

DLG Test Report 7262

ZUNHAMMER GmbH

VAN Control dual

with calibration model 14.3.1

Ingredients in liquid cattle manure,
liquid pig manure, mixed manure from cattle
and pig manure and in liquid digestate



ZUNHAMMER VAN-CONTROL DUAL
WITH CALIBRATION MODEL 14.3.1

- ✓ Ingredients in cattle manure:
DM, N_{Total}, NH₄-N, P₂O₅, K₂O
- ✓ Ingredients in liquid pig manure:
DM, N_{Total}, NH₄-N, P₂O₅
- ✓ Ingredients in mixed manure
from cattle and pig manure:
DM, N_{Total}, P₂O₅, K₂O
- ✓ Ingredients in liquid digestate:
DM, N_{Total}, NH₄-N, P₂O₅

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Overview

A test mark „DLG-APPROVED for individual criteria“ is awarded for agricultural products which have successfully fulfilled a scope-reduced usability testing conducted by DLG according to independent and recognised evaluation criteria. The test is intended to highlight particular innovations and key criteria of the test object. The test may contain criteria from the DLG test scope for overall tests, or focus on other value-determining characteristics and properties of the test subject. The minimum requirements, test conditions and procedures as well as the evaluation bases of the test results will be specified in consultation with an expert group of DLG. They correspond to the recognised rules of technology, as well as scientific and agricultural knowledge and requirements. The successful testing is concluded with the publication of a test report, as well as the awarding of the test mark which is valid for five years from the date of awarding.



ZUNHAMMER VAN-CONTROL DUAL WITH CALIBRATION MODEL 14.3.1

- ✓ **Ingredients in cattle manure:**
DM, N_{Total}, NH₄-N, P₂O₅, K₂O
- ✓ **Ingredients in liquid pig manure:**
DM, N_{Total}, NH₄-N, P₂O₅
- ✓ **Ingredients in mixed manure from cattle and pig manure:**
DM, N_{Total}, P₂O₅, K₂O
- ✓ **Ingredients in liquid digestate:**
DM, N_{Total}, NH₄-N, P₂O₅

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The DLG test for **“Precision of NIR sensors for the determination of ingredients in passing liquid manure of animal origin and liquid digestate from cattle or pig manure with renewable raw materials”** was carried out on the **VAN Control dual with calibration model 14.3.1 of ZUNHAMMER GmbH**.

The measurements for determining the contents of ingredients were carried out in in liquid cattle manure, in liquid pig manure, in liquid mixed manure from cattle and pig manure and in liquid digestate from cattle or pig manure with renewable raw materials. In each manure type, five different practice slurries were examined through the tested sensor for their levels of dry matter content (DM in weight %), total nitrogen (N_{Total} in kg/m³), ammonium nitrogen (NH₄-N in kg/m³), phosphate (phosphorous pentoxide; P₂O₅ in kg/m³), and potassium oxide (K₂O in kg/m³). During the measurements from each slurry samples were collected.

The taken samples were analyzed by a total of five different accredited specialized laboratories, preferably with wet-chemical methods. For each ingredient, the averages from the results of the laboratory analyses were calculated. For the evaluation, the differences between the value measured by the NIR Sensor and the mean value of the laboratories were determined as the relative measurement deviation. The precision of the sensor was examined at different flow rates too.

Other criteria were not tested.

Assessment in brief

On the basis of the results obtained the mobile sensor VAN Control dual with calibration model 14.3.1 is awarded the DLG test mark “DLG APPROVED in single criteria” in the measurement of ingredients in liquid manures for the parameters listed in the following table 1.

