Chapter 4 – Physical Planning of the Site

4.1 General

This chapter provides information required for room layout, site considerations and provides the requirements for the Nuclear Medicine Suite.

When laying out the installation room, thought should be given to provide the best possible functional and personnel working conditions.

Evaluate with respect to the room size the best possible relative positioning of the Gantry / Patient Table and PC Acquisition console within the room.

Allow access around the entire Gantry / Patient Table for personnel to move and help with patient positioning, and patient assistance during emergencies. Access to the system by patients confined to hospital beds should also be considered (enough room to maneuver and position the bed).

Bear in mind that the front of the patient table must be moved during the changing of the collimators. Consider where to position the collimator carts (one for each set of collimators) when these are not in use and where to move the patient table front during collimator change.

Consider cable lengths between system components and the power connections to mains sockets and the position of those sockets.

Note

After these provisional site plans are completed, they should be submitted to your GEHC representative for validation

GEHC accepts no responsibility for installation problems resulting from site plans which have not been approved by GEHC.

4.2 Selecting the Site

The Nuclear Imaging System requires one room, which will contain the following sub-systems:

- Gantry
- Table
- Computer + Monitor
- Collimator Cart(s)

Separate rooms are recommended for the following utilities:

- Office/Viewing/Processing Room
- Patient waiting room
- Patient preparation room
- Hot lab
- Printing room

Figure 4-1 shows an aexample of a site layout.

The selection of the scan area should be based on the following considerations:

- Easy access to Emergency Switch
- Influence of the surrounding rooms (radio active or magnetic sources)
- Influence of the local wireless environment
- Distance to "hot areas" such as:
  - Hot laboratory
  - Patient toilets
  - Patient waiting/preparation rooms
- Distance from diagnostic area such as:
  - Processing room
  - Viewing room
- If the patient is rolled in on a bed, facilities should be provided to "slide" the patient onto the Scanning Table.
- Floor loading capacity, as per Section 4.7 and Figure 4-10.

The selection of the Acquisition Station area should be based on the following considerations:

- Position relative to the camera:

- Gantry - Acquisition Station cable limitations
- Convenient accessibility to Gantry and Table for daily activity

- Access to communication lines (for details refer to Chapter 7):
  - Ethernet connection
  - Telephone connection for Modem, if relevant
  - Connection to hardcopy device, if it is to be directly connected to the system
- Feasibility of Emergency Unit installation within operator reach

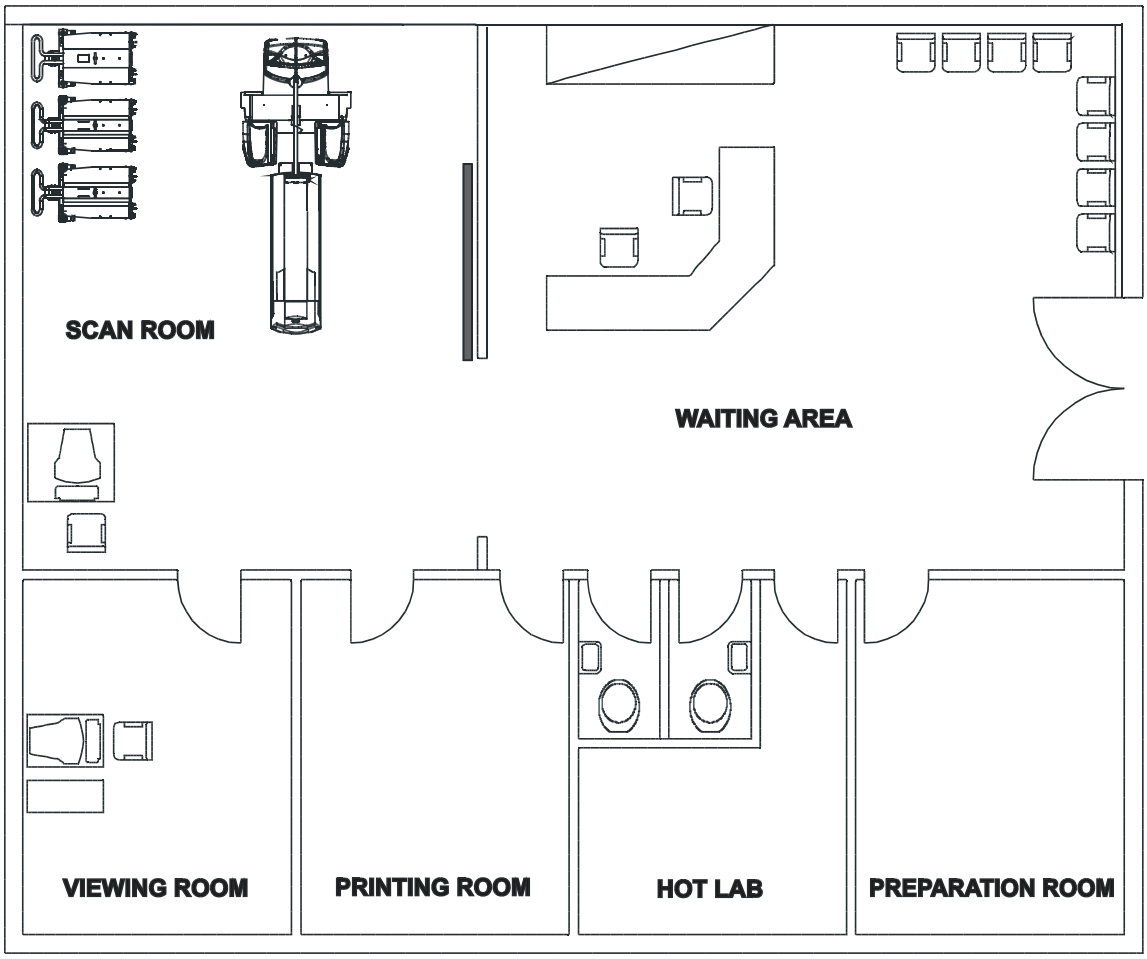


Figure 4-1 Example Area Layout

4.3 Room Size

Examples of typical and minimum room layouts are shown in Figure 4-5, and Figure 4-6, respectively. In the examples shown, the following items are included:

- Gantry
- Table
- Collimator Carts
- Acquisition Station
- Multi Imager
- Operator's Chair
- Emergency Button

When planning your room layout you must take into consideration the clearance area required for servicing the imaging system (see Figure 4-5 and Figure 4-6).

NOTE: For Systems installed in China Only

The **room height**, should be minimum 2.5 meters. This height is required for mounting the Crane used to lift and install the Detectors.

4.4 Operator Safety

4.4.1 Room Shielding

The Infinia System with Hawkeye produces X-ray radiation and involves the use and storage of radio nuclides. Appropriate barriers such as walls, lead-shielded glass, lead shields, etc. must be installed to protect staff from unnecessary exposure to radiation.

The patients become significant sources of radioactivity, therefore consideration should be given to maximize the distance between the patient and operator during the uptake and acquisition phases of scan procedures.

Scatter-room shielding requirements must be reviewed by a a qualified radiological health physicist taking into consideration:

- Scatter radiation levels within the scanning room
- Equipment Placement
- Weekly projected workloads (#patient/day technique (kvp*ma)
- Materials used for construction of walls, floors, ceilings, doors and windows
- Access to surrounding scan room areas
- Equipment in surrounding scan room area (e.g. film developer, film storage)

	Specific room shielding requirements should be determined by local regulatory considerations, facility policy and if available, the facility physicist.

4.4.2 Background Radiation

In order to facilitate and improve service and field calibration, all radiation sources should be suitably shielded.

In case the room is close to the injection room or to the hot room (were the technologists prepare or receive the radioactive source) or to the patient waiting room (after injection), a careful background level verification should be performed.

4.4.3 X-ray Scatter Plots

4.4.3.1 Scatter Isocontour Plot

The X-ray Scatter Isocontour Plots shown in Figure 4-2 were created using the following parameters:

- Body phantom
- Slice thickness 1*10mm
- High Voltage – 140kV
- Current – 2.5mA,
- 37.5mAsec/scan – half scan duration time is 14 seconds/slice

Important All scatter radiation measurements have an accuracy of ± 20% due to measurement equipment, techniques and system-to-system variation.

Isodose Contours at 40cm above floor:

The Iscontour levels in the elevation plot are: 10 - 100 MicroGrays per hour (1 - 10 mR/hour).

Since scan time is 15 second per slice the isocontours levels are 0.004 - 0.042 mR/SCAN respectively.

Isodose Contours at 90cm above floor:

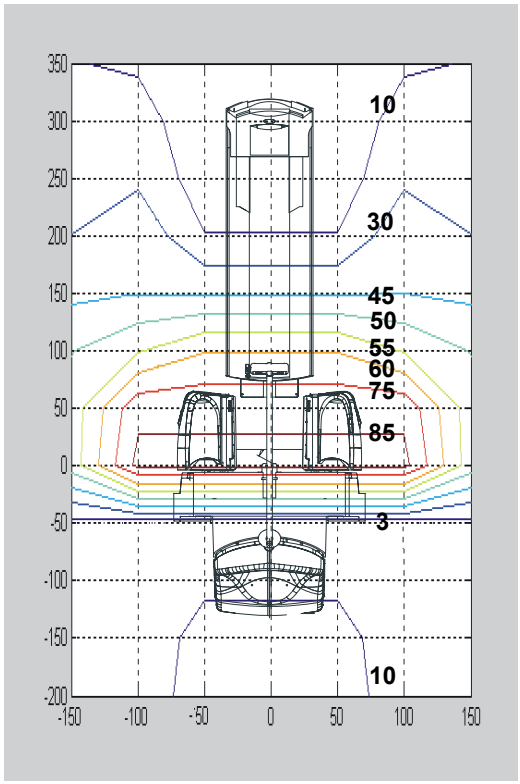
The Iscontour levels in the elevation plot are: 10 - 200 MicroGrays per hour (1 - 20 mR/hour).

Since scan time is 15 second per slice the isocontours levels are 0.004 - 0.083 mR/SCAN respectively.

