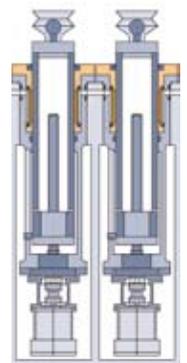


UNIVERSAL
HOLDING
FIXTURE (UHF)



FLEXIBLE TOOLING SYSTEM

(UNIVERSAL HOLDING FIXTURE – UHF)

The manufacture of free-form components involves the use, in many cases, of workpiece-configured jigs and fixtures, e.g. devices that are configured exclusively for a specific workpiece-geometry. The whole fixture then needs to be replaced whenever a new workpiece is positioned and clamped in place for processing. The consequence, depending on the range of parts being handled, is an increase in the number of jigs and fixtures required. The result is not just an accompanying increase in cost for the design and manufacture of these various jigs and fixtures, but also in the related warehousing, tooling and logistics costs (see graph on page 3).

The advantages of the KOSTYRKA® flexible tooling system

Considerable advantages with respect to the described workpiece-related jigs and fixtures are offered by so-called **Universal Holding Fixtures**, which normally remain on the processing machine. Whenever a workpiece changeover takes place, the universal device is adjusted to the new component

by repositioning of its supporting and clamping elements. These highly-flexible chucking devices can, depending on the size and structure of the workpiece, be adapted to several hundred different individual workpiece supports (see figure on page 3).

Typical applications of these Universal Holding Fixtures include the aerospace sector, the manufacture of body components in the car industry, and the area of measuring technology.

Stuttgart (Germany)-based KOSTYRKA GmbH is dedicated to the development and manufacture of flexible jigs and fixtures for the positioning and chucking of free-form components, thin-walled or unstable workpieces or components that are difficult to secure with conventional chucking methods. These jigs and fixtures and their main component parts are described on the following pages.

UHF jigs and fixtures

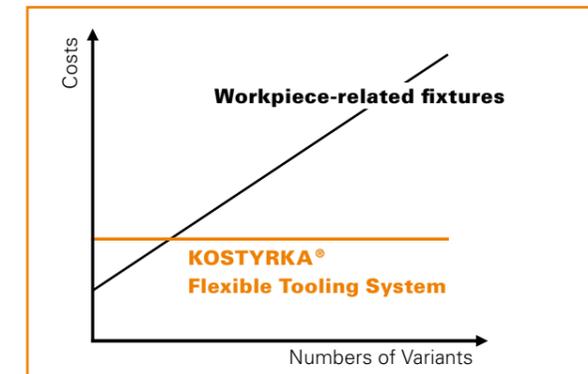
The main element of a KOSTYRKA® UHF (**U**niversal **H**olding **F**ixture) is the housing-fitted, axially adjustable piston rod, which can be secured in any position by means of a KOSTYRKA® clamping sleeve (see illustration on page 2 and “High load capacity” on page 7). The stroke and diameter of this piston rod are correspondingly established with respect to the customer-specific limit conditions. Standard diameters range from 20 mm to 50 mm, with stroke lengths of 100 mm to 400 mm. Stroke lengths of up to 1000 mm are also possible.

Depending on the type of actuation system used to move the piston rod, the UHF elements are classified into **active** and **passive elements** (see figures on page 4 and 5).

The interface to the workpiece is normally realized by a vacuum-suction device. Given their defined contact point with the workpiece, balltype supports with a correspondingly configured suction unit have proved useful in this respect. The use of other types of end-effectors is also possible.

An UHF fixture consists of a large number of individual active or passive elements, which are fitted via a flange to the corresponding frame. If there is a major change to fixture requirements, the modular fixture design allows it to extend it at any time. The replacement of individual elements or components is likewise possible without major cost outlay. This free access to individual elements also makes maintenance considerably easier.

Original KOSTYRKA® clamping sleeves secure circular guides of all types with maximum reaction speed and clamping force.



