

# **OVERHEAD TUBE SUPPORT**

**Installation/Service and Users Manual  
Part Number 01340-000**

**Rev G**

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# ***Overhead Tube Support* Service and Users Manual**

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## **Product Description**

The Summit overhead tube support provides the flexibility to facilitate a wide range of x-ray procedures.

Fully counterbalanced, this heavy-duty system can be easily positioned at any point within its total range of travel.

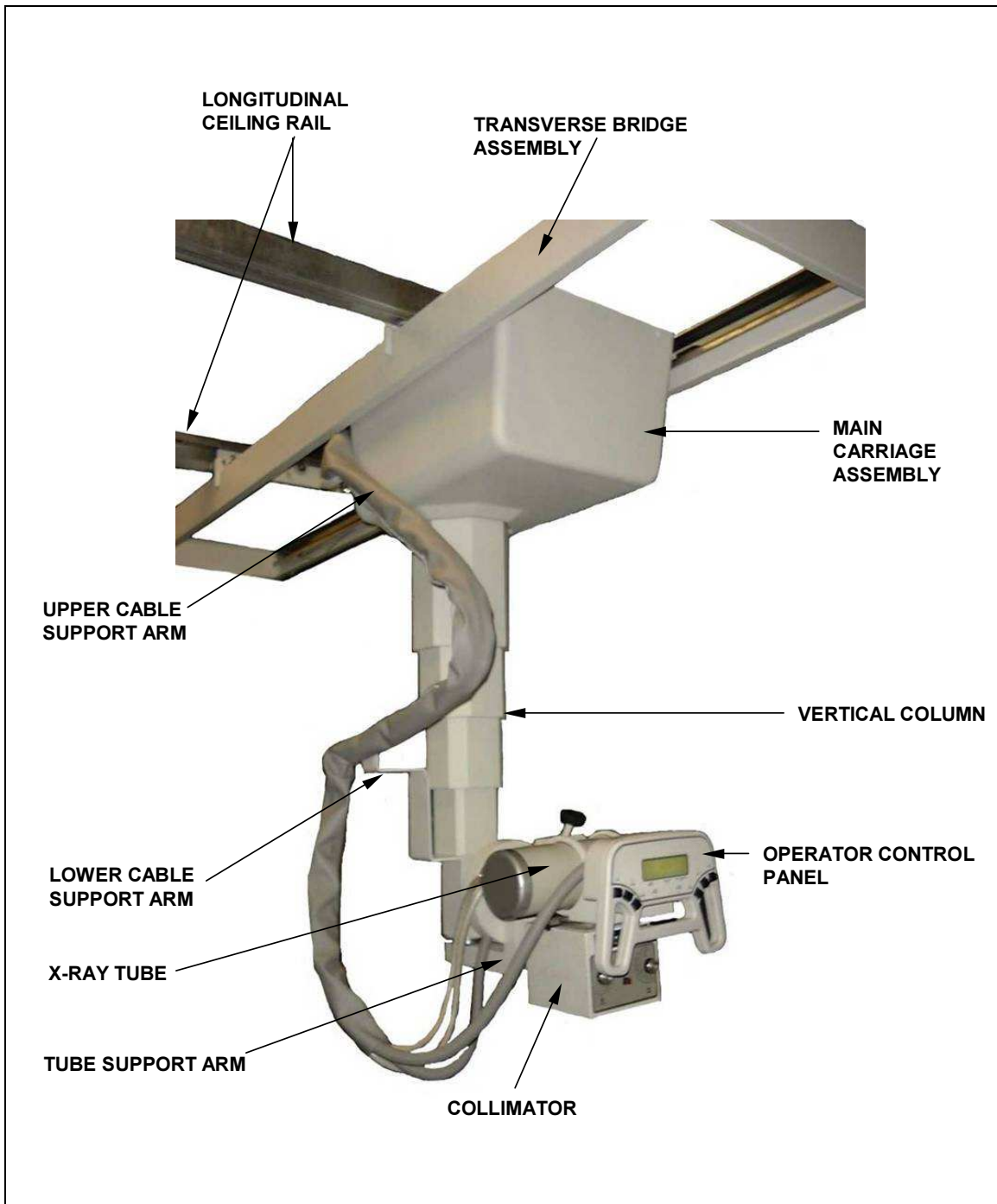
The x-ray tube rotates a full 360-degree on its vertical axis and rotates a full 240-degree on its horizontal axis with electrical and mechanical detents at each 90-degree position.

The operator control panel provides convenient selections to allow the tube to be moved in the longitudinal, transverse, vertical and rotational directions, and allows for table/wall receptor centering.

The LCD Display indicates SID to table receptor in inches or centimeters and will display the roll angle of x-ray tube in degrees.

The operating software allows for fast and easy access to calibration and configuration.

# Overhead Tube Support Service and Users Manual



**Figure 1-1**  
**Overhead Tube Support**

# ***Overhead Tube Support* Service and Users Manual**

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## **Freight Damage and Shipping Policy**

All boxes and packages need to be inspected at the time of delivery. It is the responsibility of the dealer/installer to file a shipping claim for any freight damage. If there is hidden or concealed damage to the product it is again the dealers responsibility to discover the damage within a reasonable amount of time and contact the shipping company to make a claim. To protect your company in the case of concealed damage it is recommended to accept freight "subject to inspection." This will make it easier to file a claim with the shipping company in the case of hidden damage. Do not dispose of any packing materials until the unit is fully assembled and known to be in good working order.

All shipments are F.O.B. factory.

# ***Overhead Tube Support* Service and Users Manual**

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## **TABLE OF CONTENTS**

<b>Section</b>	<b>Description</b>	<b>Page #</b>
<b>1.</b>	<b>General Information</b>	<b>9</b>
	a. General Safety	9
	b. Classification Data	10
	c. Definition of Symbols Used on the Equipment	11
	d. Precautions	11
	e. X-ray Tube and Collimator Compatibility	12
	f. System Options	13
<b>2.</b>	<b>Pre-Installation Requirements</b>	<b>14</b>
	a. Room Requirements	14
	b. Room Length and Depth	15
	c. OTS Dimensions	16
	d. Weights	17
	e. Ceiling Heights and Vertical Focal Spot Travel	17
	f. Electrical Requirements	18
	g. Unistrut® and Architectural Requirements	19
	h. Required Equipment and Tools	20
<b>3.</b>	<b>Installation</b>	<b>21</b>
	a. Longitudinal Ceiling Rails	21
	b. Transverse Bridge Assembly	23
	c. OTS Main Carriage Assembly	26
	d. Mounting the Tube Support Arm, Optional 6-inch Extension and Cable Support Arm	30
	e. Mounting the X-ray Tube, Collimator and Operator's Control	32
<b>4.</b>	<b>Cable Routing and System Interconnect</b>	<b>36</b>
	a. High Voltage, Rotor, Collimator, and PBL Cables	36
	b. Operator's Control	38
	c. Main Carriage Assembly, Transverse Bridge and Incoming System Power	43
<b>5.</b>	<b>Calibration and Adjustments</b>	<b>45</b>
	a. Vertical Counterbalance	45
	b. Tube and Collimator Balancing	46
	c. Calibration of the "Tube Roll" Digital Display	48
	d. Calibration of the "Vertical SID" Digital Display	50

# ***Overhead Tube Support* Service and Users Manual**

---

<b>Section</b>	<b>Description</b>	<b>Page #</b>
<b>6.</b>	<b>OTS Alignments and Tracking</b>	<b>51</b>
	a. Collimator Alignment	51
	b. Trunnion Assembly	51
	c. "Sag" Adjustment and Vertical Tracking	52
	d. "Yaw" Adjustment and Horizontal Tracking	54
<b>7.</b>	<b>Positive Beam Limitation (PBL)</b>	<b>57</b>
	a. Continuous Vertical SID Kit Installation	57
<b>8.</b>	<b>Final Cosmetic Dressings</b>	<b>60</b>
	a. Cable Wrap	60
	b. System Covers	60
	c. Transverse Detent Labels	62
<b>9.</b>	<b>Users Manual</b>	<b>64</b>
	a. Controls	64
	b. Displays	69
	c. SID Markers	72
	d. Transverse Center Markers	73
	e. Preventive Maintenance	74
	f. Safety Information	74
	g. Required Periodic Service Maintenance (Part 1)	75
	h. User Service and Maintenance (Part 2)	76
<b>10.</b>	<b>Preventive Maintenance</b>	<b>77</b>
	a. Longitudinal Ceiling Rails	77
	b. Transverse Bridge Assembly	77
	c. OTS Main Carriage Assembly	77
	d. Calibration, Alignments and Tracking Accuracy	78
	e. Cables, Electrical Connections and Grounding	78
	f. Painted Surfaces	78
<b>11.</b>	<b>Electrical Schematic Diagrams</b>	<b>79</b>
	00672-000 Schematic, OTS Display PCBA 00670-000	
	05982 Schematic, OTS Junction PCBA 05980	
	05992 Schematic, OTS Roll Lock Junction PCBA 05990	
	01103-000 Schematic, OTS Lock System	
	01059-000 Diagram, OTS Overall Electrical System	
	01226-000 Diagram, OTS Overall Cable Routing	
<b>12.</b>	<b>Spare Parts List</b>	<b>80</b>

# **Overhead Tube Support Service and Users Manual**

---

## **LIST OF FIGURES**

<b>Figure</b>	<b>Description</b>	<b>Page #</b>
1-1	Overhead Tube Support	3
2-1	Minimum Room Requirements Length and Depth	14
2-2	Overhead Tube Support Dimensions	16
2-3	Recommended Unistrut® Support Design	19
3-1	Longitudinal Ceiling Rail Placement, Dimensions, and Bolt Hole Locations	22
3-2	Transverse Bridge Main Bearing Assembly	25
3-3	Spacing Tool	26
3-4	Main Carriage Assembly	29
3-5	Tube Support Arm and Cable Support Arm	31
3-6	Spring Balancer Engaged/Disengaged	32
3-7	Vertical SID Pot Location	33
3-8	Procedure to Calibrate Vertical SID Pot	33
3-9	X-ray Tube, Collimator and Operator's Control Mounting Bracket	35
4-1	Roll Lock Assembly	39
4-2	Roll Junction PCB Connections	40
4-3	Main Carriage Power Supply Connections	42
4-4	Transverse Bridge Connections TB3	44
5-1	Tube and Collimator Balancing	47
5-2	Function Switch and Save Button	48
6-1	Tube Support Arm and "Sag" Adjustment	53
6-2	Transverse Detent	53
6-3	"Yaw" Detent Adjustment	55
6-4	Longitudinal Detent Ramps	56
7-1	Continuous Vertical SID and Drive Belt	58
8-1	System Covers	61
8-2	Shroud Mounting Brackets	62
9-1	Operator's Control	64
9-2	Yaw Lock Release	67
9-3	Trunnion Lock Release	68
9-4	X-ray Beam Pointed Downwards	69
9-5	X-ray Beam Pointed Horizontally	70
9-6	Roll Display	70
9-7	40" Longitudinal SID Display	71
9-8	72" Longitudinal SID Display	71
9-9	SID Markers	72
9-10	Transverse Center Markers	73

# Overhead Tube Support Service and Users Manual

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## CAUTION

**THIS MANUAL IS FOR USE BY PERSONNEL PROPERLY QUALIFIED TO INSTALL, MAINTAIN, AND OPERATE THIS EQUIPMENT.**

## 01480

### Installation/Service and Users Manual Revision History

Revision	Pages affected/Description	Release date	ECR #
A	Released	6/2/03	3243
B	Edited text, added part numbers in section 12, and added page numbers in TOC & in List of Figures	6/16/03	3729
C	Removed section 7.B.; Revised section 6.D.8; revised figures 4-3 & 4-4 for new Longitudinal SID switch design. Overall revision to meet UL 60601-1 requirements.	10/01/10	6887
D	Updated coversheet to match manual binder kit (01340-000)	2/09/11	7040
E	Updated Figures 4-1 & 4-2; Revised sections 5.C.1, 5.C.2, 5.C.3, 11 & 12.	6/17/11	7191
F	Revised Section 3, page 32; Figure 3-6, page 33; Section 6, page 51; Figure 6-2, page 52.	12/11	7396
G	Revised Section 3, pages 32 to 34. Revised Section 7.A.3, page 57.	04/14	8292

# ***Overhead Tube Support* Service and Users Manual**

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## **Section 1. General Information**

### **A. General Safety**

The proper use of this manual will provide installation, calibration, operational and preventive maintenance procedures, which will prolong the life of this product. The overhead tube support is sold under the understanding and assumption that this product will be installed and maintained by qualified and experienced x-ray service personnel with a basic understanding of overhead tube support systems. Summit Industries does not assume any responsibility for the following:

- Improper hoisting or lifting equipment
- Equipment improperly installed
- Equipment improperly operated and tested
- Equipment improperly maintained or repaired
- Equipment which has been modified or tampered with in any way without written factory approval

The overhead tube support (OTS) is only one component of an overall radiation producing x-ray system. Even though design features include primary and secondary beam limiting, it is the overall responsibility of the operator to comply with all radiation safety guidelines. The OTS is sold with the understanding this system will be operated by trained and experienced x-ray technologists. Summit Industries will not assume any responsibility for the following:

- Over exposure to patient and or operator due to poor techniques and procedures
- Injury or risk to any person as a result of x-ray exposure
- Injury or damage due to improperly trained personnel

We are proud of our products and are confident they will provide many years of useful service when installed, adjusted, operated and maintained properly.

# ***Overhead Tube Support* Service and Users Manual**

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## **Section 1. General Information**

### **B. Classification Data**

This equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

Type of protection against electric shock is Class 1.



Degree of protection against electric shock is Type B.

Degree of protection against the ingress of water is IPX0 / ordinary.

The function and intended application of this equipment is general radiography for human use.

Environmental conditions operation:

Temperature: 50° F to 104° F (10° C to 40° C)

Relative humidity: 10% to 95%, non-condensing

Atmospheric pressure: 20.67 inHg - 31.30 inHg (700 – 1060 hPa)

Environmental conditions for transport and storage:

Temperature: -40° F to 158° F (-40° C to 70° C)

Relative humidity: 10% to 100%, non-condensing

Atmospheric pressure: 14.76 inHg - 31.30 inHg (500 – 1060 hPa)

The OTS model J309 draws up to 3 Amp continuously.

The maximum support load rating of the tube arm (collimator and tube mass) is 70 lbs (32 kg).

## Section 1. General Information

### C. Definition of Symbols Used on the Equipment



- Attention Consult Accompanying Documents



- Type B Applied Part



- Protective Earth Terminations



- Direct Current

### D. Precautions

Throughout the manual are indented statements preceded by alert words. These alert words and the following statements may direct the user in the performance of a task, or inform the user of a potentially hazardous situation. Each alert word is always used with only one specific type of information. The alert words and the information they reference are as follows:



#### NOTE

Information that assists the user of the manual in the performance of a task. It may provide the user with better methods of conducting the task, or it may point out conditions that could cause the device to fail to operate properly.



#### CAUTION

Information that alerts the user of the manual to situations that could result in damage to the equipment.



#### WARNING

Information that alerts the user of the manual to situations that could be hazardous to the health of the patient, the operator, the maintenance person, or others.

# Overhead Tube Support Service and Users Manual

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## Section 1. General information

### E. X-ray Tube and Collimator Compatibility



**NOTE:** The 6" Trunnion rings are standard with the OTS. The 6.75" Trunnion rings can be optioned and upgraded in the field.

The following is a list of most commonly used x-ray tubes and collimators that are compatible with the OTS. Other x-ray tubes and collimators may be compatible. Consult factory for specific tubes and collimators not listed below.

#### X-ray tubes

<u>Manufacture</u>	<u>Model</u>
Toshiba/Summit	E7239
Toshiba/Summit	E7242
Toshiba/Summit	E7252
Varian/Eureka	Emerald series
Varian/Eureka	Diamond series
Varian/Eureka	Sapphire series

#### Collimators

<u>Manufacture</u>	<u>Model</u>
Summit	LX125
Progeny/Eureka	Linear II
Progeny/Eureka	Linear IV
Progeny/Eureka	MC150

## **Section 1. General Information**

### **F. System Options**

#### Vertical extension kit

A 6-inch vertical extension kit is available, which is recommended for ceiling heights greater than 9 feet. This will decrease the focal spot distance from the floor. See section 2.E. for ceiling heights and vertical focal spot travel.

#### X-ray tube cooling fan

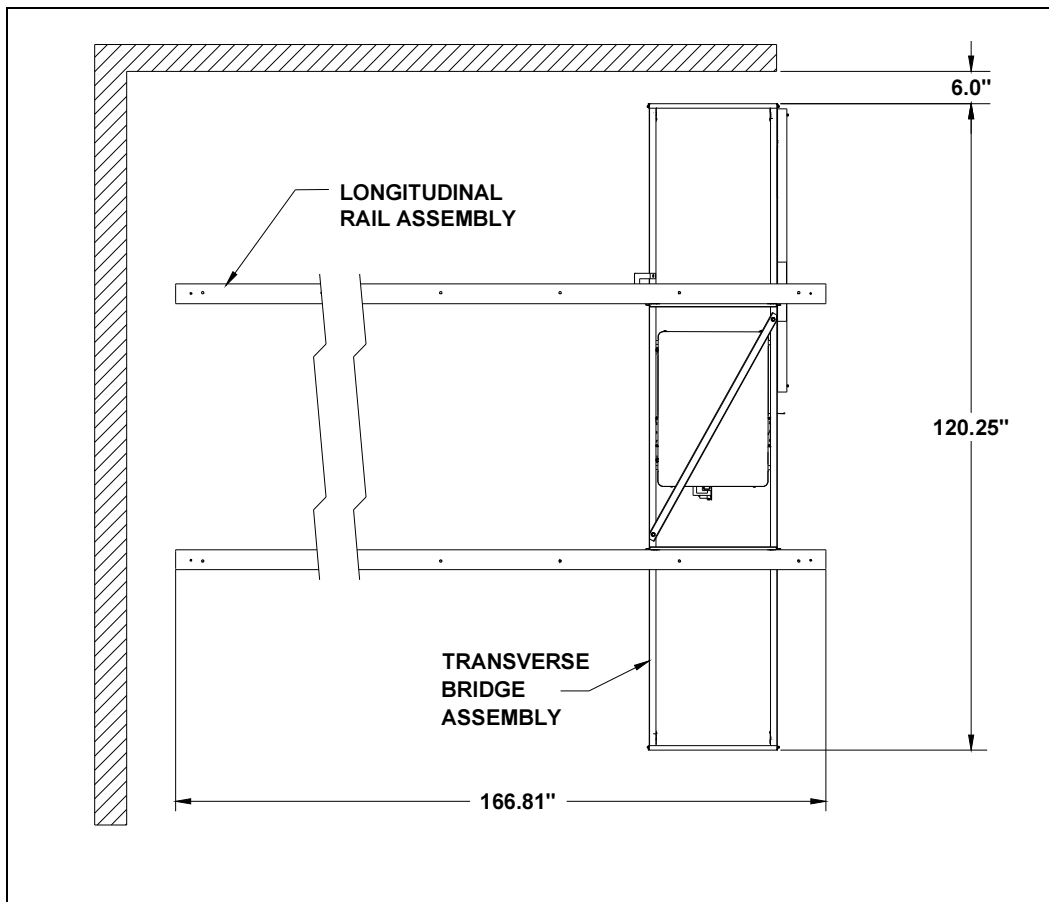
A cooling fan is available as an option, which will adapt to any size x-ray tube. A cooling fan is recommended for facilities with medium to high patient volume.

#### Positive Beam Limitation (PBL)

Both discrete and continuous SID monitor kits are available for use with automatic or semi-automatic PBL collimators.

