TYPE 83

SEPARATION SEAL

Installation, Operation & Maintenance Instructions

Introduction

This manual relates to matters affecting the operation of the T83 separation seal within compressor machinery. It covers areas directly associated with the installation, removal, operation and maintenance of the separation seal. For other related subjects, such as the correct operation of associated systems or guidance when conducting hazard analysis (as may be required under the European ATEX Directives), consult with the compressor equipment supplier and their documentation.

The T83 separation seals are robust in operation. However, any incorrect handling, assembly or fitting can easily lead to seal damage. Therefore, John Crane T83 separation seals may only be installed, commissioned and maintained by a fully trained and authorised plant machinery specialist. This person must pay close attention to these instructions, the John Crane seal installation drawing, compressor equipment supplier's manuals and documentation and all relevant regulations. Failure to do this relieves the manufacturer John Crane from any liability or warranties. It is strongly recommended that the seals are fitted by John Crane trained and approved technicians.

If there are any seal problems that need an urgent response, please contact your local John Crane sales representative.

Safety

The safety notes refer to the arrangement supplied. They can never be exclusive, and must be used in conjunction with the relevant safety regulations for the machine, auxiliary equipment, plant and sealed fluid.

WARNING SYMBOLS

The following symbols are used in this instruction manual to highlight information of particular importance:

⚠ **Danger – Mandatory instructions designed to prevent personal injury or extensive damage.**

ATTENTION Special instructions or information to avoid damage to the seal or its surroundings

NOTE Information for easy installation and efficient operation.

⚠ **ATTENTION**

Prior to any installation, removal, operation and maintenance of the T83 separation seal, all personnel involved in these activities must have read and understood this document before the commencement of any work. If there is not adequate understanding, contact John Crane for further advice.

All personnel involved in the installation, operation and maintenance of the separation seal must have adequate training and understanding with regards to:

- **The separation seals being used**
- **The equipment being worked on, including any relevant auxiliary equipment and systems**
- **All tooling and equipment associated with fitting and removing seals**
- **The environment in which work is being carried out**
- **Health, safety and environmental issues associated with the above points including all relevant local site, national and international health, safety and environmental procedures and regulations.**

Any working practice that compromises safety must be avoided.

All personnel involved in the installation, removal, operation and maintenance of the separation seals must be authorised by the responsible party to work on the equipment that the seals are fitted to.

At all times, adequate personal protection equipment should be worn/used. This equipment needs to be suitable for the environment and surroundings that a person is working within.

At all stages in work relating to the separation seal, reference must be made to the John Crane installation drawing, this document and the compressor equipment supplier's manuals and documentation and all relevant regulations.

Separation seal cartridge disassembly is not required for normal operation and maintenance and must never be undertaken other than by a John Crane trained technician approved for the seal type being worked on. Where seals require inspection and refurbishment, please contact John Crane.

Modifications and/or alterations of the separation seal in any way are not permitted without the authority of John Crane. Failure to obtain this authority relieves the manufacturer John Crane from any liabilities or warranties.

In the event of an operating problem, the machinery must be immediately switched off and made safe. Problems must be solved promptly.

A small controlled gas flow (commonly called the seal leakage) will occur within the separation seal during normal seal operation. In cases of a worn or defective seals, the leakage volumes will increase. This leakage may be hazardous, toxic and or explosive.

Attention is also drawn to the fact that, on its own, separation seal leakage may not be dangerous. However, if it was to combine with other gases, liquids and/or substances with increased or decreased pressure and temperature or be subjected to heat and/or an ignition source, then the mixture may become hazardous, toxic and/or explosive.

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All leakage will need to be collected and directed to a safe location by the equipment and systems that the separation seals are fitted/connected to. This needs to occur under all circumstances including when the separation seals ARE and ARE NOT working normally. It is the responsibility of the compressor/ machine manufacturers and equipment operators to ensure that the systems and procedures are in place to accommodate this and that these systems provide adequate health and safety to all people, as well as protection for the environment.

