

DIN EN ISO 21049

ICS 21.140; 23.080

Einsprüche bis 2010-06-19
Vorgesehen als Ersatz für
DIN EN ISO 21049:2005-11

Entwurf

**Pumpen –
Wellendichtungssysteme für Kreispumpen und rotierende
Verdrängerpumpen (ISO/DIS 21049:2009);
Englische Fassung prEN ISO 21049:2010, nur auf CD-ROM**

Pumps –

Shaft sealing systems for centrifugal and rotary pumps (ISO/DIS 21049:2009);
English version prEN ISO 21049:2010, only on CD-ROM

Pompes –

Dispositifs d'étanchéité de l'arbre pour pompes centrifuges et rotatives
(ISO/DIS 21049:2009);
Version anglaise prEN ISO 21049:2010, seulement en CD-ROM

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2010-04-19 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise als Datei per E-Mail an noeg@din.de in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter www.din.de/stellungnahme abgerufen werden;
- oder in Papierform an den Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN, 10772 Berlin (Hausanschrift: Burggrafenstr. 6, 10787 Berlin).

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevante Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 271 Seiten

Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN
Normenausschuss Maschinenbau (NAM) im DIN

Nationales Vorwort

Dieses Dokument (prEN ISO 21049:2010) wurde vom ISO/TC 115 „Pumps“, Subkomitee SC 3 „Installation and special application“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ (Sekretariat AFNOR, Frankreich) erarbeitet.

Für Deutschland hat hieran der Arbeitsausschuss NA 109-00-01 AA „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie — Spiegelausschuss zu CEN/TC 12 und ISO/TC 67“ im Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) des DIN Deutsches Institut für Normung e. V. mitgearbeitet.

Diese Europäische Norm enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung der ISO Norm.

Das Ausgabedatum des Europäischen Norm-Entwurfs stand zum Zeitpunkt der Veröffentlichung dieses DIN-EN-ISO-Entwurfs noch nicht fest; der prEN ISO wird jedoch vom CMC unter der angegebenen prEN-Nummer demnächst zur CEN-Umfrage verteilt. Um der deutschen Öffentlichkeit eine möglichst lange Einspruchsfrist einzuräumen, wurde dieser Norm-Entwurf bereits vorab veröffentlicht.

Diese Norm enthält neben den gesetzlichen Einheiten auch die Einheiten „°F“, „°R“, „BTU/(lb·°F)“, „ft“, „gal“, „inch“, „lb“, „lbf“, „NPS“, „ppm“, „psi“, „qt“ und „r/min“, die im Deutschen Normenwerk nicht zugelassen sind. Es wird ausdrücklich darauf hingewiesen, dass die Anwendung dieser Einheiten im nationalen amtlichen und geschäftlichen Verkehr aufgrund des Gesetzes über Einheiten im Messwesen nicht zulässig ist.

Umrechnung:

Nicht-SI-Einheit	SI-Einheit	Umrechnung	
°F	°C	°C	= (5/9) (°F–32)
°R	°C	1 °R	= 1,25 °C
BTU/(lb·°F)	kJ/(kg·K)	1 Btu/(lbm °F)	= 4,186 8 kJ/ (kg K)
ft	m	1 ft	= 0,3048 m
gal	l	1 gal	= 3,785 l
hp	kW	1 hp	= 0,74 kW
in (inch)	mm	1 in	= 25,4 mm
lb (pound)	kg	1 lb	= 0,453 592 37 kg
lbf	N	1 lbf	= 4,448 222 N
NPS	DN	1 NPS	= DN 25
ppm	mg/kg	1 ppm	= 1 mg/kg
psi (psig)	kPa	1 psi	= 6,894 757 kPa
qt (quart)	l	1 quart	= 0,946 l
r/min	min ^{–1}	1 r/min	= 1 min ^{–1}

Für die in diesem Dokument zitierten Internationalen Normen wird im Folgenden auf die entsprechenden Deutschen Normen hingewiesen:

ISO 7-1	siehe	DIN EN 10226-1
ISO 7-2	siehe	DIN EN 10226-3
ISO 261	siehe	DIN ISO 261
ISO 262	siehe	DIN ISO 262
ISO 286-2	siehe	DIN ISO 286-2
ISO 724	siehe	DIN ISO 724
ISO 965 all parts	siehe	DIN ISO 965 alle Teile
ISO 10438-1	siehe	DIN EN ISO 10438-1
ISO 13709	siehe	DIN EN ISO 13709
IEC 60079 all parts	siehe	DIN EN 60079 alle Teile

Änderungen

Gegenüber DIN EN ISO 21049:2005-11 wurden folgende Änderungen vorgenommen:

- a) Aktualisierung der normativen Verweisungen;
- b) Erweiterung der Begriffsdefinitionen u. a. zu „Seal ring“ und „Seal sleeve“;
- c) Erweiterung des Abschnitts 6.1 „Common design requirements (all categories)“;
- d) neue Tabelle 1 „Clearances between rotary and stationary components“;
- e) neues Bild 16 „Plastic plug with centre tab and example of warning tag“;
- f) Überarbeitete Tabelle 4 „Minimum requirements for auxiliary piping materials“;
- g) neue Tabelle 5 „Minimum pipe wall thickness“ und neue Tabelle 6 „Minimum tubing wall thickness“;
- h) Überarbeitung des Abschnitts 10.3.1 „Seal qualification testing“;
- i) Überarbeitung des Abschnitts 11 „Data transfer“;
- j) neuer Abschnitt A.4 „Alternative seal Arrangement selection method using material safety data sheet information“;
- k) Erweiterung des informativen Anhang B „Typical materials and material specification for seal chamber and mechanical seal components“ u. a. im Abschnitt B.1 „Material standards“ und Abschnitt B.2 „Seal rings and mating rings“;
- l) Neugestaltung der „Mechanical seal data sheets“ im informativen Anhang C;
- m) neuer informativer Anhang F „Technical tutorials and illustrative calculations“;
- n) neuer Abschnitt G.2 „Symbol library“;
- o) neuer normativer Anhang I „Seal qualification testing protocol“;
- p) Aktualisierung des Literaturverzeichnisses;
- q) Norm wurde redaktionell überarbeitet.

Nationaler Anhang NA (informativ)

Begriffe und Definitionen

3 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

**3.1
Verdrehsicherung**
Vorrichtung, die in einer Dichtungsanordnung ein Verdrehen eines Bauteils im Verhältnis zu einem benachbarten Bauteil verhindert

BEISPIELE Schlüssel, Stift.

**3.2
Dichtung der Anordnung 1**
siehe 4.1.4

**3.3
Dichtung der Anordnung 2**
siehe 4.1.4

**3.4
Dichtung der Anordnung 3**
siehe 4.1.4

**3.5
belüfteter Leckagesammler**
externer Behälter, der zum Auffangen der flüssigen Dichtungsleckage aus einer Dichtung der Anordnung 1 dient

**3.6
Hilfshülse**
separate Hülse, die auf den Außendurchmesser der Wellendichtungshülse montiert wird und die Montage von Dichtungsbauteilen erleichtert

**3.7
Back-to-back-Anordnung**
Doppel-Gleitringdichtung, bei der beide gefederten Elemente zwischen dem Gegenring angebracht sind. Das abgedichtete Fluid befindet sich auf der Innenseite der Innendichtung und das Sperr- oder Pufferfluid auf der Außenseite der Innen- und Außendichtung

**3.8
entlastete Gleitringdichtung**
Gleitringdichtung, in der die Fluid-Schließkräfte durch die Dichtungsstruktur verändert wurden

ANMERKUNG In dieser Internationalen Norm ist der Entlastungsfaktor der Dichtung kleiner als 1 (siehe Berechnung des Entlastungsfaktors in Anhang F).

3.9**Sperrfluid**

extern zugeführtes Fluid, mit einem höheren Druck als dem Druck in der Dichtungskammer der Pumpe, das in eine Dichtung der Anordnung 3 eingebracht wird, um die Prozessflüssigkeit vollständig von der Umgebung zu trennen

3.10**Sperr-/Pufferkammer der Dichtung**

Bauteil oder Aggregat von Bauteilen, das den Hohlraum bildet, in den die Außendichtung einer druckbelasteten oder druckentlasteten Doppel-Gleitringdichtung eingebaut wird und in dem ein Sperr- oder Pufferfluid zirkuliert

3.11**Faltenbalgdichtung**

Bauart einer Gleitringdichtung, die mit Hilfe eines flexiblen Metallfaltenbalgs eine Sekundärdichtung und Federbelastung erreicht

3.12**Pufferfluid**

extern zugeführtes Fluid, mit einem geringeren Druck als dem Druck in der Dichtungskammer der Pumpe, das als Schmiermittel und/oder Verdünnungsmittel in einer Dichtung der Anordnung 2 dient

3.13**Patronendichtung**

vollständig selbständige Einheit (einschließlich Dichtflächen, gefederte Elemente, Stopfbuchsenplatte, Wellenhülse), die vor dem Einbau vormontiert und voreingestellt wird

3.14**Dichtung der Kategorie 1**

siehe 4.1.2

3.15**Dichtung der Kategorie 2**

siehe 4.1.2

3.16**Dichtung der Kategorie 3**

siehe 4.1.2

3.17**Anschluss**

Schraub- oder Flanschverbindung, die eine Anschlussöffnung mit einer Rohrleitung oder einem Rohrstück verbindet

3.18**Berührungsdichtung**

Bauart einer Dichtung, bei der die Passflächen nicht so gestaltet sind, dass sie absichtlich aerodynamische oder hydrodynamische Kräfte erzeugen, um einen spezifischen Trennspalt aufrechtzuerhalten

ANMERKUNG Berührungsdichtungen können tatsächlich einen geschlossenen Fluidfilm entwickeln, obwohl das nicht typisch ist. Berührungsdichtungen weisen keine Gestaltung auf, z. B. durch Rillen, Beläge, Flächenwelligkeit, die sicherstellt, dass die Flächen sich nicht berühren. Der Berührungsgrad ist im Allgemeinen sehr gering und erlaubt einen zuverlässigen Betrieb mit geringer Leckage.

3.19**Rückhalteeinrichtung**

Dichtung oder Buchse, die dazu dient, die Leckage von der Innen- oder Außendichtung aufzunehmen und an einen vom Nutzer bestimmten Ort zu leiten. Für eine detaillierte Beschreibung siehe Anhang F

3.20**Sicherheitsdichtung**

spezielle Ausführung einer Außendichtung, die in einer Dichtung der Anordnung 2 verwendet wird und normalerweise in Dampf (Puffergas oder ohne Puffer) funktioniert, aber beim Versagen einer Innendichtung das Prozessfluid für eine begrenzte Zeitdauer abdichtet. Siehe 4.2

3.21**Sicherheitsdichtungskammer**

Bauteil oder Aggregat von Bauteilen, das den Hohlraum bildet, in den die Sicherheitsdichtung eingebaut wird

3.22**Leckagesammler der Sicherheitsdichtungskammer**

Sammelbehälter, der durch ein Leitungssystem mit der Sicherheitsdichtungskammer verbunden ist und zur Aufnahme der kondensierten Leckage der Innendichtung in einer Anordnung 2 dient

3.23**kristallisierendes Fluid**

Fluid, das sich im Prozess der Bildung von Feststoffen befindet oder das aufgrund von Austrocknung oder infolge einer chemischen Reaktion Feststoffe bilden kann

3.24**dezentrales Spülsystem**

Anordnung von Hohlräumen, Durchgängen, Prallwänden usw., die so konstruiert ist, dass sie eine gleichmäßige Verteilung des Spülfluids am Umfang der Dichtflächen fördert

ANMERKUNG Diese sind normalerweise erforderlich, wenn Leitungspläne eine Spülung der Dichtungskammer vorsehen.

3.25**Drehmitnahme**

externes Bauteil der Dichtungspatrone, welches das Drehmoment auf die Dichtungshülse überträgt und die axiale Bewegung der Dichtungshülse gegenüber der Welle verhindert

3.26**Doppel-Gleitringdichtung**

jegliche Bauart einer Dichtung der Anordnung 2 oder Anordnung 3

3.27**dynamische Dichtungsdruckstufe**

größte Druckdifferenz, der die Dichtungsanordnung bei maximal zulässiger Temperatur und sich drehender Welle dauerhaft standhalten kann

ANMERKUNG Danach behält die Dichtung ihre statische Dichtungsdruckstufe bei.

3.28**dynamische Sekundärdichtung**

Sekundärdichtung, die so konstruiert ist, dass sie gegenüber anderen Bauteilen gleitet oder sich bewegt, um eine axiale Bewegung des gefederten Elements zu ermöglichen

3.29**ingenieurmäßig konstruierte Dichtung**

Gleitringdichtung für Anwendungen unter Betriebsbedingungen, die außerhalb des Anwendungsbereichs von Dichtungen der Typen A, B und C liegen

ANMERKUNG Ingenieurmäßig konstruierte Dichtungen müssen keine der Konstruktions- oder Prüfungsanforderungen dieser Internationalen Norm erfüllen.

3.30**externe Zirkulationseinrichtung**

Einrichtung, die sich außerhalb der Dichtungs-/Puffer-/Sperrkammer befindet und dafür sorgt, dass das Sperrfluid durch einen Kühler oder Sperr-/Pufferfluid-Behälter zirkuliert

3.31**Face-to-back-Anordnung**

Doppeldichtung, bei der ein Gegenring zwischen den beiden gefederten Elementen und ein gefedertes Element zwischen den beiden Gegenringen montiert ist und sich das Pumpen-Prozessfluid auf der Außenseite der Innendichtung und das Sperr- bzw. Pufferfluid auf der Innenseite sowohl der Innendichtung als auch der Außendichtung befindet

3.32**Face-to-face-Anordnung**

Doppeldichtung, bei der beide Gegenringe zwischen den gefederten Elementen montiert sind und sich das Pumpen-Prozessfluid auf der Innenseite der Innendichtung und das Sperr- bzw. Pufferfluid auf der Außenseite sowohl der Innendichtung als auch der Außendichtung befindet

3.33**ortsfeste Buchse**

zylindrische Einrichtung mit engem Spiel zur Welle oder Wellenhülse, die den Durchfluss zwischen zwei Bereichen begrenzt und kein Spiel zwischen dem Außendurchmesser und dem Gehäuse aufweist, in dem es eingebaut ist

3.34**ortsfeste Drosselbuchse**

einteilige zylindrische Einrichtung, die am stationären Teil der Sicherheitsdichtungskammer befestigt ist und ein radiales Spiel zu einem rotierenden Bauteil aufweist. Sie dient dazu, Bereiche voneinander zu trennen und die Kanalisierung flüssiger Leckage zu einer Austrittsöffnung zu unterstützen. Die Konstruktionsweise soll dazu dienen, über die Betriebslebensdauer der Dichtung ein unveränderliches radiales Spiel aufrechtzuerhalten. Diese Einrichtungen haben ein niedriges L/D-Verhältnis von 0,2 oder weniger

3.35**Entspannungsverdampfung**

rasche Veränderung des Aggregatzustands des Fluids von flüssig zu gasförmig

ANMERKUNG In einer dynamischen Dichtung kann Entspannungsverdampfung auftreten, wenn dem Fluid beim Passieren der Primärdichtungsflächen Reibungsenergie hinzugefügt wird oder wenn aufgrund eines Druckabfalls über die Dichtflächen der Fluiddruck unter den Dampfdruck der Flüssigkeit absinkt.

