Background Informatio

FRIDAY, OCTOBER 4, 1996
CENTER FUEL TANK
BACKGROUND INFORMATION

BOEING

- Fuel capacity for the 747-100 is 47,210 gal. Per tank: reserve 500 gal.; outboard main 4,420; inboard main 12,240; center wing 12,890.

- All fuel is stored in four main tanks, two reserve tanks and a center wing tank which are accessible for inspection and resealing. Fuel is delivered to the engines under positive pressure by AC driven boost pumps. Tank arrangement provides center of gravity control without close fuel monitoring. Fueling with only airplane battery power is possible.

- **Fuel Venting:** The fuel vent system provides positive venting of the fuel tanks to the atmosphere during all attitudes of the airplane. Fuel tank vent ports are positioned so that at least one port is open to the expansion area at all times. Fuel vent float valves located near the top of the fuel tanks prevent fuel from entering the vent system during airplane attitude changes. Vent outlets are located near the wing tips. All tanks vent to the surge tanks and then to the vent inlets.

- Surge tanks in each wing tip provides expansion chambers for excess fuel due to over-filling or thermal expansion. Surge tank fuel is drained back into the main inboard fuel tanks. Fuel may be vented overboard, dependent upon the quantity of fuel in the surge tank.

- A jettison system provides a means of rapid weight reduction in flight. The jettison pumps incorporate standpipes which ensure a reserve fuel supply for emergency operation after jettison. The jettison manifold is continuous from wing tip to wing tip, terminating in a fixed nozzle at each end. This permits dumping from the opposite wing, should the jettison valve on either side fail to open. On the ground, the fueling manifold and jettison pumps may be used to defuel through the adapters and nozzles, down to the reserve level, and also to transfer fuel from tank to tank. The remaining fuel can be removed by the main boost pumps when a manual valve, operable only from the ground, is opened. Fuel remaining below the level of the override pump inlets in the center wing tank can be moved to an inboard main tank by means of a scavenging pump, thus minimizing the amount of unusable fuel.

- Fueling is accomplished through four adapters, two on each underwing surface. Maximum fueling rate is 2,000 gpm using the four adapters.

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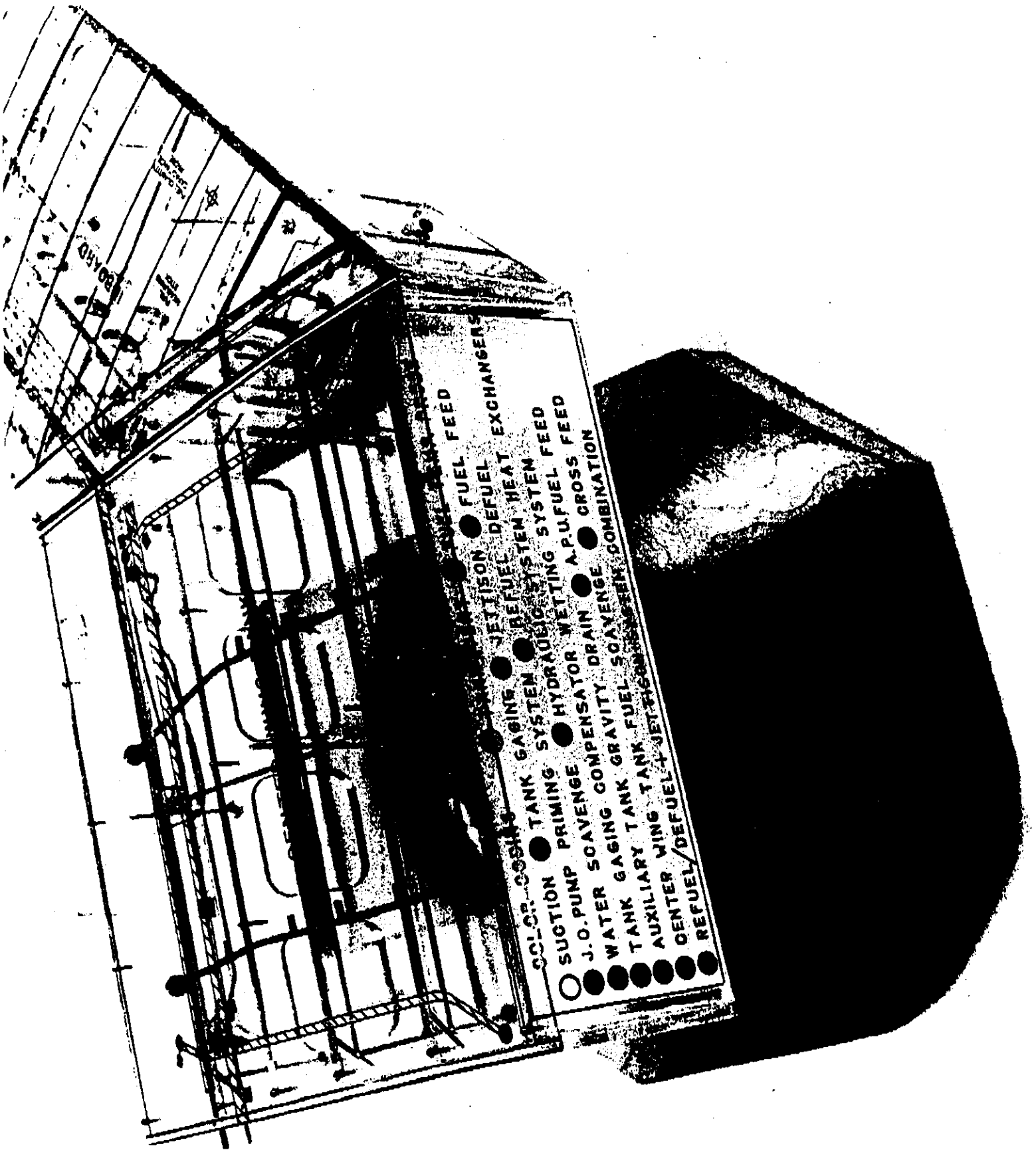
Center Fuel Tank
Background, Cont'd:

