

trailer (full, semi-, centre-axle) with air brake system acc. to 71/320/EEC, last amended by 98/12/EC and 2006/96/EC or UN/ECE-R.13.11

distribution: BODEX

please note!

This brake calculation is made under consideration of
 -the legal prescriptions mentioned above in the version valid at the time of making the program (V6.11.04.19).
 -the functional characteristics of our products as well as the data of the brake out of the test approvals of the axle manufacturers, and
 -the other vehicle data included in the brake calculation.
 Please check whether these data correspond to the actual vehicle data. Our conditions of delivery apply (particularly section 9.0). In any case we commend to do a braking harmonisation!
 WABCOBrake V6.11.04.19 db 19.04.2011

vehicle manufacturer: BODEX
 trailer model : AKM
 trailer type : 3-axle-semi-trailer
 remarks : air / hydraulic / VA suspension
 WABCO TRAILER - EBS
 TRISTOP 2+3: 16/16
 385/65 R 22,5

axle 1 + 2 + 3 : DAIMLERCHRYSLER AG, SK 7..., TDB 0815 ECE,

| | | unladen | | laden | |
|--------------------------|----------|---------|---------------|-------|---------------|
| total mass | P in kg | 6000 | - 8000 | 35000 | - 39000 |
| king-pin | PS kg | 0 | - 2000 | 11000 | - 15000 |
| axle 1 | P1 in kg | | 2000 | | 8000 |
| axle 2 | P2 in kg | | 2000 | | 8000 |
| axle 3 | P3 in kg | | 2000 | | 8000 |
| total axle mass | PR in kg | | 6000 | | 24000 |
| wheel base | E in mm | 6400 | - 8000 | | |
| centre of gravity height | h in mm | | 1300 | | 2300 |
| K-factor | | | Kv min 1,7095 | | Kc min 0,9319 |
| K-factor | | | Kv max 1,7675 | | Kc max 1,0375 |

| | | axle 1 | axle 2 | axle 3 |
|-------------------------------------|----------------|----------|----------|----------|
| no. of combined axles | | 1 | 1 | 1 |
| no. of brake chambers per axle line | KDZ | 2 | 2 | 2 |
| The power output corresponds to | | KO 195.0 | KO 196.3 | KO 196.3 |
| brake chamber manufacturer | | WABCO | WABCO | WABCO |
| chamber size | | 16 | 16/16 | 16/16 |
| lever length | lBh in mm | 76 | 76 | 76 |
| brake factor | [-] | 26,07 | 26,07 | 26,07 |
| dyn. rolling radius | rdyn min in mm | 517 | 517 | 517 |
| dyn. rolling radius | rdyn max in mm | 517 | 517 | 517 |
| threshold torque | Co Nm | 10,0 | 10,0 | 10,0 |

calculation:

| | | | | |
|--|---|-------|-------|-------|
| chamber pressure(rdyn min)pH at z=22,5%bar | | 2,5 | 2,5 | 2,5 |
| chamber pressure(rdyn max)pH at z=22,5%bar | | 2,5 | 2,5 | 2,5 |
| chamber press.(servo)pcha at pm6,5bar bar | | 5,5 | 5,5 | 5,5 |
| piston force ThA at pm6,5bar N | | 5533 | 5533 | 5533 |
| brake force(rdyn min)T lad. at pm6,5bar N | | 42185 | 42185 | 42185 |
| brake force(rdyn max)T lad. at pm6,5bar N | | 42185 | 42185 | 42185 |
| brake force within 1 % rolling friction proportion | % | 33,3 | 33,3 | 33,3 |

braking rate z laden 0,538 for rdyn min
 z = sum (TR)/PRmax 0,538 for rdyn max

Trailer may only be operated in combination with trucks/tractors with ISO 7638 supply (5 or 7 polar).

brake diagram : 841 701 101 0

maximum pressure: 8,5 bar

axle 1:

valve 1: 971 002 ... 0 WABCO
EBS emergency valve
valve 2: 480 102 ... 0 WABCO
EBS trailer modulator
brake cylinder: WABCO 423 104 710 0

axle 2:

