

7. SHAFT AND HOUSING RECOMMENDATION

7.1 SHAFT

Four main conditions make the seal and shaft more compatible and assist in providing optimal seal performance.

- **SHAFT HARDNESS**

Normally seal contact area of the shaft should be Rockwell C 45 minimum.

It is important factor to prevent excessive wear, deformation, scratches or nicks, and to allow for easy machining for proper roughness.

- **SHAFT SURFACE ROUGHNESS**

We recommend shaft surface roughness is as follow.

Rotating: 10 to 20 μ inch AA (.25 μ m to .50 μ m AA).

Reciprocating: 5 to 10 μ inch AA (.13 μ m to .25 μ m AA).

This is very critical as greatly influence the amount of lip Heat, thus this finish should not be overlooked.

- **GRINDING**

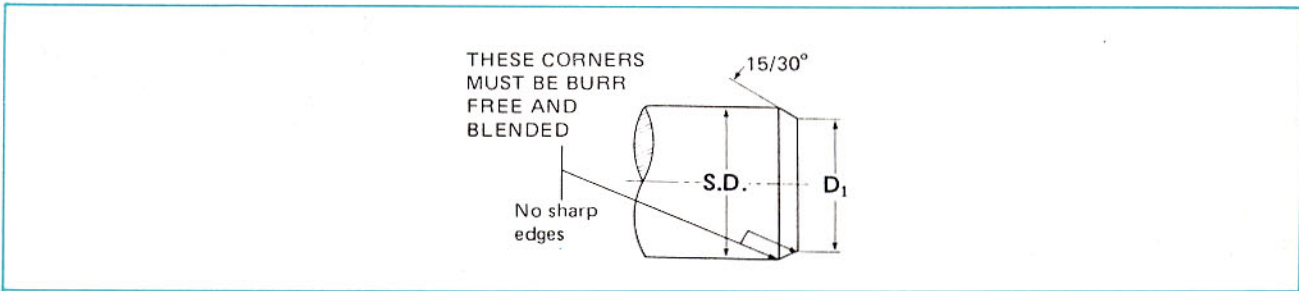
Rotating Shaft: plunge grinding is recommended, Reciprocating shaft: centerless grinding is acceptable. Cast iron or stainless steel shafts for rotating applications and for steel shafts with reciprocating applications, we suggest with hard chrome plating.

All above finishes are required surface with no machine lead, otherwise it may actually pump fluid from wider the seal lip.

- **SHAFT CHAMFER**

Without Proper chamfer on shaft, the seal lip may be damaged or distorted resulting in dislodged garter spring, we suggest chamfer as table to assist in the installation process.

TABLE 9. SHAFT CHAMFER BE RECOMMENDED BY US



INCHES				MILLIMETERS			
S.D.	D ₁	S.D.	D ₁	S.D.	D ₁	S.D.	D ₁
Up to 1.000	S.D. - .094	4.001 to 5.000	S.D. - .220	Up to 25.00	S.D. - 2.4	100.01 to 125.00	S.D. - 5.6
1.001 to 2.000	S.D. - .140	5.001 to 6.000	S.D. - .260	25.01 to 50.00	S.D. - 3.6	125.01 to 150.00	S.D. - 6.6
2.001 to 3.000	S.D. - .166	6.001 to 10.000	S.D. - .276	50.01 to 75.00	S.D. - 4.2	150.01 to 250.00	S.D. - 7.0
3.001 to 4.000	S.D. - .196	-	-	75.01 to 100.00	S.D. - 5.0	-	-

- **SHAFT TOLERANCES** recommended for general applications are listed in Table 10 below. The tolerance range should be decreased for high speed or pressure applications.

TABLE 10. RECOMMENDED SHAFT TOLERANCE

DIAMETER INCH	TOLERANCE	DIAMETER METRIC	TOLERANCE
Up to 4.000"	±.003	Up to 100 mm	±0.08
4.001" to 6.000"	±.004	100.10 to 150.00	±0.10
6.001" to 10.000"	±.005	150.10 to 250.00	± 0.13

7.2 HOUSING

The different material of bores is to be recommended using in rubber covered and metal O.D. seals as follows:
 Rubber covered O.D.: steel and cast iron, soft alloy, aluminum alloy, plastic or nylon.

Metal O.D.: Steel and cast iron.

If in aluminum or other soft alloy bores, metal O.D.