**Section 2. Pre-Installation Requirements**

**A. Room Requirements**



**Figure 2-1  
Minimum Room Requirements Length and Depth**

# Overhead Tube Support Service and Users Manual

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## Section 2. Pre-Installation Requirements

### B. Room Length and Depth

The x-ray room should be long enough to accommodate the longitudinal ceiling rails and the transverse bridge. (See **Figure 2-1**, page 14)



**NOTE:** Longitudinal ceiling rails are available in two lengths, standard and extended.

Standard longitudinal rails: Actual length 167"  
Total focal spot travel 140" (366cm)

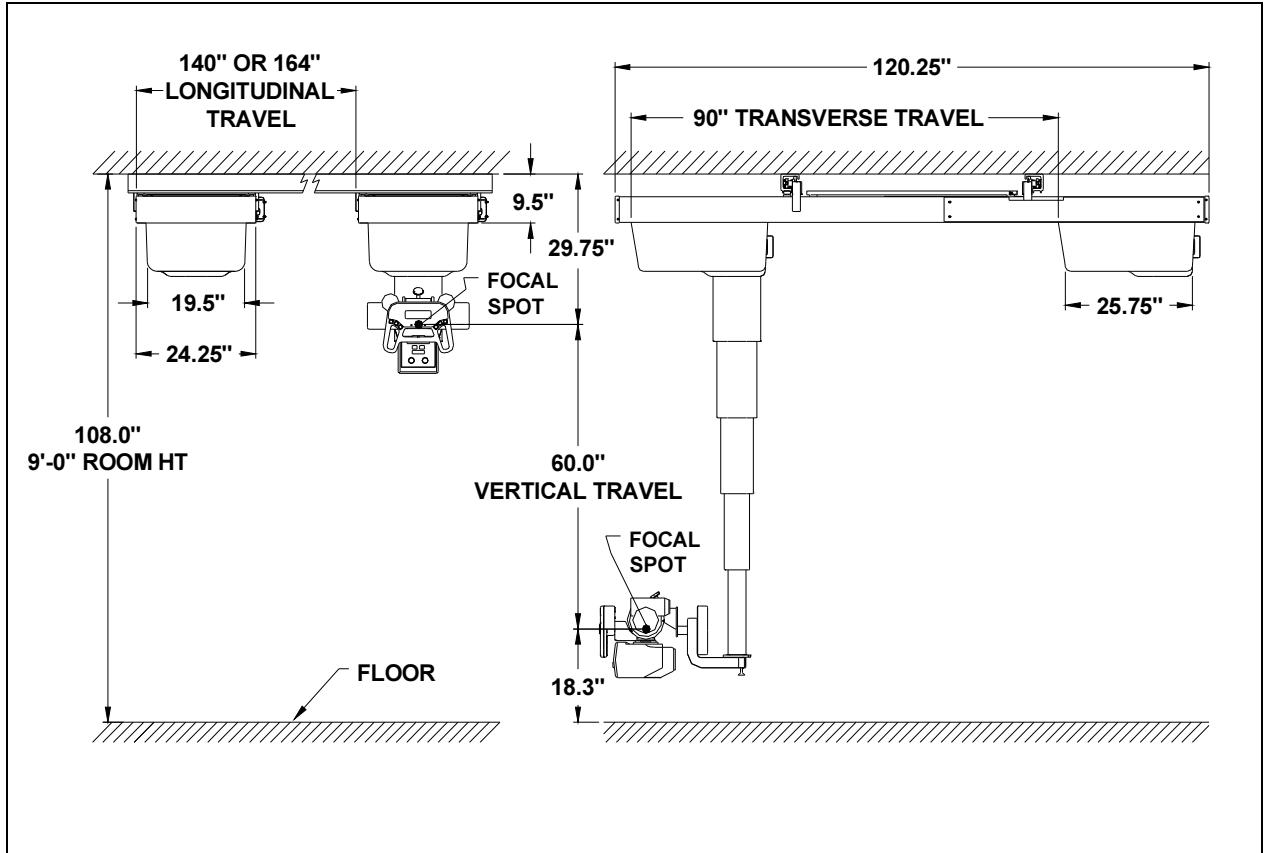
Extended longitudinal rails: Actual length 191"  
Total focal spot travel 164" (427cm)

Transverse bridge: Actual length 120"  
Focal spot travel 90" (223cm)

# Overhead Tube Support Service and Users Manual

## Section 2. Pre-Installation Requirements

### C. OTS Dimensions



**Figure 2-2**  
**Overhead Tube Support Dimensions**

# Overhead Tube Support Service and Users Manual

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## Section 2. Pre-Installation Requirements

### D. Weights



**NOTE: THIS DOES NOT INCLUDE THE WEIGHT OF THE TUBE, COLLIMATOR, OR HIGH VOLTAGE CABLES.**

The overall combined weight of the OTS is 521 lbs. (541 lbs. if you are using the extended longitudinal rails) See the list below for itemized weight.

<u>Standard Longitudinal Rails</u> (167 inches):	136 pounds (68 lbs. Ea.)
<u>Extended Longitudinal Rails</u> (191 inches):	156 pounds (78 lbs. Ea.)
<u>Transverse Bridge Assembly</u> (complete):	152 pounds
<u>Main Carriage Assembly</u> (without tube/coll.):	233 pounds

### E. Ceiling Heights and Vertical Focal Spot Travel

The information below illustrates the minimum and maximum vertical focal spot travels for various ceiling heights. A 6-inch vertical extension is available to lower the minimum focal height if required.

Ceiling Height	8-½ ft	9 ft	9-½ ft	10 ft
Max Focal Height	72-¼"	78-¼"	84-¼"	90-¼"
Min Focal Height	12-¼"	18-¼"	24-¼"	30-¼"
Max Focal Height w/ 6" Ext.	66-¼"	72-¼"	78-¼"	84-¼"
Min Focal Height w/ 6" Ext.	6-¼"	12-¼"	18-¼"	24-¼"

# ***Overhead Tube Support* Service and Users Manual**

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## **Section 2. Pre-Installation Requirements**

### **F. Electrical Requirements**

#### **Equipment Grounding**



**WARNING:** Improper equipment grounding is a shock hazard for personnel located in the room and personnel who come in contact with the equipment.

To avoid electric shock hazards all equipment must be connected to a single ground point. Measurements must be taken to verify all installed equipment is at the same ground potential.

A green/yellow ground wire #10 AWG or greater must be used between each piece of equipment and connected to a single reference ground point. Special care should be taken when terminating ground connections and should not increase the overall impedance of the conductor.



**NOTE:** Periodic checks of equipment grounding are required and should be performed as part of the preventive maintenance schedule.

#### **Incoming Power Requirements**

Ratings: 120 VAC, 50/60 Hz, 3 A



**NOTE:** The OTS should be connected to an auxiliary power supply, which is separate from the x-ray generator.

The OTS requires a nominal voltage of 120 VAC at 50/60Hz and will have a continuous load of up to 3 Amps. Incoming power should be connected to a front operated 15 Amp enclosed circuit breaker.

The maximum deviation from the nominal voltage should not exceed more than 7% under full load.

The incoming wire size should be 3-conductor #14 AWG for a run up to 20 feet. (This cable is not provided)

**Refer to NEMA electrical code for the proper wire size for runs greater than 20 feet.**

# Overhead Tube Support Service and Users Manual

## Section 2. Pre-Installation Requirements

### G. Unistrut® and Architectural Requirements

The OTS requires a sufficient support structure (Unistrut®) installed above the finished ceiling. The support structure should be fabricated and installed by a certified experienced tradesman or contractor employed by the customer.

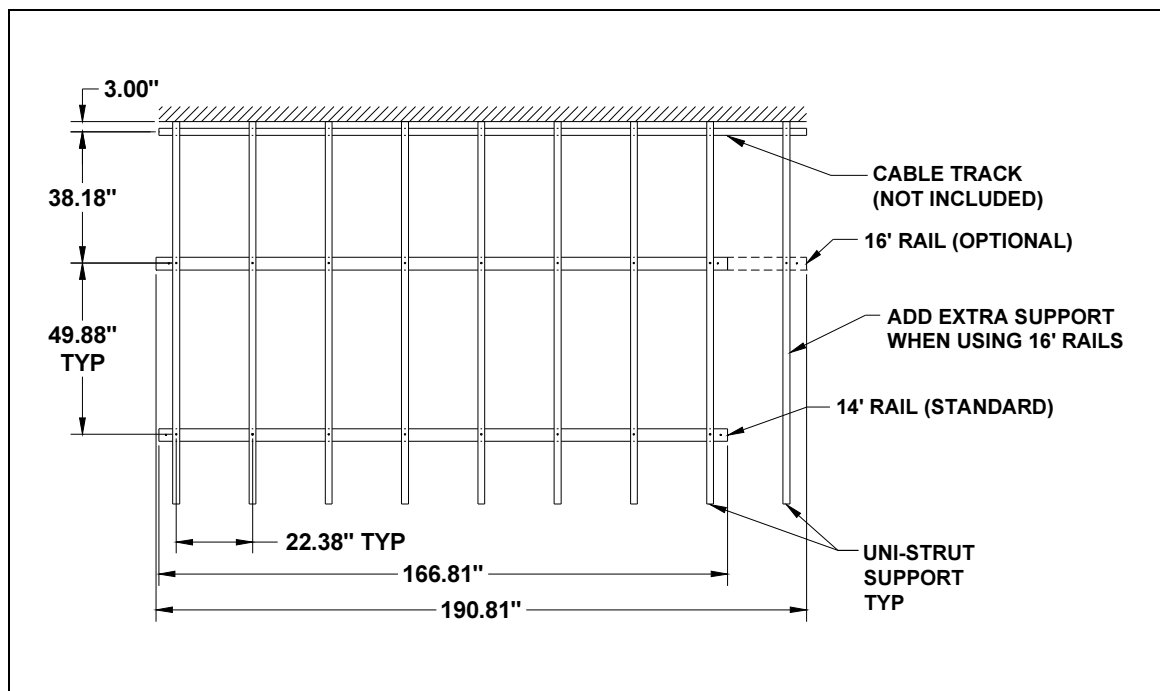
The support structure installer will be responsible for all safety rules and guidelines associated with the installation of such structures.

**(See section 2.D. for total system weight.)**

The support structure (Unistrut®) must be sturdy enough to ensure proper support and provide an adequate margin of safety. It must be properly anchored and secured to prevent against side movements and twisting when the OTS is installed.

The support structure (Unistrut®) must be level in all directions to  $\pm 0.25''$  and must be constructed so the longitudinal ceiling rails can be attached to the support and can be leveled longitudinally, transversely and vertically throughout the room and parallel to each other to within  $1/32''$  along their entire length.

**(See Figure 2-3)**



**Figure 2-3**  
**Recommended Unistrut® Support Design**

## **Section 2. Pre-Installation Requirements**

### **H. Required Equipment and Tools**

1. A suitable 4 wheeled lifting device with a minimum lifting capacity of 500 pounds. This lifting device should also have a vertical height suitable for the ceiling height in the room.
2. Level and builders square
3. Two 6-inch "C" clamps
4. Plumb bob w/ line
5. Standard tool kit used for the installation of x-ray equipment.
6. Thread locking compound
7. Standard volt meter AC/DC
8. Alcohol or trichloroethylene
9. Cable, 3-conductor #14 AWG, 20 feet (for input line cable)

# **Overhead Tube Support Service and Users Manual**

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## **Section 3. Installation**

### **A. Longitudinal Ceiling Rails**



**NOTE: See Figure 3-1, page 22, for ceiling rail placement, dimensions and bolt hole locations.**

The rear longitudinal rail should be positioned no less than 36 inches from the back wall. This measurement should be taken from the finished wall to the center of the mounting holes on the rear longitudinal ceiling rail. Take into consideration the back wall may not be straight.

The spacing between the back and the front longitudinal ceiling rails needs to be 49-7/8 inches, measured between the centers of both longitudinal ceiling rails.

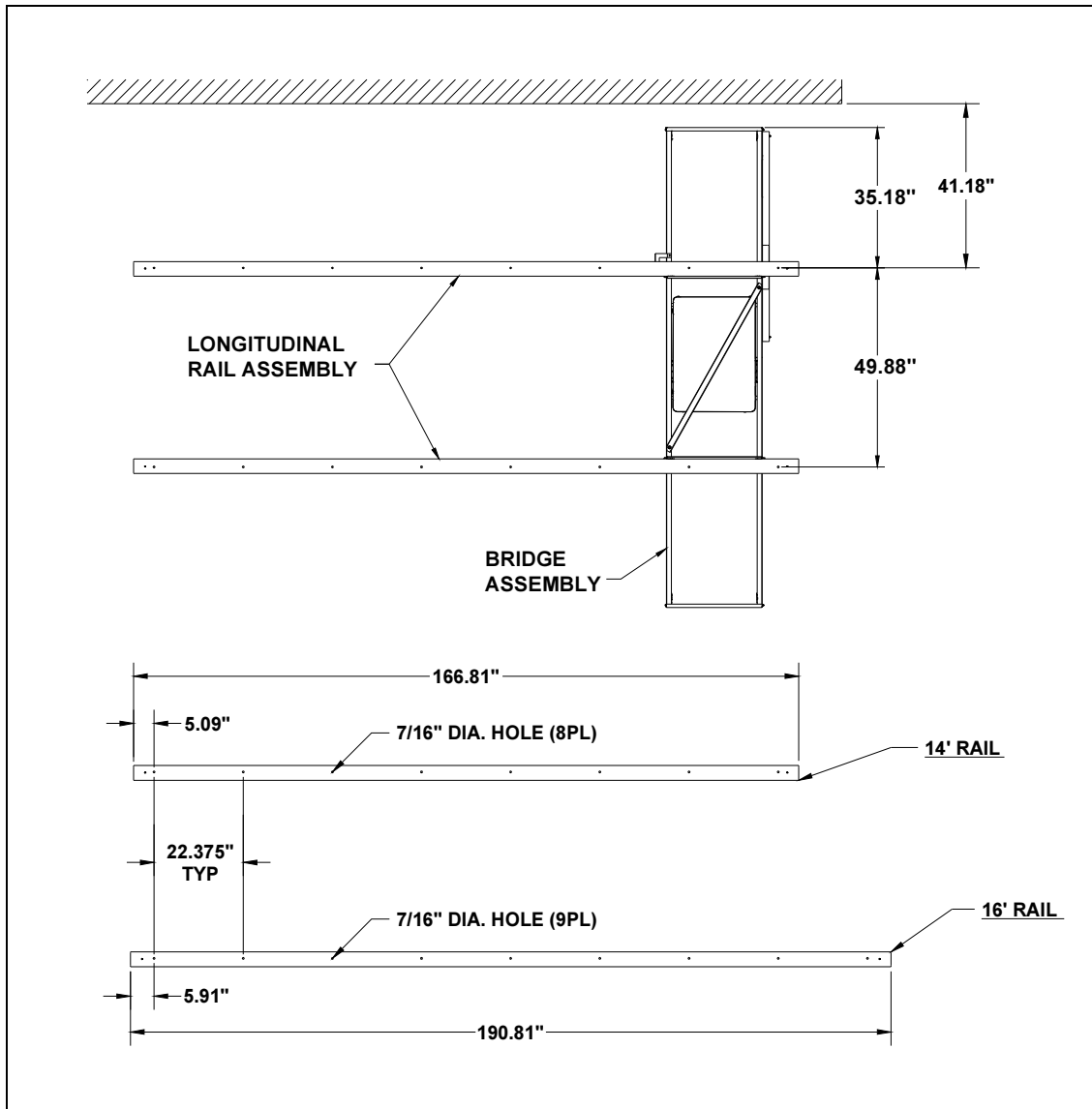
This spacing is critical as to ensure the longitudinal rails are parallel to each other within  $\pm 1/16$  of an inch in all directions along their entire length.

1. With a suitable lifting device, lift the rear longitudinal ceiling rail to the ceiling and bolt in place using the hardware provided in the ceiling support structure.

**Longitudinal rails do not include mounting hardware.**

2. Repeat step 1 with the front longitudinal ceiling rail and bolt in place. Do not completely secure the rail to the ceiling structure until the rails are level and at the specified spacing and parallel within  $\pm 1/16$  of an inch in all directions along their entire length.
3. Once the longitudinal ceiling rails have been properly spaced, level and parallel in all directions, secure the ceiling rails to the overhead support structure by fully tightening all rail hardware. All mounting holes must be used.

# Overhead Tube Support Service and Users Manual



**Figure 3-1**  
**Longitudinal Ceiling Rail Placement, Dimensions, and Bolt Hole Locations**



**CAUTION:** Use a thread-locking compound on all hardware not equipped with lock washers or other locking fasteners.

## Section 3. Installation

### B. Transverse Bridge Assembly



**WARNING:** All major structural components of the transverse bridge have been designed to serve as a structural support. Any level of disassembly of the bridge may result in damage when lifted to the ceiling.

1. Verify longitudinal ceiling rails are properly mounted and secured to the overhead support structure.
2. Remove the longitudinal ceiling rail spring stops from the end where the transverse bridge will be installed.
3. Completely remove both longitudinal lock assemblies by removing the two #10-32 screws which mount each lock.
4. Using a suitable lifting device, lift the transverse bridge assembly to the ceiling adjacent to the open end of the longitudinal ceiling rails. Terminal strip TB3 will be located on the back right side as viewed from the front.



**NOTE:** Make sure that you lift the transverse bridge evenly as one piece. Do not apply any lifting force to one end only. This will result in damage to the bridge.

5. Position the lifting device so the bearings on the transverse bridge are able to easily roll onto the longitudinal ceiling rails. Roll the transverse bridge onto the longitudinal rails and roll the bridge to approximately the middle of the longitudinal rails and immediately reinstall the spring stops on the longitudinal rail. Remove the lifting device and allow the main bearings to support the full weight of the bridge. (See **Figure 3-2**, page 25)
6. Ensure all spring stop hardware is tight and secure.



**NOTE:** It is recommended to use a suitable thread-locking compound on all hardware not equipped with lock washers or other locking fasteners.

## Overhead Tube Support Service and Users Manual

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7. Slowly move the transverse bridge along the entire length of the longitudinal ceiling rails and verify proper tracking. Bearings should ride in the center of the bearing surface and should not make contact or ride up on the sides of the rail.



**NOTE: No adjustment is provided for the bridge guide bearings.**

8. Slowly move transverse bridge to one side until bridge makes contact with the spring stops. Ensure transverse bridge makes contact with both spring stops at the same time at both ends. Line up the “take-up” bearing adjustment bushing with the adjustment hole near the end of the longitudinal rail. The “take-up” bearing adjustment will prevent rocking of the transverse bridge when the carriage assembly is moved to an extreme end position.
9. With a ½ inch deep socket and a 7/8-inch open-end wrench adjust the “take-up” bearing to slightly come in contact with the top of the longitudinal rail. Once the bearing has been properly located, hold the bearing bushing while tightening the ½ inch bolt with a socket wrench. This will lock the bearing in place.
10. Repeat step 9 for the opposite side.

