SURFACE ROUGHNESS

Dynamic surface finishes has influence on the operation & sealing life span

Having a proper finish on the seal is crucial when it comes to having an extended seal life. A smooth finish will not properly retain lubricant causing the seal to have excessive wear due to friction heat whereas a coarse finish will cause a seal failure due to surface roughness causing cuts on the seal lips. Therefore, the finish of a seal is important as it provides maximum seal performance and extends a machine's life span.

Housing surfaces and static sealing also have a significant impact on the operation and the life span of the seal. Although the surface furnish is not severe but it is good to ensure the finish recommendations are met. This is to maximize the performance and life span of the seal.

Dynamic Surface Finishes

Piston rods are hard chrome plated with a hardness of at least 67 Rockwell C (900 HV/10). With piston rods that are manufactured by established suppliers (surface finish range of 0.1 to 0.3 µm Ra (4-12 µin Ra)), would have an excellent tribological surface. An optimum surface finish also depends on the type of sealing material. Bore surface finishes tend to be more problematic. The various methods of bore finishes are listed in the graph below:

- **Drawn Over Mandrel (DOM) tubing:**

Can either be adequate or inadequate. It depends on the actual surface texture and the application.

- **Special Smooth Inside Diameter (SSID) DOM:**

With improved manufacturing processes, SSID tubing are more common. In certain circumstances SSID finishes just like its rougher finish relative DOM tube, can lead to premature wear of the seal due to flow erosion. Careful specification and regular quality checks are recommended if SSID tube are used.

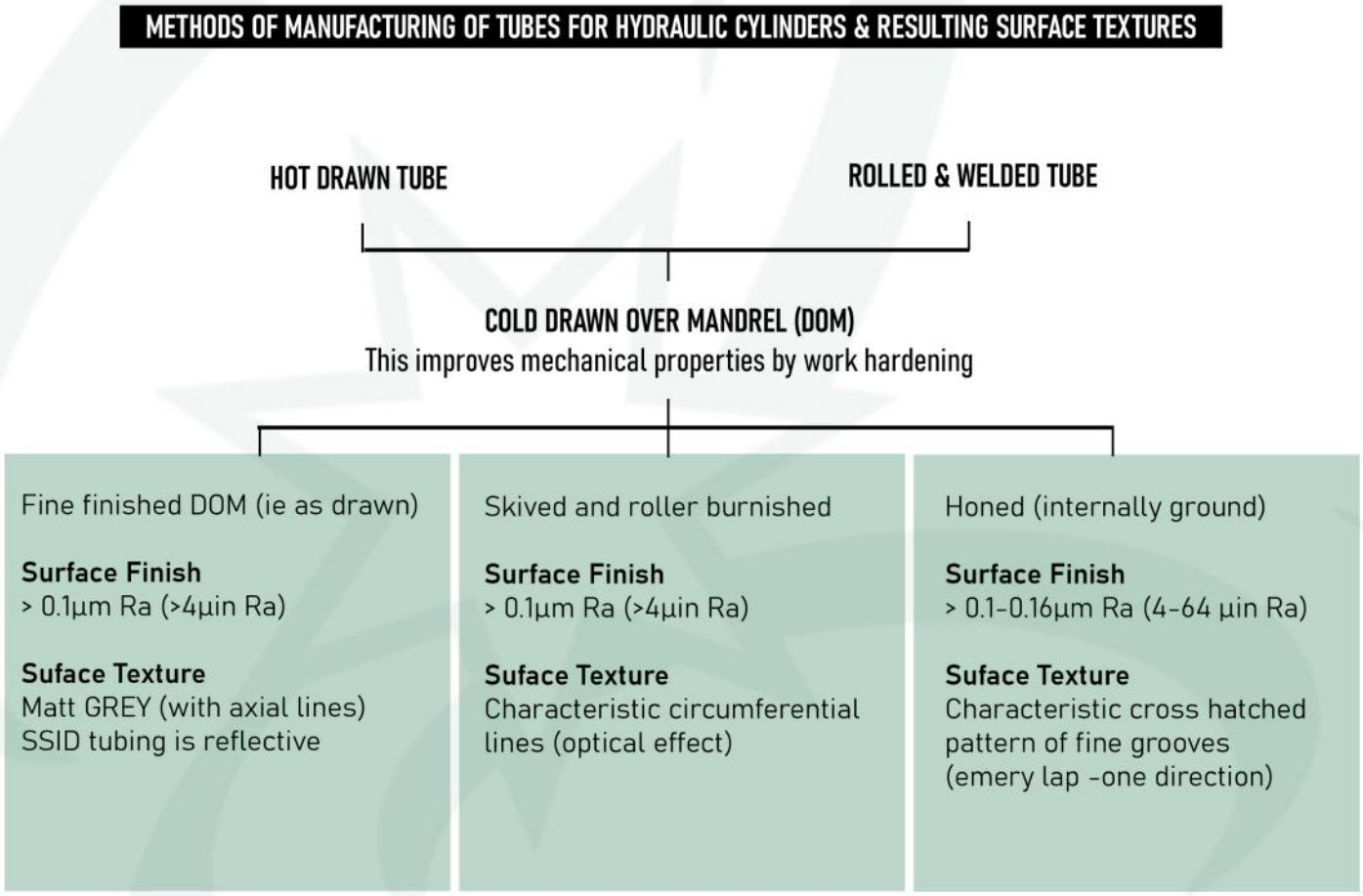
- **Optimally, skived & roller burnished, or honed tube is preferred.**