In the rare case of catastrophic seal failures, a bulk escape of process gas and/or buffer gas within the compressor casing can occur past the separation seal. This leakage may be hazardous, toxic and/or explosive. It is the responsibility of the compressor/machine manufacturers and equipment operators to ensure that systems and procedures are in place to deal with this occurrence and that these systems provide adequate health and safety to all people, as well as protection for the environment.

Hot surfaces have to be protected against accidental contact.

Separation seals can become exposed to extreme conditions, particularly during process upset and seal failure. Suitable personal protection equipment must be worn during handling, removal and disassembly of previously used seals. This includes gloves, coveralls and footwear, as well as protective headgear appropriate to the location.

In addition, hazardous chemicals and dust can be present within the separation seals. A suitable FFP3 respirator is therefore recommended. (Apart from potentially unknown chemicals in the process fluids, if gross over-heating has occurred, hydrofluoric acid and other noxious compounds may be formed). Follow the local relevant guidelines for the safe and environmentally friendly disposal of assembly lubricants, supplied fluids and scrapped components.

When returning separation seals to John Crane, customers MUST confirm in writing that the specific seals being returned are safe to handle and provide any additional safety-critical information on request. This is further discussed in Appendix I of this document.

Seal preparation

If seal cartridge installation or compressor commissioning (first start up) takes place later than 24 months after shipment from John Crane, the seals must be inspected by a John Crane trained and approved Technician.

Seal fitting and removal tools are not supplied by John Crane.

For installation the entire outer surface of the seal cartridge including the bore should be clean and dry. The cartridge should not be cleaned with any fluids or solvents that may enter cartridge or attack vulnerable components such as 'O' rings.

The seal cartridge should appear clean and free from contamination. If this is not the case DO NOT PROCEED with installation. Consult John Crane.

All secondary seals ('O' rings or polymer seal) on the outside and bore of the cartridge should be carefully examined for damage such as cuts or crushing. If damaged, they should be replaced with a correct part from the Spares/Installation kit, in-accordance with the installation drawing.

CHECKING THE SEPARATION SEAL

It is recommended that prior to installation the separation seal cartridge be checked for damage in transit and storage.

1. Generally inspect the outside of the cartridge for any visible signs of damage.
2. Check installation drawing and parts list to confirm the supply details and arrangement.
3. If the shaft sleeve/runner is within John Crane's scope of supply, it may have tolerance strip fitted in its bore. Check to ensure this is in good condition. If it needs replacing, see section REPLACEMENT OF TOLERANCE RINGS.
4. To protect the seal in transit and storage it will be supplied fitted with a setting plate arrangement.
5. If the rotating shaft sleeve or 'runner' is supplied with the cartridge it will be held in its correct working position and it is recommended that the setting plates and runner are not disturbed. In this case proceed directly to point 4 below.
6. If the shaft sleeve/runner is not supplied by John Crane, the cartridge will be fitted with a transit plate incorporating a short dummy sleeve section. This must be removed before installation. Proceed as follows:
7. Place the separation seal on bench with the transit plate uppermost. Loosen and remove the screws securing the transit plate. Carefully remove the transit plate, in the process withdrawing the dummy sleeve from the bore of the cartridge.
8. Check all the carbon segments are positioned evenly in a smooth continuous ring. Also check that the small axial thrust springs are not displaced. If any of the springs are displaced, very carefully re-position them with a fine pointed instrument being extremely careful not to damage them or the carbon segments.

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ATTENTION If any of the small thrust springs are missing or damaged, or if the carbon segments are chipped or cracked, do not proceed with the installation but contact John Crane.

1. Do not replace the transit plate and therefore handle the cartridge with great care.
2. Sparingly lubricate the outside diameter stator interface 'O' rings with silicone grease. The cartridge is now ready for installation.

ATTENTION Silicon grease must not be used on sleeve shaft 'O' rings.

