



testo 476

Instruction manual

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Preface

Foreword

Dear Testo customer,

Congratulations on choosing a Testo product. We hope that you will enjoy many years of using the product and that it will help you in your work.

If problems should occur which you cannot rectify yourself, please consult our service department or your dealer. We will endeavour to provide fast and competent assistance to save you long periods out of operation.

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This instruction manual contains important information about the features and use of the instrument. Please read this document carefully and familiarise yourself with the operation of the instrument before putting it to use. Always keep this manual close at hand in order to look up necessary information.

Standards/Tests



The conformity certificate confirms that this product fulfills the guidelines in accordance with 2004/108/EEC.

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1. Basic safety instructions

WARNING:

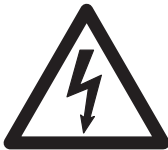
- ▶ Stroboscopes give the illusion of stopped motion. Do not touch the machine or object being observed!
- ▶ The use of stroboscopes may induce an epileptic seizure in those persons predisposed to this type of attack.
- ▶ Explosion hazard. Do not use this product in the presence of an explosive environment.

CAUTION:

- ▶ Do not use this product in wet or condensating environments.
- ▶ Do not allow liquids or metallic objects to enter into the ventilation holes.
- ▶ Recharge the battery using only the original mains unit with supplied the **testo 476**.
- ▶ Use the supplied mains unit only with the **testo 476**.

DANGER HIGH VOLTAGE!

- ▶ To reduce risk of an electronic shock, do not open the Pocket-Strobe. To replace the flash tube, refer to chapter 9. Replacing the flash tube.
There are no user-serviceable parts inside.



2. Intended use

You can use the **testo 476** in a variety of industrial, laboratory, R&D and academic environments.

Most commonly, the **testo 476** is used to make objects which are moving at high speeds appear to be moving in slow motion. When this occurs, you can then safely and easily analyse their motion, check for proper registration, determine sources of unwanted vibration, etc.

Also, you can use the **testo 476** to apparently “freeze” an object’s movement. Without making contact, you can accurately measure the object’s rotational speed or reciprocation rate.

Unlike other portable stroboscopes, the **testo 476** (XENON-)stroboscope takes only one hand to operate.

Typical applications include use with:

- High speed assembly lines, conveyor systems, bottling operations, etc.
- Printing presses and cloth looms
- Motors, fans, pumps and turbines
- Calibration and inspection equipment
- Monitoring laboratory & research applications

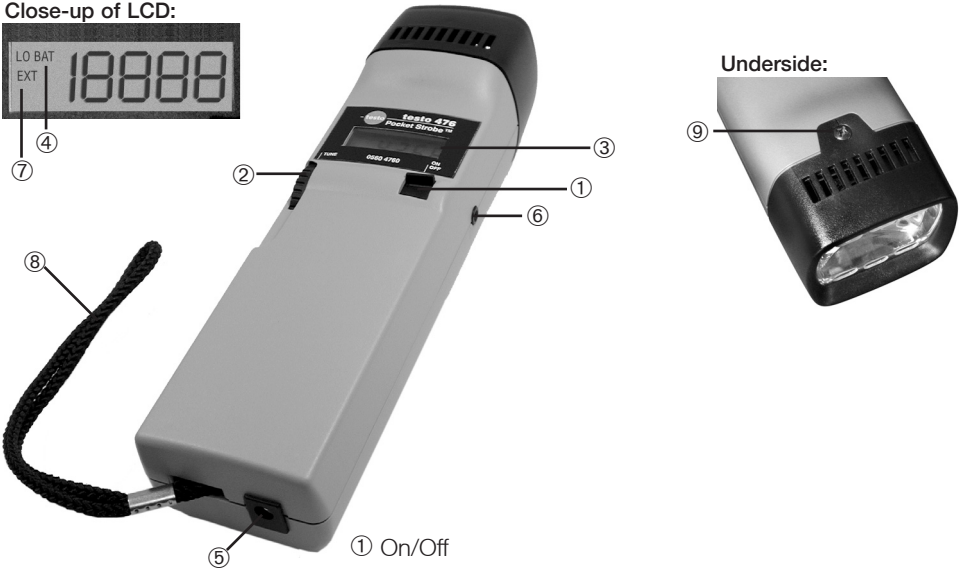
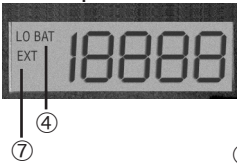
3. Delivery range

