TP MECHANICAL CONTRACTORS
SUBCONTRACT AGREEMENT

PROJECT	BLUE ASH SUMMIT PARK FACILITY
CONTRACTOR	SHOOK CONSTRUCTION
SUBCONTRACTOR	NATIONAL TAB
PROJECT ARCHITECT	
SUBCONTRACT WORK	
CONTRACT DATE	**5/17/2024**
MASTER AGREEMENT (Y or N)	No
CONTRACT AMOUNT **RETAINAGE PERCENTAGE**	**$2,200.00** **10**
SUBCONTRACT NUMBER	A1011-07

This Subcontract Agreement ("Agreement") is entered into between by TP MECHANICAL CONTRACTORS, INC. ("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.

FROM: **TP Mechanical Contractors, Inc.**
1500 Kemper Meadow Dr
Cincinnati, OH 45240
Phone: 513-851-8881
Fax: 513-851-0612

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

CC TO: _____
_____

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

TP Mechanical Contractors

_____

By: Jason Ralston

Its: VP Estimating

Date: 6-7-24

NATIONAL TAB

_____

By: _____

Its: Joe Hertenstein

Date: 5-31-24

NATIONAL TAB Comfort. Under control.		1329 E Kemper Rd, Ste 4210 CINCINNATI, OH 45246 513-860-2050 joe@nationaltab.com	
Client:	TP Mechanical	Project:	Blue Ash Summit Park Facility
Email:	kelly.simerman@tpmechanical.com	QUOTE #:	JMH-NT-15879
ATTN:	Kelly Simerman	BID DATE:	1/9/2024
Address:		Jobsite location:	Blue Ash, 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.:
Ducted Splits	6	Exhaust Fans	2
ERVs	1	Air Devices	

SCOPE OF WORK:

1. 1st Shift Work Only
2. TAB of listed equipment

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

TOTAL PRICE = $ 2,200.00

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, for the sum of: Two Thousand Two Hundred US Dollars and Zero Cents and any selected options stated above. Payment to be made as 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:** 01/09/24

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Division 01 General Requirements – Subgroup 019000 Life Cycle Activities, Specification Section 019113 "General Commissioning Requirements" for the Testing, Adjusting, and Balancing (TAB) requirements to support Commissioning.

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for all air systems including, but not limited to the following:

1. Air Systems.
2. HVAC equipment quantitative-performance settings.
3. Space pressurization testing and adjusting.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

B. Related Sections include:

1. Division 01 Section "General Requirements" – Subgroup 019000 Life Cycle Activities.
2. Specification Section 019113 "General Commissioning Requirements" for the Testing, Adjusting, and Balancing (TAB) requirements to support Commissioning.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise Criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room Criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

P. TAB: Testing, adjusting, and balancing.

Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

R. Test: A procedure to determine quantitative performance of systems or equipment.

S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

T. VFD: Variable Frequency Motor Controllers

1.4 INFORMATIONAL SUBMITTALS

A. Certified TAB reports.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

1. The supervisor directly in charge of this testing shall have a TAB certificate and shall have not less than two years of experience in TAB work.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Contract Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.
g. Schedule for submission of 1st Draft of TAB report.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

G. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, "Air Balancing."

H. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, "System Balancing."

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Phased TAB: The project may require startup and initial checkout to be executed in phases. This phasing will be planned and scheduled in a coordination meeting by the construction team, led by the TAB agency.

C. Renovation of Existing Systems: Provide pre-demolition test report for existing systems to be renovated prior to demolition work and submit report prior to new construction.
   1. Provide test data of renovated area to document existing capacity of systems to be renovated. The test shall establish existing air flows to sub-mains, branches and runouts inside the renovated area.
   2. Where a portion of a system is not included within the Scope of Work boundary on the drawings, testing of the entire existing affected systems are required prior to construction. The first test shall establish existing air flows to sub-mains, branches and run-outs to areas which are not scheduled for renovation. The final test shall reset flows of air to sub-mains, branches and run-outs outside renovated area to the recorded values from the first test.
   3. Include total capacity test of any scheduled existing equipment. Include flow test results of first and final balancing of existing systems in final report.

