

1) METHOD OF EULERO CASE 2 (COEFF. OF SAFETY 2)

-GRAPHICS DWG 9020/1 – 9030/1-1 – 9030/1-2

IT'S THE SYSTEM OF CALCULATION REQUIRED BY **UNI-EN 81.2:99** FOR $\lambda \geq 100$

1.1 $F_s \leq \frac{\pi^2 E J}{2l^2}$

FOR $\lambda < 100$

1.2 $F_s \leq \frac{A}{2} [R_m - (R_m - 210) \times (\lambda/100)^2]$

1.3 $F_s = 1.4g_n [C_m (P_3 + Q) + 0.64P_r + P_m]$

IN MARKED GRAPHICS IS SHOWED THE TOTAL FORCE APPLIED TO RAM **W**, THEREFORE:

1.4 $W = C_m (P_3 + Q) + P_{rh}$

2) IMPORTANT FORMULAS

$J = \frac{\pi}{64} [d^4 - (d - 2e)^4]$ [mm⁴]

$\lambda = \frac{l}{i}$

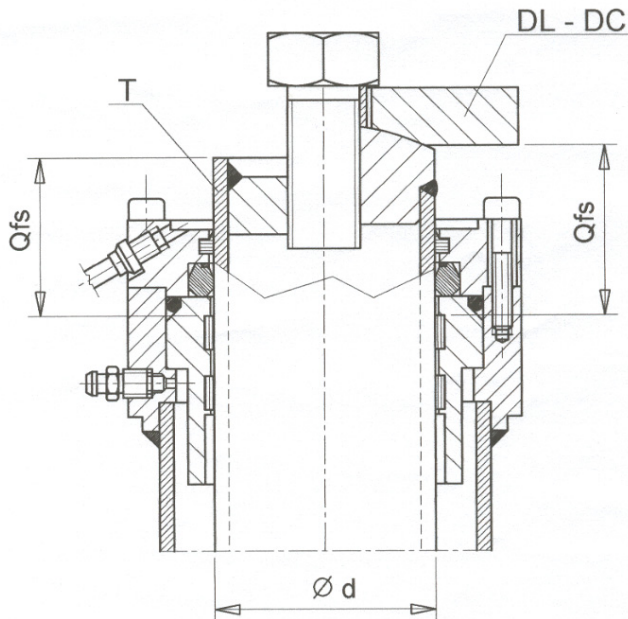
$J = \frac{\pi}{64} [d^2 - (d - 2e)^2]$ [mm²]

$P_r = \gamma l$

$i \sqrt{\frac{J}{A}}$ [mm]

$A_p = \frac{d\pi}{4}$ [mm²]

3) Qfs VALUE TO CALCULATE THE LENGTH OF THE STEM'S FREE FLEXURE (REGISTERED IN DIAGRAMS: 9020/1 - 9030/1-1 – 9030/1-2) WITH THE HIGHEST VALUE " DL – DC "



| ϕd ROD (mm) | Qfs T (mm) | Qfs DL-DC (mm) |
|-------------------------|------------------|----------------------|
| 50 / 100 | 74.5 | 84.5 |
| 110 / 150 | 81.5 | 91.5 |
| 160 / 238 | 90 | 95 |

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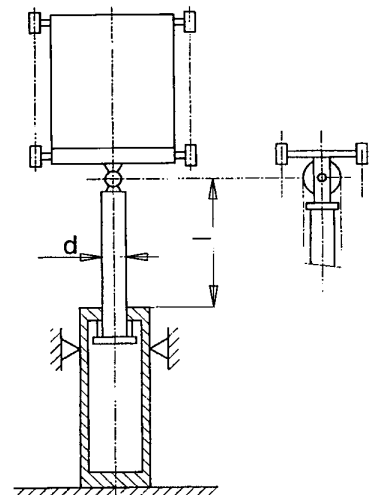
CALCULATION METHODS FOR BUCKLING FORCE APPLIED TO RODS (UNI-EN 81.2:99)

| | |
|-------|---------------|
| DATE | 05/02 |
| DWG N | 9019/1 |

| MEASUREMENTS | SYMBOL | UNIT |
|--|-------------------|-------------------|
| STRENGTH CROSS-SECTIONAL AREA OF THE RAM | A | mm ² |
| OUTSIDE DIAMETER OF THE RAM..... | d | mm |
| THICKNESS OF THE RAM | e | mm |
| OUTSIDE DIAMETER OF THE CYLINDER..... | D | mm |
| THICKNESS OF THE CYLINDER | e _{cyl} | mm |
| CROSS-SECTIONAL AREA OF THE RAM..... | A _p | mm ² |
| RADIUS OF GYRATION OF THE RAM | i | mm |
| SECOND MOMENT OF THE RAM | J | mm ⁴ |
| MASS FOR UNIT OF LENGTH OF THE RAM..... | γ | Kg/mm |
| COEFFICIENT OF SLENDERNESS OF THE RAM | λ | |
| MODULUS OF ELASTICITY (FOR STEEL, E=2.1 10 ⁵) | E | N/mm ² |
| LENGTH OF THE STEM'S FREE FLEXURE (TOTAL STROKE+Qfs+DISTANCE, IF ANY OF THE PULLEY AXIS AT THE TOP OF THE STEM | l | mm |
| TENSILE STRENGTH OF MATERIAL | R _m | N/mm ² |
| ACCELERATION OF GRAVITY | g _n | m/s ² |
| REEVING RATIO | C _m | |
| SUM OF THE MASS OF THE EMPTY CAR AND THE MASS OF THE PORTION OF THE TRAVELLING CABLES SUSPENDED FROM THE CAR..... | P ₃ | Kg |
| RATED LOAD (MASSE) DISPLAYED IN THE CAR | Q | Kg |
| MASS OF THE RAM | γ | Kg |
| MASS OF THE RAM-HEAD EQUIPMENT..... | P _{rh} | Kg |
| ACTUAL BUCKLING FORCE APPLIED..... | F _S | N |
| ADMISSIBLE VALUE OF STRENGTH ACCORDING TO DIN 4114 (FOR S _t 52.0 σ _{d,am} =210) | σ _{d,am} | N/mm ² |
| COEFFICIENT TO BE CALCULATED FROM DIN 4114 IN FUNCTION OF | ω | |
| COEFFICIENT OF OVERPRESSURE | 1.4 | |