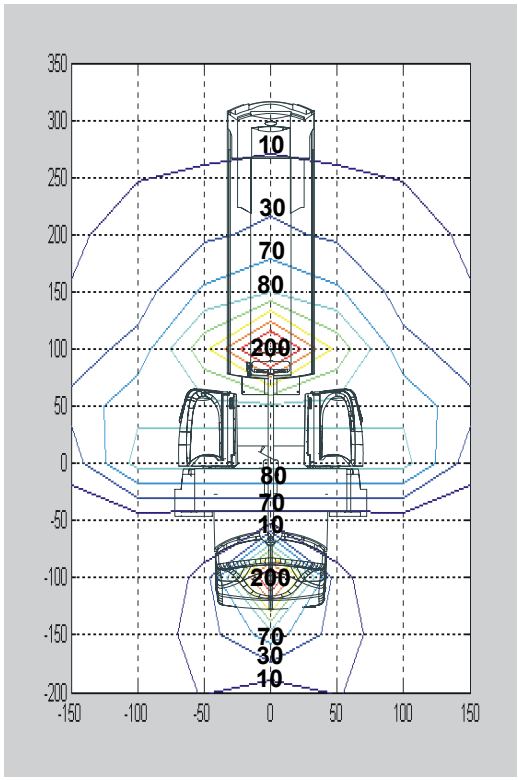
Isodose Contours at 140cm above floor:

The Iscontour levels in the elevation plot are: 10 - 130 MicroGrays per hour (1 - 13 mR/hour).

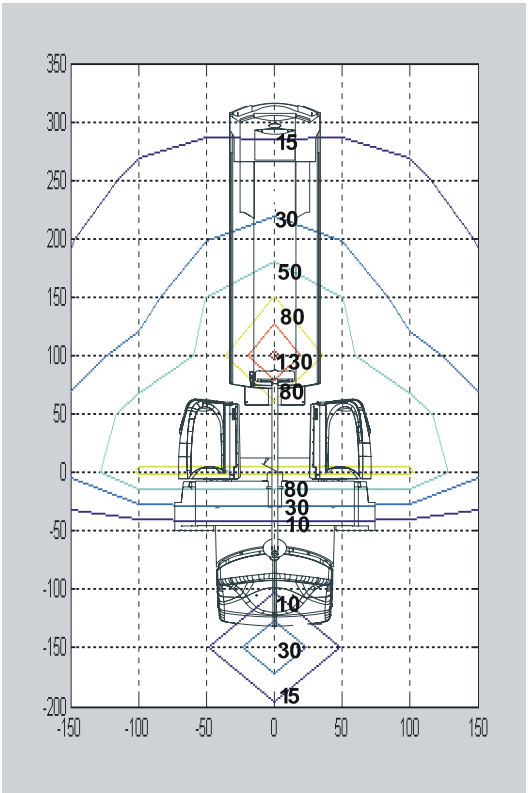
Since scan time is 15 second per slice the isocontours levels are 0.004 - 0.054 mR/SCAN respectively.



40cm Above Floor



90cm Above Floor



140cm Above Floor

Figure 4-2 X-ray Scatter Radiation Isocontours in µGray/hr

4.4.3.2 Elevation Scatter Plot

The X-ray Elevation Scatter Plot shown in Figure 4-3 was created using the following parameters:

- Body phantom
- Slice thickness 1*10mm
- High Voltage – 140kV
- Current – 2.5mA,
- 37.5mAsec/scan

The Iscontour levels in the elevation plot are: 20 - 200 MicroGrays per hour (2 - 20 mR/hour).

Since scan time is 15 second per slice the isocontours levels are 0.008 - 0.083 mR/SCAN respectively.

The elevation plot used has cylindrical symmetry 180 degrees around the center of rotation axis (from right to left of the COR axis above the floor).

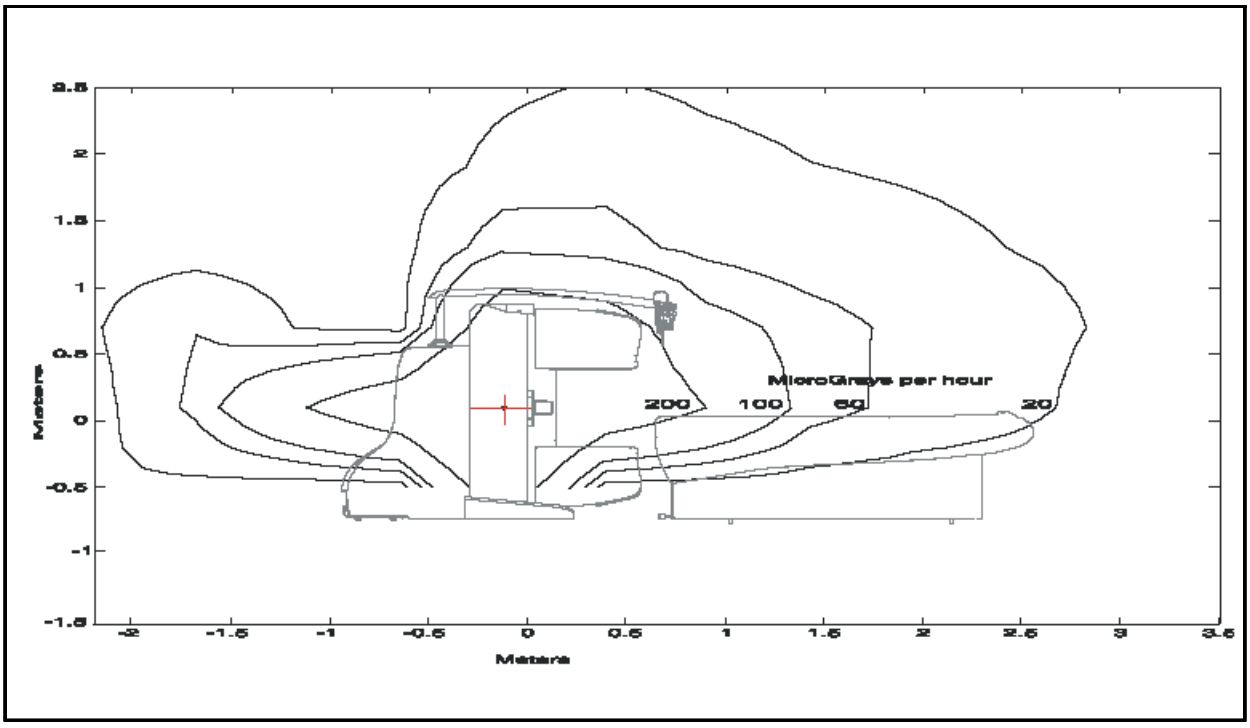


Figure 4-3 X-ray Scatter Radiation Isocontours in µGray/hr - Elevation Plot

4.5 Required Systems Clearances

Consult your local GE Sales and Project Manager of Installation (PMI) about your specific needs. Some possible room size dimensions are shown in the table below.

4.5.1 Room Size Dimensions

Room Options	Size in cm (feet)
Minimum room size	549 (18’0”) x 386 (12’8”)
Typical room size	600 (19’8”) x 400 (13’2”)

For system component dimensions refer to Chapter 2.

For clearance requirements, refer to Figure 4-4 through Figure 4-6 in this chapter.

Consult your local General Electric Project Manager of Installation (PMI) for your appropriate room specifications

Remember, sufficient Regulatory, Service and Egress clearances must be maintained around equipment for full operation, service and safety.

Cable length is an important consideration in room layout. The system is shipped with standard length cables.

Excess cable length can be stored behind the IPS. Long cable must not be cut or shortened. All NEC 70-E Electrical Regulations must be observed.

4.5.2 Regulatory and Service Clearances

4.5.3 Regulatory Clearances

MINIMUM CLEARANCES UNDER U.S. FEDERAL REGULATIONS AND NATIONAL STANDARDS: 29 CFR 1910 (OSHA), NFPA 70E (STANDARD FOR ELECTRICAL SAFETY IN THE WORKPLACE), AND NFPA 101 (LIFE SAFETY CODE):

A diagram of clearance requirements for U.S. regulatory compliance is shown in Figure 4-4. See the clearance tables on the following pages for detailed dimensional clearances.

Please note all systems installed in the United States must comply with all Federal and local regulations.

For installations outside the United States, country-specific or other local regulatory clearance requirements must be met.

