

DLG Test Report 6772

Alfred Kärcher GmbH & Co. KG

Trigger gun EASY!Force

Ergonomics and handling



**KÄRCHER
EASY!FORCE**
✓ Handling
✓ Ergonomics
DLG Test Report 6772



Overview

A quality mark “DLG-APPROVED SINGLE CRITERIA“ is awarded to agricultural products which passed DLG’s comprehensive usability test according to independent and approved evaluation criteria.

The product’s most important criteria from the farmer’s point of view are evaluated during this test. The test includes investigations on test benches and under various operating conditions and furthermore, the tested item must prove itself during a practical testing on a farm.

The test conditions and procedures are fixed in a test framework which is developed by an independent test commission and adjusted regularly according to accepted rules of engineering as well as to latest scientific and agricultural knowledge and requirements. The successful test concludes with the publication of a test report as well as with the award of the quality mark, being valid for five years after the award.

The DLG-APPROVED test “Ergonomics and handling” included the test of the needs-based handling in practical use from the point of view of health. Selected test persons were equipped with relevant sensors developing measurement data under determined comparable motion sequences during cleaning processes which were evaluated. These measurement values were compared with those of reference products tested under the same conditions. Additionally to the objectively received measurement data, the test persons were surveyed with regard to their subjective evaluation. Other criteria were not examined.



Assessment – Brief Summary

The here tested trigger gun for high-pressure cleaners “EASY!Force” was examined under practical conditions during two different cleaning processes within the framework of the DLG-APPROVED test single criteria “Ergonomics and handling”.

The test sample was subject to a 10 minutes lasting determined cleaning process both in a pig house (big fattening farm) and on a common agricultural commercial vehicle. Nine test persons were available for this purpose which were equipped with measurement sensors at relevant body parts.

Subsequently the test persons were asked for their subjective evaluation of the handling. The results were evaluated as a questionnaire.

The results of the gripping force and motion analyses showed clearly that important body parts were less strained than during the use of the reference products. Due to a more relaxed grip hand wrist and elbow tend to be less heavily stressed. In addition a relief of the back due to less rotary motion of the upper body can be observed.

During the evaluation of the questionnaires the test persons mainly indicated that both handling and ergonomics are better than the standard.

The requirements of the test program with regards to “ergonomics and handling” of the trigger gun were fulfilled. The tested grip can be evaluated as being ergonomic and easy to handle.

The Product

Applicant

Alfred Kärcher GmbH & Co. KG
Alfred-Kärcher-Straße 28-40
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Product:

Trigger gun "EASY!Force" for high-pressure cleaners

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Description and Technical Data

The pistol „EASY!Force“ tested here is a trigger gun for cold and hot water high-pressure cleaners. Besides the trigger lever being installed for the first time on the reverse side of the grip, a safety lever is mounted additionally on the front. For the operation of the high-pressure cleaner the rear trigger lever must be used. For this purpose, the safety lever must be pressed shortly before. Therefore, during the cleaning process only the trigger lever must be pressed whereby rebound effects support the posture. Due to the angular alignment between lance and pistol the rebound force shall be directed into the forearm instead of the hand. To stop the cleaning process the trigger lever only needs to be released. By the safety lever the pistol is secured against unintentional operation.

The most important components are shown in Figure 2.

Table 1 indicates the technical data of the grip.

Warranty

The manufacturer offers a warranty of 12 months for the "EASY!Force".

Table 1:

Technical data of the "EASY!Force" (manufacturer indication)

max. flow rate	2500 l/h
max. working pressure	300 bar
	30 MPa
Weight	600 g
max. water temperature	155 °C
Supply	EASY!Lock (4 gear trapezoidal thread)
Material, valve	Ceramic
Material, connecting piece	Brass
Material, housing	Glass fibre reinforce plastic

