

## Ermitteln der Nachziehlänge beim Biegen einer „Etage“ mit Tabellen

Mit den folgenden Tabellen können Sie die Nachziehlänge ohne eine aufwendige Berechnung ermitteln.

- Wählen Sie die Gradzahl ( 30°, 45° oder 60°) der Etage aus.
- Wählen Sie den Biegeradius des verwendeten Biegewerkzeuges in der oberen Zeile.
- Wählen Sie die Etagenhöhe aus der linken Spalte und gehen Sie in dieser Zeile nach rechts bis auf den verwendeten Biegeradius hier können Sie die erforderliche Nachziehlänge ablesen.

Beispiel: Etage 45°, Biegeradius 70, Etagenhöhe 100mm

| <b>Winkel</b>      |            | <b>45</b> |     |     |     |     |     |     |     |     |     |           |     |     |     |    |
|--------------------|------------|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|-----|-----|-----|----|
| <b>Biegeradius</b> |            | 20        | 25  | 30  | 36  | 40  | 45  | 50  | 55  | 60  | 65  | <b>70</b> | 75  | 80  | 85  | 90 |
| Etagenhöhe         | 5          |           |     |     |     |     |     |     |     |     |     |           |     |     |     |    |
|                    | 10         |           |     |     |     |     |     |     |     |     |     |           |     |     |     |    |
|                    | 15         |           |     |     |     |     |     |     |     |     |     |           |     |     |     |    |
|                    | 20         |           |     |     |     |     |     |     |     |     |     |           |     |     |     |    |
|                    | 25         | 19        | 15  | 11  | 6   |     |     |     |     |     |     |           |     |     |     |    |
|                    | 30         | 26        | 22  | 18  | 13  | 9   |     |     |     |     |     |           |     |     |     |    |
|                    | 35         | 33        | 29  | 25  | 20  | 16  | 12  | 8   |     |     |     |           |     |     |     |    |
|                    | 40         | 40        | 36  | 32  | 27  | 23  | 19  | 15  | 11  |     |     |           |     |     |     |    |
|                    | 45         | 47        | 43  | 39  | 34  | 31  | 26  | 22  | 18  | 14  |     |           |     |     |     |    |
|                    | 50         | 54        | 50  | 46  | 41  | 38  | 33  | 29  | 25  | 21  | 17  |           |     |     |     |    |
|                    | 55         | 61        | 57  | 53  | 48  | 45  | 41  | 36  | 32  | 28  | 24  | 20        |     |     |     |    |
|                    | 60         | 68        | 64  | 60  | 55  | 52  | 48  | 43  | 39  | 35  | 31  | 27        | 23  | 19  |     |    |
|                    | 65         | 75        | 71  | 67  | 62  | 59  | 55  | 51  | 46  | 42  | 38  | 34        | 30  | 26  | 22  | 17 |
|                    | 70         | 82        | 78  | 74  | 69  | 66  | 62  | 58  | 53  | 49  | 45  | 41        | 37  | 33  | 29  | 24 |
|                    | 75         | 89        | 85  | 81  | 76  | 73  | 69  | 65  | 61  | 56  | 52  | 48        | 44  | 40  | 36  | 32 |
|                    | 80         | 97        | 92  | 88  | 83  | 80  | 76  | 72  | 68  | 63  | 59  | 55        | 51  | 47  | 43  | 39 |
|                    | 85         | 104       | 99  | 95  | 90  | 87  | 83  | 79  | 75  | 71  | 66  | 62        | 58  | 54  | 50  | 46 |
|                    | 90         | 111       | 107 | 102 | 97  | 94  | 90  | 86  | 82  | 78  | 73  | 69        | 65  | 61  | 57  | 53 |
|                    | 95         | 118       | 114 | 109 | 105 | 101 | 97  | 93  | 89  | 85  | 81  | 76        | 72  | 68  | 64  | 60 |
|                    | <b>100</b> | 125       | 121 | 117 | 112 | 108 | 104 | 100 | 96  | 92  | 88  | <b>83</b> | 79  | 75  | 71  | 67 |
| 105                | 132        | 128       | 124 | 119 | 115 | 111 | 107 | 103 | 99  | 95  | 91  | 86        | 82  | 78  | 74  |    |
| 110                | 139        | 135       | 131 | 126 | 122 | 118 | 114 | 110 | 106 | 102 | 98  | 93        | 89  | 85  | 81  |    |
| 115                | 146        | 142       | 138 | 133 | 129 | 125 | 121 | 117 | 113 | 109 | 105 | 101       | 96  | 92  | 88  |    |
| 120                | 153        | 149       | 145 | 140 | 137 | 132 | 128 | 124 | 120 | 116 | 112 | 108       | 103 | 99  | 95  |    |
| 125                | 160        | 156       | 152 | 147 | 144 | 139 | 135 | 131 | 127 | 123 | 119 | 115       | 111 | 106 | 102 |    |
| 130                | 167        | 163       | 159 | 154 | 151 | 147 | 142 | 138 | 134 | 130 | 126 | 122       | 118 | 113 | 109 |    |

Die Nachziehlänge beträgt 83mm  
d.h. Sie müssen das Rohr nach dem 1. Bogen um 180° verdrehen und um 83mm verschieben.