1.7 DEFICIENCIES

A. Any deficiency in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible Contractor or person.

B. The work necessary to correct items on the deficiency list shall be performed and verified by the affected contractor or sub-contractor before the TAB agency returns to retest.

C. The TAB agency shall return to the site to readjust systems that do not test within specified requirements.

1.8 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

D. Coordinate schedule of on-site testing efforts and TAB report submission with the Contractor and/or the Commissioning Authority (CxA). It is intended that the TAB report will be submitted prior to on-site Commissioning witness testing.

1.9 WARRANTY

A. Special Guarantee: Provide a guarantee on national certifying agency forms stating that the national certifying agency will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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.

1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

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 equipment performance data including fan and pump curves. 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. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6 and/or ASHRAE "Fundamentals Handbook" Duct Design Chapter. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible, and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine temporary strainers and verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

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

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

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers and other controlled devices are operated by the intended controller.
2. Dampers are in the position indicated by the controller.
3. Integrity dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
5. Sensors are located to sense only the intended conditions.
6. Sequence of operation for control modes is according to the Contract Documents.
7. Controller set points are set at indicated values.
8. Interlocked systems are operating.
9. Changeover from heating to cooling mode occurs according to indicated values.

S. 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.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

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

1. Airside:

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. VFD startup is complete, and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Equipment and duct access doors are securely closed.
i. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided
j. Windows and doors are installed.
k. Suitable access to balancing devices and equipment is provided.

3.3 TAB CONSTRUCTION ADMINSTRATION SERVICES

A. Project Site Observations: During construction, the TAB agency shall observe the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Provide a minimum of two site observations when HVAC systems are approximately 50% and 80% complete and issue Field Reports indicating observations and noted deficiencies.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in the TAB firm's national certifying agency: AABC or NEBB; and this section.

1. Comply with requirements in ASHRAE 62.1, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, fan-speed-control levers, and similar controls and devices, to show final settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

M. Fans with Adjustable Speed Drives should be provided with the largest non-overloading sheaves available to match the "full speed" of the motor in Bypass or Hand mode of the Drive.

N. For constant speed fans, after the system is balanced, fixed pitch sheaves shall replace the variable pitch sheaves for all motors using multiple belt drives.

O. Outside Air. Test and adjust the outside air on applicable equipment. Outside air damper percent open shall be documented and provided to BAS contractor.

P. Fan Static Pressure Profile. Provide a diagram of each fan and air handling unit showing the static pressure profile through each pressure drop device (coil, damper, fan, coil, dampers, etc)

Q. Energy Efficiency Balancing Approach: At least one run-out volume damper shall be full open in efforts to provide an energy efficient balanced system.

R. Room Airflow Tolerance. While the air outlet tolerances are +/- 10%, the Room total air balance shall also be within 10% of the scheduled room air flow.

S. Provide duct smoke detector air differential pressure test for each duct detector in accordance with the manufacturer's instructions to insure detectors have been properly installed. Contractor shall correct any deficient installation and TAB agency shall retest.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

    a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and air-treating equipment.

    a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Make required adjustments to pulley/sheave sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Replace pulley/sheaves to provide the required fan rpm.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

E. CAV System Static Pressure Control:

1. After balancing the terminal units of the system, simulate the dirty filter pressure drop conditions.
2. Work with the controls contractor to set the fan pressure control tracking setpoint to maintain the specified flow. Record in the TAB report the static pressure requirement at the static pressure sensor. Optimize the balancing so the static pressure setpoint is as low as possible to achieve airflow at the furthest diffuser with simulated dirty filter pressure drop.
3. Record the fan adjustable speed drive speeds at both the clean and dirty filter conditions. Note that the fan shall be sheaved so the adjustable speed drive should be less than 100% at dirty filter conditions.

