W1.104

GUIDE LINES FOR SIZING AND
SELECTION OF GEARBOXES

1   Helical Gear boxes

Reduction ratios and number of stages and efficiency

Reduction ratio	number of stages	efficiency %
1.6 –6.3	1	99
6.3- 22.4	2	98
14 – 112	3	97.5
112- 630	4	97

2   Bevel Helical Gear Boxes
Reduction ratos and number of stages and efficiency

Reduction ratio	number of stages	
6.3 – 18	2	97.5
14 – 100	3	97
100 – 630	4	96.5

2   Selection of Gear boxes

Symbol	unit	description
N	r.p.m.	nominal transmission ratio
n_1	r.p.m.	input speed
n_2	r.p.m.	output speed
P_N	kw	nominal gear box rating
P_e	kw	absorbed power of driven machine
f		service factor
f_w		factor for ambient temp. ^{o}c (**Table3)**
E_P	%	running period
P_{G1}		thermal capacity without additional Cooling at 20 ^{o}c
P_{G2}		thermal capacity with fan
P_{G3}		thermal capacity with built in cooing Coil
P_{G4}		thermal capacity with cooling coli And fan
M_K	da Nm	starting or max. input torque

1      $N = n_1/ n_2$ trasmission ratio

2	$P_N >/= P_e * f$		for f see **Tables 1 & 2**
3	$M_k n_1/ (P_N*955) </= 2.5$		
4	Heating and cooling		
	Gear box suitable		
	1 without cooling when	$P_e </= P_{G1}*f_w$	
	2 with fan when	$P_e </= P_{G2}*f_w$	
	3 with built in cooling		
	coil when	$P_e </= P_{G3}*f_w$	
	4 with cooling coil and		
	and fan	$P_e </= P_{G4}*f_w$	
	5 with external cooling		
	when	$P_e >/= P_{G4}*f_w$	

3   Load Parameters   **Table 1**

Driven machine	load	hrs	Driven macchine	load	hrs
excavators			**Fans, blowers**		
Bucket chain elevator	S		Axial fans	M	
Caterpillar track	S		Centrifugal fans	M	
Bucket wheel stacker	M		Centrifugsal blowers	G	
Mining machinery			**Cranes**		
Concrete mixers	M		Traveling gear	M	
Crushers	S		Hoisting gear	M	
Briquetting press	S		Winches	G	
Chemical Industry			**Mills**		
Mixers	M		Hammer mills	S	
Agitators	M		Ball and tube mills	S	
Rotary dryer	M		Rod mills	S	
Centrifuge	M		Roller mills	S	
Cement kilns	S		**Compressors**		
Filter presses	M		Reciprocating	S	
Conveyors					
Bucket elevator	G/M				
Chain conveyor	G				
Apron conveyor	G/M				
Screw conveyor	G				
Belt conveyors	M				
Lifts	M				

G = uniform load ; M = medium load; S = heavy load
Duty hours taken as 24 in most cases.

4   Service factor   f   **Table 2**

Prime mover	Hrs of Operation Per day	Load parameter		
		G	M	S
Electric motor	3to 10	1.0	1.25	1.75
	10 to 24	1.25	1.5	2.0
Reciprocating Engine 4-6 cylinder	3 to 10	1.25	1.5	2.0
	10 to 24	1.50	1.75	2.25

5   Factor for Ambient Temp. f_w **Table 3**

Type of cooling	Ambient Temp. $^\circ$ c	Duration of Operation per hr %				
		100	80	60		
Gearboxwithout Additional cooling	30	0.88	1.06	1.23		
	40	0.75	0.9	1.05		
	50	0.63	0.76	0.88		
Gear box with fan	30	0.9	1.26	1.26		
	40	0.8	0.96	1.12		
	50	0.7	0.84	0.98		
Gearbox with Cooling coil	30	0.9	1.08	1.26		
	40	0.85	1.02	1.19		
	50	0.8	0.96	1.12		
Gearbox with Fan and cooling coil	30	0.92	1.1	1.29		
	40	0.83	1.0	1.16		
	50	0.78	0.94	1.09		

6   Example of selection

Prime mover   electric motor
Speed n_1 750 r.p.m.
Driven machine   ball mill
Rating   1000 kw
Girth gear /pinion   6:1
Pinion shaft n_2 125 r.p.m.
Mill speed   20.8 r.p.m.
Working hours   20/day
Duty   continuous
Starts   1/hr
Running time /hr   100 %
Ambient temp.   40 $^\circ$ c

Gearbox   Helical
To work out type and size of gear box

Design

Ratio n_1/n_2 = 750 125 = 6

Select single reduction helical gear box

Size of gear ox

Operating factor from Tables 1 and 2

Ball mill ; S,

f for prime mover – electric motor

- running hours 20 = 2

$P_N = P_e * f$ = 1000*2 = 2000 kw

From tables

Actual reduction ratio 6.3

Size of gear unit 560

P_N of size 560 gearbox is 2150 kw which is > 2000 kw required

Thermal capacity	without cooling	P_{G1}	1020
	With fan	P_{G2}	1750
	With cooling coil	P_{G3}	1850
	With coil and fan	P_{G4}	2600

Check starting torque

M_K = 2546 at 750 rpm and 1000 kw

2546*750 / (2150*955) = 0.9

Thermal capacity

From table 3, fw = 0.75 without cooling 1020* 0.75 = 765

0.8 **with fan** **1750* 0.8 = 1400**

0.85 with coil 1850 * 0.85 = 1572.5

0.83 with coil and fan 2600* 0.83 = 2158

Thus gearbox with cooling fan should suffice

Source: Elecon and New Allenbury Manuals

For guidance only. Use Vendors' Brochures for sizing and selection

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