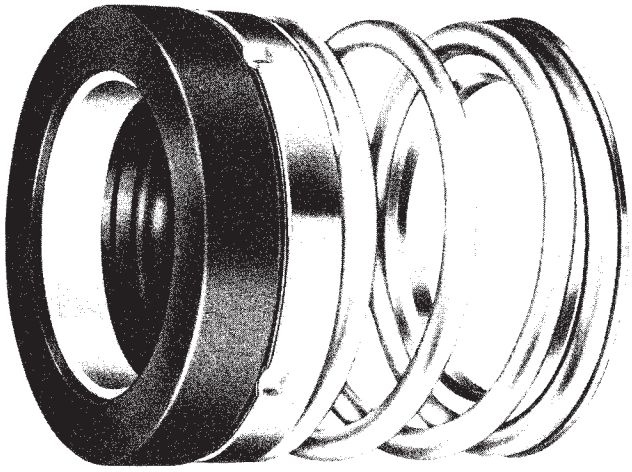
PENTAIR

AURORA®



MECHANICAL SEAL

ENGINEERING DATA

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

Part # A-03-204 | © 2012 Pentair Ltd. | 11/26/12

MECHANICAL SEAL ENGINEERING DATA

CALIFORNIA PROPOSITION 65 WARNING:

⚠WARNING This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

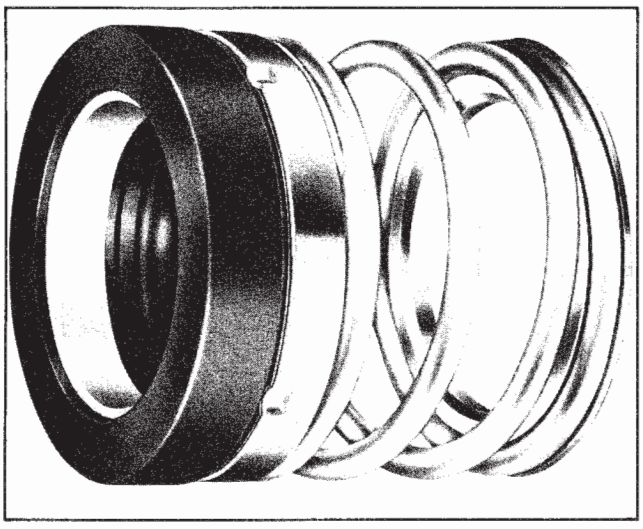
WHY MECHANICAL SEALS?

One of the most important advantages of the mechanical seal is its low leakage rate, resulting in a cost saving because of the reduction in lost liquid. The hazards of fire and personal injury are also reduced when the pumps are handling inflammable or toxic products. Simplified pump designs and reduced maintenance costs are also plus factors.

The most common seal consists of a stationary flat seat which is mounted into a gland or seal chamber, a spring loaded rotating face and a static seal along the shaft. The spring holds the rotating face to the stationary face and sealing occurs between the parallel faces. The static seals stop leakage between the shaft and the rotating seal head and also behind the stationary seat. The faces of the mechanical seal in operation do not actually rub against each other, but are separated by a thin lubricating film a few molecules thick. This can account for the slight weepage from some seals that are operating satisfactorily.

Since all the wear is on the seal faces, further savings are realized due to elimination of shaft or sleeve wear which would result in use of packing.

Most seal applications will run years with little or no maintenance. Time formerly spent on adjustment of packing can be used elsewhere.



Crane Type 21 Seal

MECHANICAL SEAL TERMS

A partial listing of terms noted when selecting mechanical seals is as follows:

Unbalanced
Describes a seal design wherein the sealing faces are exposed to the full hydraulic pressure at the sealing chamber without benefit of any predetermined counterbalance measures. Its design simplicity, cost, and ability to handle a moderate pressure range allows the unbalanced seal to be used extensively in pumping applications.

Balanced
A mechanical seal design in which the face contact area is counterbalanced to reduce the amount of hydraulic force acting on the faces. The most common way of achieving "balancing" is by providing a step in the shaft or sleeve, and moving the seal face radially inward, thereby reducing the hydraulic area under pressure. As a result, higher pressures can be handled. The cost of the balanced seal is normally greater than that for the unbalanced.

Double Seals
Often applied to severe toxic, abrasive, high temperature, or volatile applications where a single seal is not considered suitable. Two single seals are usually mounted back to back in the area to be sealed. A clean buffer liquid must be introduced into the box between the seals for lubrication and to assure absolute confinement of the pumped liquid. This is accomplished by pressurizing the neutral buffer liquid to a pressure higher than the pump pressure imposed on the box. This assures that any leakage will be that of the buffer liquid either to atmosphere or into the pumped liquid.

Seal Faces
These constitute the primary sealing area of the mechanical seal. They consist of a stationary seat mounted into a gland or seal housing and the spring loaded rotating face which turns with the shaft and seals against the stationary seat. The face materials normally are carbon against a hard face such as ni-resist, ceramic, stellite or tungsten carbide.

Secondary Seal
These are static seals, usually "O" rings or flexible Teflon* members which seal the shaft under the rotating assembly and also behind the stationary seat.

