

Rubber Component Design Manual

Engineering Guidelines for Molded Rubber Parts

[RubberQ Technical Resources](#)

1. O-Ring Gland Design

Proper gland design is critical for seal performance. Key parameters include squeeze percentage, gland fill, and surface finish requirements.

Seal Type	Squeeze %	Gland Fill %	Surface (Ra μm)
Static Face Seal	19-32%	60-90%	0.8-3.2
Static Radial Seal	10-25%	70-85%	0.8-3.2
Dynamic Reciprocating	8-16%	75-85%	0.1-0.4
Rotary Shaft Seal	3-8%	80-90%	0.1-0.3

2. Molding Design Guidelines

- Draft Angles: 0.5° minimum, 1-2° recommended, 3-5° for deep features
- Wall Thickness: Maintain uniform thickness to prevent sink marks and warping
- Parting Line: Position on non-critical surfaces, avoid sealing areas
- Corner Radii: Minimum 0.13mm (0.005") to prevent stress concentration
- Flash Allowance: Design for 0.05mm max on critical surfaces

3. Shrinkage Compensation

Material	Shrinkage Rate	Notes
NBR (Nitrile)	2-4%	Most common industrial rubber
EPDM	1.5-3%	Good dimensional stability
Silicone (VMQ)	2-3%	Higher shrinkage than EPDM
FKM (Viton)	2-3.5%	Moderate shrinkage
HNBR	<1.5%	Excellent dimensional control
Polyurethane	0.5-2%	Lowest shrinkage rate

4. Rubber-to-Metal Bonding

Successful rubber-to-metal bonding requires proper surface preparation, primer selection, and vulcanization control.

- Surface Prep: Grit blast to Sa 2.5, degrease, apply primer within 4 hours
- Primer System: Two-coat system (primer + cover coat) for best adhesion
- Testing: ASTM D429 for tensile/peel strength verification

5. Common Failure Modes

- Compression Set: Select low compression set materials, design for 10-25% squeeze
- Extrusion: Use backup rings, harder durometer, reduce clearances
- Chemical Attack: Verify elastomer compatibility with system fluids

Thermal Degradation: Select materials within rated temperature range