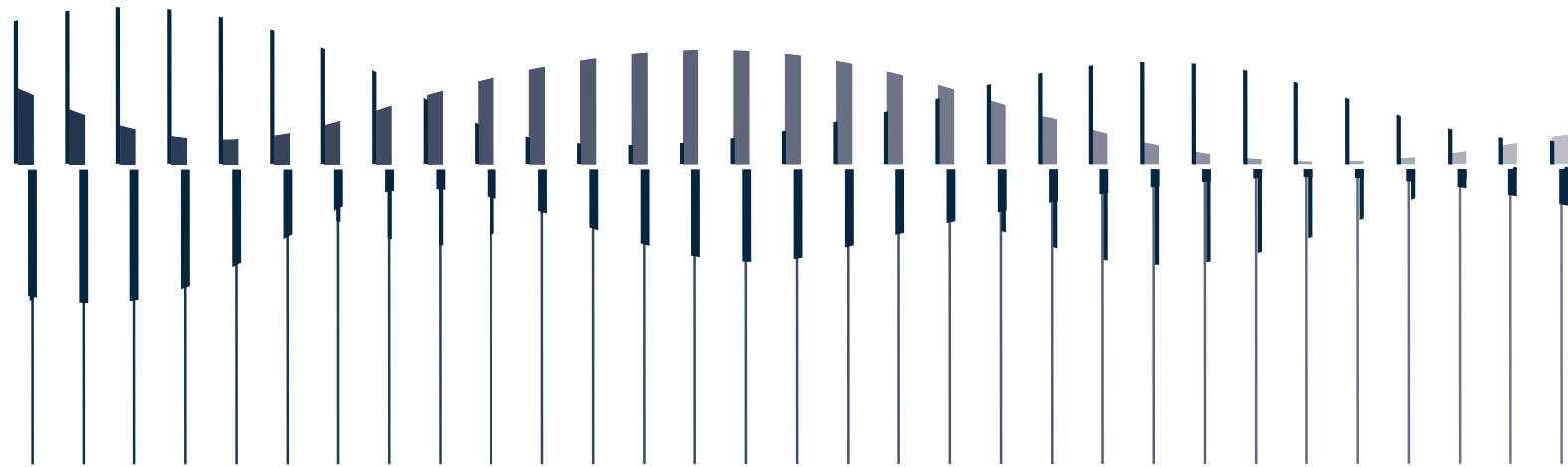




# Instruction Manual

GRAS 45EA Handset Positioning System for KEMAR



## Revision History

Any feedback or questions about this document are welcome at [documents@gras.dk](mailto:documents@gras.dk).

Revision	Date	Description
1	23 June 2011	First publication of this document
2	04 February 2017	New finger system introduced
3	22 November 2018	Global corrections because of revised finger positioning system

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## Introduction

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Thank you for purchasing the 45EA Handset Positioning System for KEMAR. It is designed with maximum flexibility and acoustic performance in mind for laboratories and development environments that care about the acoustic quality of their products.

The Handset Positioning System is designed for the GRAS 45BC KEMAR with Mouth Simulator. With this combination, you can make very realistic *in-situ* measurements on modern mobile telephones, as well as conventional handsets.

You can mount the system on the KEMAR without additional tools. The system can be mounted on either side of KEMAR, and you can easily switch it from one side to the other side.

There are two setup modes for the Handset Positioning System:

- **ERP:** This mode uses the Ear Reference Point of the ITU-T P.57 Pinna Simulator, which is determined by the ERP-gauge included with the 45EA, or referred to the EEP (ear entrance point).
- **Well-defined pressure force:** This mode uses applied handset pressure force against the pinna; this force is measured and set with the force gauge included with the 45EA.

**Note:** For telephone handset testing based on ITU-T Recommendations, 45BC must be configured with the GRAS ITU-T pinnae KB1080 and KB1081. For more information, see the KEMAR manual.

45EA comes with a 2-year warranty against defective materials and workmanship.

## Using This Manual

This manual explains how to mount the handset positioning system on a 45BC KEMAR with Mouth Simulator, and how to configure and adjust the system. Specifications are listed at the end of the manual.

## The Concept

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The 45EA is used to simulate how a person holds a handset against the ear with minimum change in the free-field condition and the head-related transfer function (HRTF). This design lets you test all telephone handsets under the same conditions as in real-life situations.

## The Design

The system is designed like an arm with a hand; Fig. 1 shows the four anatomical sections of the system—arm, wrist, palm, and fingers.

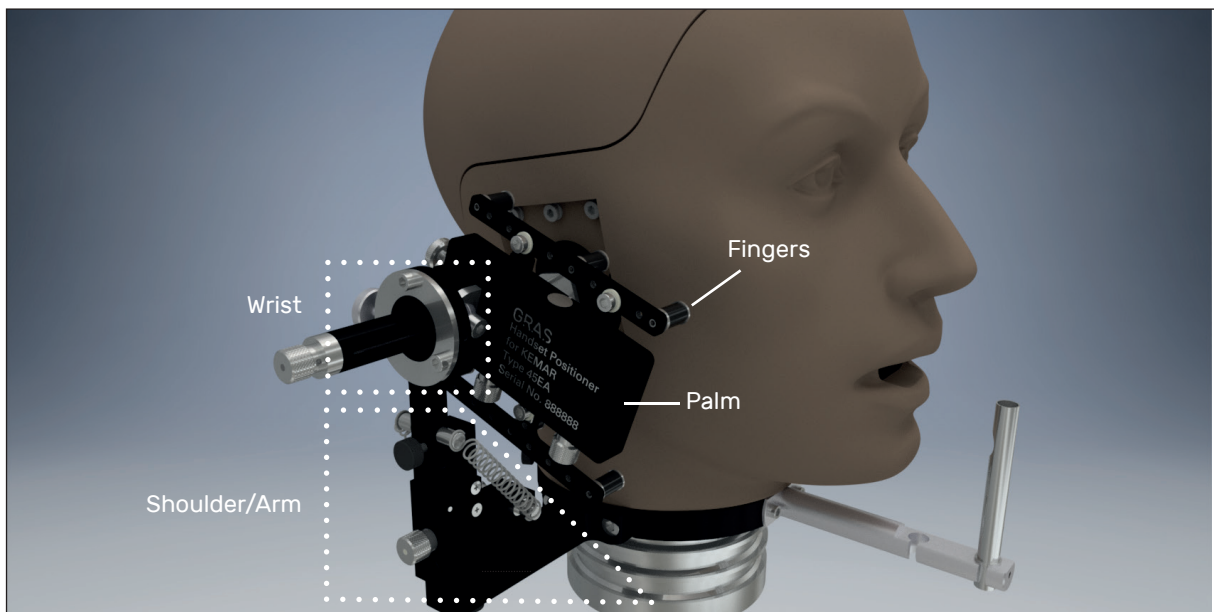
- The **arm** is mounted on a shoulder and allows for an adjustment of the force with which a handset is pressed against the pinna. The force can be adjusted in three intervals corresponding to your requirements. Depending on the choice of pinna size, pinna hardness, and research purpose, the sensitivity and leak-tolerance of the receiver can be investigated. There is a pinna-leakage adjustment for testing the influence of a leak.

The arm has two positions made for various handsets and an additional angle adjustment of the palm. The palm can also be adjusted vertically for orientation at the proper EEP or ERP.

- The **wrist** can adjust the palm angles in two perpendicular directions as well as the position on the pinna.

- The **palm** has six **fingers** and an end-stop for holding and positioning the telephone handset. Three fingers along one side are fixed. The three fingers at the opposite side are spring-loaded, which makes it easy to mount and remove the handset. They can be adjusted to accommodate for the shape and size of the handset as well as positioning at the specified ear cap reference point (ECRP) in the ear reference point (ERP).