30 Grad

| Winkel      |     | 30  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Biegeradius |     | 20  | 25  | 30  | 36  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 110 | 125 | 140 | 150 | 170 | 180 | 200 | 220 | 250 |  |
| Etagenhöhe  | 5   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 10  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 15  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 20  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 25  | 39  | 37  | 34  | 31  | 29  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 30  | 49  | 47  | 44  | 41  | 39  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 35  | 59  | 57  | 54  | 51  | 49  | 46  | 43  | 41  | 38  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 40  | 69  | 67  | 64  | 61  | 59  | 56  | 53  | 51  | 48  | 45  | 42  | 40  | 37  | 34  | 32  | 21  |     |     |     |     |     |     |     |     |  |
|             | 45  | 79  | 77  | 74  | 71  | 69  | 66  | 63  | 61  | 58  | 55  | 52  | 50  | 47  | 44  | 42  | 31  | 23  | 15  |     |     |     |     |     |     |  |
|             | 50  | 89  | 87  | 84  | 81  | 79  | 76  | 73  | 71  | 68  | 65  | 62  | 60  | 57  | 54  | 52  | 41  | 33  | 25  | 20  | 9   | 4   | -7  |     |     |  |
|             | 55  | 99  | 97  | 94  | 91  | 89  | 86  | 83  | 81  | 78  | 75  | 72  | 70  | 67  | 64  | 62  | 51  | 43  | 35  | 30  | 19  | 14  | 3   | -8  | -24 |  |
|             | 60  | 109 | 107 | 104 | 101 | 99  | 96  | 93  | 91  | 88  | 85  | 82  | 80  | 77  | 74  | 72  | 61  | 53  | 45  | 40  | 29  | 24  | 13  | 2   | -14 |  |
|             | 65  | 119 | 117 | 114 | 111 | 109 | 106 | 103 | 101 | 98  | 95  | 92  | 90  | 87  | 84  | 82  | 71  | 63  | 55  | 50  | 39  | 34  | 23  | 12  | -4  |  |
|             | 70  | 129 | 127 | 124 | 121 | 119 | 116 | 113 | 111 | 108 | 105 | 102 | 100 | 97  | 94  | 92  | 81  | 73  | 65  | 60  | 49  | 44  | 33  | 22  | 6   |  |
|             | 75  | 139 | 137 | 134 | 131 | 129 | 126 | 123 | 121 | 118 | 115 | 112 | 110 | 107 | 104 | 102 | 91  | 83  | 75  | 70  | 59  | 54  | 43  | 32  | 16  |  |
|             | 80  | 149 | 147 | 144 | 141 | 139 | 136 | 133 | 131 | 128 | 125 | 122 | 120 | 117 | 114 | 112 | 101 | 93  | 85  | 80  | 69  | 64  | 53  | 42  | 26  |  |
|             | 85  | 159 | 157 | 154 | 151 | 149 | 146 | 143 | 141 | 138 | 135 | 132 | 130 | 127 | 124 | 122 | 111 | 103 | 95  | 90  | 79  | 74  | 63  | 52  | 36  |  |
|             | 90  | 169 | 167 | 164 | 161 | 159 | 156 | 153 | 151 | 148 | 145 | 142 | 140 | 137 | 134 | 132 | 121 | 113 | 105 | 100 | 89  | 84  | 73  | 62  | 46  |  |
|             | 95  | 179 | 177 | 174 | 171 | 169 | 166 | 163 | 161 | 158 | 155 | 152 | 150 | 147 | 144 | 142 | 131 | 123 | 115 | 110 | 99  | 94  | 83  | 72  | 56  |  |
|             | 100 | 189 | 187 | 184 | 181 | 179 | 176 | 173 | 171 | 168 | 165 | 162 | 160 | 157 | 154 | 152 | 141 | 133 | 125 | 120 | 109 | 104 | 93  | 82  | 66  |  |
|             | 105 | 199 | 197 | 194 | 191 | 189 | 186 | 183 | 181 | 178 | 175 | 172 | 170 | 167 | 164 | 162 | 151 | 143 | 135 | 130 | 119 | 114 | 103 | 92  | 76  |  |
|             | 110 | 209 | 207 | 204 | 201 | 199 | 196 | 193 | 191 | 188 | 185 | 182 | 180 | 177 | 174 | 172 | 161 | 153 | 145 | 140 | 129 | 124 | 113 | 102 | 86  |  |
|             | 115 | 219 | 217 | 214 | 211 | 209 | 206 | 203 | 201 | 198 | 195 | 192 | 190 | 187 | 184 | 182 | 171 | 163 | 155 | 150 | 139 | 134 | 123 | 112 | 96  |  |
|             | 120 | 229 | 227 | 224 | 221 | 219 | 216 | 213 | 211 | 208 | 205 | 202 | 200 | 197 | 194 | 192 | 181 | 173 | 165 | 160 | 149 | 144 | 133 | 122 | 106 |  |
|             | 125 | 239 | 237 | 234 | 231 | 229 | 226 | 223 | 221 | 218 | 215 | 212 | 210 | 207 | 204 | 202 | 191 | 183 | 175 | 170 | 159 | 154 | 143 | 132 | 116 |  |
| 130         | 249 | 247 | 244 | 241 | 239 | 236 | 233 | 231 | 228 | 225 | 222 | 220 | 217 | 214 | 212 | 201 | 193 | 185 | 180 | 169 | 164 | 153 | 142 | 126 |     |  |
| 135         | 259 | 257 | 254 | 251 | 249 | 246 | 243 | 241 | 238 | 235 | 232 | 230 | 227 | 224 | 222 | 211 | 203 | 195 | 190 | 179 | 174 | 163 | 152 | 136 |     |  |
| 140         | 269 | 267 | 264 | 261 | 259 | 256 | 253 | 251 | 248 | 245 | 242 | 240 | 237 | 234 | 232 | 221 | 213 | 205 | 200 | 189 | 184 | 173 | 162 | 146 |     |  |
| 145         | 279 | 277 | 274 | 271 | 269 | 266 | 263 | 261 | 258 | 255 | 252 | 250 | 247 | 244 | 242 | 231 | 223 | 215 | 210 | 199 | 194 | 183 | 172 | 156 |     |  |
| 150         | 289 | 287 | 284 | 281 | 279 | 276 | 273 | 271 | 268 | 265 | 262 | 260 | 257 | 254 | 252 | 241 | 233 | 225 | 220 | 209 | 204 | 193 | 182 | 166 |     |  |
| 155         | 299 | 297 | 294 | 291 | 289 | 286 | 283 | 281 | 278 | 275 | 272 | 270 | 267 | 264 | 262 | 251 | 243 | 235 | 230 | 219 | 214 | 203 | 192 | 176 |     |  |
| 160         | 309 | 307 | 304 | 301 | 299 | 296 | 293 | 291 | 288 | 285 | 282 | 280 | 277 | 274 | 272 | 261 | 253 | 245 | 240 | 229 | 224 | 213 | 202 | 186 |     |  |
| 165         | 319 | 317 | 314 | 311 | 309 | 306 | 303 | 301 | 298 | 295 | 292 | 290 | 287 | 284 | 282 | 271 | 263 | 255 | 250 | 239 | 234 | 223 | 212 | 196 |     |  |
| 170         | 329 | 327 | 324 | 321 | 319 | 316 | 313 | 311 | 308 | 305 | 302 | 300 | 297 | 294 | 292 | 281 | 273 | 265 | 260 | 249 | 244 | 233 | 222 | 206 |     |  |
| 175         | 339 | 337 | 334 | 331 | 329 | 326 | 323 | 321 | 318 | 315 | 312 | 310 | 307 | 304 | 302 | 291 | 283 | 275 | 270 | 259 | 254 | 243 | 232 | 216 |     |  |
| 180         | 349 | 347 | 344 | 341 | 339 | 336 | 333 | 331 | 328 | 325 | 322 | 320 | 317 | 314 | 312 | 301 | 293 | 285 | 280 | 269 | 264 | 253 | 242 | 226 |     |  |
| 185         | 359 | 357 | 354 | 351 | 349 | 346 | 343 | 341 | 338 | 335 | 332 | 330 | 327 | 324 | 322 | 311 | 303 | 295 | 290 | 279 | 274 | 263 | 252 | 236 |     |  |
| 190         | 369 | 367 | 364 | 361 | 359 | 356 | 353 | 351 | 348 | 345 | 342 | 340 | 337 | 334 | 332 | 321 | 313 | 305 | 300 | 289 | 284 | 273 | 262 | 246 |     |  |
| 195         | 379 | 377 | 374 | 371 | 369 | 366 | 363 | 361 | 358 | 355 | 352 | 350 | 347 | 344 | 342 | 331 | 323 | 315 | 310 | 299 | 294 | 283 | 272 | 256 |     |  |
| 200         | 389 | 387 | 384 | 381 | 379 | 376 | 373 | 371 | 368 | 365 | 362 | 360 | 357 | 354 | 352 | 341 | 333 | 325 | 320 | 309 | 304 | 293 | 282 | 266 |     |  |
| 205         | 399 | 397 | 394 | 391 | 389 | 386 | 383 | 381 | 378 | 375 | 372 | 370 | 367 | 364 | 362 | 351 | 343 | 335 | 330 | 319 | 314 | 303 | 292 | 276 |     |  |
| 210         | 409 | 407 | 404 | 401 | 399 | 396 | 393 | 391 | 388 | 385 | 382 | 380 | 377 | 374 | 372 | 361 | 353 | 345 | 340 | 329 | 324 | 313 | 302 | 286 |     |  |
| 215         | 419 | 417 | 414 | 411 | 409 | 406 | 403 | 401 | 398 | 395 | 392 | 390 | 387 | 384 | 382 | 371 | 363 | 355 | 350 | 339 | 334 | 323 | 312 | 296 |     |  |
| 220         | 429 | 427 | 424 | 421 | 419 | 416 | 413 | 411 | 408 | 405 | 402 | 400 | 397 | 394 | 392 | 381 | 373 | 365 | 360 | 349 | 344 | 333 | 322 | 306 |     |  |
| 225         | 439 | 437 | 434 | 431 | 429 | 426 | 423 | 421 | 418 | 415 | 412 | 410 | 407 | 404 | 402 | 391 | 383 | 375 | 370 | 359 | 354 | 343 | 332 | 316 |     |  |
| 230         | 449 | 447 | 444 | 441 | 439 | 436 | 433 | 431 | 428 | 425 | 422 | 420 | 417 | 414 | 412 | 401 | 393 | 385 | 380 | 369 | 364 | 353 | 342 | 326 |     |  |
| 235         | 459 | 457 | 454 | 451 | 449 | 446 | 443 | 441 | 438 | 435 | 432 | 430 | 427 | 424 | 422 | 411 | 403 | 395 | 390 | 379 | 374 | 363 | 352 | 336 |     |  |
| 240         | 469 | 467 | 464 | 461 | 459 | 456 | 453 | 451 | 448 | 445 | 442 | 440 | 437 | 434 | 432 | 421 | 413 | 405 | 400 | 389 | 384 | 373 | 362 | 346 |     |  |
| 245         | 479 | 477 | 474 | 471 | 469 | 466 | 463 | 461 | 458 | 455 | 452 | 450 | 447 | 444 | 442 | 431 | 423 | 415 | 410 | 399 | 394 | 383 | 372 | 356 |     |  |
| 250         | 489 | 487 | 484 | 481 | 479 | 476 | 473 | 471 | 468 | 465 | 462 | 460 | 457 | 454 | 452 | 441 | 433 | 425 | 420 | 409 | 404 | 393 | 382 | 366 |     |  |