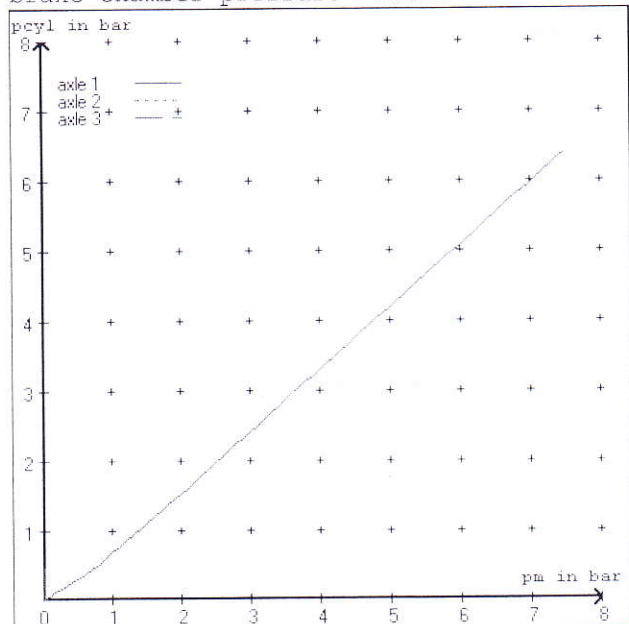
valve 1: 971 002 ... 0 WABCO
EBS emergency valve
valve 2: 480 102 ... 0 WABCO
EBS trailer modulator
brake cylinder: WABCO 925 464 4.. 0

axle 3:

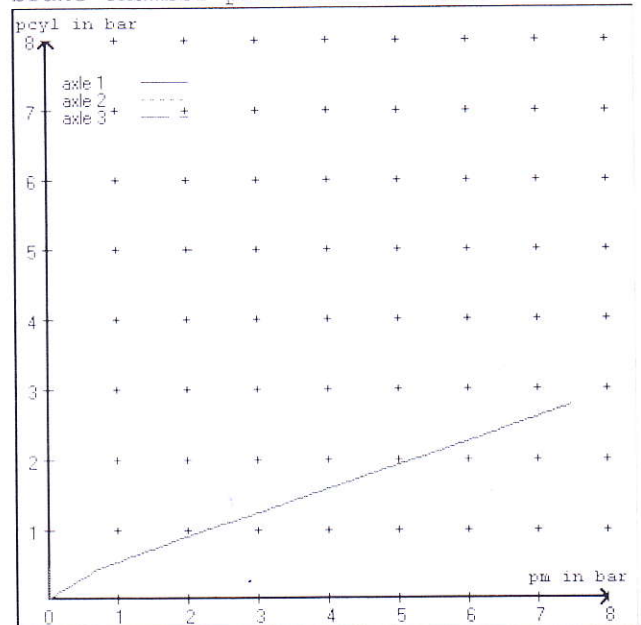
valve 1: 971 002 ... 0 WABCO
EBS emergency valve
valve 2: 480 102 ... 0 () WABCO or 480 207 0.. 0
EBS trailer modulator
brake cylinder: WABCO 925 464 4.. 0

| | | | | |
|-----------------------------|----------------|-------|-------|-------|
| test type III (zIII = 0,30) | for rdyn min : | axle1 | axle2 | axle3 |
| at pm 3,9 bar => | pcha in bar : | 3,2 | 3,2 | 3,2 |
| test type III (zIII = 0,06) | for rdyn min : | axle1 | axle2 | axle3 |
| at pm 1,2 bar => | pcha in bar : | 0,9 | 0,9 | 0,9 |

