CONVEYOR MANUFACTURERS ASSOCIATION OF SOUTH AFRICA NPC

TECHNICAL DOCUMENT

CONVEYOR PULLEY BEARING SOLE PLATES

CMA TD02 Rev00 2018

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Most plummer blocks and bearings are robust and when properly sized, mounted and lubricated should render long and trouble-free life. Incorrect mounting or loading, poor lubrication and the use of improper or inappropriate tools can have a negative influence on the life of the installation.

In the same way, the structures that support the pulleys and bearing assemblies should be designed to accommodate the forces that will be applied to the pulley. Being structural items, it is therefore necessary to insert fixed sole plates between the bearing housing and the steelwork supporting them. The correct selection of sole plates depends on the plummer block selection, the load induced by the conveyor belt and pulley and, to an extent, the structural support detail.

Therefore, sole plates serve two basic purposes, namely to provide a flat surface for the bearing housing and to facilitate proper horizontal and vertical alignment of the pulleys. However, sole plates are not always required. For example, where the conveyors and pulleys are small, the sole plates may not be required, depending on the design of the support structure.

In cases where the pulleys are large and heavy, they will require a higher degree of installation accuracy. Sole plates will allow the pulley assembly to be adjusted with minimal effort while ensuring the alignment of the pulley.

The mounting tolerances and procedures for the bearing housings are of cardinal importance. It is recommended by most manufacturers that the surface for the bearing housing mounting should be finished to a roughness $R_a \leq 12,5$ µm. The flatness of the surface should be to IT7 in accordance with ISO 1101:2012. For moderate loading, the flatness could be reduced to IT8, but the more stringent tolerance should be applied in the general case.

The fixed sole plates are usually equipped with adjusting screws on each end, in order to facilitate the adjustment of the housing when the system is aligned. For conveyor pulley installations, the vertical and horizontal installation tolerances are fixed at 1:1000. Compared to the normal structural tolerance, which is often quoted as loosely as ±5 mm, the use of packs and adjusting screws becomes important when conveyor installations are considered.

When shims or packs are required under the bearing housing, it is important that the shims or packs are made full length of the bearing housing base. Packing under the attachment bolts only will place an unnecessary stress on the unsupported centre portion of the housing. This will result in either the housing failing at the junction with the base, or distorting to such an extent that the bearing clearances will be affected. The result will be premature bearing failure or an increase in drag on the pulley, resulting in an increase in power consumption and accelerated wear of the pulley shell and lagging. Shims should be made of stainless sheet steel with sufficient strength and the ability to withstand corrosion from several media. Shims made from soft metals like copper or brass typically compress over time, causing looseness, which can eventually lead to misalignment. Whenever possible, use only one shim and never stack more than three shims.

The bolts attaching the plummer block should be specified as a minimum of grade 8.8 bolts with hexagon heads and hexagon nuts. The recommended tightening torque for the attachment bolts is given in the table below. The torque figures are quoted in N·m.

Bolt	Torque
M12	90
M16	220
M20	430
M24	750
M30	1400

It is to be noted that the torques quoted are based on the load passing vertically through the housing base. In the case when the resultant force does not act normal to the base, then it may be necessary to use grade 10.9 bolts and the tightening toque would be adjusted accordingly.

A surface friction coefficient of about $\mu = 0{,}2$ may be used to compute the required vertical force, based on the resultant force and the angle of the resultant with respect to the base.

See Appendix A

Where the bearing assemblies are to be mounted on stools, especially where the stools are designed with a sloping surface, then the sole plates should be mounted between the stool and the supporting structure. In this case, the bearings will be firmly bolted to the stools without soleplates.

Sole plates are preferably shop-welded to the structure. Should the flatness of the soleplate be compromised by welding, alternative methods, such as bolting or adhesives may be specified.

Sole plates may be bolted to the structure using countersunk screws and nuts, provided that the screws are capable of withstanding the shear forces arising from the load on the plummer blocks.

The use of epoxy adhesives to allow the sole plates to be squared and seated in position may be considered. In this case, the effects of temperature changes on the adhesive bond between the sole plate and the structure must be considered. In addition, where the resultant force is not normal to the plane of the sole plate, the specification of the adhesive must be considered in conjunction with the adhesive supplier.