Your **testo 476** hand-held stroboscope comes with the following items:

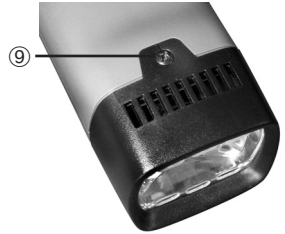
- **testo 476** Stroboscope
- Universal mains unit (100...240V AC) and 4 adapters specific to country
- External Trigger Jack
- Carrying Case
- Instruction Manual

4. Overview

Close-up of LCD:



Underside:



- ① On/Off
- ② Flash Adjustment Knob adjusts the flash rate. The speed with which the flash rate changes is controlled by how quickly the knob is rotated:
Quick rotation = flash rate changes in large increments.
Slow rotation = flash rate changes in small increments.
- ③ LCD display shows flash rate (flashes per minute = FPM).
- ④ Low Bat indicator will light up when the battery needs charging.
- ⑤ Power supply socket (incl. battery charging)
- ⑥ The External Trigger Jack is used when employing an external sensor to control the flash rate.
- ⑦ EXT illuminates when External Trigger Jack is plugged.
- ⑧ Lanyard can be looped on a belt or used as a wrist strap.
- ⑨ Front Bezel Screw is removed in order to replace the flash tube.

5. Power supply



5.1 Mains unit Setup

When first using the mains unit, select the appropriate plug connector for use in the AC power outlet (several styles provided). Align the holes in the rear side of the plug connector (①) with the pins in the receptacle in the mains unit body (②) and push. When properly seated, you will hear a click and the plug connector will not move. The charger is now ready for use.

Change the Plug Connector

To remove the connector from the mains unit, slide the switch on the mains unit (③) up and the connector will pop out. To insert a different plug connector follow the procedures described in Battery Charger Setup.

5.2 Charge the battery

Charge the battery before first use or when the “LOW BAT” indicator appears on the LCD.

NOTE:

When the “LOW BAT” indicator is shown, the **testo 476** has approximately 6 minutes of operating time remaining. When the “LOW BAT” indicator flashes on and off, the battery is empty and the **testo 476** will automatically switch off.

Before first use, you must set up the battery charger. Refer to 5.1 Battery Charger Setup.

- 1 Insert the barrel plug end of the mains unit into the power supply socket on the **testo 476**.
Plug the mains unit into a mains socket.
- 2 The red light on the mains unit will illuminate continuously while the battery is charging.
 - The instrument will recharge in about five hours.

5.3 Battery management

Several factors effect the battery life:

- The warmer the operating environment, the shorter the battery life; the cooler the environment, the longer the battery life.

To maximise the life of the battery:

- Keep the battery not fully charged.
- Keep storage temperature as low as possible (10...20 °C)

6. Operation



The **testo 476** can be operated with and without mains unit. The Lithium ion rechargeable battery is recharged when the instrument is connected to the mains unit.

- 1 Aim the **testo 476** at the moving object and turn it on (①).
 - There will be a delay of 1-2 seconds before the flash begins to operate.
 - If the LOW BAT symbol in the display is illuminated, charge the battery.
- 2 Adjust the flash rate by rotating the Flash Adjustment Knob (②) until the object appears motionless (as you approach the movement frequency, the image appears to move more slowly).
 - This value will be shown in the LCD display (③).
Unit: „Flashes per minute“ = 1/min = RPM.
To get the unit „Flashes per seconds“ = 1/s = Hz:
Divide the shown value by 60.

