NAVAL AIR TRAINING COMMAND

FUEL SYSTEM

NATIP SYSTEM UNIT

UC 09 03 02 05 ER

CNAT P-1008 (Rev. 1-82) PAT

T-28 ENGINEERING
PRIMARY

1982

NAVAL AIR STATION · CORPUS CHRISTI, TEXAS

CHIEF OF NAVAL AIR TRAINING
NAVAL AIR STATION
CORPUS CHRISTI, TEXAS 78419

Code 313

19 JAN 1982

1. CNAT P-1008 (Rev. 1-82) PAT, "Fuel System, NATIP System Unit UC 09 03 02 05 ER, T-28 Engineering, Primary," is promulgated for information, standardization of instruction and guidance of instructors and students in the Naval Air training Command.

2. This publication will be used to implement the academic portion of the Primary curriculum.

3. Recommendations for changes shall be submitted to the Commander, Training Air Wing FOUR.

4. CNAT P-1008 (Rev. 1-77) PAT is hereby canceled and superseded.

Joe L. Shaw
J. L. SHAW
Assistant Chief of Staff for
Training and Operations

Distribution:
CNATRA (4)
COMTRAWING FOUR (4) PLUS ORIGINALS
COMTRAWING FIVE (4)
CO, NAS CORPUS CHRISTI (750)
CO, NAS WHITING FIELD (400)

TABLE OF CONTENTS

NAVAL AIR TRAINING COMMAND

PRIMARY PHASE

DISCIPLINE: Engineering

COURSE TITLE: Engineering, T-28 (Primary)

UNIT: Fuel System, NATIP System Unit

PREREQUISITES: Units 1-4

FOR INSTRUCTIONAL PURPOSES ONLY

SCOPE: The purpose of this unit is to show schematically the T-28 fuel system and to familiarize the student with the components in the system, their function and capability, and to acquaint the student with system operation.

SPECIFIC INSTRUCTIONAL OBJECTIVES

Affective Domain

1. To afford the student the opportunity to view, schematically, the T-28 fuel system (Valuing).

2. To direct the student's attention to the components within the system, their function, limitations, and emergency capability, and to the system operation (Receiving).

3. To require the student to respond correctly to specific questions relative to the fuel system (Responding).

4. To afford the student an opportunity to decide the value of the information presented in this unit to him as an aviator (Valuing).

Cognitive Domain

Upon completion of this unit of instruction the student will:

1. State the fuel capacity in gallons and pounds (Comprehension).

2. Recall the fuel pumps by power source and type (Knowledge).

3. State the normal fuel pressure for the fuel boost pump and engine-driven pump (Comprehension).

4. State the function of (Comprehension):
   a. Sump tank
   b. Boost pump
   c. Gravity-feed manifold
   d. Vent system
   e. Fuel shutoff handle
   f. Fuel quantity indicating and warning system
   g. Primer system
   h. One-way check valve.

5. Recall the location of the fuel strainer drain (Knowledge).

6. Evaluate the following situations (Evaluation).
   a. High altitude with no boost pump.
   b. High altitude with no engine-driven pump.
   c. No boost pump below 10,000 feet.
   d. No engine-driven fuel pump below 10,000 feet.

Psychomotor Domain

None.

INSTRUCTIONAL MATERIAL

The instructor in charge must ensure that the following instructional material is provided:

NATOPS Flight Manual

When the student has the material listed above, he will proceed in accordance with the following directions:

DIRECTIONS TO STUDENT

STEP 1 Study pages 1-14 and 1-15 in the NATOPS Flight Manual.

STEP 2 Complete the programed text. Upon completion, review prior to commencing the criterion test.

STEP 3 Take the unit criterion test.

STEP 4 End of this unit. Remedial session prescribed if necessary.

PROGRAM PERFORMANCE VALIDATION RECORD

This instructional sequence was introduced at NAS Whiting Field on 6 May 1971. The achievements of ________ students completing the program between ____________ ________ and ______________ are shown below.

N	MEAN CRITERION TEST SCORE (PRE-UNIT)	PERCENT CORRECT	MEAN CRITERION TEST SCORE (POST-UNIT)	PERCENT CORRECT	ESTABLISHED ERROR RATE
___	___________	_______	___________	_______	_________

Percent of students obtaining 85% or better _________.
This unit is designed to be completed within _________ minutes.
The learning time required for this unit was established as follows:

MINIMUM LEARNING TIME REQUIRED	LEARNING TIME REQUIRED BY 80% OF THE POPULATION	MAXIMUM LEARNING TIME REQUIRED
________ min.	________ min.	________ min.

