Science & Technology Facilities Council
Rutherford Appleton Laboratory

IMAT - Power Operated Door Specification

Document Ref:

ISIS-TS2-PhII-IMAT-Sp-0019

1 Table of Contents

2 Introduction

The IMAT instrument is a new neutron instrument located in ISIS target station 2 at RAL. The instrument is currently accessed via a manually operated shielded slide door (shown in Figure 1). This manual slide door provides insufficient gamma radiation shielding, and so must be replaced by a heavier power operated door. The replacement door will have a mass of approximately 6,000kg. The 'dead space' into which the door will move when opened (and leaves empty when closed) must also have shielding installed into it. This specification document details the requirements for the supply and installation of this replacement power operated door, static 'dead space' shielding, associated equipment, documentation and training.

Figure 1 – Existing IMAT manually operated shield door

3 Definitions

STFC	Science and Technology Facility Council
RAL	Rutherford Appleton Laboratory, Chilton, UK
ISIS	Facilities department within STFC concerned with procuring equipment
Bidder	Company who offers a tender return
Supplier	Company who is awarded the contract
IMAT	Imaging and Materials Neutron Instrument
PDR	Preliminary Design Review
FDR	Final Design Review
FAT	Factory Acceptance Testing
PPS	IMAT Radiation Personal Protection System
Blockhouse	Shielded room into which the powered door gives access
SHE	Safety, Health and Environment (SHE)
RPS	Radiation Protection Supervisor
RPA	Radiation Protection Advisor
RAMS	Risk assessment and method statements

4 Scope

The contract shall include all mechanical and electrical calculations and the design of the equipment. The Supplier shall be responsible for the detailed design, manufacture, assembly, delivery, installation, testing, commissioning, documentation, and training. All design rights shall remain the exclusive property of STFC.

4.1 Key Responsibilities

Supplier will responsible for:

- Meeting the specification
- Ensuring fit & function
- Designing and delivering a system which is safe for operation and maintenance
- Inspecting and measuring site/existing-structures for installation and functional fit

STFC will be responsible for:

- Advising and approving design for STFC requirements
- Advising and approving design to ensure suitability for radiation environment
- Advising and approving design to ensure required radiation shielding performance
- Testing and approving radiation shielding performance

5 Contract Deliverables

5.1 Equipment

Supply and install 1 power operated shield door in line with this specification, including but not limited to:

- Support Frame
- Door
- Drives
- Controllers
- Static 'dead space' shielding

5.2 Documentation

The contract shall include the supply of the following documentation, all of which must be clearly presented in English:

- Preliminary Design Review (PDR) documentation and minutes (see Section 12.2.1.1)
- Final Design Review (FDR) documentation (see Section 12.2.1.2)
- Factory Acceptance Test Procedures
- Factory Acceptance Test Reports
- Full support manuals of equipment, including installation, operation and maintenance manuals (see Section 6.3)
- A full set of technical drawings for all equipment supplied – All dimensions to be in metric.
- A complete 3D CAD model of the assembly.
- A list of recommended spare items and costs
- Safety report – inc. electrical safety testing
- Design risk assessment – must clearly show operating hazards and control measures

5.3 Manuals

Detailed installation, operation and maintenance manuals shall be supplied (as electronic and hard copy versions) as part of this contract. The manuals must include:

- Instructions for correct operation
- Detailed assembly and disassembly instructions
- Routine maintenance requirements – including a detailed description of task, the conditions under which it must be performed and the estimated time to complete the task
- Fault diagnosis instructions
- Relevant mechanical and electrical drawings

5.4 Training

Training must be provided by the supplier, at RAL following successful commissioning. This training must cover the door maintenance and operation and be given to 3 – 5 RAL staff members. The training must include, but should not be limited to:

- Normal operation of the door
- Manual drive of the door (if applicable)
- How to power down and isolate the door for maintenance etc.
- Basic maintenance procedures

5.5 Components to be provided by RAL

It will be necessary for the door to interface with the IMAT instrument PPS as detailed in Section 10.6.1. The PPS components listed below will be supplied by RAL to the supplier free of charge:

- Trojan proximity switch
- SensaGuard™ RFID feature
- Fortress Key Unit & Lok elements

Mounting and any associated bracketry must be delivered by the supplier

5.6 Installation & Commissioning

It will be the responsibility of the supplier to complete all mechanical and electrical installation testing and commissioning. Details responsibilities and requirements for installation work at STFC can be found in Section 11.

6 Project Management

The supplier will be responsible for ensuring the project is delivered within the timeline agreed at the start of the contract. The supplier will be responsible for ensuring project milestones are met.

6.1 Delivery Date

The target completion date for the contract is the 27/04/2017. If this date is not achievable then the actual delivery date must be stated in the tender return. Quotations which deviate from this target delivery date will be considered

6.2 Program of Work

The programme shall include the following milestones:

1. Commencement of Contract
2. PDR complete
3. FDR (at RAL) complete
4. Manufacture of Door complete
5. FAT and Approval
6. Delivery, installation and commissioning at STFC
7. Completion of contract

A full delivery schedule shall be agreed within two weeks from the commencement of the contract.

Regular progress updates shall be given by the Supplier, at a period sensible to the stage of the contract. As a minimum this shall be every month. This shall be given in writing (e-mail is acceptable).

6.3 Acceptance and Approvals

STFC will need 2 working weeks from submission of the concept design and detailed design information to approve. This should be allowed for in the plan.

The approval of the concept and detailed design by STFC shall not relieve the Supplier of any responsibility for meeting the final specifications of the contract.

Section 12.2 details requirements and elements of each approval stage

7 Documents Required for Quotation

All the contractual and technical documentation shall be provided electronically and written in English. Tender returns must include the information listed in the following subsections.

