

### III.C. Operation of Systems

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References: FAA-H-8083-23; FAA-H-8083-25; FAA-H-8083-3; POH/AFM

Objectives	The student should develop knowledge of the elements related to the DA20 systems and their operation as required in the PTS.
Key Elements	<ol style="list-style-type: none"><li>1. Powerplant</li><li>2. Fuel Pump and Primer</li><li>3. Electrical Failure – 30 min</li></ol>
Elements	<ol style="list-style-type: none"><li>1. Primary Flight Controls and Trim</li><li>2. Flaps</li><li>3. Powerplant and Propeller</li><li>4. Landing Gear</li><li>5. Fuel, Oil, and Hydraulic</li><li>6. Electrical</li><li>7. Avionics</li><li>8. Pitot Static, Vacuum Pressure, and Associated Flight Instruments</li><li>9. Environmental</li><li>10. Deicing and Anti-Icing</li></ol>
Schedule	<ol style="list-style-type: none"><li>1. Discuss Objectives</li><li>2. Review material</li><li>3. Development</li><li>4. Conclusion</li></ol>
Equipment	<ol style="list-style-type: none"><li>1. White board and markers</li><li>2. References</li></ol>
IP's Actions	<ol style="list-style-type: none"><li>1. Discuss lesson objectives</li><li>2. Present Lecture</li><li>3. Ask and Answer Questions</li><li>4. Assign homework</li></ol>
SP's Actions	<ol style="list-style-type: none"><li>1. Participate in discussion</li><li>2. Take notes</li><li>3. Ask and respond to questions</li></ol>
Completion Standards	The student understands the operation of the systems in the DA20 aircraft.

**Instructors Notes:**

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**Introduction:**

**Attention**

Interesting fact or attention grabbing story

The inner workings of the airplane; to develop a better understanding of what is what, and what is where.

**Overview**

Review Objectives and Elements/Key ideas

**What**

The main systems found on the DA20. This includes the primary flight controls and trim, flaps, powerplant, propeller, landing gear, fuel, oil and hydraulic systems, electrical and avionics systems, flight instruments and the environmental system.

**Why**

Understanding how the airplane works internally will allow for better troubleshooting and problem identification. The pilot will have a better understanding of the airplane as a whole.

**How:**

**1. Primary Flight Controls and Trim**

- A. Ailerons - Carbon Fiber Reinforced Plastic (CFRP)
  - i. Actuated via push rods
  - ii. Attached with stainless steel and aluminum hinges
- B. Elevator - CFRP
  - i. Actuated via push rods
  - ii. Semi-Monocoque sandwich construction
  - iii. Trim
    - a. Controlled by a Rocker Switch
      - Switch forward = Nose Down; Switch aft = Nose Up
      - Switch controls an electrical actuator beside the vertical push rod in the vertical stabilizer
        - a The actuator applies a load to compression springs on the elevator push rod
    - b. Trim circuit breaker can be tripped manually to disable the system
- C. Rudder
  - i. Actuated via control cables
  - ii. Semi-Monocoque sandwich construction

**2. Flaps**

- A. Driven by an electric motor
  - i. Electric flap actuator is protected by a circuit breaker (5 Amp)
    - a. Located on the right side of the instrument panel and can be manually tripped to disable the system
- B. Controlled by 3 position flap operating switch on the instrument panel
  - i. Top position – Cruise – 0° (Green Light)
  - ii. Middle Position – Approach – 15° (Yellow Light)
  - iii. Bottom Position – Landing – 45° (Yellow Light)
  - iv. When two lights are illuminated at the same time, the flaps are in-between positions
- C. Cruise and Landing positions are equipped with position switches to prevent over-traveling

**3. Powerplant and Propeller**

**A. Powerplant**

- i. Continental IO-240-B Engine
  - a. Fuel Injected
  - b. 4 Cylinder
  - c. 4 Stroke
  - d. Horizontally Opposed cylinders and heads
  - e. Air cooled cylinders and heads
  - f. Propeller drive is direct from the crankshaft
  - g. 3.9 liters
  - h. 125 HP at 2800 RPM
- ii. Engine Controls
  - a. Mixture Lever
  - b. Throttle
  - c. Alternate Air
    - Full Forward = Primary Air Intake
    - Full Aft = Alternate Air Intake

**B. Propeller**

- i. Hoffmann HO-14HM-175-157
  - a. Diameter - 5' 8.9"
  - b. Two-bladed fixed pitch propeller
  - c. Wood and glass fiber
- ii. Sensenich W69EK7-63, 63G, or W69EK-63
  - a. Diameter - 5'9"
  - b. Two-bladed fixed pitch propeller
  - c. Wood prop

