UNIVERSAL PRODUCT LINE:
CAST IRON — JACKETED PUMPS

224C Series™, 1224C Series™, 4224C Series™, 324A Series™, 1324A Series™, 4324A Series™

Section	2402-IN
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RELATED PRODUCTS

Cast Iron, Non-Jacketed Pumps: Catalog Section 2401-IN

Steel Externals, Jacketed Pumps: Catalog Section 2302

Stainless Steel, Jacketed Pumps: Catalog Section 2702

SERIES DESCRIPTION

224C Series™, 1224C Series™, 4224C Series™:

The Universal Product Line has the broadest range of sealing options of all pumps built by Viking Pump. The U-Plus™ bracket design accepts numerous component seals for use in the stuffing box or behind the rotor, packing, cartridge seals and Viking Pump's own O-Pro® seals. These products come standard with a jacketed head and bracket.

This is Viking Pump's most versatile line of internal gear pumps with many design and material options these series are available with ProPort™ casing and a wide variety of flange types and sizes as well as both 90 degree and opposite port arrangements enabling flexibility when connecting pumps to piping.

324A Series™, 1324A Series™, 4324A Series™:

Viking's largest product series in the Universal Product Line offer high capacity and a variety of sealing arrangements including component or cartridge mechanical seals, packing and O-Pro® seals. These Products come standard with a jacketed bracket and optional jacketed head.

HL224C

Q224C

RS324A

OPERATING RANGE

SERIES	NOMINAL FLOW		MAXIMUM PRESSURE		TEMPERATURE RANGE		VISCOSITY RANGE	
	GPM	m^3h	PSI	Bar	°F	°C	SSU	cSt
224C Series™	15 - 500	3 - 114	200	14	−60 to +450	−50 to +230	28 to 2,000,000	0.1 to 440,000
1224C Series™	8 - 400	1.8 - 91	200	14	0 to +350	−15 to +175	100 to 2,000,000	20 to 440,000
4224C Series™	15 - 500	3 - 114	200	14	−60 to +450	−50 to +230	28 to 2,000,000	0.1 to 440,000
324A Series™	600 - 1,600	136 - 364	200	14	−60 to +450	−50 to +230	28 to 2,000,000	0.1 to 440,000
1324A Series™	550 - 1,500	125 - 340	200	14	0 to +350	−15 to +175	100 to 75,000 *	20 to 17,000 *
4324A Series™	600 - 1,600	136 - 364	200	14	−60 to +450	−50 to +230	28 to 2,000,000	0.1 to 440,000

* Consult factory for viscosities exceeding the stated operating range

UNIVERSAL PRODUCT LINE:
CAST IRON — JACKETED PUMPS

224C Series™, 1224C Series™, 4224C Series™, 324A Series™, 1324A Series™, 4324A Series™

FEATURES & BENEFITS

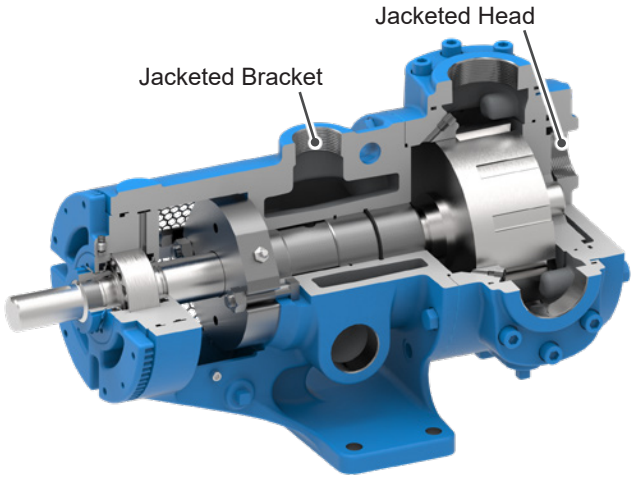
- Positive Displacement Internal Gear pumping principle handles a broad range of viscosities with constant flow rate
- **ProPort™ Casing (224C Series™, 1224C Series™ & 4224C Series™):**
  - » Adaptable port design offers a variety of port sizes and types, enabling flexibility when connecting pumps to piping
  - » H-Q sizes available with optional opposite porting
  - » Casing drain allows the pump to be drained without removing the head
  - » Optional O-ring joint seals for high pressure or difficult to seal applications
  - » Internal circulation promotes flow behind the rotor
- **U-Plus™ Bracket (224C Series™, 1224C Series™ & 4224C Series™):**
  - » Seal options include packing, O-Pro® Barrier seal, single component seals, cartridge lip seals and cartridge single and double mechanical seals. Various seal flush plans are available.
  - » Stainless steel window guards offer protection from rotating parts
- Footed one-piece iron bracket provides rigid mounting to help maintain alignment, which extends seal and bearing life
- Series designed with an enlarged bearing housing; used in conjunction with a spacer coupling permits easy cartridge seal installation and removal in place without removing the head and rotor/shaft
- Axial rotor thrust is controlled by double row ball bearing or tapered roller bearings; bushings provide a secondary point of radial shaft support
- Rotatable bearing housing provides easy rotor end clearance adjustment to compensate for viscosity or wear
- Numerous material options are available for bushings, idler pin, shaft, rotor, idler and elastomers
- Gear and pump geometry has been optimized based on more than 100 years of experience
- Can be used with direct drive, gear reducer or gearmotor drive, or belt-drive

