TENDER
SPECIFICATION

FL-DUCT WORK INSULATION REPAIR
FL FORENSIC LAB
OTTAWA, ONTARIO

TABLE OF CONTENT

1 Minimum Standard

.1 Materials shall be new and work shall conform to the minimum applicable standards of the Canadian General Standards Board, the Canadian Standards Association, the National Building Code of Canada 2005 (NBC) and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy the most stringent requirement shall apply.

2 Taxes

.1 Pay all taxes properly levied by law including Federal, Provincial and Municipal.

3 Fees, Permits and Certificated

.1 Pay all fees and obtain all permits. Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that work conforms to requirements of Authority having jurisdiction.

4 Fire safety Requirements

.1 Comply with the National Building Code of Canada 2005(NBC) for fire safety in construction and the National Fire Code of Canada 2005 (NFC) for fire prevention, fire fighting and life safety in building in use.

.2 Comply with Human Resources Development Canada (HRDC), Fire Commissioner of Canada (FCC) standards:
.1 No. 301: Standard for Construction Operations
.2 No. 302: Standard for Welding and Cutting
.3 No. 374: Fire Protection Standard for General Storage (Indoor and Outdoor)
.4 Available from Fire Protection Engineering Services, Labour Program, HRDC or following internet site:
http://info.load-otea.hrdc-drhc.gc.ca/fire_prevention/standards/commissioner.shtml
.5 Retain all fire safety documents and standards on site.

.3 Welding and cutting:
.1 At least 48 hours prior to commencing cutting, welding or soldering procedure, provide to Engineer:
.1 Notice of intent, indicating devices affected, time and duration of isolation or bypass.
.2 Completed welding permit as defined in FC 302.
.3 Return welding permit to Engineer immediately upon completion of procedures for which permit was issued.
.4 A fire watcher as described in FC 302 shall be assigned when welding or cutting

operations are carried out in areas where combustible materials within 10m may be ignited by conduction or radiation.

.4 Contractor is responsible to hire manufacturer or their representative of the existing fire alarm system to ensure all work on alarms such as by-pass etc are properly performed as required.

5 Field Quality Control

.1 Carry out Work using qualified licenced workers or apprentices in accordance with Provincial Act respecting manpower vocational training and qualification.

.2 Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licenced workers.

.3 Determine permitted activities and tasks by apprentices, based on level of training attended and demonstration of ability to perform specific duties.

6 Hazardous Materials

.1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and the provision of Material Safety Data Sheets (MSDS) acceptable to Human Resources Development Canada, Labour Program.

.2 For work in occupied buildings give the Engineer 48 hours notice for work involving designated substances (Ontario Bill 208) and hazardous substances Canada Labour Code Part II Section 10).

.3 Contractor to ensure equipment is properly locked out prior to commencing of work. Notify Engineer 48 hours that a lock out is required.

7 Temporary Utilities

.1 Existing services required for the work may be used by the Contractor without charge. Ensure capacity is adequate prior to imposing additional loads. Connect and disconnect at own expense and responsibility.

.2 Notify the Departmental Representative and utility companies of intended interruption of services, obtain requisite permission.

.3 Give the Departmental Representative 48 hours notice related to each necessary interruption of any mechanical or electrical service throughout the course of the work. Keep duration of these

interruptions to a minimum. Carry out all interruptions after normal working hours of the occupants, preferably on weekends.

8 Removed Material

.1 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site.

9 Protection

.1 Protect finished work against damage until take-over.

.2 Protect adjacent work against the spread of dust and dirt beyond the work areas.

.3 Protect operatives and other users of site from all hazards.

10 Use of Site and Utilities

.1 Execute work with least possible interference or disturbance to the normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated. Refer to article 1.22 Scheduling below for work that must be done during "off hours".

.2 Maintain existing services to building.

.3 Contractor may use elevators at Departmental Representative'sdiscretion. Protect from damage, safety hazards and overloading of existing equipment.

.4 Sanitary facilities will be assigned for Contractor's personnel. Others shall not be used. Keep facilities clean.

.5 Closures: Protect work temporarily until permanent enclosures completed.

11 Site Storage

.1 The Departmental Representative will assign storage space, which shall be equipped and maintained by the Contractor.

.2 Do not unreasonably encumber site with materials or equipment.

.3 Move stored products or equipment, which interfere with operations of Departmental Representative or other contractors.

.4 Obtain and pay for use of additional storage or work areas needed for operations.

12 Cut, Patch and Make Good

.1 Cut existing surfaces as required to accommodate new work.

.2 Remove all items so shown or specified.

.3 Patch and make good surfaces cut, damaged or disturbed, to Engineer's approval. Match existing material, colour, finish and texture.

13 Examination

.1 Examine site and conditions likely to affect work and be familiar and conversant with existing conditions.

.2 Provide photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims.

14 Signs

.1 Provide common-use signs related to information, instruction, use of equipment, public safety devices, etcetera, in both official languages or by the use of commonly-understood graphic symbols to the Departmental Representative's approval.

.2 No advertising will be permitted on this project.

15 Access and Egress

.1 Design, construct and maintain temporary "access to" and "egress from" work areas and in accordance with relevant municipal, provincial and other regulations.

16 Scaffolds and Work Platforms

.1 Design, install, and inspect scaffolds and work platforms required for work in accordance with relevant municipal, provincial and other regulations.

17 Guarantees and Warranties

.1 Before completion of work collect all manufacturer's guarantees and warranties and deposit with Departmental Representative.

18 Clean Up

.1 Clean up work area as work progresses. At the end of each work period, and more often if ordered by the Departmental Representative,remove debris from site,neatly stack material for use, and clean up generally.

.2 Upon completion remove scaffolding and work platforms, temporary protection and surplus materials. Make good defects noted at this stage.

.3 Clean areas under contract to a condition at least equal to that previously existing and to approval of Departmental Representative.

19 Security Clearances

.1 All personnel employed on this project will be subject to security check.

.2 All personnel engaged in the execution of the work

shall have the requisite security clearance prior to the commencement of on-site activities.

.3 Immediately upon award of the contract, the Contractor shall prepare and submit the requisite forms, provided by the Departmental Representative, for each employee and sub-contractor employee to be engaged in the work. The Contractor shall mobilize on site, only once the security clearance has been granted.

.4 The Contractor should batch the submissions, based on priority of work on site and allow a reasonably processing time in the project schedule for the clearance process to occur.

.5 Delays resulting from the Contractor's inability to submit the fully completed requisite form in a timely manner will not be reason for an extension to the project schedule or additional compensation.

.6 Contractor's personnel engaged in the work outside the normal working hours of Monday to Friday, 06:00 to 16:00, must be escorted. This designate will be at no cost to the Contractor.

.7 The Contractor shall give the Engineer 72 hours notice for work to be carried out during periods outside of normal working hours.

20 Building Smoking Environment

.1 Smoking is not permitted in the Building. Obey smoking restrictions on building property.

21 Scheduling

.1 On award of contract submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion. When schedule has been reviewed by the Departmental Representative, take necessary measures to complete work within scheduled time. Do not change schedule without notifying Departmental Representative.

22 Waste Management

.1 As per Section 01 74 11.

23 Precedence

.1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

24 Correspondences

.1 Other than the Tender response and all signed

documents all correspondences to be electronic only; no fax or hard copies will be accepted.

25 Operation and Maintenance Manuals

.1 As per the user document the O and M Manuals are to be assembled as follows:
The consultant is to ensure that the contractor provides 2 hard copy binders and 1 cd copy of operations and maintenance (O&M) manuals upon project completion.

O and M Manuals are to be assembled in a “1” or greater 3 ring binder labelled on the front cover and binder edge with the: Building Name and address, project name, project number, completed date (ex. October 2013).

O and M Manuals are to include a Title Page with building name , address, date, general contractor information: name, address & phone numbers, consultant : name, address & phone numbers.

O and M Manuals are to be indexed / sectioned as follows:

A-Signed letter of warranty: dated, identifying project by name, project number, location as well as warranty period. Any extended equipment warranty must also be identified.

B- Contact information for all sub-contractors & suppliers.

C-Reports: copy of all TAB reports for HVAC systems, pre-functional tests, start-up reports, functional test reports, completed performance verification forms, cabling verifications, ESA certification, TSSA certification, fire alarm certification and all other required certifications required by National Building Code.

D- As built drawings - to be marked in “red” and provide on a CAD.

E –Sequence of operation: outline how the system is designed to work.

F- CMMS Data Sheets: All equipment which is to be deleted, removed, added or replaced from site is to have a CMMS inventory sheet completed and included in the O&M manual. If this equipment is a pressure vessel and is included in the annual inspect with TSSA the orange tag that is visible is attached to the equipment must be removed prior to demolition and forwarded to the commissioning manager.

G, H...- Tab for each piece of new equipment or product to include: Copy of approved shop drawing and a Copy of Specific Service and Maintenance manual for each.

Part 1 General

1.1 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work is co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Allow 5 days for Departmental Representative's review of each submission.

.4 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.5 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.6 Accompany submissions with transmittal letter, in duplicate, containing:

.1 Date.
.2 Project title and number.
.3 Contractor's name and address.
.4 Identification and quantity of each shop drawing, product data and sample.
.5 Other pertinent data.