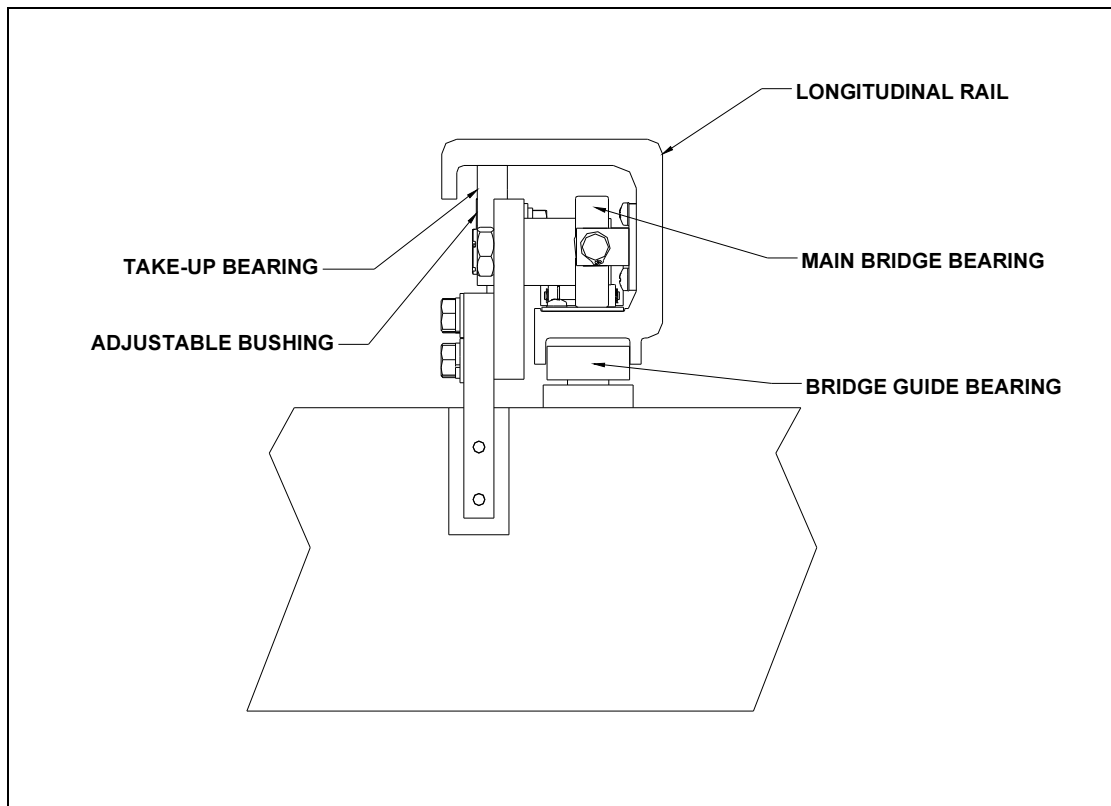


**NOTE: Do not over adjust (over tighten) the “take-up” bearings. Over adjustment will introduce drag on the bridge.**

11. Reinstall both longitudinal lock assemblies. No adjustment is necessary. Ensure hardware is tight and secure.

# Overhead Tube Support Service and Users Manual

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**Figure 3-2**  
**Transverse Bridge Main Bearing Assembly**

## Section 3. Installation

### C. OTS Main Carriage Assembly

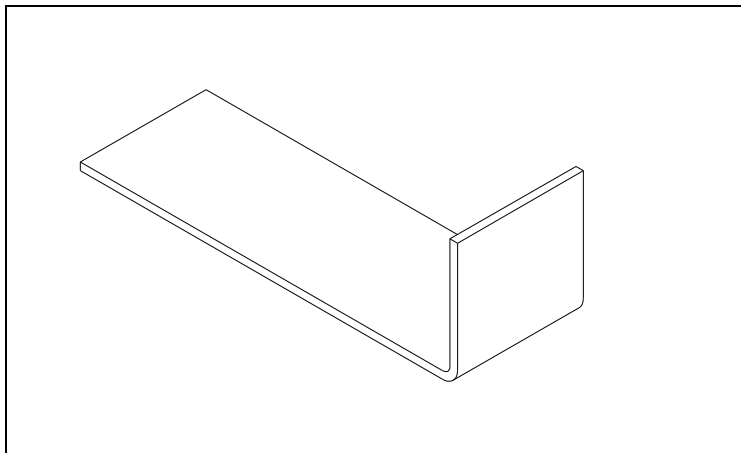
The main carriage assembly is shipped in a wooden support crate. This is the heaviest part of the OTS system and will require a suitable lifting device with a minimum lifting capacity of 500 pounds.



**NOTE:** Do not destroy or disassemble the wooden support crate. This will be needed during the installation procedure.



**NOTE:** Locate the .060-inch thick metal spacing tool in the accessory kit. This will be used in step 9 to achieve proper spacing between the main carriage bearings and the transverse rail. (See **Figure 3-3**, page 26)



**Figure 3-3**  
**Spacing Tool**

1. Ensure the longitudinal rails and transverse bridge has been properly installed and will accept the weight of the main carriage assembly.



**WARNING:** The support crate should always be used when lifting or lowering the main carriage assembly.

## Overhead Tube Support Service and Users Manual

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2. With the main carriage assembly in the support crate, position carriage under the transverse bridge in the same orientation the carriage will be lifted and installed.
3. Loosen the mounting hardware (two #10-32 screws) for the two transverse lock assemblies and slide lock brackets inward towards the interior of the carriage. **(Refer to Figure 3-4, page 29 for the remaining steps in this section)**
4. Loosen all main bearing hardware ( $\frac{1}{4}$ "-20 hex bolts one per bearing assembly) and collapse bearing shafts inward towards the interior of the carriage. These bearings are located at each of the four corners of the carriage.
5. Completely remove both guide bearing brackets, located on the left side of the carriage when viewed from the front. Remove the two  $\frac{1}{4}$ "-20 hex head bolts on each bearing bracket.
6. With a suitable lifting device raise the entire crate and carriage assembly to the ceiling within the transverse bridge.
7. Once the main carriage assembly is positioned within the bridge, slide all four main carriage bearings into the transverse rail. **Ensure the load surface of all four main carriage bearings is making contact on the rail.**
8. Reinstall the front and back guide bearing brackets and tighten mounting hardware. (Two  $\frac{1}{4}$ "-20 hex bolts per bracket) Adjust the front and back eccentric "pinch" bearings to just come in contact with the transverse rail. This is the inside bearing of the guide assembly.

The "pinch" bearings will prevent the carriage from shifting side to side in the transverse bridge.



**NOTE:** Do not over adjust (over tighten) the "pinch" bearings. Over adjustment will introduce drag on the main carriage assembly.

9. Insert the .060-inch thick spacing tool between the main carriage bearing and the transverse rail. Slide the main carriage bearing outward until the bearing makes contact with the spacing tool. Tighten the bearing hardware and remove the spacing tool. Repeat this

## ***Overhead Tube Support* Service and Users Manual**

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process on the three remaining bearings. Verify the main carriage assembly is centered between the transverse rails.



**WARNING: Ensure that the lock screws for the four main carriage bearings are tightened securely after making adjustments.**

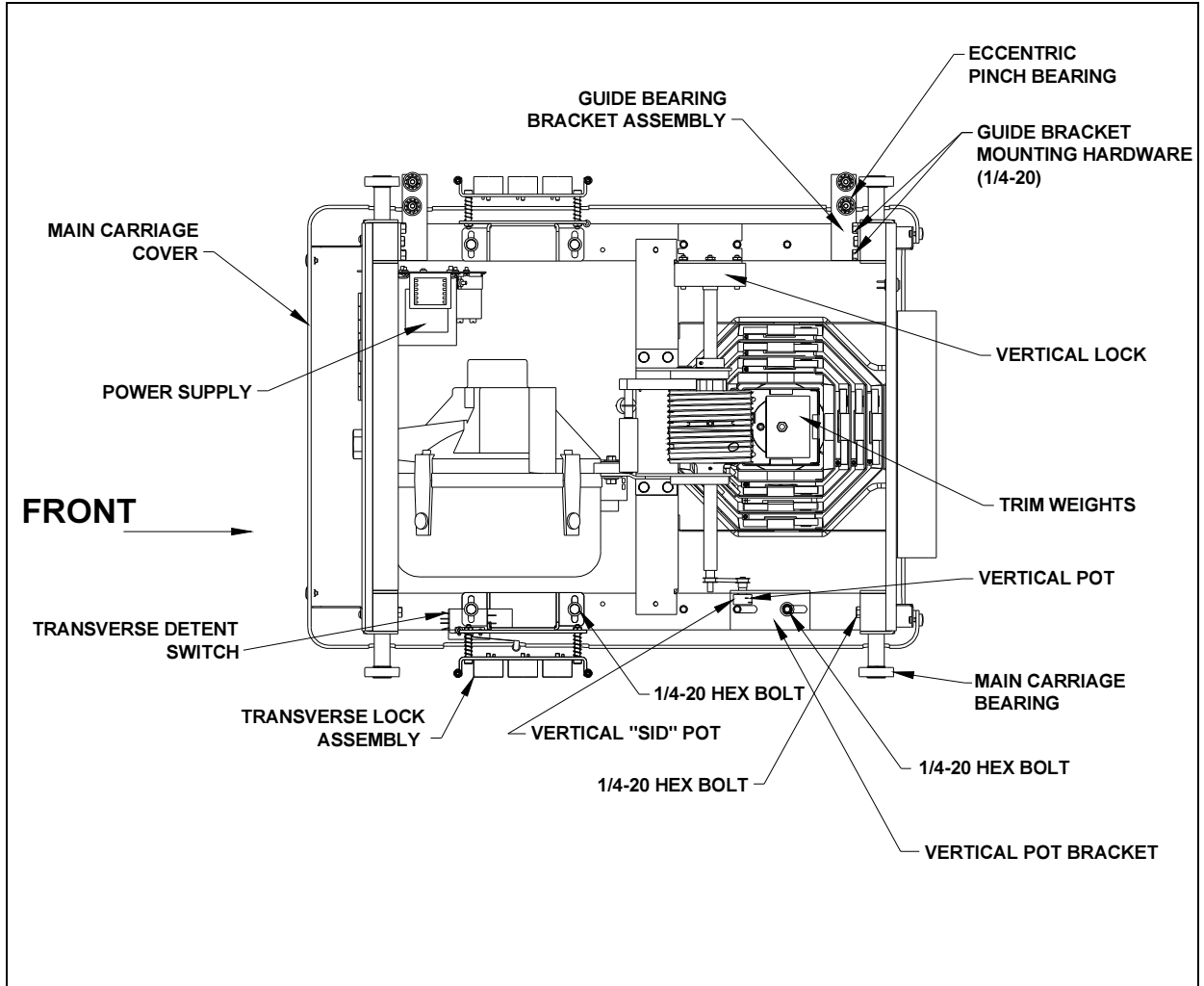
10. It is now safe to remove the wooden support crate and lifting device.
11. Slide both transverse lock assemblies back into position until the wheels just come in contact with the rail and tighten hardware.
12. Slowly move the main carriage assembly across its full range of transverse travel while verifying that the main carriage bearings are tracking properly within the rail.



**WARNING: Ensure the entire load surface of all four main carriage bearings is always making complete contact with the rail surface throughout its entire range of travel.**

13. Slowly move the transverse bridge assembly along its full range of longitudinal travel and verify bearings are tracking properly. The bearings should not climb or ride on the sides of the rail as the bridge and main carriage assembly are moved from one end to the other along the entire range of motion.

# Overhead Tube Support Service and Users Manual



**Figure 3-4  
Main Carriage Assembly**

## Section 3. Installation

### D. Mounting the Tube Support Arm, Optional 6-inch Extension and Cable Support Arm

The tube support arm, cable support arm and optional 6-inch extension will not be pre-installed. These items are shipped separately and will need to be installed.



**NOTE:** If you need to install the 6-inch extension proceed with step 1. If you do not need to install the 6-inch extension proceed to step 2.

1. Place the 6-inch extension over the yaw support shaft located on the tube support arm. Ensure the welded seams of the extension will ultimately face the rear of the unit. Line up the mounting holes of the inner detent ring with the mounting holes located on the bottom of the extension. Lift the entire tube support arm up to the bottom the smallest mast section and secure in place by using the four ¼"-20 x 7 inch socket head cap screws. The tube support arm will need to be rotated to gain access to all of the mounting holes. Ensure all mounting hardware is tight.
2. Insert the yaw support shaft into the bottom of the smallest mast section. Line up the mounting holes of the inner detent ring with the mounting holes at the bottom of the mast section. Lift the entire tube support arm up to the bottom the smallest mast section and secure with the four ¼"-20 x 1 inch socket head cap screws. The tube support arm will need to be rotated to gain access to all of the mounting holes. Ensure all hardware is tight.



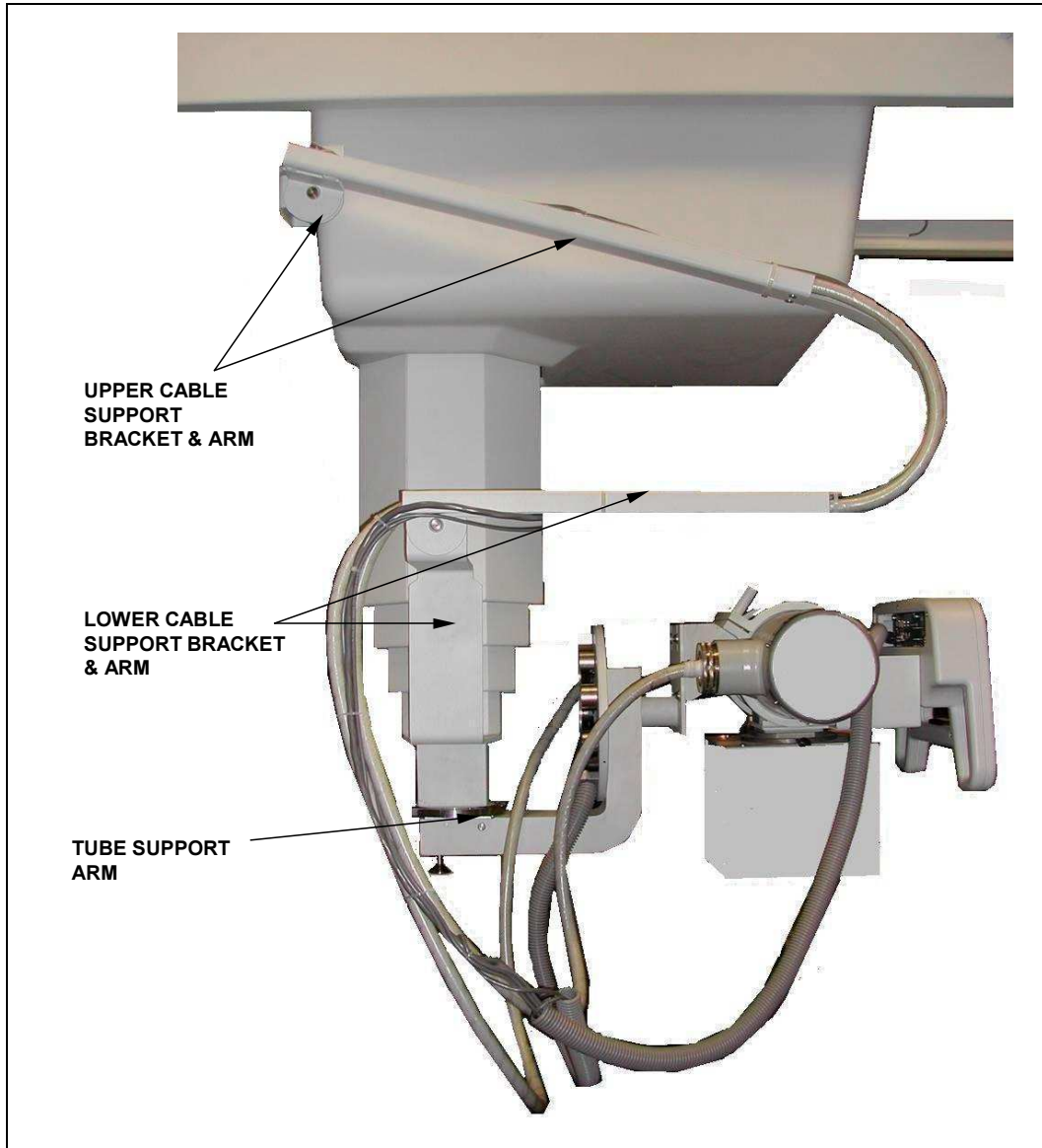
**NOTE:** The cable support arm will be installed as two pieces, an upper support arm and a lower support arm. The upper support arm will include the upper mounting bracket and the spring steel joint. The lower support arm will include the lower support bracket. (See **Figure 3-5**, page 31)

3. Install the upper support arm by attaching the upper mounting bracket to the back right side of the main carriage assembly just above the cable access hole as viewed from the back. The upper mounting bracket will be secured by two ¼"-20 nuts and lock washers from the

## ***Overhead Tube Support* Service and Users Manual**

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inside of the main carriage assembly. Install the lower cable support arm by attaching the lower support bracket to the bottom of the second lowest mast section. Secure the lower support bracket with four #10 screws, and ensure hardware is tight.



**Figure 3-5**  
**Tube Support Arm and Cable Support Arm**

## Section 3. Installation

### E. Mounting the X-ray Tube, Collimator and Operator's Control

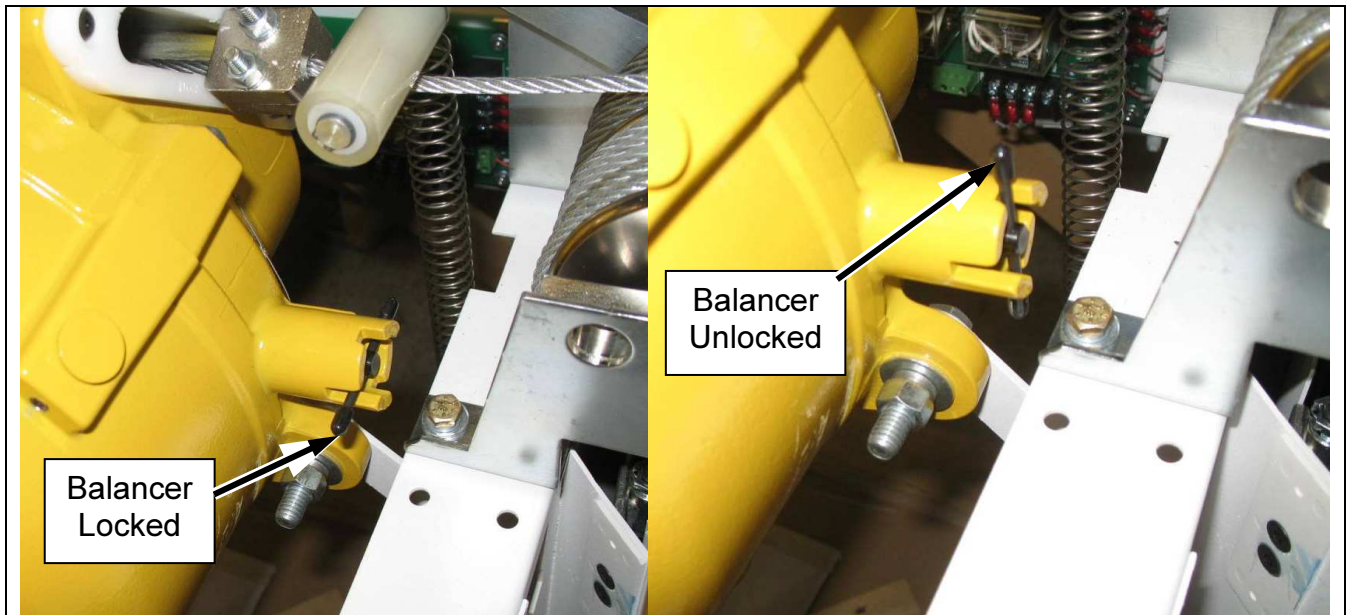


**NOTE:** When mounting the x-ray tube and collimator the vertical column must be lowered to a convenient working height. This will require two people.

