**Economic Commission for Europe**

Inland Transport Committee

**World Forum for Harmonization of Vehicle Regulations**

**Working Party on Pollution and Energy**

**Seventy-eighth session**

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Item 3(b) of the provisional agenda

**Light vehicles – Global Technical Regulations Nos. 15**

**(Worldwide harmonized Light vehicles Test Procedures (WLTP))**

**and 19 (Evaporative emission test procedure for the Worldwide**

**harmonized Light vehicle Test Procedure (WLTP EVAP))**

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| --- | --- | --- | --- |
|  | United Nations | ECE/TRANS/WP.29/GRPE/2019/2 | |
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**Proposal for Amendment 5 to global technical regulation No. 15 (Worldwide harmonized Light vehicles Test Procedures (WLTP))**

**Submitted by the Informal Working Group on Worldwide harmonized Light vehicles Test Procedure (WLTP)[[1]](#footnote-2)\***

The text reproduced below was prepared by the Informal Working Group (IWG) on Worldwide harmonized Light vehicles Test Procedure (WLTP) in line with Phase 2 of its mandate (ECE/TRANS/WP.29/AC.3/44). The text is reproduced as a consolidated version.

Global technical regulation on Worldwide harmonized Light vehicles Test Procedures (WLTP)

The text in Annex 1 and Annex 2 is based on GTR 15, Amendment 5. Further amendment proposals intended to be included in amendment 6 and adopted by the IWG at its 26th meeting in Zagreb are highlighted in green.

Proposals for further amendments to be discussed in the GSTF and in the IWG are highlighted in yellow.

Editorial changes and added explanatory text are highlighted in light blue.

Changes compared to revision 3 are highlighted in grey.

All amendment proposals can easily be found by searching for xxxxx.

Some of the amendments highlighted in yellow are related to the calculation of second by second data for acceleration and distance values.

Acceleration values are calculated differently in different annexes of the GTR, depending on the purpose of the annex



Distance values are calculated uniformly in different annexes of the GTR except for the drive trace index calculation



I did not find any specific requirements how to sum up modal emissions over the different phases or the complete cycle in the GTR.



M is the mass emission.

Annex 1

Worldwide light-duty test cycles (WLTC)

1. General requirements

The cycle to be driven depends on the ratio of the test vehicle’s rated power to mass in running order minus 75 kg, W/kg, and its maximum velocity, (as defined in paragraph 3.7.2 of this UN GTR).

xxxxx

The cycle resulting from the requirements described in this annex shall be referred to in other parts of this UN GTR as the "applicable cycle".

2. Vehicle classifications

2.1. Class 1 vehicles have a power to mass in running order minus 75 kg ratio W/kg.

2.2. Class 2 vehicles have a power to mass in running order minus 75 kg ratio > 22 but ≤ 34 W/kg.

2.3. Class 3 vehicles have a power to mass in running order minus 75 kg ratio > 34 W/kg.

2.3.1. Class 3 vehicles are divided into 2 subclasses according to their maximum speed, vmax.

2.3.1.1. Class 3a vehicles with vmax < 120 km/h.

2.3.1.2. Class 3b vehicles with vmax ≥ 120 km/h.

2.3.2. All vehicles tested according to Annex 8 shall be considered to be Class 3 vehicles.

3. Test cycles

3.1. Class 1 cycle

3.1.1. A complete Class 1 cycle shall consist of a low phase (Low1), a medium phase (Medium1) and an additional low phase (Low1).

3.1.2. The Low1 phase is described in Figure A1/1 and Table A1/1.

3.1.3. The Medium1 phase is described in Figure A1/2 and Table A1/2.

3.2. Class 2 cycle

3.2.1. A complete Class 2 cycle shall consist of a low phase (Low2), a medium phase (Medium2), a high phase (High2) and an extra high phase (Extra High2).

3.2.2. The Low2 phase is described in Figure A1/3 and Table A1/3.

3.2.3. The Medium2 phase is described in Figure A1/4 and Table A1/4.

3.2.4. The High2 phase is described in Figure A1/5 and Table A1/5.

3.2.5. The Extra High2 phase is described in Figure A1/6 and Table A1/6.

3.2.6. At the option of the Contracting Party, the Extra High2 phase may be excluded.

3.3. Class 3 cycle

Class 3 cycles are divided into 2 subclasses to reflect the subdivision of Class 3 vehicles.

