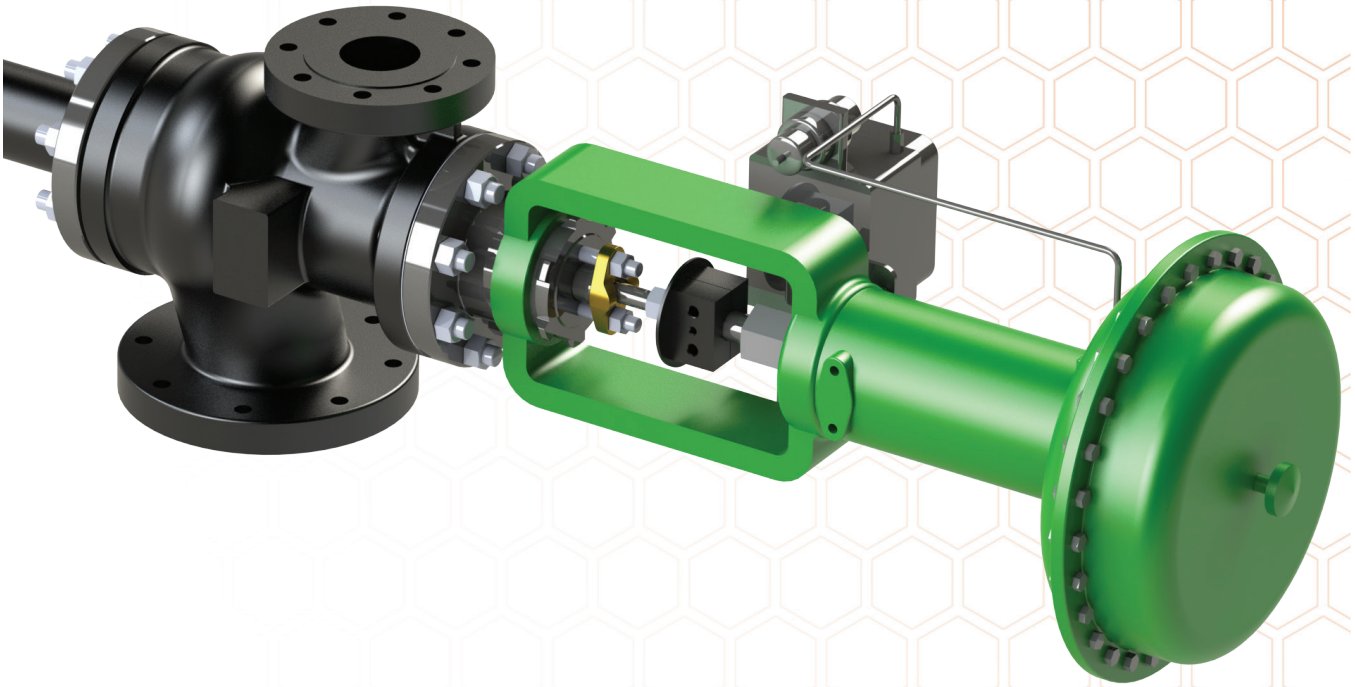
KĀDANT

FLUID HANDLING

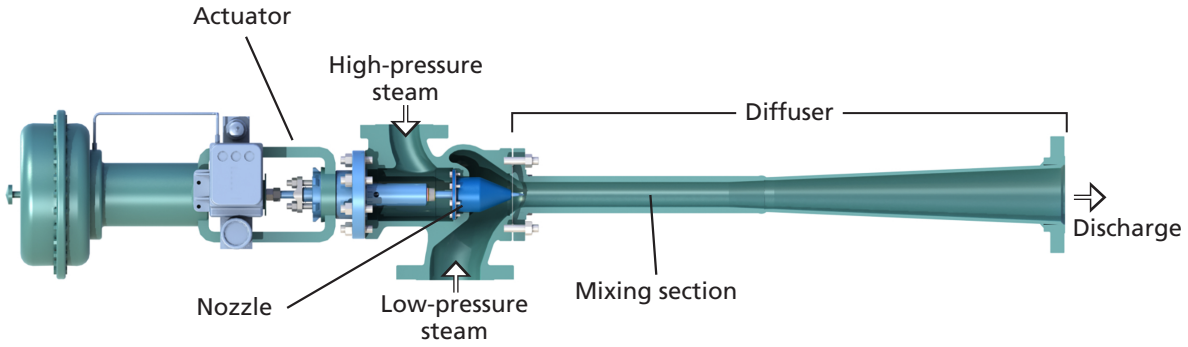
Thermocompressors

Operation and Maintenance Manual



- Recirculating and booster thermocompressor applications.
- Energy-efficient steam jet compressors