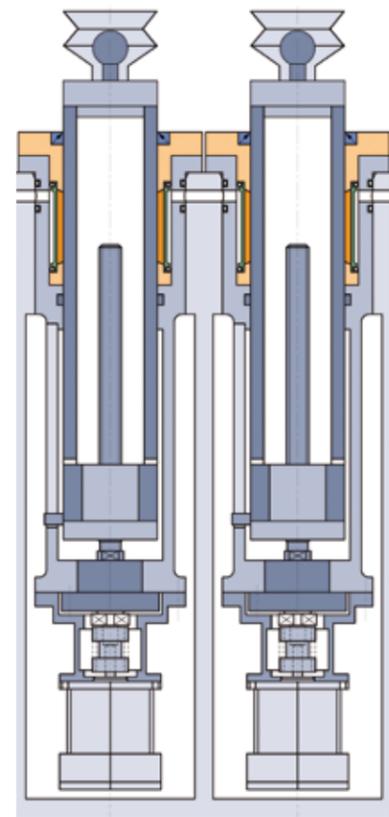
Part of an Universal Holding Fixture configured specially for securing large, thin-walled or unstable workpieces. Whenever a workpiece change takes place, the fixture is flexibly adapted to the geometry of the new component.



ACTIVE AND PASSIVE UHF ELEMENTS

Active UHF elements

Active UHF elements (see below) are fitted with their own controlled actuation system. They are programmed using a computer and compatible axial amplifier. This makes it possible to use the program control to adjust to the geometry of the corresponding workpiece. The type of drive to be used depends on the customer-specific requirements.



Active UHF elements with controlled actuation system.

Example of use of active UHF elements

The illustration (below) shows an example of active UHF elements. In this configuration, electric motors are used as actuating elements together with pre-loaded high precision ball screws. It is possible, depending on the configuration of this drive unit, to achieve repeating accuracy of just a few microns (< ,0001").

When the target position is reached, the piston rods are locked in this position with original KOSTYRKA® clamping sleeves. The drive system can now be switched off. This minimizes thermal load, thus helping to increase the service life of the drive unit.

Passive UHF elements

Passive elements (see page 5) are fitted with a non-controlled actuation system or no drive unit. Four variants are available for positioning purposes:

Variant 1

Pre-adjustable workpiece contour

- individual clamping -

In the simplest configuration, the piston rods are pulled into their corresponding positions in sequence by the handling device or by an adapter on the spindle head of the machine tool. The corresponding machine control system monitors the target position as this takes place. Adjustment speed and positioning accuracy are determined by the capacities of the machine or robot. The piston rods are then locked **individually** with an original KOSTYRKA® clamping sleeve (see example on pages 9 to 11).

Variant 2

Pre-adjustable workpiece contour

- overall chucking -

With this UHF fixture, compressed air pushes all the piston rods to their extended positions once released. A low clamping force is then created on **all** elements, which still allows the piston rods to be positioned axially.

All elements are now pushed into target position in sequence by a handling device or the actual machine tool. Once all elements are in their specified position, the clamping force is maximized to ensure secure clamping.

Variant 3

Positioning dependent on workpiece

- air advanced adjustment system -

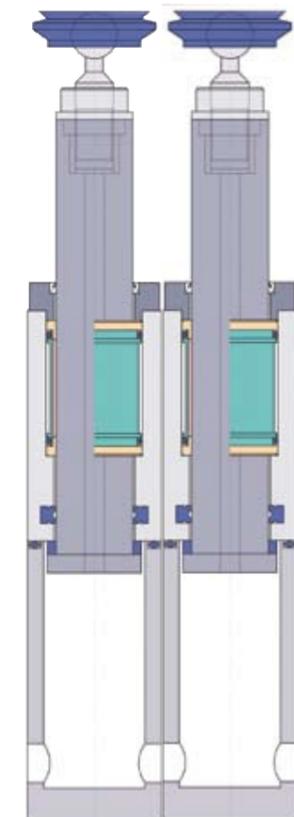
The piston rod can be moved, like a pneumatic cylinder, by means of compressed air. A special system of regulation allows the piston to be fine-adjusted with great accuracy to the contours of the workpiece. After adjustment to the workpiece has been carried out, the piston rod is clamped in place once more. The main purpose of this version is to provide support at various points, according to requirements, for a workpiece that has already been positioned.

Variant 4

Positioning dependent on workpiece

- air or spring advanced -

In this version, the piston is now fully extended by spring action or by means of an air cushion. The workpiece itself pushes back the piston rods during their placement to the positions in which they are then to be clamped.



Passive UHF elements with non-controlled actuation system.

SUMMARY

Compact configuration

The special design principle allows the individual elements to be aligned very tightly to an UHF fixture. The center distance of two adjacent active elements can be reduced to about 60 mm, and passive elements can be spaced even more dense.

These configuration possibilities also make the use of the KOSTYRKA UHF fixture possible with workpieces whose structure means that they must be gripped at as many different points as possible, or whose limited dimensions indicate tightly spaced elements.

