ISO 9001-2015 CERTIFIED COMPANY

IOM (Installation, Operation & Maintenance Manual)

Single Cartridge Mechanical Seals

Prepared by Gipfel Engineering

Applicable Seal Designs

- Single Spring: Balanced & Unbalanced
- Multi Spring: Balanced, Unbalanced & Reverse Balanced
- Models: SC605, SC600, SC615, SC620, SC625, SC630

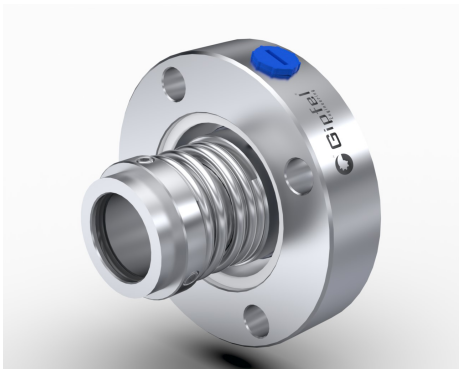
Single Spring Balanced & Un-balanced Design	Multi Spring Balanced, Un-balanced & Reverse Balanced Design
	
SC605 & SC600	**SC615, SC620, SC625 & SC630**

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14. Glossary of Abbreviations

- SDS – Safety Data Sheets
- LOTO – Lock Out / Tag Out
- API Plan – American Petroleum Institute Seal Piping Plan
- P&ID – Piping and Instrumentation Diagram
- PPE – Personal Protective Equipment

Introduction

This document constitutes the official Installation, Operation & Maintenance manual for Single Cartridge Mechanical Seals. It covers all necessary technical procedures, safety protocols, diagrams, and component tables in accordance with industry standards.

Overview

Follow all instructions and consult the associated pump and auxiliary equipment documentation before installation. Strict adherence to these procedures ensures reliable performance and safety.

Notice

Gipfel Engineering shall not be held liable for damages or malfunctions arising from misuse, improper installation, or unauthorised modifications to the sealing system. Consult an authorised Gipfel representative before any system updates or changes.

1. Document Control & Scope

Document ID	Revision	Date	Prepared / Approved
IOM-SCC-007	B	06-Sep-2025	Engineering / QA
Applies To	Single Cartridge Mechanical Seals for Centrifugal Pumps & all types of Rotating Equipment		ISO 9001-2015
Exclusions	Agitators, Vacuum Services, Dry-Running Seals, Split Seals (refer to dedicated IOMs).		

*****Always verify the latest revision before use.

*Retain obsolete copies only for reference, marked “Superseded.”

2. Safety Information

2.1 Safety Precautions

- Follow plant **LOTO** procedures and review the **Safety Data Sheet (SDS)** for all fluids.
- Only qualified, trained personnel may install, operate, or maintain seals.
- The seal must only be used for its intended application. (**Gipfel Engineering** will not accept liability for applications outside of this scope.)
- Inspect the replacement seal before removal/installation, using the technical information provided in this document. (Contact the Gipfel representative if there are any questions.)
- Ensure the pump and seal chamber are **fully depressurised** and have safe access before disassembly.

Note: *SDS = Safety Data Sheet, a document that provides details on chemical hazards, safe handling, PPE, storage, and emergency measures.*

2.2 Symbols & Definitions

Symbol	Meaning
⚠ Danger / Warning	Risk of injury; rotating equipment; pressurised systems; hot surfaces.
Notice	Equipment/seal damage prevention.
PPE	Gloves, face shield, goggles, and chemical-resistant clothing as per SDS.
⛔ Prohibited	No dry running, no hammering faces.
Tools	correct tool & torque; apply criss-cross tightening sequence.

2.3 Additional Safety Notes

- Keep seal faces clean and free of dust or scratches at all times.
- Never attempt installation without setting the clips installed.
- Confirm all auxiliary systems (flush, quench, cooler) are operational before starting equipment.

3. Preinstallation Checklist

3.1 Documentation & Reference Drawings

- Verify seal specification and bill of materials (BOM) against equipment tag sheets.

3.2 General Requirements & Seal Identification

- Confirm type, size, and correct presence of setting clips.
- Safety exposes the existing seal following OEM instructions.
- Isolate the pump; apply **Lock-Out/Tag-Out (LOTO)** and verify zero energy.
- Drain and depressurise the casing and seal chamber completely.
- Ensure work area is clean and well-lit. Only trained personnel should perform installation.
- Disassemble the pump cavity to expose the defective seal.