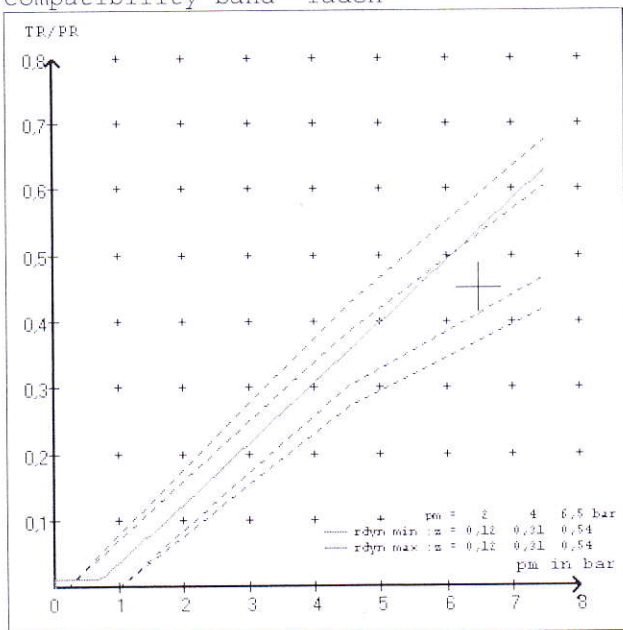
brake chamber pressure laden



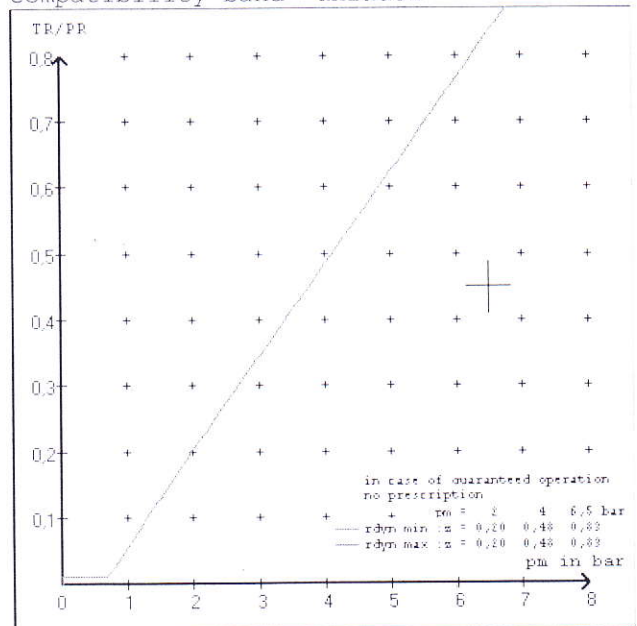
brake chamber pressure unladen



compatibility band laden



compatibility band unladen



vehicle manufacturer: BODEX
 trailer model : AKM
 trailer type : 3-axle-semi-trailer

brake chamber and lever length :
 axle 1 : 2 x type/diameter 16 (WABCO) lever length 76 mm
 axle 2 : 2 x type/diameter 16/16 (WABCO) lever length 76 mm
 axle 3 : 2 x type/diameter 16/16 (WABCO) lever length 76 mm

brake diagram : 841 701 101 0

valve :
 971 002 ... 0 WABCO EBS emergency valve
 480 102 ... 0 WABCO EBS trailer modulator
 480 102 ... 0 WABCO EBS trailer modulator or 480 207 0... 0

EBS input data

=====
 vehicle manufacturer: BODEX
 trailer model : AKM
 trailer type : 3-axle-semi-trailer
 brake calculation no. : WPL 74719S

tire circumference main axle : 3250 for rdyn max
 tire circumference auxiliary axle : 3250 for rdyn max

assignment pm / deceleration z: pm 0,7 bar z = 0,000
 (laden condition) 2,0 bar z = 0,127
 6,5 bar z = 0,540

| axle | control pressure pm | | 6,5 | control pressure pm | | 0,7 | 2,0 | 6,5 |
|------|---------------------|--------------------|-----|---------------------|------------------|-----|-----|-----|
| | axle load unladen | bellow pr. unladen | | axle load laden | bellow pr. laden | | | |
| 1 | 2000 | to be | 2,4 | 8000 | to be | 0,5 | 1,5 | 5,5 |
| 2 | 2000 | entered by | 2,4 | 8000 | entered by | 0,5 | 1,5 | 5,5 |
| 3 | 2000 | the vehicle | 2,4 | 8000 | the vehicle | 0,5 | 1,5 | 5,5 |
| 4 | 0 | manufact. | 0,0 | 0 | manufact. | 0,0 | 0,0 | 0,0 |
| 5 | 0 | | 0,0 | 0 | | 0,0 | 0,0 | 0,0 |

