

# Mobile System Silo-RoBoFox®

The Effects of cleaning and disinfection

## DLG - test report 5639F



### Applicant

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### Brief Description

The system Silo-RoBoFox serves the purpose of cleaning and disinfecting of vertical silos. A schematic system overview is shown in Figure 1. To intake the cleaning and disinfecting robot, a vertical and centered static guide rod will be installed inside the silo. The fixation of the rod is an extension of a foot rod, a three-point-support at the silo wall and a three-point-claw at the silo ceiling. Access to the silo will be achieved with a manhole, which initially has to

be installed if needed. The produced manhole will be stabilized in a position that prevents adverse effects on the statics of the silo. (Figure 2). The robot will run up and down along the center rod inside the silo (Figure 3). An arm with high-pressure nozzles is mounted on the robot. The positioning of the arm and nozzles are adjustable in a way that permits the possibility of smooth deployment in silos with different diameters.

### Manufacturer and operator

#### Manufacturer:

automation & software Günther Tausch GmbH, Lindenstraße 63  
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E-Mail: [info@silorofofox.de](mailto:info@silorofofox.de), Internet: [www.silorofofox.de](http://www.silorofofox.de)

**Tested system:** Siloservice Pragst, Birkenweg 2, D-17089 Friedland/Schwanbeck

The procedure for cleaning and disinfecting consists of four succeeding steps:

1. Soaking and cleaning the inner silo-surface with detergent VENNO CLEAN® foam cleaner, obtaining a concentration of 2%
2. High Pressure Cleaning
3. Disinfection with disinfectant VENNO® VET 1 Super<sup>1)</sup>, obtaining a concentration of 1%
4. Drying with 65°C warm air

In each of the steps 1 to 3 the silo-surface will be treated from top to bottom. Orientation and length of the arm, as well as the angle of the nozzles, are set in a position that previously removes falling dirt and does not contact previously treated surfaces.

Step 4 is carried out by a hot air blower.

All steps will be steered by a control unit, which is located in a vehicle (Figure 4).

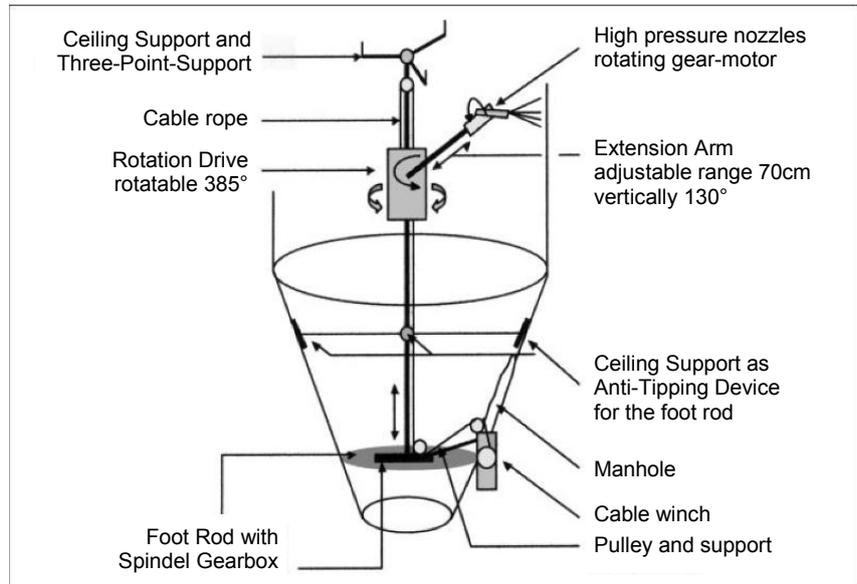


Figure 1



Figure 2



Figure 3



Figure 4

## Inspection Scope and Test Conditions

Studies were executed to assess the performance of cleaning and disinfecting of the mobile system, "Silo-RoBoFox®", for cleaning and disinfecting within the vertical silos.

The investigations were executed at 3 compound feed silos at 3 active farms. Farms and silos were randomly selected.