- Removal of old seal and assembly of the new seal requires careful operations and precautions.
- Carefully remove the existing sealing solution, ensuring that the shaft and other critical sealing surfaces are not damaged.

CAUTION: Lapped and polished faces of new seal are easily scratched and damaged. PROTECT FROM DAMAGE, DIRT and FINGER PRINTS.

3.3 Shaft & Sleeve Preparation

- Inspect shaft/sleeve OD, deburr keyways, and check finish.
- Measure shaft or sleeve OD; finish ≤ Ra 1.6 µm (63 µin).
- Verify OD (Over Diameter) tolerance h9 or better as shown in **Figure 1**.
- Clean shaft and counterbore surfaces using fine emery cloth or equivalent.
- Clean thoroughly; remove corrosion, rust, burrs, debris and wipe clean.
- For ease of installation, chamfer the leading edge of the shaft or sleeve as shown in **Figure 1**, and deburr all components.

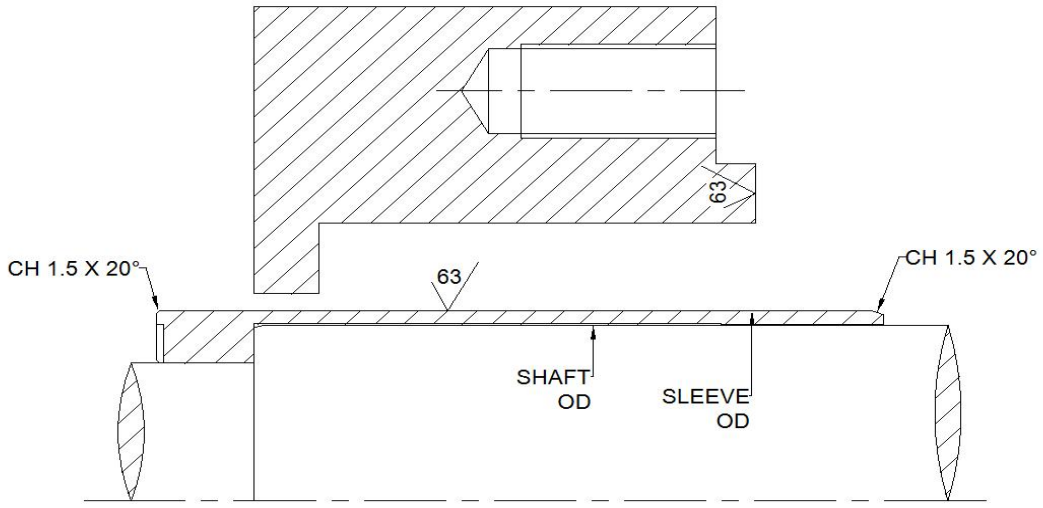


Figure 1: Surface Finish and chamfer locations.

3.4 Seal Chamber Condition

- Inspect bore/surface condition, chamber face, squareness and cleanliness to meet **Section 4** tolerances.
- Confirm concentricity and runout within specified tolerances (**see Section 4**).
- Clean chamber thoroughly, ensuring no particles remain.

3.5 Lubrication

- Elastomer lubrication:
  - EPDM → water-based (P-80/glycerine).
  - NBR/FKM → silicone or mineral oil.
- Use compatible lubricants only; avoid petroleum oil on EPDM.

3.6 Auxiliaries & Piping

- API Plan piping installed as per P&ID.
- Instruments (pressure, flow, temperature) installed and operable.
- Flush lines, quench, and cooling water systems verified.

3.7 Tools & Fasteners

- Calibrated torque wrench available.
- Confirm fastener grade (ISO 898-1 Class 8.8 minimum unless otherwise specified).
- Thread locker available for set screws/bolts.

3.8 Pump & Base Installation

- Confirm base rigidity and alignment within tolerance.
- Piping strain relieved.
- Lock-Out / Tag-Out (LOTO) applied and verified.

4. Installation Tolerances

4.1 Critical Dimensional Tolerances

- Maintain the following tolerances unless tighter OEM specifications are provided.
- All values must be verified before installation.
- Maintain consistent metric/imperial values.
- Exceeding tolerances can lead to leakage, excessive wear, or shaft damage.

