Proposal for

Region 14 Education Service Center ("ESC")

HVAC Equipment, Installation, Service & Related Products

TDIndustries

At the Heart of Your Building

July 23, 2020

NCPA

National Cooperative Purchasing Alliance

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TAB 1 - MASTER AGREEMENT/SIGNATURE FORM

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Tab 1 – Master Agreement
General Terms and Conditions

- Customer Support
  - The vendor shall provide timely and accurate technical advice and sales support. The vendor shall respond to such requests within one (1) working day after receipt of the request.

- Disclosures
  - Respondent affirms that he/she has not given, offered to give, nor intends to give at any time hereafter any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor or service to a public servant in connection with this contract.
  - The respondent affirms that, to the best of his/her knowledge, the offer has been arrived at independently, and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over other vendors in the award of this contract.

- Renewal of Contract
  - Unless otherwise stated, all contracts are for a period of one (1) year with an option to renew annually for an additional four (4) years if agreed to by Region 14 ESC and the vendor.

- Funding Out Clause
  - Any/all contracts exceeding one (1) year shall include a standard "funding out" clause. A contract for the acquisition, including lease, of real or personal property is a commitment of the entity's current revenue only, provided the contract contains either or both of the following provisions:
  - Retains to the entity the continuing right to terminate the contract at the expiration of each budget period during the term of the contract and is conditioned on a best efforts attempt by the entity to obtain appropriate funds for payment of the contract.

- Shipments (if applicable)
  - The awarded vendor shall ship ordered products within the written estimate of delivery time by the vendor to the entity after the receipt of the order unless modified. If a product cannot be shipped within that time, the awarded vendor shall notify the entity placing the order as to why the product has not shipped and shall provide an estimated shipping date. At this point the participating entity may cancel the order if estimated shipping time is not acceptable. All deliveries shall be freight prepaid, F.O.B. destination.

- Tax Exempt Status
  - Since this is a national contract, knowing the tax laws in each state is the sole responsibility of the vendor.

- Payments
  - The entity using the contract will make payments directly to the awarded vendor or their affiliates as long as written request and approval by NCPA is provided to the awarded vendor.

- Adding authorized distributors/dealers
  - Awarded vendors may submit a list of distributors/partners/resellers to sell under their contract throughout the life of the contract. Vendor must receive written approval from NCPA before such distributors/partners/resellers considered authorized.
  - Purchase orders and payment can only be made to awarded vendor or distributors/business partners/resellers previously approved by NCPA.
  - Pricing provided to members by added distributors or dealers must also be less than or equal to the pricing offered by the awarded contract holder.
  - All distributors/partners/resellers are required to abide by the Terms and Conditions of the vendor's agreement with NCPA.

- Pricing
  - All pricing submitted to shall include, as a cost of sale to the awarded vendor, the administrative fee to be remitted to NCPA by the awarded vendor**.** It is the awarded vendor's responsibility to keep all pricing up to date and on file with NCPA. For those pricing requiring annual or periodic pricing updates, awarded vendors are expected to provide these changes as submitted.
  - All deliveries shall be freight prepaid, F.O.B. destination and shall be included in all pricing offered unless otherwise clearly stated in writing

- Warranty
  - Proposals should address each of the following:
    - Applicable warranty and/or guarantees of equipment and installations including any conditions and response time for repair and/or replacement of any components during the warranty period.
    - Availability of replacement parts
    - Life expectancy of equipment under normal use
    - Detailed information as to proposed return policy on all equipment
  - All supplies, equipment and services shall include manufacturer's minimum standard warranty and one (1) year labor warranty unless otherwise agreed to in writing.

- Audit rights
  - Vendor shall, at Vendor's sole expense, maintain appropriate due diligence of all purchases made by any entity that utilizes this Agreement. NCPA and Region 14 ESC each reserve the right to audit the accounting for a period of three (3) years from the time such purchases are made. This audit right shall survive termination of this Agreement for a period of one (1) year from the effective date of termination. In the State of New Jersey, this audit right shall survive termination of this Agreement for a period of five (5) years from the date of

final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

- Region 14 ESC shall have the authority to conduct random audits of Vendor's pricing that is offered to eligible entities at Region 14 ESC's sole cost and expense. Notwithstanding the foregoing, in the event that Region 14 ESC is made aware of any pricing being offered to eligible agencies that is materially inconsistent with the pricing under this agreement, Region 4 ESC shall have the ability to conduct an extensive audit of Vendor's pricing at Vendor's sole cost and expense. Region 14 ESC may conduct the audit internally or may engage a third-party auditing firm. In the event of an audit, the requested materials shall be provided in the format and at the location designated by Region 14 ESC or NCPA.

- Indemnity

  - The awarded vendor shall protect, indemnify, and hold harmless Region 14 ESC and its participants, administrators, employees and agents against all claims, damages, losses and expenses arising out of or resulting from the actions of the vendor, vendor employees or vendor subcontractors in the preparation of the solicitation and the later execution of the contract.

- Licenses and Duty to keep current licenses

  - Vendor shall maintain in current status all federal, state and local licenses, bonds and permits required for the operation of the business conducted by vendor. Vendor shall remain fully informed of and in compliance with all ordinances and regulations pertaining to the lawful provision of services under the contract. Region 14 ESC reserves the right to stop work and/or cancel the contract of any vendor whose license(s) expire, lapse, are suspended or terminated. Vendor is expected to provide all required license(s) with this RFP response.

- Franchise Tax
  - The respondent hereby certifies that he/she is not currently delinquent in the payment of any franchise taxes.

- Supplemental Agreements
  - The entity participating in this contract and awarded vendor may enter into a separate supplemental agreement to further define the level of service requirements over and above the minimum defined in this contract i.e. invoice requirements, ordering requirements, specialized delivery, etc. Any supplemental agreement developed as a result of this contract is exclusively between the participating entity and awarded vendor.

- Certificates of Insurance

  - Certificates of insurance shall be delivered to the Public Agency prior to commencement of work. The insurance company shall be licensed in the applicable state in which work is being conducted. The awarded vendor shall give the participating entity a minimum of ten (10) days notice prior to any modifications or cancellation of policies. The awarded vendor shall require all subcontractors performing any work to maintain coverage as specified.

- Legal Obligations
  - It is the Respondent's responsibility to be aware of and comply with all local, state, and federal laws governing the sale of products/services identified in this RFP and any awarded contract and shall comply with all while fulfilling the RFP. Applicable laws and regulation must be followed even if not specifically identified herein.
- Protest
  - A protest of an award or proposed award must be filed in writing within ten (10) days from the date of the official award notification and must be received by 5:00 pm CST. No protest shall lie for a claim that the selected Vendor is not a responsible Bidder. Protests shall be filed with Region 14 ESC and shall include the following:
    - Name, address and telephone number of protester
    - Original signature of protester or its representative
    - Identification of the solicitation by RFP number
    - Detailed statement of legal and factual grounds including copies of relevant documents and the form of relief requested
  - Any protest review and action shall be considered final with no further formalities being considered.
- Force Majeure
  - If by reason of Force Majeure, either party hereto shall be rendered unable wholly or in part to carry out its obligations under this Agreement then such party shall give notice and full particulars of Force Majeure in writing to the other party within a reasonable time after occurrence of the event or cause relied upon, and the obligation of the party giving such notice, so far as it is affected by such Force Majeure, shall be suspended during the continuance of the inability then claimed, except as hereinafter provided, but for no longer period, and such party shall endeavor to remove or overcome such inability with all reasonable dispatch.
  - The term Force Majeure as employed herein, shall mean acts of God, strikes, lockouts, or other industrial disturbances, act of public enemy, orders of any kind of government of the United States or any civil or military authority; insurrections; riots; epidemics; landslides; lighting; earthquake; fires; hurricanes; storms; floods; washouts; droughts; arrests; restraint of government and people; civil disturbances; explosions, breakage or accidents to machinery, pipelines or canals, or other causes not reasonably within the control of the party claiming such inability. It is understood and agreed that the settlement of strikes and lockouts shall be entirely within the discretion of the party having the difficulty, and that the above requirement that any Force Majeure shall be remedied with all reasonable dispatch shall not require the settlement of strikes and lockouts by acceding to the demands of the opposing party or parties when such settlement is unfavorable in the judgment of the party having the difficulty.

- Prevailing Wage
  - It shall be the responsibility of the Vendor to comply, when applicable, with the prevailing wage legislation in effect in the jurisdiction of the purchaser. It shall further be the responsibility of the Vendor to monitor the prevailing wage rates as established by the appropriate department of labor for any increase in rates during the term of this contract and adjust wage rates accordingly.

- Miscellaneous
  - Either party may cancel this contract in whole or in part by providing written notice. The cancellation will take effect 30 business days after the other party receives the notice of cancellation. After the 30th business day all work will cease following completion of final purchase order.

- Cancellation for Non-Performance or Contractor Deficiency
  - Region 14 ESC may terminate any contract if awarded vendor has not used the contract, or if purchase volume is determined to be low volume in any 12-month period.
  - Region 14 ESC reserves the right to cancel the whole or any part of this contract due to failure by contractor to carry out any obligation, term or condition of the contract.
  - Region 14 ESC may issue a written deficiency notice to contractor for acting or failing to act in any of the following:
    - Providing material that does not meet the specifications of the contract;
    - Providing work and/or material that was not awarded under the contract;
    - Failing to adequately perform the services set forth in the scope of work and specifications;
    - Failing to complete required work or furnish required materials within a reasonable amount of time;
    - Failing to make progress in performance of the contract and/or giving Region 14 ESC reason to believe that contractor will not or cannot perform the requirements of the contract;
  - Upon receipt of a written deficiency notice, contractor shall have ten (10) days to provide a satisfactory response to Region 14 ESC. Failure to adequately address all issues of concern may result in contract cancellation. Upon cancellation under this paragraph, all goods, materials, work, documents, data and reports prepared by contractor under the contract shall become the property of Region 14 ESC on demand.

- Open Records Policy
  - Because Region 14 ESC is a governmental entity responses submitted are subject to release as public information after contracts are executed. If a vendor believes that its response, or parts of its response, may be exempted from disclosure, the vendor must specify page-by-page and line-by-line the parts of the response, which it believes, are exempt. In addition, the respondent must specify which exception(s) are applicable and provide detailed reasons to substantiate the exception(s).
  - The determination of whether information is confidential and not subject to disclosure is the duty of the Office of Attorney General (OAG). Region 14 ESC must provide the OAG sufficient information to render an opinion and therefore, vague and general claims to confidentiality by the respondent are not acceptable. Region 14 ESC must comply with the opinions of the OAG. Region14 ESC assumes no responsibility for asserting legal arguments on behalf of any vendor. Respondent are advised to consult with their legal

counsel concerning disclosure issues resulting from this procurement process and to take precautions to safeguard trade secrets and other proprietary information.

If awarded vendor is going to do business in the State of Arizona, the following terms and conditions shall apply

- Cancellation for Conflict of Interest

  - Per A.R.S. 38-511 a School District/public entity may cancel this Contract within three (3) years after Contract execution without penalty or further obligation if any person significantly involved in initiating, negotiating, securing, drafting, or creating the Contract on behalf of the School District/public entity is, or becomes at any time while the Contract or an extension the Contract is in effect, an employee of or a consultant to any other party to this Contract with respect to the subject matter of the Contract. The cancellation shall be effective when the awarded vendor receives written notice of the cancellation unless the notice specifies a later time.

- Registered Sex Offender Restriction

  - Pursuant to this order, the awarded vendor agrees by acceptance of this order that no employee of the awarded vendor or a subcontractor of the awarded vendor, who has been adjudicated to be a registered sex offender, will perform work on any School District's premises or equipment at any time when District students are, or are reasonably expected to be, present. The awarded vendor further agrees by acceptance of this order that a violation of this condition shall be considered a material breach and may result in a cancellation of the order at the District's discretion.

- Contract's Employment Eligibility

  - By entering the contract, awarded vendor warrants compliance with A.R.S. 41-4401, A.R.S. 23-214, the Federal Immigration and Nationality Act (FINA), and all other federal immigration laws and regulations. A School District/public entity may request verification of compliance from any contractor or subcontractor performing work under this contract. A School District/public entity reserves the right to confirm compliance in accordance with applicable laws. Should the School District/public entity suspect or find that the awarded vendor or any of its subcontractors are not in compliance, the School District/public entity may pursue any and all remedies allowed by law, including, but not limited to: suspension of work, termination of the contract for default, and suspension and/or debarment of the awarded vendor. All costs necessary to verify compliance are the responsibility of the award vendor.

- Terrorism Country Divestments

  - Per A.R.S. 35-392, a School District/public entity is prohibited from purchasing from a company that is in violation of the Export Administration Act.

- Fingerprint Checks

  - If required to provide services on School District/public entity's property, awarded vendor shall comply with A.R.S. 15-511(h).

- Indemnification

  - Notwithstanding all other provisions of this agreement, School District/public entity does not agree to accept responsibility, waive liability, or indemnify the awarded vendor, in whole or in part, for the errors, negligence, hazards, liabilities, contract breach and/or omissions of the awarded vendor, its employees and/or agents.

Process

Region 14 ESC will evaluate proposals in accordance with, and subject to, the relevant statutes, ordinances, rules, and regulations that govern its procurement practices. NCPA will assist Region 14 ESC in evaluating proposals. Award(s) will be made to the prospective vendor(s) whose response is determined to be the most advantageous to Region 14 ESC, NCPA, and its participating agencies. To qualify for evaluation, response must have been submitted on time, and satisfy all mandatory requirements identified in this document.

- Contract Administration
  - The contract will be administered by Region 14 ESC. The National Program will be administered by NCPA on behalf of Region 14 ESC.
- Contract Term
  - The contract term will be for one (1) year starting from the date of the award. The contract may be renewed for up to two (4) additional one-year terms or any combination of time equally not more than 4 years.
  - It should be noted that maintenance/service agreements may be issued for up to (5) years under this contract even if the contract only lasts for the initial term of the contract. NCPA will monitor any maintenance agreements for the term of the agreement provided they are signed prior to the termination or expiration of this contract.
- Contract Waiver
  - Any waiver of any provision of this contract shall be in writing and shall be signed by the duly authorized agent of Region 14 ESC. The waiver by either party of any term or condition of this contract shall not be deemed to constitute waiver thereof nor a waiver of any further or additional right that such party may hold under this contract.
- Products and Services additions
  - Products and Services may be added to the resulting contract during the term of the contract by written amendment, to the extent that those products and services are within the scope of this RFP and has written approval of NCPA and Region 14 ESC.
- Competitive Range
  - It may be necessary for Region 14 ESC to establish a competitive range. Responses not in the competitive range are unacceptable and do not receive further award consideration.
- Deviations and Exceptions
  - Deviations or exceptions stipulated in response may result in disqualification. It is the intent of Region 14 ESC to award a vendor's complete line of products and/or services, when possible.
- Estimated Quantities
  - The estimated dollar volume of Products and Services purchased under the proposed Master Agreement is $100 million dollars annually. This estimate is based on the anticipated volume of Region 14 ESC and current sales within the NCPA program. There is no guarantee or commitment of any kind regarding usage of any contracts resulting from this solicitation

- Evaluation
  - Region 14 ESC will review and evaluate all responses in accordance with, and subject to, the relevant statutes, ordinances, rules and regulations that govern its procurement practices. NCPA will assist the lead agency in evaluating proposals. Recommendations for contract awards will be based on multiple factors, each factor being assigned a point value based on its importance.
- Formation of Contract
  - A response to this solicitation is an offer to contract with Region 14 ESC based upon the terms, conditions, scope of work, and specifications contained in this request. A solicitation does not become a contract until it is accepted by Region 14 ESC. The prospective vendor must submit a signed Signature Form with the response thus, eliminating the need for a formal signing process.
- NCPA Administrative Agreement
  - The vendor will be required to enter and execute the National Cooperative Purchasing Alliance Administration Agreement with NCPA upon award with Region 14 ESC. The agreement establishes the requirements of the vendor with respect to a nationwide contract effort.
- Clarifications / Discussions
  - Region 14 ESC may request additional information or clarification from any of the respondents after review of the proposals received for the sole purpose of elimination minor irregularities, informalities, or apparent clerical mistakes in the proposal. Clarification does not give respondent an opportunity to revise or modify its proposal, except to the extent that correction of apparent clerical mistakes results in a revision. After the initial receipt of proposals, Region 14 ESC reserves the right to conduct discussions with those respondent's whose proposals are determined to be reasonably susceptible of being selected for award. Discussions occur when oral or written communications between Region 14 ESC and respondents are conducted for the purpose clarifications involving information essential for determining the acceptability of a proposal or that provides respondent an opportunity to revise or modify its proposal. Region 14 ESC will not assist respondent bring its proposal up to the level of other proposals through discussions. Region 14 ESC will not indicate to respondent a cost or price that it must meet to neither obtain further consideration nor will it provide any information about other respondents' proposals or prices.
- Multiple Awards
  - Multiple Contracts may be awarded as a result of the solicitation. Multiple Awards will ensure that any ensuing contracts fulfill current and future requirements of the diverse and large number of participating public agencies.
- Past Performance
  - Past performance is relevant information regarding a vendor's actions under previously awarded contracts; including the administrative aspects of performance; the vendor's history of reasonable and cooperative behavior and commitment to customer satisfaction; and generally, the vendor's businesslike concern for the interests of the customer.

Evaluation Criteria

- Product & Services/Pricing (40 points)
  - Respondent(s)' products and services (e.g.; quality and breadth of product(s)/service(s), description(s) quality, reputation in the marketplace, average on time delivery rate and historical shipping timelines, return and restocking policies and applicable fees, average Fill Rate, shipping charges and other)
  - Competitive Level of Pricing for vendor's available products and services
  - Warranties on Respondent(s)' products and services (e.g.; availability of standard/extended warranties, pricing, detailed descriptions, ease of process and others)
  - Evidence of the ability of Respondent(s)' products and services to save members time and money (e.g.; breadth of service departments, technological advances, personnel experience, product(s) efficiencies, and others)
  - Other factors relevant to this section as submitted by the responder(s)

- Ability to Provide and Perform the Required Services for the Contract (25 points)
  - Response to emergency orders & service (e.g.; response time, breadth of service coverage, strength of meeting service and warranty needs of members)
  - Customer service/problem resolution (e.g.; technical abilities of service personnel; quality of processes,)
  - Invoicing process (e.g.; ease of use; transparency, billing resolutions)
  - Respondent(s)' processes, and quality of organizational structure
  - Contract implementation/Customer transition
  - Financial condition of vendor
  - Offeror's safety record (e.g.; benchmarks, lost hours, reporting)
  - Instructional materials and training (e.g.; administrative documentation, internal technical training, training of agencies)
  - Other factors relevant to this section as submitted by the proposer

- References (10 points)
  - A minimum of ten (10) customer references for product and/or services of similar scope dating within past 3 years

- Qualification and Experience (15 points)
  - Respondent(s)' reputation in the marketplace
  - Past relationship with Region 14 ESC and/or NCPA members
  - Experience with cooperative selling (e.g.; number of other cooperatives, Exhibited understanding of cooperative purchasing)
  - Experience and qualification of key employees
  - Location and number of sales persons who will work on this contract
  - Marketing plan and capability
  - Past experience working with the government sector
  - Past litigation, bankruptcy, reorganization, state investigations of entity or current officers and directors

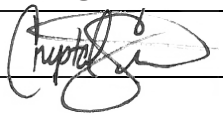
- Completeness of response (e.g.; filled out all sections, answered all questions, provided pricing)
- Other factors relevant to this section as submitted by the proposer

- Value Added Services Description, Products and/or Services (10 points)
  - Marketing and agency Training
  - Customer Service
  - Sales force training (e.g.; internal training plan, corporate officer involvement, orientation commitment)
  - Marketing plan and capability (e.g.; contract rollout plan, benchmarks, goals)
  - Green initiative(s) (e.g.; philosophy, certificates, awards)
  - Quality and breadth of value add(s)
  - Other factors relevant to this section as submitted by the proposer

Signature Form

The undersigned hereby proposes and agrees to furnish goods and/or services in strict compliance with the terms, specifications and conditions at the prices proposed within response unless noted in writing. The undersigned further certifies that he/she is an officer of the company and has authority to negotiate and bind the company named below and has not prepared this bid in collusion with any other Respondent and that the contents of this proposal as to prices, terms or conditions of said bid have not been communicated by the undersigned nor by any employee or agent to any person engaged in this type of business prior to the official opening of this proposal.

Prices are guaranteed: **120 days**

Company name	TDIndustries, Inc.
Address	9525 Derrington Road
City/State/Zip	Houston, TX 7706
Telephone No.	713.939.1986
Fax No.	N/A
Email address	crystal.seiler@tdindustries.com
Printed name	Crystal Seiler
Position with company	Manager, PST
Authorized signature	

TAB 2 – NCPA ADMINISTRATION AGREEMENT

TAB 2 CONTENTS:

Tab 2 – NCPA Administration Agreement

This Administration Agreement is made as of August 24, 2020, by and between National Cooperative Purchasing Alliance ("NCPA") and TDIndustries, Inc. ("Vendor").

Recitals

WHEREAS, Region 14 ESC has entered into a certain Master Agreement dated August 24, 2020, referenced as Contract Number 02-92, by and between Region 14 ESC and Vendor, as may be amended from time to time in accordance with the terms thereof (the "Master Agreement"), for the purchase of HVAC Equipment, Installation, Service, & Related Products;

WHEREAS, said Master Agreement provides that any state, city, special district, local government, school district, private K-12 school, technical or vocational school, higher education institution, other government agency or nonprofit organization (hereinafter referred to as "public agency" or collectively, "public agencies") may purchase products and services at the prices indicated in the Master Agreement;

WHEREAS, NCPA has the administrative and legal capacity to administer purchases under the Master Agreement to public agencies;

WHEREAS, NCPA serves as the administrative agent for Region 14 ESC in connection with other master agreements offered by NCPA

WHEREAS, Region 14 ESC desires NCPA to proceed with administration of the Master Agreement;

WHEREAS, NCPA and Vendor desire to enter into this Agreement to make available the Master Agreement to public agencies on a national basis;

NOW, THEREFORE, in consideration of the payments to be made hereunder and the mutual covenants contained in this Agreement, NCPA and Vendor hereby agree as follows:

- General Terms and Conditions
  - The Master Agreement, attached hereto as Tab 1 and incorporated herein by reference as though fully set forth herein, and the terms and conditions contained therein shall apply to this Agreement except as expressly changed or modified by this Agreement.
  - NCPA shall be afforded all of the rights, privileges and indemnifications afforded to Region 14 ESC under the Master Agreement, and such rights, privileges and indemnifications shall accrue and apply with equal effect to NCPA under this Agreement including, but not limited to, the Vendor's obligation to provide appropriate insurance and certain indemnifications to Region 14 ESC.
  - Vendor shall perform all duties, responsibilities and obligations required under the Master Agreement in the time and manner specified by the Master Agreement.
  - NCPA shall perform all of its duties, responsibilities, and obligations as administrator of purchases under the Master Agreement as set forth herein, and Vendor acknowledges that NCPA shall act in the capacity of administrator of purchases under the Master Agreement.
  - With respect to any purchases made by Region 14 ESC or any Public Agency pursuant to the Master Agreement, NCPA (a) shall not be construed as a dealer, re-marketer, representative, partner, or agent of any type of Vendor, Region 14 ESC, or such Public Agency, (b) shall not be obligated, liable or responsible (i) for any orders made by Region

14 ESC, any Public Agency or any employee of Region 14 ESC or Public Agency under the Master Agreement, or (ii) for any payments required to be made with respect to such order, and (c) shall not be obligated, liable or responsible for any failure by the Public Agency to (i) comply with procedures or requirements of applicable law, or (ii) obtain the due authorization and approval necessary to purchase under the Master Agreement. NCPA makes no representations or guaranties with respect to any minimum purchases required to be made by Region 14 ESC, any Public Agency, or any employee of Region 14 ESC or Public Agency under this Agreement or the Master Agreement.

- The Public Agency participating in the NCPA contract and Vendor may enter into a separate supplemental agreement to further define the level of service requirements over and above the minimum defined in this contract i.e. invoice requirements, ordering requirements, specialized delivery, etc. Any supplemental agreement developed as a result of this contract is exclusively between the Public Agency and Vendor. NCPA, its agents, members and employees shall not be made party to any claim for breach of such agreement.

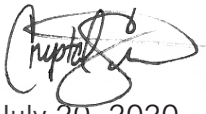
- Term of Agreement
  - This Agreement shall be in effect so long as the Master Agreement remains in effect, provided, however, that the obligation to pay all amounts owed by Vendor to NCPA through the termination of this Agreement and all indemnifications afforded by Vendor to NCPA shall survive the term of this Agreement.

- Fees and Reporting
  - The awarded vendor shall electronically provide NCPA with a detailed monthly or quarterly report showing the dollar volume of all sales under the contract for the previous month or quarter. Reports shall be sent via e-mail to NCPA offices at reporting@ncpa.us. Reports are due on the fifteenth (15th) day after the close of the previous month or quarter. It is the responsibility of the awarded vendor to collect and compile all sales under the contract from participating members and submit one (1) report. The report shall include at least the following information as listed in the example below:

Agency Name	State	Zip Code	Date	PO Number	RQN Number	Sale Amount	Admin Fee (3%)
					Total		

  - Each month NCPA will invoice the vendor based on the total of sale amount(s) reported. From the invoice the vendor shall pay to NCPA three (3%) administrative fee on the amount of the agency's purchase order less any applicable sales tax and Performance and/or Payment bond cost. Vendor's annual sales shall be measured on a calendar year basis. Deadline for term of payment will be included in the invoice NCPA provides.
  - Supplier shall maintain an accounting of all purchases made by Public Agencies under the Master Agreement. NCPA and Region 14 ESC reserve the right to audit the accounting for a period of five (5) years from the date NCPA receives the accounting. In the event of such an audit, the requested materials shall be provided at the location designated by Region 14 ESC or NCPA. In the event such audit reveals an underreporting of Contract Sales and a resulting underpayment of administrative fees, Vendor shall promptly pay NCPA the amount of such underpayment, together with interest on such amount and shall be obligated to reimburse NCPA's costs and expenses for such audit.

- General Provisions
  - This Agreement supersedes any and all other agreements, either oral or in writing, between the parties hereto with respect to the subject matter hereof, and no other agreement, statement, or promise relating to the subject matter of this Agreement which is not contained herein shall be valid or binding.
  - Awarded vendor agrees to allow NCPA to use their name and logo within website, marketing materials and advertisement. Any use of NCPA name and logo or any form of publicity regarding this contract by awarded vendor must have prior approval from NCPA.
  - If any action at law or in equity is brought to enforce or interpret the provisions of this Agreement or to recover any administrative fee and accrued interest, the prevailing party shall be entitled to reasonable attorney's fees and costs in addition to any other relief to which such party may be entitled.
  - Neither this Agreement nor any rights or obligations hereunder shall be assignable by Vendor without prior written consent of NCPA, provided, however, that the Vendor may, without such written consent, assign this Agreement and its rights and delegate its obligations hereunder in connection with the transfer or sale of all or substantially all of its assets or business related to this Agreement, or in the event of its merger, consolidation, change in control or similar transaction. Any permitted assignee shall assume all assigned obligations of its assignor under this Agreement.
  - This Agreement and NCPA's rights and obligations hereunder may be assigned at NCPA's sole discretion, to an existing or newly established legal entity that has the authority and capacity to perform NCPA's obligations hereunder
  - All written communications given hereunder shall be delivered to the addresses as set forth below.

National Cooperative Purchasing Alliance:		**Vendor:**	TDIndustries, Inc.
Name:	Matthew Mackel	Name:	Crystal Seiler
Title:	Director, Business Development	Title:	Manager, PST
Address:	PO Box 701273	Address:	9525 Derrington Road
	Houston, TX 77270		Houston, TX 7706
Signature:		Signature:	
Date:	August 24, 2020	Date:	July 20, 2020

NCPA Registered Vendor Quotation Number

RFP responders are requested to agree to a quotation number registration program to provide consistency and faster service for our facility awarded vendors, agency members and participants. The process will require Facility Contract holders to register and receive a NCPA Vendor Registered Quotation Number that must be prominently displayed on each proposal(s) that you present to the agencies. The system will track Facility transactions from the initial proposal stage to the completion of each project. NCPA has assembled an experienced Facilities Management Team that stands ready and willing to assist its vendors in providing quality services to the awarded vendor's organization. Failure to receive the Vendor Registered Quotation Number can result in potential delays to your services and the only acceptable proposals need to have a NCPA Vendor Registered Quotation Number.

NCPA Registered Vendor Quotation Number Process

Fill out the form on the Facilities page at www.NCPA.us

(Direct link is **http://www.ncpa.us/Facilities/Register)**

*** Fill out and submit.**

- All registered vendor quotation number requests must be submitted ***and*** a proposal number received ***before*** you present it to your potential customer.
- You will have a response with a NCPA Vendor Registered Quotation Number within 4 hours.
- If you have an emergency and need a quotation number sooner, call any member of the Facility Management team and we will help you.
- Include the quotation number on all proposals.

This document acknowledges that you have received and agree to the details, directions and expectations of the NCPA Vendor Registered Quotation Number process.

Date July 20, 2020

RFP Number RFP #17-20

Company Name TDIndustries, Inc.

Printed Name Crystal Seiler

Signature 

TAB 3 - VENDOR QUESTIONNAIRE

TAB 3 CONTENTS:

Tab 3 – Vendor Questionnaire

Please provide responses to the following questions that address your company's operations, organization, structure, and processes for providing products and services.

- States Covered
  - Bidder must indicate any and all states where products and services can be offered.
  - Please indicate the price co-efficient for each state if it varies.

☐ **50 States & District of Columbia** (Selecting this box is equal to checking all boxes below)

☐ Alabama	☐ Maryland	☐ South Carolina
☐ Alaska	☐ Massachusetts	☐ South Dakota
☒ Arizona	☐ Michigan	☐ Tennessee
☐ Arkansas	☐ Minnesota	☒ Texas
☐ California	☐ Mississippi	☐ Utah
☐ Colorado	☐ Missouri	☐ Vermont
☐ Connecticut	☐ Montana	☐ Virginia
☐ Delaware	☐ Nebraska	☐ Washington
☐ District of Columbia	☐ Nevada	☐ West Virginia
☐ Florida	☐ New Hampshire	☐ Wisconsin
☐ Georgia	☐ New Jersey	☐ Wyoming
☐ Hawaii	☐ New Mexico	
☐ Idaho	☐ New York	
☐ Illinois	☐ North Carolina	
☐ Indiana	☐ North Dakota	
☐ Iowa	☐ Ohio	
☐ Kansas	☐ Oklahoma	
☐ Kentucky	☐ Oregon	
☐ Louisiana	☐ Pennsylvania	
☐ Maine	☐ Rhode Island	

☐ **All US Territories and Outlying Areas** (Selecting this box is equal to checking all boxes below)

☐ American Samoa	☐ Northern Marina Islands
☐ Federated States of Micronesia	☐ Puerto Rico
☐ Guam	☐ U.S. Virgin Islands
☐ Midway Islands	

- Minority and Women Business Enterprise (MWBE) and (HUB) Participation
  - It is the policy of some entities participating in NCPA to involve minority and women business enterprises (MWBE) and historically underutilized businesses (HUB) in the purchase of goods and services. Respondents shall indicate below whether or not they are an M/WBE or HUB certified.
    - Minority / Women Business Enterprise
      - Respondent Certifies that this firm is a M/WBE ☐
    - Historically Underutilized Business
      - Respondent Certifies that this firm is a HUB ☐
- Residency
  - Responding Company's principal place of business is in the city of Dallas , State of Texas
- Felony Conviction Notice
  - Please Check Applicable Box;
    - ☐ A publically held corporation; therefore, this reporting requirement is not applicable.
    - ☒ Is not owned or operated by anyone who has been convicted of a felony.
    - ☐ Is owned or operated by the following individual(s) who has/have been convicted of a felony
  - If the 3rd box is checked, a detailed explanation of the names and convictions must be attached.
- Distribution Channel
  - Which best describes your company's position in the distribution channel:

☐ Manufacturer Direct	☐ Certified education/government reseller
☐ Authorized Distributor	☐ Manufacturer marketing through reseller
☒ Value-added reseller	☒ Other: Service Provider

- Processing Information
  - Provide company contact information for the following:
    - Sales Reports / Accounts Payable

Contact Person: Lorraine Vuong
Title: Cooperative Contracts Coordinator
Company: TDIndustries, Inc.
Address: 9525 Derrington Road
City: Houston State: Texas Zip: 77064
Phone: 713.996.2437 Email: lorraine.vuong@tdindustries.com

- Purchase Orders

  Contact Person: Lorraine Vuong
  Title: Cooperative Contracts Coordinator
  Company: TDIndustries, Inc.
  Address: 9525 Derrington Road
  City: Houston State: Texas Zip: 77064
  Phone: 713.996.2437 Email: lorraine.vuong@tdindustries.com

- Sales and Marketing

  Contact Person: Lorraine Vuong
  Title: Cooperative Contracts Coordinator
  Company: TDIndustries, Inc.
  Address: 9525 Derrington Road
  City: Houston State: Texas Zip: 77064
  Phone: 713.996.2437 Email: lorraine.vuong@tdindustries.com

- Pricing Information
  - In addition to the current typical unit pricing furnished herein, the Vendor agrees to offer all future product introductions at prices that are proportionate to Contract Pricing.
    - If answer is no, attach a statement detailing how pricing for NCPA participants would be calculated for future product introductions.

    [X] Yes [ ] No
  - Pricing submitted includes the required NCPA administrative fee. The NCPA fee is calculated based on the invoice price to the customer.

    [X] Yes [ ] No
  - Vendor will provide additional discounts for purchase of a guaranteed quantity.

    [ ] Yes [X] No

TAB 4 - VENDOR PROFILE

TAB 4 CONTENTS:

VENDOR PROFILE

VENDOR PROFILE

1. Company's official registered name.

TDIndustries, Inc.

2. Brief history of your company, including the year it was established.

TDIndustries - A Partnership of the Spirit

Established in 1946, TDIndustries has developed into one of America's premier facilities service and specialty construction companies. We are among the top 60 specialty Environmental / Mechanical/ Plumbing and Service companies in the United States and among the top 3 in Texas.

By creating a partnership with you, our customers, we are able to fulfill all your indoor environment needs through our diverse mix of life-cycle services and value-based solutions. TDIndustries is also among the most experienced facility construction companies in Texas. We know how to stage a project in an occupied building/campus setting, plan and implement the work with minimal disruption to the business at hand. In addition, our large pool of experienced technicians and installers gives TDIndustries the ability to deliver large-scale construction projects all at once on multiple campuses or at individual locations.

TDIndustries customers and employees work to fulfill our mission: We are committed to providing outstanding career opportunities by exceeding our customers' expectations through continuous aggressive improvement.

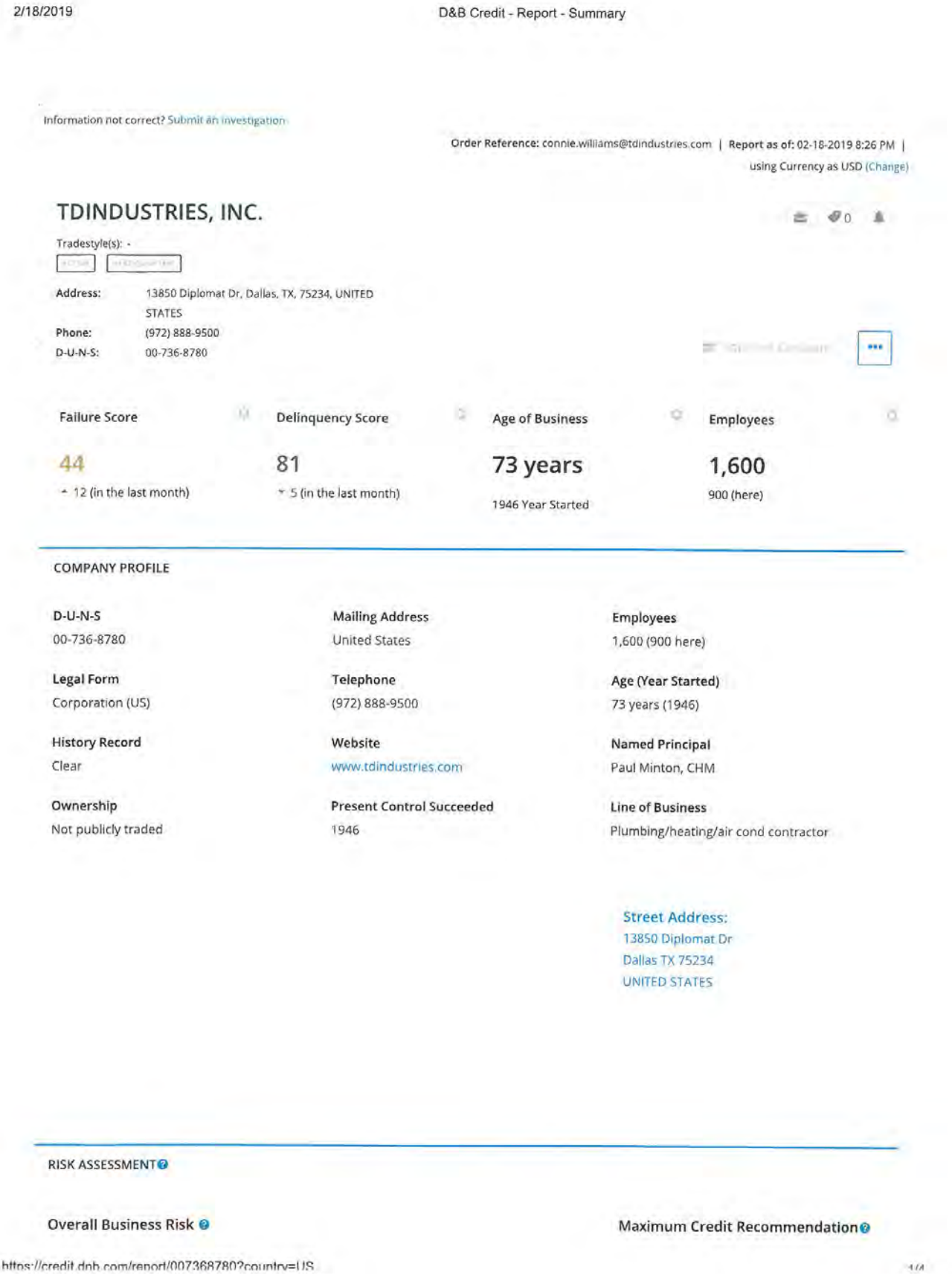
In-House Capabilities and Services – Our goal is to help you make the most of your investment in a facility. TDIndustries capably provides self-performed construction, installation, service and operations for the following systems that serve Government Entities existing facilities or ground-up construction projects.

- Energy Savings Performance and Management Solutions
- Facilities Maintenance and Operations / Facilities Management Services
- Building Automation Systems / Systems Integration Services
- Heating, Ventilation and Air Conditioning
- Plumbing / Electrical / Refrigeration
- Process and High Purity Piping
- Life Safety Systems
- Site-based Facilities Management Services

We believe that having more in-house capabilities than our traditional competitors adds tremendous benefit to Government Entities.

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.



2/18/2019 D&B Credit - Report - Summary

Information not correct? Submit an investigation

Order Reference: connie.williams@tdindustries.com | Report as of: 02-18-2019 8:26 PM | using Currency as USD (Change)

TDINDUSTRIES, INC.

Tradestyle(s): -

Address: 13850 Diplomat Dr, Dallas, TX, 75234, UNITED STATES
Phone: (972) 888-9500
D-U-N-S: 00-736-8780

Failure Score	Delinquency Score	Age of Business	Employees
44	81	73 years	1,600
▲ 12 (in the last month)	▼ 5 (in the last month)	1946 Year Started	900 (here)

COMPANY PROFILE

D-U-N-S 00-736-8780	**Mailing Address** United States	**Employees** 1,600 (900 here)
Legal Form Corporation (US)	**Telephone** (972) 888-9500	**Age (Year Started)** 73 years (1946)
History Record Clear	**Website** www.tdindustries.com	**Named Principal** Paul Minton, CHM
Ownership Not publicly traded	**Present Control Succeeded** 1946	**Line of Business** Plumbing/heating/air cond contractor

Street Address:
13850 Diplomat Dr
Dallas TX 75234
UNITED STATES

RISK ASSESSMENT

Overall Business Risk

Maximum Credit Recommendation

https://credit.dnb.com/report/007368780?country=US

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

2/18/2019 D&B Credit - Report - Summary

LOW | LOW-MODERATE | MODERATE | MODERATE-HIGH | HIGH

Dun & Bradstreet Thinks...

- Overall assessment of this organization over the next 12 months: **STABLE CONDITION**
- Based on the predicted risk of business discontinuation: **LIKELIHOOD OF CONTINUED OPERATIONS**
- Based on the predicted risk of severely delinquent payments: **LOW POTENTIAL FOR SEVERELY DELINQUENT PAYMENTS**

USA 2,650,000

The recommended limit is based on a moderately low probability of severe delinquency.

D&B Viability Rating

Portfolio Comparison Score

2

Low Risk (1) High Risk (9)

Company's risk level is: Low

Probability that a company will go out of business, become dormant/inactive, or file for bankruptcy/insolvency within the next 12 months: **3.00 %**

Failure Score Formerly Financial Stress Score

44

Low Risk (100) High Risk (1)

Company's risk level is: LOW-MODERATE

Probability of failure over the next 12 months: **0.27 %**

Past 12 Months

Delinquency Score Formerly Commercial Credit Score

81

Low Risk (100) High Risk (1)

Company's risk level is: LOW-MODERATE

Probability of delinquency over the next 12 months: **2.47 %**

Past 12 Months

PAYDEX ®

79

Low Risk (100) High Risk (0)

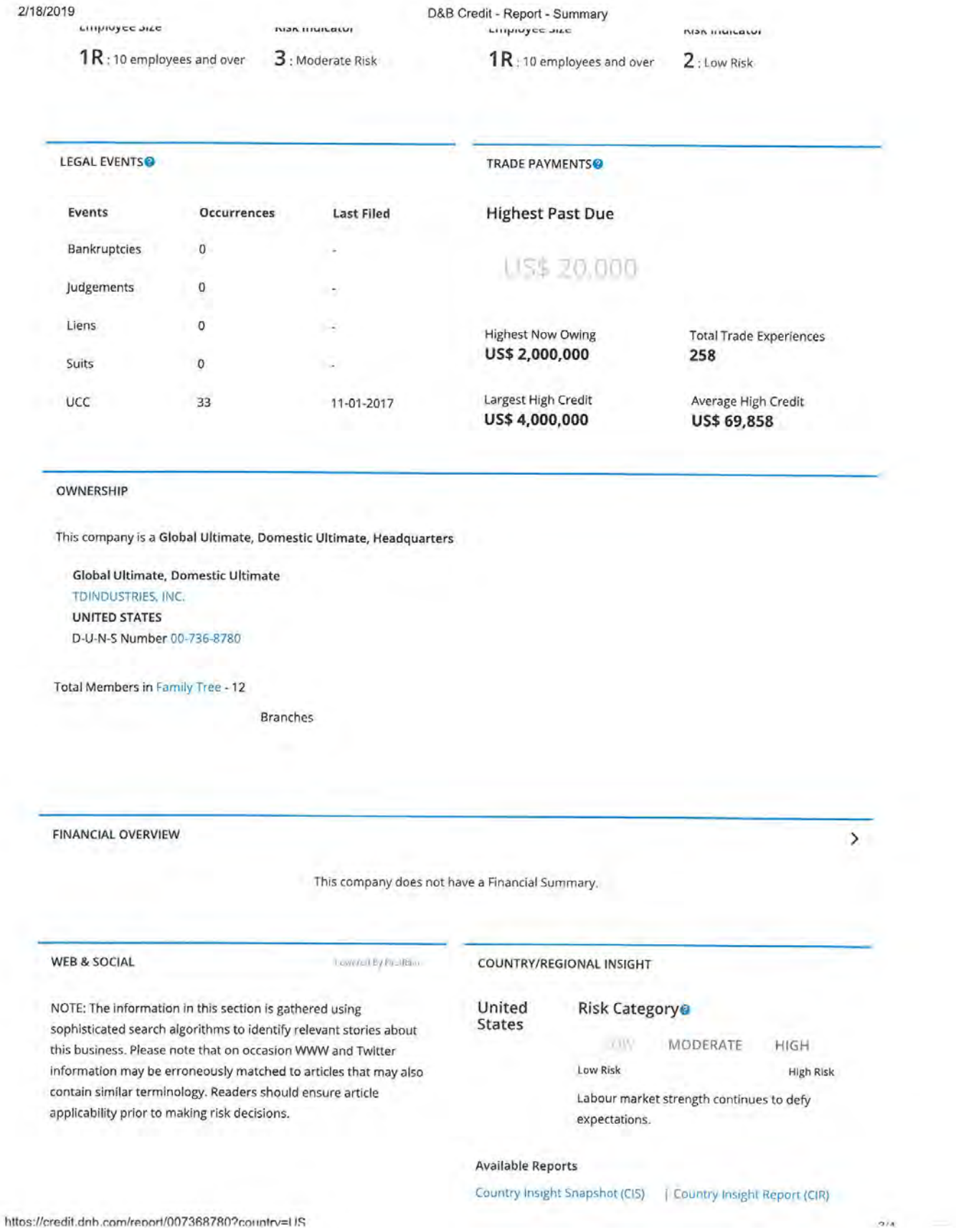
Days Beyond Terms : **2**

Past 24 Months

D&B Rating

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.



2/18/2019 D&B Credit - Report - Summary

1R : 10 employees and over — 3 : Moderate Risk

1R : 10 employees and over — 2 : Low Risk

LEGAL EVENTS

Events	Occurrences	Last Filed
Bankruptcies	0	-
Judgements	0	-
Liens	0	-
Suits	0	-
UCC	33	11-01-2017

TRADE PAYMENTS

Highest Past Due

US$ 20,000

Highest Now Owing
US$ 2,000,000

Total Trade Experiences
258

Largest High Credit
US$ 4,000,000

Average High Credit
US$ 69,858

OWNERSHIP

This company is a **Global Ultimate, Domestic Ultimate, Headquarters**

Global Ultimate, Domestic Ultimate
TDINDUSTRIES, INC.
UNITED STATES
D-U-N-S Number 00-736-8780

Total Members in Family Tree - 12

Branches

FINANCIAL OVERVIEW

This company does not have a Financial Summary.

WEB & SOCIAL

NOTE: The information in this section is gathered using sophisticated search algorithms to identify relevant stories about this business. Please note that on occasion WWW and Twitter information may be erroneously matched to articles that may also contain similar terminology. Readers should ensure article applicability prior to making risk decisions.

COUNTRY/REGIONAL INSIGHT

United States

Risk Category

LOW MODERATE HIGH

Low Risk High Risk

Labour market strength continues to defy expectations.

Available Reports

Country Insight Snapshot (CIS) | Country Insight Report (CIR)

https://credit.dnb.com/report/007368780?country=US

TDIndustries

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Texas & Louisiana People: Construction business updates for February 2019 ENR 05-Feb-2019

Satori Capital Invests in Able Machinery Movers Business Wire 11-Jan-2019

TDIndustries Promotes Sheri Tillman to General Counsel CONTRACTOR Magazine 18-Dec-2018

Pace of Work Holds Steady for Region's Subcontractors ENR 12-Dec-2018

Silicon Valley?s Radical New Idea: Treat Employees Well AFKInsider 07-Dec-2018

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

2/18/2019 D&B Credit - Report - Risk Assessment

TDINDUSTRIES, INC.
Tradestyle(s): -

Risk Assessment

D&B RISK ASSESSMENT

Overall Business Risk

LOW | MODERATE | MODERATE-HIGH | HIGH

Maximum Credit Recommendation

US$ 3,650,000

Dun & Bradstreet Thinks...

- Overall assessment of this organization over the next 12 months: **STABLE CONDITION**
- Based on the predicted risk of business discontinuation: **LIKELIHOOD OF CONTINUED OPERATIONS**
- Based on the predicted risk of severely delinquent payments: **LOW POTENTIAL FOR SEVERELY DELINQUENT PAYMENTS**

The recommended limit is based on a moderately low probability of severe delinquency.

D&B VIABILITY RATING

Portfolio Comparison Score

Low Risk (1) — High Risk (9)

Rating Confidence Level

Robust Predictions | Decision Support | Directional | Basic

Data Depth

- Rich Firmographics
- Extensive Commercial Trading Activity
- Basic Financial Attributes

Level of Risk	Probability of becoming no longer viable	Percentage of businesses ranked with this score	Average probability of becoming no longer viable
Low	3.00%	16.00%	5.00%

FAILURE SCORE Formerly Financial Stress Score

Low Risk (100) — High Risk (1)

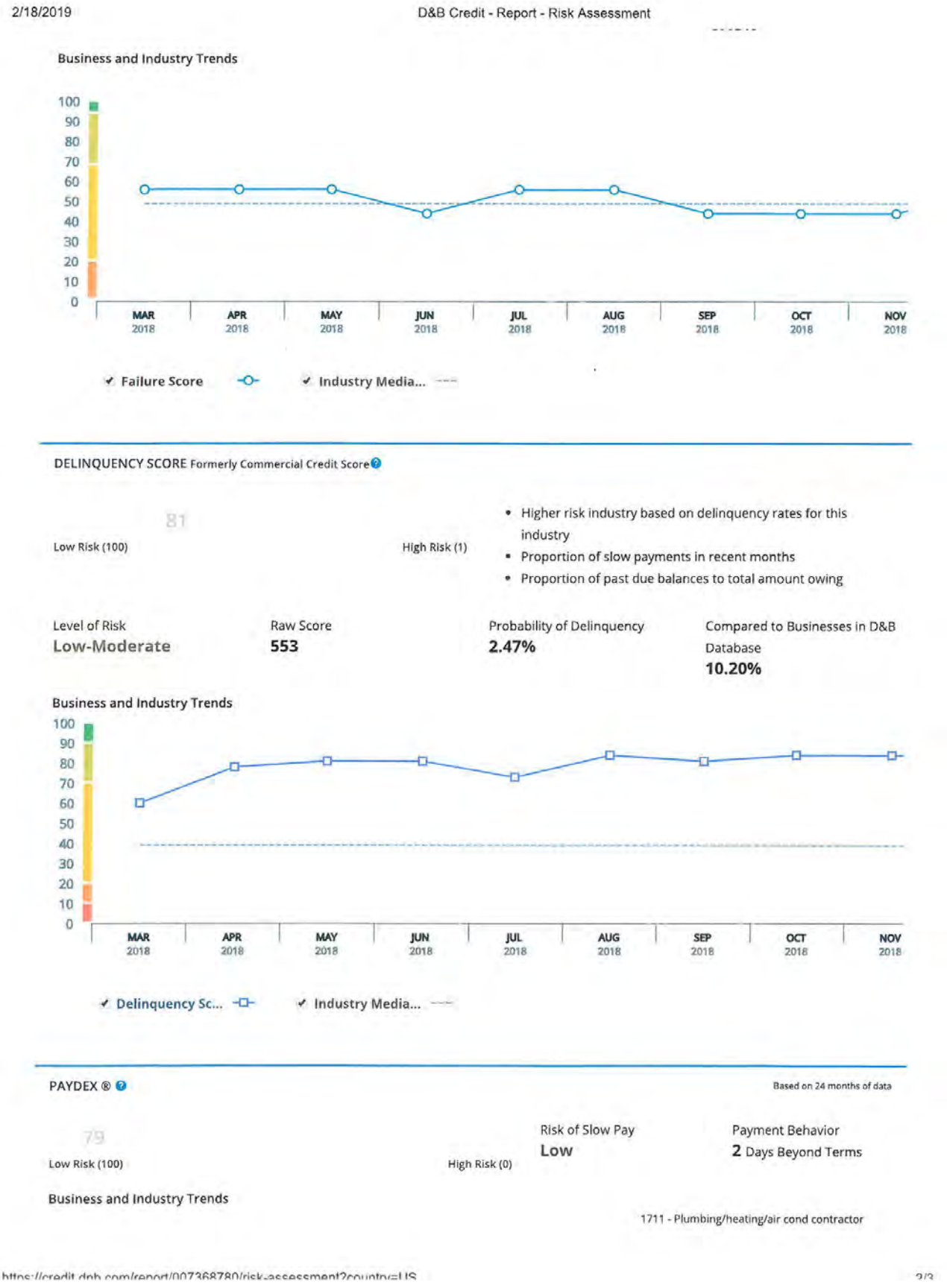
- Low proportion of satisfactory payment experiences to total payment experiences
- UCC Filings reported
- High proportion of slow payment experiences to total number of payment experiences
- High number of enquiries to D&B over last 12 months

Level of Risk	Raw Score	Probability of Failure	Average Probability of Failure for Businesses in D&B Database
Moderate	1470	0.27%	0.48%

https://credit.dnb.com/report/007368780/risk-assessment?country=US

VENDOR PROFILE

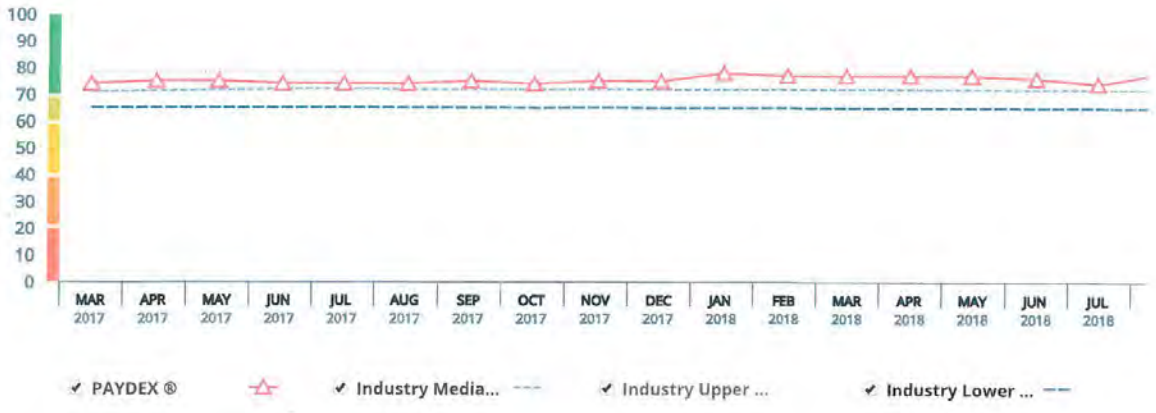
3. Company's Dun & Bradstreet (D&B) number.



VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

2/18/2019 D&B Credit - Report - Risk Assessment



D&B RATING

Current Rating as of 04-26-2016		Previous Rating	
Employee Size	**Risk Indicator**	**Employee Size**	**Risk Indicator**
1R : 10 employees and over	3 : Moderate Risk	1R : 10 employees and over	2 : Low Risk

https://credit.dnb.com/report/007368780/risk-assessment?country=US 2/2

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

TDINDUSTRIES, INC.

Tradestyle(s): -

Trade Payments

TRADE PAYMENTS SUMMARY (Based on 24 months of data)

Overall Payment Behavior	% of Trade Within Terms	Highest Past Due
2 Days Beyond Terms	72%	US$ 20,000

Highest Now Owing:
US$ 2,000,000

Total Trade Experiences:
258
Largest High Credit: US$ 4,000,000
Average High Credit: US$ 69,858

Total Unfavorable Comments:
0
Largest High Credit: US$ 0

Total Placed in Collections:
1
Largest High Credit: US$ 0

TRADE PAYMENTS BY CREDIT EXTENDED (Based on 12 months of data)

Range of Credit Extended (US$)	Number of Payment Experiences	Total Value	% Within Terms
100,000 & over	19	US$ 12,650,000	98
50,000 - 99,999	10	US$ 640,000	92
15,000 - 49,999	34	US$ 890,000	83
5,000 - 14,999	32	US$ 227,500	78
1,000 - 4,999	56	US$ 102,500	65
Less than 1,000	57	US$ 20,500	61

TRADE PAYMENTS BY INDUSTRY (Based on 24 months of data)

Collapse All | Expand All

Industry Category	Number of Payment Experiences	Largest High Credit (US$)	% Within Terms (Expand to View)	1 - 30 Days Late (%)	31 - 60 Days Late (%)	61 - 90 Days Late (%)	91 + Days Late (%)
14 - Mining and Quarrying of Non-metallic Minerals except Fuels	1	35,000					

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

2/18/2019 D&B Credit - Report - Trade Payments

Industry Category	Number of Payment Experiences	Largest High Credit (US$)	% Within Terms (Expand to View)	1 - 30 Days Late (%)	31 - 60 Days Late (%)	61 - 90 Days Late (%)	91 + Days Late (%)
17 - Construction - Special Trade Contractors	6	1,000,000					
30 - Rubber and Miscellaneous Plastics Products	1	7,500					
35 - Industrial and Commercial Machinery and Computer Equipment	23	4,000,000					
36 - Electronic and other electrical equipment and components except computer equipment	7	500,000					
37 - Transportation Equipment	3	25,000					
38 - Measuring Analyzing and Controlling Instruments; Photographic Medical and Optical Goods; Watches and Clocks	2	10,000					
42 - Motor Freight Transportation and Warehousing	1	500					
47 - Transportation Services	1	1,000					
48 - Communications	12	95,000					
49 - Electric, Gas and Sanitary Services	1	250					
50 - Wholesale Trade - Durable Goods	62	1,000,000					
51 - Wholesale Trade - Nondurable Goods	9	20,000					
55 - Automotive Dealers and Gasoline Service Stations	1	15,000					
57 - Home Furniture Furnishings and Equipment Stores	1	1,000					
59 - Miscellaneous Retail	4	30,000					
60 - Depository Institutions	4	10,000					
61 - Nondepository Credit Institutions	7	25,000					
70 - Hotels Rooming Houses Camps and other Lodging Places	1	1,000					
72 - Personal Services	2	7,500					
73 - Business Services	18	60,000					
75 - Automotive Repair, Services and Parking	7	5,000					
87 - Engineering Accounting Research Management and Related Services	3	25,000					
93 - Public Finance Taxation and Monetary Policy	12	20,000					

https://credit.dnb.com/report/007368780/trade-payments?country=US 2/6

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Industry Category	Number of Payment Experiences	Largest High Credit (US$)	% Within Terms (Expand to View)	1 - 30 Days Late (0%)	31 - 60 Days Late (0%)	61 - 90 Days Late (0%)	91 + Days Late (0%)

TRADE LINES

Select Date Range

Date of Experience	Payment Status	Selling Terms	High Credit (US$)	Now Owes (US$)	Past Due (US$)	Months Since Last Sale
02/19	Pays Promptly	-	2,500	750	0	1
02/19	Pays Prompt to Slow 45+	-	2,500	0	0	Between 2 and 3 Months
01/19	payment-status-discount	-	2,500	50	50	Between 4 and 5 Months
01/19	Pays Promptly	-	1,000,000	0	0	1
01/19	Pays Promptly	-	1,000,000	1,000,000	0	1
01/19	Pays Promptly	-	600,000	600,000	0	1
01/19	Pays Promptly	-	400,000	250,000	0	1
01/19	Pays Promptly	-	200,000	0	0	1
01/19	Pays Promptly	-	100,000	10,000	0	1
01/19	Pays Promptly	-	75,000	10,000	0	1
01/19	Pays Promptly	-	55,000	5,000	0	1
01/19	Pays Promptly	-	45,000	5,000	0	1
01/19	Pays Promptly	N30	45,000	45,000	0	1
01/19	Pays Promptly	-	40,000	0	0	Between 6 and 12 Months
01/19	Pays Promptly	-	30,000	2,500	0	1
01/19	Pays Promptly	-	25,000	15,000	0	1
01/19	Pays Promptly	-	20,000	0	0	Between 6 and 12 Months
01/19	Pays Promptly	-	15,000	7,500	0	1
01/19	Pays Promptly	-	15,000	10,000	0	1
01/19	Pays Promptly	-	10,000	0	0	1
01/19	Pays Promptly	-	7,500	2,500	0	1
01/19	Pays Promptly	-	7,500	7,500	0	1
01/19	Pays Promptly	-	7,500	2,500	0	1
01/19	Pays Promptly	-	5,000	0	0	1

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

2/18/2019 D&B Credit - Report - Trade Payments

Date of Experience	Payment Status	Selling Terms	High Credit (US$)	Now Owes (US$)	Past Due (US$)	Months Since Last Sale
01/19	Pays Promptly	-	2,500	0	0	Between 6 and 12 Months
01/19	Pays Promptly	N30	2,500	2,500	0	1
01/19	Pays Promptly	-	2,500	1,000	0	1
01/19	Pays Promptly	-	2,500	250	0	1
01/19	Pays Promptly	-	2,500	2,500	0	1
01/19	Pays Promptly	-	2,500	2,500	100	1
01/19	Pays Promptly	N30	1,000	0	0	1
01/19	Pays Promptly	-	1,000	0	0	Between 6 and 12 Months
01/19	Pays Promptly	-	1,000	0	0	Between 2 and 3 Months
01/19	Pays Promptly	-	1,000	0	0	Between 4 and 5 Months
01/19	Pays Promptly	-	1,000	0	0	Between 6 and 12 Months
01/19	Pays Promptly	-	1,000	500	0	1
01/19	Pays Promptly	-	1,000	0	0	Between 6 and 12 Months
01/19	Pays Promptly	N30	1,000	0	0	Between 6 and 12 Months
01/19	Pays Promptly	-	1,000	500	0	1
01/19	Pays Promptly	-	1,000	750	0	1
01/19	Pays Promptly	-	750	750	0	1
01/19	Pays Promptly	N30	750	750	0	1
01/19	Pays Promptly	N90	500	50	0	1
01/19	Pays Promptly	-	500	0	0	Between 6 and 12 Months
01/19	Pays Promptly	-	500	0	0	Between 6 and 12 Months
01/19	Pays Promptly	PROX	500	50	0	1
01/19	Pays Promptly	-	500	0	0	Between 2 and 3 Months
01/19	Pays Promptly	-	500	50	0	1
01/19	Pays Promptly	-	250	0	0	Between 4 and 5 Months

https://credit.dnb.com/report/007368780/trade-payments?country=US 4/6

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Date of Experience	Payment Status	Selling Terms	High Credit (US$)	Now Owes (US$)	Past Due (US$)	Months Since Last Sale
01/19	Pays Promptly	-	50	0	0	Between 4 and 5 Months
01/19	Pays Prompt to Slow 15+	-	1,000	1,000	500	1
01/19	Pays Prompt to Slow 30+	-	250,000	0	0	Between 6 and 12 Months
01/19	Pays Prompt to Slow 30+	-	55,000	35,000	5,000	1
01/19	Pays Prompt to Slow 30+	-	25,000	0	0	1
01/19	Pays Prompt to Slow 30+	-	15,000	5,000	0	1
01/19	Pays Prompt to Slow 30+	-	5,000	5,000	1,000	1
01/19	Pays Prompt to Slow 30+	-	2,500	0	0	Between 2 and 3 Months
01/19	Pays Prompt to Slow 30+	-	1,000	750	100	1
01/19	Pays Prompt to Slow 30+	-	1,000	1,000	0	1
01/19	Pays Prompt to Slow 30+	-	750	0	0	1
01/19	Pays Prompt to Slow 30+	N30	750	0	0	Between 6 and 12 Months
01/19	Pays Prompt to Slow 60+	-	-	100	0	1
01/19	Pays Prompt to Slow 60+	-	2,500	0	0	Between 4 and 5 Months
01/19	Pays Prompt to Slow 90+	-	7,500	2,500	750	1
01/19	Pays Prompt to Slow 90+	-	2,500	500	500	Between 2 and 3 Months
01/19	Pays Prompt to Slow 90+	-	250	250	250	1
01/19	Pays Prompt to Slow 150+	N30	250	0	0	Between 2 and 3 Months
01/19	Pays Slow 30+	-	2,500	0	0	Between 6 and 12 Months
01/19	Pays Slow 30+	-	1,000	250	0	1
01/19	Pays Slow 30+	-	1,000	1,000	1,000	1
01/19	Pays Slow 30+	-	500	100	100	Between 2 and 3 Months

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

2/18/2019 D&B Credit - Report - Trade Payments

Date of Experience	Payment Status	Selling Terms	High Credit (US$)	Now Owes (US$)	Past Due (US$)	Months Since Last Sale
01/19	Pays Slow 90+	-	50	50	50	Between 2 and 3 Months
01/19	Pays Slow 120+	-	1,000	1,000	1,000	1
01/19	-	Cash account	0	0	0	Between 2 and 3 Months
12/18	Pays Slow 15+	-	5,000	5,000	5,000	1
12/18	Pays Slow 90+	-	1,000	750	0	1
12/18	Pays Slow 180+	-	50	0	0	Between 6 and 12 Months

https://credit.dnb.com/report/007368780/trade-payments?country=US

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

TDINDUSTRIES, INC.

Tradestyle(s): -

Legal Events

The following Public Filing data is for information purposes only and is not the official record. Certified copies can only be obtained from the official source.

Judgements	Liens	Suits	UCC Filings
0	0	0	33
Latest Filing: -	Latest Filing: -	Latest Filing: -	Latest Filing: 11-01-2017

EVENTS

All Event Types All Dates Reset

UCC Filing - Original

Filing Date	05-02-2017
Filing Number	170014892385
Received Date	05-09-2017
Collateral	Negotiable instruments and proceeds - Account(s) and proceeds - Timber and proceeds - Oil, gas and minerals and proceeds - and OTHERS
Secured Party	JPMORGAN CHASE BANK, N.A., DALLAS, TX
Debtors	TDINDUSTRIES, INC.
Filing Office	SECRETARY OF STATE/UCC DIVISION, AUSTIN, TX

UCC Filing - Original

Filing Date	05-01-2017
Filing Number	170014834644
Received Date	05-09-2017
Collateral	Account(s) and proceeds - Timber and proceeds - Oil, gas and minerals and proceeds - Fixtures and proceeds - and OTHERS
Secured Party	JPMORGAN CHASE BANK, N.A., DALLAS, TX

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Debtors	TDINDUSTRIES, INC.
Filing Office	SECRETARY OF STATE/UCC DIVISION, AUSTIN, TX

UCC Filing - Continuation

Filing Date	01-23-2017
Filing Number	20170480662
Received Date	03-10-2017
Original Filing Date	06-28-2007
Original Filing Number	2007 2469111
Secured Party	JPMORGAN CHASE BANK, N.A., LOUISVILLE, KY
Debtors	TD INDUSTRIES, INC.
Filing Office	SECRETARY OF STATE/UCC DIVISION, DOVER, DE

UCC Filing - Original

Filing Date	04-11-2016
Filing Number	160011444405
Received Date	04-19-2016
Collateral	Leased Building(s)
Secured Party	NORTEX MODULAR LEASING AND CONSTRUCTION COMPANY DBA BOXX MODULAR, LEWISVILLE, TX
Debtors	TD INDUSTRIES, FORT WORTH, TX
Filing Office	SECRETARY OF STATE/UCC DIVISION, AUSTIN, TX

UCC Filing - Continuation

Filing Date	03-09-2015
Filing Number	1500068550
Received Date	03-10-2015
Original Filing Date	08-31-2010
Original Filing Number	100025337112
Secured Party	JPMORGAN CHASE BANK, N.A., LOUISVILLE, KY
Debtors	TDINDUSTRIES, INC.