To assess the performance of the procedure, the inner surfaces of the silos were examined by procedural methods, which are shown in

Table 1.

The swab procedure was executed according to DIN 10113-2 (bacterial count at 30°C), the squeeze method according to DIN 10113-3 (bacterial count at 30°C).

For protein detection a semi-quantitative rapid test (modified Biuret response) was used. The test reacts by a color reaction at a protein quantity of over 20 micrograms.

Because the test is designed for dry surfaces, inspections were not

performed between cleaning and disinfecting of the inner silo-surface.

The hygiene condition before cleaning and disinfecting of heavily contaminated inner surfaces of the silos were investigated by using swab samples and protein detection procedures.

Due to the heavy contamination of the inner surfaces, sufficient samples were not properly produced by the squeeze method.

Table 1:

Method and location of test to assess the hygienic status of the inside silo-surface during the course of cleaning and disinfection.

Unclean silo	Cleaned silo	Disinfected and dried silo
<b>Assessment of microbiological contamination</b>		
swab samples - ceiling	swab samples - ceiling	swab samples - ceiling
swab samples - wall	swab samples - wall	swab samples - wall
swab samples - spout cone	swab samples - spout cone	swab samples - spout cone
	swab samples - Corner between the ceiling and wall	swab samples - Corner between the ceiling and wall
	Squeeze method samples - ceiling	Squeeze method samples - ceiling
	Squeeze method samples - wall	Squeeze method samples - wall
	Squeeze method samples - spout cone	Squeeze method samples - spout cone
<b>Assessment of pollution</b>		
Protein proof - ceiling		Protein proof - ceiling
Protein proof - wall		Protein proof - wall
Protein proof - spout cone		Protein proof - spout cone

# Test Results

## Assessment of microbiological contamination

To assess the microbiological contamination and its change in the course of the work steps undertaken, hygiene conditions of the inner silo-surfaces had been verified by multiple swab- and squeeze-method samples.

Tables 2 and 3 provide an overview of the evolution of the contamination.

The results of the investigation via swab-method show a significant reduction of germs due to the application of the cleaning- and disinfecting procedure.

The results also clarify that only the combination of these two steps provides a sufficient reduction of germs.

Even the results of the investigation, via squeeze method, show the success of the measure. They confirm that only the combination of cleaning and disinfecting can ensure the desired success for a hygienic silo.

Table 2:

Evaluation of microbiological contamination of inner silo surfaces throughout the cleaning- and disinfecting procedure, via swab method, in cfu (colony forming units).

Silo N <sup>o</sup> . 1				
	Ceiling	Wall	Spout cone	Corner(ceiling/wall)
Uncleaned	< 100 cfu	< 100 cfu	5,8 x 10 <sup>3</sup> cfu	
Cleaned	< 8 cfu	< 15 cfu	180 cfu	< 15 cfu
Disinfected and dried	< 1 cfu	< 15 cfu	< 1 cfu	< 10 cfu

Silo N <sup>o</sup> . 2				
	Ceiling	Wall	Spout cone	Corner(ceiling/wall)
Uncleaned	< 1,0 x 10 <sup>3</sup> cfu	4,0 x 10 <sup>3</sup> cfu	< 1,0 x 10 <sup>3</sup> cfu	
Cleaned	1,7 x 10 <sup>2</sup> cfu	660 cfu	510 cfu	3,5 x 10 <sup>3</sup> cfu
Disinfected and dried	< 10 cfu	< 10 cfu	11 cfu	< 10 cfu

Silo N <sup>o</sup> . 3				
	Ceiling	Wall	Spout cone	Corner(ceiling/wall)
Uncleaned	3,8 x 10 <sup>5</sup> cfu	1,3 x 10 <sup>5</sup> cfu	3,8 x 10 <sup>5</sup> cfu	
Cleaned	650 cfu	2,8 x 10 <sup>3</sup> cfu	1,1 x 10 <sup>3</sup> cfu	4,9 x 10 <sup>3</sup> cfu
Disinfected and dried	< 10 cfu	< 10 cfu	27 cfu	16 cfu

Table 3:

Evaluation of microbiological contamination of inner silo surfaces throughout the cleaning- and disinfection procedure via squeeze method, in cfu (colony forming units).