.7 Submissions include:

.1 Date and revision dates.
.2 Project title and number.
.3 Name and address of:
.1 Subcontractor.
.2 Supplier.
.3 Manufacturer.
.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
.5 Details of appropriate portions of Work as applicable:
.1 Performance characteristics.
.2 Standards.

.8 After Departmental Representative's review, distribute copies.

.9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.10 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.11 Delete information not applicable to project.

.12 Supplement standard information to provide details applicable to project.

.13 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.14 The shop drawings are to be reviewed by commissioning.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Province of Ontario

.1 Occupational Health and Safety Act, R.S.O. 1990 Updated 2005.

1.2 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.

.3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative.

.4 Submit copies of incident and accident reports.

.5 Submit WHMIS MSDS - Material Safety Data Sheets.

.6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Departmental Representative.

.7 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

.9 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.4 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

.1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.6 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.7 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Health and Safety Act, R.S.O.

.2 Comply with Occupational Health and Safety Act, Industrial and Commercial Establishments Regulation.

.3 Comply with Occupational Health and Safety Regulations, 1996.

.4 Comply with Occupational Health and Safety Act, General Safety Regulations, O.I.C.

.5 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.9 UNFORSEEN HAZARDS

.1 When unforeseen or peculiar safety related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.10 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have site related working experience specific to activities associated with.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.11 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

1.12 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.13 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.14 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.15 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.

.3 Provide on-site containers for collection of waste materials and debris.

.4 Dispose of waste materials and debris off site.

.5 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.6 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.7 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.8 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.9 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris other than that caused by Owner or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Remove debris and surplus materials from ceiling space and other accessible concealed spaces.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling. Provide proof of disposal at appropriate disposal site.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.

.3 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab.

.1 Bind in with text; fold larger drawings to size of text pages.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume: provide title of project;

.1 Date of submission; names.

.2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:

- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Change Orders and other modifications to Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction.

- .1 Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

- .1 Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition.

- .1 Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative.

.6 Update the existing electrical single line diagrams and turned over to the Departmental Representative (Consultant) so that it can be incorporated in the As-Built drawings.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of black line drawings.

.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress.

- .1 Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: mark each item to record actual construction

.5 Specifications: mark each item to record actual construction, including:

- .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
- .2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications required by individual specifications sections.

.7 Provide digital photos, if requested, for site records.

.8 Provide a video of interior of ducts after sealer has been applied.

1.7 EQUIPMENT AND SYSTEMS

.1 For each item of equipment and each system include amount and length of sealer installed.

.2 Maintenance Requirements: include location of sealer and in which duct and the length of sealer.

.2 Include manufacturer's printed operation and maintenance instructions.

.3 Additional requirements: as specified in individual specification sections.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of the applied sealer to acoustic membranes to ductwork as indicated..

.2 Related Sections:

.1 Division 1

.2 Division 23

.3 Acronyms:

.1 Cx - Commissioning.

.2 O&M - Operation and Maintenance manual

.3 PI - Product Information.

.4 PV - Performance Verification.

1.2 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

.2 Objectives:

.1 Verify the silencers are installed in accordance with contract documents and design criteria and intent.

.2 Ensure appropriate documentation is compiled into the O&M manual.

.3 Effectively train O&M staff.

.3 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

.1 Systems to be verified that the pipes drain as per contract documents and in accordance with Contract Documents and design criteria.

.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.4 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

.1 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.2 Cx responsibilities is to ensure the built system is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.3 Consultant will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Commissioning manager.

.2 Equipment, components and systems have been commissioned.

.3 O&M Manual received, reviewed and approved.

.4 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should the coils, gauges, valves and piping be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by consultant, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to consultant.

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Ensure installation of related components, equipment, sub-systems, and systems are complete.

.2 Fully understand Cx requirements and procedures.

.3 Have Cx documentation shelf-ready.

.4 Understand completely design criteria and intent and special features.

.5 Submit complete start-up documentation to Commissioning manager and Consultant

.6 Have Cx schedules up-to-date.

.7 Ensure systems have been cleaned thoroughly.

.8 Ensure "As-Built" system schematics are available.

.4 Inform consultant in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to consultant before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures

.1 Submit no later than 4 weeks after award of Contract:

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to consultant for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to consultant where not specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Commissioning manager.

1.8 COMMISSIONING DOCUMENTATION

.1 Consultant to review and approve Cx documentation.

.2 Provide completed and approved Cx documentation to consultant and Cx Manager.

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Bar (GANTT) Chart.

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

1.10 STARTING AND TESTING

.1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.11 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days notice prior to commencement.

.2 Commissioning manager to witness of start-up and testing.

.3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.12 MANUFACTURER'S INVOLVEMENT

.1 Obtain manufacturers instructions prior to start-up of work and review with consultant

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.2 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

1.13 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

.2 Visual and video inspections of quality of installation.

.2 Start-up: follow accepted start-up procedures.

.3 Operational testing: document equipment performance.

.4 System PV: include repetition of tests after correcting deficiencies.

.3 Correct deficiencies and obtain approval from consultant after distinct phases have been completed and before commencing next phase.

1.14 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to consultant for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Pre-start-up inspection reports.

.2 Signed installation/start-up check lists.

.3 Start-up reports,

1.15 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit consultant for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.16 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

1.17 START OF COMMISSIONING

.1 Notify consultant and commissioning manager at least 14 days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.18 WITNESSING COMMISSIONING

.1 Commissioning manager to witness activities and verify results.

.2 Engineer (Consultant) to certify all PV results.

.3 Contractors to be present at all tests.

1.19 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to consultant within 5 days of test and with Cx report.

1.20 EXTENT OF VERIFICATION

.1 Elsewhere:

.1 Provide manpower and instrumentation to verify all reported results, unless specified otherwise in other sections.

.2 Number and location to be at discretion of consultant and Cx Manager

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Perform additional commissioning until results are acceptable to consultant and/or Cx Manager.

.5 Verification will be as follows:

.1 All silencer will be verified 100%.

1.21 REPEAT VERIFICATIONS

.1 Assume costs incurred by consultant for third and subsequent verifications where:

.1 Verification of reported results fail to receive Consultant's approval.

.2 Repetition of second verification again fails to receive approval.

.3 Consultant deems Contractor's request for second verification was premature.

1.22 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of consultant and Cx manager.

.2 Report problems, faults or defects affecting Cx to consultant in writing. Stop Cx until problems are rectified. Proceed with written approval from consultant.

1.23 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by consultant and/or Cx manager.

1.24 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.25 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

.1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.26 OCCUPANCY

.1 Cooperate fully with Owner Representative during stages of acceptance and occupancy of facility.

1.27 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Commissioning manager will not relieve Contractor from compliance with specified start-up and testing procedures.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 This section is limited to portions of the Operations and Maintenance Manual (O&M) provided to Consultant, Project Manger, Facility Manger and Cx Manager by the contractor.

.2 Related Sections:

.1 Division 1

.2 Division 23

.3 Acronyms:

.1 BMM - Building Management Manual.

.2 Cx - Commissioning.

.3 PI - Product Information.

.4 PV - Performance Verification.

.5 WHMIS - Workplace Hazardous Materials Information System.

1.2 GENERAL REQUIREMENTS

.1 Standard letter size paper 8.5 x 11.5 inches

.2 Methodology used to facilitate updating.

.3 Drawings, diagrams and schematics to be professionally developed.

.4 Electronic copy of data to be in a format accepted and approved by Project Manager and Facility Manager

.5 Prior to commencement, co-ordinate requirements for preparation, submission and approval with Cx Manager

1.3 GENERAL INFORMATION

.1 Provide to consultant and Cx Manager for review the O & M Manual as per the following Checklist

Initial Review of O&M manuals must take place 2 weeks prior to Substantial Completion or training

- Must be in a **3 "D" ring type loose leaf binder** labelled on the front cover and on the binder edge with the following information: Building Name and address, project name, project number, completed date (ex. October 2011).

- **Title Page** : O&M manual for building name, address, date, general contractor information: name address & phone numbers, consultant: name address & phone numbers.
- **Index:** sections as follows
- **A** – **Warranties -** Signed ' Letter of warranty' : dated, identifying project by name, project number, location as well as warranty period. Any extended warranty of equipment only must be identified also.
- **B** - **Contact information** - for all sub-contractors & suppliers.
- **C** - **Reports**: copy of all pre-functional tests, start-up reports, functional test reports, and all other required certifications required by National Building Code.
- **D** – **As built drawings** – changes marked in 'Red ink'
- **G, H…** – **Tab for each piece of new equipment (i.e. 'boiler # 1)**
    - to include:
    - Copy of approved shop drawing
    - Copy of Specific Service and Maintenance manual for each.

- **Last Tab : misc.**

END OF SECTION

1.13 Demolition

.1 Comply with National Building Code, Part 8, Construction Safety Measures at Construction and Demolition sites, and Provincial requirements.

.2 Protect damage to adjacent structure that are to remain in place. Protect building systems services and equipment.

.3 Demolition:
1. As indicated on the drawings including:

1.Remove existing ductwork and inner lining

.4 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.14 Work Description

.1 The work as indicated on the drawings including:

.1 Demolish as per item 1.13 in this section.

