QuadTech

Application Note

1864 Megohmmeter used in DC-10 Aircraft Maintenance

What would a QuadTech 1864 Megohmmeter be doing on a DC-10 maintenance line? Well, insulation resistance measurements of course! The DC-10 aircraft uses hydraulics to power some of its internal systems. The auxiliary hydraulic pump electric motor assembly including its motor feed cables provides some of this hydraulic power. The electric pump motor converts electric power into hydraulic power that is then distributed via tubing throughout the aircraft. Still, where does the 1864 Megohmmeter come into play? The electric motor and feed cables of the auxiliary hydraulic pump assembly are inspected and tested for electrical resistance, continuity, mechanical resistance and associated airplane wiring for resistance/voltage.

Due to the age of the aircraft, some failures have occurred in the auxiliary hydraulic pump motors and/or in the motor feed cables. These failures occurred during both ground operations and in flight and included unrestrained internal arcing in the motor and burnt or shorted feed. The problems could have been caused by contamination of the electric motor by hydraulic fluid; a failed rotor bearing and/or deterioration of the stator's external material. Now as part of routine maintenance on aircraft with 3000 flight hours and those with previously overhauled hydraulic pump motors, the auxiliary hydraulic pump motor system is inspected and repaired as necessary (Boeing Service Bulletin DC10-29A142).

Of concern for the hydraulic pump motor assembly inspection on the DC-10 aircraft is the rotor, the stator, the wiring and the motor bearings. The rotor had seized or was difficult to turn due to worn-out bearings on some of the old DC-10 auxiliary hydraulic pump motors. The outer material of the stator and the casing (insulation) of the motor wiring could be deteriorated over time by leaking hydraulic fluid.

Figure 1.0: Generic Hydraulic Pump

Parts of a Motor

Let's back up here a moment. What is a stator? How does a hydraulic pump motor function? Figure 2.0 illustrates a simplified diagram of an electric motor running a hydraulic pump. In the case of an aircraft this motor would be converting its electrical energy to the hydraulic pump which would push the hydraulic fluid through the hydraulic lines to run various aircraft hydraulic systems. Aircraft systems powered by hydraulics include landing gear extension/retraction; door open/close mechanisms; wing sweeping function and brakes (landing, speed, flap).

