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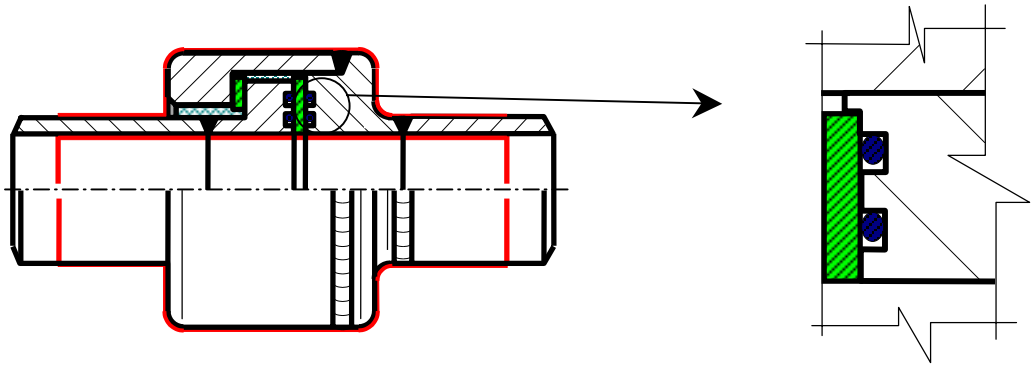
CONCEPT OF "0" RING SEAL
IN THE DESIGN AND FABRICATION OF ISOLATION JOINTS



OUR SELECTIVE SOURCES FOR CHOOSING THE APPROPRIATE 'O' RINGS FOR LOW, MEDIUM AND HIGH PRESSURE SERVICE.

Angst + Pfister

Dowty O Rings International

Many internationally recognised gas .oil and engineering's companies do recommend in their specification to use elastomeric "0" rings only which are toroidal in shape and are used for sealing components against the ingress or egress of fluids under dynamic and static conditions.

Alfa Engineering as an internationally recognised isolation joint manufacturer have adhered to the concept of using "0" Rings in the design and fabrication of monolithic isolation joints.

This concept is applied in strict accordance with several international codes and standards: ASTM D2000 – AS 568A – BS 1806 – SMS 1586 – DIN 3771 and ASME VII Div.1 appendix II.

In the seal design of isolation joints, it is essential to ensure the correct type of polymer to be used for each specific application.

"0" rings are the most versatile and economical form of seal in today's use and are accepted by all engineering companies as an essential rule for pressure containing hydraulic and pneumatic equipments.

Simple in shape, requiring limited space for installation and yet easily stretched for assembly ,these are common concepts of an "0" ring. Behind this description there is a very remarkable technology in synthetic rubber compounding and the need to produce high precision details with aside the necessary extensive quality control.

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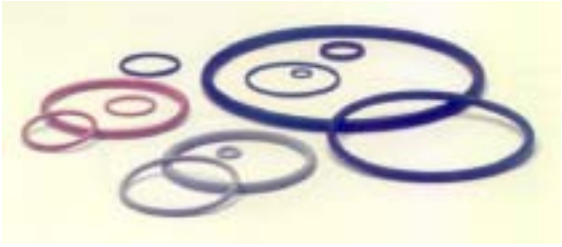
"0" Ring Seal
on isolation joint's design



Appropriate grade and type of elastomer can be used to best satisfy the fluid temperature.

Many type of elastomers are readily available Viton – NBR – Karletz – PTFE, and spring Energised elastomers unexplosive to pipeline decompression.

Mechanical design of joint body is not fixed by stock and dimension can vary. Body to suit any loadings, wall , grade etc…

"0" rings are not affected by temperature change as they can expand and contract easily in the groove.

Compression set is not a problem as the precompression is of small entity for static performance.

Double "0" ring seals are accommodated easily to give an increased safety factor in sealing.

