Project Manual

Wayne State University
I2C – MRI Installation –
Lab 5 Fit-Out

461 Burroughs St.
Detroit, Michigan 48202

Project No.: 2017-03497-000
CLIENT'S PROJECT NUMBER: 212-313128

Issued for Bids / Permits: August 12, 2019

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REFERENCE MATERIALS (BLUE PAPER)

The following items are issued for Contractor's use and do not form a part of the Contract Documents:

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SECTION 000115 - LIST OF DRAWINGS

1.1 CONTRACT DRAWINGS

A. The following Drawings, marked and dated as noted below, form a part of the Contract Documents:

1. Marked: Issued for: Bids / Permits

2. Dated: August 12, 2019

3. List: Refer to Drawing G-001, “Drawing List” for complete list of drawings.

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SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Sections:

1. Division 9 Sections for work with unit prices.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price: Concrete Slab Preparation for Finish Flooring:

1. Description: Where concrete slab does not meet specified moisture testing requirements, provide remedial floor preparation. Preparation shall include finish flooring manufacturer recommended and approved surface applied sealer/moisture barrier and all related and required surface preparation. Such remediation shall be as required for finish flooring manufacturer to fully warrant any finish flooring adhesion failures for a period of one year after substantial completion of the Project. Any finish flooring adhesion failure during this time period shall be replaced or repaired without cost to the Owner.
2. Unit of Measurement: Per square foot (s.f.) of floor slab area requiring remediation.

END OF SECTION
CJ

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Division 1 Section “Project Management and Coordination” for submitting coordination and layout Drawings.
3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Division 01 Section “Sustainable Design Requirements” for submitting LEED documents required to achieve desired credits.
5. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. **Newforma**: Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. A **Newforma** site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled date of fabrication.
    h. Scheduled dates for purchasing.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be available for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.

    a. Digital Drawing Software Program: The Contract Drawings are available in Revit.
    b. Contractor shall execute the "electronic File Transmittal" and return a copy to the Architect.
    c. Provide Architect a list by drawing number of desired files.

        1) Floor plans.
        2) Reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

    a. Fabrication commenced prior to completion of review by Architect shall be at the sole risk of the Contractor.
    b. Submission of separate specification sections in one submittal is not allowed unless materials specified in separate sections are integral to the submittal such as an electrical motor for an exhaust fan. Example of submittal not allowed is door hardware submitted with doors.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Samples shall be submitted with their related technical or product data submittal for coordinated review.
    b. When physical size of a submittal exceeds 60 drawing sheets or a cumulative total of 200 drawing sheets within any two (2) week period will occur, Contractor shall consult with the Architect to separate the submittal package into smaller packages that will avoid delay in review of the submittal by the Architect.
    c. Unless Contractor makes other arrangements, hard copy and sample submittals will be returned by standard UPS ground delivery. Contractor may send its messenger to pick up submittal from the Architect's office or at its expense, request overnight express delivery. Purchase Order from the Contractor to the Architect will be required for express delivery.
    d. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the

Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 10 days for review of each resubmittal.
4. Submittals received by 10:00 am will be marked as received on that day. Submittals received after 10:00 am will be marked as received on the next working day.
5. Concurrent Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, Owner or other parties allow 21 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. Submittals: Place a permanent label or title block on each submittal item for identification.

1. Refer to Appendix 013300-B, "Contractor's Submittal Label Information", for sample label. Sample is shown completely filled out for clarification. Size of label is optional but all information shown shall be included and shall be easily read.
2. Provide a space approximately 3-1/2" by 11" (90 by 280 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:

    a. Project name.
    b. Architect's project number and Owner's account/project number, if applicable.
    c. Date.
    d. Name and address of Architect.
    e. Name and address of Construction Manager.
    f. Name and address of Contractor.
    g. Name and address of subcontractor.
    h. Name and address of supplier.
    i. Name of manufacturer.
    j. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

    k. Number and title of appropriate Specification Section.
    l. Drawing number and detail references, as appropriate.
    m. Name of drawing preparer not initials.
    n. Name of person and company preparing submittals.
    o. Other necessary identification.

4. Transmittal for Hard Copy or Sample Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
   a. Submittals shall be addressed as follows:

      Harley Ellis Devereaux
      26913 Northwestern Hwy., Suite 200
      Southfield, Michigan 48033
      Attention: Contract Administration

   b. Refer to Appendix 013300-C, "Submittal Transmittal", for a sample transmittal form that contains all information required. The sample transmittal form is available in Microsoft Word format for Contractor's use. Contractor's form may be used if all required information is provided.
   c. Record deviations from Contract Documents, including minor variations and limitation and any other relevant information on the transmittal.
   d. Transmittal must be signed by the Contractor certifying submittal, to the best of the Contractor's knowledge, is in compliance with Contract Documents except as noted.

E. Electronic Submittals: Provide electronic submittals in PDF format or other electronic format as agreed to with the Architect. Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

   a. File name shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

   a. Submittals shall be addressed to Harley Ellis Devereaux, Attention: Contract Administration. Electronic copy of submittal transmittal and associated submittal shall be uploaded to Architect's **Newforma** site. Contractor shall email assigned Harley Ellis Devereaux contract administrator and/or project manager immediately after submittal is posted that submittal is ready for review.
   b. Refer to Appendix 013300-C, "Submittal Transmittal", for a sample transmittal form that contains all information required. The sample transmittal form is available in Microsoft Word format for Contractor's use. Contractor's form may be used if all required information is provided.
   c. Record deviations from Contract Documents, including minor variations and limitation and any other relevant information on the transmittal.

d. Transmittal must be electronically signed by the Contractor certifying submittal, to the best of the Contractor's knowledge, is in compliance with Contract Documents except as noted.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Reviewing of resubmitted Shop Drawings by the Architect shall be limited to required corrections only, and the Contractor or Subcontractor by resubmitting shall be held to represent that the resubmitted Shop Drawings contain no other alterations, additions or deletions. If additional changes have been made, same shall be specifically noted and described on the Shop Drawing and/or in the covering transmittal.
2. Should the Contractor dissent from making required changes, or have a reasonable question as to the propriety of, or reason for, such changes, a fully detailed description of the reasons for same shall be included on the Shop Drawings and/or in the covering transmittal when resubmitted.
3. Architect's services beyond those stipulated in the Owner/Architect Agreement may be a cause for the Owner to impose reimbursement by the Contractor for these additional services performed by the Architect. As a guide to establish limits of these services and provide a base for the Contractor to use in preparing its Bid, the following limits shall apply:

a. Up to two (2) reviews for each Shop Drawing, Product Data item, Sample and similar submittals.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly to **Newforma** site specifically established for Project.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file at the Project Site.

2. Submit electronic submittals via email as PDF electronic files. Obtain approval from the Architect in advance of submitting via email.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file at the Project Site.

3. Submit two paper copies of each action submittal unless otherwise indicated. Architect will return one copy.
4. Informational Submittals: Submit two paper copies of information each submittal unless otherwise indicated. Architect will not return copies.
5. Submit three sets of samples unless otherwise indicated. Architect will retain one Sample set; remainder will be returned. One set shall be retained on the Project site.

B. Action Submittal Procedure:

1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

    a. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
    b. Mark each copy of each submittal to show which products and options are applicable.
    c. Include the following information, as applicable:

        1) Manufacturer's catalog cuts.
        2) Manufacturer's product specifications.
        3) Standard color charts.
        4) Statement of compliance with specified referenced standards.
        5) Testing by recognized testing agency.
        6) Application of testing agency labels and seals.
        7) Notation of coordination requirements.
        8) Notation of applicable choices and options where published data provides multiple choices and options.

    d. For equipment, include the following in addition to the above, as applicable:

        1) Wiring diagrams showing factory-installed wiring.
        2) Printed performance curves.
        3) Operational range diagrams.
        4) Clearances required to other construction, if not indicated on accompanying Shop Drawings.
        5) Manufacturer’s installation instructions.

e. Submit Product Data before or concurrent with Samples.
f. Sheet Size: Submit product data on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than the Contract Drawing size.

2. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

   a. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

      1) Identification of products.
      2) Schedules.
      3) Compliance with specified standards.
      4) Notation of coordination requirements.
      5) Notation of dimensions established by field measurement.
      6) Relationship and attachment to adjoining construction clearly indicated.
      7) Seal and signature of professional engineer if specified.
      8) Wiring diagrams showing field installed wiring, including power, signal and control wiring.

3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than Contract Drawing size.

   a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.

4. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

   a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   b. Identification: Attach label on unexposed side of Samples that includes the following:

      1) Generic description of Sample.
      2) Product name and name of manufacturer.
      3) Sample source.
      4) Number and title of applicable Specification Section.
      5) Specification paragraph number and generic name of each item.

5. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, and identification information for record.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

C. Informational Submittals:

1. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

   a. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   b. Manufacturer and product name, and model number if applicable.
   c. Number and name of room or space.
   d. Location within room or space.

2. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

3. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
4. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
5. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
6. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
7. LEED Submittals: Comply with requirements specified in Division 01 Section “Sustainable Design Requirements.
8. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
9. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
10. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
11. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
12. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
13. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
14. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
15. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
16. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

17. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed

before installation of product, for compliance with performance requirements in the Contract Documents.

18. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
19. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
20. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
21. Manufacturer's Instructions:

    a. Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

        1) Preparation of substrates.
        2) Required substrate tolerances.
        3) Sequence of installation or erection.
        4) Required installation tolerances.
        5) Required adjustments.
        6) Recommendations for cleaning and protection.

22. Manufacturer's Field Reports:

    a. Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

        1) Name, address, and telephone number of factory-authorized service representative making report.
        2) Statement on condition of substrates and their acceptability for installation of product.
        3) Statement that products at Project site comply with requirements.
        4) Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
        5) Results of operational and other tests and a statement of whether observed performance complies with requirements.
        6) Statement whether conditions, products, and installation will affect warranty.
        7) Other required items indicated in individual Specification Sections.

    b. Insurance Certificates and Bonds:

c. Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

23. Material Safety Data Sheets:

a. Submit information directly to Owner. If submitted to Architect, Architect will not review this information but will return it with no action taken.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM File Incorporation:

1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as the original Drawings

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect. Architect will not review submittals that have not been reviewed or prepared by the Contractor.

B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Action Stamp / Sticker:

a. The Architect will stamp or affix a sticker on each submittal with a uniform, self-explanatory action stamp or sticker.

1) Refer to Appendix 013300-A, "Action Stamp", for stamp sample.

b. The stamp or sticker will be appropriately marked to indicate the final action to be taken by the Contractor, as follows:

1) "Approved (APP)" - indicates final action by the Architect: no comments noted. Shop Drawing, Product Data, and/or Sample MAY BE USED in fabrication and/or construction.
2) "Approved As Noted (AAN)" - indicates final action by Architect based on comments noted on the submitted item. Shop Drawing, Product Data, and/or Sample MAY BE USED in fabrication and/or construction, subject to comments noted.
3) "Not Approved (NA)" - indicates that submittal is not acceptable due to lack of adherence with the design concept or checking by the Contractor. Shop Drawing, Product Data, and/or Sample MAY NOT BE USED in fabrication and/or construction. Resubmit in accordance with Contract Document requirements.
4) "Submittal Not Requested (SNR)" - indicates submittal was not requested by Contract Documents to be submitted and will not be reviewed or retained by the Architect.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents will be returned by the Architect without action.

END OF SECTION 013300
CJ

Submittal

HED
HARLEY ELLIS DEVEREAUX

Review of shop drawings, product data and / or samples is for conformance with the design concept and with the information given in the Contract Documents. This review does not relieve the Contractor of responsibility for any deviation from the Contract Documents. Refer to the Contract Documents relative to submittals for clarification of Contractor responsibility.

INTERNAL USE ONLY	Discipline	Reviewer	Date	Remarks
	Architectural / Design			
	Structural			
	Civil / Site			
	Mechanical			
	Electrical			
	Interiors			

SELECTION *

Final Action for Contractor:

By * Date *

- ☐ **Approved (APP)*** Work May Proceed
- ☐ **Approved as Noted** (AAN) * Proceed on Basis of Revised Information Noted
- ☐ **Submittal Not Requested (SNR)**
- ☐ **Not Approved (NA)*** Work Shall Not Proceed Based on Information Submitted. Resubmit.
- ☐ **Provide as Specified (PAS)** Works Shall Not Proceed Based on Non-Specified Information Submitted. Resubmit.

Project No. * Item No. *

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SUBMITTAL PROCEDURES APPENDIX 013300-B - CONTRACTOR'S SUBMITTAL LABEL INFORMATION SAMPLE

Project	Wayne State University I2C – MRI Installation – Lab 5 Fit-Out
Architect's Project No. Owner's Account No. (if applicable)	2017-03497-000
Date	01/14/00
Architect	Harley Ellis Devereaux 26913 Northwestern Hwy., Suite. 200 Southfield, Michigan 48033-34764
General Contractor (Construction Manager) Address, phone number	ABC Construction Co. 6574 Wings Troy, Michigan 48123 810 666-4321
Subcontractor Address, phone number	Do-It Right 9876 Falls St. Orion, Michigan 48233 810 693-9753
Supplier/Manufacturer Address, phone number	Good Doors 425 Small St. Detroit, Michigan 48255 313 555-4444
Drawn By (name, not initials)	Dan Magrew
Specification No. and Title	08111, Steel Doors and Frames
Drawing No.	A-5 and 6
Detail Reference (if applicable)	9/A5
Name of person and company preparing submittal	John Smith ABC Construction Co.

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(Contractor's Logo and address here)

SUBMITTAL TRANSMITTAL

Project: Wayne State University
I2C – MRI Installation – Lab 5 Fit-Out

Architect's Project No.: 2017-03497-000
Contractor's Project No.: _____
Date Sent to Arch.: _____
Date Returned to Contr.: _____

To: Harley Ellis Devereaux
26913 Northwestern Hwy., Suite 200
Southfield, Michigan 48033-3476

Attn: Construction Administration

Returned Via:
___ UPS Standard Ground
___ UPS / FedEx Overnight (Purchase Order required)
___ Your Messenger

Submittal Description:

Specification Section No.:	Items Submitted: Shop Drawings, Product Data, Samples, Maint. Manuals, Etc.	Fabricator / Supplier:	Review Code *:	Arch. Submittal Log. No.:
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Deviations, Minor Variations and Limitations:
_____

The Contractor certifies that it has examined the items submitted by this transmittal and finds that they are, to the best of its knowledge, in compliance with the Contract Documents.

By: _____ Date: _____
(Signature required)

Harley Ellis Devereaux Reviewer's Remarks:

The information submitted has been reviewed for compliance with the Contract Documents. The review and the resulting notations do not assume completeness of the submittal nor suggest that information not requested is waived. Further, the review does not relieve the Contractor from the satisfactory completion of the Work in compliance with the Contract Documents.

Harley Ellis Devereaux
By: _____ Date: _____
(Signature Required)

* Review Codes:

APP	Approved:	Work May Proceed
AAN	Approved As Noted:	Proceed on Basis of revised Information Noted
NA	Not Approved:	Work Shall Not Proceed Based on Information Submitted. Resubmit.
SNR	Submittal Not Requested:	Not Reviewed or Retained by the Architect.

Harley Ellis Devereaux Routing:

Submittal Received by Architect:

Primary Checker: _____

Secondary Checkers: _____ _____ _____ _____

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SECTION 014010- TESTING AND INSPECTION SERVICES - BUILDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division -1 Specifications Sections, apply to this Section.

1.2 SUMMARY

A. MBC 2009 Chapter 17 Special Inspection and testing is specified in this Section.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Control" for general requirements and responsibilities.

C. Related Documents: Special Inspection and Testing matrix shown on contract drawings.

1.3 SUBMITTALS

A. Copies of handwritten or otherwise prepared notes for Daily Reports:

1. Daily submittal: Prior to the close of the business submit to the Architect a scanned or photographed copy of the daily notes.

a. Submit scans or photos by e-mail.

B. Written Reports (Typed):

1. Daily Reports: The Special Inspection and/or Independent Testing Agency shall submit within 10 calendar days, a certified report of each inspection, test or similar service.

a. Exception: If the testing/inspection activity is found to be not in compliance with the contract documents, the Contractor shall be notified immediately.

1) If the Contractor is unable to comply with required corrections in a timely manner, or if the Architect is required to provide direction, a written report shall be in the Architect’s and Contractor’s offices no later than 9:00 a.m., local time, the following morning. Delivery shall be by electronic mail, fax, or express mail.
2) Provide photographs of the discrepancy and the specific location thereof.

3) If delivered by electronic mail or fax, the document shall be clearly marked or flagged that a discrepancy has occurred. Use the same marking for the entire job.
4) Attach a copy of photograph(s) for each item not in compliance.

2. Retest Reports: Reports for items that are retested shall be clearly marked or flagged. Use the same marking for the entire job.
3. Summary Reports: The Special Inspection and/or Independent Testing Agency shall submit a final certified report documenting completion of all required inspections (special inspections and other inspection/testing) and correction of irregularities and deficiencies noted in the inspections.
4. Submit one copy of the reports to the Owner, to the Architect, to the Contractor, and to the governing authority.
5. Each copy shall be suitable for reproduction on an electrostatic copier; the use of precarboned forms will not be acceptable.
6. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

a. Date of issue.
b. Report Number.
c. Architect's Project Title.
d. Architect's Project Number.
e. Name, address and telephone number of Independent Testing Agency.
f. Dates and locations of samples and tests or inspections.
g. Names of individuals making the inspection or test.
h. Designation of the Work and test method.
i. Identification of product and/or test.
j. Complete inspection or test data.
k. Test results and an interpretation of test results.
l. Ambient conditions at the time of sample-taking and testing.
m. Professional evaluation as to whether inspected or tested Work complies with Contract Document requirements, including referenced codes.
n. Name and signature of laboratory inspector.
o. Recommendations on retesting.

1.4 ACCEPTABLE PROVIDERS FOR SPECIAL INSPECTION AND TESTING

A. The following companies are acceptable to provide testing and inspection services:

1. NTH Consultants, 41780 Six Mile Road, Northville, MI 48168,
   Contact: Mr. Hasam Yaldo, PE.
2. Somat Engineering, 26445 Northline Road, Taylor, MI 48180,
   Contact: Mr. Richard Anderson, PE.
3. Soils and Materials Engineers, 43980 Plymouth Oaks Blvd., Plymouth, MI 48170,
   Contact: Mr. Jerry Belian, PE.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL

A. Preconstruction Conferences:

1. Special Inspection and Independent Testing Agency Representatives consisting of field representative performing testing and his supervisor shall attend preconstruction conferences, called by the Contractor, in order to review the quality control, materials and procedures of the Section. Sections requiring preconstruction conferences shall include, but are not limited to, the following:

a. Division 5 Section “Post-Installed Anchors”.
b. Others as determined by the Contractor.

END OF SECTION
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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 024119 "Selective Structure Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 15 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

2. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Section 018113.13 "Sustainable Design Requirements - LEED for New Construction and Major Renovations.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify and Construction Manager promptly.

B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Construction Manager.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Construction Manager before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls" and Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300
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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Mechanical and Electrical Specifications on the Drawings for demolition and cutting and patching requirements specified within them.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstall.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Division 7 Sections for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119
KSR/DWH

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wood furring, grounds, nailers, and blocking.
2. Plywood nailers and plywood backing panels.

1.3 DEFINITIONS

A. Rough Carpentry:

1. Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
2. Include data for adhesives, including printed statement of VOC content.

B. Sustainable Design Submittals:

1. Product Data: For installation adhesives, indicating VOC content.

C. Shop Drawings:

1. None required.

D. Material Certificates:

1. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's (ALSC) Board of Review.

E. Wood Treatment Data and Warranty:

1. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:

a. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

2. Warranty of chemical treatment manufacturer for each type of treatment.

F. Reports:

1. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
2. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.

a. Fire-retardant-treated wood.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility for Fire-Retardant-Treated Wood:

1. Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, “FSC Principles and Criteria for Forest Stewardship”:

1. Dimension lumber framing.
2. Miscellaneous lumber.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fire-Retardant-Treated Materials, Interior Type A:

a. Baxter: J. H. Baxter Co.
b. Chemical Specialties, Inc.
c. Continental Wood Preservers, Inc.
d. Hoover Treated Wood Products, Inc.

2. Fire-Retardant-Treated Materials, Exterior Type:

a. American Wood Treaters, Inc.
b. Hoover Treated Wood Products, Inc.

2.2 GENERAL

A. Lumber Standards:

1. Comply with DOC PS 20, "American Softwood Lumber Standard", and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Plywood Standards:

1. Comply with DOC PS 1, “U.S. Product Standard for Construction and Industrial Plywood’.

C. Inspection Agencies:

1. Inspection agencies, and the abbreviations used to reference them, include the following:
2. NELMA - Northeastern Lumber Manufacturers Association.
3. NLGA - National Lumber Grades Authority (Canadian).
4. RIS - Redwood Inspection Service.
5. SPIB - Southern Pine Inspection Bureau.

6. WCLIB - West Coast Lumber Inspection Bureau.
7. WWPA - Western Wood Products Association.

D. Grade Stamps:

1. Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
2. Factory mark plywood panels to indicate compliance with applicable standard.

E. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.4 MISCELLANEOUS LUMBER

A. General:

1. Provide lumber for support or attachment of other construction, including cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
2. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

B. Moisture Content:

1. 19 percent maximum for lumber items not specified to receive wood preservative treatment.

C. Grade:

1. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.5 PLYWOOD NAILERS AND PLYWOOD BACKING PANELS

A. Exterior Grade Plywood:

1. For use as nailers for copings, at underside of miscellaneous structural members at window heads and where indicated, provide DOC PS 1, Exterior, A-C plywood in thickness indicated or, if not otherwise indicated, not less than ¾-inch thick.

B. Plywood Backing Panels:

1. For mounting Telecom, Low-Voltage and Electrical equipment, provide DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated plywood, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 GYPSUM SHEATHING

A. Refer to Division 6 Section "Sheathing" for requirements.

2.7 FASTENERS

A. General:

1. Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

a. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Screws for Fastening Plywood to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. Provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 765 hours according to ASTM B 117.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. "Table 2304.9.1--Fastening Schedule" of the ICC's International Building Code.

F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

G. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

3.3 WOOD FRAMING, GENERAL

A. Framing Standard:

1. Comply with AFPA's "Manual for Wood Frame Construction", unless otherwise indicated.

3.4 INSTALLATION OF PLYWOOD NAILERS AND PLYWOOD BACKING PANELS

A. General:

1. Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial", for types of plywood panels and applications indicated.

B. Fastening Methods:

1. Exterior Grade Plywood Nailers:

a. For attachment to cold-formed metal framing, secure plywood with screws.
b. For attachment to structural steel, secure plywood with powder-actuated fasteners.

1) Hilti X-AL-H or X-ZF, 1/8-inch diameter (minimum).

c. For attachment to CMU, secure plywood with post-installed expansion anchors.

2. Plywood Backing Panels:

    a. Nail or screw to supports.

END OF SECTION
CL

SECTION 061610 – PLYWOOD SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Plywood sheathing.

B. Related Sections include the following:

1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
2. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Fire-retardant-treated plywood.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood used as back-up for exterior and interior finishes where the plywood is backing up finishes exposed to the building interior or to plenum spaces that abut to the building interior.

1. Interior wall sheathing.

2.3 INTERIOR WALL PLYWOOD SHEATHING

A. Plywood Interior, Wall Sheathing: Exterior grade sheathing.

1. Span Rating: Not less than 40/20.
2. Nominal Thickness: Not less than 3/4 inch (19.0 mm).

2.4 ACCESSORY MATERIALS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Screws for Fastening Wood Sheathing Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For soffit, wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in 2015 Michigan Building Code."

D. Coordinate wall and roof soffit, sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD SHEATHING PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Soffit; Wall and Roof Sheathing:

a. Screw to cold-formed metal framing.
b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION 061600
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SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim.
2. Plastic-laminate cabinets.
3. Solid-surfacing-material countertops and cabinet faces.
4. Shop finishing of interior woodwork.
5. Solid-surfacing material sills and impact resistant wall protection units.
6. Cabinet hardware.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 8 Section “Flush Wood Doors” for doors specified by reference to Architectural Woodwork Standards.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. Product Data: For high-pressure decorative laminate, solid-surfacing material, fire-retardant-treated materials, cabinet hardware and accessories.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details at 1-1/2" = 1'-0" or larger scale.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets and other items installed in architectural woodwork.

C. Samples for Verification:

1. Lumber with or for transparent finish, not less than 50 sq. in. (300 sq. cm), for each species and cut, finished on 1 side and 1 edge.
2. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
3. Thermoset decorative-panels, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with edge banding on 1 edge.
4. Solid-surfacing materials, 6 inches (150 mm) square.
5. Corner pieces as follows:

    a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
    b. Miter joints for standing trim.

6. Exposed cabinet hardware and accessories, one unit for each type and finish.

D. Product Certificates: For each type of product, signed by product manufacturer.

E. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for fabricating, finishing and installing of interior architectural woodwork specified in this Section.

D. Quality Standard: Unless otherwise indicated, comply with "Architectural Woodwork Standards" (AWS) for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.

E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1. Limitations:

a. Obtain and comply with woodwork fabricator's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork will be within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

1. AWI Quality Standard: Architectural Woodwork Standard (AWS).

B. Wood Species and Cut for Transparent Finish: Birch rotary cut. .

C. Wood Products: Comply with the following:

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 10 percent.
2. Hardboard: AHA A135.4.
3. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
4. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
5. Softwood Plywood: DOC PS 1.

D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Provide PVC edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates as specified in "Finish Key" in the "Reference Materials" in the Project Manual.

F. Fiberglass Reinforced Laminate:

1. Thermofused melamine overlay, decorative paper and phenolic paper with fiber reinforcing inner layers.

a. Properties:

1) Nominal Thickness: 0.088 inch.
2) Surface Burning Characteristics: Rating of 25, or less, as tested to ASTM E84.
3) Smoke Developed: 55, tested to ASTM E84.
4) Wear Resistance: 3500, tested to NEMA 3.13.
5) Flexural Strength: 20,148 psi, tested to ASTM D 790.

2. Products: Subject to compliance with requirements, provide products as specified in "Finish Key" in the "Reference Materials" in the Project Manual. .

G. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Manufacturers: Subject to compliance with requirements, provide products as specified in "Finish Key" in the "Reference Materials" in the Project Manual.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Cabinet Hardware Schedule:

1. Refer to schedule at end of this Section for cabinet hardware required for architectural cabinets.

C. Cabinet Hardware and Accessories:

1. 5-Knuckle Overlay Hinge:

a. RPC 376-26D (Typical).
b. RPC 376SS – Type 304 stainless steel at MRI Exam Room.

2. Door and Drawer Pulls:

a. Siro Designs, Inc.; SIR 990126, 96 mm with "matte nickel" finish.

3. Magnetic Catches:

    a. Sugatsune Item No. STBRC at MRI Exam Room.

4. Adjustable Shelf Standards and Supports:

    a. Knape & Vogt 87 heavy duty wall standards and 187 heavy duty wall bracket, Anochrome finish.

5. Adjustable Shelf Supports:

    a. Hafele 282.47.702, white plastic, heavy duty, double pin
    b. Bainbridge Manufacturing, Inc. 3220WH, white plastic, heavy duty, double pin

6. Drawer Slides:

    a. Sugatsune ESR-4513 stainless steel full extension at MRI Exam Room.

7. Door Locks:

    a. National 5-pin keyway master keyed to Owner's requirements:

        1) Olympus DCN Series Cam Lock with US26 D finish.

8. Drawer Locks:

    a. National 5-pin keyway master keyed to Owner's requirements:

        1) Olympus DCN Series Cam Lock with US26 D finish.

9. Grommets for cable passage through countertops:

    a. Custom Accents' 80 mm standard round grommet with (3) piece top for adjustable hole openings. Color to be selected from manufacturer's full range of custom colors.
    b. Provide one grommet at each open knee space and elsewhere indicated on the Drawings. Locations of grommets shall be field verified with Owner prior to installation.

10. Prefabricated Metal Countertop Support Bracket:

    a. Workstation bracket in sizes indicated, fabricated of 1/8 inch steel with a load limit in excess of 1,000 pounds as manufactured by A&M Hardware, Inc., 400 W. Gramby Street, Manheim, PA 17545, phone: 888-647-0200, fax 717-664-4582.
    b. Provide factory primed bracket for field painting.

11. Extruded Aluminum Corner Trim:

a. Item #600086, M-80-0140 90 Outside Heavy Duty ½ inch radius corner; CW Systems by Futura Industries distributed by Scodesign (www.scodesign.com).

12. Extruded Aluminum Reveals:

a. ½ inch clear anodized aluminum reveals as indicated on the Drawings.

2.3 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

E. Adhesive for Bonding Plastic Laminate and Fiberglass Reinforced Laminate: As recommended by plastic laminate manufacturer.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.5 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: Premium.

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building, unless otherwise indicated.

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

2.6 PLASTIC-LAMINATE CABINETS

A. Grade: Custom.

B. AWS Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS, 0.050 inch nominal thickness.
2. Vertical Surfaces: Grade VGS, 0.028 inch nominal thickness.

a. Where wood grain laminate is specified, grain shall be run vertical, except at drawer fronts, shelves and light valances, grain direction shall be horizontal.

3. Edges:

a. PVC tape, 0.018 inch (0.460 mm) minimum thickness, matching laminate in color, pattern, and finish at wood grain laminate in public areas.
b. PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish at solid color laminates and wood grain laminates in staff and clinical areas. Machine apply edge banding with waterproof hot melt adhesives. Trim and profile edge banding to a 0.125 inch radius.

D. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade CLS, 0.020 inch nominal thickness.

a. Leading Edge of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch (3-mm) thick, matching laminate in color, pattern, and finish. Machine apply edge banding with waterproof hot melt adhesives. Trim and profile edge banding to a 0.125 inch radius.
b. Other Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
c. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS, 0.028 inch nominal thickness.

2. Drawer Sides and Backs: Thermoset decorative panels on ¾ inch particleboard.
3. Drawer Bottoms: Thermoset decorative panels on ¾ inch particleboard.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated in the “Finish Key” in the “Reference Materials” in the Project Manual.

2.7 SOLID-SURFACING-MATERIAL COUNTERTOPS AND CABINET FACES

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 1/2 inch (13 mm).

C. Solid-Surfacing-Material Substrate: DOC PS1, Exterior, A-C plywood in thickness indicated, or if not indicated, not less than ¾ inch thick.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. As indicated in “Finish Material List”.

E. Fabricate tops and cabinet faces in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with shop-applied integral, coved backsplashes. Ship side splashes loose for field installation.
3. Fabricate cabinet faces with materials and configurations indicated.

F. Install integral sink bowls in countertops in shop.

1. Provide solid-surfacing-material undermount sinks. Provide sink bowls as indicated on the Drawings.

G. Drill holes in countertops for plumbing fittings in shop.

2.1 SOLID-SURFACING-MATERIAL WINDOWSILLS AND IMPACT RESISTANT WALL PROTECTION UNITS

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 1/2-inch (13 mm).

C. Solid-Surfacing-Material Substrate: DOC PS1, Exterior, A-C plywood in thickness indicated, or if not indicated, not less than 3/4-inch thick.

1. Fabricate windowsills without joints in solid-surfacing-material or substrate to the greatest extent possible. Where joints are required, provide biscuit joints or other Architect approved mechanical joints at splices in windowsills.
2. Fabricate impact resistant wall protection units from solid surface material in configurations and edge treatments as indicated on the Drawings.

    a. Fabricate in lengths to minimize joints. Provide joints with manufacturer’s written recommendations and guidelines.
    b. Units include, but are not limited to “Corner Guard” CG-2 and “Crash Rail” CR-2.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing-material complying with the following requirements:

1. As indicated in the “Finish Material List”.

2.2 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Back priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require back priming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

D. Transparent Finish:

1. Grade: Premium.
2. AWS Finish System: 5; Conversion varnish.
3. Staining: Stain to match flush wood doors.
4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back priming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

H. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
3. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.

3.5 CABINET HARDWARE SCHEDULE

A. General:

1. Install hardware in accordance with hardware manufacturer's printed instructions. Cabinet sides shown to receive adjustable shelves shall have sides with multiple 5 mm diameter holes drilled on ± 1-1/4 inch (32 mm) centers to receive shelf supports.

B. Door Hinges:

1. Provide one pair for doors up to 4'-0” high and 1-1/2 pair for doors over 4’-0" high.

C. Door Pulls:

1. Provide one pull for each door.

D. Drawer Pulls:

1. Provide one pull for each drawer.

E. Magnetic Catches:

1. Provide one catch for each door.

F. Shelf Supports:

1. Provide 4 supports for each shelf.

G. Drawer Slides:

1. Provide one set for each drawer.

H. Locks for Doors and Drawers:

1. Provide 2 keys per lock.

END OF SECTION 064023
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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Mineral wool sound batts.

B. Related Requirements:

1. Section 078413 Section "Joint Firestopping" for insulation installed as part of a perimeter fire-resistive joint system.
2. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 MINERAL WOOL SOUND BATTS

A. Type J: Unfaced Mineral Fiber Batt Insulation (Acoustic in walls, ceilings): Acoustic insulation, non-combustible, light weight, semi rigid, wool batt insulation to comply with ASTM C 665 for Type 1 with 2.5 pound per cubic foot minimum density (batts without membrane facing); and as follows:

1. Thickness: 3-1/2 inches unless otherwise indicated on the drawings.
2. Products: Subject to compliance with requirements, provide one of the following:

a. Sound attenuation fire batts (Mineral Wool); Roxul, Inc., Roxul AFB.
b. Sound Attenuation Fire Blankets (Mineral Wool); Thermafiber LLC

3. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.

2.2 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Gemco; 90-Degree Insulation Hangers.

2. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. AGM Industries, Inc.; RC150 or SC150.
   b. Gemco; Dome-Cap R-150 or S-150.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

   a. Crawl spaces.
   b. Ceiling plenums.
   c. Where indicated.

D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Gemco; Clutch Clip.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. AGM Industries, Inc.; TACTOO Adhesive.
b. Gemco; Tuff Bond Hanger Adhesive.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Mineral Wool Insulation: Non-combustible, light weight, semi rigid, wool batt insulation to comply with ASTM C 665 for Type 1 with 2.5 pound per cubic foot minimum density (batts without membrane facing);

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with Installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.4 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Cavity wall insulation shall be installed as indicated on the Drawings.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward interior of construction.
    b. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

c. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.7 INSTALLATION OF MISCELLANEOUS VOID INSULATION

A. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Mineral Wool Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.9 INSULATION SCHEDULE

TYPE	FORM	USE
A	Mineral Wool Insulation	
B	Unfaced Extruded Polystyrene, Type IV	
C	(NOT USED)	
D	(Not Used)	
E	Unfaced Glass Fiber Batt/Blanket	Thermal in walls, ceilings, soffits.
F	Unfaced Mineral Fiber Semi-Rigid Board	
G	(NOT USED)	
H	(NOT USED)	
I	(NOT USED)	
J	Unfaced Mineral FiberSound Batt/Blanket	Acoustic in walls, ceilings.
K	(NOT USED)	

X (NOT USED)

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SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

B. Related Sections:

1. Division 7 Section "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, and in smoke barriers.
2. Division 21 Sections specifying fire-suppression piping penetrations.
3. Division 22 and 23 Sections specifying duct and piping penetrations.
4. Division 26 Sections specifying cable and conduit penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
    b. Classification markings on penetration firestopping correspond to designations listed by the following:

        1) UL in its "Fire Resistance Directory."
        2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
        3) FM Global in its "Building Materials Approval Guide."

D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.
2. RectorSeal Corporation.
3. Specified Technologies Inc.
4. 3M Fire Protection Products.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Horizontal assemblies include floors, floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.

2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

H. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

I. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:

a. Slag-wool-fiber or rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other

items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413
DWH

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors."

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

1.10 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.
2. RectorSeal Corporation.
3. Specified Technologies Inc.
4. 3M Fire Protection Products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1. Sealant shall have a VOC content of 250° gL or less.

D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so

labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Floor-to-Floor, Joint Firestopping Systems:

1. UL-Classified Systems: FF-D - as indicated on the Drawings.
2. Assembly Rating: As indicated on the Drawings.
3. Nominal Joint Width: As indicated.

C. Wall-to-Wall, Joint Firestopping Systems:

1. UL-Classified Systems: WW-D - as indicated on the Drawings.
2. Assembly Rating: As indicated.
3. Nominal Joint Width: As indicated.

D. Floor-to-Wall, Joint Firestopping Systems:

1. UL-Classified Systems: FW-D - as indicated on the Drawings.
2. Assembly Rating: As indicated.
3. Nominal Joint Width: As indicated.

E. Head-of-Wall, Fire-Resistive Joint Firestopping Systems:

1. UL-Classified Systems: HW-D - as indicated on the Drawings.
2. Assembly Rating: As indicated.
3. Nominal Joint Width: As indicated.

F. Bottom-of-Wall, Joint Firestopping Systems:

1. UL-Classified Systems: BW-D - as indicated on the Drawings.
2. Assembly Rating: As indicated.
3. Nominal Joint Width: As indicated.

END OF SECTION 078443
DWH

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

B. Related Requirements:

1. Control joint fillers at concrete floor slabs specified in Section 033000 “Cast In Place Concrete”.
2. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1. Provide if criteria for color selection is not indicated on the Drawings.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1. Provide per criteria for color selection indicated on the Drawings.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

B. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

D. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

E. Field-Adhesion-Test Reports: For each sealant application tested.

F. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: For Silicone Sealants 20 years from date of Substantial Completion.
2. Warranty Period: For all other sealants 5 years from date of Substantial Completion.

B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As indicated by color criteria indicated on the Drawings or if not indicated, as selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation: Dow Corning 756 SMS
b. Momentive Performance Materials Inc.; GE SCS900 SilPruf NB.
c. Pecora Corporation; Pecora 864NST or 895NST.
d. Tremco Incorporated; Spectrum 2 or Spectrum 3.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pecora Corporation; Dynatrol I – XL.
b. Tremco Incorporated; Dynomic FC.

B. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pecora Corporation; Dynatrol I – XL.
b. Tremco Incorporated; Dynomic 100.

C. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pecora Corporation; Pecora NR-201.
b. Tremco Incorporated; Vulkem 45SSL.

D. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pecora Corporation; Pecora NR-200 or Dyntrol II SG.
b. Tremco Incorporated; Vulkem 445SSL.

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation; 786 Silicone Sealant.
b. Momentive Performance Materials, Inc.; GE, SCS1700 Sanitary.
c. Pecora Corporation; 860.
d. Tremco Incorporated; Tremsil 200.

2.5 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik, Inc.; Bostik 300.
b. Pecora Corporation; BC-158 (Skinning) or BA-98 (Non – Skinning).

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pecora Corporation; AC-20.

b. Tremco Incorporated; Tremflex 834.

2.7 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 2 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

    a. Joints between different materials not specified in other sections.
    b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 25, T, NT.
3. Joint-Sealant Color: As indicated in PART 2 “Joint Sealants, General.”

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Construction joints in cast-in-place concrete.
    b. Control and expansion joints in unit masonry.
    c. Joints between metal panels.
    d. Joints between different materials listed above.
    e. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
    f. Control and expansion joints in ceilings, and other overhead surfaces.
    g. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As indicated in PART 2 “Joint Sealants, General.”

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

    a. Isolation joints in cast-in-place concrete slabs.

        1) Except as specified in Section 033000 “Cast In Place Concrete.”

    b. Control and expansion joints in tile flooring.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As indicated in PART 2 “Joint Sealants, General.”

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Tile control and expansion joints.
    c. Vertical joints on exposed surfaces of unit masonry, concrete, walls, and partitions.
    d. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.

3. Joint-Sealant Color: As indicated in PART 2 “Joint Sealants, General.”

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As indicated in PART 2 “Joint Sealants, General.”

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As indicated in PART 2 “Joint Sealants, General.”

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: Black or manufacturer’s standard if other than black.

END OF SECTION 079200
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SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical joint sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for non-acoustical applications.

1.3 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1. Provide if criteria for color selection is not indicated on the Drawings.

C. Samples for Verification: For each kind and color of acoustical joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1. Provide if criteria for color selection is indicated on the Drawings.

D. Acoustical-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

B. Sample Warranties: For special warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.

1. Products: Subject to compliance with requirements, provide the following:

a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:

a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
b. Pecora Corp.; BA-98.
c. Tremco, Inc.; Tremco Acoustical Sealant.

3. Colors of Exposed Acoustical Joint Sealants: As indicated by manufacturer's designations or if not indicated as selected by Architect from manufacturer's full range of colors.

B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

1. Products: Subject to compliance with requirements, provide the following:

a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
b. Pecora Corp.; BA-98.
c. Tremco, Inc.; Tremco Acoustical Sealant.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079219
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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 081416 “Flush Wood Doors” for flush wood doors in hollow metal frames.
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Interior Steel Doors and Frames:

a. Amweld Building Products, Inc.
b. Ceco Door; ASSA ABLOY
c. Curries Company; ASSA ABLOY.
d. Mesker Door, Inc.

e. Pioneer Products.
f. Republic Doors and Frames.
g. Steelcraft; an Allegion Brand.

B. Source Limitations: Obtain hollow-metal work for interior doors and frames and exterior doors and frames each from a single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Model 2, Seamless.
e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).

b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

1) Fabricate full weld flush knock down frames with mitered and continuously welded and finished smooth face seam and edges and full wire welded backside of web members joining head and jamb, for all locations, unless otherwise noted.

4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation and injected polyurethane at exterior doors.
2. Fire Door Cores: As required to provide fire-protection ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

        1) Two anchors per jamb up to 60 inches (1524 mm) high.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Three anchors per jamb up to 60 inches (1524 mm) high.
        2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that will be filled with grout. .

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. Concrete Walls: Solidly fill space between frames and concrete with grout.
5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
c. At Bottom of Door: 3/4 inch (19.1 mm)] plus or minus 1/32 inch (0.8 mm).
d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113
CL

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors plastic laminate faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 087100 “Door Hardware” for hardware.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish.
2. Plastic laminate, 6 inches (150 mm) square, for each color, texture, and pattern selected.
3. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
4. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY

A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
   b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to the requirements, provide products by one of the following:

1. Algoma Hardwoods. Inc.
2. Eggers Industries.
3. Marshfield Door Systems, Inc.
4. VT Industries, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.

B. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or] UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

C. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2.
2. Blocking: Provide wood blocking in particleboard-core doors as follows:

a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
b. 7 1/2-inch top-rail blocking in doors indicated to have parallel arm closers.
c. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
d. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

D. Mineral-Core Doors:

1. Core: Provide core and blocking as specified for particle-core doors or noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.

2. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

   a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.

2.3 PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors:

1. Grade: Premium.
2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
3. Colors, Patterns, and Finishes: As indicated on the “Finish Materials List” on the Drawings.
4. Exposed Vertical and Top Edges: Plastic laminate that matches faces, applied before faces.
5. Core: Particleboard.
6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before faces and crossbands are applied.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard noncombustible wood beads painted to match plastic laminate faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

B. Wood Beads for Light Openings in Plastic Laminate Faced Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.

1. Wood Species: Any closed-grain hardwood painted to match plastic laminate faces.
2. Profile: Manufacturer's standard shape.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Fillers may be omitted on bottom edges, edges of cutouts, and mortises.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416
DWH

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rolling Service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: As indicated on the Structural Drawings.
2. Testing: According to ASTM E 330/E 330M
3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft. (960-Pa) wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers:

a. Cookson Company
b. Cornell Ironworks.
c. McKeon Rolling Steel Door Company.
d. The Overhead Door Company. Model 625 Stormtite. (Basis of Design).
e. Raynor
f. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.

D. Curtain R-Value: 7.7 deg F x h x sq. ft./Btu (1.35 K x sq. m/W).

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats:

1. Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
2. Insulated-Slat Interior Facing: Metal.
3. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Insulated Bottom Bar with Vinyl Weatherseal: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick fabricated from hot-dip galvanized steel and finished to match door.

H. Insulated Curtain Jamb Guides: Galvanized steel with interior and exterior side weatherseals.

I. Hood: Match curtain material and finish.

1. Shape: Square.
2. Mounting: Face of wall.

J. Locking Devices: Equip door with slide bolt for padlock.

K. Manual Door Operator: Chain-hoist operator.

L. Curtain Accessories: Equip door with weatherseals.

M. Door Finish:

1. Zinc enriched powder-coated finish: Color as selected by Architect from manufacturer's full range (200 colors).
2. Interior Curtain-Slat Facing: White.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat faces, with minimum steel thickness of 0.010 inch (0.25 mm).

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion

of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
2. Lintel seal.
3. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
4. Weatherseal for interior and exterior side of guides.

2.9 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

A. Zinc Enriched Powder-Coat Finish: Manufacturer's zinc enriched finish consisting of prime coat and thermosetting topcoat. Color to be chosen from manufacturer’s full range (200 colors). Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323
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SECTION 084123 - FIRE RATED ALUMINUM FRAMED STOREFRONTS AND HEAT BARRIER ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fire rated glazing and framing systems for installation as Full Vision Fire Rated Windows or Wall Sections in interior openings

B. Related Sections:

1. Section 078443 “Fire-Resistive Joint Systems:” Firestops between work of this section and other fire resistive assemblies.
2. Section 084123 – “Fire Rated Aluminum Framed Storefronts and Heat Barrier Entrances” for fire-rated doors.
3. Section 087100 “Door Hardware:” Door hardware other than that provided by the work of this section.
4. Section 088813 “Fire-Rated Glass”
5. Section 092216 “Non Structural Metal Framing
6. Section 092900 “Gypsum Board

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA)

1. AAMA 2604 -2005 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

B. American Society for Testing and Materials (ASTM):

1. Fire safety related:

a. ASTM E119: Methods for Fire Tests of Building Construction and Materials.

2. Material related

a. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2007.
b. ASTM A 1011/A 1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2006b.

C. American Welding Society (AWS)

1. AWS D1.3 - Structural Welding Code - Sheet Steel; 2007

D. Builders Hardware Manufacturers Association, Inc.

1. BHMA A156 - American National Standards for door hardware; 2006 (ANSI/BHMA A156).

E. National Fire Protection Association (NFPA):

1. NFPA 80: Fire Doors and Windows.
2. NFPA 251: Fire Tests of Building Construction & Materials
3. NFPA 252: Fire Tests of Door Assemblies
4. NFPA 257: Fire Test of Window Assemblies

F. Underwriters Laboratories, Inc. (UL):

1. UL 9: Fire Tests of Window Assemblies.
2. UL 10 B: Fire Tests of Door Assemblies
3. UL 10 C: Positive Pressure Fire Tests of Window & Door Assemblies
4. UL 263: Fire tests of Building Construction and Materials

G. American National Standards Institute (ANSI):

1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings

H. Consumer Product Safety Commission (CPSC):

1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials

1.3 DEFINITIONS

A. A.Manufacturer: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.

1.4 SUBMITTALS

A. Submit in accordance with Section 013300.

B. Product Data:

1. Technical Information: Submit latest edition of manufacturer's product data providing product descriptions, technical data, Underwriters Laboratories, Inc. listings and installation instructions.

C. Shop Drawings:

1. Include plans, elevations and details of product showing component dimensions; framing opening requirements, dimensions, tolerances, and attachment to structure
2. Provide templates for the location of embeds and anchor locations required for any adjoining work (if applicable).

D. Structural Calculations (optional):

1. Provide structural calculations sealed by a licensed professional engineer in the State in which the project is located; prepared in compliance with referenced documents and these specifications.

E. Samples. For following products:

1. Glass sample-as provided by manufacturer
2. Sample of frame
3. Verification of sample of selected finish

F. Glazing Schedule: Use same designations indicated on drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

G. Warranties: Submit manufacturer's warranty.

H. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements.

1. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualifications according to

1. International Accreditation Service for a Type A Third-Party Inspection Body (Field Services ICC-ES Third-Party Inspections Standard Operating Procedures, 00-BL-S0400 and S0401)
2. International Accreditation Service for Testing Body-Building Materials and Systems

a. Fire Testing

1) ASTM Standards E 119
2) CPSC Standards 16 CFR 1201
3) NFPA Standards 251, 252, 257
4) UL Standards 9, 10B, 10C, 1784, UL Subject 63
5) BS 476; Part 22: 1987
6) EN 1634-1

B. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257 and UL 9.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 252, ASTM E119. Assemblies must be factory-welded or come complete with factory-installed mechanical joints and must not require job site fabrication

D. Fire-Rated Wall Assemblies: Assemblies complying with ASTM E119 that are classified and labeled by UL, for fire ratings indicated, based on testing in accordance with UL 263, ASTM E119.

E. Listings and Labels - Fire Rated Assemblies: Under current follow-up service by Underwriters Laboratories® maintaining a current listing or certification. Label assemblies accordance with limits of manufacturer’s listing.

F. Regulatory Requirements: Comply with provisions of the following:

1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," as follows:

a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
b. Door Closers: Comply with the following maximum opening-force requirements indicated:

1) Accessible doors no more than 5 lbf (22.2 N) push or pull force

2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction

2. NFPA 101: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
b. Door Closers: Not more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.

3. IBC 2015 Chapter 10 Means of Egress: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

G. Door Closers: Not more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle under provisions specified by manufacturer.

1.7 PROJECT CONDITIONS

A. Obtain field measurements prior to fabrication of frame units. If field measurements will not be available in a timely manner coordinate planned measurements with the work of other sections.

1. Note whether field or planned dimensions were used in the creation of the shop drawings.

B. Coordinate the work of this section with others effected including but not limited to: other interior components and door hardware beyond that provided by this section

1.8 WARRANTY

A. Standard five-year manufacturer warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - (ACCEPTABLE MANUFACTURERS/PRODUCTS)

A. Manufacturer Glazing Material: Basis of Design: "Pilkington Pyrostop®" 90 min. And 120 min. fire-rated glazing as manufactured by the Pilkington Group.

B. Frame System:

C. "GPX Architectural Series" by Safti First

D. "**Fireframes® Heat Barrier Series**" fire-rated frame system as manufactured and supplied by Technical Glass Products.

E. "Aluflam North America" fire-rated frame system

F. Substitutions: Provide approved equal .

2.2 PERFORMANCE REQUIREMENTS

A. Fire Rating Requirements

1. Duration-- Windows: Capable of providing a fire rating for 120 minutes.
2. Duration-- Walls: Capable of providing a fire rating for 120 minutes

B. Delegated design: For the performance requirements listed below requiring structural design provide data, calculations and drawings signed and sealed by an engineer licensed in the state where the project is located.

C. Design Requirements

1. Dimensions -- Window Assembly:

a. Perimeter framing face dimension: 3-1/8-inch at head, sill and jamb.
b. Horizontal and/or vertical mullions: 4-1/8-inch on the face.
c. Depth of perimeter and mullion: depth varies based on rating and profile

2. Construction: Narrow-profile, roll-formed steel architectural grade specialty fire doors. Conventional break-shape type hollow metal steel fire-rated doors will not be considered an acceptable substitute for the Fireframes Heat Barrier Series doors specified in this section as they do not conform to the project design intent and/or aesthetic and quality standards.

a. Knock down frames are not permittedCoordinate the lb/ft^2 with those required in the field test at the end of the section.

2.3 MATERIALS - GLASS

A. Fire Rated Glazing –

B. Basis of Design: Composed of multiple sheets of Pilkington Optiwhite™ high visible light transmission glass laminated with an intumescent interlayer.

C. Refer to section 088813 for approved equal.

D. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201(Cat. I and II).

E. Properties Interior Glazing

Property				
Fire Rating	60 minute		90 minute	120 minute
Manufacturer's designation (Pilkington)	60-101	60-201	90-102	120-104
Glazing type	single	Single	single	IGU
Nominal Thickness	7/8" (23mm)	1-1/16" (27mm)	1-7/16" (37mm)	2-1/8" (54mm) [with 8 mm spacer, or 2-3/8" (60 mm) with 14 mm spacer]
Weight in lbs/sf	10.85	12.5	17.6	21.7
Daylight Transmission	87%	86%	84%	75%
Sound Transmission Coeffi-cient	41dB	44dB	45dB	46dB

F. Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacture, testing laboratory (UL), fire rating period, safety glazing standards, and date of manufacture.

G. Glazing Accessories: Manufacturer's standard compression gaskets, standoff, spacers, setting blocks and other accessories necessary for a complete installation.

2.4 MATERIALS –ALUMINUM FRAMES

A. Aluminum Framing System: 120 min.

1. Steel Frame — The steel framing members are made of two halves, nom. 1.9 in. wide (48.3 mm) with a nom. minimum depth of 1.38 in. (35 mm) with lengths cut according to glazing size.
2. Aluminum Trim — Supplied with the steel framing members. Nom. 2 in. (50.8 mm) wide with a nom. depth of 1.54 in. (39 mm) with lengths cut according to glazing size.
3. Stainless Steel Standoffs — Supplied with the steel framing members. Nom 5/16 in. (8 mm) diameter with a nom. minimum depth of 1 1/8 in. (28 mm) with depth adjusted to match Pilkington Pyrostop® Panel thickness.

4. Stainless Steel Moment and Connecting Braces: — Supplied with the steel framing members. Nom 3/8 in. (10 mm) thick with a nom. minimum depth of 1 1/8 in. (28 mm) with depth adjusted to match Pilkington Pyrostop® Panel thickness.
5. Framing Member Fasteners — Supplied with the steel framing members. Screws are M6 x16mm Button Head Socket Cap Screws for frame assembly and #6 x 1" Pan Head Sheet Metal Screws for door installation.
6. Glazing Gasket — Supplied with the steel framing members. Nom. 3/4 in. (19 mm) by 3/16 in. (4.5 mm) black applied to the steel framing members to cushion and seal the glazing material when installed.

2.5 FABRICATION

A. Obtain reviewed shop drawings prior to fabrication.

B. Fabrication Dimensions: Fabricate fire-rated assembly to field dimensions.

C. Factory prepared, fire-rated steel door assemblies by TGP to be prehung, prefinished with hardware preinstalled for field mounting.