  - Skived & roller burnished tubing is exceptionally smooth (less than 0.1µm Ra) (4 µin Ra). Rubber sealing elements are prone to damages due to smoother surfaces.

  - Honed tube (produced between 0.1 and 0.4 µm Ra) (4-16 µin Ra) is the most expensive but has the best finish and is known to be the friendliest to mating sealing elements.

Static Surface Finishes

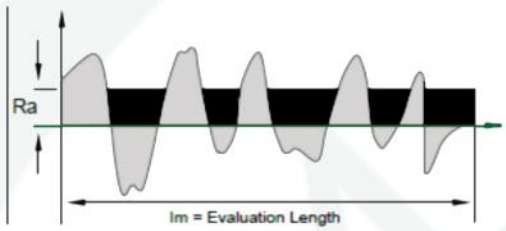
The static sealing surface finish controls leakages and should not be overlooked. These are fine turned and free from chatter marks.



Critical surface finish measurements for sealing

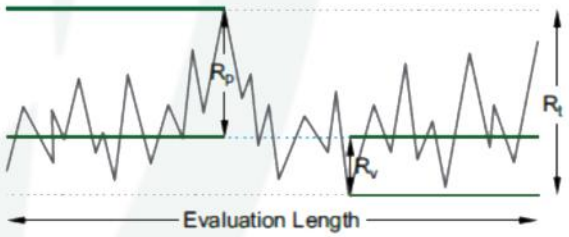
Many parameters can be used to define surface finishes, which are explained in ISO 4287 and ISO 4288. The most commonly used in the fluid power industry include:

Ra – Surface Finish Measurement



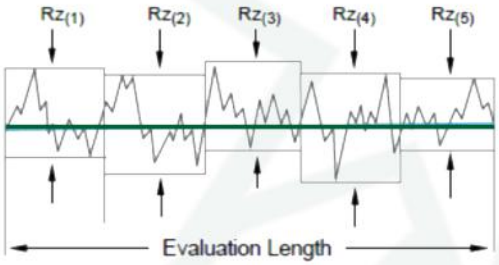
Ra = Arithmetical mean deviation of an absolute ordinate over the evaluation length

Rt – Surface Finish Measurement



Rt = Sum of height of the largest profile peak height Rp and the largest profile valley Rv over the evaluation length