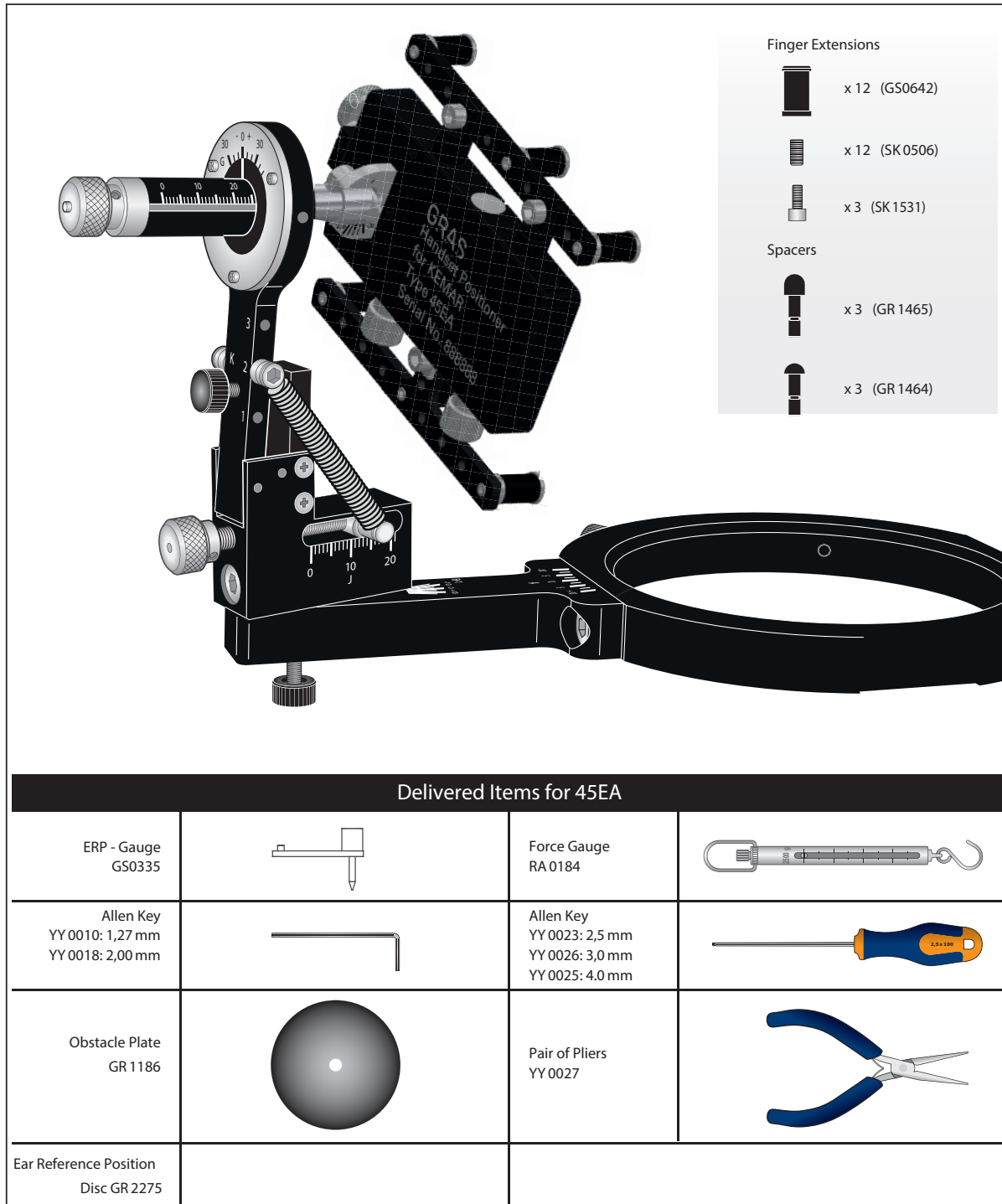
45EA can hold handsets up to either ear on the KEMAR Manikin to mimic a left-handed or right-handed person. This allows for diagnostics of handsets where the receiver and/or microphone is positioned asymmetrically, which changes the send and receive characteristics accordingly.



**Fig. 1.** The Handset Positioning System 45EA has four sections that are used to simulate the real-life use of telephone handsets – the arm/shoulder, the wrist, the palm, and the fingers.

## Delivered Items

The 45EA is delivered with all the items shown in Fig. 2. Before use, check that you have all the items. **Note:** The neck-ring and MRP calibration jig are delivered with 45BC-3 or 45BC-4 KEMAR with Mouth Simulator.



**Fig. 2.** The complete 45EA package.

## Mounting the Handset Positioning System onto KEMAR

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### The Neck-Ring

45EA is delivered with a metal neck-ring that is used to

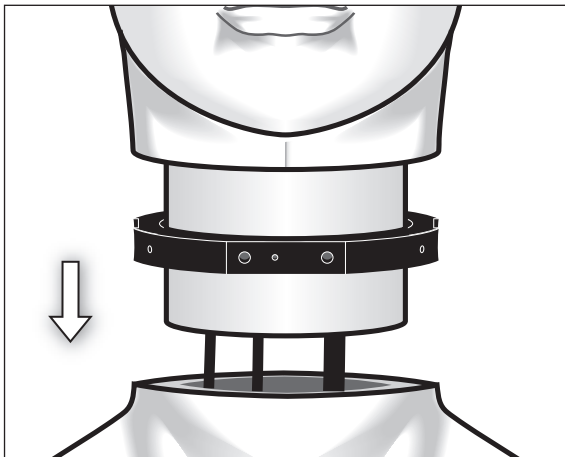
- Hold the MRP-calibration jig. For more information, see the KEMAR manual.
- Hold the handset positioning system.

To mount the neck-ring (on the right side),

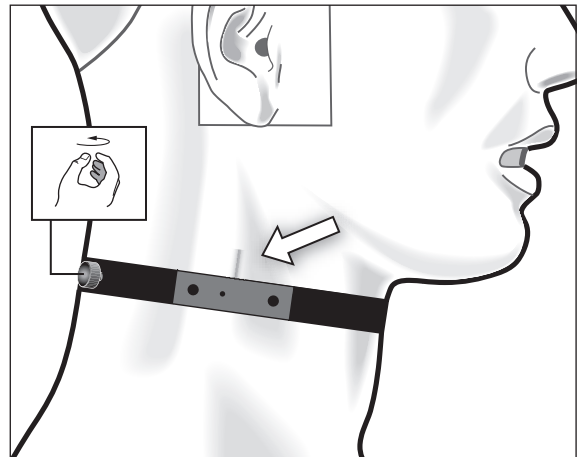
1. Remove the head from the KEMAR Manikin torso.
2. Slide the neck-ring carefully onto the neck (see Fig. 3).

**Note:** The inside chamfering of the neck-ring must point upwards.

3. Re-mount the head with the neck-ring onto the torso. Position the head so it faces forward in relation to the torso (see Fig. 4).

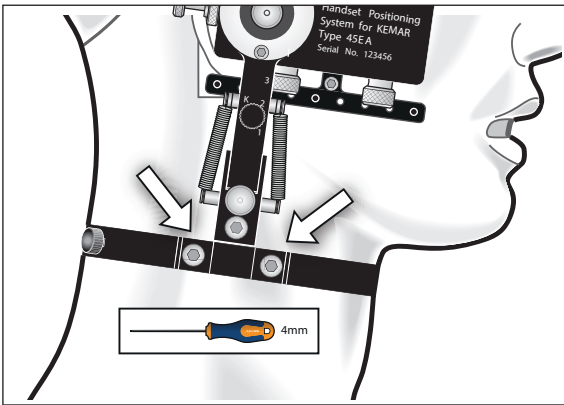


**Fig. 3.** Mounting the metal neck-ring onto KEMAR. Make sure the inside chamfering points upwards.

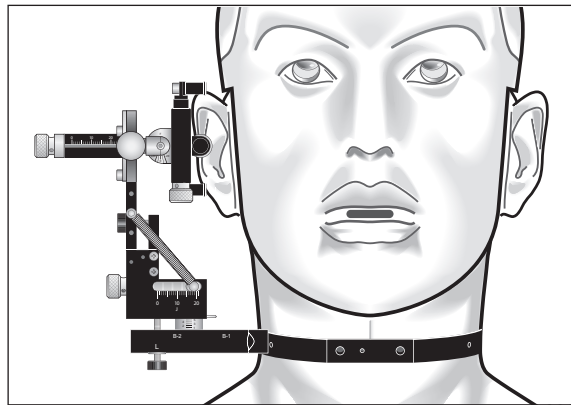


**Fig. 4.** With KEMAR's head facing forward, fasten the neck-ring in place using the two pivot screws on the back.

4. Use the pivot screws on the back of the neck-ring to fasten it securely to the neck as shown in Fig. 4. The mark on KEMAR's head serves as reference for the angle "A".
5. Fasten the system to the neck-ring using the 2 large screws provided (Fig. 5).