D. Field glaze door and frame assemblies.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish frames after assembly.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

2.7 POWDERCOAT FINISHES

A. Finish after fabrication.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

C. Interior Steel or Aluminum Finishes

1. Powder-Coat Finish: Polyester Super Durable powder coating which meets AAMA 2604 for chalking and fading. Apply manufacturer's standard powder coating finish system applied to factory-assembled frames before shipping, complying with manufacturer's

recommended instructions for surface preparation including pretreatment, application, and minimum dry film thickness.

2. Color and Gloss: As selected by Architect from manufacturer's full range.
3. Acceptable Manufacturers:

    a. Tiger Drylac
    b. Additional manufacturers as approved by TGP

D. Anodized Finishes

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Color: As selected by Architect from full range of industry colors and color densities.
3. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
4. Color and Gloss: **As selected by Architect from manufacturer's full range**

E. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for **30-mil** thickness per coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine substrates and members to which the work of this section attaches or adjoins prior to frame installation are acceptable for product installation in accordance with manufacturer’s instructions. Provide openings plumb, square and within allowable tolerances. The manufacturer recommends 3/8 inch shim space at all walls

B. Notify Architect of any conditions which jeopardize the integrity of the proposed fire wall / door system.

C. Do not proceed until such conditions are corrected.

3.2 INSTALLATION

A. See Fireframes Aluminum Series Installation Manual

3.3 REPAIR AND TOUCH UP

A. Anodized Finishes

1. Protect the anodized finish from harsh chemicals such as concrete/mortar or muriatic acid/brick wash. If reasonable care is taken during handling and high and low pH chemicals can be avoided, repair and/or touch-up of an anodize finish will not be needed.
2. Some rub marks on an anodized surface can be removed with a mild abrasive pad such as a Scotch-Brite pad prior to touch up painting.
3. Touch-up paint should be used even more sparingly over anodize. Only the visible raw aluminum in the scratch or gouge should be touched up with a matching paint.

B. Powder Coated Finishes

1. Limited to minor repair of small scratches. Use only manufacturer's recommended products.
2. Such repairs shall match original finish for quality or material and view.
3. Repairs and touch-up not visible from a distance of 5 feet Owner and Architect to approve.

C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged.

3.4 PROTECTION AND CLEANING

A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface`. Remove nonpermanent labels, and clean surfaces.

1. Do not clean with astringent cleaners. Use a clean "grit free" cloth and a small amount of mild soap and water or mild detergent.
2. Do not use any of the following:

    a. Steam jets
    b. Abrasives
    c. Strong acidic or alkaline detergents, or surface-reactive agents
    d. Detergents not recommended in writing by the manufacturer
    e. Do not use any detergent above 77 degrees F
    f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
    g. Metal or hard parts of cleaning equipment must not touch the glass surface

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION
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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division -1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Extent of hardware required is indicated on drawings and in schedules.

B. Related Work Specified in other Sections:

1. Division 5 Section "Metal Fabrications" for cast abrasive thresholds.
2. Division 6 Section "Interior Architectural Woodwork" for casework hardware.
3. Division 8 Series Sections for overhead doors and grilles, coiling doors, folding doors, revolving doors, and other specialized doors for associated hardware.
4. Division 10 Section "Wire Mesh Partitions" for wire mesh door hardware.

1.3 QUALITY ASSURANCE

A. Definition:

1. "Hardware" includes items known commercially as finish hardware which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame. Hardware shall be furnished and installed as part of the work of this section.

B. Requirements of Regulatory Agencies:

1. Provide hardware to comply with the requirements of laws, codes, ordinances, and regulations of governmental agencies having jurisdiction. Where such requirements exceed the requirements of the Specifications, furnish the most stringent.
2. Hardware to hazardous areas of public buildings shall comply with the requirements of the governmental agencies having jurisdiction. For public building accommodations, comply with governmental laws and regulations for the physically handicapped.

C. Hardware Supplier:

1. An established hardware supplier who is a factory authorized distributor for all products required, and has display samples, inventory, and qualified personnel trained and experienced in preparing Hardware Schedules, issuing templates, and ordering, furnishing,

and servicing hardware for architecturally designed projects, who employs an experienced Architectural Hardware Consultant who is available to Owner, Architect and Contractor, at reasonable times during the course of the work, for consultation about project's hardware requirements.

D. Preconstruction Meeting:

1. Prior to commencement of the Hardware Supplier's development of the Hardware Schedule, a Hardware Meeting will be held at the Architect's office. The Contractor/Construction Manager and the Hardware Supplier's personnel directly responsible for preparing the Hardware Schedule shall meet with the Architect and the Architect's Hardware Consultant. Attendance at this meeting is mandatory.

    a. Purpose of the meeting is to review the Contract Documents' hardware schedule requirements and will include, but not be limited to, the following:

        1) Review specification requirements for hardware schedule, formats, hardware locations, opening descriptions, and other information specified.
        2) Review products specified versus products proposed.
        3) Hardware Supplier shall distribute, at the meeting, samples of schedules from other projects of similar nature prepared by the same person as will prepare schedule for this Project.

E. Preinstallation Seminar:

1. Before the installation of hardware begins, the Contractor/Construction Manager shall request that a hardware installation seminar for the installation of door closers exit devices, and locksets be conducted by the manufacturer's representative of these products. Seminar to be held at job site and attended by all installers of hardware, such as aluminum doors and carpentry installers. Seminar will address proper coordination and installation of exit devices, door closers, and weatherstripping, as detailed in the hardware schedule for this Project, with the use of installation manuals, hardware schedule, templates, physical product samples, and exit device installation videos.

F. Fire-Rated Openings:

1. Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware which has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.
2. Where emergency exit devices are required on fire-rated doors that carry supplementary marking on the doors UL labels indicating "Fire door to be equipped with fire exit hardware", provide UL label on exit devices indicating "Fire Exit Hardware".

G. Fire Door Inspection Report:

1. Contractor shall engage an experienced, certified Door Hardware Consultant or other approved qualified individual to inspect all fire rated openings for compliance with NFPA 80.

2. Inspection shall take place after the fire-rated openings are completed but before Substantial Completion.

3. This inspector shall submit a preliminary written report of observations, for review. As a minimum, the following items shall be verified:

    a. No open holes or breaks exist in surfaces of either the door or frame.

    b. Glazing, vision light frames, and glazing beads are intact and securely fastened in place, if so equipped.

    c. The door, frame, hinges, hardware and noncombustible threshold are secured, aligned, and in working order with no visible signs of damage.

    d. No parts are missing or broken.

    e. Door clearances do no exceed clearances listed in 4.8.4 and 6.3.1.7.

    f. The self-closing device is operational; that is, the active door completely closes when operated from the full open position.

    g. If a coordinator is installed, the inactive leaf closes before the active leaf.

    h. Latch hardware operates and secures the door when it is in the closed position.

    i. Auxiliary hardware items that interfere or prohibit operation are not installed on the door or frame.

    j. No field modifications to the door assembly have been performed that void the label.

    k. Gasketing and edge seals, where required, are inspected to verify their presence and integrity.

4. Following contractor correction of all non-complying items. Inspector will sign and submit three final written reports to the Owner as a required Close-out Submittal.

1.4 SUBMITTALS

A. General:

1. Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product Data:

1. None required.

C. Shop Drawings:

1. None required, except as may be noted under Section "Door Schedule" or under heading "Hardware Schedule".

D. Samples:

1. None required, except as may be noted under Section "Door Schedule" or under heading "Hardware Schedule".

E. Hardware Schedules:

1. Submit proper number of Hardware Schedules to allow the Architect to retain two copies for his use, a copy for the Owner for his use, plus the number of copies required by the Contractor for its distribution and use. Include the following information in vertical format only. Horizontal format schedule will be returned without review noted "Not Approved".
2. Submit as an integral part of the Hardware Schedule a complete riser and wiring diagram for each different application of all the electrical components being provided for doors with electrical components.
3. Elevation and Wiring Drawings:

    a. Submit elevation drawing showing relationship of all electrical and pneumatic hardware components to door and frame. Indicate number and gage of wires required. Indicate size of air tubing required. Indicate PSI requirements.
    b. Submit wiring drawing showing point to point wire hook up for all components.
    c. Submit drawing showing point to point hookup of air tubing for all components.
    d. Submit system operations descriptions for each of opening; describe each possible condition.

4. Door Index, using Architect's Door Numbers, Hardware Set numbers and page numbers where hardware is listed.
5. Preface sheet listing category only and manufacturers' names of items being furnished, as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges Manufacturer A	Manufacturer B	
Locksets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

6. Opening Description:

    a. Single or pair, number, room locations, hand, active leaf, degree of swing, size, material, frame material, and UL Listed.

7. Hardware Description:

    a. Quantity, category, product number, fasteners, and finish.

8. Headings that refer to the specified Hardware Set Numbers.
9. Scheduling sequence shown in Hardware Sets.
10. Product data of each hardware item, and shop drawings where required, for items to be connected to the electrical or fire alarm systems complete with power requirements and wiring diagrams and for other special conditions and specialty hardware.
11. Typed copy.
12. Double spacing.
13. 8-1/2 x 11 inch sheets.
14. U.S. Standard finish symbols.
15. Consecutively numbered pages.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Provide each category with the products of only one manufacturer, unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.
2. Manufacturers named under each heading item are acceptable subject to compliance with requirements directly specified or by means of meeting requirements for the listed manufacturer.

    a. Where only one manufacturer or product is specified, the phrase "No Substitution" shall apply.

3. Provide hardware made to template.

B. Continuous Hinge:

1. Provide fire rated hinges at label openings.
2. Products listed in sets are Ives 224HD series.

    a. Equal product from any BHMA member will also be acceptable.

C. Locksets and Latchsets:

1. Function numbers listed are Schlage L9000 series with"03N" lever trim.

    a. Corbin-Russwin ML2000 with "LSM" lever trim will also be acceptable.
2. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips which do not project more than 1/8" beyond door-frame trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.

D. Closers:

1. Review the door frame and plan details to determine the proper length of arm and the degree of swing. The degree of swing must be indicated in the Hardware Schedule. Provide accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers.
2. Provide one Shoe Support with each closer 4040-SCUSH where required. When used with weatherstripping, provide special shoe or Stop Spacer for arm to pass below stop and weatherstripping.
3. Numbers used in Hardware sets are LCN 4011/4111 series. (No substitution per owner's standard)

E. Overhead Holders and Stops:

1. Function numbers listed are Glynn-Johnson (GLY). Size: Per Manufacturer's Selector Chart.

    a. Equal products from any BHMA member will also be acceptable.

F. Kick Plates:

1. Numbers listed in sets are Ives (IVE) 8400 series. Stainless steel sheet, 10 x 0.050 inches with 3 beveled edges x door width less 2 inches and single doors, and less 1 inch at pairs.

    a. Equal products from any BHMA member will also be acceptable.

G. Weatherstripping & Smoke Seals:

1. Numbers specified are National Guard Products. Products from other manufacturers are acceptable if equal in material, shape, thickness, and contain equal gasket material.

    a. Pemko
    b. Reese
    c. Zero

H. Cylinders & Keying:

1. Furnish Best SFIC cylinder housings for all items capable of being locked.

2. All final cores and keys will be furnished by the WSU Key Shop.

I. Miscellaneous:

1. Provide items not categorized in the above descriptions, but specified by manufacturers' names in hardware sets.
2. Provide frame marking jigs, if required, for Continuous Hinges.

J. Fasteners:

1. Provide fasteners of the proper type, size, quantity, and finish. Provide machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction.
2. Provide end caps for Pulls, Offset Pulls, and face ends of push-pull units.
3. Provide sex bolts for closers at lead lined doors.

K. Finishes:

1. Furnish finish for each item as indicated in sets.

L. Templates and Hardware Location:

1. Provide hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
2. Refer to Article "INSTALLATION", "Locations" and coordinate with templates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install hardware according to manufacturer's printed instructions and to template dimensions. Refer to Cylinders and Keying regarding replacement of construction cores with final cores.
2. Install hardware according to manufacturers' printed instructions and to template dimensions. Refer to Cylinders and Keying regarding conversion of construction cores to final cores.
3. Apply stop seals with no interruptions at head and jambs.
4. Apply weatherstripping to head and jamb stops with no cutouts for stop applied hardware.
5. Closers shall be inspected and adjusted after installation and after the HVAC System is in operation by the Factory Representative to insure proper adjustment in operation. The Manufacturer's Representative shall prepare written report stating compliance, and also recording locations and kind of non-compliance. The original report shall be forwarded to the Architect with a copy to the Contractor and Hardware Distributor.
6. Drill and countersink screw holes for oval head undercut screws.

7. Door edgings shall have cutouts made for bottom flush bolts and for lock and latch fronts and strikes. Bevel top edges to continue bevel pattern in armor and niche plates.
8. When faces of door frames are flush with adjacent walls, thresholds shall be coped at stops and mullions, but not in front of faces of frames.
9. Attach closers with wood screws at wood doors and machine screws at metal doors.

    a. Attach closers with wood screws at wood doors and machine screws at metal doors.

10. Attach closers at lead lined doors with sex bolts.

B. Templates and Hardware Locations:

1. Provide required templates and hardware locations to the door and frame manufacturers.
2. Mortising is not required for steel channel or tube steel frames.
3. Dimensions are from finish floor to center line of items.
4. Include this list in Hardware Schedule.

CATEGORY	DIMENSION
Hinges	Door Manufacturer's Standard
Levers	Door Manufacturer's Standard
Exit Device Touch Bars	Manufacturer's Template
Trim Protector Bars (inswing)	2" below trim

C. Quantities:

1. Provide one hinge for each 30 inches of door height, or fraction thereof, except where quantities are specified otherwise.
2. Provide one additional intermediate pivot for doors over 90 inches.
3. Provide hinges, electric hinges, pivot sets, electric pivots, roller latches, exit devices, push and pull hardware, closers, overhead holders, kick plates, armor plates, door edgings, bumpers, stops, seals, automatic bottoms, bottom seals, weatherstripping, and thresholds for both leaves of pairs and batteries unless specified otherwise.

3.2 ADJUST, CHECK, AND CLEAN

A. Adjust, Check, and Clean:

1. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit, prior to Owner's occupancy. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made. Clean hardware to restore finish.
2. Adjust hardware to meet ADA and other pertinent code and regulatory requirements.

B. Final Adjustment:

1. Return to the Project 30 calendar days after Owner's occupancy and make final check and adjustment of all hardware items. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made. Clean hardware to restore finish. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
2. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

3.3 HARDWARE SETS

HW SET: 01

1	EA	CONTINUOUS HINGE	224HD EPT	628	IVE
1	EA	BY DIV 281000	EPT-10	689	B/O
1	EA	BY DIV 281000	RX-L9092BDCEU 03N	626	B/O
1	EA	BY WSU	FINAL CORE	626	B/O
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	OVERHEAD STOP	900S	630	GLY
1	EA	KICK PLATE	8400 10” X 2” LDW	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	BY DIV 281000	1076D	BLK	B/O
1	EA	BY DIV 281000	CARD READER		B/O
1	EA	BY DIV 281000	POWER SUPPLY		B/O

HW SET: 02

1	EA	CONTINUOUS HINGE	224HD	628	IVE
1	EA	PASSAGE SET	L9010 03N	626	SCH
1	EA	OVERHEAD STOP	100S	630	GLY

HW SET: 03

1	EA	BY DIV 281000	EPT-10	689	B/O
1	EA	BY DIV 281000	LXRXLC-9875EO X ALK98	626	B/O
1	EA	MORTISE CYLINDER	1E74 LESS CORE	626	BES
1	EA	BY WSU	FINAL CORE	626	B/O
1	EA	BY DIV 281000	1076D	BLK	B/O
1	EA	BY DIV 281000	POWER SUPPLY		B/O

NOTE: MODIFY, PATCH AND REPAIR THE EXISTING DOOR AND FRAME FOR THE NEW HARDWARE. REUSE THE BALANCE OF EXISTING HARDWARE.

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Glass for doors, interior borrowed lites.
2. Glazing sealants and accessories.

B. Related Requirements:

1. Section 088813 Fire-Rated Glass

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. IBC: International Building Code (Michigan Building Code).

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass the following products; 12 inches (300 mm) square.

1. Coated glass.
2. Laminated glass
3. Fire Rated glass

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, and manufacturers of insulating-glass units.

B. Product Certificates: For glass.

C. Product Test Reports: For coated glass, insulating glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass and Laminated-Glass Products: Manufacturer agrees to replace coated-glass units and laminated-glass unit that deteriorate within specified warranty period. Deterioration of coated glass and laminated-glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated and laminated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, de-laminating and other indications of deterioration in coating.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness: 6 mm.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Laminated Glass: ASTM C 1172-03

D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer: Aluminum with mill or clear anodic finish or stainless steel.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 790.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. May National Associates, Inc.; Bondaflex Sil 290.
d. Pecora Corporation; 890.
e. Sika Corporation, Construction Products Division; SikaSil-C990.
f. Tremco Incorporated; Spectrem 1.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-1: Clear float glass.

1. Thickness: 6.0 mm.

2. Provide safety glazing labeling.

B. Glass Type GL-2: Clear fully tempered float glass.

1. Thickness: 6.0 mm.
2. Provide safety glazing labeling

3.9 FIRE-PROTECTION-RATED GLAZING SCHEDULE

A. Glass Type FPGL-1: 20-minute fire-protection-rated glazing without hose-stream test; fire-protection-rated tempered glass.

B. Glass Type FPGL-2: 45-minute, 60 minute or 90 minute as indicated on the Drawings fire-protection-rated glazing; laminated ceramic glazing passing hose stream test.

3.10 FIRE RESISTANT GLASS SCHEDULE

A. Glass Type GL-3: 90 min. Fire Rated Clear Full tempered.

1. Refer to Section 088813 “Fire Resistant Glazing”

B. Glass Type GL-4: 120 min. Fire Rated Clear Full tempered.

1. Refer to Section 088813 “Fire Resistant Glazing”

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SECTION 088813 FIRE-RATED GLASS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-rated glazing materials installed as borrowed lite windows in fire-rated frames and wall applications.

B. Related Sections include the following:

1. Section 084123 – "Fire Rated Aluminum Framed Storefronts and Heat Barrier Entrances" for fire-rated doors
2. Section 092900 "Gypsum Board" for gypsum board and metal stud framed area separation partition walls.

1.2 REFERENCES

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

1. ASTM E 119: Fire Tests of Building Construction and Materials.

B. American National Standards Institute (ANSI):

1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings

C. Consumer Product Safety Commission (CPSC):

1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials

D. Glass Association of North America (GANA):

1. GANA – Glazing Manual.
2. FGMA – Sealant Manual.

E. National Fire Protection Association (NFPA):

1. NFPA 80: Fire Doors and Windows.

F. Underwriters Laboratories, Inc. (UL):

1. UL 263: Fire tests of Building Construction and Materials

G. Standard Council of Canada:

1. ULC Standard CAN4-S104: Fire Tests of Door Assemblies.
2. ULC Standard CAN4-S106: Fire Tests of Window Assemblies.

H. 2012 Michigan Building Code.

1.3 PERFORMANCE REQUIREMENTS

A. Fire-rated, clear and wireless glazing material for use in locations such as doors, sidelites, transoms, borrowed lites, and wall applications with fire rating requirements ranging from 45 minutes to 2 hours with required hose stream test; for use in interior and exterior applications.

B. Provides protection by reducing the radiant and conductive heat transfer

1.4 SUBMITTALS

A. Comply with requirements of Section 013300.

B. Product data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance instructions.

C. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.

D. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

E. Samples: Submit, for verification purposes, approx. 8-inch by 10-inch sample for each type of glass indicated.

1.5 QUALITY ASSURANCE

A. Glazing Standards: FGMA Glazing Manual and Sealant Manual.

B. Fire Resistance Rated Glass: Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire resistive assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials under provisions of Section 016000.

B. Deliver materials to specified destination in manufacturer or distributor's packaging, undamaged, complete with installation instructions.

C. Pilkington Pyrostop® must not be exposed outside the range -40 degrees F to 120 degrees F (-40 degree C to +50 degrees C) during storage and transportation.

D. Store off ground, under cover, protected from weather and construction activities.

E. Do not expose the non-PVB side of glass to UV light.

F. Store sheets of glass vertically. DO NOT lean.

1.7 WARRANTY

A. Provide manufacturer's limited warranty under provision of section 017800.

PART 2 - PRODUCTS

2.1 FIRE-RATED GLAZING MATERIALS

A. Manufacturer:

1. "Pilkington Pyrostop® 90 min. & 120 min." as manufactured by the Pilkington Group and distributed by "Technical Glass Products".
2. "SuperLite II XL90, SuperLite II XL120, SuperLite II-XLB and SuperLite II-XLM" as manufactured by "Safti First".
3. "Contraflam 90, Contraflam 120" as manufactured by "Vetrotech".

B. Properties:

1. Fire-rating: Up to 2 hours.
2. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
3. STC Rating: Up to 46 dB.

C. Fire Rating – 60 Minutes and Greater: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E 119 and UL 263.

D. Substitutions: Provide approved equal.

2.2 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

A. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air and vapor seal.

B. Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:

1. Dow Corning 795 - Dow Corning Corp.
2. Silglaze-II 2800 - General Electric Co.
3. Spectrem 2 - Tremco Inc.

C. Setting Blocks: Hardwood or calcium silicate; glass width by 4 inches by 3/16 inch thick.

D. Spacers: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesive-backed on one face only, tested for compatibility with specified glazing compound.

E. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.3 FABRICATION

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
2. Minimum required face or edge clearances.
3. Observable edge damage or face imperfections.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.2 INSTALLATION (GLAZING)

A. Comply with referenced GANA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.

B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.

C. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.

D. Place setting blocks located at quarter points of glass with edge block no more than 6-inches from corners.

E. Glaze vertically into labeled fire-rated metal frames or partition walls with the same fire rating as glass and push against tape for full contact at perimeter of pane or unit.

F. Place glazing tape on free perimeter of glazing in same manner described above.

G. Do not remove protective edge tape.

H. Install removable stop and secure without displacement of tape.

I. Do not pressure glaze.

J. Glaze exterior openings with PVB layer toward the exterior of the building.

K. Knife trim protruding tape.

L. Apply cap bead of silicone sealant along void between the stop and the glazing, to uniform line, with bevel to form watershed away from glass. Tool or wipe sealant surface smooth.

M. Provide minimum 3/16 inch edge clearance.

N. Install in vision panels in fire-rated doors to requirements of NFPA 80.

O. Install so that appropriate UL and manufacturer's fire rated markings remain permanently visible.

3.3 PROTECTION AND CLEANING

A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.

B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

2.2 FRAMING SYSTEMS

A. Recycled Content: Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645. Use steel studs and runners not embossed steel studs and runners.

1. Steel Studs and Runners:

a. Manufacturers: Subject to compliance with requirements, provide products of the following:

1) Clark Dietrich Building Systems.
2) Jaines Industries Inc.
3) MarinoWare.
4) MBA Metal Framing.
5) MRI Steel Framing LLC.
6) Phillips Manufacturing Co.
7) State Building Products, Inc.
8) Steel Network, Inc.
9) Telling Industries.

b. Minimum Base-Metal Thickness: Unless otherwise indicated on Drawings, 0.0329 inch (0.836 mm) [20 gage].

1) Equivalent Gauge (EQ) studs are not acceptable unless they are the stated minimum base-metal thickness specified.

c. Depth: Unless otherwise indicated on Drawings, 3-5/8 inches (92 mm).

D. Slip-Type Head Joints: Where indicated, provide the following:

1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Product: Subject to compliance with requirements, provide the following:

1) Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
2) Metal-Lite, Inc.; Slotted Track.

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Fire Trak Corp.; Profile as indicated on drawings.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Steel sheet for blocking and bracing in length and width as indicated.
2. Minimum Base-Metal Thickness: 16 gage (0.0538 inch minimum thickness), unless otherwise indicated.

G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: Unless otherwise indicated on Drawings 1-1/2 inches (38 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings 0.0329 inch (0.836 mm).
2. Depth: Unless otherwise indicated on Drawings, 1-1/2 inches (38 mm).

I. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

J. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: Unless otherwise indicated on Drawings, 3/4 inch (19 mm).
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings 1-1/2 inches (38 mm).

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.

a. Protective Finish: Manufacturer's standard corrosion-resistant coating.

2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: Unless otherwise indicated on Drawings, 0.0329 inch (0.836 mm) [20 gage].
b. Depth: Unless otherwise indicated on Drawings, 3-5/8 inches (92 mm).

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
b. Chicago Metallic Corporation; Fire Front 650 System.
c. USG Interiors, Inc.; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to

terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Spot grout door frames. Apply spot grout at each anchor clip and immediately insert gypsum board into frames.
4. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
5. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

6. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
7. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c. unless otherwise indicated.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Product Data: For adhesives and sealants, indicating VOC content.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC (and FSTC)-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency. Provide in field testing for FSTC-Rated Assemblies per ASTM E336.

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 10 percent by weight.

B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.
    b. CertainTeed Corporation.
    c. Continental Building Products, LLC.
    d. Georgia-Pacific Building Products.
    e. National Gypsum Company.
    f. United States Gypsum Company.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet
2. Shapes:

    a. Cornerbead: Use at outsider corners, unless otherwise indicated.
    b. Bullnose bead: Use where indicated.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound. Use at exposed panel edges.
    d. L-Bead: L-shaped; exposed long flange receives joint compound. Use where indicated.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound. Use where indicated.
    f. Expansion (control) joint: Use where indicated.
    g. Curved-Edge Cornerbead: With notched or flexible flanges, use at curved openings.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh, unless otherwise recommended by panel manufacturer.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or drying-type, all-purpose compound. At Contractor's Option: High-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: As specified in Section 072100 "Thermal Insulation".

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 10 percent by weight.

E. Acoustical Sealant: As specified in Division 7 Section “Joint Sealants”.

F. Thermal Insulation: As specified in Division 7 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840 and GA-216.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC (and FSTC): -Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings. Provide in field testing for FSTC-Rated Assemblies per ASTM E336 for partitions where indicated on drawings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board and types at locations as indicated on the Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints:

1. Install control joints at locations indicated on Drawings.
2. Where not shown on the Drawings, install control joints according to ASTM C 840 and in specific locations noted below and approved by Architect for visual effect.

    a. At all changes in type of gypsum support construction.
    b. At transitions from floor supported metal framing to overhead supported framing.
    c. At control joints occurring on building construction.
    d. In walls at maximum spacing of 30 feet.
    e. Where wallboard abuts a wall or ceiling of dissimilar construction.
    f. At door jamb where the wallboard joint is less than 12" from jamb.
    g. In ceiling areas to limit area to not more than 2500 sq.ft. and not more than 50 feet o.c.
    h. In ceilings where support framing changes direction.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use at outside corners, where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840: and GA-214.

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile, panels that are substrate for acoustical tile and where indicated on Drawings.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated. This is the standard finish for gypsum board panels exposed to view.

    a. Primer and its application to surfaces are specified in Division 9 Sections “Painting."

4. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface for panel surfaces receiving gloss and semi-gloss enamels and surfaces subject to severe lighting finish and elsewhere as required for a high quality gypsum board finish. Areas to receive Level 5 finish include wall and ceiling areas abutting window mullions or skylights, corridors with a window at the end, walls receiving accent cove lighting, and elsewhere as indicated on the drawings.

    a. Provide allowance for 15% of the partitions to receive a Level 5 finish.
    b. Primer and its application to surfaces are specified in Division 9 Sections “Painting."

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Related Requirements:

1. Division 5 Section “Post-Installed Anchors” for attachments to concrete slabs on metal deck.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.10 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 450 or less.

2.3 ACOUSTICAL PANELS

A. Products: Subject to compliance with requirements, provide the products indicated in the "Finish Key" in the Reference Materials in the Project Manual.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 10 percent.

D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

E. Thickness: As indicated by product identified on the "Finish Key" in the Reference Materials in the Project Manual.

F. Modular Size: As indicated on Drawings.

G. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEM

A. Products: Subject to compliance with requirements, provide the product indicated in the "Finish Key" in the Reference Materials in the Project Manual.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

1. Intermediate-duty system unless otherwise indicated.
2. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635.

C. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

D. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. Color: White, unless otherwise indicated.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: Post-installed expansion anchors as specified in Section 058010 “Post-Installed Anchors”.
    b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
    c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316.

d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: As specified in Section 058010 “Post-Installed Anchors.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic at MRI Exam Room.
2. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400 at MRI Exam Room.
3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-)] diameter wire.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Products: Same as metal suspension system manufacturer unless otherwise indicated.

B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079200 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, or post-installed mechanical anchors, In accordance with Division 5 Section “Post-Installed Anchors.”
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires to cast-in-place hanger inserts or postinstalled anchors mechanical anchors in accordance with Division 5 Section “Post-Installed Anchors.”.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.
   b. Install panels with pattern running in one direction parallel to long or short axis of space.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

C. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113
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SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Sections:

1. Division 9 Section “Resilient Tile” for Resilient tile flooring.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

C. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Manufacturers: Provide products as indicated in the “Finish Materials List” on the Drawings:

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe) and Straight (flat or toeless) refer to Drawings for location.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: To match existing.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed.

H. Colors and Patterns: As indicated on the “Finish Materials List” on the Drawings.

I. Type:

1. Straight at carpet and carpet tile.
2. Cove at all other locations, unless otherwise indicated.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessories: Provide products by the same manufacturers as the resilient base.

B. Description: Carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet Transition strips.

C. Material: Rubber.

D. Profile and Dimensions: As indicated.

E. Colors and Patterns: As indicated on the "Finish Materials List" on the Drawings. If not indicated, as selected by Architect from manufacturer's full range.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Cove Base Adhesives: Not more than 50 g/L.
b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Preformed Corners: Install preformed corners before installing straight pieces.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 096513
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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.

B. Related Sections:

1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.
2. Indicate the direction that the grain will be run in accordance with the manufacturer's recommendations and request Architect confirmation.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

B. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.7 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box or roll for every 50 boxes or rolls or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

A. Products: Subject to compliance with requirements, provide products as indicated on the "Finish Materials List" on the Drawings.

B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm).

F. Colors and Patterns: As indicated by manufacturer's designations on the "Finish Materials List".

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. VCT Tile Adhesives: Not more than 50 g/L.
b. Rubber Floor Adhesives: Not more than 60 g/L.

2. Subject to the requirements, provide the manufacturer's floor tile adhesive recommended for the tile being installed and the application method and suited for high load applications.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
    c. Perform one of above moisture tests as recommended by manufacturer. Proceed with installation only after substrates pass testing.
    d. See Division 1 Section “Unit Prices” for remediation requirements if moisture test is failed.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis, or:

2. Lay tiles in pattern indicated on Drawings.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

a. If manufacturer recommendation for grain direction for a specific tile is contrary to this criteria, verify with the Architect before proceeding.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Clean tile surfaces that are free from soil, visible adhesive and surface blemishes just prior to substantial completion.

a. Floor Tile: Use manufacturer’s standard environmentally friendly maintenance cleaning product.

D. Floor Polish: Remove soil, visible adhesive and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply the number of coat(s) as recommended by the manufacturer.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519
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SECTION 097350 - FIBERGLASS REINFORCED PANELS (FRP)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division -1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of impact-resistant wall coverings:

1. Fiberglass reinforced panels (FRP).

1.3 SUBMITTALS

A. Product data including installation methods for each different type of substrate. Provide written data including physical characteristics, such as durability, resistance to fading, and flame resistance. Include the manufacturer's recommendations for maximum permissible moisture content of substrates.

B. Shop drawings showing location, extent, and installation details. Include indication of wall covering termination points. Provide elevations showing nonstandard conditions.

C. Product test reports from a qualified independent testing laboratory showing compliance of FRP panel materials with requirements indicated based on tests performed by the laboratory within the past five years.

D. Maintenance data for FRP panel material components for inclusion in the operating and maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has previously installed FRP panels similar in design and extent to the materials required on this Project.

B. Fire Performance Characteristics: Provide FRP panels that are identical to those tested in accordance with ASTM E 84 for the fire performance characteristics indicated below. Identify wall covering materials with appropriate markings from the testing and inspection organization.
1. Flame Spread: 25 or less.
2. Smoke Developed: 450 or less, and as specifically indicated in Part 2 - Products.

C. Single Source Responsibility: Obtain each color, texture, grade, finish, and type of impact-resistant wall covering material and FRP panels and accessories from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original factory wrappings, clearly labeled with identification of manufacturer, brand name, lot number, quality or grade, and fire hazard classification.

B. Store materials inside in original undamaged packages in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Do not store rolled goods upright; lay flat, blocked off the ground to prevent sagging and warping.

1. Maintain room temperature within the storage area at not less than 70 deg F (21 deg C) during the period vinyl plastic materials are stored. Keep sheet material out of direct sunlight to avoid surface distortion.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Do not install impact-resistant wall covering material until the space to receive the wall covering material is enclosed and weatherproof. Do not install materials until the ambient temperature within the building is maintained and stabilized at not less than 70 deg F (21 deg C) for not less than 72 hours prior to beginning of the installation.

1. During and after installation, shield walls from exposure to direct sunlight to avoid blistering and distortion.

1.7 SEQUENCING AND SCHEDULING

A. Schedule installation with other construction activities to minimize the possibility of damage and soiling during the remainder of the construction period.

1.8 MAINTENANCE

A. Maintenance Instructions: Provide the manufacturer's instructions for maintenance of installed work. Include recommended methods and frequency for maintaining materials in optimum condition under anticipated traffic and use conditions. Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

PART 2 - PRODUCTS

2.1 FIBERGLASS REINFORCED PANELS (FRP)

A. Manufacturers/Products: Subject to the requirements, provide one of the following:
   1. Panolam Industries International, Inc. Panolam FRP.
   2. C/S Construction Specialties, Acrovyn Wall Covering (Basis of design).
   3. Marlite FRP panels.

B. Fire Rating: IBC Class A / UL Class A, tested to ASTM E 84.

C. Fiberglass Reinforced Panels (FRP Panels) – Properties:
   1. Product: Fiberglass reinforced panels.
   2. Nominal Thickness: 0.090 inch (2.3 mm).
   3. Panel Size: To suit conditions shown without horizontal seams.
   4. Surface Burning Characteristics: Rating of 25; or less, as tested to ASTM E 84.
   5. Barcol Hardness ASTM D2538: 55 minimum.
   6. Use: Walls and ceilings where indicated.
   7. Colors: As selected by Architect from manufacture’s full range.

D. Accessories: Manufacturer’s standard Color matched dividers, outside corners, inside corners, end caps and fastening rivets, moldings and trim.

E. Adhesive: Provide the type of adhesive recommended by the manufacturer for use with the wall covering material on the substrate indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates scheduled to receive FRP panels for compliance with manufacturer's requirements and conditions affecting performance.
   1. Wall and ceiling surfaces to receive FRP panels shall be dry and free from dirt, grease, loose paint, and scale.
   2. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prior to installation clean substrate to remove dust, debris, and loose particles. Provide skim coat over rough walls to smooth surface.

   1. Complete all finishing operations, including painting, before beginning installation of FRP panels.

2. Prime and seal substrates, if required, in accordance with the FRP panel manufacturer's recommendations, respectively, for the type of substrate.

3.3 INSTALLATION

A. General: Install FRP panels and accessories in accordance with manufacturer's recommendations using adhesive recommended for use over the substrate.

1. Installation Type: As indicated.

3.4 CLEANING

A. General: Immediately upon completion of installation, clean FRP panels and accessories in accordance with manufacturer’s recommendations.

B. Remove excess adhesive, using methods and materials recommended by manufacturer.

C. Remove surplus materials, rubbish, and debris resulting from installation upon completion of work, and leave areas of installation in neat, clean condition.

END OF SECTION
CL

SECTION 099100- PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division -1 Specification Sections, apply to Work of this Section.

1.2 SUMMARY

A. Extent of painting work is indicated on Drawings and schedules, and as herein specified.

B. This Section includes surface preparation, field painting of the following:

1. Exposed interior items and surfaces.
2. Exposed exterior items and surfaces.

3. Surface preparation, priming of unprimed or incompatible primer finished surfaces, and touching up of damaged shop primed surfaces specified in this Section are in addition to shop surface preparation and priming specified in other Sections, when surface preparation and primer are not adequate to provide proper surface to receive specified finish coats specified in this Section.

C. Paint exposed surfaces of all new work whether or not colors are designated in "Finish and Color Schedules" on the Drawings, except where a surface or material is specifically indicated not to be painted or is to remain natural. If the "Finish and Color Schedules" do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not "Finish and Color Schedules" indicate colors. If the "Finish and Color Schedules" do not indicate color or finish, the Architect will select from standard colors and finishes available.

D. Access Panels and Electric Panelboards: Paint access panels and electric panelboards to match adjacent wall or ceiling.

E. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels, unless otherwise specified.

1. Prefinished items include the following factory-finished components (except as otherwise specified):

a. Architectural woodwork and casework.
b. Metal lockers.
c. Wood doors.

d. Finished mechanical and electrical equipment.
e. Light fixtures.
f. Distribution cabinets.

F. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Furred areas.
b. Ceiling plenums.
c. Pipe spaces.
d. Duct shafts.

2. Finished metal surfaces include the following:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.
d. Copper.
e. Bronze.
f. Brass.

3. Operating parts include moving parts of operating equipment and the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

4. Labels: Do not paint over Underwriter's Laboratories (UL), Factory Mutual (FM) or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

G. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat is a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell is a low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin is a low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.

4. Semigloss is a medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss is a high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

B. "Exposed" shall refer to items and surfaces not concealed by ceilings or chases or insulation covering or similar permanent sight barriers.

C. "Exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

1. This includes areas above the ceiling plane that are visible from standing or seated position.

D. "Finished Areas" shall refer to areas of building with tile or painted or otherwise finished walls, or with resilient tile or terrazzo or otherwise finished floor, or with painted plaster or painted drywall, or suspended acoustical or otherwise finished ceilings.

E. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.4 SUBMITTALS

A. Product Data:

1. Material List:

a. Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information:

a. Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

B. Shop Drawings:

1. None required.

C. Samples:

1. Submit samples for verification purposes. Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

2. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
3. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.

D. Qualification Data:

1. Submit Qualification Data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Record Documents:

1. As part of the requirements of Section "Closeout Procedures" for marking up the Project Manual to show actual materials used, provide paint manufacturer's paint color names and technical information for each paint used on the Project.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Coordination of Work:

1. Review other sections in which primers are to be provided to ensure compatibility of total system for various substrates. On request, furnish information or characteristics of finish materials to ensure use of compatible primers.
2. Notify the Architect of problems anticipated using the materials specified.

C. Supervision:

1. Provide at least one person who shall be present at all times during execution of the work of this Section, who shall be thoroughly familiar with the specified requirements and the materials and methods needed for their execution, and who shall direct all work performed under this Section.

D. Job Staffing and Workmen Qualifications:

1. Provide adequate numbers of workmen skilled in the necessary crafts and properly informed of the methods and materials to be used. In acceptance or rejection of the work of this Section, the Architect will make no allowance for lack of skill on the part of workmen.

1.6 DELIVERY AND STORAGE

A. Deliver materials to job site in the manufacturer's original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacturer.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg. F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing.
2. Keep storage area neat and orderly.
3. Remove oily rags and waste daily.
4. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.7 PROJECT CONDITIONS

A. Apply water-base paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F. (10 degrees C) and 90 degrees F. (32 degrees C), unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperature are between 45 degrees F. (7 degrees C) and 95 degrees F. (35 degrees C), unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist or when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces; unless otherwise permitted by paint manufacturer's printed instructions.

1. Painting may be continued during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.

1. Quantity:

a. Furnish the Owner with an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:

1. Even though many manufacturers are listed in each "Paint System" category, it is the intent of this specification that all paint materials be part of a single system supplied by one manufacturer.
2. In the list which follows, the word or phrase in parenthesis after each name is the designation by which the particular manufacturer will be referred to:

a. Benjamin Moore & Co. (Moore).
b. Glidden Pro.
c. PPG Industries, Inc. (PPG).
d. The Sherwin-Williams Company (S-W).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility:

1. Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality:

1. Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Trade Names:

1. Where the trade name or other designation of a product of a named manufacturer has been changed by the manufacturer from that specified, submit a statement giving the specified identification and the new identification for the same product.

D. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.

E. Colors:

1. Provide colors as indicated in “Finish Material List” on the Drawings, or, if not indicated, as selected by the Architect from the manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General:

1. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
2. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
3. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work:

1. Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
2. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General:

1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
2. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning:

1. Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
2. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation:

1. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
2. Provide barrier coats over incompatible primers or remove and reprime.

3. Gypsum Board Surfaces:

a. Surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material.

4. Ferrous Metals:

a. Clean un-galvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

5. Galvanized Surfaces:

a. Clean galvanized surfaces with non-petroleum based solvent so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials Preparation:

1. Mix and prepare painting materials according to manufacturer's written instructions.
2. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
3. Stir materials before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material: remove surface film and strain material before using.
4. Use only thinners approved by the paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General:

1. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
2. Paint colors, surface treatments, and finishes are indicated in the "Finish and Color Schedules".
3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
4. Omit field prime painting on items that are factory prime painted, unless otherwise shown. Touch-up damaged factory prime painted finish acceptable to receive subsequent field finishing.
5. Provide finish coats that are compatible with primers used.
6. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
7. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
8. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
9. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
10. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
11. Labeling of Rated and Non-Rated Walls: Wall rating designations shall be painted on fire-rated, smoke-tight and sound attenuating walls above the finished ceiling. Size and spacing shall be as indicated below. Coordinate with Architect.

    a. All partitions, tht extend to the structure above, are to receive labeling 6” above the ceiling line or at 8’-6” above the floor where no ceilings are scheduled.
    b. Labeling is to occur at all rooms, corridors, etc., and in all accessible spaces, including elevator hoistways.
    c. At shafts, every wall shall be labeled at 8’-6” above each floor line.
    d. Labeling is to occur at a maximum of 15’-0” on center and not less than one location per run of wall, between corners and changes in direction and/or type.

e. Where multiple construction types occur in a single run of wall such as the corridor side of a corridor wall, a 2" wide full height painted vertical line shall be provided to note changes in wall.

f. Labeling shall be in 2" high, stenciled characters in orange fluorescent paint. Manufactured labels are an acceptable alternative. The text for various type of construction shall be as listed below.

1) TWO-HOUR FIRE
2) ONE-HOUR FIRE
3) SMOKE BARRIER
4) SMOKE TIGHT – NON-RATED
5) SOUND – NON-RATED
6) NON-RATED
7) LEAD-LINED TO 7'-0" AFF (above finished floor).
8) LEAD-LINED TO DECK ABOVE

B. Scheduling Painting:

1. Surface preparation, priming and finish coats specified in this Section are in addition to surface preparation and shop priming specified in other sections, when such shop work for surface preparation is inadequate, when primer is incompatible with field finish, when touch-up is not provided, and for other similar conditions when surface finish is not acceptable to the painter.
2. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
3. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
4. Omit primer on metal surfaces that have been shop primed and touchup painted with primer compatible with Work of this Section.
5. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
6. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures:

1. Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
2. Brushes:

a. Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.

3. Rollers:

a. Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

4. Spray Equipment:

a. Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
b. Where the metalllic finish occurs, products must be sprayed using HVLP or conventional equipment.

D. Minimum Coating Thickness:

1. Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Prime Coats:

1. Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished, and has not been prime coated by others.
2. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

F. Pigmented (Opaque) Finishes:

1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

G. Completed Work:

1. Match approved samples for color, sheen and coverage. Remove, refinish or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedures at any time, and as often as the Owner deems necessary during period when paint is being applied.

B. The Owner may engage the services of an independent testing laboratory to sample the paint material being used. Samples of materials delivered to Project will be taken, identified, sealed, and certified in presence of Contractor.

C. Testing laboratory may perform appropriate tests for any or all of following characteristics:

1. Quantitive materials analysis.
2. Abrasion resistance.
3. Apparent reflectivity.
4. Flexibility.
5. Washability.
6. Absorption.
7. Accelerated weathering.
8. Dry opacity.
9. Accelerated yellowness.
10. Recoating.
11. Skinning.
12. Color retention.
13. Alkali resistance.

D. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.5 INSTALLATION OF WARNING SIGNS

A. Locate warning signs every twenty feet horizontally within the ceiling space on each side of smoke barriers, horizontal exit enclosures and fire rated partitions. Apply signs by peel and stick methods, level and fully adhered to wall surfaces.

3.6 CLEANING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.7 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting as acceptable by the Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.8 EXTERIOR PAINT SYSTEMS

A. General:

1. Provide the following paint systems for the various substrates, as indicated.

B. Ferrous Metal:

1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).

Glidden Pro:	Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish 4020-XXXX.
Moore:	P06 Super Spec HP Alkyd Metal Primer.
PPG:	6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.
S-W:	Pro-Cryl Universal Primer B66-310 Series.

b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).

Glidden Pro:	Devoe Coatings Devflex 4216HP Waterborne Acrylic Semi-Gloss Finish 4216-XXXXL.
Moore:	MoorGlo Latex House & Trim Paint #096.
PPG:	6-900 Series Speedhide Exterior Semi-Gloss Acrylic Latex House & Trim Paint.
S-W:	Sher-Cryl HPA High Performance Acrylic Semi-Gloss B66-350 Series.

C. Zinc-Coated Metal:

1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a galvanized metal primer.

a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

Glidden Pro:	Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish 4020-XXXX.
Moore:	P04 Super Spec HP Acrylic Metal Primer.
PPG:	90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
S-W:	DTM Acrylic Primer/Finish B66W1.

b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).

Glidden Pro:	Devoe Coatings Devflex 4216HP Waterborne Acrylic Semi-Gloss Finish 4216-XXXXL.
Moore:	MoorGlo Latex House & Trim Paint #096.
PPG:	90 Line Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels.
S-W:	DTM Acrylic Semi-Gloss B66W201.

3.9 INTERIOR PAINT SYSTEMS

A. General: Provide the following paint systems for the various substrates, as indicated.

B. Concrete Masonry Units:

1. Flat Acrylic Finish: 2 finish coats over a block filler.

a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils (0.13 mm).

Glidden Pro:	Concrete Coatings Block Filler Interior/Exterior Primer 3010-1200.
Moore:	160 Super Spec Latex Block Filler.
PPG:	6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.
S-W:	Heavy Duty Block Filler B42W46.

b. First and Second Coats: Flat, latex-based, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.5 mils (0.064 mm).

Glidden Pro:	Ultra-Hide 250 Flat Interior Paint 1200-XXXXN Series.
Moore:	275 Super Spec Latex Flat.
PPG:	6-70 Series Speedhide Interior Flat Latex Paint.
S-W:	ProMar 200 Zero VOC Interior Latex Flat B30-2600 Series

2. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a block filler.

a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils (0.13 mm).

Glidden Pro:	Concrete Coatings Block Filler Interior/Exterior Primer 3010-1200.
Moore:	160 Super Spec Latex Block Filler.
PPG:	6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.
S-W:	Heavy Duty Block Filler B42W46.

b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).

Glidden Pro:	Ultra-Hide 250 Interior Eggshell Paint 1402-XXXXN Series.
Moore:	274 Super Spec Latex Eggshell.
PPG:	6-411 Series Speedhide Eggshell Latex Wall and Trim Enamel.
S-W:	ProMar 200 Zero VOC Interior Latex Eg-Shel B20-2600 Series

3. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a block filler.

a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils (0.13 mm).

Glidden Pro:	Concrete Coatings Block Filler Interior/Exterior Primer 3010-1200.
Moore:	160 Super Spec Latex Block Filler.
PPG:	6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.

S-W: Heavy Duty Block Filler B42W46.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).

Glidden Pro:	Ultra-Hide 250 Interior Semi-Gloss Paint 1406-XXXXN Series.
Moore:	276 Super Spec Latex SemiGloss.
PPG:	6-500 Series Speedhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex.
S-W:	ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series

C. Gypsum Drywall Systems:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.

a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

Glidden Pro:	High Hide Interior Primer Sealer 1000-1200.
Moore:	253-00 Super Spec Latex Enamel Undercoater Primer Sealer.
PPG:	6-2 Series Speedhide Interior Latex Primer-Sealer.
S-W:	ProGreen 200 Interior Latex Primer B28W600

b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).

Glidden Pro:	Ultra-Hide 250 Interior Eggshell Paint 1402-XXXXN Series.
Moore:	274 Super Spec Latex Eggshell.
PPG:	6-411 Series Speedhide Eggshell Latex Wall and Trim Enamel.
S-W:	ProGreen 200 Interior Latex Eg-Shel B20-600 Series

2. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.

a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

Glidden Pro:	High Hide Interior Primer Sealer 1000-1200.
Moore:	253-00 Super Spec Latex Enamel Undercoater Primer Sealer.
PPG:	6-2 Series Speedhide Interior Latex Primer-Sealer.
S-W:	ProGreen 200 Interior Latex Primer B28W600

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).

Glidden Pro:	Ultra-Hide 250 Interior Semi-Gloss Paint 1406-XXXXN Series.
Moore:	276 Super Spec Latex SemiGloss.
PPG:	6-500 Series Speedhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex.
S-W:	ProGreen 200 Interior Latex Semi-Gloss B31-600 Series

D. Ferrous Metal:

1. Semigloss, Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils (0.038 mm).

Glidden Pro:	Devoe Coatings Devguard 4360 Loxw VOC Universal Metal Primer 4360-XXXX.
Moore:	P064 Super Spec HP Acrylic Metal Primer.
PPG:	6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.
S-W:	Pro-Cryl Universal Primer B66-310 Series.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).

Glidden Pro:	Ultra-Hide 250 Interior Semi-Gloss Paint 1406-XXXXN Series.
Moore:	276 Super Spec Latex SemiGloss.
PPG:	6-500 Series Speedhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex.
S-W:	ProClassic Waterborne Acrylic Semi-Gloss B31 Series

E. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:

1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.

a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

Glidden Pro:	Devoe Coatings Devflex 4020PF Direct to Metal Primer & Flat Finish 4020-XXXX.
Moore:	P04 Super Spec HP Acrylic Metal Primer.
PPG:	90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
S-W:	Pro-Cryl Universal Primer B66-310 Series.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).

Glidden Pro:	Ultra-Hide 250 Interior Semi-Gloss Paint 1406-XXXXN Series.
Moore:	276 Super Spec Latex SemiGloss.
PPG:	6-500 Series Speedhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex.
S-W:	ProClassic Waterborne Acrylic Semi-Gloss B31 Series

END OF SECTION
CL

SECTION 134950 - RADIO FREQUENCY, MAGNETIC AND ACOUSTICAL SHIELDING FOR MRI IMAGING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All work under this section is subject to the Contract Documents and the contractor shall be responsible for and governed by all the requirements there under.

1.2 SUMMARY

A. Structurally engineer, design, provide, and test 6 sided radio frequency shielded enclosure, with shielding constructed of S81 galvanized steel as **Basis of Design**; and provide copper shield as **Alternate**, for the MRI Exam Room, involving, but not limited to pneumatic door system, window assemblies, filter panels, and waveguides. Structurally engineer, design and provide and test magnetic shielding that is integrated with the RF shielding that meets the requirements of the MRI magnet supplier. Structurally engineer, design and provide acoustical shielding that is integrated with the RF shielding that meets the requirements of the MRI magnet supplier and those stated in this Section.

B. Coordination

1. Coordinate Work with MRI magnet supplier's drawings, furnished with drawing set.
2. Refer to construction documents for utility penetrations of the shielding.
3. Items furnished by this Section for installation into the work of other sections shall be furnished sufficiently in advance for proper installation.
4. Perform work for this section in proper sequence with the work of other sections and trades and in strict conformance with approved shop drawings.
5. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades that interface with work of this section.

C. Related sections

1. Division 1 - Construction Facilities and Temporary Controls: Heating of installation area to minimum of 68 degrees for a period of 24 hours prior to, and during enclosure installation.
2. Division 3: Concrete slab substrate, level within 1/4 inch in any 10 foot section, cured for minimum 7 days prior to start of enclosure installation. Maximum allowable water vapor transmission through the substrate determined to receive epoxy coatings is 3 lbs. per ASTM F-1869.
3. Division 5: Structural steel. Provide all structural steel supports for the attachment of the specified MR shielding systems.

4. Division 6 Section – “Rough Carpentry” for fire-retardant treated wood framed construction in conjunction with the MRI Room.
5. Division 7: Properly weatherproof entire area in which shielded enclosure will be installed. Protect MRI Exam Room from moisture, standing water, and running water prior to, during, and following enclosure installation to ensure enclosure integrity and specified earth ground isolation.
6. Division 9 Section – “Gypsum Board” for gypsum board construction in conjunction with the MRI Room
7. Division 9 Section – “Painting”: Field painting, either internal or external to enclosure.
8. Division 9: Finish Work enveloping shielded enclosure, or preparing surfaces to receive shielded enclosure.
9. Division 10: Unistrut or other suitable RF shield ceiling supports placed on minimum 4'-0" centers, in plane, and secured directly to the buildings structure a minimum of 6” above the exterior roof of the shielded enclosure.
10. Division 23: Connections of ductwork to or from the installed wave-guide shielded air vents as indicated on drawings.
11. Division 21/22: Dielectric connection to the exterior side of each mechanical pipe penetration of a suitable material to maintain a minimum of 1,000 ohms DC resistance to earth ground, construct of material suitable to conditions of service on which it is installed as indicated on drawings.
12. Division 21/22: Pipe connections to or from the installed wave-guide beyond cutoff pipe penetration as indicated on drawings.
13. Divisions 21-28: Special filtering, other than that specified within this section, either mechanical or electrical, related specifically to the installation of the MRI imaging system as indicated on drawings.
14. Division 26: Electrical connection to the installed power and/or signal filters, either internally or externally to the RF enclosure as indicated on drawings.

D. Design, provide, and test an MRI rated radio frequency and/or magnetic shielded enclosure.

E. Coordinate the design of the shielded enclosure with current architectural and M.E.P. construction documents and the MR manufacturer’s drawings. Conflicts between the documents are to be resolved by the customer’s agent.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. The installed radio frequency and integrated magnetic and acoustical shielding enclosure shall be designed for a Time Medical Systems Pica Whole Body MRI System. See Time Medical Systems installation planning document for radio frequency and magnetic shielding requirements.