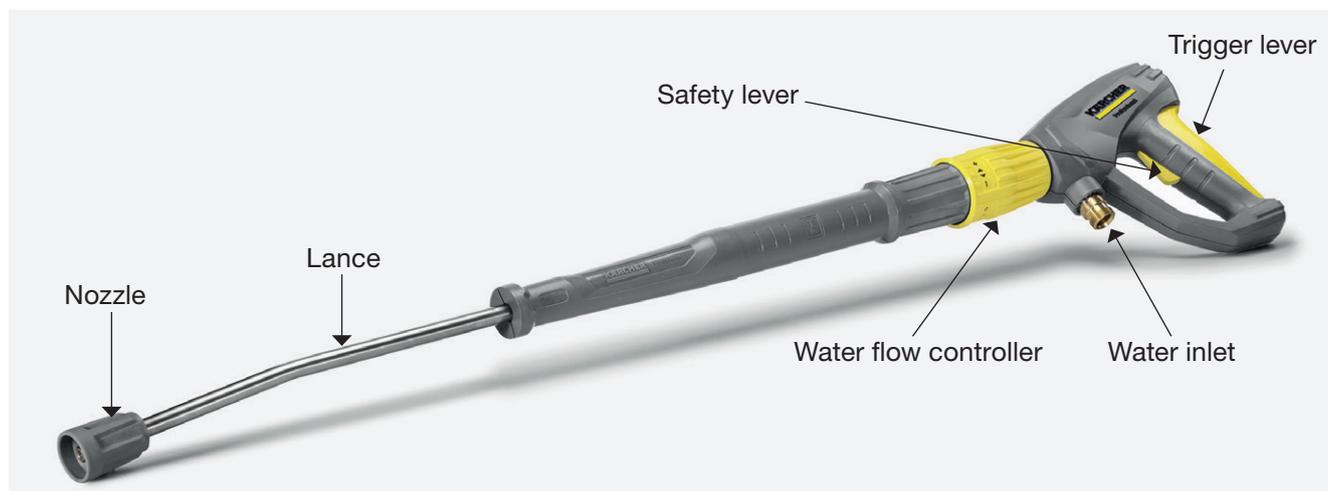


Figure 2:

Design of a high-pressure cleaner lance with new trigger gun "EASY!Force"

The Method

The test item was tested and evaluated according to the test framework "Handling and ergonomics of agricultural working units" in the version of 2017.

Objective ergonomic evaluation

In a first step pre-tests were carried out at the university in Kassel and on two agricultural farms in South Hesse. Based on the results a test program was developed which was performed at the agricultural experimental and training center Haus Düsse. At the test facility a total of five different trigger guns were examined, two trigger guns from the company Kärcher and three from the most common competitors. One of the two Kärcher trigger guns was the predecessor model ("Easy Press"), the other the current trigger gun ("EASY!-Force"). A high-pressure cleaner as well as suitable accessories were available for each test. In addition to fitting tubing long lances and 25° flat spray nozzles were used during the test. Due to

the identical periphery the pistols were tested under identical conditions.

At the test facility 9 test persons (4 female, 5 male) were available which had to clean a tractor and the pen of a pig box in a big fattening farm under comparable conditions and in the same time. During the cleaning of the vehicle the focus laid on vertical cleaning motions, while in the pig box mainly horizontal motion sequences were expected.

The individual trigger guns were each equipped with five force sensors. The test persons were provided with a "cEYEberman system" (eye-tracking and suit with inertial sensors). A PC supported mobile data recording on the back of the test persons allowed an immediate supervision of all relevant motions and lines of sight as well as a storage of the gained measurement data.

Subjective feeling (handling)

Subsequently all test persons

were asked for their assessment. In a determined questionnaire the following subjective aspects were requested:

Emotional

- simple
- practical
- predictable
- confusing
- comfortable
- save
- satisfied

Sensory impression

- Finger
- Ball of the thumb
- Hand wrist
- Arm and shoulder
- Back and legs

Summary

- Handling
- Ergonomics
- Physical effort

The questionnaires were evaluated as a ranking.

In addition, free text based statements of the test persons on their feeling were assessed.

The Test Results in Detail

Objective ergonomic approach

The measurement data of all test persons were evaluated. The measurement data of the female and male test persons were mixed. In addition to the line of sight and upper body rotation the finger forces as well as the angle changes of the right elbow and the right hand wrist were included in the evaluation.

The evaluation of the gained measurement data showed that the “EASY!Force“ provides partially significant improvements compared to the standard. The motion of the right hand wrist shows a convenient working angle during the cleaning process, also during the cleaning in the animal house. The right elbow shows a slight acute angle which demonstrates a relief of the posture during the work. It is noticeable that the upper body rotation varies less during vertical motion sequences when using the “EASY!Force“. This indicates that the back is the least strained here.

Furthermore it was observed that the fingers are relaxed by the elimination of the front trigger lever at the “EASY!Force“ and consequently do not tend to fist. Following this relaxation hand wrist, elbow and back are relieved.

Due to the comprehensive evaluation material the following diagrams are shown as an example for all measurement values. The trigger guns of the competitors were anonymised.