F. Economizer Systems:

1. Balance the supply air side according to CAV procedures using minimum outdoor air volumes. Record the balanced system return duct static pressure at the control system sensor.
2. For CAV systems the design intent is for the exhaust/return fan speed to modulate to maintain the return duct static pressure setpoint.
3. The control contractor should turn the AHU system to full economizer mode, using 100% outside air. During this mode the exhaust/return fan sheaves and fan adjustable speed drive should be set up so the adjustable speed drive is no more than 90%. This will leave 10% spare capacity for future adjustments.
4. Part Load Performance: Record duct static pressures and fan speeds for outdoor air volumes of 100%, 75%, 50%, and 25%

3.7 PROCEDURES FOR SINGLE-ZONE VARIABLE-AIR -VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and air-treating equipment.
   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Make required adjustments to pulley/sheave sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Replace pulley/sheaves to provide the required fan rpm.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower (kW).

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

E. Upon completion of balancing at the total design flow, Adjust fans to deliver minimum cooling airflow indicated and the heating airflow indicated. Unit is to maintain required OA at each of these settings.

F. Economizer Systems:
   1. Balance the supply air side according to VAV procedures using minimum outdoor air volumes. Record the balanced system return duct static pressure at the control system sensor.
   2. For VAV systems, the design intent is for the exhaust/return fan speed to modulate to maintain a slight positive (0.02" wg (3 Pa)) building or common space static pressure setpoint.
   3. The control contractor should turn the AHU system to full economizer mode, using 100% outside air. During this mode the exhaust/return fan sheaves and fan adjustable speed drive should be set up so the adjustable speed drive is no more than 90%. This will leave 10% spare capacity for future adjustments

3.8 PROCEDURES FOR MULTI-ZONE VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

   1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
   2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   3. Measure total system airflow. Adjust to within indicated airflow.
   4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

      a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

   6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

C. VAV System Static Pressure Control:

1. After balancing the terminal units of system, simulate the dirty filter pressure drop conditions.
2. Maximize the fan sheaves so that at full Adjustable Fan Speed, the motor is at or near its rated full load. Work with the control contractor to position all the VAV boxes to the maximum (or maximum diversity) airflow position during this setup.
3. No Diversity Static Pressure Setup for Energy Efficiency: The controls contractor should position all the VAV boxes to maximum airflow. Adjust the control system supply duct static pressure setpoint downward until the airflow in the farthest VAV box starts to drop below the maximum CFM value. Raise the static pressure setpoint back up slightly and record this balanced setpoint value in both the control system and the TAB report.
4. Diversity Static Pressure Setup for Energy Efficiency: The controls contractor should position the three farthest VAV boxes to maximum airflow. Adjust the control system supply duct static pressure setpoint downward until the air flow in the farthest VAV box starts to drop below the maximum CFM value. Raise the static pressure setpoint back up slightly and record this balanced setpoint value in both the control system and the TAB report.
5. Record recommended static pressure setpoint value, based on above testing. Record the fan adjustable speed drive speeds at the recommended static pressure setpoint value.

D. Economizer Systems:

1. Balance the supply air side according to VAV procedures using minimum outdoor air volumes. Record the balanced system return duct static pressure at the control system sensor.
2. For VAV systems, the design intent is for the exhaust/return fan speed to modulate to maintain a slight positive (0.02" wg (3 Pa)) building or common space static pressure setpoint.
3. The control contractor should turn the AHU system to full economizer mode, using 100% outside air. During this mode the exhaust/return fan sheaves and fan adjustable speed drive should be set up so the adjustable speed drive is no more than 90%. This will leave 10% spare capacity for future adjustments.
4. Part Load Performance: Record duct static pressures and fan speeds for outdoor air volumes of 100%, 75%, 50%, and 25%.

3.9 GENERAL PROCEDURES FOR SYSTEM BALANCING WITH AIR FILTERS

A. For supply or exhaust systems with filters, the systems shall be balanced with clean filters, then re-tested with simulated dirty filter pressure drop conditions.

