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About This Manual

This manual contains service information regarding the EPEX-Omniflex Overhead Tube Crane. It includes an overall description of how the tube crane operates as well as providing detailed service support procedures such as repair and replace, troubleshooting, calibration, and validation.

Intended Use

The EPEX-Omniflex overhead tube crane is an intricate part the radiography system which is an assembly of components for the controlled production of diagnostic images with X-rays. The tube crane provides the source for the x-ray radiation as well as a collimator for beam limitation.

Audience

This manual is intended for service engineers who have fulfilled the following training prerequisites or have equivalent experience:

- EPEX-Omniflex IV System
- X-ray system
- Radiation safety
- Electronics, including troubleshooting skills
- X-ray theory
- X-ray image quality

Organization

Chapter 1: Safety Information

Provides a description of the safety requirements for installing, maintaining, and servicing X-ray equipment.

Chapter 2: General Information

Provides a description of the overhead tube crane components.

Chapter 3: Theory of Operation

Describes the theory of operation for the Overhead tube crane components.

Chapter 4: System Installation

Provides steps for the installation process.

Chapter 5: Adjustments and Calibration

Provides the procedure for the overhead tube crane adjustments as well as a description of the calibration process.

Chapter 6: Tube Crane Operation

Provides basic information about using the EPEX-Omniflex overhead tube crane.

Chapter 7: Preventive Maintenance

Provides a preventive maintenance schedule and procedures for maintenance of the overhead tube crane components.

Chapter 8: Repair and Replacement

Explains safety considerations, access, and steps to remove and replace tube crane subassemblies and components.

Chapter 9: Diagnostics and Troubleshooting

Provides diagnostics and troubleshooting guidelines.

Appendix A: Specifications

Provides specifications for the EPEX-Omniflex overhead tube crane.

Appendix B: Forms

Provides reproducible copies of the installation, operational check and maintenance forms.

Appendix C: Field-Replaceable Units

Provides a list of the names and part numbers for the most commonly field-replaced components.

Appendix D: Wiring Diagram

Includes the wiring diagram for the EPEX-Omniflex Overhead Tube Crane.

A Glossary follows Appendix D.

Conventions Used in This Manual

This manual uses three types of special messages to emphasize information or point out potential risks to personnel or equipment. A sample of each message type follows.

Note: Notes provide additional information, such as expanded explanations, hints, or reminders.

CAUTION

Cautions point out procedures that you must follow precisely to avoid damage to equipment, loss of data, or corruption of files in software applications.

WARNING

Warnings point out procedures that you must follow precisely to avoid injury to yourself or others.

Chapter 1
Safety Information

Personnel operating and maintaining the equipment should receive EPEX-Omniflex Overhead Tube Crane technical training, and be thoroughly familiar with all aspects of its operation and maintenance. To ensure their safety, all users should read this chapter carefully before using the system. Additionally, to promote safety awareness, Service Engineers should periodically review the basic precautions outlined in this chapter.

Contents

General

The following are general safety precautions:

- Only personnel who have completed a Hologic training course for EPEX-Omniflex Overhead Tube Crane maintenance are qualified to remove the covers and repair or maintain the equipment.
- Do not defeat or bypass built-in equipment safety features.
- Observe all warnings and cautions, stated or implied, in the procedures.
- Follow all safety labels on the equipment.

Electrical

Only a qualified/trained Hologic Field Service Engineer or electrician should replace electrical components.

Only properly trained and qualified personnel should be permitted access to the internal parts. Live electrical terminals are deadly; ensure that line disconnect switches are opened and other appropriate precautions are taken before opening access doors, removing enclosure panels, or attaching accessories.

Do not remove the flexible high voltage cables from the X-ray tube housing or high voltage Generator and/or access covers from the Generator until the main and auxiliary power supplies have been disconnected and you have waited at least two minutes. When disconnecting high voltage cables, they must be grounded immediately in order to dissipate any electrical charge that may remain in the cables.

WARNING

Failure to comply with the foregoing may result in serious or potentially fatal bodily injuries to the operator or those in the area.

Mechanical

The following are mechanical safety precautions:

- All of the moveable assemblies and parts of the X-ray equipment should be operated with care. Keep fingers, hands, and tools clear of moving parts.
- Unless specifically instructed otherwise, do not operate the equipment with covers or access panels removed.
- All cables should be routed in a mannor to prevent a tripping hazard.

Safety Warnings and Cautions

General Use Warnings

WARNING

Federal law restricts this device for sale or use by or on order of a physician or properly licensed practitioner.

WARNING

Only qualified personnel may operate the EPEX-Omniflex Overhead Tube Crane. Operation of the equipment by persons who have not been trained or who are unfamiliar with the EPEX-Omniflex Overhead Tube Crane may cause serious injury to the patient, serious injury to the operator, or equipment damage.

WARNING

Before operating the EPEX-Omniflex Overhead Tube Crane, operators must familiarize themselves with the location of the emergency stop switch or switches. These switches are provided to allow the immediate shutdown of the tube crane in the event of unintended motion or other catastrophic equipment failure.

WARNING

The EPEX-Omniflex Overhead Tube Crane includes no user serviceable parts. For service assistance, contact Hologic, Inc.

Field Warnings

WARNING

The EPEX-Omniflex Overhead Tube Crane produces ionizing radiation. Operators must meet all state and local requirements and regulations.

Electrical and Flammable Warnings

WARNING

The EPEX-Omniflex Overhead Tube Crane and associated cables must not be operated in the presence of moisture.

WARNING

The EPEX-Omniflex Overhead Tube Crane is rated as Class I Equipment, ensure that the earth grounding connections between the tube crane and the host system are maintained at all times.

WARNING

The EPEX-Omniflex Overhead Tube Crane is not suitable for operation in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

WARNING

Disconnect electrical power from the EPEX-Omniflex Overhead Tube Crane before servicing. Use care not to drop tools or other objects into the EPEX-Omniflex Overhead Tube Crane when working on or around the unit. Electrical shock could result.

Moving and Using Equipment Warnings

WARNING

Use at least two qualified people when moving equipment in order to prevent injury or strain.

WARNING

The equipment is fragile and must be handled with care.

Safety Symbols

The following safety-related symbols are found on the equipment. To avoid injury, learn to recognize them.

Radiation

Power Off (used with the DirectRay Console UPS)

Power On (used with the DirectRay Console UPS)

Ethernet Connection

Twisted Pair Ethernet Connection

Explosive Gas (flammable)

Attention - Consult Accompanying Documents.

Type B Applied Part - Indicates equipment complies with all applicable IEC601-1 requirements for electric shock protection for patients and/or operators


Non- Anesthetic Proof


Universal Interface Connection Identifiers


Sound


Earphones


DirectRay Detector Orientation Identifier (on the Bucky)


Protective Earth Ground


Hazardous Voltage


Alternating Current


Power On Indicator


Hard Drive


Standby Switch (used with CPU)


On Line Indicator (used with X-ray Generator switch at DirectRay Console)


Off Line Indicator (used with X-ray Generator switch at DirectRay Console)

Prep/Exposure Switch

X-ray Expose Switch

Do Not Immerse In Liquid

This product contains no field-serviceable parts.

Special Cleaning Instructions

Lifting Warning

One or more of the following regulatory symbols are found on the equipment.

UL Classified Device

UL Listed Device

UL Recognized Device

CSA Listed Device

ETL Listed Device

Certified for Use in Europe

Safety and Compliance

Exposure to ionizing radiation such as X-rays can be hazardous. United States federal regulations establish appropriate exposure limits so that the patient, the operator, and the general public are not unnecessarily being exposed to such radiation. Personnel operating systems such as the EPEX-Omniflex Overhead Tube Crane must be trained and qualified. They must be familiar with established regulations and understand the risks associated with the operation of a X-ray system. They must know what action to take if and when a hazardous situation arises.

For a more complete understanding of radiological hazards and their control, X-ray system operators are referred to publications, such as:

- Medical X-ray, Electron Beam and Gamma Ray Protection for Energies up to 50 MeV – Equipment Design, Performance and Use (Report No. 102, National Council on Radiation Protection)
- Medical X-Ray Protection up to Three Million Volts (Handbook No. 76, National Bureau of Standards/National Institute for Standards and Technology)

In addition to ionizing radiation, other safety concerns are addressed by various U.S., Canadian, and international standards. The component parts and subsystems used in the EPEX-Omniflex Overhead Tube Crane have all been tested for compliance with the safety standards in effect at the time of manufacture in the United States (UL 2601-1 or UL 1950), Canada (C22.2 No. 601.1-M90 or C22.2 No. 950-95), and the European Union (EN60601-1, and collateral and particular standards, EN 60825-1, and/or EN60950).

The results of these safety tests and inspections show that the EPEX-Omniflex Overhead Tube Crane is safe. There are, however, certain residual hazards resulting from the mechanical articulation of the system. Minimizing the risk of injury to the patient and to the operator resulting from these residual hazards requires care and alertness at the time of installation. Pinch points are labeled as appropriate at the time of installation. These labels must not be removed. If they become soiled or damaged, they need to be replaced.

When appropriate, the equipment has also been tested and evaluated for compliance with electromagnetic compatibility (EMC) requirements, including radio frequency emissions. The CE mark displayed on the equipment indicates compliance with generally accepted EMC requirements as well as with European safety requirements.

Radiation Protection

Serious unfavorable health effects can result from short term exposure to high levels of ionizing radiation (such as X-rays) as well as from long term exposure to low levels. Personnel who operate the EPEX-Omniflex Overhead Tube Crane should familiarize themselves with both the short term and the long term effects of radiation exposure and take appropriate measures to minimize the amount of radiation to which they are exposed while performing their duties. Some effects of X-radiation are cumulative, and may extend over a period of months or years. The best safety rule for X-ray operators is to avoid exposure to the primary beam at all times.

Ionizing radiation occurs naturally in the environment. It is generated by astronomical radiation sources such as the sun and the stars, and by the soil under our feet. The atmosphere filters radiation from astronomical sources. As a result, the radiation level from these sources is much lower at sea level than on the summit of high mountains. Radiation generated in the soil varies greatly from place to place depending on the composition of the soil. For example, areas rich in granite rock have a higher level of radiation than other areas.

Any materials placed in the path of the beam absorb natural as well as manmade radiation, such as the X-rays used in the EPEX-Omniflex Overhead Tube Crane. Materials with a high atomic number, such as tungsten, lead, and uranium, absorb X-rays much more effectively than materials with a low atomic number such as hydrogen, aluminum, or beryllium. Therefore, lead is used for shielding the radiologist's workstation in most X-ray facilities, including ones using the EPEX-Omniflex Overhead Tube Crane. If there are windows in the partition separating the operator from the patient, these windows are typically glazed with lead glass and provide effective protection against ionizing radiation.

To minimize dangerous exposure, use movable lead screens, lead-impregnated gloves, and lead-impregnated aprons. These protective devices must contain 0.25 millimeter thickness of lead or the equivalent. Use such protective devices for all operators, observers, and/or servicing personnel exposed to radiation fields of five or more milli-Roentgens per hour.

The shielding provided for a typical X-ray facility's operator workstation is generally quite effective and reduces the residual radiation from diagnostic X-rays to a level that is comparable to or lower than natural background radiation. If the operator abandons the protected environment of the workstation, he or she may be exposed to a significantly higher level of radiation. For a single exposure this may still not lead to serious health effects, but repeated carelessness in this regard may lead to serious consequences.

Any object in the path of the primary beam produces scattered radiation. In the absence of proper precautions, scattered radiation can result in a substantial radiation dose to the operator or any other personnel in the facility. Moveable screens may be used to shield occupied areas from scattered radiation.

The X-ray Generator/host system used to power the EPEX-Omniflex Overhead Tube Crane only produces X-rays when high voltage is applied to the X-ray tube. When the high voltage is removed, X-ray emission ceases without delay.

Authorized EU Representatives

The manufacturers of parts and subsystems used in the EPEX-Omniflex Overhead Tube Crane are represented in the European Union by the following:

Tube Crane:

Hologic Europe
Horizon Park
Leuvensesteenweg 510, BUS 31
1930 Zaventem, Belgium

X-ray Tube and Tube Assembly:

Varian X-Ray Products
c/o Ernst Mey
De Kokermolen 2
3994 DH Houten, The Netherlands

X-ray Collimator:

CEPartner 4U
Nijverheidsstraat 5
2624 BA Delft
Netherlands

Identification Labels

The EPEX-Omniflex Overhead Tube Crane components have manufacturing and certification information affixed. The manufacturing label contains:

- The full name and address of the manufacturer of the component
- The place, month, and year of manufacture
- The model number and serial number of the component

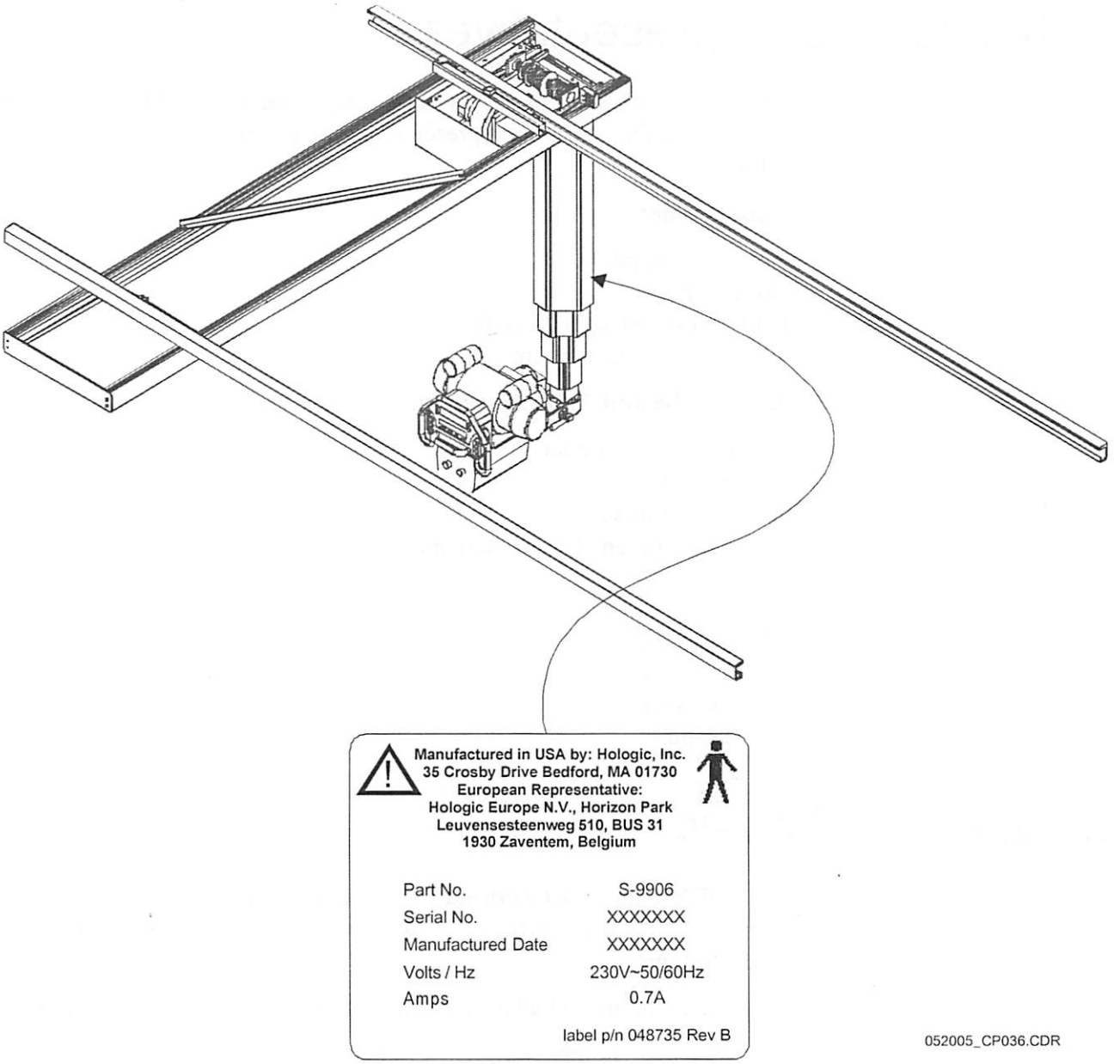
The certification label also states that the component complies with either "21CFR, Subchapter J", or the applicable DHHS standards under the Radiation Control for Health and Safety Act of 1968 (or its equivalent).

A label may combine both manufacturing and certification information.

EPEX-Omniflex Overhead Tube Crane Labels

The location of the tube crane identification labels are shown in Figure 1-1.

Figure 1-1. EPEX-Omniflex Overhead Tube Crane Identification Labels



Radiation Safety

Safety

Everyone associated with X-ray work must be familiar with the recommendations of the Center for Devices and Radiological Health (CDRH), the National Institute for Standards and Technology (NIST), the National Council on Radiation Protection (NCRP), and the International Committee on Radiation Protection (ICRP).

Be sure that all personnel authorized to operate the X-ray system are familiar with the established regulations of the authorities named above. All personnel should be monitored to ensure compliance with recommended procedures.

Current sources of information include:

- *National Council on Radiation Protection Report No. 33* ("Medical X-ray and gamma ray Protection for Energies up to 10 MEV-Equipment Design and Use").
- *National Bureau of Standards Handbook No. 76* ("Medical X-ray Protection up to Three Million Volts"). Refer to NCRP Report No. 33.
- Current recommendations of the International Committee on Radiation Protection.

Although X-radiation is hazardous, X-ray equipment does not pose any danger when properly used. Be certain all operating personnel are properly educated concerning the hazards of radiation. Persons responsible for the system must understand the safety requirements and special warnings for X-ray operation. Review this manual and the manuals for each component in the system to become aware of all safety and operational requirements.

CAUTION

Incorrectly positioning the X-ray tube and Collimator could cause the X-ray field to be misaligned with the bucky, resulting in unacceptable images.

WARNING

Ensure exposure parameters are properly adjusted within safety limits.

Manufacturer's Responsibility

Although this equipment incorporates protection against X-radiation other than the useful beam, practical design does not provide complete protection. Equipment design does not compel the operator or assistants to take the necessary precautions; nor does it prevent the possibility of improper use (authorized or unauthorized persons carelessly, unwisely, or unknowingly exposing themselves or others to direct or secondary radiation). Allow **only** authorized, properly trained personnel to operate this equipment.

Be certain that all individuals authorized to use the equipment are aware of the danger of excessive exposure to X-radiation.

This equipment is sold with the understanding that the manufacturer, its agents, and representatives, do not accept any responsibility for overexposure of patients or personnel to X-radiation.

Furthermore, the manufacturer does not accept any responsibility for overexposure of patients or personnel to X-radiation generated by the equipment used in conjunction with the EPEX-Omniflex Overhead Tube Crane components as a result of poor operating techniques or procedures.

No responsibility is assumed for any unit that has not been serviced and maintained in accordance with the technical service manual, or which has been modified or tampered with in any way.

Monitoring Personnel

Monitoring personnel to determine the amount of radiation to which they have been exposed provides a valuable cross-check to determine whether or not safety measures are adequate. This cross-check may reveal inadequate or improper radiation protection practices and/or serious radiation exposure situations.

The most effective method of determining whether the existing protective measures are adequate is the use of instruments to measure the exposure (in rads). This measurement should be taken at all locations where the operator, or any portion of the operator's body, may be inadequately shielded during exposure. Exposure must never exceed the accepted tolerable dose.

A frequently used, but less accurate, method of determining the amount of exposure is placement of film at strategic locations. After a specified period of time, develop the film to determine the amount of radiation. Fluorescent screens (used in a darkened room) may also be used to detect excessive radiation.

A common method of determining whether personnel have been exposed to excessive radiation is the use of film badges. These are X-ray sensitive film enclosed in a badge that incorporates metal filters of varying degrees of transparency to X-ray radiation. Even though this device only measures the radiation reaching the area of the body on which it is worn, it does provide an indication of the amount of radiation received.

Radiation Protection Survey

A radiation protection survey must be made by a qualified expert after every change in equipment or change in operating conditions which might significantly increase the probability of personnel receiving more than the maximum permissible dose equivalent.

Restrictions on Use

WARNING

Do not install components or accessories that were not intend for use by the system. Failure to comply could result in damage to the equipment or injury to personnel.

The user is responsible for ensuring that the application and use of the EPEX-Omniflex Overhead Tube Crane does not compromise the patient contact rating of any equipment used in the vicinity of, or in conjunction with, the system.

The use of accessory equipment and/or hardware not complying with the equivalent product safety and EMC requirements of this product may lead to a reduced level of safety and/or EMC performance of the resulting system. Consideration relating to the choice of accessory equipment used with this product shall include:

- The use of the accessory in the patient vicinity
- Evidence that the safety certification of the accessory has been performed in accordance with the appropriate IEC 60601-1 and/or IEC 60601-1-1 Harmonized National Standards
- Evidence that the EMC certification of the accessory has been performed in accordance to the IEC 60601-1-2 Harmonized National Standards

Some components of the EPEX-Omniflex Overhead Tube Crane have been classified as to acceptable applications of use in accordance with Information Technology Equipment regulations such as EN60950.

CAUTION

Observe all safety precautions recommended by the accessory equipment manufacturer in the user documentation provided with the equipment.

The hardware specified for use with the EPEX-Omniflex Overhead Tube Crane has been selected, tested, and verified by Hologic to meet the intended applications. All specified hardware meets applicable regulatory agency requirements for those countries where it is offered for sale with respect to its intended applications. Consult the user documentation included with the equipment for specific information relating to product safety and EMC compliance.

Hazardous Materials

The X-ray tube and collimator used with the EPEX-Omniflex overhead tube crane contain lead and oil. Refer to the manuals provided with the X-ray tube and collimator for additional information regarding hazardous materials.

Applicable Standards

The EPEX-Omniflex overhead tube crane complies with the requirements of the Center for Devices and Radiological Health (CDRH), Department of Health and Human Services, 21 CFR, Chapter 1, Subchapter J, at the time of manufacture. In addition, the EPEX-Omniflex overhead tube crane complies with the following regulatory requirements and design standards:

- EC Directive 93/42/EEC concerning Medical Devices (European Community)
- IEC 601.1, CSA 601.1, UL2601.1

  Type of protection against electric shock: Class I equipment.

  Degree of protection against electric shock: Not classified.

  Degree of protection against harmful ingress of water: Ordinary equipment.

  Mode of operation: Continuous operation with intermittent loading (standby - exposure).

  Equipment not suitable for use in presence of a FLAMMABLE ANESTHETIC MIXTURE WITH AIR OR WITH OXYGEN OR NITROUS OXIDE.
- IEC 601.1.2

  Immunity:

  IEC61000-4-2 Electrostatic Discharge

IEC61000-4-3 Radiated RF Field

IEC61000-4-4 Electrical Fast Transient

IEC61000-4-5 Surge

IEC61000-4-6 Conducted RF Immunity

IEC61000-4-8 Magnetic Field Immunity

IEC61000-4-11 Voltage Dips, Interrupts and Variations

Emission:

EN55011 (CISPR Publications II Emission Standards, Group 1 Class A)

- Associated Equipment Model S-9906 IEC60601-2-32: 1994

Chapter 2
General Information

This chapter provides general information about the EPEX-Omniflex Overhead Tube Crane. For detailed operational information, refer to Chapter 3.

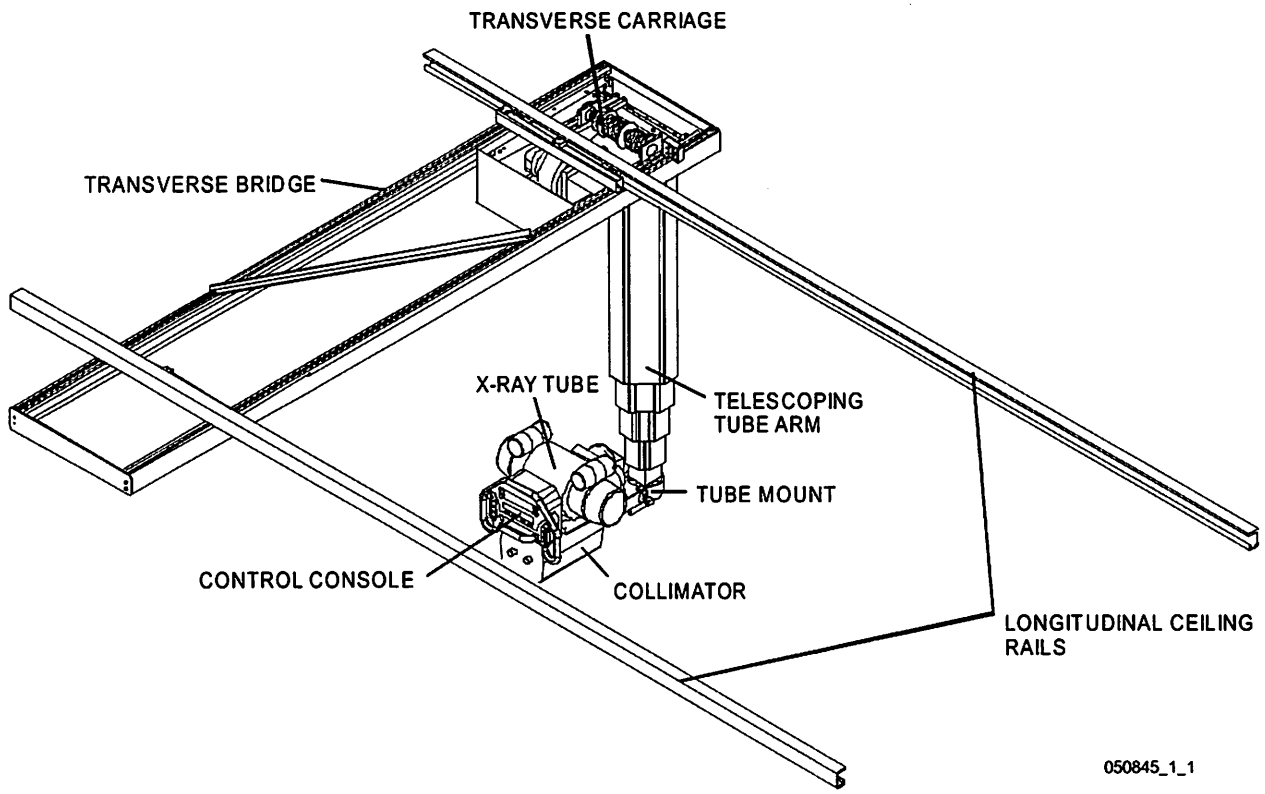
Contents

What is the EPEX-Omniflex Overhead Tube Crane?

The EPEX-Omniflex Overhead Tube Crane (See Figure 2-1) is an X-ray tube and collimator support subsystem integrated into a radiographic system. The tube crane provides flexibility in x-ray room design since it occupies no floor space and the rail design allows the tube to operate within a large area as defined by the ceiling rails. The telescoping tube arm allows the x-ray tube to be lifted up out of the way when not in use.

The EPEX-Omniflex is suspended from two longitudinal rails mounted to the ceiling. The EPEX-Omniflex weighs more than 1,000 pounds and requires substantial mounting means for safe operation.

Figure 2-1. EPEX-Omniflex Overhead Tube Crane



EPEX-Omniflex Overhead Tube Crane Components

The tube stand components are:

- **Longitudinal Rails.** There are two longitudinal rails. These rails are fixed to the ceiling structure (usally I-beams and Unistrut rails). The longitudinal rails support transverse bridge and allows movement in the left and right direction.
- **Transverse Bridge.** The transverse bridge consist of two lateral rails and end plates which are supported by the longitudinal rails by roller bearings. The transverse bridge supports the weight of the overhead tube crane components and allows their movement in the back and forth directions.
- **Electromagnetic Brakes.** These brakes are controlled by switches on the control console. They hold the X-ray tube stationary during operation.
- **Transverse Carriage.** The transverse carriage supports the X-ray tube, collimator, and the control console. It allows these components to move vertically, using an integrated counterpoised spring. Two pivot points at the base of the five-element telescope allow the remaining components to rotate horizontally and vertically to preset detented positions.
- **Control Console.** The control console provide a digital angulation readout as well as a height readout indicating the source-to-image (SID) distance between the x-ray tube focal spot and image receptor within the bucky.
- **X-ray Tube.** The X-ray tube contains an anode and cathode to generate and direct the X-rays through the collimator to the Bucky.
- **Collimator.** The collimator provides the means for adjusting the irradiated field size.

For the locations of the Tube Stand components, refer to Figure 2-1 on page 2-2.

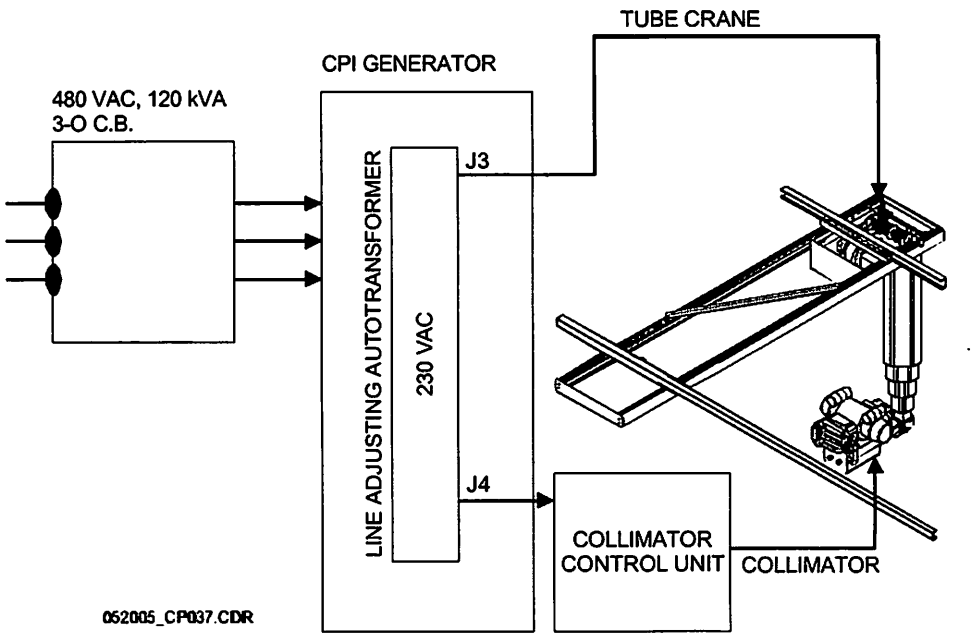
Special Requirements Related to the Electrical Power Source

For information about the required facility power to be supplied to the EPEX-Omniflex Overhead Tube Crane, refer to "Input Power." Power for the tube stand will be supplied from the X-ray generator line-adjusting transformer and permanently installed. The X-ray generator will be powered from a dedicated circuit breaker with remote emergency off shunt trip. A required emergency off switch must be installed in a location near the tube stand and accessible to the operator. The emergency off switch selected for use must meet the requirements of European EN418 Directive for emergency stop push buttons. The installation of the emergency off switch is the responsibility of the installer and must meet applicable local codes.

Input Power

230 V~ / 0.7 A, 50/60 Hz, 1 Phase electrical power to the Tube Crane is supplied by the line-adjusting transformer in the lower Generator cabinet.

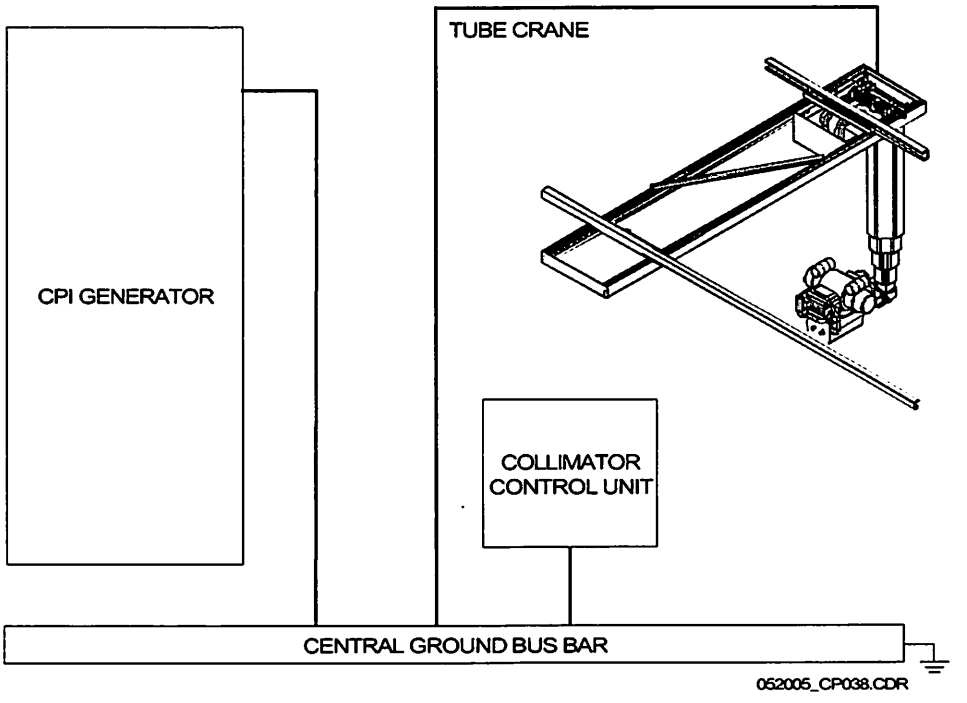
Figure 2-2.
Input Power



Tube Stand Earth Grounding Map

The ground impedance from the central grounding point to any subsystem peripheral must **not** exceed 0.1 Ω.

Figure 2-3.
Grounding Map



Compatibility Certified Components

This topic lists the components compatible with the EPEX-Omniflex Overhead Tube Crane.

Component	Model Number
X-ray Tube	PX 1436 CS (Certified Component)
Collimator	CT010 (Certified Component)
Generator	various

Chapter 3
Theory of Operation

This chapter explains the theory of operation for the EPEX-Omniflex Overhead Tube Crane, including:

- Describing the components
- Explaning the interfacing operation beween the components

Contents

Power

230 Vac power is supplied to the tube crane via terminal block TB1. The power circuit, protected by fuse F1, connects to the primary winding of the step down transformer TR1. TR1 provides 24 Vac through fuse F2 to the Universal Tube Stand Lock Control PCB.

Switching Power On/Off

When the X-ray generator is switched ON, power is applied to the tube stand. Electrical power is removed from the tube stand when the X-ray generator is switched OFF. For complete instructions on switching generator power ON/OFF, refer to the instructions supplied with the X-ray generator.

The control panel will illuminate or extinguish when the generator is switched ON or OFF, indicating to the operator that the tube crane is energized or denergized.

Emergency Stop Switch

WARNING

Before operating the tube crane, operators must familiarize themselves with the location and operation of the emergency stop switch or switches.

The emergency stop switch is used by the operator to remove power from the tube stand in the event of an emergency, such as unintended movement or other catastrophic system failure.

The emergency stop switch is provided by the installer, and therefore the switch style and location will vary from site to site. It is the responsibility of the operator to become familiar with the location and operation of the emergency stop switch. Refer to Table 3-1 for a description of a typical emergency stop switch operation.

Table 3-1. Typical Emergency Stop Switch Operation

Action	Result
Push In	Tube Stand power is removed (OFF).
Pull Out	Tube Stand power is applied (ON).

Control Console

The operator controls the overhead tube crane via the control console. The control console's universal tube stand switch panel serves as the user interface and includes membrane switches for input, plus backlit LEDs and two VFD displays to convey status such as: current SID, tube angle and error messages. The all-locks release handle has a built-in switch, that when squeezed, releases all locks (except tube rotation).

The switches and LEDs on this panel are integral to this PCB. The switches are arranged in a diode matrix set up as 2 columns of 8 rows. The anodes of the LEDs are tied to +5 Vdc and the cathodes of the LEDs are connected directly to pins on the connector. A table presenting the switches and their functions is not given as the schematic is descriptive enough.

All of the components listed above connect to the Tube Stand Controller Display PCB, which is the EPEX-Omniflex tube crane controller.

Position Sensing and Control

The overhead tube crane uses potentiometers to determine tube rotation and vertical SID. The tube rotation potentiometer is connected to the Universal Display CPU via the Tube Stand Controller Interconnect PCB. The tube vertical position potentiometer is connected to the Servo Control PCB. The Bucky position potentiometer is connected to the Interface PCB.

There are two switch banks, each containing four normally-open switches. One bank is mounted to the transverse carriage (lateral SID Switch Bank) and the other to the transverse bridge (horizontal SID switch bank). The switches are actuated by contact with designated cams. For systems laid out for Wall mode configurations A or C, the EPEX-Omniflex tube crane uses the following switches:

- Three horizontal SID switches mounted to the transverse bridge
- Wall mode lateral center switch mounted to the transverse carriage
- Table mode lateral center switch mounted to the transverse carriage

For systems laid out for Wall mode configuration B, the EPEX-Omniflex tube crane uses the following switches:

- Three horizontal SID switches mounted to the transverse carriage
- Wall mode lateral center switch mounted to the transverse bridge
- Table mode lateral center switch mounted to the transverse carriage

The switches are active when tied to +24 Vdc and connect to the Interface PCB.

The automatic collimator receives horizontal SID information through J1 on the Universal Tube Stand Lock Control PCB.

Electromagnetic locks hold the tube crane in position. There are two longitudinal locks, one lateral lock, and one angulation lock. The locks hold when 24 Vdc is applied; therefore, when power is off, the tube crane is free-floating.

The Auto Tracking feature provides for automatic (motor-driven) vertical tracking with the Bucky in Table mode and automatic SID tracking in Wall mode. The vertical axis can also be manually motor-driven. For manual (non-motor-driven) positioning, a clutch disengages the motor from the vertical axis.

The clutch also provides a means to limit the amount of force transmitted by the vertical drive motor to the telescoping column. The Clutch Control PCB regulates the current to the clutch in order to limit the force the clutch will transmit without slipping. The current level is service settable by means of a potentiometer on the Clutch Control PCB.

Tube Stand Controller Display PC Board

Power

Power is provided to the Tube Stand Controller Display PCB (5284-135-01) via the Tube Stand Controller Power Supply PCB. +5 Vdc is provided on J9 and J11. ±12 Vdc is provided on J12.

Microcontroller

The Tube Stand Controller Display PCB includes a microcontroller (CPU) and components such as an address latch, a data transceiver, and a CPLD programmable logic device that provide the necessary support the microcontroller requires to run and control the PCB. The memory section consists of EPROM for program ROM, NVRAM for calibration data, and RAM. A watchdog/power monitor provides a reset signal to the microcontroller on power-up if the 5 Vdc power supply is out of tolerance or if the program does not execute properly.

Operator Interface

The push button switches and key panel LEDs of the universal tube stand switch panel are connected to J5 of the Tube Stand Controller Display PCB. The switches are read and the LEDs are driven through the CPLD programmable logic device. The VFDs (characters displays) are connected to J3 and J4.

Serial Communication

The Tube Stand Controller Display PCB communicates with the Universal Tube Stand Lock Control PCB via CAN-Bus. J2 is an RS-232 port which is used only at the factory for PCB testing.

