRSPEED — 200 TO 275 KIAS
FLAPS — CRUISE
PATTERN — AS PUBLISHED OR DIRECTED
PENETRATION
AIRSPEED — 250 KIAS
SPEEDBRAKES — EXTENDED
RATE OF DESCENT — 4000 FT/MIN
POWER — AS REQUIRED
TRACK — AS PUBLISHED
FUEL DUMP — AS DESIRED
INITIAL APPROACH
1000 FEET ABOVE LEVEL OFF — SPEEDBRAKES — IN
AIRSPEED — 250 KIAS
DOWNWIND
SPEEDBRAKES — IN
FLAPS — 40°
GEAR — DOWN
A/A — 14 UNITS
BASE OR ARC
A/A — 15 UNITS
AIRSPEEDS CORRESPONDING TO 15 UNITS VARY WITH GROSS WEIGHTS AS FOLLOWS:
GROSS WEIGHT KIAS
44,000 LB 136
48,000 LB 141
52,000 LB 146
56,000 LB 152
60,000 LB 157
64,000 LB 162
FINAL AND GLIDE PATH
A/A — 15 UNITS
MISSED APPROACH
THROTTLES — AS REQUIRED (MAX A/B FOR SINGLE ENGINE)
GEAR — UP
FLAPS — CRUISE, ABOVE 1000 FEET AT 220 KIAS
FOLLOW PUBLISHED PROCEDURE.
A-5C-1-0-14E

Figure 6-1

ICE AND RAIN

This aircraft is not equipped to fly continuously in icing conditions. Flights shall be planned to avoid altitudes of prolonged icing. No provision is made for in-flight structural anti-icing. At moderate- to high-speed flight, impact pressure is sufficient to prevent ice buildup. Should heavy, clear ice be encountered, an immediate climb should be made in order to clear the icing area. For penetrations through icing or rain, the WINDSHIELD ANTI-ICE switch should be placed in the ON position and maintained until landing is accomplished. The canopy defrosting system should be turned on well in advance of a descent to avoid fogging.

Note

If relative humidity conditions result in fogging during take-off or letdown, the cockpit temperature control can be increased to the maximum until the fog clears, at which time the heat can be lowered to a more comfortable setting.

PITOT-STATIC ICE

The PITOT ANTI-ICE button should be depressed prior to and during flight through visible moisture to prevent unreliable readings of the pitot-static system instruments.

Note

Pitot line freezing may occur when the aircraft is operated in cirrus-type clouds for extended periods of time. Melted ice crystals can reach the rear of the pitot-static tube and freeze at the connections. The pitot heater should be turned ON prior to penetration. If freezing occurs, it may be indicated by an erroneous indicated airspeed increase when altitude is increased. If this condition is noted, the angle-of-attack indicator should be used to maintain a safe attitude until aircraft altitude is decreased to a level where melting of the ice will occur.

CAUTION

Failure of the pitot anti-icing system is not positively indicated to the pilot. Should such failure allow icing to occur, the inlet duct variable ramps may be driven toward the down position, causing engine airflow reduction and possible flame-out.

ADC MOISTURE

The presence of excessive moisture in the air data computer may cause erratic, unreliable readings in airspeed, Mach number, and altitude. This is indicated by radical transients in the flight instruments and/or a barber-pole indication on the systems operator's radar/barometric altimeter. Should this occur, depress to release the static pressure compensator button and utilize the uncorrected indications of airspeed, Mach number, and altitude.

COCKPIT FOG

Under warm, humid conditions, or when the aircraft has been subjected to soaking precipitation, heavy cockpit fog and instrument frosting may form during operation at high engine power settings unless cockpit temperature has been raised sufficiently to warm the cockpit area. In addition, windshield and canopy defrost should be utilized to prevent frosting. If accomplished prior to take-off, this procedure reduces the possibility of heavy fogging and reduces frosting as high altitudes are reached. Under humid conditions, it is recommended that the COCKPIT TEMP knob be placed at "3" (HOT) and that the WINDSHIELD CANOPY DEFROST knob be turned on to a low setting as soon as the engines are started.

ENGINE ICING

The effect of moisture or icing conditions on engine operation, although predictable, is difficult to quickly and accurately detect from engine instruments. Generally, the magnitude of changes in instrument indication is small. For example, changes noted after 5 to 10 minutes of exposure to icing conditions are similar to changes resulting from an increase in altitude of 3000 feet or a decrease in Mach number of 0.15. Therefore, the absence of marked changes in indication with respect to time, and the relatively small magnitude of change, would require almost continuous monitoring of engine instruments to detect engine inlet icing. In addition to the presence of freezing moisture, other factors (such as altitude, throttle setting, rate of water and/or ice ingestion, and the amount of ice buildup) affect the direction and amount of change in engine parameters. For example, high water or ice ingestion rates can affect engine speed holding capability. At extreme ingestion rates (i.e., thunderstorms or heavy rain), engine speed will decay as a function of the water/airflow ratio. Ice buildup on the compressor inlet during high-altitude flight decreases compressor efficiency and, under extreme conditions, can result in compressor stall and engine flame-out. The number of possible interactive effects of all factors on engine instrument indication are so numerous that detection is difficult, if not impossible.

There are two basic forms of engine or inlet duct icing: water ingestion in the form of water or ice, and ice buildup on the compressor inlet surfaces. Both forms have distinct characteristics; however, actual icing progression usually begins with ingestion and culminates in combined ingestion and ice buildup. This progression requires approximately 6 to 10 minutes. Since a relatively long time is required for this progression, there will be no sudden change in engine instrument indications.

INGESTION OF ICE AND WATER

When ice and water are ingested, evaporation in the engine compressor occurs, reducing pressures and temperatures. The direction of engine parameter change will depend, however, upon engine power setting.

Low Power Settings

At low power settings (exhaust nozzles mechanically scheduled), EGT and fuel flow decrease, while nozzle position and rpm hold constant. Since the nozzle is on the fixed mechanical schedule, lowered engine temperatures caused by water evaporation will result in a decrease in EGT and fuel flow. Engine rpm holding capability will be relatively unaffected except at extreme ingestion rates.

High Power Settings

At cruise, Military Thrust, and Maximum Thrust settings (exhaust nozzles modulate to maintain EGT at rated maximum), nozzle area decreases, fuel flow increases, and rpm and EGT hold constant. At throttle settings above approximately 92% rpm, the exhaust nozzle controllers will decrease nozzle area to maintain EGT as the water evaporates. Decreased nozzle area increases tailpipe pressure, requiring an increase in fuel flow to maintain engine speed. If ingestion rate increases, the nozzles close to the minimum area scheduled by the throttle and engine operation is the same as that covered under LOW POWER SETTINGS.

ICE BUILDUP

The effects of ice buildup on the compressor inlet surfaces are usually obscured by the presence of ingestion characteristics occurring simultaneously. Ice buildup results in a condition similar to engine operation at low ram pressure recovery.

Low Power Settings

At low power settings (exhaust nozzle on mechanical schedule), EGT and fuel flow increase, while nozzle position and rpm hold constant. Engine pressures are low at 80% rpm and below, and further reduction of engine pressures from ice buildup results in an increase in EGT and fuel flow.

High Power Settings

At cruise, Military Thrust, and Maximum Thrust settings (exhaust nozzle modulates to maintain EGT at rated maximum), nozzle position and fuel flow decrease, while EGT and rpm hold constant. Reduction of engine pressures from ice buildup at high engine speed tends to reduce fuel flow. Reduction in fuel flow tends to lower EGT. The nozzle control system senses the change and reduces nozzle area to maintain a constant EGT.

RECOMMENDATIONS

Serious ice buildup can occur before a significant change is noted in the engine instruments. Therefore, engine instruments should NOT be relied upon for diagnosing possible engine icing conditions. Move the ENGINE ANTI-ICE switch to ON and depress the PITOT ANTI-ICE button prior to entering any known or suspected area of icing conditions.

COLD WEATHER PROCEDURES

PREFLIGHT

When ambient temperature is below 32°F, it is necessary to preheat the electronic and reconnaissance compartments. Sudden surges of electrical power through extremely cold components may result in serious damage due to sudden heat expansion. In extremely cold weather, avoid touching metal surfaces with bare hands. Hot air should also be directed into the intake ducts, the landing gear wells, and the cockpits. This procedure will evaporate moisture which may have collected and frozen under controls, microswitches, etc. Ensure that all ice, snow, and frost accumulation is removed from all aircraft surfaces and activating linkages prior to flight. At ambient temperatures below −40°F, MIL-L-7808 engine oil should be used in place of the normally prescribed MIL-L-23699 (Wep) oil.

