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Aerospace series — Fluid systems and components — Methods for system sampling and measuring the solid particle contamination in hydraulic fluids

Série aérospatiale — Systèmes de fluides et éléments constitutifs — Méthodes de prélèvement et de mesure de la contamination particulaire solide dans un fluide hydraulique

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 20, *Aircraft and space vehicles,* Subcommittee SC 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition (ISO 5884:1987), which has been technically revised. The main changes compared to the previous edition are as follows:

— update of the document to be in line with current ISO rules;

— improved layout and clarity in definition;

— removal of sample analysis detail, with reference to relevant ISO method instead;

— improved sampling point recommendations;

— improved clarity of sampling methods and recommendations for preference.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

0 Introduction

0.1 General

The design of modern hydraulic equipment for aerospace purposes, its use and performance are widely determined by the type and condition of the applicable hydraulic fluids.

The quality and serviceability of hydraulic fluids are dependent on various factors (e.g. thermal stability, viscosity), but in particular on the level of solid particle contamination. Regular fluid contamination testing is required to determine if the fluid is maintained within specified limits that are set by the aircraft manufacturer or hydraulic system operator.

In order to obtain consistent and comparable test results, the test methods detailed in this document should be used.

As a result of the rapid development and improvement of hydraulic systems and their components, which meet critical requirements, the problem of solid particle contamination of hydraulic fluids has steadily increased. The need for maintaining a specified standard of fluid cleanliness in hydraulic systems requires continuous control of the number and size of the solid particle contaminants.

0.2 Solid particle contamination

Solid particle contaminants can be the cause of abrasion and wearing, thereby shortening the life of the components in a hydraulic system.

In a hydraulic system:

a) components are subject to erosion (primarily in components with higher fluid velocities);

b) all moving parts are subject to wear by abrasion; and

c) control valves are subject to silting (settlement of fine particles on the control bore).

0.3 Causes of solid particle contamination

Solid particle contamination of hydraulic fluids can be system-generated, introduced from the outside, in-built or maintenance-generated, for example:

a) dust particles in the air;

b) metal particles, produced during the manufacture of parts;

c) sand residues on castings;

d) abrasion of seals;

e) oxide layers on welding seams and on heat-formed or heat-treated steel parts;

f) chemical and physical changes in the condition of hydraulic fluids;

g) maintenance of hydraulic systems (e.g. fibres, secondary contamination, etc.);

h) wear of components from abrasion, adhesion and fatigue; and

i) ingress of particles via piston gland seals.

0.4 Layout of this document

This document is sub-divided into the following clauses:

— Sampling apparatus (Clause 4):

  — Characteristics;

  - Preparation;
- Sampling (Clause 5):
  - Recommendations for sampling point location;
  - Recommendation of sampling frequency;
  - Sampling methods;
  - Recommendation of sample marking;
- Sample analysis methods (Clause 6);
- Test report recommendations (Clause 7).

Aerospace series — Fluid systems and components — Methods for system sampling and measuring the solid particle contamination in hydraulic fluids

1 Scope

This document specifies best practice for sampling hydraulic fluid from aircraft hydraulic systems and other hydraulic systems associated with aerospace purposes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 3722, *Hydraulic fluid power — Fluid sample containers — Qualifying and controlling cleaning methods*

ISO 4021, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system*

ISO 4405, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the gravimetric method*

ISO 4406, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

ISO 4407, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the counting method using an optical microscope*

ISO 11171, *Hydraulic fluid power — Calibration of automatic particle counters for liquids*

ISO 11218, *Aerospace — Cleanliness classification for hydraulic fluids*

ISO 11500, *Hydraulic fluid power — Determination of the particulate contamination level of a liquid sample by automatic particle counting using the light-extinction principle*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Sampling apparatus

4.1 General

When establishing the solid particle contamination of hydraulic fluids, the test results can be adversely affected by not sufficiently taking account of the need for an optimum cleanliness.

To obtain meaningful results, reproducible at any place and at any time, it is essential to ensure that the sampling equipment is carefully prepared and maintained throughout the sampling process to prevent any addition of solid particle contamination to the hydraulic fluid sample taken. This is because additional solid particle contamination can be caused by using apparatus inadequately cleaned for the measurement.

