



# SLOVENSKI STANDARD

## SIST EN ISO 21049:2005

01-april-2005

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Pumps - Shaft sealing systems for centrifugal and rotary pumps (ISO 21049:2004)

Pumpen - Wellendichtungssysteme für Kreiselpumpen und rotierende  
Verdrängerpumpen (ISO 21049:2004)

Pompes - Dispositifs d'étanchéité de l'arbre pour pompes centrifuges et rotatives (ISO  
21049:2004)

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Ta slovenski standard je istoveten z: EN ISO 21049:2004

### ICS:

21.140	Tesnilke, mašilke	Seals, glands
23.080	i] æ ^	Pumps

SIST EN ISO 21049:2005

en

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN ISO 21049**

December 2004

ICS 23.100.60; 23.080; 83.140.50

English version

**Pumps - Shaft sealing systems for centrifugal and rotary pumps  
(ISO 21049:2004)**

Pompes - Dispositifs d'étanchéité de l'arbre pour pompes  
centrifuges et rotatives (ISO 21049:2004)

Pumpen - Wellendichtungssysteme für Kreislumpen und  
rotierende Verdrängerpumpen (ISO 21049:2004)

This European Standard was approved by CEN on 21 December 2004.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**Management Centre: rue de Stassart, 36 B-1050 Brussels**

**EN ISO 21049:2004 (E)****Foreword**

The text of ISO 21049:2004 has been prepared by Technical Committee ISO/TC 115 "Pumps" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 21049:2004 by Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum and natural gas industries" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

NOTE Attention is drawn to the fact that Clause 10.2.3 permits the use of alternative standards (e.g. EN 13445-5) for the non-destructive examination of materials

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

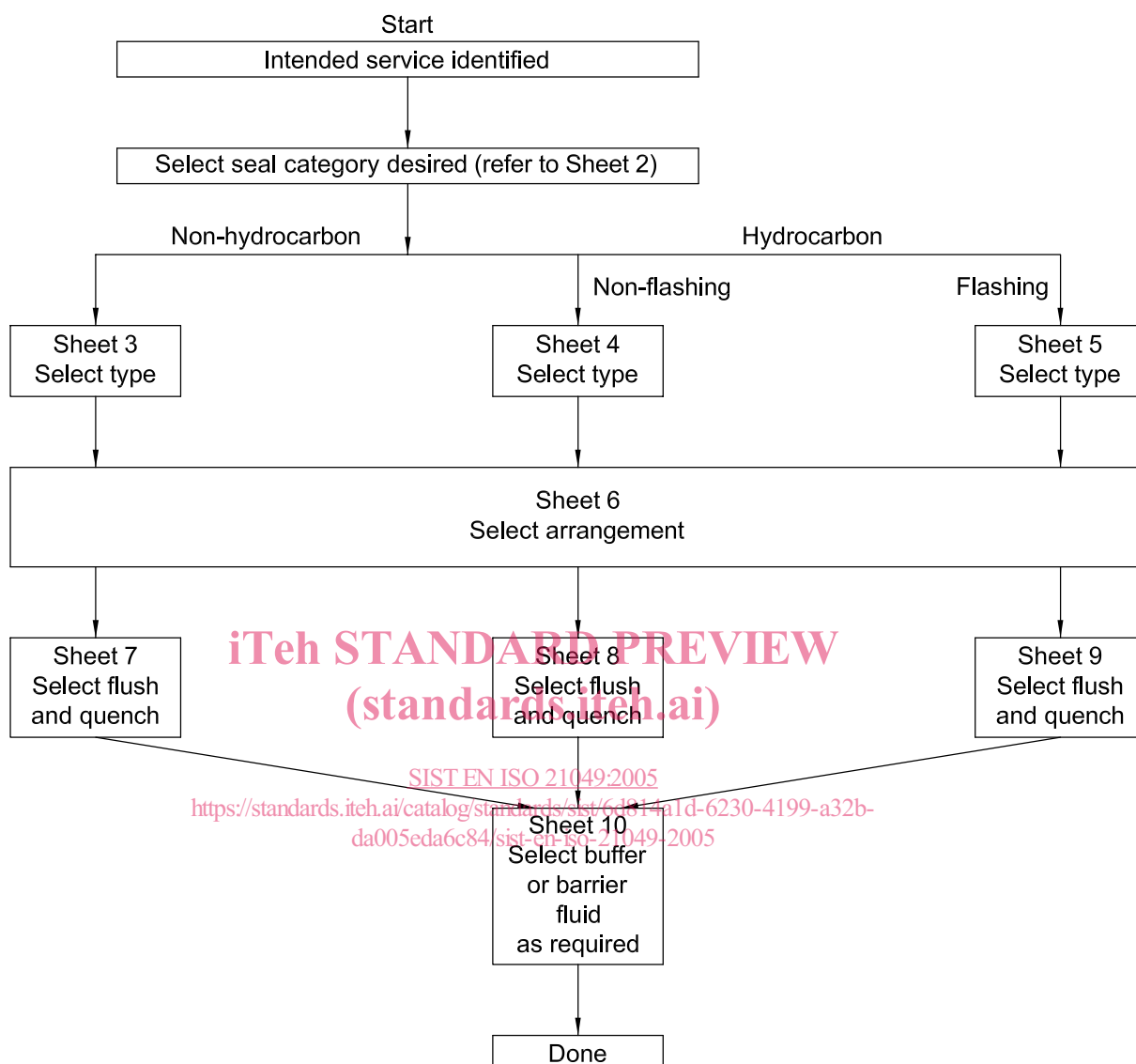
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The text of ISO 21049:2004 has been approved by CEN as EN ISO 21049:2004 without any modifications.

