

MANUFACTURING EQUIPMENT PURCHASE SPECIFICATION

NEXTEER AUTOMOTIVE

TITLE LOW TEMPERATURE CONTINUOUS DRAW FURNACES

NUMBER SD-1031

ISSUED BY: Brandon Ittner

DATE: 22 May 2007

APPROVED BY: Randall Socha

REVISION: 003

REV. DATE: 5 January 2020

SHEET: 1 OF 21

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VIII. SPECIFICATIONS

- A. There are three (3) levels of specifications in the Nexteer hierarchy of Manufacturing Equipment Purchase Specifications. Compliance to these specifications is mandatory, except those items referred to as "should". These items are highly recommended and preferred.
 - 1. The T-Series Manufacturing Equipment Purchase Specifications provide specific information on the draw furnace being purchased. This specification defines the draw furnace(s) being purchased, the parts and process, volumes and cycle time required, the location of the Nexteer facility the draw furnace will be installed, delivery requirements, quoting requirements, and any deviations and or exceptions to the SD-1000 series and SD-000 series specifications.
 - 2. The SD-1000 series of specifications covers the basic requirements for a specific type of equipment. This specification is part of the SD-1000 series. It specifies the complete design, build and run-off requirements for recirculating air, continuous draw furnaces that operate below 750° F. It is intended to provide a common standard for all low temperature draw furnaces for Nexteer facilities. It is applicable to belt draws, pusher draws, rotary draws, etc. In this specification are listed any deviations or exceptions to the SD-000 series specifications.
 - 3. The SD-000 series of specifications covers the basic requirements for all equipment being supplied to Nexteer. These specifications cover the drawings, manuals, preferred components, sound level, vibrations, etc.
- B. Unless otherwise specified, Draw Furnaces shall conform to latest National Fire Protection Association code NFPA 86, "Ovens and Furnaces". Equipment for European locations shall comply with European Standards EN 746 for Industrial Thermoprocessing Equipment.
- C. Supplier shall submit all required documentation for gas fired draw furnaces to the Nexteer fire insurance carrier for their recommendations and acceptance.
- D. Based on the Design-in Health and Safety Specification DA-2006 which is referenced in SD-000, a risk assessment shall be completed before designs can be approved. Vendor shall participate with Nexteer in risk assessment at Nexteer location.
- E. These specifications are issued for the purpose of providing standards to assure the safety of personnel, to provide trouble free operation, and to facilitate maintenance. They are not intended to inhibit design or progress of the industrial heating equipment industry. Compliance with these specifications does not, in any way, relieve the supplier of the responsibility to design and build a quality, workable piece of equipment.
- F. Deviations to these specifications must be approved prior to issuing a purchase order.
 - 1. All deviations to these specifications shall be itemized in the proposal.
 - 2. Any deviations requested after a purchase order is issued must be approved in writing by the Nexteer Process Engineer responsible for heat treat equipment.
- G. Suppliers are encouraged to submit options to these specifications that result in reduced costs and/or improved quality.

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IX. DRAW FURNACE REQUIREMENTS

A. General Draw Furnace Requirements

1. Draw furnaces shall have a maximum operating temperature of 750 °F (400 °C) at reduced capacity.
 - a) Heating system should be designed to meet the load and temperature requirements as defined in the T-series specification.
 - b) Empty draw furnaces shall heat up from ambient temperature to 750 °F (400 °C) in less than 30 minutes with the conveying mechanism running.
2. Air temperature uniformity in empty draw furnace at operating temperature shall be:
 - a) ± 5.0 °F (2.5 °C) across the width.
 - b) ± 5.0 °F (2.5 °C) across the length.
 - c) ± 5.0 °F (2.5 °C) from top to bottom.
 - d) Required for all operating temperatures.
3. With the draw furnace at operating temperature, draw furnace must be capable of heating parts to operating temperature and holding at this temperature for one hour. The core of the parts must be at temperature for a minimum of one (1) hour.
4. The length of the draw furnace shall be determined by the conveying mechanism speed, the heat-up rate, and the soak time. The furnace shall be designed such that parts are at heat at the control thermocouple. The temperature controller shall be set at the required operating temperature. A thermal head is not permitted.
5. Control Thermocouples are to be located in the Qualified Working Zone aka "Soak Zone" of the machine.
6. Where multiple thermocouples are used, function of them must be noted such as "Control" or "Monitor". Thermocouples are not permitted to be averaged together to control furnace temperature.

B. Draw Furnace Construction

1. Access openings shall be provided for maintenance and clean-out in all draw furnaces. Access openings shall be provided every 10 to 15 feet (3-5 m). The access openings can be the charge or discharge door if the draw furnace is small enough to perform all maintenance by reaching through the door opening, and the doors are large enough to allow a man to crawl into the draw furnace. Design shall include interlocks to prevent parts from going over temperature if access doors are opened with parts inside.
2. Draw furnaces shall have frequent clean-out holes along both sides of the hearth. These openings shall permit the removal of any parts, etc. from below the conveying mechanism.
3. Clearance over the conveying mechanism shall be at least 12 inches (300 mm).
4. Charge-end and discharge-end openings shall be covered with wire mesh curtains (reference Wiremation WFC-1 or equivalent) to minimize cold air infiltration.
5. If the length of any one zone exceeds 25 feet (7.5 m), the furnace shall be provided with the multiple zones.