WARNING

Failure to remove all ice, snow, and frost from all aircraft surfaces could result in dangerous disruption of airflow characteristics and loss of lift.

GROUND OPERATION

Exercise caution when running up the engines since wheels and chocks frequently slide on ice or snow. For engine check above idle rpm, aircraft should be tied down. Taxi and take-off procedures on ice-covered taxiways and runways are hazardous. The full-power brakes may act to hinder rather than to aid in taxiing. USE NOSE WHEEL STEERING AT ALL TIMES WHEN TAXIING ON SLIPPERY SURFACES. If necessary, have the aircraft towed to a point close to the runway before starting engines. On icy taxiways, once a skid is started, the aircraft may slide a considerable distance before control can be regained, even when using nose wheel steering. Always taxi SLOWLY using a minimum of power and brakes. The retarding effect of soft snow or slush on the runway will lengthen the take-off ground run.

WET OR ICY RUNWAYS

The increase in rollout distance on wet or icy runways depends on the braking conditions encountered. Normal landings with an increase of 1000 to 2000 feet of ground roll may be accomplished on wet runways where precipitation has stopped and drainage occurred. A landing in rain or on standing water may result in up to 75 percent increase in normal rollout distance. Cross-wind conditions may affect wet or icy runway landings to an equal degree in that safe aerodynamic braking is limited. In general, a wet runway landing should be accomplished by using the recommended final approach speed, touching down in the first 500 feet of the runway. If cross-wind conditions permit, use nose-high aerodynamic braking. The nose should be held off down to 115 knots, then allowed to drop with the stick full aft. Continue to hold the stick as far aft as possible and commence cautious, steady braking. If a yaw develops, cease braking and use nose wheel steering. Continue to hold the stick aft, and as speed decreases, increase brake pressure until taxi speed is reached. For icy runways, the same factors are involved except that stopping distance may be increased by more than 100 percent. For "patchy" ice conditions, extreme care must be taken to brake on clear runway and to reduce braking on ice to prevent skidding when passing from ice to clear runway. Except for possible yawing, wheel lock is difficult to detect, and a tire may fail without warning. For landings on wet or icy runways, prepare for field arrestment, or request barrier, if gear is available.

POSTFLIGHT

Attempt to park the aircraft on a clear spot if possible. Make sure the wheels are properly chocked and tie-downs installed before making any postflight engine run-ups. All aircraft covers and plugs should be installed immediately after postflight inspection.

HOT WEATHER PROCEDURES

PREFLIGHT

In hot weather, the aircraft surfaces may become extremely hot. Crew members and ground maintenance personnel should wear gloves to prevent injury. In extreme heat, the pilot should make as many of his operational checks as possible before starting engines. Before entering the aircraft, complete normal preflight items and devote particular attention to the following:

1. Check intake ducts for accumulated sand, etc.
2. Check tires, seals, and antenna covers for cracks and blisters.
3. Cockpit covers should be left on as long as possible to prevent excessive heating of metal surfaces and controls in the cockpit.
4. Check canopies for excessive scratches, particularly before night flight.

GROUND OPERATION

After engines are started, taxi rpm in hot temperature areas should be the lowest practical rpm for aircraft movement desired. Overheating of brakes is critical in hot weather. In most cases, small quantities of sand do no harm in passing through a turbojet engine; however, during hot weather and desert operation, pilots are reminded to:

1. Make ground run-up as short as possible.
2. Do not allow the engines to operate at IDLE rpm for more than 2 minutes with flaps extended with an alined autonavigator platform.
3. Avoid running up engines toward equipment or personnel, even from longer than usual distances. Sand blast can result in serious damage to other aircraft and injury to ground personnel.

Double-check the flight control system for proper operation and freedom of control surface movement. Hydraulic pressures which exceed or fall short of limitations should not be accepted as normal. Adjust cockpit air conditioning to desired temperature. If ALT COOL caution indicator is ON, reset when engine rpm is above 80%.

TAKE-OFF AND CLIMB

Power required for take-off in hot weather will depend upon aircraft configuration, weight, ambient temperature, and field elevation. During extremely hot weather and at high field elevations, maximum afterburner is recommended to avoid a prolonged take-off. This power setting should also be used to accelerate to best climb speed.

LANDING

Use of higher than normal power settings can be expected during landing approaches in hot weather. Expect gusts and turbulence at low altitudes and anticipate longer landing rollout.

POSTFLIGHT

If possible, park the aircraft cross-wind to prevent sand or dust from collecting in the intake ducts or afterburners. Canopies should be closed and wing tips and tail should be spread and locked. All covers and plugs should be installed immediately after the postflight inspection.

TABLE OF CONTENTS

RESPONSIBILITY

It is the responsibility of the pilot to ensure that all voice and visual communications and electronic transmissions from his aircraft are in compliance with applicable directives.

RADIO COMMUNICATIONS AND ELECTRONIC NAVIGATION EQUIPMENT

Adhere to the following instructions:

1. Do not interrupt another transmission.
2. Make only necessary transmissions.
3. Keep all transmissions brief and concise.
4. Use the phonetic alphabet.
5. Use approved phraseology.
6. Have message prepared before beginning transmission.
7. Use correct calls.
8. Be familiar with the Communications Section of USAF/USN FLIP Planning Document.

Note

Monitor GUARD frequency (243.0 mc) at all times. Do not transmit on GUARD except in an actual emergency.

RADIO COMMUNICATION EQUIPMENT

Multichannel/frequency UHF is the sole means of two-way voice communications. The systems operator will carry a copy of the current frequency plan for UHF on all flights. The auxiliary receiver may be used as a backup communications receiver.

ELECTRONIC NAVIGATION EQUIPMENT

The aircraft contains three electronic aids to navigation:

1. TACAN.
2. UHF airborne direction finder.
3. Bomb directing set, AN/ASB-12.

IFF/SIF PROCEDURES

Aircraft operating within the CONUS will operate the IFF/SIF equipment to conform with OPNAV/FAA regulations. During carrier operations, IFF will be operated as prescribed by current directives.

AUTHENTICATION

Authentication will be in accordance with the appropriate KAC-series, or as assigned by the Operational Commander.

EMERGENCY COMMUNICATIONS

Comply with OPNAV Instructions and the steps on the inside rear cover of FLIP, Enroute Supplement. Refer to Section V for aircraft distress reporting.

VISUAL COMMUNICATIONS

BETWEEN AIRCRAFT

Communications between aircraft within a formation will be conducted visually whenever practicable, provided no sacrifice in operational efficiency is involved.

Flight leaders will ensure that all aircraft in the formation receive and acknowledge signals when given. Visual signals as set forth in NWP 41(A) will be used. For emergency signaling, the FAA standard HEFOE system should be used:

1 finger	H	Hydraulic
2 fingers	E	Electrical
3 fingers	F	Fuel
4 fingers	O	Oxygen
5 fingers	E	Engine

INTERCOMMUNICATIONS SYSTEM FAILURE

If an ICS failure is experienced, the following procedures should be attempted in order to establish some degree of communications between the pilot and the systems operator.

IF PILOT LOSES ICS

To attract the systems operator's attention, stamp feet on deck and proceed as follows:

1. Turn the MASTER ARM switch on and off three times.

   This will flash the systems operator's ARM MAST'R ON light.

2. Dial 333.3 on the UHF radio frequency indicator.
3. The systems operator will acknowledge by taking command of the UHF radio and redialing 333.3.

IF SYSTEMS OPERATOR LOSES ICS

To attract the pilot's attention, proceed as follows:

1. Stamp feet on cockpit floor.
2. The pilot will acknowledge by taking command of the UHF radio and dialing 333.3.
3. Refer to LOST ICS—UHF CODE in the Systems Operator's NATOPS Check List (NAVWEPS 01-60ABC-1D).

BOTH CREW MEMBERS

Upon receiving the loss of ICS signal, both crew members will refer to LOST ICS—UHF CODE procedure in their respective NATOPS Check List. The following codes will be used for further communication:

333.3 Select LOST ICS—UHF CODE.
333.0 Prepare to Eject.
333.1 Squawk MAYDAY.
333.2 Squawk PAN.
333.4 Heading to nearest airfield?
333.5 Commence Emergency Descent.
333.6 Oxygen Inoperative.
333.7 Prepare to land.
333.8 Returning to home field (carrier).
333.9 TACAN Out.