1. While one person applies a slight downward pull on the tube support arm, the second person pulls the release pin away from the body of the spring balancer and rotates it 90 degrees (to vertical), then allowing it to retract and remain in this orientation. This disengages the locking mechanism. (See **Figure 3-6**, page 32)
2. Pull the vertical column down to a desired working height and lock the spring balancer in place by reorienting the release pin back to the horizontal position. This reengages the locking mechanism. (See **Figure 3-6**, page 32)



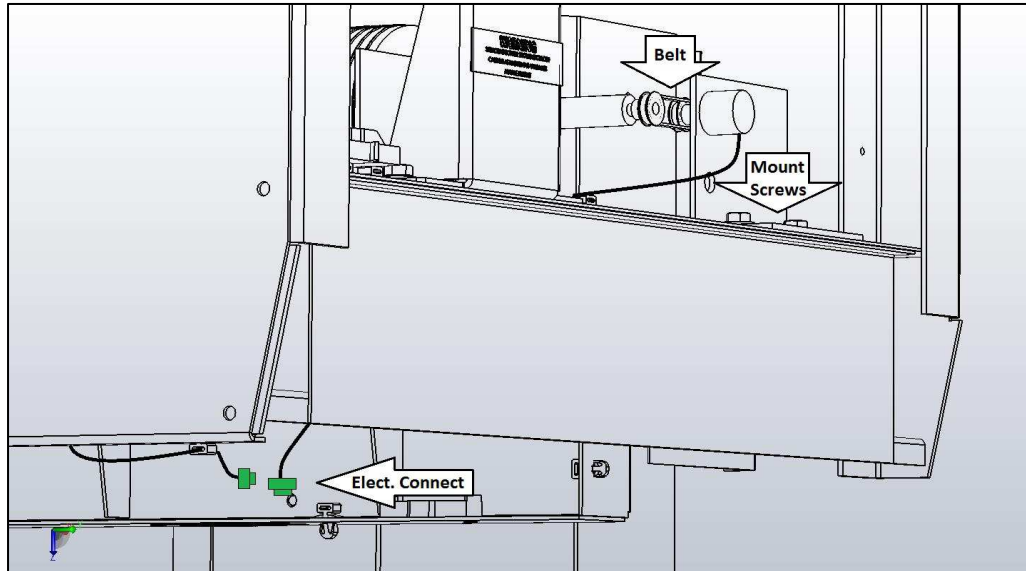
**WARNING:** You must ensure the spring balancer is in the "Full Locked" position before releasing the vertical column. Never release the locking mechanism without a fully counterbalanced load, as this may result in personal injury and damage to the equipment.



**Figure 3-6**  
**Spring Balancer Engaged/Disengaged**

# Overhead Tube Support Service and Users Manual

3. **Perform step 3 only if the vertical pot mechanism has been replaced or moved from its original factory setting.** Loosen the two ¼"-20 vertical pot bracket mounting screws and slide bracket forward to remove the tension off the drive belt.  
Disconnect the drive belt from the potentiometer pulley and *electrically* disconnected the vertical pot (See **Figure 3-7**, page 33)



**Figure 3-7**  
**Vertical SID Pot Location**

Move the column vertically until the distance from the bottom of the overhead column bracket to the top of the “gooseneck”-tube support arm-measures 48”(1270mm) (See **Figure 3-8**, page 33)



**Figure 3-8**  
**Procedure to Calibrate Vertical SID Pot**

## Overhead Tube Support Service and Users Manual

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Measure the resistance at the connector across the black and red wires or at the pot, across pins 1 & 2. The ohmic value should read **495 - 505 ohms**. If the ohmic value is not in this range, manually adjust the pot shaft to the correct ohmic value. Reconnect the drive belt and reset the belt tension by moving the vertical pot bracket to the rear. Drive belt tension should be set just tight enough as to prevent jumping of the drive belt teeth around the pulleys. (Do not stretch the drive belt.) Tighten bracket-mounting hardware. **Reconnect the electrical connection.** See section 5.D for display calibration.

4. **Perform step 4 only if the roll pot mechanism has been replaced or moved from its original factory setting.** Remove the “roll” lock assembly cover to gain access to the roll pot. Ensure the x-ray tube mounting plate is oriented appropriately to simulate the tube port pointing down. Measure the resistance of the “roll” pot at connector J31 across pins 2 and 3. The ohmic value should read 500 ohms  $\pm$ 100 ohms. If the ohmic value is not in this range, disconnect the drive belt of the potentiometer and manually adjust potentiometer to the correct ohmic value. Reconnect the drive belt and set the drive belt tension. Drive belt tension should be set just tight enough as to prevent jumping of the drive belt teeth around the pulleys. (Do not stretch the drive belt.) Reinstall the “roll” lock assembly cover.

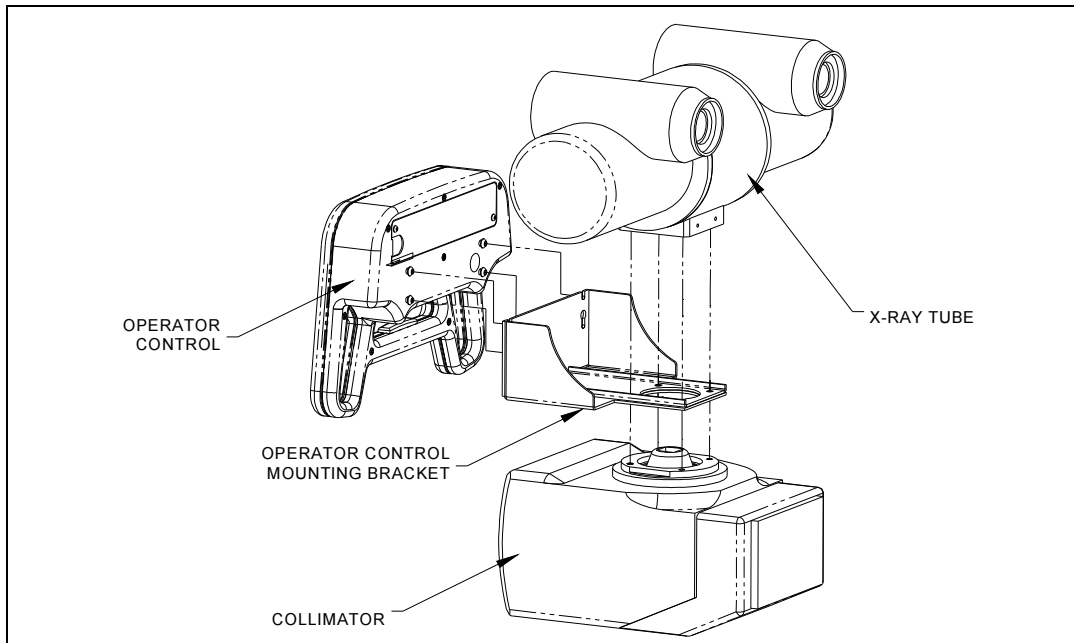


**CAUTION:** Without power applied to the roll lock assembly the tube mount plate is free to roll on its axis. The tube may fall from the trunnion if the trunnion ring assembly is open. Exercise caution when installing x-ray tube.

5. To mount the x-ray tube, loosen the trunnion lock knob and open the trunnion ring assembly. The x-ray tube should fit properly within the bottom half of the rings. Once the tube is in place close the trunnion ring assembly and tighten lock knob.
6. Install the operator’s control-mounting bracket. This will be mounted between the tube port and the collimator. (See **Figure 3-9**, page 35) For collimator mounting instructions refer to the manufacturer’s installation manual.
7. Mount the operator’s control by attaching the control box to the mounting bracket and secure by tightening the four #10-32 socket head cap screws.

# Overhead Tube Support Service and Users Manual

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**Figure 3-9**  
**X-ray Tube, Collimator and Operator's Control Mounting Bracket**

## Section 4. Cable Routing and System Interconnect

### A. High Voltage, Rotor, Collimator and PBL Cables



**NOTE:** Refer to the manufacturer's installation manual for proper cable cleaning and preparation. When installing high voltage cables, be sure to start at the tube and work your way back. It will be easier to remove slack in the cables from opposite the tube end.

1. Extend the vertical column to its maximum lowest position and lock in place. Move the main carriage assembly to its forward most position within the transverse bridge and secure. Ensure the main carriage does not move and is secured in place by clamping, if necessary. Insert the anode and cathode high voltage cables into the tube sockets and tighten the cable hardware.
2. Remove the six cable clamps (3 per section) located on the cable support arm. These will be used to secure the high voltage cables to the support arm. The high voltage cables are the only cables that will be secured in this fashion.
3. Route the high voltage, rotor, collimator, and PBL cables from the tube head to the bottom of the support arm. Ensure to leave enough slack in the cables to allow the tube to be moved, maneuvered and operated without being hindered or limited by the cable drape. Ensure to test tube movement in all directions. Tube roll, vertical, trunnion angle, tube yaw, collimator swivel, etc.
4. Route and secure the high voltage cables into the entire length of the cable support arm and tighten the cable clamp hardware. Route the rotor, collimator, and PBL cables along the top of the high voltage cables and secure in place by using wire ties. Ensure the cables are routed in a relaxed state. (All cables should not be twisted, crossed or over bent in any way.)

## ***Overhead Tube Support* Service and Users Manual**

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5. Once all cables are at the top of the cable support arm, route cables around the back of the main carriage assembly and secure with cable brackets provided. From the back of the main carriage assembly, route the cables to the back right side of the transverse bridge as viewed from the front. Secure the cables by using the front and rear cable brackets provided on the transverse bridge.
6. Route the high voltage, rotor, and collimator cables from the back of the transverse bridge to the location of the high-tension transformer and x-ray generator. Before inserting the high voltage cable terminals into the high-tension transformer sockets, refer to the manufactures cable install manual for proper cable cleaning and preparation. Properly connect the rotor cable at the x-ray generator and the collimator cable at its power source.
7. The discrete vertical PBL cable will terminate at the back right side of the transverse bridge as viewed from the front at TB3 terminals 17 and 18.
8. Disengage the vertical locking mechanism on the spring balancer and release the main carriage assembly. Move the vertical column and the main carriage assembly through its entire range of travel and ensure the high voltage cables do not bind or have sharp bends. Readjust cables' drape if necessary.

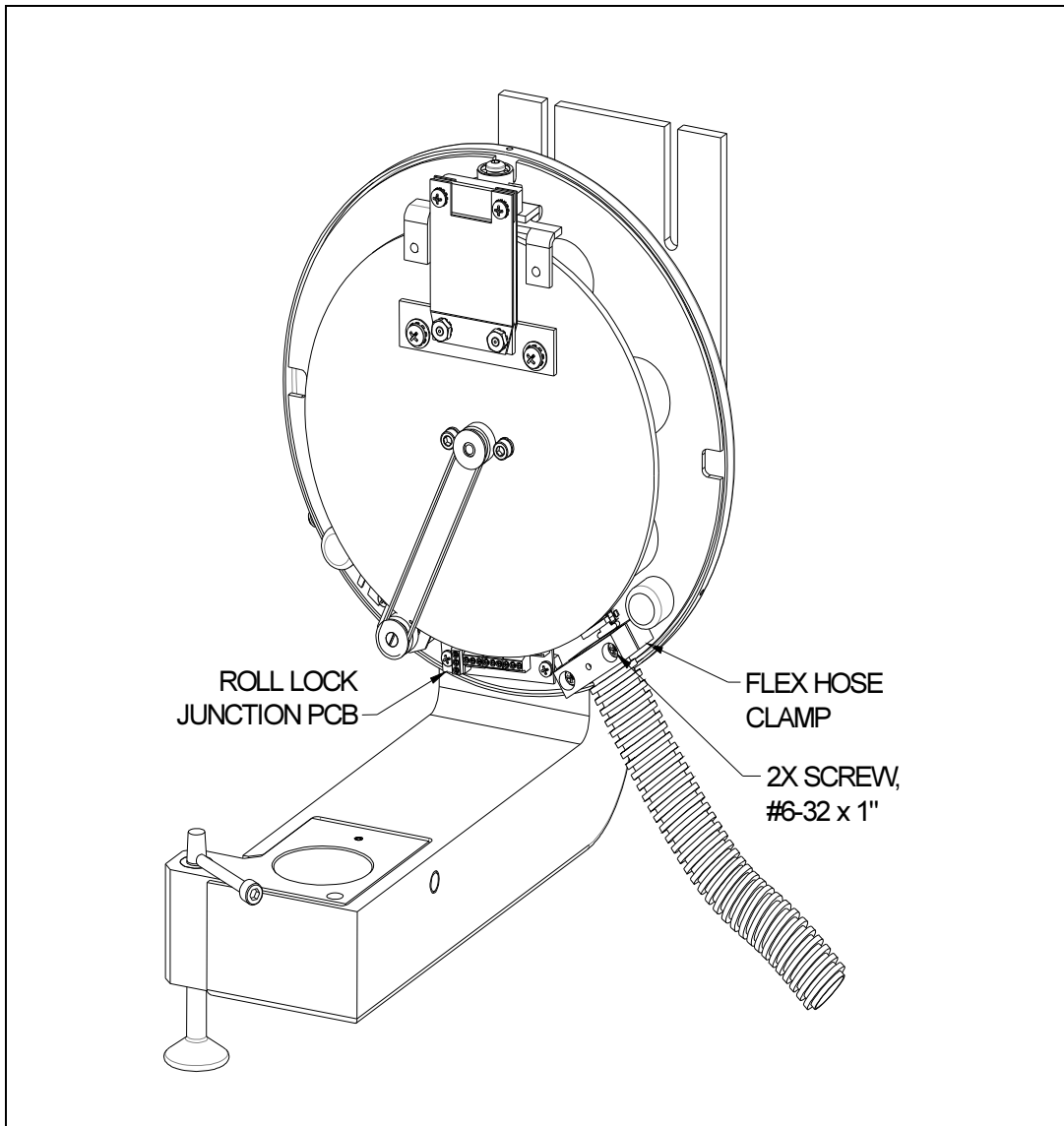
## Section 4. Cable Routing and System Interconnect

### B. Operator's Control



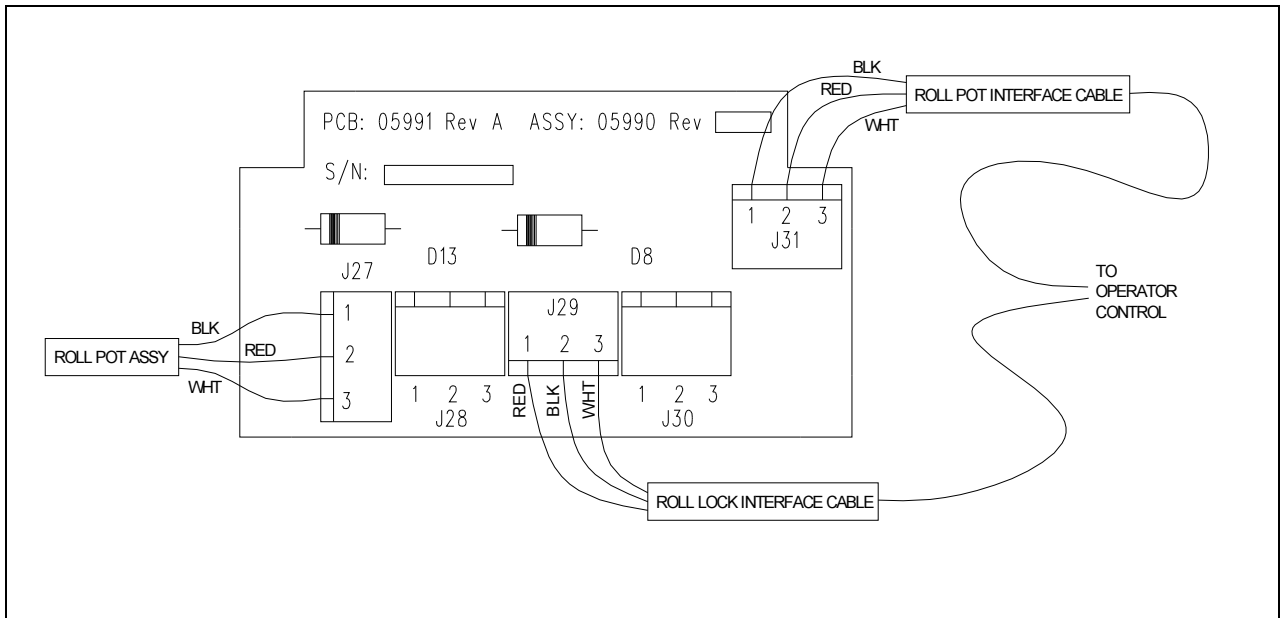
**NOTE:** Four cables originate from the operator's control, which are factory connected. These cables include a 12-conductor operator interface cable, a 3-conductor vertical pot cable, a 3-conductor roll pot cable, and a 3-conductor roll lock power cable. Two sections of flex hose are provided to facilitate cables that route from the operator's control to the roll lock assembly and then back to the cable support arm. All cables that need to be connected during installation are factory labeled to their designation.

1. Remove the roll lock assembly cover. Connect the flex hose clamp to the bottom of the lock assembly just below the locking disk. Secure in place by tightening the two #8-32 screws. (See **Figure 4-1**, page 39)
2. Connect the 3-conductor roll lock power cable to the roll junction PCB at header J29. Connect the 3-conductor roll pot cable to the roll junction PCB at header J31. (See **Figure 4-2**, page 40) Reinstall roll lock assembly cover.
3. Route the two sections of flex hose to the bottom of the cable support arm and secure in place. Ensure the hose drape does not hinder or limit the movement of the tube. The two ends of the flex hose at the cable support arm will eventually be wrapped with the high voltage cables to eliminate any possibility of stray cables being stuck or caught on structure when the system is being operated.



**Figure 4-1**  
**Roll Lock Assembly**

# Overhead Tube Support Service and Users Manual



**Figure 4-2**  
**Roll Junction PCB Connections**

4. Route the operators interface cable and vertical pot cable up to the main carriage assembly. These will be routed along with the high voltage cables in the cable support arm. Ensure to leave enough slack across the bend in the middle of the cable support arm to alleviate any strain on the cables when the vertical column is compressed in the fully up position. Secure cables with wire ties.
5. Once the cables are routed to the top of the cable support arm, loop both cables around and through the 1-inch access hole located on the bottom right side of the main carriage assembly as viewed from the back.
6. Route the vertical pot cable along the bottom left side of the OTS structure as viewed from the front. The vertical pot cable will then make a 90° bend across the center support channel just in front of the vertical mast section. Plug the female connector (H20) into the male connector (J20), which is directly connected to the vertical potentiometer. Connect the ground wire to the ground stud located in the area of the vertical pot connection. Use wire ties to secure the vertical pot cable.