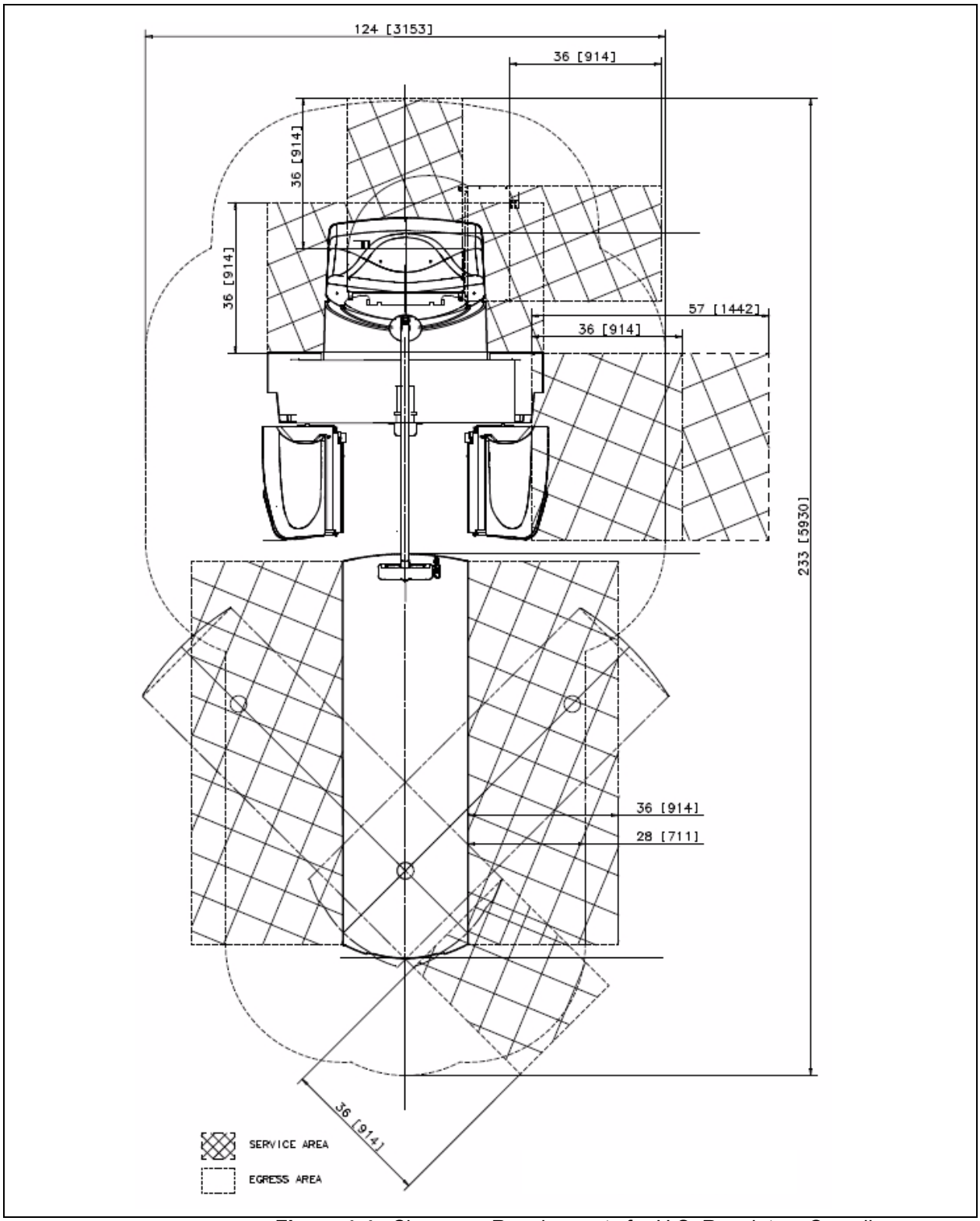


Figure 4-4 Clearance Requirements for U.S. Regulatory Compliance

The Egress Area can be defined on either side of the system, depending on equipment positioning and space availability.

4.5.4 Regulated Minimum Working Clearance by Major Subsystem

- Requirements apply to equipment operating at 600 V or less, where examination, adjustment, servicing, or maintenance is likely to be performed while live parts are exposed.
- Direction of Service Access is defined as perpendicular to the surface of the equipment being serviced.
- Required regulatory clearance distances must be maintained and may not be used for storage. This includes normal system operation as well as service inspection or maintenance.
- For the Gantry and Table, distances are measured from the enclosure, not the finish covers.

Work Space Requirement	Min Clear Space in mm (inches)	Additional Conditions
Direction of Service Access	914.4 (36)	*48 inches (1219.2 mm), if exposed live parts of 151 - 600 volts are present on both sides of the work space with the operator between *42 inches (1066.8 mm), if opposite wall is grounded and exposed live parts of 151 - 600 volts are present.
Service Access Width	762 (30)	This is the width of the working space in front of the equipment. 30 inches (762 mm) min or the width of the equipment, whichever is greater

4.5.5 Terms and Definitions

EGRESS

The path of exit from within any room. U.S. regulatory requires a minimum of 28 inches (711.2 mm) of continuous and unobstructed space including trip hazards along the path of exit.

WORK SPACE

This is the dimensional box required for safe inspection or service of energized equipment. It consists of depth, width, and height. The depth dimension is measured perpendicular to the direction of access. U.S regulation is minimum of 36 inches (914.4 mm). Additional conditions can increase the minimum requirement. GE Healthcare defines this as the envelope of the component superstructure. For the gantry and table, it is with the patient or external covers removed.

SERVICE ACCESS WIDTH

This is the width of the working space in front of the equipment, a minimum of 30 inches (762 mm), or the width of the equipment whichever is greater.

HEAD CLEARANCE

This is the height dimension of "Work Space". The height of the work space measured from floor at the front edge of equipment to ceiling or overhead obstruction(s), 78 inches (1981.2 mm) or height of equipment, which ever is greater.

GROUNDED WALL

Any wall that can be electrically conductive to earth ground. Masonry, concrete, or tile, are considered conductive. Additional commonly found aspects of a wall should also be considered as grounded. This is not an all-inclusive list:

- Medical Gas ports
- Metal door and window frames
- Water sources and metallic sink structures
- Metallic wall mounted cabinets
- A1 disconnect panel
- Equipment Emergency Off panels
- Industrial equipment such as air conditioners and vents
- Expansion joints

The following are not considered as grounded elements of a common wall:

- Standard wall outlet
- Light switches
- Telephones
- Communication wall jacks

MINIMUM

The lowest limit permitted by law or other authority.

DIMENSIONS AND CLEARANCES

Consisting of, or representing the lowest possible amount of degree for freedom permissible for equipment siting. This relationship must meet all safety, service, and regulatory requirements to be
acceptable.

PRE-INSTALLATION ESCALATION

Process to consult with Engineering, the Design Center or EHS regarding pre-installation issues related to your siting concerns.

4.5.6 Typical Room Layout

Figure 4-5 shows a typical (standard) room layout drawing showing location of all basic units for a Hawkeye 4 system. Observe that requirements for clinical access, and for peripheral clinical equipment placement, such as storage cabinets, sinks, etc., must be taken into considerations during the room layout.

- For General Requirements, see Table 4–2.
- For Service Conditions, see Table 4–3.

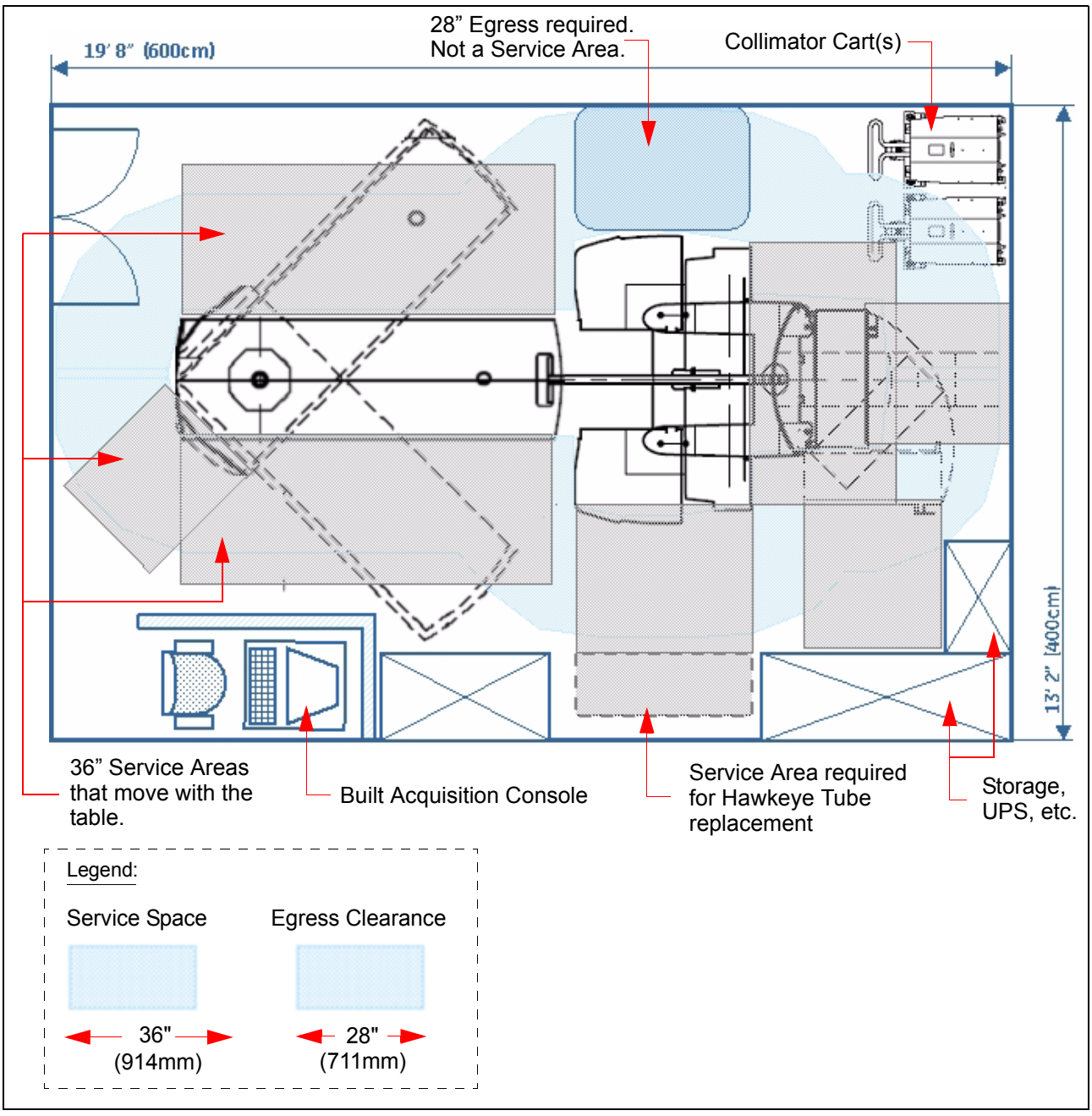


Figure 4-5 Typical Room Layout

Table 4–1: Typical Room: Dimensions

Room Dimensions	Length & Wide	Ceiling Height
Optimal Floor Space	6000 mm x 4000 mm 19’8" x 13’ 2"	2300 mm 7’6"

Table 4–2: Typical Room: General Requirements

- Stationary items (storage, UPS) must fit in blank spaces.
- Wheeled items must not interfere with normal operation.
- Underground IPS cabling.

Table 4–3: Typical Room: Service Conditions

- All gantry service done on the right side as shown in Figure 4-5.
- Table rotates for rear service access, as shown in Figure 4-5.