320.0 Are you OK?
320.1 I read you OK.
320.2 TACAN OK.
320.3 Can we continue run?
320.4 Select proper wing station.
320.5 Follow AAI.
320.6 Depress B/N SYS button.
320.7 Select MASTER ARM—ON.
320.8 Affirmative (Yes).
320.9 Negative (No).

310.0 My UHF OK.
310.1 AAI to Home.
310.2 AAI to Nearest Airfield.
310.3 Wheels and flaps down for landing.
310.4
310.5
310.6
310.7
310.8
310.9

Note

- Use codes 310.4 through 310.9 as locally directed or as prebriefed between individual crew members.
- Before selecting a UHF frequency for transmitting, switch to GUARD XMIT (243.0 mc) momentarily to let the other crew member know that the next frequency selected will be a transmitting frequency.
- The LOST ICS—UHF CODE procedure in the Pilot's NATOPS Check List (NAVWEPS 01-60ABC-1B) should be used for in-flight reference.

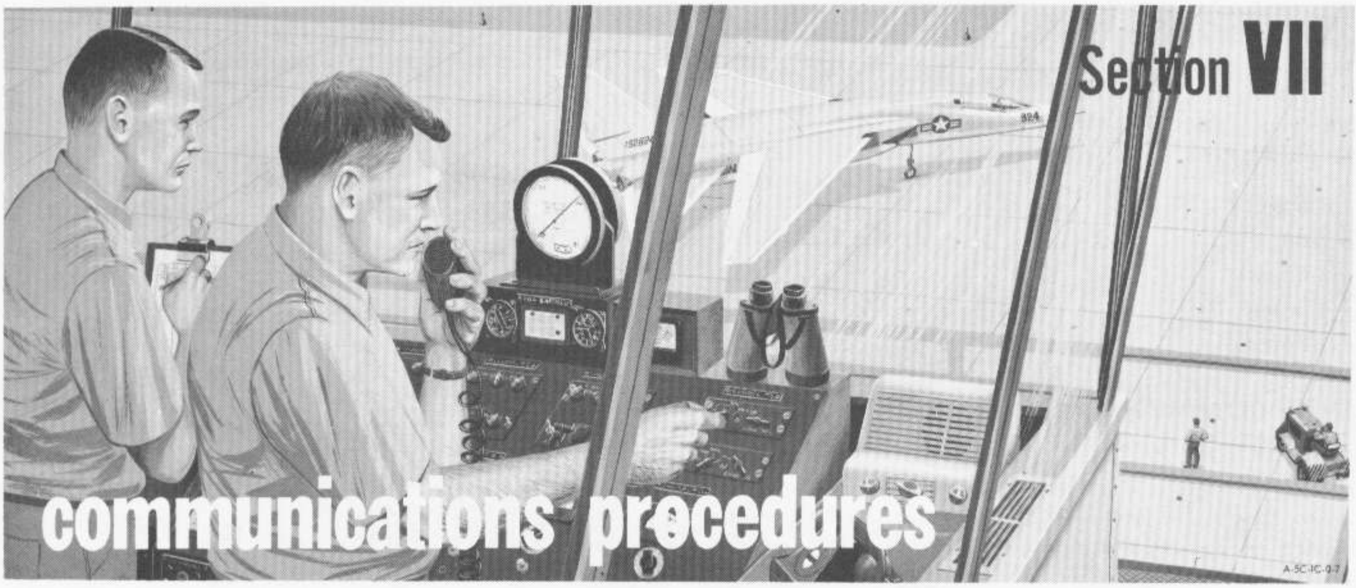


TABLE OF CONTENTS

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Multichannel/frequency UHF is the sole means of two-way voice communications. The systems operator will carry a copy of the current frequency plan for UHF on all flights. The auxiliary receiver may be used as a backup communications receiver.

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IFF/SIF PROCEDURES

Aircraft operating within the CONUS will operate the IFF/SIF equipment to conform with OPNAV/FAA regulations. During carrier operations, IFF will be operated as prescribed by current directives.

AUTHENTICATION

Authentication will be in accordance with the appropriate KAC-series, or as assigned by the Operational Commander.

EMERGENCY COMMUNICATIONS

Comply with OPNAV Instructions and the steps on the inside rear cover of FLIP, Enroute Supplement. Refer to Section V for aircraft distress reporting.

VISUAL COMMUNICATIONS

BETWEEN AIRCRAFT

Communications between aircraft within a formation will be conducted visually whenever practicable, provided no sacrifice in operational efficiency is involved.

Flight leaders will ensure that all aircraft in the formation receive and acknowledge signals when given. Visual signals as set forth in NWP 41(A) will be used. For emergency signaling, the FAA standard HEFOE system should be used:

1 finger	H	Hydraulic
2 fingers	E	Electrical
3 fingers	F	Fuel
4 fingers	O	Oxygen
5 fingers	E	Engine

INTERCOMMUNICATIONS SYSTEM FAILURE

If an ICS failure is experienced, the following procedures should be attempted in order to establish some degree of communications between the pilot and the systems operator.

IF PILOT LOSES ICS

To attract the systems operator's attention, proceed as follows:

1. Turn the MASTER ARM switch on and off three times.

   This will flash the systems operator's ARM MAST'R ON light.

2. Dial 333.3 on the UHF radio frequency indicator.
3. The systems operator will acknowledge by taking command of the UHF radio and redialing 333.3.

IF SYSTEMS OPERATOR LOSES ICS

To attract the pilot's attention, proceed as follows:

1. Stamp feet on cockpit floor.
2. The pilot will acknowledge by taking command of the UHF radio and dialing 333.3.
3. Refer to LOST ICS—UHF CODE in the Systems Operator's NATOPS Check List (NAVWEPS 01-60ABC-1D).

BOTH CREW MEMBERS

Upon receiving the loss of ICS signal, both crew members will refer to LOST ICS—UHF CODE procedure in their respective NATOPS Check List. The following codes will be used for further communication:

333.3 Select LOST ICS—UHF CODE.
333.0 Prepare to Eject.
333.1 Squawk MAYDAY.
333.2 Squawk PAN.
333.4 Heading to nearest airfield?
333.5 Commence Emergency Descent.
333.6 Oxygen Inoperative.
333.7 Prepare to land.
333.8 Returning to home field (carrier).
333.9 TACAN Out.

320.0 Are you OK?
320.1 I read you OK.
320.2 TACAN OK.
320.3 Can we continue run?
320.4 Select proper wing station.
320.5 Follow AAI.
320.6 Depress B/N SYS button.
320.7 Select MASTER ARM—ON.
320.8 Affirmative (Yes).
320.9 Negative (No).

310.0 My UHF OK.
310.1 AAI to Home.
310.2 AAI to Nearest Airfield.
310.3 Wheels and flaps down for landing.
310.4
310.5
310.6
310.7
310.8
310.9

Note

- Use codes 310.4 through 310.9 as locally directed or as prebriefed between individual crew members.
- Before selecting a UHF frequency for transmitting, switch to GUARD XMIT (243.0 mc) momentarily to let the other crew member know that the next frequency selected will be a transmitting frequency.
- The LOST ICS—UHF CODE procedure in the Pilot's NATOPS Check List (NAVWEPS 01-60ABC-1B) should be used for in-flight reference.