**Fig. 5.** Two large hex-screws hold the handset positioning system on the neck-ring as shown above.



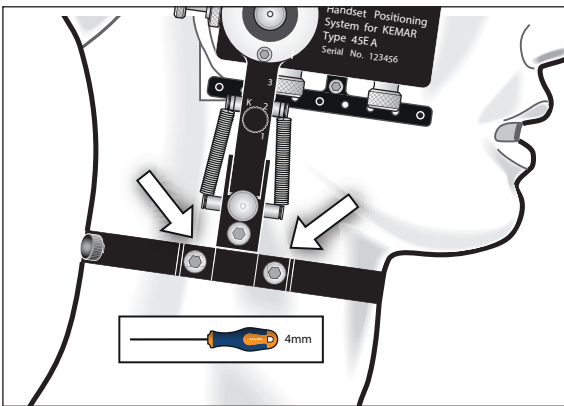
**Fig. 6.** The handset positioning system is now mounted correctly on KEMAR and ready for use.

KEMAR is now ready for telephone handset measurements with the right-sided pinna simulator.

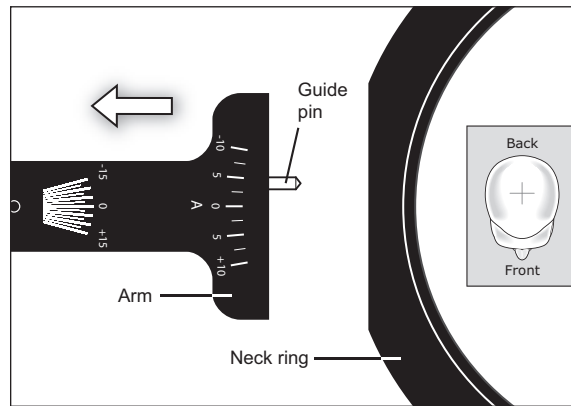
### Left-Side Measurements

It is easy to mount 45EA on the left-side of KEMAR for left-ear measurements.

1. Remove the screws that hold the system in place (Fig. 7), and remove the system from the neck-ring (Fig. 8).
2. Attach the system on the left-side of KEMAR (Fig. 9).
3. Reverse the palm as shown in Fig. 10 and Fig. 11 so that it is correctly positioned for left-side measurements.



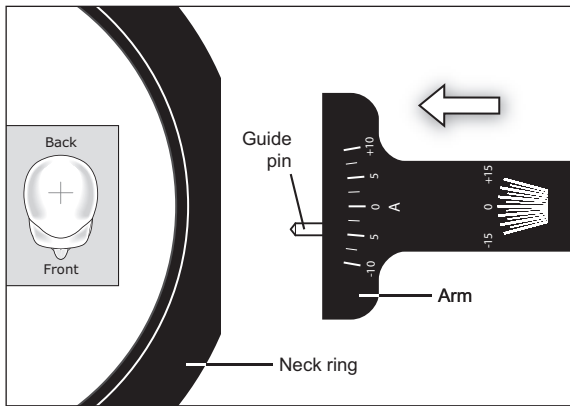
**Fig. 7.** While holding the system, use the 4 mm hex key to loosen the two hex-screws.



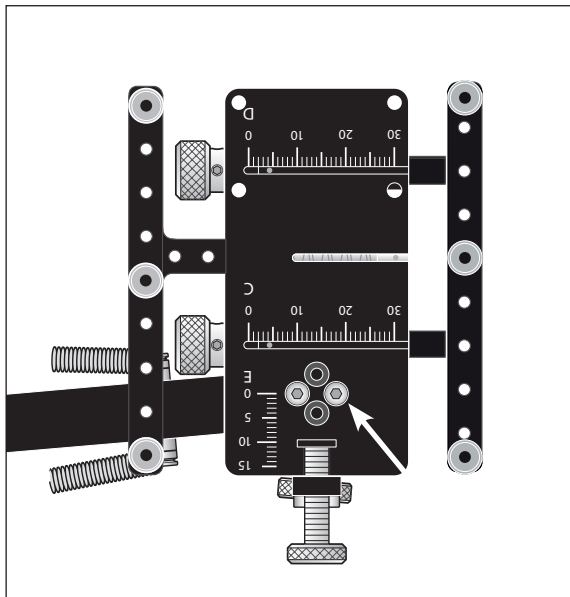
**Fig. 8.** Gently pull the system out of the neck-ring taking care not to put pressure on the guide pin.

**Note:** Never turn the palm 180 degrees without dismantling it or you will damage the wrist offset adjustment.

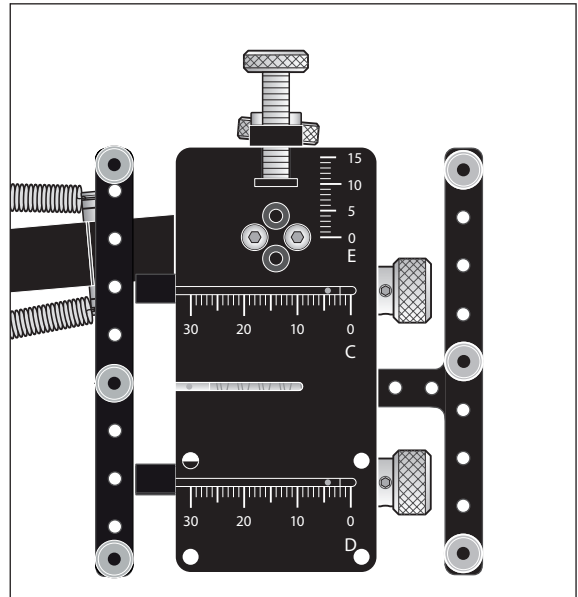




**Fig. 9.** Use the guide pin to gently push the system into the hole on the left-side of the neck-ring. Fasten the system securely to the neck-ring with the two large hex-screws.



**Fig. 10.** With the 2 mm hex key, remove the two hex-screws holding the palm in place.



**Fig. 11.** Turn the palm 180 degrees and attach it to the arm with the two hex screws.

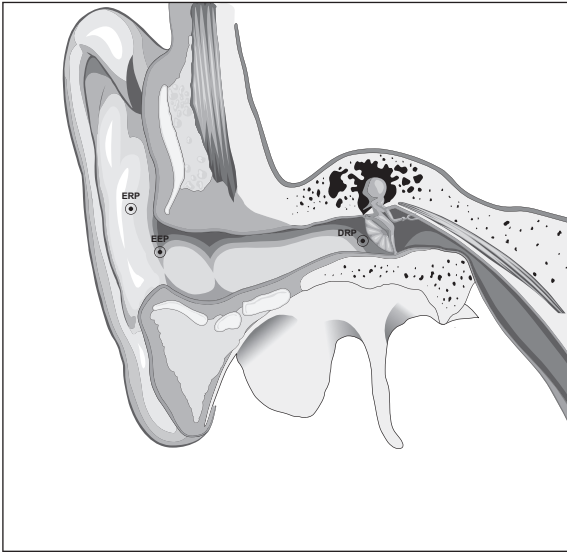
### Why is Positioning Important?

You should always report whether measurements are made on the right ear or the left ear. KEMAR, like real human beings, is not completely symmetrical. A receiver and or microphone is not always positioned symmetrically around the center of the handset. This is why 45EA is designed to measure both ears and why specifying which ear is measured for reports is important.

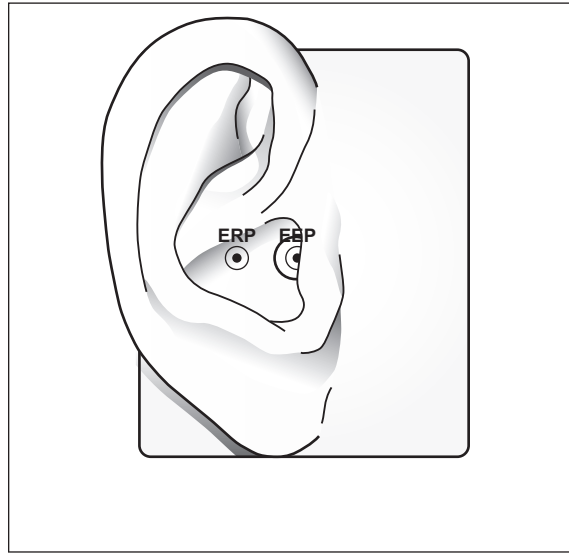
## Setting Up and Positioning a Telephone Handset

When your Handset Positioning System 45EA is mounted correctly on the KEMAR Manikin 45BC, you are ready to position the telephone handset for testing.