JACKETING

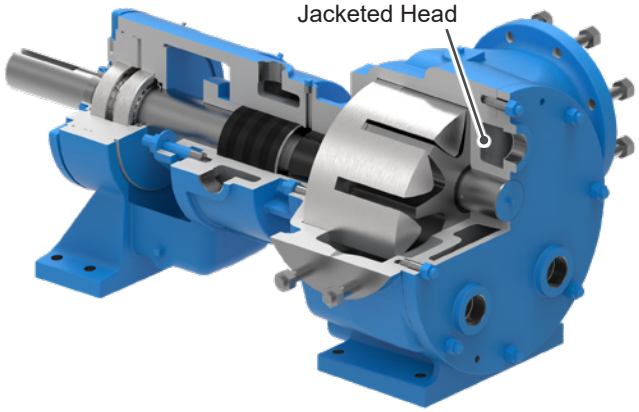
Jacketed pumps provide a cavity, or jacket, on the external wall of the pump through which steam or heat transfer liquid can be passed to control the temperature of the fluid in the pump. The heat transfer medium flows in a closed loop back to the boiler or heater. Applications include “melting” ambient temperature solids like asphalt which solidify in the pump when it cools, and maintaining precise temperature control in processes like manufacturing polymers and epoxy resins.

Standard-Jacketed Pumps

Standard-Jacketed pumps include 224C Series™, 4224C Series™ and 1224C Series™. They feature jacketing on the head and bracket only, and are typically used for melting ambient temperature solids. 324A Series™, 1324A Series™ and 4324A Series™ pumps are standard with jacketed bracket and optional jacketed head.



HL4224C
Jacketed Pump Cutaway



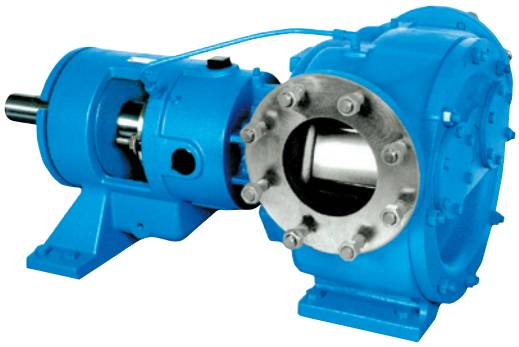
N324A
Jacketed Pump Cutaway

RELIEF VALVE CONFIGURATIONS

Jacketed pumps are provided with a jacketed head with no relief valve as standard. Integral pressure relief valves in jacketed and non-jacketed configurations are available on L through N sizes, but require a non-jacketed valve-type head.

The N size 324A Series™, 1324A Series™ & 4324A Series™ pumps are standard with a jacketed bracket, non-jacketed head and non-jacketed relief valve. A jacketed head, or a jacketed relief valve with non-jacketed valve-type head, is available as an option.

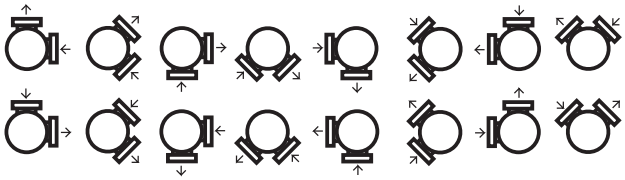
The R size 324A Series™, 1324A Series™ & 4324A Series™ pumps are standard with a jacketed bracket, a jacketed head and a non-jacketed relief valve. RS models have a jacketed bracket and head with no relief valve.



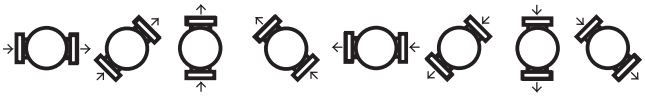
N4324A
Non-Jacketed Head with Coverplates Shown

PORT LOCATION OPTIONS

90° port options:



Opposite port options:



NOTE: See page 2402.8 for a complete list of port options for ProPort™ casing by size.

H-Q sizes are standard with 90 degree ports, optional opposite port casings are available.

QS size is standard with opposite ports.

