UNIVERSAL PRODUCT LINE:
STEEL EXTERNALS — JACKETED PUMPS
SERIES 223A, 4223A, 323A, 4323A

Section	1302
Page	1302.1
Issue	B

TABLE OF CONTENTS

Features & Benefits 2
Jacketing 2
Relief Valve Configurations 3
Porting & Sealing 3
Revolvable Pump Casings 3
Cutaway View & Pump Features 4
Model Number Key 5
Standard Materials of Construction 5
Special Materials & Options Selection Guidelines 6
Specifications 7
Optional Casings – H through RS Sizes 8
Dimensions – H through Q Sizes *(223A, 4223A)* 9
Dimensions – QS Size *(223A, 4223A)* 10
Dimensions – N & R Sizes – Jacketed Bracket *(323A, 4323A)* 11
Dimensions – RS Size – Jacketed Bracket *(323A, 4323A)* 12
Dimensions – Stuffing Box Seal Chamber 13
NPSH Required 14

RELATED PRODUCTS

Steel Externals, Non-Jacketed Pumps: Catalog Section 1301

Cast Iron, Jacketed Pumps: Catalog Section 1402

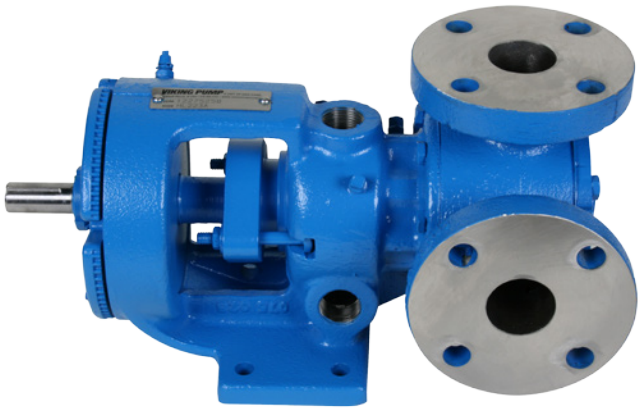
Stainless Steel, Jacketed Pumps: Catalog Section 1702

SERIES DESCRIPTION

Pumps are designed for a broad range of applications, from thin to thick, requiring continuous duty at pressures up to 200 PSI (14 Bar). Even higher pressures are possible with high fluid viscosities at reduced operating speeds (consult factory). They are also capable of operating under suction lift conditions and operate equally well in either direction.

The Universal Product Line has the broadest range of sealing options of all pumps built by Viking. The stuffing box on all sizes accepts packing, numerous component single mechanical seals, or a wide variety of cartridge seals.

The Universal Product Line is Viking Pump's most versatile line of internal gear pumps due to the availability of many design and material options.



HL223A

OPERATING RANGE

	NOMINAL FLOW		MAXIMUM PRESSURE		TEMPERATURE RANGE		VISCOSITY RANGE	
SERIES	GPM	m^3h	PSI	Bar	°F	°C	SSU	cSt
223A	15 - 500	3 - 114	200	14	−20 to +800	−25 to +425	28 to 2,000,000	1 to 440,000
4223A	15 - 500	3 - 114	200	14	−20 to +800	−25 to +425	28 to 2,000,000	1 to 440,000
323A	600 - 1,600	136 - 364	200	14	−20 to +800	−25 to +425	28 to 2,000,000	1 to 440,000
4323A	600 - 1,600	136 - 364	200	14	−20 to +800	−25 to +425	28 to 2,000,000	1 to 440,000

UNIVERSAL PRODUCT LINE:
STEEL EXTERNALS — JACKETED PUMPS

SERIES 223A, 4223A, 323A, 4323A

FEATURES & BENEFITS

- Positive Displacement Internal Gear pumping principle handles a broad range of viscosities with constant flow rate
- Axial rotor thrust is controlled by double row ball bearing or tapered roller bearings; bushings provided 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 pins, shafts, rotors, idlers and elastomers
- Gear and pump geometry has been optimized based on more than 100 years of experience
- Footed cast iron bracket provides rigid mounting to help maintain alignment, which extends seal and bearing life
- Can use direct drive, gear reducer or gearmotor drive, or belt-drive
- 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.
- Seal options include packing, single component seals, cartridge lip seals and cartridge single and double mechanical seals. Various seal flush plans are available.
- Steel externals for petroleum refineries, petrochemical plants and similar customers who require higher temperature and higher working pressures than cast iron pumps can provide

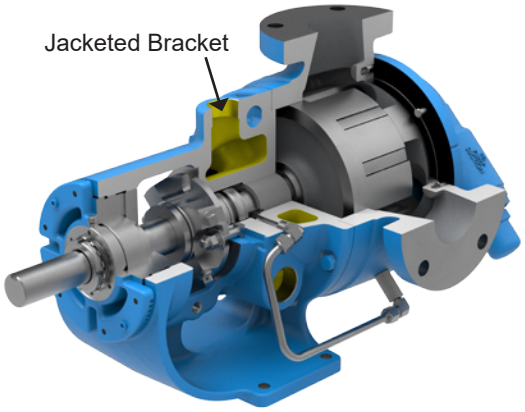
Viking Universal Product Line pumps carry a three year limited warranty. See catalog section 000 for details.