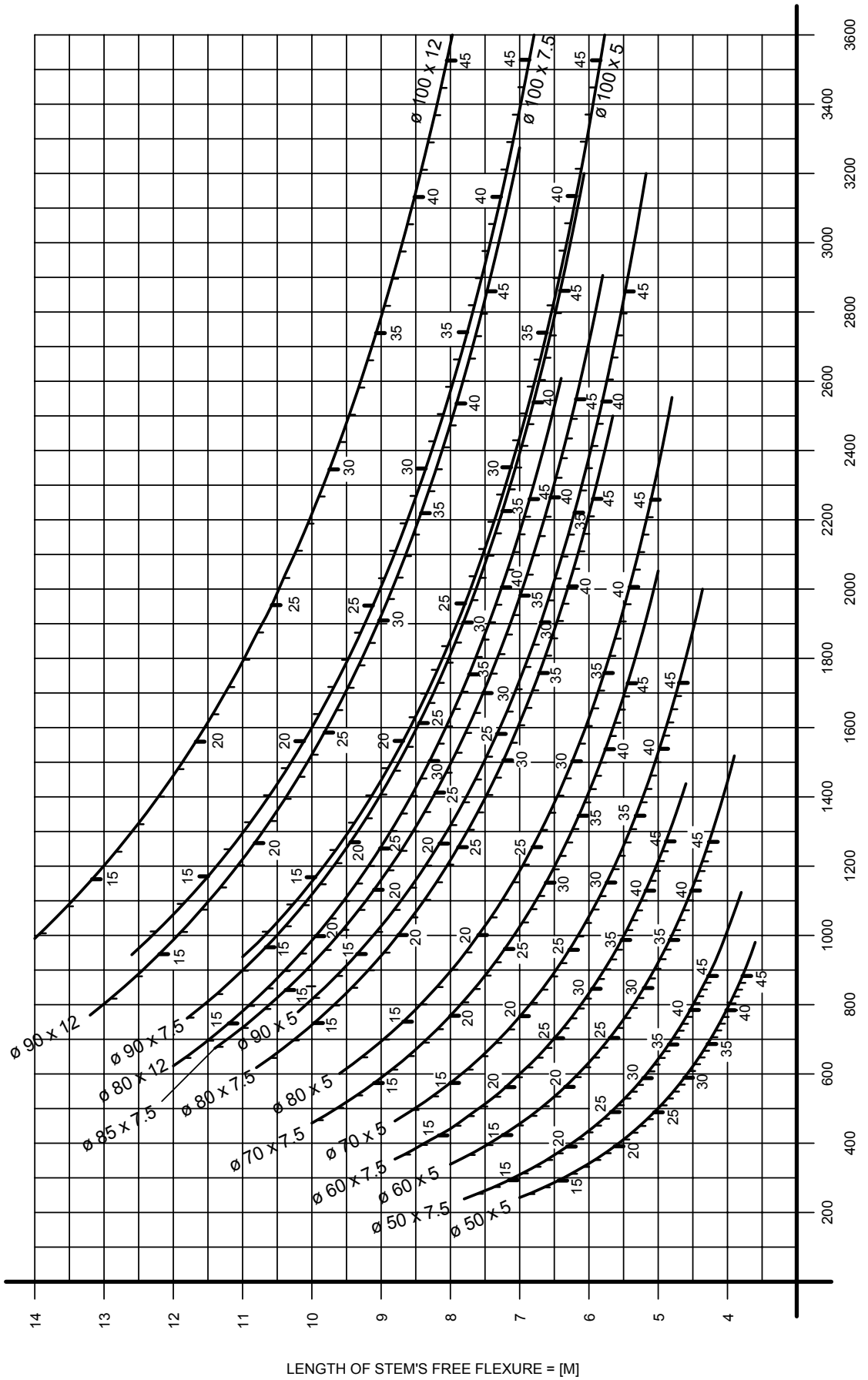
EXPLANATORY NOTES ON GRAPHICS

- 1- THE UPPER AND LOWER LIMIT OF THE CURVE IS CUT BY MAX. AND MIN. VALUES OF THE ADMISSIBLE PRESSURE (RESPECTIVELY 45 AND 12 BAR).
- 2- REPRESENTED CURVES WERE EXECUTED ACCORDING TO EULERO'S FORMULAS.
 - GRAPHICS EXECUTED ACCORDING TO STANDARD EN 81.2 FOR VALUES λ < 100: IN ORDER TO OBTAIN MORE PRECISE VALUES, MUST BE USED THE FORMULA SHOWED AT POINT 1.2 (SEE NOTES ON GRAPHICS)).
 - GRAPHICS EXECUTED ACCORDING TO STANDARD TRA 200 FOR λ ≤ 250 : IN ORDER TO OBTAIN MORE PRECISE VALUES, MUST BE USED THE FORMULA SHOWED AT POINT 4.1 (SEE NOTES ON GRAPHICS).
 - CURVES EXECUTED ACCORDING TO EULERO'S FORMULAS ARE ALWAYS ON THE SIDE OF SAFETY.



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| UT | | SYMBOLS AND NOTES FOR BUCKLING FORCE TO BE CALCULATED | DATE 05/02 |
| | | | DWG N 9019/2 |

EULERO'S METHOD CASE 2 (COEFFICIENT OF SAFETY 2)



TOTAL LOAD ON THE ROD + USEFUL LOAD + CAR WEIGHT + CAR FRAME + ACCESSOIRES = [daN]

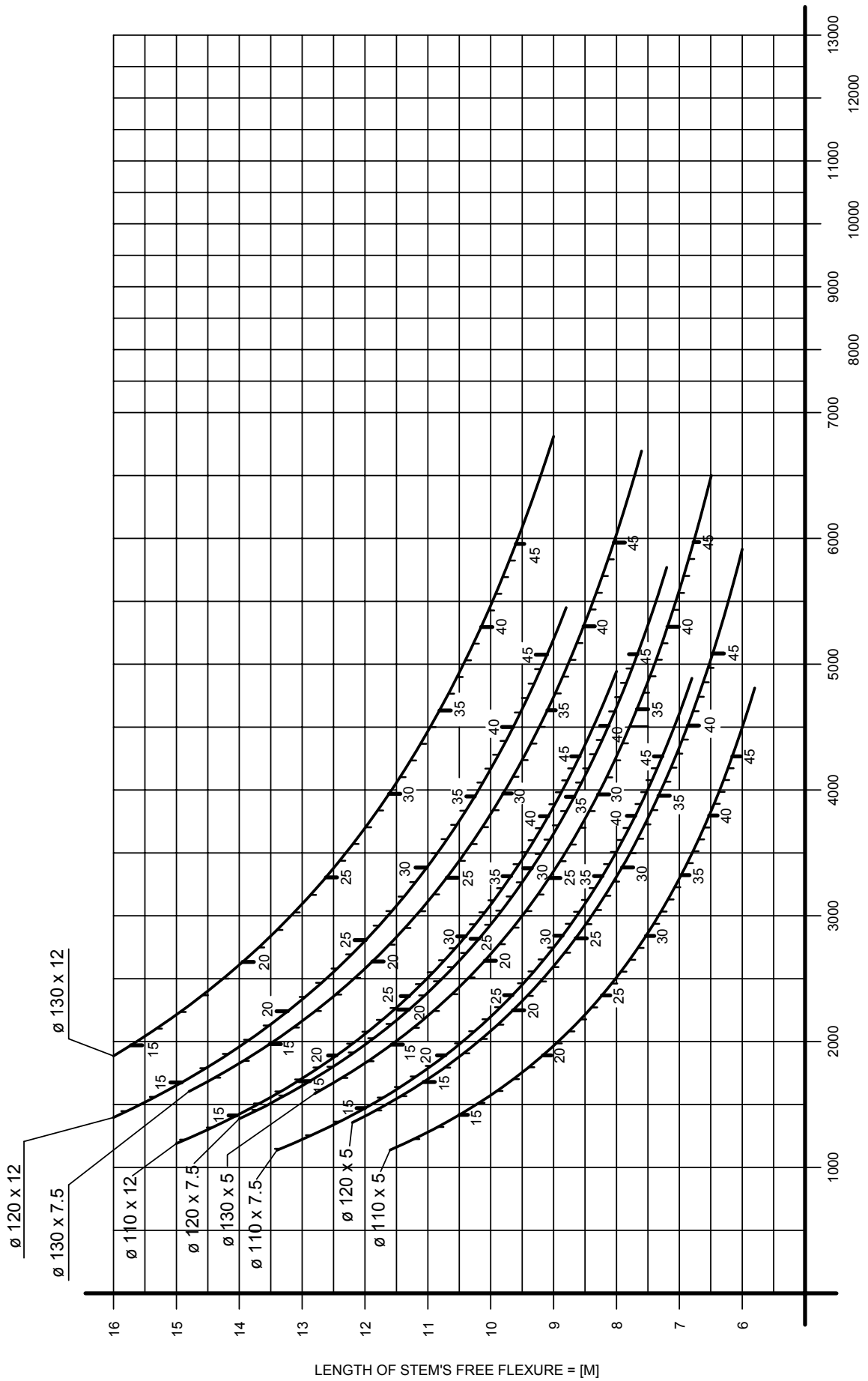
$\lambda \geq 100$: SEE DWG 9019/1

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TABLE FOR CHECKING THE MAX. LOADS
FOR RAMS ø50 A ø100
- EUROPEAN STANDARD EN 81.2 : 99 -

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|--------|--------|
| DATE | 05/02 |
| DWG N° | 9020/1 |

EULERO'S METHOD CASE 2 (COEFFICIENT OF SAFETY 2)



