B. SELECTING NOK PACKINGS

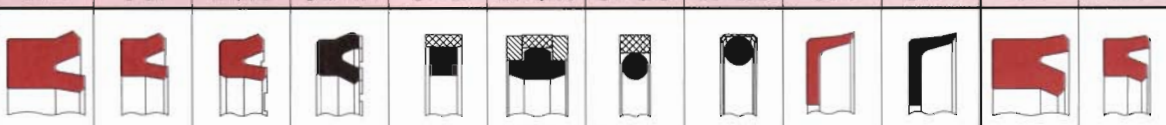
Application Range

Selecting material and the type most suitable for the operating condition is necessary to obtain optimal performance of the packing. In this chapter, we will describe the application range of seals and related products for hydraulic equipment, plus means of selection. Tables B-1, B-2, B-3, and B-4 show the application range of hydraulic seals for reciprocating motion, dust seals for reciprocating motion, dust seals for oscillating motion, and related products for hydraulic equipment. In the following case, the combined

1. Application Range of Hydraulic Seals for Reciprocating Application

Select NOK packing taking the following four conditions into consideration : 1. Pressure 2. Temperature 3. Speed 4. Stroke

<Table B-1> Application Range of Hydraulic Seals for Reciprocating Motion

Kind	Special packings for piston seals											
Classification	U Packing				Combination Seals				C Packing			
Item / Type	ODI	OSI	OUIS	OUHR	SPG	SPGW	SPGO	SPGC	CPI	CPH	IDI	ISI
Shape												
Pressure (MPa) Remark 1)	70 (*35)	42 (*30)	42 (*30)	21 (*14)	35	50	35	2	7	3.5	70 (*35)	42 (*30)
Temperature (℃) Remark 3)	100 / −35	100 / −30	110 / −10	100 / 80 / −25 / −55	160 / 100 / −20 / −40	120 / 100 / −20 / −40	160 / 100 / −20 / −30	160 / 100 / −20 / −30	100 / −35	100 / −25	100 / −35	110 / 100 / −10 / −30
Speed (m/s) Remark 4)	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	0.3	0.3	1.0	1.0
	0.03	0.03	0.03	0.008	0.005	0.005	0.005	0.005	0.01	0.01	0.03	0.03
Stroke (mm)	2,000 or less											
Fitting space	Medium	Small	Small	Small	Small	Small	Small	Very small	Medium	Medium	Medium	Small
Sliding resistance	Medium	Medium	Small	Small	Very small	Very small	Very small	Very small	Small	Small	Medium	Medium
Installation with integrated groove Remark 5)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes Remark 5)	No	No	No	Yes
Dimension table (page)	61	69	72	74	77	81	85	89	93	95	97	105

2. Application Range of Dust Seals

(1) Dust seals for reciprocating application

The main feature of a dust seal is to seal outside dust. In addition, a sealing system using a dust seal, combined with rod packings and a buffer ring, can prevent oil film being scraped out. Since these two features (dust elimination and oil scraping) conflict with each other, it is important to clarify the priority required for each application before selecting the dust seals. Specific performance will vary depending upon the type of dust seal. Therefore, if maintaining oil film on a cylinder is more important, please consult NOK.

<Table B-2> Application range of dust seals for reciprocating motion

Kind	Dust seals						
Item / Type	DKI	DWI	DWIR	DKBI	DKB	DKH	DSI
Shape							
Temperature (℃) Remark 3)	100 / −35	100 / −55	100 / −55	100 / −55	150 / 100 / 80 / −20 −20 / −55	150 / 100 / 80 / −20 −20 / −55	100 / −35
Dust proof performance	◎	◎	○	◎	○	○	○
Oil scraping proof performance	Medium	Small	Very small	Very small	Very small	Medium	Medium
Requirement of stopper	No	No	No	Yes	Yes	No	—
Installation with integrated groove Remark 5)	No	No	No	No	No	No	Yes
Dimension table (page)	163	166	168	170	172	174	176

effect of operating conditions must be carefully considered, therefore, please consult NOK.

(1) In case of minimum pressure exceeding 3MPa at all times

(2) In case of using packing at the border range of applicable temperature and pressure

(3) In case of using packing with extremely short strokes (See examples of using with extremely short strokes on page 244 and 255.)

(4) In case of using packing when speed of extending stroke of rod is greater than that of contracting stroke

Remark 1) Depending on the size of extrusion gap, backup ring might be necessary. Refer to Fig.B-7 on page 18 and dimension table.

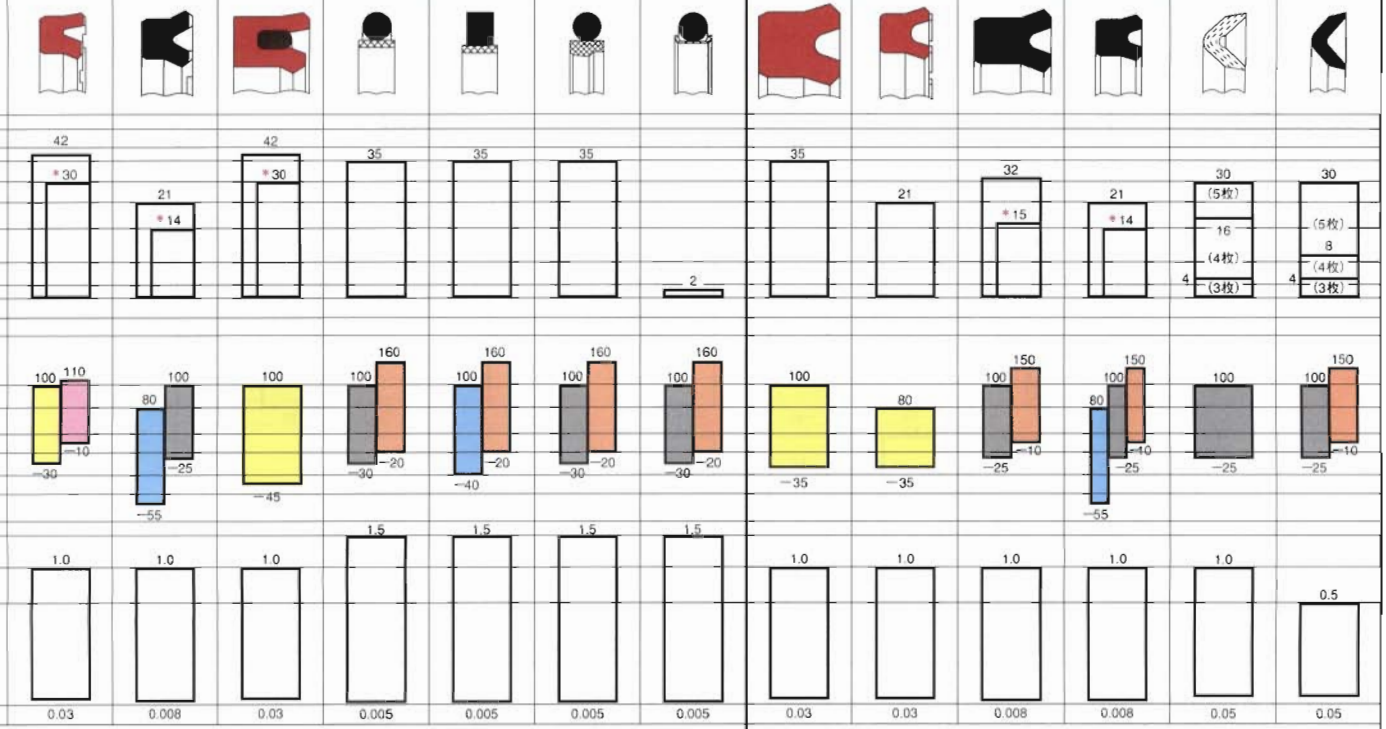
Remark 2) * mark shows the permissible maximum pressure of packing as a single piece. (→See the figure to the right.)

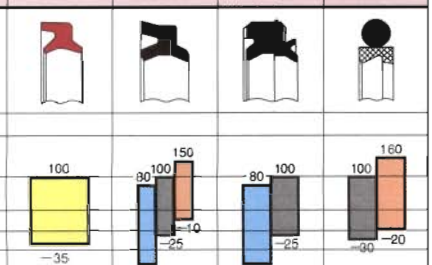
Remark 3) Applicable temperature ranges for packings and dust seals are indicated by colors for each rubber material.

Remark 4) When using the packing at a low speed, stick slip may occur depending on the cylinder structure or the using condition. In this case, consult NOK separately.

Remark 5) Some small diameter type cannot be installed with internal groove.

Nitrile rubber
Nitrile rubber for low temperature
Fluoro rubber
Iron rubber (Polyurethane elastomer)
Heat resistant Iron rubber (Polyurethane elastomer)

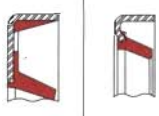
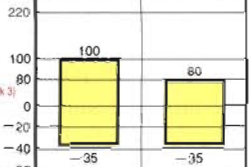
Special packings for rod seals							Packings for both piston and rod seals					
U Packing			Combination Seals				U Packing				V Packing	
IUIS	IUH	UNI	SPNO	SPN	SPNS	SPNC	UPI	USI	UPH	USH	V99F	V96H
												
0.03	0.008	0.03	0.005	0.005	0.005	0.005	0.03	0.03	0.008	0.008	0.05	0.05
2,000 or less							2,000 or less					
Small	Small	Medium	Small	Medium	Medium	Very small	Medium	Small	Medium	Small	Large	Large
Medium	Small	Medium	Very small	Very small	Very small	Very small	Medium	Small	Medium	Small	Large	Large
Yes	Yes Remark 5)	No	Yes Remark 5)	Yes Remark 5)	Yes Remark 5)	No	No	Yes Remark 5)	No	Yes Remark 5)	No	No
108	110	112	115	118	121	125	129	135	139	147	151	157

LBI	LBH	LBHK	DSPB
			
○	○	○	○
Small	Small	Small	Small
—	—	—	—
Yes	Yes	Yes	Yes Remark 5)
179	181	184	186

(2) Dust seals for oscillating application

Dust seals for oscillating motion are mainly used for hinge pin and bush parts. In contrast to dust seals for reciprocating motion, the shape of lip is specially designed to reduce torque and have a relief effect by rear-side greasing, this assures good performance in severe dust conditions.

<Table> B-3 Application range of dust seals for oscillating motion

Item \ Kind / Type	Dust seals for sliding movement	
	DLI	DLI2
Shape		
Temperature (℃) Remark 3)		
Dimension table (page)	206	208

3. Application Range of Related Products for Hydraulic Equipment

Selecting the right combination of packings and related products for the specific operating conditions will insure proper sealing effectiveness.

<Table B-4> Application range of relating product for hydraulic equipment

Kind	Special packings for rod seals		Related products for reciprocating motion						
Classification	Buffer ring		Wear ring		Contami seals	Backup ring			
Item / Type	HBY	HBTS	RYT	WR	KZT	BRT2	BRT3	BRN2	BRN3
Shape						Biascut	Endless	Biascut	Endless
Pressure (MPa)	70, 50, 35, 30, 21, 14, 7, 3, 0 — 50	35	—	—	—	—		—	
Temperature (℃) Remark 1)	220, 100, 80, 0, −20, −40, −50 — 100, 110, 120, −55, −55	100, 160, −20, −55	220, −55	120, −55	220, −55	220, −55		120, −55	
Speed (m/s) Remark 2)	1.5, 1.0, 0.5, 0 — 1.0	1.5	1.5, Remark 3)	1.0, Remark 3)	1.5	—		—	
	0.03	0.005	0.005	0.005	0.005				
Dimension table (page)	189	191	193	195	199	Described on the page of the applicable packing; and 202.			

Remark 1) Permissible temperature ranges for packings and dust seals are indicated by colors for each rubber material. (→See the figure to the right.)

Remark 2) When using the packing at a low speed, stick slip may occur depending on the cylinder structure or the using condition. In this case, consult NOK separately.

Remark 3) The permissible speed is determined by the relationship wit the load. Refer to Fig.B-8 on page 20.

- Nitrile rubber for low temperature
- Fluoro rubber
- Iron rubber (Polyurethane elastomer)
- Heat resistant Iron rubber (Polyurethane elastomer)
- Heat & cold resistant wide-range iron rubber (Polyurethane elastomer)

4. Application Range of Backup Ring

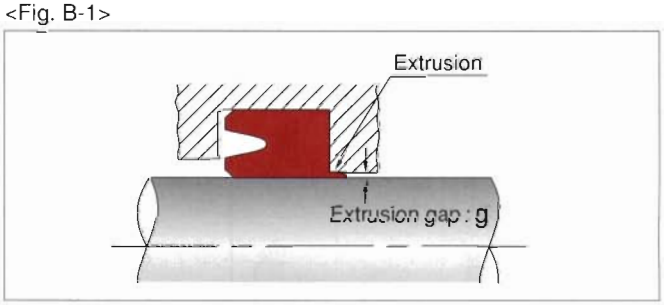
(1) The role of backup ring

If the extrusion gap is too large for the operating pressure of the packing, a heel of the packing may be damaged by extruding itself (Fig. B-1).

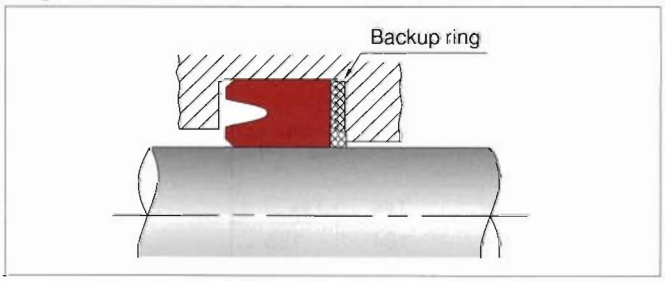
In such case, a backup ring is necessary to prevent extrusion of the packing and to improve the durability (Fig. B-2).