*DuPont Registered Trademark

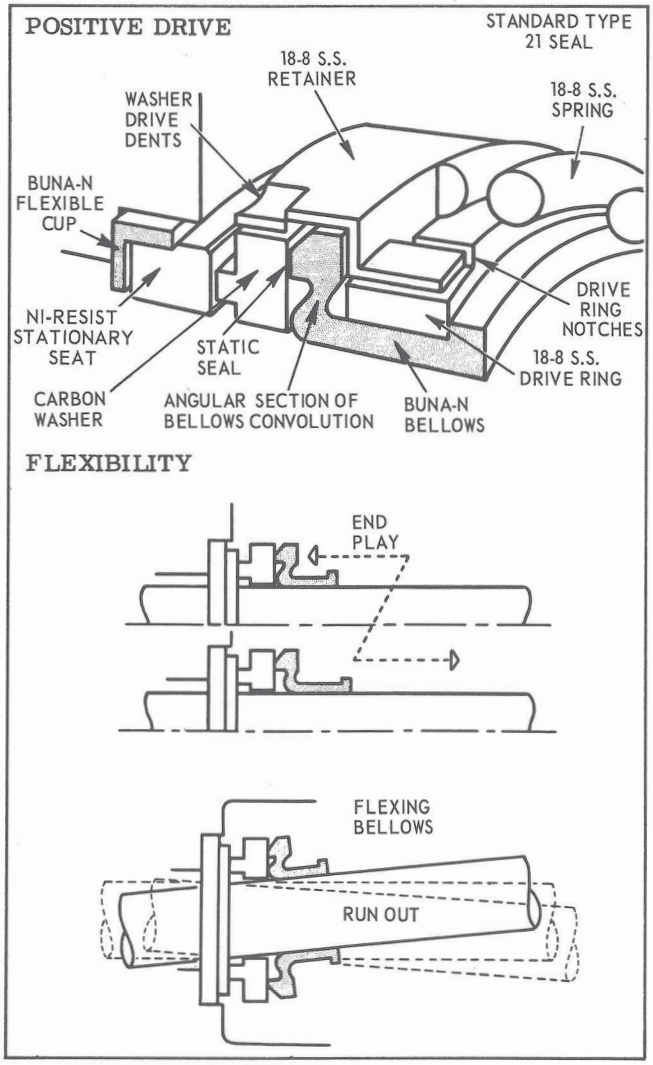
AVAILABLE MECHANICAL SEALS

The variety of available seal designs and materials is endless. To limit the confusion, Aurora has selected a number of designs which will cover the majority of our pumping applications. A listing below gives a brief description of the construction and design features.

Aurora Standard Seal Crane Type 21

The Type 21 is a general purpose unbalanced shaft seal made of 18-8 stainless steel to provide an extremely wide service range not possible with comparably priced seals of other metallurgical construction. It is recommended for broad use in the sealing of centrifugal and turbine pumps.

The standard Type 21 was selected specifically for hot water (to 225° F) but will also handle many other liquids. An optional Type 21 seal with tungsten carbide seat is recommended in hot water to 250° F. Like all Aurora Shaft Seals, washer and seat surfaces are lapped to a precision mate to assure leakproof performance.



POSITIVE DRIVE

Drive between washer and shaft is accomplished by positive pre-load of the BUNA N bellows on the shaft by the drive ring. Notches in this ring engage fingers on the retainer to provide drive to the washer by means of the washer drive dents.

Breakout and running torque is absorbed. Damaging stresses on the bellows are eliminated. Slippage is also eliminated, thus protecting shaft or sleeve against galling. The result is long seal life.

FLEXIBILITY

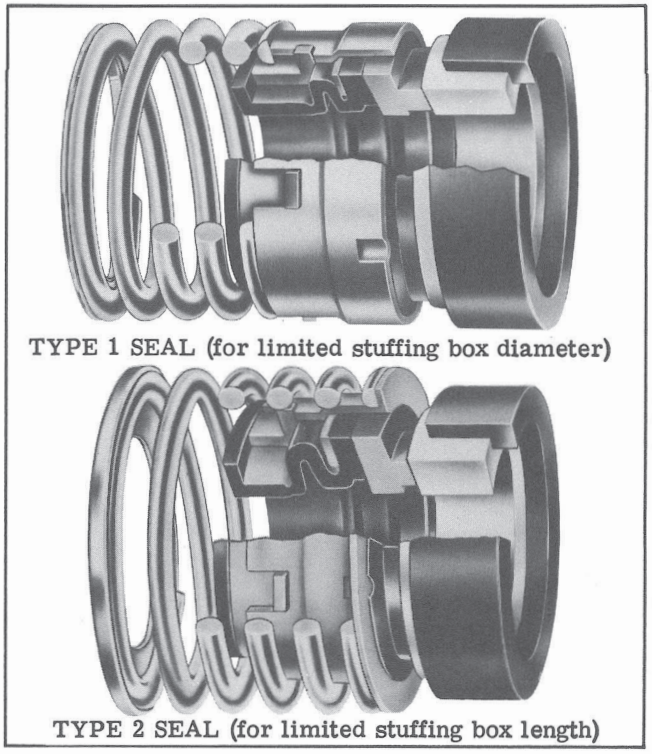
Flexing is accomplished by the static seal and angular section of the bellows convolution which allow the seal to flex freely. The positive static seal between the bellows and sealing washer, along with free bellows action, insures free forward movement at all times. The seal does not depend on stretching or rolling action between parts.

The free flexing bellows automatically compensates for normal shaft end play or runout, and washer wear. Minimum spring pressure is required for axial shaft movement and uniform spring pressure is maintained during radial shaft movement. This reduces wear and torque.

