LEAK DETECTION FLUIDS CYLINDER PACKAGES

AIGA 70/14

Revision of AIGA 70/10

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Preface

As part of a programme of harmonization of industry standards, the European Industrial Gases Association (EIGA), publication, *"Leak Detection Fluids Cylinder Packages",* has been used as the basis of an internationally harmonized gas association's publication on this subject.

This publication is intended as an international harmonized publication for the worldwide use and application by all members of Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), EIGA, and Japan Industrial and Medical Gases Association (JIMGA). Regional editions have the same technical content as the EIGA edition, however, there are editorial changes primarily in formatting, units used and spelling. Also, any references to regional regulatory requirements are those that apply to European requirements.

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	Editorial to align style with IHC associations
1	Simplification of language and separate scope section created
2	New section “Scope”
5	Additional information”
5.2	Amendment to title and further information on section
5.3	New section
6	Recommendations expanded
7	New section “References”

Note: Technical changes from the previous edition are underlined

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1 Introduction

Over the years leak detection techniques have varied from the use of a simple household “soap based” solutions to specialized leak detection fluids (LDFs). These specialized LDFs are far superior to household soap based solutions, which could contain contaminants or other detrimental constituents. As such, household soap based solutions should not be used.

There are various national regulations and international guidelines to ensure that cylinders and valves are checked for leak tightness. Though such a post fill check is an essential part of a quality control procedure to ensure that customers receive a non-leaking package, the choice of the LDF needs to be carefully considered because of potential hazards from LDFs. These potential hazards include inducing stress corrosion cracking (SCC) and incompatibility with materials and cylinder contents such as oxygen.

2 Scope

This publication applies to gas cylinder packages. It covers the selection and use of specialized leak detection fluids that are suitable for industrial gases including medical and food gases that have particular compatibility requirements.

This publication may be used as a guideline when fluids are used for leak detection in other gas applications.

3 Types of leak detection materials

For the purposes of this publication, leak detection materials are referred to as LDFs. These materials can include foams as well as liquids. They include detergent based liquids, and liquids packaged with propellants for aerosol application. Whatever material(s) is selected, it shall be assured that the final packaged LDF meets the criteria and considerations to satisfy the specific application.

4 Using a leak detection fluid

A method commonly used for general leak testing procedures is to either apply an LDF by means of a brush to joints and other potential leakage points, or by spraying a LDF on the required points on the cylinder/valve package.

The LDF solutions range from something as simple as a detergent to more sophisticated proprietary compounds supplied in aerosol cans. Often the manual application route uses a diluted solution to avoid some of the hazards (see section 4) associated with LDFs. It is essential to follow the method of use recommended by the manufacturer of the LDF

While the detergent-based LDFs are frequently used effectively in bulk applications, proprietary compounds have benefits for applications requiring ease of transportation.

5 LDFs Potential hazards

There are a number of potential hazards involved in the use of LDFs. These include:

- LDFs damaging both the cylinder or valve materials, immediately or over time (SCC);
- LDFs posing potential flammability risks, especially with oxygen.
- LDFs components/contaminants leaving residue upon drying (e.g., in the valve outlet) posing potential risks with container contents to the user in the case of medical and food gases.

5.1 LDFs Materials compatibility

Depending on the chemical constituents of any particular LDF, the overall question of materials compatibility needs to be considered. One of the possible constituents of LDFs is the ammonium radical. The latter compound, in association with oxygen and water, is frequently responsible for SCC of copper-based alloys such as brass and aluminium silicon bronze. These copper based alloys are often used for manufacturing cylinder valves. Ammonia can be introduced into LDFs by third parties who repackage LDF into aerosol cans. The original manufacturer of the LDF may be unaware of this contamination.

The corrosive effects from certain LDFs coupled with the stresses to which a cylinder valve is subjected due to mechanically applied forces, residual stresses, and gas pressure can be sufficient to result in SCC.

It is difficult to specify exactly and with a high level of confidence the minimum amount of ammonia needed to trigger SCC. However, it is known that moisture films on brass surfaces are capable of dissolving residual ammonia from atmospheric contamination, resulting in SCC.

Of further consideration is the possible presence of halide ions (usually chloride) in LDFs. Though not necessarily harmful to steel or brass surfaces, they do cause significant damage to aluminium alloy cylinders in the form of pitting. Excessive exposure to chloride ions in the form of sea water (e.g. diving cylinders) of certain aluminium alloys (e.g. AA2001) has been disastrous if the alloy has not been heat treated correctly. Even cylinders made from the much more corrosion resistant alloys of the AA6000 series have been pitted on the top surface of the cylinder's neck after successive applications of certain LDFs.