Installation and Operation



Operating Principle

Kadant Johnson thermocompressors save energy by recycling lower pressure waste steam into higher pressure steam for use in industrial processes. To capture 100% of the energy in waste steam, high-pressure motive steam enters the thermocompressor body and accelerates out the nozzle, entraining the waste steam in the mixing chamber. A precision actuator regulates the flow of motive steam and the spindle and nozzle are precisely designed for each customer's application. This minimizes the amount of motive steam used across their operating conditions. As the combined steam exits the diffuser, it expands, the velocity of the steam slows, and the pressure increases. The resulting steam is at the higher pressure needed for use in industrial processes.

With the exception of the actuator and modulating spindle, thermocompressors have no moving parts. Operation and maintenance problems should, therefore, be negligible. On the assumption that the thermocompressor has been specified correctly, satisfactory operation of the equipment will depend upon:

1. Correct installation
2. Correct utilities
3. Periodic inspection of the installation

Once the location for the thermocompressor has been determined, due consideration should be given to the motive connection, the suction connection, and the discharge connection.

Installation Consideration

The schematic, on the next page, is a guideline for thermocompressor installations.

Thermocompressor Mounting Position

The preferred installation is vertical with the actuator on top and the discharge pointing down. However, the unit can be mounted horizontally as well without any restrictions on the axis of rotation. Installation of the unit in an upside-down position (actuator pointing down and discharge pointing upward) is not recommended.

Allowable Forces and Moments

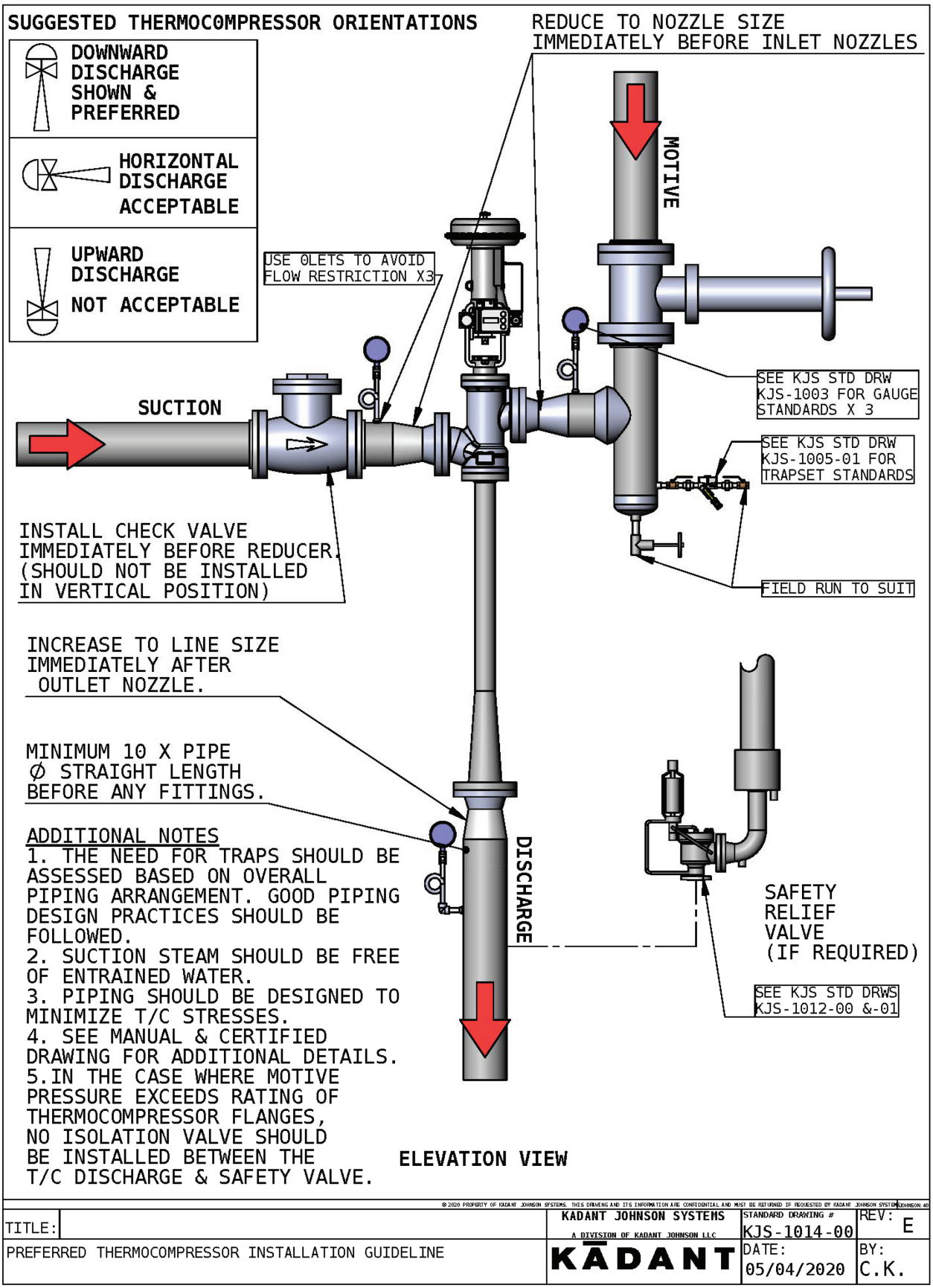
The piping should be supported/anchored so that there are no forces translated to the thermocompressor flanges. The thermocompressor should be supported by a bracket of some type that attaches to the unit itself. A rigid pipe hanger is recommended and should be placed on the body portion of the thermocompressor. All three connections should have expansion joints on or very near them to avoid applying pipe stress to the thermocompressor. An alternative is to support the unit from just one flange. If mounted vertically it should be the discharge flange, if mounted horizontally it should be the suction flange. If this method is employed, the other two flanges should have expansion joints to isolate them from the rest of the piping system.