Figure 3 shows the angle change of the right hand wrist during the cleaning process at the storage tank of the tractor (vertical motion). In Figure 4 the angle change of the right elbow at the tractor’s wheel case (rotating and horizontal motion) can be seen. The averaged forces at the finger and ball of the thumb are shown in Figure 5. Figure 6 shows the averaged upper body rotations during the floor cleaning in the animal house. Relevant to the evaluation are not the absolute measurement values, but the mean deviation of the curves.

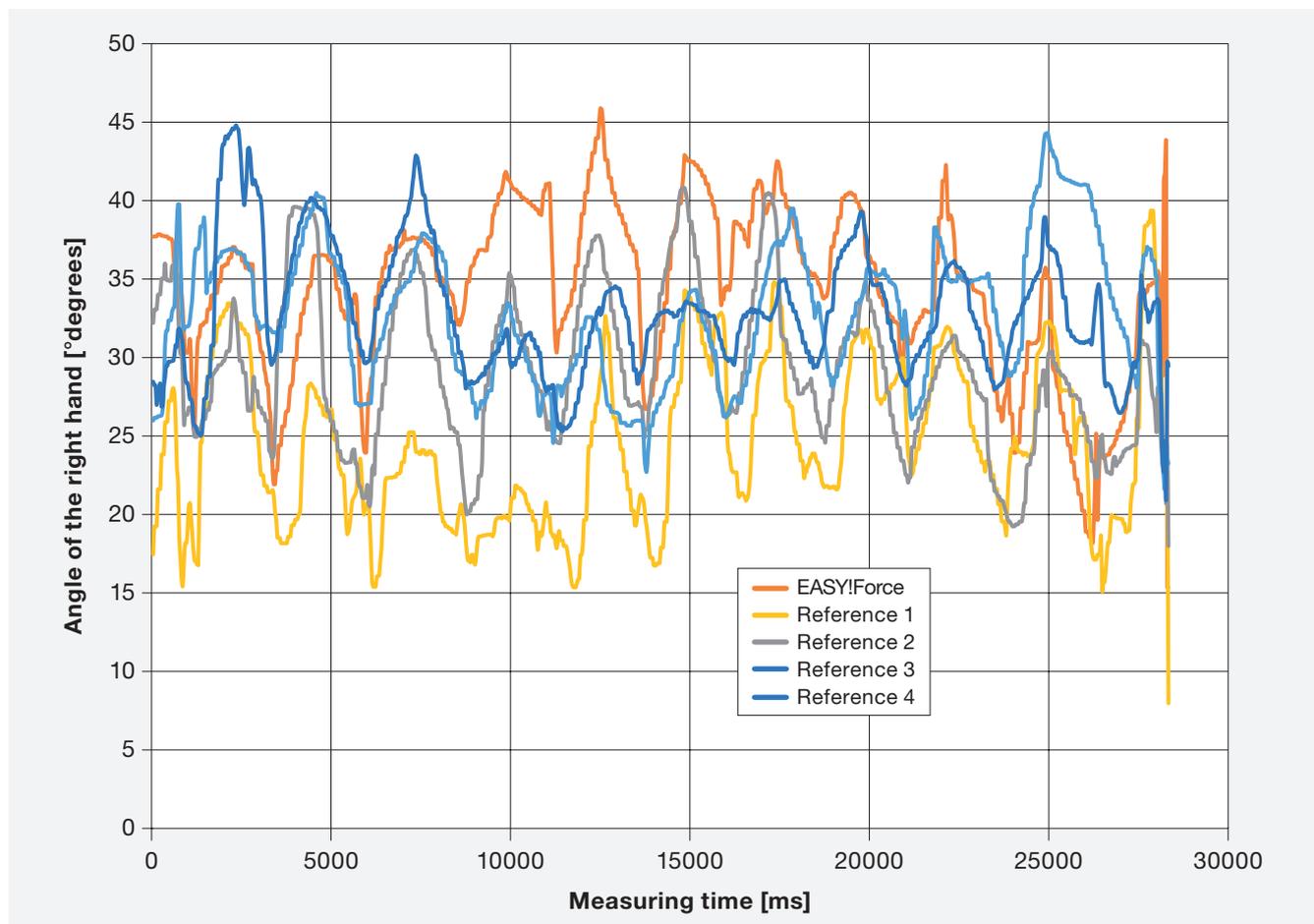


Figure 3:
Motions of the right hand wrist at the tractor’s storage tank

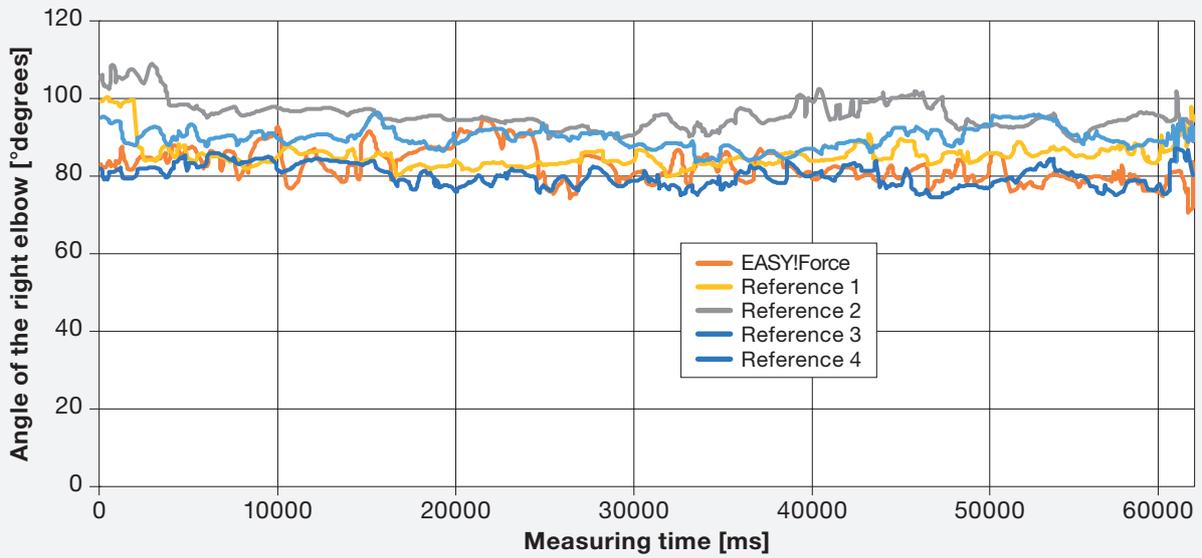


Figure 4:
Angle change of the right elbow at the wheel case of the tractor

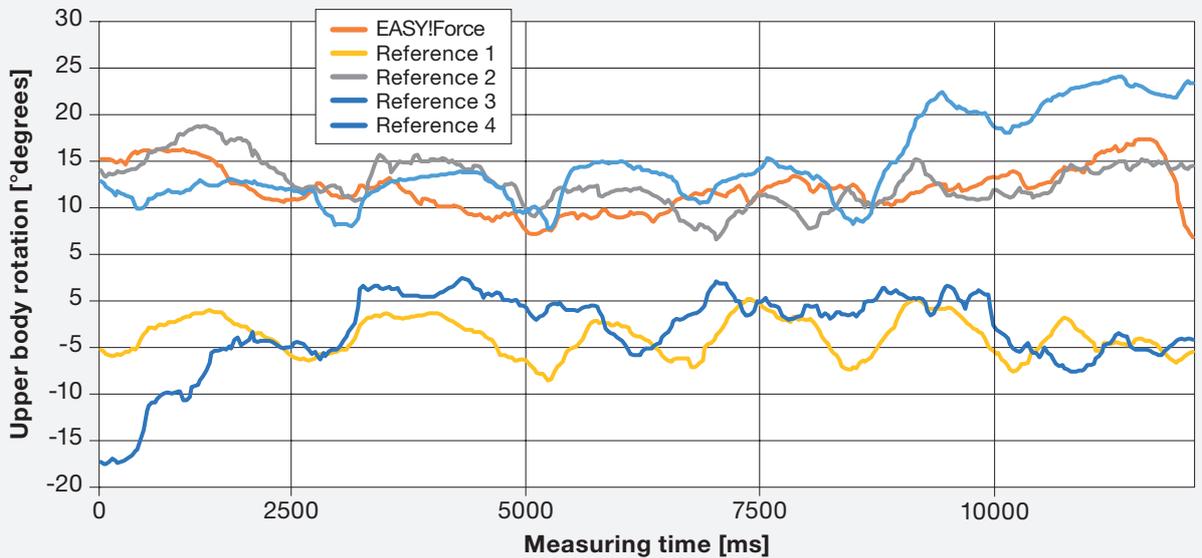


Figure 5:
Upper body rotation during the floor cleaning in the animal house

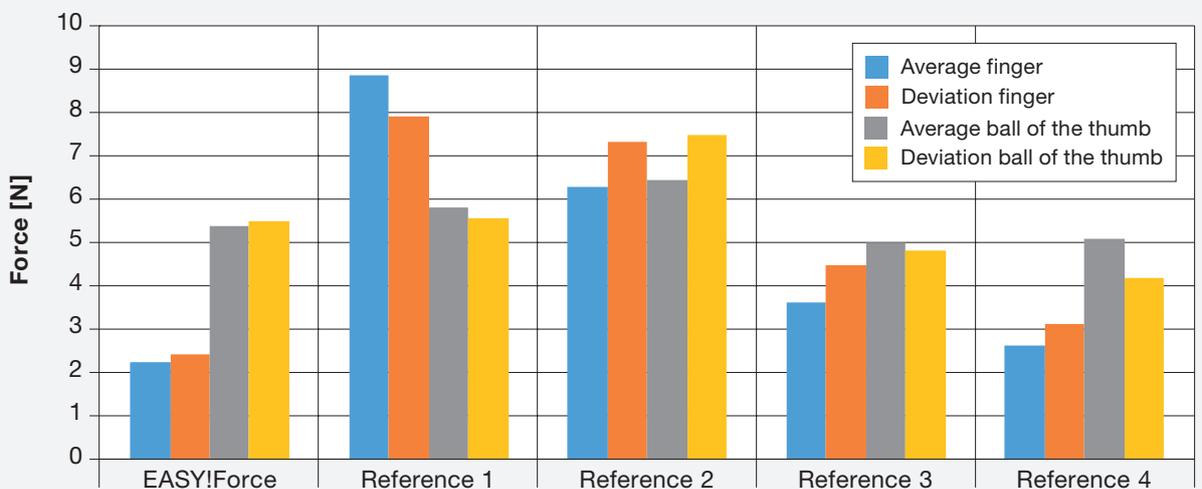


Figure 6:
Time-averaged force at the front and reverse side of the trigger guns

Subjective feeling (handling)

The evaluation of the questionnaires represents an image which fits the objective measurement data. By the test person's statements it is again confirmed that in total a relief of the most important body parts is achieved. In the ranking, the "EASY!Force" leads ahead of all other tested trigger guns.