B. Dirty Filter Simulation: Use a filter area blank off plate made of cardboard or plastic to simulate the dirty filter pressure drop.

C. Document main traversed air flows with both clean and dirty filter pressure drops.

D. Coordinate with Contractor to replace the construction filters with new filters prior to TAB.

E. If not provided in the Contract Documents, use the following values for dirty filter pressure drops.

Filter	Assumed Clean DP	Dirty DP
30% Pre (flat)	0.3"	0.6"
30% Pre (angled)	0.3"	0.6"
>60%	0.5"	1.0"
>90%	0.75"	1.5"
99%	0.75"	1.5"

3.10 PROCEDURES FOR MOTORS

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

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by VFD's: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass (if applicable) for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.11 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. For Air Handling Units: Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied. This can be accomplished thru the Building Automation System.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.12 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.13 TOLERANCES

A. Set HVAC system airflow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent to minus 10 percent. This includes duct distribution loss. For systems where minimum air change or other minimum airflows are required, tolerance shall be 0 to plus 10%.
2. Air Outlets and Inlets: Plus 10 percent to minus 10 percent, as long as the overall room is balanced properly and room minimum code required total air changes per hour are maintained.

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

3.14 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: As Work progresses, prepare 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.

3.15 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data

B. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils if applicable.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Terminal units.
4. Balancing stations.
5. Position of balancing devices.

E. General Report requirements: Include the following in reports for all equipment for comparison for recorded values:

1. Current BAS sensor readings for Outdoor airflow, static pressure sensors, etc.

F. Air-Handling Unit, Fan Coil Unit and Blower Coil Unit Test Reports: For units with coils, include the following:

1. Unit Data: Include the following:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
j. Number of belts, make, and size.
k. Number of filters, type, and size.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat coil or element static-pressure differential in inches wg.
g. Cooling coil static-pressure differential in inches wg.
h. Heating coil or element static-pressure differential in inches wg.
i. For Multizone VAV AHU's: Maximum and Minimum static pressure setpoints inches wg.
j. For Single zone VAV AHU's: VFD speeds corresponding to design maximum, minimum and heating airflows.

k. Outside airflow in cfm.
l. Return airflow in cfm.
m. Outside-air damper position.
n. Return-air damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig.
j. Refrigerant suction temperature in deg F.

H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btuh.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.

n. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btuh.
i. High-fire fuel input in Btuh.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btuh.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btuh.

I. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btuh.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btuh.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

J. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.

b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

K. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.

L. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.

f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

M. System-Coil Reports: For reheat coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.

N. Air-to-Air Heat-Recovery Unit Reports:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. If fans are an integral part of the unit, include the following for each fan:

a. Make and type.
b. Arrangement and size.
c. Sheave make, size in inches, and bore.
d. Sheave dimensions, center-to-center, and amount of adjustments in inches.

4. Test Data (Indicated and Actual Values):

a. Total exhaust airflow rate in cfm.
b. Purge exhaust airflow rate in cfm.
c. Outside airflow rate in cfm.
d. Total exhaust fan static pressure in inches wg.
e. Total outside-air fan static pressure in inches wg.
f. Pressure drop on each side of recovery wheel in inches wg.
g. Exhaust air temperature entering in deg F.
h. Exhaust air temperature leaving in deg F.
i. Outside-air temperature entering in deg F.
j. Outside-air temperature leaving in deg F.
k. Calculate sensible and total heat capacity of each airstream in MBh.

O. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.16 GAUGE AND SENSOR ACCURACY VALIDATION

A. The accuracy of the project's installed gauges, thermometers and sensors shall be validated by the TAB Contractor. The TAB Contractor shall use calibrated gauges and thermometers and compare the values against the contractor installed gauges, thermometers and sensors.