- A crossfeed manifold permits fuel delivery from any tank to any engine.
- Each main tank and the center tank has two AC powered boost pumps, connected to separate electrical buses so that a single bus failure will not disable more than one pump per tank. Each pump by itself can supply one-engine demand.
- All pumps are plug-in type, replaceable without draining or entering the fuel tank. All electrical valves are motor-operated DC power with manual override. Valve motors are outside the fuel tanks and can be replaced without draining or entering the tank.
- The reserve and main tanks are interconnected to facilitate fuel transfer during normal fuel feed operation; as fuel is used in the main tanks, the reserve tank **fuel can be transferred to the main tanks by gravity flow through the transfer valve.**
- Fuel gauging system uses all-metal, density compensating capacitor sensors in the tank. Wiring and connectors are similar to those on the 737. Indicators, at the flight engineer's panel and the left wing fueling station, show pounds remaining per tank. The engineer's panel also indicates total fuel aboard the airplane. Dripless measuring sticks permit direct underwing measurement of fuel quantity per tank on the ground.
- An NPRM on 747/757 Jettison/Boost pumps was issued July 14, 1996. The rule concerns the condition of connectors on pumps that jettison or provide fuel flow to engines in the aircraft. The rule requires airlines to run insulation resistance tests on all 747 override/jettison and boost pumps. The connectors are external to the fuel tanks.
- Speculation continues that vapors in the empty fuel tank may have been a contributing factor in the accident.


FUEL FEED
JETTISON DEFUEL
REFUEL HEAT EXCHANGERS
TANK GAGING SYSTEM
HYDRAULIC SYSTEM FEED
SUCTION PRIMING WETTING A.P.U. FUEL FEED
J.O. PUMP SCAVENGE COMPENSATOR DRAIN CROSS FEED
WATER GAGING GRAVITY SCAVENGE COMBINATION
TANK GAGING FUEL SCAVENGE SYSTEM
AUXILIARY TANK JETTISON SYSTEM
CENTER WING TANK
REFUEL/DEFUEL