Analog Inputs

All analog inputs are interfaced through J10 which connects to the Tube Stand Controller Interconnect PCB in the rear of the operator control box. The Tube Stand Controller Display PCB provides the voltage for the angulation potentiometer and receives the return voltage from the potentiometer wiper via connector J2.

Table 3-2. DIP Switches

Switch	Function	Position	Notes
SW1	Reset	ON	Resets micro-controller.
		OFF	Micro-controller runs (normal operation).
SW2-1	SID display in Table Mode when Auto in ON.	ON	44 in. SID
		OFF	40 in. SID
SW2-2	EPEX-Omniflex Mode	ON	Must be in this position.
		OFF	Not used.
SW2-3	Not Used.	N/A	Has no effect on system operation.
SW2-4	Not Used.	N/A	Has no effect on system operation.

Table 3-3. Jumper Settings

Jumper	Function	Position	Notes
JP1	CPU Reset	IN	Watchdog connected to micro-controller RESET. **This jumper must be installed for normal operation.**
		OUT	Watchdog not connected to micro-controller RESET (factory test only).
JP2	Not used.	N/A	Has no effect on system operation.

Note: When signal is active, LED is illuminated unless otherwise noted.

Table 3-4. LED Status

LED	Indication
DS1	ON, CPU is running. OFF, CPU reset.
DS16	+5 Vdc present.
DS18	+5 VC present.

Table 3-5. Test Points

Test Point	Function	Test Point	Function
TP1	+5 VD	TP2	GNDD
TP3	+5 VC	TP4	GNDC
TP5	APFB - multiplexed analog inputs.	TP6	A/D input.
TP7	Not Used.	TP8	Not Used.
TP9	GNDS	TP12	+12 VA
TP13	GNDA	TP14	-12 VA
TP15	SID voltage input from vertical servo.		

Servo Control PC Board

Power

24 Vdc power is supplied by the Universal Tube Stand Lock Control PCB to connector J8 on the Servo Control PCB (051199).

A voltage regulator provides an output of 5 Vdc for power and control signals for the tube crane's vertical drive motor amplifier.

+24 Vdc power is supplied via connector J8 to the vertical drive motor amplifier.

Functionality

The Servo Control PCB controls the vertical positioning of the X-ray tube in relation to the Bucky.

The Servo Control PCB supplies +/-5 Vdc power via connector J4 to the X-ray Tube's vertical position potentiometer. The PCB receives the potentiometer's wiper voltage via connector J3 and J4 and derives a voltage level that represents the "actual height" of the X-ray tube.

The "desired height" signal generated by the Interface PCB is inverted and added to the "actual height" signal. This resulting signal, the "difference" between the actual and desired heights of the X-ray tube, is used to generate two control signals:

- Motor Speed and Rotation Direction
- Motor Power Enable.

Motor Speed and Rotation Direction: The "difference" signal is used to determine the gain necessary for proper X-ray tube vertical drive motor operation and to drive the motor. The "difference" signal is also processed to determine the motor's direction of rotation, and consequently, the direction of the X-ray tube's travel.

Motor Power Enable: The absolute value of the "difference" signal is compared to a "window" signal. "Window" is an allowable error in the difference between the positions of the Bucky and X-ray tube. When the "window" is reached, the Servo Control PCB turns off the motor. The settings of the "window" may be adjusted using a potentiometer.

If when driven, the motor fails to move for five seconds, the vertical drive motor amplifier sends an alarm signal to the Servo Control PCB. The Servo Control PCB sends the signal to the Universal Lock Control PCB and ultimately to the Display PCB. The message MOTOR flashes on the EPEX-Omniflex display panel to alert the operator.

Limits on the X-ray tube's travel can be set using potentiometers. When the position of the Bucky passes one of these predetermined heights (upper or lower limit), the "actual height" signal is limited to the appropriate limit value, preventing the X-ray tube from traveling beyond the limit. When the X-ray tube reaches one of the limits, the Servo Control PCB inhibits exposure capability. The Servo Control PCB sends a Limit signal to the Universal Lock Control PCB and ultimately to the Display PCB. The message LIMITS? flashes on the EPEX-Omniflex display panel to alert the operator.

Table 3-6. Potentiometers

Potentiometers	Function	Description
R40	WINDOW	Sets the position differential at which X-ray tube motion is stopped.
R44	LWR LIMIT	Adjusts the lower limit of X-ray tube travel, set during calibration to prevent movement beyond set point.

Potentiometers	Function	Description
R45	UPR LIMIT	Adjusts the lower limit of X-ray tube travel, set during calibration to prevent movement beyond set point.
R47	GAIN ADJ	Adjusts the gain of the vertical drive motor speed in Auto Mode.

Note: When signal is active, LED is illuminated unless otherwise noted.

Table 3-7. LED Status

LED	Indication
DS1	Table input is ON.
DS2	Vertical drive motor protection circuit activated.
DS3	Wall input is ON.
DS4	X-ray tube at upper limit.
DS5	X-ray tube at lower limit.
DS6	Vertical drive motor running.
DS11	Motion stopped/exposure enabled.
DS12	X-ray tube/Bucky position differential within limits (window), motion disabled.

Table 3-8. Test Points

Test Point	Function	Test Point	Function
TP1	X-ray tube lower travel limit level.	TP2	X-ray tube upper travel limit level.
TP3	Differential limit level (window).	TP5	Differential signal level.
TP6	Motor speed voltage level.	TP7	GND2 (internal ground)
TP8	+5 Vdc power	TP9	+12 Vdc power
TP10	GND2 (internal ground)	TP11	-12 Vdc power
TP12	Input signal level.	TP15	Output ground.

Tube Stand Controller Interconnect PCB

The Tube Stand Controller Interconnect PCB (P/N 5284-135-07) provides for signal feed-through.

Table 3-9. DIP Switch

Switch	Function
SW1	All locks release.

Table 3-10. Jumper Settings

Jumper	Function	Position	Notes
JP1	CAN-Bus/Non CAN-Bus System	IN	CAN-Bus System **(Must be installed for this application)**.
		OUT	Non CAN-Bus System.
JP2	CAN-Bus/Non CAN-Bus System	IN	CAN-Bus System **(Must be installed for this application)**.
		OUT	Non CAN-Bus System.
JP3	CAN-Bus/Non CAN-Bus System	IN	CAN-Bus System **(Must be installed for this application)**.
		OUT	Non CAN-Bus System.

Tube Stand Controller Power Supply PC Board

This PCB is used to provide power to the Tube Stand Controller Display PCB (P/N 5284-135-04). The Universal Tube Stand Lock Control PCB provides +24 Vdc to the PCB. Regulators provide +5 Vdc ±12 Vdc.

Universal Tube Stand Lock Control PC Board

Power

24 Vac power is supplied to the Universal Tube Stand Lock Control PCB (P/N 5234-135-08) through connector J17. The 24 Vac is rectified and filtered to produce unregulated 24 Vdc. 24 Vdc power for the Tube Stand Controller Display PCB is provided through J4.

Communication

All communication with the Tube Stand Controller Display PCB (5284-135-01) is via CAN-Bus. The CAN-Bus connects to J16.

Input/Output

Horizontal SID switch inputs from the Interface PCB connect to J2 on the PCB. SID information interfaces with the collimator logic through connector J1.

Lateral center switch inputs from the Interface PCB connect to J12 on the PCB.

The lock control signals originate at SLIO U3 and ultimately drive the gates of MOSFETs. MOSFETs Q1-Q4 drive the magnetic locks. Power (+24 Vdc) is provided to one side of the lock coils. The other side of the lock coils are connected to the drains of the MOSFETs. The locks are energized when the SLIO outputs are high.

The vertical servo control signals interface to the vertical servo system through connectors J5 and J6.

Table 3-11. Jumper Settings

Jumper	Function	Position	Notes
JP1	Watchdog/Power monitor reset.	Pins 1, 2	Watchdog/Power monitor connected to SLIO reset lines (normal operation).
		Pins 2, 3	Reset switch connected to SLIO reset lines (factory test only).

Note: When signal is active, LED is illuminated unless otherwise noted.

Table 3-12. LED Status

LED	Indication
DS1	ON - SLIOs running OFF - SLIO reset
DS2	TOMO input.
DS3	36" horizontal SID input
DS4	40" horizontal SID input
DS5	48" horizontal SID input
DS6	72" horizontal SID input
DS7	Table lateral center input

LED	Indication
DS8	Wall lateral center input
DS9	Elevating table at x-ray height (tilting table horizontal) input
DS10	40" vertical SID input
DS11	Exposure interlock output (ON = exposure allowed)
DS12	Lateral lock control (ON = released)
DS13	Longitudinal lock control (ON = released)
DS14	Vertical lock control (ON = released)
DS15	Rotational lock control (ON = released)
DS16	Vertical servo enable output
DS17	Servo input select output (ON = released)
DS18	Vertical motor drive up output
DS19	Vertical motor drive down output
DS20	Vertical servo in position input
DS21	Table "Trendelenburg" input
DS22	N2 status (not used)
DS23	IN3 status (not used)

Table 3-13. Test Points

Test Point	Function	Test Point	Function
TP5	TL1 - Lateral Lock	TP6	LL1 - Longitudinal Lock
TP7	VL1 - Vertical Lock	TP8	ROTL - Rotational Lock
TP11	+24 VU	TP12	24 VR
TP15	+5 V	TP16	GND
TP17	+5 VC	TP18	GNDC

Interface PC Board

Power

The Universal Tube Stand Lock Control PCB supplies 24 Vdc power to the Interface PCB (P/N 051761) through JP11.

Functionality

The Interface PCB serves as the central processor for the tube crane. Input signals from various sources are sent to the Interface PCB where they are analyzed and processed. Once the input signals are processed, appropriate output signals are sent to continue to the next phase of operation. Some of the key functions that the Interface PCB performs are:

- Receives positioning information from the DR Bucky and EPEX-Omniflex.
- Receives detents positioning information from the EPEX-Omniflex, EPEX Table and Arm.
- Processes analog information (X-ray tube/Bucky differential signal) and provides a SID value signal to the EPEX-Omniflex control for tube crane positioning.
- Provides an analog Bucky position signal with gain and offset adjustment (plus additional offset for table position) to the Servo Control PCB.
- Provides logic circuitry to determine readiness for different operation configurations, i.e., Table and Wall in Auto and Manual modes.
- Provides an interlock signal to the generator while the system is in Auto mode and in motion to prevent exposure.
- Provides an interlock signal to the Servo Control PCB to prevent motion during exposure.
- Interfaces to/from grid motion circuitry.
- Provides Image Receptor orientation information (portrait/landscape) to the collimator.
- Provides a "Cassette Present" signal to the collimator when Auto is on in Table or Wall mode once the system is aligned.
- Provides a test mode for independently verifying individual input interface signals.

Input/Output

The Interface PCB provides the current source for the Bucky position potentiometer and reads the wiper voltage. The Interface PCB also reads the vertical position potentiometer via the Servo Control PCB.

The Interface PCB contains a CPLD programmable logic device to provide an interface for signals from components of the EPEX X-ray system (generator, EPEX-Omniflex, collimator, EPEX Table). The signals are time-multiplexed in normal operation and can be selected individually, indicated by associated LEDs, in test mode.

System mode, normal operation versus test mode, is determined by the position of a jumper. In test mode, each CPLD signal can be selected individually and step-by-step using a push button. Test mode provides a means for checking wiring connections during installation or testing. Refer to Table 3-14 on page 3-13

Table 3-14. CPLD Signals

Input Signal	Value
Bucky Format	Portrait, Landscape
Bucky Orientation	0°, +90°, -90°
Lateral Center Position	Table, Wall 1
Longitudinal SID	40 in., 44 in., 72 in.
Mode (From EPEX-Omniflex)	Wall, Table
Mode (From EPEX-Omniflex)	Auto, Manual
EPEX-Omniflex Servo Enable	Enable, Disable
Bucky Tower, Extreme Left Position	In Position, Not In Position
Bucky Start	Start, Inhibit

Table 3-15. Potentiometers

Potentiometers	Function
R5	Offset for Table Mode.
R6	Offset for Wall Mode.
R16	Common Gain (for both Table and Wall modes).
R36	Offset for X-ray tube/Bucky differential signal.
R43	Gain for X-ray tube/Bucky differential signal.
R44	Cassette size - width.
R45	Cassette size - height.

Table 3-16. DIP Switch

Switch	Function
SW1	Steps through and selects multiplexed CPLD outputs individually in Test mode.

Table 3-17. Jumper Settings

Jumper	Position	Function
JMP1	Pins 1, 2	Puts system in normal operation mode.
	Pins 2, 3	Puts system in Test mode.

Table 3-18. Test Points

Test Point	Function	Test Point	Function
TP1	GNDN	TP2	Output to Servo Control PCB.
TP3	Differential Signal	TP4	GNDF
TP5	Bucky position signal.	TP6	X-ray tube position signal plus offset.
TP7	X-ray tube position signal multiplied times gain.	TP8	GNDP

Note: When signal is active, LED is illuminated unless otherwise noted.

Table 3-19. LED Status

LED	Indication
DS14	Vertical Alignment of X-ray tube and Bucky is within "window".
DS15	Tube crane is at Wall Mode lateral center.
DS16	Tube crane is in Table Mode
DS17	Tube crane is at Table Mode lateral center.
DS18	Servo enable/Auto Mode is ON.

Use the following matrix to determine conditions indicated by the illumination of LED pairs.

LED	DS11	DS12	DS13
DS1	Bucky Orientation - Portrait	Bucky Orientation - Landscape	Not Used
DS2	Not Used	Bucky Position - Table	Bucky Position - Wall
DS3	44" SID	72" SID	40" SID
DS4	Not Used	Not Used	Not Used
DS5	Not Used	Not Used	Carriage switch in ON.
DS6	Generator Command - Bucky Start	Not Used	Not Used
DS7	Not Used	Not Used	Not Used
DS8	Not Used	Not Used	Not Used

Clutch Control PC Board

Assembly P/N 140-0125
Schematic P/N 140-0125-AD

The Clutch Control board works in conjunction with the Tube Stand Lock Control board to control the current to the vertical drive clutch. The clutch current is controlled in order to limit the force that can be transferred from the vertical drive motor to the driven telescoping column during motorized motion.

The Clutch Control board is connected in the clutch circuit between the Lock Control board and the clutch. It is powered from the 24V clutch supply when the Lock Control PCB switches the clutch on. While the 24V clutch supply is on the Clutch Control board supplies current to the electromechanical clutch from a constant current-source. The current level is service settable via a potentiometer on the board.

When the clutch power is switched from OFF to ON, a pulse circuit on the Clutch Control board causes the current source to deliver full current to the clutch to ensure proper pull-in. Following the pull-in pulse, the clutch current drops to the adjusted value. The duration of the pull-in pulse is fixed by discrete components. The clutch pull-in pulse feature can be disabled via jumper pin selection.

To facilitate cabling, the electrical connections for the cross brake are brought straight through the Clutch Control PCB. Power switching for the cross brake is performed on the Tube Stand Lock Control PCB.

Input/Output

The following tables describe the electrical connections to the Clutch Control PCB. electrical connections are via two 4-pin Molex connectors that mate with cable connectors in the clutch/cross brake wiring harness.

Inputs

Reference	Signal Name	Description
P5-1	CRBRK-	Input from Lock Control PCB. Connected to 24VRTN through low-side switch when the cross brake is ON.
P5-2	+24VIN	Input from Lock Control PCB. +24VDC, referenced to 24VRTN. Present whenever power to the tube crane is ON.
P5-3	VRTCL-	Input from Lock Control PCB. Connected to 24VRTN through low-side switch when the vertical clutch is ON
P5-4	+24VIN	Input from Lock Control PCB. +24VDC, referenced to 24VRTN. Present whenever power to the tube crane is ON.

Outputs

Reference	Signal Name	Description
J5-1	CRBRK-	Output to cross brake. Switched connection to 24VRTN, active when cross brake is ON.
J5-2	CRBRK+	Output to cross brake. Fused +24VDC, derived from +24VIN.
J5-3	VRTCL-	Output to vertical clutch. Switched connection to 24VRTN, active when vertical clutch is ON. Return for current supplied from constant current-source.
J5-4	VRTCL+	Output to vertical clutch from constant current-source, active when vertical clutch is ON. Adjustable.

Jumper Settings on the Clutch Control PCB

Reference	Description	Setting	Function
JP1	Clutch ON Pulse Enable	1-2 (default)	Enable clutch ON pulse
		2-3	Disable clutch ON pulse

X-ray Tube

Refer to the X-ray Tube service manual that came with the system.

Collimator

Refer to the Collimator service manual that came with the system.

Chapter 4
Overhead Tube Crane Installation

This chapter describes the basic installation of the EPEX-Omniflex Overhead Tube Crane.

Contents

Overview

This topic details the tasks you must do **before** installing the EPEX-Omniflex Overhead Tube Crane. The topics covered are:

- Safety equipment needed
- Personnel required
- Tools and equipment needed
- Room preparation
- Checking the ceiling

Staging the System

Before shipping the tube crane to the site, Hologic stages the entire system at the factory. Therefore:

- The longitudinal rails are precut to the proper length
- The cables are properly bundled for your site layout

Safety Equipment

The Overhead Tube Crane (OTC) consists of heavy rails, cables, cable carriages, and heavy equipment that hang from the ceiling. While installing this equipment you must protect yourself from falling assemblies, tools, and miscellaneous fasteners and components that may cause serious injury to you and/or other installers in the room.

Lifting and moving some of the assemblies can be dangerous because of their weight. Wear a back support when lifting heavy objects.

The following safety items must be worn during the installation of the equipment suspended overhead:


Safety hat


Safety glasses


Back support


Safety shoes

Personnel Required

Do not attempt to install this equipment with less than two people—three people is preferable. Each person should wear the proper safety equipment during the installation.

Tools and Other Equipment

Before starting the installation, ensure that you have the proper equipment to do the job.

Hammers: A heavy hammer such as a 32 oz ball-peen. Use this with a block of wood to adjust rails and end caps. You can also use a heavy plastic or rubber mallet.

Pliers: An assortment of pliers and cutters.

Power tools: Hammer drill, power hand drill.

Screw drivers: Varied flat blade and Phillips head drivers.

Wrenches: Assorted English and metric box and opened wrenches.

Prying tools: You may need various prying bars to remove the equipment from the crates.

Hand tools: You may need a hand saw or equivalent to remove the equipment from the crates.

Measuring tools: You need a 25 ft. tape rule and a micrometer.

Allen wrenches: You need a varied assortment of Allen wrenches, including keys and T-handles, in English and metric sizes.

Leveling device: Digital levels (various lengths), plumb bobs, chalk lines, and/or laser alignment devices.

Clamps: You may want to use clamps to secure various movable parts on the system if there is no power to activate the brakes.

Lifting device: Minimum 650 lb. capacity, minimum 10 ft. vertical travel pallet jack.

Room Preparation

The following warnings must be complied with before installation begins.

WARNING

Failure to comply with these warnings may cause serious or fatal bodily injury and degrade the unit's safety level.

WARNING

Ensure that the construction and load capacity of the ceiling are sufficient for the installation of this equipment.

WARNING

Ensure that the central ground terminal of the room has a resistance in accordance with the regulations in force.

WARNING

Ensure that the room line input is protected by means of a differential breaker calibrated for a maximum leakage current of 30mA.

WARNING

Ensure that the room emergency circuit is present and designed in accordance with the regulations in force.

WARNING

Ensure that the walls of the room have been prepared to prevent the emission of scatter radiation into adjacent areas (usually the walls are lined with lead).

Also, ensure that:

- A qualified facility official approves the room before installation begins.
- There is sufficient clearance between the equipment and the walls and doors, and so on.
- As the installation progresses, use the installation checklist as a guide. The Overhead Tube Crane Installation Checklist provide a reminder of the critacal steps for installation. Reproducible copies of the form are provided in Appendix B.

General

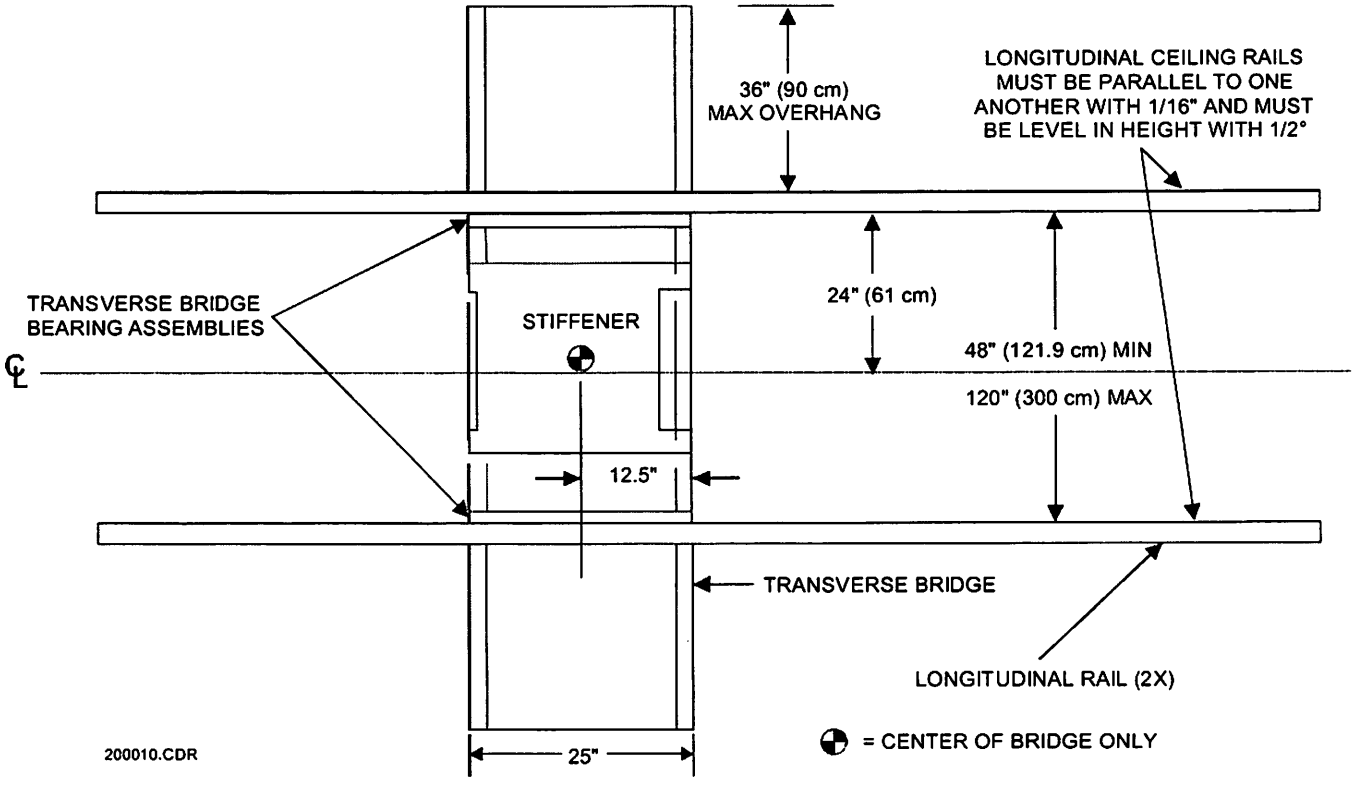
The EPEX-Omniflex Overhead Tube Crane suspends from two longitudinal rails mounted to the ceiling. The EPEX-Omniflex weighs more than 1,000 pounds and requires substantial mounting means for safe operation.

The ceiling rails must be parallel to each other and in the same horizontal plane for the system to operate properly in addition to being level to the floor. The longitudinal ceiling rails may be mounted at any spacing from 48 in. minimum to the full length of the transverse bridge. Refer to Figure 4-1.

It is advised that a certified professional engineer be consulted to determine the proper and safe method of mounting for the site in question and the specific hardware to use.

Check the longitudinal dimension of the room. If the room is large enough, the transverse bridge and carriage can be installed together through one end of the longitudinal rails, providing there is an adequate lifting device available.

Figure 4-1. EPEX-Omniflex Longitudinal Mounting Considerations



Unpacking the Equipment

The equipment was carefully inspected and tested prior to shipment. Upon its arrival, inspect each container for damage. Unpack each component as soon as possible and conduct a thorough examination of the components. Do this in the presence of the carrier if at all possible. If damage is noted, take photographs of the damaged portions and immediately file a claim with the carrier. If the carrier is not notified within 15 days of delivery, the carrier cannot be held responsible.

Note: Have a camera available to photograph any shipping damage.

To verify the receipt of all parts prior to installation of the system, unpack the items as follows:

WARNING

Beware of sharp edges, splinters, pinch points, exposed nails, and staples when unpacking. Wear leather gloves.

Step	Action
1	Take the box shells off and uncrate in truck or loading dock area.
2	Refer to the packing list and verify that all components are present.
3	Visually check each component for damage.
4	Return the TempTale temperature and humidity recorder from the DirectRay Detector packing to the Hologic Installation Coordinator.
5	Unpack the overhead tube crane and rails and move them into the room.

CAUTION

Use two people to move the OTC.

Step	Action
6	Move all crates to either the room or to the storage area.

Positioning the equipment

After the equipment has been moved to the room and unpacked, position the major components as shown on the site planning drawings. Ensure that there is enough room between the components and the walls or other equipment to complete the installation of components and cabling before final placement.

Installing the Overhead Tube Crane

Longitudinal Rails Installation

Note: Prior to the installation of the longitudinal rails, ensure the mounting provisions in the ceiling are correctly installed and level per the site specifications. Refer to "EPEX/Omniflex IV System Service Manual" for inspection criteria. Any discrepancy found must be corrected prior to the installation of the longitudinal rails.

EPEX Table longitudinal centerline must be established and clearly marked on the floor prior to the installation of the EPEX-Omniflex overhead tube crane. Refer to "EPEX/ Omniflex IV System Service Manual" for room preparation.

To install the longitudinal rails:

Step	Action
1	The longitudinal rails mount to the ceiling with hardware supplied by the installer as per the site engineer's specifications. The longitudinal rails must be mounted so that they are parallel to one another and level. Snap a line on the ceiling to mark the mounting hole centerline for one of the rails. This line must coincide with the positioning specified by the site engineer.
2	Measure the offset from the marked centerline to the centerline of the second ceiling rail and mark at two points, preferably at each end. Snap a line through these points to mark the centerline of the second rail.
3	Using the rails themselves as templates, mark the positions of the mounting holes. Prepare the ceiling for installation of the specified mounting hardware.
4	Install the specified hardware and the longitudinal rails. Verify that the rails are parallel to one another, in the same horizontal plane, and level to the floor. Adjust as necessary and as allowed by the mounting system in use. Secure the mounting hardware when satisfied with the rails' position.

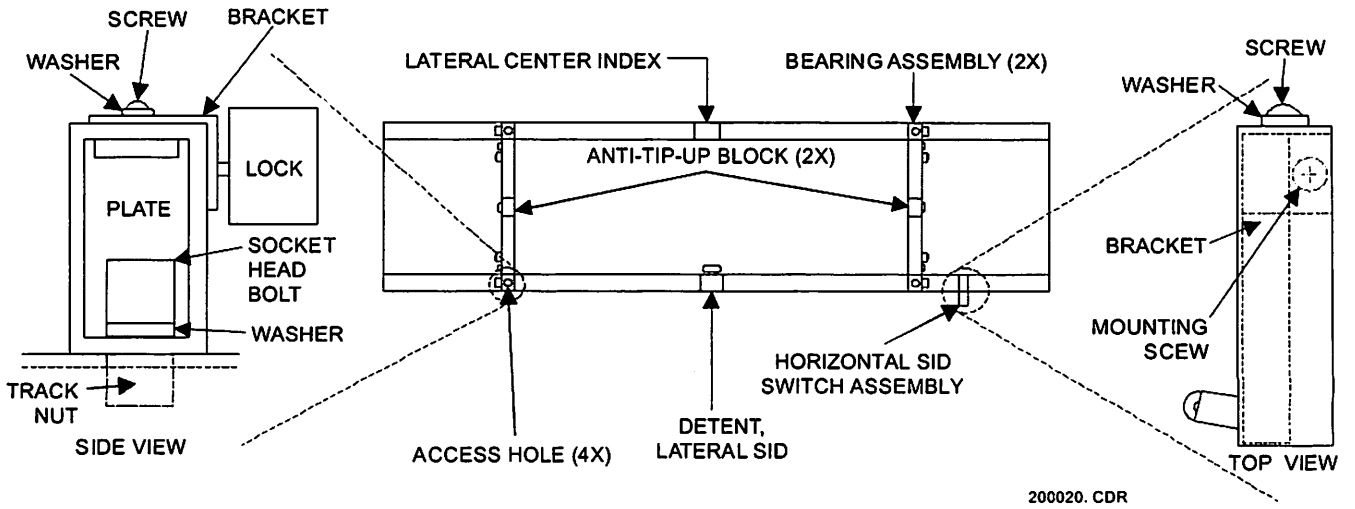
Transverse Bridge Preparation for Installation

The transverse bridge is shipped fully assembled. To assemble the EPEX-Omniflex, the bearing assemblies must be removed (Figure 4-2).

To prepare the transverse bridge for installation:

Step	Action
1	Orient the transverse bridge to ensure correct position of the steel strip, as used with the lateral lock of the transverse carriage. The strips must be positioned on the same side as the magnetic lateral lock.
2	Remove the longitudinal lock from both transverse bridge bearing assemblies to prevent damage during installation.
3	Remove the horizontal SID switch assembly to prevent damage during installation.

Figure 4-2. Transverse Bridge Bearing and Switch Assemblies



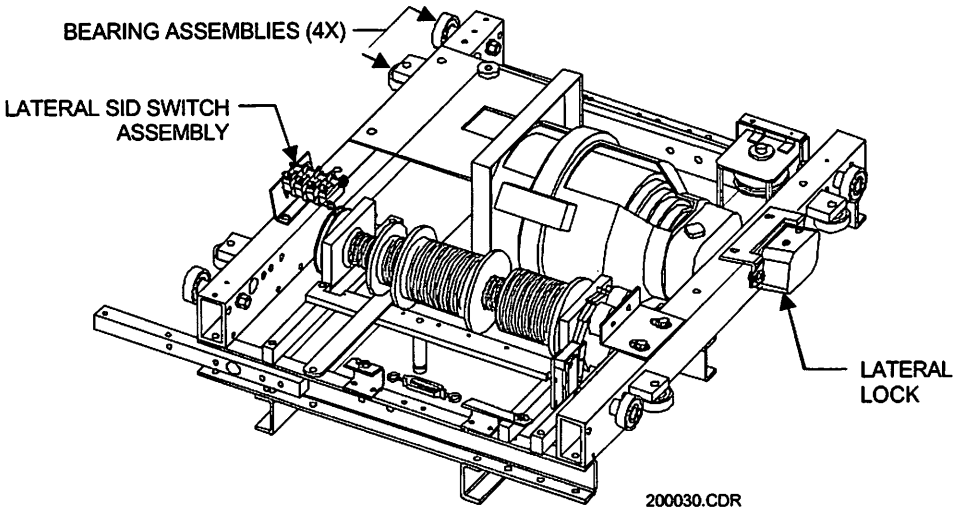
Step	Action
4	Remove the anti-tip-up block from both bearing assemblies to facilitate the installation of the transverse bridge.
5	Loosen the hex socket bolts of the transverse bridge bearing assemblies through the access holes and slide the bearing assemblies to the approximate position needed to fit the longitudinal rails.

Transverse Carriage Preparation for Installation

To prepare the transverse bridge (Figure 4-3) for installation:

Step	Action
1	Loosen the lateral lock mounting hardware and slide the lock back towards the center of the carriage to provide clearance during installation of transverse carriage. Secure the lock in place.
2	Remove the lateral SID switch assembly to prevent damage during installation.

Figure 4-3.
Transverse Carriage Locks and Bearings



Transverse Bridge Installation

There are two methods of installation and the installer should determine which to use. The proper method is dependent on the lifting equipment available and the floor area of the room. Refer to either "Installation of the Transverse Bridge and Carriage Together" or "Installation of the Transverse Bridge and Carriage Separately" on page 4-14.

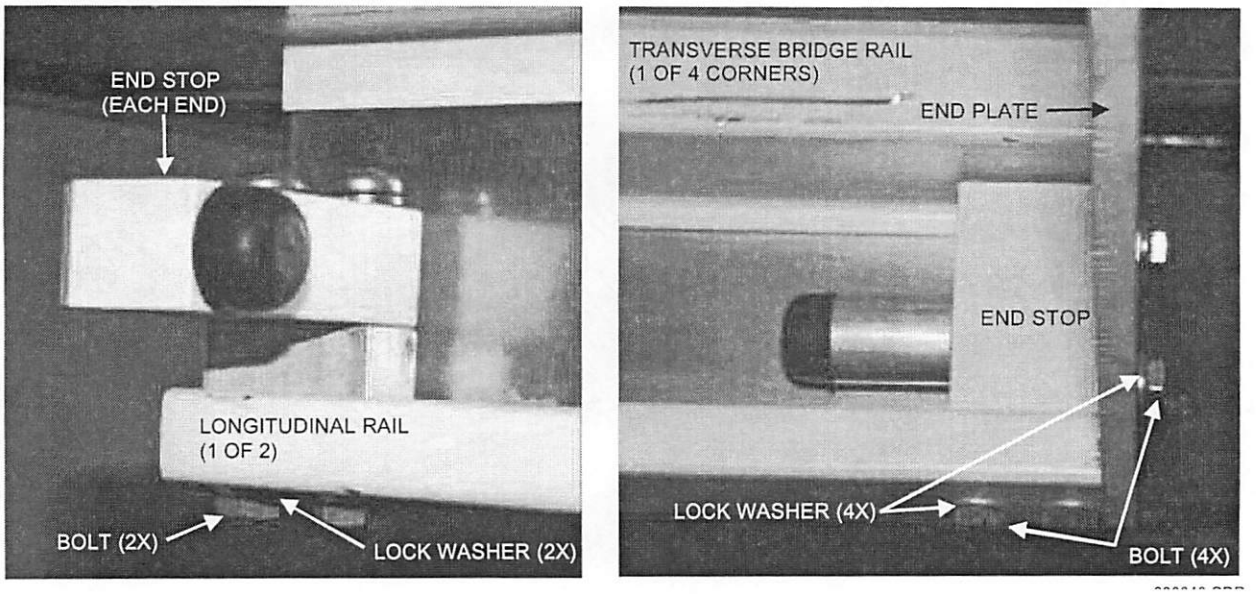
Installation of the Transverse Bridge and Carriage Together

This method should be used when adequate lift capability is available.

To install the transverse bridge and carriage together:

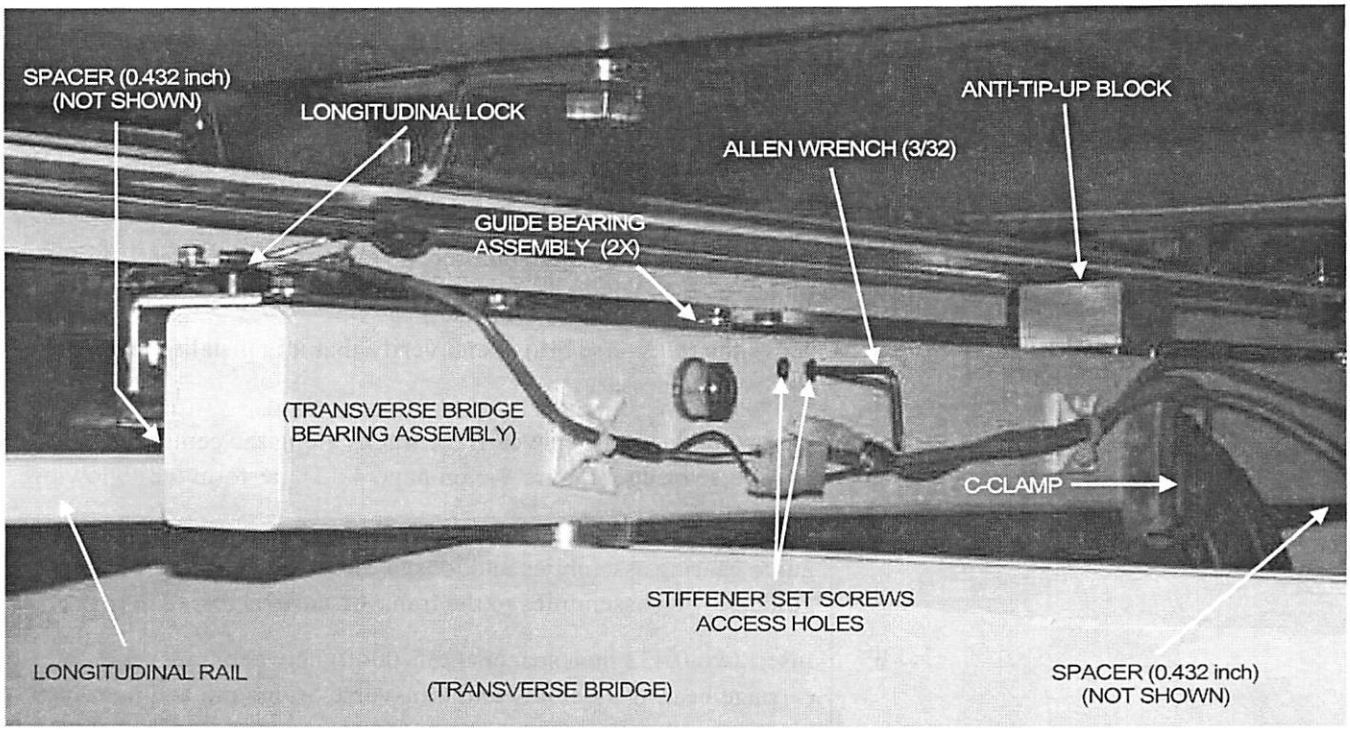
Step	Action
1	Remove the end stop and plate from one end of the transverse bridge. Refer to Figure 4-4 on page 4-10.
2	Through the open end, slide the transverse bridge rails over the transverse carriage bearing assemblies.
3	Install the end stop and plate on the transverse bridge.
4	If the magnitude of the room facilitates the installation of the transverse bridge through one end of the longitudinal rails, proceed to Step 5, otherwise, perform the following:
a.	Remove the bearing assemblies (2X) from the transverse bridge.
b.	Center the transverse bridge beneath the longitudinal rails and lift into position.

Figure 4-4. Longitudinal Rail End Stops



Step	Action
c.	Install the bearing assembly in each longitudinal rail and position over the transverse bridge. Using four socket head bolts, spacers and track nuts, temporarily secure bearing assembly to transverse bridge.
d.	Skip to Step 6.
5	To install the transverse bridge through one end of the longitudinal rails, perform the following:
a.	Remove end stop and end plate from one end of the longitudinal rails.
b.	Center the transverse bridge at the end of the longitudinal rails, and raise in place. Space the bearing assemblies accordingly and slide the transverse bridge into the longitudinal rails.
c.	Reinstall the end stop and end plate in both longitudinal rails. Refer to Figure 4-4.
6	To ensure the transverse bridge tracks along the center of the longitudinal rail, perform the following (Figure 4-5 on page 4-11):
a.	Using two 0.432 inch spacers (235-0040) provided, insert one spacer at each end of bearing assembly between bearing assembly and longitudinal rail and hold in place using a c-clamp.
b.	Tighten the four socket head bolts and track nuts to secure the bearing assemblies to the transverse bridge.