## Overhead Tube Support Service and Users Manual

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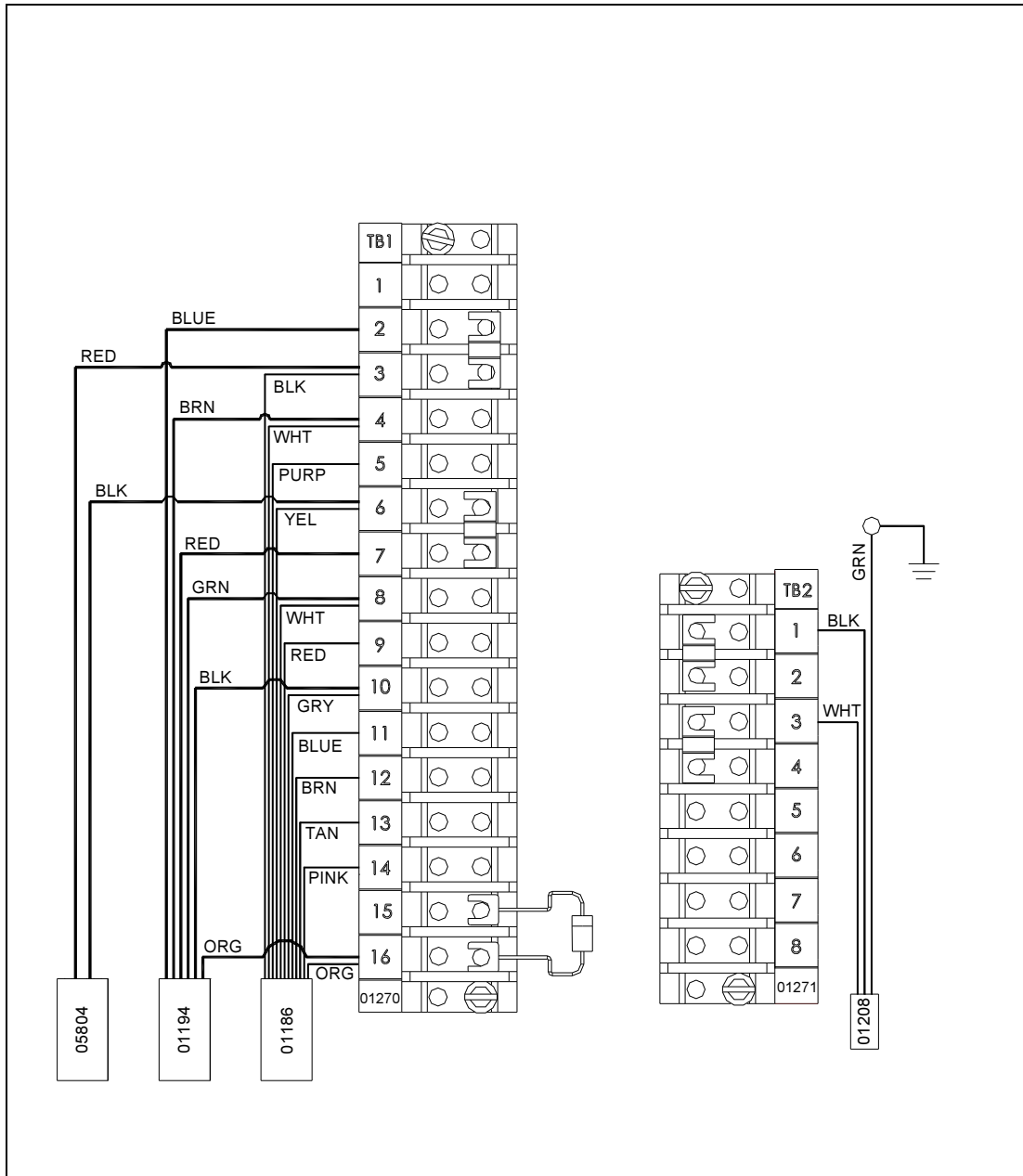
7. Route the operators interface cable from the access hole along the bottom left side of the main carriage and up to the front of the power supply assembly. Cable anchors are pre-mounted to secure the operators interface cable. These anchors also provide a clear path of the cable run. Connect the operators interface cable to the front of the power supply at TB1. (See **Figure 4-3**, page 42)



**NOTE:** If you are installing a tube-cooling fan as an option, proceed to the next step for mounting and wiring instructions. If you do not have a cooling fan skip step 8.

8. Mount the tube-cooling fan to the operator's control-mounting bracket just in front of the x-ray tube. Verify the direction of the airflow blows on the tube, then secure in place by using the two #10-32 screws provided. Route the cooling fan power cable into the lower and upper cable support arm and into the main carriage access hole in the same fashion the operator interface cable was routed in step 7. Connect the cooling fan power cable to the power supply located in the front of the OTS as viewed from the front at TB2-5, TB2-6 and ground.

# Overhead Tube Support Service and Users Manual



**Figure 4-3**  
**Main Carriage Power Supply Connections**

## Section 4. Cable Routing and System Interconnect

### C. Main Carriage Assembly, Transverse Bridge and Incoming System Power



**NOTE:** The main carriage assembly will have two cables, which are factory connected. These cables will include a 6-conductor main carriage interface cable and a 3-conductor main carriage power cable. These cables will be connected to the transverse bridge assembly at TB3.

1. The main carriage interface cable and power cable should already be routed through the 1-inch access hole located on the back right side of the main carriage assembly as viewed from the back. Route both of these cables along with the high voltage cables and secure the drape by using wire ties.
2. Connect these cables to the transverse bridge at TB3 located on the back right side as viewed from the front. (See **Figure 4-4**, page 44)



**NOTE:** All electrical components of the transverse bridge will be factory pre-wired to the TB3 terminal strip. This will include the front and rear longitudinal locks and the longitudinal detent switch.

3. Connect the 120 VAC incoming system power to the TB3 terminal strip of the transverse bridge. (See **Figure 4-4**, page 44)



**NOTE: THIS CABLE IS NOT INCLUDED.**

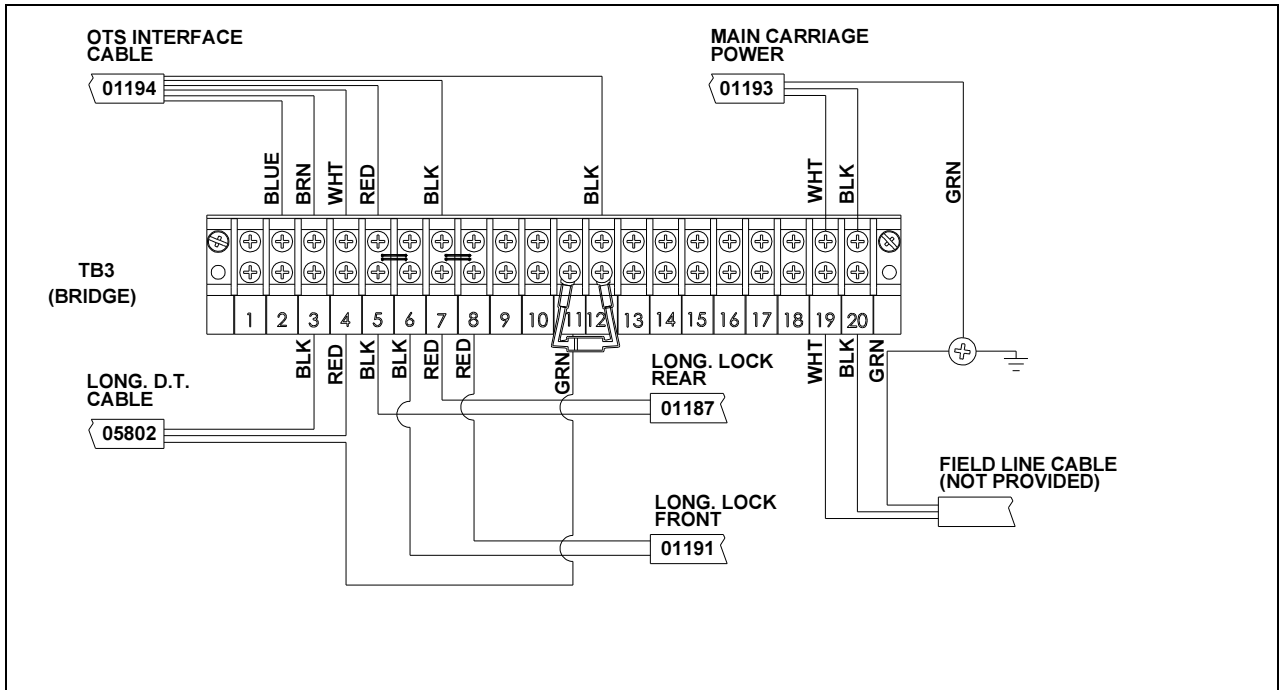
The incoming wire size should be 3-conductor #14 gauge for a run up to 20 feet. (See Section 2.F. for incoming power requirements)

**Refer to NEMA electrical code for the proper wire size for runs greater than 20 feet.**

4. Before applying power to the unit, ensure the system “ON/OFF” switch is in the “OFF” position. This switch is located on the upper right side of the main carriage assembly as viewed from the back. After the main breaker is “ON”, turn the system “ON/OFF” switch to “ON” and allow the operators console to boot-up to the operating screen. This typically takes a couple of seconds.

# Overhead Tube Support Service and Users Manual

5. Verify all functions of the operator's control panel function normally. This will include all vertical and horizontal lock assemblies.



**Figure 4-4**  
**Transverse Bridge Connections TB3**

## Section 5. Calibration and Adjustments

### A. Vertical Counterbalance



**NOTE:** Normal operating characteristics of a properly counterbalanced system are: At the maximum vertical height the vertical column will tend to extend downward slightly when the vertical lock is released. The vertical column will also tend to retract upward slightly when extended fully to the bottom of its travel. The vertical column should be stable over the entire midrange of travel, and should not require any excessive force to move the vertical column throughout its entire range of travel.

1. Depress the vertical lock switch and pull the column down to approximately the mid position and release the switch. Without touching any other part of the operator control, depress the vertical lock switch and verify vertical column does not drift. If you are experiencing a significant drift the counterbalance is not correct.
2. A sufficient amount of trim weights are included with the OTS to customize the counterbalance to the desired level. Trim weights can be added and removed to offset the pulling force of the spring balancer. (See **Figure 3-4**, page 29) With the vertical column in the fully compressed or “up” position you can gain access to the trim weight assembly located on the top of the middle or smallest mast section.



**NOTE:** After counterbalancing is complete, move the OTS throughout its entire longitudinal and transverse range of travel and periodically check for vertical drifting. This may be caused by improper cable drape. If necessary, adjust the cable drape to eliminate or minimize vertical drifting.

## Section 5. Calibration and Adjustments

### B. Tube and Collimator Balancing



**NOTE:** This adjustment will prevent an uncontrollable swing of the tube and collimator when power to the unit is turned off or a sudden loss of power to the roll lock has occurred. This adjustment should be made once the cable drape is complete. An improper cable drape will have an effect on this adjustment.

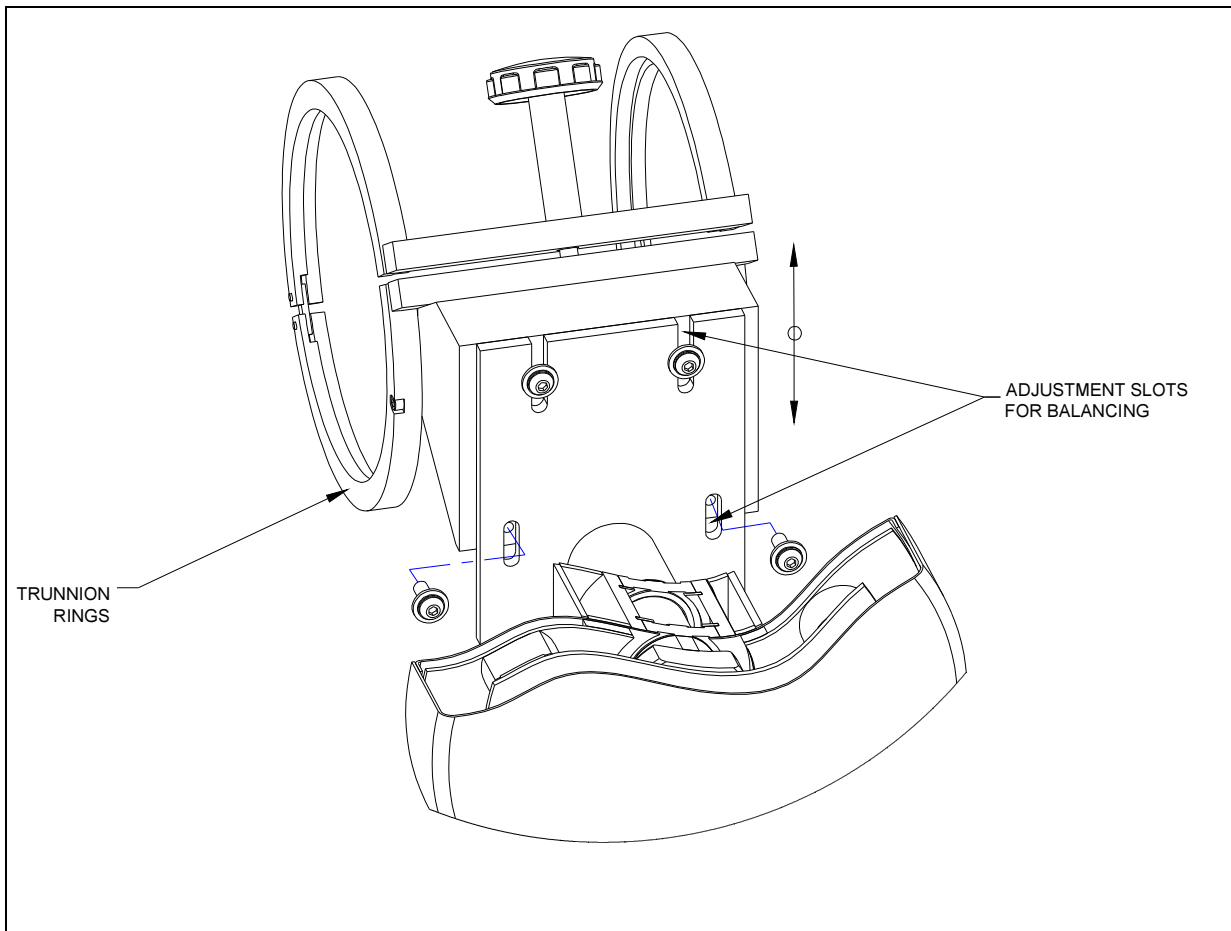


**CAUTION:** When loosening the trunnion mounting hardware the tube and collimator may drop slightly. Exercise caution when loosening this hardware.

1. Loosen all four ¼"-20 Trunnion-mounting screws until the trunnion assembly becomes loose. Do not completely remove this hardware. (See **Figure 5-1**, page 47)
2. Position the tube and collimator so that the total weight load is centered in relation to the pivot point of the tube support arm. This may be a two-person job.
3. Tighten all four ¼"-20 Trunnion-mounting screws. Angulate (roll) tube to +90° and depress the roll lock button to simulate a loss of power. Determine if the amount of downward swing is acceptable. It is recommended that the collimator swings slowly downward. If the downward swing is unacceptable, repeat this process.

# Overhead Tube Support Service and Users Manual

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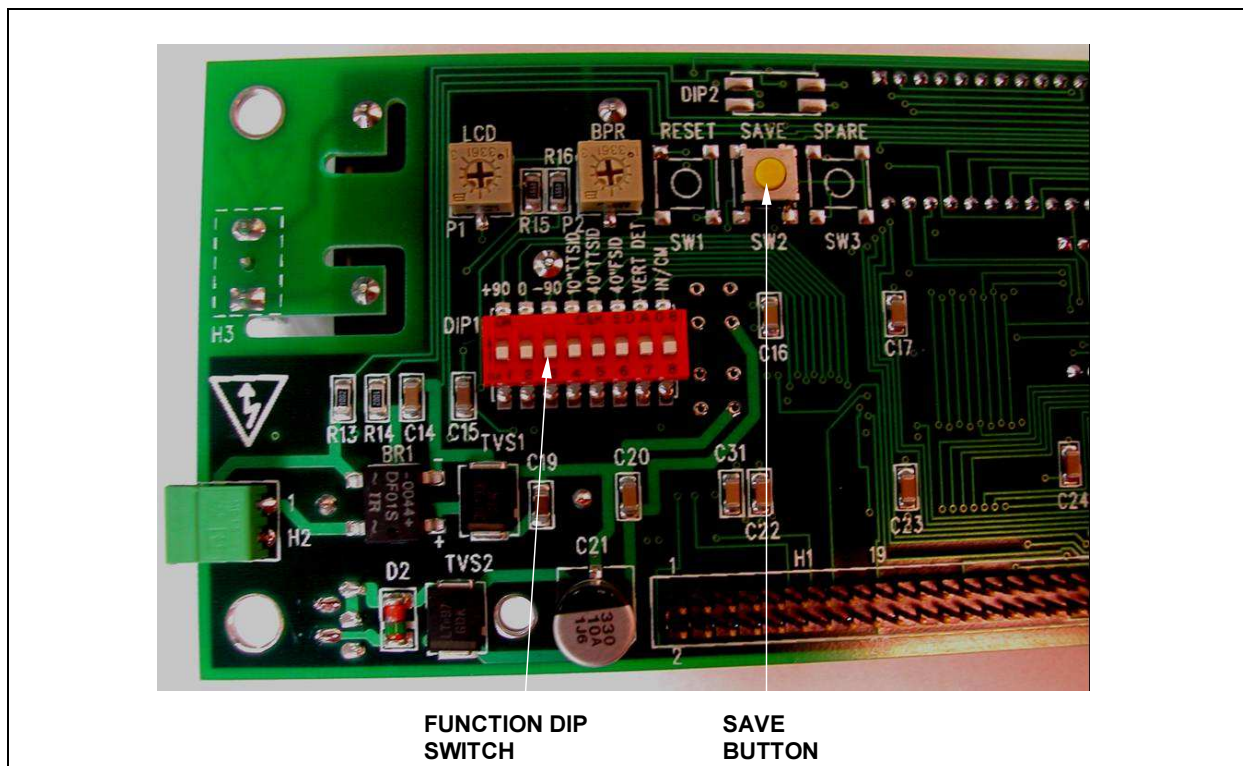
**Figure 5-1**  
**Tube and Collimator Balancing**

## Section 5. Calibration and Adjustments

### C. Calibration of the “Tube Roll” Digital Display



**NOTE:** Remove the four flat head screws and rear panel from the back of the operator control to gain access to the control board. (See **Figure 5-2**, page 48). If a cooling fan is installed, this must be removed first.



**Figure 5-2**  
**Function Switch and Save Button**

1. With switch DIP1-1 ON (closed) and all others OFF (open), Tube Angle “90°” will flash on the LCD display. Position the x-ray beam horizontal (in detent position), in the direction of the primary wall stand. Press and hold the SAVE button, a confirm message will be displayed along with a short beep tone. This will indicate the primary horizontal beam angle (90°) has been input. Release the SAVE button and turn DIP1-1 OFF.

## ***Overhead Tube Support* Service and Users Manual**

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2. With switch DIP1-2 ON (closed) and all others OFF (open), Tube Angle “0°” will flash on the LCD display. Position the x-ray beam vertically downward (in detent position). Press and hold the SAVE button, a confirm message will be displayed along with a short beep tone. This will indicate the vertical beam angle (0°) has been input. Release the SAVE button and turn DIP1-2 OFF.
3. With switch DIP1-3 ON (closed) and all others OFF (open), Tube Angle “-90°” will flash on the LCD display. Position the x-ray beam horizontal (in detent position), in the direction opposite of the primary wall stand. Press and hold the SAVE button, a confirm message will be displayed along with a short beep tone. This will indicate the secondary horizontal beam angle (-90°) has been input. Release the SAVE button and turn DIP1-3 OFF.
4. With all switches of DIP1 OFF (open), roll the x-ray beam to its three detent positions +90°, 0° and -90° and confirm that the display indications are correct and the beam position is level.

## Section 5. Calibration and Adjustments

### D. Calibration of the “Vertical SID” Digital Display



**NOTE:** The vertical SID display can be displayed in inches or in centimeters. Factory setting will be in inches. To change vertical SID display from inches to centimeters change DIP-1 SW8 to the up or “ON” position.

1. Position the x-ray beam vertically downward. With switch DIP1-4 ON (closed) and all others OFF (open) Table Top (TT) SID “10.0” (25 cm) will flash on the LCD display. Using a tape measure, position the x-ray tube’s focal spot 10 inches (or 25 cm) above the tabletop. Press and hold the SAVE button, a confirm message will be displayed along with a short beep tone. This indicates the 10-inch (or 25 cm) TT SID has been input. Release the SAVE button and turn DIP1-4 OFF.
2. With switch DIP1-5 ON (closed) and all others OFF (open). Table Top SID “40.0” (100 cm) will flash on the LCD display. Using a tape measure, position the x-ray tube’s focal spot 40 inches (or 100 cm) above the tabletop. Press and hold the SAVE button, a confirm message will be displayed along with a short beep tone. This indicates the 40-inch (or 100 cm) TT SID has been input. Release the SAVE button and turn DIP1-5 OFF.
3. With switch DIP1-6 ON (closed) and all other OFF (open). Tray SID “40.0” (100 cm) will flash on the LCD display. Using a tape measure, position the x-ray tube’s focal spot 40 inches (or 100 cm) above a film cassette placed in the film cabinet. Press and release the SAVE button, a confirm message will be displayed along with a short beep tone. This indicates the 40-inch (or 100 cm) tray SID has been input. Release the SAVE button and turn DIP1-6 OFF.
4. With all DIP1 switches OFF (open), verify the vertical display indication for various vertical SIDs to the tabletop and the film cabinet.