The results are shown in Table 2. The criteria finger/ball of the thumb, hand wrist/elbow/back and subjective feeling were evaluated.

Table 2:

Results of the trigger gun "EASY!Force" compared with 4 additional grips

	"EASY!Force"	Standard/refer- ence	Deviation to stan- dard [%]	Evaluation*
Relief finger				
Average finger forces [N]	2.23	5.35	58.3	+ +
Relief back				
Average deviation of upper body rotation [N]	1.73	2.56	32.3	+
Subjective assessment				
Survey result [ranking]	1.29	2.19	41.2	+ +

* Evaluation range: + + / + / o / - / - - (o = standard, n.e. = no evaluation)

Test execution

The test was carried out beginning June 2017 at Haus Düsse, Bad Sassendorf.

Summary

The tested trigger gun "EASY!Force" of the company Kärcher fulfils the requirements of the test framework "handling and economics of agricultural working units" with regards to ergonomics and handling.

The relief of the fingers was in comparison to the standard 58.3 %. The relief of the back resulted in 32.3 %. During the subjective assessment the ranking of the "EASY!Force" was 41.2 % above the standard.

Herewith the tested trigger gun of the company Kärcher can be considered as being ergonomic and easy to handle.

Further Information

The relevant DLG committees have published the information leaflet number 364 on the topic “Cleaning and disinfection of animal houses”.

It is available free of charge in PDF format under www.dlg.org/merkblaetter.html.

Test execution

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Test Center Technology and Farm Inputs,
Max-Eyth-Weg 1, 64823 Groß-Umstadt, Germany

Practical test

Haus Düsse, Ostinghausen,
59505 Bad Sassendorf

Laboratory and ergonomic evaluation

University of Kassel,
Work and organisational psychology,
Heinrich-Plett-Straße 40, 34132 Kassel

DLG Test Framework

DLG Test Framework “Handling and ergonomics of agricultural working units“

Expert Commission

Prof Dr Oliver Sträter, University of Kassel
Prof Dr Karsten Kluth, University of Siegen
Jürgen Ripperger, VDE Offenbach

Field

Animal husbandry

Project leader

Dipl-Ing agr Susanne Gäckler

Test engineer(s)

Dipl-Ing (FH) Tommy Pfeifer*

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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 Center 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.

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