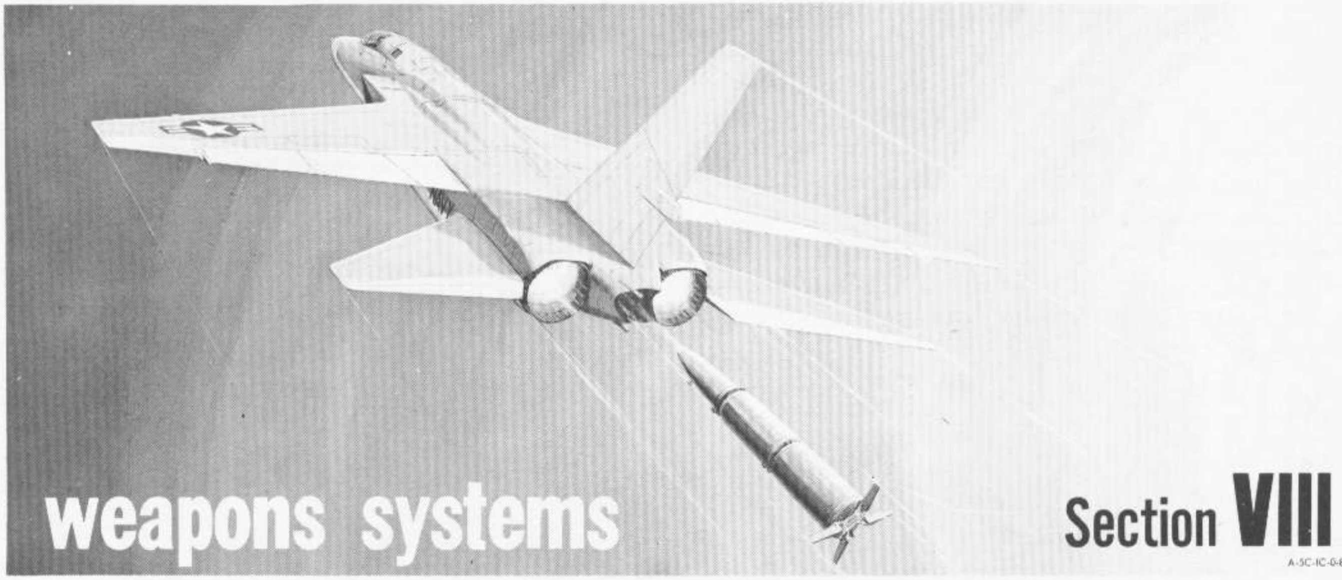

TABLE OF CONTENTS

WEAPONS DELIVERY

METHODS

The heavy attack mission requires the delivery of special or conventional weapons in all weather conditions, including tactical support for this capability. Delivery methods used are:

1. Horizontal bombing, all-weather level:
   - High level (above 55,000 feet).
   - Medium level.
   - Low level or laydown.
2. Maneuvering, all-weather:
   - Loft, medium angle.
   - Over-the-shoulder, high angle.
   - Pop-up from low-altitude approach.
3. Visual bombing:
   - Dive.
   - Dive toss.
   - Low level.
4. Alternate LABS, visual:
   - Loft, medium angle.
   - Over-the-shoulder, high angle.
   - Laydown.

LOADING AND SAFETY PRECAUTIONS

Refer to Supplemental Handbook, Special Stores for Navy Model RA-5C Aircraft (NAVWEPS 01-60ABC-13). Special weapons check lists for the RA-5C are as follows:

SPECIAL WEAPON	CHECK LIST
MK 28 (Internal)	NAVWEPS 01-60ABC-14
MK 28 (External)	NAVWEPS 01-60ABC-16
MK 43 (Internal)	NAVWEPS 01-60ABC-15
MK 43 (External)	NAVWEPS 01-60ABC-17
MK 57 (External)	NAVWEPS 01-60ABC-18

PREFLIGHT

WEAPONS SYSTEM

Preflight of the aircraft weapons system and carriage hardware (internal and/or external) shall be governed by the appropriate NAVWEPS or conventional weapons loading pre-take-off check lists.

CAUTION

- The store ejection gun shall be handled and inspected by authorized personnel only.
- Electric primers, squibs, or ejection cartridges shall be handled by authorized personnel only.
- Flight crews shall be familiar with the radiation hazards in regard to these items.

A satisfactory armament system release check shall be completed prior to loading ordnance on any aircraft. When operationally feasible, all ordnance loading will be completed 1 hour prior to scheduled launch time. Prior to loading, the ordnance crew leader shall ensure that all armament switches are OFF or SAFE, all switch guards are in place, and all bomb rack safety pins are installed. Once an aircraft is loaded, it will be attended by an ordnance man until it departs for flight.

All items specified on the preflight weapons check list, as applicable, shall be completed prior to crew acceptance of the aircraft weapons load.

BOMBING SYSTEMS

The preflight of the aircraft bombing systems (AN/ASB-12 and LABS) should include a review of recent systems discrepancies and cover all items of the AN/ASB-12 preflight check list. Knowledge of the status of inertial alinement is fundamental to primary weapons system capability. The systems operator shall make a positive check to ensure that the required ballistic adapters are aboard for the delivery modes and weapons to be used.

AIRCRAFT

The aircraft preflight shall include a review of aircraft status reports in regard to aircraft capability to perform required methods of weapons delivery.

MISSION PERFORMANCE

BRIEFING

The flight crews of all flights using ordnance will be briefed on the following:

1. Fuze settings, arming times, delays, and minimum altitude required for arming.
2. Pre-drop procedures.
3. Safety measures, including minimum safe drop altitude, jettison procedures, divert, and misfire procedures.
4. Safety procedures to be followed on completing bombing runs.
5. Safety procedures to be accomplished prior to landing.

PRE-TAKE-OFF

Air crew members will complete the following:

1. Check ordnance load for security and correctness.
2. Upon manning the aircraft, the pilot shall ensure that the MASTER ARM switch is OFF and that all delivery mode select buttons are in the OUT position. The systems operator shall ensure that the STATION SELECT and manual release buttons are OUT. When safety guards are provided for switches and buttons, they must be in place and properly secured.
3. An ordnance man shall stand by in full view of the pilot until the pilot signals for removal of the armament safety pins. After power has been applied to the aircraft and the pilot has checked all armament switches, etc, he shall signal the ordnance man to pull the armament safety pins by holding his left hand up in view of the ordnance man, clenching it into a fist, enclosing the thumb of his right hand, and extracting the thumb from the fist. To have the pins reinstalled, the reverse procedures shall be used.
4. The standard bomb bay door signals prescribed in NWP 41(A) shall be employed when utilizing Aero 8A practice bomb containers.
5. The pilot and systems operator shall complete their portion of the weapons and bombing system check lists.

IN FLIGHT

As much as possible, the conduct of the in-flight portion of the mission shall be in accordance with the preplanned profile and master time schedule. Deviations will be at the discretion of the pilot, with just reason, on the basis of mission requirements. In-flight weapons checks will be conducted as specified and in accordance with NAVWEPS or conventional ordnance check lists. The systems operator will inform the pilot of evident or suspected systems malfunctions affecting operational capability and give appropriate recommendations to aid the pilot in his decision to abort or to continue the mission.

BOMB RELEASE

1. Missions may include bombing runs using one or more of the following methods of release:

   (a) High-altitude horizontal, with automatic release from the AN/ASB-12 bomb directing set.

   (b) Low-altitude horizontal (laydown), with automatic release from the AN/ASB-12 bomb directing set.

   (c) Low-altitude horizontal, with manual release initiated by the pilot or systems operator.

   (d) Low- or medium-angle loft, with automatic release from the AN/ASB-12 bomb directing set or the flight reference set (LABS).

   (e) High-angle loft (over-the-shoulder), with automatic release from the AN/ASB-12 bomb directing set or the LABS.

   (f) Dive toss, with automatic release from the AN/ASB-12 bomb directing set.

   (g) Dive bombing, with manual release by the pilot.

2. In the event a malfunction is known to exist that will preclude automatic AN/ASB-12 or LABS release, the following alternate methods may be used at the discretion of the pilot:

   (a) Low- or high-altitude horizontal runs may be completed using the best information available, including remaining operable portions of the AN/ASB-12, except the pilot will select the manual release mode and the pilot or systems operator will release the stores manually.

   (b) Loft bombing runs may be completed using the following procedures:

      (1) The systems operator precomputes the pull-up range for the weapon to be released, utilizing aircraft gross weight and run-in altitude.

      (2) The pilot selects manual release, initiates pull-up at the precomputed pull-up point, and executes the prescribed maneuver.

      (3) The pilot calls out pitch angle every 5 degrees and, when the desired pitch angle is reached, the systems operator manually pickles off the bomb.

3. The internal jettison button can be used as an additional backup for internal stores.
   If the external jettison button is used for backup release of mechanically fuzed conventional bombs, all external stores will release in salvo and in an unarmed condition.

4. Crew members will ensure that all switch and button guards remain in place and that proper procedures are followed to prevent inadvertent release. The approved release system check list shall be used on all bombing runs.

5. The safety guard provided for all pilot's jettison buttons will remain secured except during take-off and landing, or when a decision has been made to jettison the stores.

