Boulden Installation Guide for
Dupont™ Vespel® CR-6100

DuPont™ Vespel® CR-6100 is a composite material of Teflon™ PFA and long carbon fibers. It is used for stationary wear components or inserts in centrifugal pumps and other types of rotating equipment. Vespel® CR-6100 is included in the 11th Edition of API610/ISO13709 standard for Centrifugal Pumps in Table H.3 Non-Metallic Wear Part Materials under the description of "PFA/CF reinforced composite."

Temperature Range

Cryogenic -300 ˚F up to 500 ˚F
Cryogenic -200 ˚C up to 260 ˚C

Typical Applications

- Boiler feed water
- Condensate
- Cooling water
- Demineralized water
- Sour water
- Acids (H_2SO_4, H_3PO_4)
- Naphtha
- Gasoline
- Diesel
- Jet fuel
- Gas oil
- Benzene, Xylene, Toluene
- LPG
- Propane
- NGL
- Butane
- Ethylene
- Ethylene Oxide
- Amines (MEA, DEA)
- Hydrofluoric acid
- Caustic
- Ammonia
- Catacarb® products
- Benfield™ Solution

Pump Types

North America
Boulden Company | Conshohocken, PA, USA
610-825-1515

Gulf Coast
Boulden Company | Houston, TX, USA
281-348-0888

Europe & Middle East
Boulden International, S.ar.L | Ellange, Luxembourg
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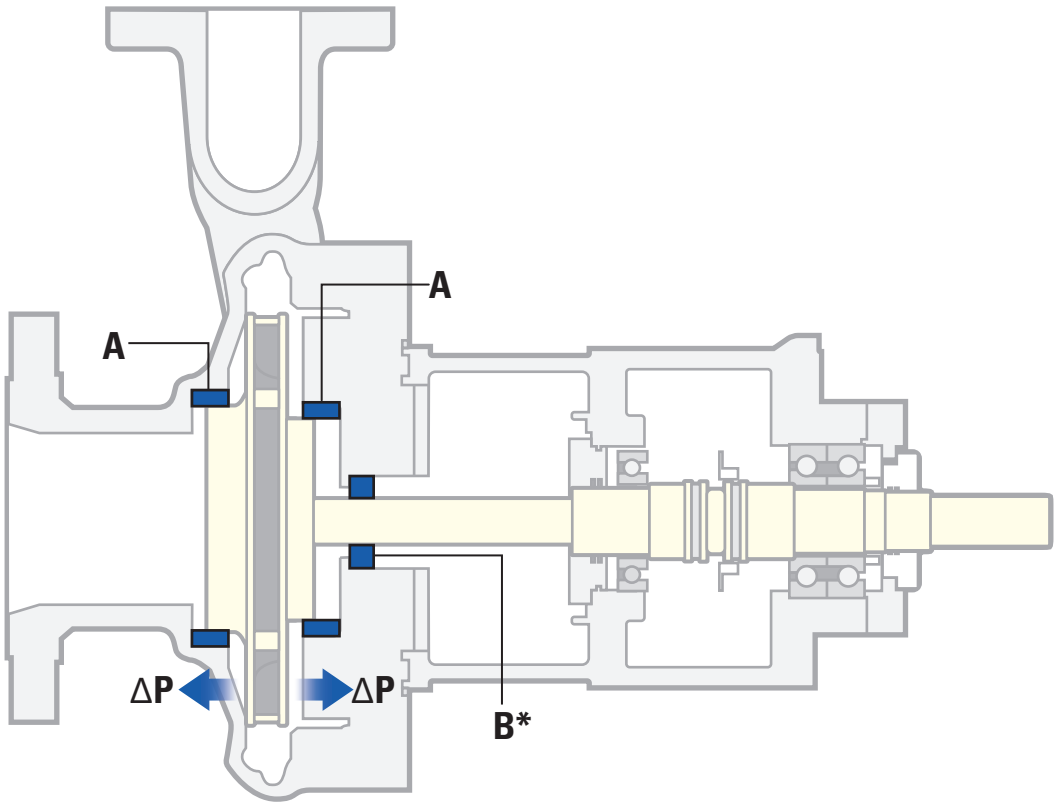
Overhung Pump Types

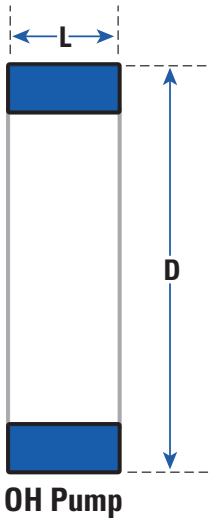
API Types OH1-OH5



A. Case Wear Rings **B.** Throat Bushings **ΔP.** Direction of differential pressure
**Direction of differential pressure across throat bushing to be confirmed by seal OEM*