3.36**verdampfender Kohlenwasserstoff****verdampfendes Fluid**

flüssiger Kohlenwasserstoff oder ein anderes Fluid mit einem absoluten Dampfdruck größer als 0,1 MPa [1 bar] [14,7 psi] bei Fördertemperatur oder ein Fluid, das bei Umgebungsbedingungen leicht siedet

3.37**gefedertes Element**

Kombination von Elementen, die die axiale Bewegung zwischen rotierenden und stationären Teilen aufnimmt

3.38**elastischer Graphit**

abgeschliffener und wieder zusammengepresster Graphit-Werkstoff, der in Gleitringdichtungen für statische Dichtungen (Sekundärdichtung) verwendet wird, von tiefkaltem bis zu heißem Betrieb

3.39**Schwimmbuchse**

zylindrische Einrichtung mit engem Spiel zur Welle oder Wellenhülse, die den Durchfluss zwischen zwei Bereichen begrenzt und ein Spiel zwischen dem Außendurchmesser und dem Gehäuse aufweist, in dem sie eingebaut ist, um die radiale Bewegung („Schwimmen“) der Buchse zu ermöglichen, falls sie mit der rotierenden Welle oder Wellenhülse in Berührung kommt

3.40**Fluorelastomer****FKM**

gesättigtes Polymer, in dem Wasserstoffatome durch Fluor ersetzt wurden. Es ist durch hervorragenden Kohlenwasserstoff und allgemeine chemische Beständigkeit gekennzeichnet

3.41**Spülung**

Fluid, das auf der dem Prozessfluid zugewandten Seite in die Dichtungskammer in unmittelbarer Nähe zu den Dichtflächen eingebracht wird und üblicherweise zur Kühlung und Schmierung der Dichtflächen und/oder dazu dient, diese sauber zu halten

3.42**Stopfbuchsenplatte****Stopfbuchsflansch**

drucktragende(s) Bauteil(e), ähnlich einem Flansch, das die stationäre Baugruppe einer Gleitringdichtung mit der Dichtungskammer verbindet

ANMERKUNG Eine Stopfbuchsenplatte kann mehr als ein drucktragendes Bauteil umfassen, zum Beispiel die beiden Stopfbuchsenplatten, die häufig in einer Doppeldichtung verwendet werden.

3.43**Hakenmuffe**

Muffe mit einer Stufe oder einem Haken, die/der am Ende des Produkts über der Welle angeordnet ist, um diese gegen Verschleiß und Korrosion zu schützen

ANMERKUNG Die Stufe liegt normalerweise am Laufrad an, um dieses in seiner Stellung zu halten, mit einer Dichtung zwischen der Welle und der Stufe (dem Haken).

3.44**Innendichtung**

diejenige Dichtung (der Anordnung 2 und Anordnung 3), die dem Laufrad der Pumpe oder dem Prozessfluid am nächsten ist

3.45**innen angebrachte Dichtung**

Dichtungsanordnung, bei der die Dichtung innerhalb der Begrenzung durch die Dichtungskammer oder die Kammer der Sicherheitsdichtung und/oder die Stopfbuchsenplatte montiert ist

3.46**interne Zirkulationseinrichtung**

Einrichtung, die sich innerhalb der Dichtungs-/Puffer-/Sperrkammer befindet und dafür sorgt, dass das Fluid durch einen Kühler oder Sperr-/Pufferfluid-Behälter zirkuliert

ANMERKUNG Es gibt verschiedene Konstruktionsweisen, um einen radialen oder axialen Durchfluss zu erreichen. Die interne Zirkulationseinrichtung kann Bestandteil anderer Dichtungsteile oder ein einzelnes Bauteil sein (diese Einrichtung wurde früher als „Pumpring“ bezeichnet).

3.47**Leckagekonzentration**

Maß der Konzentration flüchtiger organischer Verbindungen oder anderer geregelter Emissionen in der unmittelbaren Umgebung der Dichtung

3.48**Leckrate**

Volumen oder Masse eines Fluids, das/die innerhalb einer festgelegten Zeitdauer durch eine Dichtung strömt

3.49**tiefsiedender Kohlenwasserstoff**

Kohlenwasserstoff-Flüssigkeit, die bei Umgebungsbedingungen leicht siedet

ANMERKUNG Diese Definition umfasst normalerweise reines Pentan (C₅) und Pentangemische sowie leichtere Flüssigkeiten.

3.50**Gegenring**

scheiben- oder ringförmiges Bauteil, das entweder auf einer Wellenhülse oder in einem Gehäuse so montiert ist, dass es sich im Verhältnis zur Welle oder zum Gehäuse, auf der bzw. in dem es montiert ist, nicht axial bewegt, und das die Gegendichtfläche für die Dichtringfläche bildet. Die Gegenringfläche ist senkrecht zur Wellenachse angeordnet

3.51**maximal zulässige Temperatur**

höchste Dauertemperatur, für die der Hersteller die Anlage (oder irgendein Teil, auf das sich dieser Begriff bezieht) unter Berücksichtigung des zu fördernden festgelegten Fluids und des festgelegten maximalen Betriebsdrucks ausgelegt hat

ANMERKUNG 1 Diese Information wird vom Hersteller der Dichtung übermittelt.

ANMERKUNG 2 Die maximal zulässige Temperatur wird normalerweise durch Werkstoffaspekte bestimmt. Dabei kann es sich um den Werkstoff des Gehäuses handeln oder eine durch eine Dichtung oder einen O-Ring erzwungene Grenztemperatur. Die Streckgrenze und Bruchfestigkeit sind temperaturabhängig. Das Spannungsniveau eines Bauteils kann vom Betriebsdruck abhängig sein. Demzufolge ist die Spanne zwischen der Festigkeitsgrenze des Werkstoffs und der Betriebsbeanspruchung sowohl von der Betriebstemperatur des Werkstoffs als auch dem Spannungsniveau des Bauteils abhängig. Wird die Temperatur verringert, so erhöht sich die Festigkeit des Werkstoffs und das Spannungsniveau des Bauteils kann steigen. Aus diesem Grund wird die maximal zulässige Temperatur mit dem maximal festgelegten Betriebsdruck in Zusammenhang gebracht.

3.52**maximal zulässiger Betriebsdruck****MAWP**

höchster Dauerdruck, für den der Hersteller die Anlage (oder irgendein Teil, auf das sich die Benennung bezieht) ausgelegt hat, wenn das festgelegte Fluid bei der festgelegten maximal zulässigen Betriebstemperatur gefördert wird

vgl. **statische Dichtungsdruckstufe** (3.84), **dynamische Dichtungsdruckstufe** (3.27)

3.53**maximaler dynamischer Wellendichtungsdruck****MDSP**

der an der Wellendichtung (oder den Wellendichtungen) zu erwartende höchste Überdruck bei den jeweiligen festgelegten Betriebsbedingungen sowie während des Anfahr- und Abfahrbetriebs

ANMERKUNG Bei der Bestimmung dieses Drucks sind der maximale Saugdruck, der Spüldruck sowie Auswirkungen aufgrund von Veränderungen des Spiels innerhalb der Pumpe zu berücksichtigen. Es handelt sich hierbei um eine Prozessbedingung, und sie wird durch den Käufer festgelegt.

3.54**maximale Betriebstemperatur**

höchste Temperatur, der die Wellendichtung (oder die Wellendichtungen) ausgesetzt werden kann (können)

ANMERKUNG Es handelt sich hierbei um eine Prozessbedingung, und sie wird durch den Käufer festgelegt.

3.55**maximaler statischer Dichtungsdruck****MSSP**

höchster Druck, mit Ausnahme von Drücken, die während hydrostatischer Prüfung auftreten, denen die Wellendichtung (oder Wellendichtungen) beim Abschalten der Pumpe ausgesetzt werden kann (können)

ANMERKUNG Es handelt sich hierbei um eine Prozessbedingung, und sie wird durch den Käufer festgelegt.

3.56**berührungsfreie Dichtung****selbsttätige Dichtung**

Dichtungskonstruktion, bei der die Flächen so gestaltet sind, dass sie absichtlich aerodynamische oder hydrodynamische Trennkräfte erzeugen, um einen spezifischen Trennspalt zwischen dem Dichtring und dem Gegenring aufrechtzuerhalten

ANMERKUNG Berührungsfreie Dichtungen sind speziell so konstruiert, dass stets ein Betriebsspalt zwischen der stationären und der rotierenden Fläche erhalten bleibt.

3.57**nicht-verdampfender Kohlenwasserstoff****nicht-verdampfendes Fluid**

flüssiger Kohlenwasserstoff oder ein anderes Fluid, dessen Dampfdruck bei jeglicher festgelegten Betriebstemperatur kleiner als ein Absolutdruck von 0,1 MPa [1 bar] [14,7 psi] ist oder ein Fluid, das bei Umgebungsbedingungen nicht leicht siedet

3.58**kohlenwasserstofffreier Betrieb**

Betrieb, bei dem das Fluid, wie beispielsweise saures Wasser, Kesselspeisewasser, Natronlauge, Säuren und Amine, keinen Kohlenwasserstoff enthält oder das Fluid relativ geringe Mengen mitgerissenen Kohlenwasserstoffs aufweist

3.59**Überwachungsprüfung**

Produktprüfung, die nach dem Ermessen des Käufers, der vom Hersteller über die Prüfung benachrichtigt wurde, überwacht wird, aber keinen Haltepunkt innerhalb der Herstellung darstellt

3.60**Drosselstutzen**

aus massivem Stangenmaterial gefertigter Rohrnippel mit einer Drosselöffnung, die durch ihn hindurch gebohrt ist, um beim Defekt eines Rohres in einem Hilfssystem oder eines Bauteils die Leckage zu begrenzen

ANMERKUNG Drosselstutzen findet man normalerweise in Systemen des Rohrleitungsplans 11.

3.61**O-Ring**

elastischer Dichtring mit O-förmigem (kreisförmigem) Querschnitt, der entweder als statische oder als dynamische Sekundärdichtung verwendet werden kann

3.62**Außendichtung**

diejenige Dichtung (der Anordnung 2 und Anordnung 3), die am weitesten vom Laufrad der Pumpe oder dem Prozessfluid entfernt angeordnet ist

3.63**Perfluorelastomer****FFKM**

voll fluoriertes Fluorkohlenstoff-Elastomer, das üblicherweise als Sekundärdichtung für Hochtemperatur- und/oder korrosiven Betrieb verwendet wird

3.64**Rohrleitungsplan**

Anordnung von Zubehörteilen, Instrumenten, Steuerungen und/oder Fluiden, die zur Leitung und Steuerung der Umgebung der Dichtung konstruiert wurden

ANMERKUNG Die Pläne von Hilfsrohrleitungen unterscheiden sich je nach Anwendung, Dichtungsart und Anordnung.

3.65**polymerisierendes Fluid**

Fluid, das sich im Prozess der Umwandlung befindet bzw. sich umwandeln kann, wobei es sich aus einer chemischen Zusammensetzung in eine andere mit länger-kettigen Bestandteilen und anderen Eigenschaften verändert und normalerweise bedeutend dickflüssiger und/oder klebriger wird

3.66**Anschlussöffnung**

Fluidkanal, der sich üblicherweise in der Stopfbuchsenplatte befindet

3.67**Druckgehäuse**

Gesamtheit aller stationären, drucktragenden Bauteile der Wellendichtung, einschließlich Dichtungskammer, Sperr-/Pufferfluidkammer, Sicherheitsdichtungskammer und Stopfbuchsenplatte, und ausschließlich Dichtring, Gegenring, Faltenbalg, Wellenhülse, sonstige innenliegenden Dichtungsteile sowie atomosphärenseitige Stopfbuchsenverbindungen, die nicht vom Atmosphärendruck getrennt werden können

ANMERKUNG Der MAWP des Hilfssystems ist in Abschnitt 8 festgelegt.

3.68**Produkttemperaturdifferenz**

Differenz zwischen der Verdampfungstemperatur des Fluids bei Dichtungskammerdruck und der tatsächlichen Temperatur des Fluids

ANMERKUNG Bei reinen Fluiden entspricht die Verdampfungstemperatur der Sättigungstemperatur bei Dichtungskammerdruck; bei gemischten Fluiden ist die Verdampfungstemperatur gleich der Siedepunkttemperatur bei Dichtungskammerdruck.

3.69**Pumpenhersteller**

Unternehmen, das die Pumpe konstruiert, herstellt, prüft und den Wartungsdienst übernimmt

ANMERKUNG Der Pumpenhersteller darf auch das Dichtungssystem einkaufen und den Einbau durchführen.

3.70**Förderfluid****Prozessfluid**

Fluid/Flüssigkeit, das/die im Datenblatt für den Pumpenbetrieb als Prozessstrom angegeben ist

3.71**Käufer**

Unternehmen, das dem Verkäufer eine Bestellung erteilt und eine Spezifikation erstellt

3.72**belastete Dichtung**

Dichtung, die eine dynamische Sekundärdichtung aufweist, um die axiale Bewegung des gefederten Elements zu ermöglichen. Die axiale Bewegung wird durch eine mechanische und/oder hydraulische Kraft bewirkt

3.73**Quench**

neutrales Fluid, normalerweise Wasser, Wasserdampf oder Stickstoff, das auf der Atmosphärenseite der Dichtung zugeführt wird, um die Bildung von Feststoffen zu hemmen, die die Bewegung der Dichtung beeinträchtigen können, oder zu anderen Zwecken, zum Beispiel um Verkokung, Kristallisation oder Vereisung zu verhindern

3.74**Dichtung****Gleitringdichtung**

Einrichtung, die die Leckage von Fluiden zwischen einer Welle und einem Gehäuse in Relativbewegung verhindert. Die Abdichtung erfolgt durch eine stationär gelagerte Dichtfläche gegenüber der Fläche eines rotierenden Dichtrings. Die Dichtflächen sind senkrecht zur Wellenachse angeordnet

3.75**Entlastungsfaktor der Dichtung**

Verhältnis zwischen der Dichtfläche, die durch hydraulischen Druck in der Dichtungskammer den Schließkräften ausgesetzt ist, und der gesamten Dichtfläche (siehe Anhang F)

ANMERKUNG Er wird manchmal als Prozentsatz angegeben.

