INSTRUCTION FOR SELECTION OF JACK

For a quick selection of the jack use the graphs in this section.
They have been calculated with a safety factor gE = 2,8
(see EN81-2: 2 = Eulero stabilty safety factor, 1,4 = over pressure factor).
For different values of gE, please consult GMV or specify them on the order.

The total forces (T) on ram top are drawn on horizontal axis; the buckling lengths (in this case Lo = Lp) are drawn on vertical axis.
Trace two perpendicular lines from the total force and from the buckling length.
If the intersection of the two lines is below the graph of the selected jack it is verified against buckling.
If the intersection is close to the graph we suggest carrying out the analytical calculation to verify the jack.

The formulas for the calculation of T and Lp are shown below.

T = total load on the top of the jack $= 0,981 \cdot \frac{Q + P3}{Nr}$ [daN]

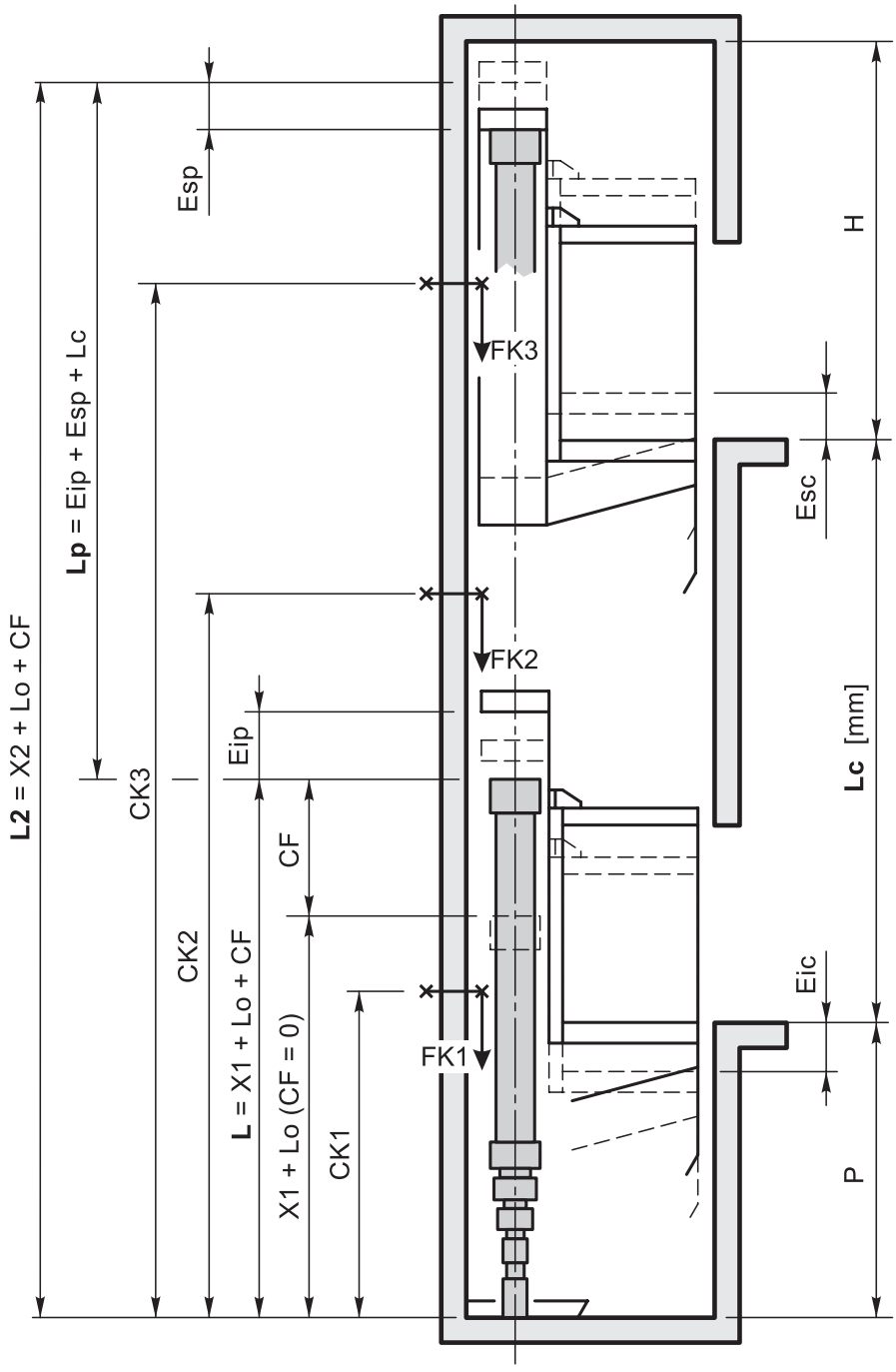
Q = rated load [kg]
P3 = mass of the car, sling and travelling cables [kg]
Nr = number of jack
Lp = total stroke of the jack (Lc + Esp + Eip) [cm]
Lc = car travel [cm]
Eic = bottom overtravel of the car [cm]
Eip = top overtravel of the jack [cm]
Esc = top overtravel of the car = Esp [cm]
Esp = top overtravel of the jack [cm]
(With car buffers completely compressed, the piston must have a lower residual overtravel at least 3 cm)
CF = elongation for cylinder (length of closed jack longer than the standard one) [cm]
(The verifying calculation includes the weight of CF in the cylinder weight)