IMPORTANT:

Motionless images do not only appear when the movement frequency is reached, but also when multiples and fractions of the movement frequency are reached.

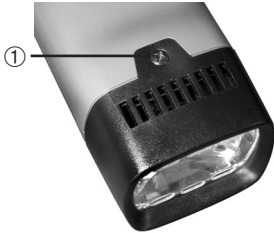
For additional information on visually slowing down the motion of an object as well as using your **testo 476** as a tachometer, please refer to the appropriate section(s) later in this manual.

Helpful Hints:

- The flash frequency for which the image of the object appears with the greatest contrast is the movement frequency.

7. Error messages

Underside:

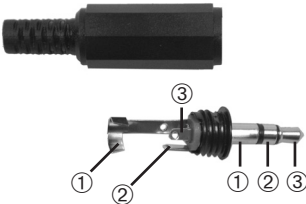


E1: Front bezel is not fastened correctly. If the E1 message appears, the instrument must be switched off. Remove the front bezel screw, reseal the reflector and tighten the front bezel screw (①).

8. External triggering



EXT illuminates when External Trigger Jack is plugged.



The **testo 476** can be externally triggered.

The EXTERNAL TRIGGER jack is DTL/ TTL compatible. It detects a square-wave signal of 0 to +5 volts which is at least 800nsec in duration.

The EXTERNAL TRIGGER jack uses a standard 1/8" phono plug (max. cable length 3m, shielded cable is recommended) with the configuration shown below (only valid for supplied plug!):

- ① The outer connection (barrel) is common.
- ② The middle connection provides an unregulated direct voltage output (6 - 7.5 VDC, $R_i = 100 \Omega$) to drive external sensors which are not self-powered.
- ③ The center connection is the input signal, which triggers the flash.

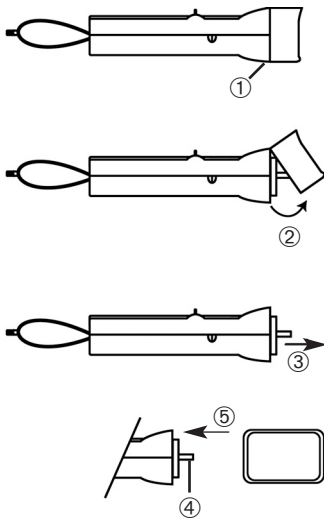
NOTES:

- Turn the Pocket-Strobe off when inserting or removing a trigger cable.
- Whenever an external trigger is used, the Flash Adjustment Knob is disabled.

WARNING:

- Do not trigger the device with signals over 208 Hz.

9. Replacing the flash tube



- 1 Remove the front bezel screw located on the underside of the front bezel (①).
- 2 Swing the bezel upwards and outward carefully (②). Be sure not to break the old flash tube. Ensure that the bezel hooks on the top edge are released. Remove the bezel.
- 3 Firmly grasp the spent flash tube and pull it straight out (③).
- 4 Using a lint and oil-free tissue, insert a new flash tube , with the marking pointing up, (④) into the socket.

⚠ CAUTION:

- Make sure that the flash tube is correctly installed in the socket. If it is crooked, the light output of the reflector is reduced.
- 
- 5 Slide the front bezel (⑤) over the new tube and rehing it at the top. Rotate the bezel back towards the bottom of the case and reinsert the front bezel screw.

NOTE:

As a safety precaution, the unit will not flash unless the bezel is in place. If the bezel is not secured properly, an emergency message “E1” will be shown in the display. Refer to 7. Error messages for additional information.

10.1 Slowing down motion

As discussed, the primary use of the Pocket-Strobe is to slow down or “freeze” the apparent motion of moving objects. This allows you to analyse their run-time performances safely and easily.

To make an object appear to move in slow motion, you need to strobe it at a rate slightly above or slightly below its actual speed (or any harmonic of its speed as discussed below). Simply use the COARSE/FINE ADJUSTMENT knob until you achieve the desired apparent movement.

Helpful Hints:

The speed at which the object appears to move can be determined by subtracting the flash rate from the object's actual rate.