Shut-Off Plug

It is dangerous to use the shut-off device (actuator) fitted to this thermocompressor as an isolating valve. The actuator is neither intended nor designed for leak-free closure. Its only purpose is to arrest the flow of high-pressure steam for a short period, during air failure or plant shutdown, to enable the main steam isolating valve to be closed.

In the event of **air failure** or **plant shut-down, do not rely** on the shut-off device fitted to the thermocompressor to give complete sealing of the high-pressure steam. To maintain the pressure and temperature integrity of the body and diffuser, and in the interest of safety, the main steam isolating valve must be closed before closing any isolating valves fitted in the suction or discharge line.

Installation and Operation



Installation and Operation

The Motive Connection:
It is recommended that the maximum demand flow be considered when sizing the steam supply main.

Dry steam is a basic requirement for good performance and easy maintenance. The motive steam nozzle is designed for 98% or better quality steam to give efficient performance. Wet steam is detrimental both to the performance and to the parts of a thermocompressor. It erodes the nozzle and could affect the performance by clogging the nozzle with water droplets. It is recommended that all steam supply lines come off the top of the main steam supply line and, where necessary, provisions be made for draining. A well-designed steam separator and trap assembly will correct a wet steam condition.

High-pressure drops in the main supply lines should be eliminated. The lower the operating supply pressure, the more operating steam is required by the thermocompressor. A steam pressure gauge should be located as close to the high-pressure steam inlet as possible.

The Low-Pressure Suction Connection:
The low-pressure suction line should be the same diameter as the suction connection of the thermocompressor and it should be as free from any restrictions as practical. A steam pressure gauge should be located as close to the suction connection as possible.

The Discharge Connection:
The mixed discharge connection should be the same diameter as the thermocompressor discharge outlet. Care should be taken to avoid placing any restrictions or undue obstructions in the discharge line that will have the effect of increasing the discharge pressure above that of the design value. It is important to design the discharge line correctly. If the discharge pressure is increased beyond the design value, the thermocompressor will not operate correctly or efficiently.

NOTE: A block valve should never be installed on the discharge piping.

Utilities
In the case of a thermocompressor, the basic utility is a supply of quality dry steam. For an efficient design it is essential to know the minimum motive steam pressure that will be experienced at the high-pressure inlet to the thermocompressor.