B. The function of RF construction is to permit an interference free environment within the RF enclosure, with a single ground point using industry standard construction techniques. Shielding vendor shall be responsible for providing and installing RF shield ground.

1. For this purpose the interference free environment must meet these minimum functional requirements.

a. Attenuation to Magnet Field: As required by MRI magnet supplier.
b. Attenuation to Electric Field: As required by MRI magnet supplier.
c. Attenuation to Plane Waves: As required by MRI magnet supplier.
d. Attenuation of airborne sound: As required by MRI magnet supplier and as stated in this Section.
e. The RF enclosure must be constructed with a minimum resistance from the RF shield to building ground of 1,000 ohms.

1.4 SUBMITTALS

A. Shop Drawings: Include typical floor plan of space, enclosure elevations, typical construction, sections, and locations of all shield penetrations including RF filter and wave guide penetrations.

1. Provide details of shielding doors, frames, and window assemblies, including anchorage to and coordinate with other work. Provide locations of electrical conduit and boxes for connecting door switches. Show all wall sections and materials for RF shielding with integral magnetic and acoustical shielding.
2. Provide location of single point RF shield ground. Provide location of pneumatic door pump and electrical requirements, if applicable.
3. Provide wiring diagrams, door switch specification and electrical conduit and junction box sizes.

B. Test Reports (Before and After Completion)

1. RF Qualification and Acceptance Test
2. Acoustical Shielding Qualification and Acceptance Test
3. Magnetic Shielding Qualification and Acceptance Test
4. Ground Isolation monitoring Test before and after utility connections.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain radio frequency, magnetic and acoustical shielding product through one source.

B. Preinstallation Construction Team Conference: Conduct a construction team conference at Project Site. Review methods and procedures related to radiation protection including, but not limited to, the following:

1. Sequence and schedule of RF, magnetic and acoustical shielding work in relation to other work.
2. Supplementary shielding at duct, pipe, and conduit penetrations of RF, magnetic and acoustical shielding.
3. Methods of attaching other construction and equipment to radio frequency shielding, including penetration panel.
4. Notification procedures for work that requires modifying radio frequency shielding.

5. Review and coordination of construction criteria for concrete floor, perimeter wall, overhead construction and building mechanical and electrical work with respect to the work of this Section.
6. Coordinate schedule for test and approval of RF, magnetic and acoustical shielding before and after completion of project.

C. Use of Dissimilar Metals

1. The use of dissimilar metals shall not be allowed.

    a. RF shielding medium shall display an anodic voltage differential index of less than 0.40 volts and a cathodic group number of 1 (0.00 volts) to 9 (0.40 volts).
    b. Construct shielding system with proper materials so that ionic conduction across joints and RF seams shall be less than 0.10 volts.

1.6 REFERENCES

A. The standards of the issue listed below form a part of this specification. Standards are referred in the text by basic reference only.

B. Standards:

1. MIL-STD-220-A – Method of Insertion Loss Measurements for Radio Frequency Power Line Filters.
2. MIL-STD-285 - (as modified for MRI Testing) Methods of Attenuation Measurements for Electromagnetic Shielding Enclosures for Electrical Test Purposes.
3. NSA 65-6-RF – Shielded Enclosures for Communication Equipment: General Specifications.
4. FS-SS-A-118B – Flame Resistance Test.
5. ASTM E-84-81A – Test for Surface Burning Characteristics of Building Materials.
6. UL 1283 – Standard for Safety Electromagnetic Interference Filters.
7. ASTM E-90-83 – Recommended Practice for Laboratory Measurements of airborne Sound Transmission Loss of Building Partitions.
8. ASTM E-413-73 – Standard Classification for Determination of Sound Transmission Class.
9. DIN 45645 – Determining Noise Rating Levels From Measured Data- Part 1: Environmental Noise.
10. IEEE-299 - (as modified for MRI testing) Methods of Attenuation Measurements for Electromagnetic Shielding Enclosures for Electrical Test Purposes.
11. ASTM Standards: E84-01 – surface burning characteristics
12. ASTM F-1869
13. ASTM E90/E413 – acoustic performance

1.7 WARRANTY

A. Warrant the system to be free of defects in materials and workmanship as evidenced by retention of specified RF, magnetic and acoustical shielding characteristics for periods as follows:

1. Basic RF Enclosure: Five (5) years from date of Substantial Completion.
2. Magnetic Shield: Five (5) years from date of Substantial Completion.
3. Acoustical Shield: Five (5) years from date of Substantial Completion.
4. EMI Electrical Filters, RF Shielded Doors, RF Shielded Windows, Pipe Penetrations, and Air Vent Wave Guides and RF filters: Five (5) years from date of Substantial Completion.

B. Pass-through warranties provided by subcontractors to manufacturer shall not be allowed.

1.8 DEFINITIONS

A. RF = Radio Frequency

B. Enclosure = Entire integrated RF, magnetic and acoustical shield.

C. MRI = Magnetic Resonance Imaging

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide RF shield with integral magnetic and acoustical shield system by one of the following:

1. Lindgren RF Enclosures, Inc., 400 High Grove Blvd., Glendale Heights, IL 60139, (630) 307-7200, Attention: Eric Kaad. Website: www.ets-lindgrenrf.com
2. IMEDCO America Ltd., 1730 E. Pleasant Street, Noblesville, IN 46060 317-773-8500, Attention: Mike Krachon, mikek@imedco.net

2.2 RADIO FREQUENCY (RF) SHIELDING

A. Radio Frequency (RF) Shield: Design and engineer a free-standing, S81 galvanized steel (BOD) or copper (Alternate) RF shield (floor, ceiling and four walls).

1. Provide manufacturer's standard system meeting the performance requirements of the MRI magnet supplier as shown on the referenced Drawings.
2. See Drawings for basis of design typical wall section.

B. Radio Frequency (RF) Shielded Hinged Door: The RF shielded doors shall provide full RF integrity while presenting the appearance of a conventional door. Doors shall be provided as a complete assembly with frame and all required hardware.

1. RF Performance of Door: Provide a proven RF pneumatic seal design that is easily maintained and serviced. The RF door leaf, frame and seal assembly shall maintain a shielding effectiveness equal to that of shielded enclosure.
2. Door Construction: Wood veneer faces over manufacturer's RF shielded core and with upgraded acoustical properties. Wood veneer finish as designated on Finish Schedule. Reference Division 8 Section "Flush Wood Doors" for additional construction requirements.
3. Door RF seal shall be of pneumatic design as standard with manufacturer. Copper finger design can be Bid, but vendor must include sectional detail and drawings to demonstrate that copper fingers are protected and easily replaceable. Pneumatic door seal shall have continuous shielding strip and operate from the shielding vendor's supplied/installed pneumatic pump, controls and push button actuators.
4. See Construction Documents for location and quantity of hinged doors.

    a. Provide two (2) push button actuators per each pneumatic door, one inside MRI Room, one on opposite side of door.

5. Door Operation: Door shall be opened or closed with a force less than 22.5 lbs.
6. Hardware: Provide manufacturer's standard hinges, latch with push/pull handle, closer and smooth transition threshold. Provide keyed deadbolt lock.

    a. Hinges and lock/latch hardware shall have a US32D satin stainless steel finish.

C. Radio Frequency (RF) Shielded Window Assemblies: Provide factory assembled RF shielded window assemblies of sizes and locations as indicated on Drawings. The shielding effectiveness of the RF shield shall not be degraded by the window assembly.

1. RF Shielded window assembly shall consist of a window frame, two layers of RF shielding conductive mesh material and two pieces of ¼ inch thick glass.
2. Provide upgraded acoustical properties of the RF shielded window assembly.
3. Transparency of window as required by MRI magnet supplier.
4. Attenuation Factor as required by MRI magnet supplier.
5. Exterior Window Assembly (, if applicable): Window assembly shall meet the required shielding requirements as specified. Based on field verification, the window assembly shall:

    a. Match the existing window assembly that it is replacing in size, configuration, appearance and finish.
    b. Match the existing window assembly that it is replacing in energy performance.

D. Radio Frequency (RF) Shielded Floor: Provide all necessary elements, less final finish flooring.

1. Survey concrete floor slab for flatness/levelness to within 1/16 inch over the foot print of the magnet system. Remedy conditions found outside this range prior to floor shielding installation.
2. Provide shielded floor system capable of complying with magnet and Patient Imaging Table requirements as identified by MRI magnet supplier. Provide all necessary elements, less final finish flooring. Entire RF shield floor assembly shall not exceed 1" thickness. Provide system floor for existing slab (non-recessed).

E. Radio Frequency (RF) Shielded Accessories:

1. Power Line and Signal Electrical Filters: Shall provide an attenuation which is satisfactory for the intended application. Electrical conductors shall pass through RF filters which are an integral part of the RF shield. Provide a RF filter for each electrical conductor that penetrates the enclosure, including neutral conductors. UL ratings will be required on all power line conductors.
2. Waveguide Safety Air Vents: Waveguide below cutoff type, size as required by MRI magnet supplier. Construct air vent waveguide of suitable material and of size and length to maintain shielding effectiveness equal to that of shielded enclosure. This safety air vent shall prevent the build up of air pressure inside the MRI exam room during the event of a cryogen leak. Hex cell type waveguides are not acceptable.
3. Feed Thru connector Assemblies: Shall be coaxial feed thru connectors which shall be mounted to removable service panels. Set up panels to conform to the requirements of the MRI magnet supplier. Feed thru service panels shall be easily accessible to MRI control room staff. Provide two 4" I.D. feed through connectors under control room countertop to MRI procedure room. Provide additional feed thru connectors as shown on construction documents.
4. Mechanical Penetrations: Shall be RF shielded waveguide below cutoff type nonferrous pipe penetrations for all piping entering the shielded enclosure. Construct pipe penetrations of a material suitable to conditions of service on which it is installed, and to maintain shielding effectiveness equal to that of the shielded enclosure.
5. Grounding: Provide single point ground. Locate ground terminal as close as possible to MRI penetration panel and power line filters. Shielding vendor shall be responsible for providing and installing single point ground.

    a. Equipment Grounds: Provide grounding for superconducting magnet and RF front end shall be as required by MRI magnet supplier.

6. See MRI vendor site specific drawings and Architectural and Engineering Construction Documents for required location and quantity of RF filters and waveguide. RF filters and waveguides provided and installed shall be included but are not limited to the following:

    a. One spare feed through aperture for future RF filters and waveguides 24" x 30" between equipment room and MRI procedure room.
    b. One spare feed through aperture for future RF filters and waveguides 24" x 30" between control room and MRI procedure room.
    c. One waveguide for fiber optic control cable between control room and MRI procedure room. Coordinate for above ceiling installation

d. One spare feed through aperture for future use. Provide filter panel approximately 24" x 24". Coordinate exact requirements with MRI vendor installation specialist.
e. RF filters for lighting, and receptacle power.
f. Low voltage RF filters for hospital IT network outlets and DC lighting.
g. Waveguides for medical gas piping, fire protection piping, room supply and return air ducts and others, including items in MRI vendor site specific drawings.

7. Provide a Unit Price for all RF filters, waveguides, feed through apertures and feed through connectors.
8. Provide breakdown RF wall panel(s) for installation of magnet equipment and future renewal. Coordinate with Construction Manager, installation of all hardware and devices to accommodate clear area for easy installation and removal of MRI magnet in the future. See Construction Documents and MRI vendor site specific drawings for exact location and size.

2.3 ACOUSTICAL SHIELDING

A. Acoustical Issues: Shielding manufacturer to demonstrate the knowledge and ability to effectively reduce airborne sound transmissions produced from the MRI system to ancillary areas around the magnet suite. In addition, the following criterion shall be met:

1. The acoustical shielding provided and installed shall attenuate the maximum noise level produced by MRI magnet so that the maximum time averaged sound pressure level (LAF,r) is below 35 dB(A) in all rooms, corridors and spaces directly adjacent to the MRI exam room. Maximum time averaged sound pressure levels shall be in compliance with DIN 45645 standards for determining noise level ratings from measured data in adjacent spaces. Confirm with the Owner that the dB (A) levels specified in this Section are acceptable to the clinical staff that will be working in the spaces adjacent to the MRI exam room.
2. Provide documentation of testing performed in accordance with ASTM E90/E413 by a third party testing laboratory.
3. The perimeter parent wall system shall provide a minimum STC53 without openings. The RF wall and ceiling panel system shall be capable of providing an additional 7db to 10db of ancillary sound reduction dependent upon the type of interior wall construction indicated. The combined performance of the parent shell wall, the RF shield panel system, and the interior finished wall and ceiling shall provide at a minimum STC60 sound transmission loss.
4. The RF door system shall provide a minimum ASTM – STC42 rating.
5. The RF window system shall provide a minimum ASTM - STC40 rating.

2.4 MAGNETIC SHIELDING

A. Provide magnetic shielding if required and as specified in the MRI vendor site planning documentation for this project.

B. Steel type, locations, and thickness shall match MRI vendor site planning documentation for this project.

C. Provide and install all hardware necessary to securely fasten steel plates to building structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive RF, magnetic and acoustic shielding for compliance with requirements, installation tolerances, and other conditions affecting performance of the RF, magnetic and acoustical shielding.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. RF, Magnetic and Acoustic shielding shall be continuous with tight seams. Where other work, materials or accessories penetrate the shielding, install shielding patches or sleeves to provide continuity of the shielding.

B. Installation of the shielding shall be by manufacturer's certified technicians.

C. All panels shall be installed in a straight line with true, level, plumb and even surfaces. Align and secure joints.

D. At completion of installation, provide identification of magnet isocenter location.

3.3 TESTING

A. Test RF enclosure in accordance with MIL-STD-285, as modified for MRI system installation.

B. Qualification Testing of RF enclosure: Perform immediately after completion of the RF enclosure and prior to installation of architectural surfaces within or outside the enclosure. Make no trade connections to RF enclosure until successful completion of test process. Demonstrate the required attenuation as specified by MRI magnet supplier.

1. Testing will be witnessed by a representative of the Owner, and by the MRI magnet supplier.
2. Furnish a written test report to the Owner and Architect.

C. Acceptance Testing of RF enclosure: Perform immediately after installation of the MRI cryostat and closure of the RF entrance panel. Demonstrate the required attenuation as specified by MRI magnet supplier.

1. Testing will be witnessed by a Representative of the Owner, and by the MRI magnet supplier.
2. Furnish a written test report to the Owner and Architect.

D. Qualification Testing of Acoustic and Magnetic Shielding: Perform immediately after completion of the shielding and prior to installation of architectural surfaces within or outside the shielding. Demonstrate the required attenuation as specified by MRI magnet supplier and this Section.

1. Testing will be witnessed by a Representative of the Owner, and by the MRI magnet supplier.
2. Furnish a written test report to the Owner and Architect.

E. Acceptance Testing of Acoustic and Magnetic Shielding: Perform immediately after installation of the MRI cryostat. Demonstrate the required attenuation as specified by MRI magnet supplier and this Section.

1. Testing will be witnessed by a Representative of the Owner, and by the MRI magnet supplier.
2. Furnish a written test report to the Owner and Architect.

F. Ground Isolation Monitoring: Utilize a ground alert system (audio and visual) to monitor ground isolation continuously during entire phase of construction for a minimum of 1000 ohms above earth potential. Immediately correct deficiencies found that are the result of a fault condition caused by the enclosure supplier. Immediately report deficiencies found to be caused by other trades and advise what actions should be taken to rectify the ground condition.

1. Correct deficiencies in or remove and replace RF shielding systems that test reports indicate does not comply with specified requirements.
2. Furnish a written test report to the Owner, Architect and MRI magnet supplier.

3.4 CLEANING

A. Exposed surfaces shall be thoroughly cleaned of all dirt, finger marks, and foreign matter resulting from handling or installation and all areas shall be left free from defects.

END OF SECTION
DWH/DB

Preliminary Site Survey Report

Record the information obtained from the first and second site survey in Part A (Site Environment Information) and Part B (Specification Information) respectively.

Part A. Site Environment Information (For the First Site Survey)

Customer Number: _____TMC-1011_____ Project Number: _____P0896068_____

Site Address: __461 Burroughs St_____ Report Date: ___30th July 2019_____

__Detroit, MI 48202, USA_____ Customer: ___Ching, Luk_____(name)

System Model: ___0.35T Pica_____ _____(signature)

Field Service Engineer: _Johnson Chong__

Site Environment Concerns

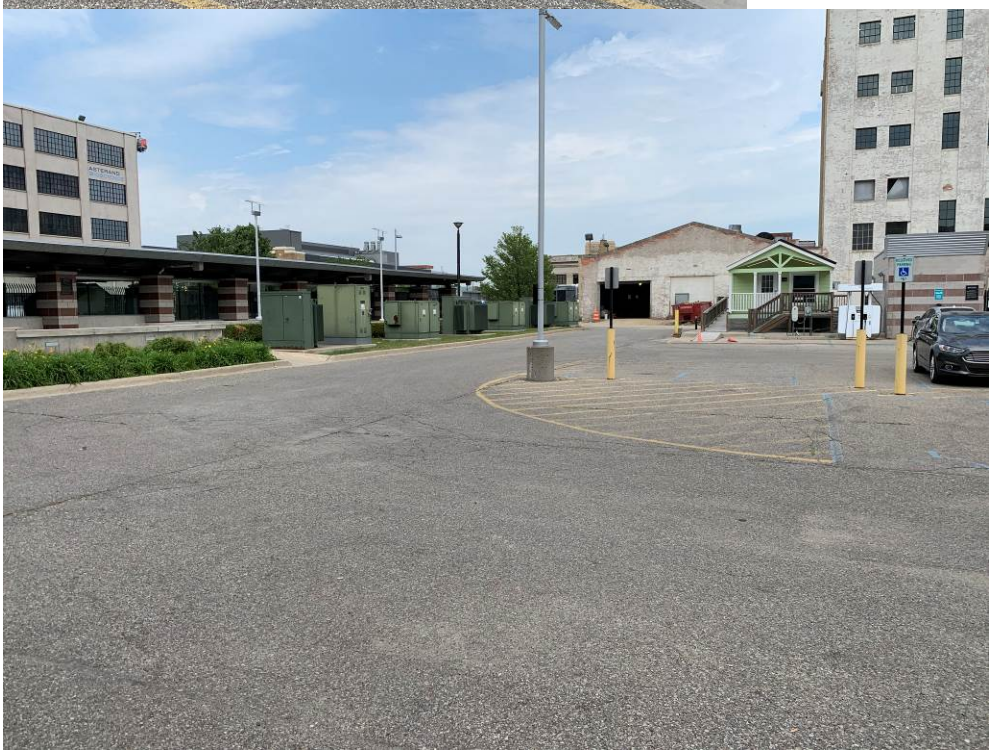
Category		Source	Exist(Y/N/TBC)	Description	Solution
EMI interference	RF	Mobile Phone	N		
		Radio Tower	N		
		Others:			
	AC 50HZ/60HZ or DC	Transformer	N		
		Power Station	N		
		Transmission Line	N		
		Fan	Y	Central air condition system at the roof (est. >20m away)	
		Compressor	Y	Central air condition system at the roof (est. >20m away)	
		Pump	N		
		Others：	/		
	Moving Metal Objects	Elevator, Escalator	N		
		Car, Minivans, Pickup Trucks, Ambulance	Y	MRI Suite next to 2nd Ave	Site testing is recommended
		Bus, Truck (Dump, Tractor, Trailer, Utility, Fire Truck)	Y	MRI Suite next to 2nd Ave	Site testing is recommended
		Railway: Train/Tram/ Subway	Y	Over 300m away from MRI suite	
		Others：	/		

EMI interference	Medical Equipment	MRI	N		
		CT	N		
		X-Ray	N		
		DR	N		
		US	N		
		PET	N		
		Others:	Y	Electric car charging stations behind the MRI suite building	Site testing is recommended
	Static Ferrous Objects	Iron Pillar	N		
		Warehouse	N		
		Others:	/		
Category		Source	Exist(Y/N/TBC)	Description	Solution
Structural Vibrations		Car Park	Y	Car Park behind the MRI suite building	Site testing is recommended
		Railway: Train/Tram/ Subway	Y	300m away from MRI suite	
		Roadway	Y	MRI Suite next to 2nd Ave	Site testing is recommended
		Others：	/		

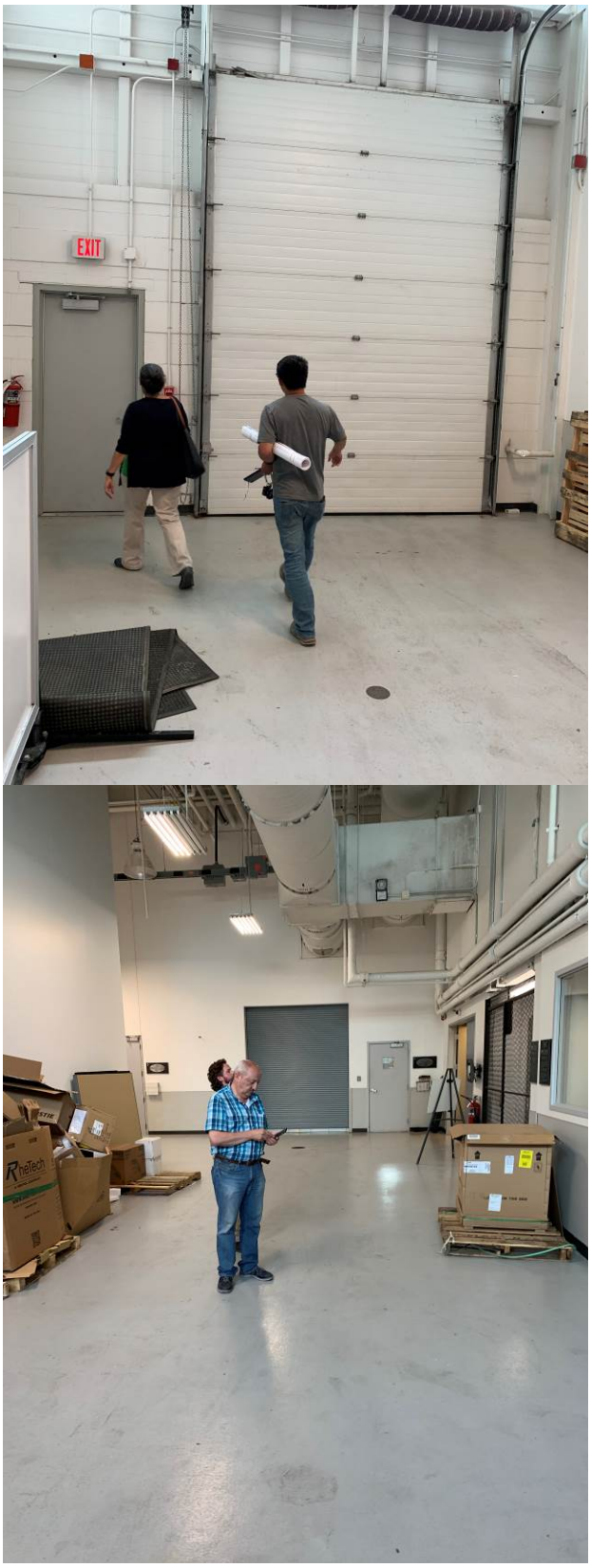
Special issue

Issue	Description

Remarks:

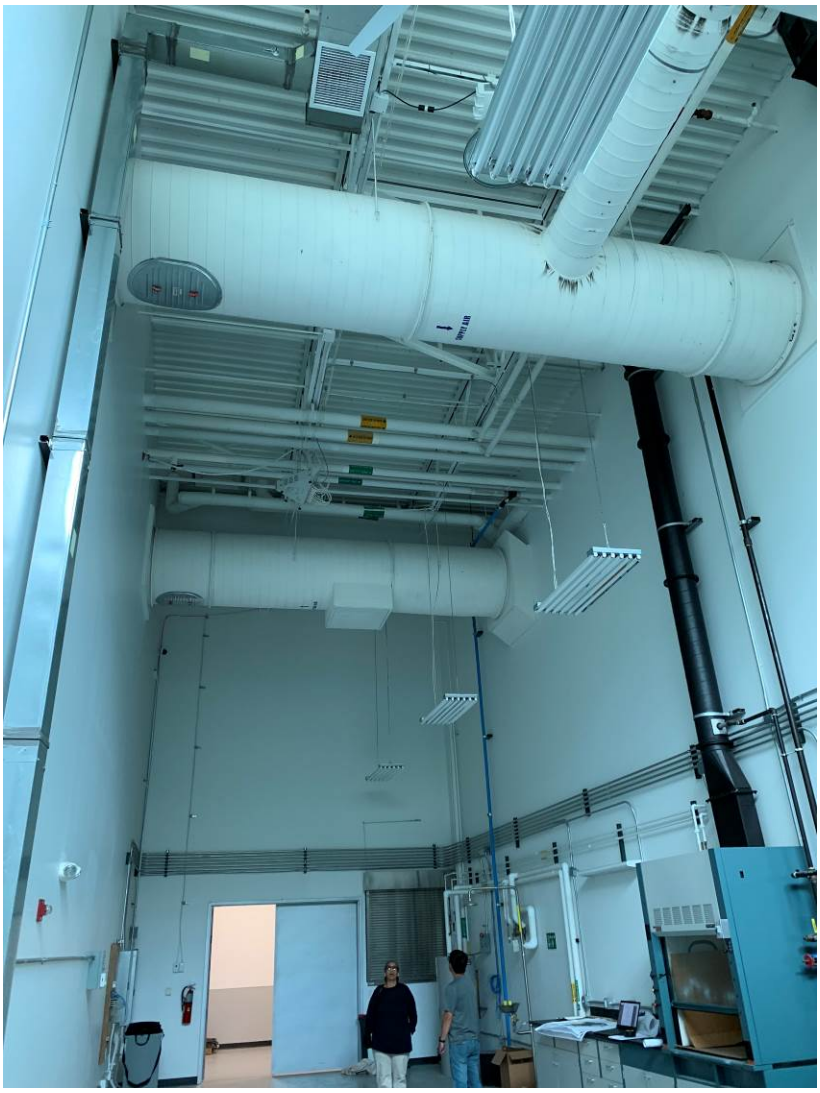


Outdoor magnet transportation path option A



Indoor magnet transportation path option A

Outdoor magnet transportation path (next to 2nd Ave) option B



MRI Suite

Charging stations at car park.

Charging stations next to the main building

Part B. Specification Information (For the Second Site Survey)
Note: Make sure Part A of the report has been completed before filling in Part B.

Customer Number: _____TMC-1011_____ Project Number: _____P0896068_____

Site Address: __461 Burroughs St_____ Report Date: ___30th July 2019_____

__Detroit, MI 48202, USA_____ Customer: ___Ching, Luk_____(name)

System Model: ___0.35T Pica_____ _____(signature)

Field Service Engineer: _Johnson Chong__

Please measure and fill in the specification information in following tables, and attach vibration graph, DC and AC fluctuation graphs in Appendix pages if available.

Structural Information

Rooms	Recommended Space (mm)			Measurement (mm)			Result	
	L	W	H	L	W	H	Pass	Fail
Shield Room	6500	4500	3000	6500	4500	3048	☑	☐
Shield Room Door	-	1200	2100	-	1250	2133.6	☑	☐
Shied Room Window	-	1500	1200	-	3048	1219.2	☑	☐
Equipment Room	3000	3000	2800	1575	4500	3048	☐	☑
Control Room	3000	4000	2500	2100	4500	3048	☑	☐
Equipment Room Door	-	900	2100		1016	2133.6	☑	☐
Control Room Door	-	900	2100	-	1250	2133.6	☑	☐

Infrastructure	Minimum Requirement / Suggested Configuration	Measurement	Result	
			Pass	Fail
Site Location	Ground floor with NO basement underneath	NO basement	☑	☐
MRI Suite Floor Loading	20kPa	TBC	☐	☐
MRI Transportation Path Floor Loading	20kPa	TBC	☐	☐
MRI Suite Floor Leveling	Better than: 5mm/3m	TBC	☐	☐

Electrical Information

Power Requirement	Minimum Requirement	Measurement	Result	
			Pass	Fail
Number of Phase	3-phase	3-phase	☑	☐
Main Voltage	380VAC/480VAC	480VAC	☑	☐
Voltage Fluctuation %	±10%, 380VAC/480VAC	TBC	☐	☐
Voltage Frequency	50Hz/60Hz	60Hz	☑	☐
Frequency Fluctuation	±1Hz, 49 - 51Hz	TBC	☐	☐

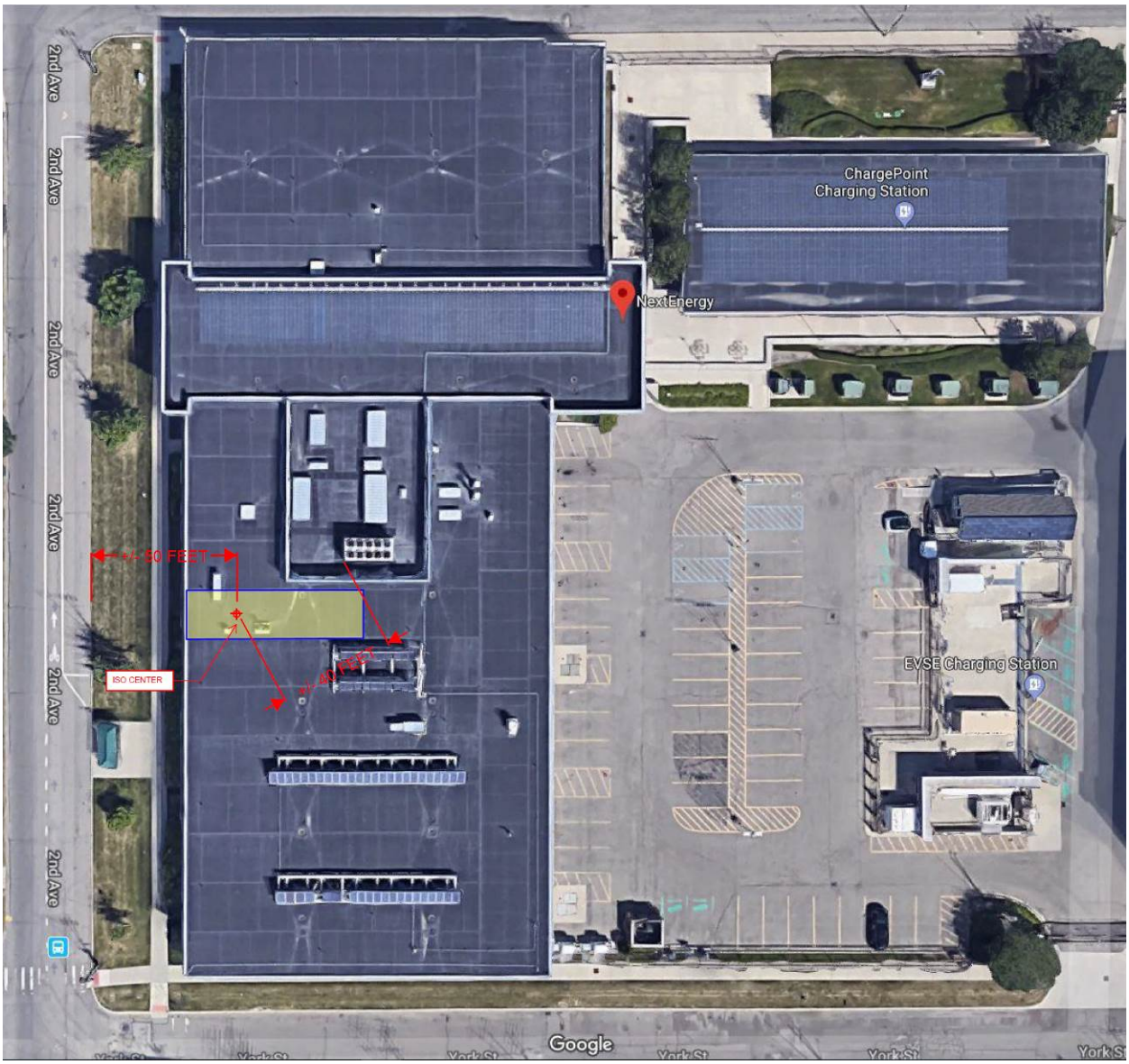
Environmental Information

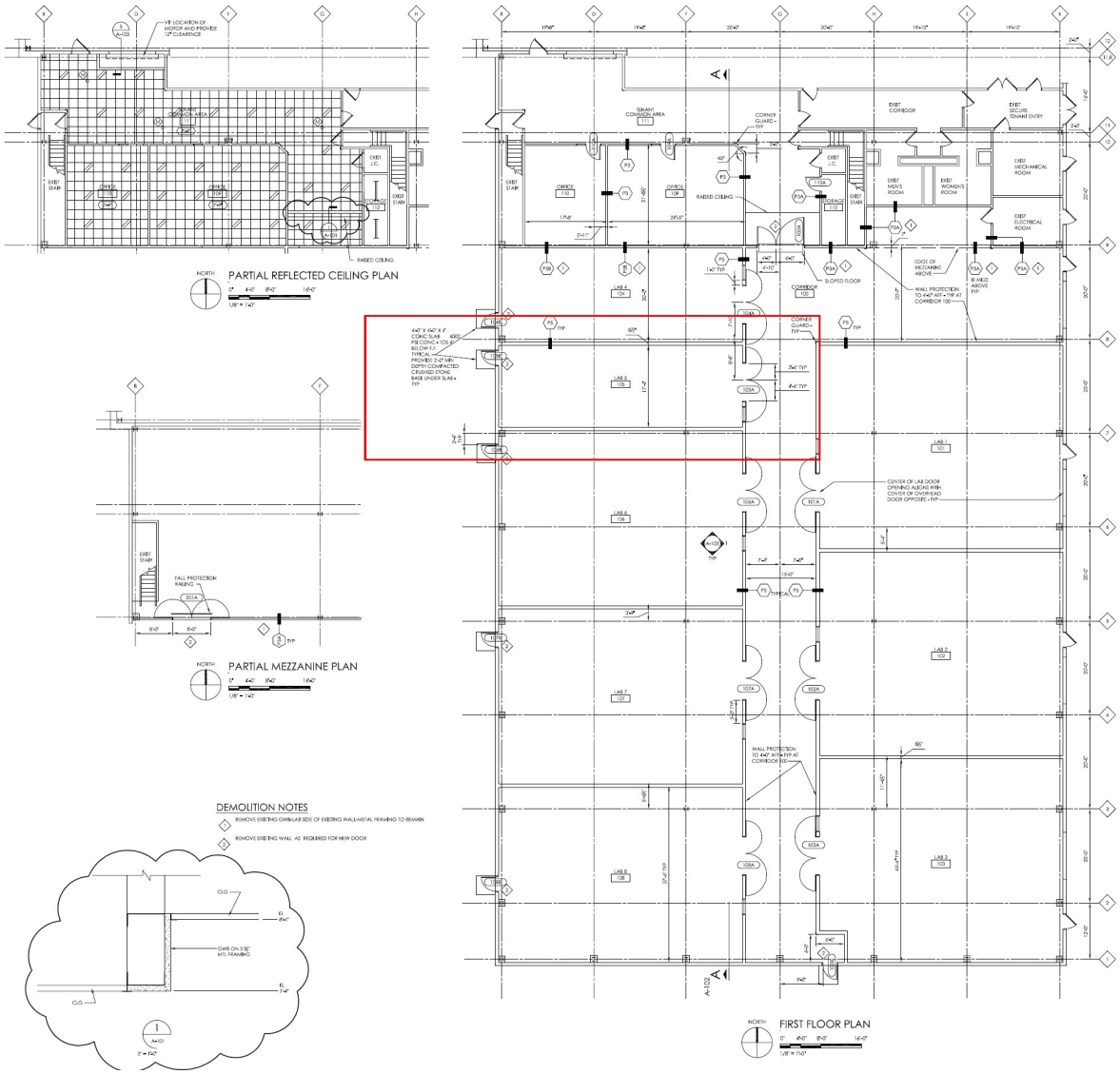
Category	Source of Interference		Area(s) affected				Distance (m)		Result	
			AC	DC	Vib	EMI	Min.	Measurement	Pass	Fail
AC 50Hz/ 60Hz or DC	Transformer		✓	X	X	X	>10	NA	☑	☐
	Transmission Line		✓	✓	X	X	>100	NA	☑	☐
	Fan		✓	X	X	X	>10	NA	☑	☐
	Compressor		✓	X	X	X	>10	NA	☑	☐
	Pump		✓	X	X	X	>10	NA	☑	☐
	Others _____							/	☐	☐
Train/ Tram/ Subway	AC 16.6Hz		✓	X	X	X	>400	300m	☐	☑
	DC		X	✓	X	X	>100	300m	☑	☐
	Others _____							/	☐	☐
Moving Metal Objects	Wt (kg)	Example								
	<50	Trolley	X	✓	X	X	>5	15m	☑	☐
	200	Patient Table	X	✓	✓	X	>7	NA	☑	☐
	900	Car, Small Elevator	X	✓	✓	X	>9	15m	☑	☐
	>4500	Truck, Large Elevator	X	✓	✓	X	>15	15m	☐	☑
	>20000	Big Truck, Excavator	X	✓	✓	X	>25	15m	☐	☑
	Others _____							/	☐	☐
Environ-mental Vibrations	Car Park		X	✓	✓	X	>10	35m	☑	☐
	Railway		X	✓	✓	X	>500	300m	☐	☑
	Roadway		X	X	✓	X	>15	15m	☐	☑
	Others _____							/	☐	☐
Medical Equipment	MRI		✓	X	X	✓	>10	NA	☑	☐
	CT		✓	X	X	✓	>10	NA	☑	☐
	X-Ray		✓	X	X	✓	>10	NA	☑	☐
	DR		✓	X	X	✓	>10	NA	☑	☐
	PET		✓	X	X	✓	>10	NA	☑	☐
	Others _____							/	☐	☐

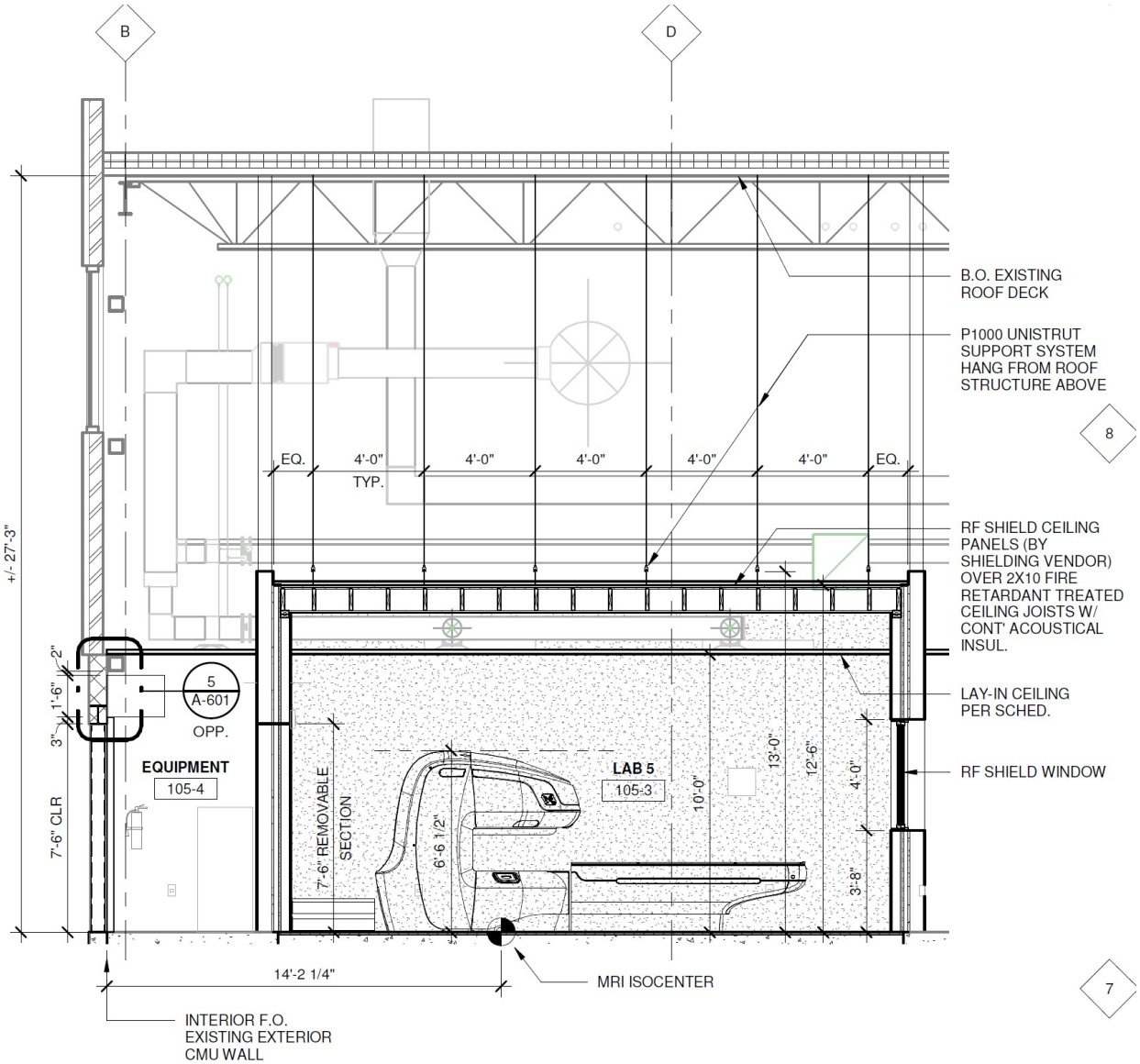
Remarks

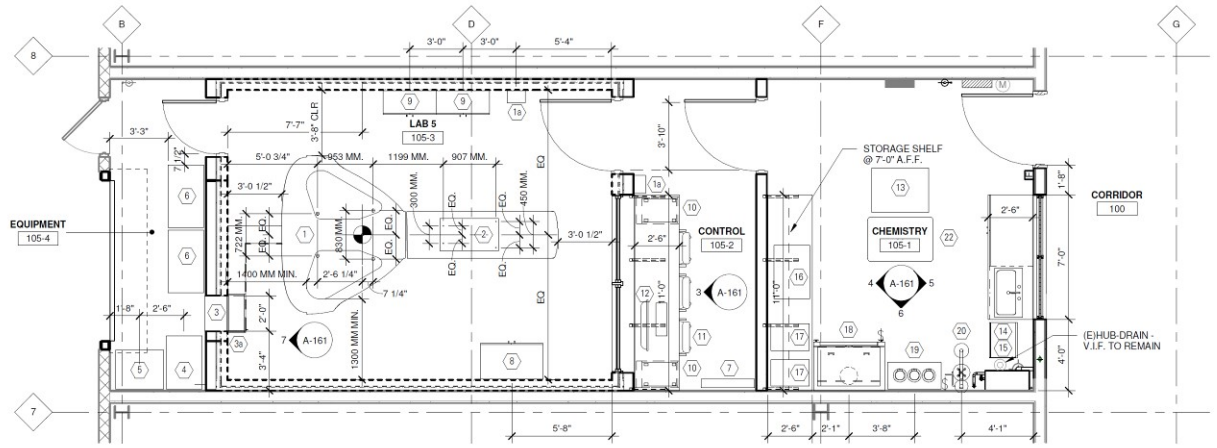
Electric car charging stations behind the MRI suite building. Another charging station building next to the main building. Possible EMI interference source. 2nd Ave is ~15M away from system ISO center, marginal for vibration interference. Site testing is recommended.

Please attach reference site photos and provide descriptions in the following areas if necessary:
1. Site location; 2. MRI suite; 3. Interior of MRI suite; 4. Areas surrounding MRI suite; 5. Power distribution room of MRI suite/site; and 6. Other relevant photos with descriptions.

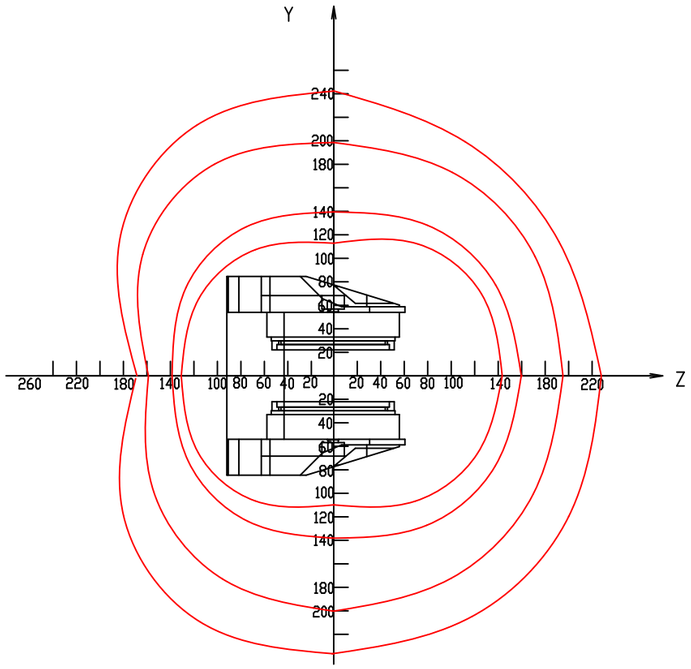


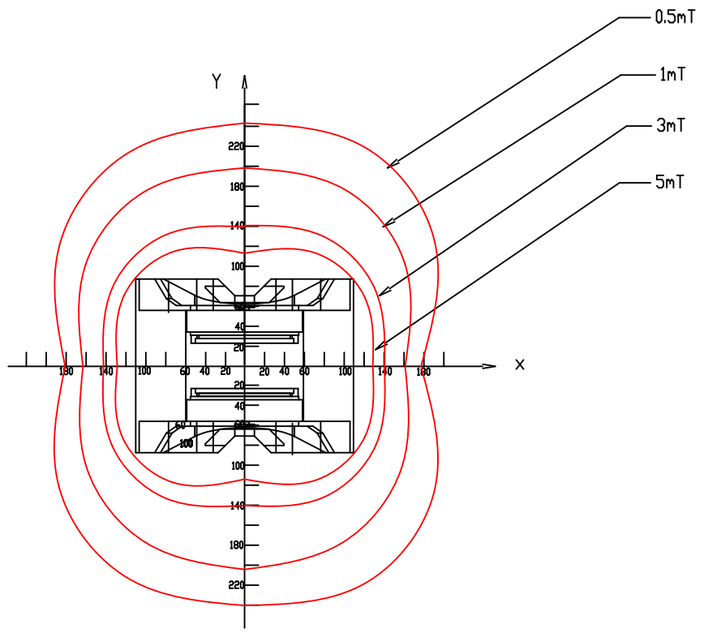

PARTIAL REFLECTED CEILING PLAN
PARTIAL MEZZANINE PLAN
DEMOLITION NOTES
FIRST FLOOR PLAN

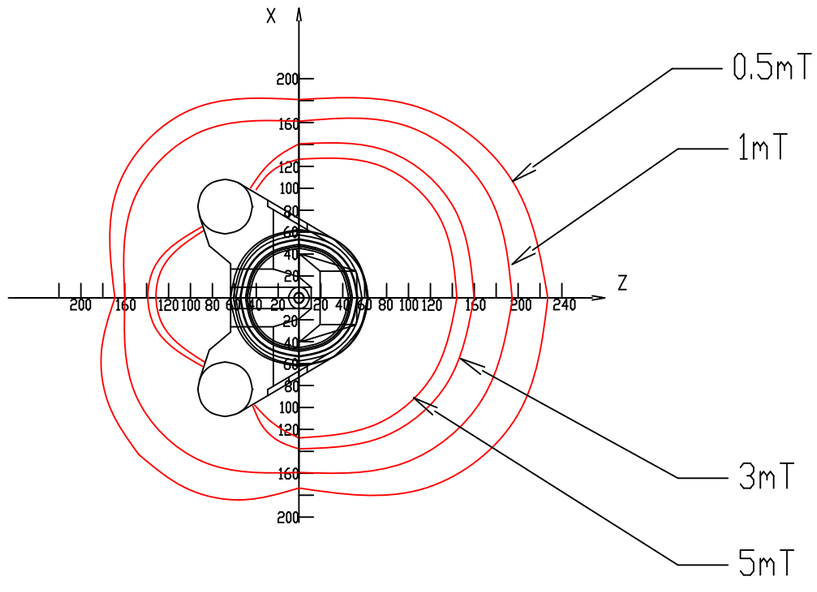




1 / 0001 DETAIL EQUIPMENT PLAN - LAB 5
SCALE: 1/4" = 1'-0"







Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)
Created by					
Reviewed by					
Approved by					

PICA Fringe Field

TIME MEDICAL SYSTEMS

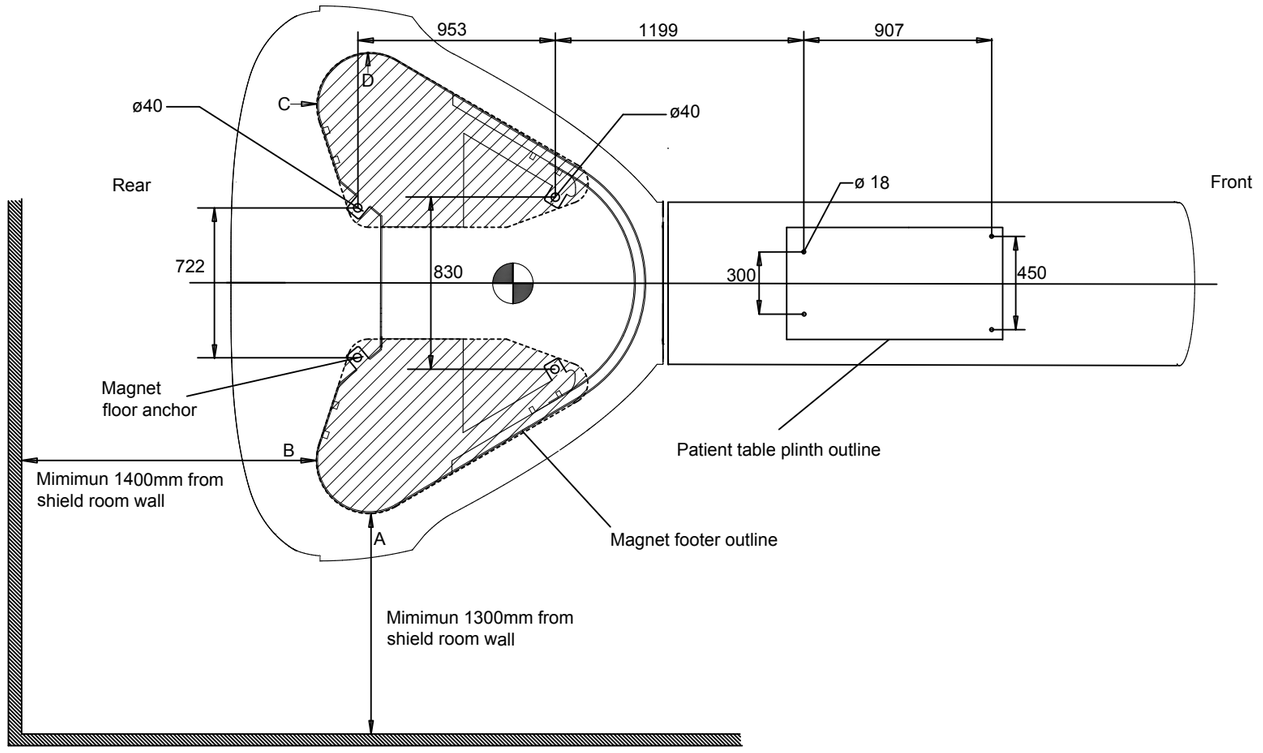
MS046 PICA Fringe Field 1.0.1

Phrase	Weight	Scale

Jun 2014

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

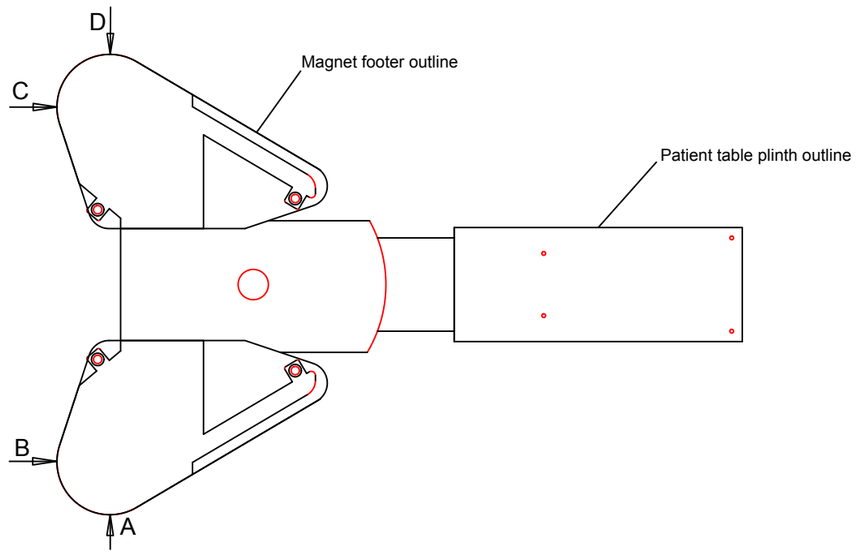
A3



Footprint Sheet Placement:

1. Place the footprint sheet on the shield room floor.

2. Align the sheet such that the sheet satisfies the following conditions:
- Point B and C must be kept equally at least 1400mm from wall of shield room.
- EITHER point A OR D must be kept at least 1300mm from wall of shield room.



Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)

Created by			
Reviewed by			
Approved by			

PICA Positioning

Phrase	Weight	Scale

TIME MEDICAL SYSTEMS

MS009 PICA Position 1.1.1

Jun 2014

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

A3

Overall Dimension of a Fully Fitted PICA - Use Only as a Reference for Site Survey

PICA-WHOLE-BODY MRI SYSTEM SPECIFICATIONS
(Refer to system specification document for latest specifications)

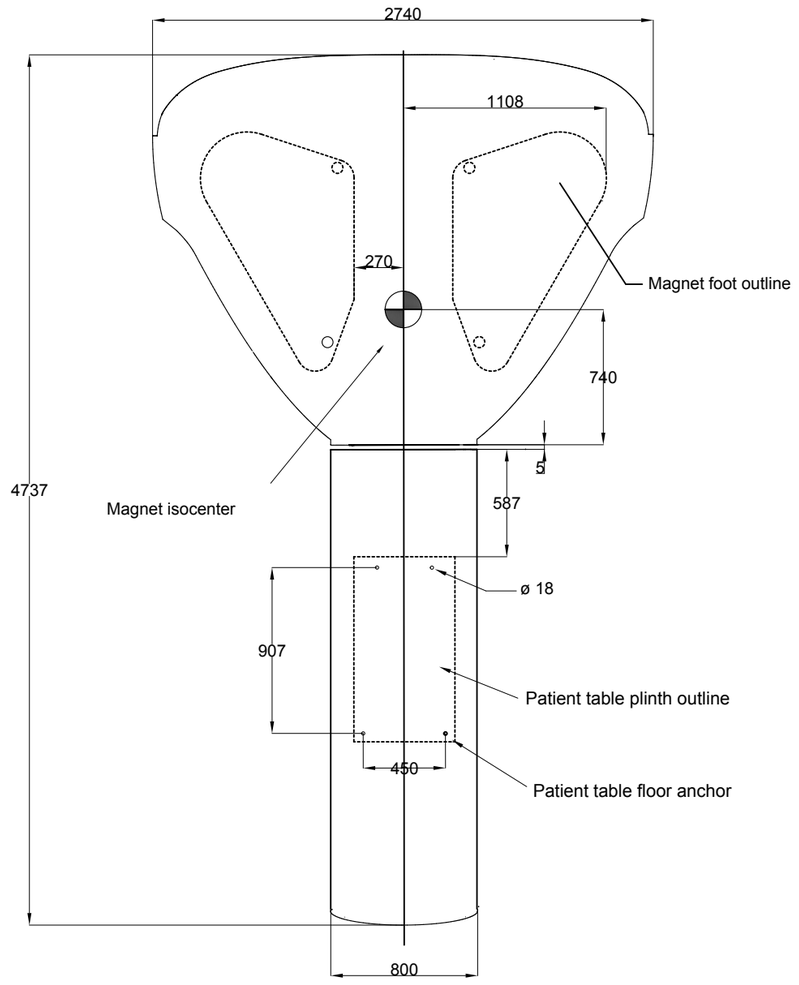
MAGNET
TYPE: Permanent, active shims
FIELD STRENGH:0.35 Tesla
OPENING:400mm / 15.7 in.
FRINGE FIELD: 5 gauss line 2.5m / 8.2 ft. (axial) x 2.5m / 8.2 ft. (radial)
FIELD STABILITY:<0.2ppm/hr
MAGNET UNIT SIZE: 1600 x 2220 x 1730mm / 5.2 x 7.3 x 5.7 ft. (L x W x H)
MAGNET UNIT + COVER SIZE: 2260 x 2740 x 1996mm / 7.4 x 9 x 6.5 ft. (L x W x H)
MAGNET UNIT WEIGHT: 17000kg / 37480lb
MAGNET UNIT + COVER WEIGHT: 17200kg / 37920lb

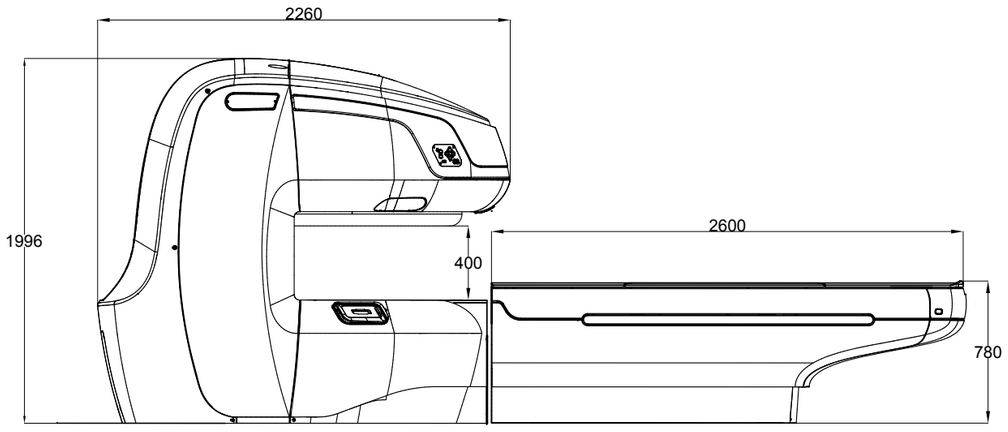
PATIENT TABLE
MOVEMENT:6-direction movements
WEIGHT: 470kg / 1036lb
SIZE:2600 x 800 x 780mm / 8.5 x 2.6 x 2.6 ft. (L x W x H)

OPERATING ENVIRONMENT
TEMPERATURE RANGE: 21 ± 3°C / 70 ± 3°F
TEMPERATURE STABILITY:1°C/hr
HUMIDITY RANGE:50 ± 5% air turnover as required in clinical environment

FLOORING
FLOOR LOADING: >20kPA
FLOOR COVER: Less than 1.3kV electrostatic potential
3 second half life
105-10Ω impedance
Carpet meets IBM-CL standards
Floor coverings do not ground RF shielding

FLOOR LEVELING: 5mm/3m
Note: Floor leveling must be maintained very carefully inside the indicated constraints to guarantee correct functioning of equipment





Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)

Created by			
Reviewed by			
Approved by			

PICA System Cable Connection

TIME MEDICAL SYSTEMS

3500WB-02 SCC 1.0.7

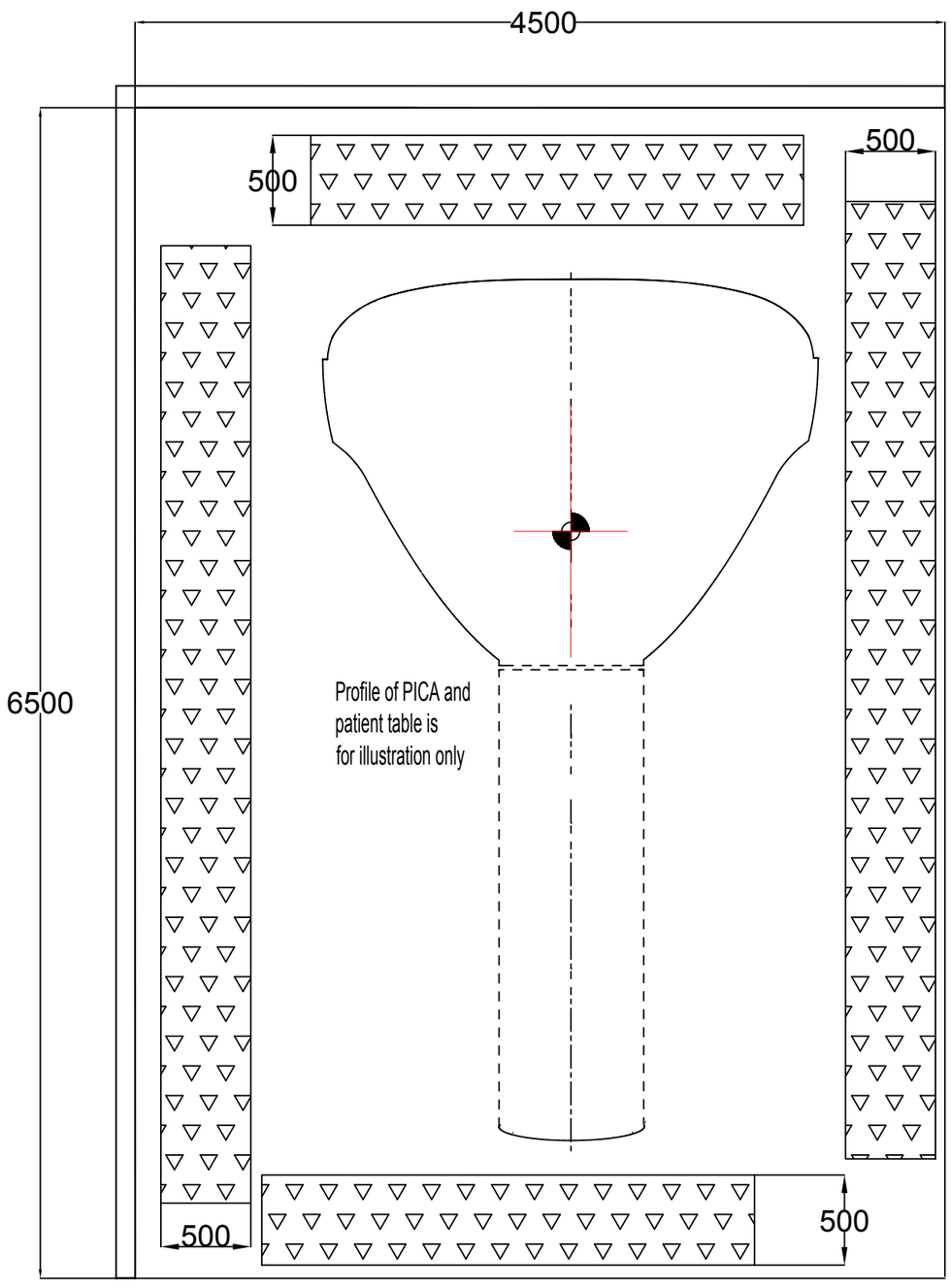
Phrase	Weight	Scale

Jun 2014

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

A3

Illustration of 500mm Minimal Passage Width Taken at Floor Level



Minimal room dimension:

6500mm x 4500mm

Minimum passage width (standard placement within magnet room):

Servicing area -- minimum passage width taken at floor level -- is the space that allows access of servicing personnels.

This "passage width" is bounded by the distance between a vertical wall and the panel of PICA. One passage for each side of the fully installed PICA.

The minimum "passage width" of practical MRI magnet room is 500mm.

Please refer to contractual drawings for exact passage width for each magnet room.

Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)

Created by			
Reviewed by			
Approved by			

PICA Site Passage Width

Phrase	Weight	Scale

TIME MEDICAL SYSTEMS

MS011 PICA MPW 1.0.3

Jun 2014

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

A3

PICA Anchoring

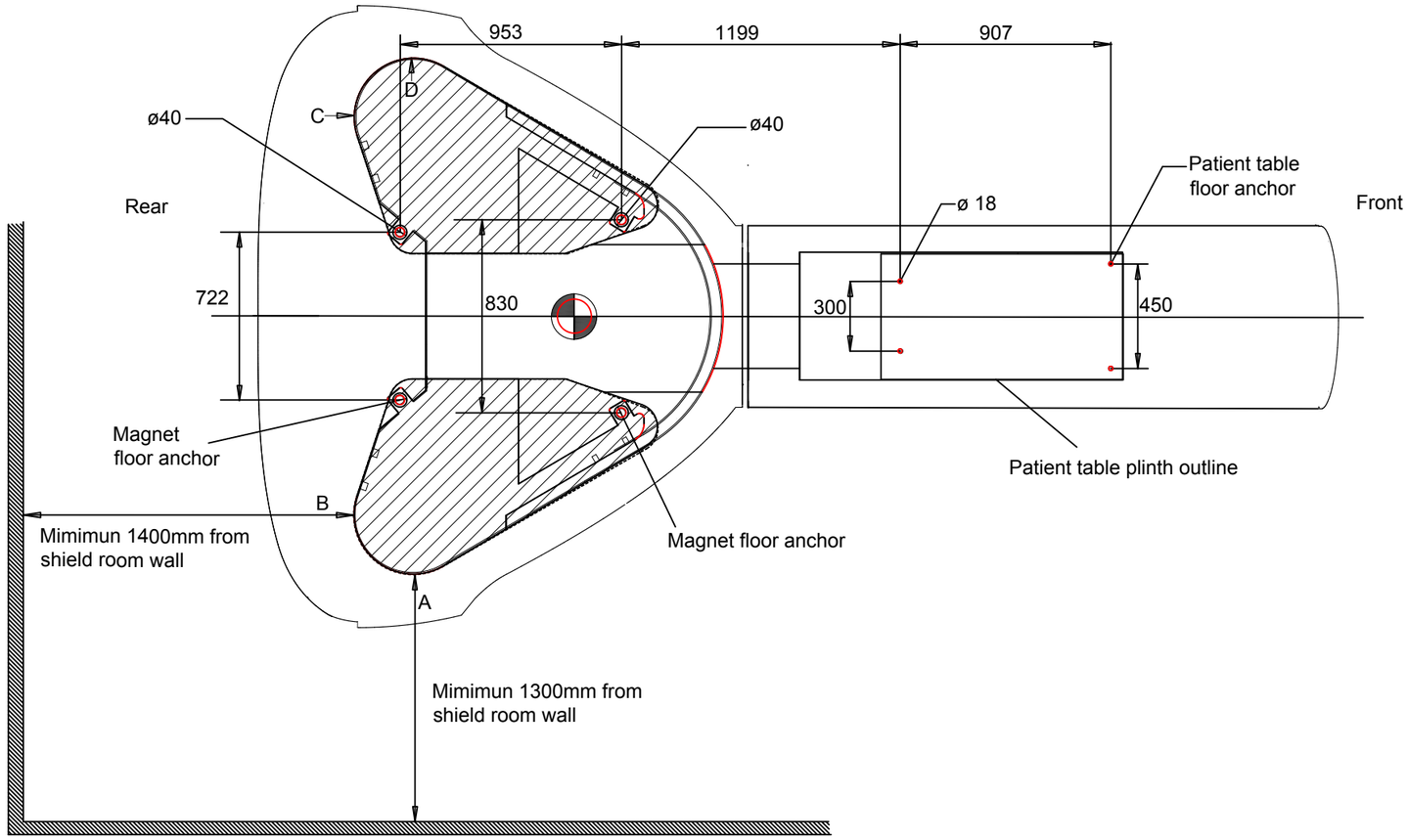
Footprint Sheet Usage:

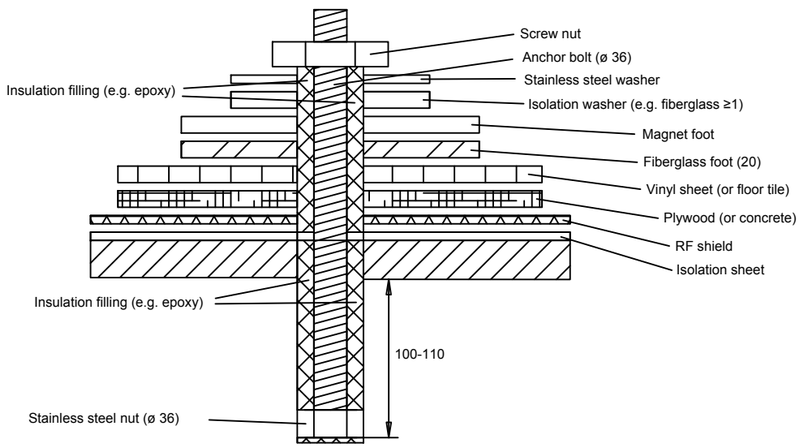
1. Place the footprint sheet on the shield room floor.

2. Align the sheet such that the sheet satisfies the 2 conditions:
- Point A and D must be kept at least 1300mm from wall of shield room.
- Point B and C must be kept at least 1400mm from wall of shield room with the same distance.

3. Mark floor anchors on the floor.

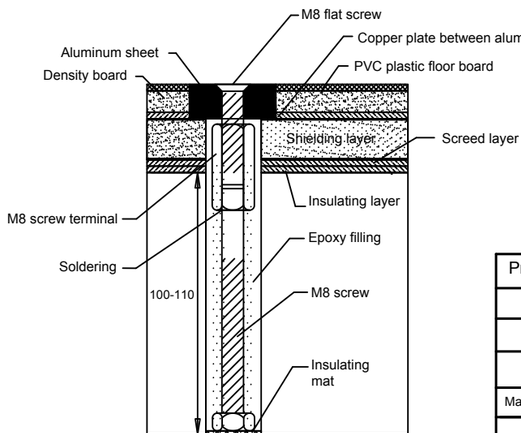
4. Remove the footprint sheet and drill.





Drawing not to scale

Magnet Anchoring Method



Patient Table Anchoring Method

Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)
Created by					
Reviewed by					
Approved by					

PICA Anchoring

TIME MEDICAL SYSTEMS

MS036 PICA Anchoring 1.0.3

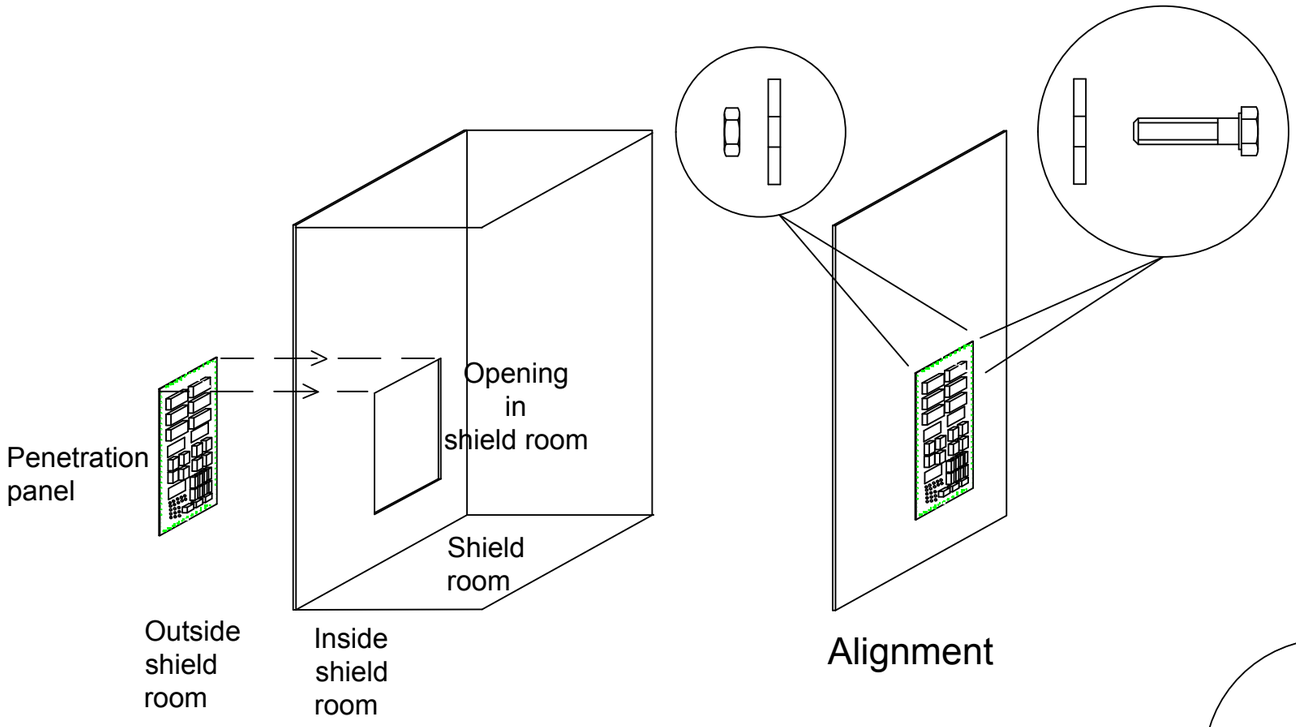
Phrase	Weight	Scale

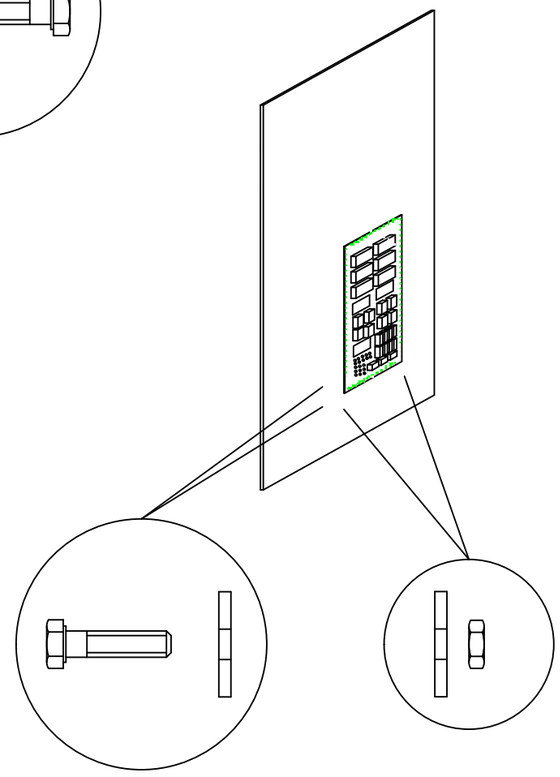
Jun 2014

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

A3

Details of Cutout, Mounting Screw Holes of Shield Room Opening





Follow these steps to install penetration panel to shield room opening:

1. Lift the penetration panel and align it against the top mounting holes at corners.
2. Insert the top corner bolts to temporary take the weight of the penetration panel.
3. Continue to support the penetration panel until all bolts are fitted.
4. Temporary fit the washers and nuts to the top mounting bolts from outside shield room.
5. Insert the top corner bolts from inside shield room direction. Make sure washers are applied on both sides of the bolt.

Refer to "Penetration Panel Installation" document within service document set for details.

Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)
Created by					
Reviewed by					
Approved by					

PICA Penetration Panel Fitting

Phrase	Weight	Scale

TIME MEDICAL SYSTEMS

MS013 PICA PP Fitting 1.0.3

Jun 2014

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

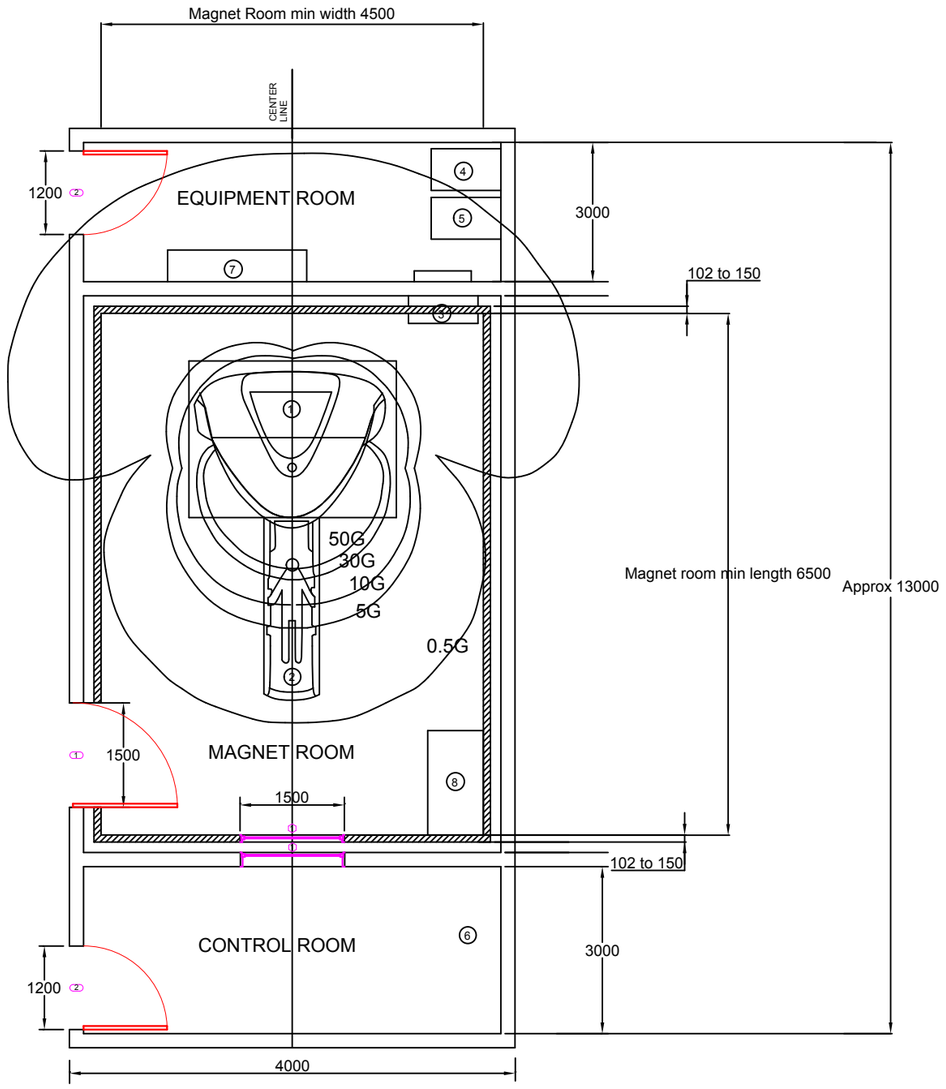
A3

MRI Suite Dimension, Layout for Civil Works

Confirm exact details with Time Medical Systems and make sure details agreed between Customer and Time Medical Systems prior to construction.

Dimensions in following drawings are for illustration only.

Refer to "Installation Planning" document for details on minimum room dimensions.



Magnet position and Patient Table anchoring defined in "MS009 PICA Position" document

KEY PARAMETERS

NO	DESCRIPTION	WEIGHT	DIMENSION			REMARKS
			LENGTH	WIDTH	HEIGHT	
1	MAGNET UNIT W/COVER	17200kg 37920 lb	2260mm 7.4 ft.	2740mm 9 ft.	1996mm 6.5 ft.	See "3500WB-02 QI"
2	PATIENT TABLE	470kg 1036 lb	2600mm 8.5 ft.	800mm 2.6 ft.	780mm 2.6 ft.	See "3500WB-02 QI"
3	PANETRATION PANEL	30kg 66 lb	N/A	610mm 2 ft.	1200mm 4 ft.	Copper penetration panel permits RF shielding integrity at connection points where cables enter/exit shield room
4	POWER CABINET	390kg 860 lb	670mm 2.2 ft.	820mm 2.7 ft.	970mm 3.2 ft.	
5	IMAGING CABINET	460kg 1013 lb	910mm 3 ft.	610mm 2 ft.	1735mm 5.7 ft.	
6	CONTROL ROOM	N/A	3000mm 9.8 ft.	4000mm 13.1 ft.	2800mm 9.2 ft.	
7	AIR CONDITIONER	N/A	N/A	N/A	N/A	Cool Capacity: 7.49kW
8	COIL STORAGE CABINET	N/A	N/A	N/A	N/A	OPTIONAL

DOOR SCHEDULE

NO	DESCRIPTION	DIMENSION	
		WIDTH	HEIGHT
1	RF SHIELDED SINGLE DOOR	1500mm 4.9 ft.	2200mm 7.2 ft.
2	SINGLE FLUSH DOOR	1200mm 3.9 ft.	2100mm 6.9 ft.

VIEW WINDOW SCHEDULE

NO	DESCRIPTION	DIMENSION	
		WIDTH	HEIGHT
1	RF VIEW WINDOW	1500mm 4.9 ft.	1200mm 3.9 ft.
Height of view window at 850mm above floor level			

RF SHIELDING REQUIREMENT

SHIELD ROOM REQUIRES AN RF SHIELDING EFFICIENCY OF BETTER THAN 90dB ATTENUATION AT 10MHz; BETTER THAN 100dB AT 100MHz.
AT A MINIMUM, THE ROOM SHOULD HAVE ALUMINUM SHEET TO SURROUND THE MAGNET FOR RF SHIELDING.

EXTENSIVE SHIELDING SHOULD BE PROVIDED BY SURROUNDING THE ENTIRE ROOM WITH IRON WALLS OF 1 TO 7-INCH THICK. THE IRON SHIELDING SHOULD CONTAIN BOTH RF AND MAGNETIC FIELDS FROM THE MAGNET SUCH THAT 5 GUASS LINE IS CLOSED IN SHIELD ROOM.

THE RF SHIELDING SHOULD NEVER BE CONNECTED WITH A GROUND WIRE, IRON REINFORCEMENT, LIGHTING ROD OR SIMILAR OBJECT.

Objects affect magnetic field	
15-gauss line or closer	All ferromagnetic construction materials except small amounts of steel reinforcing bar, normally not exceeding 11kg/m² (2.5 lb/ft²).
5 to15-gauss	Presence or movement of ferromagnetic objects over 45kg (100lb): eg. pushcarts, hand trucks, gas cylinders, etc.
2 to 5 gauss	Presence or movement of ferromagnetic objects over 450kg (1000lb): eg. small delivery trucks, automobiles, pallet movers, forklifts, elevators, etc.
1 to 2 gauss	Presence or movement of ferromagnetic objects over 34,000kg (75,000lb): eg. trains, large trucks, etc.
Objects affected by magnetic field	
15 gauss line or closer	Cardiac pacemakers, ferromagnetic implants, and unrestrained ferromagnetic objects: eg. tools, keys, electronic equipment, analog watches, magnetic data storage media, credit cards, etc.
1 to 2 gauss	Extremely sensitive electronic equipment: eg. linear accelerators, electron microscopes, CRTs, etc.
2 to 5 gauss	Very sensitive electronic equipment: eg. unshielded image intensifiers, photomultiplier tubes, etc.
5 to 15 gauss	Cardiac pacemakers and electronic equipment: eg. shielded CRTs, computers, shielded image intensifiers, shielded photomultiplier tubes, etc.

Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)
Created by					
Reviewed by					
Approved by					

PICA Site Drawing

TIME MEDICAL SYSTEMS

MS006 PICA Site 1.0.4

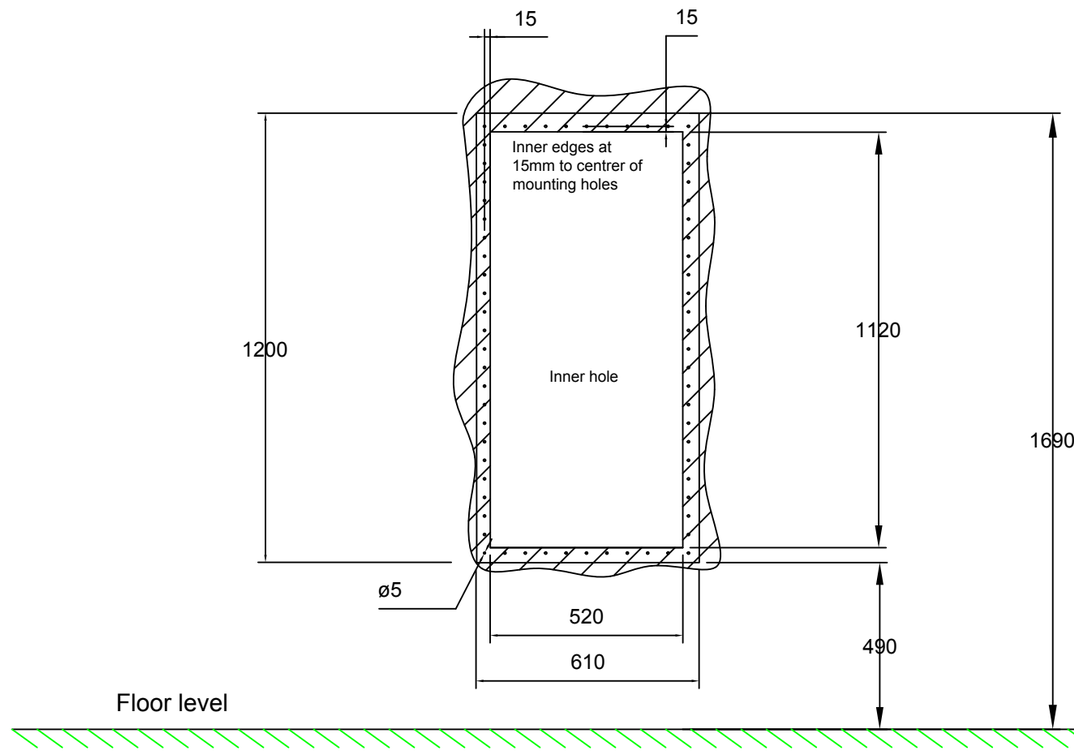
Phrase	Weight	Scale

Jun 2014

DRAWING NOT TO SCALE. FOR REFERENCE ONLY

A3

Details of Cutout, Mounting Screw Holes of Shield Room Opening



Follow these steps to determine dimension and position of shield room opening:

1. Establish the lower horizontal edge of the opening by taking a 490mm measurement from floor level.
2. Identify the required amount of horizontal/sideway space for ease of cable access and working, this establish a vertical edge of the opening.
3. The opening should measure 1120mm (H) x 520mm (W).
4. Mount holes for M5 bolts center at 15mm from the edges of the opening.

Refer to "penetration panel installation document" within servicing document set for detailed installation method.

Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)
Created by					
Reviewed by					
Approved by					

PICA Penetration Panel
Civil Drawing

TIME MEDICAL SYSTEMS

MS012 PICA PP Civil 1.0.4

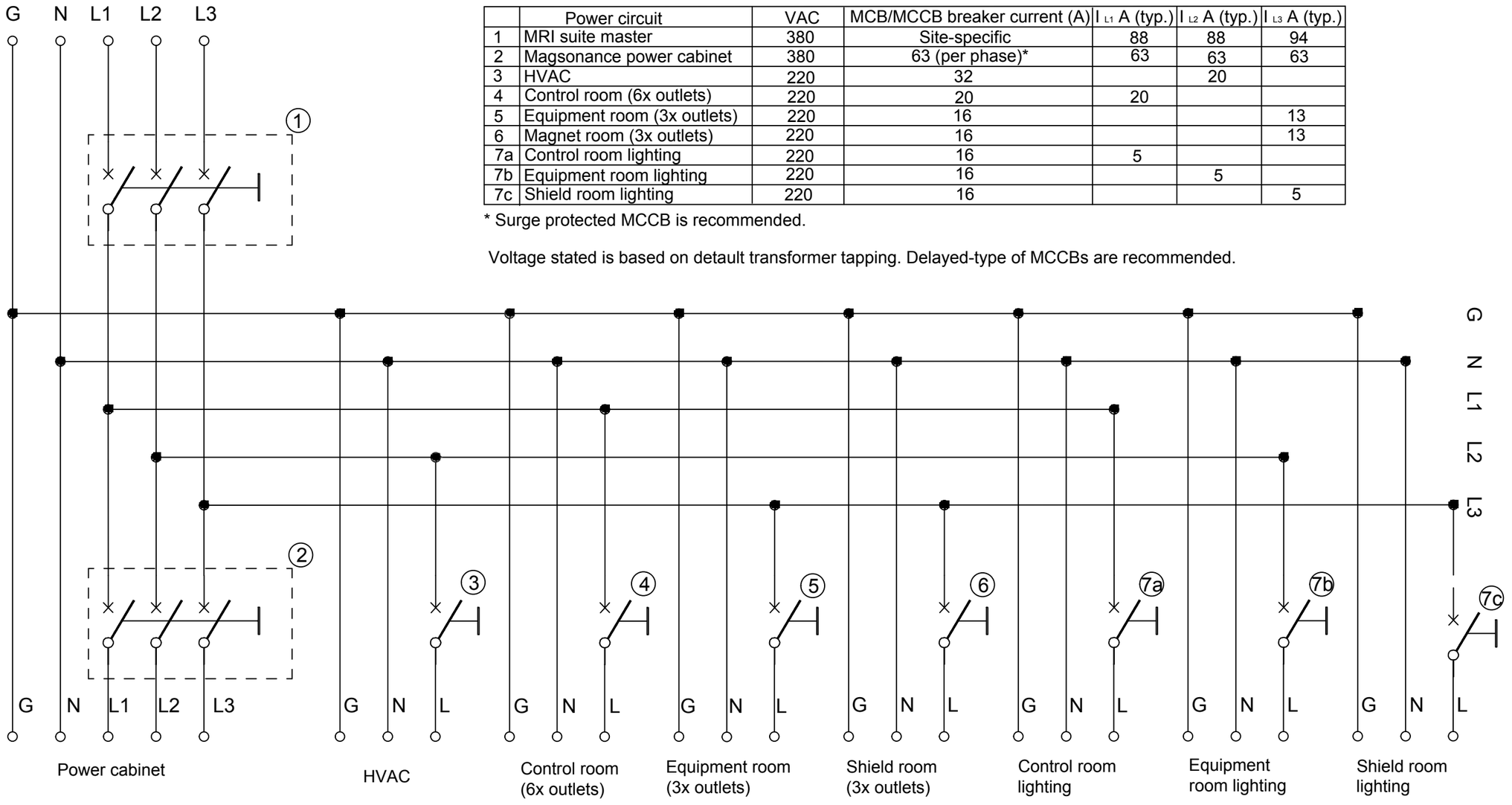
Phrase	Weight	Scale

Jun 2014

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

A3

PICA Suite Power Distribution



	Power circuit	VAC	MCB/MCCB breaker current (A)	I_{L1} A (typ.)	I_{L2} A (typ.)	I_{L3} A (typ.)
1	MRI suite master	380	Site-specific	88	88	94
2	Magsonance power cabinet	380	63 (per phase)*	63	63	63
3	HVAC	220	32		20	
4	Control room (6x outlets)	220	20	20		
5	Equipment room (3x outlets)	220	16			13
6	Magnet room (3x outlets)	220	16			13
7a	Control room lighting	220	16	5		
7b	Equipment room lighting	220	16		5	
7c	Shield room lighting	220	16			5

* Surge protected MCCB is recommended.

Voltage stated is based on detault transformer tapping. Delayed-type of MCCBs are recommended.

Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)
Created by					
Reviewed by					
Approved by					

PICA Suite Power Distribution

TIME MEDICAL SYSTEMS

MS026 PICA Suite Power Distribution 1.0.4

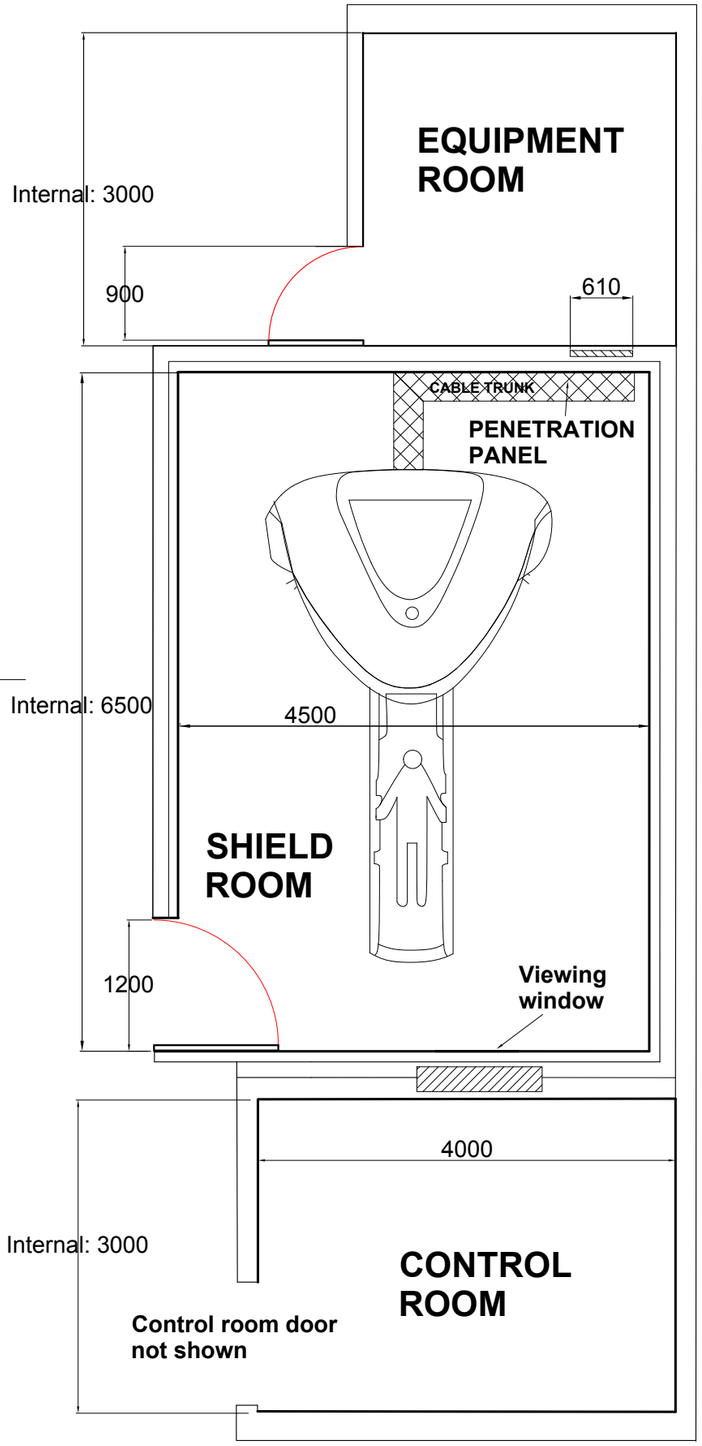
Phrase	Weight	Scale

Jun 2014

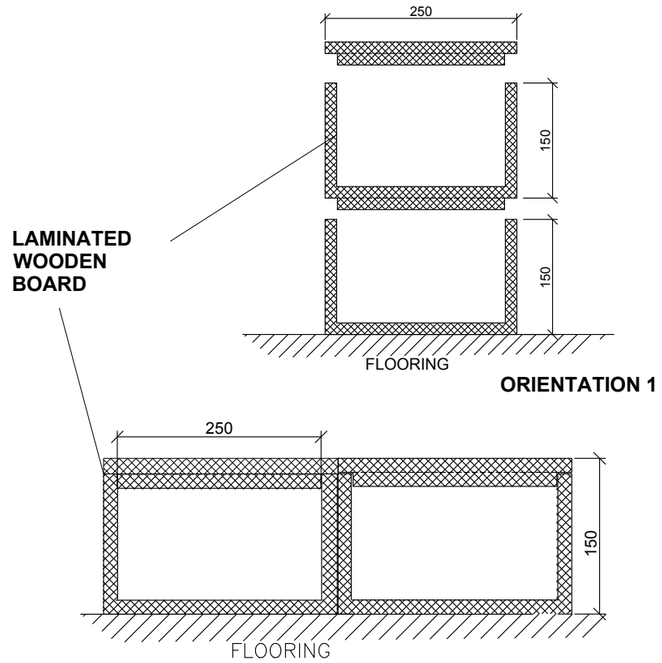
DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

A3

Minimal Room Dimensions
(Exact dimension and layout refer to agreed version between customer and Time Medical Systems)



CABLE TRUNK CONSTRUCTION



PROVISION OF CABLE TRUNK/CONDUIT/RACEWAY

a) Fabrication to length and reach for site specification:
1) For fitting within equipment room
2) For fitting within shield room
3) Provision of three sub-segments

Suggested dimension for cable trunk from equipment room to control room is 10 x 10cm (H x W), with length being site-specific.

b) Assess size and reach of trunking from equipment room to control room:
1) Trunking is fitted as part of the site construction
2) Assess cross section is sufficient to accommodate all cables

CABLE ROUTING

EQUIPMENT ROOM REQUIREMENT
Equipment room should be constructed with sufficient lengths of wooden/plastic cable trunks from cabinets to penetration panel. Overall cross section dimension should be 500 x 70mm (W x H). Cable trunking can be installed above or below drop ceiling.

Cable trunks should be fitted with internal dividers to create 3 narrow routes, each of which having an equal internal width of approximately 150mm. This arrangement physically separates the following runs of cables along the cable trunks:

- RF signal cables
- DC power and high-power gradient cables
- Remaining signal cables

Use ladders to manage vertical cable runs.

Add protection cover for penetration panel.

SHIELD ROOM REQUIREMENT
Add protection cover for penetration panel.

Shield room should be constructed with sufficient lengths of wooden/plastic cable trunks from penetration panel to magnet, with an overall cross section dimension of 500 x 70mm (W x H). Cable trunks should be floor-mounted, and be fitted with internal dividers to create 3 narrow routes, each of which having an equal internal width of approximately 150mm.

CONTROL ROOM REQUIREMENT
Sufficient lengths/width of plastic cable trunks should be provisioned to route cables from equipment room to control room.

MAIN POWER SUPPLY REQUIREMENTS

VOLTAGE AND FREQUENCY	380VAC 3-PHASE ± 10% (50/60Hz ± 1Hz) 440VAC 3-PHASE ± 10%\PLINE-TO-LINE UNBALANCE, 2% Max
ON-SITE MCB/FUSE RATING	MCCB breaker current 63A (Contact Time Medical Systems for suitable MCCB)
MAXIMUM LINE IMPEDANCE	0.24Ω at 380V, 0.32Ω at 480V; Rising linearly
SYSTEM GROUND	2 GNDs: one for MRI system, one for MCCB <1Ω
NEUTRAL-TO-GROUND VOLTAGE	<2V

POWER OUTLETS

EQUIPMENT ROOM REQUIREMENT
Provision sockets for 3-phase 5 lines mains power to PICA power cabinet.
Provision of 3 sets of 110/220 VAC single phase outlets.

RF SHIELD ROOM REQUIREMENT
RF tight and non-magnetic
Provision of 2 13A sockets at both side away from magnet.

CONTROL ROOM REQUIREMENT
PICA workstations and peripherials typically require 6 220VAV outlets. Outlet position should accommodate the anticipated needs of equipment used in control room.
Minimize ground loop interference by feeding a single 20A circuit for all electrical outlets. Surge protection strongly recommended.

Project	Part	Detail	Quantity
1			
2			
3			

Mark	Num	Zone		Signature	Date (YY/MM/DD)
Created by					
Reviewed by					
Approved by					

PICA Power

TIME MEDICAL SYSTEMS

Phrase	Weight	Scale

MS007 PICA Power 1.0.6

Oct 2015

DRAWING NOT TO SCALE.
FOR REFERENCE ONLY

A3

MAGNET BODY
HANDLING AND POSITIONING

TIME MEDICAL SYSTEMS

The information contained herein is the responsibility of and is approved by the following, to whom all enquiries should be directed in the first instance:

Service Support
Time Medical Systems

Created by:	Reviewed by:	Approved by:
Date:	Date:	Date:

0.1 CONTENTS

0.2 INDEX TO FIGURES AND TABLES

0.3 HISTORY/ISSUE CONTROL

Issue No.	Date	E-N-U	Details Of Change	Section
1	2014/06/05	1.0.0	- Document updated from 11.01.03003M PICA QI 1.0.0	All

1 OVERVIEW

This document provides instructions for the safe installation of the PICA magnet body. Safe handling is essential for maintaining the magnet body in peak condition. Pay extra attention to the dangers associated with handling the large and heavy magnet.

WARNING: Cardiac pacemaker wearers must remain outside the 5 gauss perimeter in all directions from the magnet until safety is clearly established. PICA Whole-Body MRI magnet generates strong magnetic and electromagnetic fields that can inhibit operation of some cardiac pacemakers, resulting in death or serious injury to the user. Consult the pacemaker user's manual, contact the manufacturer, or confer with a physician to determine the effect on a specific pacemaker. Time Medical Systems provides signs with each system to warn pacemaker wearers of this hazard.

Instructions are provided for all stages of transportation, unloading and move-in as well as final positioning of the magnet body, documented in the PICA magnet footer document. (Ref.: 2)

Please consult site drawings and contractual drawings prior to planning for the installation.

The complete installation sequence of PICA documented in the installation sequence document (Ref.: 1) has been broken down as follows.

The overall installation sequence is summarized as:

Day 0: pre-magnet move-in preparation (site renovation NOT complete)
Day 1: system installation preparation
Day 2: magnet temperature stabilizing
Day 3: system installation
Day 4: shimming
Day 5: RF system connections and checking
Day 6: system & software tuning
Day 7 & 8: system FQC
Day 9: customer acceptance and customization, application training

--End of Section--

2 MAGNET HANDLING REQUIREMENT

The magnet body is a permanent magnet with static field strength of 0.35T. It has a net weight of 17000kg, and gross weight of 17500kg including the wooden box.

Maximum tilt for handling the magnet body is no more than 15 degrees at all times. The magnet body is lifted from the wooden box while sitting on the transport vehicle.

2.1 PRE-DELIVERY INSTRUCTIONS

It is a prerequisite for all parties involved in transporting the magnet to fully understand and know exactly the designated magnet location at customer premises.

Consult the PICA magnet footer document (Ref.: 2) for instructions to define the magnet body position.

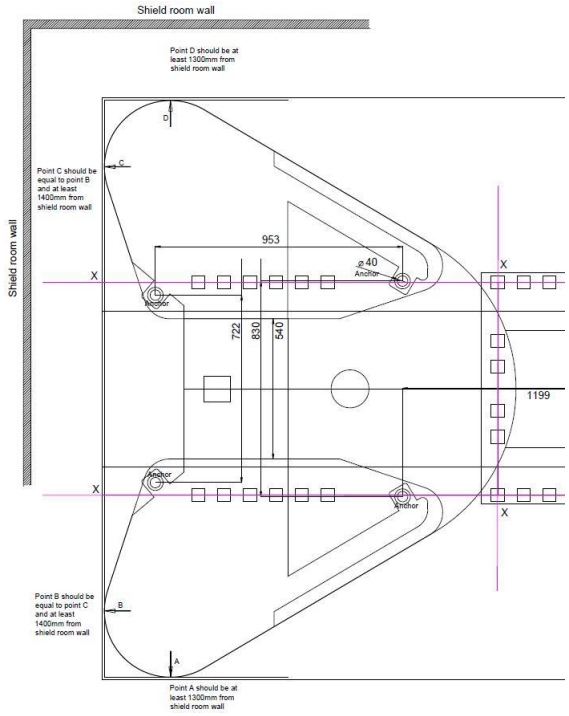


Figure 1: PICA Position

After satisfying the required distance of PICA magnet body placement in the shield room, conduct and document a site survey, and prepare a set of contractual site drawings.

On the day of delivery, take contractual site drawings and transpose magnet room layout plan to the actual magnet room floor. Identify the floor location for placement of the PICA footprint sheet.

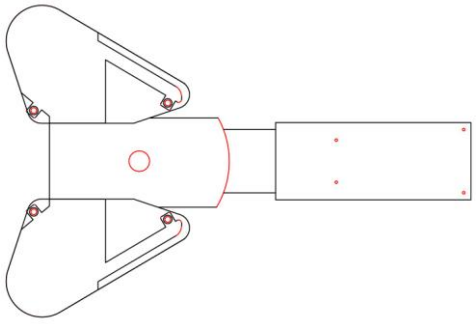


Figure 2: PICA Footprint Sheet

Follow the site survey to prepare the following:

- Floor plan showing move-in route
- Rigging tools
- Hoists
- Floor protection materials

2.2 TEMPORARY STORAGE REQUIREMENTS

At all stages of the transportation to its final destination, the magnet and other wooden boxes may be required to store at a temporary climate-controlled location so that the shipment is not exposed to extreme conditions in attributes such as:

- Temperature
- Humidity
- Sunlight
- Rain
- Snow

For exact values, refer to section “temporary secure storage” of the installation planning document. (Ref.: 8)

2.3 GOODS INWARD INSPECTION

Conduct a standard goods inward inspection to confirm the shipment, and identify for signs of possible damage to the container.

Inspect the wooden box for signs of tilt and shock during transportation.

Review the packing list for all items shipped from the factory, and ensure each item for installation is available before proceeding with actual installation.

2.4 UNCRATING INSTRUCTIONS

The wooden box used to house the magnet body is illustrated below.

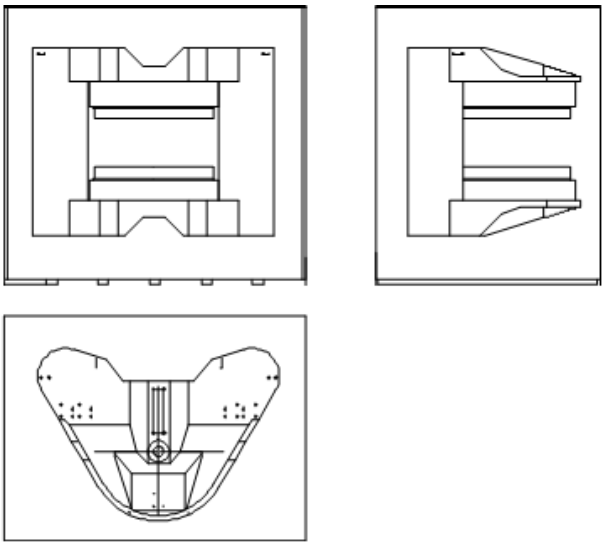


Figure 3: Magnet Body in Wooden Box

As delivered, the magnet is packed in a wooden box. The magnet is to be lifted from the transport vehicle to a specified loading point.

WARNING: PICA Whole-Body MRI magnet generates strong magnetic and electromagnetic fields that can inhibit operation of some cardiac pacemakers, resulting in death or serious injury to the user. Consult the pacemaker user's manual, contact the manufacturer, or confer with a physician to determine the effect on a specific pacemaker. Time Medical Systems provides signs with each system to warn pacemaker wearers of this hazard.

The wooden box and markings outside the box are shown below. In general, verify the information against the packing list before proceeding to handling any wooden box.

Figure 4: Wooden Box Markings

Follow steps below to open the wooden box:

1. While the wooden box is on the transportation vehicle, remove lid of the box.

2. Inspect and remove protection wrapping materials (i.e. cling wrapping film) if necessary.

Figure 5: Magnet with Wrapping Materials

Note: the magnet body is fully wrapped in insulation foam and it should not be unwrapped.

3. Inspect the integrity of transportation protection bar fitted to the front of the magnet opening to provide protection against vibration. Inspect integrity of wooden protective boards fitted at the magnet opening.

Figure 6: Transportation Protection Bar and Wooden Protective Boards

4. Locate 4 M48 eye-bolts as part of the shipment, and verify each had been screwed down to the magnet body until fully engaged.