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Filing Office	SECRETARY OF STATE/UCC DIVISION, AUSTIN, TX

UCC Filing - Continuation

Filing Date	01-12-2012
Filing Number	2012 0161275
Received Date	02-24-2012
Original Filing Date	06-28-2007
Original Filing Number	2007 2469111
Secured Party	JPMORGAN CHASE BANK, N.A., LOUISVILLE, KY
Debtors	TD INDUSTRIES, INC.
Filing Office	SECRETARY OF STATE/UCC DIVISION, DOVER, DE

UCC Filing - Original

Filing Date	08-31-2010
Filing Number	100025337112
Received Date	09-07-2010
Collateral	Inventory and proceeds - Account(s) and proceeds - General intangibles(s) and proceeds - Equipment and proceeds - Chattel paper and proceeds
Secured Party	JPMORGAN CHASE BANK, N.A., LOUISVILLE, KY
Debtors	TDINDUSTRIES, INC.
Filing Office	SECRETARY OF STATE/UCC DIVISION, AUSTIN, TX

UCC Filing - Original

Filing Date	03-05-2010
Filing Number	100006401466
Received Date	03-19-2010
Collateral	Equipment and proceeds
Secured Party	UNITED RENTALS NORTHWEST, INC., IRVING, TX
Debtors	TDINDUSTRIES, INC.
Filing Office	SECRETARY OF STATE/UCC DIVISION, AUSTIN, TX

UCC Filing - Original

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Filing Date	06-28-2007
Filing Number	2007 2469111
Received Date	08-07-2007
Collateral	Inventory and proceeds - Account(s) and proceeds - General intangibles(s) and proceeds - Equipment and proceeds - Chattel paper and proceeds
Secured Party	JPMORGAN CHASE BANK, N.A., LOUISVILLE, KY
Debtors	TD INDUSTRIES, INC.
Filing Office	SECRETARY OF STATE/UCC DIVISION, DOVER, DE

UCC Filing - Original

Filing Date	02-02-2007
Filing Number	2007 0434851
Received Date	05-21-2007
Collateral	Equipment
Secured Party	TOYOTA MOTOR CREDIT CORPORATION, TORRANCE, CA
Debtors	TD INDUSTRIES LTD
Filing Office	SECRETARY OF STATE/UCC DIVISION, DOVER, DE

UCC Filing - Amendment

Filing Date	01-22-2007
Filing Number	2007 0260017
Received Date	02-26-2007
Original Filing Number	6457277 2
Secured Party	MOORE, TAMMY
Debtors	TD INDUSTRIES LTD
Filing Office	SECRETARY OF STATE/UCC DIVISION, DOVER, DE

UCC Filing - Original

Filing Date	12-29-2006
Filing Number	6457277 2
Received Date	01-25-2007

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Collateral	Equipment
Secured Party	TOYOTA MOTOR CREDIT CORPORATION, TORRANCE, CA
Debtors	TD INDUSTRIES MANAGEMENT LLC
Filing Office	SECRETARY OF STATE/UCC DIVISION, DOVER, DE

UCC Filing - Original

Filing Date	12-27-2006
Filing Number	6454506 7
Received Date	01-25-2007
Collateral	Equipment
Secured Party	TOYOTA MOTOR CREDIT CORPORATION, TORRANCE, CA
Debtors	TD INDUSTRIES LTD
Filing Office	SECRETARY OF STATE/UCC DIVISION, DOVER, DE

UCC Filing - Original

Filing Date	02-09-2006
Filing Number	060004515566
Received Date	02-24-2006
Collateral	Leased Computer equipment including proceeds and products - Leased Business machinery/equipment including proceeds and products - Leased Equipment including proceeds and products
Secured Party	KIP AMERICA, INC., JACKSONVILLE, FL
Debtors	TD INDUSTRIES MANAGEMENT LLC
Filing Office	SECRETARY OF STATE/UCC DIVISION, AUSTIN, TX

The public record items contained in this report may have been paid, terminated, vacated or released prior to the date this report was printed. This information may not be reproduced in whole or in part by any means of reproduction

There may be additional UCC Filings in D&B's file on this company available by contacting 1-800-234-3867.

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

TDINDUSTRIES, INC.
Tradestyle(s): -

Special Events

12-19-2016

The Chief Executive Officer is now Paul Minton, CHM.

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

TDINDUSTRIES, INC.

Tradestyle(s): -

Company Profile

COMPANY OVERVIEW

D-U-N-S 00-736-8780	**Mailing Address** United States	**Employees** 1,600 (900 here)
Legal Form Corporation (US)	**Telephone** (972) 888-9500	**Age (Year Started)** 73 years (1946)
History Record Clear	**Website** www.tdindustries.com	**Named Principal** Paul Minton, CHM
Ownership Not publicly traded	**Present Control Succeeded** 1946	**Line of Business** Plumbing/heating/air cond contractor

Street Address:
13850 Diplomat Dr
Dallas TX 75234
UNITED STATES

BUSINESS REGISTRATION

Corporate and business registrations reported by the secretary of state or other official source as of: -
This data is for informational purposes only, certification can only be obtained through the Office of the Secretary of State.

Registered Name	TDINDUSTRIES, INC.
Corporation Type	Corporation (US)
Business Commenced On	1946

PRINCIPALS

Officers

PAUL MINTON, CHM
HAROLD F. MACDOWELL, CEO

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

MAUREEN UNDERWOOD, EX V PRES
JASON CINEK,SR V PRES
MICHAEL J. KOTUBEY, PRES
ROD JOHANNSEN, V PRES
PHIL CLAYBROOKE, V PRES
BEN HOUSTON, DIR
MICHAEL J FITZPATRICK, CFO

Directors

DIRECTOR(S): THE OFFICER(S)

COMPANY EVENTS

The following information was reported on: 11-24-2018

The Texas Secretary of State's business registrations file showed that TDIndustries, Inc. was registered as a Corporation on June 25, 2007, under the file Registration number 0800834585.

Business started 1946. 100% of capital stock is owned by ESOP.

RECENT EVENTS:.

On September 17, 2010, an inside source stated that TDIndustries, Inc., Dallas, TX, was acquired by JBS Mechanical, Inc., Phoenix, AZ, on September 2, 2010, for $2.2 million. With this transaction TDIndustries, Inc. discontinued its business and its operations were integrated into TDIndustries, Inc., Tempe, AZ. Further details were unavailable.

PAUL MINTON. Antecedents are unknown.

HAROLD F. MACDOWELL born 1961. 1985-present active here.

MAUREEN UNDERWOOD. Antecedents are unknown.

JASON CINEK. Antecedents are unknown.

MICHAEL J. KOTUBEY. Served as president of MMC Contractors.

ROD JOHANNSEN. Antecedents are unknown.

PHIL CLAYBROOKE. Antecedents are unknown.

BEN HOUSTON born 1936. 1961-present active here.

MICHAEL J FITZPATRICK born 1949. 1984-present active here.

AFFILIATES: The following are related through common principals, management and/or ownership: TDIndustries Holdings, Dallas, TX. Started in 2001. Operates as a Delaware limited liability company. TDIndustries Management, Dallas, TX. Started in 2001. Operates as a Delaware limited liability company.

On January 27, 2010, an investigation revealed that the previous telephone number listed for TD Industries Inc (469 374-8733) was incorrect, and appears to have been changed without the company's knowledge. The correct telephone number is now reported as (972) 888-9500.

Former name of the business was TD Industries LTD.

BUSINESS ACTIVITIES AND EMPLOYEES

The following information was reported on: 11-24-2018

Business Information

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Business Information

Description	Contractor of heating and air conditioning systems. Contracts call for. Terms are. Has 4000 account(s). Terms are Net 30 days and contractual basis. Sells to commercial concerns. Territory : United States.
Employees	1,600 which includes officer(s). 900 employed here.
Financing Status	Secured
Seasonality	Nonseasonal.
Tenure	Owns
Facilities	Owns 120,000 sq. ft. in a two story steel building.
Location	Suburban business section on well traveled street.

SIC/NAICS Information

SIC Codes	SIC Description	Percentage of Business
1711	Plumbing/heating/air cond contractor	-
17110400	Heating and air conditioning contractors	-

NAICS Codes	NAICS Description
238220	Plumbing, Heating, and Air-Conditioning Contractors

GOVERNMENT ACTIVITY

Activity Summary

Borrower(Dir/Guar)	No
Administrative Debt	No
Contractor	Yes
Grantee	No
Party excluded from federal program(s)	No

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

Privacy Policy | Terms of Use

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

TDINDUSTRIES, INC.

Tradestyle(s):

Financials

Source: D&B | Currency: All figures shown in USD unless otherwise stated

KEY BUSINESS RATIOS

Statement date	Based on Number of Establishments
12-31-2000	25

	Ratio for the business	Industry Median	Industry Quartile
Profitability			
Return On Assets	-	3.1	-
Return on Net Worth	-	13.3	-
Return on Sales	-	1.4	-
Short Term Solvency			
Current Liabilities to Inventory	999.9	948.3	1
Current Liabilities Over Net Worth	212.2	158.1	1
Current Ratio	1.7	1.5	1
Quick Ratio	1.4	1.2	1
Efficiency			
Accounts Payable to Sales	-	10.3	-
Assets Over Sales	-	49.7	-
Collection Period	-	82.5	-
Sales to Inventory	-	64.3	-
Sales Over Net Working Capital	-	8.6	-
Utilization			
Total Liabilities Over Net Worth	362.0	237.1	

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

TDINDUSTRIES, INC.

Tradestyle(s): -

Financials

Source: D&B | Currency: All figures shown in USD unless otherwise stated

KEY BUSINESS RATIOS

Statement date	Based on Number of Establishments
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Sales Over Net Working Capital	-	8.6	-
Utilization			
Total Liabilities Over Net Worth	362.0	237.1	1

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

TDINDUSTRIES, INC.

Tradestyle(s): -

Web & Social

The information in this section is gathered using sophisticated search algorithms to identify relevant stories about this business. Please note that on occasion WWW and Twitter information may be erroneously matched to articles that may also contain similar terminology. Readers should ensure article applicability prior to making risk decisions.

LATEST NEWS

Powered By FirstRain

Texas & Louisiana People: Construction business updates for February 2019 ENR 05-Feb-2019

Satori Capital Invests in Able Machinery Movers Business Wire 11-Jan-2019

TDIndustries Promotes Sheri Tillman to General Counsel CONTRACTOR Magazine 18-Dec-2018

Pace of Work Holds Steady for Region's Subcontractors ENR 12-Dec-2018

Silicon Valley?s Radical New Idea: Treat Employees Well AFKInsider 07-Dec-2018

Big project, big time and cost savings Building Design & Construction 14-Nov-2018

TDIndustries Wins Safety, Project Awards from ABC Contracting Business Magazine 09-Oct-2018

CRE Opinion: Why Internships Matter For Our Industry's Future SideDish 02-Oct-2018

See who's getting hired, promoted at Crescent Real Estate, Haynes and Boone and more for the first week of September. Biz Beat Blog 10-Sep-2018

TOP BUSINESS TWEETS

Powered By FirstRain

There are no recent tweets to show.

MANAGEMENT CHANGES

Powered By FirstRain

There are no management changes to show.

EVENT TIMELINE

Powered By FirstRain

DEC-2018

TDIndustries Promotes Sheri Tillman to General Counsel 18-Dec-2018

NOV-2018

Big project, big time and cost savings 14-Nov-2018

OCT-2018

TDIndustries Wins Safety, Project Awards from ABC 09-Oct-2018

SEP-2018

See whos getting hired, promoted at Crescent Real Estate, Haynes and Boone and more for the first week of September. 10-Sep-2018

AUG-2018

How ABC Members Are Working Together to Include Women on the Jobsite 27-Aug-2018

VENDOR PROFILE

3. Company's Dun & Bradstreet (D&B) number.

4. Corporate office location

13850 Diplomat Drive, Dallas, TX 75234

5. List number of employees either nationally or regionally (if your response is not all states) with breakdown of direct sales, sales support, service technicians, engineering support and administration.

Dallas:
Executive Management: 138
Engineering & Professional: 17
Technical: 218
Sales: 16
Clerical-Administrative: 206
Production & Field: 610
TOTAL: 1205

Fort Worth:
Executive & Management: 29
Engineering & Professional: 10
Technical: 79
Sales: 11
Clerical-Administrative: 32
Production & Field: 126
TOTAL: 287

Houston:
Executive & Management: 52
Engineering & Professional: 0
Technical: 111
Sales: 8
Clerical-Administrative: 64
Production & Field: 152
TOTAL: 387

Central Texas (Austin):
Executive & Management: 28
Engineering & Professional: 7
Technical: 38
Sales: 6
Clerical-Administrative: 25
Production & Field: 117
TOTAL: 221

Central Texas (San Antonio)
Executive & Management: 26
Engineering & Professional: 3
Technical: 41
Sales: 7
Clerical-Administrative: 29
Production & Field: 144
TOTAL: 250

Phoenix:
Executive & Management: 29
Engineering & Professional: 1
Technical: 33
Sales: 4
Clerical-Administrative: 37
Production & Field: 210
TOTAL: 314

6. List the number and location of offices, or service centers for all states being offered in solicitation.

TD provides services out of the following 12 office locations.

- Dallas, TX
- Fort Worth, TX
- Richardson, TX
- Lubbock, TX
- San Antonio, TX
- Austin, TX
- Houston, TX
- Phoenix, AZ
- Tucson, AZ
- Denver, CO
- Midland, TX
- Amarillo, TX

Additionally, list the names of key contacts at each location with title, address, phone and e-mail address.

James Venegas
Sr. Vice President, Houston Service and Facilities Management
Years of Experience: 22
Phone: 832-347-3764
Email: James.Venegas@TDIndustries.com

Mary Kobe
Sales Director, Dallas
Years of Experience: 9
Phone: 214-435-5148
Email: Mary.Kobe@TDIndustries.com

Jeff Sherman
Vice President, Fort Worth Service
Years of Experience: 10
Phone: 817-683-5557
Email: Jeff.Sherman@TDIndustries.com

Clint Allen
Vice President, Arizona Service
Years of Experience: 20
Phone: 602-284-0571
Email: Clint.Allen@TDIndustries.com

Bret Smart
Director. San Antonio Service
Years of Experience: 14
Phone: 210-646-8476
Email: Bret.Smart@TDIndustries.com

Nicolas Sfeir
Vice President - Austin
Years of Experience: 19
Phone: 512-310-5051
Email: Nicolas.Sfeir@TDIndustries.com

7. Please provide contact information for the person(s) who will be responsible for the following areas, including resumes:

a. Sales
b. Sales Support
c. Marketing
d. Financial Reporting
e. Executive Support

Sales:
Lorraine Vuong and TD Partners - Cooperative Contract Coordinator
Lorraine.Vuong@TDIndustries.com
713-996-2437

Sales Support:
Lorraine Vuong - Cooperative Contract Coordinator
Lorraine.Vuong@TDIndustries.com
713-996-2437

Marketing:
Lorraine Vuong and TD Marketing Team - Cooperative Contract Coordinator
Lorraine.Vuong@TDIndustries.com
713-996-2437

Financial Reporting:
Lorraine Vuong - Cooperative Contract Coordinator
Lorraine.Vuong@TDIndustries.com
713-996-2437

Executive Support:
Crystal Seiler - Professional Services Team Manager
Crystal.Seiler@TDIndustries.com
713-996-3121

TDIndustries provides plumbing, HVAC and electrical maintenance, installation, renovation and preventive maintenance service and repair from twelve offices. We have nine offices in Texas: Dallas; Houston, Austin, San Antonio, Fort Worth, Lubbock, Midland, Amarillo and Richardson. We also serve the state of Arizona, with offices in the Phoenix Metro area and Tucson as well as Colorado with an office in Denver.

Please see the following page for Lorraine's resume.

LORRAINE VUONG, COOPERATIVE CONTRACTS COORDINATOR

Lorraine is TDIndustries' dedicated liaison with cooperative purchasing networks. Her role is to navigate the administrative and legal needs of both NCPA and Region 14 to help ensure that TD is delivering service excellence. Lorraine is completely dedicated to this type of business and has the experience and skill to coordinate and facilitate the execution of cooperative contracts.

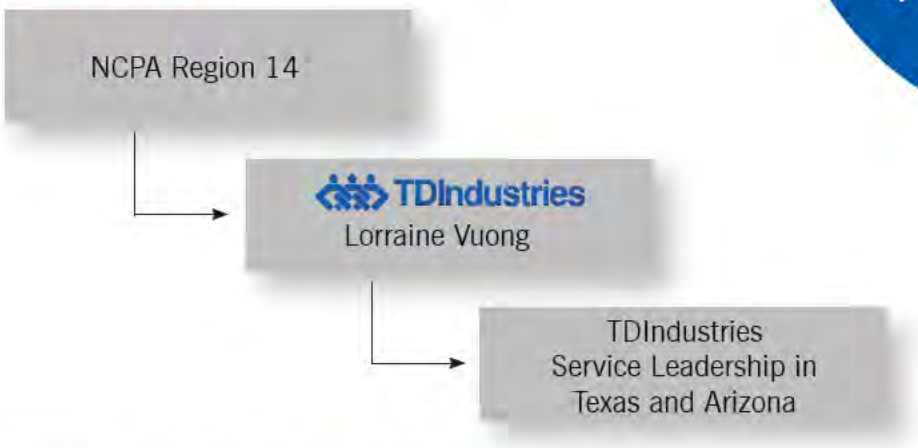
Lorraine's Experience

Years of Experience: 15
Education: Accounting Manager, Eldorado Business School
Relevant Training: TASBO Procurement Courses
COOP Experience:

- NCPA
- OMNIA Partners
- GSA
- TXMAS
- BuyBoard
- PACE
- 1 GPA

NCPA and Region 14 will have a single Point of Contact within TDIndustries, Lorraine Vuong. She will disseminate information and coordinate with the appropriate parties within TDIndustries.

Flow of Information



8. Define your standard terms of payment.

Net 30.

9. Who is your competition in the public marketplace?

We are among the top 60 specialty Environmental / Mechanical / Plumbing, Building Automation, Energy Services and Mechanical Systems Service companies in the United States and among the top 3 in Texas. We consider the following as our competitors in our major markets:

- Letsos
- EcoLab
- Trane
- Brandt (Dallas)
- DSI
- Neva Corporation

12. What is your strategy to increase market share in the public space?

TDIndustries will steadily build market share by generating new, high quality leads through the strategic leveraging of tradeshows, marketing campaigns, and networking events. These leads will be appraised and the highest valued ones will be pursued with the full force of our marketing and sales teams. Our performance on these new and current projects in the market will lend to better leads and more references which in turn will increase our volume and value of opportunities and leads.

13. What differentiates your company from your competitors?

What makes TDIndustries stand out from our competitors is our in-house capabilities. We have the ability to perform Design/Build improvements with Government Entities to reduce utility and operating costs on both sides of the utility meter. The majority of the trade contracting work is performed by TD Partners, eliminating markup on trade subcontractor markup - providing unmatched value per dollar invested.

TDIndustries is wholly owned by employees and all employees have the ability to own stock. More than 70% of our employees own stock. Employees with an ownership stake have a greater incentive to provide value to customers and keep them with TD. We do not take shortcuts or take a short term view of our relationships with our customers. We thrive because our customers see this value and know that TD is the best place in the market to find it.

14. Briefly summarize your company's Quality Control/Quality Assurance program.

Please see TD's Quality Control/Quality Assurance program starting on page 264.

15. Provide information regarding whether your firm, either presently or in the past, has been involved in any litigation, bankruptcy, or reorganization.

TDIndustries Legal Statement:

"The Company is a party to a number of legal proceedings arising in the ordinary course of business. In the opinion of management, the resolution of these proceedings will not have a material adverse effect on the financial position or results of operations of the Company."

Sheri L. Tillman

Sheri L. Tillman
Corporate Counsel
TDIndustries | www.tdindustries.com
Office 972-888-6844 |Cell 972-375-3603

16. Provide evidence of your company's ability to continuously lower the customer's costs. Provide examples of any documented cost reduction results that your company has engaged in with your customers.

Energy Savings Performance Contracting (ESPC) Process and Experience TDIndustries has been in the energy/water savings business for more than 15 years. We are distinguished from many of our competitors by the fact that we self- perform most of the work and utilize as few sub-contractors as is feasible thus avoiding the multiple layers of profit margins you will see from our competitors. TDIndustries can provide the customer with the full range of ESPC services through a turnkey project offering, where TDIndustries personnel perform all key technical, management, and financial functions, rather than consultants, subcontractors, or partners. This allows for an efficient, cost-effective, and seamless project delivery starting with the detailed energy audit and continuing throughout the ESPC term. It also means that the customer will enjoy streamlined communications with their energy partner through a single point of contact and a single point of responsibility for project performance, with no "finger pointing." The following brief descriptions highlight the ESPC services TDIndustries will provide to the customer as the project progresses through its phases:

1. Energy auditing and facility assessment
   a. Preliminary Audit - Expert modeling and analysis of baseline energy usage and savings
   b. Detailed Energy Audit - Project development and economic analysis
2. In-house design engineering and specification
3. Construction project management
   a. Procurement of materials and trade labor
   b. Safety coordination by our in-house certified safety professional and OSHA authorized trainer
4. Ongoing Commissioning - ex. utiliVisor, Clockworks
5. Monitoring Base Commissioning - ex. utiliVisor, Clockworks
6. Ongoing Maintenance and Support Services
7. Guaranteed Savings Performance Monitoring and Verification
   a. Performance guarantee backed by a history of financial strength, organizational longevity, and stability
8. Facility staff and occupant training
9. Financing procurement support, as well as identifying and securing all available grants, rebates, and incentives available to offset project costs

PRODUCTS

17. What is the reputation of your company's products in the public marketplace?

As a service and maintenance contractor, we do not directly provide products. To see the reputation of our services, please see our response to question 49.

18. Indicate your company's ability to provide temporary cooling when needed.

TDIndustries has relationships with Entech and Aggreko and other national providers of temporary chillers and other cooling/refrigeration equipment as well as other vendors who can provide cooling.

19. What equipment/system support documents will your company provide?

Installation instructions, operation and maintenance manuals, and the manufacturer's recommendations for preventative maintenance.

20. Identify the process of receiving a purchase order to the ordering of equipment.

When a Customer purchase order for equipment is received, it is assigned to a construction project manager who reviews the agreement with our sales department and the Customer in a kickoff / requirements meeting. The service project manager assigns the appropriate lead technician and together they review the contract, terms and conditions with the assigned customer care representative in the TDIndustries customer cate center. The lead technician and customer care center then schedule the site visit to review project conditions and make appropriate internal planning and site access notes. The project is then assigned to a resource in our engineering and project coordination department to begin the design, MISOP and construction planning processes.

21. Describe your company's shipping schedule notification procedures.

Our shipping schedule is a live document. It is constantly automatically updated.

Examples:

- When a customer updates their delivery needs, the delivery schedule changes.
- When a work order is created, a delivery is scheduled.
- When an order is placed on hold, the delivery is pushed out. The product is still built on the original schedule and upon completion is stored in finished goods inventory.

22. Describe how your company deals with shipping delays. How do you notify your customer of delays?

Daily progress meetings are held. The meetings focus only on the progress of the orders scheduled to be complete in the next four days. With information from the daily progress meeting, we are able to and try to provide our Customer a three day notice of any late deliveries. The only exceptions would be for orders placed with less than a three day lead time.

23. Provide your shipping schedule reporting form. How many times do you update?

Our shipping schedule is a live document. It is automatically updated on a consistent basis.

Please see an example delivery schedule on the following page.

Delivery Schedule

Business Unit	Delivery Due Date	Completion Date	Work Order	Package #	Work Type	Rush	Estd Wt (lbs)	Packing Status	Description	Shipping Instructions	Project Num
CTBU South Major Proj	07/16/2020	07/16/2020	M-19680-A-281	ACED-63B	Round	No	585.4	Complete	L-13-OA unlined rnd		B196803034
Dallas Special Projects	07/17/2020	07/17/2020	M-183A9-A-067	CEDR2-38B	Round	No	224.2	Partial	Highlighted Drawing (BLUE) 2A-LP SA unlined rnd		B183003N01
Dallas Special Projects	07/17/2020	07/17/2020	M-183A9-A-069	CEDR2-38D	Round	No		Complete	Highlighted Drawing (BLUE) 2A-MP SA unlined rnd		B183003N01
Dallas Special Projects	07/17/2020	07/17/2020	M-183A9-A-071	CEDR2-38F	Round	No	153.6	Partial	Highlighted Drawing (BLUE) 2A-RA unlined rnd		B183003N01
Dallas Special Projects	07/17/2020	07/17/2020	M-183A9-A-076	CEDR2-39A	Rectangle	No		Complete	misc. lp unlined rect & 16ga shop angle		B183003N01
Dallas Special Projects	07/17/2020	07/17/2020	M-183A9-A-078	CEDR2-40	Round	No	223.1	Complete	2B 6in spiral pipe		B183003N01
Dallas Special Projects	07/17/2020	07/17/2020	M-27213-A-021	BADE-12	Round	No		Complete	6-14in stamped rnd 90's		B272133140
Dallas Special Projects	07/15/2020	07/15/2020	M-27213-A-019	BADE-10B	Round	No	1412.8	Partial	pg.2 lp unlined rnd		B272133140
FWCG	07/17/2020	07/17/2020	M-27070-A-019	LSFW-8D	Round Lined	No	5356.6	Not Packed	RTU 22-8-3-4-5 lp sa 1-1/2in lined rnd paintgrip W/Duraflange rings Exposed section mount taps		B270703078
FWCG	07/17/2020	07/17/2020	M-27070-A-020	LSFW-8E	Round Lined	No	472.0	Not Packed	RTU 22-8-3-4-5 lp sa 1-in lined rnd paintgrip Exposed section mount taps		B270703078
FWCG	07/17/2020	07/17/2020	M-27070-A-021	LSFW-8F	Round	No	701.1	Not Packed	RTU 22-8-3-4-5 lp sa unlined rnd paintgrip W/Duraflange rings Exposed section mount taps		B270703078
FWCG	07/17/2020	07/17/2020	M-27070-A-046	LSFW-16	Round Lined	No	100.4	Not Packed	RTU-18-lpsa 1.5in lined round paintgrip exposed missing #157 spiral		B270703078
FWCG	07/17/2020	07/17/2020	M-27070-A-047	LSFW-17	Round Lined	No	130.3	Not Packed	RTU-10-lpsa 1.5in lined round paintgrip exposed missing #185 spiral		B270703078

Business Unit	Delivery Due Date	Completion Date	Work Order	Package #	Work Type	Rush	Estd Wt (lbs)	Packing Status	Description	Shipping Instructions	Project Num
FWCG	07/13/2020	07/13/2020	M-27070-A-014	LSFW-7B	Round Lined	No	749.0	Not Packed	LIVING SPACES RTU 2,16,21,9,17_lp 1in lined round section mount tap	PALLATIZE	B270703078
FWCG	07/13/2020	07/13/2020	M-27070-A-015	LSFW-7C	Round Lined	No	9004.2	Partial	LIVING SPACES RTU 2,16,21,9,17_ lp constant volume lined round section mount taps	PALLATIZE	B270703078
FWCG	07/13/2020	07/20/2020	M-19650-A-018	ROAS-9	Weld Rect	No	1729.9	Partial	Roof Curb Drops Section 6 exposed stainless 304 16ga welded rect		B196503104
FWCG	07/13/2020	07/13/2020	M-19437-A-012	DIAM-5C	Round	No	2165.2	Partial	RTU-80, 81, 85, EF 3, 5_ RA and CVS unlined round Section mount taps	Pallatize wrap individual ends	B194373078
FWCG	07/13/2020	07/13/2020	M-19437-A-013	DIAM-5D	Round	No	50.4	Partial	RTU-80, 81, 85, EF 3, 5_EXH unlined round Section mount taps	Pallatize wrap individual ends	B194373078
Major Projects	07/17/2020	07/17/2020	M-194A4-A-117	GPM2TI-35D	Round	No	2493.0	Partial	Level#7- b&E TI -lp unlined round section mount taps exposed sa		B194473N01
Major Projects	07/15/2020	07/15/2020	M-19447-A-303	JPM2FG-308B	Round Lined	No	58.6	Partial	Lv1 Area B exposed lined rnd pa		B194473018
Major Projects	07/14/2020	07/14/2020	M-27212-S-001	THA-1	Other	No		Not Packed	HOT SLEEVE ORDER		B272123067

Date OnSite between 7/13/2020 and 7/17/2020

Business Unit(s) in (12000 - Building Systems Integration, 18000 - Facilities O & M, 20000 - TDMANUFACTURING, 40000 - Multifamily, 50000 - Washington DC, 60000 - Houston Construction, 60600 - Houston Special Projects, 70500 - Corpus Christi, 70600 - Valley, 70700 - CTBU North Major Proj, 70750 - Austin Service , 70760 - CTBU North Spec Proj, 70800 - CTBU South Major Proj, 70860 - CTBU South Spec Proj, 80000 - Phoenix Construction, 85200 - Major Projects, 85400 - FWCG, 85600 - Dallas Special Projects, 85800 - Technology, 90000 - ADMIN (OVERALL))

Project Number Like (%)

24. How many products do you stock? Where?

Each of our local offices' Service Departments has a stock (including truck stock) of all required consumables, belts, filters, refrigerants (each location has a recycling/recovery station) and other HVAC Service related components. We also hold stocks of critical replacement parts for commercial refrigeration and parts reserves for specific Customers where expedited replacement is key to their processes. We do not typically stock complete HVAC units as we have supplier/manufacturer relationships in all locations for rapid replacement requirements.

25. What is your percentage of on-time delivery at each manufacturing plant?

TDIndustries requires a detailed project plan on each project from the project manager. For projects that meet this requirement with no changes/change orders, etc. our on-time delivery rate is 98%. About 25% of the Manufacturing time is spent dealing with "Hot Calls", instances where there is a last minute project change order, additional materials required, parts damaged in shipment, etc. For those "Hot Calls", our on-time delivery rate is 95%.

26. Describe any direct order entry system or capabilities your organization has such as internet capabilities.

Since our Field Technicians are connected to the Service Center via hand-held devices and all Service Calls are scheduled and processed in real time, the time frame associated truly depends on the customer's desired response time. When a Service Call is completed, the Technician will be able to email a work order/invoice to the Customer's attention / to Customer's designated Contact person / Accounts Payable immediately. The Customer will also have access to a Portal, where with a Username / Password, they will be able to access all account activity / work orders / invoices and all other data related to their Agreement / Account.

Our online system enables TDIndustries to invoice the customer immediately upon completion of repair or replacement call. We have invested a lot in to this wireless / paperless transaction, Customer portal and invoicing system in order to increase productivity and Customer Satisfaction.

27. Are all HVAC units UL listed and in compliance with all applicable codes in all states?

Yes, all HVAC units provided by TDIndustries are UL listed and comply with all applicable codes in all states.

28. If your product is defective, what is the replacement process and turnaround?

All equipment warranties on all products installed by TDIndustries are captured in a master database - New Construction/Retrofit and Service replacements. Should a warranty claim arise, the database provides the feedback loop to our Project Managers to initiate the warranty claim with the appropriate manufacturer, dealer or distributor. Turnaround time is dependent on the supplier, but TDIndustries will leverage our size and buying power to help suppliers prioritize our replacement delivery and if necessary, we will provide temporary heating/cooling if the problem leaves our Customer without comfort in the meantime.

29. What is the capability of your company to respond to emergency/rush orders?

TDIndustries believes that your emergencies are ours. That's why we respond to your needs 24 hours a day, seven days a week, and 365 days a year. We staff more than 290 highly specialized technicians who are committed to getting your system up and running, with minimal disruption, as soon as humanly possible. Not only are our technicians specially trained, our Customer Service Group representatives are crosstrained in all disciplines so they can send the right team out to correct your problem. Whether it is equipment change-out, start up or shut downs, TDIndustries is there for you.

30. State whether your company provides a quality guarantee on your products. If so, please describe.

TD provides a one year warranty. A warranty letter can be provided upon request.

31. Describe your procedures to monitor the quality of your products.

TD analyzes the Quality of the vendors we use as well the quality of service we perform through various methods. Equipment vendors will be evaluated primarily based on prior service and deliverability. Secondly they will be evaluated on their ability to provide the specified equipment in compliance with the plans and specifications.

Materials vendors will be evaluated primarily based on prior service and deliverability. Secondly they will be evaluated on their ability to provide the specified materials in compliance with the plans and specifications. Due to frequency of deliveries for commodity items, these vendors must prove compliance in advance with safety policies and approval.

32. Do you offer extended parts and labor warranties? If yes, state length of warranty.

Yes, if the Customer is interested in an extended warranty option, we will provide a quotation. (Examples: 2-5 years).

33. Please give examples of state and local agencies where your company has extended labor warranties. Include length of these warranties.

Denton Independent School District – 2 years parts and labor
Richardson Independent School District – 2 years parts and labor
Ft. Stockton Independent School District – 5 year parts and labor

34. What is you standard warranty on Building Automation Controls?

Typically one year, but could be longer depending on Customer acceptance of extended warranties.

35. What is your standard warranty on replacement parts?

Typically one year, but could be longer depending on Customer acceptance of extended warranties.

36. How does your company track warranties and update equipment lists/warranty periods as units or components are replaced?

All equipment warranties on all products installed by TDIndustries are captured in a master database - New Construction/Retrofit and Service replacements. Should a warranty claim arise, the database provides the feedback loop to our Project Managers to initiate the warranty claim with the appropriate manufacturer, dealer or distributor.

37. What states would your company not honor pricing on your supplied equipment for this contract, in the event that this contract is made available to all states?

TDIndustries will not be providing our services to all states.

SERVICES

38. Describe your company's Customer Service Department (hours of operation, number of service centers, parts outlets, number of technicians, etc.) Clarify if the service centers are owned by your company of if they are a network of subcontractors.

TDIndustries provides preventative maintenance, repair and emergency service 24/7 with 290 service technicians. All activities are coordinated by our centralized TDIndustries Customer Service Center, located in out Dallas Headquarters. Our dispatch Center manages the dispatching operations for all service branches after 5pm weekly, and all day on the weekends.

You can contact our Contact Center through a dedicated 800 number, by e-mail, or fax through the following channels:

Toll Free Number: 1-800-864-7717
E-mail: service@TDIndustries.com
Fax: (713) 996-2414

Service Technicians (Includes BSI Service Techs and Life Safety Service Techs)

39. Describe how your company handles after-hours customer service needs indicate your average response time to emergency service calls.

All emergency calls are considered top priority. The afterhours TDIndustries Call Center Response Team is responsible for assessing the appropriate course of action. If there are questions or concerns, the first point of contact is the TDIndustries Service Manager for that particular trade, and the Customer's designated TDIndustries Customer Care Manager. TDIndustries response time for emergency service calls ranges from two (2) to four (4) hours at the latest.

40. Discuss your organization's capability and historical flexibility in completing timely service calls and problem resolution.

Once on the dispatch board, the request can be tracked for how long before it was dispatched, who dispatched the call and to whom and when, when the call was received by the technician's device, accepted and when they were in route to when they arrived on site. The time "on the job site" is tracked until the work completed and the customer representative signs the work ticket. This allows us to keep historical data on our service calls to develop ways to create improvements.

41. Please describe the quality program(s) within your company which measures your service work.

Please see the answer to Question 40 above. The historical data of our service calls allow us to develop ways to create improvements.

42. List your company's standard scope of work performed for preventative maintenance visits.

Service, Repair, Replacement and Maintenance of HVAC equipment (including but not limited to Air Cooled and Water Cooled Chilled Water Systems, Split Systems, Package Units, Computer Room Air Conditioners, Variable Frequency Drives, Fan Powered Boxes, and VAV boxes). Maintenance includes performing, at designated intervals, annual and routine planned maintenance inspections of HVAC equipment per manufacturer's specifications and requirements with the goal of extending the equipment's useful life through proper operating conditions. Inspections will include a combination of assessment and cleaning of condensers, evaporators, coils, condensate lines and drains, filters, belts, electrical connections and safeties, refrigerant systems, heaters, blowers, bearings, and motors. Equipment will also be inspected for proper airflow, pressures, temperatures, operating issues such as short cycling, vibrations and noises.

44. Describe your call center organization.

TDIndustries provides preventative maintenance, repair and emergency service 24/7 with 290 service technicians. All activities are coordinated by our centralized TDIndustries Customer Service Center, located in out Dallas Headquarters.

45. Does your company offer a dedicated, 800 number for all locations to place phone and fax orders? Is the call center available 24 hours/7 days week?

Yes, you can contact our Contact Center through a dedicated 800 number, by e-mail, or fax through the following channels:

Toll Free Number: 1-800-864-7717
E-mail: service@TDIndustries.com
Fax: (713) 996-2414

46. Describe how service call problems get escalated in emergency situations during and after hours. Who would be responsible in your company for assessing the appropriate course of action to remedy the problem?

The afterhours TDIndustries Call Center Response Team is responsible for assessing the appropriate course of action. If there are questions or concerns, the first point of contact is the TDIndustries Service Manager for that particular trade, and the Customer's designated TDIndustries Customer Care Manager.

47. List the steps taken from start to finish in receiving a service call through to completion of repair and invoicing. Include time frames associated with each step.

Since our Field Technicians are connected to the Service Center via hand-held devices and all Service Calls are scheduled and processed in real time, the time frame associated truly depends on the customer's desired response time. When a Service Call is completed, the Technician will be able to email a work order/invoice to the Customer's attention / to Customer's designated Contact person / Accounts Payable immediately. The Customer will also have access to a Portal, where with a Username / Password, they will be able to access all account activity / work orders / invoices and all other data related to their Agreement / Account.

48. What technology such as GPS tracking does your company use to track completion of repairs?

Our service fleet in all locations use hand held PDA's, all trucks have GPS tracking linked to our Central Dispatch Team. When Central Dispatch receives a call from a Client requiring immediate attention, they know where all the Technicians are working, the capabilities / skill level of each Technician and the tools they are carrying in the Service vehicle. This allows Central Dispatch to get to the right person and to the right job in the shortest time allowable. All field generated quotations and resulting invoices are generated in real time and all company financial systems capture the information and status (in progress / completed / incomplete) from each Technician on every Service call or Maintenance Agreement task as it happens.

49. What is the reputation of your company's service in the public marketplace?

TDIndustries is one of the premiere mechanical contractors in the southwest United States. Our reputation is well known and we have received numerous accolades including most recently:

- ABC Safety Excellence Pinnacle Award
- ABC Eagle Award for Mansfield Wellness Center
- Multiple TEXO Distinguished Building Awards
- 2019 Southwest Top Specialty Contractor by ENR
- No. 32 on ENR's Top 600 Specialty Contractors List (2019)
- Contractor of the Year (2019), CONTRACTOR Magazine

50. How does your company spread the cost of a Preventative Maintenance contract over the entire year?

TDIndustries allows for the PM cost to be spread over a year and billed on a monthly or quarterly basis.

51. Identify the process of receiving a purchase order to the providing of a service contract.

When a Customer purchase order for a Maintenance Agreement is received, it is assigned to a Service Project Manager who reviews the Agreement with Sales and the Customer in a kickoff/requirements meeting. The Service Project Manager assigns the appropriate Lead Technician and together they review the contract, terms and conditions with the assigned Customer Care Representative in the TDIndustries Customer Care Center. The Lead Technician and Customer Care Center then schedule the first HVAC Service visit. This process generally takes 5-10 business days depending on Customer availability.

52. List your company's current capabilities for energy management system monitoring. Discuss the process involved when resolving a problem associated with an HVAC unit or system where an energy management system is installed.

We can monitor all types/vintages of EMS systems and receive emails and all forms of electronic communication in the event of emergencies. Some brands/types/vintages do not allow remote programming or program changes. Typically, we work with the Customer to identify specific points of monitoring and control that are critical and those points would be assigned to an out call process that contact our central Customer Care Center, which will connect remotely or dial into the Customer EMS system to assess the nature of the alarm/off normal condition and respond according to a Customer approved response scheme.

53. List the number of sites your company currently monitors Energy Management Systems (EMS).

Texas Tech University - Lubbock, TX (15-20 buildings)
University of Texas at Arlington - Arlington, TX
Confidential Client - Richardson, TX
The Crescent Office Towers, Dallas, TX
Security Services Federal Credit Union - San Antonio, TX
Texas Scottish Rite Hospital - Dallas and Frisco, TX
TD Headquarters - Dallas, TX

54. List your company capabilities regarding system changes and repairs to EMS systems.

We have the capability for complete EMS System additions, upgrades, changes and repairs to most types/vintages of Customer's systems.

55. List the reporting capabilities your company has for EMS system parameters.

Typically, remote monitoring is related to equipment status or off normal temperature/humidity conditions or any value/variable that is critical to the Customer's process or premises. However, where we have remote dial in/web connection capabilities, we can "see" the Customer's entire connected system, building, campus or enterprise.

56. Does your company maintain and repair/replace EMS in-house (self-perform) including monitoring, alarm resolution, repairs and adjustments?

TDIndustries has in-house staff with EMS expertise for all areas of the EMS systems.

57. Describe your process for trouble shooting a problem (HVAC, lighting, etc.) at a site with an EMS system. How does repair get escalated for service?

TDIndustries EMS group staff is trained to trouble shoot and repair the EMS systems. The repair gets escalated through the Customer Care Center staff.

58. Describe your company's startup and system checkout responsibilities

TDIndustries goal during installations is to have little to no outstanding items on our punch list. Our highly trained start-up technicians help ensure this goal through equipment checklists. As part of our overall start up service, we offer:

j. Starting up systems and preparing for commissioning
k. Test and Balance
l. Performance Certification – After the time of your system's start up, TDIndustries Warranty takes effect.
m. A seamless transition to life-cycle operation and maintenance service.

59. Describe your company's post-installation and warranty support

Call center and project manager / account manager stays involved.

60. Describe your company's steps for system analysis.

Our HVAC Service group can survey the existing systems for condition, efficiency and repair history and create a customized year by year replacement program with our customer to propose guaranteed multi-year fixed-price modernization program methods segregated into categories that include weather related energy, occupant dependent energy, and building operating hour dependent energy, among other categories.

TDIndustries will further evaluate the facility's energy pricing structure to determine, based on the specific load profile, whether the facility is on the most appropriate and cost-justified utility rate schedule. Finally, energy system and facility audits are conducted in which TDIndustries engineers identify potential improvements while in the field, and then analyze them thoroughly for the technical and economic viability.

61. Discuss your company's current computer systems architecture. How do your company's computer system guarantee customers receive consistent service support, HVAC responsibility verification, and management reporting?

Our field technicians will be connected to the Service Center via hand-held devices and all service calls will be scheduled and processed in real time. The field hand-held devices will be in communication with all of TDIndustries business process systems. Data from field service work orders will be downloaded to these business process systems for invoicing, cost accounting/maintenance record keeping, etc.

The Customer will also have access to a Portal, where with a Username/Password, they will be able to access all account activity/work/invoices and all other data related to their agreement/account.

62. What does your company do to ensure bills are received from service centers within a reasonable time frame and issued to government entities for payment?

All field generated quotations and resulting invoices are generated in real time and all company financial systems capture the information and status (in progress/completed/incomplete) from each technician on every Service call or Maintenance Agreement task as it happens.

63. Explain how your company qualifies/certifies its service centers and what types of checks are performed to ensure standards are upheld.

Each of TDIndustries functional departments, i.e. Truck-based Service, Construction, MIS, Manufacturing, Administration, Executive Leadership, has permanent standing Quality Steering Team in place. These teams are required to meet monthly to work on specific issues and initiatives within their department and report to TDIndustries Executive Leadership team once a quarter and to the TDIndustries Board of Directors twice annually.

64. Is warranty coverage dependent on using your start-up procedure?

No. Extended warranties usually require Manufacturer's start-up/varies by Manufacturer.

65. Who performs your start-up procedure?

Each TDIndustries location has a designated Start-up leader. The leader coordinates Start-up processes with TDIndustries Technicians and Manufacturer's personnel as required.

67. List the other functions your company can provide regarding unit replacement to offer a turnkey project (ex. electrical, sheet metal work, EMS system connection and programming, etc.)

TDIndustries has the trained and certified staff to provide all of the trade specialties listed above. In addition, we have a centralized Engineering group that can offer Design/Build/Assist services to our Customers to meet the needs of the most complex Turnkey Retrofits.

68. Explain how your company would propose a planned unit replacement program including how units would be identified for replacement and how pricing would be addressed.

In the case of a customer who needs an ongoing system replacement strategy, our HVAC Service group can survey the existing systems for condition, efficiency and repair history and create a customized year by year replacement program with the customer to propose a guaranteed multi-year fixed-price modernization program methods and segregated into categories that include weather related energy, occupant dependent energy, and building operating hour dependent energy, among other categories. TDIndustries will further evaluate the facility's energy pricing structure to determine, based on the specific load profile, whether the facility is on the most appropriate and cost-justified utility rate schedule. Finally, energy system and facility audits are conducted in which TDIndustries engineers identify potential improvements while in the field, and then analyze them thoroughly for the technical and economic viability.

When calculating energy savings opportunities, it is important to review the project and savings calculations at a macro level and compare against usage patterns of other similar facilities. Our years of experience developing, implementing, and monitoring projects in similar buildings have provided us with substantial benchmarking date for comparison. Realistic savings are the foundation for successful energy efficiency and infrastructure improvement programs. We will perform calculations at both the macro and micro levels in order to ensure we are not double counting savings, ignoring the interactive effects of the performance of several of the measures, or being too conservative with our projections. In these times of shrinking operating budgets, it is imperative that the savings projected actually materialize. This is possible only if both the cost and savings sides of the project ledger are developed with rigorous attention to detail and field-proven technology is selected for long-term performance and durability.

Design Engineering: TDIndustries offers Government Entities a turnkey ESPC expertise. We utilize a “close-loop” management strategy, which ensures consistency and a high degree of quality control throughout the project life cycle and is essential to providing the Government Entity with an integrated best value solution. Our design engineering process further emphasizes minimization of costs while providing quality designs. The same engineers who participate in the audits complete the project design, create bid specifications, assist with construction management, and consult on operations. This approach allows for a smooth transition from the development stage through the operations stage. Moreover, these engineers are motivated to ensure that each energy conservation measure (ECM) is implemented successfully, rather than simply passing the job along to another department as the ECM progresses from design to construction to operations. TDIndustries’ s engineering procedures ensure that work is completed accurately in accordance with generally accepted engineering practices and all applicable regulations.

69. Describe what project scheduling tools your company use to track projects during construction.

ProCore, Microsoft Office 365, Dynamics, field visits, and field feedback.

70. How does your company make the proper equipment selection on a turnkey or energy retrofit contract project?

Equipment Selection Process After analyzing the savings potential of various equipment options, identifying various system alternatives, and making preliminary equipment and component selections, the next step is to develop conceptual designs, perform a detailed load analysis and selection of specific equipment. It is generally most cost-efficient not to favor particular manufacturers in the equipment selection process. Equipment selection will be based on the engineering specifications required for the best performance and economic analysis of all available models that can meet the specifications. This also encourages vendors to be creative in matching the most cost effective equipment option to the specified performance, or suggesting alternate performance parameters that may improve measure economics. TDIndustries maintains a neutral position with respect to manufacturers or vendors in its equipment selections. The most important person in the equipment selection process is the owner; TDIndustries will seek to have your review and insight for all equipment selections.

All equipment selected and/or specified and installed will satisfy the necessary requirements of the governing agencies, such as local and state codes, testing and approving agencies (UL, AGA, NFPA, ANSI, ASHRAE, ASME, etc.), and construction (SMACNA, ASTM, NEC, NEMA, etc.) and represent the highest standards of the industry. Equipment and systems will be selected that both minimize O&M requirements and can be simply and effectively serviced. Equipment is also selected on the basis of environmental emissions characteristics, with emphasis on minimizing emission of pollutants.

The specifics of available energy savings, durability, operation, maintenance, and cost for each option will be evaluated and the best option available will be selected. Facility personnel are encouraged to participate in the selection processes to ensure conformance with established design standards, operational practices, and critical facility issues. Design costs and activity interruptions during installation will be minimized by early review of the various optional construction methodologies for each ECM.

71. Describe how your company handles site development and project permitting process.

Project Manager gets building permit from the General Contractor. They fill out their portion of a permit application and give to Department Administrator, and he/she pulls the permits from that information for mechanical and plumbing. Once the permit is obtained it is sent to the project manager and superintendent for the particular project and then as inspections are needed, Debbie or one of the department admins request the inspection either online for the City of Houston or by telephone for other municipalities. Copies of the permits are kept in a permit folder on our computerized bulletin board until the project is complete. Once the permits are closed out the final permits are placed in the Project Management folder online.

72. Describe you company's design-build quality control guidelines for design, construction and review on a turnkey or energy retrofit contract project.

TDIndustries carefully schedules and tracks the performance of projects based on the critical path method so that timely purchase and delivery of material and equipment is ensured and adequate manpower and resources are available as needed. Our project managers are experienced in the use of specialized scheduling software tools from ProCore, Dynamics and Microsoft Office 365 to utilize these tools extensively in the management of projects. Key milestones, such as obtaining permits and host facility approvals, are given equal weight to the more labor intensive tasks, since they can impact the overall project duration. Scheduling and frequent auditing for compliance with the anticipated project construction plan is a major focus of the TDIndustries construction management staff. Deviations from the schedule are quickly detected and swift corrective action taken as necessary to restore the schedule. The careful attention to scheduling allows for anticipation of delays and development of a work around plan to minimization of their effects. The project scheduling documentation is readily available to the Customer for auditing, review and comment as frequently as necessary for your comfort.

Along with general project scheduling, TDIndustries and its subcontractors are able to make maximum use of the scheduling process to generate:

- Projected drawing schedules
- Manpower utilization schedules
- "Value earned" profiles for establishment of percent completion payments
- Purchasing schedules
- Design schedules
- Submittal/approval schedules
- Testing, balancing, and commissioning schedules
- Maintenance schedules

The sequence and timing of TDIndustries construction trades along with any required subcontractor efforts is carefully tracked, especially when there is interdependence between trades. The construction site manager or his assignee will keep daily logs of personnel on site, changes or directions issued, and construction activity completed. TDIndustries knows from experience how critical timing is to the successful completion of an ESPC. Our construction management process therefore incorporates careful tracking of the following time-related elements: Subcontractor pre-qualification process is completed prior to final design to allow them maximum input into the design and construction process and fully integrate their skills and experience with the other team members early on.

- Project management techniques are used to track purchase and delivery of materials and key milestones such as obtaining permits and host facility. Energy Conservation Improvements and Services Contract approvals. They also ensure that adequate manpower and resources are available when they are needed.
- Sequence and timing of subcontractor efforts are carefully tracked, especially when there is interdependence between trades.
- A flowchart is developed early on, defining the relationships between the parties and identifying roles and responsibilities, communication channels, and sign-off or quality control authority of each team member.
- Progress meetings are convened on a regular basis, both within the TDIndustries team and with the facility in order to manage properly and keep all interested parties informed of critical dates.
- A commissioning plan is reviewed with all subcontractors before construction is underway so they know what will be required of them regarding start-up, performance testing, training, and documentation. Commissioning can then proceed smoothly and in parallel with construction activities, without causing delays.

QUALITY CONTROL

TDIndustries uses a site-based quality management process – the Quality Walk. A quality walk is the responsibility of the Production Superintendent.

Following are some of the purposes of a Quality Walk:

- To observe quality work and give positive feedback to the worker.
- To assure all work installed is in compliance.
- To assure ourselves that we have a productive work place.
- To assess the material handling effort.
- To assure adequate and appropriate tools are being used.
- To assure that we are providing a safe place to work.

A "Quality Walk" should be repetitive, for example at 1:00pm each Friday. On short term jobs, Quality Walks need to be done as appropriate for the duration of the job. The Production Superintendent should encourage Foremen to question and learn from each others' work.

The Quality Walk Check-List, Quality Walk-Through Report, and Work to be performed by Other Trades forms (examples of each follow in this section) are meant to help remind us of all the different aspects of the project that need attention. These forms will never provide an all-inclusive list for all jobs. TDIndustries will add and possibly delete some items as the Customer dictates.

73. What is your company's design approach and philosophy for a turnkey or energy retrofit contract project?

The approach for turnkey energy retrofit gives the opportunity for the designers and owners to focus on original equipment status and equipment current status to achieve energy savings to the owner. This approach is truly a collaborative process that recognizes combining the specialized knowledge of the design professional and the construction team results in a better product. Depending on the project relationships, size, and complexity, the way to handle every project is unique. This is why TD provides a unique approach for design on turnkey or energy retrofit projects.

74. Describe your company's construction management plan.

TD's construction management plan is to be used as a guide to assist in tracking the process, progress and consistency on carrying out a construction project from the beginning of a substantial "Lead" to the turning over control of the site to the Owner.

The information contained in our plan is primarily directed to Major Projects and Special Projects Business Units in the various branches. The processes may however vary in areas such as Process Solutions, Service Departments, etc. It is laid out in the sequence stated below:

- Preconstruction
- Project Setup
- Planning and Finances
- Quality and Production
- Closeout

75. What is your standard warranty on installation?

One year on workmanship.

76. What is your standard warranty on energy retrofit contracting?

One year / materials and workmanship.

77. Do you differentiate in your company's standard warranty if financing is part of the contract? If so, please describe.

We will try to match the length of an extended parts and labor warranty to the financing term if the customer requires this type of arrangement.

78. State whether your company provides a quality guarantee on your service. If so, please describe.

There have been instances where we have provided warranties that were tied to system performance, efficiency and energy/operational cost reductions. These warranties were over and above whatever parts and labor warranties provided.

79. What states would your company not honor pricing on services for this contract, in the event that this contract is made available to all states?

TDIndustries will not be providing services to all states. Only Texas and Arizona.

SAFETY

80. Describe your company's safety program during service/repair work.

Please see page 276 for TD's safety program.

81. Describe your company's safety program during construction.

Please see page 276 for TD's safety program.

82. Indicate number of lost hours or other benchmarks to verify your company's effectiveness of their safety record.

	EMR	LTIR	TRIR	TOTAL HOURS WORKED
2019	.63	.03	1.4	6,661,989
2018	.77	.3	2.3	6,136,430
2017	.7	.2	2	5,686,471
2016	.73	.2	2.3	4,671,298
2015	.68	.1	2	4,167,223

83. What reporting mechanism does your company provided to the customer upon completion of any project?

Within construction, a letter of substantial completion or one of completion is furnished. From TD's position, we issue a warranty letter, O & M's, owner training, and we request for final payment.

MARKETING/SALES

84. Detail how your organization plans to market this contract within the first 90 days of the award date. This should include, but not be limited to:

a. A co-branded press release within first 30 days
b. Announcement of award through any applicable social media sites
c. Direct mail campaigns
d. Co-branded collateral pieces
e. Advertisement of contract in regional or national publications
f. Participation in trade shows
g. Dedicated NCPA and Region 14 ESC internet web-based homepage with:
i. NCPA and Region 14 ESC Logo
ii. Link to NCPA and Region 14 ESC website
iii. Summary of contract and services offered
iv. Due Diligence Documents including; copy of solicitation, copy of contract and any
v. amendments, marketing materials

FIRST 30 DAYS

» In our first 30 days of being awarded, TD's Cooperative Contract Coordinator will notify all Service Sales Team Leaders that TD has been awarded a new NCPA contract.
» TDIndustries marketing will announce to all TD partners that TD has been awarded for a new contract with NCPA. They will be informed of the new contract number and what TD services this contract covers.
» Marketing will work with NCPA marketing to create a co-branded press release on social media sites. We will also work with NCPA marketing team to promptly update our landing page for our new contract.

60 DAYS

» Modify existing brochures/marketing materials to incorporate the new contract in our cooperative capabilities.
» TDIndustries will work with NCPA to strategize an NCPA roadshow in each of our TX and AZ locations. In these roadshow meetings, the market opportunity, customer profiles, contract terms, and business processes will all be reviewed so that all TD partners get the message and are prepared to seize the opportunities. NCPA will be asked to participate in those meetings to provide answers to questions.
» Plan a meeting with TD Service Sales Team and NCPA Development Manager and Regional Managers to strategize a sales plan with all that NCPA has to offer.

90 DAYS

» We will participate in joint marketing activities that NCPA determines that TDIndustries should participate in, co-host, etc.…
» We will participate in trade shows and exhibitions where the government entities are likely to participate.

We will continuously train and have roundtable discussions with our TD partners to make certain they understand the program rules to better utilize our contracts and be compliant.

In person events and meetings are contingent on COVID-19 and related policies.

85. Describe how your company will demonstrate the benefits of this contract to eligible entities if awarded.

When holding an open house / meeting for existing and prospective Government Entity Customers, we will illustrate how obtaining our services through cooperative purchasing will provide the most value to their project / service needs. This can be illustrated by demonstrating the cost of procuring services via the traditional time and resource consuming route vs. obtaining our services and acquiring significant savings of both time and money.

86. Explain how your company plans to market this agreement to existing government customers.

Please see the response to question 84.

87. Provide a detailed 90-day plan describing how the contract will be implemented within your company.

Please see the response to question 84.

88. Describe how you intend on train your national and/or regional sales force on the Region 14 ESC agreement.

Our first step will be in a seminar/conference in our local offices where Lorraine Vuong will fully describe the NCPA contract offering to all Sales and Operations personnel. During this meeting, the Market Opportunity, Customer Profiles, Contract Terms, Business Processes will all be reviewed so that all hands get the message and are prepared to seize the opportunity.

We will continuously train and retrain our Partners to make certain they understand the program rules, reward those that adopt the strategies and produce the results. Our intention is to arrange a competition between Departments and Locations, with rewards commensurate with their levels of production of work under both TDIndustries existing Energy Services contract and the HVAC Equipment, Installation, Service, and Related Items contract.

89. Acknowledge that your organization agrees to provide its company logo(s) to Region 14 ESC and agrees to provide permission for reproduction of such logo in marketing communications and promotions.

TDIndustries agrees to provide our company logo to Region 14 ESC and agrees to provide permission for reproduction of such logo in marketing communications and promotions.

ADMINISTRATION

91. Describe your company's implementation and success with existing cooperative purchasing programs, if any, and provide the cooperative's name(s), contact person(s) and contact information as reference(s).

TDIndustries currently holds contracts with the following cooperatives:

PACE

» Building Repair and Maintenance

1GPA

» Food Service Equipment, Supplies and Repair Services

BUYBOARD

» HVAC Equipment, Supplies, and Installation of HVAC Equipment
» Trade Services

OMNIA

» HVAC Equipment, Installation, Service, and Related Products

GSA

» Complete Facilities Maintenance and Management
» Refrigeration, Heating, Ventilation, Air Conditioning, Boiler and Chiller, HVAC Maintenance
» Ancillary Repair and Alterations

TDIndustries has been most successful in our implementation with NCPA. With our current processes and procedures producing such success, our other cooperative contracts have been modified to model similar processes and procedures.

Since all of our NCPA projects are channeled through one contact (Lorraine Vuong), we have the ability track the progress and report sales for all projects in a timely manner. Due to the compliance review program, we recently

created internal estimate sheets that are based off of our current contract terms and conditions. This allows our estimators and service team to be sure they do not exceed the contract established labor rates, margins and to be sure they include equipment discounts. This new process has been quite successful in allowing our customers to feel reassured they are receiving pricing that is better than or equal to our established NCPA rates.

92. Describe the capacity of your company to report monthly sales through this agreement.

Lorraine Vuong, our Government Contract and Compliance Manager will be responsible for keeping track of requested proposal numbers and reporting successful sales in the month they are complete by communicating with all business units at all TD locations.

93. Describe the capacity of your company to provide management reports, i.e. consolidated billing by location, time and attendance reports, etc. for each eligible agency.

Lorraine Vuong will also be responsible for facilitating management reports for all NCPA projects upon request.

94. Please provide any suggested improvements and alternatives for doing business with your company that will make this arrangement more cost effective for your company and Participating Public Agencies.

We suggest that billing be done on a monthly basis so that our accounting department can assure fees are appropriately charged to projects before close out.

GREEN INITIATIVES

We are committed to helping to build a cleaner future! As our business grows, we want to make sure we minimize our impact on the Earth's climate. So we are taking every step we can to implement innovative and responsible environmental practices throughout Region 14 ESC to reduce our carbon footprint, reduce waste, promote energy conservation, ensure efficient computing, and much more. We would like vendors to partner with us in this enterprise. To that effort, we ask respondents to provide their companies environmental policy and/or green initiative.

95. Please provide your company's environmental policy and/or green initiative.

We are committed to helping to build a cleaner future! As our business grows, we want to make sure we minimize our impact on the Earth's climate. So we are taking every step we can to implement innovative and responsible environmental practices throughout Region 14 ESC to reduce our carbon footprint, reduce waste, promote energy conservation, ensure efficient computing, and much more. We would like vendors to partner with us in this enterprise. To that effort, we ask respondents to provide their companies environmental policy and/or green initiative.

TDIndustries believes in doing our part to make the world a greener place. By providing recycling bins at every desk and every trash location, reducing unnecessary printing of documents and eliminating the use of Styrofoam products in our offices, Partners eliminate tons of recyclables from ending up in landfills. Furthermore, we do our part to recycle as much waste as possible on worksites by providing a separate bin for items that can be re-purposed or recycled. TDIndustries is also committed to the environment in the projects we work on. We have completed over 50 LEED certified projects and employ over 40 LEED Accredited Professionals.

VENDOR CERTIFICATIONS (IF APPLICABLE)

96. Provide a copy of all current licenses, registrations and certifications issued by federal, state and local agencies, and any other licenses, registrations or certifications from any other governmental entity with jurisdiction, allowing respondent to perform the covered services including, but not limited to licenses, registrations or certifications. M/WBE, HUB, DVBE, small and disadvantaged business certifications and other diverse business certifications, as well as manufacturer certifications for sales and service must be included if applicable.

LICENSES

Below is a listing of applicable licenses. Copies of individual licenses will be provided upon request.

DALLAS:

- Larry Bartlett------Plumbing—M-16723
- Dennis Grissom—AC/Refrigeration/Process Piping—TACLA26339C
- Stephen Rogers---Electrical –EC-17889

FORT WORTH:

- David Hollowell—Plumbing—M-19925
- Lyn Freeman---- AC/Refrigeration/Process Piping—TACLA17611C
- Stephen Rogers---Electrical –EC- 17889

AUSTIN:

- Weslee Jones----Plumbing ---M-36838
- John C. McRae---AC/Refrigeration/Process Piping---TACLA27827C
- Greg Gillespie----Electrical---EC- 26107

SAN ANTONIO:

- Louis Menard – Plumbing-- M-42395
- Billy Wayne Sides -- AC/Refrigeration/Process Piping---TACLA00058529C
- Greg Gillespie---Electrical--- EC- 26107

HOUSTON:

- Alvin Schneider-- Plumbing--M-35508—
- Mark Gafford-----AC/Refrigeration/Process Piping---TACLA00060764C
- Stephen Rogers---Electrical—EC-17889

WEST TEXAS OFFICES: AMARILLO AND LUBBOCK (USING FORT WORTH LICENSES FOR NOW)

- David Hollowell—Plumbing—M-19925
- Lyn Freeman---- AC/Refrigeration/Process Piping—TACLA17611C

COLORADO:

Tony Dixon-- Plumbing—MP-185879

TDOwned-----Plumbing State Contactor---PC-2056 // TDOwned---City Mechanical HVAC—237339 // TDOwned---City Refrigerant A----237340 // TDOwned--- Plumbing Contractor----17500

ARIZONA:

TDOwned--- ROC246533-C-39 // TDOwned--- ROC246535-C-37 // TDOwned--- ROC264254-C-74 // TDOwned--- ROC323889-CR-11

FIRE LIFE SAFETY:

- ACR-3105 Alarm Contractor's Registration -TD Owned
- ECR-1944 Extinguisher Contractor's Registration- TD Owned
- SCR-G-1065 Sprinkler Contractor's Registration- TD Owned

TAB 5 - PRODUCTS AND SERVICES

TAB 5 CONTENTS:

PRODUCTS AND SERVICES

Air Handling

Type (e.g., central station-manufactured or custom makeup air, fan filter, coil sections):	Virtually unlimited Mixed Air Single Path, Mixed Air Dual Path, 100% outside air Single Path, 100% outside air Duct Path, Variable-Speed, Drives, Heat Pipes, Heat Wheels, Fixed-plate Heat, Exchangers, High R-Value Insulation, High-Efficiency Motors, Preheat Coil, Heating Coil Cooling Coil, Supply Fan, Air Flow Station, Humidifier Discharge Static Pressure sensors, Exhaust, Mixed Air Damper, Airflow Stations
Brand Name(s):	Ex. Johnson Controls/York
Fan Types (e.g., Backward incline, Forward curve, Airfoil):	Fan Coil/Blower Coils, Package AHUs, Modular AHUs, Custom AHUs, Fan Wall, Backward incline, Forced, Pull Through, Airfoil
Capacity Range (CFM):	0 to 100,000 CFM
Heating Medium (Electric, Gas, Steam, Hot Water):	Electric, Gas, Steam, Hot Water, Re-Heat
Cooling Medium (DX, Chilled Water):	DX, Chilled Water
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 10 years parts and labor
Estimated Lead/Delivery Time:	6-8 Weeks
Location of Manufacturing (City, State, or Country):	Waynesboro, Pennsylvania
Range of Efficiencies:	Motors - 98% Efficiency
Estimated Market Share (North America):	30%
Provide example data on each type of product provided:	Please see Attachment A starting on page 112
Detail Features and Benefits:	**Mass Customization** - AHUs deliver custom-like performance and flexibility as well as being faster and more economical than was previously possible **Design Flexibility** - Offers variable-aspect-ratio sizing, plus a wide range of component/material choices **Faster Delivery** - Sophisticated computer engines speed-up the custom-manufacturing process of Johnson Controls AHUs **Flexible Factory-Packaged Controls** - No more limited control configurations: designers can now customize them to meet application requirements
Other Manufacturers:	Carrier, McQuay, Rheem, Ruud, Goodman, Lennox, Magic Aire, York, Johnson Controls, etc.

Air Terminal Devices and Heating Products

Type (e.g., VAV, Fan coils, Unit ventilators, Unit heaters, Fin tube radiation/convectors):	Virtually unlimited Electronic Variable-Speed Drive, Fan Coil Units, Heating and Cooling Coils, FlexSys Underfloor Air Systems, Unit, Ventilators, Variable-Air-Volume Terminals, Airside Technical Services, Single Duct Terminal
Brand Name(s):	Ex. Johnson Controls/York
Capacity Range (CFM):	0-6.000
Heating Medium (Electric, Gas, Steam, Hot Water):	Electric, Gas, Steam, Hot Water
Cooling Medium (DX, Chilled Water):	DX, Chilled Water
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 10 years parts and labor
Estimated Lead/Delivery Time:	6-8 Weeks
Location of Manufacturing (City, State, or Country):	Waynesboro, Pennsylvania
Estimated Market Share (North America):	30%
Provide example data on each type of product provided:	Please see Attachment B starting on page 120
Detail Features and Benefits:	**Precise Zone Control** **Design Flexibility** **Lasting Components and Low Cost Operation** **A Variety of Controls** **Patented Flow Star Sensor Control** **Unique Electric Heat Design**
Other Manufacturers:	Carrier, McQuay, Rheem, Ruud, Goodman, Lennox, Magic Aire, Johnson Controls, Greenheck, Trane, etc.

Boilers & Water Heaters

Type (e.g., modulating, condensing, cast iron, water tube, packaged, other):	Virtually unlimited
Brand Name(s):	Ex. AERCO, Condensing Unit
Capacity Range (CFM):	Boilers 750-Mb h to 6000 Mb h; Water Heaters - 600 Mb h - 1350 Mb h
Heating Medium (Electric, Gas, Steam, Hot Water):	Gas, Propane, Dual Fuel
Standard Warranty (Parts and Labor):	Parts only-pressure vessel/heat exchanger is 10 years non-prorated, Control panel is 2 years. 18 months all other components
Optional Warranty (components covered and labor):	As per customer needs. Can create a customized optional warranty.
Estimated Lead/Delivery Time:	4 Weeks
Location of Manufacturing (City, State, or Country):	Vlauvelt, NY USA
Range of Efficiencies:	94-99%
Estimated Market Share (North America):	40%
Provide example data on each type of product provided:	Please see Attachment C starting on page 150 and Attachment D starting on page 160
Detail Features and Benefits:	Reliability: » Superior Construction Materials » Advanced Design and Components » Warranty Installation Advantages: » Venting Versatility » Space-Saving Design » Zero Side Clearance Environmental Advantages » O2 Monitoring System » Low NOx burner Advanced Controls: » C-More » Remote Data Collection » Boiler Management System
Other Manufacturers:	Hydro Therm, Precision Boilers, RBI Water Heaters, Superior Boilers, etc.

