Hydraulic GSE

Maintenance and troubleshooting

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When properly maintained and operated, hydraulic GSE equipment should provide many years of trouble free service. This article is a supplement to the OEM maintenance manual provided with the equipment. Proper operation should be according to the OEM manual. Longer equipment life, less frequent unscheduled maintenance, and lowest life cycle cost are three good reasons to properly maintain hydraulic GSE equipment. GSE equipment that hydraulically interfaces with the aircraft, if not properly maintained, could contaminate the aircraft hydraulic system and damage sensitive hydraulic aircraft components. All hydraulic systems require regular maintenance; some only call for checking fluid level and seal integrity.

CONTAMINATION

A comprehensive contamination control program should be the foundation of any hydraulic GSE maintenance plan. Development of a contamination program can be broken down into six major steps:

1. A company wide agreement to support this program (financial, training, equipment, material, manual labor).
2. Training for personnel involved (possibly supplied by the equipment manufacturer, Hydraulic Training Center, or School of Engineering).
3. Standards for acceptable level of fluid contamination (airframe manufacturer's recommendation).
4. Baseline testing of all GSE equipment (fluid sample sent to an analysis laboratory, or using a contamination monitor).
5. Equipment or materials acquired to implement program (contamination monitor, sample analysis bottles, improved filtration, contamination removal equipment).
6. Maintenance and testing scheduled (specificintervals for testing and filter replacement, regular evaluation of the program).

Many closed systems (no interface with the aircraft hydraulic systems) only require checking fluid levels,

inspection for fluid leaks, and visual or infrequent laboratory fluid analysis.

Contamination problems in hydraulic GSE fluid can be separated into four major categories:

1. Particles (solid foreign material in the fluid).
2. Water (either in solution or free water).
3. Air (either dissolved or entrained).
4. Chemical (foreign or fluid deterioration).

Particles: Can cause many types of wear in a system which can lead to component failure. Tight operating clearance components and orifices can stick or plug because of particle contamination – abrasive wear on moving components, edge, or critical surface deterioration.

Water: Moisture can react with almost anything in hydraulic fluids, causing chemical reactions, which can lead to an increase in wear and interference. Water in hydraulic fluids can also promote rust or corrosion through galvanic action. Corrosive wear degrades the surface, bearing fatigue.

Air: Undissolved air can cause premature wear on equipment and pressure changes that compress the air and produce a large amount of heat. Efficiency levels can drop due to the work required to compress the air, and oxidation of metal parts and additives – increased operating temperature, increase in noise level, loss of transmitted power.

Chemical: Incompatible fluids entering the hydraulic system, cleaning solvent residue not removed during component maintenance, or chemical reaction with components (hose material, plated component, elastomer material). Thermal damage, excessive mechanical shear, and additive deterioration are other examples. – viscosity variance, fluid additive breakdown.

Many GSE systems include hydraulics, for example:

- Hydraulic Power Units (Mules)
- Hydraulic Test Units (Static and Dynamic)
- Reservoir Service Units (Hydraulic fluid and Engine oil)
- Hydraulic Jacks (NLG, MLG, and Axle)
- Towbars (with Hydraulic Height Adjustment)
- RAT or ADG Ground Test Units (Emergency Power Systems)
- Hydraulic Cranes (Engine, APU, Battery, Utility)
- Fluid Dispensing Units (Hydraulic fluid and Engine oil)
- Hydraulic Maintenance Platforms (B4, B5, Utility)
- Hydraulic Tire Beadbreakers
- Hydraulic Wheel and Brake Dollies

PREVENTION

The best offense is a good defense — prevent contaminants from entering the system. Make sure the fluid filler cap is in proper operating condition, and only is removed for servicing the reservoir. Change filters often enough to maintain the required contamination level of the system (or annually as a minimum, more frequently depending on usage). Ensure that the air filter/desiccant is not saturated which could either limit air from exchanging with the reservoir, or allow contaminates to enter the reservoir.

Consider upgrading (or adding) the filtration system of the hydraulic GSE equipment to take advantage of progress in media and filter design. Pressure system filtration should be a non-bypass, high collapse type, 2 or 3-micron rated filter. Return system filters a bypass type, 5 to 10-micron rated. Fiberglass type media offer excellent benefits over cellulose and wire mesh type filters. The filters should be properly chosen to handle the required system flow and

HYDRAULIC SYSTEM MAINTENANCE & TROUBLESHOOTING CHECKLIST (GENERIC):