Figures	Parameter	Metric	Imperial
Figure 2	Shaft runout at seal location (TIR)	≤ 0.05 mm	≤ 0.002 in
Figure 3	Radial Shaft movement	≤ 0.05 mm	≤ 0.002 in
Figure 4	Seal chamber face squareness to shaft	≤ 0.0127 mm/25.4 mm	≤ 0.0005 in/in
Figure 5	Bore to shaft concentricity (TIR)	≤ 0.127 mm	≤ 0.005 in
Figure 6	Axial endplay (rotor)	≤ 0.25 mm	≤ 0.010 in

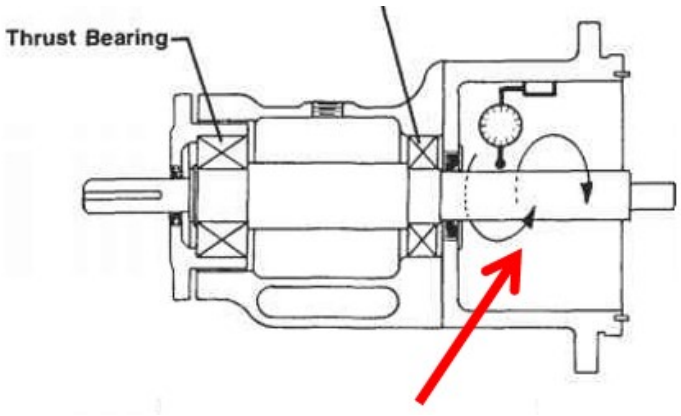


Figure 2: Shaft Runout

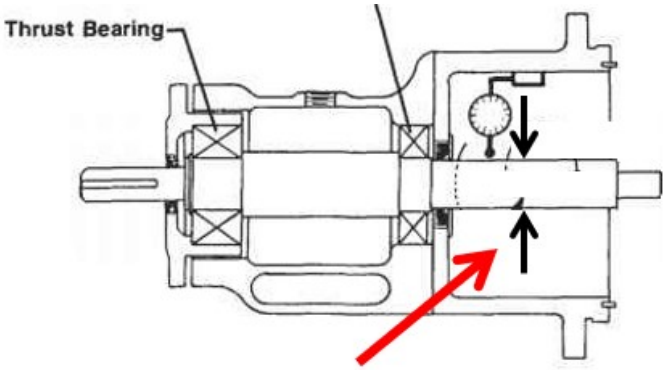


Figure 3: Radial Shaft Movement

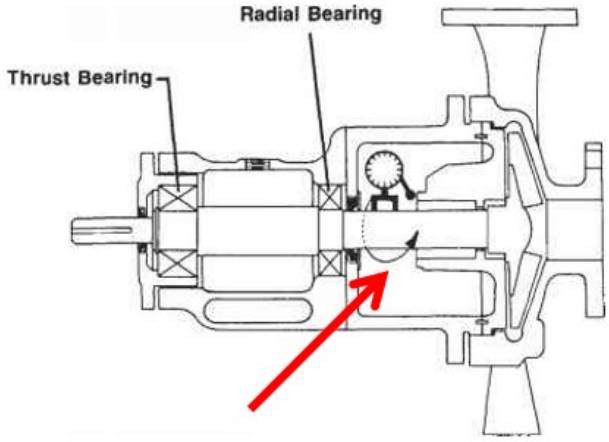


Figure 4: Seal Chamber Face Squareness

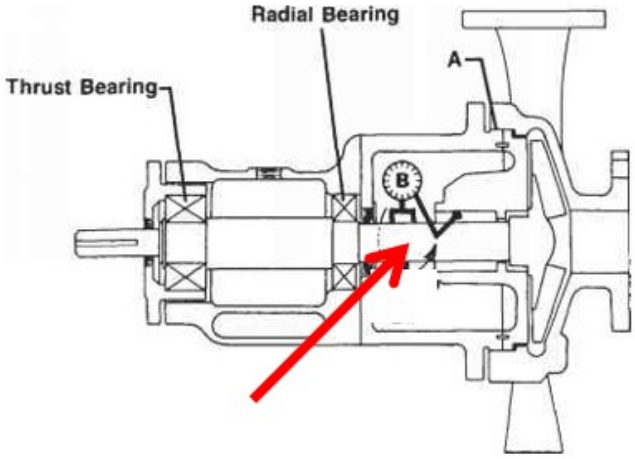


Figure 5: Seal Chamber Bore Concentricity

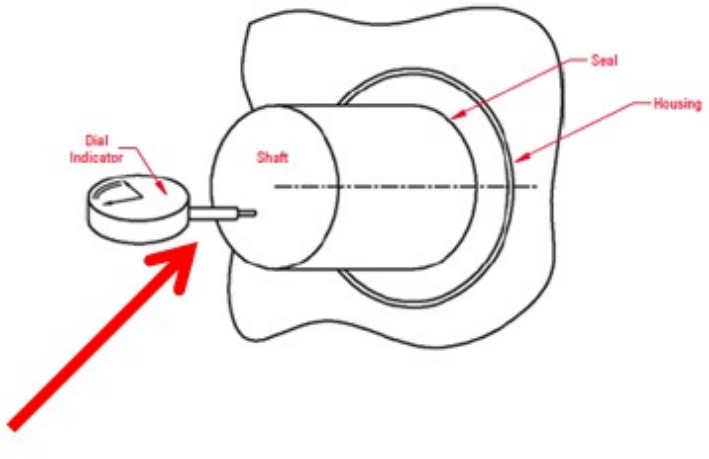


Figure 6: Shaft Endplay

4.2 Important Notes

- OEM-specified tolerances always take precedence.
- Equivalent metric and imperial values must be maintained consistently.
- Exceeding these tolerances can result in premature leakage, face wear, or sleeve fretting.

5. Materials & Lubricant Compatibility

5.1 Component Selection Reference

Component	Primary Options	Typical Service	Notes
Faces	SiC. / SiC. – TC / SiC. Carbon / SiC.	Fines / Abrasion / Clean Water / Slurries	Hard–hard for solids / Carbon–SiC for general duties
Secondary Seals (Elastomers)	NBR / EPDM / Aflas® / FKM / FFKM	Hot Water / Alkali / Oils / Acids / Solvents	Avoid petroleum oil on EPDM / check SDS & chemical compatibility
Metallics	SS316L / Duplex 2205 / Hastelloy C (where required)	General duties/chloride stress / aggressive chemicals	Select per corrosion level, chloride content and temperature
Set-screws	Cup-point on sleeve / soft-tip with thread locker	Shaft drive	Proper torque, Prevent scoring
Lubricants for O-rings	P-80 / Glycerine / Soapy Water / Silicone / Mineral Oil	Assembly lubricant	No swelling agents