Figure 4-5. Transverse Bridge Tracking Adjustment



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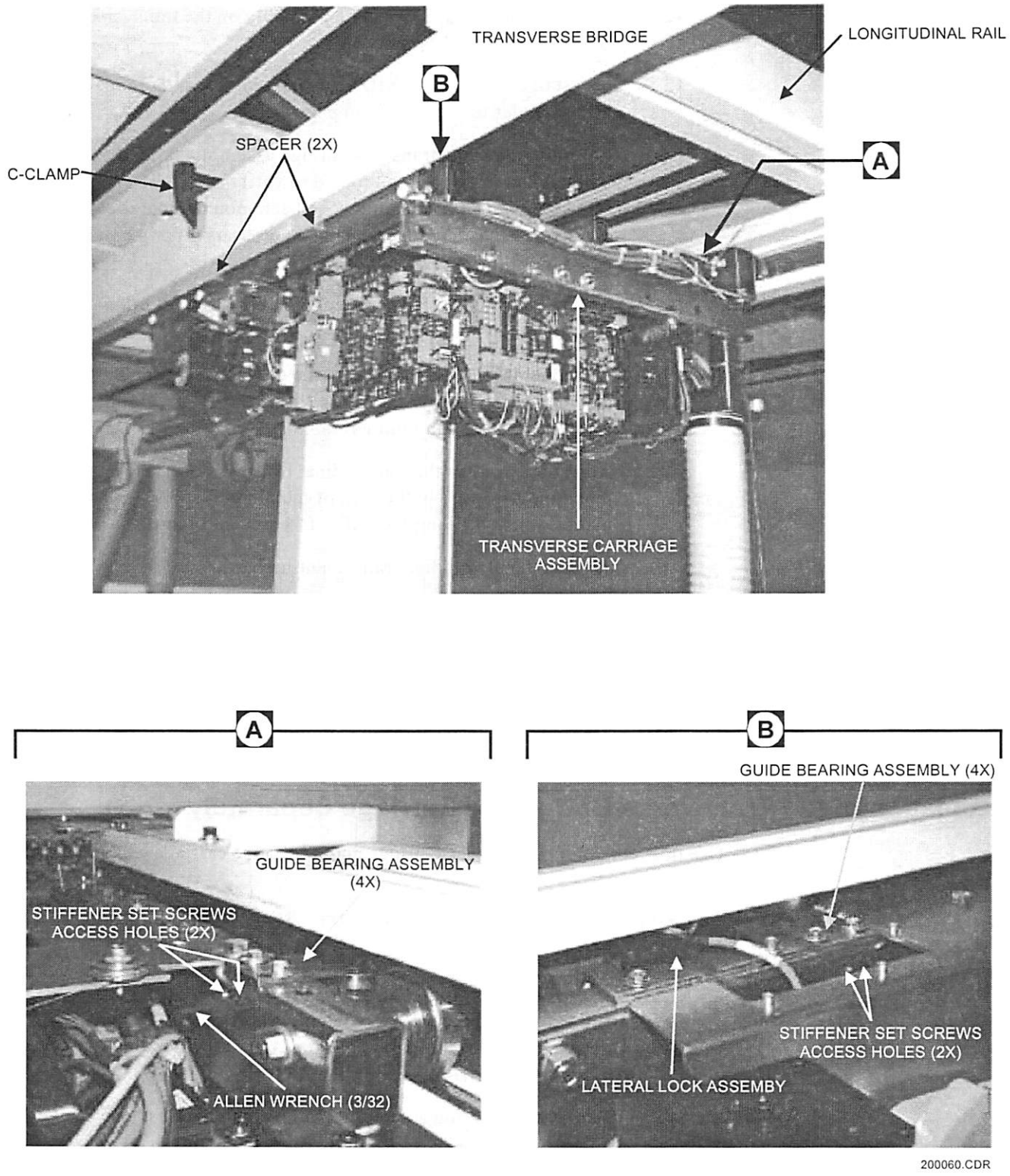
Step	Action
c.	Loosen hardware securing guide bearing assembly. Insert electrical tape or equivalent shim (0.008 inch) between guide bearing and longitudinal rail. Slide guide bearing towards longitudinal rail until slight contact with shim is made. Tighten hardware to secure guide bearing assembly.
d.	To prevent the guide bearing assembly from flexing during transverse bridge travel, tighten the two stiffener set screws until contact with guide bearing assembly is made. Do not overtighten setscrews.
e.	Remove shim and repeat Steps c. and d. for other guide bearing assembly.
f.	Loosen the hardware securing the longitudinal lock. Insert electrical tape or equivalent shim (0.008 inch) between the lock and longitudinal rail. Slide lock towards longitudinal rail until slight contact with shim is made. Tighten hardware to secure longitudinal lock in place. Remove shim.
g.	Remove spacers (2X) and c-clamp and repeat Steps a. through g. for remaining bearing assembly.
7	Install the anti-tip-up block (2X) as follows (Figure 4-5):

Step	Action
a.	Position the anti-tip-up block on the center of the bearing assembly and temporarily secure using 4 countersunk screws.
b.	Using an hex wrench, tighten the two set screws evenly until the roller bearing makes contact with the longitudinal rail upper bearing raceway.
c.	Tighten the four countersunk screws ensuring that the anti-tip-up block roller bearing remains in contact with the longitudinal rail.
8	Move the transverse bridge and verify that it is installed squarely. Adjust as necessary.
9	To ensure the transverse carriage tracks along the center of the transverse bridge (Figure 4-6 on page 4-13), perform the following:
a.	Back off the two stiffener setscrews from each of the four adjustable guide bearing assemblies and loosen the hardware securing the guide bearing assemblies to the transverse carriage.
b.	Insert two 0.432 inch spacers (235-0040) between transverse carriage bearing assembly and transverse bridge rail and hold in place using a c-clamp.
c.	Insert electrical tape or equivalent shim (0.008 inch) between the guide bearing and transverse bridge rail. Slide guide bearing towards rail until slight contact with shim is made. Tighten hardware to secure guide bearing assembly in place.
d.	To prevent the guide bearing assembly from flexing during transverse carriage travel, tighten the two stiffener set screws until contact with guide bearing assembly is made. Do not overtighten setscrews.
e.	Remove shim and repeat Steps b. through d. until all four guide bearing assemblies have been adjusted.
f.	Loosen the hardware securing the lateral lock. Insert electrical tape or equivalent shim (0.008 inch) between the lock and transverse bridge rail. Slide lock towards rail until slight contact with shim is made. Tighten hardware to secure lateral lock in place. Remove shim.
g.	Remove spacers (2X) and c-clamp from transverse carriage.
10	Carefully lower and remove the lifting gear. Remove any crating and packing materials from under the assembly.
11	Move the transverse carriage and verify that it is installed squarely. Adjust as necessary.

Figure 4-6. Transverse Carriage Tracking Adjustment



Step	Action
12	Reinstall the lateral SID switch assembly on the transverse carriage. Refer to Figure 4-3 on page 4-9.
13	Reinstall the horizontal SID switch assembly on the transverse bridge. Refer to Figure 4-2 on page 4-8
14	Carefully move the transverse bridge assembly along the longitudinal rails from end to end to verify that there is no binding. The longitudinal rails should have been mounted parallel to each other, but slight adjustment may be necessary. If any binding is noted, perform the following:
a.	Repeat Step 6. If no further binding is noted, no additional adjustment is required.
b.	If binding is still noted, position the transverse bridge in the area in which the binding occurs. Lift the system enough to allow adjustment of the longitudinal rail.
c.	Adjust only **one** of the longitudinal rails by loosen the appropriate mounting hardware in the area of the binding and using a rubber mallet, adjust the longitudinal rail to prevent binding.
d.	Tighten the longitudinal rail mounting hardware.
15	Carefully move the transverse carriage assembly along the transverse bridge from end to end to verify that there is no binding. If any binding is noted, repeat Step 9 until no further binding is noted.
16	Proceed to "X-ray Tube and Collimator Installation" on page 4-18

Installation of the Transverse Bridge and Carriage Separately

Use this method if the transverse bridge and transverse carriage cannot be lifted together.

To install the transverse bridge and carriage separately:

Step	Action
1	If the magnitude of the room facilitates the installation of the transverse bridge through one end of the longitudinal rails, proceed to Step 2, otherwise, perform the following:
a.	Remove the bearing assemblies (2X) from the transverse bridge.
b.	Center the transverse bridge beneath the longitudinal rails and lift into position.

Step	Action
c.	Install the bearing assembly in each longitudinal rail and position over the transverse bridge. Using four socket head bolts, spacers and track nuts, temporarily secure bearing assembly to transverse bridge.
d.	Skip to Step 3.
2	To install the transverse bridge through one end of the longitudinal rails, perform the following:
a.	Remove end stop and end plate from one end of the longitudinal rails.
b.	Center the transverse bridge at the end of the longitudinal rails, space the bearing assemblies accordingly and slide the transverse bridge into the longitudinal rails.
c.	Reinstall the end stop and end plate in both longitudinal rails. Refer to Figure 4-4 on page 4-10.
3	To ensure the transverse bridge tracks along the center of the longitudinal rail (Figure 4-5 on page 4-11), perform the following:
a.	Using two 0.432 inch spacers (235-0040) provided, insert spacers at each end of bearing assembly between bearing assembly and longitudinal rail and hold in place using a c-clamp.
b.	Tighten the four socket head bolts and track nuts to secure the bearing assemblies to the transverse bridge.
c.	Loosen hardware securing the guide bearing assembly. Insert electrical tape or equivalent shim (0.008 inch) between the guide bearing and longitudinal rail. Slide guide bearing towards longitudinal rail until slight contact with shim is made. Tighten hardware to secure guide bearing assembly in place.
d.	To prevent the guide bearing assembly from flexing during transverse bridge travel, tighten the two stiffener set screws until contact with guide bearing assembly is made. Do not overtighten setscrews.
e.	Remove shim and repeat Steps c. and d. for other guide bearing assembly.
f.	Loosen the hardware securing the longitudinal lock. Insert electrical tape or equivalent shim (0.008 inch) between the lock and longitudinal rail. Slide lock towards longitudinal rail until slight contact with shim is made. Tighten hardware to secure longitudinal lock in place. Remove shim.
g.	Remove spacers (2X) and c-clamp and repeat Steps a. through g. for remaining bearing assembly.

Step	Action
4	Install the anti-tip-up block (2X) (Figure 4-5 on page 4-11) as follows:
a.	Position the anti-tip-up block on the center of the bearing assembly and temporarily secure using 4 countersunk screws.
b.	Using an hex wrench, tighten the two set screws evenly until the roller bearing makes contact with the longitudinal rail upper bearing raceway.
c.	Tighten the four countersunk screws ensuring that the anti-tip-up block roller bearing remains in contact with the longitudinal rail.
5	Move the transverse bridge and verify that it is installed squarely. Adjust as necessary.
6	Remove the end stop and plate from one end of the transverse bridge. Refer to Figure 4-4 on page 4-10.
7	If the magnitude of the room facilitates the installation of the transverse carriage through one end of the transverse bridge, proceed to Step 8, otherwise, perform the following:
a.	On the transverse bridge, remove two hex socket bolts from only one side of the stiffener bracket.
b.	Position the transverse carriage assembly at the open end of the transverse bridge. Raise the transverse carriage to just beneath the transverse bridge.
c.	Remove the hex socket bolt and spacer from one end of the transverse bridge bearing assembly and carefully spread the transverse bridge assembly rails just enough to allow the transverse carriage bearings to fit between them.
d.	Raise the transverse carriage between the transverse bridge rails and close the rails over the bearings.
e.	Reinstall the hex socket bolt through the transverse bridge bearing assembly, spacer, track nut, and tighten securely.
f.	Reinstall the end stop and end plate on the transverse bridge.
g.	Ensure the transverse bridge stiffener aligns with mounting holes in rail and secure in place using two hex socket bolts.
h.	Skip to Step 9.
8	To install the transverse bridge through one end of the transverse bridge rails, perform the following:

Step	Action
a.	Center the transverse carriage at the open end of the transverse bridge rails and raise in place. Carefully slide the transverse carriage into the transverse bridge rails.
b.	Reinstall the end stop and end plate in both transverse bridge rails. Refer to Figure 4-4 on page 4-10.
9	To ensure the transverse carriage tracks along the center of the transverse bridge (Figure 4-6 on page 4-13), perform the following:
a.	Back off the two stiffener setscrews from each of the four adjustable guide bearing assemblies and loosen the hardware securing the guide bearing assemblies to the transverse carriage.
b.	Insert two 0.432 inch spacers (235-0040) between transverse carriage bearing assembly and transverse bridge rail and hold in place using a c-clamp.
c.	Insert electrical tape or equivalent shim (0.008 inch) between the guide bearing and transverse bridge rail. Slide guide bearing towards rail until slight contact with shim is made. Tighten hardware to secure guide bearing assembly in place.
d.	To prevent the guide bearing assembly from flexing during transverse carriage travel, tighten the two stiffener set screws until contact with guide bearing assembly is made. Do not overtighten setscrews.
e.	Remove shim and repeat Steps b. through d. until all four guide bearing assemblies have been adjusted.
f.	Loosen the hardware securing the lateral lock. Insert electrical tape or equivalent shim (0.008 inch) between the lock and transverse bridge rail. Slide lock towards rail until slight contact with shim is made. Tighten hardware to secure lateral lock in place. Remove shim.
g.	Remove spacers (2X) and c-clamp from transverse carriage.
10	Carefully lower and remove the lifting gear. Remove any crating and packing materials from under the assembly.
11	Move the transverse carriage and verify that it is installed squarely. Adjust as necessary.
12	Reinstall the lateral SID switch assembly on the transverse carriage (Figure 4-3 on page 4-9).
13	Reinstall the horizontal SID switch assembly on the transverse bridge (Figure 4-2 on page 4-8).

Step	Action
14	Carefully move the transverse bridge assembly along the longitudinal rails from end to end to verify that there is no binding. The longitudinal rails should have been mounted parallel to each other, but slight adjustment may be necessary. If any binding is noted, perform the following:
a.	Repeat Step 6. If no further binding is noted, no additional adjustment is required.
b.	If binding is still noted, position the transverse bridge in the area in which the binding occurs. Lift the system enough to allow adjustment of the longitudinal rail.
c.	Adjust only one of the longitudinal rails by loosen the appropriate mounting hardware in the area of the binding and using a rubber mallet, adjust the longitudinal rail to prevent binding.
d.	Tighten the longitudinal rail mounting hardware.
15	Carefully move the transverse carriage assembly along the transverse bridge from end to end to verify that there is no binding. If any binding is noted, repeat Step 9 until no further binding is noted.
16	Proceed to "X-ray Tube and Collimator Installation" on page 4-18.

X-ray Tube and Collimator Installation

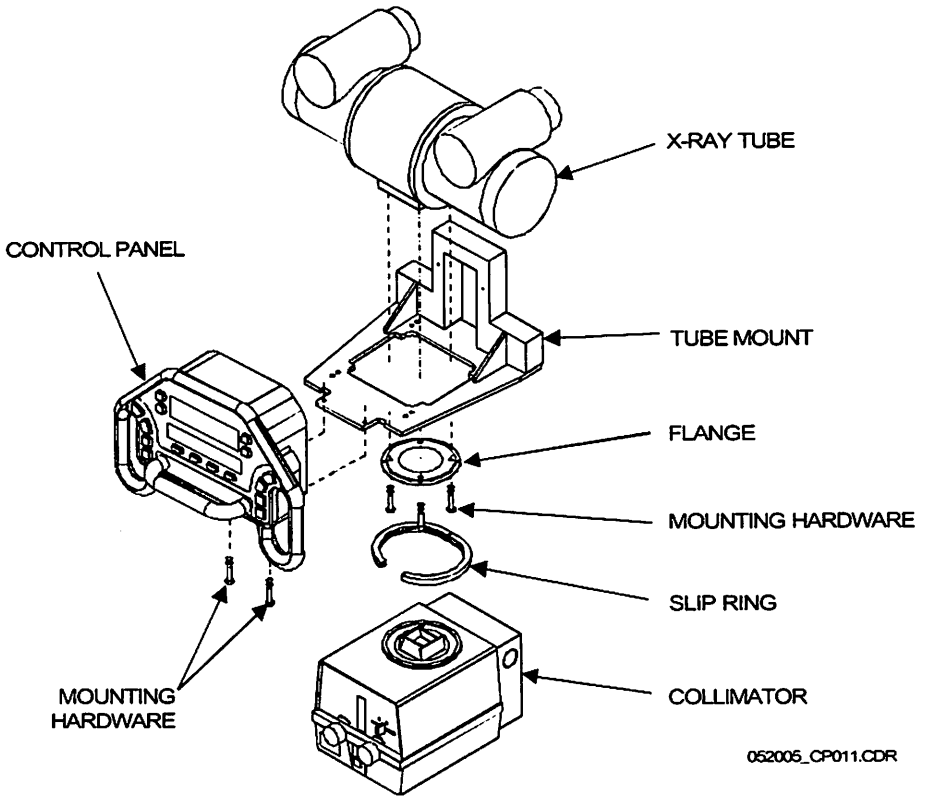
CAUTION

Installation of the X-ray tube requires two persons: one to hold the tube in place and another to perform the steps that follow.

To install the X-ray tube and collimator:

Step	Action
1	Pull the X-ray tube mount down to a comfortable working height and secure by triggering the safety mechanism. Refer to Chapter 8 "Safety Mechanism - Telescoping Tube Arm" for instructions.
2	Place the X-ray tube on the X-ray tube mount (Figure 4-7).
3	Place the flange and any required spacers beneath the tube mount and install the 4 screws (supplied with the collimator) through the flange and into the x-ray tube. Tighten securely. Use of Loctite™ #242 is recommended.
4	Turn the X-ray tube upside down so that the collimator mounting flange faces up.

Figure 4-7.
Tube Arm Assembly



Step	Action
5	Carefully place the collimator upside down on the mounting flange. Hold the X-ray tube support arm in position so that it does not rotate. Take care not to damage any protruding assemblies of the collimator.
6	Secure the screw in the collimator slip ring.
7	Turn the assembly so that the collimator is on the bottom.

Control Console Installation

To install the control console:

Step	Action
1	Install the control panel in front of the X-ray tube using four screws and washers to secure it to the tube arm if not already installed (Figure 4-7).
2	Reset the safety mechanism. Refer to Chapter 8 "Safety Mechanism - Telescoping Tube Arm" for instructions.

Cable Installation

Cable Hoses

Figure 4-8 shows the EPEX-Omniflex and its cable hoses. Three flexible cable hoses are provided with the EPEX-Omniflex:

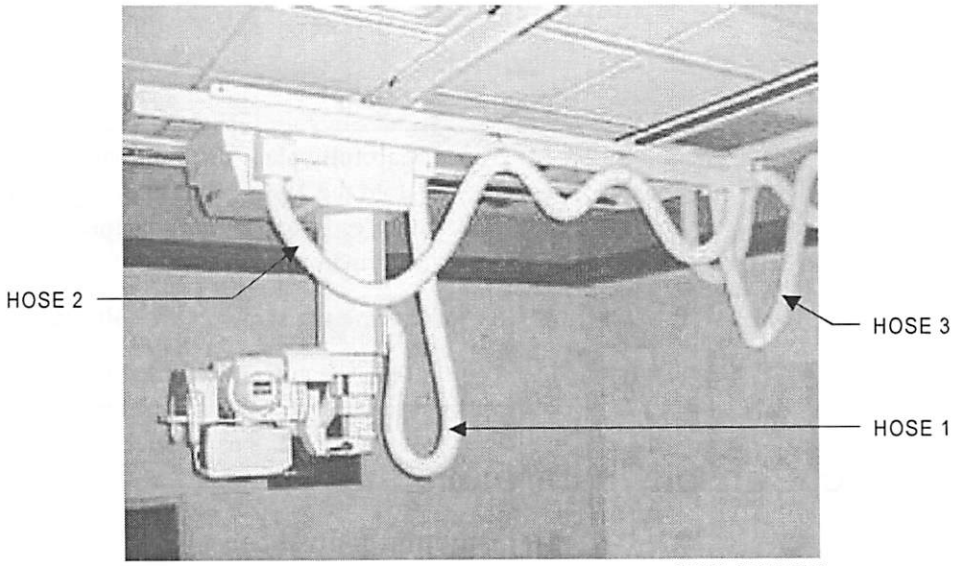
Hose 1 (10 feet long) will carry all cabling between the tube/collimator assembly and the rest of the system.

Hose 2 (15 feet long) will carry longitudinal lock, SID switch, and various interconnect cables. This hose is supported on a separate rail with trolley and tracks the carriage's transverse travel.

Hose 3 (21 feet long) will permit longitudinal movement for the EPEX-Omniflex while maintaining required connections between the EPEX-Omniflex and generator. This hose is shipped with the bridge. The hose is supported on a separate rail with trolley and provides egress for system cables to the generator.

After installing the mechanical assemblies, connect cables as described below.

Figure 4-8.
EPEX-Omniflex
Overhead Tube Crane



Cable Routing

A safety mechanism is provided to prevent injury due to sudden telescoping of the tube arm. When working with the tube arm, it is recommended that you engage the safety mechanism. Refer to Chapter 8 "Safety Mechanism - Telescoping Tube Arm" for instructions.

WARNING

Using two persons, lock the x-ray tube at a working height and set the safety mechanism to prevent the tube arm from telescoping suddenly.

Note: Use the Interconnect Diagram (P/N 052450) included in this manual to verify all cable connections.

To install system interconnect cables:

Step	Action
1	The Longitudinal rails switch assembly cable, P/N 052135, and Carriage switch assembly cable, P/N 052175, can be connected one of two ways depending on your system's Wall mode configuration. Refer to Chapter 6 "Wall Mode Configurations" for more information. Once you have identified your Wall mode configuration, connect the cables as shown on the interconnect diagram.
2	Remove the covers to expose the EPEX-Omniflex hose mounting brackets for hoses mounted at locations "A", "B", "C" and "D" (Figure 4-9).
3	Connect hose 1 to connector "A".
4	Run the EPEX-Omniflex control cable (P/N 052219) through connector "A" and hose 1. Run the vertical position cable (P/N 5187-135-03) via the same route.
5	Run the collimator control cable (supplied with the collimator) up through hose 1, through connector "A", through the transverse carriage, and out connector "B".
6	Run the rotor cable (P/N 052206) and H.V. cables (2 x P/N 9440-760-00) up through hose 1 and through connector "A".
7	Connect the cables specified in the previous steps to the X-ray tube assembly. To connect the H.V. cables, remove the tube cover securing brackets. Insert and tighten the H.V. cables using two right angle high voltage cable ends.

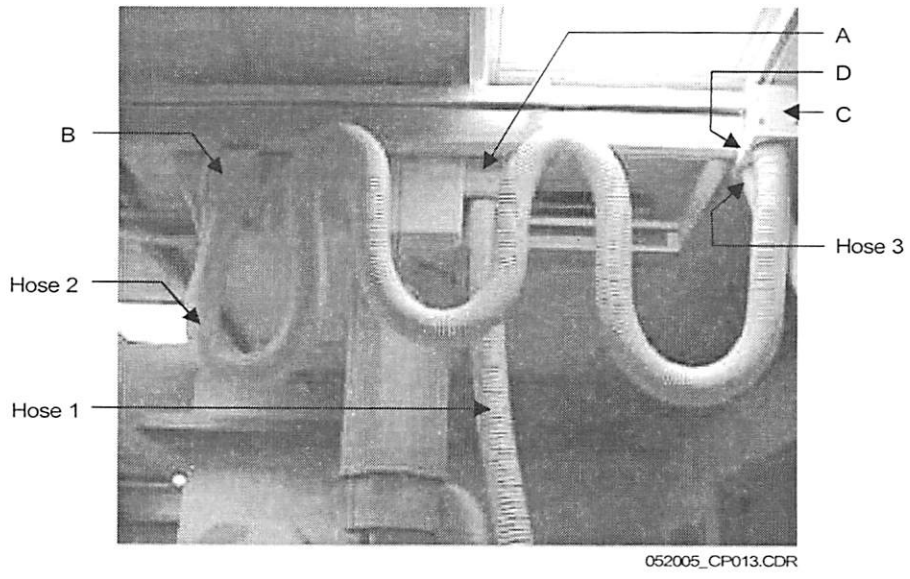
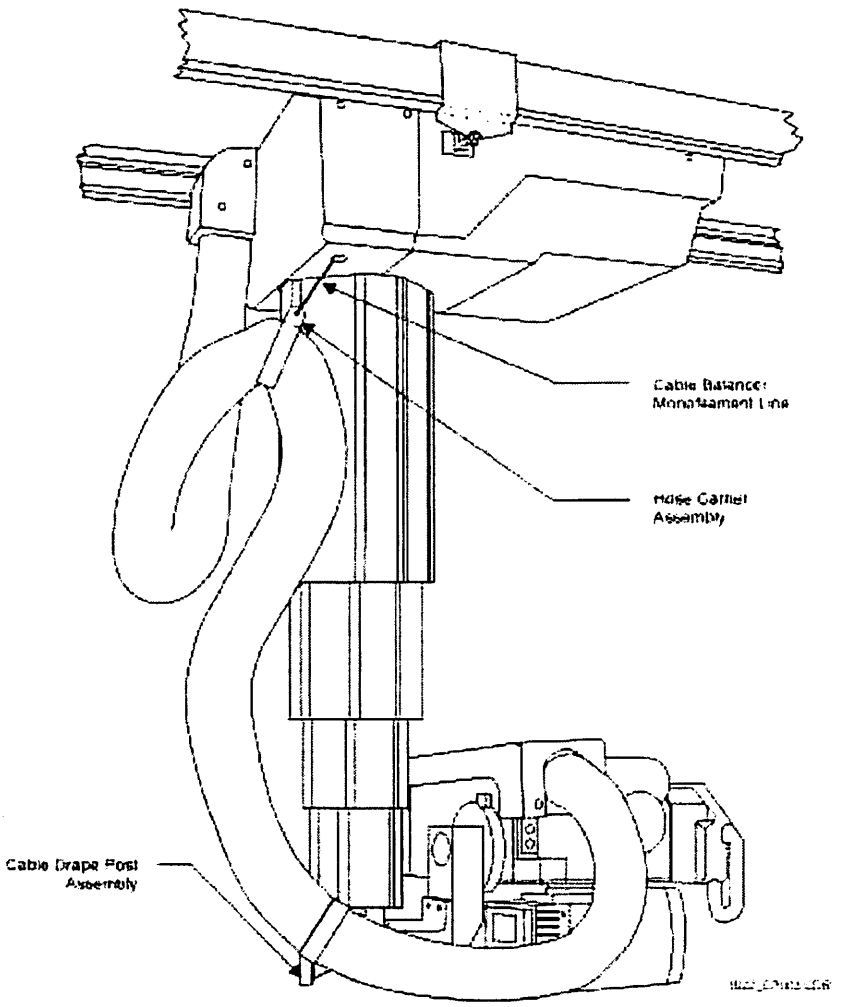


Figure 4-9. Cable Routing

Step	Action
8	Loosen (slightly), the screw securing the cable balancer to the mount bracket. The cable balancer should be able to rotate, but still be able to hold its position under a load.
9	After connecting cables to the X-ray tube assembly section, adjust for correct length.
10	Temporarily install the transverse carriage rear cover using the existing hardware.
11	Ensuring the rubber bumper is positioned above the stop clamp, reinstall the stop clamp approximately six inches from the end of the monofilament line.
12	Attach snap hook on the end of the monofilament line to the hose carrier assembly.
13	Rotate the cable balancer angle as required until monofilament line is centered in the cover access hole.
14	Set the cable balancer tension by turning the large knob on the balancer in the clockwise direction. To relieve tension, press the incremental tension release lever. Tension should be set to lowest setting that permits the hose to return to the fully retracted position.
15	Lower the transverse carriage top rear cover and tighten the screw securing the cable balancer to the mount bracket.
16	Reinstall the transverse carriage rear cover.
17	Attach the cable hose guide (P/N 030-3087) to the hose approximately 3 feet from the hose mount bracket on the cable drape post assembly. Insert bushing (P/N 030-3088) through the nylon bearings on the hose guide and secure in place using a hair pin (P/N 295-0924). Tighten the shoulder screw to the bracket. Refer to Figure 4-10.

Figure 4-10.
Cable Balancer and Draping



Step	Action
18	Secure the hose clamp to the cable drape post assembly using one shoulder screw (P/N 200-0462).
19	Attach the hose carrier assembly (P/N 010-1508) to the cable hose approximately 4 feet from the hose mount bracket on the rear of the transverse carriage. Secure in place using one 1/4-20 x 3/4-inch hex head screw (P/N 124-6420-1212), lock washer (P/N 123-4142-20), and 1/4-20 acorn nut (P/N 215-0058). Refer to Figure 4-10.
20	After connecting cables to the X-ray tube assembly section, adjust for correct length.
21	Connect the EPEX-Omniflex control cable to the Lock Control PCB and the vertical position cable to the Interface PCB as specified on the interconnect diagram.

22	Straighten and lay out to full length the remaining cables that emerge from connector "B", including: • Cassette sense cable (P/N 052252) • Vertical SID monitor cable (supplied with collimator) • Collimator horizontal SID cable (P/N 5187-134-10) • Differential SID monitor cable (P/N 052081) • Generator interlock cable (P/N 051843) • Power cable (P/N 052449) • Power cable (P/N 052078) • 230 Vac power cable (P/N 9513-430-00) • Bucky position cable (P/N 051769) • Bucky control cable (P/N 052401) • Rotor and high voltage cables that were connected to the X-ray tube assembly
23	Connect all cables that terminate at the transverse carriage up through connector "B".
24	Slide hose 2 to cover remaining cables emerging from connector "B". Fasten hose 2 to connector "B".
25	With the cable bundle emerging from hose 2 still on the ground, group cables destined for the Transverse Bridge area, generator/ collimator logic, and IRT.
26	Lift hoses 2 and 3 near their intersection; slide cables destined for the generator/collimator logic and IRT into slots of connectors "C" and "D" and through hose 3. Clamp hoses to connectors "C" and "D". Connector "D" is on the opposite end of "C".
27	Connect cables destined for TB1.
28	Run cables destined for the transverse bridge area out the top of the hose box and connect.
29	Drape hose 2 at two points along transverse cable hanger.
30	Drape hose 3 at a minimum of three points along the longitudinal cable hanger.
31	Verify all EPEX-Omniflex connections against the interconnect diagram.

32	Check for cable drape interference by performing the following steps: a. Verify the hose moves freely in both Table and Wall mode configurations when the x-ray tube is raised and lowered to their mechanical limits. Hose should retract completely when x-ray tube is raised, if not, adjust the cable balancer tension as required. b. Rotate the x-ray tube 90° clockwise and counterclockwise about the vertical axis and back to 0°. Verify the hose moves freely and does not enter the x-ray field. If interference is noted, adjust the position of the hose guide and repeat this step.
33	Install the transverse carriage covers.

Connecting the Mains Input Power Cord to the External Power Source

WARNING

Before Connecting input power, de-energize the external power source to which the tube crane will be connected.

A qualified electrical equipment installer must perform the connection of the tube crane to the external power source in a manner that complies with all applicable national and local safety regulations.

The tube crane is supplied with a 3-conductor, #18AWG power cord, terminated on the tube crane at TB1. Externally, connect the power cord to an external source of 230 Vac power according to Table 4-1.

Table 4-1. Tube Crane Power Cord Connections

Power Cord Conductor	Tube Crane Connection	External Power Source Connection
Brown	TB1-1	Line (230 Vac "hot" switched system power, switched under control of the emergency stop switch)
Blue	TB1-2	Neutral (grounded conductor)
Green/Yellow	TB1-3	230 Vac Equipment ground

Connecting the Ground Cable to External Ground

The tube crane is supplied with a separate green and yellow #12AWG ground cable, terminated on the tube crane at the ground stud inside the rear hose mount housing on the ceiling carriage. The cable is equipped with a #10 ring lug, which must be used to connect the ground cable externally to 230 Vac equipment ground or to the room central ground bus bar, if present.

Longitudinal Rail Horizontal Switch Bank Cam Installation

This procedure details the installation of the horizontal switch bank cams on the rear longitudinal rail. In Wall Mode A & C configuration, the horizontal switch bank and cams provide the 40"/44" and 72" SID indications. When configured for Wall Mode B position, only the lateral center (bucky center) position indication in achieved.

To install the horizontal switch bank cams:

Step	Action
1	Position the EPEX-Omniflex overhead tube crane in the desired location; either SID or lateral center.
2	Mark the spot where the appropriate switch roller on the switch bank, aligns with the longitudinal rail.
3	Temporarily install the appropriate length cam over this mark using 2-sided tape.
4	Verify placement of the cam, by positioning the transverse bridge so that the roller on the appropriate switch is directly over the cam. The contacted switch roller will be pushed in. Adjust the position of the cam as required and remark location. Remove cam.
5	Use a center punch and ball peen hammer to mark the center of the hole to be drilled. Drill a 5/16" deep hole using a No. 29 drill bit.

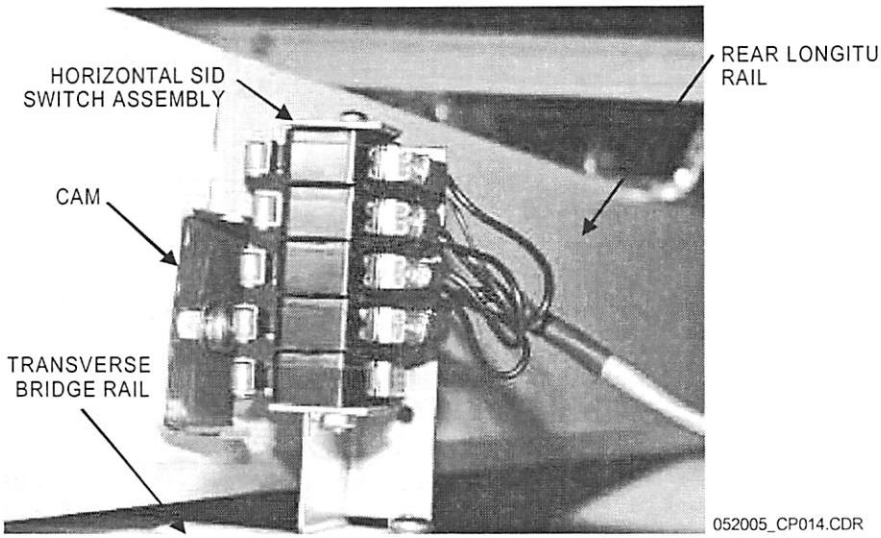
CAUTION

Do not drill through the steel lock strip on the longitudinal rail.

Step	Action
6	Secure the cam to the longitudinal rail using one of the supplied self-threading screws.
7	Verify correct placement of cam. The cam is slotted to allow slight adjustments to the cam position (Figure 4-11 on page 4-27).
8	Repeat Steps 1 through 8 for each SID location.

Step	Action
9	Verify correct alignment of the each cam with the horizontal SID switch assembly. The position of the horizontal SID switch assembly can be adjusted as required to ensure proper switch engagement.

Figure 4-11.
Horizontal Switch Bank Assembly



(HORIZONTAL SWITCH BANK COVER REMOVED FOR CLARITY)

Lateral Index Bracket(s) Installation

In **Wall Mode A** configuration (Refer to Chapter 6 "Wall Mode Configuration A" for more information.), two lateral index brackets are used. The first bracket is a left-hand index bracket and is installed in the table lateral center position. The second bracket is a right-hand index bracket and is installed in the wall mode lateral center position. Refer to Figure 4-12 on page 4-28 for typical installation.

In **Wall Mode B** configuration (Refer to Chapter 6 "Wall Mode Configuration B" for more information.), three types of lateral index brackets are used. The first bracket is a left-hand index bracket and is installed in the table lateral center position. The second bracket is a symmetrical index bracket and is installed in the 40/44" SID position. The third bracket is a right-hand index bracket and is installed in the 72" SID position. Refer to Figure 4-13 on page 4-28 for typical installation.

In **Wall Mode C** configuration (Refer to Chapter 6 "Wall Mode Configuration C" for more information.), one lateral index bracket is used. The bracket is a left-hand index bracket and is installed in the table lateral center position. This position is also used as the wall mode lateral center position. Refer to Figure 4-14 on page 4-29 for typical installation.