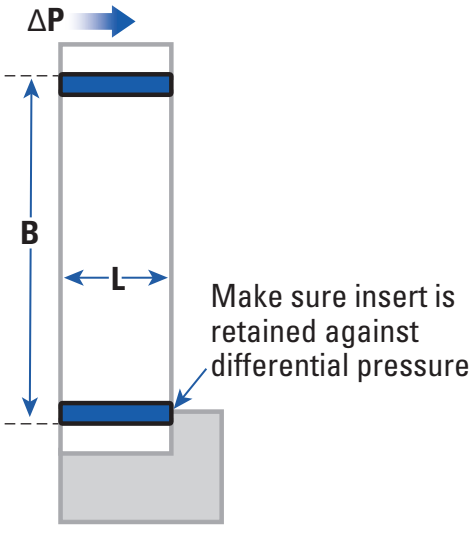
Solids or Inserts? Overhung Pumps

Option 1–Solid Vespel® CR-6100 Ring



D. Diameter of existing case ring
L. Overall part length

Option 2–Vespel® CR-6100 Insert



B. Inside diameter of stationary bore
L. Length of bore
ΔP. Direction of differential pressure

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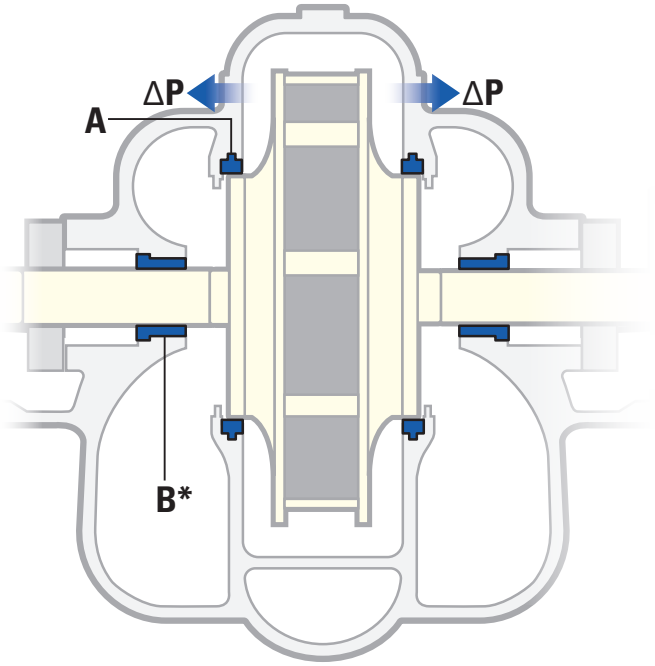
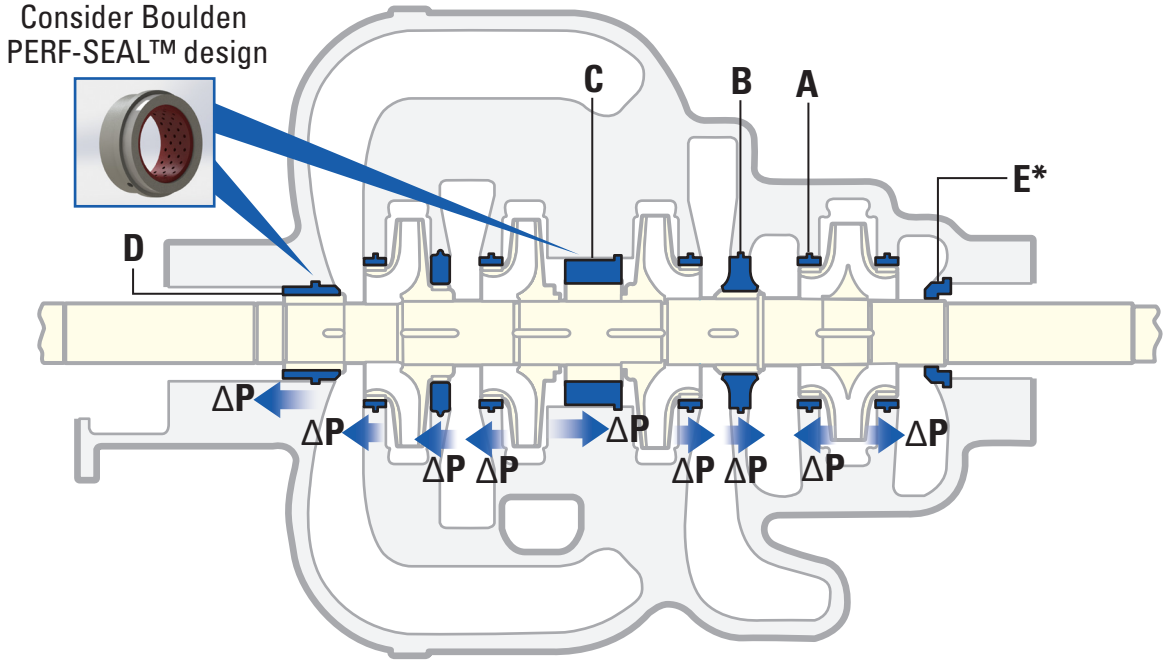
Between Bearings, Axially Split Pump Types

Single-Stage (API Type BB1)



A. Case Wear Rings **B.** Throat Bushings **ΔP.** Direction of differential pressure
**Direction of differential pressure across throat bushing to be confirmed by seal OEM*

Multi-Stage (API Type BB3)



A. Case Wear Rings **B.** Inter-stage Rings **C.** Center Bushings **D.** Throttle Bushings **E.** Throat Bushings **ΔP.** Direction of differential pressure **Direction of differential pressure across throat bushing to be confirmed by seal OEM*