COMPRESSOR PREPARATION

ATTENTION The compressor cavity into which the separation seal is fitted must be in accordance with the seal Installation drawing. Prior to any work being carried out on the compressor, it must be in a safe condition. All pressures within the compressor casing need to be atmospheric pressure with no differential pressures present (including partial vacuum conditions). No hazardous or toxic gases or liquids must be present and any required decontamination procedures must be carried out. For further information, consult the compressor equipment supplier's manuals and documentation. The compressor casing and shaft must be adequately earthed and electrical earth continuity must be maintained. See compressor equipment suppliers manual and documentation for details.

The following text assumes that the compressor is ready to accept the separation seal cartridge.

John Crane recommend use of a suitable anti seize compound for shaft/seal sleeve assembly lubrication as appropriate to local site regulations. John Crane recommends the use of either:

- Dow Corning MolyKote® G-N Paste or MolyKote® G-N Plus Paste
- Jet-Lube White Knight™ anti-seize compound.

These compounds should be applied sparingly, and only at the seal sleeve/compressor shaft interface. Silicone grease is used for lubricating stator interface 'O' rings. This too must be applied sparingly.

Under no circumstance must silicone compound be used for shaft/seal sleeve assembly lubrication otherwise shaft sleeve galling can result.

Excess grease and compound must be removed, and care taken to prevent ingress of these lubricants into the sealing area during cartridge installation. The suitability of alternative lubricants should be confirmed with John Crane.

1. Clean the entire area into which the seal fits. Ensure that it is free from defects and any rough or sharp edges that could damage the seal on installation.
2. Ensure that the compressor shaft is positioned correctly to the compressor casing to allow fitting of the separation seal. Both the axial and radial alignment needs to be considered. Ensure that the shaft is angularly aligned with the casing such that any pin positions, keys, bolts or other features in the shaft and casing are aligned with the corresponding features within the separation seal with the installation plates fitted. Consult the compressor equipment supplier's manual and documentation for appropriate method for shaft and casing alignment.

The compressor shaft should be locked to prevent it from moving while fitting the separation seal into position. For further information, consult the compressor equipment supplier's manuals and documentation.

3. If the separation seals have not been previously fitted to the compressor or if there is a new rotor, check that the seal operating envelope(s) are in accordance with Installation drawings
4. Apply a film of anti seize compound to the shaft.
5. Axial positioning shims or spacers may be provided. If supplied, these need to be adjusted by appropriate machining to achieve the correct rotor to stator working position. Once correctly adjusted, fit shims or spacers into the compressor or to seal cartridge as shown on the installation drawing or compressor equipment suppliers manuals and documentation.

FITTING THE SEPARATION SEALS

Ensure that the separation seal cartridge is the correct one for the compressor shaft end that it is being fitted to. Consult equipment supplier's manuals and documentation to ascertain correct part numbers and compare these against the seal cartridge part numbers and the seal installation drawings.

1. Using appropriate lifting equipment position the seal on the shaft.

If the shaft runner is already installed ensure that it has a suitable chamfer or 'lead-in' on its outer edge and take special care not to damage carbon segments as they are fed onto the runner.

2. Align any keys, pins, slots or holes on the stator and rotor as appropriate.
3. Using the fitting tools provided by the compressor manufacturer (or if unavailable, suitable studding and jacking bar) carefully and evenly jack the seal assembly into position.

Take special care to ensure that the seal is kept square to the shaft to prevent it "binding".

NOTE It may be necessary to axially lock the shaft to prevent it from moving whilst jacking the seal into position.

4. When the seal is fully engaged in its home position, remove all fitting tools.
5. Remove the seal setting rings, where used, and their cap head screws as per installation drawing.
6. Lock the seal stator to the housing and the rotor to the shaft as shown on the installation drawing.

NOTE The seal rotor and stator should be located in their relative correct axial positions as identified on the installation drawing. The setting plates, when supplied, can generally be used to verify this.

Any John Crane supplied screws used to retain separation seal components must be tightened adequately. Where these screws are secured into non John Crane supplied parts, then consult with the compressor equipment suppliers manuals and documentation for any bolt torque requirements. It is essential that the separation seal rotor is effectively locked onto the compressor shaft and the seal retainer effectively locked within the compressor chamber and that any locking devices are fully secured and tightened. Please consult the compressor equipment suppliers manuals and documentation. Prior to any attempt to rotate the shaft, the separation seal installation plates and associated screws must be removed. Complete compressor assembly as per the compressor equipment supplier's manuals and documentation. If compressor shaft has been locked, ensure this has been removed prior to any compressor operation. Consult compressor equipment supplier's manual and documentation for further information.