Should an epoxy adhesive be considered, the maximum adhesive film thickness should be no more than 2,0 mm.

The supporting steel work is to have slots to match the sole plates, irrespective of the attachment method employed.

The weld between the sole plate and the structure should make a water-tight seam on the first pass (±3 mm weld), so that stitch-welding (if applied) minimises weld distortion, which could affect the flatness of the plates.

The corners of the sole plates may be cropped 45°×10 mm, in order to minimise snag points. Remove all snags and burrs from the edges by an appropriate method.

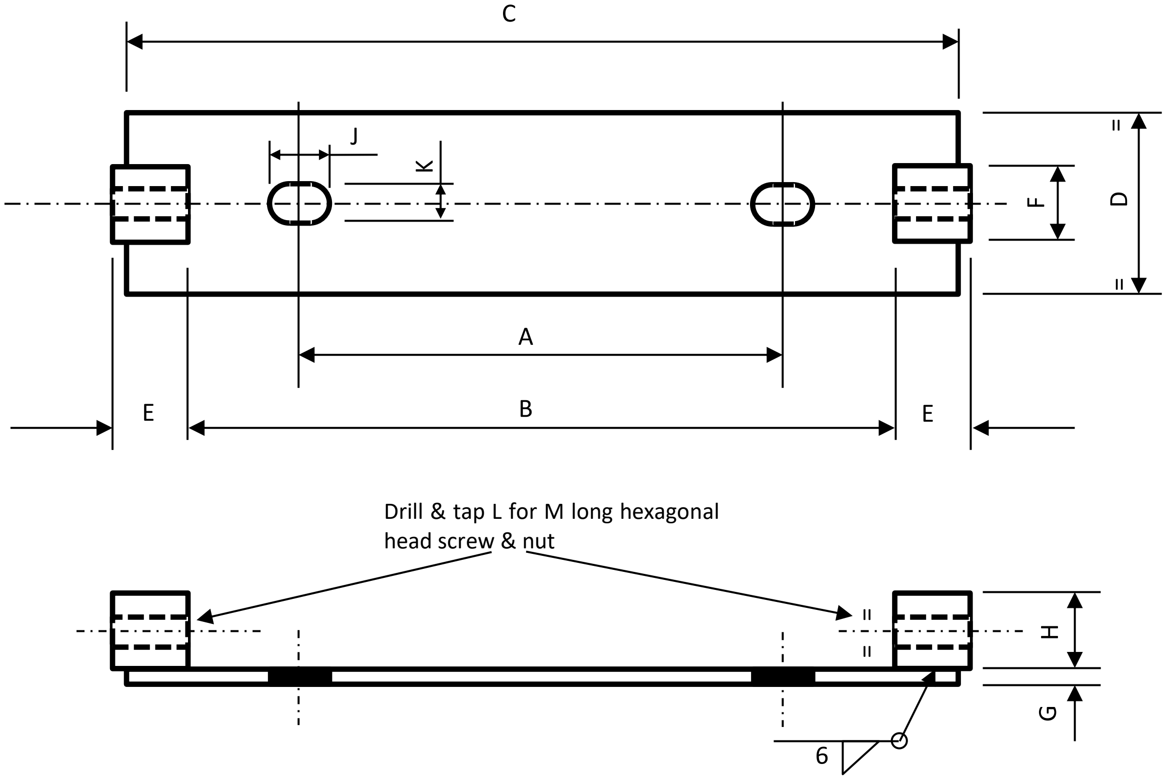
Sole plates may be divided into 4 basic types, as follows.

a) Type 1, for plummer blocks with two bolts
b) Type 2 for plummer blocks with 4 bolts and single jacking bolts each side
c) Type 3 for plummer blocks with 4 bolts and a double jacking block each side
d) Type 4 for static-shafted pulley dead-eyes

For very large bearing housings, such as shafts equipped with BND housings with diameters in excess of 300 mm, the sole plates should be designed in consultation with the bearing housing supplier.