**4. Landing Gear**

- i. Two main landing gear wheels (mounted to aluminum spring struts)

**B. Nose Wheel**

- i. 60° castering
- ii. Suspension is provided by an elastomer spring

**C. Wheel Brakes**

- i. Hydraulically operated disc brakes
- ii. Operated individually using toe-brake pedals

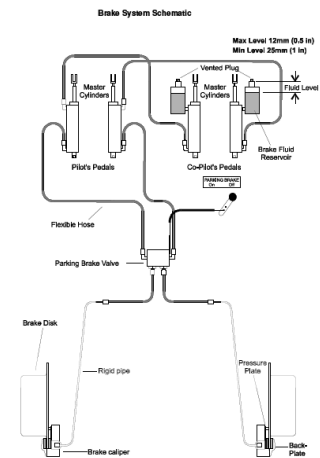
**D. Parking Brake**

- i. Repeated pushing of the toe-brake pedals will build up the required brake pressure, which will remain in effect until the brake is released

**5. Fuel, Oil, and Hydraulic**

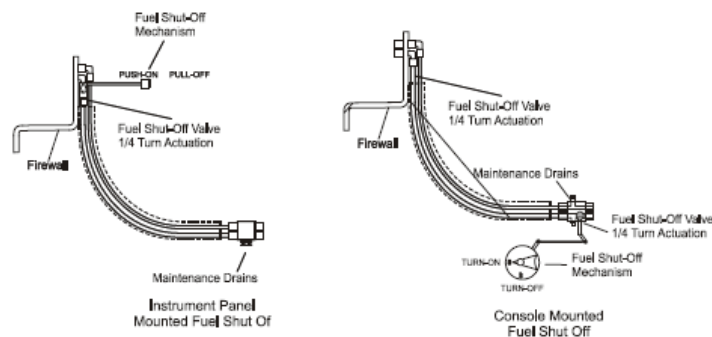
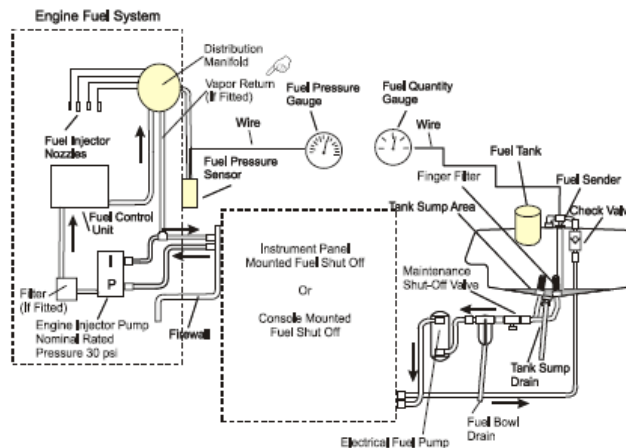
**A. Fuel**

- i. Aluminum Fuel Tank
  - a. Located behind the seats, below the baggage compartment
  - b. 24.5 Gallons fuel (24 Gallons Usable)
  - c. Operation
    - Fuel is gravity fed to a filter bowl (gascolator) and then to the electric fuel pump
      - a. Filter bowl must be drained before flight (black tube)
    - Electric fuel pump primes for starting (Prime ON) and is used for low throttle operations
      - a. When the pump is off, fuel flows through the pump's internal bypass
    - From electric pump, fuel is delivered to the mechanical fuel pump by the fuel supply line



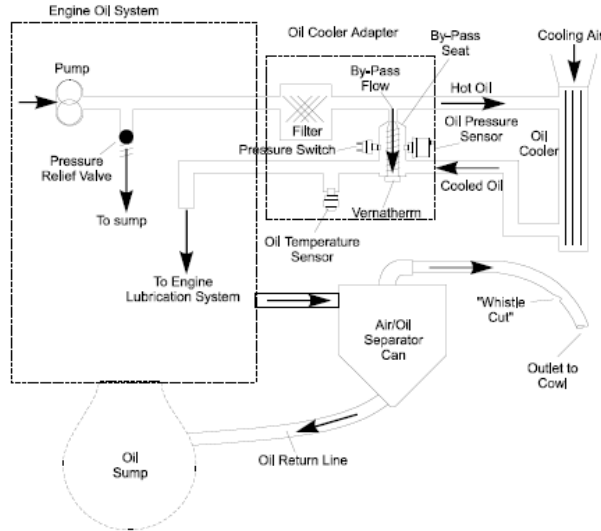
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- Fuel is metered by the fuel control unit and flows via the fuel distribution manifold to the injector nozzles
  - Return line from mechanical fuel pump's fuel vapor separator returns vapor/excess fuel to the tank
- d. Electric Fuel Pump
- DUKES constant flow, vane type, two speed, electric fuel pump
    - a Fuel Prime
      1. Pump's high speed setting, used for priming the engine prior to engine start
      2. Turning the prime pump on while running will enrichen the mixture considerably
        - a. At high throttle settings the effect is less noticeable
        - b. At low throttle settings may cause engine roughness or engine stoppage
    - b Fuel pump
      1. Required for maintaining positive fuel pressures at low throttle settings
- e. Fuel Shutoff Valve
- Closing will cause the engine to stop within a few seconds