Q224C with ProPort™ Casing, 90° Ports

HL224C
Opposite Ports

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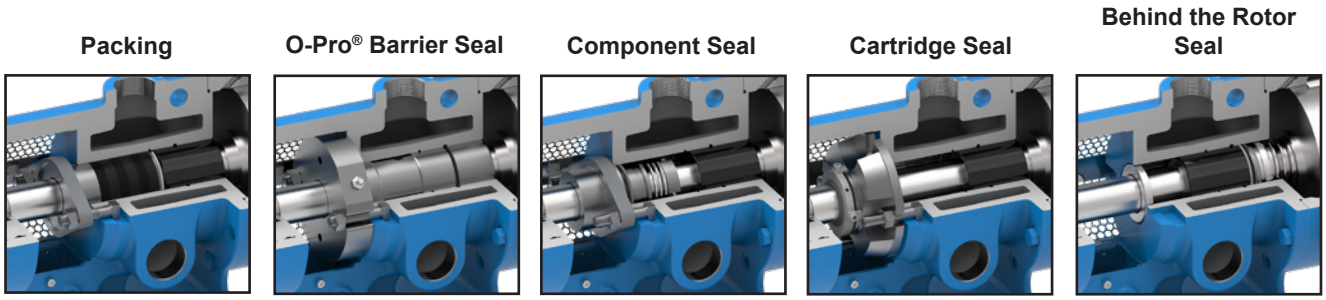
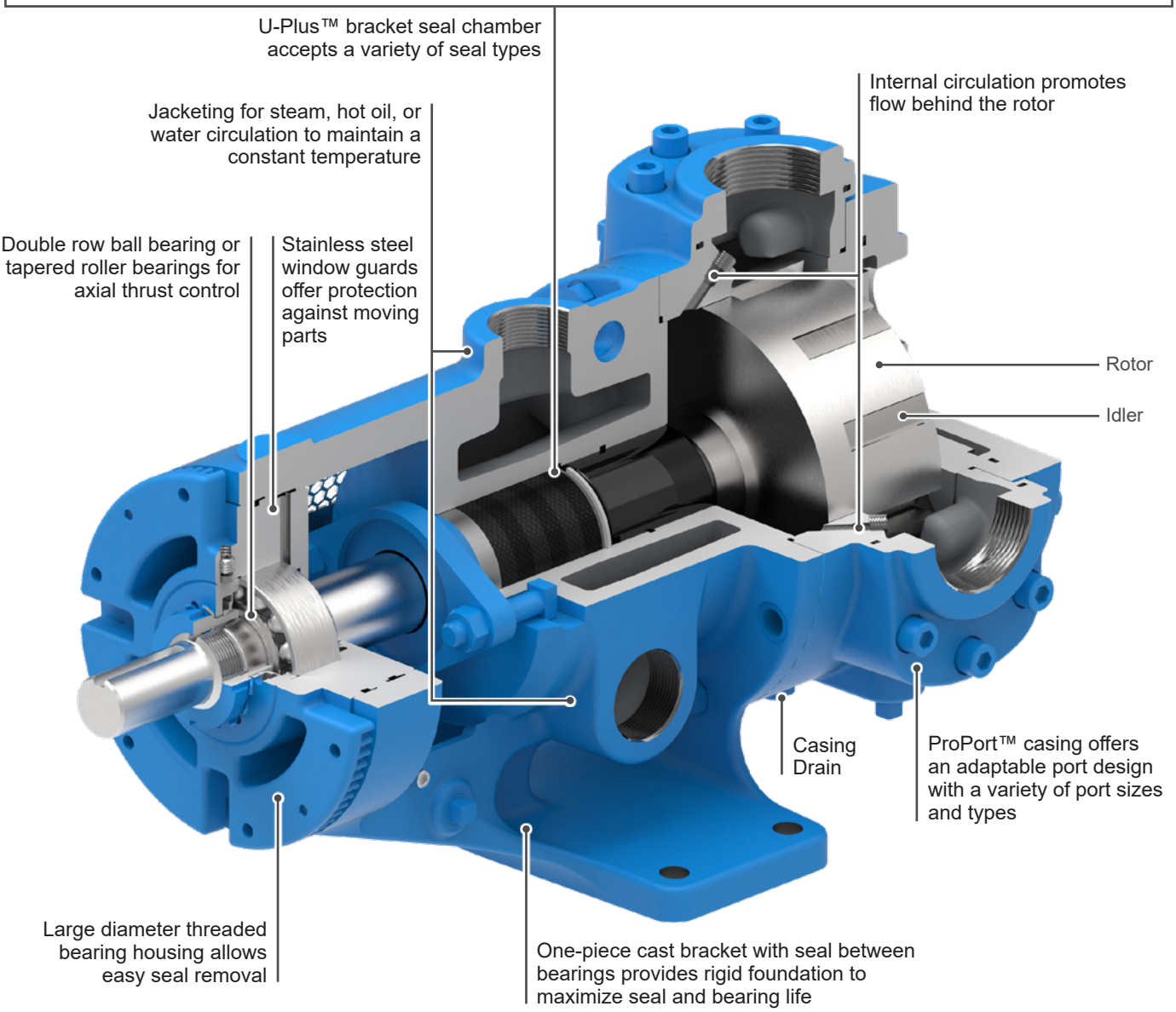
CUTAWAY VIEW & PUMP FEATURES





MODEL NUMBER KEY

L S 4 2 2 4 C

Size:
H Q
HL QS
KK N
L R
LS RS

Shaft Seal:
1 = O-Pro® Seal
4 = Mechanical Seal
Blank = Packing

Jacketing:
2 = Jacketed
3* = Foot Mount Casing w/ Jacketed Bracket

Basic Series Configuration

Material of Construction:
4 = Cast Iron

Seal Location:
A = Stuffing Box Seal
C = U-Plus™ Bracket for Stuffing Box or Behind the Rotor Seals

* Only the N through RS sizes are foot mount with jacketed bracket (3).