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**RECOMMENDED SEAL SELECTION PROCEDURE (US CUSTOMARY UNITS)**  
**SHEET 1 OF 10**



**RECOMMENDED SEAL SELECTION PROCEDURE (US CUSTOMARY UNITS)**  
**SEAL CATEGORY, TYPE, AND ARRANGEMENT SUMMARY**  
**SHEET 2 OF 10**

Seal category shall be Category 1, 2 or 3 as specified.

The major features of each category are summarized below. Options, where they exist for each feature, are listed in the text as “if specified”. Clause numbers in parentheses indicate where the requirements are specified.

FEATURE	CATEGORY 1	CATEGORY 2	CATEGORY 3
Seal chamber size. (4.1.2)	ISO 3069 Type C, ASME B73.1 and ASME B73.2.	ISO 13709.	ISO 13709.
Temperature range. (4.1.2)	– 40 °F to 500 °F	– 40 °F to 750 °F	– 40 °F to 750 °F
Pressure range, absolute. (4.1.2)	315 psi	615 psi	615 psi
Face materials. (6.1.6.2)	Premium blister-resistant carbon vs. self-sintered silicon carbide.	Premium blister-resistant carbon vs. reaction-bonded silicon carbide.	Premium blister-resistant carbon vs. reaction-bonded silicon carbide.
Distributed inlet flush requirements, Arrangements 1 and 2 with rotating flexible elements.	When required per 6.1.2.14 or if specified. (6.2.1.2.1)	When required per 6.1.2.14 or if specified. (6.2.2.2.1)	Required. (6.2.3.2)
Gland plate metal-to-metal contact requirement.	Required. (6.2.1.2.2) <a href="https://standards.iteh.ai/catalog/standards/sis/6d814a1d-6230-4198-a52b-da005eda6c84/sist-en-iso-21049-2005">https://standards.iteh.ai/catalog/standards/sis/6d814a1d-6230-4198-a52b-da005eda6c84/sist-en-iso-21049-2005</a>	Required inside and outside of the bolt circle diameter. (6.2.2.2.2)	Required inside and outside of the bolt circle diameter. (6.2.2.2.2)
Cartridge seal sleeve size increments required.	None	10 mm increments. (6.2.2.3.1)	10 mm increments. (6.2.2.3.1)
Throttle bushing design requirement for Arrangement 1 seals. (7.1.2.1)	Fixed carbon. Floating carbon option. (7.1.2.2)	Fixed, non-sparking metal. Floating carbon option. (7.1.2.2)	Floating carbon.
Dual-seal circulation device head flow curve provided.	If specified. (8.6.2.2)	If specified. (8.6.2.2)	Required. (8.6.2.2)
Scope of vendor qualification test.	Test as Category 1 unless faces interchangeable with Category 3. (10.3.1.2.3)	Test as Category 2 unless faces interchangeable with Category 3. (10.3.1.2.3)	Test as Category 3, entire seal assembly as a unit. (10.3.1.2.2)
Proposal data requirements.	Minimal. (11.2.1)	Minimal. (11.2.1)	Rigorous, including qualification test results. (11.2.1)
Contract data requirements.	Minimal. (11.3.1)	Minimal. (11.3.1)	Rigorous. (11.3.1)

## SHEET 2 OF 10 (continued)

Seal type shall be Type A, B, or C as specified.