- Check quick disconnect couplings and coupling plugs for leaks or damage – repair or replace.
- Verify the fluid filler cap is in proper operating condition - replace.
- Check external and internal hoses for cuts, worn areas, blistering, or areas that seep fluid (form a drop) – replace.
- Verify all indicator lights are operational – repair or replace.
- Check for any hydraulic leaks (fittings, O-rings, gaskets, shaft seals) - re-torque, repair, or replace.
- Verify cooling fan is operating properly – clean, repair, or replace.
- Check condition of fluid either by sending a sample to an analysis laboratory, or using a portable contamination monitor – filter and dehumidify as necessary to achieve required levels that meet (airframe) manufactures specifications or replace.
- Replace all fluid filters on a regular schedule – Use periodic fluid samples, operating hours, or filter delta-pressure gauges as required or annually as a minimum depending on usage.
- Replace air filter/desiccant element on a regular schedule – Silica Gel type desiccant filters turn pink when saturated or annually as a minimum depending on usage.
- Verify hydraulic pump(s) performance as required – see OEM maintenance manual.
- Check system pressure relief valve setting – see OEM maintenance manual.
- Check reservoir interior for visible objects or silt buildup – drain, clean, and re-fill with new filtered fluid.
- Check reservoir fluid level with all cylinders retracted at operating temperature - fill as required.
- Run system and purge of any entrapped air – circulate at varying flows and pressures.

TABLE 1 Fluid Cleanliness Required for Typical Hydraulic Components (Parker)

Components	NAS 1638	ISO code
Servo control valves	5	16/14/11
Proportional valves	6	17/15/12
Vane and piston pumps and motors	7	18/16/13
Directional and pressure control valves	7	18/16/13
Gear pumps and motors	8	19/17/14
Flow control valves and cylinders	9	20/18/15
New unused fluid	9	20/18/15
ISO code: particles ≥ 2 micron/particles ≥5 microns/particles ≥ 15 micron		

Source: Parker Hannifin Corp.

pressure, and a filter beta ratio of 200 or greater at the rated micron rating should be maintained.

Fluid reservoirs should be a sealed type with an air filter and desiccant to control the condition of the fluid inside the reservoir system. Consider adding an air filter and desiccant system to the reservoir. This can be accomplished by replacing the breather type filler cap with a flange adapter and a replaceable filter and desiccant element. Other external systems can be added if this is not convenient, then a sealed filler cap is required to limit the exchange of air only through the air filter and desiccant system.

MONITORING

Regular fluid monitoring assures that the fluid meets the required specifications of the fluid, airframe, or component manufacture (initial baseline, 25 hours operation in an indoor facility, more frequently for outdoor or harsh environments) This can be done by taking a fluid sample (using ANSI/NFPA T2.9.11-1999) and sending to an analysis laboratory, or using a portable contamination monitor. Required testing intervals can be adjusted according to individual results and rate of fluid contamination deterioration. Monitoring allows you to adjust maintenance programs to keep contamination levels at an acceptable level without excessive costs.

Hydraulic GSE equipment and aircraft systems can be examined using portable monitors that give immediate results of the ISO or NAS cleanliness level, also moisture level in the fluid system. A portable filtration and moisture removal unit can be used to bring levels down to acceptable levels that conform to the airframe manufacturer's recommendation.

Off-line cleaning of a hydraulic fluid system is another method of keeping a system at acceptable levels. Looping fluid through an onboard or kidney loop system until levels are acceptable.

FLUID COMPATIBILITY AND ASSOCIATED PROBLEMS

With so many fluids used in an aircraft today, extra care must be exercised to keep all the fluids isolated. Petroleum based and phosphate ester hydraulic fluids, engine oils, and anti-icing fluids all require different wetted materials in hydraulic GSE equipment. The same servicing equipment must never be used for more than one fluid type and a fluid type placard should be attached to all units.

If a unit does become contaminated with a foreign fluid, great care must be exercised to assure that all affected components are replaced, or thoroughly cleaned and dried prior to installation. The fluid in question should be properly disposed of, and an ICP spectrometric fluid analysis should be done to assure that all traces of the foreign fluid has been removed from the system. In many cases, this cost will exceed purchasing a new piece of equipment.

Proper GSE maintenance involves knowing the condition of the fluid and components, keeping the unit's contamination level at an acceptable value, and operating the unit properly all in accordance with the OEM manual to ensure a long, trouble free life.

REFERENCES:

The Handbook of Hydraulic Filtration, Parker Hannifin Corporation, Metamora, OH

Fluid Systems, two-part series, January and February 2000 editions Power Engineering, David Brown of Parker Hannifin Corporation

Specifications and Properties of Skydrol Fluid, Solutia, Pub. No. 7249153B

Tronair is a worldwide supplier of GSE equipment that manufactures: towbars, jacks, hydraulic equipment, electrical equipment, oxygen and nitrogen equipment, engine maintenance equipment, cabin pressure test units, deicers, maintenance platforms, tire/brake/strut service equipment, potable water units, lavatory service carts, and many others products.

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