OPTIONAL SEALS (AVAILABLE ONLY AS SHOWN IN PRICE SHEETS)

Crane Type 1 and 2 (Unbalanced)

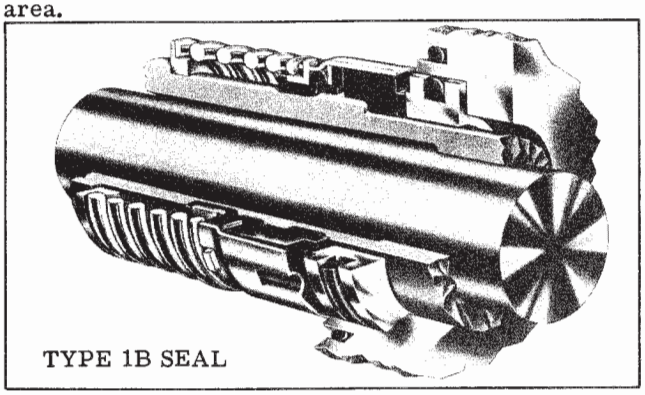
General purpose bellows type unbalanced seal design similar to Type 21. Flexible seal head moves freely under spring and hydraulic pressure, automatically compensating for washer wear.



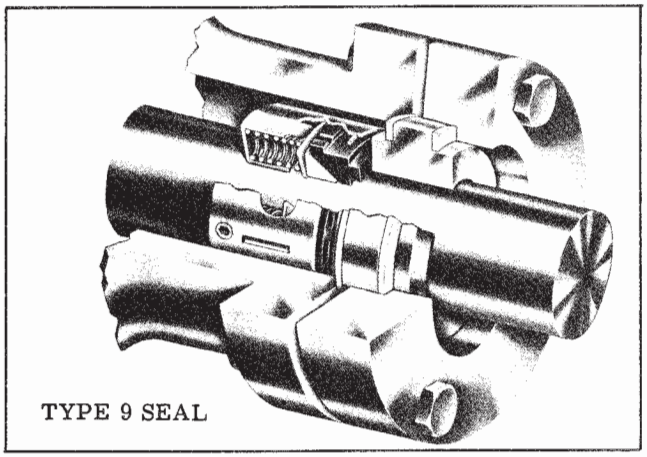
TYPE 1 SEAL (for limited stuffing box diameter)

TYPE 2 SEAL (for limited stuffing box length)

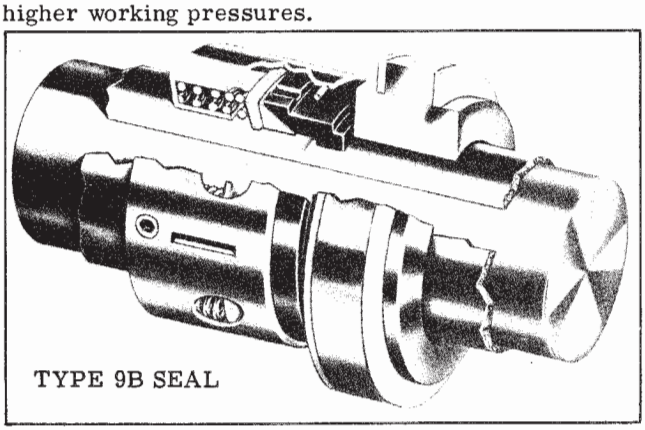
Crane Type 1B and 2B (Balanced)
An adaptation of the Type 1 and 2 seals. The basic seal design is the same, but hydraulic balance of pressure against the sealing faces is effected by means of a step in the shaft or sleeve. This allows face diameters to be lowered, thus reducing pressure on the seat by cutting down the effective hydraulic area.


TYPE 1B SEAL

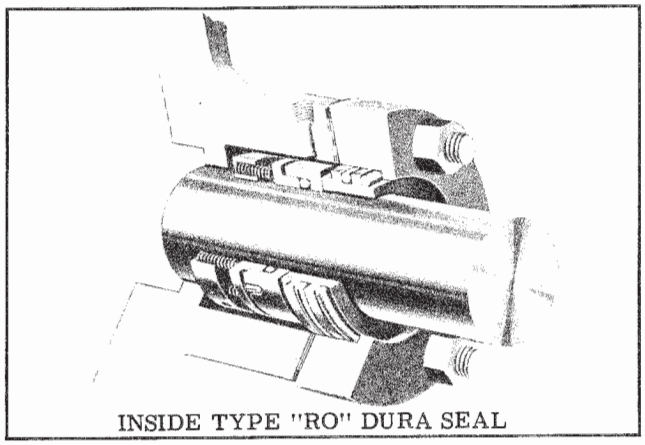
Crane Type 9 or 9T (Unbalanced)
Expressly designed to handle high temperature and corrosive applications which would destroy most synthetic rubber stocks. The flexible sealing member is molded from Teflon*, which is not affected by corrosive service. The rotating portion of the seal is driven through multi-springs and pins by a collar locked to the shaft by means of setscrews.


TYPE 9 SEAL

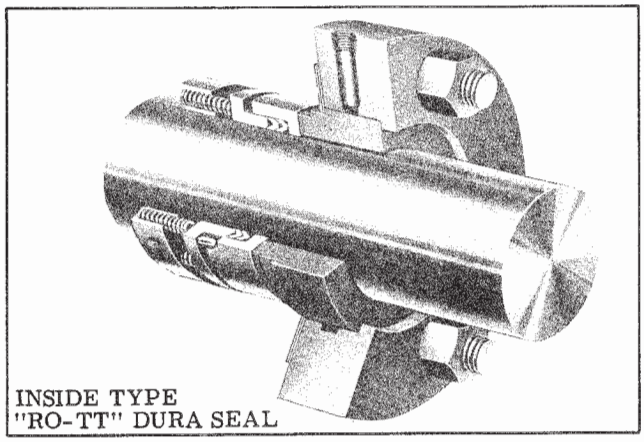
Crane Type 9B or 9BT (Balanced)
Similar in materials to the Type 9. The design is modified to incorporate a step in the shaft or sleeve to reduce effective hydraulic area for withstanding higher working pressures.