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C. Cool-Off Station/Ventilation Requirements

1. Each end of the draw furnace shall have a ventilation system with hoods and fans to prevent smoke and exhaust from entering the plant.
2. A cool-off station shall be provided immediately following the draw furnace, so that the parts can be handled immediately and to limit the heat load on the plant.
 - a) The cool off station shall be a push/pull design.
 - b) Design shall inhibit operators from pulling hot parts out of the cooling station.
 - c) The station shall be designed to utilize outside make-up air.
 - d) The parts should exit the station within 30° F (15 °C) of ambient. Maximum part temperature allowable for handling without gloves is 113 ° F (45 °C).
 - e) The cool-off station should also serve as the discharge end ventilation.
 - f) The design of the cool-off station shall include access doors as required.
3. Ventilation/Cooling Station design shall:
 - a) Limit the Plant ambient heat load and yet keep make-up air requirements low.
 - b) Account for any negative air pressure that may exist in the Plant.
 - c) Keep noise level below 80 Db.
 - d) Consider altitude of the Plant and existing negative air pressure in the plant.
 - e) Unless otherwise specified in the T specification, assume parts loaded into the draw furnace will have been quenched in a water based polymer quenchant.
4. All required motor starters, push buttons, pilot lamps, logic, wiring, hoods, dampers, fans, motors, remote disconnects, and ductwork shall be provided up to and including the fans.
5. Disassembly should not be required for shipping. Nexteer to complete design, build and installation of ductwork from the top of the fans to outside of the Plant. Nexteer connection points shall have flanged openings with bolt holes.
6. The ventilation/cooling fans shall be equipment mounted. A structural steel base for fan mounting including any miscellaneous stairways and platforms complete with railings required for fan access and maintenance shall be provided.
7. The ventilation/cooling fans shall be centrifugal fans.
 - a) Fan base should be an integral type to incorporate motor mounting (assuming belt drive) with spring type isolators.
 - b) Fans should be non-overloading backward inclined type Class II construction.
 - c) The fans shall be sized to accommodate a 50 foot (15 m) run of straight ductwork and still maintain its required flow rate.
 - d) The size, type and flow rate of the fans shall be stated in the proposal.
8. Draw furnaces that require an internal exhaust system:
 - a) The recirculation fan shall be utilized to supply fresh air and exhaust air from the draw furnace.
 - b) Fresh air inlet if required should be located on top of the draw and have a lockable damper that requires a tool to alter position. Damper should be open to minimum

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requirements for the draw furnace operation and locked in place. Position should be indicated on the draw furnace and recorded in the operating manual.

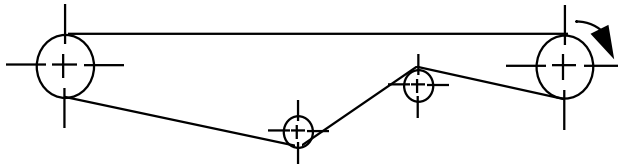
- c) Draw furnace exhaust outlet, if required, should be located on the top of the draw furnace. Outlet should have a lockable damper that requires a tool to alter position. Damper should be open to minimum requirements for the draw furnace operation and locked in place. Position should be indicated on the draw furnace and recorded in the operating manual. Ductwork shall not be direct connected to draw furnace exhaust.

- d) Purge time requirements (if applicable) shall be posted on the draw furnace panels

D. Conveyor and Drive Requirements

1. Variable speed drive conveyor systems are preferred for continuous motion belt and chain draw ovens. All drive settings shall be visible and adjustable in the PLC from the HMI. All drive settings are to be password protected and documented on the drawings and in the manuals.
2. Single speed fixed conveyor drive systems are preferred for indexing motion belt or chain systems.
3. Belt furnaces shall use a U-Link Flat Wire belt per SS-AL82104 or equivalent. The belt, installation and adjustment shall be included in the base furnace price.
4. Fixture furnaces shall use a double pitch attachment chain. The chain, installation and adjustment shall be included in the base furnace price.
 - a) Pins on fixture style conveyors shall use replaceable Pins held on by ¼"-20 non-hardened bolts.
5. The drive drum at the discharge end of belt furnaces shall be constructed such that a sprocket or tooth engages with every strand of chain.
6. The idler and drive drums shall extend beyond all of the belt furnace structure mechanisms and supports to permit installation of the load and unload material handling equipment under the drums.
7. Belt draw furnace shall utilize take-up mechanisms designed to compensate for changes in the belt length due to wear, temperature changes, variations in load, etc., and to keep belt tension constant at the proper level. An automatic take-up belt stretch plus thermal expansion shall be provided at the drive end of the furnace.

A Typical Belt Take-Up System



E. General Information

1. Provisions must be made for slings, hooks, or skids adequate to handle the draw furnace, cooling tunnels and carts during loading, unloading and shipping. When lifting points are critical, they shall be marked.