45 Grad

| Winkel      |     | 45  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Biegeradius |     | 20  | 25  | 30  | 36  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 110 | 125 | 140 | 150 | 170 | 180 | 200 | 220 | 250 |  |
| Etagenhöhe  | 5   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 10  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 15  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 20  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 25  | 19  | 15  | 11  | 6   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 30  | 26  | 22  | 18  | 13  | 9   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 35  | 33  | 29  | 25  | 20  | 16  | 12  | 8   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 40  | 40  | 36  | 32  | 27  | 23  | 19  | 15  | 11  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 45  | 47  | 43  | 39  | 34  | 31  | 26  | 22  | 18  | 14  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 50  | 54  | 50  | 46  | 41  | 38  | 33  | 29  | 25  | 21  | 17  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 55  | 61  | 57  | 53  | 48  | 45  | 41  | 36  | 32  | 28  | 24  | 20  |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 60  | 68  | 64  | 60  | 55  | 52  | 48  | 43  | 39  | 35  | 31  | 27  | 23  | 19  |     |     |     |     |     |     |     |     |     |     |     |  |
|             | 65  | 75  | 71  | 67  | 62  | 59  | 55  | 51  | 46  | 42  | 38  | 34  | 30  | 26  | 22  | 17  |     |     |     |     |     |     |     |     |     |  |
|             | 70  | 82  | 78  | 74  | 69  | 66  | 62  | 58  | 53  | 49  | 45  | 41  | 37  | 33  | 29  | 24  |     |     |     |     |     |     |     |     |     |  |
|             | 75  | 89  | 85  | 81  | 76  | 73  | 69  | 65  | 61  | 56  | 52  | 48  | 44  | 40  | 36  | 32  | 15  |     |     |     |     |     |     |     |     |  |
|             | 80  | 97  | 92  | 88  | 83  | 80  | 76  | 72  | 68  | 63  | 59  | 55  | 51  | 47  | 43  | 39  | 22  |     |     |     |     |     |     |     |     |  |
|             | 85  | 104 | 99  | 95  | 90  | 87  | 83  | 79  | 75  | 71  | 66  | 62  | 58  | 54  | 50  | 46  | 29  | 17  |     |     |     |     |     |     |     |  |
|             | 90  | 111 | 107 | 102 | 97  | 94  | 90  | 86  | 82  | 78  | 73  | 69  | 65  | 61  | 57  | 53  | 36  | 24  |     |     |     |     |     |     |     |  |
|             | 95  | 118 | 114 | 109 | 105 | 101 | 97  | 93  | 89  | 85  | 81  | 76  | 72  | 68  | 64  | 60  | 43  | 31  | 18  |     |     |     |     |     |     |  |
|             | 100 | 125 | 121 | 117 | 112 | 108 | 104 | 100 | 96  | 92  | 88  | 83  | 79  | 75  | 71  | 67  | 50  | 38  | 25  | 17  |     |     |     |     |     |  |
|             | 105 | 132 | 128 | 124 | 119 | 115 | 111 | 107 | 103 | 99  | 95  | 91  | 86  | 82  | 78  | 74  | 57  | 45  | 33  | 24  |     |     |     |     |     |  |
|             | 110 | 139 | 135 | 131 | 126 | 122 | 118 | 114 | 110 | 106 | 102 | 98  | 93  | 89  | 85  | 81  | 64  | 52  | 40  | 31  | 15  |     |     |     |     |  |
|             | 115 | 146 | 142 | 138 | 133 | 129 | 125 | 121 | 117 | 113 | 109 | 105 | 101 | 96  | 92  | 88  | 72  | 59  | 47  | 38  | 22  | 14  |     |     |     |  |
|             | 120 | 153 | 149 | 145 | 140 | 137 | 132 | 128 | 124 | 120 | 116 | 112 | 108 | 103 | 99  | 95  | 79  | 66  | 54  | 45  | 29  | 21  |     |     |     |  |
|             | 125 | 160 | 156 | 152 | 147 | 144 | 139 | 135 | 131 | 127 | 123 | 119 | 115 | 111 | 106 | 102 | 86  | 73  | 61  | 53  | 36  | 28  |     |     |     |  |
| 130         | 167 | 163 | 159 | 154 | 151 | 147 | 142 | 138 | 134 | 130 | 126 | 122 | 118 | 113 | 109 | 93  | 80  | 68  | 60  | 43  | 35  | 18  |     |     |     |  |
| 135         | 174 | 170 | 166 | 161 | 158 | 154 | 149 | 145 | 141 | 137 | 133 | 129 | 125 | 121 | 116 | 100 | 87  | 75  | 67  | 50  | 42  | 25  |     |     |     |  |
| 140         | 181 | 177 | 173 | 168 | 165 | 161 | 157 | 152 | 148 | 144 | 140 | 136 | 132 | 128 | 123 | 107 | 94  | 82  | 74  | 57  | 49  | 32  | 16  |     |     |  |
| 145         | 188 | 184 | 180 | 175 | 172 | 168 | 164 | 159 | 155 | 151 | 147 | 143 | 139 | 135 | 131 | 114 | 102 | 89  | 81  | 64  | 56  | 39  | 23  |     |     |  |
| 150         | 196 | 191 | 187 | 182 | 179 | 175 | 171 | 167 | 162 | 158 | 154 | 150 | 146 | 142 | 138 | 121 | 109 | 96  | 88  | 71  | 63  | 46  | 30  |     |     |  |
| 155         | 203 | 198 | 194 | 189 | 186 | 182 | 178 | 174 | 169 | 165 | 161 | 157 | 153 | 149 | 145 | 128 | 116 | 103 | 95  | 78  | 70  | 54  | 37  | 12  |     |  |
| 160         | 210 | 206 | 201 | 196 | 193 | 189 | 185 | 181 | 177 | 172 | 168 | 164 | 160 | 156 | 152 | 135 | 123 | 110 | 102 | 85  | 77  | 61  | 44  | 19  |     |  |
| 165         | 217 | 213 | 208 | 204 | 200 | 196 | 192 | 188 | 184 | 179 | 175 | 171 | 167 | 163 | 159 | 142 | 130 | 117 | 109 | 93  | 84  | 68  | 51  | 26  |     |  |
| 170         | 224 | 220 | 216 | 211 | 207 | 203 | 199 | 195 | 191 | 187 | 182 | 178 | 174 | 170 | 166 | 149 | 137 | 124 | 116 | 100 | 91  | 75  | 58  | 33  |     |  |
| 175         | 231 | 227 | 223 | 218 | 214 | 210 | 206 | 202 | 198 | 194 | 189 | 185 | 181 | 177 | 173 | 156 | 144 | 132 | 123 | 107 | 98  | 82  | 65  | 40  |     |  |
| 180         | 238 | 234 | 230 | 225 | 221 | 217 | 213 | 209 | 205 | 201 | 197 | 192 | 188 | 184 | 180 | 163 | 151 | 139 | 130 | 114 | 105 | 89  | 72  | 47  |     |  |
| 185         | 245 | 241 | 237 | 232 | 228 | 224 | 220 | 216 | 212 | 208 | 204 | 199 | 195 | 191 | 187 | 171 | 158 | 146 | 137 | 121 | 113 | 96  | 79  | 55  |     |  |
| 190         | 252 | 248 | 244 | 239 | 236 | 231 | 227 | 223 | 219 | 215 | 211 | 207 | 202 | 198 | 194 | 178 | 165 | 153 | 144 | 128 | 120 | 103 | 86  | 62  |     |  |
| 195         | 259 | 255 | 251 | 246 | 243 | 238 | 234 | 230 | 226 | 222 | 218 | 214 | 209 | 205 | 201 | 185 | 172 | 160 | 152 | 135 | 127 | 110 | 94  | 69  |     |  |
| 200         | 266 | 262 | 258 | 253 | 250 | 246 | 241 | 237 | 233 | 229 | 225 | 221 | 217 | 212 | 208 | 192 | 179 | 167 | 159 | 142 | 134 | 117 | 101 | 76  |     |  |
| 205         | 273 | 269 | 265 | 260 | 257 | 253 | 248 | 244 | 240 | 236 | 232 | 228 | 224 | 219 | 215 | 199 | 186 | 174 | 166 | 149 | 141 | 124 | 108 | 83  |     |  |
| 210         | 280 | 276 | 272 | 267 | 264 | 260 | 256 | 251 | 247 | 243 | 239 | 235 | 231 | 227 | 222 | 206 | 193 | 181 | 173 | 156 | 148 | 131 | 115 | 90  |     |  |
| 215         | 287 | 283 | 279 | 274 | 271 | 267 | 263 | 258 | 254 | 250 | 246 | 242 | 238 | 234 | 229 | 213 | 201 | 188 | 180 | 163 | 155 | 138 | 122 | 97  |     |  |
| 220         | 295 | 290 | 286 | 281 | 278 | 274 | 270 | 266 | 261 | 257 | 253 | 249 | 245 | 241 | 237 | 220 | 208 | 195 | 187 | 170 | 162 | 145 | 129 | 104 |     |  |
| 225         | 302 | 297 | 293 | 288 | 285 | 281 | 277 | 273 | 268 | 264 | 260 | 256 | 252 | 248 | 244 | 227 | 215 | 202 | 194 | 177 | 169 | 153 | 136 | 111 |     |  |
| 230         | 309 | 305 | 300 | 295 | 292 | 288 | 284 | 280 | 276 | 271 | 267 | 263 | 259 | 255 | 251 | 234 | 222 | 209 | 201 | 184 | 176 | 160 | 143 | 118 |     |  |
| 235         | 316 | 312 | 307 | 303 | 299 | 295 | 291 | 287 | 283 | 278 | 274 | 270 | 266 | 262 | 258 | 241 | 229 | 216 | 208 | 192 | 183 | 167 | 150 | 125 |     |  |
| 240         | 323 | 319 | 315 | 310 | 306 | 302 | 298 | 294 | 290 | 286 | 281 | 277 | 273 | 269 | 265 | 248 | 236 | 223 | 215 | 199 | 190 | 174 | 157 | 132 |     |  |
| 245         | 330 | 326 | 322 | 317 | 313 | 309 | 305 | 301 | 297 | 293 | 288 | 284 | 280 | 276 | 272 | 255 | 243 | 231 | 222 | 206 | 197 | 181 | 164 | 139 |     |  |
| 250         | 337 | 333 | 329 | 324 | 320 | 316 | 312 | 308 | 304 | 300 | 296 | 291 | 287 | 283 | 279 | 262 | 250 | 238 | 229 | 213 | 204 | 188 | 171 | 146 |     |  |

60 Grad

| Winkel      |     | 60  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Biegeradius |     | 20  | 25  | 30  | 36  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 110 | 125 | 140 | 150 | 170 | 180 | 200 | 220 | 250 |  |
| Etagenhöhe  | 30  | 12  | 6   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 35          | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 40          | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 45          | 29  | 23  | 17  | 10  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 50          | 35  | 29  | 23  | 16  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 55          | 40  | 35  | 29  | 22  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 60          | 46  | 40  | 35  | 28  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 65          | 52  | 46  | 40  | 33  | 29  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 70          | 58  | 52  | 46  | 39  | 35  | 29  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 75          | 64  | 58  | 52  | 45  | 40  | 35  | 29  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 80          | 69  | 64  | 58  | 51  | 46  | 40  | 35  | 29  | 23  | 17  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 85          | 75  | 69  | 64  | 57  | 52  | 46  | 40  | 35  | 29  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 90          | 81  | 75  | 69  | 62  | 58  | 52  | 46  | 40  | 35  | 29  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |     |  |
| 95          | 87  | 81  | 75  | 68  | 64  | 58  | 52  | 46  | 40  | 35  | 29  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |     |  |
| 100         | 92  | 87  | 81  | 74  | 69  | 64  | 58  | 52  | 46  | 40  | 35  | 29  | 23  | 17  | 12  |     |     |     |     |     |     |     |     |     |     |  |
| 105         | 98  | 92  | 87  | 80  | 75  | 69  | 64  | 58  | 52  | 46  | 40  | 35  | 29  | 23  | 17  |     |     |     |     |     |     |     |     |     |     |  |
| 110         | 104 | 98  | 92  | 85  | 81  | 75  | 69  | 64  | 58  | 52  | 46  | 40  | 35  | 29  | 23  |     |     |     |     |     |     |     |     |     |     |  |
| 115         | 110 | 104 | 98  | 91  | 87  | 81  | 75  | 69  | 64  | 58  | 52  | 46  | 40  | 35  | 29  |     |     |     |     |     |     |     |     |     |     |  |
| 120         | 115 | 110 | 104 | 97  | 92  | 87  | 81  | 75  | 69  | 64  | 58  | 52  | 46  | 40  | 35  |     |     |     |     |     |     |     |     |     |     |  |
| 125         | 121 | 115 | 110 | 103 | 98  | 92  | 87  | 81  | 75  | 69  | 64  | 58  | 52  | 46  | 40  | 17  |     |     |     |     |     |     |     |     |     |  |
| 130         | 127 | 121 | 115 | 109 | 104 | 98  | 92  | 87  | 81  | 75  | 69  | 64  | 58  | 52  | 46  | 23  |     |     |     |     |     |     |     |     |     |  |
| 135         | 133 | 127 | 121 | 114 | 110 | 104 | 98  | 92  | 87  | 81  | 75  | 69  | 64  | 58  | 52  | 29  |     |     |     |     |     |     |     |     |     |  |
| 140         | 139 | 133 | 127 | 120 | 115 | 110 | 104 | 98  | 92  | 87  | 81  | 75  | 69  | 64  | 58  | 35  | 17  |     |     |     |     |     |     |     |     |  |
| 145         | 144 | 139 | 133 | 126 | 121 | 115 | 110 | 104 | 98  | 92  | 87  | 81  | 75  | 69  | 64  | 40  | 23  |     |     |     |     |     |     |     |     |  |
| 150         | 150 | 144 | 139 | 132 | 127 | 121 | 115 | 110 | 104 | 98  | 92  | 87  | 81  | 75  | 69  | 46  | 29  |     |     |     |     |     |     |     |     |  |
| 155         | 156 | 150 | 144 | 137 | 133 | 127 | 121 | 115 | 110 | 104 | 98  | 92  | 87  | 81  | 75  | 52  | 35  | 17  |     |     |     |     |     |     |     |  |
| 160         | 162 | 156 | 150 | 143 | 139 | 133 | 127 | 121 | 115 | 110 | 104 | 98  | 92  | 87  | 81  | 58  | 40  | 23  |     |     |     |     |     |     |     |  |
| 165         | 167 | 162 | 156 | 149 | 144 | 139 | 133 | 127 | 121 | 115 | 110 | 104 | 98  | 92  | 87  | 64  | 46  | 29  |     |     |     |     |     |     |     |  |
| 170         | 173 | 167 | 162 | 155 | 150 | 144 | 139 | 133 | 127 | 121 | 115 | 110 | 104 | 98  | 92  | 69  | 52  | 35  |     |     |     |     |     |     |     |  |
| 175         | 179 | 173 | 167 | 161 | 156 | 150 | 144 | 139 | 133 | 127 | 121 | 115 | 110 | 104 | 98  | 75  | 58  | 40  | 29  |     |     |     |     |     |     |  |
| 180         | 185 | 179 | 173 | 166 | 162 | 156 | 150 | 144 | 139 | 133 | 127 | 121 | 115 | 110 | 104 | 81  | 64  | 46  | 35  |     |     |     |     |     |     |  |
| 185         | 191 | 185 | 179 | 172 | 167 | 162 | 156 | 150 | 144 | 139 | 133 | 127 | 121 | 115 | 110 | 87  | 69  | 52  | 40  |     |     |     |     |     |     |  |
| 190         | 196 | 191 | 185 | 178 | 173 | 167 | 162 | 156 | 150 | 144 | 139 | 133 | 127 | 121 | 115 | 92  | 75  | 58  | 46  | 23  |     |     |     |     |     |  |
| 195         | 202 | 196 | 191 | 184 | 179 | 173 | 167 | 162 | 156 | 150 | 144 | 139 | 133 | 127 | 121 | 98  | 81  | 64  | 52  | 29  |     |     |     |     |     |  |
| 200         | 208 | 202 | 196 | 189 | 185 | 179 | 173 | 167 | 162 | 156 | 150 | 144 | 139 | 133 | 127 | 104 | 87  | 69  | 58  | 35  |     |     |     |     |     |  |
| 205         | 214 | 208 | 202 | 195 | 191 | 185 | 179 | 173 | 167 | 162 | 156 | 150 | 144 | 139 | 133 | 110 | 92  | 75  | 64  | 40  | 29  |     |     |     |     |  |
| 210         | 219 | 214 | 208 | 201 | 196 | 191 | 185 | 179 | 173 | 167 | 162 | 156 | 150 | 144 | 139 | 115 | 98  | 81  | 69  | 46  | 35  |     |     |     |     |  |
| 215         | 225 | 219 | 214 | 207 | 202 | 196 | 191 | 185 | 179 | 173 | 167 | 162 | 156 | 150 | 144 | 121 | 104 | 87  | 75  | 52  | 40  |     |     |     |     |  |
| 220         | 231 | 225 | 219 | 212 | 208 | 202 | 196 | 191 | 185 | 179 | 173 | 167 | 162 | 156 | 150 | 127 | 110 | 92  | 81  | 58  | 46  | 23  |     |     |     |  |
| 225         | 237 | 231 | 225 | 218 | 214 | 208 | 202 | 196 | 191 | 185 | 179 | 173 | 167 | 162 | 156 | 133 | 115 | 98  | 87  | 64  | 52  | 29  |     |     |     |  |
| 230         | 242 | 237 | 231 | 224 | 219 | 214 | 208 | 202 | 196 | 191 | 185 | 179 | 173 | 167 | 162 | 139 | 121 | 104 | 92  | 69  | 58  | 35  |     |     |     |  |
| 235         | 248 | 242 | 237 | 230 | 225 | 219 | 214 | 208 | 202 | 196 | 191 | 185 | 179 | 173 | 167 | 144 | 127 | 110 | 98  | 75  | 64  | 40  |     |     |     |  |
| 240         | 254 | 248 | 242 | 236 | 231 | 225 | 219 | 214 | 208 | 202 | 196 | 191 | 185 | 179 | 173 | 150 | 133 | 115 | 104 | 81  | 69  | 46  | 23  |     |     |  |
| 245         | 260 | 254 | 248 | 241 | 237 | 231 | 225 | 219 | 214 | 208 | 202 | 196 | 191 | 185 | 179 | 156 | 139 | 121 | 110 | 87  | 75  | 52  | 29  |     |     |  |
| 250         | 266 | 260 | 254 | 247 | 242 | 237 | 231 | 225 | 219 | 214 | 208 | 202 | 196 | 191 | 185 | 162 | 144 | 127 | 115 | 92  | 81  | 58  | 35  |     |     |  |