Figure 4-12.
Wall Mode A Configuration Setup

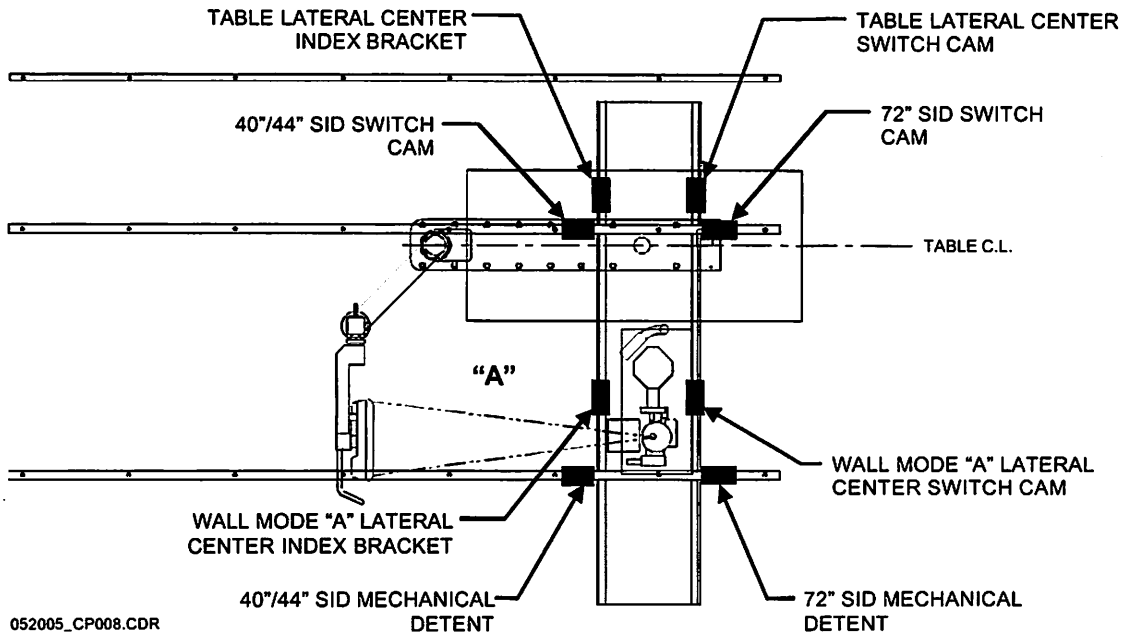


Figure 4-13.
Wall Mode B Configuration Setup

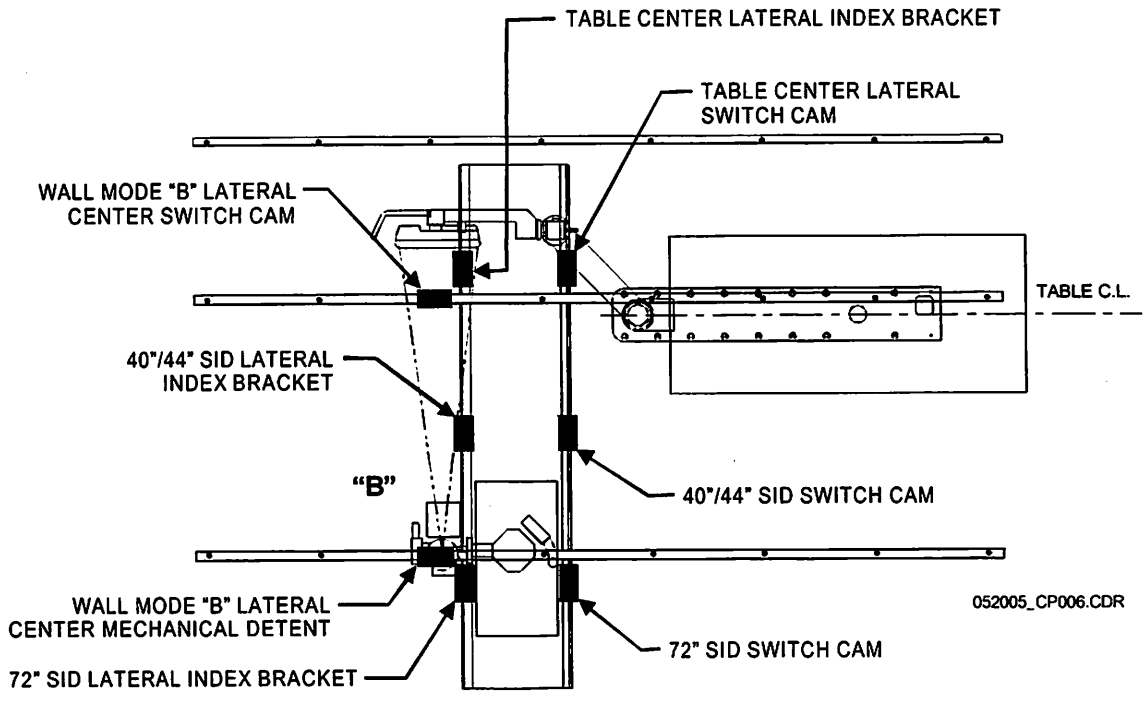
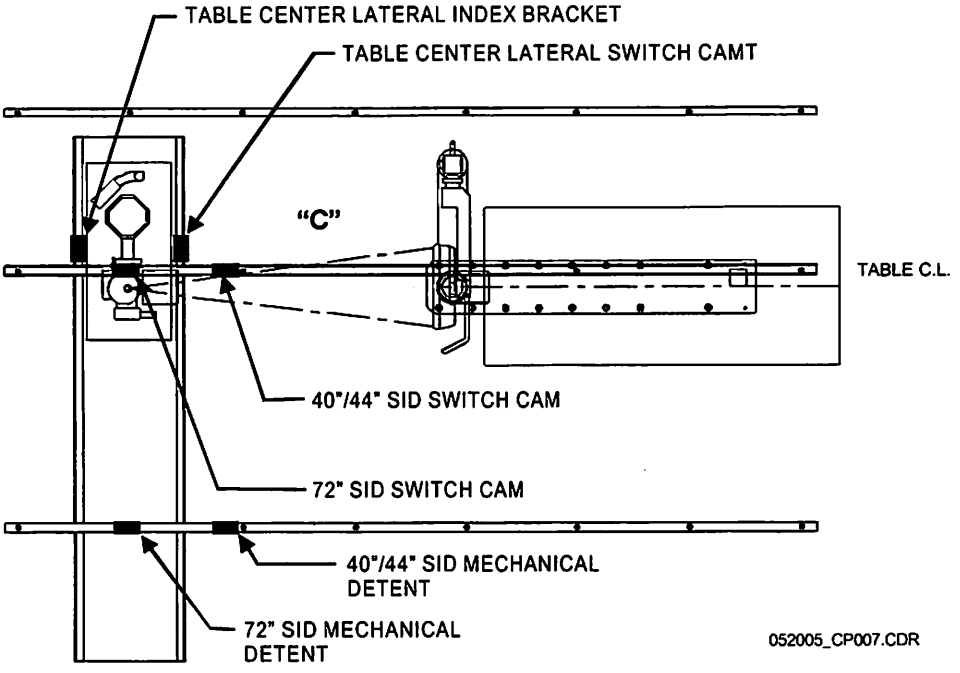


Figure 4-14.
Wall Mode C Configuration Setup

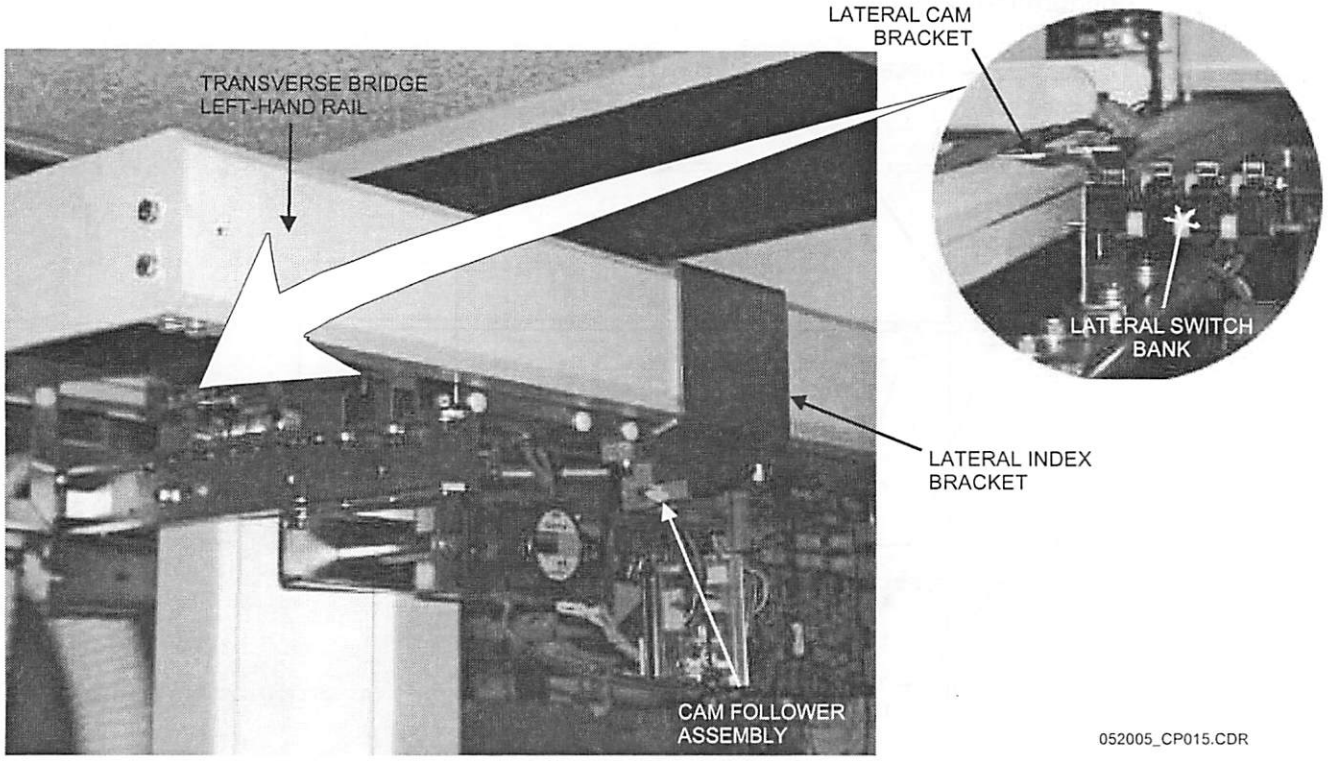


Note: The use of right-hand, left-hand, and symmetrical index brackets, refers to the asymmetrical lobe on the bracket. A left-hand index bracket has the asymmetrical lobe facing away from the operator and on a right-hand index bracket, the asymmetrical lobe is facing towards the operator. A symmetrical index bracket has lobes of the same height.

To install the lateral index bracket(s):

Step	Action
1	Position the EPEX-Omniflex overhead tube crane to the desire location; either SID, table and/or wall lateral center.
2	Loosen and position the lateral detent bracket over the appropriate switch on the lateral switch bank. The switch should be actuated at this time. Refer to Figure 4-15 on page 4-30.
3	Tighten the lateral detent bracket in place.
4	Loosely install the lateral index bracket on transverse bridge left-hand rail and position the index bracket until the cam follower assembly, on the transverse carriage, falls into the detent on the index bracket.
5	Tighten the lateral index bracket in place.
6	Repeat Steps 1 through 5 to install additional lateral index brackets, if required.
7	Verify correct engagement of the lateral SID switch assembly with each cam. The lateral SID switch assembly can be adjusted vertically as required to ensure proper switch engagement.

Figure 4-15. Transverse Centering Bracket and Table Center Switch Cam Installation



Transverse Bridge Mechanical Detents

Wall Mode "A" or "C" Position 40/44" and 72" SID Mechanical Detents

The exact location of the SID mechanical detents on the longitudinal rail differ according to the Wall Mode configuration being utilized; either A or C configuration. Refer to Figure 4-12 on page 4-28 or Figure 4-14 on page 4-29 respectfully, for typical installation location.

Note: Do not install the 40/ 44" and 72" SID mechanical detents until the EPEX-Omniflex system has been successfully calibrated. A properly calibrated system is crucial to the installation of the mechanical detent(s). If the system calibration has not been perform, proceed to Chapter 5 "Adjustments and Calibrations".

Apply Loctite™ 242 (blue) to all fastener threads.

To install the transverse bridge mechanical detents:

Step	Action
1	Remove electrical power from the EPEX-Omniflex overhead tube crane.
2	Install the detent plunger assembly in the left-hand side of the transverse bridge rail (opposite side from SID cam plates) approximately 1.5 inches from the front longitudinal rail and secure in place using two hex socket bolts, washers, lock-washers and track nuts. Refer to Figure 4-16 on page 4-31.

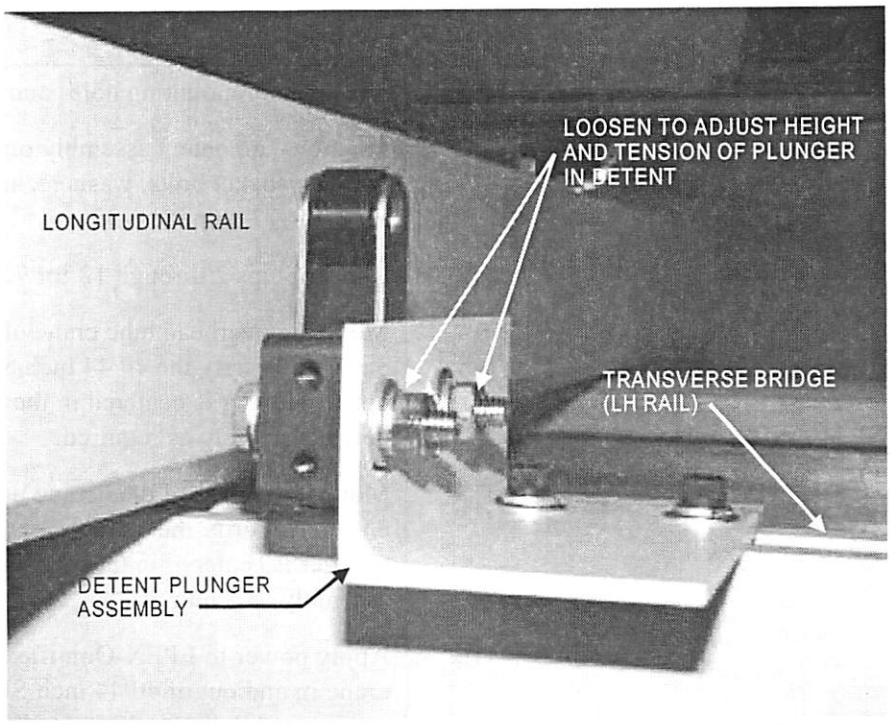


Figure 4-16. Detent Plunger Assembly

Step	Action
3	With the bucky in wall mode "A" or "C", align the EPEX-Omniflex tube crane with the bucky so that the 40/44 inch SID switch is activated and centered on the SID detent bracket.
4	Verify the tube crane to bucky alignment and physically measure the SID before proceeding.
5	Using a pencil, mark the center of the detent plunger on the longitudinal rail. Move the tube crane out of the way to gain access to the pencil mark on the longitudinal rail.
6	Photo copy and cut out the drill pattern template located in Figure 4-18 on page 4-35. Align the template with the top of the longitudinal rail ensuring the center line of the template is aligned with the pencil mark on the longitudinal rail and secure in place using tape.
7	Using a center punch and hammer, mark the center of the two mounting holes to be drilled. Remove drill pattern template.
8	Using the supplied 1/16 inch drill bit, drill a pilot hole at each of the two marked locations.
9	Enlarge the two pilot holes using the supplied No. 3 (.213 diameter) drill bit.
10	Tap each of the two mounting holes using the supplied 1/4-28 inch tap.

Step	Action
11	Deburr both mounting holes and clean area of all metal shavings.
12	Position cam detent assembly on longitudinal rail and secure using two hex socket bolts, washers, and lock-washers. Refer to Figure 4-17 on page 4-33.
13	Repeat Steps 2 through 12 for 72 inch SID.
14	Move the overhead tube crane until the 40/44 inch SID detent is engaged. Verify the 40/44 inch SID switch is activated when the detent plunger is centered in the mechanical detent. Adjust cam detent assembly as required.
15	Move the overhead tube crane until the 72 inch SID detent is engaged. Verify the 72 inch SID switch is activated when the detent plunger is centered in the mechanical detent. Adjust cam detent assembly as required.
16	Apply power to EPEX-Omniflex overhead tube crane. Move tube crane in and out of 40/44 inch SID and verify the 40/44 inch SID mechanical detent and longitudinal lock are functioning correctly.
17	With the tube crane in the 40/44 inch SID position, press the Auto Mode soft-key on the control panel and verify "HORIZ SID?" is not displayed. If it is, slight adjustment of the cam detent assembly may be required.
18	Repeat Steps 16 and 17 for 72 inch SID.

Wall Mode "B" Position Lateral Center Mechanical Detent

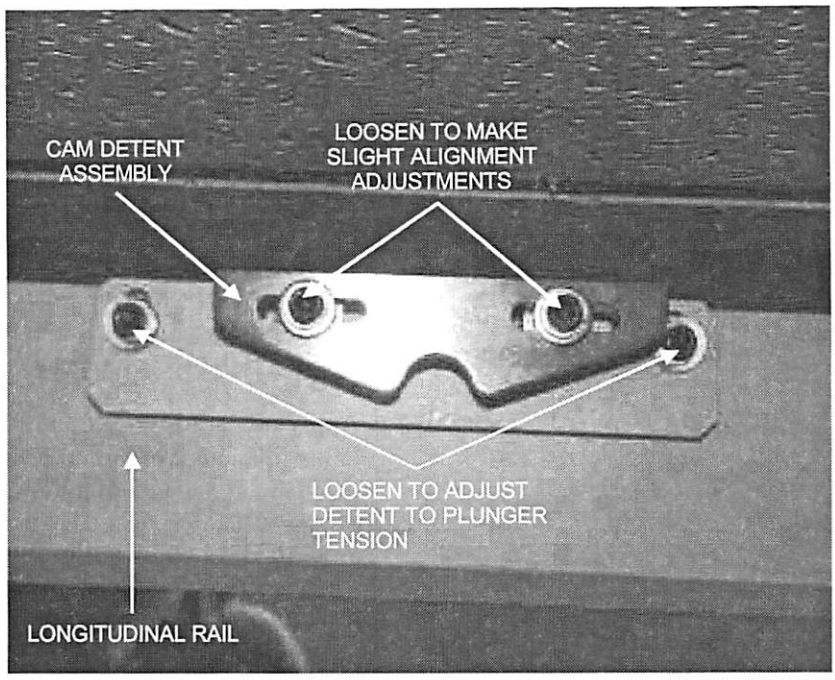
Note: Do not install the lateral center mechanical detent until the EPEX-Omniflex system has been successfully calibrated. A properly calibrated system is crucial to the installation of the mechanical detent(s). If the system calibration has not been perform, proceed to Chapter 5 "Adjustments and Calibrations".

Apply Loctite™ 242 (blue) to all fastener threads.

To install the transverse bridge mechanical detents:

Step	Action
1	Remove electrical power from the EPEX-Omniflex overhead tube crane.
2	Install the detent plunger assembly in the left-hand side of the transverse bridge rail (opposite side from SID cam plates) approximately 1.5 inches from the longitudinal rail and secure in place using two hex socket bolts, washers, lock-washers and track nuts. Refer to Figure 4-16 on page 4-31.

Figure 4-17.
Cam Detent Assembly



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Step	Action
3	With the bucky in wall mode "B", align the EPEX-Omniflex tube crane with the bucky so that the lateral center switch is activated and centered on the lateral detent bracket. Refer to Figure 4-13 on page 4-28.
4	Verify the tube crane to bucky alignment before proceeding.
5	Using a pencil, mark the center of the detent plunger on the longitudinal rail. Move the tube crane out of the way to gain access to the pencil mark on the longitudinal rail.
6	Photo copy and cut out the drill pattern template located in Figure 4-18 on page 4-35. Align the template with the top of the longitudinal rail ensuring the center line of the template is aligned with the pencil mark on the longitudinal rail and secure in place using tape.
7	Using a center punch and hammer, mark the center of the two mounting holes to be drilled. Remove drill pattern template.
8	Using the supplied 1/16 inch drill bit, drill a pilot hole at each of the two marked locations.
9	Enlarge the two pilot holes using the supplied No. 3 (.213 diameter) drill bit.
10	Tap each of the two mounting holes using the supplied 1/4-28 inch tap.

Step	Action
11	Deburr both mounting holes and clean area of all metal shavings.
12	Position cam detent assembly on longitudinal rail and secure using two hex socket bolts, washers, and lock-washers. Refer to Figure 4-17 on page 4-33.
13	Move the overhead tube crane until the lateral center detent is engaged. Verify the lateral center switch is activated when the detent plunger is centered in the lateral center detent. Adjust cam detent assembly as required.
14	Apply power to EPEX-Omniflex overhead tube crane. Move tube crane in and out of lateral center and verify the lateral center mechanical detent and longitudinal lock are functioning correctly.
15	With the tube crane in the lateral center position, press the Auto Mode soft-key on the control panel and verify "BUCKY? LAT CNTR?" is not displayed. If it is, slight adjustment of the cam detent assembly may be required.

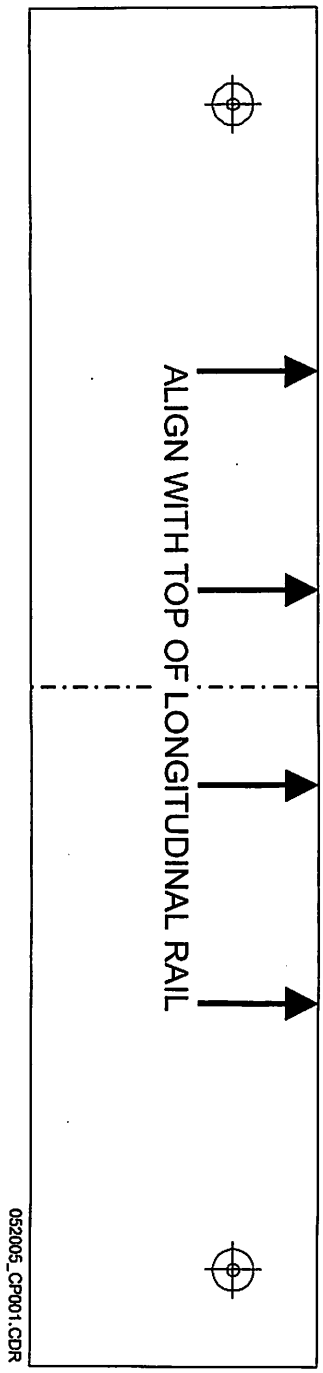
Calibration

To complete the installation of the EPEX-Omniflex Overhead Tube Crane, perform all adjustments and calibrations procedures outlined in Chapter 5 "Adjustments and Calibrations".

Installing the Covers

After all adjustments and calibrations are complete, install the tube crane covers. Refer to Chapter 8 "Tube Crane Covers" for detailed instructions.

Figure 4-18. Drill Pattern Template



Chapter 5
Adjustments and Calibrations

This chapter provides the procedures required to adjust and calibrate the EPEX-Omniflex Overhead Tube Crane. Adjustments may be required to fine tune the system after the initial installation or if components have been replaced.

Contents

Mechanical Adjustments

SID Jumper and Switch Adjustment

To configure the tube crane for either 40-Inch or 44-Inch SID:

Step	Action
1	Remove electrical power from the EPEX-Omniflex overhead tube crane and collimator.
2	Disconnect the electrical connectors (3 ea.) on the rear of the control console.
3	Disconnect the ground wire from the rear of the control console.
4	Rotate the collimator 90° to gain access to the two control console mounting screws.
5	Remove the two screws securing the console to the tube mount assembly and remove the control console.
6	Remove the four screws securing the rear plate and carefully separate the rear plate assembly from the control console.
7	Locate the Tube Stand Controller Display PC Board (P/N 5284-135-01) on the inside of the rear plate assembly. Refer to Figure 5-1 on page 5-3.
8	Determine which SID the institution intends on using, either the 40-Inch SID or 44-Inch SID. On the Tube Stand Controller Display PC Board set SW2-2 dip switch accordingly. Refer to Table 5-1. To set Auto Mode SID, refer to the Table Mode Tracking Calibration procedure in this chapter.
9	Ensure that SW2-1 (on the same board) is in the ON position.
10	If the intention is to utilize Wall Mode B Configuration, install a jumper between pins 1 and 2 of connector J2 on the Universal Tube Stand Lock Control PC Board. Refer to Figure 5-2 on page 5-3. Refer to Chapter 6 "Wall Mode Configurations" for more information.

Note: Visually verify that the SW2-4 dip switch is in the ON position. This dip switch toggles between displaying (ON) and hiding (OFF) the SID display.

Table 5-1. Manual Drive Auto Stop SID DIP Switch

Manual Drive Auto Stop SID	SW2-2 Dip Switch Setting
40-Inch SID	Off
44-Inch SID	On

Step	Action
11	Reverse steps 1 through 6 in order to reassemble the control console.

Figure 5-1.
Tube Stand Controller Display PC Board (P/N 5284-135-01)

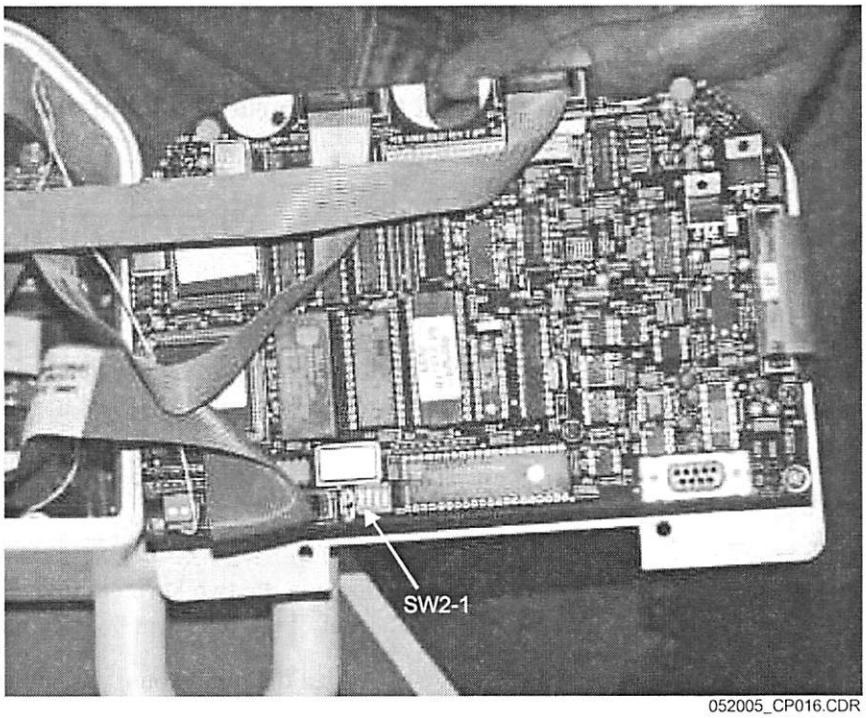
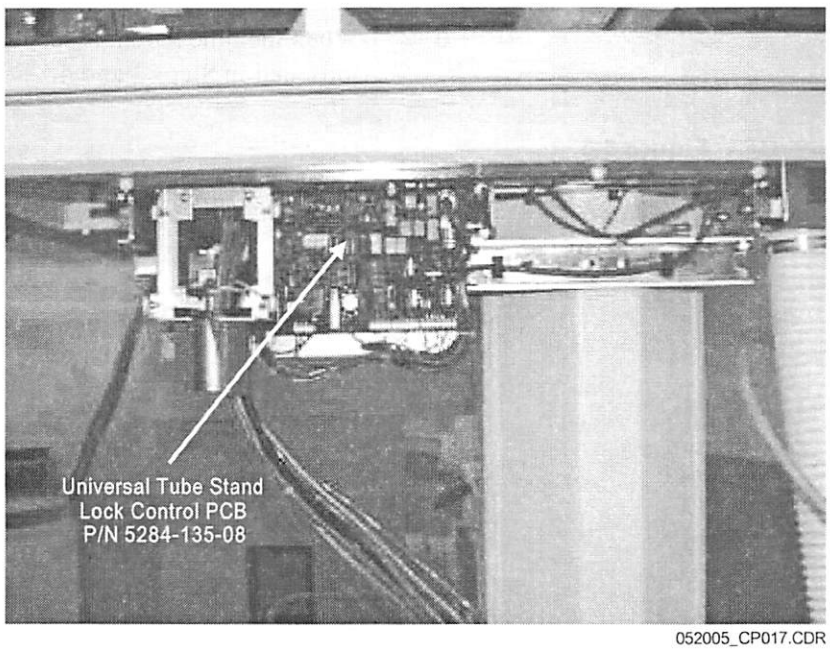


Figure 5-2.
Right Side of Transverse Carriage



Tube Arm Horizontal (0°) Leveling

This procedure levels the tube arm from front to back. Proper installation requires the longitudinal rails and transverse bridge to be level, which means that the bottom surface of the collimator will be close to level also. This procedure must be performed prior to adjusting the collimator light field/X-ray field.

To level the tube arm in the horizontal axis (Figure 5-3):

Step	Action
1	Place a calibrated digital level on the lower surface of the tube mount assembly and verify the tube mount is level. If it is level, no adjustment is necessary. Otherwise, proceed to Step 2.
2	Loosen the two button-head capscrews on the rear of the tube arm rotator assembly one half turn. These screws secure the tube arm bearing block.
3	Loosen the two socket-head capscrews on the front bottom of the tube arm bearing block.
4	Tighten the two horizontal leveling adjustment set screws on the front of the tube arm bearing block.
5	Adjust the tube mount assembly to be level (front to back) by tightening or loosening the two adjustment set screws as necessary. The two capscrews may have to be loosened an additional amount.
6	When the tube mount assembly is level, tighten the four cap screws loosened in Steps 3 and 4.

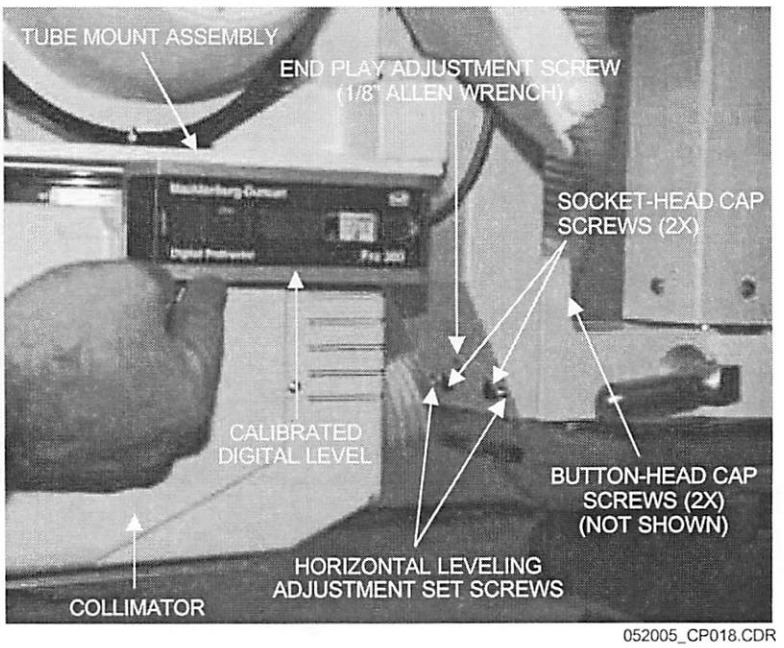


Figure 5-3. Tube Arm Horizontal Leveling

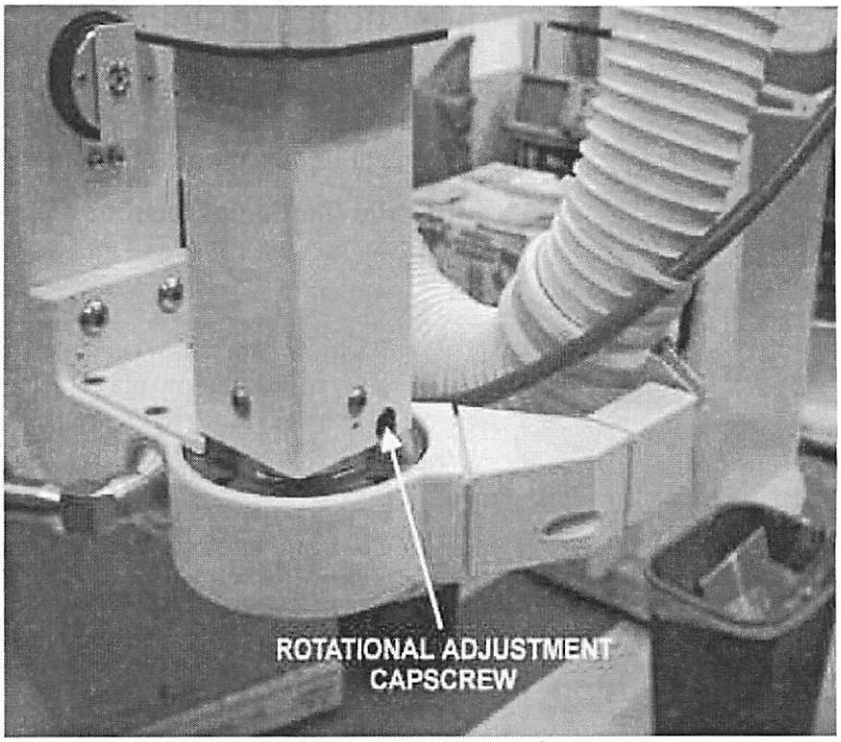
Tube Arm Rotational Adjustment (Vertical Axis)

Perform this procedure to align the collimator light field with the bucky pattern along the vertical axis. This procedure must be performed prior to the adjustment of the collimator light field/X-ray field.

To adjust the rotation of the tube arm in the vertical axis:

Step	Action
1	Verify that there is no end play in the tube mount. If there is end play, tighten the end play adjustment set screw until there is no end play noted. Refer to Figure 5-3 on page 5-4.
2	Configure the EPEX-Omniflex and Bucky for wall mode configuration (A, B, or C). Refer to Chapter 6 "Wall Mode Configurations" for more information.
3	Center the tube crane laterally by pressing the Transverse Lock soft-key and manually reposition the tube crane until Wall mode lateral center is achieved.
4	Move the tube crane longitudinally to the 72" SID from the bucky. Press [◁] or [▷] and move the tube crane longitudinally until the tube crane engages the 72" SID mechanical detent.
5	Using the angulation soft keys, angulate the X-ray tube until the ANGLE display indicates 90°.
6	Press **[LAMP]** on the collimator and open the collimator shutters approximately halfway to display an image on the bucky receptor.
7	Using a pencil, mark the edges of the light field for the lateral shutters.
8	Reposition the tube crane until the 40/44" SID mechanical detent is engaged.
9	Press **[LAMP]** on the collimator and fine-tune the collimator shutters until the light field aligns with the pencil marks made in Step 7. If the lateral edges of the light field coincides with the pencil marks on the bucky, no adjustment is required; otherwise, proceed to Step 10.
10	Loosen the rotational adjustment capscrew and slightly rotate the tube assembly in same direction as the error. Tighten the rotation adjustment capscrew. Refer to Figure 5-4 on page 5-6.
11	Repeat Steps 4 through 10 until the light field aligns with the pencil marks at both the 72" and 40/44" SIDs.

Figure 5-4.
Tube Arm Rotational Adjustment



Angulation Detent Lock Adjustment (Horizontal Axis)

To align the light field with bucky along the horizontal axis:

Step	Action
1	Start by ensuring the x-ray tube mount is level. To do this, perform the following:
a.	Rotate collimator 90° and place a calibrated digital level on the lower surface of the tube mount assembly behind the collimator and verify the tube mount is level. Refer to Figure 5-5 on page 5-7. If it is level, proceed to Step 2. Otherwise, continue.
b.	Loosen the two mounting cap screws enough to allow the angulation dent lock assembly to float freely. Refer to Figure 5-6 on page 5-7.
c.	Using a blunt object (rubber mallet), make slight adjustments to the tube mount assembly until the digital level reads 0°.
d.	Align angulation dent lock assembly with the 0° dent and tighten the two mounting cap screws.
e.	Repeat Step a. until the tube mount is level.
2	Center the tube crane laterally by pressing the Transverse Lock soft-key and manually reposition the tube crane until Table mode lateral center is achieved.

Figure 5-5.
Tube Mount assembly leveling

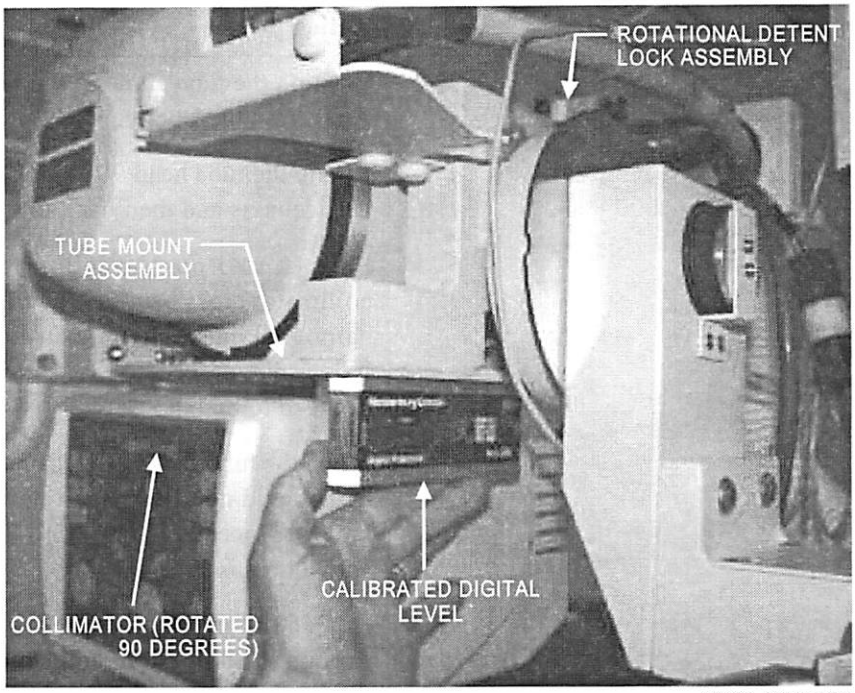
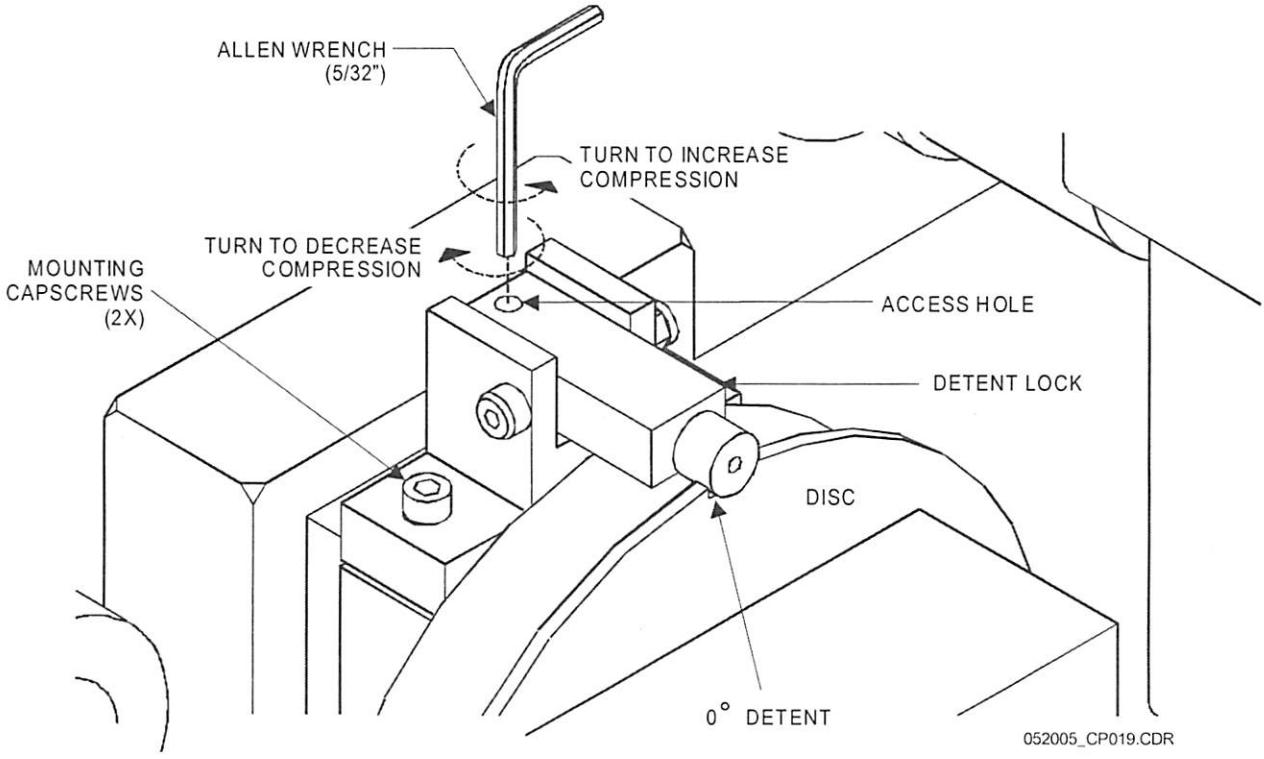


Figure 5-6. Angulation Detent Lock Adjustment



Step	Action
3	Position the tube crane to the farthest preset position (40 or 44 in. SID) from the Bucky.
4	Rotate the tube head 90° clockwise and counterclockwise about the vertical axis and then back to 0°.
5	Press [**LAMP**] on the collimator and note the position of the collimator cross hairs relative to the center of the table. The cross hair of the image should coincide with the center line of the table. If it does not, proceed to Step 7 and then return to this step; if it does, proceed to Step 6.
6	Move the tube crane toward and away from the table. The light cross hair should not move up or down throughout the movement. If it moves, proceed to Step 7 and then return to step5. If it does not, no adjustment is necessary.
7	Loosen the angulation lock assembly mounting capscrews (2X) enough to allow slight adjustment of the image to the target. When the centers of the image and target coincide, tighten the capscrews. *Note: If the tube rotation is too difficult, the compression of the detent lock can be adjusted by turning the detent lock set screw. To adjust the detent lock set screw, insert a Allen wrench through the access hole as shown in Figure 5-6 on page 5-7.*

Vertical Drive Chain Tensioning

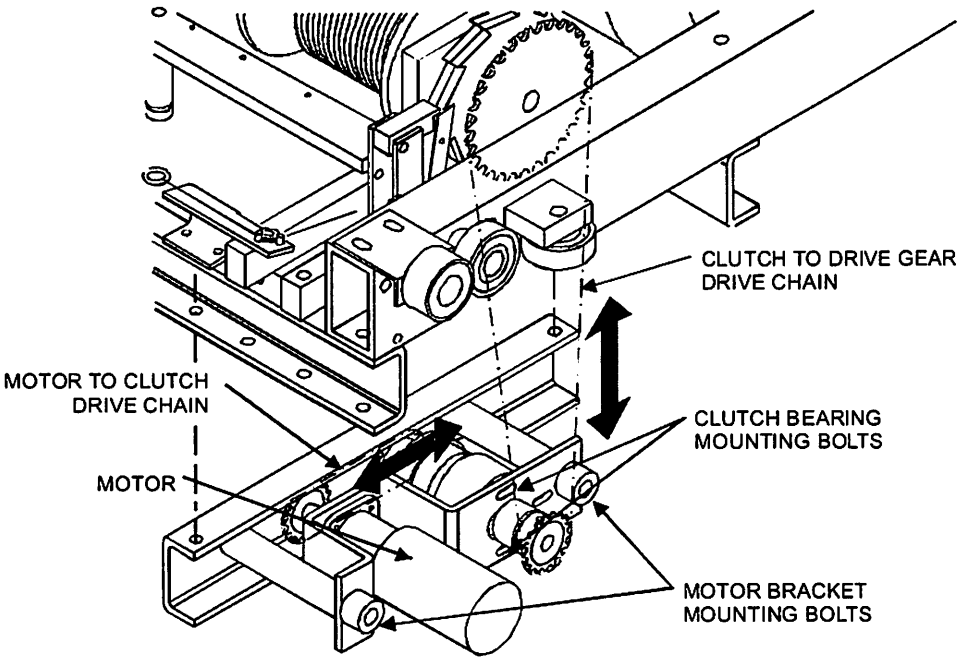
There are two chains used to drive the telescoping column up and down; one between the drive motor and clutch and the other between the clutch and drive gear. Refer to Figure 5-7 on page 5-9.