All apparatus used for determination of the solid particle contamination level of hydraulic fluids shall be thoroughly cleaned before use in accordance with the procedure specified in 4.3.3.

It is important that for all sampling apparatus, due consideration is given to the suitability and resistance to both the cleaning fluid used to prepare the sample apparatus and to the fluid to be sampled. This is especially important when considering the compatibility differences between mineral oil /synthetic hydrocarbon and Phosphate Ester–based hydraulic fluids.

4.2 Sampling apparatus characteristics

4.2.1 Manual sampling apparatus

4.2.1.1 General

Most system fluid samples can be obtained with the use of a simple sample bottle and tubing (if necessary) to transfer the fluid from the sampling point to the bottle.

It is preferable to purchase suitable sample bottles that meet the provisions of ISO 3722. The system operator shall specify the required cleanliness level.

Tubing shall be pre-cleaned or purchased in a condition which is in accordance with a cleanliness level required by the system operator.

If cleaning manual sampling apparatus is required prior to use, then refer to 4.3.

4.2.1.2 Sample bottles

The sample bottles shall be made from glass or polyethylene terephthalate (PET or PETG). They shall have a maximum capacity of 250 ml and a minimum capacity of 100 ml. They should be sealed by means of caps (preferably of phenolic resin with glass bottles) which do not cause contamination. Otherwise, a non-flaking plastic film compatible with the hydraulic fluid should be used.

4.2.1.3 Sample tubing

The sample tubing (if necessary for sampling of fluid) shall be in accordance with the description given in ISO 4021.

4.2.2 Automated sampling apparatus

4.2.2.1 General

Automatic sampling of fluid systems can be carried out using equipment such as a field monitor or portable cleanliness monitor. These systems are preferred to bottle sampling methods as there is a much lower possibility of contamination of the results, especially in adverse environmental conditions.

Automated sampling monitors shall be flushed prior to use. This can be completed using the system fluid itself, or a fluid which has a similar viscosity and a cleanliness class better than the requirement for the system fluid. The volume of fluid used for flushing should be at least twice that of the hose used to connect the monitor to the hydraulic system.

4.2.2.2 Field monitors

Field monitors contain membrane filters suitable for subsequent microscopic analysis (ISO 4407) or gravimetric analysis (ISO 4405).

The membrane filters shall be pre-installed in the field monitor in a clean environment.

During flushing, the fluid should bypass the membrane and therefore a three-way valve shall direct the flow from the membrane. Following flushing and prior to sampling, the valve is actuated to direct the flow to the membrane filter.

4.2.2.3 Laser particle counter systems

Portable laser particle counter systems use light extinction techniques to produce an immediate analysis of the system cleanliness. The monitors shall be calibrated in accordance with ISO 11171. The output from the systems is in the form of a coded cleanliness level in accordance with ISO 4406 or cleanliness classes in accordance with ISO 11218.

NOTE SAE AS 4059 or NAS 1638 can also be taken as equivalent standards to ISO 11218.

ISO 11218 (or SAE AS 4059) should be used in place of NAS 1638, except in special circumstances where comparison to earlier data is necessary.

These types of monitors are affected by the occurrence of water droplets or air bubbles in the sampled fluid. Therefore, care shall be taken with the location of the sampling point (5.2).

4.2.2.4 Portable mesh blockage monitors

Portable mesh blockage monitors determine particulate contamination levels by passing a specified flow of sample fluid through a series of calibrated mesh screens in a specified sequence. Pressure drop build-up (or flow degradation), which is dependent on particulate contamination levels, is measured and converted via algorithms into:

— a coded cleanliness level in accordance with ISO 4406; or

— cleanliness classes in accordance with ISO 11218.

NOTE SAE AS 4059 or NAS 1638 can also be taken as equivalent standards to ISO 11218.

ISO 11218 (or SAE AS 4059) should be used in place of NAS 1638, except in special circumstances where comparison to earlier data is necessary.

These monitors are especially suited to systems in which the fluid is likely to contain free water or air bubbles and can also be used to measure viscosity, temperature and fluid water content (if equipped with a water sensor).

4.3 Sample apparatus preparation

4.3.1 General

Sampling apparatus requires careful preparation to achieve a high level of cleanliness and control prior to use. This ensures that sampled fluid is not contaminated by background contaminant already present on the sample apparatus itself.