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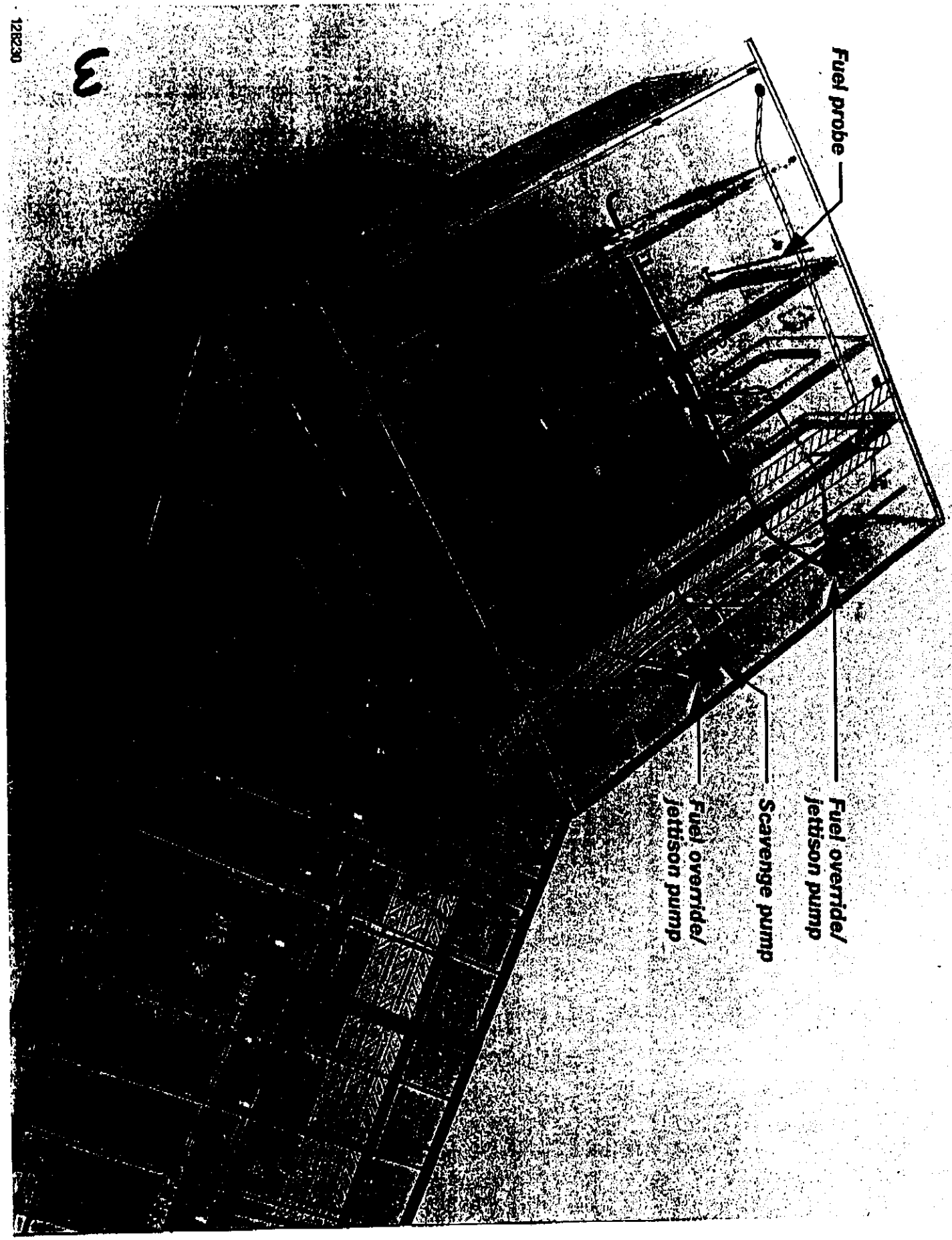
Fuel probe
Fuel override/ jettison pump
Scavenge pump
Fuel override/ jettison pump
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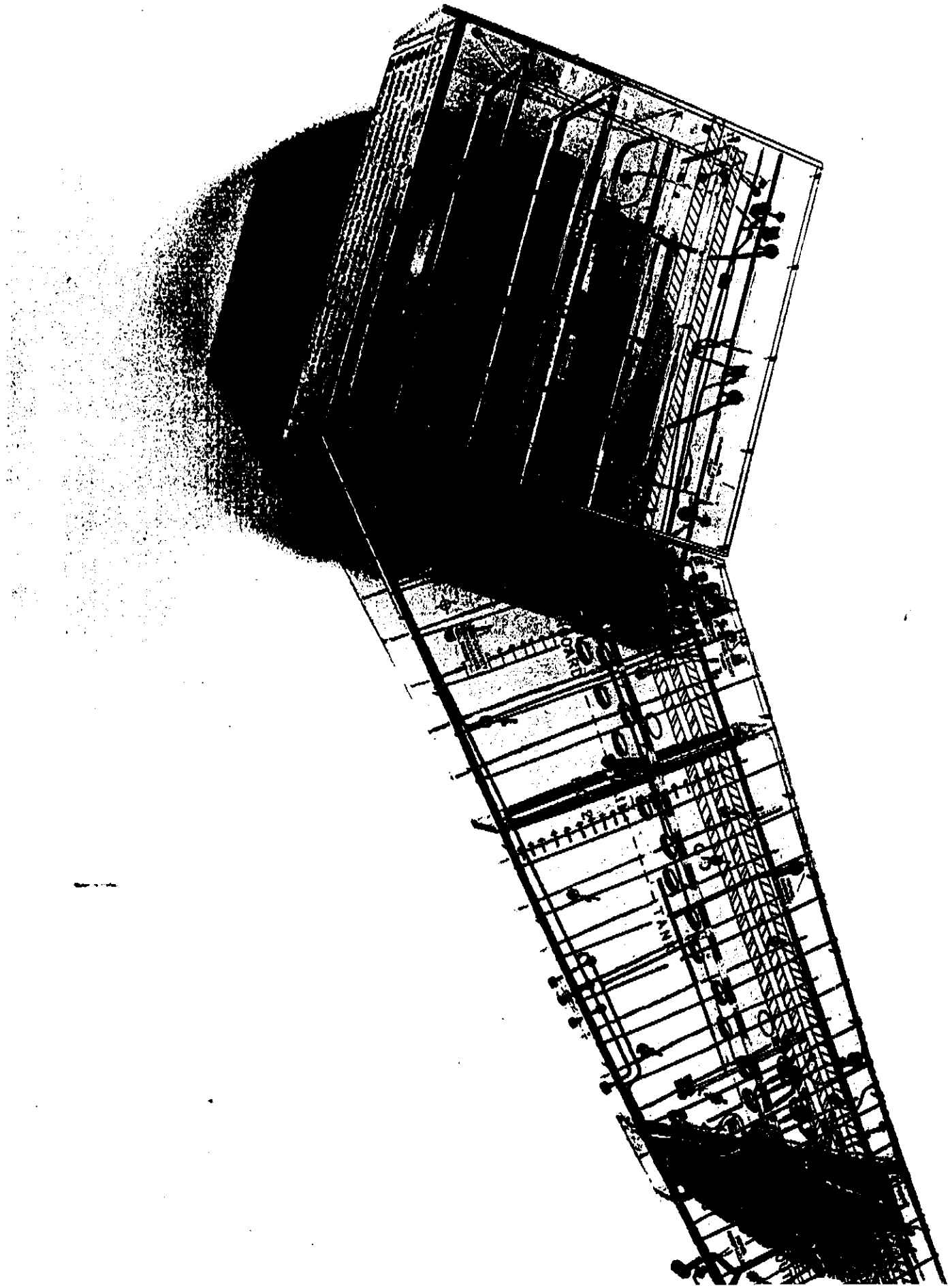

