

## **Gas Cylinder Identification**

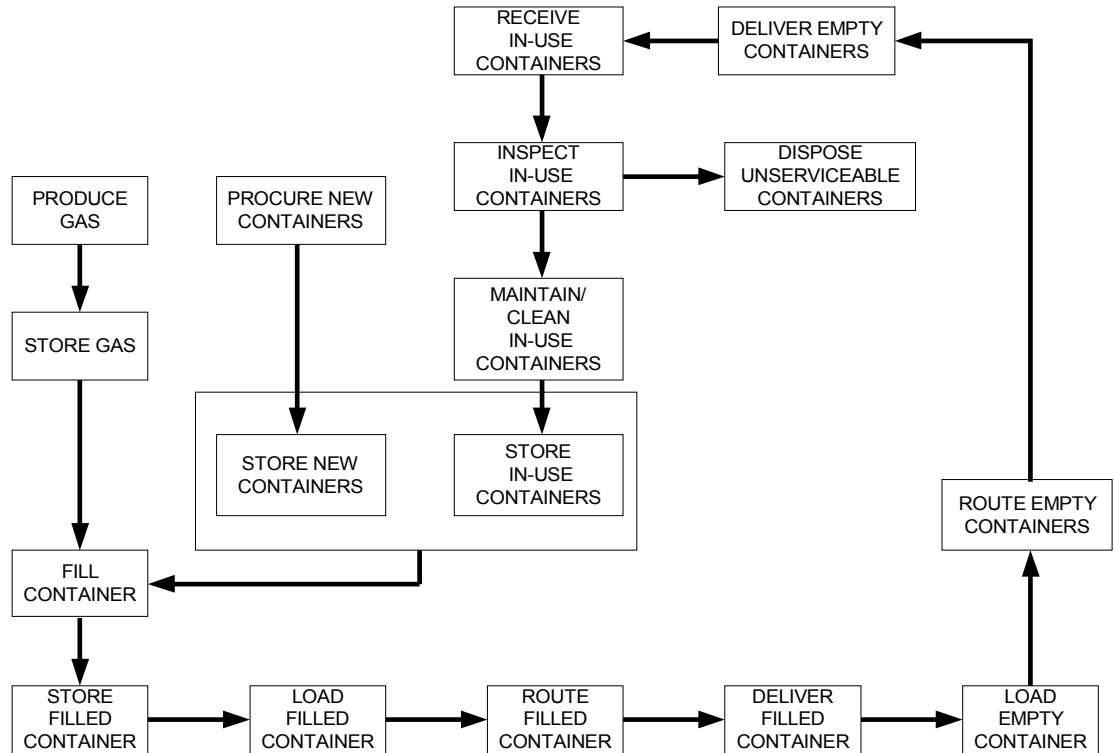
**Evaluation report on the identification of 71 gas cylinders loaded on a truck moving underneath a gantry fitted with two UHF RFID readers.**

## 1. General

### 1.1. Introduction

The effective and efficient management of gas cylinders as assets and returnable containers could have a significant influence on balance sheet and income statement sections of the gas provider's management accounts.

The typical life-cycle of gas cylinders is shown in the diagram below.



Worldwide, gas companies experience cylinder inventory, return, shrinkage and routing related problems that could be reduced by real-time point-of-transaction ERP systems updating during each of the functions as shown in the above diagram.

The use of UHF RFID as an automatic identification method to effect/assist this updating of cylinder related information has been widely debated and evaluated. Individual cylinders can be tagged and registered on the ERP system.

These tagged cylinders can subsequently be identified during the cylinder life cycle either;

- as mass loads,
- or
- individually.

This identification can be achieved by means of:

- handheld reading devices,
- or
- overhead fixed reading devices.

The identification process can be used to update the;

- Filled status,
- Quantity related info in the depot,
- Geographic location in the depot,
- Quantity related info at client sites,
- Geographic location in the user cycle,
- Transaction related to responsible entity,
- Date and Time stamps,
- Inspection and Maintenance related into.

The proximity reading of individual gas containers by hand is relatively simple and reliable results can easily be obtained. In contrast, the mass identification of

- Cradle loads (up to 25 cylinders in a fork lift operation scenario),  
and
- Mass loads (70 plus in a truck operation scenario),  
needed to be proven feasible and reliable.