STANDARD MATERIALS OF CONSTRUCTION

Component	Standard Material	
Casing	Cast Iron, ASTM A48, Class 35B	
Ports	Cast Iron, ASTM A48, Class 35B	
Head	Cast Iron, ASTM A48, Class 35B	
Head Plate	Cast Iron, ASTM A48, Class 35B	
Bracket	Cast Iron, ASTM A48, Class 35B	
Idler	**Standard**	① Cast Iron, ASTM A48, Class 35B
	Steel Fitted	①② Cast Iron, ASTM A48, Class 35B
Rotor	**Standard**	③ Cast Iron, ASTM A48, Class 35B
	Steel Fitted	④ Steel, ASTM A148, Grade 80-40
Shaft	Hardened High Strength Steel, ASTM A434, Grade 4140, Class BC	
Idler Pin	Hardened Steel, ASTM A108, Grade 1045	
Idler Bushing	**(4224C Series™, 4324A Series™)**	Carbon Graphite
	(1224C Series™, 1324A Series™)	Hardened Cast Iron
	(224C Series™, 324A Series™)	Bronze, ASTM B584 (B505), Alloy C93700
Bracket Bushing *(Not applicable on 1224C Series™ or 1324A Series™)*	**(4224C Series™, 4324A Series™)**	Carbon Graphite
	(224C Series™, 324A Series™)	Bronze, ASTM B584 (B505), Alloy C93700
Pressure Relief Valve	⑤ Cast Iron, ASTM A48, Class 35B	
Standard Packing (224C Series™, 324A Series™)	Braided PTFE	
O-Pro® Barrier Seal (1224C Series™, 1324A Series™)	Hardened Cast Iron, Sanitary FKM Elastomers	
Standard Mechanical Seal (4224C Series™, 4324A Series™)	Carbon vs. Silicon Carbide Faces, PTFE Elastomers	
Optional Abrasive Liquid Seal (4224C Series™)	Silicon Carbide vs. Silicon Carbide Faces, FKM Elastomers	

① H and HL sizes have a powdered metal idler: Powdered Metal MPIF 35, FC-0208-50
② Q and QS sizes have a steel idler when pump is steel fitted: ASTM A148 Grade 80-40.
③ KK, LS, QS, N and RS sizes have ductile iron rotor: ASTM A536 Grade 60-40-18.
④ Material specification for HL steel rotor is AISI 8620, LS steel rotor is ASTM A148 80-50.
⑤ RS relief valve not available. Contact factory for options.

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SPECIAL MATERIALS & OPTIONS SELECTION GUIDELINES

For High Viscosities - Above 2,500 SSU (550 cSt)

- Steel fitted construction recommended above the following viscosities, according to pump size:

Viscosity	Pump Size									
	H	HL	KK	L	LS	Q	QS	N	R	RS
SSU	25,000	7,500	75,000	25,000	75,000	7,500	75,000	75,000	25,000	75,000
cSt	5,500	1,700	17,000	5,500	17,000	1,700	17,000	17,000	5,500	17,000

- Extra clearances, depending on viscosity. Contact factory for clearance specifications.
- Special Sealing:
  Fluoroelastomer (FKM) Type 1 component seals good up to 15,000 SSU (3,300 cSt).
  PTFE Type 9 seals good up to 25,000 SSU (5,500 cSt).
  Packed gland good up to 2,000,000 SSU (440,000 cSt).
  Cartridge triple lip seals available to 2,000,000 SSU (440,000 cSt).
- Larger ports may be required depending on suction conditions.
- Pump should be operated at slower than normal speeds, which may require a larger pump.
- For viscosities over 250,000 SSU (55,000 cSt), contact factory for additional pump construction and operation recommendations.

For low viscosities or non-lubricating liquids – Below 100 SSU (20 cSt)

- Carbon graphite bushings.
- Pump should be operated at slower than normal speeds, which may require a larger pump.
- O-Pro® seals are not recommended for viscosities less than 100 SSU (20 cSt)

For high temperatures – Above 225° F (107°C)

- High temperature elastomers – Buna up to 225°F (105°C); FKM up to 350°F (175°C); PTFE up to 450°F (230°C); FFKM up to 550°F (290°C); Grafoil up to 700°F. (370°C). High temp packing in excess of 500°F (260°C).
- High temperature bushings recommended depending on temperature, size and specific material. See ESB-3 for recommendations.
- Additional operating clearances may be required depending on temperature, size and specific material. See ES-2 for recommendations.
- For temperatures above 450°F (230°C), special materials and sealing requirements may be needed. Contact factory for recommendations.
- Pump should be operated at slower than normal speeds, which may require a larger pump.

For abrasive or dirty liquids

- If possible, filter or strain out the abrasives present.
- Wear resistant bushings - hardened cast iron, tungsten carbide or Colmonoy coated.
- Abrasive-resistant idler pin - tungsten carbide or Colmonoy plus TC filler coated pins.
- Hardened or hard-coated shafting.
- Abrasive-resistant seals.
- For high concentrations of abrasives or particle sizes greater than 250 microns (0.010 in), contact factory for recommendations.
- Pump should be operated at slower than normal speeds, which may require a larger pump.
- Consult factory for specific recommendations.