## Section 6. OTS Alignments and Tracking

### A. Collimator Alignment



**NOTE:** This section is written under the assumption that the x-ray generator has been installed, calibrated, and configured to operate with the OTS system.

Perform all of the necessary alignments to the collimation system. This will prepare the OTS for alignment and is essential as a first step. **(Refer to the manufacturer's installation manual for collimator alignments and adjustments.)** All adjustments should be made as accurately as possible to preclude excessive tolerance build up.

1. Take a series of exposures and align and size the collimators light field to the x-ray field. Ensure the light field coincides with the x-ray field.
2. Verify proper alignment of the collimator "cross-hairs". Adjust collimator exit window as required.

### B. Trunnion Assembly

1. The collimator must be square in relation to the tube support arm. Loosen the trunnion-locking knob and adjust the tube and collimator so the bottom face of the collimator is parallel to the bottom of the tube support arm, or with a builder's square, adjust the tube and collimator so the bottom face of the collimator is perpendicular to the front face of the tube support arm. (See **Figure 6-1**, page 53) Tighten the trunnion-locking knob and verify adjustment. Tightening the locking knob may change the adjustment. Re-adjust if necessary.
2. Once the collimator is square to the tube support arm, tighten the trunnion-locking knob. Keep the trunnion locked throughout the remaining steps in this section.

## Section 6. OTS Alignments and Tracking

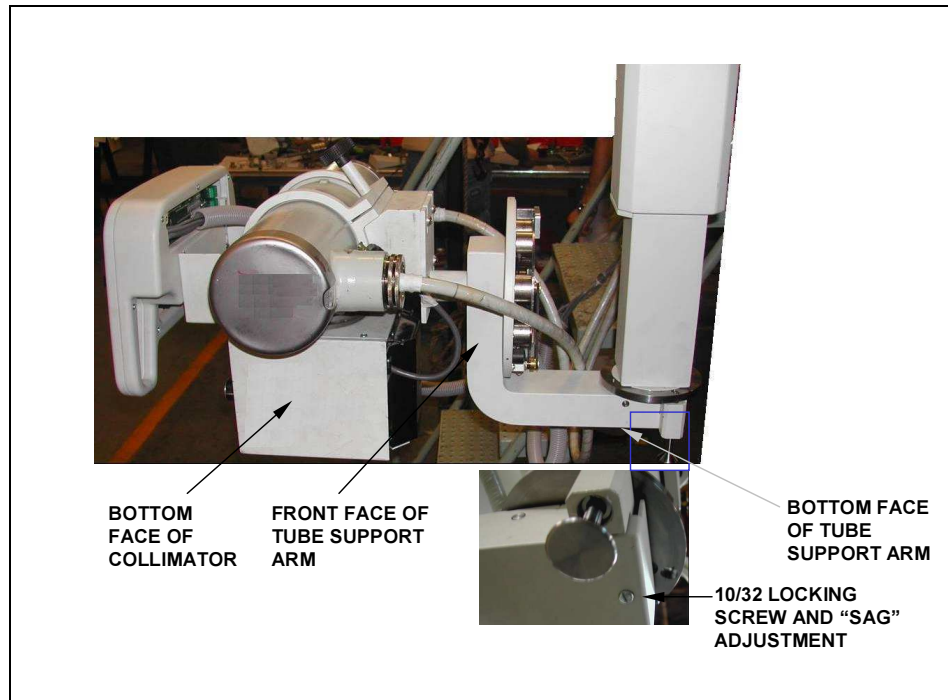
### C. “Sag” Adjustment and Vertical Tracking



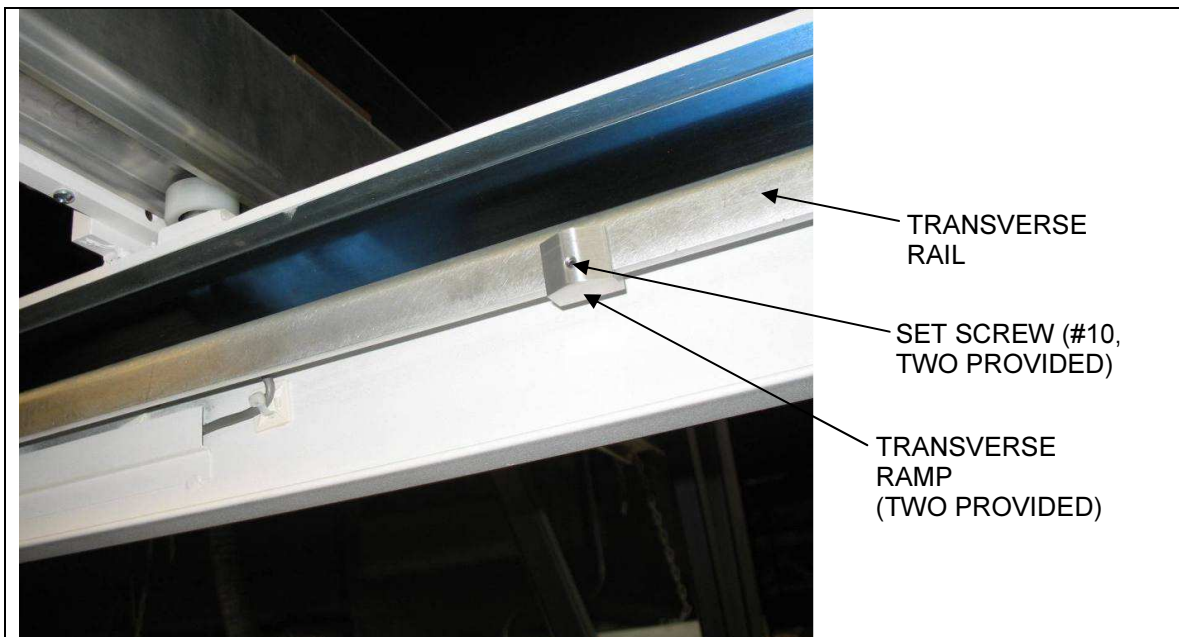
**NOTE:** This adjustment is recommended before the x-ray table is actually located and anchored to the floor. The centerline of the x-ray table will be affected by both the “Sag” adjustment and the accuracy of the vertical tracking.

1. With the x-ray beam pointed downward and the collimator light “ON”, release the vertical lock and pull the vertical column down to the lowest SID position. Open both collimator blades to their fully open positions. Mark a spot on the floor (tape or chalk line) at the point the longitudinal cross hairs of the collimator projects an image.
2. While keeping the main carriage assembly stationary and the roll locks mobilized, raise the vertical column throughout most of its vertical range and adjust the tube “Sag” until the longitudinal cross hairs track the marked position on the floor in the transverse direction. To gain access to the “Sag” adjustment, remove the #10-32 pan head locking screw. Adjust the 5/16”-18 cap head screw counter-clockwise to raise the tube arm assembly and clockwise to lower the tube arm assembly. (See **Figure 6-1**, page 53, for “Sag” adjustment location.) This may take a few attempts before acceptable tracking is achieved. Reinstall the #10-32 pan head locking screw.
3. Move the main carriage assembly within the transverse bridge back to the desired “transverse centerline” position. This will be the centerline of the x-ray table and the wall stand. With the tube focal spot over the transverse centerline of the table, locate the transverse detent ramp, slip it into place on the transverse rail (See **Figure 6-2**, page 53) so that it actuates the transverse detent switch and energizes the locks. Secure in place with the #10 set screw. Adjust the transverse detent switch location if necessary by loosening its mounting screws. Note two transverse detent ramps are provided. If a second transverse detent location is required repeat the above process utilizing the second ramp.

# Overhead Tube Support Service and Users Manual



**Figure 6-1**  
**Tube Support Arm and "Sag" Adjustment**



**Figure 6-2**  
**Transverse Detent**

## Section 6. OTS Alignments and Tracking

### D. “Yaw” Adjustment and Horizontal Tracking



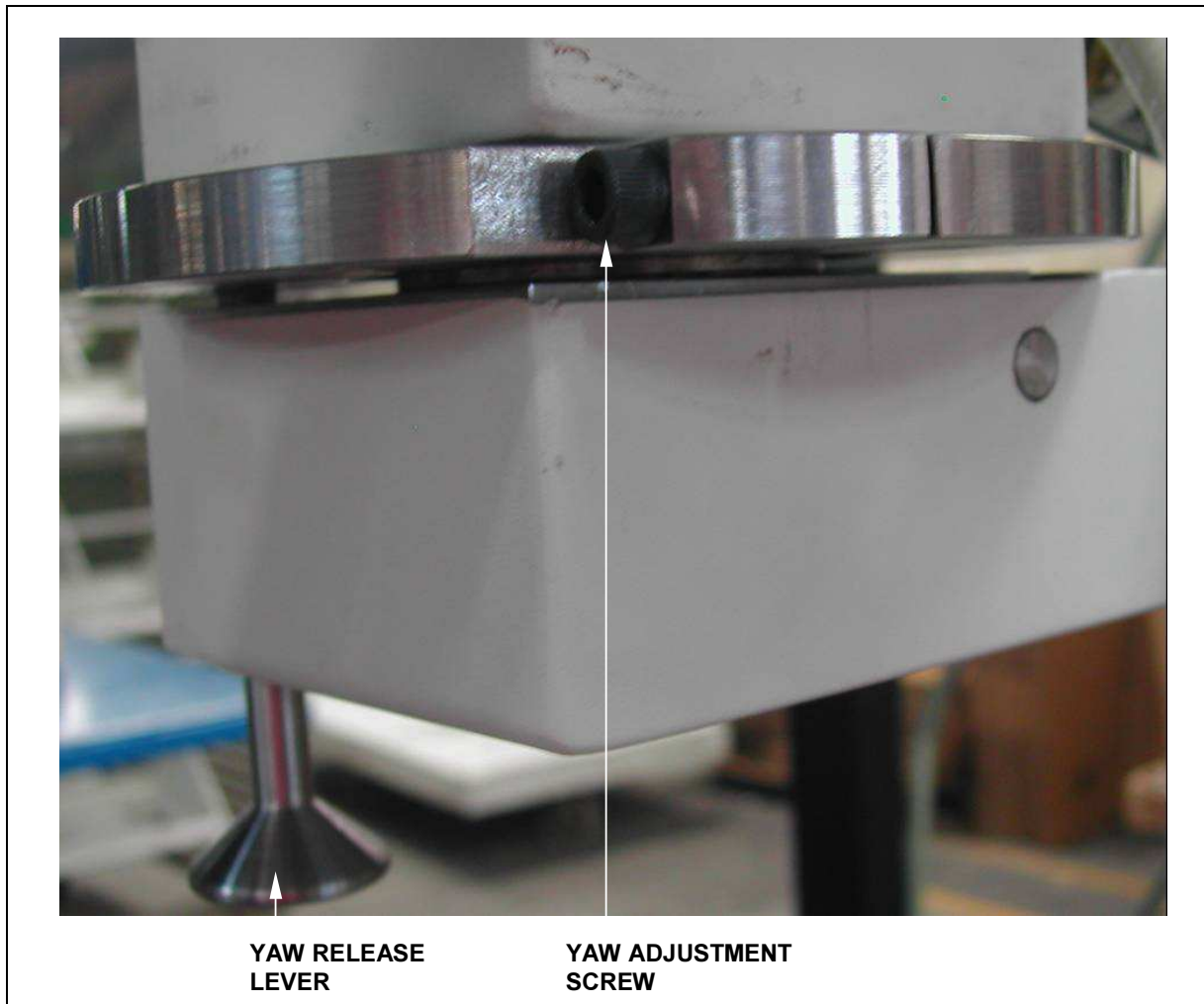
**NOTE:** This step will need to be performed before positioning and anchoring the wall stand. This step will establish a transverse centerline on the wall where the wall stand and the image receptor will be installed.

1. Move the main carriage assembly within the transverse bridge unit the transverse detent is actuated. Energize all locks and ensure OTS does not move.
2. Hang a plumb line from the front surface of the front longitudinal ceiling rail. Position the tube roll to  $0^\circ$ . Measure the distance between the x-ray tube (focal spot) and the plumb line. This will be called distance “A”.
3. With a suitable straight edge, extend the distance of the front longitudinal rail, horizontally, all the way to the wall where the wall stand will be located. With a straight edge and a level, pencil in a straight line towards the rear of the room the same distance as distance “A”. Hang a plumb line from this point and this becomes the transverse centerline and therefore, the horizontal centerline for the wall stand and image receptor. (Keep the plumb line in place for the remainder of this procedure.)
4. Depress the “roll” lock switch and angulate the x-ray tube to  $+90^\circ$  towards the wall stand. Turn the collimator lamp “ON” and adjust the “Yaw” detent plate to align the collimator vertical cross hair to the plumb line. (See **Figure 6-3**, page 55, for the “Yaw” adjustment location.)



**NOTE: DO NOT ADJUST THE TRUNNION ASSEMBLY.**

5. Release the longitudinal lock and move the entire bridge assembly to approximately 10 inches (25 cm) from the wall and then back to approximately 72 inches (183 cm) and verify the collimator vertical crosshairs track and remain centered on the plumb line. Readjust “Yaw” detent plate if necessary.



**Figure 6-3**  
**“Yaw” Detent Adjustment**

6. Verify the transverse centerline of the table. Position the x-ray tube over the table until the transverse detent is actuated. Set a 40” SID (102 cm) and move the x-ray tube longitudinally across the length of the table. Verify the collimator light field is aligned with the film cabinet within  $\pm 0.25$  inches across its entire range. Reposition x-ray table if necessary.
7. Verify the vertical tracking by hanging a plumb line on the transverse centerline on the wall where the wall stand will be mounted. With the tube at  $+90^\circ$  and the collimator light field “ON”, raise and lower the vertical column. The light field should remain centered on the plumb line throughout the entire vertical range to within  $\pm 0.25$  inches.

## Overhead Tube Support Service and Users Manual



**NOTE:** If the OTS does not track within an acceptable tolerance, this is an indication of one or more discrepancies. (1) The longitudinal rails may not be level, either longitudinally or transversely. (2) The main and guide bearings on the main carriage assembly are not riding properly in the transverse rail. (3) Improper alignment of the trunnion or tube-mount assembly.

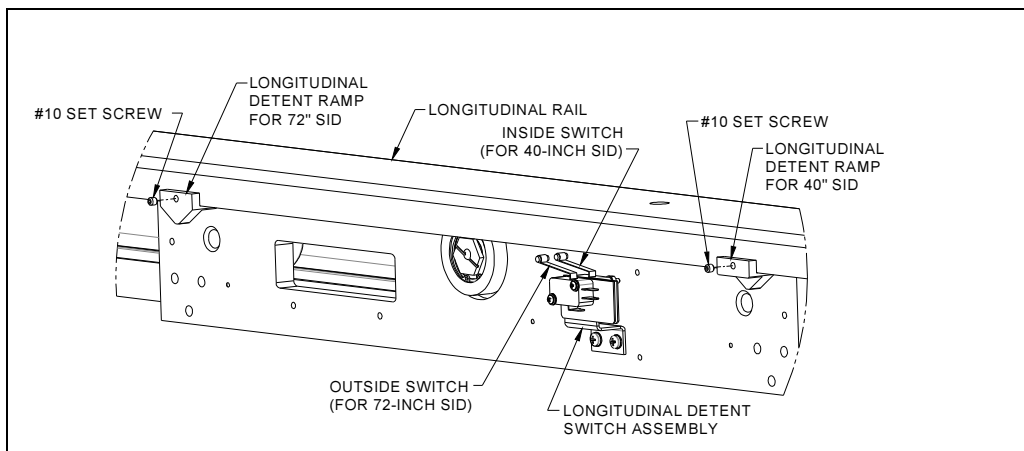
Determine the location of the discrepancy and take corrective action as required.

8. Position the transverse bridge assembly to achieve 40 inches from the tube's focal spot to the film plane of the wall stand. Install the longitudinal detent ramp using included #10 set screw so the inside switch (dedicated to 40-inch horizontal SID) is actuated. Next position the bridge assembly for 72 inches between focal spot and film plane. Install the second longitudinal detent ramp so the outside switch (dedicated to 72-inch SID) is actuated.



**NOTE:** The mounting orientation of the actuators will differ by 180°. The 40-inch ramp will be inside the longitudinal rail and the 72-inch outside the rail. **Figure 6-4**, page 56, below is a view of the back of the front bearing plate on the bridge assembly (below the front longitudinal rail). In this view the film plane is to the right (film plane left facing the x-ray tube).

Once the detent ramps are installed, label the 40 and 72 inch SID locations with the labels provided. Install the 40 and 72 inch SID pointer. This will be mounted with a single thumbscrew on the back left side of the transverse bridge as viewed from the front.



**Figure 6-4**  
**Longitudinal Detent Ramps**

## Section 7. Positive Beam Limitation (PBL)

Automatic or semi-automatic PBL collimators require either discrete or continuous SID signals or both. These signals tell the PBL electronics the location of the focal spot in relation to the film plane. Manual collimators are not compatible with PBL. The Discrete Vertical and Horizontal SID are standard features on all units. Depending on the type of collimator, the optional/not provided Continuous Vertical SID Kit may need to be installed.

**Continuous Vertical SID Kit** (optional) - Necessary for collimators that require a continuous vertical SID signal. This kit must be field installed into the OTS main carriage assembly. This kit will include a vertical SID potentiometer, a pulley, and a vertical SID drive belt.

**Discrete Vertical SID** (standard on all units) - Necessary for collimators that require a discrete 40-inch vertical SID signal from a normally open isolated contact. This signal will be generated from the operators' control and will use the input from the vertical SID potentiometer that is factory installed on all units. Normally open isolated contact connection points are provided on the transverse bridge at TB3-17 and 18 to input to the PBL electronics.

**Discrete Horizontal SID** (standard on all units) - Necessary for collimators that require a discrete 40 and 72-inch horizontal SID signal. These signals will be generated by (2) normally open isolated contacts pre-installed at the factory. Two detent ramps will be provided together with #10-32 set screws for field installation. Normally open isolated contact connection points are provided on the transverse bridge at TB3-9 (40"), TB3-10 (72") and TB3-13 (COM) to input to the PBL electronics.

### A. Continuous Vertical SID Kit Installation



**NOTE:** The continuous vertical SID kit will include a 1K OHM potentiometer with a pre-wired 3-conductor cable, a pulley, and a drive belt.

