Chapter 11B Design of Seals

Design of Face Seals

Wear of Face Seals

(From Ayala, et al. 1998)

Diagram removed for copyright reasons.
See Ayala, H.M., Hart, D.P., Yeh, O.C., Boyce, M.C. "Wear of Elastomeric Seals in Abrasive Slurries", Wear, 220, 9-21, 1998.

Percentage of lip worn as a function of the number of cycles for flat lip surface

(From Ayala, et al., 1998)

Graph removed for copyright reasons.
See Ayala, H.M., Hart, D.P., Yeh, O.C., Boyce, M.C. "Wear of Elastomeric Seals in Abrasive Slurries", Wear, 220, 9-21, 1998.

Wear of Face Seals

(Sequential images of wear particles trapped in the seal face)
(From Ayala, et al., 1998)

Photos removed for copyright reasons.
See Ayala, H.M., Hart, D.P., Yeh, O.C., Boyce, M.C. "Wear of Elastomeric Seals in Abrasive Slurries", Wear, 220, 9-21, 1998.

FRs of Face Seals

FR1 = Carry the applied normal load

FR2 = Prevent abrasive particle penetration

FR3 = Prevent the leakage of the lubricant

FR4 = Prevent particle agglomeration

FR5 = Lubricate the seal/metal interface

The top figure shows the surface of the seal with pad. The second figure shows the seal face with holes, and the last pad with holes

(From Ayala, et al., 1998)

Diagram and photos removed for copyright reasons.
See Ayala, H.M., Hart, D.P., Yeh, O.C., Boyce, M.C. "Wear of Elastomeric Seals in Abrasive Slurries", Wear, 220, 9-21, 1998.

Percentage of lip worn as a function of the number of cycles for textured lip surfaces

(From Ayala, et al., 1998)

Graph removed for copyright reasons.
See Ayala, H.M., Hart, D.P., Yeh, O.C., Boyce, M.C. "Wear of Elastomeric Seals in Abrasive Slurries", Wear, 220, 9-21, 1998.

Design of seals for rotating shaft

Functional Requirements of Seals for Rotating Shaft

FR1 = Support the normal load

FR2 = Prevent particle migration across the seal

FR3 = Prevent agglomeration of particles in the seal/shaft interface

FR4 = Prevent plowing of the seal surface

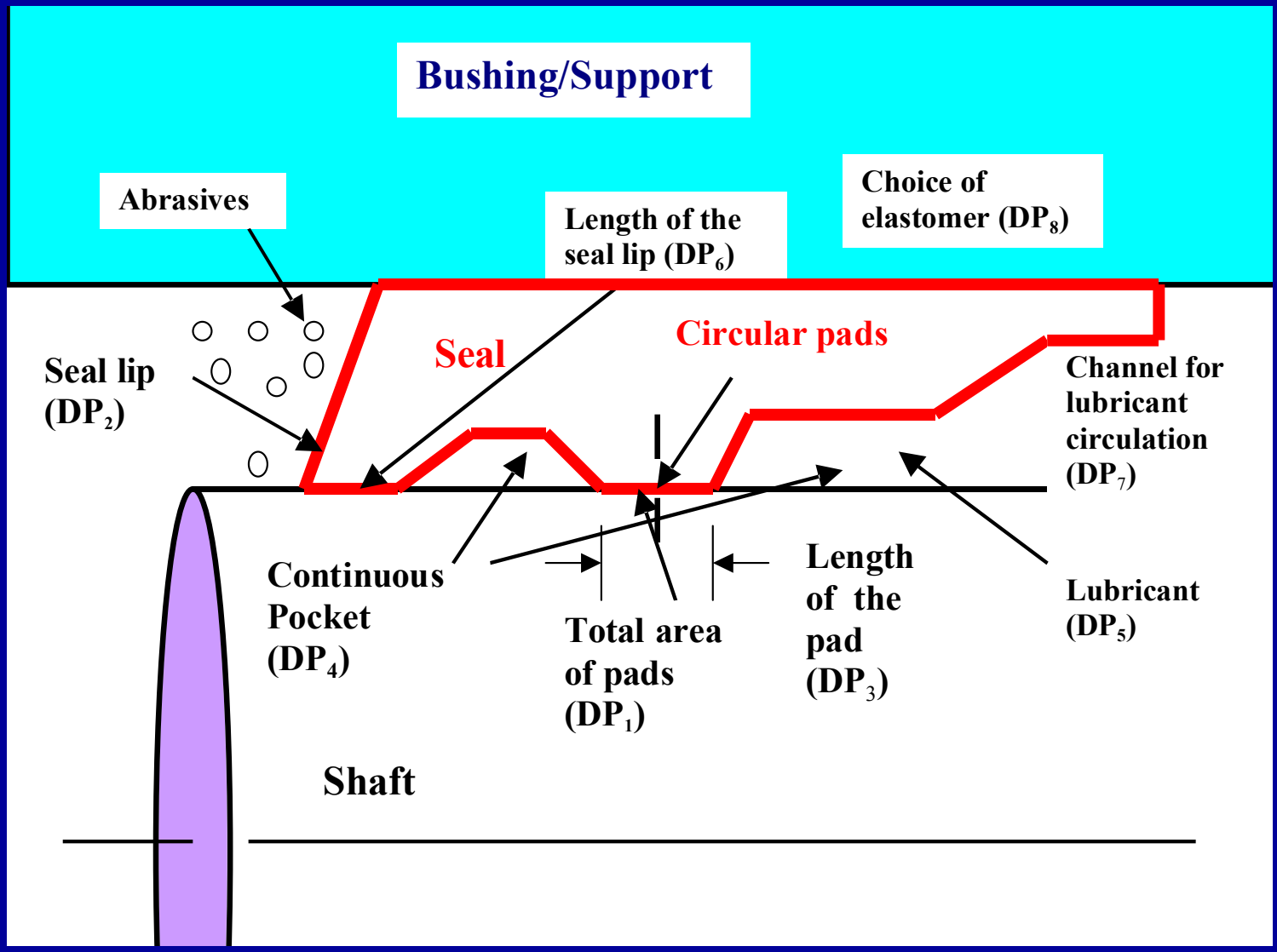
FR5 = Provide the lubricant to the interface

FR6 = Prevent the flow of the lubricant out of the seal area

FR7 = Remove the heat generated at the interface

FR8 = Delay the initiation of the initial wear process

Design Concept:
Seals for Rotating Shaft



Design Parameters (DPs):

Seals for Rotating Shaft

DP1 = Total area of the pad, A

DP2 = Seal lip

DP3 = Length of the pad, λ

DP4 = Continuous pocket for wear particles

DP5 = Lubricant

DP6 = Length of the seal lip, L

DP7 = Channel for lubricant circulation

DP8 = Seal material

Design Equation and Design Matrix

Seals for Rotating Shaft

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \\ FR_4 \\ FR_5 \\ FR_6 \\ FR_7 \\ FR_8 \end{Bmatrix} = \begin{bmatrix} X & 0 & 0 & 0 & 0 & 0 & 0 & X \\ 0 & X & 0 & 0 & 0 & 0 & 0 & x \\ 0 & 0 & X & 0 & 0 & 0 & 0 & x \\ x & 0 & 0 & X & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & X & 0 & 0 & 0 \\ 0 & x & 0 & 0 & 0 & X & 0 & x \\ 0 & 0 & 0 & 0 & 0 & 0 & X & x \\ 0 & 0 & x & 0 & 0 & 0 & 0 & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \\ DP_4 \\ DP_5 \\ DP_6 \\ DP_7 \\ DP_8 \end{Bmatrix}$$