Cooling Towers

Type (e.g., open, closed, evaporative, other):	Open, closed, evaporative, air cooled, hybrid
Brand Name(s):	Ex. Evapco
Capacity Range (tons):	Up to 5,000 Tons
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 10 years parts and labor
Estimated Lead/Delivery Time:	10 Weeks
Location of Manufacturing (City, State, or Country):	Taneytown, Maryland
Range of Efficiencies:	493 to 21,960 kw
Estimated Market Share (North America):	20%
Provide example data on each type of product provided:	Please see Attachment E starting on page 174
Detail Features and Benefits:	Principle of operation IBC Compliant Easy Field Rigging Efficient Drift Wliminators EVAPAK® Fill Superior Air Inlet Louver and Screen Design Reduced Piping Costs Pressurized Water Distribution System Optimum Design for Freezing Climates Fast, On-Time Shipments
Other Manufacturers:	Delta cooling, Armstrong, Evaptech, Marley, Kemrock, Paltech

DDC Controls

Type (e.g., core components, end devices, lighting, panels):	Tridium Niagara AX Web-based Multi-protocol Building Management Platform with Distech, Vykon or Siemens Talon equipment controllers
Brand Name(s):	Ex. Tridium
System Protocol (BACnet, LonWorks, Proprietary or Combo):	BACnet LonWorks
LAN Communication Structure (Peer-to-peer, Polling):	MSTP I/P Peer to peer
Human Machine Interface (HMI) types (PC, Notebooks, Handheld terminals):	All systems installed by TDIndustries are web accessible using most popular browsers Access via mobile devices
Third Party Interface (Drivers and Gateways):	All building automation systems installed by TDIndustries utilizes open protocols In retrofit applications, integration to existing proprietary automation systems is done using protocol drivers and hardware gateways
Remote Alarm and Message Capabilities:	Remote alarming available via email or text message
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 5 years parts and labor
Estimated Lead/Delivery Time:	6-8 weeks
Location of Manufacturing (City, State, or Country):	Tridium primary manufacturing facility Richmond, VA, USA
Estimated Market Share (North America):	40%
Provide example data on each type of product provided:	Please see Attachment F starting on page 180
Detail Features and Benefits:	Full integration capability for BACnet, LonWorkds, Modbus and other widely used protocols Distributed digital controls for HVAC, lighting and mechanical window shades Energy management programs, utility metering, data management UL864 rated smoke controls
Other Manufacturers:	Trane, Johnson Controls, ABB, BAC, Liebert, York, Distech, Siemens Talon

Energy Services

Type (e.g., Energy Tracking, Energy Analysis, Evaluation fo Potential Upgrades, Demand Response, Rebates and others):	Energy Savings Performance & Management Solutions. » Energy auditing and facility assessment » In-house Design Engineering and Specification » Construction Project Management » Continuous Commissioning » Ongoing Maintenance and Support Services » Guaranteed Savings Performance Monitoring and Verification » Facility Staff and Occupant Training » Financing Procurement Support » Surge Protection
Define Processes for eachtype of energy services:	Energy Auditing and Facility Assessment » Preliminary Audit-Expert modeling and analysis of baseline energy usage and savings » Detailed Energy Audit-Project development and economic analysis • In-house Design Engineering and Specification • Construction Project Management » Procurement of materials and trade labor » Safety coordination by our in-house Certified Safety Professional and OSHA-Authorized Trainer • Continuous Commissioning • Ongoing Maintenance and support Services • Guaranteed Savings Performance Monitoring and Verification » Performance guarantee backed by a history of financial strength, organizational longevity • Facility Staff and Occupant Training • Financing Procurement Support Including Identifying and securing all available grants, rebates, and incentives available to offset Project costs.
Certifications of Personnel:	Certified Energy Manager - Association of Energy Engineers
List key personnel (factory, subcontract, others):	All work is performed internally Ken Scheepers - Project Manager III Chuck Swallow - VP of National Accounts Randy Heidrich - Sr. Manager Operations
References (public sector only): **Additional References and details available upon request**	University of Texas at Arlington Guaranteed Savings: $11,480,960 / 10 years Bobby Kirby, Director of Energy and Mechanical Ops 817.272.9392 Denton Independent School District Actual Savings: $3,928,625 / 3 years & 38 M Gallons of Water Paul Andress Director of Operations 940.369.0230
Case Studies describing benefits of services:	Please see the following pages.

ENERGY MANAGEMENT AT TEXAS TECH

Growing energy footprint requires improved monitoring

Texas Tech University has big energy needs. The university has a growing student population exceeding 36,000 and a campus spanning 1,839 acres. To rein in its energy costs, Texas Tech turned to TDIndustries to tackle this challenge through smart data tracking technology.

In 2000, Texas Tech began tracking its energy consumption in an effort to understand how and where energy was being used. Throughout the years, the university has developed a broad energy management program, which is aligned with Texas Government Code, Chapter 447.

In 2013, Texas Tech contracted with TDIndustries and utiliVisor, an energy management firm, to analyze the real-time operating data gathered from the various university energy plants and provide recommendations for energy efficiency. In 2017, TD began campus utility metering services, providing meter installation, monitoring and reporting for a wide range of energy sources including electricity, steam, steam condensate, chilled water, irrigation and domestic water.

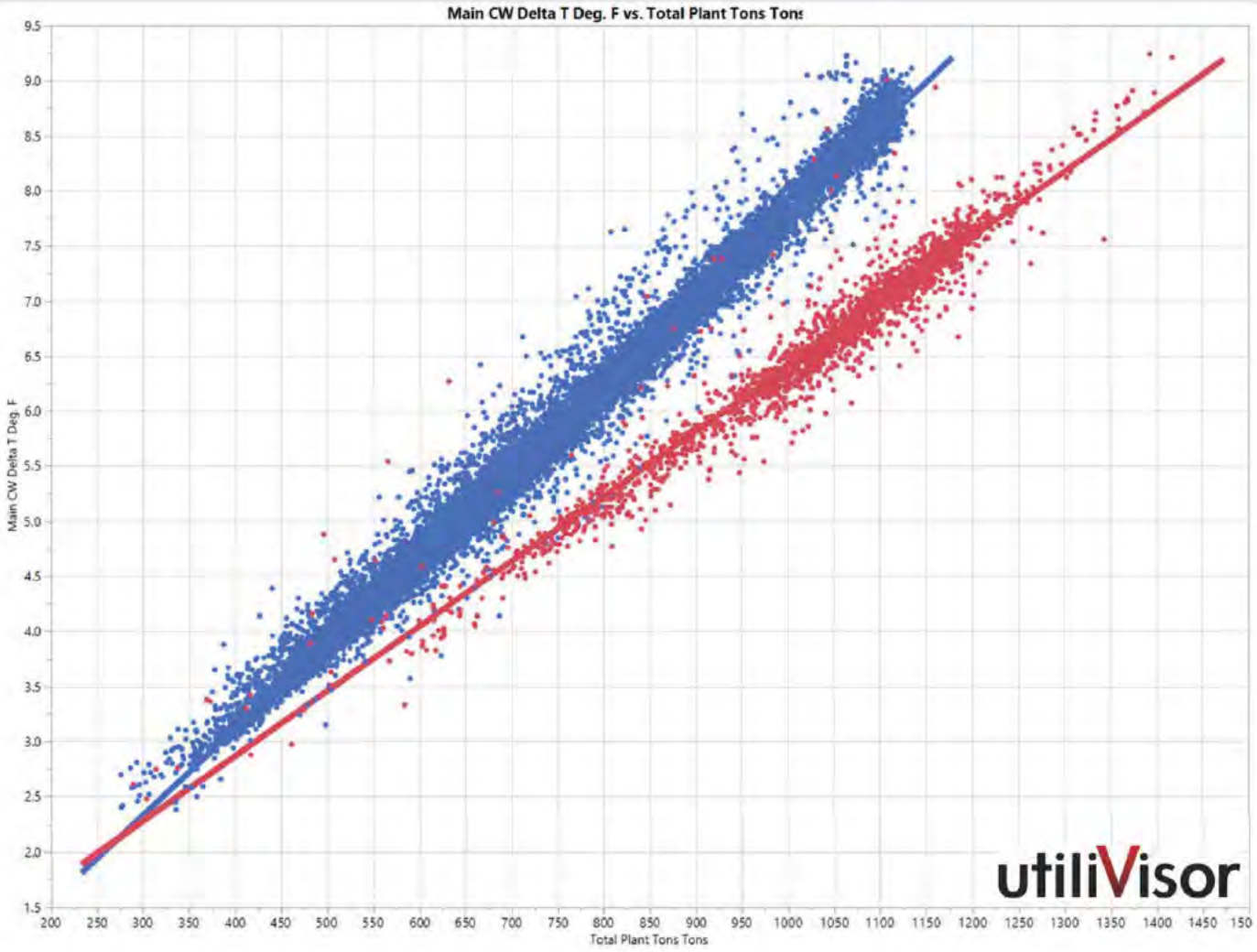
TD works in partnership with Texas Tech's Building & Construction Department, which oversees the metering program, to identify upgrades or new meters needed on a building-by-building basis. TD installs the meters and runs the electrical supply and energy source to the meter. The meters are tied into data drops provided by Texas Tech. During a meter installation, the energy supply must be completely shut down, which requires close coordination with all affected departments to minimize any impacts to campus operations.

The TDIndustries Difference

- Metering installation, monitoring, and reporting for a wide variety of energy sources
- Smart data collection technology to understand and control energy consumption
- Dedicated Partners who take ownership of campus energy performance
- System troubleshooting to quickly identify issues with timely solutions
- Continuous quality service and access to specialty knowledge that would be too expensive to maintain internally

tdindustries.com

TDIndustries
At the Heart of Your Building



TD uses utiliVisor software to analyze real-time operating data from Texas Tech's mechanical plants. Many of the reports are similar to this example, which compare the plant's efficiency against industry benchmarks.

Once the meter is complete, the meter is integrated into the utiliVisor database for data collection. Using the different views of this versatile, state-of-the-art system, TD provides regular reports on:

- Consumption per meter
- Consumption per building
- Consumption throughout the campus

In addition, TD closely monitors campuswide energy systems to alert the university of any usage spikes or trends that may indicate a potential problem or risk.

Texas Tech uses the collected information to balance the energy plant loads and integrate the data into its eSight Energy Accounting System. This specially designed system is used for campuswide monitoring and billing for non-educational buildings and common spaces, such as the student union. The information helps the university understand its energy consumption and costs and aids in the development of new energy saving initiatives.

Since 2000, Texas Tech's overall Energy Use Index (EUI), which tracks all energy used on campus, has shown a 37 percent decrease in energy usage, and from 2008 through 2018, the university reported $18 million in energy savings and an 18 percent reduction in the university's overall carbon footprint. Through close monitoring and analysis of its energy consumption metrics, Texas Tech has significantly reduced its energy consumption while expanding campus facilities to meet the needs of the increasing student population. Today, Texas Tech is recognized as a leader in energy efficiency, providing mentorship and lessons learned for other universities.

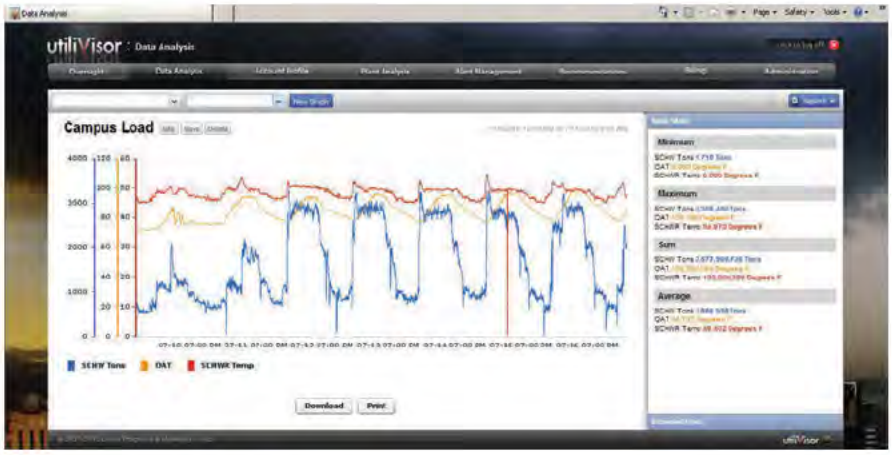
TDIndustries is proud to support Texas Tech and work in partnership to provide innovative solutions to help meet their energy performance goals.

TDIndustries

Attachment B-6.1

Energy Solutions

"Our commitment to innovation and sustainability in all aspects of energy-efficient planning and implementation ultimately means one thing for you: extended life for your plant and facilities with an optimal environment – and minimized environmental impact."



The TDIndustries Difference

- *Guaranteed reduced operating costs*
- *Tenant comfort and satisfaction grow exponentially*
- *TDLINKS Energy Audit pays back every cent+*
- *Extend the life of systems you already have*
- *Attain and retain your energy accreditation*
- *Empower highly accurate predictive budgeting*

The Face of Sustainability

TDIndustries (TD) is able to offer the most energy-efficient and environmentally sound solutions in the industry today because we've been committed to learning, adapting and applying new technologies as they are developed for a long time. Innovation drives our company. And a commitment to increasing sustainability drives every project we undertake for you.

Combine our commitment to sustainability and expanding innovation with powerful new means of collecting and analyzing data in real time. That's what we've done over the past 10 years, and we've worked tirelessly to exponentially increase the extent of our customers' control over facilities – all to reduce energy consumption and operating costs.

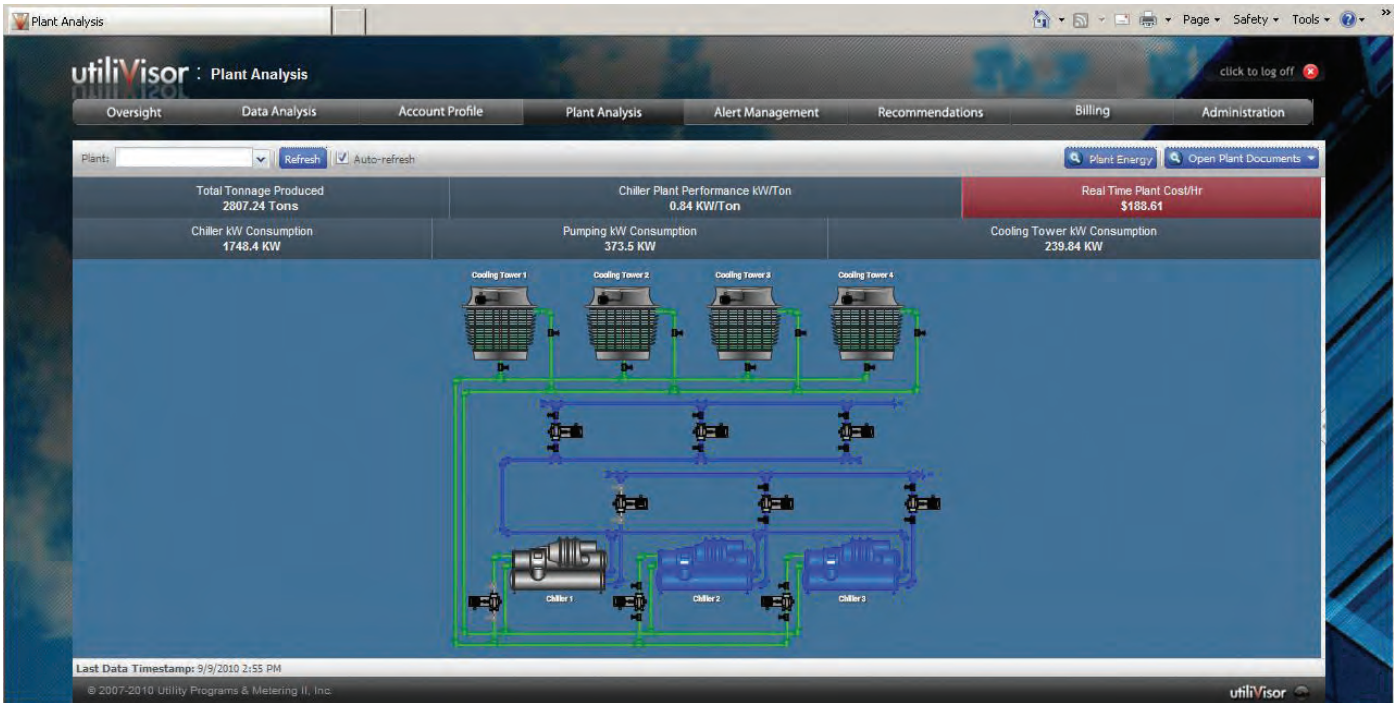
TD offers a full arsenal of energy solutions that includes a powerful array of energy audits and assessments, energy engineering, retrofitting, continuous commissioning, measurement and verification, building management systems and controls, and even financing to help your facility run cost effectively. It is in the optimal integration of all these initiatives that the sustainability of any building is maximized.

Energy Retrofits

If you operate an older building, you know how they can waste energy and burn capital. TD offers excellent services to modernize older, inefficient equipment operations, reduce utility, maintenance and operating costs, improve comfort, safety and compliance, and redirect capital to other needs.

THE FACE OF INNOVATION

tdindustries.com



New Buildings

Maximizing sustainability from the inception of a new building demands broad expertise and a singular focus on quantifiable ROI in all areas – cost, energy, time and more. Our goal is to offer our new building customers a no-risk business proposition with guaranteed savings, and verifiable results against worldwide standard protocols. Any shortfall can be made up by TD.

With our dedicated team of Certified Energy Managers, LEED-Accredited Professionals, Registered Professional Engineers and analysts, boasting memberships in EPA Green Light and Energy Star programs, we keep green objectives front and center when working on your project.

Building Oversight

For large, mission-critical chiller plants and CHP (Combined Heating and Power) environments, our utiliVisor™ building oversight strategy yields exponential savings and performance benefits related to the most complex and critical components of a facilities infrastructure. An expert team of operating engineers works with your staff to coordinate and manage this web-based, continuous oversight tool that:

- *Monitors, presents and analyzes key facility indicators – 24/7*
- *Leverages TD's extensive operations expertise*
- *Offers utility cost reductions of 5 to 25 percent*
- *Rescues and redeploys funds from inefficiencies back to your business*

Green Solutions That Mean Green Savings

For many customers, a determination to pursue green solutions begins with a routine maintenance or emergency service call that reveals a significant energy "challenge."

With precision metrics, and thorough data collection and analysis, we identify potential systemic and operational improvements to your sustainability. Better still, we have the depth of expertise necessary to ensure sensible, cost-effective implementation of those solutions.

Our commitment to innovation and sustainability in all aspects of energy-efficient planning and implementation ultimately means one thing for you: extended life for your plant and facilities with an optimal environment – and minimized environmental impact.

TDLINKS "Clicks" for You

No matter how big, small, new or old your systems might be, odds are you just don't know exactly what is driving your energy usage. How could you? With TDLINKS Energy Audit, you'll find out and be given a choice of actions to improve your efficiency. Our audit can chart the exact performance of your current or planned facility and then spell out how to optimize.

We start with an ASHRAE Level II audit, where we assess all controls and intelligent integrated systems. We report our findings to you, along with good/better/best optimization recommendations. Then our service teams implement the energy-efficiency and cost-saving measures accordingly. And all can be realized at no or low cost as operating expense or self-funded capital expense enhancements. Because the optimizations pay for themselves in reduced energy costs!

Contact us today to explore just how green your operations can be with our full range of energy solutions.

Count on TD to give you the sustainable advantage for the good of your building – and the planet.

TD SUPPORTS HIGH-IMPACT GROWTH AT DENTON ISD

Background

Founded in 1882, Denton Independent School District sits roughly 30 miles north of Dallas. One of the fastest-growing school districts in the nation, Denton ISD has grown its campus space from 3.5 million sf to more than 6 million sf since 2007. With 45 K-12 schools and educational facilities, it has counted on TDIndustries to maintain and operate these facilities for 29 years.

Challenges

Denton ISD's growth has been great for development, but also has come with growing pains. The school district has additional utility and energy costs, as well as increases in energy monitoring costs. With so many new buildings rising every year, the district quickly became overwhelmed with its manual monitoring method. One Denton ISD employee was calling every campus each month, then sending the bills to TD's engineering team to plug into a spreadsheet. Through this inefficient process, data was often 6-8 months behind.

Benefits of IFM for Denton ISD

- Cost reduction/mitigation
- Improved efficiency
- Right-sized support
- Utility monitoring
- Predictable cost structure
- Minimize backlog
- Single point of contact
- Growth options for employees

Solutions

TDIndustries provided two ways to combat these challenges:

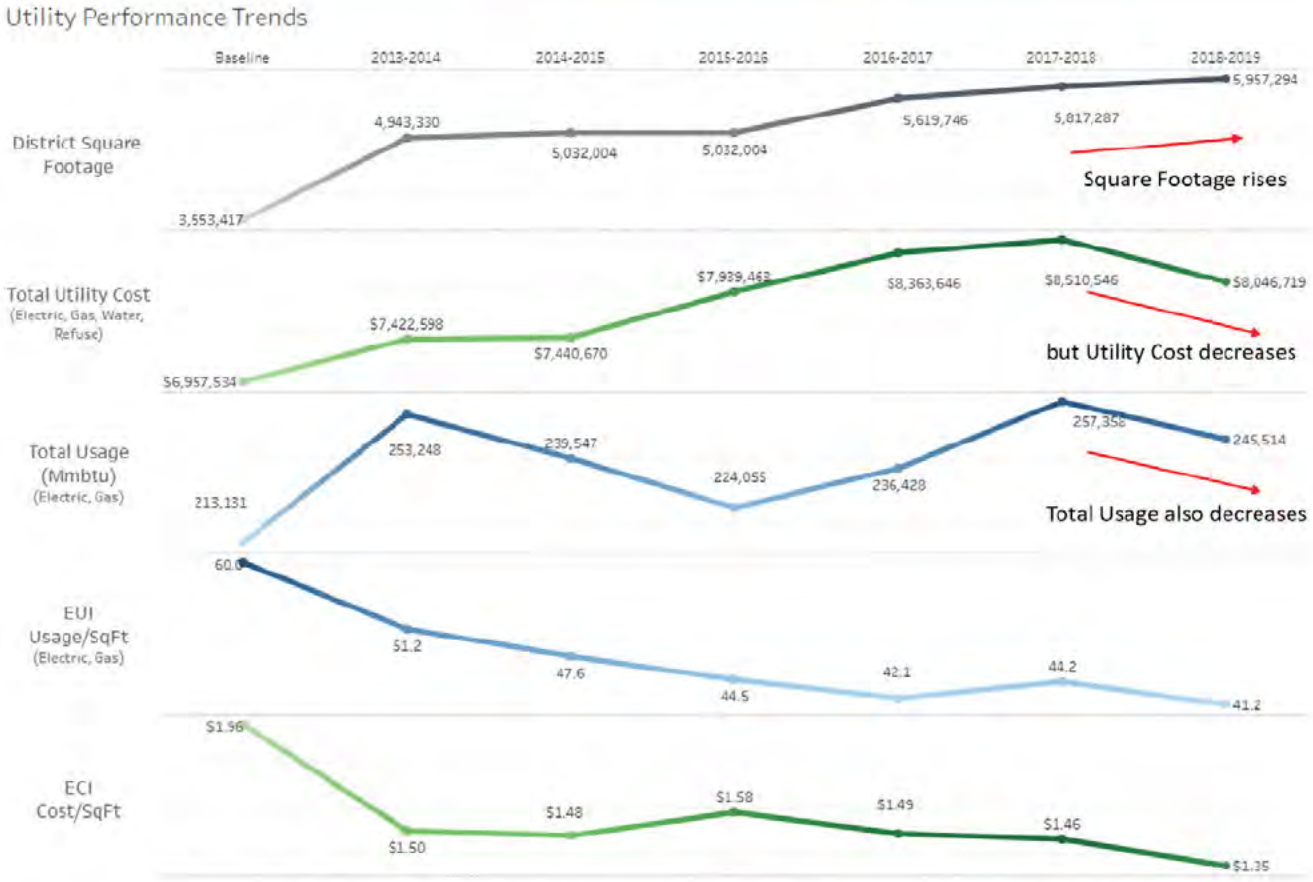
Growing its facility maintenance team: As the district grew, TD's commitment did as well. TD flexed its labor and monitoring services to adequately fit the district's growing needs. With trained, onsite maintenance personnel, TD could control costs more efficiently than relying on service agreements. Currently, 25 Partners maintain and operate Denton ISD facilities.

Provide energy monitoring services: Using TD's energy tracking platform, TD automated the energy usage data and easily identified potential savings, problematic outliers, and improvements.

TDIndustries
At the Heart of Your Building

tdindustries.com

TD PROVIDES SAVINGS OPPORTUNITIES FOR DENTON ISD



Between 2018 and 2019, total square footage rose, but utility costs and total energy usage decreased.

Results

In 2018, TDIndustries saved Denton ISD almost $130,000 in utility bill savings – enough to hire two additional teachers, Superintendent Jamie Wilson said. These savings occurred while the total portfolio size increased from 5.8 million sf in 2018, to 5.95 in 2019. In that same time frame, total utility cost decreased from $8.5 million to $8 million, and total usage decreased from 257,358 million btu to 245,514.

Additionally, TD's energy monitoring service reduced natural gas costs by 25 percent.

Beyond energy monitoring, TD's energy tracking program helped to identify a water usage spike. TD identified this data outlier as a water leak and promptly fixed it. Without the software, the utility company estimated that 10,000 gallons of water would have leaked before the problem would have been identified.

"We really work hard to find as many innovative ways as possible to get resources in the classroom," Wilson said.

"One of the ways you do that is by having good partners who can help you do the different pieces that aren't necessarily educating students, but they're important for the work we do."

Equipment Parts and Supplies

Type (e.g., Manufactured parts, emergency parts, miscellaneous material and supplies and other):	Manufactured parts, emergency parts, miscellaneous material and supplies
Brand Name(s) stocked:	Virtually unlimited. As specified by Customer or Customer Preference
Location of stocking parts:	Various
Standard Warranty (Parts and Labor):	One year labor and parts
Optional Warranty (Components covered and Labor):	Up to 10 years labor and parts
Estimated Lead/Delivery Time:	Varies depending on equipment parts/supplies selected
Percentage of locally stocked parts to delivered parts:	TDIndustries does not keep on hand parts or supplies. We utilize JIT supply chain management and are able to utilize our purchasing power to obtain parts in a timely manner.
Detail Features and Benefits:	Varies depending on equipment parts/supplies selected.

Financial Services

Type (e.g., Leasing, prompt and pre-payment discounts, guaranteed savings and other):	» Pre-payment/prompt payment discounts » Guaranteed Savings as required by State Statutes » As required by Customers
Describe type of each funding and availability:	TDIndustries offers pre-payment/prompt payment discounts as well as Guaranteed Savings as required by State Statutes (Energy Savings Performance Contracting) or as required by Customers.
Funding Sources (internal and/or external):	Internal and external
List key personnel (internal and/or external):	Evelyn Miller - CFO 13850 Diplomat Drive Dallas, TX 75234
References (public sector only):	Bonding Agent: Ward & Moore Insurance Services 12700 Park Central Drive Suite 1440 Dallas, TX 75251 Contact: Doug Moore 214-221-8300 Bank (since 1989): JPMorgan Chase Bank N.A. 2200 Ross Avenue, 8th Floor TX 1-2939 Dallas, TX 75201 Contact: Credit Department Bank Officer: Andra Phillips Andra.S.Phillips@Chase.com 214-965-3959
Case studies describing benefits of services:	Please see the Denton ISD case study starting on page 31.

HVAC Refrigeration

Type (e.g., rotary, centrifugal, scroll, reciprocating, absorption):	Frick Compressors, Centrifugal, Scroll & Rotary Screw Compressor with 3 Step volume ration and continuous capacity control, Models 12-101
Cooling medium (e.g., air, water):	Air cooled & Water cooled
Brand Name(s):	Johnson Controls, Inc. / York
Capacity Range (tons):	210 to 6,000 Tons
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 10 years parts and labor on all components
Estimated Lead/Delivery Time:	Depends on sizes and configurations
Location of Manufacturing (City, State, or Country):	Waynesboro, Pennsylvania USA
Range of Efficiencies (KW/Ton):	(740-21, 100 KW)
Estimated Market Share (North America):	60%
Provide example data on each type of product provided:	Please see Attachment G starting on page 123.
Detail Features and Benefits:	Quality, Satisfaction, and Reliability Energy Efficiency Engineered Control Systems Feature Q-Net Technology Guaranteed overall plant efficiency for cooling/heating
Other Manufacturers:	York, Copeland, Drake, Johnson Controls-Frick, TECUMSEH

HVAC Specialty Products

Type (e.g., modular, outside/inside, S&T heat recovery, humidity control, heat wheel, heat pipe, heat exchangers):	Heat Exchangers, Humidity Control, Heat Wheel, *Energy Recovery Units, Geothermal Heat Pump System, Ductless Systems, Oil Furnaces, Boilers
Brand Name(s):	Ex. Carrier
Heating Medium (electric, gas, steam, hot water):	Electric, Gas, Steam, Hot Water
Cooling Medium (e.g., DX Chilled Water):	DX, Chilled Water
Capacity Range (CFM and/or MBH):	1.5 to 2.5 MBH per 100 square Feet of total Building Feet 45 CFM to 7100 CFM
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 10 years parts and labor
Estimated Lead/Delivery Time:	6-8 Weeks
Location of Manufacturing (City, State, or Country):	Collierville, Tennessee
Range of Efficiencies (KW/Ton):	9 SEER to 21 SEER
Estimated Market Share (North America):	35%
Provide example data on each type of product provided:	Please see Attachment G starting on page 123 and Attachment H starting on page 196.
Detail Features and Benefits:	Type: Wheel Nominal Airflow: 350 cfm Tilt Angle (Heating/Cooling): N/A Degrees Pressure Drop: 0.38 Inches
Other Manufacturers:	Mitsubishi, McQuay, Reem Ruud, Goodman, Lennox, Copeland, Magic Aire, TECUMSEH, Tecscoma, York, Johnson Controls

Installation and Turnkey Contracting

Type (e.g., retrofit, new construction, energy retrofit, controls new - and upgrade and other):	All types of Turnkey Contracting, Design/Build and Design Assist across all of TDIndustries specialties
Define Processes for each type install of the system or the equipment:	We take a lifecycle view in planning, designing, specifying and installing our mechanical construction solutions. Whether it's a new design-build project, an expansion or retrofit, our long-range perspective, balanced with your priorities, creates the optimal solution. Through our experience, we have focused a great deal of effort in key areas of our mechanical construction to ensure safe, on-time, on-budget completion of systems that work, and work well. These advances include our deep resources, which enable us to self-perform all of our jobs; our pre-fabrication/ manufacturing; our tools; and our startup process, which ensure successful commissioning.
Bonding and licensing capabilities:	Virtually unlimited
List key personnel (factory, sub-contract, other):	Use Organizational Chart located on page 210-211.
References (Public sector only):	Denton ISD Paul Andress Director of Operations 940.369.0230 Texas State University Destiny Llamas HUB Specialist 512.245.6243. City of Maricopa Dan Leonard Facilities Manager 520.316.6949 City of Houston Eric Alexander Senior Procurement Specialist 832.393.8704
Case studies describing benefits of services:	Please see the following pages for a recent design-build project TD completed.

RAYTHEON CONTINUES THRIVING WITH DESIGN-BUILD METHOD

Located in Richardson, TX at the upscale CityLine mixed-use development, Raytheon's new facility consists of three campus-style buildings designed to accommodate future expansion. With ideal security and privacy, a training room, full-service cafeteria, fitness center, an extensive data center, and a prime location near public transit and major freeways, Raytheon continues to thrive as a $24 billion defense contractor in the LEED-certified facility.

The Situation

When Raytheon was looking to relocate nearly 2,000 employees from its original campus built in the 1950s, they envisioned a state-of-the-art facility that would include high security, diverse workspace options, flexible meeting rooms, an abundance of windows, aesthetic designs, and satisfying dining options to attract and retain top-notch engineers. Raytheon needed to be out by the time their lease ended in 15 months.

The owner, KDC, sought to provide a new home impeccably tailored to Raytheon's culture, talent acquisition, and mission-critical needs. However, going from design to construction on a fast schedule wasn't feasible through the conventional plan-spec method. Due to Raytheon's nature of work, an expertise in working around sensitive compartmented information facilities (SCIFs) and other restricted areas was critical.

Raytheon
by the Numbers

- (2) three-story buildings
- (1) four-story building
- 500,000 sf approximate total
- (1) modular CUP
- Finished in six months

The Solution

By collaborating early through the design-build method, KDC and TD were able to tackle the aggressive timeline and later alterations with reliability and ingenuity. Weekly meetings with decision-makers, trusting relationships, and transparency played a pivotal role in streamlining the process. Constructability engineering, adequate manpower, minimal RFIs, and a no change-order guarantee were essential to completing the project on time and within budget.

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TACKLING AGGRESSIVE TIMELINES WITH RELIABILITY AND INGENUITY

TD provided mechanical and plumbing engineering design and construction for the three buildings including two three-story buildings and one four-story building. The facility included a fully prefabricated modular central utility plant (CUP) measuring 45 feet by 20 feet. The plant was manufactured offsite and installed within one day of delivery. By utilizing modular construction of the CUP, critical savings included one month of labor, as well as, significantly reduced equipment costs. Additional work included chilled water serving building A with DX rooftops serving buildings B and C.

Some of the cost saving and value-added innovations provided by TD's constructability engineers included spiral duct instead of rectangular duct, plug and play reduced pressure zone (RPZ) device in wall connect manifolds in each breakroom, and therma-fusers with a grill for huddle rooms. TD's expertise in building data centers, healthcare facilities, offices, and government facilities provided the best in security throughout the project.

The Success

The conventional plan-spec route would have taken at least a year to complete Raytheon's new home, but KDC's decision to pursue the design-build method with TD resulted in a 500,000 sf facility being finished in six months. TD's LEED-accredited professionals collaborated with KDC and Raytheon to meet necessary standards and criteria, and delivered a sustainable, innovative facility without compromising on quality and performance.

Raytheon is a prime example of TD's turnkey capabilities. Our Controls and Service Teams were awarded the contract to complete the full life-cycle of the building. TD Controls' knowledge of the project from their early involvement, with budgeting and designing the building controls, was key to the project's success – bridging the gap between our construction group and service as they began their service agreement for HVAC, electrical, fire/life safety, and automation.

"The performance of TD has not only met but surpassed our expectations for the Design-Build implementation. The D-B approach and the level of team work between TD and Walker Engineering has been key to the success of the project, allowing the team to be nimble, flexible and responsive to Raytheon's ever-evolving needs and still meet our contractual commitments."

– Mike Rosamond, KDC Executive VP

Invertors

Brand Name(s):	Ex. Carrier
Capacity Range (HO):	2.5 to 4Hz or 10 to 14HP on a 200HP Motor
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 10 years parts and labor
Location of Manufacturing (City, State, or Country):	Collierville, Tennessee
Estimated Lead/Delivery Time:	Currently in stock for standard compressor needs and 3-5 days on specialty needs for inverters. The quantity of invertors could also result in a delay of lead time as well.
Estimated Market Share (North America):	35%
Provide example data on each type of product provided:	Special Magnetic flux vector control VFDs Power Range: Single phase 1.5kw to 2.2kw 3 Phase Integrated RS485, Modbus-RTU communication Protocol 32 Bit high speed CPU special for ac motor controlling Built in braking unit the VFD Braking, 15kw Power to Lower Please see Attachment I starting on page 204 for more information.
Detail Features and Benefits:	High Performance Optimized voltage space Vector V/F algorithm and high efficiency VFD low Noise and low electromagnetic interference. Motor Speed monitor function allow smooth start for various loads such as centrifuges and de-watering machines anytime.
Other Manufacturers:	ABB, Emerson, Liebert, Johnson Controls, York

Professional Services

Type (e.g., Engineering, Design, Drafting, Architectural, Project Management and other):	Engineering, Design, Drafting, Architectural, Data Management
Describe type of each professional service and availability:	In terms of our Design-Build capabilities, out theory is that your mechanical system is the engine-the-heart of your facility. When your system is running smoothly and seamlessly, your business hums along. That's why you can rely on TDIndustries to deliver superior results with anything you can hand us new systems, expansions or change-outs. We bring several innovations to the table including: Mechanical Engineering services for Design Build HVAC/ Plumbing and DDC Controls, Building Information Modeling for HVAC/Plumbing design/duct/pipe fitting/prefabrication. LEED certification for Design/Build & Assist Projects.
Licensing and certification capabilities:	TDIndustries has several licensed registered Engineers and LEED accredited professionals. Certified Energy Manager (CEM)
List key personnel (internal and/or external):	All work performed by TDIndustries Engineering Group
References (public sector only):	Lone Star: Greene's Point Campus - Houston, TX Wendy Hipes: 713-996-2799
Case studies describing benefits of services:	Please see the following pages.

TDIndustries

At the Heart of Your Building

Lone Star College

Case Study

Facilities Management & Energy Solutions

Situation

Lone Star College is a higher education system based in Texas that serves the local communities of Houston, Conroe and The Woodlands. TDIndustries (TD) provides Facility Management Services to five of Lone Star College's campuses, encompassing more than 1 million square feet of campus space. Before TD began work, the Lone Star College System was managing the maintenance operations with their own employees. The operations at these North Harris campuses were outsourced to TDIndustries Facilities Partners to allow the Lone Star managers the ability to focus on their business of educating the 18,000 students that attend these campuses.

PARTNERS PROVIDE SOLID FACILITIES MANAGEMENT AND ENERGY SOLUTIONS AT THE NORTH HARRIS CAMPUS

Solution

TD brought its industry-leading capabilities with critical systems and technician management. Using a hybrid staffing model, TD was able to bolster Lone Star College's existing facilities team. Through continued efforts with safety training, efficient scheduling in the equipment maintenance and work order system, TD's onsite team has been a renewed asset to the campus staff.

Success

The total facilities management approach employed at the Lone Star College System, has allowed TD to do more with less. The existing Lone Star facilities personnel are key to the daily campuses deliverables. TD has provided ancillary management of this team to control daily operations, allowing the TD staff the ability to build additional value offerings for the customer.

An initial water savings project at the North Harris Campus was started within the first six months of the contract starting. TD invested an additional $17,250 annually to upgrade the water treatment control, monitoring, and chemical feed equipment. Experienced TDPartners also saw an opportunity to reduce costs by correcting and metering the blowdown from the cooling tower. TD capitalized on water treatment recommendations to change the make-up water feed to the cooling tower and use less total water for cooling. All of these program changes and upgrades aided in removing mineral deposition from the equipment in the central plant. The efforts improved the efficiency of the campus HVAC equipment and uncovered a healthy operations cost savings for the Lone Star North Harris Campus. These gained efficiencies lead to a total utility cost reduction of $59,643, in the 2016 fiscal year.

Savings aside, the customer is pleased with TD's ability to provide full facilities management with an impeccable safety record – 100% no incidents – and both parties look forward to a long and prosperous relationship.

From maintaining aesthetics to management of Lone Star College's staff, the full range of services includes:

Mechanical, electrical and plumbing (MEP) services

Landscaping

Elevator maintenance

Housekeeping and related paper products

Pest control

Fire, life and security systems

Specialized roofing

Building automation systems

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TDIndustries

Health & Biomedical Sciences Center Case Study

The University of Houston Accelerates Biomedical Center Construction

TDIndustries Establishes Milestones and Meets Them

The University of Houston's (UH) Health and Biomedical Sciences Center Building is an approximate 172,000 square foot, six-story building with a mechanical penthouse connected to UH's College of Optometry. The $68 million research and patient eye-care facility was designed using green/ sustainable principles and includes an ambulatory surgical center, The Laser Center, specialized research laboratories, animal care facilities, offices, seminar spaces, a new conference facility, and classrooms. The project also includes the construction of a 16,000 square foot satellite central plant to support the new facility.

THE FACE OF INNOVATION

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The Situation

In its trek to achieve Tier One status, UH has embarked upon a major capital projects initiative. The Health and Biomedical Sciences Center (HBSC) Building represents a bold step toward becoming an integrated, cross-disciplinary research facility necessary for a Tier One university.

UH engaged Tellepsen Builders as the Construction Manager at Risk for the project. Tellepsen turned to TDIndustries to construct the central plant that will support the new facility.

UH set an aggressive construction schedule with a start date of November 2010 and an expected completion in late 2012. One of the major milestones was for the structure to be "air on" within six months of the start date.

The Solution

TD quickly focused on the schedule and developed its plans to meet milestones while working on a restricted jobsite connected to an occupied facility. Expectations were for an extremely fast schedule, beginning with 80% documents and having the majority of the rough-in completed with "air on" by the six month deadline.

TD's scope included:

- Building a completely independent 2, 250 ton central plant with cooling tower and associated pumps and pipe valve fittings, and
- Installing high pressure steam boilers that provide steam to water heat exchangers, steam to clean steam heat exchangers and clean steam to the Vivarium on Level 6.

Elements of TD's processes and technologies to meet scope deliverables included:

- Building Information Modeling (BIM) to provide 3-D coordination in the planning phase, and
- Prefabrication of central plant and skid mounted systems along with air handling unit hookups.

These tactics proved invaluable in accelerating the pace of work and TD's ability to meet the client's milestones.

The Success

TD met the "air on" date and the project is on schedule for its 2012 completion date. Tellepsen has been impressed with TD's ability to respond to changing situations in a timely and professional manner, its attention to precision work and its commitment to safety.

Pumps

Type (e.g., single stage, split case, end suction, inline, circulator, turbines):	Single stage, Split Case, End Suction, Inline, Circulator, Turbines, Domestic Cold Water, Waste Water Dosing and Disinfection, Multi Stage*, Systems Chill Water, Systems Hot Water, Centrifugal Pumps, Screw Pump, Gear Pump, Vacuum Pump, Any Type pump for application needs
Brand Name(s):	Ex. Sulzer
Capacity Range (GPM):	Any GPM can be manufactured as required for Job/Project
Standard Warranty (Parts and Labor):	One year parts and labor
Optional Warranty (components covered and labor):	Up to 10 years parts and labor
Estimated Lead/Delivery Time:	6-8 Weeks or unless pump is in stock
Location of Manufacturing (City, State, or Country):	Easley, South Carolina Portland, Oregon Houston, Texas
Range of Efficiencies (KW/Ton):	65% Minimum 85% for motors up to 15kw 90% for motors above 15kw
Estimated Market Share (North America):	20%
Provide example data on each type of product provided:	Please see Attachment J starting on page 215.
Detail Features and Benefits:	Multiphase Pumps: » Helicoaxial stages axially compress the effluent to avoid separation and gas binding » Stage design changes to compensate for gas compression through the pump » Horizontal (onshore) or vertical (subsea) configurations to fit the application » Subsea qualification testing and JIP projects welcomed » Variety of sizes available from 1 to 10 MW to suit the field development, production and decline Main Applications » Remote or subsea multiphase pressure boosting Main Design Features » Helicoaxial stages » Cartridge construction for retrofitting ease as field conditions change » Sulzer pressure boundary design experience to 1000 bar » Variety of performances: single-phase, multiphase or hybrid » Variety of performances: Motor, GT, high-speed permanent magnet motor, etc.
Other Manufacturers:	Myers, Gundfos, Sta-Rite, Hydroflo, Bell & Gossett, Pumps, Goulds

Service & Maintenance

Type (e.g., Preventative and full maintenance contracts, man-at attendance, remote monitoring, annuals, emergency services, regulatory compliance, cleaning) (e.g., duct, coils, and filters):	(Oil, refrigerant, vibration, chemical analysis, annuals, full maintenance, preventative maintenance) We offer complete HVAC, Plumbing, and Electrical scheduled maintenance services
Define Processes for each type of services and/or maintenance of the system or the equipment:	Service, Repair, Replacement and Maintenance of HVAC equipment (including but not limited to Air Cooled and Water Cooled Chilled Water Systems, Split Systems, Package Units, Computer Room Air Conditioners, Variable Frequency Drives, Fan Powered Boxes, and VAV boxes). Maintenance includes performing, at designated intervals, annual and routine planned maintenance inspections of HVAC equipment per manufacturer's specifications and requirements with the goal of extending the equipment's useful life through proper operating conditions. Inspections will include a combination of assessments and cleaning of condensers, evaporators, coils, condensate lines and drains, filters, belts, electrical connections and safeties, refrigerant systems, heaters, blowers, bearings, and motors. Equipment will also be inspected for proper airflow, pressures, temperatures, and operating issues such as short cycling, vibrations and noises.
List of key personnel (factory, sub-contract, other):	Please see Org Chart on pages 210 and 211.
References (public sector only):	Please refer to proposal references on page 284.
Case Studies describing benefits of services:	Please see below.

Lake Dallas ISD – Lake Dallas, Texas

TD services a variety of schools in Lake Dallas ISD to make sure that their HVAC and refrigeration equipment is highly functional and passes inspection. Our technicians are on call to help ensure that equipment is operating efficiently and reliably, especially during peak seasons. Scheduled maintenance includes HVAC preventative measures, commercial refrigeration, filters, building automation control systems support, rooftop units, ice machines, split systems, and air unit planned maintenance tasks.

Site Surveys

Type (e.g., equipment, system analysis, operational, architectural and other):	(Equipment, system analysis, operational architectural) Equipment, system analysis, lifecycle cost analysis, design-build/assist, preparation of as built diagrams, 3D modeling of plant, piping, ductwork, etc.
Describe type of survey:	In-house capabilities, complete building modeling for System Analysis/Energy use modeling, etc.
Licensing and certification capabilities:	Certified Energy Managers - Association of Energy Engineers. Licensed Engineers
Advanced technology uses for each type of survey:	With new, and existing facilities, generating ongoing energy savings can be achieved through a comprehensive monitoring-based commissioning (MBCx) process to ensure that all building systems remain "in tune". It is common knowledge that buildings rarely perform as intended.
List key personnel (internal and/or external):	TDIndustries Engineering Group
References:	» Texas Women's University, Denton Campus » George Bush Intercontinental Airport, Houston » University of Texas, Arlington » Fountain Place, Dallas » City Place, Dallas
Case studies describing benefits of services:	**UT Arlington:** » Chiller efficiency caused by evaporator approach which is never a part of the commissioning agents scope repaired by the Mfg. under warranty » Cooling Tower VFDs had issues repaired by the Mfg. representative under warranty » Cooling Tower performance issues and improper flow meter installation issues identified **TWU Denton:** » TWU Denton has 3 chillers, 115 data points with a service cost of $27,400/year » The average plant operating cost avoidance is 15.5% or $44K annually

Startup and Commissioning

Define process for validation of system or equipment operation to design:	Commissioning is a systematic documented process to ensure that facilities, systems, and equipment meet established design requirements and operation design intent. The Commissioning process verifies the following: » The equipment that was specified for installation was properly installed per engineer design and the manufacturer's recommendation. » Functions within designed airflow, design pressures and performance and functions per purpose. » The operation and design criteria was meet and performance is demonstrated to the engineer and owner. » Demonstration to the owner on proper preventive maintenance requirements per the manufacturer's recommendation to maintain warranty requirements and are performed to train the owner of the equipment.
Type (e.g., equipment startups, system checkouts, control verification, retro commissioning, M&V verifications, rebate auditing, other):	Start-up Prior to starting equipment or systems, obtain and review manufacturer's installation, starting and operating instructions Use manufacturer and supplier's trained personnel where necessary to maintain validity of manufacturer's warranty Compare actual installation with manufacturer's recommended installation. Correct deviations detrimental to equipment performance prior to starting equipment. Refer to the contract regarding the requirement of pre-existing and/or owner furnished equipment System Checkouts: Air Handling Units, Chilled Water Coils, Chiller(s), Cooling Tower(s), Boiler(s), Deaerator(s), Condensate Pumping Unit(s), VAV/CT Terminal Box(es), Chilled Water, Cold Water, Heating Hot Water Pump(s), Steam and Condensate piping, Heating Water Piping, Steam and Condensate Piping. Control Verification: The commissioning process starts with verifying the control inputs and outputs on a point-to-point basis. Calibration of each analog input and output using an independent and certified measurement device for temperature, pressure, and accurate readings on the graphics. The test will also include the sequences of operation in all normal modes and verify the points against the intended functionality of the system as a whole. Retro Commissioning: Retro commissioning is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro commissioning can often resolve problems that occurred during design or construction, or address problems that have developed throughout the building's life.

List key personnel (factory, sub-contract, other):	Tasos Banos Sr. Vice President TDIndustries Peyton Hill Operations Manager
References (Public sector only):	Memorial Hermann Pavilion II 6411 Fannin Street Houston, Texas 77030 Chris Barrow - Project Manager 713.996.2459 Memorial Hermann Katy 23900 Katy Freeway Katy, Texas 77494 Chris Barrow - Project Manager 713.996.2459 University of St. Thomas Chase Morris - Project Manager 832-309-2646
Case studies describing benefits of services	Scott White Hospital Dollar value of the Agreement to date: $27,168,746 Dollar value received relative to the Cx: $1,245,000 MD Anderson Cancer Hospital Dollar value of the agreement to date: $350,000,000 Dollar value received relative to the Cx: $2,500,000 Performed commissioning tasks and acted at the commissioning agent, performing design document and submittals reviews, oversaw the development of the commissioning plan, start-up, and pre-functional, and functional test procedures. Witnessed the pre-functional and functional tests of the MEP systems, and developed a detailed corrective action log which the contractor was required to implement. Witnessed the retesting of deficient systems, and observed and verified owner training was successfully completed, no delays were on this project.

Unitary

Type (e.g., rooftops, split systems, VRFs, heat pumps, PTACs, water-source, mini splits):	Rooftops, *Split Systems, DX, VRFs, Heat Pumps, PTACs, Chill/ Hot Water
Brand Name(s):	Johnson Controls / York
Capacity Range:	RTUs 25, 30, and 40 Tons RTUs 50 through 65 Tons Series 100 Single Package Units
Heating Medium (Electric, Gas, Steam, Hot Water):	Electric, Gas, Steam, Hot Water
Cooling Medium (DX, Chilled Water):	DX, Chilled Water
Standard Warranty (parts & labor):	One year parts and labor
Optional Warranty (components covered & labor):	Up to 10 years parts and labor
Estimated Lead/Delivery Time:	6-8 Weeks
Location of Manufacturing (City, State, or Country):	Collierville, Tennessee
Range of Efficiencies (EER, SEER, COP):	Up to 16 SEER, Energy Star Qualification
Estimated Market Share (North America):	40%
Provide example data on each type of product provided:	Please see Attachment K starting on page 219. 1.5 to 5 Ton 208-230 Volts Heavy Gauge Galvanized Steel Construction Single Stage Scroll Compressor
Detail Features and Benefits:	Models meets the Department of Energy's higher EER rating required to meet the region's minimum efficiency.
Other Manufacturers:	Carrier, Mitsubishi, Rudd, McQuay, Reem, Goodman, Lennox, Trane, Greenheck

Warranty

Type (e.g., Extended parts & labor, define maximum number of years available, delayed start-up and other):	Extended parts & labor up to 10 years, delayed start-up
Define processes for each type of warranty:	Priced as an option to Customer-lowest lifecycle cost at time of purchase. All equipment warranties on all products installed by TDIndustries are captured in a master database - New Construction/Retrofit, & Service replacements. Should a warranty claim arise, the database provides the feedback loop to our Project Managers to initiate the warranty claim with the appropriate manufacturer, dealer or distributor. Turnaround time is dependent on the Supplier, but TDIndustries will leverage our size and buying power to help Suppliers prioritize our replacement delivery and if necessary, we will provide temporary heating/colling if the problem leaves our Customer without comfort in the meantime.
List key personnel (factory, subcontract, other):	Please refer to Org Chart on pages 210 and 211.
References (public sector only):	Denton Independent School District - 2 years parts and labor Richardson Independent School District - 2 years parts and labor Fr. Stockton Independent School District - 5 year parts and labor
Case studies describing benefits of services:	Lone Star College Woodlands, a customer on Facilities Preventive Maintenance agreement, found five IT rooms were not cooling. This caused the door to stay open and dependent on the building cooling system to remove the heat load from the equipment rooms. After investigating, it was found that the liquid line set was not installed per manufacturer's requirements and was missing a Freon trap system. This caused all the oil to relocate in the evaporator coil instead of the compressor, which is required for lubrication, causing the compressor to fail as well as several electrical safety devices in the system. TDIndustries acting as the warranty administrator for the project was able to order all five compressors which were no longer manufactured and locate several electrical safety devices for the system and install the trap system required fore proper colling to the IT areas in the building.

Indoor Air Quality Products and Devices

Type (e.g., rooftops, split systems, VRFs, heat pumps, PTACs, water-source, mini splits):	TDIndustries does not utilize active polarization, non-ionizing, and electronic air cleaning systems due to their harmful nature. We utilize Foster products 4030 & 4020 for microbial remediation.
Brand Name(s):	Foster
Capacity Range:	N/A
Standard Warranty (parts & labor):	One year labor and materials
Optional Warranty (components covered & labor):	Up to 10 years parts and labor on all components
Estimated Lead/Delivery Time:	1-5 days
Location of Manufacturing (City, State, or Country):	Houston, Texas
Range of Efficiencies (EER, SEER, COP):	N/A
Estimated Market Share (North America):	60%
Provide example data on each type of product provided:	Attachment L starting on page 223
Detail Features and Benefits:	The outstanding Foster® product line of surface coatings and accessory products are designed for air handling systems and for walls and ceilings to promote and/or maintain excellent indoor air quality (IAQ). Foster IAQ products are scientifically proven to be effective in worst case scenarios through extensive ASTM D-5590 testing.

YORK® SOLUTION® AIR-HANDLING UNITS

ATTACHMENT A

Design without limits

YORK®
BY JOHNSON CONTROLS

TDIndustries

Solution® air-handling units experience and flexibility

We've built Solution units for all types of commercial, institutional, and industrial facitlities.

Names you know and trust

YORK® Solution® air-handling units (AHUs) by Johnson Controls – the only names you need to know for an AHU line that has no limits, ranging from basic indoor units up to penthouse mechanical-equipment rooms. And whatever the air-handling challenge – IAQ, acoustics, energy, controls, you name it – Johnson Controls has the experience to build a Solution AHU that will meet your needs.

In the air-handling business, the reputation and experience of the manufacturer is as important as the product. Johnson Controls has been manufacturing air-handling equipment since the 1950s. Then, in the 1990s, we acquired two of the most well-known and respected AHU companies in the business: the PACE Company and the Miller-Picking Corporation. Their 100-plus years of experience have now been joined with the worldwide engineering, manufacturing, service, and support of Johnson Controls, a Fortune 80 firm with a 125-year legacy in HVACR technology. The result is a company dedicated to providing uncompromising solutions for your air-handling needs.

For commercial and institutional facilities, for industrial manufacturing and process operations, and for critical hygienic applications in hospitals and cleanrooms, Solution AHUs can be built to handle any requirement – no limits.

Design it your way, every time, every way

Dimensional flexibility: Space constraints are a reality on most construction projects. Why be constrained by fixed AHU sizes? Solution AHUs offer variable aspect-ratio, so you can design the unit to fit the application and the space. And if rectangular-shaped units can't fit the space, units can be configured to fit within just about any existing space or around any obstacle. L-shaped and T-shaped units, stacked units, notched units – we can do it.

Material flexibility: We offer a complete line of construction materials, including galvanized steel, pre-painted steel, stainless steel, and aluminum.

Component flexibility: To enable you to meet any AHU requirement, Solution units offer every available air-handling component. And as technology creates new capabilities, Johnson Controls will apply these to our Solution line.

EXPERIENCE? WE'VE BUILT AHUs FOR ALL THESE

- Commercial space: office buildings, theaters, performance halls
- Institutional space: schools, universities, churches
- Industrial manufacturing: automotive, aerospace, chemical, petrochemical
- Hygienic systems: hospitals, life sciences, R&D facilities, food processing, cleanrooms
- Process manufacturing: pharmaceutical, electronics, semiconductor

The smart way to raise your IAQ

Superior casing performance

Because indoor air quality (IAQ) is now vital to your project's success, your AHU's performance is absolutely critical. That's why Solution AHUs offer advanced features that can meet any IAQ challenge you face. It all begins with casing performance. Casing leakage can deteriorate the quality of the air supplied to the occupants by allowing dirty,unfiltered air to leak into the airstream downstream of the filters. To minimize leakage, all Solution AHUs employ superior casing construction. As a minimum, air leakage is limited to a miniscule 1% at ±8" w.g. If needed, the leakage can be limited to only 0.5% at as high a design pressure as required.

Filter out impurities

A complete line of filters is available for all Solution AHUs. For light- or prefiltering duty, use our pleated and extended-surface filters. For more stringent requirements, 60% to 95% efficient rigid or bag filters can be specified. HEPA filters are available to trap particles as small as 0.3 microns with 99.97% effectiveness. Ultra-HEPA filters can remove particles as small as 0.1 microns. Activated-carbon filters are excellent at removing odors and volatile-organic compounds from the airstream.

A complete line of filters is available, including pleated, rigid, bag, HEPA and carbon.

Hygienic drain-pan design

Micro-organisms can flourish in drain pans when cooling-coil condensate remains there during "off" or "heating" cycles. Solution AHUs move that condensate out of the unit with multi-sloped drain pans that ensure positive drainage. All pan designs also offer accessibility for periodic cleaning, now required by ASHRAE Standard 62-2001.

Ensure adequate ventilation

An adequate supply of ventilation air is critical for the health of facility occupants. However, having to condition too much outside air can drive up energy costs. The solution is the AMS-60 damper, which incorporates an airflow-measuring station. The AMS-60 damper simultaneously measures and controls the volume of ventilation air, making sure it's neither too little nor too much.

Multi-sloped drain pans ensure positive drainage.

The AMS-60 damper measures and controls ventilation-air volume.

IAQ FEATURES TO HELP YOU CLEAR THE AIR

- Double-wall construction
- IAQ drain pans
- AMS-60 dampers
- Perforated liners
- Low-leak dampers
- P-cone fan monitoring
- All filter types (flat, angle, carbon, HEPA, etc)

Put your AHUs on an energy diet

Heat-recovery wheels reduce the cost of conditioning ventilation air.

Variable-speed drives offer dramatic fan-energy savings.

FEATURES THAT SAVE DOLLARS AND MAKE SENSE

- Variable-speed drives
- Heat wheels
- Fixed-plate heat exchangers
- Heat pipes
- High R-value insulation
- High-efficiency motors

Designed to save energy

Our industry has taken a leadership role by creating energy-performance guidelines, such as ASHRAE 90.1. Solution AHUs are designed with ASHRAE 90.1 in mind and can help you curb your energy intake.

Stretch your dollars with energy recovery

The exhaust airstream represents an energy-saving opportunity. An energy-recovery wheel can economically transfer heat and moisture between the exhaust-air and fresh-air paths, reducing the cost of conditioning the fresh air.

Take advantage of "free" cooling with an economizer section. During spring and fall operation, cool/dry outside air cools and dehumidifies the facility, reducing the need for mechanical refrigeration.

Keep heat where it belongs

Superior casing performance affects more than just indoor air quality. In extreme ambient conditions, heat transfer through the casing must be controlled. All Solution casings offer a minimum of R-7 to R-14 insulation in the floors, walls and roof. Higher R-value insulations are also available. To prevent energy-robbing air leaks, units are designed for a maximum casing leakage of 1%, or even 0.5%.

Reduce fan operating costs

In an AHU, the fan is the largest energy consumer. Solution fans offer a range of energy-saving options. High- or premium-efficiency motors can be specified. Direct-drive plenum fans eliminate belt-and-pulley energy losses.

If the air system is designed for variable-air volume VAV), Solution AHUs offer the most efficient method of VAV fan control. Factory-mounting a Johnson Controls variable-speed drive reduces jobsite labor costs and provides single-source responsibility.

Increase fans – decrease energy

Critical applications, such as life-science facilities or process operations, demand efficient and redundant air-handling operations. Solution AHUs meet this need by offering fan arrays ranging from 2 to 6 fans. When the fan array is optimized, the design can also increase efficiency by operating the fans at their most efficient points.

Reduce noise complaints

When noise matters
Applications such as theaters, performance halls and churches consider acoustics to be as critical as occupant comfort. That's why Solution AHUs ensure your success with a wide range of noise-reducing technologies that will quiet any complaint.

Fans that whisper
Since the fan is the primary moving part in an air-handling system, it's the first place to look when reducing noise. Solution AHUs are available with a variety of low-noise fans. Plenum fans generate less ductwork noise than do standard DWDI fans. Varying the number of blades in a fan wheel can also improve its sound characteristics.

Minimize vibration noise
Solution AHUs offer an array of construction and isolation techniques to help control vibration noise and its transmission. All fans are mounted on an isolated steel base. The entire fan assembly is dynamically balanced to ensure vibration-free operation. Direct-drive plenum fans can further reduce vibration by eliminating the belt-and-pulley mechanism.

Attenuate remaining sounds
What little noise is left can be further reduced with direct methods of sound attenuation. Using sound-absorbing walls, and sound traps in the fan and discharge-plenum sections, Johnson Controls sales engineers can design a Solution AHU to meet your critical sound requirements.

Tested sound levels
Being able to reliably predict the sound performance of an AHU is an engineering challenge. Our acousticians have created ARI-260-compliant, acoustical-calculation tools based on thousands of hours of real-world testing on hundreds of units.

Theatres, performance halls, and churches often consider acoustics as critical as occupant comfort.

Solution AHUs offer a variety of techniques to improve fan acoustics.

SOUND TECHNIQUES TO IMPROVE ACOUSTICS

- Standard low-noise fans
- Direct-drive plenum fans
- Vane-axial fans
- Sound attenuators
- Sound-absorptive panels
- Inertia bases
- Special balancing and vibration-isolation options

Take control of your application

Factory-mounted controls increase reliability

When AHU controls are installed at the jobsite, costs can go up and reliability can go down. To eliminate these problems, Solution AHUs can be equipped with Metasys® controls which are engineered, installed, and tested in the factory.

Solution AHUs can be equipped with factory-packaged Metasys controls.

Factory-installation improves quality, saves time

While a Solution AHU is being manufactured, Johnson Controls technicians can easily access all its segments. So, there are no accessibility problems to cramp the quality of the controls installation, which can occur on the jobsite. Also, all sensing probes have been pre-engineered to determine their best mounting location, ensuring accurate and reliable readings.

Factory-testing ensures accurate operation

Factory-mounted Metasys controls undergo a detailed testing process at the factory. The testing ensures that all wiring is installed correctly, and that all control panels and end devices work appropriately before the AHU is shipped. It also means that Solution AHUs can be up-and-running faster when they arrive on-site.

Factory-testing ensures that all controls work appropriately.

Factory-engineering speeds field connections

Solution AHUs are factory-engineered to simplify field connection of the controls. For example, coil valves are shipped uninstalled, but pre-wired with a flexible conduit with quick-connects. In some instances, the AHU is too large to ship in one piece, and must be split. To ensure fast and easy jobsite assembly of the Metasys controls, labeled quick-connects come standard on all shipping splits.

Labeled, quick-connect wiring makes split units easy to reassemble.

YOU ARE IN COMMAND WITH METASYS® CONTROLS

- Field equipment controllers
- Input/Output modules
- Damper actuators
- Differential-pressure sensors
- Temperature sensors
- Valves and actuators
- Static-pressure transducers
- Differential-pressure switches
- Fan start/stop relays
- Humidity sensors
- Variable-speed controls
- Safety switches/resets

Support when you need it

Johnson Controls has the experience and support you demand

To unburden specifiers from the time-consuming task of system layout, we employ powerful design tools. The System Selection Tool is available to all qualified systems designers to assist in the development of plans and specifications for standard HVAC equipment and controls. Systems contained in the tool provide the user with flow diagrams, points lists and sequence of operations. Additionally, the software provides an output to the YORKworks™ program, the design tool that configures the Solution AHU and prepares the necessary specifications, schedules and drawings. For highly complex configurations or performance requirements, a team of factory engineers are available to support our sales professionals.

Support after the sale

As assurance that your Solution AHUs will meet your performance expectations, Johnson Controls offers validation- and witness-testing at our factory for a variety of parameters: airflow, sound, vibration, and air-leakage, to name a few. We can provide certified technicians for jobsite installation and commissioning, drawing on a force of more than 5,000 technicians in over 500 locations worldwide. Project-management services are also available.

For air-handling units designed to meet your demanding requirements, call your nearby Johnson Controls representative.

Powerful design tools are available to aid system designers.

SOLUTION AHUS ARE AN EASY CHOICE

- Worldwide support and resources
- Powerful design tools
- Backed by factory-engineering team
- Factory validation- and witness-testing
- Project-management services can be provided
- Maintenance and repair services are also available

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www.johnsoncontrols.com

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ENGINEERING GUIDE

ATTACHMENT B

TSS Single-Duct VAV Terminals

Johnson Controls

TDIndustries

TABLE OF CONTENTS

NOTES:

- All data is subject to change without notice. Drawings in this guide are not for installation purposes.
- Some drawings are not shown in this catalog. Construction drawings and performance data contained herein should not be used for submittal purposes.
- ETL Listing Number 492864.
- Visit www.johnsoncontrols.com for current literature and submittal drawings or contact your local sales representative for more information.

FEATURES AND BENEFITS

PRECISE ZONE CONTROL

Model TSS terminals provide variable air volume (VAV) control beyond the typical single duct box. They are specifically designed for precise air delivery throughout the entire operating range, regardless of the installed inlet conditions. They also offer improved space comfort and flexibility for a wide variety of HVAC applications. TSS terminals take advantage of typical benefits provided by single duct units, while performing at extremely low sound levels. This is critical in today's buildings, where occupants are placing more emphasis on indoor acoustics.

The ability to provide comfort to the occupant is the measurement of quality for any VAV terminal. Comfort is achieved through quiet and precise control of airflow to the occupied space.

The TSS terminal provides the ultimate in airflow control with the patented FlowStar™ airflow sensor. No other sensor in the industry can match the FlowStar's ability to quietly and precisely measure airflow. Accurate airflow measurement is the basis for airflow control.

DESIGN FLEXIBILITY

Selection and Layout. The TSS provides flexibility in system design. The compact cabinet design and quiet operation give the system designer the versatility to place units directly above occupied spaces. It is not necessary to locate the unit in the crowded space above a hall or corridor. This will reduce lengthy and expensive discharge duct runs. The FlowStar sensor ensures accurate control, even when space constraints do not permit long straight inlet duct runs to the terminal.

Sizes. Model TSS terminals are available in ten unit sizes to handle airflow capacities between 45 and 8000 CFM.

A Windows® based Computer Selection Program is available on CD-ROM to facilitate the selection process. Contact your representative to obtain a copy of this powerful and time-saving program.

CONVENIENT INSTALLATION

Quality. All TSS terminals are thoroughly inspected during each step of the manufacturing process, including a comprehensive "pre-ship" inspection, to maintain the highest quality product available. All TSS terminals are packaged to minimize damage during shipment.

Quick Installation. A standard single point electrical main power connection is provided with all electronic controls and electrical components located on the same side of the casing, for quick access, adjustment, and troubleshooting. Installation time is minimized with the availability of factory calibrated controls and a low profile compact design.

The FlowStar sensor ensures accurate airflow measurement, regardless of the field installation conditions. A calibration label and wiring diagram is located on the terminal for quick reference during start-up.

The terminal is constructed to allow installation with standard metal hanging straps. Optional hanger brackets for use with all-thread support rods or wire hangers are also available.

LASTING COMPONENTS AND LOW COST OPERATION

Quality. All metal components are fabricated from galvanized steel. Unlike most manufacturers' terminals, the TSS is capable of withstanding a 125 hour salt spray test without showing any evidence of red rust.

Energy Efficiency. In addition to quiet and accurate temperature control, the building owner will benefit from lower operating costs. The highly amplified velocity pressure signal from the FlowStar inlet sensor allows precise airflow control at low air velocities.

The FlowStar sensor's airfoil shape provides minimal pressure drop across the terminal. This allows the central fan to run at a lower pressure and with less brake horsepower.

Agency Certification. Model TSS terminals with electronic controls and/or electric heat are listed with ETL as an assembly, and bear the ETL label.

TSS terminals and accessories are wired in compliance with all applicable NEC requirements and tested in accordance with AHRI Standard 880.

Maintenance and Service. TSS terminals require no periodic maintenance and provide trouble-free operation. Controls are located on the outside of the unit casing for easy access by maintenance personnel.

A VARIETY OF CONTROLS

Model TSS terminals are available with analog electronic, consignment DDC, pneumatic controls and Johnson Controls DDC for BACnet, Lon or N2 specifically designed for use with TSS terminals. These controls are designed to accommodate a multitude of control schemes.

From the most basic to the most sophisticated sequence of operation, the controls are designed by experts in VAV single duct terminal operation. Refer to the Electronic Controls Selection Guide, and the Pneumatic Controls Selection Guide for a complete description of the sequences and schematic drawings that are available.

Available Control Types:
- Analog Electronic (shown above)
- Pneumatic
- Factory mounted consignment DDC
- Johnson Controls DDC for BACnet, Lon or N2

Standard Control Features:
- Patented FlowStar Airflow Sensor
- ETL Listing
- NEMA 1 Enclosure
- 24 Volt Control Transformer
- Floating Modulating Actuator
- Balancing Tees and Plenum Rated Tubing

FEATURES AND BENEFITS

PATENTED FLOWSTAR SENSOR CONTROL

The air valve features the FlowStar airflow sensor which has brought new meaning to airflow control accuracy. The multi-axis design utilizes between 12 and 20 sensing points that sample total pressure at center points within equal concentric cross-sectional areas, effectively traversing the air stream in two planes. Each distinct pressure reading is averaged within the center chamber before exiting the sensor to the controlling device.