4.5.7 Minimum Room Layout

Figure 4-6 shows a minimum room layout drawing showing location of all basic units for a Hawkeye 4 system. Observe that the dimensions given are for installation of the system only, requirements for clinical access, and for peripheral clinical equipment placement, such as storage cabinets, sinks, etc., must be taken into considerations during the room layout.

- For General Requirements, see Table 4–5.
- For Service Conditions, see Table 4–6.

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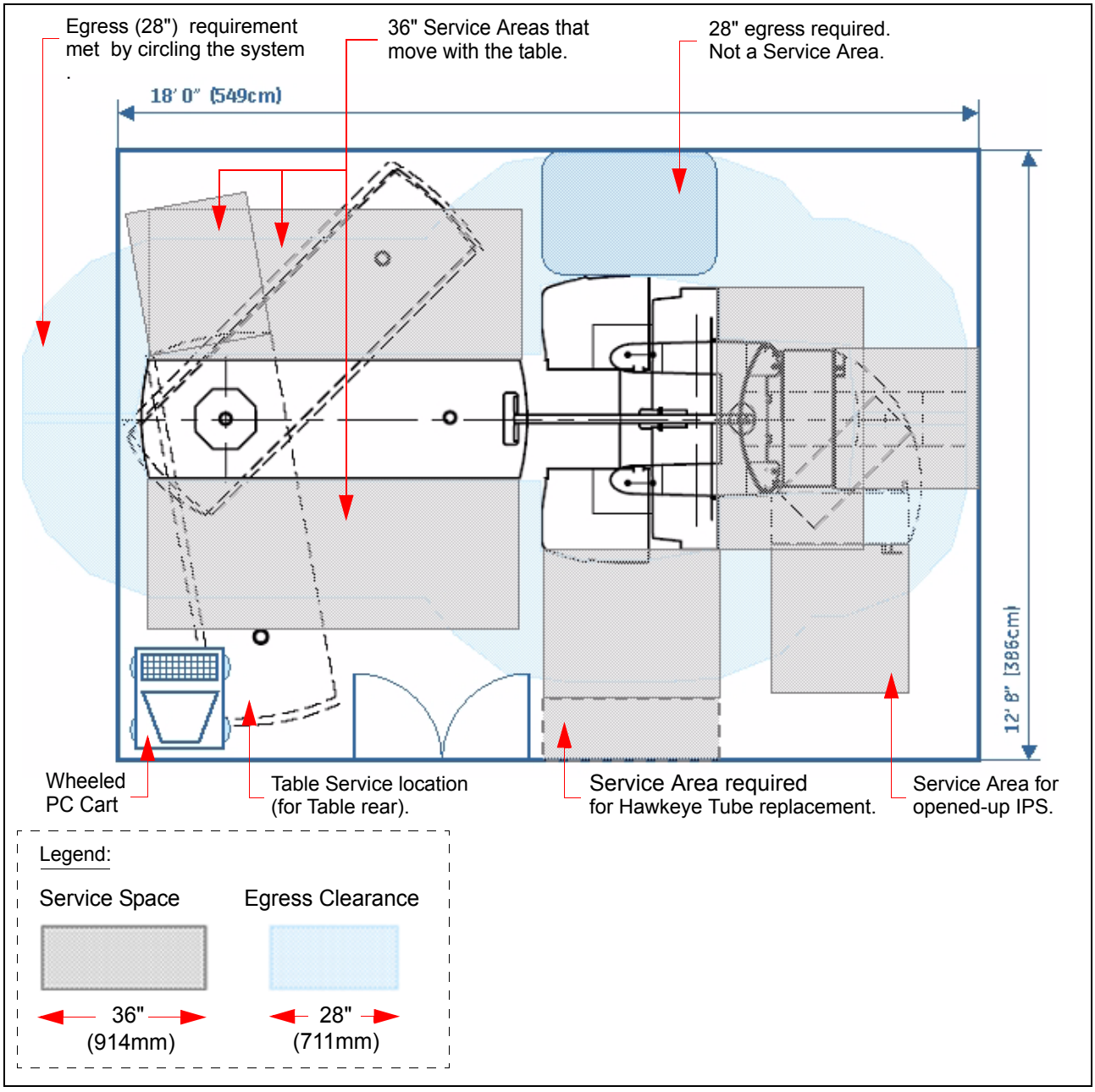


Figure 4-6 Minimum Layout for System

Table 4–4: Minimum Room: Dimensions

Room Dimensions	Length & Wide	Ceiling Height
Minimum Floor Space	5490 mm x 3860 mm 18’0" x 12’8"	2300 mm 7’6"

Table 4–5: Minimum Room: General Requirements

- Stationary items (storage, UPS) must fit in blank spaces.
- Wheeled items must not interfere with normal operation.
- Underground IPS cabling.

Table 4–6: Minimum Room: Service Conditions

- All gantry service done on the right side as shown in Figure 4-6.
- Table rotates for rear service access, as shown in Figure 4-6.

4.6 Room Layouts

The layout of the system with and without the Hawkeye Option is shown in Figure 4-8 and Figure 4-9 respectively.

The examples include the following items:

- Gantry
- Table
- Collimator Carts
- Acquisition Station
- Printing
- Operator's Chair
- Emergency Button

The room layout for the Infinia with Hawkeye option differs from that recommended for the basic system in two respects:

- Location of the Acquisition Station. This change is required to protect the operator from exposure to X-ray radiation
- Distance of Gantry from the rear wall:
  - Infinia GP system - 1080 mm (42.5")

    For systems without the Hawkeye option, clearance of 880 mm (34.65") is sufficient for maximum Stretcher extension. However, the default clearance of 1080 mm (42.5") should be cosidered wherever possible.
  - Infinia GP with Hawkeye Option
    - Recommended: 1380 mm (54")
    - Typical Room: 1310 mm (52")
    - Minimum Room: 1260 mm (49")

    Clearance of 1380 mm (54") includes maximum Stretcher extension for systems with the Hawkeye option. This is the default clearance. However, the default clearance of 1380 mm (54") should be allowed when possible to enable upgrading the system for future use of the Hawkeye Option.

For system positioning in order to avoid X-ray penetration of adjacent rooms, please refer to Figure 4-2. Note that 10 µGray = 1 mRem.

Note The dose values in Figure 4-2 were measured while scanning a phantom, and represent the dose rate from leakage and scatter from the phantom while X-rays are ON.

4.6.1 Scan Room Design Considerations

1. When designing the layout of the system inside the scan room, make sure that the Table rotates to its slanted position away from the entrance to the room. This allows for adequate space to place a hospital bed under the Heads of the Gantry.
2. Collimator carts should NOT be positioned on the side of the Gantry to which the Table rotates. This ensures that the Collimator Carts may be moved directly to the Gantry by the shortest route (Collimator Cart footprint is 500 x 900 mm (19.7 x 35.4 inches).
3. The Alignment Point (located on the system axis) must be clearly defined for each site by providing measurements to adjacent walls, either by physically marking it on the floor or by providing a site diagram.
4. When planning your room layout you must take into consideration the clearance area required for servicing the imaging system (see Figure 4-16).