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2. Any items that require regular maintenance and all control devices such as thermocouples, motor operated valves, drive motors, reducers, valves, gauges, pressure switches, motors, recirculating fans, etc. shall be located within 6 feet of the Plant floor or from a provided platform.
 - a) An access ladder with non-slip surfaces and a self-closing gate are required for any platform more than 6 feet (2 m) above floor level.
 - b) All platforms shall have 42 inches (1m) high hand rails, mid rails and 4 inch (100 mm) toe boards.
 - c) Bar (Gary or equivalent) type grating shall be used on elevated platforms.
 - d) All platforms shall have load rating prominently displayed.
3. The draw furnace shall be approved for safe operation by the Nexteer Safety Department prior to shipping. The supplier is responsible to correct any safety violations identified by the Nexteer Safety Department.
4. Hydraulic power shall not be used unless approved in writing by the Nexteer Process Engineer.
5. Cooling water shall not be used unless approved in writing by the Nexteer Process Engineer.
6. Vertical doors (guillotine type doors) shall not be used unless approved in writing by the Nexteer Process Engineer.
7. All devices shall be effectively shielded from heat, flames, oil, and dirt.
8. A minimum of two (2) V-belts shall be provided on all belt driven drives, fans, blowers, etc.
9. A two (2) year warranty shall be supplied.
10. Where possible draw furnace should be shipped completely assembled with control panel mounted on the draw furnace. Installation should only require setting draw furnace in place on Nexteer Plant floor and making required utility drops to draw furnace.
 - a) Note: Where machines are required to be split due to access or shipping limitations, assembly instructions and markings are to be provided with the machine in order to properly set and assembly the machine in Nexteer Plant Facilities.
11. Start-up service shall be provided in Nexteer facility. Service to include start-up, qualification and training.

F. Documentation

1. The supplier shall identify a project manager to communicate and coordinate all activity. The project manager shall act as the liaison with Nexteer to expedite all phases of the project including engineering, build, start-up and run off.
2. A timeline shall be issued within one month of the receipt of order and updated monthly. Vendor is to include a schedule that details the anticipated timing for the major phases of the program, i.e. design, concept approval, build, debug, draw furnace run-off, shipping schedule.
3. All drawings shall comply with Nexteer SD-003 requirements.

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- a) English shall be provided on all drawings (Mechanical, Tooling, Electrical, Piping, etc.).
- b) Programmable devices (PLC, HMI, Temperature controllers and recorders, etc.) shall be programmed and documented in English.
- c) For U.S. Nexteer facilities use English dimensioning. For all other Nexteer locations use metric and English dual dimensioning.
- d) A layout shall be supplied for each draw furnace that includes layout of equipment with all door swings and explosion reliefs identified, control cabinets with door swings, stacks, vents, utility requirements and locations, etc. Layout should include overall dimensions, shipping dimensions, and estimated shipping weight.
4. Microsoft Word and Microsoft Excel shall be used for all operating instructions, service manuals, etc written exclusively for this equipment. Electronic files shall be provided along with hard copies.
5. Four (4) operating instruction manuals are to be supplied. Two (2) in English and two (2) in the language of the receiving Nexteer Plant. Standard vendor literature supplied with purchased components shall be in English or if available, in the language of the Nexteer Plant receiving the draw furnaces.
6. Vendor shall supply a digital copy of the operating instructions with all electronic files available.
7. Component identification shall be consistent with the operating instruction manual and the engineering drawings.
 - a) All machine sensors, pressure switches, meters, control panels, disconnects, instruments, thermocouples, pilot lamps, selector switches, push buttons, etc., shall have permanent engraved labels attached indicating their function.
 - b) Draw furnace mounted descriptive tags (operator panel legend tags, solenoid and switch tags, etc.) and any screen text shall be provided in the language of the receiving Nexteer Plant.
 - c) Tags shall be mounted near (not on) the device.
 - d) Tags shall be readable with the guards closed.
 - e) H.M.I. screens shall be provided in both English and the language of the receiving Nexteer Plant, and easily alternated via buttons in the H.M.I.
8. All information provided by Nexteer on our products and processes is considered confidential.
- G. Lubrication
 1. Each lubrication point shall have an individual fitting. Grease fittings shall be centralized and easily accessible from the Plant floor level.
 2. Any lubrication point inaccessible from the floor level shall have a filler tube or lubricant line terminating at approximately the five-foot (1.5 m) level.
 3. Steel tubing shall be used for all exposed filler tubes or lubricant lines. Lines protected from potential mechanical damage can be copper.
 4. Lubrication points shall include a tag with Nexteer lubrication code and recommended lubrication frequency.

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H. Insulation

1. All draw furnaces supplied shall be adequately insulated to prevent the skin temperature from exceeding 30 F° (15 C°) above ambient.
2. Door frames, joints between panels and any surfaces that exceed 150°F (65 C°) shall be guarded or identified with warning labels.

I. Guarding Requirements

1. All drives shall be covered with six sided guards.
2. Guards that do not require a tool to remove shall be electrically interlocked with draw furnace controls.
3. Guards shall not be welded to equipment.
4. Explosion relief doors and panels shall be identified on layout and with tags mounted on the draw furnace.
5. All guards on the furnace should require tools to open.
6. Doors, guards and panels that are not mechanically held closed require safety door switches and will alarm if opened during operation.

J. Painting

1. Draw furnaces shall be painted white RAL 9001. Those areas of the draw furnace exposed to high temperature shall be painted with high temperature heat resistant silver gray RAL 5009.
2. Color code piping as follows:
 - a) Yellow - Natural gas
 - b) Light Blue - Combustion air
3. Guarding shall be painted RAL 1021 safety yellow with any perforated mesh painted RAL 9011 black.

K. Shipping

1. Estimated shipping weight and dimensions shall be included on draw furnace layout drawing.
2. The maximum width of new equipment that can be received and moved into our plant is limited by the effective receiving door opening, aisle widths, and shall not exceed 11.5 feet (3.5 m) wide by 18 feet (5.5 m) high.
3. Vendor shall provide all crating, packaging and loading for shipment.