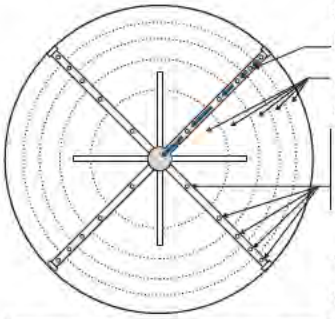
This sensor adds a new dimension to signal amplification. Most differential pressure sensors provide a signal equal to 1.5 times the equivalent velocity pressure signal. The FlowStar provides a differential pressure signal that is 2.5 to 3 times the equivalent velocity pressure signal. This amplified signal allows more accurate and stable airflow control at low airflow capacities. Low airflow control is critical for indoor air quality, reheat minimization, and preventing over cooling during light loads.

Unlike other sensors which use a large probe surface area to achieve signal amplification, the FlowStar utilizes an unprecedented streamline design which generates amplified signals unrivaled in the industry. The streamlined design also generates less pressure drop and noise.

The VAV schedule should specify the minimum and maximum airflow setpoints, maximum sound power levels, and maximum air pressure loss for each terminal.

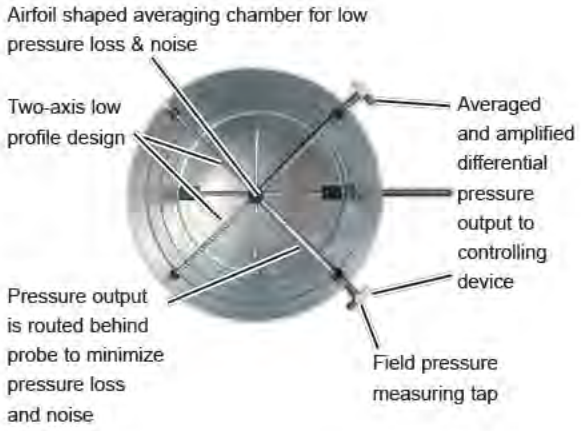
The specification for the VAV terminal must detail the required performance of the airflow sensor. For maximum building occupant satisfaction, the VAV system designer should specify the airflow sensor as suggested in the Guide Specifications of this catalog.
Using FlowStar sensing to amplify the airflow signal allows you to use lower minimum airflow setpoints. Many VAV controllers require a minimum differential pressure signal of 0.03 inch W.G. The airflow sensor should be able to generate this signal with only 400 to 450 FPM air velocity through the inlet collar.

Conventional airflow sensors without amplification capabilities require approximately 700 FPM to generate a 0.03 inch W.G. signal. If 700 FPM represents a 20% minimum condition, the inlet velocity would be 3500 FPM at the maximum airflow setpoint. This results in extremely noisy conditions. In addition, the airflow sensor should generate a differential pressure range of at least one inch W.G. over the operating range of the terminal unit.



FlowStar™ Airflow Sensor
Patent #5,481,925

Sizes 6 & 8: 12 Sensing Points
Sizes 10 & 12: 16 Sensing Points
Sizes 14 & 16: 20 Sensing Points



UNIQUE ELECTRIC HEAT DESIGN

Model TSS-EH models are unique in that they correct common industry heating problems. Historically, heater elements placed downstream of a VAV damper have experienced two major problems:

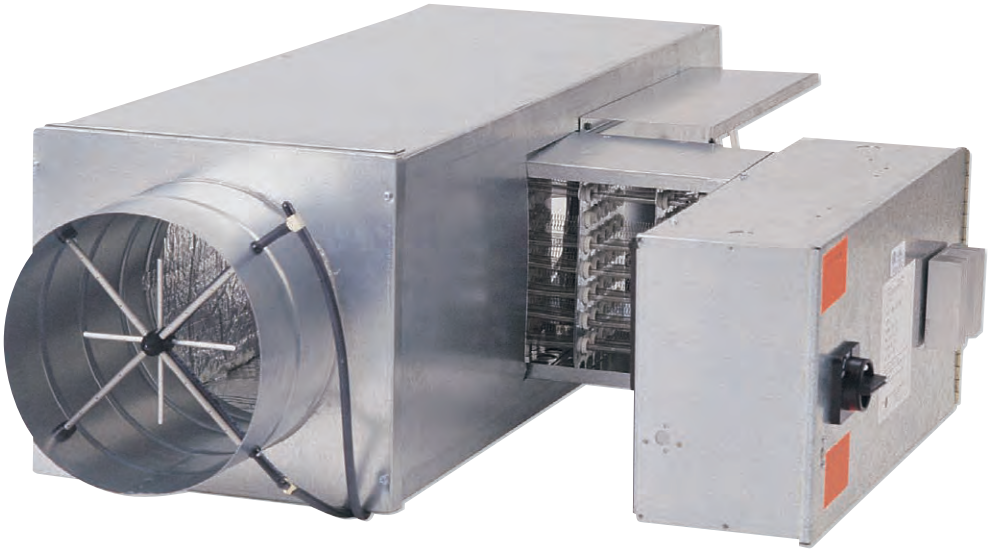
- Elements fail prematurely due to hot spots resulting from an uneven air velocity profile over the heater face
- Heaters suffer rapid nuisance cycling of the contactors and elements because the airflow switch probe is located on the low pressure (downstream side) of the VAV damper

Our unique electric heat VAV terminal, the TSS-EH, solves these problems. The heater elements are located midway between the air inlet and the damper. (See photo below.) This design provides uniform airflow over the face of the electric heater at all damper positions. Element life is extended, reducing repair cost and inconvenience.

With the heater elements located on the high pressure side of the VAV damper, the airflow pressure switch receives a reliable pressure signal even at minimum damper positions. This arrangement provides greater safety, as well as enhanced reliability.

The TSS-EH design permits tremendous flexibility when selecting KW, voltage, phase, balanced or unbalanced circuits and method of control.

The TSS-EH breaks new ground in single duct VAV electric heater design. The patented FlowStar sensor permits modulation to lower airflow levels than all other sensors in the industry. This minimizes the energy expended for heat in many applications.

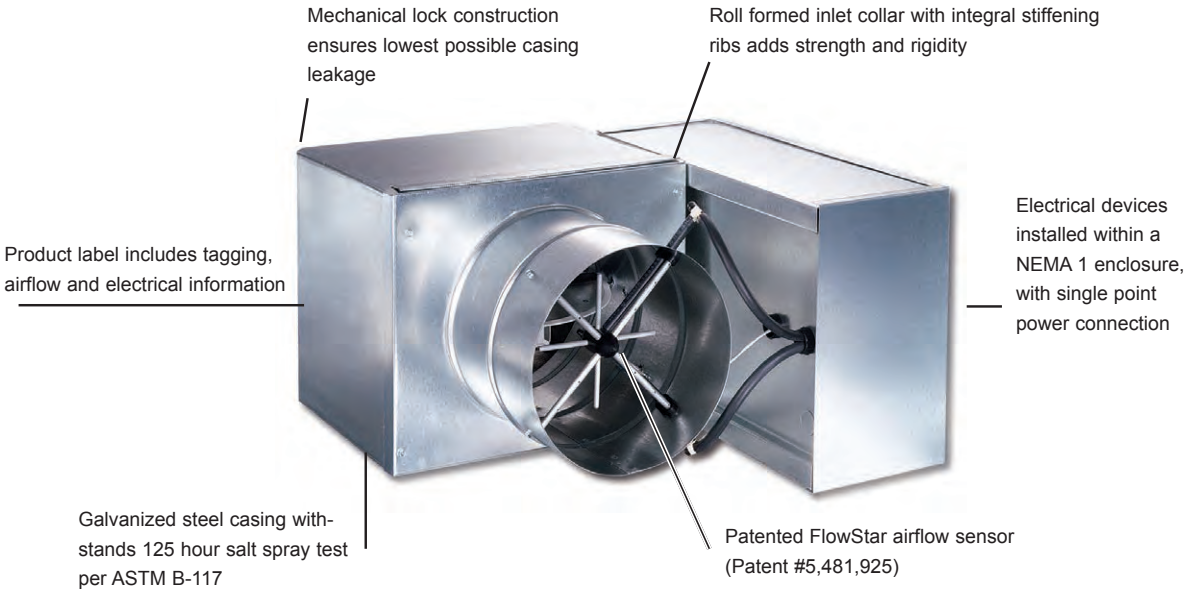


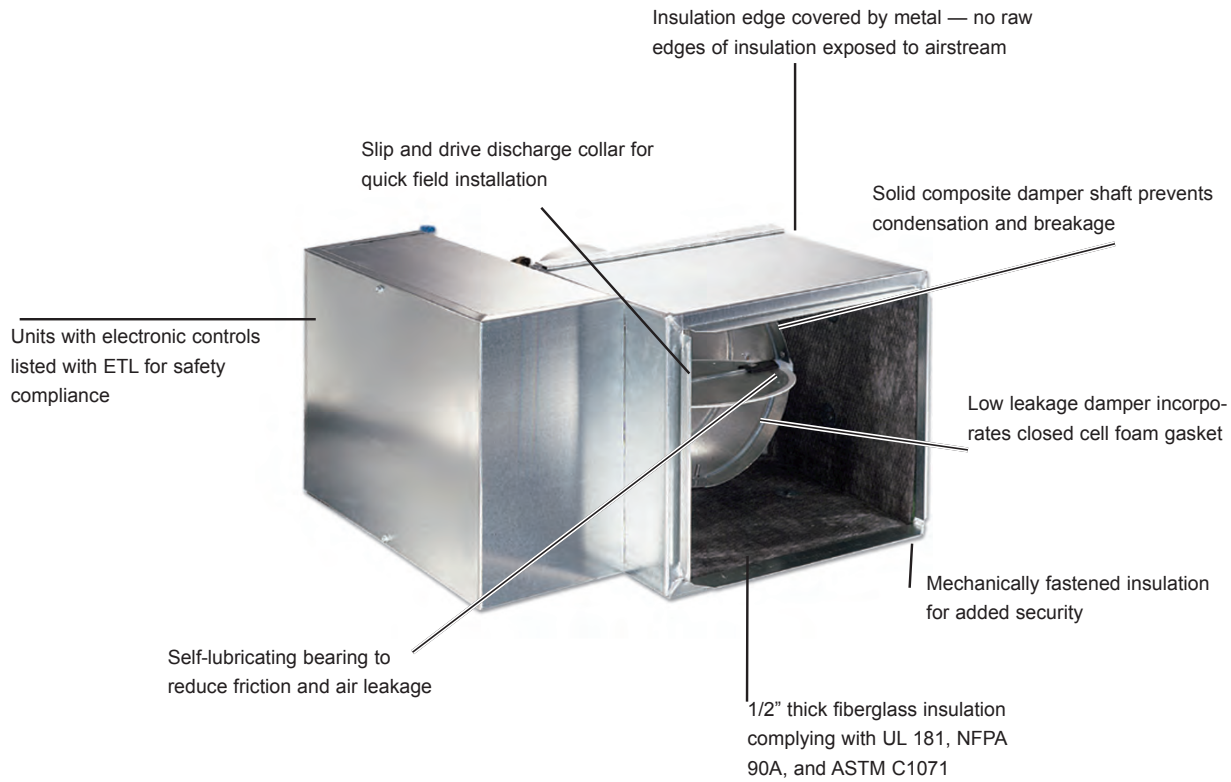
The FlowStar probe is visible in the inlet of the TSS-EH. The elements, partially removed for this photo, are midway between the inlet and the damper.

STANDARD CONSTRUCTION

MODEL TSS

The TSS terminal incorporates many standard features that are expensive options for other manufacturers.





OPTIONAL CONSTRUCTION

MODEL TSS

The TSS single duct terminal is available with many optional features to meet any project requirement.

Double wall construction (not shown)

Factory piping packages (refer to Piping Packages catalog)

Factory control options:
- Analog Electronic
- DDC Electronic
- Pneumatic

For more information, see corresponding Control Selection Guides

Mounting brackets (not shown) to accept all-thread hanging rods or wire hangers

Low temperature construction for use in thermal storage applications, includes:
- Thermally isolated primary air inlet
- Composite damper shaft

Scrim reinforced foil faced insulation meeting ASTM C1136 for mold, mildew and humidity resistance or 1/2" thick elastomeric closed cell foam insulation

STANDARD AND OPTIONAL FEATURES

STANDARD FEATURES

Construction
- AHRI 880 certified and labeled
- 22 gauge galvanized steel casing and valve
- 1/2" thick fiberglass insulation, mechanically fastened for added security

Primary Air Valve
- Embossed rigidity rings
- Low thermal conductance damper shaft
- Position indicator on end of damper shaft
- Mechanical stops for open and closed position
- FlowStar™ center averaging airflow sensor
- Balancing tees
- Plenum-rated sensor tubing

Hot Water Coil
- Designed and manufactured by Johnson Controls
- AHRI 410 certified and labeled
- 1, 2, 3 or 4 rows
- Left or right hand connections
- Tested at a minimum of 450 PSIG under water and rated at 300 PSIG working pressure at 200°F

Electrical
- cETL listed for safety compliance with UL 1996
- NEMA 1 wiring enclosure

Electric Heat
- cETL listed as an assembly for safety compliance
- Automatic reset primary and back-up secondary thermal limits
- Airflow switch
- Single point power connection
- Hinged electrical enclosure door
- Fusing per NEC

OPTIONAL FEATURES

Construction
- 20 gauge galvanized steel construction
- 3/4" and 1" insulation
- Foil faced scrim backed insulation
- 1/2" thick elastomeric closed cell foam insulation
- Double wall construction with 22 gauge liner

Hot Water Coil
- Coil access plate for cleaning coil

Electrical
- Toggle disconnect switch
- Primary and secondary transformer fusing

Electric Heat
- Proportional SSR heater control
- Mercury contactors
- Door interlocking disconnect switches

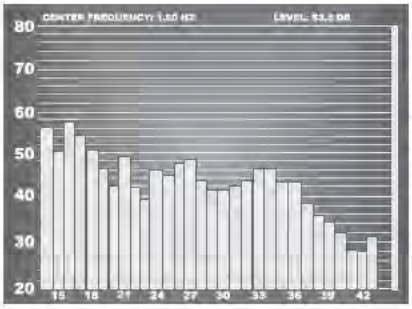
Controls
- Factory provided controls include:
  - Analog electronic
  - Pneumatic
- Factory mounted JCI DDC controls (factory mount and wire)

Piping Packages
- Factory assembled – shipped loose for field installation
- 1/2" and 3/4", 2 way, normally closed, two position electric motorized valves
- Isolation ball valves with memory stop
- Fixed and adjustable flow control devices
- Unions and P/T ports
- Floating point modulating control valves
- High pressure close-off actuators

APPLICATION AND SELECTION

ACOUSTICAL CONCEPTS

The focus on indoor air quality is also having an effect on proper selection of air terminal equipment with respect to acoustics.



Sound. At the zone level, the terminal unit generates acoustical energy that can enter the zone along two primary paths. First, sound from the primary air valve can propagate through the downstream duct and diffusers before entering the zone (referred to as Discharge or Airborne Sound). Acoustical energy is also radiated from the terminal casing and travels through the ceiling cavity and ceiling system before entering the zone (referred to as Radiated Sound).

To properly quantify the amount of acoustical energy emanating from a terminal unit at a specific operating condition (i.e. CFM and static pressure), manufacturers must measure and publish sound power levels.

The units of measurement, decibels, actually represent units of power (watts). The terminal equipment sound power ratings provide a consistent measure of the generated sound independent of the environment in which the unit is installed. This allows a straight forward comparison of sound performance between equipment manufacturers and unit models.

Noise Criteria (NC). The bottom line acoustical criteria for most projects is the NC (Noise Criteria) level. This NC level is derived from resulting sound pressure levels in the zone. These sound pressure levels are the effect of acoustical energy (sound power levels) entering the zone caused by the terminal unit and other sound generating sources (central fan system, office equipment, environment, etc.).

The units of measurement is once again decibels; however, in this case decibels represent units of pressure (Pascals), since the human ear and microphones react to pressure variations.

There is no direct relationship between sound power levels and sound pressure levels. Therefore, we must predict the resulting sound pressure levels (NC levels) in the zone based in part by the published sound power levels of the terminal equipment. The NC levels are totally dependent on the project specific design, architecturally and mechanically. For a constant operating condition (fixed sound power levels), the resulting NC level in the zone will vary from one project to another.

AHRI 885. A useful tool to aid in predicting space sound pressure levels is an application standard referred to as AHRI Standard 885. This standard provides information (tables, formulas, etc.) required to calculate the attenuation of the ductwork, ceiling cavity, ceiling system, and conditioned space below a terminal unit. These attenuation values are referred to as the "transfer function" since they are used to transfer from the manufacturer's sound power levels to the estimated sound pressure levels resulting in the space below, and/or served by the terminal unit. The standard does not provide all of the necessary information to accommodate every conceivable design; however, it does provide enough information to approximate the transfer function for most applications. Manufacturers use different assumptions with respect to a "typical" project design; therefore, it is impossible to compare product performance simply by looking at the published NC values.

GENERAL DESIGN RECOMMENDATIONS FOR A QUIET SYSTEM

The AHU. Sound levels in the zone are frequently impacted by central fan discharge noise that either breaks out (radiates) from the ductwork or travels through the distribution ductwork and enters the zone as airborne (discharge) sound. Achieving acceptable sound levels in the zone begins with a properly designed central fan system which delivers relatively quiet air to each zone.

Supply Duct Pressure. The primary factor contributing to noisy systems (including single duct applications) is high static pressure in the primary air duct. This condition causes higher sound levels from the central fan and also higher sound levels from the terminal unit, as the primary air valve closes to reduce the pressure. This condition is compounded when flexible duct is utilized at the terminal inlet, which allows the central fan noise and air valve noise to break out into the ceiling cavity and then enter the zone located below the terminal. Ideally, the system static pressure should be reduced to the point where the terminal unit installed on the duct run associated with the highest pressure drop has the minimum required inlet pressure to deliver the design airflow to the zone. Many of today's

APPLICATION AND SELECTION

HVAC systems experience 0.5" w.g. pressure drop or less in the main trunk. For systems that will have substantially higher pressure variances from one zone to another, special attention should be paid to the proper selection of air terminal equipment.

To date, the most common approach has been to select (size) all of the terminals based on the worst case (highest inlet static pressure) condition. Typically, this results in 80% (or higher) of the terminal units being oversized for their application. This in turn results in much higher equipment costs, but more importantly, drastically reduced operating efficiency of each unit. This consequently decreases the ability to provide comfort control in the zone. In addition, the oversized terminals cannot adequately control the minimum ventilation capacity required in the heating mode.

A more prudent approach is to utilize a pressure reducing device upstream of the terminal unit on those few zones closest to the central fan. This device could simply be a manual quadrant type damper if located well upstream of the terminal inlet. In tight quarters, perforated metal can be utilized as a quiet means of reducing system pressure. This approach allows all of the terminal units to experience a similar (lower) inlet pressure. They can be selected in a consistent manner at lower inlet pressure conditions that will allow more optimally sized units.

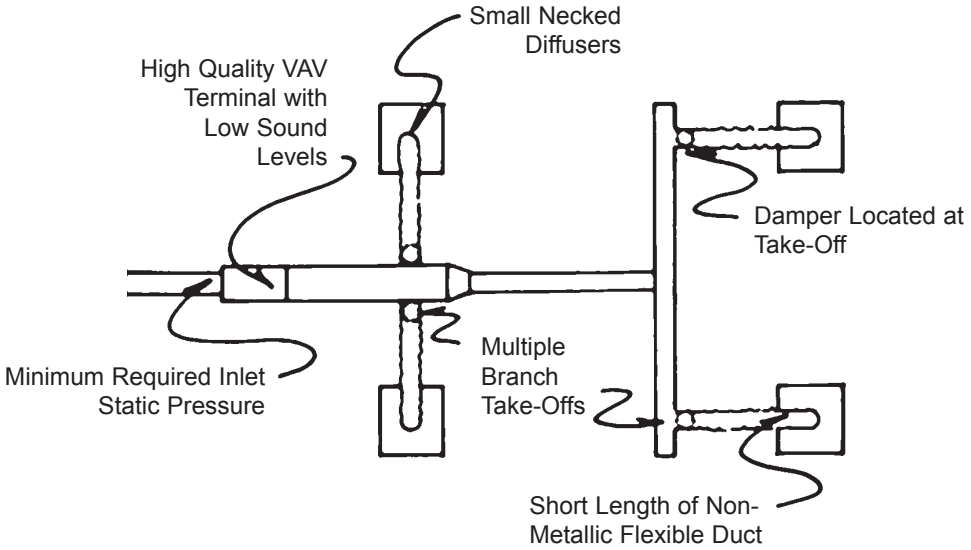
Inlet duct that is the same size as the inlet collar and as straight as possible will achieve the best acoustical performance. For critical applications, flexible duct should not be utilized at the terminal inlet.

Zoning. On projects where internal lining of the downstream duct is not permitted, special considerations should be made to obtain acceptable noise levels. In these cases, a greater number of smaller zones will help in reducing sound levels. Where possible, the first diffuser takeoff should be located after an elbow or tee and a greater number of small necked diffusers should be utilized, rather than fewer large necked diffusers.

The downstream ductwork should be carefully designed and installed to avoid noise regeneration. Bull head tee arrangements should be located sufficiently downstream of the terminal discharge to provide an established flow pattern downstream of the fan. Place diffusers downstream of the terminal after the airflow has completely developed.

Downstream splitter dampers can cause noise problems if placed too close to the terminal, or when excessive air velocities exist. If tee arrangements are employed, volume dampers should be used in each branch of the tee, and balancing dampers should be provided at each diffuser tap. This arrangement provides maximum flexibility in quiet balancing of the system.

IDEAL DUCT DESIGN



DIMENSIONAL DATA

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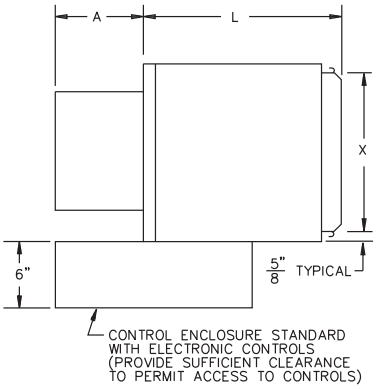
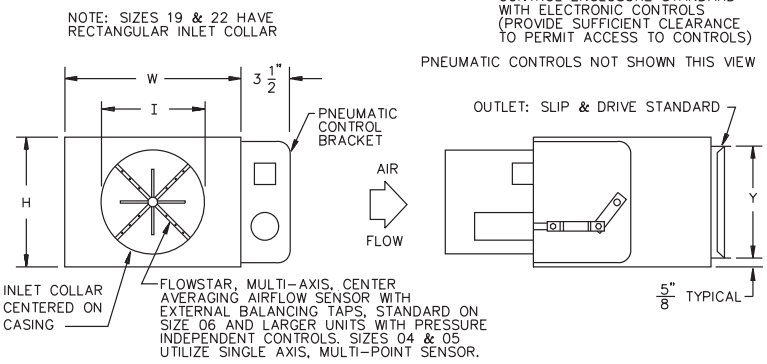
16	24 [610]	17 1/2 [445]	17 1/2 [445]	6 1/2 [165]	15 7/8 [403]	22 3/4 [578]	16 1/4 [413]
19	30 [762]	17 1/2 [445]	11 [279]	8 [203]	28 1/4 [718] x 13 7/8 [352]	28 3/4 [730]	16 1/4 [413]
22	34 [864]	17 1/2 [445]	11 [279]	8 [203]	32 1/4 [819] x 15 7/8 [403]	32 3/4 [832]	16 1/4 [413]

NOTES:
1. All dimensions are in inches [mm] with a tolerance of ±1/8" [3mm].
2. Sizes 19 and 22 have rectangular inlet collar.



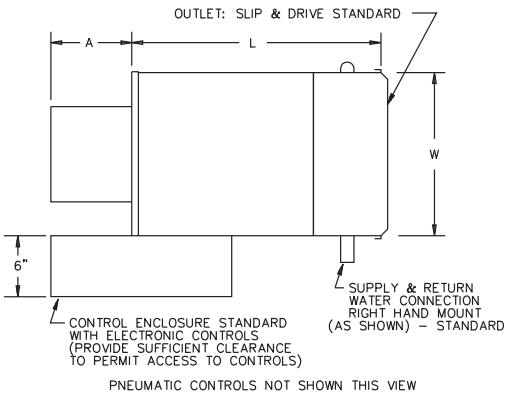
PNEUMATIC CONTROLS NOT SHOWN THIS VIEW



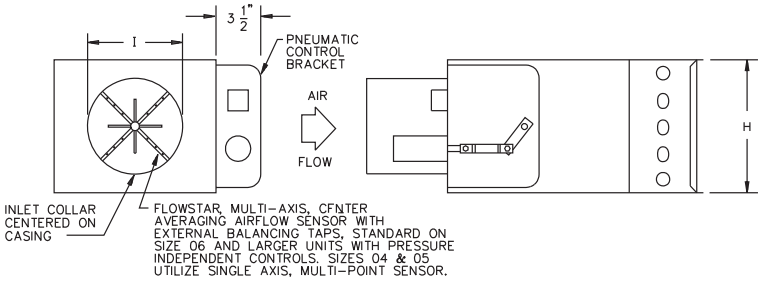
ELECTRONIC CONTROLS NOT SHOWN THESE VIEWS

UNIT SIZE	DIMENSIONS				
	W	H	L	A	I
4	10 [254]	10 [254]	15 1/2 [394]	10 1/2 [267]	3 7/8 [98]
5	10 [254]	10 [254]	15 1/2 [394]	10 1/2 [267]	4 7/8 [124]
6	10 [254]	10 [254]	15 1/2 [394]	6 1/2 [165]	5 7/8 [149]
8	12 [305]	10 [254]	15 1/2 [394]	6 1/2 [165]	7 7/8 [200]
10	14 [356]	12 1/2 [318]	17 1/2 [445]	6 1/2 [165]	9 7/8 [251]
12	16 [406]	15 [381]	17 1/2 [445]	6 1/2 [165]	11 7/8 [302]
14	20 508]	17 1/2 [445]	21 1/2 [546]	6 1/2 [165]	13 7/8 [352]
16	24 [610]	17 1/2 [445]	21 1/2 [546]	6 1/2 [165]	15 7/8 [403]
19	30 [762]	17 1/2 [445]	15 1/2 [394]	8 [203]	28 1/4 [718] x 13 7/8 [352]
22	34 [864]	17 1/2 [445]	15 1/2 [394]	8 [203]	32 1/4 [819] x 15 7/8 [403]

NOTES:
1. All dimensions are in inches [mm] with a tolerance of ±1/8" [3mm].
2. Sizes 19 and 22 have rectangular inlet collar.



PNEUMATIC CONTROLS NOT SHOWN THIS VIEW



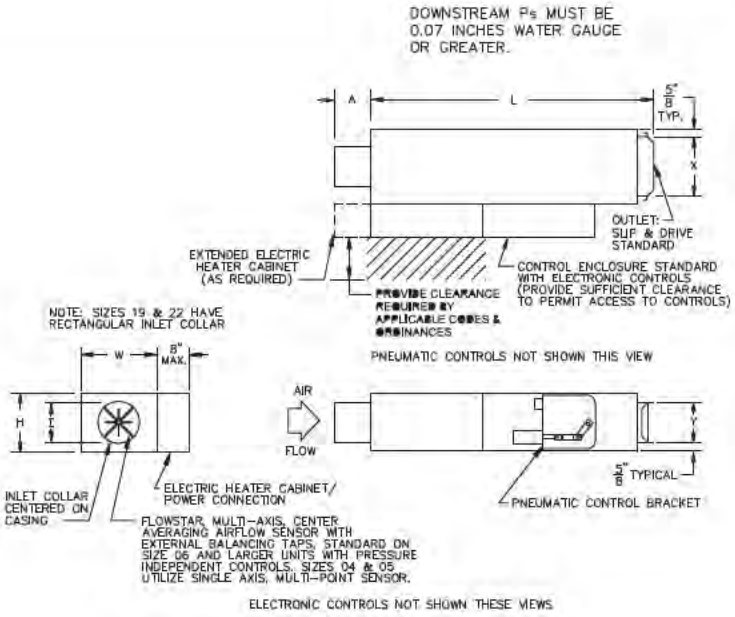
ELECTRONIC CONTROLS NOT SHOWN THESE VIEWS

DIMENSIONAL DATA

MODEL TSS - EH

UNIT SIZE	DIMENSIONS						
	W	H	L	I	X	Y	A
4	10 [254]	10 [254]	41 [1041]	3 7/8 [98]	8 3/4 [222]	8 3/4 [222]	10 1/2 [267]
5	10 [254]	10 [254]	41 [1041]	4 7/8 [124]	8 3/4 [222]	8 3/4 [222]	10 1/2 [267]
6	10 [254]	10 [254]	41 [1041]	5 7/8 [149]	8 3/4 [222]	8 3/4 [222]	6 1/2 [165]
8	12 [305]	10 [254]	41 [1041]	7 7/8 [200]	10 3/4 [273]	8 3/4 [222]	6 1/2 [165]
10	14 [356]	12 1/2 [318]	41 [1041]	9 7/8 [251]	12 3/4 [324]	11 1/4 [286]	6 1/2 [165]
12	16 [406]	15 [381]	41 [1041]	11 7/8 [302]	14 3/4 [375]	13 3/4 [349]	6 1/2 [165]
14	20 [508]	17 1/2 [445]	41 [1041]	13 7/8 [352]	18 3/4 [476]	16 1/4 [413]	6 1/2 [165]
16	24 [610]	17 1/2 [445]	41 [1041]	15 7/8 [403]	22 3/4 [578]	16 1/4 [413]	6 1/2 [165]
19	30 [762]	17 1/2 [445]	44 1/2 [1130]	28 1/4 [718] x 13 7/8 [352]	28 3/4 [730]	16 1/4 [413]	1 1/2 [38]
22	34 [864]	17 1/2 [445]	44 1/2 [1130]	32 1/4 [819] x 15 7/8 [403]	32 3/4 [832]	16 1/4 [413]	1 1/2 [38]

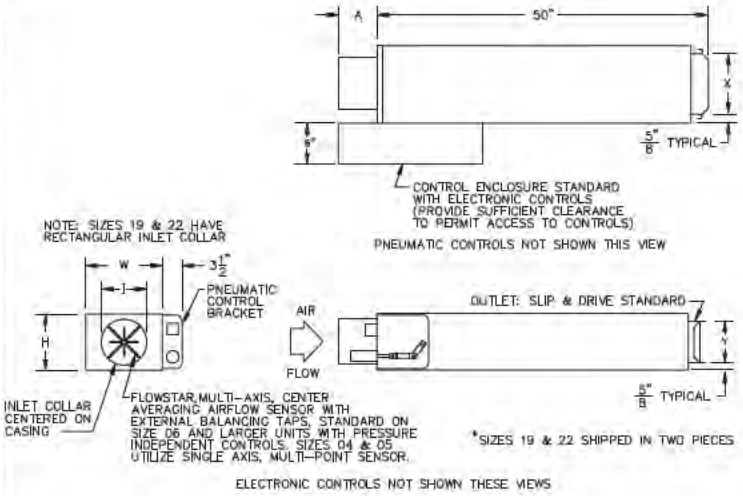
NOTE: All dimensions are in inches [mm] with a tolerance of ±1/8" [3mm].



MODEL TSS - SA

UNIT SIZE	DIMENSIONS					
	W	H	A	I	X	Y
4	10 [254]	10 [254]	10 1/2 [267]	3 7/8 [98]	8 3/4 [222]	8 3/4 [222]
5	10 [254]	10 [254]	10 1/2 [267]	4 7/8 [124]	8 3/4 [222]	8 3/4 [222]
6	10 [254]	10 [254]	6 1/2 [165]	5 7/8 [149]	8 3/4 [222]	8 3/4 [222]
8	12 [305]	10 [254]	6 1/2 [165]	7 7/8 [200]	10 3/4 [273]	8 3/4 [222]
10	14 [356]	12 1/2 [318]	6 1/2 [165]	9 7/8 [251]	12 3/4 [324]	11 1/4 [286]
12	16 [406]	15 [381]	6 1/2 [165]	11 7/8 [302]	14 3/4 [375]	13 3/4 [349]
14	20 [508]	17 1/2 [445]	6 1/2 [165]	13 7/8 [352]	18 3/4 [476]	16 1/4 [413]
16	24 [610]	17 1/2 [445]	6 1/2 [165]	15 7/8 [403]	22 3/4 [578]	16 1/4 [413]
19*	30 [762]	17 1/2 [445]	8 [203]	28 1/4 [718] x 13 7/8 [352]	28 3/4 [730]	16 1/4 [413]
22*	34 [864]	17 1/2 [445]	8 [203]	32 1/4 [819] x 15 7/8 [403]	32 3/4 [832]	16 1/4 [413]

NOTE: All dimensions are in inches [mm] with a tolerance of ±1/8" [3mm].

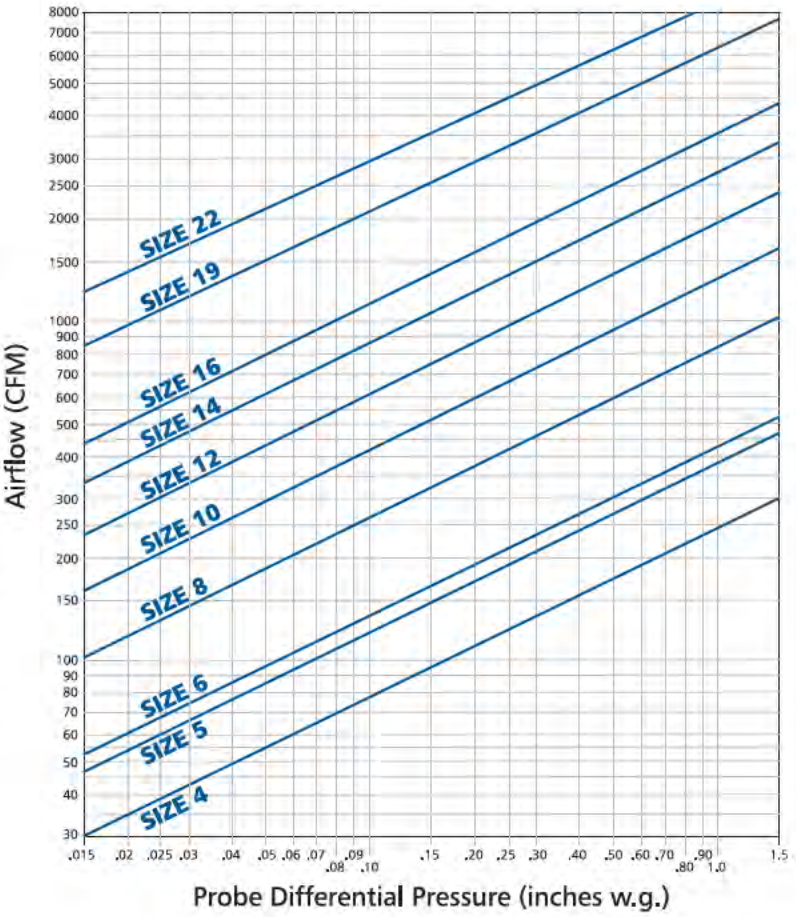


AIRFLOW CALIBRATION

FLOWSTAR CALIBRATION CHART

(For dead-end differential pressure transducers)

NOTE: Maximum and minimum CFM limits are dependent on the type of controls that are utilized. Refer to the table below for specific values. When DDC controls are furnished by others, the CFM limits are dependent on the specific control vendor that is employed. After obtaining the differential pressure range from the control vendor, the maximum and minimum CFM limits can be obtained from the chart above (many controllers are capable of controlling minimum setpoint down to .015" w.g.).



AIRFLOW RANGES (CFM)

UNIT SIZE	400 SERIES (PNEUMATIC) STANDARD CONTROLLER		7000 SERIES ANALOG ELECTRONIC		DDC CONSIGNMENT CONTROLS (See Notes Below)				
					MIN.			MAX.	
	MIN.	MAX.	MIN.	MAX.	MIN. TRANSDUCER DIFFERENTIAL PRESSURE (IN. W.G.)			MAX. TRANSDUCER DIFFERENTIAL PRESSURE (IN. W.G.)	
					0.015	0.03	0.05	1.0	≤1.5
4	43	250	35	250	30	43	55	250	250
5	68	350	50	350	48	65	88	350	350
6	75	490	60	550	53	75	97	435	530
8	145	960	115	1000	105	145	190	840	1000
10	235	1545	185	1600	165	235	305	1355	1600
12	340	2250	285	2300	240	340	440	1975	2300
14	475	3100	390	3100	335	475	615	2750	3100
16	625	4100	520	4100	440	625	805	3595	4100
19	1180	6500	1025	6500	845	1180	1510	6375	6500
22	1730	8000	1450	8000	1260	1730	2200	8000	8000

NOTES:
1. Minimum and maximum airflow limits are dependent on the specific DDC controller supplied. Contact the control vendor to obtain the minimum and maximum differential pressure limits (inches W.G.) of the transducer utilized with the DDC controller.
2. Maximum CFM is limited to value shown in General Selection Data.

SELECTION DATA

TERMINAL SIZE	CFM	MINIMUM ΔPs			DISCHARGE NOISE CRITERIA (NC)						RADIATED NOISE CRITERIA (NC)		
					0.5" ΔPs		1.0" ΔPs		3.0" ΔPs		0.5" ΔPs	1.0" ΔPs	3.0" ΔPs
		Model SDR / SDR-SA	Model SDR-WC 1 Row	Model SDR-WC 2 Row	Model SDR	Model SDR-SA	Model SDR	Model SDR-SA	Model SDR	Model SDR-SA	Model SDR & SDR-SA	Model SDR & SDR-SA	Model SDR & SDR-SA
4	100	0.01	0.02	0.03	--	--	--	--	20	--	--	--	20
	150	0.01	0.03	0.04	--	--	24	--	29	21	--	--	24
	200	0.01	0.04	0.07	23	--	29	23	34	28	--	22	29
	250	0.01	0.05	0.09	26	20	31	28	38	33	23	25	33
5	100	0.01	0.02	0.03	--	--	--	--	--	--	--	--	--
	200	0.01	0.04	0.07	--	--	24	--	28	--	--	--	24
	300	0.01	0.07	0.13	23	--	28	--	31	21	--	23	31
	350	0.01	0.09	0.16	24	--	30	21	33	24	21	25	33
6	200	0.02	0.05	0.08	--	--	--	--	25	--	--	--	29
	250	0.03	0.07	0.11	--	--	--	--	28	--	--	--	31
	300	0.04	0.10	0.16	--	--	--	--	28	20	--	20	33
	350	0.06	0.14	0.21	--	--	21	--	30	23	--	21	35
	450	0.10	0.22	0.33	--	--	24	--	33	25	--	24	36
	550	0.14	0.30	0.46	20	--	28	24	35	30	23	28	37
8	300	0.01	0.05	0.10	--	--	--	--	24	--	--	--	26
	400	0.01	0.08	0.15	--	--	--	--	26	--	--	--	29
	500	0.01	0.11	0.22	--	--	--	--	29	--	--	20	30
	600	0.01	0.15	0.30	--	--	--	--	30	20	--	21	32
	800	0.03	0.25	0.46	--	--	21	--	33	24	20	24	34
	1000	0.04	0.35	0.66	21	--	25	21	35	28	23	26	37
10	600	0.01	0.08	0.16	--	--	--	--	30	--	--	--	32
	800	0.01	0.13	0.26	--	--	--	--	30	20	--	--	32
	1000	0.02	0.20	0.39	--	--	20	--	31	24	--	21	32
	1200	0.02	0.25	0.47	--	--	23	--	34	28	--	23	34
	1400	0.03	0.32	0.61	--	--	25	20	35	29	20	24	35
	1600	0.04	0.40	0.76	20	--	28	24	36	31	24	26	37
12	800	0.01	0.08	0.15	--	--	--	--	26	--	--	21	33
	1100	0.01	0.13	0.26	--	--	--	--	28	--	--	22	34
	1400	0.02	0.21	0.40	--	--	20	--	30	24	--	24	35
	1700	0.02	0.26	0.50	--	--	21	--	33	28	--	25	36
	2000	0.03	0.34	0.65	--	--	23	--	35	30	20	26	37
	2300	0.04	0.43	0.82	20	--	25	20	36	31	22	28	38
14	1100	0.01	0.07	0.14	--	--	--	--	26	--	--	--	30
	1500	0.02	0.13	0.24	--	--	--	--	29	23	--	--	31
	1900	0.03	0.20	0.36	--	--	--	--	30	25	--	21	33
	2300	0.05	0.26	0.47	--	--	21	--	33	28	--	23	34
	2700	0.07	0.34	0.62	--	--	24	20	34	29	20	25	35
	3100	0.09	0.43	0.77	21	--	26	21	35	31	22	28	37
16	1600	0.01	0.10	0.19	--	--	--	--	24	--	--	--	33
	2100	0.02	0.17	0.31	--	--	--	--	29	23	--	20	35
	2600	0.03	0.24	0.45	--	--	20	--	34	29	--	21	35
	3100	0.04	0.29	0.55	--	--	23	20	35	30	--	24	36
	3600	0.05	0.37	0.70	20	--	25	21	37	34	21	26	37
	4100	0.06	0.46	0.86	23	--	28	23	39	36	24	29	38
19	2500	0.06	0.19	0.32	23	20	29	21	38	26	29	35	43
	3000	0.09	0.27	0.45	24	21	30	25	39	30	30	36	44
	3500	0.13	0.37	0.61	26	24	31	26	40	33	31	37	45
	4500	0.21	0.53	0.86	26	24	31	28	40	36	34	40	48
	5500	0.32	0.77	1.22	29	25	33	29	43	39	38	44	53
	6500	0.44	1.03	1.62	31	28	33	29	45	41	41	48	56
22	4000	0.06	0.30	0.55	28	24	33	26	41	33	31	37	48
	5000	0.09	0.46	0.83	28	24	34	29	41	36	34	39	50
	6000	0.14	0.56	0.99	29	26	34	31	43	38	36	41	53
	7000	0.18	0.72	1.27	30	28	36	33	44	40	39	45	56
	8000	0.24	0.91	1.59	33	29	37	34	45	41	41	47	58

NOTES:

- Min. ΔPs is the static pressure difference between the terminal inlet and discharge with the damper wide open.
- Performance data obtained from tests conducted in accordance with AHRI Standard 880.
- Dash (-) indicates NC level less than 20.
- NC values calculated based upon the 2002 Addendum to AHRI Standard 885 Appendix E Typical Sound Attenuation Values (shown at right) using Ceiling Type 2 for calculating Radiated NC.
- NC (sound pressure) levels predicted by subtracting appropriate values at right from published sound power levels (following pages).

DISCHARGE ATTENUATION VALUES	OCTAVE BAND					
	2	3	4	5	6	7
Small Box (< 300 CFM)	24	28	39	53	59	40
Medium Box (300-700 CFM)	27	29	40	51	53	39
Large Box (> 700 CFM)	29	30	41	51	52	39

RADIATED ATTENUATION VALUES	OCTAVE BAND					
	2	3	4	5	6	7
Type 2 - Mineral Fiber Ceiling	18	19	20	26	31	36

SOUND DATA

DISCHARGE SOUND POWER DATA - MODEL TSS

TERMINAL SIZE	CFM	OCTAVE BAND NUMBER																							
		0.5" ΔPs						1.0" ΔPs						1.5" ΔPs						3.0" ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
4	100	57	55	46	42	36	35	61	59	50	46	43	43	61	61	52	48	45	45	62	61	56	53	52	52
	150	62	60	50	46	41	39	66	64	54	50	46	45	68	67	58	54	49	48	68	68	60	57	56	56
	200	66	63	53	49	44	42	71	67	57	53	48	48	72	69	59	55	50	50	73	72	64	60	58	58
	250	69	65	55	53	46	45	73	70	59	55	51	49	74	71	61	57	53	52	77	76	67	62	60	59
5	100	55	53	44	40	35	33	58	57	48	43	42	43	59	58	50	46	44	45	59	59	54	50	50	51
	200	63	60	51	46	41	39	66	64	54	50	45	44	67	66	57	52	47	47	66	67	61	57	55	55
	250	65	62	53	48	43	41	69	67	56	52	47	45	70	68	59	55	51	50	69	69	63	59	56	56
	300	68	64	54	50	45	43	71	68	58	54	49	47	72	70	60	56	51	50	71	71	64	60	58	56
	350	69	65	55	51	47	45	73	70	59	55	50	49	74	71	62	57	53	51	73	72	66	62	60	57
6	200	54	51	48	44	39	36	59	56	52	48	44	42	60	59	55	51	47	45	65	65	62	57	54	53
	250	59	53	49	46	40	37	63	58	53	49	45	43	64	61	56	52	48	47	66	67	63	59	56	55
	300	61	55	51	47	41	39	64	60	54	51	46	44	65	63	57	54	50	48	68	68	64	60	57	55
	350	62	57	52	48	42	40	65	63	55	52	47	46	66	64	58	55	51	50	70	70	65	62	58	57
	400	63	58	53	50	43	41	66	64	57	53	48	48	69	67	60	57	52	52	71	71	66	63	59	58
	450	64	59	54	51	44	42	68	65	58	54	49	48	70	68	60	57	52	52	73	72	67	64	59	60
	550	67	62	55	53	46	45	70	68	61	56	50	50	72	70	63	59	54	53	76	74	69	66	61	63
8	300	55	50	47	44	41	37	58	55	52	47	47	45	60	58	55	50	50	48	65	65	65	60	60	59
	400	58	53	49	46	43	39	61	58	53	50	48	46	63	61	56	53	51	49	67	67	66	60	60	59
	500	60	55	51	48	44	41	64	60	54	52	49	47	65	63	57	55	53	50	69	69	67	61	61	60
	600	62	57	52	50	46	42	66	61	56	53	50	48	67	65	59	56	54	52	71	70	68	63	61	60
	700	64	58	54	51	47	43	68	63	57	55	52	49	69	67	62	60	57	55	73	72	68	64	62	60
	800	66	60	55	52	48	44	69	64	59	56	53	50	71	67	63	60	57	55	74	73	68	65	63	61
	1000	70	63	57	54	50	46	72	67	62	58	55	52	74	70	64	61	58	56	78	75	70	67	65	62
10	600	57	53	49	46	44	40	63	59	56	50	49	46	64	62	59	53	51	50	69	70	68	63	59	57
	800	60	55	52	49	46	42	64	61	57	52	51	48	67	63	60	55	54	52	71	71	69	64	61	59
	1000	63	58	54	51	48	44	67	63	59	54	52	50	69	65	61	57	56	53	74	72	69	64	63	60
	1100	64	58	55	52	48	45	68	64	59	55	53	50	70	67	63	60	57	54	74	73	69	65	64	61
	1200	65	59	55	53	49	45	69	65	60	56	54	51	71	67	63	61	57	55	75	74	70	66	64	62
	1400	67	61	57	54	50	47	70	67	62	58	55	52	73	69	64	61	58	56	77	75	71	67	65	63
	1600	69	63	59	56	51	48	74	69	65	60	56	53	76	71	67	62	60	57	80	76	73	69	67	64
12	800	57	52	49	45	43	40	61	59	58	54	52	50	63	61	61	56	54	52	68	68	68	63	60	59
	1100	61	55	52	48	46	42	65	61	60	55	53	52	67	63	62	58	56	54	71	69	68	65	63	61
	1400	63	57	54	51	48	44	67	63	61	56	54	52	70	65	63	59	56	54	74	71	71	67	64	62
	1600	65	58	56	52	49	45	69	64	62	57	55	52	71	67	64	61	59	57	75	72	72	68	65	63
	1700	66	59	56	53	49	46	69	64	62	58	55	52	72	67	65	61	59	57	76	73	72	69	66	64
	2000	68	61	58	54	51	47	71	65	64	60	57	53	74	68	66	62	60	57	78	75	73	70	67	66
	2300	69	63	61	56	52	49	73	67	65	61	58	55	75	70	67	63	60	58	80	76	75	70	68	67
14	1100	58	51	49	46	43	40	63	58	54	53	52	52	64	61	57	56	54	54	69	68	67	64	62	62
	1500	61	54	52	48	46	42	65	59	56	54	53	52	67	62	59	57	56	55	72	70	68	65	63	63
	1900	64	57	55	51	47	44	68	62	58	55	54	53	70	64	61	58	56	56	74	71	69	66	64	63
	2100	65	58	56	52	48	45	69	63	59	56	54	54	71	67	64	60	58	57	76	72	69	67	65	64
	2300	66	59	57	53	49	46	70	63	60	56	55	54	73	67	65	60	58	57	77	73	70	68	66	64
	2700	68	60	59	54	50	47	72	65	62	58	56	55	74	68	65	61	59	58	79	74	72	69	67	65
	3100	70	62	61	56	52	48	74	66	64	60	57	56	76	69	67	62	60	59	80	75	74	70	68	67
16	1600	60	52	51	46	43	41	63	57	54	54	52	51	66	59	57	56	54	53	70	65	64	62	62	60
	2100	63	55	54	49	46	43	67	60	57	55	54	51	69	63	60	58	56	54	73	70	67	65	64	62
	2600	65	57	56	51	47	45	69	63	59	56	54	53	71	66	62	59	57	56	76	74	69	68	67	65
	2800	66	58	57	52	48	45	70	64	60	56	54	53	74	68	65	60	58	57	76	74	70	68	67	65
	3100	67	59	58	53	49	46	71	65	61	57	55	54	75	69	65	60	58	57	78	75	71	69	67	66
	3600	69	61	59	54	50	47	73	67	63	58	56	54	75	69	66	61	59	57	80	77	73	70	68	67
	4100	71	63	62	56	51	49	75	68	67	60	57	55	77	71	69	62	60	58	81	79	74	70	68	68
19	2500	69	65	59	57	57	51	72	70	67	63	63	59	73	73	71	68	65	62	77	78	77	76	74	71
	3000	70	66	60	59	58	52	73	71	69	65	64	60	74	74	73	69	66	62	78	79	78	77	74	71
	3500	71	68	61	61	60	55	74	72	70	66	66	61	75	75	74	70	68	63	79	80	79	78	75	72
	4500	72	68	63	63	62	58	75	72	72	69	68	64	77	76	76	72	70	66	82	80	81	80	78	74
	5400	73	70	66	65	65	61	76	73	73	71	70	67	77	78	79	75	70	68	84	82	83	83	79	76
	5500	73	70	66	65	65	61	76	73	73	71	70	67	78	78	79	75	72	69	84	82	83	83	79	76
	6500	75	72	71	68	67	63	78	73	74	72	71	69	80	79	80	77	73	71	87	84	85	85	80	78
22	4000	71	69	64	60	56	54	75	73	70	66	62	60	77	76	74	70	65	63	82	81	81	79	75	72
	5000	72	69	66	63	59	57	77	74	74	68	64	62	79	76	76	72	67	65	84	81	83	80	76	73
	6000	74	70	69	66	62	60	79	74	76	71	67	65	81	77	78	74	70	68	85	82	85	82	77	75
	7000	77	71	71	68	64	63	80	76	77	73	69	67	81	78	79	75	71	69	86	83	86	83	79	76
	7100	77	71	71	68	64	63	80	76	77	73	69	67	82	80	82	76	71	69	86	83	86	83	79	76
	8000	79	72	74	70	66	65	81	77	78	75	71	69	83	80	82	77	73	71	87	84	88	84	80	77

- Performance data obtained from tests conducted in accordance with AHRI Standard 880.
- Sound levels are expressed in decibels, dB re: 1 x 10^{-12} watts
- Duct end corrections included in sound power levels per AHRI Standard 880.
- Certified AHRI data is highlighted blue. Application data (not highlighted blue) is outside the scope of the certification program.

SOUND DATA

RADIATED SOUND POWER DATA - MODEL TSS

TERMINAL SIZE	CFM	OCTAVE BAND NUMBER																							
		0.5" ΔPs						1.0" ΔPs						1.5" ΔPs						3.0" ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
4	100	46	43	35	29	26	27	49	44	39	32	27	24	49	46	42	34	29	26	48	50	46	38	33	31
	150	49	47	40	33	29	28	52	48	44	36	31	28	53	53	46	38	33	30	53	55	50	43	37	34
	200	52	51	44	37	32	29	56	52	48	40	35	31	56	54	50	42	37	33	58	59	54	47	41	38
	250	54	54	47	40	36	32	58	55	51	43	38	34	59	57	53	45	40	37	61	62	58	50	45	41
5	100	42	36	33	27	23	20	45	40	37	29	25	22	46	42	40	32	27	24	47	47	44	36	32	30
	200	46	44	40	33	28	28	49	48	44	36	31	28	50	49	46	38	33	29	52	53	50	43	37	34
	250	49	47	43	36	31	28	51	51	47	39	33	29	53	52	49	41	35	32	54	54	53	45	40	36
	300	51	49	45	38	34	30	54	53	49	41	36	32	55	55	51	43	38	34	56	57	56	48	42	39
	350	54	52	47	40	36	32	57	55	51	43	38	35	57	57	54	45	40	37	58	59	58	50	45	41
6	200	43	38	38	37	33	23	47	44	45	44	40	29	48	46	49	47	43	32	51	52	54	51	47	37
	250	46	41	39	36	32	23	48	46	45	44	41	30	49	49	51	49	46	34	53	54	56	55	51	40
	300	48	43	40	36	31	24	50	48	46	44	41	30	51	51	51	49	46	35	55	56	58	57	54	42
	350	50	46	42	37	31	26	53	50	47	43	40	30	52	52	51	49	46	36	57	58	60	58	55	43
	400	52	47	43	37	32	27	55	52	48	44	40	31	56	54	52	49	46	36	58	59	61	59	56	44
	450	54	48	45	38	32	28	57	53	50	45	40	32	58	55	53	49	46	36	60	60	61	59	56	45
	550	60	53	49	43	36	30	64	58	53	46	41	34	58	56	56	50	46	38	63	63	62	57	55	46
8	300	46	37	38	33	28	24	49	46	42	38	33	29	50	48	45	41	37	30	53	53	52	47	43	35
	400	49	40	40	35	30	24	52	47	44	39	35	30	54	49	47	43	38	32	58	56	54	49	44	37
	500	50	42	41	36	32	25	53	48	46	41	37	31	54	50	49	44	40	33	57	57	55	51	46	40
	600	53	44	43	38	33	26	56	50	47	42	38	31	57	52	50	46	41	34	60	58	57	52	47	41
	700	56	45	44	39	34	27	58	52	48	44	39	32	58	56	52	47	42	35	62	60	58	53	48	42
	800	58	47	45	40	35	28	60	53	50	45	40	33	61	56	53	48	43	36	64	61	59	54	50	43
	1000	60	52	48	42	37	30	62	56	52	46	42	35	63	58	55	50	45	38	67	63	62	56	51	45
10	600	49	40	38	32	27	28	53	47	43	37	31	29	54	50	46	40	34	31	58	58	57	49	42	36
	800	51	42	40	34	28	29	55	49	45	38	33	30	56	52	48	42	37	32	60	59	57	50	43	38
	1000	53	44	43	36	30	29	56	51	47	40	35	30	58	53	50	44	38	33	62	60	57	50	45	40
	1100	54	45	44	37	31	29	56	52	48	41	36	31	59	55	53	44	39	34	63	60	58	51	45	40
	1200	55	46	45	37	32	29	57	53	49	42	37	31	59	55	53	45	40	35	64	61	59	52	46	41
	1400	57	48	46	39	33	29	59	54	50	43	38	33	60	56	54	47	42	36	65	62	60	53	48	43
	1600	61	51	48	40	34	29	63	56	52	45	40	34	64	58	55	48	43	38	67	63	62	54	49	44
12	800	47	41	39	33	30	29	51	49	47	40	37	33	52	52	50	43	40	36	54	60	58	52	47	43
	1100	49	44	41	34	31	29	54	51	48	42	38	33	55	54	51	45	40	36	58	61	59	53	48	45
	1400	51	46	42	35	32	29	56	52	50	43	39	34	57	54	52	46	42	37	60	62	60	54	49	46
	1600	52	47	44	37	33	29	56	53	51	44	39	34	59	56	53	44	40	35	62	63	61	55	49	46
	1700	53	48	44	37	33	29	56	53	51	44	39	34	59	56	54	47	42	37	63	63	61	55	49	46
	2000	54	49	46	39	33	29	58	54	52	45	40	34	60	56	54	48	42	37	64	64	62	56	50	46
	2300	55	50	48	40	35	30	59	55	53	46	41	35	62	58	56	49	44	39	66	65	63	57	51	47
14	1100	47	42	36	34	34	30	53	49	42	39	40	36	55	52	45	42	42	38	60	60	54	50	47	45
	1500	49	44	39	36	34	30	54	51	45	40	41	36	56	54	48	43	43	39	62	61	55	52	48	47
	1900	51	46	42	37	34	30	56	53	47	43	43	37	58	55	49	46	45	40	63	62	56	53	51	48
	2100	52	47	43	38	34	30	56	54	48	43	43	37	60	58	51	46	46	41	64	62	57	54	52	49
	2300	53	48	44	38	34	30	57	54	48	43	43	37	60	58	52	46	46	41	65	63	58	54	53	50
	2700	55	50	46	40	35	31	59	56	50	45	43	37	61	58	54	48	46	41	66	64	60	55	54	50
	3100	56	53	48	42	37	32	61	58	52	46	43	38	63	60	55	49	46	41	67	65	62	57	55	50
16	1600	48	44	37	35	30	30	53	49	43	40	36	33	55	52	46	42	38	35	60	62	56	50	46	41
	2100	50	46	40	36	33	30	55	52	46	41	39	34	57	55	48	44	41	37	61	64	56	52	47	44
	2600	53	48	43	39	35	31	57	53	47	43	40	36	59	56	50	46	43	39	63	64	58	53	49	46
	2800	54	48	44	39	36	31	58	54	48	44	41	37	60	59	52	47	44	40	64	64	58	54	50	46
	3100	55	49	45	41	37	32	59	55	49	45	42	38	61	59	52	48	45	41	65	65	59	55	51	47
	3600	56	51	47	42	38	34	61	57	51	47	43	39	63	59	54	50	47	43	67	66	61	56	53	49
	4100	58	53	50	44	40	35	62	59	53	48	45	40	65	61	56	51	48	44	69	67	63	58	54	50
19	2500	59	57	54	47	41	33	65	60	60	52	46	39	66	63	63	55	50	42	70	67	67	63	57	50
	3000	59	58	55	47	41	34	65	61	61	52	46	39	66	63	64	56	50	43	70	68	68	64	58	50
	3500	60	59	56	48	42	35	66	62	62	53	47	40	67	64	65	57	51	44	71	68	69	64	59	51
	4500	60	61	59	50	45	37	66	64	65	55	50	43	68	66	68	59	53	46	72	70	72	67	61	54
	5400	62	62	62	52	48	40	67	66	68	57	52	45	68	68	71	61	56	49	73	72	75	69	64	57
	5500	62	63	63	53	48	40	67	66	68	58	53	46	68	68	71	62	56	49	73	72	76	70	64	57
	6500	66	65	66	56	51	44	67	68	72	61	56	49	69	70	75	65	60	53	75	75	79	73	67	60
22	4000	59	60	56	48	42	36	65	63	62	53	47	41	66	66	65	57	51	46	70	71	72	67	60	54
	5000	60	61	59	50	44	38	65	64	64	55	48	43	67	67	67	59	53	48	72	72	74	68	62	56
	6000	62	62	61	51	46	40	65	65	66	56	50	45	67	68	70	61	54	49	72	73	76	70	64	58
	7000	64	63	64	53	48	41	66	66	69	58	52	47	68	69	72	63	56	51	74	74	79	72	66	59
	7100	64	63	64	54	48	41	66	66	69	59	53	47	69	69	73	63	57	51	74	74	79	72	66	59
	8000	66	64	66	55	50	43	67	67	71	60	54	48	70	70	75	65	58	53	75	75	81	74	68	61

- Performance data obtained from tests conducted in accordance with AHRI Standard 880.
- Sound levels are expressed in decibels, dB re: 1 x 10^{-12} watts
- Certified AHRI data is highlighted blue. Application data (not highlighted blue) is outside the scope of the certification program.

DISCHARGE SOUND POWER DATA - MODEL TSS - SA

TERMINAL SIZE	CFM	OCTAVE BAND NUMBER																	
		0.5" ΔPs						1.0" ΔPs						3.0" ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
4	100	52	47	35	29	21	22	55	51	42	34	24	24	55	54	48	41	30	28
	150	55	52	39	32	23	22	61	57	45	37	27	23	63	62	54	45	35	32
	200	60	56	43	35	24	25	66	61	48	40	29	26	68	67	58	48	37	34
	250	64	59	46	41	28	26	70	63	51	43	32	27	73	71	62	50	39	34
5	100	49	43	35	29	20	20	50	44	39	30	23	24	53	51	45	37	28	27
	200	53	49	39	30	20	21	56	51	44	35	24	23	60	60	54	44	34	31
	300	60	53	43	34	21	22	65	57	48	39	26	24	66	63	58	48	37	32
	350	62	55	45	36	24	21	68	60	50	42	29	25	68	65	60	51	39	32
6	200	49	45	35	28	19	22	54	50	43	32	22	23	59	58	51	43	32	29
	250	56	49	38	30	22	23	59	54	46	35	23	23	61	59	53	45	33	31
	300	59	52	41	32	22	23	61	57	48	37	25	23	64	62	57	46	35	31
	350	59	54	44	35	23	24	62	60	51	40	27	24	65	64	59	48	37	33
	450	60	55	46	37	23	24	65	61	54	42	28	24	69	66	61	50	38	36
	550	64	59	50	42	26	26	67	65	57	46	32	29	73	70	65	52	39	38
8	300	52	45	39	29	22	22	53	50	47	36	28	27	59	56	57	47	38	36
	400	55	46	40	30	23	23	57	51	46	37	28	28	60	57	58	47	38	36
	500	57	50	43	34	24	24	61	54	49	39	30	28	63	60	60	50	41	38
	600	58	52	45	36	26	24	63	56	49	42	30	28	65	62	62	52	41	38
	800	62	55	49	39	29	26	66	60	53	45	34	30	71	66	62	53	43	39
	1000	66	60	53	44	33	29	69	64	57	49	40	32	75	69	65	55	44	40
10	600	54	49	42	34	23	23	58	54	51	40	30	29	64	59	57	49	37	37
	800	56	51	43	35	25	24	61	57	52	42	31	30	66	63	60	53	40	39
	1000	59	54	47	38	28	26	63	59	54	44	34	32	70	66	62	55	43	40
	1200	60	57	49	40	29	27	65	61	56	45	37	33	72	69	64	56	44	42
	1400	62	59	51	43	32	29	67	63	58	48	40	35	74	70	66	58	46	44
	1600	65	61	56	47	35	32	71	66	62	51	43	37	77	72	68	61	48	46
12	800	52	49	44	35	28	26	55	55	54	45	36	33	61	59	58	51	42	40
	1100	54	52	47	37	29	28	59	58	56	46	38	38	65	62	61	55	47	43
	1400	56	54	50	40	32	28	62	60	57	47	40	38	66	66	66	58	49	45
	1700	58	55	52	42	34	31	64	61	58	49	42	38	70	69	67	60	52	48
	2000	61	59	54	45	37	33	66	62	60	51	45	40	74	71	69	61	53	51
	2300	65	61	57	48	40	37	69	63	61	52	47	42	76	72	70	61	55	52
14	1100	53	47	42	38	32	26	60	55	50	44	39	35	65	62	59	53	48	45
	1500	57	50	45	39	34	28	62	57	52	45	41	38	67	65	62	57	51	48
	1900	57	52	48	42	35	29	65	60	54	46	43	41	70	67	65	58	53	49
	2300	60	56	51	45	38	32	66	61	56	47	45	43	72	69	65	60	56	51
	2700	62	57	54	47	40	36	68	63	58	49	47	45	75	70	67	61	57	53
	3100	64	59	56	49	42	37	67	64	60	51	48	46	77	72	68	61	58	56
16	1600	54	48	43	36	32	27	58	54	50	47	39	34	64	59	53	51	48	43
	2100	58	52	47	40	34	29	63	58	52	48	42	37	66	65	59	57	52	47
	2600	59	53	50	43	36	30	66	61	54	49	43	41	70	70	63	62	56	51
	3100	61	57	52	46	39	33	67	63	57	49	45	43	74	71	66	61	57	53
	3600	62	59	56	47	41	36	68	64	60	50	47	44	77	74	68	62	58	55
	4100	64	61	59	50	42	38	68	65	63	52	49	45	79	76	70	62	59	57
19	2500	66	63	54	50	47	38	70	64	60	56	50	42	72	68	65	62	58	51
	3000	67	64	56	53	49	41	71	67	63	58	52	46	74	71	68	66	61	54
	3500	68	66	57	54	50	46	72	68	65	59	55	49	75	73	70	69	63	56
	4500	69	66	59	56	52	49	73	69	68	61	58	53	79	76	75	71	68	61
	5500	70	67	62	58	56	51	74	70	69	63	61	57	82	79	78	75	69	64
	6500	72	69	67	60	58	53	75	70	69	64	63	59	85	81	80	77	71	67
22	4000	68	66	60	53	46	41	73	68	66	58	50	46	78	73	74	69	63	57
	5000	68	66	62	57	49	45	75	70	70	61	53	50	80	76	77	73	65	59
	6000	71	68	65	60	53	49	77	72	73	63	57	54	82	78	79	73	67	62
	7000	74	69	68	62	55	53	78	73	74	65	60	57	84	80	81	74	68	63
	8000	76	70	71	64	57	55	78	74	74	67	63	59	85	81	82	75	70	65

- Performance data obtained from tests conducted in accordance with AHRI Standard 880.
- Sound levels are expressed in decibels, dB re: 1 x 10^{-12} watts
- Duct end corrections included in sound power levels per AHRI Standard 880.