TOTAL LOAD ON THE ROD + USEFUL LOAD + CAR WEIGHT + CAR FRAME + ACCESSOIRES = [daN]

LENGTH OF STEM'S FREE FLEXURE = [M]

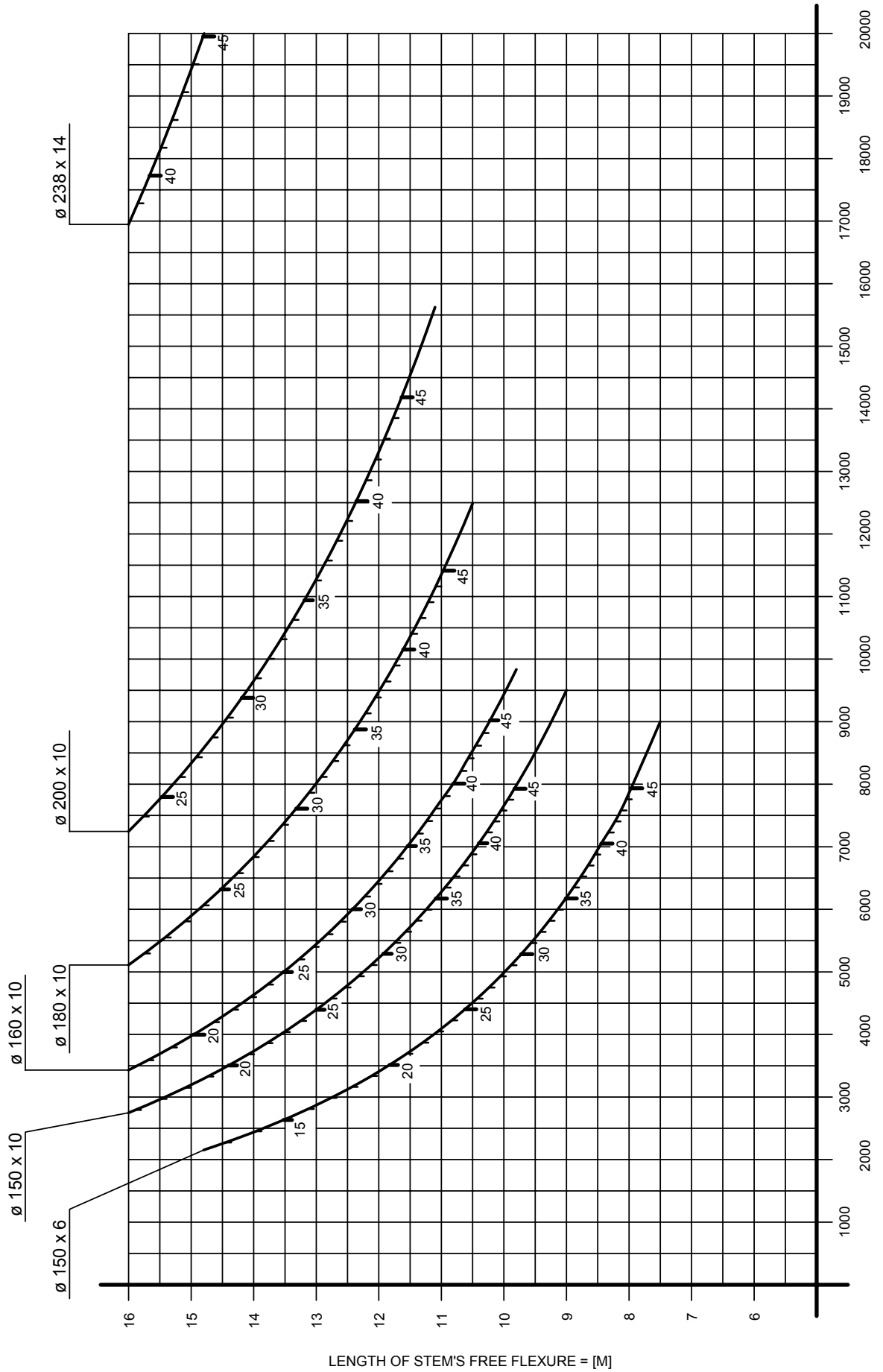
$\lambda > 100$: SEE DWG 9019/1

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TABLE FOR CHECKING THE MAX. LOADS
FOR RAMS $\varnothing 110$ A $\varnothing 130$
- EUROPEAN STANDARD EN 81.2 : 99 -

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|--------|----------|
| DATE | 05/02 |
| DWG N° | 9030/1-1 |

EULERO'S METHOD CASE 2 (COEFFICIENT OF SAFETY 2)



TOTAL LOAD ON THE ROD + USEFUL LOAD + CAR WEIGHT + CAR FRAME + ACCESSOIRES = [daN]

$\lambda \geq 100$: SEE DWG 9019/1

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TABLE FOR CHECKING THE MAX. LOADS
FOR RAMS $\varnothing 150$ A $\varnothing 238$
- EUROPEAN STANDARD EN 81.2 : 99 -

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|--------|----------|
| DATE | 05/02 |
| DWG N° | 9030/1-2 |

Live load = Q (Kg) _____
 Cage weight + frame + Accessories = F (Kg) _____
 Weight pulley + Ropes = K (Kg) _____
 (Indirect installation 2:1)

Cage speed = S (m/sec) _____

Run + over run cage = C (m) _____
 Net axe distance-top of piston = I (m) _____
 (Indirect installation 2:1)

Net weight on the piston = P (Kg) _____
 Direct installation 1:1 with one jack = Q+F
 Indirect installation 2:1 with one jack = (Q+F)x2+K
 Direct installation 1:1 with double jack = (Q+F)/2
 Indirect installation 2:1 with double jack = Q+F+K

Calculation length of piston = L (m) _____
 Direct installation = C
 Indirect installation = (C/2)+I

The diagram point at the crossing of the right lines characteristic of load "P" and of piston length "L" excludes the use of all jacks represented by the curves below this point.
 Therefore, choose the jack which curve is the closest to this point, above.
 The intersection point of the right line extension characteristic of the chosen jack gives the corresponding pressure value at full load, in BAR.
 If the pressure at full charge results too high, choose the type of jack just higher.

Jack type _____ Pressure = B (bar) _____

Jack speed = V (m/sec) _____
 Direct installation 1:1 with one jack = S
 Indirect installation 2:1 with one jack = S/2
 Direct installation 1:1 with double jack = Sx2
 Indirect installation 2:1 with double jack = S

On the speed and power tabulation, choose the type of gear case (L/min) which better corresponds to the value of jack speed "V".
 Engine power (CV) is that to which a higher or even static pressure (BAR) correspond to that of the jack "B".

type of gear case: L/min _____ CV _____

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CHOICE OF THE PISTON TYPE AND OF THE POWER UNIT

| | |
|--------|-------|
| DATE | 08/99 |
| DWG N. | 9601 |

- THE ROD PIPE IS MADE OF STEEL St52.0 - DIN 1629/DIN 2391
- THE CYLINDER PIPE IS MADE OF STEEL St52.0 - DIN 1629/DIN 2448
- THE FEEDING PIPE IS MADE OF STEEL St37.0 - DIN 1629/DIN 2391

