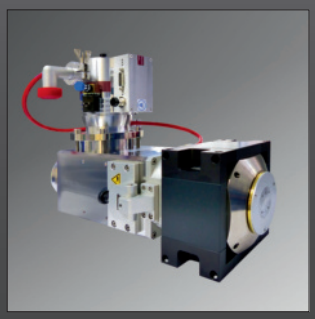
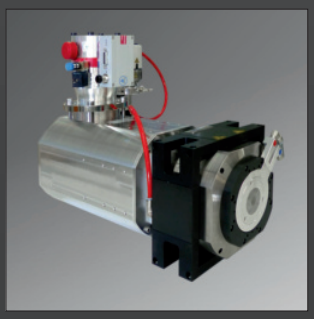
X-RAY WorX

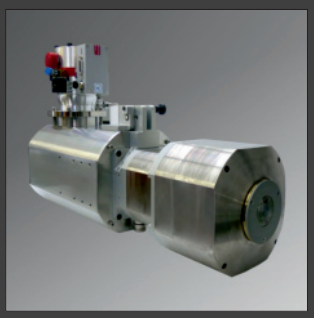
Superior Microfocus Technology

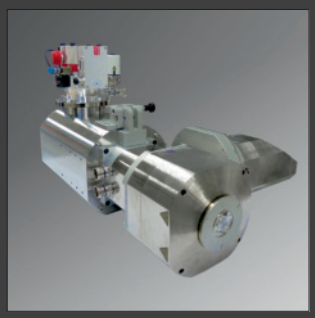
# X-RAY WorX

## Microfocus X-ray Tubes









# INTRODUCTION

Microfocus X-ray sources have been used since more than 35 years in innumerable scientific and industrial applications. Starting as a niche technology for leading edge research, it became a standard in material and life sciences, prototyping, and industrial quality control.

New production methods like additive manufacturing, increasing requirements in quality testing and metrology but also the availability of advanced X-ray detectors and powerful computer systems are pushing the development of highest performance X-ray systems.

Automated digital radiography, high resolution computed tomography and industrial metrology require specialized X-ray sources. We at X-RAY WorX are listening to our customers carefully and developed a range of X-ray products tailored for particular tasks.

The most important drivers of X-RAY WorX development activities are the reduction of cycle times, the increase of accuracy, the improvement of stability and reliability and the ease of use for both integration and operation.

X-RAY WorX offers X-ray tubes with transmission targets for highest magnification and resolution. The cooling of the transmission target allows target power up to 50 Watt which helps decreasing scanning times in inline testing. Reflection target tubes are designed for higher power up to 350 Watt and support applications with medium magnification and focal spot sizes between 5 and 300 microns. Rod anode tubes help customers increasing their efficiency in weld inspection by switching to panoramic exposure or by replacing film based inspection by digital radiography.

If you are interested in learning more about microfocus technology and products that will provide benefits for your tasks or X-ray machine, please contact one of X-RAY WorX local representatives or X-RAY WorX sales department directly. We will provide you more detailed technical information about our products and may also recommend the most suitable microfocus X-ray source for your application.

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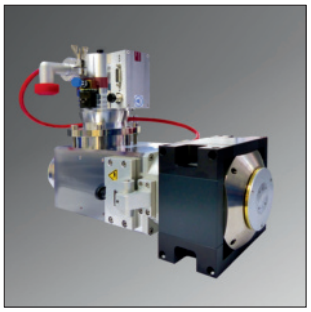
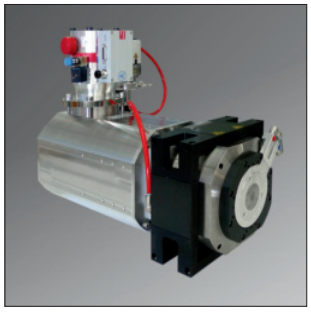
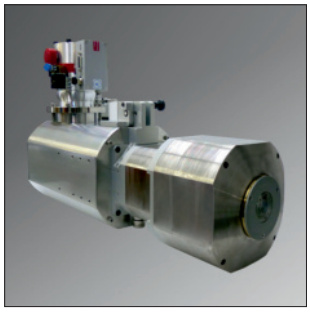
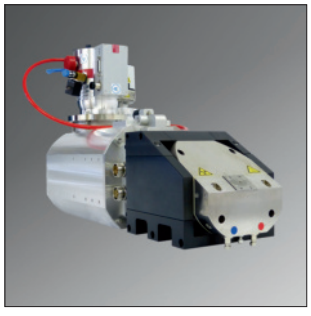
# X-RAY WorX