The unladen values indicated in the above table are values for the basic parameter set. Higher unladen axle loads and liftaxles are automatically recognized and do not require separate adjustment. The above unladen axle loads must not be fallen below.

| axle 1 | | axle 2 | | axle 3 | |
|-----------|------|-----------|------|-----------|------|
| axle load | pcyl | axle load | pcyl | axle load | pcyl |
| 2000 | 2,4 | 2000 | 2,4 | 2000 | 2,4 |
| 2500 | 2,7 | 2500 | 2,7 | 2500 | 2,7 |
| 3000 | 2,9 | 3000 | 2,9 | 3000 | 2,9 |
| 3500 | 3,2 | 3500 | 3,2 | 3500 | 3,2 |
| 4000 | 3,4 | 4000 | 3,4 | 4000 | 3,4 |
| 4500 | 3,7 | 4500 | 3,7 | 4500 | 3,7 |
| 5000 | 4,0 | 5000 | 4,0 | 5000 | 4,0 |
| 5500 | 4,2 | 5500 | 4,2 | 5500 | 4,2 |
| 8000 | 5,5 | 8000 | 5,5 | 8000 | 5,5 |

data sheet to EC/ECE vehicle type-approval certificate concerning braking equipment: according to 98/12/EC annex IX 2.7.4 / ECE R13 annex 11

axle 1 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: Jurid 539
 test report : TDB 0815 ECE date : 11.07.2005
 axle 2 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: Jurid 539
 test report : TDB 0815 ECE date : 11.07.2005
 axle 3 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: Jurid 539
 test report : TDB 0815 ECE date : 11.07.2005

calc. verif. of residual (hot) braking force type III
 (item 4.2 of appendix I to annex VII)

| | | |
|--------|---------------|---------------|
| axle 1 | (rdyn 517 mm) | T = 20,0 % Fe |
| axle 2 | (rdyn 517 mm) | T = 20,0 % Fe |
| axle 3 | (rdyn 517 mm) | T = 20,0 % Fe |

calculated actuator stroke in mm
 (item 4.3.1.1 of appendix I to annex VII)

| | | |
|--------|--------------|-----------|
| axle 1 | (sp = 49 mm) | s = 43 mm |
| axle 2 | (sp = 49 mm) | s = 43 mm |
| axle 3 | (sp = 49 mm) | s = 43 mm |

average thrust output in N at pm = 6,5 bar (however max. pcha = 7,0 bar)

| | |
|-------|--------------|
| axle1 | ThA = 5533 N |
| axle2 | ThA = 5533 N |
| axle3 | ThA = 5533 N |

calc. residual (hot) braking force in N
 (item 4.3.1.4 of appendix I to annex VII)

| | | |
|--------|---------------|-------------|
| axle 1 | (rdyn 517 mm) | T = 35231 N |
| axle 2 | (rdyn 517 mm) | T = 35231 N |
| axle 3 | (rdyn 517 mm) | T = 35231 N |

braking rate of the vehicle
 (item 4.3.2 to appendix I to annex VII)

| | | | |
|-----------------------------------|------|---|------|
| basic test of subject trailer (z) | 0,54 | type III (calculated) residual (hot)braking | 0,45 |
|-----------------------------------|------|---|------|

required braking rate
 (items 1.3.3 and 1.6.2 to annex II)