REMOVAL OF SEPARATION SEALS

Before removal of the separation seal, the compressor needs to be in a safe state. All pressures within the compressor casing need to be atmospheric pressure with no differential pressures present (including partial vacuum conditions). No hazardous or toxic gases or liquids must be present and any required decontamination procedures must be carried out. For further information, consult the compressor equipment supplier's manuals and documentation.

In accordance with the compressor equipment supplier's instructions, disassemble the compressor to the point where there is access to the separation seal.

The compressor shaft should be locked to prevent it from moving while removing the separation seal from the compressor. For further information, consult the compressor equipment supplier's manuals and documentation.

1. Carefully study the installation drawing. All devices that secure the seal stator or rotor to the compressor casing or shaft must be removed.
2. If the seal sleeve/runner is part of the cartridge as supplied by John Crane, fit and secure the setting plates as shown on the installation drawing.
3. Fit seal removal tools provided by the compressor manufacturer (or, if unavailable, suitable studding and jacking bar) to facilitate seal removal.
4. Using these tools extract the seal cartridge from the compressor housing.

NOTE It is imperative that while extracting the seal cartridge, it is kept square to the machine. Otherwise it may bind onto the shaft or in the housing.

NOTE It may be necessary to lock the shaft to prevent it moving axially during this operation.

5. Using appropriate lifting equipment, carefully remove the seal cartridge from the shaft.

REPLACEMENT OF TOLERANCE RINGS

Some Type 83 separation seals are fitted with tolerance rings located in the bore of the seal sleeve. The tolerance rings fit into grooves machined into the bores of the sleeve and are glued or spot welded in place. If damaged, the tolerance strip can be changed though this may adversely affect the seal balance.

It is essential the strip is fully located in the appropriate groove. If excessive glue is used shaft damage and out of balance can result.

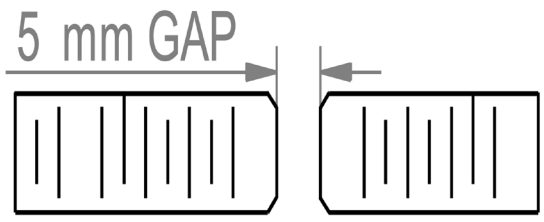
The method of installing a tolerance ring is as follows:

1. Remove the old tolerance ring and all traces of adhesive or spot weld from the groove in the sleeve bore.
2. Carefully cut a new tolerance ring (between "waves") to slightly longer than required.

Exercise extreme care when handling tolerance strip. The edges may be sharp.

3. Curl to provide the best possible fit in groove, and trim the length such that a gap of approximately 5mm is established between the ends of the tolerance ring as shown in figure 1.
4. Chamfer the corners of both cut ends as shown in figure 1.

FIGURE 1



5. Clean the tolerance ring and the sleeve bore grooves with a suitable solvent.

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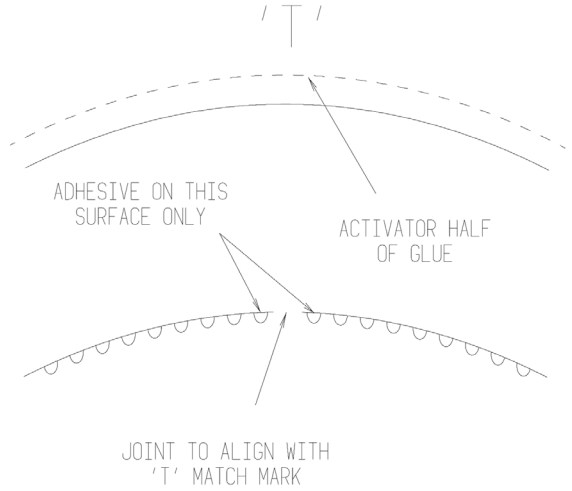
6. Ensure gap aligns with T balance mark (if there is one). See figure 2. The tolerance strip is held in place by a two-part quick acting adhesive such as Loctite Multi Bond (not supplied by John Crane).
7. Apply adhesive sparingly to 5 waves only of one end of the replacement tolerance ring.
8. Apply hardener to groove.
9. Locate and hold tolerance strip in place until set (approximately 60 seconds).
10. Repeat steps 7 to 9 for the other end of the replacement tolerance ring ensuring that it is pushed back well into its groove.
11. When the adhesive is set, remove any excess from the bore.

