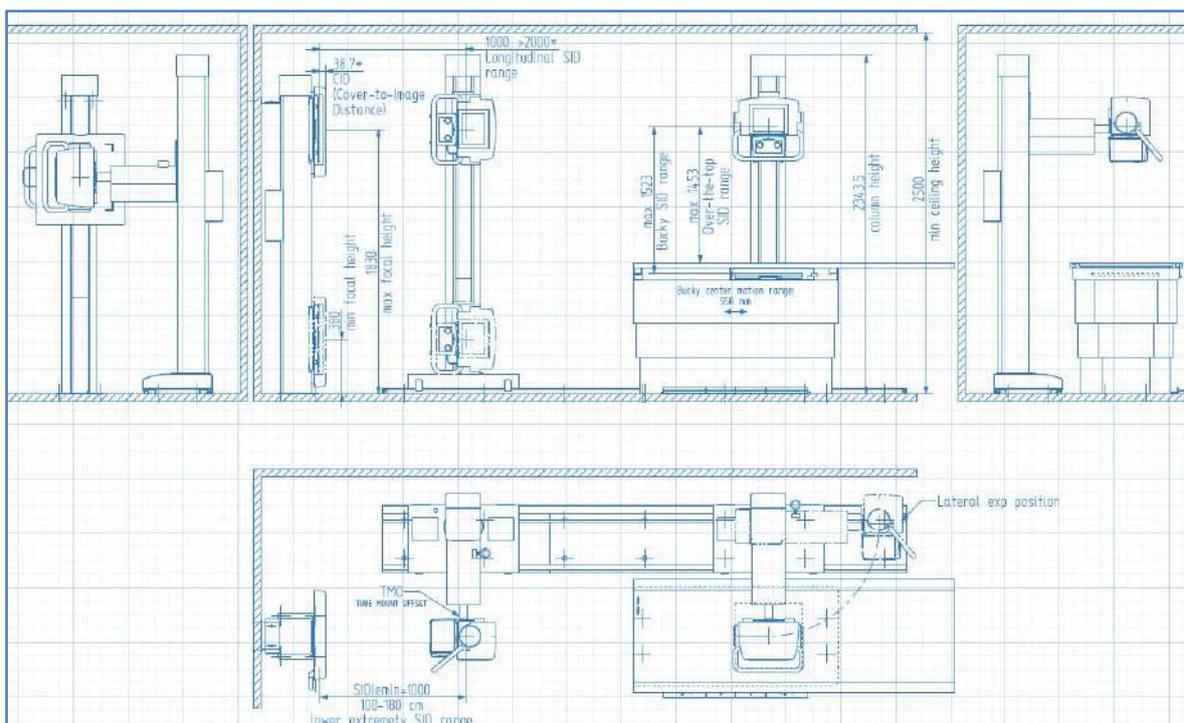


# Perform-X F400 Radiographic System

Technical Manual

CE  
1011



## Manufacturer:

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91 pages

Document ID: 6125 / 02

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# 1 IMPORTANT SAFETY INFORMATION

## 1.1 WARNINGS



### **WARNING!**

This equipment may be used only if the operator is familiar with its operation and safety features. The operating instructions (present document) must be carefully studied before operation.

#### **ELECTRICAL SAFETY**

Only trained service personnel are permitted to remove covers and panels from the equipment. The provisions of the local standards and electrical codes shall be observed at all times.

To avoid the risk of fire and electric shock, this equipment shall only be connected to a supply mains with protective earth.

#### **MECHANICAL SAFETY**

It is the operator's responsibility to ensure patient safety during positioning and using the device.

#### **X-RAY PROTECTION**

- This equipment in itself does not have any control which can trigger radiation. Exposure can be initiated only from a radiation-protected area, from the generator control console. Any person present in the room during radiographic examinations shall comply with applicable local radiation protection regulations. To protect the patient and the operator against unnecessary radiation exposure, additional radiation safety devices shall be installed and used, including personal wearable protection devices.
- **Set safe exposure factors, limit radiation field, keep safe distance and provide radiation protection for the patient.**

#### **DANGER OF INJURY**

- Do not reach into the equipment. It may cause injury or the moving part may catch your cloth.
- Positioning the X-ray tube may cause injury to persons in the area of danger.
- Do not reach behind the X-ray tube stand control. The X-ray tube assembly may be hot and could cause injury.

#### **PROTECTION AGAINST EXPLOSION AND FIRE**

- Do not use the equipment in the presence of flammable anaesthetics – explosion may occur.
- Before disinfecting or cleaning the unit, the power shall be turned off and kept off until the disinfecting or cleaning material has evaporated.

## 2 GENERAL INFORMATION

### 2.1 SCOPE OF THE INSTALLATION MANUAL

**This document is provided for field service engineers.** All service personnel must be trained and authorized by Control-X Medical to perform any procedure related to installation covered in this document. The service engineers have to possess a good understanding of general medical and X-ray equipment and the nature and potential dangers of high voltage and X-ray radiation.

### 2.2 DOCUMENT REFERENCES

#### 2.2.1 Operating Instructions

Document **D-4788 – Perform-X F100-400 C100-400 Radiographic System Operating Instructions** is inseparable from the present document (*Installation Manual*) and contains important and essential information on the Perform-X F400 System. It **must be thoroughly studied** prior to installing the equipment.

In particular, refer to the Operating Instructions for the following information:

- Intended use, application, and counterindications;
- Compatibility;
- Symbols, markings, and product label samples;
- Specifications;
- Operator controls / using the Perform-X System.

#### 2.2.2 Third-party Technical Manuals

This manual contains all the necessary information on installing the mechanical components of the Perform-X system. However, additional documentation may be needed from the manufacturers of third-party system components (such as generators, collimator etc.) to perform a complete system installation.

#### 2.2.3 Installation Report Form

Completion of the installation must be reported using the Installation Report online form: <https://www.cognitofoms.com/ControlXMedical/InstallationReport>

*Pursuant to European regulations Control-X Medical is required to be informed and keep records of the installation of its radiographic systems. In order to comply with these rules and to verify the system release of fixed radiographic equipment, Control-X Medical requests – in line with its General Terms and Conditions (GTC), section IX – that **this report be submitted by the installer within 15 (fifteen) days of installation.***

### 2.3 INTENDED USE, APPLICATION

This document describes the usage of the mechanical components of the **Perform-X F400 Radiographic System** (hereinafter also referred to as Perform-X). The equipment forms a complete diagnostic system when equipped with other components (e.g. X-ray generator,

digital acquisition workstation, flat panel detector, etc.).

Refer to document [D-4788 – Perform-X F100-400 C100-400 Radiographic System Operating Instructions](#) for further details.

## 2.4 SYSTEM CONFIGURATION

The F100-F400 are specific FLOOR MOUNTED configurations of the Perform-X Radiographic System series.

The F400 configuration consists of the following equipment and options compared to other configurations of the Perform-X series:

Component / feature	Description	Perform-X F100-F400			
		F100	F200	F300	F400
TS99N	Floor-mounted X-ray tube stand	Default	Default	Default	Default
WS99N	Wall bucky stand	Default	Default	Default	Default
Phoenix 2	6-way float top elevating radiographic table	Optional	Default	Default	Default
Manual movements	Manual (non-motorized) positioning of the X-ray tube, wall and table receptors	INCLUDED	INCLUDED	INCLUDED	INCLUDED
Motorized movements	Motorized vertical movement of the X-ray tube and the wall receptor	N/A	INCLUDED	INCLUDED	INCLUDED
Wall receptor auto tracking	Vertical tracking of the wall receptor movement	N/A	INCLUDED	INCLUDED	INCLUDED
Constant table SID	Vertical tracking of the table receptor and the X-ray tube (constant SID over the table)	N/A	INCLUDED	INCLUDED	INCLUDED
Table receptor auto centring	Longitudinal tracking of the table receptor and the X-ray tube	Optional	INCLUDED	INCLUDED	INCLUDED
Smart stitching	Perform automatic tube and receptor movements during a multi-frame stitching procedure	N/A	N/A	INCLUDED	INCLUDED
APR positioning	Save and retrieve default equipment positions for each APR	N/A	N/A	N/A	INCLUDED

## 2.5 SERVICE PERSONNEL, INSTALLATION

The installation instructions (along with all the system documentation, including the Operating Instructions) are located in the packaging / crate marked with the following label:



*Figure 1 – Label on crate to locate the system documentation*

	<p><b>Only qualified and trained service personnel may perform any installation and/or maintenance</b> on this equipment.</p>
<p><b>ATTENTION!</b></p>	

## 2.6 ENVIRONMENT, FREQUENCY OF USE AND MOBILITY

The Perform-X System is designed and manufactured to be used as a fixed equipment permanently installed in a professional hospital or clinical environment. The **patient environment** is the 1.5m proximity of the patient during the upright, table, or special procedures and includes the radiographic stand and tables. The system Control Box is not part of the patient environment.

## 3 BEFORE YOU BEGIN

### 3.1 SAFETY

  
**CAUTION!**

The components of the Perform-X System are **heavy objects**.  
Always **lift and move parts with help**.

  
**ATTENTION!**

The entire installation should be performed with **at least TWO service personnel** present.  
Always be ready to intervene in case of a mechanical or electrical injury.

  
**ATTENTION!**

When connecting **cables with PE (PROTECTIVE EARTH) connection**, always connect the PE (yellow-green) conductor first!  
When disconnecting such cables, always disconnect the PE (yellow-green) conductor last!

### 3.2 ACCURACY AND POSITIONING PRECISION

The Perform-X System contains a number of moving mechanical parts, many of them connected through adjustable bearings, rollers and fasteners. The final **dimensions of the main components and their relative positions may vary from installation to installation** by as much as 1-2 cm.

**Do NOT start by drilling all the bores** based on a room layout (if applicable) as minor adjustments may be necessary throughout the installation process. Follow the recommended steps outlined in this document and make final positioning / mounting as suggested.

### 3.3 NECESSARY TOOLS AND MATERIALS

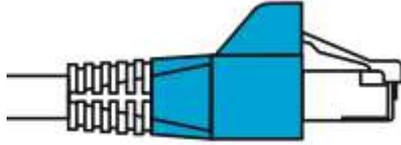
1. General hand tools, metric wrenches (7, 8, 10, 13, 17 and 24 mm) and Allen keys
2. Tape measure
3. Level, preferably with a digital display
4. Tools for drilling and anchoring the equipment to the floor and wall (depends on floor and wall properties)

### 3.4 SYSTEM CABLING CONVENTIONS

Throughout the Perform-X F400 system, UTP cables with coloured strain relief boots are

used. The following is the colour coding for the UTP cables:

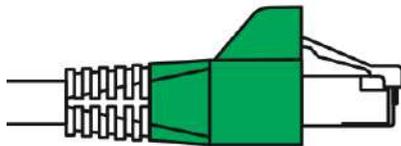
**BLUE strain relief boots**



**CAN cable connecting two CAN nodes on the CAN (Controller Area Network) bus.**

The CAN network requires that all nodes be connected in a specific order to allow propagating of all messages and the bus. A broken / disconnected CAN bus may result in loss of functionality.

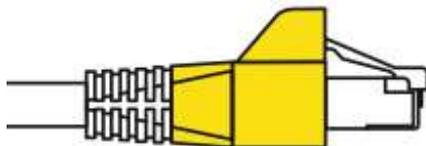
**Green strain relief boots**



**DAP (Dose Area Product) meter connection.**

The DAP signal in the Perform-X systems is fed from the collimator mount DAP meter all the way to the acquisition workstation.

**Yellow strain relief boots**



**APR positioning interface connection.**

This cable connects the 10.4" tube mount PC with the acquisition workstation providing a TCP/IP connection for functions like APR positioning, tube side generator control, and tube side image preview.



All interconnecting cables are clearly marked showing the destination connector or terminal. Wherever possible, the interconnecting cables are factory connected on at least on one end.

## 4 X-RAY ROOM PREPARATION

### 4.1 GENERAL RULES OF ROOM DESIGN AND EQUIPMENT PLACEMENT

Plan a layout and prepare the X-ray room before starting the installation. Refer to the general (provided) or customized (subject to availability) room layout and floor plan drawings.

1. The X-ray room must be designed for optimal and conforming (to applicable local rules) **primary X-ray beam direction protection** using appropriate shielding and / or adequate distance from the wall.
2. The room must be designed so that the **operator has the entire equipment in sight** from the control room (protected area) e.g. by using lead glass window with appropriate radiation protection. Radiographic exposures may only be initiated from behind an adequate barrier or from a protected area.
3. The room design must provide for **safe operator and patient traffic**. Cables must be routed in unobtrusive cable channels.
4. The **relative positions of the components (TS / WS / radiographic table) must allow performing all the required procedures and projections**.
  - a. On the wall stand side, the distance between the wall and the edge of the floor rail should allow 100 cm SID (source image distance), but collision with the wall stand must be avoided.
  - b. To perform low extremity exposures, the table position must allow the X-ray tube to travel to near the floor at about horizontal SID = 100 cm.

### 4.2 SYSTEM ORIENTATION

The Perform-X System is factory prepared for LEFT or RIGHT orientation. The orientation primarily determines the **loading direction of the wall receptor and affects patient positioning**. Once shipped, the equipment orientation cannot be changed on-site. Please contact Control-X Medical Zrt. in case the orientation needs to be modified.

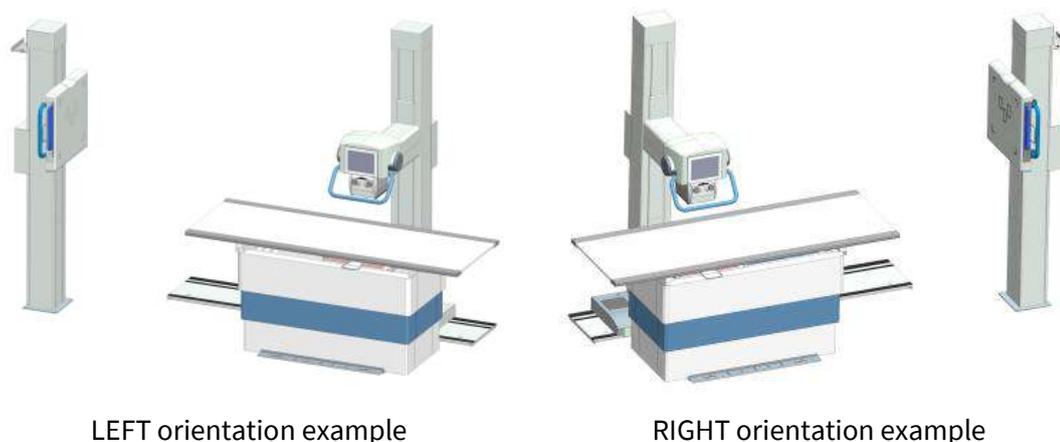


Figure 2 – System orientation

### 4.3 X-RAY ROOM PROPERTIES

Inspect the room before installation. If the condition of the wall and the floor is not suitable for levelling, corrective action shall be taken.

The tube stand requires at least C20/25 grade reinforced concrete floor according to EN 206-1:

Concrete grade	Group	Compression strength of D=150mm / h=300mm object	Compression strength of 150mm cube
C20/25	Ordinary concrete	20 N/mm <sup>2</sup>	25 N/mm <sup>2</sup>

When anchoring the equipment, the following anchoring or equivalent shall be used.

**Anchors and bolts are NOT SHIPPED with the Perform-X System.**

**Actual types used should be selected according to actual floor quality:**

Anchor type	Bore depth (h <sub>2</sub> )	Bore diameter (d <sub>0</sub> )
	12 to 20 pcs Fischer * TA M8T/25 S M8	Min. 95 mm (3 3/4 ")  Ø12 mm (15/32")

(\*) **the number of bolts** depends on the floor rail length and the wall stand mounting configuration (floor-to-wall or floor only mount)

## 4.4 ELECTROMAGNETIC SHIELDING

The Perform-X system may only be installed in an electromagnetically shielded location (room).



### ATTENTION!

The Perform-X Radiographic System is suitable for use in all establishments other than domestic, and may be used in domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes, provided **the following warning is heeded:**

**Warning:** *This equipment/system is intended for use by healthcare professionals only. This equipment/ system may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the Perform-X Radiographic System or shielding the location.*

The Perform-X Radiographic System **must be used only in a shielded location** with a minimum RF shielding effectiveness and, for each cable that exits the shielded location, a **minimum RF filter attenuation of 20dB** for radio signals 30MHz – 1000MHz.

The Perform-X Radiographic System may interfere with and may be disturbed by other RF emitting devices even if they comply with CISPR emission requirements.

Do not use electronic devices in the X-ray room that **emit high RF energy**, such as radio transmitters and therapeutic equipment operating with electromagnetic radiation.

A warning sign must be installed on the door of the x-ray room stating the following:

### CAUTION!

DO NOT USE ELECTRONIC DEVICES EMITTING HIGH RF ENERGY,  
SUCH AS RADIO TRANSMITTERS, MICROWAVE OVENS  
OR THERAPEUTIC EQUIPMENT OPERATING WITH  
ELECTROMAGNETIC / ULTRASONIC RADIATION  
IN THIS X-RAY ROOM.

## 4.5 ISOLATION FROM THE SUPPLY MAINS

The main wall switch of the **room shall be equipped with a green Power ON indicator light**. (If the system includes a Control Box, the ON indicator of the Control Box is also lit whenever the power is ON.)

The Perform-X radiographic system incorporates an emergency switch that disconnects the motorized drives (if applicable) and the electromagnetic brakes from the mains supply on all phases. However, some associated equipment, such as computers, flat panel detectors are not disconnected when activating the emergency switch for data / study integrity reasons.



### ATTENTION!

The X-ray room must be equipped with a **suitable ISOLATION DEVICE** (e.g. 3-phase breaker) that disconnects the entire radiographic system (including the X-ray generator, associated equipment and accessories) from the mains supply in case of:

- the equipment not in use
- emergency

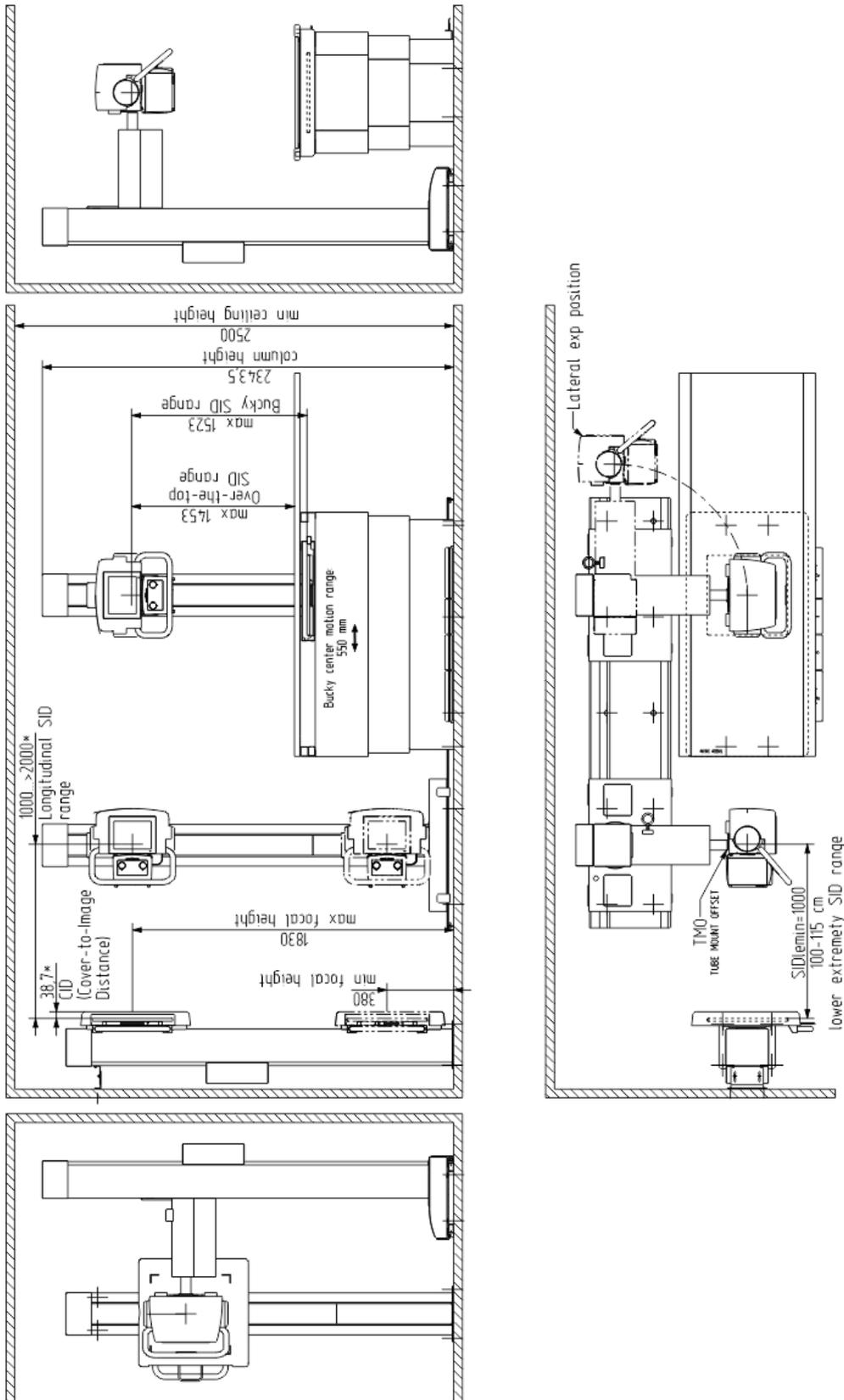
The isolation device must be equipped with an indicator for both the ON and OFF states and must lock into both ON and OFF positions.

The voltage and current rating of the isolation device must be equal to or greater than the supply mains requirements indicated in the X-ray generator accompanying documents.

**RECONNECT** (turn ON) the mains only after safe usage conditions are ensured.

The **OVERCURRENT PROTECTION DEVICE**, e.g. circuit breaker or RCD (residual current device or FI-relay) shall not be used as the system disconnect device. You must use a separate device, e.g. a magnetic breaker.