TYPE 9B SEAL

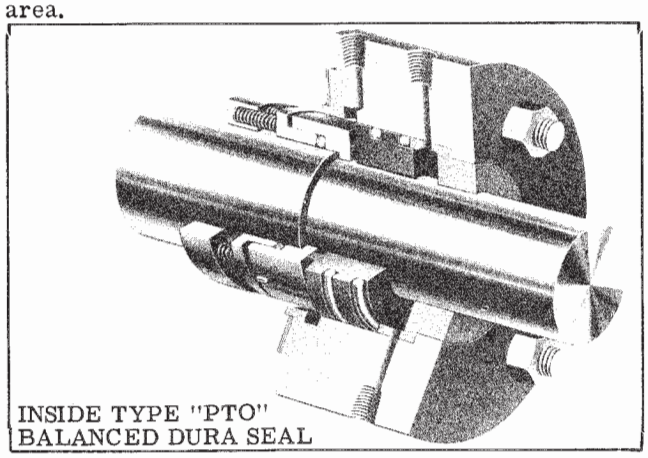
Durametallic RO (Unbalanced)
Heavy duty multi-spring driven seal that incorporates "O" ring secondary seal along the shaft. Good for liquids not injurious to BUNA N, Neoprene, Viton or other synthetic rubbers.


INSIDE TYPE "RO" DURA SEAL

Durametallic RO-TT (Unbalanced)
Same seal as RO except that Teflon* "V" rings are used as secondary seals along the shaft. Especially suited to corrosive or high temperature liquids which would attack synthetic rubber.


INSIDE TYPE
"RO-TT" DURA SEAL

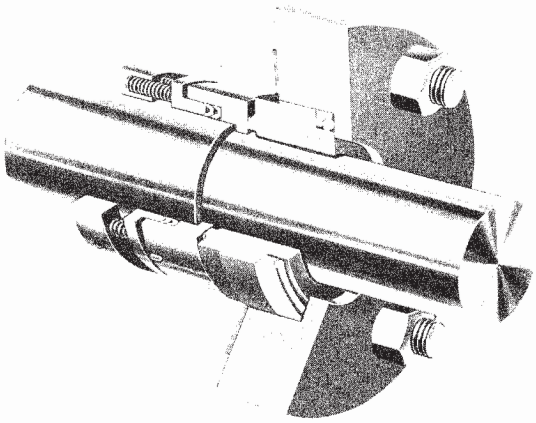
Durametallic PTO (Balanced)
Incorporates synthetic rubber such as BUNA N, Neoprene or Viton as the secondary seal along the shaft and for flexibly mounting the stationary insert. The PTO seal is balanced by means of a step cut into the shaft or sleeve to cut down the effective hydraulic area.

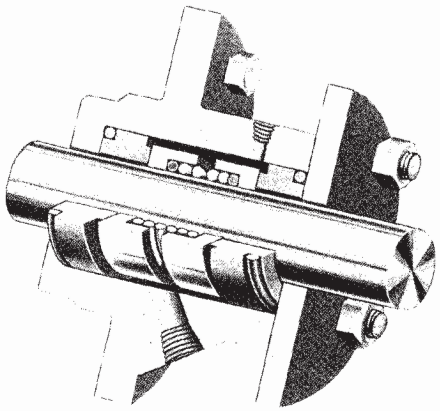

INSIDE TYPE "PTO"
BALANCED DURA SEAL

*DuPont Registered Trademark

Durametallic PT (Balanced)
Same seal as PTO except that Teflon* "V" rings are incorporated as secondary seal along the shaft. Teflon* is also used to flexibly mount the stationary insert. This seal is used in high temperature or high pressure corrosive applications which would attack synthetic rubber.

Durametallic CRO (Unbalanced)
This seal incorporates synthetic "O" rings not only as the secondary seal along the shaft and for flexibly mounting the stationary inserts, but also to drive the rotating assembly. It is used quite often in the double arrangement where two seals are mounted into one sealing box as shown in the illustration.


INSIDE TYPE "PT" BALANCED DURA SEAL


INSIDE DOUBLE "CRO" DURA SEAL

MECHANICAL SEAL MATERIAL CODES

Based on past experience and also on recommendation of the seal manufacturers, Aurora Pump regularly uses the following seal material codes. For Aurora bronze fitted centrifugal pumps, handling water to 225°F, the standard seal code is normally $B_{30}P_{66}171$. For 110 Series turbine pumps, the standard code is $B_{30}P_{66}271$. The balance of the codes listed are for pump construction other than bronze fitted; for liquids corrosive to the standard seal materials; and for optional seals requiring different materials. Additional material selections are available as required by special pumping applications. Refer to factory Application Engineering Department.

	Seal Code	Aur. Matl. Code	Static Seal (Note 1)	Rotating Face	Metal Parts	Stationary Seat	Spring
CRANE	$B_{30}P_{66}171$	749	BUNA	Carbon	St. Steel	Ni-Resist	St. Stl.
	$B_{30}P_{66}271$	755	BUNA	Carbon	Brass	Ni-Resist	St. Stl.
	BP871	756	BUNA	Carbon	Plt. Steel	Ni-Resist	St. Stl.
	QP1C1	762	Teflon*	Carbon	St. Steel	Ceramic	St. Stl.
	XP1C1	764	Viton	Carbon	St. Steel	Ceramic	St. Stl.
	$O_{28}P_{66}1D1$	769	Hi-Temp. Elastomer	Carbon	St. Steel	Tungsten Carbide	St. Stl.
	$XP_{66}1D1$	767	Viton	Carbon	St. Steel	Tungsten Carbide	St. Stl.
	NP871	758	Neoprene	Carbon	Plt. Steel	Ni-Resist	St. Stl.
	QP191	763	Teflon*	Carbon	St. Steel	Stellite	St. Stl.
	BP1C1	753	BUNA	Carbon	St. Steel	Ceramic	St. Stl.
DURAMETALLIC	E55330	773	BUNA	Ceramic Over Stainless	St. Steel	Carbon	St. Stl.
	E5533T	776	Teflon*	Ceramic Over Stainless	St. Steel	Carbon	St. Stl.
	EX5330	777	BUNA	Ceramic	St. Steel	Carbon	St. Stl.
	EM533V	779	Viton	Tungsten Carbide M	St. Steel	Carbon	St. Stl.
	EU533V	782	Viton	Solid Tung. Carbide	St. Steel	Carbon	St. Stl.

