

SECTION 13 49 00  
RADIATION PROTECTION  
HIGH DENSITY MODULAR RADIATION SHIELDING

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Applicable provisions of the General Conditions, Supplementary Conditions, Division 1, General

Requirements, and the related sections apply to the work under this section.

B. Interlocking Radiation Shielding Modules and related support structure.

C. Radiation Shielding Door System and related support and operating systems.

1.02 RELATED SECTIONS

A. Section 05 12 00 - Structural Steel

B. Section 05 12 10 - Structural Steel Erection

C. Section 05 50 00 - Miscellaneous Metals

D. Section 08 34 49 - Radiation Shielded Doors and Frames.

E. Section 13 51 00 - Lead Sheets and Lead Plates.

1.03 REFERENCES

A. Federal Specifications

1. QQL-171 Grade C.

2. QQL-201 F Grade C.

B. National Council on Radiation Protection (NCRP)

1. NCRP Report No. 51, "Radiation Protection for Particle Accelerator Facilities".

2. NCRP Report No. 79, "Neutron Contamination from Medical Electron Accelerators".

3. NCRP Report No. 91, "Recommendations on Limits or Exposure to Ionizing Radiation.

4. Structural Shielding Design and Evaluation for Megavoltage X and Gama Ray Radiotherapy Facilities.

C. British Journal Supplement No. 11.

D. ASTM International (ASTM):

1. ASTM A 36 - Standard Specification for Carbon Structural Steel.

2. ASTM A 366 - Standard Specification for Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled.

3. ASTM A 500 - Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

1.04 DEFINITIONS

A. Modular/Modules: Radiation shielding components shall be individual elements or modules that are combined together to form a composite structure to create the required radiation attenuating environment.

B. Interlocking: Modules shall interlock together to form a solid and stable structure comprised primarily of dry stacked module system.

D. Proper Attenuation: Shielding of all photon, neutron and electron radiation to the levels specified by the governing regulatory agencies as identified in the final physics report.

E. Radiation Shielded Environment: The overall structure providing the radiation shielding along with associated components such as doors and duct shielding, thus forming the full shielded room.

#### 1.05 SYSTEM DESCRIPTION

A. Furnish all labor, materials and equipment, and perform all work required to install high density modular radiation shielding work as shown on the drawings, including shielding modules, steel support structure, prefabricated metalwork, and all necessary incidental work in connection therewith. Shielding contractor shall be responsible for the radiation shielding design and related physics report, manufacturing, fabrication and installation of the shielding system inclusive of walls, ceiling, door, duct shielding, and other penetrations as may be required.

1. Detailed physics analysis and shielding design - Shielding system shall ensure proper attenuation of emitted radiation fields to limits prescribed by client physics parameters or governing regulatory agencies.
2. Structural Engineering Design - Furnish and install complete structural support system as necessary to contain and support all items of required radiation shielding.
3. Radiation Shielding - Provide and install all items of radiation shielding work as required for neutron, photon or electron radiation attenuation per contract documents.

#### 1.06 SUBMITTALS

A. Refer to Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Guarantee: Written documentation guaranteeing that the design, shielding material and finished installation will meet or exceed the attenuation performance required by the Physicist of Record, or should testing indicate any deficiencies in shielding performance, these would be remedied by the shielding manufacturer at no additional cost.

C. Manufacturer's Physics Report documenting the full shielding design and certifying that the high density interlocking modules and all related items in this section fully comply with the requirements stated by the Physicist of Record.

D. Project manual containing:

- |              |   |
|--------------|---|
| 00 73 16-1.1 | Insurance Requirements - Certificate of Insurance       |
| 01 29 73-1.1 | Schedule of Values                                      |
| 01 32 16-1.1 | Construction Progress Schedule                          |
| 01 32 19-1.1 | Submittals Schedule                                     |
| 01 35 29-1.1 | Health, Safety, and Emergency Response Procedures       |
| 01 78 23-1.1 | Operation and Maintenance Data                          |
| 01 78 36-1.1 | Warranties  |
| 08 34 49-1.1 | Radiation Shielding Doors and Frames Data               |
| 09 70 00-1.1 | Door Finishes   |
| 13 49 00-1.1 | Product Data – Interlocking Shielding Modules and Grout |
| 13 49 00-3.1 | CD Submittals   |

E. Shop Drawings - complete shielded environment, including plan, section, elevation views and all details of construction. Submit shop drawings for any special components or installations not fully dimensioned or detailed in manufacturer's product data. Shop drawings detailing construction and assembly shall be submitted for approval prior to the start of any fabrication.