Example:

If an object is rotating at 1,000 RPM and you strobe it at a rate of 1,005 flashes per minute (FPM), the object will appear to be moving at a rate of 5 RPM.

$$\begin{aligned}\text{Speed} &= \text{Actual Rate} - \text{Flash Rate} \\ &= 1,000 \text{ PRM} - 1,005 \text{ PRM} \\ &= 5 \text{ RPM}\end{aligned}$$

10. Application information

10.2 Apparent direction of movement

The direction (clockwise vs. counterclockwise or forward vs. backward) at which the object appears to move is determined by the flash rate, the object's actual direction of movement and the orientation of the stroboscopic beam to the object.

Example:

Assume you wish to visibly slow down the movement of a fan which is rotating clockwise at 1,000 RPM.

Case 1: If you stand in front of it and strobe it at a rate of 1,005 flashes per minute (FPM), the object will appear to be moving at a rate of 5 RPM in a counterclockwise direction.

Case 2: If you stand in front of it and strobe it at a rate of 995 FPM, it will appear to move at a rate of 5 RPM in a clockwise direction.

Case 3: If you stand behind it and strobe it at a rate of 1,005 FPM, it will appear to move in a clockwise direction at a rate of 5 RPM.

Case 4: If you stand behind it and strobe it at a rate of 995 FPM, it will appear to move in a counterclockwise direction at a rate of 5 RPM.

10.3. Harmonics

If you continuously increase the flash rate while strobing an object, it may appear to freeze, slow down, speed up, go forward, freeze again, go backwards, form multiple images, etc. These images appear at mathematically determined multiples or harmonics of the object's actual speed.

Example:

Assume you wish to slow the motion of the fan used in the last example, but you want it to be brighter.

Technique: Starting from 1,000 FPM, slowly increase the flash rate. At 1,500 FPM the image will appear to freeze again. Continue to increase the rate.

10. Application information

The image will appear to freeze again at 3,000 FPM. At this rate, the fan appears to be very bright. You can now use the FINE ADJUSTMENT knob to vary the rate above and below 3,000 to make the fan appear to move both clockwise and counterclockwise.

Helpful Hints:

- Harmonic images appear at both whole number multiples as well as fractional intervals of the object's actual rate.
For example, a fan rotating at 1,000 RPM will appear to be frozen at the whole number multiples of 2,000 (2x), 3,000 (3x), 4,000 (4x) etc., as well as at the fractional rates of 500 ($1/2x$), 750 ($3/4x$) and 1,500 ($1\ 1/2x$), etc.
- Some of the harmonic images are "singular" in appearance while others are "multiple". This becomes important if you want to determine the objects actual rate as discussed in chapter 10.4 Determining an object's true RPM.

10.4 Determining an object's true RPM

The Pocket-Strobe can be used as a digital tachometer to determine the true RPM and/or the reciprocation rate of an object. This is done by visually "freezing" the object's movement and then reading the LCD display. As with all stroboscopes, it is important to verify that this frozen image is not a harmonic of the object's actual rate.

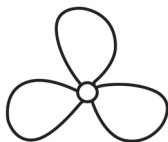
Helpful Hints:

- Knowing the approximate rate of the object in advance gives you a useful starting point.
- If the object has a uniform shape, like a multi-blade fan or motor shaft, you must give it an identifying mark (using paint or reflective tape or equivalent) in order to differentiate its orientation.
- A single image always appears if the rotational speed set on the instrument matches the rotational speed of the object or if an integer divisor ($1/2$, $1/3$, ...) of the object speed has been set on the instrument.

10. Application information

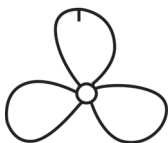
Example 1 (mark needed):

This example shows why identifying marks are important.