Here below the strokes of the upper cushioned stop are reported:

- 2 stages jack = 8 cm
- 3 stages jack = 9 cm
- 4 stages jack = 10 cm

For each type of jack different graphs are drawn:

- TCS, EC ... - 2N = 2 stages without external guide
- TCS, EC ... - 2Y = 2 stages with external guide
- TCS, EC ... - 3Y = 3 stages with external guide
- EC ... - 4Y = 4 stages with external guide



L2 : Extended jack
Lp : Total stroke of jack
L : Closed jack
Lc : Car travel

Table 1 - Parameters for calculation of jack length and position of chain fastening

	X1	X2	Lo	CK1	CK2	CK3
	[mm]					
TCS, EC ... 2N	1/2 Lp	3/2 Lp	680	min 1/2 Lp + 450 max 1/2 Lp + 1000	****	****
TCS, EC ... 2Y	1/2 Lp	3/2 Lp	430			
TCS, EC ... 3Y	1/3 Lp	4/3 Lp	555	min 1/3 Lp + 450 max 1/3 Lp + 1000	min 2/3 Lp + 600 max 2/3 Lp + 1100	****
EC ... 4Y	1/4 Lp	5/4 Lp	680	min 1/4 Lp + 550 max 1/4 Lp + 1100	min 1/2 Lp + 650 max 1/2 Lp + 1200	min 3/4 Lp + 700 max 3/4 Lp + 1200

VERIFYING CALCULATION FOR JACK

When using graphs it happens that the intersection point is placed close to the graph of the selected jack. In this case the analytical calculation shall be requested to **GMV.**

CALCULATION OF FULL LOAD STATIC PRESSURE (19 ≤ pstat ≤ 40):

The full load static pressure is the one at the oil inlet. Formulas for static pressures calculation are following:

$$pstat = 0,981 \cdot \frac{\frac{(Q \cdot P3)}{Nr} + \frac{CF}{100} \cdot C + B + \frac{Lp}{100} \cdot A}{Am} \quad [bar]$$

CALCULATION OF EMPTY CAR STATIC PRESSURE:

To achieve the rated down speed it is necessary to ensure a no load (empty car) static pressure bigger than the following values:

- for power unit with valve block type 3010: pv ≥ 12 bar
- for power unit with valve block type 5000: pv ≥ 5 bar

$$pv = 0,981 \cdot \frac{\frac{P3}{Nr} + \frac{CF}{100} \cdot C + B + \frac{Lp}{100} \cdot A}{Am} \quad [bar]$$

Table 2 - parameters for calculation of static pressures

JACK TYPE	A [kg/m]	B [kg]	C [kg/m]	Am [cm^2]
TCS, EC 45-2N	7,54	18,16	11,10	22,50
TCS, EC 60-2N	9,89	21,98	14,35	36,76
TCS, EC 75-2N	12,48	25,16	17,91	54,55
TCS, EC 90-2N	15,33	29,24	21,80	75,87
TCS, EC 105-2N	18,41	33,03	25,99	100,73
TCS, EC 120-2N	21,74	38,21	30,51	129,12
TCS, EC 45-2Y	7,54	15,59	11,10	22,50
TCS, EC 60-2Y	9,89	18,62	14,35	36,76
TCS, EC 75-2Y	12,48	20,92	17,91	54,55
TCS, EC 90-2Y	15,33	24,03	21,80	75,87
TCS, EC 105-2Y	18,41	26,76	25,99	100,73
TCS, EC 120-2Y	21,74	30,81	30,51	129,12
TCS, EC 45-3Y	8,06	29,93	14,35	29,93
TCS, EC 60-3Y	10,28	35,53	17,91	45,95
TCS, EC 75-3Y	12,73	40,02	21,80	65,50
TCS, EC 90-3Y	15,39	42,43	25,99	88,59
TCS, EC 105-3Y	18,26	48,94	30,51	115,22
EC 60-4Y	11,3	50,97	21,80	56,32
EC 75-4Y	13,6	59,12	25,99	77,64
EC 90-4Y	16,2	63,20	30,51	102,50

CALCULATION OF OTHER JACK DATA

For the data used in following formulas refer to data sheet of characteristics for jacks type “TCS” ed “EC”.

CALCULATION OF OIL VOLUMES:

The following formulas are used to calculate the oil volumes to enable the complete extension of the ram and to fill up the cylinder.