1. Drawings shall be prepared, signed and sealed by a qualified Professional Engineer. A letter of certification shall state that all structural shop drawings were prepared under their direction, and their seal will appear on all shop drawings.

F. Closeout and Maintenance Documents:

1. Closeout Conference: Including all parties as may be appropriate.
2. Onsite inspection reports and final punch list.
3. Operator manuals, maintenance schedules and contact information as necessary.
4. Shielding Guarantee Certificate

#### 1.07 QUALITY ASSURANCE

A. Qualifications: Shielding supplier with minimum of 5 years successful experience manufacturing radiation protection products similar to those specified for this project.

B. Single Source Responsibility: Obtain radiation protection materials and accessories produced as standard products from single manufacturer regularly engaged in production of high energy shielding materials, equipment, and accessories.

C. Radiation Protection Survey: Employ registered Health Physicist, certified by American Board of Radiology, for testing specified radiation protective work and to conduct radiation protection survey of facility.

D. Radiation Protection Work: Shall comply with National Council of Radiation Protection (NCRP)

Report No. 049 - Structural Shielding Design and Evaluation for Medical Use of Gamma Rays of Energies up to 18 MV.

1. Comply with requirements of local regulatory agencies where local standards and criteria exceed requirements for NCRP Report No. 049.
2. Shall be installed per the recommended practices of National Council on Radiation Protection as outlined in handbooks #151, #51 (#144) and #49.

E. Guarantee: Completed installation must be 100% guaranteed to meet agreed upon shielding requirements applicable at the time of contract, and that any shielding deficiencies will be rectified by the shielding manufacturer at no additional charge.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions for receiving, handling, storing, and protecting materials.

1. Provide reasonable access to the building site and protect existing floors, carpets, tile, plumbing/electric stub up fixtures, walls, etc. as necessary.
2. Provide hard surfaced storage area capable of supporting 2 ton pallets.
3. Ensure that all routes into the building site to be accessible and capable of supporting the loads noted herein.

B. Exercise care to prevent damage to individual modules.

#### 1.09 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

#### 1.10 SCHEDULING WITH OTHER WORK:

A. Coordinate with other trades to ensure they have ample opportunity to build in their work as the shielding work progresses.

## 1.10 PRE-INSTALLATION MEETINGS

A. There shall be a pre-installation conference at the job site at the beginning of the project, or at least two months prior to shielding installation to review all requirements of construction including shielding placement, protection and inspection.

B. Conduct the conference to comply with the requirements in Division 01 Section "Project Management and Coordination". Review methods and procedures related to radiation protection.

1. The shielding subcontractor shall prepare a comprehensive "Shielding Construction Plan (SCP)" addressing all procedures associated with supply and placement of the shielding and associated assemblies. Submit plan to Architect and Owner's Testing and Inspection Agency a minimum of seven (7) days prior to Pre-installation Conference. SCP to include:

- a. Shielding design and door system requirements.
- b. Consistency of materials.
- c. Staging, scheduling and access.
- d. Sufficient plant and field manpower.
- e. Procedures for placement with sufficient backup equipment.
- f. Coordination with other trades.
- g. Inspections and acceptances.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. To ensure that all shielding design criteria are met, the specifications and construction drawings are based on the use of High Density Shielding Modules as manufactured by:

Veritas Medical Solutions, LLC,  
160 Cassell Road, Harleysville, PA 19438  
Phone: 484.991.8928  
[www.veritas-medicalsolutions.com](http://www.veritas-medicalsolutions.com)