3.76**Dichtungskammer**

Bauteil, das entweder Teil des Pumpenkörpers (Gehäuses) oder von diesem getrennt ist und das den Bereich zwischen der Welle und dem Gehäuse bildet, in dem die Dichtung eingebaut ist

3.77**Dichtfläche****Dichtflächen**

die Überlappungsfläche eines Gegenrings oder Dichtrings, die den anderen Ring berührt oder in dessen unmittelbare Nähe kommt und die relative Drehbewegung der Dichtungsoberfläche(n) ermöglicht

3.78**Hersteller der Dichtung**

Unternehmen, das für die Konstruktion, Herstellung, Prüfung von und den Wartungsdienst für Dichtungen und zugehörige unterstützende Dichtungssysteme sorgt

3.79**Dichtring**

scheiben- oder ringförmiges Bauteil, das entweder auf einer Wellenhülse oder in einem Gehäuse so montiert ist, dass es sich im Verhältnis zur Welle oder zum Gehäuse, auf der bzw. in dem es montiert ist, axial bewegen kann, und das die Gegendichtfläche für die Gegenringfläche bildet. Die Dichtringfläche ist senkrecht zur Wellenachse angeordnet

3.80**Dichtungshülse**

hohlzylindrisches Bauteil, das mit einer engen Passung am Außendurchmesser der Welle anliegt, eine statische Sekundärdichtung mit der Welle umfasst und über die Stopfbuchsenplatte hinausreicht. Es wird in der Baugruppe der Dichtungsbauteile verwendet und stellt sicher, dass sich diese mit der Welle bewegen

3.81**Sekundärdichtung**

Einrichtung (wie beispielsweise ein O-Ring, flexibler Graphitring, eine mit elastischem Graphit gefüllte spiralförmige Dichtung oder Faltenbälge), die die Leckage des abgedichteten Fluids, Sperrfluids, Pufferfluids oder Quenchmediums auf andere Weise verhindert als die inneren und äußeren Dichtflächen, die Rückhalte-einrichtung oder der vorgesehene Abfluss

3.82**segmentierte Schwimmbuchse**

Grund- oder Drosselbuchse, die aus Umfangssegmenten besteht, die durch eine Spanneinrichtung gehalten werden

3.83**Betriebsbedingung**

maximale(r) oder minimale(r) Temperatur oder Druck unter statischen oder dynamischen Bedingungen

3.84**statische Dichtungsdruckstufe**

größter Druck, dem die Dichtung bei der maximal zulässigen Temperatur und sich drehender Welle dauerhaft standhalten kann

ANMERKUNG Danach behält die Dichtung ihre dynamische Dichtungsdruckstufe bei.

3.85**statische Sekundärdichtung**

Sekundärdichtung zwischen zwei Oberflächen, die keine Relativbewegung aufweisen

3.86**Siebfilter**

eine Einrichtung mit relativ geringem Druckverlust, die dazu dient, Feststoffpartikel aus der Spülung oder einem anderen Fluid zu entfernen

3.87**Grundbuchse**

Einrichtung mit engem Spiel um die Wellenhülse (oder Welle) zwischen Dichtungskammer und Laufrad

3.88**Drosselbuchse**

Rückhalteeinrichtung mit engem Spiel um die Wellenhülse am atmosphärenseitigen Ende einer Stopfbuchsenplatte

3.89**Gesamtanzeige****gesamte Rundlaufabweichung****TIR**

Differenz zwischen den maximalen und minimalen abgelesenen Werten eines Skalenzeigers oder eines ähnlichen Gerätes zur Überwachung einer Fläche oder zylindrischen Oberfläche während einer vollständigen Umdrehung der überwachten Oberfläche

ANMERKUNG Bei einer vollständig zylindrischen Oberfläche entspricht die Exzentrizität der Hälfte des Indikatorwertes. Bei einer vollständig ebenen Fläche entspricht die vom Indikatorwert angegebene Abweichung von der Rechtwinkligkeit dem angezeigten Wert. Ist der betreffende Durchmesser nicht vollständig zylindrisch oder eben, dann ist die Interpretation der Bedeutung von TIR komplexer und kann Ovalität oder Keulenförmigkeit darstellen.

3.90**Dichtung vom Typ A**

siehe 4.1.3

3.91**Dichtung vom Typ B**

siehe 4.1.3

3.92**Dichtung vom Typ C**

siehe 4.1.3

3.93**Verkäufer**

Hersteller der Anlage oder dessen Vertreter, der normalerweise für den Wartungsdienst zuständig ist

ANMERKUNG In dieser Internationalen Norm werden die Zuständigkeiten zweier Parteien behandelt, die als Käufer und Verkäufer definiert sind. Am Kauf und der Herstellung der Anlage sind viele Parteien beteiligt. Diese Parteien erhalten in Abhängigkeit von ihrer Reihenfolge in der Vertriebskette unterschiedliche Bezeichnungen. Sie dürfen als Erwerber, Auftragnehmer, Hersteller oder Sublieferant bezeichnet werden. So darf zum Beispiel die Partei, die eine Schmieröl-Konsole liefert, der Konsolenverkäufer des Herstellers des Kompressors sein, der Sublieferant des Käufers und der Käufer von Bauteilen für die Konsole. Alle diese Begriffe können jedoch auf den Käufer und den Verkäufer reduziert werden. Aus diesem Grund sind nur diese beiden Begriffe definiert. Bestrebungen, diese anderen Begriffe zu definieren, würden nur Verwirrung stiften.

3.94**flüchtige gefährliche Luftschadstoffe****VHAP**

jegliche Verbindung wie in Title 1, Part A, Section 112 der U.S. National Emission Standards for Hazardous Air Pollutants (NESHAPs) (Clean Air Act Amendment) definiert

3.95**Inspektion unter Zeugen****Prüfung unter Zeugen**

Inspektion oder Prüfung, bei der der Käufer über den Zeitpunkt unterrichtet ist und die Produktion solange angehalten wird, bis der Käufer oder dessen Vertreter vor Ort ist

Nationaler Anhang NB (informativ)

Literaturhinweise

DIN EN 10226-1, *Rohrgewinde für im Gewinde dichtende Verbindungen — Teil 1: Kegelige Außengewinde und zylindrische Innengewinde — Maße, Toleranzen und Bezeichnung*

DIN EN 10226-3, *Rohrgewinde für im Gewinde dichtende Verbindungen — Teil 3: Prüfung mit Grenzlehren*

DIN EN 60079 (alle Teile), *Explosionsfähige Atmosphäre*

DIN EN ISO 10438-1, *Erdöl-, petrochemische und Erdgasindustrie — Schmieröl-, Sperröl- und Regelöl-versorgungsanlagen und Hilfsanlagen — Teil 1: Allgemeine Anforderungen*

DIN EN ISO 13709, *Kreiselpumpen für den Einsatz in der Erdöl-, petrochemischen und Erdgasindustrie*

DIN ISO 261, *Metrisches ISO-Gewinde allgemeiner Anwendung — Übersicht*

DIN ISO 262, *Metrisches ISO-Gewinde allgemeiner Anwendung — Auswahlreihen für Schrauben, Bolzen und Muttern*

DIN ISO 286-2, *ISO-System für Grenzmaße und Passungen — Tabellen der Grundtoleranzgrade und Grenzabmaße für Bohrungen und Wellen*

DIN ISO 724, *Metrische ISO-Gewinde allgemeiner Anwendung — Grundmaße*

DIN ISO 965 (alle Teile), *Metrisches ISO-Gewinde allgemeiner Anwendung — Toleranzen*

English Version

Pumps —
Shaft sealing systems for centrifugal and rotary pumps
(ISO/DIS 21049:2009)

Pompes —
Dispositifs d'éanchéité de l'arbre pour pompes centrifuges
et rotatives
(ISO/DIS 21049:2009)

Pumpen —
Wellendichtungssysteme für Kreiselpumpen und rotierende
Verdrängerpumpen
(ISO/DIS 21049:2009)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 12.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (prEN ISO 21049:2010) has been prepared by Technical Committee ISO/TC 115 „Pumps“, in collaboration with Technical Committee CEN/TC 12 “Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries” the secretariat of which is held by AFNOR.

This document is currently submitted to the parallel Enquiry.

This document will supersede EN ISO 21049:2004.

Endorsement notice

The text of ISO/DIS 21049:2010 has been approved by CEN as a prEN ISO 21049:2010 without any modification.

Introduction

This International Standard is based on the accumulated knowledge and experience of manufacturers and users of equipment in the petroleum, natural gas and chemical industries, but its use is not restricted to these industries.

Users of this International Standard should be aware that further or differing requirements may be needed for individual applications. This International Standard is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly appropriate where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

The purpose of this International Standard is to assist purchasers with the selection and operation of mechanical seals for pumps.

In this International Standard, where practical, US Customary units are included in brackets for information.

A bullet (●) at the beginning of a clause or subclause indicates that either a decision is required or further information is to be provided by the purchaser. This information should be indicated on data sheets or stated in the enquiry or purchase order (see examples in Annex C).

1 Scope

This International Standard specifies requirements and gives recommendations for sealing systems for centrifugal and rotary pumps used in the petroleum, natural gas and chemical industries. It is applicable mainly for hazardous, flammable and/or toxic services where a greater degree of reliability is required for the improvement of equipment availability and the reduction of both emissions to the atmosphere and life-cycle sealing costs. It covers seals for pump shaft diameters from 20 mm (0,75 in) to 110 mm (4,3 in).

This International Standard is also applicable to seal spare parts and can be referred to for the upgrading of existing equipment. A classification system for the seal configurations covered by this International Standard into categories, types, arrangements and orientations is provided.

This International Standard is a stand-alone seal standard and is referenced normatively in ISO 13709. It is applicable to both new and retrofitted pumps, and to pumps other than ISO 13709 pumps (e.g. ASME B73.1, ASME B73.2 and API 676 pumps).

This International Standard might also be referenced by other machinery standards such as other pumps, compressors and agitators. Users are cautioned that this International Standard is not specifically written to address all of the potential applications that a purchaser may specify. This is especially true for the size envelope specified for ISO 21049 seals. The purchaser and seal vendor shall mutually agree on the features taken from this International Standard and used in the application.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7 (all parts), *Pipe threads where pressure-tight joints are made on the threads*

ISO 261, *ISO general-purpose metric screw threads — General plan*

ISO 262, *ISO general-purpose metric screw threads — Selected sizes for screws, bolts, and nuts*

ISO 286-2, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 724, *ISO general-purpose metric screw threads — Basic dimensions*

ISO 965 (all parts), *ISO general-purpose metric screw threads — Tolerances*

ISO 7005-1, *Metallic flanges — Part 1: Steel flanges*

ISO 10438 (all parts), *Petroleum, petrochemical and natural gas industries — Lubrication, Shaft-sealing and control-oil systems and auxiliaries*

ISO 13709, *Centrifugal pumps for petroleum, petrochemical and natural gas industries*

ISO 15649, *Petroleum and natural gas industries — Piping*

IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

AISI, *Standards, codes and specifications of the American Iron and Steel Institute* ¹⁾

API RP 520 (all parts), *Sizing, selection, and installation of pressure-relieving devices in refineries* ²⁾

API Std 526, *Flanged steel pressure relief valves*

ASME V, *ASME Boiler and pressure vessel code, Section V, Non-destructive examination* ³⁾

ASME VIII, *ASME Boiler and pressure vessel code, Section VIII, Rules for the construction of pressure vessels*

ASME IX, *ASME Boiler and pressure vessel code, Section IX, Welding and brazing qualifications*

ASME B1.1, *Unified inch screw threads (UN and UNR thread form)*

ASME B1.20.1, *Pipe threads, general purpose, inch*

ASME B16.11, *Forged fittings, socket-welding and threaded*

ASME B16.20, *Metallic gaskets for pipe flanges — Ring joint, spiral-wound, and jacketed*

ASME B31.3, *Process Piping*

ASME B73.1, *Specification for horizontal end suction centrifugal pumps for chemical process*

ASME B73.2, *Specification for vertical in-line centrifugal pumps for chemical process*

ASME PTC 8.2, *Centrifugal pumps, performance test codes*

AWS D1.1, *Structural welding code — Steel* ⁴⁾

EN 287 (all parts), *Approval testing of welders — Fusion welding* ⁵⁾

EN 288 (all parts), *Specification and approval of welding procedures for metallic materials*

EN 13445 (all parts), *Unfired pressure vessels*

EPA Method 21, Appendix A of Title 40, Part 60 of the U.S. Code of Federal Regulations, *Environmental Protection Agency, United States* ⁶⁾

NEMA 250, *Enclosures for electrical equipment (1 000 volts maximum)* ⁷⁾

NFPA 70, *National Electrical Code* ⁸⁾

-
- 1) Available from the American Iron and Steel Institute: 1140 Connecticut Ave., Suite 705, Washington, D.C. 20036, USA.
- 2) Available from the American Petroleum Institute, 1220 L Street, NW, Washington, D.C. 20005-4070, USA.
- 3) Available from the American Society of Mechanical Engineers: Three Park Avenue, New York, NY 10016-5990, USA.
- 4) Available from the American Welding Society, 550 N.W. Le Jeune Rd, Miami, FL 33126, USA.
- 5) Comité Européen de Normalisation, 36, rue de Stassart, B-1050 Brussels, Belgium.
- 6) Available from the National Archives and Records Administration, 700 Pennsylvania Avenue, N.W., Washington, D.C. 20408, USA.
- 7) Available from the National Electrical Manufacturers Association, 1300 North 17th Street, Rosslyn, VA 22209, USA.
- 8) Available from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA.