>= 0,4 and
 >= 0,6*z (0,32)

calc. residual (hot) braking force in N
 (item 4.3.1.4 of appendix I to annex VII)

| | | |
|--------|---------------|-------------|
| axle 1 | (rdyn 517 mm) | T = 35231 N |
| axle 2 | (rdyn 517 mm) | T = 35231 N |
| axle 3 | (rdyn 517 mm) | T = 35231 N |

braking rate of the vehicle
 (item 4.3.2 to appendix I to annex VII)

| | | | |
|-----------------------------------|------|---|------|
| basic test of subject trailer (z) | 0,54 | type III (calculated) residual (hot)braking | 0,45 |
|-----------------------------------|------|---|------|

required braking rate
 (items 1.3.3 and 1.6.2 to annex II)

>= 0,4 and
 >= 0,6*z (0,32)

data sheet to EC/ECE vehicle type-approval certificate concerning braking equipment: according to 98/12/EC annex IX 2.7.4 / ECE R13 annex 11

axle 1 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: FER 4550
 test report : TDB 0815 ECE date : 14.07.2005
 axle 2 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: FER 4550
 test report : TDB 0815 ECE date : 14.07.2005
 axle 3 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: FER 4550
 test report : TDB 0815 ECE date : 14.07.2005

calc. verif. of residual (hot) braking force type III
 (item 4.2 of appendix I to annex VII)

axle 1 (rdyn 517 mm) T = 20,0 % Fe
 axle 2 (rdyn 517 mm) T = 20,0 % Fe
 axle 3 (rdyn 517 mm) T = 20,0 % Fe

calculated actuator stroke in mm
 (item 4.3.1.1 of appendix I to annex VII)

axle 1 (sp = 49 mm) s = 44 mm
 axle 2 (sp = 49 mm) s = 44 mm
 axle 3 (sp = 49 mm) s = 44 mm

average thrust output in N at pm = 6,5 bar (however max. pcha = 7,0 bar)

axle1 ThA = 5533 N
 axle2 ThA = 5533 N
 axle3 ThA = 5533 N

calc. residual (hot) braking force in N
 (item 4.3.1.4 of appendix I to annex VII)

axle 1 (rdyn 517 mm) T = 37736 N
 axle 2 (rdyn 517 mm) T = 37736 N
 axle 3 (rdyn 517 mm) T = 37736 N

basic test of subject trailer (z) type III (calculated) residual (hot)braking

braking rate of the vehicle
 (item 4.3.2 to appendix I to annex VII)

0,54 0,48

required braking rate
 (items 1.3.3 and 1.6.2 to annex II)

>= 0,4 and
 >= 0,6*z (0,32)

calc. residual (hot) braking force in N
 (item 4.3.1.4 of appendix I to annex VII)

axle 1 (rdyn 517 mm) T = 37736 N
 axle 2 (rdyn 517 mm) T = 37736 N
 axle 3 (rdyn 517 mm) T = 37736 N

basic test of subject trailer (z) type III (calculated) residual (hot)braking

braking rate of the vehicle
 (item 4.3.2 to appendix I to annex VII)

0,54 0,48

required braking rate
 (items 1.3.3 and 1.6.2 to annex II)

>= 0,4 and
 >= 0,6*z (0,32)

data sheet to EC/ECE vehicle type-approval certificate concerning braking equipment: according to 98/12/EC annex IX 2.7.4 / ECE R13 annex 11

axle 1 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: Textar T3060
 test report : TDB 0815 ECE date : 31.08.2005
 axle 2 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: Textar T3060
 test report : TDB 0815 ECE date : 31.08.2005
 axle 3 : reference axle: DAIMLERCHRYTE5 - TL5 - T brake lining: Textar T3060
 test report : TDB 0815 ECE date : 31.08.2005

calc. verif. of residual (hot) braking force type III
 (item 4.2 of appendix I to annex VII)

| | | |
|--------|---------------|---------------|
| axle 1 | (rdyn 517 mm) | T = 20,0 % Fe |
| axle 2 | (rdyn 517 mm) | T = 20,0 % Fe |
| axle 3 | (rdyn 517 mm) | T = 20,0 % Fe |

calculated actuator stroke in mm
 (item 4.3.1.1 of appendix I to annex VII)