Table 1:

Overview of results

DLG QUALITY PROFILE	
Ingredient	Evaluation*
Cattle manure	
Dry Matter (DM)	✓
Total nitrogen (N _{Total})	✓
Ammonium nitrogen (NH ₄ N)	✓
Phosphorous Pentoxide (P ₂ O ₅)	✓
Potassium oxide (K ₂ O)	✓
Pig manure	
Dry Matter (DM)	✓
Total nitrogen (N _{Total})	✓
Ammonium nitrogen (NH ₄ N)	✓
Phosphorous Pentoxide (P ₂ O ₅)	✓
Mixed manure from cattle and pig manure	
Dry Matter (DM)	✓
Total nitrogen (N _{Total})	✓
Phosphorous Pentoxide (P ₂ O ₅)	✓
Potassium oxide (K ₂ O)	✓
Liquid digestate from cattle or pig manure with renewable raw materials	
Dry Matter (DM)	✓
Total nitrogen (N _{Total})	✓
Ammonium nitrogen (NH ₄ N)	✓
Phosphorous Pentoxide (P ₂ O ₅)	✓

* Evaluation range: Requirements fulfilled (✓) / Requirements not fulfilled (✗)

The product

Manufacturer and Applicant

ZUNHAMMER GmbH
Biebing 19, 83301 Traunreut
Germany

Product:

ZUNHAMMER VAN Control dual
with calibration model 14.3.1

Description and technical data

The ZUNHAMMER VAN Control dual measuring system is a NIR (NearInfraRed) measuring system developed for the compositional analysis of organic substances, such as animal farm fertiliser and digestates.

The ZUNHAMMER VAN Control dual is integrated into the existing pipe system of the pumping station or the manure tank truck. To ensure error-free functionality of the sensor the installation positions specified by the manufacturer must be observed.

In addition, the manufacturer offers also an application for the determination of ingredients in passing feed if the system is attached to the spout of KRONE forage harvesters.

The data can be georeferenced and easily communicated from

the agrirouter to a farm management software such as Next Machine Management. The yield and nutrient maps can be merged with seed and fertilizer application maps. Through this farmers and agronomists can improve their planning for the next season.

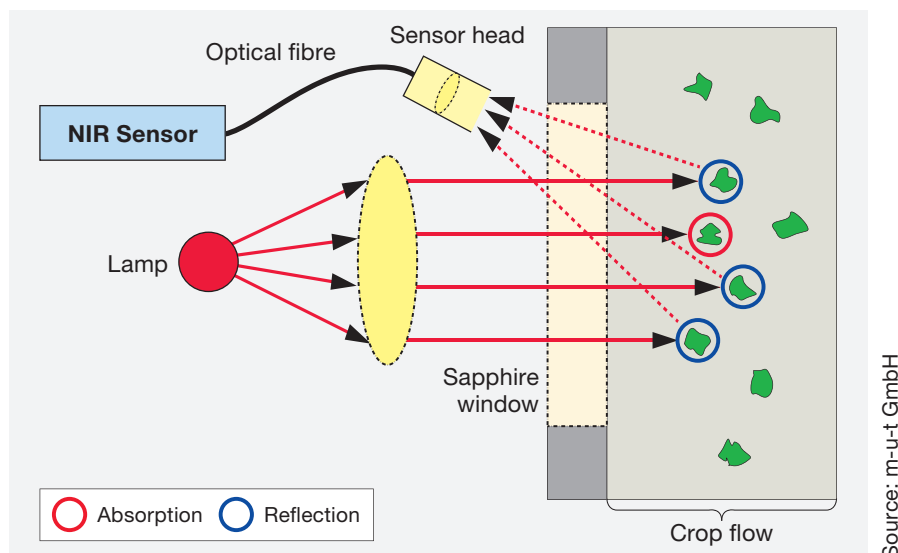
Procedure of near-infrared measurement

The function of a NIR sensor systems is shown in Figure 2. The passing material is separated from the sensor by a sapphire window. During the NIR analysis, the passing material is irradiated

with infra-red light source of known spectrum. The reflected or re-emitted light is detected. To compensate for the temperature-dependent shifts in the spectrum, the system runs regular white and dark referencing. The measurement data are processed via an evaluation unit and converted into measurement values with unit specifications in a microcomputer using the calibration models stored for the parameters to be determined.

