TP MECHANICAL CONTRACTORS
SUBCONTRACT AGREEMENT

PROJECT	SOLVITA PHASE II
CONTRACTOR	MILLER VALENTINE CONSTRUCTION
SUBCONTRACTOR	NATIONAL TAB
PROJECT ARCHITECT	
SUBCONTRACT WORK	BALANCE SUBCONTRACT PER THE ATTACHED QUOTE AND PER SPECIFICATIONS
MASTER AGREEMENT (Y or N)	No
CONTRACT AMOUNT	$19,447.00
SUBCONTRACT NUMBER	E1170-07

This Subcontract Agreement ("Agreement") is entered into between by TP MECHANICAL CONTRACTORS LLC ("TP") and NATIONAL TAB("Subcontractor**")** for the purposes set forth below.

Background Information

A. TP has its principal corporate office at 1500 Kemper Meadow Drive, Cincinnati, Ohio 45240 and is in the business of providing labor, equipment, material and services to various customers;

B. "Owner" for the purposes of this agreement refers to the owner set forth in the purchase order provided by TP;

C. Subcontractor is in the business of providing labor, equipment, material and services, and other construction and maintenance work of a general nature and represents that it is skilled and experienced in the performance of such work and desires and agrees to perform such work for TP; and,

D. TP desires to enter into a Master Agreement with Subcontractor to cover one or multiple Projects.

Statement of Agreement

The parties, after acknowledging the accuracy of the above Background Information, agree to the following terms and conditions:

ARTICLE 1
SCOPE OF WORK

1.1 TP has retained the Subcontractor as an independent contractor to provide labor, material, equipment and services as set forth in this Agreement (the "Subcontract Work"). Subcontractor shall perform the Subcontract Work under the general direction of TP in accordance with this Agreement.

1.2 In conjunction with this Agreement, Subcontractor may be issued a "Purchase order" for a specific Project or Projects. Such Purchase order will describe the specific work to be undertaken by the Subcontractor. Along with Purchase orders, TP may include plans, drawings, and particular work specifications with which Subcontractor must comply in completing the work specified in the Purchase order.

1.3 The scope of the Subcontract Work shall consist of all work necessary, or incidental to all work, in accordance with, and reasonably inferable from the Subcontract Work, and as being necessary to produce the intended results.

1.4 In performing the Subcontract Work, Subcontractor shall have total control of the manner in which the Subcontract Work is performed. However, TP and/or TP's customer, the Owner, shall retain the right, but not the

obligation, to inspect, stop work, prescribe alterations, and generally supervise the Subcontract Work to ensure that it conforms to Owner's installation specifications.

1.5 The Purchase order shall control and govern the scope of the Subcontractor Work. The Purchase order shall supersede all other documents received from Subcontractor prior to the execution of this Agreement, including but not limited to any Proposal, Bid or Conditional Bid.

1.6 Subcontractor's obligations to complete its Work under this Agreement shall survive this Agreement and the completion of any Project contemplated by this Agreement, including any termination under paragraph 21.3.

1.7 Regardless of the fact that this is a Master Agreement, TP shall have no obligations to issue any Purchase orders during its term.

ARTICLE 2
SUBCONTRACT DOCUMENTS

2.1 The "Subcontract Documents" that shall govern the relationship between the parties consist of this Agreement and the following listed documents, schedules and attachments which are all incorporated by reference and made a part hereof:

(a) "The Prime Contract Documents", hereinafter referred to as the "Prime Contract";

(b) "Owner's Plans, Specifications and Other Requirements";

(c) "TP Safety Plan";

(d) Any Trade Code or Standards attached;

(e) Uniform Standard Specifications distributed by the Owner;

(f) All Municipal Ordinances and State Codes, which may apply to the Subcontract Work;

(g) TP Commissioning Plan; and

(h) TP Water response and Mold Prevention Program.

2.2 TP shall make available to Subcontractor the Subcontract Documents to review and copy during TP's regular business hours. It is the Subcontractor's responsibility to review and/or obtain copies of all Subcontract Documents, including TP Mechanical's subcontractor with their customer or owner.

ARTICLE 3
MUTUAL OBLIGATIONS

3.1 TP and Subcontractor shall be mutually bound by the terms of this Agreement and, to the extent that provisions of the Prime Contract apply to the Subcontract Work, TP shall assume toward the Subcontractor all obligations and responsibilities that TP, under the Prime Contract, assumes toward Owner. TP shall have the benefit of all rights, remedies, and redress against the Subcontractor, that Owner has under the Prime Contract against TP. Where a provision of the Prime Contract is inconsistent with the provisions of this Agreement, this Agreement shall govern.

ARTICLE 4
SUBCONTRACT PRICE

4.1 The firm fixed-price, unit prices, cost plus, and/or time and material rates and prices referenced in the Purchase order for the project are hereinafter referred to as the "Subcontract Price".

4.2 TP will designate in a Purchase order the method (whether fixed-price, unit prices and/or time and materials) to be used to arrive at the Subcontract Price for the Purchase order when TP issues the Purchase order.

4.3 Subcontractor shall pay all sales taxes, use taxes, occupation taxes, excise taxes, FICA taxes, unemployment taxes and any other tax or levy applicable to this Subcontract Agreement.

ARTICLE 5
TERM OF THIS AGREEMENT

5.1 The terms of this Agreement shall be for a period of 5 years unless otherwise terminated in accordance with Article 21 of this Agreement.

5.2 Subcontractor agrees to maintain its unit prices in accordance with the Schedule of Unit Prices attached to each purchase order issued for the entire term of the purchase order . Subcontractor also agrees to maintain its time and material rates and prices in accordance with the Schedule of Labor and Material Costs attached to each purchase order for the entire term of the purchase order. .

ARTICLE 6
DATE OF COMMENCEMENT AND COMPLETION

6.1 The date of commencement for any Subcontract Work is the date provided by TP to Subcontractor in the Purchase order.

6.2 In issuing a Purchase order, TP will provide to Subcontractor the completion date and/or schedule with milestone dates for the work. All work is to be completed on or before the completion and/or milestone dates. Subcontractor shall prosecute the Subcontract Work with promptness and diligence, and shall complete the several parts of the whole herein with program schedules as may be prepared and issued by Subcontractor to TP.

6.2.1 If the Subcontractor believes that the scheduled completion and/or milestone dates cannot be met, Subcontractor shall propose a revised completion date to TP prior to the Subcontract Work beginning.

6.3 It is expressly understood and agreed that time **IS OF THE ESSENCE** of this Agreement on the part of the Subcontractor, that Subcontractor shall at all times have a sufficient number of labor, material and equipment on the Project, and that all work shall be done expeditiously by the Subcontractor.

6.3.1 If, in TP's opinion and sole discretion, Subcontractor is not diligent prosecuting the Subcontract Work or any portion thereof, and after a seventy-two (72) hour written notice then Subcontractor must provide a written plan to recover their deficiencies, if at that time TP Mechanical does not approve plan, then at the Subcontractor's expense, additional labor, shifts and overtime to promptly complete the Subcontract Work, and TP shall be entitled to withhold any payment to Subcontractor until such time as Subcontractor has complied with the time allowed for completion of the Subcontract Work.

6.4 Subcontractor acknowledges and recognizes that its proper and timely performance of the Subcontract Work is necessary for TP to successfully complete its work for Owner under the Prime Contract. Subcontractor acknowledges that it shall be responsible to TP for any and all liquidated damages assessed against TP by Owner to the extent and in the amount provided for in the Prime Contract for the delays caused by or contributed to by Subcontractor, Subcontractor's employees and agents, sub-Subcontractors, suppliers, or any other person or entity for whose acts Subcontractor may be liable, including all or a portion of any liquidated damages assessed by Owner against TP attributable in whole or in part to such Subcontractor-caused delays. In the event liquidated damages or actual damages, or both, are caused by the Subcontractor and another entity, TP shall have the right to reasonably apportion said damages between the parties, and such apportionment shall be binding on the Subcontractor.

6.5 Subcontractor acknowledges that revisions may be made in the commencement and completion date set forth in the Purchase order and this Article 6 and Subcontractor agrees to make no claim for acceleration or delay by reason of such revisions so long as such revisions are of the type normally experienced in the work of this scope and

complexity. In the event Subcontractor is unable to maintain progress in accordance with the dates for commencement and completion by reason of events for which extensions of time are permitted in the Subcontract Documents, Subcontractor's time for completion shall be extended for a reasonable mutually agreed upon time, provided that a time extension is given by Owner to TP, and further, provided that timely notification of delay is given within 3 days of the start of such delay. This time extension shall be the sole remedy for such delays, inefficiencies or impacts. Subcontractor shall not be entitled to recover damages from TP for any delays, inefficiencies or impacts if TP is not fully compensated by Owner for any such delays of Subcontractor. No such extension shall be deemed a waiver by TP of its right to terminate this Contract for cause as hereinafter provided or relieve the Subcontractor from full responsibility for performance of its obligations hereunder, and no such delay shall give rise to any right to the Subcontractor to claim damages therefore from TP. TP shall not be liable for any damages that may occur from delays or other causes on the part of other contractors or subcontractors involved in the Subcontract Work, or the furnishing of materials, pertaining to the Project specified in the Purchase order.

ARTICLE 7
PERFORMANCE OF SUBCONTRACT WORK

7.1 The Subcontractor shall use its best care, skill and diligence in supervising, directing, and performing the Subcontract Work. Subcontractor shall have responsibility and control over the performance of the Subcontract Work.

7.2 The Subcontract Work shall be performed by individuals as employees of the Subcontractor, which is an independent contractor, and not as employees of TP. The Subcontractor and its employees do not have authority to act for TP, or to bind TP in any respect whatsoever, or to incur any debts or liabilities in the name of or on behalf of TP.

7.3 Subcontractor shall furnish all tools, vehicles and equipment needed by Subcontractor to carry out the Subcontract Work at its own expense. Subcontractor shall be liable for any injury or property damage resulting from the use, misuse or failure of such tools, vehicles and equipment.