| ROD | | | | | | | | CYLINDER | | |
|----------|---------|----------------------|--|---------|----------------------|-----------|----------------------------|----------|-------------|-------|
| ∅d mm | e mm | A mm ² | Ap mm ² | i mm | J mm ⁴ | γ kg/m | CONNECTION WEIGHT kg | ∅D mm | e cyl mm | |
| 50 | 5 | 706.9 | 1963.5 | 16.01 | 181132 | 5.5 | / | 101.6 | 3.6 | |
| | 7.5 | 1001.4 | | 15.26 | 233134 | 7.8 | | | | |
| 60 | 5 | 863.9 | 2827.4 | 19.53 | 329376 | 6.7 | / | 101.6 | 3.6 | |
| | 7.5 | 1237.0 | | 18.75 | 434884 | 9.6 | | | | |
| 70 | 5 | 1021.0 | 3848.5 | 23.05 | 542416 | 7.9 | 10 | 114.3 | 4.0 | |
| | 7.5 | 1472.6 | | 22.26 | 729408 | 11.5 | | | | |
| 80 | 5 | 1178.1 | 5026.5 | 26.58 | 832031 | 9.2 | 13 | 114.3 | 4.0 | |
| | 7.5 | 1708.2 | | 25.77 | 1134379 | 13.3 | | | | |
| | 12 | 2563.5 | | 24.41 | 1527870 | 20.0 | | | | |
| 85 | 7.5 | 1826.1 | 5674.5 | 27.53 | 1383804 | 14.3 | 13 | 114.3 | 4.0 | |
| 90 | 5 | 1335.2 | 6361.7 | 30.10 | 1210004 | 10.4 | 17 | 133.0 | 4.5 | |
| | 7.5 | 1943.9 | | 29.29 | 1667468 | 15.2 | | | | |
| | 12 | 2940.5 | | 27.90 | 2289203 | 23.0 | | | | |
| 100 | 5 | 1492.3 | 7854.0 | 33.63 | 1688115 | 11.7 | 22 | 139.7 | 4.5 | |
| | 7.5 | 2179.5 | | 32.81 | 2346346 | 17.1 | | | | |
| | 12 | 3317.5 | | 31.40 | 3271077 | 25.9 | | | | |
| 110 | 5 | 1649.3 | 9503.3 | 37.17 | 2278146 | 12.9 | 27 | 159.0 | 5.0 | |
| | 7.5 | 2415.1 | | 36.34 | 3188686 | 18.9 | | | | |
| | 12 | 3692.64 | | 34.92 | 4501764 | 28.9 | | | | |
| 120 | 5 | 1806.4 | 11309.7 | 40.70 | 2991876 | 14.1 | 34 | 159.0 | 5.0 | |
| | 7.5 | 2650.7 | | 39.86 | 4212158 | 20.7 | | | | |
| | 12 | 4071.5 | | 38.42 | 6009540 | 31.8 | | | | |
| 130 | 5 | 1963.5 | 13273.2 | 44.23 | 3841088 | 15.3 | 43 | 177.8 | 5.6 | |
| | 7.5 | 2886.3 | | 43.39 | 5434434 | 22.5 | | | | |
| | 12 | 4448.5 | | 41.93 | 7822679 | 34.7 | | | | |
| 150 | 6 | 2714.3 | 17671.5 | 50.96 | 7047774 | 21.2 | 58 | 193.7 | 6.3 | |
| | 10 | 4398.2 | | 49.62 | 10830641 | 34.4 | | | | |
| 160 | 10 | 4712.4 | 20106.2 | 53.15 | 13312499 | 36.8 | 76 | 219.1 | 8.0 | |
| 180 | 10 | 5340.7 | 25446.9 | 60.21 | 19360065 | 41.7 | 105 | 244.5 | 8.0 | |
| 200 | 10 | 5969.0 | 31415.9 | 67.27 | 27009843 | 46.6 | 115 | 273.0 | 10.0 | |
| 238 | 14 | 9852.0 | 44488.1 | 79.35 | 62033336 | 76.9 | 159 | 323.9 | 12.5 | |
| UT | | | GEOMETRIC CHARACTERISTICS FOR RODS TO BE CALCULATED | | | | | DATE | | 05/02 |
| | | | | | | | | DWG N. | | 9040 |

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BEGINNING DATA

RAM

FEED PIPE

| | | | | | | | | | | | | | | | | | | | |
|---|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|----|
| OUTSIDE DIAMETER | Ø | 50 | 60 | 70 | 80 | 85 | 90 | 90 | 100 | 110 | 120 | 130 | 150 | 160 | 180 | 200 | 238 | 35 | 42 |
| CYLINDER THICKNESS | e _{cyl} | 3.6 | 3.6 | 4.0 | 4.0 | 4.0 | 4.5 | 4.5 | 4.5 | 5.0 | 5.0 | 5.6 | 6.3 | 8.0 | 8.0 | 10.0 | 12.5 | 2.5 | 3 |
| CYLINDER OUTSIDE DIAMETER | D | 101.6 | 101.6 | 114.3 | 114.3 | 114.3 | 133.0 | 133.0 | 139.7 | 159.0 | 159.0 | 177.8 | 193.7 | 219.1 | 244.5 | 273.0 | 323.9 | 35 | 42 |
| CYLINDER BASE THICKNESS | e ₁ | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 28.0 | 28.0 | 28.0 | 28.0 | 35.0 | 35.0 | 35.0 | 35.0 | | |
| CYLINDER INSIDE DIAMETER | Di | 94.4 | 94.4 | 106.3 | 106.3 | 106.3 | 124.0 | 124.0 | 130.7 | 149.0 | 149.0 | 166.6 | 181.1 | 203.1 | 228.5 | 253.0 | 298.9 | | |
| BASE EMBEDDING RADIUS | r ₁ | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 6.0 | 6.0 | 6.0 | 6.0 | 7.0 | 7.0 | 7.0 | 7.0 | | |
| BASE RIM THICKNESS | S1 | 4.3 | 4.3 | 4.9 | 4.9 | 4.9 | 5.5 | 5.5 | 5.2 | 6.0 | 6.0 | 6.7 | 7.5 | 9.5 | 9.3 | 11.5 | 14.6 | | |
| RAM HEAD WELDING | Q.2 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 6.0 | 7.0 | 8.0 | 8.0 | 10.0 | 13.0 | | |
| SCREWS N ^o . OF THE RAM HEAD | n | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | | |
| SCREWS DIAMETER | ØK | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 12 | 12 | 12 | 12 | 14 | 14 | 16 | 18 | 18 | | |
| CONSTANT | C5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | |
| BASE BEARING DIAMETER | ØA1 | 69.3 | 69.3 | 79.3 | 89.3 | 94.3 | 99.3 | 99.3 | 109.3 | 119.3 | 129.3 | 139.3 | 159.3 | 174.3 | 189.3 | 209.3 | 247.3 | | |
| RAM HEAD EXTRACTING DIAMETER | DA | 53.0 | 63.0 | 73.0 | 83.0 | 88.0 | 93.0 | 93.0 | 103.0 | 113.0 | 123.0 | 133.0 | 153.0 | 163.0 | 183.0 | 203.0 | 241.0 | | |
| RAM HEAD INSIDE DIAMETER | DI | 99.0 | 99.0 | 107.0 | 117.0 | 117.0 | 127.0 | 127.0 | 136.0 | 146.0 | 155.0 | 165.0 | 190.0 | 197.0 | 216.0 | 241.0 | 278.0 | | |
| STRENGTH MATERIAL | R _{p0.2} | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | | |
| CONNECTION THREAD LENGHT | L | - | - | 57 | 57 | 57 | 57 | 57 | 57 | 54.5 | 54.5 | 54.5 | 54.5 | 56.5 | 56.5 | 56.5 | 56.5 | | |
| THREAD OUTSIDE DIAMETER | Df | - | - | 123 | 123 | 123 | 142 | 142 | 151 | 173 | 173 | 186 | 209 | 230 | 257 | 282 | 339 | | |
| O-RING SEAT DIAMETER | Do | - | - | 125.0 | 125.0 | 125.0 | 144.5 | 144.5 | 153.0 | 178.0 | 178.0 | 191.7 | 212.7 | 234.7 | 261.1 | 286.1 | 342.7 | | |
| BASE OUTSIDE DIAMETER | DB | 103.0 | 103.0 | 116.1 | 116.1 | 116.1 | 135.0 | 135.0 | 141.1 | 161.0 | 161.0 | 180.0 | 196.1 | 222.1 | 247.1 | 276.0 | 328.1 | | |