.2 Supply and install
.1 New silencer and insulation
.2 Reinstall ductwork
.3 New duct insulation

.3 Clean all ductwork as per Section 23 33 00

PART 2 - PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 - EXECUTION

3.1 Not Used

.1 Not Used.

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

1.2 References

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
.1 ANSI/ASME B31.1-01, Power Piping, (SI Edition).

.2 American Society for Testing and Materials (ASTM)
.1 ASTM A 125-1996, Specification for Steel Springs, Helical, Heat-Treated.
.2 ASTM A 307-00, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
.3 ASTM A 563-00, Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
.1 MSS SP58-1993, Pipe Hangers and Supports - Materials, Design and Manufacture.
.2 MSS SP69-1996, Pipe Hangers and Supports - Selection and Application.
.3 MSS SP89-1998, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 Design Requirements

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

1.4 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit shop drawings and product data for following items:
.1 Bases, hangers and supports.

1.5 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 00 10 – General Instruction item 1.22

PART 2 - PRODUCTS

2.1 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 Pipe Hangers

.1 Finishes:
.1 Pipe hangers and supports: galvanized after manufacture.
.2 Use hot dipped galvanizing process.
.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: Suspension from lower flange of I-Beam.
.1 Cold piping NPS 2 maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
.1 Rod: 9 mm UL listed or 13 mm FM approved.
.2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: Suspension from upper flange of I-Beam.
.1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed, FM approved to MSS SP69.
.2 Cold piping NPS 2 1/2 or greater, all hot piping:

Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.

.4 Upper attachment to concrete.
.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed or FM approved to MSS SP69.

.5 Shop and field-fabricated assemblies in accordance with the requirements of ASME B31.1 and MSS SP58.

.6 Hanger rods: threaded rod material to MSS SP58.
.1 Ensure that hanger rods are subject to tensile loading only.
.2 Provide linkages where lateral or axial movement of pipework is anticipated.
.3 Do not use 22 mm or 28 mm rod.

.7 Pipe attachments: material to MSS SP58.
.1 Attachments for steel piping: carbon steel galvanized.
.2 Attachments for copper piping: copper plated black steel.
.3 Use insulation shields for hot pipework.
.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 UL listed and FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A 563.
.1 Finishes for steel pipework: galvanized.
.2 Finishes for copper pipework: epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 Riser Clamps

.1 Steel or cast iron pipe: galvanized or black carbon steel to MSS SP58, type 42, UL listed and FM approved.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.4 Insulation Protection Shields

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.5 Constant Support Spring Hangers

.1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).

.2 Load adjustability: [10] % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 Variable Support Spring Hangers

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops.

.4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

PART 3 - EXECUTION

3.1 Installation

.1 Install in accordance with:
.1 manufacturer's instructions and recommendations.

.2 Clamps on riser piping:
.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
.2 Bolt-tightening torques to be to industry standards.
.3 Steel pipes: Install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: Install below joint.

.3 Clevis plates:
.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Use approved constant support type hangers where:
.1 vertical movement of pipework is 13 mm or more,
.2 transfer of load to adjacent hangers or connected equipment is not permitted.

.5 Use variable support spring hangers where:
.1 transfer of load to adjacent piping or to connected equipment is not critical.
.2 variation in supporting effect does not exceed 25 % of total load.

3.2 Hanger Spacing

.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code or authority having jurisdiction.

.2 Copper piping: up to NPS 1/2: every 1.5 m.

.3 Within [300] mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m

3.3 Hanger Installation

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.
.2 Equalize loads.

.2 Adjustable clevis:
.1 Tighten hanger load nut securely to ensure proper hanger performance.
.2 Tighten upper nut after adjustment.

.3 C-clamps:
.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:
.1 Hammer jaw firmly against underside of beam.

PART 1- GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.2 National Fire Protection Association (NFPA)
.1 NFPA 13-Latest edition, Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (NBC) – latest edition

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province Ontario, Canada.
.2 Provide separate shop drawings for each isolated system complete with performance and product data.
.3 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29 06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Sustainable Requirements Construction]

2.2 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.3 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm

minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.4 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.5 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor 100% relative humidity installations.

.4 Colour code springs.

2.6 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or

rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Performance: as indicated.

2.7 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

.6 Performance: as indicated.

2.8 ACOUSTIC

.1 Acoustic barriers: between pipe and support,

BARRIERS FOR ANCHORS AND GUIDES

consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.9 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.10 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.11 INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place

reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

2.12 ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled without need for sub-base.

.2 Lower member: continuous rectangular steel tube or extruded aluminum channel.

.3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.

.4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum or neoprene.

.7 Hardware: cadmium plated or galvanized.

2.13 SEISMIC CONTROL MEASURES

.1 General:

.1 Following systems and/or equipment to

remain operational during and after earthquakes:

.1 Chiller.

.2 Seismic control systems to work in every direction.

.3 Fasteners and attachment points to resist same maximum load as seismic restraint.

.4 Drilled or power driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Supports of cast iron or threaded pipe not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment:

.1 Use one or more of following methods depending upon site conditions and as indicated:

.1 Install tight to structure.

.2 Cross brace in every direction.

.3 Brace back to structure.

.4 Cable restraint system.

.3 Seismic restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.3 As indicated.

.4 Piping systems:

.1 Piping systems: hangers longer than 300 mm; brace at each hanger.

.2 Compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:
.1 Approved by Departmental representative.
.2 Structural angles or channels.
.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

.6 Service and utilities entrance into building: mechanically flexible joints or expansion loops

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
.1 After delivery and storage of Products.
.2 After preparatory work is complete but before installation commences.
.3 Twice during the installation, at 25% and 60% completion stages.
.4 Upon completion of installation.
.3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
.4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up a

.2 Take vibration measurements for equipment listed below.

.1 Chiller and pumps.

.3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.5 Submit complete report of test results including sound curves.

3.4 CLEANING

.1 Proceed in accordance with Section [01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 SUMMARY

.1 The balancing report to follow the same as per attached report done in 20007. Copy of repot attached at the end of this section.

.2 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.3 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Provide documentation confirming qualifications, successful experience.

.2 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002
.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.3 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.4 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.5 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.6 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.7 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by

codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

.1 Notify [Departmental Representative 2 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 All cleaning has been completed.

.4 New duct work in the mechanical room has been completed

.5 Provisions for TAB installed and operational.

.6 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Laboratory HVAC systems: plus 10 %, minus 0 %.

.2 Other HVAC systems: plus 5 %, minus 5 %.

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

.3

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.

1.15 TAB REPORT

.1 Format in accordance with referenced standard. Copy of previous report is attached at the end of this section.

.2 TAB report to show results in SI units and to include:
.1 Project record drawings.
.2 System schematics.

.3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

.2 Provide personnel and instrumentation to verify up to 30 % of reported results.

.3 Number and location of verified results as directed by Departmental Representative.

.4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section or TAB standards of AABC NEBB SMACNA ASHRAE.

.2 Do TAB and follow previous report of which a copy is attached.

.3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage.

.6 Locations of equipment measurements: to include as appropriate:
.1 As per attached repot. Measure all equipment listed in the report.

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:
.1 Qualifications of TAB personnel: as for air systems specified this section.
.2 Quality assurance: as for air systems specified this section.

.2 Laboratory fume hoods:
.1 Standard: Treasury Board of Canada Handbook of Occupational Health and safety,

4th edition Canada Labour Code state applicable Provincial.

.2 TAB procedures: as described in standard.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

PART 1 - GENERAL

1.1 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
.1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM C 449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
.2 ASTM C 612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.

.3 Canadian General Standards Board (CGSB)
.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

.5 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
.2 CAN/ULC-S701-01, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.3 Definitions

.1 For purposes of this section:
.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as defined herein.
.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
.1 CRD: Code Round Ductwork,
.2 CRF: Code Rectangular Finish.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 00 10 – General Instructions.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 samples

.1 Submit samples in accordance with Section 01 00 10 - General Instructions.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.6 Manufacturers' Instructions

.1 Submit manufacturer's installation instructions in accordance with Section 01 00 10 - General Instructions.

.2 Installation instructions to include procedures used and installation standards achieved.

1.7 Qualifications

.1 Installer: specialist in performing works of this section, and have at least 3 years successful experience in this size and type of project.

1.8 Delivery, Storage and Handling

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended by manufacturer.

1.9 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 00 10 - General Instructions Item 22

PART 2 - PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24° C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

2.3 Jackets

.1 Canvas:
.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

2.4 Accessories

.1 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 ULC Listed Canvas Jacket:
.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.5 Tape: self-adhesive, plain 75 mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

PART 3 - EXECUTION

3.1 Pre-installation Requirements

.1 Surfaces clean, dry, free from foreign material.

3.2 Installation

.1 Install on the outside of the ducts and in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with ASHRAE.

.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

.7 Contractor to remove and reinstall all conduits, sensing devices and sprinklers that are required to be removed to provide space for installing the duct insulation. All fire related equipment that are removed are to be reinstalled as per Section 01 00 10 General Instructions Item Fire Safety Requirements. Coordinate all work with Departmental Representative.

.8 Where space between duct system is such that the full thickness of the insulation is greater than the space available, the contractor may use less insulation at that location after review and approval by the Departmental Representative. Placing one insulation wrap over more than one duct is not acceptable.