L. Hazardous Materials

1. The supplier shall obtain approval per the global Hazardous Material Control Procedure G1126 for all materials shipped to Nexteer. The use of items supplied that contain any hazardous materials is prohibited unless prior written approval is received from the Nexteer Process Engineer responsible for the draw furnaces.
2. The use of mercury in devices (pressure switches, etc.) is prohibited.
3. An MSDS sheet for all insulation used shall be provided in operating manual.

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X. DRAW FURNACE CONTROLS

A. Utility data

1. The supplier is responsible for all controls necessary to use Nexteer Utilities. Typical utility supply data for U.S. Plants are as follows: See T-Specification or SD-001 for Plants outside the U.S.

UTILITY	DATA
Electricity	480 volts 60 hertz, 3-phase
Compressed Air	70 P.S.I.G. (4.8 Bar)
Natural Gas	10 P.S.I.G. (0.7 Bar) 1,000 BTU/Ft ³ (10 KW/M ³)

2. Nexteer will make one connection for each utility for each piece of equipment with a separate capital tag number.
3. Unless otherwise specified, the vendor shall supply a single shut off device, valve, fused disconnect, or circuit breaker for each utility connection. The shut off mechanism shall be accessible or operable from the plant floor. All shut off devices shall have lock-out devices.

B. Temperature Control Instrumentation

1. The temperature controller shall be an Eurotherm Nanodac.
 - a) Supply one (1) spare with the draw furnace.
 - b) Controllers shall have Ethernet IP communication capability.
 - c) Control modes shall be as follows:
 - (i) Electric draw furnaces shall have 4-20 ma current adjusting output.
 - (ii) Direct fired gas draw furnaces shall be position adjusting type controllers.
 - d) Draw furnaces shall have the following alarms:
 - (i) +/- 10 F° (5 C°) deviation band alarm to notify operator.
 - (ii) - 10 F° (5 C°) deviation alarm contact to stop the conveying mechanism.
 - (iii) 150 °F. (65 C°) low temperature alarm for automatic shut-down.
2. Over Temperature Instrument shall be a FM approved Eurotherm 3204e.
 - a) Supply one (1) spare with the draw furnace.
 - b) The over temperature instrument shall be set a minimum of 50 F° (25 C°) over the highest operating temperature but not to exceed the rated safe maximum operating temperature. Over-temperature setting shall be password protected.

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- c) An over temperature condition would shut off the heating system and a pilot light and an alarm shall be provided to notify the operator.
 - 3. A "Proof-Of-Motion" system shall be provided on all conveyor mechanisms.
 - a) A sprocket and proximity switch shall monitor the motion of the conveyor. Sprocket shall be machined to allow setting prox switch as close as possible without mechanical damage.
 - b) The sprocket shall be located on an idle roll (a roll that rotates only from the conveying mechanism motion).
 - 4. For indexing belt conveyor systems an Encoder shall be used to program the indexing distance. Distance to be settable via the H.M.I. and password protected.
 - 5. Indexing fixture conveyors Index position to be controlled via a proximity switch located at the load section of the furnace. Proximity sensor to use a machinal feature of the belt or chain to confirm position.
 - 6. Documentation shall be provided describing all temperature control instrumentation in detail. All information required to purchase, install, configure, and program the instruments shall be supplied.
- C. Thermocouples
 - 1. Thermocouples shall be type J.
 - 2. Thermocouples shall be ¼ inch (6 mm) MGO (magnesium oxide) with 304 stainless steel sheath and exposed junction.
 - 3. Thermocouples shall have an NPT double fitting or compression fitting.
 - a) Thermocouples shall be screwed into bushing mounted on draw furnace to a fixed depth. If a compression fitting is used the insertion depth must be identified on drawings and with a tag on draw furnace.
 - b) Thermocouples shall have a standard connector.
 - 4. All thermocouples shall be identified as to their function (control or over temperature) with permanent labels.
 - 5. All required thermocouples, protection tubes, and lead wire shall be supplied by the vendor.
 - 6. A test port shall be provided within 2 inches (50 mm) of control thermocouple to facilitate installing a proving thermocouple.
 - 7. Thermocouple extension wire should be 20 gage or greater Teflon with ANSI color codes.
- D. Alarm Systems
 - 1. All draw furnaces shall have alarm systems.
 - 2. Alarms shall be displayed on the H.M.I. display and by a Stack light and horn to alert the operators.
 - 3. Silencing an alarm for one fault shall not prevent subsequent faults from re-sounding the alarm.

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- a) The alarm silence can be a push-button on the Panel in addition to being selectable from the H.M.I. alarms screen
- b) When the alarm is silenced, a red pilot lamp labeled "Alarm Silenced" shall remain lit until the fault is corrected.
4. Only the fault being displayed shall be reset by "Fault Reset" and only after the fault condition has been cleared.
5. All fault circuits shall be designed to "seal" the fault circuit until "Fault Reset".
6. As a minimum, any fault that prevents the draw furnace cycle from starting, or which interrupts the cycle shall be displayed.
7. A means shall be provided to scroll through all existing active faults.
8. Fault History Screens are to require an input password to be cleared.
9. An air flow switch shall be provided to determine if the recirculating fan, cooling chamber supply fan, cooling chamber exhaust fan and main exhaust fan is running.
10. The electrical controls shall include indication and a silenceable alarm system for that typically would include the following items:

<u>Item</u>	<u>HMI</u>	<u>Alarm</u>
Recirculating Fans	Running/Not Running	Yes
Exhaust Fans	On/Off	Yes
Cool-Off Station Fans	On/Off	Yes
Conveying Mechanism	Running/Not Running	Yes
Furnace Over-Temperature	By Zone	Single
Process Temperature	High-By Zone	Single
Deviation	Low-By Zone	Single
Alarm Silenced	Red	When Fault Corrected
Main Safety shut off	Open/Close	Yes
Flame Supervision	On/Off	Yes

E. Control Cabinets

1. Panels shall be identified with a sign with one-inch-high letters.
2. A NEMA 12 IP54 enclosure shall be used for all control circuits.
3. All push buttons and selector switches shall be labeled as to their function.
4. Pilot lamps/HMI tags labeled "running" shall only be used where there is proof of running other than the motor-starter contacts. Motor starter contacts can only be used when it is not practical to sense the running or operational condition and shall be labeled "On".
5. Push buttons shall be used instead of selector switches, except in the alarm circuit.
6. Cabinet doors or HMI shall contain the following as a minimum:
 - a) "Master Start" - Green flush push button.
 - b) "Master Stop" - Red extended push button.
 - c) "Power On" – Green light.

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- d) "Emergency Stop" - Red mushroom detented push button.
- e) "Alarm Reset" Black flush push button.

- 7. An internal, continuous duty, cooling fan shall be provided in all panels. No external venting allowed. Power to cooling fans shall be supplied from main panel. In most cases, use of a fan for cooling is sufficient. If not, a water cooled heat exchange or panel air conditioning unit shall be provided.
- 8. Electrical panel shall be mounted on the side of the draw furnace.
 - a) Allow an air gap between draw furnace and panel.
 - b) The control cabinet is to be installed in a manner that isolates it from any vibration.
 - c) Electrical panel shall be mounted in a proximity that allows ease of operator use but maintains non-affective temperatures to components.
 - (i) For Gas ovens the control panel is to be mounted on the same side as the gas train to allow for actuation of Gas Safety Shutoff Valve (main gas) valve.
 - d) The top of the screen of all instruments, recorders, HMIs, etc. should ideally be 62 inches (1575 mm) from the floor. A range of 58 to 65 inches (1473-1651 mm) is ergonomically acceptable.
 - e) Panel is to be securely fastened in this position.
 - f) Panel shall have a covered internal enclosure for electrical prints.
 - g) Panel shall have an external port for communicating with programmable logic controller.

F. Miscellaneous Controls

- 1. A programmable logic controller (PLC) shall be used in conjunction with an H.M.I. for machine control.
- 2. Temperature control should be done using the Nanodac, not the PLC.
- 3. All switches shall be sufficiently labeled for troubleshooting purposes.
- 4. A programmable logic controller shall be used.
- 5. All motors shall be U-frame.
- 6. Recirculation air flow switch shall be located within 6 feet of the floor or provided platform and accessible without removing guards.
- 7. Thermocouples shall be located within 6 feet of the floor or provided platform.
- 8. A 3 unit stack light shall be supplied on each draw furnace and cooling tunnel.
 - a) Green lamp on top of stack to indicate cycle in progress.
 - b) Amber lamp in middle of stack to indicates support (load/unload) is required.
 - c) Red lamp on bottom of stack to indicate an alarm condition.
- 9. Guards which can be opened without tools shall be electrically interlocked to the furnace circuitry.
 - a) The interlock shall consist of a safety switch.

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- b) Interruption of the interlock during automatic operation shall result in an "emergency stop".

G. Logic Requirements

1. PLC's shall be programmed with output communication to the previous operation (i.e., Induction Hardener). If the draw furnace is not in cycle for a minimum of 2 hours after the induction hardener cycles, an alarm will sound at the Induction hardener.
2. Any temperature deviation greater than +/- 10 F° (5 C°) will sound a process deviation alarm. Low or high temperature deviation messages should be displayed any time the temperature is outside of the deviation band.
3. Draw Furnace to communicate directly with any load and unload material handling equipment. Material handling equipment to stop loading operations when the proof of motion device had indicated belt motion is halted.
4. Draw furnaces immediately following induction hardening, plating, or painting operations, shall have logic to stop the furnace conveying mechanism if:
 - a) The heating system is off.
 - b) Furnace temperature deviates more than 10° F (5 C°) below set point.
5. Draw furnace shall have an automatic shut-down cycle. When the automatic shut-down cycle is selected, parts will no longer be loaded, and a timer will start as soon as the load table is sensed to be clear. Timer will be set to shut-off the conveying mechanism and heat once all parts are out of the heat. Once the temperature is below 150 °F. (65 C°) all fans shall shut-off.

H. Electric Heating System

1. Draw furnaces shall be heated by electrical resistance Ni-Cr heating elements and controlled with Silicon-Controlled Rectifiers (SCRs) and current adjusting-type proportional controllers.
2. SCR control shall be either two or three-leg synchronous firing control.
3. A contactor shall be used to shut off heating power when:
 - a) Control system components reach excessive temperature.
 - b) A current imbalance condition occurs in the heating elements.
 - c) Ground fault.
 - d) Over temperature by zone.
4. Proof of power to the heating system shall be provided.
 - a) An alarm and a message on the H.M.I. when the SCR heating power is shut off.
 - b) The current in each leg shall be displayed in the HMI, or alternately an ammeter can be placed on the panel to show this amperage.
 - c) The voltage in each leg shall be displayed in the HMI, or alternately a voltmeter can be placed on the panel to show this voltage.
 - d) The instruments shall be dampened to accept the variable voltage applied to the heating system.