The only technology considered capable of achieving the read range that would be required for the reading of the mass load described above is RFID operating in the UHF band (860 to 960 MHz depending on the jurisdiction). In order to demonstrate the capability of achieving the required reading performance a simple test was planned to demonstrate the performance of:

- Shroud Tags based on the EM4222 RFID Transponder chip,  
and
- 915 MHz 4w RFID readers (legal under South African jurisdiction).

## **1.2. Purpose of this Report**

The purpose of this report is to document the results and recommendations of the evaluation of the identification of gas cylinders on a truck moving underneath a gantry equipped with two 4W UHF RFID readers.

This evaluation was undertaken on the 6<sup>th</sup> of November, 2003 at the Air Liquide gas depot in Alberton, South Africa.

## **2. Objectives**

**2.1. Determine the identification success of 71 gas cylinders on a truck passing underneath an RFID gantry set-up.**

**2.2. Determine the identification reliability of 71 gas cylinders on a truck passing underneath an RFID gantry set-up.**

## **3. Evaluation Requirements**

**3.1. Determine the identification success of 71 gas cylinders on a truck passing underneath an RFID gantry set-up.**

- 20 Large cylinders located on the front of the loading area. See Figure 2.

- 3 Medium cylinders stacked between the large cylinders. See Figure 2.
- 21 Medium cylinders located directly behind the large cylinders. See Figure 2.
- 27 Small cylinders located above the back axle of the truck. See Figure 2.
- All Cylinders fitted with Shroud Tags.
- The shrouds to be orientated randomly with respect to each other.
- Two 4 Watt 915 MHz Readers installed on a gantry.
- Reader height above the Large Cylinders of 1 meter.
- Truck speed of 5 km/h. (Depot exit / enter scenario).
- Recording of individual gas cylinder identification events on a mobile computer.

### 3.2. Determine the identification reliability of 71 gas cylinders on a truck passing underneath an RFID gantry set-up.

- Scenario as per 2.1.
- Record results for 10 passes.