.9 Supply and install Canvas Jacket as per manufacturer recommendations.

3.3 Ductwork Insulation Schedule

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular Cold temperature supply air ducts	C-1	yes	50

.2 Jacket shall be canvas only for exposed in mechanical rooms

PART 1 - GENERAL

1.1 SUMMARY

.1 Related Sections:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 30 - Health and Safety Requirements.

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.4 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials (ASTM).

.1 ASTM A 653/A653M-[04a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 Sheet Metal Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, [95 (Addendum No. 1, (1997)].

.2 SMACNA HVAC Air Duct Leakage Test Manual, 1st

Edition [1985].

.3 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 - PRODUCTS

2.1 DUCTWORK

.1 Material:

Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A 653/A653M.
Thickness: to SMACNA.

.2 Construction - rectangular:
Ducts: to SMACNA.
Transverse joints: welded joints SMACNA seal Class A and B.
Fittings:

.1 Elbows: smooth radius; centreline radius 1.5 x width of duct. No vanes.

.2 Branches: with conical branch at 45

degrees and 45 degrees elbow.

2.2 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
2500	A
1500	A
1000	A
750	B

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with gaskets or sealant or tape or combination thereof.

2.3 SEALANT

.1 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound. .

2.4 TAPE

.1 Polyvinyl treated, open weave fibre glass, 50 mm wide.

2.5 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping Equipment.

.1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm diameter or longest side, to ASHRAE and SMACNA

.3 Hangers: black or galvanized steel angle with black or galvanized steel rods to ASHRAE and SMACNA following table.

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

2.6 DUCT SILENCERS

.1 SUBMITTAL

Performance Data:

Silencer manufacturer to provide submittal drawings detailing all duct silencer data specified in the mechanical drawing schedule.

The silencer manufacturer shall provide, for approval, acoustical system calculations for all duct systems with silencers to demonstrate that the submitted silencers will reduce mechanical fan noise to following NC-Levels in the occupied space. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations.
A minimum of 70 dbA to be achieved at the duct branches as it leaves the mechanical room at the floor level.

Source quality-control reports:

Silencer manufacturer to provide a copy of their laboratory NVLAP accreditation certificate for the ASTM E-477-06a test standard with the submittals.
Data from non-NVLAP accredited test facilities will not be accepted.

2. GENERAL REQUIREMENTS

1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.
2. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.
4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted in Section G below, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
5. All perforated steel shall be adequately stiffened to insure flatness and form.
6. Fire-Performance Characteristics: Silencer assemblies, sealants, and acoustical spacer, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

8. Rectangular Silencers: Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel.

9. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel.

3. PRINCIPAL SOUND-ABSORBING MECHANISM:

Dissipative silencers:

Type with acoustic media. Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.

Media Protection:

Film Lined silencers: The acoustic media shall be completely wrapped with Vibar™ film to help prevent shedding, erosion and impregnation. The wrapped acoustic media shall be separated from the perforated metal by a factory installed ½" thick acoustically transparent spacer. The spacer shall be flame retardant and erosion resistant. A mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

.3 SILENCER SCHEDULE:

TAG: SIL-1
FACE DIMENSION: 1850 mm Wide x 1275 mm Height
LENGTH: 7675 mm
FLOW: 17540 L/s
VELOCITY: 7.2 m/s
SILENCER P.D.: 42 Pa
NOISE CRITERIA: 70 dBa at duct located at concrete pad in mechanical room

Silencer manufacturer must provide acoustic calculations demonstrating silencer will acheive 70 dBA at duct located at concrete pad in mechanical room.

PART 3 - EXECUTION

3.1 GENERAL

.1 Do work in accordance with ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Insulate band hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with ASHRAE and SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

3.2 HANGERS

.1 Band hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with ASHRAE and SMACNA:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA [and] to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.4 LEAKAGE TESTS

.1 In accordance with SMACNA HVAC Duct Leakage

Test Manual.

.2 Perform leakage tests in sections.

.3 Perform trial leakage tests, as instructed to demonstrate workmanship.

.4 Do not install additional ductwork until trial tests have been achieved.

.5 Test section of duct and branch takeoffs and elbows.

.6 Complete tests before performing insulation or concealment Work.

3.5 SILENCERS

.1 Install in accordance with recommendations of manufacturer and as indicated.

1.1 GENERAL WORK

.1 The work includes cleaning all supply ducts and the main exhaust ducts on the following floors and areas.

.1 Lower Floor Part Plan- Corridor Link
.2 Lower Floor Part Plan-North
.3 Lower Floor Part Plan-South
.4 Penthouse Floor and Main Roof Plan
.5 Upper Floor Part Plan- Link Corridor
.6 Upper Floor Part Plan-North
.7 Upper Floor Part Plan-South

.2 The supply fans and the exhaust fans blades are to be cleaned.

1.2 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 00 10 – General Instruction item 22

PART 2 - PRODUCTS

N/A

PART 3 - EXECUTION

3.1 CLEANING

.1 Contractor to clean all supply ducts and diffusers as highlighted in blue colour and the main exhaust ducts highlighted in yellow on the attached drawings titled,

.1 Lower Floor Part Plan- Corridor Link
.2 Lower Floor Part Plan-North
.3 Lower Floor Part Plan-South
.4 Penthouse Floor and Main Roof Plan
.5 Upper Floor Part Plan- Link Corridor
.6 Upper Floor Part Plan-North
.7 Upper Floor Part Plan-South

.2 The supply fans and the exhaust fans blades are to be cleaned.

.3 Contractors to clean TO NADCA STANDARD.

.1 To clean all ducts, fog, mist and sanitize the ducts.
.2 Clean the air handlers and coils.
.3 Mechanical cleaning and restoration of fan coils

25, 26, 27, 28, 29, fan coil in room 118 and cassette units 1,2 &3 in room 69. Replace or clean air filters depending on type sanitize and fog units. .4 Mechanical cleaning and restoration of fan coils 1 through 21 in the hallways. Replace or clean air filters depending on type sanitize and fog units. .5 Contractor to provide video before and after cleaning on a DVD.

.4 The contractor prior to cleaning is to cover the complete area with plastic to prevent dust or debris contaminating the area. Only new plastic material shall be use. Reuse plastic material is not allowed.

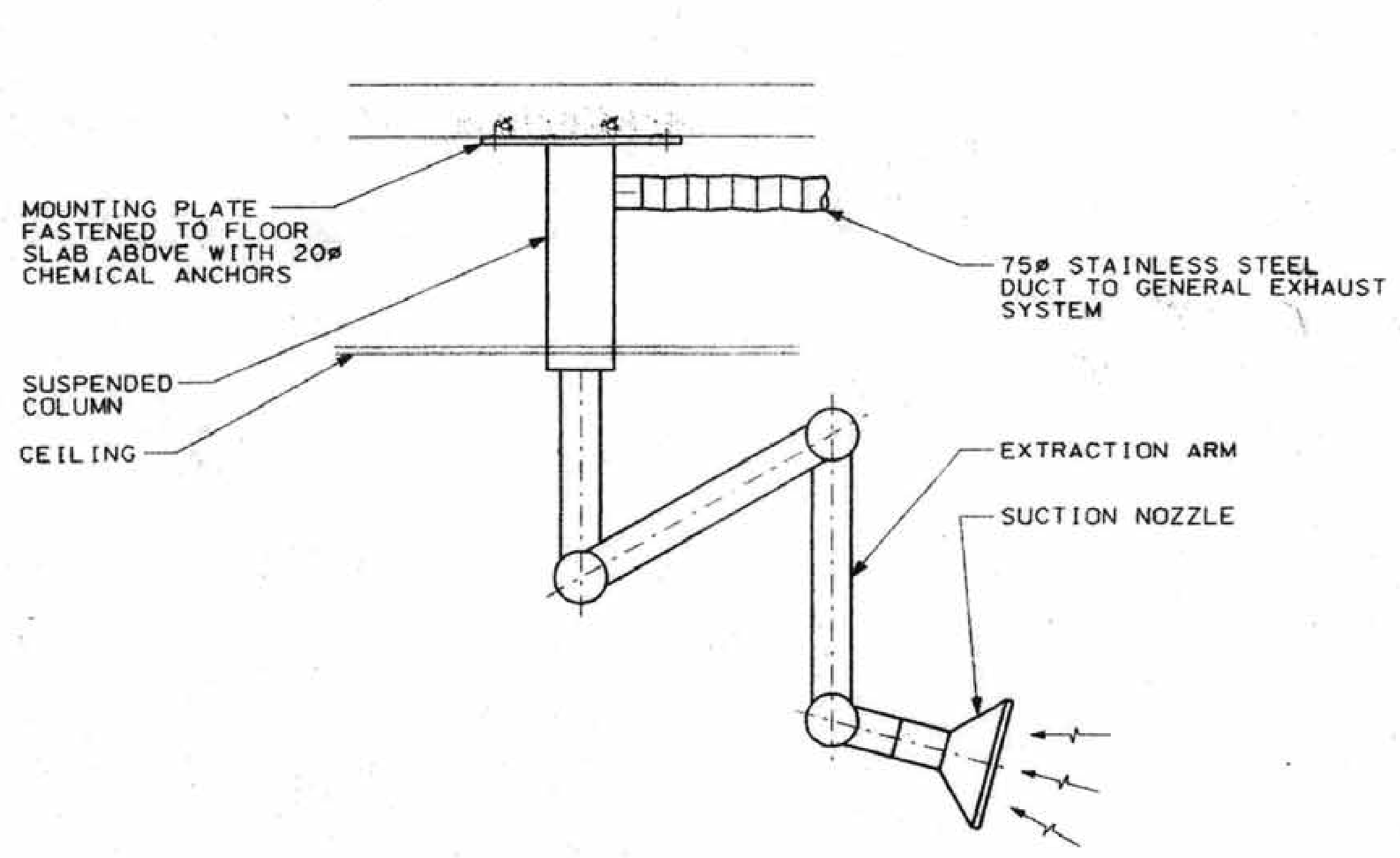
.5 All duct larger than 300 x 300 shall be cleaned by hand.