I. Gas-Fired Heating Systems

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1. Gas fired draw furnaces shall be direct fired, recirculating air.
2. The natural gas heating system shall include position adjusting type proportional controls.
3. Pressure gauges shall be provided in the natural gas piping to monitor plant utility supply pressure and shall be installed on both sides of all major piping components where the pressure changes.
4. Pressure switch requirements:
 - a) All pressure switches shall be free of Mercury.
 - b) All pressure switches shall reset automatically.
 - c) All pressure switches shall include a pressure gauge mounted adjacent to the switch.
 - d) Pressure switches shall be mounted in a manner to allow easy access to cover screws and adjustment.
5. A High Gas Pressure switch shall be located downstream of the safety shut off valve. Switch range shall be provided so that operation of switch can be checked by lowering set point below the regulated operating pressure. High gas pressure switch shall be an Antunes RHGP-A #803112803 (reference flex # 51-37-1542) and located downstream of the safety shut off valve. This switch shall be automatic reset.
6. A Low Gas Pressure switch shall be located between the pressure regulator and the safety shut off valve. Low gas pressure switch shall be an Antunes RLGP-A #803112703 (reference flex #51-37-1541). This switch shall be automatic reset.
7. A Maxon series 808 safety shut off valve with a 115 vac coil and an internally mounted, single pole, double throw microswitch rated at 15 amps shall also be included.
8. A block and vent system shall be supplied on direct fired draw furnaces. No check valve shall be used. Both the blocking valve and vent valve shall be Asco solenoid valves or equivalent. The vent pipe shall be supplied to top of the draw furnace.
9. One air blower shall be furnished to meet the low pressure air requirements of the draw furnace. Air blower shall have a filter. Air blower shall have a silencer as required to meet sound level specifications.
10. Combustion air pressure switch shall be an Antunes RLGP-A #803112703 (reference flex #51-37-1541). This switch shall be automatic reset.
11. All regulators, pressure switches, etc. that require venting shall have vent lines piped to the top of the draw furnaces.
 - a) Devices requiring venting upstream of the Maxon shutoff valve shall be manifolded together.
 - b) Devices requiring venting downstream of the blocking valve shall be manifolded together.
12. A Dewey or equivalent airflow switch shall be supplied to monitor recirculation fan. A petcock shall be installed in the piping to the Dewey airflow switches near the unit for our safety-aid inspection test.
13. A spark ignited, interrupted, supervised pilot shall be provided.

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14. One (1) four inch in diameter blast gate with sight glass shall be used to observe the pilot and burner flame. An additional remote push button to start the pilot should be located in reach of the sight glass so that pilot ignition can be observed.
15. Motorized valves shall be wired per Process Specification P-3579.
16. Flame Supervision shall comply with Process specification P-3581

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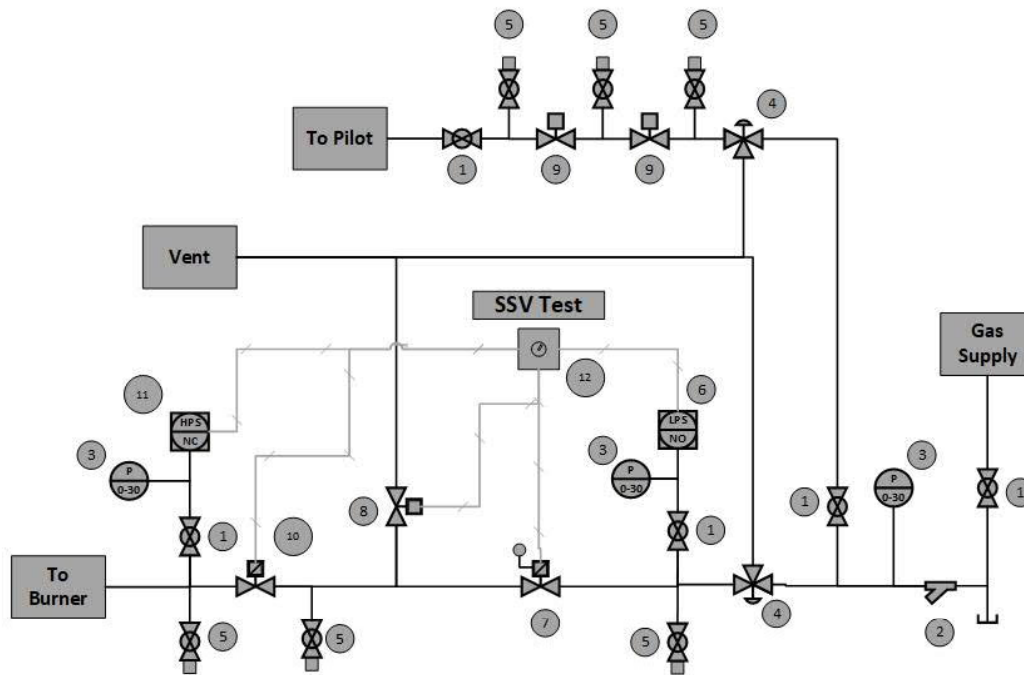
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TYPICAL GAS TRAIN



Reference Components or Nexteer Automotive Approved Equivalent

- 1) Isolation Valve – lubricated Plug valve preferred at Main gas inlet
- 2) Y- Strainer
- 3) Pressure Gauge (2 ½" with dual scaling for both W.C. and psi)
- 4) Fisher Regulator with vent relief
- 5) ¼" Leak Test Port with Plug
- 6) Low Gas Pressure Switch
- 7) Maxon Series 808 Safety Shutoff Valve – Per NFPA 86 requires both Indication and Proof of Closure
- 8) Asco Vent Solenoid Valve
- 9) Asco Pilot Solenoid Valve – Per NFPA 86 Dual valves required. Indication required above 150,000 BTU.
- 10) Asco Blocking Solenoid Valve – Per NFPA 86 requires both Indication above 150,000 BTU and proof of closure if burner is above 400,000 BTU.
- 11) High Gas Pressure Switch
- 12) Safety Shutoff Valve Test Switch Box

NOTE(S): These are minimum requirements. Additional isolation valving for maintenance purposes may be required based on machine size and layout. NFPA references are based on NFPA 86 version 2019.