FIGURE 2



Commissioning procedure

These tasks should be undertaken following seal cartridge installation and prior to starting the compressor.

STATIC TEST

1. Follow carefully the instructions in the Dry Gas Seal IOM. The following points are additional and relate specifically to the separation seal.
2. Commission the separation gas system and ensure that it is functioning correctly. The separation seal gas supply must be on before the oil supply to the bearings is started.
3. Pressurise the separation seals to 0.3 – 0.5 bar. The seal must be pressure regulated in this way and not throttled to control flow with any restriction downstream of the pressure regulator.
4. Initial gas consumption may be high if the separation seals have not been run before, as Type 83's require 'bedding-in'. This is usually complete within the first few hours of dynamic operation.

DYNAMIC TEST

1. Commence normal start procedure. Regularly record the separation gas consumption, to monitor the 'bedding-in' of the separation seals.
2. If continuing excessive gas consumption is observed appropriate action should be taken to investigate the cause of the problem.

Compressor operation and maintenance

The seals are designed to cover the widest range of operating parameters and require virtually no maintenance. It is recommended that separation seal gas consumption is regularly monitored. A trend of increasing leakage may give forewarning of a separation seal problem.

The following notes are intended for guidance:

NOTE 1. **CHECK MONTHLY** for oil in the atmospheric vent lines between the separation seal and the dry gas seal. Drain any oil in these lines, and rectify the cause.

NOTE 2. **FOR PERIODS OF SHUTDOWN** or if the compressor is stored for a prolonged time the seal cartridges should be isolated by blanking off all connecting ports

NOTE 3. **TYPE 83 Separation Seals are bi directional** and reverse rotation is permissible.

NOTE 4. **SEAL LEAKAGE.** The seal should not be operated if the leakage is greater than factory set shutdown trip levels.

NOTE 5. **CORRECT PRESSURE DIFFERENTIAL** must be maintained across each separation seal stage. Recommended suitable pressure differentials are usually within the range 0.2 to 1 bar. The barrier cannot act effectively unless the supplied pressure exceeds that each side of the barrier by a necessary margin. Low pressures may result in oil ingress into the seal. Alarm for low pressure is recommended. Excessive pressure differential (>1 bar) will cause greatly accelerated wear of carbon segments and increased heat generation.

NOTE 6. **REVERSE PRESSURE** is unlikely to occur with a barrier seal and less likely to result in damage. However it must still be avoided – see Note: f) above.

NOTE 7. Whilst **SMALL QUANTITIES OF BEARING OIL** and/or hydrocarbon condensate on the sealing surface are generally not detrimental to the barrier seal, continuous flooding of seals should be avoided.

NOTE 8. Trip of the compressor is recommended in case of **LOSS OF SEPARATION GAS**. This failure can lead to oil migration into the dry gas seal which can lead to gas seal failure. The cause of loss of pressure must be investigated and corrected before the seals are operated again. the bore.