Circulating oil:

The useful capacity of the tank is calculated according to the oil needed for the complete extension of the ram. A margin of over 10% on the tank capacity is suggested.

$$Qtc = Qc \cdot \frac{Lp}{100} \ [dm^3]$$

Oil for filling:

Oil volume to fill up the cylinder:

$$Qtr = Qr\frac{Lp}{100} + qlcyl \cdot \frac{CF}{100} \ [dm^3]$$

CALCULATION OF WEIGHTS:

Total weight of the jack:

The total weight of the jack without oil is:

$$Qtp = Qpo + Qp1 \cdot \frac{Lp}{100} + qcyl \cdot \frac{CF}{100} = [kg]$$

CALCULATION OF CHAIN FASTENING:

The following tables report the maximum forces referred to a pair of chains with a static pressure of 40 bar.

Table 3 - forces on chain fastening for two stages jack

	TCS, EC 60-2N, Y	TCS, EC 75-2N, Y	TCS, EC 90-2N, Y	TCS, EC 105-2N, Y	TCS, EC 120-2N, Y
FK1 [daN]	348	432	515	602	692

Table 4 - forces on chain fastening for three stages jack

	TCS, EC 60-3Y	TCS, EC 75-3Y	TCS, EC 90-3Y	TCS, EC 105-3Y
FK1 [daN]	358	448	537	634
FK2 [daN]	404	490	577	670

Table 5 - forces on chain fastening for four stages jack

	EC 60-4Y	EC 75-4Y	EC 90-4Y
FK1 [daN]	350	432	517
FK2 [daN]	604	730	859
FK3 [daN]	254	297	342

For the right distribution of chain forces, the chain must be erected along an exact vertical line and tensioned with equal strength with fully compressed jack.

OIL INLET POSITION:

The oil inlet is always at the bottom (85 mm from the ground).

EXAMPLE

Selection of three stages jacks (four jacks) for a lift having the following characteristics:

Q = rated load = 2500 kg

P3 = mass of the car, sling and travelling cables = 3000 kg

Nr = number of jacks = 4

CF = elongation for cylinder = 60 cm

T = total load on the top of the jack $= 0,981 \cdot \frac{Q + P3}{Nr} = 1361$ daN

Lc = car travel = 976 cm

Esc = top overtravel of the car = Esp

Esp = top overtravel of the jack = 12 cm

Eic = bottom overtravel of the car = 12 cm

Eip = bottom overtravel of the jack = Eic + 5 = 17 cm

Lp = total stroke of the jack $= Lc + Esp + Eip = 1005$ cm

For a total force on jack top of 1361 daN and a jack stroke of 1005 cm a jack type TCS 60 - 3Y is needed. The static pressure are the following:

$$pstat = 0,981 \cdot \frac{\frac{(Q + P3)}{Nr} + \frac{CF}{100} \cdot C + B + \frac{Lp}{100} \cdot A}{Am} = 32,25 \text{ bar}$$

$$pv = 0,981 \cdot \frac{\frac{P3}{Nr} + \frac{CF}{100} \cdot C + B + \frac{Lp}{100} \cdot A}{Am} = 18,91 \text{ bar}$$

CALCULATION OF JACK LENGTH AND POSITION OF CHAIN FASTENINGS:

CJ = closed jack = 1/3 Lp + Lo + CF = 4505 mm

EJ = extended jack = 4/3 Lp + Lo + CF = 14555 mm

CK1 = position of chain fastening #1

CK1 min = 1/3 Lp + 450 = 3800 mm

CK1 max = 1/3 Lp + 1000 = 4350 mm

FK1 = maximum force on chain fastening #1 = 348 daN

CK2 = position of chain fastening #2

CK2 min = 2/3 Lp + 600 = 7300 mm

CK2 max = 2/3 Lp + 1100 = 7800 mm

FK2 = maximum force on chain fastening #2 = 404 daN

CALCULATION OF CIRCULATING OIL:

$$Qtc = Qc \cdot \frac{LC}{100} = 4,59 \cdot \frac{1005}{100} = (46,13 \text{ dm}^3$$

The useful capacity of the tank (for 4 jacks) shall not be less than 46,13 x 4 x 1,1 = 202,97 dm^3

CALCULATION OF THE OIL VOLUME TO FILL UP THE JACK:

$$Qtr = Qr \cdot \frac{Lp}{100} + qlcyl \cdot \frac{CF}{100} = 1,51 \cdot \frac{1005}{100} + 6,65 \cdot \frac{60}{100} = 19,17 \text{ dm}^3$$

The total oil volume for the four jacks is 19,17 x 4 = 76,66 dm^3

CALCULATION OF THE WEIGHT OF THE JACK:

$$Qtp = Qpo + Qp1 \cdot \frac{Lp}{100} + qcyl \cdot \frac{CF}{100} = 183,52 \text{ kg}$$