6. Compressor Cleaning

The cleaning and preservation practices which are necessary for proper maintenance of the compressor are as follows:

A. Water Rinse.

Accomplish on a daily basis, when operating in a corrosive atmosphere, using the best water available. Usable water can be obtained from the discharge of an air conditioner or from a cistern. It is not necessary to disconnect any tubing during the water rinse; however, the bleed valve must be blocked in the closed position.

WARNING: SALT LADEN HUMIDITY AND CHEMICALS WILL CORRODE COMPRESSOR BLADES AND VANES AND CAUSE THEM TO FAIL.

CAUTION: BE SURE THE IGNITION CIRCUIT BREAKER IS PULLED TO PREVENT IGNITION DURING THE RINSE CYCLE.

(1) Compressor Contamination Removal

Engines subjected to salt water or other chemically laden atmosphere (including pesticides, herbicides, industrial pollutants, sulfur laden atmosphere, etc.) shall undergo water rinsing after shutdown following the last flight of the day. Perform the rinse operation as soon as practical after flight, but not before the engine has cooled to near ambient temperature.

NOTE: Operators should be aware that salt or chemically laden air may be encountered for 75–150 miles (121–241 km) from the source under certain weather conditions. If there is any doubt about the condition in which your engines are operated, the compressors should be given a daily water rinse. Water will not damage the engine but salt and chemicals will.

(a) Precautions to be observed during the spray rinse:

1 Do not loosen or disconnect any pneumatic or fuel lines in performing the water rinse.

2 Never perform the rinse procedure while the engine is operating. Rinsing at operating speeds is ineffective in cleaning corrosive residue from the blade root and the compressor blades and vanes may be damaged.

3 A motored rinse procedure utilizing the starter with N_1 speed below 10% is the only authorized procedure for the Model 250–C20 Series engines.

4 Use the highest quality water available.

5 Do not spray water into a hot engine. The engine temperature should be satisfactory for water rinse when the bare hand can be placed on the outer combustion case without discomfort.

6 Avoid conditions which would allow the rinse water to freeze.

NOTE: Methyl alcohol may be added to the water to prevent freezing during water rinse in below freezing weather. Mix one part methyl alcohol to one part water. This mixture prevents freezing down to –40°C (–40°F). The methyl alcohol shall contain methanol in concentrations not less than 99.85% by volume. See table 301, 72–00–00, Engine–Servicing.

7 Do not inject a solid stream of water into the engine. The nozzle must provide a diffused spray pattern.

8 Hold the nozzle so that the spray is centered around the bullet nose of the inlet to ensure that all of the spray is injected into the engine.

9 Spray a minimum of one quart (one liter) into the compressor; there is no maximum limit.

PARA 6.A. (1) (cont)

(b) Materials and equipment.

1 The highest quality water available must be used.

a The most rapid and economical means to assess water quality is by measuring electrical conductivity. Control of electrical conductivity to a specific low level will automatically yield a low level of chlorides, sulfates, sodium, and other elements. Distilled, demineralized, or deionized water with a maximum electrical conductivity of 3 micromhos per cubic centimeter would be theoretically ideal. However, a more practical level of 20 micromhos per cubic centimeter maximum would control the above impurities to a level of less than 10 ppm.

NOTE: Most water deionizing equipment has the capability to determine electrical conductivity. Commercially purchase deionized/demineralized water, conductivity information should be requested from the vendor.

b Should the electrical conductivity of the water not be known, the use of distilled, demineralized, or deionized water is preferred.

2 Portable equipment such as a garden sprayer or fire extinguisher which can be pressurized to obtain the required flow rate is recommended for water rinse. To provide capability for rinse with either portable equipment or a water supply system, a nozzle capable of flowing the recommended rate at about 55 psig (379 kPa) is desired.

3 The spray nozzle shall provide a diffused spray of water at a flow rate of one quart (one liter) in nine to eleven seconds at the pressure conditions used during compressor rinse. The nozzle should be sized to provide the proper flow rate at the average pressure maintained during each rinse cycle.

NOTE: Test for proper water flow at the pressure to be used by placing the nozzle in a large container so that no water can splash out. Time the flow for 10 seconds and measure the quantity collected. Proper nozzle size for the pressure used should accumulate 1 to 1–1/8 quarts (1.0 to 1.1 liters). Adjust nozzle size as necessary to meet the specified flow limits.

4 A quick opening valve shall be installed in the supply tube as close to the nozzle as practical.

5 6886024 Compressor Cleaning Protector Kit (bleed valve wedge).

(c) Spray rinse procedure:

1 Make sure the anti–ice valve is in the "OFF" position.

2 Make sure the engine ignition circuit breaker is pulled.

3 Block the bleed valve in the closed position using the wedge in 6886024 compressor cleaning protector kit (See Figure 217). It is not necessary to disconnect any lines.