Fig. B-7 on page 18 shows the relationship between operating pressure and extrusion gap.

<Fig. B-1>



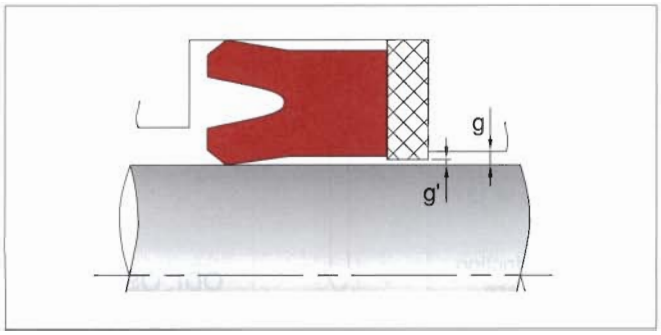
<Fig. B-2>



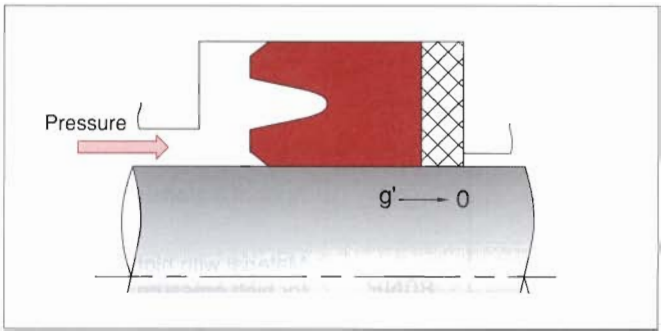
(2) Mechanism preventing extrusion

When the pressure is loaded, the backup ring is compressed and deformed to reduce the gap (g' → 0), which prevents the extrusion of the packing heel (Fig. B-3 and 4).

<Fig. B-3>



<Fig. B-4>



(3) Application Range of Backup Ring

Material characteristics required for a backup ring are easy compression deformation and extrusion resistance under working pressure. Friction resistance and low-friction characteristics are also important because a compressed and deformed backup ring moves in contact with the sliding surface. Considering these requirements, NOK made available two engineered plastic materials; polytetra-fluoro-ethylene (PTFE) resin (NOK rareflon) and polyamide resin. Rareflon is mainly used, while polyamide resin with high rigidity against deformation is used in high pressure conditions. Table B-5 shows guidelines for material selection and Table B-6 on page 18 shows the sign and characteristics of these materials and applicable packing type signs.

<Table B-5> Guideline for backup ring material selection

Pressure (MPa) / Packing material	0 – 14	14 – 32	32 – 35	35 – 70
Iron rubber (polyurethane elastomer)	Rareflon (polytetrafluoroethylene, PTFE, resin)		Polyamide resin	
Nitrile, fluororubber, etc.			※ Combination of NOK rareflon and polyamide resin (Fig. B-5) ※ Pair sheet (see Fig. B-6): Effective in adapting to the current groove or as a measure against abrasion (wear) in the heel section.	

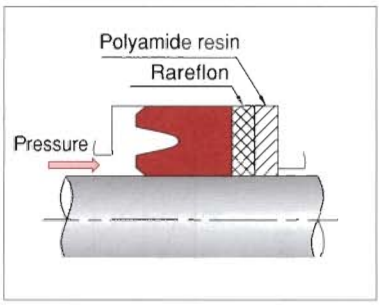
Remark 1) This table is a guideline for backup ring material selection. In selecting a packing, conditions other than pressure, such as extrusion gap, temperature, and packing shape, should also be considered.

Remark 2) Some of the packing profiles, especially small sizes, may not fit in the appropriate groove.

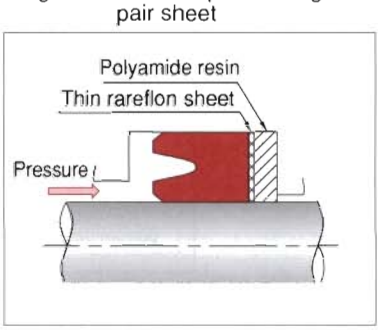
Remark 3) The dimensions of the polyamide resin may change due to moisture adsorption. If moisture-proof packaging is necessary, consult NOK.

Remark 4) When using the large diameter size (inner diameter (d) exceeding the classification 300mm), consult NOK.

<Fig. B-5>



<Fig. B-6> An example of using the pair sheet



<Table B-6> Material code and characteristics of backup ring

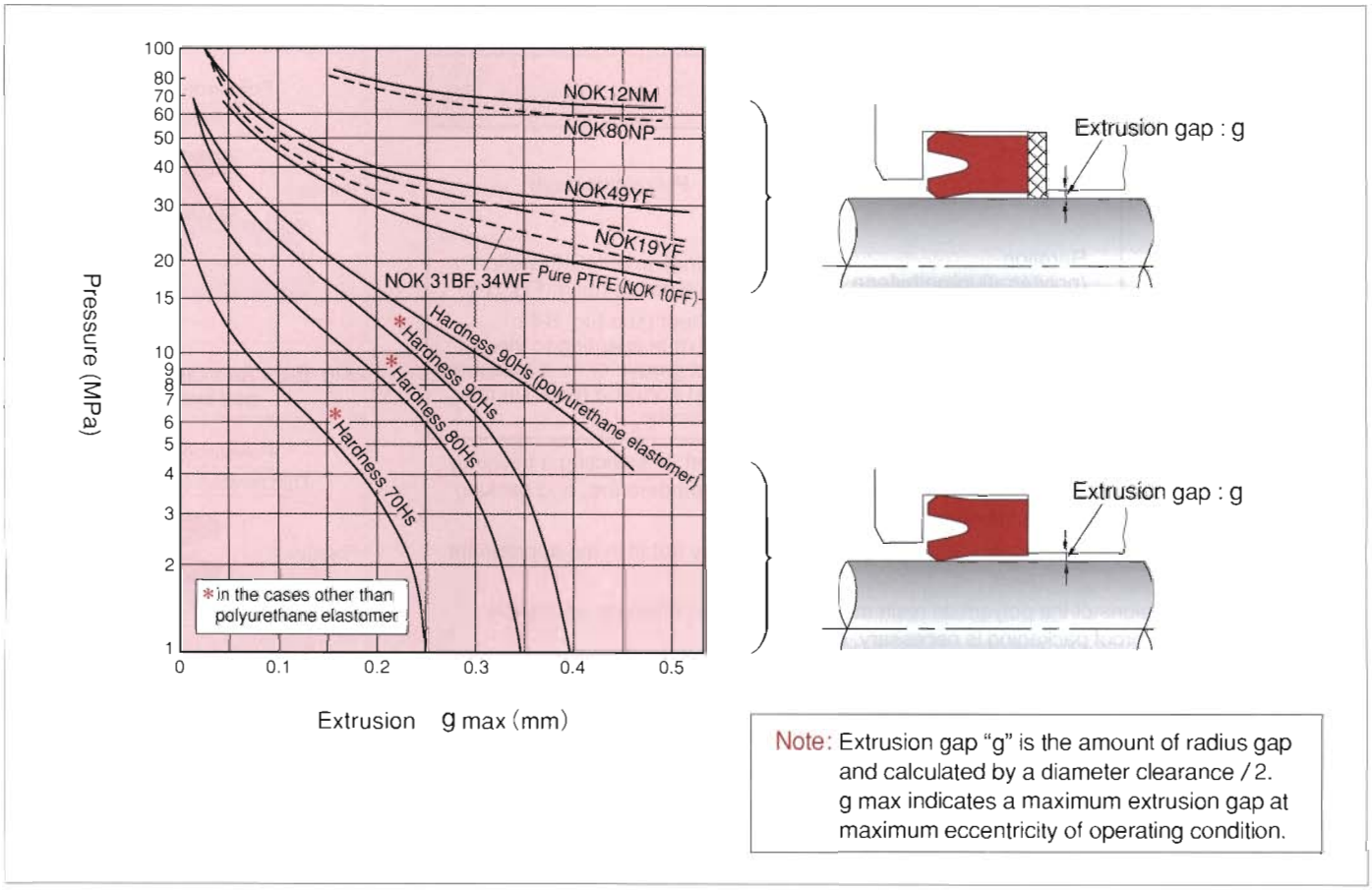
Material	NOK material code	Features	Durability	Applicable packing type sign
Rareflon (polytetrafluoro ethylene,PTFE, resin)	10FF	Pure PTFE. This material is excellent in heat resistance, cold resistance, and chemical resistance	Low ⇕ High	OUHR UPH、USH IUH
	31BF	Low frictional resistance material with improved frictional and creep resistance against pure PTFE		
	34WF	This material is a white material for backup rings that has the pure PTFE's characteristics plus enhanced abrasion resistance and creep resistance.		
	19YF	Standard material with high resistance against extrusion and friction under high pressure operation		
	49YF	Special material with improved extrusion resistance of 19YF		
Polyamide resin	80NP	Material with high resistance against extrusion and friction for high pressure. Its machining manufacturing process makes large diameter seals available		ODI、OSI、OUIS UPI、USI IDI、ISI、IUIS、 UNI
	12NM	Material for injection molding having the same performance as 80NP with smaller dimension changes by water absorption		

※The dimensions of the polyamide resin may change due to moisture adsorption. If the moisture-proof packaging is necessary, consult NOK separately.

4) Extrusion limit

Fig. B-7 is extrusion limit curves prescribed by JOHS showing extrusions of rubber material for packings. This figure also shows the extrusion limit curves of NOK backup ring materials. The extrusion value of packings and backup rings varies depending on the temperature, pressure, and operating time. Therefore, please refer to the extrusion limit curves on dimension tables of each type for proper application.

<Fig. B-7> Extrusion limit curves



Note: Extrusion gap "g" is the amount of radius gap and calculated by a diameter clearance / 2. g max indicates a maximum extrusion gap at maximum eccentricity of operating condition.

※ Extrusion limit may vary depending on the temperature, pressure, and operating time. Therefore, please consult NOK when using under excessive high temperature and high pressure condition for long term use.

5. Application Range of Wear Ring

(1) The role of wear rings

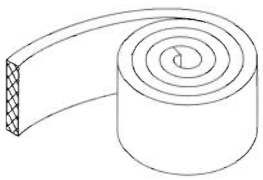
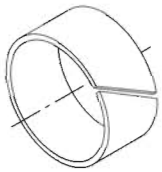
Wear rings are used as bearings on a piston to prevent scuffing the piston and cylinder, minimize the eccentricity, and improve the durability of packings.

(2) Selecting the wear rings

Select the shape and material of a wear ring according to the operating condition. For low speed and heavy load operations such as construction equipment, type WR with fabric reinforced phenolic resin (NOK 12RS·15RS) is recommended.

This material has excellent characteristics against compression load. For high speed and light load operations or operations where stick slip may be possible, type RYT of polytetrafluoroethylene resin (NOK Rareflon, 05ZF) is recommended. This material has excellent characteristics against friction and wear. Table B-7 shows the characteristics and application range of each wear ring type.

<Table B-7> Characteristics and application range of wear ring

Type	RYT	WRT2	WR
Shape			
Material (NOK sign)	Polytetrafluoroethylene(PTFE) resin (rareflon 05ZF)	Polytetrafluoroethylene(PTFE) resin (rareflon 08GF)	Fabric reinforced phenolic resin (12RS, 15RS)
Characteristics	●Low friction and stick slip free wear ring ●Excellent wear resistance under high speed and light load operation ● Supplied in hoop (10m/roll) enabling to be cut according to the cylinder diameter	●Low friction and stick slip free wear ring ●Excellent wear resistance under high speed and light load operation ●Thin rareflon sheet has a bias cut at one location and any required size for diameter and width is available	●NOK standard wear ring having excellent compression resistance characteristics ●Excellent wear resistance under low speed and heavy load operation ●Wide range of diameter and width size are available. Each piece has one point biascut. (Sizes other than those on the dimension table are available.) ●Wear rings of rareflon (WRT) are also available.
Allowable temperature range	−55～220℃		−55～120℃

(3) Dimension Set up of Wear Rings

RYT (NOK 05ZF) and WR (NOK 12RS) of various diameter sizes and width sizes are prepared so that the customer can select them according to cylinder diameter and groove size. For details, see the dimension table on pages 193 to 198. Consult NOK for WRT2 (NOK 08GF) and WR (NOK 15RS) manufacturing. Set width size "h", using the following calculation expression.