Parts of a Motor

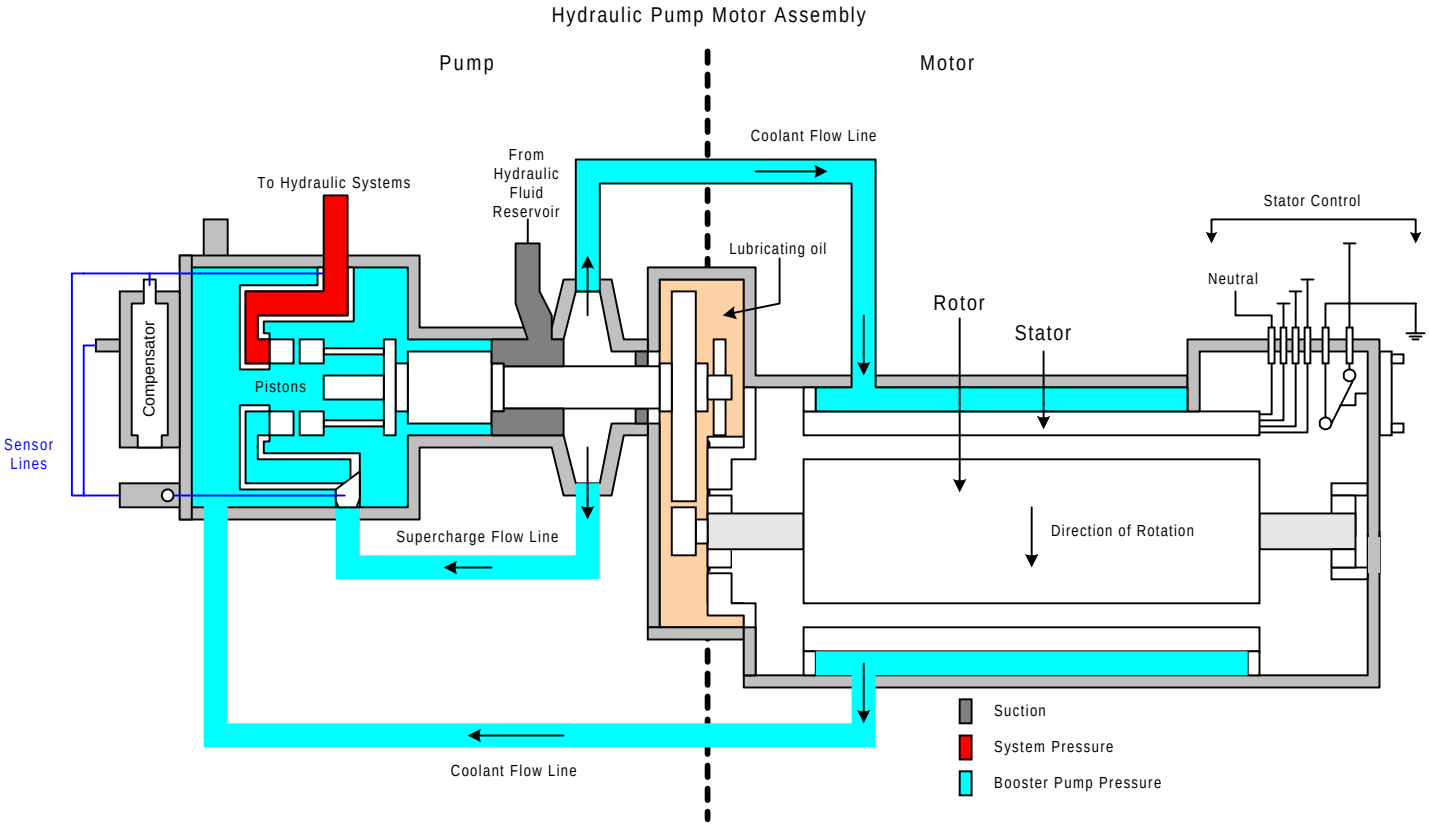

Figure 2.0: Parts of a Hydraulic Pump Motor Assembly

Definitions*

Stator:	(Electrical) The portion of a rotating machine that contains the stationary parts of the magnetic circuit and their associated windings. (Mechanical) A stationary machine part in or about which the rotor turns.
Rotor:	(Electrical) The rotating member of an electrical machine or device, such as the rotating armature of a motor or generator, or the rotating plates of a variable capacitor.
Armature:	That part of an electric rotating machine that includes the main current carrying winding in which the electromotive force produced by magnetic flux rotation is induced. (i.e.: the stator armature)
Hydraulic:	(Engineering) Liquid under pressure is used to transmit energy or operate a device. Hydraulics: (Mechanical Engineering) branch of science and technology studying the mechanics of fluids.
Hydraulic pump:	(Mechanical) a device for forcing a fluid to a higher level by using the kinetic energy of flow.
Hydraulic motor:	(Mechanical) a motor activated by water or another liquid under pressure.
Hydraulic fluid:	(Matter) a low viscosity fluid used to operate a hydraulic system.

* McGraw Hill Dictionary of Scientific and Technical Terms © 1974

Damage and Inspection

Hydraulic fluid used in aircraft comes in several types: water-based, mineral-based and synthetic type oils. Hydraulic fluid by its very composition is destructive to many materials. Contact with metal could result in corrosion of the contacts and with wiring it could eat through cable insulation. Figure 3.0 illustrates damage from hydraulic fluid to an electrical connector.

Figure 3.0: Hydraulic Fluid Damage

Fire results from an electrical spark. So electrical arcing in a motor could cause a fire and damage the electrical system and/or the structure of the auxiliary hydraulic pump motor assembly. An electrical arc occurs when there is a very rapid variation in voltage or current and produces an audible cracking sound and spark. A stress test (dielectric withstand, dielectric breakdown, voltage breakdown) is performed on the device under test (DUT = motor) to determine its insulation properties. A detection circuit in an electrical safety tester can monitor the current flowing through the DUT and check the magnitude and timing of deviations from normal values. The detection circuit sensing a current greater than a predetermined value, considered to be a breakdown, will sound an alarm and cut off the current supply. Current less than the established limit is not considered harmful but a value in excess of said limit is an indication of a defective product. The dielectric withstand test is a very valuable evaluation tool for verifying an electrical product's insulation and dielectric barriers.

The 1864 Megohmmeter is used to test the insulation resistance of the wiring of the auxiliary hydraulic pump motor assembly and verify that the resistance is in compliance with the DC-10 aircraft maintenance manual specifications. The 1864 Megohmmeter is a portable, steel encased high resistance tester capable of supplying 200 test voltages from 10V-1090V DC and measure resistance up to 200TΩ (that's 2 x 10^{14} ohms!). Besides aircraft wiring, the 1864 Megohmmeter has been employed in IR tests on wire & cable (cable reels), capacitors, rectifiers and solid-state diodes plus a wide variety of electronic components.

For complete product specifications on the 1864 Megohmmeter or any of QuadTech's products, visit us at http://www.quadtech.com/products. Do you have an application specific testing need? Call us at 1-800-253-1230 or email your questions to info@quadtech.com.

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