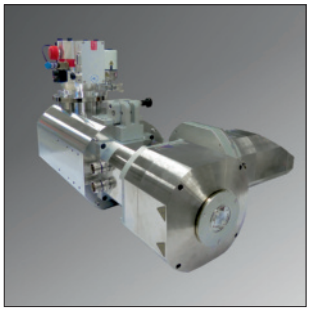
## Submicron resolution X-Ray Tubes











# LEGEND

## TECHNICAL PRODUCT DATA SHEETS

### Applications for Microfocus X-Ray Tubes

**Microfocus computed tomography (CT)** is a high resolution test procedure to generate two-dimensional cross sectional images of an object. The procedure is used for quality management in all fields of industry. The cooperation of high contrast digital detectors and high resolution X-ray tubes allows very short cycle times to achieve three-dimensional test results of high grade products. At high levels of magnification it is possible to analyze details in the size of a few microns only. This requires highly stable X-ray sources with active management of the heat generated during operation.

**Planar computed tomography (PCT)** is a special procedure of computed tomography for the high resolution X-ray inspection of large-scale flat components. Planar computed tomography is employed for testing of assembled printed circuit boards (PCBs), semiconductor components in power electronics, or assemblies made of compound materials. It allows examination of selected two-dimensional layers to detect cracks, flaws, and delamination.

**Dimensional measurement (DM)** describes the metrological analysis of distances and dimensions inside a volume data set that was acquired by a microfocus CT scan or microfocus PCT scan. Dimensional measurement is used for first article inspection and quality management in routine testing. It may partly replace coordinate measurement with touch probes or optical sensors. Measurement accuracy may be down to a tenth of the voxel size of the underlying volume data set due to the high number of virtual measuring points. In some cases an accuracy of less than one micron can be achieved.

**Highest resolution (HR) X-ray microscopy** allows the presentation and analysis of minute details in magnitudes of a few microns down to less than 500 nanometers. It requires a magnification of more than 1000x and an X-ray tube with a resolution of less than 1 micron. During long exposure times the X-ray source is stabilized by efficient cooling of tube head and turbo pump.

**Two-dimensional (2D) X-ray testing** allows for the quick and accurate evaluation of hidden details in the magnitude between 10 and 100 microns. It is an excellent procedure for the screening of high quantities so that it provides the fundament for an efficient quality management. With a potential inspection speed of more than one part per second, two-dimensional X-ray inspection is the fastest procedure of X-ray testing with the lowest costs per unit.

**Inline X-ray inspection (IN)** describes the integration of X-ray inspection into the production line. Test parts are automatically inspected and separated into groups of good parts and bad parts. Permanent operation, semi- or fully-automatic loading of the test parts as well as automatic defect recognition (ADR) are essential features of an X-ray system for inline inspection. The X-ray sources in use must be operated with highest stability and accuracy to guarantee a high rate of defect detection.

**Radiographic testing (RT)** is an imaging procedure of non-destructive testing to represent differences in material. The density of a test object is mapped to an X-ray film using an X-ray source. After processing the X-ray film, differences in material and defects can be identified. Radiographic testing is applied in all areas of industry and specified by numerous codes and standards (e.g. DIN EN ISO 17636-1:2013 on radiographic testing of welds)

**Computed radiography (CR)** with imaging plates is a digital imaging procedure, similar to the classical radiographic testing. Instead of X-ray film, a reusable phosphor imaging plate is used, that is read out by a scanner after exposure. The scanner generates a digital image of the radiographed object. Computed radiography is used in all industries and is specified in numerous standards and codes (e.g. DIN EN 14784-1:2005 and ASTM E 2445:2005 on the classification of systems for industrial computed radiography).

**Digital radiography (DR)** is the most recent imaging procedure of industrial radiography. It applies an electronic detector to capture the radiographic image. Using digital radiography the digital image of a test object is available in real-time and can be evaluated right after the exposure. Digital detectors provide higher dynamics than X-ray film so that exposure times can be decreased. Often the magnification technique is used. Digital radiography of welds is described in the standard DIN EN ISO 17636-2:2013.