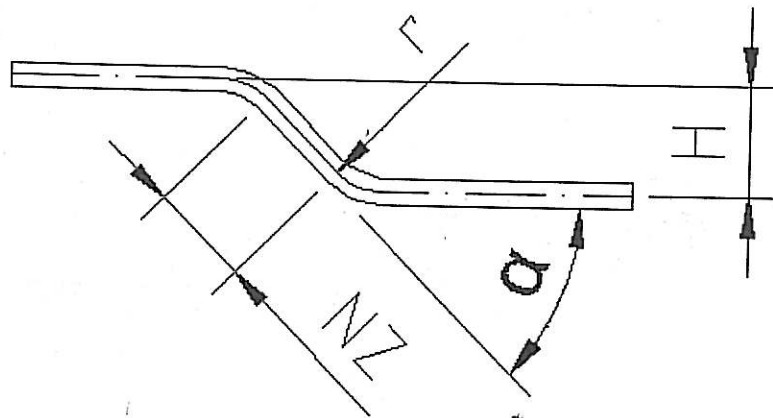
## Berechnung der Nachziehlänge beim Biegen einer „Etage“

$$\text{Nachziehlänge} = \frac{H - 2 * r(1 - \cos \alpha)}{\sin \alpha}$$

H = gewünschte Etagenhöhe

r = Radius des Biegewerkzeuges

$\alpha$  = erforderlicher Etagenwinkel



Beispielrechnung:

Biegeradius = 70mm

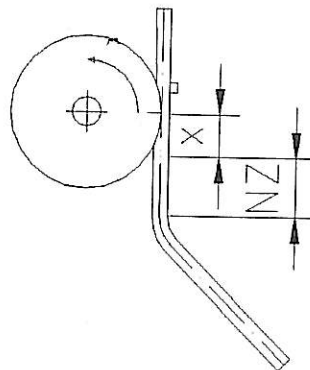
Etagenwinkel = 40°

Etagenhöhe = 120mm

Gesucht NZ = Nachziehlänge ( Maß von Bogenende bis Bogenanfang )

$$NZ = \frac{120 - 2 * 70 * (1 - \cos 40)}{\sin 40} = \frac{120 - 140 * 0,234}{0,6428} \rightarrow NZ = 136\text{mm}$$

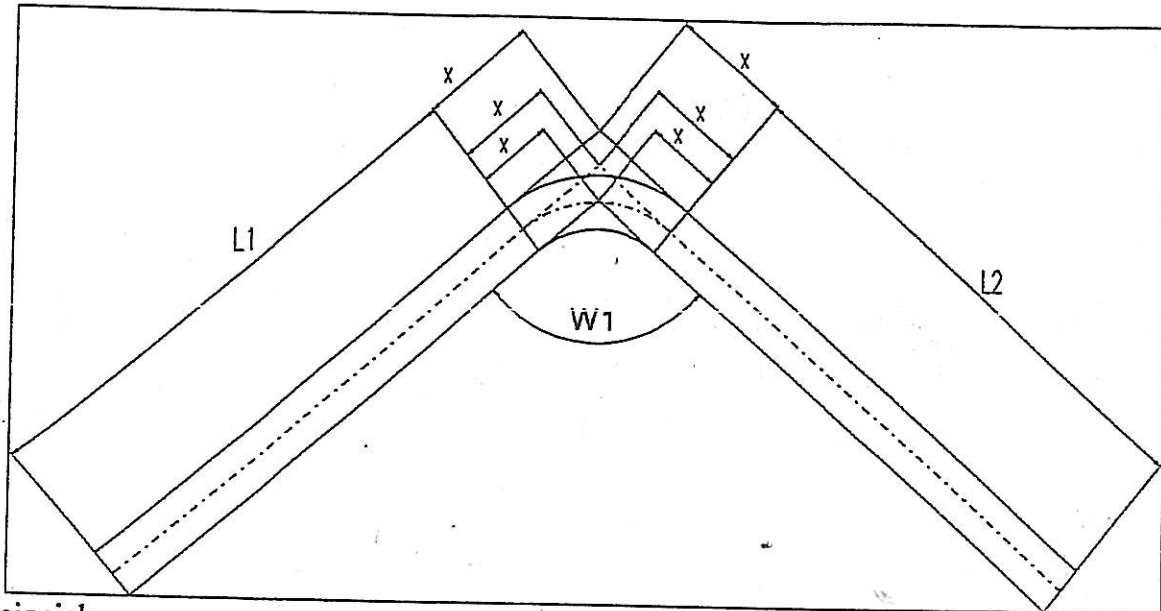
Wenn Sie das Rohr nach dem 1 Bogen nicht im Werkzeug weiter schieben sondern von hinten erneut aufstecken benutzen Sie bitte zusätzlich die folgende Formel.



$$x = \frac{r * 2 * \pi * \alpha}{360} + NZ$$

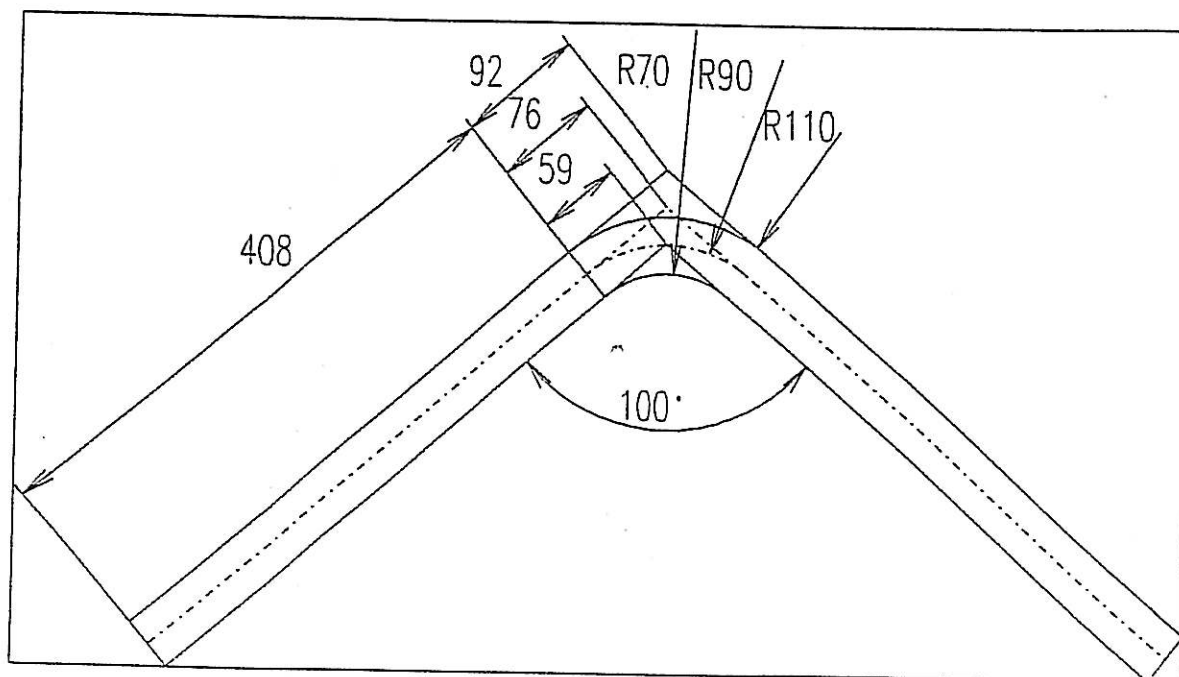
## Berechnungstabelle

Mit der Berechnungstabelle kann das Schenkelmaß X der Rohrbogen ermittelt werden. Das Schenkelmaß X ist abhängig vom Biegeradius und Winkel W1.