Modular concept

UHF are of modular design, and can thus be configured to customer requirements, the specifications of the machine tool or current working conditions. (Cf. description on page 8).

Flexibility

Various components can be secured by an Universal Holding Fixture by fast, precise adjustment of the support and clamping elements. Modifications can also be carried out at any stage to the support- and clamping elements. This is of particular importance in cases where the instability of a component does not become apparent until it is being secured. The subsequent corrections are then carried out quickly and trouble-free with the flexible UHF-elements.

Variable control concept

The programming and control of the individual UHF elements are normally carried out via a computer and axial amplifier. Depending on the drive-system design selected and the number of elements, various single- and multi-axis controllers are available for this purpose. These take on all the corresponding drive-related control and monitoring functions.

The networking of the controllers to each other is carried out via serial ports or a field bus. The actual programming of the position settings and/or running of programs takes place at a control-system computer. The decision as to which type of control system is most effective for each application is based on the corresponding customer-specific requirements.

High precision

The use of high-accuracy components and fine-resolution drive systems with active elements allows the target position to be adopted with precision to within 0.005 mm, and repeating accuracy to within 0.002 mm.

High load capacity

The elements of KOSTYRKA Universal Holding Fixtures are characterized by their extraordinarily high axial and radial load capacity. This is made possible by the use of **original KOSTYRKA® clamping sleeves**. These hydraulically-actuated flexible sleeves are characterized by their excellent ability to transfer very high clamping forces.

KOSTYRKA® clamping sleeves open and close in a matter of milliseconds in a completely reaction-free way, e.g. without influencing the position of the part being clamped. Program-controlled and highly accurate, they constitute a major part of each UHF element.

Great reliability

KOSTYRKA UHF are basically designed for long-term operation without supervision. Once the target position is reached and the clamping process successfully finished, the power supply to the device can be shut down completely. This is also made possible by the fail-safe principle by which the clamping device functions. An electrical current or stream of compressed air is required to release the clamping.

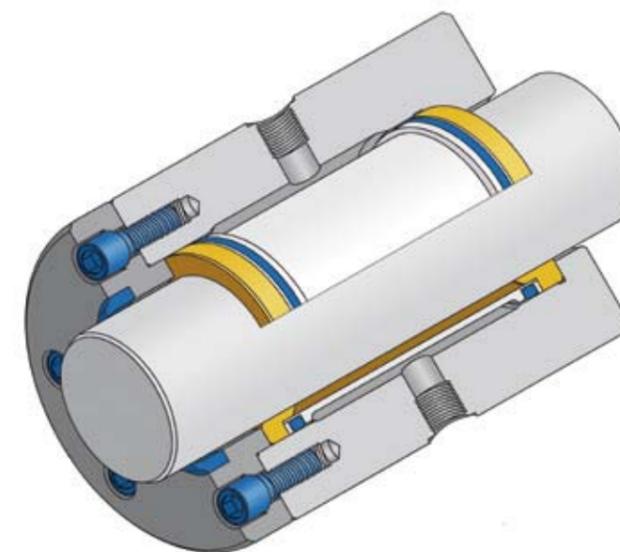
A considerable advantage in this respect is that, in addition to clear energy savings, the minimizing of thermal load leads to a corresponding increase in the service life of the drive system.

Simple maintenance

The housing configuration of the KOSTYRKA UHF is adapted to the corresponding working conditions, taking into special account the effects of the material being processed (e.g. fibre composites), along with any coolant used. These fixtures are maintenance-free under normal operating conditions. If any part does need replacement, this is usually carried out simply via the top of the UHF.