6. All pylons installed will be equipped with jettison cartridges, except when otherwise directed by the Commanding Officer. Jettisoning of pylons normally will be reserved for in-flight emergencies or when range and/or speed requirements of the mission require a clean aircraft. If the preplanned cruise control and/or profile of the mission requires pylon jettisoning, it should be accomplished as soon after external store release as practicable.
   To ensure clean separation, jettisoning of external stores normally will be accomplished with positive "g's" applied to the aircraft.

7. All armament switches will be returned to either OFF or SAFE prior to landing.

POSTFLIGHT

1. Armament safety pins will be installed in all aircraft returning from a flight. All ordnance remaining on the aircraft will be unloaded for further disposition.

2. All discrepancies within the armament release system will be corrected prior to scheduling the aircraft on an additional flight which includes the use of ordnance materials.

TACTICAL

Delivery tactics, special equipment check lists, and planning and fuzing forms for weapons delivery are contained in the A-5 Supplement to NWIP 41-3. Planning for the mission should include consideration of all tactical aspects of the planned mission, including:

1. Strike radius, route versus tactical time requirements.

2. Primary/secondary targets and delivery methods.

3. En route:
   Offense.
   Defense.

4. Target approach and retirement:
   Offense.
   Defense.

5. Weather:
   Navigation.

ATTACK MODE PROCEDURES

Refer to Section IX, Part 4, of the Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

For flight crew coordination procedures, refer to Section IX, Systems Operator's NATOPS Manual (NAVWEPS 01-60ABC-1C).

TABLE OF CONTENTS

PART 1 — STANDARDIZATION EVALUATION PROGRAM

CONCEPT

The operating procedures described in Sections I through IX represent the standardized methods of operating the aircraft. The ground and flight evaluations are intended to evaluate both individual and unit compliance with these procedures. The evaluations performed by the Standardization Instructor and the Standardization Evaluator are designed to aid the Unit Commanding Officer in improving individual and unit effectiveness through objective observation and constructive comments.

APPLICABILITY

The standardization evaluation check will be administered annually to all pilots in accordance with OPNAVINST P3710 and 3510 (series).

IMPLEMENTATION

The standardization evaluation check will be conducted in accordance with the instructions of the Type Commander; however, instruction in and observation of individual and unit adherence to standard operating procedures must be on a day-to-day basis within each unit to realize maximum benefit.

DEFINITIONS

The following definitions will apply to terms used in this section.

GRADING CRITERIA

The parts of this section that prescribe the standards to be used in determining grades as a result of the performance observed or recorded during the standardization evaluation check.

STANDARDIZATION EVALUATION RECHECK

A standardization evaluation check administered to a pilot who has been placed in an unqualified status. Only those areas in which an unsatisfactory level of knowledge or adherence to prescribed procedures is indicated will be observed during this check.

EMERGENCY

An aircraft component or system failure, or a condition that requires instantaneous recognition, analysis, and proper action.

MALFUNCTION

An aircraft component or system failure, or a condition that requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

AREA

A routine of flight preparation, flight, and postflight procedures which is observed and graded during a standardization evaluation flight.

SUB-AREA

That portion of an area that covers a specific single procedure or a particular aspect of maneuver performance, such as airspeed control on an instrument approach.

CRITICAL AREA

Any major area or sub-area which covers items of significant importance to the overall mission requirement or the marginal performance of which would jeopardize safe conduct of the flight. An unqualified rating in any critical area will result in an overall grade of Unqualified. Critical areas are preceded by an asterisk on the worksheet and in the grading criteria.

MINOR DISCREPANCIES AND/OR OMISSIONS

Minor discrepancies and/or omissions which will not adversely affect the successful completion of the mission or jeopardize the safety of the crew and/or equipment.

MOMENTARY DEVIATIONS

Deviations from the tolerances set forth in the grading criteria which are momentary in nature, and which will not be considered in marking, provided the individual being checked is alert in applying corrective action and the deviation does not jeopardize the safety of the aircraft or crew. Momentary deviations beyond the limitations prescribed for Conditionally Qualified will not be cause for downgrading unless the limit in question is marked with a double asterisk. Cumulative momentary deviations may result in downgrading in the applicable area or sub-area.

QUALIFIED (Q)

A pilot who has good knowledge of standard operating procedures and thorough understanding of aircraft capabilities and limitations.

CONDITIONALLY QUALIFIED (CQ)

A pilot who meets the minimum acceptable standards and is considered safe, and who is qualified to fly the aircraft solo/unchased. He needs more practice in specific areas to become qualified, and such flying may be of the self-practice type.

UNQUALIFIED (U)

A pilot who fails to meet minimum acceptable standards as established by these criteria. This pilot should have supervised instruction until he has gained a Qualified or Conditionally Qualified rating, and must accomplish a recheck within 60 days after receiving an Unqualified grade.

ANNUAL EVALUATION

A Standardization Evaluation Check will consist of ground phases (I and II) and a flight phase (III).

GROUND EVALUATION (PHASES I AND II)

The ground evaluation consists of two phases. Phase I is comprised of an oral walkaround examination on preflight and servicing items (Part 1), and an open and closed book written examination (Part 2). Phase II consists of a WST mission with emphasis placed on emergency procedures for the pilot and the systems operator.

ORAL EXAMINATION

The oral examination will cover selected items of the aircraft preflight inspection. In addition, the pilot will demonstrate knowledge of RA-5C servicing procedure sufficient to show that he could satisfactorily supervise the servicing of his aircraft by jet maintenance personnel (not trained for the RA-5C) at a strange field.

WRITTEN EXAMINATION

A bank of questions and answers will be maintained by the replacement squadron for the purpose of compiling the written examination. Examinations will be made up from these question banks by Instructors and Evaluators as they are required. Examinations will be kept in the custody of the Instructor or Evaluator concerned. The Evaluators will be responsible for the distribution, coordination, and updating of questions and answers.

Open Book

The open book examination will comprise 50 percent of the written examination.

Closed Book

The closed book examination will comprise 50 percent of the written examination.

Composition

Written examination questions will be taken from the following sources in the percentages shown:

SOURCE	OPEN (PERCENT)	CLOSED (PERCENT)
1. NATOPS Flight Manual	35	35
2. (Deleted.)		
3. Supplemental NATOPS Flight Manual	10	10
4. Station Ops Manual and/or Carrier Air Traffic Control Procedures	5	5

GROUND TRAINER PROCEDURES CHECK (PHASE II)

The WST/OFT/CPT check will be utilized emphasizing emergency procedures and normal procedures not observable in the flight check. The pilot grading form utilized on this check is shown in Part 3 of this section. Emphasis will be placed on the pilot's knowledge of emergency procedures. Normal procedures will be graded as they occur, but a grade of Unqualified in a critical area concerning normal procedures will not cause the check to be graded as Unqualified, unless Phase III is waived. A WST/OFT/CPT check must be administered, however, in every case where Phase III is waived.

Note

An aircraft cockpit may be utilized when the WST/OFT/CPT are not available.

FLIGHT EVALUATION (PHASE III)

Phase III is designed to measure the degree of standardization demonstrated by pilots. Although the check is not meant to grade proficiency or ability, objectivity requires the use of certain limits in order to measure all flight crew members against a recognized and realistic standard. These limits have been established with the idea that the vast majority of flight crew members who consistently follow standard procedures should have no difficulty staying within them. In order to record the grades achieved in each area and sub-area of the flight check, an evaluation report form (Part 2 of this section) will be completed for each flight evaluation.

FLIGHT EVALUATION SCORE

The flight evaluation is designed to evaluate crew member standardization in those areas of flight normally encountered in a mission. In those instances where some areas cannot be evaluated, the cognizant Standardization Evaluator will determine whether or not the flight will be counted as a completed check or must be reflown. In each case where all areas are not graded, the Evaluator/Instructor must include the reasons therefore, with his remarks on the evaluation report form if a waiver is being requested. The Standardization Evaluator will review each such situation individually and will grant or reject each request for a waiver, based on the individual merits of the case. Waivers will be granted or rejected in writing, with appropriate remarks in the evaluation report form.

FLIGHT EVALUATION

The flight evaluation shall consist of a mission, including photo-reconnaissance and weapons delivery, planned and flown in accordance with current NATOPS procedures. SLR, data matrix blocks, and camera coverage may be used to ensure compliance with planned track and conformance to standard procedures. The mission shall consist of the items listed in the following paragraphs.