(1) BORE CHAMFER

To assist in installation of the seal, a bore chamfer is necessary. If without or improper chamfer will distort seal case and will require more assembly force craving is our recommendation of the chamfer.

(2) SURFACE ROUGHNESS

Excessively rough bore finishes may allow paths for fluid to leak between seal O.D. and bore. Following is recommended maximum roughness.

TABLE 11. HOUSING BORE ROUGHNESS

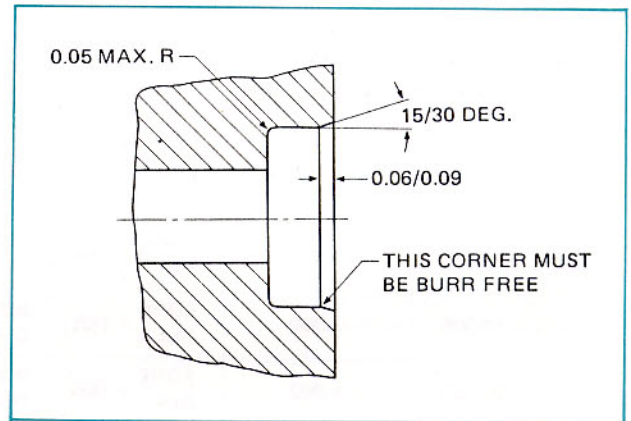
	METAL O.D.	RUBBER O.D.
MAXIMUM	100 μ inch AA	150 μ inch AA
ROUGHNESS	2.50 μ M AA	3.75 μ M AA

The rubber O.D. seal is capable of functioning with a rougher finish.

seals occasionally back out of the bore due to thermal expansion of the soft alloy.

Rubber, having a higher coefficient of thermal expansion than carbon steel, will tighten in the bore as temperature rises. Plastic or nylon are not recommended because they typically expand at a high rate causing a major problem for metal OD seals.

Figure 3. RECOMMENDED BORE LEAD CORNER



(3) BORE DIAMETER TOLERANCE

The recommended housing bore diameter, bore tolerance nominal pressfit are indicated in Table 12 and Table 13.

TABLE 12. BORE DIAMETER IN INCH SIZES

BORE DIAMETER	BORE TOLERANCE	NOMINAL PRESSFIT		O. D. – TOLERANCE (1)	ECCENTRICITY (2)	
		SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.	SEALS O.D.	SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.
Up to 1.000	±.001	BORE DIA + .004	BORE DIA + .006	±.002	.005	.010
1.001 – 2.000	±.001	BORE DIA + .004	BORE DIA + .007	±.002	.005	.010
2.001 – 3.000	±.001	BORE DIA + .004	BORE DIA + .008	±.002	.008	.015
3.001 – 4.000	±.0015	BORE DIA + .005	BORE DIA + .010	±.002	.010	.020
4.001 – 6.000	±.0015	BORE DIA + .005	BORE DIA + .010	+0.003 –.002	.010	.020
6.001 – 8.000	±.002	BORE DIA + .006	BORE DIA + .010	+0.003 –.002	.012	.025
8.001 – 10.000	±.002	BORE DIA + .008	BORE DIA + .010	+0.004 –.002	.015	.030
10.001 – 20.000	±.002	BORE DIA + .008	BORE DIA + .010	+0.006 –.002	.020	.040

(1) Seal O. D. – The average of minimum three measurements to be taken at equally spaced positions.

(2) Eccentricity – The maximum variance between any of the readings used in determining Seal O. D.

TABLE 13. BORE DIAMETER IN METRIC SIZES

BORE DIAMETER	BORE TOLERANCE	NOMINAL PRESSFIT		O.D. TOLERANCE		ECCENTRICITY	
		METAL O.D.	RUBBER O.D.	METAL O.D.	RUBBER O.D.	METAL O.D.	RUBBER O.D.
6.1 – 50	±0.025	+0.15	+0.23	±0.05	±0.07	0.12	0.25
50.1 – 80	±0.025	+0.18	+0.28	±0.05	±0.07	0.18	0.35
80.1 – 120	±0.040	+0.20	+0.28	±0.05	±0.07	0.25	0.50
120.1 – 180	±0.040	+0.23	+0.35	±0.05	±0.10	0.33	0.65
180.1 – 300	±0.050	+0.25	+0.35	±0.05	±0.10	0.40	0.80
300.1 – 500	±0.070	+0.29	+0.43	±0.06	±0.12	0.50	1.00