The major features of each type are summarized below. Options, where they exist for each feature, are listed in the text as "if specified". Clause numbers in parentheses indicate where the requirements are specified.

FEATURE	TYPE A	TYPE B	TYPE C
Standard temperature application range. (4.1.3)	– 40 °F to 350 °F	– 40 °F to 350 °F	– 40 °F to 750 °F
Hydraulic balance requirement. (4.1.3 and 6.1.1.7)	Balanced (e.g. hydraulic balance less than 1).	Balanced (e.g. hydraulic balance less than 1).	Balanced (e.g. hydraulic balance less than 1).
Mounting requirement. (4.1.3)	Inside the seal chamber.	Inside the seal chamber.	Inside the seal chamber.
Cartridge requirement. (4.1.3 and 6.1.1.1)	Cartridge design.	Cartridge design.	Cartridge design.
Flexible element style. (4.1.3)	Pusher (e.g. sliding elastomer).	Non-pusher (e.g. bellows).	Non-pusher (e.g. bellows).
Flexible element orientation. (4.1.3)	Rotating. Stationary option. (6.1.1.2)	Rotating. Stationary option. (6.1.1.2)	Stationary. Rotating option. (6.1.1.3)
Bellows material. (6.1.6.6)	Not applicable.	Alloy C-276	Alloy 718
Spring type. (4.1.3)	Multiple-coil springs. Single spring option. (6.1.5.1)	Single bellows.	Single bellows.
Limit for stationary element application. (6.1.1.5)	4 500 ft/min	4 500 ft/min	4 500 ft/min
Secondary sealing element material. (4.1.3)	Elastomer.	Elastomer.	Flexible graphite.

## ISO 21049:2004(E)

## SHEET 2 OF 10 (continued)

Seal arrangement shall be Arrangement 1, 2, or 3 as specified.

The major features of each arrangement are summarized below. Options, where they exist for each feature, are listed in the text as "if specified". Clause numbers in parentheses indicate where the requirements are specified.

FEATURE	ARRANGEMENT 1	ARRANGEMENT 2	ARRANGEMENT 3
Number of "seals" per cartridge, see definition of "seal" in 3.61. (4.1.4)	One (3.2 and 4.1.4)	Two (3.3 and 4.1.4)	Two (3.4 and 4.1.4)
Uses a barrier or buffer fluid. (4.1.4)	No	Sometimes but not required. Liquid or gas buffer permitted.	Yes, barrier fluid required, liquid or gas permitted.
Allows non-contacting (wet or dry) seals. (4.1.4)	No	Yes, Figure 4.	Yes, Figure 6.
Arrangement 1 throttle bushing requirement. (7.1.2.1)	Category 1: Fixed carbon. Category 2: Fixed, non-sparking metallic. Category 3: Floating carbon.	Not applicable.	Not applicable.
Arrangements 2 & 3 throttle bushing requirement.	Not applicable.	Fixed carbon, if specified. (7.2.3)	Fixed carbon, if specified. (7.3.3.1)
Arrangement 2 containment seal chamber bushing requirement.	Not applicable.	Required with dry-running containment seal regardless of inner seal design. (7.2.5.1 and 7.2.6.1)	Not applicable.
Tangential buffer/barrier fluid outlet required ?	Not applicable.	If specified, for Categories 1 and 2. Required for Category 3. (7.2.4.2)	If specified, for Categories 1 and 2. Required for Category 3. (7.3.4.3)
Maximum buffer/barrier fluid temperature rise.	Not applicable.	15 °F aqueous or diesel, 30 °F mineral oils. (7.2.4.1)	15 °F aqueous or diesel, 30 °F mineral oils. (7.3.4.1)
Seal chamber pressure/flush design requirement. (6.1.2.14)	Minimum margin of 30 % of seal chamber pressure above fluid vapour pressure or 36 °F margin.	Minimum margin of 30 % of seal chamber pressure above fluid vapour pressure or 36 °F margin.	None
Minimum operating seal chamber pressure requirement. (6.1.2.14)	5 psi above atmospheric.	5 psi above atmospheric.	None
Minimum gland plate connection sizes and orientation.	See Table 1.	See Table 1.	See Table 1.
Minimum barrier/buffer fluid liquid reservoir.	Not applicable.	3 U.S. gal for shaft diameter 2,5 in and smaller; otherwise 5 U.S. gal [8.5.4.3 a)]	3 U.S. gal for shaft diameter 2,5 in and smaller; otherwise 5 U.S. gal [8.5.4.3 a)]
Test requirements.	(10.3.1.2.8)	(10.3.1.2.9) and (10.3.1.2.10)	(10.3.1.2.11) and (10.3.1.2.12)