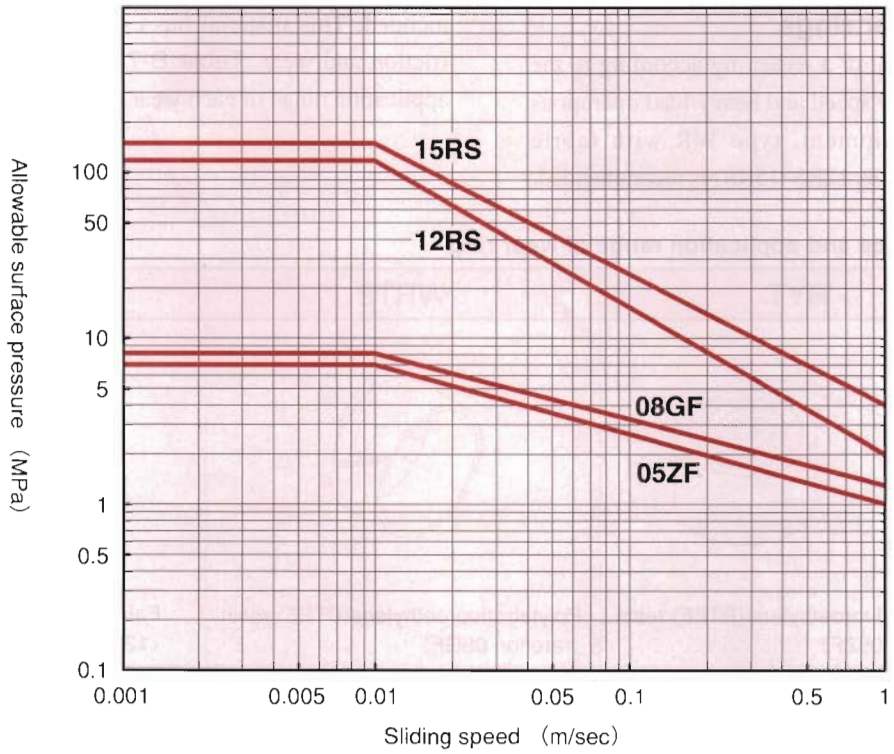
$$h_{min} \geqq \frac{F \cdot S_0}{\sigma \cdot D \cdot \pi \cdot (1/3)} + 2C \quad \cdots\cdots (a)$$

h_{min} : Minimum width size of wear ring (mm)
F : Load charged on wear ring (N)
S_0 : Safety coefficient
σ : Allowable surface pressure of wear ring material (MPa)
D : Inner diameter of cylinder tube (mm)
C : Chamfer width of wear ring (mm)
(12RS·15RS は C＝0.8、05ZF·08GF は C＝0)

Allowable Surface Pressure of Wear Ring Material : σ

Fig. B-8 shows the allowable surface pressure of wear ring material under the oil lubrication condition.
The allowable surface pressure varies with sliding speed.

<Fig. B-8> Sliding speed and wear ring material's allowable surface pressure



Load that is Applied to Wear Ring : F

The load that is applied to wear rings is based on the principle of leverage and is calculated using the following calculation expression.

①When lateral load exists

<Piston>

$$W \times L_2 = F_1 \times L_1$$

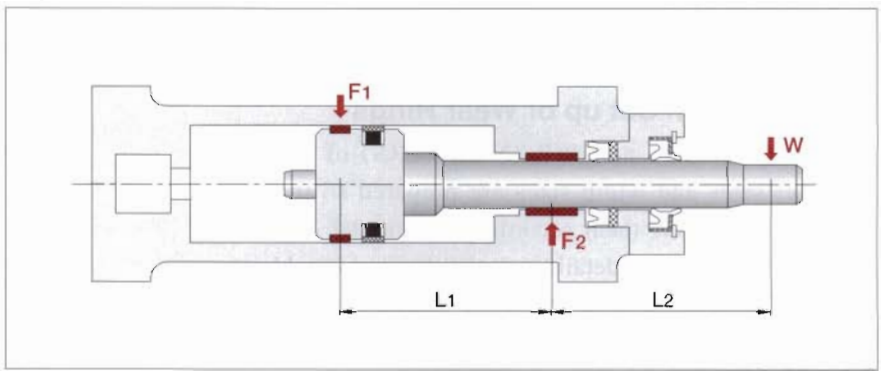
$$F_1 = W \times \frac{L_2}{L_1} \quad \cdots\cdots (b)$$

<Rod>

$$F_2 = F_1 + W$$

$$F_2 = W \times \frac{L_1 + L_2}{L_1} \quad \cdots\cdots (c)$$

<Fig. B-9>



②When lateral load does not exist

<For both piston and rod>

$$F^{※} = (\text{Piston's weight} + \text{rod's weight}) + \frac{1}{200} \times \frac{\pi \cdot D^2}{4} \times P_{max} \quad \cdots\cdots (d)$$

※F = F1 = F2

Safety Rate : S_0

①When lateral load exists

S_0 { When impact lateral load does not exist : 1.5
When impact lateral load exists : 4

②When lateral load does not exist

$S_0 = 1$

W : Lateral load (N)
L1, L2 : Distance (mm)
D : Inner diameter of cylinder tube (mm)
P max : Maximum pressure (MPa)
F1 : Load that is applied to wear ring for piston (N)
F2 : Load that is applied to wear ring for rod (N)

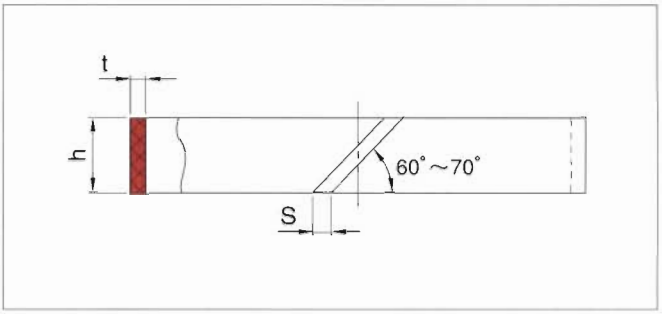
Set width size "h", using the calculation expression described in (3).
Calculate length "L" which is cut according to the inner diameter of the cylinder, using the following calculation expression:

$$L = \pi \cdot (D - t) - S$$

D : Inner diameter of cylinder tube (mm)
t : Thickness of wear ring (mm)
S : Clearance of wear ring (mm)

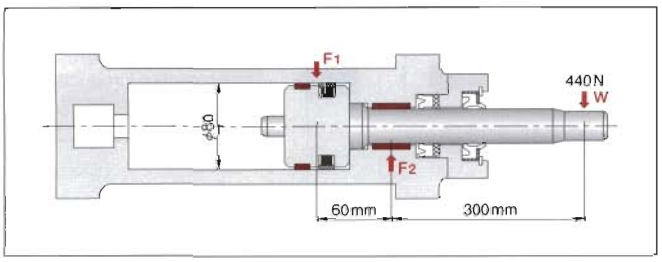
Note: For t and S, see the dimension table on page 194.

<Fig. B-10>



Example Calculation Example of Width Size of Wear Ring

Calculate the width size of wear ring (type: WR, material: 12RS) for the piston, based on the following using condition.



<Conditions>

Item	Description
Maximum lateral load (W)	440 N
Maximum rod length (L2)	300 mm
Minimum bearing clearance (L1)	60 mm
Speed (V)	0.3 m/s
Cylinder tube inner diameter (D)	φ80
Impact lateral load	あり

Step 1 What is the load applied to the wear ring?

First, calculate load F1 for the wear ring.
Since the above condition includes lateral load, calculate the load that is applied to the wear ring, using expression (b).

$$F_1 = W \times \frac{L_2}{L_1} = 440 \times \frac{300}{60} = 2200 \text{ (N)}$$

Step 2 What is the allowable surface pressure of wear ring material?

The line drawing in Fig. B-8 shows that the allowable surface pressure of 12RS material at V = 0.3 m/s is 6 MPa.

Step 3 What is the dimension of wear ring width?

Assign the values obtained in the above steps (1) and (2) to the expression (a) that calculates width size "h" (minimum).
Also, when impact lateral load exists, set the safety rate S_0 to 4.

$$h_{min} \geqq \frac{2200 \times 4}{6 \times 80 \times \pi \times (1/3)} + 1.6$$

$$= 19.1 \text{ mm}$$

From the above, 20 mm is obtained for the width size of wear ring for the piston under the above conditions.

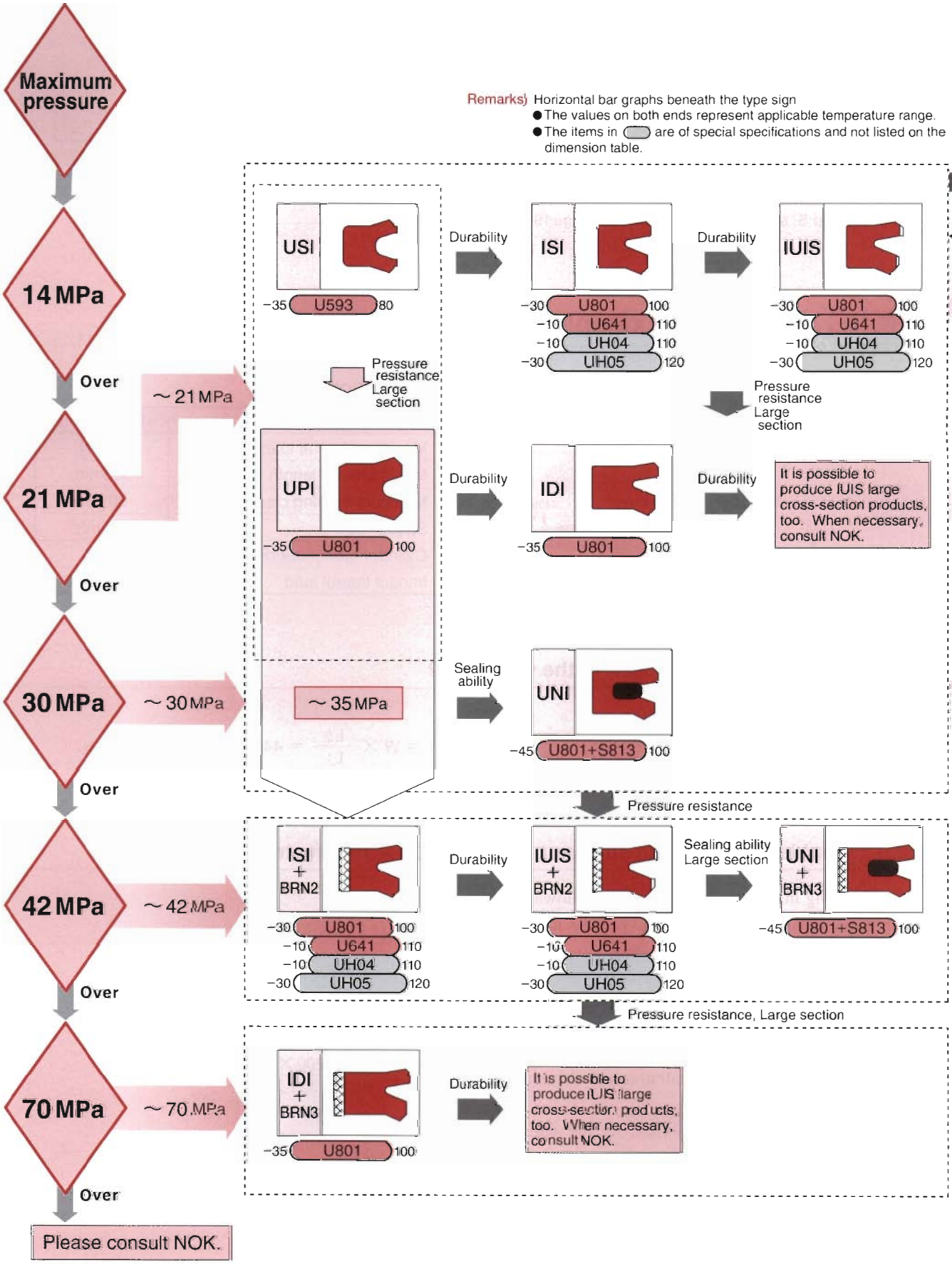
Note: When setting width size, round up the value after the decimal point.

6. Flow Chart for Selecting the Packing Type

NOK has been providing various seals, considering various conditions. A selection flow chart is shown to set the optimum seal.

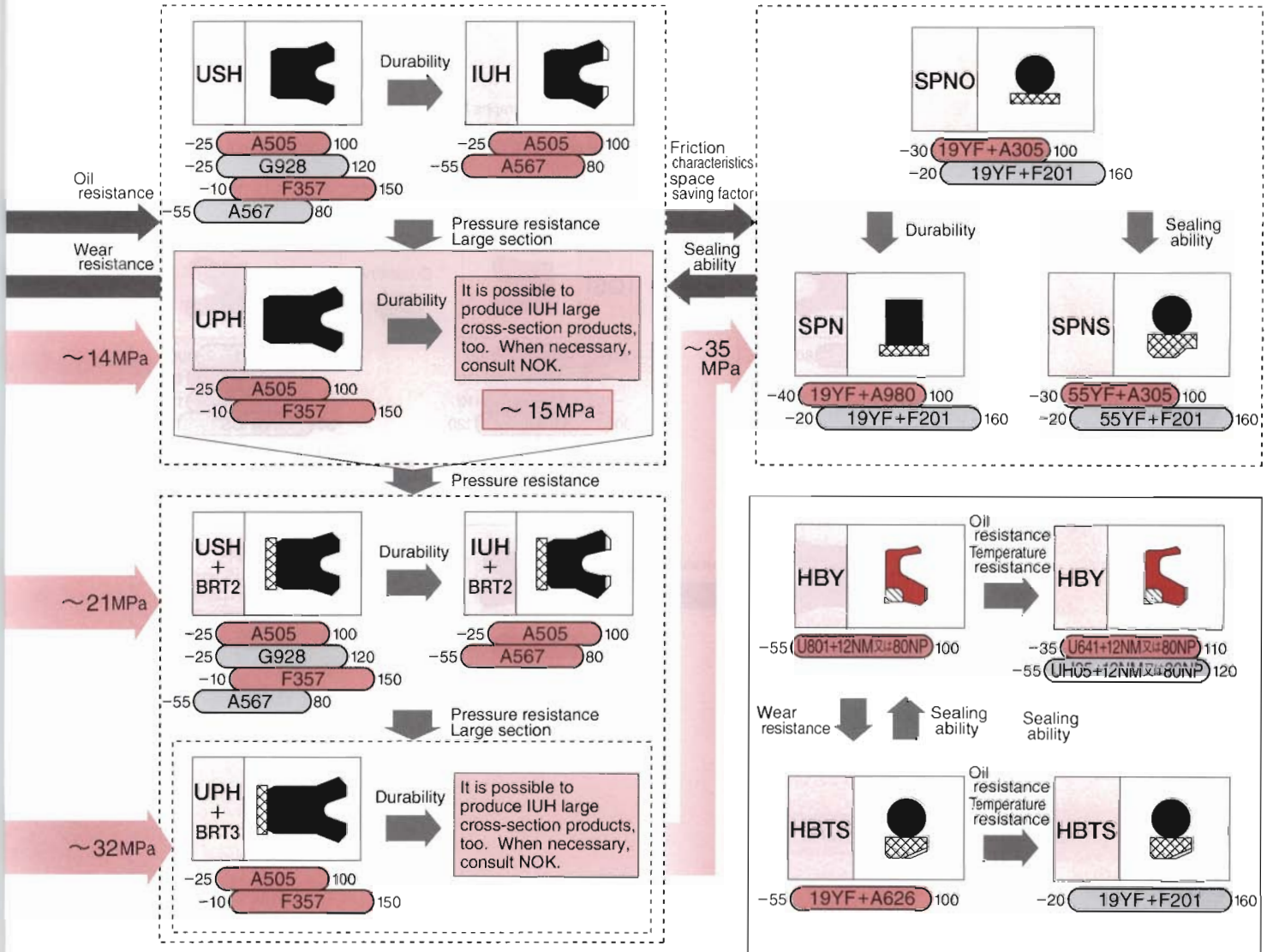
1. After selecting the packing type, check if the working temperature, the speed, and the stroke are in the applicable range for each seal, by referring to pages 14 and 15.