3.3.1. Class 3a cycle

3.3.1.1. A complete cycle shall consist of a low phase (Low3), a medium phase (Medium3a), a high phase (High3a) and an extra high phase (Extra High3).

3.3.1.2. The Low3 phase is described in Figure A1/7 and Table A1/7.

3.3.1.3. The Medium3a phase is described in Figure A1/8 and Table A1/8.

3.3.1.4. The High3a phase is described in Figure A1/10 and Table A1/10.

3.3.1.5. The Extra High3 phase is described in Figure A1/12 and Table A1/12.

3.3.1.6. At the option of the Contracting Party, the Extra High3 phase may be excluded.

3.3.2. Class 3b cycle

3.3.2.1. A complete cycle shall consist of a low phase (Low3) phase, a medium phase (Medium3b), a high phase (High3b) and an extra high phase (Extra High3).

3.3.2.2. The Low3 phase is described in Figure A1/7 and Table A1/7.

3.3.2.3. The Medium3b phase is described in Figure A1/9 and Table A1/9.

3.3.2.4. The High3b phase is described in Figure A1/11 and Table A1/11.

3.3.2.5. The Extra High3 phase is described in Figure A1/12 and Table A1/12.

3.3.2.6. At the option of the Contracting Party, the Extra High3 phase may be excluded.

~~3.4. Duration of all phases~~

~~3.4.1. All low speed phases last 589 seconds.~~

~~3.4.2. All medium speed phases last 433 seconds.~~

~~3.4.3. All high speed phases last 455 seconds.~~

~~3.4.4. All extra high speed phases last 323 secondsxxxxx.~~

3.4. Duration of the cycle phases

3.4.1. Class 1 cycle.

The first low speed phase starts at second 0 (tstart\_low11) and ends at second 589 (tend\_low11, duration 589 s)

The medium speed phase starts at second 589 (tstart\_medium1) and ends at second 1022 (tend\_medium1, duration 433 s)

The second low speed phase starts at second 1022 (tstart\_low12) and ends at second 1611 (tend\_low12, duration 589 s)

3.4.2. Class 2 and class 3 cycles.

The low speed phase starts at second 0 (tstart\_low2, tstart\_low3) and ends at second 589 (tend\_low2, tend\_low3, duration 589 s)

The medium speed phase starts at second 589 (tstart\_medium2, tstart\_medium3) and ends at second 1022 (tend\_medium2, tend\_medium3, duration 433 s)

The high speed phase starts at second 1022 (tstart\_high2, tstart\_high3) and ends at second 1477 (tend\_high2, tend\_high3, duration 455 s)

The extra high speed phase starts at second 1477 (tstart\_exhigh2, tstart\_exhigh3) and ends at second 1800 (tend\_exhigh2, tend\_exhigh3, duration 323 s)

3.5. WLTC city cycles

OVC-HEVs and PEVs shall be tested using the appropriate Class 3a and Class 3b WLTC and WLTC city cycles (see Annex 8).

The WLTC city cycle consists of the low and medium speed phases only.

At the option of the Contracting Party, the WLTC city may be excluded.