| | | |
|--------|--------------|-----------|
| axle 1 | (sp = 49 mm) | s = 44 mm |
| axle 2 | (sp = 49 mm) | s = 44 mm |
| axle 3 | (sp = 49 mm) | s = 44 mm |

average thrust output in N at pm = 6,5 bar (however max. pcha = 7,0 bar)

| | |
|-------|--------------|
| axle1 | ThA = 5533 N |
| axle2 | ThA = 5533 N |
| axle3 | ThA = 5533 N |

calc. residual (hot) braking force in N
 (item 4.3.1.4 of appendix I to annex VII)

| | | |
|--------|---------------|-------------|
| axle 1 | (rdyn 517 mm) | T = 34736 N |
| axle 2 | (rdyn 517 mm) | T = 34736 N |
| axle 3 | (rdyn 517 mm) | T = 34736 N |

| | |
|-------------|--------------|
| basic test | type III |
| of subject | (calculated) |
| trailer (z) | residual |
| | (hot)braking |

braking rate of the vehicle
 (item 4.3.2 to appendix I to annex VII)

0,54 0,44

required braking rate
 (items 1.3.3 and 1.6.2 to annex II)

>= 0,4 and
 >= 0,6*z (0,32)

calc. residual (hot) braking force in N
 (item 4.3.1.4 of appendix I to annex VII)

| | | |
|--------|---------------|-------------|
| axle 1 | (rdyn 517 mm) | T = 34736 N |
| axle 2 | (rdyn 517 mm) | T = 34736 N |
| axle 3 | (rdyn 517 mm) | T = 34736 N |

| | |
|-------------|--------------|
| basic test | type III |
| of subject | (calculated) |
| trailer (z) | residual |
| | (hot)braking |

braking rate of the vehicle
 (item 4.3.2 to appendix I to annex VII)

0,54 0,44

required braking rate
 (items 1.3.3 and 1.6.2 to annex II)

>= 0,4 and
 >= 0,6*z (0,32)

spring parking brake

| | axle 2 | axle 3 |
|---|-----------|-----------|
| no of TRISTOP-actuators per axle line KDZ | 2 | 2 |
| TRISTOP-actuator type | 16/16 | 16/16 |
| lever length lbh in mm | 76 | 76 |
| stat. tyre radius rstat max in mm | 494 | 494 |
| at a stroke of s in mm | 30 | 30 |
| min. force of spring brake TFZ in N | 5847 | 5847 |
| sp.brake chamber no 925 ... | 464 4.. 0 | 464 4.. 0 |
| release pressure pLs in bar | 5,1 | 5,1 |

calculation:

| | | |
|--|--------|--------|
| ratio until road | 4,0108 | 4,0108 |
| $iFb = lbh \cdot \eta \cdot C \cdot rBt / (rBn \cdot rstat)$ | | |
| for rstat in mm | 494 | 494 |
| brake force of spring br. Tf in N | 45846 | 45846 |
| $Tf = (TFZ \cdot KDZ - 2 \cdot Co / lbh) \cdot iFb$ | | |
| braking rate zf laden | 0,250 | |
| $zf = \sum (Tf) / P + 0,01$ | | |

Test of the frictional connection required by the parking brake

minimum wheelbase/minimum supporting width min Ef necessary to fulfil the regulations

$$\min Ef = E \cdot (1 - PR/P + zferf \cdot h/E) / (1 - zferf / (fzul \cdot nf/ng))$$

min Ef = 4340 mm for E = 6400 mm

min Ef = 5269 mm for E = 8000 mm

- min Ef = minimum distance between front axle(s) (trailer) or support (semitrailer) and the rear axle(s) (resultant of the bogie)
- E = wheel base
- fzul = 0,80 maximum permissible frictional connection required
- zferf = 0,18 maximum required braking ratio of the parking brake
- h = 2300 mm height of center of gravity - laden
- PR = 24000 kg maximum bogie mass - laden
- P = 39000 kg maximum total mass - laden
- nf = 2 no. of axle(s) with TRISTOP spring brake actuators
- ng = 3 no. of bogie axle(s)