7.4 Subcontractor shall perform the Subcontract Work with diligence in accordance with the standards of the Subcontract Documents, including those practices set forth in the Prime Contract and such other requirements as may be set forth in writing.

7.5 Subcontractor shall timely notify all utility companies and others who may have underground facilities in the vicinity of the Subcontract Work should the Subcontract Work involve excavation or construction. Subcontractor shall obtain appropriate information of the location of buried cable and utilities prior to performing any Subcontract Work, and shall be responsible for locating, exposing and protecting from damage all existing underground facilities, including electrical, telephone, water, gas, sewer or other utilities. Subcontractor has assumed the risk of underground facilities in its price and shall not be entitled to any extra or additional with respect thereto.

7.5.1 The Subcontractor shall indemnify, defend and hold harmless TP, its agents and employees from any and all claims, judgments, costs, liabilities, damages and expenses (including reasonable attorneys' fees) arising out of or related to damage or destruction of existing underground or other facilities caused directly or indirectly by the Subcontractor or any of its employees, Subcontractors, or agents.

7.5.2 Subcontractor shall ensure, at its own expense that immediate temporary repairs are made for any damage caused to subsurface structural properties and at the same time report the damage to the Owner of the property and TP. The Subcontractor shall not make permanent repairs to such structures unless the consent of the Owner of the property has first been obtained. This provision shall survive the termination of the Agreement.

7.6 Subcontractor shall contact all Owners of public and private right of way to obtain the permission required to perform the Subcontract Work prior to entering the property or starting any work thereon. Subcontractor shall comply with all conditions of such rights of way.

7.7 Subcontractor shall provide “as-built drawings” to TP upon completion of the Subcontract Work. The “as-built drawings” shall be submitted with the Subcontractor’s request for final payment. Final payment will not be made until complete “as-built drawings” have been received by TP.

ARTICLE 8
SUBCONTRACTOR’S OBLIGATIONS

8.1 Subcontractor acknowledges that it will visit and inspect each site on which the Subcontract Work is to be performed and will gain an understanding of the local conditions as much as reasonably possible. Subcontractor further acknowledges that no additional compensation shall be paid to Subcontractor for costs caused by usual or ordinary work associated with subsurface objects, obstructions, including but not limited to, excessive flow of traffic, pedestrians, terrain of the work area, construction access to property or other such obstacles, that would have been reasonably discoverable in advance of the start of the Subcontract Work.

8.2 If in the performance of the Subcontract Work the Subcontractor finds latent, concealed or subsurface physical conditions which differ materially from the conditions the Subcontractor reasonably anticipated, or if physical conditions are materially different from those normally encountered and which caused additional cost to the Subcontractor in completing the Subcontract Work, Subcontractor must provide TP with written notice within 3 days of the discovery of these conditions. The Subcontractor may be entitled to an equitable adjustment in the Subcontract Price to the same extent TP receives such an adjustment from Owner.

8.3 Every part of the Subcontract Work shall be executed in strict accordance with the Subcontract Documents and in a workmanlike and substantial manner. All materials used in the Subcontract Work shall be new except such materials as may be expressly provided in the Subcontract Documents to be otherwise.

8.4 The Subcontractor shall correct in a timely fashion any Subcontract Work rejected by TP or Owner for failing to comply with the Subcontract Documents. Any and all such corrective work shall be performed solely at the Subcontractor’s own cost and time.

8.5 Subcontractor is required to perform all work in a safe and reasonable manner, and to protect employees and other persons at the site, materials and equipment stored at the site, and all property and structures located at the site and adjacent to work areas. The Subcontractor shall give all required notices and comply with all applicable rules, regulations, orders and other lawful requirements established to prevent injury, loss or damage to persons or property.

8.6 Subcontractor shall give immediate verbal notice to TP’s onsite supervisor and prompt written notice to TP of any accident involving personal injury requiring a physician’s care or any property damage exceeding an estimated value of $500.

ARTICLE 9
SUBCONTRACTOR’S LIABILITIES

9.1 Subcontractor hereby assumes the entire responsibility and liability for all work, supervision, labor and materials provided hereunder, whether or not erected in place, and for all plant, scaffolding, tools, equipment, supplies and other things provided by Subcontractor until final acceptance of the work by Owner. In the event of any loss, damage or destruction thereof from any cause, Subcontractor shall be liable therefore, and shall repair, rebuild and make good said loss, damage or destruction at Subcontractor's cost.

9.2 Subcontractor shall be liable to TP for all costs TP incurs as a result of Subcontractor's failure to perform this Subcontract in accordance with its terms. Subcontractor's failure to perform shall include the failure of its suppliers and/or subcontractors of any tier to perform. Subcontractor's liability shall include, but not be limited to (1) damages and other delay costs payable by TP to Owner; (2) TP's increased costs of delays or improper Subcontractor work; (3) warranty and rework costs; (4) liability to third parties; (5) excess costs; and (6) attorneys' fees and related costs.

9.3 If, as a result, in whole or in part, of negligence (or other act for which there is legal liability) of Subcontractor, his employees, agents or lower tier Subcontractors, any persons (including employees of Subcontractor) suffers injury

or death or any property is damaged, lost or destroyed, Subcontractor assumes the liability therefore and agrees to hold TP and its agents, servants, employees and sureties harmless therefore.

9.4 In the event that Subcontractor or any of its agents, employees, suppliers, or lower-tier subcontractors utilize any machinery, equipment, tools, scaffolding, hoists, lifts, or similar items belonging to or under the control of TP, Subcontractor shall be liable to TP for any loss or damage (including personal injury or death) which may arise from such use, except where such loss or damage shall be due solely to the negligence of TP's employees operating TP-owned or TP-leased equipment.

9.5 Subcontractor's assumption of liability is independent from and not limited in any manner by the Subcontractor's insurance coverage required by this Agreement or otherwise. All amounts owed by Subcontractor to TP as a result of the liability provisions of this Subcontract shall be paid upon demand.

9.6 Subcontractor's liability for TP's costs under this Article 9, and under any other applicable provision of this Subcontract, shall include a 5% markup. This markup is not a penalty but is established as liquidated damages to compensate TP for its administrative costs and/or to allow TP a reasonable profit on work which TP must perform as a result of Subcontractor's failure to properly perform.

9.7 The Subcontractor's liability under this Article shall also be in addition to any indemnity liability imposed by the Contract Documents.

ARTICLE 10
SUBCONTRACTOR'S WARRANTIES

10.1 The Subcontractor warrants that the Subcontract Work shall be performed in a professional and competent manner, defect free and shall be of the quality specified by TP and Owner and in accordance with all criteria set forth in the Subcontract Documents. Subcontractor warrants its work and materials hereunder to TP on the same terms, and for the same period, as TP warrants the work to Owner under the Subcontract Documents; and, with respect to the Subcontract Work, Subcontractor shall perform all warranty obligations and responsibilities assumed by TP under the Contract Documents. The Subcontractor agrees to satisfy any and all warranty obligations without cost to TP.

10.2 If any portion of the Work should be covered by the Subcontractor contrary to the request of TP or Owner, or to requirements specifically expressed in the Contract Documents, it must, if required in writing by TP or Owner, be uncovered for observation and shall be replaced at the Subcontractor's expense.

10.3 The Subcontractor shall also: (1) promptly correct all Work rejected by TP or Owner as defective or as failing to conform to the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Subcontractor shall bear all costs of correcting such rejected Work, including compensation for TP's and/or architect's additional services made necessary thereby; (2) If, within one year after the date of final completion of the work or designated portion thereof or within one (1) year after acceptance by the Owner of designated equipment or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the Work performed by the Subcontractor is found to be defective or not in accordance with the Contract Documents, the Subcontractor shall correct it promptly after receipt of a written notice from TP or Owner to do so unless the Owner has previously given TP and/or Subcontractor a specific written acceptance of such condition; (3) The Subcontractor shall remove from the site all portions of the Work which are defective or non-conforming and which are defective or non-conforming and which have not been corrected unless removal is waived by the Owner; (4) If the Subcontractor fails to correct defective or non-conforming Work, TP may correct it at the Subcontractor's expense and/or exercise any of the options provided for in Article 23; and (5) The Subcontractor shall bear the cost of making good all work of the Owner or separate contractors destroyed or damaged by such correction or removal.

ARTICLE 11
PAYMENT

11.1 TP agrees to pay the Subcontractor for the full and faithful performance of the Subcontract Work in current funds, subject to the additions and deductions for changes in the Subcontract Work as may be agreed upon in writing

before the work is performed; provided, however, that no payments are to be made unless the Subcontractor's rate of progress, work done and materials and/or services furnished are satisfactory to TP in its sole discretion and as herein agreed upon. Payments to the Subcontractor shall be made monthly, based on TP's estimate, or upon invoices or progress payment requests that have been submitted in a timely manner and approved and paid by Owner, which properly reflect the work actually and satisfactorily accomplished. All materials and work covered by partial payments shall become the property of TP, or, if the Contract Documents so provide, the property of Owner; however, this provision shall not relieve Subcontractor from the sole responsibility and liability for all work and materials upon which payments have been made until final acceptance thereof by Owner. TP encourages the subcontractor to consider an early payment discount if subcontractor is paid on the 10th of the month following its billing month.

11.2 As a condition for receiving payment, Subcontractor shall provide, in a form satisfactory to TP and Owner, lien or claim waivers and affidavits from Subcontractor, its sub-Subcontractor's and suppliers, on TP's approved form, for all work performed and materials supplied through the current payment request. If such lien waivers are conditional upon receipt of payment by TP, Subcontractor, with the next payment applications, will provide full and unconditional lien or claim waivers and affidavits for the previous month's payment from Subcontractor, its sub-Subcontractors and suppliers.

11.3 TP shall hold retainage from any and all payments due to Subcontractor equal to the percentage retained by Owner, from payments made to TP.