(1) Rod seals <Fig. B-11>



2. Check the affinity between the oil that is used and the seal material, by referring to pages 256 to 276 and to the oil resistance data in Chapter J.
3. Check the sealing system of the equipment and model that are used, by referring to page 41 and to the use example in Chapter E.

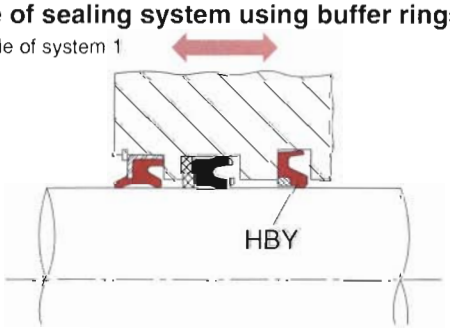
When using a special oil or using the under the condition outside the applicable range, consult NOK separately.



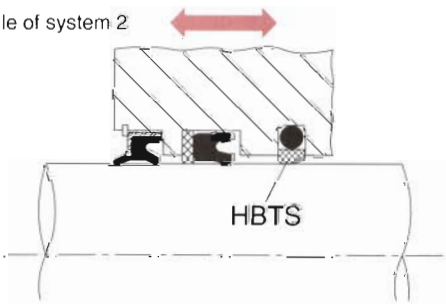
In combination with the buffer ring, the rod seal is effective in buffering the impact pressure, in inhibiting the oil temperature transfer, and in reducing the sliding heat generation, thus being able to improve the durability of the rod seal. (See "Buffer ring" on page 243.)

Example of sealing system using buffer rings

Example of system 1

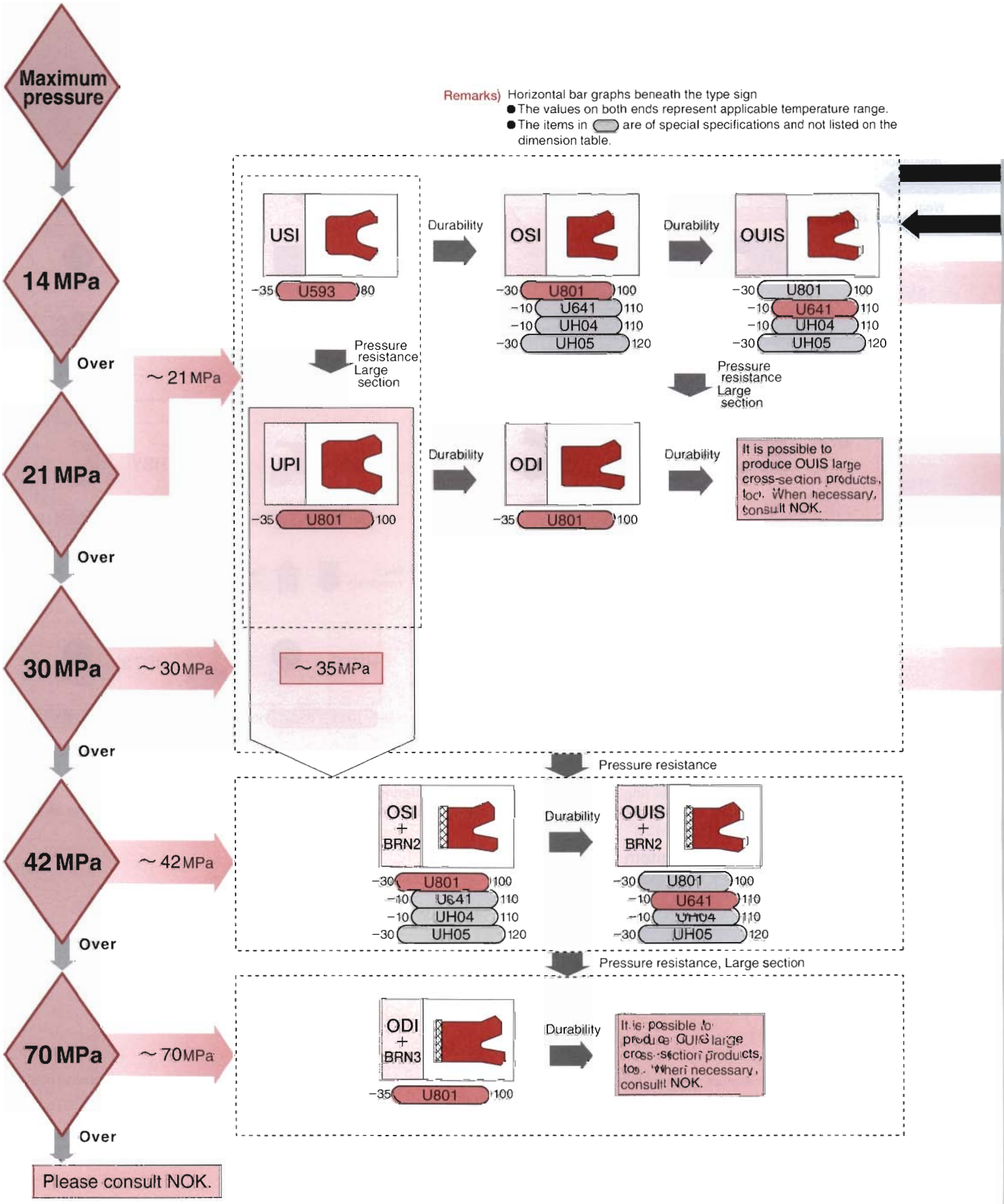


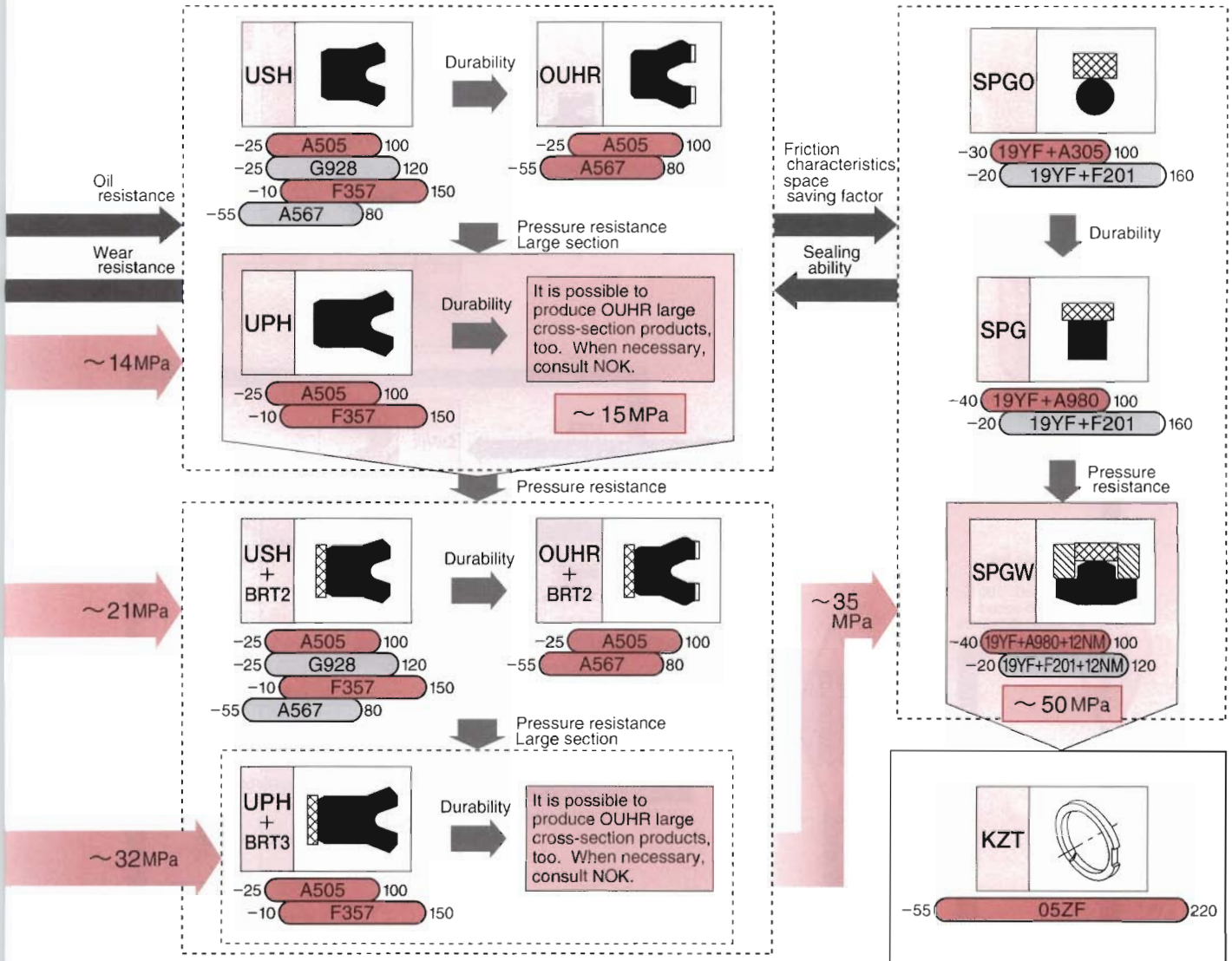
Example of system 2



※1. When the minimum pressure that is applied is usually 3 MPa or larger, the life of the seal is decreased, so we recommend that the customer use the seal in combination with the buffer ring.
※2. In combination with the buffer ring, the customer can use the seal under high pressure.
For example, in the case of IUH type packing, up to 34.3 MPa can be applied (see power shovel, rod sealing system on page 47).

(2) Piston seals <Fig. B-12>

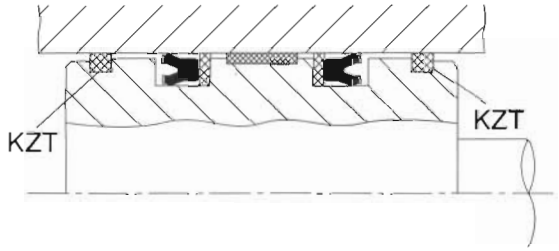




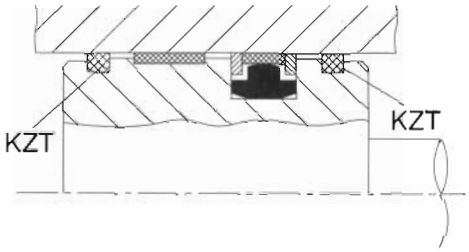
In combination with the contamination seal, the piston seal prevents damage due to foreign objects or adiabatic compression, thus being able to improve the durability of the piston seal.
(See "Burnout phenomenon" on page 246.)