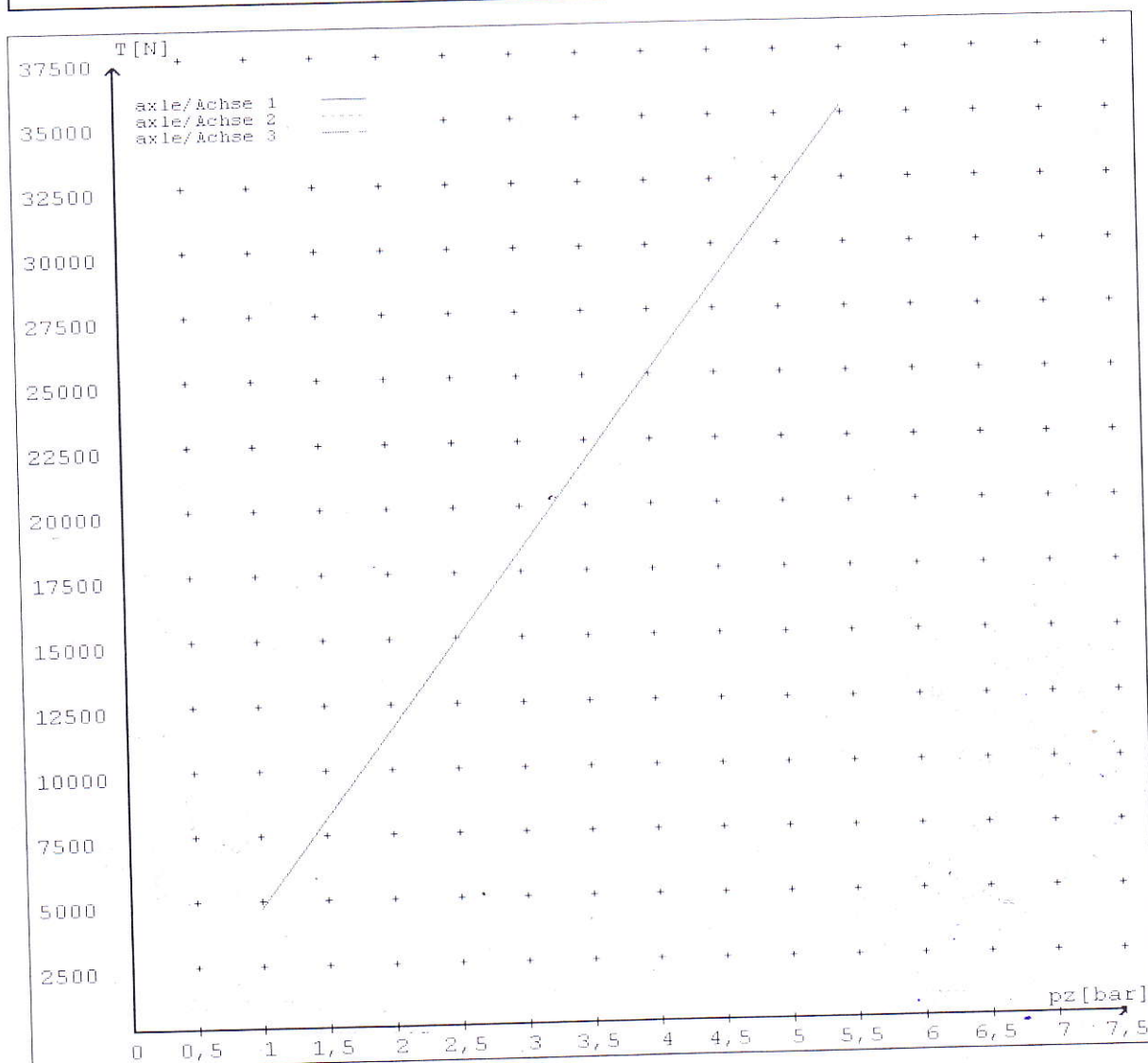
reference values

reference values for z = 45% for max rdyn: 517 mm

| | pz [bar] | T [N] | T [N] |
|--------|----------|-------|-------|
| axle 1 | 1,0 | | 4647 |
| | 5,5 | | 35285 |
| axle 2 | 1,0 | | 4647 |
| | 5,5 | | 35285 |
| axle 3 | 1,0 | | 4647 |
| | 5,5 | | 35285 |