Staff performing any cleaning procedures shall wear lint-free clothes (e.g. cap, smock frock, boots) to avoid excessive secondary contamination by fibres.

The standard of the workroom shall be such as to ensure that the specified cleanliness standard can be achieved repeatedly.

4.3.2 Solvents

4.3.2.1 General

Liquid solvents shall be used to ensure removal of both solid and liquid contamination of sampling equipment.

The solvents used shall be verified as physically and chemically compatible with the sampling equipment and shall not react with the hydraulic oil to be stored in the bottle.

The following solvents are recommended solvents. Other approved equivalents are permitted, but should be agreed prior to use.

— Solvent Type A: Water in accordance with ISO 3696, Grade 3.

— Solvent Type B: 2-propanol (isopropyl alcohol), reagent-pure.

— Solvent Type C: Hydrocarbon solvent (e.g. Petroleum Ether), reagent-pure.

The solvents used shall conform to at least the cleanliness requirement specified for the sampling apparatus and preferably to a higher cleanliness level. Solvents should preferably be purchased in the required cleanliness condition. If solvent filtration is required, then the procedure of 4.3.2.2 or 4.3.2.3 shall be followed.

4.3.2.2 Solvent pressure filtration (preferred method)

4.3.2.2.1 Apparatus

4.3.2.2.1.1 Pressure tank, stainless steel.

4.3.2.2.1.2 Filter-jet spray gun, with filter attachment, cleaned in accordance with 4.3.3.

4.3.2.2.1.3 Membrane filter, having an aperture size less than or equal to 0,5 µm.

4.3.2.2.2 Procedure

The filter-jet spray gun, with a membrane filter fitted, shall be connected by a hose to the pressure tank containing the solvent. The gun shall produce a concentrated jet of filtered solvent for cleaning the surfaces. Pre-cleaning of the solvent is therefore not required.

Nitrogen pressurization is recommended for any spray gun tanks filled with flammable fluids.

Continued use of the apparatus shall not require further cleaning, provided that the filter membrane remains in place. On removal of the filter membrane (usually connected with completion of batch sampling duties), the apparatus shall be cleaned again.

4.3.2.3 Solvent vacuum filtration

4.3.2.3.1 Apparatus

4.3.2.3.1.1 Vacuum pump.

4.3.2.3.1.2 Filtration apparatus, stainless steel or glass, cleaned in accordance with 4.3.3.

4.3.2.3.1.3 Membrane filter, having an aperture size less than or equal to 0,5 µm.

4.3.2.3.1.4 Wash bottles, clear glass or clear-transparent polyethylene terephthalate (PET or PETG), cleaned in accordance with 4.3.3.

4.3.2.3.2 Procedure

For vacuum filtration of the solvent, the filtration apparatus shall be fitted with a membrane filter and connected to the vacuum pump by a hose. The solvent shall be filtered through the membrane filter by the vacuum in the flask of the filtration apparatus. The filtrate collected in the flask shall be transferred to the corresponding wash bottle.

It is recommended that the clamp which holds the flask be connected to ground using a static dissipative connection.

When using a piece of compatible plastic film to seal the wash bottles, the film shall be cleaned with pre-filtered solvent and the film shall be placed over the mouth of the sample bottle with the edges of the film bent downwards and the cap screwed onto the bottle. Care shall be taken not to use excessive torque to tighten the cap, to avoid breaking the plastic film.

Continued use of the apparatus shall not require further cleaning, provided that the filter membrane remains in place. On removal of the filter membrane (usually connected with completion of batch sampling duties), the apparatus shall be cleaned again.

4.3.3 Cleaning procedure for sampling apparatus

Before the first use, any filtration apparatus, filter-jet spray gun or wash bottles should be cleaned with the following method:

a) rinse with a degreasing fluid;

b) wash thoroughly in a hot water solution of detergent;

c) rinse twice with hot water (at a temperature of between 40 °C and 60 °C);

d) rinse twice with solvent type A (4.3.2.1), filtered in accordance with 4.3.2.2 or 4.3.2.3;

e) rinse with solvent type B (4.3.2.1), filtered in accordance with 4.3.2.2 or 4.3.2.3;

f) rinse with solvent type C (4.3.2.1), filtered in accordance with 4.3.2.2 or 4.3.2.3 is preferred, but is not essential;

When carrying out steps d) to f), care shall be taken to ensure that the whole surface of the apparatus is rinsed from bottom to top.