Note

An asterisk indicates a critical area, sub-area, or question unless otherwise indicated.

MISSION PLANNING

1. Route Planning.
2. Fuel Planning.
3. Flight Plan.
4. Take-off Computation.

*PREFLIGHT

*1. Acceptance of the Aircraft.
2. Preflight Inspection.

*EMERGENCIES

*1. Engine Malfunctions.

*2. Fuel System Failures.

*3. Electrical System Failures.

*4. Hydraulic System Malfunctions.

*5. Flight Control System Malfunctions.

*6. Reconnaissance Systems Malfunctions.

*7. Flight Reference Set Malfunctions.

*8. Bomb Directing Set Malfunctions.

*TACTICS

*1. High-altitude Horizontal Bombing.

*2. Laydown.

3. (Deleted.)

*4. Reconnaissance.
*(a) Photo coverage.
(b) SLR.

POSTFLIGHT AND DEBRIEFING

1. (Deleted.)

2. Postflight.

3. Debriefing.

GRADING INSTRUCTIONS

PHASE I (ORAL EXAMINATION)

The oral examination will be graded in two parts.

PART ONE (PREFLIGHT INSPECTION)

Part One will consist of pilot's preflight inspection items. A grade of Qualified will be assigned if the pilot being graded can satisfactorily explain 95 percent or more of the items selected (Conditionally Qualified, 90 to 95 percent), and none of the items not satisfactorily explained would jeopardize safety of flight or ability to accomplish the mission.

A grade of Unqualified will be assigned if the pilot being graded cannot satisfactorily explain 90 percent of the items selected, or cannot satisfactorily explain an item which would jeopardize safety of flight or ability to accomplish the mission.

PART TWO (SERVICING)

Part Two will consist of a demonstration by the pilot of his knowledge of servicing procedures. A grade of Qualified will be assigned if the pilot being graded demonstrates sufficient knowledge of the servicing procedures to be able to supervise servicing with the help of jet maintenance personnel (not RA-5C qualified) at a strange field for each of the following systems:

1. Fuel.
2. Hydraulic.
3. Engine Oil.
4. Pneumatic.
5. Liquid Oxygen.

A grade of Unqualified will be assigned if the pilot being graded does not demonstrate sufficient knowledge of servicing procedures to supervise servicing as required for Qualified.

ORAL EXAMINATION MATERIALS

An oral examination form is shown in Part 3 of this section. Although the two parts are graded separately, only one grade is given for the entire oral examination. If a grade of Unqualified is obtained on either portion, then the entire oral examination is graded Unqualified; however, only the portion graded Unqualified will be covered on the re-examination.

PHASE I (WRITTEN EXAMINATION)

OPEN BOOK EXAMINATION GRADING CRITERIA

To obtain a grade of Qualified on the open book examination, a minimum score of no lower than 3.5 must be achieved.

CLOSED BOOK EXAMINATION GRADING CRITERIA

To obtain a grade of Qualified on the closed book examination, a minimum score of no lower than 3.3 must be achieved.

PHASE II (WST/OFT/CPT CHECK)

Using the check form shown in Part 2 of this section, both normal and emergency procedures for the pilot will be graded as follows.

EMERGENCIES/MALFUNCTIONS

If proper corrective action is initiated within the time limits specified on the forms shown in Parts 2 and 3 of this section, the response will be graded Qualified or Conditionally Qualified, according to the reaction time. The response will be graded Unqualified if the reaction time for Conditionally Qualified is exceeded. For those emergencies or malfunctions where no reaction time is specified, the criteria will be graded as follows: If proper action is initiated with minimum delay, the response will be graded as Qualified. If action is initiated with some delay and nonstandard procedures are utilized but the emergency is successfully coped with, the response will be graded Conditionally Qualified. If action is not initiated in time to prevent jeopardizing safety of flight or if nonstandard procedures are utilized which fail to correct the emergency, the response will be graded Unqualified.

Emergencies in each section will be graded as follows: If any emergency or malfunction is graded Unqualified, the area grade will be Unqualified; if less than half the emergencies or malfunctions are graded Qualified, the area grade will be Conditionally Qualified; if more than half of the emergencies or malfunctions are graded Qualified, the area grade will be Qualified.

NORMAL PROCEDURES

Normal Procedures will be graded using the criteria in this section.

NORMAL PROCEDURES AND EMERGENCY PROCEDURES

Normal procedures and emergency procedures will be graded separately. The overall grade will be determined as follows:

Qualified	Both procedures graded Qualified, or the emergency procedures graded Qualified and the normal procedures graded Conditionally Qualified.
Conditionally Qualified	Both procedures graded Conditionally Qualified, or the emergency procedures graded Conditionally Qualified and the normal procedures graded Qualified.
Unqualified*	Either or both examinations graded Unqualified.

*If Phase III is waived. If Phase III is completed, a grade of Unqualified in normal procedures will not bring the overall grade below Conditionally Qualified.

PHASE III (FLIGHT EVALUATION)

In answering each question: if yes, mark Qualified; if no, but these are extenuating circumstances or if only a qualified yes, mark Conditionally Qualified; if the answer is an unqualified no or if the extenuating circumstances are not an adequate explanation, mark Unqualified.

MISSION PLANNING

1. Route Planning.
   (a) Were all necessary charts and publications drawn?
   (b) Was planning commenced in sufficient time to permit meeting the scheduled launch time without undue hurrying and/or omitting necessary items?
   (c) Was an accurate in-flight card prepared, showing distance, time, and Navaids for each leg?
   (d) Were alternate landing fields appropriate to the flight preplanned?
   (e) Were all NOTAMS and other necessary information sources checked?
   (f) Were predicted winds used in flight planning?
   (g) Was an alternate plan computed in the event fuel ran below that predicted?
2. Fuel Planning.
   (a) Were fuel checks computed at the end of each leg or each half hour and each minute of AB operation?
   (b) Was fuel, time, and speed information taken from the Supplemental NATOPS Flight Manual or appropriate REST computer?
   (c) If supersonic, was an alternate Hot Day profile computed?
   (d) Were cruising speeds computed as either Mach number or KIAS?
3. Flight Plan.
   (a) Was weather briefing completed, including wind data?
   (b) Was DD-175 or other applicable flight plan properly filled out without error or omission in accordance with existing directives?
4. Take-off Computations.
   (a) Were take-off computations accurately computed in accordance with existing directives?

*PREFLIGHT

*1. Acceptance of the Aircraft.
   (a) Were a minimum of 10 yellow sheet parts "B" checked if available?
   (b) Was the Plane Captain's preflight completed and the yellow sheet part "A" properly filled in and signed prior to acceptance of the aircraft?
   *(c) Did the pilot accept an aircraft with unexplained discrepancies which could affect safety of flight and/or accomplishment of the mission? (Grade either Q or U.)

2. Preflight Inspection.
   (a) Did the pilot complete the external inspection, noting each item on the inspection check list?

(b) Was pilot wearing appropriate flight gear considering type of flight and time of year?

(c) Was pilot's personal equipment operable and within a current inspection period?

*EMERGENCIES

Emergency procedures will be graded by utilizing the WST, OFT, or CPT. If these trainers are not available, the pilot will be visually and verbally graded in the cockpit of the actual aircraft. If an actual emergency occurs during the flight evaluation, it should be evaluated as feasible, according to the following criteria.

Qualified	Recognized the emergency situation with a minimum of delay or within time limits specified. Took timely and appropriate action in accordance with governing directives.
Conditionally Qualified	Recognized emergency situation with delay not endangering safety of flight or exceeding time limits specified. Successfully coped with the situation but deviated from governing directives.
Unqualified	Failed to recognize situation or exceeded time limits for Conditionally Qualified. Use of improper procedures or unnecessary delay in commencing corrective action allowed controllable situation to proceed out of control. Endangered safety of flight.

Note

()—Denotes time limit for Qualified.

#—Denotes time limit for Conditionally Qualified.

*1. Engine Malfunctions.

(a) Wet start	(5 secs)	#8 secs
(b) False start	(5 secs)	#8 secs
(c) Hot start	(5 secs)	#8 secs
*(d) Engine failure		
*(e) Engine fire	(5 secs)	#8 secs
(f) Low oil pressure		
(g) Autoacceleration		

*2. Fuel System Failures.

(a) Failure of bomb bay can transfer.