4. WLTC Class 1 cycle

# Figure A1/1

**WLTC, Class 1 cycle, phase Low11**

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# Figure A1/2a

**WLTC, Class 1 cycle, phase Medium1**

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# xxxxx

# Figure A1/2b

**WLTC, Class 1 cycle, phase Low12**



# Table A1/1

# **WLTC, Class 1 cycle, phase Low11 (Second 589 is the end of phase Low11 and the start of phase Medium1)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0.0 | 47 | 18.8 | 94 | 0.0 | 141 | 35.7 |
| 1 | 0.0 | 48 | 19.5 | 95 | 0.0 | 142 | 35.9 |
| 2 | 0.0 | 49 | 20.2 | 96 | 0.0 | 143 | 36.6 |
| 3 | 0.0 | 50 | 20.9 | 97 | 0.0 | 144 | 37.5 |
| 4 | 0.0 | 51 | 21.7 | 98 | 0.0 | 145 | 38.4 |
| 5 | 0.0 | 52 | 22.4 | 99 | 0.0 | 146 | 39.3 |
| 6 | 0.0 | 53 | 23.1 | 100 | 0.0 | 147 | 40.0 |
| 7 | 0.0 | 54 | 23.7 | 101 | 0.0 | 148 | 40.6 |
| 8 | 0.0 | 55 | 24.4 | 102 | 0.0 | 149 | 41.1 |
| 9 | 0.0 | 56 | 25.1 | 103 | 0.0 | 150 | 41.4 |
| 10 | 0.0 | 57 | 25.4 | 104 | 0.0 | 151 | 41.6 |
| 11 | 0.0 | 58 | 25.2 | 105 | 0.0 | 152 | 41.8 |
| 12 | 0.2 | 59 | 23.4 | 106 | 0.0 | 153 | 41.8 |
| 13 | 3.1 | 60 | 21.8 | 107 | 0.0 | 154 | 41.9 |
| 14 | 5.7 | 61 | 19.7 | 108 | 0.7 | 155 | 41.9 |
| 15 | 8.0 | 62 | 17.3 | 109 | 1.1 | 156 | 42.0 |
| 16 | 10.1 | 63 | 14.7 | 110 | 1.9 | 157 | 42.0 |
| 17 | 12.0 | 64 | 12.0 | 111 | 2.5 | 158 | 42.2 |
| 18 | 13.8 | 65 | 9.4 | 112 | 3.5 | 159 | 42.3 |
| 19 | 15.4 | 66 | 5.6 | 113 | 4.7 | 160 | 42.6 |
| 20 | 16.7 | 67 | 3.1 | 114 | 6.1 | 161 | 43.0 |
| 21 | 17.7 | 68 | 0.0 | 115 | 7.5 | 162 | 43.3 |
| 22 | 18.3 | 69 | 0.0 | 116 | 9.4 | 163 | 43.7 |
| 23 | 18.8 | 70 | 0.0 | 117 | 11.0 | 164 | 44.0 |
| 24 | 18.9 | 71 | 0.0 | 118 | 12.9 | 165 | 44.3 |
| 25 | 18.4 | 72 | 0.0 | 119 | 14.5 | 166 | 44.5 |
| 26 | 16.9 | 73 | 0.0 | 120 | 16.4 | 167 | 44.6 |
| 27 | 14.3 | 74 | 0.0 | 121 | 18.0 | 168 | 44.6 |
| 28 | 10.8 | 75 | 0.0 | 122 | 20.0 | 169 | 44.5 |
| 29 | 7.1 | 76 | 0.0 | 123 | 21.5 | 170 | 44.4 |
| 30 | 4.0 | 77 | 0.0 | 124 | 23.5 | 171 | 44.3 |
| 31 | 0.0 | 78 | 0.0 | 125 | 25.0 | 172 | 44.2 |
| 32 | 0.0 | 79 | 0.0 | 126 | 26.8 | 173 | 44.1 |