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

### 2.02 HIGH DENSITY SHIELDING MODULES

A. Provide High Density VeriShield® interlocking modules in full and half module increments.

1. Cementitious modular shielding with a sine wave shape.
2. 100% interlocking edge with no straight line seams.
3. Interlocking blocks shall be supplied in two thicknesses so as to allow for the offsetting of the various layers of modules. No wall ties shall be required. Block shall stack to provide a stable, structural construction.
  - a. Full modules - 10" (254mm) by 5" (127mm) by 5" (127mm).
  - b. Half modules - 10" (254mm) by 2 1/2" (64mm) by 5" (127mm).
4. Minimum 2,800 lbs./sq. in. compressive strength
5. Provide appropriate density modules to fully meet Physics Requirements.
  - a. 150 lbs./cu. ft.
  - b. 220 lbs./cu.ft.
  - c. 250 lbs./cu.ft.
  - d. 300 lbs./cu.ft.
6. Individual units shall not exceed 45 lb. maximum safe handling limit. No special lifting devices or safety machinery shall be required.

## 2.03 MORTAR AND GROUT

A. Grout used for infilling structural or penetration voids shall be provided by the manufacturer in a density corresponding to the density of the shielding modules.

B. Mortar used for levelling shall be freshly mixed and shall be proportioned with 1 part cement, 1 part lime and 6 cu.ft. sand (Type N mix). Mortar shall comply with ASTM C270 for Type N mortar (750 psi compressive strength).

## 2.04 RADIATION ATTENUATION

A. Modules shall be placed at a proper thickness and density to attenuate all photon and neutron radiation produced to acceptable levels as prescribed by the physicist of record and other Governing Regulator Agencies.

B. Built-In Items: Where items penetrate shielding, manufacturer shall provide grout as required to maintain the continuity of shielding. Install in accordance with manufacturer's instructions.

C. Where outlet boxes, junction boxes, ducts, conduit and similar items penetrate shield walls or ceilings the shielding subcontractor shall provide shielded baffles and/or overlaps to maintain the integrity of design shielding and eliminate any paths for radiation "streaming" or "channeling" effects.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify and correct conditions detrimental to proper or timely completion.

8. Prior to installation of interlocking modules, carefully inspect all prior work of other trades that may impact on the installation of the shielding to insure that conditions are acceptable.

C. Do not proceed until any unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION OF MODULAR SHIELDING

A. Determine boundaries for all walls, doors and equipment.

8. Layout of Work: Before starting module installation, lay out all walls, space individual block coursing accurately based upon manufacturer drawings, and lay out course lengths to minimize cutting of interlocking block.

C. Installation: Lay first course of interlocking modules in full bed of mortar, plumb, true to line and level. Before placing additional layers, be sure to remove any debris, flashing, etc. that may be attached to the block.

D. Place all interlocking block in a modified running bond pattern. See manufacturer drawings for specific details. Do not use mortar between each course.

E. Every fifth course, offset the layer by using half modules to fully interlock with previous block layer. Lay this course in a leveling bed of 3/8" maximum thickness of mortar.

F. Pack all voids, intersection areas, etc. with high density grout to insure shielding integrity.

G. Build in all frames, cable raceways, electrical, plumbing and HVAC penetrations as required. Pack around all penetrations with high density grout.

### 3.03 INSTALLATION OF PENETRATING ITEMS

A. At penetrations, provide shielding to maintain continuity of protection. Refer to manufacturers drawings. Provide sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.

B. Duct Penetrations will be located either on the wall or on the roof. Refer to manufacturers drawings.

### 3.06 FIELD QUALITY CONTROL

A. Field Inspection: Owner will engage qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Shielding manufacturer will correct deficiencies in, or remove and replace, all radiation protection that inspection reports indicate does not comply with specified requirements.

### 3.07 CLEANING

A. Cleaning work will be conducted per Section 01 73 00 – Execution.

B. Remove excess materials from site daily. Vacuum surfaces in compliance with OSHA Standard 1926.62.

C. Leave exposed surfaces ready for site finishing

### 3.08 PROTECTION

A. Take reasonable care to protect installed materials from damage. Repair any existing materials that may be damaged by shielding work to match original.