Example of sealing system using contami seals

Example of system 1

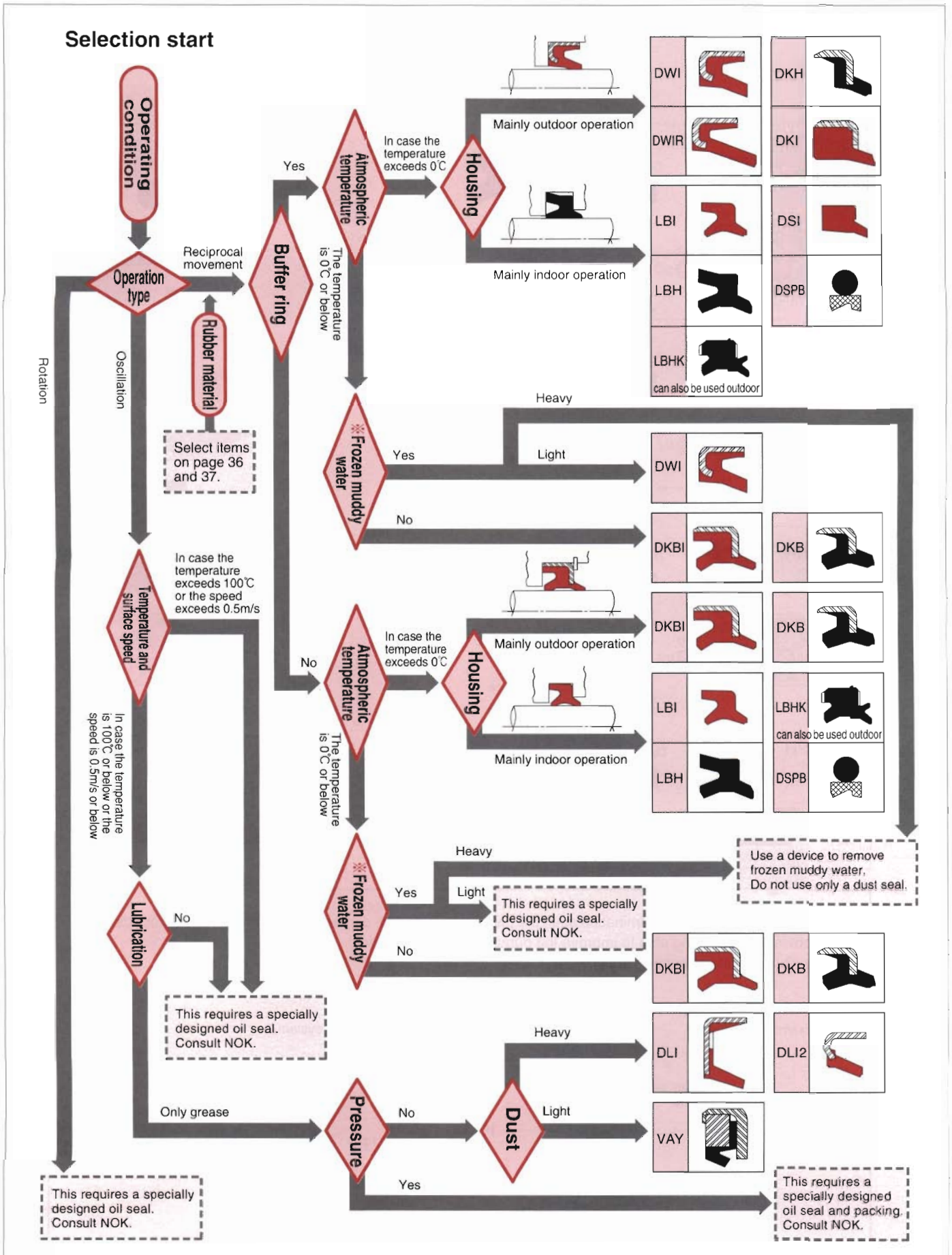


Example of system 2



(3) Dust Seal

<Fig. B-13> Flow chart for selecting dust seal types



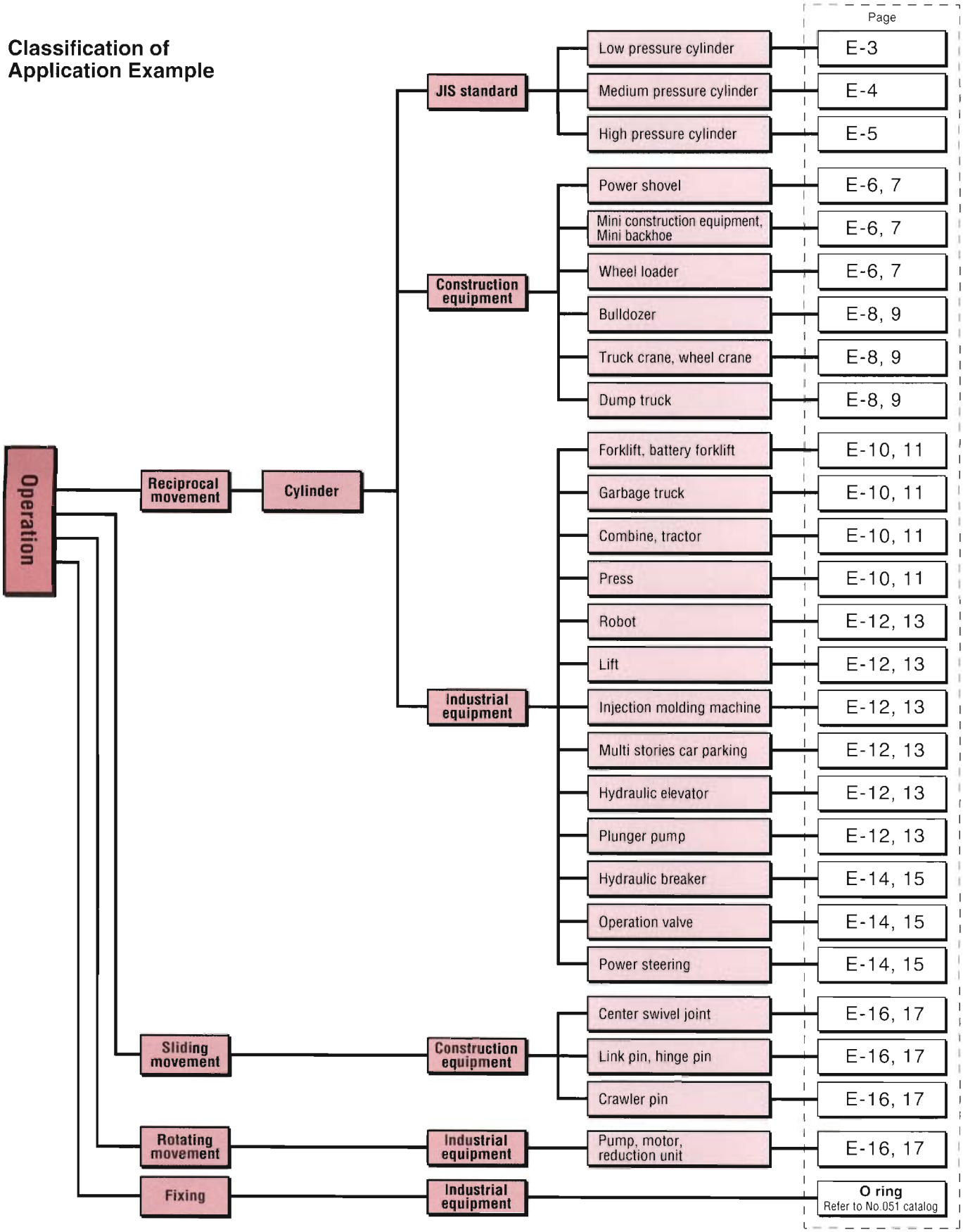
※ frozen muddy water : This is a condition where water on the rod surface has frozen.
(It is the case that water is put on the rod during daytime operation and it has frozen in night time low temperature.)

If the selection cannot be made by this flow chart because of the operating condition such as within muddy water, sea water, vacuum, or negative pressure, please consult NOK.

E. APPLICATION EXAMPLES OF NOK PACKING

The following classification shows typical application examples of various hydraulic equipment seals, including packings for reciprocal movement, dust seals for sliding and rotating movement, and oil seals. These examples are NOK's recommended applications based on its significant experience in the market. Some special types without dimension tables are introduced here. If any types and materials with unique specifications are required, please consult NOK.

Classification of Application Example



JIS Standard Cylinder (Old JIS B 8354 : 1992)

Hydraulic cylinder for low pressure : 7 MPa or less

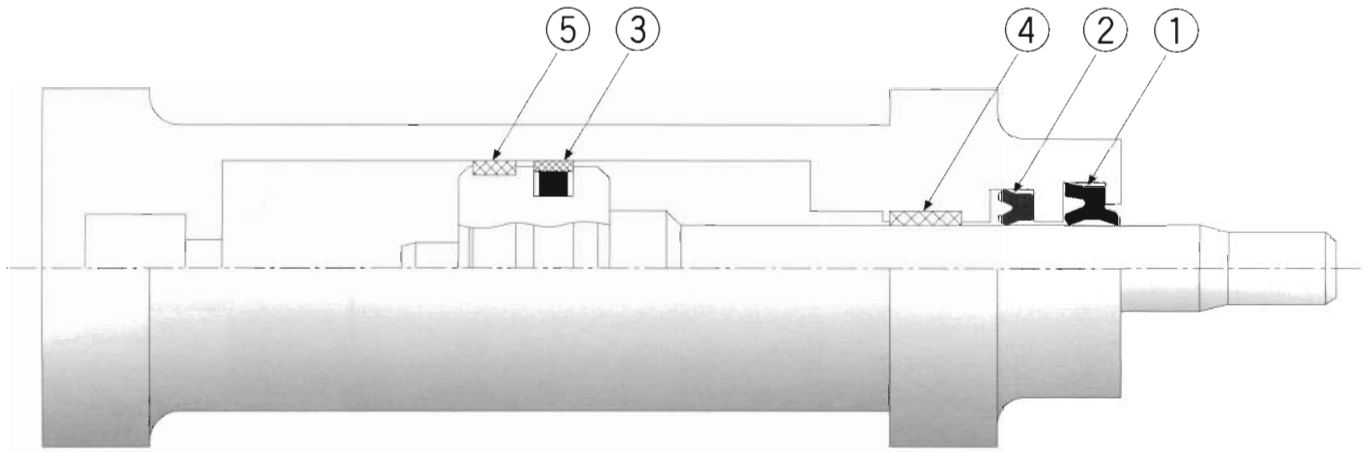
◆ **Applicable temperature rang :**

Standard specifications	−20～80℃
Heat resistant specifications	−10～120℃
Low temperature specifications	−55～60℃

※ Old JIS B 8354 : 1992, the ambient temperature range is prescribed from −5 to 80°C. NOK, however, provides packings applicable for a wider range of temperature.

Remark) Items having — sign in the column of dimension table indicate special specifications. If the data of such items are required, please consult NOK.

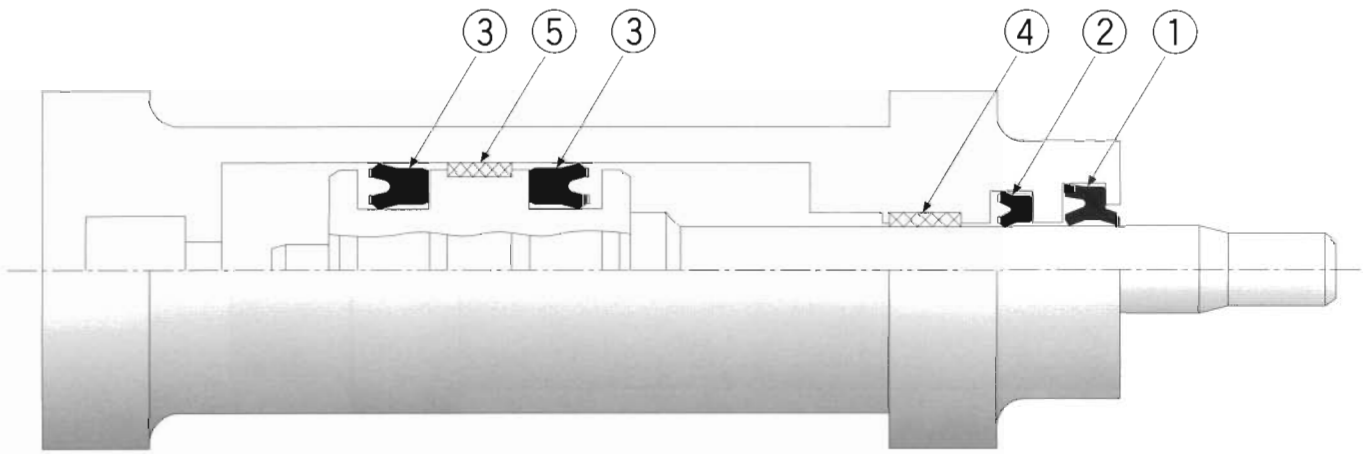
Recommended example 1



	Item	Standard specifications			Heat resistant specifications			Low temperature specifications		
		Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)
①	Dust seal	LBH	A505	183	LBH	F357	183	DKB	A980 SPCC	—
②	Rod packing	IUH	A505	110	USH	F357	147	IUH	A567	110
③	Piston packing	SPG	19YF A980	77	SPG	19YF F201	—	SPG	19YF A980	77
④	Wear ring	RYT	05ZF	196	RYT	05ZF	196	RYT	05ZF	196
⑤	Wear ring	RYT	05ZF	196	RYT	05ZF	196	RYT	05ZF	196

To reduce the sliding friction, The SPG is employed for the piston packing and small section U packing for rod packing. For the dust seal of low temperature application, instead of LBH, we recommend DKB with a metal case that has low shrinkage percentage of diameter at low temperature.

Recommended example 2



	Item	Standard specifications			Heat resistant specifications			Low temperature specifications		
		Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)
①	Dust seal	LBH	A505	183	LBH	F357	183	DKB	A980 SPCC	—
②	Rod packing	IUH	A505	110	USH	F357	147	IUH	A567	110
③	Piston packing	OUHR	A505	74	USH	F357	147	OUHR	A567	74
④	Wear ring	RYT	05ZF	196	RYT	05ZF	196	RYT	05ZF	196
⑤	Wear ring	RYT	05ZF	196	RYT	05ZF	196	RYT	05ZF	196

The U packings are employed to improve the sealing ability of piston. For the dust seal of low temperature application, instead of LBH, we recommend DKB with a metal case that has low shrinkage percentage of diameter at low temperature.