.6 All ceiling tiles that will be removed and replaced must be cleaned.

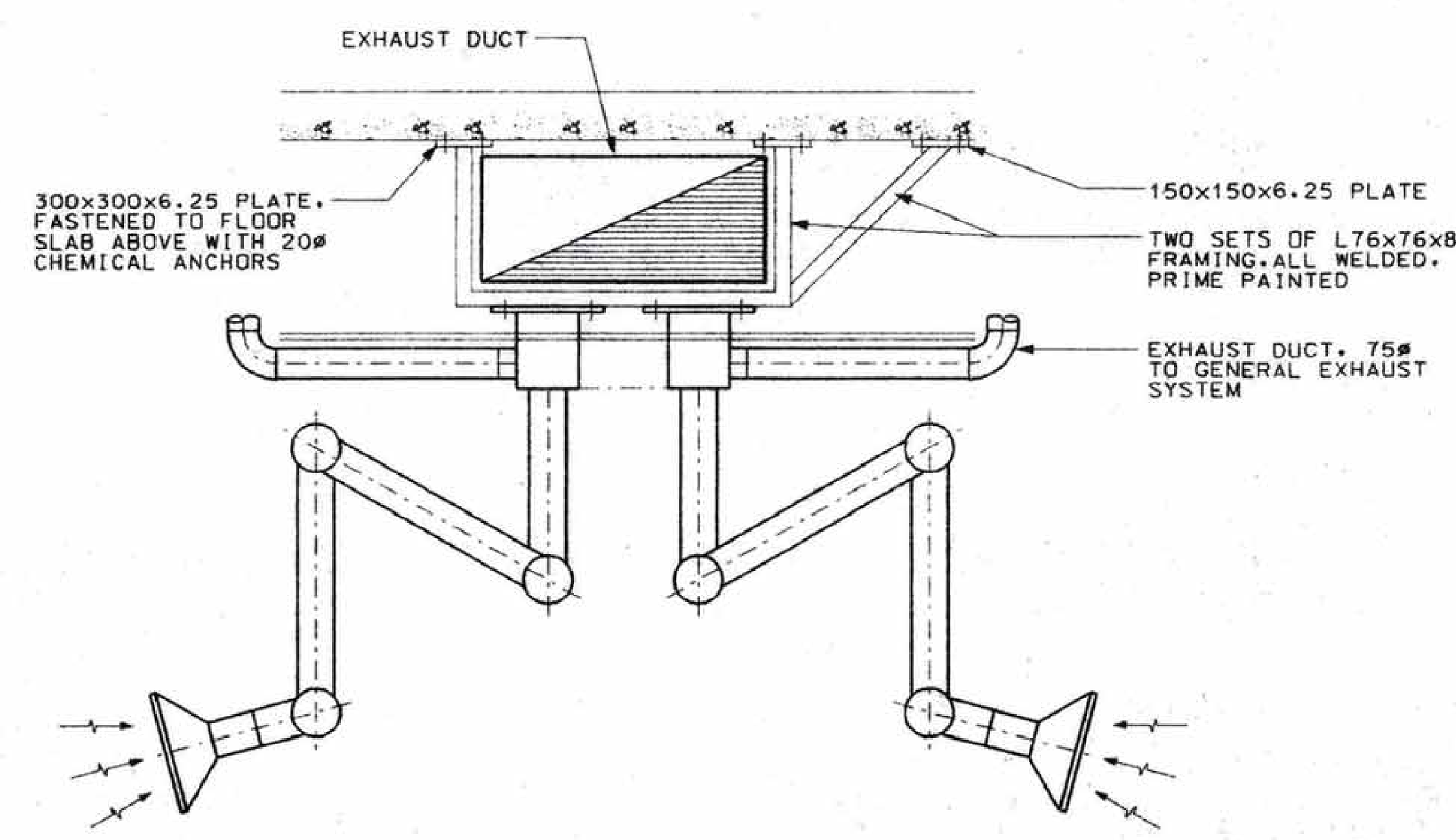
.7 Any ceiling tiles that are damaged must be replaced with similar type.

.8 All dampers must be cleaned including frame and blades.

.9 After 10% of the works has been cleaned an inspection of the cleaned work is to take place. Contractor to provide 48 hour notice to Department Representative when the 10% clean work has been done so it may be inspected.