CAUTION: TO PREVENT POSSIBLE BLADE DAMAGE AND TO ASSURE ADEQUATE RINSE AT THE BASE OF THE BLADES, N1 MUST NOT EXCEED 10% RPM. IF N1 RPM REACHES 10%, RELEASE THE STARTER AND CONTINUE THE WATER SPRAY. PERMIT N1 RPM TO REDUCE TO APPROXIMATELY 5% AND THEN RE–ENERGIZE THE STARTER TO OBTAIN A FULL TEN SECONDS OF ENGINE ROTATION WHILE WATER IS SPRAYED INTO THE COMPRESSOR.

4 Start the water injection three seconds prior to engaging the starter. The three second delay will reduce the tendency of the engine to accelerate above 10% rpm.

PARA 6.A. (1) (c) (cont)

5 Spray water into the compressor inlet for 10 seconds while the engine is being motored with the starter. The spray must flow the water as close to the bullet nose of the compressor inlet as possible to ensure that all of the spray is injected into the engine. Do not flood the engine prior to starter engagement.

NOTE: Observe engine speed during the 10 second rinsing operation. The engine rpm will generally stagnate at or just below 10%, but when using a fully charged battery or an A.P.U., the rpm may tend to exceed 10%.

6 Continue injection of water spray during coast down until N_1 stops; this procedure improves the rinse of the base of the blades. Do not continue spray after engine stops.

7 Allow engine to drain. Combustion drain valves may be removed to improve rapid draining of the turbine.

8 Restore engine to operating configuration.

a Remove the wedge from the bleed valve.

b Reinstall the combustion drain valves, and plumbing, if previously removed.

9 Within 15 minutes of the water rinse, operate the engine at idle for five minutes to purge and evaporate all residual water as soon as possible, actuate anti-icing system for one minute.

NOTE: If exposure to excessive salt or other corrosive media has occurred, a repetition of the rinse procedure may be necessary. In cases where the engine has not been receiving regular daily water rinsing, a double rinse may be required to prevent corrosive attack of metals in the engine.

B. Cleaning Compressor Blading

CAUTION: NEVER PERFORM THE CLEANING PROCEDURE WHILE THE ENGINE IS OPERATING; THE COMPRESSOR BLADES AND VANES MAY BE DAMAGED. A MOTORED CLEANING PROCEDURE UTILIZING THE STARTER WITH N_1 SPEED BELOW 10% IS THE ONLY AUTHORIZED PROCEDURE FOR THE MODEL 250-C20 SERIES ENGINES.

CAUTION: ONCE THE COMPRESSOR BLADE CLEANING PROCEDURE HAS BEEN STARTED, IT MUST BE CARRIED THROUGH TO COMPLETION WITHOUT DELAY.

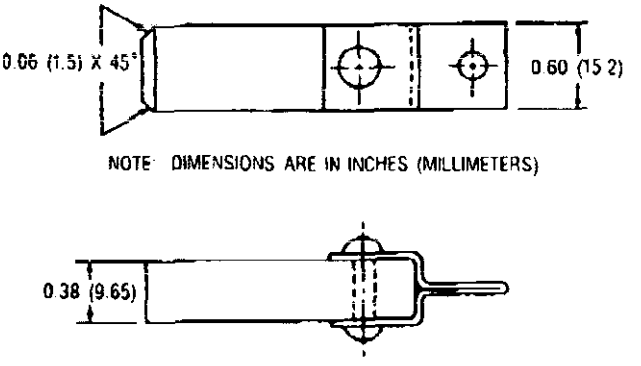
(1) Clean the compressor to regain lost performance due to buildup of dirt.

(2) Cleaning is normally required after 200-300 hr of operation in smoggy areas.

(3) Do not spray cleaning solution into a hot engine. The engine temperature should be satisfactory for cleaning when the bare hand can be placed on the outer combustion case without discomfort

(4) Tubing must be removed and the bleed valve must be blocked closed during the cleaning.

(5) The solution for cleaning the compressor blading consists of an approved cleaner and water, distilled if available. Refer to Table 301, 72-00-00, Engine-Servicing.



Bleed Valve Wedge
Figure 218

PARA 6.B. (cont)

(6) (All aircraft except McDonnell Douglas) On engines with Bendix controls, remove the bleed valve sensing tube and the scroll–to–P_c filter P_c tube by disconnecting each tube at both ends. On engines with CECO controls, remove the scroll–to–governor P_c tube by disconnecting at both ends. Removal of the tubes will prevent compressor cleaning solution from entering the fuel control/governor and the bleed valve pneumatic circuits. Cap and plug the disconnected fittings to prevent contamination of the pneumatic system and to prevent compressor cleaning solution from spraying into the engine compartment.

NOTE: Inspect the scroll–to–P_c filter tube at each end for cracks and fretting wear, especially beneath the area of the floating ferrule and at the flared ends. Also, inspect the P_c tube scroll elbow for cracks or damage.