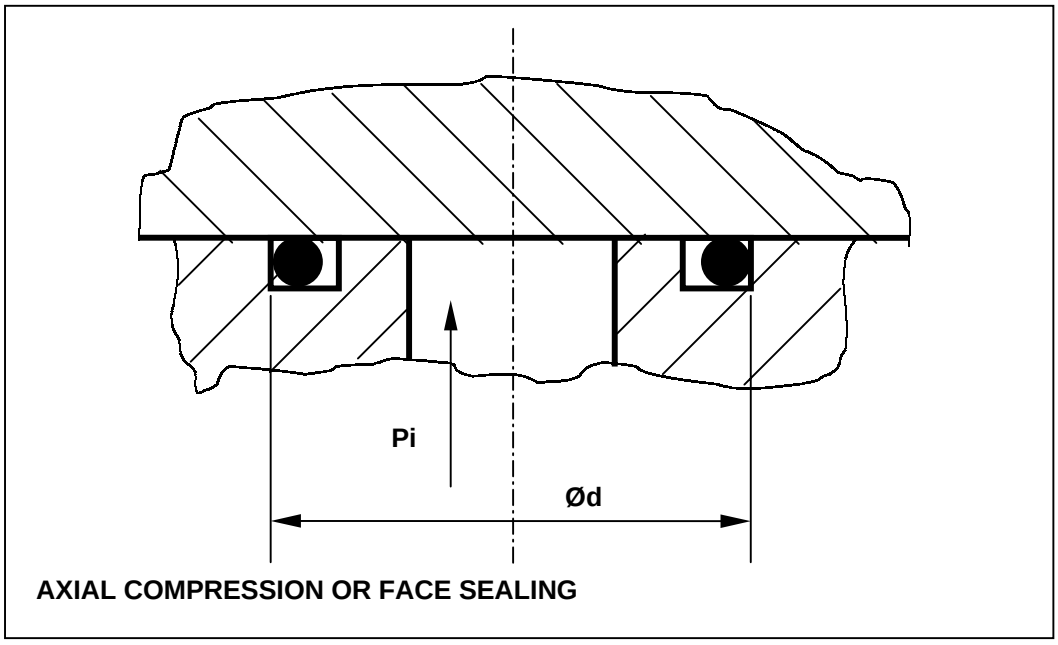
It is worthwhile to mention that "0" Ring seal design is the only recognised and coded application for static, dynamic and intermittent use under low, medium and very high pressures.

"0" Rings are recommended for all pressure vessels and are in use for pressure vessels such as valves, cylinders, isolation joints and have also large and secure application in aerospace and naval engineering practice.

TYPE OF APPLICATION

"0" Rings have diverse usage but it is possible to categorise them into three major type of application.

1. Radial compression
2. Axial compression or face sealing
3. Triangular sealing



AXIAL COMPRESSION OR FACE SEALING

Axial compression or face sealing. In the petrochemical industry and for pressure vessel equipments for static use, this is the simplest application of "0" Rings provided the basic rules are contemplated.

The seal squeeze is controlled by the depth of groove and should be in the region of 15% to 30%.

Elastomer can be considered to act as fluid under pressure and undue movement of the seal within its own housing , particularly under pulsating pressure conditions shall be prevented.
For internal pressure or vacuum the inner (d_8) is used.
Ideally $d_7 = d_1 + 2d_2$ and $d_8 = d_1$.

PERFORMANCE

To take full advantage for the “0” Ring, it is essential to understand some basic rules and ensure that it is used in the correct manner. Within this knowledge the designer will find that his selection of the correct “0” Ring will give him an optimum sealing performance.

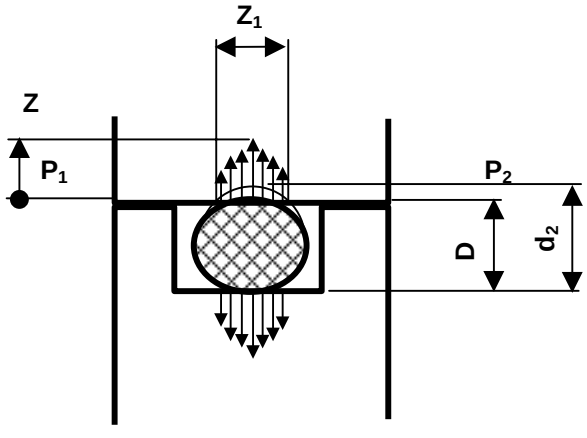
Basic parameters.

1. Under most conditions elastomer may be considered incompressible and when squeezed in one plane must be allowed to deflect in the other plane.

2. Elastomer has a high volumetric coefficient of expansion e.g. in the region of 10 times that of mild steel for acrylonitrile butadiene rubber (NBR).