It is also possible to use a purpose built rig designed to carry out the cleaning process and therefore the use of solvent type B or type C only is acceptable.

4.3.4 Cleaning procedure for sample bottles

Sample bottles and caps shall be thoroughly cleaned in accordance with the procedure specified in 4.3.3. In carrying out steps d) to f) of 4.3.3, care shall be taken to ensure that the whole surface of the sample bottles is rinsed from bottom to top.

A small amount of solvent type C may remain in the sample bottle after the last rinse, if used. The resultant gas pressure inside the sample bottle helps to prevent contamination entering the bottle when opened.

When using a piece of compatible plastic film to cover the bottle opening, the film shall be rinsed with filtered solvent type B or type C and shall then be placed over the mouth of the sample bottle with the edges of the film bent downwards and the cap screwed onto the bottle. Care shall be taken not to use excessive torque to tighten the cap, to avoid breaking the plastic film.

4.3.5 Checking and controlling cleaning methods

Checking of cleaned sample bottles shall be performed in accordance with ISO 3722. This shall be completed for example on a 1 in 100 basis, depending on the batch size of cleaned sample bottles.

The sample bottles shall not contain more than 200 particles greater than 10 µm nor more than 500 particles greater than 5 µm per (100 ± 5) ml.

5 Sampling

5.1 General

It is strongly suggested that all apparatus and equipment used in sampling methods B, C and D (5.4) shall be cleaned in accordance with the procedure specified in 4.3.

There can be instances where the apparatus and means of ensuring cleanliness are not available "in field". In this case, the apparatus may be rinsed with the fluid from the system that the sample is to be taken from.

Sampling from a pressurized hydraulic system can be hazardous and all precautions should be taken during sampling, including the wearing of suitable hand, eye and body protection

The environmental conditions at time of sampling can have a significant effect on contamination of the sample, for example if there is a swirling wind condition and a dusty environment. If this is the case, then the sample should be taken at a time when conditions are more conducive to non-contamination from the ambient environment. Otherwise, suitable shielding shall be provided by a second person. The environmental conditions should be noted at time of sampling.

It is advisable, and, in some cases, required, to operate the system at full flow prior to taking a fluid sample to ensure that the sample taken is representative of the aircraft at near flight conditions or the hydraulic system when operating.

5.2 Recommendations for sampling point location

The sampling point differs from one hydraulic system to another and shall be defined by the system designer. The location should be a point where the best chances for a representative distribution of the solid particle contamination are given.

The following provisions and the criteria set by the aircraft/system manufacturer shall be taken into account when defining the sampling point:

a) Any sampling valve shall be:

   — automatic-closing and contain a separate cap with an integral seal;

   — capable of withstanding system pressure;

   — be placed at the sampling point without the link tubing being too long.

b) Samples should preferably be taken from a main line turbulent point in the fluid system to ensure adequate mixing of the contaminant per fluid volume.

c) The sampling location could be upstream or downstream of a return line filter or a pressure line filter.

d) Samples from low points in a reservoir or pipe run should be avoided, as contaminant may collect in such an area giving an indication of a system which is more contaminated than is the case.

e) Samples taken from a suitable location in a system reservoir should be taken with the system fluid flowing. If samples are taken without the system fluid flowing, then the sample should be taken within 30 mins of shutting down the system.

f) In addition, the guidance given in ISO 4021 should be observed.

5.3 Sampling frequency

Sampling should be performed regularly and consistently as agreed with the aircraft/system manufacturer, to determine the condition of the hydraulic fluid and to highlight any issues in the hydraulic system.

Additional sampling should be carried out in instances where the hydraulic system suffers a problem, when system parts are removed or when the hydraulic system is opened.