If any elements of this specification cannot be achieved, whether they be technical, targeted delivery date, installation time, documentation, or otherwise, suppliers are encouraged to offer a quotation with proposed achievable details outlined clearly in the tender return. Quotations including such deviations will be considered.

7.1 Technical Description of Equipment

1. Full technical details of the proposed solution including outline drawings with plan elevation and side views. The Bidder shall describe the equipment to be supplied in sufficient detail for STFC to understand the method of construction and method of operation.
2. A preliminary indication of the space envelope required.
3. An indication of the expected power requirements, if appropriate compressed air requirements.

7.2 Installation

The Bidder shall provide an overview of the expected installation method

7.3 Maintenance / servicing

The Bidder shall provide the expected maintenance and servicing requirements for the equipment.

7.4 Recommended Spare Parts List

The Bidder shall include a list indicating anticipated spares including usage and prices.

7.5 List of Included Items

Bidders shall provide list of all of the deliverables that will be supplied as listed in section 6.4.

7.6 List of Excluded Items

Bidders shall provide a list of any deliverables which will not be supplied (exclusions).

7.7 Compliance List

A confirmation of acceptance, or otherwise, of the present specification

7.8 Non-Compliance List

The Bidder shall clearly list any elements of the present specification which cannot be met

7.9 Programme of Work

1. The total duration of the contract.
2. A programme Gantt chart showing the design, procurement, manufacturing, assembly, testing and delivery of the systems. The programme must include milestones listed in Section 7.2.
3. List of the significant work packages to be undertaken by the Supplier, and by any sub-contractors, together with their names.

7.10 Reference List

The Bidder shall produce a list of customers previously supplied with similar components. The Bidder should supply contact details of the customers which STFC may contact in the tender evaluation.

8 Tender Details

8.1 Stage Payments

STFC suggest the following stage payments:

1. Following STFC acceptance of the FDR – 20%
2. Payment for raw materials and components required for this tender following receipt of photographic evidence that these have been procured and marked as 'The Property of the Science & technology Facilities Council' – 30%
3. Following STFC acceptance of successful FAT and delivery of all documentation – 30%
4. Following STFC acceptance of successful (i.e. full and undamaged) Installation at RAL 20%

8.2 Tender Evaluation

The tender replies will be evaluated with the overriding principle for STFC to gain best value for money. STFC admit this specification is technically challenging, therefore evidence of previous similar work and technical capability is imperative. Tenders will be judged on the following considerations, which have been given weightings of importance:

	Weighting
Price	*40*
Adherence to technical requirements	*50*
Delivery Time	*10*

9 Technical requirements

9.1 Overview

The IMAT instrument is a new neutron instrument located in ISIS target station 2 at RAL. The instrument currently includes a manually operated shielded slide door. This manual slide door provides insufficient gamma radiation shielding, and so must be replaced by heavier power operated door. The replacement door will have a mass of approximately 6,000kg. The replacement door must meet the shielding material, thicknesses and geometries defined in this document. The 'dead space' which the door slides into, also requires additional shielding. This dead space shielding and the door-end overlap shielding must be supplied as a part of the contract. Figure 2 shows the labelled principle layout for the system. Figure 3 shows an acceptable alternative layout with the static dead space shielding on the inside face.

