



$F_p$  - press force

$F_R$  - ram force

$F_T$  - table force

$F_a$  - acceleration force

$F_s$  - separation force

$F_{Rm}$  - force due to mass -ram die

$F_{Tm}$  - force due to mass -table die

$F_{Rn}$  - ram force per element

$F_{Tn}$  - table force per element

diagram- press forces

## A) Calculation procedure:

Total clamping force at the ram:

$$F_R = m_S \cdot (g+b) + c \cdot F_P$$

Total clamping force per element at ram:

$$F_{Rn} = S \cdot \frac{F_R}{n}$$

Total clamping force at the table:

$$F_T = c \cdot F_P - m_T \cdot g$$

Required clamping force per element on the table:

$$F_{Tn} = S \cdot \frac{F_T}{n}$$

Abbreviations:

- b - ram acceleration during separation [m/s<sup>2</sup>]
- c - multiplication factor for die separation forces [0,05 ... 0,2]\*
- F<sub>P</sub> - nominal operating force of the press [kN]
- g - acceleration due to gravity [9,81 m/s<sup>2</sup>]
- m<sub>S</sub> - mass of upper die [10<sup>3</sup>kg=to]
- m<sub>T</sub> - mass of lower die [10<sup>3</sup>kg=to]
- n - number of clamping elements
- S - safety factor [1,2 ... 1,5]

### \* separation forces

The die separation forces redominantly by friction at separation forces are mainly due to friction generated during separation of the two die halves (also called stripping forces). The multiplication factor "c" can be enquired from the press or machine tool manufacturer or be determined experimentally through test.

## B) Calculation example

Selection of the suitable element for the ram

Data:

nominal press force	F <sub>p</sub> = 400 to ≅ 4000 kN
mass of upper die	m <sub>s</sub> = 2000 kg ≅ 2 to
ram acceleration during die separation	b = 1 x g
multiplication factor for the die separation	c = 0,1
clamping height	h = 50 mm
T-slot-width	a = 28 mm

Total clamping force at ram

$$F_P = 2 \cdot (2 \times 9,81) + 0,1 \cdot 4000 = 440 \text{ kN}$$

Clamping force per element:

$$\text{for 4 clamping elements: } F_{Rn} = 1,25 \cdot \frac{440}{4} = 138 \text{ kN per clamping element}$$

$$\text{for 8 clamping elements: } F_{Rn} = 1,25 \cdot \frac{440}{8} = 69 \text{ kN per clamping element}$$

Selection of appropriate clamping element:

- 4x MCA 150 - M24
- 4x MDA 150 - M24
- 8x MCA 100 - M24
- 8x MDA 100 - M24
- 8x MES 100 - 50 - 28