SOUND DATA

RADIATED SOUND POWER DATA - MODEL TSS-SA

TERMINAL SIZE	CFM	OCTAVE BAND NUMBER																	
		0.5" ΔPs						1.0" ΔPs						3.0" ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
4	100	46	43	35	29	26	27	49	44	39	32	27	24	48	50	46	38	33	31
	150	49	47	40	33	29	28	52	48	44	36	31	28	53	55	50	43	37	34
	200	52	51	44	37	32	29	56	52	48	40	35	31	58	59	54	47	41	38
	250	54	54	47	40	36	32	58	55	51	43	38	34	61	62	58	50	45	41
5	100	42	36	33	27	23	20	45	40	37	29	25	22	47	47	44	36	32	30
	200	46	44	40	33	28	28	49	48	44	36	31	28	52	53	50	43	37	34
	300	51	49	45	38	34	30	54	53	49	41	36	32	56	57	56	48	42	39
	350	54	52	47	40	36	32	57	55	51	43	38	35	58	59	58	50	45	41
6	200	43	38	38	37	33	23	47	44	45	44	40	29	51	52	54	51	47	37
	250	46	41	39	36	32	23	48	46	45	44	41	30	53	54	56	55	51	40
	300	48	43	40	36	31	24	50	48	46	44	41	30	55	56	58	57	54	42
	350	50	46	42	37	31	26	53	50	47	43	40	30	57	58	60	58	55	43
	450	54	48	45	38	32	28	57	53	50	45	40	32	60	60	61	59	56	45
	550	60	53	49	43	36	30	64	58	53	46	41	34	63	63	62	57	55	46
8	300	46	37	38	33	28	24	49	46	42	38	33	29	53	53	52	47	43	35
	400	49	40	40	35	30	24	52	47	44	39	35	30	58	56	54	49	44	37
	500	50	42	41	36	32	25	53	48	46	41	37	31	57	57	55	51	46	40
	600	53	44	43	38	33	26	56	50	47	42	38	31	60	58	57	52	47	41
	800	58	47	45	40	35	28	60	53	50	45	40	33	64	61	59	54	50	43
	1000	60	52	48	42	37	30	62	56	52	46	42	35	67	63	62	56	51	45
10	600	49	40	38	32	27	28	53	47	43	37	31	29	58	58	57	49	42	36
	800	51	42	40	34	28	29	55	49	45	38	33	30	60	59	57	50	43	38
	1000	53	44	43	36	30	29	56	51	47	40	35	30	62	60	57	50	45	40
	1200	55	46	45	37	32	29	57	53	49	42	37	31	64	61	59	52	46	41
	1400	57	48	46	39	33	29	59	54	50	43	38	33	65	62	60	53	48	43
	1600	61	51	48	40	34	29	63	56	52	45	40	34	67	63	62	54	49	44
12	800	47	41	39	33	30	29	51	49	47	40	37	33	54	60	58	52	47	43
	1100	49	44	41	34	31	29	54	51	48	42	38	33	58	61	59	53	48	45
	1400	51	46	42	35	32	29	56	52	50	43	39	34	60	62	60	54	49	46
	1700	53	48	44	37	33	29	56	53	51	44	39	34	63	63	61	55	49	46
	2000	54	49	46	39	33	29	58	54	52	45	40	34	64	64	62	56	50	46
	2300	55	50	48	40	35	30	59	55	53	46	41	35	66	65	63	57	51	47
14	1100	47	42	36	34	34	30	53	49	42	39	40	36	60	60	54	50	47	45
	1500	49	44	39	36	34	30	54	51	45	40	41	36	62	61	55	52	48	47
	1900	51	46	42	37	34	30	56	53	47	43	43	37	63	62	56	53	51	48
	2300	53	48	44	38	34	30	57	54	48	43	43	37	65	63	58	54	53	50
	2700	55	50	46	40	35	31	59	56	50	45	43	37	66	64	60	55	54	50
	3100	56	53	48	42	37	32	61	58	52	46	43	38	67	65	62	57	55	50
16	1600	48	44	37	35	30	30	53	49	43	40	36	33	60	62	56	50	46	41
	2100	50	46	40	36	33	30	55	52	46	41	39	34	61	64	56	52	47	44
	2600	53	48	43	39	35	31	57	53	47	43	40	36	63	64	58	53	49	46
	3100	55	49	45	41	37	32	59	55	49	45	42	38	65	65	59	55	51	47
	3600	56	51	47	42	38	34	61	57	51	47	43	39	67	66	61	56	53	49
	4100	58	53	50	44	40	35	62	59	53	48	45	40	69	67	63	58	54	50
19	2500	59	57	54	47	41	33	65	60	60	52	46	39	70	67	67	63	57	50
	3000	59	58	55	47	41	34	65	61	61	52	46	39	70	68	68	64	58	50
	3500	60	59	56	48	42	35	66	62	62	53	47	40	71	68	69	64	59	51
	4500	60	61	59	50	45	37	66	64	65	55	50	43	72	70	72	67	61	54
	5500	62	63	63	53	48	40	67	66	68	58	53	46	73	72	76	70	64	57
	6500	66	65	66	56	51	44	67	68	72	61	56	49	75	75	79	73	67	60
22	4000	59	60	56	48	42	36	65	63	62	53	47	41	70	71	72	67	60	54
	5000	60	61	59	50	44	38	65	64	64	55	48	43	72	72	74	68	62	56
	6000	62	62	61	51	46	40	65	65	66	56	50	45	72	73	76	70	64	58
	7000	64	63	64	53	48	41	66	66	69	58	52	47	74	74	79	72	66	59
	8000	66	64	66	55	50	43	67	67	71	60	54	48	75	75	81	74	68	61

- Performance data obtained from tests conducted in accordance with AHRI Standard 880.
- Sound levels are expressed in decibels, dB re: 1×10^{-12} watts

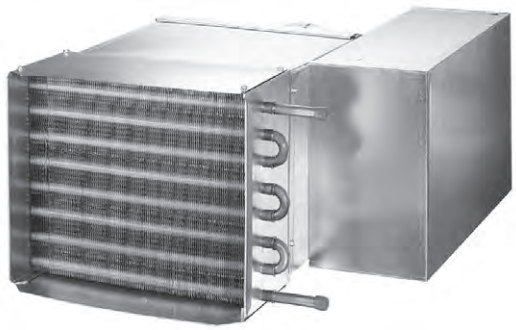
AHRI RATINGS

SIZE	RATED AIRFLOW CFM	MINIMUM OPERATING PRESSURE (IN. W.G.)	STANDARD RATINGS SOUND POWER LEVEL, dB RE: 1 x 10^{-12} WATTS											
			1.5" WATER STATIC PRESSURE											
			RADIATED						DISCHARGE					
			Hz Octave Band Center Frequency						Hz Octave Band Center Frequency					
			125	250	500	1000	2000	4000	125	250	500	1000	2000	4000
4	150	0.01	53	53	46	38	33	30	68	67	58	54	49	48
5	250	0.02	53	52	49	41	35	32	70	68	59	55	51	50
6	400	0.10	56	54	52	49	46	36	69	67	60	57	52	52
8	700	0.03	58	56	52	47	42	35	69	67	62	60	57	55
10	1100	0.03	59	55	53	44	39	34	70	67	63	60	57	54
12	1600	0.04	59	56	53	44	40	35	71	67	64	61	59	57
14	2100	0.06	60	58	51	46	46	41	71	67	64	60	58	57
16	2800	0.04	60	59	52	47	44	40	74	68	65	60	58	57
19	5400	0.38	68	68	71	61	56	49	77	78	79	75	70	68
22	7100	0.20	69	69	73	63	57	51	82	80	82	76	71	69

- Rated in accordance with AHRI Standard 880
- Duct end corrections included in sound power levels per AHRI Standard 880.

HOT WATER COIL DATA

MODEL TSS-WC



STANDARD FEATURES

- Designed, manufactured, and tested by Johnson Controls
- Aluminum fin construction with die-formed spacer collars for uniform spacing
- Mechanically expanded copper tubes leak tested to 450 PSIG air pressure and rated at 300 PSIG working pressure at 200°F
- Male sweat type water connections
- 1, 2, 3, and 4 row configurations

OPTIONAL FEATURES

- Low pressure steam coils
- Multi-circuit coils for reduced water pressure drop
- Opposite hand water connections
- Bottom and top access plates for cleaning

SELECTION PROCEDURE

TSS-WC Hot Water Coil Performance Tables are based upon a temperature difference of 125°F between the entering water and the entering air. If this ΔT is suitable, proceed directly to the tables for selection. All pertinent performance data is tabulated. **For Variable Air Volume Applications, the static pressure drop must be based on the maximum air volume.**

ENTERING WATER - AIR TEMPERATURE DIFFERENTIAL (DT) CORRECTION FACTORS															
ΔT	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
FACTOR	0.15	0.19	0.23	0.27	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.63	0.67	0.71
ΔT	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165
FACTOR	0.75	0.79	0.83	0.88	0.92	0.96	1.00	1.04	1.08	1.13	1.17	1.21	1.25	1.29	1.33

The table above gives correction factors for various entering ΔT's (difference between EWT and EAT). Multiply MBH values obtained from selection tables by the appropriate correction factor above to obtain the actual MBH value. Air and water pressure drop can be read directly from the selection tables. The LAT and LWT can be calculated from the following fundamental formulas:

$$LAT = EAT + \frac{BTUH}{1.085 \times CFM}$$

$$LWT = EWT - \frac{BTUH}{500 \times GPM}$$

DEFINITION OF TERMS

EAT Entering Air Temperature (°F)
EWT Entering Water Temperature (°F)
LWT Leaving Water Temperature (°F)
LAT Leaving Air Temperature
CFM Air Volume (Cubic Feet per Minute)
GPM Water Capacity (Gallons per Minute)
MBH 1,000 BTUH
BTUH Coil Heating Capacity (British Thermal Units per Hour)

MODEL TSS-WC - SIZES 4,5,6

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
50	1 Row	0.01	0.5	0.3	0.1	123.7	149 3	164.7	159.1	3.7	5.1
	2 Row	0.01	1.0	1.0	0.3	128.4	155 8	171.8	168 8	4 0	5.5
			2.0	3.4	0.9	131.2	159 3	175.8	174 2	4.1	5.7
			4.0	12.2	3.4	132.7	161 2	177.8	177 0	4 2	5.8
100	1 Row	0.01	0.5	0.3	0.1	105.7	127.4	157.5	147 9	5 5	7.8
	2 Row	0.02	1.0	1.0	0.3	111 2	137 0	167.5	161 8	6.1	8.9
			2.0	3.4	1.0	114.6	142 8	173.4	170 2	6 5	9.5
			4.0	12.2	3.4	116.5	146 2	176.6	174 9	6.7	9.9
150	1 Row	0.02	0.5	0.3	0.1	96.0	114.0	152.7	140 8	6.7	9.6
	2 Row	0.03	1.0	1.0	0.3	101.7	124.7	164.4	156 8	7 6	11.3
			2.0	3.4	1.0	105.3	131.7	171.6	167 2	8 2	12.5
			4.0	12.2	3.4	107.5	135 8	175.6	173 3	8 5	13.1
200	1 Row	0.03	0.5	0.3	0.1	89.8	104 9	149.1	135 8	7 5	10.8
	2 Row	0.06	1.0	1.0	0.3	95.4	115.9	162.0	153 0	8 8	13.2
			2.0	3.4	1.0	99.1	123 5	170.2	164 8	9 6	14.8
			4.0	12.2	3.4	101.4	128.1	174.8	171 9	10.0	15.8
250	1 Row	0.04	0.5	0.3	0.1	85.4	98.4	146.3	132 0	8 2	11.8
	2 Row	0.08	1.0	1.0	0.3	90.9	109 3	160.1	149 9	9.7	14.7
			2.0	3.4	1.0	94.6	117.1	169.0	162.7	10.7	16.8
			4.0	12.2	3.4	96.9	122.1	174.2	170.7	11.3	18.2
300	1 Row	0.06	0.5	0.3	0.1	82.1	93.4	144.0	129 0	8 8	12.5
	2 Row	0.12	1.0	1.0	0.3	87.4	104.1	158.4	147 3	10.5	16.0
			2.0	3.4	1.0	91.1	112.0	167.9	161 0	11.7	18.5
			4.0	12.2	3.4	93.4	117.2	173.6	169 6	12.5	20.2
350	1 Row	0.08	0.5	0.3	0.1	79.5	89.5	142.1	126 6	9 3	13.1
	2 Row	0.15	1.0	1.0	0.3	84.6	99.9	157.0	145 2	11.2	17.0
			2.0	3.4	1.0	88.3	107 8	167.0	159 5	12.6	20.0
			4.0	12.2	3.4	90.6	113.1	173.1	168.7	13.5	22.0
400	1 Row	0.10	0.5	0.3	0.1	77.4	86.4	140.4	124 6	9.7	13.6
	2 Row	0.19	1.0	1.0	0.3	82.4	96.4	155.7	143 3	11.9	17.9
			2.0	3.4	1.0	86.0	104 3	166.2	158.1	13.4	21.4
			4.0	12.2	3.4	88.3	109 6	172.6	167 8	14.4	23.7

MODEL TSS-WC - SIZE 8

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
175	1 Row	0.02	0.5	0.3	0.1	95.7	113.1	148.4	135 0	7.7	11.0
	2 Row	0.03	1.0	1.0	0.3	101.7	124 5	161.8	153 0	8 9	13.2
			2.0	3.5	1.0	105.6	131 9	170.1	165 0	9 6	14.6
			4.0	12.7	3.5	107.9	136 2	174.8	172.1	10.0	15.4
250	1 Row	0.03	0.5	0.3	0.1	88.0	101 9	143.4	128 2	8 9	12.7
	2 Row	0.06	1.0	1.0	0.3	94.0	113.5	158.4	147 6	10.6	15.8
			2.0	3.6	1.0	97.9	121 6	168.1	161 5	11.6	18.0
			4.0	12.7	3.5	100.4	126 6	173.7	170 0	12.3	19.4
325	1 Row	0.05	0.5	0.3	0.1	83.0	94.4	139.7	123 5	9 9	13.9
	2 Row	0.10	1.0	1.0	0.3	88.7	105.7	155.7	143 5	11.9	17.9
			2.0	3.6	1.0	92.7	114.1	166.4	158.7	13.3	20.8
			4.0	12.7	3.6	95.2	119.5	172.7	168 3	14.1	22.7
400	1 Row	0.07	0.5	0.3	0.1	79.4	89.0	136.8	119.9	10.6	14.7
	2 Row	0.14	1.0	1.0	0.3	84.9	99.9	153.4	140 2	13.0	19.5
			2.0	3.6	1.0	88.8	108 3	165.0	156 3	14.7	23.1
			4.0	12.7	3.6	91.3	113.9	171.9	166 9	15.7	25.5
475	1 Row	0.09	0.5	0.3	0.1	76.7	85.0	134.4	117.1	11.2	15.4
	2 Row	0.19	1.0	1.0	0.3	82.0	95.4	151.6	137 6	13.9	20.8
			2.0	3.6	1.0	85.8	103.7	163.7	154 3	15.9	25.1
			4.0	12.7	3.6	88.3	109.4	171.2	165 6	17.1	28.0
550	1 Row	0.12	0.5	0.3	0.1	74.6	81.9	132.4	114.9	11.7	16.0
	2 Row	0.25	1.0	1.0	0.3	79.6	91.7	149.9	135 3	14.7	21.9
			2.0	3.6	1.0	83.4	100 0	162.6	152 6	16.9	26.8
			4.0	12.7	3.6	85.8	105.7	170.6	164 5	18.4	30.2
625	1 Row	0.15	0.5	0.3	0.1	72.9	79.3	130.6	113.0	12.1	16.5
	2 Row	0.31	1.0	1.0	0.3	77.7	88.7	148.5	133.4	15.4	22.8
			2.0	3.6	1.0	81.4	96.8	161.7	151 0	17.9	28.3
			4.0	12.7	3.6	83.8	102 5	170.0	163 5	19.5	32.2
700	1 Row	0.19	0.5	0.3	0.1	71.4	77.2	129.1	111.4	12.5	16.9
	2 Row	0.38	1.0	1.0	0.3	76.1	86.2	147.3	131.7	16.0	23.7
			2.0	3.6	1.0	79.7	94.1	160.8	149.7	18.7	29.6
			4.0	12.7	3.6	82.1	99.8	169.5	162 6	20.5	34.0

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

HOT WATER COIL DATA

MODEL TSS-WC - SIZE 10

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
300	1 Row	0.02	0.5	0.3	0.1	89.6	103.0	134.1	116.4	11.2	15.6
	2 Row	0.04	1.0	1.2	0.3	96.5	116.2	152.4	139.4	13.5	19.9
			2.0	4.2	1.2	101.1	125.3	164.6	156.6	15.0	22.9
			4.0	14 9	4.2	103.9	130.9	171.8	167.3	15.9	24.7
400	1 Row	0.04	0.5	0.3	0.1	83.8	94.5	129.1	110.4	12.5	17.1
	2 Row	0.07	1.0	1.2	0.3	90.4	107.3	148.6	133.7	15.4	22.7
			2.0	4.2	1.2	95.1	116.9	162.2	152.5	17.4	26.8
			4.0	14 9	4.2	98.0	123.0	170.4	164.9	18.6	29.5
500	1 Row	0.05	0.5	0.3	0.1	79.8	88.6	125.2	106.0	13.4	18.2
	2 Row	0.11	1.0	1.2	0.3	86.1	100.8	145.5	129.4	16.9	24.8
			2.0	4.2	1.2	90.7	110.5	160.2	149.3	19.3	30.0
			4.0	14 9	4.2	93.6	116.9	169.3	162.8	20.9	33.5
600	1 Row	0.07	0.5	0.3	0.1	76.8	84.2	122.2	102.8	14.2	19.0
	2 Row	0.15	1.0	1.2	0.3	82.9	95.8	143.0	125.9	18.1	26.5
			2.0	4.2	1.2	87.4	105.4	158.4	146.5	21.0	32.7
			4.0	14 9	4.2	90.3	111 9	168.2	161.0	22.9	37.0
700	1 Row	0.10	0.5	0.3	0.1	74.5	80.9	119.7	100.2	14.8	19.6
	2 Row	0.19	1.0	1.2	0.3	80.3	91.8	140.8	123.1	19.2	27.9
			2.0	4.2	1.2	84.7	101.2	156.9	144.1	22.5	35.1
			4.0	15 0	4.2	87.6	107.9	167.3	159.4	24.7	40.1
800	1 Row	0.12	0.5	0.3	0.1	72.7	78.3	117.6	98.1	15.3	20.2
	2 Row	0.25	1.0	1.2	0.3	78.2	88.6	138.9	120.7	20.1	29.1
			2.0	4.2	1.2	82.5	97.8	155.6	142.1	23.8	37.1
			4.0	15 0	4.2	85.3	104.4	166.5	158.0	26.3	42.8
900	1 Row	0.15	0.5	0.3	0.1	71.2	76.1	115.7	96.4	15.8	20.6
	2 Row	0.30	1.0	1.2	0.3	76.5	85.9	137.3	118.6	20.9	30.1
			2.0	4.2	1.2	80.6	94.9	154.4	140.3	25.0	38.9
			4.0	15 0	4.2	83.4	101.5	165.8	156.8	27.7	45.3
1000	1 Row	0.18	0.5	0.3	0.1	69.9	74.4	114.2	94.9	16.2	21.0
	2 Row	0.37	1.0	1.2	0.3	75.0	83.6	135.8	116.8	21.6	31.0
			2.0	4.2	1.2	79.1	92.4	153.3	138.7	26.1	40.5
			4.0	15 0	4.2	81.8	98.9	165.1	155.6	29.1	47.6

MODEL TSS-WC - SIZE 12

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
400	1 Row	0 02	0.5	0.4	0.1	87.5	98.9	122 5	102.7	14.1	19 0
	2 Row	0 04	1.0	1.4	0.4	95.3	113.5	144 3	128 3	17.4	25 3
			2.0	4.9	1.4	100.6	124.0	159.7	149.4	19 8	29 9
			4.0	17.4	4.9	103.9	130 5	169.1	163 2	21 2	32.7
550	1 Row	0 04	0.5	0.4	0.1	81.3	89.8	116.2	95.8	15.7	20.7
	2 Row	0 07	1.0	1.4	0.4	88.6	103.5	139.1	121.1	20 0	28 9
			2.0	4.9	1.4	93.9	114.5	156 2	143 8	23 2	35.4
			4.0	17.4	4.9	97.3	121.6	167.1	159.7	25 2	39.7
700	1 Row	0 05	0.5	0.4	0.1	77.1	83.8	111.7	91.3	16 8	21 9
	2 Row	0.11	1.0	1.4	0.4	84.0	96.6	135.1	115.8	22 0	31 5
			2.0	5.0	1.4	89.2	107.4	153.4	139.4	25 9	39.7
			4.0	17.4	4.9	92.6	114.9	165.4	156.7	28 5	45.4
850	1 Row	0 08	0.5	0.4	0.1	74.2	79.6	108 2	88.1	17.7	22.7
	2 Row	0.16	1.0	1.4	0.4	80.6	91.4	131 8	111.8	23 6	33 5
			2.0	5.0	1.4	85.7	102.0	151.1	135 8	28 3	43 3
			4.0	17.5	5.0	89.0	109.6	163 9	154 3	31 3	50 3
1000	1 Row	0.10	0.5	0.4	0.1	71.9	76.5	105.4	85.6	18.4	23 3
	2 Row	0 21	1.0	1.4	0.4	78.0	87.4	129.1	108 6	24 9	35.1
			2.0	5.0	1.4	82.9	97.7	149 0	132 8	30 2	46 2
			4.0	17.5	5.0	86.2	105.3	162 6	152.1	33 8	54 5
1150	1 Row	0.13	0.5	0.4	0.1	70.2	74.1	103.1	83.7	18 9	23 8
	2 Row	0 27	1.0	1.4	0.4	75.9	84.3	126 8	105 9	26.1	36.4
			2.0	5.0	1.4	80.7	94.2	147 3	130 2	32 0	48 8
			4.0	17.5	5.0	83.9	101.7	161 5	150 2	36.1	58 2
1300	1 Row	0.17	0.5	0.4	0.1	68.8	72.2	101.1	82.1	19.4	24 2
	2 Row	0 33	1.0	1.4	0.4	74.2	81.7	124 8	103.7	27.1	37 5
			2.0	5.0	1.4	78.8	91.2	145.7	128 0	33 5	51 0
			4.0	17.5	5.0	82.0	98.7	160 5	148 5	38.1	61 5
1450	1 Row	0 20	0.5	0.4	0.1	67.6	70.6	99.5	80.8	19 8	24 5
	2 Row	0.40	1.0	1.4	0.4	72.8	79.5	123.1	101 8	27 9	38 5
			2.0	5.0	1.4	77.2	88.7	144 3	126.1	34 9	52 9
			4.0	17.5	5.0	80.4	96.1	159 6	147 0	39 9	64 5

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

MODEL TSS-WC - SIZE 14

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
700	1 Row	0.03	0 5	0.5	0.1	80.2	87 0	102.4	81.8	19.1	24.2
	2 Row	0.06	1 0	1.7	0.5	88.6	102.1	128.1	107.4	25.5	35.7
			2 0	6.0	1.7	94.9	114.8	149.0	133.7	30.3	45.4
			4 0	21.0	6.0	99.1	123.3	162.9	153.5	33.4	51.8
900	1 Row	0.04	0 5	0.5	0.1	75.9	81 0	97.3	77.5	20.4	25.3
	2 Row	0.09	1 0	1.7	0.5	83.7	94.7	123.1	101.4	27.9	38.7
			2 0	6.0	1.7	89.9	107.2	145.2	128.1	34.0	50.9
			4 0	21.1	6.0	94.0	116.1	160.5	149.5	38.0	59.6
1100	1 Row	0.06	0 5	0.5	0.1	72.9	76 9	93.5	74.6	21.3	26.0
	2 Row	0.13	1 0	1.7	0.5	80.1	89 3	119.1	97.0	29.9	40.9
			2 0	6.1	1.7	86.1	101.4	142.1	123.6	37.0	55.3
			4 0	21.1	6.0	90.2	110.5	158.5	146.2	41.9	66.1
1300	1 Row	0.08	0 5	0.5	0.1	70.6	73 9	90.6	72.5	22.0	26.6
	2 Row	0.17	1 0	1.8	0.5	77.4	85 3	115.8	93.6	31.5	42.6
			2 0	6.1	1.7	83.1	96 9	139.5	120.0	39.6	58.9
			4 0	21.1	6.0	87.2	105.9	156.8	143.4	45.3	71.7
1500	1 Row	0.11	0 5	0.5	0.1	68.9	71 6	88.3	70.9	22.6	27.0
	2 Row	0.22	1 0	1.8	0.5	75.2	82.1	113.1	90.8	32.9	44.0
			2 0	6.1	1.8	80.8	93 2	137.2	116.9	41.9	62.0
			4 0	21.2	6.1	84.7	102.1	155.2	140.9	48.3	76.5
1700	1 Row	0.14	0 5	0.5	0.1	67.5	69 8	86.3	69.6	23.1	27.3
	2 Row	0.27	1 0	1.8	0.5	73.5	79 5	110.8	88.6	34.0	45.1
			2 0	6.1	1.8	78.8	90.1	135.2	114.3	43.9	64.6
			4 0	21.2	6.1	82.7	98 9	153.9	138.7	51.0	80.8
1900	1 Row	0.17	0 5	0.5	0.1	66.4	68.4	84.7	68.6	23.5	27.5
	2 Row	0.33	1 0	1.8	0.5	72.0	77.4	108.8	86.7	35.0	46.0
			2 0	6.1	1.8	77.2	87 5	133.4	112.0	45.6	66.9
			4 0	21.2	6.1	81.0	96.1	152.6	136.8	53.5	84.7
2100	1 Row	0.20	0 5	0.5	0.1	65.5	67 2	83.3	67.8	23.9	27.8
	2 Row	0.40	1 0	1.8	0.5	70.8	75 6	107.0	85.1	35.9	46.8
			2 0	6.1	1.8	75.8	85 3	131.8	110.0	47.2	68.8
			4 0	21.2	6.1	79.5	93.7	151.5	135.0	55.7	88.1

MODEL TSS-WC - SIZE 16

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
1600	1 Row	0.09	0.5	0.6	0.1	68.9	71.2	82.5	66.6	24.1	28.1
	2 Row	0.18	1.0	1.9	0.6	75.6	82.1	107.4	85.0	35.7	46.9
			2.0	6.6	1.9	81.7	94.0	132.8	111.3	46 3	67.5
			4.0	22.9	6.6	86.1	103.7	152.4	136 9	53 9	84.4
1800	1 Row	0.11	0.5	0.6	0.1	67.6	69.5	80.7	65.5	24 5	28.3
	2 Row	0.22	1.0	1.9	0.6	73.9	79.6	105.1	82.9	36 9	47.9
			2.0	6.6	1.9	79.8	91.0	130.7	108.7	48 3	70.1
			4.0	22.9	6.6	84.1	100.6	150.9	134 6	56 8	88.9
2000	1 Row	0.13	0.5	0.6	0.1	66.5	68.2	79.2	64.7	24 9	28.5
	2 Row	0.26	1.0	1.9	0.6	72.5	77.5	103.1	81.2	37 9	48.8
			2.0	6.6	1.9	78.1	88.4	128.8	106.4	50.1	72.4
			4.0	23.0	6.6	82.4	97.9	149.6	132 6	59.4	92.9
2200	1 Row	0.16	0.5	0.6	0.1	65.6	67.0	78.0	64.0	25 2	28.7
	2 Row	0.31	1.0	1.9	0.6	71.3	75.8	101.3	79.7	38.7	49.5
			2.0	6.6	1.9	76.7	86.2	127.2	104.4	51 8	74.4
			4.0	23.0	6.6	80.9	95.5	148.4	130.7	61 8	96.6
2400	1 Row	0.18	0.5	0.6	0.1	64.8	66.1	76.8	63.4	25 5	28.8
	2 Row	0.37	1.0	1.9	0.6	70.2	74.3	99.7	78.4	39 5	50.2
			2.0	6.6	1.9	75.5	84.3	125.6	102 6	53 3	76.2
			4.0	23.0	6.6	79.6	93.4	147.3	129.1	64 0	99.9
2600	1 Row	0.21	0.5	0.6	0.1	64.1	65.3	75.9	62.9	25.7	29.0
	2 Row	0.42	1.0	1.9	0.6	69.3	73.0	98.3	77.3	40 2	50.7
			2.0	6.6	1.9	74.4	82.6	124.2	101 0	54.7	77.8
			4.0	23.0	6.6	78.4	91.5	146.2	127 5	66 0	102.9
2800	1 Row	0.24	0.5	0.6	0.1	63.6	64.6	75.0	62.5	25 9	29.1
	2 Row	0.48	1.0	1.9	0.6	68.5	71.9	97.0	76.3	40 9	51.2
			2.0	6.7	1.9	73.5	81.1	123.0	99.6	56 0	79.2
			4.0	23.0	6.6	77.4	89.9	145.2	126.1	67 9	105.7
3000	1 Row	0.27	0.5	0.6	0.1	63.0	64.0	74.2	62.1	26.1	29.2
	2 Row	0.55	1.0	1.9	0.6	67.8	70.9	95.9	75.4	41.4	51.7
			2.0	6.7	1.9	72.6	79.8	121.8	98.3	57.1	80.5
			4.0	23.1	6.6	76.5	88.3	144.3	124 8	69.7	108.3

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

HOT WATER COIL DATA

MODEL TSS-WC - SIZE 19

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
2300	1 Row	0.11	0.5	0.6	0.1	65.7	66.9	72.3	60.5	26.6	29.6
	2 Row	0.23	1.0	2.2	0.6	71.9	76.1	94.6	73.8	42.1	52.5
			2.0	7.4	2.2	78.1	87.5	121 5	97.9	57.4	80.9
			4.0	25.6	7.4	82.8	97.9	144 5	125.5	69.4	106 9
2600	1 Row	0.14	0.5	0.6	0.1	64.6	65.6	70.8	59.9	27.0	29.7
	2 Row	0.28	1.0	2.2	0.6	70.3	73.9	92.4	72.2	43.2	53.3
			2.0	7.4	2.2	76.2	84.6	119.1	95.3	59.8	83.5
			4.0	25.7	7.4	80.9	94.8	142.7	122.9	72.9	112.0
2900	1 Row	0.17	0.5	0.6	0.1	63.7	64.5	69.7	59.4	27.3	29.8
	2 Row	0.34	1.0	2.2	0.6	69.1	72.2	90.4	70.8	44.2	54.0
			2.0	7.5	2.2	74.7	82.3	117.0	93.0	61.8	85.7
			4.0	25.7	7.4	79.2	92.1	141.1	120.6	76.1	116.6
3200	1 Row	0.21	0.5	0.6	0.1	62.9	63.6	68.7	59.0	27.5	29.9
	2 Row	0.41	1.0	2.2	0.6	68.0	70.7	88.7	69.7	45.0	54.6
			2.0	7.5	2.2	73.4	80.3	115.2	91.1	63.7	87.6
			4.0	25.8	7.4	77.8	89.8	139 6	118.5	79.0	120.7
3500	1 Row	0.24	0.5	0.6	0.1	62.3	62.9	67.8	58.7	27.7	30.0
	2 Row	0.48	1.0	2.2	0.6	67.1	69.5	87.3	68.7	45.7	55.0
			2.0	7.5	2.2	72.2	78.6	113.5	89.5	65.3	89.3
			4.0	25.8	7.5	76.6	87.8	138 3	116.7	81.7	124.4
3800	1 Row	0.28	0.5	0.6	0.1	61.8	62.3	67.1	58.4	27.9	30.1
	2 Row	0.56	1.0	2.2	0.6	66.3	68.5	86.0	67.9	46.4	55.4
			2.0	7.5	2.2	71.2	77.1	112.0	88.0	66.8	90.8
			4.0	25.8	7.5	75.4	86.0	137 0	115.0	84.2	127.7
4100	1 Row	0.32	0.5	0.6	0.1	61.3	61.8	66.5	58.2	28.1	30.2
	2 Row	0.64	1.0	2.2	0.6	65.6	67.6	84.8	67.2	47.0	55.8
			2.0	7.5	2.2	70.4	75.7	110.6	86.7	68.2	92.1
			4.0	25.8	7.5	74.5	84.4	135 8	113.5	86.5	130.7
4400	1 Row	0.36	0.5	0.6	0.1	60.9	61.3	65.9	58.0	28.2	30.2
	2 Row	0.73	1.0	2.2	0.6	65.0	66.8	83.7	66.6	47.5	56.1
			2.0	7.5	2.2	69.6	74.6	109.4	85.5	69.5	93.3
			4.0	25.9	7.5	73.6	83.0	134 8	112.1	88.6	133 5

MODEL TSS-WC - SIZE 22

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN. W.G.)		Rate (GPM)	Water PD (FT. W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
3100	1 Row	0.16	0.5	0.7	0.1	63.4	64.0	66.6	58.0	28.0	30 2
	2 Row	0.31	1.0	2.3	0.7	68.8	71.6	86.0	67.6	46.4	55 6
			2.0	8.0	2.3	74.7	81.9	112.8	88.6	66.1	90 2
			4.0	27.5	8.0	79.5	92.2	137 9	116.4	82.4	124.9
3500	1 Row	0.19	0.5	0.7	0.1	62.5	63.0	65.5	57.6	28.3	30 3
	2 Row	0.39	1.0	2.3	0.7	67.5	69.8	84.0	66.4	47.4	56 2
			2.0	8.0	2.3	73.1	79.4	110.4	86.3	68.4	92 5
			4.0	27.6	8.0	77.8	89.3	135 9	113.8	86.3	130.1
3900	1 Row	0.23	0.5	0.7	0.1	61.8	62.2	64.7	57.4	28.5	30.4
	2 Row	0.47	1.0	2.3	0.7	66.4	68.4	82.3	65.4	48.2	56.7
			2.0	8.0	2.3	71.7	77.4	108 3	84.3	70.5	94 5
			4.0	27.6	8.0	76.2	86.9	134 2	111.5	89.7	134.7
4300	1 Row	0.28	0.5	0.7	0.1	61.2	61.5	63.9	57.1	28.7	30.4
	2 Row	0.56	1.0	2.3	0.7	65.5	67.3	80.8	64.5	49.0	57.1
			2.0	8.0	2.3	70.5	75.6	106 5	82.6	72.3	96.1
			4.0	27.7	8.0	74.9	84.8	132 6	109.4	92.9	138.8
4700	1 Row	0.33	0.5	0.7	0.1	60.7	61.0	63.3	56.9	28.9	30 5
	2 Row	0.66	1.0	2.3	0.7	64.7	66.3	79.6	63.9	49.6	57 5
			2.0	8.1	2.3	69.5	74.2	104 8	81.2	74.0	97 6
			4.0	27.7	8.0	73.8	83.0	131 2	107.6	95.7	142.4
5100	1 Row	0.38	0.5	0.7	0.1	60.2	60.5	62.8	56.8	29.0	30 5
	2 Row	0.76	1.0	2.3	0.7	64.1	65.5	78.4	63.3	50.2	57 8
			2.0	8.1	2.3	68.7	72.9	103.4	79.9	75.4	98 8
			4.0	27.7	8.0	72.8	81.4	129 8	106.0	98.4	145.7
5500	1 Row	0.43	0.5	0.7	0.1	59.9	60.1	62.3	56.7	29.1	30 5
	2 Row	0.87	1.0	2.3	0.7	63.5	64.7	77.5	62.8	50.7	58 0
			2.0	8.1	2.3	67.9	71.8	102 0	78.8	76.8	100.0
			4.0	27.7	8.1	71.9	80.0	128 6	104.5	100.8	148.7
5900	1 Row	0.49	0.5	0.7	0.1	59.6	59.8	62.0	56.6	29.2	30 6
	2 Row	0.99	1.0	2.3	0.7	63.0	64.1	76.6	62.3	51.1	58 2
			2.0	8.1	2.3	67.2	70.8	100 8	77.8	78.0	101.0
			4.0	27.8	8.1	71.1	78.7	127 5	103.1	103.0	151.4

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

ELECTRIC HEAT

MODEL TSS-EH

STANDARD FEATURES

- cETL listed as an assembly
- Single point power connection
- Primary auto-reset high limit
- Secondary high limit
- Airflow switch
- Hinged control panel
- Ni-Chrome elements
- Primary/secondary power terminations
- Fusing per NEC
- Wiring diagram and ETL label
- Available kW increments are as follows:
  0.5 to 8.0 kW - .50 kW; 8.0 to 16.0 kW - 1.0 kW
  Above 16 kW - 2.0 kW

OPTIONAL FEATURES

- Disconnect (toggle or door interlocking)
- PE switches
- Mercury and magnetic contactors
- Manual reset secondary limit
- Proportional control (SSR)
- 24 V control transformer

SELECTION PROCEDURE

With standard heater elements, the maximum capacity (kW) is obtained by dividing the heating (minimum) SCFM by 70. In other words, the terminal must have at least 70 SCFM per kW. In addition, each size terminal has a maximum allowable kW based upon the specific heater element configuration (i.e. voltage, phase, number of steps, etc.). Contact your Johnson Controls representative or refer to the VAV computer selection program for design assistance.

Heaters require a minimum of 0.07" w.g. downstream static pressure to ensure proper operation.

Selection Equations

$$kW = \frac{SCFM \times DT \times 1.085^*}{3413}$$

$$SCFM = \frac{kW \times 3413}{\Delta T \times 1.085^*}$$

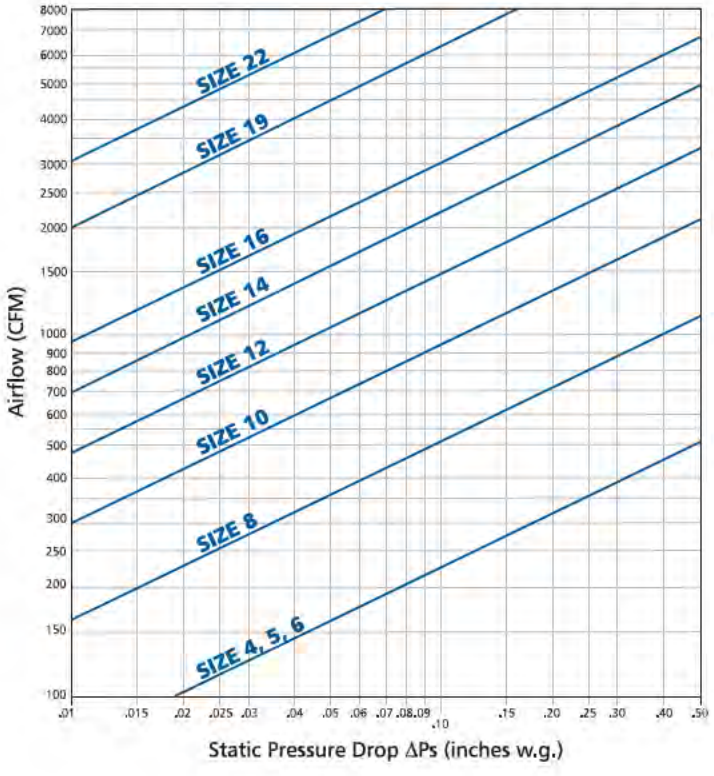
$$\Delta T = \frac{kW \times 3413}{SCFM \times 1.085^*}$$

** Air density at sea level - reduce by 0.036 for each 1000 feet of altitude above sea level.*

Calculating Line Amperage

$$\text{Single Phase Amps} = \frac{kW \times 1000}{Volts}$$

$$\text{Three Phase Amps} = \frac{kW \times 1000}{Volts \times 1.73}$$



GUIDE SPECIFICATIONS

GENERAL

Furnish and install Johnson Controls Model TSS Single Duct Variable Air Volume Terminal Units of the sizes and capacities as scheduled. Terminals shall be certified by AHRI and bear the AHRI 880 seal.

CONSTRUCTION

Terminals shall be constructed of not less than 22 gauge galvanized steel, able to withstand a 125 hour salt spray test per ASTM B-117. Stainless steel casings, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. The terminal casing shall be mechanically assembled (spot-welded casings are not acceptable).

Casing shall be internally lined with 1/2" thick fiberglass insulation, rated for a maximum air velocity of 5000 f.p.m. Maximum thermal conductivity shall be .24 (BTU • in) / (hr • ft^2 • °F). Insulation must meet all requirements of ASTM C1071 (including C665), UL 181 for erosion, and carry a 25/50 rating for flame spread/smoke developed per ASTM E-84, UL 723 and NFPA 90A. Raw insulation edges on the discharge of the unit must be covered with metal liner to eliminate flaking of insulation during field duct connections. Simple "buttering" of raw edges with an approved sealant is not acceptable.

All appurtenances including control assemblies, control enclosures, hot water heating coils, and electric heating coils shall not extend beyond the top and bottom of the unit casing. At an inlet velocity of 2000 f.p.m., the static pressure drop across the basic terminal or basic terminal with a sound attenuator shall not exceed .08" W.G. for all unit sizes.

PRIMARY AIR VALVE

The primary air valve shall consist of a minimum 22 gauge cylindrical body that includes embossment rings for rigidity. The damper blade shall be connected to a solid shaft by means of an integral molded sleeve which does not require screw or bolt fasteners. The shaft shall be manufactured of a low thermal conducting composite material, and include a molded damper position indicator visible from the exterior of the unit. The damper shall pivot in self lubricating bearings. The damper actuator shall be mounted on the exterior of the terminal for ease of service. The valve assembly shall include internal mechanical stops for both full open and closed positions. The damper blade seal shall be secured without use of adhesives. The air valve leakage shall not exceed 1% of maximum inlet rated airflow at 3" W.G. inlet pressure.

PRIMARY AIRFLOW SENSOR

For inlet diameters 6" or greater, the differential pressure airflow sensor shall traverse the duct along two perpendicular diameters. Cylindrically shaped inlets shall utilize the equal cross sectional area or log-linear traverse method. Single axis sensor shall not be acceptable for duct diameters 6" or larger. A minimum of 12 total pressure sensing points shall be utilized. The total pressure inputs shall be averaged using a pressure chamber located at the center of the sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. The sensor shall output an amplified differential pressure signal that is at least 2.5 times the equivalent velocity pressure signal obtained from a conventional pitot tube. The sensor shall develop a differential pressure of 0.03" w.g. at an air velocity of <450 FPM. Documentation shall be submitted which substantiates this requirement. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

HOT WATER COIL

Single duct terminal shall include an integral hot water coil where indicated on the plans. The coil shall be manufactured by the terminal unit manufacturer and shall have a minimum 22 gauge galvanized sheet metal casing. Stainless steel casings, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. Coil to be constructed of pure aluminum fins with full fin collars maintaining accurate fin spacing and maximum tube contact. Fins shall be spaced with a minimum of 10 per inch and mechanically fixed to seamless copper tubes for maximum heat transfer.

Each coil shall be hydrostatically tested at a minimum of 450 PSIG under water, and rated for a maximum 300 PSIG working pressure at 200°F.

ELECTRIC HEATERS

Terminal shall include an integral electric heater where indicated on the plans. Heater shall be cETL listed. The heater cabinet shall be constructed of not less than 20 gauge galvanized steel. Stainless steel cabinets, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. Heater shall have a hinged access panel for entry to the controls.

Electric heaters shall be factory mounted to the terminal with the heating elements located upstream of the airflow control damper to ensure uniform velocity profile

over the elements. Elements located downstream of the damper are not acceptable.

A power disconnect shall be furnished to render the heater non-operational. Heater shall be furnished with all controls necessary for safe operation and full compliance with UL 1996 and National Electric Code requirements.

Heater shall have a single point electrical connection. It shall include a primary disc-type automatic reset high temperature limit, secondary high limit(s), airflow switch, Ni-Chrome elements, and fusing per UL and NEC. Heater shall have complete wiring diagram with label indicating power requirement and kW output.

SOUND ATTENUATOR

Sound attenuator shall be provided where scheduled to meet acoustical performance requirements. The attenuator and terminal unit shall be single piece construction at least 50" long. Attenuator casing shall be constructed as specified for the base terminal.

MULTIPLE-OUTLET PLENUM

Multiple-outlet plenum (MOP) shall be provided where scheduled. The MOP shall have trim balancing dampers in each outlet. Damper shall have a locking quadrant to ensure that the damper position is maintained. Multiple-outlet casing shall be constructed as specified for the base terminal.

OPTIONS

Foil Faced Insulation
Insulation shall be covered with scrim backed foil facing. All insulation edges shall be covered with foil or metal nosing. Insulation shall meet ASTM C1136 for mold, mildew, and humidity resistance.

Elastomeric Closed Cell Foam Insulation
Provide Elastomeric Closed Cell Foam Insulation in lieu of standard. Insulation shall conform to UL 181 for erosion and NFPA 90A for fire, smoke and melting, and comply with a 25/50 Flame Spread and Smoke Developed Index per ASTM E-84 or UL 723. Additionally, insulation shall comply with Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Polyethylene insulation is not acceptable.

Double Wall Construction
The terminal casing shall be double wall construction using a 22 gauge galvanized metal liner covering all insulation.

Low Temperature Construction
Terminals shall be designed for use with primary airflow temperatures as low as 46°F and maximum ceiling plenum conditions of 78°F and 60% R.H. In addition to other design criteria, the primary air valve shall be thermally isolated from the terminal casing. The damper shaft shall be made from non-conducting thermoplastic composite material. Metal shafts will not be acceptable.

Piping Packages
Provide a standard factory assembled non-insulated valve piping package to consist of a 2 way, on/off, motorized electric control valve and two ball isolation valves. Control valves are piped normally closed to the coil. Maximum entering water temperature on the control valve shall be 200°F. The maximum close-off pressure is 40 PSIG (1/2") or 20 PSIG (3/4"). Maximum operating pressure shall be 300 PSIG.

Option: Provide 3-wire floating point modulating control valve (fail-in-place) in lieu of standard 2-position control valve with factory assembled valve piping package.

Option: Provide high pressure close-off actuators for 2-way, on/off control valves. Maximum close-off pressure is 50 PSIG (1/2") or 25 PSIG (3/4)".

Option: Provide either a fixed or adjustable flow control device for each piping package.

Option: Provide unions and/or pressure-temperature ports for each piping package.

Piping package shall be completely factory assembled, including interconnecting pipe, and shipped separate from the unit for field installation on the coil, so as to minimize the risk of freight damage.

CONTROLS

Analog Electronic Controls
Furnish and install Series 7000 Pressure Independent Analog Electronic Control System where indicated on the plans and in the specifications. The complete system shall be fully operational and include the following:

- Single duct, dual duct, and/or fan powered terminal units
- Pressure independent Series 7000 analog electronic zone controllers with integral differential pressure transducer
- Analog electronic wall thermostat
- Electronic air valve actuator
- 24 VAC control transformers

- Air pressure switches as required
- Electronic duct temperature sensors as required

Pneumatic Controls
Units shall be controlled by a pneumatic differential pressure reset volume controller. Controller shall be capable of pressure independent operation down to 0.03 inches W.G. differential pressure and shall be factory set to the specified airflow (CFM). Controller shall not exceed 11.5 scim (Standard Cubic Inches per Minute) air consumption @ 20 PSIG.

Unit primary air valve shall modulate in response to the room mounted thermostat and shall maintain airflow in relation to thermostat pressure regardless of system static pressure changes. An airflow (CFM) curve shall be affixed to the terminal unit expressing differential pressure vs. CFM. Pressure taps shall be provided for field use and ease of balancing.

Terminal unit manufacturer shall supply and manufacture a 5 to 10 PSIG pneumatic actuator capable of a minimum of 45 in. lbs. of torque.

Actual sequence of operation is shown on the contract drawings. Terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.

JOHNSON CONTROLS DDC CONTROL

N2
Each VAV terminal unit shall be bundled with a digital controller. The controller shall be compatible with a Johnson Controls N2 system network. A unique Johnson Controls N2 network address shall be assigned to each controller, and referenced to the tagging system used on the drawings and in the schedules provided by the Project Engineer. All controllers shall be factory mounted and wired, with the controller's hardware address set, and all of the individual terminal's data pre-loaded into the controller. The terminal's data shall include, but not be limited to the Max CFM, Min CFM, Heating CFM, and terminal K factor. Heating system operating data shall also be factory installed for all terminals with heat. Communication with the digital controller shall be accomplished through the Johnson Controls N2 network. The digital controller shall have hardware input and output connections to facilitate the specified sequence of operation in either the network mode, or on a stand-alone basis. The terminal unit manufacturer shall coordinate, where necessary, with the temperature Control Contractor.

MS/TP BACnet
Each VAV terminal unit shall be bundled with a digital controller. The controller shall be compatible with a MS/TP BACnet system network. A unique network address and a BACnet site address shall be assigned to each controller, and referenced to the tagging system used on the drawings and in the schedules provided by the Project Engineer. All controllers shall be factory mounted and wired, with the controller's hardware address set, and all of the individual terminal's data pre-loaded into the controller. The terminal's data shall include, but not be limited to Max CFM, Min CFM, Heating CFM, and terminal K factor. Heating system operating data shall also be factory installed for all terminals with heat. Communications with the digital controller shall be accomplished through the MS/TP BACnet network or through a Bluetooth connector. The digital controller shall have hardware input and output connections to facilitate the specified sequence of operation in either the network mode, or on a stand-alone basis. The terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.

LON
Each VAV terminal unit shall be bundled with a digital controller. The controller shall be compatible with a LON system network. A unique network address shall be assigned to each controller and referenced to the tagging system used on the drawings and in the schedules provided by the Project Engineer. All controllers shall be factory mounted and wired, and all of the individual terminal's data pre-loaded into the LNS database for the project. The terminal's data shall include, but not be limited to Max CFM, Min CFM, Heating CFM, and terminal K factor. Heating system operating data shall also be factory installed for all terminals with heat. Communication with the digital controller shall be accomplished through the LON network. The digital controller shall have hardware input and output connections to facilitate the specified sequence of operation in either the network mode, or on a stand-alone basis. The terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.

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www.johnsoncontrols.com

ATTACHMENT C

AERCO

INNOVATION

HIGH-PERFORMANCE WATER HEATER

25 YEARS 1987 • 2012
Condensing Firetube Designs

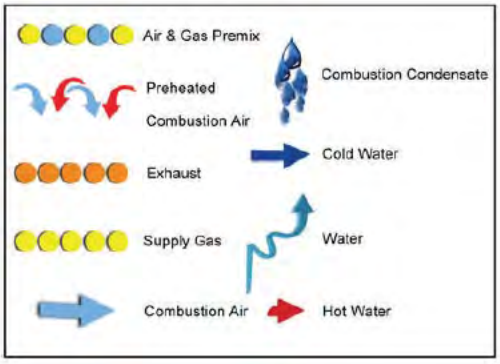
TDIndustries

INNOVATION

AERCO, the company that developed the first high-efficiency, commercial, condensing gas-fired, domestic water heater and hydronic boiler in the U.S. over two decades ago, continues to lead the way in commercial water-heating technology with the Innovation line of water heaters. Available in four sizes – 600, 800, 1060 and 1350 MBH – Innovation features advanced condensing/modulating technology and a thermal shock-proof, firetube heat exchanger that is highly resistant to scale buildup.

The Innovation design is based on AERCO's 25+ years of experience in the condensing domestic heater market. This gives AERCO an advantage over the competition with long history of success with:

- **Real-world installation scenarios**
- **Real-world domestic heater water load profiles and changes**
- **Real-world operating efficiencies**



INDUSTRY LEADING EFFICIENCY—UP TO 99%

Innovation is the only commercial-size tankless water heater that provides hot water on demand without the need for any storage. Thanks to its unique tankless design, the Innovation is highly space efficient and cost-effective, as it eliminates the need for significant storage volume to buffer load change and provide stable hot water outlet temperatures, which tank-type heaters require.

Key features of Innovation include:

- **Up to 99% efficiency**
- **+/-4°F temperature control, thanks to dynamic feed-forward sensing and unmatched turndown (up to 30:1)**
- **All stainless steel helical firetube heat exchanger that is thermal shockproof and scale resistant**
- **Small footprint and high installation flexibility**
- **Reduced cycling losses due to unmatched turndown and onboard multiunit sequencing controls**
- **Low NOx and low CO emissions**
- **1/3 standby losses compared to conventional tank-type heaters**
- **Designed and manufactured in the USA**

Enhanced Waterside Flow Distribution

AERCO Innovation water heaters utilize state-of-the-art technology to easily meet highly diverse, demanding commercial and industrial hot water requirements in a compact and reliable condensing design. Its durable, high-efficient, helical wound firetube heat exchanger is time-tested to be impervious to thermal stress for an extended life. Enhanced waterside flow distribution maintains constant minimum velocities above 4 ft/sec across the heat exchanger. This keeps solids in suspension and greatly reduces scale dropout to maintain high efficiency and long life.

Combine two benefits, reduced scaling and no (minimal) fireside cleaning, into lower maintenance requirements than other commercial water heaters.

The all stainless steel construction maximizes longevity in the condensing application and will never need fireside cleaning. The corrugated tubes increase effective heat transfer surface area for optimal thermal efficiencies up to 99%.

Precise Temperature Control and High Turndown Delivers Money-Saving Precision

INN600 @ 14:1 Turndown **INN1060 @ 24:1 Turndown**

INN800 @ 18:1 Turndown **INN1350 @ 30:1 Turndown**

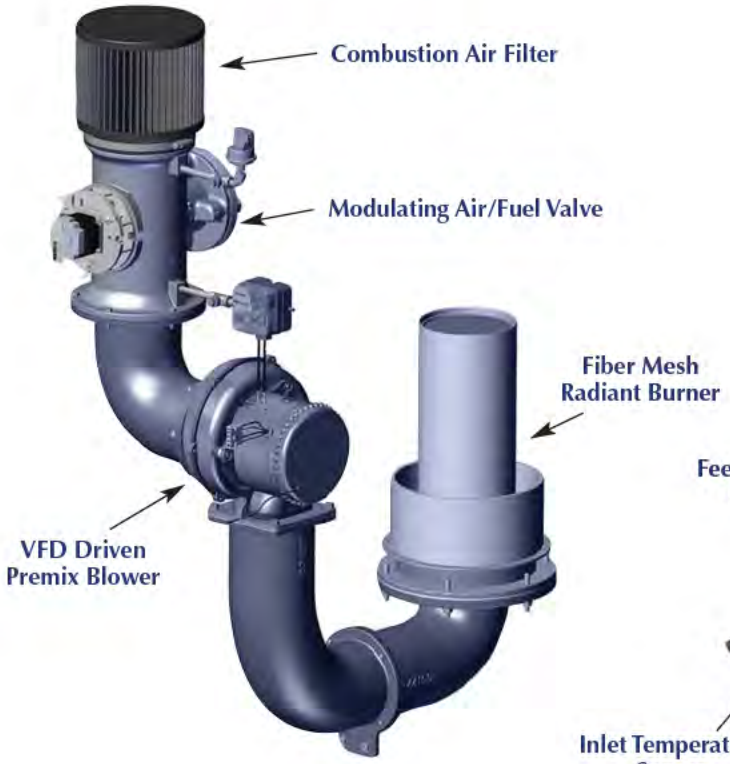
ADVANCED DESIGN AND COMPONENTS

Further improving the efficiency of Innovation is AERCO's Dynamic Load Anticipator, an advanced control system that helps maintain precise modulation of the high turndown air/fuel delivery system. Field-proven for more than 60 years, dynamic feed-forward sensing uses feed-forward and feed-back sensors that monitor inlet flow via the proportional change in mixed temperature due to variations in the flow. The system controls fire the unit to accurately match load requirements and produce tight +/-4°F outlet temperature control.

The high turndown air/fuel delivery system of Innovation consists of AERCO's patented fully modulating air/fuel valve, VFD driven premix blower, and fiber mesh radiant burner. The system guarantees safe, stable, reliable and efficient combustion with the lowest NOx and CO emissions, as well as eliminates wasted fuel and reduces operating costs, making Innovation a smart choice for "green" designs.

Dynamic Load Anticipator

High Turndown Air/Fuel Valve Delivery System



Commercial Tankless Design

The unique tankless design of the Innovation water heaters allows the system to operate with set points of 120°F or below – saving energy and reducing the risk of scalding. Because water volume is kept to a minimum and continuous circulation is maintained through the Innovation unit, the risk of Legionella bacteria growth is virtually eliminated.

Venting Versatility

Innovation provides a number of venting options. Sidewall, through-the-roof, and sealed combustion capabilities (direct-vent), approved for venting with PVC, CPVC, Polypropylene, or AL29-4C materials, are all available and provide broad installation flexibility and savings.

Space-Saving Design

The AERCO Innovation is delivered as a single, fully assembled unit. Its small footprint, doorway size, and quiet operation make it ideal for both new construction and retrofit applications. The tankless design ensures the smallest possible footprint for a commercial size application, reducing standby losses to 1/3 of a comparable storage-type system.

Vent Configurations


Vertical vent/room air


Sidewall vent/room air


Direct-vent


Vertical vent/sidewall air


Common vertical vent/ room air


Common vertical vent/ individual vertical air


Common vertical vent/ individual sidewall air


Individual sidewall vent/ common sidewall air

Advanced C-More Controls with Onboard Sequencing

Developed specifically to support the fully modulating operation of AERCO water heaters, the C-More Control System combines temperature and operating controls, combustion safeguards and fault enunciator functions in a single, state-of-the-art controller. In addition to basic water heater operation, C-More has many other beneficial features:

- **User-friendly interface with step-by-step diagnostics menus and status messages**
- **Ability to read system status during start-up sequence and operation**
- **One-touch access to operating parameters and recent fault history**
- **Flash-upgradeable platform**
- **Building Automation system integration via Modbus with optional support for LonWorks, BACnet, N2, etc.**
- **Supports tracking of more than 100 data points**
- **Ensures fail-safe heater operation if external building controls fail**

C-More also includes onboard multi-unit sequencing logic designed to efficiently sequence up to eight water heaters on the same system to meet load requirements. This minimizes cycles per unit to maximize system efficiency and turndown, and significantly reduces service and maintenance costs. With this unique feature, the operating systems turndown will equal the individual unit turndown multiplied by the number of units employed. Hence an application using eight INN1060s @ 24:1 will modulate to meet system load with a total turndown of 192:1.

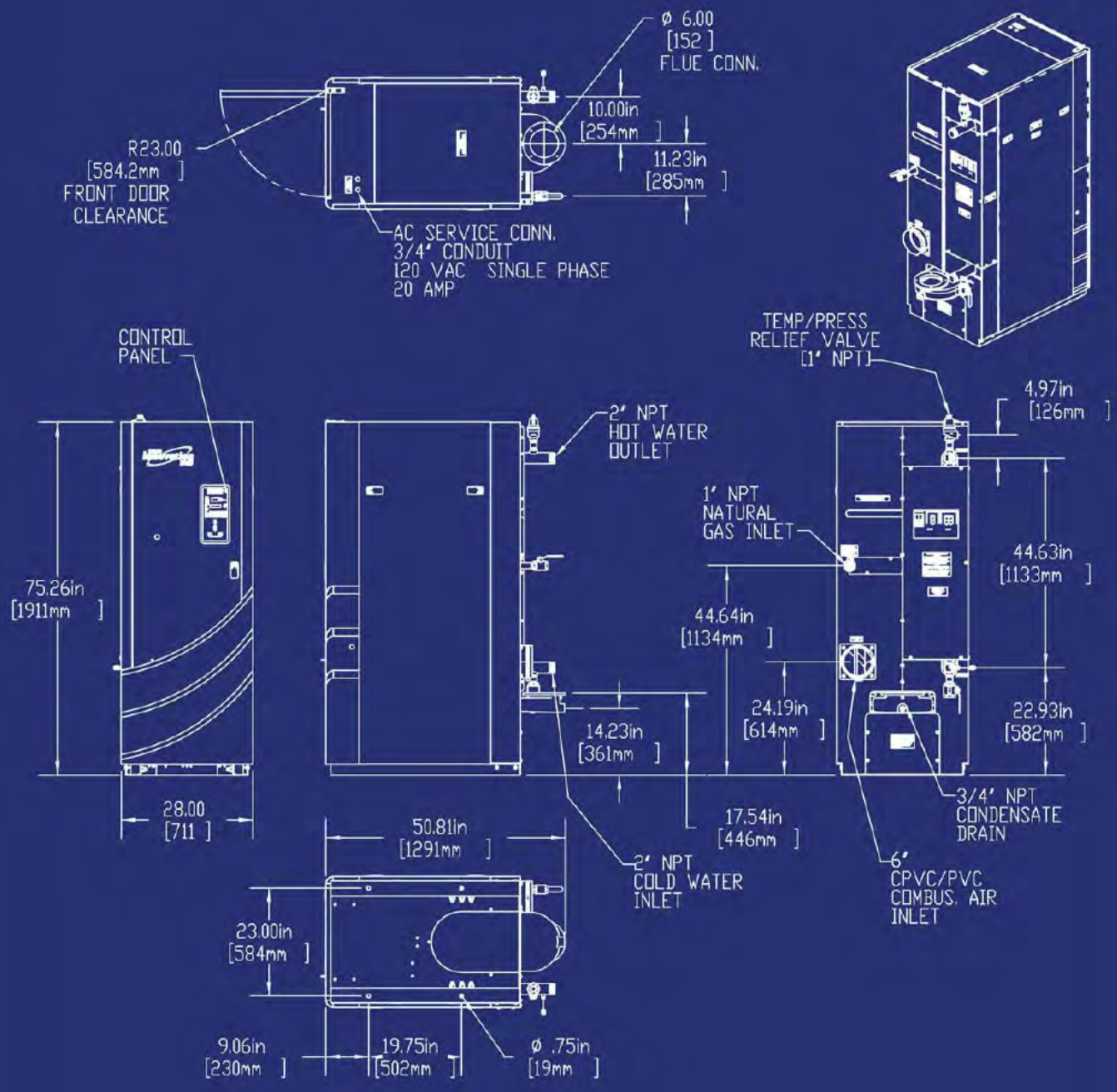
The “Master C-More” operates one motorized valve per unit as an element of the load sequencing. The program logic also incorporates a unique master/slave backup feature that provides automatic bumpless transfer of master functions to the next unit on the chain, in case of designated master unit shutdown.

The result is the most energy-efficient and reliable water heating system design available. Only those units required to meet load are operating. Units in standby do not needlessly cycle to maintain set point – reducing system standby losses and unit wear to the bare minimum. Compared to a conventional storage system which requires 125 gallons of storage for every 500 MBTUH input, an Innovation system truly provides reliable domestic hot water on demand in the smallest possible energy footprint.

SETTING A NEW STANDARD

Innovation provides consulting specifying engineers, facilities management, and building owners with time-tested and trusted excellence that the industry has come to expect from AERCO. Innovation features the cutting-edge technology necessary to maximize forward-thinking designs – no matter the environment or conditions.

ADVANCED DESIGN AND COMPONENTS



INNOVATION SPECIFICATIONS

	600	800	1060	1350
Adjustable Temperature Control	50°F to 190°F	50°F to 190°F	50°F to 190°F	50°F to 190°F
Ambient Temperature	0°F to 130°F	0°F to 130°F	0°F to 130°F	0°F to 130°F
Accuracy	+/-4°F	+/-4°F	+/-4°F	+/-4°F
Input	600,000 BTUH (Natural Gas)	800,000 BTUH (Natural Gas)	1,060,000 BTUH (Natural Gas)	1,350,000 BTUH (Natural Gas)
Net Output	578,000 BTUH (Natural Gas)	771,000 BTUH (Natural Gas)	1,022,000 BTUH (Natural Gas)	1,310,000 BTUH (Natural Gas)
Turndown Ratio	14:1	18:1	24:1	30:1
Flue Size	6" Diameter	6" Diameter	6" Diameter	6" Diameter
Flue Material (per local code)	PVC, CPVC, PP or AL29-4C	PVC, CPVC, PP or AL29-4C	PVC, CPVC, PP or AL29-4C	PVC, CPVC, PP or AL29-4C
Water Inlet & Outlet	2" NPT Male	2" NPT Male	2" NPT Male	2" NPT Male
Gas Connection	1" NPT Male	1" NPT Male	1" NPT Male	1" NPT Male
Gas Pressure Requirements	14" WC Maximum, 4" WC Minimum @ Full Load (Nat. Gas)	14" WC Maximum, 4" WC Minimum @ Full Load (Nat. Gas)	14" WC Maximum, 4" WC Minimum @ Full Load (Nat. Gas)	14" WC Maximum, 4" WC Minimum @ Full Load (Nat. Gas)
Maximum Continuous Water Flow	50 GPM	50 GPM	50 GPM	50 GPM
Condensate Connection	3/4" NPT Female	3/4" NPT Female	3/4" NPT Female	3/4" NPT Female
Maximum Condensate Flow	4.5 GPH	6 GPH	8 GPH	11 GPH
Pressure Rating	160 PSIG @ 210°F	160 PSIG @ 210°F	160 PSIG @ 210°F	160 PSIG @ 210°F
NOx Emissions Certifications	SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ
Standard Listing & Approvals	UL, CUL, ASME (HLW)	UL, CUL, ASME (HLW)	UL, CUL, ASME (HLW)	UL, CUL, ASME (HLW)
Gas Train Options	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)
Electrical Requirements	120/1/60 20 AMP (9 Amp FLA)	120/1/60 20 AMP (9 Amp FLA)	120/1/60 20 AMP (9 Amp FLA)	120/1/60 20 AMP (15 Amp FLA)
Water Pressure Drop @ 15 gpm	.75 psi	.75 psi	.75 psi	.75 psi
Water Pressure Drop @ 30 gpm	1.5 psi	1.5 psi	1.5 psi	1.5 psi
Water Volume	26 gallons	24.5 gallons	23 gallons	20.6 gallons
Weight, Installed	960 lbs (dry), 1,177 lbs (wet)	980 lbs (dry), 1,202 lbs (wet)	1,000 lbs (dry), 1,190 lbs (wet)	1,050 lbs (dry), 1,222 lbs (wet)
Weight, Shipping	1,060 lbs	1,080 lbs	1,100 lbs	1,150 lbs

AERCO

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AERCO

ATTACHMENT D

Business/Residential/Hotels

Available in 7 sizes from 750,000 to 6 million BTU/hr.

Education

Government

BENCHMARK SERIES High-Efficiency Boilers

AERCO. The Benchmark of High-Efficiency for 25 Years.

AERCO introduced condensing firetube designs to the commercial marketplace over 25 years ago, raising the standard in hydronic heating. While other companies have attempted to develop similar designs, only AERCO has decades of experience, making its condensing, fully modulating boilers the standard by which all others are measured.

The Benchmark boiler family re-affirms AERCO's leadership. Having the longest proven performance record of any condensing, modulating boiler, Benchmark delivers unparalleled cost savings, efficiency benefits, and design advantages. With the introduction of re-designed 1.5 - 3 million BTU/hr and revolutionary 6 million BTU/hr models, AERCO once again raises the bar.

At a Glance

Key Features

- Available in seven models ranging from 750,000 BTU/hr to 6 million BTU/hr
- High Efficiency – up to 98%
- Stainless Steel Firetube Heat Exchanger
- Low NOx and CO Emissions
- Small Footprint
- Installation Flexibility
- Serviceability
- Designed and Manufactured in the USA

Leader in High Efficiency

High efficiency has become a buzz term in recent years, but it is a philosophy at AERCO. Since the first Benchmark boiler was installed in 1997, it has set the gold standard for high efficiency.

Reliability

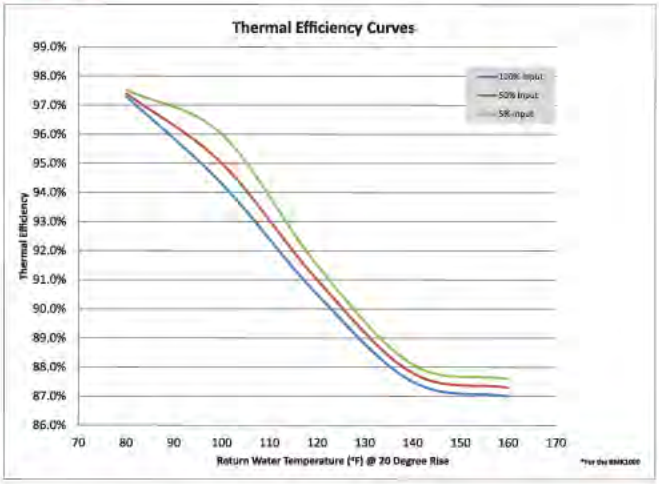
First introduced in 1997, the Benchmark boiler is among the oldest high-efficiency products available in the U.S. The market leader for the last decade, several thousand Benchmark units have been installed throughout North America and have continued to operate flawlessly season after season. Their performance proven reliability can be credited to:

Superior Construction Materials – A new 439 stainless steel heat exchanger offers even longer life and improves longevity with a simplified design that has only two moving parts.

Advanced Design and Components – AERCO's patented air/fuel delivery system and fully modulating burner reduces cycling losses, as well as wear and tear.

Warranty – AERCO stands behind its products. The heat exchanger in the Benchmark boilers has a 10-year full (non-prorated) warranty.

Efficiency



Benchmark Model Numbers As Approved and Listed on the AHRI Directory	Thermal Efficiency, 100% Input • (High Fire) 100°F Temperature Differential • (80°F to 180°F)
BMK750	95.6%
BMK1000	96.8%
BMK1500	94.6%
BMK2000	94.6%
BMK2500	93.5%
BMK3000	93.5%
BMK6000	94.5%

Environmental

The Greenspec® Listed Benchmark boilers are perfect for "green" designs. Their small footprint, flexible venting/piping options, high efficiency, and lower operating costs can help facilities earn LEED points. Benchmark has been designed with environmental advantages:

O_2 monitoring system – Benchmark units are available with AERCO's proprietary O_2 monitoring system, which displays the oxygen level directly on the C-More controller in real time. It can be monitored via Modbus, so customers can measure emission levels and fuel combustion efficiency to maximize fuel economy.

Low NOx burner – Benchmark boilers are fitted with a low NOx burner whose emissions consistently meet the highest regulatory standards. Ultra low NOx (9 ppm or less) calibrations are available.*

*See tech data sheets for model specs.

Advanced Controls

C-More

Efficiency and operation are further optimized via the C-More Control System. Intuitive, advanced, and simple to operate, C-More combines temperature and operating controls, combustion safeguards and fault enunciator functions – all at your fingertips! Benefits include:

- User-friendly intuitive control
- Simplifies diagnostic troubleshooting
- Full integration with BAS and EMS systems
- Supports remote monitoring and control
- Integrated Boiler Sequencing Technology (BST)

Ensures fail-safe boiler operation (if external building controls fail).

Remote Data Collection

AERCO's remote data collection continually monitors the internal operations of your AERCO equipment, scanning performance parameters and potential fault risks. This information, transmitted via the Internet, is collected and evaluated at our data center. Our data center has the capability to monitor performance trends and fault occurrences. Future capabilities include early warnings before faults occur and email alerts to the user.*

*Consult AERCO if you are interested in the benefit of remote monitoring service.