(b) Failure of wing tank transfer.

*3. Electrical System Failures.

(a) Loss of either a-c generator	(5 secs)	#8 secs
*(b) Loss of all a-c power	(3 secs)	#5 secs
(c) Loss of d-c inverter	(5 secs)	#8 secs
*(d) Loss of all a-c and d-c power	(3 secs)	#5 secs

*4. Hydraulic System Malfunctions.

(a) Loss of either pump, No. 1 system	(8 secs)	#12 secs
(b) Loss of both pumps, No. 1 system	(5 secs)	#8 secs
(c) Loss of either pump, No. 2 system	(8 secs)	#12 secs
(d) Loss of both pumps, No. 2 system	(5 secs)	#8 secs
(e) Loss of hydraulic fluid in either system	(5 secs)	#8 secs
*(f) Wing flap emergency operation		
*(g) Landing gear emergency operation		
(h) Failure of gear to retract		

*5. Flight Control System Malfunctions.

(a) Loss of pitch aug	(3 secs)	#5 secs
*(b) Runaway trim (roll, pitch, or yaw)	(3 secs)	#5 secs
(c) Failure of normal trim system		
*(d) Malfunction in lateral or longitudinal system	(3 secs)	#5 secs

6. (Deleted.)

*7. Flight Reference Set Malfunctions.

*TACTICS

*1. High-altitude Horizontal Bombing (RBS or Pinpoint).

*2. Laydown.
   (a) Was preplanned IP utilized?
   (b) (Deleted.)
   *(c) Was run-in altitude within limits?
   (d) Did weapon release?

3. (Deleted.)

*4. Reconnaissance.
   *(a) Was photo coverage on preplanned track and altitude?
   (b) Was SLR on preplanned track and altitude?

Pages 231 and 232 deleted.

POSTFLIGHT AND DEBRIEFING

1. (Deleted.)

2. Postflight.
   (a) Did pilot perform postlanding aircraft inspection?

3. Debriefing.
   (a) Were yellow sheet entries made accurately and correctly?
   (b) Were discrepancies reported in writing, using accepted terminology and in a clear, concise manner?
   (c) Were debriefing and other required postflight forms filled out?
   (d) Was crew debriefed by applicable debriefing officer in accordance with governing directives?

FINAL GRADE DETERMINATION

PHASE I

The overall grades for the oral examination and the written examination will be determined as described under GRADING INSTRUCTIONS. A final grade of Qualified will be given for Phase I if both examinations are graded Qualified. A final grade of Conditionally Qualified will be given if either examination is graded Conditionally Qualified. A final grade of Unqualified will be given if either examination is graded Unqualified.

PHASE II

The overall grade for this phase will be determined as described under PHASE II (WST/OFT/CPT CHECK) and will serve as the final grade for this phase.

PHASE III

The overall grade for the flight evaluation will be determined as described and will serve as the final grade for this phase. In grading each sub-area question, the following numerical equivalents shall be used:

Qualified—2.0

Conditionally Qualified—1.0

Unqualified—0

The overall grade will be determined by the average of all areas graded. Average grades must fall in the following ranges for corresponding adjective grades shown:

Qualified—2.0 to 1.5

Conditionally Qualified—1.49 to 1.0

Unqualified—0.99 to 0

FORMS AND RECORDS

FORMS

The forms described will be used in recording data and reporting grades:

1. Annual Standardization Evaluation Form.
2. Pilot's Grading Form.
3. Oral Examination Worksheet.
4. Standardization Evaluation Worksheets.

RECORDS

The Stan/Eval forms and worksheets used on each standardization evaluation will be retained by the Unit Standardization Instructor concerned until the standardization evaluation for the following year is successfully completed. The Standardization Evaluation form used on each standardization evaluation will be retained by Unit Standardization Instructor for as long as the crew member concerned is serving in that unit.

Unit Standardization Instructors will maintain a record of flight crew members assigned and the standardization evaluation phases they have completed.

CRITIQUE

Each phase will be critiqued separately as follows:

1. PHASE I. Both the oral and written examinations will be critiqued by the Standardization Instructor/ Evaluator.
2. PHASE II. Each crew member will be critiqued individually by the Standardization Instructor/ Evaluator.
3. PHASE III. Each crew member will be critiqued individually by the Standardization Instructor/ Evaluator.

Critiques will be formally conducted, scheduled events. The Standardization Evaluation form will be completed at the Phase III critique and will be forwarded immediately afterward, with pertinent comments and recommendations made at the critique, to the Unit Commanding Officer.

If the standardization evaluation is being conducted by the Standardization Evaluators, an additional critique will be held with the Unit Commanding Officer and Unit Standardization Instructors present, at which time the unit standardization program will be reviewed and pertinent comments and recommendations made.

PART 2 — STANDARDIZATION EVALUATION FORM

STANDARDIZATION EVALUATION FORM		STAN/EVAL	DATE
PILOT______ *S/O______		RECHECK	

INSTRUCTIONS

1. This form will be completed in accordance with instructions contained in Section X, NATOPS Flight Manual (NAVWEPS 01-60ABC-1).
2. Entries on this form will be made by the Standardization Evaluator/Instructor.
3. Comments will be made stating reason for failure to complete Sub-area/Item.

NAME	RANK/RATE	FILE/DESIG/SERIAL
SQUADRON/DETACHMENT	DATE OF BIRTH	AC TYPE/MODEL

PREREQUISITES

FLIGHT	PREVIOUS 6 MO	PREVIOUS 12 MO	TOTAL HOURS	GROUND	PREVIOUS 6 MO	PREVIOUS 12 MO	TOTAL HOURS
PILOT TIME				WST			
FIRST PILOT TIME				LINK			
*RA-5C SPECIAL CREW TIME				OFT			
SIM. INST. TIME				CPT			
ACT. INST. TIME				RA-5C COCKPIT			
INST. APPROACHES							
CCA/GCA							
*RA-5C CV LDGS D/N	/	/					
*RA-5C LOFTS	/	/					
*BOMB DROPS							
*RBS RUNS							
*SLR RUNS							
*PHOTO RECON RUNS							
*PECM RECON RUNS							

DATE OF FLIGHT CHECK	OVERALL GRADE ASSIGNED	EVALUATOR/INSTRUCTOR

EVALUATOR/INSTRUCTOR: REMARKS/RECOMMENDED CORRECTIVE ACTION

Evaluator/Instructor	Date	Signature

SQUADRON COMMANDING OFFICER: REMARKS

Squadron Commanding Officer	Date	Signature

CORRECTIVE ACTION COMPLETED:

Squadron Commanding Officer	Date	Signature

PILOT GRADING FORM

(PHASES I AND II)

ITEM	DATE	GRADE
CLOSED BOOK		
OPEN BOOK		
WST/OFT/CPT		
ORAL EXAMINATION		

FLIGHT (PHASE III)

AREA	SUB-AREA/ITEM								AREA GRADE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Q	CQ	U
MISSION PLANNING											
PREFLIGHT											
EMERGENCIES											
TACTICS											
POSTFLIGHT AND DEBRIEFING											

PART 3 — PILOT STANDARDIZATION EVALUATION WORKSHEETS

Pilot's Oral Examination Worksheet

PHASE I

Pilot________________________________

Squadron________________ Date________________

Evaluator/Instructor______________________________

Part I EXTERIOR INSPECTION

Q—95% or better; CQ—90% to 95%; U—less than 90%
Failure to properly check any one essential item—U.

Part I Grade________________

Part II AIRCRAFT SERVICING

Mark the questions Q or U as indicated by the level of knowledge observed. The grade for each system should indicate whether or not the pilot observed can satisfactorily supervise the servicing of the aircraft in that system.

SYSTEM	MATERIAL REQ'D	EQUP'T REQ'D	SERV. TECHNIQUE	GRADE
FUEL				
HYDRAULIC				
ENGINE OIL				
PNEUMATIC				
LIQUID OXYGEN				

A grade of Q is required in each system or the grade for part II will be U.