To make repeatable and standardized measurements, all handset positions are referred to a single point on the pinna. This point is called ERP, or the Ear Reference Point.



**Fig. 12.** Location of the ERP, the EEP, and the DRP.



**Fig. 13.** ERP and EEP marked on the KEMAR pinna simulator.

### ERP – How to Determine the Ear Reference Point

The ERP is described in several ITU-T Recommendations. It is defined as the point in the middle of the concha.

The position of this virtual point is shown on the anatomical illustration in Fig. 12 along with the EEP (Ear Entrance Point) and the DRP (Drum Reference Point). The position of the ERP and EEP are shown on the pinna simulator in a side-view in Fig. 13; the DRP is not visible because it is behind the EEP.

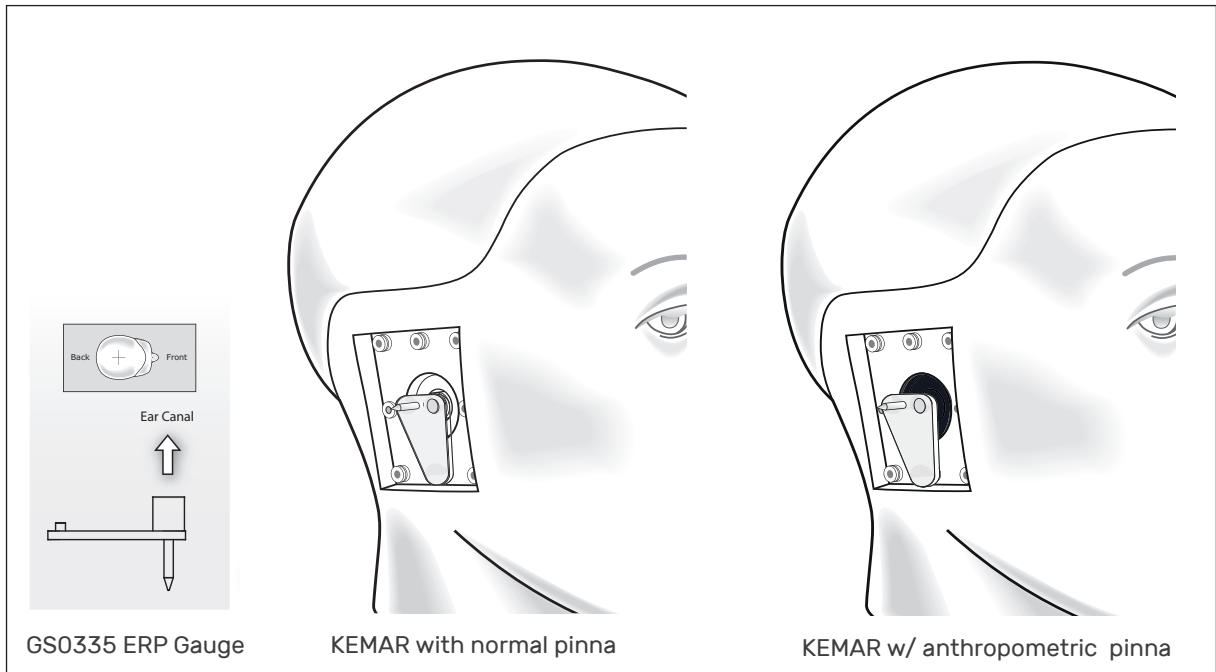
You define the ERP on the un-loaded pinna, that is, without a handset pressing against the pinna simulator. The pinna changes shape when a handset is pressed against it. This will naturally move the ERP, which becomes undefinable. However, ERP is defined as a virtual position not dependent on the application force. The pinna's deformation and the resulting leakage is therefore solely given by the shape of the handset. Therefore, the spring arrangement must be in its neutral position when ERP is used as reference.

For information about using pressure force as the setup mode, see “Application Force” on page 16

On the 45BC KEMAR Manikin, use the ERP gauge to determine ERP.

1. Remove the pinna simulator from KEMAR's head.
2. Insert the ERP-gauge into the ear-canal/entrance of the ear simulator and make sure the small tab points downwards.

The ERP gauge needle tip points at the ERP.



**Fig. 14. KEMAR with normal pinna:** When the ERP gauge is correctly mounted in the ear-canal, the gauge needle points at the Ear Reference Point and the handset being tested can be positioned to this standardized point.

**KEMAR with anthropometric pinna:** GR2275 (the black part behind the gauge) is used as a guide between the GS0335 ERP Gauge and the ear simulator. This is necessary because the ear simulator in this configuration is used without ear canal extension. When the ERP gauge is correctly mounted in the ear-canal, the gauge needle points at the Ear Reference Point.

Now the telephone handset to be tested can be mounted in the palm so the specified ECRP of the handset can be specified.

**Note:** For this setup, adjust the pinna leakage offset screw ( see Fig. 15 ) to obtain “neutral” force, that is, no deformation of the pinna.

## Adjustment Options

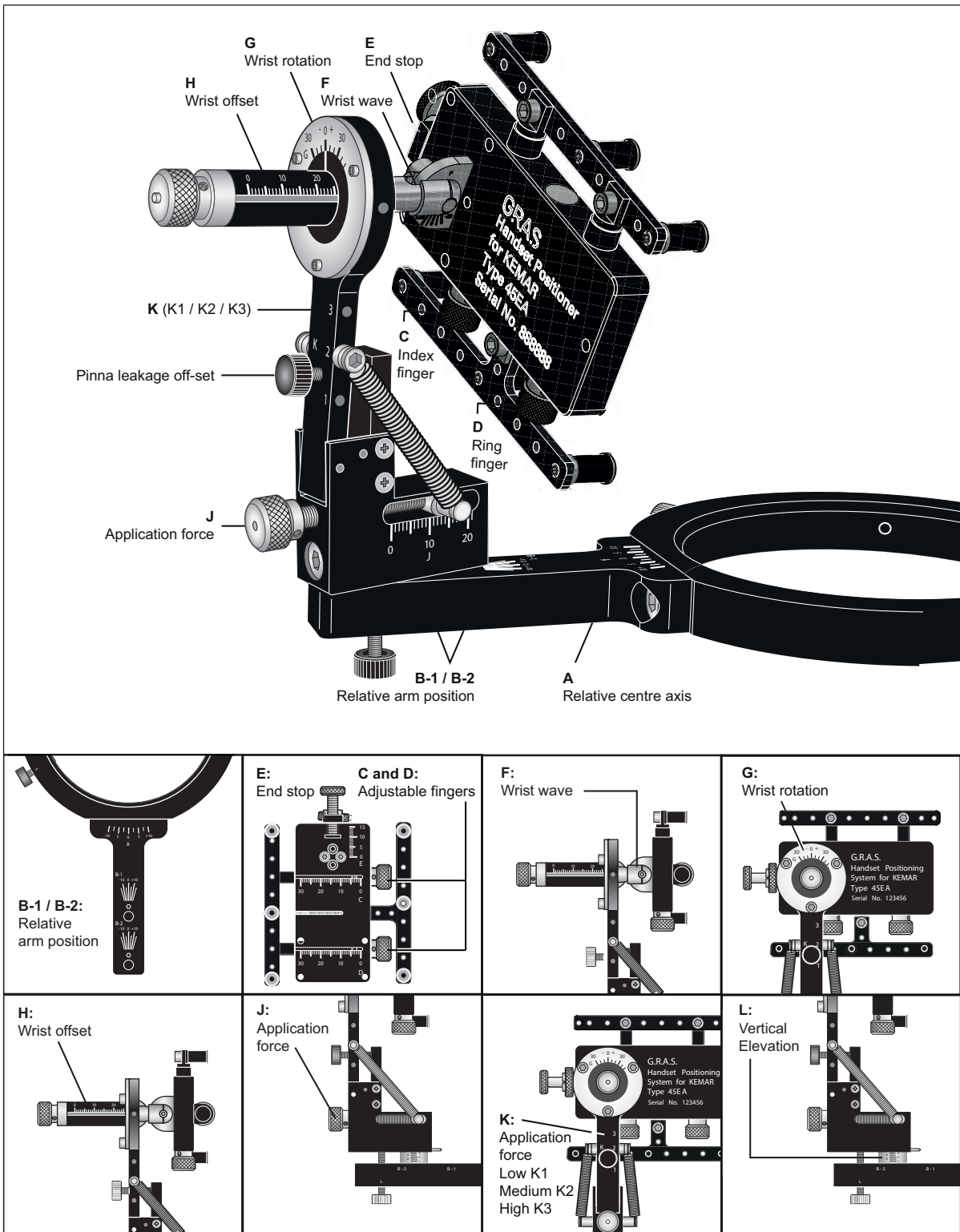
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The handset positioning system is a highly flexible tool and is designed to hold modern mobile telephone handsets in any desired position. The positioning fixture can help the device designer to optimize the form-factor of the handset for the best possible sound quality and performance.