MAX. CALCULATED PRESSURES

RAM

FEED PIPE

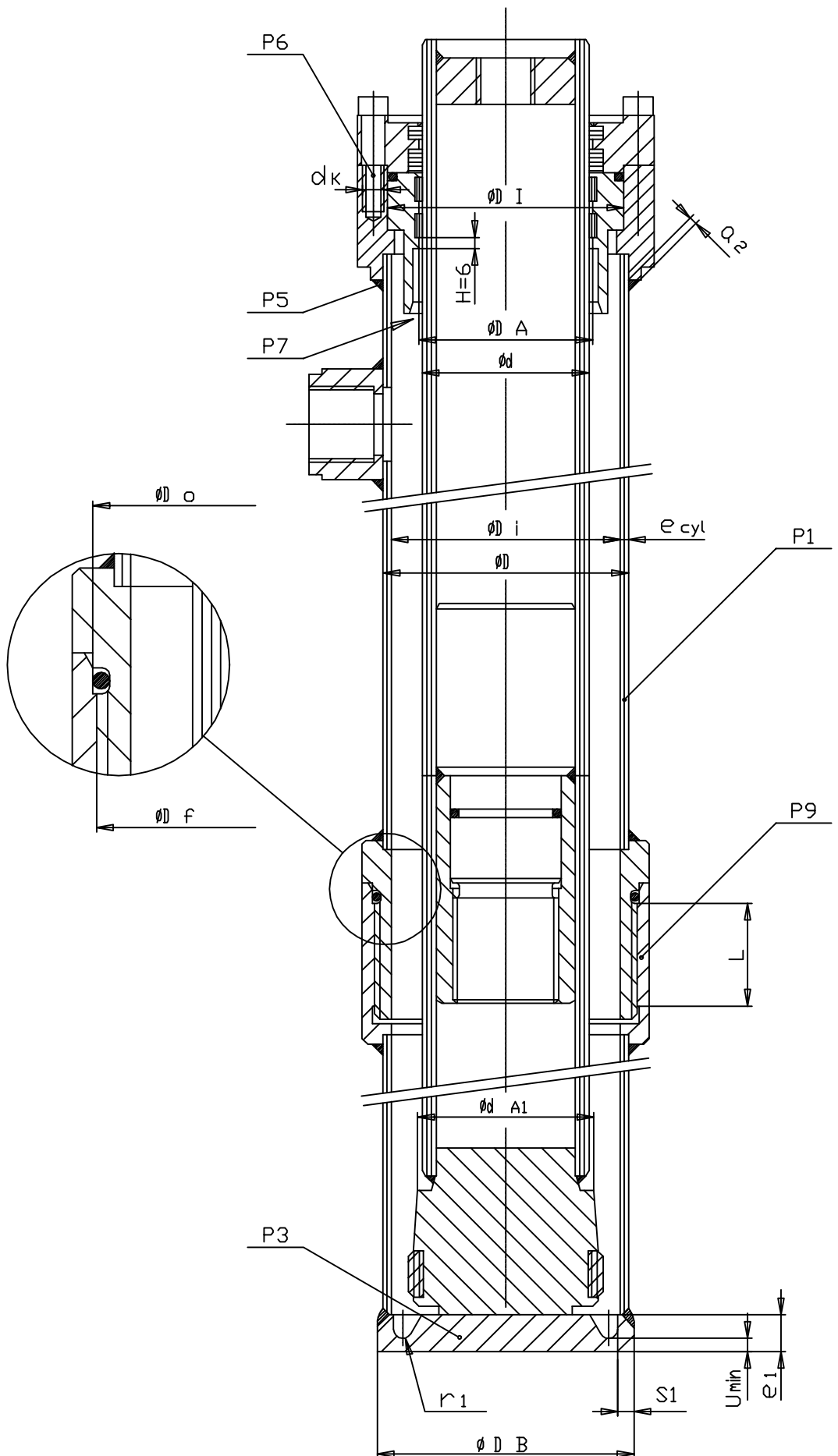
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|---------------------------------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|
| OUTSIDE DIAMETER | Ø | 60 | 60 | 70 | 80 | 85 | 90 | 90 | 100 | 110 | 120 | 130 | 150 | 160 | 180 | 200 | 238 | 35 | 42 |
| CYLINDER PIPE | P1 | 46.5 | 46.5 | 47.7 | 47.7 | 47.7 | 47.8 | 47.8 | 45.5 | 45.7 | 45.7 | 47.0 | 49.7 | 58.0 | 52.0 | 59.9 | 64.5 | | |
| CYLINDER BASE | P3 | 152.2 | 152.2 | 120.0 | 120.0 | 120.0 | 88.2 | 88.2 | 79.4 | 123.3 | 123.3 | 98.7 | 83.5 | 105.3 | 83.2 | 67.8 | 48.6 | | |
| CYLINDER HEAD WELDING | P5 | 67.1 | 67.1 | 59.6 | 59.6 | 59.6 | 64.1 | 64.1 | 61.0 | 53.6 | 53.6 | 57.5 | 61.6 | 62.2 | 55.8 | 62.4 | 68.4 | | |
| CYLINDER HEAD SCREWS | P6 | 93.2 | 93.2 | 79.8 | 66.7 | 66.7 | 56.6 | 56.6 | 81.7 | 70.9 | 62.9 | 55.5 | 62.5 | 58.1 | 67.5 | 72.2 | 54.3 | | |
| RAM BASE AND CYLINDER HEAD | P7 | 424.1 | 177.3 | 155.9 | 139.1 | 132.0 | 125.5 | 114.4 | 114.4 | 105.1 | 97.1 | 90.3 | 79.2 | 128.2 | 66.9 | 60.6 | 51.4 | | |
| FEED LINE PIPE | P8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 68.7 | 71.6 |
| CALCULATION CYLIN. CONNECTION | P9 | - | - | 611.3 | 611.3 | 611.3 | 528.1 | 528.1 | 500.9 | 405.4 | 405.4 | 375.8 | 343.0 | 321.4 | 290.2 | 265.2 | 222.2 | | |
| REMAINING THICKNESS ON THE BASE | U _{min} | 5.2 | 5.2 | 6.0 | 6.0 | 6.0 | 6.9 | 6.9 | 6.9 | 7.8 | 7.8 | 8.9 | 10.1 | 12.9 | 13.1 | 16.5 | 16.0 | | |

Fe520 Rp0.2 = 355 N/mm² YELD TENSION MATERIAL CYLINDRE
 Fe370 Rp0.2 = 235 N/mm² YELD TENSION MATERIAL BASE
 Fe370 Rp0.2 = 235 N/mm² YELD TENSION MATERIAL FEED PIPE
 Fe370 Rp0.2 = 98 N/mm² RESISTANCE TO SHEARING STRESS RAM HEAD

- THE MAX. WORKING PRESSURE OF EACH CYLINDER IS
 THE SMALLER AMONG THE INDICATED ONES (IN BAR)

BEGINNING DATA AND MAX. PRESSURES
 CALCULATED FOR CYLINDER
 (AND FEED PIPE) CHECKING

DATE 05/02
 DWG N. 9041/1



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DRAWING FOR CYLINDER
CALCULATION PROCEDURE

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| DATE | 05/02 |
| DWG N. | 9041/2 |

CYLINDER CALCULATION PROCEDURE

- THE FOLLOWING TECHNICAL DOCUMENTATION IS ABOUT THE CHECKING OF THE CYLINDERS INVOLVED IN LIFTS WORKING.
- CHECKS ARE CARRIED OUT ACCORDING TO STANDARD **TRA 200** (AND RELATING REFERENCE MARKS) AND HARMONISED STANDARD **UNI-EN 81.2:99**.
- THE MAX ADMISSIBLE STATIC PRESSURE FOR EACH CYLINDER, WHICH COORRESPONDS TO THE MAX. ADMISSIBLE LOAD, IS INDICATED IN THE ENCLOSED TABLE
- FOR EACH PLANT IS INDICATED THE REAL LOAD, WHICH MUST BE ALWAYS SMALLER OR EQUAL TO THE MAX. ADMISSIBLE ONE
- THE CONSIDERED CYLINDER, DEVELOPED BY **MORIS** FACTORY, CORRESPONDS TO DRAWING **0367/2-P**
- MEASUREMENT UNITS GENERALLY USED CORRESPOND TO THE INTERNATIONAL SYSTEM (**S.I.**)
- THE SYMBOLOGY ADOPTED REFERS TO THAT OF STANDARDS **TRA 200** (AND SUBSEQUENT REFERENCES) AND STANDARDS **UNI-EN 81.2:99**