### 4.6 RECOMMENDED SYSTEM ROOM LAYOUT (LEFT ORIENTATION & STANDARD FLOOR RAIL)



Tabletop dimensions: 2200 x 810  
 Covered surface with  
 LNG & TRNS movements: 3300 x 1018  
 Irradiated surface under table: 980 x 430

Figure 3 – Perform-X F400 System typical room layout

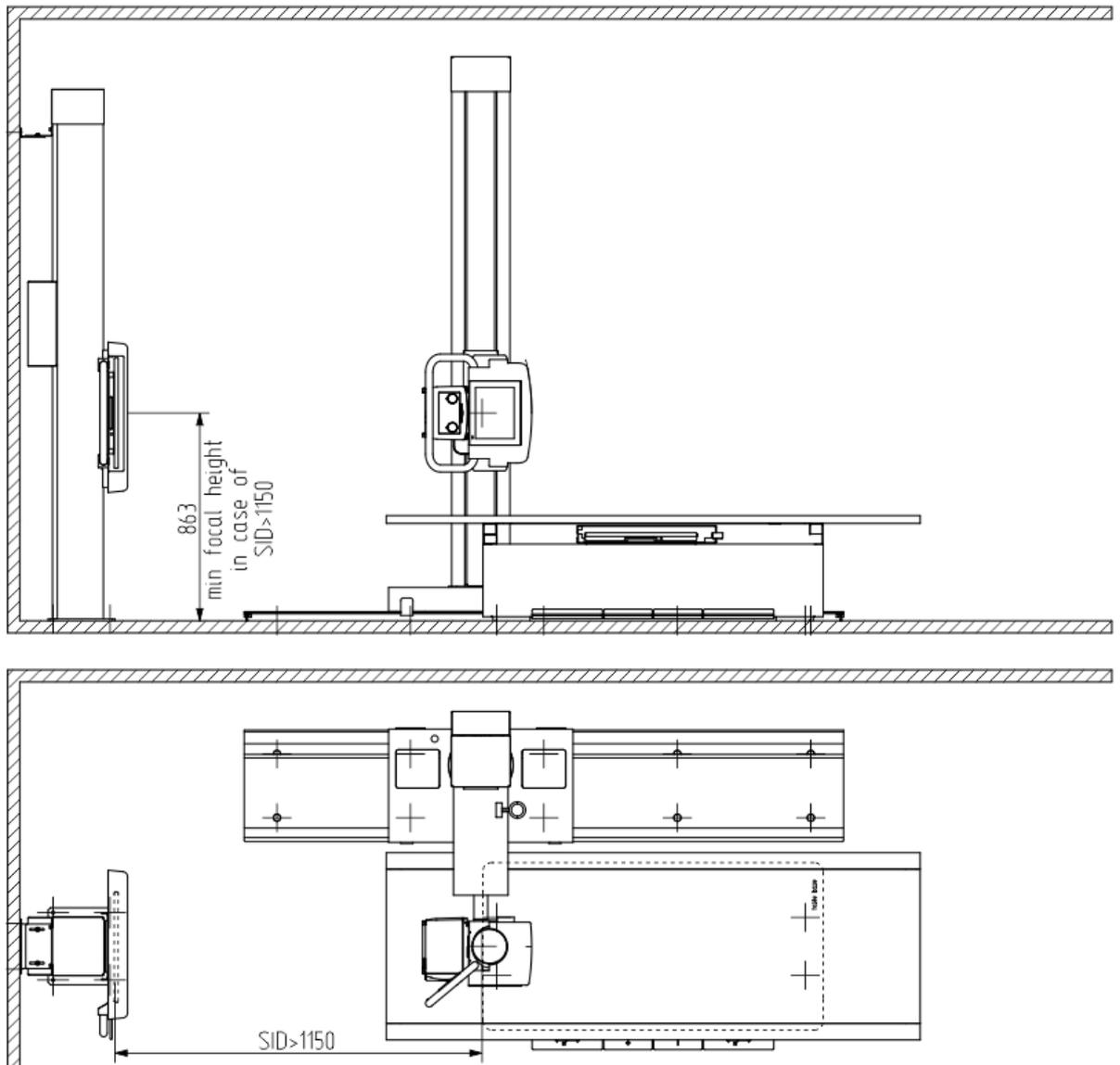


Figure 4 – Perform-X F400 System typical room layout (wall receptor procedure)

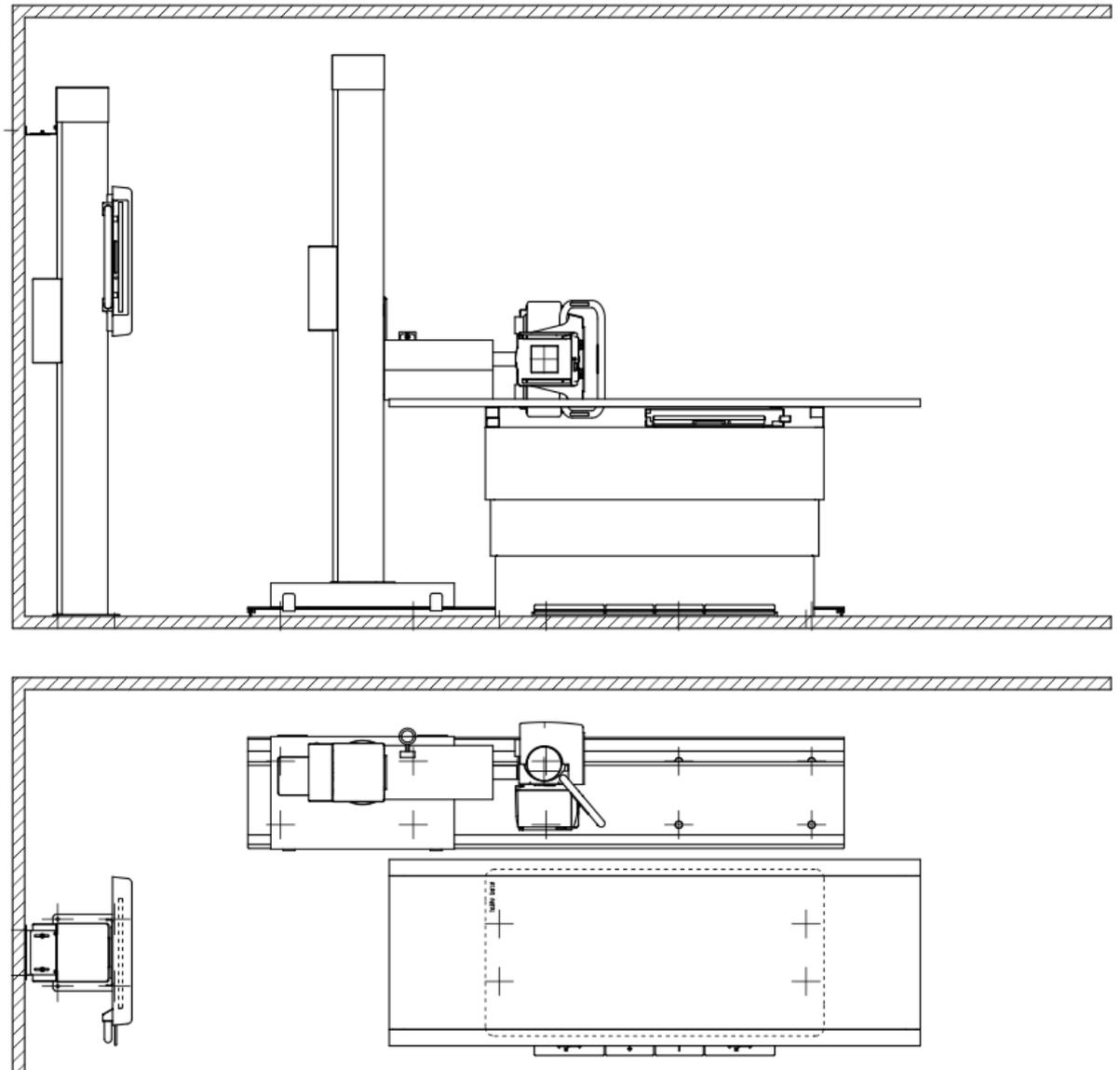


Figure 5 - Perform-X F400 System typical room layout (lateral projection)

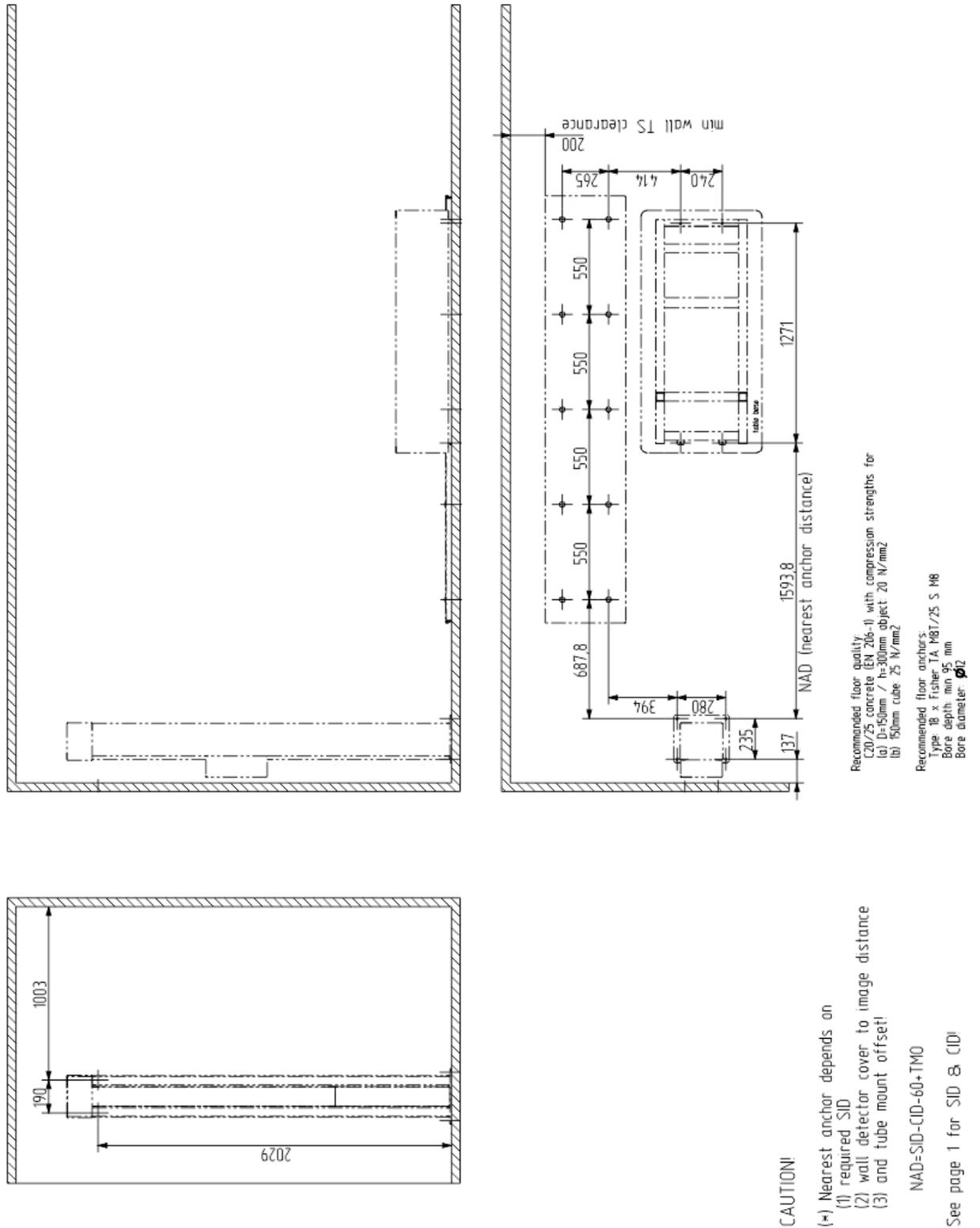
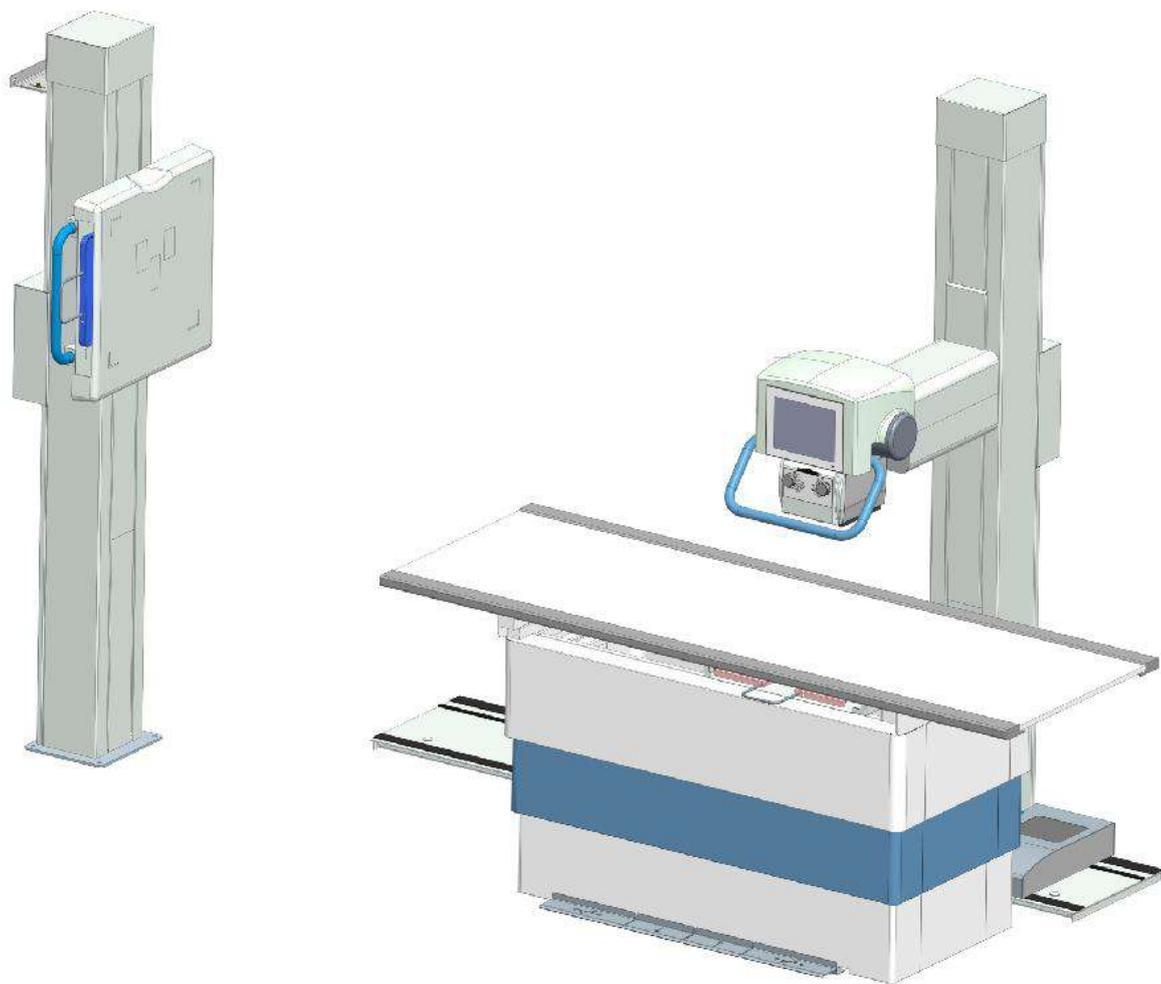


Figure 6 – Perform-X F400 System typical drill pattern



*Figure 7 – Perform-X F400 System typical component placement*

## 5 SHIPPING ARRANGEMENT AND UNPACKING

### 5.1 CRATES

Depending on configuration, the Perform-X System ships in 8 or 9 crates.

Package item	Dimensions (L x W x H)	Approx. weight	Comments
TS99N + WS99N column crate	250 x 74 x 60/50* cm	250 – 350 kg*	
TS99N + WS99NN accessories crate	83 x 58 x 90 cm	Up to 125 kg**	
TS 99 (N) extended rail crate	367 x 54 x 13 cm	113 kg	With PFX-R360 only
Phoenix 2 Radiographic table crate	152 x 89 x 66 cm	258 kg	
Tabletop crate	228 x 90 x 6 cm	51 kg	
Accessories crate PCA	83 x 86 x 88 cm	160 kg	
Accessories crate DRF	83 x 111 x 88 cm	250 kg	
X-ray generator crate	<i>Depends on generator model – please refer to generator technical documentation</i>		

(\*) Height is 50 cm when shipped with extended 360 cm floor rail (PFX-R360 option) which is in separate crate

#### 5.1.1 TS99N / WS99N Column Crate

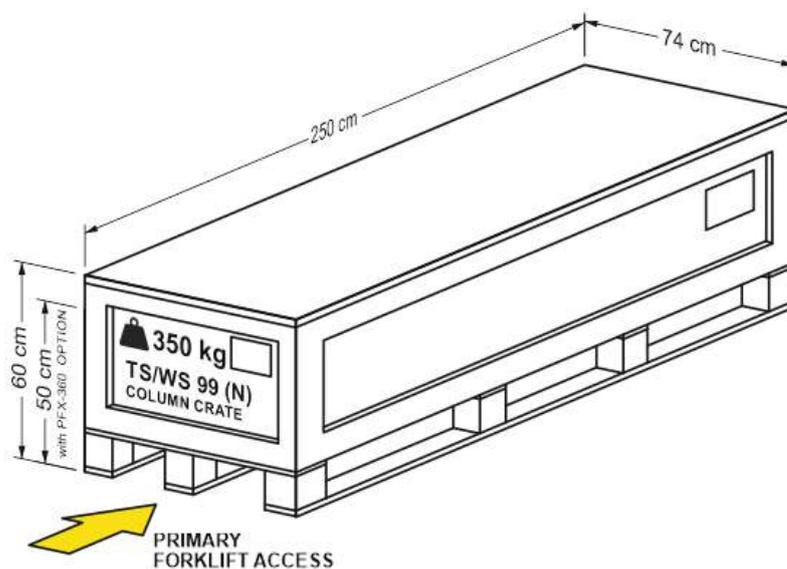


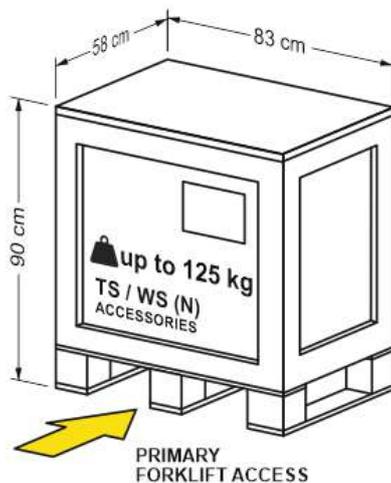
Figure 8 – TS99N / WS99N column crate

The crate contains:

1. the two preassembled column bodies;
2. WS 99 (N) wired remote controller (OPTIONAL);
3. WS 99 (N) base plate;
4. Faux leather cable covers;
5. in case of STANDARD 247 cm rail: rail with spacers and mounting hole covers

Please note that the crate is somewhat lower and lighter for systems with extended (360 cm) rail which are packed in separate crate.

### 5.1.2 TS99N / WS99N Accessories Crate



The accessories crate includes:

1. Counterweight plates;
2. TS floor carriage (varies depending on configuration);
3. TS tube arm (varies depending on configuration);
4. X-ray tube rotor cable;
5. Remote box;
6. X-ray tube Trunnion ring;
7. X-ray tube mounting assembly and control console.

Figure 9 - TS99N / WS99N accessories crate

### 5.1.3 TS99N Extended Rail Crate (ONLY WITH OPTION PFX-R360)

Systems with extended floor rail include a **separate rail crate**. Please note that for protection smaller items and rail accessories (spacers, hole covers, etc.) are packaged in the TS / WS accessories crate.

Be **careful when using, lifting and moving forklift**: the crate has low profile 20 mm legs.

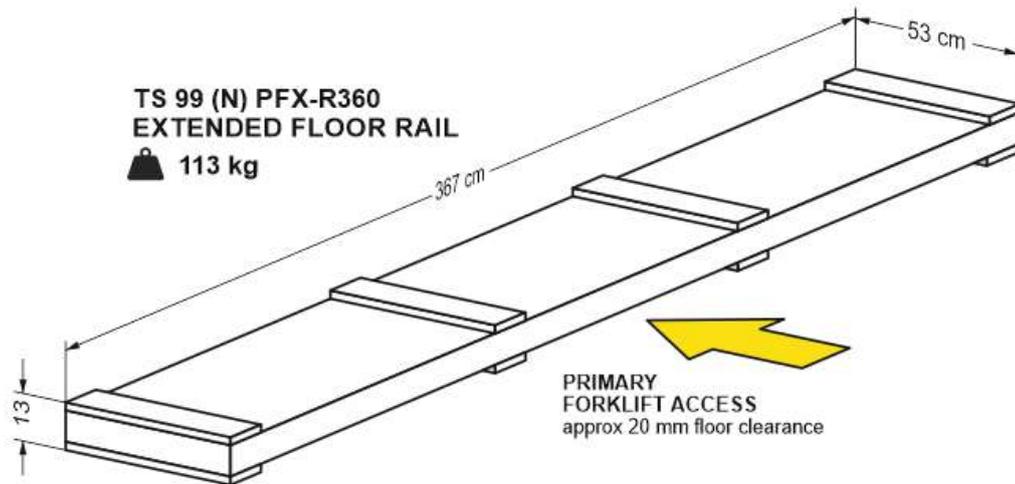


Figure 10 - CTM-200 rails crate

### 5.1.4 Radiographic Table Crate

The table crate contains the preassembled table base **without the tabletop**.

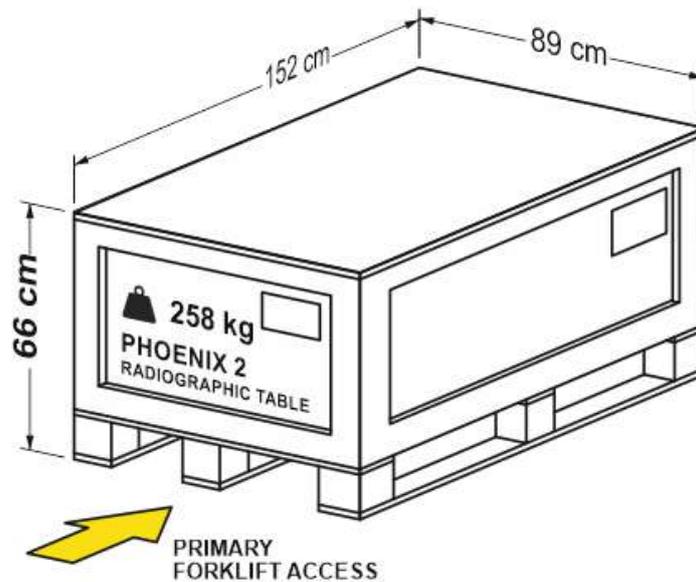


Figure 11 - Phoenix 2 radiographic table crate

### 5.1.5 Tabletop Crate

The tabletop always ships in its own crate.

Please note that for non-standard, shorter tabletops the crate is accordingly shorter.

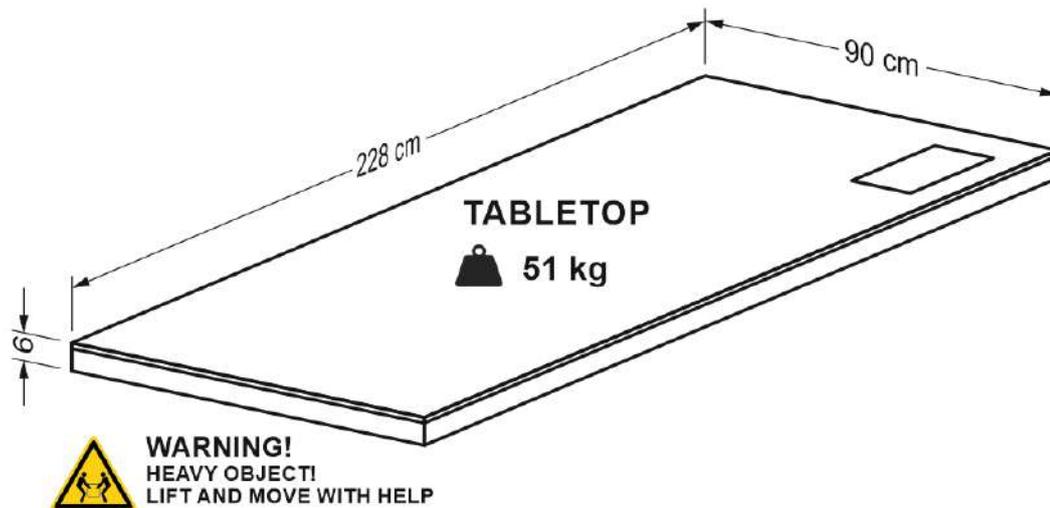


Figure 12 – Table top crate

### 5.1.6 System Accessories Crates PCA and DRF

One or two **system accessories crates** (P/N: CRATE-PCA and CRATE-DRF) may be included with the Perform-X F400 system. They contains one or more of the following smaller system accessories:

- |                         |  |
|-------------------------|--|
| 1. X-ray tube           | 8. Cassette tray(s)                    |
| 2. High voltage cables  | 9. Printed system documentation        |
| 3. Collimator           | 10. Flat panel detector                |
| 4. Receptor holder(s)   | 11. Image acquisition workstation      |
| 5. DAP                  | 12. System Control Box                 |
| 6. AEC detector(s)      | 13. Miscellaneous parts and components |
| 7. Anti-scatter grid(s) |  |

## 5.2 UNPACKING THE EQUIPMENT

When unpacking the equipment, please observe the following:

1. VERIFY that **all crates and packages belong to the same system**. Some parts and components (e.g. table and tabletop) are factory adjusted and optimized. In shipments of multiple systems each crate is labelled with a unique system ID.
2. Ensure **sufficient room** to lift / move the equipment from the crate. A separate (e.g., adjoining) room might be useful to allow adequate space to temporarily store the components, accessories and packaging material of the system.
3. Use **soft surfaces** when temporarily removing the parts from the crates. Instead of laying them on the floor, use A-frames when working with the columns.
4. Hold on to the **packaging material at least until completing the installation** in case an item must be returned

5. ALWAYS HOLD ON to the packaging material of **flat panel detectors, monitors and computers!**
6. **Adhere to any handling and storage instructions** displayed on the packaging (stacking, storage orientation, environment data, etc.)
7. When uncrating, **do not leave screws in the crate** as they may cause injury.
8. **Do NOT unpack all the crates at once** to prevent misplacing items and to provide a comfortable working area. Uncrate instead according to the installation progress.

**Recommended order** of unpacking (see also detailed instructions and installation steps below) involves removing:

1. Control Box from the system accessories crate;
2. Floor rail (from column crate or from separate rail crate);
3. TW / WS columns;
4. TW / WS accessories from accessories crate (carriage, counterweights etc.);
5. Radiographic table;
6. Generator;
7. Tabletop.