| 33 | 0.0 | 80 | 0.0 | 127 | 28.2 | 174 | 44.0 |
| 34 | 0.0 | 81 | 0.0 | 128 | 30.0 | 175 | 43.9 |
| 35 | 1.5 | 82 | 0.0 | 129 | 31.4 | 176 | 43.8 |
| 36 | 3.8 | 83 | 0.0 | 130 | 32.5 | 177 | 43.7 |
| 37 | 5.6 | 84 | 0.0 | 131 | 33.2 | 178 | 43.6 |
| 38 | 7.5 | 85 | 0.0 | 132 | 33.4 | 179 | 43.5 |
| 39 | 9.2 | 86 | 0.0 | 133 | 33.7 | 180 | 43.4 |
| 40 | 10.8 | 87 | 0.0 | 134 | 33.9 | 181 | 43.3 |
| 41 | 12.4 | 88 | 0.0 | 135 | 34.2 | 182 | 43.1 |
| 42 | 13.8 | 89 | 0.0 | 136 | 34.4 | 183 | 42.9 |
| 43 | 15.2 | 90 | 0.0 | 137 | 34.7 | 184 | 42.7 |
| 44 | 16.3 | 91 | 0.0 | 138 | 34.9 | 185 | 42.5 |
| 45 | 17.3 | 92 | 0.0 | 139 | 35.2 | 186 | 42.3 |
| 46 | 18.0 | 93 | 0.0 | 140 | 35.4 | 187 | 42.2 |
| 188 | 42.2 | 237 | 39.7 | 286 | 25.3 | 335 | 14.3 |
| 189 | 42.2 | 238 | 39.9 | 287 | 24.9 | 336 | 14.3 |
| 190 | 42.3 | 239 | 40.0 | 288 | 24.5 | 337 | 14.0 |
| 191 | 42.4 | 240 | 40.1 | 289 | 24.2 | 338 | 13.0 |
| 192 | 42.5 | 241 | 40.2 | 290 | 24.0 | 339 | 11.4 |
| 193 | 42.7 | 242 | 40.3 | 291 | 23.8 | 340 | 10.2 |
| 194 | 42.9 | 243 | 40.4 | 292 | 23.6 | 341 | 8.0 |
| 195 | 43.1 | 244 | 40.5 | 293 | 23.5 | 342 | 7.0 |
| 196 | 43.2 | 245 | 40.5 | 294 | 23.4 | 343 | 6.0 |
| 197 | 43.3 | 246 | 40.4 | 295 | 23.3 | 344 | 5.5 |
| 198 | 43.4 | 247 | 40.3 | 296 | 23.3 | 345 | 5.0 |
| 199 | 43.4 | 248 | 40.2 | 297 | 23.2 | 346 | 4.5 |
| 200 | 43.2 | 249 | 40.1 | 298 | 23.1 | 347 | 4.0 |
| 201 | 42.9 | 250 | 39.7 | 299 | 23.0 | 348 | 3.5 |
| 202 | 42.6 | 251 | 38.8 | 300 | 22.8 | 349 | 3.0 |
| 203 | 42.2 | 252 | 37.4 | 301 | 22.5 | 350 | 2.5 |
| 204 | 41.9 | 253 | 35.6 | 302 | 22.1 | 351 | 2.0 |
| 205 | 41.5 | 254 | 33.4 | 303 | 21.7 | 352 | 1.5 |
| 206 | 41.0 | 255 | 31.2 | 304 | 21.1 | 353 | 1.0 |
| 207 | 40.5 | 256 | 29.1 | 305 | 20.4 | 354 | 0.5 |
| 208 | 39.9 | 257 | 27.6 | 306 | 19.5 | 355 | 0.0 |
| 209 | 39.3 | 258 | 26.6 | 307 | 18.5 | 356 | 0.0 |
| 210 | 38.7 | 259 | 26.2 | 308 | 17.6 | 357 | 0.0 |
| 211 | 38.1 | 260 | 26.3 | 309 | 16.6 | 358 | 0.0 |
| 212 | 37.5 | 261 | 26.7 | 310 | 15.7 | 359 | 0.0 |
| 213 | 36.9 | 262 | 27.5 | 311 | 14.9 | 360 | 0.0 |