Title 1, Part A, Section 112, *U.S. National Emission Standards for Hazardous Air Pollutants (NESHAPs) (Clean Air Act Amendment)* ⁹

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

anti-rotation device

device used to prevent rotation of one component relative to an adjacent component in a seal assembly

EXAMPLES Key, pin.

3.2

arrangement 1 seal

see 4.1.4

3.3

arrangement 2 seal

see 4.1.4

3.4

arrangement 3 seal

see 4.1.4

3.5

atmospheric leakage collector

external reservoir arranged to capture liquid seal leakage from an arrangement 1 seal

3.6

auxiliary sleeve

separate sleeve mounted on the outer diameter of the seal shaft sleeve that facilitates assembly of seal components.

3.7

back-to-back configuration

dual seal in which both of the flexible elements are mounted between the mating ring. The sealed fluid is on the ID of the inner seal and the barrier or buffer fluid is on the OD of the inner and outer seal.

3.8

balanced seal

mechanical seal in which the fluid closing forces have been modified through seal design

NOTE In this International Standard the seal balance ratio is less than 1 (see balance ratio calculation in Annex F).

3.9

barrier fluid

externally supplied fluid at a pressure above the pump seal chamber pressure, introduced into an Arrangement 3 seal to completely isolate the process liquid from the environment

⁹⁾ Environmental Protection Agency, Ariel Rios Building, 1200 Pennsylvania Avenue, N.W., Mail Code 3213A, Washington, D.C. 20460, USA.

3.10

barrier/buffer seal chamber

component or aggregate of components which form the cavity into which the outer seal of a pressurized or unpressurized dual seal is installed and in which a barrier or buffer fluid is circulated.

3.11

bellows seal

type of mechanical seal which uses a flexible metal bellows to provide secondary sealing and spring loading

3.12

buffer fluid

externally supplied fluid, at a pressure lower than the pump seal chamber pressure, used as a lubricant and/or to provide a diluent in an Arrangement 2 seal

3.13

cartridge seal

completely self-contained unit (including seal faces, flexible elements, seal gland plate sleeve which is pre-assembled and preset before installation

3.14

category 1 seal

see 4.1.2

3.15

category 2 seal

see 4.1.2

3.16

category 3 seal

see 4.1.2

3.17

connection

threaded or flanged joint that mates a port to a pipe or to a piece of tubing

3.18

contacting seal

seal design in which the mating faces are not designed to intentionally create aerodynamic or hydrodynamic forces to sustain a specific separation gap

NOTE Contacting seals can actually develop a full fluid film but this is not typical. Contacting seals do not incorporate geometry, e.g. grooves, pads, face waviness, to ensure that the faces do not touch. The amount of contact is generally very low and permits reliable operation with low leakage.

3.19

containment device

seal or bushing which is intended to manage leakage from the inner or outer seal and divert it to a location determined by the user. See Annex F for further description

3.20

containment seal

special version of an outer seal used in Arrangement 2 and which normally operates in a vapour (gas buffer or not buffer) but will seal the process fluid for a limited time in the event of an inner seal failure. See 4.2

3.21

containment seal chamber

component or aggregate of components which form the the cavity into which the containment seal is installed

3.22

containment seal chamber leakage collector

reservoir, connected by pipework to the containment seal chamber for the purpose of collecting condensed leakage from the inner seal of an Arrangement 2.

3.23

crystallizing fluid

fluid which is in the process of forming solids or which may form solids due to dehydration or chemical reaction

3.24

distributed flush system

arrangement of holes, passages, baffles, etc., designed to promote an even distribution of flush fluid around the circumference of the seal faces.

NOTE these are normally required when piping plans provide flush into the seal chamber

3.25

drive collar

external part of the seal cartridge that transmits torque to the seal sleeve and prevents axial movement of the seal sleeve relative to the shaft

3.26

dual mechanical seal

Arrangement 2 or Arrangement 3 seal of any type

3.27

dynamic sealing-pressure rating

highest pressure differential that the seal assembly can continuously withstand at the maximum allowable temperature while the shaft is rotating

NOTE Thereafter, the seal retains its static sealing pressure rating.

3.28

dynamic secondary seal

secondary seal which is designed to slide or move relative to other components to allow axial movement of the flexible element.

3.29

engineered seal

mechanical seal for applications with service conditions outside the operation scope of Type A, B and C seals

NOTE Engineered seals are not required to meet any of the design or testing requirements of this International Standard.

3.30

external circulating device

device located outside of the seal/buffer/barrier chamber to circulate seal chamber fluid through a cooler or barrier/buffer fluid reservoir

3.31

face-to-back configuration

dual seal in which one mating ring is mounted between the two flexible elements and one flexible element is mounted between the two mating rings and the pump process fluid is on the OD of the inner seal and barrier of buffer fluid is on the ID of both the inner and outer seal.

3.32

face-to-face configuration

dual seal in which both of the mating rings are mounted between the flexible elements and the pump process fluid is on the ID of the inner seal and barrier or buffer fluid is on the OD of both the inner and outer seal

3.33

fixed bushing

cylindrical device with a close clearance to the shaft or sleeve which restricts flow between two regions and which does not have a clearance on the outer diameter relative to the housing in which it is mounted

3.34

fixed throttle bushing

one-piece cylindrical device that is fitted to the stationary part of the containment seal chamber and has a radial clearance to a rotating component. It is used to help isolate one region from another and assist in channelling liquid leakage to an exit port. The design is intended to maintain a fixed radial clearance over the operating life of the seal. These devices have a low L/D ratio 0,2 or lower.

3.35

flashing

rapid change in fluid state from liquid to gas

NOTE In a dynamic seal, this can occur when frictional energy is added to the fluid as it passes between the primary seal faces, or when fluid pressure is reduced below the fluid's vapour pressure because of a pressure drop across the seal faces.

3.36

flashing hydrocarbon

flashing fluid

liquid hydrocarbon or other fluid with an absolute vapour pressure greater than 0,1 MPa [1 bar] [14,7 psi] at the pumping temperature, or a fluid that will readily boil at ambient conditions

3.37

flexible element

combination of elements which accommodate axial movement of between rotating and stationary parts

3.38

flexible graphite

exfoliated and recompressed graphite material used for static (secondary seal) gaskets in mechanical seal design, from cryogenic to hot service

3.39

floating bushing

cylindrical device with a close clearance to the shaft or sleeve which restricts flow between two regions and which has a clearance on the outer diameter relative to the housing in which it is mounted to allow radial motion ("floating") of the bushing should it come in contact with the rotating shaft or sleeve

3.40

fluoroelastomer

FKM

saturated polymer in which hydrogen atoms have been replaced with fluorine. It is characterized by excellent hydrocarbon and general chemical resistance.

3.41

flush, noun

fluid which is introduced into the seal chamber on the process fluid side in close proximity to the seal faces and typically used for cooling and lubricating the seal faces and/or to keep them clean

3.42

gland plate **gland end plate**

pressure retaining component(s) similar to a flange which connects the stationary assembly of a mechanical seal to the seal chamber

NOTE A gland plate may consist of more than one pressure containing component for example the two gland plates often used in a dual seal

3.43

hook sleeve

sleeve, with a step or hook at the product end, placed over the shaft to protect it from wear and corrosion

NOTE The step is usually abutted against the impeller to hold it in place with a gasket between the shaft and the step (hook).

3.44

inner seal

(Arrangement 2 and Arrangement 3) the seal closest to the pump impeller or process fluid

3.45

internally-mounted seal

seal configuration in which the seal is mounted within the boundaries of the seal chamber or containment seal chamber or and gland plate

3.46

internal circulating device

device located in the seal buffer/barrier chamber to circulate fluid through a cooler or barrier/buffer fluid reservoir

NOTE There are various designs to achieve radial or axial flow. The internal circulating device can be integral with other seal parts or a separate part. (This device was formerly known as a "pumping ring").

3.47

leakage concentration

measure of the concentration of a volatile organic compound or other regulated emission in the environment immediately surrounding the seal

3.48

leakage rate

volume or mass of fluid passing through a seal in a given length of time

3.49

light hydrocarbon

hydrocarbon liquid that will readily boil at ambient conditions

NOTE Typically this definition includes pure and mixed streams of pentane (C₅) and lighter liquids.

3.50

mating ring

disk- or toroidal-shaped member, mounted either on a sleeve or in a housing such that it does not move axially relative to the sleeve or the housing on or which it is mounted, and, which provides the mating seal face for the seal ring face. The mating seal face is perpendicular to the axis of the shaft

3.51

maximum allowable temperature

maximum continuous temperature for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the specified fluid at the specified maximum operating pressure

NOTE 1 This information is supplied by the seal manufacturer.

NOTE 2 The maximum allowable temperature is usually set by material considerations. This may be the material of the casing or a temperature limit imposed by a gasket or O-ring. The yield strength and ultimate strength are temperature-dependent. A component's stress level can depend on operating pressure. Thus, the margin between the strength limit of the material and the operating stress depends on both the material's operating temperature and the component's stress level. If the temperature is lowered, the material's strength increases and the stress level of the component may increase. This is the reason for associating the maximum allowable temperature to the maximum specified operating pressure.

3.52

maximum allowable working pressure

MAWP

maximum continuous pressure for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the specified fluid at the specified maximum operating temperature .

cf. **static sealing-pressure rating** (3.84), **dynamic sealing-pressure rating** (3.27)

3.53

maximum dynamic sealing pressure

MDSP

highest pressure expected at the seal (or seals) during any specified operating condition and during start-up and shutdown

NOTE In determining this pressure, consideration is given to the maximum suction pressure, the flush pressure, and the effect of clearance changes within the pump. This is a process condition and is specified by the purchaser.

3.54

maximum operating temperature

maximum temperature to which the seal (or seals) can be subjected

NOTE This is a process condition and is specified by the purchaser.

3.55

maximum static sealing pressure

MSSP

highest pressure, excluding pressures encountered during hydrostatic testing, to which the seal (or seals) can be subjected while the pump is shut down

NOTE This is a process condition and is specified by the purchaser.

3.56

non-contacting seal

self acting seal

seal design in which the faces are designed to intentionally create aerodynamic or hydrodynamic separating forces to sustain a specific separation gap between the seal ring and the mating ring

NOTE Non-contacting seals are specifically designed so that there is always an operating gap between the stationary and rotating face.

3.57

non-flashing hydrocarbon

non-flashing fluid

liquid hydrocarbon or other fluid whose vapour pressure at any specified operating temperature is less than an absolute pressure of 0,1 MPa [1 bar] [14,7 psi], or a fluid that will not readily boil at ambient conditions

3.58

non-hydrocarbon service

service in which the fluid, such as sour water, boiler feed water, sodium hydroxide, acids and amines, contains no hydrocarbons or the fluid has relatively small quantities of entrained hydrocarbons

3.59

observed test

product test which is observed at the discretion of the purchaser, who has been given notice of the test by the manufacturer, but does not constitute a manufacturing hold point

3.60

orifice nipple

pipe nipple made of solid bar stock with an orifice hole drilled through it to restrict leakage in the event of an auxiliary system pipe or component failure

NOTE Orifice nipples are commonly found on Piping Plan 11 systems.

3.61

o-ring

elastomeric sealing ring with an O-shaped (circular) cross-section, which may be used as either a static or dynamic secondary seal.

3.62

outer seal

(Arrangement 2 and Arrangement 3) the seal located farthest from the pump impeller or process fluid

3.63

perfluoroelastomer

FFKM

fully fluorinated fluorocarbon elastomer commonly used as a secondary seal in high temperature and/or corrosive service

3.64

piping plan

configuration of accessories, instruments, controls and/or fluids designed to manage or control the environment around the seal

NOTE Auxiliary piping plans vary with the application, seal type and arrangement.

3.65

polymerizing fluid

fluid which is in the process of changing, or is capable of changing, from one chemical composition to another with longer-chain components and different properties, usually becoming significantly more viscous and/or tacky

3.66

port

fluid passageway, typically located in the gland plate

3.67

pressure casing

composite of all the stationary pressure-containing parts of the seal, including seal chamber barrier or buffer fluid chamber, containment seal chamber and seal gland plate, and excluding seal ring, mating ring, bellows, sleeves, miscellaneous internal seal parts and atmospheric side gland connections which cannot be isolated from atmospheric pressure.

NOTE The MAWP of the auxiliary system is specified in Clause 8.

3.68

product temperature margin

difference between the vaporization temperature of the fluid at the seal chamber pressure and the actual temperature of the fluid

NOTE For pure fluids, the vaporization temperature is the saturation temperature at seal chamber pressure; for mixed fluids, the vaporization temperature is the bubble-point temperature at the seal chamber pressure.

3.69

pump manufacturer

agency that designs, manufactures, tests and provides service support for the pump

NOTE The pump manufacturer may also purchase the sealing system and perform the installation.

3.70

pumped fluid

process fluid

fluid/liquid that is the process stream designated in the data sheet for the pump service

3.71

purchaser

agency that issues the order and specifications to the vendor

3.72

pusher seal

seal which incorporates a dynamic secondary seal to allow axial movement of the flexible element. The axial movement is driven (pushed) by mechanical and/or hydraulic force

3.73

quench, noun

neutral fluid, usually water, steam or nitrogen introduced on the atmospheric side of the seal to retard formation of solids that may interfere with seal movement, or for other purposes such as prevention of coking, crystallization or icing

3.74

seal

end face mechanical seal

device that prevents the leakage of fluids between a shaft and housing in relative motion. Sealing is accomplished by a stationary seal face bearing against the face of a rotating seal ring. The sealing faces are mounted perpendicular to the shaft axis.

3.75

seal balance ratio

ratio of seal face area exposed to closing force by hydraulic pressure in the seal chamber, to the total seal face area (see Annex F)

NOTE It is sometimes expressed as a percentage.

3.76

seal chamber

component, either integral with or separate from the pump case (housing), that forms the region between the shaft and casing into which the seal is installed

3.77

seal face

seal faces

the lapped surface of a mating ring or seal ring which comes in contact or close proximity to the other ring and provides the relative rotary motion sealing surface(s)

3.78

seal manufacturer

agency that designs, manufactures, tests, and provides service support for seals and associated support sealing systems

3.79

seal ring

disk or torrodial shaped member, mounted either on a sleeve or in a housing such that it is able to move axially relative to the sleeve or the housing on or in which it mounted, and which provides the mating seal face for the mating ring face. The seal ring face is perpendicular to the axis of the shaft.

