DRIVE DESIGN EXAMPLE

DRIVE DESIGN EXAMPLE, USING A STANDARD SPEED ELECTRIC MOTOR AND STANDARD PULLEY DIAMETERS

GIVEN

1. A 30 kilowatt squirrel cage electric motor is to drive an air compressor with following characteristics: flow 4m³/min at 0.7 MPa (7 kg/cm²) according to DIN.
2. 2850 RPM motor speed.
3. The desired compressor speed is 1250 RPM.
4. Shaft to shaft centre distance should be about 760 mm. Because of space limitations, the maximum pulley datum diameter cannot exceed 220 mm.
5. Normal service - one year of service is requested.

DRIVE DESIGN	RESULTS
Step 1 A one year belt service is normal for this kind of application, thus 6000 hrs life range needs to be taken.	Service life range: 6000 hrs.
Step 2 **A.** From table No. 1 the normal service factor is 1.2 **B.** The power requirement is 30 kW **C.** Design power = 1.2 x 30 kW = 36 kW	Service factor: 1.2 Design power: 36 kW
Step 3 From table No. 2, 3 or 4 find the proper cross-section: Gates Quad-Power II, moulded notch, XPA section.	Belt section: XPA
Step 4 Speed ratio: $\frac{2850}{1250} = 2.28$	Speed ratio: 2.28
Step 5 & 6 Pulley diameters can be selected from tables Nos. 5 and 6. In this case space availability is the limiting factor. For that reason we have to start from the driveN pulley. With a maximum of 220 mm, locate a possible large pulley diameter range in the top row of table No. 6 and go down to find a speed ratio close to 2.28. Using a driveN pulley of 212 mm and a ratio of 2.23 the driveR becomes 95 mm. $V = \frac{95 \times 2850}{19100} = 14.2$ m/s	d: 95 D: 212 Belt speed: 14.2 m/s
Step 7 **A.** Tentative belt length: $2 \times 760 + 1.57 (212 + 95) + \frac{(212 - 95)^2}{4 \times 760} = 2006$ mm **B.** From the size listing on page 11, find the closest standard datum length to be 2000 mm or XPA 2000. Then calculate the actual centre distance: F = 2000 - 1.57 (212 + 95) = 1518 mm $\frac{D - d}{F} = \frac{212 - 95}{1518} = 0.0771$ from table No. 9: h = 0.04 $A = \frac{1518 - 0.04 (212 - 95)}{2} = 757$ mm	Tentative belt length: 2006 mm Standard datum length: 2000 mm or XPA 2000 Actual centre distance: 757 mm
Step 8 **A.** From table A find the basic kW rating: 8.02 kW **B.** From table B find the additional kW for speed ratio: 0.66 kW **C.** Table C gives the additional kW for belt life: $C = \frac{95 \times 2850}{362319} = 0.75$	Basic kW A: 8.02 kW Additional kW B: 0.76 kW Additional kW C: 0.75 kW

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Open the cover flap and follow step by step the drive design method.

$\frac{D - d}{A} = \frac{212 - 95}{757} = 0.15$	
D. From table G find the arc of contact correction factor G: 0.98	Arc correction factor G: 0.98
E. Table C_L gives the belt length correction factor: 0.98	Length correction factor C_L: 0.98
F. Net kW per belt: (8.02 + 0.76 + 0.75) x 0.98 x 0.98 = 9.15	Net kW per belt: 9.15
G. Number of belts required:	
$\frac{36}{9.15}$ = 3.93 or 4 belts	Number of belts: 4
Pulley width: (3 x 15) + (2 x 10) = 65 mm	Pulley width: 65 mm
Step 9	
From table No. 11 find the: - minimum allowance on centre distance for installation: 25 mm - minimum allowance on centre distance for takeup: 40 mm	Installation allowance: 25 mm Takeup allowance: 40 mm
THE DRIVE REQUIRES 4 GATES QUAD-POWER II BELTS WITH CROSS-SECTION XPA 2000	
TENSIONING	
Step 10	
Static tension per belt (Table No. 13: M = 0.104)	
$T_s = 450 \times \frac{(2.5 - 0.98)}{0.98} \times \frac{30}{4 \times 14.2} + 0.104 \times (14.2)^2 = 390$ N	Static tension per belt: 390 N
Step 11	
A.	
Span length $t = 757 \left[1 - 0.125 \left(\frac{212 - 95}{757}\right)^2\right] = 755$ mm	Span length: 755 mm
B.	
Deflection = $\frac{755}{100}$ = 7.55 mm	Deflection: 7.55 mm
C. Minimum and maximum recommended deflection forces: (Table No. 13: Y = 20)	
Minimum recommended deflection force = $\frac{390 + 20}{25}$ = 16.4 N	Min. deflection force: 16 N
Maximum recommended deflection force = $\frac{1.5 \times 390 + 20}{25}$ = 24.2 N	Max. deflection force: 24 N

Kilowatt rating tables (Step 8)