1. Move the column vertically until the distance from the bottom of the overhead column bracket to the top of the tube support arm measures 48" (1270mm) (See **Figure 3-8**, page 33). Gain access to the vertical potentiometer-mounting bracket. This is located in the main carriage assembly on the right side as viewed from the front. (See **Figure 3-7**, page 33). Loosen the two ¼"-20 mounting bracket screws, slide the mounting bracket forward. Remove and discard the original vertical pot

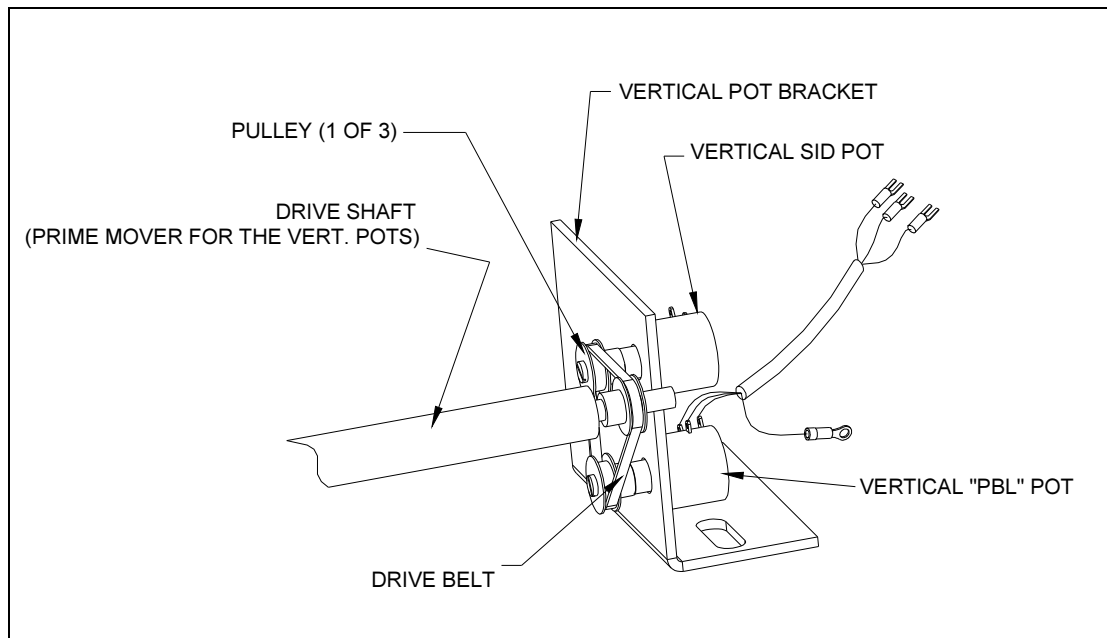
## Overhead Tube Support Service and Users Manual

drive belt. Ensure not to disturb the position of the existing vertical potentiometer.



**NOTE:** The vertical SID digital display should be recalibrated after the continuous vertical SID kit has been installed.

2. Install the vertical PBL potentiometer and wire by inserting the shaft through the empty mounting hole and tightening the mounting nut. Install the pulley onto the shaft. (See **Figure 7-1**, page 58) Ensure the setscrews on the pulley are tight on the shaft. Connect the ground lead to the ground stud.



**Figure 7-1**  
**Continuous Vertical SID Pot and Drive Belt**



**CAUTION:** Before installing the drive belt, you must measure the resistance of the continuous vertical SID potentiometer for proper range. Not doing so may result in mechanical damage and destruction of the potentiometer.

## **Overhead Tube Support Service and Users Manual**

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3. With the top of the tube support arm at 48" from the bracket above (See **Figure 3-8**, page 33). Take an ohmmeter and measure the resistance at the connector across the black and red wires or at the potentiometer across pins 1 and 2. The ohmic value should read **495 - 505 ohms**. If the ohmic value is not in this range, Manually adjust the pot shaft to the correct ohmic value. **Ensure that the Vertical SID pot also measures 495-505 ohms.**
4. Install the vertical potentiometer drive belt as shown in **Figure 7-1**, page 58. Set the belt tension by moving the vertical potentiometer mounting bracket to the rear and tightening the ¼"-20 mounting hardware. Belt tension should just tight enough as to prevent the teeth of the drive belt from jumping around the pulley. **Do not over tighten the drive belt.**
5. The PBL potentiometer cable will need to be routed back to the access hole, located on the bottom right hand side of the main carriage assembly as viewed from the back. Route the PBL potentiometer cable along with the existing vertical SID cable and through the access hole. Route the remaining cable along with the high voltage cable drape back towards the rear of the transverse bridge and terminate at TB3 positions 14, 15 and 16. (See **Figure 4-4**, page 44)

## **Section 8. Final Cosmetic Dressings**

### **A. Cable Wrap**

The high voltage cable drape and associated cables will be covered in a vinyl wrapping. There will be two lengths of vinyl wrap, one for the cable support arm drape and one for the main carriage to transverse bridge drape. Both lengths of wrap will be fastened with Velcro<sup>®</sup> installed in the inseam.

1. Locate the nine-foot section of wrap with the two 3 inch cut outs. This will be used to wrap the drape in the cable support arm. Starting at the top of the cable support arm, apply the wrap and work towards the tube end. The cut out sections will be placed around the cable support arm pivot joints.
2. Locate the six-foot section of wrap. This will be used to wrap the cable drape from the main carriage assembly to the transverse bridge. Starting on the left side of the main carriage assembly as viewed from the back, wrap the high voltage and associated cables. Secure in place with wire ties. Apply the wrap along the entire cable drape. Secure the end to the transverse bridge by using wire ties.

### **B. System Covers**

There are five covers that need to be installed. The main carriage shroud (plastic), the main carriage back cover, the transverse bridge terminal cover, and two bridge bearing plate covers. (See **Figure 8-1**, page 61). Ensure all covers are tight and secure.

1. Install all four shroud mounting brackets and secure in place with two #8-32 screws per bracket. Ensure the bracket orientation is correct. Each bracket is specific to its location. (See **Figure 8-2**, page 62)
2. Position and mount the shroud by using the four #8-32 mounting screws and plastic screw head covers.
3. Install the back cover and secure in place by using two #10-32 screws. Ensure not to pinch any of the cables that run across the back of the main carriage assembly. Any excess vinyl cable wrap will be tucked under the main carriage back cover.

## Overhead Tube Support Service and Users Manual

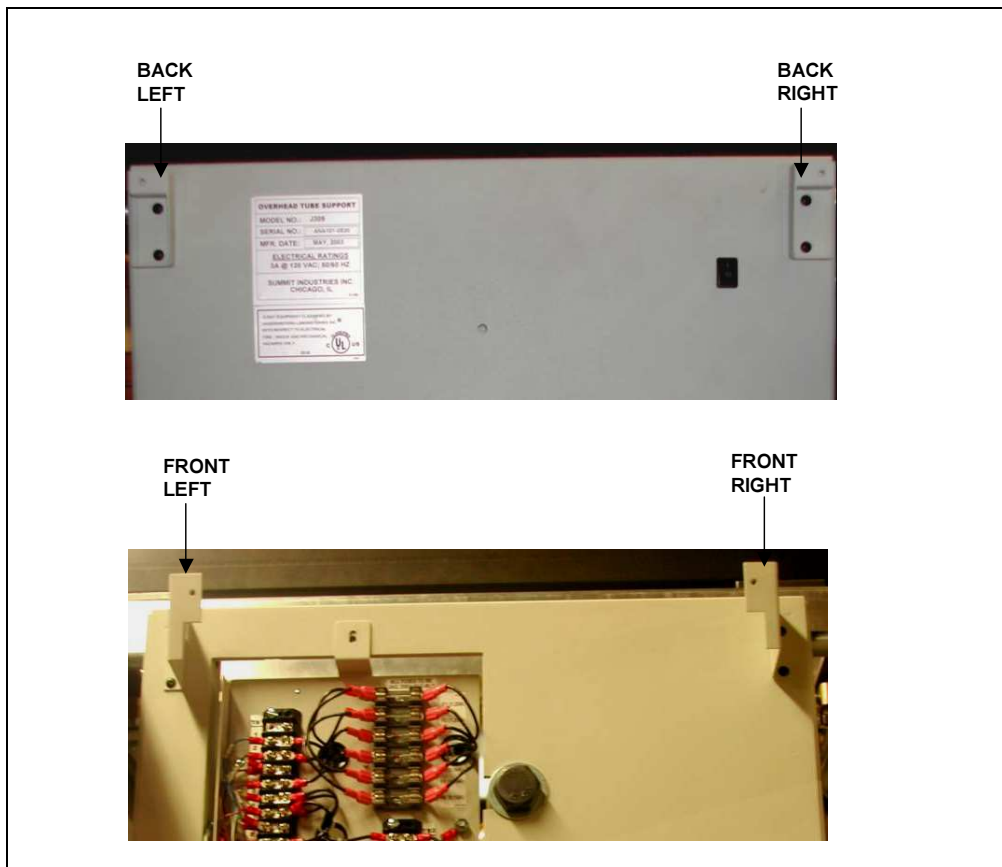
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4. Install the transverse bridge terminal cover to the right side of the transverse bridge as viewed from the front. Secure in place by using four #10-32 screws. Ensure not to pinch any cables when tightening down the terminal cover.



**Figure 8-1**  
**System Covers**

# Overhead Tube Support Service and Users Manual



**Figure 8-2**  
**Shroud Mounting Brackets**

## C. Transverse Detent Labels

Transverse detent labels and an arrow indicator are included. These are to be applied to the underside of the transverse bridge and the main carriage shroud. Once applied, these labels should be in clear view of the user, to indicate the transverse center position of the x-ray beam. These labels will include: 1 arrow indicator, 1 “Table” label, 1 “Wall and Table” label and 1 “Wall” label.

1. Apply the arrow indicator to the underside of the main carriage shroud on the front right side as viewed from the front. Ensure the arrow is pointing outward.



**NOTE:** If your x-ray table centerline is the same as the wall stand centerline continue to step 2. If your wall stand centerline is offset from the x-ray table centerline, skip to step 3.

## ***Overhead Tube Support* Service and Users Manual**

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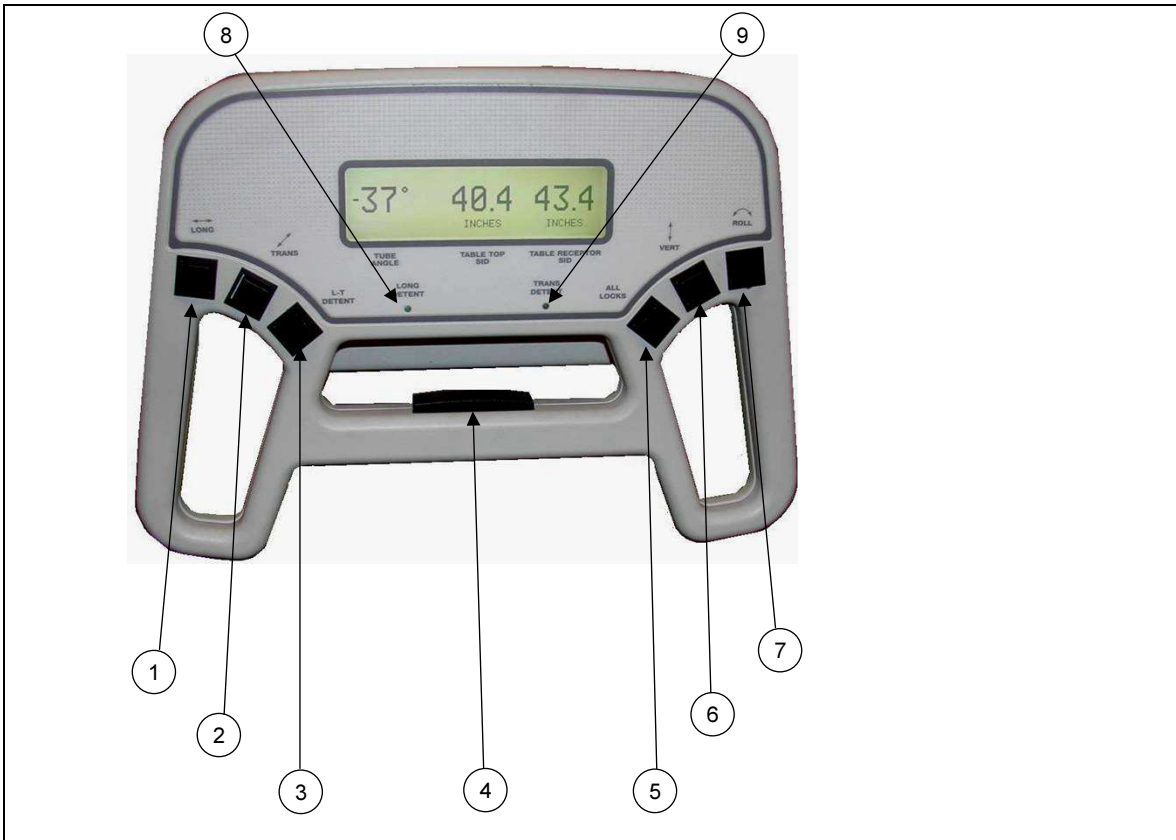
2. Move the OTS in the transverse direction until the transverse detent locks energize. Physically verify the centerline of the x-ray beam is positioned over the center of the x-ray table. Rotate the x-ray tube towards the wall stand and verify the vertical centerline is centered to the vertical centerline of the wall stand. Apply the “Table and Wall” label to the underside of the transverse bridge. Ensure the label lines up with the arrow indicator on the main carriage shroud applied in step 1 above.
  
3. Move the OTS in the transverse direction until the transverse detent locks energize over the x-ray table. Physically verify the centerline of the x-ray beam is positioned over the centerline of the x-ray table. Apply the “Table” label to the underside of the transverse bridge. Ensure the label lines up with the arrow indicator on the main carriage shroud applied in step 1. Rotate the x-ray tube towards the wall stand. Release the transverse locks and move the OTS forward until the transverse detent locks energize. Physically verify the vertical centerline is entered to the vertical centerline of the wall stand. Apply the “Wall” label to the underside of the transverse bridge. Ensure the label lines up with the arrow indicator, on the main carriage.

# Overhead Tube Support Service and Users Manual

## Section 9. Users Manual

### A. Controls

The picture below shows the operator's control and display of the OTS. Each control is keyed to the following list.




**Figure 9-1  
Operator's Control**

# Overhead Tube Support Service and Users Manual

## Section 9. Users Manual

### A. Controls

Number	Control	Function
1	<b>Longitudinal Lock Release Switch</b>	Depress this switch to release only the longitudinal lock. Use this action when it is desired to move the tube longitudinally without disturbing other positioning. Release the switch to lock the OTS in the desired longitudinal position.
2	<b>Transverse Lock Release Switch</b>	Depress this switch to release only the transverse lock. Use this action when you want to move the tube transversely without disturbing other positioning. Release the switch to lock the OTS in the desired transverse position.
3	<b>Longitudinal / Transverse Detent Switch</b>	<p>Depress this switch and hold it depressed while moving the OTS slowly toward the transverse and /or longitudinal center position. The appropriate lock will activate automatically when the tube reaches the Transverse Center and/or the Longitudinal Detent position. Release the switch to re-engage the longitudinal and transverse locks.</p> <p> <b>NOTE:</b> This system may have up to two transverse detent positions and two longitudinal detent positions.</p>
4	<b>One Hand Multi-Lock Release Switch</b>	Grasping the center handle activates this switch and releases all electromagnetic locks that secure all OTS motions (except the "ROLL" motion). The OTS may now be moved in any direction, including vertical. Release the center handle switch to re-engage all locks.
5	<b>All Locks Release Switch</b>	Depress this switch to release all electromagnetic locks that secure all OTS motions (except the "ROLL" motion). The OTS may now be moved in any direction, including vertical. Release the switch to re-engage all locks.

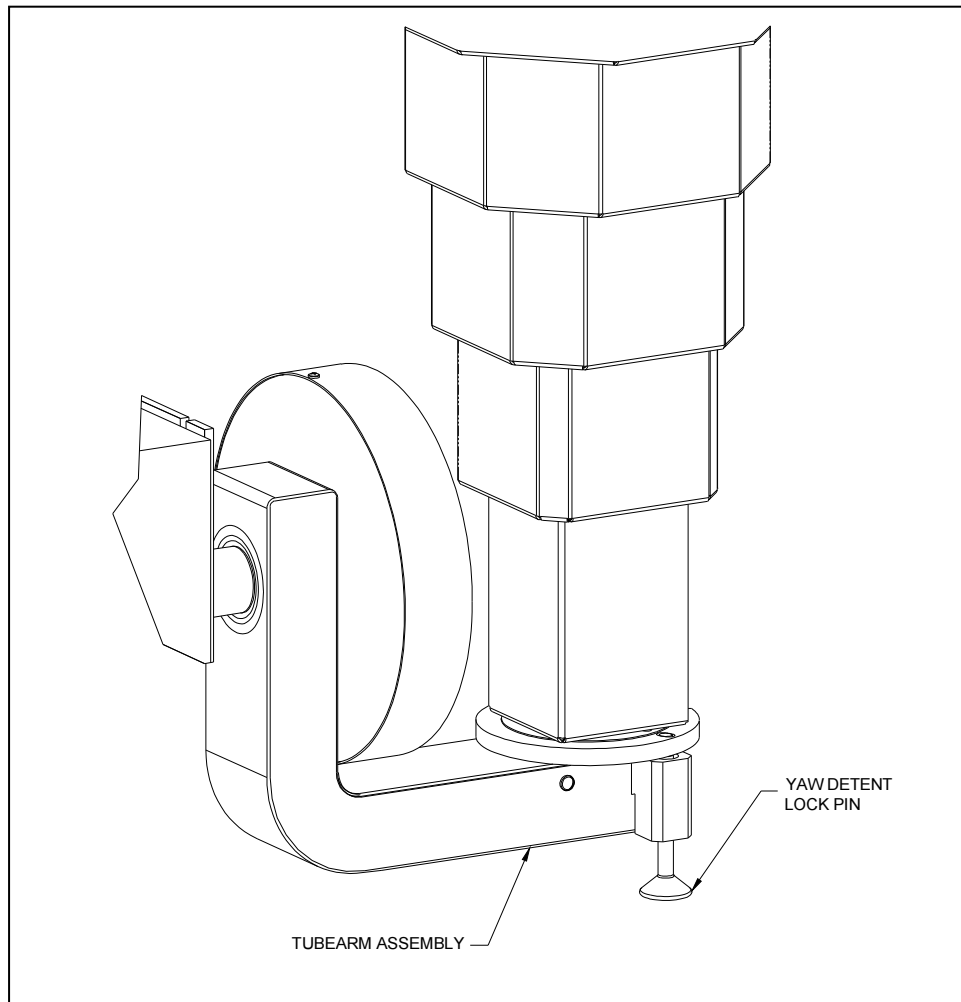
## Overhead Tube Support Service and Users Manual

6	<b>Vertical Lock Release Switch</b>	Depress the switch to release only the vertical lock. Use this action when you want to move the tube vertically without disturbing other positioning. Release the switch to lock the OTS in the desired vertical position. When the SID changes, the value displayed in the LCD Display Window is highlighted. See Section 9.B. titled: "Displays".
7	<b>Roll Lock Release Switch</b>	Rotation about the tube's horizontal axis is called "roll". The tube may be turned to any "roll" position and locked. Depress the switch to release the lock, and then roll the x-ray tube slowly into the desired position (a "detent" is provided to assist positioning at 90° increments.) Release the Roll Lock Release Switch to secure the x-ray tube at the desired angle. When the angle changes, the roll angle is displayed in the LCD Display Window and the angle value is highlighted. See Section 9.B. titled: "Displays".
8	<b>Longitudinal Detent Indicator</b>	This indicator will light when the tube is positioned at the Longitudinal SID detent. There can be up to two SID detent positions. Viewing the SID markers will indicate the SID.
9	<b>Transverse Detent Indicator</b>	This indicator will light when the tube is positioned at the Transverse Center. There can be up to two transverse detent positions. Viewing the transverse markers will indicate the transverse centers.

## Overhead Tube Support Service and Users Manual

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In addition to roll, vertical, transverse and longitudinal travel, the OTS is designed to allow the x-ray tube to rotate about the vertical axis (Yaw Movement). To rotate the tube about its vertical axis, release the yaw detent lock pin. The detent has stopping positions at the four 90° yaw positions.