## RECOMMENDED SEAL SELECTION PROCEDURE (US CUSTOMARY UNITS)

## SHEET 3 OF 10

## Non-hydrocarbon services

	Fluids	Operating conditions, recommended seal types and special features							
		1	2	3	4	5	6	7	8
		Water	Water	Water	Sour water	Sour water	Caustic, amines crystallize	Caustic, amines crystallize	Acids <sup>a</sup> H <sub>2</sub> SO <sub>4</sub> , H <sub>3</sub> PO <sub>4</sub>
	Pumping temp., °F	< 180	< 180	> 180	< 180	< 180	< 180	< 180	< 180
	Seal chamber gauge pressure, psig Category 1 seals	< 300		< 300	< 300		< 300		< 300
	Seal chamber gauge pressure, psig Category 2 and 3 seals	< 300	300 to 600	< 600	< 300	300 to 600	< 300	300 to 600	< 300
	Standard seal type	Type A	Type A	Type A	Type A	Type A	Type A	Type A	Type A
	Options when specified	Type B Type C	ES <sup>b</sup>	ES <sup>b</sup>	Type B Type C	ES <sup>b</sup>	Type B Type C	ES <sup>b</sup>	Type B Type C
	Required special features			Circulating device	Perfluoro-elastomer	Perfluoro-elastomer	Amine-resistant perfluoro-elastomer	Amine-resistant perfluoro-elastomer	Perfluoro-elastomer and single spring for Type A seals
<b>Special features for contaminants <sup>c</sup></b>	Abrasive particulates	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface
This selection procedure chooses seal designs consistent with the default positions throughout this International Standard. Listed options meeting this International Standard might perform equally well.									
<sup>a</sup> Up to 20 % H <sub>2</sub> SO <sub>4</sub> at 77 °F only. Up to 20 % H <sub>3</sub> PO <sub>4</sub> at 176 °F only. All other acids, including hydrofluoric acid, fuming nitric acid and hydrochloric acid require special engineering agreed between purchaser and vendor.									
<sup>b</sup> Totally engineered sealing system. Consult vendor to ensure special design considerations are accounted for.									
<sup>c</sup> Special features listed apply only in mixtures having pH between 4 and 11.									

## RECOMMENDED SEAL SELECTION PROCEDURE (US CUSTOMARY UNITS)

## SHEET 4 OF 10

## Non-flashing hydrocarbons

	Fluids	Operating conditions, recommended seal types and special features							
		1	2	3	4	5	6	7	8
	Pumping temp., °F	– 40 to 20	– 40 to 20	20 to 350	20 to 350	350 to 500	350 to 500	500 to 750	500 to 750
	Seal chamber gauge pressure, psig Category 1 seals	< 300		< 300		< 300		N/A	N/A
	Seal chamber gauge pressure, psig Category 2 and 3 seals	< 300	300 to 600	< 300	300 to 600	< 300	300 to 600	< 300	300 to 600
	Standard seal type	Type A	Type A	Type A	Type A	Type C	ES <sup>a</sup>	Type C	ES <sup>a</sup>
	Option when specified	Type B	ES <sup>a, b</sup>	Type B	ES <sup>a, b</sup>	ES <sup>a</sup>		ES <sup>a</sup>	
	Option when specified	Type C		Type C					
	Required special features	Nitrile O-rings	Nitrile O-rings						
Special features for contaminants <sup>c</sup>	Caustic			Perfluoro-elastomer	Perfluoro-elastomer				
	Abrasive particulates	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface
	Aromatics and/or H <sub>2</sub> S			Perfluoro-elastomer	Perfluoro-elastomer				
	Amines			Amine-resistant perfluoro-elastomer	Amine-resistant perfluoro-elastomer				
This selection procedure chooses seal designs consistent with the default positions throughout this International Standard. Listed options meeting this International Standard might perform equally well.									
<sup>a</sup> Totally engineered sealing system. Consult vendor to ensure special design considerations are accounted for. <sup>b</sup> Engineered (high pressure) bellows. <sup>c</sup> Special features listed apply only in mixtures having pH between 4 and 11.									