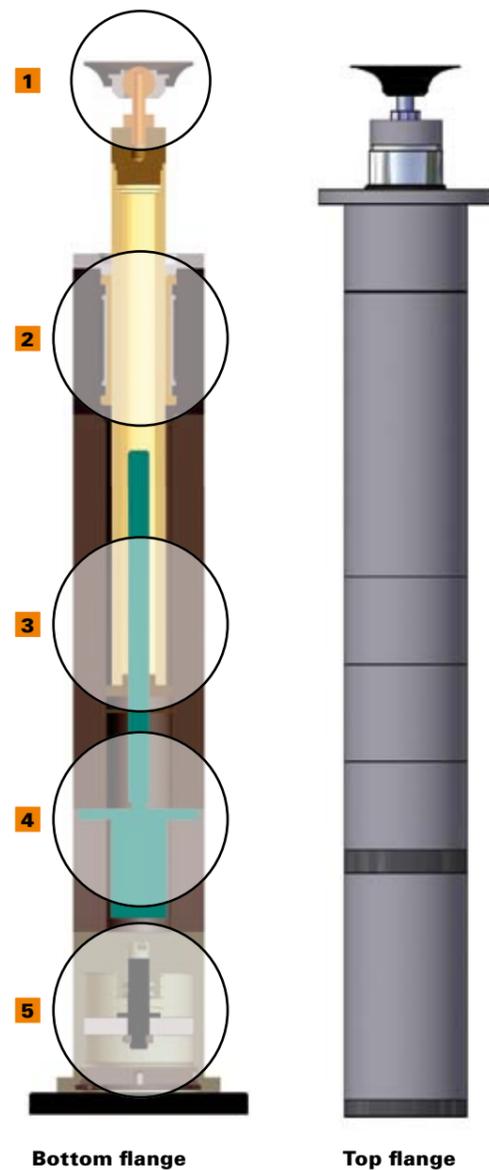


Modular control cabinet for 28 UHF elements, complete with low-voltage power supply.



Original KOSTYRKA®-Clamping Sleeves
Successful in hundreds of thousands of applications worldwide – since 1969.

MODULAR DESIGN



Efficient and reliable clamping depends to a large extent on the configuration of the interface between the workpiece and piston rod of the UHF elements. The material characteristics and rigidity of the workpieces, their degree of convex or concave curvature, the procedures used to manufacture them and the pressure-sensitivity of their outer surfaces all determine the choice of a suitable **vacuum-suction cup** and the configuration of the **workpiece supports** (see item 1).

Passive UHF elements can only be used in conjunction with **original KOSTYRKA® clamping sleeves**, which are a vital part of the assembly. They can also be used successfully with active elements. The drive unit can be remained very compact, as it only needs to actuate the piston. The actual load is transferred to the housing via the clamping sleeve (see item 2).

The diameter of the UHF element remains constant along its entire length. Apart from the option of fitting a **bottom flange** (left) or **top flange** (right) there is also the possibility of attaching these fixing elements by means of a clamping device at each point on the UHF unit (see item 3).

Step-controlled and servomotors, with or without encoder and/or resolver, are available for **actuating** the active UHF elements. Depending on the gear ratio required, various types of transmission can be used. The required precision, traversing speed and maximum load capacity are all decisive criteria when it comes to making the right selection (see item 4).

An **air/oil pressure intensifier** can be integrated into the base of the UHF element for piston-clamping purposes. It can be actuated electrically or by compressed air (see item 5).

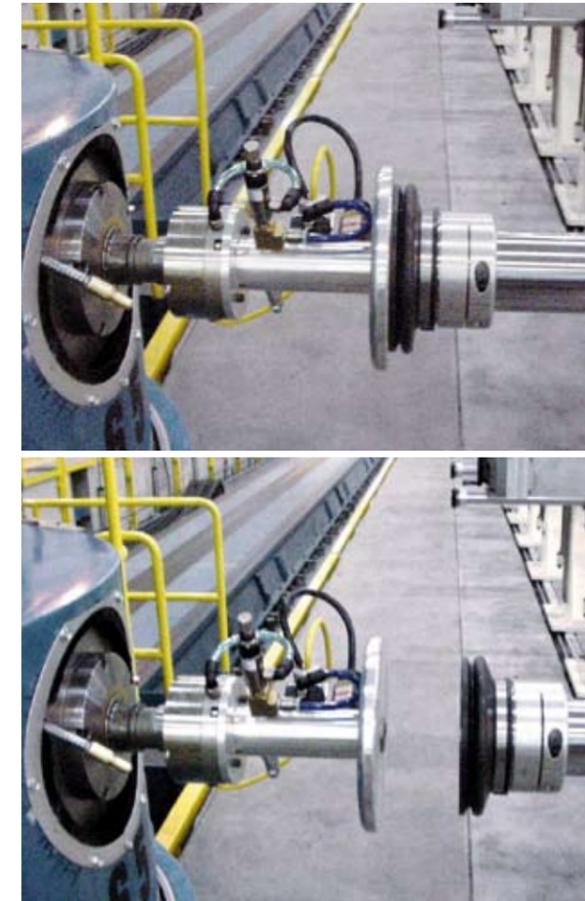
UNIVERSAL HOLDING FIXTURE IN OPERATION

The KOSTYRKA UHF shown on the following pages allowed a leading company in the aerospace industry to reduce drastically its wing spar production costs.