5.2 LDFs Oxidizer / flammability risks

LDFs are used to check external and internal leaks of cylinder valves. When LDFs are used to check for internal leaks, the repeated action of application and subsequent drying of an LDF in the valve outlet is one of the causes of an ignition in oxidizer service. This is due to the progressive accumulation of residues, especially in the valve outlet where the LDF is introduced to check for seal integrity. Subsequent use of the valve will expose this residue to a high-pressure gas stream. This is especially true if the LDF is made from a household soap based solution that could contain mineral oil, vegetable oil, or fatty acids.

These operational findings have been confirmed in the laboratory using an "oxygen bomb" testing equipment. The results for many commercially marketed LDFs sold as "safe for oxygen," "oxygen safe" etc. have shown that in every case their dried residues were easy to ignite in high pressure gaseous oxygen or liquid oxygen.

Be cautious as low temperature LDFs can contain glycols.

5.3 LDFs Medical and food gases contaminant residue risks

In addition to the flammability risks identified in 5.2 above, hazards associated with the build-up of contaminants or minor constituents of an LDF need to be considered in terms of potential impact with medical and food gases. The LDF shall be evaluated and selected with the knowledge of the contaminants and the potential for build-up of those contaminants in the gas stream and subsequent inhalation by end users of medical and food gases. Any LDF used to check for leaks that could come in contact with medical and food gas shall be manufactured with materials that do not present a health or inhalation hazard to end users.

NOTE LDFs manufactured with ethylene glycol are typically not acceptable for medical use.

6 Recommendations

It is difficult to make a specific recommendation for a choice of LDF. Users need to decide which LDF is best suited for the application. The following are some general recommendations when deciding which LDF to choose:

- Read the manufacturer's safety data sheet (SDS) or other appropriate documentation prior to using any LDF;
- Avoid using LDFs that contain ammonia / ammonium radicals. Be aware that ammonia can be introduced into LDFs by third parties who repackage LDF into aerosol cans.
- Avoid using LDFs that can cause SCC. For example, ASTM G188, *Standard Specification for Leak Detector Solutions Intended for Use on Brasses and Other Copper Alloys* [1], and ASTM G186, *Standard Test Method for Determining Whether Gas-Leak-Detector Fluid Solutions Can Cause Stress Corrosion Cracking of Brass Alloys* [2], provide methods to evaluate LDFs for potential to cause SCC in brass and copper alloys.
- Consider chemical analysis of LDFs to determine potential for SCC of brass and copper alloys, (for example the presence of ammonia).
- Select an LDF having a residue with an auto-ignition temperature (as measured using an oxygen environment), which is compatible with the intended application. For example, MIL-PRF-25567, *Performance Specification: Leak Detection Compound, Oxygen Systems* [3], provides a means to evaluate LDFs for compatibility with oxygen and other oxidizers including residues.
- If used for medical or food gas applications, select an LDF that will not cause a residue containing an incompatible contaminant or component.
- Avoid using LDFs that contain halide ions especially in conjunction with aluminium alloy cylinders.
- Use the most diluted solution of an LDF consistent with the method of application and the manufacturer's recommendation.
- Consider only premixed solutions from the LDF manufacturer. Diluting LDFs with water or other liquids (e.g., tap water or de-ionized water) can lead to SCC or other incompatibilities.
- A household soap based solution should not be used as a LDF.
- Avoid corrosive LDFs (e.g., acids and bases).
- Consider the potential hazards to the environment and personal exposure when choosing LDFs.
- Be aware of LDF operating temperature range as some LDFs can freeze making them ineffective or inaccurate at low temperatures.
- If possible, select a single LDF that is compatible with oxidizers, medical, and food gas applications. This can prevent the inadvertent application of an incompatible LDF.

7 References

[1] ASTM G188 *Standard Specification for Leak Detector Solutions Intended for Use on Brasses and Other Copper Alloys* ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA www.astm.org

[2] ASTM G186 - 05(2011) *Standard Test Method for Determining Whether Gas-Leak-Detector Fluid Solutions Can Cause Stress Corrosion Cracking of Brass Alloys* ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA www.astm.org

[3] MIL-PRF-25567, *Performance Specification: Leak Detection Compound, Oxygen Systems Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.*