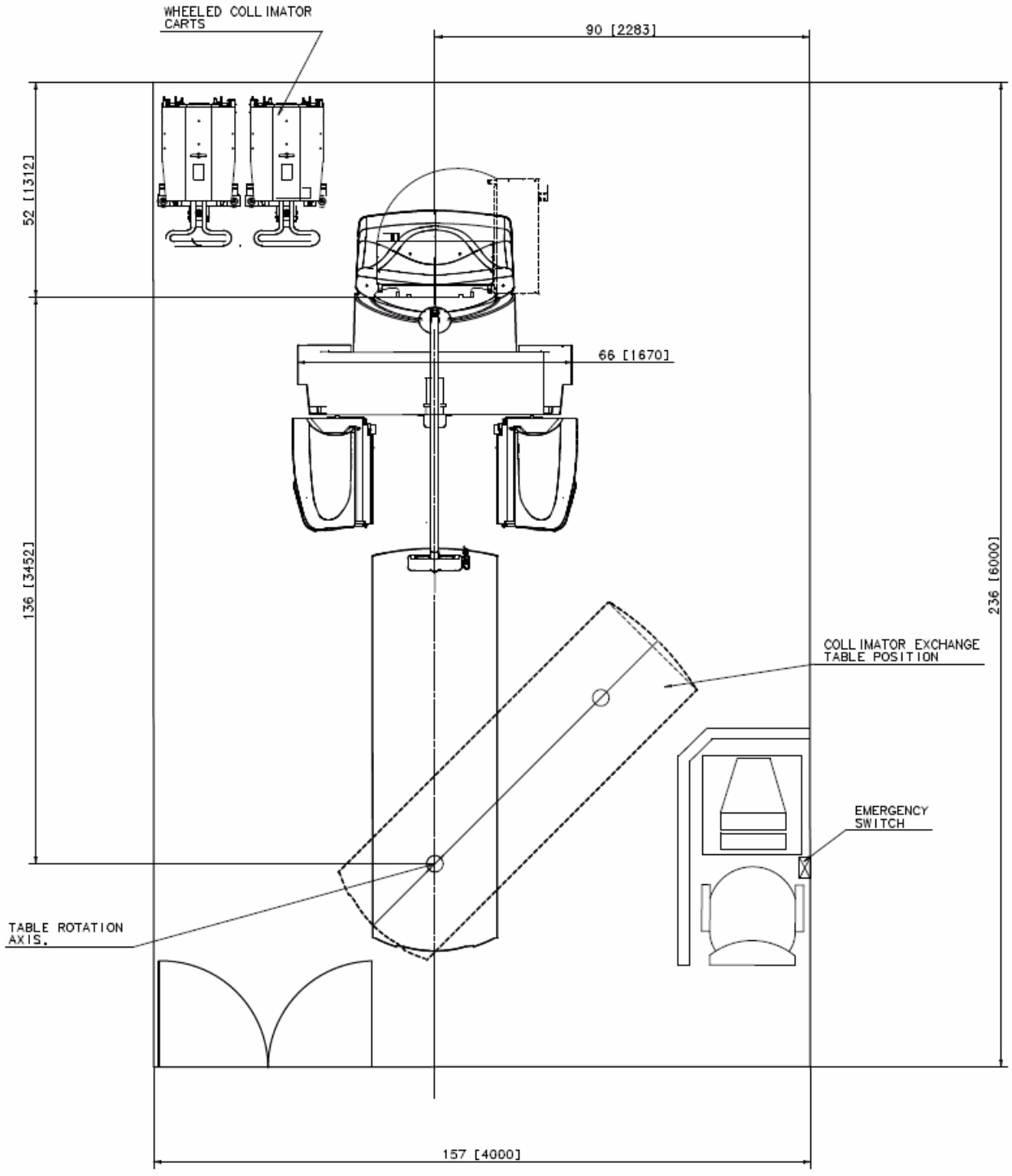


Figure 4-7 Example of Typical Room Layout for Infinia GP with Hawkeye Option

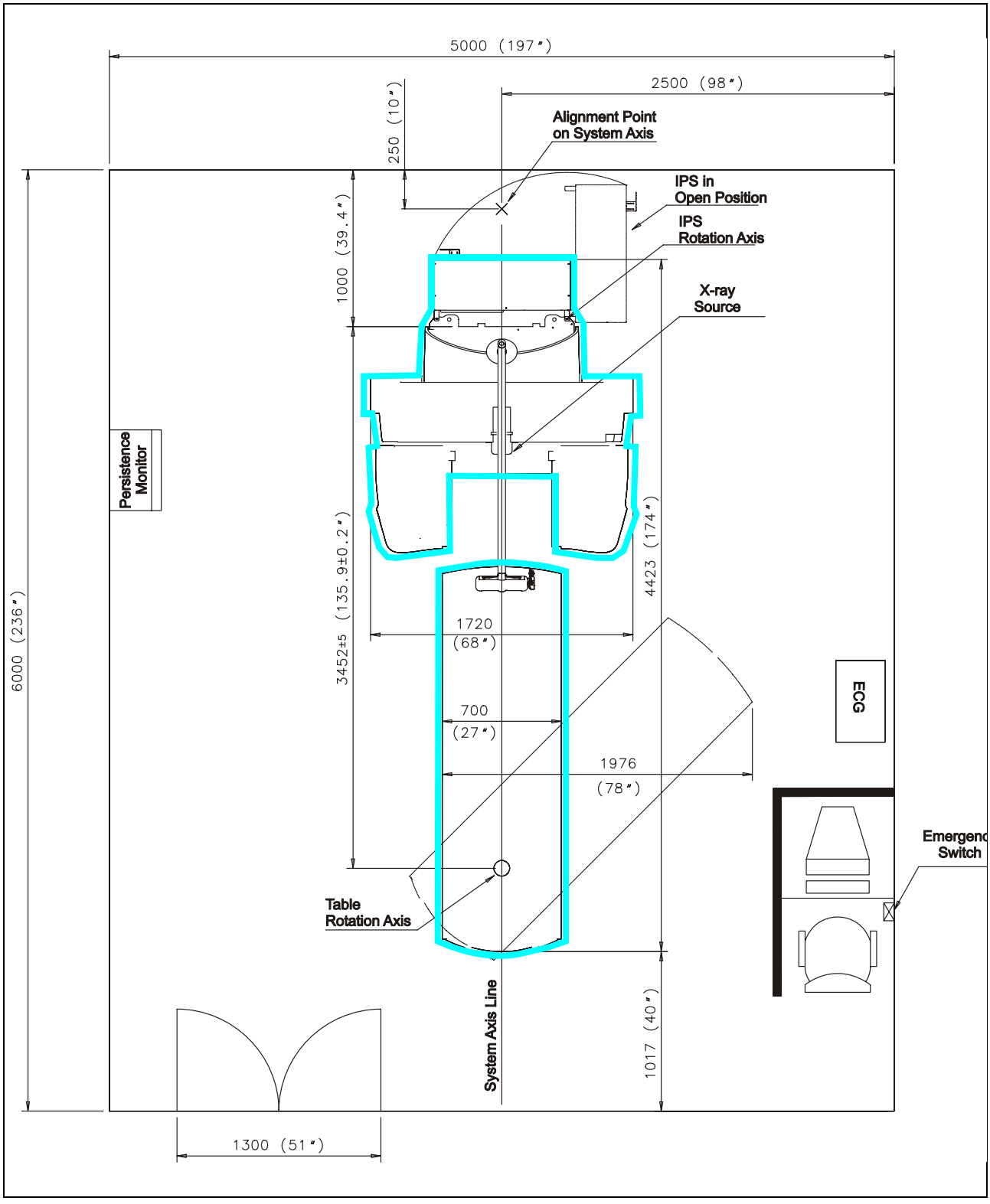
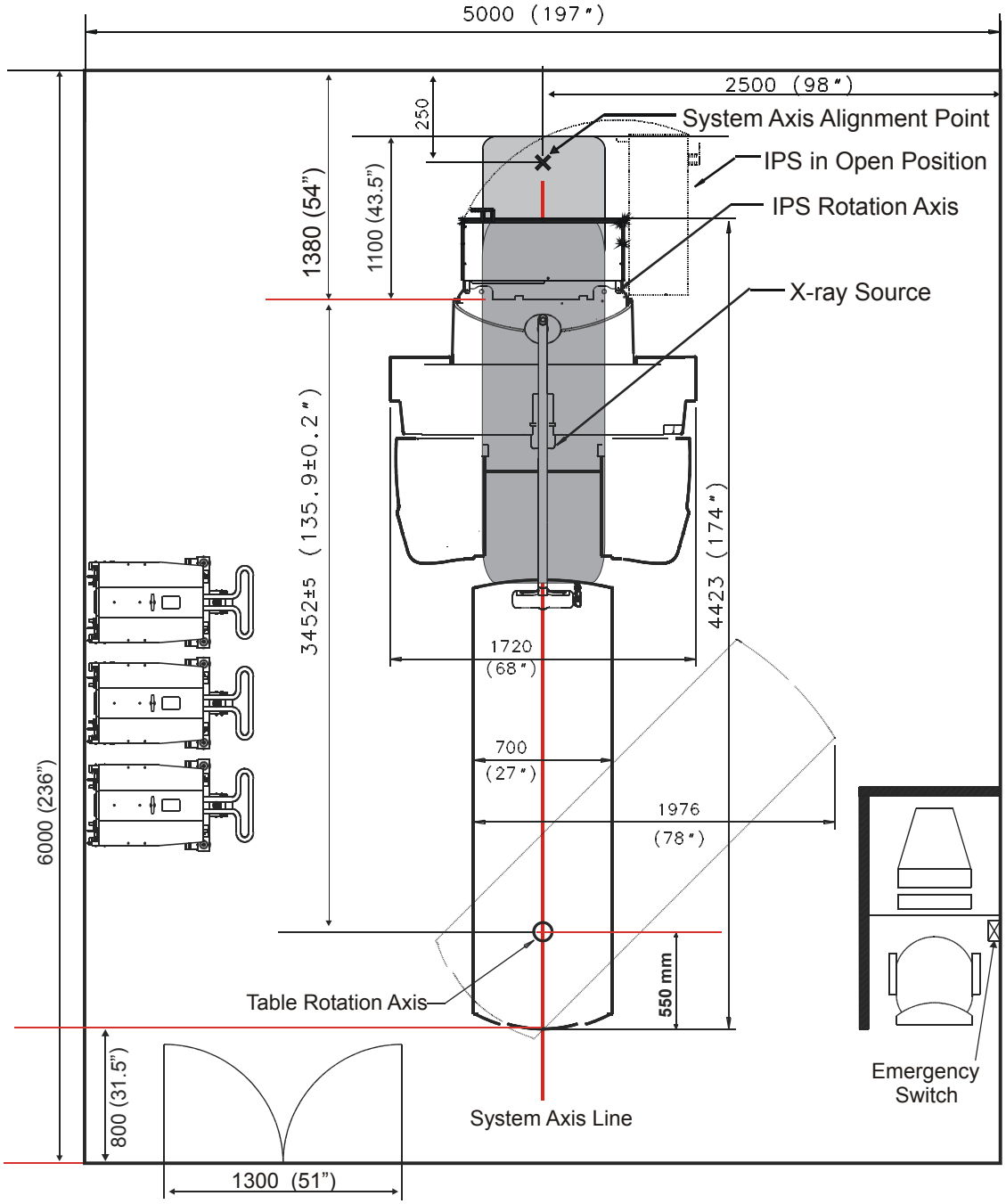


Figure 4-8 Example of a Room Layout for Infinia GP Systems (No Hawkeye)



NOTES
1. If X-ray source is in use:
   A. Operator should be located as far as possible from X-ray source rotation path.
   B. Distance from X-ray source to operator should be more than 1500mm (59").
   C. Operator should be protected in an 'L' shaped 1mm (.04") lead equivalent 200mm (7.87") high shield.
   D. Persistence monitor is part of the basic Hawkeye configuration and should be taken into account in the room layout.
2. Table is to be opened away from room entrance ('Hospital Bed' Mode).
3. Collimator Cart foot print: 500 x 900mm (19.69 x 35.43").

Figure 4-9 Example of a Room Layout for Infinia Systems fitted with Hawkeye

Note

1. Clearance of 1380 mm (54") includes maximum Stretcher extension for systems with the Hawkeye option. This is the default clearance.
2. For systems without the Hawkeye option, clearance of 880 mm (34.65") is sufficient for maximum Stretcher extension. However, the default clearance of 1380 mm (54") should be allowed for, whenever room size considerations permit, to enable upgrading the system to use the Hawkeye option in the future.

4.7 Floor Preparation

The floor must be capable of supporting the weight of the equipment and accessories described in Section 4.7.1.

The floor slope and flatness must meet the requirements listed in Section 4.7.2, to ensure smooth access for loading/unloading collimators and phantoms to/from Collimator Carts and Heads.

Floor preparation differs according to its construction and level:

- Floor preparation of site where the construction is made of concrete and the site is on ground level (and on real ground), or where there is a possibility to cast concrete. This information should be obtained from the structural engineer for the building in which the system is to be installed.
- Floor preparation of site where the floor is made of a thin layer of concrete and is supported by a beam construction. See Section 4.7.1.2 for an example.