11.4 Applications for payment shall by made monthly by the 20th of the month which the work is being performed,. Invoice should include any cost through the current work month.

11.5 It is specifically understood and agreed that TP is not obligated to make any payments to Subcontractor for any work done pursuant to this Agreement, unless and until Owner has paid TP therefore.

11.6 Subcontractor shall insure that all sub-subcontractors, employees and suppliers, at all times, are paid all amounts due in connection with the performance of this Subcontract. After the first partial payment hereunder, TP shall have the right to withhold any subsequent partial payments until Subcontractor submits evidence satisfactory to TP that all amounts owed in connection with performance of this Subcontract have been paid. Further, Subcontractor agrees that TP shall have the right but not the obligation, to pay all persons that have not been paid the monies due them in connection with this Subcontract whether or not a lien has been filed, and Subcontractor shall, to the extent that TP has not recovered these amounts pursuant to withholding, pay said amounts to TP upon demand. Any such payment by TP shall in no way relieves the Subcontractor of any obligation under this Subcontract. Subcontractor shall also immediately reimburse TP for any amounts paid under TP's payment bond in connection with this Subcontract and indemnified by TP. In the event TP is required to pay or indemnify any person hereunder, Subcontractor shall immediately reimburse TP for the *full cost* thereof, plus 5% for administrative and overhead costs.

11.7 All materials and work covered by partial payments shall become the property of TP, or, if the Contract Documents so provide, the property of Owner; however, this provision shall not relieve Subcontractor from the sole responsibility and liability for all work and materials upon which payments have been made until final acceptance thereof by Owner.

11.8 Final payment for the Subcontract Work, constituting the entire unpaid balance owed for the Subcontract Work, including retention, shall be paid within thirty (30) days after all of the following have occurred: (a) the Subcontract Work has been complete; (b) the Subcontract Documents have been fully performed; (c) the Subcontract Work has received and passed any and all final governmental inspections; (e) Subcontractor has provided full, final and unconditional lien or claim waivers and affidavits from Subcontractor, its sub-Subcontractors and suppliers; payment may be made sooner if TP Mechanical is paid in full by the owner, however, TP Mechanical has the right to withhold payment to subcontractor if owner has not paid TP Mechanical because of outstanding warranty items causing TP Mechanical's non-payment with the owner.

ARTICLE 12
LABOR RELATIONS

12.1 The Subcontractor may employ union labor. If the Subcontractor employs union labor, Subcontractor agrees that it shall maintain in full force and effect for the duration of the Subcontract Work, a valid collective bargaining agreement between the Subcontractor and any appropriate union. All Subcontract Work performed by the Subcontractor shall be rendered in accordance with the terms and provisions of any such collective bargaining agreement and any revisions, extensions or renewals thereof, and Subcontractor shall timely pay all fringe benefits or other charges to any appropriate union. The Subcontractor agrees that it will bind by written contract, a copy of which shall be supplied to TP, all of its union Subcontractors to the appropriate collective bargaining agreement or agreements hereinabove referred to.

ARTICLE 13
INSURANCE

13.1 Subcontractor shall fully comply with the workers' compensation laws for each state in which the Subcontract Work is performed by its employees, and with the safety, health and other regulations of the governmental authorities which administer such laws. Before commencing Subcontract Work, Subcontractor shall deliver to TP certificates evidencing such compliance with respect to each applicable state. Subcontractor shall procure and maintain in full force and effect workers' compensation insurance providing coverage for statutory benefits and employer's liability coverage of $l,000,000 per occurrence. The policy shall contain an All States endorsement. The policy shall be endorsed to provide a waiver of subrogation in favor of TP. TP, without notice to Subcontractor, may pay any workers' compensation premiums, wage deficiencies or other payments charged against TP based on Subcontractor's payrolls. Subcontractor shall repay any sums so advanced by TP upon demand.

Commercial General Liability insurance shall be written on an occurrence basis with the limits not less than $1,000,000 each occurrence and $2,000,000 aggregate. The policy shall include coverage for premises/operations, independent contractors, contractual liability (sufficient to cover the liability assumed by the Subcontractor under this Agreement), property damage arising out of the "XCU" hazards, completed operations, products liability, broad form property damage and personal injury. The completed operations coverage shall be maintained for at least two (2) years after the final completion of the Project. If the policy contains a general aggregate limitation, then the policy shall be endorsed to provide a $1,000,000 specific aggregate for Subcontract Work under this Agreement. The policy shall name TP and its officers, employees and agents as additional insureds and shall be endorsed to state that the insurance provided to TP shall be primary insurance in respect to TP and any other insurance policy that TP may have in effect shall be deemed excess and not contributory.

13.2 Subcontractor shall procure and maintain during the entire progress of the Subcontract Work no less than the following insurance coverage:

Insurance Summary Table	**Occurrence**	**Aggregate**
Commercial General Liability	$1,000,000	$2,000,000
Business Automobile Liability	$1,000,000	$1,000,000
Workers' Compensation	Statutory Limits	Statutory Limits

(1) Commercial General Liability Insurance, of no less than $1,000,000 per occurrence, $2,000,000 in the aggregate, including:

(a) premises-operations coverage with blasting, collapse and underground exclusions deleted;

(b) products and completed operations coverage;

(c) contractual coverage including both oral and written contracts covering the liability assumed under the indemnity provisions of this Agreement;

(d) broad form property damage coverage including completed operations; and

(e) personal injury coverage

(2) Business Auto Liability insurance, with a combined single limit, including bodily injury and property damage, of no less than $1,000,000.00 per occurrence, $1,000,000.00 in the aggregate, including coverage for owned autos, hired or borrowed autos, and non-owned autos;

(3) Full and Unlimited Workers' Compensation Insurance, including employer's liability and unemployment compensation insurance

(4) Excess Liability coverage (umbrella) in the amount of $2,000,000 shall be maintained throughout the project and for a period of two (2) years after project completion.

13.3 All insurance required hereunder shall name TP as an additional insured with coverage as set forth above, including completed operations, and shall waive all rights of subrogation against TP and/or Owner. If any policy of insurance requires an endorsement to maintain coverage with such additional insured requirement waivers, the Owner of such policy will cause the policy to be so endorsed.

13.4 Subcontractor insurance shall be maintained with insurance companies with a Best's Rating of A- or better, which companies shall be an admitted carrier subject to the insolvency fund of the state in which the project is located. Any exceptions to this requirement must be requested by subcontractor to TP Mechanical Contractors in writing and written consent received in writing from TP Mechanical Contractors at least five days prior to work commencement by subcontractor. The Subcontractor shall furnish TP with certificates of such insurance before commencement of the Subcontract Work. The insurance required by this article shall be written for not less than any limits of liability specified in this article, or required by law, whichever is greater.

13.5 The insurance shall also protect against claims resulting from acts or omissions of any Subcontractor or any anyone directly or indirectly employed by TP or any Subcontractor, or by anyone through whose acts any of them may be liable. The insurance required shall include contractual liability insurance applicable to the Subcontractor's obligations under Article 15 of this Agreement.

13.6 The insurance shall provide that any policy shall not be cancelled, non-renewed or reduced in coverage until thirty (30) days after written notice shall have been given to TP of cancellation, non-renewal or reduction in coverage.

ARTICLE 14
SURETY BONDS

14.1 TP shall have the right at any time, prior to signing a purchase order, to require the Subcontractor to furnish a bond or bonds covering the full and faithful performance of the Subcontract Work and the payment of all obligations arising there under. The surety providing the bonds to contractor must be Best's Rated A- or better and must appear on the Federal Treasury Register. Form of bonds must be acceptable to TP Mechanical Contractors.

14.2 The Subcontractor shall be reimbursed, without retainage, for the cost of any required performance and payment bonds with the first progress payment made by TP to Subcontractor after the performance and/or payment bonds are procured, provided that the Owner has paid TP.

14.3 In the event Subcontractor shall fail to promptly provide any required bonds, TP may terminate this Agreement. The Subcontractor shall pay all costs and expenses incurred by TP as a result of said termination.

ARTICLE 15
INDEMNIFICATION

15.1 To the fullest extent permitted by law, the Subcontractor shall, at its expense, defend, indemnify and hold harmless TP and Owner, and the agents and employees of each of them (hereinafter "Indemnified Parties"), for, from and against any and all claims, losses actions, damages, expenses and any other liability, including, but not limited to, costs and reasonable attorney's fees, arising out of or resulting from performance of the Subcontract Work, its agents, subcontractors, or employees provided that any such claim, loss, action, damage, expense or other liability is attributable to bodily injury, sickness, disease or death, or to the injury to or destruction of tangible property including the loss of use resulting there from.

ARTICLE 16
SUBCONTRACTOR'S COMPLIANCE WITH LAWS / SAFETY

16.1 Unless exempt under the rules and regulations of the Secretary of Labor or other proper authority, this Agreement is subject to applicable laws and executive orders relating to equal opportunity and nondiscrimination in employment. Subcontractor shall not discriminate in its employment practices against any person by reason of race, religion, color, sex or national origin and agrees to comply with the provisions of said laws and orders, as well as all laws and orders relating to the employment of the handicapped, the employment of veterans and the use of minority and women's business enterprises, to the extent any such laws and orders are applicable to the performance of the Subcontract Work or the furnishing of services, materials, equipment or supplies pursuant to this Agreement.

16.2 The Subcontractor shall comply, at its own expense, with all applicable provisions of workers compensation laws, unemployment compensation laws the Federal Social Security Law, the Fair Labor Standards Act, and all other federal, state and local laws and regulations which may be applicable to the Subcontractor as an employer of labor, including hiring verification and record keeping requirements and nondiscrimination provisions imposed by the Immigration Reform Control Act of 1986 insofar as it relates to the Subcontractor's employees. In addition, the Subcontractor shall comply, at its own expense, with all other federal, state, county, and municipal laws, ordinances, rules, regulations, orders, permits and franchises of any public authority bearing on the performance of the Subcontract Work.