At the same time, the accuracy and quality of the workpieces produced were brought up to levels that had never been achieved previously.

Conventional fabrication previously required, depending on the type of aircraft concerned, four different specially-made fixtures. Now it is possible to manufacture the wing spars of all ranges with considerably reduced incidental and fixed costs. In addition, new parts can be added to the system for nearly no additional expense.

The Universal Holding Fixture shown can handle the entire range of existing and also newly-designed workpieces. This advantage stands in stark contrast to conventional (workpiece-dependent) fixtures, which cannot be adapted to new shapes.



The illustrations show how the machine tool is connected to the piston rod of the UHF element with the help of the coupling element.



The picture on the left shows one of 25 towers with two flexible UHF elements installed.

UNIVERSAL HOLDING FIXTURE IN OPERATION

The UHF device illustrated shows the main components of a largely automated production cell. A total of 58 horizontally-aligned passive elements are organized into 25 groups.

Each individual group consists of two or three units, which are stacked one above the other to form "towers". The piston rod of each UHF element can be pushed along its axis with minimal effort. The UHF elements are also easy to move vertically.

An air-bearing system also allows the towers, despite their great weight, to be moved easily in a lengthwise direction.

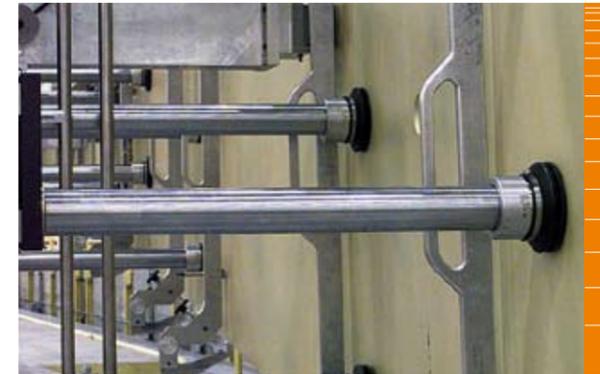
This mobility along all three axes permits free positioning of the corresponding workpiece supports at each point within the traversing range, allowing this UHF to achieve an outstanding degree of flexibility.

The entire device is some 60 metres long. Positioning of the individual elements is carried out by means of a special adapter on the spindle nose of the mobile machining center. The adapter is located, along with the tools, in a magazine – and is changed automatically when required.

After positioning of the UHF elements all axes are locked. Clamping pressure is maintained even if the power or compressed-air supply is shut down.

An UHF of this type also allows several working procedures to run in parallel, with one part of the device being loaded with workpieces, while an operating or inspection process takes place elsewhere.

The working concept presented here is described by the customer as "**benchmark-setting technology for use in the manufacture of wing spars**".



UHF elements hold a wing spar in place.



Overall view of the UHF; the machining centre can be seen in the background.



Clamped wing spar on KOSTYRKA passive UHF.

**Extract from the customer list**

- ABB Robotics GmbH
- Boeing Company, USA
- Carl Zeiss AG
- Daimler AG
- Deckel Maho Pfronten GmbH
- Dörries Scharmann Technologie GmbH
- Dr. Ing. h.c. F. Porsche AG
- F. Zimmermann GmbH
- Fibro GmbH
- Gebr. HELLER Maschinenfabrik GmbH
- General Electric Canada Inc., Kanada
- GKN Aerospace GmbH
- Handtmann A-Punkt Automation GmbH
- Hilti Aktiengesellschaft, Liechtenstein
- Hofmann Mess- u. Teiltechnik GmbH & Co. KG
- Hyundai Motor Company, Süd Korea
- INA Tooling Technique Pvt. Ltd., Indien
- INDEX-Werke GmbH & Co. KG Hahn & Tessky
- Israel Aerospace Industries Ltd., Israel
- Japan Machinery Company Ltd., Japan
- Lindauer DORNIER GmbH
- MAN Nutzfahrzeuge AG
- Maschinenfabrik Berthold Hermle AG
- Robert Bosch GmbH
- Romheld Australia Pty. Ltd., Australien
- Schott AG
- Siemens AG
- StarragHeckert GmbH
- Steinway & Sons Pianoforte-Fabrikanten
- Swarovski AG, Österreich
- ThyssenKrupp AG, Brasilien
- Traub Drehmaschinen GmbH & Co. KG
- TRUMPF GmbH + Co. KG
- WALDRICH SIEGEN Werkzeugmaschinen GmbH
- ZF Friedrichshafen AG

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