Motor to Clutch Drive Chain

To adjust the motor to clutch drive chain tension:

Step	Action
1	Verify the chain tension by pushing on the chain at the middle of the span. There should be 1/4 in. (.64 cm) deflection. If the deflection is as stated no adjustment is necessary, otherwise continue.
2	Loosen the screws securing the clutch in position to allow movement.
3	Slide the clutch towards or away from the motor until the chain is straight. Tighten the screw to secure the position.
4	Repeat Steps 1 through 3 until tension is properly set.

Figure 5-7.
Vertical Drive Chain Tensioning



Clutch to Drive Gear Drive Chain

To adjust the clutch to drive gear drive chain tension:

Step	Action
1	Verify the tension by pushing on the chain at the middle of the span. There should be 1/4 in. (.64 cm) deflection. If the deflection is as stated no adjustment is necessary, otherwise continue.
2	Loosen the screws securing the clutch bracket in position to allow movement.
3	Pivot the clutch bracket up or down until the chain is straight. Tighten the screw to secure the position.
4	Repeat Steps 1 through 3 until tension is properly set.

Spring Counterbalance Adjustment

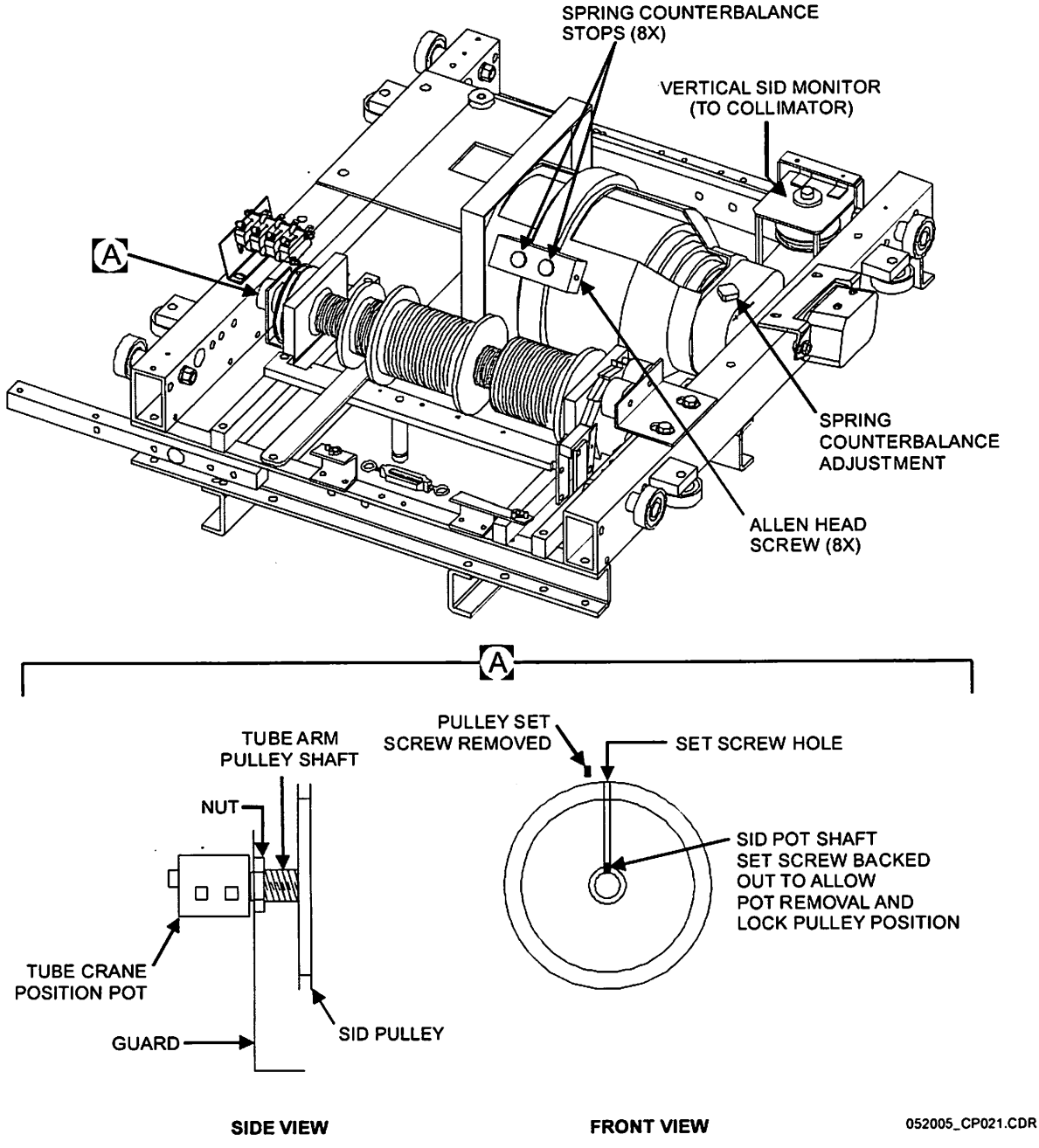
The spring counterbalance provides the force that carries the X-ray tube and collimator up and down. This force may need adjustment due to variations in X-ray tube weight.

Note: All components and cabling for the X-ray tube must be mounted on the telescopic tube arm before performing the spring counterbalance adjustment.

To perform the spring counterbalance force adjustment:

Step	Action
1	Cycle the telescopic arm up and down. Refer to Chapter 6 "Using the Tube Crane Control Panel to Position the X-ray Tube" for more information.
2	Observe the motion and adjust as follows:
a.	If the arm moves at a steady rate over its full range of travel, no adjustment is necessary.
b.	If the arm is fully extended (X-ray tube at its lowest point) and cannot be moved upward, increase the spring tension by rotating the spring counterbalance adjustment bolt head clockwise using a ½" open end wrench. Refer to Figure 5-8 on page 5-11.
c.	If the arm cannot be fully extended (X-ray tube cannot be moved to its lowest point), reduce the spring tension by rotating the spring counterbalance adjustment bolt head counterclockwise.
3	If you adjusted the spring tension, cycle the telescopic arm up and down to verify it moves at a steady rate over its full range of travel.
4	For low-weight X-ray tubes, an additional adjustment may be necessary. As the tension in the spring counterbalance is reduced, pins on the spring counterbalance rotor extend outward. If these internal pins extend against the spring counterbalance stops, the tube arm will lock up, impeding or preventing vertical motion. Perform the following steps as needed to adjust the spring balance stops:
a.	To verify that the spring counterbalance stops need to be adjusted: Increase the spring tension by rotating the spring counterbalance adjustment bolt head clockwise using a ½" open end wrench to retract the internal pins away from the spring counterbalance stops. Refer to Figure 5-8 on page 5-11. Cycle the telescopic arm up and down. If the arm moves at a steady rate over its full range of travel, no further adjustment is necessary. If not, perform the following steps to adjust the spring counterbalance stops.
b.	Remove the Allen head screws (8X) securing the spring counterbalance stops (8X) and remove the stops.
c.	Install 1 spacer ring (4132-134-06) under each of the stops and reinstall the stops.
d.	Reduce the tension in the spring counterbalance by rotating the adjustment bolt head counterclockwise.
e.	Cycle the telescopic arm up and down.
f.	If the arm continues to lock up, repeat Steps a. through e., adding one additional spacer ring under each stop.

Figure 5-8. SID Sensing System



Vertical Drive Force Adjustment

Adjusting the clutch current level on the Clutch Control PCB (P/N 140-0125) controls the maximum force that can be exerted by the motorized telescoping column of the tube crane. The Clutch Control PCB is located on the opposite side of the panel to which the Servo Control PCB is mounted. The vertical drive force adjustment should be performed at installation, periodically (refer to the preventive maintenance schedule in this manual) and following the replacement of the vertical drive clutch or the Clutch Control PCB.

Two methods of adjusting vertical drive force are described here. The preferred method of adjustment requires the use of a force gauge. If a force gauge is not available and it is necessary to adjust the vertical drive force, perform the procedure "Setting Vertical Drive Force Without a Force Gauge" which follows the force gauge method below.

Vertical Drive Force Adjustment (Force Gauge Method)

Adjustment of the vertical drive force requires the use of a force gauge capable of measuring up to 25 lbs, minimum. The gauge may be a spring scale or digital force meter and can be either a pull or push type.

Step	Action
1	Determine the optimum location for applying the force gauge in the area of the x-ray tube mount or operator console. The gauge must be applied such that it will measure the force exerted by the tube crane as it is driven downward. Caution: If using a push type gauge, do not push on the clear panel on the face of the collimator.
2	Set the tube crane vertical height to approximately 12 inches above the tabletop, with the table at the full up position.
3	While holding the force gauge such that it will record the downward force exerted by the tube crane, press the Down pushbutton on the operator console to activate the motor drive down.
4	When the opposing force of the gauge stops the downward motion, note the force displayed on the gauge, then release the Down pushbutton to de-activate the motor drive.
5	The measured force should be 22 lbs. +6/-2 lbs. If the measured force is not within this range, adjust the clutch current by turning potentiometer AR1 on the Clutch Control PCB (P/N 140-0125). Turning AR1 clockwise will INCREASE the drive force; turning AR1 counter-clockwise will DECREASE the drive force.
6	Repeat Steps 2-5 as required until the drive force is within the desired

Setting Vertical Drive Force Without a Force Gauge

This procedure should be used only when the vertical drive force requires adjustment and the above procedure cannot be used because a force gauge is not available.

Step	Action
1	On the Clutch Control PCB (P/N 140-0125), set the clutch current to minimum by turning potentiometer AR1 counter-clockwise at least 25 turns, or until potentiometer "clicks".
2	Use the Up and Down push buttons on the operator's console to drive the tube crane up and down throughout its entire range of motion.
3	As the tube crane moves up and down, watch for any indication the clutch is slipping abnormally. Abnormal slipping may be indicated by slowness, hesitation or stopping of the motion in the range between the mechanical ends of travel. Note, it is normal for the motion to stop and the clutch to slip at the mechanical end of travel.
4	If no abnormal clutch slipping is observed in the previous step, no further adjustment is required. If abnormal slipping was observed, increase the clutch current setting as described below.
5	Use a voltmeter to measure the voltage across diode D3 on the Clutch Control PCB (P/N 140-0125). Increase the voltage by approximately one volt by turning potentiometer AR1 clockwise.
6	Repeat Steps 2-6 as required until no abnormal slippage of the clutch is observed during motorized vertical motion.

SID Display and Tracking Settings

The EPEX-Omniflex control system monitors the vertical positions of the x-ray tube and the image receptor in order to:

- Perform servo tracking in Auto Mode
- Display the differential source-to-image (SID) on the control panel display

For these purposes, information on the x-ray tube position is provided to the electronics by a rotary potentiometer, mounted in the tube crane and turned by the cable windlass. A linear transducer, mounted at the bottom of the bucky tower, provides information on the image receptor position. This transducer also provides information on the image receptor position to the collimator. So that the collimator can calculate differential SID, it also receives information on the x-ray tube position from a dedicated vertical SID monitor, also mounted in the tube crane. Refer to Figure 5-8 on page 5-11 for location of SID monitor.

The tube crane position potentiometer must be set-up initially to assure that the output will change linearly over the entire range of vertical motion. The image receptor transducer and the SID monitor normally require no adjustment.

Tube Crane Position Potentiometer Setup

This procedure sets the initial position of the tube crane position potentiometer. This would normally only be performed at time of new installation or when the potentiometer has been replaced.

Note: If the tube crane position potentiometer is re-positioned as described in this procedure, it will be necessary to perform "Auto Chest Calibration" on page 5-20, "Table Mode Tracking Calibration" on page 5-26and "SID Calibration" on page 5-18 procedures.

To set the initial potentiometer position:

Step	Action
1	Move the tube arm to its highest position.
2	Remove the set screw securing the large pulley to the tube arm shaft.
3	Loosen the set screw which secures the potentiometer in the tube arm shaft.
4	Rotate the potentiometer shaft fully clockwise as looking down the shaft toward the potentiometer.
5	Back-off the potentiometer approximately 1-1/2 turns.
6	Tighten the set screw to secure the potentiometer shaft in the tube arm shaft.
7	Secure the large pulley to the tube arm shaft using the set screw previously removed.

Differential SID Display Scaling and Offset Adjustment

To calibrate the differential readings for vertical positions of the x-ray tube and bucky:

Step	Action
1	Move the x-ray tube to the highest level, just before reaching the upper limit of travel.
2	Slide the bucky to its lowest position.
3	Connect the DVM (+) lead to Interface PCB connector J8 pin 2 and the (-) lead to J8 pin 1 and note the voltage.
4	Connect the DVM (-) lead to test point TP1 (GNDN) and the (+) lead to test point TP7. Adjust potentiometer R43 to attain a voltage equal to that noted in the previous step multiplied by two.
5	Leaving the DVM leads on the same test points, move the X-ray tube up or down until the DVM reads 0±0.01 Vdc, and then proceed to the next step. If the ceiling height is less than 90 inches, it might not be possible to attain a reading of 0 ±0.01 Vdc. If you cannot attain this voltage, perform the following SID potentiometer adjustment:
a.	Manually position the x-ray tube at the approximate middle of its vertical travel.
b.	Loosen the nut that secures the SID sensing potentiometer against its mounting bracket. Refer to Figure 5-8 on page 5-11.
c.	Disconnect connector P16 of the SID sensing potentiometer cable.
d.	Rotate the potentiometer counterclockwise.
e.	Reconnect P16 and ensure the voltage is approximately 0.0 Vdc.
f.	Tighten the nut to secure the SID sensing potentiometer against its mounting bracket.
g.	Move the x-ray tube up or down until the DVM reads 0 ±0.01 Vdc.
6	Move the DVM (+) lead to test point TP3 and adjust potentiometer R36 to set the voltage to 0 ±0.01 Vdc.
7	Leaving the DVM leads connected to the same test points, slide the Bucky up 10 inches from its position and note the voltage. ***Note:*** *If unable to move the bucky up 10 inches, it may be moved down 10 inches.*

Step	Action
8	Slide the bucky back to its previous position. Move the X-ray tube up 10 inches and adjust potentiometer R43 to attain the voltage noted in the previous step, regardless of polarity.
9	Move the X-ray tube to the upper position, just before reaching the upper limit of travel.
10	Slide the Bucky to its lowest position.
11	Move the DVM (+) lead to test point TP3. If this voltage is higher than 4.8 Vdc, adjust potentiometer R36.
12	Remove DVM.

Tube Crane Software Calibration

Entering Setup/Calibration Mode

Note: In order to enter Set/ Calibration mode, the following procedure must be performed within 15 seconds after system power-up is complete and the screen returns to normal operation.

To enter setup/calibration mode:

Step	Action
1	Press and hold both the angle ▲ (up) and ▼ (down) buttons on the tube crane control panel. Refer to Figure 5-9.
2	Press and release the left-hand ▲ (up) button 3 times. The SETUP screen should be displayed.

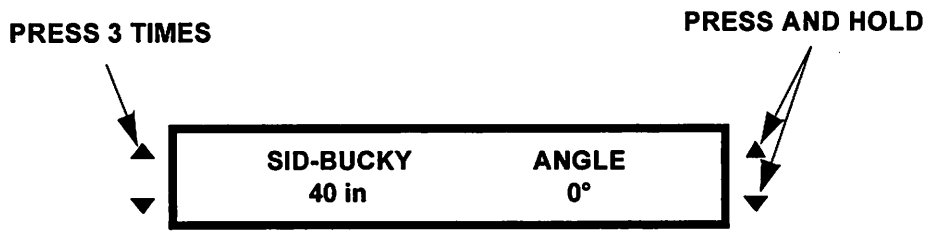


Figure 5-9. Entering Setup/ Calibration Mode

Setup

To perform system setup:

Step	Action
1	The left ▼ button selects the system setup function and the following screen is displayed. The right ▼ button advances to the next calibration routine in the sequence (tube angle display calibration).

Step	Action
	
2	The left ▼ button enables the vertical servo option and the next setup screen is displayed. The right ▼ button disables the vertical servo option and the next setup screen is displayed. 
3	The left ▼ button selects SID displayed in inches and the next setup screen is displayed. The right ▼ button selects SID displayed in centimeters and the next screen is displayed.  *Note: If units are changed, SID calibration must be performed. See "SID Calibration" on page 5-18.*
4	The left ▼ button configures the tube crane for operation with a non-tilting table and the next calibration procedure is displayed. The right ▼ button configures the tube crane for operation with a tilting table and the next calibration procedure is displayed. 

Tube Angle Display Calibration

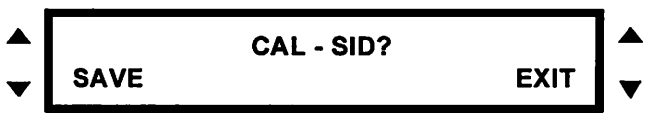
To calibrate the tube angle display:

Step	Action
1	The left ▼ button selects the tube angle calibration routine and the following screen is displayed. The right ▼ button advances to the next calibration routine in the sequence (SID Calibration).

Step	Action
	
2	Rotate the tube to 0° and press SAVE to store the data. Press EXIT to exit the procedure without saving data. 
3	Rotate the tube to 90° toward the Bucky in vertical position, ensure that the Omniflex and Bucky are positioned and oriented properly according to your system's Wall mode configuration. Refer to Chapter 6 "Wall Mode Configurations" for more information. Press SAVE to store the data. Press EXIT to exit the procedure without saving data. 
4	Rotate the tube to 90° away from the wall bucky and press SAVE to store the data. Press EXIT to exit the procedure without saving data. 

SID Calibration

To calibrate the SID:

Step	Action
1	The left ▼ button selects the SID calibration routine. The right ▼ button advances to the next calibration routine in the sequence (SETUP?). 

Step	Action
2	Advance to the following screen. The procedure can be exited by pressing the right ▼ button. Position the Bucky approximately 30 in. above the floor. Position the X-ray tube 38 in. above the surface of the Bucky (this position is equal to 40 in. above the Image Receptor) and press SAVE to store the data. Press EXIT to exit the procedure without saving data. 
3	Position the tube crane 18 in. above the surface of the Bucky (this position is equal to 20 in. above the Image Receptor) and press SAVE to store the data (press and hold the SID "DOWN" button for three seconds). Press EXIT to exit the procedure without saving data. 

Exiting Setup/Calibration Mode

Note: A "Calibration data saved" message is displayed for 3 seconds before the unit is returned to normal operating mode. Calibration data is not written to NVRAM unless calibration mode is exited. (Power may be turned off during calibration mode to discard data without saving.)

To exit the setup/calibration mode:

Step	Action
1	Press and hold both the left-hand ▲ (up) and ▼ (down) buttons on the tube crane control panel for 3 seconds.
2	Move the X-ray tube up and down using the Vertical Up and Vertical Down soft-keys on the tube crane control panel. Check that the calibration is correct by verifying that the SID shown on the control panel display represents the actual distance between the Image Receptor in the Bucky and the X-ray tube's focal spot. Keep in mind that the surface of the Image Receptor is located 2 in. beneath the surface of the Bucky.

Tube Crane Vertical Travel Limits and Speed Adjustments

X-ray Tube Travel Limits Initialization

To set the x-ray tube upper and lower travel limits:

Step	Action
1	Locate the Omniflex Servo Control PC Board. Refer to Figure 5-10 on page 5-21.
2	Connect the DVM (-) lead to test point TP7 (GND2) and the (+) lead to test point TP2 (LIMIT UP).
3	Adjust potentiometer R45 to set the voltage to -4.5±0.5 Vdc.
4	Move the (+) lead to test point TP1 (LIMIT DOWN) and adjust potentiometer R44 to set the voltage to +4.5±0.5 Vdc.

Manual Mode Vertical Speed Adjustment

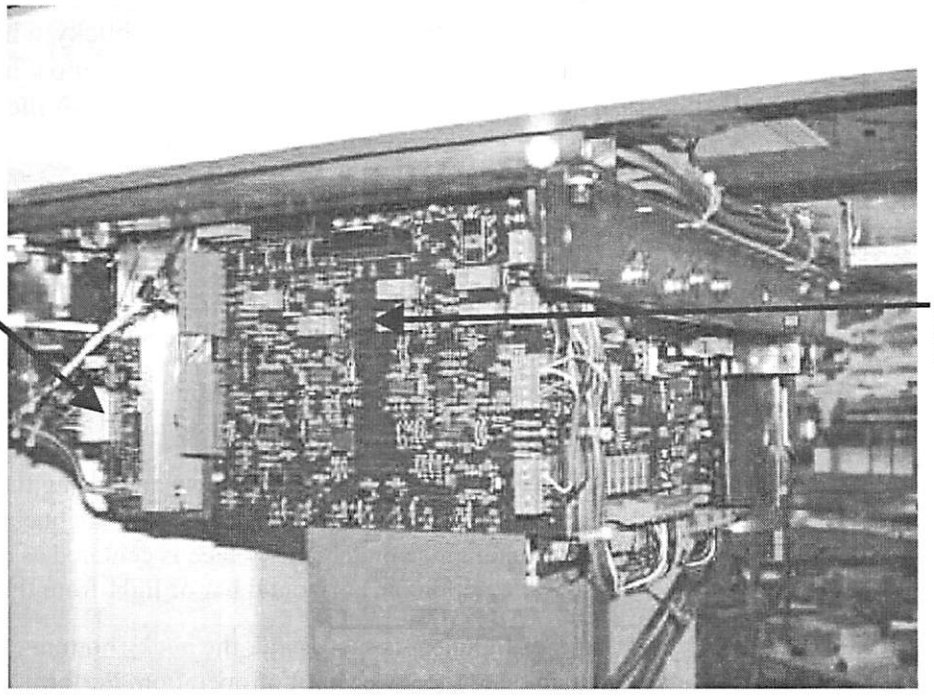
To set the manual mode vertical speed:

Step	Action
1	Locate the vertical drive motor amplifier. Refer to Figure 5-10 on page 5-21.
2	Drive the x-ray tube up or down by pressing the VERTICAL UP or VERTICAL DOWN soft-key on the control panel. Note the time required for the x-ray tube to travel a measured distance.
3	Adjust potentiometer VR1 on the vertical drive motor amplifier to set the speed to at least 2.7 inches/second.

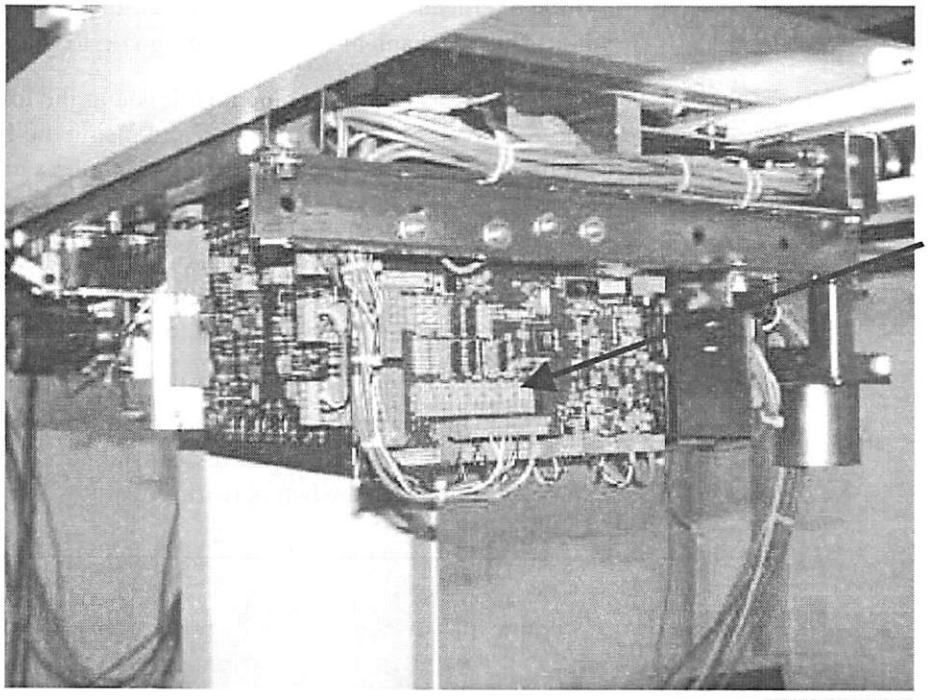
Auto Chest Calibration

This procedure calibrates the Auto Chest Tracking function, in which the x-ray tube automatically tracks the vertical position of the table bucky in Wall mode. For this procedure, the overhead tube crane and the table should be set up for operation in Wall mode. Refer to Chapter 6 "Wall Mode Configurations" for setup instructions.

Figure 5-10. EPEX-Omniflex Transverse Carriage PC Board Locations



(LEFT SIDE OF CARRIAGE)



(FRONT OF CARRIAGE)

052005_CP022.CDR

Determine Lower Limit of Operation

In some installations (dependent on ceiling height) the overhead tube crane may not have sufficient range to align with the bucky when the bucky is at the bottom end-of-travel. Before beginning the "Auto Chest Tracking Calibration" on page 5-23, it is necessary to establish the lowest point at which the system can be operated.

To determine the lower limit of operation:

Step	Action
1	Verify that tracking mode is set to manual (AUTO OFF).
2	Move the bucky down to the bottom end-of-travel (bucky arm should contact the mechanical end-stops).
3	Manually drive the tube crane down and, using the collimator field light, align the x-ray tube vertically with the bucky so that the horizontal guide on the bucky face is centered as accurately as possible within the horizontal bar of light from the collimator.
a.	If the alignment is successful, the bucky bottom end-of-travel establishes the lower limit of operation. Perform "Auto Chest Tracking Calibration" on page 5-23
b.	If the overhead tube crane cannot be aligned with the bucky because it hits the mechanical end-of-travel, go on to Step 4.
4	Keep the overhead tube crane positioned at the lower mechanical end-of-travel. Move the bucky up and, using the field light on the collimator, align the bucky vertically with the x-ray tube.
5	Use masking tape, light pencil marks, etc. to accurately mark the bucky position relative to the bucky column. This must be done in such a way that it will be possible to return to this position with an accuracy of +/- 1/8" during the Auto Chest Position Calibration procedure.
6	The bucky position marked in Step 5 above represents the lower limit of operation for the system, as installed. Leave this indication so that it can be used when performing Auto Chest Position Calibration.

Auto Chest Tracking Calibration

Note: If at anytime during this procedure, the red LED DS2 (ALARM) on the Servo Control PCB illuminates and the flashing message MOTOR appears on the control panel, the motor was overloaded, and the motor speed controller protection circuit disconnected the motor. To reset the protection circuit, perform the following:

a. Disconnect the +24 Vdc power by unplugging connector J8 on the Servo Control PCB and then plugging it back in.

b. With Auto Tracking on, slide the bucky and x-ray down slightly from the upper limit of travel and continue calibration.

To calibrate the auto chest tracking function:

Step	Action
1	On the Servo Control PCB (Figure 5-10 on page 5-21), turn R57 counter-clockwise all the way (at least 20 turns or until potentiometer "clicks"). Turn clockwise five turns.
2	Move the bucky down to the lowest point of operation, as established in the preceding section.
3	Manually drive the tube crane down and, using the collimator field light, align the x-ray tube vertically with the bucky so that the horizontal guide on the bucky face is centered as accurately as possible within the horizontal bar of light from the collimator.
4	Measure the bucky position feedback signal voltage using a Digital Voltmeter (DVM) between TP5 (+) and TP1 (-) on the Interface PCB (Figure 5-10 on page 5-21) and record value (Vdc).
5	Multiply the value of the voltage measured in Step 4 by .75 and record value (Vdc).
6	Connect a DVM to monitor the voltage between U3 pin 7 (+) and TP1 (-) on the Interface PCB. **Adjust R16 on the Interface PCB** until the measured voltage is equal to the voltage calculated in Step 4, +/- 0.01V.
7	Connect a DVM to monitor the overhead tube crane feedback signal voltage between U4 pin 14 (+) and TP7 (-) on the Servo PCB; record value (Vdc).
8	Connect a DVM to monitor the scaled and offset bucky position feedback signal between U2 pin 1 (+) and TP7 (-) on the Servo PCB. Adjust R6 on the Interface PCB until the measured voltage is equal in magnitude to the voltage in Step 7 +/- 0.01Vdc (polarity will be opposite). Disconnect the DVM.
9	Move bucky to the top end-of-travel.
10	On the overhead tube crane control panel, turn on vertical tracking by pressing the AUTO soft key. The tube crane should drive up to align x-ray tube with the bucky.
11	Use the collimator field light to determine the alignment of the x-ray tube to the bucky. Adjust R6 on the Interface PCB to move the tube so that the horizontal guide marks on the bucky surface are centered as accurately as possible within the horizontal bar of light from the collimator.

Step	Action
	Note: In Step 11, if the tube crane reaches its mechanical end-of-travel before the bucky is at the lower limit of travel, move the bucky up slightly until the tube cranes drives up off of its mechanical stop.
12	Move the bucky to the lowest point of operation. The tube crane should move down to align the x-ray tube with the bucky.
13	Use the collimator field light to determine the alignment of the x-ray tube to the bucky. Adjust R16 on the Interface PCB to move the tube so that the horizontal guide marks on the bucky surface are centered as accurately as possible within the horizontal bar of light from the collimator.
14	Repeat Steps 9 through 132 as required until the x-ray tube and bucky automatically align within +/-1/8 inch at the top and bottom of the bucky travel without the need for adjustment of R6 or R16. *Note: R6 is used to adjust alignment only at the top end of travel and R16 is used to adjust alignment only at the bottom end of travel.*

Lower End of Travel Adjustment

To set the lower end of the x-ray tube's vertical travel:

Step	Action
1	Position the bucky at the lower limit of operation as determined above.
2	Turn the Auto Tracking function off by pressing the AUTO MODE soft-key on the tube crane control panel.
3	Manually drive the tube crane down and, using the collimator field light, align the x-ray tube vertically with the bucky so that the horizontal guide on the bucky face is centered as accurately as possible within the horizontal bar of light from the collimator.
4	With the bucky and the tube crane still aligned at the lower limit, turn R44 on the Servo PCB counter-clockwise until the DS5 "Limit Down" LED lights (Figure 5-10 on page 5-21).
5	Turn R44 clock-wise just until DS5 "Limit Down" LED turns off; turn clock-wise an additional ¼ turn.

Upper End of Travel Adjustment

To set the upper limit of the X-ray tube's vertical travel:

Step	Action
1	With the EPEX-Omniflex system in Table mode, turn Auto on by pressing the AUTO MODE soft-key on the overhead tube crane control panel.
2	Turn the Auto tracking function off by pressing the AUTO MODE soft-key on the tube crane control panel.
3	Manually move the x-ray tube vertically to the upper mechanical end-of-travel, then move back down approximately 1 inch.
4	Move the bucky so that the SID is 40" or 44" (dependant upon the configured Table mode SID) from the x-ray tube focal spot. *Note: Surface of the bucky should be 38" from the collimator, as measured with the collimator tape measure.*
5	On the Servo Control PCB, adjust potentiometer R45 clockwise just until "Limit Up" LED DS4 illuminates (if DS4 is already lit, proceed to the next step).
6	Turn R45 counter-clockwise just until the "Limit Up" LED DS4 extinguishes.

Auto Tracking Vertical Speed Adjustment

To adjust the vertical speed of the x-ray tube in Auto mode:

Step	Action
1	With the EPEX-Omniflex system in Wall mode, turn Auto on by pressing the AUTO MODE soft-key on the control panel.
2	Slide the bucky up or down and check the x-ray tube's vertical speed. If the speed (Distance/Time) is less than 2.7 inches/second, adjust the gain on the Servo Control PCB (Figure 5-10 on page 5-21):
a.	Disconnect the motor power (ribbon) cable from connector CN3 on the Vertical Drive Motor Amplifier.
b.	Connect the DVM (-) lead to test point TP15 (GND3) and the (+) lead to test point TP6.
c.	Slide the bucky to its upper or lower limit of travel and check the voltage. Adjust potentiometer R47 on the Servo Control PCB to set the voltage to 4.8±0.1 Vdc.

Step	Action
d.	Reconnect the motor power cable.
e.	Slide the bucky up or down and note the time required for the X-ray tube to travel a measured distance. Verify that the X-ray tube's vertical speed (Distance/Time) is at least 2.7 inches/second.
f.	Disconnect the DVM.

Table Mode Tracking Calibration

In Table mode with Auto Mode on, the x-ray tube will track the bucky's vertical travel, maintaining the selected SID.

To calibrate the x-ray tube's automatic vertical tracking of the bucky in Table mode:

Step	Action
1	Set-up the EPEX-Omniflex system for Table mode. Refer to Chapter 6 "Table Mode" for setup instructions.
2	Position the bucky such that its top surface is 29 inches above the floor.
3	Using the collimator tape measure as a guide, adjust potentiometer R5 on the Interface PCB (Figure 5-10 on page 5-21) to raise or lower the x-ray tube to the configured SID (either 40 in or 44 in). *Note: The Image Receptor is 2 inches below the surface of the Bucky.*

Linear Collimator SID Adjustment

At several points during the calibration procedure, you will be instructed to set the source-to-image distance (SID) to a particular value. In this context, SID is intended to mean the distance from the x-ray tube focal spot to the image receptor surface.

In the EPEX-Omniflex system, the image receptor surface is two inches below the surface of the digital Bucky. These two inches must be compensated for when setting the SID. This means that for a 40" SID the Bucky surface should be 38 inches from the x-ray tube focal spot. This applies whether in Table (vertical SID) or Wall (horizontal SID) modes.

The tape measure that is internal to the collimator may be used for setting the required SID during the calibration procedure. This tape measure is already compensated for the distance from the collimator to the x-ray tube focal spot. Therefore, correct SID will be achieved by using the tape to set the distance between the collimator and Bucky surface to the desired SID, minus 2 inches.

To calibrate the linear collimator:

Step	Action
1	Position the x-ray tube to the highest level, at the tube crane upper end-of-travel.
2	Rotate the bucky to portrait orientation.
3	Using a DVM connect the (-) lead to JP-10 pin-1 and the (+) lead to JP-10 pin-2 on the interface PCB. Adjust potentiometer R45 until the voltage reads +1.800 ±0.005Vdc.
4	Move the (+) lead to JP-10 pin-3 and adjust potentiometer R44 until the voltage reads +2.350 ±0.005Vdc.
5	Position the bucky until the top surface of the bucky is 38 inches from the x-ray tube focal spot (40" SID).
6	Enter Linear IV collimator calibration mode.
a	Press CAL button on collimator front panel. "Service Mode" message should appear.
b	Press ENT/SET button within four seconds to enter Service Mode. "Enter Code _____" is displayed.
c	Enter the security code, by pressing the following buttons in order: LAST SIZE, MAG SIZE, ENT/SET, CAL, ENT/SET.
d.	"CALIBRATE?" should be displayed. If it is not, press the CAL button until it is displayed and press ENT/SET button to enter.
7	The collimator display will show "AUTO-CALIBRATE" for four seconds followed by "MODE ENGLISH?". Select either english or metric mode using the Cross Close or Open buttons. Press ENT/SET to select desired mode.
8	"DO LIMITS CAL?" is displayed. Press the ENT/SET button to set the mechanical limits of the collimator shutters.
9	The display will prompt you to "OPEN SHUTTERS TO MAXIMUM FIELD". Using the shutter buttons, open the shutters to maximum field and press ENT/SET button.