X-RAY WorX GmbH • Siemensstrasse 26 • D-30827 Garbsen • Germany
Tel: +49 5131 48712-60 • Fax: +49 5131 48712-66 • info@x-ray-worx.com • www.x-ray-worx.com

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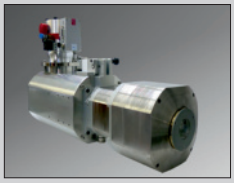
Product Data Overview

# MICROFOCUS X-RAY TUBES - SUBMICRON RESOLUTION

PRODUCT LINES *TC, TCHE, TCHE PLUS, TCNF, TCNF PLUS*

## Microfocus Submicron Resolution X-Ray Tubes



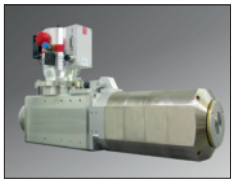
Resolution ★★★★★ 0.9 µm
Power ★★☆☆☆ 10 Watt
Magnification ★★★★★
Applications CT HR

**Product line *TC* - highest resolution microfocus tubes**

Product line ***TC*** is recommended for computed tomography (CT) and high resolution inspection (HR) in electronics and medical industry.

JIMA resolution of 0.9 microns (µm) and three modes of operation: ***Submicron, Microfocus, High Power.***

Up to 25 Watt target power using the optional ***High Energy Target.***



Resolution ★★★★★ 0.9 µm
Power ★★★☆☆ 25 Watt
Magnification ★★★★☆
Applications CT PCT DM HR

**Product line *TCHE* - highest resolution for CT applications**

Product line ***TCHE*** comprises the most common options for highest resolution computed tomography (CT).

The paramount target power combined with sub-micron resolution makes it the perfect choice for flexible leading edge applications in industry and science.

JIMA resolution of 0.9 microns and three modes of operation.

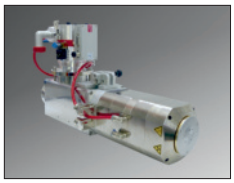
Resolution ★★★★★ 0.9 µm
Power ★★★★☆ 50 Watt
Magnification ★★★★☆
Applications CT PCT DM HR

**Product line *TCHE Plus* - highest resolution for CT applications**

Product line ***TCHE Plus*** comprises the most common options for highest resolution computed tomography (CT).

The paramount target power combined with sub-micron resolution makes it the perfect choice for flexible leading edge applications in industry and science.

JIMA resolution of 0.9 microns and three modes of operation.



Resolution ★★★★★ 0.5 µm
Power ★★★☆☆ 25 Watt
Magnification ★★★★☆
Applications CT HR DM

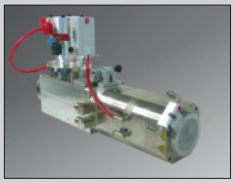
**Product line *TCNF* - microfocus tubes with highest resolution and optimized focal spot stability**

Product line ***TCNF*** is recommended for computed tomography (CT), metrology (DM), and high resolution (HR) inspection in electronics industry and science.

Internal liquid cooling of tube head for permanent stability of focal spot position, liquid cooling of turbo pump to avoid vibrations.

25 Watt max. target power.

Ultimate JIMA resolution of 0.5 microns (µm) and highest magnification for semiconductor, electronics, and composite applications, featuring the ***High Resolution Diamond Target***.



Resolution ★★★★★ 0.5 µm
Power ★★★★☆ 50 Watt
Magnification ★★★★☆
Applications CT HR DM

**Product line *TCNF Plus* - maximum target power up to 50 Watt**

Product line ***TCNF Plus*** extends the application range of ***TCNF*** tubes by doubling the maximum target power to paramount 50 Watt.

The internal cooling of the tube head and nanometer resolution allow for highest resolution computed tomography (CT) scanning while allowing shorter scanning times with medium-sized samples.

**Innovative Microfocus X-Ray Tubes - Made in Germany**

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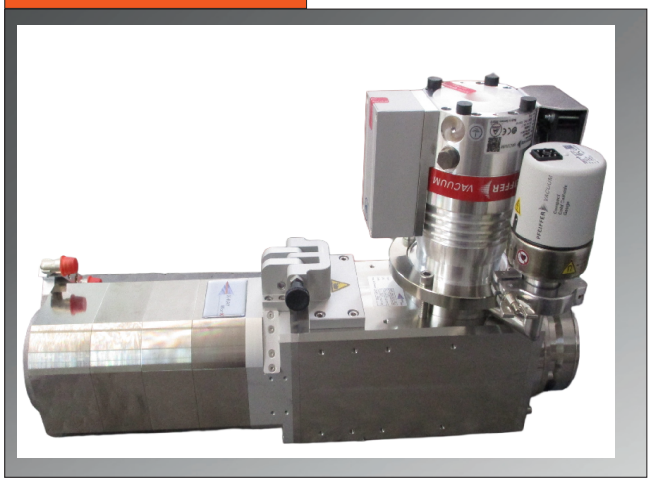
Technical Product Data Sheet