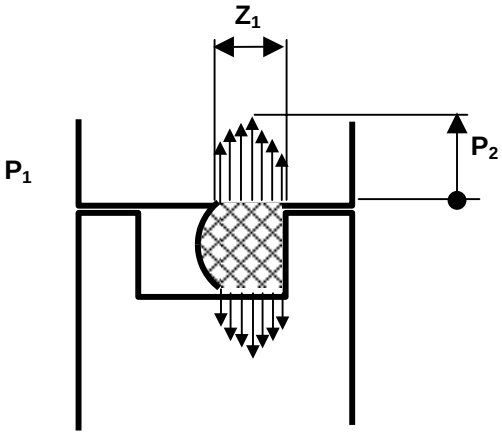
3. Elastomer will tend to act as a highly viscous fluid under pressure. The force pressure is transmitted in equal force in all directions (B. Pascal elementary rule for hydrostatic performance).
   For a good seal performance “0” Ring must have radial compression.

   Due to radial compression the “0” Ring reacts as force Z (fig 2 below) in correspondence with the contact zone z of the metal surface, where is added the fluid pressure. The global force Z (fig. 3 below) increases in equal proportion with the fluid pressure P.



$P_1 = P_2$

Figure 2



$P_1 > P_2$

Figure 3

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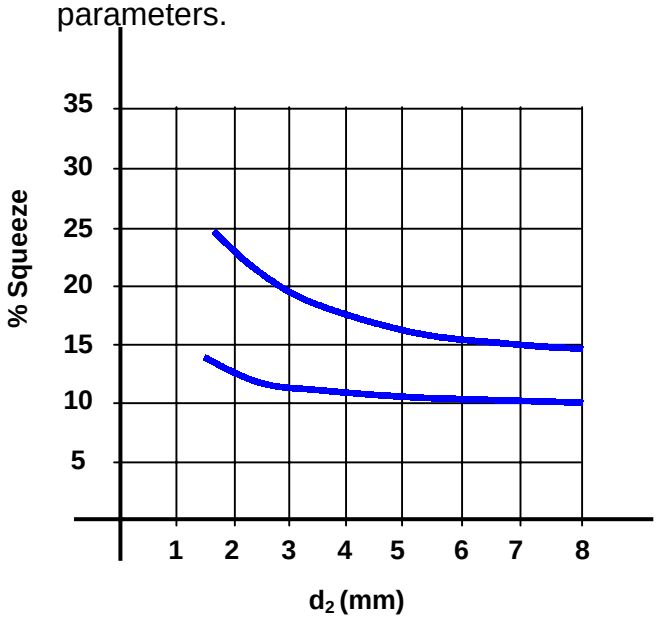
SEAL SQUEEZE

For many years "0" Ring housing recommendations took no account of the type of application involved and many manufacturers had to resort to modifications to cater for the requirements of their own particular product.

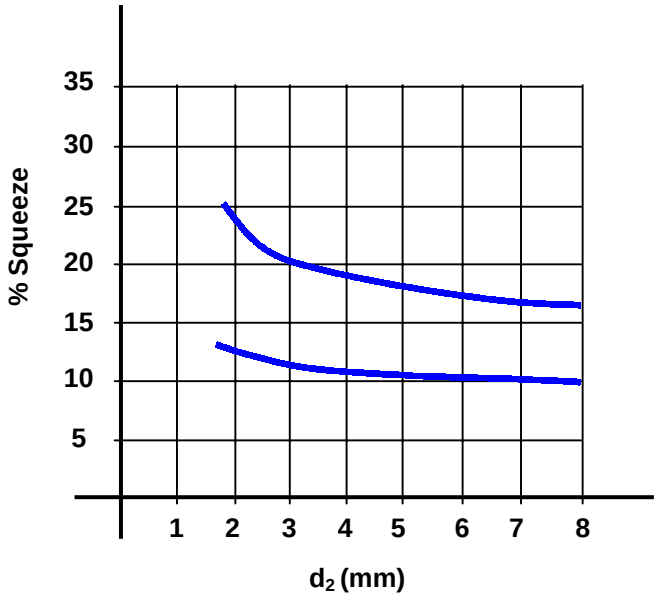
In recent years there has been an application of the need to differentiate between static, dynamic, hydraulic and pneumatic applications.

Static applications with radial compression can accommodate a relatively high degree of squeeze depending on diameter up to 30%.