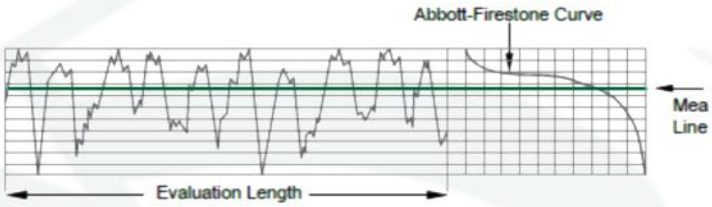
Rz – Surface Finish Measurement



$Rz = (Rz_{(1)} + Rz_{(2)} + Rz_{(3)} + Rz_{(4)} + Rz_{(5)})/5$

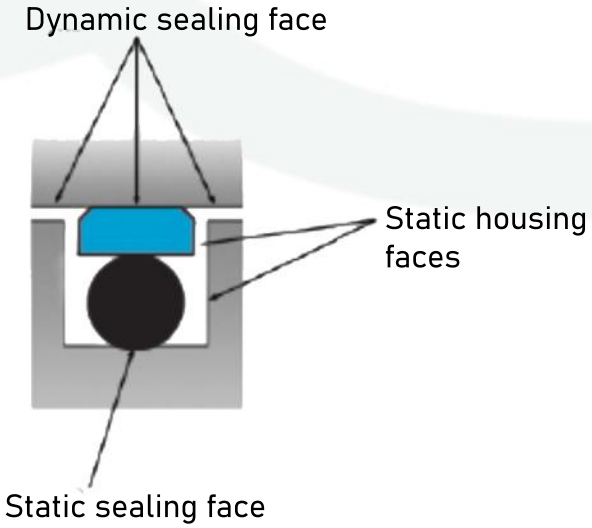
$Rz_{(n)}$ = Sum of height of the largest profile peak height Rp and the largest profile valley Rv within a sampling length

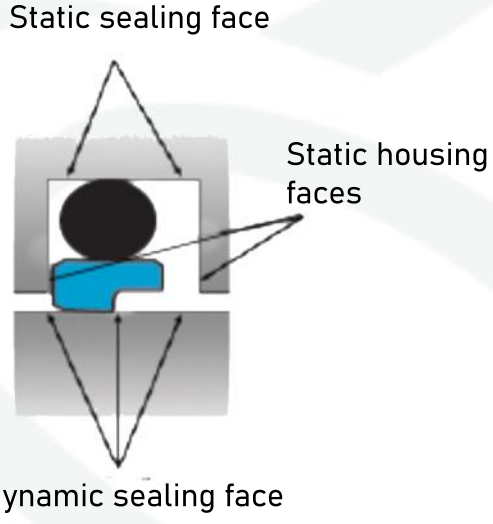
Rmr – Surface Finish Measurement



The 'sharpness' of the surface using a material ratio taken from the Abbott-Firestone curve. The material ratio at a particular height is a slice through the profile giving the percentage length of the cut at that height compared to the evaluation length. The Rmr values are at a depth of 25% of the Rz value from a reference level of 5%.

Surface finish recommendations - PTFE materials





Surface finish reccomendations - Teflon materials

	Metric			Inch			Rmr*
Surface Roughness	**µmRa**	**µmRz**	**µmRt**	**µinRa**	**µinRz**	**µinRt**	
Dynamic Sealing $Ød_1$	0.05 – 0.2	1.6 max	2 max	2 – 8	63 max	157 max	50-80%
Static Sealing Face $ØD_1$	1.6 max	6.3 max	10 max	63 max	250 max	394 max	
Static Housing Faces L_1	3.2 max	10 max	16 max	125 max	394 max	630 max	

Rmr is measure at a depth of 25% of the Rz value based upon a ference level (zero line) at 5% material/bearing area.

Surface finish recommendations - Polyurethane & Elastomer materials

	Metric			Inch			Rmr*
Surface Roughness	**µmRa**	**µmRz**	**µmRt**	**µinRa**	**µinRz**	**µinRt**	
Dynamic Sealing $Ød_1$	0.1 – 0.4	1.6 max	4 max	4 – 16	63 max	157 max	50-80%
Static Sealing Face $ØD_1$	1.6 max	6.3 max	10 max	63 max	250 max	394 max	
Static Housing Faces L_1	3.2 max	10 max	16 max	125 max	394 max	630 max	

Rmr is measure at a depth of 25% of the Rz value based upon a ference level (zero line) at 5% material/bearing area.