Under **critical** flow conditions, lowering the motive steam pressure below that of the design value may cause the thermocompressor to chatter and become unstable in operation. Under **sub-critical** flow conditions, lowering the steam pressure below that of the design value could result in a serious loss of capacity, coupled with a resultant loss of compressive ability.

Conversely, the use of motive steam pressures above the design pressure will not enhance the performance of the unit and, if the steam pressure is considerably above the design value, the performance could be adversely affected due to the throats of the nozzle and diffuser being overloaded.

Wet steam will cause poor performance and, in addition, will also erode the internal components of the thermocompressor which will cause further losses in performance.

Any superheat present in the steam supply to the thermocompressor must be taken into consideration at the final design stage. Significant amounts of superheat will affect the unit's performance because the steam nozzle and diffuser throats will be undersized.

Inspection

In order to help ensure trouble-free service and to obtain maximum operational economy, it is recommended that a periodic inspection of the thermocompressor internals be conducted. The frequency of this inspection will depend upon the type of service and quality of the steam supply. A thermocompressor that is used in corrosive or erosive service must be inspected more frequently than one that is used in non-corrosive or non-erosive service. An acceptable minimum practice would be to inspect the thermocompressor whenever related equipment is inspected. In particular, examine the **nozzle, diffuser,** and **spindle tip** for any signs of wear, damage, or debris. A visual examination will normally be all that is required. If the diffuser and steam nozzle is smooth and round, and neither erosion nor corrosion is indicated, then replacement is not required.

Troubleshooting and Maintenance

Troubleshooting and Operating Problems

Although thermocompressors are normally efficient and trouble-free in operation, there are times when thermocompressors can be subject to breakdowns. Some knowledge of the correct procedures for locating the most usual causes of trouble could save valuable production.

Most of the reasons for sub-standard performance can be traced to either **external** or **internal** causes. Sub-standard performance can also be classified as either **sudden** or **gradual**. A gradual deterioration in performance usually results in a loss of **re-compression**, suggesting either erosion or corrosion, whereas a sudden loss of compression will suggest an internal breakage or external cause. Since the external causes of trouble are usually easier to check, they should be investigated first.

External Causes of Poor Performance

When a fault is investigated, first investigate all the gauges fitted, especially Bourdon Tube Type dial gauges. If possible these gauges should be recalibrated, then check other external causes of trouble.

- Low motive steam pressure
- Wet motive steam
- Differential pressure too high
- Incorrect discharge pressure
- Change in load
- Attempting to operate outside the design parameters
- Broken check valves or isolation valves around unit

Internal Causes of Poor Performance

When the external causes have been checked and are trouble-free, check for internal causes of trouble.

- Eroded or corroded internal parts
- Blocked nozzles and/or diffusers
- Cracked or worn parts
- Leakage from the high-pressure area to the low-pressure area (check nozzle gasket)
- Misaligned nozzle and spindle assembly

When commissioning a new plant, clogged steam nozzles could also be a source of trouble. If the nozzle inlet is red or black, look for scale deposits which can be removed by careful scraping and polishing.

Recommended Spare Parts List

Item No.	Item Description	Item No.	Item Description
1	Body	6	Packing Assembly*
2	Diffuser Gasket*	7	Packing Follower*
3	Diffuser	10	Nozzle Gasket*
4	Bonnet Gasket	11	Nozzle*
5	Bonnet	12	Spindle*

**Items marked with an asterisk are recommended parts to be kept in the end user's store inventory.*

To order spare parts please contact customer service at Kadant Johnson LLC
• Tel: 269-278-1715
• Email: orders.tr@kadant.com
Parts are normally available in three to four weeks after order.
Always refer to the thermocompressor serial number when ordering parts.

Troubleshooting and Maintenance

Disassembly Procedures

Actuator Removal:

1. Disconnect incoming cable or tubing to the positioner manually
2. Apply 5 to 10 psi air pressure to the actuator to pull the spindle off the seat
3. Disconnect the stem connector on the actuator
4. Release the air pressure
5. Remove the locknut securing the actuator to the motive body
6. The actuator is now free to be removed

WARNING: Keep hands from between actuator end and spindle end. Actuator may be under air or spring force and move unexpectedly.