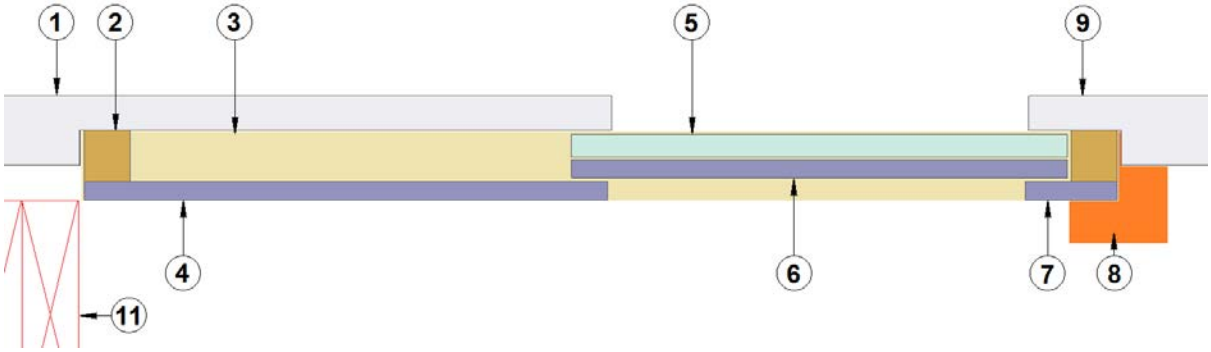


Figure 2 – Principle layout

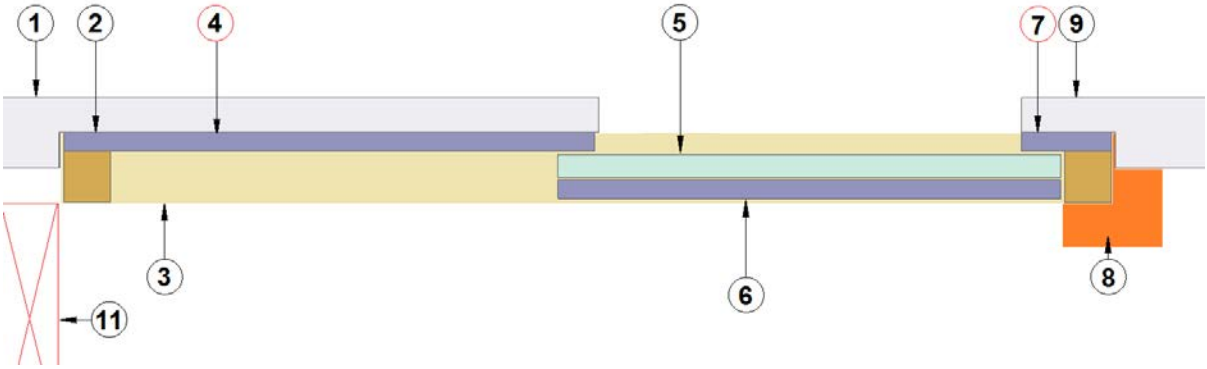


Figure 3 – Alternative layout with static shielding on the inside

1) Existing blockhouse wax tank wall
2) Door support frame
3) Dead space into which door moves
4) Lead dead space static shielding
5) Door - Borated Poly
6) Door - Lead Shielding
7) Door-end overlap static shielding
8) Area available for controls
9) Existing blockhouse wax tank wall
10)
11) Stairway

9.2 Radiation Shielding Material Requirements

The replacement door must include a thickness of 100mm of borated poly material and a thickness of 80mm of lead across its entire effective area. These shielding materials must be clad in cosmetic covers to prevent exposure to toxic lead material and provide acceptable aesthetics. The effective area must form a minimum overlap of 150mm above & to both sides of the door with the wax tank walls and the static shielding (Figure 4 & Figure 5). The clearance between the floor must be <40mm.

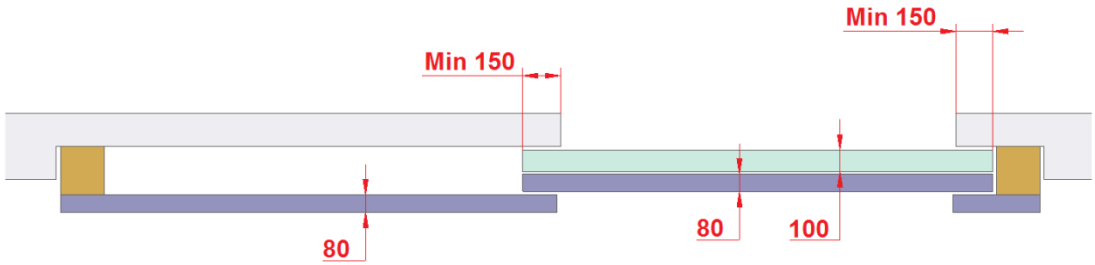


Figure 4 – Shielding material thicknesses and overlap

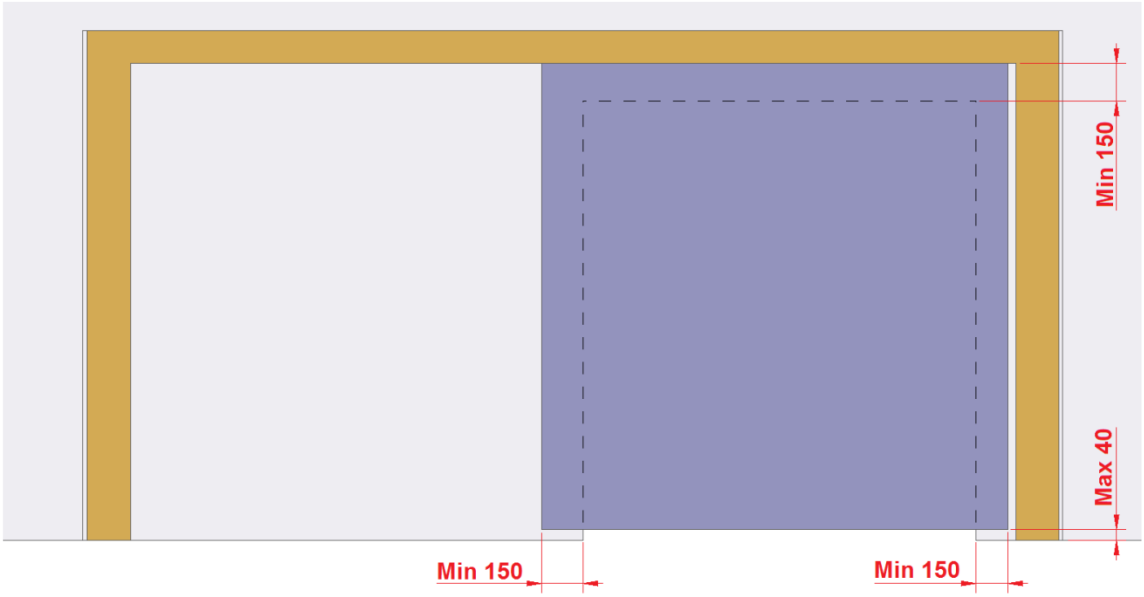


Figure 5 – Effective area overlap

The dead space into which the door moves must include extra shielding. This static shielding can sit on the outside or inside face of the dead space and must be made from a thickness 80mm of lead. The door end overlap must also include extra shielding. This must be made from a thickness of 80mm of lead.

