My Calculation

Engineering Calculation Sheet

Calculation no

Subject

External / Internal O-Ring Friction Load Estimation

Prepared By YUDHI Date 24-Mar-15

O-Ring cross section

This calculation was conducted in order to estimate static friction load of external/internal O-ring by using nomographic method. Parameters shall include differential pressure & O-Ring squeeze

Type:	External O-Ring			W	
D _P D _{P_max} D _{P_min}	13.535 ± 13.540 [in] 13.530 [in]	0.005	[in]	Piston diameter	D _P
D _C D _{C_max} D _{C_min}	13.550 ± 13.555 [in] 13.545 [in]	0.005	[in]	Cylinder diameter	EXTERNAL
D _G D _{G_max} D _{G_min}	13.067 ± 13.072 [in] 13.062 [in]	0.005	[in]	Gland diameter	O-RING
ID ID _{_max} ID _{_min}	12.475 ± 12.480 [in] 12.470 [in]	0.005	[in]	O-Ring ID	

Stretch & Squeeze

0.275

0.277 [in]

0.273 [in]

W

 $W_{_\text{max}}$

 $W_{_{\text{min}}}$

Maximum % stretch =
$$[(D_{G_{max}} - ID_{min}) / ID_{min}] \times 100$$

= 4.83%

0.002

[in]

Minimum % stretch =
$$[(D_{G_{min}} - ID_{max}) / ID_{max}] \times 100$$

= 4.66%

Maximum corrected % squeeze =
$$\{[W_{actual_max} - .5(D_{C_min} - D_{G_min})] / W_{actual_max}\} \times 100$$

Minimum corrected % squeeze =
$$\{[W_{actual_min} - .5(D_{C_max} - D_{G_min})] / W_{actual_min}\} \times 100$$

= 5.29%

These information's are solely provided for educational and/or discussion purposes and should not be interpreted as a recommendation for a specific treatment plan, course of action or product/ service. Use of any of this information does not replace consultations with individuals qualified in these respective fields.

_	Alculation ering Calculation Sh	Page <u>2</u> of <u>3</u>					
Subject	External / Internal O-Ri		Prepared By	YUDHI			
D₽	13.535 [in]	Nominal piston diameter					
D _c	13.550 [in]	Nominal cylinder diamet					
D_{G}	13.067 [in]	Nominal gland diameter					
ID	12.475 [in]	O-Ring nominal ID					
S _W	12.18 [%]	Nominal cross section so	queeze = [(W	5(D _c - D _G)) / W] >	x 100		
Nomogra	ph A						
ΔΡ	5,000 [PSI]	Differential pressure					
W	0.275 [in]	O-Ring cross section					
D_{m}	12.750 [in]	O-Ring mean diameter	= ID +	W			
Α	12.0 [in ²]	Annulus area					
f_h	97 [PSI]	Friction density					
F _H	1,200 [lbf]	Friction force due to ΔP					
Nomogra							
OD	13.025 [in]	O-Ring nominal OD	= ID +	2W			
S _W *	8.55 [%]	Cross section squeeze					
H _s	70 [shore A]	O-Ring shore hardness					
L _o	37 [in]	Rubbing length					
f _c	0.6 [lbf/in]	Linear friction					
F_c	24 [lbf]	Friction force due to squ	eeze				
F_{DYN}	1,224 [lbf]	Total dynamic force	= F _H +	F _c			
F _{STATIC}	3,672 [lbf]	Static friction	= 3 x F	DYN			
P_L	721,005 [lbf]	Pressure load	= ΔP x	$(\pi/4 \times D_c^2)$			
d_ _{hys}	0.17 [%]	Dynamic hysteresis	= (F _{DY}	_N / P _L) x 100			
* Cross se	ection squeeze can be put	either nominal % squeez	e (S _W) or maxir	num corrected % so	queeze.		

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My Calculation **Engineering Calculation Sheet** Calculation no 005 Prepared By YUDHI External / Internal O-Ring Friction Load Date 24-Mar-15 Estimation Nomograph A: O-ring friction caused by differential pressure AP 10,000 -150 FH Dm 5000 4000 0.1 30 2000 3000 - 70 Oring cross-section 1000 0.2 50 0.3 500 10 0.4 Friction caused by pressure, ib 1000 Differential pressure, psi Projected pressure area, in.2 200 0.7 O-ring mean dla., in. 5 100 500 0.275 1.0 3 50 300 2. 0.210 200 2.0 20 0.139 0.103 3.0 10 -1.0 100 0.7 5.0 8 5.0 0.070 0.5 50 6 20 E 10 0.3 1.0 20 20 0.5 0.1 10 Nomograph B: O-ring friction caused by cross-section squeeze Sw 00,10 Lo 10.0 100 Read horiz. Shore-A hardness 80 (outside for piston application, inside for rod application) 500 20 pivot points 60 Cross-section squeeze, % 5.0 15 200 4.0 40 friction caused by Orring squeeze, ib 100 3.0 30 8 50 -6 2.0 O-ring rubbing length, 20 30 15 20 10 1.0 10 10-15 8.0 8 -2 20 25 30 3 0.4 1.00 1.0 0.3 0.80 0.60 0.40 0.1 **Reference** Product Engineering magazine, June 1979, page 56

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