JIS Standard Cylinder (Old JIS B 8354 : 1992)

Hydraulic cylinder for medium pressure : 14 MPa or less

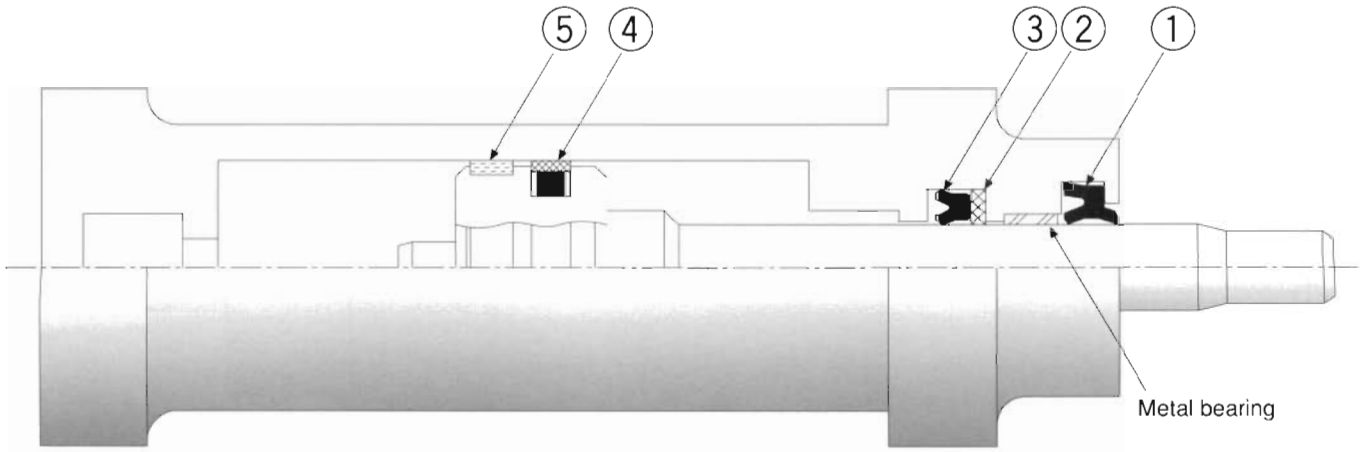
◆Applicable temperature rang :

Standard specifications	−20～80℃
Heat resistant specifications	−10～120℃
Low temperature specifications	−55～60℃

※ Old JIS B 8354 : 1992, the ambient temperature range is prescribed from −5 to 80°C. NOK, however, provides packings applicable for a wider range of temperature.

Remark) Items having — sign in the column of dimension table indicate special specifications. If the data of such items are required, please consult NOK.

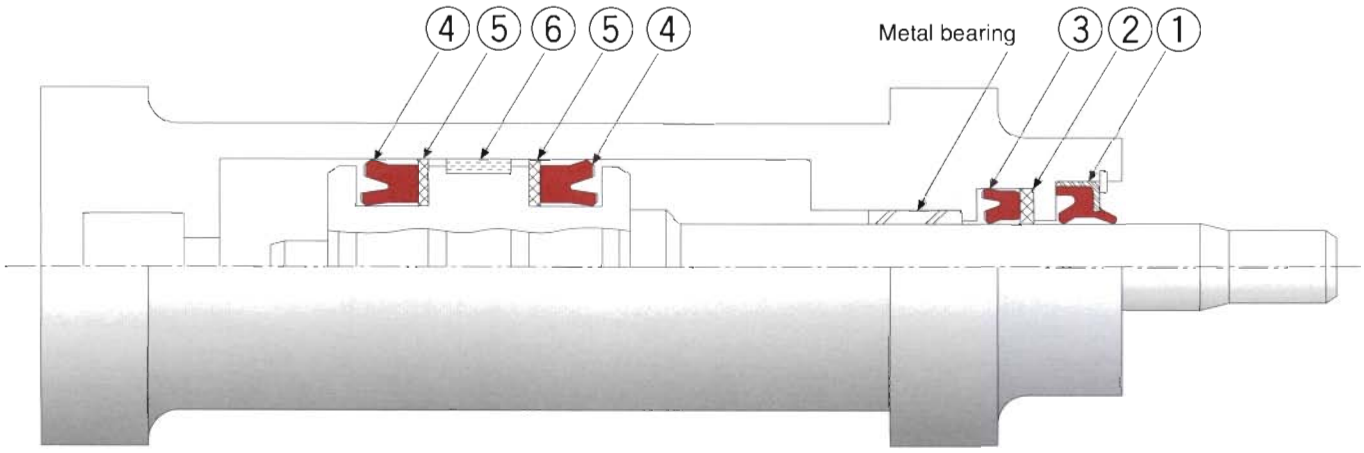
Recommended example 3



	Item	Standard specifications			Heat resistant specifications			Low temperature specifications		
		Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)
①	Dust seal	LBH	A505	183	LBH	F357	183	DKB	A980 SPCC	—
②	Backup ring	BRT2	19YF	110	BRT2	19YF	147	BRT2	19YF	110
③	Rod packing	IUH	A505	110	USH	F357	147	IUH	A567	110
④	Piston packing	SPG	19YF A980	77	SPG	19YF F201	—	SPG	19YF A980	77
⑤	Wear ring	WR	12RS	199	WR	12RS	199	WR	12RS	199

The low friction SPG packing and high load durability wear ring are employed for the piston. For the dust seal of low temperature application, instead of LBH, we recommend DKB with a metal case that has low shrinkage percentage of diameter at low temperature.

Recommended example 4



	Item	Standard specifications			Heat resistant specifications			Low temperature specifications		
		Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)
①	Dust seal	DKBI	U801 SPCC	170	LBH	F357	183	DKB	A980 SPCC	—
②	Backup ring	—	—	—	BRT2	19YF	147	BRT2	19YF	110
③	Rod packing	IUIS	U801	108	USH	F357	147	IUH	A567	110
④	Piston packing	OUIS	U801	72	USH	F357	147	OUHR	A567	74
⑤	Backup ring	—	—	—	BRT2	19YF	147	BRT2	19YF	74
⑥	Wear ring	WR	12RS	199	WR	12RS	199	WR	12RS	199

The U packings are employed to improve the sealing ability of piston.

JIS Standard Cylinder (Old JIS B 8354 : 1992)

Hydraulic cylinder for high pressure : 21 MPa or less

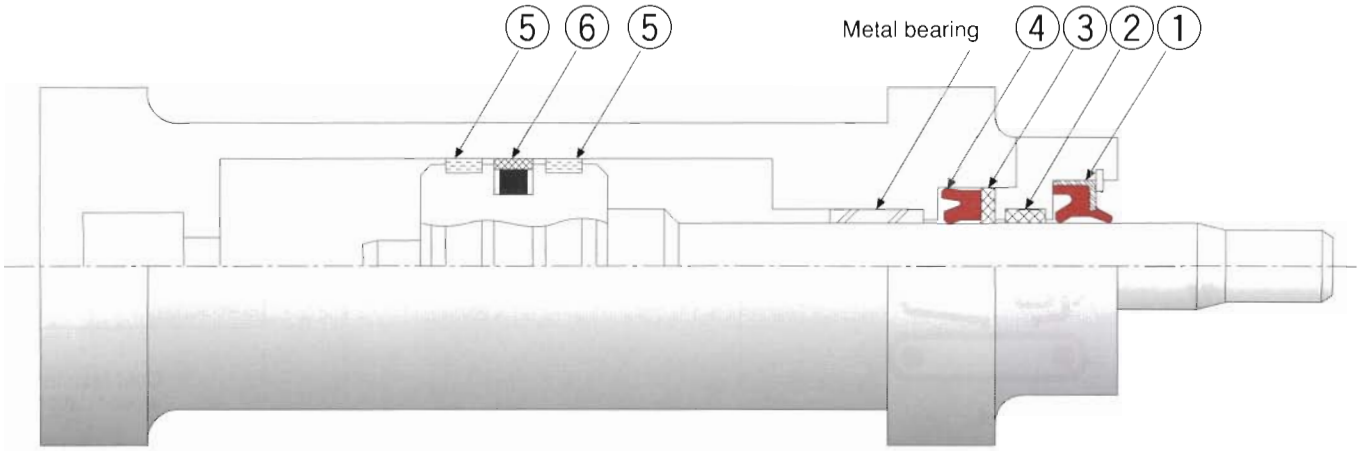
◆ **Applicable temperature rang :**

Standard specifications	−20～80℃
Heat resistant specifications	−10～120℃
Low temperature specifications	−55～60℃

※ Old JIS B 8354 : 1992, the ambient temperature range is prescribed from −5 to 80°C. NOK, however, provides packings applicable for a wider range of temperature.

Remark) Items having — sign in the column of dimension table indicate special specifications. If the data of such items are required, please consult NOK.

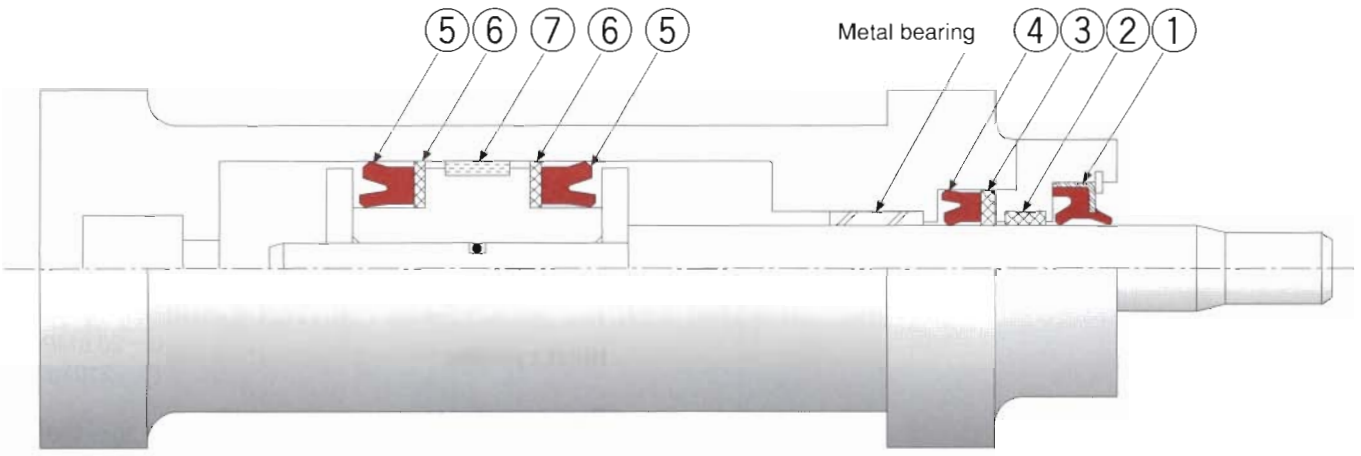
Recommended example 5



	Item	Standard specifications			Heat resistant specifications			Low temperature specifications		
		Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)
①	Dust seal	DKBI	U801 SPCC	170	LBH	F357	183	DKBI	U801 SPCC	170
②	Wear ring	RYT	05ZF	196	RYT	05ZF	196	RYT	05ZF	196
③	Backup ring	—	—	—	BRT2	19YF	139	BRT2	19YF	—
④	Rod packing	IDI	U801	97	UPH	F357	139	UPH	A567	—
⑤	Wear ring	WR	12RS	199	WR	12RS	199	WR	12RS	199
⑥	Piston packing	SPG	19YF A980	77	SPG	19YF F201	77	SPG	19YF A980	77

The low friction SPG packing and the high load durability wear ring are employed for the piston.The large section U packing are employed for the rod packing considering its high durability.

Recommended example 6

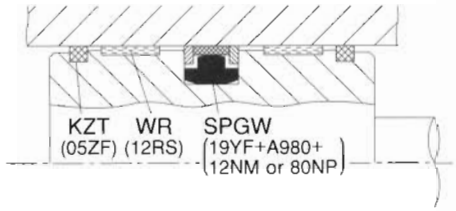
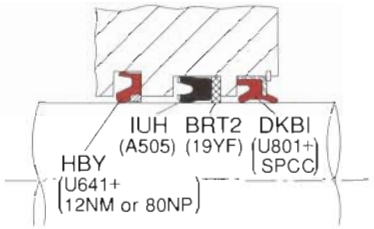
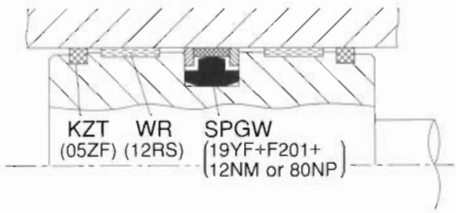
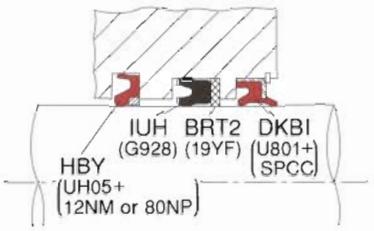
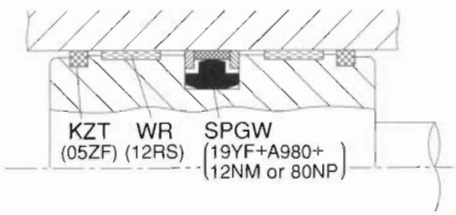
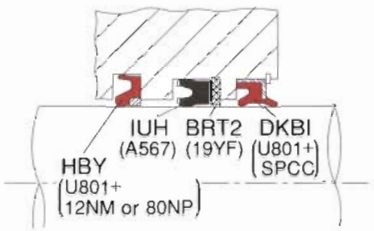
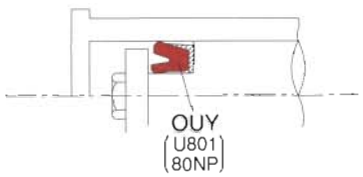
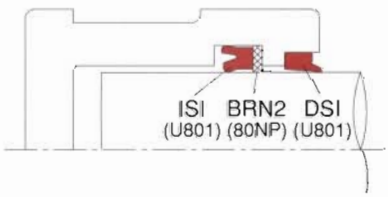
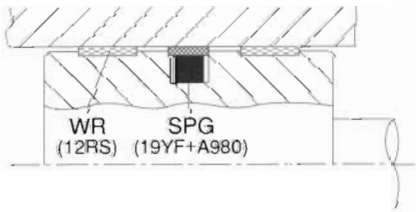
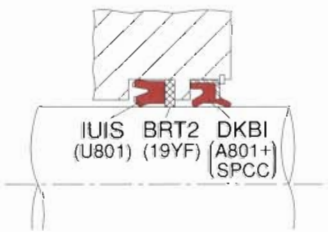
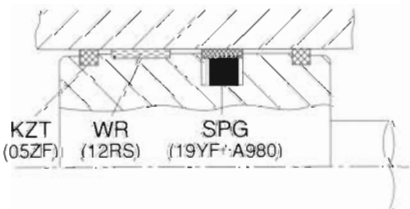
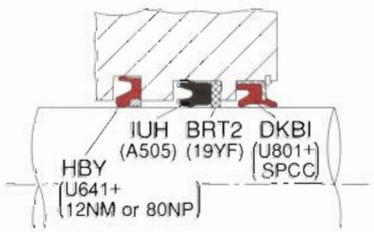
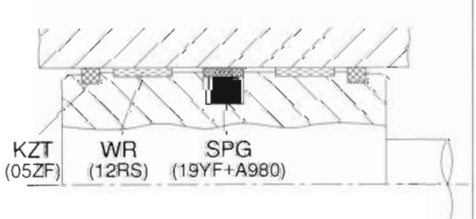
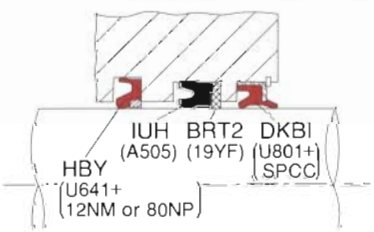