Beispiel:

Musterbogen: Rohr 40 mm  
mittlere Biegeradius 90 mm



### Berechnungstabelle

| Winkel | Radius |      |     |     |     |     |     |      |      |      |      |      |      |      |      |      |
|--------|--------|------|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|
|        | 10     | 15   | 20  | 25  | 30  | 35  | 40  | 45   | 50   | 55   | 56   | 60   | 65   | 68   | 70   | 75   |
| 5      | 229    | 344  | 458 | 573 | 687 | 802 | 916 | 1031 | 1145 | 1260 | 1286 | 1374 | 1489 | 1568 | 1603 | 1718 |
| 10     | 114    | 171  | 229 | 286 | 343 | 400 | 457 | 514  | 572  | 629  | 642  | 686  | 743  | 782  | 800  | 857  |
| 15     | 76     | 114  | 152 | 190 | 228 | 266 | 304 | 342  | 380  | 418  | 427  | 456  | 494  | 520  | 532  | 570  |
| 20     | 57     | 85   | 113 | 142 | 170 | 198 | 227 | 255  | 284  | 312  | 318  | 340  | 369  | 388  | 397  | 425  |
| 25     | 45     | 68   | 90  | 113 | 135 | 158 | 180 | 203  | 226  | 248  | 253  | 271  | 293  | 309  | 316  | 338  |
| 30     | 37     | 56   | 75  | 93  | 112 | 131 | 149 | 168  | 187  | 205  | 210  | 224  | 243  | 255  | 261  | 280  |
| 35     | 32     | 48   | 63  | 79  | 95  | 111 | 127 | 143  | 159  | 174  | 178  | 190  | 206  | 217  | 222  | 238  |
| 40     | 27     | 41   | 55  | 69  | 82  | 96  | 110 | 124  | 137  | 151  | 154  | 165  | 179  | 188  | 192  | 206  |
| 45     | 24     | 36   | 48  | 60  | 72  | 84  | 97  | 109  | 121  | 133  | 136  | 145  | 157  | 165  | 169  | 181  |
| 50     | 21     | 32   | 43  | 54  | 64  | 75  | 86  | 97   | 107  | 118  | 120  | 129  | 139  | 147  | 150  | 161  |
| 55     | 19     | 29   | 38  | 48  | 58  | 67  | 77  | 86   | 96   | 106  | 108  | 115  | 125  | 131  | 134  | 144  |
| 60     | 17     | 26   | 35  | 43  | 52  | 61  | 69  | 78   | 87   | 95   | 97   | 104  | 113  | 119  | 121  | 130  |
| 65     | 16     | 24   | 31  | 39  | 47  | 55  | 63  | 71   | 78   | 86   | 88   | 94   | 102  | 107  | 110  | 118  |
| 70     | 14     | 21   | 29  | 36  | 43  | 50  | 57  | 64   | 71   | 79   | 80   | 86   | 93   | 98   | 100  | 107  |
| 75     | 13     | 20   | 26  | 33  | 39  | 46  | 52  | 59   | 65   | 72   | 73   | 78   | 85   | 89   | 91   | 98   |
| 80     | 12     | 18   | 24  | 30  | 36  | 42  | 48  | 54   | 60   | 66   | 67   | 72   | 77   | 82   | 83   | 89   |
| 85     | 11     | 16   | 22  | 27  | 33  | 38  | 44  | 49   | 55   | 60   | 61   | 65   | 71   | 75   | 76   | 82   |
| 90     | 10     | 15   | 20  | 25  | 30  | 35  | 40  | 45   | 50   | 55   | 56   | 60   | 65   | 68   | 70   | 75   |
| 95     | 9      | 14   | 18  | 23  | 27  | 32  | 37  | 41   | 46   | 50   | 51   | 55   | 60   | 63   | 64   | 69   |
| 100    | 8      | 13   | 17  | 21  | 25  | 29  | 34  | 38   | 42   | 46   | 47   | 50   | 55   | 57   | 59   | 63   |
| 105    | 8      | 12   | 15  | 19  | 23  | 27  | 31  | 35   | 38   | 42   | 43   | 46   | 50   | 53   | 54   | 58   |
| 110    | 7      | 11   | 14  | 18  | 21  | 25  | 28  | 32   | 35   | 39   | 39   | 42   | 46   | 48   | 49   | 53   |
| 115    | 6      | 10   | 13  | 16  | 19  | 22  | 25  | 29   | 32   | 35   | 36   | 38   | 41   | 44   | 45   | 48   |
| 120    | 6      | 9    | 12  | 14  | 17  | 20  | 23  | 26   | 29   | 32   | 32   | 35   | 38   | 40   | 40   | 43   |
| 125    | 5      | 8    | 10  | 13  | 16  | 18  | 21  | 23   | 26   | 29   | 29   | 31   | 34   | 36   | 36   | 39   |
| 130    | 5      | 7    | 9   | 12  | 14  | 16  | 19  | 21   | 23   | 26   | 26   | 28   | 30   | 32   | 33   | 35   |
| 135    | 4      | 6    | 8   | 10  | 12  | 14  | 17  | 19   | 21   | 23   | 23   | 25   | 27   | 28   | 29   | 31   |
| 140    | 4      | 5    | 7   | 9   | 11  | 13  | 15  | 16   | 18   | 20   | 20   | 22   | 24   | 25   | 25   | 27   |
| 145    | 3      | 5    | 6   | 8   | 9   | 11  | 13  | 14   | 16   | 17   | 18   | 19   | 20   | 22   | 22   | 24   |
| 150    | 3      | 4    | 5   | 7   | 8   | 9   | 11  | 12   | 13   | 15   | 15   | 16   | 17   | 18   | 19   | 20   |
| 155    | 2      | 3    | 4   | 6   | 7   | 8   | 9   | 10   | 11   | 12   | 12   | 13   | 14   | 15   | 16   | 17   |
| 160    | 2      | 3    | 4   | 4   | 5   | 6   | 7   | 8    | 9    | 10   | 10   | 11   | 11   | 12   | 12   | 13   |
| 165    | 1      | 2    | 3   | 3   | 4   | 5   | 5   | 6    | 7    | 7    | 7    | 8    | 9    | 9    | 9    | 10   |
| 170    | 1      | 1    | 2   | 2   | 3   | 3   | 3   | 4    | 4    | 5    | 5    | 5    | 6    | 6    | 6    | 7    |
| 175    | 0      | 1    | 1   | 1   | 1   | 2   | 2   | 2    | 2    | 2    | 2    | 3    | 3    | 3    | 3    | 3    |
| Radius | 10     | 15   | 20  | 25  | 30  | 35  | 40  | 45   | 50   | 55   | 56   | 60   | 65   | 68   | 70   | 75   |
| Kreis  | 62,8   | 94,2 | 126 | 157 | 188 | 220 | 251 | 283  | 314  | 346  | 353  | 377  | 408  | 430  | 440  | 471  |