5.2 Important Notes

- Always confirm MOC (Material of Construction) against process SDS and corrosion data.
- Elastomer shelf life: EPDM/NBR/FKM typically **5–10 years** (per ISO standards); verify date codes before use.
- For aggressive media, consult Gipfel Engineering for special metallurgy (e.g., Alloy 20, Titanium, Hastelloy).

- During assembly, ensure lubricants are applied sparingly and only to elastomers—not to seal faces.

6. Seal Support System (API Plan)

6.1 API Plan Reference Guide for Typical Single Seal

(Use in conjunction with P&ID and project specifications)

Plan	Purpose	Minimum Differential / Conditions	Notes
Plan 11	Product recirculation to faces	ΔP ≥ 0.1–0.2 bar across faces	Keep taps free of elbows / Use a strainer or cyclone if solids are present
Plan 21	Recirculation through the cooler	Maintain adequate cooling water flow	Recommended for hot services / Monitor viscosity and vapour pressure
Plan 23	Internal circulation with a pumping ring & a cooler	Correct orientation of the pumping ring is required	More efficient cooling than Plan 21 / Reduces seal face temperature
Plan 32	External clean flush to faces	Flush ≥ seal chamber pressure by 1–2 bar	Best for dirty / slurry services / Ensure high-quality flush fluid
Plan 62	Quench on the atmospheric side	Gentle, non-contaminating quench only	Prevents icing or crystallisation/ Not intended for face lubrication

6.2 Additional Guidance

- Ensure proper instrumentation (pressure gauges, flow indicators, thermocouples) is installed and functioning.
- Flush and quench fluids must be **compatible with process fluid and seal elastomers**.
- Always maintain the required differential pressure to avoid reverse leakage or contamination.
- Strainers, orifices, and piping should be installed as per API 682 / ISO 21049 recommendations.