Type 1

Sole plates for 2-bolt bearings up to and including ø140 mm

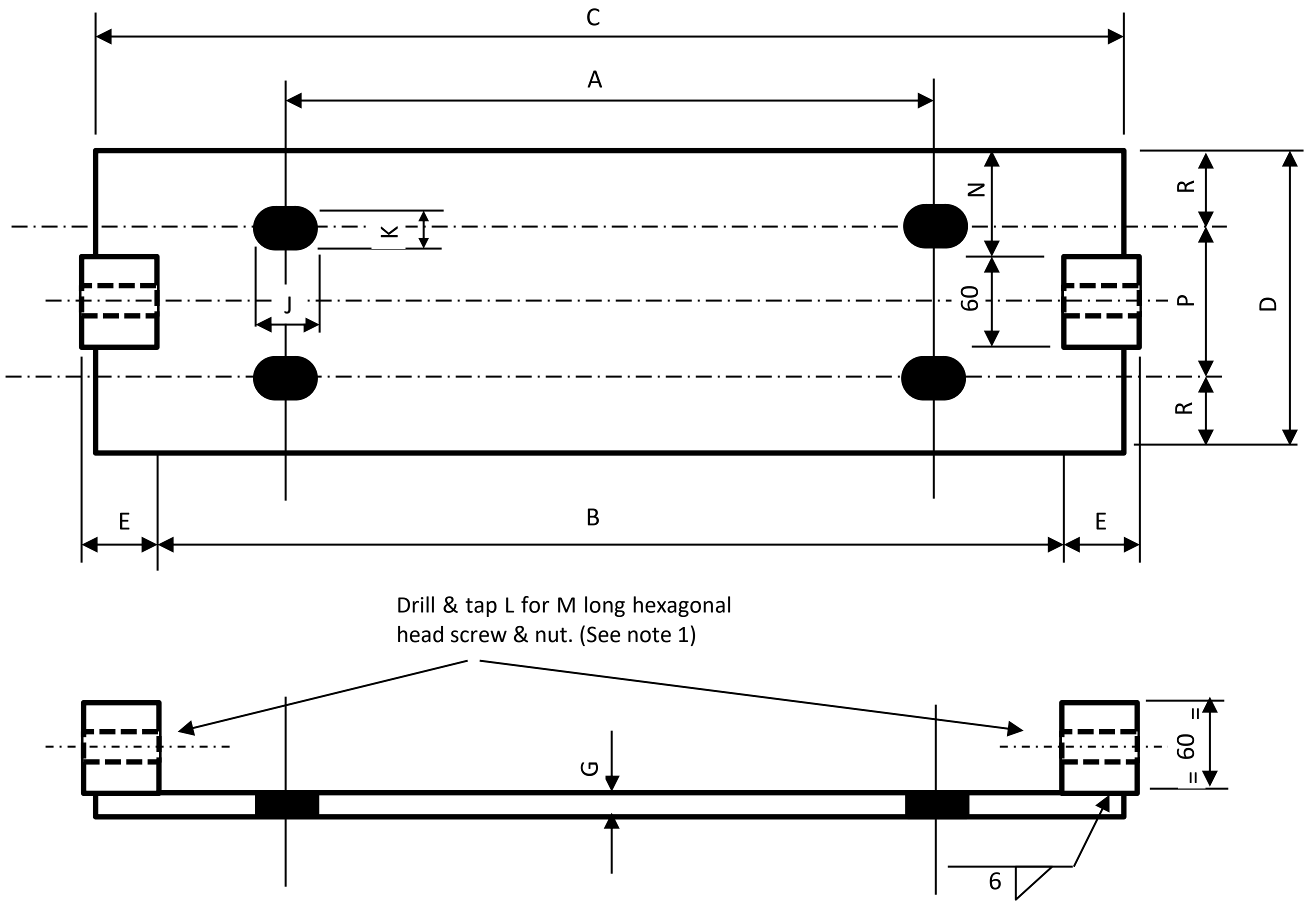


Shaft	Dimensions												Mass kg
	A	B	C	D	E	F	G	H	J	K	L	M	
40	170	275	345	65	30	30	8	30	15	115	M12	23	1.74
50	210	330	400	75	40	40	10	40	18	115	M16	27	3.17
65	230	355	425	85	40	40	10	40	18	115	M16	27	3.65
75	260	395	465	100	40	40	10	40	22	115	M16	33	4.43
90	320	460	550	120	50	50	10	50	26	125	M20	39	6.76
100	350	490	580	130	50	50	12	50	26	125	M20	39	8.65
110	350	490	580	130	50	50	12	50	26	125	M20	39	8.65
115	380	525	615	140	50	50	12	50	26	140	M20	39	9.66
125	420	590	680	160	50	50	12	50	33	140	M20	50	11.70
135	450	620	710	170	50	50	12	50	33	140	M20	50	12.82
140	470	640	730	170	50	50	12	50	33	140	M20	50	13.14

The approximate mass of each plate excludes the mass of the screws and nuts.
The range of shaft sizes is in accordance with SANS 1669/1 Table 2, column 2