3.80

seal sleeve

hollow cylindrical component which fits on the outer diameter of the shaft with a close tolerance fit, incorporates a static secondary seal with the shaft and extends beyond the seal gland plate. It is used in the assembly of the seal components and ensures they rotate with the shaft

3.81

secondary seal

device (such as an O-ring, flexible graphite ring, flexible graphite filled spiral wound gasket, or bellows) that prevents leakage of the sealed fluid, barrier fluid, buffer fluid or quench medium through paths other than the inner or outer seal faces, the containment device or designated drain.

3.82

segmented floating bushing

throat or throttle bushing which is composed of circumferential segments retained by a tensioning device.

3.83

service condition

maximum or minimum temperature or pressure under static or dynamic conditions

3.84

static sealing-pressure rating

highest pressure that the seal can continuously withstand at the maximum allowable temperature while the shaft is not rotating

NOTE Thereafter, the seal maintains its dynamic sealing pressure rating.

3.85

static secondary seal

secondary seal between two surfaces which have no relative motion

3.86

strainer

a relatively low pressure drop device designed to remove solid particles from the flush or other fluid.

3.87

throat bushing

device that forms a restrictive close clearance around the sleeve (or shaft) between the seal chamber and the impeller

3.88

throttle bushing

containment device that forms a restrictively close clearance around the sleeve at the atmospheric end of a gland plate

3.89

total indicator reading

total indicated runout

TIR

difference between the maximum and minimum readings of a dial indicator or similar device when monitoring a face or cylindrical surface during one complete revolution of the monitored surface

NOTE For a perfectly cylindrical surface, the indicator reading implies an eccentricity equal to half the reading. For a perfectly flat face, the indicator reading gives an out-of-squareness equal to the reading. If the diameter in question is not perfectly cylindrical or flat, interpretation of the meaning of TIR is more complex, and may represent ovality or lobing.

3.90
type A seal
see 4.1.3

3.91
type B seal
see 4.1.3

3.92
type C seal
see 4.1.3

3.93
vendor
manufacturer of the equipment, or his agent, normally responsible for service support

NOTE This International Standard addresses the responsibilities between two parties, defined as the purchaser and the vendor. There are many parties that are involved in the purchase and manufacture of the equipment. These parties are given different titles depending on their order in the chain. They may be called buyer, contractor, manufacturer or subvendor. For example, the party supplying a lubricating oil console may be the console vendor of the compressor manufacturer, the subvendor of the purchaser, and the purchaser of components within the console. All of these terms, however, can be reduced to the purchaser and vendor. It is for this reason that only these two terms are defined. Attempts to define these other terms would only cause confusion.

3.94
volatile hazardous air pollutant
VHAP

any compound as defined by Title 1, Part A, Section 112 of the U.S. National Emission Standards for Hazardous Air Pollutants (NESHAPs) (Clean Air Act Amendment)

3.95
witnessed inspection
witnessed test

inspection or test for which the purchaser is notified of the timing and a hold is placed on production until the purchaser or his representative is in attendance

4 Sealing systems

4.1 Seal categories, types and arrangements

4.1.1 General

The seal configurations covered by this International Standard can be classified into three categories (1, 2 and 3), three types (A, B and C) and three arrangements (1, 2 and 3). Further, Arrangement 2 and 3 seals can be in three orientations: “face-to-back”, “back-to-back” and “face-to-face”. These categories, types, arrangements and orientations are defined below.

See Figures 1 to 9 for typical representations.

4.1.2 Seal categories

There are three seal categories, as follows.

- **Category 1** seals are intended for use in non-ISO 13709 pump seal chambers, meeting the dimensional requirements of ASME B73.1, and ASME B73.2 seal chamber dimensions and their application is limited to seal chamber temperatures from -40 °C (-40 °F) to 260 °C (500 °F) and gauge pressures up to 2 MPa [20 bar] (300 psi).
- **Category 2** seals are intended for use in seal chambers meeting the chamber envelope dimensional requirements of ISO 13709. Their application is limited to seal chamber temperatures from -40 °C (-40 °F) to 400 °C (750 °F) and gauge pressures up to 4 MPa [40 bar] (600 psi).
- **Category 3** provides the most rigorously tested and documented seal design. It is required that the entire seal cartridge is qualification tested as an assembly in the required fluid. They meet the seal chamber envelope requirements of ISO 13709 (or equal). Their application is limited to seal chamber temperatures from -40 °C (-40 °F) to 400 °C (750 °F) and gauge pressures up to 4 MPa [40 bar] (600 psi).

A summary of the main differences in seal categories is given in Annex A.

Temperatures and pressures outside the ranges of these categories, or which involve fluids not included in Annex A, may require engineering and seal selection guidance other than provided in this International Standard.

The process temperature can be significantly lower than those stated above and API 682 seals can still be applied.

4.1.3 Seal types

There are three seal types, as follows.

- **Type A** seal is a balanced, internally-mounted, cartridge design, pusher seal with multiple springs. Secondary sealing elements are elastomeric O-rings.
Materials are specified in Clause 6. Guidance on equivalent materials standards is given in Annex B. Figure 7 depicts a Type A seal.
- **Type B** seal is a balanced, internally -mounted, cartridge design, (metal bellows) seal. Secondary sealing elements are elastomeric O-rings.
Materials are specified in Clause 6. Guidance on equivalent materials standards is given in Annex B. Figure 8 depicts a Type B seal. A metal bellows seal offers the advantage of having only static secondary seals. It may be specified instead of the default Type A seal for low temperature service.
- **Type C** seal is a balanced, internally -mounted, cartridge-design (metal bellows) seal. Secondary sealing elements are flexible graphite.
Materials are specified in Clause 6. Guidance on equivalent materials standards is given in Annex B. Figure 9 depicts a Type C seal. Bellows seals are inherently balanced. Stationary metal bellows seals are the primary choice for high temperature arrangement 1 seals.
- **Type ES** seal is a totally engineered seal for service conditions outside the operation scope of Type A, B and C seals. This may refer to temperatures, pressures, shaft diameters, mediums and specific medium properties which are not covered by this International Standard (see also A.1.2). Therefore engineered seals are not required to meet any of the design or testing requirements of this International Standard.

Type A and Type B seals are suitable for temperatures up to 176 °C (350 °F). Type C seals are for high temperatures up to 400 °C (750 °F).

4.1.4 Seal Arrangements

There are three seal arrangements, as follows:

- **Arrangement 1:** Seal configurations having one seal per cartridge assembly;
- **Arrangement 2:** Seal configuration having two seals per cartridge assembly, with the space between the seals at a pressure less than the seal chamber pressure.
- **Arrangement 3:** Seal configurations having two seals per cartridge assembly, utilizing an externally supplied barrier fluid at a pressure greater than the seal chamber pressure.

NOTE 1 The principal difference between Arrangement 2 and Arrangement 3 configurations is the concept of containment of leakage versus the elimination of process fluid leakage. Refer to the associated definitions and Annex A piping plan descriptions.

NOTE 2 In Arrangement 2 and Arrangement 3, the containment seal can be a conventional wet seal or a dry-running seal. The inner seal utilizes a piping plan typical of Arrangement 1 seals. If the containment seal is a conventional wet seal design, an unpressurized liquid buffer fluid is supplied to the containment seal chamber. If the containment seal is a dry-running seal, a gas buffer may be used.

Alternative technology designs and sealing methods are also considered, as follows:

- contacting wet (CW) seals: seal design where the mating faces are not designed to intentionally create aerodynamic or hydrodynamic forces to sustain a specific separation gap (refer to definitions)
- non-contacting (NC) seals (whether wet or dry): seal design where the mating faces are designed to intentionally create aerodynamic or hydrodynamic separating forces to sustain a specific separation gap; (refer to definitions) and
- containment seals (CS), whether contacting or non-contacting: seal design with one flexible element, seal ring and mating ring mounted in the containment seal chamber.

Figure 1 places all these concepts in one diagram, providing a comprehensive way to look at their interrelationships.

4.1.5 Seal orientations

Arrangement 2 and Arrangement 3 seals can be in the following three orientations:

- face-to-back: dual seal configuration in which one mating ring is mounted between the two flexible elements and one flexible element is mounted between the two mating rings;
- back-to-back: dual seal configuration in which both of the flexible elements are mounted between the mating rings; and
- face-to-face: dual seal configuration in which both of the mating rings are mounted between the flexible elements.

Other orientations such as concentric seals may be agreed by the purchaser and vendor and are considered an Engineered Seal

4.2 Objectives

Shaft sealing systems conforming to this International Standard are intended to meet the following objectives.

- a) All seals should operate continuously for 25 000 h without need for replacement;
- b) Arrangement 2 outer seals should operate for at least 25 000 h without need for replacement (wet or dry seals) at any containment seal chamber or buffer fluid chamber pressure equal to or less than the seal leakage pressure switch setting [not to exceed a gauge pressure of 0,07 MPa [0,7 bar] [10 psi] and for at least 8 h at the seal chamber conditions;

- c) All seals should operate for 25 000 h without need for replacement while either complying with local emissions regulations, or exhibiting a maximum screening value of 1 000 ml/m³ (1 000 ppm vol) as measured by the EPA Method 21, whichever is more stringent.

4.3 Specifying and/or purchasing a sealing system

The data sheet (Annex C) shall be used to convey purchasing requirements. Default requirements are identified therein that allow the purchaser to specify a seal with minimum information. The minimum data required on the data sheet to obtain budgetary pricing on a sealing system is expressed in the seal code. Typical seal codes which can be used are given in Annex D. This assumes all standard defaults (construction features and materials). The minimum information required on the data sheet to purchase a seal with assurance that the selection will satisfy the objectives of 4.2 is the pump data, fluid data and seal specification.

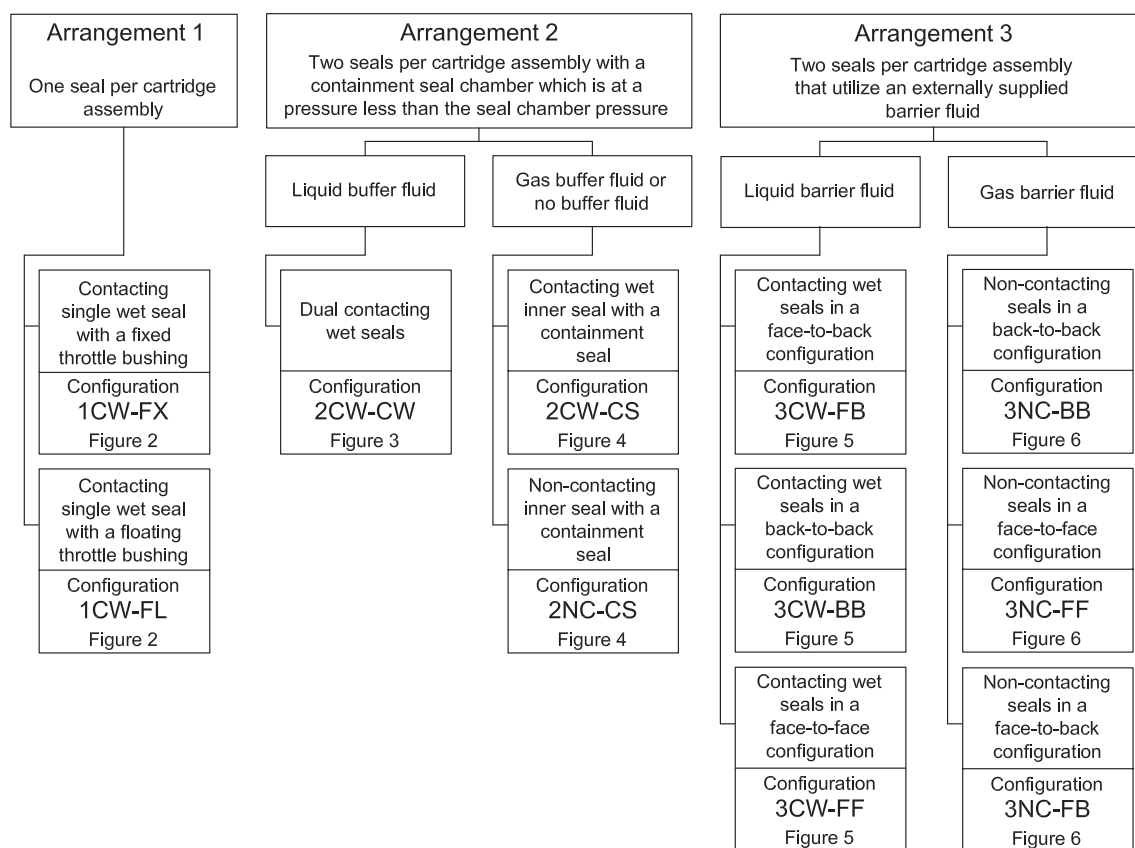
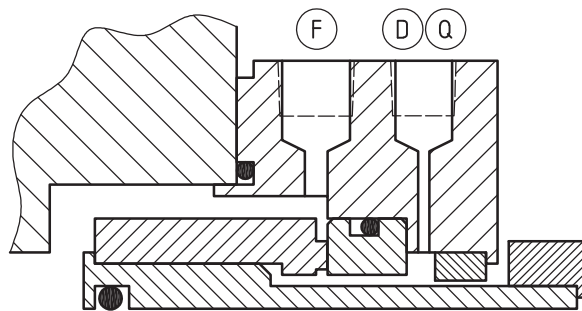
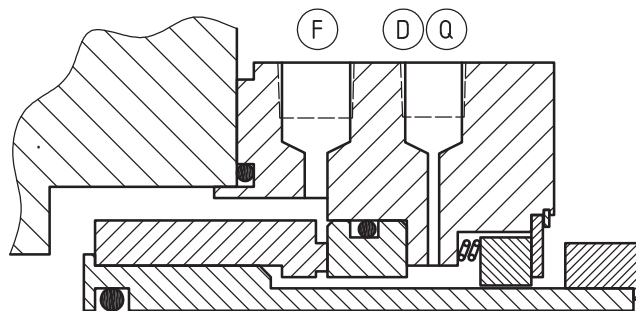