The system has more than 15 positioning options, including angles, distances, forces, and finger lengths. In Fig. 15, each function is marked with a letter for identification.

The letters in Fig. 15 are also found on the reference position form that you can use for documenting the measurement setup (see “Reference Position Form” on page 21).

As described earlier the handset positioning system can be divided into 3 anatomical sections: arm, wrist and palm. The following sections describe how to adjust these sections in detail. The adjustment descriptions use the identification letters from Fig. 15.



**Fig. 15.** All adjustment options are marked with a letter and a scale for setting up and identifying required positions and testing properties.

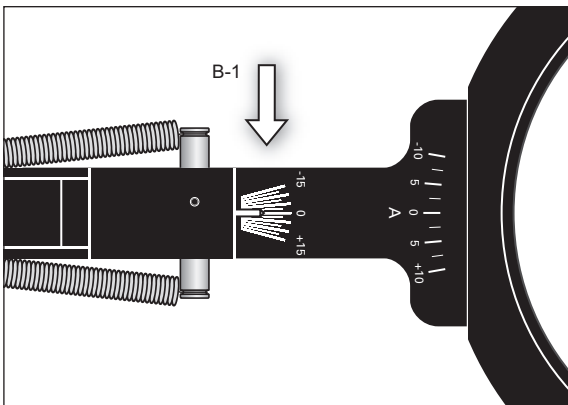
## Positioning the Arm and Shoulder

Positions on the arm and shoulder are identified by A, B-1, B-2, and L.

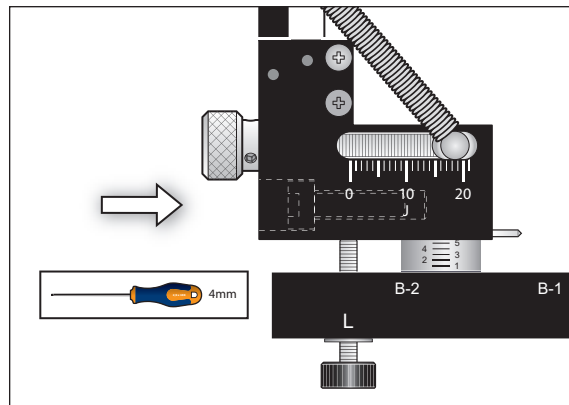
- A is the relative center axis position. It is fastened to the neck-ring by two hex screws.
- B-1 and B-2 are the arm positions, which are designed to accommodate various handset thickness designs: B-1 is for thin handsets and B-2 is for thicker handsets. The difference between B-1 and B-2 is 25 mm.
- L is used to adjust the vertical displacement of the handset relative to EEP/ERP.

After having found the desired angles and displacement use the 4 mm hex key to secure the vertical, sunken screw shown with the arrow in Fig. 17.

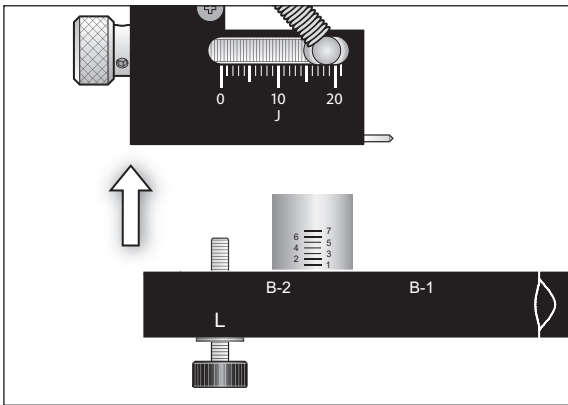
The following illustrations show how to move the arm from B-1 to B-2.



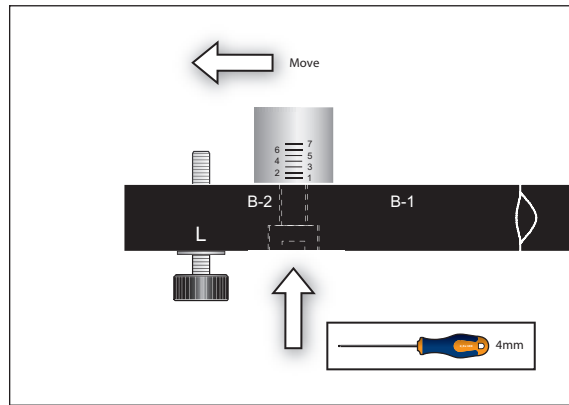
**Fig. 16.** The arm is in position B-1.



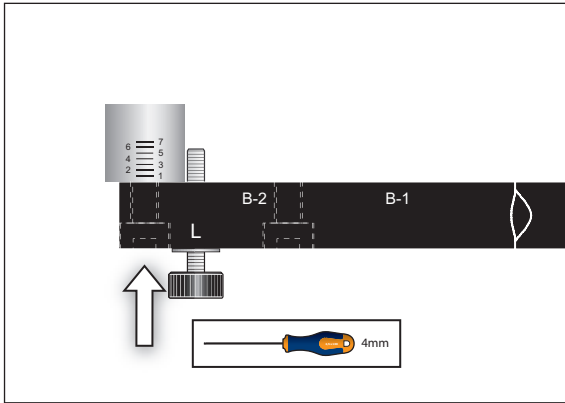
**Fig. 17.** Loosen the sunken screw in the arm with the 4 mm hex key, removing completely.



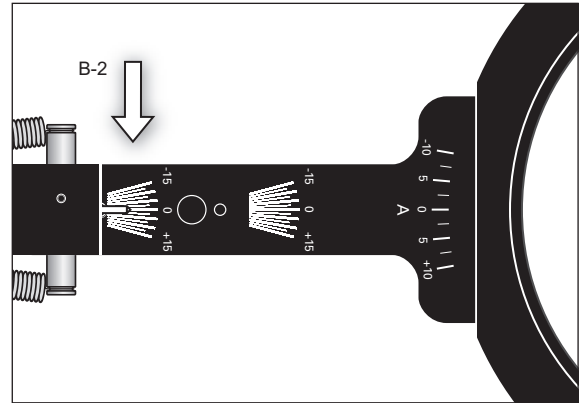
**Fig. 18.** Lift the arm up gently, separating it completely from the shoulder.



**Fig. 19.** Loosen the sunken screw in the shoulder with the 4 mm hex key so the cylindrical stud with guide pin can be removed.