Type 2

Sole plates for 4-bolt bearings (SD housings) with single jacking bolts

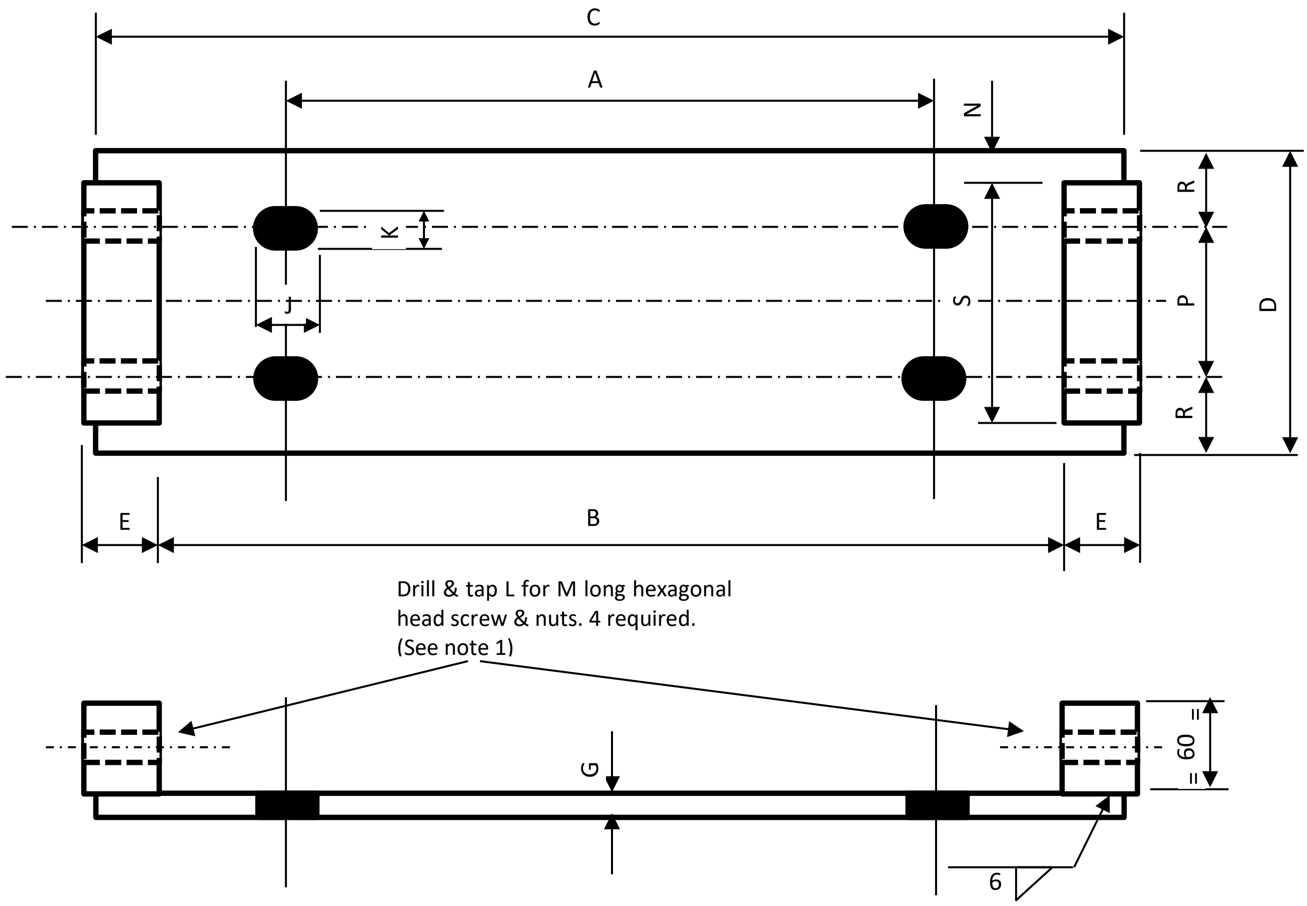


Shaft	Dimensions mm													Mass kg
	A	B	C	D	E	G	J	K	L	M	N	P	R	
150	430	600	680	200	50	16	39	26	M24	150	70	100	50	52.59
160	450	620	700	200	50	16	39	26	M24	150	70	110	45	55.79
170	480	650	730	230	50	16	39	26	M24	150	85	120	55	60.81
180	510	700	780	250	50	16	50	33	M24	150	95	130	60	69.14
200	540	730	810	250	50	16	50	33	M24	150	95	140	55	74.74
220	600	790	920	280	75	20	50	33	M30	180	110	150	65	114.95
240	650	870	1000	300	75	20	60	40	M30	180	120	160	70	136.52
260	670	890	1020	300	75	20	60	40	M30	180	120	160	70	142.45
280	710	930	1060	330	75	20	60	40	M30	180	135	190	70	154.32
300	750	980	1110	350	75	20	60	40	M30	180	145	200	75	170.21

The approximate mass of each plate excludes the mass of the screws and nuts.
The range of shaft sizes is in accordance with SANS 1669/1 Table 2, column 2