1) CYLINDER PIPE THICKNESS CALCULATION FOR DETERMINING THE INNER PRESSURE

- CALCULATION IS MADE IN COMPLIANCE WITH ANNEX K OF **UNI-EN 81.2:99** STANDARDS AND WITH STANDARD **DIN 2413** APPLICATION FIELD 1
- MATERIAL FEATURES ACCORDING TO **DIN 1629** WITH TESTING CERTIFICATE IN CONFORMITY WITH **DIN 50049-3.1B** (MAX. WORKING PRESSURE 160 bar)
- DIMENSIONS ACCORDING TO **DIN 2448**
- MATERIAL **ST. 52,0 DIN 1629** (1.0421)
- YIELD TENSION $R_{p0,2} = 355 \text{ N/mm}^2$
- BREAKING PERCENTAGE ELONGATION **A5** > 21 %
- FROM **DIN 2413**:

$$e_{\text{cyl}} = \frac{D \times P}{20 \times \sigma_{\text{amm}} \times \eta_n} + e_o \quad \text{WITH } P \text{ (bar)}$$

- ACCORDING TO **TRA 200/229.11** $P = 2,3 \times P_{\text{max}}$
 $e_o = 1$

- FROM **DIN 2413** $\eta_n = 1$ FOR WELDLESS PIPES
 $\eta_n = 0,8$ FOR WELDED PIPES

$$\sigma_{\text{amm}} = \frac{R_{p0,2}}{S} \quad \text{WITH } S = 1,7$$

- REPLACING THE VALUES AND SOLVING WITH RESPECT TO P_{max} :

$$P_{1\text{max}} = \frac{2 \times R_{p0,2} \times (e_{\text{cyl}} - 1)}{2.3 \times 1.7 \times D} \times 10 \quad \text{WELDLESS PIPES}$$

2) CYLINDER PLANE BASE CALCULATION

- CALCULATION ACCORDING TO TECHNICAL SHEET **AD-MERKBLATT B5, 6.1.1** CASE (E)
- MATERIAL **DIN 17.100 RST 37-2** (1.0038)

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| UT | | | | DATE | 05/02 |
| CYLINDER CALCULATION PROCEDURE | | | | DWG N | 9041/3 |

- YIELD TENSION $R_{P0,2} = 235 \text{ N/mm}^2$

$$e_1 = c \times D_i \times \sqrt{\frac{P \times S}{10 \times R_{P0,2}}} + e_0$$

- ACCORDING TO **TRA 200** $P = 2,3 \times P_{\max}$

$$e_0 = 1$$

- ACCORDING TO **AD-MERKBLATT B0** TABLE 2 $S = 1,5$

- ACCORDING TO **EN 81.2** $S = 1,7$

- ACCORDING TO **AD-MERKBLATT B5** TABLE 1 $C = 0,4$

- REPLACING THE VALUES ($S = 1,7$) E RISOLVENDO PER P_{\max} :

$$P_{3\max} = \frac{R_{P0,2}}{2,3 \times 1,7} \times \frac{2,5^2 \times (e_1 - 1)^2}{D_i^2} \times 10$$

REMANING THICKNESS CALCULATION

- CALCULATION ACCORDING TO **AD-MERKBLATT B5**, TABLE 1, AND ANNEX **K** OF **UNI-EN 81.2:99** STANDARDS.
- CALCULATION OF "U_{min}" THICKNESS, WITH PRESSURE **P**, IS \leq THAN THE MINIMUM PRESSURE AMONG MAXIMUM ALLOWABLE PRESSURES FOR ALL THE SYSTEM COMPONENTS.

$$U_{\min} = 1,3 \times \frac{(D_i \times 0,5 - r_1) \times (2,3 \times 1,7 \times P_{\max} \times 0,1)}{R_{P0,2}} + 1$$

MOREOVER, THE FOLLOWING PROJECT CONDITIONS MUST BE VERIFIED:

$$U_{\min} \geq 5 \text{ mm}$$

$$r_1 \geq 0,2 \times S_1$$

$$r_1 \geq 5 \text{ mm}$$

$$U_{\min} \leq 1,5 \times S_1$$

$$h_1 \geq u_1 + r_1$$

3) CYLINDER PIPE / CYLINDER HEAD WELDING CALCULATION

- MATERIAL **RSt 37-2 DIN 17.100**

$$R_{P0,2} = 98 \text{ N/mm}^2 \text{ (DV 952)}$$

- WELDING AREA $A = \pi \times D \times a_2$

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- ACTUAL FORCE ON THE WELDING

$$F = \frac{\pi}{4} \times D^2 \times \frac{2,3 \times P_{\max}}{10}$$

$$\tau = \frac{F}{A} \leq R_{P0,2}$$

- SOLVING WITH RESPECT TO P_{\max} SI HA:

$$P_{5\max} = \frac{R_{P0,2} \times a_2 \times 40}{2,3 \times D}$$

4) CALCULATION OF THE CYLINDER HEAD FIXING SCREW

- CALCULATION ACCORDING TO **AD-MERKBLATT B7**
- SCREWS M.....x**UNI 5931 – 8.8**
- ELASTIC LIMIT ACCORDING TO **DIN 267 PAR. 3** $R_{P0,2} = 640 \text{ N/mm}^2$
- ACTUAL FORCE ON THE SCREWS :

$$F = \frac{2,3 \times P_{\max} \times \pi \times D l^2}{40}$$

- MIN. NEEDED BOLT DIAMETER:

$$d_K = Z \times \sqrt{\frac{F}{R_{P0,2} \times n}} + C5$$

$Z = 1,51$ FROM **AD-MERKBLATT B7** TABLE 3

n = SCREWS NUMBER

ASSUMING THAT: $Z \times \frac{F}{R_{P0,2} \times n} = Y$

| | | |
|------|---------------|--------------------------|
| FOR: | $Y \leq 20$ | $C5 = 3$ |
| | $Y \geq 50$ | $C5 = 1$ |
| | $20 < Y < 50$ | $C5 = \frac{(65-Y)}{15}$ |

- SOLVING WITH RESPECT TO P_{\max} :

$$P_{6\max} = \frac{n \times (d_K - C5)^2}{D l^2} \times 1553,85$$

PROJECT CONDITIONS

- SCREWS PITCH NOT MORE THAN $5 \times d_K$
- MIN. SCREWS NUMBER 4
- MIN. SCREWS DIAMETER M10
- SCREW SHANK LENGTH AT LEAST $2 \times d_K$
- MIN. ENGAGEMENT DEPTH **L (CLASSE 8.8)**

$$d / P < 9 L = 1,0 \times d_K$$

$$d / P > 9 L = 1,25 \times d_K$$

P = THREAD PITCH

| | | | | | | |
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| CYLINDER CALCULATION PROCEDURE | | | | | | |

5) CALCULATION OF THE LIMIT BEARING PRESSURE BETWEEN RAM BASE AND CYLINDER HEAD

- YIELD TENSION RAM BASE:

$$F = 2,3 \times P_{\max} \times \frac{\pi}{4} \times d_{A1}^2$$

- REACTION SURFACE:

$$A = \frac{\pi}{4} \times (d_{A1}^2 - D_A^2)$$

- SOLVING WITH RESPECT TO P_{\max}

$$P7_{\max} = \frac{10 \times R_{P0,2} \times (d_{A1}^2 - D_A^2)}{d_{A1}^2 \times 2.3}$$