5.4 Sampling methods

5.4.1 General

There are four main methods of sampling and these are listed in order of preference:

a) Automated Field Monitor membrane/PCM System sampling

This is the preferred method, as it poses the least possibility of contamination of sample and results can be provided immediately for assessment of system cleanliness condition. However, the time allowed for sampling may not permit this method.

b) Direct collection from a system sampling valve (most preferred manual method)

This is the fastest method for sampling, when quick turnaround times are required for aircraft maintenance.

c) Reservoir sampling with vacuum pump and tubing

Sampling using this method should be completed as soon as access to the reservoir is possible to minimize a high percentage of contaminant fallout in the reservoir volume.

d) Reservoir sampling with direct bottle dipping (least preferred method)

This method is more likely to be used on hydraulic systems and test stands as opposed to aircraft systems.

This method has distinct possibilities for contamination of the system fluid (due to open access of ambient airborne contaminant to the fluid surface) and, if the sample is not taken soon after shutting down the system, then the contaminant itself can have fallen to the bottom of the reservoir. This method should be avoided wherever possible.

Sampling of hydraulic fluid should be carried out by two persons wherever possible to minimize the risk of contamination of the sample fluid.

5.4.2 Sampling method A — Field monitor/PCM system

5.4.2.1 Remove the cap from the quick disconnect coupling and attach the sample-releasing apparatus to the quick disconnect coupling.

5.4.2.2 Fit the field monitor/PCM system (4.2.2.2) onto the sample-releasing apparatus and position the three-way valve so that the hydraulic fluid is diverted by a hose before it reaches the monitor inlet.

5.4.2.3 Open the sample valve and release a volume of hydraulic fluid to flush the sampling system into a waste container. A minimum volume of 100 ml is recommended. In determining the minimum volume to be flushed, full account shall normally be taken of the link pipe volume.

5.4.2.4 Position the three-way valve so that the hydraulic fluid filters through the monitor and flows into a graduated collecting bottle.

5.4.2.5 Close the sampling valve.

5.4.2.6 After the desired sample volume has been taken, return the three-way valve to its initial position.

5.4.2.7 Before removing the monitor, attach the injector nozzle and ensure that the remaining fluid passes through the monitor. Then, remove the monitor and mount caps.

The whole procedure should be carried out with reference to the manufacturer's instructions.

5.4.2.8 Transportation of the monitors with the membrane filter from the sampling point to the laboratory shall be carried out with care to prevent contaminants dropping off the membrane. The surface holding the contaminants shall always be directed upwards and the determination of the fluid cleanliness shall be made as quickly as possible.

5.4.3 Sampling method B — Sampling valve (using sample bottles)

5.4.3.1 The sampling valve of the hydraulic system should be capped. If the sampling valve is not capped then the valve should be pressure rinsed using a filter spray gun, in accordance with the procedure of 4.3.2.2, with a suitable solvent (if safe to do so).

5.4.3.2 Remove the sampling valve cap (if applicable) and open the sample valve and release a volume of hydraulic fluid to flush the sampling system into a waste container. A minimum volume of 100 ml is recommended. In determining the minimum volume to be flushed, full account shall normally be taken of the link pipe volume

Do not close the sampling valve during flushing of the sampling system and filling of the sample bottle.

5.4.3.3 Remove the sealing cap, along with plastic film (if used) from the sample bottle and drain off any residual solvent from the bottle, if necessary. The sample bottle lid should be maintained (by hand) facing downwards. Fill the sample bottle to (50 to 70) % of its capacity (100 ml minimum) within 10 seconds to minimize potential contamination from the environment.

5.4.3.4 The following considerations should be taken into account during the sampling of the system fluid:

— Care should be taken that no system fluid sprays from the sample bottle onto the sampling valve by way of jetting into the sampling bottle, thereby allowing potential contaminant from the valve itself to contaminate the sample. If this should occur, then the sample bottle shall be replaced by a new sample bottle.

— Ensure that the internal surface of the bottle does not come into contact with the sampling valve. If this should occur, then the sample bottle shall be replaced by a new sample bottle.

— Care should be taken not to deposit either the sampling valve cap or the sealing cap from the sampling bottle onto any surface. Each cap should be held with the opening downwards and without touching the internal surface to prevent contamination of the cap. Therefore, it is preferable for two people to carry out the sampling.

— Ensure that the sampling valve is not actuated during the flushing or sampling period.

5.4.3.5 Remove the sampling bottle from the fluid stream.

5.4.3.6 Close the sample bottle with the sealing cap, and plastic film (if used).

5.4.3.7 Close the sampling valve and cover with a suitable cap to avoid contamination. Do not wipe the sampling valve after use, as this can introduce contamination for the next sample.