16.3 The Subcontractor shall be responsible for its safety, the safety of its employees, its Subcontractors, and the site in general and shall comply with all applicable provisions of local, state and federal law, regulations and orders affecting safety and health, including but no limited to the occupational Safety and Health Act of 1970 (hereinafter collectively referred to as "OSHA"). The Subcontractor agrees that it shall give access to the authorized representatives of the Secretary of Labor or any state or local official for the purpose of inspecting, investigating or carrying out any duties under the OSHA and the Subcontractor shall immediately notify TP that access has been sought. The Subcontractor shall be solely responsible for any violation of the OSHA by it or its sub-Subcontractors, shall immediately remedy any condition giving rise to correct any violations, and shall defend and hold TP and Owner harmless from any penalty, fine or liability in connection therewith.

16.4 Safety Measures

(a) Subcontractor shall take necessary or required safety precautions to protect the public during performance of the Subcontract Work, including, but not limited to providing, erecting, and maintaining proper warning signals, signs, lights, barricades, and fences on and along the line of the work. Subcontractor must have an on-site designated safety representative with minimum of 10-Hour OSHA Construction Training.

(b) Subcontractor must perform weekly toolbox talks and documented safety audits with a copy being forwarded to TP on-site management on a weekly basis or subcontractors employees must attend TP Mechanical's weekly Toolbox Talks and sign all appropriate attendee forms.

(c) Subcontractor must comply with the Occupational Safety and Health act, policies and procedures, owner's specific policies and procedures, and any other applicable federal, state, and local ordinances. Hard hats, safety glasses, and full clothing are required 100% on all projects.

(d) All Subcontractors must report incidents involving injury and or property damage to the TP Project Superintendent within ½ hour of occurrence.

ARTICLE 17
HAZARDOUS MATERIALS

17.1 "Hazardous Materials" means any hazardous, radioactive, or toxic substance, material, or waste defined or regulated as such in or under any environmental, health or safety law including without limitation asbestos, lead, and those hazardous materials, substances, and wastes defined by the United States Department of Transportation ("DOT"), Occupational Safety and Health Administration ("OSHA"), Environmental Protection Agency ("EPA") or the Nuclear Regulatory Commission ("NRC") through their enabling statutes, or regulations, orders or rules.

17.2 In connection with its activities under this Agreement and all work under this Agreement, the Subcontractor shall comply with all applicable provisions of The Hazardous Materials Transportation Act (49 USC 1801, et seq.), the Resource Conservation and Recovery Act (42 USC 6901, et seq.), the Toxic Substances Control Act of 1976 (15 USC 2601, et seq.), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 USC 9601, et seq.), the Occupational Safety and Health Act of 1970 ("OSHA"), and any other applicable federal, state and local laws and regulations governing Hazardous Materials or safety, including but not limited to state and federal motor carrier safety regulations, the DOT Hazardous Materials regulations and any regulations governing conveyance, packaging, marking, identification, storage, handling and/or disposition of Hazardous materials, or governing any accidents or incidents in connection with such activities involving Hazardous Materials, all as they may be amended or supplemented from time to time.

17.3 The Subcontractor will immediately notify TP of the discovery of any hazardous material or substance previously undisclosed to the Subcontractor. To the extent applicable, the Subcontractor shall furnish TP with Material Safety Data Sheets that comply with the requirements of the OSHA Hazard Communication Standard (29 CRF 1910.1200), as the same may be amended or supplemented from time to time, for any materials the Subcontractor furnishes under the Contract.

17.4 The Subcontractor shall indemnify and hold TP harmless in accordance with Article 15 entitled "Indemnification" for any claims, liabilities and damages, including but not limited to attorneys' fees, costs of defense, clean-up costs, response costs, costs of corrective action, costs of financial assurance, and/or natural resource damages, that may arise, be imposed on, be incurred by, be asserted against or be sustained by TP by reason of the Subcontractor's failure to comply with the terms of this Article.

ARTICLE 18
RIGHT TO INSPECT AND AUDIT

18.1 Subcontractor shall maintain accurate and complete records for all charges incurred in connection with the Subcontract Work. Such records shall be maintained in conformance with generally accepted accounting principles and procedures. Subcontractor recognizes that TP and Owner reserve the right to inspect and audit said records, without notice, on the Subcontractor's premises, during the Subcontractor's business hours.

ARTICLE 19
CHANGES

19.1 Owner may make changes in the Subcontract Work by issuing modifications to the Prime Contract. On receipt of any such modification issued subsequent to the execution of this Agreement, TP shall promptly notify the Subcontractor of the modification. Unless otherwise directed by TP in writing, the Subcontractor shall not thereafter order materials or perform Subcontract Work, which would be inconsistent with the changes made by the modifications to the Prime Contract.

19.2 TP may order the Subcontractor, without invalidating this Agreement, to make changes in the Subcontract Work within the general scope of this Agreement consisting of additions, deletions or other revisions, including those required by modifications to the Prime Contract issued after the execution of this Agreement, with the Subcontract Price and the completion date being adjusted accordingly. The Subcontractor, prior to the commencement of such changed or revised Subcontract Work, shall submit written copies of a claim for adjustment to the Subcontract Price and completion date for such revised Subcontract Work to TP within 2 working days after receipt of the changes

suggested by TP in a manner consistent with the requirements of the Subcontract Documents. If TP and Subcontractor agree on the price and/or extension of time for a change, TP will issue a change order. If TP and Subcontractor cannot agree upon the price of changes in the Work or an extension of time, Subcontractor must, after being directed in writing to perform the disputed work by TP, perform the work and the amount of the change being determined by Article 22.

19.3 The Subcontractor agrees to make all claims promptly to TP for additional costs, extensions of time or other causes in accordance with the Subcontract Documents. A claim that will affect or become part of a claim which TP is required to make under the Prime Contract within a specified time period or in a specified manner shall be made in sufficient time to permit TP to satisfy the requirements of the Prime Contract. Such claims shall be received by TP not less than 2 working days preceding the time by which TP's claim must be made. Failure of the Subcontractor to make such a timely claim shall bind the Subcontractor to the same consequences as those to which TP is bound under the terms of the Prime Contract. In the event the claim involves the Owner, in whole or in part, Subcontractor's claim against TP must be stayed until the dispute is resolved between TP and Owner. TP agrees that no more than 10% of contract and change orders to date will be required to proceed with unpriced or emergency change orders.

ARTICLE 20
FORCE MAJEURE

20.1 The Subcontractor shall be excused from performance of the Subcontract Work if Subcontractor's performance is prevented by acts or events beyond the Subcontractor's reasonable control, including extreme and unusual weather conditions, industry wide strikes, pandemics, epidemics, fires, embargoes, actions of civil or military law enforcement authorities, acts of God or acts of legislative, judicial, executive, or administrative authority. Subcontractor's time for completion may be extended for a reasonable, mutually agreed upon time, provided that a time extension is given by Owner to TP and, further, provided that notification of the delay and request for an extension of time is given as provided in this Agreement. In that event, the time extension shall be Subcontractor's sole remedy for such a delay.

ARTICLE 21
TERMINATION

21.1 It is the opinion of TP, Subcontractor shall at any time (1) refuse or fail to provide sufficient properly skilled workmen or materials of the proper quality, (2) fail in any respect to prosecute the work according to the current schedule; (3) cause, by any action or omission, the stoppage or delay of or interference with the work of TP or of any other TP or Subcontractor; (4) fail to comply with all provisions of this Subcontract or the Contract Documents; (5) be adjudged a bankrupt, or make a general assignment for the benefit of its creditors; (6) have a receiver appointed; (7) become insolvent or a debtor in reorganization proceedings; or (8) be or become unable to complete the work for financial reasons or otherwise, then, after serving 2 days written notice, unless the condition specified in such notice shall have been eliminated within such 2 days, TP, at its option (i) without voiding the other provisions of this Subcontract and without notice to the sureties, may take such steps as are necessary to overcome the condition, in which case the Subcontractor shall be liable to TP for the cost thereof, (ii) terminate the Subcontract for default; or (iii) seek specific performance of Subcontractor's obligations hereunder, it being agreed by Subcontractor that specific performance may be necessary to avoid irreparable harm to TP and/or Owner. In the event of termination for default; TP may, at its option, (a) enter the Project site and take possession, for the purpose of completing the work, of all materials, tools and specialized equipment of Subcontractor; (b) require Subcontractor to assign to TP any or all of subcontracts or purchase orders involving the Project; or (c) either itself or through others complete the work, by whatever method TP may deem expedient. In case of termination for default, Subcontractor shall not be entitled to receive any further payment until the work shall be completed and accepted by Owner. At such time, if the unpaid balance of the price to be paid shall exceed the expense incurred by TP, such excess shall be paid by TP to Subcontractor. If such amount due TP shall exceed such unpaid balance, then Subcontractor shall pay TP the difference.

21.2 The Subcontractor may terminate this Agreement for the same reasons and under the same circumstances and procedures with respect to TP as TP may terminate with respect to Owner under the Prime Contract.

21.3 TP reserves the right to terminate any Agreement with Subcontractor in the event that TP, in its sole discretion, believes that it has defaulted or is in default on any other Projects covered by this Agreement.

21.4 TP may, at any time, terminate this Agreement for TP's convenience and without cause. Upon receipt of written notice from TP of such termination for TP's convenience, the Subcontractor shall: (1) cease operations as directed by TP in the notice; (2) take actions necessary, or that TP may direct, for the protection and preservation of the Subcontract Work; and (3) except for Subcontract Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing work and purchase orders entered into and enter into no further purchase orders or other work. In case of such termination for TP's convenience, Subcontractor will only be entitled to receive payment for work actually accomplished and equipment and materials supplied pursuant to this Agreement and no profit or overhead on unperformed work.

ARTICLE 22
DISPUTE RESOLUTION

22.1 Any and all controversies or claims, whether based on contract, statute, tort, fraud, misrepresentation or other theory, related directly or indirectly to this Agreement between TP and the Subcontractor, shall be resolved in accordance with the dispute resolution procedures set forth in the Prime Contract.