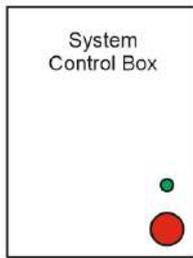
## 6 INSTALLATION INSTRUCTIONS

### 6.1 SYSTEM INSTALLATION OVERVIEW & CHECKLIST

The Perform-X F400 system is a complex equipment with a number of integrated components. The order of installation is typically organized around the tube stand. However, as the installation progresses, other components must also be installed in order to power up the devices. **Recommended steps of the room installation:**

- A.  Install system control box
- B.  TS99N basic installation: floor rails, floor carriage, column and arm, tube head installation, cabling
- C.  Temporary installation of the WS99N wall stand, including cabling to control box and the wired remote controller
- D.  Temporary installation of the Phoenix 2 table, including cabling to control box
- E.  Turn on the power, test brakes and basic movement functionality and collimator light field
- F.  Mount accessories, like patient grip and grid
- G.  Tube stand and wall stand balancing
- H.  Centring and final positioning of the wall stand and radiographic table
- I.  Calibrate relative positioning of the components using the PXIM Service Application
- J.  Generator and image acquisition workstation installation (control room and router installation) – this can be performed parallel with the above steps if adequate personnel is available
- K.  Connect generator and image acquisition workstation
- L.  Assemble stitching stand if applicable – this can be performed parallel with the above steps if adequate personnel is available
- M.  Test complete system: take exposures, calibrate X-ray tube and DR flat panel(s), test advanced functions (e.g. stitching, tube head integration functions) as necessary
- N.  Test collimator light field accuracy and adjust if necessary
- O.  Perform AEC calibration
- P.  Connect and test room safety circuitry, e.g., door light and door interlock
- Q.  Finalize room cabling, close cable channels
- R.  Install covers on all the equipment: tube stand, wall stand and radiographic table, generator, etc.
- S.  Check balancing once more and adjust counterweight if necessary
- T.  Hand over system: train operators, hand over operating manuals and guides, maintenance schedule
- U.  Call for acceptance test
- V.  Fill in and submit installation checklist

## 6.2 SYSTEM CONTROL BOX INSTALLATION



The **System Control Box** provides the following functionality:

1. powers and connects the components (ceiling tube stand, wall stand and table);
2. provides interface for diagnostics (the PXIM Service Application);
3. emergency stop switch to stop all motorized movement.

During the installation, the components will need to be powered up one by one. Therefore, mounting the Control Box first is recommended to provide power and CAN bus connectivity.

1. **Remove the Control Box** from the system accessories crate
2. Choose a location relatively **near the input power line**.
3. Make sure that the EMERGENCY SWITCH is **easily accessible** in case the equipment must be powered down. Adjust the height so that the EMERGENCY SWITCH is within arm's reach and the operator can activate the switch without having to bend down or reach high.
4. Mount the Control Box using the mounting holes at the back. The drawing below shows its outside dimensions.

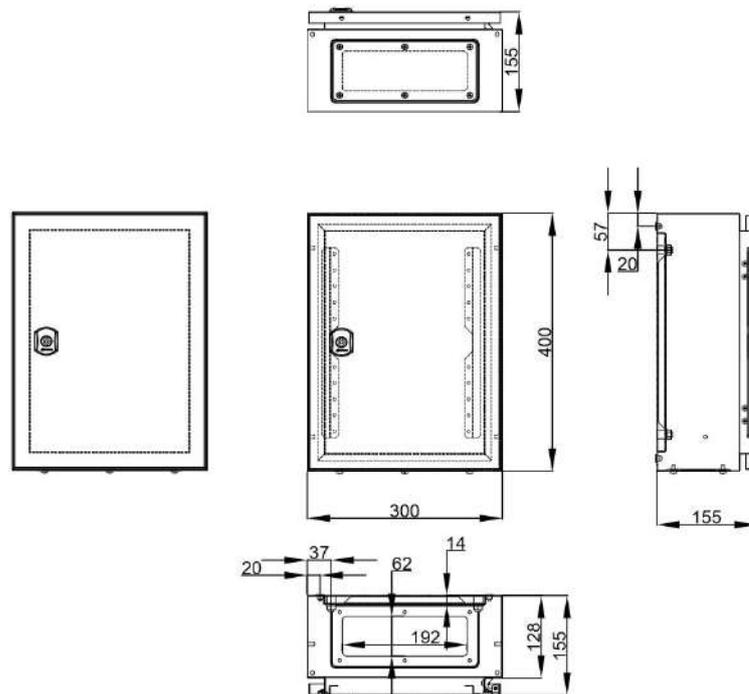


Figure 13 – System Control Box dimensions

5. When using wall cable channels, we recommend to route all cables exiting from the bottom plate of the Control Box.
6. The cables already connected and the ones to be connected from other equipment are clearly labelled.

### 6.3 SERVICE APPLICATION

The **Perform-X Service Application** (PXIM Service Application) is required to configure, calibrate and monitor the Perform-X System and its components.

System requirements:

1. Desktop or laptop PC;
2. Windows 10 or 11 operating system (32/64 bit);
3. USB port;
4. Optionally drivers for the USB-to-serial port (in case Windows cannot find or install the drivers automatically).

It is also recommended to download the Control-X Medical remote support application in case remote assistance or trouble-shooting is required.

**Download URLs:**

5. **PXIM Service Application:** <https://cxmed.com/download>
6. **USB to Serial converter drivers\*:** <https://www.ftdichip.com/Drivers/VCP.htm>  
(please select driver according to OS and processor architecture)
7. **CXRemoteSupport:** <https://get.teamviewer.com/cxmed>

(\*) *Third-party supplier, URL may change without notice.*

To install the C-Service app, simply **download and execute PXIM Service Application installer**. To run the application, double click on the PXIM Service icon.

Please refer to **D-3138 - Perform-X C-Service Application Technical Manual** for more information.

### 6.4 CONNECTING THE CX REMOTE BOX

Locate the **CX Remote Box** and its accessories in the accessories crate. This box provides a connection and CAN bus / USB interface to the equipment allowing:

- local or remote diagnostics through the PXIM Service Application and
- PC side functionality for the operator from the control room.

Connect the Remote Box with the service PC using the supplied or any commercially available USB A-B cable:

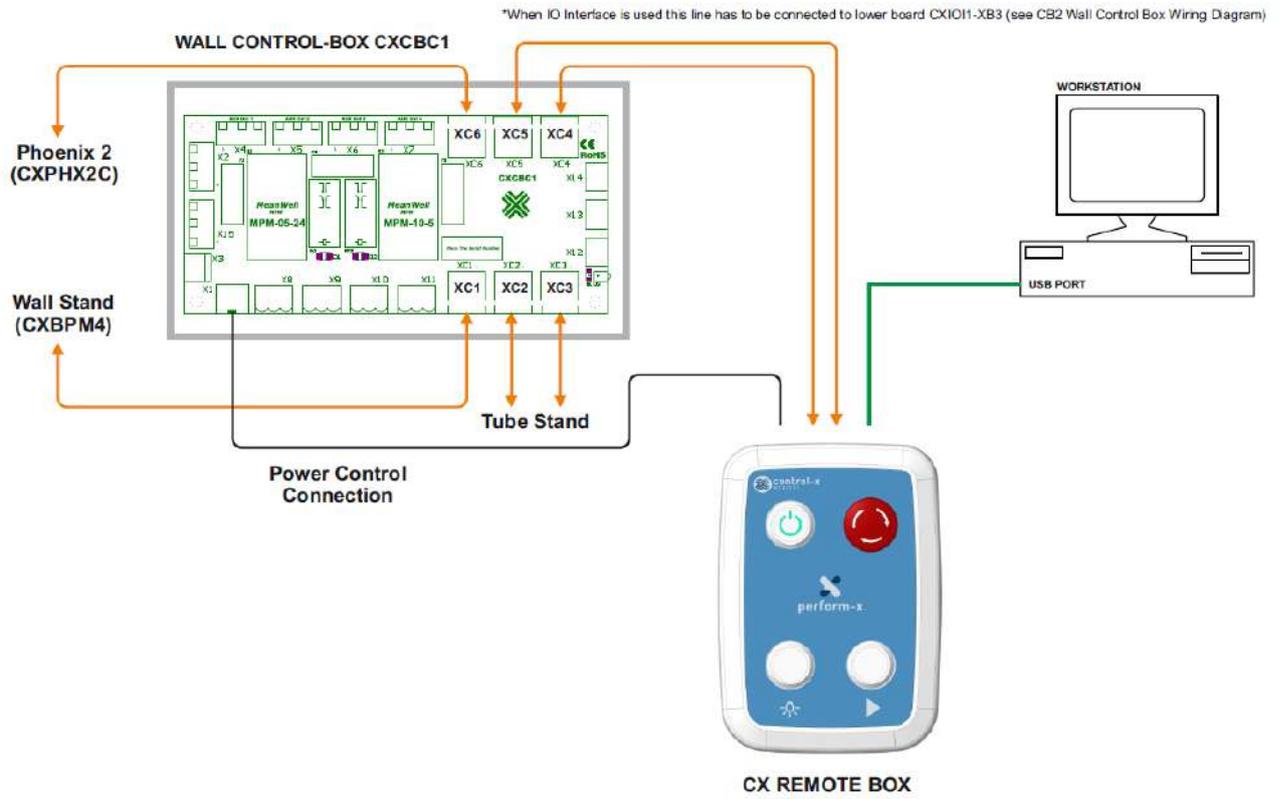


Figure 14 - Remote box connections

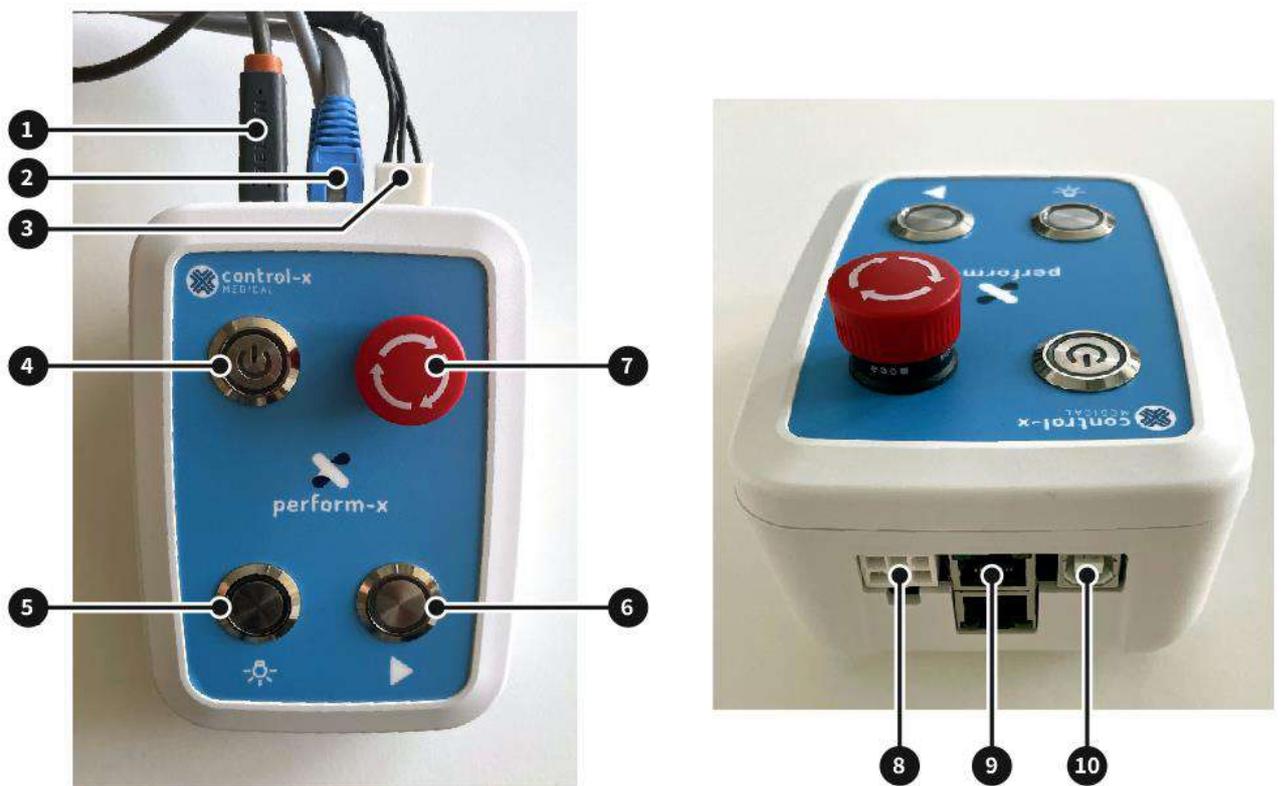


Figure 15 - Remote box with and without cables

<b>Position</b>	<b>Descriptions for <i>Figure 15</i></b>
1	USB A-B cable connecting to PC
2	2 x CAN cables connecting to control box
3	Cable with mini MNL connector connecting to control box
4	POWER ON / OFF pushbutton
5	COLLIMATOR LIGHT pushbutton
6	MOVE TO POSITION pushbutton *
7	EMERGENCY SWITCH <ul style="list-style-type: none"> <li>• When pushed, immediately removes power from the equipment and stops all motorized movements (remote box remains powered)</li> <li>• Pull switch to reset emergency stop status and allow motorized movements</li> </ul>
8	Mini MLN connector for connecting to control box
9	2 x RJ45 connectors for CAN cables connecting to control box
10	UBS-B connector to connect box to PC for PXIM Service Application functionality

(\*) *The MOVE TO POSTION button can be configured in PXIM Service App to SINGLE USH or PUSH-AND-HOLD (dead man switch) operation.*

## 6.5 TS99N TUBE STAND INSTALLATION

### 6.5.1 TS99N Main Parts

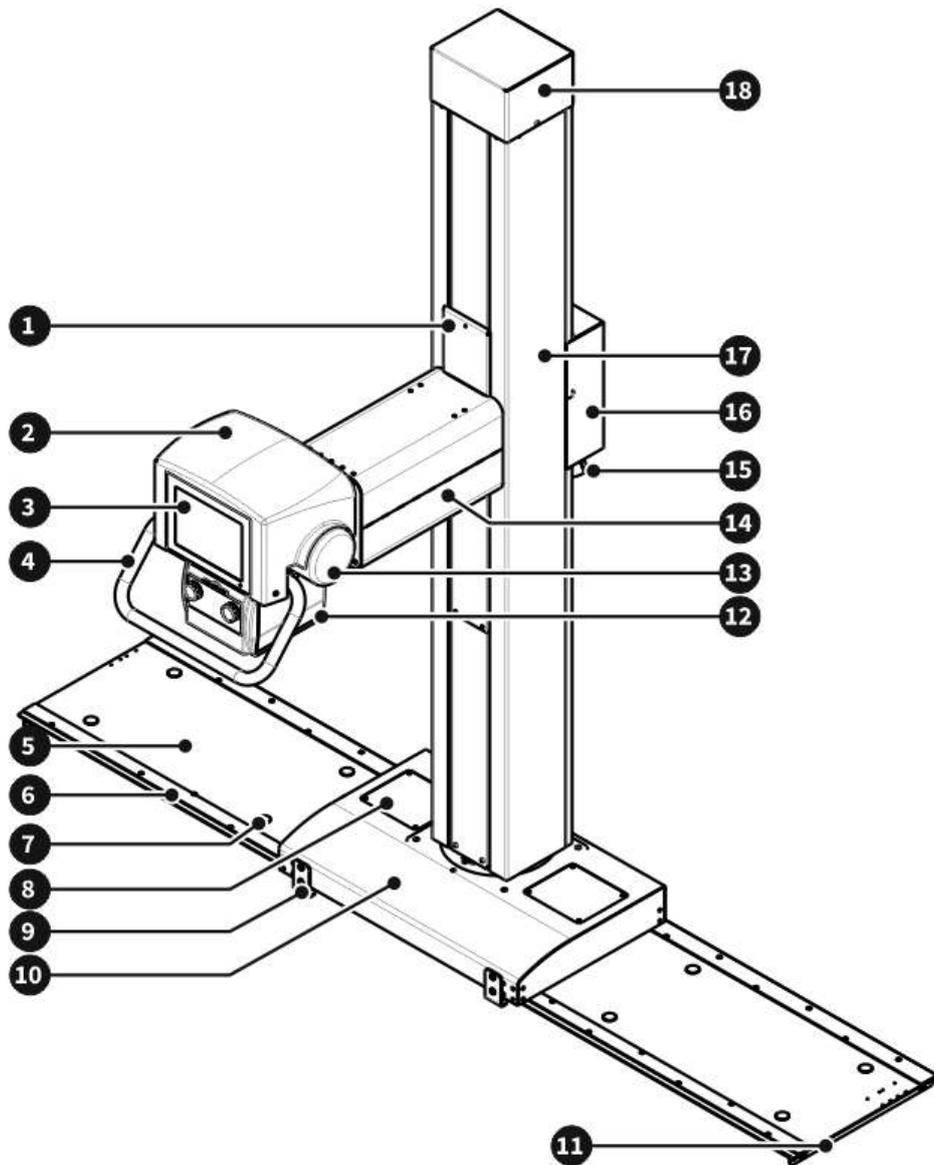


Figure 16 – TS99N main parts

The TS99N floor stand consists of the following main parts:

1. Vertical carriage and cover
2. X-ray tube cover
3. 10.4” touch screen LCD console
4. Brake release handle
5. Floor rail
6. 2 x Floor rail tracks (with drive belt near the rear track)

7. Mounting holes / plastic cover caps
8. Longitudinal drive service access cover
9. Floor carriage front grips
10. Floor carriage (carriage for rotating column shown)
11. Floor rail end piece
12. Collimator
13. X-ray tube
14. Tube arm
15. E-Box cable exit
16. E-Box
17. Column body
18. Top cover / vertical drive

#### 6.5.1.1 Floor Rail

The longitudinal rails are made of extruded aluminium section; they are attached to the radiology room ceiling (different mounting solutions are possible).

Channels go along all rails entire length; they have the following functions:

1. they guarantee the rails adaptability to different mounting systems (see “Common Fixing Methods”);
2. they make the rails assembly easier and permit more freedom during the mounting (in option solutions with different length rails are available);
3. they permit the positioning of one or more alignment position indicators of the radiant beam with one or more receptors which are in the radiological room.
4. Allow the housing for the motor components (motors and toothed belts) for the motorized movements of translation of the stands (option)

The rails are supplied complete with tapered head bolts supplied with holes for the rails fastening.

#### 6.5.1.2 Floor Carriage

The transverse bridge slides on the longitudinal rails; it is composed by a couple of rails, of the same kind of the longitudinal ones, connected to each other. The carriage with the telescopic stand moves inside this bridge.

#### 6.5.1.3 Column Body

The telescopic elements of the stand are made of extruded aluminium and are connected to each other through stainless steel ropes which guide their movement in an precise way (synchro ropes).

The end of the telescopic stand is hung by a steel drive rope; this winds round a drum to which counterbalancing springs are connected. The springs contrast the weight of the

stand and of the X-ray tube assembly.

The main rope is placed side by side to a safety rope which avoids any kind of danger or injury for operators or patients in case of a main cable breakage: a safety device becomes immediately operative--blocking the telescope extension movement.

On the carriage, which is made of a rigidly bolted heavy aluminium plate, the motor springs for the units balancing is mounted; it is possible to hold one or more reserve springs as well. Its innovative conception optimizes all available space and permits to hold up to 10 springs (9 standard + 1 optional). This allows the stand to position the heavy therapy tubes or to mount a horizontal arm of different design.

The telescope is made of extruded aluminium; it has a light weight and is not susceptible to corrosion; it guarantees at the same time the required mechanical strength and durability.

Moreover, the light weight makes all aerial structures lighter; these are mechanically less stressed and requires limited maintenance.

#### 6.5.1.4 Tube Arm

The horizontal arm, that supports the X-ray tube assembly is fastened to the lower end of the telescope and can rotate around the vertical and the horizontal axis.

For the linear movements, electromagnetic brakes are used – for the rotational movements, brakes with permanent magnet are used. These assure the braking action even in case of sudden interruption of mains supply.

#### 6.5.1.5 LCD Touch Screen Control Console

The tube mount touch screen console provides user interface for controlling the following system functions:

1. brake release control;
2. equipment movements;
3. managing preset positions;
4. display primary positioning parameters;
5. provide generator parameters interface (optional);
6. smart stitching interface;
7. image preview.

#### 6.5.2 TS99N Installation Overview

The installation of the TS99N tube stand consist of several steps and require performing complex mechanical and electrical procedures. The recommended order of the amin installation steps is as follows (*detailed instructions are described in sections below*):

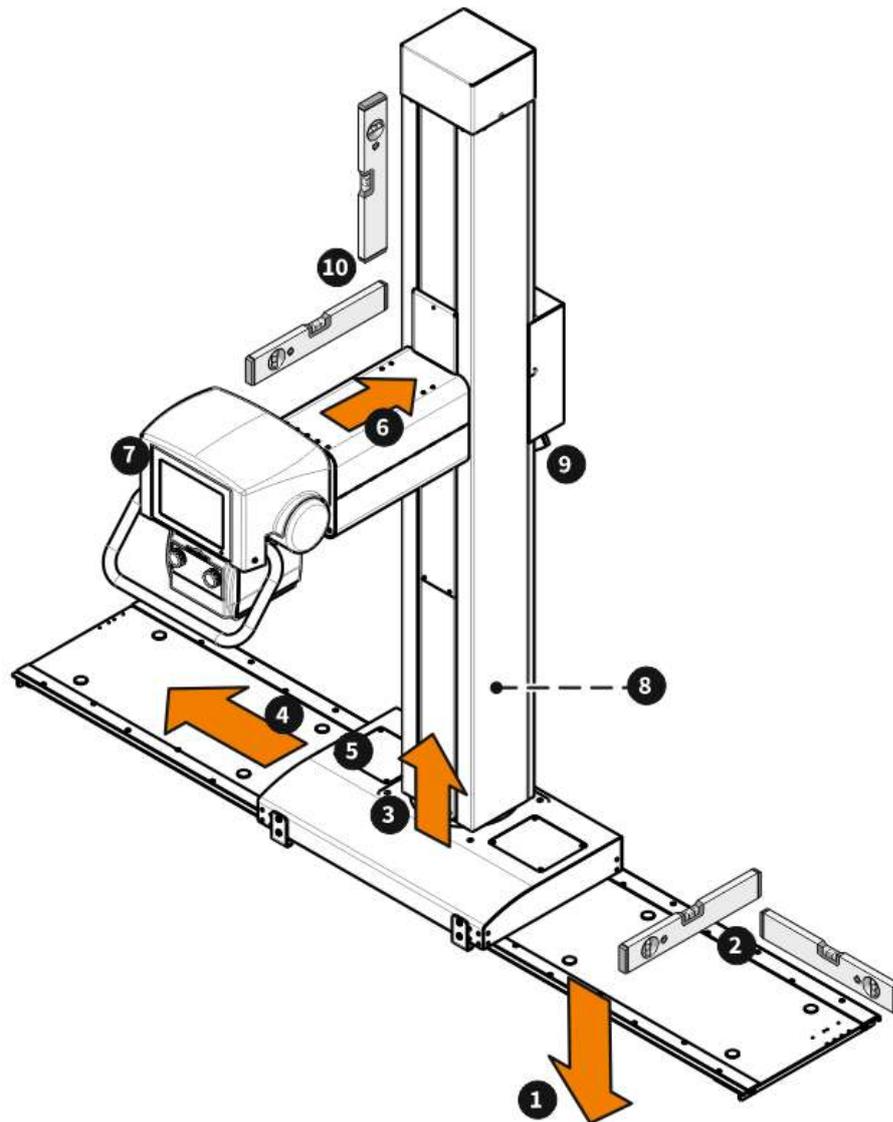


Figure 17 – TS99N main installation steps

1. Mount the floor rail. **The rail is a fundamental part of the equipment which affects the basic safety and performance of the equipment. Be sure to closely follow the instructions below.**
2. Verify that the rail is level. Make adjustments as necessary.
3. Mount the floor carriage onto the column body with **the column body laying on a horizontal surface (i.e. A-frames)**
4. Mount the assembled column body and floor carriage onto the rail. (Remove before and reinstall after the rear roller guides as instructed below.)
5. Mount and adjust the longitudinal drive.
6. Install the tube arm.
7. Install the tube assembly.
8. Counterbalance the tube stand (later adjustments may be necessary).
9. Connect the internal and external interconnecting cables.
10. Centre the X-ray beam.



**ATTENTION!**

Please note that additional installation steps will be required to calibrate the positioning of the complete system.