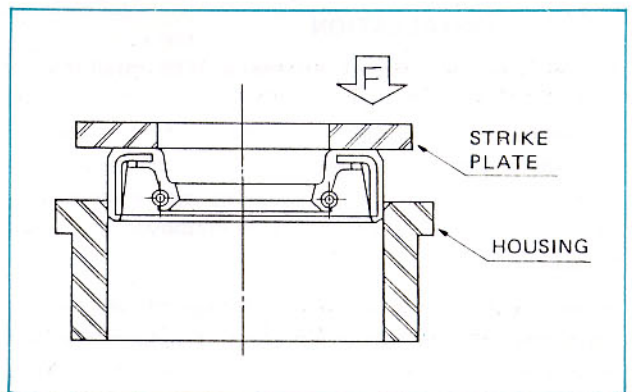
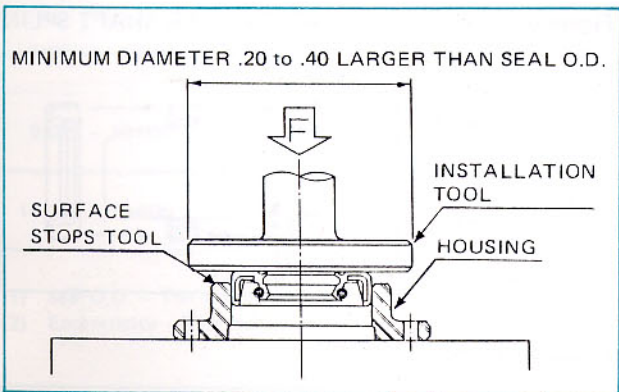
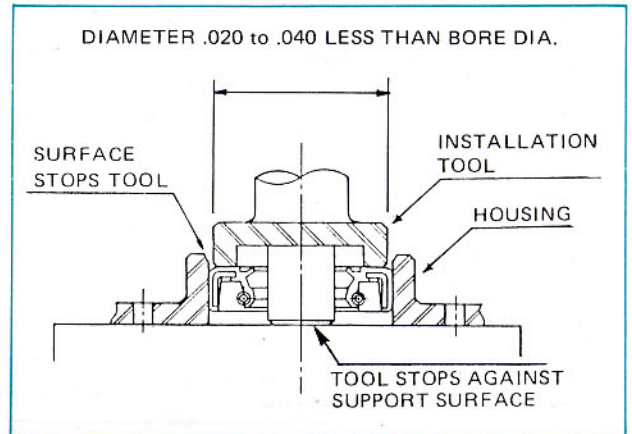
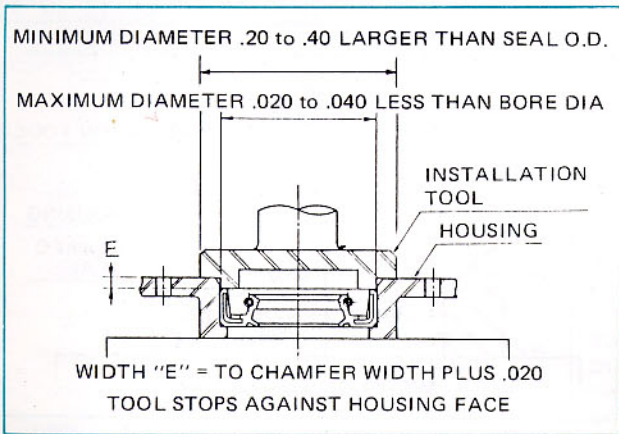
(1) Seal O.D. – The average of minimum three measurements to be taken at equally spaced positions.

(2) Eccentricity – The maximum variance between any of the readings used in determining Seal O. D.

The subject of installation represents an area commonly overlooked when selecting an oil seal for an application. Studies have shown this area to be one of the major causes of premature seal failure. To assist the installation, the oil seal should be prelubricated with grease or oil to reduce sliding friction of contact surfaces. This will also help protect the seal lips during initial run-in. Section 7 expands on recommended procedures for installation.

An installation tool should always be used when installing an oil seal. The use of a tool improves ease of installation and reduces the possibility of seal cocking (non-perpendicular to shaft). A hydraulic or pneumatic press is advised to supply necessary force to install the seal. Following are examples of both recommended and improper installation methods.

Figure 4. ACCEPTABLE METHOD



In each preferred method, installation load is absorbed by either housing or bottom plate to prevent seal damage and to assist in locating the seal properly within the bore.