Reverse Blank

THE FUEL SYSTEM

FRAME 1

The recommended fuel for the T-28 is 100/130 grade and 115/145 is an alternate fuel. The total usable fuel carried in the T-28 is 177 U.S. gallons, or 1062 pounds. A 174 gallons of fuel is stored in four interconnected, rubberized canvas storage cells, two in each wing. This material is used to accommodate vibration, fatigue, and thermal expansion.

The fuel used in the T-28 is normally ____/____ grade, and the usable capacity is ________ U.S. gallons.

100/130
177

FRAME 2

The fuel system consists of the following: fuel cells, fuel lines, fuel sump, fuel boost pump, fuel gravity-feed manifold, fuel shutoff valve, fuel strainer, engine-driven fuel pump, fuel system check valves, vent lines, fuel pressure gauges, fuel low-level warning lights, fuel quantity gauges, primer system, and an oil dilution system. (See figure 1.)

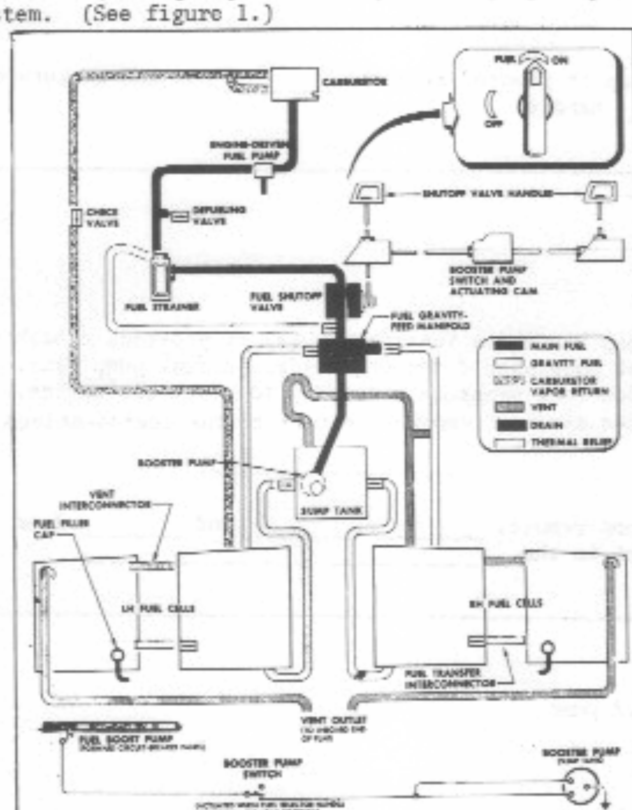

Fig. 1

No response required

FRAME 3

A 3-gallon metal fuel sump tank is located in the right main landing gear well. The fuel flows from the inboard cells to the sump tank by gravity. The fuel is forced by a fuel boost pump in the sump tank, forward to the engine.

A _____-gallon sump tank, located in the _______ wheel well, is fed by _______. Fuel from the sump tank is transferred to the engine by means of a _______ _______ _______.

3
right
gravity
fuel boost pump

FRAME 4

The fuel boost pump is d.c. powered from the secondary bus. It is energized when the fuel shutoff handle is ON.

The fuel boost pump is powered from the _______ bus and is turned on by the _______ _______ handle.

---

secondary
fuel shutoff

FRAME 5

The fuel boost pump has three functions. (1) It provides a back up for the engine-driven fuel pump should the engine-driven fuel pump fail. (2) The fuel boost pump provides fuel pressure necessary to start the engine. (3) The fuel boost pump provides air and vapor-free fuel to the engine-driven pump.

The fuel boost pump removes _______ _______ and _______ from the fuel, and delivers this fuel to the _______-_______ _______ _______.

---

fuel vapor
air
engine-driven fuel pump

FRAME 6

It is essential that the engine function on vapor-free fuel at altitudes above 10,000 feet. If the boost pump should fail above this altitude, there is a possibility of the mixture becoming lean enough to cause high CHT, preignition, backfiring, and loss of engine power.

If the boost pump should fail at 12,000 feet, a possibility of a ______ mixture exists, which could cause ______ ______, ______, ______, and loss of ______ ______.