### Berechnungstabelle

| Winkel | Radius |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|        | 80     | 85   | 87   | 90   | 95   | 100  | 105  | 110  | 111  | 115  | 120  | 125  | 130  | 135  | 140  |
| 5      | 1832   | 1947 | 1989 | 2061 | 2176 | 2290 | 2405 | 2519 | 2547 | 2634 | 2748 | 2863 | 2977 | 3092 | 3207 |
| 10     | 914    | 972  | 993  | 1029 | 1086 | 1143 | 1200 | 1257 | 1271 | 1314 | 1372 | 1429 | 1486 | 1543 | 1600 |
| 15     | 608    | 646  | 660  | 684  | 722  | 760  | 798  | 836  | 845  | 874  | 911  | 949  | 987  | 1025 | 1063 |
| 20     | 454    | 482  | 493  | 510  | 539  | 567  | 595  | 624  | 631  | 652  | 681  | 709  | 737  | 766  | 794  |
| 25     | 361    | 383  | 392  | 406  | 429  | 451  | 474  | 496  | 502  | 519  | 541  | 564  | 586  | 609  | 631  |
| 30     | 299    | 317  | 324  | 336  | 355  | 373  | 392  | 411  | 415  | 429  | 448  | 467  | 485  | 504  | 522  |
| 35     | 254    | 270  | 275  | 285  | 301  | 317  | 333  | 349  | 353  | 365  | 381  | 396  | 412  | 428  | 444  |
| 40     | 220    | 234  | 239  | 247  | 261  | 275  | 288  | 302  | 306  | 316  | 330  | 343  | 357  | 371  | 385  |
| 45     | 193    | 205  | 210  | 217  | 229  | 241  | 253  | 266  | 268  | 278  | 290  | 302  | 314  | 326  | 338  |
| 50     | 172    | 182  | 186  | 193  | 204  | 214  | 225  | 236  | 238  | 247  | 257  | 268  | 279  | 290  | 300  |
| 55     | 154    | 163  | 167  | 173  | 182  | 192  | 202  | 211  | 214  | 221  | 231  | 240  | 250  | 259  | 269  |
| 60     | 139    | 147  | 150  | 156  | 165  | 173  | 182  | 191  | 193  | 199  | 208  | 217  | 225  | 234  | 242  |
| 65     | 126    | 133  | 136  | 141  | 149  | 157  | 165  | 173  | 175  | 181  | 188  | 196  | 204  | 212  | 220  |
| 70     | 114    | 121  | 124  | 129  | 136  | 143  | 150  | 157  | 159  | 164  | 171  | 179  | 186  | 193  | 200  |
| 75     | 104    | 111  | 113  | 117  | 124  | 130  | 137  | 143  | 145  | 150  | 156  | 163  | 169  | 176  | 182  |
| 80     | 95     | 101  | 104  | 107  | 113  | 119  | 125  | 131  | 133  | 137  | 143  | 149  | 155  | 161  | 167  |
| 85     | 87     | 93   | 95   | 98   | 104  | 109  | 115  | 120  | 121  | 126  | 131  | 136  | 142  | 147  | 153  |
| 90     | 80     | 85   | 87   | 90   | 95   | 100  | 105  | 110  | 111  | 115  | 120  | 125  | 130  | 135  | 140  |
| 95     | 73     | 78   | 80   | 82   | 87   | 92   | 96   | 101  | 102  | 105  | 110  | 115  | 119  | 124  | 128  |
| 100    | 67     | 71   | 73   | 76   | 80   | 84   | 88   | 92   | 93   | 96   | 101  | 105  | 109  | 113  | 117  |
| 105    | 61     | 65   | 67   | 69   | 73   | 77   | 81   | 84   | 85   | 88   | 92   | 96   | 100  | 104  | 107  |
| 110    | 56     | 60   | 61   | 63   | 67   | 70   | 74   | 77   | 78   | 81   | 84   | 88   | 91   | 95   | 98   |
| 115    | 51     | 54   | 55   | 57   | 61   | 64   | 67   | 70   | 71   | 73   | 76   | 80   | 83   | 86   | 89   |
| 120    | 46     | 49   | 50   | 52   | 55   | 58   | 61   | 64   | 64   | 66   | 69   | 72   | 75   | 78   | 81   |
| 125    | 42     | 44   | 45   | 47   | 49   | 52   | 55   | 57   | 58   | 60   | 62   | 65   | 68   | 70   | 73   |
| 130    | 37     | 40   | 40   | 42   | 44   | 47   | 49   | 51   | 52   | 54   | 56   | 58   | 61   | 63   | 65   |
| 135    | 33     | 35   | 36   | 37   | 39   | 41   | 43   | 46   | 46   | 48   | 50   | 52   | 54   | 56   | 58   |
| 140    | 29     | 31   | 32   | 33   | 35   | 36   | 38   | 40   | 40   | 42   | 44   | 45   | 47   | 49   | 51   |
| 145    | 25     | 27   | 27   | 28   | 30   | 32   | 33   | 35   | 35   | 36   | 38   | 39   | 41   | 43   | 44   |
| 150    | 21     | 23   | 23   | 24   | 25   | 27   | 28   | 29   | 30   | 31   | 32   | 33   | 35   | 36   | 38   |
| 155    | 18     | 19   | 19   | 20   | 21   | 22   | 23   | 24   | 25   | 25   | 27   | 28   | 29   | 30   | 31   |
| 160    | 14     | 15   | 15   | 16   | 17   | 18   | 19   | 19   | 20   | 20   | 21   | 22   | 23   | 24   | 25   |
| 165    | 11     | 11   | 11   | 12   | 13   | 13   | 14   | 14   | 15   | 15   | 16   | 16   | 17   | 18   | 18   |
| 170    | 7      | 7    | 8    | 8    | 8    | 9    | 9    | 10   | 10   | 10   | 10   | 11   | 11   | 12   | 12   |
| 175    | 3      | 4    | 4    | 4    | 4    | 4    | 5    | 5    | 5    | 5    | 5    | 5    | 6    | 6    | 6    |
| Radius | 80     | 85   | 87   | 90   | 95   | 100  | 105  | 110  | 111  | 115  | 120  | 125  | 130  | 135  | 140  |
| Kreis  | 503    | 534  | 546  | 566  | 597  | 628  | 660  | 691  | 699  | 723  | 754  | 785  | 817  | 848  | 880  |



### Berechnungstabelle

| Radius        |            |            |            |            |            |            |            |            |            |            |            |            |            |  |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--|
| Winkel        | 145        | 150        | 155        | 160        | 165        | 170        | 175        | 180        | 190        | 200        | 210        | 220        | 203        |  |
| 5             | 3321       | 3436       | 3550       | 3665       | 3779       | 3894       | 4008       | 4123       | 4352       | 4581       | 4810       | 5039       | 4649       |  |
| 10            | 1657       | 1715       | 1772       | 1829       | 1886       | 1943       | 2000       | 2057       | 2172       | 2286       | 2400       | 2515       | 2320       |  |
| 15            | 1101       | 1139       | 1177       | 1215       | 1253       | 1291       | 1329       | 1367       | 1443       | 1519       | 1595       | 1671       | 1542       |  |
| 20            | 822        | 851        | 879        | 907        | 936        | 964        | 992        | 1021       | 1078       | 1134       | 1191       | 1248       | 1151       |  |
| 25            | 654        | 677        | 699        | 722        | 744        | 767        | 789        | 812        | 857        | 902        | 947        | 992        | 916        |  |
| 30            | 541        | 560        | 578        | 597        | 616        | 634        | 653        | 672        | 709        | 746        | 784        | 821        | 758        |  |
| 35            | 460        | 476        | 492        | 507        | 523        | 539        | 555        | 571        | 603        | 634        | 666        | 698        | 644        |  |
| 40            | 398        | 412        | 426        | 440        | 453        | 467        | 481        | 495        | 522        | 549        | 577        | 604        | 558        |  |
| 45            | 350        | 362        | 374        | 386        | 398        | 410        | 422        | 435        | 459        | 483        | 507        | 531        | 490        |  |
| 50            | 311        | 322        | 332        | 343        | 354        | 365        | 375        | 386        | 407        | 429        | 450        | 472        | 435        |  |
| 55            | 279        | 288        | 298        | 307        | 317        | 327        | 336        | 346        | 365        | 384        | 403        | 423        | 390        |  |
| 60            | 251        | 260        | 268        | 277        | 286        | 294        | 303        | 312        | 329        | 346        | 364        | 381        | 352        |  |
| 65            | 228        | 235        | 243        | 251        | 259        | 267        | 275        | 283        | 298        | 314        | 330        | 345        | 319        |  |
| 70            | 207        | 214        | 221        | 229        | 236        | 243        | 250        | 257        | 271        | 286        | 300        | 314        | 290        |  |
| 75            | 189        | 195        | 202        | 209        | 215        | 222        | 228        | 235        | 248        | 261        | 274        | 287        | 265        |  |
| 80            | 173        | 179        | 185        | 191        | 197        | 203        | 209        | 215        | 226        | 238        | 250        | 262        | 242        |  |
| 85            | 158        | 164        | 169        | 175        | 180        | 186        | 191        | 196        | 207        | 218        | 229        | 240        | 222        |  |
| 90            | 145        | 150        | 155        | 160        | 165        | 170        | 175        | 180        | 190        | 200        | 210        | 220        | 203        |  |
| 95            | 133        | 137        | 142        | 147        | 151        | 156        | 160        | 165        | 174        | 183        | 192        | 202        | 186        |  |
| 100           | 122        | 126        | 130        | 134        | 138        | 143        | 147        | 151        | 159        | 168        | 176        | 185        | 170        |  |
| 105           | 111        | 115        | 119        | 123        | 127        | 130        | 134        | 138        | 146        | 153        | 161        | 169        | 156        |  |
| 110           | 102        | 105        | 109        | 112        | 116        | 119        | 123        | 126        | 133        | 140        | 147        | 154        | 142        |  |
| 115           | 92         | 96         | 99         | 102        | 105        | 108        | 111        | 115        | 121        | 127        | 134        | 140        | 129        |  |
| 120           | 84         | 87         | 89         | 92         | 95         | 98         | 101        | 104        | 110        | 115        | 121        | 127        | 117        |  |
| 125           | 75         | 78         | 81         | 83         | 86         | 88         | 91         | 94         | 99         | 104        | 109        | 115        | 106        |  |
| 130           | 68         | 70         | 72         | 75         | 77         | 79         | 82         | 84         | 89         | 93         | 98         | 103        | 95         |  |
| 135           | 60         | 62         | 64         | 66         | 68         | 70         | 72         | 75         | 79         | 83         | 87         | 91         | 84         |  |
| 140           | 53         | 55         | 56         | 58         | 60         | 62         | 64         | 66         | 69         | 73         | 76         | 80         | 74         |  |
| 145           | 46         | 47         | 49         | 50         | 52         | 54         | 55         | 57         | 60         | 63         | 66         | 69         | 64         |  |
| 150           | 39         | 40         | 42         | 43         | 44         | 46         | 47         | 48         | 51         | 54         | 56         | 59         | 54         |  |
| 155           | 32         | 33         | 34         | 35         | 37         | 38         | 39         | 40         | 42         | 44         | 47         | 49         | 45         |  |
| 160           | 26         | 26         | 27         | 28         | 29         | 30         | 31         | 32         | 34         | 35         | 37         | 39         | 36         |  |
| 165           | 19         | 20         | 20         | 21         | 22         | 22         | 23         | 24         | 25         | 26         | 28         | 29         | 27         |  |
| 170           | 13         | 13         | 14         | 14         | 14         | 15         | 15         | 16         | 17         | 17         | 18         | 19         | 18         |  |
| 175           | 6          | 7          | 7          | 7          | 7          | 7          | 8          | 8          | 8          | 9          | 9          | 10         | 9          |  |
| <b>Radius</b> | <b>145</b> | <b>150</b> | <b>155</b> | <b>160</b> | <b>165</b> | <b>170</b> | <b>175</b> | <b>180</b> | <b>190</b> | <b>200</b> | <b>210</b> | <b>220</b> | <b>203</b> |  |
| <b>Kreis</b>  | 911        | 942        | 973,9      | 1005       | 1037       | 1068       | 1100       | 1131       | 1194       | 1257       | 1319       | 1382       | 1275       |  |