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MECHANICAL SEAL LIMITATIONS AND TYPICAL APPLICATIONS

Seal Type	Pump Series Avail. (Note 1)	Seal Code	Aur. Matl. Code	Min. & Max. Pressure Limitation (Note 2)	Minimum and Maximum Temperature Limitation °F (Note 3)	Typical Seal Application
Crane Type 21	130 220 320 340 360 370 380 410 420 430 610 650 660 680	$B_{30}P_{66}171$ (Standard)	749	26" Hg Vac. to 100 PSI	-25° to 225°	Hot clean water to 225°F
		$XP_{66}1C1$	764	26" Hg Vac. to 100 PSI	-10° to 300° (Hydrocarbons)	Chemical Service
		$XP_{66}1D1$	767	26" Hg Vac. to 100 PSI	-10° to 250° (Water) -10° to 300° (Hydrocarbons)	Hot clean water to 250°F, or chem. serv.
		$O_{28}P_{66}1D1$	769	26" Hg Vac. to 100 PSI	-25° to 250°	Hot water to 250°F
		BP1C1	753	26" Hg Vac. to 100 PSI	-25° to 210°	Medium Temp. water to 210°F and chem. serv.
Crane Type 1	360 370 410 420 430	$B_{30}P_{66}171$	749	20" Hg Vac. to 100 PSI	-25° to 225°	Hot clean water to 225°F
		BP871	756	20" Hg Vac. to 100 PSI	-25° to 210°	Med. Temp. Water to 210°F
		BP1C1	753	20" Hg Vac. to 100 PSI	-25° to 210°	Chemical Service
		$O_{28}P_{66}1D1$	769	20" Hg Vac. to 100 PSI	-25° to 275°	Hot water to 275°F
Crane Type 1B	410 420 430	BP871	756	50 PSI Min. to 500 PSI	-25° to 210°	High press. applications. Cold water at high suction press.
Crane Type 2	110 210 280	$B_{30}P_{66}271$	755	20" Hg Vac. to 150 PSI	-25° to 225°	Hot clean water to 225°F
		NP871	758	20" Hg Vac. to 150 PSI	-25° to 210°	Med. Temp. water to 210°F & all iron pumps.
Crane Type 9 or 9T	110 150 360 410 420 430	QP1C1 (Note 4)	762	30" Hg Vac. to 150 PSI	-75° to 300°	Corrosive Chem. Serv.
		QP191 (Note 4)	763	30" Hg Vac. to 150 PSI	-75° to 300°	Corrosive Chem. Serv.
Crane Type 9B or 9BT	150 360 410 420 430	QP1C1 (Note 4)	762	50 PSI Min. to 500 PSI	-75° to 300°	High Press. Corros. Serv.
		QP191 (Note 4)	763	50 PSI Min. to 500 PSI	-75° to 300°	High Press. Corros. Serv.
Crane Type 8B5	340	$B_{30}P_{66}171$	749	50 PSI Min. to 500 PSI	-25° to 225°	Hot clean water to 225°F
	382	$O_{28}P_{66}1D1$	769		-25° to 275°	Hot water to 275°F

MECHANICAL SEAL LIMITATIONS AND TYPICAL APPLICATIONS CONTINUED

Seal Type	Pump Series Avail. (Note 1)	Seal Code	Aur. Matl. Code	Min. and Max. Pressure Limitation	Minimum and Maximum Temperature Limitation of (Note 3)	Typical Seal Application
Dura Type RO	110 150 360 410 420 430	E55330	773	30" Hg Vac. to 150 PSI	-25° to 225°	Chem. Serv. not injurious to "O" rings
	410 420	EU533V	782	30" Hg Vac. to 250 PSI	-10° to 250°	House Serv. Pumps-Hot or Cold water with high suction pressure.
Dura Type ROTT	110 150 360 410 420 430	E5533T	776	30" Hg Vac. to 150 PSI	-75° to 300°	Corrosive Chem. Serv.
Dura Type PTO	110 150 360 410 420 430	E55330	773	50 PSI Min. to 500 PSI	-25° to 225°	High press. chem. serv. not injurious to "O" rings.
		EM533V	779	50 PSI Min. to 500 PSI	-10° to 275°	High Temp. water to 275°F
Dura Type PT	110 150 360 410 420 430	E5533T	776	50 PSI Min. to 500 PSI	-75° to 300°	High Pressure Corrosive Service
Dura Type CRO	610 650 660	EX5330	777	20" Hg Vac. to 75 PSI	-25° to 180°	Double Seals for Sewage Serv. and slurries

Note 1) Each material code listed may not be available on each pump series listed. Refer to price sheets for final selection.