## RADIATION SHIELDED DOORS AND FRAMES

### SECTION 13 51 00

## RADIATION SHIELDED DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

A. Radiation protection products including the following:

1. Direct Entry Swing Door.

#### 1.02 RELATED SECTIONS

A. Section 05 12 00 - Structural Steel

B. Section 05 12 10 - Structural Steel Erection

C. Section 05 50 00 - Miscellaneous Metals

D. Section 13 49 00 - Modular Radiation Shielding

E. Section 13 55 00 - Lead Sheets and Lead Plates.

### 1.03 REFERENCES

#### A. American Society for Testing and Materials (ASTM):

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A568/S68M - Standard Specification for Steel, Sheet, Carbon, Structural, and High Strength, Low Alloy, Hot Rolled and Cold Rolled.
3. ASTM 829 - Standard Specification for Refined Lead.

#### B. National Council on Radiation Protection and Measurements (NCRP):

1. NCRP Report No. 038 - Protection Against Neutron Radiation.
2. NCRP Report No. 144 - Radiation Protection for Particle Accelerator Facilities.
3. NCRP Report No. 147 - Structural Shielding for Medical X-Ray Imaging Facilities.
4. NCRP Report No. 148 - Radiation Protection in Veterinary Medicine.
5. NCRP Report No. 151 - Structural Shielding Design and Evaluation for Megavoltage X and Gamma Ray Radiotherapy Facilities.

#### C. U.S. Department of Labor Occupational Safety and Health Administration (OSHA):

1. OSHA standard 29 CFR 1910.1025 - (Alloy) Lead.
2. OSHA standard 29 CFR 1926 - Safety and Health Regulations for Construction
3. OSHA standard 29 CFR 1926.62 - Lead.
4. CAL-OSHA Title 8 Sec 1532.1, Sec 5198, and Sec 5216.

### 1.04 DEFINITIONS

A. Pre-Engineered: The advance design of shielding elements and room components to maximize performance and compatibility with the overall project parameters.

B. Modular/Modules: Radiation shielding components shall be individual elements or modules that are combined together to form a composite structure to create the required radiation attenuating environment. The modular system shall retain the ability to be deconstructed and reused. The individual block units shall not exceed 45 lb. maximum safe handling limit and shall provide a 100% interlocking joint between mating modules.

C. Interlocking: All photon, neutron and electron shielding modules shall feature a design that presents a full 100% interlocking edge. Lapping or alternating of seams which result in straight line paths and allow radiation streaming will not be permitted. Modules shall interlock together to form a solid and stable structure comprised primarily of dry stacked module system. Horizontal and vertical structurally reinforced bond beams may be incorporated into module system to create the necessary lateral reinforcement and stability of the entire structure.

D. Proper Attenuation: Shielding of all photon, neutron and electron radiation to the levels specified by the governing regulatory agencies as identified in the final physics report.

E. Radiation Shielded Environment: The overall structure providing the radiation shielding along with associated components such as doors and duct shielding, thus forming the full treatment room.

### 1.05 PERFORMANCE REQUIREMENTS

A. Performance Criteria: This is a performance specification and the manufacturer shall be responsible for the complete design, fabrication, and installation of door assembly. Doors shall be designed according to manufacturer's recommendations. The design for the shielding door shall be as manufactured by Veritas Medical Solutions of Malvern, PA.

Manufacturer shall determine size, door lap, hinge loading, and all structural requirements from shielding figures and clear opening dimensions. Unless otherwise specified, shielding thickness shall be determined by Veritas based on owner provided equipment and facility

workloads and operating parameters. Doors installed on high energy medical linear facilities shall limit weekly exposure to 1 00u-Sv/week for controlled spaces and if installed in a public area, exposure shall be limited to 20u-Sv/week. In both instances, the maximum permissible dose to a person is governed by yearly exposure limits of 5 mSv/year and 1 mSv/year. These limits are based on NCRP-151 recommendations and are generally applicable to all doors installed within the United States. If local regulations require exposure limits be reduced to comply with instantaneous dose rate values or "in any hour" limits, these limits for the various states or localities shall be provided by the client in advance of the request for proposal. Otherwise doors shall be designed and manufactured to be compliant with NCRP-151 recommendations with respect to maximum yearly permissible dose. For doors installed outside of the United States, instantaneous and time average dose rates shall be considered for each respective country and local installation. It is the client's responsibility or their appointed radiological health physicist and architect to provide the manufacturer with the parameters under which they wish the design to comply. Doors will be aesthetically covered and will be completely finished utilizing high quality door finishes of durable polymers and high pressure laminates, stainless steel or anodized aluminum.