4.7.1 Floor Loading

Important

The load-bearing capability of the floor in the scan area is an essential consideration. These calculations should be obtained from the structural engineer for the building in which the system is to be installed.

The floor, under certain circumstances, may require additional reinforcing. It is recommended to use cast concrete B-300 or stronger
These decisions should be made by the structural engineer for the building
.

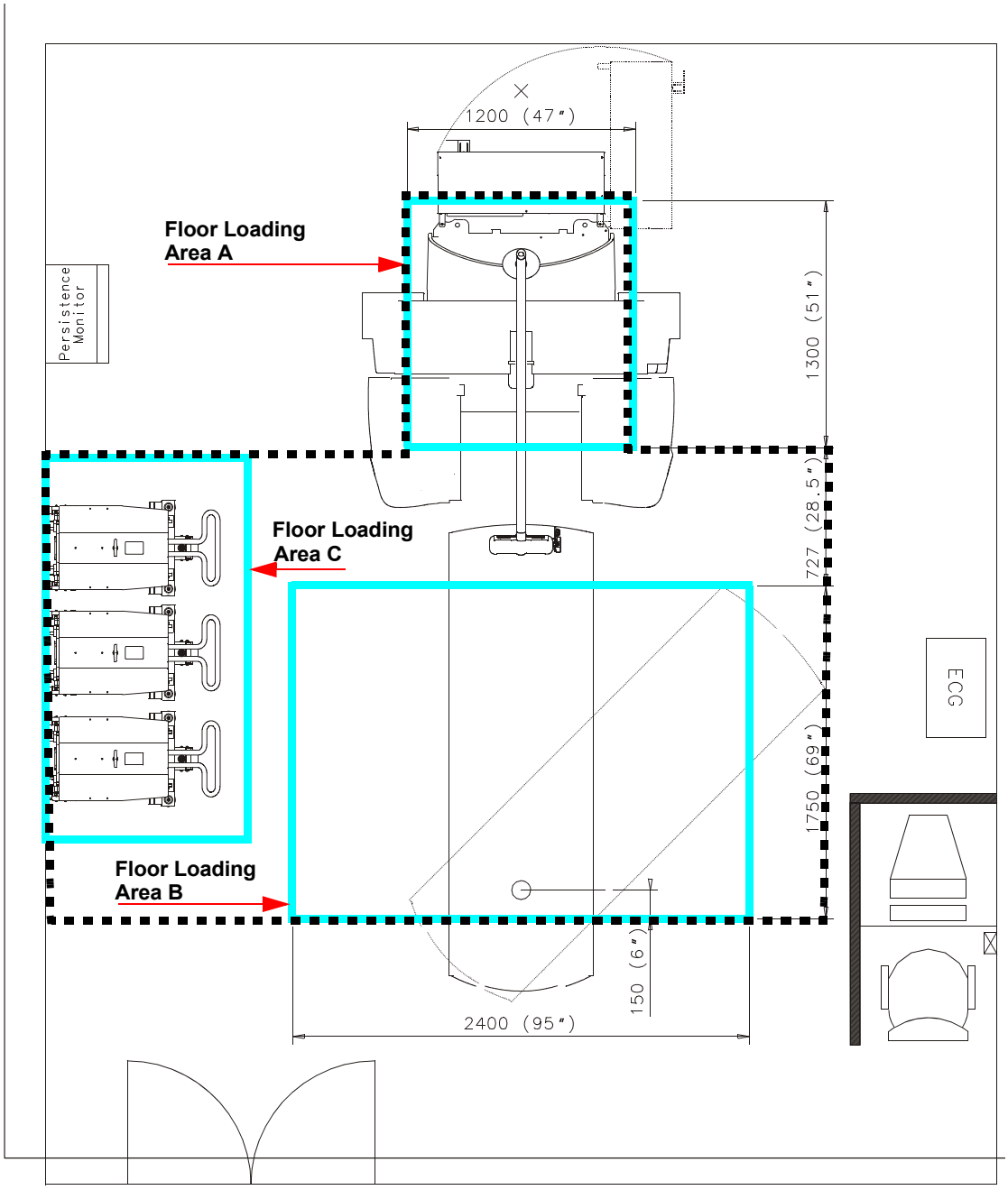


Figure 4-10 Floor Loading

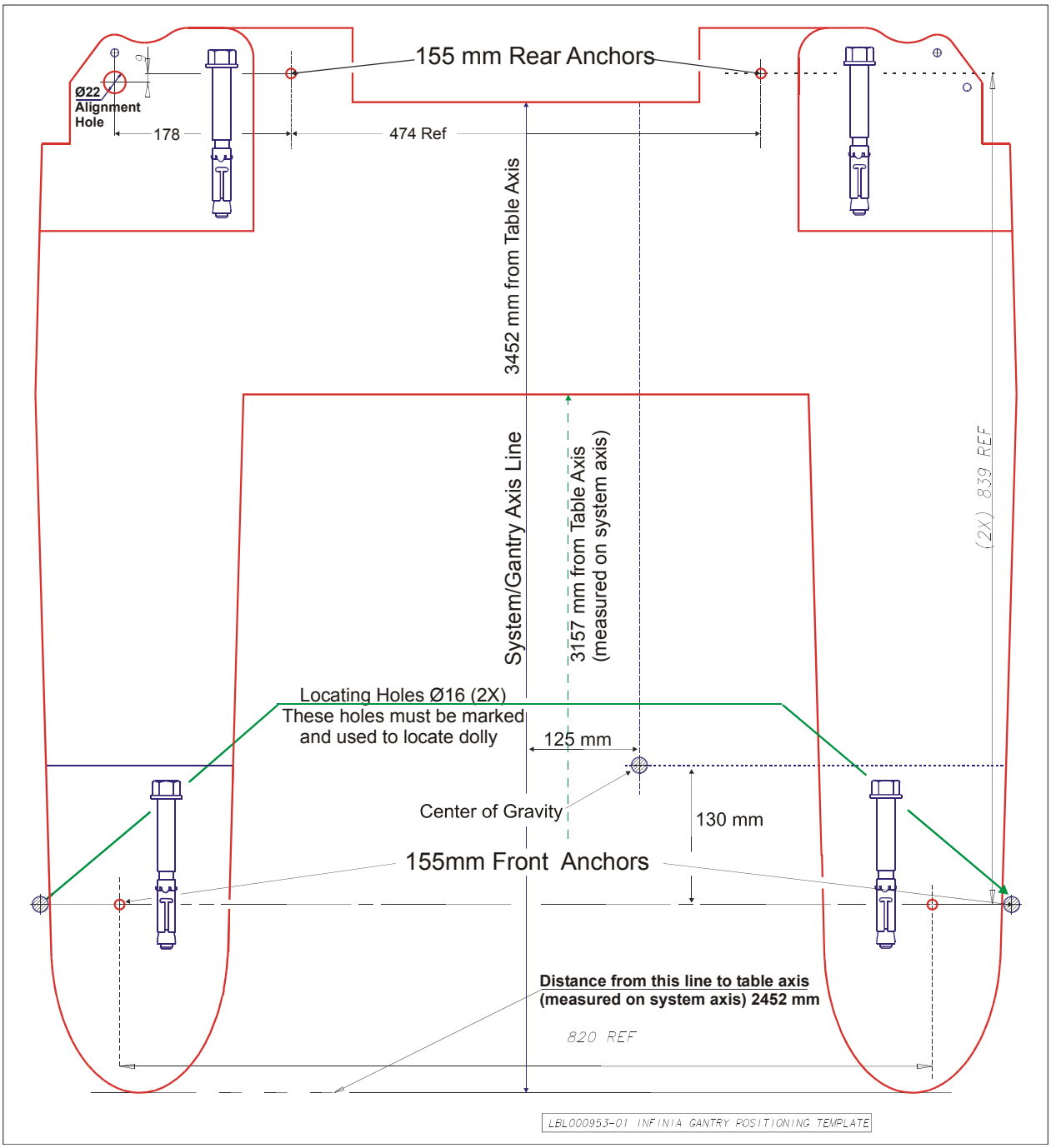


Figure 4-11 Center Of Gravity (COG) location

4.7.1.1 Center Of Gravity (COG) Location

COG LOCATION	A	B
STATIC COG	50	125
DYNAMIC COG	30	170

The Static and Dynamic Loads of the gantry on the floor and the Center Of Gravity (COG) location

are calculated for the worst case – Detectors in L-Mode, with Heavy Collimators fitted, stopped during CW rotation in 3 o'clock position.

Important: For L-Mode, stopped during CCW rotation in 9 o'clock, COG will be **(B)** shifted left from the gantry center (not right as shown on the picture for the 3 o'clock case). So Gantry left side will be more loaded than the right side.

Gantry static load on the floor is 2700 kg without Hawkeye option and 2800 kg with Hawkeye.

Gantry dynamic load on the floor is 3100 kg without Hawkeye option and 3200 kg with Hawkeye.

The Gantry weighs 2700 kg (5787 lb.) with heaviest collimators and Hawkeye option and about 3100 kg (6834 lb.) dynamic load (at maximum rotation speed and asymmetric heads positioning). The Gantry applies a point loading of 4.2 kg/cm^2 (60 lbs/inch^2).

The Scanning Table weighs about 400 kg (896 lb.).

The Collimator Cart loaded with two Collimators weighs between 170 to 430 kg (375 - 950 lb.), depending on the Collimators' type.

The entire room floor must tolerate the load of the loaded Collimator Cart.

The floor loading areas for the Gantry, Table and Collimator Carts (floor loading areas A, B, and C, respectively) are shown in Figure 4-10.

4.7.1.2 Reinforced Area

In situations where the Imaging System is to be installed on ground level and the floor is constructed of concrete, a suitably-reinforced area must be prepared.

It is recommended that the reinforced area be of cast concrete B-300 or stronger. The size and shape of the area should be in accordance with that shown in Figure 4-10.

Additional information should be obtained from the structural engineer for the building in which the system is to be installed.