Step	Action
10	The display will prompt you to "CLOSE SHUTTERS TO MINIMUM FIELD". Using the shutter buttons, close the shutters to minimum field and press ENT/SET button.
11	"DO VERTICAL CAL?" is displayed. Press ENT/SET button to start vertical calibration.
12	"Set SID to 40" is displayed. Press the ENT/SET button.
13	Position Test Pattern #1 (70-09021, supplied with collimator) on Bucky and align center lines using the collimator light field.
14	Set collimator field size to 14" X 14" (35 cm X 35 cm) square @40" SID. Adjust the light field and press ENT/SET button.
15	Set collimator field size to 5" X 5" (13 cm X 13 cm) square @40" SID. Adjust the light field and press ENT/SET button.
16	Set collimator field size to 14" X 14" (35 cm X 35 cm) square @72" SID (actual SID is 40"). Adjust the light field and press ENT/SET button.
17	Set collimator field size to 5" X 5" (13 cm X 13 cm) square @72" SID (actual SID is 40"). Adjust the light field and press ENT/SET button.
18	"TABLE IMG RC CAL"is displayed. Press the ENT/SET button.
19	"INSERT CASS L-17" is displayed. Press the ENT/SET button.
20	Rotate the bucky.
21	"INSERT CASS L-14" is displayed. Press the ENT/SET button.
22	"SID CALIBRATION" is displayed. Press the ENT/SET button.
23	"FIXED SID SYS?" is displayed on the collimator.Press Cross Close to display "CONT. SID SYS?" and press the ENT/SET button.
24	"SET SID TO 40" displayed. Raise the x-ray tube to the highest level and position the table bucky 38 inches from the x-ray tube (40 inch SID) to the bucky using the measuring tape. Press the ENT/ SET button.
25	"SET SID TO 72" is displayed. Press the Cross Open button to toggle through the SID selections until "SET SID TO 36" (92 cm)" is displayed. Lower x-ray tube down four inches (36" SID) using the collimator measuring tape. Press the ENT/SET button.
26	"SYS SINGLE SID" is displayed. Press the Cross Close button until "SYS-DIFF SID" is displayed. Press the ENT/SET button.

Step	Action
27	Raise the x-ray tube up four inches (40" SID) using the collimator measuring tape.
28	"SET TUBE MAX HT SET IR TO 40" displayed. Press the ENT/ SET button.
29	SET TBL DOWN TO 8" displayed.Lower the table bucky 8 inches to an SID of 48 inches. Press the ENT/SET button.
30	"END SID CAL TABLE SID OFFSET" displayed. Press the ENT/ SET button.
31	"TABLE SID OFFSET" displayed.Press the Long Open button to set the offset to 2 inches. Press the ENT/SET button.
32	The collimator will now calculate the vertical compensation and calibration parameters for your sys-tem. When completed "HORIZONTAL CAL?" is displayed. To enter the horizontal calibration routine, press the ENT/SET button.
33	When "SET COLL TO WALL" is displayed,properly reposition and orient the x-ray tube and bucky according to the systems Wall Mode con-figuration being utilized at this site. Once the collimator is tilted towards the bucky in the Wall Mode configuration, press the ENT/ SET button.
34	"HORIZ FIELD CAL" is displayed. Press the ENT/SET button.
35	SET SID TO 40" is displayed. Position the tube until the top surface of the bucky is 38 inches from the x-ray tube focal spot (40"SID). Press the ENT/SET button.
36	Position the Test Pattern (supplied with the collimator)on the bucky and align the center lines using the light field of the collimator.
37	Set collimator field size to 14" X 14" square @40" SID displayed. Adjust the light field and press the ENT/SET button.
38	Set collimator field size to 5" X 5" square @40"SID displayed. Adjust the light field and press the ENT/SET button.
39	Set collimator field size to 14" X 14" square @72"SID displayed.(Do not move tube or change SID) Adjust the light field and press the ENT/SET button.
40	Set collimator field size to 5" X 5" square @72"SID displayed. Adjust the light field and press the ENT/SET button.
41	"WALL IMG RC CAL" displayed. Press the ENT/SET button.
42	Rotate the bucky to the portrait orientation.
43	"INSERT CASS L = 17" displayed. Press the ENT/SET button.

Step	Action
44	Rotate the bucky.
45	"INSERT CASS L = 14" displayed. Press the ENT/SET button.
46	"SHOW CONT SID" displayed. Press the ENT/SET button.
47	"SHOW HORIZ SID" displayed. Press the ENT/SET button.
48	The collimator will now store the data and "END OF CALIBRATION" is displayed for three seconds fol-lowed by a return to normal collimator operation.
49	Verify proper calibration of the collimator as follows:
a.	In Wall Mode, vertically align the x-ray tube and bucky. At each of the preset horizontal SID posi-tion, verify that the SID displayed on the collimator is correct for that position.
b.	In Table Mode, manually set the SID to 40" with the tube crane at the upper mechanical end-of- travel. Verify that the SID displayed on the collimator is accurate to within 1% of the actual mea-sured SID. Repeat the test at 45" and 50" SID, moving the tube crane down approximately two inches between each test.

Chapter 6
Tube Crane Operation

This chapter provides basic information about using the EPEX-Omniflex Overhead Tube Crane.

Contents

WARNING

To minimize the risk of injury to the patient, it is recommended that the tube crane be moved by manual means only, when within 11.8 inches (300 mm) of the tabletop or 3.9 inches (100 mm) adjacent to the table. Press and hold the lock release push-button while manually positioning the tube crane as required.

WARNING

When operating the tube crane, the operator should be alert to events such as stiffness or binding of the mechanism, unusual noise or vibration. Any abnormal operation should be immediately reported to service personnel.

Tube Crane Power

Emergency Stop Switch

WARNING

Before operating the EPEX-Omniflex Overhead Tube Crane, operators must familiarize themselves with the location of the emergency stop switch or switches.

The emergency stop switch is used by the operator to remove power from the overhead tube crane in the event of an emergency, such as unintended movement or other catastrophic system failure.

The emergency stop switch is provided by the installer, and therefore the switch style and location will vary from site to site. It is the responsibility of the operator to become familiar with the location of the emergency stop switch and its operation. Typical emergency stop switch operation is described in Table 6-1.

Table 6-1. Typical Emergency Stop Switch Operation

Action	Response
Push in	Overhead tube crane power is switched OFF.
Pull out	Overhead tube crane power is switched ON.

CAUTION

Pressing the emergency stop switch may also result in the immediate shutdown of the X-ray generator and associated equipment, terminating any ongoing image acquisition procedure.

Switching Power ON/OFF

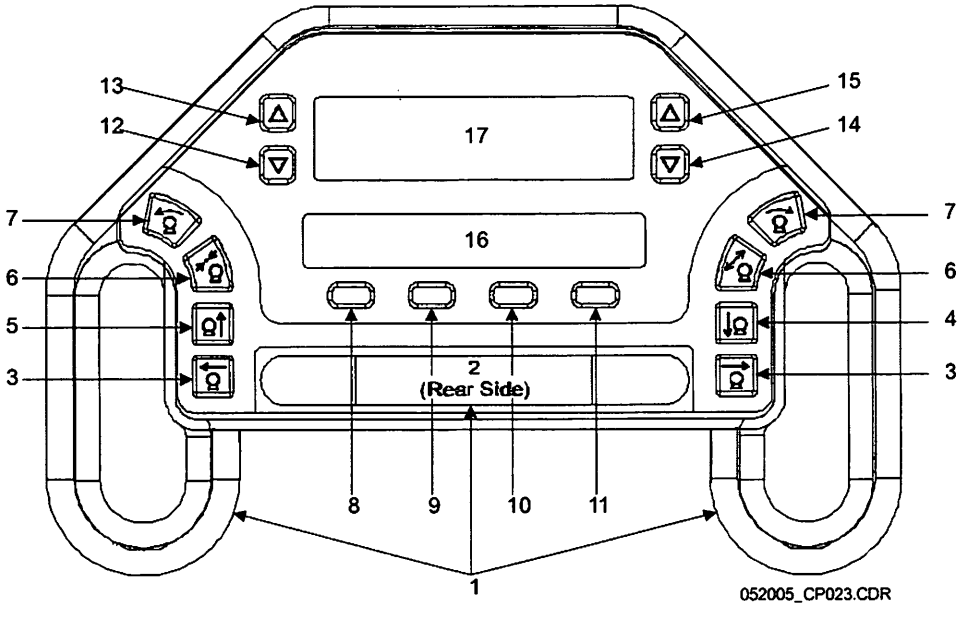
When the X-ray generator power is switched on, power is applied to the overhead tube crane. The display on the control console will be illuminated (active) indicating to the operator that the overhead tube crane is energized (power on). Electrical power is removed from the overhead tube crane when the X-ray generator is switched off. For complete instructions on switching generator power ON/OFF, refer to the instructions supplied with the X-ray generator.

Using the Tube Crane Control Panel to Position the X-ray Tube

You position the x-ray tube by pressing one of the related buttons on the overhead tube crane's control panel, moving the X-ray tube arm to the desired position, then releasing the button to lock the crane into position.

Figure shown the control panel. The functions of the control panel are described in table.

Figure 6-1. EPEX-Omniflex Control Panel



Note: All directions for use of the EPEX-Omniflex tube crane are described from the point of view of a user standing in front of the tube crane.

The system's layout may alter the meaning of some directions. For example, in Wall Mode Configurations A and C, the lateral center position for the tube crane is in the tube crane's transverse direction; in Wall Mode Configuration B, the lateral center position for the tube crane is in the tube crane's longitudinal direction. The meanings of control console soft-keys and LEDs change accordingly.

Unless noted otherwise, the LED above the soft-key indicates the lock status: ON = locks active, OFF = locks released.

A flashing LED generally indicates a function that needs to be performed to comply with required conditions.

Table 6-2. EPEX-Omniflex Control Panel Component Descriptions

Control Component	Description
1. Handles	The control panel has three handles; two on either side and one at the center below the panel.
2. All Locks Release Grip Switch	Squeeze this grip switch, located at the rear of the center handle, to release the lateral, longitudinal, and vertical locks and manually position the tube crane. To lock the tube crane in the current position, release this switch. When squeezed, this switch stops all automatic motions and turns Auto mode off, if it was on.
3. Longitudinal Lock Soft-Key	Pressing either soft-key releases the longitudinal lock, allowing you to manually move the tube crane longitudinally. ***Note:** With Auto Mode engaged, the longitudinal lock is automatically applied when either the lateral center or SID position(s) is reached. This function is dependant upon which Wall Mode position the room is configured for.*
4. Down Soft-Key	This soft-key activates the drive motor and moves the telescopic arm down. While the arm is moving down, its associated LED flashes. To release the vertical lock and move the tube crane up and down manually, press the Down and Up soft-keys simultaneously. Pressing this soft-key while Auto mode is on turns Auto mode off.
5. Up Soft-Key	This soft-key activates the drive motor and moves the telescopic arm up. While the arm is moving up, its associated LED flashes. To release the vertical lock and move the tube crane up and down manually, press the Down and Up soft-keys simultaneously. Pressing this soft-key while Auto mode is on turns Auto mode off.

Control Component	Description
6. Transverse Lock Soft-Keys	Pressing either soft-key releases the transverse locks, allowing you to manually move the tube crane transversely. *Note: The transverse lock is automatically applied when either the lateral center or SID position(s) is reached. This function is dependant upon which Wall Mode position the room is configured for.*
7. Angulation Lock Soft-keys	Pressing either soft-key releases the angulation lock, allowing you to rotate the X-ray tube about the horizontal axis. Press both angulation soft-keys simultaneously to release all locks (vertical, angulation, longitudinal and lateral) so that you can manually move the tube crane in all available directions and orientations. However, pressing both soft-keys simultaneously while Auto mode is on, will turn Auto mode off.
8.	Not Used.
9. Auto Mode Soft-Key	This soft-key toggles between auto and manual mode, as described below. The current setting is shown just above the soft-key in the status display called out by number 16 in Figure 6-1.
Table Mode (Auto Off)	Use this setting when in Table mode and you want to manually position the X-ray tube vertically to establish the SID.
Table Mode (Auto On)	Use this setting when in Table mode and you want the X-ray tube to automatically track the Bucky's vertical motion, maintaining the predetermined SID (a vertical SID of either 40 in. or 44 in. can be set during calibration).
Wall Mode (Auto Off)	Use this setting when in Wall mode and you want to manually position the X-ray tube vertically to align it with the Bucky.
Wall Mode (Auto On)	Use this setting when in Wall mode and you want to have the X-ray tube automatically align itself vertically with the Bucky.
10.	Not Used.

Control Component	Description
11.	Not Used.
12.	Only used during EPEX-Omniflex Software Calibration.
13.	Only used during EPEX-Omniflex Software Calibration.
14.	Only used during EPEX-Omniflex Software Calibration.
15.	Only used during EPEX-Omniflex Software Calibration.
16.Status Display	The status display relays pertinent information to the user. Such information as current SID in units of inches or centimeters (in/cm), Auto Mode status, positioning information, and system ready status are displayed in this window.
17.Angulation Display	The right side of this display shows the current tube angle in angular degrees, with 0° indicating the vertical direction and 90° the horizontal direction.

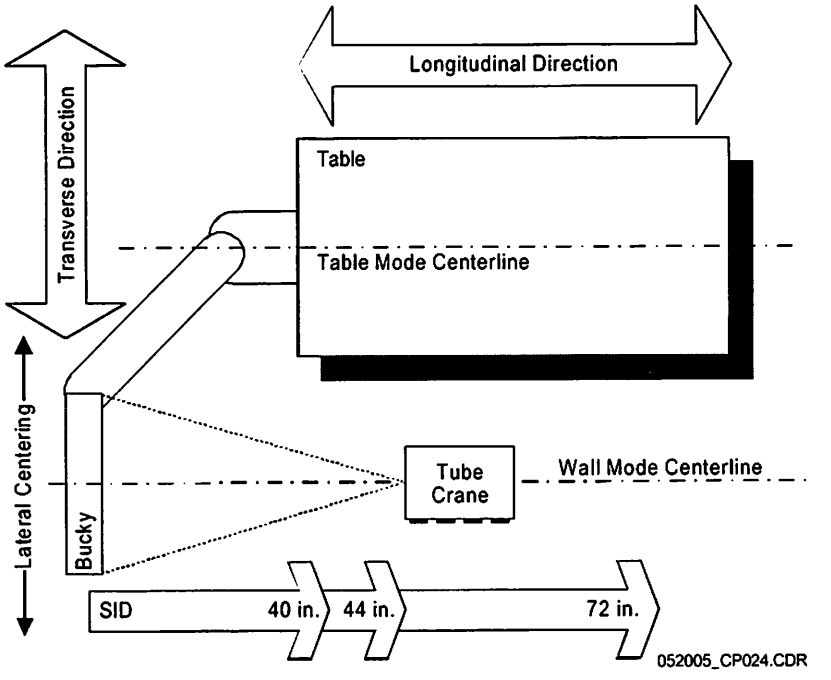
Wall Mode Configurations

Wall Mode Configuration A

To configure the EPEX-Omniflex system for Wall Mode Configuration A (Figure 6-2):

Step	Action
1	Move the Bucky tower all the way to the left.
2	Position the Bucky Stand arm at 135°.
3	Rotate the Bucky to vertical position.
4	Raise the Bucky to the height of interest.
5	Ensure that the Bucky is in Portrait or Landscape orientation, not an intermediate orientation.
6	Angulate the X-ray tube/collimator to the 90° position, facing the Bucky.

Figure 6-2.
Wall Mode Configuration A



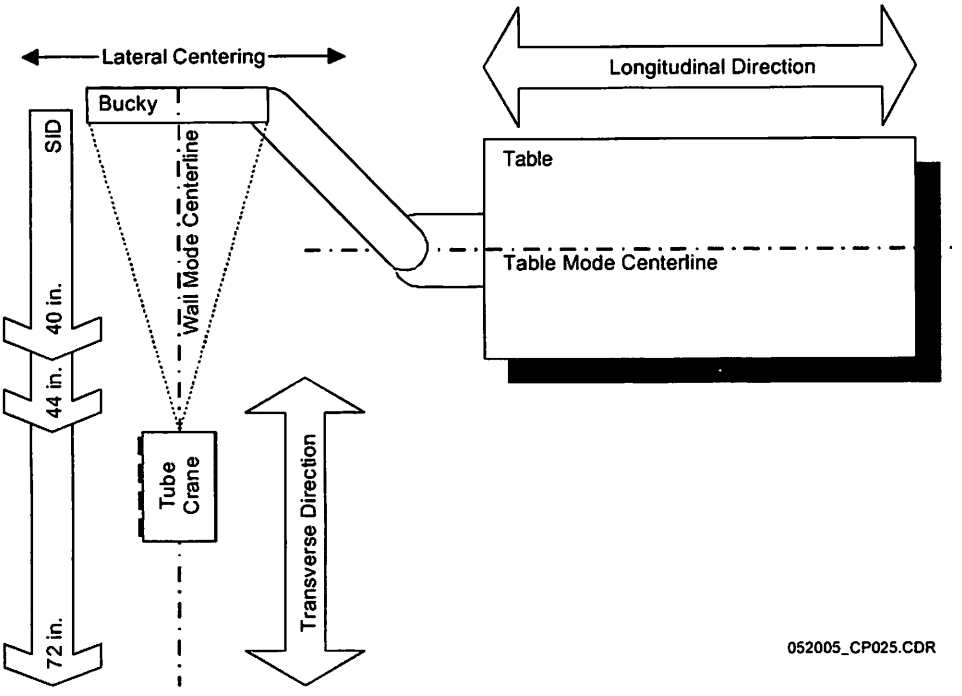
Step	Action
	Note: The EPEX-Omniflex automatically enters Wall mode whenever the angulation of the X-ray tube is 90°±15° clockwise (horizontal, X-rays aimed left) or counterclockwise (horizontal, X-rays aimed right).
7	Perform the following steps to put the EPEX-Omniflex system in Auto mode. Refer to "Auto Tracking On In Wall Mode" on page 6-11 for further information.
a.	Turn on Auto mode by pressing the Auto Mode soft-key.
b.	The Lateral Center function turns on automatically. If the message BUCKY? LAT CNTR? flashes on the EPEX-Omniflex control panel display, move the tube crane to Wall mode lateral center.
c.	If the message HORIZ SID? flashes on the EPEX-Omniflex control panel display, position the X-ray tube at one of the predetermined horizontal SIDs (40 in., 44 in., or 72 in.) and verify that the SID is displayed on the control panel. ***Note:*** *In Auto mode, the X-ray tube must reach vertical alignment with the center of the Bucky before exposure is enabled.*
8	To put the collimator in Automatic Collimation mode, ensure that the angulation of the X-ray tube is 90°±2°, facing the Bucky.

Wall Mode Configuration B

To configure the EPEX-Omniflex system for Wall Mode Configuration B (Figure 6-3):

Step	Action
1	Move the Bucky tower all the way to the left.
2	Position the Bucky Stand arm at 45°.
3	Rotate the Bucky to vertical position.
4	Raise the Bucky to the height of interest.
5	Ensure that the Bucky is in Portrait or Landscape orientation, not an intermediate orientation.
6	Ensure that the tube crane has been rotated about its vertical axis to the 90° position.
7	Angulate the X-ray tube/collimator to the 90° position, facing the Bucky.
	Note: *The EPEX-Omniflex automatically enters Wall mode whenever the angulation of the X-ray tube is 90°±15° clockwise (horizontal, X-rays aimed left) or counterclockwise (horizontal, X-rays aimed right).*
8	Perform the following steps to put the EPEX-Omniflex system in Auto mode. Refer to "Auto Tracking On In Wall Mode" on page 6-11 for further information.
a.	Turn on Auto mode by pressing the Auto Mode soft-key.
b.	The Lateral Center function turns on automatically. If the message BUCKY? LAT CNTR? flashes on the EPEX-Omniflex control panel display, move the tube crane to Wall mode lateral center.
9	If the message HORIZ SID? flashes on the EPEX-Omniflex control panel display, position the X-ray tube at one of the predetermined horizontal SIDs (40 in., 44 in., or 72 in.) and verify that the SID is displayed on the control panel.
	Note: *In Auto mode, the X-ray tube must reach vertical alignment with the center of the Bucky before exposure is enabled.*
10	To put the collimator in Automatic Collimation mode, ensure that the angulation of the X-ray tube is 90°±2°, facing the Bucky.

Figure 6-3.
Wall Mode Configuration B



Wall Mode Configuration C

To configure the EPEX-Omniflex system for Wall Mode Configuration C (Figure 6-4):

Step	Action
1	Move the Bucky tower all the way to the left.
2	Position the Bucky Stand arm at 0°.
3	Rotate the Bucky to vertical position.
4	Raise the Bucky to the height of interest.
5	Ensure that the Bucky is in Portrait or Landscape orientation, not an intermediate orientation.
6	Angulate the X-ray tube/collimator to the 90° position, facing the Bucky. ***Note:*** *The EPEX-Omniflex automatically enters Wall mode whenever the angulation of the X-ray tube is 90°±15° clockwise (horizontal, X-rays aimed left) or counterclockwise (horizontal, X-rays aimed right).*
7	Perform the following steps to put the EPEX-Omniflex system in Auto mode. Refer to "Auto Tracking On In Wall Mode" on page 6-11 for further information.

Step	Action
a.	Turn on Auto mode by pressing the Auto Mode soft-key.
b.	The Lateral Center function turns on automatically. If the message BUCKY? LAT CNTR? flashes on the EPEX-Omniflex control panel display, move the tube crane to Wall mode lateral center.
c.	If the message HORIZ SID? flashes on the EPEX-Omniflex control panel display, position the X-ray tube at one of the predetermined horizontal SIDs (40 in., 44 in., or 72 in.) and verify that the SID is displayed on the control panel. *Note: In Auto mode, the X-ray tube must reach vertical alignment with the center of the Bucky before exposure is enabled.*
8	To put the collimator in Automatic Collimation mode, ensure that the angulation of the X-ray tube is 90°±2°, facing the Bucky.

Figure 6-4. Wall Mode Configuration C

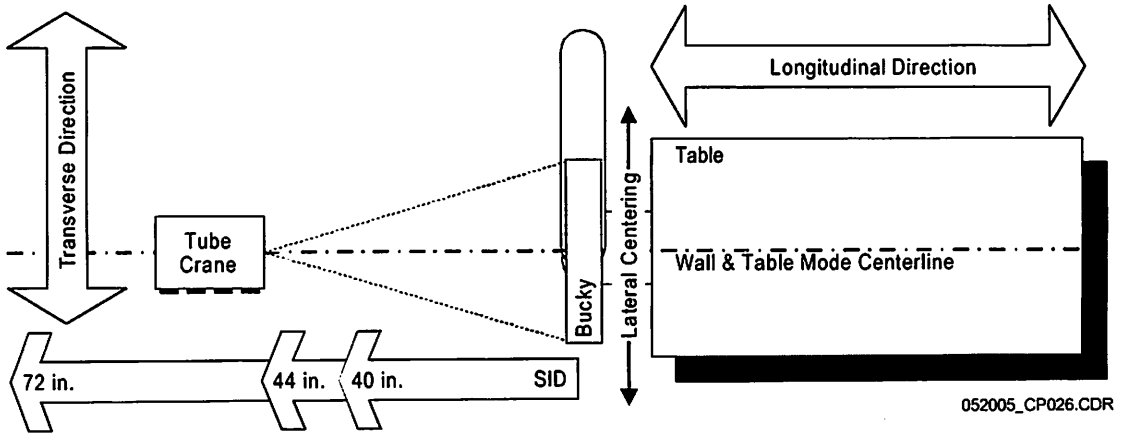


Table Mode

To put the EPEX-Omniflex system in Table mode:

Step	Action
1	Rotate the Bucky to horizontal position.
2	Position the Bucky Stand's arm at 0°.
3	Ensure that the Bucky is in Portrait or Landscape orientation, not an intermediate orientation.
4	Rotate the X-ray tube to 0°.

Step	Action
	Note: The EPEX-Omniflex automatically enters Table mode whenever the angulation of the X-ray tube is 0°±15° (X-rays aimed vertically downward).
5	Perform the following steps to put the EPEX-Omniflex system in Auto mode. Refer to "Auto Tracking On In Table Mode" on page 6-12 for further information.
a.	Turn on Auto mode by pressing the Auto Mode soft-key
b.	The Lateral Center function turns on automatically. If the message BUCKY? LAT CNTR? flashes on the EPEX-Omniflex control panel display, move the tube crane to Table mode lateral center.
c.	Verify that the predetermined vertical SID (40 in. or 44 in.) is displayed on the control panel.
6	To put the collimator in Automatic Collimation mode, ensure that the angulation of the X-ray tube is 0°±2° (vertical).
	Note: When Auto is off in Table mode, the differential SID between the X-ray tube and Bucky appears on the collimator control panel.

Auto Mode

The Auto Tracking feature allows automatic vertical tracking of the X-ray tube to the Bucky. Refer to "Auto Tracking On In Wall Mode" or "Auto Tracking On In Table Mode" on page 6-12 for instructions on turning Auto Mode on.

Auto Tracking On In Wall Mode

With Auto Tracking on in Wall mode, the EPEX-Omniflex continually drives the x-ray tube up or down to maintain alignment of the X-ray field and the Bucky. It is important to remember that the operator moves the Bucky to the desired height, and the X-ray tube follows, not the other way around.

*Note: When **none** of the below conditions exist, automatic tracking of the bucky resumes.*

In Auto mode, the system will suspend automatic vertical tracking for the duration of the occurrence of any of the following conditions:

- X-ray tube is not in Wall mode lateral center position
- Bucky horizontal centerline has been raised or lowered beyond the tube crane's limit of travel
- Bucky is not in the vertical position (+90° for Wall mode configurations A and B, -90° for Wall Mode Configuration C
- SID is not 40 in., 44 in., or 72 in
- X-ray tube angle is not 90°±2°

Note: If Auto mode turns off automatically, the operator must press the Auto Mode soft-key to turn it back on.

The system will automatically turn off Auto mode upon the occurrence of any of the following events:

- Lateral Center function is turned off
- Left or Right soft-key is pressed, releasing the longitudinal lock
- Any manual vertical motion control is activated, whether activating the drive motor or not
- Any manual multi-axis motion control is activated

One of the following messages will be displayed on the EPEX-Omniflex control panel when the required operational condition is not met:

- IN MOTION indicates the X-ray tube is in motion, aligning itself with the Bucky
- HORIZ SID? is a prompt instructing the operator to position the X-ray tube at the selected horizontal SID
- BUCKY? LAT CNTR? indicates that the EPEX-Omniflex is not at Wall mode lateral center or that the Bucky is not vertical
- ANGLE 90? indicates the X-ray tube angle is not 90°±2°
- READY indicates all requirements are met

Auto Tracking On In Table Mode

With Auto Tracking on in Table mode, the EPEX-Omniflex drives the telescopic tube-arm vertically to maintain the predetermined vertical SID (40 in. or 44 in.) with the Bucky in the 0° position (horizontal). It is important to remember that the operator positions the Bucky to the desired height, and the X-ray tube follows, not the other way around.

Note: When none of the below conditions exist, automatic SID tracking resumes.

In Auto mode, the system will suspend automatic tracking for the duration of the occurrence of any of the following conditions:

- X-ray tube is not in Table mode lateral center position
- Bucky has been raised or lowered to a point such that tracking of the specified SID would take the tube crane beyond its limit of travel
- Bucky is not in the 0° (horizontal) position
- X-ray tube angle is not 0° ±2°

Note: If Auto mode turns off automatically, the operator must press the Auto Mode soft-key to turn it back on.

The system will automatically turn off Auto mode upon the occurrence of any of the following events:

- Lateral Center function is turned off
- Left or Right soft-key is pressed, releasing the longitudinal lock
- Any manual vertical motion control is activated, whether activating the drive motor or not
- Any manual multi-axis motion control is activated

One of the following messages will be displayed on the EPEX-Omniflex control panel when the required operational condition is not met:

- IN MOTION indicates the X-ray tube is in motion and has not stopped at the predetermined vertical SID position
- BUCKY? LAT CNTR? indicates that the EPEX-Omniflex is not at Table mode lateral center or that the Bucky is not horizontal
- ANGLE 0? indicates the X-ray tube angle is not 0° ±2°
- READY indicates that all positioning requirements are met

Chapter 7
Preventive Maintenance

Service procedures must be performed by trained personnel only. This chapter contains:

- Preventive Maintenace Schedules and Checklists
- Preventive maintenace procedures

A Note on Serviceability and Repairability:

All provided products and associated components are designed for replacement or service in a hospital environment.

Contents

In-Service Observation

Observe the movement of the tube crane throughout its full range of travel with power off. Irregular movements or other malfunctions should be repaired immediately.

Observe the movement of the tube crane throughout its full range of travel with power on. Irregular movements or other malfunctions should be repaired immediately.

Preventive Maintenance Schedules and Checklists

The Semi-Annual/Annual preventive maintenance checklist form is shown in Figure 7-1 on page 7-3. You should perform the tasks listed on the form, given the preventive maintenance schedule currently required for the site. Reproducible copies of the form are provided in Appendix B.

WARNING

All service and maintenance including the procedures described within this chapter, are to performed by qualified service personnel only.

WARNING

Disconnect power before performing any maintenance action on the EPEX-Omniflex Overhead Tube Crane.

Figure 7-1. Semi-Annual/Annual Preventive Maintenance

Semi-Annual/Annual Preventive Maintenance Checklist

Semi-Annual:

Inspection	Comments
☐ Inspect spring balancer cables for signs of wear, kinks, broken strands, or any other deformities that may exist.	
☐ Inspect main support cables for signs of wear, kinks, broken strands, or any other deformities that may exist.	
☐ Inspect bearings for serviceability. Replace bearings as required.	
☐ Inspect safety mechanism for proper operation; ease of movement. Inspect cable for proper tension (no slack). Replace cable if any of the following conditions exist: wear, kinks, broken strands, or any other deformities that may exist.	
☐ Perform safety mechanism operational check.	
☐ Check all electrical connections for condition, security, and cables for proper dressing.	
☐ Check for proper operation of control console cooling fan; ensure blades are clean.	
☐ Perform tube crane operational check.	
☐ Check markings on control panel and equipment labels for legibility. Replace as required.	
☐ Check vertical drive force and adjust as necessary.	

Annual:

Inspection	Comments
☐ Clean all exterior surfaces of the equipment.	

Tube Crane Operational Check

An operational check of EPEX-Omniflex Overhead Tube Crane is to be performed semi-annually to ensure the tube stand is operating within the set parameters and at optimal performance.

The Operational Check form is shown in Figure 7-2. Reproducible copies of the form are provided in Appendix B. A copy of this form should be kept with the tube stands permanent service documentation.

Figure 7-2. EPEX-Omniflex Overhead Tube Crane Operational Check

EPEX-Omniflex Overhead Tube Crane Operational Check

Step	Pass	Fail
1. Ensure system power is OFF.		
2. Verify the X-ray tube moves freely in all axes; transverse, vertical, longitudinal, and rotational.	❑	❑
3. Verify the X-ray tube is properly balanced (tube does not drift up or down).	❑	❑
4. Ensure system power is OFF.		
5. Press either tube angulation lock release soft-key and verify the X-ray tube moves freely throughout its full range of travel.	❑	❑
6. Verify the tube angulation lock status LEDs are ON when the tube angulation soft-keys are not pressed, and OFF when either soft-key is pressed.	❑	❑
7. Verify the tube angulation mechanically detents at the horizontal position and the tube angel display reads "0°"..	❑	❑
8. Verify the tube angulation mechanically detents at 90 degrees clockwise and the tube angle reads "90°".	❑	❑
9. Verify the tube angulation mechanically detents at 90 degrees counterclockwise and the tube angle reads "90°". Return the X-ray tube to the horizontal position.	❑	❑
10. Press the transverse lock release soft-key and verify that the X-ray tube moves freely throughout its transverse range of motion.	❑	❑
11. Verify the transverse lock status LED is ON when the transverse lock is applied and OFF when the lock is released.	❑	❑
12. Angulate the X-ray tube 90 degrees towards the wall Bucky. Press the transverse lock release soft-key for wall mode configurations "A" and "C" or the longitudinal lock release soft-key for wal mode configuration "B". Verify the X-ray tube moves freely until it engages the lateral center mechanical detent.	❑	❑
13. Verify lateral center mechanical alignment to the Bucky in wall and table modes.	❑	❑
14. Angulate the X-ray tube 90 degrees towards the wall Bucky. Press up and down soft-keys simultaneously and verify the X-ray tube moves freely throughout its full range of vertical travel.	❑	❑
15. Press the vertical drive up soft-key and verify that the X-ray tube drives up.	❑	❑
16. Press the vertical drive down soft-key and verify that the X-ray tube drives down.	❑	❑
17. Verify the display shows "- - -" in table mode when the Bucky is not at X-ray height or if the X-ray tube is at an angle outside of ±15°.	❑	❑
18. Press each longitudinal lock release soft-key and verify the X-ray tube moves freely throughout its full range of longitudinal travel.	❑	❑
19. Verify the longitudinal lock status LEDs are ON when either longitudinal lock release soft-key is not pressed and OFF when either lock release soft-key is pressed.	❑	❑
20. Angulate the X-ray tube 90 degrees towards te wall Bucky and verify the display shows "SID-WALL".	❑	❑

Sheet 1 of 2

Tube Crane Operational Check.CDR

Figure 7-2. EPEX-Omniflex Overhead Tube Crane Operational Check - Continued

EPEX-Omniflex Overhead Tube Crane Operational Check

Step	Pass	Fail
21. Move the X-ray tube longitudinally and verify the longitudinal locks are applied when the X-ray tube reaches each horizontal SID and the display shows the correct SID for each position.	❑	❑
22. Verify the X-ray tube moves freely in the vertical, transverse, and longitudinal directions when the all locks release handle is squeezed.	❑	❑
23. Trip the safety mechanism by pulling on one of the sensor cables. Verify the X-ray tube will not move up or down.	❑	❑
24. Reset the safety mechanism for normal operation.	❑	❑
25. Repeat Steps 24 and 25 using the other sensor cable.	❑	❑
26. Enter table mode, turn on "Auto" mode, and verify the X-ray tube positions itself at the predetermined SID of either 40 inches (101.6 cm) or 44 inches (111.76 cm) above the table Bucky at all Bucky heights where the X-ray tube travel is not limited by calibration. Verify actual SID using the collimator tape measure. ***Note:*** *The DirectRay detector array is located two inches below the Bucky surface.*	❑	❑
27. Enter wall mode, turn on "Auto" mode, and verify the X-ray tube positions itself at 72 inches (182.9 cm) SID. Verify the X-ray tube aligns itself vertically with the Bucky throughout the Bucky's range of travel (the X-ray tubes travel may be limited by calibration settings). Verify the actual SID using the collimator tape measure.. ***Note:*** *The DirectRay detector array is located two inches below the Bucky surface.*	❑	❑

Note: *If the EPEX-Omniflex Overhead Tube Crane fails any portion of this operational check, stop the operational check and correct the problem. Once the problem has been rectified, restart the operational check from the beginning.*

EPEX-Omniflex Overhead Tube Crane Maintenance

Cleaning the Tube Crane Assembly

- Ensure the power has been disconnected and that the emergency switches have been activated, before starting any cleaning operation.
- Ensure no liquid gets into the unit.
- Do not immerse the equipment, including any components or accessories, in liquid.
- Do not autoclave the equipment, including any component or accessories.
- Do not use water. Water can short-circuit the electrical installation and cause corrosion to mechanical parts.
- Do not use acid or abrasive products.
- Use only a dry cloth to clean chrome-plated parts.
- Only the surface areas of unit parts, including accessories and connection cables, should be disinfected using a gaseous disinfectant. For safety reasons, do not spray disinfectants.
- Clean painted parts with a cloth and products appropriate for cleaning plastic materials; after cleaning wipe the surfaces with a clean, dry cloth.
- Do not spray cleaning or disinfection solution directly on the equipment. To disinfect, mositen a cloth with a 70% Isopropyl alcohol solution or equivalent and wipe the surface of the equipment.
- When disinfecting the examination room, ensure the unit is covered with plastic sheets.

WARNING

This equipment is not classified as anaesthetic-proof and may ignite inflammable anesthetics. Flammable agents used for skin cleaning or disinfecting may also produce an explosion hazard.

Chapter 8
Repair and Replacement

This chapter details the repair and replace procedures for the EPEX-Omniflex Overhead Tube Crane.

Contents

Inspections

The following sections contain detailed inspections of the EPEX-Omniflex Overhead Tube Crane.

Fasteners

- Check all nuts, bolts, screws. rivets, and all other fasteners for integrity and tightness. Tighten as necessary.
- Replace any fasteners that appear damaged.

Electrical

- Check all electrical connectors for proper seating.
- Check all cables and connectors for damage, such as abrasions, cracks, etc. Pay close attention to the HV cables, especially where they enter the connector back shell for damage from the mechanical motions of the system.
- Repair or replace as necessary.

Labeling and Exterior

- Examine all exterior painted or plated surfaces for evidence of deterioration.
- Examine all name plates and warning labels. Ensure they are present, legible, and securely mounted.
- Repair as required.

Longitudinal Rails

- Inspect the bottom track surfaces for wear. If extreme wear or damage is evident, replace the metal strip acting as the bearing surface.
- Inspect the mounting hardware for tightness and integrity. If any of the hardware is questionable, replace it.
- Inspect the rails for damage.

Transverse Bridge Rails

- Inspect the bottom track surfaces for wear. If wear or damage is evident, replace the metal strip acting as the bearing surface.
- Inspect the rails for damage.

Transverse Bridge Bearing Inspection

Inspect the bearings by lifting the transverse bridge enough to allow them to be rotated. If there is evidence of binding, the bearing(s) must be replaced.

Transverse Carriage Bearing Inspection

Inspect the bearings by lifting the transverse carriage enough to allow them to be rotated. If there is evidence of binding, the bearing(s) must be replaced.

Safety Mechanism - Telescoping Tube Arm

The tube crane is designed with a safety mechanism to prevent injury due to sudden telescoping of the tube arm. The mechanism consists of a retaining latch and pawl which, when engaged, locks against the ratchet wheel teeth. When either the spring balancer cable or the telescoping tube arm cable break, the safety mechanism is triggered preventing rotation of the pulley shaft. Refer to Figure 8-1 on page 8-4.

The systems of both the telescoping tube arm and the spring balancer utilize two cables each. One of the cables is constantly carrying the load while the other cable acts as a sensor. The sensor function is obtained by leaving the cable slack with a small pulley riding on it. Attached to the pulley the safety cable, which is also attached to the pawl. When the load-carrying cable of either the telescoping tune arm or spring balance breaks, the sensor cable picks up the load which takes up the slack and pulls on the safety cable triggering the pawl. The pawl engages the ratchet wheel teeth, preventing any rotation of the pulley shaft. The telescoping tube arm is then locked into the position it was in when the break occurred. Immediate service is required.