Figure 7: Eye-Bolts

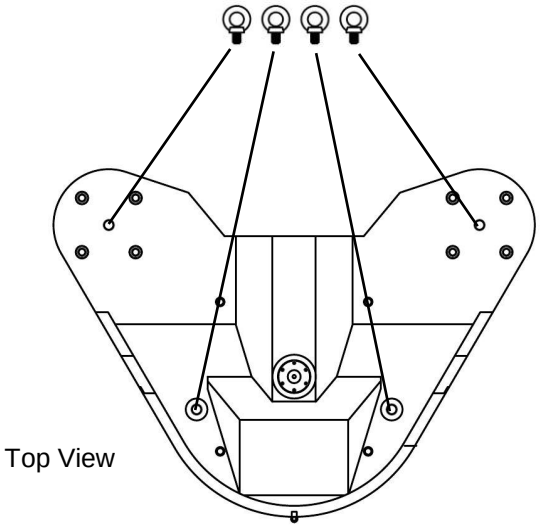


Figure 8: Lifting Eye-Bolts and Fixing Locations on Magnet Body

2.5 MAGNET BODY UNLOADING PREPARATION

Unload the magnet body by lifting it from the transportation vehicle to a designated settle point.

The weight of magnet body is 17,000kg. Ensure safe working load (SWL) is observed for all mechanical handling equipment throughout magnet body unloading.

Use steel wire rope slings with a rated capacity equal to or greater than the rated capacity required for the corresponding rigging technique.

Make sure the tilting angle (sling-to-load angle) is equal for each sling where possible.

Observe a load factor for the sling-to-load angle to derive the rated sling capacity to safely lift the 17000kg load.

Connection to magnet-body:

A 4-leg wire rope sling is attached to the magnet body and the lifting machine by means of lifting hooks or appropriate terminal fittings. Sling legs should not be twisted or knotted.

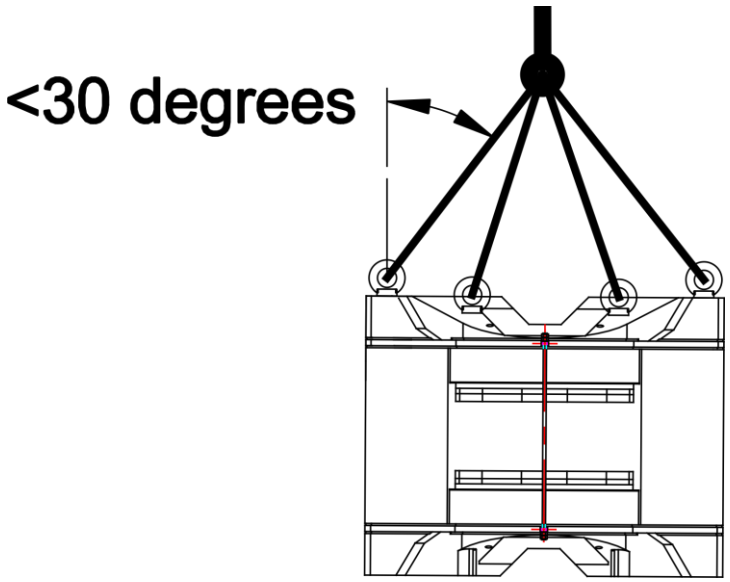
The lifting point should be seated well down in a hook, never on the point or wedged in the opening. The sling hook should be free to incline in any direction to avoid bending.

The magnet body is designed for attaching 4-leg wire rope sling to the eye-bolts. The slings must not be attached to any other parts of the magnet body.

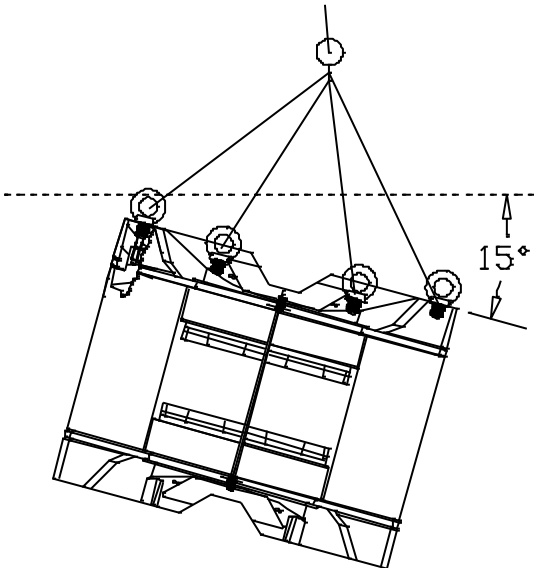
Illustrated below are the lifting rings fitted on top the magnet for lifting.

Figure 9: Lifting Eye-Bolts Fixed on Magnet

Ensure the sling angle of each sling leg is less than 30 degrees to the vertical as illustrated below.



Ensure at all times, the magnet body must not be tilted by more than 15 degrees to the horizontal.



2.6 MAGNET BODY LIFTING

Before lifting, ensure that the load is free to move and is not bolted down or otherwise obstructed.

Follow the procedures below to lift and unload the magnet.

1. Verify SWL of lifting apparatus and accessories are capable of handling lifting of 17000kg.
2. Verify lifting/crane clearance.
3. Prepare for unloading on the designated flat and solid surface.
4. Lift the magnet smoothly with a crane.
5. Avoid impact or jolts which may damage the magnet.
6. Slowly lower the magnet.

- If magnet transport tanks are not available at this stage, insert them later.

7. Unload the magnet on the designated flat and solid surface.
8. Verify the magnet is steady on the surface.
9. Unhook the magnet.

2.7 TANKS

A total of 4 tanks (P/N: 23.02.00003P) are used for moving the magnet. Depending on contract terms, these are either packed with the shipment, or available from the local Time Medical Systems office.

Do not use the tanks on uneven surfaces; runaway load and uneven load distribution may occur.

Figure 10: Tank

- Position 2 tanks at the rear of the magnet body.
- Position 2 tanks at the front of the magnet body.

Consult Time Medical Systems to discuss any questions you may have about a potential move or the use of tanks.

2.8 TANK CONFIGURATIONS

Truck points are the designated locations at the base of magnet body for resting on tanks during magnet move-in.

The 4 designated locations are illustrated below. Tanks are inserted to, or removed from the base of the magnet only after the magnet body has been jacked to a clearance height of at least 120mm above floor level (not including any shimming plate).

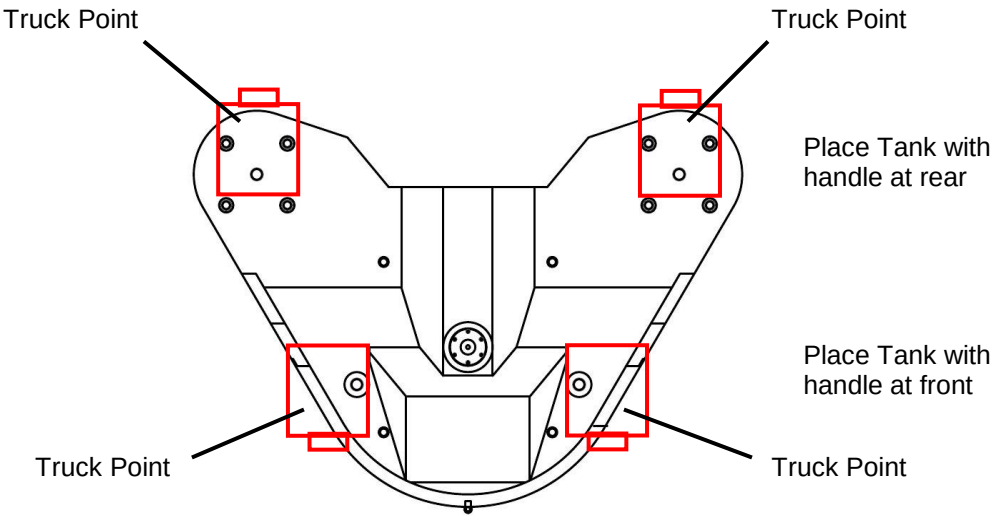


Figure 11: Truck Points

This is the preferred arrangement to achieve a balance of the load on the tanks and allowing the direction of magnet body movement to be adjusted.

2.9 MAGNET BODY JACKING

2.9.1 MAGNET BODY JACKING POINTS

Jacking points allow the magnet body to be elevated sufficiently with jacking handles and appropriate hydraulic jacks. Elevating the magnet body is required for placement or removal of the tanks before move-in.

The magnet is designed with 4 jacking points for the attachment of jacking handles. The following figures show the front and rear jacking handles provided by Time Medical Systems.

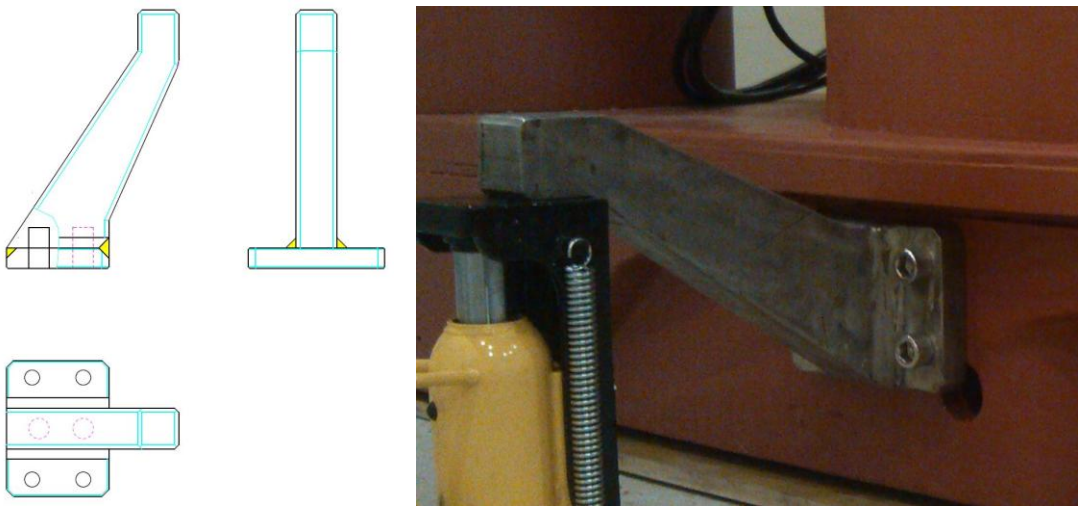


Figure 12: Front Jacking Handles

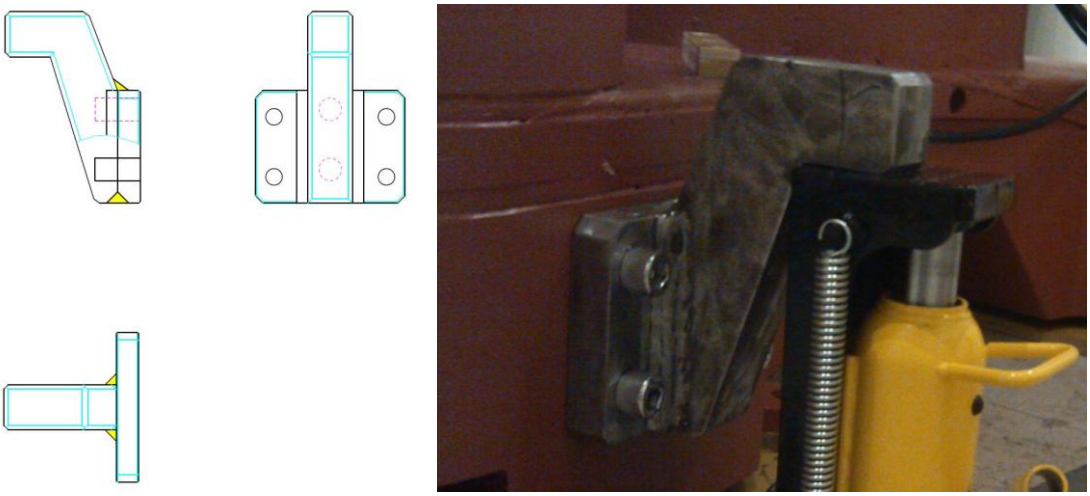


Figure 13: Rear Jacking Handles

The following table lists the suggested magnet jacking requirements.

SWL being lifted	20000kg
Jack required	4
Magnet-to-floor distance	>120mm

Table 1: Suggested Magnet Jacking Requirements

2.9.2 JACKING ARM FITTING

Check if the jacking arms have been fitted on the magnet. Otherwise, locate the jacking handles, and attach each to the magnet according to the following figure.

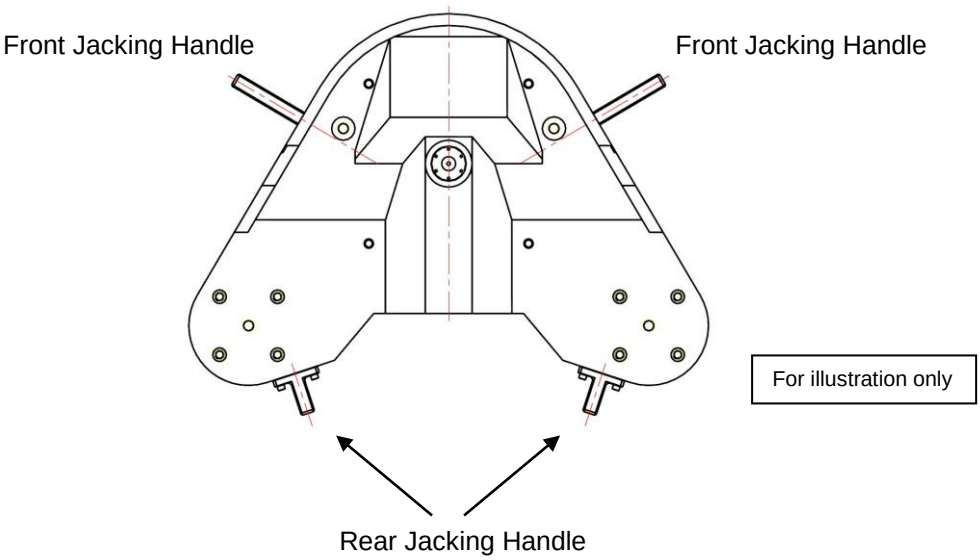


Figure 14: Jacking Handle Positions

Caution: the loading platform of each handle should fully support the leveled tip of the jacking handle, and should be in center alignment with the tip to ensure a balanced load.

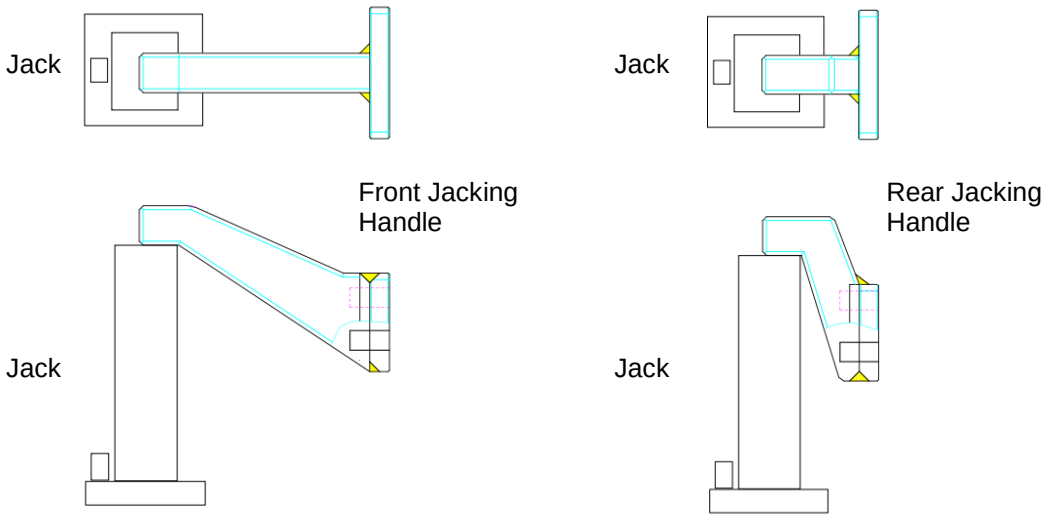


Figure 15: Placement of Jacks

2.9.3 MAGNET BODY JACKING PROCEDURES

Follow the procedures below to lift the magnet, insert tanks, and lower the magnet.

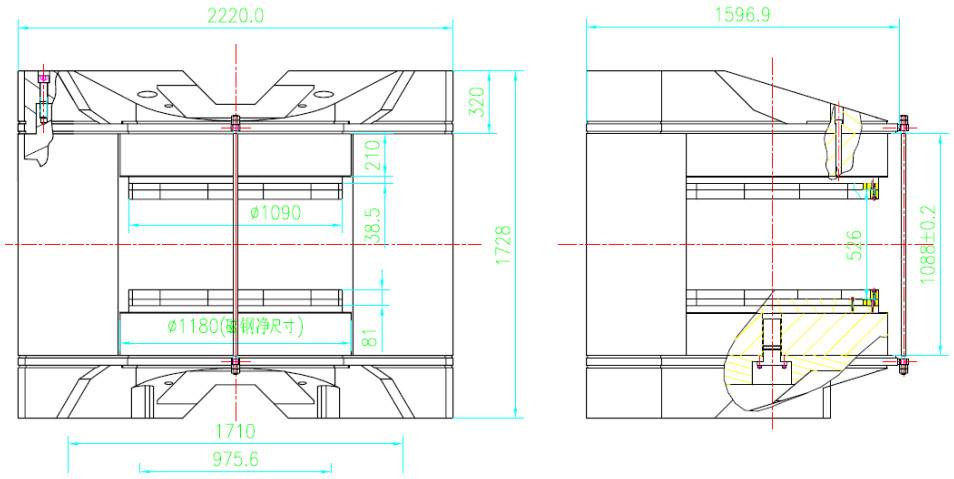
1. Stack plywood and place the stack on the ground if site construction is complete.
2. Set each jack on a stable point (on the plywood stack).
3. Position each jack under each jacking handle.
4. Slowly jack up the magnet by operating each jack together. Take the weight of the magnet body slightly. Slowly raise the magnet body evenly to achieve about 120mm off the floor (not including shimming plates) for insertion of tanks.
5. Place tanks at their truck points.*
6. Gradually and evenly lower the magnet evenly until all tanks are fully distributing the weight of the magnet body.
7. Fully lower and remove each jack.
8. Remove plywood stack and other objects to clear path for magnet moving.

*Refer to “tanks configuration” section for instruction of tanks insertion.

2.10 MAGNET MOVE-IN INSTRUCTIONS

At this stage the magnet is ready for moving into the shield room or temporary on-site storage. At all times, ensure safe practices and warnings are observed.

The dimensions of PICA magnet are illustrated below for quick reference. Refer to the PICA dimension document for details (Ref.: 3).

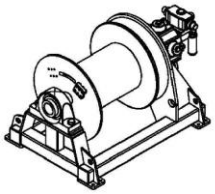


The manpower required to push and pull a load varies greatly and are mostly influenced by two factors:

Floor conditions: it is easier to move a load on smooth and level concrete surfaces than on rough and uneven ones. Make sure the moving path is kept as straight as possible.

Weight per footprint: it is less difficult to move a load on a larger tank than on a small one; as more rollers are available to support the weight, there is less weight for each individual roller to carry. Since each roller has less pressure placed on it, the load becomes easier to move.

Estimated man power is 5 men with suitable winch.



2.11 MOVING WITH TANKS

Before moving the magnet body, verify the intended move-in path and plan for each segment of the move-in path including turns. Pre-align each tank so that they face the direction of intended travel of each segment of the move-in path.

Tanks must only be used on a smooth, hard surface capable of withstanding the weight of the load.

Thoroughly clear and clean the floor area to remove oil, grease and swarf.

Do not use other under-specification tanks to avoid damaging the magnet body or the floor.

Verify the tanks are attached at the proper locations under the magnet, and the magnet body rests on the skate top pads.

Commence steering/turning by jacking the magnet until it is completely separated from the tanks. Turn the tanks physically to the desired direction. Lower the magnet again such that the tanks take the full load. Verify their alignments before and during magnet movement.

Repeat in small segments of the move-in path to turn the magnet.

Illustrated below is the magnet body resting on the tanks for move-in.

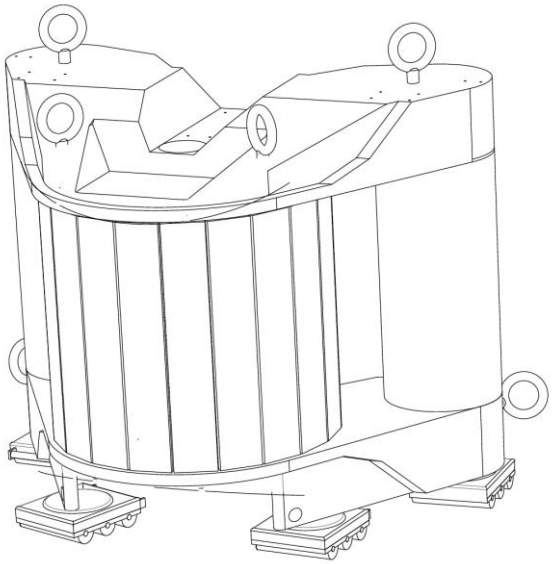


Figure 16: Magnet Body on Tanks

Consult contractual site drawings for the move-in path and move the magnet body to the designated location.

Continually check the path to make sure there are no trip hazards. Do not allow the magnet body to travel at speed or change its direction abruptly.

Never allow anyone to be in a position between the magnet body and a wall or other fixed structures as one could become trapped and seriously injured.

2.12 RIGGING POINT

Depending on site requirement, this rigging technique can be applied to assist horizontal movement of the magnet body on tanks.

It is a requirement that winches have adequate strength for moving the 17000kg load.

Allow a suitable margin for safety concern. Equipment deployed should be compliant with relative standards.

Shown below is a simple rigging point which is a permanent part of the building architecture.

Figure 17: Rigging Point

See below for details of rigging-point (i.e. anchor bolt) fitted to a rigging-winch along the move-in route. It is assumed suitable attachments are used for attaching suitable sling-rope.

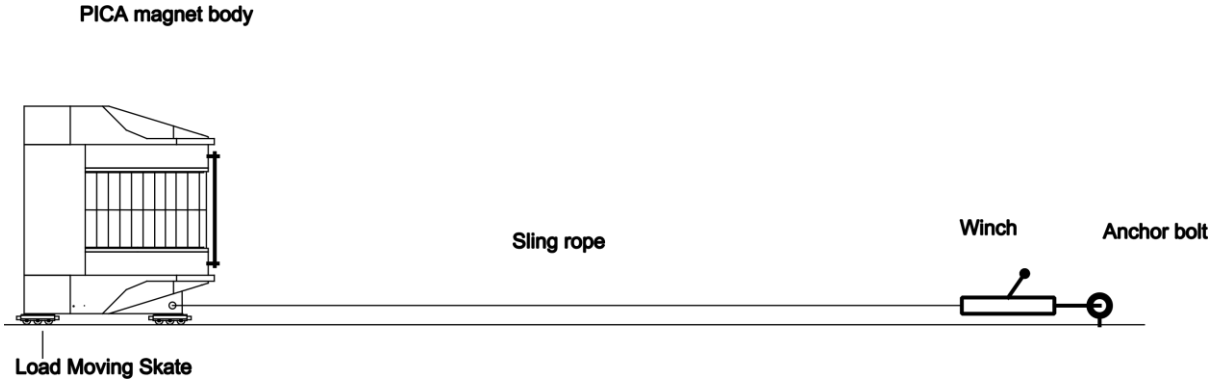


Figure 18: Illustration of Rigging Set-up

Pay extra attention to the selection, specification and fixing of mounting and fixing points (anchors).

A secure anchor is critical to winching operation. An anchor must be strong enough to hold while winching.

Before rigging, verify the anchor points for the following:
- Size and quantity of anchoring points conformed to site specific construction;
- Characteristic resistance to be tensile and shear;
- Design resistance to be tensile and shear;
- Recommended load to be tensile and shear;
- Anchor bolt installed into concrete; and
- Appropriate anchor bolt type (heavyweight variants) deployed.

Allowable load for anchors is subjected to combined shear and tension forces are determined by the following equation:

$(Ps/Pt) + (Vs/Vt) \leq 1$

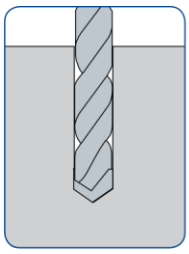
where:
- Ps = Applied service tension load.
- Pt = Allowable service tension load.
- Vs = Applied service shear load.
- Vt = Allowable service shear load.

Do not use anchor points for any other purpose.

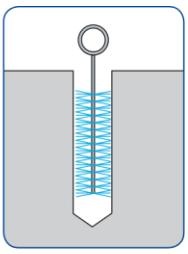
Follow the recommended guideline of heavy weight anchor bolt when installing anchor bolts.

Anchor holes must be pre-drilled in normal-weight concrete using a masonry drill bit. The anchors must be installed in holes with the same diameter as the nominal anchor diameter, drilled to the required depth.

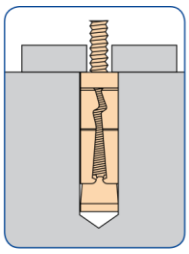
Installation of anchor bolt:
- Drill hole in correct diameter to the correct depth. Depending on concrete density, pilot holes may be drilled followed by drilling the correct diameter hole.
- Clean the hole thoroughly to remove dust and debris.
- Tapped the anchor bolt into the hole until it flushes with the work surface at the desired embedment depth.
- Use the correct setting equipment and procedure as specified by anchor bolt manufacturer.
- Tighten the bolt of the anchor assembly with the recommended torque.



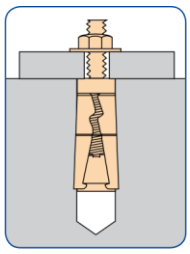
1: Drill a hole of required diameter and depth. Note: When fixing into brickwork, motar joints should be avoided.



2: Remove debries and thoroughly clean hole with brush and pump.



3: Remove nut and washer and insert anchor into hole. Position fixture over the thread.



4: Add washer and nut and tighten to recommended torque.

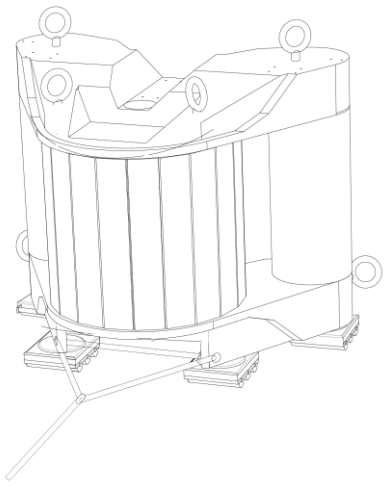
Observe the following winching safety notes:

- Read and understand operating instructions before using winches.
- Do not use the general purpose hand winches for lifting.
- Never lift or pull more than the rated capacities of the winches.
- Ensure wire ropes or straps are correctly secured before use.
- Never apply a load on the winch with the wire rope fully extended, always ensure there is at least three full wraps of wire rope on the drum at all times.
- Always ensure the winch is fastened securely to the structure and that the structure is capable of withstanding the intended load before operation.

2.13 SLING ATTACHMENT

Two designated points on the base of the magnet are provisioned for sling rope attachment. Select the correct Clevis/D-shackle and follow its instruction for correct usage.

Pass the sling rope through the shackle and ensure the sling legs are of equal length.



2.14 MINIMUM CORRIDOR WIDTH

The minimum corridor width for a right angle turn is illustrated below.

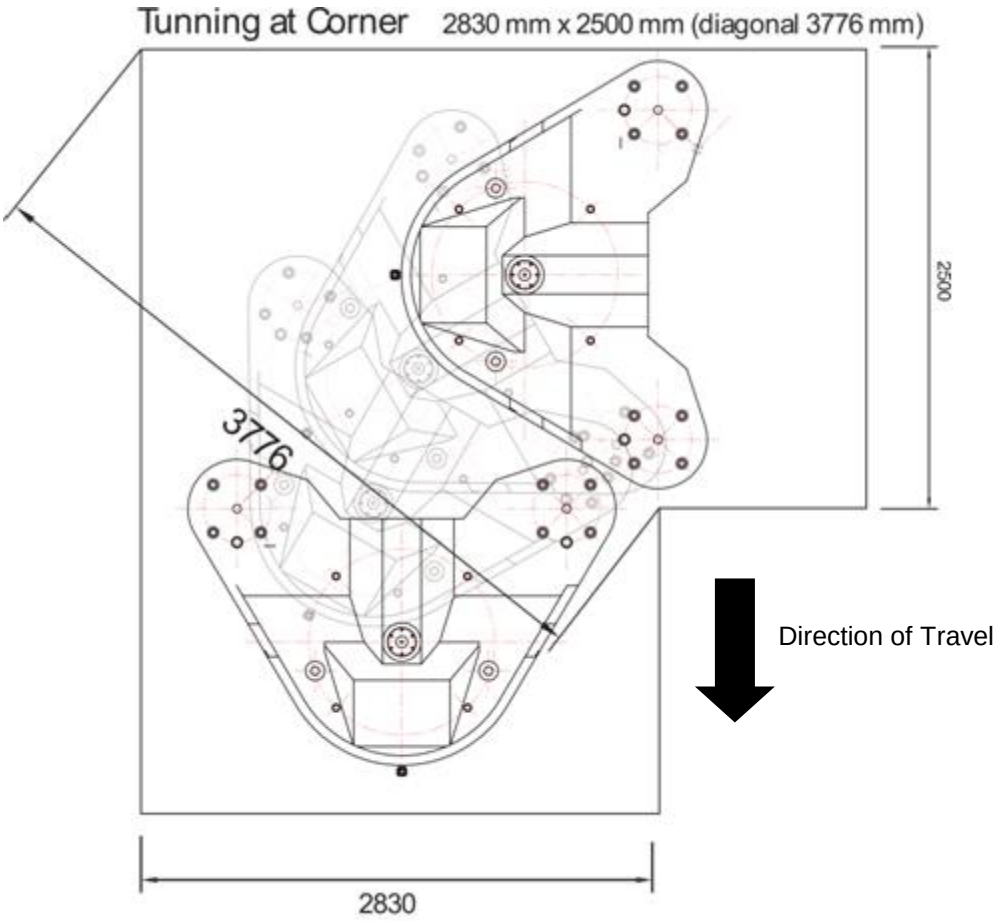


Figure 19: Minimum Corridor Width and Diagonal Width

2.15 MAGNET POSITION ADJUSTMENT AND CHECKING

During the construction of the shield room, the magnet isocenter or a datum has been defined. From this information, the exact placement of the magnet is known.

Before the magnet is positioned, the position of the PICA footprint sheet must be accurately established on the floor of the shield room at its intended position.

The accurate positioning of the magnet body relies on the accurate positioning of the PICA footprint sheet.

Refer to the PICA magnet footer document (Ref.: 2) for details.

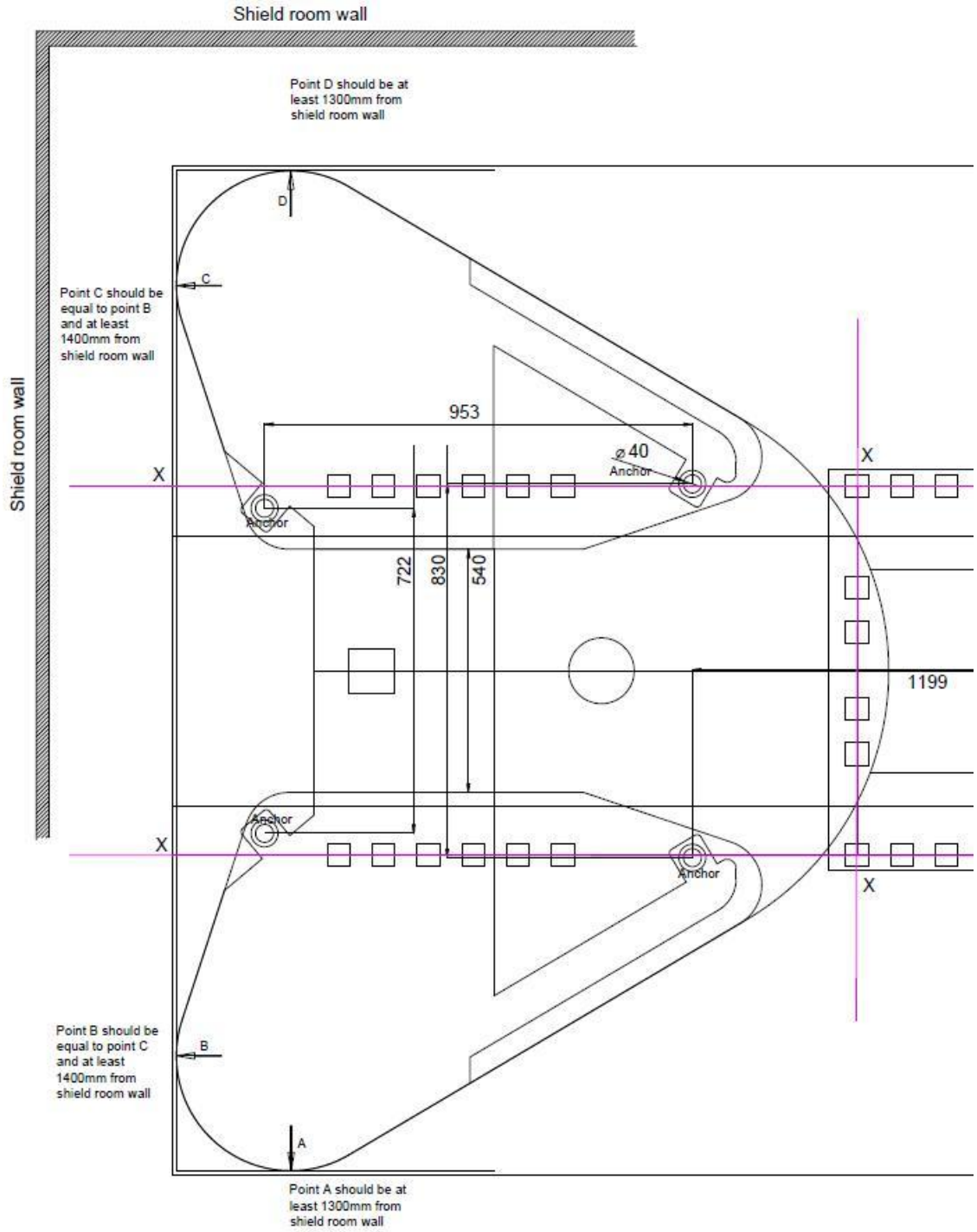
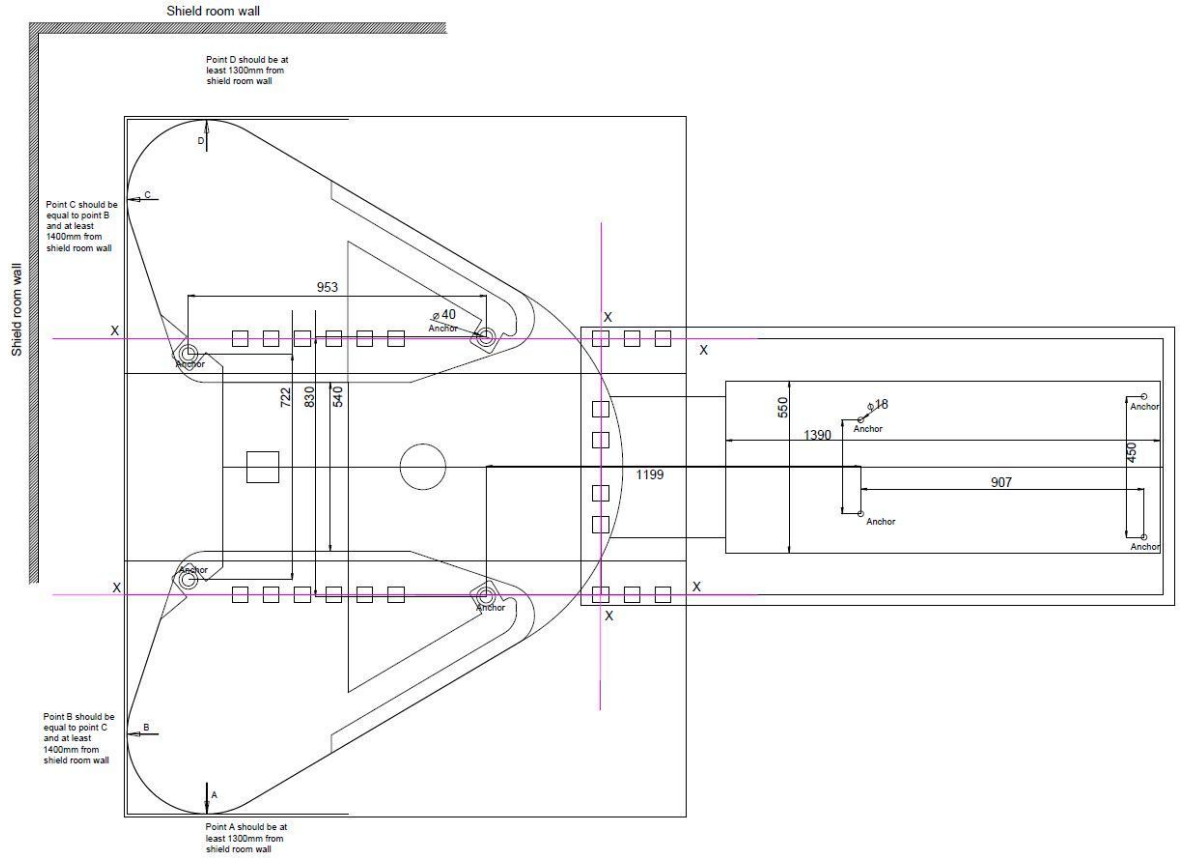


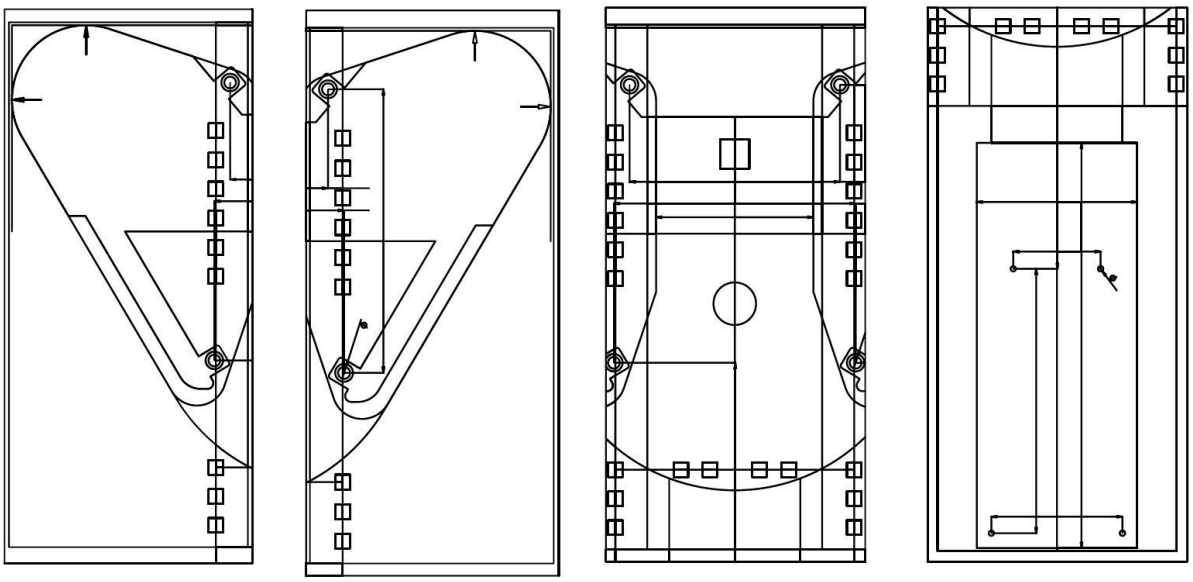
Figure 20: Datum and Magnet Isocenter Location

Follow the steps below for correct footprint sheet placement:

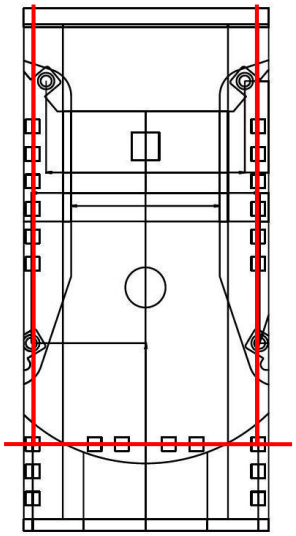
- Refer to the PICA magnet footer document (Ref.: 2) for the source drawing.



1. Prepare the following 4 footprint sheets.



2. Locate the following footprint sheet and cut along the centerlines bisecting the square markings as shown below.



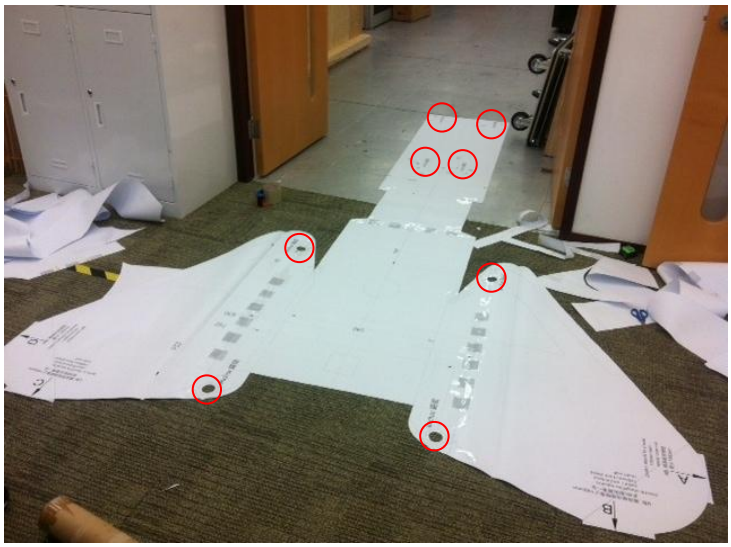
3. Put the above sheet on top of the others and align accurately the half square markings with the complete square markings on the other 3 footprint sheets.

4. Measure the dimension on the footprint sheets.

- The dimension information shown in the PICA magnet footer document is for measurement verification. If measurements of sheets from shipment do not match with those specified in the document, prepare another set of sheets.

5. Assemble the 4 footprint sheets together with tapes.

6. Trim the outline of the magnet footprint and all anchoring points as shown below.



7. Place the footprint sheet on floor of shield room, with special attention be paid to the following:

- Point B and C must be kept equally at least 1400mm from wall of shield room.

- Either point A or D must be kept at least 1300mm from wall of shield room.

8. Mark the positions of all anchoring points on the floor and remove the footprint sheet.

9. Position the magnet body aligning with the markings of anchoring points.

2.16 MAGNET BODY LEVELING

Place the spirit level on the rim of the magnet opening to verify the leveling of the magnet. Verify for each of the four locations.

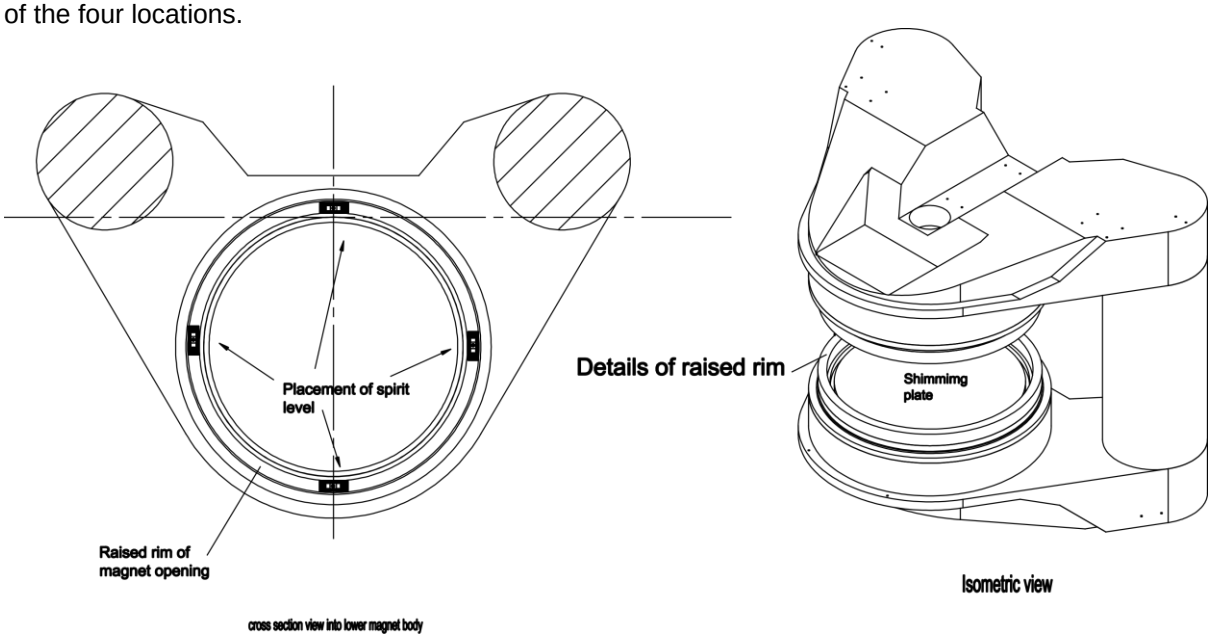


Figure 21: Spirit Level Placement on Magnet

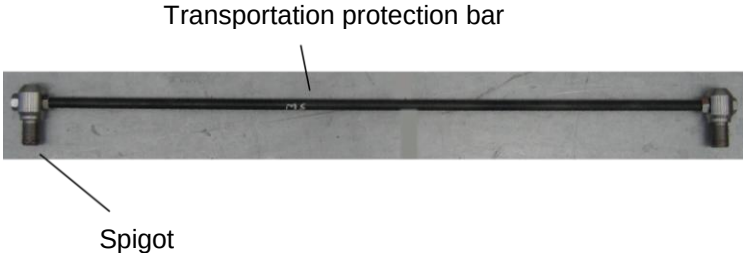
Insert additional fiber-glass shimming sheets to achieve magnet body leveling.

If shield room construction is carried out after the magnet is positioned, replace the wooden protective strips to provide protection during the remaining construction. Either tape or use the original wire to hold the wooden boards in place.

2.17 REMOVING TRANSPORTATION PROTECTION BAR

The magnet body transportation protection bar is a factory-fitted item to protect the magnet body from damage during transportation. Once the magnet body has been positioned and confirmed being level horizontally, the bar can be removed to commence the remainder of the system installation.

The bar is fitted to the front of the magnet opening, with a spigot attachment at the upper and lower magnet. Use a spanner to loosen and remove the nuts to withdraw the bar. Complete by unscrewing and remove both spigots from the magnet body.



2.18 REMOVING MAGNET-BODY PROTECTION

At this stage and after the shield room construction and decoration have been completed, the remaining protective materials that protect the magnet opening may be removed.

Remove plastic cover sheets if this has not been done.

Remove the holding wire that has been nailed down to the perimeter of the wooden protective boards.

Remove each wooden protective board and any protruding nails.

Carefully remove all wooden protective boards, remove gradient coil, accessories and other kit of parts from within the magnet opening. At this stage, the shimming plate should be visible.

To prepare for possible re-positioning, the transportation protection bar must remain in place to protect the magnet body opening.

2.19 MAGNET-BODY TASK COMPLETION CHECK LIST

After achieving the final move-in position, perform the following:

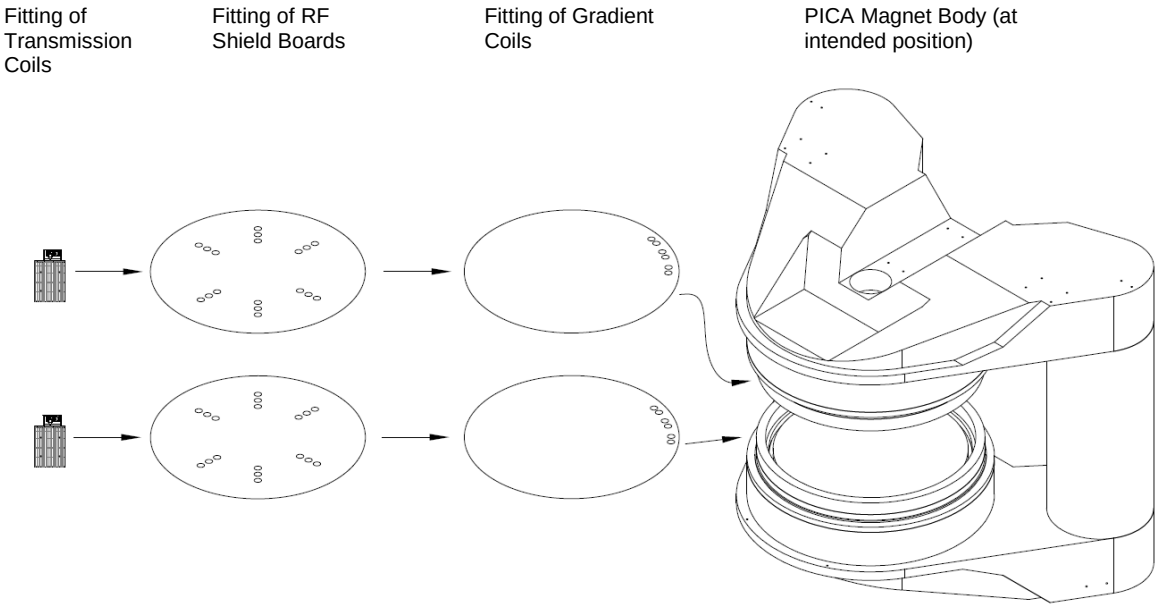
- Remove and dispose wrapping materials.
- Remove transportation protective wooden pillars at magnet opening.
- Good-inwards verification: magnet opening remains at 400mm.
- Remove transportation protection support bar at magnet opening.
- Remove jacking arms.

--End of Section--

3 SUBSEQUENT INSTALLATION TASKS

With the magnet in position, the following will be installed and cabled in sequence according to site access schedule:

1. Fitting of gradient coils (upper and lower), wiring of internal gradient cables. Refer to the gradient coil installation document (Ref.: 4).
2. Fitting of RF shield boards (upper and lower), wiring of earth wire. Refer to the RF shield board installation document (Ref.: 5).
3. Fitting of transmission coils (upper and lower) and wiring to frontend unit. Refer to the transmission coil installation document (Ref.: 6) and frontend unit installation document (Ref.: 7).



-- End of section --

4 REFERENCES

1	MS016 Inst Seq	PICA installation sequence
2	MS055 PICA Magnet Footer	PICA magnet footer
3	MS005 PICA Dimension	PICA dimension
4	15.02.01001P PICA QI	Gradient coil installation
5	17.17.01002V PICA QI	RF shield board installation
6	15.01.01011P PICA QI	Transmission coil installation
7	17.10.03002V PICA QI	Frontend unit installation
8	3500WB-02 QI	Installation planning

-- End of section --

--End of Document--

PICA WHOLE BODY MRI SYSTEM INSTALLATION PLANNING

TMS-MRI-3500WB-02

TIME MEDICAL SYSTEMS

The information contained herein is the responsibility of and is approved by the following, to whom all enquiries should be directed in the first instance:

Service Support
Time Medical Systems

Created by:	Reviewed by:	Approved by:
Date:	Date:	Date:

0.1 CONTENTS

Section Page

0.2 INDEX TO FIGURES AND TABLES

0.3 SAFETY NOTICES AND ADMONISHMENTS

This document contains safety notices in accordance with appropriate standards. In the interests of conformity with the territory standards for the country concerned, the equivalent territorial admonishments are also shown.

Any installation, adjustment, maintenance and repair of the equipment must only be carried out by trained, authorized personnel. At all times, personnel must comply with any safety notices and instructions.

Specific hazards are indicated by symbol labels on or near the affected parts of the equipment. The labels conform to international standards, are triangular in shape, and are colored black on a yellow background. An informative text label may accompany the symbol label.

Hazard labels are supplemented by safety notices in the appropriate equipment manual. These notices contain additional information on the nature of the hazard and may also specify precautions.

Warning:
These draw the attention of personnel to hazards which may cause death or injury to the operator or others. Examples of use are cases of high voltage, laser emission, toxic substances, point of extreme temperature, and etc.

Alert:
These draw the attention of personnel to hazards which may cause damage to the equipment. An example of use is the case of static electricity hazard.
Caution notices may also be used in this document to draw attention to matters that do not constitute a risk of causing damage to the equipment but at where there is a possibility of seriously impairing its performance, e.g. by mishandling or gross maladjustment. Warnings and Cautions within the main text do not incorporate labels and may be in shortened form.
.

0.4 SERVICING POLICY AND RETURN OF EQUIPMENT

The repair of individual unit and module of this equipment is not considered practicable without factory facilities. It is, therefore, the policy of Time Medical Systems whereby faulty units or modules are returned to the local agent for repair. To enable an efficient, prompt after sale service to be provided for the diagnosis, repair and return of any faulty equipment, please comply with the following requirements.

Returned items should be packaged to provide both electrostatic and physical protection. A completed Return Merchandize Authorization (RMA) should be included with the item for repair, and be sent to the nearest Time Medical Systems office:

Time Medical Systems

Time Medical Systems, Inc
3560 Dunhill Street, Suite #130,
San Diego, CA 92121,
USA
Tel: +1-858-458-0166

Time Medical International Pte Ltd
Block 71, Ayer Rajah Crescent
#03-05
Singapore 139951
Tel: +65-6776-7819

Hong Kong
Time Medical Limited
G/F, Bio-Informatics Centre
No. 2, Science Park West Avenue
Hong Kong Science Park, Shatin, N.T.
Hong Kong
Tel: +852-2156-1711

China
Time Medical System (Shanghai) Co Ltd
1/F, Block B, 563B Song Tao Road
Zhangjiang Hi-Tech Park
Pudong, Shanghai, 201203
China
Tel: +86-21-5080-4982

--End of Section--

1 INTRODUCTION

1.1 GENERAL

The installation and service of equipment described herein is performed by qualified personnel employed or authorized by Time Medical Systems or one of its affiliates. Any other personnel not employed by, directly affiliated with, authorized by Time Medical Systems or one of its affiliating technical services is required to contact the local office of Time Medical Systems or its affiliates for any servicing procedures.

This document specifies and describes the planning tasks for the correct installation of PICA Whole-Body MRI System to guarantee safe and trouble-free high quality imaging.