22.2 If a dispute arises out of or relates to this Agreement or its breach, the parties shall endeavor to settle the dispute first through direct discussions. If the dispute cannot be resolved through direct discussions, the parties shall participate in mediation under the Construction Industry Mediation Rules of the American Arbitration Association before recourse to any other form of binding dispute resolution. The location of the mediation shall be the location of the Project. Once a party files a request for mediation with the other party and with the American Arbitration Association, the parties agree to commence such mediation within thirty (30) days of filing of the request.

22.3 Either party may terminate the mediation at any time after the first session, but the decision to terminate must be delivered in person to the other party and the mediator. Engaging in mediation is a condition precedent to any other form of binding dispute resolution. Unless otherwise agreed in writing, the Subcontractor shall continue the Subcontract Work and maintain the Progress Schedule during any dispute resolution proceedings.

22.4 In any controversy or claim between TP and Owner in any way arising out of or related to the Subcontract Work, Subcontractor agrees that it may be joined as a party by TP and that any litigation or arbitration, which may take place pursuant to this Agreement, may be consolidated with any litigation or arbitration between Owner and TP. In the event that the provisions for resolution of disputes between TP and the Owner contained in the Subcontract Documents do not permit consolidation or joiner with disputes of third parties, such as the Subcontractor, resolution of disputes between the Subcontractor and TP involving in whole or in part disputes between TP and the Owner shall be stayed pending conclusion of any dispute resolution procedure between TP and the Owner. At the conclusion of those proceedings, disputes between the Subcontractor and TP shall be submitted again to mediation. Any disputes not resolved by mediation shall be decided in the manner selected in the agreement between the Owner and TP.

ARTICLE 23
CLEANUP

23.1 It is understood and agreed that the Subcontractor will, during the progress of the work, remove from the Project at his own expense and on a daily basis, the dirt and debris resulting from his operations, unless TP shall direct otherwise in writing. If the Subcontractor fails to perform the required daily housekeeping activities, the work may be performed by TP after 48 hours written notice to Subcontractor's on-site supervisor, with the resulting costs charged to the Subcontractor. Upon completion of his work, he shall remove from the Project all equipment and unused materials and leave the premises in a condition satisfactory to TP.

ARTICLE 24
COOPERATION WITH OTHER CONTRACTORS

24.1 The Subcontractor agrees to cooperate fully with all other contractors and/or subcontractors performing work on this Project and to carefully fit his own work to that provided for under such contracts and/or subcontracts as may be directed by TP Mechanical Contractors. The Subcontractor shall not commit or permit any act and/or omission that will interfere with the performance of work by any other contractor or subcontractor.

ARTICLE 25
SUBCONTRACTOR'S RESPONSIBLE PERSON

25.1 During the progress of the Subcontractor Work, Subcontractor's responsible person shall be as set forth in the Purchase order. The responsible person shall at all times supervise the Subcontractor's work and shall act as a representative of the Subcontractor with the right and power to obligate the Subcontractor. The Subcontractor shall give ten (10) days prior written notice to TP of any change in the responsible person, and TP must consent to the replacement. Subcontractor is required to provide TP Mechanical's superintendent a 4-Week Look Ahead work schedule each week that the subcontractor is onsite.

ARTICLE 26
COMMISSIONING

26.1 Where applicable, the Subcontractor is required to assist TP in the Commissioning Process per TP Commissioning plan as follows:

DDC Control Contractors

Attendance will be required at bi-weekly start up and commissioning meetings beginning at approximately 60% of project completion, or as TP Mechanical's Commissioning Agent deems necessary, or 2 months before system start up. All attendees will be required to be responsible and capable of making decisions related to the project.

A complete sequence of operation, including adjustable set point values, shall be submitted to TP for functional test purposes no later than 50% of project completion.

DDC contractor will be required to assist the test and balance contractor in the performance of the test and balance operation. It will be acceptable for the DDC contractor to "loan" any operating software to the test and balance contractor in lieu of assisting in the completion. Hand held devices for test and balance will not be acceptable.

A DDC technician will be required to be on site during functional testing. Pending Owner's approval, the functional testing can be inclusive with the owners training.

All testing and check out performed on the DDC system will be required to be documented and copies of those documents will be turned over to TP for inclusion into commissioning binder.

Test and Balance Contractors

Attendance will be required at start up and commissioning meetings beginning at approximately 90% of project completion, and continuing until owner acceptance.

A contract drawing review will be done during the bid phase in order to generate a list of all missing dampers and balance devices. This list will be submitted to TP before construction.

Attendance will be required at all functional testing exercises that will relate to or create system balance issues.

A completed balance report will be submitted no more than 10 working days after test and balance work is completed.

ARTICLE 27
LIENS

27.1 The Subcontractor agrees that if at any time there shall be evidence of any lien or any other claim of any kind or description for which TP may become liable, and which is chargeable to the Subcontractor, or any subcontractor of his, and/or when damage shall be caused by this Subcontractor to the work of TP, or any other contractor or subcontractor, the Subcontractor shall promptly discharge or relieve such lien and/or claim by bonding, payment or otherwise, and in case of the failure of the Subcontractor to so discharge such lien and/or claim, TP shall have the right in addition to any other right afforded to him under the contract, to retain out of any payment then due, or thereafter to become due, an amount sufficient in the opinion of TP to completely indemnify TP against any such lien or claim.

ARTICLE 28
SUBLETTING OR ASSIGNMENT

28.1 Subcontractor agrees that he will not sublet, assign, or transfer this Subcontract or any part thereof, or any interest therein, or any monies due hereunder, without first obtaining the written consent of TP. Any work so sublet, assigned or transferred, or any transfer of any interest or any monies due hereunder, shall be subject to all the provisions herein and such subletting, assignment or transfer shall not relieve the Subcontractor, his assignee or transferee, or any of the responsibilities required by this Subcontract.

ARTICLE 29
DISPUTES INVOLVING OWNER

29.1 All disputes arising under or relating to the Prime Contract and/or the Owner's conduct hereunder shall be governed by and resolved in accordance with the disputes clause of the Prime Contract (or other similar provision providing a method or procedure for resolving disputes between Owner and TP) to the extent permitted by law, which clause is hereby incorporated by reference herein.

29.2 All "claims," as that term is defined under the disputes clause of the Prime Contract by Subcontractor arising under or relating to the Prime Contract and/or the Owner's conduct hereunder, shall be made in writing and submitted to TP within sufficient time, but no later than (72) hours after subcontractor becomes aware of the issue causing the claim, to permit TP to comply with the terms of the Prime Contract. Subcontractor shall submit with its claim all certifications required by the Prime Contract.

29.3 TP shall submit to the Owner those claims of Subcontractor which have been properly certified in accordance with the requirements of the disputes clause of the Prime Contract and which in TP's judgment are not frivolous or a sham.

29.4 Any decision of the Owner with respect to claims submitted on behalf of Subcontractor that binds TP shall likewise bind Subcontractor.

29.5 Subcontractor shall be responsible for the pursuit of any claim, suit or appeal under this Article submitted by TP to Owner solely on Subcontractor's behalf. Subcontractor shall be responsible for all costs, expenses and attorneys' fees incurred in connection therewith. With respect to claims, suits or appeals in the joint interest of TP and Subcontractor, TP shall be responsible for pursuing such claim, suit or appeal and each party shall be responsible for its own costs, expenses and attorneys' fees incurred.

29.6 TP shall have no liability to Subcontractor on account of any claim, suit or appeal arising under or relating to the Prime Contract or the Owner's conduct hereunder except that recovered by TP from the Owner on Subcontractor's behalf, if any, less any markups and other amounts due TP on account of such claim, suit or appeal,

29.7 Nothing said or written in the prosecution of any claims) against the Owner shall constitute nor be regarded as admissions or declarations against interest of either party in any litigation between TP and Subcontractor.

29.8 Unless otherwise directed by TP in writing, pending resolution and a final decision of any dispute under this Article, Subcontractor shall proceed diligently with the performance of the Contract. Any failure by Subcontractor to continue to perform in strict accordance with the terms of the Contract pending resolution (unless otherwise directed) shall constitute a default by Subcontractor.

ARTICLE 30
MISCELLANEOUS PROVISIONS

30.1 This Agreement, and all work performed under this Agreement, shall be governed by and interpreted or construed in accordance with the laws of the State of Ohio. Venue and jurisdiction shall be exclusively in Ohio.

30.2 In any dispute which in any way arises from or relates to the Subcontract Work or any of the terms and conditions of this Agreement, the prevailing party shall be entitled to recover all costs and expenses, including attorneys' fees, incurred in any adversary proceedings, including but not limited to litigation and/or arbitration.

30.3 The Subcontractor shall not assign this Agreement, sublet it as a whole, or delegate or subcontract its duties hereunder, without the written consent of TP, which consent TP may withhold in its sole discretion

30.4 The parties agree and represent that this Agreement comprises the full and entire agreement between the parties affecting the Subcontract Work and no other agreement or understanding of any nature concerning the Subcontract Work has been entered into or will be recognized and that all negotiations, proposals, acts, work performed or payments made prior to the execution of this Agreement shall be deemed merged in, integrated and superseded by this Agreement. This Agreement can be modified only by written agreement signed by authorized representatives of TP and the Subcontractor.

30.5 Waivers of any breach of this Agreement shall not constitute a waiver of any subsequent breach of the same or any other provision of this Agreement.

30.6 The headings appearing in this Agreement are inserted as a matter of convenience only and for reference purposed only and are not intended to be a part of this Agreement, or in any way to define or describe the scope and intent of the particular section to which they refer.

30.7 If any terms of this Agreement or any application thereof to any person or circumstance shall, to any extent, be invalid or unenforceable, the remainder of this Agreement, or the application of such terms to persons or circumstances other than those to which it is invalid or unenforceable, should not be affected thereby, and each term and provision of this Agreement shall be valid and be enforceable to the fullest extent permitted by law.