4.7.2 Leveling and Flattening the Floor Area

Important

No fill material should be used to compensate for holes or depressions in the floor surface. If necessary, level and flatten the entire floor area. See Section 4.7.2.1.1

The scan room floor must be leveled, and its surface must be smooth. Any deviation in levels will have a detrimental effect on the Table-to-Gantry alignment which may effect collimator exchange.

It is recommended that the floor in the entire room will be leveled and flattened, according to the specifications given in Section 4.7.2.1.1. If this is not possible, it is imperative that the system installation area (inside the dotted lines - see Figure 4-10) is leveled and flattened. The dimensions are shown in Figure 4-10.

Upon completion of the installation area, verify the surface flatness (of the entire area), using a straight edge of 150 cm (5') in length (or longer).

Leveling specifications are listed in Table 4–7..

Table 4–7: Floor Leveling Specifications

Floor Leveling Area	14' X 16' (427 cm x 488 cm) minimum
Slope	Within $\pm$ $1^{3}/_{16}$" over 170" ($\pm$ 3 cm over 430 cm)
Flatness	Surface should be smooth and have no more than 3/16" (0.5 cm) deviation in any 60" (150 cm) throughout the room or system installation area
Floor Surface	Floor should have one single poured surface.

4.7.2.1 Floor Checking Procedure

This procedure provides details on how to verify that the floor is both flat and level before system installation is to begin. Measurements should be taken left-to-right **or** right-to-left, front-to-back **or** back-to-front, and diagonally in **either** direction. Refer to Figure 4-12.

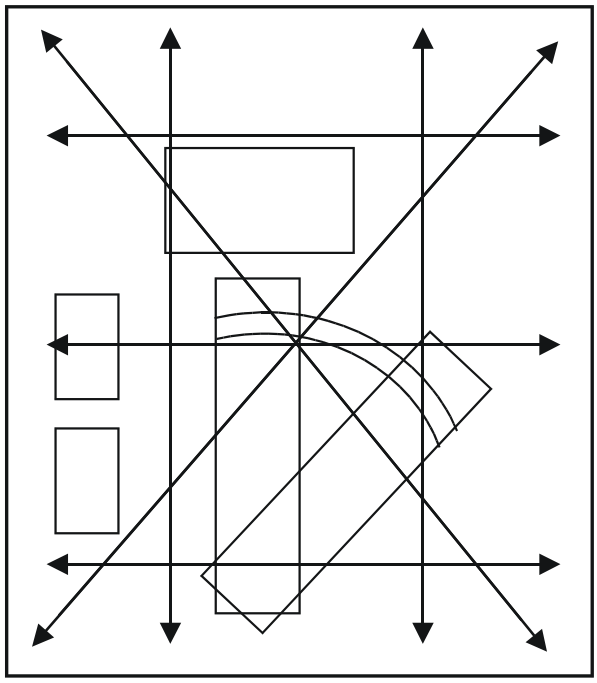


Figure 4-12 Measurement Directions

1. The floor slope should be within ± $1^{3}/_{16}$" over 170" (± 3 cm over 430 cm). Refer to Figure 4-12.
   - **a.** Place laser level on floor.
   - **b.** Make sure that the laser leveling device is absolutely level.
   - **c.** Turn on laser.
   - **d.** Use a ruler to measure the height of the laser light from the floor next to the laser level. (This is reference point on the ruler for all other measurements.) Refer to Figure 4-13.

Note

Depending on make and model of the laser level, the beam will be fanned out to form a horizontal line, typically having a spread of 90°.

   - **e.** Keep the laser ON and use a ruler to measure the height of the laser light beam at various points 170” from the laser. The measurement from the floor should be within $1^{3}/_{16}$"(3 cm) of the original laser light reference point. Repeat at various points and directions as shown in Figure 4-12

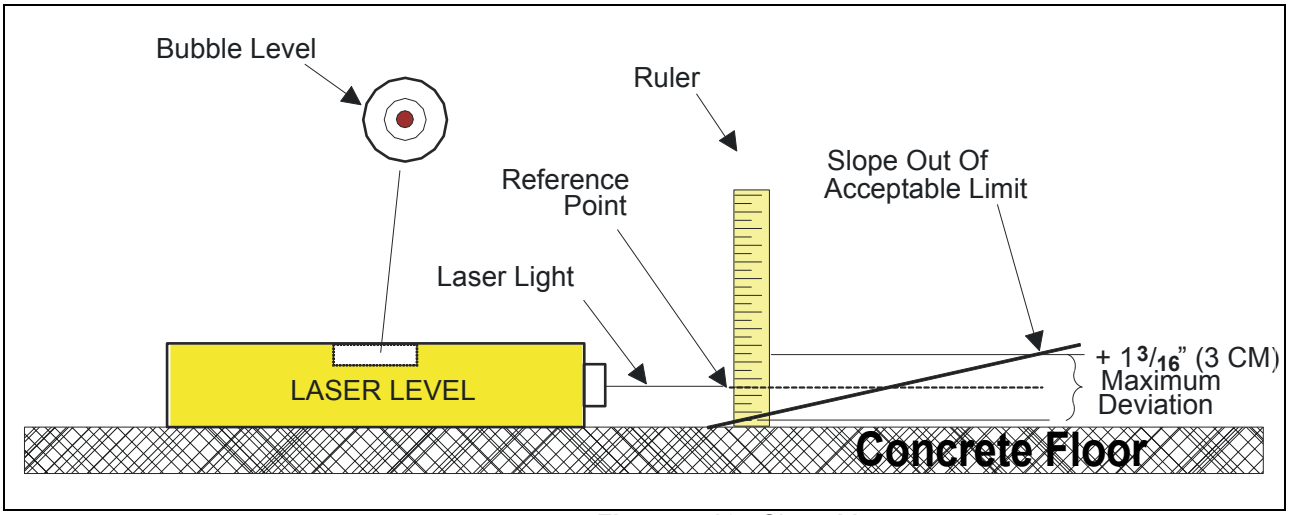


Figure 4-13 Slope Measurement

The floor surface should be smooth and have no more than 3/16" (0.5 cm) deviation in any 60 “. (150 cm) segment in all the room area. Refer to Figure 4-14.

Any measurements out of acceptable limits are an indication that the floor needs to be leveled with some sort of leveling compound. See Section 4.7.2.1.1 for details

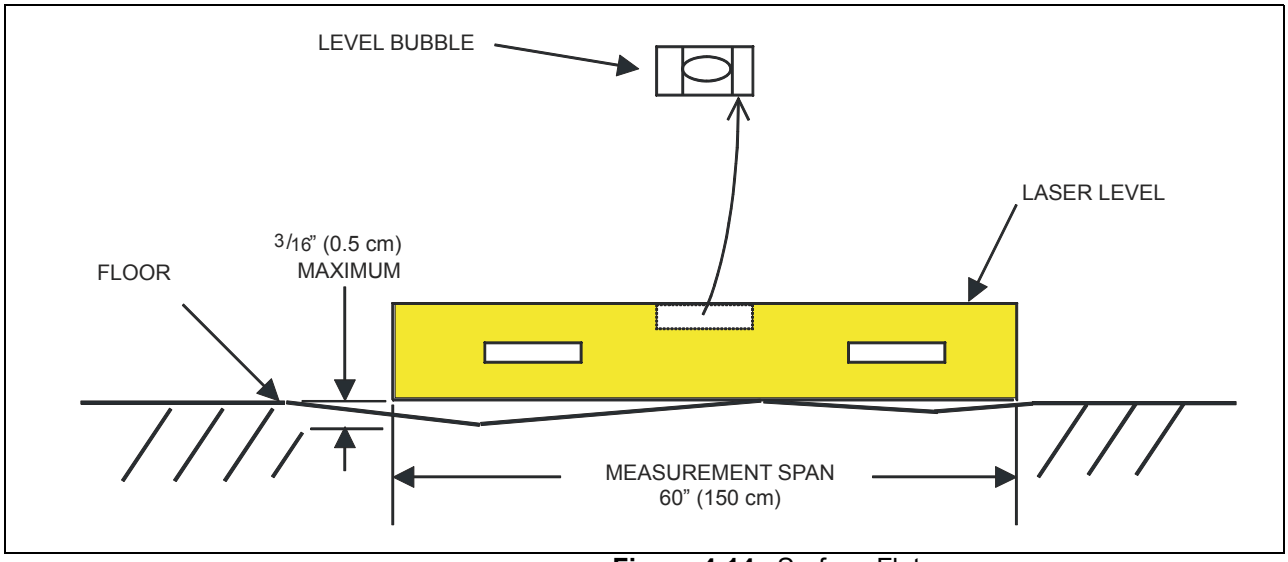


Figure 4-14 Surface Flatness

2. Verify surface flatness for the entire room; use a straight edge that is 60” (150 cm) long, upon completion of the room.

Note

No fill material is allowed as a patch to compensate for surface deviations. Patches will eventually crack and pop out.

Where unacceptable deviations exist, the whole room (minimum system area) should be re-surfaced. See Section 4.7.2.1.1

4.7.2.1.1 Corrective Action

When the floor does not meet level and flatness specifications, the floor will need to be corrected. The entire area of the room 4200 mm x 4700 mm (14 ft x 16 ft) should be levelled. The GE Field Engineer (FE) performing the inspection must immediately notify the GE Project Manager of Installation of any deviation in specifications. The GE Project Manager of Installation will notify the customer, and together they can work with their contractors, to develop a schedule to correct the floor.

Note

It is imperative that this deviation in specifications and its follow-up plan be promptly communicated to all applicable personnel.

It is recommended to use Micorox X-tra Fluid Grout, Mipolam 410, or any other similar material. The materials used to flatten the floor must be anti static.

4.7.3 System Cables

To avoid damage to the system cables, three options are available for cable routing:

- sunken ducts - usually only possible when the site is on ground level See Preparation of Built-in Floor Ducts on page 4-31
- under floor - in cases where the floor is supported by beam construction. See Under Floor Cable Routing on page 4-33
- above ground.