(7) (McDonnell Douglas Aircraft Only) Remove the bleed valve sensing tube by disconnecting at both ends. Disconnect the control system P_c pressure sensing tube at the governor tee (T) fitting. Plug the tube and cap the tee fitting with a metal plug and cap. Dead–heading the P_c tube will minimize the amount of cleaning solution getting into the P_c filter.

(8) Make sure the anti–ice valve is in the "OFF" position.

(9) Make sure the engine ignition circuit breaker is pulled.

(10) Block the bleed valve in the closed position using the 0.60 in. (15.2 mm) dimension wedge in 6886204 compressor protector cleaning kit (See Figure 218).

(11) Disconnect any airframe installed bleed air system, heaters, environmental control units, etc., that may be damaged or contaminated by the compressor cleaning solution.

PARA 6.B. (cont)

(11) Cap or plug all disconnected fittings.

CAUTION: DO NOT EXCEED 10% N1 RPM MOTORING SPEED DURING CLEANING OR RINSING CYCLES. DO NOT INJECT A SOLID STREAM OF FLUID INTO THE COMPRESSOR.

(12) Inject solution with an aspirator or sprayer equipped with a quick opening valve. Use a steam powered aspirator and hot water, if available.

(13) Start injection three seconds prior to starter engagement and disengage starter at 10% N_1 rpm.

(14) While motoring the engine with the starter, without ignition, inject one quart (one liter) in 9 to 11 seconds to maintain speed below 10% for duration of injection. Repeat injection cycle as necessary to clean compressor.

(15) (McDonnell Douglas aircraft only). Remove the metal plug from the end of the P_c tube. This will allow flushing the P_c filter in the next step.

(16) After injection of cleaning solution, spray steam or clean water (distilled preferred) into the compressor inlet. Start injection three seconds prior to starter engagement, injecting one pint to one quart (0.5 to 1.0 liter) in approximately 5 to 10 seconds, and again disengaging starter before speed accelerates above 10% N_1 rpm.

WARNING: FAILURE TO PROPERLY INSTALL, ALIGN AND TIGHTEN FUEL, OIL, AND AIR FITTINGS AND TUBES COULD RESULT IN AN ENGINE FAILURE.

(17) Clean the bleed valve. (Refer to Cleaning Bleed Valve, Para 3., 75–10–02.)

(18) (All aircraft other than McDonnell Douglas aircraft). Reconnect the pressure sensing tubes and airframe bleed air plumbing. Tighten the P_c tube coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(19) (McDonnell Douglas aircraft only). Remove the cap from the governor tee (T) fitting and reconnect the P_c pressure sensing tube to the governor tee. Tighten the P_c tube coupling nut to 80–120 lb in. (9.0–13.6 N·m). Reconnect the bleed valve sensing tube and tighten the coupling nuts to 80–120 lb in. (9.0–13.6 N·m).

(20) Start and operate the engine for a minimum of five minutes. Operate the engine anti–icing system to purge any compressor cleaning solution from the compressor inlet housing. Operate all aircraft systems that utilize compressor bleed air. Complete the engine drying run as soon as possible after cleaning and rinsing.

(21) If power is not restored after the compressor has been cleaned, reclean as follows:

(a) Remove one case half and clean the blades and vanes with a small brush (toothbrush) and a mild dishwashing detergent (Lux or equivalent). (Refer to Compressor Case Replacement, para 2., this section, for proper procedure.)

(b) Reinstall the cleaned case half. Remove the second (dirty) case half. Clean blades and vanes and replace case half in the same manner as used with the first case half.

C. Cleaning Water–Alcohol Residue from Engine.

Regular use of water alcohol augmentation may temporarily reduce engine power if impure water has been used. Contaminants from impure water build up in the compressor airflow path. Restore normal power by removing contaminants using the normal compressor cleaning process (Brulin). If Brulin cleaning does not restore normal engine power, clean the engine with 0–200 micron dry Arizona road dust (AC Spark Plug Coarse Air Cleaner Test Dust, or equivalent) as follows:

(1) Start the engine. Load to power requirement just short of liftoff.

PARA 6.B. (cont)

(2) Feed 1/4 pound (113 grams) of dry 0–200 micron Arizona road dust into the inlet. Feed the dust at a rate of 1/4 pound (113 grams) per 10–20 minutes.

CAUTION: EXCESSIVE USE OF THE DUST CLEANING PROCESS CAN CAUSE PERMANENT ENGINE POWER DEGRADATION DUE TO EROSION OF COMPRESSOR COMPONENTS.

(3) Check engine power output. If power has not recovered satisfactorily, repeat the dust cleaning procedure.

(4) When engine power has recovered satisfactorily, flush the engine with clean water (distilled is recommended) using the same procedure as used for compressor contamination removal. (Refer to Compressor Contamination Removal, para 6.A.(1), this section.)

D. Preservation

Accomplish when the engine will be idle for extended periods of time using moisture absorbing rust preventive. (Refer to para 12.D., 72–00–00, Engine–Servicing.)