Type 3

Sole plates for 4-bolt bearings (SD housings) with double jacking bolts

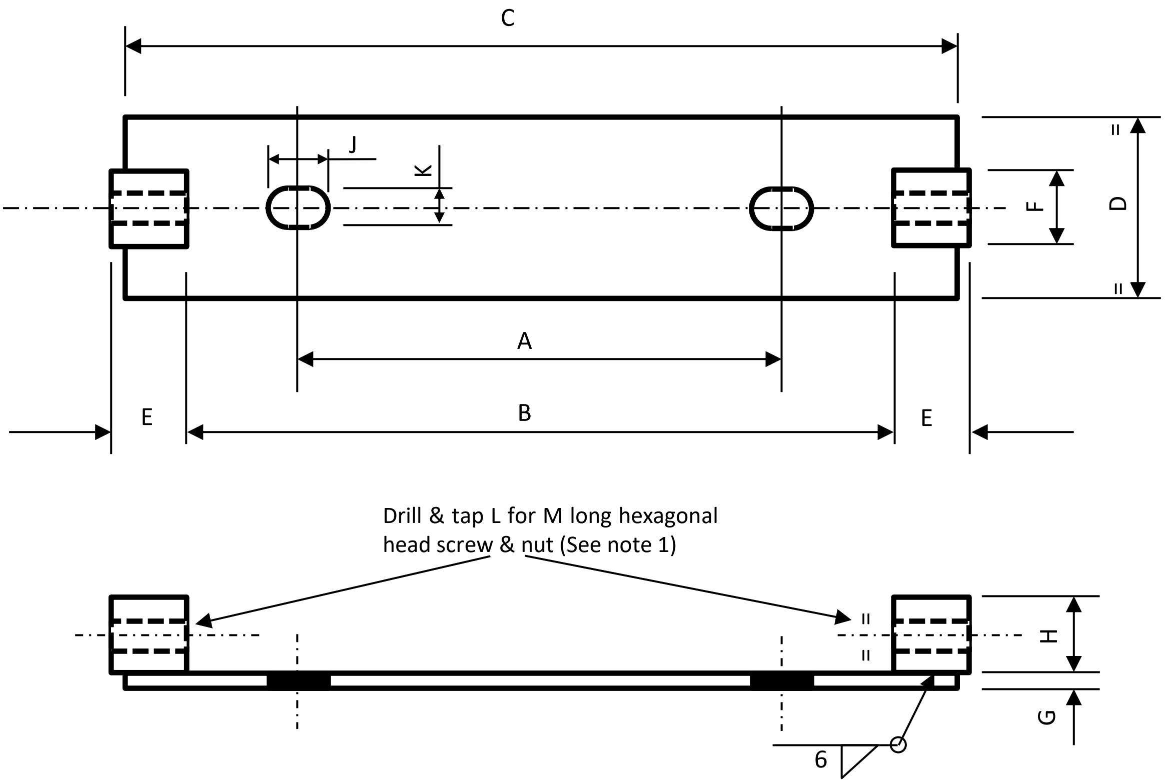


Shaft	Dimensions mm														Mass kg
	A	B	C	D	E	G	J	K	L	M	N	P	R	S	
150	430	600	680	200	50	16	39	26	M24	150	70	100	50	160	57.24
160	450	620	700	200	50	16	39	26	M24	150	70	110	45	170	60.91
170	480	650	730	230	50	16	39	26	M24	150	85	120	55	180	66.40
180	510	700	780	250	50	16	50	33	M24	150	95	130	60	190	75.20
200	540	730	810	250	50	16	50	33	M24	150	95	140	55	200	81.28
220	600	790	920	280	75	20	50	33	M30	180	110	150	65	210	125.44
240	650	870	1000	300	75	20	60	40	M30	180	120	160	70	220	147.71
260	670	890	1020	300	75	20	60	40	M30	180	120	160	70	220	153.65
280	710	930	1060	330	75	20	60	40	M30	180	135	190	70	250	167.64
300	750	980	1110	350	75	20	60	60	M30	180	145	200	75	260	184.23

The approximate mass of each plate excludes the mass of the screws and nuts.
The range of shaft sizes is in accordance with SANS 1669/1 Table 2, column 2

Type 4

Sole plates for static shafted pulley dead-eyes



Dimension table overleaf.