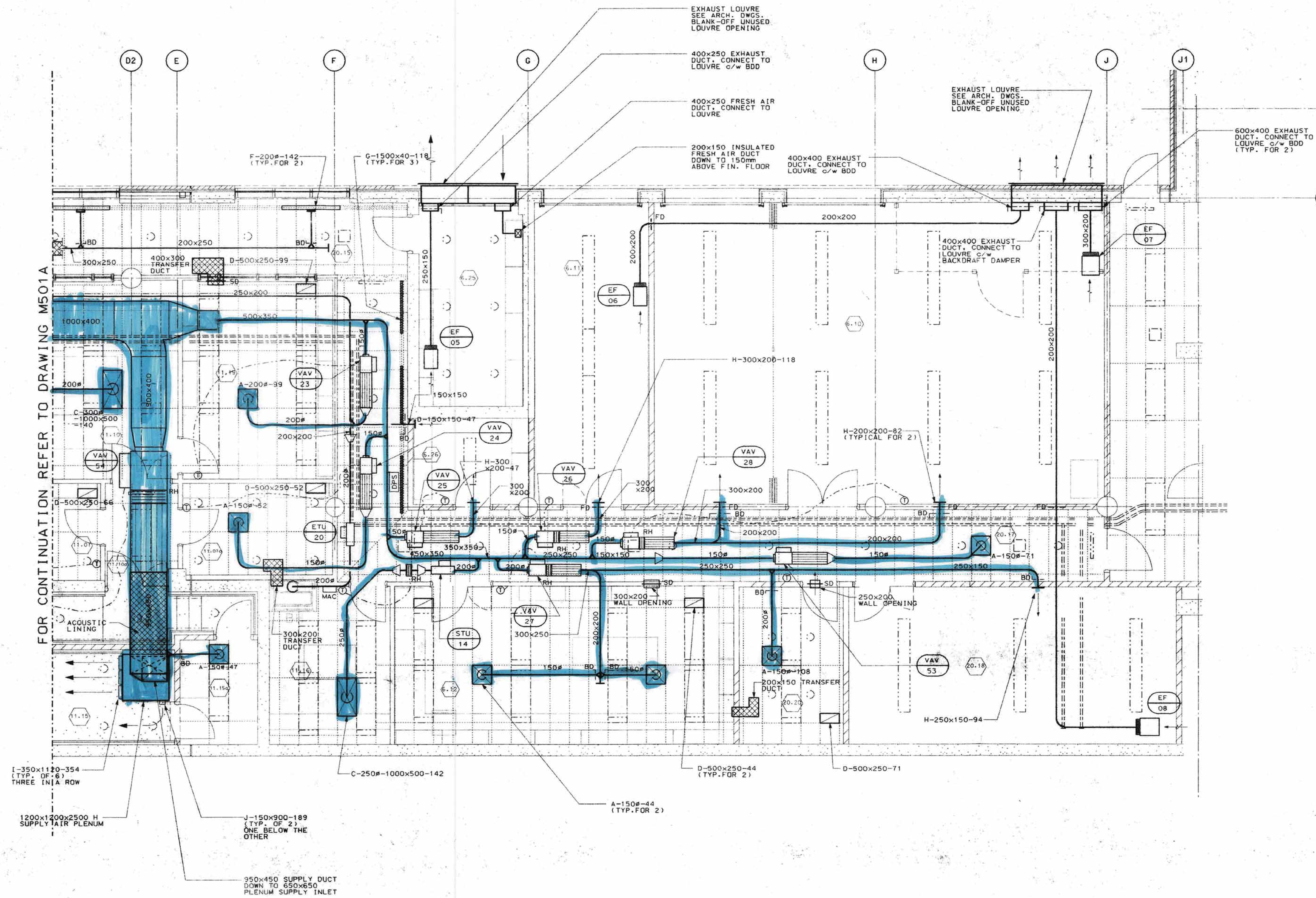


1 TYPICAL SNORKEL DETAIL
M501 M502 | M501B N.T.S.



2 SNORKEL DETAIL: COLUMN SUPPORT UNDER LARGE DUCT N.T.S.
M502 | M501B

PLOT SCALE 1:1



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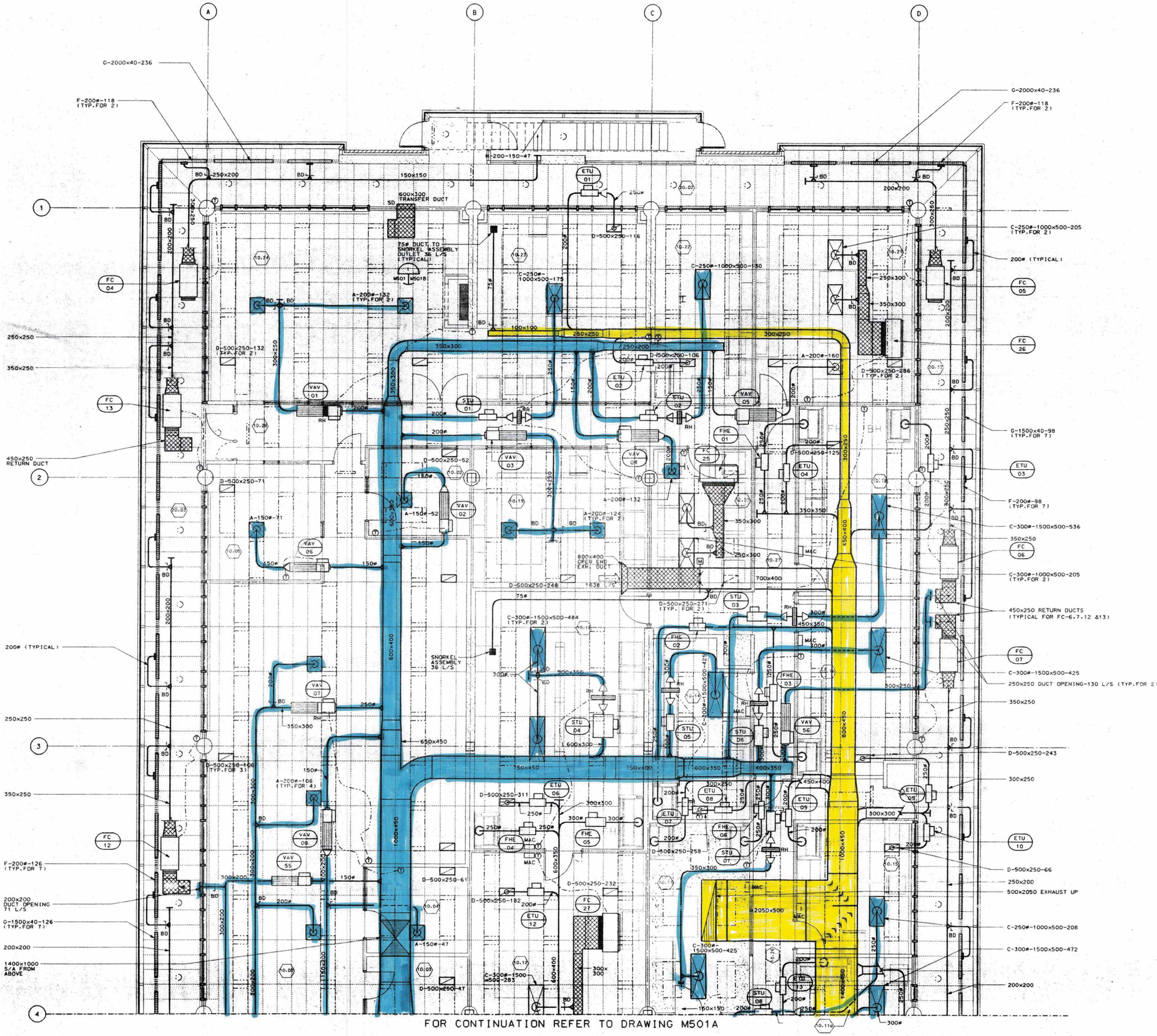
LOWER FLOOR PART PLAN-CORRIDOR LINK
SCALE 1:50 FIN.FLR.EL.59.8

5-FEB-1998 oledz



N

LOWER FLOOR PART PLAN - NORTH

SCALE 1:50 FIN.FLR.EL.59.8

NOTE: PROVIDE 38mm ø SS TUBE FROM EACH SOLVENT AND ACID STORAGE CABINET, CONNECTED DIRECTLY TO GENERAL EXHAUST SYSTEM IN CEILING SPACE. REFER TO ARCHITECTURAL DRAWINGS A029 TO A041 FOR LOCATIONS. ALLOW FOR 15 PER FLOOR.

PLOT SCALE 1:1

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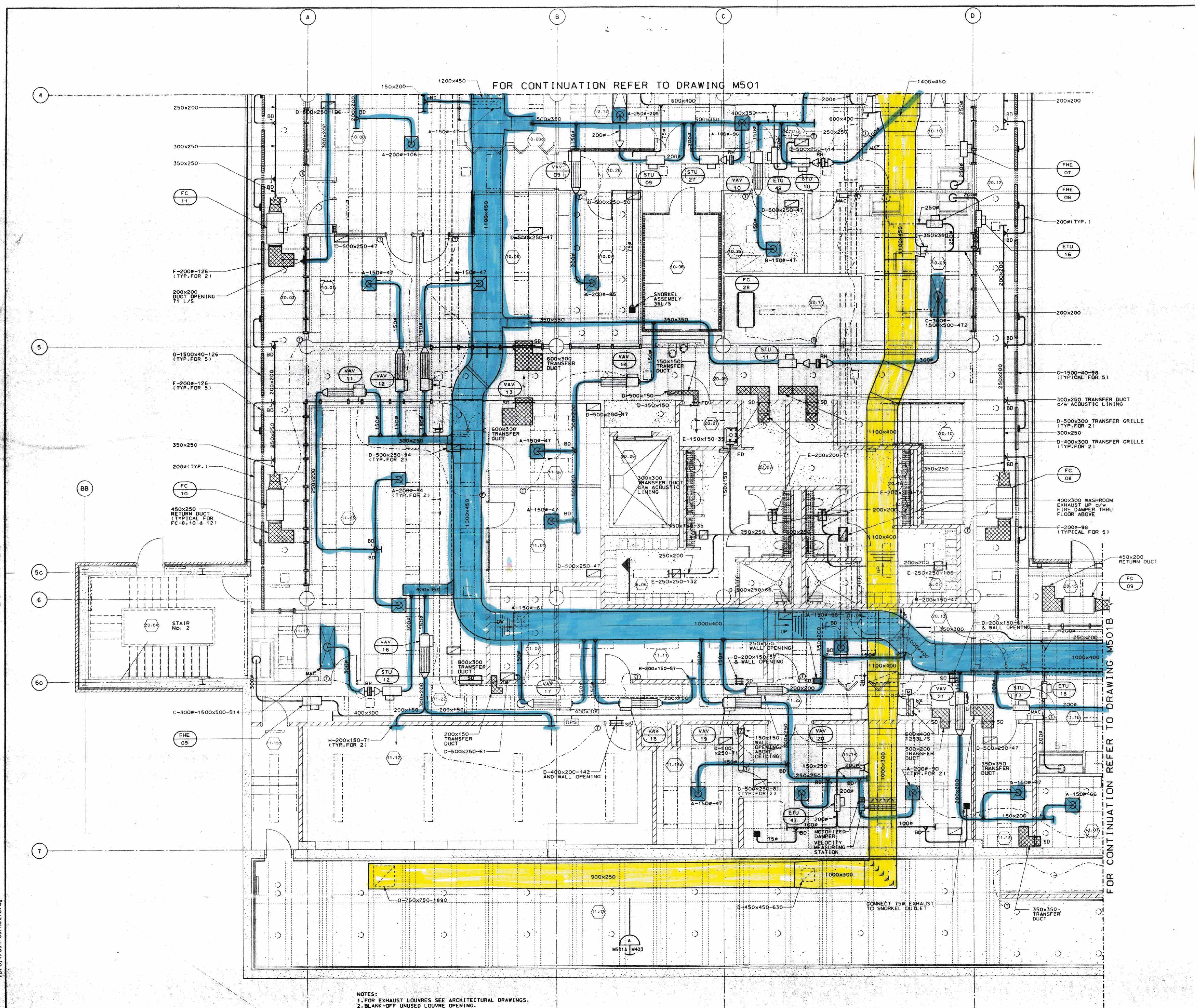
PWGSC A0