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XI. Pre-RUNOFF REQUIREMENTS

- A. The draw furnace shall pass a traveling thermocouple test to verify temperature uniformity before Nexteer visits to qualify the draw furnace for shipping.
- B. All lanes in the draw furnaces shall be checked at the same time.
- C. The thermocouples shall be buried in the area of greatest mass of the part.
- D. The thermocouples shall be located as follows:
 - 1. On multiple lane basket draw furnaces, 1 point shall be checked per lane.
 - 2. On bulk loaded draw furnace less than 2 feet (0.6 m) wide, 1 point in the center of the load.
 - 3. On bulk loaded draw furnaces 2 to 4 feet wide (0.6 - 1.2 m) wide, at least 2 points across the width of the draw furnace must be checked at the same time.
 - 4. On bulk loaded draw furnace over 4 feet wide (1.2 m) wide, at least 3 points across the width of the draw furnace must be checked at the same time.
 - 5. 1 point to measure air temperature in the draw furnace. Point shall be located to correlate with temperature controller.
- E. Unless otherwise specified the core temperature of all parts shall be within +/-5.0 F° (2.5 C°) across the width and length of the draw furnaces during the soak time.
- F. The vendor shall supply all manpower and all necessary equipment to process thermocouple test.
- G. All instrumentation, wire and thermocouples shall be certified. Documentation to be supplied to Nexteer.
- H. The pre-qualification run shall be repeated at the discretion of Nexteer.

XII. QUALIFICATION REQUIREMENTS AT VENDOR

- A. The Nexteer Run-off Team with the vendor's assistance will perform the actual draw furnace qualification at the vendor. The purpose is to assure that the draw furnace meets all requirements before shipping.
- B. Draw furnaces will be completely inspected and qualified by Nexteer personnel prior to shipment as follows:
 - 1. Complete review of PreRUN-OFF thermocouple test results.
 - 2. Draw furnaces shall be thoroughly inspected to verify compliance before shipping per Process Specification P-3575, Run-off Checklist for Ovens and Draw Furnaces".
 - 3. A safety review of all guarding, etc. shall be completed. Reference DS-3260, "Nexteer Machinery/Equipment Safety Checklist".
 - 4. An inspection of all safety devices shall be completed per Process Specification (P-3501 or P-3562).
 - 5. Electrical construction checklist (MDC-071) should be completed.

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6. An ergonomics review should be made of draw furnaces and any associated material handling.
7. Sound level testing shall be completed and documented in the operating manual.
8. Temperature control capability shall be demonstrated at a steady state condition with and without a load.
 - a) All temperature controllers, recorders and over temperature instruments located in close proximity in the furnace shall read within $\pm 5.0^{\circ}\text{F}$ (2.5°C) of each other.
 - b) Temperature shall be controlled within $\pm 2.0^{\circ}\text{F}$ (1.0°C) of set point during soak.
 - c) Record the time to bring an empty cold draw furnace up to operating temperature.
9. Verify air temperature uniformity in empty draw furnace at operating temperature:
 - a) $\pm 5.0^{\circ}\text{F}$ (2.5°C) across the width.
 - b) $\pm 5.0^{\circ}\text{F}$ (2.5°C) across the length.
 - c) $\pm 5.0^{\circ}\text{F}$ (2.5°C) from top to bottom.
10. Nexteer will typically supply enough scrap parts for a full load. Parts will be run repeatedly. Vendor will supply all labor for loading and unloading.
11. The draw furnace and cooling station shall pass a traveling thermocouple test:
 - a) All lanes in the draw furnaces shall be checked at the same time.
 - b) The thermocouples shall be buried in the area of greatest mass of the part.
 - c) The thermocouples shall be located as follows:
 - (i) On multiple lane basket draw furnaces, 1 point shall be checked per lane.
 - (ii) On bulk loaded draw furnace less than 2 feet (0.6 m) wide, 1 point in the center of the load.
 - (iii) On bulk loaded draw furnaces 2 to 4 feet wide (0.6 - 1.2 m) wide, at least 2 points across the width of the draw furnace must be checked at the same time.
 - (iv) On bulk loaded draw furnace over 4 feet wide (1.2 m) wide, at least 3 points across the width of the draw furnace must be checked at the same time.
 - (v) 1 point to measure air temperature in the draw furnace. This point shall be located to correlate with temperature controller.
 - d) Unless otherwise specified the core temperature of all parts shall be within $\pm 5.0^{\circ}\text{F}$ (2.5°C) of set point for at least 60 minutes. Typically, parts with the thickness of the largest cross section less than 1.5" require 45 minutes heat up time in the draw furnace.
 - e) All parts should exit the station within 30°F (15°C) of ambient. Maximum part temperature allowable for handling without gloves is 113°F (45°C).
 - f) The vendor shall supply all manpower, instrumentation and all necessary equipment to process thermocouple test.
 - g) All instrumentation, wire and thermocouples shall be certified. Documentation to be supplied to Nexteer.
 - h) The qualification run shall be repeated at the discretion of the Run-off Team.