SPECIFICATIONS

Model Number	Standard Port Size ③	Nominal Pump Rating (100 SSU & below)			Max. Hydrostatic Pressure ④		Max. Discharge Pressure ①		Max. Recommended Temp. for Standard Pump		Approx. Shipping Weight with Valve	
	Inches	GPM	m^3/h	RPM	PSIG	BAR	PSIG	BAR	°F	°C	Lbs.	Kg.
H224C	1 ½	15	3.5	1750	400	28	200	14	450	230	38	17
H1224C	1 ½	8	1.8	1000	400	28	200	14	350	175	41	19
H4224C	1 ½	15	3.5	1750	400	28	200	14	450	230	38	17
HL224C	1 ½	30	7	1750	400	28	200	14	450	230	40	18
HL1224C	1 ½	18	4	1000	400	28	200	14	350	175	41	19
HL4224C	1 ½	30	7	1750	400	28	200	14	450	230	40	18
KK224C	2	100	23	780	400	28	200	14	450	230	110	50
KK1224C	2	100	23	780	400	28	200	14	350	175	117	53
KK4224C	2	100	23	780	400	28	200	14	450	230	110	50
L224C	2	135	31	640	400	28	200	14	450	230	155	70
L1224C	2	135	31	640	400	28	200	14	350	175	161	73
L4224C	2	135	31	640	400	28	200	14	450	230	155	70
LS224C	3	200	45	640	300	21	200	14	450	230	190	86
LS1224C	3	200	45	640	300	21	200	14	350	175	234	106
LS4224C	3	200	45	640	300	21	200	14	450	230	190	86
Q224C	4	300	68	520	250	17	200	14	450	230	440	200
Q1224C	4	275	62	470	250	17	200	14	350	175	324	147
Q4224C	4	300	68	520	250	17	200	14	450	230	440	200
QS224C	6	500	114	520	250	17	200	14	450	230	540	245
QS1224C	6	400	91	470	250	17	200	14	350	175	318	144
QS4224C	6	500	114	520	250	17	200	14	450	230	540	245
N324A	6	600	136	350	250	17	200	14	450 ②	230 ②	810	367
N1324A	6	550	125	330	250	17	200	14	350	175	937	425
N4324A	6	600	136	350	250	17	200	14	450 ②	230 ②	810	367
R324A	8	1,100	250	280	250	17	200	14	450 ②	230 ②	1,435	651
R1324A	8	1,000	227	260	250	17	200	14	350	175	1,523	691
R4324A	8	1,100	250	280	250	17	200	14	450 ②	230 ②	1,435	651
RS324A	10	1,600	364	280	250	17	125	9	450 ②	230 ②	2,000	907
RS1324A	10	1,500	340	260	250	17	125	9	350	175	1,987	901
RS4324A	10	1,600	364	280	250	17	125	9	450 ②	230 ②	2,000	907

① For maximum recommended discharge pressures at different viscosities, see performance curves, which can be electronically generated with the Viking Pump Curve Generator, located on www.vikingpump.com. If suction pressure exceeds 50 PSIG, consult factory. Higher pressures possible with factory approval based on application details.

② Extra clearances are required above 225°F / 105°C. Higher temperatures can be handled with special construction, consult factory.

③ Ports are tapped for standard (NPT) pipe on sizes H through L. See table on page 8 for additional port options. Sizes LS through RS have flange ports suitable for use with Class 125 ANSI cast iron companion flanges or flanged fittings.
H-Q sizes are *standard* with 90° ports.
QS, N, R and RS ports are *standard* with 180° (opposite) ports.

④ Maximum hydrostatic pressure for standard pump construction. Rating is dependent on seal, gaskets and ports.

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PORT OPTIONS FOR PROPORT™ CASING

Port Options	Pump Sizes						
	H	HL	KK	L	LS	Q	QS
1.5" NPT	S	S					
2" NPT			S	S			
1.5" Class 150 ①	✓	✓					
1.5" Class 300 ②	✓	✓					
2" Class 150 ①	✓	✓	✓				
2" Class 300 ②	✓	✓	✓				
2.5" Class 150 ①				✓			
2.5" Class 300 ②				✓			
3" Class 150 ①			✓	✓	S		
3" Class 300 ②			✓	✓	✓		
4" Class 150 ①			✓	✓	✓	S	
4" Class 300 ②				✓	✓	✓	
6" Class 150 ①							S
6" Class 300 ②							✓
DIN 32 PN16 *	✓	✓					
DIN 40 PN16 *	✓	✓					
DIN 50 PN16 *	✓	✓	✓				
DIN 65 PN16 *			✓	✓			
DIN 80 PN16 *			✓	✓	✓		
DIN 100 PN16 *				✓	✓	✓	✓
DIN 150 PN16 *						✓	✓