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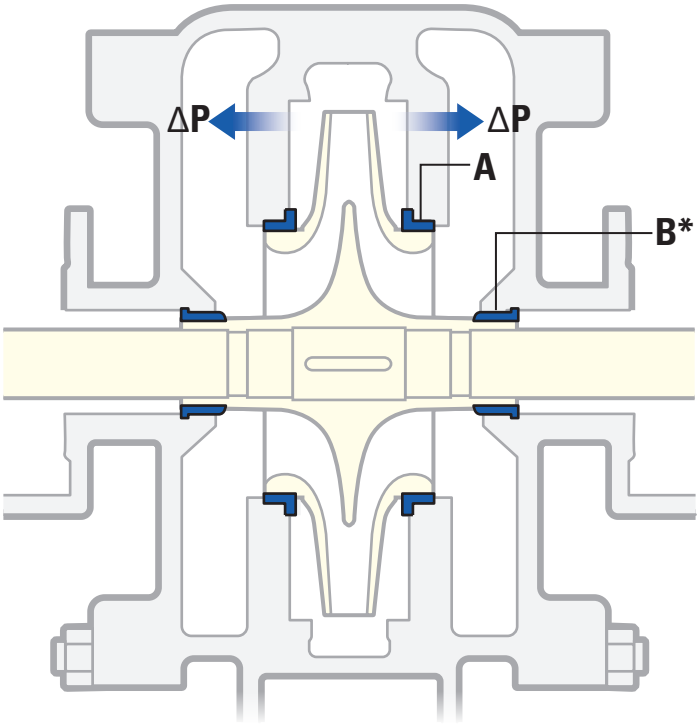
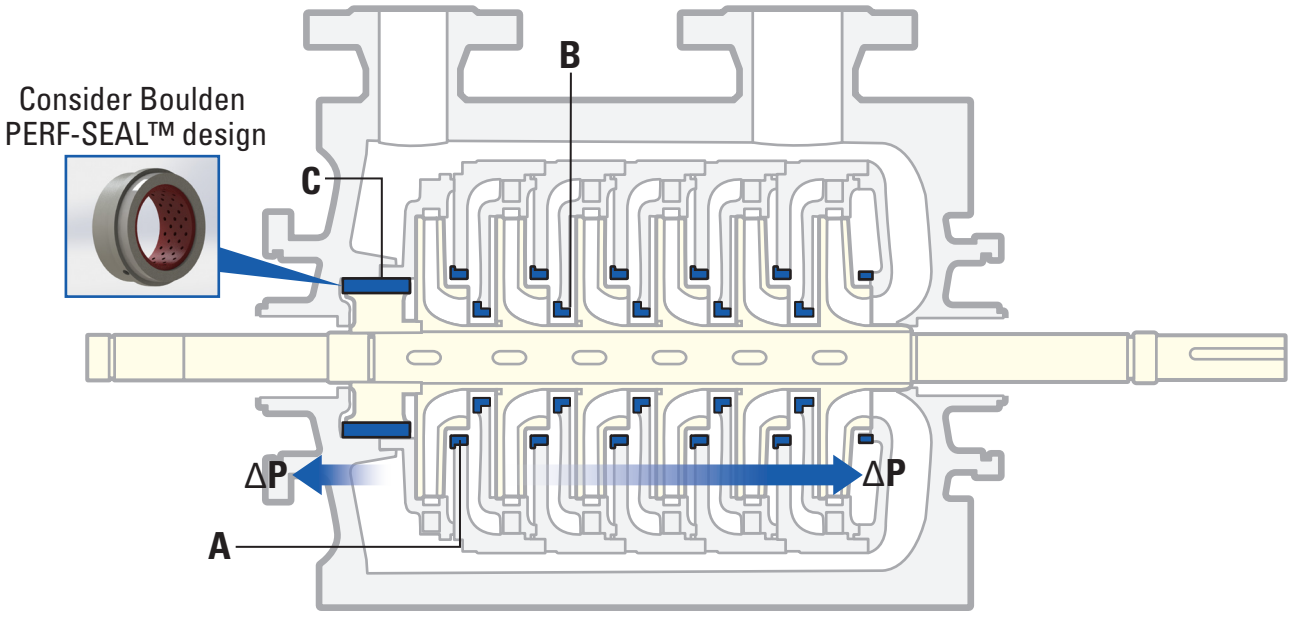
Between Bearings, Radially Split Pump Types

Single-Stage (API Type BB2)



A. Case Wear Rings **B.** Throat Bushings **ΔP.** Direction of differential Pressure
**Direction of differential pressure across throat bushing to be confirmed by seal OEM*

Multi-Stage (API Type BB4 and BB5)



A. Case Wear Rings **B.** Inter-stage Rings **C.** Throttle Bushings **ΔP.** Direction of differential Pressure

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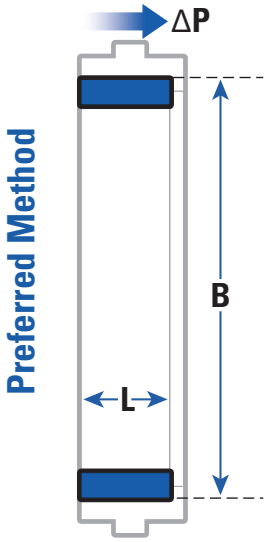
Solid or Inserts? Between Bearings, Axially Split

Option 1–Vespel® CR-6100 Insert into Existing Metal Ring

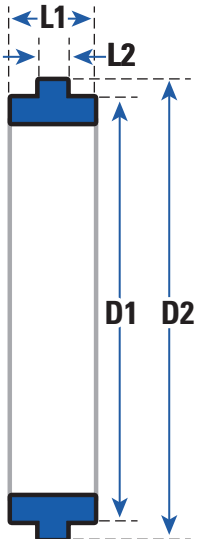
Up to 500 ˚F (260 ˚C)



B. Inside diameter of stationary bore
L. Length of bore
ΔP. Direction of differential pressure

Option 2–Vespel® CR-6100 Ring

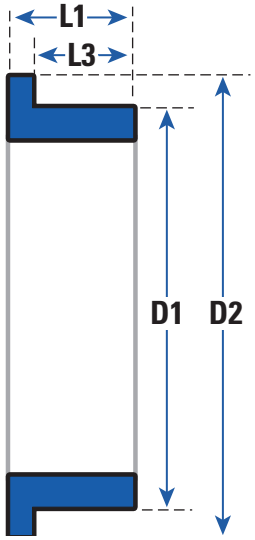
Up to 140 ˚F (60 ˚C)



D1. Outside diameter of existing case ring
D2. Outside diameter of existing case ring
L1. Overall part length
L2. Length of major diameter.