Note 2) Pressure limitations refer to seal box pressures. (Pump limitations prevail on maximum pressures allowable.)

a) Centrifugal pump seal box pressure usually equal to pump suction pressure.

b) Turbine pump seal box pressure equal to suction pressure plus 0.6 times pump differential pressure.

Note 3) Maximum temperature based partially on pump limitations.

Note 4) Occasionally stationary seat can be mounted using a different elastomer and is noted by a slash in the seal code. Example: Q/XP1C1, Q - Teflon* secondary seal/X - Viton seat "O" ring.

*DuPont Registered Trademark

MATERIAL SELECTION CHART

Selections	Seal Code														Remarks
For guidance only. Subject to changes based on temperature, concentration or Mfr. revisions.	B30P66171	B30P66271	BP 871	BP 1C1	NP 871	XP 1C1	XP661D1	QP 1C1	QP 191	O28P661D1	E55330	E5533T	EX5530	EM533V	
Acetaldehyde						X	X	X	X			X			
Acetate Solvents								X	X			X			
Acetic Anhdride								X				X			(316 SS)
Acetone								X	X	X		X			
Acid, Acetic								X	X			X			(316 SS)
Acid, Benzoic								X	X			X			
Acid, Boric (50% Con)	X			X		X	X	X	X	X	X	X	X	X	
Acid, Butyric								X	X			X			
Acid, Carbolic (Phenol)						X	X	X	X			X		X	Double Seal
Acid, Carbonic	X		X	X		X	X	X	X	X	X	X	X	X	
Acid, Citric						X	X	X	X	X	X	X	X	X	
Acid, Fatty						X	X	X	X			X		X	(316 SS)
Acid, Formic						X	X	X	X			X		X	(316 SS)
Acid, Fruit				X		X	X	X	X		X	X	X	X	
Acid, Hydrochloric															Refer to Aurora
Acid, Hydrocyanic	X		X	X	X	X	X	X	X	X	X	X	X	X	
Acid, Maleic				X		X	X	X	X		X	X	X	X	(316 SS)
Acid, Naphthenic	X	X	X	X	X	X	X	X	X		X	X	X	X	
Acid, Nitric															Refer to Aurora
Acid, Phosphoric						X		X				X			(Carp. 20)
Acid, Sulfuric															Refer to Aurora
Acid, Tannic				X		X	X	X	X	X	X	X	X		
Acrylonitirile								X	X			X			
Alcohols (Ethyl & Methyl)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Alum Solution						X	X	X	X			X		X	(Carp. 20)
Ammonia (Aqua or Anhydrous)															Refer to Aurora
Ammonium-Carbonate						X	X	X	X	X					
Ammonium Nitrate								X	X	X		X			(316 SS)
Ammonium-Phosphate Di, mono & tri basic						X	X	X	X	X		X		X	
Ammonium Sulfate								X				X			(316 SS)
Amyl Acetate								X	X	X		X			
Amyl Alcohol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Aniline						X	X	X	X			X		X	
Aniline Dyes															Refer to Aurora
Antifreeze, Water Alcohols or Glycols	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Arochlor #1248						X	X	X	X						
Aromatic Fuels						X	X	X	X			X		X	
Barium Chloride								X			X	X	X	X	(316 SS)
Barium Nitrate				X				X	X	X	X	X	X	X	(316 SS)
Beer	X	X		X	X	X	X	X	X	X	X	X	X	X	
Beet Juice	X	X		X		X	X	X	X	X	X	X	X	X	
Benzene						X	X	X	X						
Benzine (Petroleum Ether)						X	X	X	X			X		X	
Benzol						X	X	X	X			X		X	
Borax (Sodium Borate)				X		X	X	X	X	X	X	X	X	X	
Brine, Calcium & Sodium Chloride	X	X	X	X	X	X	X	X		X	X	X	X	X	
Brine, Sodium Chloride	X	X	X	X	X	X	X	X		X	X	X	X	X	
Butadiene	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Butane	X	X	X	X	X	X	X	X	X		X	X	X	X	
Butyl Acetate								X	X			X			
Butyl Alcohol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Butyl Amine	X		X	X		X	X	X	X		X	X	X	X	
Butylene	X	X	X	X		X	X	X	X		X	X	X	X	
Calcium Carbonate	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