| 214 | 36.3 | 263 | 28.4 | 312 | 14.3 | 361 | 2.2 |
| 215 | 35.7 | 264 | 29.4 | 313 | 14.1 | 362 | 4.5 |
| 216 | 35.1 | 265 | 30.4 | 314 | 14.0 | 363 | 6.6 |
| 217 | 34.5 | 266 | 31.2 | 315 | 13.9 | 364 | 8.6 |
| 218 | 33.9 | 267 | 31.9 | 316 | 13.8 | 365 | 10.6 |
| 219 | 33.6 | 268 | 32.5 | 317 | 13.7 | 366 | 12.5 |
| 220 | 33.5 | 269 | 33.0 | 318 | 13.6 | 367 | 14.4 |
| 221 | 33.6 | 270 | 33.4 | 319 | 13.5 | 368 | 16.3 |
| 222 | 33.9 | 271 | 33.8 | 320 | 13.4 | 369 | 17.9 |
| 223 | 34.3 | 272 | 34.1 | 321 | 13.3 | 370 | 19.1 |
| 224 | 34.7 | 273 | 34.3 | 322 | 13.2 | 371 | 19.9 |
| 225 | 35.1 | 274 | 34.3 | 323 | 13.2 | 372 | 20.3 |
| 226 | 35.5 | 275 | 33.9 | 324 | 13.2 | 373 | 20.5 |
| 227 | 35.9 | 276 | 33.3 | 325 | 13.4 | 374 | 20.7 |
| 228 | 36.4 | 277 | 32.6 | 326 | 13.5 | 375 | 21.0 |
| 229 | 36.9 | 278 | 31.8 | 327 | 13.7 | 376 | 21.6 |
| 230 | 37.4 | 279 | 30.7 | 328 | 13.8 | 377 | 22.6 |
| 231 | 37.9 | 280 | 29.6 | 329 | 14.0 | 378 | 23.7 |
| 232 | 38.3 | 281 | 28.6 | 330 | 14.1 | 379 | 24.8 |
| 233 | 38.7 | 282 | 27.8 | 331 | 14.3 | 380 | 25.7 |
| 234 | 39.1 | 283 | 27.0 | 332 | 14.4 | 381 | 26.2 |
| 235 | 39.3 | 284 | 26.4 | 333 | 14.4 | 382 | 26.4 |
| 236 | 39.5 | 285 | 25.8 | 334 | 14.4 | 383 | 26.4 |
| 384 | 26.4 | 433 | 0.0 | 482 | 3.1 | 531 | 48.2 |
| 385 | 26.5 | 434 | 0.0 | 483 | 4.6 | 532 | 48.5 |
| 386 | 26.6 | 435 | 0.0 | 484 | 6.1 | 533 | 48.7 |
| 387 | 26.8 | 436 | 0.0 | 485 | 7.8 | 534 | 48.9 |
| 388 | 26.9 | 437 | 0.0 | 486 | 9.5 | 535 | 49.1 |
| 389 | 27.2 | 438 | 0.0 | 487 | 11.3 | 536 | 49.1 |
| 390 | 27.5 | 439 | 0.0 | 488 | 13.2 | 537 | 49.0 |
| 391 | 28.0 | 440 | 0.0 | 489 | 15.0 | 538 | 48.8 |
| 392 | 28.8 | 441 | 0.0 | 490 | 16.8 | 539 | 48.6 |
| 393 | 29.9 | 442 | 0.0 | 491 | 18.4 | 540 | 48.5 |
| 394 | 31.0 | 443 | 0.0 | 492 | 20.1 | 541 | 48.4 |
| 395 | 31.9 | 444 | 0.0 | 493 | 21.6 | 542 | 48.3 |
| 396 | 32.5 | 445 | 0.0 | 494 | 23.1 | 543 | 48.2 |
| 397 | 32.6 | 446 | 0.0 | 495 | 24.6 | 544 | 48.1 |
| 398 | 32.4 | 447 | 0.0 | 496 | 26.0 | 545 | 47.5 |
| 399 | 32.0 | 448 | 0.0 | 497 | 27.5 | 546 | 46.7 |
