LEAK DETECTION FLUIDS USE WITH GAS CYLINDER PACKAGES

AIGA 70/20

Revision of AIGA 70/14

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Preface

As part of a programme of harmonisation of industry standards, the Asia Industrial Gases Association has issued AIGA 70, *Leak Detection Fluids with Gas Cylinder Packages*, jointly produced by members of the International Harmonisation Council and originally published as Doc 78 by European Industrial Gases Association (EIGA) as *Leak Detection Fluids with Gas Cylinder Packages*.

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). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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Amendments to 70/14

Section	Change
3	Added Publication Terminology
5	Improved wording, with a Note
6	Improved wording

Note: Technical changes from the previous edition are underlined

1 Introduction

Over the years leak detection techniques have varied from the use of simple household soap-based solutions to specialized leak detection fluids (LDFs). These specialized LDFs are far superior to household soap-based solutions that can 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 postfill check is an essential part of a quality control procedure to ensure that customers receive a nonleaking 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 LDFs 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 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

3.1.4 Will

Is used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.

4 Types of leak detection materials

These LDFs 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, the final packaged LDF shall meet the criteria and considerations to satisfy the specific application.

5 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 an 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. Often the manual application route uses a diluted solution to avoid some of the hazards (see Section 6) associated with LDFs. It is essential to follow the method of use recommended by the manufacturer of the LDF.

NOTE—Where applications require higher sensitivity than that which can be achieved by LDFs, other leak detection methods may be necessary.

6 Leak detection fluids 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 potentially causing unexpected and sudden catastrophic failure. See 6.1;
- LDFs posing potential flammability risks, especially with oxygen. See 6.2; and
- LDFs components/contaminants leaving residue upon drying (for example, in the valve outlet) posing potential risks with container contents to the user in the case of medical and food gases. See 6.3.

6.1 Leak detection fluids 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, that 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 could 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 of certain aluminium alloys (for example, diving cylinders made of 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 experience pitting on the top surface of the cylinder's neck after successive applications of certain LDFs.

6.2 Leak detection fluids 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 exposes this residue to a high pressure gas stream. This is especially true if the LDF is made from a household soap-based solution that can contain mineral oil, vegetable oil, or fatty acids.

These operational findings have been confirmed in the laboratory using "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.

6.3 Leak detection fluids medical and food gases contaminant residue risks

In addition to the flammability risks identified in 6.2, hazards associated with the buildup of contaminant residue, minor constituents, or impurities 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 buildup 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.

7 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* and ASTM G186, *Standard Test Method for Determining Whether Gas-Leak-Detector Fluid Solutions Can Cause Stress Corrosion Cracking of Brass Alloys* provide methods to evaluate LDFs for potential to cause SCC in brass and copper alloys [1, 2];[1]
- 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 autoignition temperature (as measured using an oxygen environment) that is compatible with the intended application. For example, MIL-PRF-25567E, *Performance Specification: Leak Detection Compound, Oxygen Systems* provides a means to evaluate LDFs for compatibility with oxygen and other oxidizers including residues [3];
- If used for medical or food gas applications, select an LDF that does 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 (for example, tap water or de-ionized water) can lead to SCC or other incompatibilities;
- Use of household soap-based solutions as an LDF should not occur;
- Avoid LDFs that can lead to corrosion (for example, acids and bases) from the use or application of the LDF or the accumulation of residues;
- Consider the potential hazards to the environment and personal exposure when choosing LDFs;
- Be aware of the LDFs operating temperature range as some LDFs can freeze making them ineffective or inaccurate at low temperatures; and
- 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.

8 References

[1] ASTM G188, *Standard Specification for Leak Detector Solutions Intended for Use on Brasses and Other Copper Alloys*, ASTM International. www.astm.org

[2] ASTM G186, *Standard Test Method for Determining Whether Gas-Leak-Detector Fluid Solutions Can Cause Stress Corrosion Cracking of Brass Alloys*, ASTM International. www.astm.org

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

[3] MIL-PRF-25567E, *Performance Specification: Leak Detection Compound, Oxygen Systems*, Defense Supply Center Richmond. www.dla.mil