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 series 223A & 4223A. They feature jacketing on the head and bracket only, and are typically used for melting ambient temperature solids.



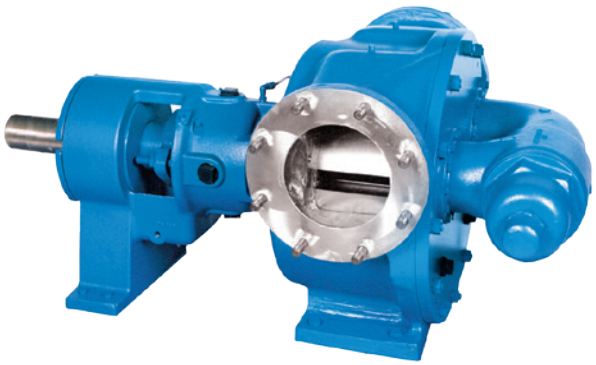
LS4223A
Jacketed Pump Cutaway

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 “LQ” through “N” sizes, but require a non-jacketed valve-type head.

The “N” 323A & 4323A 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” 323A & 4323A 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.



R4323A Jacketed Head with Non-Jacketed Relief Valve Shown

PORTING & SEALING

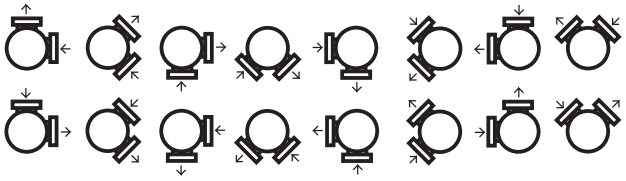
A variety of opposite and 90° port configurations are available, including top suction with bottom or side discharge designs typically mounted at the bottom of a tank or reactor.

Jacketed port options for steam or heat transfer liquid are threaded.

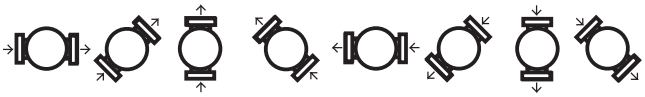
The seal chamber design accepts packing, component seals or cartridge seals. Seal plans, including API plan 53 and 54, are available.

REVOLVABLE PUMP CASINGS

90° port options:



Opposite port options:

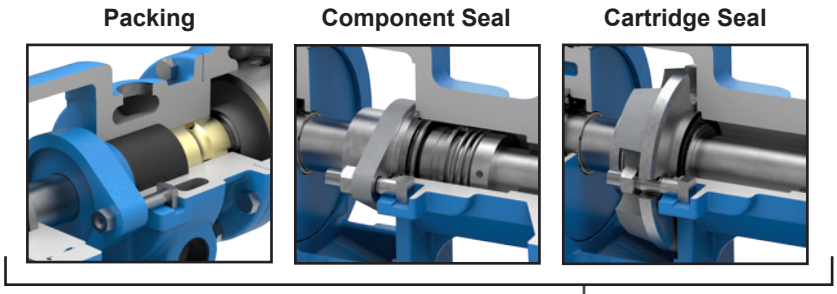


NOTE: See page 1302.8 for a complete list of casing options by size.

UNIVERSAL PRODUCT LINE:
STEEL EXTERNALS — JACKETED PUMPS

SERIES 223A, 4223A, 323A, 4323A

CUTAWAY VIEW & PUMP FEATURES



Seal chamber accepts packing and a variety of component and cartridge style mechanical and lip seals, in both single and double mechanical seal configurations

Jacketing (highlighted in yellow) for steam, hot oil or hot water circulation

Double row ball bearing or tapered roller bearings for axial thrust control

(Shown with optional raised face flanges)

Rotor

Idler

Multiple port sizes, types, and ratings are available including flanged (Class 150, Class 300)

Large diameter threaded bearing housing allows easy removal of cartridge seals

One-piece cast bracket with seal between bearings provides rigid foundation to maximize seal and bearing life