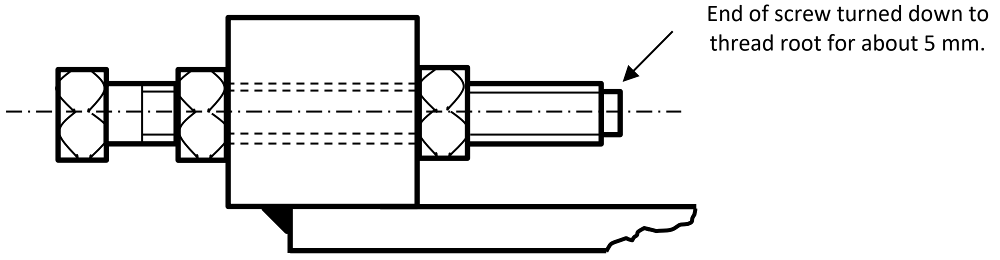
Type 4

Sole plates for static shafted pulley dead-eyes - Dimensions

SHAFT	Dimensions mm												Mass kg
	A	B	C	D	E	F	G	H	J	K	L	M	
50	190	311	370	80	40	40	10	40	40	22	M12	70	3.01
55	195	316	375	80	40	40	10	40	40	22	M12	70	3.05
60	200	321	380	80	40	40	10	40	40	22	M12	70	3.08
65	205	326	385	80	40	40	10	40	40	22	M12	70	3.11
70	210	331	390	80	40	40	10	40	40	22	M12	70	3.14
75	215	336	395	80	40	40	10	40	40	22	M12	70	3.17
80	220	341	420	80	50	50	10	50	40	22	M12	80	4.27
85	225	346	425	80	50	50	10	50	40	22	M12	80	4.30
90	230	351	430	80	50	50	10	50	40	22	M12	80	4.33
100	240	361	440	80	50	50	12	50	40	22	M12	80	4.90
110	278	423	500	90	50	50	12	50	48	26	M16	85	5.63
115	283	428	510	90	50	50	12	50	48	26	M16	85	5.71
125	293	438	520	90	50	50	12	50	48	26	M16	85	5.80
135	303	448	530	90	50	50	12	50	48	26	M16	85	5.88
140	308	453	353	90	50	50	12	50	48	26	M16	85	4.38
150	318	463	545	90	50	50	16	50	48	26	M16	85	7.41
160	370	551	630	110	50	50	16	50	60	32	M24	90	9.46
170	380	561	640	110	50	50	16	50	60	32	M24	90	9.60
180	390	571	650	110	50	50	16	50	60	32	M24	90	9.73
200	410	591	670	110	50	50	16	50	60	32	M24	90	10.01
220	430	611	690	110	50	50	20	50	60	32	M24	90	12.46
240	492	709	810	120	60	60	20	60	72	38	M24	110	16.70
260	512	729	830	120	60	60	20	60	72	38	M24	110	17.08
280	532	749	850	120	60	60	20	60	72	38	M24	110	17.46
300	552	769	870	120	60	60	20	60	72	38	M24	110	17.83

The approximate mass of each plate excludes the mass of the screws and nuts.
The range of shaft sizes is in accordance with CMA MP01 rev 0 Table 4, column 1

It is recommended that the bolts in the jacking blocks have the first 5 mm of thread turned down to the root, in order to minimise thread damage against the plummer blocks or dead-eyes. See detail below



TYPICAL DETAIL AT JACKING BLOCK & SCREW

Note 1 While the relevant tables indicate that the jacking block may be tapped to suit the screw (dimension M an L), it may be useful to specify a clearance hole in the jacking block, with the screws supplied with two nuts (one each side). This will eliminate the possibility of the sole plate being rendered unserviceable if the internal threads are damaged for any reason.