| 400 | 31.3 | 449 | 0.0 | 498 | 29.0 | 547 | 45.7 |
| 401 | 30.3 | 450 | 0.0 | 499 | 30.6 | 548 | 44.6 |
| 402 | 28.0 | 451 | 0.0 | 500 | 32.1 | 549 | 42.9 |
| 403 | 27.0 | 452 | 0.0 | 501 | 33.7 | 550 | 40.8 |
| 404 | 24.0 | 453 | 0.0 | 502 | 35.3 | 551 | 38.2 |
| 405 | 22.5 | 454 | 0.0 | 503 | 36.8 | 552 | 35.3 |
| 406 | 19.0 | 455 | 0.0 | 504 | 38.1 | 553 | 31.8 |
| 407 | 17.5 | 456 | 0.0 | 505 | 39.3 | 554 | 28.7 |
| 408 | 14.0 | 457 | 0.0 | 506 | 40.4 | 555 | 25.8 |
| 409 | 12.5 | 458 | 0.0 | 507 | 41.2 | 556 | 22.9 |
| 410 | 9.0 | 459 | 0.0 | 508 | 41.9 | 557 | 20.2 |
| 411 | 7.5 | 460 | 0.0 | 509 | 42.6 | 558 | 17.3 |
| 412 | 4.0 | 461 | 0.0 | 510 | 43.3 | 559 | 15.0 |
| 413 | 2.9 | 462 | 0.0 | 511 | 44.0 | 560 | 12.3 |
| 414 | 0.0 | 463 | 0.0 | 512 | 44.6 | 561 | 10.3 |
| 415 | 0.0 | 464 | 0.0 | 513 | 45.3 | 562 | 7.8 |
| 416 | 0.0 | 465 | 0.0 | 514 | 45.5 | 563 | 6.5 |
| 417 | 0.0 | 466 | 0.0 | 515 | 45.5 | 564 | 4.4 |
| 418 | 0.0 | 467 | 0.0 | 516 | 45.2 | 565 | 3.2 |
| 419 | 0.0 | 468 | 0.0 | 517 | 44.7 | 566 | 1.2 |
| 420 | 0.0 | 469 | 0.0 | 518 | 44.2 | 567 | 0.0 |
| 421 | 0.0 | 470 | 0.0 | 519 | 43.6 | 568 | 0.0 |
| 422 | 0.0 | 471 | 0.0 | 520 | 43.1 | 569 | 0.0 |
| 423 | 0.0 | 472 | 0.0 | 521 | 42.8 | 570 | 0.0 |
| 424 | 0.0 | 473 | 0.0 | 522 | 42.7 | 571 | 0.0 |
| 425 | 0.0 | 474 | 0.0 | 523 | 42.8 | 572 | 0.0 |
| 426 | 0.0 | 475 | 0.0 | 524 | 43.3 | 573 | 0.0 |
| 427 | 0.0 | 476 | 0.0 | 525 | 43.9 | 574 | 0.0 |
| 428 | 0.0 | 477 | 0.0 | 526 | 44.6 | 575 | 0.0 |
| 429 | 0.0 | 478 | 0.0 | 527 | 45.4 | 576 | 0.0 |
| 430 | 0.0 | 479 | 0.0 | 528 | 46.3 | 577 | 0.0 |
| 431 | 0.0 | 480 | 0.0 | 529 | 47.2 | 578 | 0.0 |
| 432 | 0.0 | 481 | 1.6 | 530 | 47.8 | 579 | 0.0 |
| 580 | 0.0 |  |  |  |  |  |  |
| 581 | 0.0 |  |  |  |  |  |  |
| 582 | 0.0 |  |  |  |  |  |  |
| 583 | 0.0 |  |  |  |  |  |  |
| 584 | 0.0 |  |  |  |  |  |  |
| 585 | 0.0 |  |  |  |  |  |  |
| 586 | 0.0 |  |  |  |  |  |  |
| 587 | 0.0 |  |  |  |  |  |  |
| 588 | 0.0 |  |  |  |  |  |  |
| 589 | 0.0 |  |  |  |  |  |  |
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# Table A1/2a