The measurement is performed continuously on the passing material. Measuring values are output every second when in measuring mode. Depending upon the requirements, mean values for user-specific time intervals, or live values, are displayed in real time.

The manufacturer specifies the measurement ranges shown in Table 2 for calibration model 14.3.1.



Source: m-u-t GmbH

Figure 2:
Functional principle and system structure
ZUNHAMMER VAN Control dual

Table 2:
Measurement range of ZUNHAMMER VAN Control dual
with calibration model 14.3.1

Parameter	Value range
DM [%]	0,5 – 11,00
N _{Total} [kg/m ³]	0,5 – 9,00
NH ₄ -N [kg/m ³]	0,0 – 4,00
P ₂ O ₅ [kg/m ³]	0,0 – 6,00
K ₂ O [kg/m ³]	0,5 – 7,00

The method

The aim of the DLG Test „Precision of mobile sensors for the determination of ingredients in passing liquid manure of animal origin and liquid digestate“ is to examine the accuracies of mobile sensors in conjunction with appropriate calibration models in comparison to laboratory analysis with officially recognized methods.

A major advantage of NIR measuring technology compared to the conventional methods for the determination of ingredients in liquid manures through sampling and laboratory analysis, consists in the immediate availability of measurement results, and in the permanent measurement of the ingredients along the complete manure volume.

The scope in the DLG Test is limited on substrates, which are described as manure according to the German Fertilizer Act, so on cattle manure, pig manure, mixed manure from cattle and pig manure, and liquid digestate from cattle or pig manure with renewable raw materials.

The DLG test is available for the measurement of the following ingredients:

- Dry matter content (DM in % Weight.)
- Total Nitrogen amount (N_{Total} in kg/m³)
- Ammonium nitrogen amount (NH₄N in kg/m³)
- Phosphate content (Phosphorous Pentoxide; P₂O₅ in kg/m³)
- Potassium (Potassium Oxide; K₂O in kg/m³)

In order to cover a wide range of applications, the test attempts to use a diverse spectrum for each type of substrate:

- Cattle manure: 4 % DM – 9 % DM, where possible from dairy cows and fattened cattles
- Pig manure: 2 % DM – 7 % DM, where possible from sow-keeping + fattened pigs
- Mixed manure from cattle and pig manure: concentration series as follows
10 %cattle : 90 %pig / 30 %cattle : 70 %pig / 50 %cattle : 50 %pig / 70 %cattle : 30 %pig / 90 %cattle : 10 %pig
- Liquid digestate from cattle or pig manure with renewable raw materials: 5 % DM – 8 % DM

The DLG approval can be awarded for individual types of manure and individual ingredients. To get a DLG recognition, at least the requirements for the measurement of the total nitrogen content (N_{Total}) need to be met. When the requirements for the measurement of the total nitrogen content are met, other ingredients can be freely chosen.

The process

Depending on each type of manure (cattle manure, pig manure, mixed manure from cattle and pig manure, liquid digestate from cattle or pig manure with renewable raw materials) five individual and as diverse as possible samples are measured and sampled on different farms. For this purpose, a subset of 3 m³ to 5 m³ is pumped from the previously stirred slurry storage in an intermediate tank.

At the intermediate tank, a pump and a common piping system are installed. On the piping system one or more sensors to be tested and a bypass for sampling are attached. If necessary, a flow meter for the control of flow rates can be attached (see figure 3).

In a preliminary phase the collected manure is intensively homogenized in the intermediate tank by continuous circulation in a closed circuit.

Following this preliminary phase, the measured values of the sensor are documented. Afterwards sub-samples for the reference analyses are then taken via the bypass while maintaining inflation around the closed circuit. In order to determine any possible influence on the sensor values, subsequently the flow velocity is varied and the measured values are re-documented.