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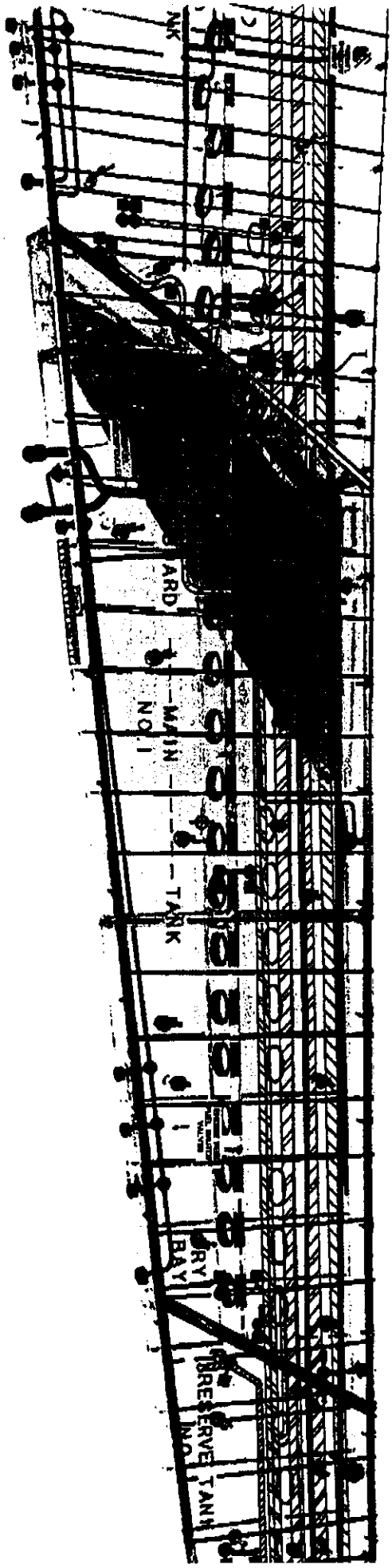