# **WLTC, Class 1 cycle, phase Medium1 (The start of this phase is at second 589)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 590 | 0.0 | 637 | 18.4 | 684 | 56.2 | 731 | 57.9 |
| 591 | 0.0 | 638 | 19.0 | 685 | 56.7 | 732 | 58.8 |
| 592 | 0.0 | 639 | 20.1 | 686 | 57.3 | 733 | 59.6 |
| 593 | 0.0 | 640 | 21.5 | 687 | 57.9 | 734 | 60.3 |
| 594 | 0.0 | 641 | 23.1 | 688 | 58.4 | 735 | 60.9 |
| 595 | 0.0 | 642 | 24.9 | 689 | 58.8 | 736 | 61.3 |
| 596 | 0.0 | 643 | 26.4 | 690 | 58.9 | 737 | 61.7 |
| 597 | 0.0 | 644 | 27.9 | 691 | 58.4 | 738 | 61.8 |
| 598 | 0.0 | 645 | 29.2 | 692 | 58.1 | 739 | 61.8 |
| 599 | 0.0 | 646 | 30.4 | 693 | 57.6 | 740 | 61.6 |
| 600 | 0.6 | 647 | 31.6 | 694 | 56.9 | 741 | 61.2 |
| 601 | 1.9 | 648 | 32.8 | 695 | 56.3 | 742 | 60.8 |
| 602 | 2.7 | 649 | 34.0 | 696 | 55.7 | 743 | 60.4 |
| 603 | 5.2 | 650 | 35.1 | 697 | 55.3 | 744 | 59.9 |
| 604 | 7.0 | 651 | 36.3 | 698 | 55.0 | 745 | 59.4 |
| 605 | 9.6 | 652 | 37.4 | 699 | 54.7 | 746 | 58.9 |
| 606 | 11.4 | 653 | 38.6 | 700 | 54.5 | 747 | 58.6 |
| 607 | 14.1 | 654 | 39.6 | 701 | 54.4 | 748 | 58.2 |
| 608 | 15.8 | 655 | 40.6 | 702 | 54.3 | 749 | 57.9 |
| 609 | 18.2 | 656 | 41.6 | 703 | 54.2 | 750 | 57.7 |
| 610 | 19.7 | 657 | 42.4 | 704 | 54.1 | 751 | 57.5 |
| 611 | 21.8 | 658 | 43.0 | 705 | 53.8 | 752 | 57.2 |
| 612 | 23.2 | 659 | 43.6 | 706 | 53.5 | 753 | 57.0 |
| 613 | 24.7 | 660 | 44.0 | 707 | 53.0 | 754 | 56.8 |
| 614 | 25.8 | 661 | 44.4 | 708 | 52.6 | 755 | 56.6 |
| 615 | 26.7 | 662 | 44.8 | 709 | 52.2 | 756 | 56.6 |
| 616 | 27.2 | 663 | 45.2 | 710 | 51.9 | 757 | 56.7 |
| 617 | 27.7 | 664 | 45.6 | 711 | 51.7 | 758 | 57.1 |
| 618 | 28.1 | 665 | 46.0 | 712 | 51.7 | 759 | 57.6 |
| 619 | 28.4 | 666 | 46.5 | 713 | 51.8 | 760 | 58.2 |
| 620 | 28.7 | 667 | 47.0 | 714 | 52.0 | 761 | 59.0 |
| 621 | 29.0 | 668 | 47.5 | 715 | 52.3 | 762 | 59.8 |
| 622 | 29.2 | 669 | 48.0 | 716 | 52.6 | 763 | 60.6 |
| 623 | 29.4 | 670 | 48.6 | 717 | 52.9 | 764 | 61.4 |
| 624 | 29.4 | 671 | 49.1 | 718 | 53.1 | 765 | 62.2 |
| 625 | 29.3 | 672 | 49.7 | 719 | 53.2 | 766 | 62.9 |
| 626 | 28.9 | 673 | 50.2 | 720 | 53.3 | 767 | 63.5 |
| 627 | 28.5 | 674 | 50.8 | 721 | 53.3 | 768 | 64.2 |
| 628 | 28.1 | 675 | 51.3 | 722 | 53.4 | 769 | 64.4 |
| 629 | 27.6 | 676 | 51.8 | 723 | 53.5 | 770 | 64.4 |
| 630 | 26.9 | 677 | 52.3 | 724 | 53.7 | 771 | 64.0 |
| 631 | 26.0 | 678 | 52.9 | 725 | 54.0 | 772 | 63.5 |
| 632 | 24.6 | 679 | 53.4 | 726 | 54.4 | 773 | 62.9 |
| 633 | 22.8 | 680 | 54.0 | 727 | 54.9 | 774 | 62.4 |
| 634 | 21.0 | 681 | 54.5 | 728 | 55.6 | 775 | 62.0 |
| 635 | 19.5 | 682 | 55.1 | 729 | 56.3 | 776 | 61.6 |