✓ = Available Port Option

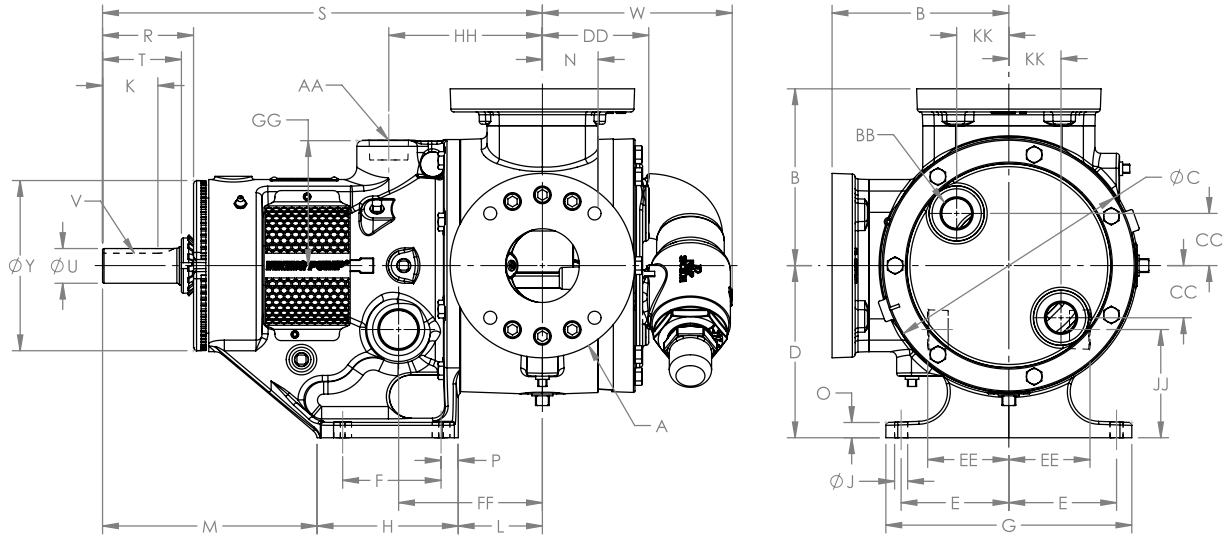
S = Standard Porting

① = Ports are suitable for use with Class 150 steel or stainless steel companion flanges or flanged fittings

② = Ports are suitable for use with Class 300 steel or stainless steel companion flanges or flanged fittings

* Ports are sutable for use with DIN PN16 steel or stainless steel companion flanges or flanged fittings

DIMENSIONS – H THROUGH Q SIZES



These dimensions are average and not for construction purposes. Certified prints on request.

Model Number			① A (in)		B	C	D	E	②③ F	G	H	J	K	L	M	N	O	②③ P	R
Packed	O-Pro® Seal	Mechanical Seal																	
H224C HL224C	H1224C HL1224C	H4224C HL4224C	⑤ 1.5 NPT	in	3.50	4.75	3.50	2.75	2.25	6.75	3.50	0.47	0.99	3.38	5.19	1.19	0.56	0.62	2.2
				mm	89	121	89	70	57	171	89	12	25	86	132	30	14	16	56
KK224C	KK1224C	KK4224C	2	in	5.25	8.00	5.50	4.00	2.75	9.25	4.00	0.53	1.42	3.00	9.38	1.75	0.62	0.62	2.84
				mm	133	203	140	102	70	235	102	13	36	76	238	44	16	16	72
L224C	L1224C	L4224C	2	in	7.19	10.25	7.00	4.38	4.00	10.00	5.38	0.53	2.25	3.58	8.89	1.75	0.62	0.62	3.7
				mm	183	260	178	111	102	254	137	13	57	91	226	44	16	16	94
LS224C	LS1224C	LS4224C	3	in	7.19	10.25	7.00	4.38	4.00	10.00	5.38	0.53	2.55	4.75	9.12	2.44	0.62	0.62	3.9
				mm	183	260	178	111	102	254	137	13	65	121	232	62	16	16	99
Q224C	Q1224C	Q4224C	4	in	8.25	14.00	8.75	4.12	4.00	10.00	6.00	0.69	3.58	6.62	11.12	3.00	0.8	1	5.2
				mm	210	356	222	105	102	254	152	18	91	168	282	76	20	25	132

Model Number				S	T	U (in)	V (in)	W*	Y	AA (in)	BB (in)	④ CC	DD	EE	FF	GG	HH	JJ	④ KK
Packed	O-Pro® Seal	Mechanical Seal																	
H224C HL224C	H1224C HL1224C	H4224C HL4224C	in	12.06	1.62	0.75	.19 x .09	4.04	5.75	0.75	0.50	0.84	2.41	1.83	4.04	2.39	4.04	1.76	0.43
			mm	306	41			103	146			21	61	46	103	61	103	45	11
KK224C	KK1224C	KK4224C	in	16.38	2.25	1.12	.25 x .12	7.00	6.75	1.25	1.25	1.75	3.25	2.75	5.78	4.01	5.78	3.38	—
			mm	416	57			178	171			44	83	70	147	102	147	86	—
L224C	L1224C	L4224C	in	17.87	3.13	1.44	.38 x .19	7.18	7.00	1.25	1.00	3.00	3.81	3.30	5.85	5.12	6.25	4.40	—
			mm	454	80			182	178			76	97	84	149	130	159	112	—
LS224C	LS1224C	LS4224C	in	19.25	3.50	1.44	.38 x .19	7.72	7.00	1.25	1.00	3.00	4.50	3.30	7.00	5.12	7.40	4.40	—
			mm	489	89			196	178			76	114	84	178	130	188	112	—
Q224C	Q1224C	Q4224C	in	23.75	4.50	1.94	.50 x .25	11.25	8.38	1.50	1.00	3.75	5.06	4.50	6.62	7.00	7.62	5.50	3.75
			mm	603	114			286	213			95	129	114	168	178	194	140	95

① Unless otherwise noted, ports are suitable for class 125 ANSI iron companion flanges or flanged fittings.

② H-HL bracket foot has slotted foot mounting holes. Dimension F = 1.65-2.38 [42-60] and dimension P = 0.52-0.65 [13-16].

③ L-LL-LS bracket foot has slotted foot mounting holes. Dimension F = 3.81-4.19 [81-106] and dimension P = 0.45-0.64 [12-16].

④ Q-QS jacketed heads have 3 connection points on a 3.75 radius. Two are at the 3 and 6 o'clock positions, and the third is .97 to the right of the vertical centerline and 3.62 above the horizontal centerline.

⑤ H-HL Pro-Port™ Casing has a different port centerline compared to the integral port casing.