### 6.5.3 Install the Floor Carriage and Column

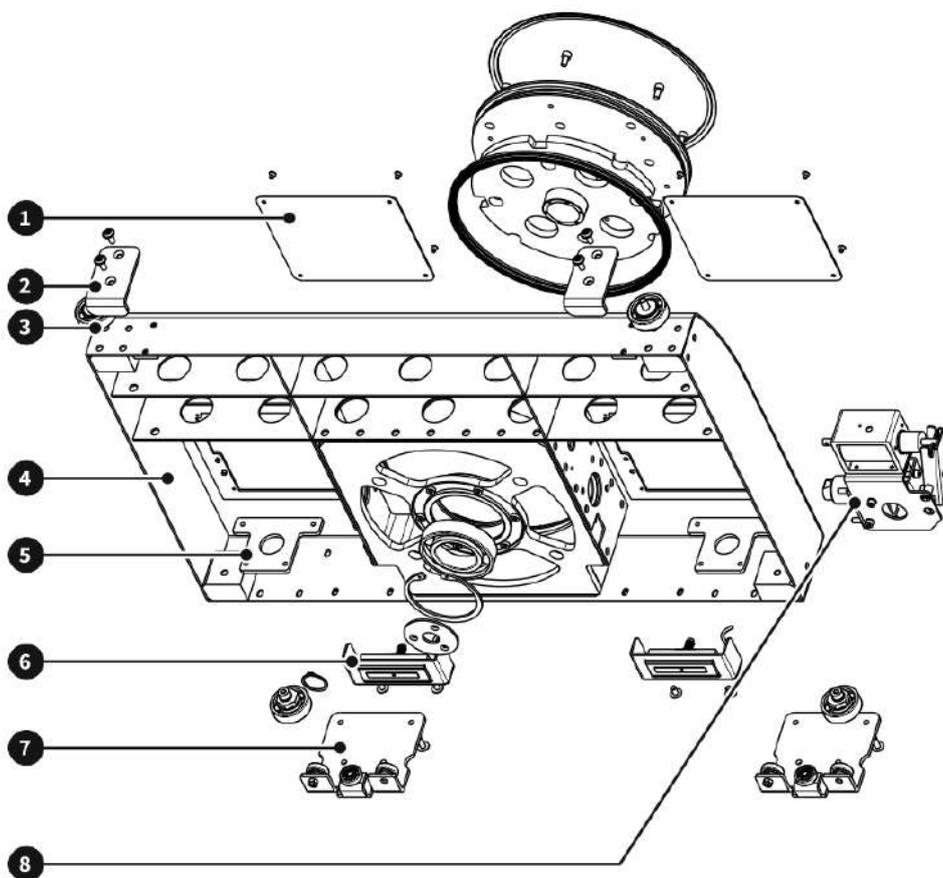


Figure 18 – Floor carriage

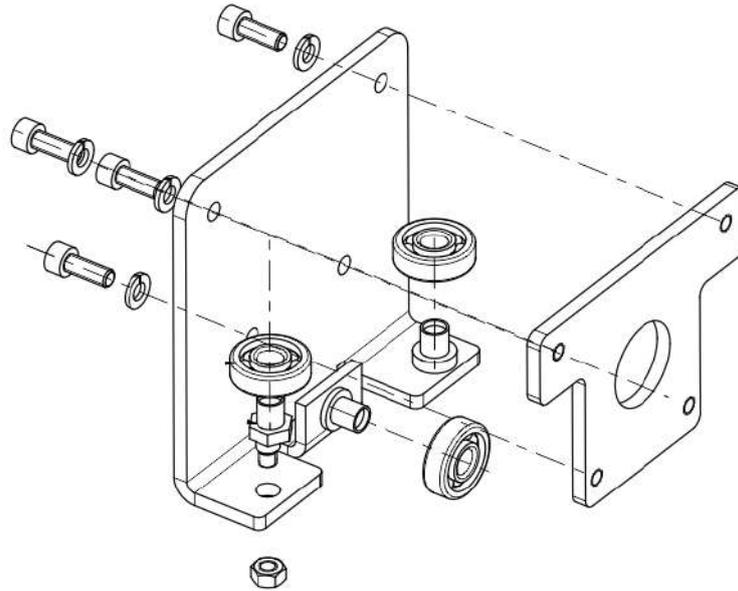


Figure 19 – Floor carriage detail – rear roller bracket

Position	Descriptions for Figure 18Figure 15	Qty	P/N
1	Floor carriage access port cover	2	NFC 50 003 1
2	Front rail grips	2	NFC 50 002 1
3	Front non-eccentric bearing assembly	2	NFC 40 001 1
4	Rotating floor carriage	1	NFC 00 001 1
5	Threaded mounting plate for the rear roller bracket	2	NFC 20 007 1
6	Assembled longitudinal positive electromagnetic brake	2	NFC 30 001 1
7	Rear eccentric bearing assembly	2	NFC 45 001 1
8	Rear roller brackets	2	NFC 20 001 1
9	Rotational brake with solenoid	1	RFC 00 001

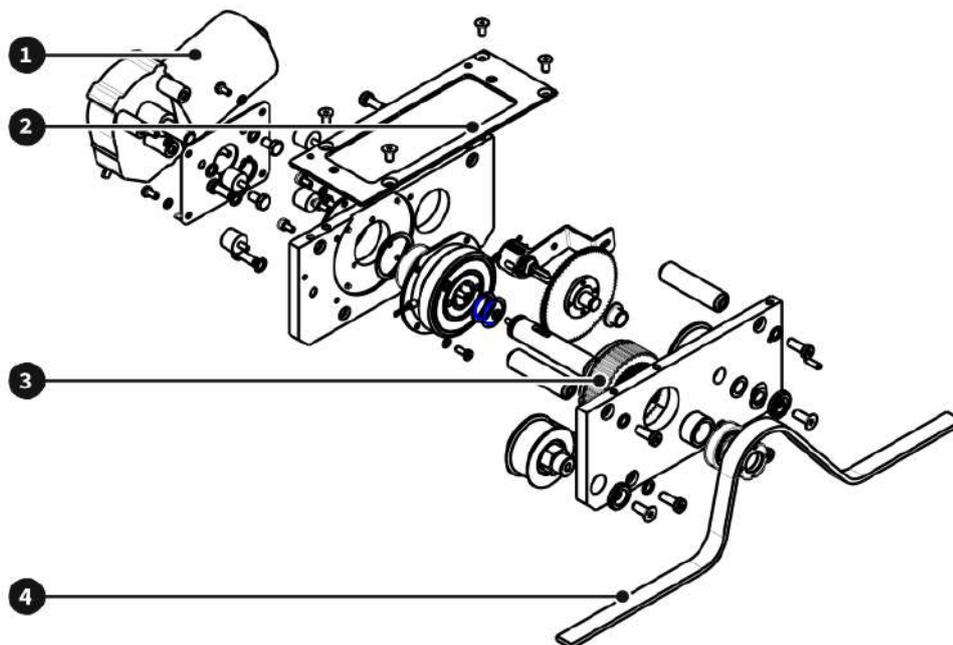


Figure 20 – Longitudinal motor drive (in carriage rear left)

Position	Descriptions for Figure 20	Qty	P/N
1	DC motor	1	404 67
2	Motor assembly mounting plate	1	RCD 00 023 2
3	Drive belt gear	1	
4	Drive belt	1	HTD 05M

1. Remove the TS99N tube stand column body from the TS / WS column crate. You can identify the TS column from the silver product label on the side of the column. To remove the column, first remove the wooden support blocks across the inside of the crate, then the walls of the crate. To lift the column from its shipping cradle, the shipping bolts must also be removed.
2. **Place the column on an A-frame or table with soft surface on the top.** Ensure that the stand is laying on its side to avoid pressing on the vertical carriage or the E-Box



**ATTENTION!**

Mounting the carriage onto the column body is only possible in the horizontal position of the column.

3. Locate and remove the floor carriage from the TS / WS accessories crate. Mount the floor carriage onto the column base using the supplied 6 pcs of M8 Allen screws (Figure 23). **Make sure that the front of the carriage (with the chamfered face) faces the front of the column.**

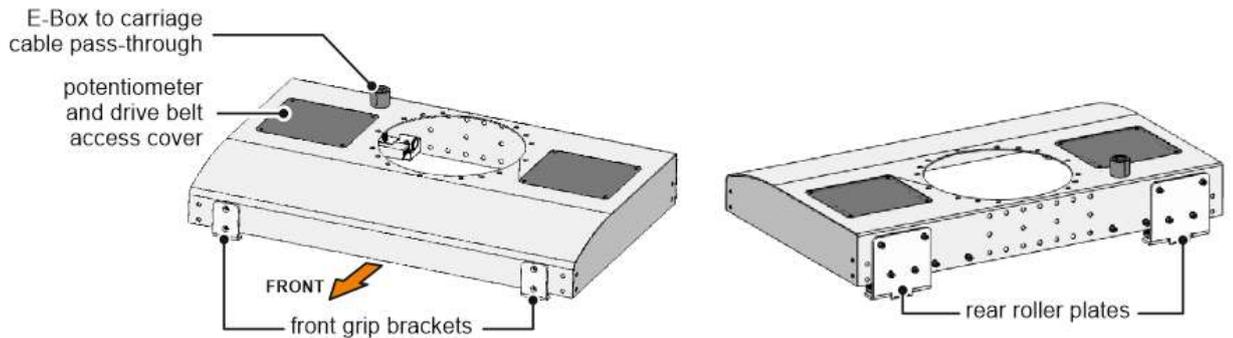


Figure 21 – Floor carriage front and rear view (rotating carriage version shown)

The screws (4 pcs M10) for mounting the floor carriage to the column are packed with the column body (Figure 22).



Figure 22 – Floor carriage with mounting hardware attached



Figure 23 – The floor carriage mounted on the column body

4. Remove the cover from the left side service access opening from the floor carriage and remove the 4 screws holding the motor drive assembly.
5. The floor carriage ships with the front grip brackets and rear roller brackets mounted on the carriage. **REMOVE THE 2X ROLLER BRACKETS FROM THE REAR AND THE FRONT GRIPS.** Later, you'll need to insert the rear plates into the rear roller track of the

rails.

6. When removing the REAR roller brackets, the internal T-shaped threaded mounting plate of the LEFT REAR roller plate will become loose. Take it out by reaching inside from the bottom while taking the roller plate off and set it aside.



7. In case of ROTATING floor carriage: leading the cables through the back **corrugated cable pass-through**, make the appropriate connections between the TS99N tube stand E-box and the floor carriage connector PCB:
  - a. X17
  - b. X14
  - c. X11
8. In case of FIXED (non-rotating) floor carriage: make the appropriate connections **directly behind the back metal cover** of the stand between the TS99N tube stand E-box and the floor carriage connector PCB:
  - a. X14
  - b. X11

#### 6.5.4 Floor Rail Installation

1. Make sure that the intended position (based on the standard or customized room layout) of the floor rail is level, clean and free of debris, floor heating installations, cable channels and similar objects.
2. Remove the floor rail from the TS / WS column crate or the separate rail crate (in case of extended rail) and place it in its intended position. **Make sure that the rail is in the right orientation (front facing front).**

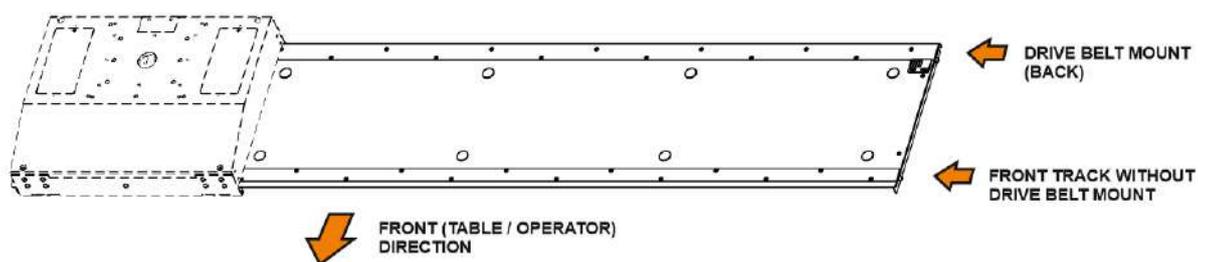


Figure 24 – Floor rail orientation (standard 247 cm rail shown)

3. Check if the rail is level in both longitudinal and lateral direction and take measures in case of significant unevenness (requiring more than 2-3 mm shimming).
4. Depending on rail length, mark the 10 or 14 mounting bores in the floor. Please note that for proper tube stand installation and beam adjustment, the floor rail needs to be bolted at the beginning of the installation. **Double-check the positioning** before drilling the bores.
5. Temporarily set the rail aside, drill the bores and place the anchors into the mounting bores so that the anchors are slightly below floor level. Clean the rail area and place the rail over the anchors.
6. Insert the previously removed rear roller brackets into the rear roller track of the floor rail.
7. Locate and remove the floor rail levelling spacers from the TS / WS accessories crate. The spacers / shims are provided in three different thickness. Before tightening the anchors, verify that rail is levelled in both longitudinal and lateral direction – if necessary, use shimming;

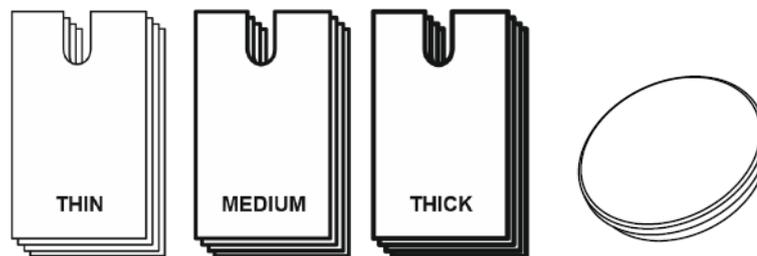


Figure 25 – Floor rail spacers and plastic mounting bore covers

### 6.5.5 Mounting the Column and Carriage on the Rail



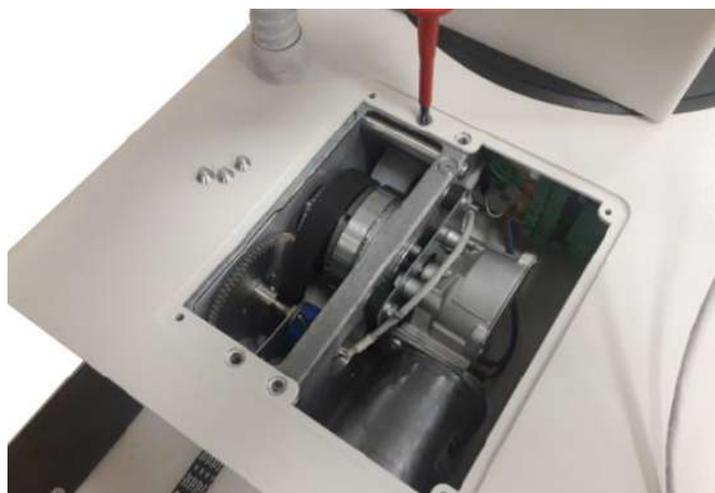
#### WARNING!

The column and carriage assembly is a **heavy object**.  
Always **lift and move parts with help**.

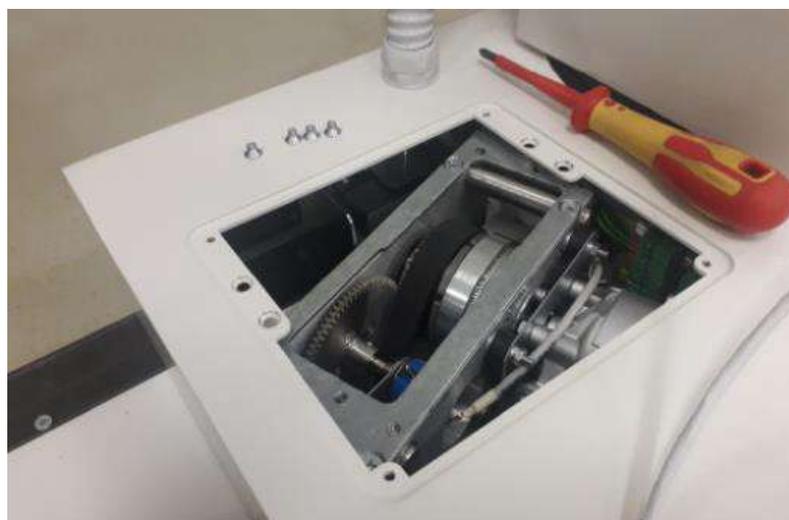
1. Carefully place the column with the floor carriage onto the rail. Use a soft cloth or similar material on top of the rail to prevent damage to the surfaces of the rail and carriage. When placing the column, make sure that:
  - a. the column orientation is correct (front faces forward);
  - b. the bottom rollers are positioned on the upper tracks on the rail;
  - c. the carriage is aligned and is parallel with the rail.
2. Mount the front grips back into their place on the floor carriage (see Figure 21).
3. **ROTATIONAL CARRIAGE ONLY:** Remove the cover from the LEFT SIDE service access opening on the floor carriage.



4. **ROTATIONAL CARRIAGE ONLY:** Remove the 4 screws holding the motor drive assembly.



5. **ROTATIONAL CARRIAGE ONLY:** Remove the drive assembly so that the previously removed T-shaped threaded plate can be inserted to secure the roller holder.



6. Slide the back roller brackets of the floor carriage in place and mount them.

7. Mount the rear roller brackets using 4 screws, but leave the assemblies loose (do not tighten the screws yet).



8. On both sides of the floor carriage: insert the T-shaped threaded plates inside the carriage. Mount and **pull up the brackets firmly** until the rollers inside reach the roller track, then tighten the roller brackets mounting screws.



9. **ROTATIONAL CARRIAGE ONLY:** Reinstall the motor assembly. Leave the cover of the access port off.

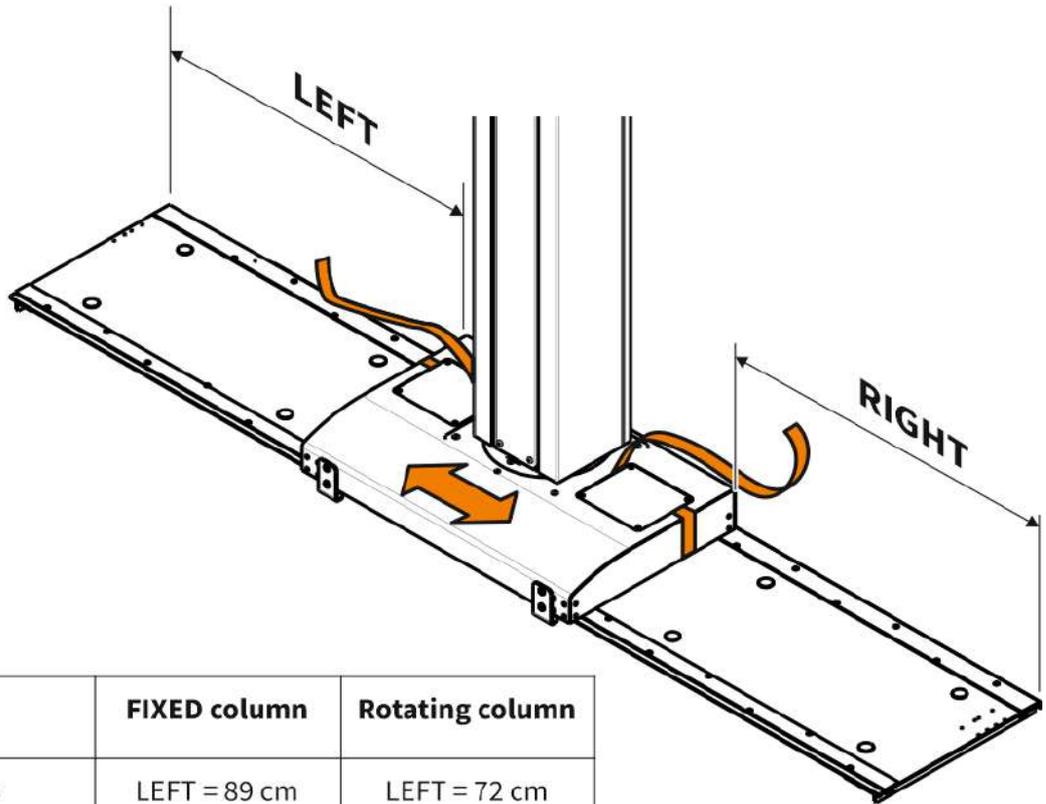


10. CAREFULLY move the tube stand into a position that corresponds to the factory preset position of the longitudinal potentiometer. The position is slightly asymmetrical. Use the values as indicated in Figure 26.



**ATTENTION!**

The longitudinal POTENTIOMETER inside carriage is factory adjusted to exactly half the travel.



	<b>FIXED column</b>	<b>Rotating column</b>
<b>247 cm standard rail</b>	LEFT = 89 cm RIGHT = 98 cm	LEFT = 72 cm RIGHT = 81 cm
<b>360 cm extended rail</b>	LEFT = 137 cm RIGHT = 146 cm	LEFT = 129 cm RIGHT = 138 cm

Figure 26 – Column position for proper drive belt mounting to prevent damage to the longitudinal potentiometer

11. Now the column and floor carriage should be in place. The rear roller brackets and the front grip brackets are mounted. The drive belt is secured with the service access covers on both sides.



*Figure 27 – The installed floor carriage*

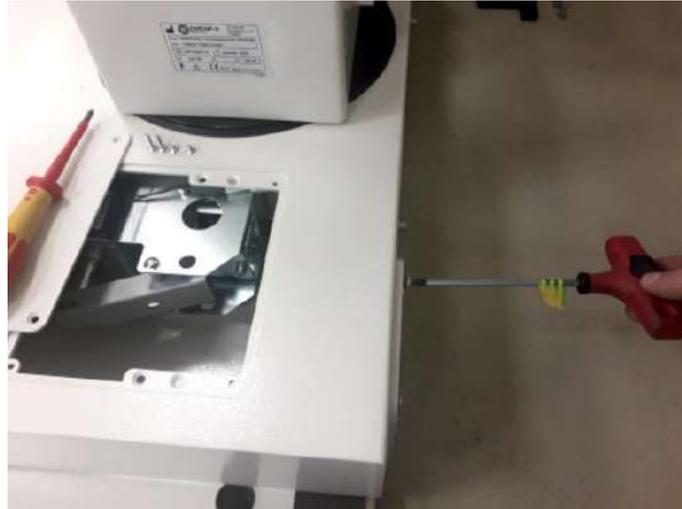
12. Straighten the belt and move the carriage so that the belt could be mounted on the FIXED (left) side. Secure the belt.



13. Remove the right side service access cover. Repeat the drive belt flattening and securing on the right hand side.



14. Mount the threaded plate here similarly to that of the left side and install the rear roller bracket assembly. At this point, the drive belt is flattened, but is NOT YET TIGHTENED.



Fix the belt on the tightener end (right side). Tighten the belt using the M6 tightening (tension adjust) screw. Fix the belt mounting unit using the 2 pcs M4 Philips head screws in the ovals and mount the tensioner cover. (Refer to

15. Figure 28.)

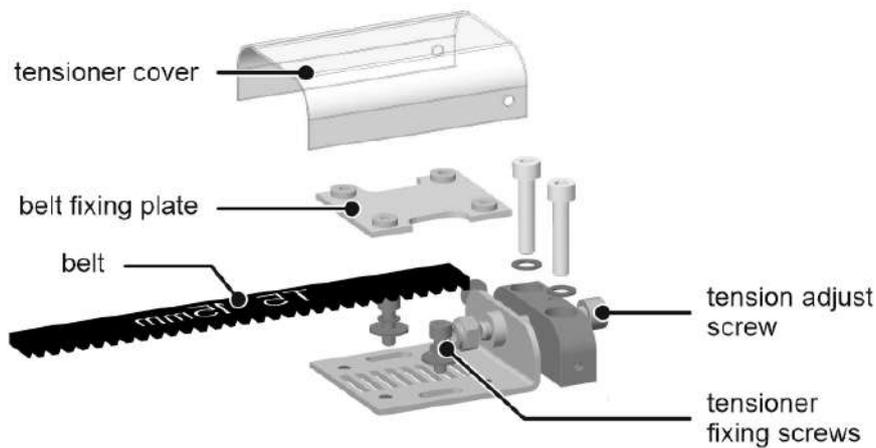


Figure 28 – Drive belt tensioner exploded view

16. Check the air gap between the horizontal brake and the bearing / brake track. Adjust if not in between 1 – 1.5 mm. The brakes are accessible through the service access opening on each side.