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Storage and transportation of seals

STORAGE

1. John Crane Type 83 Separation Seals should always be stored as complete cartridge units. The seals should be assembled as a unit with the sleeve and setting plate(s) or transit plate properly fitted as shown on the installation drawing.
2. Prior to dispatch every seal is packaged in a purpose built case with a foam lining. If the seal is delivered as a complete cartridge then the crate is suitable for subsequent shipment and storage over the maintenance period. Seals and/or spare elastomers should be stored in their original packaging, indoors and at a temperature between 15 and 25°C.
3. If the seals are to be stored inside the compressor for long periods (more than 8 weeks), it is necessary to ensure the seal faces are not filmed with oil. This would be indicated if oil were found in the in line between the gas seal and the barrier seal.
4. If the separation has been flooded with oil the seals should be removed for inspection and cleaning by a John Crane EAA trained Technician.
5. If the compressor is shipped with the seals in situ the shaft should be restrained to prevent movement and potential seal damage. All compressor connections should be sealed off, after ensuring that the atmosphere within the machine is dry. Preserving oil should not be allowed to contact the seal.
6. Separation seal cartridges need routine refurbishment at regular intervals. After the agreed period of operation, they should be returned to John Crane for 'O' ring replacement and general inspection.

ATTENTION Maximum storage and installed service time combined is 10 years.

Maximum installed service time is 5 years.

At the end of these periods the cartridge should be returned to John Crane for inspection and refurbishment.

Note that the length of the successful installed service period will vary depending on the application parameters such as, speed and pressure applied. Seal condition should be assessed in operation by monitoring gas consumption level and oil presence in the vents.

SHIPPING OF THE SEAL CARTRIDGE

1. It is essential that the seals are suitably packaged and always transported in the purpose built case supplied by John Crane.
2. The separation seals should be assembled as a cartridge unit with the sleeve and setting plate(s) or transit plate fitted (preventing movement and damage in transit).
3. Any "loose" items placed inside the transportation case must be securely wrapped to prevent transit damage.
4. For shipments over 16kg: To ensure safe handling, all items exceeding this weight threshold must be secured on pallets in addition to using the purpose-built transportation case.
5. For other shipping procedures see Appendix II.

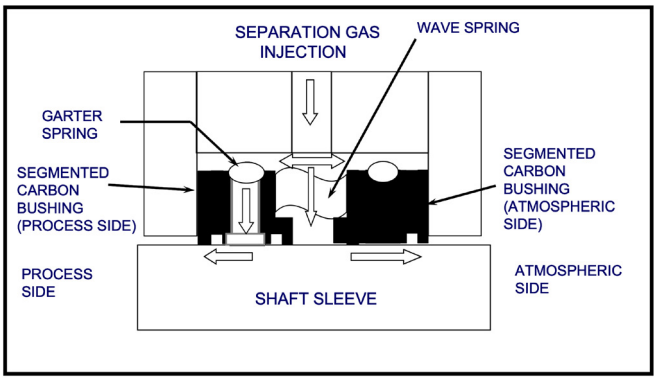
APPENDIX I. Principle of operation

John Crane Type 83 Separation Device (Contacting Segmented Carbon Bushing)

The separation device, which is gas buffered, provides separation between the outboard side of the dry gas seal cartridge and the machine's bearings. It impedes the flow of product gas into the bearing and excludes bearing lubrication oil from migrating inboard into the dry gas seal.

The T83 consists of a pair of segmented carbon bushes as shown in Figure 3. The bushing segments are held in position by spring loading augmented by the pressure of the separation gas. The segments are in rubbing contact with the rotor sleeve but pressure balanced to limit the contact pressure.

FIGURE 3



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APPENDIX II. Returning seals to John Crane

All separation seals should be returned to John Crane for any refurbishment.

Prior to refurbishment, customers must confirm in writing that the specific seals being returned are safe to handle and provide any additional safetycritical information on request. John Crane can provide a suitable form for this purpose.

The following information must be made available on the shipping documentation.

1. Installation drawing numbers

2. Cartridge numbers

3. Value (for insurance only)

4. Commodity code 84842000000

For refurbishment, contact your local John Crane sales representative for shipping details of your nearest John Crane Turbomachinery Service Center.

North America
United States of America
Tel: 1-847-967-2400

Europe
United Kingdom
Tel: 44-1753-224000

Latin America
Brazil
Tel: 55-11-3371-2500

Middle East & Africa
United Arab Emirates
Tel: 971-481-27800

Asia Pacific
Singapore
Tel: 65-6518-1800