Care must be taken to minimise the clearance hole, in order to prevent the screws from being skewed.

Table 5

Recommended clearance holes for plain drilled Jacking Blocks

Clearance Holes for Metric Bolts		
Screw	Fine	Medium
M12	13	14
M16	17	18
M20	21	22
M24	25	26
31	32	37
39	43	45

It is preferred t o use the fine series of clearance holes (H12). However, the medium series clearances (H13) may be considered.

APPENDIX A

The relationship between the clamping force F_p and the bolt tightening torque Q_b may be expressed as $F_p = \frac{n \cdot Q_b}{4 \cdot 1000 \cdot d_b \cdot K}$ kN, where

F_p =	Clamping force	kN
Q_b =	Bolt tightening torque	N·m
n =	Number of bolts	
d_b =	Bolt diameter	m
K =	Friction coefficient	Values of K lie between **0,1** to **0,5** depending on the type of plating and the presence of lubricants on the bolts and nuts. The normal design value for K would be **0,3**.

The value 4 is based on the general spread of 25% of torque values as a result of different finishes on the bolts and nuts, lubrication (or lack thereof) and so on. It can therefore be seen as a factor of safety.

Example

A non-drive pulley bends the belt through 180° and the belt tension at the pulley is calculated as 47,8 kN. The resultant force (ignoring the pulley weight) will therefore become 47,8×2 = 95,60 kN. To allow for some belt wander, the load on the bearing will become 0,6×95,60 = 57,36 kN and we can design for 57,5 kN. . Ideally, the load should be shared equally by each bearing on the pulley shaft.

For a friction coefficient of 0,2 between the bearing housing and the sole plate, the total clamping force must then be $F_p = 0{,}6 \times \mu \cdot R = 0{,}6 \times 0{,}2 \times 95{,}60 = 11{,}50$ kN (nearly).

Assuming a bearing housing designation SNH515, with 2×M16 bolts, the minimum torque on each bolt, with K = 0,3 would therefore become

$$Q_b = \frac{4 \cdot 1000 \cdot F_p \cdot d_b \cdot K}{n} = \frac{4 \times 1000 \times 11{,}50 \times 0{,}016 \times 0{,}3}{2} = 110{,}4 \text{ N·m}.$$

The normally accepted value for M16 bolts should not exceed 220 N·m and the installation should therefore be acceptable.