### 6.5.6 Tube Arm Installation

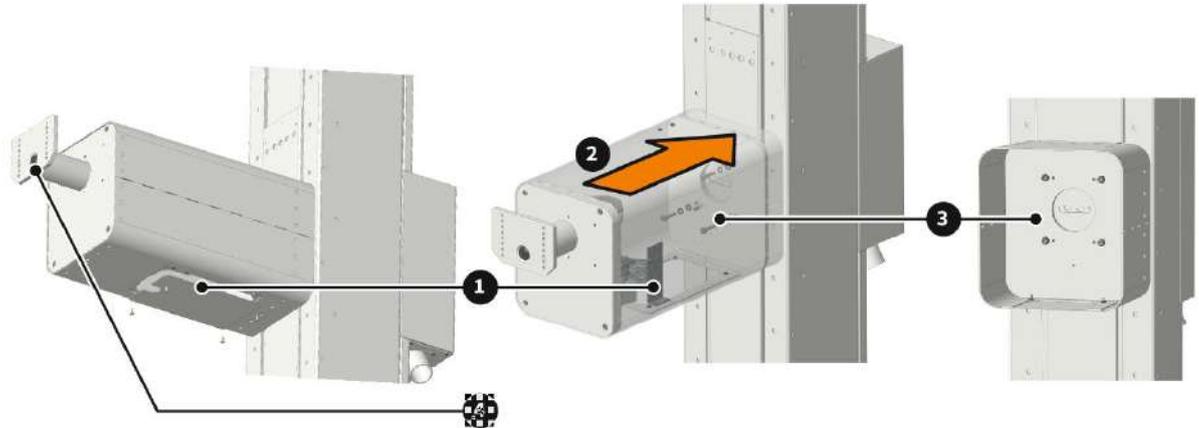


Figure 29 – Mounting the tube arm

1. For easier installation, place 2-3 weight plates into the weight carriage in the back of the column before mounting the arm. Refer to section 6.5.9 for details on working with counterweights.
2. Remove the cover from the arm service access port (Figure 29 #1). For better access, the PC board inside can also be removed.
3. The column is shipped with the 4x mounting screws mounted in the threaded holes. Remove them temporarily in order to mount the arm.
4. **With help**, place the arm (Figure 29 #2) on the vertical carriage 4x mounting holes (Figure 29 #3).
5. Secure the arm by tightening the 4x mounting screws (Figure 29 #3).
6. Leave the service access port cover off, as the beam centering may require reaching inside the arm.

### 6.5.7 X-ray Tube Assembly Installation

Figure 30 shows the parts of the X-ray tube head assembly. Follow the steps below to mount the tube head.

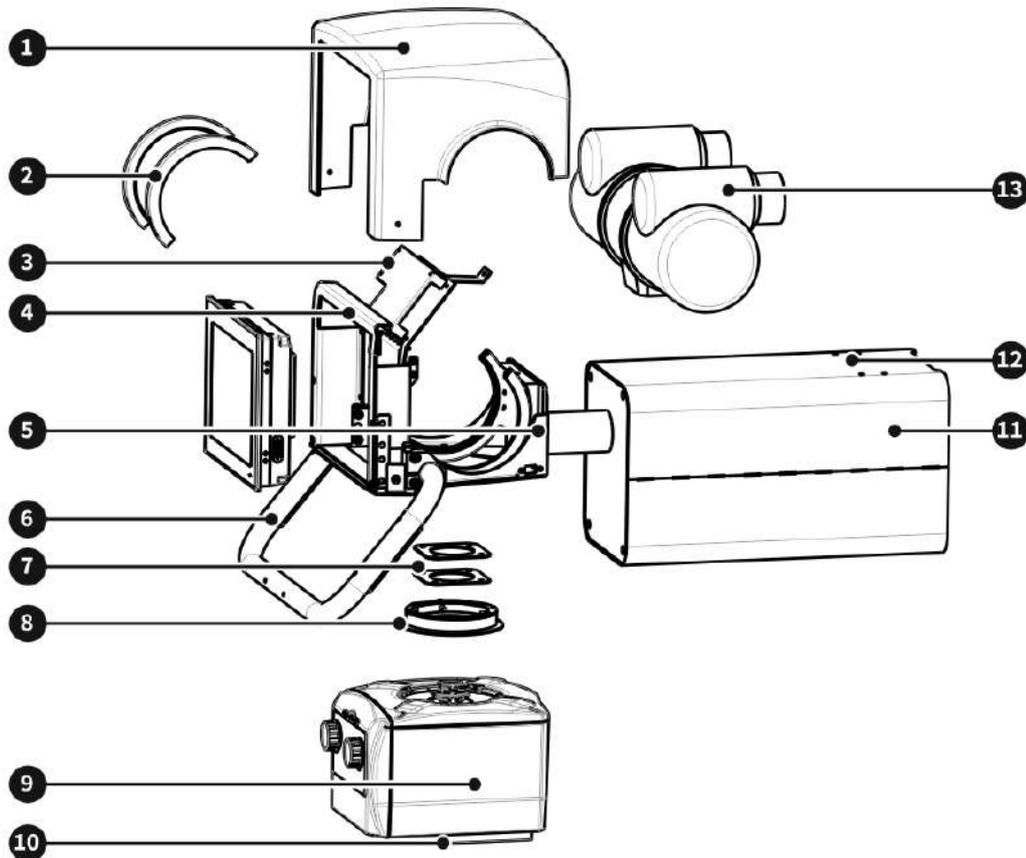


Figure 30 – Tube head mount

Position	Descriptions for Figure 30	Qty
1	Tube assembly plastic cover	1
2	Trunnion half rings	2
3	CXTSD PC board cover	1
4	LCD touch screen mounting bracket	1
5	Tube mount cradle	1
6	Brake release handle with brake release pushbuttons	1
7	Spacers	3-5
8	Collimator flange	1
9	Collimator	1
10	DAP meter mounting rails + DAP meter	1
11	Tube arm cover	1
12	Cable guide mounted on left or right	1
13	X-ray tube	

1. Locate, remove and unpack the following items from the accessories crate:
  - a. Tube control console assembly and mounting accessories

- b. Trunnion ring and tube cradle (Figure 30 #5)
  - c. X-ray tube (Figure 30 #13)
  - d. Collimator (Figure 30 #9) – in its original packaging
  - e. DAP (Figure 30 #10)
2. Unpack the partially assembled tube head assembly (Figure 30 #5) in the accessories crate. The X-ray tube and collimator are shipped in their own original packaging.
3. Again, before putting the weight of the tube assembly onto the arm, place 2-3 weight plates into the weight carriage in the back of the column. Refer to section 6.5.9 for details on working with counterweights.
4. Mount the tube cradle (Figure 30 #5) and the base of the Trunnion ring onto the end of the tube arm (Figure 29 #4). If the mounting position is marked in factory, please use the holes marked. Install the lower halves of the Trunnion ring onto the base. If the mounting position is NOT marked, mount the tube so that the Trunnion rings almost touch the edge of the opening on the bottom of the cradle.


**ATTENTION!**

Handle the tube mount console with care especially when working with the 10.4" LCD touch screen PC.

5. Loosen and move the brake release handle (Figure 29 #6) from shipping position to its operating position. Leave the protective sleeve on the handle until the room installation is completed.
6. Remove the white frame of the 10.4" touch screen PC, then remove the 10.4" touch screen PC and set it aside.
7. Remove the securing screw of the CXTSD PC board bracket (Figure 29 #3) and lift the bracket up to allow access to the inside of the tube mount.
8. Place the X-ray tube (Figure 29 #13) in the lower halves of the Trunnions and secure it by mounting the upper Trunnion halves (Figure 29 #2).
9. Put the CXTSD board bracket (Figure 30 #2) back to its place and secure it with its mounting screw.
10. From the bottom, mount the following onto the tube port using the supplied 4 M6 sunken screws:
  - a. collimator spacers (Figure 30 #7) under the console holder;
  - b. collimator rotating flange (Figure 30 #8) – make sure that the flange orientation is correct (front facing forward, so that it can be turned 90 degrees in both CW and CCW directions) below the spacers.

The required amount of spacers depends on the type of the tube housing. Use the following spacer thicknesses:

X-ray tube / housing type	Focus-to-port distance	Additional spacer thickness to insert
RAD-13 / RAD-14 / RAD-68 / RAD-74 (Varex Leo / Diamond housing)	53 mm	7 mm
Varex Sapphire housing	56 mm	4 mm
Varex B-130H housing	57 mm	3 mm

11. Mount the collimator Figure 30 #9) as instructed in the collimator user manual onto the rotating flange.



When connecting any cables / connectors, match the cable labels with the PC board connector labels and the printed wiring diagrams next to the PC boards (if there are any).

12. Connect the 10.4" touch screen PC with the CXDST5 board:
- a. Serial cable between PC / COM1 and CXTSD / X6
  - b. WITH MANUAL COLLIMATOR:
    - Power supply cable between the PC and CXTSD / X4
  - c. WITH AUTOMATIC COLLIMATOR:
    - Power supply cable between the PC and CXTSD / X5
    - Collimator power cable to CXTSD / X4
13. Connect the APR positioning interface cable:
- a. the FTP cable with the YELLOW strain relief boot (from the carriage) to the LAN1 connector of the 10.4" touch screen PC.
  - b. USB-A cable for devices like keyboard, mouse and USB drive. When not in use, push the access USB cable length into the tube cradle.



**ATTENTION!**

These cable must be connected before mounting the 10.4" touch screen PC.

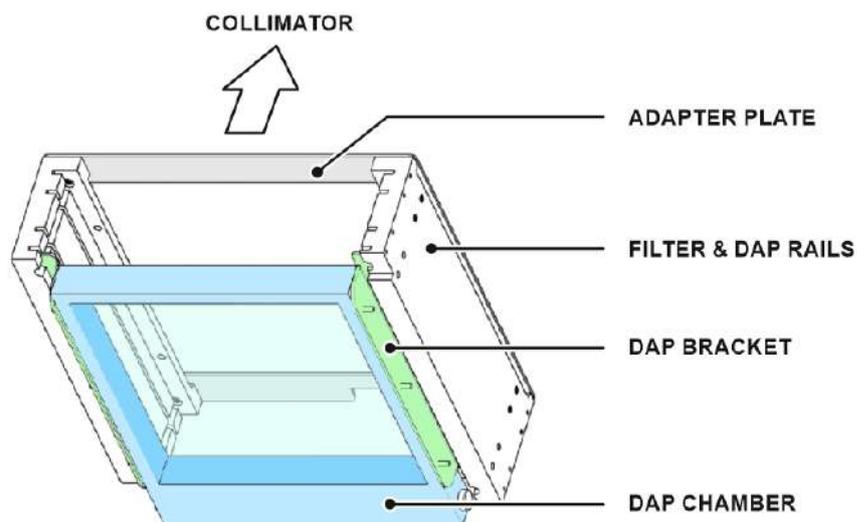
14. Connect the following cables to the CXTSD5 PC board on the tube end:
- d. 2 x CAN cables
  - e. Power supply cable



Connecting these short cables may require mounting the 10.4” touch screen PC.

**ATTENTION!**

15. Mount the 10.4” touch screen PC and its frame.
16. Locate the DAP meter in the accessories crate and unpack.
17. Mount the DAP measuring chamber adapter rails onto the bottom of the collimator. Please note that these rails may already be factory installed.
18. Slide the measuring chamber of the DAP meter into the DAP rails. Make sure that the measuring chamber is held firmly in place.
19. In some cases, the collimators and DAP chamber assemblies are prepared for accepting profile (wedge) filters that can slide between the collimator and DAP chamber:



*Figure 31 - Wedge filter rails & DAP rail assembly*

20. Connect the DAP cables:
  - a. the FTP cable from the carriage with GREEN strain relief boot to CXTSD5 / XD1 (DAP OUT)
  - b. the short FTP cable with GREEN strain relief boot from the DAP package to CXTSD5 / XD2 (DAP IN).



The **DAP meter** is shipped **factory calibrated**. Please refer to the instructions for use supplied with DAP meter for **recommended calibration schedule**.

**ATTENTION!**

21. Connect the collimator to its power source:

- a. connect the free end of the collimator cable to CXTSD5 / X5.
22. Connect the high voltage cables and rotor cable to the X-ray tube. For insulation, use the supplied silicon grease. ALWAYS HAND-TIGHT the HV plugs – do not use clamp tools.
23. .
24. The X-ray tube cover is packed separately. The cover shall be mounted at the end of the installation process. Keep the cover in its original packaging until then to prevent damage.

**ATTENTION!**

Once the X-ray and connected devices are mounted, the weight on the tube arm is now sufficient for approximate balancing

### 6.5.8 TS99N Cabling

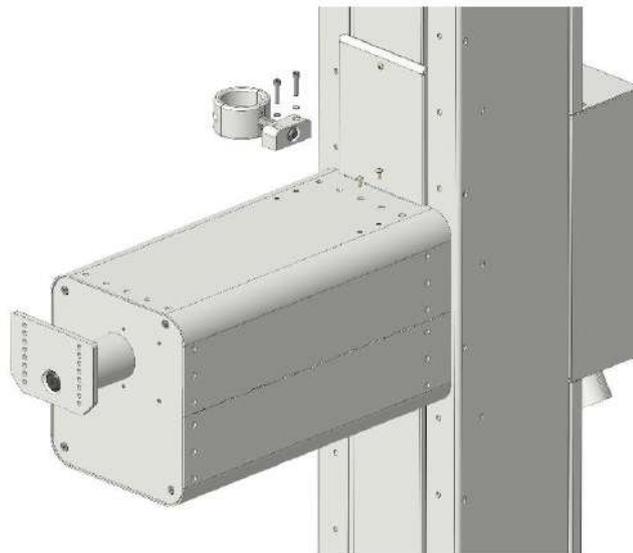


Figure 32 – Mounting the cable clamp on tube arm

1. Mount the cable clamp (Figure 32) on the tube arm using the supplied Allen-head screws.

**ATTENTION!**

To prevent the cables from interfering with positioning, **mount the tube arm clamp on the side opposite from the wall stand.**

2. Lead the HV cables, anode rotation cable, the DC power cable, the CAN cables (blue

strain relief boots), the DAP cable (green strain relief boot) and the APR positioning interface cable (yellow strain relief boot) through the tube arm cable clamp to the E-Box (Figure 16 #16) at the back of the column body.

3. Connect the following cables coming from the E-Box (Figure 16 #16) to the system control box:
  - a. The 2 pcs FTP CAN cables with the blue strain relief boots to the free RJ45 CAN connectors in the control box.
  - b. The 5VDC power supply cable to X13.
4. Connect the cables coming from the floor carriage to the E-Box CXBPM (TSHOR) / X7 and X9. Make sure the cables go around the weight carriage opening.
5. Connect the following cable to the image acquisition workstation:
  - a. The FTP DAP cable with the green strain relief boot to the serial communication converter supplied with the DAP meter. Refer to Figure 33.
  - b. The FTP APR positioning cable with the yellow strain relief boot to the appropriate RJ45 LAN port of the image acquisition PC.

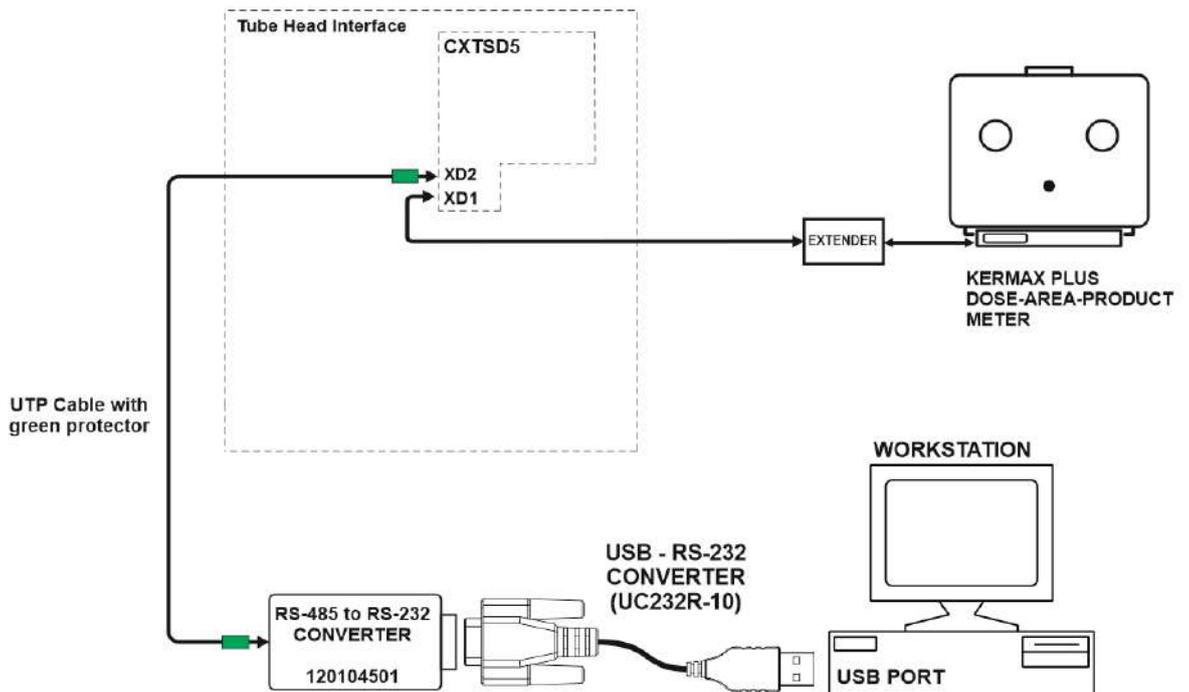


Figure 33 – DAP meter connection

### 6.5.9 Balancing the Tube Stand

The TS99N stand is counterbalanced using steel weight plates in a weight carriage inside the column body.



**ATTENTION!**

**Complete and accurate balancing can only be performed with all the covers and accessories installed.**

1. Locate and remove the **counterbalance weight plates** from the bottom of the TS / WS accessories crate. **Please note that the number of weight plates varies depending on the configuration and weight of the components.**
2. Remove the **lower half of the back cover** of the column located below the E-Box.
3. Insert the required amount of counterbalance plates into the weight carriage through the opening at the back of the column.

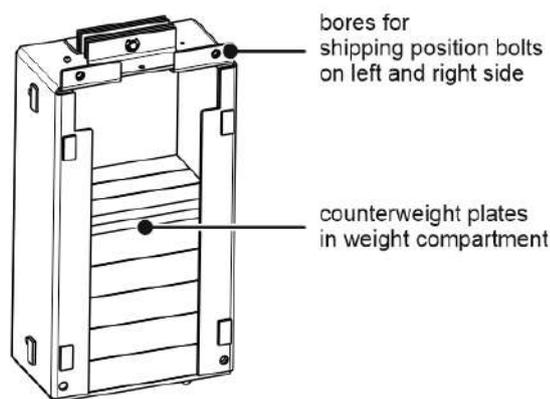


Figure 34 – Weight carriage with weight plates

4. Remove the 2 shipping position fixing bolts. Any minor imbalance should be held by the permanent brakes, **but be prepared to hold the tube arm assembly** in case it starts moving down.
5. The stand should be connected to the system control box by now. Carefully **test the balancing** by releasing the vertical brake. Insert or remove weight plates as necessary. *Note that the final balancing will be performed after completing the cabling. Leave the back cover of the column off for the moment.*

### 6.5.10 X-ray Beam Adjustment

Before centring the X-ray beam with the receptors, the beam must be adjusted. **Adjusting the beam direction requires that the stand and the collimator be powered up.**

1. Check the vertical leaning of the column at least at the leftmost, centre and rightmost column position on both the SIDE and the FRONT OR BACK surface of the column.
  - a. If the values vary in these positions, **doublecheck the rail levelling** and use

spacers again to correct the rail level.

- b. In case there is a constant side-to-side and/or front / back leaning, use the **eccentric bearings in the back** of the floor carriage to compensate. The bearings are **factory adjusted**, but they may require a small additional adjustment. The bearings are accessible through the top covers to the left and right of the column.

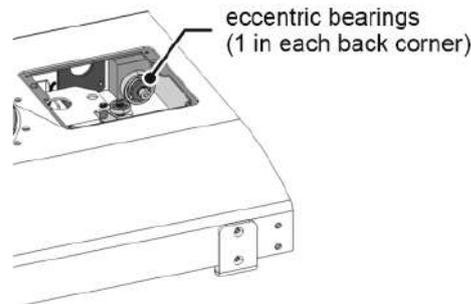


Figure 35 –Eccentric bearing to compensate for column leaning

2. Verify that the Trunnion rings are properly adjusted (*these steps assume a perfectly vertical column*).
  - a. At this point, the collimator and the tube stand should be powered up.
  - b. Position the X-ray tube vertically in a convenient position. Rotate the tube to the closer wall or any vertical surface that is available for this test.
  - c. Activate the light field.
  - d. Move the X-ray tube closest to the wall and mark the centre of the light field.
  - e. Move the X-ray tube away from the wall to a distance where the light field is still clearly visible and check if the centre of the light field is aligned with the mark previously made.
  - f. If not, adjust the Trunnion ring accordingly.
  - g. Repeat until the X-ray tube is aligned.
3. Once the rail and the column is adjusted, check the arm leaning and correct if necessary.
  - a. Bring the tube to its topmost position with the beam pointing down.
  - b. Activate the light field of the collimator and mark the centre of the light field.
  - c. Move the tube down to its lowest position and check if the centre of the light field is aligned with the mark previously made.
  - d. If not (the light field moves inward our outward), adjust the arm leaning using the adjust screws in the lower part of the tube arm mounting plate. CAREFULLY loosen the mounting screws so that the adjustment set screws could be adjusted. Adjust the screws and retighten the mounting screws.
  - e. Repeat until the X-ray tube is aligned.

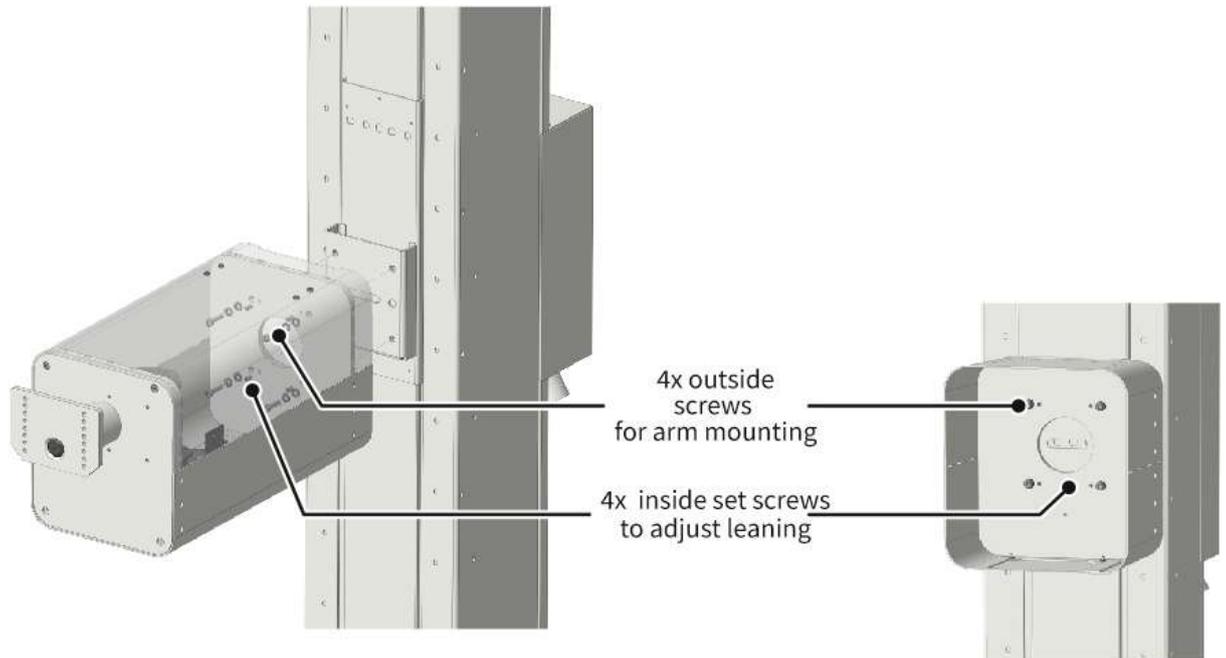


Figure 36 – Tube arm leaning adjustment set screws

- 4. Please note that steps (2) and (3) will affect each other and they may have to be repeated multiple times until the X-ray beam is aligned in both directions.**

## 6.6 WS99N WALL STAND INSTALLATION

### 6.6.1 WS99N Main Parts

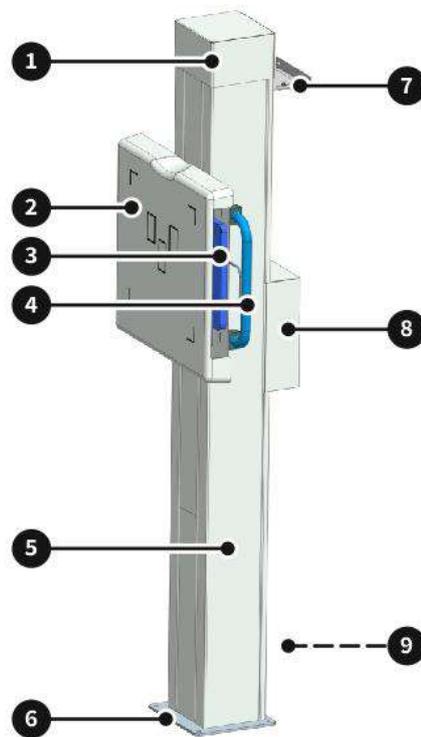


Figure 37 – WS99N main parts

1. Vertical drive with motor, brake and position sensor
2. Grid cabinet, preconfigured in factory for LEFT or RIGHT orientation. Includes rails for removable grid, AEC detector
3. Fixed flat panel detector with fixing kit OR portable flat panel detector with tray (portable detector shown)
4. Brake release handle
5. Column body
6. Column base for mounting to floor
7. Wall mount bracket for default mounting configuration
8. E-box with PC boards and electrical connections
9. Place of free-standing attachment for optional free-standing mount configuration (refer to Figure 38).