---

lean
high CHT
preignition
backfiring
engine power

FRAME 7

The fuel boost pump test switch is located on the right console in the front cockpit. This switch is spring-loaded to the ON (forward) position. When the switch is placed in the OFF (aft) position or the fuel boost pump circuit breaker is pulled, the fuel boost pump is turned off, and it is possible to check the operation of the engine-driven fuel pump.

By placing the fuel test switch in the ______ position, a check of the ______-______ ______ ______ may be made.

OFF (aft)
engine-driven fuel pump

FRAME 8

In the event of boost pump failure, the fuel from the inboard cells will flow to the fuel gravity-feed manifold. It is drawn from this unit to the carburetor by the engine-driven fuel pump.

With a loss of the boost pump, fuel from the ______ cells will flow to the ______-______ ______.

---

inboard
gravity-feed manifold

FRAME 9

A two-position fuel shutoff valve is incorporated in the system between the gravity-feed manifold and the strainer. This valve is manually operated by a mechanical linkage from the control handle located on the left console in each cockpit. When the control handle is turned to the ON position, it opens the fuel shutoff valve and completes a circuit in the fuel boost pump system. If balanced flight is maintained, no action of the pilot will be required to maintain balanced fuel levels in the fuel cells.

Turning the fuel shutoff control handle to the ON position manually opens the _______ _______ _______ and completes a circuit in the fuel _______ _______ _______.

---

fuel shutoff valve
boost pump system

FRAME 10

A fuel strainer is incorporated into the system for separating water and sediment from the fuel. A fuel strainer drain valve is provided for draining the fuel strainer. The fuel strainer is located on the port side of the aircraft next to the nose gear door. The drain valve at the bottom of the strainer is the lowest point in the fuel system.

The fuel strainer, located on the _______ side of the aircraft aft of the nose gear door, separates _______ and _______ from the fuel.

---

port
water
sediment

FRAME 11

The engine-driven fuel pump is a positive displacement, rotary-vane pump mounted on the right side of the accessory gear case. A relief valve is incorporated in the pump to control the discharge pressure. A bypass valve is also incorporated to pass fuel around the pump in the event of a pump failure. A faulty pump may be detected by observing fuel dripping from the engine-driven fuel pump drain.

The engine-driven fuel pump is located on the right side of the _______ _______ _______ and incorporates a _______ _______ to permit boost pump fuel to bypass the engine-driven fuel pump, should the engine-driven fuel pump fail.

---

accessory gear case
bypass valve

FRAME 12

Check valves are incorporated at various points in the fuel system, allowing fuel to flow in one direction only. A check valve is mounted in the gravity-feed line from the outboard fuel cells to the inboard fuel cells. Check valves are located between the inboard cells and the sump tank and between the inboard cells and the gravity-feed manifold to prevent any reverse flow of fuel. A check valve is mounted in the thermal relief line at the outlet side of the fuel gravity-feed manifold to prevent fuel bypassing the shutoff valve and fuel strainer. The check valves will also help prevent uneven flow of fuel, particularly during unbalanced flight.

Check valves are located in the fuel system to prevent ________ flow of fuel. With a properly functioning check valve, it is ________ to get fuel to flow from the sump tank to the inboard fuel cells.

---

reverse
impossible

FRAME 13

The fuel vent system is provided to permit even flow of fuel and to allow for expansion. Fuel vapor is vented from the sump tank to the right inboard fuel cell. Both inboard fuel cells are vented to the outboard cells and overboard via the vents located under each flap. The carburetor vapor return line is vented to the left inboard fuel cell.

Fuel from the sump tank is vented to the ________ ________ ________ ________ and from the carburetor to the ________ ________ ________ ________.

---

right inboard fuel cell
left inboard fuel cell

FRAME 14

A fuel pressure gauge is located on each cockpit instrument panel. The engine-driven fuel pump pressure gauge will indicate both the fuel boost pump pressure and the engine-driven fuel pump pressure. Normal pressure for the fuel boost pump is 19 to 24 p.s.i., and the engine-driven fuel pump pressure is 21 to 25 p.s.i. In the event of an engine-driven or boost pump failure, it may be impossible to tell from the gauge indication that a pump has failed. The boost pump must provide at least 13 p.s.i. to start the engine. Minimum fuel pressure for takeoff is 21 p.s.i.

Normal pressure for the boost pump is _______ to _______ _______, and engine-driven pump pressure is _______ to _______ _______.