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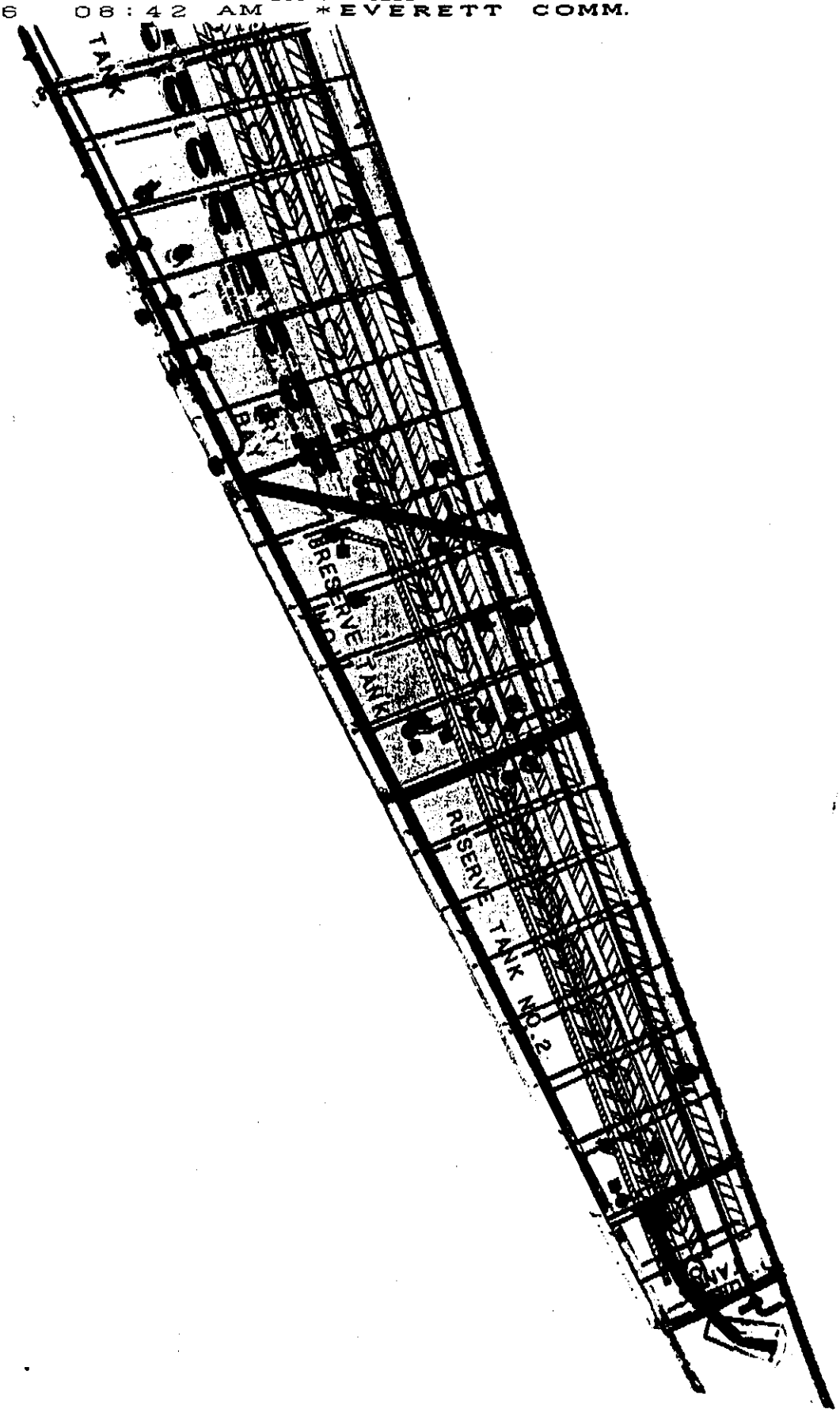

P09
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Design Philosophy for Flammable Fluid on Aircraft

Fact: Fuel is flammable under certain pressure & temperature conditions.

Fact: Fuel tanks on all aircraft often pass through the temperature regions where the fuel is flammable during operation.

Fact: Fuel Tanks are not designed to contain an explosion.

So: Safety is ensured by eliminating all ignition sources from the fuel tanks.

Tanks are designed to withstand all normal and adverse ground and flight loads and prevent leakage.

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Types of Ignition Sources

1. A spark created by an electrical fault in a wire or motor, lightning, or other static discharge. The spark must contain enough energy and the fuel must be in a flammable condition.

2. A hot surface. The surface must be above the auto-ignition temperature of fuel. Boeing uses 450° F; can actually be as high as 900° F. to auto-ignite.

3. An external source, i.e., fire, bomb, missile.

The Federal Aviation Regulations and the industry design practice are based on preventing Items 1 and 2.