It may be necessary for the door and or the static shielding to include structural features which interrupt the shielding materials over the effective area (e.g. screws or supporting steels). Such weaknesses in the effective area should be avoided where possible, but can be accepted under specific approval by STFC. As a general guide they should:

- Be kept to a minimum
- Be spread out
- The total penetrated area should not exceed 0.025m^2
- Not include empty space but be filled with steel or other approved material

All materials used in areas exposed to the radiation inside the IMAT instrument must be approved by STFC. The borated poly material should contain by weight ≥5% boron and ≥10% hydrogen – an example material data sheet is attached in document *"Rochling High Performance Plastics Technical Data Sheet Polystone D nuclear with B_2O_3"*

9.3 Geometric Requirements

All elements of the door system including frame, static shielding, and operational controls must fit within the foot print shown in Figure 6. The complete door system must not block access to the stairway in the open or closed position. The drive mechanisms can be located anywhere within the given foot print at ground level or at high level. If necessary, additional space can be used outside of the acceptable foot print at high level (above 2000mm) provided it does not impinge on the stair space. Below 2000mm all elements of the door system should fit within the given footprint. To provide the necessary level of structural stability, special exemptions to the above will be considered for structural elements placed in the areas highlighted in Figure 7. These structural elements should be minimised and avoided if possible. The design of these structural elements must be sympathetic to the access requirements through the door, down the stairway and around the stairway.

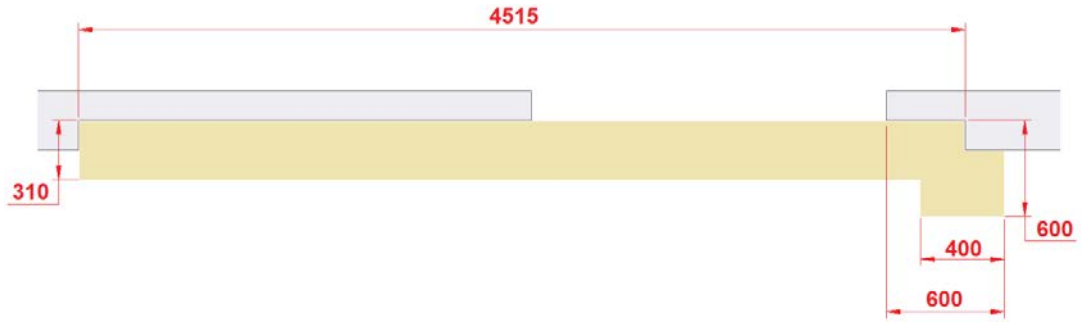


Figure 6 – Door system footprint

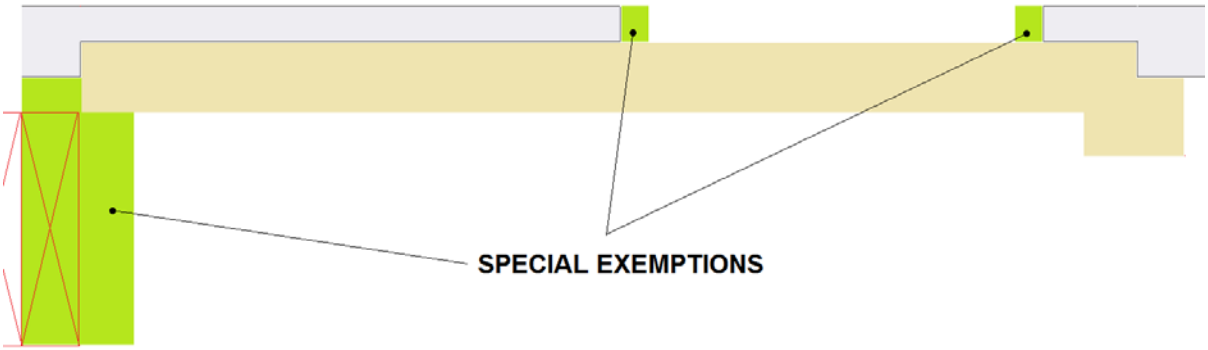


Figure 7 – Foot print special exemptions

The opening in the existing wax tank structure measures approximately 1810 x 2000 mm. The recessed feature in the wax tank has depth of approximately 100mm and covers an area of approximately 4515 x 2380 mm as shown in Figure 8.

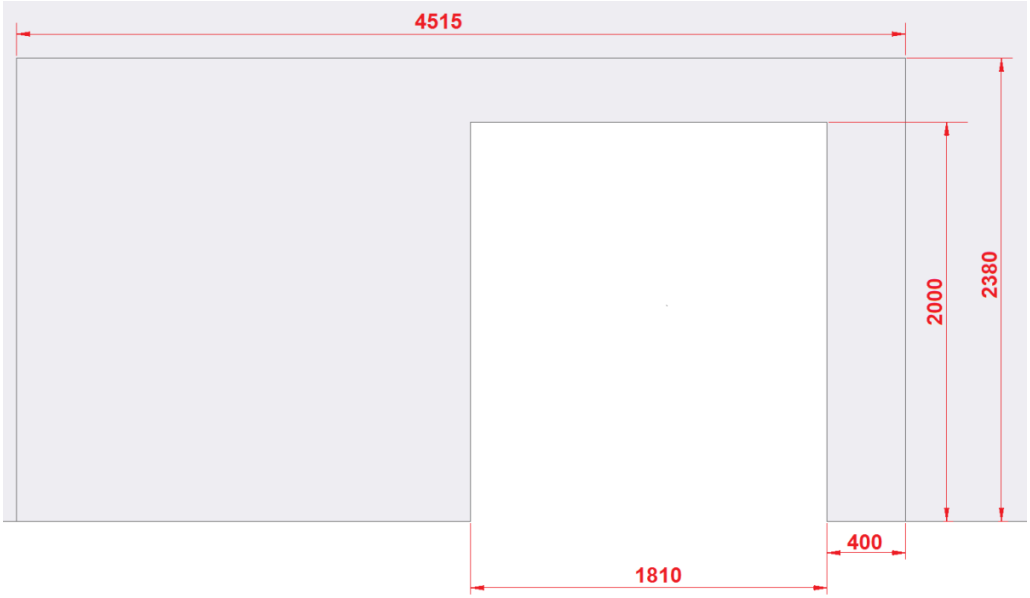


Figure 8 – Approximate geometry of existing wax tank

Above the door, space is available which can be occupied by elements of the door system, but a location must remain available for the digital display (shown in Figure 9).