Installation Advantages

Venting Versatility

Benchmark products provides a number of venting options; Sidewall, through-the-roof, and ducted combustion capabilities (direct-vent), approved for venting with PVC, CPVC, Polypropylene, or AL29-4C materials are all available and provide broad installation flexibility and savings.

Space-saving Design

All Benchmark products are delivered as a single, fully assembled unit. Its small footprint, doorway size, and quiet operation make it ideal for both new construction and retrofit applications. Our new Benchmark 6000 model is the most compactly designed 6 million BTU/hr boiler in the market. No one is even close. A re-designed Benchmark 3000 model is 22% smaller than earlier generations.

Zero Side Clearance

The redesigned Benchmark can be serviced via the front or top of the boiler, as well as the side. This flexibility allows units to be configured side by side.

BMK 3000
Shown

Consult an AERCO representative of factory for additional venting configuration inquiries.

Vent Configurations

Vertical vent/room air

Sidewall vent/room air

Direct-vent

Vertical vent/sidewall air

Common vertical vent/room air

Common vertical vent/
individual vertical air

Common vertical vent/
individual sidewall air

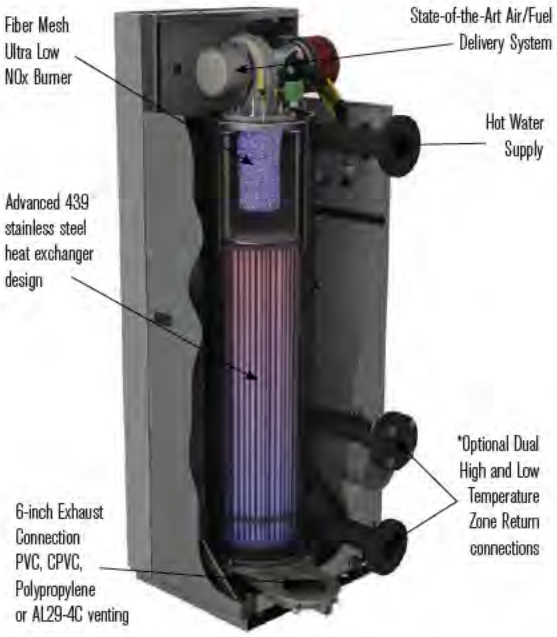
Individual sidewall vent/
common sidewall air

At a Glance

Benchmark 750 (BMK750) and Benchmark 1000 (BMK1000)

Features

- BMK 750 – 15:1 Turndown Ratio (7%)
- BMK 1000 – 20:1 Turndown Ratio (5%)
- Oxygen Level (O_2) Monitoring standard
- Stainless Steel Firetube Heat Exchanger
- Capable of variable primary flow installations
- NOx Emissions 20 ppm or less at all firing rates
- 9 ppm optional calibration
- Compact Footprint (25"D x 28"W x 78"H)
- High and Low Temperature System Return Connections*
- Ducted Combustion Capable
- Acceptable vent materials AL29-4C, Polypropylene, CPVC, and PVC
- Available in Natural Gas and Propane



Benchmark 1500 (BMK1500) and Benchmark 2000 (BMK2000)

Features

- BMK 1500 – 20:1 Turndown Ratio (5%)
- BMK 2000 – 20:1 Turndown Ratio (5%)
- Oxygen Level (O_2) Monitoring standard
- Stainless Steel Firetube Heat Exchanger
- Capable of variable flow installations
- NOx Emissions 20 ppm or less at all firing rates
- 9 ppm optional calibration
- Compact Footprint (41"D x 28"W x 79"H)
- Ducted Combustion Capable
- Available in Natural Gas, Propane, and Duel Fuel
- Acceptable vent materials AL29-4C, and Polypropylene

At a Glance

Benchmark 2500 (BMK2500) and Benchmark 3000 (BMK3000)

Features

- Natural Gas
- 15:1 Turndown Ratio (7%)
- Oxygen Level (O_2) Monitoring
- Stainless Steel Firetube Heat Exchanger
- Capable of variable primary flow installations
- NOx Emissions 20 ppm or less at all firing rates
- Compact Footprint (78"H x 28"W x 56"D)
- Ducted Combustion Capable
- Acceptable vent materials AL29-4C, Polypropylene
- Available in Natural Gas, Propane, and Duel Fuel

Benchmark 6000 (BMK6000)

Features

- Natural Gas
- 15:1 Turndown Ratio (7%)
- Oxygen Level (O_2) Monitoring
- Stainless Steel Firetube Heat Exchanger
- Capable of variable primary flow installations
- NOx Emissions 20 ppm or less at all firing rates
- Compact Footprint (78"H x 34"W x 88"D)
- Ducted Combustion Capable
- Acceptable vent materials AL29-4C, Polypropylene
- 9 ppm optional calibration (requires 14" exhaust venting)
- Available in Natural Gas and Duel Fuel

Venting

AERCO understands that every system design is different. To provide flexibility and meet any space configuration, venting options are available:

- Security Chimneys International SS and SSD/SSID venting systems are made from AL29-4C® super-ferritic stainless steel. The single- and double-wall SS and SSD/SSID install effortlessly, are highly reliable and meet industry specifications.
- DuraVent PolyPro® polypropylene vent pipe is for ANSI Category II and IV gas-burning appliances. The PolyPro vent system is suitable for exhaust temperatures up to 230°F/110°C and a maximum positive pressure of 15 in w.c. without the toxic risk associated with other plastic materials.

  Engineering support - Customers can also leverage the vast experience of AERCO engineers who have devoted their careers to developing cost- and space-saving solutions. Standard services available include:

  • Engineering – AERCO engineers work with manufacturers to verify vent sizing/design for enhanced reliability.
  • AutoCAD drawings
  • Submittal information
  • Customer service
  • Quotes within two business days
  • Orders shipped within 10 days of receipt

DuraVent PolyPro®

Security Chimneys SS and SSD/SSID Venting Systems

Accessories

AERCO Control System (ACS)

The ACS is the best choice for maximizing heating plant efficiency if your heating plant has more than eight boilers or if your designing a combination control system as shown in the diagram on the next page. There is an ACS relay panel available to provide additional pump and valve control for several combination control configurations.

Motorized Valves

The Belimo F6...HDU Series 2-way butterfly valves are designed to meet the needs of HVAC and commercial application requiring bubble tight shut-off for liquids. Typical applications include boiler isolation, chiller isolation, cooling tower isolation, change-over systems, air handler coil control, bypass and process control applications. Valves specifically designed for easy installation on BST configured boiler plants are available as well.

BST Integration Panel

BST boiler plants have this option available to enable the BST Master to automatically switch a C-More Slave to the BST Master control if the currently designated master is not able to manage the boilers in the plant. The change is automatic so there is no need for a technician to intervene. The C-More may change from a slave to a master if a unit is taken down for service or if there is a fault that disables the C-More currently acting as the BST Master. The panel is the connection point for the Modbus sensors used by the BST Master Control. This allows the signal input of any sensors attached to the Integration Panel to be accessed at any node on the BST communication cables.

AERCO Protonode/Gateways

AERCO offers a multi-protocol, communications gateway to support integration with customers' building control and energy management systems. The plug-n-play package supports integration with BACnet/IP, BACnet MS/TP, LonWorks, and Johnson Controls Metasys N2 systems. AERCO's Communications Gateway is available for all AERCO boilers, water heaters and electronically controlled indirect systems.

Condensate Neutralizer Kit

AERCO Condensate Neutralizers are ideal for neutralizing condensate from condensing boilers and furnaces operating on natural gas or propane. The condensate is acidic and has the potential to harm the environment and the sewer system. The AERCO Condensate Neutralizer will raise the pH of the condensate to a more neutral level before it is discharged to drain.

Buffer Tanks

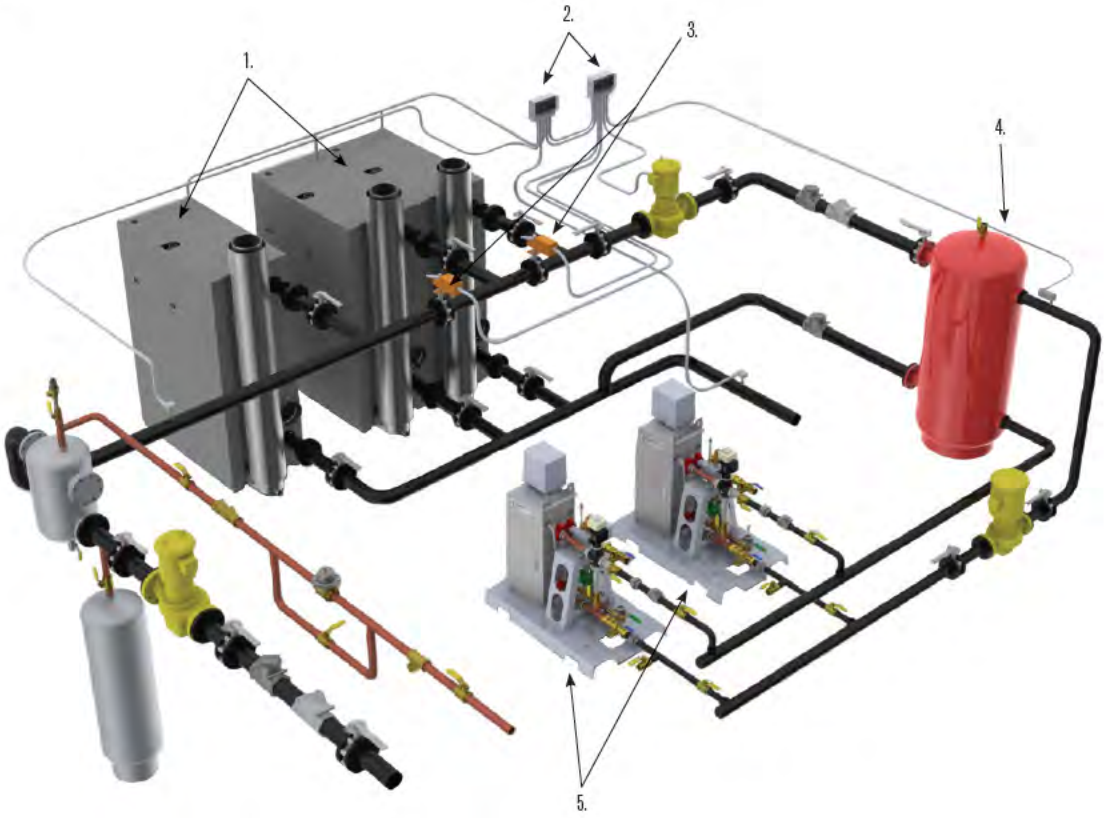
AERCO buffer tanks are ASME certified pressure vessels designed for use with high efficiency, low volume systems that incorporate low-mass condensing boilers. They add thermal mass, dampen fast transitions and minimize boiler cycling that occurs during zero or low domestic load conditions. The AERCO buffer tanks are available in two and four-port (Primary-Secondary) configurations.

Venting Muffers

AERCO offers 6", 8", and 14" exhaust mufflers that are specifically designed with flanged ends to fit directly on the exhaust manifold of Benchmark boilers. The flanged-end design allows the muffler to be used with any venting system manufacturer – the only adapter required is an AERCO starter piece at one or both ends of the muffler.

Sample Installation

1. Benchmark 3000
2. AERCO Control System (ACS) and ACS Relay Panel
3. Motorized Valves
4. Buffer Tank
5. SmartPlate



Benchmark Specifications

	750	1000	1500
Adjustable Temperature Control	50°F to 190°F	50°F to 190°F	50°F to 190°F
Ambient Temperature	0°F to 130°F	0°F to 130°F	0°F to 130°F
Accuracy	+/-4°F	+/-4°F	+/-4°F
Input	750,000 BTUH (Natural Gas)	1,000,000 BTUH (Natural Gas)	1,500,000 BTUH (Natural Gas)
Net Output	697,000 BTUH (Natural Gas)	930,000 BTUH (Natural Gas)	1,395,000 BTUH (Natural Gas)
Turndown Ratio	15:1	20:1	20:1
Flue Size	6" Diameter	6" Diameter	6" Diameter
Flue Material (per local code)	PVC, CPVC, PP or AL29-4C	PVC, CPVC, PP or AL29-4C	AL29-4C, PP
Water Inlet and Outlet	3" 150# Flange	3" 150# Flange	4" 150# Flange
Gas Connection	1" NPT Male	1" NPT Male	2" NPT Male
Gas Pressure Requirements*	14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load
Min/Max Water Flow	12-175 GPM	12-175 GPM	25-250 GPM
Condensate Connection	3/4" NPT Female	3/4" NPT Female	1.5" Tube
Maximum Condensate Flow	6 GPH	8 GPH	9 GPH
Pressure Rating	160 PSIG at 210°F	160 PSIG at 210°F	160 PSIG at 210°F
NOx Emissions Certifications	SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ
Standard Listing and Approvals	UL, CUL, ASME	UL, CUL, ASME	UL, CUL, ASME
Gas Train Options	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)
Electrical Requirements	120/1/60 20 AMP (13 AMP FLA)	120/1/60 20 AMP (13 AMP FLA)	120/1/60 20 AMP (16 AMP FLA)
Water Pressure Drop at 20°ΔT	1.5 psi	3 psi	2.8 psi
Water Volume	16.25 gallons	14.25 gallons	44 gallons
Weight, Installed	669 lbs. (dry), 802 lbs. (wet)	700 lbs. (dry), 817 lbs. (wet)	1,406 lbs. (dry), 1,654 lbs. (wet)

*Values are for Natural Gas FM Compliant gas trains only. See Benchmark Gas Components & Supply Design Guide GF-2030 for Propane, DBB & Duel Fuel gas train gas pressure requirements.

2000	2500	3000	6000
50°F to 190°F	50°F to 190°F	50°F to 190°F	50°F to 190°F
0°F to 130°F	0°F to 130°F	0°F to 130°F	0°F to 130°F
+/-4°F	+/-4°F	+/-4°F	+/-4°F
2,000,000 BTUH (Natural Gas)	2,500,000 BTUH (Natural Gas)	3,000,000 BTUH (Natural Gas)	6,000,000 BTUH (Natural Gas)
1,820,000 BTUH (Natural Gas)	2,325,000 BTUH (Natural Gas)	2,790,000 BTUH (Natural Gas)	5,580,000 BTUH (Natural Gas)
20:1	15:1	15:1	15:1
8" Diameter	8" Diameter	8" Diameter	12" or 14" Diameter
PP or AL29-4C	PP or AL29-4C	PP or AL29-4C	PP or AL29-4C
4" 150# Flange	4" 150# Flange	4" 150# Flange	6" 150# Flange
2" NPT Male	2" NPT Male	2" NPT Male	2" NPT Male
14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load	14" WC Maximum, 4" WC Minimum at Full Load	2" PSI Maximum, 14" WC Minimum at Full Load
25-350 GPM	25-350 GPM	25-350 GPM	75-600 GPM
1.5" Tube	1.5" Tube	1.5" Tube	1.5" Tube
10 GPH	17 GPH	20 GPH	40 GPH
160 PSIG at 210°F	160 PSIG at 210°F	160 PSIG at 210°F	80 PSIG at 210°F / 150 PSIG at 210°F
SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ	SCAQMD, TCEQ
UL, CUL, ASME	UL, CUL, ASME	UL, CUL, ASME	UL, CUL, ASME
FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)	FM Compliant or Factory Installed, Double Block and Bleed (Formerly IRI)
120/1/60 20 AMP (16 AMP FLA)	208-230/3/60 20 AMP (10 AMP FLA) 460-230/3/60 15 AMP (5 AMP FLA)	208-230/3/60 20 AMP (10 AMP FLA) 460-230/3/60 15 AMP (5 AMP FLA)	208-230V/3/60 30 AMP (19 AMP FLA) 460/3/60 15 AMP (12 AMP FLA) 575/3/60 15 AMP (9 AMP FLA)
3.4 psi	2.9 psi	4 psi	6.2 psi
40 gallons	58 gallons	55 gallons	110 gallons
1,500 lbs. (dry), 1,760 lbs. (wet)	2,000 lbs. (dry), 2,332 lbs. (wet)	1,700 lbs. (dry), 2,364 lbs. (wet)	3,000 lbs. (dry), 3,920 lbs. (wet)

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ATTACHMENT E

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Since its founding in 1976, EVAPCO, Incorporated has become an industry leader in the engineering and manufacturing of quality heat transfer products around the world. EVAPCO's mission is to provide first class service and quality products for the following markets:

- Commercial HVAC
- District Energy
- Industrial Process
- Industrial Refrigeration
- Power

EVAPCO's powerful combination of financial strength and technical expertise has established the company as a recognized manufacturer of market-leading products on a worldwide basis. EVAPCO is also recognized for the superior technology of their environmentally friendly product innovations in sound reduction and water management.

EVAPCO is an employee owned company with a strong emphasis on research & development and modern manufacturing plants. EVAPCO has earned a reputation for technological innovation and superior product quality by featuring products that are designed to offer these operating advantages:

- Higher System Efficiency
- Environmentally Friendly
- Lower Annual Operating Costs
- Reliable, Simple Operation and Maintenance

With an ongoing commitment to Research & Development programs, EVAPCO provides the most advanced products in the industry – ***Technology for the Future, Available Today***!

EVAPCO products are manufactured in 19 locations in 9 countries around the world and supplied through a sales network consisting of over 170 offices.

Experience, Innovation, Guaranteed Performance

With over 45 U.S. Patents and their 92 foreign counterparts, EVAPCO's engineering expertise speaks for itself and provides an exceptional foundation for various product development projects. This foundation is the catalyst for providing customer driven features and benefits in an environmentally safe manner.

The state of the art Research & Development Center, located at EVAPCO's World Headquarters in Taneytown, Maryland USA, has over 60,000 square feet dedicated to thermal analysis and product development. Experienced R&D engineers perform product and application research year round in seven environmental test chambers.

The Research & Development Center features customized laboratories that are designed to conduct tests through a wide range of environmental conditions. The computerized data acquisition system records the data and graphically displays continuous results, thereby providing the R&D engineers with valuable test information on a continuous basis.

The Research & Development Center also has the industry's largest Low Temperature Environmental Test Chamber. This test chamber was converted from ammonia to CO_2 refrigerant in order to perform detailed thermal analysis on steel evaporators.

In addition, the R&D Center houses a modern Water Analytical Laboratory for advanced water chemistry analysis in support of the company's *Pulse*~Pure® Non-Chemical and Smart Shield® Solid, Time Released Water Treatment business and an AMCA Fan Test Chamber for evaporator fan performance verification. Product sound ratings are measured on a dedicated Sound Test Pad located on the property.

Most recently, EVAPCO has designed, built and commissioned a unique wind tunnel to investigate Air Cooled Condenser (ACC) heat exchangers. This one of a kind laboratory incorporates a full size heat exchanger test section. The heat exchanger is tested with steam under vacuum rather than hot water to allow EVAPCO to optimize the ACC design with unprecedented accuracy.

EVAPCO products are the result of extensive research and thermal testing. As a result, EVAPCO products deliver guaranteed performance in order to maximize system performance.

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cAT

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Field Erected

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eco-ATWE

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Chemical Water Treatment

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eco-ATC


WDC


cATC

Induced Draft Models

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eco-PMC/PMC-E


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Critical Process Air Systems


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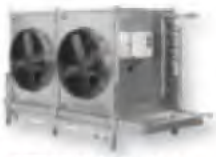
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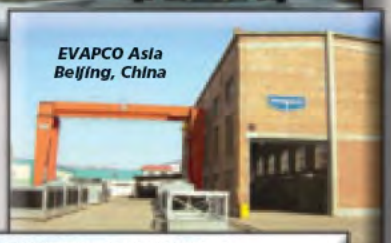
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ATTACHMENT F

Niagara Analytics Framework

Shrink big data and grow performance for your customers with the only analytics framework native to Niagara

The Niagara platform is the industry's first truly open framework, harnessing the power of the Internet of Things. Now, with the Niagara Analytics Framework, we're giving you the power to bring your customers the one thing they need most to optimize their operations—real-time intelligence that gives them actionable insights into their enterprise.

The Niagara Analytics Framework takes the big data generated by Niagara and shrinks it through a variety of analytic applications—from building automation to manufacturing to transportation and beyond. But unlike the vast majority of analytics tools, which provide business intelligence through historical data, the Niagara Analytics Framework captures historical patterns as well as real-time data on events as they unfold. No longer do your customers have to rely solely on data from last cycle to plan for the upcoming cycle—with our analytics platform they can respond proactively and make smarter, swifter decisions that drive their business forward.

BECAUSE THE NIAGARA ANALYTICS FRAMEWORK IS POWERED BY NIAGARA, YOU GET THE ADDED BENEFIT OF:

- The Niagara community to help expand your product
- Our global, end-user footprint to upsell a high-demand solution
- An open platform for support of multiple analytics applications
- Built-in analytics to enhance your enterprise solutions

AND YOUR CUSTOMERS BENEFIT FROM AN ENTERPRISE SOLUTION THAT INCLUDES:

- Operational intelligence—real-time visibility for immediate remediation
- Single software certification for a complete solution

TDIndustries

Niagara Analytics Framework

Niagara Analytics Framework will run in Niagara^{AX} Supervisor and is compatible with Niagara^{AX} 3.7.106 or later.

DATA DEFINITIONS VIEW

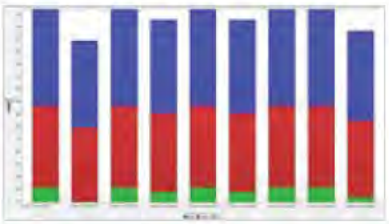
Data definitions let the user define data and formulas in a specific way to make results clearer and more consistent when running analytics.

FORMULA & RULE CREATIONS VIEW

Formulas and rules can be created on the Niagara Wiresheet without code, so no new programming or logic language needs to be learned.

LINE CHART VIEW

Issues can be identified on a line chart—for example, when the belt drive speed increases while the belt tension decreases, resulting in belt slippage.



BAR CHART VIEW

Data can be viewed in aggregate—for example, this bar chart shows the electrical load of the HVAC, lighting and plug circuits.

INDIVIDUAL RESULTS VIEW

Individual results—such as this alarm record of a faulty water valve on an air handler—can be reviewed with hourly and total cost implications.

DATA MODELING VIEW

Data is taken out of the "driver-based" modeling format in Niagara^{AX} and set up in a geographically or system-typed model based on project requirements.

Integrate the Niagara Analytics Framework with your next application and give your customers the real-time intelligence they need to increase production, reduce costs and improve quality.

Contact your Niagara OEM to get started.

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REFRIGERATION EQUIPMENT

For Food and Beverage

A complete line of Industrial Refrigeration products

ATTACHMENT G

Frick®
BY JOHNSON CONTROLS

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Why buy FRICK products?

FRICK HAS A REPUTATION FOR MAKING RELIABLE PRODUCTS

Frick began building quality products in Waynesboro, PA, USA in 1853. We built our first refrigeration compressor in 1883 and have been on the cutting edge of technology ever since. Each year, Frick continues to be stronger and strengthens its reputation for reliability, world-class engineering and application knowledge.

PART OF JOHNSON CONTROLS

As a part of Johnson Controls, Frick has access to the technical and financial resources of a Fortune 100 company. This allows us to share knowledge among our various sales and service organizations around the world.

FRICK FACTOR NETWORK

When you purchase a Frick industrial refrigeration system from your Frick Factor, you get the benefits of Frick product and service experience. Frick Factors have the skills to understand complex processes, product applications, and provide reliable, energy-wise installations, and service after the installation.

STATE-OF-THE-ART TECHNOLOGY IN BOTH DESIGN AND MANUFACTURING

We lead the industrial refrigeration industry with cutting edge controls technologies that allow for seamless system integration. Our product innovations continue to be a major focus as we strive to bring tomorrow's products to the marketplace today.

ENGINEERING EXCELLENCE

Frick engineers have provided reliable products for over 150 years. Frick engineers continually refine existing products, adding features and incorporating the newest technologies. This constant evolution of products ensures that Frick and Frick Factors will deliver customer satisfaction by providing the most technologically advanced equipment in the industry. As we make changes to improve the performance of current products, Frick engineers ensure that these improvements can be applied to previous installations. This allows continual upgrades to existing equipment and allows you to keep your Frick equipment current.

QUALITY, SATISFACTION AND RELIABILITY

The Industrial refrigeration industry places high demands on the equipment it uses. Today's equipment must be easy to maintain and meet high standards for quality, reliability and energy efficiency. Unit designs must be both robust and easily installed. Frick products accomplish all of these goals. High quality materials, innovative design and modern manufacturing methods add up to a product that is unmatched in overall quality. JOHNSON CONTROLS QUALITY POLICY - We will deliver products and services that conform to our customer's requirements and strive to exceed their expectations.

ENERGY EFFICIENT

Facility owners and operators are focused on energy efficiency now more than ever. Energy efficiency investments must provide a reasonable payback. Frick's many years of experience in the industrial refrigeration industry provides for varied and innovative energy efficiency solutions for your system. As an example, our VSD drives with unique liquid cooling ensure that your compressor operates at the most energy efficient level. Our cutting edge designs, along with Frick Control Systems and the use of VSD's can dramatically reduce operating costs.

ENGINEERED CONTROL SYSTEMS FEATURE Q-NET TECHNOLOGY

Get optimum performance when you use Q-Net to take control of your refrigeration system. View, monitor and control your entire system by changing setpoints; react to system changes from one location because everything is linked. Our

constant evaluation of best practices regarding energy conservation and system performance keeps pace with current technologies and sets the standard by which competition is gauged. We offer nearly limitless expansion of your controls capability to keep pace with controls technology. Select from complete PLC based Engineered Control Systems to Q-Net Technology panels.

SUPERIOR SYSTEM INTEGRATION

Our expertise in each product area means a better understanding of how to build a complete and superior refrigeration system with integrated controls. This complete system integration allows for a dependable, efficient and sustainable refrigeration system.

COOLWARE

Coolware selection software enables the user to select the best system components for a refrigeration system. Coolware allows products to be selected, priced, and placed directly into an order document, assuring that the correct equipment is ordered. It also provides flexibility in selection considerations to model a total system that is green, sustainable and efficient. Coolware is the most sophisticated and complete software found in industrial refrigeration today.

WE ARE ENVIRONMENTALLY GREEN

NATURAL REFRIGERANTS DON'T LEAVE A FOOTPRINT!

Ammonia and CO2 are the primary refrigerants used for industrial refrigeration. Both are natural refrigerants that are environmentally friendly and have low Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

AFTERMARKET SERVICE

If you have FRICK equipment, it is our policy to support it. Our technical support does not end with the warranty. The Baltimore Parts Center online ordering system is designed to help Frick® Factors obtain parts fast. Prompt and accurate service is our standard. We also offer a priority order service to expedite in-stock parts orders when same day shipment is required.

A GLOBAL LEADER

The Frick Brand is produced by Johnson Controls, a global diversified technology and industrial leader serving customers in over 150 countries. Johnson Controls serves these markets through three business units; Building Efficiency, Automotive Experience, Power Solutions.

Our Values

- Integrity
- Customer Satisfaction
- Employee Engagement
- Innovation
- Sustainability

Our commitment to sustainability includes our products, services, and operations. We believe in efficient use of resources around the world. We are committed to delivering value and making our customers successful.

Our 130,000 employees create quality products, services and solutions to optimize energy and operational efficiencies of buildings; lead-acid automotive batteries and advanced batteries for hybrid and electric vehicles; and interior systems for automobiles.

Building Efficiency is a leading provider of equipment and controls for heating, ventilating, air-conditioning and refrigeration, as well as security systems for buildings.

Automotive Experience is a global leader in automotive seating, overhead systems, door and instrument panels, and interior electronics.

Power Solutions is the global leader in lead-acid and advanced batteries fro the automotive industry.

RWF II and RXF Rotary Screw Compressors Quiet! Reliable! Efficient!

Frick® RWF II and RXF Rotary Screw Compressors... leading the food and beverage industry with the most innovative and broadest product range available for industrial applications.

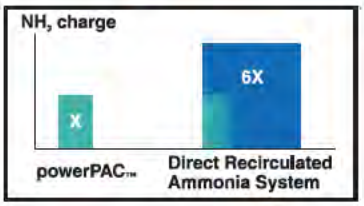
- **Variable volume ratio** for maximum efficiency
- **Infinite capacity control** to match changing loads... exactly!
- **Smart Series™ Motors** are NEMA premium efficient, low noise. Standard on Frick® compressor packages.
- **Flange mounting** eliminates troublesome field alignment between low-noise motor and compressor
- **Factory-mounted starter** simplifies electrical installation
- **Cold-start valve** provides oil pressure without the need for a pump
- **Lower leakage potential** because of fewer threads, less fittings and welded connections
- **Oil Cooling** by EZ-Cool™ Liquid Injection using a motorized expansion valve controlled by the Frick® Quantum™LX for optimum discharge temperature control; or by Thermosyphon which uses a plate and shell vessel to cool the oil with no compressor capacity lost or compressor power penalties incurred.

QUANTUM™LX CONTROL Easy To Learn! Easy To Use!

Our new LX display has contemporary graphics that are easy to read and navigate, just like the web. For today's personal computer user, the look and feel of Quantum™LX is second nature.

Our simple graphical interface is perfect for your newest users, while our advanced interface has detail to satisfy even your most experienced operator.

- Four user-defined capacity control modes for a wide application range
- Built-in diagnostic functions simplify troubleshooting
- Quantum™LX has on-screen calibrations and operator-friendly graphics
- Real-time and historical trending
- Smart safeties mean trouble-free operation
- Uses Ethernet for high-speed communications
- Backward compatible to Plus/Quantum™ micro with serial communication
- Industry standard serial communication protocols: Frick® ASCII • Allen-Bradley® DF1 Serial, Modbus ASCII • Modbus RTU
- Ethernet: Modbus TCP/IP • Web accessible



Frick® PowerPac™ ...Your next refrigeration plant should be easy to buy, easy to install and easy to operate!

Frick® PowerPac™ reduces the need for field labor. Frick® compressors, heat exchangers, evaporators, and condensers come in a compact package controlled by Frick® Quantum™LX controls and Frick® "turnkey" software.

Your Frick® PowerPac™ puts advanced heat exchanger technology to work for reduced refrigerant usage and maximum operating efficiency.

Reduces the requirement for a Process Safety Management (PSM) program.

Frick® PowerPac™

- Less jobsite labor means lower cost
- Optimized design means fewer welds
- "Factory Built" controlled environment; site delivered ready to operate
- Simplified electrical hookups
- Process side uses pumped glycol
- Freeze protection from 3-Directional expansion
- Plate and frame heat exchanger means less refrigerant charge

Unit-Mounted Solid-State Starter or Variable Speed Drive...Why?

- Lower installation costs
- Less mounting space
- Extended motor life and improved system integrity because it's factory wired
- Superior motor overload protection
- Main circuit breaker disconnect provides immediate shutdown protection at the compressor.

Vyper™ Variable Speed Drive gives you the kind of control you need, today, to respond to the unique load demands of your Process Cooling Requirements.

There are many processes that could benefit from the use of the Vyper™ VSD. Some examples are:

• Carbonated Beverage • Cold Storage • Meat Processing • Dairy • Poultry Processing • Industrial Bakeries • Seafood • Fruits & Vegetables • Breweries • Ice Making

Contact your Frick® sales representative to better realize the potential of this technology when applied to your process.

A smart, environmentally friendly way to upgrade your facility and reduce your carbon footprint!

Frick SmartPac™ Heat Pumps

SmartPac™ Heat Pumps capture the heat from your ammonia refrigeration system that is normally rejected to the atmosphere. SmartPac™ then transforms this valuable resource into hot water that can then be utilized throughout your industrial facility.

SmartPac™ enables you to make more efficient use of your ammonia refrigeration system ... bottom line ... lower utility bills and a reduced carbon footprint.

Frick® SmartPac™–Easy to Install; Easy to Own

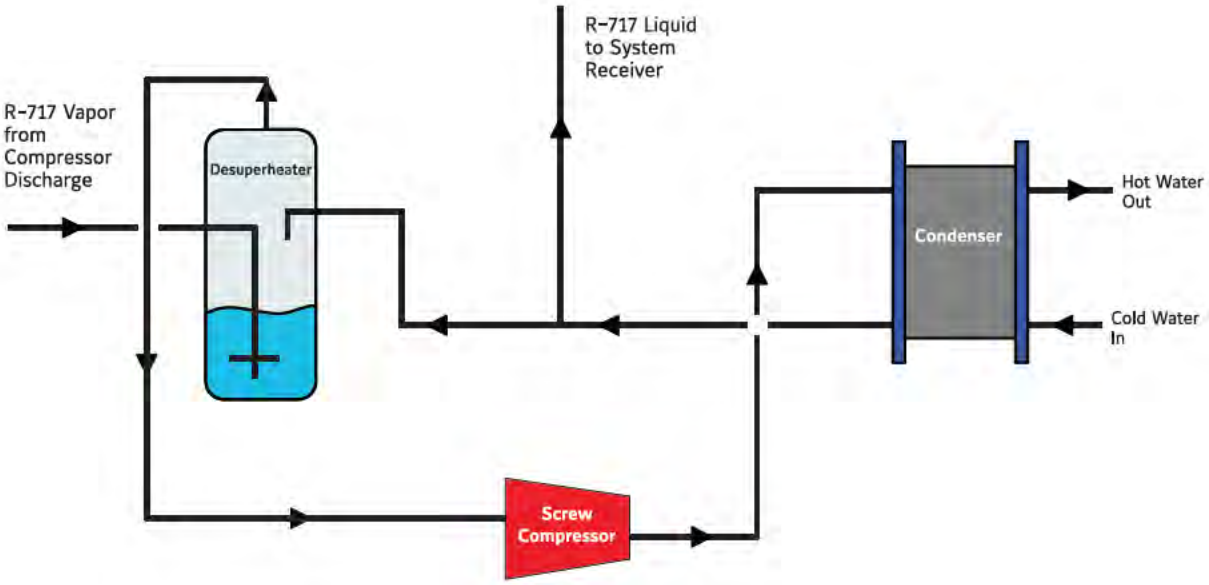
Frick screw compressors, heat exchangers, pressure vessels and controls all come together in a compact package ready to install.

Advanced heat exchanger technology increases operating efficiency with a reduced refrigerant charge.

When installed by a Frick Factor, get a 3-year warranty No worries start saving $$ now.

SmartPac™ Applications

- **Beef**
- **Poultry**
- **Dairy**
- **Brewery**
- **Prepared Foods**
- **Ice Rinks**
- **District Heating**



ACUAIR® HYGIENIC AIR HANDLING UNITS

Sanitary conditions, compliance with regulations and the demand to deliver a quality product are all part of the success equation. Frick® AcuAir® systems are precision-engineered and painstakingly built to the high sanitary standards of food processors and help you meet the requirements of the United States Department of Agriculture.

Frick AcuAir® Hygienic Air-Handling Units

Process Room Control of Temperature, Pressure, and Filtration, Creating a Safe, Sanitary Food Processing Environment

- Hygienic air conditioning
- Rooftop installation
- Engineered to your specific sanitary requirements

Makeup Air Handlers

Whether your application requires simple fresh-filtered air with little temperature conditioning or specific volumes of tempered air, the AcuAir applications team knows just the questions to ask in order to provide you with your most economical solution.

Frick AcuAir® products are the best solution for clean, conditioned air!

Custom Engineering

The extensive experience of Frick AcuAir® and the array of unit options allows us to customize a unit for your specific application..

AcuAir products controlled by Quantum™LX technology provide access for monitoring and control, using the web browser of any connected network computer or a laptop at the unit. Simply type in the Unit's IP Address for easy access. The remote mounted System Interface Panel (optional & shown here) can also be used for quick easy access to monitor and control your AcuAir units. The System Interface Panel will also provide access to any Quantum™LX control panel (compressor, evaporator, condenser/vessel) on the network from one convenient, central location.

Designed for Internal Wash-Down

Floor drains are provided throughout the unit that are piped to the exterior of the unit base. Under the cooling coil and downstream, the unit is provided with recessed stainless steel drain pans that are double-sloped for positive water drainage. Internal wiring and motors are also engineered for wash-down duty.

A Frick® heavy-duty evaporator means:

- Reliable heat transfer for continuous operation at all temperature levels
- Design flexibility in geometry, fan selection, and construction materials.

Innovative solutions driven by your application needs!

- CleanCoil™ hygienic fin design
- Fully welded hygienic drain pans
- Vari-Fin frost management design
- Full coverage drain pans

Frick Quantum™LX controllers provide the right solution for efficient capacity control.

- Flexible defrost-sequencing control platform
- Control up to 32 evaporators from each Quantum™LX graphical interface
- Remote terminal boxes minimize wiring requirements and reduce installation expenses.

And ... for extremely large facilities, link several Frick® Quantum™LX control panels together to manage all of the evaporators at the same time.

RTF Rooftop Freezer Systems

Penthouse Unit Features:

- **4" (R-32) or 5" (R-41) urethane foamed-in-place wall panels.**
- **Exterior painted, stucco-embossed steel panel.**
- **Large service doors with heated seals.**
- **OSHA guards at fan inlet.**
- **Fan motor service rail.**
- **Interior maintenance lighting.**
- **Refrigerant and drain lines extend through the insulated enclosure.**
- **Insulated drain pan – with or without hot gas pan coil. Interconnecting hot gas piping not included.**
- **External electrical control panel (Optional).**

The Evaporator System Includes:

- **Coils constructed of stainless steel tube and aluminum fins or all hot dip galvanized steel.**

- **Direct-drive cast aluminum, non-overloading axial propeller fans. Standard motors are TEFC, 1160 or 1750 RPM.**
- **Air or hot gas defrost coil designs**

Easy Maintenance

- Internal Access – The interior of the unit is spacious and easily accessible via multiple large hinged access doors for adjusting the float valve, cleaning the strainer, or flushing the basin.
- Basin Sweeper System – The basin contains an optional piping system to sweep away sediment.
- Harmony™ Removal System – Water distribution branch removal system that requires no tools.

Reliable Year-Round Operation

- Drive System – The fans, motor, and drive system are located to protect them from moisture, condensation and icing. Backed by a 5-year fan drive and motor warranty, these units are suitable for year-round operation.
- HDGAF Coil – The coil is hot dip galvanized after fabrication.

Low Installed Cost

- Support – All models mount directly on two parallel I beams and ship complete with motors and drives factory installed and aligned.
- Modular Design– Large models ship in multiple sections to minimize the size and weight of the heaviest lift, allowing for the use of smaller, less costly cranes.

Green (Energy Saving)

- PE VFD Motors – Fan motors are premium efficient inverter duty.
- VFD – Variable frequency fan motor drives are optional.
- Design – Evaporative condensers lower the condensing temperature saving up to 15% compared to a traditional condenser.

The Frick Quantum™LX Condenser Control Panel

- Multi-step head pressure control
- Graphical operator interface (GOI) simplifies operator training
- Menu driven control-sequencing options
- Vessel level control to manage engine room needs

PRESSURE VESSELS

Accumulators

Vertical accumulators with or without coils.

Intercoolers

Vertical intercoolers with or without coils..

Receivers

- Horizontal and vertical high-pressure receivers.
- Horizontal and vertical thermosyphon receivers.
- Vertical high-pressure thermosyphon receivers.

Oil Pots

Horizontal oil pots.

Economizers

Flash type and shell-and-coil type.

Surge Drums

Horizontal surge drums with either single-flow or dual-flow.

Surge Drum Packages

Horizontal vessel design with sufficient room for plate and frame heat exchangers mounted below vessel.

Special Vessels and Packages

Frick® manufactures vessels and packages customized to specific application and design requirements.

Horizontal and Vertical Liquid Recirculator Vessels and Packages

Horizontal and vertical recirculator packages and vessels from 24 to 120 inch outside diameter. Offered with either mechanical seal or semihermetic style pumps, packages are completely factory piped and come standard with a 3-inch float column and 3 level eyes. Standard ammonia packages include an oil pot. Options include control panels, liquid-level control systems, oil pot heaters, variable speed drives, and liquid makeup assemblies (shipped loose).

HEAT EXCHANGERS

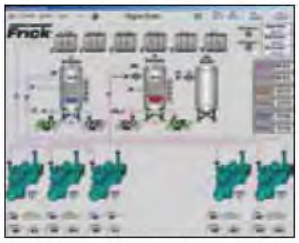
A plate and frame heat exchanger mounted on a structural base, piped to a liquid separator and wired with a NEMA 4 liquid level control panel. Designed to cool water or brine utilizing liquid refrigerant from a central refrigeration system.

Frick custom engineered control systems are tailored to your individual requirements and are used on all types of new and existing Industrial Refrigeration applications.

- Custom solutions for any refrigeration application
- All setpoints password-protected with supervisor-assigned accessibility
- Open architecture
- Nonproprietary hardware and software

Opto 22 · Allen-Bradley®
RSView®32™ · Wonderware® In-Touch®

- All systems are protected by a NEMA 4 enclosure. NEMA 4x available as an option.



Engine room overview screen

- Remote monitoring
- Data logging and trending
- Report generation and printouts

Individual or group evaporator overview screen

- Unit-Mounted Starters and Controls for ease of installation and accessibility

Single Source Industrial Refrigeration Solutions!

Johnson Controls

Johnson Controls Inc.
100 CV Avenue • P.O. Box 997
Waynesboro, PA 17268-0997 U.S.A.
Tel: 717-762-2121 • Fax: 717-762-8624
www.johnsoncontrols.com

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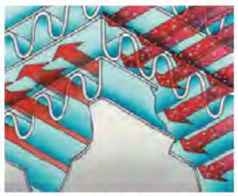
TDIndustries

BREATHE EASY WITH A CARRIER ENERGY RECOVERY VENTILATOR.

TECHNOLOGY



This illustration shows how the cen ral core doesn't mix the fresh air from outside with the s ale polluted air from inside

1. **Efficiency and comfort** is ensured by he high e ficiency energy recovery central core which recovers energy from he indoor air and transfers it to the fresh incoming air without mixing airstreams The core also helps to remove unwanted humidity from air inside your home during winter, and removes the humidity from he ou side air before it enters your home in the summer
2. **Quiet comfort and energy savings** are provided by the motor which efficiently moves air through the system
3. **Fresh, outdoor air is cleaned** by the filter prior to entering your iving space
4. **Better operating control and re iabi ity** is provided by the electronic circuit board
5. **Energy savings and added system reliability** is provided by the damper defrost By periodically recirculating indoor air when emperatures drop below 23 degrees, the damper defrost helps prevent frost from forming, e iminating he need for energy consuming supplementary electric defrost that can be found on competitive models
6. **Easy access to internal components** comes from the briefcase style latches No tools are required for removing and cleaning ilters

Energy Recovery Ventilators (ERVs)

Model #	ERVCCLHU1150	ERVCCLHU1200
Capacity (CFM) @ 0.5–0.3 ESP(in. wc)	117-152	182-214
Apparent Sensible Effectiveness @ 32 degrees F – percent	79	76
Net Moisture Transfer Efficiency 95 degrees F – percent	52	45
Cooling Season Total Recovery Efficiency 95 degrees – percent	45	41

This information is in the ERVC Product Data ERV 2PD
Units can be installed as independent systems for ba hrooms or kitchens or integrated for whole house ventla ion

CARRIER INDOOR COMFORT SYSTEMS OFFER UNMATCHED PERFORMANCE.

CARRIER SYSTEMS

Humidifier
As part of a c al indoor com fort system a Carr er humidi fier replenishes moisture s dry indoor air

Evaporator Coil
A Car ier evapo a or coil is matched with the proper out door unit o provide top cooling ef iciency and years of reliab e service If replacing your out door unit Car ier ecommends the replacement of he indoor section as wel l to ensu e peak performance and re iability

Furnace
Ca rier offers a complete line of top quality high ef ciency gas and oil furnaces Ask your Ca rier dealer which one is r ght for you

Air Cleaner
Ca rier air c eaners can sub stant ally improve your indoor comfort by removing harmful and ir itating airborne po lutants f om your home

Air Conditioner
A comp ete line of Ca rier air conditioners provides re iable high efficiency cooling for ong asting com ort and energy savings Ask your Car ier dealer about environmenta ly sound Ca rier air conditioners with Puron® efrigerant

Zoning
Comfort zoning allows you to set di ferent temperatures for differ ent areas of your home Enjoy greater comfort and added energy savings with room to room tempe a ure control

Comfort Ventilator
A Car ier comfort ven ila or adds a breath of fresh air to today's igh ly constructed home t combines fresh out door air wi h conditioned indoor air for improved ai r and energy exchanges

Thermidistat™ Control
A Ca rier Therm distat™ Con rol s your command center P ec se tempe a ure control and programmab e eatures keep you in touch with your comfort

MATCHING COMPONENTS PROVIDE OPTIMUM COMFORT, EFFICIENCY AND PERFORMANCE

- Forced ai systems are usually built a ound an indoor unit, such as a fu nace o a fan coil
- The outdoor unit will be an air conditioner or h at pump combined wi h a fu nace for year round comfort.
- Air quali ty is gr atly imp oved wi h the addition of an air cleaner, humidifie and a ventilator.
- Precise tempe ature cont ol com s f om a Carrier thermosta t matched to your indoor comfort system.
- Zoning p ovides the ultimate in cont ol over your indoor comfort system.

WARRANTY

Carrier extends your comfort by provid ng wr tten product and component warranties The Energy Recovery Ventilator (ERV) s covered by a five year parts limited warranty and a lifetime limited warranty on the core A k your Carrier dealer for details

Carrier

EXPERTISE

Carrier has been on the leading edge of the indoor comfort industry since Willis Carrier invented what we now know as air conditioning in 1902. Since hat time, Carrie scientists, enginee s and d alers have been providing homeowners with he most advanced indoor comfort technology a ailable. This technologi al advantage has enabled Carrier to customize indoor comfort systems for millions of homeowners nationwide.

Today you can rely on your local Carrier dealer to evaluate your indoor comfort needs and suggest a customized system that fits those precise requirements. By recommending he app op iate furnace, air conditioner, humidifier air cl aner ventilator, zoning system and controls, your Carrier d aler an deliver enhanced comfort while imp oving he efficiency of you system. Ask your Carrier d aler fo a system e aluation today.

Carrier
www.carrier.com

A member of the United Technologies Corporation family. Stock Symbol UTX

ENERGY RECOVERY VENTILATOR

Attachment B-10.1

THE CARRIER ERV REFRESHES YOUR INDOOR AIR

A CARRIER ENERGY RECOVERY VENTILATOR ENHANCES YOUR OVERALL COMFORT.

IAQ

As the cold weather settles in, let a Carrier Energy Recovery Ventilator (ERV) provide the fresh comfort you deserve. Today's air tight homes prov de excellent ne gy effici ncy. However, better insulation restricts he air exchange, t apping stale, polluted air inside your home. Wi hout p oper v nilation, dust, airbo ne particles, volatile o ganic compounds (VOCs), excessive humidity and o her pollutants from building mate ials constantly recir culate th oughout your home. That's why Carrier offe s he ERV

EFFICIENCY

The Carrier ERV recove s energy from indoor air and transfe s it to incoming outdoor air so you can enjoy fresh air without sacrificing energy efficiency. The ERV draws fr sh air into your home f om outside as stale, polluted air is pulled out of your home and expelled outside. When he two air str ams move th ough he c ntral ne gy recove y core, energy is t ansferred from he stale outgoing air to the fresh incoming air wi h out ever mixing airstreams. That means maximum comfort wi h fresh, clean ai and efficient performance from your indoor comfort system.

Climate Map for Energy and Heat Recovery Ventilators

HRV or ERV? If you live in a colder climate with a longer heating season your dealer will likely recommend the HRV. For most of the United States ERV are recommended because of their year round efficiency. Your local Carrier dealer can determine which is best for you.

FOR UNEQUALLED PERFORMANCE AND DURABILITY, CHOOSE CARRIER.

CUSTOM COMFORT

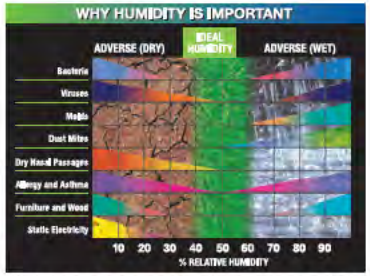
In addition to improving air quality, the ERV enhances your overall comfort. Wi h he easy to use, wall mounted cont ol unit equipped wi h three different modes, you'll have fresh ai at your fingertips. The recirculation mode p ovides air movem nt hroughout your home wi hout bringing in outside air. The continuous mode works 24 hou s a day to p ovide a continuous flow of fresh outdoo air into your home. The intermittent mode operates when he indoor humidity exceeds your desired level, p oviding maximum fuel economy. The ERV will ensure your indoor comfort for years to come.

Simple wall control makes operating the ERV easy and convenient

Integrated System

AIRFLOW

A Carrier ERV expels stale polluted air outdoors and refreshes your home with clean outside air, while at the same time recovering energy. This helps prevent and dilute he build up of radon gas, ca bon monoxide and o her volatile organic compounds (VOCs). It is much more economi al than opening a window in the middle of winter o summer. It also reduces humidity levels during winter mon hs to reduce condensation on windows and doors.



Maintaining ideal humidity in your home can be he key s relief from dry nasal passages static electricity and dry itchy skin. Proper humidity con rol is also important for minimizing he growth of bacteria, molds viruses and dust mites. With ighter bu lt homes too much humidi y in the winter can be a problem. For example excessive moisture in the winter can cause sweating/water drops to develop on windows and door jambs. This condition could prematurely deteriorate windows and door jambs in corners near floors or basements and cause mold and mildew to develop.

AN ENERGY RECOVERY VENTILATOR CAN BE THE SOLUTION TO IMPROVING YOUR INDOOR AIR QUALITY.

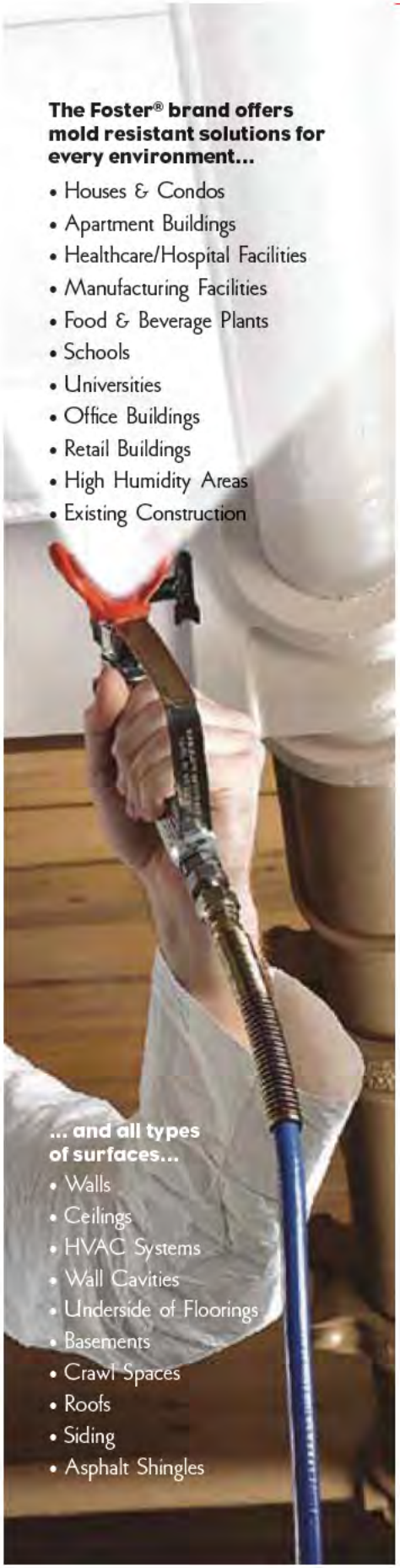
ERV AIRFLOW

TODAY'S HOMES NEED PROPER VENTILATION

ATTACHMENT H

Foster™

Mold Remediation and Prevention Products



The Foster® brand offers mold resistant solutions for every environment...

- Houses & Condos
- Apartment Buildings
- Healthcare/Hospital Facilities
- Manufacturing Facilities
- Food & Beverage Plants
- Schools
- Universities
- Office Buildings
- Retail Buildings
- High Humidity Areas
- Existing Construction

... and all types of surfaces...

- Walls
- Ceilings
- HVAC Systems
- Wall Cavities
- Underside of Floorings
- Basements
- Crawl Spaces
- Roofs
- Siding
- Asphalt Shingles

A World Leader

For over 60 years, the Foster® brand of products have been leading the way with its mastic, coating, sealant and adhesive products for the industrial, commercial and residential construction markets. Foster introduced the first EPA-registered antimicrobial coating, and still the only, for use in HVAC systems in 1992 and has continued to manufacture and sell water-based coatings, disinfectants and accessory products for mold remediation and prevention to the indoor air quality market. Our reputation has been built on the best technical expertise driving the best technology for superior performing products.

When tested against rigorous American Standards Testing Method (ASTM) D-5590, Foster products exhibit a "0" growth rate (see next page for more information). This means Foster products have proven performance and superior efficacy that truly work!

As a leader in the IAQ industry, the Foster brand product line includes:

- EPA-Registered Antimicrobial Products
- Mold Resistant Products
- Disinfectant/Sanitizer
- Accessory Products

For additional information, please visit **www. fosterproducts.com**.

EPA-Registered Antimicrobial Products

Our customers come first, and our ability to meet their needs is the key to our success.

Foster® products are "Globally Specified, Proven, and Preferred" by IAQ professionals around the world. Specifically, our antimicrobial coatings are ideal for use in buildings and locations where mold already exists, or may potentially exist. These products have been successfully used in the field as the number one mold resistant coatings since 1992. Both of our EPA-Registered mold resistant coatings (Foster® 40-20™ and Foster® 40-30™) are the only coatings registered for use both in HVAC systems and on walls/ceilings.

Solutions that Work!

The cost of remediating a mold-infested building can be staggering, especially when it may be repeated due to mold growth on an inferior coating. When applied to lined and unlined HVAC systems, walls, sub floors, and studs, Foster EPA-Registered fungicidal coatings provide long-term protection by preventing the growth and spread of odor causing bacteria and mold on the coating surface.

The samples at the right show standard untreated house paint (above) vs. Foster coating (below). The Foster 40-20 coating is free of mold!

Mold covers the control sample completely

Mold growth is inhibited on the Foster® 40-20™ coating

Foster® Coatings Proven Effective 15 Years and Running . . .

Regardless of the job, Foster 40-20 offers the highest level of resistance to mold growth on its surface while protecting the substrate from deterioration. It is the first and only EPA-registered coating for application in HVAC duct work, as well as on walls, ceilings, pipes or wherever effective controls are essential. Foster 40-20 provides a flexible, tough film that remains clean while retarding fiber release and further erosion of the duct insulation. Over the past 15 years, Foster 40-20 has been extensively specified and used in numerous mold remediation projects. In one study, when used in the duct system of a prominent maximum security prison, Foster 40-20 has remained fully effective since 1992.

Visit www. fosterproducts.com for the full case study, and the use of Foster 40-20 in other remediation situations.

EPA-REGISTERED PRODUCTS

There are 3 antimicrobial products registered with the EPA: Foster® 40-20™ coating, Foster® 40-30™ coating, and Foster® 40-80™ disinfectant. These products have all gone through rigorous independent testing, required by the EPA. Both the Applicator and End User can be assured of:

Low Toxicity
These products have been fully tested for toxicity and labeled with the lowest possible toxicity warning of "caution."

Accurate Claims
Fact based—there are no misleading claims to the consumers.

Testing
These products have been tested by an independent lab for both efficacy and toxicity.

Consistency
The formulation of EPA-Registered products is consistent with the original formula registered with the EPA.

EPA-Registered Antimicrobial Products

All Foster® Indoor Air Quality products are water-based. Additional information and specifications can be found on the MSDS sheets and Product Data Sheets, available at **www.fosterproducts.com.**

Product Number/ General Description	Color	Substrate	Coverage	Dry Time	Application Method	Spray Tips
Foster® Fungicidal Protective Coatings						
40-20™ Fungicidal Protective Coating • Industry leading antimicrobial coating. • Prevents the re-growth and spread of odor causing bacteria and mold on its surface. • Provides a tough, elastic, water resistant coating. • Prevents air erosion and fiber release when applied to fibrous duct liner insulation.	White	• Walls • Ceilings • Pipes • Interior & Exterior HVAC duct systems	80 ft^2/gal. (2.0 m^2/L)	Set to touch: 4 hours Dry through: 16 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.023 to 0.025", 8" to 10" fan width
40-30™ Fungicidal Protective Coating • Prevents the re-growth and spread of odor causing bacteria and mold on its surface. • Prevents air erosion and fiber release when applied to fibrous duct liner insulation.	Black	• Fiberglass duct liners • Duct board insulation • Galvanized surfaces	Galvanized Metal: 133 ft^2/gal. (3.3 m^2/L) New Duct Liner: 100 ft^2/gal. (2.5 m^2/L) Old Eroded Duct Liner: 67 ft^2/gal. (1.6 m^2/L)	Set to touch: 6 hours Dry through: 24 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
Foster® Disinfectant/Sanitizer						
40-80™ Disinfectant/Sanitizer** • Use as a disinfectant, sanitizer, cleaner, fungicide, deodorizer, virucide and germicide. • Kills a large variety of microbes within minutes. • Contains surfactants to help clean and remove residue. • Designed for use in water damage restoration situations.	Clear	• All hard, non-porous surfaces • Sanitizes porous and semi-porous materials	Depends on application method and surface. Apply sufficient quantity to insure the surface remains wet continuously for at least ten (10) minutes.	Dry thoroughly before applying top coating.	• Garden sprayer, spray bottle, cloth, mop or sponge	Airless sprayers are NOT recommended. Coarse spray only.

Guide to Primer Use

Surface	Required Primer	Coating
Wood (structural studs, OSB, plywood)	None	All
Metal (galvanized, foil)	40-26 (recommended)	All
Drywall (unpainted)	None	All
Concrete, brick, plaster, masonry cement block (unpainted)	40-22 or 40-26	All
Painted surfaces (flat finish)	None	All
Painted surfaces (gloss finish)	40-26 or sanding	All
Wood (smooth, sanded, hardwoods)	40-26	All
Ductliner, duct board	None	40-20 or 40-30

Airless Spray Equipment Guidelines

Foster Mold Resistant Coatings can be applied with most manufacturers commercial grade electric airless sprayers. Sprayers with the following minimum specifications are suggested:

Operating Pressure (psi):	3000
Motor Size (hp)	3/8
Volume (gpm):	0.45
Hose (inches i.d.):	1/4" up to 50', 5/16" over 50'
Spray Tips*:	Refer to Product Information Chart.

* Tip sizes as small 0.017" may be used, however, application will be slower and may require multiple passes to achieve recommended coverage rate. Spray equipment manufacturers specifications should be reviewed for maximum tip size acceptable for the sprayer being used.

** Not for use on the interior on HVAC systems. Refer to product label for use directions.

Mold Resistant Products

Resisting Mold in the Toughest Environments

Foster® brand coatings provide the highest level of performance even in the harshest conditions. Foster Mold Resistant Coatings specialize in resisting long-term mold growth on their surface. In addition to coatings, our accessory products improve the adhesion and aesthetic appeal when used.

ASTM D-5590 Testing Provides Evidence

We demonstrate the efficacy of our mold resistant products with extensive ASTM D-5590 Testing. ASTM D-5590 is specifically designed to test paints and coatings in the most severe environment possible for promotion of fungal growth. This makes it an excellent method for evaluation of a mold resistant coating's performance under the harshest conditions.

Foster® Brand Products Superior Performance and Highest Standards

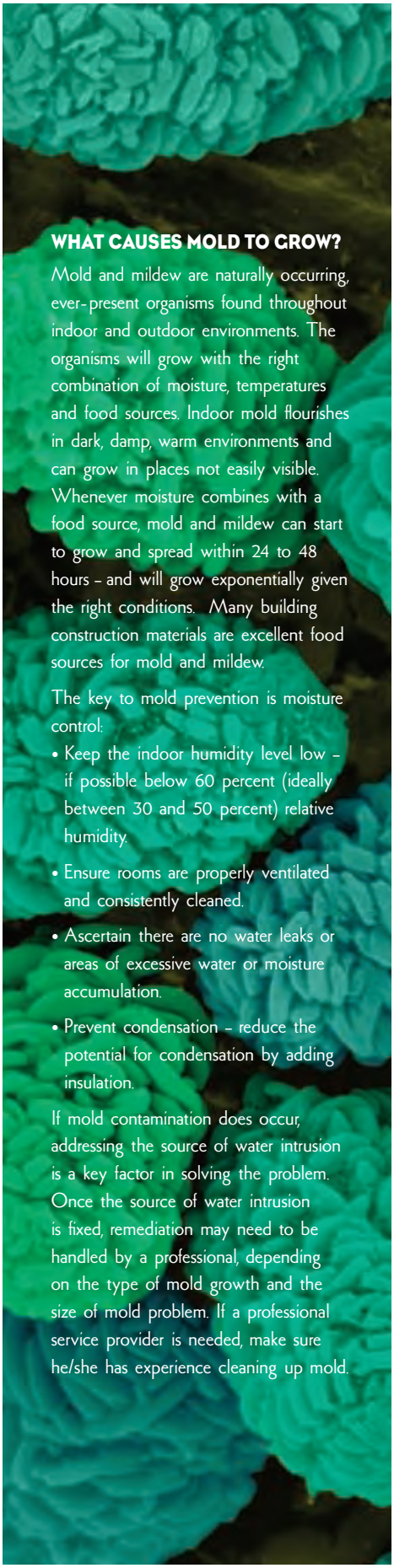
Our products are constantly monitored for high quality through our ISO 9001 certification. This high level plant quality certification assures consistent, high quality Foster brand products. In addition, we test independently through a leading commercial IAQ laboratory (Aerotech Laboratories, Inc.) to maintain our position of leadership.

ASTM D-5590 Test Method

ASTM D-5590 was purposefully developed to test paints and coatings in the "worst-case conditions" possible for promotion of mold, mildew, fungus and algae growth. This method is the best for evaluating a mold resistant coating's performance under ideal mold growth situations.

Mold requires three elements for growth: high humidity, proper temperatures and a food source. ASTM D-5590 provides these elements in an optimal environment for growth. To insure continual exposure, the sample is surrounded with active, continually re-generating mold spores, truly testing the product's resistance to growth. These conditions represent a worst-case scenario in a real world application where there is active mold spore generation on an adjacent substrate to the coated material at a temperature and humidity highly conducive to mold growth.

Other commonly cited tests do not provide this high standard of testing combining all three elements, and consequently do not reflect the product's performance under the most relentless mold growth conditions.



WHAT CAUSES MOLD TO GROW?

Mold and mildew are naturally occurring, ever-present organisms found throughout indoor and outdoor environments. The organisms will grow with the right combination of moisture, temperatures and food sources. Indoor mold flourishes in dark, damp, warm environments and can grow in places not easily visible. Whenever moisture combines with a food source, mold and mildew can start to grow and spread within 24 to 48 hours – and will grow exponentially given the right conditions. Many building construction materials are excellent food sources for mold and mildew.

The key to mold prevention is moisture control:

- Keep the indoor humidity level low – if possible below 60 percent (ideally between 30 and 50 percent) relative humidity.
- Ensure rooms are properly ventilated and consistently cleaned.
- Ascertain there are no water leaks or areas of excessive water or moisture accumulation.
- Prevent condensation – reduce the potential for condensation by adding insulation.

If mold contamination does occur, addressing the source of water intrusion is a key factor in solving the problem. Once the source of water intrusion is fixed, remediation may need to be handled by a professional, depending on the type of mold growth and the size of mold problem. If a professional service provider is needed, make sure he/she has experience cleaning up mold.

Mold Resistant Products

All Foster® Indoor Air Quality products are water-based. Additional information and specifications can be found on the MSDS Sheets and Product Data Sheets, available at **www.fosterproducts.com.**

Product Number/ General Description	Color	Substrate	Coverage	Dry Time	Application Method	Spray Tips
Foster® Mold Resistant Coatings and Sealants						
40-10™ Duct Liner Adhesive Coating • Seals and reinforces the surface of new and aged duct liner. • Prevents air erosion and fiber release. • Resists mold, fungus, and discoloration from mildew and mold stains on its surface.	White	• Fibrous duct liner • Unfaced duct board insulation	80 to 200 ft^2/gal. (2.0 to 4.9 m^2/L)	Set to touch: 6 hours Dry through: 24 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
40-11™ Eclipse™ Coating • Matches the original surface color of most duct liner insulations. • Seals and reinforces the surface of new and aged duct liner. • Prevents air erosion and fiber release resists mold, fungus and discoloration.	Black	• Fibrous duct liner • Duct board insulation	50 to 150 ft^2/gal. (1.2 to 3.7 m^2/L)	Set to touch: 6 hours Dry through: 24 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
40-23™ Insulation Sealer • Penetrates deeply into existing HVAC duct liner insulations, forming a damage resistant surface that reduces particle release. • Resists fungus and mold growth on its surface.	White	• Fibrous duct liner • Duct board insulation	50 to 150 ft^2/gal. (1.2 to 3.7 m^2/L)	Dry through: 2-4 hours at ambient	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
40-50™ Mold Resistant Coating • Formulated with EPA-registered antimicrobial agents which provide protection against odor causing bacteria, mildew and mold growth on the product surface. • For use in areas prone to the growth of mold.	White	• Wall cavities, floor joists, attic spaces • Wood and metal studs, drywall, OSB, furring strips, masonry	300 ft^2/gal. (7.4 m^2/L)	Dry through: 1-2 hours at ambient	• Airless Sprayer • Brush or Roller	Tip Size*: 0.015 to 0.017", 8" to 10" fan width
40-51™ Mold Resistant Coating • Provides a clear finish leaving the original surface visible after application. • Specially formulated with EPA-registered antimicrobial agents for long-term protection from mold growth on its surface.	Clear	• Wall cavities, floor joists, attic spaces • Wood and metal studs, drywall, OSB, furring strips, masonry	Wood: 250 to 450 ft^2/gal. (6.1 to 11.0 m^2/L) Non-Porous Surfaces: 500 to 600 ft^2/gal. (12.3 to 14.7 m^2/L)	Dry through: 1 hour at ambient	• Airless Sprayer • Brush or Roller	Tip Size*: 0.015 to 0.017", 8" to 10" fan width
40-55™ Clear Defense™ Mold Resistant Coating • Specifically designed to protect and maintain the aesthetics of residential, commercial and industrial surfaces. • Formulated with EPA-registered additives, providing long-term resistance to the growth of mold, mildew, fungus and algae on its surface without blushing or yellowing.	Clear	• Masonry, stucco, concrete and clay roofing tiles • Asphalt shingles, vinyl, aluminum, painted wood	Non-Porous Surfaces: 300 ft^2/gal. (7.4 m^2/L) Porous will require more product.	Dry through: 40 minutes-1 hour	• Airless Sprayer • Brush or Roller	Tip Size*: 0.015 to 0.017", 8" to 10" fan width
Foster® Accessory Products						
40-16™ Block Filler • Abrasion-resistant fill coat eliminates pores, depressions and crevices in a one-coat application.	Off White	• Unpainted masonry surfaces	40 to 70 ft^2/gal. (1.0 to 1.7 m^2/L)	Set to touch: 1-2 hours Dry through: 15 hours	• Airless Sprayer • Brush or Roller	30:1 Air Pump with Inductor Plate. Tip Size: 0.021 to 0.025", 8" to 10" fan width
40-22™ Masonry Sealer & Primer • Penetrates into the surface, strengthening it and sealing it to help eliminate blistering and peeling.	Off White (dries clear)	• Unpainted block plaster • Cement surface	50 to 200 ft^2/gal. (1.2 to 4.9 m^2/L)	Dry through: 2-4 hours at ambient	• Airless Sprayer • Garden Sprayer or Spray Bottle	Tip Size: 0.017 to 0.021", 8" to 10" fan width
40-26™ Water-based Primer • Bonds and protects against stains and corrosion. • Increases the bondability of retrofit systems.	Off White (dries translucent)	• Metal, and rusty metal • Concrete • Masonry • Wood	Metal: 200 to 300 ft^2/gal. (4.9 to 7.4 m^2/L) for corrosion protection; 400 to 600 ft^2/gal. (9.8 to 14.7 m^2/L) for improving adhesion.	Dry through: 1 hour at ambient	• Airless Sprayer • Brush or Roller	Tip Size: 0.017 to 0.021", 8" to 10" fan width

*See Airless Spray Equipment Guidelines for information.

The Foster® Clean, Kill & Coat™ three-phased approach for mold remediation eliminates the chance for the return of mold.