MODEL NUMBER KEY

L Q 4 2 2 3 A

Size:
H LS
HL Q
K QS
KK N
LQ R
LL RS

Shaft Seal:
4 = Mechanical Seal
Blank = Packing

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

Basic Series Configuration

Material of Construction:
3 = Steel Externals

Seal Location:
A = Stuffing Box Seal

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

STANDARD MATERIALS OF CONSTRUCTION

Component	Standard Material	
Casing	Steel, ASTM A216, Class WCB	
Head	Steel, ASTM A216, Class WCB	
Head Plate	Steel, ASTM A216, Class WCB	
Bracket	Steel, ASTM A216, Class WCB	
Idler	**Standard**	① Cast Iron, ASTM A148, Class 35B
	Steel Fitted	①② Cast Iron, ASTM A148, Class 35B
Rotor	**Standard**	③ Cast Iron, ASTM A148, Class 35B
	Steel Fitted	④ Steel, ASTM A148, Grade 80-40
Shaft	⑤ Steel, ASTM A108, Grade 1045	
Idler Pin	Hardened Steel, ASTM A108, Grade 1045	
Idler Bushing	**(4224A, 4324A)**	Carbon Graphite
	(224A, 324A)	Bronze, ASTM B584 (B505), Alloy C93700
Bracket Bushing	**(4124A, 4324A)**	Carbon Graphite
	(124A, 324A)	Bronze, ASTM B584 (B505), Alloy C93700
Pressure Relief Valve	⑥ Steel, ASTM A216, Class WCB	
Standard Packing (123A, 323A)	Braided PTFE	
Standard Mechanical Seal (4123A, 4323A)	Carbon vs. Silicon Carbide Faces, Viton™ Elastomers	

① H and HL sizes have a powdered metal idler: Powdered Metal MPIF 35, FC-0208-50 (G) , Powdered Metal MPIF 35, FC-0208-45 (H, HL)
② Q and QS sizes have a hardened 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 LQ, LL and LS sizes are high strength steel ASTM A434 Type 4140 Grade BC or equivalent.
⑥ LQ, LL and LS relief valve bodies are stainless steel.

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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	K	KK	LQ	LL	LS	Q	QS	N	R	RS
SSU	25,000	7,500	25,000	75,000	25,000	2,500	75,000	7,500	75,000	75,000	25,000	75,000
cSt	5,500	1,700	5,500	17,000	5,500	550	17,000	1,700	17,000	17,000	5,500	17,000

- Extra clearances, depending on viscosity. See ES-2 for recommendations.
- Special Sealing:
  Viton™ or Buna N 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.

For high temperatures – Above 225°F (105°C)

- High temperature elastomers – Viton™ up to 350°F (175°C); Buna up to 225°F (105°C); PTFE up to 450°F (230°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 shaft.
- 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	③ Standard Port Size	Nominal Pump Rating (100 SSU & below)			Max. Hydrostatic Pressure		① Maximum Discharge Pressure		Max. Recommended Temperature for Standard Pump		Approx. Shipping Weight with Valve	
	Inches	GPM	m^3/h	RPM	PSIG	BAR	PSIG	BAR	°F	°C	Lbs.	Kg.
H223A	1 ½	15	3	1750	400	28	200	14	450	230	42	19
H4223A	1 ½	15	3	1750	400	28	200	14	450	230	42	19
HL223A	1 ½	30	6.8	1750	400	28	200	14	450	230	45	20
HL4223A	1 ½	30	6.8	1750	400	28	200	14	450	230	45	20
K223A	2	80	18	780	400	28	200	14	450	230	120	54
K4223A	2	80	18	780	400	28	200	14	450	230	120	54
KK223A	2	100	23	780	400	28	200	14	450	230	125	57
KK4223A	2	100	23	780	400	28	200	14	450	230	125	57
LQ223A	2 ½	135	31	640	400	28	200	14	450	230	190	86
LQ4223A	2 ½	135	31	640	400	28	200	14	450	230	190	86
LL223A	3	140	32	520	400	28	200	14	450	230	210	95
LL4223A	3	140	32	520	400	28	200	14	450	230	210	95
LS223A	3	200	45	640	400	28	200	14	450	230	210	95
LS4223A	3	200	45	640	400	28	200	14	450	230	210	95
Q223A	4	300	68	520	400	28	200	14	450	230	490	222
Q4223A	4	300	68	520	400	28	200	14	450	230	490	222
QS223A	6	500	114	520	400	28	200	14	450	230	590	268
QS4223A	6	500	114	520	400	28	200	14	450	230	590	268
N323A	6	600	136	350	400	28	200	14	② 450	230	810	367
N4323A	6	600	136	350	400	28	200	14	② 450	230	810	367
R323A	8	1,100	250	280	400	28	200	14	② 450	230	1,435	651
R4323A	8	1,100	250	280	400	28	200	14	② 450	230	1,435	651
RS323A	10	1,600	364	280	400	28	125	9	② 450	230	2,500	1,140
RS4323A	10	1,600	364	280	400	28	125	9	② 450	230	2,500	1,140

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 suitable for Class 150 steel or stainless steel companion flanges or flanged fittings.