B. Mechanism: Door should consist of a single leaf swing style shielding door. Door shall be supported by a radial/thrust pivot bearing, surface mounted to the concrete and top radial bearing installed into a steel frame support. Door shall be hinged from the spine edge of the door and shall provide a 4 ft. X 7 ft. clear opening when positioned at the 90 degree position. Door hinge mechanism shall be motor driven operating through advanced roller pinion gear with high positional accuracy. Drive mechanism shall be a direct drive assembly type with built in current limit sensing to interrupt operation in the event of excessive current draw. Door drive shall be concealed behind panelized doors that match the door veneers and shall provide simple access to drive components without the need to disengage door features. Panelized doors shall be hinged and shall provide protection at the hinge side of the door to prevent objects from getting trapped and injury to personnel by concealing the operator and eliminating the normal gap between the door faces and jam pockets.

C. Opening / Closing Speeds: Swing door shall rotate to a full open or close position in approximately ten (10) to twelve (12) seconds. Doors shall be equipped with top mounted infra-red or ultrasonic presence sensing devices mounted on the face of each door panel. This sensor shall cast a safety zone to detect people or objects that may be within the unsafe zone for safe door operation. All obstructions would need to be cleared before the door sensors allow the unit to operate.

D. Materials and Construction: Door shell shall be constructed of A36 carbon steel plate face panels, and minimum 1/2 inch thick edged banding along 3 sides (top, bottom and trailing edge). The inner core of the door shall contain Verishield™ ultra high density materials for the attenuation of all photon or neutron attenuation reducing exposure to the permissible design limits.

E. Electrical Requirements: Door system shall operate on 220 volt, 3 phase, 30 amp power supply with low voltage wiring to all door controls and presence sensors and safety systems. Doors shall be all steel, and be prime coated with 2 coats of rust inhibitive primer. All exposed surfaces of the door shall be full finished with designer finish materials selected from manufacturers standards of plastic, wood or metal laminated finishes.

F. Controls and Operation: Drive will be designed to have a zero backlash operation. A programmable touch screen interface will be utilized as a Human Machine Interface (HMI). In addition to the standard Veritas Safety Package (infra-red sensors, interlocks, etc.), the drive system must be able to sense and respond to voltage current draw as an added means of safety. If drive system senses additional current draw, due to an obstruction, drive will stop as a precaution.

G. Manual Operation: Door system must be “free wheeling” in the event of power failure, such that the door can be opened and closed manually. Personnel must be able to manually open/close door under their own power or by utilizing an optionally purchased battery back up system.

H. Radiation Shielding Protection: Provide complete radiation shielding barriers and enclosures as described on contract drawings. All shielding shall be homogeneous and contain high atomic number materials and neutron moderating additives as required. Radiation attenuating requirements shall be determined by radiological health physicist or radiation shielding engineer appointed by owner. Number of courses of VeriShield™, as well as type and grade, required to attenuate radiation levels to that prescribed by same, shall be determined by manufacturer. Interlocking VeriShield™ blocks manufactured and guaranteed by Veritas Medical Solutions, LLC shall provide shielding for both photon and neutron radiation as required.

I. Interlocking Modules: Door system shall be of a modular design for all items of radiation shielding. All photon, neutron and electron shielding materials must be designed, fabricated and installed with an interlocking design to present a full 100% interlocking edge. Lapping or alternating of seams which result in any straight line paths for radiation streaming will not be permitted.

#### 1.06 SUBMITTALS

A. Refer to Section 01 30 00 -Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer’s data sheets on each product to be used, including:

1. Performance data and physical properties.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.

C. Shop Drawings:

1. Indicate dimensions, description of materials and finishes and general construction.
2. Indicate layout of radiation protected areas.
3. Indicate the thickness of the shielding materials.

D. Closeout and Maintenance Documents:

1. Closeout Conference: Schedule project closeout conference with sufficient time to prepare for requesting Substantial Completion. This conference shall be attended by the Owner, General Contractor, Shielding Subcontractor, Owner’s Testing and Inspection Agency, Architect and all other parties as may be appropriate.
2. Manufacturer shall provide operator manuals, maintenance schedules and contact information as necessary.