7. Installation Procedure

7.1 General Requirements

- Lightly lubricate elastomers with approved lubricant (see **Section 5**).
- Slide the whole cartridge assembly unit carefully onto the shaft, up to the seal chamber Surface as shown **Figure 3**.
- Do not force the seal over burrs or shaft damage.
- Ensure clips are seated properly against the seal assembly's gland groove.

7.2 Cartridge Assembly Mounting

- Use an installation sleeve, push the cartridge body carefully, and keep the seal faces protected.
- Seat on the shaft shoulder, align, tighten the set screws to spec, and remove the setting clips after alignment.
- Slide the rotating assembly carefully onto the shaft, up to the setting clips/stops.

- Finger-tighten bolts to hold the gland in position; do not fully torque yet.

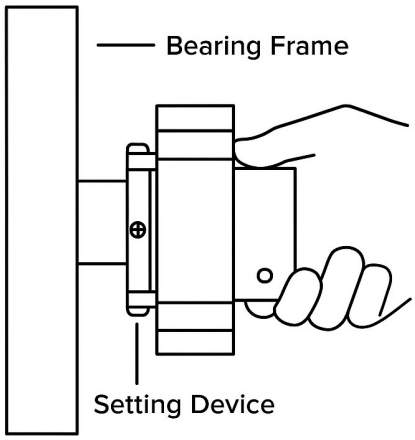


Figure 2

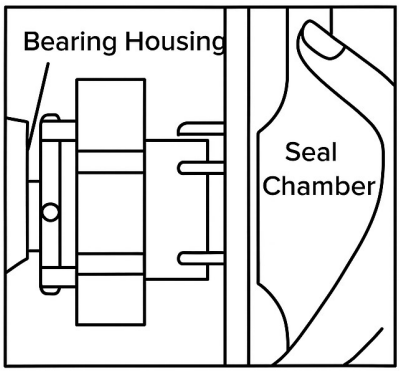


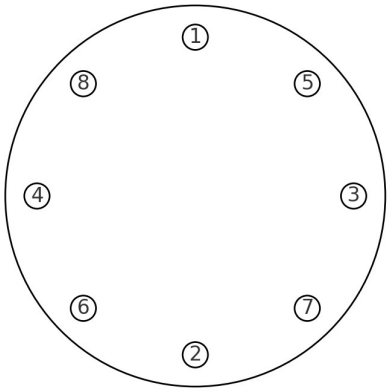
Figure 3

ILLUSTRATION – SEAL PUSHING ONTO SHAFT (FIGURE 2 & FIGURE 3)

7.3 Gland Bolt Tightening

- Align the gland so it sits flat on the chamber face.
- Tighten bolts in a **criss-cross (star) sequence** to ensure uniform load.

Illustration – Bolt Tightening Sequence



(8-bolt criss-cross pattern)

7.4 Torque Guidance

Torque Rating for Cartridge Seal Gland Bolts (Flat Gasketed Gland)

Shaft Size	1.000” – 2.000” 24mm – 50mm	2.125” – 3.250” 53mm – 80mm	3.375” – 4.000” 85mm – 100mm
Recommended	20 ft-lbs.	25 ft-lbs.	30 ft-lbs.

Shaft Size	1.000” – 2.000” 24mm – 50mm	2.125” – 3.250” 53mm – 80mm	3.375” – 4.000” 85mm – 100mm
Torque	27 N-m	34 N-m	41 N-m

Bolt Size	Thread Pitch	Tightening Load (kN)	Torque Dry (N·m)	Torque Oiled (N·m)
M8	1.25	16	25	19
M10	1.5	25	49	37
M12	1.75	36	86	65
M16	2.0	57	210	160
M20	2.5	89	410	310

Set Screw Torque Specifications

Screw Size (Imperial)	Alloy Steel	Stainless	Screw Size (Millimetre)	Alloy Steel	Stainless
#10	36 in. lbs.	26 in. in.-lbs.	**M4**	2.0 N-m	1.5 N-m
1/4	87 in. lbs.	70 in. lbs.	**M6**	7.9 N-m	6.1 N-m
5/16	165 in. lbs.	130 in.-lbs.	**M8**	19.6 N-m	15.4 N-m
3/8	290 in. lbs.	230 in. lbs.	**M10**	37.0 N-m	29.5 N-m
1/2	620 in. lbs.	500 in. lbs.	**M12**	60.3 N-m	N-m

*Values for ISO 898-1 Class 8.8; K≈0.20 (dry) and K≈0.15 (oiled).