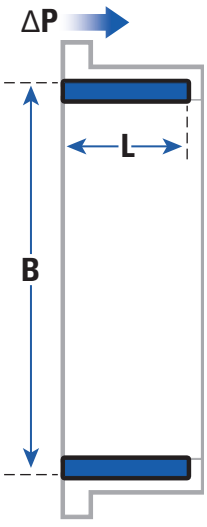
Solids or Inserts? Between Bearings, Radially Split

Option 1–Vespel® CR-6100



D1. Outside diameter of existing case ring
D2. Outside diameter of existing case ring
L1. Overall part length
L3. Length of minor diameter

Option 2–Vespel® CR-6100 Insert



B. Inside diameter of stationary bore
L. Length of bore
ΔP. Direction of differential pressure

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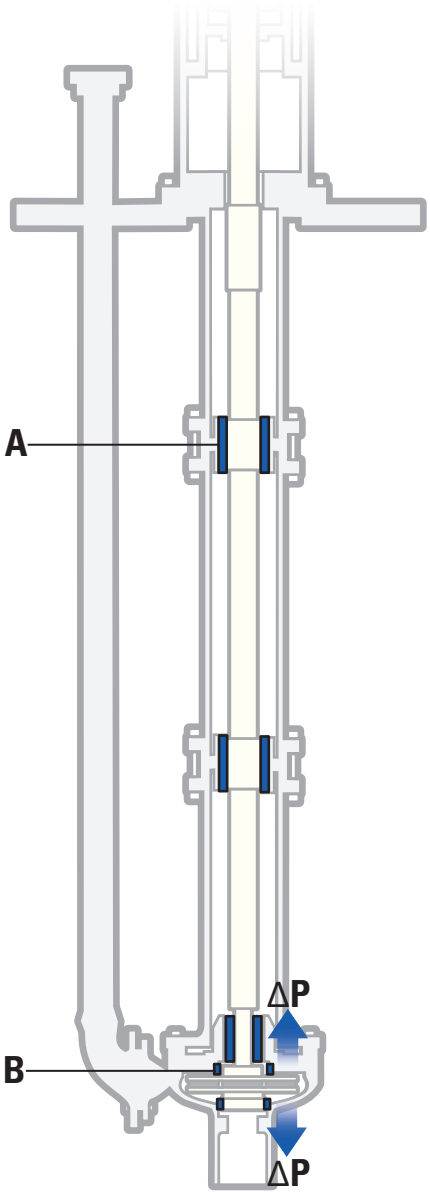
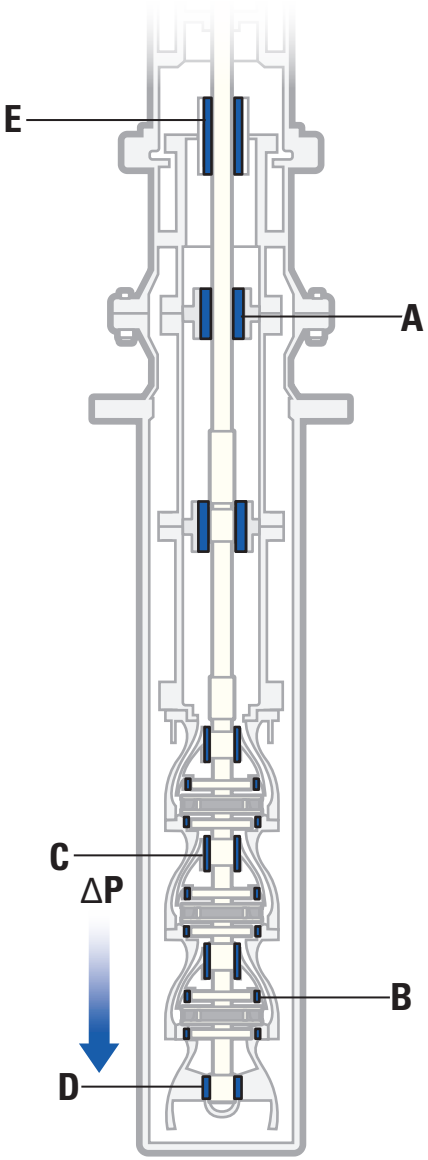
Vertically Suspended Pump Types

Separate Discharge (VS4-VS5)