UNIVERSAL PRODUCT LINE:
STEEL EXTERNALS — JACKETED PUMPS
SERIES 223A, 4223A, 323A, 4323A

OPTIONAL CASINGS – H THROUGH RS SIZES

Size	Standard Casings		Standard Jacketed Pumps Optional Ports	Fully-Jacketed Casings
	Ports (Inches)	Rotatable Data		
H	1.5"①Ⓡ	Fully Rotatable	1.5" ②Ⓡ, 2" ①Ⓡ, 2" ②Ⓡ	2"②Ⓡ
HL	1.5"①Ⓡ	Fully Rotatable	1.5" ②Ⓡ, 2" ①Ⓡ, 2" ②Ⓡ	2"②Ⓡ
K	2"①Ⓡ	Ports cannot face down	2" ②Ⓡ, 2.5" ①Ⓡ, 2.5" ②Ⓡ, 3" ①Ⓡ, 3" ②Ⓡ, 4" ①Ⓡ, 4" ②Ⓡ	3"①Ⓡ, 4"①Ⓡ, 3"②Ⓡ, 3"②◎
KK	2"①Ⓡ	Ports cannot face down	2" ②Ⓡ, 2.5" ①Ⓡ, 2.5" ②Ⓡ 3" ①Ⓡ, 3" ②Ⓡ, 4" ①Ⓡ, 4" ②Ⓡ	3"①Ⓡ, 4"①Ⓡ, 3"②Ⓡ, 3"②◎
LQ	2.5"②Ⓡ	Ports cannot face down	2.5" ②Ⓡ, 3" ②Ⓡ, 4" ①Ⓡ, 4" ②Ⓡ, 6" ①Ⓡ	3"①Ⓡ, 3"②Ⓡ, 4"②Ⓡ
LL	3"②Ⓡ	Ports cannot face down	3" ②Ⓡ, 4" ①Ⓡ, 4" ②Ⓡ	
LS	3"②Ⓡ	Fully Rotatable	4"①Ⓡ	4"①Ⓡ, 6"①Ⓡ, 4"②Ⓡ
Q	4"②Ⓡ	Fully Rotatable	4" ②Ⓡ, 5" ①Ⓡ, 5" ②Ⓡ 6" ①Ⓡ*, 6" ②Ⓡ*, 6" ①◎, 6" ②◎	4"①Ⓡ, 4"②Ⓡ
QS	6"②◎	Rotatable with special casing	6" ①Ⓡ, 6" ②◎	6"①Ⓡ, 6"②◎
N	6"②◎	Not Rotatable		6"①Ⓝ, 8"②◎
R	8"②◎	Not Rotatable		8"①◎
RS	10"②◎	Not Rotatable		

① Ports suitable for Class 150 ANSI steel or stainless steel companion flanges or flanged fittings.

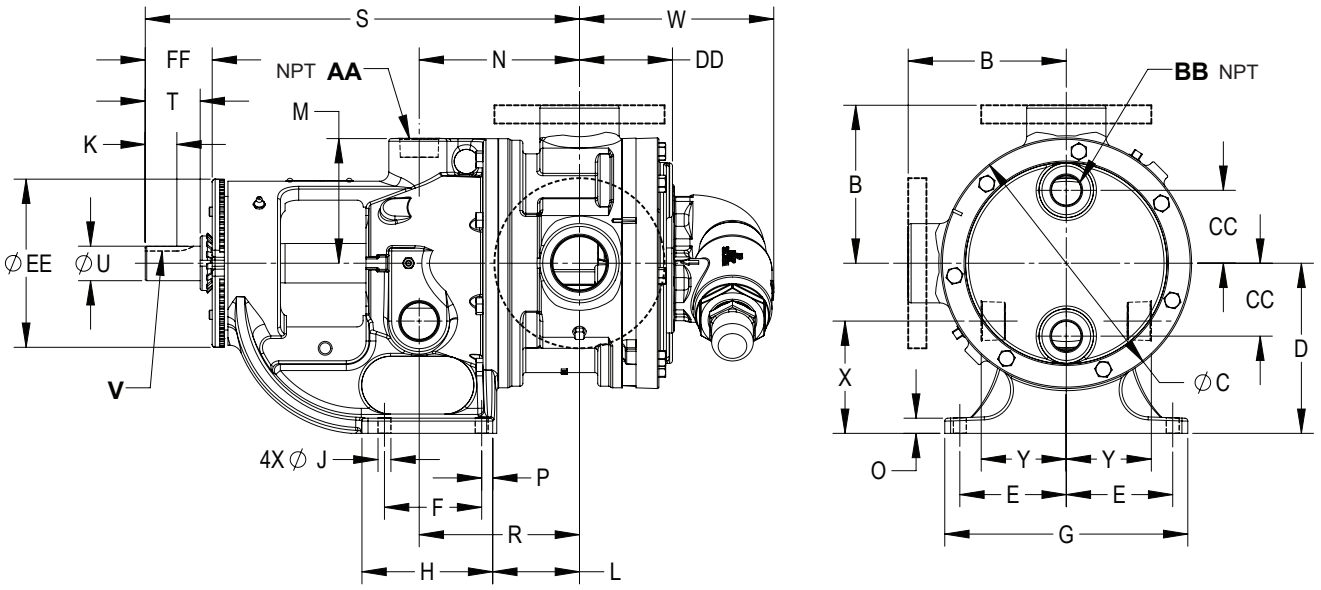
② Ports suitable for Class 300 ANSI steel or stainless steel companion flanges or flanged fittings.