*Verify against project/OEM requirements.

7.5 Tools (Wrench & Allen Key) Reference Table

The following table guides on selecting the appropriate wrench and Allen key sizes required for the installation and tightening of gland bolts, set screws, and flush connection screws for cartridge mechanical seals.

Torque values are indicative and must be confirmed based on the fastener grade (8.8 / 10.9) and the specific application.

Component	Fastener Size (mm)	Recommended Tool Size (mm)	Torque Reference (Nm)*
Gland Plate Bolts	M10	17 mm Ring/Socket Wrench	45 – 50
Gland Plate Bolts	M12	19 mm Ring/Socket Wrench	75 – 80
Gland Plate Bolts	M16	24 mm Ring/Socket Wrench	150 – 160
Set Screws (Shaft Clamping)	M6	5 mm Allen Key	8 – 10
Set Screws (Shaft Clamping)	M8	6 mm Allen Key	18 – 20
Flush Connection Screws (if any)	M10	8 mm Allen Key	40 – 45

* Always use a calibrated torque wrench.

*Set-screws on sleeves typically 6-10 N·m (M6-M8) unless otherwise specified.
*Avoid overtightening to prevent sleeve distortion.
*Verify against project/OEM requirements.

7.6 Release for Operation

- Tighten drive/set-screws to specified torque; use thread locker as recommended.
- Remove all setting clips/stops and retain them as spares.
- Connect API plan piping (flush/quenches/coolers) and verify flow, pressure, and direction.
- Reinstall coupling and guards.
- Remove LOTO only after the **installation checklist** has been signed off.

8. Start-up & Break-in

8.1 Pre-Start Checks

- Prime pump and **vent seal chamber and casing** fully; “Strictly prohibited; causes significant damage”.
- Confirm all auxiliaries (flush, quench, coolers) are started and flows verified **before rotation**.
- Check instrument readings (pressure, temperature, flow) and record baseline values.

8.2 Start-up Sequence

- Start auxiliaries.
- Rotate the pump slowly by hand to ensure free movement.
- Start motor and bring unit up to operating speed gradually.
- Monitor gland for leakage, noise, and vibration.

8.3 Break-in Observations

- Expect a **small amount of initial leakage** at start-up, which should stabilise.
- Gland temperature should rise gradually, but remain typically **< 20–30 °C above ambient**.
- Observe operation for **30–60 minutes**: noise, vibration, leakage. Initial trace leakage may stabilise.

8.4 Data Recording

- Document pressures, temperatures, and flush flows at steady state.
- Use baseline data as a reference for future troubleshooting and condition monitoring.

9. Troubleshooting & Fault Matrix

9.1 General Notes

- Always verify that installation steps, torque values, and auxiliary systems were completed correctly before diagnosing a fault.
- Troubleshooting should be performed by qualified maintenance personnel with proper safety measures (LOTO, depressurisation).

9.2 Troubleshooting Matrix

Symptom	Likely Cause	Check	Corrective Action

Symptom	Likely Cause	Check	Corrective Action
Leakage on start-up	Air trapped in the chamber / setting clips not removed / gland misalignment / improper torque	Verify clips removed/check gland flatness and torque / inspect venting	Remove air / re-align gland / re-torque bolts / ensure clips are removed
High gland temperature	Insufficient flush/dry running/cooler not in service	Check flush flow and ΔP / verify cooler inlet/outlet temperature	Restore flush supply / open cooler / verify cooling water flow
Rapid facial wear	Wrong face combination/solids in product / poor lubrication/pump vibration	Inspect flush quality / check vibration spectrum / inspect face condition	Upgrade to sic. – sic. / Improve flush quality (plan 32, cyclone separator) / balance rotating parts
Sleeve fretting/scoring	Set screws directly on the shaft / micro-movement / insufficient torque	Inspect sleeve witness marks / check screw tips	Use sleeve / specify cup-point or soft-tip screws / apply proper torque
Product contamination	Incorrect quench/flush mixing/reservoir malfunction	Inspect quench plan / check reservoir level, temperature, pressure	Correct plan / isolate contamination path/repair/replace reservoir

10. Recommended Spares & Stocking

10.1 Spare Parts Specification

- **Elastomer & Secondary Seal Kit**
  - Complete set of O-rings and gaskets for a minimum of **two years of operation**.
  - Verify elastomer shelf life before use (see Section 5).