	Item	Standard specifications			Heat resistant specifications			Low temperature specifications		
		Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)	Type	Material code	Dimension table (page)
①	Dust seal	DKBI	U801 SPCC	170	LBH	F357	183	DKBI	U801 SPCC	170
②	Wear ring	RYT	05ZF	196	RYT	05ZF	196	RYT	05ZF	196
③	Backup ring	—	—	—	BRT2	19YF	139	BRT2	19YF	—
④	Rod packing	IDI	U801	97	UPH	F357	139	UPH	A567	—
⑤	Piston packing	ODI	U801	61	UPH	F357	139	UPH	A567	—
⑥	Backup ring	—	—	—	BRT2	19YF	139	BRT2	19YF	—
⑦	Wear ring	WR	12RS	199	WR	12RS	199	WR	12RS	199

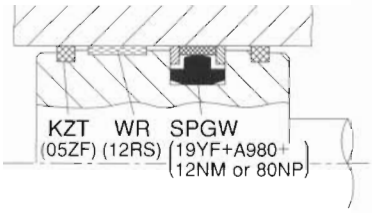
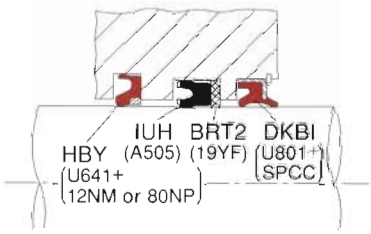
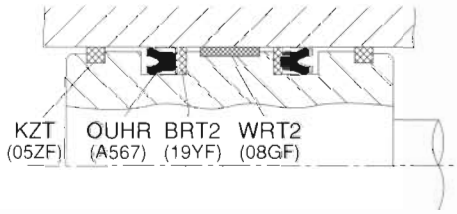
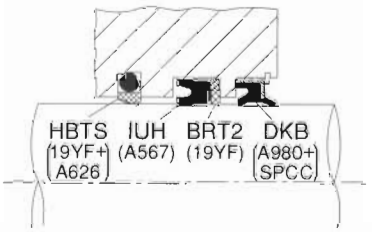
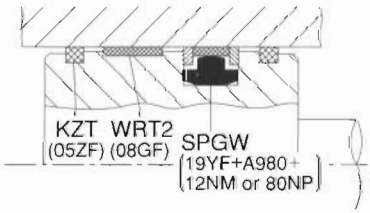
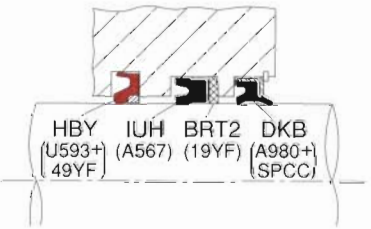
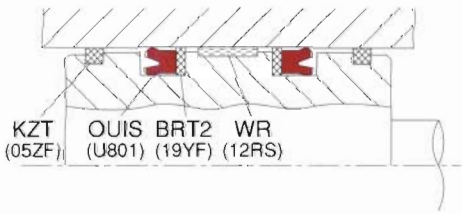
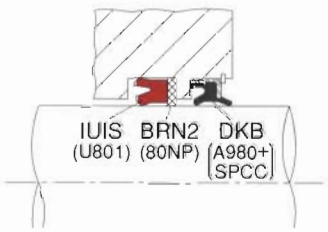
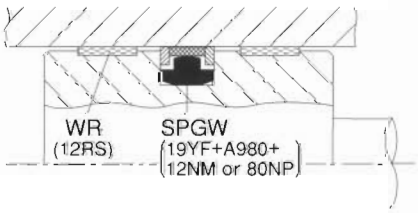
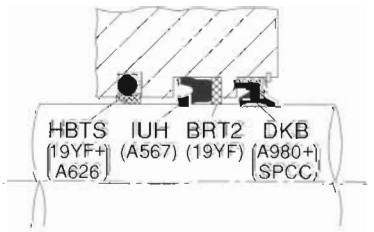
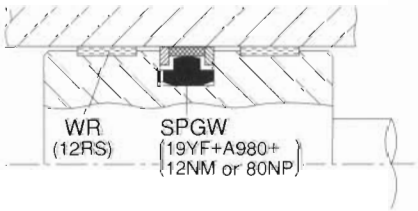
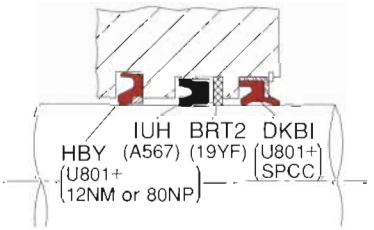
The U packings are employed to improve the sealing ability of piston.

Application Examples by Equipment

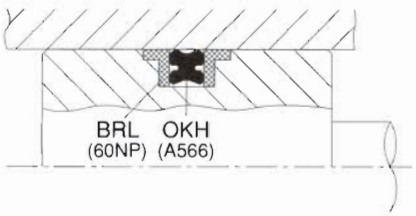
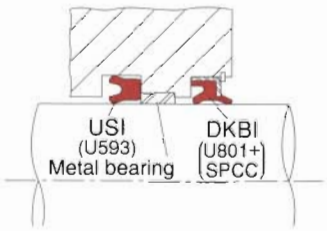
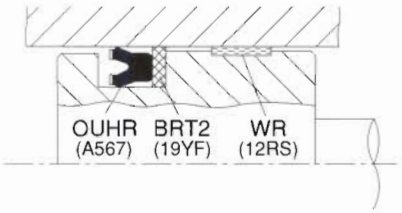
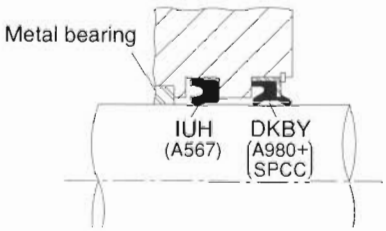
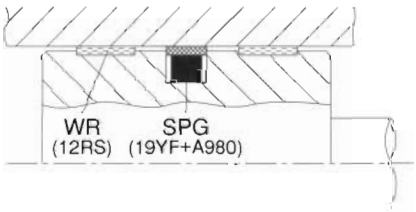
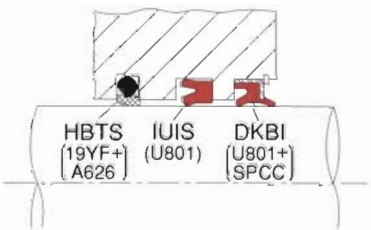
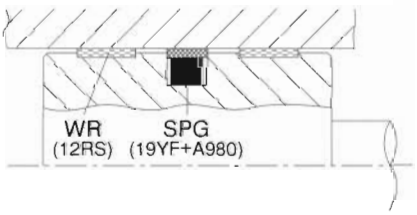
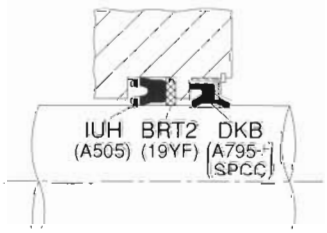
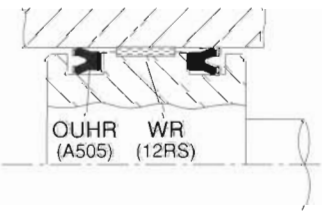
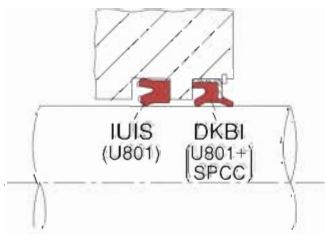
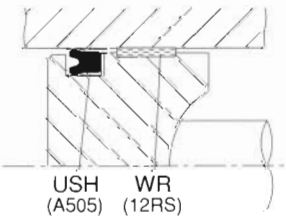
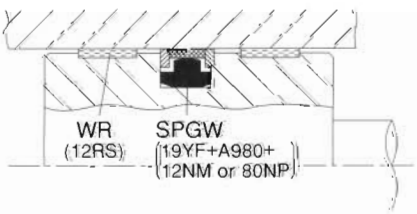
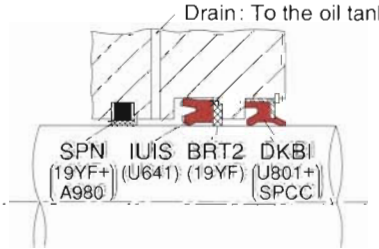
Equipment	Application	Operating condition
 Power shovel	**Boom cylinder** **Arm cylinder** **Bucket cylinder**	Standard specifications 0～34.3MPa {0～350kgf/cm²} −30～100℃
		Heat resistance specifications 0～34.3MPa {0～350kgf/cm²} −30～120℃
		Cold resistance specifications 0～34.3MPa {0～350kgf/cm²} −50～80℃
	Adjust cylinder (grease cylinder)	0～78.5MPa {0～800kgf/cm²} −30～100℃
 Mini construction equipment Mini back hoe	**Boom cylinder** **Arm cylinder** **Bucket cylinder** **Blade cylinder**	0～20.6MPa {0～210kgf/cm²} −30～100℃
 Wheel loader	**Hoist cylinder** **Bucket cylinder**	0～20.6MPa {0～210kgf/cm²} −30～100℃
	Steering cylinder	0～20.6MPa {0～210kgf/cm²} −30～100℃

Piston sealing system	Feature	Rod sealing system	Feature
	High durability for severe operating condition with the selected materials; SPGW that is applicable for high pressure and KZT that removes foreign objects in hydraulic fluid oil and prevents seal damages caused by adiabatic compression		HBY is used to prolong life of the rod seal, and nitrile rubber. (A505) having good oil resistance and backup ring (19YF) are used for rod seals.
	Fluoro rubber(F201) is applied to the back ring of SPGW to enable high temperature operation.		Heat resistant Iron rubber (UH05) is used for HBY and hydrogenated nitrile rubber (G928) for rod seals. Oil scraping can be prevented by using DKBI.
	Standard material for back ring of SPGW is low temperature resistant nitrile rubber.		Low temperature resistant nitrile rubber (A567) is used for IUH.
	Special seal for piston OUY is used to enable the operation of extremely short strokes under high pressure (under such operation, oil film can be broken with ordinary seals).		Because of small operation range of pressure, ISI is used in combination with backup ring of polyamide resin(80NP) of high extrusion proof characteristics.
	Compact SPG for medium pressure is used. Two WR are used to prevent scoring between the piston head and the cylinder tube that can be caused by high lateral load typical for such operation condition.		To prevent extrusion, the backup ring is used for IUIS. To prevent oil scrape-out, DKBI is used for dust seals.
	Compact SPG for medium pressure is used. For hoist and bucket cylinder for which high temperature working characteristics are important, fluoro rubber (F201) is used for back ring material. For steering cylinder for which cold temperature working characteristics are important, low temperature resistant nitrile rubber (A980) is used.		HBY (U641 + 80NP) is used to prevent sliding heat increase at the packings. Nitrile rubber (A505) is used for IUH.
			Because of wide operation range of pressure, HBY (U641 + 80NP) is used. Nitrile rubber (A505) is used for IUH.