**Figure 9-2**  
**Yaw Lock Release**

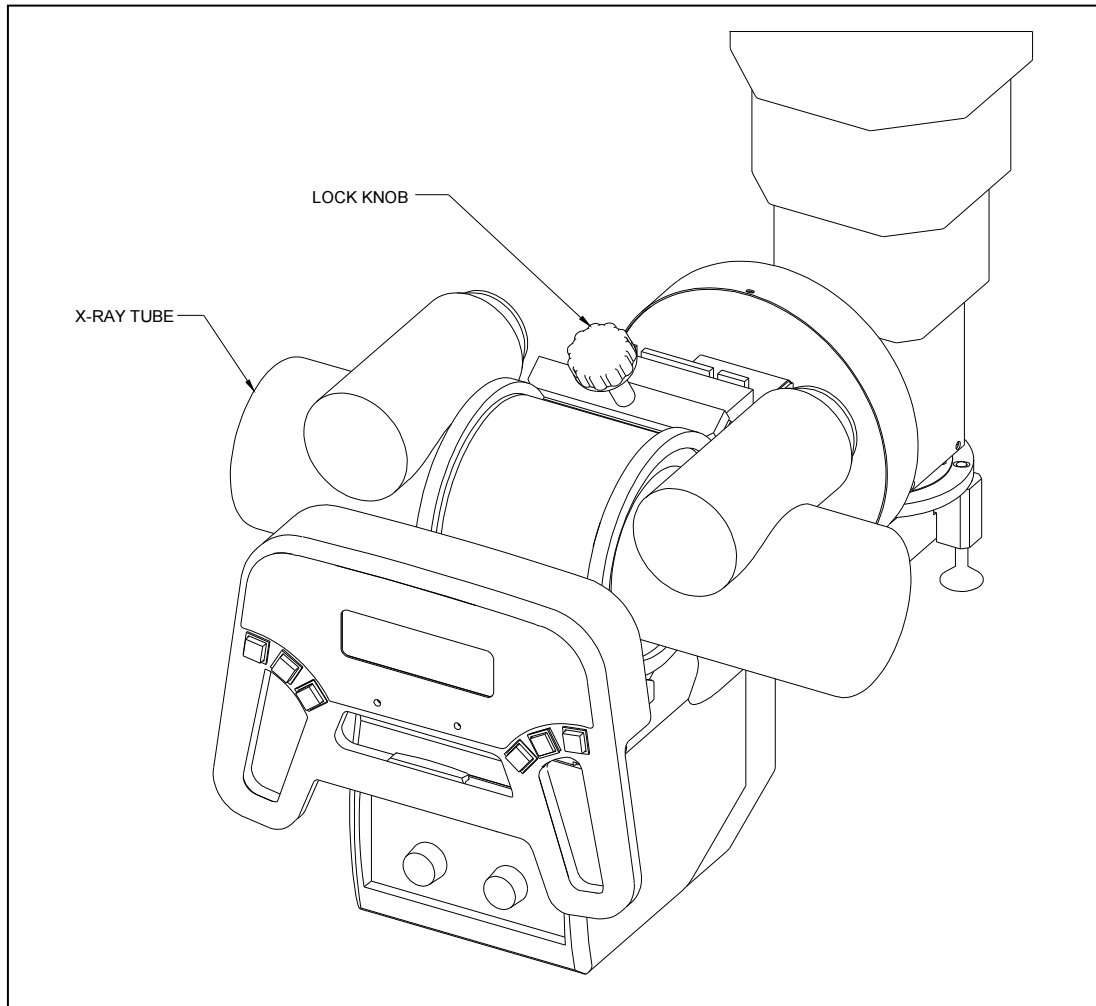


**CAUTION:** X-Ray exposures should not be performed in other than a “locked” 90° yaw position. The tube position may drift if not locked at one of four 90° points. Tube drift during exposure may result in an unusable radiograph.

## Overhead Tube Support Service and Users Manual

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In addition to roll, vertical, transverse and yaw, the OTS is designed to allow the x-ray tube to rotate about the horizontal axis (Trunnion Movement). To rotate the tube about its horizontal axis, turn the lock knob counterclockwise to loosen. Align the marker on the tube with the desired angle indicated on the tube mounting rings. Turn the lock knob clockwise to tighten.



**Figure 9-3**  
**Trunnion Lock Release**

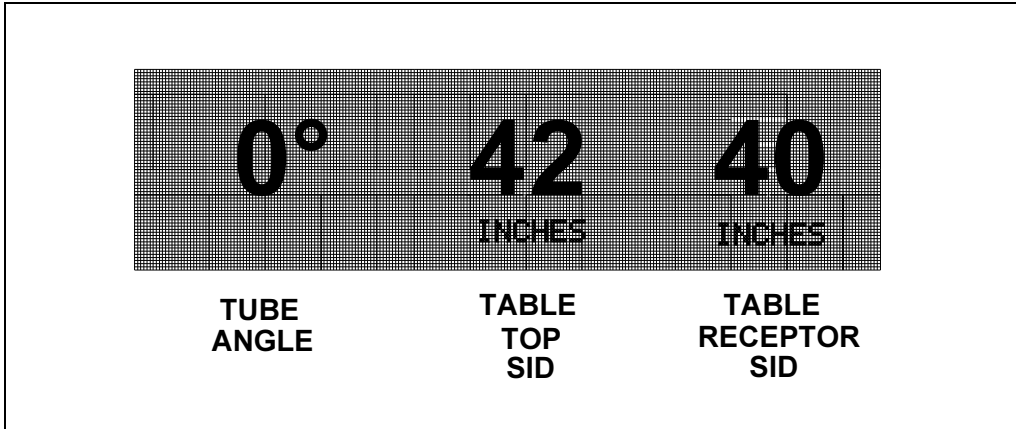


**CAUTION:** X-Ray exposures should not be performed in other than in a “locked” position. The tube position may drift if not locked. Tube drift during exposure may result in an unusable radiograph.

## Section 9. Users Manual

### B. Displays (with unit configured for “inches”)

The following displays will be observed during operation.



**Figure 9-4**  
**X-ray Beam Pointed Downwards**

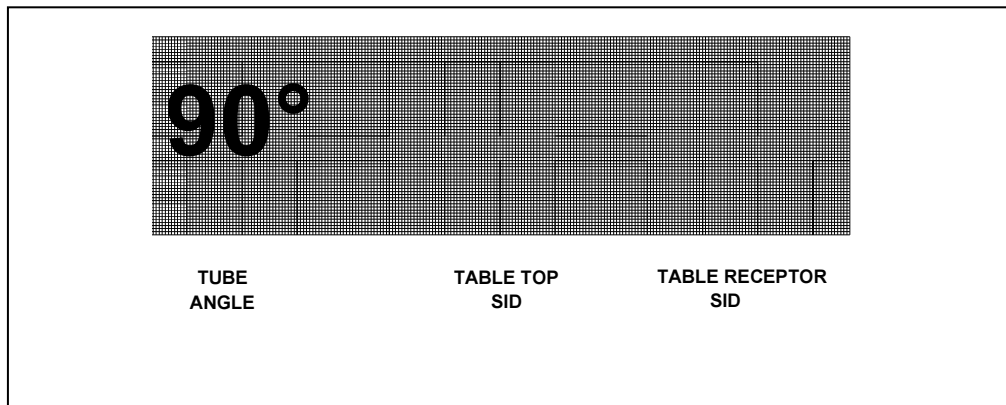
The control display as seen in Figure 9-4 above appears when the x-ray beam is pointed downwards, as when using the table receptor.

The number at the right represents the Source to Image Distance (SID) to the table receptor. The number in the center represents the Source to Image Distance (SID) to the table top. These SID values can be displayed in “inches” or “centimeters” (programmable by the installer).

The number at the left represents the Tube Angle.

**When the tube is moved, the values above, that are changing, are highlighted by an outline box to notify the operator.**

# Overhead Tube Support Service and Users Manual

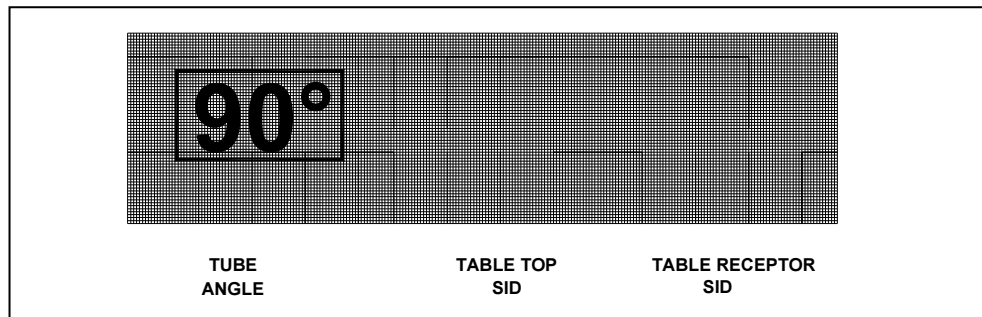


**Figure 9-5**  
**X-ray Beam Pointed Horizontally**

The control as seen in Figure 9-5 above appears when the tube is pointed horizontally toward the wall receptor.

The Source to Image Distance (SID) to the wall receptor is indicated by the SID Markers. (See Section 9.C., titled: "SID Markers") The vertical SID displays will disappear whenever the Tube Angle is greater than  $45^\circ$  or less than  $-45^\circ$ . The number at the left represents the Tube Angle.

**When the tube is moved, the values above, that are changing, are highlighted by an outline box to notify the operator.**



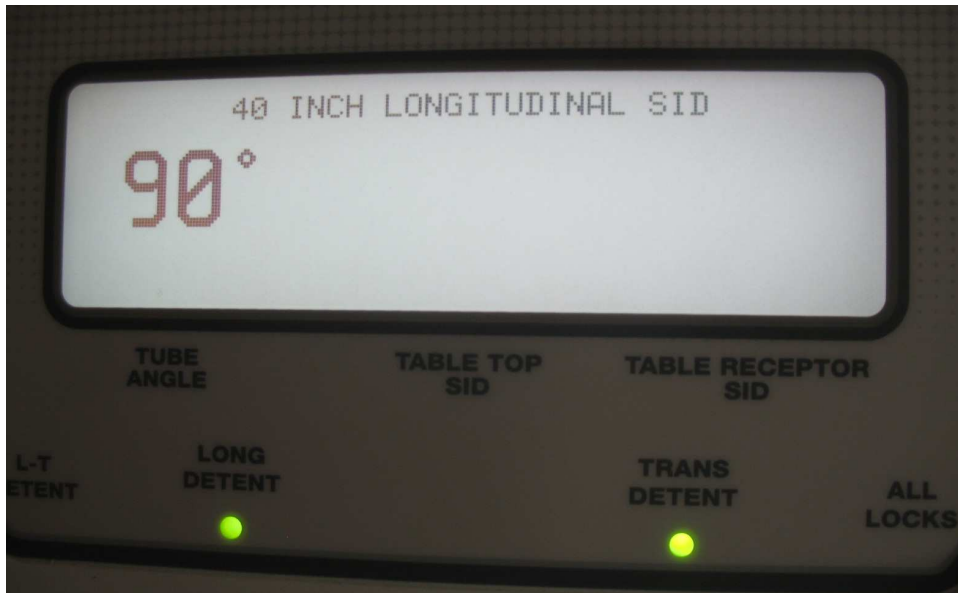
**Figure 9-6**  
**Roll Display**

The control display as seen in Figure 9-6 above appears when the Roll Lock Release Switch is depressed and the tube is angled. The number to the left represents the Tube Angle to  $\pm 1^\circ$ .

**When the tube is angled, the Angle value is highlighted by an outline box to notify the operator.**

## Overhead Tube Support Service and Users Manual

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**Figure 9-7**  
**40" Longitudinal SID Display**

The control display as seen above appears when the tube is pointed horizontally toward the wall receptor and 40 inches away from the wall receptor.



**Figure 9-8**  
**72" Longitudinal SID Display**

The control display as seen above appears when the tube is pointed horizontally toward the wall receptor and 72 inches away from the wall receptor.



## **Section 9. Users Manual**

### **D. Transverse Center Markers**

Adhesive backed markers are provided and located during initial installation of the OTS to indicate the transverse tube alignment with the table center and wall receptor center or wall mounted cassette holders. Markers showing table center, wall receptor center or both are furnished. Align the OTS to the decal of choice.



**Figure 9-10  
Transverse Center Markers**

# ***Overhead Tube Support* Service and Users Manual**

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## **Section 9. Users Manual**

### **E. Preventive Maintenance**

In order to assure continued safe performance of this x-ray equipment, a preventive maintenance schedule must be established. It is the owner's responsibility to arrange for this required service.

Maintenance procedures for the OTS are required within 30 days after completion of the installation and every 6 months thereafter. Safe equipment performance also requires the use of service personnel who are specifically trained and experienced with medical x-ray equipment. Applicable preventive maintenance or any repair service should be performed by these skilled individuals.

Maintenance information is divided into two parts. Part 1 covers those inspections, procedures and recalibrations, which must be performed at specified intervals by qualified personnel. Part 2 covers inspections to be made by the user to confirm continued operations and absence of physical damage.

### **F. Safety Information**

Personnel engaged in maintenance activities should exercise normal caution and care while working with electromechanical equipment. Before removing or opening any electrical power panels or covers, verify the incoming power supply is turned OFF. In the event maintenance procedures require power to be supplied to the unit, extreme care **MUST** be exercised to ensure the safety of service or other personnel in the area. Always verify the equipment is properly grounded before attempting any electrical operation or adjustment.

## **Section 9. Users Manual**

### **G. Required Periodic Service Maintenance (Part 1)**

Service maintenance must be performed to the OTS to assure continued compliance with Federal Performance Standards and electrical and mechanical safety of patients and operators. Consult the calibration and service instructions as supplied by the manufacturers of the collimator, the cassette tray and the tube housing assembly for any required periodic service to those components in the system.

#### **Maintenance Schedule**

Preventive maintenance should be performed 30 days after installation, and every six months thereafter.

The items to be inspected are:

- Bearings
- Electrical cabling
- Fasteners
- All surfaces for visible corrosion, which may weaken structure
- Counterbalance cables
- Ceiling structural fasteners
- Ground connections
- X-ray to light field alignment

# ***Overhead Tube Support* Service and Users Manual**

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## **Section 9. Users Manual**

### **H. User Service and Maintenance (Part 2)**

Cleanliness is a fundamental rule in maintaining equipment. Periodically, external metallic surfaces and exposed bearing surfaces should be wiped to remove dust built-up or any other foreign material that may have accumulated. The bearing surfaces should be wiped with a cloth slightly moistened with light oil, to provide sufficient lubrication to ensure smooth operation and to protect against rust. Painted metal surfaces should be cleaned using a clean cloth slightly moistened in clean water. Do not use harsh cleaners or solvents of any kind as they may promote corrosion. Polish with PURE liquid or paste wax. Do not use a wax containing a cleaning substance.



**NOTE:** This x-ray equipment contains safeguards to ensure maximum safety. Aside from routine maintenance, any abnormal noise, vibration or unusual performance should be investigated by a qualified serviceman. Before requesting service, however, be sure the equipment is being operated according to instructions in this manual.

# Overhead Tube Support Service and Users Manual

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## Section 10. Preventive Maintenance

The following is a list of items and areas to clean and inspect.

### A. Longitudinal Ceiling Rails

1. Ensure all mounting hardware is tight and secure.
2. Inspect all four spring stops and ensure hardware is tight.
3. Clean all bearing surfaces and inspect for nicks and abrasions.

### B. Transverse Bridge Assembly

1. Ensure all transverse bridge mounting hardware is tight and secure.
2. Inspect all four spring stops and ensure hardware is tight.
3. Clean all bearing surfaces and inspect for nicks and abrasions.
4. Move the transverse bridge along the entire length of the longitudinal ceiling rails and verify proper bearing tracking. Bearings should ride in the center of the bearing surface and should not make contact or ride up on the sides of the rail.
5. Verify proper adjustment of the “take-up” bearings. (See Section 3.B.8.)
6. Inspect all four main transverse bridge bearings. All bearings should move freely and make full contact with the bearing surface. Verify bridge-mounting hardware is tight and secure. If a grinding sound is heard or signs of wear exist, replace bearing.

### C. OTS Main Carriage Assembly



**NOTE:** Any component or sub component of the spring balancer other than the tension adjustment is not field serviceable. This will include the main counterweight cable and safety cable. Any assembly or sub assembly of the vertical mast sections is also not field serviceable. This will include rocker arms, rocker arm alignment bearings and intermediate mast support cables.

**If you experience any major problems with these items, take the room out-of-service and call the factory for corrective action.**

1. Ensure all mounting hardware is tight and secure.
2. Inspect all four main carriage bearings. All bearings should move freely and make full contact with the bearing surface. Verify all main

# **Overhead Tube Support Service and Users Manual**

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- bearing hardware is tight and secure. If a grinding sound is heard or signs of wear exist, replace bearing.
3. Verify proper adjustment of the “pinch” bearings. (See Section 3.C.8.)
  4. Verify proper spacing between all four main carriage bearings and the transverse rail. (See Section 3.C.9.)
  5. Move the main carriage assembly across its full range of transverse travel and verify main carriage bearings are tracking properly within the transverse bridge. Ensure bearings do not roll off the bearing surface.
  6. Inspect the spring balancer main counterweight cable and safety cable. Check for wear and fraying of these cables and ensure vertical travel is smooth.
  7. Check the condition of the vertical SID potentiometer belt.

## **D. Calibration, Alignments and Tracking Accuracy**

1. Verify the accuracy of the “tube roll” LCD display. (See Section 5.C.)
2. Verify the accuracy of the “vertical SID” LCD display. (See Section 5.D.)
3. Confirm x-ray to light field alignment to within 2% of SID.
4. Verify vertical tracking accuracy. (See Section 6.C.)
5. Verify horizontal tracking accuracy. (See Section 6.D.)

## **E. Cables, Electrical Connections and Grounding**

1. Check all electrical connections and ensure connections are tight.
2. Inspect the entire external cable drape and ensure cables are not under any stress when the OTS is moved from one extreme to the other.
3. Ensure there are no bare wires exposed.
4. Inspect cables for nicks and cuts. Particular attention should be made of the incoming line cable, and all the cables that are secured to the cable support arm.
5. Inspect / replace the vapor proofing compound at the high voltage cable tube end.
6. Check all ground connections for loose or broken wires. Ensure ohmic value of all ground paths measure less than 1 ohm.

## **F. Painted Surfaces**

1. Clean all painted surfaces with a mild detergent. Do not use any alcohol-based solvents or abrasive cleaners.
2. Ensure all painted surfaces are wiped dry. Standing water and moisture will promote rust.

# ***Overhead Tube Support* Service and Users Manual**

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## **Section 11. Electrical Schematic Diagrams**

- 00672-000 Schematic, OTS Display PCBA 00670-000
- 05982 Schematic, OTS Junction PCBA 05980
- 05992 Schematic, OTS Roll Lock Junction PCBA 05990
- 01103-000 Schematic, OTS Lock System
- 01059-000 Diagram, OTS Overall Electrical System
- 01226-000 Diagram, OTS Overall Cable Routing

# Overhead Tube Support Service and Users Manual

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## Section 12. Spare Parts List

Part #	Description	Quantity
00744	Longitudinal Ceiling Rail End Stops	4
00749	Longitudinal Lock Assembly	2
00560	Front Guide bearing Assembly	1
00561	Rear Guide bearing Assembly	1
01213-000/001	Transverse Lock Assembly	2
H267	Transverse Bridge Main Bearing Assembly	4
H215	OTS Main Bearing Assembly	4
01252-000	Vertical Lock Assembly	1
00473-00	Roll Lock	5
HAA54	Slack Cable Tension Spring	1
HAA11	Longitudinal Detent Switch	1
HAB09	On/Off Switch	1
HAA11	Transverse Detent Switch	1
J766	Operator Control Switch	6
H233	Operator Control Bar Switch	1
01253-000	Vertical Potentiometer	1
H209	Roll Potentiometer	1
HAB43	Vertical Pot Drive Belt	1
HAA69	Roll Pot Drive Belt	1
01203-000	Power Supply	1
J436	Bridge Rectifier (BR1)	1
K426	Capacitor C1	1
HX19	T1 Transformer	1
HF69	T2 Transformer	1
06040	Operator Control Assembly	1
00670	OTS Display PCBA	1
00701	LCD Display	1
05980	OTS Junction PCBA	1
05990	OTS Roll Lock Junction PCBA	1