Ⓝ Non-Rotatable Ports at 90 degree angle, contact factory for available orientation (right hand or left hand)

◎ Opposite Ports

Ⓡ 90° port arranged for Right Hand inlet (viewed from shaft end)

DIMENSIONS – H THROUGH Q SIZES (223A, 4223A)



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

Model Number		A (in)		B	C	D	E	F	G	H	J	K	L	M	N	O
Packed	Mechanical Seal															
H223A HL223A	H4223A HL4223A	③1.5	in	4.00	4.75	3.50	2.75	2.25	6.75	3.50	0.47	0.99	3.38	2.38	4.00	0.56
			mm	102	121	89	70	57	171	89	12	25	86	61	102	14
K223A KK223A	K4223A KK4223A	③2	in	5.25	8.00	5.50	4.00	2.75	9.25	4.00	0.53	1.42	3.00	4.00	5.75	0.62
			mm	133	203	140	102	70	235	102	14	36	76	102	146	16
LQ223A	LQ4223A	③ 2.5	in	7.19	10.25	7.00	4.38	4.00	10.00	5.38	0.53	1.42	3.38	5.12	6.56	0.62
			mm	183	260	178	111	102	254	137	14	36	86	130	167	16
LL223A	LL4223A	③ 3	in	7.19	10.25	7.00	4.38	4.00	10.00	5.38	0.53	1.42	3.38	5.12	6.56	0.62
			mm	183	260	178	111	102	254	137	14	36	86	130	167	16
LS223A	LS4223A	②3	in	7.19	10.25	7.00	4.38	4.00	10.00	5.38	0.53	2.55	4.75	5.12	7.40	0.62
			mm	183	260	178	111	102	254	137	14	65	121	130	188	16
Q223A	Q4223A	③ 4	in	8.25	14.00	8.75	4.12	4.00	10.00	6.00	0.69	3.58	6.62	7.00	7.62	0.75
			mm	210	356	222	105	102	254	152	18	91	168	178	194	19

Model Number			P	R	S	T	U (in)	V (in)	W*	X	Y	AA (in)	BB (in)	CC	DD	EE	FF
Packed	Mechanical Seal																
H223A HL223A	H4223A HL4223A	in	0.62	4.00	12.06	1.62	0.75	.19 X .09	4.04	1.80	1.83	0.75	0.50	0.94	2.41	5.75	2.30
		mm	16	102	306	41			103	46	47			24	61	146	58
K223A KK223A	K4223A KK4223A	in	0.62	5.75	16.38	2.25	1.12	.25 X .12	7.00	3.38	2.75	1.25	1.25	1.75	3.25	6.75	2.92
		mm	16	146	416	57			178	86	70			44	83	171	74
LQ223A	LQ4223A	in	0.62	6.56	17.88	2.25	1.12	.25 X .12	7.18	4.62	3.25	1.25	1.00	3.00	3.81	6.75	2.93
		mm	16	167	454	57			182	117	83			76	97	171	74
LL223A	LL4223A	in	0.62	6.56	17.88	2.25	1.13	.25 X .12	7.18	4.62	3.25	1.25	1.00	3.00	4.31	6.75	2.93
		mm	16	167	454	57			182	117	83			76	110	171	74
LS223A	LS4223A	in	0.62	7.00	19.25	3.50	1.44	.38 X .19	7.72	4.40	3.30	1.25	1.00	3.00	4.50	7.00	4.03
		mm	16	178	489	89			196	112	84			76	114	178	102
Q223A	Q4223A	in	1.00	6.62	23.75	4.50	1.94	.50 X .25	11.25	5.50	4.50	1.50	1.00	—	4.57	8.38	5.35
		mm	25	168	603	114			286	140	114			—	116	213	136

① Ports are tapped for standard (NPT) pipe. Other thread standards available.

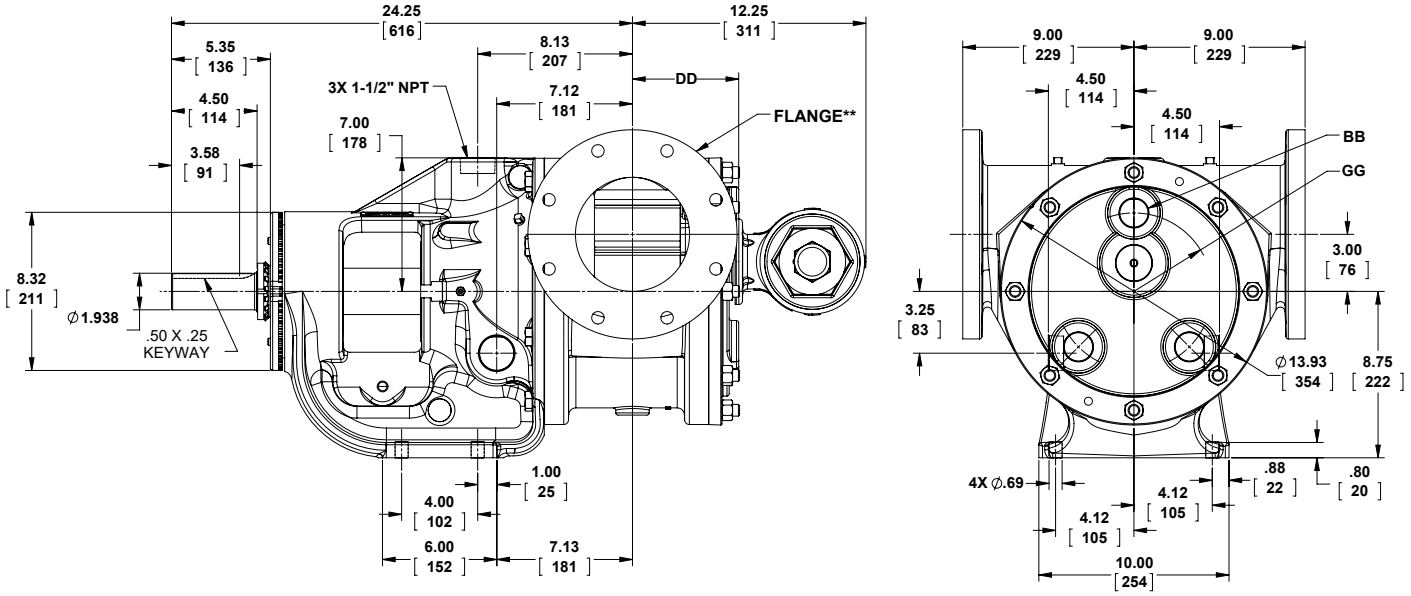
② Ports are suitable for use with Class 125 ANSI cast iron.