30.8 Any notice provided in this Agreement shall be deemed received either when delivered personally, transmitted via fax or electronic communication, or two (2) business days after being sent by first class United States mail, postage prepaid, to the following persons at the addresses set forth below, or to such other persons and/or addresses as either party hereto may from time to time designate in writing and deliver in a like manner to the other party.

30.9 This effective date of this Agreement shall be the date it has been signed by both parties.

TO: TP Mechanical Contractors LLC

TP Mechanical Contractors LLC
Attn: Jason Ralstin
2130 Franklin Road
Columbus, OH 43209
Fax: 614-253-8559

CC TO: _____
_____
_____
_____
_____

TO: NATIONAL TAB
1329 E KEMPER RD
SUITE 4210
CINCINNATI, OH 45246

IN WITNESS WHEREOF, the parties have duly executed this Agreement, as of the date set forth below.

TP Mechanical Contractors	**Subcontractor NATIONAL TAB**
_____	_____
By: _____	By: _____
Its: _____	Its: _____ President
Date: _____	Date: _____

NATIONAL TAB Comfort. Under control.		1329 E Kemper Rd, Ste 4210 CINCINNATI, OH 45246 513-860-2050 bids@nationaltab.com	
Client:	TP Mechanical	Project:	Solvita Phase 2
Email:	kelly.simerman@tpmechanical.com	QUOTE #:	JMH-NT-17649
ATTN:	Kelly Simerman	BID DATE:	4/4/2025
Address:		Jobsite location:	950 Forrer Blvd - Kettering, OH

Thank you for allowing National TAB this opportunity to bid on the testing and balancing of this project.
The following is our understanding of the scope of work and the associated cost.

Equipment:	Qty.:	Equipment:	Qty.:
DOAS	1	AHU coil	2
Split Systems	4	VAV Reheat	68
VAVs	68	UH/CUH	19
Exhaust Fans	5	Domestic Water Balance	
Air Devices			

SCOPE OF WORK:

1. 1st Shift Work Only
2. TAB of listed equipment
3. Domestic Water Balance to include (1) Recirculation pump and (1) Balance Valve

This proposal includes a written report to be submitted upon completion of all work by National TAB.

TOTAL PRICE = $ 19,447.00

Any parts if required will be additional. However, no parts will be provided without initial approval unless National TAB, LLC has agreed with the client for a set fee to perform specific task. Lift rental to be additional if required if not provided by owner or GC. Work to be performed 1st shift only.

Not included in price: Prevailing Wage, Sound and Vibration testing, Indoor Air Quality testing, and Pre-testing is not included unless price is specified separately above.

WE HEREBY PROPOSE to furnish labor complete in accordance with NATIONAL TAB specifications,
#NAME?
Terms as specified by our acct department. New accounts are required to fill out a credit application.

Acceptance of proposal - The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work as specified. Payment will be made in accordance to terms agreed upon. **Client Signature** _____ **Client Date of Acceptance**_____	**Authorized Signature for NT:** Joe Hertenstein **Date:** 04/04/25

TP Mechanical
CONTRACTORS | SERVICE | FABRICATION

Project Name:	SOLVITA PHASE II
Project Number:	E1170
Project Manager:	JOSH BOLTON
Vendor Name:	National Tab
Completed By:	Lindsey Ward
Date Completed:	4/11/2025

SUBCONTRACTOR SCOPE REVIEW - TEST & BALANCE

Scope Requirements	Yes	No	Subcontractor Comments	Yes	No	
GENERAL						
Drawing Date Included in Scope Review:	2/10/2025		Basis of Proposal:			
Addenda Included in Scope Review (Number):	2		Basis of Proposal:			
Bulletins Included in Scope Review:	0		Basis of Proposal:			
			EDGE - WBE - MBE - Veteran Certified:			
Labor Warranty Required:		X	If YES, Provided in Proposal:			
Material Warranty Required:		X	If YES, Provided in Proposal:			
Required Warranty Period:	N/A		Provided in Proposal:			
			Warranty Starts at "Substantial Project Completion"			
			If NO, Provide Additional Cost, if any:			
			Lead Time for Final Balance Reports After Scope is Complete:	1 WEEK		
Is Certified Payroll Required:		x	If YES, Provided in Proposal:			
Will an AIA SOV be required from Subcontractor:		X	If YES, Provided in Proposal:			
			Will provide insurance documents as required:	X		
			Will submit to background / drug checks as required:	X		
			Will abide by all safety requirements while on project:	X		
			Will attend weekly job meetings as requested:	X		
			Will provide clean up of own work daily:	X		
			Will be responsible for own jobsite parking:	X		
			Will attend Daily Group Huddles When on Site:	X		
			Will provide all necessary work platforms to complete work:	X		
			Will provide material handling as required:			
Other:			If YES, Provided in Proposal:			
Other:			If YES, Provided in Proposal:			
Other:			If YES, Provided in Proposal:			
Other:			If YES, Provided in Proposal:			
SUBCONTRACTOR - TEST & BALANCING (S00400)						
TAB Testing Prior to Construction Required:		X	If YES, Provided in Proposal:		X	
PLBG-Domestic Water Balance Required:	x		If YES, Provided in Proposal:	X		BALANCE VALVE
PLBG-Domestic Recirculation Pumps Balance Required:	X		If YES, Provided in Proposal:	X		
PLBG-Pump Balance Required:		X	If YES, Provided in Proposal:		X	
HYD-Chilled Water System Balance Required:	X		If YES, Provided in Proposal:	X		
HYD-Condenser Water System Balance Required:		X	If YES, Provided in Proposal:		X	
HYD-Cooling Tower Equipment Balance Required:		X	If YES, Provided in Proposal:		X	
HYD-Heating Hot Water System Balance Required:	X		If YES, Provided in Proposal:	X		
HYD-Pump Balance Required:		X	If YES, Provided in Proposal:		X	
HYD-Equipment Coils (CWS&R, HHWS&R) Balance Required:	X		If YES, Provided in Proposal:	X		
HYD-Reheat Coils (HHWS&R) Balance Required:	X		If YES, Provided in Proposal:	X		
HVAC-AHU (S/A, R/A, OA, Relief Air) Balance Required:	X		If YES, Provided in Proposal:	X		
HVAC-Air Flow Monitoring Station Balance Required:		X	If YES, Provided in Proposal:		X	
HVAC-Exhaust Fans Balance Required:	X		If YES, Provided in Proposal:	X		
HVAC-MUA / SA Fans Balance Required:		X	If YES, Provided in Proposal:		X	
HVAC-LAB Flow Control Valves Balance Required:		X	If YES, Provided in Proposal:		X	
HVAC-LAB Hood Systems Balance Required:		X	If YES, Provided in Proposal:		X	
HVAC-Kitchen Hood Systems Balance Required:		X	If YES, Provided in Proposal:		X	
HVAC-Final VFD / Speed Control Adjustment Required:		X	If YES, Provided in Proposal:		X	

HVAC-Ductwork Systems Balance Required:		X	If YES, Provided in Proposal:		X
HVAC-Air Device Balance Required:	X		If YES, Provided in Proposal:	X	
HVAC-Replacement Sheaves & Belts Required:		X	If YES, Provided in Proposal:		X
HVAC-Duct Pressure Testing Required:		X	If YES, Provided in Proposal:		X
Other:			If YES, Provided in Proposal:		
Other:			If YES, Provided in Proposal:		

VENDOR PROPOSAL

Any Specific Exclusions in the Proposal:					
a.					
b.					
c.					
d.					
e.					
f.					
g.					
h.					
i.					
Is this a Taxable project:	NO		If YES, Included in Proposal:		
Is this a Prevailing Wage project:	NO		If YES, Provided in Proposal:		
Bid Price:	$19,447.00				
			Final PO Amount:	$19,447.00	
			Payment Terms:	Per TPMC Subcontract	

SCHEDULE

Anticipated Scope Start Date:			Manpower Available to Meet Construction Schedule:		
Anticipated Scope Completion Date:			Manpower Available to Meet Construction Schedule:		
Anticipated Weekend Work Required:		X	If YES, Included in Proposal:		
Other:			If YES, Included in Proposal:		

OTHER COMMENTS

ACKNOWLEDGEMENT

By signing the Scope Review below, the Subcontractor acknowledges that he has reviewed all drawings and specifications and that the product & services being provided meets or exceeds all design criteria, with the exception of those exclusions specifically listed above. And in doing so, the Subcontractor is obligated to turn-over a fully functional / operational system at the conclusion of the project.

Supplier:	Jeffrey S Springer Digitally signed by Jeffrey S Springer DN: C=US, E=jsspr@nationaltab.com, O=National TAB LLC, OU=VP of Regional Markets, CN=Jeffrey S Springer Date: 2025.04.11 10:56:06-05'00'	VP of Regional Markets	4/11/2025
		Signature and Title	Date
TP Mechanical:	Lindsey Ward / APM		4/11/2025
		Signature and Title	Date

SECTION 230593 – TESTING, ADJUSTING, AND BALANCING HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

1.2 SUMMARY

A. This section includes the requirements for testing, adjusting and balancing the following systems:

1. Balancing Air Systems:

a. Supply air distribution systems.
b. Exhaust air distribution systems.
c. Supply and exhaust air devices.
d. Energy recovery air side systems.

2. Balancing Hydronic Piping Systems:

a. Heating & cooling hydronic systems.

3. Testing, Adjusting, and Balancing Equipment:

a. Heat exchangers.
b. Pumps.
c. Air handling units.
d. Heat transfer coils.
e. Supply and exhaust terminal units.
f. Fan coil units, cabinet heaters, unit heaters.
g. Exhaust/Relief/Return air fans.

4. Testing, adjusting, and balancing existing systems and equipment:

a. Limited to renovation projects. See drawings for locations of existing HVAC equipment.