If the sampling valve cap is a replacement, then it is suggested that the cap be pressure rinsed using a filter spray gun, in accordance with the procedure of 4.3.2.2, with a suitable solvent.

5.4.3.8 Identify the sample clearly in accordance with 5.5.

5.4.4 Sampling method C — Reservoir sampling with vacuum pump and tubing

5.4.4.1 This method of sampling should be completed within 30 min of shutdown of the system to ensure that contaminant is still mixed within the system fluid volume.

5.4.4.2 Attach an initial sample bottle to the vacuum sampling equipment. This bottle shall be used to clean the vacuum sampling equipment only.

5.4.4.3 Locate the end of the sample tubing into a mid-point of the reservoir (ensuring it does not touch any side walls or baffles) and draw approximately 75 % of the bottle volume. Shut off vacuum, open bottle and dispose of fluid (do not re-introduce into the reservoir if possible).

5.4.4.4 Repeat step 5.4.4.3 two further times to ensure the equipment and tubing is flushed.

5.4.4.5 Fit a fresh sample bottle to the vacuum equipment (the sample bottle lid should be maintained facing downwards and should not be placed on a contaminated surface)

5.4.4.6 Draw a final bottle sample to (50 to 70) % of its capacity (100 ml minimum) and close the sample bottle with the sealing cap, and plastic film (if used).

5.4.4.7 Identify the sample clearly in accordance with 5.5.

5.4.5 Sampling method D — Reservoir sampling with direct bottle dipping

5.4.5.1 This method of sampling should be completed within 30 min of shutdown of the system to ensure that contaminant is still mixed within the system fluid volume.

5.4.5.2 Clean the outside of a sample bottle with a filter-jet spray gun filled with solvent and allow the solvent to evaporate.

5.4.5.3 Remove the sample bottle cap and ensure the bottle opening and cap opening are facing downwards to minimize the likelihood of airborne contamination settling on the internal surfaces.

Ensure that the cap is not placed onto a contaminated surface.

5.4.5.4 Dip the sample bottle into reservoir fluid and sample approximately 75 % of the bottle volume.

5.4.5.5 Close the sample bottle with the sealing cap, and plastic film (if used).

5.4.5.6 Identify the sample clearly in accordance with 5.5.

5.5 Sample marking

Sample bottles should be marked with the following information:

a) an identifier of the specific system or serial number of the specific aircraft from which the sample has been taken;

b) a short description of the system from which the sample was taken (e.g. Green Hydraulic system);

c) the type and specific identification of the system hydraulic fluid (e.g. Phosphate Ester – Skydrol PE-5/Hyjet V);

d) the location from which the sample was taken, description of type of sample, e.g. sampling valve or reservoir;

e) reference to the sampling method used, for example, “Sample taken in accordance with ISO 5884:— , x.x.x”;

f) a sample ID (identification);

g) the date and time of sampling;

h) adverse environmental conditions at time of sampling;

i) the name of the technician who carried out the measurement;

j) safety related Safety Data Sheet (SDS) or Material Safety Data Sheet (MSDS).

6 Sample analysis methods

Three suggested methods are identified for analysis of the solid particle contamination of the sampled hydraulic fluids:

a) microscopic method (in accordance with ISO 4407);

b) automatic particle counting method (in accordance with ISO 11500);

c) gravimetric method (in accordance with ISO 4405).

Any one of these methods may be used to analyse the solid particulate contamination.

It can be necessary, if an unexpected result is obtained, to carry out multiple analyses, including the use of more than one of the above methods to clarify the reading.

The results of these three methods are not comparable with each other. Comparison may only be made by results obtained using the same method.

7 Test reporting

7.1 General

The test report shall contain the results established by measuring the solid particle contamination of aircraft hydraulic fluids. The analysis based on the test report permits the evaluation of the cleanliness of hydraulic fluids. Consequently, appropriate action can be taken in time to detect and correct deficiencies within the hydraulic system which can be detrimental to its operation.

7.2 Test report form

The laboratory carrying out the measurement of the solid particle contamination of hydraulic fluids shall complete the test report form accompanying the samples. The laboratory shall retain a copy on