### 6.6.2 Positioning the Wall Stand (Standard Floor-to-Wall Mount)

1. Remove the weight plates from the crate.
2. Remove the column from the WS column crate. To lift the column from its shipping cradle, shipping bolts and red shipping bracket must be removed.
3. Locate and remove the wall stand base plate from the WS column crate. Mount the base using the supplied 6 pcs M8 sunken head Allen screws.
4. Place the stand to its approximate position. If available, use the collimator light field as a guide.
5. Mark the anchor positions on the wall through the wall mounting bracket.
6. Temporarily (but securely) mount the wall stand to the WALL ONLY (*final positioning and aligning is recommended to be performed later*).
7. Remove the back cover of the wall stand.
8. Insert the required amount of counterbalance plates (but at least 5 pcs) into the weight carriage through the opening at the back of the column.

### 6.6.3 Positioning the Wall Stand (Optional Free-standing Configuration)

9. Remove the weight plates from the crate.
1. Remove the WS99N column from the WS column crate. To lift the column from its shipping cradle, shipping bolts and red shipping bracket must be removed.
2. Locate and remove the wall stand base plate from the WS column crate. Mount the base using the supplied 6 pcs M8 sunken head Allen screws.
3. Locate and remove the free-standing column attachment (P/N: PFX-FMK 01) from the WS column crate. Mount the free-standing attachment to the column using the supplied screws. Do not install the cover of the free-standing attachment yet as the column may need to be counter-balanced.
4. Place the stand to its approximate position. If available, use the collimator light field as a guide.
5. Mark the anchor positions on the floor.
6. Mount the wall stand to the floor.
7. Remove the back cover of the wall stand.
8. Insert the required amount of counterbalance plates (but at least 5 pcs) into the weight carriage through the opening at the back of the column.

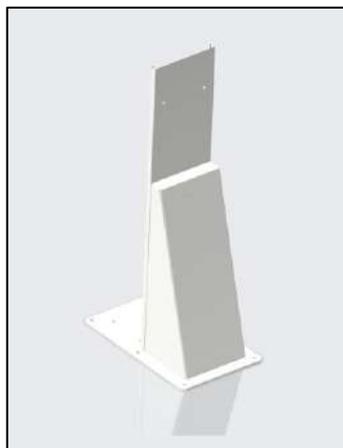


Figure 38 – Free-standing kit PFX-FMK 01 with cover and WS base plate

#### 6.6.4 Receptor Holder Installation

1. Remove the receptor holder adaptor (H-frame) from the grid cabinet.
2. Mount the receptor holder adaptor (H-frame) onto the vertical carriage.
3. Mount the receptor holder (grid cabinet) onto the H-frame.
4. Grid cabinets prepared for portable DR flat panels already have the cassette tray installed. Leave the AEC detector in place for cassette type removable receptors.
5. In case the wall receptor is a FIXED DR FLAT PANEL:
  - a. If the wall stand is equipped with an AEC detector, remove the AEC detector from the receptor holder. Mark the centre position for easy reinstall later.
  - b. Mount the fixed DR flat panel. Refer to [Figure 39](#).
  - c. Reinstall the AEC detector and make sure that it is aligned in the centre of the holder. Use previously marked position if available.

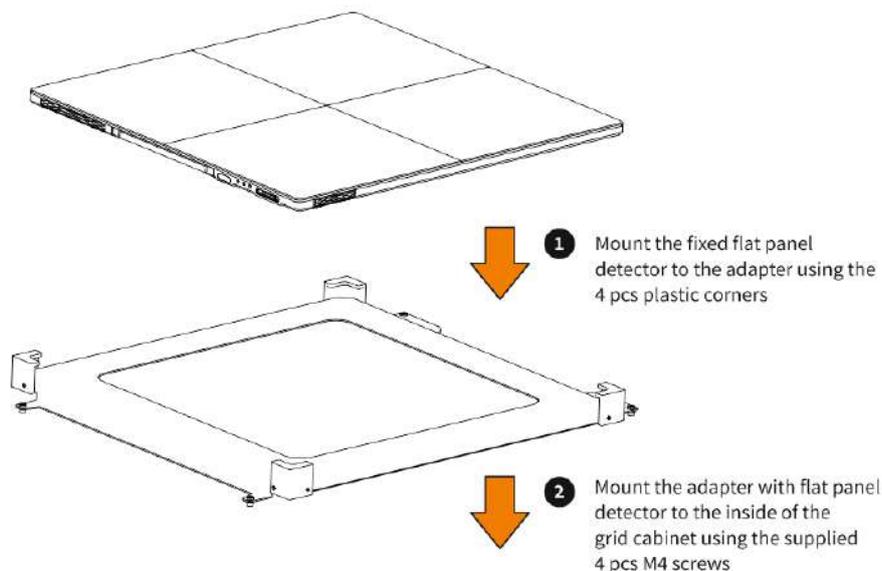


Figure 39 – Fixed DR flat panel mounting

#### 6.6.5 Electrical Connections

1. TURN OFF the system control box.
2. Remove the E-Box cover located at the back of the column.
3. If the wired remote controller is connected to the E-Box, unplug it and set it aside (*the wired remote controller is normally packed unconnected and separately*).
4. Gather the following cables and lead them into the E-Box through the cable entry from the bottom:
  - a. receptor holder brake release cable;
  - b. AEC detector cable (if applicable);
  - c. DR flat panel interface cable (if applicable);
  - d. Bucky cable (if applicable).
5. Connect the brake release cable. Refer to the wiring diagrams supplied with the system

for exact cable end points (CXWSD / X10 or CXBPM4 / X5).

6. Replace the cover of the E-box.
7. Connect the wired remote controller to the RJ socket located on the side of the E-Box.
8. Connect the cables from the wall stand (24VDC power, 5VDC power, CAN-bus) and the yellow-green PE cable to the system control box. *Please note that not all cables may be available depending on system configuration.*

#### 6.6.6 Balancing the Wall Stand



Note that final balancing of the wall stand will have to be performed when all the accessories and covers are mounted on the stand.

1. TURN ON the system control box.
2. In case of REMOVABLE GRID, insert the wall receptor grid into its slot (use the grid with the longer focal distance in case there are 2 grids for the system).
3. Remove the 2 pcs shipping position fixing bolts. Any minor imbalance should be held by the permanent brakes, **but be prepared to hold the receptor holder** in case it starts moving down.
4. Release the vertical brake using the brake release switch. Add or remove weight plates through the opening at the back of the column as necessary until the balancing is completed.

#### 6.6.7 Final Positioning and Securing the Stand

1. Check and adjust stand verticality using a level on both the front and side column surfaces.
2. Using the collimator light field, adjust the transversal centre of the wall stand accurately.
3. Repeat steps (1) and (2) until the wall stand positioning is centred in the entire vertical receptor movement range.
4. Using the collimator light field, make sure that the light field on the detector cover is symmetrical (the edges are in the same distance from the centre vertical line). Slightly rotate the stand if necessary.
5. Mark the floor anchor positions through the base plate. Mark the wall mounting bracket position as well (if applicable), as the stand may temporarily be removed from its position.
6. Carefully set the stand aside temporarily. Avoid tension on the cables already installed. Drill the bores and place the anchors into the mounting bores so that the anchors are slightly below floor level. Clean the area and replace the column over the anchors.
7. Anchor the stand to the floor and to the wall. Check the alignment as described in steps (1) through (4).

## 6.7 PHOENIX 2 RADIOGRAPHIC TABLE INSTALLATION

### 6.7.1 Phoenix 2 Radiographic Table Main Parts

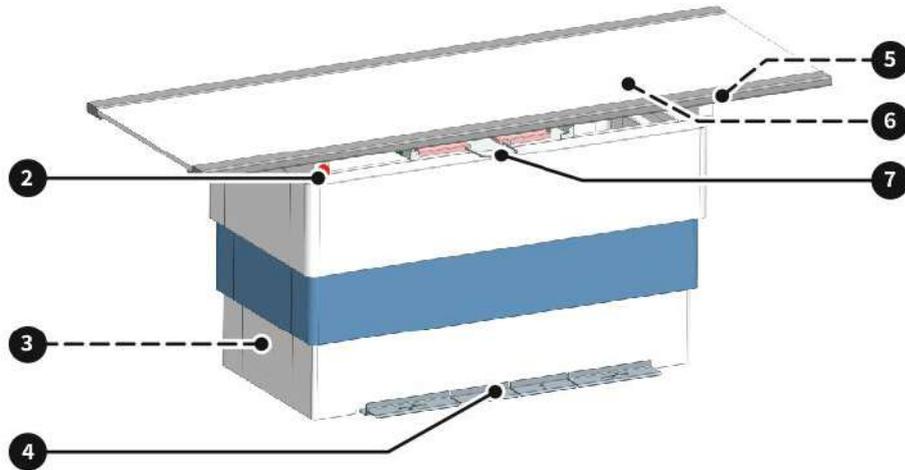
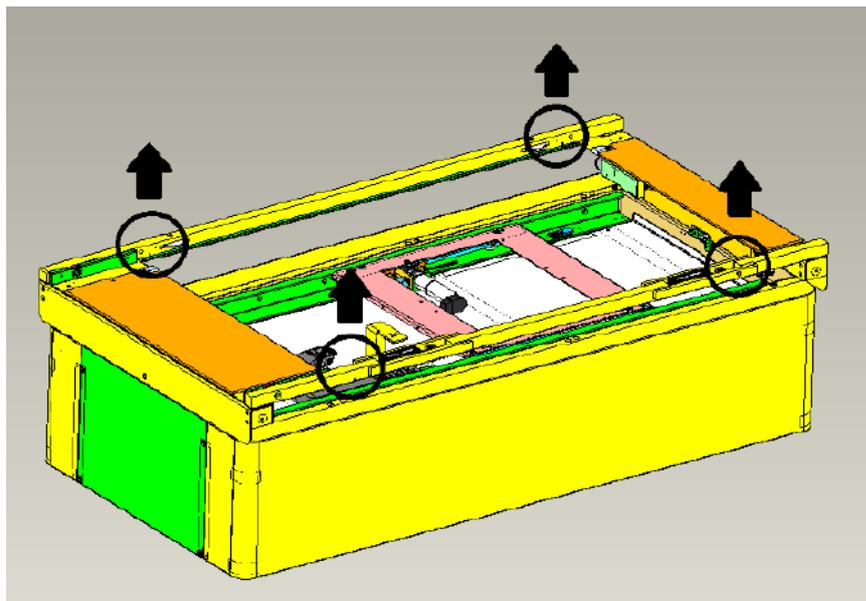


Figure 40 – Phoenix 2 main parts

- 1.

### 6.7.2 Positioning the Table

1. Remove the table from its crate and place it into its approximate position.  
For lifting points on the table frame please see image below:



2. Make sure that there will be enough room between the table base and the wall receptor holder to perform low extremity procedures – typically 100 cm SID (*exact SID depends on user requirements*).

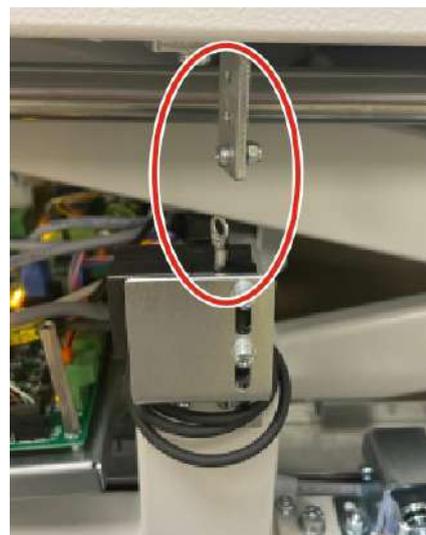
3. Check the transverse beam positioning using the collimator light field. Also make sure that the table is parallel with the tube stand ceiling rails. Adjust the table position as necessary.
8. Mark the anchor positions. Temporarily remove the table from its position. Drill the bores and place the anchors into the mounting bores so that the anchors are slightly below floor level.
9. Clean the area and place the table over the anchors.
10. Use shimming as necessary to level the table. Use a level on the table frame in both longitudinal and transversal directions.

### 6.7.3 Connecting the Vertical Positioning Sensor

Remove the cover of the table and locate the vertical position sensor in the front left of the table as indicated. (Connected state shown.)

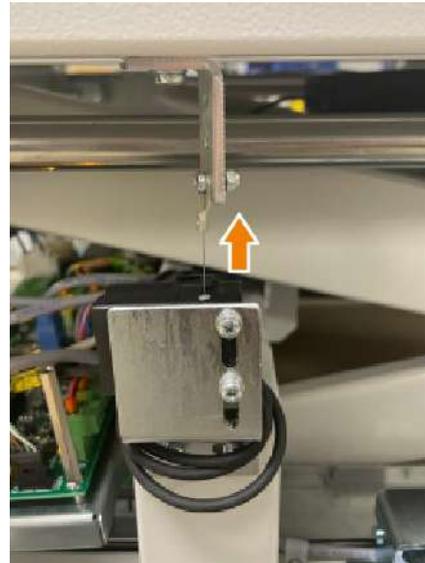


The wire of the sensor is disconnected to prevent damage during shipment.



Remove the M3 screw and nut from the L bracket on the upper frame.

Carefully pull up the wire and connect the eye of wire to the L bracket using the M3 screw and nut.



#### 6.7.4 Receptor Holder Installation

1. Mount the receptor holder adaptor (H-frame) onto the vertical carriage.
2. Mount the receptor holder (grid cabinet) onto the H-frame.
3. Grid cabinets prepared for portable DR flat panels already have the cassette tray installed. Leave the AEC detector in place for cassette type removable receptors.
4. In case the wall receptor is a FIXED DR FLAT PANEL:
  - a. If the wall stand is equipped with an AEC detector, remove the AEC detector from the receptor holder. Mark the centre position for easy reinstall later.
  - b. Mount the fixed DR flat panel. Refer to Figure 41.
  - c. Reinstall the AEC detector and make sure that it is aligned in the centre of the holder. Use previously marked position if available.

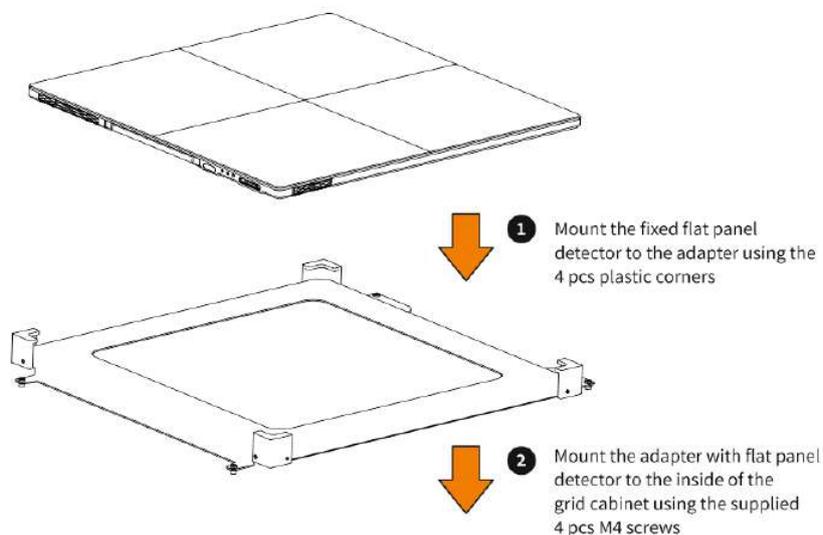


Figure 41 – Fixed DR flat panel mounting

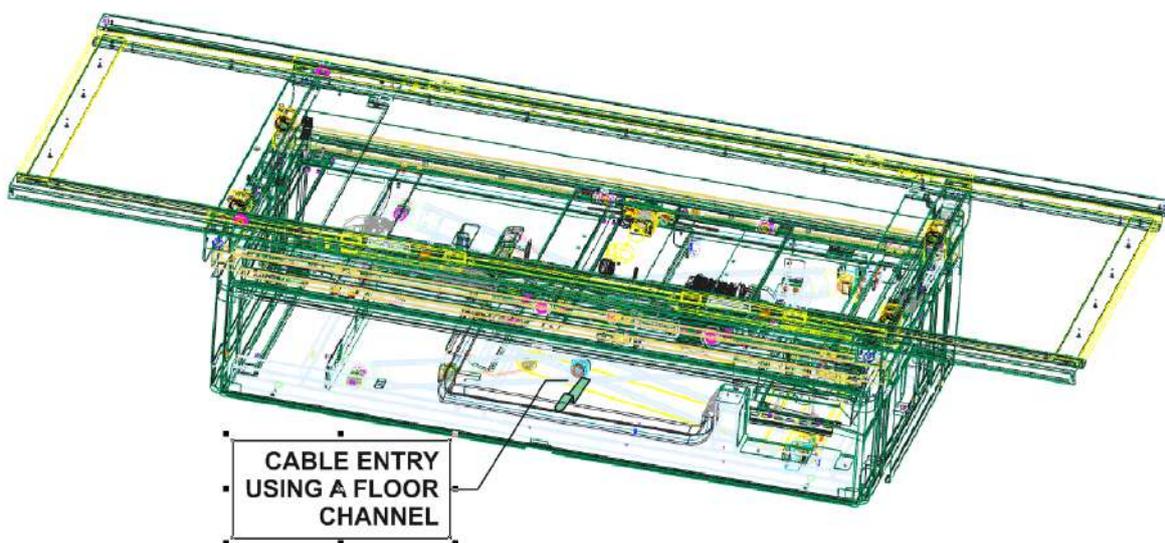
1. In case the table receptor is a FIXED DR FLAT PANEL and the wall stand is equipped with an AEC detector:
  - a. Remove the AEC detector from the receptor holder. Mark the centre position for easy reinstall later. (*Note: leave the AEC detector in place for cassette type removable receptors.*)
  - b. Mount the fixed DR flat panel.
  - c. Reinstall the AEC detector and make sure that it is aligned in the centre of the holder. Use previously marked position as available.
  - d. Route the DR flat panel interface cable along with the other cables.

### 6.7.5 Tabletop Installation

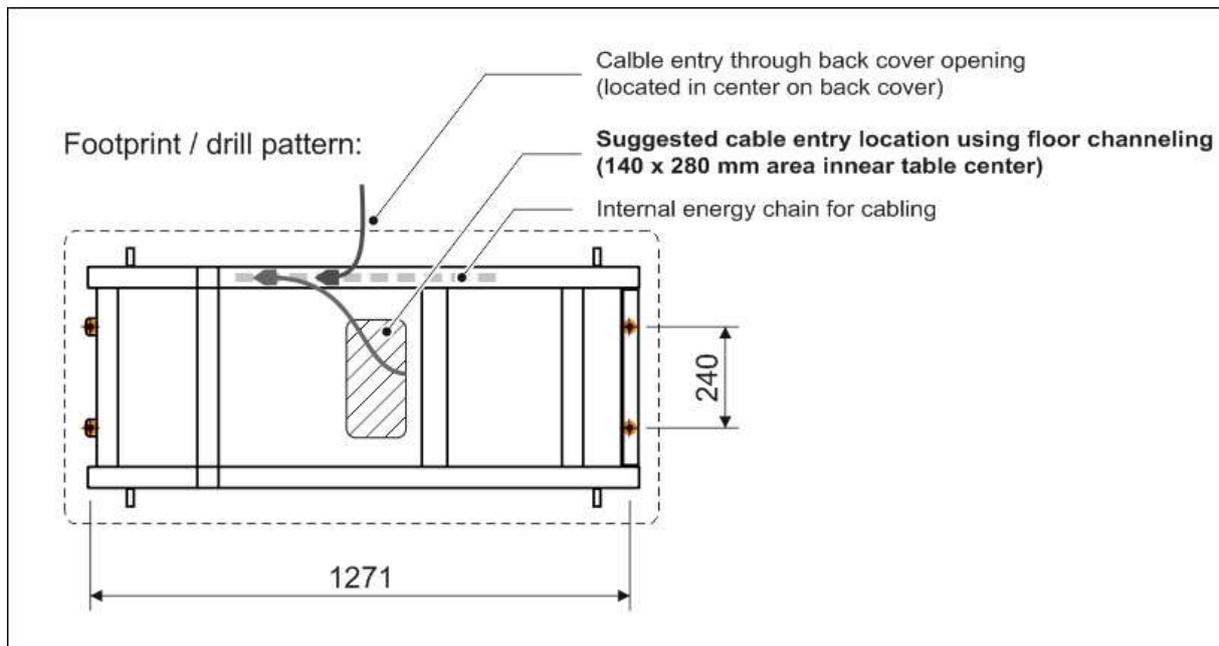
1. Tabletops are factory adjusted for the table frames. Check the marking on the sides of the table. The markings on the table and the tabletop must be on the same side (left or right).
2. Locate and uncrate the tabletop.
3. Remove two end stops from one side of the tabletop so that:
  - a. the tabletop can slide on the frame from opposite the wall stand;
  - b. the tabletop marking will end up on the same side of the table.
4. Carefully slide the tabletop onto the frame. While sliding, push down each brake into its nest to prevent collision with the tabletop.
5. Reinstall the two end stops.

### 6.7.6 Cable Entry Using a Floor Channel

The recommended method of connecting the power and interconnecting cables is using a floor channel reaching underneath the table. Plan the opening according to the following drawing:

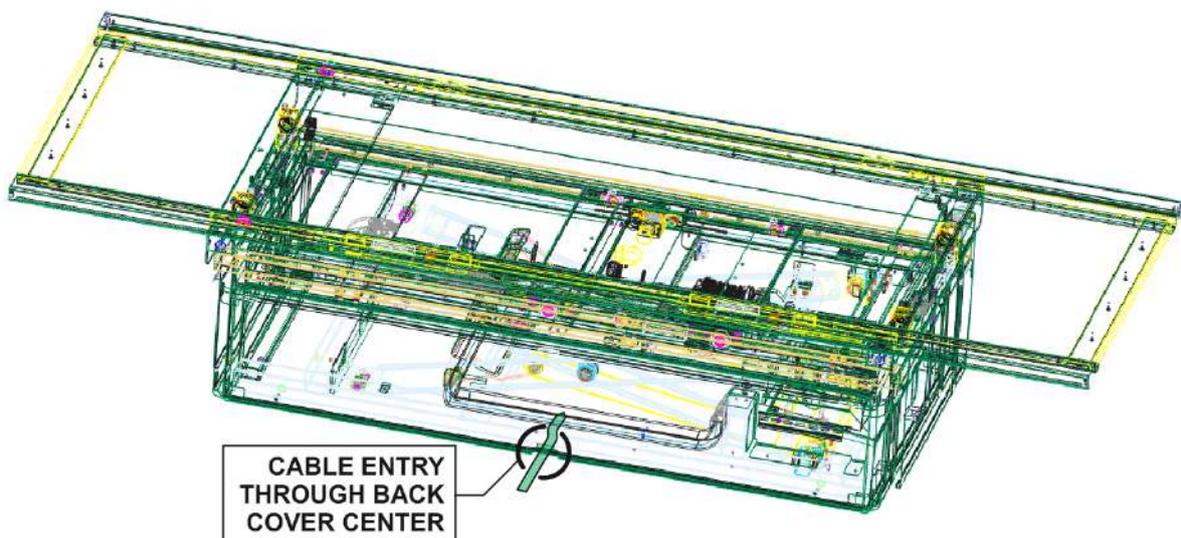


The floor opening (up to ~ 140 x 280 mm) should be planned in the center on the table base. Use the following diagram for approximate opening location:



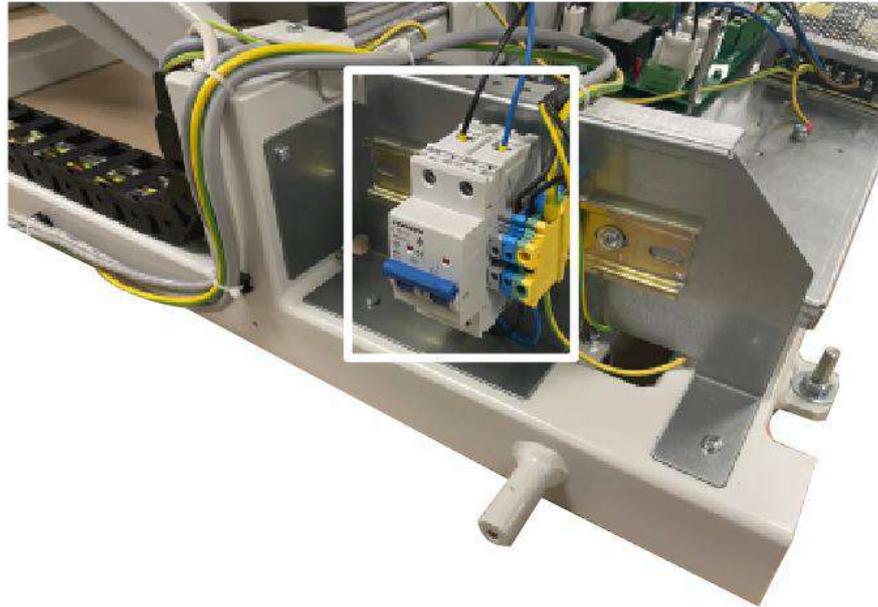
### 6.7.7 Cable Entry Through the Back Cover

Alternatively, the cables can be lead through the center opening of the back cover. Run the cables through the center opening, then enter the cables into the internal energy chain mounted on the lower table frame.