- **Setting Clips & Sleeve O-rings**
  - Keep spare **setting clips/stops** for each cartridge supplied.
  - Maintain extra sleeve O-rings for emergency replacement.

- **Cartridge Assemblies**
  - Maintain **one spare cartridge assembly** per 10 identical seals, or **one per critical duty**.
  - Ensure spare cartridges are tagged and stored per Section 11 (Storage & Handling).

- **Consumables & Accessories**
  - Gland gasket sheet material compatible with process fluid.
  - Approved thread locker (medium strength, suitable for fasteners in contact with process vapours).

Note: To ensure reliable operation and minimise downtime, the following spares should be maintained for each seal size and duty cycle.

10.2 Stocking Recommendations

- Review criticality of equipment and production schedules to define stocking levels.

- Align spare stocking policy with plant **preventive maintenance plans** and **OEM recommendations**.
- Store spares in a clean, dry, controlled environment per guidelines in Section 11.

11. Storage & Handling

11.1 General Storage Guidelines

- Store seals in their **original boxes/containers** in a clean, dry, dust-free area.
- Ambient conditions: **Temperature < 40 °C**, **Relative Humidity < 70%**.
- Keep away from ozone, UV sources, direct sunlight, and corrosive vapours.

11.2 Seal Protection

- Keep **setting clips installed** during storage and transport.
- Avoid applying loads on seal faces; do not stack cartons in a manner that risks face damage.
- Prevent shock, vibration, or accidental impacts during handling.

11.3 Elastomer Shelf Life

- EPDM / NBR / FKM: typically, **5–10 years** as per ISO standards.
- Alfas® / FFKM: verify per manufacturer's certification.
- Always check date codes and supplier recommendations before installation.

11.4 Handling Precautions

- Handle seals only with **clean, dry hands** or with lint-free gloves.
- Do not expose seals to oils, solvents, or incompatible cleaning agents before installation.
- Always keep **face protection covers** in place until the seal is mounted on the shaft.

12. RMA & Decontamination Procedure

12.1 Purpose

- This procedure ensures safe return of mechanical seals for inspection, repair, or warranty evaluation, while protecting personnel from hazardous exposure.

12.2 Authorisation (RMA) Requirements

➢ Before shipping a seal back to Gipfel Engineering:

- Obtain an official **RMA number** from GIPFEL's service department.
- Complete the **Decontamination Certificate** fully and truthfully.
- Attach the completed certificate to the shipment.
- Ensure all packaging is secure and clearly labelled with "Decontaminated Equipment."

12.3 Decontamination Certificate (Required Information)

Field	Details to be Provided
Customer	Company name, address
Contact	Name / Phone / Email

Field	Details to be Provided
Seal Model / Size	As per the IOM or PO
Pump Model / Tag No.	Identify equipment
Service Fluid	Composition, temperature, pressure
Flush / Quench Plans in Use	API Plan numbers
Observed Symptoms	Leakage, vibration, wear, etc.
Time in Service	Operating hours since commissioning
Decontamination Method Applied	Cleaning/neutralisation steps taken
SDS Attached (Y/N)	Provide Safety Data Sheet
Safety Hazards Remaining	Clearly state residual risks
Special Handling Instructions	PPE or restrictions
Return Authorisation No.	Issued by Gipfel Engineering
Ship To	Gipfel Engineering Service Centre
Signature / Date	Authorised company signatory

12.4 Safety Notes

- Seals returned without proper **decontamination and certification** may be rejected.
- Customer is responsible for ensuring compliance with **local EHS regulations**.
- Gipfel reserves the right to refuse acceptance of contaminated or unsafe returns.