**RECOMMENDED SEAL TYPE SELECTION PROCEDURE (US CUSTOMARY UNITS)**  
**SHEET 5 OF 10**  
**Flashing hydrocarbons**

	Fluids	Operating conditions, recommended seal types and special features							
		1	2	3	4	5	6	7	8
	Pumping temp., °F	– 40 to 20	– 40 to 20	20 to 350	20 to 350	350 to 500	350 to 500	500 to 750	500 to 750
	Seal chamber gauge pressure, psig Category 1 seals	< 300		< 300		< 300		N/A	N/A
	Seal chamber gauge pressure, psig Category 2 and 3 seals	< 300	300 to 600	< 300	300 to 600	< 300	300 to 600	< 300	300 to 600
	Standard seal type	Type A	Type A	Type A <sup>d</sup>	Type A <sup>d</sup>	Type C	ES <sup>a, b</sup>	Type C	ES <sup>a, b</sup>
	Option when specified	ES <sup>a</sup>	ES <sup>a, b</sup>	ES <sup>a</sup>	ES <sup>a, b</sup>	ES <sup>a</sup>		ES <sup>a</sup>	
	Required special features	Nitrile O-rings	Nitrile O-rings						
<b>Special features for contaminants<sup>c</sup></b>	Caustic			Perfluoro-elastomer	Perfluoro-elastomer				
	Abrasive particulates	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface	Hardface vs hardface
	Aromatics and/or H <sub>2</sub> S			Perfluoro-elastomer	Perfluoro-elastomer				
	Amines			Amine-resistant perfluoro-elastomer	Amine-resistant perfluoro-elastomer				
	Ammonia	NH <sub>3</sub> -resistant carbon graphite	NH <sub>3</sub> -resistant carbon graphite	NH <sub>3</sub> -resistant carbon graphite	NH <sub>3</sub> -resistant carbon graphite	NH <sub>3</sub> -resistant carbon graphite	NH <sub>3</sub> -resistant carbon graphite	NH <sub>3</sub> -resistant carbon graphite	NH <sub>3</sub> -resistant carbon graphite

This selection procedure chooses seal designs consistent with the default positions throughout this International Standard. Listed options meeting this International Standard might perform equally well.

<sup>a</sup> Totally engineered sealing system. Consult vendor to ensure special design considerations are accounted for.