### B. Oil

- i. High pressure wet sump lubrication system
  - a. Wet sump oil systems store the oil in the engine pan, dry sump systems store the oil in a separate tank
- ii. Oil is pumped by a mechanical, engine driven pump
- iii. Oil must be between 4 and 6 quarts



**6. Electrical**

**A. Power Generation**

- i. 40 Amp Generator
  - a. Feeds the Main Bus via the Generator Circuit Breaker (50 Amps)
- ii. Generator Warning Light
  - a. Activated by internal voltage regulator monitoring circuit - illuminates if generator fault occurs

**B. Power Storage**

- i. 12V battery
  - a. Connects to the Master Bus via the Battery Circuit Breaker (50 Amps)

**C. Power Distribution**

- i. Electrical Bus

**D. Consumers**

- i. Individual consumers (e.g. Radio, Fuel Pump, Position Lights, etc.) are connected in series with their respective circuit breakers

**E. Electrical Monitoring Instruments**

- i. Voltmeter
  - a. Indicates the status of the Electrical Bus
  - b. Consists of a dial marked numerically from 8 – 16 volts in divisions of 2
    - Scale
      - a. **RED** for 8.0 - 11.0 volts
      - b. **YELLOW** for 11.0 - 12.5 volts
      - c. **Green** for 12.5 - 16.0 volts
      - d. **REDLINE** at 16.1 volts
- ii. Ammeter
  - a. Indicates the charging (+) and discharging (-) of the battery
  - b. Consists of a dial which is marked numerically from -60 to 60 amps
- iii. Generator Warning Light
  - a. Illuminates during generator failure
    - No output from the generator
  - b. The only remaining power source is the battery (20 Amps for 30 min)

**7. Avionics**

**A. Center of the instrument panel contains the radio and navigation equipment**

- i. Operating instructions should be taken from the manuals of the respective manufacturers

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- B. Vertical Stabilizer contains the antenna for the VHF radio equipment
- C. Horizontal Stabilizer contains the antenna for the NAV equipment (VOR)

#### 8. Pitot-static, Vacuum Pressure, and Associated Flight Instruments

- A. Pitot-Static
  - i. Pitot pressure is measured on the leading edge of a calibrated probe below the left wing
    - a. Airspeed indicating error, refer to Chapter 5 of POH
  - ii. Static pressure is measured by the same probe
    - a. Error of the static pressure system is negligible
  - iii. Instruments
    - a. Airspeed Indicator
      - Pitot Pressure (Ram Air Pressure) and Static Pressure
    - b. Altimeter
      - Static Pressure
    - c. Rate of Climb Indicator
      - Static Pressure
- B. Vacuum Pressure (Gyros)
  - i. Instruments
    - a. Heading Indicator
    - b. Attitude Indicator
- C. Electrically Driven Instruments
  - i. Turn Coordinator

#### 9. Environmental

- A. Cabin Heat and Defrost
  - i. Directs ram air through the exhaust heat shroud into the cabin heat valve
    - a. The air is directed to the window defrosting vents and to the cabin floor as selected by the lever
  - ii. The cabin heat selector is used to regulate the flow of heated air

#### 10. Deicing and Anti-Icing

- A. Defrost
  - i. Can be used to deice the windshield (if the icing is light)

#### Conclusion:

Brief review of the main points

A thorough understanding of the airplane's systems makes a safer, smarter pilot.

#### PTS Requirements:

To determine that the applicant exhibits instructional knowledge of the elements related to the operation of systems, as applicable to the airplane used for the practical test, by describing the following systems:

1. Primary and secondary flight controls
2. Trim
3. Water rudders (ASES)
4. Powerplant and propeller
5. Landing gear
6. Fuel, oil, and hydraulic
7. Electrical
8. Avionics including autopilot
9. Pitot static, vacuum/pressure and associated instruments
10. Environmental
11. Deicing and anti-icing