1.3 Not used.

1.4 ACTION SUBMITTALS

A. Agency Data: within thirty (30) days of award of contract submit proof that proposed testing, adjusting, and balancing agency meets the qualifications specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within thirty (30) days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within ninety (90) days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within sixty (60) days of Contractor's Notice to Proceed, submit TAB strategies and step by step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within ninety (90) days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Final TAB Report Submittal: Within thirty (30) days after all fieldwork has been completed, submit a final TAB report as detailed in Part 3 of this Section to assure design objectives are met and to assist Owner in future maintenance.

1.6 CLOSEOUT SUBMITTAL

A. Operation and Maintenance Data: Include a copy of the final approved TAB Report in the operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. General: Employ services of an independent testing, adjusting, and balancing agency to be the single source of responsibility to test, adjust, and balance the HVAC systems indicated on the drawings serving the project area. Services shall include checking installations for conformity to design, measurement and establishment of fluid quantities of mechanical systems as required to meet the requirements of the design documents, and record and report the results.

B. Certification: Certified by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one (1) Professional Engineer registered in State in which services are to be performed, certified by AABC as Test and Balance Engineer. NEBB certified balancing companies will not be permitted.

C. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

G. Work shall be accomplished in accordance with specifications. Procedures specified shall be followed and, if not specifically described herein, in general, shall be in accordance with Associated Air Balance Council's National Standards.

H. Design Review: Review all design drawings and specifications.

1. Review shall include:

a. Duct pressure classification.
b. Control device location and balancing devices location in duct systems and piping systems.
c. Indicate additional balancing devices required for proper balancing.
d. Specifications on all devices required for balancing.
e. Note any potential noise problems.

2. Within ninety (90) days of award of contract, meet with the CM, Owner, A/E, Mechanical Contractor, and Building Automation System Contractor to review procedures and agenda and comments on design documents as to potential problem areas.

I. Shop Drawing Review: Review the Building Automation System (BAS) shop drawing submittals noting any potential balancing problems. Note comments on submittal, sign, stamp and return to General Contractor. All BAS submittals must be reviewed by balancing agency prior to review by the engineer.

J. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct conference with the CM, Owner, and representatives of installers of mechanical systems. Objective of conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

K. During construction, balancing agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of heating, ventilating, and air conditioning systems. Inspections shall be performed periodically as work progresses. Minimum of two (2) inspections are required as follows:

1. One (1) when 60% of ductwork is installed;
2. Two (2) when 90% of equipment is installed.

3. Balancing agency shall submit brief written report of each inspection to Owner and engineer.

1.8 STANDARDS

A. Associated Air Balance Council (AABC) Publication: National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems, Latest Edition.

B. American Society of Heating, Refrigeration and air Conditioning Engineers (ASHRAE) Publications:

1. "ASHRAE Research Report No. 1162, "Air Flow Measurements at Intake and Discharge Openings and Grilles," ASHVE Transactions, Volume 46.
2. ASHRAE Handbook of Fundamentals, Latest Edition.

C. American National Standards Institute (ANSI) Publications:

1. ANSI/AIHA Z9.5 American National Standard for Laboratory Ventilation, Latest Edition.
2. S1.4 General - Purpose Sound Level Meters, Specifications for,

D. Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA) - Air Duct Leakage Test Manual, Latest Edition.

E. Scientific Equipment & Furniture Association (SEFA) Standard SEFA1-1992 Laboratory Fume Hoods.

1.9 FIELD CONDITIONS <Edit for particular Project>

A. New Construction Project: Personnel will occupy the new building beginning from the projects date of substantial completion. All TAB operations shall be completed prior to the date of substantial completion.

B. Renovation Projects: During the renovation to the project area, adjacent areas of the building outside of the project area are occupied by personnel. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.10 WARRANTY/GUARANTEE

A. See Division 23 Specification Section “Basic Mechanical Requirements – HVAC” for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements shall be in accordance with requirements of AABC.

B. Instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by A/E upon request. Calibration and maintenance of instruments shall be in accordance with requirements of AABC.

2.2 INSTRUMENT TEST HOLE PLUGS

A. Center-pull plugs similar to Alliance Plastics CP Series. Plug material shall be Grade 1 virgin polyethylene.

B. Do not drill test holes in welded ducts serving containment areas.

2.3 FUME HOOD TESTING AND MEASUREMENT EQUIPMENT

A. Anemometers:

1. Accuracy: +/-5% of reading
2. Internal Time Constant (ITC): Less than or equal to 100 ms
3. Definitions:

    a. ITC is the amount of time it takes the sensor to respond 63% of the way to a step change.
    b. Response time is the length of time to get to within the stated accuracy of the sensor.
    c. Response time = ITC * three (3) or five (5) depending on the accuracy.

B. Tracer gas ejector in accordance with ANSI/ASHRAE 110.

C. Tracer Gas (SF6) Sensor:

1. Sensitivity: 0.01 to 100 ppm
2. Accuracy:
3. Above 0.1 ppm: +/-10% of reading.
4. At or below 0.1 ppm: +/-25% of reading.

D. Data Acquisition System: Minimum six channel system capable of simultaneous sampling of 10Hz or greater.

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES

A. General: Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in

this Section to obtain air and water quantities indicated and required for proper operation of the systems.

B. System Operation: During all tests, it shall be demonstrated that all systems shall be free from leaks and all parts of each system are operating correctly. If not, report deficiencies to the CM/GC and the UMB – PM. Balancing Firm shall make final adjustments to equipment as may be required for proper operation, maintaining correct temperatures in all parts of the building. Controls shall be adjusted by BAS technicians in conjunction with Balancing Firm. Coordinate set points and adjustments with BAS.

C. Hydronic Systems: Balance each hydronic circulation system installed under this contract to achieve water quantities, pressure and temperature drops in all equipment and parts of system as indicated on the plans, in specifications, and on the approved shop drawings.

D. Air Systems: Balance each air circulation system, installed under this contract to achieve air quantities, pressure and temperature drops and static pressures in all equipment and parts of system as indicated on the plans, in specifications, and on the approved shop drawings.

E. Noise: Study and report on excessive noise conditions which may develop during system balancing. Report shall be sent to CM and UMB – PM in a form of a “pdf” file.

F. TAB Field Markings: Field mark equipment and balancing devices, including damper control positions, valve position indicators, fan speed control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

G. Traverse Test Probes: Where insulation on ductwork and/or plenums needs to be removed to perform traverse measurements cut and remove insulation as necessary to complete the TAB work. When the work has been completed plug each opening with a properly sized rubber grommet to seal the holes air tight. Coordinate with the mechanical contractor to have the duct insulation repaired to match its previous condition.

H. Acceptable System Tolerance: Unless otherwise specified, the maximum acceptable tolerances for the air and water flow rates shall be +/- 10% of the flow rates as indicated on the drawings and approved submittals.

3.2 TAB REPORT

A. TAB Report: The TAB report shall include the following:

1. Certification form signed and dated by a TAB professional engineer who represents the TAB Company.
2. Table of contents with separate sections for air system balance and hydronic system balance.
3. List of abbreviations used in the report.

4. List of instruments used with instrument type, manufacturer, serial number, range, and calibration date.
5. Job notes.
6. Completed TAB Data Forms as specified.

B. Units of Measurement: Units of measurements shall be in inch/pound (IP) units.

C. Equipment Labels: Includes all major equipment and devices in each system. Include the following:

1. Equipment tag from the drawings.
2. Equipment name.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Location.

D. TAB Data Forms: For each component that requires a TAB procedure provide a TAB data form with the design data from the construction documents and/or approved submittals and the actual measured data that represents the operation of each system and components as follows:

1. Hydronic Systems and Equipment: AHU coils, pumps, and terminal unit coils:

   a. Total water flow rate in GPM.
   b. Water side pressure drop in feet (ft.).
   c. Water temperature entering in °F.
   d. Water temperature leaving in °F.
   e. Water side temperature difference in °F between EWT/LWT.

2. Air Systems and Equipment: Air handling units, energy recovery units and fans:

   a. Total air volume in CFM.
   b. Return air volume in CFM.
   c. Outside air volume in CFM.
   d. Static pressure (TSP/ESP) in inches wg.
   e. Suction pressure in inches wg.
   f. Discharge pressure in inches wg.
   g. Air side pressure drop in inches water gauge (wg).
   h. Air temperature entering in °F.
   i. Air temperature leaving in °F.
   j. Air side temperature difference in °F between EAT/LAT.
   k. Damper positions % open/closed.

3. Motors: For fans and pumps:

a. Motor HP.
b. Motor BHP.
c. Motor volts and phase.
d. Motor amps.
e. Motor RPM.
f. Fan RPM.
g. Fan sheave.
h. Motor sheave.
i. Belts.
j. Motor efficiency.

4. Air Devices: Diffusers and grilles:

a. Outlet number.
b. Outlet size
c. Outlet type.
d. Min/max air volume in CFM.

5. Terminal Units: Include supply and exhaust terminal units, fan coil units, cabinet heaters, unit heaters:

a. Outlet number.
b. Min/max air volume in CFM.
c. Velocity pressure at minimum.
d. Velocity pressure at maximum.
e. DDC set point value.
f. Damper position % open/closed.

6. Duct Traverses:

a. Duct height in inches.
b. Duct width in inches.
c. Duct area in square feet.
d. Average velocity in FPM.
e. Design air volume in CFM.
f. Actual air volume in CFM.
g. Duct S.P. in inches wg.
h. Measured velocity table with appropriate traverse points and velocity readings for indicated duct size.

E. Instrument Calibration Reports: Instrument calibration reports shall include the following data:

1. Instrument type and make.
2. Serial number.
3. Application.

4. Dates of use.
5. Dates of calibration.

3.3 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and/or underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units such as CV/VAV supply boxes, CV/VAV exhaust boxes (general exhaust & fume hoods), fan coil units, unit heaters, cabinet heaters, compressorized cooling units and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.4 PREPARATION

A. Perform system readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Air Side:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Water Side:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.

g. Shutoff and balance valves have been verified to be 100% open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.5 PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain approved submittals and manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan design flow rates.