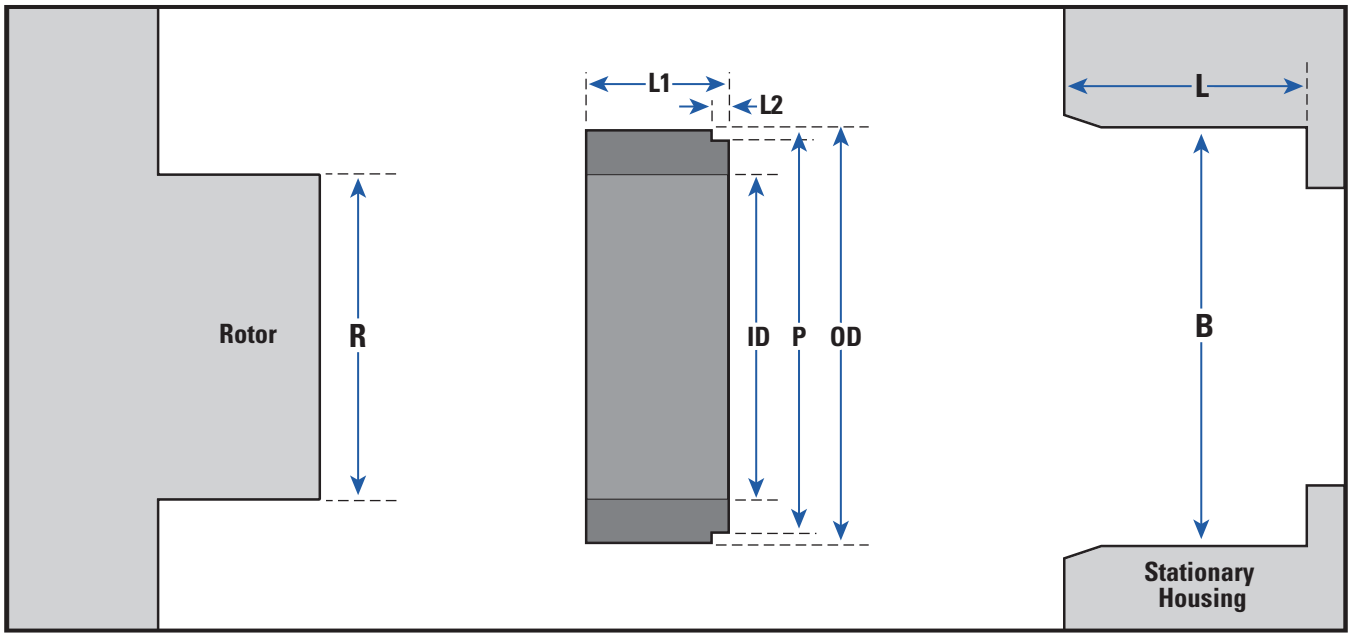
A. Shaft Bearings
B. Case Wear Rings
(Clean Services Only)
ΔP. Direction of differential pressure

Discharge Through Column (VS1-3, VS6-7)



A. Shaft Bearings
B. Case Wear Rings
C. Stage Bearings
D. Bottom Bearings
E. Throat Bushings
ΔP. Direction of differential pressure

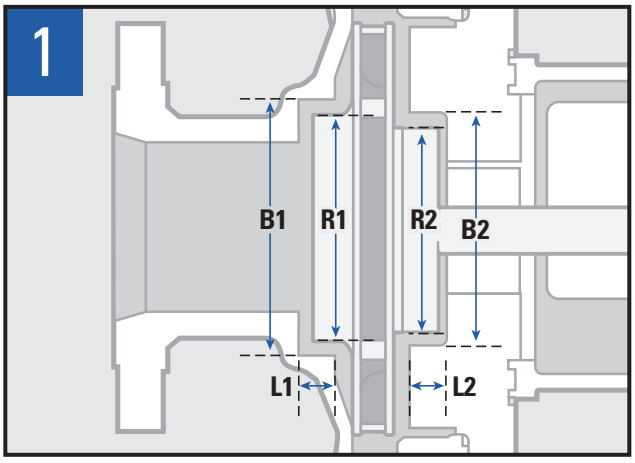
Dimensions



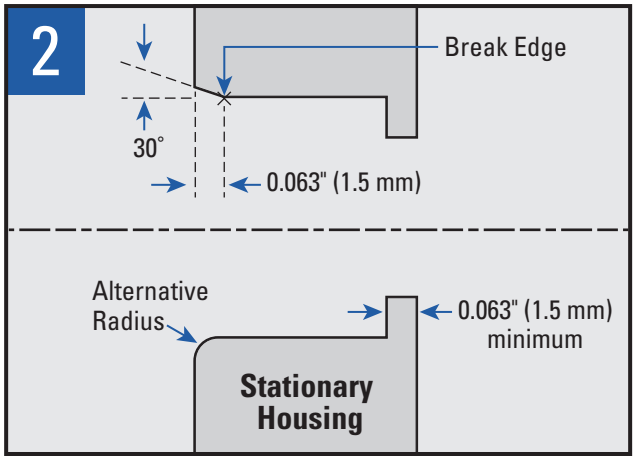
Vespel® CR-6100 Part Dimensions		Typical Tolerances	
		Imperial	Metric
L1	Overall part length	+/-0.005"	+/-0,125 mm
L2	Length of pilot dimension		
OD	Outside diameter of part	+0.002"/-0.000"	+0,05/-0,00 mm
P	Pilot diameter	+0.002"/-0.004"	+0,05/-0,1 mm
ID	Inside diameter of part	+0.002"/-0.000"	+0,05/-0,00 mm

Required Dimensions	
R	Outside diameter of rotating part
B	Inside diameter of stationary bore
L	Length of bore

Installation



Measure existing hardware.



Prepare bore of stationary housing.