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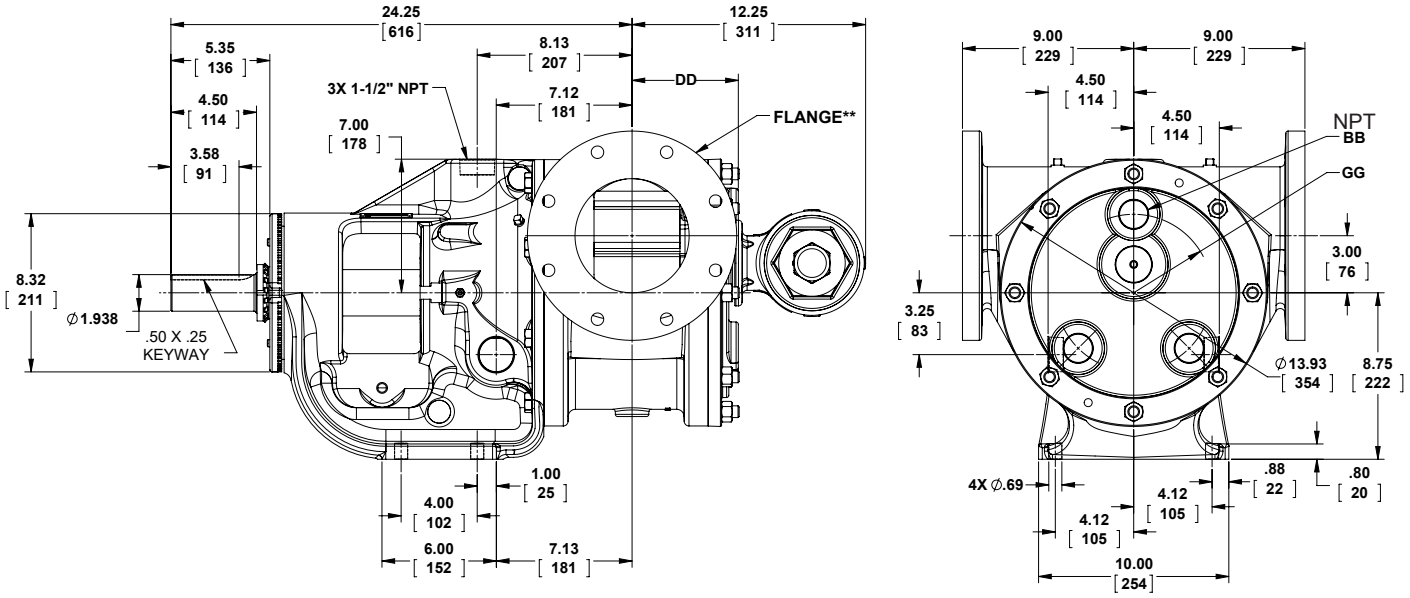
DIMENSIONS – QS SIZE

Dimensions shown in inches with millimeter equivalent shown in parentheses



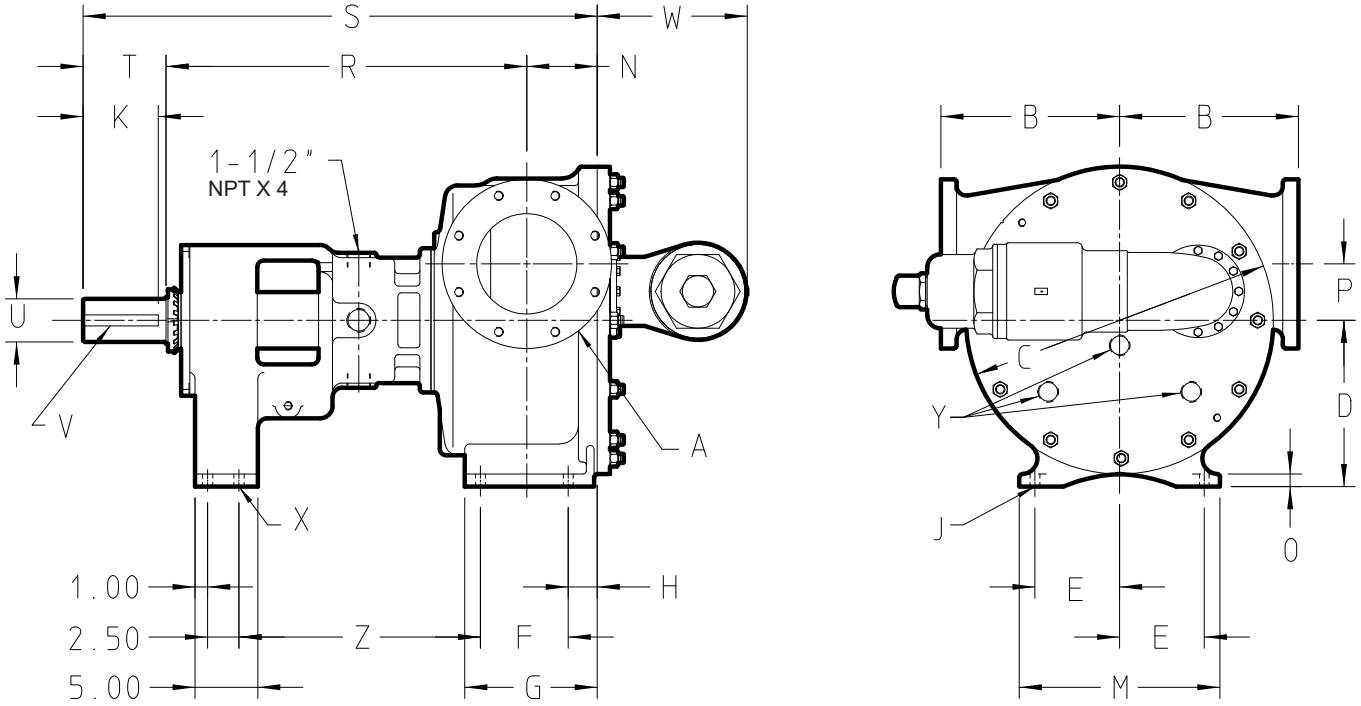
Model Number			BB*	DD	GG
Packed	O-Pro® Seal	Mechanical Seal			
QS224C	QS1224C	QS4224C	1.25	5.57 (141)	4.12 (105)