* Non-jacketed valve only.

UNIVERSAL PRODUCT LINE:
STEEL EXTERNALS — JACKETED PUMPS
SERIES 223A, 4223A, 323A, 4323A

DIMENSIONS – QS SIZE (223A, 4223A)

Dimensions shown in inches with millimeter equivalent shown in parentheses

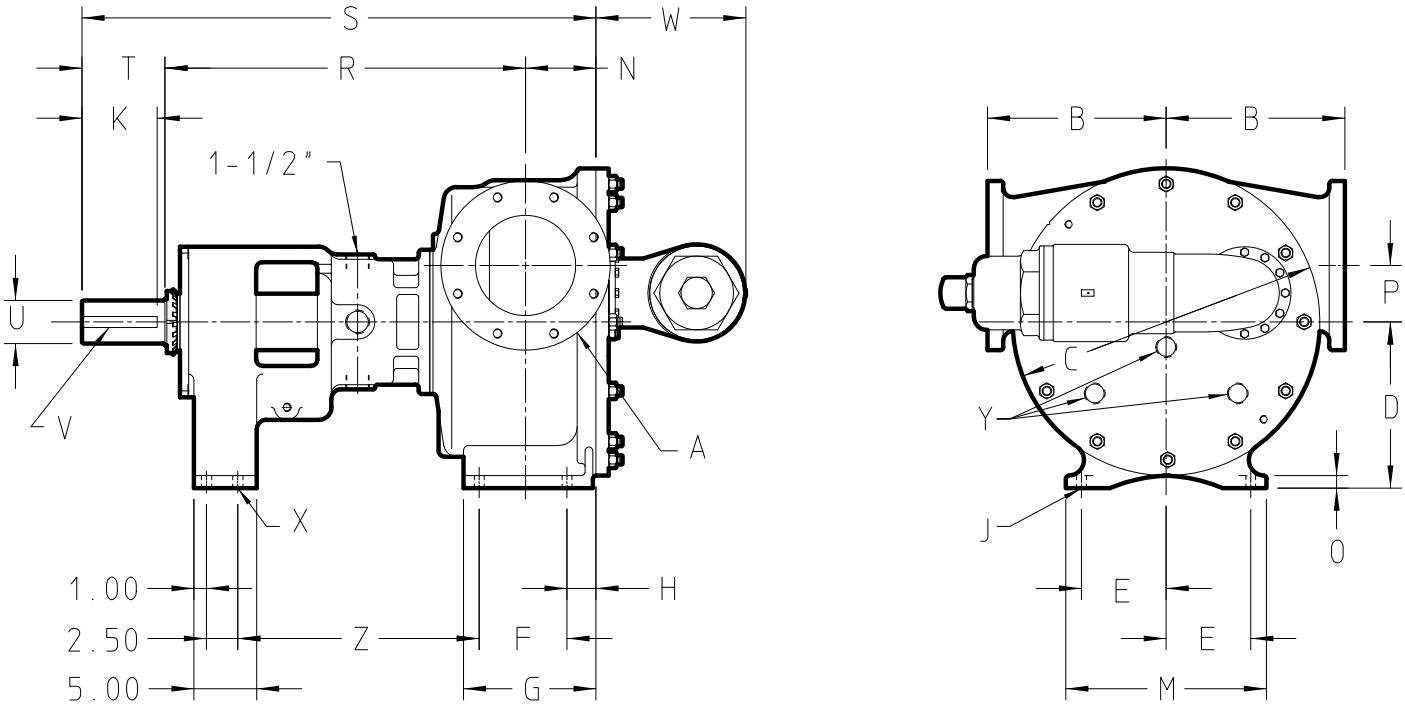


Model Number		BB*	DD	GG
Packed	Mechanical Seal			
QS223A	QS4223A	1.00	6.06 (153)	3.75 (95)

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

223A/4223A ports suitable for use with Class 150 ANSI steel or stainless steel companion flanges or flanged fittings.