Figure 9 – Digitial display

9.4 Operational Requirements

The controls for the power operated door should be located in the area labelled OPERATIONAL CONTROLS in Figure 10. The controls must be mounted at an ergonomic height for operation by a standing adult (male and female). The controls must be labelled. The controls must include a resettable emergency stop. The controls must position the operator such that they can see the door easily when using the controls.

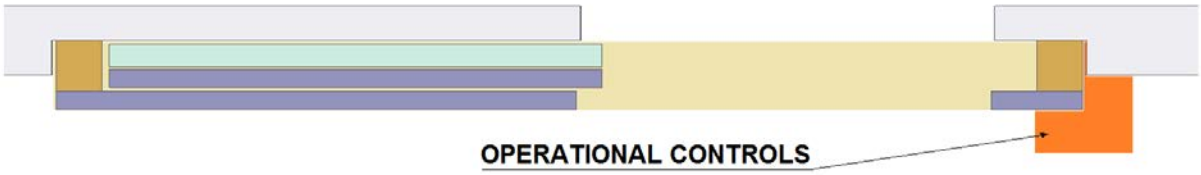


Figure 10 – Operational control location

When operated the door should fully close within 18s, and fully open within 18s. It should be possible to partially open and close the door. When fully open, the door must provide an opening 1500mm wide and 2000mm high (shown in Figure 11). The floor of the door openening must be free from tracks or guides so that sensitive scientific equipment can easliy be wheeled into the blockhouse without impediments or risk of damage. If it is necessary for a flat load bearing plate to be located into the floor in the opening it must not deviate from the existing floor surface by more than 2mm.

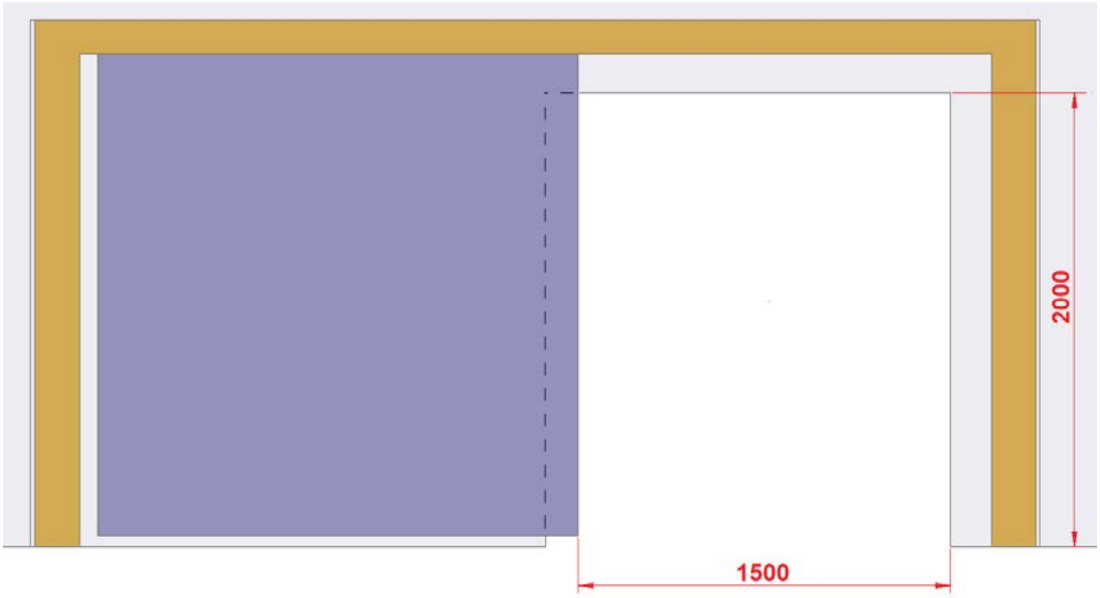


Figure 11 – Door opening geometry

The door system should include an area light and sounder to alert people in the area that the door is moving. The door operation must be push and hold (dead man's handle).

9.4.1 Noise & Vibration

The door should create minimal noise and vibration when operating. Disagreeable mechanical wear or abrasion noises must be prevented (scrapping, squealing grinding).

9.5 Structural Requirements

The door will be installed into the existing opening in the blockhouse wax tank wall. The blockhouse wax tank walls cannot support any significant load - as such the complete system must be self-supporting for normal use, emergency stops, emergency operation, and reasonably foreseeable misuse.

The concrete slab floor can support a load of 25T/m^2. As shown in Figure 12 a floor trench runs through the edge of the door foot print. Figure 13 & Figure 14 show the cross section of the trench.