Bonnet and Spindle Removal:

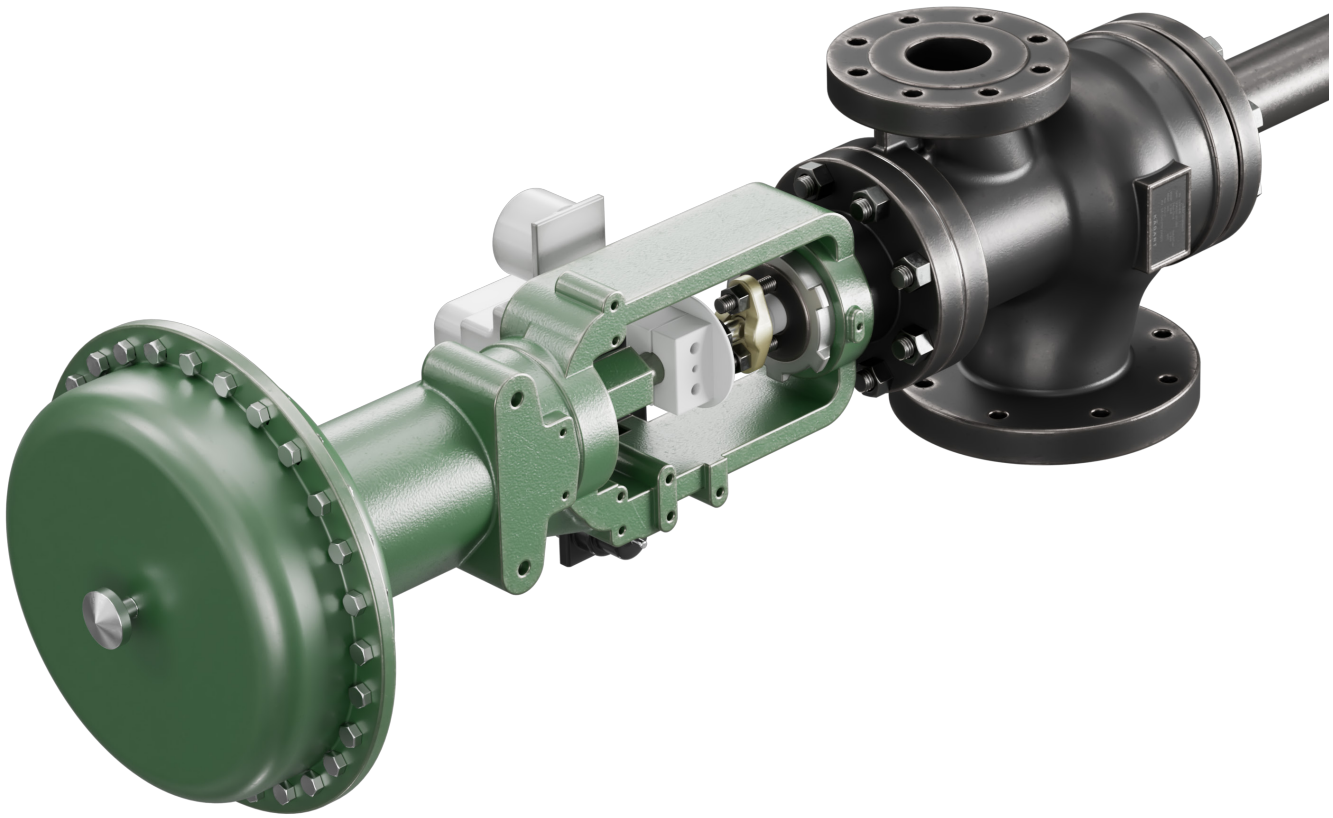
1. Remove the nuts securing the bonnet to the body; the bonnet, spindle, and spindle guide can now be removed from the body
2. Remove the two nuts securing the packing flange to the bonnet
3. Remove the packing flange and packing follower by sliding them over the spindle stem
4. Remove the spindle from the bonnet
5. Remove the packing from the bonnet
6. Remove the spindle guide if worn or damaged

Nozzle Removal:

1. Remove the cap screws securing the nozzle to the body
2. The nozzle can now be removed from the body as well as the nozzle gasket
3. Clean nozzle gasket face thoroughly

Diffuser Removal:

1. Remove the nuts securing the diffuser to the body
2. The diffuser can now be removed from the body as well as the diffuser gasket



Troubleshooting and Maintenance

Reassembly Procedures

If it is found necessary to disassemble the thermocompressor for inspection, parts replacement, or for any other reason, care must be exercised during the inspection and reassembly process.