VIN - no.:

| | Axle(s) / Achse(n) | | | | |
|---|--------------------|-------|-------|---|---|
| brake cylinder type (service / parking) Bremszylinder Typ (Betrieb / Fest) | 16/ | 16/16 | 16/16 | / | / |
| Maximum stroke smax = ...mm maximaler Hub smax = ...mm | 57 | 57 | 57 | | |
| Lever length = ...mm Hebellänge = ...mm | 76 | 76 | 76 | | |



print on WABCO no. 899 200 922 4 (only possible with laser printers!)

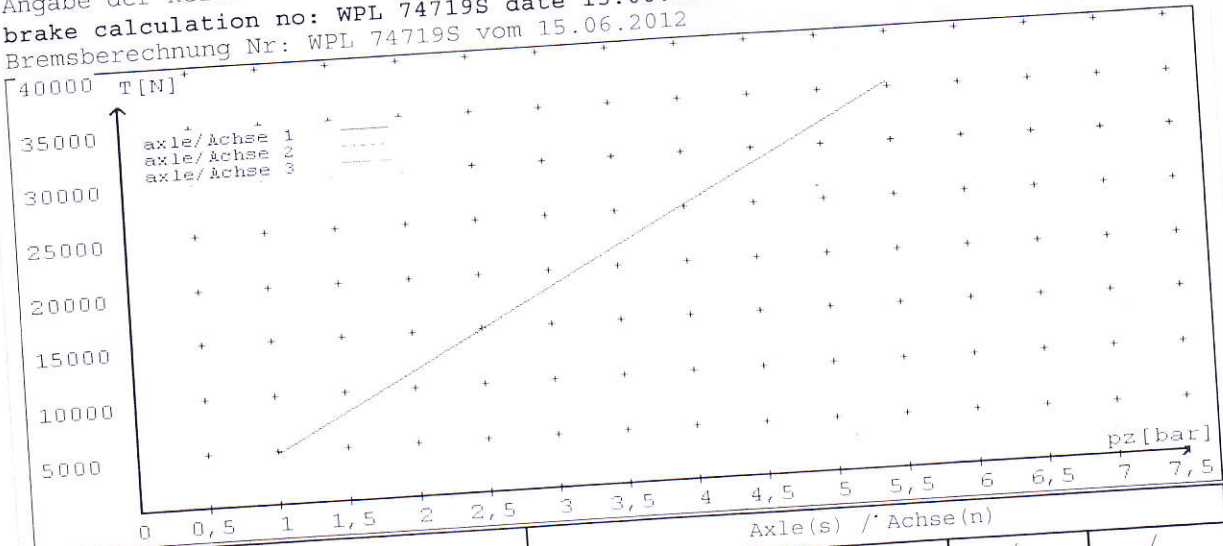
for max r_{dyn}: 517 mm
für max r_{dyn}: 517 mm

reference values for z = 0,45

Angabe der Referenzwerte für z = 0,45

brake calculation no: WPL 74719S date 15.06.2012

Bremsberechnung Nr: WPL 74719S vom 15.06.2012



| | Axle(s) / Achse(n) | | | | |
|---|--------------------|-------|-------|---|---|
| brake cylinder type (service / parking) Bremszylinder Typ (Betrieb / Fest) | 16/ | 16/16 | 16/16 | / | / |
| Maximum stroke s _{max} = ...mm maximaler Hub s _{max} = ...mm | 57 | 57 | 57 | | |
| Lever length = ...mm Hebellänge = ...mm | 76 | 76 | 76 | | |