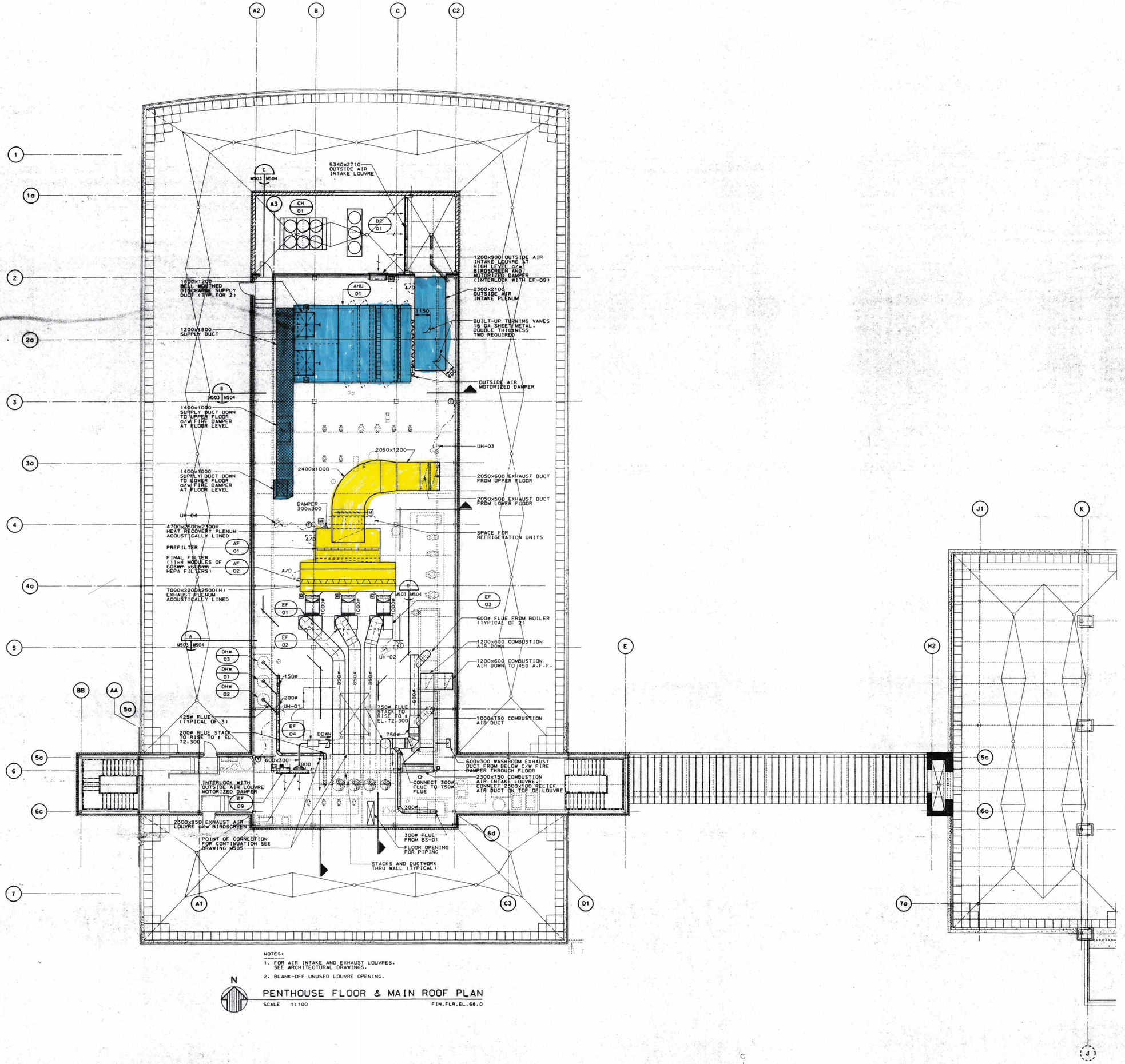
NOTES:
1. FOR EXHAUST LOUVRES SEE ARCHITECTURAL DRAWINGS.
2. BLANK-OFF UNUSED LOUVRE OPENING.

NOTE: PROVIDE 38mmø SS TUBE FROM EACH SOLVENT AND ACID STORAGE CABINET, CONNECTED DIRECTLY TO GENERAL EXHAUST SYSTEM IN CEILING SPACE. REFER TO ARCHITECTURAL DRAWINGS A029 TO A041 FOR LOCATIONS. ALLOW FOR 15 PER FLOOR.

N

LOWER FLOOR PART PLAN - SOUTH

SCALE 1:150 FIN.FLR.EL.59.8



NOTES:

1. FOR AIR INTAKE AND EXHAUST LOUVRES. SEE ARCHITECTURAL DRAWINGS.
2. BLANK-OFF UNUSED LOUVRE OPENING.

N

PENTHOUSE FLOOR & MAIN ROOF PLAN

SCALE 1:100 FIN.FLR.EL.68.0

PLOT SCALE 1:1

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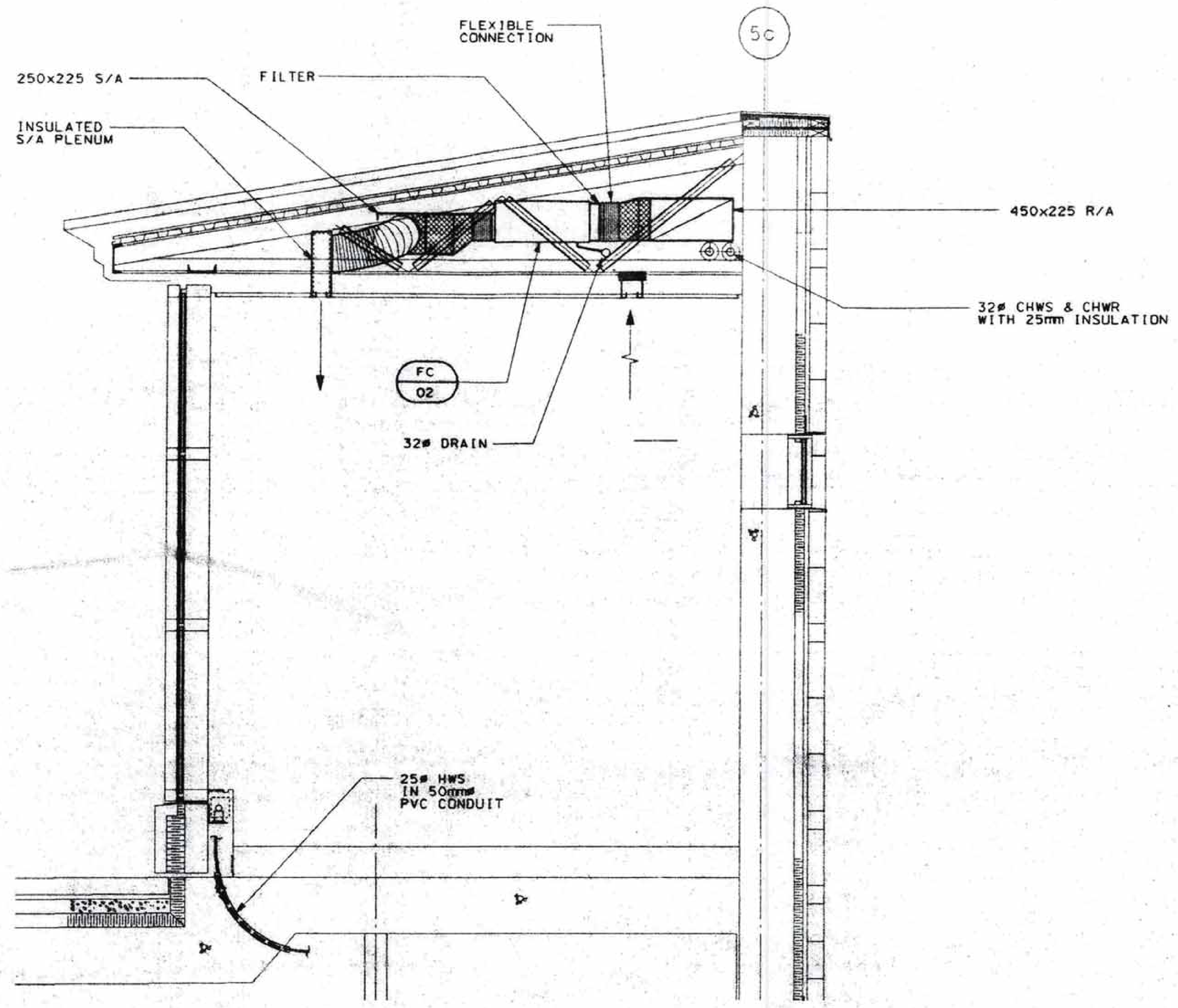
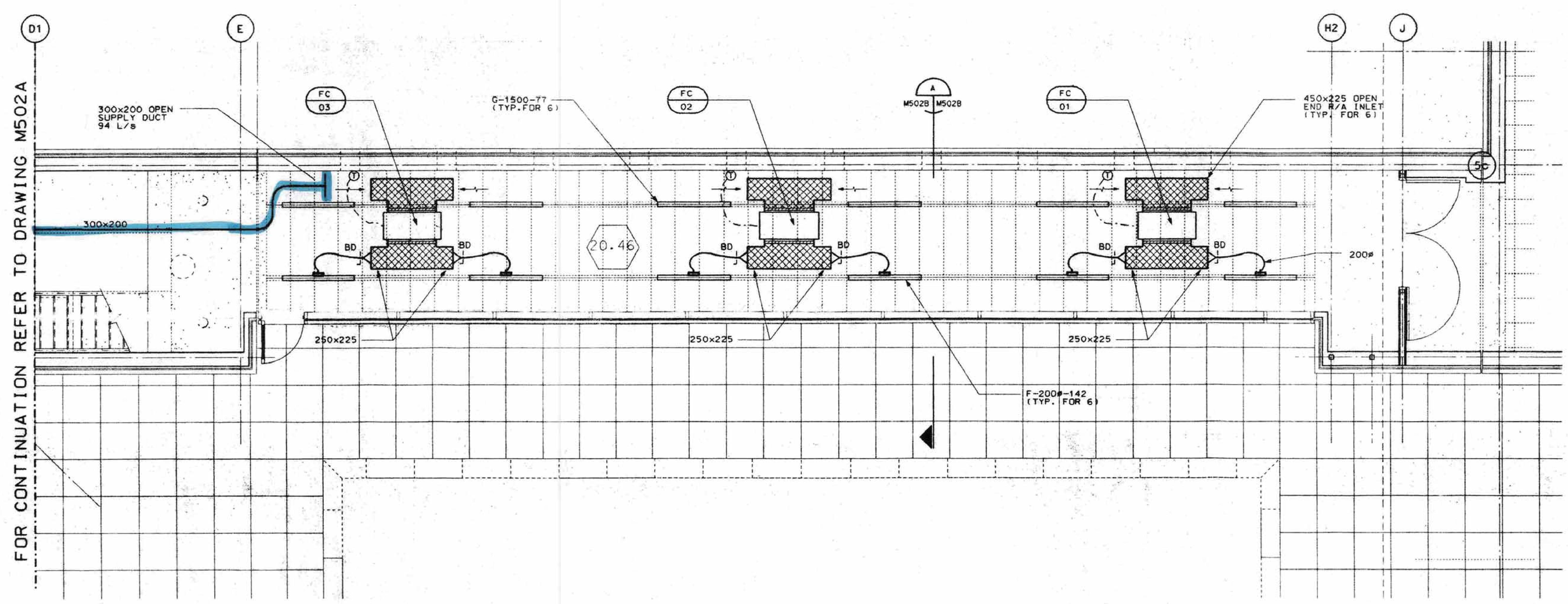