In general, an MRI system is sensitive to RF interference. A shield room is required for shielding the system from unwanted RF interferences. A built-to-specification shield room is required for a new MRI suite. Existing shield room may only be used for PICA, after consultation with Time Medical Systems.

During installation, observe all safe handling practices at each site, as well as the correct mechanical handling of strong magnet, high voltage electricity and various forms of RF energies.

1.2 ABOUT THE DOCUMENT

This document provides information for customer who plans to install an MRI system (hereafter referred to as customer) on site selection, assessment and preparation for civil works. It also provides guidance for customers to physically transport the PICA system to site and its final destination. Brief notes on system installation are mentioned.

1.3 OVERVIEW OF COMPONENTS

The PICA Whole-Body MRI System consists of the components shown below. Indicative weights and overall dimensions are provided within this document. Refer to the latest specification document (Ref.: 1) for changes to specification during the product lifecycle.

- Complete PICA Magnet System
- Patient Table
- Magsonance Imaging Cabinet
- Magsonance Isolated Power Cabinet
- Filter Penetration Panel
- Workstation (PC)
- RF Coils
- DICOM Printer (Optional)

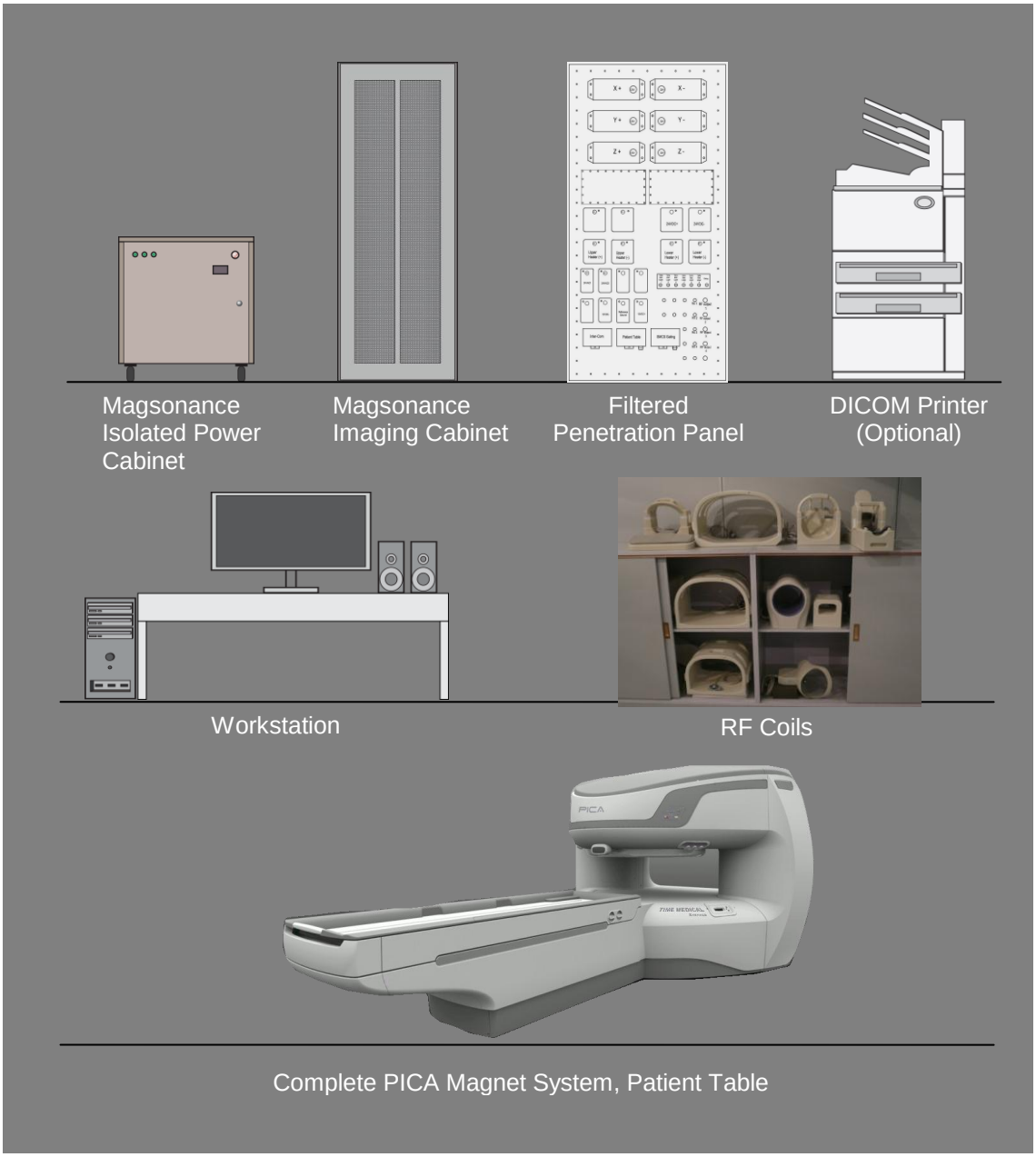


Figure 1: Components of PICA Whole-Body MRI System

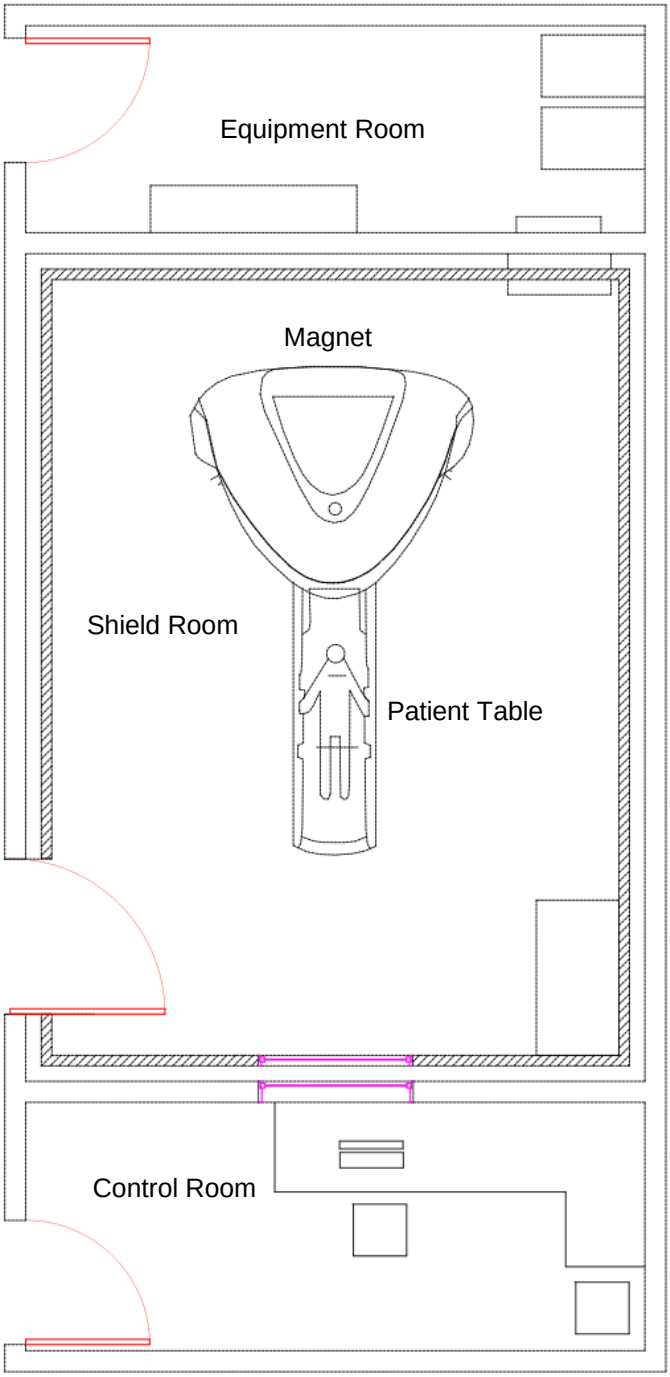


Figure 2: PICA Whole-Body MRI System Arrangement (for Illustration Only)

1.4 SYSTEM SPECIFICATION

Refer to the latest specification document (Ref.: 1) for the updated PICA system specifications.

1.5 SAFETY PRECAUTIONS

Only qualified operators should operate the PICA system. Operators are suggested to follow the instructions specified in training sessions offered by Time Medical Systems during installation.

WARNING Do not connect additional multiple portable socket outlets or extension cords to the system.

WARNING Do not connect items not specified as part of the system to PICA.

With the strong magnetic field generated from PICA's magnet, the following are strongly prohibited when using the system:

- Patients wearing electric implants. Electric implants such as cardiac pacemakers may be susceptible to interferences from the magnetic and RF fields produced by PICA, which may result in altered operation of those devices. Persons with cardiac pacemakers or other implanted electronic devices are therefore prohibited from entering the zone of magnetic field exceeding 5 gauss.

- Patients wearing ferromagnetic implants. The magnetic field exerts a force on ferromagnetic objects within the field, which may cause movements or displacements of these implanted surgical clips or other ferromagnetic materials such as an aneurysm clip or prosthesis. Patients suspected of having embedded conductive or magnetic fragments in or near the eye are required to remove or dislodge such fragmented or embedded objects before scan. These patients must be closely evaluated by a physician prior to scanning.

- Pregnant or possibly pregnant patients. Even though magnetic fields usually do not cause any harm to human, there are different opinions if it is safe for infants. Currently, no proof is available for the effect of health of pregnant women or infants for an MRI scan. Some pregnant women have had MRIs in the first trimester of pregnancy with no known side effects. However, to ensure safety, women who are less than three-month pregnancy should be prohibited from undergoing an MRI scan unless it is a life threatening situation.

- Decompensate cardiac patients. The time required for performing an MRI scan may pose a risk to decompensated cardiac patients and febrile patients with impaired ability to perspire.

Pacemaker hazard and other warning signs that indicate a magnetic field is present may be necessary at the rooms, or on the floors adjacent to the magnet.

The potential hazards of the presence of strong magnetic fields to devices such as certain pacemakers should be well-explained and illustrated. Cardiac pacemaker wearers should be refrained from entering a zone with high magnetic intensity which will cause adverse effects on cardiac pacemakers. For assistance on the effect of the system on pacemakers, refer to the pacemaker user manual, contact the manufacturer, or consult a physician. Actual level of intensity may vary and thus should be checked after the magnet installation.

Since the magnetic field exists in both horizontal and vertical directions, the effect of the field on human, electronic equipment, computers, and other objects located adjacent to the magnet must also be

considered. Pacemaker hazards and other signs illustrating a “magnetic field is present” signal are necessary at the floors adjacent to the magnet.

MRI workers are exposed to high levels of static magnetic field. The magnet’s strong magnetic field intensity is sufficient enough to attract free ferromagnetic objects, which can hit on anybody within and around the scanner, and cause injury. Time Medical Systems recommends properly defining and clearly marking the magnetic safety zone to help reduce this risk.

Caution must also be taken when imaging patients who are likely to develop seizure or claustrophobic reactions, who are known to have a higher potential for cardiac arrest, or who are unconscious, heavily sedated or confused, and with whom no reliable communications can be maintained (e.g. children).

There are patients who are prohibited from being examined by MRI, or should be examined with special care. Customers have the responsibility to plan for appropriate reception procedures, which serve the purpose of getting from patients all significant information necessary to determine if he/she can undergo an MR examination.

For qualified patient, it is the customer’s responsibility to implement appropriate levels of patient monitoring according to pre-determined procedures in which all possible levels of assistance have been considered. All patients should be granted at least visual and audio communication with the operator during examination.

Special cares and cautions should be taken for patients under the following situations during the examination:

- Patients with conductive or magnetic implants near or in the eyes
- Patients with decompensatory cardiac disease, pyrogenic or dyshidrosis disease, who are required to have physician’s approval to undergo examination
- Patients using medicinal products in transdermal patches that may cause burns to the underlying skin
- Patient having a higher possibility of cardiac arrest than usual cases
- Patient having a possibility of suffering from claustrophobia
- Patient under unconscious condition, deeply sedated condition, administrated with sedative, confused condition or incapable of full communications (e.g. children)

Figure 3: Strong Magnetic Fields Warning Sign

WARNING

Cardiac pacemaker wearers must remain outside the 5 gauss perimeter in all directions from the magnet until safety is clearly established. PICA whole-body MRI magnet generates strong magnetic and electromagnetic fields that can inhibit operation of some cardiac pacemakers, resulting in death or serious injury to the user. Consult the pacemaker user manual, contact the manufacturer, or consult a physician to determine the effect on a specific pacemaker. Time Medical Systems provides signs with each system to warn pacemaker wearers of this hazard.

1.6 FIRE PREVENTION

Installation of fire prevention at an MRI site should be done before installing the system. The fire prevention works should be implemented according to local fire prevention standards. Customer is required to provide non-ferrous fire extinguishers. Customer should also notify local fire officials of the presence of an MRI suite, and establish local rules associated with MRI systems.

1.7 LASER LOCALIZER

PICA is equipped with an integrated low-power laser localizer for accurate patient handling for imaging. The laser is a Class 1 laser device.

The use and operation of the laser localizer should be conducted by strictly trained personnel, conformed to its instruction manual and observed local laws and regulations.

WARNING

Human eyes are vulnerable to laser. Do not make direct eye contact with the laser localizer after it is on, so as to avoid potential harm to eyes.

Observe the following precautions at all times while using the laser localizer:

- The use of the laser localizer must strictly follow its instruction manual. Otherwise, harmful radiation exposure may occur.
- If the laser localizer is damaged, contact Time Medical Systems service personnel immediately for replacement. Do not dissemble or repair the laser localizer without permission.

The warning labels for laser localizer are shown as below. Refer to PICA user manual for positions of the warning labels.

Figure 4: Laser Warning Sign

The laser localizer is installed at the control panel on magnet cover. The installation and maintenance should be carried out by Time Medical Systems professional personnel. If any fault occurs during the use, contact Time Medical Systems service personnel promptly.

Refer to PICA user manual for use instruction of the laser localizer.

--End of Section--

2 OVERVIEW AND ROLES

Time Medical Systems suggests that customer should allocate at least 8 months for the selection, qualification, design and construction of an MRI imaging facility.

The table below lists the sequence for creating a PICA MRI suite, with the key roles and responsibilities of different parties involved identified.

Sequence	Task	Customer Responsibility	Time Medical Systems Responsibility	Remarks
1	Commercial negotiations	Project manager	Sales representative	Project manager provides technical clarifications
2	Establish customer file	Project manager	Sales representative	
3	Preliminary room layout	Project manager, Planner	Sales representative	
4	Check cable lengths	Project manager		
5	Final room layout	Project manager, Planner		A presentation and explanation followed by customer sign-off
6	Planning of required personnel		Time Medical Systems	
7	Schedule installation	Project manager	Time Medical Systems	Project manager coordinates different parties at customer side and provides possible schedule
8	Site and room preparation	Project manager		
9	Installation preparation	Project manager		
10	Arrange temporary storage	Project manager		Temporary on-site storage
11	System delivery	Project manager	Time Medical Systems	
12	System installation	Project manager	Installation team	
13	System startup		Installation team	
14	QA and acceptance tests	Project manager	Installation team	
15	Applications training	Application specialist		
16	Customer acceptance	Project manager	Installation team, Sales representative	

Table 1: Task Sequence and Party Roles

--End of Section--

3 INSTALLATION PLANNING PROJECT MANAGEMENT

3.1 PROJECT MANAGEMENT

Good management of the installation planning project helps reduce installation duration and expenses.

In planning the system installation, good communications on a frequent basis are essential between the customer, the facility planner or architect, and Time Medical Systems. Any questions or problems should be addressed immediately to avoid delays and additional costs.

We recommend appointing a person from the customer's institution as the project manager to coordinate site planning and preparation. The person should represent all users or the institution in dealing with Time Medical Systems and the facility planner or architect.

3.2 ROLE OF PROJECT MANAGER

Project manager is the customer's focal point for the entire project. The project manager must have the authority to execute project tasks and take ownership of the entire process from quote to turnover. He/She is responsible for the following:

- Communication between customer, suppliers and Time Medical Systems
- Handling all aspects of the installation planning and installation project
- Coordination between the technical and administrative facets of the project
- Ensuring to follow the schedules

Project manager should avoid unnecessary expense and make sure transportation personnel and equipment are ready for the shipment on the delivery day.

3.3 PROJECT MANAGER

The following information is required for successful site planning:

- Architectural drawings of the installation site
- Use of the rooms and surfaces within 40m radius of the magnet iso-center (items within the magnetic fringe field that are affected by the magnetic field or items that may affect the magnet homogeneity)
- Location of mass iron girders in the vicinity of the magnet

If the homogeneity of the magnetic field has been affected, the interference levels should be measured. Time Medical Systems will compute the room shielding required for the magnetic fringe field upon request.

In case of reasonable doubt, the mechanical vibrations of the installation site should be measured. Suspect locations include upper floors of buildings and areas near railroad tracks or truck routes.

3.4 PROJECT KICK OFF

When the project starts, the project manager establishes, initiates communications with all parties involved and commences to assist sales by tracking order processing, organizing logistic arrangements, such as delivery schedule and handling special requests.

3.5 ORDER ENTRY

Project manager facilitates the order entry process by assuring a complete technical clarification.

At this point, cables lengths for the rooms should be confirmed so that the correct cable sets can be ordered.

3.6 ORDER FOLLOW-UP

Project manager should keep track on the order progress and take responsibility on the following:

- Communication between customer and Time Medical Systems
- Coordination order modifications
- Supervision on timetables and project costs
- Tracking site preparation construction work
- Coordination between the installation supervisor, architect, installation team and logistics
- Responding to deadlines

3.7 DELIVERY AND INSTALLATION

Project manager should coordinate and monitor shipping, customs clearance and system delivery to the site. Project manager should also resolve issues with the carrier before system delivery such as:

- Establishing the transport route of the truck and crane
- Establishing the transport route within the building
- Ensuring the equipment for moving the magnet is on site

When the system is delivered, project manager must be on site to oversee the following:

- To resolve issues with the carrier before the system is delivered
- To clarify the final location of the individual components

Project manager should control and audit the installation progress, ensure the professional completion of the project and completion of all acceptance documentation.

3.8 PRE-INSTALLATION CHECKLIST

To make sure the MRI system is installed as planned, project manager must plan, supervise and coordinate the following:

- Installation-related schedules
- Construction work at the installation site (the finished site must be rooms that are properly cleaned up, etc)
- Completed installation of the heating and air conditioning systems
- Completion of ceilings, flooring, and cable ducts
- Installation of shield room
- Installation of RF shielding
- Suitability of transport routes, floor loading, intermediate storage, and etc.
- Installation of the on-site power and water supplies
- Transport of system components into the building and the site
- Mechanical and cable installation of the system components
- Availability of the required installation tools, measurement devices and spare parts. Installation tools are non-ferrous, and will be provided by Time Medical Systems for each customer installation.

--End of Section--

4 SITE SELECTION PROCEDURES

This stage concerns the identification of a suitable site for the PICA MRI suite. A site survey must be performed to capture key parameters prior to planning for civil construction. This stage prevents any non-compliance with the system specification.

Site selection is the process of finding a location for the magnet, which provides the least interference within the building it occupies. The selection of an optimum site is determined almost entirely by the high magnetic fringe field of the system. This process calls for skills and equipment to detect and evaluate the interaction of the magnetic field with the surrounding environment.

Time Medical Systems provides technical support and advice during site preparation. Time Medical Systems or one of its affiliates will send an authorized representative to visit the site at the beginning of installation and after the site is finished. The role of Time Medical Systems in the preparation period is to help the process run as smoothly as possible and to be available for consultation on any possible situation.

The selection process is as follows:

1. Customer uses this guide as a reference to locate several potential sites.
2. A site planning specialist visits the facility to further refine the selection process if necessary.
3. A facility planner or architect is engaged to assist with the capture of preliminary details of proposed site(s).
4. Customer provides and forwards detailed building/floor plans with the magnet location to Time Medical Systems.
5. Time Medical Systems reviews proposed site(s).
6. Customer and Time Medical Systems agree on the selected site.
7. An architect or facility planner draws up architectural and construction plans for the proposed facility.
8. Time Medical Systems reviews and gives advice on the final site drawings.
9. Customer commences civil works for MRI suite construction.

4.1 BUILDING INFRASTRUCTURE VIBRATION REQUIREMENTS

Building vibration or shocks affecting the magnet may degrade image quality. Vibration acceleration amax* transferred by means of building vibrations to the magnet must not exceed -70dBg for all three spatial orientations in the frequency range of 0 to 100Hz.

The presence of other equipment in the building may affect the maximum level of vibrations. Perform vibration measurements during working hours.

The positioning of magnet near the bearing walls or main structure will reduce vibration that the magnet is exposed to.

* amax is the maximum RMS value measured in the Fourier transformation of the recorded signal spectrum.

4.2 ROOM SPECIFICATIONS

In general, three rooms are defined for an MRI suite:

- Shield room
- Equipment room
- Control room

Below is the summary of recommended internal specifications of the rooms with RF and magnetic shielding installed.

Specification	Shield Room	Equipment Room	Control Room
Recommended floor size (Internal dimensions)	6500 x 4500mm (21.3 x 14.8ft.)	3000 x 3000mm (9.8 x 9.8ft.)	3000 x 4000mm (9.8 x 13.1ft.)
Minimum ceiling height	3000mm (9.8ft.)	2800mm (9.2ft.)	No strict requirement
Floor requirements	Antistatic, level	Antistatic	Antistatic
RF shielding	Better than 90dB attenuation at 10MHz; better than 100dB at 100MHz	Not required	Not required
Magnetic field shielding	Mandatory	Not required	Not required
Power outlet provisioning	For clinical equipment: 3 x 110/220 VAC recommended	Mandatory: 1 x 380 VAC (3 phase) For other loads: 3 x 110VAC or 220VAC recommended	For IT equipment: 6 x 110VAC or 220VAC recommended
Network outlets (LAN)	No requirement	2 (directly connected to control room)	2 (directly connected to equipment room)
Climatic control by HVAC	Mandatory	Mandatory	For general human comfort
Internet connection (WAN)	Not required	Not required	Mandatory Minimum requirement: 1Mbps (upload/download) Suggested: 2Mbps (upload/download)
Power supply requirement		MCCB (125A)	

Table 2: Room Specification

4.3 MAGNETIC FIELD CONSIDERATION

The surroundings of the MRI site(s) must be examined very carefully. It is important to check for magnetic interference or fluctuation due to external field sources, moving metallic objects or other causes at an early stage of the project.

The first consideration in site planning is the interaction of the fringe field with objects that come within its range. Contact Time Medical Systems for advice on magnetic field and its effect on existing installation. The fringe field contour around the magnet is visualized as spheroid.

4.3.1 SOURCES OF MAGNETIC FIELD FLUCTUATIONS

Building steelworks and reinforcements within 6m of the magnet iso-center affects the magnetic field homogeneity within the measuring area of the magnet. Details should be provided to Time Medical Systems of beams and columns in excess of 100kg/m around the shield room and reinforced concrete or steel beams up to 40kg/m^2 below the magnet. These pieces of information allow Time Medical Systems to ensure that the magnet will reach the required specifications.

The need for magnetic compensation and the shielding method is determined according to the quasi-static (DC < 5Hz) and slow changing magnetic field fluctuation (AC 16-20Hz; AC 50-60Hz).

Maximum Acceptable Magnetic Fluctuation Values without Magnetic Compensation Requirements		
DC (<5Hz)	1mG	100nT
AC (16.6Hz)	0.2mG	20nT
AC (50-60Hz)	1mG	100nT

Table 3: Maximum Acceptable Magnetic Fluctuation

4.3.2 INTERFERENCE CONSIDERATION

Common sources of magnetic interference are fluctuating loads on adjacent power lines, radio or television transmissions, heavy-duty transformers, elevator motors and similar electromagnetic devices. Consult Time Medical Systems for concerns about the proximity of electromagnets, elevators, loading docks, parking areas, and etc.

Maintain a minimum distance between magnet and anything that can cause a detrimental effect on the field homogeneity or the structural integrity of the magnet. Conditions that may interfere with the magnet include (but not limited to) a wall with metal sheathing or steel studding, a concrete support column with steel reinforcing bars, and cryogenic storage area containing steel dewars. Analyze each site carefully to ensure optimum performance of PICA.

Source of Interference	**Minimum Distance**
- AC 50Hz or 60Hz	>10m
- AC 50Hz or 60Hz: transformers, fans	>10m
- AC 16.6Hz or other train frequencies	>400m
- Moving iron (dynamic interference)	
• <50kg: e.g. wheel trolleys	>5m
• 200kg: e.g. patient table	>7m
• 900kg: e.g. cars, small elevators	>9m
• >4500kg: e.g. trucks, large elevators	>15m
• >20000kg e.g. big trucks, excavators	>25m
DC cables from trams or subway	>50m

Table 4: Minimum Distance to Source of Interference

Objects that Affect Magnetic Field	
15-gauss line or closer	All ferromagnetic construction materials except small amounts of steel reinforcing bar, normally not exceeding 11kg/m^2 (2.5lb/$ft.^2$)
5 to 15 gauss	Presence or movement of ferromagnetic objects over 45kg (100lbs): pushcarts, hand trucks, gas cylinders and etc.
2 to 5 gauss	Presence or movement of ferromagnetic objects over 450kg (1000lbs): small delivery trucks, automobiles, pallet movers, forklifts, elevators and etc.
1 to 2 gauss	Presence or movement of ferromagnetic objects over 34000kg (75000lbs): trains, large trucks and etc.
Objects Affected by Magnetic Field	
15-gauss line or closer	Cardiac pacemakers, ferromagnetic implants, and unrestrained ferromagnetic objects: tools, keys, electronic equipment, analog watches, magnetic data storage media, credit cards and etc.
5 to 15 gauss	Cardiac pacemakers and electronic equipment: shielded CRTs, computers, shielded image intensifiers, shielded photomultiplier tubes and etc.
2 to 5 gauss	Very sensitive electronic equipment: unshielded image intensifiers, photomultiplier tubes and etc.
1 to 2 gauss	Extremely sensitive electronic equipment: linear accelerators, electron microscopes, CRTs and etc.

Table 5: Interaction between Common Objects and Magnetic Field

4.3.3 SERVICE LINE

The permissible magnetic flux density B (magnetic induction) for the AC, three-phase power meter is B ≤2mT.

Magnetic shielding must be provided at higher magnetic flux densities to ensure the proper operation of the AC and three-phase power meter.

--End of Section--

5 INFRASTRUCTURE SPECIFICATIONS

5.1 MRI SUITE FLOOR LOADING SPECIFICATIONS

Magnet is the heaviest component of the whole-body MRI system, which weights around 17000kg (37479lbs) (excluding shielding, gradient frames and patient table). Floor loading requirement is above 45kPa.

For floor loading calculation, refer to the table below for overall dimensions and weights of each major component.

Components	Overall dimension (LWH or DWH)	Weight
PICA magnet system (Magnet unit w/ cover)	2260 x 2740 x 1996mm (7.4 x 9.0 x 6.5ft.)	17200kg (37840lbs)
Magsonance imaging cabinet	910 x 610 x 1735mm (3.0 x 2.0 x 5.7ft.)	387.5kg (937.2lbs)
Magsonance isolated supply cabinet	670 x 820 x 970mm (2.2 x 2.7 x 3.2ft.)	315kg (858lbs)
Patient table	2600 x 804 x 780 mm (8.5 x 2.6 x 2.6ft.)	470kg (1034lbs)

Table 6: Major Component Dimensions and Weights

With respect to the “front view” of each unit, LWH denotes Length x Width x Height and DWH denotes Depth x Width x Height.

The weight due to the shielding materials of the shield room is required for consideration. Based on the recommended dimensions stated earlier in this document, it is assumed to be about 2000kg (4400lbs).

5.2 RF SHIELDING

The RF shielding requirement of the shield room is to achieve better than 90dB at 10MHz and better than 100dB at 100MHz.

5.3 NOISE ATTENUATION

The MRI suite should be noise attenuated. The attenuation levels of each room are listed below:

- Equipment room: <73dB (A)
- Shield room: <83dB (A)
- Control room: <63dB (A)

5.4 MRI SUITE FLOOR LEVELING SPECIFICATIONS

The floor must be leveled better than: 5mm/3m.

Maintain the floor leveling to this specification to guarantee the correct functioning of the equipment.

5.5 FLOOR COVERING SPECIFICATIONS

Floor coverings within the MRI suite must be antistatic and meet the following requirements:

- Less than 1.3kV electrostatic potential
- 3-second half life
- 10^5 - $10^{10}\Omega$ impedance
- Carpet meets IBM-CL standards
- Floor covering does not ground the RF shielding

NOTE: The RF shielding must be undamaged in any way and must remain electrically isolated from the building earth ground. Internal finishes to the RF shielding must be fitted according to the manufacturer's instructions.

5.6 ELECTRICAL SYSTEM SPECIFICATIONS

5.6.1 LINE CONDITIONING

To protect the system from unexpected high voltages (transients, surges and spikes) that may occur in the power lines, we recommend transient surge protector. The transient surge protector must meet the following requirements:

- Service frequency: 50/60Hz
- Response time: 5ns
- Power dissipations: 300,000W/phase at Vmax (1 x 1000µs)
- Standby power: 10W/phase max
- Minimum clamping voltage: 470V peak
- Maximum clamping voltage: 700V peak

5.6.2 LINE VOLTAGE STABILIZER

A line voltage stabilizer is required when the line voltage specifications cannot be maintained.

5.6.3 PICA POWER FEED SPECIFICATIONS

The whole-body MRI system must have a dedicated main power supply. Do not connect any mechanical services (e.g. air conditioning) or other domestic circuits to the same supply.

The power source to PICA must comply with the values shown in the specification document (Ref.: 1):

Requirement	**Specification**
Voltage and frequency	Standard: 380 VAC 3-phase ±10% (50Hz ± 1Hz) With option: 440VAC ±10% (50/60Hz ± 1Hz)
Line-to-line unbalance	2% max.
System power consumption (excluding: lighting and IT equipments)	42kVA max.
MCCB breaker current	63A max.
Maximum line impedance	0.24Ω at 380V, 0.32Ω at 480V; rising linearly
System ground	2 grounds (MRI system and MCCB), <1Ω
Neutral-to-ground voltage	<2V

System transformer generates large instantaneous current during start up. Type D MCCB with time delay is recommended.

A line voltage stabilizer is required when line voltage specification cannot be maintained.

5.6.4 SYSTEM GROUNDING

To prevent the introduction of earth loops, all equipment earth must be connected to the same ground and earthed to building ground.

5.6.5 MCCB CIRCUIT BREAKER

An MCCB circuit breaker, which is used for protection and emergency shutdown, should comply with the following specifications.

- Ambient temperature for MCCB co-ordination purposes: +40°C
- Breaker rating (continuous amperes) In: 63A (max.)
- Protection: D curve
- Maximum voltage ratings: 480/277VAC
- Terminal connectivity: 0.75-25mm^2

5.6.6 POWER FEED CONNECTION SPECIFICATIONS

Refer to the specification of electrical connection for power feed into the Magsonance isolated power cabinet. Use power cable with 25mm^2 CSA conductors for power feed.

5.6.7 PICA CABINET – POWER CABLE DISTRIBUTION

In accordance with the Time Medical Systems installation planning, the electrical contractor supplies and runs a 5-core 16 mm^2 type CY screened cable between Magsonance isolated power cabinet and the imaging cabinet.

Power connections between cabinets are carried out by Time Medical Systems. The electrical contractor is responsible for power connections excluding those between the cabinets.

A 3m cable tail is required for the main supply cable connection within the cabinet. The tail is measured from the chassis of Magsonance isolated power cabinet.

All other system main and signal cables are supplied by Time Medical Systems which is responsible for the MR system installation after the delivery to the site. Connections to the emergency stop buttons may not be considered part of equipment installation. It is regarded as part of the responsibility of the electrical contractor along with lighting and small power.

All cable connection to the shield room must pass through the penetration panel (i.e. RF filter). It includes all lighting and small power. Shield room provider should provide RF filters for the single power circuit (lighting) with a maximum rating of 20-30A, and a single power filter with a maximum rating of 20-30A. All circuits within the shield room should be completed and tested through a loop of cable temporarily passing through the RF penetration panel aperture. Final connection to the filters is made following delivery. An 8mm lug on either side of the filter is required.

All electrical trucking and conduit in the shield room should be non-ferrous. Routes are required from the RF penetration panel to the magnet and emergency stops. Cable trucking/tray is required between system components, and constructed to run above the false ceiling, dropping down at the appropriate position within the internal wall. Holes in the ceiling tiles are required at the appropriate locations.

All emergency stops should be mounted at 1800mm (5.9ft.) above the floor level. The cable route should be within the wall, including the PICA MRI system cable completed with connector.

5.7 HVAC SYSTEM

Provision of dedicated HVAC equipment is required to maintain the ambient temperature and humidity of the MRI suite.

The climatic conditions of PICA MRI suite should be maintained at:

- Shield room
    - Desired ambient temperature: 21°C ±3°C
    - Temperature Stability: 1°C/hour max
    - Relative humidity: 50% ±5%
- Equipment room
    - Temperature range: from practical ambient temperature to a maximum of 30°C
    - Relative humidity: 40 to 70%, without condensation
- Control room
    - Temperature set for human comfort: room temperature typically ranges between 17°C and 27°C depending on establishments
    - Relative humidity: 40 to 70%, without condensation
- To maintain shielding, use “RF honeycombs" for supply and exhaust air duct.
- Filtration: classification EU 4, >80% Ashrae
- Ventilation/air change rate as per clinical environment

If the above values are exceeded and 3Wkg is applied, body temperature may increase by more than 1°C (established tolerance value).

Refer to the table below for PICA system heat dissipation.

Location	**Equipment**	**Mean Heat Dissipation**	**Maximum Heat Dissipation**
Shield room	PICA magnet, frontend unit, lighting, patient table and heat from cablings	1.20kW	1.20kW
Equipment room	Magsonance cabinets and heat from cablings (typical value based on normal operational usage)	2.80kW	5.85kW
Control room and evaluation room	Provisioned with PC and monitor (2 sets), printer and quad panel medical film viewer	0.44kW	0.44kW
Total heat dissipation		4.44kW	7.49kW

Table 7: PICA System Heat Dissipation

Considering the mean total heat dissipation as cooling capacity (total/sensible), the climatic control by HVAC system should be at 4.4kW.

5.8 HVAC DUCTWORK

All HVAC ductwork interfacing the shield room has to be nonferrous and connected to an RF filter (provided by the RF shielding supplier). Ductwork connections to these filters must be electrically isolated by means of a rubber or similar material joint.

5.9 MRI SUITE ENVIRONMENT MONITORING

To achieve optimum performance of the system, it is important to provide patients and operators with a comfortable environment, as well as to meet the temperature, humidity and other environmental conditions.

If environmental requirements are not maintained/achieved, system functioning and image quality are not guaranteed.

For daily temperature and humidity record of each room in the MRI suite, it is recommended to either operate a chart recorder or to monitor centrally with the help of building management services. It gives an indication of problems arising from changes in the rooms as soon as possible.

5.10 ILLUMINATION SYSTEM

No fluorescent lights or dimmer switches are permitted in the shield room. Tungsten lamps with non-ferrous fittings are required, with different levels of illumination achieved through selective switching in the room. DC voltage is recommended to increase lamp life and prevent any RF from being generated by a faulty bulb. A transformer and rectifier outside the shield room with output ripple of less than 5% are required.

For comfortable working condition, it is recommended that the level of illumination is 300lux, which maintains all parts of the MRI suite, together with a separately switched fitting mounted directly above the magnet.

In the control room, where operators control the workstation, install suitable anti-glare lighting with dimmer switch for operator comfort.

5.11 OTHER SMALL POWER LOADS

For powering other clinical/optional loads at the site, consult site requirement for detail. In general, twin power outlets for servicing are required adjacent to the equipment room. Equipment in the equipment room requires a single power outlet.

Twin power outlets for servicing are required for the control and evaluation desks and for cabinets in the equipment room. A single outlet is required adjacent the magnet.

To discourage accidental use of ferrous equipment (e.g. vacuum cleaners), do not install a user-accessible power outlet within the shield room. Such power outlets may have safety hazards.

Time Medical Systems suggests a wall outlet should be prepared and reserved for use with equipment that comes with patients (e.g., patient monitoring or anesthesia). The use of isolation transformer is required and the additional RF filters may also be required.

5.12 FIRE EXTINGUISHERS

Customer must provide non-ferrous fire extinguishers. Notify local fire officials about the presence of an MRI suite and establish local rules and codes associated with MRI systems.

5.13 METAL DETECTORS

Hand-held "wand" type metal detectors are recommended to use together with a questionnaire to prescreen patients before entering shield room.

5.14 STORAGE LOCKERS – GENERAL

Provide storage lockers outside the shield room for temporary storage of items that are sensitive to strong magnetic fields (e.g. watches, credit cards).

5.15 STORAGE – PHANTOMS

Provide sufficient space in the shield room for all test phantoms and surface coils storage.

The arrangement allows the temperature of test phantoms to maintain equilibrium, as well as for general ease of access.

Recommended storage is a 600 x 1500mm (2.0 x 4.9ft.) free-standing cupboard unit with 3 or 4 shelves.

5.16 STORAGE – OTHER PICA MATERIALS

Provide space in the equipment room for storage of technical documentations. The minimum requirements are double-door tall cabinets.

The relative humidity for storage and transport is 60-80% non-condensing. The recommended storage temperature range is -20°C to 45°C.

5.17 NETWORK CONNECTIVITY

PICA is an MRI solution with advanced network function which allows remote diagnosis.

Arrange a working WAN network connection available in the control room. Collaborate with local IT department for the appropriate firewall, virus protection and security settings provisioned.
Install 2 cable outlets in equipment room and control room for LAN cables running through walls.

For details of network requirement, refer to the “room specifications” section.

Time Medical Systems makes extensive use of the internet to support its imaging solutions with a globally installed base.

5.18 TELEPHONE LINE

Time Medical Systems recommends the provision of a regular voice telephone line near the workstation to provide on-line support to the operator.

--End of Section--

6 SHIELD ROOM SPECIFICATION

This section provides specification for the shield room of PICA.

The following components are located in the shield room:

- PICA (magnet and patient table)
- Frontend unit
- Cables and connections to penetration panel

Shown below is the overall dimension of PICA (diagram not in scale, for illustration purpose only). For detailed dimension of PICA, refer to PICA specification document (Ref.: 1).

The frontend unit is a mounted unit located in the magnet cover for the cable connections of components.

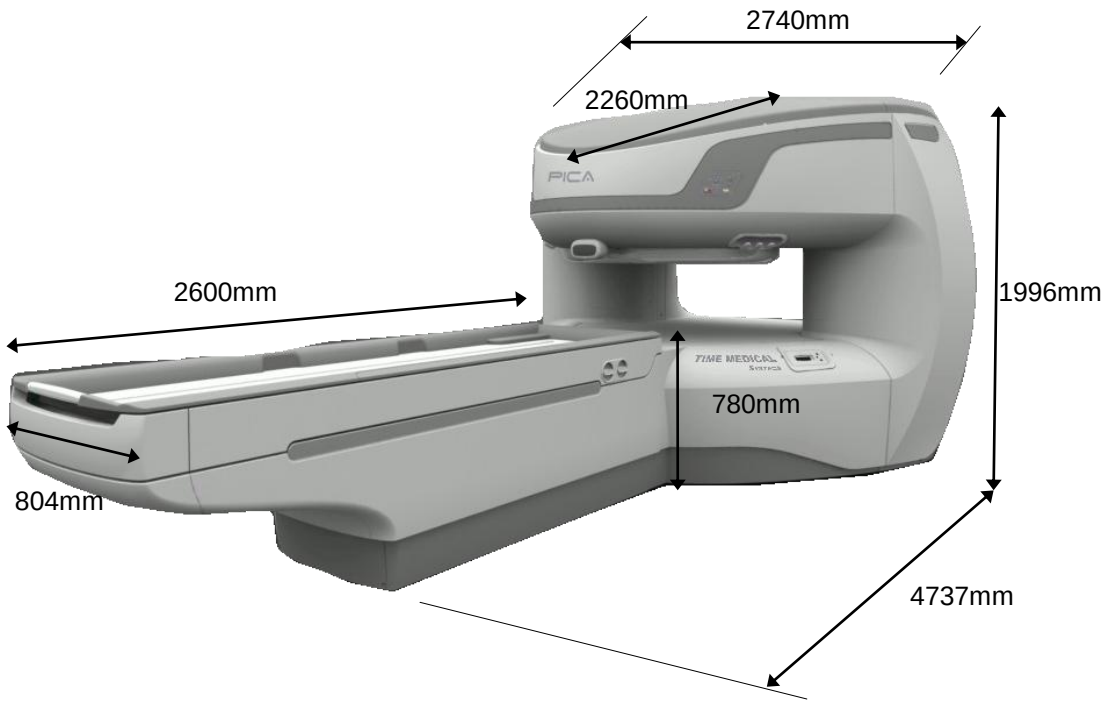


Figure 5: Overall Dimension of PICA in Shield Room

6.1 SHIELD ROOM COMPONENTS

Shield room contains the following components:

- RF shielding
- Magnet and magnet cover
- Patient table
- RF transmit and receiver coils
- Emergency stop button

6.2 CIVIL SPECIFICATION – SHIELD ROOM

Requirement	Specification
Recommended floor size (Min.)	6500 x 4500mm (21.3 x 14.8ft.)
Ceiling height	3000mm (9.8ft.)
Floor loading	45kPA vertical floor loading at contact points 20.0k/N/m^2 actual load for all areas
Floor level	5mm/3m
Floor covering	Antistatic floor covering
Door size - delivery access (W x H)	1200mm x 2100mm (3.9 x 6.9ft.)
Viewing window	Safety glass and double-layer screen mesh between shield room and control room
Door opening – general access	As per local protocol for medical facility
Power outlets – PICA	Power supply to PICA equipment made through connections on the penetration panel within the shield room
Power outlets – clinical equipment	3 power outlets at 110/220VAC outlets, 20A circuits with surge protection recommended
Cable routing	2 sets of 500 x 70mm (1.6 x 0.2ft.) wooden/plastic cable trays recommended
HVAC	See “heat dissipation” section of this document

Table 8: Essential Specification for Shield Room Construction

In addition to the essential specifications listed above, specific requirements for each component within the shield room are as follows.

6.3 MAGNET ANCHORING

For magnet anchoring information, contact Time Medical Systems for support.

6.4 SHIELDING SPECIFICATIONS

Magnetic shielding (shown below for illustration purpose) is necessary to contain the stray magnetic field and helps to isolate the PICA magnet from unwanted effects of nearby ferrous objects.

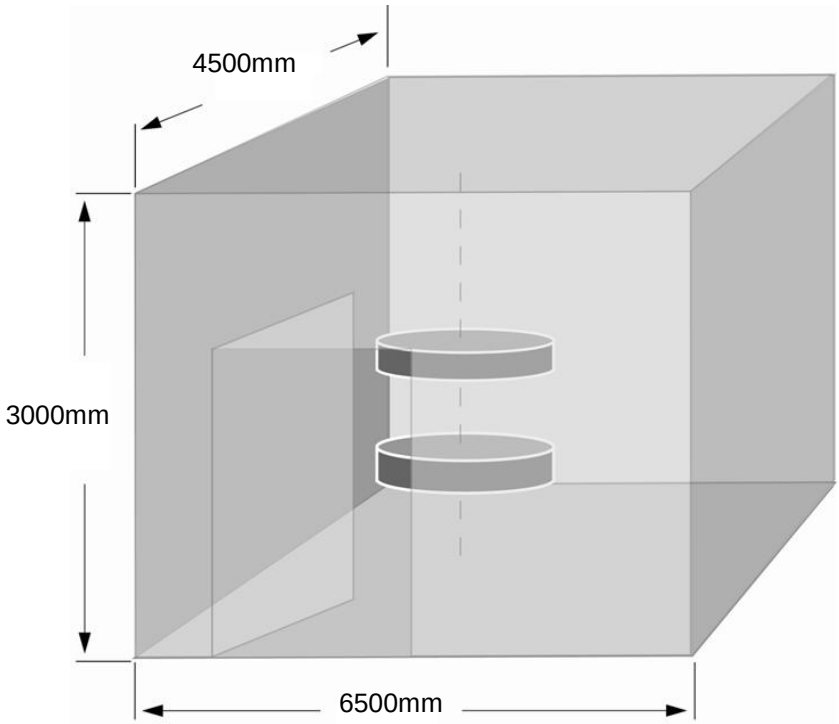


Figure 6: Magnet Shield Room Concept

During site planning for PICA, the following environments must be considered:

- Influence of the stray magnetic field
- Effect of any ferrous objects, both static (e.g. reinforcement, beams, columns) and dynamic (e.g. elevators, cars, trucks)

The extent of the stray magnetic field depends on the field strength of the PICA magnet. The magnetic field should be kept out of other work areas. The following stray magnetic field effects should also be considered:

- 5 gauss (0.5mT) – pacemaker, insulin pump, and metal prosthesis limit. An access-controlled area must be established to ensure all people fitted with cardiac pacemakers, insulin pumps, or metal prostheses are prevented from entering.
- 0.5 gauss (0.05mT) – Limit for X-ray image intensifiers, gamma cameras and linear accelerators

Large fixed or moving ferrous objects can affect the quality (homogeneity) of the magnetic field used for imaging. To ensure that the magnetic field within the measuring area can be shimmed to within the required homogeneity, customer should make sure that all steelworks and reinforcement beams are within 6m (19.7ft.) of the magnet center. Absolute limits are beams or columns in excess of 100kg/m around the shield periphery and reinforced concrete or steel beams up to 40kg/m^2 below the magnet.

The use of additional magnetic shielding (iron plates on walls, ceiling and floor) helps satisfy the requirement for most site conditions. This shielding can be constructed from soft iron plates, laminated low-silicon steel, or any other ferrous material for which the BH curve (hysteresis curve) is known. The required thickness and extent of the required shielding depends on the characteristics of the site and the properties of the material used, and must be calculated by an appropriate specialist.

6.5 STRAY MAGNETIC FIELD CONTAINMENT

The permanent magnet generates a homogeneous magnetic field with field strength of 0.35T. The main field is oriented in the direction along the vertical axis of the magnet.

The stray magnetic field (or fringe field) can affect the functions of devices operated in the vicinity of the magnet. Contact Time Medical Systems for advice on devices that might be affected by magnetic fields. The figures below show stray magnetic field distances for the MRI imaging magnets.

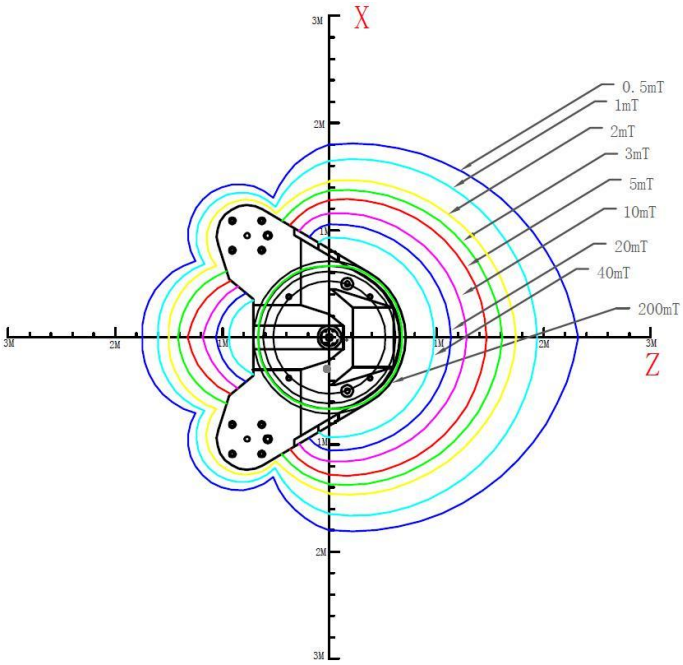


Figure 7: Top View of Stray Magnetic Field Profile

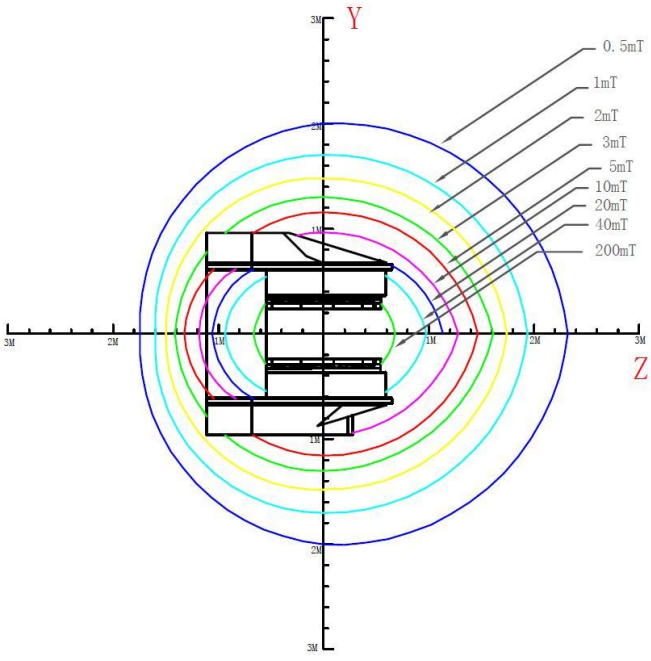


Figure 8: Side View of Stray Magnetic Field Profile

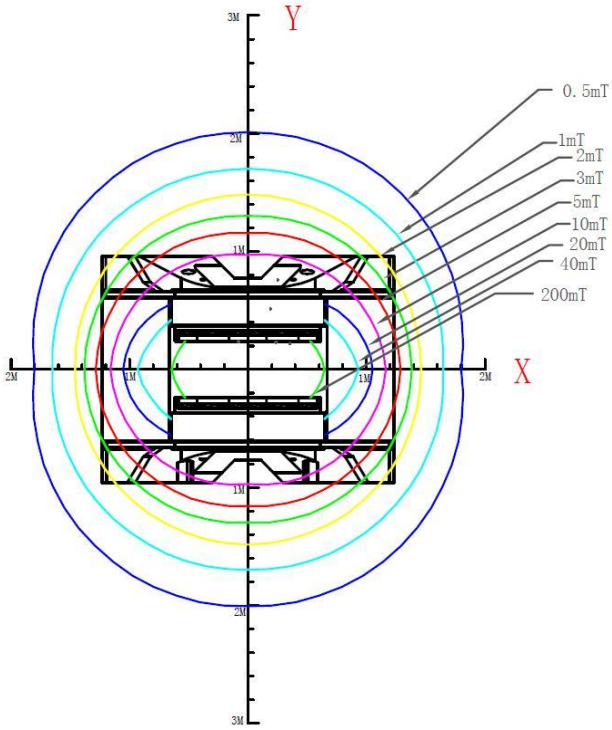


Figure 9: Front View of Stray Magnetic Field Profile

Shown below is the top view of the PICA, completed with patient table.

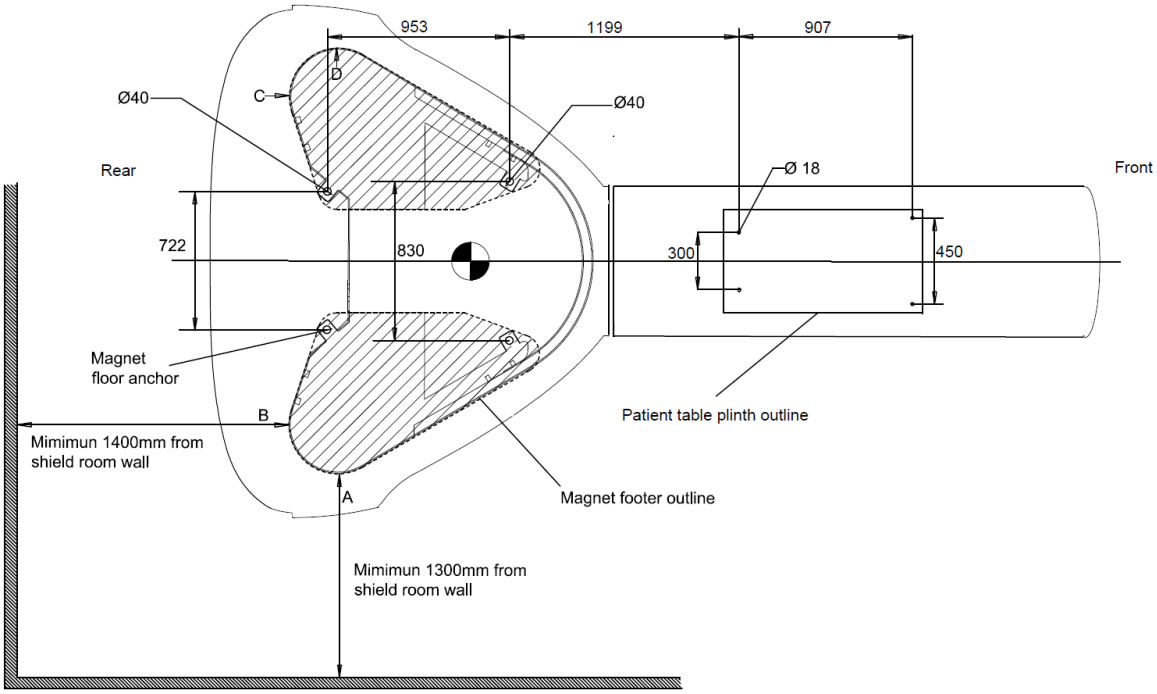


Figure 10: Magnet and Patient Table Dimensions, Top View

Requirement	**Specification**
Shielding requirement	RF shielding achieves at least 90dB at 10MHz and at least 100dB at 100MHz Aluminum sheeting surrounding the magnet for RF shielding, or surrounding the entire room with iron walls with thickness of 1-7 inch. Iron shielding contains both RF and magnetic fields from the magnet, so that 5-gauss line will be closer in. RF shielding not connected with power connected wire, iron reinforcement, lightning rod, or similar object.