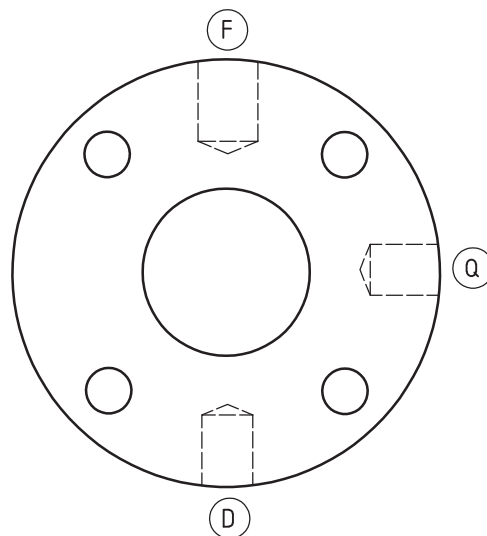
Figure 1 — Seal configurations



a) 1CW-FX, contacting single wet seal with a fixed throttle bushing



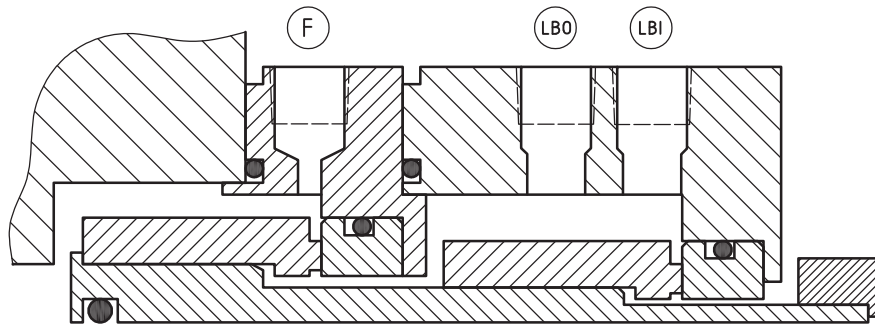
b) 1CW-FL, contacting single wet seal with a floating throttle bushing



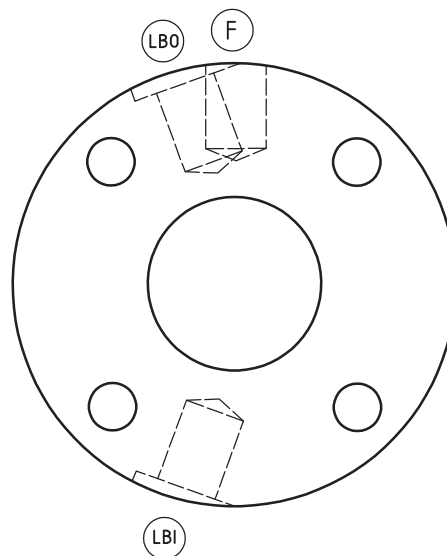
c) Typical gland plate connection orientation

NOTE For connection designations, see Table 2.

Figure 2 — Arrangement 1: One seal per cartridge assembly



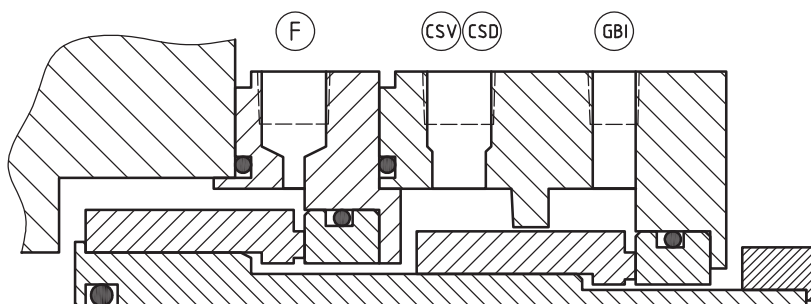
a) 2CW-CW, dual contacting wet seal



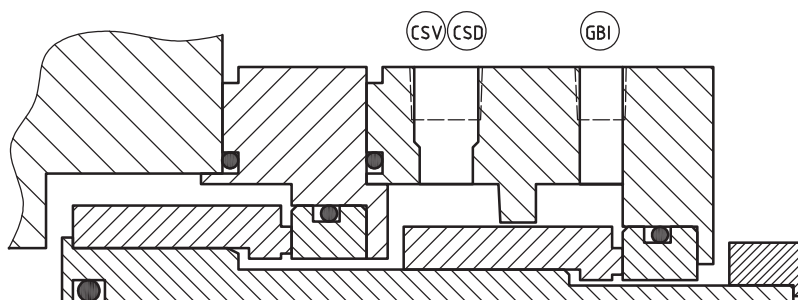
b) Typical gland plate connection orientation

NOTE For connection designations, see Table 2.

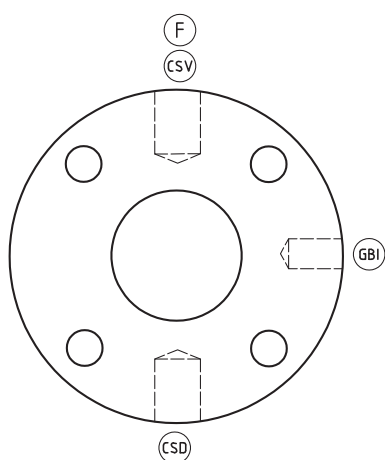
Figure 3 — Arrangement 2: Two seals per cartridge assembly with a liquid buffer fluid



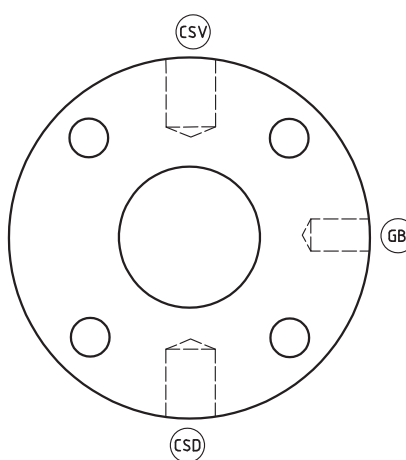
a) 2CW-CS, contacting wet inner seal with a containment seal



b) 2NC-CS, non-contacting inner seal with a containment seal



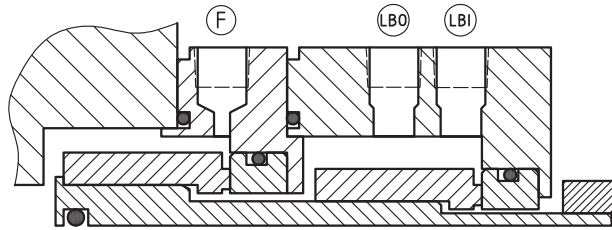
c) Typical gland plate connection
orientation for 2CW-CS



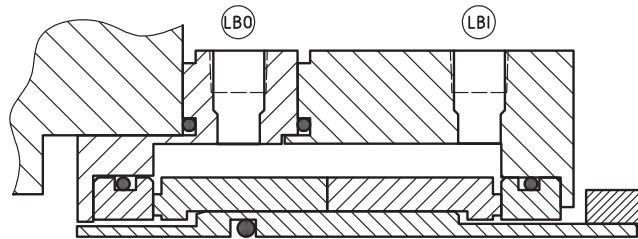
d) Typical gland plate connection
orientation for 2NC-CS

NOTE For connection designations, see Table 2.

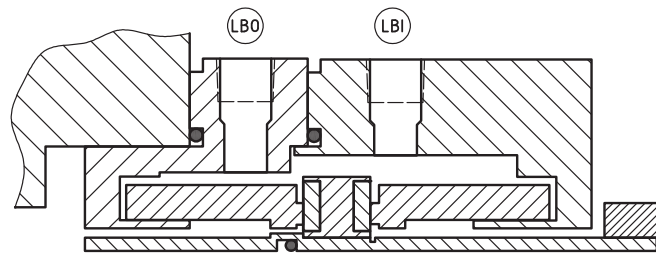
Figure 4 — Arrangement 2: Two seals per cartridge assembly with or without a gas buffer fluid



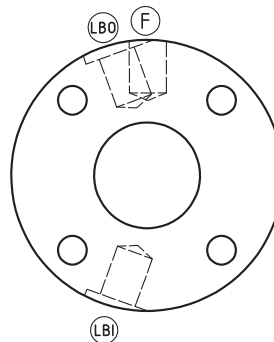
a) 3CW-FB, contacting wet seals in a face-to-back configuration



b) 3CW-BB, contacting wet seals in a back-to-back configuration



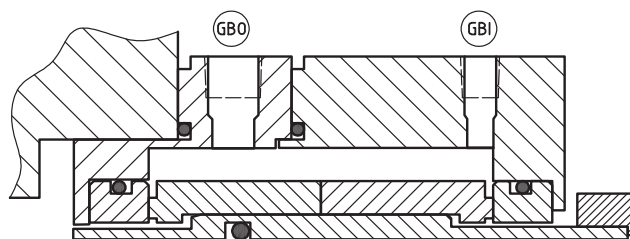
c) 3CW-FF, contacting wet seals in a face-to-face configuration



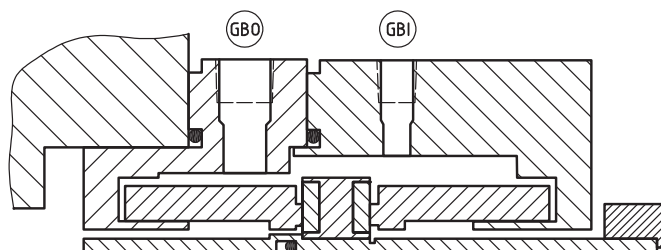
d) Typical gland plate connection orientation

NOTE For connection designations, see Table 2.

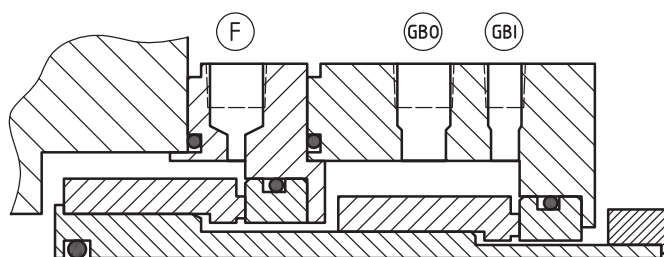
Figure 5 — Arrangement 3: Two seals per cartridge assembly with a liquid barrier fluid



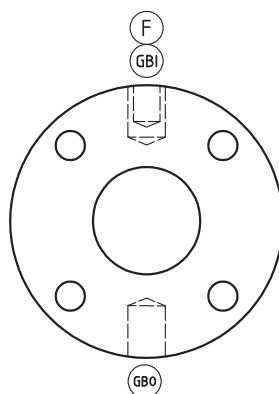
a) 3NC-BB, non-contacting seals in a back-to-back configuration



b) 3NC-FF, non-contacting seals in a face-to-face configuration



c) 3NC-FB, non-contacting seals in a face-to-back configuration



d) Typical gland plate connection orientation

NOTE For connection designations, see Table 2.

Figure 6 — Arrangement 3: Two seals per cartridge assembly with a gas barrier fluid

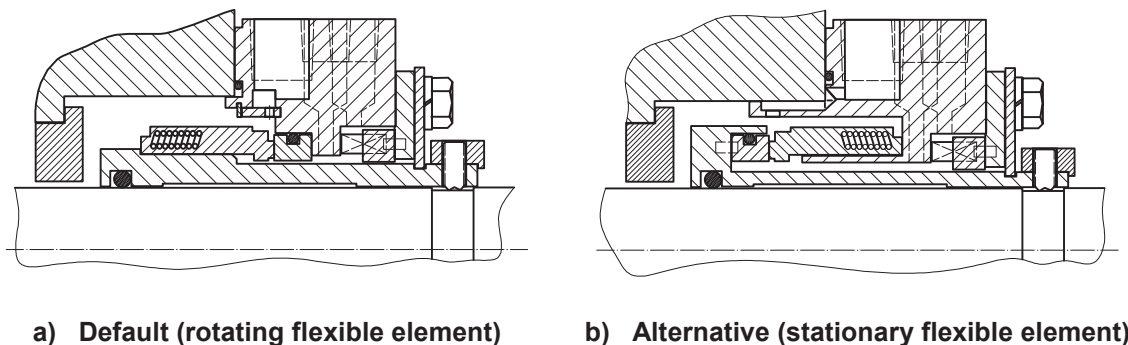


Figure 7 — Arrangement 1 Type A seals

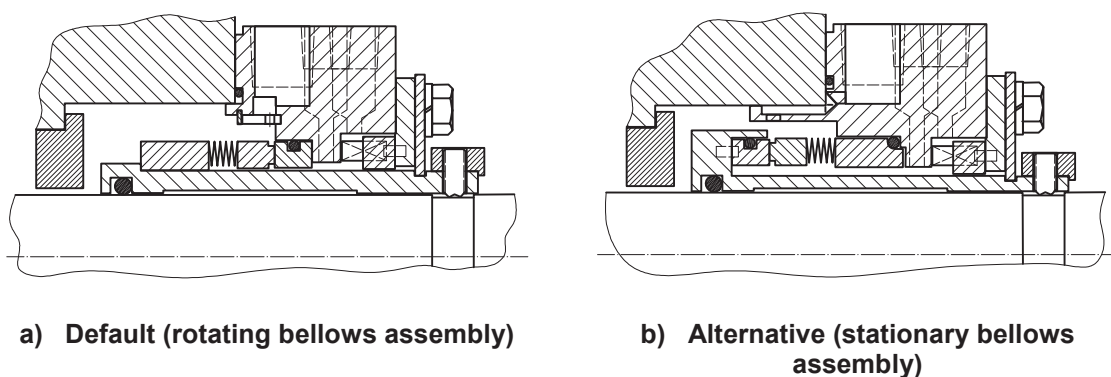


Figure 8 — Arrangement 1 Type B seals

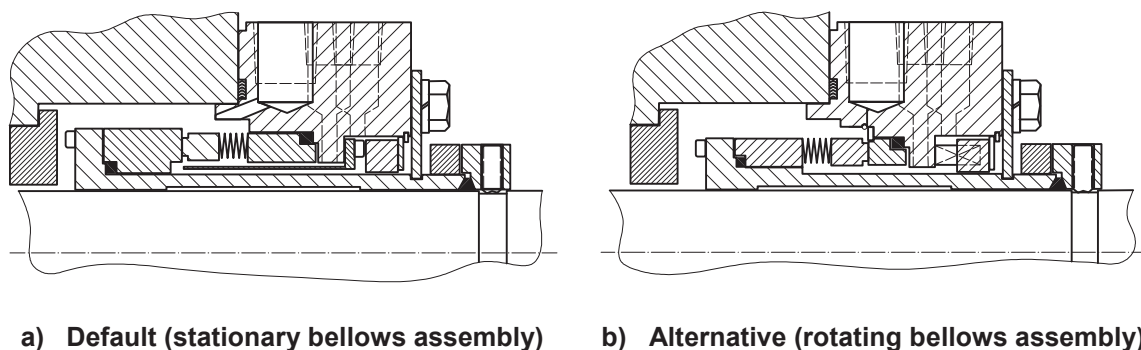


Figure 9 — Arrangement 1 Type C seals

5 General

5.1 Unit responsibility

Unless otherwise specified, the pump vendor shall have unit responsibility for the seal system if the seal system is purchased as part of a pump system. If not purchased as part of a pump system, the seal vendor shall have unit responsibility for the seal system. The vendor who has unit responsibility shall ensure that all sub-vendors comply with the requirements of this International Standard. Annex E specifies the interface responsibilities of the pump and seal vendors.