6) CALCULATION OF THE FEED LINE PIPES

- CALCULATION ACCORDING TO **DIN 2413**, APPLICATION FIELD 1, AND ANNEX **K** OF **UNI-EN 81.2:99** STANDARDS
- MATERIAL FEATURES ACCORDING TO **DIN 1629** WITH TESTING CERTIFICATE IN CONFORMITY WITH **DIN 50049-3.1 B** (MAX WORKING PRESSURE **160 bar**)
- DIMENSIONS ACCORDING TO **DIN 2391**
- MATERIAL **St. 37.0 DIN 1629 (1.0254)**
- YIELD TENSION $R_{P0,2} = 235 \text{ N/mm}^2$
- BREAKING PERCENTAGE ELONGATION **A5 = 25%**
- FROM **DIN 2413** SI HA:

$$e_{\text{cyl}} = \frac{D \times P}{20 \times \sigma_{\text{amm}} \times \eta_n} + e_o \quad \text{CON } P \text{ (bar)}$$

- ACCORDING TO **TRA 200/229.11** $P = 2,3 \times P_{\max}$

$$e_o = 0,5$$

- FROM **DIN 2413** $\eta_n = 1$

$$\sigma_{\text{amm}} = \frac{R_{P0,2}}{S} \quad \text{CON } S = 1,7$$

- REPLACING THE VALUES AND SOLVING WITH RESPECT TO P_{\max}

$$P8_{\max} = \frac{2 \times R_{P0,2} \times (e_{\text{cyl}} - 0.5)}{2.3 \times 1.7 \times Dt} \times 10$$

7) CYLINDER CONNECTION CALCULATION

- THREAD CALCULATION ACCORDING TO TECHNICAL SHEET **AD-MERKBLATT B8 6.13**
- MATERIAL **St. 37.0 DIN 1629 (1.0254)**
- YIELD TENSION..... $R_{P0,2} = 235 \text{ N/mm}^2$
- BREAKING PERCENTAGE ELONGATION **A5 = 25%**
- WELDINGS CALCULATION ISN'T NECESSARY; SEE POINT **3** (DRAWING N. 9041/4)

| | | | | | | |
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CYLINDER CALCULATION PROCEDURE

THREAD CALCULATION

- FROM TECHNICAL SHEET **AD-MERKBLATT B8**:

$$\frac{R_{P0.2}}{S} = \frac{2 \times F}{L \times \pi \times D_f}$$

- WITH:

L = THREAD LENGTH

Df = THREAD DIAMETER

S = SAFETY FACTOR = 1,5

R_{P0.2} = YIELD TENSION MATERIAL

F = TENSILE FORCE

$$F = \frac{\pi}{40} \times D_o^2 \times 2,3 \times P_{\max}$$

- REPLACING THE VALUES AND SOLVING WITH RESPECT TO **P_{max}**, SI HA:

$$P_{\max} = \frac{2 \times R_{P0.2} \times L \times D_f}{2.3 \times 1.5 \times D_o^2} \times 10$$

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CYLINDER CALCULATION PROCEDURE

DATE

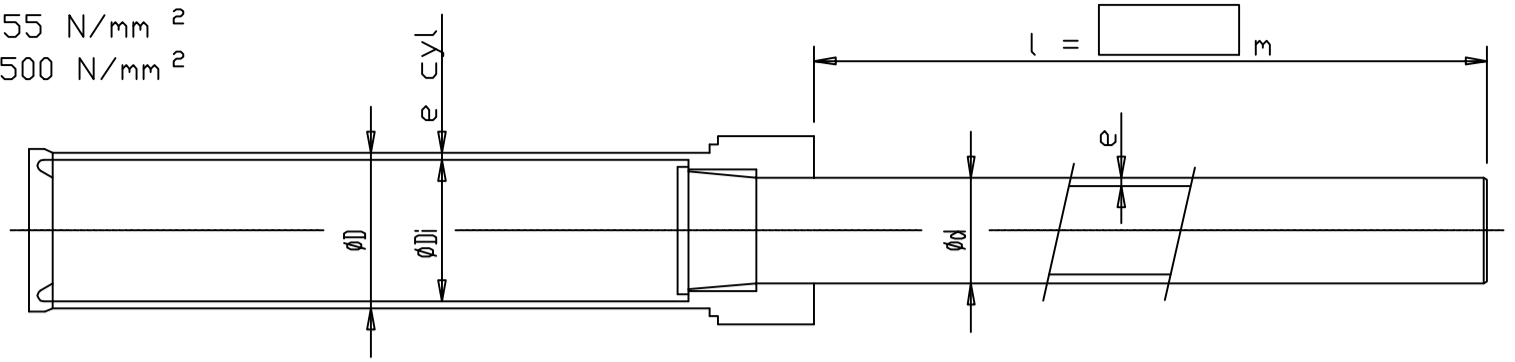
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DWG N

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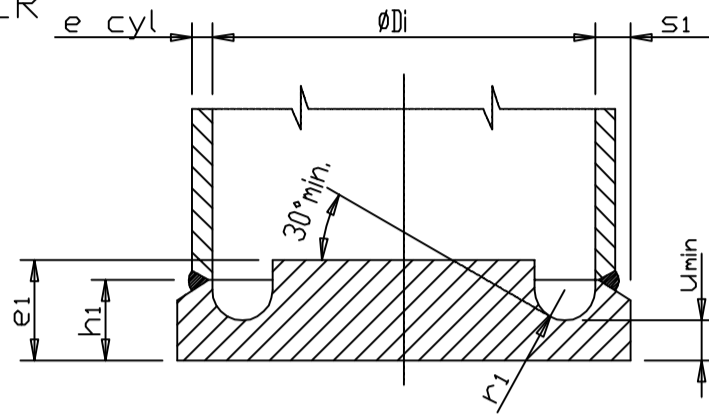
SIMPLE CYLINDERCE