Figure 12 – Floor trench in door footprint

Figure 13 – Floor trench

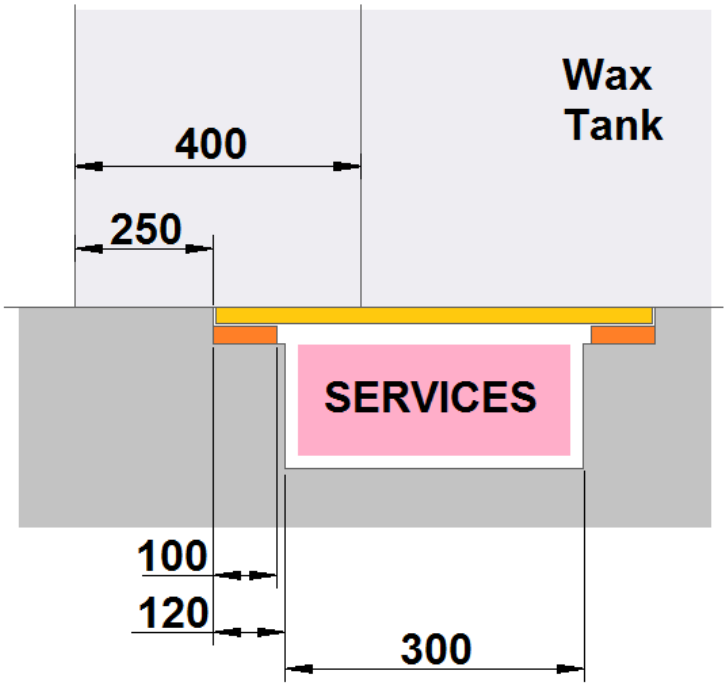


Figure 14 – Floor trench approximate cross-sectional dimensions

9.6 Safety Requirements

The door will be used by trained personnel. Untrained personnel will have access to the door and door operating area. The door controls should include a sprung flip guard with suitable notices to highlight the requirement for the door to be used only by trained personnel. It will be operated 10 times per day, 200 days of the year. The door's safety systems and design must manage hazards created by its interaction with the existing area and physical elements in the proximity of the door - it will be the responsibility of the supplier to inspect the area and existing physical elements in the proximity of the door and ensure they are suitably accounted for. All moving parts of the guide and drive mechanisms which present a trap/pinch hazard should be guarded. The door operation must be push and hold (dead man's handle). The door should also include a bump strip or equivalent on the leading edge to protect persons and objects from being trapped in the door.

The power operated door system must conform to all appropriate legislation and guidelines to ensure the system is safe for use for the operating conditions outlined in this specification. At a minimum this must include:

- 2006/42/EC The Machinery Directive
- BS EN 16005:2012 - Power Operated Pedestrian Doorsets Safety in use Requirements and test methods.

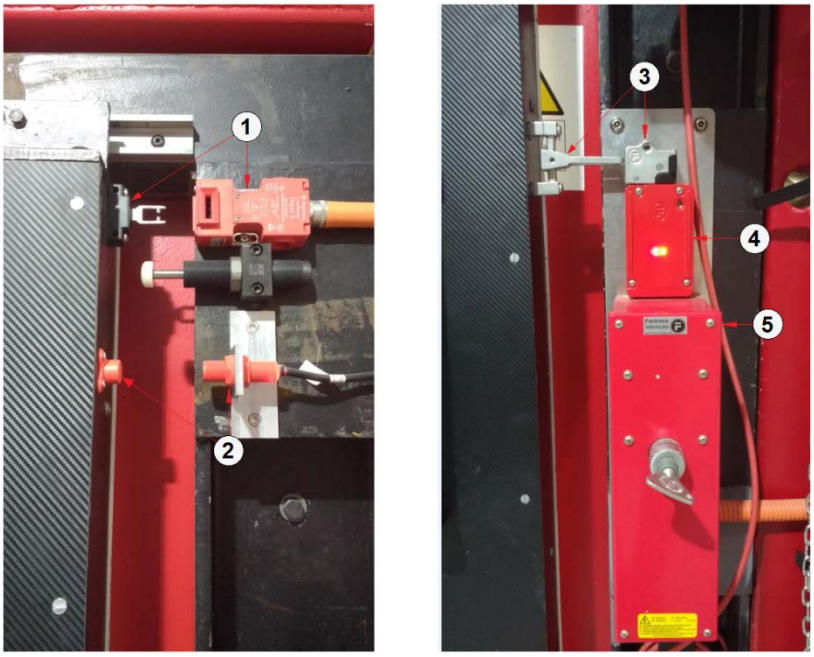
It will not be necessary for the door to have a 'breakout' mechanism to allow persons trapped inside the blockhouse to escape via the power operated door in an emergency. An alternative escape route is available, and the blockhouse must be searched before the door can be closed (as detailed in section 10.6.1)

The complete door system must be electrically tested in line with all relevant legislation and guidelines. The supplier will be responsible for all safety testing.

9.6.1 Radiation Personnel Protection System

The blockhouse will be searched in line with the IMAT search radiation protection search procedure before the door is closed. Once searched, a signal will be provided from the IMAT PPS control system to the door control system via 2 volt free contacts. It must not be possible to close the door in the normal operating mode, without the searched signal from the PPS control system being received. Once closed, the door will be locked via the Fortress Key Unit. This will trigger the locking pin on the Fortress Lok Unit and will operate 2 volt free contacts on the Fortress Key Unit. The volt free contacts on the Fortress Key Unit must be used to ensure the door cannot be opened once locked via the Fortress Key Unit.

The door must support the PPS interlock actuators and ensure they mate with their corresponding switches. These interlocks include the Trojan proximity switch; SensaGuard™ RFID; and the Fortress Lok as shown in there configuration on the existing door in Figure 15. The positional precision required for each interlock, and so the required repeatability of the door position, are shown Table 3. Where there has been difficulty achieving this level of precision in comparable systems, 'floating' brackets have been used successfully to allow the interlock devices to self-align. This is an acceptable solution but will require specific approval in the design approval stages. All actuators and switches must be mounted on independent brackets such that should a bracket fail only 1 interlock element is compromised. The Fortress Key Unit and Fortress Lok elements are, and must remain, electrically connected but can be physically separated if required.