MATERIAL SELECTION CHART CONTINUED

Selections	Seal Code														Remarks
For guidance only. Subject to changes based on temperature, concentration or Mfr. revisions.	$B30P66^{171}$	$B30P66^{271}$	BP 871	BP 1C1	NP 871	XP 1C1	$XP66^{1D1}$	QP 1C1	QP 191	$O28P66^{1D1}$	E55330	E5533T	EX5530	EM533V	
Calcium Chloride Brine	X	X	X	X	X	X	X	X		X	X	X	X	X	
Calcium Phosphate	X	X	X	X		X	X	X	X	X	X	X	X	X	
Cane Juice	X	X		X		X	X	X	X	X	X	X	X	X	
Carbon Bisulphide						X	X	X	X			X		X	
Carbon Tetrachloride															Refer to Aurora
Caustics															Refer to Aurora
Chlorobenzene								X	X			X		X	
Chloroform						X	X	X	X			X		X	
Cocoa Butter	X	X	X	X		X	X	X	X	X	X	X	X	X	
Copper Nitrate						X		X			X	X	X	X	(316 SS)
Copper Sulfate						X	X	X	X	X	X	X	X	X	(316 SS)
Creosote						X	X	X	X		X	X	X	X	
Cupric Sulfate						X	X	X	X	X	X	X	X	X	(316 SS)
DE Butanizer Reflux	X	X	X	X		X	X	X	X		X	X	X	X	
DE Ethanizer Charge	X	X	X	X		X	X	X	X		X	X	X	X	
DE Propanizer Reflux	X	X	X	X		X	X	X	X		X	X	X	X	
Dichlorobenzene						X	X	X	X			X		X	
Diesel Fuel	X	X	X	X		X	X	X	X		X	X	X	X	
Diethylene Glycol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Dish Water	X	X		X		X	X	X	X		X	X	X	X	
Dowtherm "A"															Refer to Aurora
Ether								X	X			X			
Ethyl Acetate								X	X			X			
Ethyl Alcohol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Ethylene Glycol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Ferric Sulfate				X		X	X	X	X		X	X	X	X	(316 SS)
Formaldehyde or Formaline				X		X	X	X	X			X			
Freon 11 Liquid						X	X	X	X		X	X	X	X	
Freon 12 Liquid						X	X	X	X		X	X	X	X	
Freon 22 Liquid								X	X			X			
Fruit Juices	X	X		X		X	X	X	X		X	X	X	X	
Furfural								X	X			X			
Gas Oil	X	X	X	X	X	X	X	X	X		X	X	X	X	
Gasoline (Aromatic)						X	X	X	X			X		X	
Gasoline Auto Grades (Ethyl, 100 & 130 Octane)	X	X	X	X		X	X	X	X		X	X	X	X	
Glucose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Glue	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Glue Sizing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Glycerine/Glycerol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Grape Juice				X		X	X	X	X		X	X	X	X	
Heptane	X	X	X	X	X	X	X	X	X		X	X	X	X	
Hexane	X	X	X	X	X	X	X	X	X		X	X	X	X	
Iso-Butane	X	X	X	X	X	X	X	X	X		X	X	X	X	
Iso-Butyl Alcohol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Iso-Butylene	X	X	X	X		X	X	X	X		X	X	X	X	
Iso-Octane						X	X	X	X			X		X	
Iso-Pentane	X	X	X	X		X	X	X	X		X	X	X	X	
Iso-Propyl-Alcohol	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Iso-Propyl-Amine	X		X	X		X	X	X	X		X	X	X	X	
JP, 3, 4, & 5	X	X	X	X		X	X	X	X		X	X	X	X	
Kerosene	X	X	X	X		X	X	X	X		X	X	X	X	
Lacquer								X	X			X			
Lacquer Solvents								X	X			X			
Lard	X	X	X	X	X	X	X	X	X		X	X	X	X	
Liquified Petroleum Gas (LPG)	X	X	X	X	X	X	X	X	X		X	X	X	X	

MATERIAL SELECTION CHART CONTINUED

Selections	Seal Code														Remarks
For guidance only. Subject to changes based on temperature, concentration or Mfr. revisions.	$B_{30}P_{66}171$	$B_{30}P_{66}271$	BP 871	BP 1C1	NP 871	XP 1C1	$XP_{66}1D1$	QP 1C1	QP 191	$O_{28}P_{66}1D1$	E55330	E5533T	EX5530	EM533V	
Magnesium Hydroxide	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Magnesium Sulfate	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Methanol (Methyl Alcohol)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Methyl Chloride						X	X	X	X			X		X	
Methylene Chloride						X	X	X	X			X			
Methyl Ethyl Ketone (MEK)						X	X	X	X	X		X			
Milk				X		X	X	X	X	X		X		X	Check Sanitary Laws
Mineral Spirits	X	X	X	X		X	X	X	X			X		X	
Molasses	X	X	X	X	X	X	X	X	X			X		X	
Naptha	X	X	X	X		X	X	X	X			X		X	
Nitrobenzine						X	X	X	X			X		X	
Oils, Animal & Fish Whale, Bone, Sperm Neatsfoot, Cod, Menhadden, Lard	X	X	X	X		X	X	X	X		X	X	X	X	
Oil, Creosote						X	X	X	X		X	X	X	X	
Oil, Crude, Cold				X		X	X	X	X		X	X	X	X	
Oil, Diesel Fuel	X	X	X	X		X	X	X	X		X	X	X	X	
Oil, Fuel, Domestic	X	X	X	X		X	X	X	X		X	X	X	X	
Oil, Lubricating, Refined	X	X	X	X		X	X	X	X		X	X	X	X	
Oil, Mineral	X	X	X	X		X	X	X	X		X	X	X	X	
Oil, Quenching	X	X	X	X		X	X	X	X		X	X	X	X	
Oil, Turbine Lube	X	X	X	X		X	X	X	X		X	X	X	X	
Oils, Vegetable Caster, China Wood, Cocoanut, Corn, Cottonseed, Linseed Olive, Palm, Peanut Rape Seed, Rosin, Sesame, Soya Bean	X	X	X	X		X	X	X	X		X	X	X	X	
Paraffin Liquid	X	X	X	X		X	X	X	X		X	X	X	X	
Pectin Liquor				X		X	X	X	X			X		X	
Pentane	X	X	X	X		X	X	X	X		X	X	X	X	Double Seal
Perchlorethylene						X	X	X	X						
Phenol						X	X	X	X			X		X	Double Seal
Photographic Developer						X	X	X	X		X	X	X	X	
Poly Glycols	X	X	X	X	X	X	X	X	X		X	X	X	X	
Potash, Alum (Aqueous)				X		X	X	X	X		X	X	X	X	
Potassium Bicarbonate				X				X	X					X	
Potassium Bromide				X		X	X	X	X		X	X	X	X	
Potassium Carbonate	X	X	X	X	X	X	X	X	X					X	
Potassium Chlorate	X		X	X	X	X	X	X	X	X	X	X	X	X	
Potassium Chloride				X		X	X	X	X	X	X	X	X	X	
Potassium Nitrate	X		X	X		X	X	X	X	X	X	X	X	X	
Potassium Permanganate								X	X			X			
Potassium Phosphate								X	X			X			
Potassium Sulfate	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Propane	X		X	X				X	X		X	X	X	X	
Propylene Glycol	X	X	X	X	X	X	X	X	X		X	X	X	X	
Sewage													X		Double Seal Refer to Aurora
Soap Liqour						X	X	X	X	X				X	
Sodium Acetate						X	X	X	X	X		X		X	
Sodium Aluminate	X	X	X	X		X	X	X	X		X	X	X	X	
Sodium Bicarbonate	X	X		X		X	X	X	X	X	X	X	X	X	
Sodium Chloride (Brine)	X	X	X	X	X	X	X	X		X	X	X	X	X	
Sodium Hydrosulfite	X		X	X		X	X	X	X			X		X	