Diffuser Inspection and Reassembly:
After removing the diffuser for inspection, these checks and steps should be made to ensure that:

1. The diffuser/body gasket is new and that the seating surfaces are clean
2. Before inserting and locking the bolts, ensure that the diffuser male/female pilots are inserted properly (see drawing for torque values)
3. The diffuser throat bore is concentric to the nozzle bore
4. There is no debris or any other form of obstruction within the diffuser that may prevent free passage of steam

Nozzle Inspection and Reassembly:
After removing the nozzle for inspection or replacement, these checks and steps should be made to the assembly to ensure:

1. The nozzle/body gasket is new and that the seating surfaces are clean
2. The nozzle is repositioned with numbers visible through suction flange
3. Blue Loctite® is used on nozzle retaining screws (tighten cup screws to drawing torque values)
4. The nozzle seat is sealed to prevent leakage of the high-pressure steam into the low-pressure section of the body
5. There is no debris or any other form of obstruction within the nozzle that may prevent the free passage of steam

Spindle and Bonnet Inspection and Reassembly:
After removing the spindle for inspection, carry out these checks and steps to ensure that:

1. Any damaged soft parts of the packing guide are removed and discarded
2. Remove and discard the soft parts of the packing if the spindle threads have been pulled through them
3. The packing guide (reference drawing A50270) is in good condition, reassemble it and place it back into the bonnet
4. The spindle guide (13) is clean and in good condition. If removed or replaced, reassemble the bonnet with locking compound, and tape the flats down to pin (see notes on drawings)
5. Inspect the areas of the spindle where guides ride are clean and in good condition and insert the spindle (12) through the bonnet and both guides
6. Slide the packing (2) on drawing A50270 carefully over the spindle threads and install it in the bonnet (5)
7. The bonnet/body gasket (4) is new, and the seating surfaces are clean
8. The packing follower and packing flange are clean and in good condition, slide the flange and follower over spindle threads
9. Install nuts (18) on studs (17) in bonnet and tighten to 20 ft-lbs torque. (do not over tighten as it can cause drag on the spindle)
10. Check packing after the unit is started up, if packing leaks tighten nuts in 1/4 turn increments until it stops

Actuator and Positioner Inspection and Reassembly:

1. A product bulletin for the actuator and positioner are available on fisher.com
2. Put the thin nut on the spindle then the bigger one, and then the travel indicator, run all the way down
3. Align the actuator to the body and hammer the big locknut tight with Blue Loctite®
4. Line up the top white line on the travel indicator with the middle line on the black magnet

WARNING: Keep hands from between actuator end and spindle end. Actuator may be under air or spring force and move unexpectedly.

Before the thermocompressor is put back in service, it is advisable to stroke test the spindle/actuator assembly to ensure that the spindle is not coming into shock contact with the nozzle or that the packing follower was not over-tightened causing the spindle to chatter, lag, or stick.

Note: Locite is a registered trademark of Henkel Corporation

About Kadant Johnson

Kadant Johnson is part of Kadant's Flow Control segment and supplies equipment and critical components used in process industries worldwide. Kadant Johnson's products, technologies, and services play an integral role in enhancing process efficiency, optimizing energy utilization, and maximizing productivity in resource-intensive businesses.

Primary Industries Served

- Chemical
- Construction
- Converting
- Corrugating
- Food and beverage
- Machine tool
- Metals
- Oil and gas
- Pulp and paper
- Rubber and plastics
- Textiles/nonwovens

Products

Rotary Joints and Unions

- Custom rotary unions
- Multi-passage rotary unions
- Precision unions
- Single passage rotary joints

Jet Devices

- Desuperheaters
- Thermocompressors

Liqui-Mover Condensate Pumps

- Float Free™ level control
- Float level control
- LMX™ smart pump
- Replacement level control
- ThermoZone™ condensate handling station

Accessories

- Air and steam separators
- Flexible metal hose
- Sight flow indicators
- Steam traps
- Syphon systems
- Turbulator® Tube™ bars
- Vacuum breakers
- Variable Moisture Steam™ showers

Services

- Boiler room safety audits
- Dryer performance audits
- Inspections and nondestructive testing (NDT)
- Installation and repair
- Steam system audits

Systems

- Dryer Management System® (DMS) control system
- Project management
- Steam and condensate system design
- Steam system performance evaluations

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