5.2 Dimensions

The purchaser shall specify whether data, drawings, hardware (including fasteners), and equipment supplied to this International Standard shall use SI units or US Customary units.

6 Design requirements

6.1 Common design requirements (all categories)

6.1.1 General information

6.1.1.1 All mechanical seals, regardless of type or arrangement, shall be of the cartridge design, without hook sleeves.

ISO 13709 already requires that pumps be designed to enable seal removal without disturbing the driver. If pumps are being retrofitted that are not back-pullout design, it should be verified that adequate shaft end spacing exists by comparing the seal cartridge length to the distance between shaft ends (DBSE).

- **6.1.1.2** Unless otherwise specified the flexible element shall be rotating for type A and B seals. If specified, or if recommended by the seal manufacturer and agreed by the purchaser, a stationary flexible element shall be supplied for Type A or Type B seals.

NOTE Within the scope of this International Standard, rotating and stationary flexible elements are considered to be technically equivalent but the optimum choice is influenced by many different factors. The default for rotating or stationary elements for different seal types and their arrangements have been based on installed population and reliable operation.

There are a number of factors, related to the design, manufacture, installation, and repair of the equipment, which should be considered when making the selection of a rotating or stationary flexible element. The relative merits of rotary and stationary flexible element seals and the factors influencing the choice are addressed in other paragraphs of this clause and F.4.

- **6.1.1.3** Unless otherwise specified the flexible element shall be stationary for type C seals. If specified or if recommended by the seal manufacturer and agreed by the purchaser a rotating flexible element shall be used for Type C seals.

NOTE See Note in 6.1.1.2.

6.1.1.4 The cartridge seal shall incorporate a setting device (such as setting plates) that is sufficiently robust to enable the assembly to be pushed or pulled during installation, rotor adjustment or disassembly without transferring radial or axial load to the seal faces.

6.1.1.5 A stationary flexible-element seal shall be provided if seal-face surface speed at the mean diameter of the seal face exceeds 23 m/s (4 500 ft/min).

NOTE As speed increases, the flexible element of a rotating seal flexes at a correspondingly faster rate to keep the seal faces closed. At very high speeds (and for large seal sizes), the forces required to keep the faces closed become so large that they negatively affect the seal life.

Consideration should be given for requiring a stationary flexible element if:

- balance diameter exceeds 115 mm (4,5 in) (see 6.1.1.7);
- pump case or gland plate distortion and misalignment exist due to pipe loads, thermal distortion, pressure distortion, etc.;
- the perpendicularity of the seal chamber mounting surface to the shaft is a problem, aggravated by high rotational speed; or

— the seal chamber face runout requirements described in 6.1.2.13 cannot be met (as found in ASME B73.1 and ASME B73.2 pumps, and with some slender-shaft, multi-stage pump designs).

6.1.1.6 This International Standard does not cover the design of the component parts of mechanical seals; however, the design and materials of the component parts shall be suitable for the specified service conditions. The maximum allowable working pressure shall apply to all parts referred to in the definition of pressure casing.

NOTE It is not normal practice for seals to be rated for the maximum allowable working pressure for the pump in which they are installed.

6.1.1.7 The seal manufacturer shall design the seal faces and seal balance ratio to minimize seal-face-generated heat consistent with optimum life expectations in 4.2 and emissions limit requirements. Balance diameter varies with seal design, but for spring pusher seals it is normally the diameter of the sliding contact surface of the dynamic O-ring. For the inner seal of a dual seal the sliding surface can vary depending on whether the pressure is internal or external. For welded metal bellows-type seals, the balance diameter is normally the mean diameter of the bellows, but this will vary with pressure. Contact the seal vendor for determination of the balance diameter under varying pressure conditions.

NOTE 1 Temperature of the environment around the seal as influenced by seal face generated heat and heat soak will have an impact on seal performance. Refer to F.2.1 and F.2.2 for discussion of seal balance diameter, seal generated heat and heat soak.

NOTE 2 Starting torque and seal power can be significant issues for small pump drivers, seals at or above the balance diameter and pressure boundaries of this International Standard, and for Arrangement 3 seals.

6.1.1.8 The seal supplied shall be capable of handling normal and transient differential axial movement between the rotor and stator.

NOTE Maximum axial movement is of particular concern in hot multi-stage pumps. During start-up conditions, it is not unusual for a large amount of differential thermal growth to occur between the shaft and casing. This differential can exceed the capabilities of some seals. Appropriate warm up procedures can minimise this problem. Axial movement is also a concern in some vertical pump designs that rely on the motor bearing for thrust positioning (i.e. in-line pumps without pump bearing housings and vertical can pumps). In certain conditions, process pressure can result in an upward thrust. Shaft axial movement is only limited by motor-bearing axial float in these cases.

6.1.1.9 Unless otherwise specified, O-ring sealing surfaces, including all grooves and bores, shall have a maximum surface roughness (Ra) of 1,6 µm (63 µin) for static O-rings. The surface against which dynamic O-ring slide shall have a maximum surface roughness of 0,8 µm (32 µin).

Seal to pump interface sealing diameters shall have a minimum 3 mm (0,12 in) radius or a minimum 1,5 mm (0,06 in) chamfered lead-in for static O-rings. Chamfers shall have an angle of between 15° and 30°.

Chamfers or radii internal to the cartridge seal shall be adequate to prevent O-ring damage during assembly and shall be identical to the specification used in the qualification test.

NOTE Lead-in chamfers internal to the cartridge seal can vary from the values specified in paragraph 2 of this clause.

6.1.1.10 O-ring grooves shall be sized to accommodate perfluoroelastomer O-rings.

NOTE Some perfluoroelastomers have a greater thermal expansion than most other O-ring materials, such as fluoroelastomer. Installing a perfluoroelastomer in a groove designed for fluoroelastomer can lead to damage to the O-ring. On the other hand, fluoroelastomer O-rings function properly in the larger perfluoroelastomer grooves. Choosing the wider groove as a standard eliminates this potential cause of O-ring failure and reduces the number of necessary spares. Note that thermal expansion damage in perfluoroelastomer O-rings is often confused with damage due to chemical-induced swelling of the O-rings, and vice versa.

6.1.1.11 For vacuum services, all seal components shall be designed with a means of retaining the sealing components to prevent them from being dislodged by atmospheric pressure (see Figure 10 for examples of

such designs). The seal design shall be adequate to seal under vacuum conditions when the pump is not operating (see 6.1.2.14).

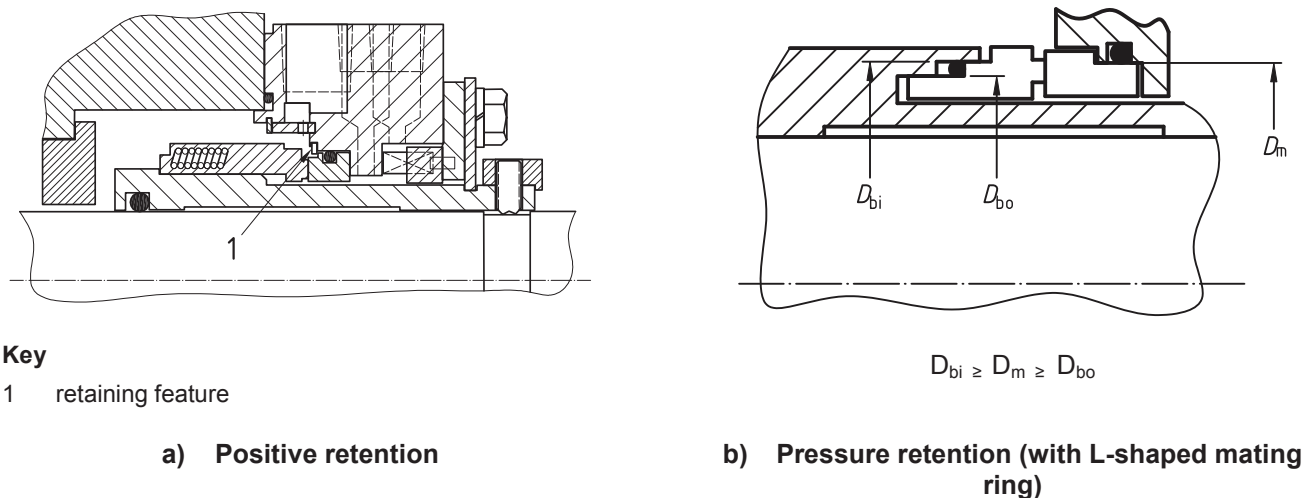


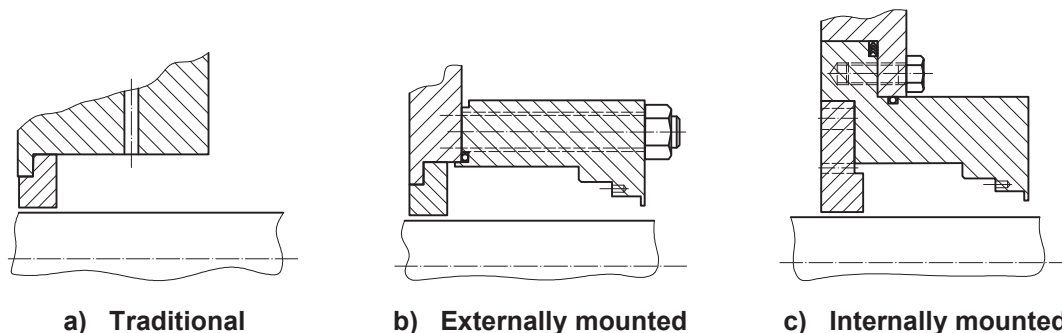
Figure 10 — Retention of seal components in vacuum services

6.1.2 Seal chamber and gland plate

6.1.2.1 Gland plates shall be provided by the seal manufacturer.

6.1.2.2 Unless otherwise specified, seal chambers shall be provided by the pump manufacturer.

6.1.2.3 Seal chambers are one of three types: traditional, externally mounted or internally mounted. Seal chambers are not required to accommodate packing. Figure 11 shows the three types of seal chamber.



NOTE Type b, the externally mounted seal chamber, offers the most flexibility in terms of its ability to accommodate arrangement 2 and 3 seals. The seal chamber can be optimized for the axial placement of flush, barrier, and buffer porting facilitating unrestricted flow paths.

Figure 11 — Seal chamber types

6.1.2.4 The default seal chamber is the traditional type (cylindrical chamber, integral to the casing of the pump) supplied by the pump manufacturer.

Category 1 seals shall be designed to fit into the dimensional envelope defined by ASME B73.1 and ASME B73.2.

Category 2 and Category 3 seals shall be designed to fit into the dimensional envelope of ISO 13709.

Seal chamber designs that utilize all the design features of this International Standard should result in improved reliability and general standardization of components. Reduced seal radial clearance requires the user to address Piping Plans and construction requirements for non-compliant seals.

The reliability of a mechanical seal is affected by the radial clearance between its rotating parts and the seal chamber bore. Meeting the minimum radial clearance requirements of this International Standard is particularly important when sealing difficult services, such as those with significant solids content or those that can result in excessive seal face temperature. Alternative seal chamber designs used in some chemical industry pumps, such as large-bore or tapered seal chambers with flow modifiers, may eliminate the need for a flush or enhance performance based on design of the chamber.

It is expected that the majority of Category 1 seals will be applied to ASME B73.1 and ASME B73.2 pumps, and the majority of Category 2 and Category 3 seals will be installed in ISO 13709 applications. However, there is a recognized possibility that Category 1 seals may be installed in ISO 13709 applications, and Category 2 and Category 3 seals, in certain configurations, may be installed in ASME B73.1 and ASME B73.2 pumps. Careful consideration should be given to correctly applying seal categories into pump types or services for which they are not intended.

- **6.1.2.5** If specified, an internally mounted or externally mounted bolt-on seal chamber shall provided by the seal manufacturer shall be supplied. (Figure 12)
- 6.1.2.6** The minimum diametral clearance between rotary and stationary components shall be sufficient to prevent contact between parts in relative motion and shall conform to the values in this clause and Table 1.
 - a) For contacting seals, the minimum diametral clearance between the rotating components of the seal and the stationary surfaces of the seal chamber and gland plate shall be 6 mm (1/4 in) in order to promote fluid circulation and cooling around the seal faces.
 - b) For arrangement 2 or 3 seals where the inner seal is a non-contacting type (2 NC-CS or 3 NC-XX) the minimum diametral clearance between the rotating components of the seal and the stationary surfaces of the seal chamber and gland plate shall be 3 mm (1/8 in). Non contacting seals generate minimal amount of heat, only that resulting from the viscous shear of the sealed fluid.
 - c) The first point of radial contact by a metal component of the seal shall not be at the seal ring or mating ring (see NOTE 2).

Table 1 — Clearances between rotary and stationary components

Inside Diameter	Outside Diameter		Minimum Diametral Clearance ^a	Reference
ID seal chamber bore & gland plate	OD rotating seal part	CW seal type NC seal type	6 mm (0,25 in) 3 mm (0,125 in)	6.1.2.6
ID stationary seat	OD rotating seal part	shaft ≤ 60 mm shaft > 60 mm	1 mm (.039 in) 2 mm (0,079 in)	6.1.2.6
ID stationary gland part	OD internal circulation device	shaft ≤ 60 mm shaft > 60 mm	1 mm (0,039 in) 2 mm (0,079 in)	7.1.2.9
ID containment bushing 2CW-CS, 2NC-CS	OD rotating seal part	shaft ≤ 60 mm shaft > 60 mm	1 mm (.039 in) 2 mm (0,079 in)	7.2.6.1
^a The minimum diametral clearances are calculated by subtracting the maximum outside diameter (of the internal part) from the minimum inside diameter (of the external part).				
Inside Diameter	Outside Diameter		Maximum Diametral Clearance ^b	Reference
ID floating carbon bushing	OD rotating sleeve	20 mm to 50 mm 51 mm to 80 mm 81 mm to 110 mm	0,18 mm (0,007 in) 0,225 mm (0,009 in) 0,28 mm (0,011 in)	6.1.2.23
ID fixed throttled bushing	OD rotating sleeve	20 mm to 50 mm 51 mm to 75 mm 76 mm to 100 mm 101 mm to 110 mm	0,635 mm (0,025 in) 0,762 mm (0,030 in) 0,889 mm (0,035 in) 1,016 mm (0,040 in)	6.1.2.22
^b The maximum diametral clearances are calculated by subtracting the minimum outside diameter (of the internal part) from the maximum inside diameter (of the external part).				