$R_{p\ 0.2} = 355\ \text{N/mm}^2$
 $R_m = 500\ \text{N/mm}^2$



BOTTOM OF CYLINDER

$R_{p\ 0.2} = 235\ \text{N/mm}^2$
 $R_m = 350\ \text{N/mm}^2$



CONDITION FOR EXHAUST OF WELDED COUPLING

$r1 \geq 0.2\ s1\ e\ r1$
 $U_{min} \leq 1.5\ s1$
 $h1 \geq U_{min} + r1$

| | | UNIT | RAM | | | | | | | | | | | | | | | |
|----------|-----|-----------------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|---------|----------|
| | | | 50 | 60 | 70 | 80 | 85 | 90 | 100 | 110 | 120 | 130 | 150 | 160 | 180 | 200 | 238 | |
| d | | mm | 50 | 60 | 70 | 80 | 85 | 90 | 100 | 110 | 120 | 130 | 150 | 160 | 180 | 200 | 238 | |
| e cyl | | mm | 36 | 36 | 4.0 | 4.0 | 4.0 | 4.5 | 4.5 | 5.0 | 5.0 | 5.6 | 6.3 | 8.0 | 8.0 | 10.0 | 12.5 | |
| D | | mm | 101.6 | 101.6 | 114.3 | 114.3 | 114.3 | 133.0 | 139.7 | 159.0 | 159.0 | 177.8 | 193.7 | 219.1 | 244.5 | 273.0 | 323.9 | |
| e1 | | mm | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 28.0 | 28.0 | 28.0 | 28.0 | 35.0 | 35.0 | 35.0 | 35.0 | |
| Di | | mm | 94.4 | 94.4 | 106.3 | 106.3 | 106.3 | 124.0 | 130.7 | 149.0 | 149.0 | 166.6 | 181.1 | 203.1 | 228.5 | 253.0 | 298.9 | |
| r1 | | mm | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 6.0 | 6.0 | 6.0 | 6.0 | 7.0 | 7.0 | 7.0 | 7.0 | |
| S1 | | mm | 4.3 | 4.3 | 4.9 | 4.9 | 4.9 | 5.5 | 5.2 | 6.0 | 6.0 | 6.7 | 7.5 | 9.5 | 9.3 | 11.5 | 14.6 | |
| h1 | | mm | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 28 | 28 | 28 | 28 | 35 | 35 | 35 | 35 | |
| U min | | mm | 5.2 | 5.2 | 6.0 | 6.0 | 6.0 | 6.9 | 6.9 | 7.8 | 7.8 | 8.9 | 10.1 | 12.9 | 13.1 | 16.5 | 16.0 | |
| e | 5 | mm | x | x | x | x | | x | x | x | x | x | | | | | | |
| | 6 | | x | x | x | x | | x | x | x | x | | | | | | | |
| | 7.5 | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | |
| | 10 | | | | | | | | | | | | | | | | | |
| | 12 | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | x | |
| Ap | | mm ² | 1963.5 | 2827.4 | 3848.5 | 5026.5 | 5674.5 | 6361.7 | 7854.0 | 9503.3 | 11309.7 | 13273.2 | 17671.5 | 20106.2 | 25446.9 | 31415.9 | 44488.1 | |
| A | 5 | mm ² | 706.9 | 863.9 | 1021.0 | 1178.1 | | 1335.2 | 1492.3 | 1649.3 | 1806.4 | 1963.5 | | | | | | |
| | 6 | | 1001.4 | 1237.0 | 1472.6 | 1708.2 | 1826.1 | 1943.9 | 2179.5 | 2415.1 | 2650.7 | 2886.3 | | | | | | |
| | 7.5 | | | | | 2563.5 | | 2940.5 | 3317.5 | 3692.64 | 4071.5 | 4448.5 | 4398.2 | 4712.4 | 5340.7 | 5969.0 | | |
| | 10 | | | | | | | | | | | | | | | | | 9852.0 |
| | 12 | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | |
| i | 5 | mm | 16.01 | 19.53 | 23.05 | 26.58 | | 30.10 | 33.63 | 37.17 | 40.70 | 44.23 | | | | | | |
| | 6 | | 15.26 | 18.75 | 22.26 | 25.77 | 27.53 | 29.29 | 32.81 | 36.34 | 39.86 | 43.39 | 50.96 | | | | | |
| | 7.5 | | | | | | | | | | | | 49.62 | 53.15 | 60.21 | 67.27 | | |
| | 10 | | | | | | | | | | | | | | | | | 79.35 |
| | 12 | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | |
| J | 5 | mm ⁴ | 181132 | 329376 | 542416 | 832031 | | 1210004 | 1688115 | 2278146 | 2991876 | 3841088 | | | | | | |
| | 6 | | 233134 | 434884 | 729408 | 1134379 | 1383804 | 1667468 | 2346346 | 3188686 | 4212158 | 5434434 | 7047774 | | | | | |
| | 7.5 | | | | | | | | | | | | 10830641 | 13312499 | 19360065 | 27009843 | | |
| | 10 | | | | | | | | | | | | | | | | | 62033336 |
| | 12 | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | |
| γ | 5 | Kg/m | 5.5 | 6.7 | 7.9 | 9.2 | | 10.4 | 11.7 | 12.9 | 14.1 | 15.3 | | | | | | |
| | 6 | | 7.8 | 9.6 | 11.5 | 13.3 | 14.3 | 15.2 | 17.1 | 18.9 | 20.7 | 22.5 | 21.2 | | | | | |
| | 7.5 | | | | | | | | | | | | 34.4 | 36.8 | 41.7 | 46.6 | | |
| | 10 | | | | | | | | | | | | | | | | | |
| | 12 | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | 76.9 | |

Ap = CROSS-SECTIONAL AREA OF THE RAM

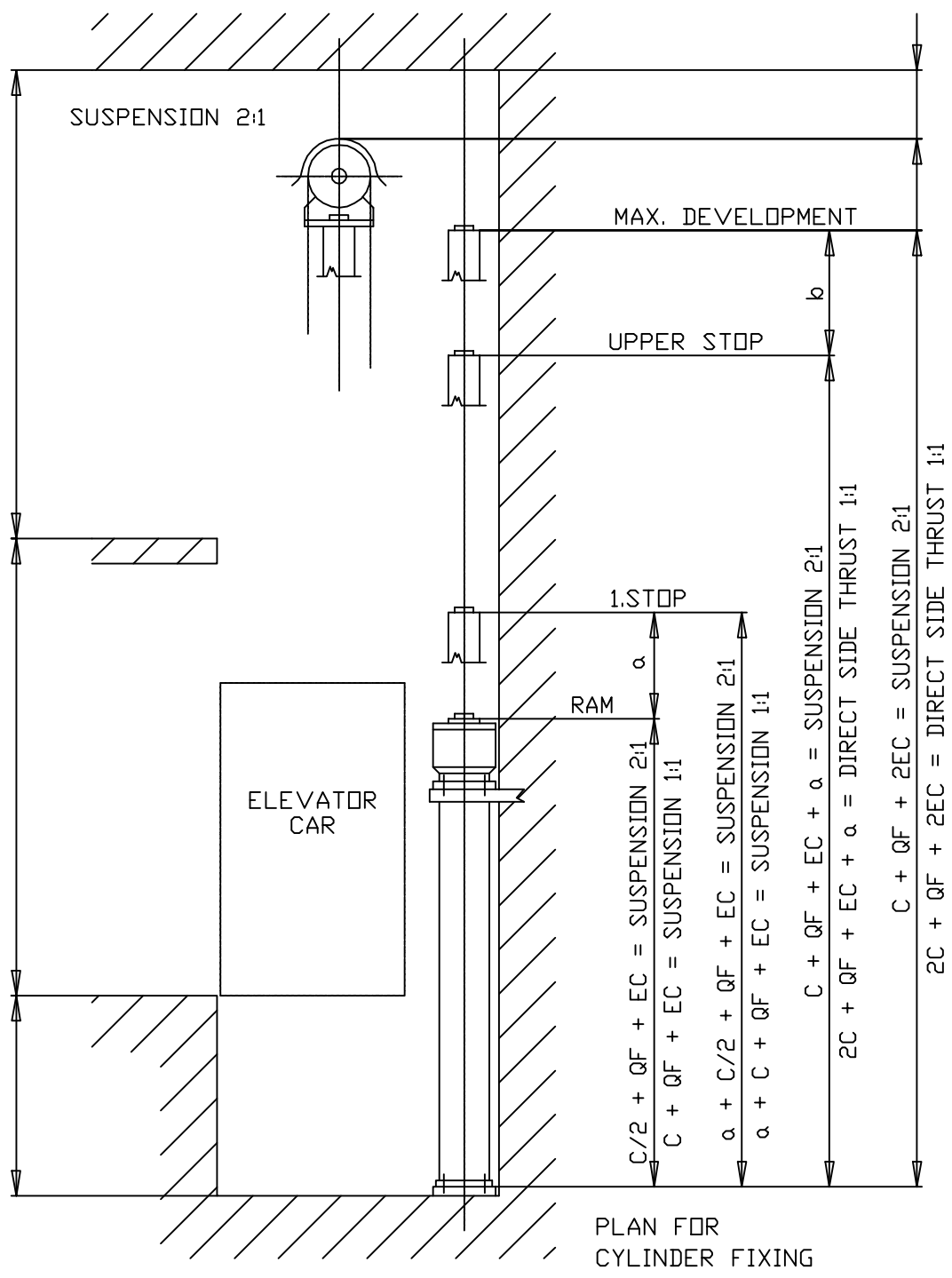
A = STRENGTH CROSS-SECTIONAL AREA OF THE RAM

i = RADIUS OF GYRATION OF THE RAM

J = SECOND MOMENT OF THE RAM

γ = MASS OF THE RAM

| | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|--------|
| UT | | | | | | | | | | | | | | | | | | DATE | 05/02 |
| | | | | | | | | | | | | | | | | | | DWG N. | 9041/S |
| INITIAL DATA FOR CYLINDER - PISTON GROUP - "HARMONISED STANDARDS UNI EN 81.2:1999" - | | | | | | | | | | | | | | | | | | | |



C : STROKE
 EC : EXTRA STROKE (a+b)

| | | | |
|--|----------|--------|-------|
| | SIDE RAM | DATE | 04/90 |
| | | DWG N. | 9315 |