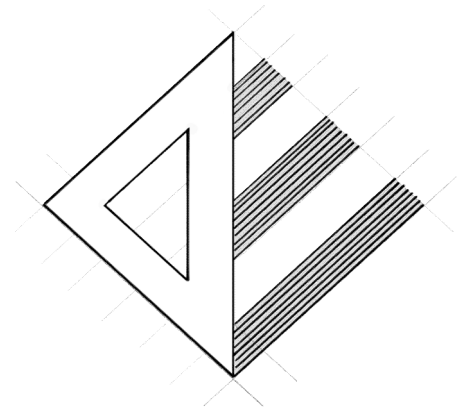


Ball Bearing Life Calculation

Design Inputs				
Bearing Description		DE Bearing	NDE Bearing	
Bearing designation	SKF#	61806	61809	-
Bore	d	30	45	mm
Outer diameter	D	42	58	mm
Width	B	7	7	mm
Basic dynamic load rating	C	4090	5720	N
Basic static load rating	C ₀	2900	5000	N
Fatigue load limit	P _u	146	212	N
Minimum load factor	k _r	0.015	0.015	-
Calculation factor	f ₀	13.9	15.1	-
Mass	m	24	25	g
Clearance class	-	Normal	Normal	-
Center to shaft flange	x	10	70	mm
Preload		200	N	
Locating bearing?		NDE Bearing		
Shaft orientation		Vertical	-	
Required rated life		40 000	h	
Reliability		90	%	
Peak load factor		1.5	-	
Grease		MT33		
Grease has EP properties?		No		
Seals		2RZ Non-contact		
Shaft Material		Stainless Steel 17-4PH		
Housing Material		Alumnium 6061-T6		
Bearing Material		Steel 4140HSTR		



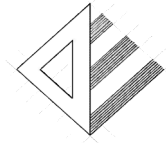
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Project Primary Transmission Shaft
Date 2023-02-05
Author Matthew Davidson

Structural and Thermal Loading		Direct to Shaft						
Load case		1	2	3	4	Mean	Peak	
Duty cycle		0.5	0.25	0.15	0.1	-	-	-
Oscillation speed	n _{osc}	40	110	120	150	105	0	ppm
Oscillation range	θ	180	360	360	350	313	0	°
Temperature - Shaft		20	30	50	80	45	90	°C
Temperature - Housing		20	25	45	75	41	90	°C
Radial (at shaft)	Fr	150	250	400	500	325	750	N
Axial (at shaft)	Fa	20	25	30	35	28	10	N
Moment (at shaft)	M	7	5	5	5	6	10	Nm
-	-							-
-	-							-
		loadcase0	loadcase1	loadcase2	loadcase3			

Ball Bearing Life Calculation

Rated Life Estimation using ISO281



Project Primary Transmission Shaft
 Date 2023-02-05
 Author Matthew Davidson

Structural and Thermal Loading								
Load case		1	2	3	4	Mean	Peak	
Duty cycle		0.5	0.25	0.15	0.1	-	-	-
Oscillation speed	nosc	40	110	120	150	105	0	ppm
Oscillation range	θ	180	360	360	350	313	0	°
Temperature - Shaft		20	30	50	80	45	90	°C
Temperature - Housing		20	25	45	75	41	90	°C
Radial (at shaft)	Fr	150	250	400	500	325	750	N
Axial (at shaft)	Fa	20	25	30	35	28	10	N
Moment (at shaft)	M	7	5	5	5	6	10	Nm
Effective speed	n	40.0	220.0	240.0	291.7	182.3	0.0	rpm