The manure samples are clearly marked, frozen and stored frozen. Five suitable laboratories are commissioned with the reference analysis. Each laboratory receives partial samples of each manure. The analyses in the laboratory must be carried out using officially recognized methods, preferably wet-chemical methods.

For each manure and each ingredient, the arithmetic mean value is calculated as a reference value from the laboratory results. The assessment of accuracy is based on the relative deviations from the sensor value in comparison with the reference value.

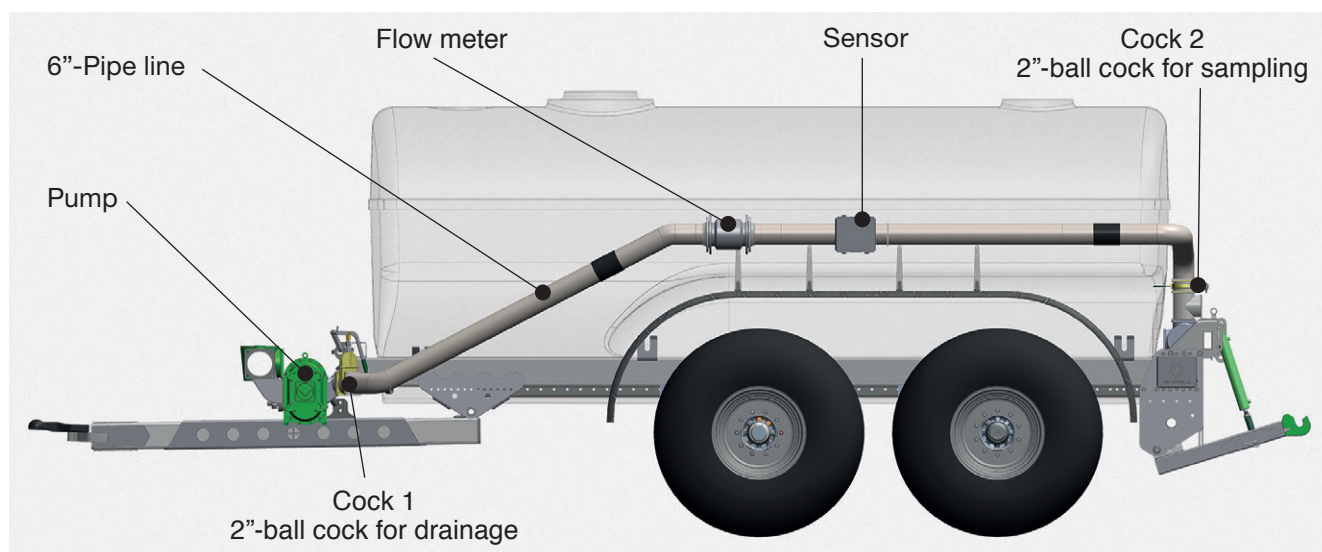


Figure 3:
Schematic structure of the DLG measuring system

Detailed account of the test results

The trials were conducted jointly with the Educational Center located at Triesdorf, Germany (Landwirtschaftliche Lehranstalten LLA, Triesdorf). Flow rates from 6 m³/min to 9 m³/min were set during the measurements. The different flow rates showed no influence on the measured values of the sensor. In table 3 the individual results are given.

Based on the obtained results, the mobile Sensor ZUNHAMMER VAN Control dual with calibration model 14.3.1 is awarded the test mark „DLG-APPROVED in individual criteria“ for the measurement of:

- Ingredients in liquid cattle manure: DM, N_{Total}, NH₄-N, P₂O₅, K₂O
- Ingredients in liquid pig manure: DM, N_{Total}, NH₄-N, P₂O₅
- Ingredients in mixed manure from liquid cattle and liquid pig manure: DM, N_{Total}, P₂O₅, K₂O
- Ingredients in liquid digestate from cattle or pig manure with renewable raw materials:
DM, N_{Total}, NH₄-N, P₂O₅