## 4. Evaluation Setup

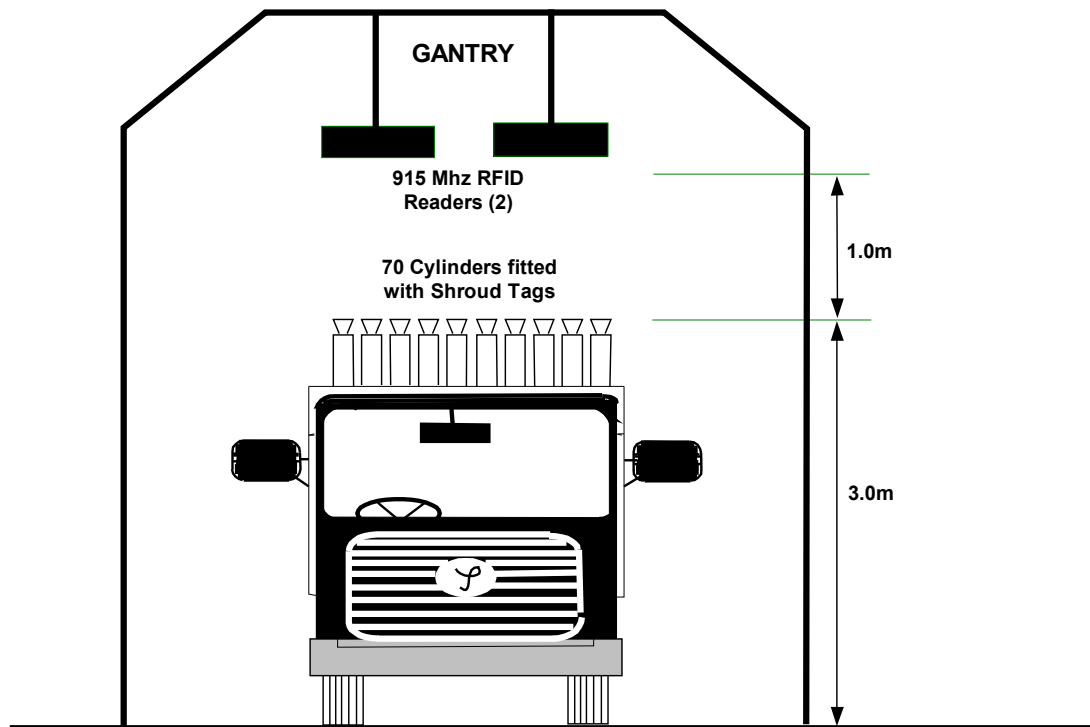


Figure 1 - Reader and Gantry Arrangement

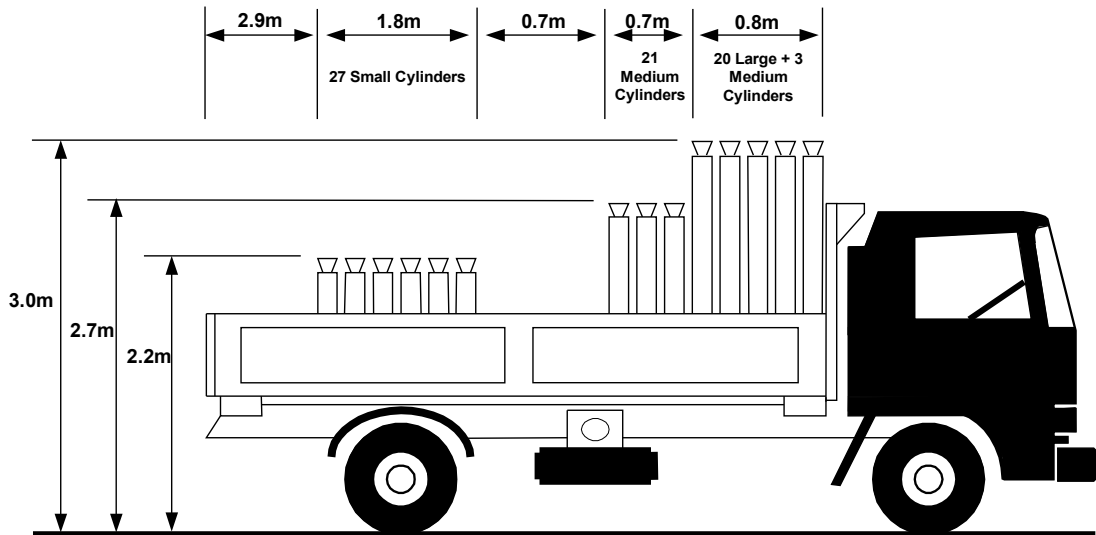


Figure 2 - Load Placement on Truck

## 5. Evaluation Results

Test Run	Number of Cylinders Identified	Percentage of Cylinders Identified
1	68	98.6%
2	68	98.6%
3	68	98.6%
4	69	100%
5	69	100%
6	69	100%
7	68	98.6%
8	69	100%
9	68	98.6%
10	69	100%
<b>Average</b>		<b>99.3%</b>

Note: Two faulty tags were excluded from the test results as these were damaged during installation. This is discussed in section 1.1.

## 6. Discussion

The test was undertaken with very limited resources. Old, scrap bottles had to be recovered and cleaned up prior to fitting of the Shroud Tags. Testing had to be achieved without any impact on the normal operation of the depot and without assistance from the depot staff. Testing time was restricted to a single day.

Installation of the Shroud Tags was achieved without the availability of the Installation Tool (a simple Drift to spread the hammering impact over a larger area). During post-

installation testing two defective shrouds were identified. Investigation showed that the inlets were damaged during the installation procedure. This would not have occurred had the Installation Tool been available at the time of the testing. The 2 faulty tags were eliminated from the test population reported on in section 1.1 above. The cylinders on which these faulty tags were mounted were not removed from the truck as it was felt that this would maintain realistic spacing and radio wave reflection patterns.

Reader installation was achieved using a simple, rapidly constructed, gantry arrangement and no attempt was made to optimise reader positioning or orientation.

During the testing 68 of the 69 cylinders with operational tags were identified in the 10 test passes. During 5 of the 10 test passes all 69 cylinders were identified.

A video was made of the testing and from this it can be seen how the tags were installed on the bottles and how robust the tags are. It can also be seen that due to the simple gantry construction it was not practical to re-orientate the readers for optimum RF coverage or separation.

## 7. Conclusion

The good results achieved on such a simple and rapidly undertaken test give a very high degree of confidence that reliable and accurate mass gas cylinder identification will be achieved using the RF Tags Shroud Tags and UHF RFID Readers.

In order to prove the viability of RFID tags in gas bottle tracking, a larger scale (more bottles) and fully live test is proposed. This test should run for several months and should include both mass reading at the depot as well as point of delivery reading by truck drivers.

For a totally optimised solution variables such as required truck speed, reader height restrictions, cylinder types and preferred loading methods must be identified and the UHF RFID application read scenario designed accordingly.

We believe that using UHF RFID will be a solution to the current problems experienced in the mass identification of gas cylinders.