**Fig. 20.** Move the cylindrical stud with guide pin to position B-2 and fasten it in place with the hex screw.

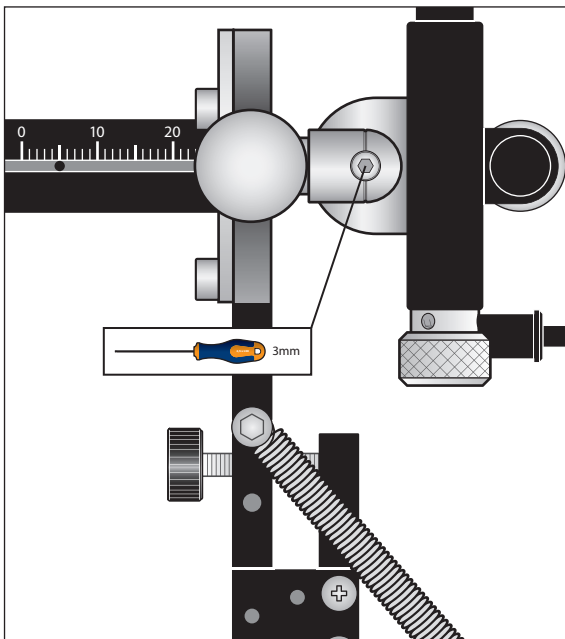


**Fig. 21.** The arm is now in position B-2.

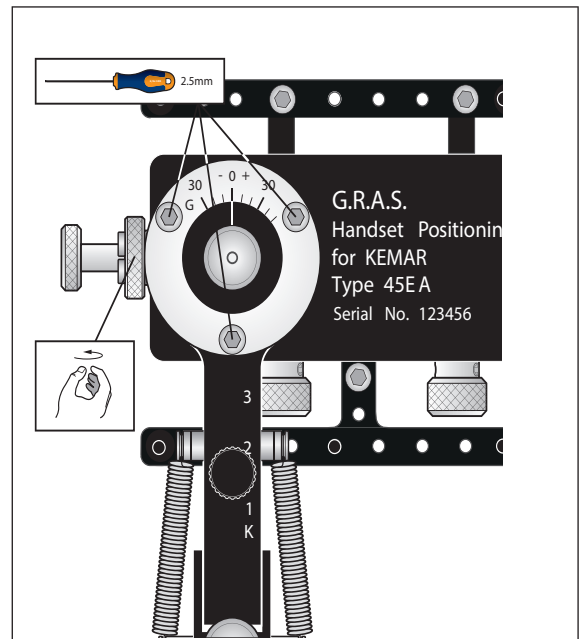
### Positioning the Wrist

The wrist positions are identified by F, G, and H.

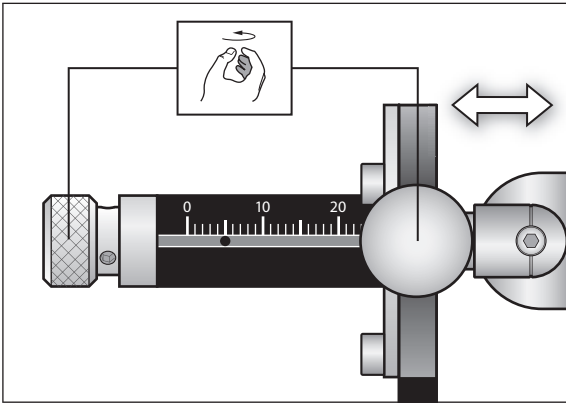
- F is the wrist wave.
- G is the wrist rotation.
- H is the wrist offset.



**Fig. 22.** The hex screw that adjusts the wrist wave.



**Fig. 23.** The wrist rotation adjustment.  
**Note:** Remember to loosen the finger screw before changing the angle.



**Fig. 24.** The wrist offset adjustment.

**Note:** Remember to loosen the finger screw before changing the angle.

Configure **F, the wrist wave** (Fig. 22), by loosening the hex-screw, adjusting the palm, and then tightening the hex-screw to secure the setting. The adjustment range is  $-20$  to  $+20^\circ$ .

Configure **G, the wrist rotation** (Fig. 23), by loosening the 3 hex-screws **and** the finger screw on the side, adjusting the angle, and tightening all the screws to secure the setting. The adjustment range is  $-30^\circ$  to  $30^\circ$ .

Configure **H, the wrist offset** (Fig. 24), by loosening the wrist-rotation finger screw first, and then turning the finger screw at the end of the offset scale clockwise to adjust the distance of the palm to the pinna. Tighten the wrist-rotation finger screw to secure the setting. The adjustment scale is 0 mm to 20 mm.

## Application Force

With 45EA, you can simulate the force with which a person holds a telephone against the ear.

The measured receive loudness ratings (RLR) value depends primarily on the sealing between the telephone handset and pinna simulator. The influence from the pinna depends on the hardness and size of the chosen pinna simulator. This is why it is important to state what kind of pinna is used for testing the telephone.

**Note:** The reference position form (page 21) has a “Right” and “Left” field for recording this information.

With 45EA, the force at which a handset is pressed against the pinna simulator can be adjusted continuously in three ranges from 2 to 23 Newton K1: 2-7 N, K2: 6-14 N. K3: 10-23 N.

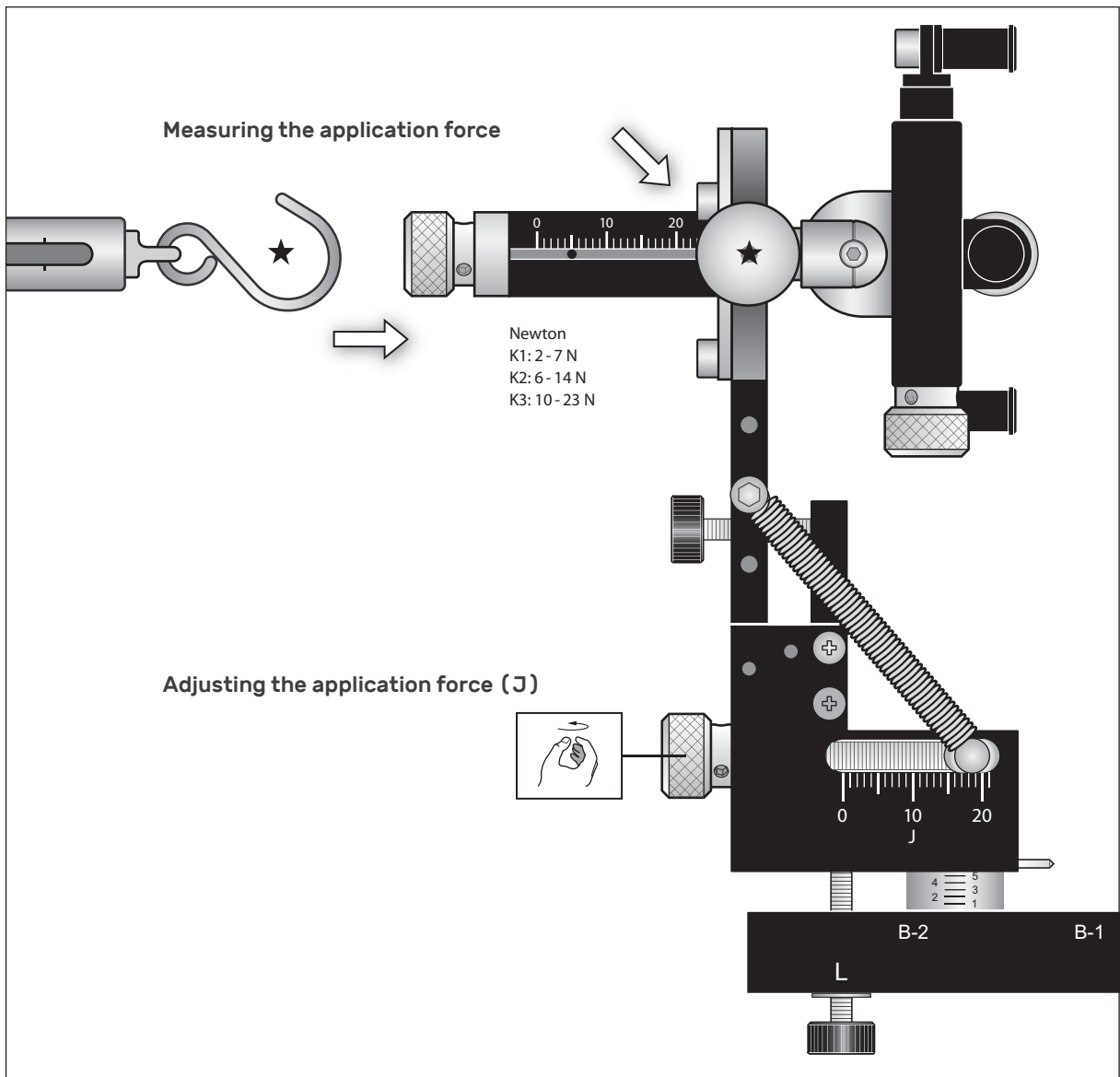


## Adjusting the Force

### Measuring the Application Force and Changing the Range

Fig. 25 illustrates how the force gauge is mounted on the positioning system. Attach the hook (marked by a star) to the finger screw (marked by a star). The force is easily determined by pulling the gauge until the palm "just slips" - starts moving.