loadcase0 loadcase1 loadcase2 loadcase3

Calculations									
Bearing Loads									
DE Bearing									
Radial load	Fr_1	292	375	550	667	471	1042	N	
Axial load	Fa_1	200	200	200	200	200	200	N	
Axial load ratio	F _a /C ₀	0.07	0.07	0.07	0.07	0.07	0.07	-	
Factored axial load ratio	f ₀ * F _a /C ₀	0.96	0.96	0.96	0.96	0.96	0.96	-	
Axial/radial load factor	F _a /F _r	0.68	0.53	0.36	0.30	0.42	0.19	-	
Radial load factor	X ₀	0.60	0.60	0.60	0.60	0.60	0.60	-	
Axial load factor	Y ₀	0.50	0.50	0.50	0.50	0.50	0.50	-	
Equivalent static bearing load	P ₀	292	375	550	667	471	1042	N	
NDE Bearing									
Radial load	Fr_2	142	125	150	167	146	292	N	
Axial load	Fa_2	220	225	230	235	228	210	N	
Axial load ratio	F _a /C ₀	0.04	0.05	0.05	0.05	0.05	0.04	-	
Factored axial load ratio	f ₀ * F _a /C ₀	0.66	0.68	0.69	0.71	0.69	0.63	-	
Axial/radial load factor	F _a /F _r	1.55	1.80	1.53	1.41	1.56	0.72	-	
Radial load factor	X ₀	0.60	0.60	0.60	0.60	0.60	0.60	-	
Axial load factor	Y ₀	0.50	0.50	0.50	0.50	0.50	0.50	-	
Equivalent static bearing load	P ₀	195	188	205	218	201	292	N	
Static Safety Factor									
Bearing 1	S ₀	9.9	7.7	5.3	4.3	6.2	2.8	-	
Bearing 2	S ₀	25.6	26.7	24.4	23.0	24.8	17.1	-	
Dynamic Safety Factor									
DE Bearing									
Limit for load ratio	e	0.28	0.28	0.28	0.28	0.28		-	
Radial load factor	X	0.56	0.56	0.56	0.56	0.56		-	
Axial load factor	Y	1.58	1.58	1.58	1.58	1.58		-	
Equivalent dynamic bearing load	P	480	527	625	690	580		N	
Load Ratio	P/C	0.12	0.13	0.15	0.17	0.14		-	
Fatigue limit / dynamic load factor	P _d /P	0.30	0.28	0.23	0.21	0.25		-	
Basic rating life at 90% reliability	L ₁₀	618	468	281	208	350		(10 ⁶ rotations)	
NDE Bearing									
Limit for load ratio	e	0.26	0.26	0.26	0.26	0.26		-	
Radial load factor	X	0.56	0.56	0.56	0.56	0.56		-	
Axial load factor	Y	1.73	1.72	1.71	1.70	1.71		-	
Equivalent dynamic bearing load	P	460	456	477	493	471		N	
Load Ratio	P/C	0.08	0.08	0.08	0.09	0.08		-	
Fatigue limit / dynamic load factor	P _d /P	0.46	0.46	0.44	0.43	0.45		-	
Basic rating life at 90% reliability	L ₁₀	1921	1967	1728	1561	1789		(10 ⁶ rotations)	
Life adjustment factor for reliability	a ₁	1.0	1.0	1.0	1.0	1.0			
Life modification factor	a _{ISO}	1.0	1.5	2.0	1.8	1.0			
Estd. Rated Life (ISO281) : DE Bearing									
Predicted life at 90% reliability	L _{10mh}	257,420h	53,211h	38,979h	21,402h	31,984h	150,000h		
Predicted life @ design reliability (90%)	L _{1mh}	257,420h	53,211h	38,979h	21,402h	31,984h	150,000h		
Life safety factor against design life	S.F.	6.4	1.3	1.0	0.5	1	4		
Estd. Rated Life (ISO281) : NDE Bearing									
Predicted life at 90% reliability	L _{10mh}	800,477h	223,569h	239,956h	160,565h	163,608h	508,181h		
Predicted life @ design reliability (90%)	L _{1mh}	800,477h	223,569h	239,956h	160,565h	163,608h	508,181h		
Life safety factor against design life	S.F.	20.0	5.6	6.0	4	4	13		