10. 15. 96 08:42 AM 206 294 6200 *EVERETT COMM. P11

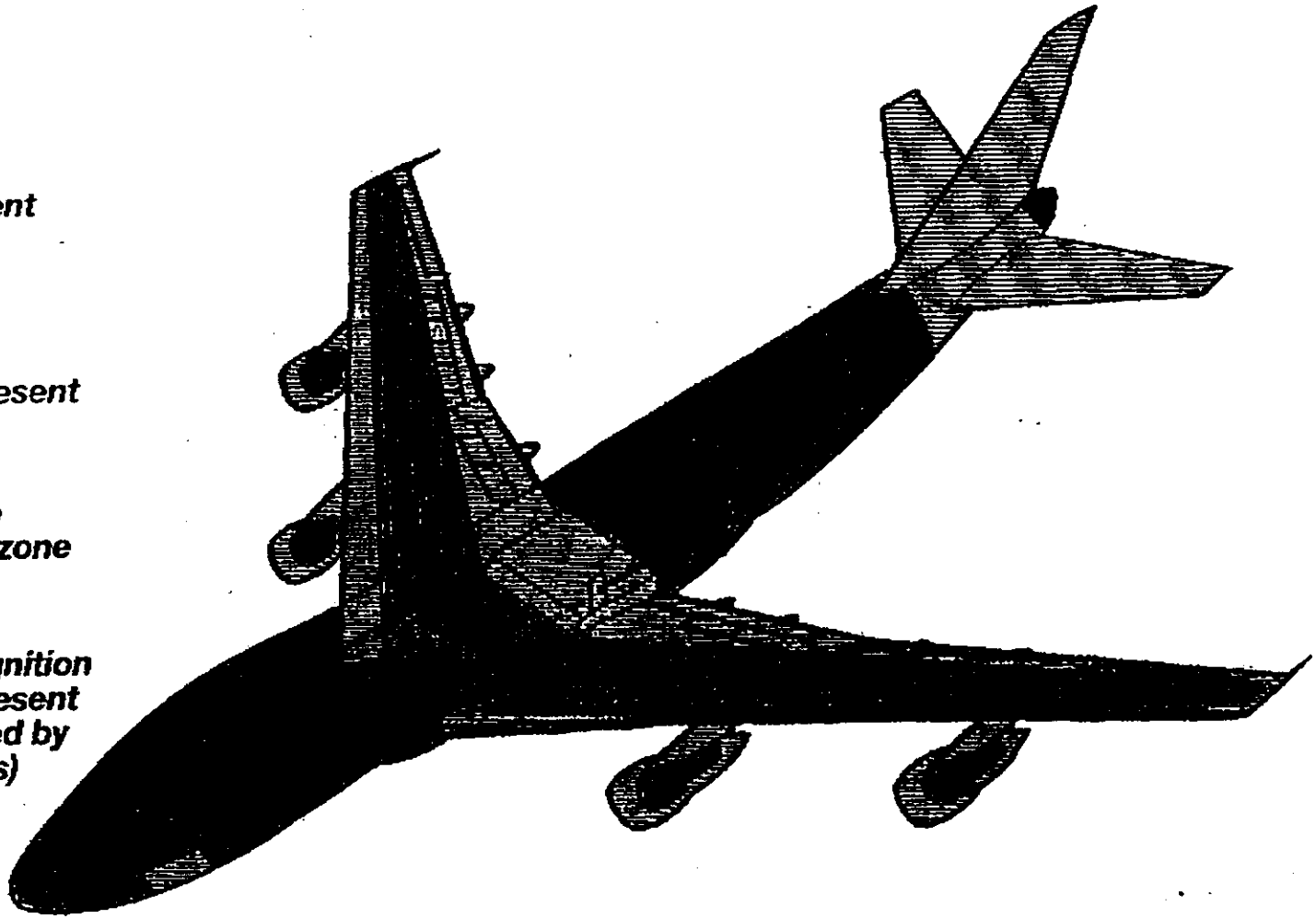
747 Fire Protection Zones

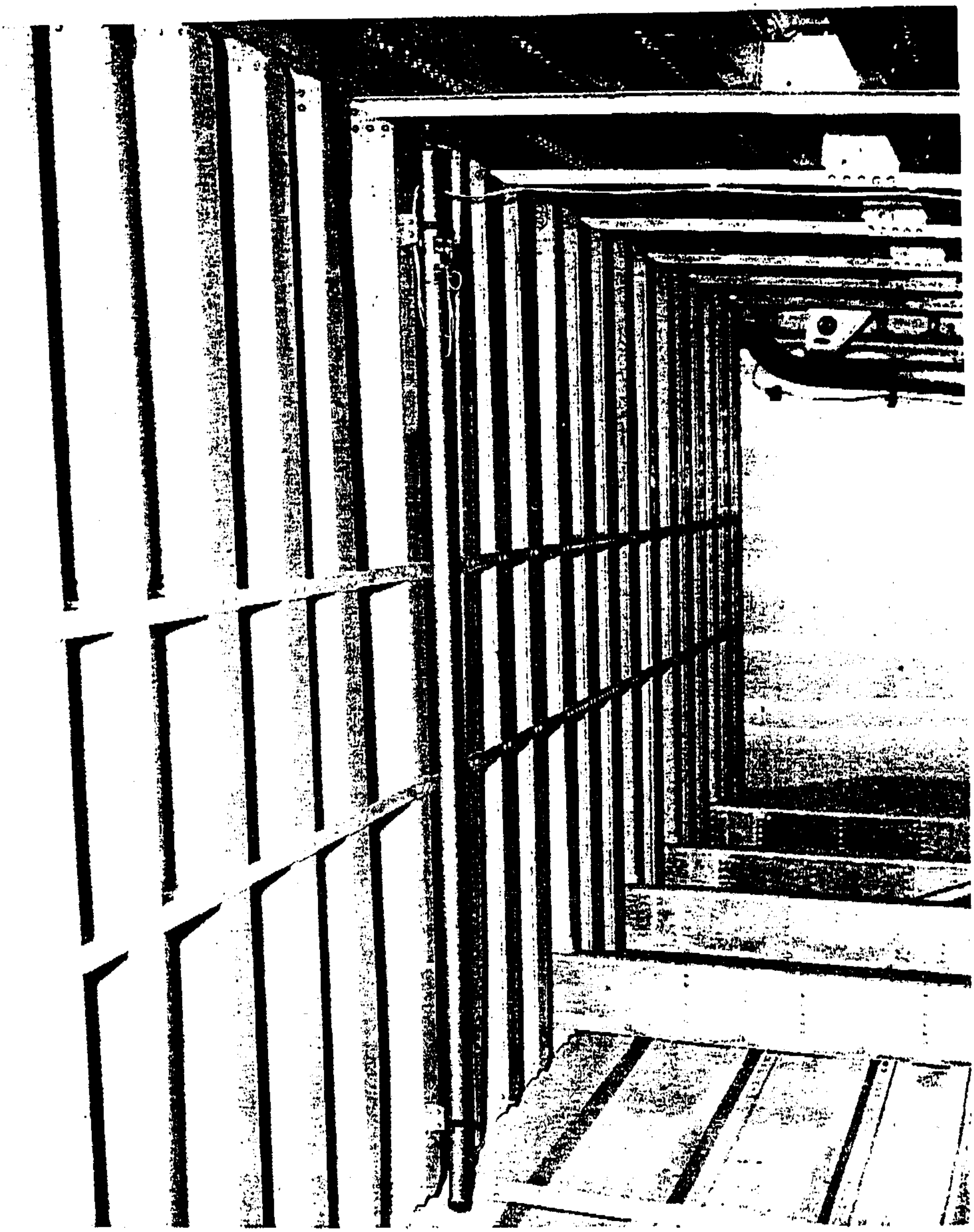
Zone 1
Spark present

Zone 2
Flammable material present

Zone 3
Adjacent to flammable zone

Zone 4
Potential ignition sources present (e.g., carried by passengers)





TANK UNIT INSTALLATION (TYPICAL)