Part II Grade__________

Part I Part II FINAL GRADE

page 1

STANDARDIZATION/EVALUATION WORKSHEET
WST/OFT/CPT CHECK—PILOT

SQUADRON____________________ DATE____________________

CREW POSITION	NAME	RANK	FILE/SERVICE

EVALUATOR/INSTRUCTOR

____

DESCRIPTION OF SIMULATED FLIGHT

Both NORMAL and EMERGENCY procedures for the pilot will be graded as follows:

EMERGENCIES/MALFUNCTIONS: If proper corrective action is initiated within the time limits specified, the response will be graded Q or CQ, according to the reaction time. The response will be graded U if the reaction time for CQ is exceeded. For those emergencies or malfunctions where no reaction time is specified, the criteria will be graded as follows: If proper action is initiated with minimum delay, the response will be graded as Q. If action is initiated with some delay and nonstandard procedures are utilized but the emergency is successfully coped with, the response will be graded CQ. If action is not initiated in time to prevent jeopardizing safety of flight or if nonstandard procedures are utilized which fail to correct the emergency, the response will be graded U.

STANDARDIZATION/EVALUATION WORKSHEET
01-60ABC-1).

Emergencies in each section will be graded as follows: If any emergency or malfunction is graded U, the area grade will be U; if less than half the emergencies or malfunctions are graded Q, the area grade will be CQ; if more than half of the emergencies or malfunctions are graded Q, the area grade will be Q.

I PRESTART

Time started check list__________

Items missed on check list:

ITEM NO	ITEM	RESPONSE

page 2

Check list completed____________

Discrepancies missed by pilot:

		U	CQ	Q	TIME
II	START/GROUND CHECKS Emergencies/Malfunctions	__	__	__	____
	1.____________________	__	__	__	____
	2.____________________	__	__	__	____
	3.____________________	__	__	__	____
	4.____________________	__	__	__	____

COMMENTS:

Items missed on Ground Checks

ITEM NO	ITEM	RESPONSE

Taxi Time____________

III PRE-TAKE-OFF/TAKE-OFF

Items missed on Pre-take-off Check

ITEM NO	ITEM	RESPONSE

Full Power Check __ __ __

Take-off Time____________

page 3

Emergencies/Malfunctions	U	CQ	Q	TIME
1.______	__	__	__	____
2.______	__	__	__	____
3.______	__	__	__	____
4.______	__	__	__	____

COMMENTS:

IV DEPARTURE

	U	CQ	Q	TIME
Followed Departure Clearance	__	__	__	
Voice Reports	__	__	__	
Gear Up: ______KIAS______Rate of Climb				
Flaps Up:______KIAS______Altitude				
Climb Schedule	__	__	__	
Post-take-off Items Missed	__	__	__	
1.______	__	__	__	
2.______	__	__	__	
3.______	__	__	__	
4.______	__	__	__	
Emergencies/Malfunctions				
1.______	__	__	__	____
2.______	__	__	__	____
3.______	__	__	__	____
4.______	__	__	__	____
5.______				

COMMENTS:

page 4

V	LEVEL-OFF/CRUISE	U	CQ	Q	TIME
	Voice Reports				
	Followed Clearance				
	Aircraft Control				
	Pilot's Bomb Switches for RBS				
	Knowledge of FAA Procedures				
	Emergencies/Malfunctions				
	1.				
	2.				
	3.				
	4.				
	5.				
	6.				
	7.				
	8.				
	9.				
	10.				

COMMENTS:

VI	LOW-LEVEL CRUISE/LOW-LEVEL ATTACK	U	CQ	Q
	Followed NAV Steering			
	Airspeed Control			
	Altitude Control			
	Bomb Switches Positioned			
	Run-in Airspeed			
	Run-in Altitude			
	Attack Technique			

page 5

Emergencies/Malfunctions	U	CQ	Q	TIME
1.____________	__	__	__	____
2.____________	__	__	__	____
3.____________	__	__	__	____
4.____________	__	__	__	____

COMMENTS:

VII HOLDING/PENETRATION/APPROACH

	U	CQ	Q	TIME
Holding Pattern Entry	__	__	__	
Holding Pattern	__	__	__	
Holding Airspeed	__	__	__	
Holding Altitude	__	__	__	
Number of Circuits Made	__	__	__	
Penetration Procedures	__	__	__	
Penetration Airspeed	__	__	__	
Penetration Rate of Descent	__	__	__	
Transition to Level-off	__	__	__	
Transition to P/A	__	__	__	
Final Approach Airspeed	__	__	__	
Final Approach MIN ALT	__	__	__	
Recognized Missed Approach +______–______				
Voice Procedures	__	__	__	
Emergencies/Malfunctions				
1.____________	__	__	__	____
2.____________	__	__	__	____
3.____________	__	__	__	____
4.____________	__	__	__	____
5.____________	__	__	__	____
6.____________	__	__	__	____

COMMENTS:

page 6

GRADING

NORMAL PROCEDURES	U	CQ	Q
TOTAL GRADED	___	___	___
NORMAL PROCEDURES GRADE ______			
EMERGENCIES/MALFUNCTIONS			
TOTAL GRADED	___	___	___
EMERGENCY PROCEDURES GRADE ______			
PHASE II GRADE ______			

TRAINER INSTRUCTOR ______________________

NATOPS EVALUATOR/INSTRUCTOR ______________________

PILOT STAN/EVAL WORKSHEETS

page 1

Squadron__________ Date__________ BuNo__________

Name__________ Rank__________ Serial__________

Evaluator/Instructor__________

Description of Mission Flown

NOTE: Information on the following pages will be filled in as accurately as possible. When additional comments are required to clearly describe performance, they should be placed on the backs of adjoining pages.

page 2

MISSION PLANNING

(1) Route Planning

	YES	NO	COMMENTS
1. Were necessary charts and pubs drawn?	___	___	________
2. Adequate time allowed for planning?	___	___	________
3. Suitable in-flight card prepared?	___	___	________
4. Alternate fields?	___	___	________
5. NOTAMS, etc, checked?	___	___	________
6. Predicted winds used?	___	___	________
7. Alternate plans?	___	___	________

Comments:

(2) Fuel Planning

	YES	NO	COMMENTS
1. Fuel checks planned?	___	___	________
2. Source for fuel planning was:	________		
3. Hot Day fuel plan made if required?	___	___	________
4. Cruising speeds computed as IMN or KIAS?	___	___	________

Comments:

(3) Flight Plan

	YES	NO	COMMENTS
1. Complete Wx briefing obtained?	___	___	________
2. DD-175 completed without error?	___	___	________

Comments:

(4) Take-off Computations

T. O. Alt________GWT/CG________. Runway Temp.________. Wind________.

	Pilot Comp	Evaluator Comp
T. O. Roll		
T. O. Airspeed		

page 3

*PREFLIGHT

	YES	NO	COMMENTS
*(1) Aircraft Acceptance			
1. How many prior yellow sheets checked?	___	___	___
2. Plane Captain's preflight completed and yellow sheet signed off?	___	___	___
*3. Plane accepted with unexplained critical gripes?	___	___	___

Comments:

	YES	NO	COMMENTS
(2) Preflight Inspection			
1. External inspection complete all items?	___	___	___
2. Pilot's flight gear adequate?	___	___	___
3. Pilot's personal equipment current?	___	___	___

Comments:

page 4

*EMERGENCIES

Actual emergencies occurring in flight should be written up as well as possible under the circumstances.

Type Emergency:

Pilot Reaction:

*TACTICS

*(1) High-altitude Bombing

Type: RBS______ Pinpoint______

Comments:

page 5

	YES	NO	COMMENTS
*(2) Laydown			
1. Was preplanned IP utilized?			
2. (Deleted.)			
*3. Run-in altitude deviation:			
4. Weapon release?			
*(3) (Deleted.)			

Comments:

	YES	NO	COMMENTS
*(4) Reconnaissance			
*1. Photo coverage:			
On preplanned track?	___	___	___________
On preplanned altitude?	___	___	___________
2. SLR:			
On preplanned track?	___	___	___________
On preplanned altitude?	___	___	___________

POSTFLIGHT AND DEBRIEFING

	YES	NO	COMMENTS
(1) (Deleted.)			
(2) Postflight			
1. Aircraft parked and shut down IAW SOP?	___	___	___________
2. Did pilot perform postlanding aircraft inspection?	___	___	___________

Comments:

	YES	NO	COMMENTS
(3) Debriefing			
1. Yellow sheet entries proper?	___	___	___________
2. Discrepancies written up clearly and concisely?	___	___	___________
3. Debriefing forms filled out as applicable?	___	___	___________
4. Crew debriefed as required?	___	___	___________

Comments:

Pages 253 through 256 deleted.

ALPHABETICAL INDEX

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