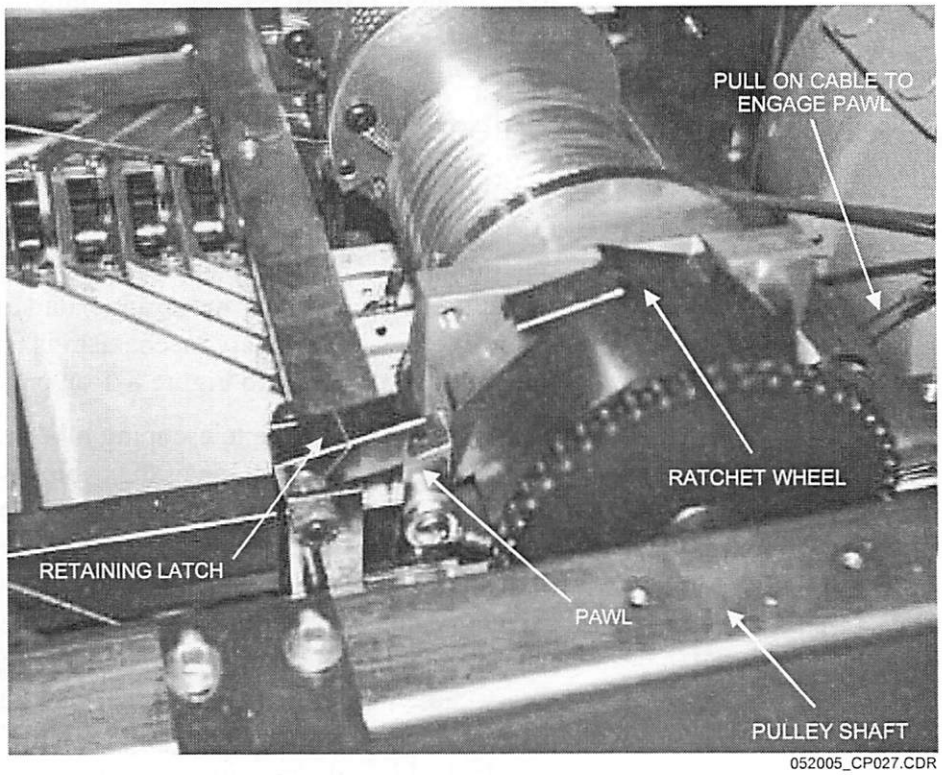
Safety Mechanism Operational Check

To perform the safety mechanism operational check:

Step	Action
1	Pull on safety cable to position the pawl against the ratchet wheel. Refer to Figure 8-1 on page 8-4.
2	Manually move the telescoping tube arm up or down until the pawl engages the teeth on the ratchet wheel.
3	Try to move the telescoping tube arm up or down manually. No movement of the telescoping tube arm is allowed. If movement is noted, inspect safety mechanism and replace any faulty components.

Step	Action
4	To reset safety mechanism, perform the following:
a.	Pull back on the retaining latch and hold in place.
b.	Manually move the telescoping tube arm up or down until the pawl disengages from the ratchet wheel teeth.
c.	The safety mechanism is now ready for normal operation.

Figure 8-1.
Safety Mechanism



Spring Balancer Cables

The spring balancer cables, which support the telescoping arm of the tube crane, should be inspected visually, after removing the covers as necessary to gain access to the spring balancer. The inspection is most easily performed from above while the tube crane is slowly lowered and raised. The wire rope cables should be observed for kinks, fraying, and tracking. If kinks, fraying, or misalignment of cables are detected, perform remedial service immediately.

Miscellaneous Transverse Carriage Parts

Inspect the parts and systems housed with the transverse carriage. The system should be operated carefully by one person while another observes its functioning. The cables must be inspected for integrity and replaced when damage becomes evident.

Telescoping Tube Arm

The telescoping tube arm should move freely with no binding and should not require excessive force to move. Move the arm up and down to verify proper movement. If it appears that the tube arm requires maintenance action the factory should be contacted.

Tube Arm Rotator Assembly

Pivot Rotation

Note: If the handle/lock does not function properly, loosen or tighten the two brake adjustment screws to set the proper amount of drag.

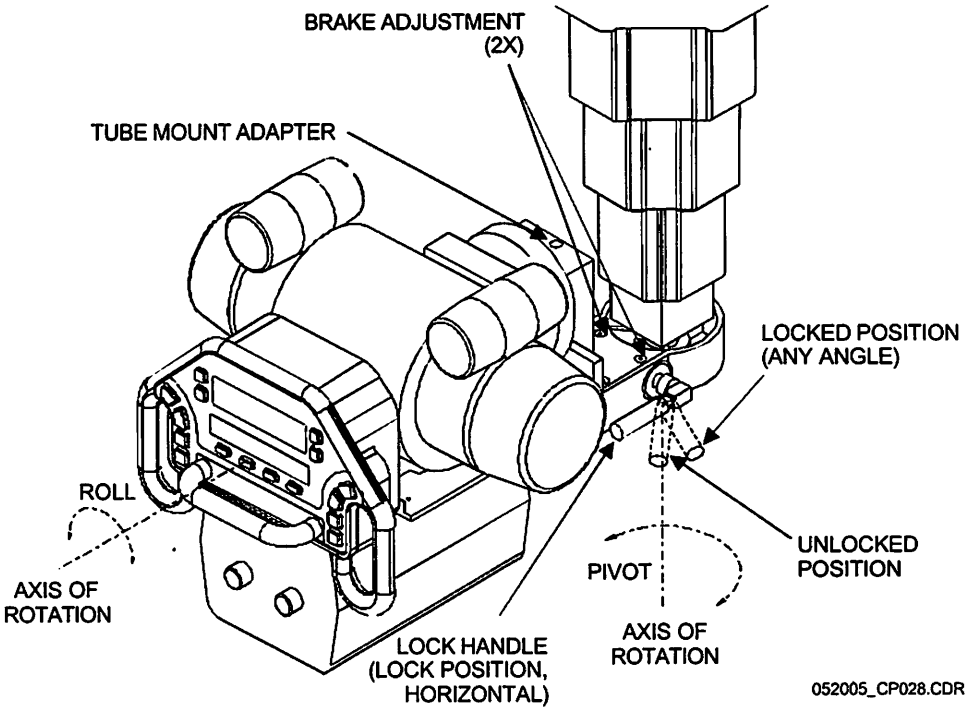
The X-ray tube assembly is able to pivot about the vertical axis with 360° of freedom. The system has four mechanical rotation detents each positioned 90° apart. The lock handle has three positions for operating the brake. Refer to Figure 8-2 on page 8-6.

- **Horizontal Lock** - When the lock handle is in the horizontal position, it locks into one of the four detents. If the lock handle is rotated to its horizontal position but does not lock into a detent, the X-ray tube assembly will rotate freely until it locates the nearest detent and will lock into the detent, due to the spring action of the handle/lock mechanism.
- **Unlocked** - When the lock handle is rotated 90° downward, the X-ray tube assembly unlocks and can rotate freely throughout its 360° of freedom.
- **Locked** - When the lock handle is rotated past the 90° downward position, the X-ray tube assembly locks in its current rotational position on the 360° axis.

Roll Rotation

The tube arm angle or roll assembly should rotate smoothly about the horizontal axis when the system power is OFF or if either Tube Angulation soft-key is pressed when system power is ON. If movement is not smooth, check the lock and bearings.

Figure 8-2.
Tube Arm Rotators



Removal/Replacement Procedures

The following procedures are intended to aid the technician in system maintenance actions. The procedures are written in nested fashion to avoid needless repetition of tasks. Unless stated, the replacement procedure is the reverse of the removal procedure.

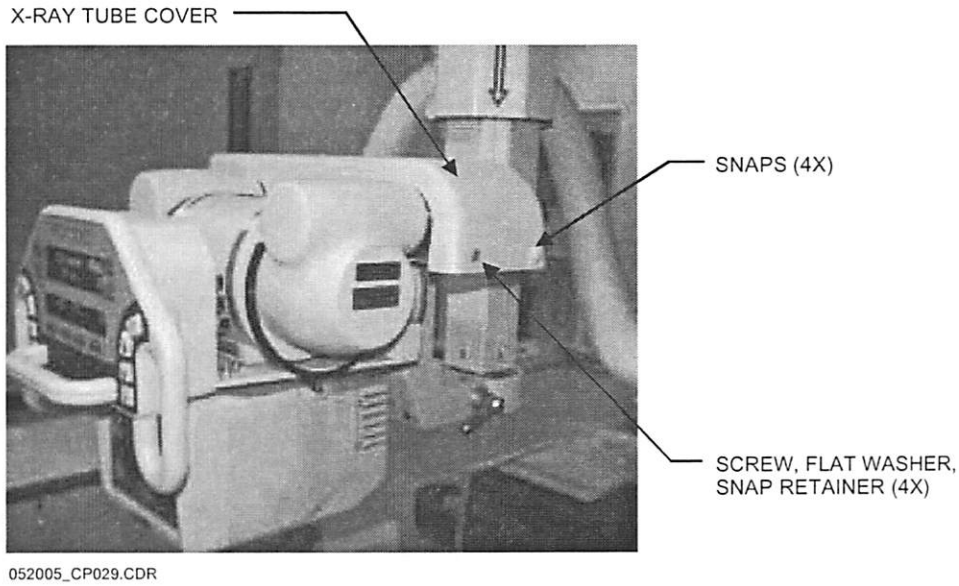
Tube Crane Covers

X-ray Tube Cover

To remove the X-ray tube cover:

Step	Action
1	Remove four white snaps covering the retaining hardware. Refer to Figure 8-3 on page 8-7.
2	Remove four screws, flat washers, and snap retainers securing the cover.
3	Remove x-ray tube cover.

Figure 8-3.
X-ray Tube Cover

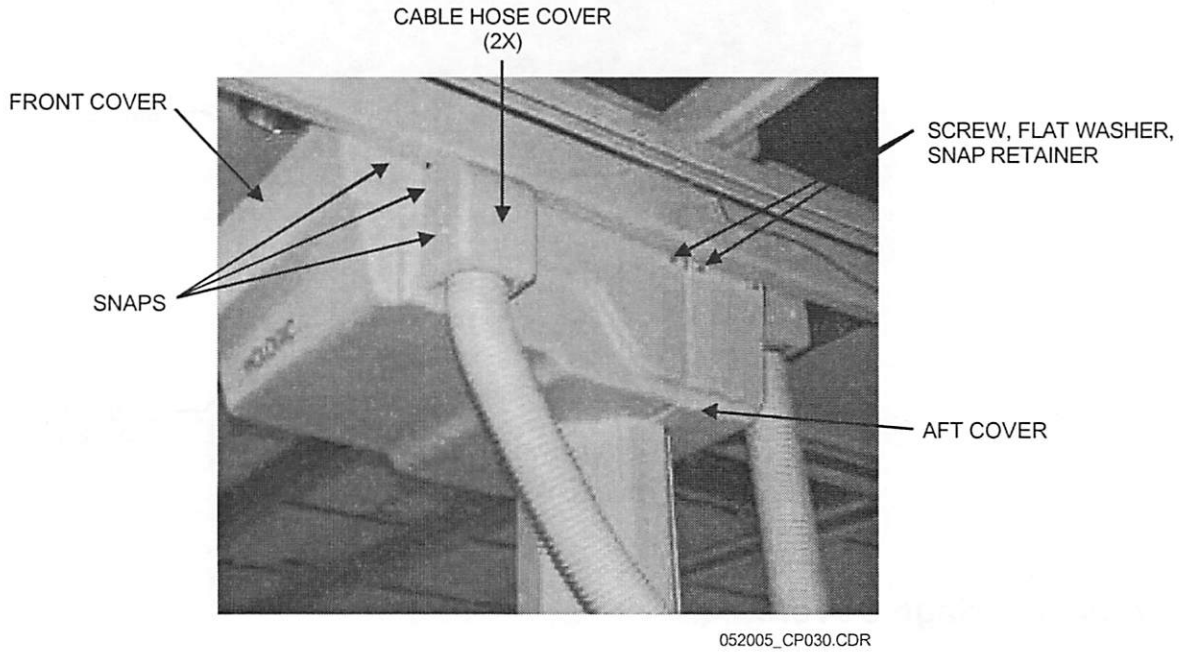


Transverse Carriage Covers

To remove the transverse covers:

Step	Action
1	Remove white snaps from both cable hose covers and both transverse carriage covers. Refer to Figure 8-4 on page 8-8.
2	Remove four screws, flat washers, and snap retainers from each cable hose cover. Remove cover and set aside.
3	To facilitate the removal of the front transverse cover, loosen both screws on the right-hand cable mount bracket.
4	Starting with the front cover, remove the four screws, flat washers, and snap retainers securing the cover. Carefully remove the cover by sliding the cover down and away from the tube stand.
5	Remove the four screws, flat washers, and snap retainers securing the aft cover. Carefully remove the cover by sliding the cover down.

Figure 8-4. Transverse Carriage Covers



Control Console

To remove the control console:

Step	Action
1	Remove electrical power from the EPEX-Omniflex overhead tube crane and collimator.
2	Disconnect the electrical connectors (3 ea.) on the rear of the control console.
3	Disconnect the ground wire from the rear of the control console.
4	Rotate the collimator 90× to gain access to the two control console mounting screws.
5	Remove the two screws securing the console to the tube mount assembly and remove the control console.

Tube Stand Controller Display PC Board

To remove the Tube Stand Controller Display PC Board:

Step	Action
1	Remove the control console.

Step	Action
2	Remove the four screws securing the rear plate and carefully separate the rear plate assembly from the control console.
3	Disconnect the electrical connectors (7 ea.) from the PCB (P/N 5284-135-01).
4	Remove the screws securing the PCB and remove the PCB.
5	Position new PCB and secure in place using existing hardware. Refer to "Tube Stand Controller Display PC Board" in Chapter 3 for DIP switches and jumper settings for replacement PCB.
6	Reconnect electrical cables to PCB. Refer to the EPEX-Omniflex Control Box Wiring Diagram (P/N 052282) for connection information.
7	Reassembly the rear plate assembly and control console and secure together using four screws.
8	Secure the control console to the tube mount assembly using two screws.
9	Perform tube crane calibration procedure. Refer to "Tube Crane Software Calibration" in Chapter 5for details.

Control Console Fan (Optional)

To remove the control console fan:

Step	Action
1	Remove the control console.
2	Remove the four screws securing the rear plate and carefully separate the rear plate assembly from the control console.
3	Remove the Tube Stand Controller Display PCB (P/N 5284-135-01).
4	Disconnect the fan wiring harness from J8 on the Tube Stand Controller Interconnect PCB (P/N 5284-135-07).
5	Remove the screws securing the fan and intake guard to the rear cover and remove the fan and guard.

Tube Stand Controller Power Supply PC Board

To remove the Tube Stand Controller Power Supply PC Board:

Step	Action
1	Remove the control console.
2	Remove the four screws securing the rear plate and carefully separate the rear plate assembly from the control console.
3	Remove the Tube Stand Controller Display PCB (P/N 5284-135-01).
4	Before disconnect the wiring harnesses from the Tube Stand Controller Power Supply PCB (P/N 5284-135-04), label each wire to its location on the PCB.
5	Disconnect the wiring harnesses from J1 and J2 on the PCB.
6	Remove the screws securing the PCB and remove the PCB.
7	Refer to "Tube Stand Controller Power Supply PC Board" in Chapter 3for DIP switches and jumper settings for replacement PCB.

Tube Stand Controller Interconnect PC Board

To remove the Tube Stand Controller Interconnect PC Board:

Step	Action
1	Remove the control console.
2	Remove the four screws securing the rear plate and carefully separate the rear plate assembly from the control console.
3	Remove the Tube Stand Controller Display PCB (P/N 5284-135-01).
4	Remove the Tube Stand Controller Power Supply PCB (P/N 5284-135-04).
5	Before disconnect wiring harnesses from the Tube Stand Controller Interconnect PCB (P/N 5284-135-07), label each wire to its location on the PCB. Disconnect the wiring harnesses for J8 on the PCB.
6	Disconnect the ribbon cable from J5 on the PCB.
7	Remove the screws securing the PCB and remove the PCB.
8	Refer to "Tube Stand Controller Interconnect PCB" in Chapter 3for DIP switches and jumper settings for replacement PCB.

VFD Display(s)

To remove the VFD displays:

Step	Action
1	Remove the control console.
2	Remove the four screws securing the rear plate and carefully separate the rear plate assembly from the control console.
3	Disconnect the ribbon cable for the VFD Display board(s).
4	Remove the screws securing the VFD display board(s) and remove board(s).

Collimator

To remove the collimator:

Step	Action
1	Turn power OFF.
2	Pull the X-ray tube mount down to a comfortable working height and secure by triggering the safety mechanism. Refer to "Safety Mechanism - Telescoping Tube Arm" on page 8-3 for instructions.
3	Rotate the tube mount so that the collimator is on top and the X-ray tube is upside down and secure to prevent rotation.
4	Loosen the screw in the collimator slip ring and remove slip ring and remove the collimator.

X-Ray Tube

To remove the X-ray tube:

Step	Action
1	Turn power OFF.
2	Disconnect the collimator and X-ray tube from the system.
3	Remove the collimator.
4	Rotate the tube mount so that the X-ray tube is right-side up and secure tube mount to prevent rotation.

WARNING

When the mounting screws are removed, the X-ray tube is not secured and may fall if the mount is not prevented from rotating.

Step	Action
5	Remove the X-ray tube cover.
6	Remove the four screws securing the flange and X-ray tube to the tube mount. Remove the X-ray tube.

Transverse Carriage and Bridge

It is suggested that a method of support be provided for holding the carriage when taken down from the ceiling rails. When the EPEX-Omniflex was shipped from the factory the transverse carriage was crated suspended, with the telescopic arm fully retracted. A lifting device capable of holding over a 1000 lbs. will be required for removal.

To remove the transverse carriage and bridge:

Step	Action
1	Remove the control console, collimator and X-ray tube.
2	Raise the tube arm to its fully retracted position and engage the safety mechanism to prevent the tube arm from extending during this procedure.
3	Move the tube crane to a location which will allow the transverse bridge and carriage to be removed without removal of the cables at this time.
4	Position the lifting device beneath the transverse bridge and so that the tube crane be properly balanced upon removal from the ceiling rails.
5	Extend the lifting device until it contacts the rails of the transverse bridge. Lift is so that the lifting device securely holds the weight of the transverse bridge and carriage allowing removal of the socket head bolts securing the bridge bearing assemblies to the rails via the track nuts.
6	Remove the bearing assembly socket head bolts from the track nuts in the transverse bridge rails.
7	Lower the bridge and carriage to a comfortable working height.
8	Remove the covers and cable supports from the carriage. Tie the cabling out of the way on the bridge rails. They should be secured so that the carriage can be removed from one end of the bridge once an end plate is removed.
9	Disconnect the carriage from the wiring harness.

Step	Action
10	Support the carriage on its frame so that the bridge may be removed. When the carriage is supported, remove the lifting device.
11	Remove one end plate and both end stops from one end of the bridge. Support the bridge and remove it from the carriage.
12	Place the bridge on the floor out of the way of the carriage. The carriage is now ready for crating for shipment back to the factory for maintenance.

Longitudinal Rail Bearing Surface

To remove the bearing surface from the longitudinal rails:

Step	Action
1	During the normal life of the system, the bearing surface should not need to be replaced. This procedure is provided in the event that damage occurs.
2	Support the transverse bridge and carriage so that the load is lifted.
3	Remove the end stop from one end of the longitudinal rail to allow access to the end of the strip.
4	Slide the bearing strip out.

Transverse Bridge Rail Bearing Surface

To remove the bearing surface from the transverse bridge rails:

Step	Action
1	During the normal life of the system, the bearing surface should not need to be replaced. This procedure is provided in the event that damage occurs.
2	Support the transverse carriage so that the load is lifted from the bearing strip.
3	Remove one end-plate and stop from one end of the transverse rail to allow removal of the strip.
4	Slide the bearing strip out.

Transverse Bridge Bearing

To remove the transverse bridge bearings:

Step	Action
1	With the transverse bridge adequately supported, remove the lock brackets which cover the access holes for the hex socket bolts.
2	Remove the hex socket bolts from the track nuts and carefully remove the bearing rail.
3	Remove the damaged bearing.

Transverse Carriage Bearing

To remove the transverse carriage bearings:

Step	Action
1	Remove one end stop form the transverse bridge to allow the transverse carriage to be partially pulled out.
2	Support the transverse carriage and pull it out far enough to remove the damaged bearing.
3	Remove the faulty bearing.

Spring Balancer

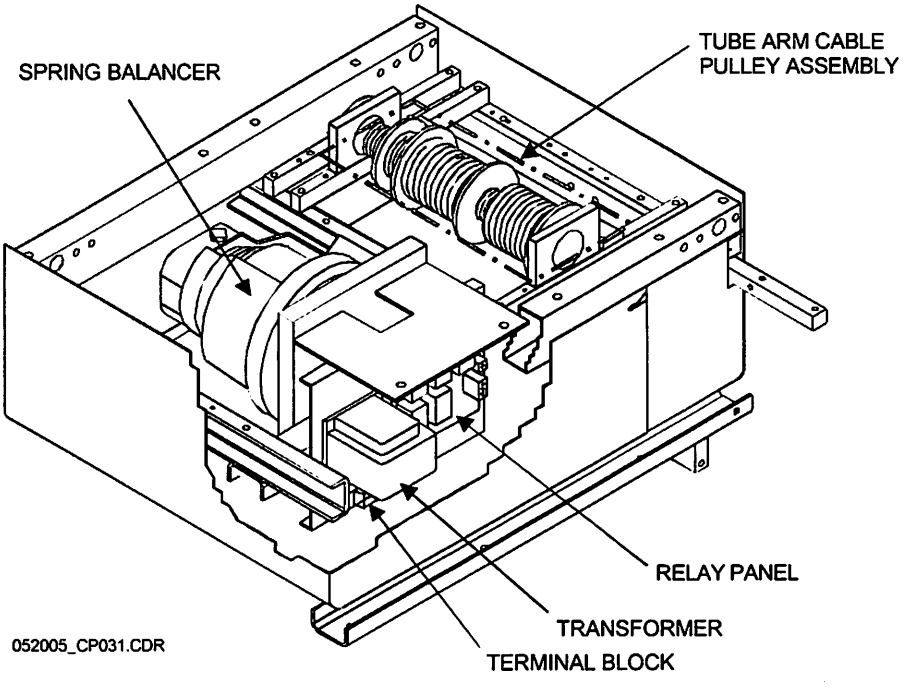
To remove the spring balancer:

Step	Action
1	Engage the safety mechanism so that the tube sections are locked in place. Refer to "Safety Mechanism - Telescoping Tube Arm" on page 8-3 for instructions.
2	Secure the balancer rotating drum check carefully, with a wooden block so that the balancer cables are not under tension.
3	Unscrew cable mounting screws and remove the balancer.

Miscellaneous Transverse Carriage Assemblies

There are many mechanical and electrical parts housed within the transverse carriage (Figure 8-5) which may have to be replaced. The damaged part may be accessed while the transverse carriage is installed. There are two phillips screws on the cable carrier side which require a short-shaft screwdriver for removal. If more access is necessary, remove the transverse carriage. Refer to "Transverse Carriage and Bridge" on page 8-12 for instructions.

Figure 8-5. Transverse Carriage Assemblies



Relay Panel

To remove the relay panel:

Step	Action
1	The relay panel may be accessed while the transverse carriage is still installed.
2	Remove the four phillips screws securing the front cover to the transverse carriage.
3	Disconnect the panel harness connectors from the board connectors.
4	Remove the four screws securing the relay panel and remove the panel.

SID Potentiometer

To remove the VFD displays:

Step	Action
1	The SID potentiometer may be accessed while the transverse carriage is still installed. Refer to Figure 8-6.
2	Remove the cable support arm and allow to hang freely.
3	Remove the rear covers from the transverse carriage.
4	Move the tube arm up or down so that the set screw hole of the pulley comes into view, allowing good access.
5	Remove the SID pulley set screw. It is important to maintain the position of the pulley to back-out the set screw securing the SID pot shaft in the shaft of the tube arm pulley. Back-out the set screw enough to allow the SID pot to be removed, leaving the set screw in place.
6	Remove the wires from the bad SID potentiometer.
7	After installation of new SID potentiometer is complete, perform "SID Calibration" in Chapter 5.

Vertical Drive Motor

To remove the vertical drive motor:

Step	Action
1	Loosen the hardware that secures the needle bearing assembly. This will provide slack in the short drive chain. Refer to Figure 8-7 on page 8-18.
2	Disconnect the motor from the wiring harness.
3	Remove the motor mounting hardware and remove the motor.
4	Remove the sprocket from the motor shaft.
5	When reinstalling the motor, drive chain tension should be set in accordance with "Vertical Drive Chain Tensioning" in Chapter 5.

Figure 8-6. SID Potentiometer

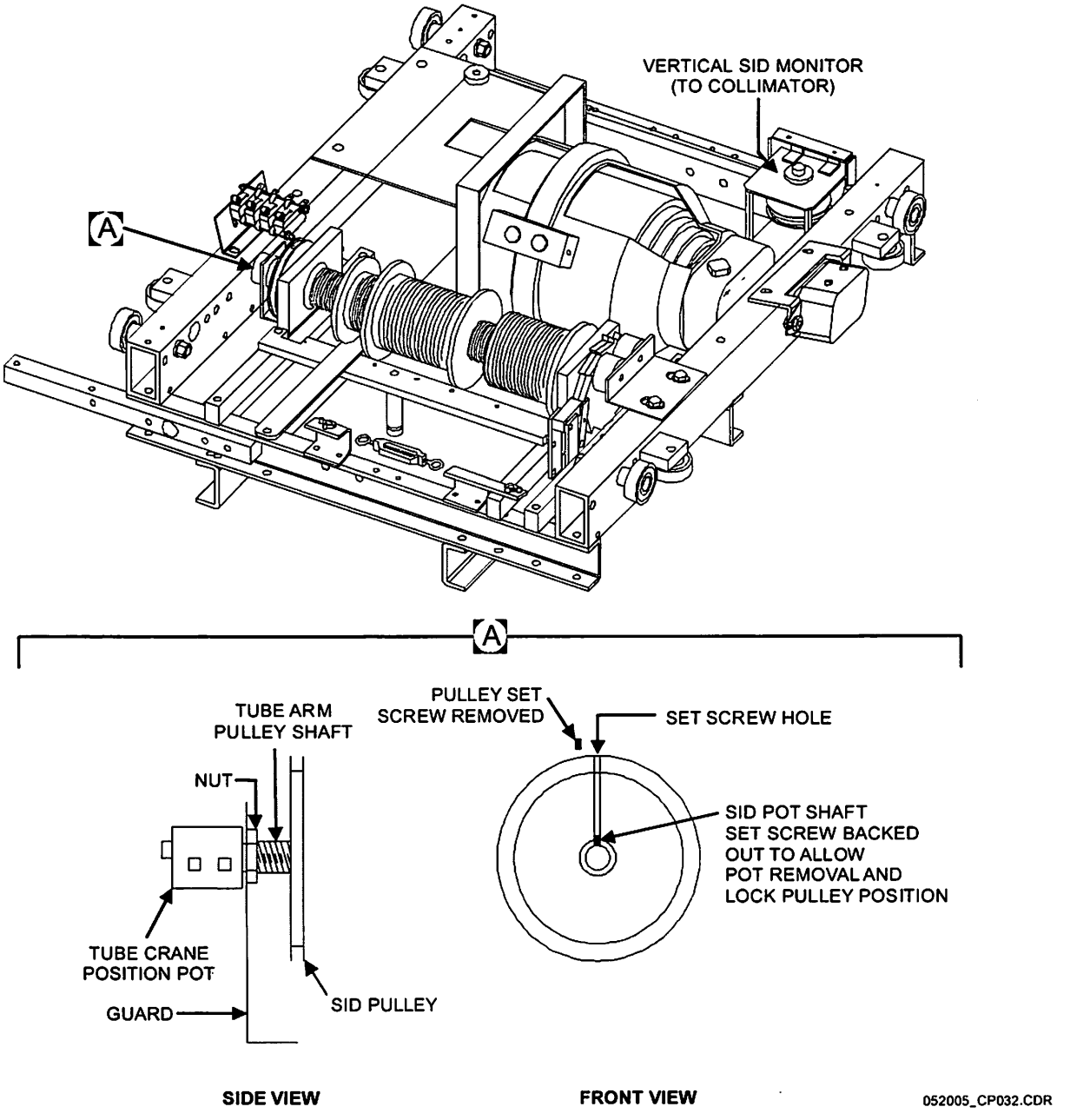
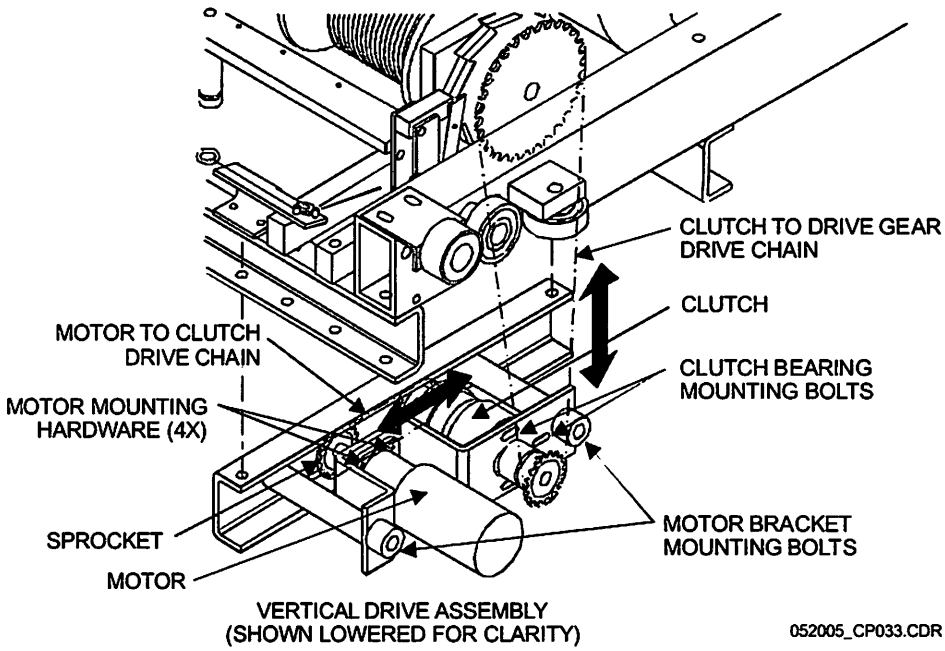


Figure 8-7.
Vertical Drive Motor Assembly



Vertical Drive Clutch

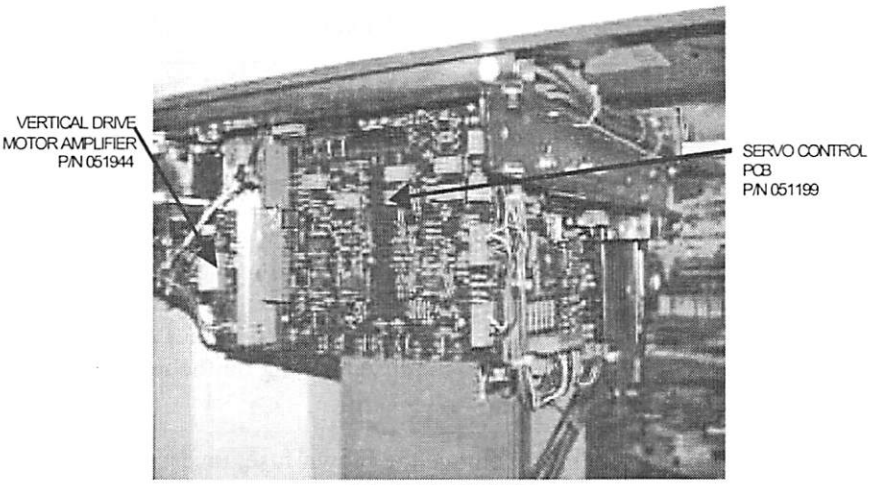
To replace the vertical drive clutch:

Step	Action
1	Loosen the hardware which secures the motor/clutch bracket in position. This will provide slack in the long drive chain. Remove the drive chain from the sprocket. Refer to Figure 8-7.
2	Remove the sprocket and spacer from the clutch shaft.
3	Remove the clutch and needle bearing assembly from the bracket.
4	Remove the drive clutch from the needle bearing assembly.
5	When reinstalling the clutch, drive chain tension should be set in accordance with "Vertical Drive Chain Tensioning" in Chapter 5.
6	Perform the "Vertical Drive Force Adjustment" procedure in this manual

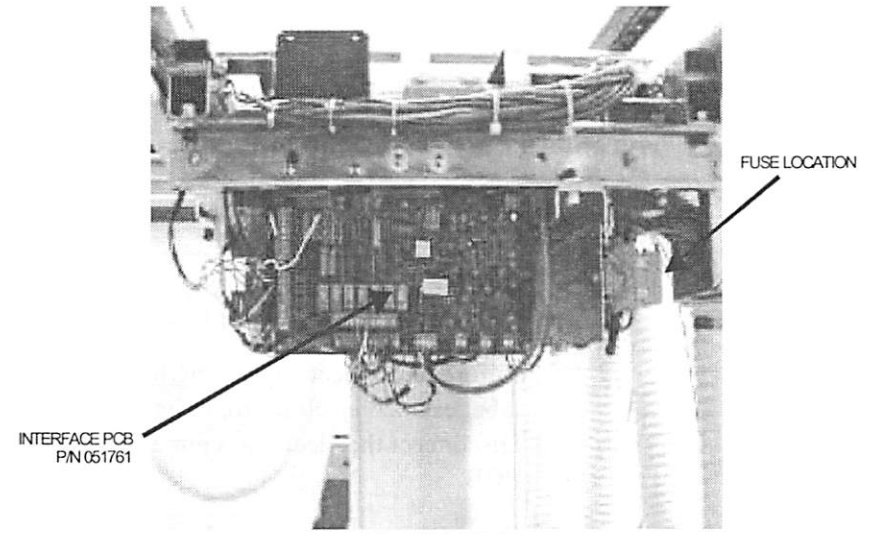
Fuses

The tube crane's input power fuses F1 and F2 are mounted in the terminal block on the right side of the transverse carriage (Figure 8-8 on page 8-19). Refer to Table 8-1 for fuse data.

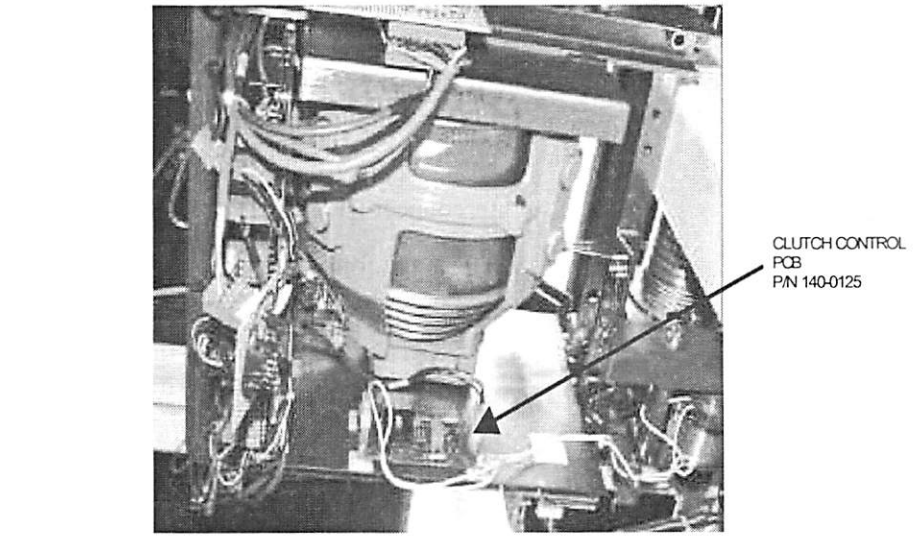
Figure 8-8. Tube Crane PCB and Fuse Locations



(LEFT SIDE OF CARRIAGE)



(FRONT OF CARRIAGE)



(INSIDE OF LEFT SIDE OF CARRIAGE)

Table 8-1. Fuse Data

Fuses	Description
F1	Bussman MDA-1 (1A, time delay, 250 V)
F2	Bussman MDL-7 (7A, time delay, 250 V)

To replace a blown fuse:

Step	Action
1	Open the fuse housing on the terminal block by pulling it forward and downward.
2	Remove the blown fuse, insert the new one, and close the fuse housing.

Servo Control PC Board

To replace the Servo Control PC Board:

Step	Action
1	Remove the tube crane cowling to gain access to the Servo Control PCB (P/N 051199). Refer to Figure 8-8 on page 8-19.
2	Before disconnect any wiring harnesses or electrical connectors, label each connector/wire to its proper location on the PCB. Disconnect the electrical connectors and wiring harnesses from the PCB.
3	Remove the attaching hardware securing the PCB to the transverse carriage and remove the PCB.
4	Position the new PCB and secure in place using the existing hardware. Refer to "Servo Control PC Board" in Chapter 3 for DIP switches and jumper settings for replacement PCB.
5	Reconnect electrical cables to PCB. Refer to the EPEX-Omniflex Interconnect Diagram (P/N 052450) for connection information.
6	Perform the following calibration procedures outlined in Chapter 3 in the order listed: • X-ray Tube Travel Limits Initialization • Lower End of Travel Adjustment • Upper End of Travel Adjustment • Auto Tracking Vertical Speed Adjustment

Interface PC Board

To replace the Interface PC Board:

Step	Action
1	Remove the tube crane cowling to gain access to the Interface PCB (P/N 051761). Refer to Figure 8-8 on page 8-19.
2	Before disconnect any wiring harnesses or electrical connectors, label each connector/wire to its proper location on the PCB. Disconnect the electrical connectors and wiring harnesses from the PCB.
3	Remove the attaching hardware securing the PCB to the transverse carriage and remove the PCB.
4	Position the new PCB and secure in place using the existing hardware. Refer to "Interface PC Board" in Chapter 3 for DIP switches and jumper settings for replacement PCB.
5	Reconnect electrical cables to PCB. Refer to the EPEX-Omniflex Interconnect Diagram (P/N 052450) for connection information.
6	Perform the following calibration procedures outlined in chapter 3 in the order listed: • SID Display and Tracking Settings • Linear Collimator SID Adjustment • Differential SID Display and Offset Adjustment • SID Calibration • Auto Chest Tracking Calibration • Table Mode Tracking Calibration

Clutch Control PC Board

To replace the Clutch Control PC board:

Step	Action
1	Turn off power to the tube crane.
2	Remove the tube crane cowling to gain acces to the Clutch Control PC Board. See Figure 8-8 on page 8-19.
3	Disconnect the two cable connectors from the board.

Step	Action
4	Prior to removing, note the mounting orientation of the installed Clutch Control Board for replacement purposes. Remove the board by depressing the latch on each PCB mount standoff while gently pulling the board away from the standoffs.
5	Mount the new Clutch Control PC Board by aligning the 4 mounting holes with the standoffs and pushing the board onto the standoffs until each latch engages.
6	Reconnect the two cables to their respective connectors on the board.
7	Re-apply power to the tube crane.
8	Perform the "Vertical Drive Force Adjustment" procedure found in Chapter 5.
9	Turn off power to the tube crane.
10	Replace the cowlings on the tube crane.