The force is adjusted by the finger screw on the arm at position J at the base of the arm.



**Fig. 25.** The force gauge measures the application force. The finger screw on the arm is used to adjust the force in a range from 2 to 23 Newton, depending on the position of the spring arrangement.

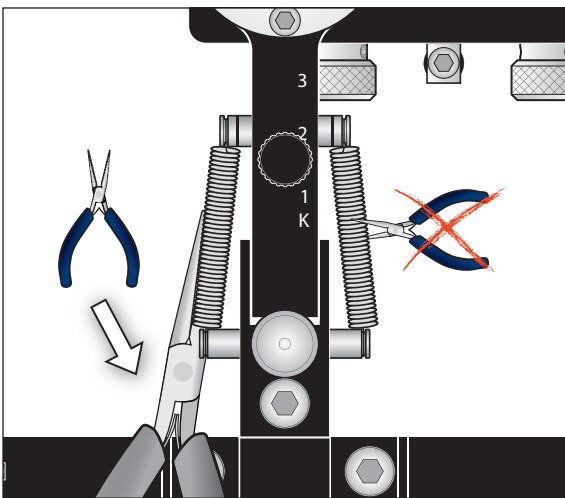
**Note:** The scale does not directly reflect the force in Newton. The positions of the application force range determine the force in Newton:

Position	Force Range
K1 - low	2 - 7 Newton
K2 - medium	6 - 14 Newton
K3 - high	10 - 23 Newton

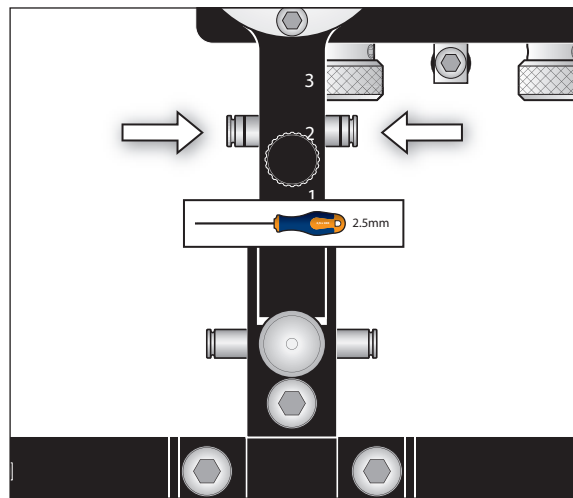
The three positions are set by adjusting the springs using the pliers and the hex key.

The springs must be removed properly to avoid damage. Fig. 26 shows how to use the pliers to release the springs **before** loosening the spring holder screws.

Fig. 27 shows how the position of the spring holder screws are adjusted with the 2.5 mm hex key. When the screws are set in their new position, you can remount the springs using the pliers.



**Fig. 26.** Use the pliers to remove the springs **before** the holder screws are unscrewed. When the range is changed, use the pliers to mount the springs again.



**Fig. 27.** Use the 2.5 mm hex key to adjust the spring holder screws and change the force range.

For information about using the ERP as the setup mode, see “ERP – How to Determine the Ear Reference Point” on page 10.

### Pinna Leakage Offset

The pinna leakage offset adjustment on the 45EA lets you make fine adjustments to the sealing or leakage so you can investigate the leak tolerance of the telephone handset (receiver). One turn of the finger screw equals 0.5 mm (0.020”) movement.

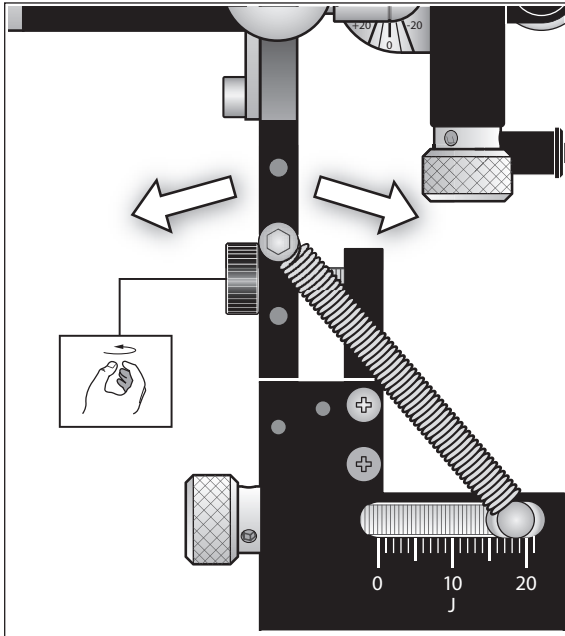
There are two ways of performing standardized measurements with 45EA:

- The ERP method, where the handset is positioned in a virtual point resulting in a possible deformation of the pinna simulator. The deformation and resulting seal depends on the handset design and pinna properties. Using this method, the handset is positioned in ERP (without paying attention to the force).

When using the ERP-method the pinna leakage offset adjustment should initially be in its neutral position, that is, where the arm is vertical.

- The application force method, where the handset is positioned in ERP but letting the applied force set the deformation of the pinna (without paying attention to the deviation in distance to the ERP).

When using the application force method, turn the pinna leakage offset adjustment fully counterclockwise initially so as not to influence the spring-loaded movement of the arm.



**Fig. 28.** The pinna leakage offset adjustment lets you make fine adjustments to the handset-pinna sealing. One turn moves the 0.5 mm (0.020"),

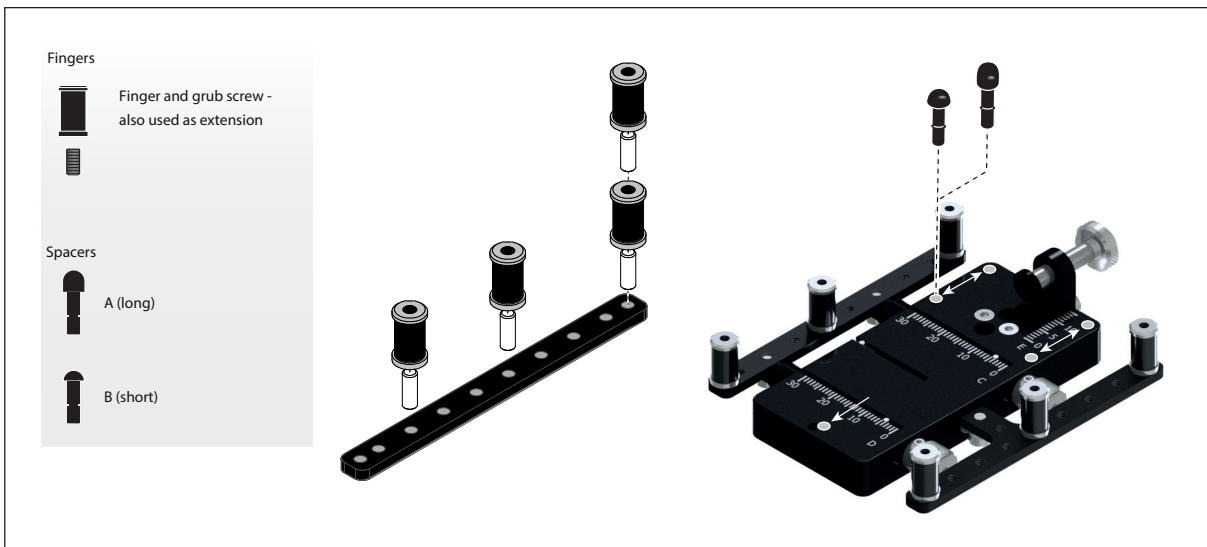
## Accommodating Different Handset Types

With the finger extensions, the fingers of the palm can be adjusted to accommodate as many different handset designs as possible, such as broader and thicker handset types.

Fig. 29 illustrate different extension possibilities. Use the 2.5 mm hex key to loosen or tighten the hex-screws.