Step 1. Clean

- Remove any water-damaged and mold contaminated materials that cannot be salvaged such as carpeting, furniture and wallboard.
- Thoroughly dry all materials to be left in place by exposing them to circulated dry air.
- Follow with a thorough cleaning and removal of all contaminants.

Step 2. Kill

- Sanitize the affected porous and non-porous surfaces with the ready-to-use, EPA-registered Foster® 40-80™ Disinfectant/Sanitizer to clean, deodorize and remove any residual microbial contaminants.
- The surface should remain wet for 10 minutes.

Step 3. Coat

- Coat the surface with the appropriate Foster brand protective coating evenly and thoroughly. We recommend an airless sprayer for an even application.
- Ventilate well for proper drying. Continue ventilation using appropriate fans, negative air machines or air scrubbers until odors are reduced to acceptable levels.
- Always ensure the use of PPE (Proper Protective Equipment).

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TDIndustries

VARIABLE FREQUENCY DRIVE

OPERATION AND APPLICATION OF VARIABLE FREQUENCY DRIVE (VFD) TECHNOLOGY

Carrier Corporation
Syracuse, New York

October 2005

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INTRODUCTION

Variable frequency drive (VFD) usage has increased dramatically in HVAC applications. The VFDs are now commonly applied to air handlers, pumps, chillers and tower fans. A better understanding of VFDs will lead to improved application and selection of both equipment and HVAC systems. This paper is intended to provide a basic understanding of common VFD terms, VFD operation, and VFD benefits. In addition this paper will discuss some basic application guidelines regarding harmonic distortion with respect to industry standards.

Common VFD Terms

There are several terms used to describe devices that control speed. While the acronyms are often used interchangeably, the terms have different meanings.

Variable Frequency Drive (VFD)
This device uses power electronics to vary the frequency of input power to the motor, thereby controlling motor speed.

Variable Speed Drive (VSD)
This more generic term applies to devices that control the speed of either the motor or the equipment driven by the motor (fan, pump, compressor, etc.). This device can be either electronic or mechanical.

Adjustable Speed Drive (ASD)
Again, a more generic term applying to both mechanical and electrical means of controlling speed.

This paper will discuss only VFDs.

VFD OPERATION

Understanding the basic principles behind VFD operation requires understanding the three basic sections of the VFD: the rectifier, dc bus, and inverter.

The voltage on an alternating current (ac) power supply rises and falls in the pattern of a sine wave (see Figure 1). When the voltage is positive, current flows in one direction; when the voltage is negative, the current flows in the opposite direction. This type of power system enables large amounts of energy to be efficiently transmitted over great distances.

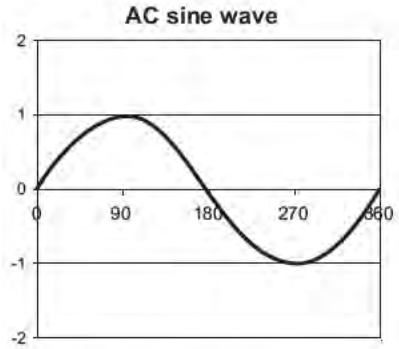

Fig. 1. AC sine wave

The **rectifier** in a VFD is used to convert incoming ac power into direct current (dc) power. One rectifier will allow power to pass through only when the voltage is positive. A second rectifier will allow power to pass through only when the voltage is negative. Two rectifiers are required for each phase of power. Since most large power supplies are three phase, there will be a minimum of 6 rectifiers used (see Figure 2). Appropriately, the term "**6 pulse**" is used to describe a drive with 6 rectifiers. A VFD may have multiple rectifier sections, with 6 rectifiers per section, enabling a VFD to be "**12 pulse,**" "**18 pulse**," or "**24 pulse.**" The benefit of "*multi-pulse*" VFDs will be described later in the harmonics section.

Rectifiers may utilize diodes, silicon controlled rectifiers (SCR), or transistors to rectify power. Diodes are the simplest device and allow power to flow any time voltage is of the proper polarity. Silicon controlled rectifiers include a gate circuit that enables a microprocessor to control when the power may begin to flow, making this type of rectifier useful for solid-state starters as well. Transistors include a gate circuit that enables a microprocessor to open or close at any time, making the transistor the most useful device of the three. A VFD using transistors in the rectifier section is said to have an "**active front end.**"

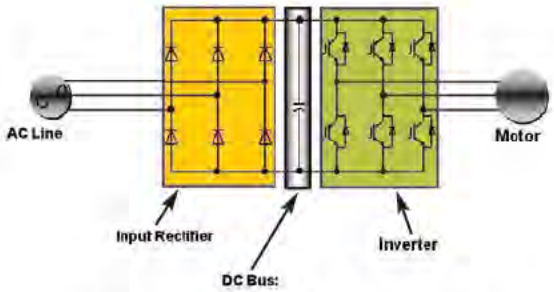

Fig. 2. VFD basics: Existing technology

After the power flows through the rectifiers it is stored on a **dc bus**. The dc bus contains capacitors to accept power from the rectifier, store it, and later deliver that power through the inverter section. The dc bus may also contain inductors, dc links, chokes, or similar items that add inductance, thereby smoothing the incoming power supply to the dc bus. The final section of the VFD is referred to as an "**inverter.**" The inverter contains transistors that deliver power to the motor. The "**Insulated Gate Bipolar Transistor**" (IGBT) is a common choice in modern VFDs. The IGBT can switch on and off several thousand times per second and precisely control the power delivered to the motor. The IGBT uses a method named "**pulse width modulation**" (PWM) to simulate a current sine wave at the desired frequency to the motor.

Motor speed (rpm) is dependent upon frequency. Varying the frequency output of the VFD controls motor speed:

Speed (rpm) = frequency (hertz) x 120 / no. of poles

Example:

2-pole motor at different frequencies
3600 rpm = 60 hertz x 120 / 2 = 3600 rpm
3000 rpm = 50 hertz x 120 / 2 = 3000 rpm
2400 rpm = 40 hertz x 120 / 2 = 2400 rpm

BENEFITS OF VFD

As VFD usage in HVAC applications has increased, fans, pumps, air handlers, and chillers can benefit from speed control. Variable frequency drives provide the following advantages:

- energy savings
- low motor starting current
- reduction of thermal and mechanical stresses on motors and belts during starts
- simple installation
- high power factor
- lower KVA

Understanding the basis for these benefits will allow engineers and operators to apply VFDs with confidence and achieve the greatest operational savings.

VFD Capacity Control Saves Energy

Most applications do not require a constant flow of a fluid. Equipment is sized for a peak load that may account for only 1% of the hours of operation. The remaining hours of operation need only a fraction of the flow. Traditionally, devices that throttle output have been employed to reduce the flow. However, when compared with speed control, these methods are significantly less efficient.

Mechanical Capacity Control

Throttling valves, vanes, or dampers may be employed to control capacity of a constant speed pump or fan. These devices increase the head, thereby forcing the fan or pump to ride the curve to a point where it produces less flow (Figure 3). Power consumption is the product of head and flow. Throttling the output increases head, but reduces flow, and provides some energy savings.

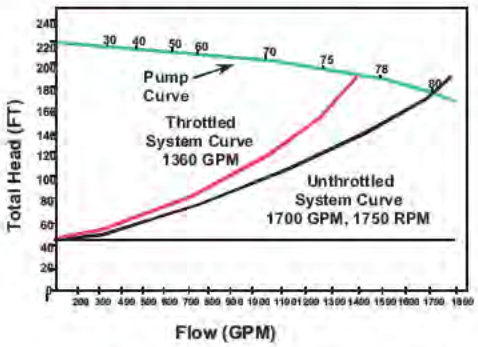

Fig. 3. Mechanical capacity control

Pump power ~ flow x head / 3960[1]

Variable Speed Capacity Control

For centrifugal pumps, fans and compressors, the ideal fan (affinity) laws describe how speed affects flow, head and power consumption (Table A).

When using speed to reduce capacity, both the head and flow are reduced, maximizing the energy savings. A comparison of mechanical and speed control for capacity reduction (Figure 4) shows that variable speed is the most efficient means of capacity control.

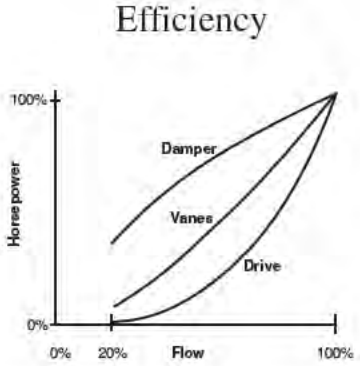

Fig. 4. Comparison of mechanical capacity control and speed capacity control

Table A
Effects of Changes in Fan Speed

Flow changes linearly with speed	$Flow\ Rate_2 = Flow\ Rate_1 \times (RPM_2/RPM_1)$
Head varies as the speed squared	$Lift_2 = Lift_1 \times (RPM_2/RPM_1)^2$
Power varies as the speed cubed	$Power_2 = Power_1 \times (RPM_2/RPM_1)^3$

[1] Assumes fluid is fresh water, (specific gravity = 1).

Low Inrush Motor Starting

Motor manufacturers face difficult design choices. Designs optimized for low starting current often sacrifice efficiency, power factor, size, and cost. With these considerations in mind, it is common for AC induction motors to draw 6 to 8 times their full load amps when they are started across the line. When large amounts of current are drawn on the transformers, a voltage drop can occur[2], adversely affecting other equipment on the same electrical system. Some voltage sensitive applications may even trip off line. For this reason, many engineers specify a means of reducing the starting current of large AC induction motors.

Soft Starters

Wye-delta, part winding, autotransformer, and solid-state starters are often used to reduce inrush during motor starting. All of these starters deliver power to the motor at a constant frequency and therefore must limit the current by controlling the voltage supplied to the motor. Wye delta, part winding, and auto-transformer starters use special electrical connections to reduce the voltage. Solid-state starters use SCRs to reduce the voltage. The amount of voltage reduction possible is limited because the motor needs enough voltage to generate torque to accelerate. With maximum allowable voltage reduction, the motor will still draw two to four times the full load amps (FLA) during starting. Additionally, rapid acceleration associated with wye-delta starters can wear belts and other power transmission components.

VFDs as Starters

A VFD is the ideal soft starter since it provides the lowest inrush of any starter type as shown in Table B. Unlike all other types of starters, the VFD can use frequency to limit the power and current delivered to the motor. The VFD will start the motor by delivering power at a low frequency. At this low frequency, the motor does not require a high level of current. The VFD incrementally increases the frequency and motor speed until the desired speed is met. The current level of the motor never exceeds the full load amp rating of the motor at any time during its start or operation. In addition to the benefit of low starting current, motor designs can now be optimized for high efficiency.

Table B
Comparison of Starter Types Based on Inrush

Starter Type	Starting Current (% of FLA)
VFD	100%
Wye-Delta Starter	200-275%
Solid State Soft Starter	200%
Autotransformer Starter	400-500%
Part Winding Starter	400-500%
Across the Line Starter	600-800%

Easy Installation

Many pieces of equipment are factory shipped with unit mounted VFDs that arrive pre-programmed and factory wired. Motor leads, control power for auxiliaries, and communication lines are all factory wired. The VFD cooling lines on unit-mounted chiller VFDs are also factory installed. The installing contractor needs only to connect the line power supply to the VFD.

High Power Factor

Power converted to motion, heat, sound, etc. is called real power and is measured in kilowatts (kW). Power that charges capacitors or builds magnetic fields is called reactive power and is measured in Kilovolts Amps Reactive (kVAR). The vector sum of the kW and the kVAR is the Total Power (energy) and is measured in Kilovolt Amperes (KVA) (Figure 5). Power factor is the ratio of kW/KVA.

Motors draw reactive current to support their magnetic fields in order to cause rotation. Excessive reactive current is undesirable because it creates additional resistance losses and can require the use of larger transformers and wires. In addition, utilities often penalize owners for low power factor. Decreasing reactive current will increase power factor.

[2] This is a significant consideration for "soft" systems such as backup generators.

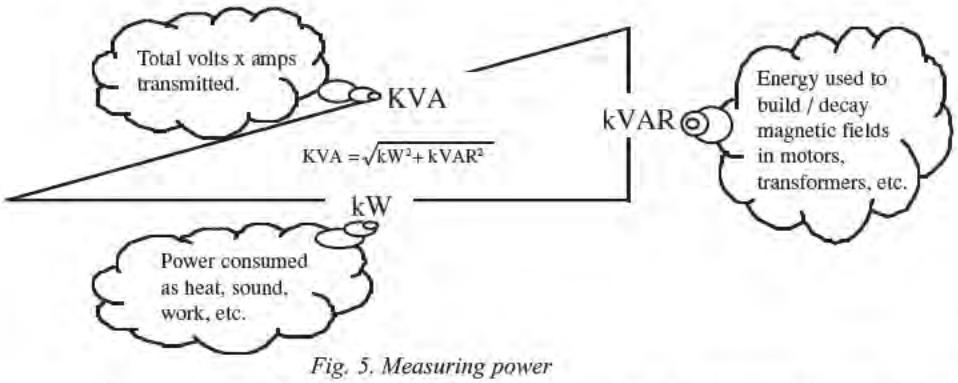

Fig. 5. Measuring power

Typical AC motors may have a full load power factor ranging from 0.84 to 0.88. As the motor load is reduced, the power factor becomes lower. Utilities may require site power factor values ranging from 0.85 to 0.95 and impose penalties to enforce this requirement. Power factor correction capacitors can be added to reduce the reactive current measured upstream of the capacitors and increase the measured power factor. To prevent damage to the motor, power factor correction capacitors should not exceed the motor manufacturer's recommendations. In most cases, this results in maximum corrected values of 0.90 to 0.95.

The VFDs include capacitors in the DC Bus that perform the same function and maintain high power factor on the line side of the VFD. This eliminates the need to add power factor correction equipment to the motor or use expensive capacitor banks. In addition, VFDs often result in higher line side power factor values than constant speed motors equipped with correction capacitors.

Low Full Load KVA

Total Power (KVA) is often the limiting factor in the amount of energy that can be transmitted through an electrical device or system. If the KVA required by equipment can be reduced during periods of peak demand, it will help alleviate voltage sags, brown outs, and power outages. The unit efficiency and power factor are equally weighted when calculating KVA. Therefore, equipment that may be equal or worse in efficiency, but higher in power factor has significantly lower KVA (Table C).

In this example, equipment with a higher power factor uses 15% less KVA while performing the same job. This can lower electrical system cost on new projects and free up KVA capacity on existing systems.

Table C
Power Factors and Energy Usage

Input kW	Power Factor	Amps	Volts	KVA
350.4	.84	502	Nominal 480	417
350.4	.99	426	Nominal 480	354

NOTE: KVA = Volts x Amps x 1.732

Backup generators are typically sized to closely match the load. Lowering KVA can reduce the size of the generator required. When VFDs with active front ends are used, the generator size can approach an ideal 1:1 ratio of kW/KVA because the power factor is near unity (1.0) and the harmonics produced by the VFD are extremely low.

Lower KVA also benefits utilities. When the power factor is higher, more power (kW) can be delivered through the same transmission equipment.

HARMONIC DISTORTION AND INDUSTRY STANDARDS

A discussion of the benefits of VFDs often leads to a question regarding harmonics. When evaluating VFDs, it is important to understand how harmonics are provided and the circumstances under which harmonics are harmful.

Harmonic Definition

In the United States, three-phase AC power typically operates at 60 hertz (60 cycles in one second). This is called the **fundamental frequency**.

A **harmonic** is any current form at an integral multiple of the fundamental frequency. For example, for 60-hertz power supplies, harmonics would be at 120 hertz (2 x fundamental), 180 hertz, 240 hertz, 300 hertz, etc.

What Causes Harmonics?

VFDs draw current from the line only when the line voltage is greater than the DC Bus voltage inside the drive. This occurs only near the peaks of the sine wave. As a result, all of the current is drawn in short intervals (i.e., at higher frequencies). Variation in VFD design affects the harmonics produced. For example, VFDs equipped with DC link inductors produce different levels of harmonics than similar VFDs without DC link inductors. The VFDs with active front ends utilizing transistors in the rectifier section have much lower harmonic levels than VFDs using diodes or silicon controlled rectifiers (SCRs).

Electronic lighting ballasts, uninterruptible power supplies, computers, office equipment, ozone generators, and other high intensity lighting are also sources of harmonics.

Rocks and Ponds

Obviously, the magnitude of the contributing wave forms has an effect on the shape of the resultant wave form. If the fundamental wave form (60 Hz) has a very large magnitude (5,000 amps) and the harmonic wave forms are very low (10 amps), then the resultant wave form will not be very distorted and total harmonic distortion will be low. If the harmonic wave form current value is high relative to the fundamental, the effect will be more dramatic.

In nature, we see this effect with waves in water. If you continually throw baseball size rocks into the ocean, you would not expect to change the shape of the waves crashing onto the beach. However, if you threw those same size rocks into a bathtub, you would definitely observe the effects. It is similar with electrical waves and harmonics.

When you calculate harmonics you are calculating the effect of the harmonics on the fundamental current wave form in a particular distribution system. There are several programs that can perform estimated calculations. All of them take into account the amount of linear loads (loads drawing power through out the entire sine wave) relative to non-lin ear loads (loads drawing power during only a fraction of the sine wave). The higher the ratio of linear loads to non-linear loads, the less effect the non-linear loads will have on the current wave form.

Are Harmonics Harmful?

Harmonics that are multiples of 2 are not harmful because they cancel out. The same is true for 3rd order harmonics (3rd, 6th, 9th etc.). Because the power supply is 3 phase, the third order harmonics cancel each other out in each phase [3]. This leaves only the 5th, 7th, 11th, 13th etc. to discuss. The magnitude of the harmonics produced by a VFD is greatest for the lower order harmonics (5th, 7th and 11th) and drops quickly as you move into the higher order harmonics (13th and greater).

Harmonics can cause some disturbances in electrical systems. Higher order harmonics can interfere with sensitive electronics and communications systems, while lower order harmonics can cause overheating of motors, transformers, and conductors. The opportunity for harmonics to be harmful, however, is dependent upon the electrical system in which they are present and whether or not any harmonic sensitive equipment is located on that same electrical system.

Understanding IEEE 519

IEEE (Institute of Electrical and Electronics Engineers) created a recommendation for evaluating harmonics. The IEEE-519 standard provides recommended limits for harmonic distortion measured at the point of common coupling. The point of common coupling is the point at which the customer's electrical system is connected to the utility.

[3] The neutral wire sizing should account for 3rd order harmonic current.

Although the IEEE standard recommends limits for both voltage distortion and current distortion, specifications that reference a 5% harmonic limitation are generally referring to current distortion. In most cases, if the current distortion falls within IEEE-519 requirements, the voltage distortion will also be acceptable.

Determining compliance with IEEE-519 requires an actual measurement of the system during operation. Predicting compliance in advance often requires a system study that accounts for all electrical equipment (transformers, wires, motors, VFDs, etc.) in the system.

Introduction To Harmonic Terms

Total Harmonic Voltage Distortion - THD (V)

As harmonic currents flow through devices with reactance or resistance, a voltage drop is developed. These harmonic voltages cause voltage distortion of the fundamental voltage wave form. The total magnitude of the voltage distortion is the THD (V). The IEEE-519 standard recommends less than 5% THD (V) at the point of common coupling for general systems 69 kV and under.

Total Harmonic Current Distortion - THD (I)

This value (sometimes written as THID) represents the total harmonic current distortion of the wave form at the particular moment when the measurement is taken. It is the ratio of the harmonic current to the fundamental (non-harmonic) current measured for that load point. Note that the denominator used in this ratio changes with load.

Total Demand Distortion - TDD

Total Demand Distortion (TDD) is the ratio of the measured harmonic current to the full load fundamental current. The full load fundamental current is the total amount of non-harmonic current consumed by all of the loads on the system when the system is at peak demand. The denominator used in this ratio does not change with load. Although TDD can be measured at any operating point (full or part load), the worst case TDD will occur at full load. If the full load TDD is acceptable, then the TDD measured at part load values will also be acceptable. To use our rock analogy, the full load fundamental current is the size of our pond and the harmonic current is the size of our rock. (See Table D.)

Table D
Comparison of TDD and THD(I)

Fundamental Current (rms)	Harmonic Current (rms)	THD(I)	TDD
1000	50	5%	5%
800	43.8	5.4%	4.4%
600	36.3	6.1%	3.6%
400	29.7	7.4%	3.0%
200	20.0	10%	2%
100	13.4	13.4%	1.3%

TDD - Total Demand Distortion
THD(I) - Total Harmonic Current Distortion

Short Circuit Ratio

Short circuit ratio is the short circuit current value of the electrical system divided by its maximum load current. Standard IEEE-519 Table 10.3 defines different acceptance levels of TDD depending on the short circuit ratio in the system. Systems with small short circuit ratios have lower TDD requirements than systems with larger short circuit ratios. This difference accounts for the fact that electrical systems with low short circuit ratios tend to have high impedances, creating larger voltage distortion for equivalent harmonic current levels. (See Table E.)

Mitigating Harmonics

Some utilities now impose penalties for introducing harmonics onto their grid, providing incentives for owners to reduce harmonics. In addition, reducing harmonic levels can prevent potential damage to sensitive equipment residing on the same system. There are many approaches to mitigating harmonics. Several commonly used methods are discussed here.

Line Reactors

Line reactors add reactance and impedance to the circuit. Reactance and impedance act to lower the current magnitude of harmonics in the system and thereby lower the TDD. Line reactors also protect

Table E
Representation of IEEE Table 10.3

I_{SC}/I_L	<11	11<7<17	17<h<23	23<h<35	35<h	TDD
<20	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

LEGEND: h = harmonic number
I_{SC} = maximum short-circuit current at PCC
I_L = maximum demand load current (fundamental) at PCC

devices from large current spikes with short rise times. A line reactor placed between the VFD and the motor would help protect the motor from current spikes. A line reactor placed between the supply and VFD would help protect the supply from current spikes. Line reactors are typically only used between the VFD and the motor when a freestanding VFD is mounted more than fifty feet from the motor. This is done to protect the motor windings from voltage peaks with extremely quick rise times.

Passive Filters

Trap Filters are devices that include an electrical circuit consisting of inductors, reactors, and capacitors designed to provide a low impedance path to ground at the targeted frequency. Since current will travel through the lowest impedance path, this prevents the harmonic current at the targeted frequency from propagating through the system. Filters can be mounted inside the drive cabinet or as free standing devices. Trap filters are typically quoted to meet a THD(I) value that would result in compliance with IEEE-519 requirements if the system were otherwise already in compliance.

Active Filters

Some devices measure harmonic currents and quickly create opposite current harmonic wave forms. The two wave forms then cancel out, preventing harmonic currents from being observed upstream of the filter. These types of filters generally have excellent harmonic mitigation characteristics. Active filters may reduce generator size requirements.

VFDs Using Active Front End Technology (AFE)

Some VFDs are manufactured with IGBT rectifiers. The unique attributes of IGBTs allow the VFD to actively control the power input, thereby lowering harmonics, increasing power factor and making the VFD far more tolerant of supply side disturbances. The AFE VFDs have ultra low harmonics capable of meeting IEEE-519 standards without any external filters or line reactors. This significantly reduces installation cost and generator size requirements. An AFE drive provides the best way to take advantage of VFD benefits and minimize harmonics.

Multi-Pulse VFDs (Cancellation)

There are a minimum of six rectifiers for a three-phase AC VFD. There can be more, however. Manufacturers offer 12, 18, 24, and 30 pulse drives. A standard six-pulse drive has six rectifiers, a 12-pulse drive has two sets of six rectifiers, an 18-pulse drive has three sets of six rectifiers and so on. If the power connected to each set of rectifiers is phase shifted, then some of the harmonics produced by one set of rectifiers will be opposite in polarity from the harmonics produced by the other set of rectifiers. The two wave forms effectively cancel each other out. In order to use phase shifting, a special transformer with multiple secondary windings must be used. For example, with a 12-pulse VFD, a Delta/Delta-Wye transformer with each of the secondary phases shifted by 30 degrees would be used.

CONCLUSION

- **VFDs provide the most energy efficient means of capacity control.**
- **VFDs have the lowest starting current of any starter type.**
- **VFDs reduce thermal and mechanical stresses on motors and belts.**
- **VFD installation is as simple as connecting the power supply to the VFD.**
- **VFDs with AFE technology can meet even the most stringent harmonic standards and reduce backup generator sizing.**
- **VFDs provide high power factor, eliminating the need for external power factor correction capacitors.**
- **VFDs provide lower KVA, helping alleviate voltage sags and power outages.**

NOTE: It is the responsibility of the user to evaluate the accuracy, completeness or usefulness of any content in this paper. Neither Carrier nor its affiliates make any representations or warranties regarding the content contained in this paper. Neither Carrier nor its affiliates will be liable to any user or anyone else for any inaccuracy, error or omission, regardless of cause, or for any damages resulting from any use, reliance or reference to the content in this paper.

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ATTACHMENT J

SULZER

Dunbar Field Life extended using Sulzer Multiphase Pumps

"The advent of high power multiphase pumps is changing the world of oil production, in particular by allowing the exploitation of fields nearing the end of their useful lives. This revolutionary technique has been operated since Autumn 1999 on the Dunbar platform, in the British segment of the North Sea"

TOTALFINA ELF Exploration & Production Magazine March 2001

Sulzer Multiphase Pumps

- The Sulzer MPP range of pumps are of the helico-axial design originally developed from the Poseidon research programme.
- Pumps of this design are particularly well suited to high capacities. Current installations include pumps with a total capacity of over 500,0000 bpd

The role of Multiphase Pumping

Multiphase Pumping is essentially a means of adding energy to the unprocessed effluent which enables gas/liquid mixtures to be transported over longer distances without the need for prior phase separation. This also enables the wells to produce at a lower WHFP (Wellhead Flowing Pressure) and so consequently :

- The production from existing fields and weak wells is increased
- Ultimate recovery is increased
- Life of a field can be extended.
- Development costs are reduced

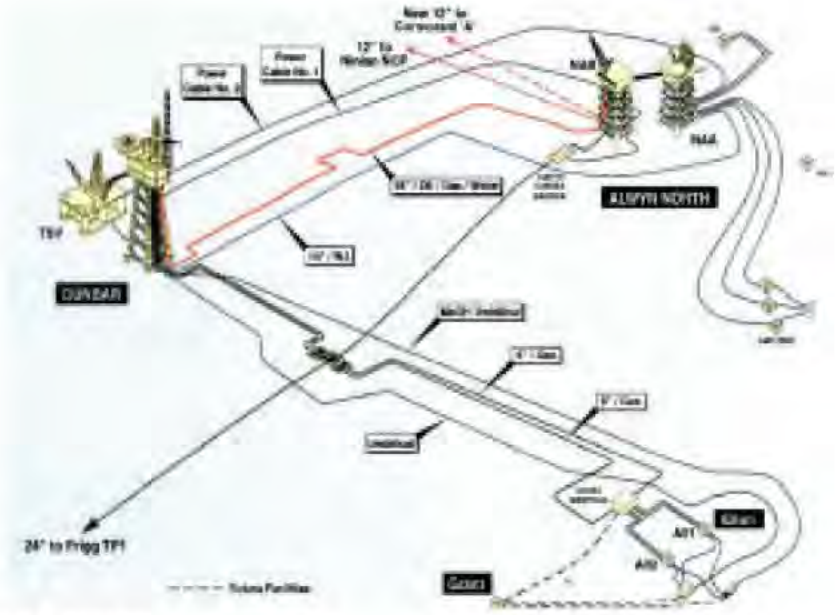
The Dunbar development is an example which demonstrates how these benefits have been realised in the field.

The Dunbar Field

The Dunbar field is located 120 km North East of the Shetland Islands and 440 km from Aberdeen. Dunbar is a wellhead platform which is operated as a satellite of the Alwyn North Platform located 22 km to the North East.

In the first phase of production the wellhead pressure was sufficient for the effluent to flow naturally from Dunbar fields along a 16" multiphase pipeline to the Alwyn platform.

The introduction of multiphase pumps on Dunbar for the second phase has enabled production to continue in the face of declining wellhead pressure.



The Dunbar field

Why multiphase pumps

The two main alternatives considered for the second production phase were :

Firstly a conventional system comprising a separator operated at low pressure with the liquids pumped and the gas compressed upstream of the multiphase pipeline

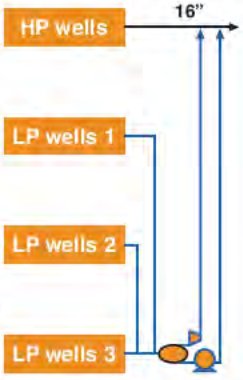
Secondly an innovative system using multiphase pumps to boost the low pressure wells directly in into the multiphase pipeline.

Multiphase pumps were selected in preference to a separator based solution because :

- There would be no need to modify the existing facilities or process operating conditions
- They provide a more cost effective solution
- A module incorporating multiphase pumps would be over 30% lighter
- Vertically installed pumps minimised space requirements
- Weight and space reductions would facilitate the design of the proposed cantilevered module extension

Operational flexibility maximised by implementing a well segregation scheme using multiphase pumps

Concentional concept



Well segregation scheme

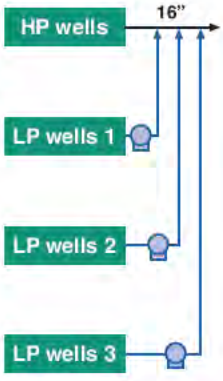
This scheme makes maximum use of the natural energy of the wells which means that electrical power requirements are minimised.

There are three independent lines

- High pressure wells bypass the pumps
- LP wells will be boosted from approx 70 to 125 bar.g via an 8 stage pump
  Note : Both pumps are identical although the pump in this line is destaged to 8 stages
- LLP wells will be boosted from approx 50 to 125 bar.g via a 12 stage pump
- There is also provision for a third pump for even lower pressure wells (20-30 bar.g)

This system therefore matches pumping requirements to evolving and fluctuating production requirements

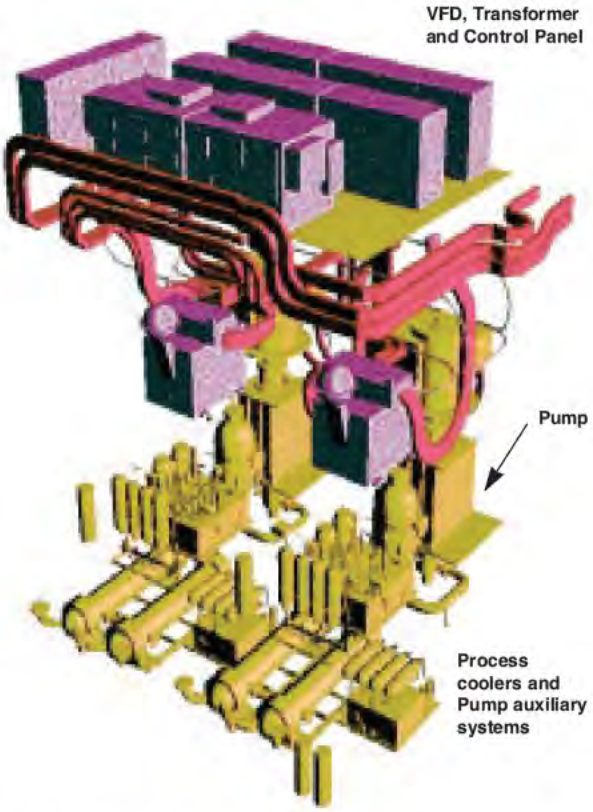
TotalFina Elf estimate that by 2004, approximately 84% of the oil production will be boosted



Well segregation scheme

The pumpset packages were supplied by a consortium between Sulzer and ABB (who were responsible for the electrical equipment. Each pumpset comprises the following main items

- Process Cooler (by TotalFinaElf)
- Buffer tank at pump suction
- Multiphase Pump
- Epicyclic gearbox
- Lube oil and seal oil systems
- Electric motor
- Frequency converter
- Transformer
- Anti-harmonic filters



Main Pumpset Components

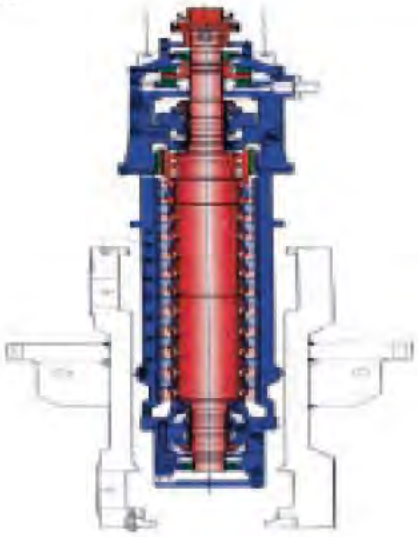
Pump Description

Total Capacity	**180,000 bpd**
GVF	**30 – 90%**
Suction Pressure	**50 – 70 Bar.g**
Discharge Pressure	**125 Bar.g**
Speed Range	**3,500 to 6,000 rpm**
Motor Rating	**4500 kW**

Pump design features include:

- Vertical barrel installation
- Axially split inner casing
- Twistlock design
- Tilting pad bearings
- Balance piston

These are the largest multi-phase pumps installed offshore world wide.

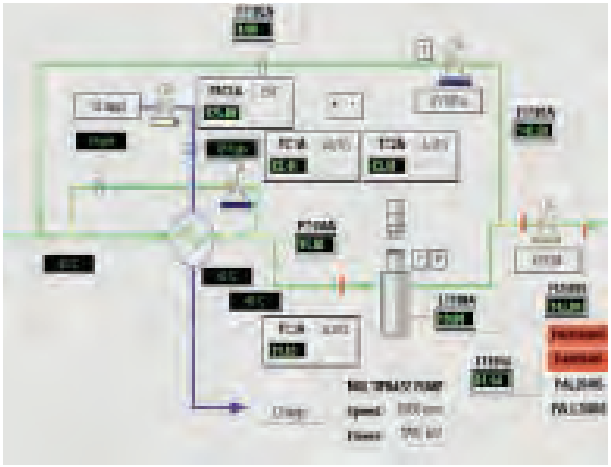


Cartridge replacement

- Twistlock casing design facilitates cartridge withdrawal.
- Cartridges of different hydraulic design or stage combinations can be fitted to suit evolving production requirements

Pumpset Control

- The pump speed is adjusted via the frequency converter to suit process and export requirements.
- The pump is designed for use on an unmanned installation. Pump monitoring and speed control can be effected remotely from Alwyn



Installation

The pump was incorporated into the module at the fabrication yard. The module measures 12m x 7.5m x 19m high and weighs 650 tonnes.The module was installed on the platform in the summer of 1999 and the pumps commissioned in November of the same year.

Since the pumps were commissioned, the pressure in certain wells has declined further. To compensate for this, the pump in the LP line has since been uprated to 12 stages.

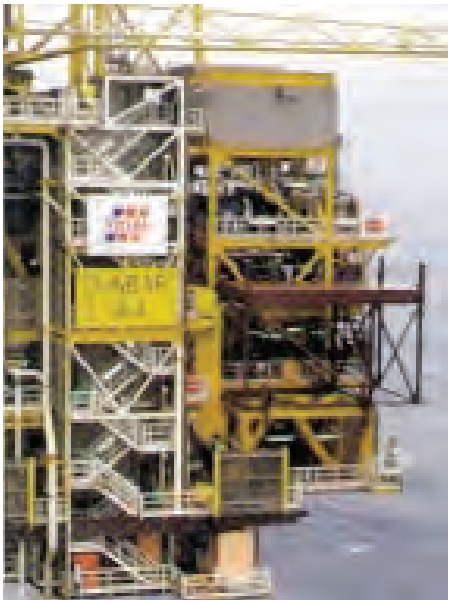
Field Reserves significantly increased

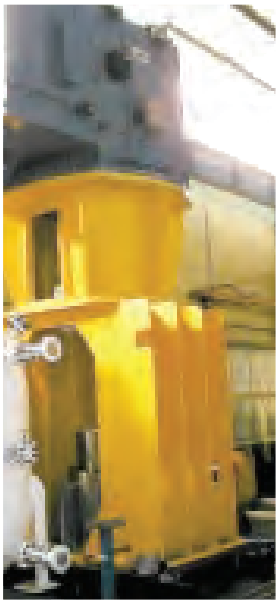
The importance of this multiphase pump installation is demonstrated by TotalFinaElf's estimate that the impact on production from the Dunbar field will be as follows :

"**Key Figures :**

- Estimated Reserves in 1986 : 435 million bep
- Reserves re-assesses in 1994 at 700 bep
- Estimated reserves in 2001 owing to multiphase pumps; 1.2 billion bep"

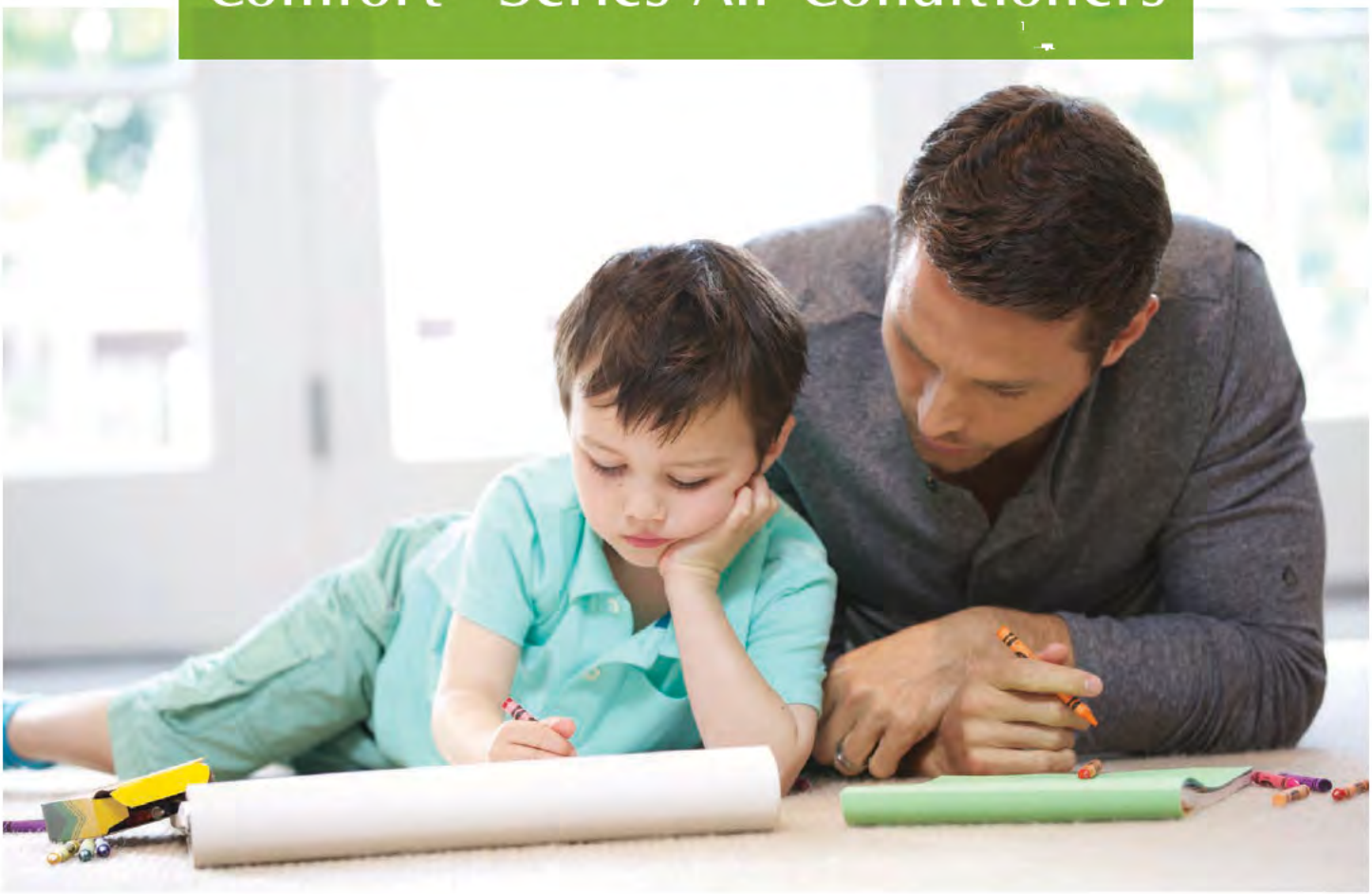
TOTALFINA ELF Exploration & Production Magazine
March 2001





Carrier®
turn to the experts™

Comfort™ Series Air Conditioners



Proven, reliable comfort, up to 16.5 SEER rating

ENERGY STAR LEARN MORE AT energystar.gov Qualifying Models Only

24AAA6, 24ABC6, 24AAA5, 24ACC4, 24ABB3, 24ABB3**C

TDIndustries

What You Can Expect From Carrier

Innovation, efficiency, quality: Carrier® Comfort™ Series air conditioners represent years of research and design with one goal in mind – making your family comfortable. With standard models and units designed specifically for the rigors of coastal area installations, Comfort Series air conditioners represent the Carrier quality, environmental stewardship and lasting durability that have endured for more than a century. And, to ensure maximum year-round performance, your dealer can include a new Carrier gas furnace or fan coil and thermostat, all backed by the indoor comfort experts.

Efficiency

SEER (Seasonal Energy Efficiency Ratio) ratings are like your car's MPG – the higher the number, the greater the potential for savings. Comfort™ Series air conditioners offer a range of efficiencies that start at your region's minimum SEER and reach as high as 16.5 SEER.

Durability

A galvanized steel cabinet, heavy-duty wire coil guard and baked-on powder paint provide superior protection against dings, dents and other outdoor threats. For home comfort in a coastal environment, ask about Comfort™ Series models with WeatherShield™ protection for extra-tough, longer lasting corrosion resistance to withstand the harsh sea coast air.

Environment

Carrier was the first to offer systems with Puron® refrigerant, which does not contribute to ozone depletion. Our century-plus commitment to delivering energy-saving comfort continues with our insistence on earning ENERGY STAR® designation on most of our Comfort™ Series air conditioners.

Sound

Carrier® Comfort™ Series air conditioners cool your home quietly. All models include components that help keep sound levels low, including an aerodynamic top and quiet motor mounts.

Limited Warranty

To the original owner, Carrier® Comfort™ Series air conditioners are covered by a 10-year parts limited warranty upon timely registration. The limited warranty period is five years if not registered within 90 days of installation. Jurisdictions where warranty benefits cannot be conditioned on registration will receive the registered limited warranty period. See warranty certificate at carrier.com for complete details and restrictions.

Regional Efficiency Standards

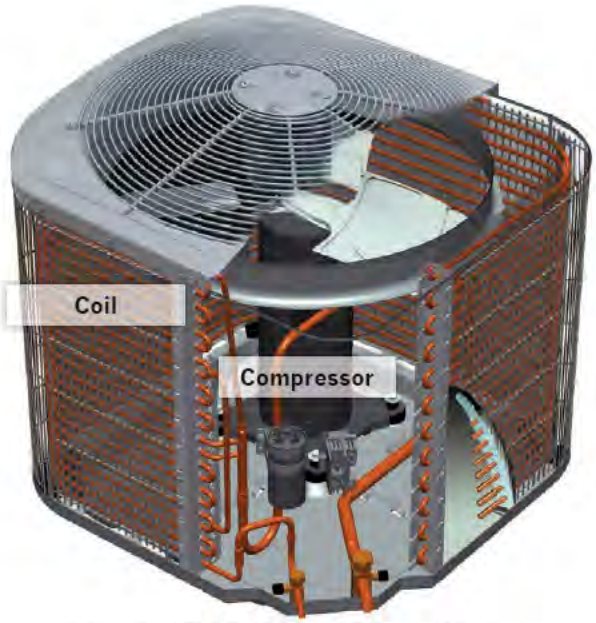
On January 1, 2015, a new set of minimum efficiency standards took effect. Under the new standards, there are different efficiency minimums for air conditioners in each of three regions – North, Southeast and Southwest. Your Carrier® dealer will have a Comfort™ Series air conditioner to meet your region's minimum requirement.

A Range of Comfort

Carrier delivers cooling systems in a range of shapes and sizes. Check out this side-by-side comparison to see how our efficient Comfort™ Series air conditioners measure up against our Infinity® and Performance™ models.

	Infinity® Series	Performance™ Series	Comfort™ Series
Performance	Variable-speed rotary, two-stage and single-stage scroll compressors available	Two-stage and single-stage scroll compressors available	Single-stage scroll compressor
Efficiency	Up to 21.0 SEER rating	Up to 17.5 SEER rating	Up to 16.5 SEER rating
Durability	WeatherArmor™ Ultra cabinet protection	WeatherArmor™ Ultra cabinet protection	WeatherArmor™ cabinet protection
Controls	Infinity® Touch Control	Côr™ Wi-Fi® Thermostat	Carrier® Wi-Fi® Thermostat
Sound	Silencer System II™, dBA as low as 56	Silencer System II™, dBA as low as 72	dBA as low as 72
Limited Warranty	10-year parts*	10-year parts*	10-year parts*

* Upon timely registration. The warranty period is five years if not registered within 90 days of installation.
Wi Fi® is a registered trademark of the Wi Fi Alliance Corporation.



Comfort™ 16 Air Conditioner Shown

The Carrier® Difference

If you could look under the hood of a Carrier Comfort™ Series air conditioner, you'd see what drives the performance: a serious commitment to quality. Our microtube coil technology saves space and provides lasting comfort with its corrosion-resistant construction. And, our smooth-running compressor represents the solid, reliable performance you expect.

Comfort Series air conditioners are built to look their best while enduring exposure to hail, errant soccer balls, lawn equipment and more. The cabinet plays an important role in sound as well, using an aerodynamic top to facilitate airflow and keep operating sound to a minimum.

Visit carrier.com for model comparisons and product specifications.
Explore the full line of Carrier® air conditioners and other system components to find the ideal fit for your home.
24AAA6, 24ABC6, 24AAA5, 24ACC4, 24ABB3, 24ABB3**C

The Total Indoor Comfort System

Your Carrier® dealer will recommend a system that is best suited to meet your home-comfort needs and local weather environment:

1. **Air Conditioner** provides reliable, high-efficiency cooling for long-lasting comfort and energy savings.
2. **Gas Furnace** provides reliable, high-efficiency heating for long-lasting comfort and energy savings.
3. **Wi-Fi® Thermostat** offers precise, programmable comfort from your web-connected device.
4. **Zoning** sets different temperatures for up to three different areas of your home for truly customized comfort and enhanced utility savings.
5. **Air Cleaner** improves air quality by removing harmful and irritating airborne pollutants from your home.
6. **Humidifier** replenishes moisture to dry air.
7. **UV Lamp** inhibits the growth of contaminants on the evaporator coil, leaving your home with cleaner, fresher indoor air.
8. **Ventilator** combines fresh outdoor air with conditioned indoor air for improved air quality – great for today's tightly constructed home.
9. **Evaporator Coil** is matched with the proper outdoor unit to provide top cooling efficiency and years of reliable service.

More Than a Century of Cool

In 1902, a determined engineer answered one of mankind's most nagging questions: How do we make hot, sticky, indoor air go away? In creating the world's first modern air conditioning system, Willis Carrier forever changed indoor life, and, more than a century later, the corporation that bears his name takes inspiration from his example.

Carrier continues to improve on our founder's breakthroughs, introducing new technologies that make life at home even cooler. Today, our nationwide network of experts continues to advance Willis Carrier's lifework. Your expert Carrier® dealer is equipped to evaluate your home and create a customized system designed around your lifestyle.

As an ENERGY STAR® partner, Carrier Corporat on has determined that qualifying models meet ENERGY STAR guidelines for energy eff c ency. Ask your dealer for details or visit www energystar.gov.

Carrier® turn to the experts

Comfort SERIES

01-824-083-25

carrier.com 1-800-CARRIER

ATTACHMENT L

Foster™

Mold Remediation and Prevention Products

The Foster® brand offers mold resistant solutions for every environment...

- Houses & Condos
- Apartment Buildings
- Healthcare/Hospital Facilities
- Manufacturing Facilities
- Food & Beverage Plants
- Schools
- Universities
- Office Buildings
- Retail Buildings
- High Humidity Areas
- Existing Construction

... and all types of surfaces...

- Walls
- Ceilings
- HVAC Systems
- Wall Cavities
- Underside of Floorings
- Basements
- Crawl Spaces
- Roofs
- Siding
- Asphalt Shingles

Foster™

A World Leader

For over 60 years, the Foster® brand of products have been leading the way with its mastic, coating, sealant and adhesive products for the industrial, commercial and residential construction markets. Foster introduced the first EPA-registered antimicrobial coating, and still the only, for use in HVAC systems in 1992 and has continued to manufacture and sell water-based coatings, disinfectants and accessory products for mold remediation and prevention to the indoor air quality market. Our reputation has been built on the best technical expertise driving the best technology for superior performing products.

When tested against rigorous American Standards Testing Method (ASTM) D-5590, Foster products exhibit a "0" growth rate (see next page for more information). This means Foster products have proven performance and superior efficacy that truly work!

As a leader in the IAQ industry, the Foster brand product line includes:

- EPA-Registered Antimicrobial Products
- Mold Resistant Products
- Disinfectant/Sanitizer
- Accessory Products

For additional information, please visit **www. fosterproducts.com**.

EPA-Registered Antimicrobial Products

Our customers come first, and our ability to meet their needs is the key to our success.

Foster® products are "Globally Specified, Proven, and Preferred" by IAQ professionals around the world. Specifically, our antimicrobial coatings are ideal for use in buildings and locations where mold already exists, or may potentially exist. These products have been successfully used in the field as the number one mold resistant coatings since 1992. Both of our EPA-Registered mold resistant coatings (Foster® 40-20™ and Foster® 40-30™) are the only coatings registered for use both in HVAC systems and on walls/ceilings.

Solutions that Work!

The cost of remediating a mold-infested building can be staggering, especially when it may be repeated due to mold growth on an inferior coating. When applied to lined and unlined HVAC systems, walls, sub floors, and studs, Foster EPA-Registered fungicidal coatings provide long-term protection by preventing the growth and spread of odor causing bacteria and mold on the coating surface.

The samples at the right show standard untreated house paint (above) vs. Foster coating (below). The Foster 40-20 coating is free of mold!

Mold covers the control sample completely

Mold growth is inhibited on the Foster® 40-20™ coating.

Foster® Coatings Proven Effective 15 Years and Running . . .

Regardless of the job, Foster 40-20 offers the highest level of resistance to mold growth on its surface while protecting the substrate from deterioration. It is the first and only EPA-registered coating for application in HVAC duct work, as well as on walls, ceilings, pipes or wherever effective controls are essential. Foster 40-20 provides a flexible, tough film that remains clean while retarding fiber release and further erosion of the duct insulation. Over the past 15 years, Foster 40-20 has been extensively specified and used in numerous mold remediation projects. In one study, when used in the duct system of a prominent maximum security prison, Foster 40-20 has remained fully effective since 1992.

Visit www. fosterproducts.com for the full case study, and the use of Foster 40-20 in other remediation situations.

EPA-REGISTERED PRODUCTS

There are 3 antimicrobial products registered with the EPA: Foster® 40-20™ coating, Foster® 40-30™ coating, and Foster® 40-80™ disinfectant. These products have all gone through rigorous independent testing, required by the EPA. Both the Applicator and End User can be assured of:

Low Toxicity
These products have been fully tested for toxicity and labeled with the lowest possible toxicity warning of "caution."

Accurate Claims
Fact based—there are no misleading claims to the consumers.

Testing
These products have been tested by an independent lab for both efficacy and toxicity.

Consistency
The formulation of EPA-Registered products is consistent with the original formula registered with the EPA.

TDIndustries

EPA-Registered Antimicrobial Products

All Foster® Indoor Air Quality products are water-based. Additional information and specifications can be found on the MSDS sheets and Product Data Sheets, available at **www.fosterproducts.com.**

Product Number/ General Description	Color	Substrate	Coverage	Dry Time	Application Method	Spray Tips
Foster® Fungicidal Protective Coatings						
40-20™ Fungicidal Protective Coating • Industry leading antimicrobial coating. • Prevents the re-growth and spread of odor causing bacteria and mold on its surface. • Provides a tough, elastic, water resistant coating. • Prevents air erosion and fiber release when applied to fibrous duct liner insulation.	White	• Walls • Ceilings • Pipes • Interior & Exterior HVAC duct systems	80 ft^2/gal. (2.0 m^2/L)	Set to touch: 4 hours Dry through: 16 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.023 to 0.025", 8" to 10" fan width
40-30™ Fungicidal Protective Coating • Prevents the re-growth and spread of odor causing bacteria and mold on its surface. • Prevents air erosion and fiber release when applied to fibrous duct liner insulation.	Black	• Fiberglass duct liners • Duct board insulation • Galvanized surfaces	Galvanized Metal: 133 ft^2/gal. (3.3 m^2/L) New Duct Liner: 100 ft^2/gal. (2.5 m^2/L) Old Eroded Duct Liner: 67 ft^2/gal. (1.6 m^2/L)	Set to touch: 6 hours Dry through: 24 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
Foster® Disinfectant/Sanitizer						
40-80™ Disinfectant/Sanitizer** • Use as a disinfectant, sanitizer, cleaner, fungicide, deodorizer, virucide and germicide. • Kills a large variety of microbes within minutes. • Contains surfactants to help clean and remove residue. • Designed for use in water damage restoration situations.	Clear	• All hard, non-porous surfaces • Sanitizes porous and semi-porous materials	Depends on application method and surface. Apply sufficient quantity to insure the surface remains wet continuously for at least ten (10) minutes.	Dry thoroughly before applying top coating.	• Garden sprayer, spray bottle, cloth, mop or sponge	Airless sprayers are NOT recommended. Coarse spray only.

Guide to Primer Use

Surface	Required Primer	Coating
Wood (structural studs, OSB, plywood)	None	All
Metal (galvanized, foil)	40-26 (recommended)	All
Drywall (unpainted)	None	All
Concrete, brick, plaster, masonry cement block (unpainted)	40-22 or 40-26	All
Painted surfaces (flat finish)	None	All
Painted surfaces (gloss finish)	40-26 or sanding	All
Wood (smooth, sanded, hardwoods)	40-26	All
Ductliner, duct board	None	40-20 or 40-30

Airless Spray Equipment Guidelines

Foster Mold Resistant Coatings can be applied with most manufacturers commercial grade electric airless sprayers. Sprayers with the following minimum specifications are suggested:

Operating Pressure (psi):	3000
Motor Size (hp)	3/8
Volume (gpm):	0.45
Hose (inches i.d.):	1/4" up to 50', 5/16" over 50'
Spray Tips*:	Refer to Product Information Chart.

* Tip sizes as small 0.017" may be used, however, application will be slower and may require multiple passes to achieve recommended coverage rate. Spray equipment manufacturers specifications should be reviewed for maximum tip size acceptable for the sprayer being used.

** Not for use on the interior on HVAC systems. Refer to product label for use directions.

Mold Resistant Products

Resisting Mold in the Toughest Environments

Foster® brand coatings provide the highest level of performance even in the harshest conditions. Foster Mold Resistant Coatings specialize in resisting long-term mold growth on their surface. In addition to coatings, our accessory products improve the adhesion and aesthetic appeal when used.

ASTM D-5590 Testing Provides Evidence

We demonstrate the efficacy of our mold resistant products with extensive ASTM D-5590 Testing. ASTM D-5590 is specifically designed to test paints and coatings in the most severe environment possible for promotion of fungal growth. This makes it an excellent method for evaluation of a mold resistant coating's performance under the harshest conditions.

Foster® Brand Products Superior Performance and Highest Standards

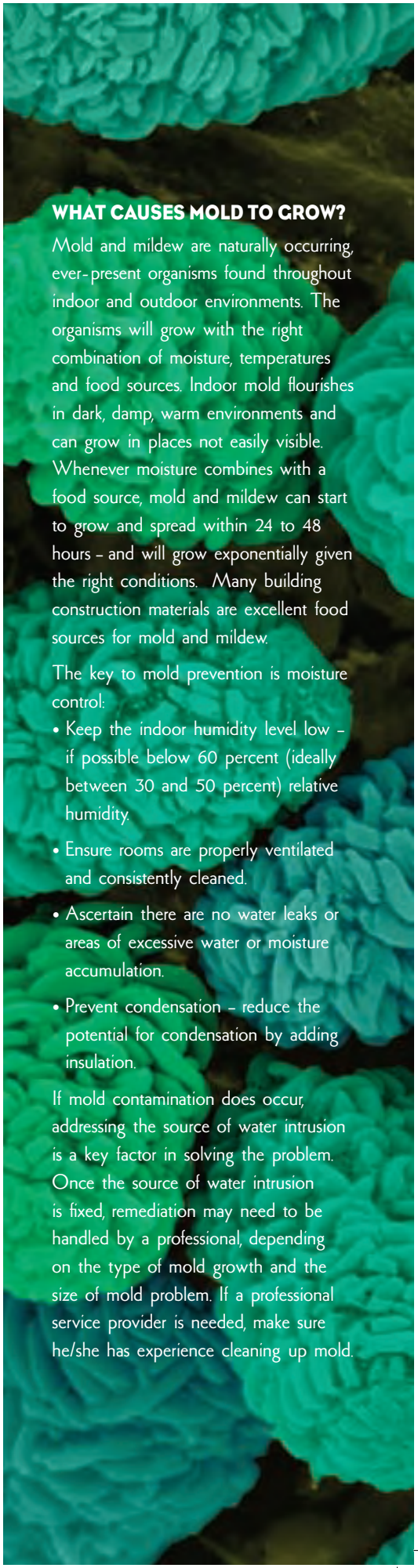
Our products are constantly monitored for high quality through our ISO 9001 certification. This high level plant quality certification assures consistent, high quality Foster brand products. In addition, we test independently through a leading commercial IAQ laboratory (Aerotech Laboratories, Inc.) to maintain our position of leadership.

ASTM D-5590 Test Method

ASTM D-5590 was purposefully developed to test paints and coatings in the "worst-case conditions" possible for promotion of mold, mildew, fungus and algae growth. This method is the best for evaluating a mold resistant coating's performance under ideal mold growth situations.

Mold requires three elements for growth: high humidity, proper temperatures and a food source. ASTM D-5590 provides these elements in an optimal environment for growth. To insure continual exposure, the sample is surrounded with active, continually re-generating mold spores, truly testing the product's resistance to growth. These conditions represent a worst-case scenario in a real world application where there is active mold spore generation on an adjacent substrate to the coated material at a temperature and humidity highly conducive to mold growth.

Other commonly cited tests do not provide this high standard of testing combining all three elements, and consequently do not reflect the product's performance under the most relentless mold growth conditions.



WHAT CAUSES MOLD TO GROW?

Mold and mildew are naturally occurring, ever-present organisms found throughout indoor and outdoor environments. The organisms will grow with the right combination of moisture, temperatures and food sources. Indoor mold flourishes in dark, damp, warm environments and can grow in places not easily visible. Whenever moisture combines with a food source, mold and mildew can start to grow and spread within 24 to 48 hours – and will grow exponentially given the right conditions. Many building construction materials are excellent food sources for mold and mildew.

The key to mold prevention is moisture control:

- Keep the indoor humidity level low – if possible below 60 percent (ideally between 30 and 50 percent) relative humidity.
- Ensure rooms are properly ventilated and consistently cleaned.
- Ascertain there are no water leaks or areas of excessive water or moisture accumulation.
- Prevent condensation – reduce the potential for condensation by adding insulation.

If mold contamination does occur, addressing the source of water intrusion is a key factor in solving the problem. Once the source of water intrusion is fixed, remediation may need to be handled by a professional, depending on the type of mold growth and the size of mold problem. If a professional service provider is needed, make sure he/she has experience cleaning up mold.

TDIndustries

Mold Resistant Products

All Foster® Indoor Air Quality products are water-based. Additional information and specifications can be found on the MSDS Sheets and Product Data Sheets, available at **www.fosterproducts.com.**

Product Number/ General Description	Color	Substrate	Coverage	Dry Time	Application Method	Spray Tips
Foster® Mold Resistant Coatings and Sealants						
40-10™ Duct Liner Adhesive Coating • Seals and reinforces the surface of new and aged duct liner. • Prevents air erosion and fiber release. • Resists mold, fungus, and discoloration from mildew and mold stains on its surface.	White	• Fibrous duct liner • Unfaced duct board insulation	80 to 200 ft^2/gal. (2.0 to 4.9 m^2/L)	Set to touch: 6 hours Dry through: 24 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
40-11™ Eclipse™ Coating • Matches the original surface color of most duct liner insulations. • Seals and reinforces the surface of new and aged duct liner. • Prevents air erosion and fiber release resists mold, fungus and discoloration.	Black	• Fibrous duct liner • Duct board insulation	50 to 150 ft^2/gal. (1.2 to 3.7 m^2/L)	Set to touch: 6 hours Dry through: 24 hours	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
40-23™ Insulation Sealer • Penetrates deeply into existing HVAC duct liner insulations, forming a damage resistant surface that reduces particle release. • Resists fungus and mold growth on its surface.	White	• Fibrous duct liner • Duct board insulation	50 to 150 ft^2/gal. (1.2 to 3.7 m^2/L)	Dry through: 2-4 hours at ambient	• Airless Sprayer • Brush or Roller	Tip Size*: 0.019 to 0.025", 8" to 10" fan width
40-50™ Mold Resistant Coating • Formulated with EPA-registered antimicrobial agents which provide protection against odor causing bacteria, mildew and mold growth on the product surface. • For use in areas prone to the growth of mold.	White	• Wall cavities, floor joists, attic spaces • Wood and metal studs, drywall, OSB, furring strips, masonry	300 ft^2/gal. (7.4 m^2/L)	Dry through: 1-2 hours at ambient	• Airless Sprayer • Brush or Roller	Tip Size*: 0.015 to 0.017", 8" to 10" fan width
40-51™ Mold Resistant Coating • Provides a clear finish leaving the original surface visible after application. • Specially formulated with EPA-registered antimicrobial agents for long-term protection from mold growth on its surface.	Clear	• Wall cavities, floor joists, attic spaces • Wood and metal studs, drywall, OSB, furring strips, masonry	Wood: 250 to 450 ft^2/gal. (6.1 to 11.0 m^2/L) Non-Porous Surfaces: 500 to 600 ft^2/gal. (12.3 to 14.7 m^2/L)	Dry through: 1 hour at ambient	• Airless Sprayer • Brush or Roller	Tip Size*: 0.015 to 0.017", 8" to 10" fan width
40-55™ Clear Defense™ Mold Resistant Coating • Specifically designed to protect and maintain the aesthetics of residential, commercial and industrial surfaces. • Formulated with EPA-registered additives, providing long-term resistance to the growth of mold, mildew, fungus and algae on its surface without blushing or yellowing.	Clear	• Masonry, stucco, concrete and clay roofing tiles • Asphalt shingles, vinyl, aluminum, painted wood	Non-Porous Surfaces: 300 ft^2/gal. (7.4 m^2/L) Porous will require more product.	Dry through: 40 minutes-1 hour	• Airless Sprayer • Brush or Roller	Tip Size*: 0.015 to 0.017", 8" to 10" fan width
Foster® Accessory Products						
40-16™ Block Filler • Abrasion-resistant fill coat eliminates pores, depressions and crevices in a one-coat application.	Off White	• Unpainted masonry surfaces	40 to 70 ft^2/gal. (1.0 to 1.7 m^2/L)	Set to touch: 1-2 hours Dry through: 15 hours	• Airless Sprayer • Brush or Roller	30:1 Air Pump with Inductor Plate. Tip Size: 0.021 to 0.025", 8" to 10" fan width
40-22™ Masonry Sealer & Primer • Penetrates into the surface, strengthening it and sealing it to help eliminate blistering and peeling.	Off White (dries clear)	• Unpainted block plaster • Cement surface	50 to 200 ft^2/gal. (1.2 to 4.9 m^2/L)	Dry through: 2-4 hours at ambient	• Airless Sprayer • Garden Sprayer or Spray Bottle	Tip Size: 0.017 to 0.021", 8" to 10" fan width
40-26™ Water-based Primer • Bonds and protects against stains and corrosion. • Increases the bondability of retrofit systems.	Off White (dries translucent)	• Metal, and rusty metal • Concrete • Masonry • Wood	Metal: 200 to 300 ft^2/gal. (4.9 to 7.4 m^2/L) for corrosion protection; 400 to 600 ft^2/gal. (9.8 to 14.7 m^2/L) for improving adhesion.	Dry through: 1 hour at ambient	• Airless Sprayer • Brush or Roller	Tip Size: 0.017 to 0.021", 8" to 10" fan width

*See Airless Spray Equipment Guidelines for information.

The Foster® Clean, Kill & Coat™ three-phased approach for mold remediation eliminates the chance for the return of mold.

Step 1. Clean

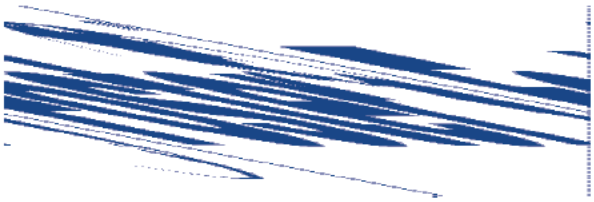
- Remove any water-damaged and mold contaminated materials that cannot be salvaged such as carpeting, furniture and wallboard.
- Thoroughly dry all materials to be left in place by exposing them to circulated dry air.
- Follow with a thorough cleaning and removal of all contaminants.

Step 2. Kill

- Sanitize the affected porous and non-porous surfaces with the ready-to-use, EPA-registered Foster® 40-80™ Disinfectant/Sanitizer to clean, deodorize and remove any residual microbial contaminants.
- The surface should remain wet for 10 minutes.

Step 3. Coat

- Coat the surface with the appropriate Foster brand protective coating evenly and thoroughly. We recommend an airless sprayer for an even application.
- Ventilate well for proper drying. Continue ventilation using appropriate fans, negative air machines or air scrubbers until odors are reduced to acceptable levels.
- Always ensure the use of PPE (Proper Protective Equipment).



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TDIndustries

Houston Community College Case Study

Houston Community College Nets Sustainable Results

TDIndustries Puts its Skilled Team on Campus

Houston Community College (HCC) serves more than 70,000 students with 66 facilities covering 623 square miles. TDIndustries maintains and services all of HCC's campus facilities.

THE FACE OF INNOVATION

tdindustries.com

The Situation

More than 40 TD facility partners support the HCC system. They provide all mechanical, electrical and plumbing services, including:

- HVAC systems,
- general maintenance,
- preventive and corrective maintenance,
- elevators and wheelchair lifts,
- building automation systems (BAS),
- building energy management systems (BEMS),
- building security systems (BSS),
- fire life safety equipment (FLSE, and
- computerize maintenance management system (CMMS) .

With its large geographic area and customer base, TD's challenges include:

- Managing and controlling the budget,
- Serving multiple locations and reaching them in Houston's high traffic corridors,
- Keeping customers, including students, faculty, administrators and visitors, satisfied,
- Dealing with fast transitions of less than 30 days,
- Maintaining and improving system reliability, and
- Attracting and retaining good technically competent managers and technicians.

Along with on-site facilities support, TDIndustries provides incremental service and support from the company's Houston branch office. TD's goal with the HCC is to ensure a mutually responsive partnership that considers both short and long-term facilities needs and costs.

The Solution

For technical support, TD employs the Maximo Computerize Maintenance Management System (CMMS). TD has also designed and implemented a preventive maintenance program based on the reliability centered maintenance (RCM) approach. In addition, TD has implemented a do-it-now (DIN) team to respond to customer needs.

One of the greatest transitions for HCC was moving from outsourcing to multiple vendors to bringing their facilities work back in-house and using additional resources as needed. To effectively make this transition, TD met with existing suppliers and evaluated those outsourced activities versus on-site work.

TD recommended that the majority of the facilities work move back on-site with TD staff and M/WBE Business Partners. The outcome was a zone maintenance approach along with a highly skilled all zone Business System Group, M/WBE business partners and backup support from TD's Houston branch office. This team composition has enabled rapid response to on-site maintenance requirements.

In order to meet TAMU's requirements for HVAC components and installations, TD procured and installed the following:

- 5 Air Handling Units
- 1 Outside Air Handling Units
- 8 Fan Coil Units
- 16 Airflow Monitoring Stations
- Two 20 hp Chilled Water Pumps
- Two 7.5 hp Heating Hot Water Pumps
- 2 Sound Attenuators
- 107 Fan Powered Terminal Units
- 128 Single Duct VAV Terminal Units
- Siemens was subcontracted to perform the installation of the Building Automation System, and integrate it to the main network on campus.
- Sound and acoustical accommodations were made to the HVAC system and the vertical storm drain risers with added insulation.
- More than 170,000 pounds of ductwork including double wall spiral and over seven miles of piping were fabricated in TD's manufacturing facility.