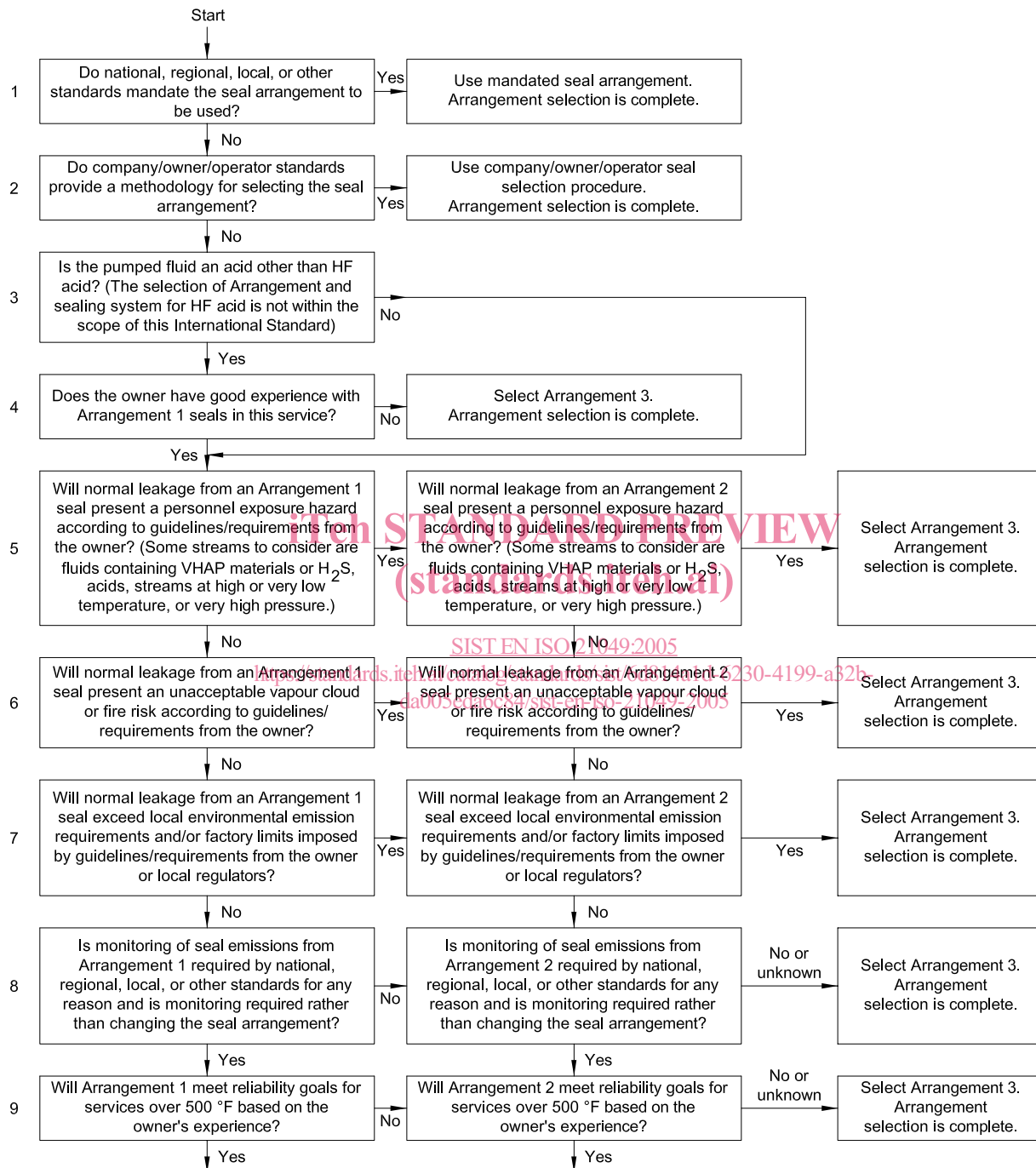
<sup>b</sup> Engineered bellows.