1. Pressure Gauges and BAS Sensors – Air Systems

a. The installed pressure gauges and BAS pressure sensors shall be within 10% of the TAB contractor's calibrated gauge at the normal operating pressures.
b. TAB shall notify the responsible contractor of gauge or sensor deficiency for the above to be re-calibrated or replaced.
c. Replaced gauges shall be verified for accuracy by TAB.
d. The following are the tolerances for various pressure gauges and sensors:

1)	Filters:	+/- 10%
2)	Duct:	+/- 10%
3)	Space:	+/-0.01"
4)	Isolation Room:	+/- 0.001" wg

2. Thermometers and BAS Sensors – Air Systems

a. The installed duct thermometers shall be within 1F of the TAB contractors calibrated gauge.
b. Duct or air handling unit mounted BAS sensors shall be within 1F of TAB contractor's calibrated gauge. This includes OA, MA, coil, leaving air, and return air sensors.
c. TAB shall notify responsible contractor of accuracy deficiency, for the device to be recalibrated or replaced.

3. Air Flow Measuring Stations (AFMS)

a. The TAB Contractor shall validate the accuracy of air flow measuring stations by taking traverse readings. The accuracy shall be within 5%.
b. TAB shall notify responsible contractor of accuracy deficiency for the device to be recalibrated or replaced.

3.17 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
c. Measure space pressure of at least 10 percent of locations.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner or Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner or Architect.
3. Owner or Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

C. Authority Having Jurisdiction Inspection

1. Attend inspection by AHJ. A completed and approved certified copy of the TAB report shall be available at the project site at the AHJ inspection. This includes AHCA and OSHPD inspections.

3.18 DEFICIENCY RESOLUTION

A. As testing progresses and a deficiency is identified, the TAB contractor shall coordinate with the Contractors to identify the deficiency for a timely resolution of the deficiency.

B. The TAB contractor shall include in their base bid, the initial test adjust balance, plus returning to the site for two additional visits to retest systems that do not test within specification requirements. Any additional testing requirements will fall under requirements listed under Cost of Retesting.

C. Cost of Retesting

1. The cost for any additional testing beyond the requirements in the paragraph above shall be borne by the installing Contractors, if they are responsible for the deficiency. If they are not responsible, then reasonable costs for retesting shall be negotiated with the Contractor.
2. The time for the Architect/Engineer to direct any retesting required because a specific system report to have been successfully completed, but determined during testing to be faulty, will be back-charged to the Contractor, who may choose to recover costs from the party responsible for stating the system was complete and ready for testing.

D. Failure Due to Manufacturer Defect: If 10%, or three (whichever is greater), of identical pieces (size does not constitute a difference) of equipment fails to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance, then all identical units may be considered unacceptable by the TAB agency or the Architect/Engineer. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the TAB agency, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Architect/Engineer within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor or manufacturer's representative shall provide a signed and dated written explanation of the problem, cause of failures, etc., and proposed solutions which shall include full equipment submittals. The propose solutions shall not significantly exceed the specification requirements of the original installation.
3. The Architect/Engineer will determine whether a replacement of all identical units or a repair is acceptable.

4. The proposed solution will be installed by the Contractor, and tested for up to one week, upon which the Architect/Engineer will decide whether to accept the solution.
5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

3.19 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, then the TAB contractor shall return to perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

1. Air handler coil performance test shall be recorded during the opposite season.
2. To verify system calibration, control and operation, test and record 25% of the previously recorded room temperatures (dry bulb and wet bulb). Measurements shall be made near each room sensor or thermostat location in each separate controlled zone. The resulting temperature data shall be included in a revised report with associated thermostat or control setpoint during the tests. Outside temperature and humidity conditions shall also be recorded during the testing periods.
3. Areas of verification include: economizer airflows, building or space pressurization, coil leaving air temperature accuracy.

3.20 SPACE TEMPERATURE AND HUMIDITY VERIFICATION

A. For hotel guestrooms, apartment units and condo units, provide one week of temperature and humidity data for a guestroom, apartment or condo unit on each floor. This can be achieved through the Building Automation System or by the use of data loggers.

END OF SECTION 230593