Note

It is also possible to route the system cables in ducts above floor level See Section 4.7.3.2 and Figure 4-16.

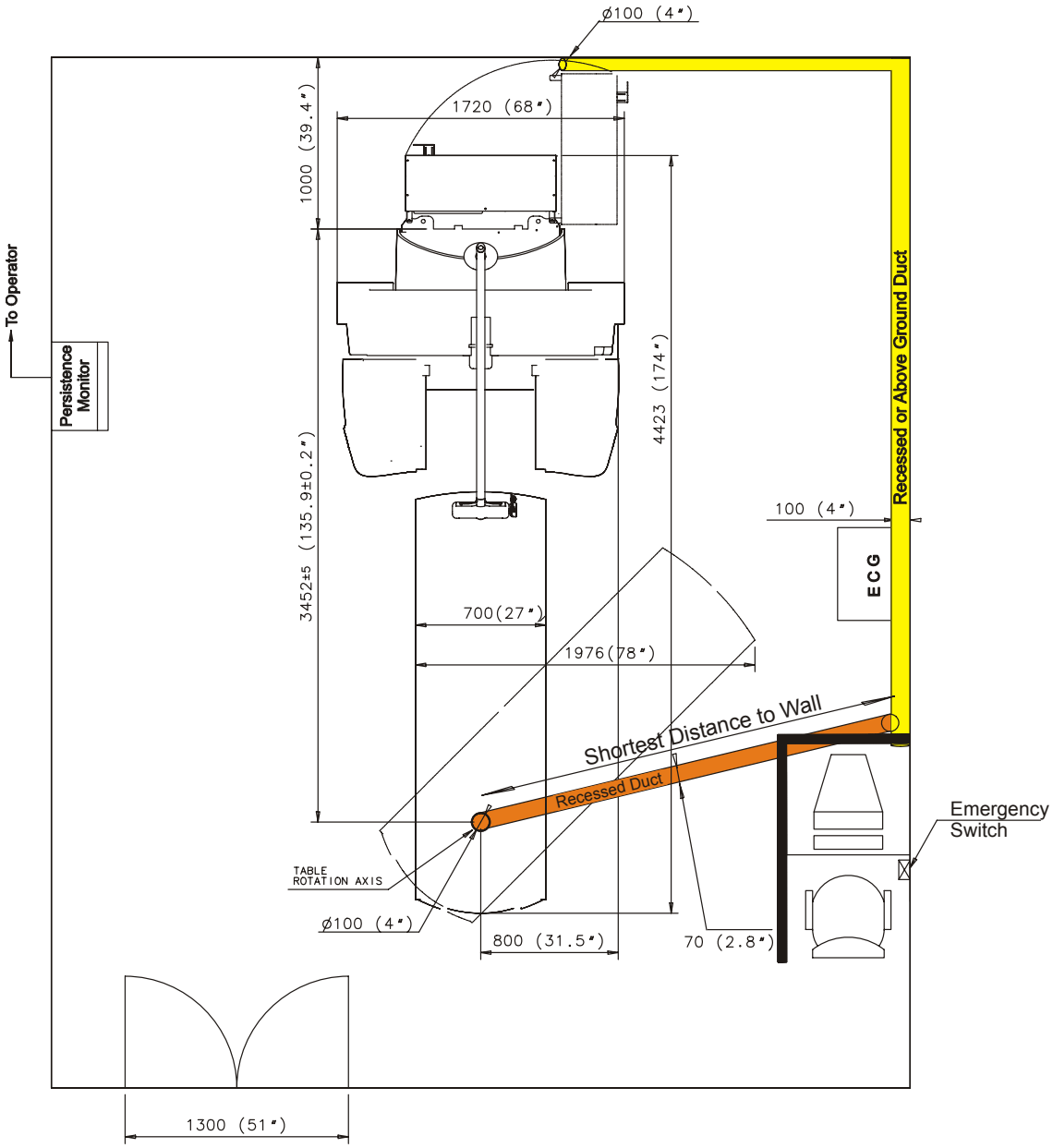
4.7.3.1 Preparation of Built-in Floor Ducts

If floor ducts are **not** going to be used proceed to Section 4.7.3.2

- The Gantry-Table cable must be routed within a duct either beneath or above the floor surface.
- The Gantry-Computer cable should also be routed within a duct, or at least part of it between the Gantry and the near-by wall.
- Ducts built in the floor should be beneath the floor surface, at 75 mm depth, at least.
- The minimum duct width is 70 mm.
- The optional P-scope can be installed on a mechanical arm attached to any wall in the Gantry room according to the customer requirements. The Persistence Monitor cable of 15 meters length (49.215 ft.) may be routed in a plastic duct attached to the wall.
- An example of locations and measurements of floor ducts is provided in Figure 4-16.

A few recommendation for duct preparation are given below:

1. The Table/Gantry cable must approach the Table from the rear.
2. The duct that will house the Table cable should be accurate in length: 9.5 ± 0.5 meters (31.17 + 1.64 ft.).
3. Building ducts under the Floor Plates should be avoided, except for the Rear Table Plate.
4. Ducts should not be routed under the Gantry.



Notes

1. Ducts are 75mm (2.95”) deep with a drainage opening.
2. Ducts path should:
   A. Not pass through the system’s footprint.
   B. Be 160mm (6.3”) minimum away from the Gantry base.
3. Inner radius of ducts path: 50mm (1.97”).
4. Maximum length of ducts:
   - Table to IPS: 9 meters (354.33”)
   - Operator to IPS: 7 meters (275.6”)
5. Above scheme does not include:
   A. Cable routing for X-ray indication room entrance to IPS.
   B. Cable routing from monitor to acquisition station.
6. Collimator cart footprint: 500 x 900mm (19.69 x 35.43”)
7. Hatched area in diagram: Cutout section showing one side of Gantry case footprint (see also positioning template).

.

Figure 4-15 Recommended Floor Duct Layout

4.7.3.2 Alternatives to Floor Ducts

In situations where floor ducts are not used:

4.7.3.2.1 Under Floor Cable Routing

1. Drill through the floor
2. Route the cables beneath the floor securing the cables at intervals along the way. Cable trays may als be used.

4.7.3.2.2 Ubove Ground Cable Routing

A diagram detailing the above ground cable layout is shown in Figure 4-16

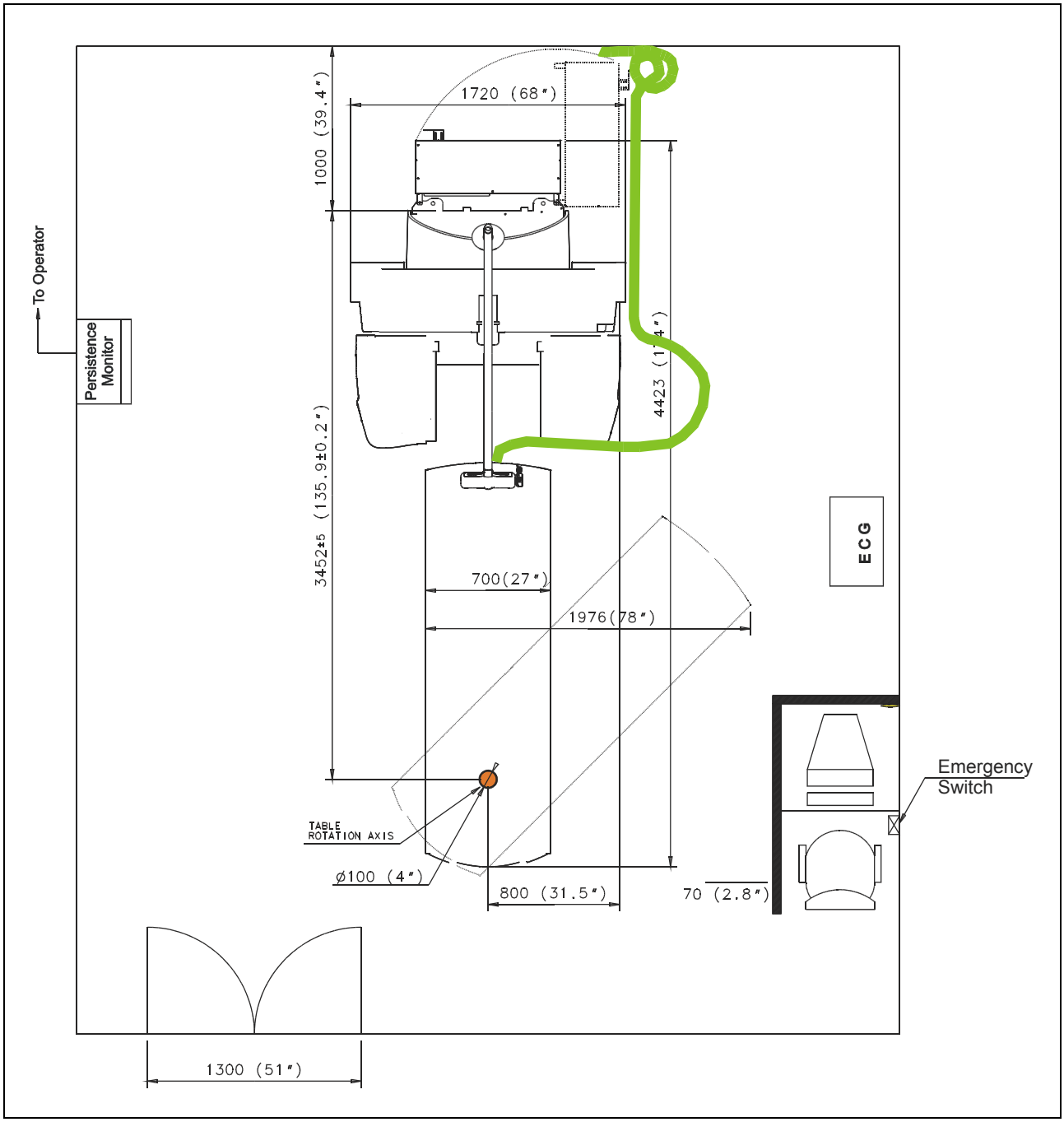


Figure 4-16 Above Ground Cable Layout