1. Trojan proximity switch
2. SensaGuard™ RFID
3. Fortress Lok Head
4. Fortress Lok Unit
5. Fortress Key Unit

Figure 15 – Existing PPS interlock elements

#	Interlock	Linear accuracy	Axial accuracy
1	Trojan proximity switch	±2.5mm	±0.75mm
2	SensaGuard™ RFID	±7mm	±7mm
3	Fortress Lok	*±5mm*	*±5mm*

Table 1 – Positional accuracy required for PPS interlocks

9.7 Maintenance & Life Cycle Requirements

The door will be operated 10 times per day, for 200 days of the year. The environment in which the door will operate is detailed in section 10.8. The system must operate under these usage conditions without the need for repair or unscheduled maintenance for 10yrs (20,000 cycles). It must be possible for the door to be left static in any position (open, closed, partial) for 3mths without jamming, sticking or becoming damaged.

In the event of loss of power it must be possible to manually drive the door into the open position. To ensure the door cannot be opened manually when the Fortress Door Key Unit is locked:

- The fortress Lok will prevent the door from opening
- Access to the mechanism to manually drive the door should be guarded with a cover which should be screwed in place with pin torx screws; include padlock eyes; and have appropriate signage – to be agreed by STFC

Battery operation in the event of loss of power is not required

It should be mechanically possible to safely detach/disassemble the drive mechanism from the door to allow the door to be slide open manually should any of the drive elements seize or fail. Access for repair and maintenance, to drive and guide mechanics, should be possible with minimal removal required, of heavy shielded sections.

If lubrication is required:

- Any lubricants must not be liable to leak into areas where they are not required
- Lubrication method should be such that it can be applied without risk of spillage
- Where appropriate lubricant and lubricated elements should be contained

9.8 Environmental Conditions

The door will be located inside the IMAT extension building. The normal environmental conditions of the extension have a temperature range of 15°C to 30°C and 40% to 60% humidity.

9.8.1 Radiation

As detail in section 5.1 STFC will be responsible throughout the contract for providing the necessary guidance to ensure suitability of the system for the radiation environment, and to ensure it delivers the required shielding performance.

The inside of the door will be exposed to radiation created by the instrument. The shielding materials in the door and static shielding sections will block this radiation. See Figure 16

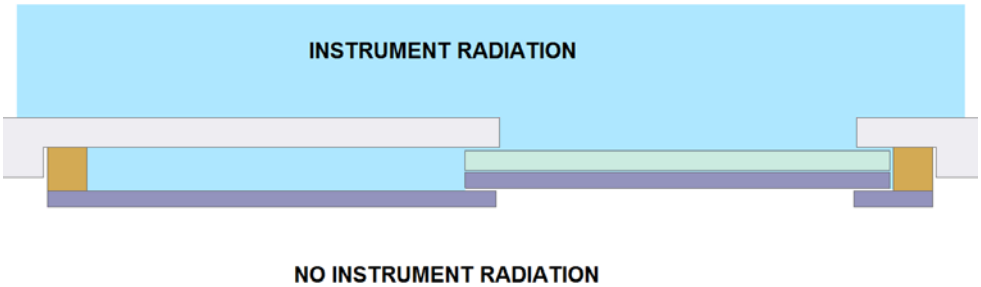


Figure 16 – Door exposure to ionizing radiation

Certain materials can create secondary radiation and or present an activation risk when exposed to the radiation present inside the IMAT instrument. The outline design detailed in this specification has been designed to manage this risk. Primarily this means only the shielding materials are exposed to the instrument radiation. Where other materials are required inside the exposed environment (screws, support elements etc.) their material composition will require review by STFC. In such cases the radiation levels and energies present in the instrument are unlikely to result in a requirement for specialist materials or methods beyond those explicitly outlined in this document.

Neutron and gamma radiation can cause damage to materials resulting in changes in their mechanical performance and electrical behaviour. As such, all control and drive components should be located out of the radioactive environment.

9.9 Services

STFC will install power, and if required compressed air service connection points for the door system with local isolators. The electrical power (voltage, current, single/3 phase) requirements for the door system must be specified by the supplier. A maximum of 32amp (400V 3 phase, or 240V single phase) can be made available. If compressed air is to be used, compressed air is available at normal operating pressure of 8bar. See section 11.2.1 for details on installation responsibilities and requirements.

10 Delivery / Installation details

10.1 Delivery Address

R80 – IMAT Extension
Rutherford Appleton Laboratory,
Science & Technology Facilities Council,
Harwell,
Oxfordshire,
OX11 0QX UK

Deliveries to RAL must be on site between 08:30 & 15:00 Monday to Thursday and 08:30 & 14:00 Friday. 24 hours' notice must be given before delivery any deliveries not meeting this Criteria will not be accepted on site.

10.2 Installation

It will be the responsibility of the supplier to install and commission the door system. The supplier will be responsible for all mechanical and electrical installation and testing unless explicitly stated otherwise in this specification – see section 11.2.1 & 11.2.2. The supplier will be responsible for measuring the existing structures and ensuring the suitable fit and access for installation. The system must be installed with the existing wax tank structure in place; as such access for floor cutting is limited. The supplier must provide all personnel, tools and equipment necessary to complete the installation with the exceptions of Cranes, Forklifts, MEWP and scaffolds as detailed below:

Cranes

A 10T crane covers the installation and unload area. Certain areas within this space do not have crane access and obstructions are present within the installation and unload area. The supplier is responsible for assessing the crane access and obtaining approval for the proposed use/method by STFC. All crane operation will be completed by STFC staff under instruction by the supplier. Any crane use must be included within the suppliers RAMS.

Forklift

STFC has on site, various forklifts which can be used for the installation with a load capacity up to 9T. Certain locations within the installation and unload area have obstructions which limit forklift access and capability. The supplier is responsible for assessing the forklift access and obtaining approval for the proposed use/method by STFC. All forklift operation will be completed by STFC staff under instruction by the supplier. Any forklift use must be included within the suppliers RAMS.