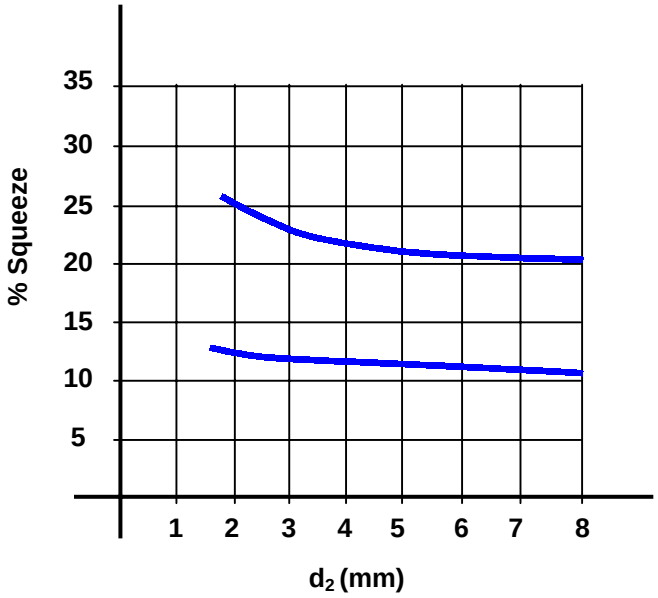
Below graphs indicate the acceptable squeeze differentials. Since the squeeze variation is due to tolerances on both seal and housing, it is necessary to maintain close machining tolerances on the housing diameters to remain in most cases within such parameters.



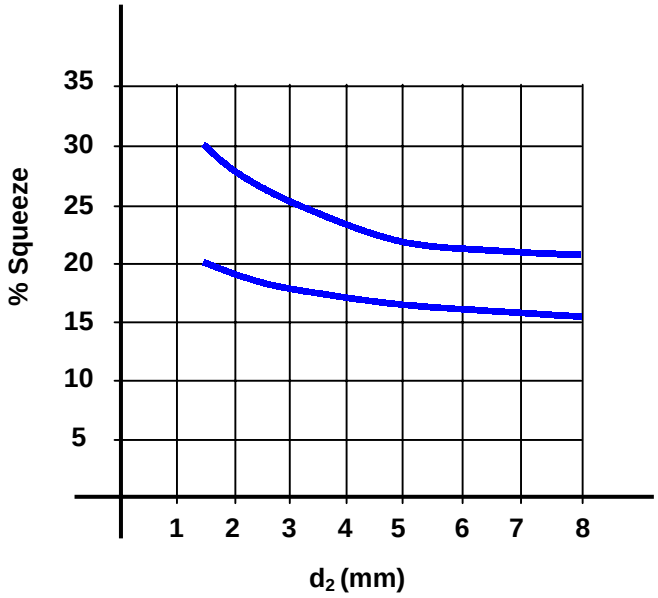
Dynamic-Hydraulic



Dynamic-Pneumatic



Static-Radial



Static-Axial

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SURFACE FINISH

Sealing efficiency is directly related to surface finish. The application must therefore be considered from a number of aspects to establish the most effective and economic surface finish or texture.

Static seals are less demanding and will tolerate rougher finishes particularly in axial compression or face sealing applications because of the use of higher compression.

Surface	Application	Pressure	Surface roughness Ra σm	CLA max σin.
Housing sides And Static diameter	STATIC	Non pulsating and non altering	1.6	63
		Pulsating or altering	0.8	32
	DYNAMIC	All types	0.8	32
Mating surface in contact with "O" Ring	STATIC	Non pulsating and none altering	0.8	32
		Altering and pulsating	0.4	16
	DYNAMIC	All types	0.4	16

The above table is for guidance only and covers the majority sealing application.