NOTE 1 The intent of setting minimal clearances should in no way be construed as implying that any seal component can be used to restrict shaft movement in the event of bearing failure or other machinery or operation problem.

NOTE 2 The requirement in 6.1.2.6 c) is to minimize potential leakage levels and/or a friction generated ignition source in the rare fault event where the relative radial position of the rotating components to the stationary components would be beyond the minimum diametral clearances in Table 1. The importance of having sufficient design clearance to ensure adequate reliability and personal safety in hazardous, toxic and flammable services is paramount. Diametral clearances may be compromised in the event of the following scenarios:

- Wear of shaft bearings beyond their design limits
- Operation of the pump beyond its allowable operating range
- Existing pumps that have damaged, corroded or worn parts that control the radial location of the shaft to the casing.

On hazardous services it is important to ensure pump installation to the appropriate standards, operational condition monitoring and controlled maintenance and reconditioning procedures are always applied.

NOTE 3 These minimal clearances will be adequate in equipment that is built and/or maintained to the specifications of ISO 13709 and ANSI B73. For other equipment built, repaired, or operated to different specifications these clearances might not be sufficient. Larger clearances should be considered for:

- Pump designs unable to conform to the shaft, casing and seal design limits in ISO 13709, ISO 21049 and the shaft/casing limits in ANSI B73.1 and ANSI B73.2. Potentially vulnerable pump designs are discussed in ISO 13709.
- Pumps installed with mounting and flange strain, from connecting pipe-work, beyond the recommended limits of ISO 13709 and ANSI B73.1 and ANSI B73.2.

NOTE 4 These minimal clearances are to prevent contact between rotary and stationary parts, but internal clearances in Arrangement 2 and 3 CW seals also need to be sufficient to insure proper circulation of the barrier/buffer fluid and cooling of the seal faces. This is particularly important in face to back configuration where barrier/buffer fluid circulation to the inner seal is inherently physically remote from the connections. Inadequate cooling of the inner seal can result in reduced seal reliability. Selection of 3CW-BB or FF configuration or use of process fluid seal chamber cooling may resolve an inner seal cooling problem.

6.1.2.7 All bolt and stud stresses shall be in accordance with the pressure design code at the maximum allowable working pressure. Four studs shall be used. The diameter of the studs shall be in accordance with the seal chamber dimensional references in 6.1.2.4. Larger studs shall be furnished only if required to meet the stress requirements of EN 13445 or ASME VIII, or to sufficiently compress spiral-wound gaskets in accordance with ASME B16.20.

6.1.2.8 The maximum allowable working pressure of the seal pressure casing shall be equal to or greater than that of the pump pressure casing on which it is installed. The seal pressure casing shall have a corrosion allowance of 3 mm (1/8 in), and shall have sufficient rigidity to avoid any distortion that would impair seal operation, including distortion that may occur during tightening of the bolts to set gasketing. If approved by the purchaser, a smaller corrosion allowance may be acceptable for some higher alloy materials.

The following shall also apply.

- a) Unless otherwise specified, gland plates shall be provided with holes (not slots) for attachment studs.
- b) Provisions shall be made for centring the seal gland plates and/or chamber with either an inside- or an outside-diameter register fit. The register-fit surface shall be concentric to the shaft and shall have a total indicated runout of not more than 0,125 mm (0,005 in), see Figure 12. The rabbet diametrical clearance shall be H7/f7 in accordance with ISO 286-2.
- c) A shoulder at least 3 mm (1/8 in) thick shall be provided in the seal gland plate to support the axial load generated by seal chamber pressure acting on the seal components see Figure 13.

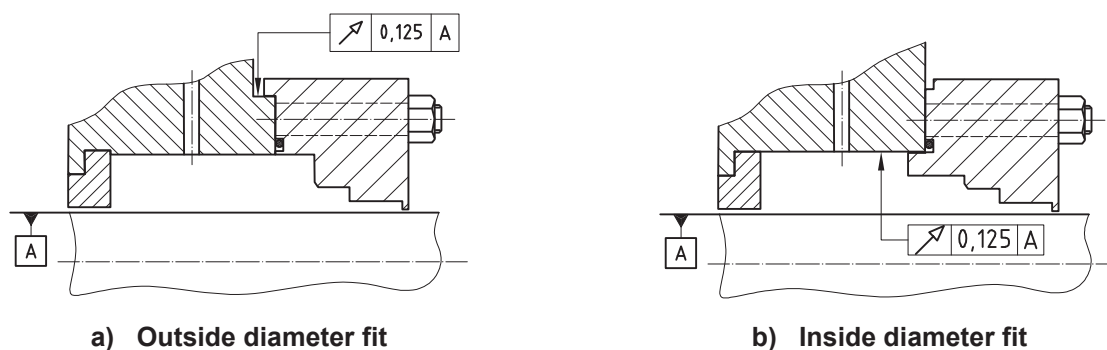
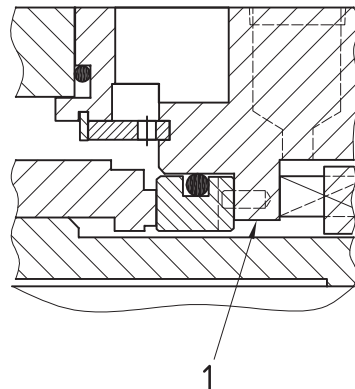


Figure 12 — Seal chamber register concentricity



Key

1 seal gland plate shoulder

Figure 13 — Section showing seal gland plate shoulder

6.1.2.9 Stress values used in the design of the pressure casing for any material shall not exceed the values used in the design of the pump casing on which it is installed. Where the original pump design values are not available, the stress values shall be in accordance with ISO 13709.

6.1.2.10 Manufacturing data report forms, third party inspections, and stamping, such as those specified in codes such as ASME VIII, are not required.

6.1.2.11 The use of threaded holes in pressurized parts shall be minimized. To prevent leakage in pressure sections of casing, metal equal in thickness to at least half the nominal bolt diameter, in addition to any corrosion allowance, shall be left around and below the bottom of drilled and tapped holes.

6.1.2.12 Threading details for bolting for pressure casings shall be in accordance with ISO 261, ISO 262, ISO 724 and ISO 965, or with ASME B1.1. Metric fine and UNF threads shall not be used.

Unless otherwise specified, studs in accordance with ISO 13709 Table H.1 shall be used, rather than other fasteners such as cap screws for connection of seal chamber to pump and seal gland plate to pump or seal chamber.

NOTE For the purpose of this provision, API 610 is equivalent to ISO 13709.

Adequate clearance shall be provided at bolting locations to permit the use of socket or box wrenches.

Manufacturers marking shall be located on all fasteners 6 mm (1/4 in) and larger (excluding washers and headless set screws). For studs, the marking shall be on the nut end of the exposed stud end.

NOTE 1 A set screw is a headless screw with an internal hex opening on one end.

NOTE 2 Adequate clearance to use socket or box wrenches at gland plate bolting locations might not be feasible on small pumps.

6.1.2.13 The seal manufacturer shall design for seal chamber face runout (TIR) up to 0,5 µm/mm (0,000 5 in/in) of seal chamber bore, see Figure 14. Some multistage, slender-shaft designs may not be able to meet the requirements of this clause (see 6.1.1.5).

NOTE Mechanical seal performance can be adversely affected by excessive runout at the mechanical seal chamber. Seal chamber face runout or seal chamber interface runout is a measure of the squareness of the pump shaft with respect to the face of the seal chamber mounting.

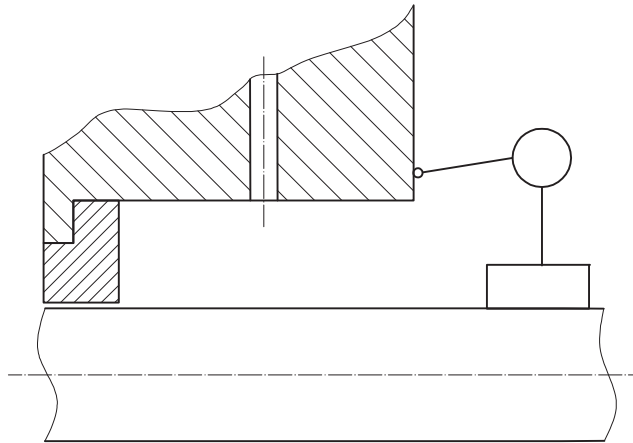


Figure 14 — Seal chamber face runout

6.1.2.14 For Arrangement 1 and Arrangement 2, seal chamber pressure and support systems for contacting wet seals (excluding containment seals) shall be designed for proper seal operation. Pumps that develop low differential pressure and pumps that handle high vapour pressure fluids may not achieve the required margins specified in 6.1.2.14.1 and 6.1.2.14.2. If the seal chamber conditions do not meet the specified margins, the seal manufacturer shall

- a) confirm the adequacy of the seal selection and Piping Plan based on the specified fluid,
- d) recommend the seal chamber operating conditions (minimum pressure and maximum temperature) that will result in a seal installation that has a high probability of achieving 3 years of uninterrupted service,
- e) furnish the seal gland plate or seal chamber with a second flush connection to permit measurement of seal chamber pressure directly, and
- f) furnish a distributed flush system unless space limitations preclude its use.

NOTE 1 Depending on the seal ring orientation and space available on some seal designs with a Piping Plan 23 a distributed flush as shown in Figure 24 may not be advisable if the added resistance of the flush geometry detrimentally impacts on the flush flow velocity. In these circumstances consult the seal manufacturer for detailed information on the evidence for achieving reliable operation without a distributed flush.

NOTE 2 If the pump is vertical and a Piping Plan 13 is required to assist in vapour removal from the seal face environment, a Piping Plan 14 with a distributed flush injection is a solution combining both features.

NOTE 3 For contacting wet seal designs, maintaining an adequate vapour pressure margin helps protect the seal faces against localized boiling of the process fluid at the seal faces. Boiling of the process fluid at the seal faces can cause loss of seal-face lubrication and subsequent seal failure. Low-density fluids are some of the most troublesome fluids to seal and account for a high percentage of seal repairs. These margins can be achieved in many ways. For example, using one or a combination of the following options can provide a vapour pressure and product temperature margin for reliable seal performance. The application of these solutions is usually the result of mutual agreement between the purchaser, seal manufacturer and pump manufacturer:

- lowering the seal chamber fluid temperature by cooling the flush fluid;
- raising the seal chamber pressure by removing the back wear ring and plugging impeller balance holes;
- utilizing an external flush fluid; and/or
- raising the seal chamber pressure through the use of a close-clearance (floating) throat bushing.

Lowering the flush fluid temperature (seal chamber fluid temperature) is always preferable to pressurizing the seal chamber by using a close clearance throat bushing. Bushing wear inevitably results in a decreased seal chamber pressure and margin over vapour pressure.

The user should be aware that there may be other criteria that should be used to establish seal chamber conditions to achieve target reliability. An example is water at a temperature above 82 °C (180 °F), which requires cooling to maintain adequate fluid lubricity (see Annex A for seal selection process).

Some applications may not need complicated seal flush systems. A generic example of this is cooling water service. Assuming the water is at 38 °C (100 °F) and an atmospheric pump suction and seal chamber pressure exists, the absolute vapour pressure would be 0,0065 MPa (0,065 bar) (0,94 psi). The absolute vapour pressure at 58 °C (136 °F) would be about 0,0186 MPa (0,186 bar) (2,7 psi). Ample product temperature margin would be present in the seal chamber to provide good seal life without seal flush fluid cooling or pressurizing the seal chamber.

6.1.2.14.1 During operation, the seal chamber pressure shall be at least 0,035 MPa (0,35 bar) (5 psi) above atmospheric pressure. This is particularly important if the inlet pressure to the pump is below atmospheric.

6.1.2.14.2. During operation, a pressure margin of not less 0,35 MPa (3,5 bar) (50 psi) between the seal chamber pressure and the maximum fluid vapour pressure shall be maintained.

6.1.2.15 If supplied, throat bushings shall be renewable and designed so that they cannot be forced out by hydraulic pressure.

- **6.1.2.16** If specified, or if recommended by the seal manufacturer, close-clearance floating throat bushings shall be furnished. Materials and clearances shall be suitable for the service and approved by the purchaser

NOTE Close-clearance throat bushings can be used for any or all of the following purposes along with the appropriate Piping Plans:

- to increase or decrease seal chamber pressure;
- to isolate the seal chamber fluid; and/or
- to control the flow into or out of the seal chamber.

See F.5.2 for additional guidance concerning the use of throat bushings.

6.1.2.17 Data sheet-specified gland plate and seal chamber connections shall be identified by symbols permanently marked (e.g. stamped or cast) on the component. The symbol, size and location in Table 2 shall be used (see Figure 15 for the relative axial position of the process and atmospheric connections). Where appropriate, the letters I and O (In and Out) shall be used in conjunction with these markings. For horizontal pumps, 0° is vertical on top. For vertical pumps, the location of the flush (F) connection defines 0° (see Figure 2 to Figure 6). Where the size of the pump or seal gland precludes the inclusion of the required connection on the seal gland, the seal vendor shall advise the pump vendor to include the necessary connection on the pump or seal chamber. If tangential porting is used, the location of the drilled port into the seal chamber shall comply with Table 2. However, the associated locations for the gland plate tapped connections may differ from those specified in Table 2.

The lack of space for tap and port connections in the seal chamber area may require that these be included within the pump manufacturer's scope of supply. Annex J specifies the interface responsibilities of the pump and seal vendors.

Differential sizing minimizes the possibility of improper assembly, particularly during maintenance in the field. The purchaser should be aware that the specified connection size and location in Table 2 might not be practical on smaller pumps.