Suppose you want to determine the true RPM of this fan. The only thing you know is that its speed is less than 3,500 RPM. If you slowly decrease the flash rate starting from 3,500 FPM, the following “frozen” images appear:

Image No.:	1	2	3	4
Flash Rate:	3,300	2,200	1,650	1,320
Image No.:	5	6	7	8
Flash Rate:	1100	825	733.3	550



What is the actual rate of the fan? Images 1, 3, 5, 6 and 8 are all “frozen,” so the rate could be taken as 3,300, 1,650, 1,100, 825 and 550. Which is correct?

In order to determine the fan’s actual speed, a mark is added to one of the blades and the test is run again.

Image No.:	1	2	3	4
Flash Rate:	3,300	2,200	1,650	1,320
Image No.:	5	6	7	8
Flash Rate:	1,100	825	733.3	550

10. Application information

Using the orientation mark, it is now clear that the images appearing at 3,300, 1,650 and 825 RPM are multiple-image harmonics. In each of these cases, three identification marks appear. On the other hand, a singular image appears at 1,100 and again at 550.

The first single image with only one reflection mark appears if 1.100 rpm has been set on the instrument, another one at 550. Please remember, a single image always appears if the rotational speed set on the instrument matches the rotational speed of the object or if an integer divisor (1/2, 1/3, ...) of the object speed has been set on the instrument. The true rotational speed therefore is 1.100 rpm. If the instrument is set to 550 rpm, only every second rotor revolution will be flashed.

Example 2 (no mark needed):



This example illustrates how the actual speed of an object can be determined without the use of an orientation mark - provided that the object has a suitable shape.

Assume that the speed of this cam is known only to be less than 7,000 RPM. Because it has a unique shape, it does not need an identifying mark. As the flash rate is lowered from 7,000, the following harmonic images appear:

Image No.:	1	2	3	4
Flash Rate:	6,000	4,000	3,000	1,500

The harmonic images at 6,000 and 4,000 RPM are not singular, but double and quadruple. A singular image does appear at 3,000 and again at 1,500 RPM. 3.000 rpm is the actual rotational speed.

11. Maintenance

Due to the high voltage contained within the **testo 476**, the user should not attempt to repair the device (exception: Replacing the flash tube, see p. 12).
If your **testo 476** needs repair, please contact the nearest Testo service point.

Clean the external surfaces with a dry, lint free cloth only.
Do not allow any liquids to enter into the instrument.

12. Accessories / Spare parts

Name	Part no.
Belt bag with clip for hand–held stroboscope	0516 4760
Spare xenon flash lamp for hand–held stroboscope High light intensity	0213 0020
ISO calibration certificate/rpm Optical and mechanical rpm measuring instruments; cal. points 500; 1000; 3000 rpm	0520 0012

13. Technical data

Display Parameters	
Range	30...12,500FPM (flashes per minute)
Accuracy	±0.01% from Display ±1 digit
Resolution	±1 FPM
Repeatability	±1 FPM
Display	5 Digit LCD
Flash Tube Parameter	
Longevity	200,000,000 flashes at 6000 FPM (approx. 550 hours)
Flash Duration	< 9µs
Light Emission	1200 Lux measured at 20cm / 8" approx. from target
Flash Colour	6.000...6.500K
Flash Energy	max. 170mJ
Electrical Specification	
Use	Battery and mains operation
Continuous Usage Time	>2 h at 1.500 FPM on 23°C / 73°F
External Trigger Input	0...5V DTL/TTL compatible 3.5 mm / 1/8" standard connector U _{out} = 7.2V unregulated direct voltage output (6 – 7.5 VDC, R _i = 100 W)
Line Power Input for recharging	100...240V, 50/60Hz; incl. 4 area connector pins
Battery	Lithium ion battery block
Recharging Time	max. 3.5h
Overload protection / trickle charge	yes
Housing	
Material	ABS
Dimensions	240 x 65 x 40mm / 9,75 x 2,75 x 1,75inch
Weight	465g
Ambient Conditions	
Ambient Temp.	0°...40°C (32°...114°F)
Storage Temp.	–25°C...70°C (–10°F...125°F)
Humidity	max. 95% not condensed
Warranty	2 years, warranty conditions see website www.testo.com/warranty