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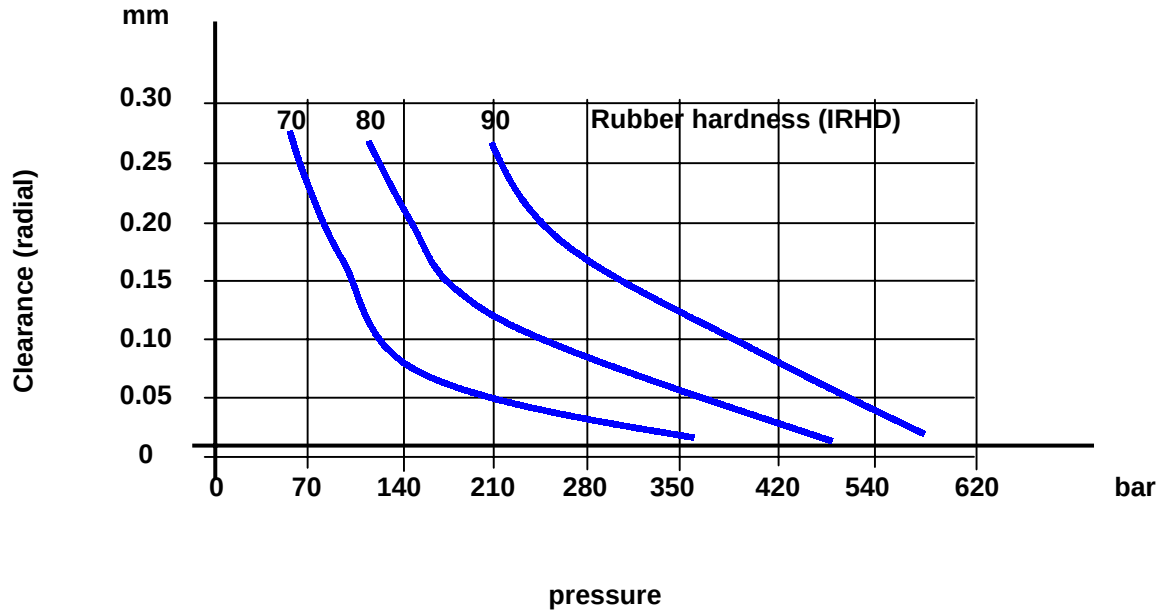
EXTRUSION

Extrusion is the result of rubber being forced under pressure through a clearance gap within the housing assembly.
The major controlling factors are the tolerances, pressure (pulsating or static), hardness of elastomer and temperature.

STATIC APPLICATION

Guidance is given in below graph indicating pressure/clearance limitations based on good quality NBR compound at room temperature and under static pressure condition.

The clearance specified represents radial clearance if eccentricity is zero, or diametral clearance if concentricity of mating diameters is not assured.



Anti-extrusion rings are required when considering conditions to the right of the relevant hardness curve.

Materials below nominal 70IRHD are excluded from this graph being considered impractical for pressures above 50 bar.

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Specific advantage when using the correct seal in isolation joints.

ISOLATION JOINTS USING "0" RING CONCEPT

1.	Design	Asme VIII div. I Appendix II
2.	Codes	BS 1806 – DIN 3771 – SMS 1586
3.	Tightness	Good
4.	Elastomer shape and size	Supported by BS 1806, DIN 3771, SMS 1586, AS 568A
5.	Medium transudment beyond rubber seal	None
6.	Insulation value after hydrostatic test	No limit, no medium bypass, no leak.
7.	Dielectric strength after hydrostatic test	12 Kv-50 Hz. Flange faces are Clean and dry after hydrostatic test. hence dielectric strength is high.
8.	Vacum test	1 millibarg (no risk of extrusion)
9.	Hydrostatic test without resin filler compound	Severe and very demanding tests have shown that isolation joints with "0" Ring design can be tested hydraulically without resin compound and no leak.

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REFERENCES

In the petrochemical and gas industry for most engineering companies the use of "0" Rings in the design and construction of isolation joints and pressure vessels is mandatory requirement.
Brief excerpt is given below.

End User	Specification	Extract
COMPANIES OF THE ROYAL DUTCH/SHELL GROUP	DEP 31.40.21.31	"Elastomer materials for ring seals shall be "0" Ring and shall resist explosive decompression….!
BECHTEL LIMITED	EGP-20.36	"Only continuously moulded precision "0" Rings Viton seals shall be used. All dimensions shall be in accordance with BS 4518…."
TRANSGÁS GAS NATURAL - PORTUGAL	P-0000-SPC.PF 1003	"Elastomer seal shall be from continuously moulded precision "0" Rings…"
THE BAHRAIN NATIONAL OIL COMPANY	SPC 001982008	"Continuously moulded precision "0" Rings unexplosive to decompression shall be used…."
British Gas	BGC/PS/E17 PT1	"Toroidal sealing Ring "0" Rings are used to effect a pressure seal. The "0" Rings shall be moulded construction and shall be preferably continuos…"
TEBODIN	TEB-1982005	"Double seals and required. Continuously moulded precision viton seal "0" Rings shall be used…"
JOHN BROWN	6140/80/SP/5461	"Only continuously moulded precision "0" Rings shall be used…"
ABU DHABI COMPANY FOR ONSHORE OIL OPERATIONS	12.78.12.604"	Only continuously moulded precision "O" Rings unexplosive to decompression shall be used