Vertical Drive Motor Amplifier

To remove the vertical drive motor amplifier:

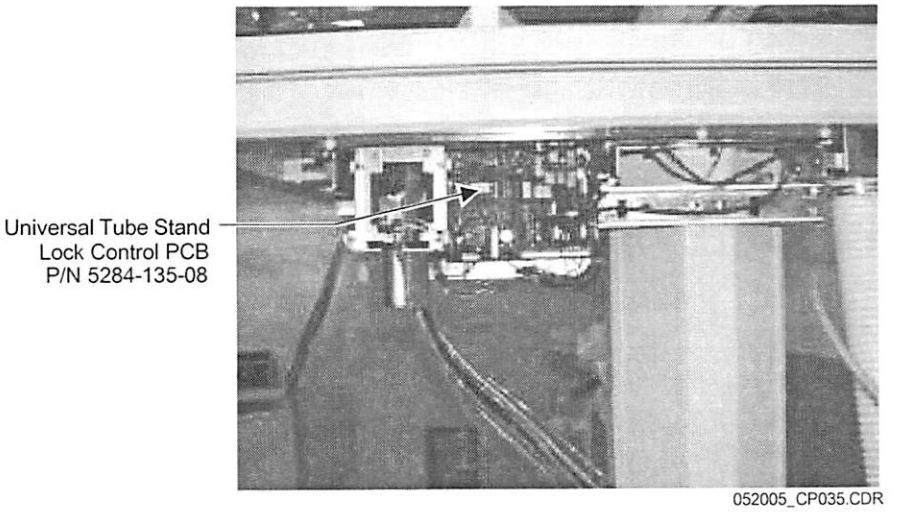
Step	Action
1	Remove the tube crane cowling to gain access to the Vertical Drive Motor Amplifier (P/N 051944). Refer to Figure 8-8 on page 8-19.
2	Before disconnect any wiring harnesses or electrical connectors, label each connector/wire to its proper location on the amplifier. Disconnect the electrical connectors and wiring harnesses from the amplifier.
3	Remove the attaching hardware securing the amplifier to the transverse carriage and remove the amplifier.
4	Position the new PCB and secure in place using the existing hardware.
5	Reconnect electrical cables to PCB. Refer to the EPEX-Omniflex Interconnect Diagram (P/N 052450) for connection information.
6	Perform "Manual Mode Vertical Speed Adjustment" in Chapter 5.

Universal Tube Stand Lock Control PC Board

To remove the Universal Tube Stand Lock Control PC Board:

Step	Action
1	Remove the tube crane cowling to gain access to the Universal Tube Stand Lock Control PCB (P/N 5284-135-08). Refer to Figure 8-9 on page 8-23.
2	Before disconnect any wiring harnesses or electrical connectors, label each connector/wire to its proper location on the PCB. Disconnect the electrical connectors and wiring harnesses from the PCB.
3	Remove the attaching hardware securing the PCB to the transverse carriage and remove the PCB.
4	Position the new PCB and secure in place using the existing hardware. Refer to "Universal Tube Stand Lock Control PC Board" in Chapter 3 for DIP switches and jumper settings for replacement PCB.
5	Reconnect electrical cables to PCB. Refer to the EPEX-Omniflex Interconnect Diagram (P/N 052450) for connection information.
6	No calibration is required for the replacement of the Universal Tube Stand Lock Control PCB.

Figure 8-9.
Universal Tube Stand Lock Control PCB Location



Chapter 9
Diagnostics and Troubleshooting

This chapter describes the diagnostic and troubleshooting procedures for the EPEX-Omniflex Overhead Tube Crane.

Contents

Troubleshooting Tube Crane Mechanical Problems

Symptoms of problems, probable cause, and recommended actions are detailed in Table 9-1.

WARNING

All service and maintenance, including the procedures described within this chapter, are to performed by qualified service personnel only.

WARNING

Disconnect power before performing any maintenance action on the S-9825 Tube Stand.

Table 9-1. Tube Stand Mechanical Problems

Symptom	Possible Cause(s)	Recommended Actions
Tube Crane does not move smoothly lateral and longitudinally with power off.	Dirty Rails	Inspect rails for debris or damage to bearing surface.
	Faulty Bearings	Inspect bearings.
	Faulty Locks	Inspect magnetic lock assemblies.
Tube Crane does not move smoothly or at all vertically with power off.	Safety Mechanism Engaged	Inspect safety mechanism. If engaged, inspect all cables for damage, mechanical integrity, proper mounting.

WARNING

If the safety mechanism is set, there may be a mechanical problem. Proceed with caution when resetting the safety mechanism. Support the tube to prevent the sudden and potentially dangerous extension of the telescopic arm in the event that a cable has failed.

Symptom	Possible Cause(s)	Recommended Actions
	Spring Balancer	Inspect the spring balancer. The spring balancer is equipped with safety pins that protrude and contact safety stops (yellow pins protruding through the housing and held in place with silver retaining rings, in pairs every 120°) in case a spring breaks. This will be evident in that the x-ray tube will move up or down only a short distance. In normal operation the safety pins are visible but clear the safety stops during revolution.

Symptom	Possible Cause(s)	Recommended Actions
	Mechanical Alignment	Verify that the telescoping tube arm is vertical. If the tube arm is not plumb it will not extend/retract smoothly resulting in undue wear or damage to the telescoping sections.
	Faulty Bearing	Listen and feel for bearing grinding during movement. If a bearing internal to the tube arm is damaged and requires replacement, contact Hologic Service Department.

Troubleshooting Tube Crane Electrical Problems

Refer to Appendix C for tube crane wiring diagram and PCB schematics. Symptoms of problems, probable cause, and recommended actions are detailed in this section.

WARNING

All service and maintenance, including the procedures described within this chapter, are to performed by qualified service personnel only.

WARNING

Disconnect power before performing any maintenance action on the S-9825 Tube Stand.

Table 9-2. Tube Crane Electrical Problems

Symptom	Possible Cause(s)	Recommended Actions
	Note: In all cases of fault isolation always verify cable continuity and connector seating before concluding that a PCB is faulty. Most problems can be traced to the connectors, their seating, broken wires or improper connections. Although not explicitly directed to verify wire continuity during troubleshooting (for sake of clarity), perform this check as part of each procedure.	
Control console LED's and Display(s) not illuminated and no locks engaged.	X-ray generator not turned ON.	Operator error; turn X-ray generator ON.
	230 Vac not present at tube crane.	Check for 230 Vac on terminals 1 (230 Vac) and 2 (N) of TB1. Check 230 Vac source.

Symptom	Possible Cause(s)	Recommended Actions
	Blown fuse.	Check fuses F1 and F2 in upper section of EPEX-Omniflex. Replace if necessary.
	Defective Lock Control PCB.	If 24 Vdc is present across J71 pins 1 and 2 on the Universal Tube Stand Lock Control PCB, replace the PCB.
Control console LED's and display(s) not illuminated and all locks engaged.	No power to operator control box.	Unplug J3 from rear of control box and check for 24 Vdc across pins 9 (24 VR) and 14 (+24 V). Check the 24 Vdc source (Universal Lock Control PCB).
	Defective power supply PCB.	Remove rear panel assembly from operator control box, apply power and check the following voltages on the Universal Display CPU PCB: • 5 Vdc across J9 pins 1 (+5 V) and 2 (GND) • 5 Vdc across J11 pins 1 (+5 VC) and 2 (GNDC) • +12 Vdc across J12 pins 1(+12 VA) and 2 (GNDA) • -12 Vdc across J12 pins 2(GNDA) and 3 (-12 VA) • If necessary, replace the Tubestand Controller Power Supply PCB (5284-135-04).
	Defective Universal Display CPU PCB.	If previous steps in this table check out and there is still no activity on the operator control panel, replace Universal Display CPU PCB (5284-135-01).
No locks release when buttons area pressed.	Bad connection between key panel and Universal Display CPU PCB.	Check connection.
	Defective Universal Display CPU PCB.	If pressing the lock release buttons does not cause the appropriate lock status LED(s) to turn off, replace Universal Display CPU PCB (5284-135-01).
X-ray tube rotation lock does not turn on.	Defective Push Button	If the tube rotation lock status LEDs remain ON when either tube rotation button is pressed, replace the Tube Stand Control Panel (4559-134-01).

Symptom	Possible Cause(s)	Recommended Actions
	Defective Lock PCB	If the tube rotation lock cannot be turned on by connecting TP8 (ROTL) to TP2 (24 VR) on the Universal Tube Stand Lock Control PCB, replace PCB (5284-135-08).
X-ray tube rotation lock released without tube rotation buttons pressed.	Defective Push Button	If the tube rotation lock status LEDs are OFF and the tube rotation buttons are not pressed, replace Tube Stand Control Panel (4559-134-01).
	Defective Lock PCB	Unplug J2 at the rear of the operator control box. If +24 Vdc is present between pins 1 (ROTL) and 4 (24 VU) of J2 on the Tube Stand Controller Interconnect PCB, replace the rotational lock. Additionally, a DVM may be used to check the rotation lock for open windings across pins 1 and 4 of P2.
	Defective Lock PCB.	If +24 Vdc is present on TP8 with reference to TP2 on the Universal Tube Stand Lock Control PCB, replace the PCB (P/N 5284-135-08).
Lateral locks do not turn on.	Defective Push Button	If the lateral lock status LED remains ON when the lateral lock button is pressed, replace the Tube Stand Control Panel (4559-134-01).
	Defective Lock PCB	If the lateral lock cannot be turned on by connecting TP5 to TP2 (24 VR) on the Universal Tube Stand Lock Control PCB, replace the PCB (5284-135-08).
Lateral locks released without lateral lock button pressed.	Lateral Center Function Active.	If the lateral center LED on the operator control is ON, the lateral center function is active.
	Defective Push Button.	If the lateral lock status LED is OFF when the lateral lock button is not pressed, replace Tube Stand Control Panel (4559-134-01).
	Defective Lock.	If +24 Vdc is present on J3 pin 2 (TL1) or J3 pin 3 (TCL) with reference to TP2 (24 VR) on the Universal Lock Control PCB, replace the lateral locks. Additionally, a DVM may be used to check the lateral lock for open windings across pins 1 and 3 of P9 and P10.

Symptom	Possible Cause(s)	Recommended Actions
	Defective Lock PCB.	If +24 Vdc is present on TP5 with reference to TP2 (24 VR) on the Universal Tube Stand Lock Control PCB, replace the PCB (5284-135-08).
Lateral center function does not operate in Table Mode.	Lateral Center Function not Active.	If the lateral center LED on the operator control is OFF, the lateral center function is not active.
	Defective Push Button.	If the lateral center soft-key LED does not toggle ON/OFF when the lateral center button is pressed, replace Tube Stand Control Panel (4559-134-01).
	System not in Table Mode.	Verify that the system is set up for Table mode. Refer to "Table Mode" in Chapter 6.
	CAM/Switch out of Adjustment.	If LED DS17 on the Interface PCB (051761) is off, verify that the lateral center switch cam actuates the lateral center switch. Adjust the switch if necessary.
	Defective Switch.	If LED DS17 on the Interface PCB is off, check continuity of lateral center switch and verify switch contacts open/close when cam contact is made. Replace switch if necessary.
	Defective Interface PCB.	If LED DS17 on the Interface PCB is illuminated, check for 24 Vdc measured across JP9A pin 6 and JP11 pin 1. If 24 Vdc in not present, replace the Interface PCB.
Lateral center function does not operate in Wall Mode.	Lateral Center Function not Active.	If the lateral center LED on the operator control is OFF, the lateral center function is not active.
	Defective Push Button.	If the lateral center soft-key LED does not toggle ON/OFF when the lateral center button is pressed, replace Tube Stand Control Panel (4559-134-01).
	System not in Table Mode.	Verify that the system is set up for Table mode. Refer to "Table Mode" in Chapter 6.
	CAM/Switch out of Adjustment.	If LED DS15 on the Interface PCB (051761) is off, verify that the lateral center switch cam actuates the lateral center switch. Adjust the switch if necessary.

Symptom	Possible Cause(s)	Recommended Actions
	Defective Switch.	If LED DS15 on the Interface PCB is off, check continuity of lateral center switch and verify switch contacts open/close when cam contact is made. Replace switch if necessary.
	Defective Interface PCB.	If LED DS15 on the Interface PCB is illuminated, check for 24 Vdc measured across JP9A pin 4 and JP11 pin 1. If 24 Vdc in not present, replace the Interface PCB.
Horizontal SID function does not operate in Wall Mode.	System not in Wall Mode.	Verify that the system is set up for Wall mode. Refer to "Wall Mode Configurations" in Chapter 6.
	Wall Bucky Horizontal SID Switch not Functioning.	Set Interface PCB jumper JP1 to position 2-3 to enter Test mode. LED DS10 (TEST) will illuminate. Press switch S1 to step through the test signals until led DS3 illuminates. Move the tube crane longitudinally and verify that LED DS13 illuminates when the 40 in. horizontal SID switch is actuated and DS12 illuminates when the 72 in. SID switch is actuated and DS11 illuminates when the 44 in. SID switch is actuated. If not, verify that the switch cam actuates the horizontal SID switch. Adjust the switch if necessary. If the appropriate LED still fails to illuminate when the switch is actuated, check continuity of the switch and verify switch contacts open/close when cam contact is made. Replace the switch if necessary. Set jumper JP1 to position 1-2 to return the system to normal operation mode.
	Defective Interface PCB.	If the horizontal SID switches and cables are functional, check for +24 Vdc measured across JP9B pin 4 and JP11 pin 1. If +24 Vdc is not present, replace the Interface PCB.
	Defective Lock PCB.	If 0 V is not present on TP6 (LL1) with reference to TP2 (24 VR) on the Universal Lock Control PCB, replace the PCB (5284-135-08).
Longitudinal lock does not release when longitudinal lock button pressed.	Defective Push Button.	If the longitudinal lock status LEDs remain ON when either longitudinal lock button is pressed, replace the Tube Stand Control Panel (4559-134-01).

Symptom	Possible Cause(s)	Recommended Actions
	Defective Lock PCB.	If +24 Vdc is not present on TP6 (LL1) with reference to TP2 (24 VR) on the Universal Tube Stand Lock Control PCB, replace the PCB.
Longitudinal lock released without longitudinal lock button pressed.	Defective Push Button.	If the longitudinal lock status LED is OFF when neither longitudinal lock button is pressed, replace tube stand control panel (4559-134-01).
	Defective Lock.	If +24 Vdc is present on J5 pin 1 (LL1) with reference to TP2 (24 VR) on the Universal Lock Control PCB, replace the longitudinal locks. Additionally, a DVM may be used to check the longitudinal locks for open windings across pins 1 and 3 of P11, P12, P15, and P17 located near the longitudinal locks.
	Defective Lock PCB.	If +24 Vdc is present on TP6 (LL1) with reference to TP2 (24 VR) on the Universal Tube Stand Lock Control PCB, replace the PCB (5284-135-08).
Vertical clutch does not engage when vertical lock (Up/ Down) Button(s) Pressed.	Defective Push Button.	If the vertical lock status LEDs remain ON when either vertical lock button is pressed (or both buttons pressed for units equipped with vertical servo), replace the Tube Stand Control Panel (4559-134-01).
	Defective Lock PCB.	If 0 V is not present on TP7 with reference to TP2 (24 VR) on the Universal Tube Stand Lock Control PCB, replace the Universal Tube Stand Lock Control PCB (5284-135-08).
Vertical clutch engaged without vertical lock button(s) pressed.	Defective Push Button.	If the vertical lock status LED is OFF when neither vertical lock button is pressed, replace tube stand control panel (4559-134-01).
	Defective Lock.	If +24 Vdc is present on J3 pin 4 (VL1) referenced to TP2 (24 VR) on the Universal Lock Control PCB, replace the vertical locks. Additionally, a DVM may be used to check the vertical lock resistance across pins 3 and 4 of P5, located near the vertical locks.

Symptom	Possible Cause(s)	Recommended Actions
	Defective Lock PCB.	If 0 V is present on TP7 with reference to TP2 (24 VR) on the Universal Tube Stand Lock Control PCB, replace the PCB (5284-135-08).
All locks do not release when all locks release handle pressed.	Defective Push Button.	Disconnect J7 from the Universal Display CPU PCB. If there is no continuity between P7 pins 1 and 2 when the all locks release handle is pressed, replace the EPEX-Omniflex Control Box Handle Switch (4267-135-01).
	Defective Universal Display CPU PCB.	Disconnect J7 from the Universal Display CPU PCB. If there is continuity between P7 pins 1 and 2 when the all locks release handle is pressed, replace the Universal Display CPU PCB (5284-135-01).
X-ray tube angle display incorrect.	Display Not Calibrated.	Calibrate display. See "Tube Angle Display Calibration" in Chapter 5 for details.
	Defective Tube Rotation Pot.	Unplug J2 from the rear of the operator control box (DB9). The resistance between pins 6 and 8 of P2 should be 5kΩ and the resistance between pins 6 and 7 of P2 should vary as the tube is rotated. Replace the tube rotation pot if necessary.
	Defective Universal Display CPU PCB.	If previous steps in this table check out, and tube angle is still not properly displayed, replace the Universal Display CPU PCB (5284-135-01).
SID Display Incorrect.	SID not calibrated.	Perform SID calibration. See "SID Calibration" in Chapter 5 for details.
	Defective SID pot.	Disconnect J16/P16 located near the SID pot. The resistance between pins 1 and 3 of P16 should be 1kΩ and the resistance between pins 1 and 2 of P16 should vary as SID changes. Replace the SID pot if necessary.

Symptom	Possible Cause(s)	Recommended Actions
	Defective Chest Unit Control Circuit.	Disconnect J4/P4 from the rear of the operator control box. Measure the voltages across the following pins of P4: • pin 8 to pin 7 should be +12 Vdc • pin 8 to pin 20 should be -12 Vdc • Pin 8 to pin 21 should vary as SID changes. • If any of the above voltages are not present, check voltages on Chest Unit Control PCB (5284-125-01) and Dedicated Chest Unit Control PCB (5284-125-02).

Appendix A
Tube Crane Specifications

This appendix details the EPEX Omniflex Overhead Tube Crane specifications.

Contents

EPEX-Omniflex Overhead Tube Crane

Weight	14 ft. (4.27 m) Longitudinal Rails	154 lb. (69.5 kg)
	16 ft. (4.88 m) Longitudinal Rails	177 lb. (80.2 kg) (Optional Equipment)
	18 ft. (5.49 m) Longitudinal Rails	200 lb. (90.7 kg) (Optional Equipment)
	20 ft. (6.09 m) Longitudinal Rails	225 lb. (102.0 kg) (Optional Equipment)
	8 ft. (2.44 m) Transverse Bridge	175 lb. (79.3 kg) (Optional Equipment)
	10 ft. (3.05 m) Transverse Bridge	200 lb. (90.7 kg)
	12 ft. (3.66 m) Transverse Bridge	225 lb. (102.0 kg) (Optional Equipment)
	14 ft. (4.27 m) Transverse Bridge	250 lb. (113.3 kg) (Optional Equipment)
	16 ft. (4.88 m) Transverse Bridge	275 lb. (124.7 kg) (Optional Equipment)
	Tube Crane Assembly	300 lb. (136.0 kg)
	X-ray Tube/Collimator	75 lb. (34.0 kg)
Muliplanar Motion	Angulation about the Horizontal Axis	±140°
	Angulation about the Vertical Axis	±180°
	Vertical Travel	Nominal 60 in. (152.4 cm)
Output Heat	400 BTUs/Hr (421 kJ/Hr)	

Physical Specifications

The outline of the Overhead Tube Crane is detailed in Figure A-1, Figure A-2, and Figure A-3.

Environment

Transit/Storage

Temperature:	-20° to +70°C (-4° to +158°F)
Relative humidity:	10% to 95% (allow condensation dry time before installing)
Atmospheric Pressure Ranger:	500 to 1060 hPa (375 to 795 mm Hg)

Operating

Temperature:	10° to 40°C (50° to 104°F)
Relative humidity:	30% to 75%, non-condensing
Atmospheric Pressure Ranger:	500 to 1060 hPa (375 to 795 mm Hg)

Installation Requirements

Ceiling

Suggested Height: 114 in. (289.5 cm)

Figure A-1. EPEX Omniflex Operating Range

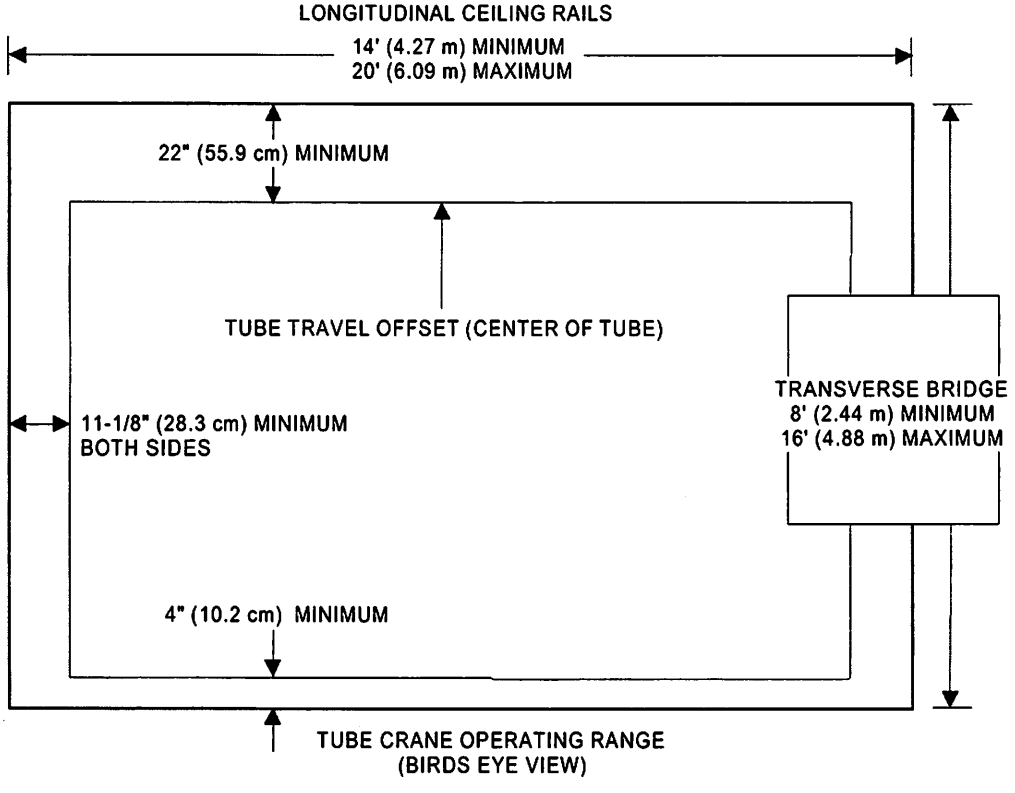


Figure A-2. Tube Crane Operating Envelope

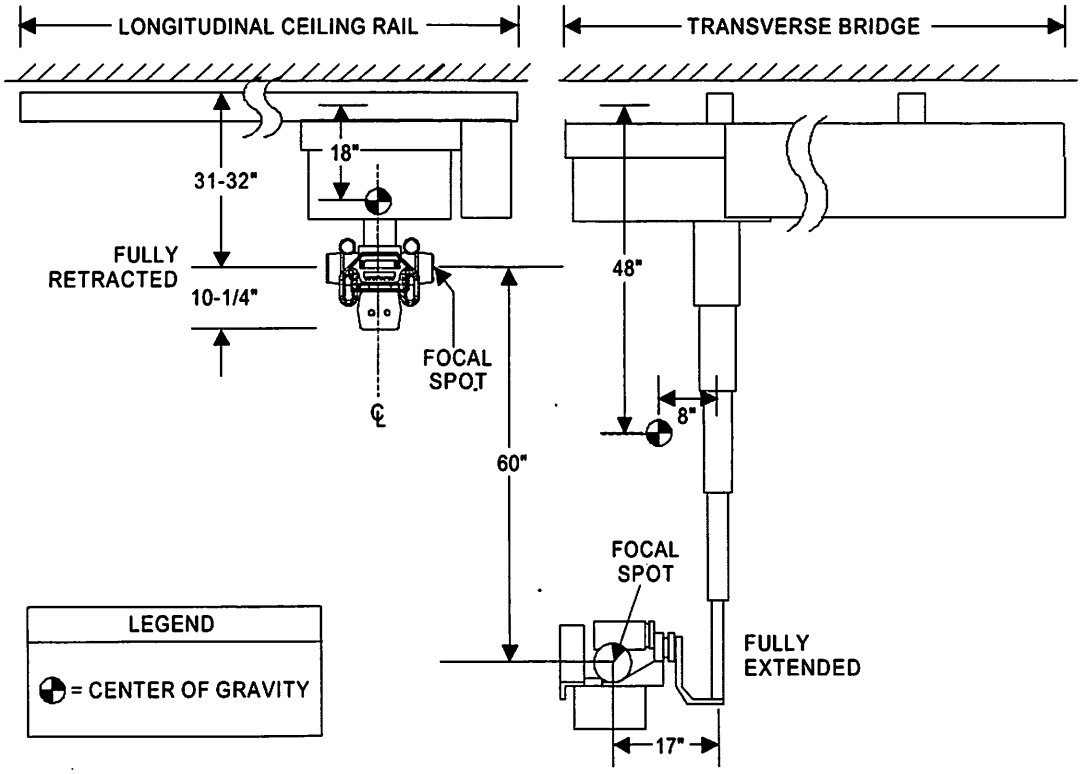
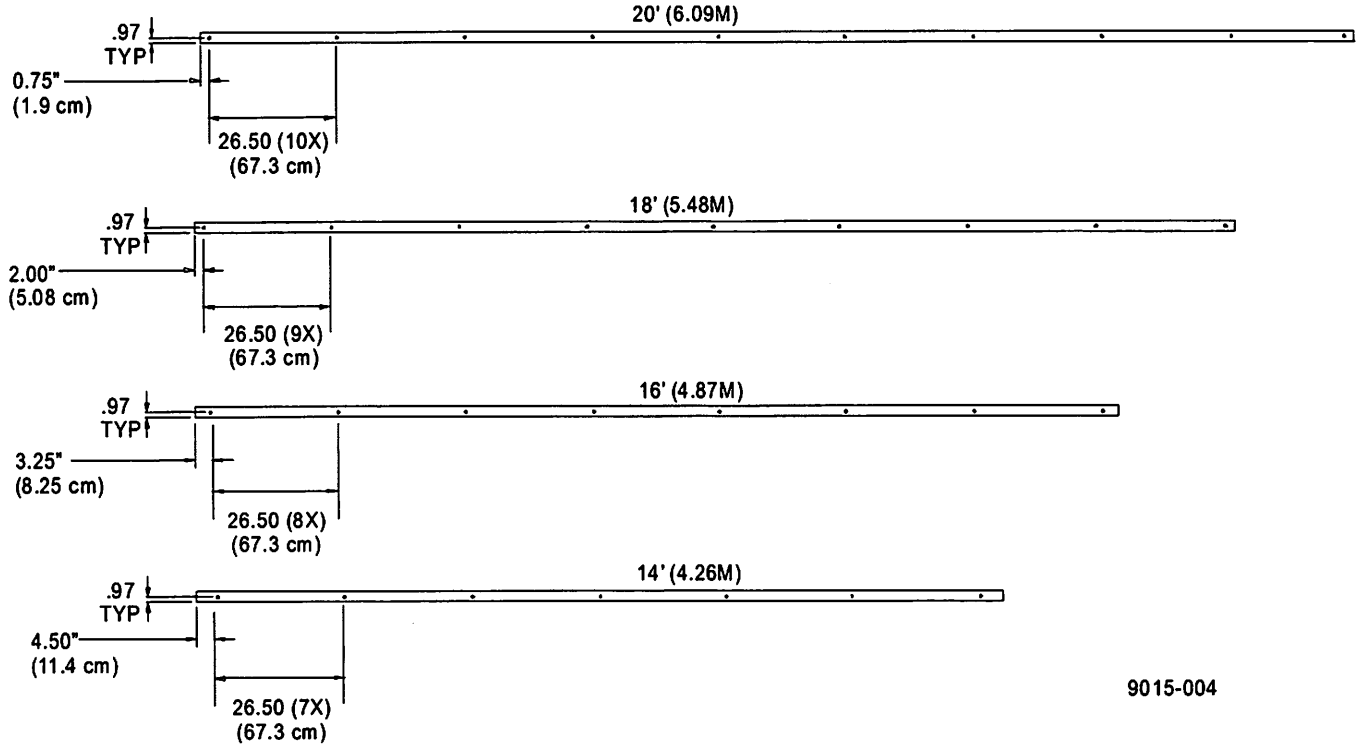


Figure A-3. Longitudinal Rail Mounting Hole Pattern



Appendix B
Forms

This appendix provides the required forms for the installation and preventive maintenance of the EPEX-Omniflex Overhead Tube Crane.

Contents

Overhead Tube Crane Installation

On the following page is the form required when installing the overhead tube crane using the procedures in Chapter 4.

EPEX-Omniflex Overhead Tube Crane Installation Checklist

- ❑ Delivery Completed
- ❑ Equipment Unpacked
- ❑ Positioning the Equipment
- ❑ Overhead Tube Crane
  - ❑ Position
  - ❑ Install the Longitudinal Rails
  - ❑ Install the Transverse Bride
  - ❑ Install the Transverse Carriage
  - ❑ Install the X-ray Tube
  - ❑ Install the Collimator
  - ❑ Install Control Console
  - ❑ Cable Drapes
- ❑ Electrical and Communication Lines:
  - ❑ X-ray Tube Anode and Cathode Cables
  - ❑ System Cables
- ❑ System Calibration

Preventative Maintenance Form

On the following page is the form required when performing the semi-annual preventive maintenance actions.

Semi-Annual/Annual Preventive Maintenance Checklist

Semi-Annual:

Inspection	Comments
☐ Inspect spring balancer cables for signs of wear, kinks, broken strands, or any other deformities that may exist.	
☐ Inspect main support cables for signs of wear, kinks, broken strands, or any other deformities that may exist.	
☐ Inspect bearings for serviceability. Replace bearings as required.	
☐ Inspect safety mechanism for proper operation; ease of movement. Inspect cable for proper tension (no slack). Replace cable if any of the following conditions exist: wear, kinks, broken strands, or any other deformities that may exist.	
☐ Perform safety mechanism operational check.	
☐ Check all electrical connections for condition, security, and cables for proper dressing.	
☐ Check for proper operation of control console cooling fan; ensure blades are clean.	
☐ Perform tube crane operational check.	
☐ Check markings on control panel and equipment labels for legibility. Replace as required.	

Annual:

Inspection	Comments
☐ Clean all exterior surfaces of the equipment.	

Epex-Omniflex Tube Crane Operational Check

On the following page is the form required when performing the Omniflex Tube Crane operational check.

EPEX-Omniflex Overhead Tube Crane Operational Check

Step	Pass	Fail
1. Ensure system power is OFF.		
2. Verify the X-ray tube moves freely in all axes; transverse, vertical, longitudinal, and rotational.	❑	❑
3. Verify the X-ray tube is properly balanced (tube does not drift up or down).	❑	❑
4. Ensure system power is OFF.		
5. Press either tube angulation lock release soft-key and verify the X-ray tube moves freely throughout its full range of travel.	❑	❑
6. Verify the tube angulation lock status LEDs are ON when the tube angulation soft-keys are not pressed, and OFF when either soft-key is pressed.	❑	❑
7. Verify the tube angulation mechanically detents at the horizontal position and the tube angel display reads "0°"..	❑	❑
8. Verify the tube angulation mechanically detents at 90 degrees clockwise and the tube angle reads "90°".	❑	❑
9. Verify the tube angulation mechanically detents at 90 degrees counterclockwise and the tube angle reads "90°". Return the X-ray tube to the horizontal position.	❑	❑
10. Press the transverse lock release soft-key and verify that the X-ray tube moves freely throughout its transverse range of motion.	❑	❑
11. Verify the transverse lock status LED is ON when the transverse lock is applied and OFF when the lock is released.	❑	❑
12. Angulate the X-ray tube 90 degrees towards the wall Bucky. Press the transverse lock release soft-key for wall mode configurations "A" and "C" or the longitudinal lock release soft-key for wal mode configuration "B". Verify the X-ray tube moves freely until it engages the lateral center mechanical detent.	❑	❑
13. Verify lateral center mechanical alignment to the Bucky in wall and table modes.	❑	❑
14. Angulate the X-ray tube 90 degrees towards the wall Bucky. Press up and down soft-keys simultaneously and verify the X-ray tube moves freely throughout its full range of vertical travel.	❑	❑
15. Press the vertical drive up soft-key and verify that the X-ray tube drives up.	❑	❑
16. Press the vertical drive down soft-key and verify that the X-ray tube drives down.	❑	❑
17. Verify the display shows "- - -" in table mode when the Bucky is not at X-ray height or if the X-ray tube is at an angle outside of ±15°.	❑	❑
18. Press each longitudinal lock release soft-key and verify the X-ray tube moves freely throughout its full range of longitudinal travel.	❑	❑
19. Verify the longitudinal lock status LEDs are ON when either longitudinal lock release soft-key is not pressed and OFF when either lock release soft-key is pressed.	❑	❑
20. Angulate the X-ray tube 90 degrees towards te wall Bucky and verify the display shows "SID-WALL".	❑	❑

EPEX-Omniflex Overhead Tube Crane Operational Check

Step	Pass	Fail
21. Move the X-ray tube longitudinally and verify the longitudinal locks are applied when the X-ray tube reaches each horizontal SID and the display shows the correct SID for each position.	❑	❑
22. Verify the X-ray tube moves freely in the vertical, transverse, and longitudinal directions when the all locks release handle is squeezed.	❑	❑
23. Trip the safety mechanism by pulling on one of the sensor cables. Verify the X-ray tube will not move up or down.	❑	❑
24. Reset the safety mechanism for normal operation.	❑	❑
25. Repeat Steps 24 and 25 using the other sensor cable.	❑	❑
26. Enter table mode, turn on "Auto" mode, and verify the X-ray tube positions itself at the predetermined SID of either 40 inches (101.6 cm) or 44 inches (111.76 cm) above the table Bucky at all Bucky heights where the X-ray tube travel is not limited by calibration. Verify actual SID using the collimator tape measure. ***Note:*** *The DirectRay detector array is located two inches below the Bucky surface.*	❑	❑
27. Enter wall mode, turn on "Auto" mode, and verify the X-ray tube positions itself at 72 inches (182.9 cm) SID. Verify the X-ray tube aligns itself vertically with the Bucky throughout the Bucky's range of travel (the X-ray tubes travel may be limited by calibration settings). Verify the actual SID using the collimator tape measure.. ***Note:*** *The DirectRay detector array is located two inches below the Bucky surface.*	❑	❑

Note: *If the EPEX-Omniflex Overhead Tube Crane fails any portion of this operational check, stop the operational check and correct the problem. Once the problem has been rectified, restart the operational check from the beginning.*

Appendix C
Field-Replaceable Units

This appendix lists the names and part numbers for the most commonly field-replaced components.

Contents

Ordering Parts

Parts can be ordered from:

Hologic, Inc.
35 Crosby Drive
Bedford, MA 01730 USA
Service: 1-877-371-4372

Component	Part Number	Description	Units Per Assembly
Tube Crane Assembly	S-9906	Assy, Omni-IV, EPEX, W/Tracking	0
Control Box	051937	Assy, Control Box, W/Tracking	1
	5284-135-04	Assy, PCB, Power Supply	1
	5284-135-07	Assy, PCB, Tubestand Controller Interconnect	1
	051933	Assy, PCB, Tubestand Controller Display W/Software	1
	4189-135-02	Display, VF 2X40 4.7mm	1
	4189-135-03	Display, VF 2X20 .5mm MDFD	1
	4283-134-02	Fan, 24 Vdc	1
Vertical Drive Assembly	051738	Assy, Vertical Drive	1
	049321	Motor, Dc, Brushless	1
	052024	Gear Head, Motor 50:1	1
	4186-125-01	Clutch, 28Vdc Electromagnet	1
	228-1100-01	Chain, 1/4P #25 Single	0.77 ft.
	01372	Link, Master # 25	1
Vertical Drive Electronics	051983	Assy, Vertical Drive Electronics	0
	051199	Assy, PCB, Auto Chest Servo Control	1
	051994	Assy, Driver, Brushless Dc Motor	1
Tube Mount Assembly	5536-134-06	Assy, Omniflex Tube Mount	0
	5236-133-03	Assy, Lock, Rotation Magnetic	1
	5236-135-01	Assy, Angulation Potentiometer	1

Component	Part Number	Description	Units Per Assembly
EPEX-Omniflex Control	052446	Assy, Control, EPEX-Omniflex	0
	052470	Assy, Transformer, 115/230, 24, 130VA	1
	5284-135-08	Assy, PCB, Universal Tubestand Lock Control	1
Interface PCB	051761	Assy, PCB, Interface, EPEX-Omniflex	1
Clutch Control PCB	140-0125	Assy, PCB, Clutch Control	1
Lateral SID Switch Bank	010-1493	Assy, Lateral SID Switch	1
	4181-851-01	Switch, SPDT Roller Micro	4
Horizontal SID Switch Bank	5136-134-11	Assy, Horizontal SID Switch	1
	4181-851-01	Switch, SPDT Roller Micro	4
Lateral SID Detent Assembly	052182	Assy, Detent, Lateral SID	4
Mechanical Detent Plunger	052334	Assy, Track Roller	4
Magnetic Lock Assembly	5236-134-25	Assy, Large Magnetic Lock	3
Vertical SID Potentiometer Assembly	5187-134-20	Assy, CA, SID, Potentiometer	1
Rotation Potentiometer Assembly	5185-135-02	Assy, CA, Rotation Potentiometer	1
Mains Power Input Fuse	590-0577	Fuse, 1A, 250V, Time Delay	1
24 Volt Power Fuse	590-0578	Fuse, 7A, 250V, Time Delay	1

Appendix D
Tube Crane Wiring Diagram

This appendix includes the schematics for the EPEX-Omniflex Overhead Tube Crane Interconnect Diagram as well as PCB schematics.

Glossary

The glossary contains general terms that are used in the tube crane service manual.

Anode	The positively charged portion of a vacuum tube. In the X-ray tube, the anode contains the target that is bombarded by electrons during X-ray production.
Autoclave	The process of disinfecting articles by heating them with pressurized steam.
Bucky	The component that houses the DirectRay Detector, AEC, moving grid, and related components. In the DirectRay System, the Bucky contains the DirectRay Detector instead of the conventional film cassette.
Calibration	Process of measuring the actual output of a machine as compared to its indicated or metered output.
Capacity	General term referring to the maximum output of a machine or to the ability that a device possesses to sustain a load.
CE Mark	Name of the regulatory clearance needed to ship products to Europe.
Central Ray	Theoretical center of the X-ray beam. The central ray leaves the focal spot at 90° from the long axis of the tube housing. Also known as the principle ray.
Collimator	Regulates the size and shape of the X-ray beam to accurately localize the area of interest on the patient, while reducing overall patient irradiation exposure.
Cone	Cone-shaped device placed between the X-ray tube and the patient to limit the beam of primary radiation striking the part, thus reducing the amount of secondary radiation that is formed.
Diagnostic X-ray System	An X-ray system designed for irradiation of any part of the human body for the purpose of diagnosis or visualization.
Focal Distance	The distance from the source of the X-rays to the patient.
General Radiography	Imaging of skeletal structures in large anatomic areas like the limbs, chest, and the abdomen. Also referred to as Projection Radiography.
Generator	Device that supplies power to and controls the X-ray tube.
Lateral	Possible view position for X-ray exposure so that the X-ray beam passes from one side to the other. Pertaining to the side away from the midline.

Longitudinal	Positioning along the patient axis.
Portrait Position	The long dimension, parallel to the patient axis.
Radiological Society of North America (RSNA)	Largest scientific society of radiologists and medical physicists.
RSNA	Radiological Society of North America.
Three-phase Generators	A three-phase Generator produces an almost constant voltage because there are no deep valleys between pulses. Commercial electric power is usually produced and delivered by three-phase alternating-current (ac) generators.
Transformer	Device that either increases or decreases the voltage in a circuit.