### Berechnungstabelle

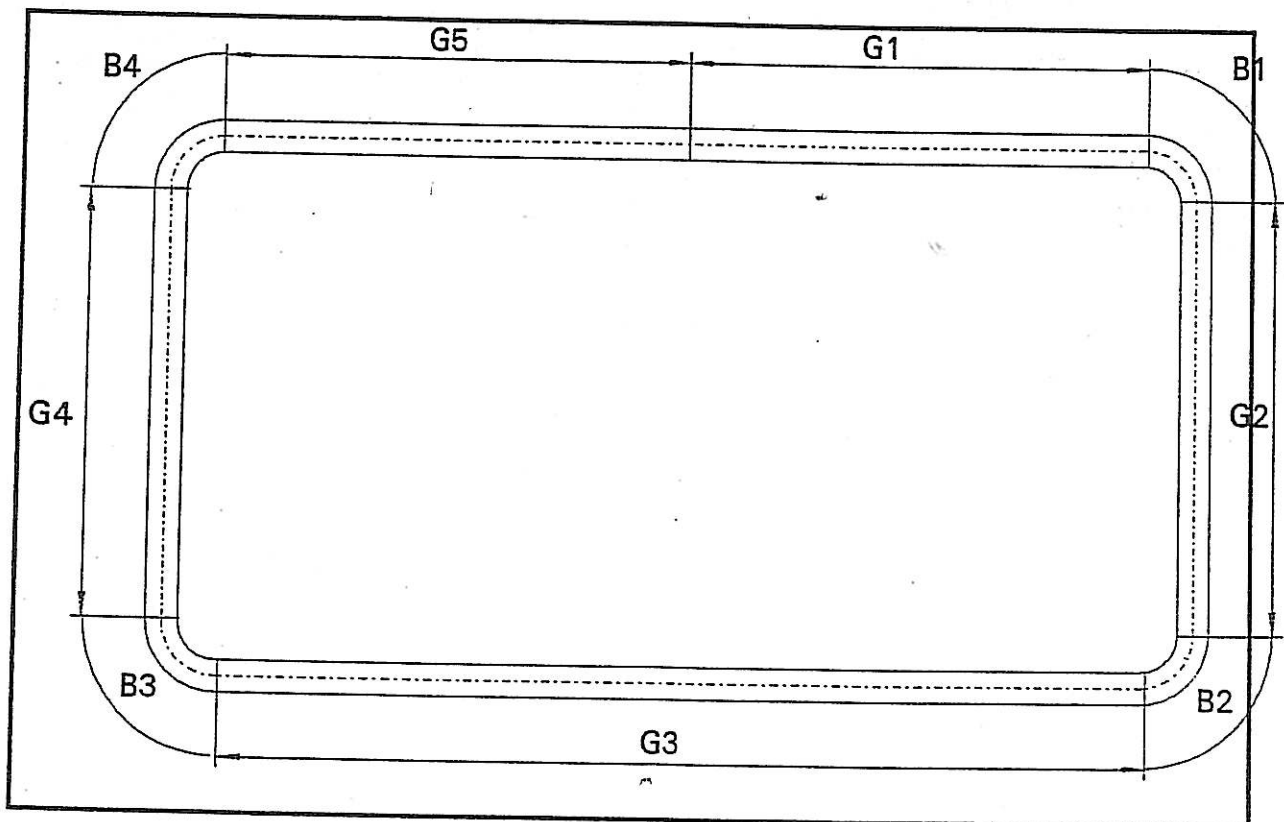
| Winkel        | Radius     |            |            |            |            |            |            |
|---------------|------------|------------|------------|------------|------------|------------|------------|
|               | 240        | 250        | 260        | 270        | 280        | 290        | 300        |
| 5             | 5497       | 5726       | 5955       | 6184       | 6413       | 6642       | 6871       |
| 10            | 2743       | 2858       | 2972       | 3086       | 3200       | 3315       | 3429       |
| 15            | 1823       | 1899       | 1975       | 2051       | 2127       | 2203       | 2279       |
| 20            | 1361       | 1418       | 1475       | 1531       | 1588       | 1645       | 1701       |
| 25            | 1083       | 1128       | 1173       | 1218       | 1263       | 1308       | 1353       |
| 30            | 896        | 933        | 970        | 1008       | 1045       | 1082       | 1120       |
| 35            | 761        | 793        | 825        | 856        | 888        | 920        | 951        |
| 40            | 659        | 687        | 714        | 742        | 769        | 797        | 824        |
| 45            | 579        | 604        | 628        | 652        | 676        | 700        | 724        |
| 50            | 515        | 536        | 558        | 579        | 600        | 622        | 643        |
| 55            | 461        | 480        | 499        | 519        | 538        | 557        | 576        |
| 60            | 416        | 433        | 450        | 468        | 485        | 502        | 520        |
| 65            | 377        | 392        | 408        | 424        | 440        | 455        | 471        |
| 70            | 343        | 357        | 371        | 386        | 400        | 414        | 428        |
| 75            | 313        | 326        | 339        | 352        | 365        | 378        | 391        |
| 80            | 286        | 298        | 310        | 322        | 334        | 346        | 358        |
| 85            | 262        | 273        | 284        | 295        | 306        | 316        | 327        |
| 90            | 240        | 250        | 260        | 270        | 280        | 290        | 300        |
| 95            | 220        | 229        | 238        | 247        | 257        | 266        | 275        |
| 100           | 201        | 210        | 218        | 227        | 235        | 243        | 252        |
| 105           | 184        | 192        | 200        | 207        | 215        | 223        | 230        |
| 110           | 168        | 175        | 182        | 189        | 196        | 203        | 210        |
| 115           | 153        | 159        | 166        | 172        | 178        | 185        | 191        |
| 120           | 139        | 144        | 150        | 156        | 162        | 167        | 173        |
| 125           | 125        | 130        | 135        | 141        | 146        | 151        | 156        |
| 130           | 112        | 117        | 121        | 126        | 131        | 135        | 140        |
| 135           | 99         | 104        | 108        | 112        | 116        | 120        | 124        |
| 140           | 87         | 91         | 95         | 98         | 102        | 106        | 109        |
| 145           | 76         | 79         | 82         | 85         | 88         | 91         | 95         |
| 150           | 64         | 67         | 70         | 72         | 75         | 78         | 80         |
| 155           | 53         | 55         | 58         | 60         | 62         | 64         | 67         |
| 160           | 42         | 44         | 46         | 48         | 49         | 51         | 53         |
| 165           | 32         | 33         | 34         | 36         | 37         | 38         | 39         |
| 170           | 21         | 22         | 23         | 24         | 24         | 25         | 26         |
| 175           | 10         | 11         | 11         | 12         | 12         | 13         | 13         |
| <b>Radius</b> | <b>240</b> | <b>250</b> | <b>260</b> | <b>270</b> | <b>280</b> | <b>290</b> | <b>300</b> |
| <b>Kreis</b>  | 1508       | 1571       | 1634       | 1696       | 1759       | 1822       | 1885       |

## 1. Beispielrechnung:

### Problemstellung:

Es soll ein Rahmen mit folgenden Maßen gebogen werden:

|                     |         |              |
|---------------------|---------|--------------|
| Höhe des Rahmens:   | 900 mm  | (Außenmaß)   |
| Breite des Rahmens: | 2000 mm | (Außenmaß)   |
| Biegeradius:        | 70 mm   | (Mitte Rohr) |
| Rohrdurchmesser:    | 33,7 mm |              |



Der Rahmen wird wie oben gezeigt in gerade und gebogene Abschnitte aufgeteilt.

|                     |                              |
|---------------------|------------------------------|
| HA = Höhe außen     | H = Höhe (Mitte Rohr)        |
| BA = Breite außen   | B = Breite (Mitte Rohr)      |
| D = Rohrdurchmesser | R = Biegeradius (Mitte Rohr) |

$$G2 = HA - R - R - D$$

$$G2 = 900 - 70 - 70 - 33,7 = 726,3 \text{ mm}$$

$$G3 = BA - R - R - D$$

$$G3 = 2000 - 70 - 70 - 33,7 = 1826,3 \text{ mm}$$

$$G1 = G3 : 2$$

$$G1 = 1826,3 : 2 = 913,15 \text{ mm}$$

$$G1 = G5 = 913,15 \text{ mm}$$

Zuschnittslänge des Rohres:

$$U = G1 + G2 + G3 + G4 + G5 + (2 * R * 3,14)$$

$$U = 913,15 + 726,3 + 1826,3 + 726,3 + 913,15 + (2 * 70 * 3,14)$$

$$U = 5105,2 + (439,6)$$

$$U = 5554,8 \text{ mm}$$

**Ergebnis:**

$$U = 5554,8 \text{ mm}$$

$$G1 = 913,15 \text{ mm}$$

$$G2 = 726,3 \text{ mm}$$

$$G3 = 1826,3 \text{ mm}$$

$$G4 = 726,3 \text{ mm}$$

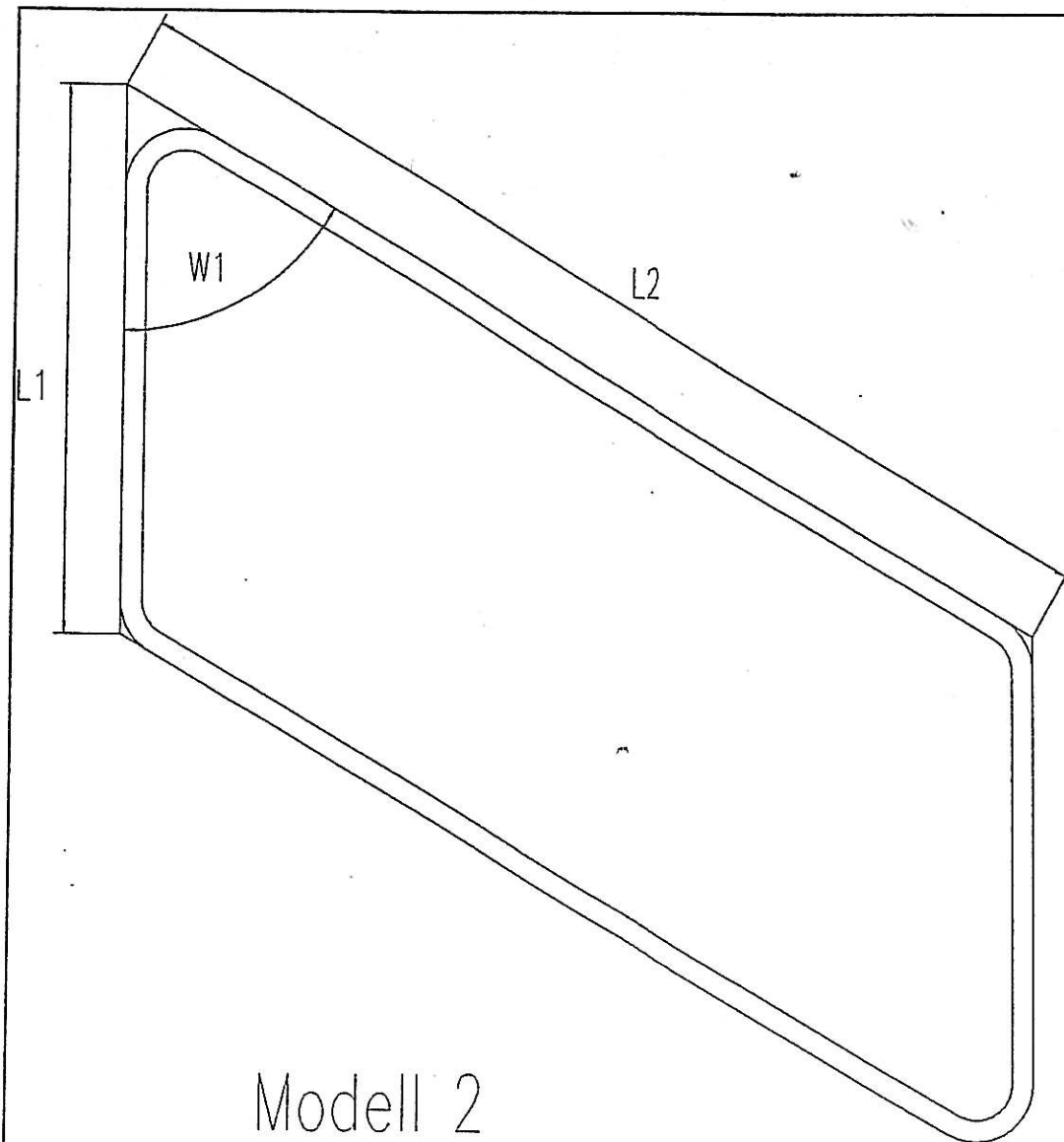
$$G5 = 913,15 \text{ mm}$$

## 2. Beispielrechnung:

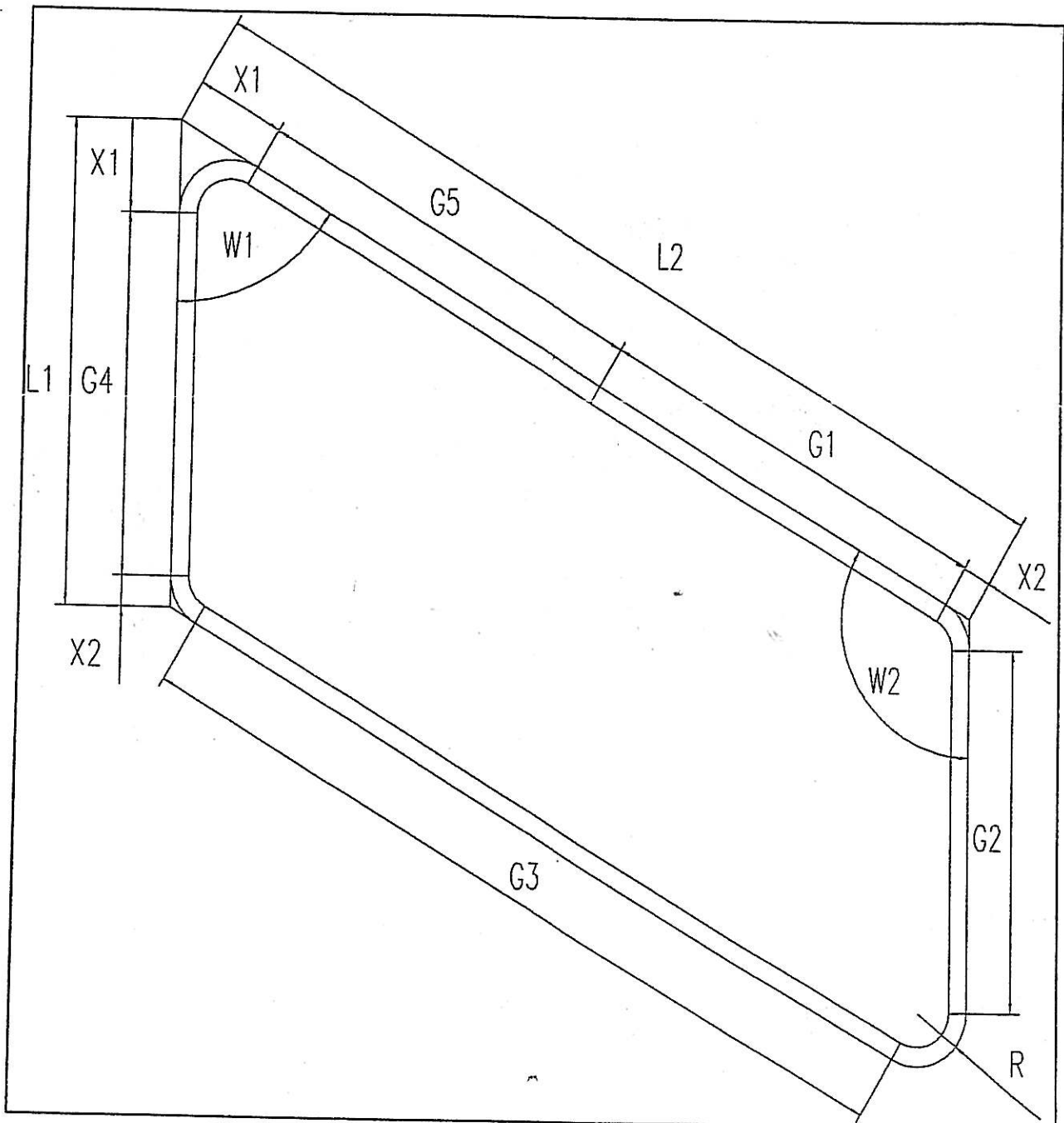
### Problemstellung:

Es soll ein Rahmen mit folgenden Maßen gebogen werden:

|                     |         |              |
|---------------------|---------|--------------|
| Höhe des Rahmens:   | 1000 mm | (Außenmaß)   |
| Breite des Rahmens: | 2000 mm | (Außenmaß)   |
| Biegeradius:        | 90 mm   | (Mitte Rohr) |
| Rohrdurchmesser:    | 40 mm   |              |
| Winkel 1:           | 60 °    |              |



Der Rahmen wird in gerade und gebogene Abschnitte aufgeteilt.



Für die Berechnung der Geraden G1 bis G5 benötigt man die Abschnitte X1 und X2.  
 X1 und X2 sind abhängig vom Biegewinkel und Biegeradius. Man erhält diese Werte aus der Berechnungstabelle.

X1:  
 Biegewinkel  $60^\circ$  Biegeradius 110mm

**X1 = 191 mm**

X2:

Biegewinkel 120° Biegeradius 110 mm

$X_2 = 64 \text{ mm}$

**Wichtig:**

Für die Ermittlung der X-Werte ist immer der Radius maßgebend, an dem die Längenmaße eingetragen werden.

Beispiel:

Biegewerkzeug 42,4 R90  
mittlerer Biegeradius 90 mm  
Biegeradius außen 111,2 mm

Hinweis:

Die äußeren Biegeradien der Dornwerkzeuge für 1/2", 3/4", 1" und 1 1/4" sind in der Berechnungstabelle fett gedruckt.

Nachdem die X-Werte ermittelt sind, können die Geraden G1 bis G5 errechnet werden.

$$G_3 = L_2 - X_1 - X_2$$

$$G_3 = 2000 - 191 - 64$$

$$G_3 = 1745 \text{ mm}$$

$$G_1 = G_5 = G_3 : 2$$

$$G_1 = G_5 = 1745 : 2$$

$$G_1 = G_5 = 872,5 \text{ mm}$$

$$G_2 = G_4 = L_1 - X_1 - X_2$$

$$G_2 = G_4 = 1000 - 191 - 64$$

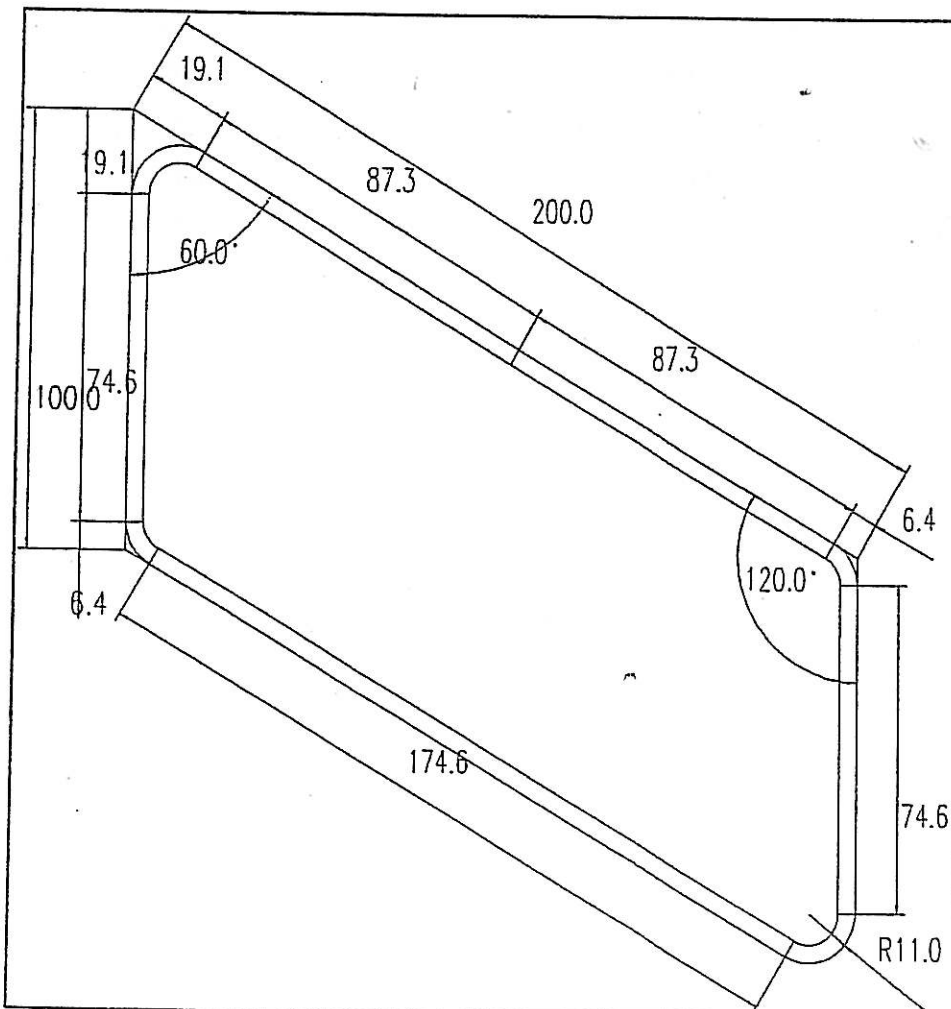
$$G_2 = G_4 = 745 \text{ mm}$$

**Zuschnittslänge des Rohres:**

$$U = G1 + G2 + G3 + G4 + G5 + (2 * R * 3,14)$$
$$U = 872,5 + 745 + 1745 + 745 + 872,5 + (2 * 90 * 3,14)$$
$$U = 5235 + (565,2)$$
$$U = 5800,2 \text{ mm}$$

**Ergebnis:**

$$G1 = 872,5 \text{ mm}$$
$$G2 = 745 \text{ mm}$$
$$G3 = 1745 \text{ mm}$$
$$G4 = 745 \text{ mm}$$
$$G5 = 872,5 \text{ mm}$$
$$U = 5800,2 \text{ mm}$$



Fertiger Rahmen mit allen Maßen in cm