Figure 5. IMPROPER METHOD

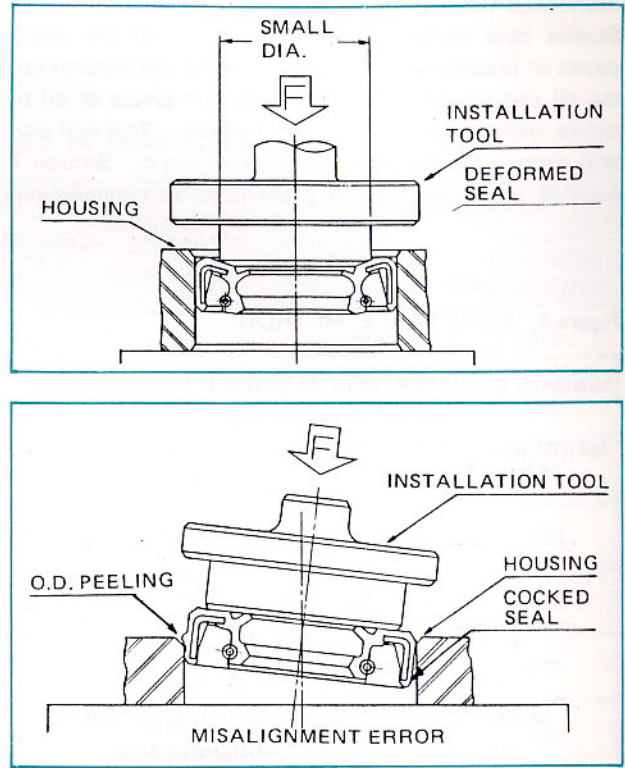
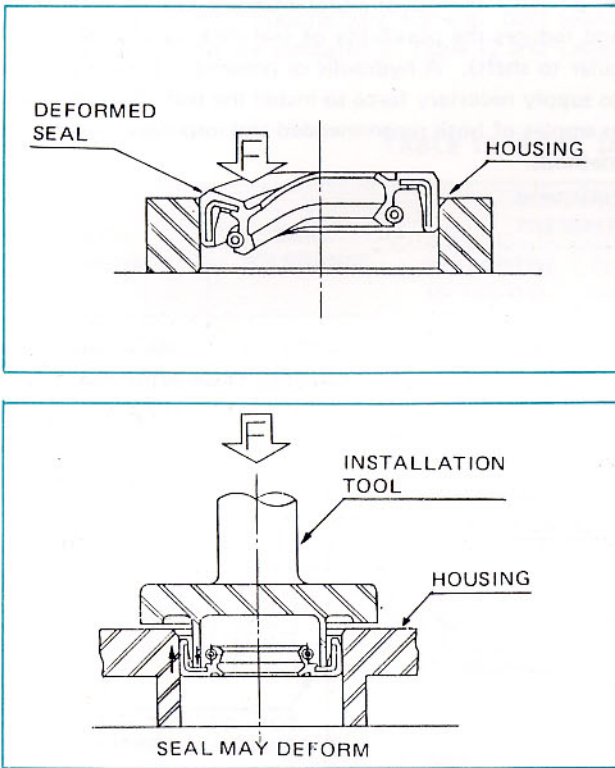


Figure 6. SEAL INSTALLATION OVER SHAFT SPLINES

B. SHAFT INSTALLATION

The advisable sequence of installation is to install the seal over the shaft and then into the housing bore. Care should be exercised not to damage or deform the seal lip. The proper chamfer angle will minimize this problem (reference figure 6). When installing over a keyway or spline, a sleeve or bullet should be employed to protect the seal lip from cuts.

Where the shaft must be installed through the seal, centering guides for the shaft will prevent lip deformation and dislodging of the spring. When possible, the shaft should be rotated as it passes through the seal to reduce sliding friction.

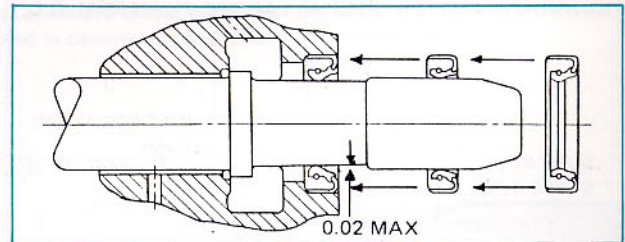


Figure 8. LONG SHAFT

Figure 7. HEAVY WEIGHT HOUSING