Table 9: Shielding Specification for Shield Room

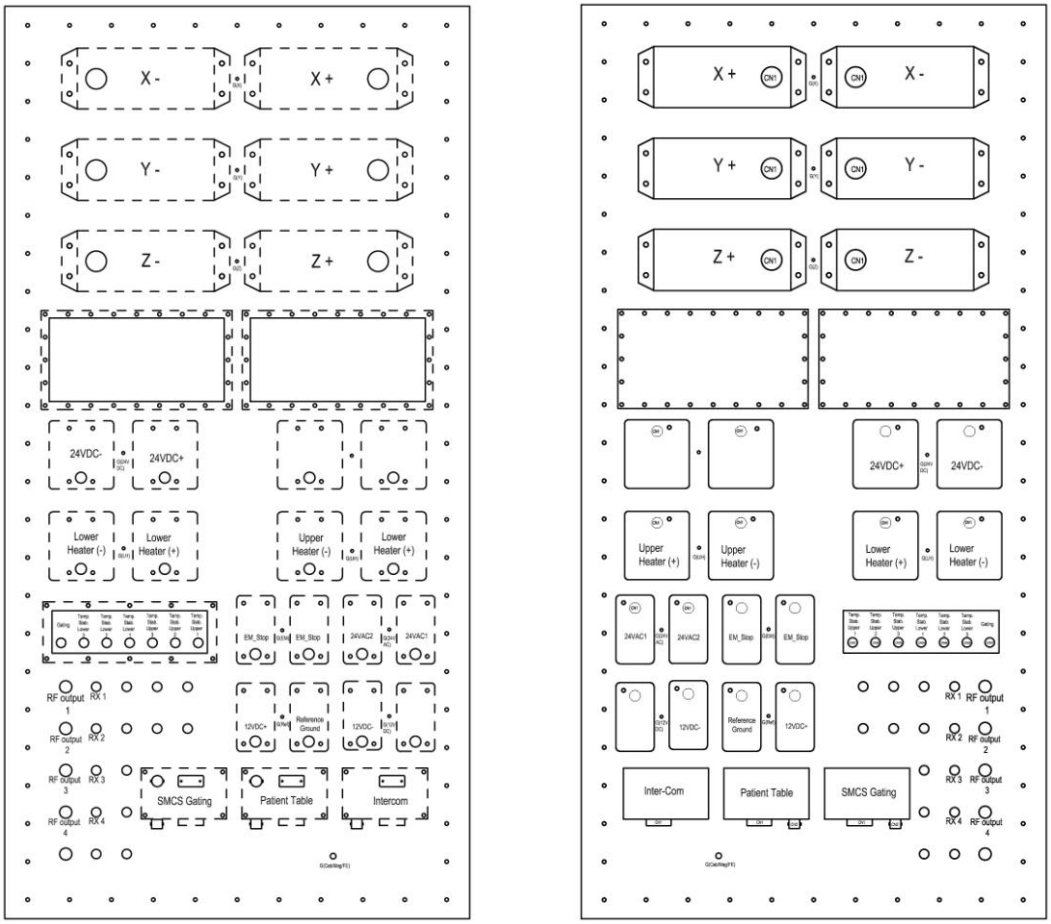
6.6 FILTER PENETRATION PANEL

The filter penetration panel is made of copper which allows RF shielding to remain intact for cables to penetrate the walls of shield room. The shield room is totally enclosed by a continuous conductive surface that contains the electric and magnetic fields created by RF pulses and other vents in and around the magnet.

The filter penetration panel measures at 610 x 1200mm (2 x 3.9ft.). It should be shrouded with adequate ventilation and cable access.

The intake and exhaust vents should be at least 450 x 100mm (1.5 x 0.3ft.).

For penetration panel civil information refer to PICA Penetration Panel Civil Drawing document (Ref.: 2)



View from INSIDE shield room View from OUTSIDE shield room

Figure 11: Penetration Panel

6.7 PATIENT TABLE

The power-assisted patient table supports the patient and enables automatic and accurate patient positioning within the magnet and gradient system.

Patient table specifications and dimensions are shown below.

Requirement	Patient Table
Dimensions (HWD)	See figure below
Patient table weight	470kg (1034lbs)
Dissipated heat (max)	25W
Cooling requirement	Convection
Operating temperature	Same as ambient temperature of shield room
Maximum patient weight	200kg (441lbs)
Key compliances	IEC 60601 - 1 (Safety)

Table 10: Patient Table Specification

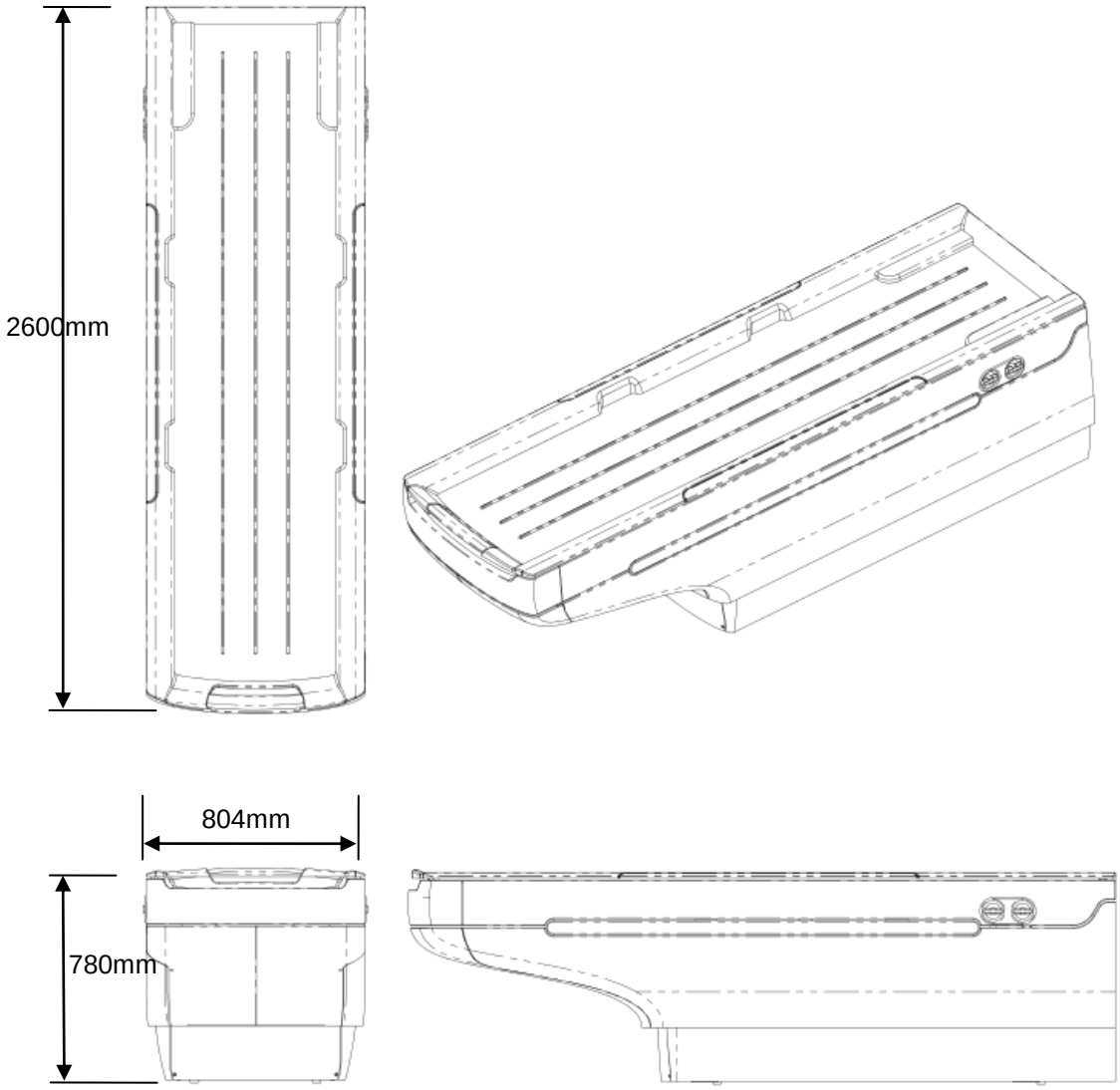


Figure 12: Patient Table Dimension

6.8 EMERGENCY STOP BUTTON

The emergency stop button for the PICA system is installed in the shield room.
This unit weighs about 0.3kg (0.7lbs) and is installed about 1800mm (6ft.) from the floor, as shown in the following figure.

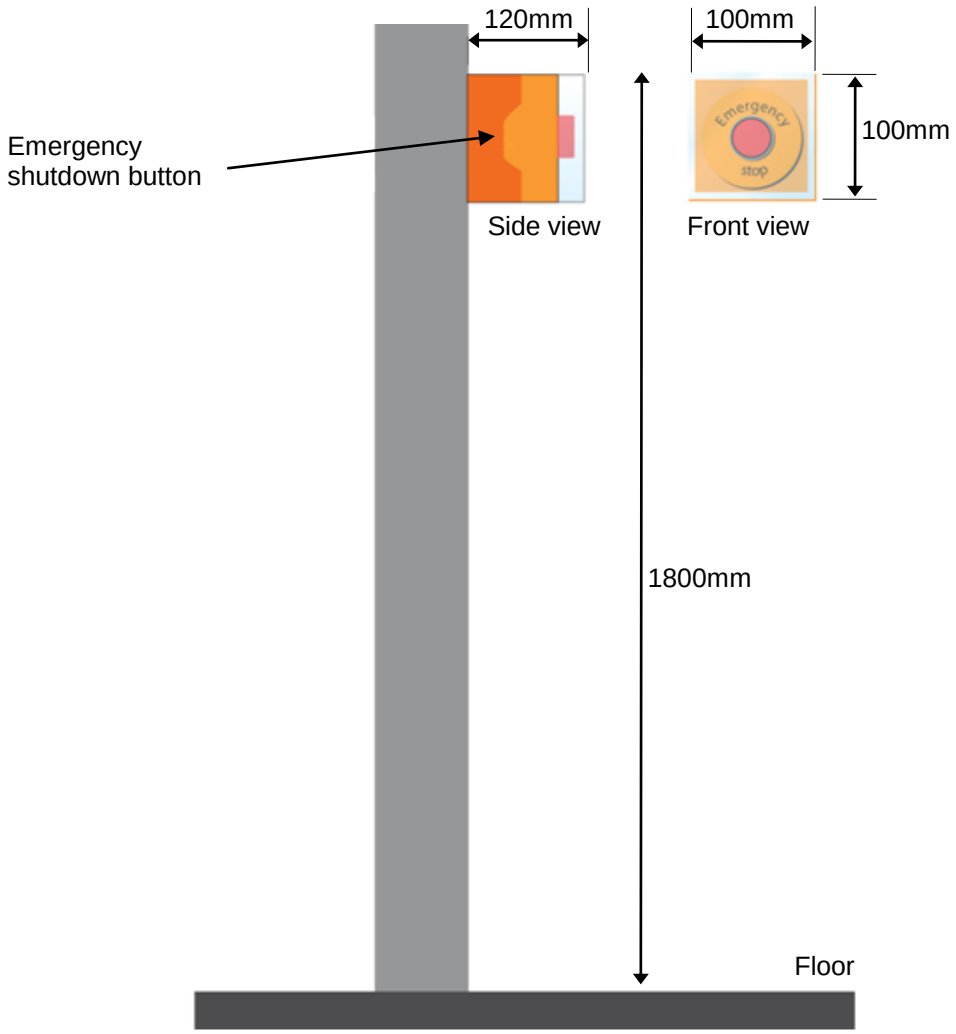


Figure 13: Emergency Stop Button

--End of Section--

7 EQUIPMENT ROOM SPECIFICATION

This section provides the specifications of the equipment room for PICA.

The following PICA cabinets are located in the equipment room:

- Magsonance Imaging Cabinet
- Magsonance Isolated Power Cabinet

Equipment room door should be in a minimum size or higher to accommodate the delivery of the cabinets. If the equipment room has a drop ceiling, appropriate cutouts should be made for system cables.

7.1 EQUIPMENT ROOM REQUIREMENT

Requirement	**Equipment Room**
Recommended size	3000 x 3000mm (9.8 x 9.8ft.). Arrange the electronic cabinets to fit into a smaller room at the expense of restricted room for maintenance personnel.
Ceiling height	Minimum 2800mm (9.2ft.). False/Drop ceiling is optional.
Floor covering	Antistatic finishing
Minimum door opening	1200 x 2100mm (2.95 x 6.89ft.)
Insulation, shielding	No special shielding requirements
PICA - power feed arrangement	Dedicated MCCB protected circuit within equipment room System power cabinet should be installed as close to the equipment room as possible for supplying system power. Use a shielded cable to connect the power feed into the Magsonance isolated power cabinet.
Power outlets – other loads	3 x 110/220V VAC outlets. 20A circuits with surge protection are recommended.
Climatic requirement	See “heat dissipation” section of this document
Cable routing	Install 3 wooden/plastic cable trays: 500 x 70mm (1.6 x 0.2ft.): - one for RF signal cables - one for high-power gradient cables - one for remaining signal/control cables The cable trays can be installed above or below the drop ceiling. Cables from various components are bundled appropriately and run through flexible conduits or aluminum ladders up to the ceiling. The ceiling cable trays hold the cables that go to the filter plates.
Control room – shield room intercom	Bi-directional voice communication, air tube acoustics

Table 11: Key Requirement for Equipment Room

7.1.1 MAGSONANCE ISOLATED POWER CABINET

This provides an isolated power supply to maintain the quality of the power feed into PICA. The table below is extracted from the specification document (Ref.: 1). Refer to the latest specification document for the most updated specification.

Requirement	Standard Specification
Dimensions (DWH)	670 x 820 x 970mm (2.2 x 2.7 x 3.2ft.)
Cabinet weight	315kg (694lbs)
AC power supply requirements	380VAC 3-phase, neutral ±10%
Frequency	50/60Hz ±1Hz
In-rush current	Max: >130A
Rated power	42kVA (maximum)
System ground	<1Ω
Line to line unbalance	2% max
Maximum heat dissipation (i.e. transformer loss)	About 2.2kW based on η = 95%
Operating temperature	Typ: ambient temperature Mean: 40°C (for co-located power supply cabinet and imaging cabinet)

Table 12: Magsonance Isolated Power Cabinet Specification

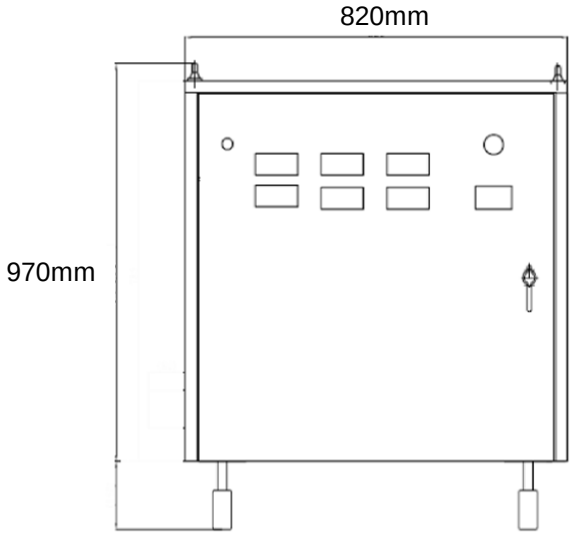


Figure 14: Magsonance Isolated Power Cabinet

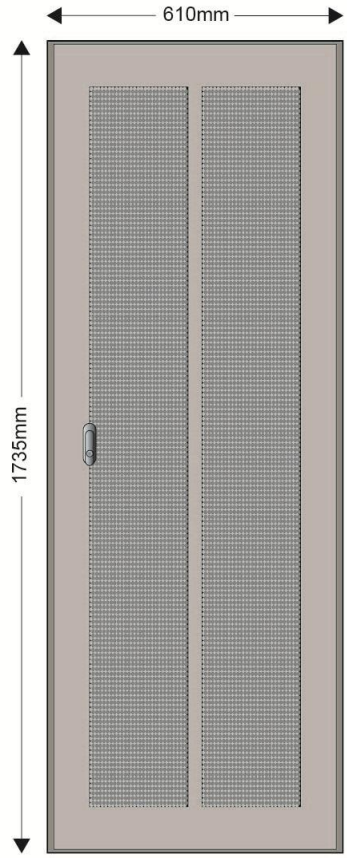


Figure 15: Magsonance Imaging Cabinet Dimension

--End of Section--

7.1.2 MAGSONANCE IMAGING CABINET

The table below is extracted from specification document (Ref.: 1) and lists the specifications of the cabinet. Refer to the latest specification document for the most updated specification.
This cabinet provides the protected power with UPS, MRI acquisition computer, RF and gradient control system.

RF system consists of transmitting and receiving sections. The hardware for RF pulse generation is integrated into the electronics cabinet as well as the hardware for the received and pre-amplified MR signals processing.

UPS Requirement	**Magsonance Imaging Cabinet**
UPS input voltage	220VAC
UPS input frequency	50/60Hz ±1Hz
UPS output voltage	220VAC
UPS output frequency	50Hz/60Hz ±1Hz
UPS configuration	Non-redundant
UPS battery autonomy	20 minutes
UPS load	1.5kVA

Requirement	**Magsonance Imaging Cabinet**
Dimensions (DWH)	910 x 610 x 1735mm (3.0 x 2.0 x 5.7ft.)
Cabinet weight	387.5kg (854lbs)
AC power supply requirements	Fed from Magsonance isolated power cabinet
Max current consumption	63A (from one phase)
Cooling	Electric fans within equipment
Heat dissipation	3.75k
Operating temperature	Typ: ambient temperature Mean: 30°C

Table 13: Magsonance Imaging Cabinet, and UPS System Specification

8 CONTROL ROOM SPECIFICATION

This section provides the specifications for the control room for PICA.

The control room contains the client workstation and accessories including printer and plotter.

Requirement	Control Room
Recommended size	3000 x 4000mm (9.8 x 13.1ft.)
Ceiling height	Slab-to-slab ceiling: 3300mm (10.82ft.) Drop/false ceiling: 2800mm (9.2ft.)
Floor covering	Antistatic finishing
Insulation, shielding	No special shielding requirements
Power outlets – PICA workstations and peripherals	Provision 6 110/220V VAC outlets. More may be installed to cater for future expansion. 20A circuits with surge protection are recommended.
Climatic requirement	Primarily for human comfort, refer to section “HVAC Requirement” of this document.
Cable routing	2 sets of 500 x 70mm wooden/plastic cable trays are recommended. These can be installed either above or below the drop ceiling.
Control room – shield room intercom	Bi-directional voice communication

Table 14: Key Requirements for Control Room

8.1.1 POWERING IN CONTROL ROOM

The quantity and type of power outlets typically required for control room are listed above in “Power outlets – PICA workstations and peripherals”.

8.1.2 CLIENT WORKSTATION

The client workstation is a PC installed with Microsoft XP or other compatible operating system approved by Time Medical Systems and is used to run Time Medical Systems Prodiva MRI software. The workstation is connected to a gigabit network and it allows the operator to control various parts of the MRI system as well as obtain, process, view and store data.

8.1.3 PRINTER AND PLOTTER ACCESSORIES

Accessories include the following:

- Laser printer (PostScript compatible) for printing images, text data and etc.

- DICOM compatible film printer for printing MRI films

8.1.4 ALARM BOX AND EMERGENCY STOP BUTTON

The alarm box and emergency stop button should be installed at an easily accessed position with proper protection. The alarm box and emergency stop button weigh 0.3kg (0.7lb). The flux density limit is 4mT (max).

--End of Section--

9 CABLES AND ROOM LAYOUT REQUIREMENTS

This section provides guidelines for cable length information, pipe work/ducting lengths, and some illustrations of typical room layouts for the whole-body MRI imaging suite.

9.1 CABLE LENGTH

The total cable length is the length routed to each PICA component in addition to the length required inside the components.

Figure below shows the free cable lengths between the exit points. When planning the final location of the system components, do not exceed the free cable lengths. Route the cables in parallel in cable tray or cable ducts.

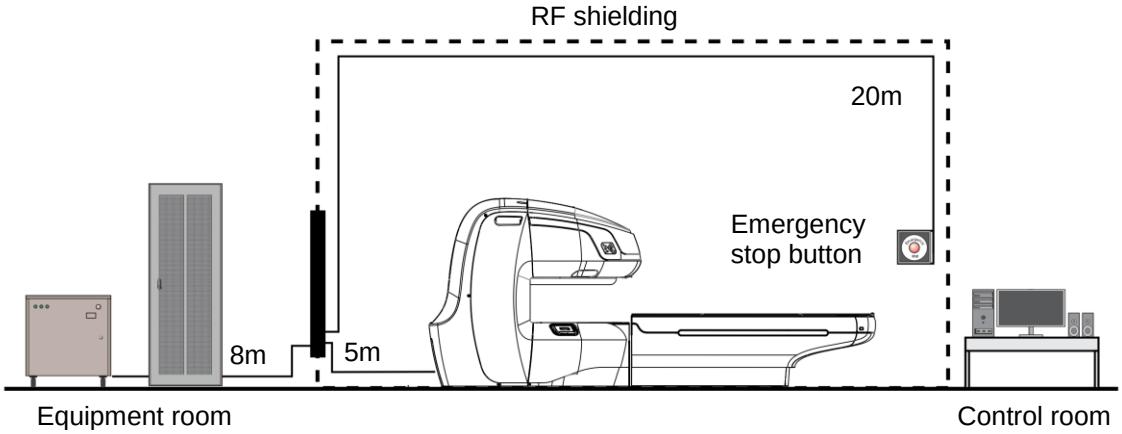


Figure 16: Standard Free Cable Lengths

The size of openings (e.g. in walls or ceilings) as well as the cable ducts should allow for various shapes of cable connectors used.

When installing cables, pay attention to the minimum bending radius (R_B) for the following cables:

- Gradient cable: $R_B \geq 380mm$
- Transmitter cable: $R_B \geq 380mm$

Table below lists the cables requirements according to respective IEC standards:

Cable Connection	Cable Type	Cable Specification	Cable Length (m)	Shielding
Mains power to Power cabinet	Power cable	RVVP	6	No
Power cabinet to imaging cabinet	Power cable	RVVP	6	No
Imaging cabinet to penetration panel	Ground cable	BVR	5	No
X amplifier output to penetration panel	Power cable	RVVP	5	Yes
Y amplifier output to penetration panel	Power cable	RVVP	5	Yes
Z amplifier output to penetration panel	Power cable	RVVP	5	Yes
Temperature control signal input to penetration panel (2 sets)	Signal cable	BNC	7	Yes
Temperature control upper heating output to penetration panel	Power cable	RVVP	6	Yes
Temperature control lower heating output to penetration panel	Power cable	RVVP	6	Yes
24V AC power output of chassis bottom board to penetration panel	Power cable	RVVP	5	Yes
RF amplifier signal output to penetration panel	Signal cable	RG213	7	Yes
Penetration panel to spectrometer pre-amplifier	Signal cable	RG58	7	Yes
Spectrometer gating signal output to penetration panel	Signal cable	RG174	7	Yes
Spectrometer network cable port to PC console	Network cable	Cat 6E twisted-pair cable	20	Yes
Respiratory gating network cable port to PC console	Network cable	Cat 6E twisted-pair cable	20	Yes
Respiratory gating power output to penetration panel	Power cable	RVVP	7	Yes
Penetration panel to respiratory gating	Signal cable	RG58 cable	7	Yes
Penetration panel to main unit of intercom system	Power/Signal cable	DB9 cable	15	Yes
Main unit of intercom system to console interphone	Signal cable	DB9 cable	15	Yes

Table 15: EMC Cable Labels and Identifications

9.2 MRI SUITE LAYOUT

A typical MRI suite should be defined to enable the following:
- Civil works for a typical working MRI suite
- Implementation of a suitable HVAC system
- Correct provision of power feed into MRI suite

Time Medical Systems will be pleased to assist the customer in the conversion or retrofit of existing site for use with PICA. Examples of other workable MRI suite layout are shown below.

Refer to site drawings for the specific MRI suite. Typical MRI suite layouts are shown below for reference only:

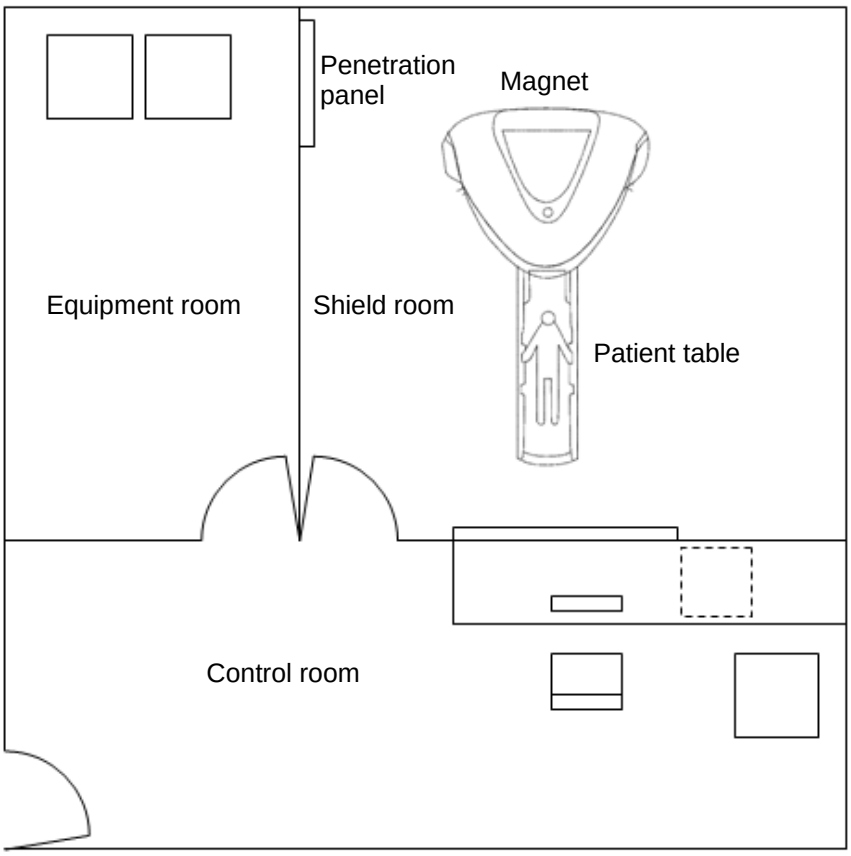


Figure 17: MR Suite Layout 1 (for Illustration Only)

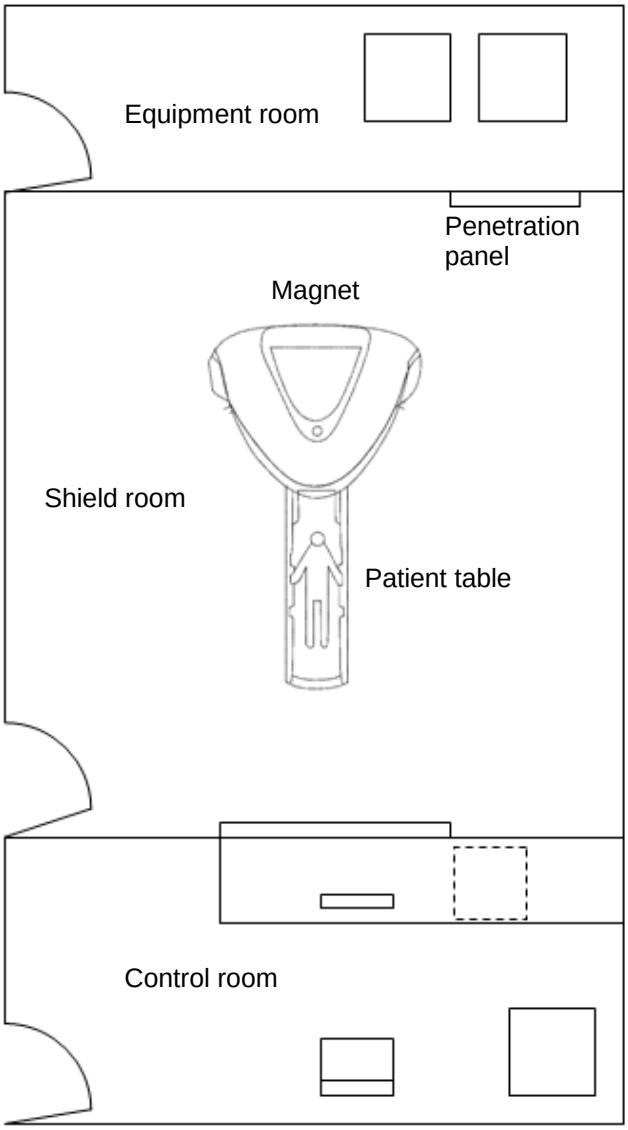


Figure 18: MR Suite Layout 2 (for Illustration Only)

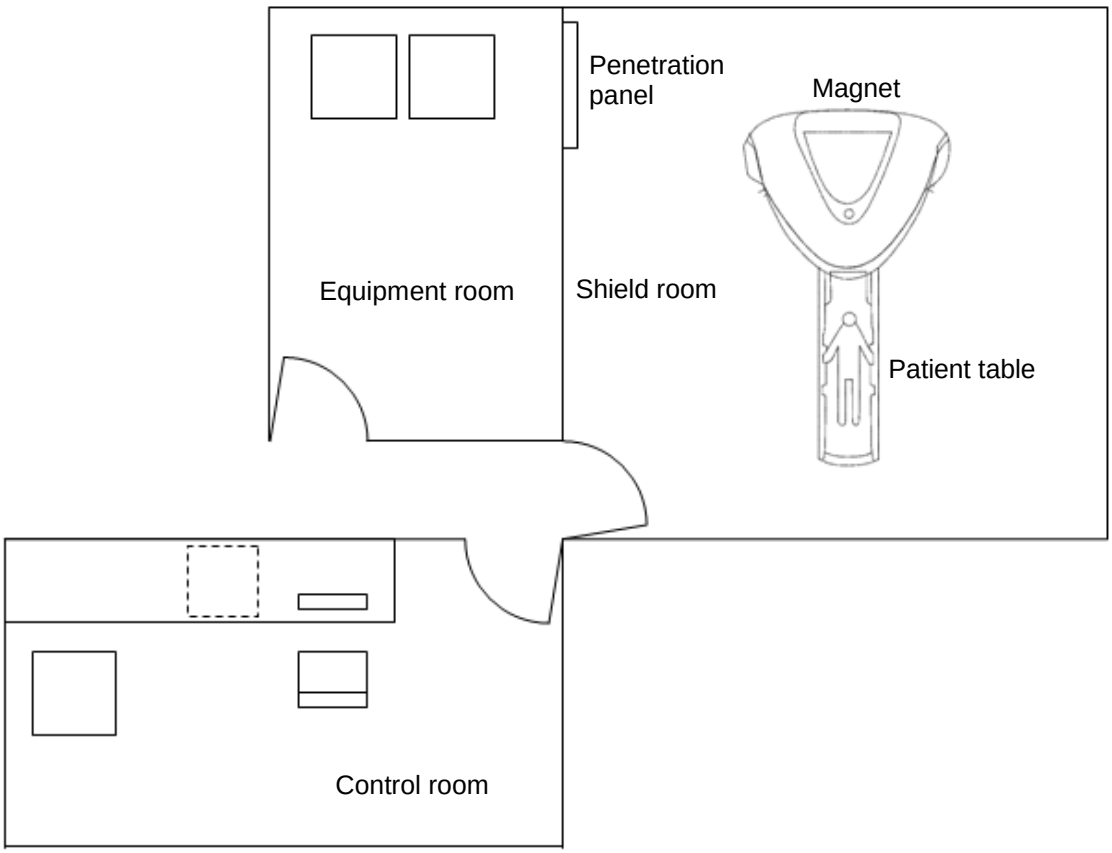


Figure 19: MR Suite Layout 3 (for Illustration Only)

--End of Section--

10 TRANSPORTATION PLANNING

In this section, the end-to-end floor loading requirement for transportation is specified for:

- Transport routes
- Secure temporary storage

10.1 PRE-DELIVERY CONDITION

Delivery of PICA into an MRI suite can only be scheduled when the following resources or conditions are in place. This calls for the completion of all civil construction and decoration works.

- Dedicated electrical power feeds and connection points ready
- Earth connection points ready
- Floor, walls, ceilings installed, finished and painted
- Cable ducts installed
- All power, phone and network cables and electrical installation completed
- Room lighting installed and tested
- HVAC system (fan coils, chiller plant, duct or pipe work and control panel) installed and tested
- An on-site secure temporary storage available
- Shield room installed and verified against specification
- Interior of shield room as complete as possible
- MRI suite cleaned and kept dust-free
- Risk of transporting route evaluated

The architect or structural engineer is required to certify that the transport routes and storage areas are capable of withstanding the floor loading of the system components.

10.2 SHIPPING INFORMATION

Select only a licensed carrier for all transport activities. The carrier is responsible for obtaining information concerning the various transport routes before the actual transport.

The following table lists the shipping items for a complete PICA system, consult actual shipping document for detailed and updated information.

Box No.	PICA shipment contents	Shipping container dimension						Shipping weight (Gross)	
		mm			ft			kg	lbs
		L	W	H	L	W	H		
1	Magnet and gradient coil	2720	2230	2350	8.9	7.3	7.7	17500.00	38500.00
2	Imaging cabinet	1070	770	2000	3.5	2.5	6.6	459.50	1013.00
3	Power supply cabinet	910	660	1090	3.0	2.2	3.6	355.50	709.50
4	Magnet IF and cover	2660	1370	950	8.7	4.5	3.1	322.50	512.60
5	Magnet cover, phantoms and accessories	2420	1930	1060	7.9	6.3	3.5	333.50	733.70
6	Panels, cables and IF accessories	2420	1230	900	7.9	4.0	2.9	172.50	379.50
7	PC, table and chair	2820	2280	1150	9.3	7.5	3.8	487.00	1,071.40
8	Receive coils	1250	1000	1000	4.1	3.3	3.3	71.50	157.30
9	Patient table	2870	950	1030	9.4	3.1	3.4	580.50	1,277.10
10	Patient table cover, mattress and cushion	2870	950	1030	9.4	3.1	3.4	194.00	426.80
11	Penetration panels and filter	1420	720	320	4.7	2.4	1.0	62.00	136.40

Table 16: Shipping Information

10.3 TEMPORARY SECURE STORAGE

Occasional building work may slip behind completion schedule. It is a requirement to provide a secure storage for PICA shipment on site until the MRI suite is ready.

The following conditions should be observed:

- Safe storage temperature should be between -20°C and 45°C.
- Relative humidity at <60%.
- Take precautions for rain, sunshine, fire, and/or corrosion.
- Establish a warning sign 3m away to warn personnel to maintain a safe distance from the shipment.

10.4 INFORMATION FOR CARRIER

The following information and documents are required for the transportation planning of licensed carrier:

- Layout of the transport routes and storage area
- Certification of the weight capacity of the floor
- Final destination of transport. This gives the carrier adequate time to estimate on methods of transport and routes.
- Weight and dimension of components to be transported. The carrier is responsible for selecting the type of transportation for PICA to the pre-agreed destination.

Minimum door size for delivery of the PICA components should have been specified. The magnet is usually transported through a temporary constructed opening at the side wall of the shield room.

To allow passages for PICA cabinets, overall clearance height for the transport routes should be at least 2m.

The strong magnet creates risks to personnel during transportation. **Any person with pacemaker or ferromagnetic implants must maintain a safe distance from the magnet.** A recommended separation is more than 3m away from the magnet.

The same separation is recommended for any person carrying metallic items such as watches, credit cards, eyeglasses, keys or electronic devices.

Shipping boxes are packed with shocking and tilt indicators that record mishandling. Exercise care in moving containers.

Figure 20: Indicators

10.4.1 TRANSPORTATION REQUIREMENTS

It is recommended to transport only in good weather when possible. Make sure the following conditions for the magnet are met during transportation:

- Temperature of the magnet maintained at <45˚C
- Relative humidity at <85%
- Atmospheric pressure at between 860hPa - 1060hPa

Exercise appropriate protection for shipping boxes to reduce the possible damage from the following natural conditions:

- Direct sunlight
- Hot/Flammable objects
- Rain
- High humidity level (60 - 80%)
- Lightning strike and possible natural disaster

Ensure the PICA shipping boxes are secured, and are protected from tilting, bumping, moving and scratching. Make sure the transporting boxes do not tilt more than 15°.

In general, slow down the transport task when road condition is poor. This limits intense vibration (<25g) during transportation.

If the use of metallic tools is necessary during loading or unloading, ensure that any person to stay at least 3m away from the shipping boxes.

Make sure the customer has made arrangements for lifting and rigging tasks when necessary.

The strong magnet creates risks to personnel during transportation. Any person with pacemaker or ferromagnetic implants must maintain a safe distance from the magnet. A recommended separation is more than 3m away from the magnet.

The same separation is recommended for any person carrying metallic items such as watches, credit cards, eyeglasses, keys or electronic devices.

10.5 POST DELIVERY

Make available a temporary storage space for the inspection of any sign of damage on the shipping boxes upon delivery.

Verify if appropriate arrangements have been made for the disposal of transporting or packing materials.

10.6 INWARDS INSPECTION AT SITE

Do not attempt to open any box without proper authorization from Time Medical Systems or its representing agent.

CAUTION

DO NOT open any box without direct instructions from a Time Medical Systems service representative. In particular, the box with the magnet contains components that will be irreparably damaged if opened incorrectly.

Conduct an immediate visual inspection of each transportation box for any sign of damage. Follow these steps if any damage is found:

- Note the nature of the damage on the carrier's waybill.
- Request an inspection and written damage report by a representative of the carrier.
- Forward a copy of the damage report to the local Time Medical Systems representative.
- In case of damage, the FOB block on the Time Medical Systems Order Acknowledgment form determines owner responsibility.
- Transfer of ownership occurs when the shipment leaves the factory. The customer is responsible for claims due to shipping damage. Upon request, Time Medical Systems will provide assistance in filing claims.
- Transfer of ownership occurs at customer's point of receipt. Time Medical Systems is responsible for claims due to shipping damage.
- Damage discovered 15 or more days after delivery is not recoverable. Such damage will be considered at the expense of the customer.

In general, Time Medical Systems assumes responsibility for the installation until it is completely installed and accepted.

10.7 MOVING IN MRI SUITE

While considerable care is taken during the transportation of the PICA system, the size and weight of each item may result in some minor damage to the decorations at the installation site. Additional protections are recommended on walls and floors for all delivery routes at the site.

Use a forklift or hydraulic pallet mover to transport the boxes into the MRI suite. Shipping boxes should be kept at an upright position when moving. Do not drop or mishandle. Shipping boxes are packed with shocking and tilt indicators that record mishandling. Exercise care in moving containers.

Identify and verify the transportation route for passage/doorway clearance before the actual moving. Contact Time Medical Systems service representative for help if necessary.

--End of Section--

11 INSTALLATION CONTROL

Directly after delivery and assembly of the magnet, engineers from Time Medical Systems will begin connecting system cables. During this time, any connections to other equipment, on-site power supply, telephone and/or network will be with the support from appropriate site contractor.

The initial installation stage takes about one week, after which, Time Medical Systems personnel may leave the site to allow for any remaining work outside the shield room to be completed by specialists. Time Medical Systems personnel will return to the site and complete the system installation after the remaining work has finished. From this point onwards, the MRI suite should be under the control of Time Medical Systems personnel.

11.1 SYSTEM POWER ON SEQUENCE

Switch on PICA only with the defined power-on sequence, documented in the PICA power on sequence document. (Ref.: 3)

--End of Section--

12 APPENDICES

12.1 APPENDIX A – SUGGESTED PLANNING ACTIONS

The followings are the recommended actions while planning for a system installation:

- Verify room size against the minimum space required for the system.
- Define the preliminary room layout.
- Check to see if reinforcement on floor is required for the total load of PICA system.
- Check to see if the floor leveling requirements are fulfilled.
- Make sure the building vibration requirements are met.
- Ensure the physical environments (doors, floors, elevators, and etc.) of the site fulfill the passage dimension and system weight.
- Perform a site measurement of magnetic field fluctuation.
- Ensure the HVAC system fulfills room temperature requirements.
- Ensure the power, grounding and lighting requirements are met.
- Ensure that LAN network connection is available.
- Verify no unwanted electrical installation exists in the shield room (emergency lamp, smoke detector and medical tubing).
- Define and document the final room layout.

12.2 APPENDIX B – SITE QUICK REFERENCE

Clearances				
Part	Dimension (mm)			Weight (kg)
	Width	Depth	Height	
RF shield room				
Magnet				
Patient table				
Electronic unit				
Console				
Installation cart				
Maximum cable length between electronic unit and filter panel				5m
Patient table extension clearances				
5 Gauss fringe field from magnet isocenter				
X Forward		X Forward		
Y Right		Y Right		
Z Upward		Z Upward		
1 Gauss fringe field from magnet isocenter				
X Forward		X Forward		
Y Right		Y Right		
Z Upward		Z Upward		

Infrastructural Requirements	
Total floor load requirement	20000kg (44093lbs)
Floor load requirement per surface unit	45kPa
Floor leveling requirement	5mm/3m
Vibrations requirement from 0 - 100Hz (Every direction)	amax - 70dBg

Table 17: Site Quick Reference

12.3 APPENDIX C – SITE SURVEY REPORT

This is available as “MS035 Site Survey report” document (Ref.: 4).

Site Survey Report

TIME MEDICAL SYSTEMS

Case Number: _____ Project Number: _____

Site Address: _____ Report Date: _____

_____ Customer: _____(name)

System Model: _____ _____(signature)

Field Service Engineer: _____

Structural

Rooms	Minimum Requirement / Suggested Space			Measurement			Result	
	L	W	H	L	W	H	Yes	No
Shield Room	6500	4500	3000				☐	☐
Shield Room Door	-	1200	2100				☐	☐
Shied Room Window	-	1500	1200				☐	☐
Equipment Room	3000	3000	2800				☐	☐
Equipment Room Door	-	900	2100				☐	☐
Control Room	3000	4000	2500				☐	☐
Control Room Door	-	900	2100				☐	☐

Infrastructure	Minimum Requirement / Suggested Configuration	Measurement	Result	
			Yes	No
Site Location	Ground floor with NO basement underneath		☐	☐
MRI Suite Floor Loading	20kPa		☐	☐
MRI Transportation Path Floor Loading	20kPa		☐	☐
MRI Transportation Path Corridor Width	2500mm		☐	☐
MRI Suite Floor Leveling	Better than: 5mm/3m		☐	☐
Foundation Slab	At magnet position		☐	☐
Shield Room	5-gauss line within shield room		☐	☐
Resistance Between Shielding and Ground (Under 500VDC)	≥1mΩ		☐	☐
Attenuation	≥-90dB, f = 10 to 100MHz		☐	☐
Shield Room Temperature	21°C ±3°C		☐	☐
Equipment Room Temperature	<30°C		☐	☐

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Site Survey Report

TIME MEDICAL SYSTEMS

Control Room Temperature	17°C - 23°C		☐	☐
Illumination in Each Room	300lux		☐	☐
Wall Outlets in Equipment Room	3 x 110/220VAC		☐	☐
Wall Outlets in Control Room	6 x 220VAC		☐	☐
Doors, Windows, Floors and Interior Decoration completed	N/A	N/A	☐	☐
All Materials are Fire-protected	N/A	N/A	☐	☐
Cable Ducts on the Ground	N/A	N/A	☐	☐
Cable Ducts under the Ground	N/A	N/A	☐	☐
Cable Ducts on the Wall	N/A	N/A	☐	☐
Cable Ducts in the Wall	N/A	N/A	☐	☐
Cable Ducts in the Ceiling	N/A	N/A	☐	☐

Electrical

Power Requirement	Minimum Requirement	Measurement	Result	
			Yes	No
No. of Phase	3-phase		☐	☐
Main Voltage	380VAC		☐	☐
Voltage Fluctuation %	±10%, 380VAC		☐	☐
Voltage Frequency	50Hz		☐	☐
Frequency Fluctuation	±1Hz, 49 - 51Hz		☐	☐
Area of Cross-section of Power Cable	25mm²		☐	☐
Grounding Resistance	<1Ω		☐	☐
Area of Cross-section of Ground Conduct Line	16mm²		☐	☐
Distance from Grounding to Distribution Cabinet	N/A		N/A	
Anti-static Floor in Equipment Room	N/A	N/A	☐	☐
Power Distribution Cabinet Installed to Designated Position in Standby Condition	N/A	N/A	☐	☐

Site Survey Report

TIME MEDICAL SYSTEMS

Environmental

Category	Source of Interference		Area(s) affected				Distance (m)		Result	
			AC	DC	Vib	EMI	Min.	Measurement	Yes	No
AC 50Hz or 60Hz or DC	Transformer		■				>10		□	□
	Transmission Line		■	■			>100		□	□
	Fan		■				>10		□	□
	Compressor		■				>10		□	□
	Pump		■				>10		□	□
	Others, please specify								□	□
Train/Tram/ Subway	AC 16.6Hz		■				>400		□	□
	DC			■			>100		□	□
	Others, please specify								□	□
Moving Metal Objects	Wt (kg)	e.g.		■			>5		□	□
	<50	Trolley		■			>7		□	□
	200	Patient Table		■	■		>9		□	□
	900	Car, Small Elevator		■	■		>15		□	□
	>4500	Truck, Large Elevator		■	■		>25		□	□
	>20000	Big Truck, Excavator		■	■				□	□
	Others, please specify								□	□
Environ-mental Vibration	Car Park			■	■		>10		□	□
	Railway			■	■		>500		□	□
	Roadway				■		>15		□	□
	Others, please specify								□	□
Medical Equipment	MRI		■			■	>10		□	□
	CT		■			■	>10		□	□
	X-Ray		■			■	>10		□	□
	DR		■			■	>10		□	□
	PET		■			■	>10		□	□
	Others, please specify								□	□

12.4 APPENDIX D – PRELIMINARY SITE SURVEY REPORT

This is available as “MS034 Preliminary Site Survey Report” document (Ref.: 5).

Preliminary Site Survey Report

TIME MEDICAL SYSTEMS

Case Number: _____ Project Number: _____

Site Address: _____ Report Date: _____

_____ Customer: _____(name)

System Model: _____ _____(signature)

Field Service Engineer: _____

Please measure and fill in the specification information in following tables, and attach vibration graph, DC and AC fluctuation graphs in Appendix pages if available.

Structural Information

Rooms	Minimum Requirement / Suggested Space			Measurement			Result	
	L	W	H	L	W	H	Pass	Fail
Shield Room	6500	4500	3000				☐	☐
Shield Room Door	-	1200	2100				☐	☐
Shied Room Window	-	1500	1200				☐	☐
Equipment Room	3000	3000	2800				☐	☐
Control Room	3000	4000	2500				☐	☐
Equipment Room Door	-	900	2100				☐	☐
Control Room Door	-	900	2100				☐	☐

Infrastructure	Minimum Requirement / Suggested Configuration	Measurement	Result	
			Pass	Fail
Site Location	Ground floor with NO basement underneath		☐	☐
MRI Suite Floor Loading	20kPa		☐	☐
MRI Transportation Path Floor Loading	20kPa		☐	☐
MRI Suite Floor Leveling	Better than: 5mm/3m		☐	☐

Electrical Information

Power Requirement	Minimum Requirement	Measurement	Result	
			Pass	Fail
Number of Phase	3-phase		☐	☐
Main Voltage	380VAC		☐	☐
Voltage Fluctuation %	±10%, 380VAC		☐	☐
Voltage Frequency	50Hz		☐	☐
Frequency Fluctuation	±1Hz, 49 - 51Hz		☐	☐

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12.5 APPENDIX E – RECEIVER COILS

For identification purposes – their handling and storage are not described in this document, refer to operation document for their respective uses.