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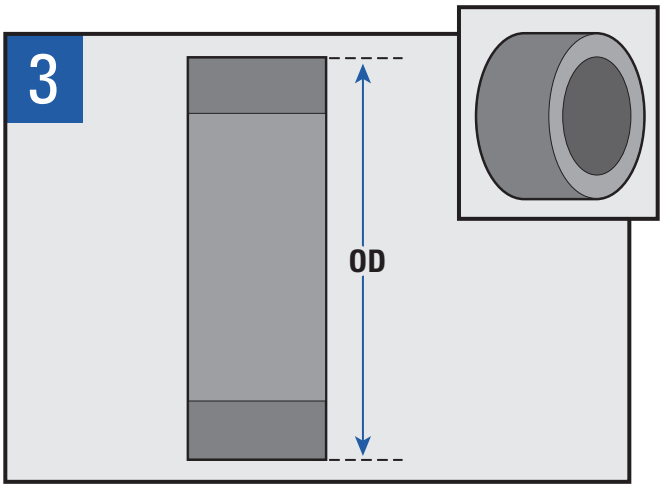
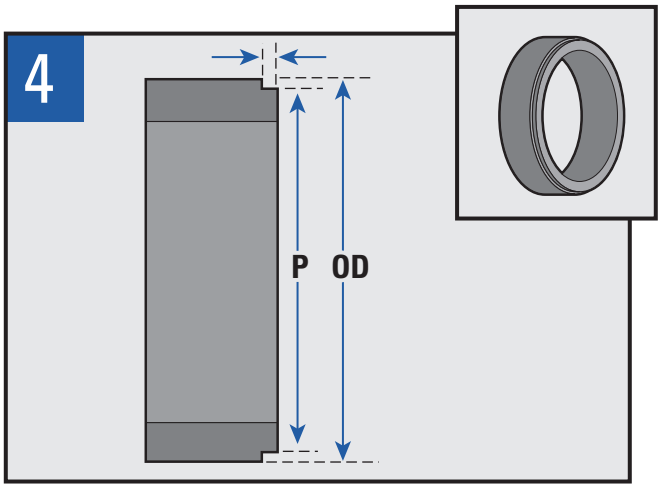
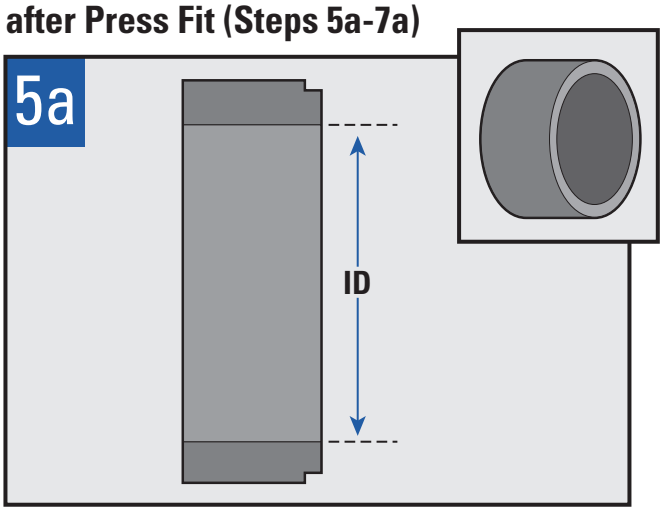


Calculate and machine part outside diameter.
OD = B + Interference Fit (see Table 1).

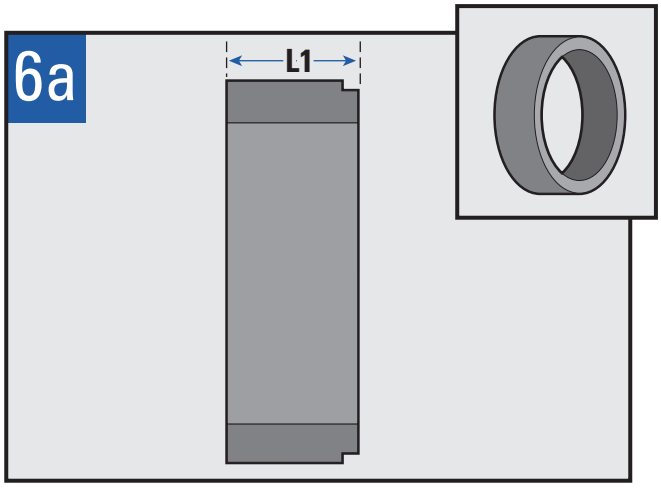


Machine the leading edge with pilot fit.
P= B - 0.004" (imperial)
P= B - 0.1 mm (metric)

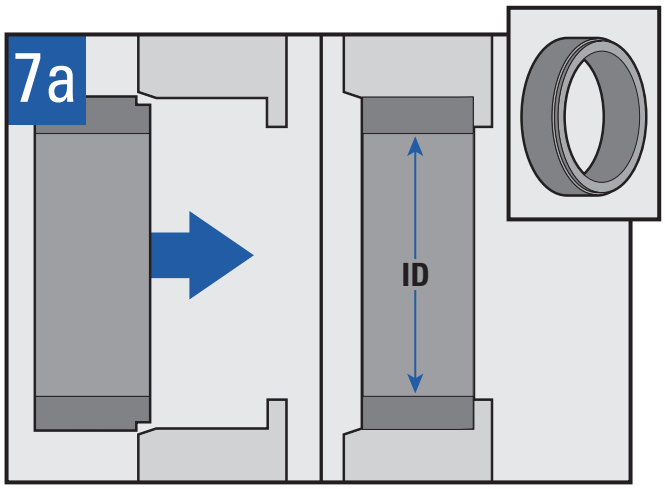
Preferred Method–Final Machine after Press Fit (Steps 5a-7a)



Rough machine inside diameter.
ID = R - 0.063" (imperial)
ID = R - 1.5 mm (metric)

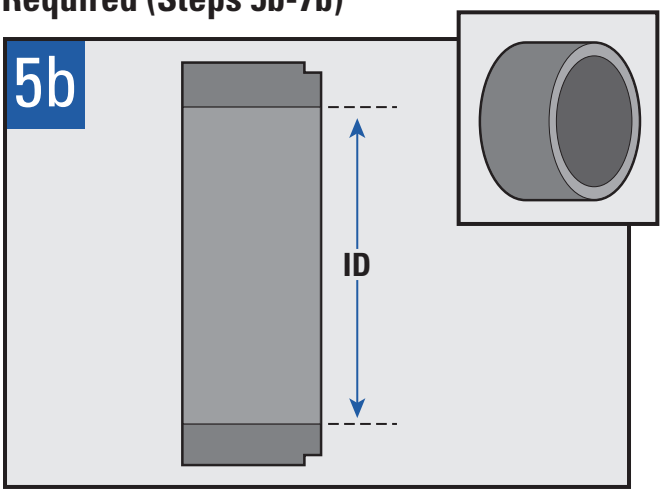


Calculate and machine part **L1** (overall part length).
L1 = L x (1-G), (see Table 4).