Table 3:
Individual results

Type designation	ZUNHAMMER VAN Control dual with calibration model 14.3.1	Evaluation*
Installation position (tilt)		
	90°	
Installation position		
	horizontal 6" pipe	
Cattle manure		
	DM in % by weight	+
	N _{Total} in kg/m ³	○
	NH ₄ -N in kg/m ³	○
	P ₂ O ₅ in kg/m ³	○
	K ₂ O in kg/m ³	++
Pig manure		
	DM in % by weight	++
	N _{Total} in kg/m ³	○
	NH ₄ -N in kg/m ³	○
	P ₂ O ₅ in kg/m ³	○
	K ₂ O in kg/m ³	–
Mixed manure from cattle and pig manure		
	DM in % by weight	○
	N _{Total} in kg/m ³	++
	NH ₄ -N in kg/m ³	–
	P ₂ O ₅ in kg/m ³	○
	K ₂ O in kg/m ³	+
Liquid digestate from cattle or pig manure with renewable raw materials		
	DM in % by weight	○
	N _{Total} in kg/m ³	+
	NH ₄ -N in kg/m ³	+
	P ₂ O ₅ in kg/m ³	○
	K ₂ O in kg/m ³	–

DLG-assesment scheme:

- ++ = passed, very good (4/5 value pairs within a manure type ≤ 10 % and no > 20 % rel. deviation)
- + = passed, good (4/5 value pairs within a manure type ≤ 15 % and no > 25 % rel. deviation)
- = passed (3/5 value pairs within a manure type ≤ 25 % and no > 35 % rel. deviation)
- = failed

Summary

In addition, the system meets the DLG requirements



IS ALSO AVAILABLE HERE:

Further information

Testing agency

DLG TestService GmbH,
Gross-Umstadt location, Germany

Landwirtschaftliche Lehranstalten, Triesdorf

The tests are conducted on behalf of DLG e.V.

DLG test framework

“Precision of NIR sensors for the determination of ingredients in passing liquid manure of animal origin and liquid digestate” (current as of 09/2020)

Department

Agricultural technology

Members of the competent

DLG Test Commission “Fertilising Technology“

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of North Rhine-Westphalia

Dr. Harm Drücker, Chamber of Agriculture of
Lower Saxony
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Sven Schneider (farmer and contractor), Brensbach
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Dr. Ulrich Rubenschuh*

Test engineer(s)

Dipl. Ing. agr. Georg Horst Schuchmann

Photos and graphics

Zunhammer, m-u-t, DLG

* Author

The DLG

In addition to being the executing body of well-known tests for agricultural engineering, farm inputs and foods, the DLG is also an open forum for the exchange of knowledge and opinions in the agricultural and food industry.

Some 180 full-time employees and more than 3,000 volunteer experts are developing solutions to current problems. The more than 80 committees, working groups and committees thereby form the basis of expertise and continuity for the professional work. At the DLG, a great deal of specialist information for agriculture is created in the form of information leaflets and working papers, as well as articles in journals and books.

DLG organises the world's leading professional exhibitions for the agriculture and food sector. This contributes to the transparent presentation of modern products, processes and services to the public. Secure the competitive edge as well as other benefits, and contribute to the expert knowledge base of the agricultural industry. Further information can be obtained under www.dlg.org/mitgliedschaft.

The DLG Test Center Technology and Farm Inputs

The DLG Test Centre Technology and Farm Inputs in Groß-Umstadt is the benchmark for tested agricultural products and farm inputs, as well as a leading testing and certification service provider for independent technology tests. The DLG test engineers precisely examine product developments and innovations by utilizing state-of-the-art measurement technology and testing methods gained from practice.

As an accredited and EU registered testing laboratory the DLG Test Center Technology and Farm Inputs offers farmers and practitioners vital information and decision support for the investment planning for agricultural technology and farm inputs through recognized technology tests and DLG testing.

Internal test code DLG: 2022-0045

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