MATERIAL SELECTION CHART CONTINUED

Selections	Seal Code														Remarks
For guidance only. Subject to changes based on temperature, concentration or Mfr. revisions.	$B_{30}P_{66}^{171}$	$B_{30}P_{66}^{271}$	BP 871	BP 1C1	NP 871	XP 1C1	XP_{66}^{1D1}	QP 1C1	QP 191	$O_{28}P_{66}^{1D1}$	E55330	E5533T	EX5530	EM533V	
Sodium Hydroxide															Refer to Aurora
Sodium Perborate	X		X	X	X	X	X	X	X	X	X	X	X	X	
Sodium Phosphate (Mono, Di, Tri, Meta)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Sodium Silicate	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Sodium Sulfate	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Sodium Thiosulfate (Hypo)								X	X	X	X	X	X	X	
Starch	X	X	X	X	X	X	X	X	X		X	X	X	X	
Stoddard Solvent	X	X	X	X		X	X	X	X		X	X	X	X	
Styrene						X	X	X	X			X		X	
Sugar Solutions	X	X		X		X	X	X	X		X	X	X	X	
Tallow	X	X	X	X	X	X	X	X	X		X	X	X	X	
Tanning Liquors						X	X	X	X			X		X	
Tar, Road (Hot)						X	X	X	X			X		X	
Tetra Ethyl Lead						X	X	X	X			X		X	
Toluene (Toluol)						X	X	X	X			X		X	
Trichloroethylene (Dry)						X	X	X	X			X		X	
Turpentine						X	X	X	X			X		X	
Varnish Non-Aromatic	X	X	X	X		X	X	X	X			X		X	
Vegetable Juices						X	X	X	X			X		X	
Vinegar						X	X	X	X	X		X		X	
Water, Boiler Feed (225°F)	X	X					X			X				X	
Water, Boiler Feed (250°F)							X			X				X	
Water, Condensate (210°F)	X	X					X			X	X	X	X	X	
Water, Distilled, Cool	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Water, Salt (Brine)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Water, Soapy (210°F)	X	X		X		X	X	X	X		X	X	X	X	
Water, Clean, Cool	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Water with Soluble Oil	X	X	X	X		X	X	X	X		X	X	X	X	
Whiskey and Wine				X		X	X	X	X	X	X	X	X	X	
Xylene or Xylol						X	X	X	X			X		X	
Zinc Sulfate						X	X	X	X	X	X	X	X	X	

WARRANTY

Seller warrants equipment (and its component parts) of its own manufacture against defects in materials and workmanship under normal use and service for one (1) year from the date of installation or start-up, or for eighteen (18) months after the date of shipment , whichever occurs first. Seller does not warrant accessories or components that are not manufactured by Seller; however, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller. Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid. Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Seller assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B., Seller's factory. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing. The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced, whichever is greater. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired. Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service. This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired. Seller may substitute new equipment or improve part(s) of any equipment judged defective without further liability. All repairs or services performed by Seller, which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any labor costs or charges incurred in repairing or replacing defective equipment or parts, including the cost of reinstalling parts that are repaired or replaced by Seller; (g) any expense of shipment of equipment or repaired or replacement parts; or (h) any other loss, damage or expense of any nature.

The above warranty shall not apply to any equipment which may be separately covered by any alternate or special warranties.

PERFORMANCE: In the absence of Certified Pump Performance Tests, equipment performance is not warranted or guaranteed. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy under Hydraulic Institute procedures.

LIABILITY LIMITATIONS: Under no circumstances shall the Seller have any liability under the Order or otherwise for liquidated damages or for collateral, consequential or special damages or for loss of profits, or for actual losses or for loss of production or progress of construction, regardless of the cause of such damages or losses. In any event, Seller's aggregate total liability under the Order or otherwise shall not exceed the contract price.

ACTS OF GOD: Seller shall in no event be liable for delays in delivery of the equipment or other failures to perform caused by fires, acts of God, strikes, labor difficulties, acts of governmental or military authorities, delays in transportation or procuring materials, or causes of any kind beyond Seller's control.

COMPLIANCE WITH LAW: Seller agrees to comply with all United States laws and regulations applicable to the manufacturing of the subject equipment. Such compliance shall include: The Fair Labor Standards Acts of 1938, as amended; Equal Employment Opportunity clauses of Executive Order 11246, as amended; Occupational Safety and Health Act of 1970 and the standards promulgated thereunder, if applicable. Since compliance with the various Federal, State, and Local laws and regulations concerning occupational health and safety, pollution or local codes are affected by the use, installation and operation of the equipment and other matters over which Seller has no control, Seller assumes no responsibility for compliance with those laws and regulations, whether by way of indemnity, warranty, or otherwise. It is incumbent upon the Buyer to specify equipment which complies with local codes and ordinances.

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