# MICROFOCUS X-RAY TUBES

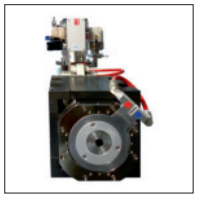
## PRODUCT LINE *TCHE PLUS*

CT PCT DM HR

## Product image



**Microfocus X-ray tube XWT-225-TCHE Plus with optional cooling of tube head**



**Microfocus X-ray tube XWT-160-TCHE Plus**

**Filter holder and set of filters**


**JIMA resolution 0.9 µm**

Images show options

## Technical data

| Data | Product line *TCHE Plus* | | | |
|---|---|---|---|---|
| Max. voltage (kV) | 160 | 190 | 225 | 240 |
| Min. voltage (kV) | 20 | 20 | 20 | 20 |
| Max. current (mA) | 1.0 | 1.0 | 1.0 | 1.0 |
| Min. current (mA) | 0.05 | 0.05 | 0.05 | 0.05 |
| Max. power, target (Watt) | 50 | 50 | 50 | 50 |
| JIMA resolution (µm) | 0.9 | 0.9 | 0.9 | 0.9 |
| Tube type | Transmission | | | |
| Target type | *High Energy* | | | |
| Target material (substrate/active layer) | Diamond / Tungsten | | | |
| Min. focus-object-distance (FOD, mm) | 0.30 | 0.30 | 0.30 | 0.30 |
| Opening angle (approx. °) | 160 | 160 | 160 | 160 |
| Mounting length incl. 90° HV plug (mm) | 719 | 719 | 810 | 902 |
| Tube weight (approx. kg) | 37 | 37 | 58 | 58 |

| Operation Mode | Target power range (W) | JIMA resolution range (µm) |
|---|---|---|
| Submicron | 0.1 - 1.5 | 0.9 - 1.5 |
| Microfocus | 1.0 - 10.0 | 1.5 - 4.0 |
| High Power | 10.0 - 50.0 | 3.0 - 35.0 |

## Highlights

- JIMA resolution 0.9 microns (µm)
- Three modes of operation: *Submicron, Microfocus, High Power*
- The X-ray tubes provide outstanding 50 Watt target power
- Automatic tube calibration for optimum performance
- Easy maintenance with adjusted ready-to-use click-in cathodes and automatic tube venting
- Unlimited lifetime

See our new catalogue **Options and Accessories** to find additional auxiliary equipment for your X-RAY WorX tube.

## Scope of delivery

- Open microfocus X-ray tube with transmission target, turbo vacuum pump, vacuum gauge, and electronic drive unit
- High voltage generator and high voltage cable
- Pre-vacuum pump with vacuum hose
- Tube controller, power supplies, and safety relays on 19” mounting panels
- Set of cables for electrical connection of X-ray tube and components
- Spare parts case, documentation, and operating software

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# Product Line TCHE Plus

## JIMA resolution

| *High Energy* target | | | Voltage [kV] | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 60 | 100 | 150 | 190 | 225 | 240 |
| Mode / Target power [W] | Sub-micron | 0.5 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| | | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| | | 1.5 | 1.5 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| | Microfocus | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | | 3.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | | 5.0 | 3.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | | 7.0 | 3.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | | 10.0 | 4.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | High Power | 10.0 | 7.0 | 5.0 | 4.0 | 3.0 | 3.0 | 3.0 |
| | | 17.5 | 10.0 | 7.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| | | 25.0 | 15.0 | 10.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| | | 50.0 | 35.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |

JIMA resolution in microns (µm)