DIMENSIONS – N & R SIZES – JACKETED BRACKET (323A, 4323A)

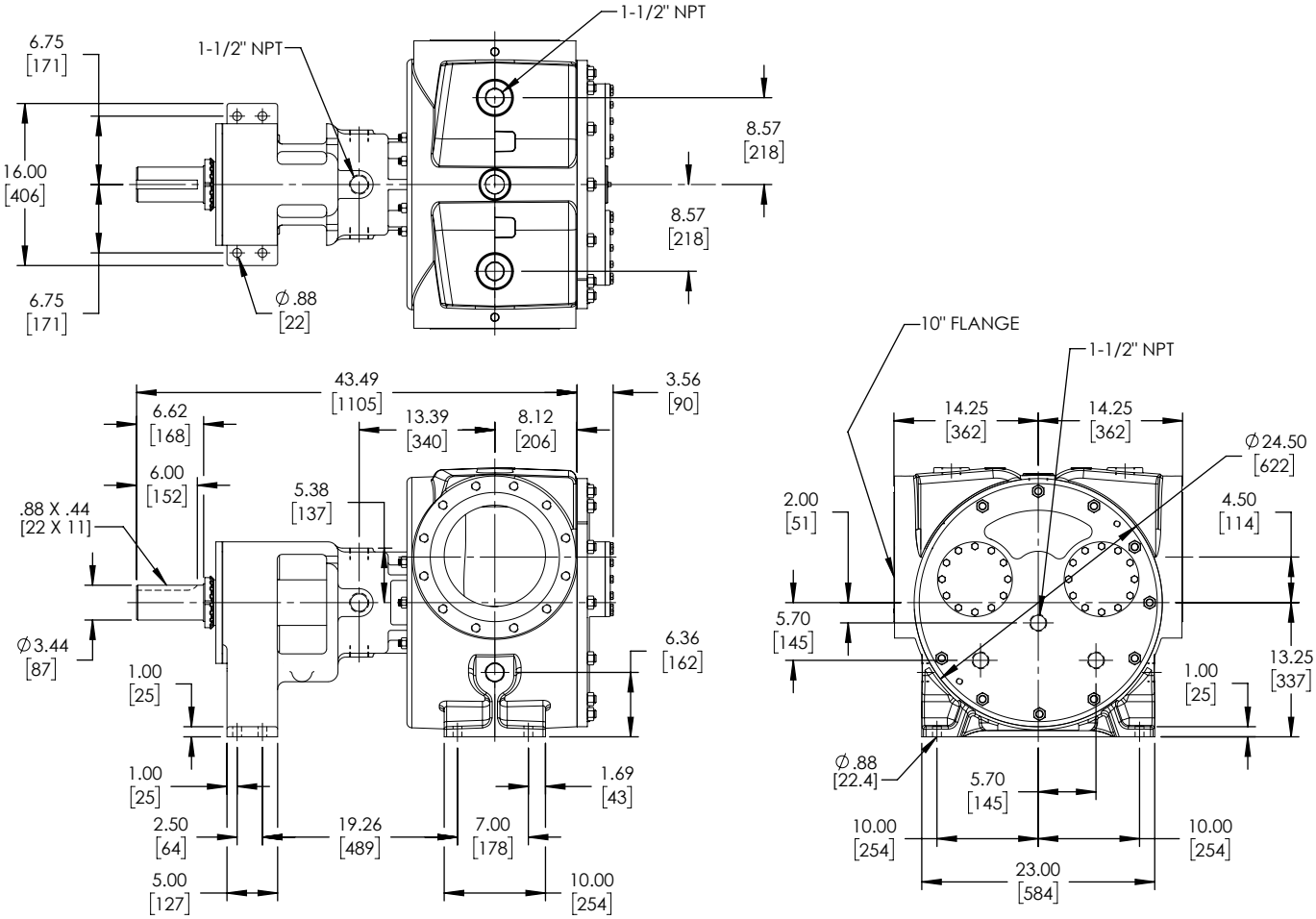


Model Number		A (in)		B	C	D	E	F	G	H	J	K	M	N	O	P	R	S	T	U (in)	V (in)	W	X	Y (in)	Z
Packed	Stuffing Box Seal																								
N323A	N4323A	①	in	9.75	17.25	9.50	5.00	6.25	8.69	1.62	0.69	4.50	12.00	4.50	1.00	3.00	26.00	36.50	6.00	2.44	.62 x.31	8.63	0.69	N/A	18.94
		6	mm	248	438	241	127	159	221	41	18	114	305	114	25	76	660	927	152			219	18		481
R323A	R4323A	①	in	14.25	24.50	13.25	6.75	7.00	10.56	2.31	0.78	6.00	16.00	5.62	1.00	4.50	28.75	41.00	6.62	3.44	.88 x.44	12.00	0.69	1.25	19.25
		8	mm	362	622	337	171	178	268	59	20	152	406	143	25	114	730	1041	168			305	18		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.