E. Certification: Manufacturer’s written certification stating that doors, frames, and all related items to be furnished hereunder, meet or exceed the shielding performance requirements required by physicist of record report(s).

F. Manufacturer’s Instructions: Manufacturer’s installation instructions and diagrams for components installed under other trades.

G. Welders’ certificates will be supplied as required.

#### 1.07 QUALITY ASSURANCE

A. Qualifications: Firm with minimum of 5 years successful experience manufacturing radiation protection products similar to those specified for this project.

B. Radiation Protection Survey: Employ registered Health Physicist, certified by American Board of Radiology, for testing specified radiation protective work and to conduct radiation protection survey of facility.

1. After equipment has been installed and placed in operating condition, the radiation shielding will be tested by a Health Physicist contracted by the owner and certified by a nationally recognized agency. The Shielding Contractor shall be notified ten (10) days in advance of test to permit verification of shielding integrity.

2. Testing will be performed in accordance with the recommendations and guidelines outlined by NCRP guidelines and as called for by the radiation shielding experts Testing Protocol Manual. Final testing and acceptance is the responsibility of the owner appointed Radiological Health Physicist. Radiation shielding integrity testing must be completed within 60 days of project completion.

C. Radiation Protection Work: Comply with National Council of Radiation Protection (NCRP) Report No. 049 - Structural Shielding Design and Evaluation for Medical Use of Gamma Rays of Energies up to 18 MV.

1. Comply with requirements of local regulatory agencies where local standards and criteria exceed requirements for NCRP Report No. 049.

D. After equipment has been installed and placed in operating condition, the owner will engage a radiation health physicist to test radiation protection.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instruction for receiving, handling, storing, and protecting materials.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

1. Owner shall provide adequate area for storage and staging of all materials delivered to the site. Reasonable access to the site must be provided.

2. Any required protection of existing floors, carpets, tile, plumbing/electric stub up fixtures, walls, etc. shall be the responsibility of the Owner/Construction Manager shall provide hard surfaced area suitable for delivery and storage of palletized 2 ton packaged materials.

C. Store materials in original packaging, protected from exposure to harmful environmental conditions, including static electricity, and at temperature and humidity conditions recommended by manufacturer.

D. Exercise care to prevent edge damaged materials.

#### 1.09 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

#### 1.10 DESIGN REQUIREMENTS

A. Door shall be designed for swing style conditions and shall be complete with:

1. Heavy duty maintenance free ShieldTech™ drive mechanism.

2. Acceleration and deceleration ramp speed control.

3. Minimum of twelve (12) second cycle speed (open or close).

4. Concealed radial and thrust ball bearing support system.

5. Safety Sensor Package for interior and exterior sides.

6. Light Curtain: Electric eye to detect the presence of people or other objects as they pass through the door opening. In the event of detection the door will be signaled to stop.

7. Presence Sensor: Ceiling mounted device detects people as they pass through the detection field sending a signal to the operator to stop.

8. X-ray interlock (Note: Wiring requirements shall be coordinated with equipment vendor).

9. "Zero weight system" allows for easy manual door movement in power out conditions, virtually eliminating maintenance issues.
10. Noise resistant electrical cabling.
11. Silent operation with infinitely variable door speed.
12. Full structural support system and mounting hardware.
13. 100% shielding guarantee to meet or exceed specified shielding parameters.
14. Decorative brushed US32D stainless door hardware.
15. Two (2) customized push button stations with brushed aluminum faceplates.
16. "Smart Door" Technology Advanced Monitoring System with HMI touch screen panel control center to monitor all door functions.
17. Innovative operator interface - Controls and monitors all aspects of door operation, Door Position, Operation History, Door Speed, Safety Status, Stop Points, Lock Out Status, Power Status, Service Issues.
18. High quality door finishes selected from an array of durable polymers and high pressure laminates, stainless steel or anodized aluminum.
19. Interior and exterior door edge protection panels.