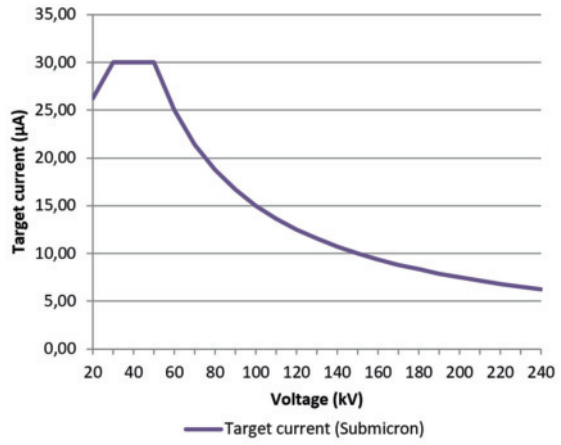
## JIMA resolution

| *High Resolution Diamond* target* | | | Voltage [kV] | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 60 | 100 | 150 | 190 | 225 | 240 |
| Mode / Target power [W] | Sub-micron | 0.5 | 0.8 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 |
| | | 1.0 | 1.0 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 |
| | | 1.5 | 1.5 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 |
| | Microfocus | 1.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | | 2.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | | 3.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | | 5.0 | 2.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | | 7.0 | 2.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | | 10.0 | 3.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | High Power | 10.0 | 7.0 | 5.0 | 4.0 | 3.0 | 3.0 | 3.0 |
| | | 17.5 | 10.0 | 7.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| | | 25.0 | 15.0 | 10.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| | | 50.0 | 35.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |

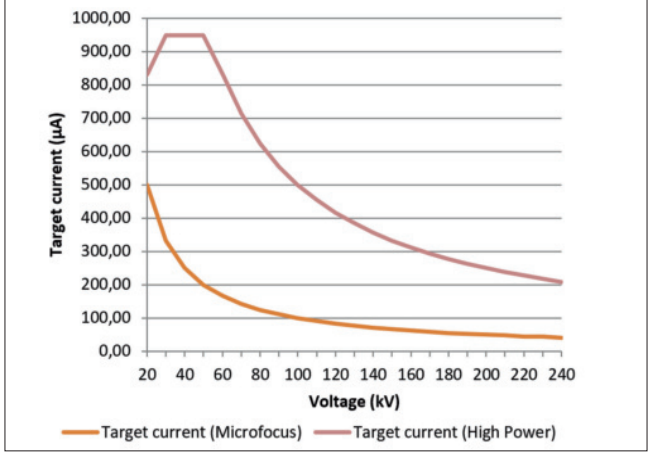
JIMA resolution in microns (µm)

*Option, resolution achievable with additional tube head cooling

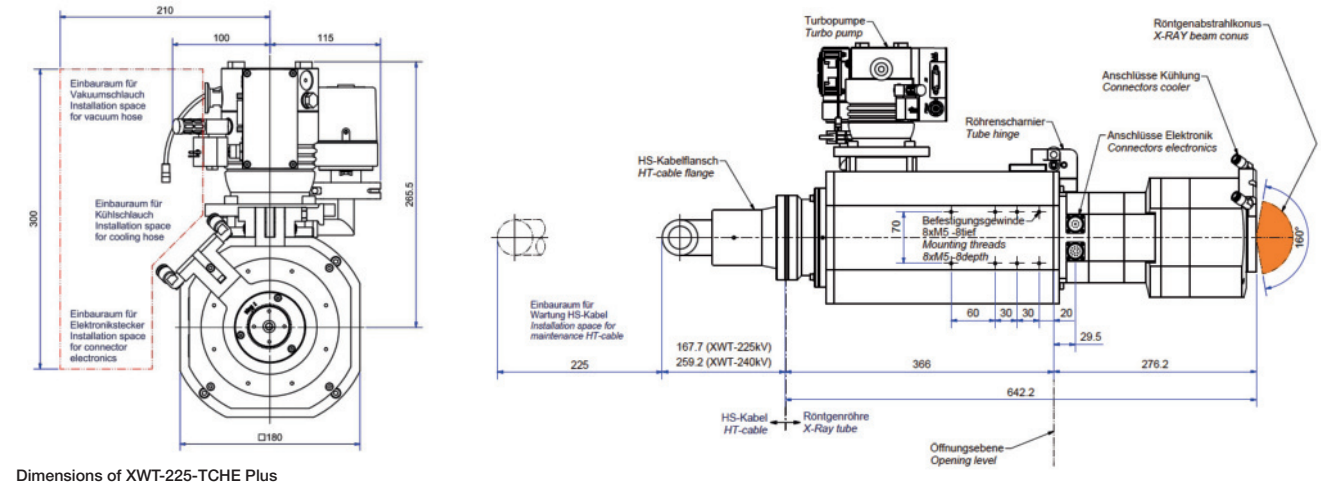
## Power rating chart




## Power rating chart




## Tube dimensions




Dimensions of XWT-225-TCHE Plus

X-RAY WorX GmbH • Siemensstrasse 26 • D-30827 Garbsen • Germany
Tel: +49 5131 48712-60 • Fax: +49 5131 48712-66 • info@x-ray-worx.com • www.x-ray-worx.com