### 6.7.8 Connections to the System Control Box

1. Make sure that the system control box is OFF.
2. Connect the 230VAC cable, CAN bus cable and the yellow-green PE cable to the system control box.
3. Once the connections are completed, make sure that the circuit breaker inside the table is switched on.



### 6.7.9 Setting Phoenix 2 Table Functions

The CXPHX2 board has a set of DIP switches that configure some of the functions of the table. The DIP switches are factory configured for the following:

DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8
OFF	OFF	OFF	OFF	ON	OFF	ON	ON
Auto test mode	Table top brake release config	RESERVED	Stop at Center Pos and SID height	Speaker Enable	Double - Kick Enable	CAN Bus Com	HW Test Mode

The PHOENIX elevating table features two circuits where the duration of the vertical movement STOP time and the transversal movement of the tabletop are adjustable.

The following service functions are available:

#### **DS2: STOP at tabletop center and SID position**

When OFF:

Both the left and right brake release foot pedals release the transverse AND longitudinal brakes.

When ON:

- (1) The LEFT brake release foot pedal releases the transverse AND longitudinal brakes.
- (2) The RIGHT brake release foot pedal releases the LONGITUDINAL brakes ONLY.

#### **DS4: STOP at tabletop center and SID position**

When ON:

- (1) the tabletop will stop at the center of travel for a few seconds while positioning the tabletop. Movement can continue when the STOP delay elapses.
- (2) The vertical travel will stop for a few seconds when reaching the preset SID height. Movement continues after the STOP delay elapses.

#### **DS5: Enable the speaker (buzzer) on controller board**

#### **DS6: Enable double kick (double tap) safety feature for the vertical travel**

### **6.7.10 Safety Feature Settings**

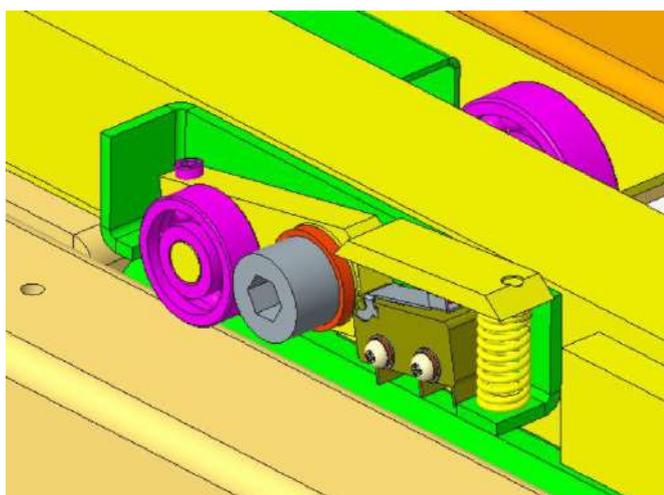
The Phoenix 2 elevating table is equipped with several safety features that prevent the undesired operation of the table (i.e. patients getting on or off the table and involuntarily stepping on the foot pedal) and avoid accident.

#### **Vertical Movement**

The table vertical movement cannot be started unless the operator initiates it by double tapping on the foot pedal. To activate the preferred feature set DS5 DIP switch to ON position.

#### **Crash Guard**

To prevent damage to the table while lowering accidentally on any object, crash guards are installed in all four corners of the tabletop frame. This guard stops the down motion when the tabletop is pushed upward.



*Figure 42 – Crash guard mounted on the table frame*

### 6.7.11 Phoenix 2 Crash Guard Setup Procedure

1. In order to prevent the possible collisions between the tabletop and the crash guard, it has to be set up properly. In the first step, the actuator lever (1) has to be levelled using a set screw (2). The tip of the actuator lever has to be just slightly lower than the topmost point of the load-bearing (3).

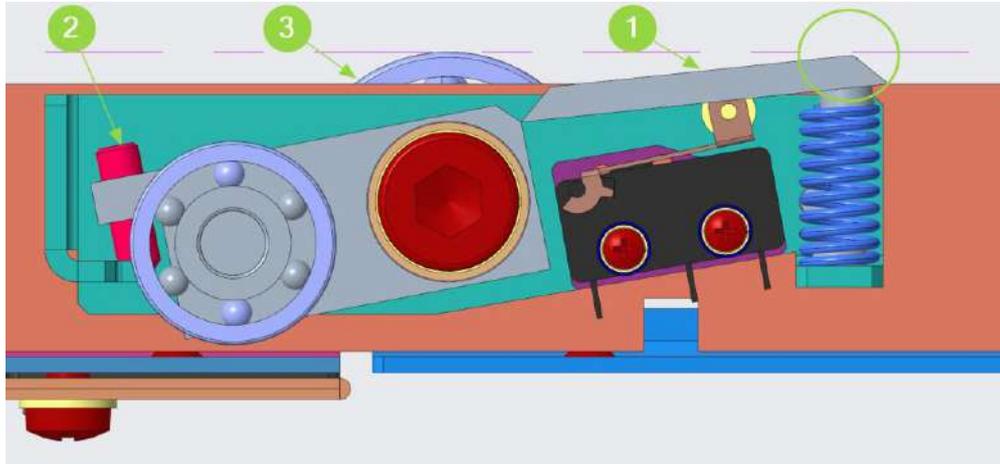


Figure 43 – Correct setup of Phoenix 2 crash guard

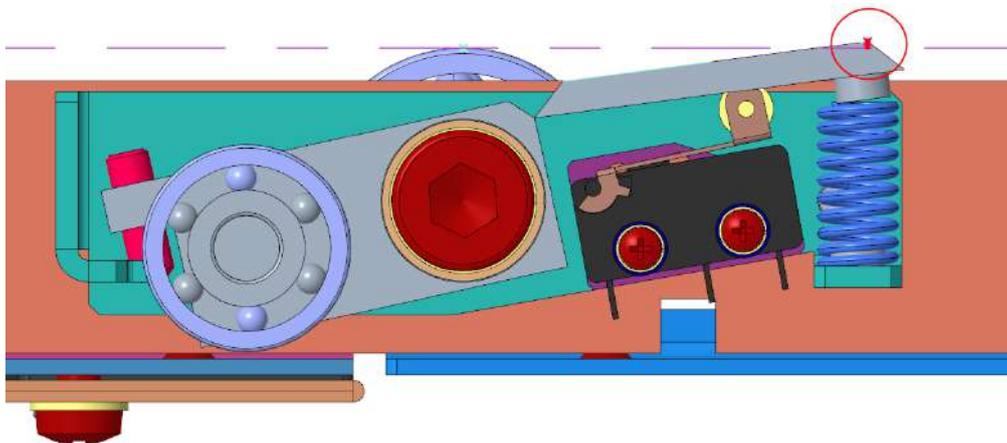


Figure 44 – Incorrect setup of Phoenix 2 crash guard

2. This is followed by the switching point adjustment. After loosening the screws (5) the microswitch can be translated along the red arrow and re-tightened in the desired position. In the optimal setup the actuator lever travels 1.5 - 2 mm to the switching point.

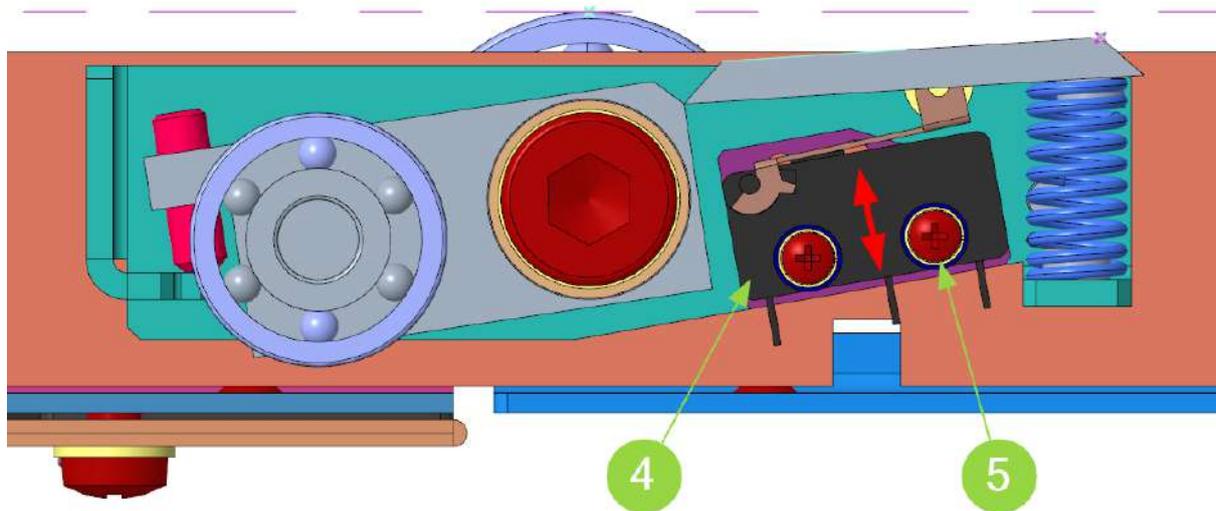


Figure 45 – Positioning of the crash guard microswitch

### 6.7.12 Tabletop SID Height Setting

The vertical movement can be configured to stop at the desired SID height (see section *Table Function Settings* - defaults to 75cm). To activate the SID height stop feature, set dip switch DS4 to ON.

To change the SID height setting:

1. Move the table to the desired SID height
2. Simultaneously press the Bucky brake release button AND step on BOTH left and right table top release pedals.

### 6.7.13 Tabletop Brakes

The function of the brakes is to hold the tabletop in a fixed position while the releasing foot pedal is not activated. If the tabletop tends to move in any directions while the brakes are activated, please check the surface of the brakes and the rails system facing the brakes. The brakes and rails are treated before shipment to avoid oxidation on the surface, so this protecting layer may reduce effectiveness of the brakes. If needed brakes and rails must be cleaned. Remove all protecting grease or oil from the surface to have best performance. To get access to the cross-table brakes, remove the side cover on both sides (inside the table) of the transverse travel bearing assembly, clean the brakes, and surface as necessary. The longitudinal brakes are underneath the tabletop, you need to slide the top in one and the other direction (remove the stopping end-pieces first) to have access to the brakes.

## 7 SYSTEM CONNECTIONS

### 7.1 AEC CONNECTIONS



#### ATTENTION!

The AEC detectors are shipped installed into the receptor holder centred to the receptor. When removing and reinstalling the AEC detector during the AEC detector, **make sure that the AEC detector is properly centred** with the receptor.

The AEC preamplifiers are connected to the generator using the supplied 10 or 15m D-SUB9 shielded cables (*if shipped with special circular connectors, please refer to the relevant particular instructions*).

The AEC detectors are connected according to the following:

AEC detector	Channel	CMP-200 connection	Milestone LC connection
Table receptor	1	AEC interface board (P/N 737998) J1	LCAEC board J1 (AEC 1 in)
Wall receptor	2	AEC interface board (P/N 737998) J2	LCAEC board J2 (AEC 2 in)

For AEC configuration (e.g. channel configuration, straight or mirrored orientation) and calibration (e.g. kV tracking and channel balancing), please refer to the X-ray generator technical manual.

### 7.2 BUCKY CONNECTIONS

The receptor holders may be equipped with an oscillating grid mechanism. In this case, the B1-B8 terminal block must be connected to the X-ray generator using the supplied cable.

Receptor	Channel	CMP-200 connection	Milestone LC connection
Table receptor	1	Room interface board J2	LCBSC board J1
Wall receptor	2	Room interface board J4	LCBSC board J2

Please refer to the wiring diagram supplied in the system documentation for connection details:

1. D-1752 - CMP 200 Bucky Wiring
2. D-1706 - MS LC Bucky Wiring

### 7.3 APR POSITIONING INTERFACE

The Perform-X F400 system is integrated with the image acquisition workstation to provide APR positioning, tube side generator control and tube side preview functionality. The 10.4” LCD touch screen control console on the tube stand is preconfigured for the integration. With saved equipment positions, the operator can save **default physical positions** for any APRs selected in dicomPACS DX-R.

The equipment positioning interface on the tube side is shown on *Figure 46*.



Figure 46 – APR positioning interface on the tube side console

Pos	Descriptions for <i>Figure 46</i>
1	List of saved APR positions. The sort order of display can be specified in PXIM Service Application – alphabetical order is shown.
2	The currently selected APR is shown with distinctive colour: <ul style="list-style-type: none"> <li>• BLUE background: selected entry, equipment NOT physically in required position</li> <li>• GREEN background: selected entry, equipment physically in required position</li> <li>• ORANGE background: new (unsaved) APR received from the acquisition workstation. Operator must save the position to keep the entry in the database.</li> </ul>
3	Favourite (e.g., frequently used) positions can be marked with a star.
4	Generator control and preview page selector buttons. The superimposed small notification icons provides information on interface status (error, number of images in current study, etc.).
5	Display favourites only or all positions is list.
6	Generator control and preview page selector buttons when indicating connection error with dicomPACS DX-R.

In case of connection problems (as indicated by *Figure 46* #6), verify the following:

1. The 10.4” tube side LCD touch screen control console must be connected to the acquisition workstation using the FTP cable with the yellow strain relief boot.
2. Verify IP addresses for the devices:
  - a. 10.4” tube side LCD touch screen control console: 192.168.13.38
  - b. Image acquisition workstation: 192.168.13.37
3. dicomPACS DX-R is running
4. Check if there is a valid (200) HTTP response to the following request on the dicomPACS DX-R PC using a browser:  
<http://localhost:7002/swagger-ui>

## 8 ALIGNMENT AND ADJUSTMENT

After installing the tube stand, wall stand and table, verify that the centring and positioning of the equipment is correct. If necessary, make small adjustments using the procedures described above. *(Please note that this final positioning may need to be performed with images, once the receptor / acquisition system is operational.)*

### 8.1 PREPARATIONS FOR CENTERING

**AT THIS POINT THE FOLLOWING COMPONENTS SHOULD BE CONNECTED COMPLETELY READY TO BE POWERED UP:**

- **Control Box**
  - **CX Remote Box**
  - **Tube stand**
  - **Wall stand**
  - **Radiographic table**
  - **Collimator**
  - **PXIM Service Application is installed**
1. Make sure the system control box is ON (emergency switch is deactivated and the circuit breaker inside is in the ON position)
  2. Power the system up by turning on room power
  3. Run the PXIM Service Application previously installed on a laptop or on the image acquisition workstation
  4. Check basic movement and collimator light field functionality

## 8.2 X-RAY TUBE ROTATION CALIBRATION

Check X-ray beam wandering in both horizontal (90°) and vertical (0°) beam directions in the entire SID range. Use the projected collimator laser guide if available. If the beam wandering is larger than 1 cm, perform the mechanical alignment procedure as described in the *Perform-X System Installation Manual*.

Once the mechanical centering / adjustment is acceptable, the tube rotation drive positioning accuracy must be verified and calibrated if necessary.

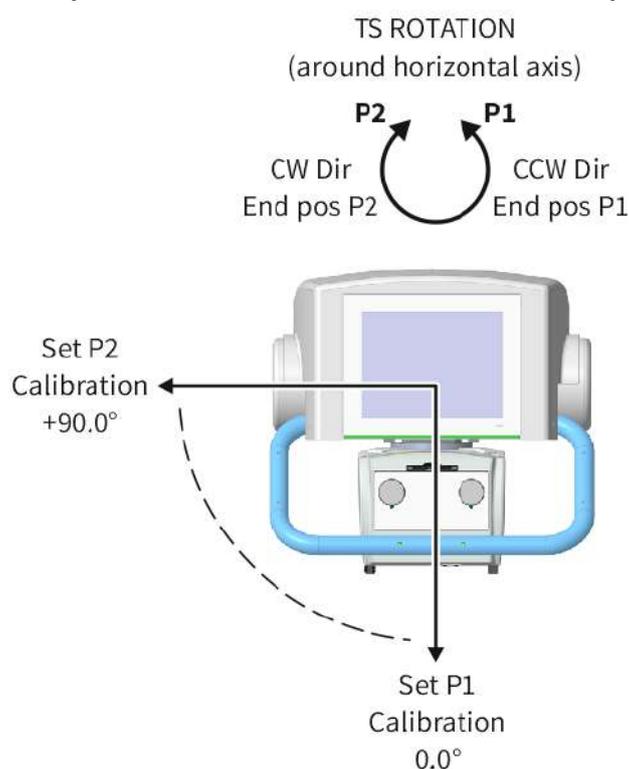


Figure 47 – X-ray tube rotation calibration

### Calibration procedure for **LEFT wall stand orientation**:

1. Select TS Rotation Drive in Connection Menu.
2. Using the remote controller, turn the X-Ray tube towards the Wall receptor so that the X-ray beam travels horizontally.
3. Enter **90** into **P2** field and press **Cal P2**.
4. Using the remote controller, turn the X-Ray tube towards the Table receptor so that the X-ray beam travels vertically.
5. Enter **0** into **P1** field and press **Cal P1**.
6. Setting the X-ray tube to 0° and 90° (e.g. using the GO TO position function in the service application), check the beam wandering in both directions in the entire SID range. If necessary, repeat the calibration procedure until the beam wandering is acceptable.

### Calibration procedure for **RIGHT wall stand orientation**:

*IMPORTANT! During the calibration, the rotation values are negative for RIGHT beam direction. The console (user mode) rotation display shows positive values when turned*

towards the wall receptor.

1. Select TS Rotation Drive in Connection Menu.
2. Using the remote controller, turn the X-Ray tube towards the Wall receptor so that the X-ray beam travels horizontally.
3. Enter **-90** into **P1** field and press **Cal P1**.
4. Using the remote controller, turn the X-Ray tube towards the Table receptor so that the X-ray beam travels vertically.
5. Enter **0** into **P2** field and press **Cal P2**.
6. Setting the X-ray tube to 0° and -90° (e.g. using the GO TO position function in the service application), check the beam wandering in both directions in the entire SID range. If necessary, repeat the calibration procedure until the beam wandering is acceptable.

### 8.3 X-RAY TUBE VERTICAL CALIBRATION



The X-ray tube vertical position is factory adjusted. Should a recalibration be necessary, follow the steps in this section.

The X-ray tube absolute vertical position in ceiling mount systems is affected by the mechanical installation and room properties (room height) and must be calibrated on-site.

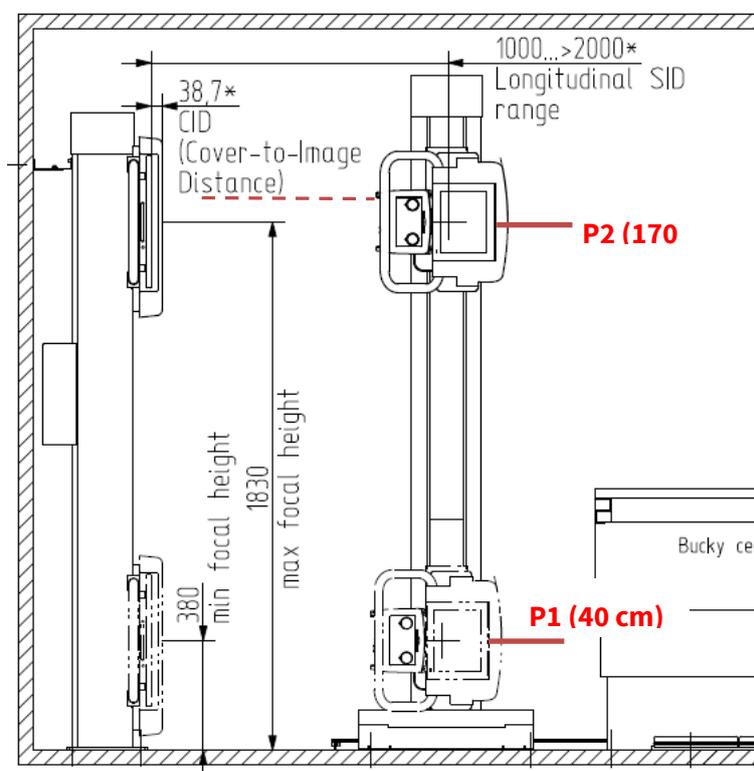


Figure 48 – X-ray tube vertical position calibration

1. Select **TS Rotation** Drive in Connection Menu.
2. Using the GO TO Position function, set the X-ray tube rotation to 90° (LEFT orientation systems) or to -90° (RIGHT orientation systems) so that the beam is directed towards the wall receptor.
3. Make sure that vertical wall receptor to X-ray tube **tracking is OFF**.
4. Select **TS Vertical** Drive in Connection Menu.
5. Move the X-ray tube vertically to 170 cm focus-to-floor height.
6. Enter **170** into field **P2** and press **Cal P2**.
7. Select **WS Vertical** Drive in Connection Menu.
8. Move the wall receptor vertically so that the receptor is centered with the X-ray beam. Use the collimator laser guide if available.
9. Enter **170** into field **P2** and press **Cal P2**.
10. Select **TS Vertical** Drive in Connection Menu.
11. Move the X-ray tube vertically to 40 cm focus-to-floor height.
12. Enter **40** into field **P1** and press **Cal P1**.
13. Select **WS Vertical** Drive in Connection Menu.
14. Move the wall receptor vertically so that the receptor is centered with the X-ray beam. Use the collimator laser guide if available.
15. Enter **40** into field **P1** and press **Cal P1**.

## 8.4 WALL STAND VERTICAL CALIBRATION

To match the vertical position calibration of the X-ray tube, the wall receptor must also be calibrated on-site.

Pre-requisites for this step are:

- Calibrated X-ray tube rotation (section 0)
- Calibrated X-ray tube vertical movement (section 8.3)

Refer to [Figure 49](#) for calibration arrangement.