The above specifications were developed without considering whether patents may or may not be involved.
In all cases, therefore, the supplier shall be required to assume patent liability.

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- i) This qualification run shall be documented by the vendor utilizing a spread sheet style timeline recording all the furnace malfunctions. Record all faults, root cause and corrective action taken during this qualification run. This document shall be supplied in the operating manual with a copy sent to the Process Engineer responsible for the furnace.
 - j) The Nexteer Process Engineer responsible for the job shall retain the chart paper/data. A copy shall be supplied in the operating instructions.
- C. No hardness checks are required. Per Manufacturing Equipment Statistical Qualification Requirements SD-002, statistical analysis is not required for draw type furnaces.
- D. Upon completion of Qualification Requirements at vendor, the Nexteer New Equipment Run-off Checklist, DS3392 shall be completed by Nexteer Run-off Team and vendor. Form and supporting documentation to be sent to Nexteer management for approval to ship. Draw furnace can not be shipped until signed approval is obtained.
- E. Update operating instructions and drawings. A set of operating instructions shall be available to operators whenever draw furnaces are running. An updated set of prints and a PLC logic printout if applicable shall be maintained in the main electrical panel.
- F. The draw furnaces will be completely re-qualified on our production floor and all the above checks repeated on our floor.

XIII. RUN-OFF REQUIREMENTS AT NEXTEER

- A. The Nexteer Run-off Team with vendor start-up service will duplicate the draw furnace qualification at the vendor on our floor. The purpose is to assure nothing has changed during installation and that the draw furnace meets all requirements before releasing for production.
- B. Complete review of PreRUN-OFF and Qualification results. Any or all tests shall be repeated at the discretion of the Run-off Team.
 - 1. PreRUN-OFF traveling thermocouple test.
 - 2. Process Specification P-3575, "Run-off Checklist for Ovens and Draw Furnaces".
 - 3. DS-3260, "Nexteer Machinery/Equipment Safety Checklist".
 - 4. Process Specification P-3501 or P-3562, "Inspection of Gas or Electrically Heated Draws".
 - 5. MDC-071, "Electrical Construction Checklist".
 - 6. DS-3376, "Ergonomics Checklist".
 - 7. SL 1.0 Sound Level Specification".
 - 8. Temperature control capability.
 - 9. Air temperature uniformity check.
 - 10. Traveling thermocouple test results.
 - 11. The draw furnace and cooling station shall pass a traveling thermocouple test:
 - a) All lanes in the draw furnaces shall be checked at the same time.
 - b) The thermocouples shall be buried in the area of greatest mass of the part.
 - c) The thermocouples shall be located as follows:

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- (i) On multiple lane basket draw furnaces, 1 point shall be checked per lane.
- (ii) On bulk loaded draw furnace less than 2 feet (0.6 m) wide, 1 point in the center of the load.
- (iii) On bulk loaded draw furnaces 2 to 4 feet wide (0.6 - 1.2 m) wide, at least 2 points across the width of the draw furnace must be checked at the same time.
- (iv) On bulk loaded draw furnace over 4 feet wide (1.2 m) wide, at least 3 points across the width of the draw furnace must be checked at the same time.
- (v) 1 point to measure air temperature in the draw furnace. Point shall be located to correlate with temperature controller.
- d) Unless otherwise specified the core temperature of all parts shall be within $\pm 10^{\circ}\text{F}$ (5.0°C) of set point for at least 60 minutes. Typically, parts with the thickness of the largest cross section less than 1.5" require 45 minutes heat up time in the draw furnace.
- e) All parts should exit the station within 30°F (15°C) of ambient. Maximum part temperature allowable for handling without gloves is 113°F (45°C).
- f) The vendor shall supply all manpower, instrumentation and all necessary equipment to process thermocouple test.
- g) All instrumentation, wire and thermocouples shall be certified. Documentation to be supplied to Nexteer.
- h) The qualification run shall be repeated at the discretion of the Run-off Team.
- i) This qualification run shall be documented by the vendor utilizing a spread sheet style timeline recording all the furnace malfunctions. Record all faults, root cause and corrective action taken during this qualification run. This document shall be supplied in the operating manual with a copy sent to the Process Engineer responsible for the furnace.
- j) The Nexteer Process Engineer responsible for the job shall retain the chart paper/data. A copy shall be supplied in the operating instructions.
- C. No hardness checks are required. Per Manufacturing Equipment Statistical Qualification Requirements SD-002, statistical analysis is not required for draw type furnaces.
- D. Update operating instructions and drawings. A set of operating instructions shall be available to operators whenever draw furnaces are running. An updated set of prints and a PLC logic printout if applicable shall be maintained in the main electrical panel.

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XIV. SPECIFICATION REVISION RECORD

Page	Symbol	Revision	Date	Issued By
All	--	Released SD-1031	22 May 2007	R. Bal
All	--	Removed references to Delphi	19 Oct 2010	R. Bal
2	001	I.A. was GE GAP	19 Oct 2010	R. Bal
All	002	Revised SD-1031.	10/1/2020	B. Ittner
16	003	Updated Typical Gas train items 9 and 10.	1/5/2021	B. Ittner