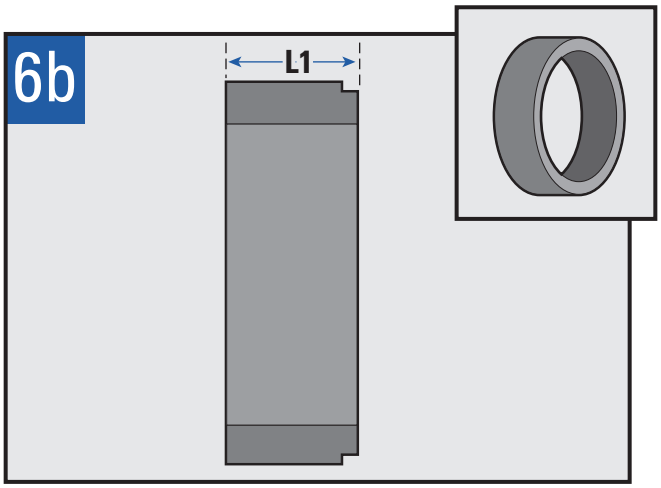


Press into place, final machine inside diameter
ID = R + clearance
(see Table 2 for horizontal pumps; Table 3 for vertically suspended pumps).

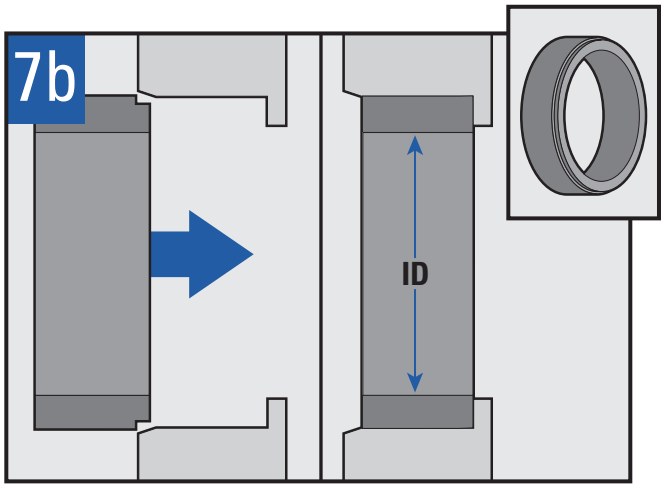
Optional Method – No Final Machining Required (Steps 5b-7b)



Calculate and machine part inside diameter.
ID = R + Interference Fit + Clearance (see Table 2 for horizontal pumps; Table 3 for vertical pumps).



Calculate and machine part **L1** (overall part length).
L1 = L x (1-G), (see Table 4).



Press into place, verify ID is correct.
Final machine if needed.

Additional Notes:

- Locking with anti-rotation pins or screws is not necessary or recommended.
- Minimum radial wall thickness of Vespel® CR-6100 components is 0.125" (3mm). Contact Boulden for recommendation in high temperature applications >200 °F (100 °C)
- Contact Boulden for guidance on split designs.

Table 1a Interference Fits (Imperial)

Bore Diameter (in.)	Pump Operating Temperature (degrees F)									
	Ambient	100	150	200	250	300	350	400	450	500
	Recommended Interference Fit at Installation (in.)									
0.001–1.000	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005
1.001–2.000	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.007	0.008	0.008
2.001–3.000	0.007	0.007	0.008	0.009	0.009	0.010	0.010	0.011	0.011	0.012
3.001–4.000	0.008	0.008	0.009	0.010	0.011	0.012	0.013	0.013	0.014	0.015
4.001–5.000	0.010	0.011	0.012	0.013	0.014	0.015	0.016	0.017	0.018	0.019
5.001–6.000	0.012	0.013	0.014	0.015	0.017	0.018	0.019	0.021	0.022	0.023
6.001–7.000	0.014	0.015	0.016	0.018	0.019	0.021	0.023	0.024	0.026	0.027
7.001–8.000	0.016	0.017	0.019	0.021	0.022	0.024	0.026	0.028	0.029	0.031
8.001–9.000	0.018	0.019	0.021	0.023	0.025	0.027	0.029	0.031	0.033	0.035
9.001–10.000	0.020	0.021	0.024	0.026	0.028	0.030	0.033	0.035	0.037	0.039
10.001–11.000	0.022	0.023	0.026	0.028	0.031	0.033	0.036	0.038	0.041	0.043
11.001–12.000	0.024	0.026	0.028	0.031	0.034	0.036	0.039	0.042	0.045	0.047
12.001–13.000	0.026	0.028	0.031	0.034	0.037	0.040	0.042	0.045	0.048	0.051
13.001–14.000	0.028	0.030	0.033	0.036	0.039	0.043	0.046	0.049	0.052	0.055
14.001–15.000	0.030	0.032	0.035	0.039	0.042	0.046	0.049	0.052	0.056	0.059
15.001–16.000	0.032	0.034	0.038	0.041	0.045	0.049	0.052	0.056	0.060	0.063

Table 1b Interference Fits (Metric)