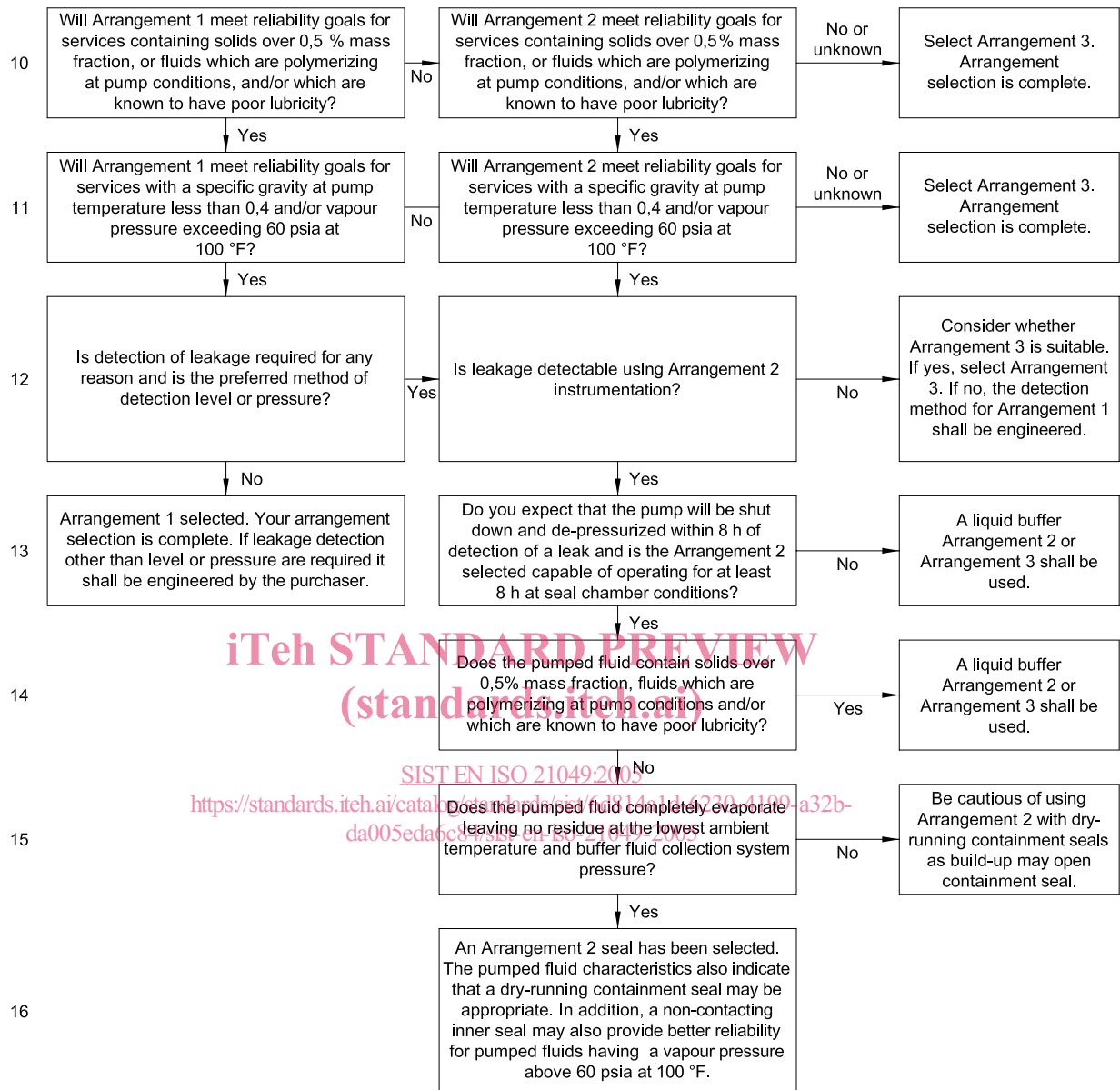
<sup>c</sup> Special features listed apply only in mixtures having pH between 4 and 11.

<sup>d</sup> Requires special feature (circulating device) above 140 °F, and special feature (perfluoroelastomer) if pumping temperature is above 350 °F.

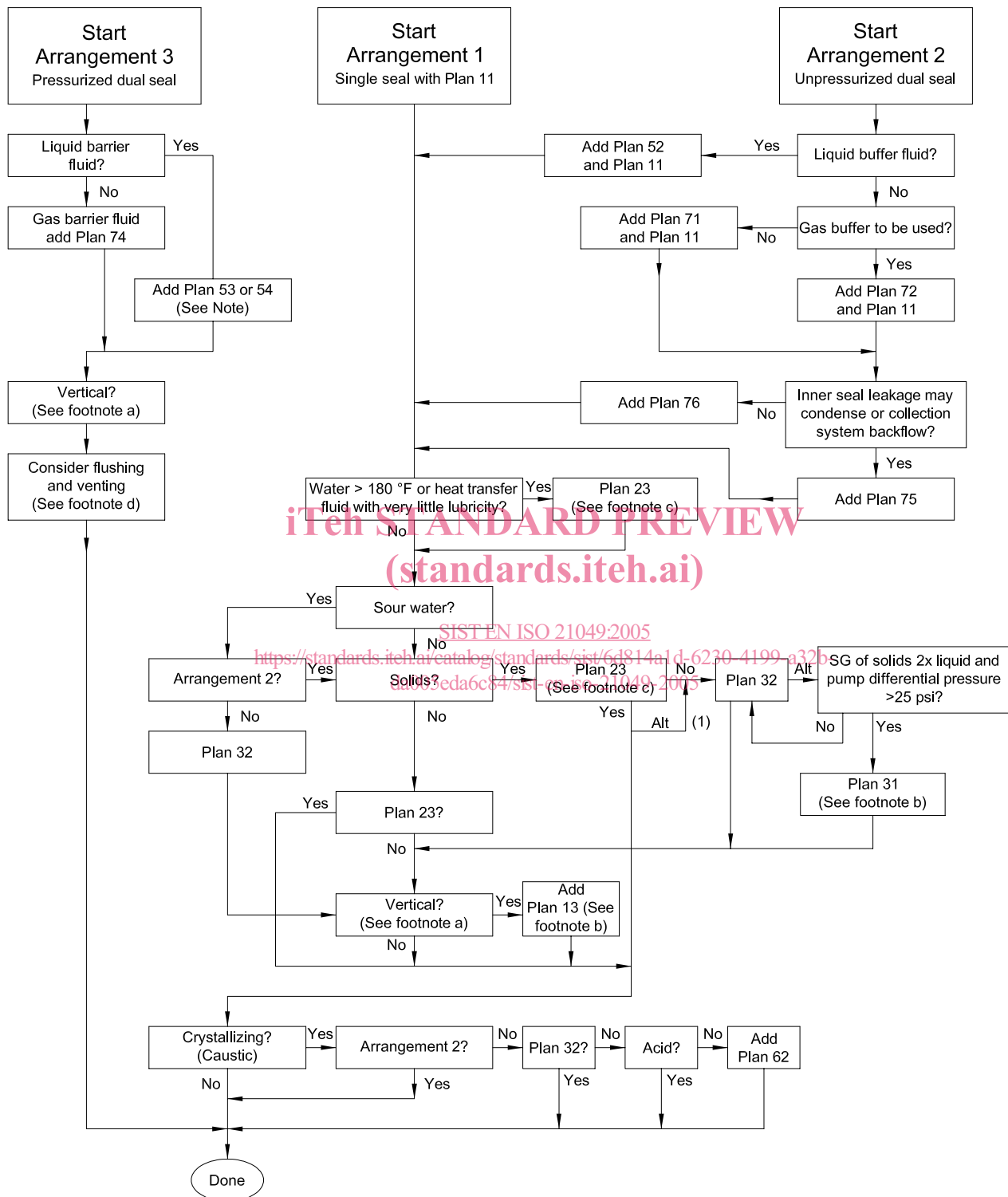
# RECOMMENDED SEAL ARRANGEMENT SELECTION PROCEDURE (US CUSTOMARY UNITS) SHEET 6 OF 10