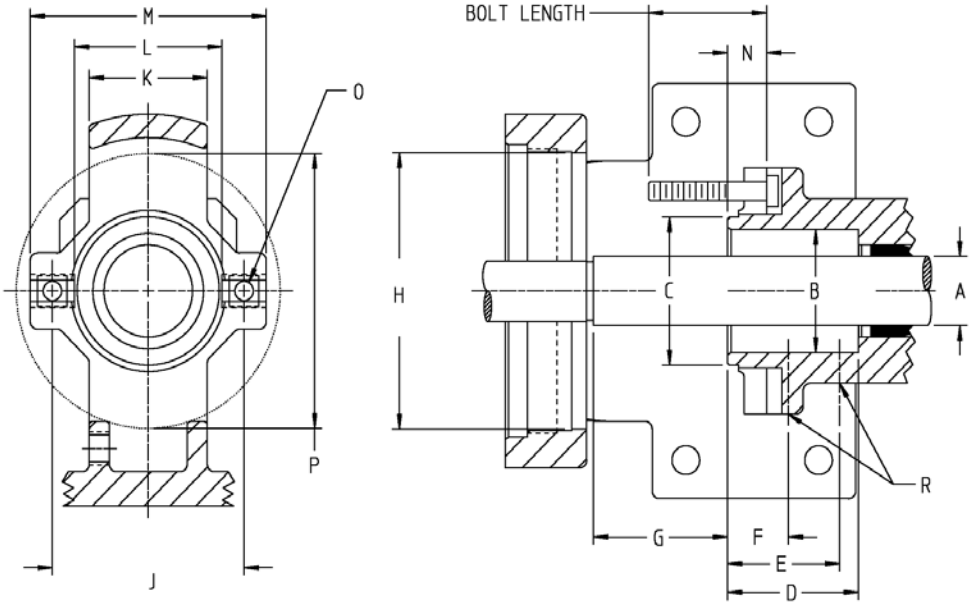
① Ports are suitable for use with Class 150 ANSI steel or stainless steel companion flanges or flanged fittings.

DIMENSIONS – RS SIZE – JACKETED BRACKET (323A, 4323A)



NOTE: RS size pumps are only available with a jacketed casing, as shown.

DIMENSIONS – STUFFING BOX SEAL CHAMBER



Pump Size		A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R
H & HL	In	1.12	2.00	2.41	2.22	1.90	1.03	2.27	4.50	3.00 to 3.50	2.00	2.50	4.00	0.66	5/16	4.47	1/8
	mm		51	61	56	48	26	58	114	76 to 89	51	64	102	17		114	3
K & KK	In	1.44	①2.31	3.00	3.13	2.25	1.25	3.00	5.25	3.50 to 4.50	2.50	3.00	5.00	0.38	7/16	5.25	1/4
	mm		①58.7	76	80	57	32	76	133	89 to 114	64	76	127	10		133	6
LQ, & LL	In	1.44	①2.31	3.00	3.13	2.25	1.25	4.00	5.25	3.50 to 4.50	2.50	3.00	5.00	0.44	7/16	5.25	1/4
	mm		①58.7	76	80	57	32	102	133	89 to 114	64	76	127	11		133	6
LS	In	1.62	2.38	2.80	2.70	2.25	1.16	3.52	5.25	3.25 to 4.50	3.00	2.80	5.00	0.46	7/16	5.25	1/4
	mm		60	71	69	57	30	89	133	83 to 114	76	71	127	12		133	6
Q & QS	In	2.44	3.42	4.50	4.00	2.50	1.53	4.10	6.75	5.50 to 6.25	3.20	4.50	7.20	0.56	5/8	6.75	1/4
	mm		87	114	102	64	39	104	171	140 to 159	81	114	183	14		171	6
N	In	3.44	4.69	—	5.56	1.65	—	4.91	8.81	6.75	—	—	—	—	②3/4	9.00	1/4
	mm		119	—	141	42	—	125	224	171	—	—	—	—		229	6
R & RS	In	4.50	5.75	—	5.56	1.53	—	4.79	9.81	7.75	—	—	—	—	②3/4	9.81	1/4
	mm		146	—	141	39	—	122	249	197	—	—	—	—		249	6

① Bracket is counter bored to a diameter of 2.687 inches (68 mm), 0.12 inches (3 mm) deep from stuffing box face.

② Studs are used in place of cap screws.

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
K, KK	—	1.7	1.8	1.9	2.1	2.3	2.8	3.3	4.4	6.3	9.1	—	—	—	—
LQ	1.6	1.8	2.0	2.2	2.5	3.0	3.8	5.0	7.3	10.8	—	—	—	—	—
LL	1.6	1.8	2.0	2.2	2.5	3.0	3.8	5.0	7.3	—	—	—	—	—	—
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	—	—	—	—	—	—	—	—	—