13. Annexures

13.1 Annex A: Dual Cartridge [Pressurized (API Plan 53A/53B)]

- For services requiring zero visible leakage or isolation from crystallising/contaminating fluids.
- Maintain barrier fluid pressure at ≥ 1.5 bar above seal chamber pressure.
- Use clean, compatible barrier oil.
- Reservoir (Plan 53A) or bladder/accumulator (Plan 53B) must include:
  - Pressure, level, and temperature indication.
  - Pressure relief and alarm setpoints.
- Commission as per vendor procedure and verify interlocks.

13.2 Annexe B: Dual Cartridge [Unpressurized (API Plan 52)]

- Used where controlled leakage collection is acceptable and product dilution must be avoided.
- Provide a properly vented, cooled reservoir with a circulation device.
- Monitor level and temperature regularly.
- Not suitable for toxic or vaporising services without prior risk assessment.

13.3 Annexe C: Heavy-Duty Seal for Slurry / Suspended Solids

- Recommended for services with high solids load.

- Use hard–hard face pairs (SiC v/s SiC) and locate stationary springs outside the product to resist clogging.
- Prefer Plan 32 (clean external flush) or cyclone separator on recirculation to protect faces.
- Maintain minimum flush differential pressure (ΔP) and flow at all times.

13.4 Annexe D: Metal Bellow (Single / Dual)

- Suitable for high-temperature duties or where O-ring hang-up risk exists.
- No dynamic O-rings; eliminates risk of elastomer extrusion.
- Confirm bellows metallurgy vs. process chemistry and operating temperature.
- Consider thermal growth and cycling — follow supplier-specific guidelines.

13.5 Annexe E: Split Mechanical Seal (Large Horizontal / Vertical Pumps & Equipment)

- Designed for pumps with limited lifting or maintenance access.
- Allows seal change without drive removal.
- Requirements:
  - Excellent sleeve condition.
  - Accurate split-line alignment.
- Expect minor vapour leakage at the split during start-up.
- Use dedicated fixtures and follow the split-seal torque sequence.
- Perform a thorough inspection after assembly.

14. Glossary of Abbreviations

14.1 SDS – Safety Data Sheet

A standardised document that provides complete information about a chemical substance or mixture. It includes:

- Identification of the chemical and supplier.
- Hazard classification (toxic, flammable, corrosive, etc.).
- Safe handling and storage guidelines.
- Recommended **PPE** (Personal Protective Equipment).
- Emergency response and first-aid measures.
- Environmental and disposal considerations.

14.2 LOTO – Lock Out / Tag Out

A safety procedure used in industrial and maintenance work to ensure that dangerous machines are properly shut off and not started again before the completion of maintenance or servicing. It involves:

- **Lockout**: Placing a physical lock on the energy-isolating device (valves, breakers).
- **Tagout**: Attaching a warning tag that prohibits operation.
- Prevents accidental startup of pumps, motors, and rotating equipment during servicing.
- Mandatory before working on mechanical seals.

14.3 API Plan – American Petroleum Institute Seal Piping Plan

Standardised auxiliary piping arrangements defined in **API 682 / ISO 21049** for mechanical seals. Each plan has a specific function to ensure seal reliability. Examples include:

- **Plan 11**: Product recirculation from pump discharge to seal chamber.
- **Plan 21**: Recirculation through cooler, then to seal chamber.
- **Plan 23**: Circulation through pumping ring and cooler (closed loop).
- **Plan 32**: Clean external flush injected into the seal chamber.
- **Plan 52**: Unpressurized dual seal buffer fluid system with reservoir.
- **Plan 53A/53B**: Pressurised dual seal barrier system with bladder/accumulator and reservoir.
- **Plan 62**: Quench fluid on the atmospheric side of the seal.

14.4 P&ID – Piping and Instrumentation Diagram

- A detailed engineering drawing that shows the interconnection of piping, process equipment, and instrumentation. It is used for installation, operation, and maintenance reference.
- In seal manuals, the P&ID ensures correct connection of **API Plans** (flush, quench, cooling lines) and compliance with project specifications.

14.5 PPE – Personal Protective Equipment

- Specialised clothing and equipment worn by workers to protect against workplace hazards. Examples include:
  - Safety gloves, goggles, and face shields.
  - Hearing protection and helmets.
  - Chemical-resistant suits and aprons.
  - Safety shoes or boots.

Note: PPE is always specified in the **SDS** and must be used during seal installation, operation, and maintenance.