Assume Arrangement 1 to begin



**SHEET 6 OF 10** *(continued)*

**RECOMMENDED SEAL TYPE SELECTION PROCEDURE (US CUSTOMARY UNITS)**  
**SHEET 7 of 10**  
**Non-hydrocarbon**



NOTE See A.4.13 for guidance on selecting Plan 53A, 53B or 53C.

<sup>a</sup> The user should evaluate whether to add Plan 13 or not, considering such factors as the inclusion of a bleed bushing, contamination of the seal chamber with pumped fluid, the need for venting of the seal chamber, and the need to reduce seal chamber pressure, due to static or dynamic pressure rating of the seal versus the expected static and dynamic seal chamber pressure.

<sup>b</sup> If Plan 31, 32 or 41 is selected and pump is vertical, Plan 13 is also recommended for venting. Users should consider installation of a “bleed bushing” design, in which an annulus and port cut into the throat bushing is connected to suction to keep solids out of the seal chamber. Ensure seal chamber is vented prior to start-up.

<sup>c</sup> Cooling is needed due to low lubricity at elevated temperature. The recommended flush plan is 23 because field experience has shown that this plan is much less prone to plugging than Plan 21 due to recirculation of cooler fluid from the seal chamber. However, the user may wish to reconsider using Plan 21 due to the added seal complexity imposed by Plan 23 (size and cost) and other factors such as the use of an air cooler for Plan 21 in areas where water cannot be used or is not available. (An air cooler works better on Plan 21 due to the higher temperature difference between the pumped fluid and the cooling medium.) The user may also wish to consider the use of Plan 32 if a suitable fluid is available, especially if the fluid is normally injected into the process anyway (such as make-up water). See the flush descriptions later in this annex for additional detail.

<sup>d</sup> Consider the need to add additional flushing to the process side of the inner seal. Flushing is sometimes needed for Arrangement 3 FB orientation to provide additional cooling and Plan 11 or 13 may be a suitable choice. Other services may require a Plan 32 flush if the pumped fluid is extremely corrosive, aggressive or solids-laden. Consider the need for venting on vertical pumps. Special attention may be needed on Arrangement 3 NC configurations to ensure effective pump operation. Consult the pump vendor if the pump is vented through the seal chamber, and consider the effects listed in footnote <sup>a</sup> above.

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