B. In conjunction with the BAS, fans and equipment shall be started and operated per design/approved sequence of operation.

C. With the supply and exhaust fans set for the respective design air flow volumes, system static pressures, fan rpm, motor rpm and power, and with system dampers set to handle normal minimum outdoor air perform and record the following test:

1. Air Handling Equipment:

a. Test for Total Air

1) Sum of discharge, exhaust air, return air and outside air ducts.
2) Number and locations of velocity readings taken.
3) Duct average velocity.
4) Total airflow.

b. After completion of tests, adjustments, and balancing under minimum outdoor air conditions, set system for 100% outdoor air. Repeat the total airflow tests to check field versus design conditions. Result’s under the outdoor air cycle shall agree with conditions found under "minimum fresh air operation" before system is considered to be in balance. Adjustments of proper dampers shall be made to achieve balance.

c. If airflow is not within 10% of design capacity at rated speed, review system conditions, procedures, and recorded data. Check and record pressure drops across filters, compensate for clean versus dirty filters, coils, sound traps, airflow sensors, etc., to indicate excessive pressure loss or leakage. Resolve problems with appropriate contractor. If systems are properly operating, and airflow is still unacceptable, adjust fan drive in accordance with manufacturer's recommendations to obtain proper airflow and static pressure. Systems shall be balanced and operated at lowest feasible static pressure with allowance for filter loading. Record fan suction pressure, fan discharge pressure, amperage and airflow measurement. Correct fan curves to indicate new points of balance. Fan motor shall not be overloaded.

2. Air Duct Mains and Branches:

   a. Design and actual airflow.
   b. Adjust, measure and record airflow, static pressure of duct mains and branch ducts to provide required pressure and airflow at terminal devices.

3. Terminal Units:

   a. Design and actual airflow.
   b. Adjust minimum or maximum setting of each terminal unit as required to obtain required airflow of outlets in accordance with manufacturer's procedures and recommendations.
   c. In conjunction with the BAS, operate controls, i.e., thermostats, switches and pressure controls in accordance with design sequence to verify proper operation.
   d. Report control problems in writing to the Contractor. Resolve sequence problems with the BAS, with the Contractor and Architect at no additional cost.

4. Air Outlets (supply, return and exhaust registers diffusers and grilles):

   a. Design and actual airflow.
   b. Adjust outlets to obtain design airflow within ±5%.
   c. Adjust direction of throw as required to match final installation location to prevent drafts.
   d. With supply, return and exhaust balanced to design airflow, report room pressurization, (positive or negative). Record pressure readings relative to adjacent spaces and submit them to the Owner and Architect.

5. Fume Hoods and Biosafety Cabinets:

   a. Perform fume hood testing and performance verification for all hoods and biosafety cabinets as described in SEFA 1-1992 "Fume Hood Evaluation in the Field" and in accordance with ASHRAE 110 - Velocity test.
   b. Tests shall be performed in conjunction with other balancing for laboratories have been completed.
   c. Work with the Contractor and Installers to remedy deficiencies. Retest as required until hoods are performing properly. If required, readjust supply and exhaust minimum and maximum airflows to achieve specified face velocities.
   d. Provide field tag for each hood indicating that its performance has been field-verified (format as per Owner's standard).
   e. Coordinate with the BAS and provide him with data in order to calibrate fume hood and biosafety cabinet face velocity monitors.
   f. Some of fume hoods and biosafety cabinets shown on drawings may be installed after completion of contract, and ceiling exhaust grille will be

connected to exhaust duct in lieu of connecting exhaust duct to hood (or cabinet). Perform testing and balancing for laboratories where hoods are replaced to obtain same airflows and sequences of operation as required when hood (or cabinet) is present.

6. Laboratory Pressurization:

a. Supply and exhaust valves:

1) Verify supply and general exhaust valve maximum and minimum air quantities via flow hood readings at outlets/inlets.
2) Verify fume hood exhaust valves for maximum and minimum air quantities via duct traverse.

b. Perform fume hood testing as specified above.
c. Readjust supply/exhaust maximum and minimum air quantities to achieve specified face velocities at hoods.
d. Using smoke stick, verify room pressurization for each lab through entire range of volume tracking control. In conjunction with the BAS adjust supply and exhaust air quantities to maintain desired direction of airflow over entire control range.

D. Sheaves and Belts: Should the air balance fall short of or exceed the specified tolerances, change and replace sheaves and belts to achieve the acceptable air balance. Replacement of sheaves and belts shall be provided at no additional cost.

E. Verify that air duct system is sealed as specified. Balancing contractor shall witness leakage tests required of sheet metal construction.

F. Balancing contractor shall witness leakage tests required of sheet metal contractor.

3.6 PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for each system pump, and equipment. Obtain approved submittals and manufacturer recommended testing procedures. Cross check the summation of required coil and equipment flow rates with each system pump design flow rate.

B. In conjunction with the BAS, pumps and equipment shall be started and operated per design/approved sequence of operation.

C. With manual valves open, and control valves in normal position, adjust discharge balancing valve to obtain design flow. Compare data with pump submittal curve. If test point falls on curve, proceed with balancing. If recorded data does not fall on pump curve, plot new curve parallel with other curves on chart, from zero to maximum flow. Open discharge balancing valve to full and record discharge pressure, suction pressure and total head. Readjust balancing valve to obtain suction and discharge design flow and pressure, and record data. Check and record pump motor voltage and amperage. Pump motor shall not be overloaded.

D. With pump system adjusted, perform following tests, compile data and submit report:

1. Pumps:

a. Design Data:

1) Flow and total dynamic head.
2) Pump speed, and motor output.

b. Installed equipment:

1) Manufacturer, size and model number.
2) Type drive.
3) Motor rating, voltage, and phase.
4) Full load amperes.

c. Field Test:
1) Discharge pressures: Full flow and zero flow.
2) Suction pressures: Full flow and zero flow.
3) Operating flow and total dynamic head
4) No load amperes (where possible.)
5) Full flow amperes, zero flow amperes.
6) Calculated motor output.

E. With pump system properly adjusted, proceed with following tests adjustments and compilation of data:

1. Pipe Mains and Branches:

a. Adjust branch balancing valves to obtain pressure and flowrates required for terminal devices, i.e., coil, radiation, etc.
b. Provide the following:

1) Manufacturer's model number, size of heat exchanger, number of passes.
2) Design and actual flow rate and pressure drop.
3) Record entering and leaving water temperatures.
4) In conjunction with the BAS adjust steam control valve as required to obtain design temperatures at design flowrate.

c. Terminal Devices:

1) Manufacturer's model number, type of terminal device and rated heat output.
2) Flowrate and differential pressure through component including control device.

3) Adjust balancing device to obtain required flowrate through device, in accordance with manufacturer's procedures and recommendations.
4) Record the temperature of the fluid at inlet and outlet of device. Record the temperature of the air entering and leaving the coils. Compare data with design performance, if data is not in conformance with approved shop drawings or design intent, readjust water system to obtain acceptable performance.
5) With air and water system balanced and in conjunction with “BAS” operate controls, i.e., thermostats, switches, etc., in accordance with design sequence to verify proper operation.
6) Report control problems in writing to General Contractor. Resolve sequence problems with the BAS, the Contractor and Architect at no additional cost.

d. Heat transfer equipment including steam, hot water, chilled water, glycol water, coils, etc.

1) Measured Parameters:

a) Flowrate.
b) Heat transfer.
c) Entering and leaving temperatures.
d) Pressure drops.
e) Ambient dry and wet bulb (for cooling towers).

2) Equipment data:

a) Manufacturer and model number.
b) Motor output horse powers.
c) Serial numbers.

3) Design Data:

a) Include design data in submittal for comparison.

F. Check and Verify: Check and verify the following system requirements have been completed and are in proper working order:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow control valves for proper position.
4. Locate start/stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.7 PROCEDURES FOR PRIMARY/ SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design gpm:

1. Measure total water flow:

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

D. Adjust flow measuring devices installed in mains and branches to design water flows.
1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Remeasure each main and branch after all have been adjusted.

E. Adjust flow measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Remeasure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

F. For systems with pressure independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

G. For systems without pressure independent valves or flow measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:

1. Remeasure and confirm that total water flow is within design.
2. Remeasure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.8 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal protection element rating.
8. Service factor and frame size.

B. Motors Driven by Variable Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering and leaving air temperatures.

C. Record fan and motor operating data.

3.10 PROCEDURES FOR HEAT TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering and leaving water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry bulb temperature of entering and leaving air.
5. Wet bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering and leaving air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry bulb temperature of entering and leaving air.
2. Wet bulb temperature of entering and leaving air.
3. Airflow.

3.11 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.12 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.

2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.13 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5%, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5% or less, equipment adjustments are not required.
4. Balance each air outlet.

3.14 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10%.
2. Air Outlets and Inlets: Plus or minus 10%.
3. Heating Water Flow Rate: Plus or minus 10%.
4. Cooling Water Flow Rate: Plus or minus 10%.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.15 PROGRESS REPORTING

A. Initial Construction Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL TAB REPORT

A. Final TAB Report: The final TAB report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the TAB process and serve as a reference of the actual operating conditions of the systems. All measurements and test results that appear in the TAB report must be made on site and dated by the AABC technicians and/or TAB engineer performing the work. This report shall be provided as a complete electronic “pdf” file organized as specified and submitted to the A/E for review.

B. Sign & Seal: Final TAB report shall bear the seal and signature of Test and Balance Engineer. TAB Report shall be certified proof that systems have been tested, adjusted, and balanced in accordance with referenced standards; are an accurate representation of how systems have been installed; are true representation of how systems are operating at completion of testing, adjusting, and balancing procedures; and are accurate record of final quantities measured, to establish normal operating values of the systems.

END OF SECTION 230593