#### 1.11 WARRANTY

- A. Door drive mechanism and shielding components shall be designed and offered with a 100% Guarantee against radiation streaming, mechanical failure etc.
- B. Door system will be designed to guarantee against radiation streaming through joints and seams from radiation emanating from any point within the room.
- C. A lifetime warranty shall be provided that insures maximum "up time" and covers all parts and labor for door drive and guidance mechanism and related parts for a minimum of 10 years (expected service life of the door assembly).

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Veritas Medical Solutions, LLC,  
160 Cassell Road, Harleysville, PA 19438  
Phone: 484.991.8928
8. Substitutions: Not Permitted.

### 2.02 MATERIALS

- A. Steel Bars and Plates: ASTM A36.
- B. Roll Formed Steel Members: ASTM A36.
- C. Bolts and Fasteners: ASTM A325 and A490 as required.
- D. Rust inhibitive primer paint for all steel components prone to oxidation.
- E. Certification: Manufacturer's written certification stating that doors, frames, and all related items to be furnished hereunder, meet or exceed the shielding performance requirements required by physicist of record report(s).
- F. Manufacturer's Instructions: Manufacturer's installation instructions and diagrams for components installed under other trades.
- G. Welders' certificates will be supplied as required.
- H. Veritas Ultra High Density Shielding:  
VeriShield: Cementitious interlocking modular shielding with a sine wave shape that eliminates straight line seams and provides neutron, proton, and particle attenuation at the joints. Fabricate the dry stacked modular shielding of one of the following densities:

1. Size: V-250S: 10" inches (254mm) by 5" inches (127mm) by 5" inches (127mm).
2. Size: V-300S: 10" inches (254mm) by 5" inches (127mm) by 5" inches (127mm).

## 2.03 MATERIAL COMPOSITION AND CHARACTERISTICS

### A. Veritas Verishield Composition Information:

#### Major Compounds

Chemical Name CAS Regist<sup>o</sup> Number

Portland Cement \*65997 -15-1

Gypsum (calqium sulfate) 13397-24-5

\*May contain crystalline silica 14808-60-7

### B. Physical/Chemical Characteristics:

Boiling Point NIA

Vapor Pressure (mm Hg) NIA

Melting Point NIA

Vapor Density (AIR-1) NIA

Evaporation Rate NIA

Solubility in Water NIA

Appearance & Odor Grey, no odor

C. Fire and Explosion Hazard Data - None

### D. Reactivity Data:

Stability: Stable

### E. Weight per module:

V250 36 lbs. - 16.4 kg

V300 43 lbs. - 19.7 kg

### F Density:

V250 250 lbs./cu. ft.

4 g/cu. Cm (median)

V300 300 lbs.ICU.ft.

5 g/cu. Cm (median)

G. Compressive Strength: 5,200 psi - 366 kgf/cum<sup>2</sup>

Solubility: Insoluble

Reactivity: Non-Reactive

Melting Point: "2,800° F - 1,538° C

Boiling Point: NIA

## 2.04 RADIATION ATTENUATION

Attenuation is based on interpolated data for some energies. The listed IVL's represent the average tenth value thickness after 5 decades of attenuation. First TVT and equilibrium IVL's may be available for thin barrier sections.

### A. V250 Attenuation -Secondary Barrier (IIVL=)

6MV:

10MV:

15MV:

18MV:

6.5" - 16.5cm

7.7" - 19.6cm

8"-20.3cm

8.2" -20.8cm

B. V300 Attenuation -Secondary Barrier (IIVL=)

6MV:

10MV:

15MV:

18MV:

PART 3 - EXECUTION

3.01 PREPARATION

5.25" -13.3cm

6.2"-15.7cm

6.4" -16.3cm

6.6" - 16.8cm

Examine structure, substrates, and conditions under which work is to be installed for conditions detrimental to the correct and timely completion of the project. Installation constitutes acceptance of responsibility for performance.

3.02 INSTALLATION

Installation of Veritas structural frame and "Smart Door" assembly system is the responsibility of

Veritas Medical Solutions and/or its assigns.

3.03 OPERATOR

Veritas HMI and electric door operator system shall be installed and maintained by Veritas approved and trained personnel only.

END OF SECTION

13 51 00 - 08 CD