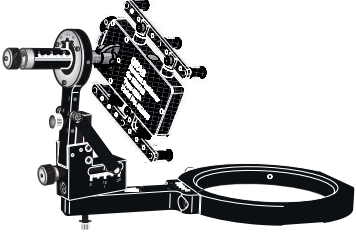
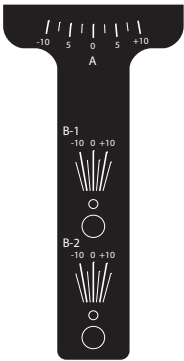
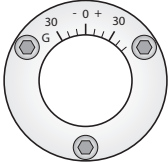
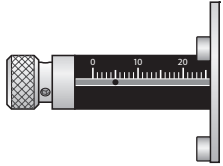
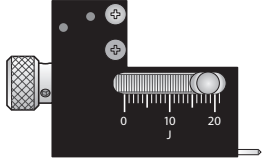
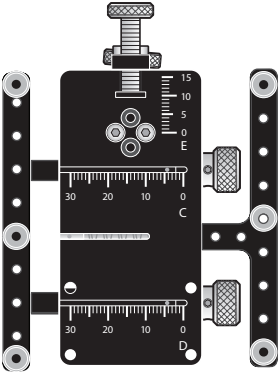
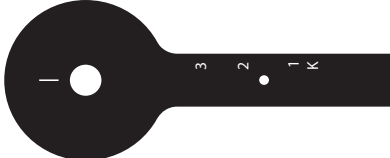



A total of 3 spacers – either long or short – can be inserted into three of the five light gray holes (indicated with arrows below) to adjust the distance to the palm.

If you have any special requirements, GRAS is always available to advise or discuss customized solutions for holding your specific handset.



**Fig. 29.** Note that the six fingers can be moved along the pole to accommodate any design bulges on the handset. The spacers A (long) or B (short) can be inserted into three of the five light gray holes to adjust the distance to the palm. The fingers can be stacked to accommodate thick DUTs. The holes in the fingers and the poles are threaded.

# Reference Position Form

	Telephone Modul : _____ Telephone Firmware : _____  Location : _____ Test System : _____  Operator : _____ Date : _____		
45BC S/N: _____	Right: _____	IEC 60318-4 S/N: _____	
45BA S/N: _____	Left: _____	Pinna S/N: _____	
	<b>A</b> Relative centre axis <input type="text"/>	<b>G</b> Wrist rotation <input type="text"/>	
	<b>B-1</b> Arm position <input type="text"/>	<b>H</b> Wrist offset <input type="text"/>	
	<b>B-2</b> Arm position <input type="text"/>	<b>J</b> Application force <input type="text"/>	
	<b>C</b> Index finger <input type="text"/>	<b>K1, K2, K3</b> Application force areas K1: 2 - 7 N _____ K2: 6 - 14 N _____ K3: 10 - 23 N _____	
	<b>D</b> Ring finger <input type="text"/>	<b>L</b> Vertical elevation <input type="text"/>	
	<b>E</b> End stop <input type="text"/>	<b>N</b> Force gauge <input type="text"/>	
	<b>F</b> Wrist wave <input type="text"/>	<b>GRAS Sound &amp; Vibration A/S</b> E-mail : <a href="mailto:gras@gras.dk">gras@gras.dk</a> <a href="http://www.gras.dk">www.gras.dk</a>	

## Calibration

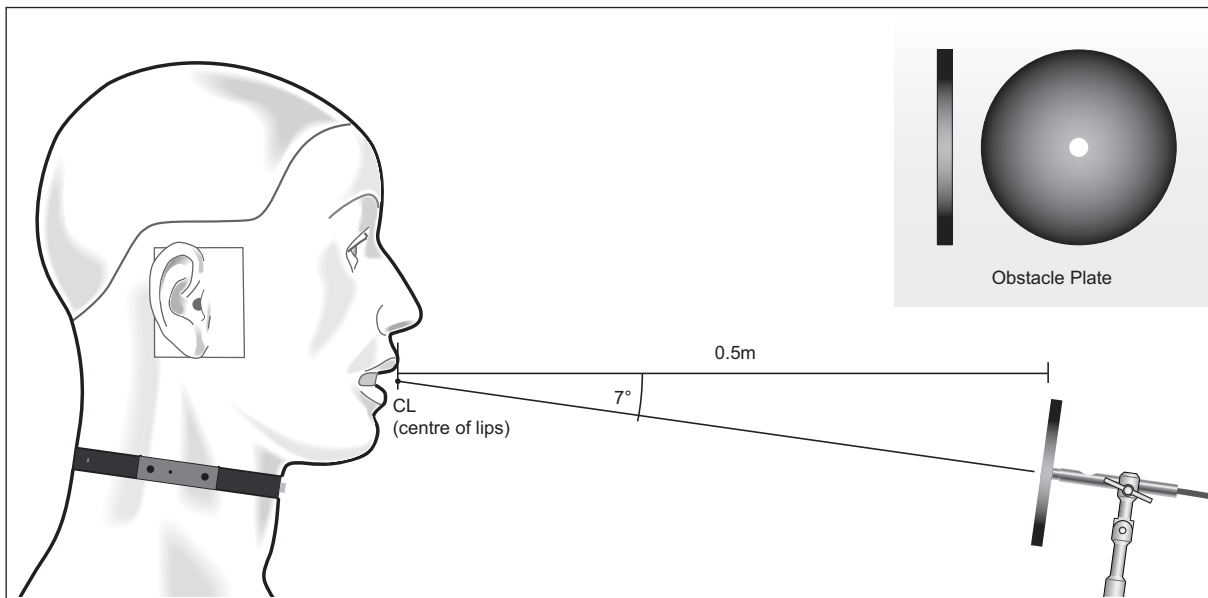
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For information about calibrating the ear and the mouth, see the KEMAR manual.

### Obstacle Diffraction

Historically, older artificial mouth types were linearized using an acoustical feedback called compressor technique. This caused an obstacle correction which is standardized by ITU in P.58. More modern systems use digital linearization which does not cause the obstacle correction and therefore eliminates the need for an obstacle plate.

A setup with the obstacle plate is shown in Fig. 30.



**Fig. 30.** MRP (mouth reference point) and LRP (lip reference point) with the obstacle plate.

## Specifications

The following specifications table uses the identification letters from Fig. 15.

<b>Standards</b>	The Handset Positioning System is based on the following ITU-T Recommendations when mounted on KEMAR Manikin with Mouth Simulator Type 45BM	
	• P.51 Artificial Mouth	
	• P.57 Artificial Ears	
	• P.58 Head and Torso Simulator for Telephonometry (HATS)	
	• P.64 Determination of Sensitivity/Frequency Characteristics of Local Telephone Systems	
<b>Arm Simulator</b>	Relative center axis (A)	-10° to +10°
	Arm position (B-1)	-15° to +15°
	Arm position (B-2)	-15° to +15°
<b>Finger Simulator (Handset Fixture)</b>	The width of the mounted handset is 55–90 mm determined by the distance between the opposite fingers:	
	• Fixed	0–6 mm (0 to 0.24")
	• Spring operated	0–30 mm (0 to 1.18")
	Length of mounted handset	Determined by ear–mouth distance
	End stop (E)	0–15 mm (0 to 0.59")
<b>Wrist Simulator</b>	Wrist wave (F)	-20° to +20°
	Wrist rotation (G)	-30° to +30°
	Wrist offset (H)	0–25 mm (0 to 0.98")
<b>Application Force</b>	K1	2 to 7 Newton
	K2	6 to 14 Newton
	K3	10 to 23 Newton

## Warranty, Service and Repair

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### Warranty

GRAS products are made of components from our proven standard portfolio and are all manufactured of high-quality material and branded parts that were chosen and processed to ensure life-long stability and robustness. The warranty is 2 years.

The warranty does not cover products that are damaged due to negligent use, an incorrect power supply, or an incorrect connection to the equipment.

### Service and Repairs

All repairs are made at GRAS International Service Center located in Denmark. Our Service Center is equipped with the newest test equipment and staffed with dedicated and highly skilled engineers. Upon request, we make cost estimates based on fixed repair categories. If a product covered by warranty is sent for service, it is repaired free of charge, unless the damage is the result of negligent use or other violations of the warranty. All repairs are delivered with a service report, as well as an updated calibration chart.

Manufactured to conform with:

CE marking directive:  
93/68/EEC



WEEE directive:  
2002/96/EC



RoHS directive:  
2002/95/EC



GRAS Sound & Vibration continually strives to improve the quality of our products for our customers; therefore, the specifications and accessories are subject to change.