Silo N <sup>o</sup> . 1			
	Ceiling	Wall	Spout cone
Cleaned	8 cfu	13 cfu	cultivation of biological film
Disinfected and dried	5 cfu	2 cfu	1 cfu

Silo N <sup>o</sup> . 2			
	Ceiling	Wall	Spout cone
Cleaned	cultivation of biological film	cultivation of biological film	cultivation of biological film
Disinfected and dried	0 cfu	6 cfu	7 cfu

Silo N <sup>o</sup> . 3			
	Ceiling	Wall	Spout cone
Cleaned	5 cfu	cultivation of biological film	cultivation of biological film
Disinfected and dried	2 cfu	3 cfu	0 cfu

## Assessment of pollution

To assess the pollution and its reduction in the course of the process undertaken, the inner silo-surfaces were assessed via multiple quick-tests for the presence of proteins. Table 4 provides an overview of the development of pollution.

The results show that after the completion of the cleaning- and disinfecting procedure the degree of pollution of the surfaces were reduced to a "clean" condition. It was very clear that the cleaning effects could be established.

All assessed surfaces were determined as "heavily dirty" before the start of the procedure and rated as "clean" after completion of the process.

Table 4:  
Assessment of the pollution of the inner silo-surface during a cleaning- and disinfecting procedure using modified biuret response.

Silo N <sup>o</sup> . 1			
	Ceiling	Wall	Spout cone
Cleaned	heavily dirty	heavily dirty	heavily dirty
Disinfected and dried	clean	clean	clean

Silo N <sup>o</sup> . 2			
	Ceiling	Wall	Spout cone
Cleaned	heavily dirty	heavily dirty	heavily dirty
Disinfected and dried	clean	clean	clean

Silo N <sup>o</sup> . 3			
	Ceiling	Wall	Spout cone
Cleaned	heavily dirty	heavily dirty	heavily dirty
Disinfected and dried	clean	clean	clean

### Evaluation:

< 75 µg Protein = clean

up to 250 µg Protein = moderate dirty

> 250 µg Protein = heavily dirty

## Summary

The mobile system "Silo-RoBoFox®" for silo-cleaning and -disinfecting was examined based on its cleaning- and disinfecting performance.

The tested system uses VENNO CLEAN foam cleaner for the cleaning process, obtaining a concentration of 2%, and VENNO® VET 1 Super<sup>1)</sup> for disinfecting obtaining a concentration of 1%.

The investigations were executed in three randomly selected compound feed silos located at three

active farms. Assessed were the microbiological contamination and the degree of pollution of the inner silo-surfaces throughout a cleaning - and disinfecting procedure.

To assess the microbiological contamination, swab- and squeeze methods were used. For the degree of pollution a protein detection method was used.

The results show that the tested system reached a sufficient cleaning- and disinfecting effect.

In all cases, the degree of pollution of the surfaces improved from "heavily dirty" to "clean".

The assessment of microbiological contamination shows that with this procedure a complete disinfection will be reached. The germ elimination rate based on the initial number of germs, amounts to a factor of 100,000 (10<sup>-5</sup>). Meaning, that the germ-cover was reduced to a hundred thousandth of the starting amount.

The tested procedure generated efficient hygienic silos.

<sup>1)</sup>Use biocides safely. Before usage, always read the identification mark and product information.

## Assessment

The DLG-FokusTest for the mobile system "Silo-RoBoFox®" for silo-cleaning and -disinfection included the criteria "cleaning- and disinfection performance."

### Other criteria were not tested.

Given the present results and in the tested execution of the system, the system meets the requirements for the award of the test, "DLG-FokusTest."

### Project Manager Hygiene

Michael Eise

### Project Manager Quality and Safety

Winfried Gramatte



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11/2006  
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