MEWP

It will be the responsibility of the supplier to define any requirement for the use of MEWP and agree with STFC. This must be agreed with STFC prior to submission of RAMS. STFC will be responsible for MEWP equipment hire, and will bear the cost of equipment hire. The supplier will be responsible for ensuring only trained operators use MEWP equipment. Training certification must be provided by the supplier to STFC for review and approval

Scaffold

It will be the responsibility of the supplier to define all access requirements and agree with STFC any scaffold needed. This must be agreed with STFC prior to submission of RAMS. STFC will be responsible for installation and certification of any scaffold, and will bear the cost.

During the installation it will be necessary to stop use of the IMAT instrument. As such the installation and commissioning period must be agreed by STFC. The total installation and commissioning time should not exceed 2 weeks. As detailed in section 7.1 the target completion date for the contract is the 27/04/2017. If these targets are not feasible expected deviations from these targets should be highlighted in the quotation documentation. Quotations which deviate from these targets will still be considered.

It will be the responsibility of the supplier to ensure all waste created by the installation is dealt with responsibly and in line with all relevant legislation & guidelines. All waste generated from material brought to site by the supplier must be removed by the supplier. Special waste generated from RAL site material (drilling existing structures, etc.) must be packaged by the supplier for disposal by STFC.

The removal of the existing door and support frame will be the responsibility of the STFC and will be completed prior to the installation work commencing.

10.2.1 Installation to STFC Services

The electrical power requirements for the door system must be specified by the supplier. STFC will install a local isolator and spur for connection to the door system. STFC will be responsible for connection of the power operated door to the local isolator.

If compressed air is to be used:
STFC will provide compressed air outlet with a manual isolator to the location required. The supplier will be responsible for connection to the compressed air outlet. The supplier will be responsible for supplying and installing any handling systems including local regulators, filters etc. which are required for the door system. The supplier will be responsible for leak testing of all door components.

10.2.2 PPS Installation and testing

STFC will be responsible for connecting PPS switches to the PPS control system. STFC will be responsible for testing of the PPS system.

10.2.3 Installation H&S

It will be necessary to submit RAMS in advance of the installation and commissioning work for review by STFC. STFC will need 2 working weeks from submission of the RAMS to approve. This should be allowed for in the plan. Method of installation should have prior agreement by STFC as outlined in Section 11.2 & Section 12.2.1.

10.2.4 Radiation Risk

The installation location is within a Radiation Controlled Area under IRR99. The instrument will not be in use during the installation process and as such the radiation risk should be minimal. The STFC site RPS will be responsible for reviewing RAMS and assessing any radiation hazard. Where necessary, advice will be sought from the STFC RPA. Local rules regarding radiation safety must be followed by the supplier during installation – these can be found in Attachment "ISIS_LR_R80_001 Rev 4 Local Rules For R80 Experimental Hall"

11 Appendix

11.1 Responsibilities at STFC

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Table 2 – Responsibilities at STFC

11.2 Approval steps description

11.2.1 Design reviews

11.2.1.1 Preliminary Design Review

Within one month of the commencement of the contract a Preliminary Design Review (PDR) meeting will be held either at RAL or the Supplier's site. The location for these design reviews will be by mutual agreement between STFC and the Supplier.

The PDR will examine the concept design, and examine the impact of any alterations to the specification as a result of the tendering process. The installation method overview will be reviewed at this stage. This review should act as a 'hold point' and the project should not continue until approval has been given from STFC. At this stage a programme of technical and progress reviews will be agreed between the Supplier and RAL.

11.2.1.2 Final Design Review

At the Final Design Review (FDR) meeting the Supplier must present the detailed final design including:

- 3D CAD files of complete assembly (STFC operates Solid Edge as its 3D CAD system but compatible files are acceptable)
- Complete set of production drawings
- Detailed design of the system
- Detailed list of major mechanical and electrical components
- Engineering calculations
- A detailed manufacturing and assembly programme with regular milestones to allow progress checking
- Details of proposed acceptance tests to establish performance of the system against the agreed specification.
- Electrical diagrams, including block cable diagram and connections drawings
- An outline of maintenance, operating and hazard management documents
- Overview of installation method

Unless otherwise agreed in writing by STFC, STFC must approve the final design presented at the FDR before the Supplier proceeds to the ordering of any materials, components or equipment. Should there be significant issues raised through these reviews, it may be necessary to repeat the reviews. The Supplier must honour STFC request for further reviews and bare any costs that may be incurred as a result. Any outcome of the design reviews shall not relieve the Supplier from the responsibility of delivering to the specification or the contracted delivery date.

11.2.2 Approval Before Delivery

Delivery to RAL shall not commence until the successful completion of all factory acceptance tests and after written authorisation by STFC. FAT testing methods must be agreed well in advance at the FDR stage. As a minimum FAT must include:

- Testing of normal operating modes
- Testing of manual operating modes
- Testing of motion safety systems

11.3 Requirements for Drawings

A complete set of 'as built' two-dimensional detailed engineering drawings shall be included as documentation of the engineering design. Drawings shall be provided as electronic copies in .dwg or .dxf formats. If a 3D model is used, then a 3D model shall also be provided. STFC operates Solid Edge as its 3D CAD system and AutoCAD for electrical drawings; compatible files are acceptable.

11.4 Requirements for Engineering Calculations

All design calculations such as dynamic and static stress etc. should be documented and supplied. These documents should be referenced by the drawings.

12 Attachment List

Attachments referenced in this document are listed below:

Example Borated Poly Spec
Rochling High Performance Plastics Technical Data Sheet Polystone D nuclear with B_2O_3

ISIS Local Rules
ISIS_LR_R80_001 Rev 4 - Local Rules For R80 Experimental Hall