Head Coil


Shoulder Coil


Neck Coil


Wrist Coil


Body Coil


Knee Coil


Ankle Coil


Flexi Body Coil

Figure 21: Receiver Coils

12.6 APPENDIX F – CONVERSION TABLES FOR STANDARD UNITS

Quantity	Symbol	Name
Temperature	ºC	Degree celsius (1.8C + 32 = F)
Temperature	ºF	Degree fahrenheit (0.56(F - 32) = C)
Temperature	K	Kelvin
Force	N	Newton
Force	ft-lb	Foot-pound
Power	kcal	Kilocalorie
Mass	g	Gram
Mass	kg	Kilogram
Length	m	Meter
Length	mm	Millimeter
Length	in.	Inch
Length	ft	Foot
Area	m^2	Square meter
Area	cm^2	Square centimeter
Area	sq.in.	Square inch
Area	sq.ft.	Square foot
Volume	m^3	Cubic meter
Volume	cm^3	Cubic centimeter
Volume	cu.in.	Cubic inch
Volume	cu.ft.	Cubic foot
Time	h	Hour
Magnetic field strength	A/m	Ampere per meter
Magnetic flux density(induction)	T	Tesla (1T=104gauss)
Magnetic flux	Wb	Weber (1T=1Wb/m^2)

Table 18: Definition of Standard Units

12.7 APPENDIX G – CONVERSION TABLES

Unit	mm	m	in.	ft.
1mm	1	0.001	0.0393701	0.0032808
1m	1000	1	39.37	3.281
1in.	25.4	0.0254	1	0.08333
1ft.	304.8	0.3048	12	1

Table 19: Units of Length Conversions

Unit	cm^3	m^3	cu in.	cu ft.
$1cm^3$	1	0.000001	0.06702	0.03531
$1m^3$	1,000,000	1	61,023	35.21
1cu in.	16.9	0.0006452	1	0.000579
1cu ft.	28,316	0.028316	1,728	1

Table 20: Units of Volume Conversions

Unit	kcal/h	kJ/h	kW
1kcal/h	1	4.1868	0.00163
1kJ/h	0.2388	1	0.0002777
1kW	860	3,600	1

Table 21: Units of Power Conversions

Unit	Kcal	kJ	kWh
1kJ	0.2388	1	0.0002777
1kWh	860	3,600	1

Table 22: Units of Energy Conversions

Unit lb/sq.in. (psi)	N/m^2(Pa)	N/cm^2	kp/m^2	kp/cm^2	lb/sq.ft.	lb/sq.in.(psi)
$1N/m^2$	1	0.0001	0.1019	0.1019 × 10-4	2.088 × 10-2	1.45 × 10-5
$1N/cm^2$	10,000	1	1019	0.1019	208.8	1.45
$1kp/m^2$	9.80665	9.8066 × 10-4	1	0.001	0.2084	1.422 × 10-3
$1kp/cm^2$	98,066.5	9.80665	10,000	1	2048	14.22
1lb./sq.ft.	47.87	4.787 × 10-3	4.882	4.882 × 10-4	1	6.943 × 10 -3
1lb./sq.in. (psi)	6,896	0.6896	703	7.032 × 10-2	144	1

Table 23: Units of Pressure/Force Conversions

12.8 APPENDIX H – CONVERTING AWG NUMBERS

1 circ mil = 5.07×10-10m^2 = 0.000507mm^2

AWG No	Wire diameter (mm)	Cross-section of conductor (mm^2)	circ mils
40	0.079	0.0048	10
39	0.089	0.0062	12
38	0.102	0.0081	16
37	0.114	0.0103	20
36	0.127	0.0126	25
35	0.142	0.0159	31
34	0.160	0.0201	40
33	0.180	0.0255	50
32	0.203	0.0325	64
31	0.226	0.0412	79
30	0.254	0.051	100
29	0.287	0.065	128
28	0.320	0.081	159
27	0.363	0.102	202
26	0.404	0.128	253
25	0.455	0.163	320
24	0.511	0.205	404
23	0.574	0.259	511
22	0.643	0.33	640
21	0.724	0.41	812
20	0.813	0.52	1024
19	0.912	0.65	1289
18	1.024	0.82	1624
17	1.151	1.04	2052
16	1.290	1.31	2581
15	1.450	1.65	3260
14	1.628	2.08	4109
13	1.829	2.63	5184
12	2.052	3.31	6529
11	2.304	4.17	8226
10	2.588	5.26	10384
9	2.906	6.63	13087
8	3.268	8.37	16512
7	3.665	10.55	20822
6	4.115	13.30	26244
5	4.620	16.77	33088
4	5.189	21.15	41738
3	5.827	26.66	52624
2	6.543	33.62	66358
1	7.348	42.41	83625
1/0	8.252	53.52	105625
2/0	9.266	67.43	133079
3/0	10.404	85.01	167772
4/0	11.684	107.21	211600
5/0	-	135.35	266773
6/0	-	170.50	336400

Table 24: AWG Conversions

12.9 APPENDIX I – CONVERTING DBM TO VOLTS AND WATTS

dBm	Vrms	V p-p	W
-90	7.069µV	19.99µV	1000pW
-89	7.934µV	22.44µV	1.259pW
-88	8.900µV	25.17µV	1.585pW
-87	9.989µV	28.25µV	1.995pW
-86	11.21µV	31.69µV	2.512pW
-85	12.57µV	35.56µV	3.162pW
-84	14.11µV	39.89µV	3.981pW
-83	15.83µV	44.77µV	5.012pW
-82	17.76µV	50.23µV	6.309pW
-81	19.93µV	56.36µV	7.943pW
-80	22.36µV	63.23µV	10.00pW
-79	25.09µV	70.95µV	12.59pW
-78	28.15µV	79.61µV	15.85pW
-77	31.58µV	89.32µV	19.95pW
-76	35.43µV	100.2µV	25.12pW
-75	39.78µV	112.5µV	31.62pW
-74	44.63µV	126.2µV	39.81pW
-73	50.07µV	141.6µV	50.12pW
-72	56.15µV	158.8µV	63.09pW
-71	63.01µV	178.2µV	79.43pW
-70	70.69µV	199.9µV	100.0pW
-69	79.34µV	224.5µV	125.9pW
-68	89.02µV	251.7µV	158.5pW
-67	99.88µV	282.5µV	199.5pW
-66	112.07µV	316.9µV	251.2pW
-65	125.74µV	355.6µV	316.2pW
-64	141.09µV	399.0µV	398.1pW
-63	158.30µV	447.7µV	501.2pW
-62	177.62µV	502.3µV	630.9pW
-61	199.29µV	563.6µV	794.3pW
-60	223.61µV	632.4µV	1.000nW
-59	250.89µV	709.5µV	1.259nW
-58	281.50µV	796.1µV	1.585nW
-57	315.85µV	893.2µV	1.995nW
-56	354.39µV	1.002 mV	2.512nW
-55	397.64µV	1.125 mV	3.162nW
-54	446.15µV	1.262 mV	3.981nW
-53	500.59µV	1.416 mV	5.012nW
-52	561.67µV	1.588 mV	6.310nW
-51	630.2µV	1.782 mV	7.943nW
-50	701.1µV	1.999 mV	10.00nW
-49	793.4µV	2.244 mV	12.59nW
-48	890.2µV	2.517 mV	15.85nW
-47	998.9µV	2.825mV	19.95nW
-46	1.121mV	3.169mV	25.12nW
-45	1.257mV	3.556mV	31.62nW
-44	1.411mV	3.989mV	39.81nW
-43	1.583mV	4.477mV	50.12nW
-42	1.776mV	5.023mV	63.09nW
-41	1.993mV	5.636mV	79.43nW
-40	2.236mV	6.323mV	100.0nW
-39	2.509mV	7.095mV	125.9nW
-38	2.815mV	7.961mV	158.5nW
-37	3.158mV	8.932mV	199.5nW

-36	3.543mV	10.02mV	251.2nW
-35	3.978mV	11.25mV	316.2nW
-34	4.463mV	12.62mV	398.1nW
-33	5.007mV	14.16mV	501.2nW
-32	5.615mV	15.88mV	630.9nW
-31	6.301mV	17.82mV	794.3nW
-30	7.069mV	19.99mV	1.000µW
-29	7.938mV	22.45mV	1.259µW
-28	8.900mV	25.17mV	1.585µW
-27	9.989mV	28.25mV	1.995µW
-26	11.21mV	31.69mV	2.512µW
-25	12.57mV	35.56mV	3.162µW
-24	14.11mV	39.90mV	3.981µW
-23	15.83mV	44.77mV	6.012µW
-22	17.76mV	50.23mV	6.309µW
-21	19.93mV	56.36mV	7.943µW
-20	22.36mV	63.24mV	10.00µW
-19	25.09mV	70.95mV	12.59µW
-18	28.15mV	79.61mV	15.85µW
-17	31.59mV	89.32mV	19.95µW
-16	35.44mV	100.2mV	25.12µW
-15	39.76mV	112.5mV	31.62µW
-14	44.62mV	126.2mV	39.81µW
-13	50.06mV	141.6mV	50.12µW
-12	56.17mV	158.8mV	63.10µW
-11	63.02mV	178.2mV	79.43µW
-10	70.71mV	199.9mV	100.0µW
-9	79.34mV	224.4mV	125.9µW
-8	89.02mV	251.7mV	158.5µW
-7	99.88mV	282.5mV	199.5µW
-6	112.1mV	316.9mV	251.2µW
-5	125.7mV	355.6mV	316.2µW
-4	141.1mV	398.9mV	398.1µW
-3	158.3mV	447.7mV	501.2µW
-2	177.6mV	502.3mV	630.9µW
-1	199.3mV	563.6mV	794.3µW
0	223.6mV	632.3mV	1.000mW
1	250.9mV	709.5V	1.259mW
2	281.5mV	796.1V	1.585mW
3	315.9mV	893.2V	1.995mW
4	354.4mV	1.000V	2.512mW
5	397.6mV	1.125V	3.162mW
6	446.2mV	1.262V	3.981mW
7	500.6mV	1.416V	5.012mW
8	561.7mV	1.588V	6.309mW
9	630.2mV	1.782V	7.943mW
10	707.1mV	1.999V	10.00mW
11	793.4mV	2.245V	12.59mW
12	890.2mV	2.517V	15.85mW
13	998.9mV	2.825V	19.95mW
14	1.121V	3.169V	25.12mW
15	1.267V	3.556V	31.62mW
16	1.411V	3.990V	39.81mW
17	1.583V	4.477V	50.12mW
18	1.776V	5.023V	63.09mW
19	1.993V	5.636V	79.43mW
20	2.236V	6.324V	100.0mW
21	2.509V	7.095V	125.9mW

22	2.815V	7.961V	158.5mW
23	3.158V	8.932V	199.5mW
24	3.543V	10.02V	251.2mW
25	3.978V	11.25V	316.2mW
26	4.463V	12.62V	398.1mW
27	5.007V	14.16V	501.2mW
28	5.615V	15.88V	631.0mW
29	6.301V	17.82V	794.3mW
30	7.069V	19.99V	1.000W
31	7.935V	22.44V	1.259W
32	8.900V	25.17V	1.585W
33	9.989V	28.25V	1.995W
34	11.21V	31.69V	2.512W
35	12.57V	35.56V	3.162W
36	14.11V	39.89V	3.981W
37	15.83V	44.77V	5.012W
38	17.76V	50.23V	6.309W
39	19.93V	56.36V	7.943W
40	22.36V	63.23V	10.00W
41	25.09V	70.95V	12.59W
42	28.15V	79.61V	15.95W
43	31.59V	89.32V	19.95W
44	35.44V	100.2	25.12W
45	39.76V	112.5	31.62W
46	44.62V	126.2	39.81W
47	50.06V	141.6	50.12W
48	56.17V	158.8	63.09W
49	63.02V	178.2	79.43W
50	70.71V	199.9	100.0W
51	79.34V	224.5	125.9W
52	89.02V	251.7	158.5W
53	99.88V	282.5	199.5W
54	112.1V	316.9	251.2W
55	125.7V	355.6	316.2W
56	141.1V	398.9	398.1W
57	158.3V	447.7	501.2W
58	177.6V	502.3	630.9W
59	199.3V	563.6	794.3W
60	223.6V	632.4	1.000kW
61	250.9V	709.5	1.260kW
62	281.5V	796.1	1.585kW
63	315.9V	893.2	1.995kW
64	354.4V	1.002	2.512kW
65	397.6V	1.125	3.162kW
66	446.2V	1.262	3.98kW
67	500.6V	1.416	5.012kW
68	561.7V	1.588	6.310kW
69	630.2V	1.782	7.943kW
70	707.1V	2.000	10.00kW
71	793.4V	2.244	12.59kW
72	890.2V	2.517	15.85kW
73	998.8V	2.825	19.95kW
74	1.121kV	3.169	15.12kW
75	1.257kV	3.556	31.62kW
76	1.411kV	3.990	39.81kW
77	1.583kV	4.477	50.12kW
78	1.776kV	5.023	63.10kW
79	1.993kV	5.636	79.43kW

80	2.236kV	6.324	100.0kW
81	2.509kV	7.095	125.9kW
82	2.815kV	7.961	158.5kW
83	3.159kV	8.932	199.5kW
84	3.544kV	10.02	251.2kW
85	3.976kV	11.25	316.2kW
86	4.462kV	12.62	398.1kW
87	5.006kV	14.16	501.2kW
88	5.617kV	15.88	631.0kW
89	6.302kV	17.88	794.3kW
90	7.07kV	20.00	1.000kW
91	7.934kV	22.44	1.259kW

Table 25: dBM Conversions

12.10 APPENDIX J – CALCULATED GRADIENT COIL GAUSS LINES

This section is the complete table of gradient coil gauss lines.

B of each direction

B : X Direction

Angle (°)\zi(m)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1
0	2.631E-03	2.553E-03	2.541E-03	7.500E-03	7.185E-03	8.260E-04	7.081E-04	5.668E-04	5.069E-04	4.603E-04	4.200E-04	3.850E-04
22.5	2.800E-03	2.717E-03	3.170E-03	6.699E-03	5.605E-03	5.294E-04	6.536E-04	5.708E-04	5.148E-04	4.674E-04	4.261E-04	3.902E-04
45	2.690E-03	2.806E-03	3.678E-03	4.833E-03	3.330E-03	9.235E-04	6.570E-04	5.977E-04	5.401E-04	4.887E-04	4.442E-04	4.057E-04
67.5	2.564E-03	2.742E-03	3.217E-03	3.346E-03	2.395E-03	1.243E-03	7.960E-04	6.605E-04	5.840E-04	5.240E-04	4.737E-04	4.308E-04
90	2.803E-03	2.912E-03	3.128E-03	3.019E-03	2.275E-03	1.394E-03	9.208E-04	7.382E-04	6.417E-04	5.706E-04	5.124E-04	4.636E-04
112.5	4.089E-03	4.068E-03	4.085E-03	3.814E-03	2.662E-03	1.453E-03	9.770E-04	8.076E-04	7.037E-04	6.226E-04	5.560E-04	5.003E-04
135	7.258E-03	6.819E-03	6.308E-03	5.980E-03	3.771E-03	1.247E-03	9.563E-04	8.584E-04	7.590E-04	6.711E-04	5.970E-04	5.349E-04
157.5	1.287E-02	1.074E-02	8.428E-03	8.396E-03	6.135E-03	7.862E-04	8.971E-04	8.849E-04	7.963E-04	7.057E-04	6.267E-04	5.600E-04
180	1.523E-02	1.136E-02	8.413E-03	8.394E-03	7.693E-03	1.481E-03	8.685E-04	8.910E-04	8.091E-04	7.182E-04	6.376E-04	5.693E-04
202.5	1.287E-02	1.074E-02	8.428E-03	8.396E-03	6.135E-03	7.862E-04	8.971E-04	8.849E-04	7.963E-04	7.057E-04	6.267E-04	5.600E-04
225	7.258E-03	6.819E-03	6.308E-03	5.980E-03	3.771E-03	1.247E-03	9.563E-04	8.584E-04	7.590E-04	6.711E-04	5.970E-04	5.349E-04
247.5	4.089E-03	4.068E-03	4.085E-03	3.814E-03	2.662E-03	1.453E-03	9.770E-04	8.076E-04	7.037E-04	6.226E-04	5.560E-04	5.003E-04
270	2.803E-03	2.912E-03	3.128E-03	3.019E-03	2.275E-03	1.394E-03	9.208E-04	7.382E-04	6.417E-04	5.706E-04	5.124E-04	4.636E-04
292.5	2.564E-03	2.742E-03	3.217E-03	3.346E-03	2.395E-03	1.243E-03	7.960E-04	6.605E-04	5.840E-04	5.240E-04	4.737E-04	4.308E-04
315	2.690E-03	2.806E-03	3.678E-03	4.833E-03	3.330E-03	9.235E-04	6.570E-04	5.977E-04	5.401E-04	4.887E-04	4.442E-04	4.057E-04
337.5	2.800E-03	2.717E-03	3.170E-03	6.699E-03	5.605E-03	5.294E-04	6.536E-04	5.708E-04	5.148E-04	4.674E-04	4.261E-04	3.902E-04

B : Y Direction

Angle (°)\zi(m)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1
0	2.631E-03	3.074E-03	3.217E-03	3.848E-03	2.984E-03	1.349E-03	8.754E-04	7.009E-04	5.987E-04	5.257E-04	4.689E-04	4.227E-04
22.5	2.509E-03	2.825E-03	3.161E-03	3.831E-03	2.852E-03	1.350E-03	9.004E-04	7.185E-04	6.113E-04	5.353E-04	4.766E-04	4.290E-04
45	2.683E-03	2.838E-03	3.321E-03	3.412E-03	2.343E-03	1.340E-03	9.582E-04	7.671E-04	6.482E-04	5.640E-04	4.995E-04	4.479E-04
67.5	3.050E-03	3.110E-03	3.151E-03	2.793E-03	2.019E-03	1.389E-03	1.048E-03	8.445E-04	7.088E-04	6.113E-04	5.374E-04	4.789E-04
90	3.255E-03	3.255E-03	3.149E-03	2.748E-03	2.119E-03	1.566E-03	1.199E-03	9.584E-04	7.944E-04	6.770E-04	5.892E-04	5.207E-04
112.5	3.833E-03	3.965E-03	4.130E-03	3.812E-03	2.903E-03	2.014E-03	1.455E-03	1.119E-03	9.048E-04	7.579E-04	6.511E-04	5.698E-04
135	5.509E-03	6.186E-03	7.458E-03	7.768E-03	5.616E-03	3.034E-03	1.849E-03	1.319E-03	1.028E-03	8.431E-04	7.143E-04	6.187E-04
157.5	1.021E-02	1.303E-02	1.558E-02	1.896E-02	1.361E-02	4.800E-03	2.280E-03	1.501E-03	1.131E-03	9.114E-04	7.635E-04	6.560E-04
180	1.696E-02	2.189E-02	2.284E-02	3.044E-02	2.232E-02	5.981E-03	2.478E-03	1.577E-03	1.172E-03	9.381E-04	7.823E-04	6.702E-04
202.5	1.021E-02	1.303E-02	1.558E-02	1.896E-02	1.361E-02	4.800E-03	2.280E-03	1.501E-03	1.131E-03	9.114E-04	7.635E-04	6.560E-04
225	5.509E-03	6.186E-03	7.458E-03	7.768E-03	5.616E-03	3.034E-03	1.849E-03	1.319E-03	1.028E-03	8.431E-04	7.143E-04	6.187E-04
247.5	3.833E-03	3.965E-03	4.130E-03	3.812E-03	2.903E-03	2.014E-03	1.455E-03	1.119E-03	9.048E-04	7.579E-04	6.511E-04	5.698E-04
270	3.255E-03	3.255E-03	3.149E-03	2.748E-03	2.119E-03	1.566E-03	1.199E-03	9.584E-04	7.944E-04	6.770E-04	5.892E-04	5.207E-04
292.5	3.050E-03	3.110E-03	3.151E-03	2.793E-03	2.019E-03	1.389E-03	1.048E-03	8.445E-04	7.088E-04	6.113E-04	5.374E-04	4.789E-04
315	2.683E-03	2.838E-03	3.321E-03	3.412E-03	2.343E-03	1.340E-03	9.582E-04	7.671E-04	6.482E-04	5.640E-04	4.995E-04	4.479E-04
337.5	2.509E-03	2.825E-03	3.161E-03	3.831E-03	2.852E-03	1.350E-03	9.004E-04	7.185E-04	6.113E-04	5.353E-04	4.766E-04	4.290E-04

B : Z Direction

Angle (°)\zi(m)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1
0	4.667E-03	1.677E-02	3.583E-02	1.664E-01	1.726E-01	3.808E-02	8.643E-03	3.299E-03	1.578E-03	8.658E-04	5.218E-04	3.365E-04
22.5	4.265E-03	1.497E-02	3.503E-02	1.262E-01	1.041E-01	2.838E-02	7.602E-03	2.990E-03	1.442E-03	7.933E-04	4.787E-04	3.089E-04
45	3.441E-03	9.841E-03	2.432E-02	4.834E-02	3.619E-02	1.432E-02	5.142E-03	2.180E-03	1.075E-03	5.954E-04	3.603E-04	2.330E-04
67.5	1.837E-03	4.834E-03	1.004E-02	1.375E-02	1.080E-02	5.564E-03	2.451E-03	1.121E-03	5.659E-04	3.160E-04	1.918E-04	1.243E-04
90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
112.5	1.837E-03	4.834E-03	1.004E-02	1.375E-02	1.080E-02	5.564E-03	2.451E-03	1.121E-03	5.659E-04	3.160E-04	1.918E-04	1.243E-04
135	3.441E-03	9.841E-03	2.432E-02	4.834E-02	3.619E-02	1.432E-02	5.142E-03	2.180E-03	1.075E-03	5.954E-04	3.603E-04	2.330E-04
157.5	4.265E-03	1.497E-02	3.503E-02	1.262E-01	1.041E-01	2.838E-02	7.602E-03	2.990E-03	1.442E-03	7.933E-04	4.787E-04	3.089E-04
180	4.667E-03	1.677E-02	3.583E-02	1.664E-01	1.726E-01	3.808E-02	8.643E-03	3.299E-03	1.578E-03	8.658E-04	5.218E-04	3.365E-04
202.5	4.265E-03	1.497E-02	3.503E-02	1.262E-01	1.041E-01	2.838E-02	7.602E-03	2.990E-03	1.442E-03	7.933E-04	4.787E-04	3.089E-04
225	3.441E-03	9.841E-03	2.432E-02	4.834E-02	3.619E-02	1.432E-02	5.142E-03	2.180E-03	1.075E-03	5.954E-04	3.603E-04	2.330E-04
247.5	1.837E-03	4.834E-03	1.004E-02	1.375E-02	1.080E-02	5.564E-03	2.451E-03	1.121E-03	5.659E-04	3.160E-04	1.918E-04	1.243E-04
270	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
292.5	1.837E-03	4.834E-03	1.004E-02	1.375E-02	1.080E-02	5.564E-03	2.451E-03	1.121E-03	5.659E-04	3.160E-04	1.918E-04	1.243E-04
315	3.441E-03	9.841E-03	2.432E-02	4.834E-02	3.619E-02	1.432E-02	5.142E-03	2.180E-03	1.075E-03	5.954E-04	3.603E-04	2.330E-04
337.5	4.265E-03	1.497E-02	3.503E-02	1.262E-01	1.041E-01	2.838E-02	7.602E-03	2.990E-03	1.442E-03	7.933E-04	4.787E-04	3.089E-04

Table 26: Gradient Coil Gauss Lines

--End of section--

13 REFERENCES

1.	3500WB-02 SS	PICA System Specification Document
2.	MS012 PICA PP Civil	PICA Penetration Panel Civil Drawing
3.	MS015 PICA Power-On Seq	PICA System Power On Sequence
4.	MS035 Site Survey Report	Site Survey Report
5.	MS034 Preliminary Site Survey Report	Preliminary Site Survey Report

--End of Section--

14 GLOSSARY OF TERMS

Abbreviation	Definition
ACQ	Acquisition
AC	Alternating Current
B0	Main magnetic field strength
B1	Radio frequency field strength
Coils	General term for "RF Coils", "Gradient Coils"
DC	Direct Current
DICOM	Digital Imaging and Communications in Medicine
EC	Eddy Current
ECG	Electro CardioGraph
Echo	Regrowth of the transverse component of magnetization after it has disappeared
Eddy Current	An induced spurious electrical current produced by time-varying magnetic fields
EMF	ElectroMagnetic Field
FID	Free Induction Decay
FIR	Fast Inversion Recovery
FOS	Fold Over Suppression
FOV	Field Of View
G	Gauss
Gx, Gy, Gz	Gradient Coils
IR	Inversion Recovery
MR / MRI	Magnetic Resonance, Magnetic Resonance Imaging
Phantom	An artificial object of known dimensions and properties to test or monitor an MRI system’s homogeneity, imaging performance
PPM	Parts Per Millions
Q	Quality factor of the RF-coil
RF	Radio Frequency
RF Coil	Radio Frequency Coil
ROI	Region Of Interest
SAR	Specific Absorption Rate
Shimming	Process to optimize the magnetic field homogeneity
SNR	Signal to Noise Ratio
T/R Coil	Transmit Receive Coil
T0	Time of arrival
T1	Spin lattice relaxation Time
T2	Spin spin relaxation Time
TD	Trigger Delay
TD	Time Difference
TE	Echo Time

--End of Section--

15 READER COMMENT

For any amendment/remedial action be carried out promptly, we appreciate user's co-operation in filling out and returning of this customer reply sheet as soon as possible.

Customer Information:

Name	
Title	
Company	
Date	
Address	
Telephone Number	
System Model	

Customer Comments:

Page number	
Details of inaccuracies	
Other comments	

Submit to:

E-mail: info@time-medical.com
Fax: +852-2156-0908

--End of Section--

--End of Document--

EMI SITE SURVEY REPORT

Customer:	**Imedco**
Location:	**Wyane State University**
	461 Burroughs St **Detroit, MI 48202**
Report Status:	**EMI Survey**
Test Specification:	**OEM Site Planning Guide**
Test Report No.:	**20190806A**
Job Number:	**N/A**

DOCUMENT HISTORY

Revision	Issue Date	Affected Page(s)	Description of Modifications	Revised By	Approved By
0	10 Aug 2019		Initial release		

TEST REPORT NO. 20190806A
From:
R-BOX TESTING
MOBILE TESTING

Test for:
IMEDCO American LTD

Written By Barkley Wesselius 11 August 2019

Barkley Wesselius, NDT Technician

TEST PERSONNEL – R-Box Testing

Barkley Wesselius	NDT Technician, RBOX Testing

CUSTOMER TEST WITNESS

N/A	Imedco

Test Facility	R-BOX Mobile Test Lab
Address	Po Box 58
Address	
City, State Zip Code	Bartonsville, PA 18321
Phone	(570) 350-4914
Fax	(570) 300-1643

TABLE OF CONTENTS (This document contains a total of 11 pages.)

Table of Contents

1 INTRODUCTION

This report documents the results of a series of EMI measurements performed at a location intended for magnetic sensitive equipment.

This series of measurements was performed by R-BOX testing mobile test laboratory at
Wyane State University
461 Burroughs St
Detroit, MI 48202

R-Box Testing is a completely independent test and measurement service that performs tests and measurements in accordance with the latest U.S. Government and manufacturers' guidelines requiring impartial testing.
R-Box Testing is not affiliated with any systems, equipment, or facilities manufacturers.

2 TEST DATES

6 August 2019

3 TEST SPECIFICATION

OEM Site Planning Guide

4 PURPOSE OF TEST

The purpose of this series of measurements was to measure any sources that would effect the operation of the proposed equipment to be installed.

5 SITE DESCRIPTION

The proposed location is for the installation of Time Medical System MRI. The proposed location is at ground level of a existing single story building. This building is located at 461 Burroughs St, Detroit, MI 48202. The proposed MRI suite is currently an unused lab. The location has a solid floor on grade. EMI measurements were taken at an estimated ISO center.

6 TEST LOCATION

Wyane State University
461 Burroughs St
Detroit, MI 48202

7 CUSTOMER

IMEDCO
1730 E Pleasant St.
Noblesville, IN 46060

8 TEST PERSONNEL

Barkley Wesselius, NDT Technician

9 MEASUREMENT PROCEDURE

Overview: To determine the levels of ambient EMI the OEM Site Planning Guide was used to setup, data collection and presentation. Measurements were taken at approximate ISO-center.

- Building steelworks and reinforcements within 6m of the magnet iso-center affects the magnetic field homogeneity within the measuring area of the magnet. Details should be provided to Time Medical Systems of beams and columns in excess of 100kg/m around the shield room and reinforced concrete or steel beams up to 40kg/m_2 below the magnet. These pieces of information allow Time Medical Systems to ensure that the magnet will reach the required specifications.

The need for magnetic compensation and the shielding method is determined according to the quasi-static (DC < 5Hz) and slow changing magnetic field fluctuation (AC 16-20Hz; AC 50-60Hz).

Maximum Acceptable Magnetic Fluctuation Values without Magnetic Compensation Requirements	
DC (<5Hz)	1mG 100nT
AC (16.6Hz)	0.2mG 20nT
AC (50-60Hz)	1mG 100nT

10 TEST RESULTS

Fluctuation minimum exceeds the requirement without compensation.
The results are indicated in section 13.

11 CONCLUSION

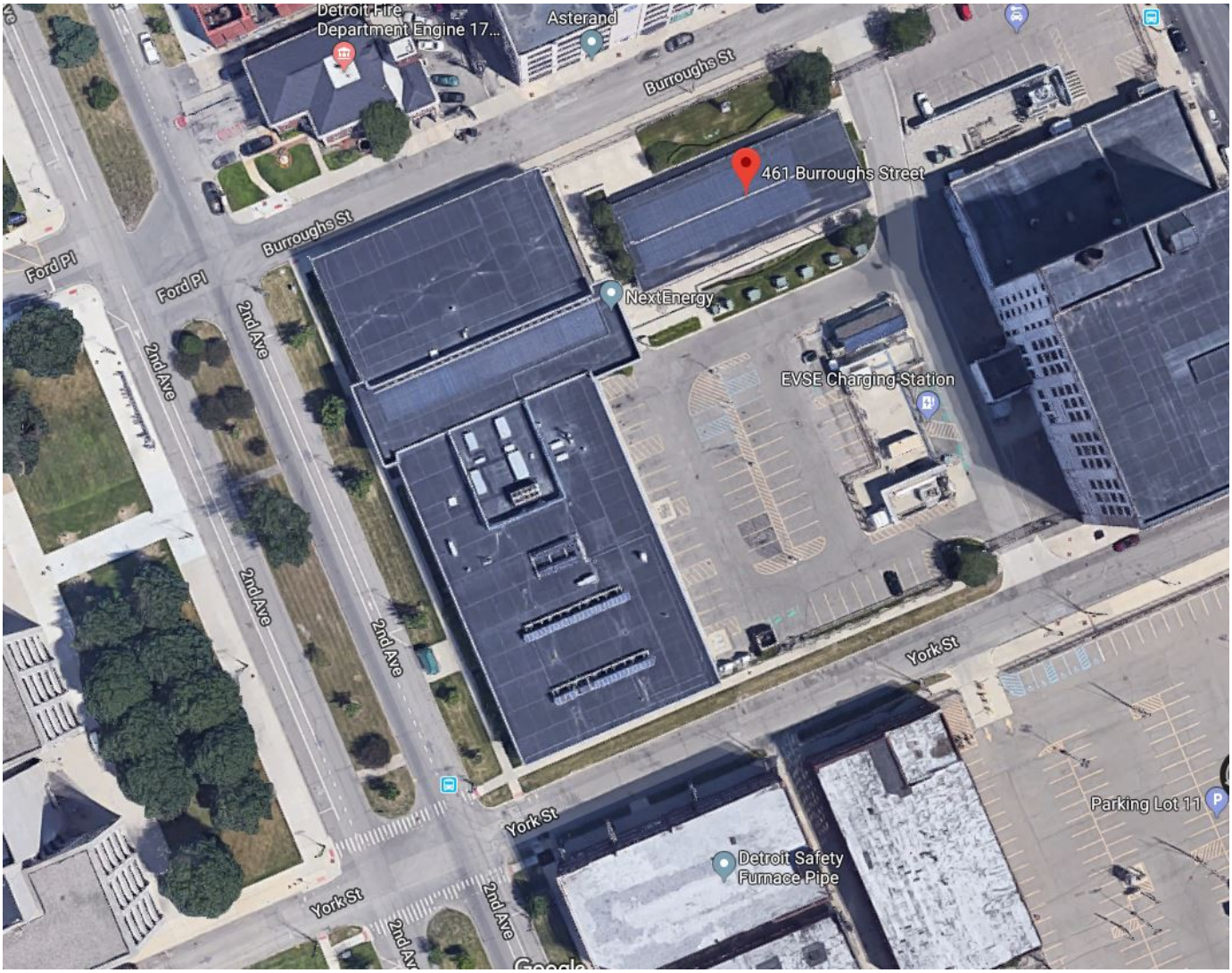
Measurements followed OEM Site Planning Guide and has been accepted by the customer for the evaluation of the site described previous. The planning guide recommended a maximum acceptable magnetic fluctuation values without Magnetic Compensation Requirements

All data collected was above the recommend levels as stated in the OEM Site Planning Guide.

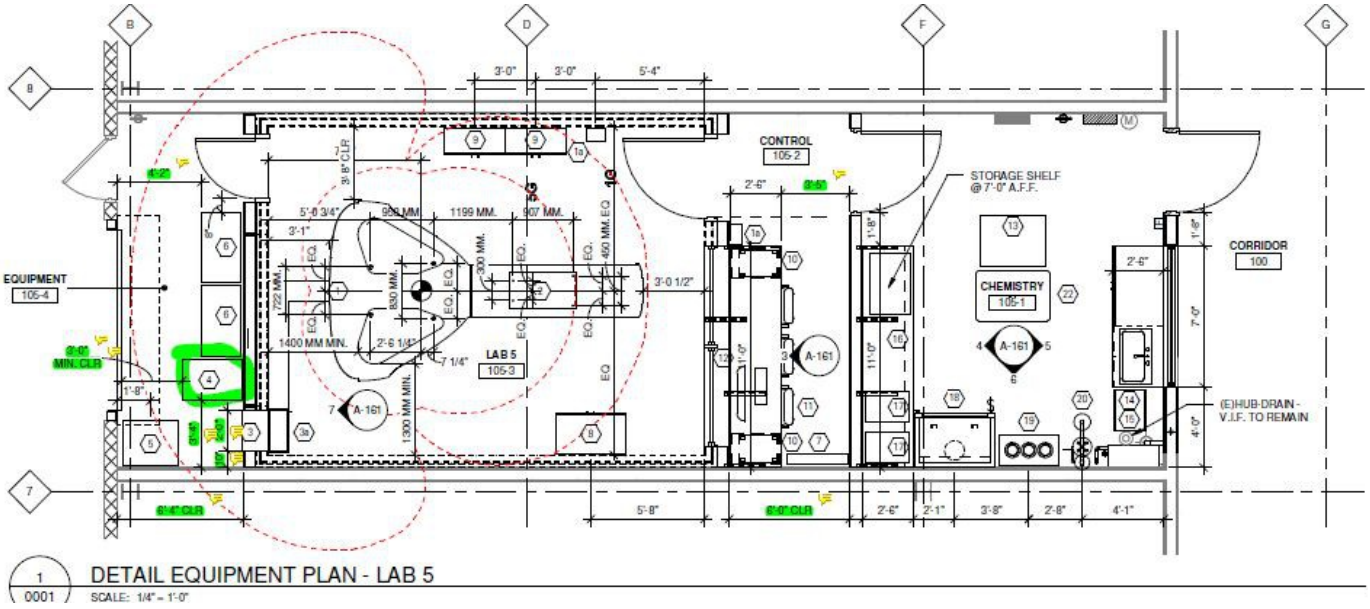
Refer to the measurement data for compliance.

12 SITE DETAIL

12.1 Site Map



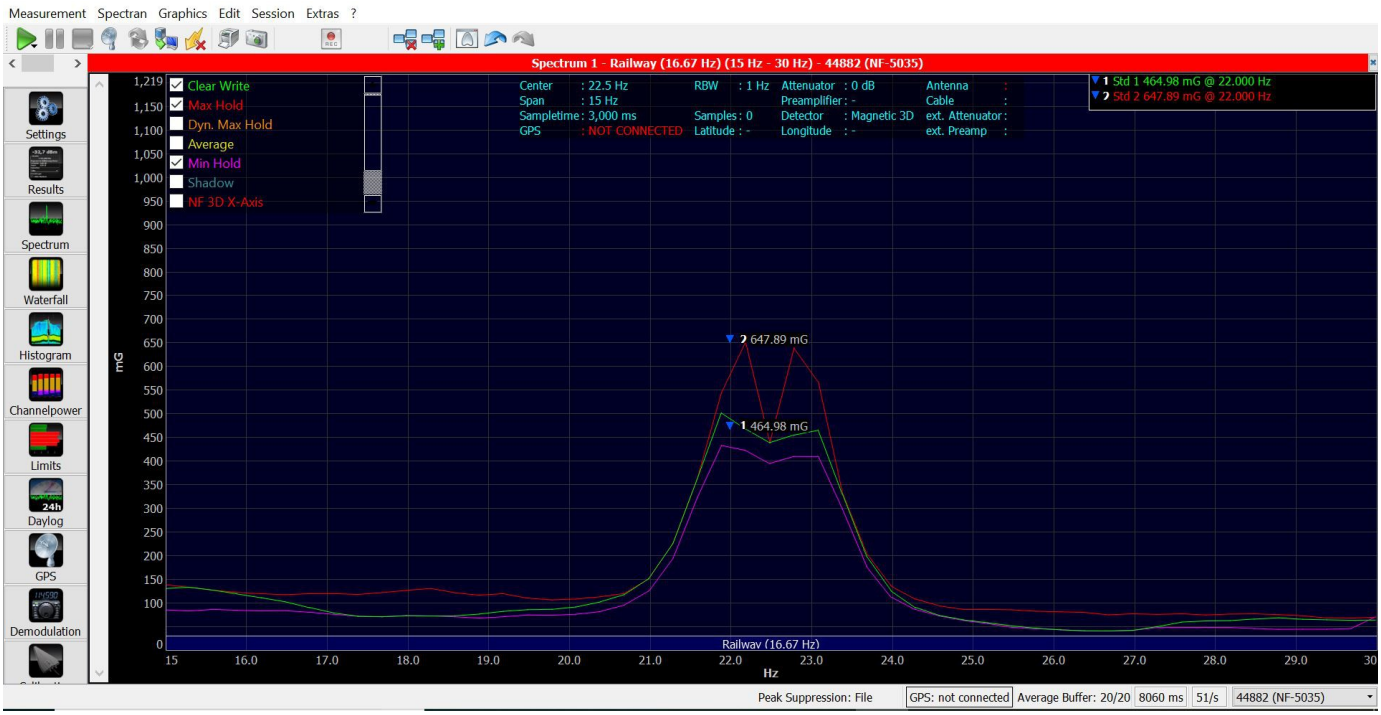
12.2 Site Plan



1 / 0001 DETAIL EQUIPMENT PLAN - LAB 5
SCALE: 1/4" = 1'-0"

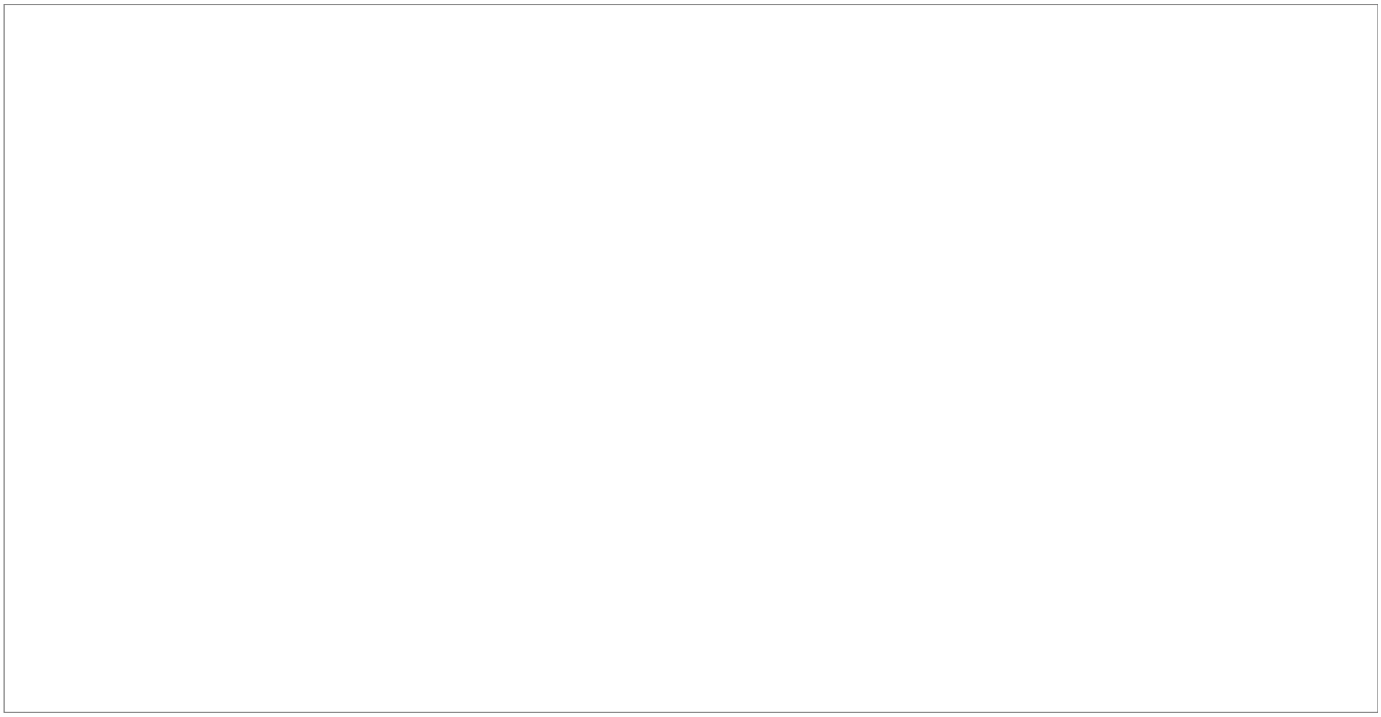
13 MEASUREMENT DATA

13.1 DC<5Hz = 182.91mG



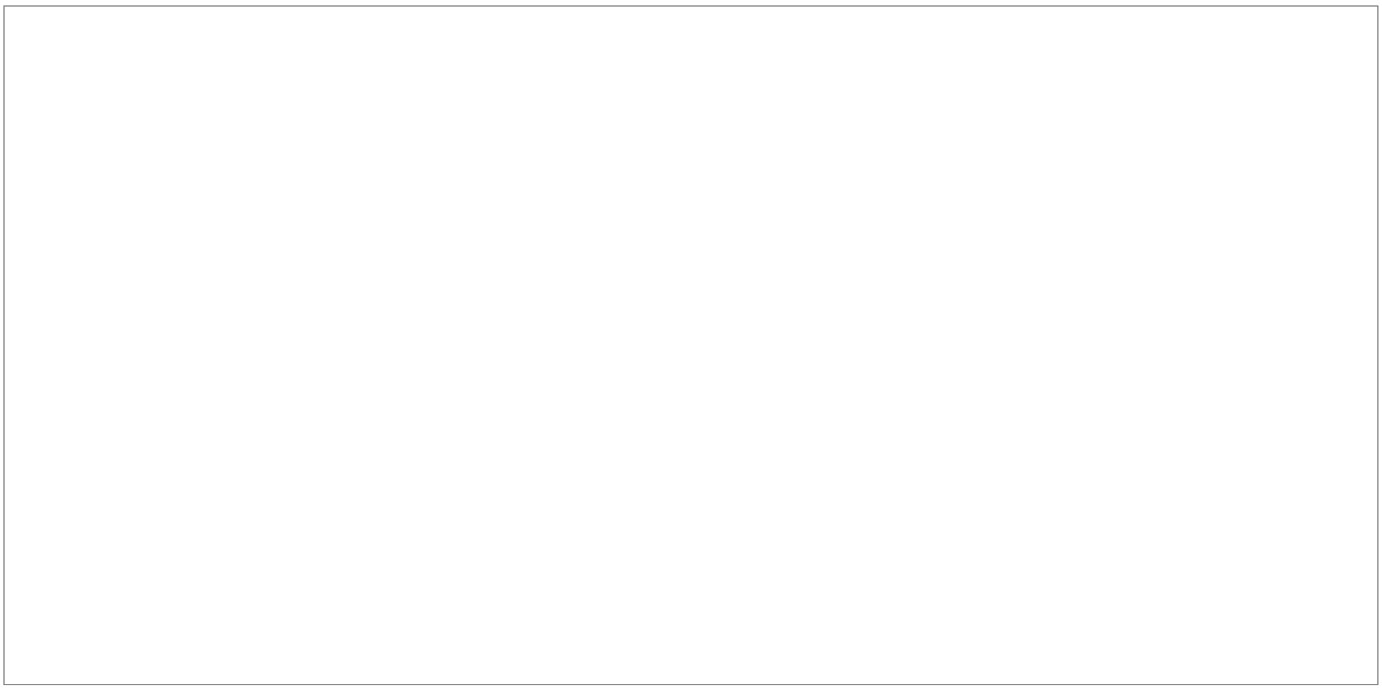
Fluctuation minimum exceeds the 1mG requirement without compensation.

13.2 AC (16.6 Hz) (Rail Frequency) = 42.40mG



Fluctuation minimum exceeds the 0.2mG requirement without compensation.

13.3 AC (50-60 Hz) (Mains Power Frequency) = 66.89mG



Fluctuation minimum exceeds the 1mG requirement without compensation.

14 EMI/RFI TEST EQUIPMENT LIST

14.1 Table: MRI Test Equipment List

Mfgr./Model	**Description**	**Serial**
Lonova	Laptop / Windows 10	MP17VE14
Spectran/NF-5035	DC – 1MHz Spectrum Analyzer	44882

VIBRATION REPORT

Customer:	**Imedco**
Location:	**Wyane State University**
	461 Burroughs St **Detroit, MI 48202**
Report Status:	**EMI Survey**
Test Specification:	**OEM Site Planning Guide**
Test Report No.:	**20190806B**
Job Number:	**N/A**

DOCUMENT HISTORY

Revision	Issue Date	Affected Page(s)	Description of Modifications	Revised By	Approved By
0	10 Aug 2019		Initial release		

TEST REPORT NO. 20190806B
From:
R-BOX TESTING
MOBILE TESTING

Test for:
IMEDCO American LTD

Written By Barkley Wesselius 11 August 2019

Barkley Wesselius, NDT Technician

TEST PERSONNEL – R-Box Testing

Barkley Wesselius	NDT Technician, RBOX Testing

CUSTOMER TEST WITNESS

N/A	Imedco

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Address	Po Box 58
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City, State Zip Code	Bartonsville, PA 18321
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2 TEST DATES

6 August 2019

3 TEST SPECIFICATION

OEM Site Planning Guide

4 PURPOSE OF TEST

The purpose of this series of measurements was to measure any sources that would effect the operation of the proposed equipment to be installed.

5 SITE DESCRIPTION

The proposed location is for the installation of Time Medical System MRI. The proposed location is at ground level of a existing single story building. This building is located at 461 Burroughs St, Detroit, MI 48202. The proposed MRI suite is currently an unused lab. The location has a solid floor on grade. Measurements were taken at an estimated ISO center.

6 TEST LOCATION

Wyane State University
461 Burroughs St
Detroit, MI 48202

7 CUSTOMER

IMEDCO
1730 E Pleasant St.
Noblesville, IN 46060

8 TEST PERSONNEL

Barkley Wesselius, NDT Technician

9 MEASUREMENT PROCEDURE

Overview: To determine the levels of vibration the OEM Site Planning Guide was used to setup, maximum levels. Measurements were taken at approximate ISO-center.

- BUILDING INFRASTRUCTURE VIBRATION REQUIREMENTS

Building vibration or shocks affecting the magnet may degrade image quality. Vibration acceleration amax* transferred by means of building vibrations to the magnet must not exceed -70dBg for all three spatial orientations in the frequency range of 0 to 100Hz.
The presence of other equipment in the building may affect the maximum level of vibrations. Perform vibration measurements during working hours.
The positioning of magnet near the bearing walls or main structure will reduce vibration that the magnet is exposed to.

10 TEST RESULTS

All Spatial Orientations met the OEM Specification.
The results are indicated in section 13.

11 CONCLUSION

Measurements followed OEM Site Planning Guide and has been accepted by the customer for the evaluation of the site described previous. The planning guide recommended a maximum acceptable vibration level. All tests in the three spatial orientations meet the OEM specification.

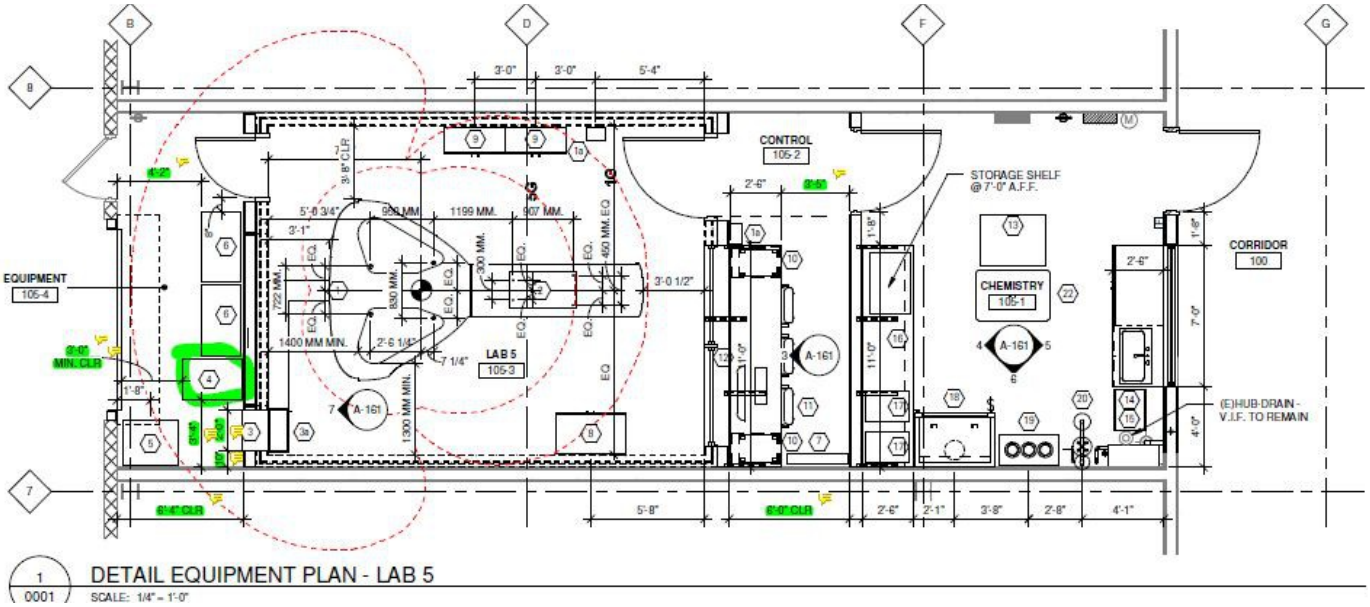
All data collected was below the recommend levels as stated in the OEM Site Planning Guide.

Refer to the measurement data for compliance.

12 SITE DETAIL

12.1 Site Map

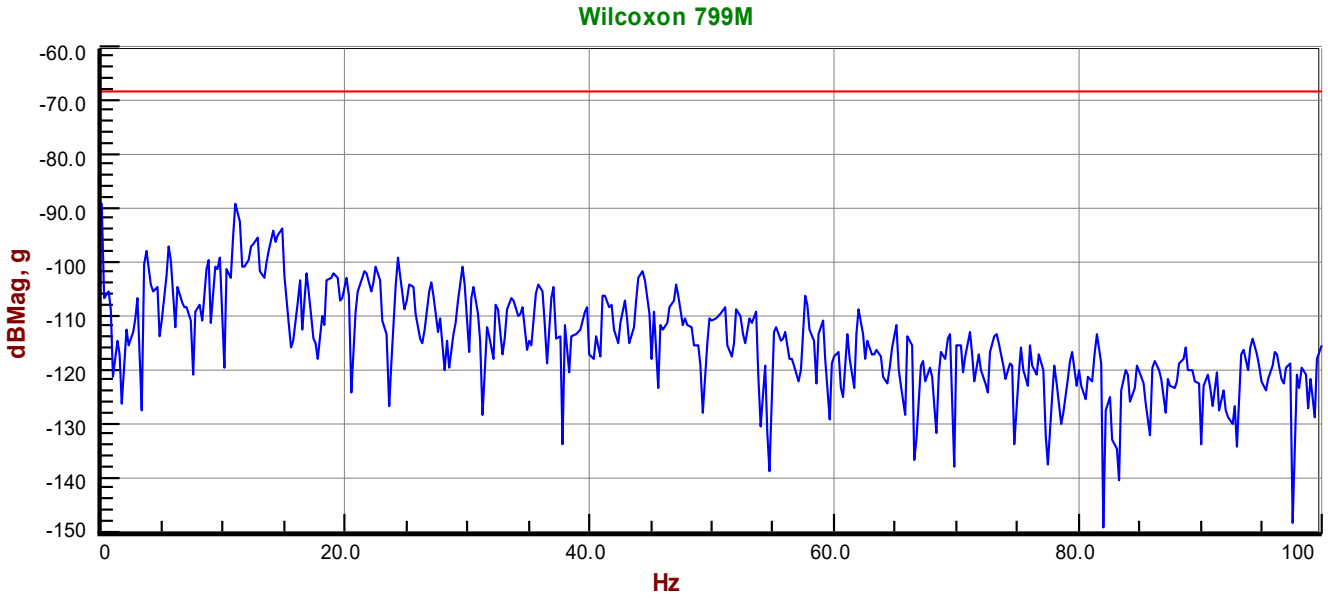
12.2 Site Plan



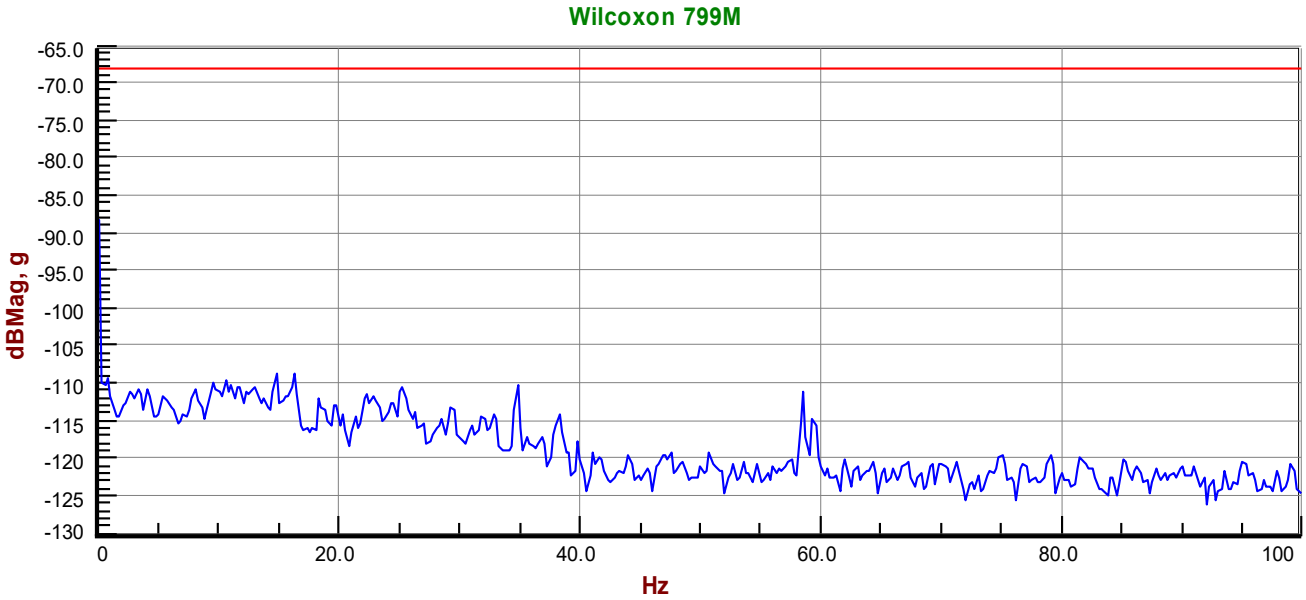
13 MEASUREMENT DATA

All Spatial Orientations met the OEM Specification.

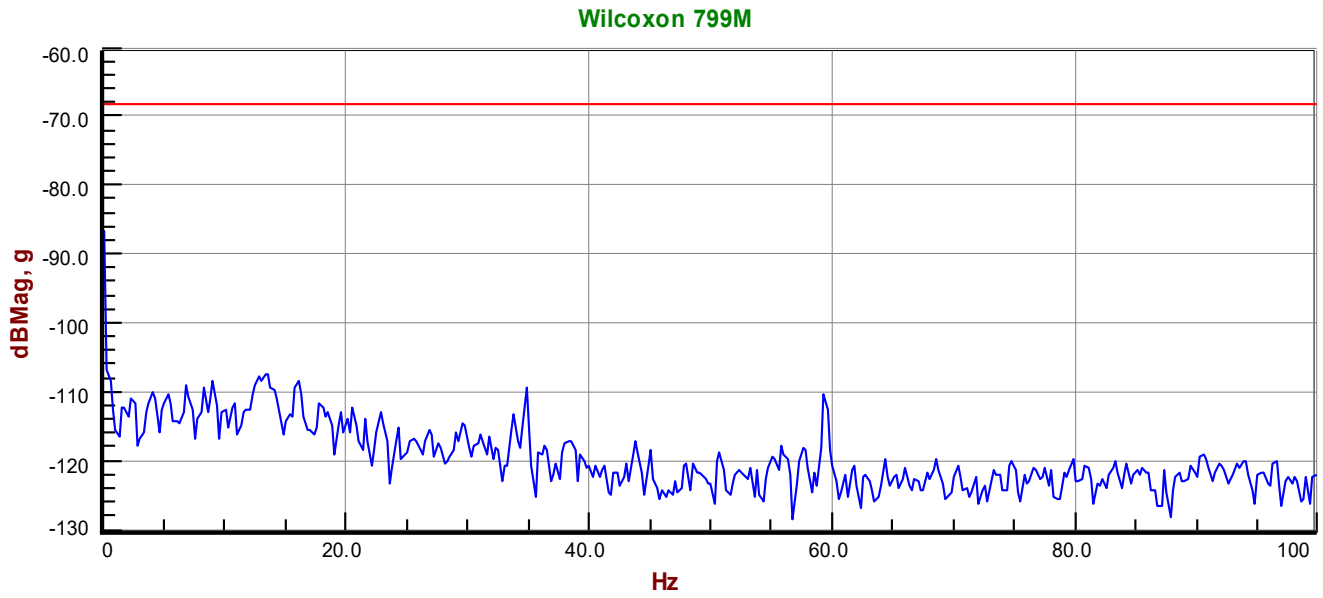
13.1 X-Axis



13.2 Y-Axis



13.3 Z-Axis



All Spatial Orientations met the OEM Specification.

14 EMI/RFI TEST EQUIPMENT LIST

The measurement of vibration levels was performed using a Data Physics Quattro Dynamic Signal Analyzer coupled to an Wilcoxon 799M seismic accelerometer. The Data Physiscs Quattro is a portable four-channel high performance FFT-based spectrum/network analyzer. All inputs are coupled to dedicated 24 bit sigma-delta ADCs with a frequency span of DC to 93KHz and a variable resolution capability. Provides over 120dB dynamic range with up to 94KHz real time rate. The Wilcoxon 799m seismic accelerometer has a response in the frequency range of 0.2Hz to 2.50KHz, with a nominal sensitivity of 1,000mV/g.

14.1 Table: MRI Test Equipment List

Mfgr./Model	**Description**	**Serial**
Lonova	Laptop / Windows 10	MP17VE14
Data Physics Quattro	Dynamic Signal Analyzer	22201
Wilcoxon 799m	Seismic Accelerometer	15478