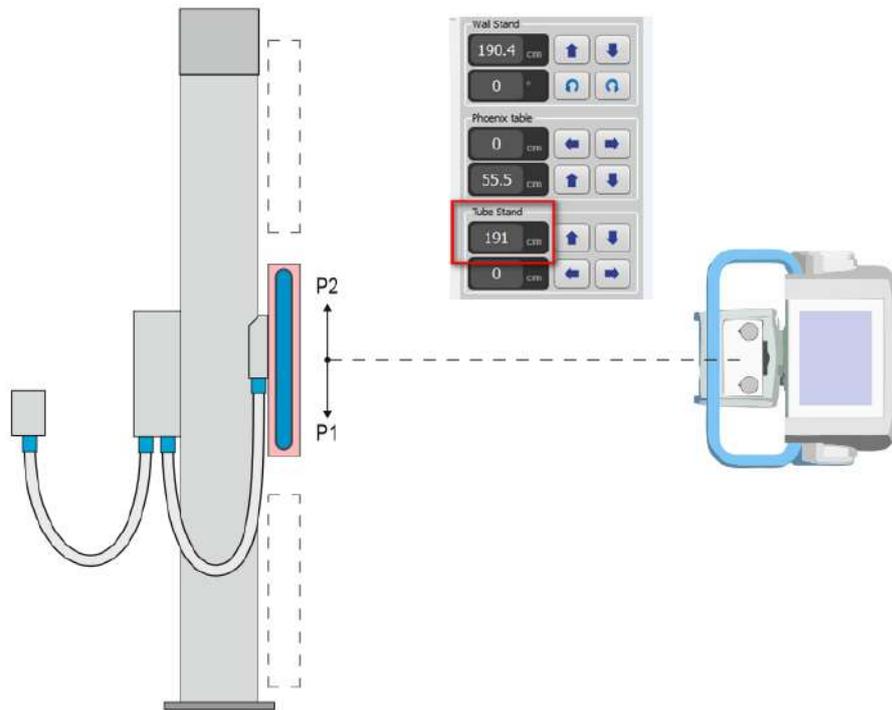
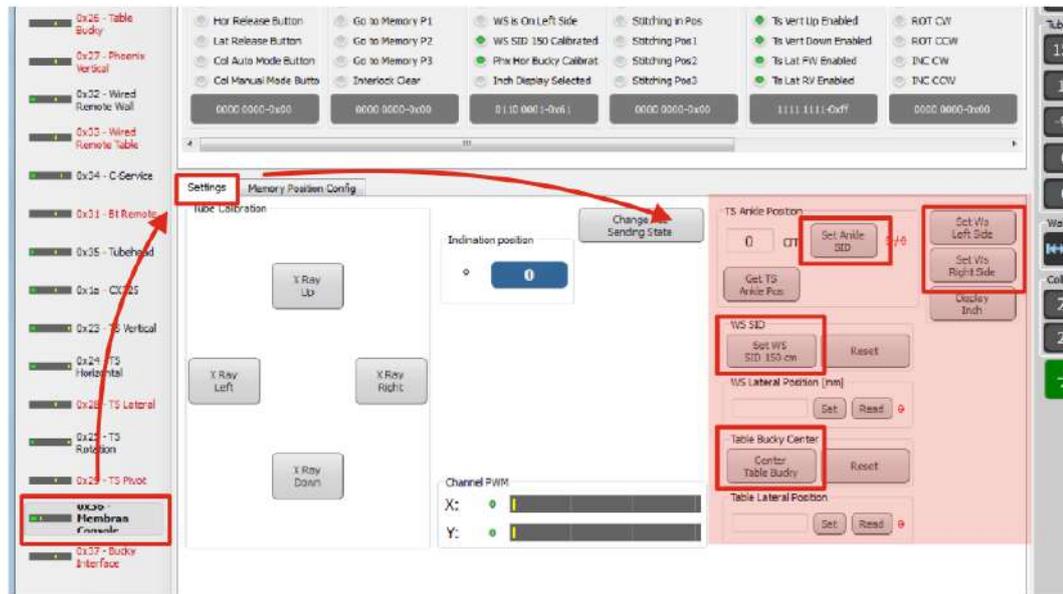


Figure 49 – WS vertical calibration arrangement

1. Select **TS Rotation** Drive in Connection Menu.
2. Using the GO TO Position function, set the X-ray tube rotation to 90° (LEFT orientation systems) or to -90° (RIGHT orientation systems) so that the beam is directed towards the wall receptor.
3. Make sure that vertical wall receptor to X-ray tube **tracking is OFF**.
4. Select **WS Vertical** Drive in Connection Menu.
5. Move the WALL RECEPTOR vertically to its highest position.
6. Press **Set End Pos 2**.
7. Move the WALL RECEPTOR vertically to its highest position where the X-ray tube can be centered with the receptor (the highest position of the tube may be lower than that of the receptor).
8. Read the TUBE STAND vertical position value from the Movement Monitor.
9. Enter this value into the **P2 field** and press **Cal P2**.
10. Move the WALL RECEPTOR vertically to its lowest position.
11. Press **Set End Pos 1**.
12. Move the WALL RECEPTOR vertically to its lowest position where the X-ray tube can be centered with the receptor (the lowest position of the tube may be higher than that of the receptor).
13. Read the TUBE STAND vertical position value from the Movement Monitor.
14. Enter this value into the **P1 field** and press **Cal P1**.

## 8.5 RELATIVE CALIBRATION OF THE COMPONENTS

The relative positions of each component are set using the C-Service service application. Start the application, make sure it connects to the CAN bus and select the 'Membrane Console' page. The position controls are located on the 'Settings' tab.

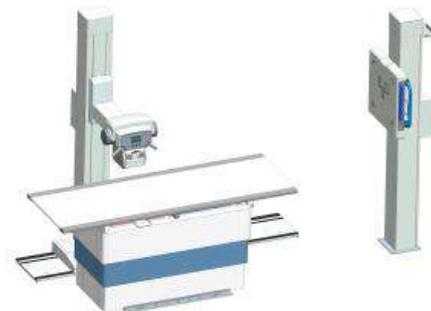


### 8.5.1 Checking / Setting System Orientation

The Perform-X system can be shipped / installed in left or right orientation. The orientation affects the horizontal SID measurement, the low extremities SID functionality and the automatic positioning (if applicable).



*LEFT orientation example*



*RIGHT orientation example*

### 8.5.2 Setting the 150 cm Horizontal SID

To calibrate the horizontal SID display, simply set 150 cm horizontal SID on the equipment and press the ‘**Set WS SID 150 cm**’ button in the PXIM Service Application.

Make sure that the SID is measured between the X-ray tube focal point and the image plane. Use the collimator tape measure when available.

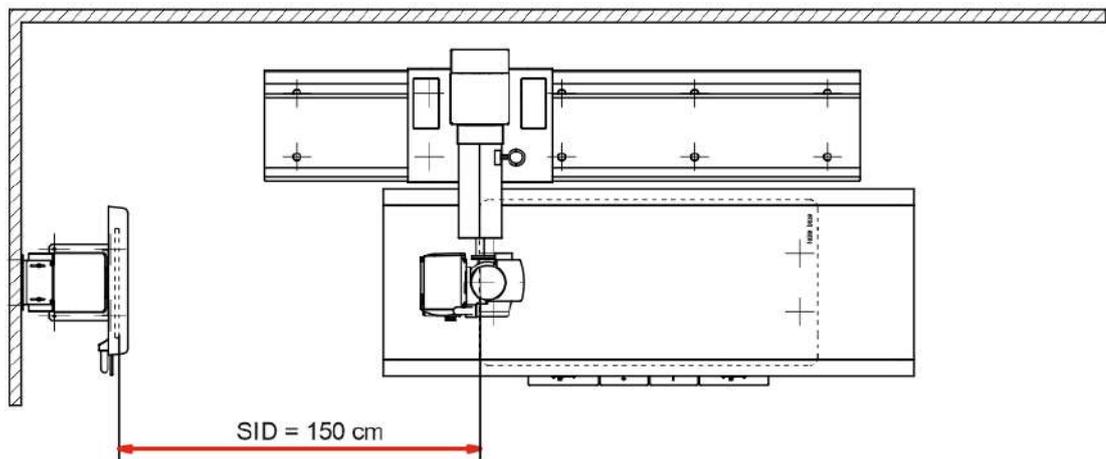


Figure 50 – Setting the 150 cm horizontal SID for calibration

### 8.5.3 Setting the Minimum SID for Low Extremity Procedures

In order **to avoid collision** between the X-ray tube and the patient table during low extremity examinations at the wall stand (with the tube near the floor), the maximum ankle SID must to be configured.

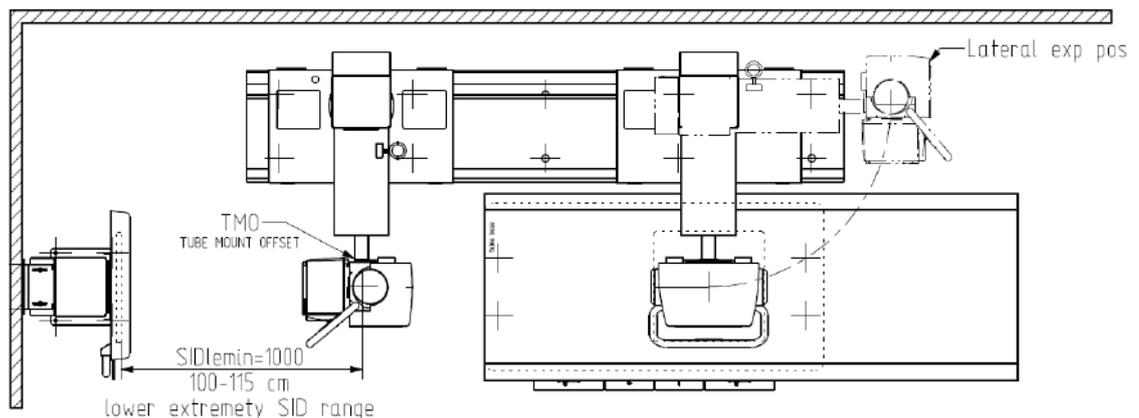


Figure 51 – Example layout for low extremity max SID calibration with the tabletop pushed aside

1. Select Console node from the Connection Menu in the PXIM Service Application
2. Slide the tabletop away from the wall receptor to allow the X-ray tube to travel near the floor

3. Move the X-ray tube into low extremity exposure position making sure that there is safe clearance between the X-ray tube assembly and the patient table (at least 5 cm)
4. Read the SID value shown in the Control Menu area of the PXIM Service Application. Enter this value into field '**TS Ankle Position**' and press '**Set Ankle SID**'.

#### 8.5.4 Centring the Table Receptor

The relative positioning of the X-ray tube and the table receptor must be calibrated.

1. Position the X-ray tube over the table receptor centre with vertical X-ray beam.
2. Make sure that the receptor is in the exact centre of the travel.
3. In the PXIM Service Application, press the '**Centre Table Receptor**' button to calibrate and save the position.

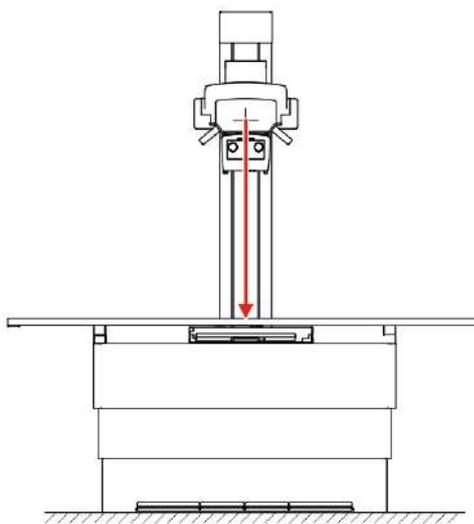


Figure 52 – Centering the table receptor longitudinally

## 9 ELECTRICAL DIAGRAMS

See drawings added to each system

## 10 ACCEPTANCE TEST

### 10.1 INTRODUCTION

 <b>WARNING!</b>	The Acceptance Test shall be performed after the installation is completed and the equipment is calibrated, before putting the system in service.
 <b>ATTENTION!</b>	For test requiring producing X-rays, such as parameter accuracy, linearity and reproducibility, refer to the generator's maintenance manual / acceptance test.

The acceptance test shall be performed on a **fully assembled and functional** Perform-X system. The acceptance testing verifies that the Perform-X system with the generator and accessories is performing according to requirement that the manufacturer specified and its essential performance and basic safety requirements are met. It shall be done:

- after the system is installed and calibrated;
- when components which may affect the beam quality / centring / mechanical safety are replaced;
- (recommended) every 2 years during periodic maintenance.

The following is a list of components that warrant acceptance test when replaced:

- X-ray tube (tube assembly) and collimator (beam limiting device)
- Counterbalance spring and associated mechanical components
- Distance / angle measuring potentiometers
- Motor drive and / or its circuit boards
- Keypads (detector side or remote controller)
- Software

 <b>WARNING!</b>	During the following process <b>X-ray may be produced</b> . Take all appropriate safety precautions to protect personnel from irradiation!
 <b>WARNING!</b>	Always ensure that the equipment under test and all associated test equipment is <b>properly grounded</b> . Ensure that the <b>high voltage cables are intact</b> / undamaged and properly connected before attempting exposures!

## 10.2 STABILITY, SYSTEM INTEGRITY AND COUNTERBALANCING

The '**system in standby**' below refers to a powered ON state with none of the movement controls or motorized movements active.

The X-ray tube position is securely locked when power is OFF and when the system is in standby (tube does not move when a directional force of 30N or less applied).	<input type="checkbox"/>
The wall detector position is securely locked when power is OFF and when the system is in standby (detector does not move when a directional force of 30N or less applied).	<input type="checkbox"/>
The tabletop position is securely locked when power in ON and when the system is in standby (detector does not move when a directional force of 30N or less applied).	<input type="checkbox"/>
The table withstands 250kg <b>distributed load</b> on the tabletop, does not collapse or lowers height (if applicable).	<input type="checkbox"/>
All of the primary vertical mechanical safety mechanisms (safety wire ropes) are intact.	<input type="checkbox"/>
When releasing the X-ray tube vertical brake release, the tube does not move up or down (with no directional force applied).	<input type="checkbox"/>
When releasing the X-ray tube rotational brake release, the tube does not rotate (with no directional force applied).	<input type="checkbox"/>
When releasing the wall detector vertical brake release, the detector does not move up or down (with no directional force applied).	<input type="checkbox"/>

## 10.3 MANUAL MOVEMENTS

Horizontal manual X-ray tube movement is possible when pressing the brake release button with directional force of 30N or less applied in either direction.	<input type="checkbox"/>
Horizontal tube movement range is at least 160 cm	<input type="checkbox"/>
Vertical manual X-ray tube movement is possible when pressing the brake release button with directional force of 30N or less applied in either direction.	<input type="checkbox"/>
When turned towards the wall detector, tube focus-floor distance range is at least 35-180 cm.	<input type="checkbox"/>
Rotational manual X-ray tube movement is possible when pressing the brake release button with directional force on the handles of 30N or less applied in either direction.	<input type="checkbox"/>
Rotational X-ray tube movement range is at least -150 to 150 degrees.	<input type="checkbox"/>
Vertical manual wall detector movement is possible when pressing the brake release button with directional force of 30N or less applied in either direction.	<input type="checkbox"/>
Wall detector centre to floor distance range is at least 35-180 cm.	<input type="checkbox"/>

Longitudinal manual tabletop movement is possible when pressing the brake release button with directional force of 30N or less applied in either direction.	<input type="checkbox"/>
Total longitudinal tabletop movement range is at least 110 cm.	<input type="checkbox"/>
Transversal manual tabletop movement is possible when pressing the brake release button with directional force of 30N or less applied in either direction.	<input type="checkbox"/>
Transversal tabletop movement range is at least 24 cm.	<input type="checkbox"/>

#### 10.4 POSITION MEASUREMENT ACCURACY

Set the horizontal SID to 100 cm and measure the tube focal spot-to-detector plane distance. The measured value is between 98 and 102 cm (+/- 2%).	<input type="checkbox"/>
Set the horizontal SID to 180 cm and measure the tube focal spot-to-detector plane distance. The measured value is between 176,4 and 183,6 cm (+/- 2%).	<input type="checkbox"/>
Set the vertical SID to 100 cm and measure the tube focal spot-to-detector plane distance. The measured value is between 98 and 102 cm (+/- 2%).	<input type="checkbox"/>
Set the tube rotation to 0 degrees and measure the tube rotation angle using a digital level. The measured value is between -0,5 and +0,5 degrees.	<input type="checkbox"/>
Set the tube rotation to 90 degrees (towards wall receptor) and measure the tube rotation angle using a digital level. The measured value is between +89,5 and +90,5 degrees.	<input type="checkbox"/>

#### 10.5 X-RAY BEAM CENTERING

Take an X-ray on the wall detector with the following settings: SID=130 cm, light field = 20 cm x 20 cm. Mark the corners of the light field before taking the exposure. Verify that the greatest difference between the light field area and irradiated area is no more than 4 cm in any direction.	<input type="checkbox"/>
Take an X-ray on the table detector with the following settings: SID=130 cm, light field = 20 cm x 20 cm. Mark the corners of the light field before taking the exposure. Verify that the greatest difference between the light field area and irradiated area is no more than 4 cm in any direction.	<input type="checkbox"/>
Centre the light field on the wall detector at the shortest SID. Move the X-ray tube to the longest SID and check if the light field centring is within $\pm 2$ cm in both vertical and horizontal directions.	<input type="checkbox"/>
Centre the light field on the table detector at the shortest SID. Move the X-ray tube to the longest SID and check if the light field centring is within $\pm 1$ cm in both vertical and horizontal directions	<input type="checkbox"/>

## 10.6 NON-DESTRUCTIVE ACTIVE SAFETY FEATURES

If the tube stand motorized vertical drive is available, move the X-ray tube, then hold the X-ray tube to stop the movement. The over-current protection activates and the motorized drive stops within 1 second.	<input type="checkbox"/>
M the X-ray tube using the motorized drive, then hold the X-ray tube to stop the movement. The over-current protection activates and the motorized drive stops within 1 second.	<input type="checkbox"/>
Move the detector using the motorized drive, then hold it to stop the movement. The over-current protection activates and the motorized drive stops within 1 second.	<input type="checkbox"/>
When driving the table down, an audible warning signal (beep) is activated in the lowest 10 cm of travel.	<input type="checkbox"/>
Make sure the tabletop is in centre position (symmetrical to the table base). When driving the table down (if applicable), the movement immediately stops when lifting any of the corners of the tabletop (check all 4 corners).	<input type="checkbox"/>
While using the motorized drive (e.g. auto-tracking is active), push the emergency switch located on the system control box. The movement immediately stops.	<input type="checkbox"/>
When pressing (pushing in) the EMERGENCY STOP button on the system control box (if applicable): <ul style="list-style-type: none"> <li>• motorized movements (if applicable) are not possible;</li> <li>• the permanent brakes are engaged and moving parts, like X-ray tube and wall receptor stay firmly in place.</li> </ul>	<input type="checkbox"/>

**In case any of the above tests fail, take appropriate action and correct / restore the failed functionality before using or commissioning the equipment.**

## 11 MAINTENANCE

The Perform-X radiographic system requires regular maintenance to ensure safe operation and increase the operating life of the equipment. The operator shall check the equipment for functional defects or any deviation from the normal operation. In case of deviation, the unit shall be turned off and your professional service company must be notified. The equipment shall not be used until the defect is repaired.

### 11.1 MAINTENANCE SCHEDULE

The following is a list of maintenance activities with a recommended schedule. The activities are detailed in the sections below.

Action	Performed by	Frequency
Cleaning and disinfection	Operator	Before patient enters the occupancy zone
Thorough cleaning (1)	Operator	Between shifts, at least weekly
Routine check (basic visual and operational check)	Operator	Start of every shift
Periodic maintenance	Service personnel	Yearly
X-ray tube and AEC calibration (2)	Service personnel	Yearly
Motorized movement calibration (if applicable)	Service personnel	Yearly
Acceptance test	Service personnel	Every 2 years
DAP calibration (3)	Service personnel / DAP manufacturer	Every 5 years
Safety wire ropes replacement	Service personnel	Every 5 years

- (1) Perform a thorough cleaning at least once a week even if the system is not in daily use.
- (2) Assuming average use (up to 100 exposures per day). More frequent calibration may be necessary in case of higher traffic.
- (3) As per DAP manufacturer recommendation.

### 11.2 DAILY ROUTINE CHECK

Check the operating elements (X-ray tube, imager, tabletop, brakes etc.) for proper functioning. If you hear unusual noises or unusual sounds while positioning or experience

slower elevating speed (Phoenix table, if applicable), contact your service company immediately.

### 11.3 WEEKLY CHECK

The rails must be clean for proper operation and smooth horizontal travel. If necessary, clean the rails with a lint-free cloth.

### 11.4 PERIODIC MAINTENANCE

To ensure safe and trouble free operation the system shall be checked by a professional service company, at least annually.



Each failing component which effects the safe operation of the equipment, shall be replaced with original spare parts.

**ATTENTION!**

Parts of the equipment are treated with anti-corrosion agents. To prevent wear, the manufacturer applied lubricants and under normal circumstances there is no need for further lubrication. Contact your service company if lubrication becomes necessary.

### 11.5 CALIBRATION

Some of the components require periodic calibration:

- The X-ray tube must be calibrated every 12 months to compensate for tube aging and ensure accurate operation (refer to the X-ray generator technical manual for calibration instructions)
- If the system is shipped with a DAP (dose area product) meter, the DAP meter is factory calibrated. The calibration certificate is included in the DAP packaging. Recommended frequency of recalibration is 5 years and must be carried out based on the included DAP user manual.

## 11.6 CLEANING AND DISINFECTION

In case the system is equipped with touchscreen, it is recommended to clean the surface of the screen with a dry lint-free cloth that does not leave scratches and other marks on it before use.

The Perform-X System does not require special cleaning or sterilization. However, it is recommended to clean from time to time:

1. the tube stand control box and handles;
2. the tabletop;
3. wall bucky / detector holder cover and brake release handles.

For cleaning without disinfecting, you may use mild soapy water or an equivalent cleaning solution. Apply some solution with lint-free cloth or paper towel and wipe down the surface.

If for some reason, the handles or other surfaces require disinfection, you may use Actichlor (contains Sodium Dichloroisocyanurate, a form of chlorine) or equivalent with a 3 to 5% Hypochlorite concentration.

Method of disinfection:

1. Turn off the system completely (using the wall disconnect switch);
2. Use 50/50 disinfectant / water solution;
3. Apply (e.g. spray) the disinfectant on a lint-free cloth. Make sure the **cloth is only damp and not wet;**
4. **Do NOT apply the disinfectant directly** on the surfaces as the substance may get into the equipment;
5. Wipe the surfaces carefully with the cloth.;
6. Before turning the equipment on again, make sure that the disinfectant has evaporated.



**WARNING!**

To clean / treat the surfaces, only acid-free, non-corrosive, non-abrasive substances shall be used.

Only such disinfecting methods shall be used that correspond to the relevant regulations and rules as well as the protection from explosion.

The use of disinfecting spray is not recommended because it can get inside the equipment.



**WARNING!**

Make sure that no water or other liquids enter any component of the Perform-X system. Such liquids may cause short circuit in electrical components and / or corrosion on surfaces.

## 11.7 DISPOSAL AND DECOMMISSIONING

X-ray machines do not present a radiation hazard when they are not in operation. However, many structural components are built with materials that may be considered hazardous (e.g., lead, tungsten) for disposal purposes. These materials must be segregated and disposed of in accordance with relevant local rules.

Dismantling and disposing the X-ray equipment may be subject to **clearance by a radiological survey**.



**WARNING!**

All dismantling and decommissioning activities related to the Perform-X system must be performed by organizations authorized to perform such tasks.



**WARNING!**

The Perform-X system is permanently installed equipment with radiation protection material that may contain hazardous materials. These include but are not limited to:

- Lead (in the X-ray tube and the collimator);
- Tungsten (in the X-ray tube);
- X-ray film (not supplied by Control-X Medical).



**WARNING!**

During decommissioning and disposal, serious injury may occur when dismantling such as:

- glass inside the X-ray tube max brake and splinters may cause injuries;
- skin may come into contact with hazardous substances (lead, tungsten);
- weights and heavy parts can become loose when disassembling.



### 11.8 EXAMPLE MAINTENANCE LOG

System ID: VR - \_\_\_\_\_ OR S/N: P- \_\_\_\_\_  
 Installation site: \_\_\_\_\_  
 Installation date: \_\_\_\_\_ Signature: \_\_\_\_\_

**Periodic maintenance**

Year after installation	Date	X-ray tube calibration	Mechanical calibration	Acceptance test	DAP calibration	Other: _____	Other: _____	Signature
1		<input type="checkbox"/>						
2		<input type="checkbox"/>						
3		<input type="checkbox"/>						
4		<input type="checkbox"/>						
5		<input type="checkbox"/>						
6		<input type="checkbox"/>						
7		<input type="checkbox"/>						
8		<input type="checkbox"/>						
9		<input type="checkbox"/>						
10		<input type="checkbox"/>						
11		<input type="checkbox"/>						
12		<input type="checkbox"/>						
13		<input type="checkbox"/>						
14		<input type="checkbox"/>						

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## 13 REVISION HISTORY

<b>Version</b>	<b>Date</b>	<b>Change</b>	<b>Pages</b>
01	2023.07.20	Original version	Entire document
02	2023.08.18	Deleted electrical drawings from section 9	79-86