A SECTION
M502B | M502B SCALE 1:20



FOR CONTINUATION REFER TO DRAWING M502A

N

UPPER FLOOR PART PLAN-LINK CORRIDOR

SCALE 1:50 FIN.FLR.EL.63.9

NOTE: PROVIDE 38mmø SS TUBE FROM EACH SOLVENT AND ACID STORAGE CABINET. CONNECTED DIRECTLY TO GENERAL EXHAUST SYSTEM IN CEILING SPACE. REFER TO ARCHITECTURAL DRAWINGS A029 TO A041 FOR LOCATIONS. ALLOW FOR 15 PER FLOOR.

PLOT SCALE 1:1

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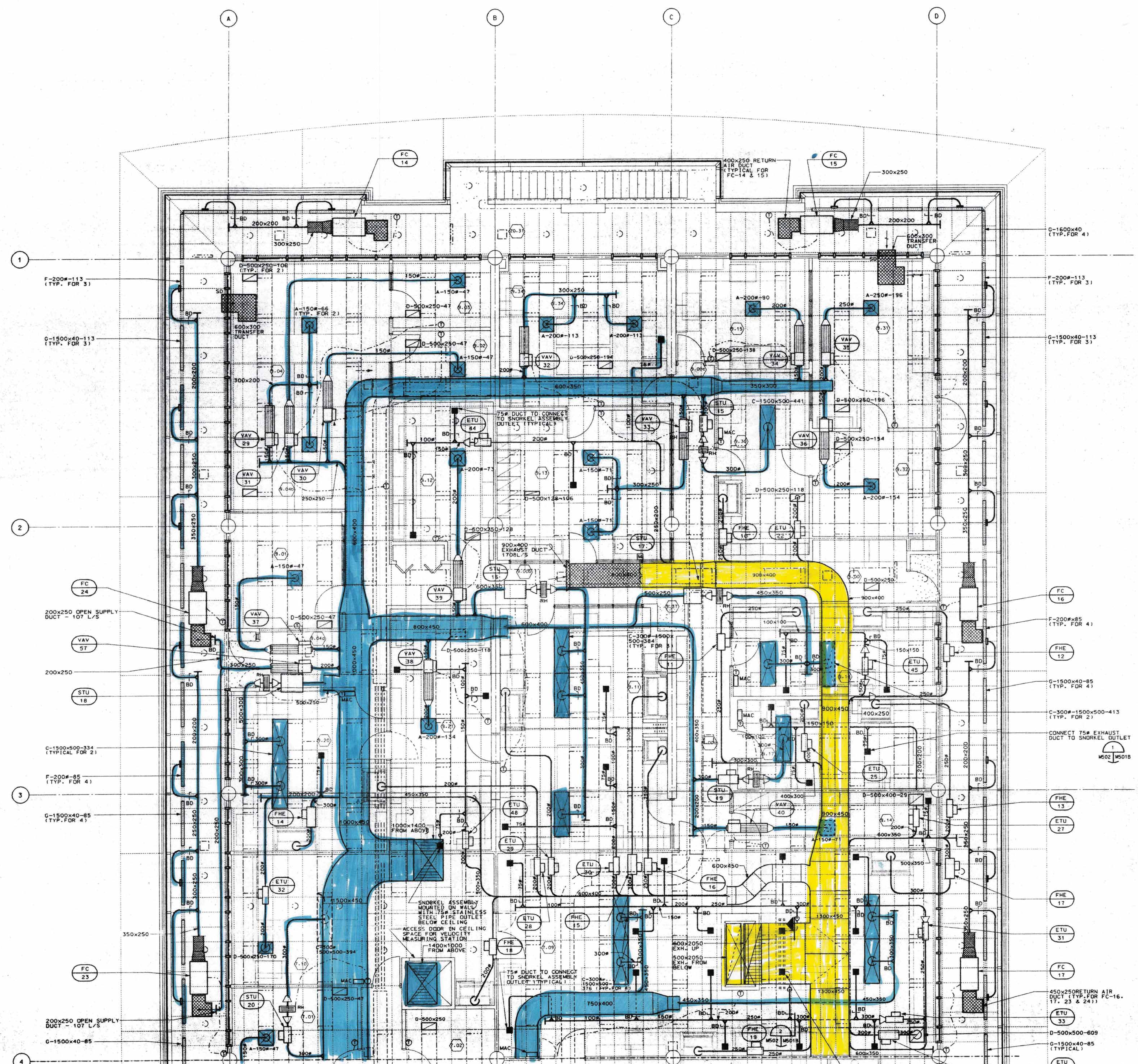
4-NOV-1997 04walter



FC 14
FC 15
400x250 RETURN AIR DUCT (TYPICAL FOR FC-14 & 15)
300x250
G-1600x40 (TYP. FOR 4)
600x300 TRANSFER DUCT
F-200#-113 (TYP. FOR 3)
G-1500x40-113 (TYP. FOR 3)
FC 24
200x250 OPEN SUPPLY DUCT - 107 L/S
VAV 57
200x250
STU 18
C-1500x500-334 (TYPICAL FOR 2)
F-200#-85 (TYP. FOR 4)
G-1500x40-85 (TYP.FOR 4)
350x250
FC 23
200x250 OPEN SUPPLY DUCT - 107 L/S
G-1500x40-85
FC 16
F-200#x85 (TYP. FOR 4)
FHE 12
G-1500x40-85 (TYP. FOR 4)
C-300#-1500x500-413 (TYP. FOR 2)
CONNECT 75# EXHAUST DUCT TO SNORKEL OUTLET
FHE 13
ETU 27
FHE 17
ETU 31
FC 17
450x250RETURN AIR DUCT (TYP.FOR FC-16, 17, 23 & 24)
ETU 33
D-500x500-609
G-1500x40-85 (TYPICAL)
ETU 34
75# DUCT TO CONNECT TO SNORKEL ASSEMBLY OUTLET (TYPICAL)
900x400 EXHAUST DUCT 1708L/S
SNORKEL ASSEMBLY MOUNTED ON WALL WITH 75# STAINLESS STEEL PIPE OUTLET BELOW CEILING
ACCESS DOOR IN CEILING SPACE FOR VELOCITY MEASURING STATION
1000x1400 FROM ABOVE
1400x1000 FROM ABOVE
600x2050 EXH. UP
500x2050 EXH. FROM BELOW
PROVIDE STRUCTURAL STEEL SUPPORT BELOW EXHAUST DUCT AND FASTEN SNORKEL ASSEMBLY (TYP.FOR 2)

FOR CONTINUATION REFER TO DRAWING M502A

PLOT SCALE 1:1

UPPER FLOOR PART PLAN-NORTH

SCALE 1:50 FIN.FLR.EL.63.9

NOTE: PROVIDE 38mm SS TUBE FROM EACH SOLVENT AND ACID STORAGE CABINET. CONNECTED DIRECTLY TO GENERAL EXHAUST SYSTEM IN CEILING SPACE. REFER TO ARCHITECTURAL DRAWINGS A029 TO A041 FOR LOCATIONS. ALLOW FOR 15 PER FLOOR.

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FOR CONTINUATION REFER TO DRAWING M502

FOR CONTINUATION REFER TO DRAWING M502B

UPPER FLOOR PART PLAN-SOUTH

SCALE 1:50 FIN.FLR.EL.63.9

NOTE: PROVIDE 38mm∅ SS TUBE FROM EACH SOLVENT AND ACID STORAGE CABINET, CONNECTED DIRECTLY TO GENERAL EXHAUST SYSTEM IN CEILING SPACE. REFER TO ARCHITECTURAL DRAWINGS A029 TO A041 FOR LOCATIONS. ALLOW FOR 15 PER FLOOR.

PLOT SCALE 1:1

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