* Ports for steam or hot oil jacketing are inch standard NPT threads.

224C Series™ / 4224C Series™ ports suitable for use with Class 125 ANSI cast iron companion flanges or flanged fittings.

NOTE: Flanges are 6", suitable for use with Class 125 ANSI cast iron companion flanges or flanged fittings.
They are studded, not through-bolt.

DIMENSIONS – N, R & RS SIZES – JACKETED BRACKET



Model Number			A (in)		B	C	D	E	F	G	H	J	K	M
Packed	O-Pro® Seal	Stuffing Box Seal												
N324A	N1324A	N4324A	② 6	in	9.75	17.25	9.50	5.00	6.25	8.69	1.62	0.69	4.50	12.00
				mm	248	438	241	127	159	221	41	18	114	305
R324A	R1324A	R4324A	② 8	in	14.25	24.50	13.25	6.75	7.00	10.56	2.31	0.78	6.00	16.00
				mm	362	622	337	171	178	268	59	20	152	406
RS324A	RS1324A	RS4324A	② 10	in	14.25	24.50	13.25	6.75	7.00	13.12	4.81	0.88	6.00	16.46
				mm	362	622	337	171	178	333	122	22	152	418

Model Number				N	O	P	R	S	T	U (in)	V (in)	W	X	Y (in)	Z
Packed	O-Pro® Seal	Stuffing Box Seal													
N324A	N1324A	N4324A	in	4.50	1.00	3.00	26.00	36.50	6.00	2.44	.62 x.31	8.63	0.69	N/A	18.94
			mm	114	25	76	660	927	152			219	18		481
R324A	R1324A	R4324A	in	5.62	1.00	4.50	28.75	41.00	6.62	3.44	.88 x.44	12.00	0.69	1.25 NPT	19.25
			mm	143	25	114	730	1041	168			305	18		489
RS324A	RS1324A	RS4324A	in	8.12	1.30	4.50	28.55	43.49	6.62	3.44	.88 x.44	12.00	0.88	1.25 NPT	19.25
			mm	206	33	114	725	1105	168			305	22		489

NOTE: The N size is standard with a jacketed bracket and non-jacketed head and non-jacketed relief valve, while the "R" size is standard with a jacketed bracket, a jacketed head, and a non-jacketed relief valve. "RS" contact factory for jacketing options.

② Ports are suitable for use with Class 125 ANSI cast iron companion flanges or flanged fittings.

NPSH REQUIRED

Printed performance curves are not available.

Performance curves can be electronically generated with the Viking Pump Curve Generator on vikingpump.com.

NPSHR data is not available on the pump selector.

NPSH (Net Positive Suction Head): The $NPSH_R$ (Net Positive Suction Head Required by the pump) is given in the table below and applies for viscosities through 750 SSU. $NPSH_A$ (Net Positive Suction Head – Available in the system) must be greater than the $NPSH_R$. For a complete explanation of NPSH, see Application Data Sheet AD-19.

FOR VISCOSITIES UP TO 750 SSU – See $NPSH_R$ table below.

$NPSH_R$ for high viscosities can be estimated using the following method:

1. Calculate line loss for a 1 foot long pipe of a diameter matching the pump inlet port size. Use your flow rate and max viscosity.
2. Convert this value into Feet of Liquid (S.G. 1.0)
3. Add this value to the $NPSH_R$ value in the chart below.

$NPSH_R$ – FEET OF LIQUID (Specific Gravity 1.0), Viscosities up to 750 SSU

PUMP SIZE	PUMPS SPEED, RPM														
	100	125	155	190	230	280	350	420	520	640	780	950	1150	1450	1750
H, HL	—	—	—	—	1.7	1.8	1.9	2.1	2.4	2.8	3.4	4.5	6.2	9.5	13.5
KK	—	1.7	1.8	1.9	2.1	2.3	2.8	3.3	4.4	6.3	9.1	—	—	—	—
L	1.6	1.8	2.0	2.2	2.5	3.0	3.8	5.0	7.3	10.8	—	—	—	—	—
LS	1.6	1.8	2.0	2.2	2.5	3.0	3.8	5.0	7.3	10.8	—	—	—	—	—
Q, QS	1.9	2.1	2.3	2.7	3.3	4.2	6.1	8.4	12.7	—	—	—	—	—	—
N	2.1	2.3	3.5	4.5	6.3	9.5	15.0	—	—	—	—	—	—	—	—
R	6.1	7.1	8.3	10.1	12.1	15.2	—	—	—	—	—	—	—	—	—
RS	7.0	8.5	10.4	13.1	17.2	22.4	—	—	—	—	—	—	—	—	—