The Success

The project was completed on time and on budget. Skanska USA and TAMU were impressed with TD's proactive communications, BIM leadership role and periodic safety audits conducted throughout the project.

TD was also recognized for the firm's professionalism in working with other trades and the owner's representatives.

THE FACE OF INNOVATION

tdindustries.com

TDIndustries

Texas A&M LAAH Building Case Study

Delivering a Sustainable Performance Facility for Texas A&M

TD Focuses on Best Practices for Higher Education Project

The Liberal Arts and Humanities Building (LAAH) is a five-story, 125,000 square-foot facility located in the historic core of Texas A&M University's flagship campus in College Station, Texas. The $46 million building is the first to be designed specifically for instruction and scholarship in the arts and humanities. Designed to meet LEED silver rating, it will contain faculty offices, classrooms, computer-based teaching classrooms, theater performance studios, music practice and rehearsal rooms, recording studios and music teaching labs.

THE FACE OF INNOVATION

tdindustries.com

The Situation

TThe Texas A&M University System's Office of Facilities Planning and Construction (OFPC) is committed to excellence in design and sustainability in the construction and renovation of buildings for all A&M System facilities. All new construction must meet Leadership in Energy and Environmental Design (LEED) Silver standards. The OFPC also develops guidelines that affect every aspect of a building's design, operations, maintenance, sustainability and energy performance.

In January 2011, Texas A&M University (TAMU) awarded Skanska USA the contract to build the LAAH facility with a targeted completion date of the summer of 2012. The building was designed by Brown Reynolds Watford (BRW) Architects. Shah Smith & Associates acted as the MEP Engineer. Skanska USA engaged TDIndustries under a hard bid or lump sum contract to provide HVAC services on the project.

TAMU's goals for the project were:

1. For the building to meet its sustainability guidelines;
2. For the project to be completed on time and on budget;
3. For a safe, clean jobsite; and
4. For construction to be conducted with as little disruption as possible to campus activities.

The building's location in the center of the campus created some logistical issues which required significant coordination of numerous trade subcontractors and the placement/storage of material and equipment. In addition, all trades had to allow for scheduling in order to meet TAMU's requirement that all trade contractors participate in its inspections and re-inspections during each phase of construction.

The Solution

TD prides itself in designing and constructing HVAC systems that meet the most stringent sustainability guidelines regarding air quality, acoustics, lighting, energy efficiency, system automation and controls and water conservation. TD is also adept in its use of Building Information Modeling (BIM) and takes a leadership role in leading the BIM process with other trades.

TDIndustries

Houston Community College Case Study

Houston Community College Nets Sustainable Results

TDIndustries Puts its Skilled Team on Campus

Houston Community College (HCC) serves more than 70,000 students with 66 facilities covering 623 square miles. TDIndustries maintains and services all of HCC's campus facilities.

THE FACE OF INNOVATION

tdindustries.com

The Success

By completing the majority of the work on-site with highly trained TD personnel, two major benefits were achieved for HCC:

1. Increased customer response time and satisfaction, and
2. Budget efficiencies.

TD helped HCC succeed in reducing costs and improving life cycle operations by redesigning HCC's current operations and applying new technologies and a skillful team of technicians to maintain and support HCC's facilities.

By improving reliability and system comfort, HCC has experienced fewer corrective calls due to TD's improved preventive maintenance system. Monthly reporting enables TD to manage costs and performance.

Best of all, savings per year has been $2 million with a projected $10 million over the life of the 5-year contract.

For large campus solutions, TD's truck-based service, fire and life safety department, building automation controls (BAS) and special projects departments provide the depth and resources that deliver sustainable results.

TDIndustries

Value Proposition around Reducing our Customers Utility Costs

Attachment B-17.1

Product Title	Building Type / Size	Typical Sales Leader	Sales Process
Energy Solutions	• Greater than 100,000 sq/ft • Multi Building Campus • Large Process Loads	• Special Projects, Business Development Manager	• Miller Heiman Sales Process
TDSaves	• Less than 100,000 sq/ft	• Truck Based Service, Business Development Manager	• Sandler Sales Process

This information outlines the "Go to market Strategies" Using Utility Savings as the Value Proposition

- It is to be used as a guideline helping you make the right decisions on the type of proposal, presentation and product offering.
- It also instructs you on which sales technique is appropriate for a given job opportunity.
- Following these guidelines as closely as possible increases the chances for better customer relations and higher margins.

Characteristics of a Sale

- Sold to Owners of Buildings
- Follows a Structured Sales Process that includes an Energy Audit
- Reduced operating costs pay for project and services
- Negotiated at the Executive Level
- Includes ongoing Measurement and Verification (M&V) of savings
- Can include an Energy Savings Guarantee
- Includes Multi-Year Support Services
- Often includes utility incentives and financing

Partial List of Energy Conservation Measures

HVAC
- Replace worn-out inefficient equipment
- Install variable frequency drives
- Perform retro-commissioning
- Install/upgrade, integrate building control systems
- Chiller Control Systems

Plumbing
- Water Saving Fixtures
- Intelligent Irrigation Controls
- Replace inefficient boilers and water heaters
- Solar Thermal

Electrical
- Lighting Fixture Retrofits
- Power Factor Correction
- Demand Response Program
- Solar PV

Support Services
- Service Agreements
- M&V Services
- Building Performance Management (utiliVisor)

TAB 7 - PRICING

TAB 7 CONTENTS:

PRICING

Pricing has been uploaded separately per the request of the submission requirements.

TAB 8 - VALUE ADDED PRODUCTS AND SERVICES

TAB 8 CONTENTS:

ADDITIONAL INFORMATION

i. Provide any additional information related to products and services Offeror proposes to enhance and add value to the Contract.

Facilities Maintenance and Operations/Facilities Management Services **Please see Attachment "G-1"**	Type: Full Facility Operations and Maintenance Our Customers: » Airports » Higher Education » Convention and Entertainment » Corporate Environment » Data Centers/Critical Environments » Government » Healthcare » School Districts
	Personnel: All work performed by TD Partners
	Detailed Features and Benefits: Your buildings serve a deeper purpose; it provides a welcoming, safe environment that houses your customers, staff, and students. We tailor facilities management service to support your business goals. With a local on-site highly qualified team and a wide range of services, we stand ready to flex with your business needs. » Mechanical system operation and maintenance » Vertical transportation » Security systems » Renovation and retrofit » Fire Life and Safety » Lighting » Energy Management » Cost containment » LEED certification
Fire Life and Safety (FLS) **Please see Attachment "G-2"**	Type: Code Compliance, Auditing, Design Engineering, Construction Management, Operation and Maintenance, Training Fire Suppression Systems and Services
	Personnel: All work performed by TD Partners
	Detailed Features and Benefits: TDIndustries offers a full range of Fire/Life Safety and Fire Suppression Systems and Services. The need for innovation and continuous improvement methods has never been greater. With our leadership and training programs, we will put in place highly trained personnel to provide a turnkey project performing all key technical, management, and financial functions.

ADDITIONAL INFORMATION

Energy Savings Performance and Management Solutions **Please see Attachment "G-3"**	Type: Energy Auditing and Facility Assessment » Preliminary Audit-Expert modeling and analysis of baseline energy usage and savings » Detailed Energy Audit-Project development and economic analysis Personnel: All work performed by TD Partners Detailed Features and Benefits: » In-house Design Engineering and Specification » Construction Project Management » Procurement of materials and trade labor » Safety coordination by our in-house Certified Safety Professional and OSHA-Authorized Trainer » Continuous Commissioning » Ongoing Maintenance and Support Services » Guaranteed Savings Performance Monitoring and Verification » Performance guarantee backed by a history of financial strength, organizational longevity » Facility Staff and Occupant Training » Financing Procurement Support » Including identifying and securing all available grants, rebates, and incentives available to offset project costs
Automation/Controls **Please see Attachment "G-4"**	Type: Building Automation Systems/Systems Integration Services (BPSI Anti-Terrorism Facility Protection, Intelligent Irrigation Matters, Lighting, Metering, Security/Access Controls, System Integration) Personnel: All work performed by TD Partners Detailed Features and Benefits: TDIndustries develops, deploys, and supports the entire spectrum of intelligent automation and sustainability technologies because they save our customers money. Not only reducing energy costs, but maintenance and emergency costs as well. At the same time, smart systems increase overall efficiency and tenant satisfaction, and extend the life of your building. Our processes dramatically affect long-term planning and your bottom line. They drive efficiencies that, in the end, pay for themselves, including: » Total integration of the systems in your building » Reduce operating expenses » You get to make better system choices » A centralized location for all facility data » Web-based interface and open systems architecture » Real-time measurement » Increased tenant satisfaction » Increased employee productivity » Increased property value

ADDITIONAL INFORMATION

Truck Based Services **Please see Attachment "G-5"**	Type: We offer complete Refrigeration, HVAC, Plumbing, and Electrical repair and maintenance services.
	Personnel: All work performed by TD Partners
	Detailed Features and Benefits: We offer a wide variety of superior services ready for immediate response and resolution of jobs of all sizes and complexity. Our comprehensive truck based services, ServiceLink technology, and our broad spectrum of service and repair plans are just a few of the ways we support our commitment to service.
Refrigeration **Please see Attachment "G-5"**	Type: Commercial Refrigeration Installation, Repair and Maintenance
	Personnel: All work performed by TD Partners
	TD works with a variety of manufacturers to offer you the best possible costs on equipment and parts. We also provide preventative maintenance contracts to increase the efficiency and extend the life of your equipment. Our employees are highly trained and experienced to install and service commercial refrigeration systems and are on call 24/7/365 to provide your company with emergency repairs. We support a variety of equipment with low temperature needs and HVAC (heating, ventilation, and air conditioning) sales and service. A sample of the types of facilities we service: » Supermarkets » Colleges and Schools » Convenience Stores » Restaurants » Taverns & Bars » Manufacturing Facilities » Refrigerated Warehouses

ADDITIONAL INFORMATION

HVAC **Please see Attachment "G-5"**	Type: Commercial Heating & Air Conditioning System Services
	Personnel: All work performed by TD Partners
	Detailed Features and Benefits: TD offers comprehensive services for boilers, chillers, air handlers, pumping systems, control systems, and water treatment. Our performance guarantees are unmatched by any other company in this industry. Not only is your exposure to risk reduced, but the quality of service you can expect is superior as well. Regularly scheduled inspections, 24- hour emergency service, full-service maintenance and repairs all extend the life of your systems.
Electrical **Please see Attachment "G-5"**	Type: Electrical Repair Services
	Personnel: All work performed by TD Partners
	Detailed Features and Benefits: TD is Equipped to handle all of your electrical needs with highly skilled technicians who are licensed and certified in the latest national electrical codes, city codes, and OSHA safety regulations. our service professionals are empowered to give on-site quotes for providing: » Interior Finish-Out » Industrial Systems » Electrical Controls » Infrared Imaging Services » Lighting Contracts » Multifamily Services » Outdoor Lighting » Retrofits and Upgrades
Plumbing **Please see Attachment "G-5"**	Type: Commercial Plumbing Services
	Personnel: All work performed by TD Partners
	Detailed Features and Benefits: For the total lifecycle of your facility - repairs, replacements, renovations, or retrofits - TD has the resources in place. Fully licensed plumbers are available 24 hours a day, seven days a week, to provide: » Boiler/Chiller System Repair and Maintenance » Hydro-Jet Service » Water System Repair and Maintenance » Sewer System Repair and Maintenance » Gas System Repair and Maintenance » Certified Backflow Testing » OSHA Certified Confined Entry » Certified Medical Gas Installation and Repair » Electronic Leak Detection » Electronic Line Location » Pro-Temp Service and Maintenance

ATTACHMENT "G-1"

FACILITY MAINTENANCE / MANAGEMENT SERVICE

EXECUTIVE SUMMARY

Thank you for giving TDIndustries the opportunity to provide our proposal for Facility Maintenance Service. We are excited by the opportunity to serve The Cooperative Purchasing Network. TDIndustries has the knowledge, experience, capabilities and flexibility to mobilize a workforce to meet the facility challenges facing NCPA.

The need for innovation and continuous improvement methods has never been greater. With our leadership and training programs, we will put in place a highly trained, competent site manager backed by professional management and a dedicated facility support and local service team. We will further develop a total facility service plan around your facility needs and support our onsite Supervisor with additional local technicians as needed. We will make the transition to TDIndustries seamless and provide ongoing service with no disruption to NCPA.

Our staffing plan is built on flexibility. The billable cost presented in the Pricing Section covers staffing as required in the RFP.

Benefit to the Agency Members of NCPA—You get the benefit of our experience and capabilities in Facilities Management to develop and implement a staffing plan to meet your needs, at no additional charge.

MANAGEMENT AND TECHNICAL EXPERTISE

TDIndustries proposes a manager that will proactively and effectively manage all aspects of facility services. He will be supported by an Operations Manager and our Professional Services Group. Our organization is specifically designed for efficiency with the flexibility to comply with both NCPA and TDIndustries' operational requirements.

Benefit to the Agency Members of NCPA—With TDIndustries' leadership and knowledge of facilities, policies and procedures, the transition period will be short with no disruptions—which will increase efficiencies and save you money.

CERTIFICATION/TRAINING OF MULTI-SKILLED WORKFORCE

TDIndustries utilizes highly-skilled technicians at all of our continuous-presence mechanical and facilities services sites. Each TDIndustries employee is tested using TDIndustries' Progression Program. This training and certification program focuses on written and hands-on criteria to determine employee skill levels. The employee then enters the program with the full support of management to continue their career development in as many crafts as desired.

Benefit to the Agency Members of NCPA—You will not waste any time or money developing a new certification /training program. You will also have the assurance that the people performing your repair work have the necessary skills for the job to be performed in a safe, efficient, and correct manner.

ATTACHMENT "G-1"

FACILITY MAINTENANCE / MANAGEMENT SERVICE

EXECUTIVE SUMMARY

FULL-SERVICE SUPPLIER

TDIndustries is a full-service supplier of engineering, construction and maintenance service. By selecting TDIndustries, you will have over 2,000 professionals and skilled technicians available to you. This includes specialty services such as total facilities and HVAC repair.

Benefit to the Agency Members of NCPA—Any need you might have associated with repairs, maintenance and capital projects is one phone call away.

MAINTENANCE EXPERIENCE

TDIndustries performs over $141,000,000 annually at continuous-presence and service/facilities maintenance revenue. We bring the successful programs from these operations to you. They include safety, benchmarking, cost control, quality, equipment availability, management model, employee leadership, community involvement and long term relationships.

Benefit to the Agency Members of NCPA—You get the benefit of our management processes, procedures and expertise to develop and implement these programs at no additional charge.

SAFETY

TDIndustries is firmly committed to providing excellence in safety. From the CEO to the field supervisor to the technician, every employee recognizes and accepts the requirement to make safety our most important responsibility.

Within TDIndustries, safety and health are not priorities, but values instilled in our employees at all levels.

TDIndustries is focused on getting everyone to automatically think about safety first.

Benefit to the Agency Members of NCPA—You will not waste any time or money dealing with the issues that arise from developing a new safety program for your mechanical and facility maintenance operation or from someone being injured in the workplace. These safety programs and policies already exist and produce excellent results.

TRANSITION PLAN

TDIndustries has the experience to implement a smooth transition. We have a structured transition plan with proven processes and procedures refined over hundreds of project startups.

Benefit to the Agency Members of NCPA—You get the benefit of TDIndustries' transition expertise to help ensure no disruption of service at your buildings.

ATTACHMENT "G-2"

FIRE/LIFE SAFETY AND FIRE SUPPRESSION SYSTEMS

EXECUTIVE SUMMARY

Thank you for giving TDIndustries the opportunity to provide our proposal for Fire/Life Safety and Fire Suppression Systems. We are excited by the opportunity to serve The Cooperative Purchasing Network.

TDIndustries offers a full range of Fire/Life Safety and Fire Suppression Systems and Services. The need for innovation and continuous improvement methods has never been greater. With our leadership and training programs, we will put in place highly trained personnel to provide a turnkey project performing all key technical, management, and financial functions.

CODE COMPLIANCE AUDITING

TDIndustries uses a holistic approach that combines visual inspection, technical analysis, and interviews with facility staff in order that we may provide NCPA with a detailed review of the current state of buildings fire alarm and fire suppression systems and current code issues that may impact the building and its occupants. This approach enables our engineers to construct a detailed report and a current code compliance matrix that will provide the highest capacity for improvement and the best value to NCPA.

Benefit to the Agency Members of NCPA—Successful life safety system and infrastructure improvement programs resulting in increased building occupant safety and current code compliance.

DESIGN ENGINEERING

The design engineering process emphasizes minimization of cost while providing quality designs. The same engineers that participated in the audits will complete the project design, create bid specifications, assist with construction management, and consult on operations. TDIndustries refers to this approach as the "closed-loop" management strategy, which insures consistency and a high degree of quality control throughout the project life cycle and is essential in providing NCPA with an integrated best value solution.

Benefit to the Agency Members of NCPA —Allows for a smooth transition from the development stage through the operations stage.

CONSTRUCTION MANAGEMENT

TDIndustries construction management team will inspect the work of all subcontractors for compliance with the design documents and project intent and will develop specific project acceptance criteria, startup, commissioning, and retro-commissioning processes. TDIndustries will focus intently on scheduling work in a manner that minimizes disruption while maintaining a safe environment.

Benefit to the Agency Members of NCPA —TDIndustries construction strategy will provide for fast implementation and short construction timelines while minimizing disruptions to the building occupants so that the customer will begin to realize life safety system improvements early in the project while minimizing disruption.

ATTACHMENT "G-2"

FIRE/LIFE SAFETY AND FIRE SUPPRESSION SYSTEMS

EXECUTIVE SUMMARY

OPERATION AND MAINTENANCE

TDIndustries will provide a maintenance program for all or part of the contract term, as desired by NCPA, for all equipment installed under the project. Our role as one of the nation's most experienced Truck and Site-based Services provider and as an operator of facilities for a wide variety of clients, has enabled us to become expert at developing maintenance plans that will help provide reliable operation with minimal downtime and operational disruption.

Benefit to the Agency Members of NCPA —You will receive a maintenance strategy that will be based on cost-effectiveness while ensuring that equipment remains in optimal operating condition through the application of sound preventative and predictive maintenance programs.

TRAINING

TDIndustries primary focus for education will be to ensure that the impacted people understand why changes are being made, the proper use of new equipment, and procedures for reporting equipment not performing properly. Technical training for facility personnel will be to provide comprehensive instruction on the operation, troubleshooting, maintenance, and repair of equipment and systems modified or installed.

Benefit to the Agency Members of NCPA —All parties working together to ensure improved safety, reliability, and peace of mind on a sustained basis.

"TDIndustries has a team of dedicated professionals ready to support all of NCPA facility needs".

ATTACHMENT "G-3"

ENERGY SAVINGS PERFORMANCE CONTRACTING

EXECUTIVE SUMMARY

Thank you for giving TDIndustries the opportunity to provide our proposal for Energy Savings Performance Contracting (ESPC). We are excited by the opportunity to serve The Cooperative Purchasing Network.

TDIndustries offers a full range ESPC Services. The need for innovation and continuous improvement methods has never been greater. With our leadership and training programs, we will put in place highly trained personnel to provide a turnkey project performing all key technical, management, and financial functions.

ENERGY AUDITING

TDIndustries uses a holistic approach that combines visual inspection, technical analysis, and interviews with facility staff in order that we may provide NCPA with an Investment Grade Energy. This approach enables our engineers to construct a detailed model that will provide the highest capacity for improvement and the best value to NCPA.

Benefit to the Agency Members of NCPA—Successful energy efficiency and infrastructure improvement programs resulting in realistic savings.

DESIGN ENGINEERING

The design engineering process emphasizes minimization of cost while providing quality designs. The same engineers that participated in the audits will complete the project design, create bid specifications, assist with construction management, and consult on operations. TDIndustries refers to this approach as the "closed-loop" management strategy, which insures consistency and a high degree of quality control throughout the project life cycle and is essential in providing NCPA with an integrated best value solution.

Benefit to the Agency Members of NCPA —Allows for a smooth transition from the development stage through the operations stage.

CONSTRUCTION MANAGEMENT

TDIndustries construction management team will inspect the work of all subcontractors for compliance with the design documents and ECM intent and will develop specific project acceptance criteria, starup, commissioning, and retro-commissioning processes. TDIndustries will focus intently on scheduling work in a manger that minimizes disruption while maintaining a safe environment.

Benefit to the Agency Members of NCPA —TDIndustries construction strategy will provide for fast payback items with short construction timelines to be installed first so that the customer will begin to realize savings early in the project.

ATTACHMENT "G-3"

ENERGY SAVINGS PERFORMANCE CONTRACTING

EXECUTIVE SUMMARY

OPERATION AND MAINTENANCE

TDIndustries will provide a maintenance program for all or part of the contract term, as desired by NCPA, for all equipment installed under the project. Our role as one of the nation's most experienced Truck and Site-based Services provider and as an operator of central energy plants for a variety of facilities, has enabled us to become expert at developing maintenance plans that will help provide reliable operation with minimal downtime and operational disruption.

Benefit to the Agency Members of NCPA —You will receive a maintenance strategy that will be based on cost-effectiveness while ensuring that equipment remains in optimal operating condition through the application of sound preventative and predictive maintenance programs.

MEASUREMENT AND VERIFICATION PLAN DEVELOPMENT

TDIndustries places a great emphasis on the measurement of results and takes great pride in the performance of our projects. We will develop an annual Measurement & Verification (M&V) plan that best meet the requirements of NCPA and which will be in compliance with International Performance Measurement and Verification Protocols and with the Texas Energy Assessment Monitoring and Verification Guidelines.

Benefit to the Agency Members of NCPA —An agreed upon M&V plan that will clearly measure the results and protect NCPA from the potential of an under-performing project.

TRAINING

TDIndustries primary focus for education will be to ensure that the impacted people understand why changes are being made, the proper use of new equipment, and procedures for reporting equipment not performing properly. Technical training for facility personnel will be to provide comprehensive instruction on the operation, troubleshooting, maintenance, and repair of equipment and systems modified or installed.

Benefit to the Agency Members of NCPA —All parties working together to ensure improved comfort, reliability, and guaranteed energy savings on a sustained basis.

"TDIndustries has a team of dedicated professionals ready to support all of NCPA facility needs".

ATTACHMENT "G-4"

AUTOMATION AND CONTROLS

EXECUTIVE SUMMARY

TD knows and deeply understands how seamlessly, efficiently and optimally buildings operate when they have the right automation and controls. And the truth is, these days you can't afford not to have them.

ENERGY AUDITING

That's why having automation and controls are so critical. They dramatically affect long-term planning and your bottom line. Plus they drive efficiencies that, in the end, pay for themselves, including:

- Total integration of the systems in your building
- Reduce operating expenses
- You get to make better system choices
- A centralized location for all facility data
- Web-based interface and open systems architecture
- Real-time measurement
- Increased tenant satisfaction
- Increased employee productivity
- Increased property value

Benefit to the Agency Members of NCPA— can make a dramatic difference in how intelligently your business operates. We're here to enhance your facility and guide you toward economies in all areas of your business. However, these days the one area in which you can get the most cost savings is in energy consumption. At the heart of energy savings is automation and controls.

BPSI ANTI-TERRORISM FACILITY PROTECTION

TD has an exclusive agreement with BPSI, the developers of the first complete chemical, biological, radiological, nuclear (CBRN) detection system that actively and reliably protects buildings, mass transit stations, stadiums and public events from airborne toxins. It's a breakthrough, mission-critical detection solution no building should be without.

INTELLIGENT IRRIGATION MATTERS

A number of technologically astute irrigation systems are available to help you manage your grounds. Should you need sprinkler systems with automatic sensors, we can provide them. Should you need a sustainable solution, we offer a system that captures and uses rainwater and gray water. But these are just a couple of the many innovative irrigation services available. You can rely on TD professionals' in-depth knowledge and understanding to guide you in determining which systems will be best for your facility.

ATTACHMENT "G-4"

AUTOMATION AND CONTROLS

EXECUTIVE SUMMARY

LIGHTING

Better lighting control increases productivity. That's why TD is ready with high-level conceptual solutions. We do it all – from design and implementation of new lighting systems to retrofits with existing operations. Either way, we make sure they are properly integrated with other critical building systems.

Sustainability is also paramount in terms of using energy efficiently, which is why TD offers clever daylight strategies to extend light in the workplace. Another unique offering is the manipulation and modulation of artificial lighting to reflect daylight availability.

METERING

TD enables you to have real-time knowledge about utility consumption. When you know what's going on, you save.

The industry-defining solution we offer is utiliVisor, a well-known Continuous Commissioning™ application. Our Web-based, continuous oversight process measures, presents and analyzes key facility indicators – 24/7. It calculates real-time operating cost, and monitors and archives critical building data. You can't afford not to use it.

TD can install meters and sub-meters, or even integrate with existing meters. Beyond savings on metering solutions, this can also improve your tenant billing accuracy.

SECURITY / ACCESS CONTROLS

Safeguarding your building is an area of expertise for us. That's why TD offers the most sophisticated systems available that include CCTV Camera Systems, Video Badging, Access Control and more. You can feel confident and secure that TD is watching out for you in every way.

SYSTEM INTEGRATION

Superior system integration means receiving one intelligent, comprehensive solution that provides effective streamlining of operations, lower installation costs and optimized energy efficiency. It also reduces operating costs, offers multiple protocol management, and gives you something that everybody wants: increased comfort and productivity in the workplace. At TD, you get all this and more, from the following specialized services:

- Custom Integration Solutions
- HVAC Control Systems
- Lighting Control Systems
- Direct Digital Controls
- Electronic Access Controls
- Video Badging
- CCTV Camera Systems
- Power Distribution
- Elevator Controls
- Planned Maintenance
- Emergency Systems and Services
- Software and Programming Support
- Operator Support and Training
- Remote Monitoring and Support
- Multi-Building Campus Integration
- Utility Metering Solutions
- Energy Use and Consumption Analysis
- Design Specification Consulting

ATTACHMENT "G-5"

HVAC, ELECTRICAL, AND PLUMBING

EXECUTIVE SUMMARY

TRUCK BASED SERVICES

TD has a wide variety of superior services ready for immediate response and resolution of jobs of all sizes and complexity, the core of which is based in our comprehensive Truck-Based Services.

In addition to truck-based services, real-time operations are what drive this excellent offering, the foundation of which is a proprietary, state-of-the-art Tier 1 database. This world-class, highly secure knowledge base is comprised of everything that can possibly be logged from the day we begin your service: start-up dates, service numbers, statistics, strategic plans, LEED reports, energy calculations and more.

More than 65 years of experience has led us to consistently offer you the following tangible benefits:

- Technical expertise – extensively trained, experienced TD Partners
- Self-performed delivery
- Customer Contact Center – 24/7 live operator and dispatch
- Large truck fleet – 300+ available at all times
- Broad geographic coverage

Planned Maintenance Services / Select Capital Projects / Scheduled Repair and Replace Services / Emergency On-Demand Service

Benefit to the Agency Members of NCPA — We are available 24 hours a day, seven days a week, 365 days a year. For service that extends beyond a one-tome visit, we offer Diagnostic Evaluation and Problem Resolution. Also, our service plans have no manufacturer bias. TD will research all manufacturers for the absolute best value and application when replacing system components. We work with you to give you the best solutions because we have your best interests in mind.

ATTACHMENT "G-5"

HVAC, ELECTRICAL, AND PLUMBING

EXECUTIVE SUMMARY

REFRIGERATION

TDIndustries is a local service provider with a wide range of capabilities that include Commercial Kitchen repairs and maintenance. TDIndustries' local team is comprised of licensed technicians in HVAC, Plumbing, and Electrical adding to total capabilities. The TD commercial kitchen group has extensive experience with a variety of equipment.

This type of equipment includes but is not limited to:

- Coolers
- Ice machines
- Ovens
- Steamers
- Warmers
- Fryers
- Grills and Griddles
- Beverage Dispensers
- Exhaust Systems
- Walk-in Coolers
- Batch Freezers
- Commercial and Industrial Refrigeration

TDIndustries is familiar with numerous purchasing cooperatives allowing TD to streamline purchasing needs on special projects that may be time sensitive. As a local service provider staffed with a 24-hr service call line we are available with response times typically between 2-4 hours and in some cases sooner.

Our Industrial Refrigeration and Food and Beverage Equipment technicians service both hot-side as well as cold-side equipment in food service and industrial or commercial operations.

ELECTRICAL

Whether replacing a light switch, rebuilding a 1,000-amp service in the middle of the night, or providing major service upgrades, TD is equipped to handle your electrical needs. Here are the benefits of our services:

- Highly skilled technicians that are licensed, certified and trained in the latest national electrical codes, city codes and OSHA safety regulations
- Service professionals empowered to give on-site quotes, offering you competitive estimates
- Expert installers that deliver interior finish-out and system upgrades

Plus, TD responds 24 hours a day, seven days a week to provide:

- Electrical Controls
- Industrial Systems
- Infrared Camera Services
- Lighting Contracts
- Multi-family Service
- Outdoor Lighting
- Retrofits and Upgrades
- Surge Protection

ATTACHMENT "G-5"

HVAC, ELECTRICAL, AND PLUMBING

EXECUTIVE SUMMARY

PLUMBING

From emergency repairs to a major renovation, a small or large commercial industrial or multi-family installation, TD has the resources. Years of extensive experience, training and education programs enable us to fully understand what it takes to keep your specific system operating at its peak efficiency. Fully licensed plumbers are available 24 hours a day, seven days a week for your convenience. Among the highly specialized plumbing services available are:

- Boiler/Chiller System Repair and Maintenance
- Hydro-Jet Service
- Water System Repair and Maintenance
- Sewer System Repair and Maintenance
- Gas System Repair and Maintenance
- Certified Backflow Testing
- OSHA-Certified Confined Entry
- Certified Medical Gas Installation and Repair
- Electronic Leak Detection
- Electronic Line Location
- Sewer Pipe Video Inspection
- Pro-Temp Service and Maintenance

HVAC

TD offers expert, comprehensive services that include everything from boilers, chillers, and air handlers to pumping systems, control systems and water treatment. Our performance guarantees are admittedly unmatched by any other company, so it reduces your risk. You can also expect regularly scheduled inspections, 24-hour emergency service, and full-service maintenance and repairs that extend the life of your systems.

TD's strength in commercial HVAC service is based upon the coupling of high-level thinking with high concept technology. It's a powerful dynamic that empowers expert, brand-savvy TD professionals to investigate and swiftly uncover the root causes of building system failures. And then offer exceptional commercial HVAC solutions you can trust.In the technology arena, TD leverages:

- Special leak-detection tools, which mean faster and less disruptive repairs
- Infrared imaging that identifies potentially dangerous situations in your electrical circuitry
- Vibration analysis that reduces your equipment downtime and extends equipment life

Overall, TD's ability for solving air-conditioning and refrigeration problems is respected throughout the industry. Why? It all comes down to customer trust, which is based on putting you first.

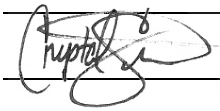
TAB 9 - REQUIRED DOCUMENTS

TAB 9 CONTENTS:

Clean Air and Water Act & Debarment Notice

I, the Vendor, am in compliance with all applicable standards, orders or regulations issued pursuant to the Clean Air Act of 1970, as Amended (42 U.S. C. 1857 (h), Section 508 of the Clean Water Act, as amended (33 U.S.C. 1368), Executive Order 117389 and Environmental Protection Agency Regulation, 40 CFR Part 15 as required under OMB Circular A-102, Attachment O, Paragraph 14 (1) regarding reporting violations to the grantor agency and to the United States Environment Protection Agency Assistant Administrator for the Enforcement.

I hereby further certify that my company has not been debarred, suspended or otherwise ineligible for participation in Federal Assistance programs under Executive Order 12549, "Debarment and Suspension", as described in the Federal Register and Rules and Regulations

Potential Vendor	TDIndustries, Inc.
Print Name	Crystal Seiler
Address	9525 Derrington Road
City, Sate, Zip	Houston, TX 7706
Authorized signature	
Date	July 21, 2020

Contractor Requirements

Contractor Certification
Contractor's Employment Eligibility

By entering the contract, Contractor warrants compliance with the Federal Immigration and Nationality Act (FINA), and all other federal and state immigration laws and regulations. The Contractor further warrants that it is in compliance with the various state statues of the states it is will operate this contract in.

Participating Government Entities including School Districts may request verification of compliance from any Contractor or subcontractor performing work under this Contract. These Entities reserve the right to confirm compliance in accordance with applicable laws.

Should the Participating Entities suspect or find that the Contractor or any of its subcontractors are not in compliance, they may pursue any and all remedies allowed by law, including, but not limited to: suspension of work, termination of the Contract for default, and suspension and/or debarment of the Contractor. All costs necessary to verify compliance are the responsibility of the Contractor.

The offeror complies and maintains compliance with the appropriate statutes which requires compliance with federal immigration laws by State employers, State contractors and State subcontractors in accordance with the E-Verify Employee Eligibility Verification Program.

Contractor shall comply with governing board policy of the NCPA Participating entities in which work is being performed

Fingerprint & Background Checks

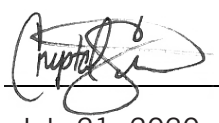
If required to provide services on school district property at least five (5) times during a month, contractor shall submit a full set of fingerprints to the school district if requested of each person or employee who may provide such service. Alternately, the school district may fingerprint those persons or employees. An exception to this requirement may be made as authorized in Governing Board policy. The district shall conduct a fingerprint check in accordance with the appropriate state and federal laws of all contractors, subcontractors or vendors and their employees for which fingerprints are submitted to the district. Contractor, subcontractors, vendors and their employees shall not provide services on school district properties until authorized by the District.

The offeror shall comply with fingerprinting requirements in accordance with appropriate statutes in the state in which the work is being performed unless otherwise exempted.

Contractor shall comply with governing board policy in the school district or Participating Entity in which work is being performed

Business Operations in Sudan, Iran

In accordance with A.R.S. 35-391 and A.R.S. 35-393, the Contractor hereby certifies that the contractor does not have scrutinized business operations in Sudan and/or Iran.

Authorized signature 

Date July 21, 2020

TDIndustries

Antitrust Certification Statements (Tex. Government Code § 2155.005)

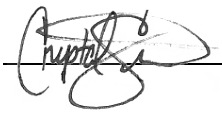
I affirm under penalty of perjury of the laws of the State of Texas that:

(1) I am duly authorized to execute this contract on my own behalf or on behalf of the company, corporation, firm, partnership or individual (Company) listed below;

(2) In connection with this bid, neither I nor any representative of the Company has violated any provision of the Texas Free Enterprise and Antitrust Act, Tex. Bus. & Comm. Code Chapter 15;

(3) In connection with this bid, neither I nor any representative of the Company has violated any federal antitrust law; and

(4) Neither I nor any representative of the Company has directly or indirectly communicated any of the contents of this bid to a competitor of the Company or any other company, corporation, firm, partnership or individual engaged in the same line of business as the Company.

Company name	TDIndustries, Inc.
Address	9525 Derrington Road
City/State/Zip	Houston, TX 7706
Telephone No.	713.939.1986
Fax No.	N/A
Email address	crystal.seiler@tdindustries.com
Printed name	Crystal Seiler
Position with company	Manager, PST
Authorized signature	

Required Clauses for Federal Funds Certifications

Participating Agencies may elect to use federal funds to purchase under the Master Agreement. The following certifications and provisions may be required and apply when a Participating Agency expends federal funds for any purchase resulting from this procurement process. Pursuant to 2 C.F.R. § 200.326, all contracts, including small purchases, awarded by the Participating Agency and the Participating Agency's subcontractors shall contain the procurement provisions of Appendix II to Part 200, as applicable.

APPENDIX II TO 2 CFR PART 200

(A) Contracts for more than the simplified acquisition threshold currently set at $150,000, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.

(B) Termination for cause and for convenience by the grantee or subgrantee including the manner by which it will be effected and the basis for settlement. (All contracts in excess of $10,000)

(C) Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 CFR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

Pursuant to Federal Rule (C) above, when a Participating Agency expends federal funds on any federally assisted construction contract, the equal opportunity clause is incorporated by reference herein.

(D) Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non- Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision

for compliance with the Copeland “Anti-Kickback” Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, “Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States”). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

(E) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of “funding agreement” under 37 CFR §401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that “funding agreement,” the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.

(G) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended— Contracts and subgrants of amounts in excess of $150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401- 7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251- 1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

(H) Debarment and Suspension (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), “Debarment and Suspension.” SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

(I) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)—Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee

of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

RECORD RETENTION REQUIREMENTS FOR CONTRACTS INVOLVING FEDERAL FUNDS

When federal funds are expended by Participating Agency for any contract resulting from this procurement process, offeror certifies that it will comply with the record retention requirements detailed in 2 CFR § 200.333. The offeror further certifies that offeror will retain all records as required by 2 CFR § 200.333 for a period of three years after grantees or subgrantees submit final expenditure reports or quarterly or annual financial reports, as applicable, and all other pending matters are closed.

CERTIFICATION OF COMPLIANCE WITH THE ENERGY POLICY AND CONSERVATION ACT

When Participating Agency expends federal funds for any contract resulting from this procurement process, offeror certifies that it will comply with the mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. 6321 et seq.; 49 C.F.R. Part 18).

CERTIFICATION OF COMPLIANCE WITH BUY AMERICA PROVISIONS

To the extent purchases are made with Federal Highway Administration, Federal Railroad Administration, or Federal Transit Administration funds, offeror certifies that its products comply with all applicable provisions of the Buy America Act and agrees to provide such certification or applicable waiver with respect to specific products to any Participating Agency upon request. Purchases made in accordance with the Buy America Act must still follow the applicable procurement rules calling for free and open competition.

Required Clauses for Federal Assistance provided by FTA

ACCESS TO RECORDS AND REPORTS

Contractor agrees to:

a) Maintain all books, records, accounts and reports required under this Contract for a period of not less than three (3) years after the date of termination or expiration of this Contract or any extensions thereof except in the event of litigation or settlement of claims arising from the performance of this Contract, in which case Contractor agrees to maintain same until Public Agency, the FTA Administrator, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims or exceptions related thereto.

b) Permit any of the foregoing parties to inspect all work, materials, payrolls, and other data and records with regard to the Project, and to audit the books, records, and accounts with regard to the Project and to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed for the purpose of audit and examination.

FTA does not require the inclusion of these requirements of Article 1.01 in subcontracts. Reference 49 CFR 18.39 (i)(11).

CIVIL RIGHTS / TITLE VI REQUIREMENTS

1) Non-discrimination. In accordance with Title VI of the Civil Rights Act of 1964, as amended, 42 U.S.C. § 2000d, Section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, Section 202 of the Americans with Disabilities Act of 1990, as amended, 42 U.S.C. § 12132, and Federal Transit Law at 49 U.S.C. § 5332, Contractor or subcontractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, marital status age, or disability. In addition, Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

2) Equal Employment Opportunity. The following Equal Employment Opportunity requirements apply to this Contract:

   a. Race, Color, Creed, National Origin, Sex. In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal Transit Law at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable Equal Employment Opportunity requirements of U.S. Dept. of Labor regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor, 41 CFR, Parts 60 et seq., and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of this Project. Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, marital status, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, Contractor agrees to comply with any implementing requirements FTA may issue.

   b. Age. In accordance with the Age Discrimination in Employment Act (ADEA) of 1967, as amended, 29 U.S.C. Sections 621 through 634, and Equal Employment Opportunity Commission (EEOC) implementing regulations, "Age Discrimination in Employment Act", 29 CFR Part 1625, prohibit employment discrimination by Contractor against individuals on the basis of age, including present and prospective

employees. In addition, Contractor agrees to comply with any implementing requirements FTA may issue.

c. Disabilities. In accordance with Section 102 of the Americans with Disabilities Act of 1990, as amended (ADA), 42 U.S.C. Sections 12101 *et seq.*, prohibits discrimination against qualified individuals with disabilities in programs, activities, and services, and imposes specific requirements on public and private entities. Contractor agrees that it will comply with the requirements of the Equal Employment Opportunity Commission (EEOC), "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 CFR, Part 1630, pertaining to employment of persons with disabilities and with their responsibilities under Titles I through V of the ADA in employment, public services, public accommodations, telecommunications, and other provisions.

d. Segregated Facilities. Contractor certifies that their company does not and will not maintain or provide for their employees any segregated facilities at any of their establishments, and that they do not and will not permit their employees to perform their services at any location under the Contractor's control where segregated facilities are maintained. As used in this certification the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion or national origin because of habit, local custom, or otherwise. Contractor agrees that a breach of this certification will be a violation of this Civil Rights clause.

3) Solicitations for Subcontracts, Including Procurements of Materials and Equipment. In all solicitations, either by competitive bidding or negotiation, made by Contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by Contractor of Contractor's obligations under this Contract and the regulations relative to non-discrimination on the grounds of race, color, creed, sex, disability, age or national origin.

4) Sanctions of Non-Compliance. In the event of Contractor's non-compliance with the non-discrimination provisions of this Contract, Public Agency shall impose such Contract sanctions as it or the FTA may determine to be appropriate, including, but not limited to: 1) Withholding of payments to Contractor under the Contract until Contractor complies, and/or; 2) Cancellation, termination or suspension of the Contract, in whole or in part.

Contractor agrees to include the requirements of this clause in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.

DISADVANTAGED BUSINESS PARTICIPATION

This Contract is subject to the requirements of Title 49, Code of Federal Regulations, Part 26, "*Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs"*, therefore, it is the policy of the Department of Transportation (DOT) to ensure that Disadvantaged Business Enterprises (DBEs), as defined in 49 CFR Part 26, have an equal opportunity to receive and participate in the performance of DOT-assisted contracts.

1) Non-Discrimination Assurances. Contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. Contractor shall carry out all applicablerequirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or other such remedy as public agency deems appropriate. Each subcontract Contractor signs with a subcontractor must include the assurance in this paragraph. (See 49 CFR 26.13(b)).

2) Prompt Payment. Contractor is required to pay each subcontractor performing Work under this prime Contract for satisfactory performance of that work no later than thirty (30) days after Contractor's receipt of payment for that Work from public agency. In addition, Contractor is required to return any retainage payments to those subcontractors within thirty (30) days after the subcontractor's work related to this Contract is satisfactorily completed and any liens have been secured. Any delay or postponement of payment from the above time frames may occur only for good cause following written approval of public agency. This clause applies to both DBE and non-DBE subcontractors. Contractor must promptly notify public agency whenever a DBE subcontractor performing Work related to this Contract is terminated or fails to complete its Work, and must make good faith efforts to engage another DBE subcontractor to perform at least the same amount of work. Contractor may not terminate any DBE subcontractor and perform that Work through its own forces, or those of an affiliate, without prior written consent of public agency.

3) DBE Program. In connection with the performance of this Contract, Contractor will cooperate with public agency in meeting its commitments and goals to ensure that DBEs shall have the maximum practicable opportunity to compete for subcontract work, regardless of whether a contract goal is set for this Contract. Contractor agrees to use good faith efforts to carry out a policy in the award of its subcontracts, agent agreements, and procurement contracts which will, to the fullest extent, utilize DBEs consistent with the efficient performance of the Contract.

ENERGY CONSERVATION REQUIREMENTS

Contractor agrees to comply with mandatory standards and policies relating to energy efficiency which are contained in the State energy conservation plans issued under the Energy Policy and Conservation Act, as amended, 42 U.S.C. Sections 6321 *et seq.* and 41 CFR Part 301-10.

FEDERAL CHANGES

Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Contract between public agency and the FTA, as they may be amended or promulgated from time to time during the term of this contract. Contractor's failure to so comply shall constitute a material breach of this Contract.

INCORPORATION OF FEDERAL TRANSIT ADMINISTRATION (FTA) TERMS

The provisions include, in part, certain Standard Terms and Conditions required by the U.S. Department of Transportation (DOT), whether or not expressly set forth in the preceding Contract provisions. All contractual provisions required by the DOT, as set forth in the most current FTA Circular 4220.1F, dated November 1, 2008, are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Contract. Contractor agrees not to perform any act, fail to perform any act, or refuse to comply with any public agency requests that would cause public agency to be in violation of the FTA terms and conditions.

NO FEDERAL GOVERNMENT OBLIGATIONS TO THIRD PARTIES

Agency and Contractor acknowledge and agree that, absent the Federal Government's express written consent and notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying Contract, the Federal Government is not a party to this Contract and shall not be subject to any obligations or liabilities to agency, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying Contract.

Contractor agrees to include the above clause in each subcontract financed in whole or in part with federal assistance provided by the FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS

Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. §§ 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 CFR Part 31, apply to its actions pertaining to this Contract. Upon execution of the underlying Contract, Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to me made, pertaining to the underlying Contract or the FTA assisted project for which this Contract Work is being performed.

In addition to other penalties that may be applicable, Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on Contractor to the extent the Federal Government deems appropriate.

Contractor also acknowledges that if it makes, or causes to me made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5307 (n)(1) on the Contractor, to the extent the Federal Government deems appropriate.

Contractor agrees to include the above clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

State Notice Addendum

The National Cooperative Purchasing Alliance (NCPA), on behalf of NCPA and its current and potential participants to include all county, city, special district, local government, school district, private K-12 school, higher education institution, state, tribal government, other government agency, healthcare organization, nonprofit organization and all other Public Agencies located nationally in all fifty states, issues this Request for Proposal (RFP) to result in a national contract.

For your reference, the links below include some, but not all, of the entities included in this proposal:

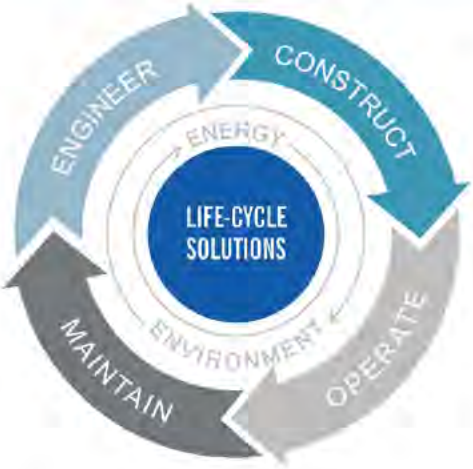
http://www.usa.gov/Agencies/Local_Government/Cities.shtml
http://nces.ed.gov/globallocator/
https://harvester.census.gov/imls/search/index.asp
http://nccsweb.urban.org/PubApps/search.php
http://www.usa.gov/Government/Tribal-Sites/index.shtml
http://www.usa.gov/Agencies/State-and-Territories.shtml
http://www.nreca.coop/about-electric-cooperatives/member-directory/
https://sos.oregon.gov/blue-book/Pages/state.aspx
https://portal.ehawaii.gov/government/
https://access.wa.gov/governmentagencies.html

APPENDIX:

ADDITIONAL QUALIFICATIONS AND EXPERIENCE

QUALIFICATIONS AND EXPERIENCE

viii. Provide any additional information relevant to this section.



LIFE-CYCLE SOLUTIONS

Unlike most mechanical construction providers, TDIndustries is also a full service design, facility management and demand-service provider.

By being a life-cycle mechanical contractor we are able to offer our customers a "one-stop shop" solution for our customers. We understand the unique requirements of critical operating systems.

SAFETY

COVID-19 PROTOCOL

With COVID-19 affecting the economy in a negative way, companies have found themselves in a recession-like situation, faster and earlier than expected. With the unknown ahead, TD is proactively working to keep partners safe and clients happy.

To stay ahead of the pandemic and to help ensure the safety of others, TD has implemented protocol for COVID-19 on every jobsite including:

SAFETY AWARDS

TDIndustries continues to be acknowledged as a leader in safety at the local, regional and national levels, most recently by the Associated General Contractors (AGC) of America where TDIndustries won the Second Place National Construction Safety Excellence Award for a Specialty Contractor with Over 1 Million Work Hours. The award was earned based on results, risk mitigation, hazard identification and control, training and a comprehensive safety program. For many years, those results (EMR, TRIR and other measurements) tell the same story - TD is a leader in the Specialty Contracting Industry. Our safety metrics have consistently been among the best in the country.

In 2019 TDIndustries' Safety Culture was recognized by both AGC and ABC:

- ABC Pinnacle Safety Award
- Second Place National Construction Safety Excellence Award by the Associated General Contractors of America (AGC)

TD'S WORLD-CLASS SAFETY PROGRAM

Our commitment to safety is reflected in our Core Values. Our Partners are the most valued assets of the company and the welfare of everyone is of the highest importance. We continually and aggressively communicate our safety programs to our Partners and subcontractors.

TDIndustries remains committed to continuously improving our safety programs and culture. In an effort to become a world-class safety focused organization, we began to practice behavioral-based safety. Following this process leads to a more proactive approach, focusing on safe behaviors to prevent injuries. In 2016, we debuted the TD Safety Observation Training (TSOT) program for behavior-based safety training. All leaders from the CEO to foremen have underwent TSOT education.

Safety Observations are the key to improving safety performance by addressing the lead measure indicators and behaviors before they manifest as incidents. These tools will be incorporated into our safety program for this project as well. All local Partners attend our safety orientations which cover all major safety topics for construction sites.

TDIndustries

DRUG-FREE WORKPLACE

To help ensure a drug-free workplace, we have a comprehensive drug testing program including: pre-employment drug screen, post-incident drug screen, random drug screens and screening upon probable cause. In addition, we require weekly safety meetings, as well as a "Pre-Task Safety Plan" which consists of an outline of individual tasks, any required PPE and how to perform the task safely.

RECENT SAFETY DATA

	EMR	LTIR	TRIR	TOTAL HOURS WORKED
2019	.63	.03	1.4	6,661,989
2018	.77	.3	2.3	6,136,430
2017	.7	.2	2	5,686,471
2016	.73	.2	2.3	4,671,298
2015	.68	.1	2	4,167,223

A SAMPLE OF TD TRAININGS AND CERTIFICATIONS FOR SUPERINTENDENTS, SUPERVISORS, AND MORE

All field supervisors or leads are required to take TEXO Safety First, OSHA 10-hour safety training, as well as other TD required training such as PPE, Fall Protection, EEW, Lockout-Tagout, etc.

FIRST AID/CPR

PPE

LADDER

TEXO SAFETY FIRST

OSHA TRAINING

WHAT IS THE VALUE OF TD'S SAFETY RESOURCES?

LAYERS OF PROTECTION

1. Culture

TD is partner-owned, and family-oriented. Partners consistently watch out for each other, and leaders encourage open communication and safety practices.

2. Protocol

When partners are first hired, each of them go through TD's safety protocol and training.

3. Training

Not only does TD train their employees, we also pay for the necessary certifications, and offer resources on our internal website to reference safety as well as on each jobsite.

4. PPE

This should be the last layer of protection. If everything mentioned prior including culture, protocol and training is being followed, PPE should not be needed. Nonetheless, TD recognizes that things happen, and we make sure our Partners and subcontractors are prepared with the necessary PPE when on a jobsite.

HOW DOES TD STAY UP TO DATE?

SAFETY APP

TD teamed with application developer, SmartTagIt, to utilize a new real-time and integrated safety app to send notifications, share pre-task safety plans, inspections, observations, and safety alerts.

The system offers robust reporting and safety metrics. The alerts and observations include Partner feedback on their own severity-level rating of the condition or behavior observed.

The safety app helps make TD's safety processes:

- Easier to follow
- More effective
- More engaging

The app brings better awareness of hazards and improved planning. It is used by 900+ Partners, including all field leadership and up, plus all service technicians. Partners performing either safety inspections or safety observations have been provided SmartTagIt accounts.

The app will also:

- Manage the safety performance on all job sites
- Fix hazards
- Provide tools to stop unsafe working behaviors

Engage in proactive safety processes consistently and often

Sample Pre-Task Safety Plan

DIVERSITY PROGRAMS

Do you currently have a diversity program or any diversity partners that you do business with? Yes No

(If the answer is yes, attach a statement detailing the structure of your program, along with a list of your diversity alliances and a copy of their certifications.)

Valuing differences has always been one of TD's basic values. And that belief is practiced among our Partners, customers, suppliers and vendors, and within our community. TD understands that the diversity among us is our greatest strength and is critical to our continued success. Our CEO, Harold MacDowell, continuously strives for representation and inclusion at all levels of the organization. TD recognizes that diversity and inclusion are not only the right things to do, but are strategic pillars to achieving our success and growth for the future

TDIndustries

At the Heart of Your Building

Quality Assurance Plan

Project Name: **NCPA Cooperative**

Project Number: **RFP #17-20**

Location: **Enterprise-wide**

Document Date and Revision: 23-July-2020

Table of Contents

CONCEPTS & POLICIES

Quality consciousness in today's building industry has become an essential and valuable aspect of the construction process. TDIndustries stands firmly by our principles to provide the client with the highest quality and standards along with successful turnover of a project free from deficiencies. We understand the value of a proactive Quality Assurance/ Quality Control program and emphasize its importance as a vital contributor in ensuring client satisfaction.

Failures or defects during the installation process can result in a project burdened with large costs and delays, deflated morale, dissatisfied customers and can even result in personal injuries or fatalities. Our model of quality assurance is based on the TDIndustries values to Passionately Pursue Excellence and Build and Maintain Trusting Relationships. We view our quality culture as key to outstanding performance throughout the construction process. On any TDIndustries project, Quality comes second only to Safety.

TDIndustries maintains the Construction Process Manual (CPM) to define and communicate the processes, tools and lessons learned of carrying out a construction project from the beginning of a substantial lead to the turning over control of a site to the Owner. The CPM is supplemented by a project specific Quality Assurance Plan. This plan provides a systematic approach for defect prevention, quality measurement (inspection and testing) and concern resolution, to assure the achievement of project quality objectives. This plan is a living document that will mold itself to the project requirements and can also adjust to any changing of the project.

As an employee owned company, we are committed to fostering a spirit of pride that stimulates our creativity, powers our initiative, perfects our performance and strengthens our already strong sense of responsibility. While specific individuals have assigned tasks toward quality assurance and quality control on a project, ultimately it is the responsibility of all TD Partners involved.

QUALITY CONTROL / QUALITY ASSURANCE RESPONSIBILITIES

The responsibilities of the TDIndustries Project Team are to ensure the highest standards of workmanship are being employed and the project is installed skillfully, professionally and in conformance to project requirements and standards. This requires the team to be knowledgeable and informed of the project plans and specifications, materials and equipment being installed as well as applicable local, state and federal codes. In summary:

- **The Senior Project Manager** shall be responsible for assigning responsibilities to Project Managers in the areas of operations, document control and quality support. Together with QA/QC Partners, these individuals shall be responsible for implementing and maintaining conformance with the Quality Assurance Plan for the project.
- **The Senior Superintendent** shall be responsible for the performance of all work on site to be installed safely and per the quality expectations set forth in this plan.
- **The Quality Assurance Manager** shall be responsible for verifying and documenting the conformance of installed systems.
    - Monitor TDIndustries subcontractors for compliance to quality control procedures.
    - Review welding certificates and other applicable qualifications.
    - Witness and maintain documentation of system tests.
    - Distribute test reports, flush reports and all test documentation associated with project to TDIndustries Project Team and Customer's QA Manager as required. QA/QC documents should be filed so that they are available for quick accessibility by all members of the project team.
    - Create and administer internal punch lists. Track status of repair/rework and verify completion of punch lists prior to inspections.
    - Manage job site inspections. These includes preparing, performing and documenting inspections that may include: initial, preparation for final, and final inspections. Trade specific inspections may consist of wall close-ins, shaft close-ins, ceiling close-ins, floor close-ins, and equipment room inspections.
    - Maintain records of all discrepancy reports on the project and periodically review these items with project leadership and craftsman and respond accordingly.
    - Support project team by reviewing QC concerns brought forth by the customer, owner or other client parties. Coordinate discussions between all parties to ensure prompt resolution of issues.
    - Monitor quality of in-house pre-fabrication.

In addition to the above tasks, TDIndustries project team continually observe work in progress and address any installation methods that may lead to an unacceptable or inadequate product.

PROCEDURES

The TDIndustries Quality Assurance process consists of four phases: **Planning Phase, In-Process Inspection Phase, Close-in Inspection Phase and Final Inspection Phase**. These phases are applied to the many mechanical, plumbing and piping systems that are a part of a large-scale construction project. The activities within these phases are described as follows:

1. PLANNING PHASE

Project planning never stops. Throughout the project, methods and activities to accomplish compliance with the project drawings and specifications for the project will be determined, performed and monitored for successful completion. Key quality assurance elements of TDIndustries planning process include:

- Spec Summary Sheet (SSS) is a summary of the chosen materials, including, but not limited to pipes, valves, fittings, and sheet metal. System materials are selected in accordance with the project drawings and specifications during the estimating process. These materials are further validated and defined once the project is initiated by the Project Manager and Superintendent. Trade specific means and methods are documented by the Superintendent prior to procurement of the materials.
- Project Planning Sessions is the planning method TD has developed in order to plan job progress and eliminate the negative effects associated with poor planning. It is a guide that provides structure, schedule, and accountability for complete project planning. There are several defined sessions, including trade specific and for startup. These may occur separately or jointly, depending on the type and duration of a project. Planning is started prior to construction and continues throughout the project. Typically, these meetings establish goals, review project drawings, specifications, submittals, the project Quality Control Plan, and serve to confirm that the entire Project Team is prepared to comply with the requirements of the contract documents. Below is a list of what may be expected at a TDIndustries Project Planning Session.
    - □ Advance review of the requirements relevant to the agenda.
    - □ Complete full review of all applicable construction drawings, specification sections, submittals, RFIs.
    - □ Identification of risks and development of mitigation plans.
    - □ Identification of specific inspection or testing requirements associated with the work. This may include hold points to review first in kind work.
    - □ Review of project schedules, inspection schedules and coordination of trades.
    - □ Review of safety requirements, and applicable Pre-Task Safety Plans as appropriate.
    - □ Review of TD Lessons Learned database for applicable learnings.

Upon completion of the review, all actions, issue resolutions and / or agreements made are

documented. Meeting minutes are distributed to the TDIndustries Project Team and other attendees. A critical part of all Planning Sessions is the follow up of all action plans that are developed. Actions are addressed and updated at succeeding Team meetings.

- Procurement – TDIndustries ensures that all materials, equipment, and subcontracted services are provided and installed in compliance with the plans and specifications for the project.
  - □ Materials and equipment suppliers will be selected and evaluated based on their ability to provide the specified materials and equipment in compliance with the plans and specifications, prior successful partnership and performance with TD, and service/technical support deliverability. Subcontractors will be evaluated based on prior service and ability to meet the installation requirements of this project.
  - □ After selection of an equipment/materials vendor or subcontractor, submittals will be prepared and forwarded to TDIndustries for review and comparison by the Project Manager to confirm compliance with the requirements of plans and specifications. Any clarifications or corrections required will be made prior to submission of the specific products to the Contractor.
    - ✓ A submittal log (through the appropriate means) will be monitored to ensure prompt and timely return/approval of submittals so delays in the work can be prevented.
    - ✓ The complete submittal packet as commented upon by the reviewing entity will be forwarded to the vendor/subcontractor for their review, action, and incorporation into the job files.
    - ✓ A copy of all approved submittals are provided to the Quality Assurance Manager for use in ensuring compliance as materials/equipment arrives on site.

- Document Management – TDIndustries ensures that relevant documents, such as plans, specs, drawings, and submittals that are required for project success and quality are available to TDPartners that need them. TDIndustries uses Autodesk BIM360 to deliver this information to our field partner's hand-held technology, ensuring secure access to the most current approved information wherever they are on the job. Additionally, the 3D BIM model may be provided.
- Partner Qualifications – TDIndustries ensures TD Partners have the skills to perform their work to the applicable codes, specifications and TD requirements. Welding processes and operators are qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX.
- Method of Procedure (MOP) – TDIndustries ensures thorough consideration of the risks associated with preforming work in critical or operating environments through use of a MOP. The intent is to perform all construction activities successfully without impact on our customers. A copy of the MOP template is attached.

2. IN-PROCESS PHASE

The in-process phase consists of monitoring installation activities and verifying they meet job specifications. TDIndustries has procedures including visual and physical examination of work in place, leak testing of ductwork, pressure testing of piping and plumbing systems, Quality issue creation and management, and red-line drawings for as-built drawing submittals. By monitoring construction work during installation, any issues are found as early as possible and prevented from recurrence by addressing their causes.

This monitoring process is guided by the use of Checklists within the BIM360 Field Management software module. Any observed irregularities, discrepancies, defects or deficiencies are exposed during this phase and immediately addressed prior to any subsequent inspections. The following actions occur during the in-process inspection phase:

- Equipment Verifications – TDIndustries staff will utilize Equipment Checklists to inspect equipment as it is delivered from the manufacturer. This will ensure that any potential issues are brought forward at the earliest possible opportunity rather than waiting for the installer of the equipment to find them at a later date.

- First Work is evaluated as defined during the planning phase. This includes inspections that verify the work plan from planning phase is being followed, and that quality and workmanship reflect the planning meeting requirements.

- Rough-in Inspections - TDIndustries staff will observe areas of work on a regular basis and verify that the basic scope of work is being installed in compliance with plans and specs and without irregularities.

- Self-Work Completion Review – Quality at the source is a powerful Lean tool practiced by TDIndustries. TD Partners are responsible for the quality of their own work. Field personal will visually check the following in their work area before reporting an area as completed.

  - □ Quality of installation
    - ✓ Installation meets criteria set forth in codes, specifications, TD workmanship standards, approved submittals and mock ups, when applicable.
    - ✓ Correct materials were used.
    - ✓ Supports are correctly sized, spaced, and installed.
    - ✓ Installations are clean and free of damage.
  - □ Openings are covered and/or protected from contamination.
  - □ Internal and external cleanliness of all systems.
  - □ Adherence to good housekeeping practices.

- Subcontractor Quality –TD QAQC monitors and assesses the acceptability of work performed by TD Subcontractor work. Subcontractors are required to perform work to all required codes and specifications, in addition to TD's internal quality requirements/

- Control of Nonconformances – Should discrepancies or deficiencies occur in the quality of work, TD will systematically contain the issue and promptly review and make corrections as appropriate. These issues are documented and tracked in BIM360 Field Management as defined below. Each item will detail the condition found, the location, the associated trade, and the required completion date. Foreman or superintendents will arrange for the proper repair, replacement or rework to bring the material or workmanship into conformance. Should there be a need for customer approval, the Project Manager will formalize this through an RFI.

  These items will be regularly reviewed in team meetings and monitored for resolution. Once the nonconformance is corrected, the item will be statused by the foreman or superintendent as completed, and reinspection will be performed by QAQC. Once successfully evaluated, QAQC will status the tracking issue as closed.

  Fixing problems is not sufficient. TDIndustries systematically prevents recurrence of issues to ensure continual improvement in quality. TDIndustries uses a structured process to perform root cause analysis and to implement solutions. Solutions may involve a combination of enhanced process controls, training, upgrading of personnel qualifications, or improved processes.

  - Quality Issues – These are found internally, while work is still in progress, and are items that are nonconforming to code, specification or workmanship guidelines. They may be found during quality walks or in-process inspection. They require cross functional review and resolution. Resolution may include rework, repair, or customer approval to leave in place. The intention is that early detection of issues will prevent items from becoming a Punch List item later in the project.
  - Action Items – These are internal items needing attention by a member of the project team. They may be incomplete work, a clash with other trades, or damaged work. They are found internally during quality walks or in-process inspections and may be assigned to internal trade foremen or subcontractors for completion or to the Project Superintendent for resolution with other trades.
  - Make Ready Needs – These are actions needing team attention that Items that directly affect schedule and/or critical path. These items may prevent work from being done if not addressed within the requested timeframe.
  - Startup – These are equipment readiness items that prevent the proper startup of equipment. These may be triggered by the equipment specific checklists for startup.
  - Warranty - work performed after turnover for the customer to address concerns in system or equipment performance or quality. This may be initiated by customer request, or as a follow on an existing concern.

External Punch Lists are addressed in the customer specified system, such as a project form, BIM360, Procore, etc. TDIndustries Quality Assurance Manager will review and evaluate all external Punch Lists or discrepancies published by client or owner. If there is disagreement in the validity of the item, the Quality Assurance Manager and/or others from the Project Team will discuss and reach a resolution with the publisher. TDIndustries recognizes these items must be resolved promptly to support project timelines. It is important to understand that Items to Complete should not be managed as discrepancies and are likely a reflection of work in progress due to the iterative nature of mechanical installations.

- Pressure Testing - TDIndustries QA/QC monitors the performance of all necessary and specified pressure testing of systems and will coordinate any required 3rd party witnesses. All leak detection and final pressure testing and inspections will be performed in accordance with technical specifications and contract documents, as well as TDIndustries procedures. The Sr. Superintendent shall approve and endorse each test based on available information. All pressure testing should be completed prior to shaft, wall, ceiling or floor close-ins. If testing before insulation or close in is not feasible, TD will work with the customer for any required RFIs or waivers. An example of the test report is attached.

- Duct Leak Testing – TDIndustries QA/QC monitors the performance of all required duct leak testing, which is performed per the industry guidelines established in SMACNA HVAC Duct Leakage Test Manual. Results are confirmed to be acceptable per the applicable specification or code.

3. CLOSE-IN INSPECTION PHASE

Additional quality activities are performed at the close-in inspection phase. These typically include ceiling and wall close-ins. TDIndustries QA/QC will examine TD work, documenting any discrepancies in internal punch lists and verifying completion of work prior to scheduled inspection dates. Issues found at this time will become Internal Punch List Items as described above. Timeliness of review and completion of re-work is essential so that project delays do not occur. Readiness for closure will be indicated by a color coded marking on the studs or ceiling grids. Approved work will be documented by photograph. The following details are specific to each type of close in:

- Ceiling Close-In Inspections – Where mechanical or piping systems are located above ceilings, TDIndustries will verify that all systems are installed per current contract drawings, specifications and approved changes. The intent of this inspection is to ensure that all work is tested and installed in a satisfactory manner prior to installation of finished ceilings. This may include but is not limited to hanger spacing, hanger sizes, repairs to insulation, access to valves or equipment, vents and low point drains, identification, fire damper access, filters, valve tags and caulking.

- Wall Close-In Inspections – Where mechanical or piping systems are located inside walls, TDIndustries will verify that systems are installed per the contract drawings, specifications

and approved changes. The intent of this inspection is to confirm that all work being covered up by a finished material is tested and installed in a professional manner. This may include but is not limited to support spacing and sizes, access to valves and/or equipment, correct rough-in dimensions for fixtures, required clean-outs with proper access and completed insulation.

4. FINAL INSPECTION PHASE

The last phase of the inspection process is the Final Inspection Phase. Preparations and pre-final inspections precede and verify the readiness of an area or system for final inspection and acceptance by the customer and/or the owner.

- TDIndustries Startup Team verifies equipment readiness for the Testing Adjusting and Balancing subcontractor. TDIndustries will utilize internal pre-commissioning checklists to verify the readiness of equipment and systems for TAB as well as commissioning. While performance of commissioning may be outside the scope of work for TDIndustries, the TDIndustries Project Team is fully committed to supporting this very important phase of construction as needed.

- TD QA/QC performs pre-final inspections where work is evaluated for completion to required specifications and codes. TD QA/QC uses BIM360 Field Management to track and ensure that items have been completed and accepted prior to the scheduled final inspection.

- TD Quality Manager will walk with the Customer and/or Owner's Quality Assurance representative for the Final Inspection to illustrate that the work is complete and ready for acceptance. The intent is that the applicable area will be signed off and accepted for project turnover. Photographs of the condition of the completed and approved work may be made for record purposes.

TDIndustries works to achieve Zero Punch List at time of substantial turnover. Any damage, defects or deficiencies the owner or client exposes during the Final Inspections will be addressed with urgency. The TDIndustries Quality Assurance Manager will take the punch list published by client or owner and manage it as an External Punch List item as described previously. All External Punch List items identified at time of substantial completion will be incorporated into the BIM360 Field Management tracking system, and will communicate the issues to the TDIndustries Project Manager, and TD Quality Director, as well as the appropriate superintendent and foreman for repair or correction.

TURNOVER

TDIndustries wants the final turnover to demonstrate and accentuate our dedication to quality, value and partnership with our customers. The benefits of our commitment to quality execution and system performance, combined with years of "lesson learned" assure that proper quality is implemented early on, and throughout the project.

ATTACHMENTS

To be defined by project team:

BIM 360 sample checklists

- TD-NTXC Above Ceiling Checklist
- TD-NTXC Quality Walk Checklist

Pressure Test Report

MOP Template