Bore Diameter (mm)	Pump Operating Temperature (degrees C)										
	Ambient	50	75	100	125	150	175	200	225	250	260
	Recommended Interference Fit at Installation (mm)										
1–25	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13
26–50	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.18	0.19	0.20	0.20
51–75	0.18	0.19	0.21	0.22	0.23	0.25	0.26	0.27	0.29	0.30	0.30
76–100	0.20	0.23	0.24	0.26	0.28	0.30	0.32	0.34	0.35	0.37	0.38
101–125	0.25	0.28	0.31	0.33	0.35	0.38	0.40	0.43	0.45	0.47	0.48
126–150	0.30	0.34	0.37	0.40	0.43	0.46	0.49	0.51	0.54	0.57	0.58
151–175	0.36	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.64	0.67	0.69
176–200	0.41	0.45	0.49	0.53	0.57	0.61	0.65	0.69	0.73	0.77	0.79
201–225	0.46	0.51	0.56	0.60	0.65	0.69	0.74	0.78	0.83	0.87	0.89
226–250	0.51	0.57	0.62	0.67	0.72	0.77	0.82	0.87	0.92	0.97	0.99
251–275	0.56	0.63	0.68	0.74	0.79	0.85	0.90	0.96	1.01	1.07	1.09
276–300	0.61	0.68	0.74	0.80	0.86	0.93	0.99	1.05	1.11	1.17	1.19
301–325	0.66	0.74	0.81	0.87	0.94	1.00	1.07	1.14	1.20	1.27	1.29
326–350	0.71	0.80	0.87	0.94	1.01	1.08	1.15	1.23	1.30	1.37	1.40
351–375	0.76	0.85	0.93	1.01	1.08	1.16	1.24	1.31	1.39	1.47	1.50
376–400	0.81	0.91	0.99	1.08	1.16	1.24	1.32	1.40	1.48	1.57	1.60

Table 2a (Imperial)

Recommended Minimum Clearance Horizontal Pumps: OH1–OH5, BB1–BB5		
Bore Diameter (in.)	**Case Wear Rings (in.)**	**Throat Bushings**
<2.999	0.006	Use Recommended Clearance from Mechanical Seal OEM
3.000–3.499	0.007	
3.500–3.999	0.007	
4.000–4.499	0.008	
4.500–4.999	0.008	
5.000–5.999	0.009	
6.000–6.999	0.009	
7.000–7.999	0.010	
8.000–8.999	0.010	
9.000–9.999	0.011	
10.000–10.999	0.011	
11.000–11.999	0.012	
12.000–12.999	0.012	
13.000–13.999	0.013	
14.000–14.999	0.013	
15.000–15.999	0.014	

Table 2b (Metric)

Recommended Minimum Clearance Horizontal Pumps: OH1–OH5, BB1–BB5		
Bore Diameter (mm)	**Case Wear Rings (mm)**	**Throat Bushings**
<79.99	0.15	Use Recommended Clearance from Mechanical Seal OEM
80–89.99	0.17	
90–99.99	0.18	
100–114.99	0.19	
115–124.99	0.20	
125–149.99	0.22	
150–174.99	0.23	
175–199.99	0.24	
200–224.99	0.25	
225–249.99	0.27	
250–274.99	0.28	
275–299.99	0.29	
300–324.99	0.30	
325–349.99	0.32	
350–374.99	0.33	
375–406	0.34	

Table 3a (Imperial)

Minimum Recommended Clearance Vertically Suspended Pumps VS1–VS7				
Shaft/ sleeve Diameter	**Shaft Bearings (if OEM clearance is known)**	**Shaft Bearings (if OEM clearance is uknown)**	**Wear Rings**	**Throat Bushings**
<0.999	Use OEM clearance	0.006	Use Shaft bearing clearance plus 0.002"	Use Recommended Clearance from Mechanical Seal OEM
1.000–1.499		0.007		
1.500–1.999		0.008		
2.000–2.499		0.009		
2.500–2.999		0.010		
3.000–3.499		0.011		
3.500–3.999		0.012		
4.000–4.999		0.013		
5.000–5.999		0.014		
6.000–6.999		0.015		
7.000–7.999		0.016		

Table 3b (Metric)

Minimum Recommended Clearance Vertically Suspended Pumps VS1–VS7				
Shaft/ sleeve Diameter (mm)	**Shaft Bearings (if OEM clearance is known)**	**Shaft Bearings (if OEM clearance is unknown)**	**Wear Rings**	**Throat Bushings**
<24.99	Use OEM clearance	0.15	Use Shaft bearing clearance plus 0.05 mm	Use Recommended Clearance from Mechanical Seal OEM
25.00–37.49		0.18		
37.50–49.99		0.20		
50.00–62.49		0.23		
62.50–74.99		0.25		
75.00–87.49		0.28		
87.50–99.99		0.30		
100.0–124.9		0.33		
125.0–149.9		0.35		
150.0–174.9		0.38		
175.0–199.9		0.40		

Table 4

Process Temperature (˚F)	Process Temperature (˚C)	% Axial growth (G) from ambient 68 ˚F (20 ˚C)
70	20	0%
120	50	1%
210	100	3%
300	150	4%
390	200	7%
480	250	11%
500	260	12%

Dupont™ Vespel® CR-6100 – Installation Checklist

	Checklist items
	Vespel® CR-6100 installed as the stationary part (in compression)
	Rotating/mating part is metal
	Operating temperature less than 260°C/500°F
	Service is not an abrasive slurry requiring hard-coatings or special alloys
	Metal bore is prepared for the press fit with a small chamfer or radius at leading edge
	Vespel® CR-6100 is installed with the correct press fit? (Tables 1a/1b)
	Vespel® CR-6100 is retained against differential pressure?
	The Vespel® CR-6100 component has clearance necessary for axial thermal expansion? (Table 4)
	Clearance is correct based on component type? • Horizontal pump parts (Tables 2a/2b) • Vertically suspended pump bushings (Tables 3a/3b) • Vertically suspended pump wear rings (Tables 3a/3b) • Throat bushings (Tables 2a/2b/3a/3b)
	Rotor turns freely once the pump is assembled?
	Vertical pump rotor turns freely after coupled in the field?
	High pressure throttle bushings made with PERF-Seal™ design? (Contact Boulden for details)