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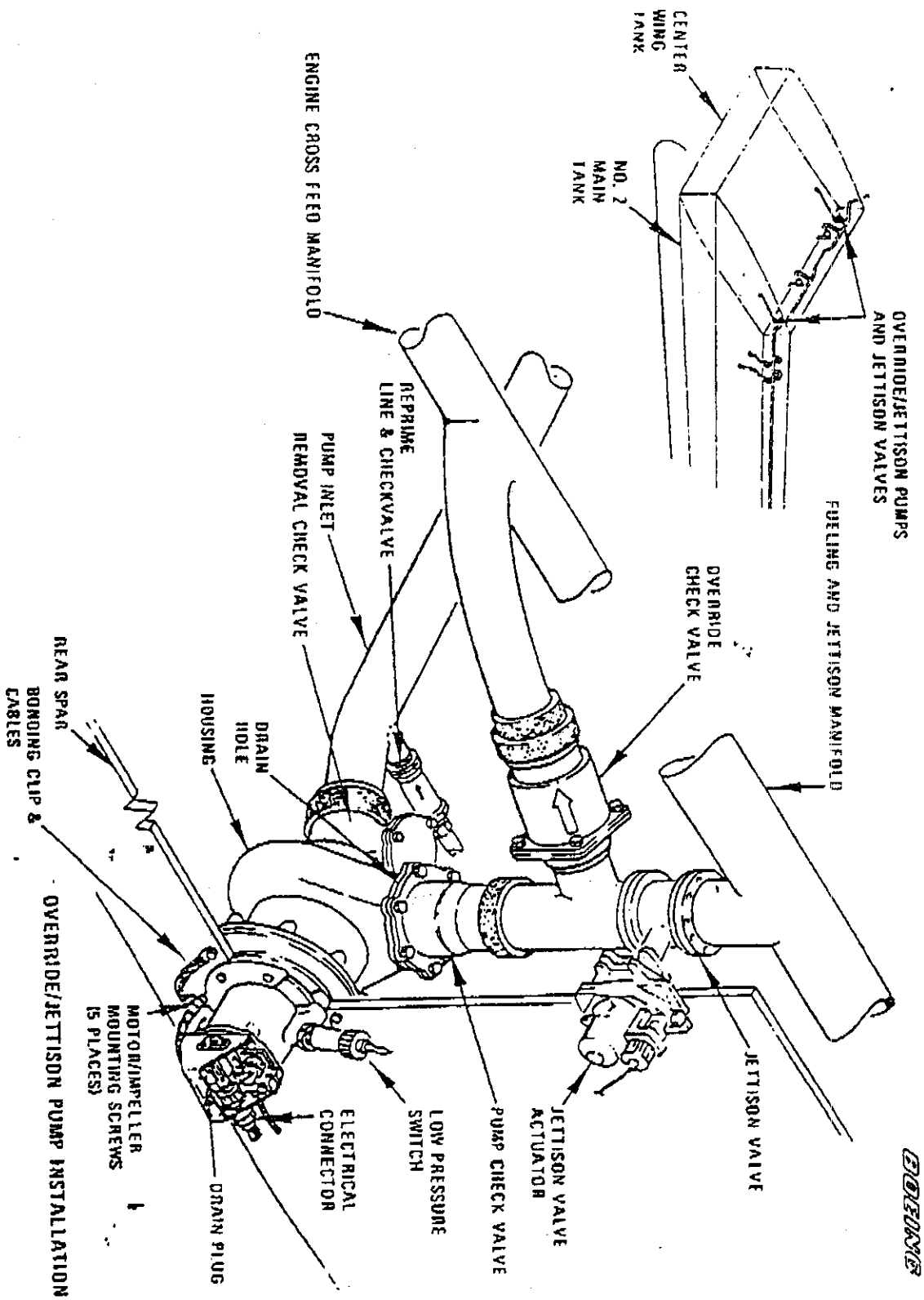
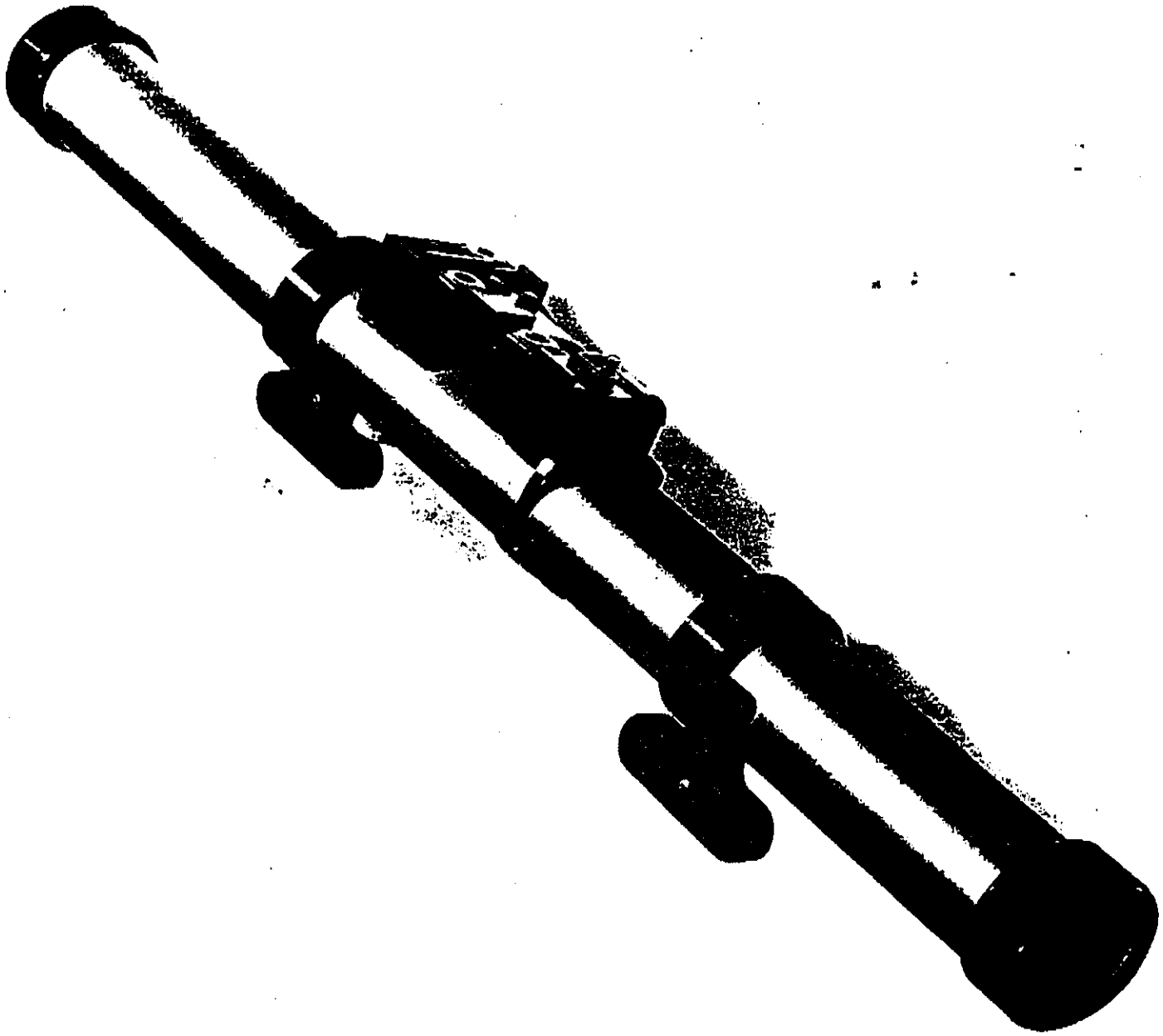
OVERRIDE/JETTISON PUMP INSTALLATION





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