---

19 to 24 p.s.i.
21 to 25 p.s.i.

FRAME 15

The d.c. operated fuel quantity measuring system is of the liquid densiometer type that measures the weight of fuel on board. A low-level fuel warning light is located on each cockpit instrument panel. This light will be illuminated whenever there is a low-fuel state indicating less than 200 pounds or whenever there is less than 200 pounds in either wing and that wing is selected by the fuel quantity switch. Since the low-level fuel warning light indicates only an approximate quantity of fuel, any illumination of the low fuel light could be an indication of less than 200 pounds.

The low-level fuel warning light will _______ whenever the fuel quantity is less than _______ pounds in either wing, if selected, or whenever the total quantity reads less than _______ pounds.

---

illuminate
200
200

FRAME 16

A fuel quantity indicator, graduated in 40-pound increments, is located in both cockpits and will give an indication of the total fuel in pounds. The full marker is set at 1040 pounds if measured at 25° C. A three-position switch, spring-loaded to the center position, is located directly under the fuel quantity gauge. In the center position, the indicator will show the pounds of fuel in both wings; in the left position, pounds of fuel in the left wing will be indicated; and in the right position, pounds of fuel in the right wing will be indicated. Sump tank fuel and the fuel in the lines are not shown on the quantity indicator. This additional fuel will bring the total fuel on board to 1062 pounds.

With a full load of fuel at 25° C., the indicator will indicate _______ pounds of fuel. When the switch is deflected left, the indicator will indicate total fuel in the _______ _______.

1040
left wing

FRAME 17

The d.c. operated fuel indication system automatically compensates for the changes in fuel density so that the quantity indicator will always register the actual number of pounds of fuel in the tanks, regardless of fuel expansion or contraction due to temperature variation. The actual weight of a measured gallon of fuel will vary from approximately 5.7 pounds on a very hot day to about 6.4 pounds on a cold day. For general computations, 6 pounds per gallon is the accepted weight of fuel, unless critical weight is a safety-of-flight factor.

When the tanks are filled on a hot day, the fuel indicator will indicate _______ than 1040 pounds, due to fuel _______.

---

less
expansion

FRAME 18

The T-28 has a d.c. electrical primer system. The primer switch is located on the electrical console. By depressing the spring-loaded switch, fuel is primed directly into the supercharger impeller section. Pressure for prime is provided by the fuel boost pump, and 13 p.s.i. is required for priming operation. Without sufficient fuel pressure the engine will not start.

With the fuel boost pump circuit breaker pulled, an engine start is _______ because the _______ cannot receive fuel from the sump tank.

---

impossible
primer

FRAME 19

The airplane is equipped with an oil dilution system for cold weather operation. Gasoline is allowed to enter the oil system, lowering the viscosity of the oil for easier starting. Dilution time will vary from 1 to 5 minutes, depending upon the anticipated temperature. Oil dilution is always done with the oil temperatures at 40° C. or below and in accordance with NATOPS Flight Manual procedures.

The purpose of oil-dilution is to _______ _______ _______ _______ when cold weather is expected.

---

lower the oil viscosity

FRAME 20

Boost pump failure. Should the fuel boost pump fail, the engine-driven fuel pump will provide sufficient fuel for operation below 10,000 feet. Above 10,000 feet, because of low atmospheric pressure, too much vaporized fuel may cause a rough running engine.

No response required

FRAME 21

Engine-driven pump failure. In the event of an engine-driven fuel pump failure, the fuel boost pump will supply adequate fuel for continuous operations at all altitudes. This failure may go undetected without trouble shooting.

No response required

FUEL SUMMARY

1. The T-28 fuel system holds 174 gallons in four rubberized canvas fuel cells located in the wings. An additional three (3) gallons are in the sump tank and lines, making 177 gallons on board.

2. The fuel shutoff valve handle activates the fuel boost pump as well as opening the fuel shutoff valve.

3. Without an operating fuel boost pump, the engine cannot be started. However, once the system is running, fuel can pass through the gravity-feed manifold to the engine-driven fuel pump should the boost pump fail.

4. The sump tank serves as a common gathering point for fuel from each wing. It is located in the right main landing gear well, and contains the boost pump.

5. The fuel system is fully vented, with the overboard vents located on the lower side of the flaps.

6. Fuel quantity is measured by a d.c. powered liquid densiometer that measures the actual weight of fuel on board.