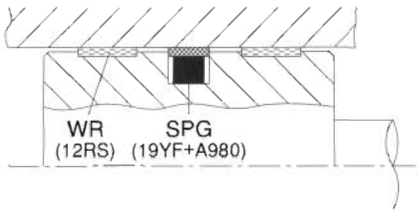
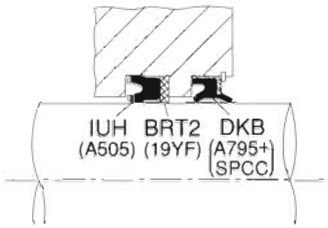
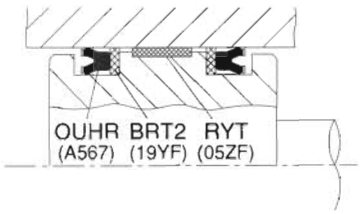
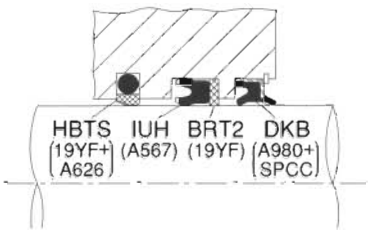
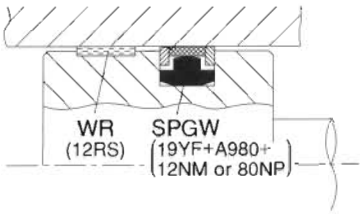
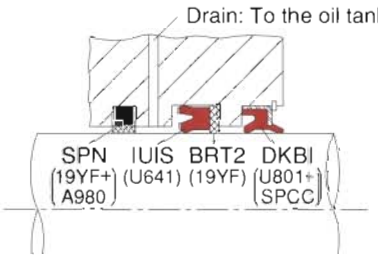
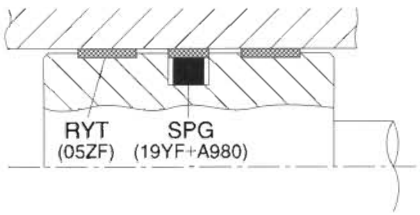
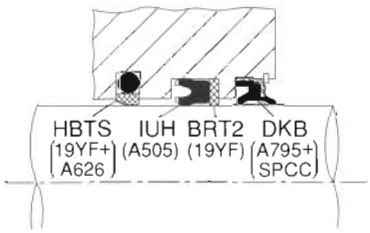
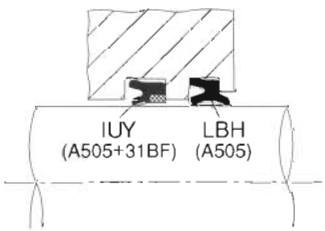
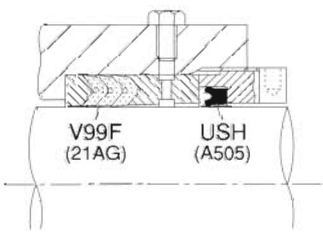
Equipment	Application	Operating condition
 Bulldozer	Hoist cylinder Blade cylinder	0～34.3MPa {0～350kgf/cm²} −30～100℃
 Truck crane	Derricking cylinder Telescopic cylinder Slide cylinder	0～20.6MPa {0～210kgf/cm²} −40～80℃
		0～31.4MPa {0～320kgf/cm²} −30～100℃
 Wheel crane	Jack cylinder	0～31.4MPa {0～320kgf/cm²} −30～100℃
	Hydraulic suspension cylinder	0～20.6MPa {0～210kgf/cm²} −30～100℃
 Dump truck	Dump cylinder	0～41.2MPa {0～420kgf/cm²} −50～100℃

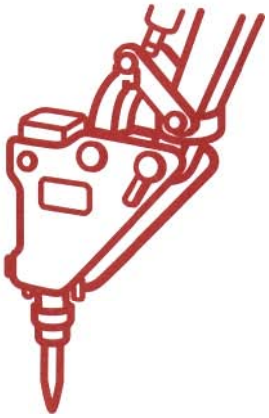
Piston sealing system	Feature	Rod sealing system	Feature
	SPGW is used in high impact pressure. KZT is used for both ends to prevent heat damage of packings by adiabatic compression.		HBY is used to prolong rod seal life, and nitrile rubber (A505) having good oil resistance and backup ring (19YF) are used for rod seals.
	OUHR with stick slip proof characteristics is used considering operating conditions that require keeping extended work pressure. 08GF having small friction resistance is used for wear ring material.		HBTS is also used to prevent stick slip.
	SPGW is used in high pressure operating conditions. 08GF having small friction resistance is used for wear ring material to prevent stick slip. KZT is used to prevent heat damage of the seals. By the combination of all above features, this system is excellent for severe operating condition.		Specially designed HBY absorbs surge pressure for assuring high rod seal life.
	OUIS is used in combination with backup rings to improve sealing ability.		To prevent extrusion, backup rings are used for IUIS. DKB (A980) excellent in low temperature sealing characteristics and in scrape-out resistance is used for dust seals.
	SPGW is used to meet the operating condition that requires durability against impact pressure and extremely short strokes.		To reduce the damage to rod seals, HBTS is used. IUH (A567) with high sealing ability in low temperature is also used.
	For the operating condition that requires extremely high pressure, SPGW is used. Two WR are used considering lateral load that is typical for such operating condition.		Considering the extremely high operating pressure, HBY is used to reduce damage to rod seals. IUH (A567) with high sealing ability in low temperature is used.

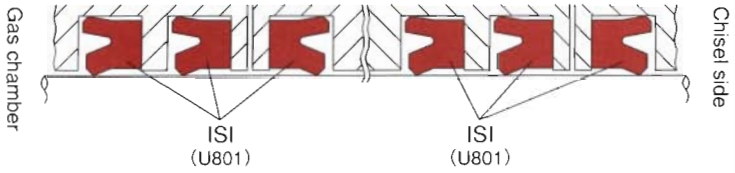
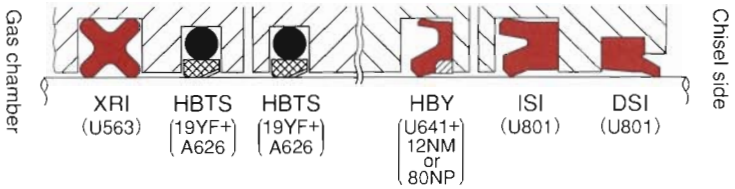
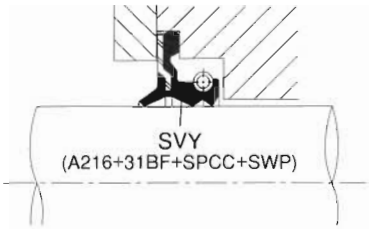
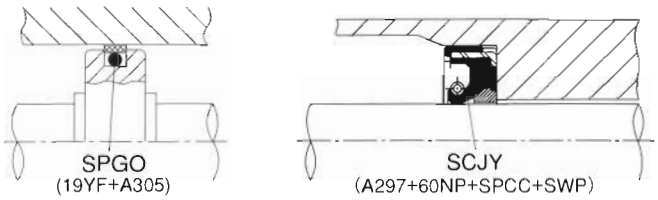
Equipment	Application	Operating condition
 Forklift  Battery forklift	**Tilt cylinder**	0～20.6MPa {0～210kgf/cm²} −30～100℃
	Lift cylinder (low temperature specifications)	0～20.6MPa {0～210kgf/cm²} −55～80℃
	Steering cylinder	0～20.6MPa {0～210kgf/cm²} −30～100℃
 Garbage truck	—	0～20.6MPa {0～210kgf/cm²} −30～100℃
 Combine  Farm tractor	**Double acting cylinder**	0～13.7MPa {0～140kgf/cm²} −30～100℃
	Single acting cylinder	0～13.7MPa {0～140kgf/cm²} −30～100℃
 Pressing machine	—	0～27.5MPa {0～280kgf/cm²} −10～80℃

Piston sealing system	Feature	Rod sealing system	Feature
	Compact OKH assures easy assembly and high sealing ability.		The combination of USI and DKBI is used to realize compact sealing system.
	OUHR is used because maintaining oil film is important for such single acting cylinder.		IUH is used in combination with DKBY because of the fluid filling type single acting cylinder. Dust seals are specially designed DKBY.
	SPG is usable for operating condition requiring extremely short strokes.		HBTS is used for buffer rings because this system is used in sealed conditions.
	SPG with high durability is used. Two WR are used to prevent scoring between the piston head and the cylinder tube that can be caused by high lateral load typical for such operating condition.		Packing and dust seal of nitrile rubber are used.
	Packings of nitrile rubber are used.		DKBI with high dust proof characteristics is used for dust seals.
	Because of less severe operating condition, O rings are mostly used, but USH packings are recommended to improve durability.	—	—
	SPGW is used in high impact pressure and for durability.		SPN is used for buffer rings to reduce high impact pressure. Return leaked oil (oil film) into the oil tank via the drain.

Equipment	Application	Operating condition
 Robot	—	0～20.6MPa {0～210kgf/cm²} −10～80℃
 Lift	—	0～20.6MPa {0～210kgf/cm²} −30～80℃
 Injection molding machine	—	0～31.4MPa {0～320kgf/cm²} −10～100℃
 Multi stories parking	—	0～13.7MPa {0～140kgf/cm²} −30～100℃
 Hydraulic elevator	—	0～4.9MPa {0～50kgf/cm²} −20～80℃
 Plunger pump	—	0～13.7MPa {0～140kgf/cm²} −10～80℃

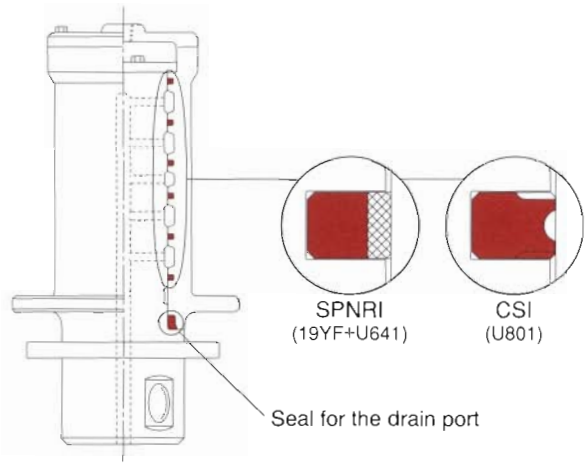
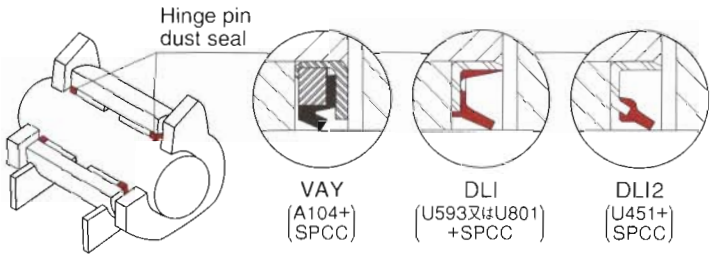
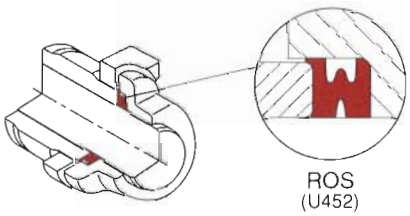
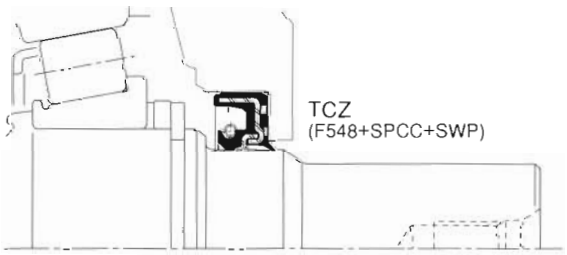
Piston sealing system	Feature	Rod sealing system	Feature
	High durability SPG is used. Two WR are used to prevent scoring between the piston head and the cylinder tube that can be caused by high lateral load typical for such operating condition.		Packing and dust seal of nitrile rubber are used.
	OUHR with stick slip proof characteristics is used considering the operating condition that requires to keep working pressure for a long time. O5ZF having small friction resistance is used for wear ring material.		HBTS is used to prevent stick slip.
	SPGW is used since such operating conditions mainly performed under high pressure require the durability. This packing has also excellent durability for the operations requiring extremely short strokes.		SPN is used for buffer rings to reduce high impact pressure. Return leaked oil (oil film) into the oil tank via the drain.
	High durability SPG is used. O5ZF having small friction resistance is used for wear ring material.		HBTS is used to prevent stick slip.
—	—		IUY (of special shape) is used for packing to prevent stick slip. Rareflon is molded on to the IUY lip.
—	—		Fabric reinforced rubber V packings are used because in such operating conditions, fluids with poor lubricity, such as water and agricultural chemicals are handled and the frequency of operation is high. When pressure and frequency of operation are low, rubber V packings can be used.

Equipment	Application	Operating condition
 Hydraulic breaker	—	0～16.7MPa {0～170kgf/cm²} −30～100℃
	—	0～17.7MPa {0～180kgf/cm²} −30～100℃
 Operation valve	—	0～0.3MPa {0～3kgf/cm²} −30～100℃
 Power steering	—	0～8.3MPa {0～85kgf/cm²} −30～100℃

Magnified view of sealing system	Feature
	ISI are used in parallel because of high speed and high pressure. Noxlan is used for rubber material because of severe operating conditions.
	HBY is used for upper hydraulic seals to reduce the friction. HBTS is also used to absorb impact pressure and reduce the friction. XRI with high wear resistance characteristics is used for gas seals to prevent oil scraping off from the gas chamber.
	SVY is used for low friction and high lip follow-ability to eccentricity. This packing is flat metal case type with dust lip for easy seal replacement.
	Low friction SPGO is used for the piston rings to improve system response. O ring is used for back ring to make compact the piston unit. For rod seals, oil seal SCJY with backup ring for high pressure operation is used. This seal has low friction resistance and high sealing ability.

Equipment	Application	Operating condition
 Construction equipment	Center swivel joint	0～34.3 MPa {0～350 kgf/cm²} −30～100 ℃
 Construction equipment	Link pin Hinge pin	— −30～100 ℃
 Construction equipment	Crawler belt pin	— −30～80 ℃
 Industrial equipment	Pump Motor Reduction unit	Surge pressure: Max 2 MPa {20 kgf/cm²} −16～120 ℃

E APPLICATION EXAMPLES OF NOK PACKING

Magnified view of sealing system	Feature
	The seal fitting groove is mainly provided on the rotor side. ROI or SPNRI is used for each oil port seal. These packings have high durability and sealing ability. For the sealing of drain ports, oil seal or o-ring for high pressure is mainly used. This seal is used also as a dust seal.
	VAY or DLI2, DLI is used to protect the bearings from dust. Grease draining mechanism should be provided for periodical grease replacement.
	ROC is used for this oscillating application, in order to retain lubricant oil and prevent entry of dust. The sealing characteristics are good due to excellent abrasion resistance, even under the severe condition that mud, earth and sand, etc. exist.
	TCZ is used for high pressure application.