| 636 | 18.6 | 683 | 55.6 | 730 | 57.1 | 777 | 61.4 |
| 778 | 61.2 | 827 | 49.7 | 876 | 53.2 | 925 | 44.4 |
| 779 | 61.0 | 828 | 50.6 | 877 | 53.1 | 926 | 44.5 |
| 780 | 60.7 | 829 | 51.6 | 878 | 53.0 | 927 | 44.6 |
| 781 | 60.2 | 830 | 52.5 | 879 | 53.0 | 928 | 44.7 |
| 782 | 59.6 | 831 | 53.3 | 880 | 53.0 | 929 | 44.6 |
| 783 | 58.9 | 832 | 54.1 | 881 | 53.0 | 930 | 44.5 |
| 784 | 58.1 | 833 | 54.7 | 882 | 53.0 | 931 | 44.4 |
| 785 | 57.2 | 834 | 55.3 | 883 | 53.0 | 932 | 44.2 |
| 786 | 56.3 | 835 | 55.7 | 884 | 52.8 | 933 | 44.1 |
| 787 | 55.3 | 836 | 56.1 | 885 | 52.5 | 934 | 43.7 |
| 788 | 54.4 | 837 | 56.4 | 886 | 51.9 | 935 | 43.3 |
| 789 | 53.4 | 838 | 56.7 | 887 | 51.1 | 936 | 42.8 |
| 790 | 52.4 | 839 | 57.1 | 888 | 50.2 | 937 | 42.3 |
| 791 | 51.4 | 840 | 57.5 | 889 | 49.2 | 938 | 41.6 |
| 792 | 50.4 | 841 | 58.0 | 890 | 48.2 | 939 | 40.7 |
| 793 | 49.4 | 842 | 58.7 | 891 | 47.3 | 940 | 39.8 |
| 794 | 48.5 | 843 | 59.3 | 892 | 46.4 | 941 | 38.8 |
| 795 | 47.5 | 844 | 60.0 | 893 | 45.6 | 942 | 37.8 |
| 796 | 46.5 | 845 | 60.6 | 894 | 45.0 | 943 | 36.9 |
| 797 | 45.4 | 846 | 61.3 | 895 | 44.3 | 944 | 36.1 |
| 798 | 44.3 | 847 | 61.5 | 896 | 43.8 | 945 | 35.5 |
| 799 | 43.1 | 848 | 61.5 | 897 | 43.3 | 946 | 35.0 |
| 800 | 42.0 | 849 | 61.4 | 898 | 42.8 | 947 | 34.7 |
| 801 | 40.8 | 850 | 61.2 | 899 | 42.4 | 948 | 34.4 |
| 802 | 39.7 | 851 | 60.5 | 900 | 42.0 | 949 | 34.1 |
| 803 | 38.8 | 852 | 60.0 | 901 | 41.6 | 950 | 33.9 |
| 804 | 38.1 | 853 | 59.5 | 902 | 41.1 | 951 | 33.6 |
| 805 | 37.4 | 854 | 58.9 | 903 | 40.3 | 952 | 33.3 |
| 806 | 37.1 | 855 | 58.4 | 904 | 39.5 | 953 | 33.0 |
| 807 | 36.9 | 856 | 57.9 | 905 | 38.6 | 954 | 32.7 |
| 808 | 37.0 | 857 | 57.5 | 906 | 37.7 | 955 | 32.3 |
| 809 | 37.5 | 858 | 57.1 | 907 | 36.7 | 956 | 31.9 |
| 810 | 37.8 | 859 | 56.7 | 908 | 36.2 | 957 | 31.5 |
| 811 | 38.2 | 860 | 56.4 | 909 | 36.0 | 958 | 31.0 |
| 812 | 38.6 | 861 | 56.1 | 910 | 36.2 | 959 | 30.6 |
| 813 | 39.1 | 862 | 55.8 | 911 | 37.0 | 960 | 30.2 |
| 814 | 39.6 | 863 | 55.5 | 912 | 38.0 | 961 | 29.7 |
| 815 | 40.1 | 864 | 55.3 | 913 | 39.0 | 962 | 29.1 |
| 816 | 40.7 | 865 | 55.0 | 914 | 39.7 | 963 | 28.4 |
| 817 | 41.3 | 866 | 54.7 | 915 | 40.2 | 964 | 27.6 |
| 818 | 41.9 | 867 | 54.4 | 916 | 40.7 | 965 | 26.8 |
| 819 | 42.7 | 868 | 54.2 | 917 | 41.2 | 966 | 26.0 |
| 820 | 43.4 | 869 | 54.0 | 918 | 41.7 | 967 | 25.1 |
| 821 | 44.2 | 870 | 53.9 | 919 | 42.2 | 968 | 24.2 |
| 822 | 45.0 | 871 | 53.7 | 920 | 42.7 | 969 | 23.3 |
| 823 | 45.9 | 872 | 53.6 | 921 | 43.2 | 970 | 22.4 |
| 824 | 46.8 | 873 | 53.5 | 922 | 43.6 | 971 | 21.5 |
| 825 | 47.7 | 874 | 53.4 | 923 | 44.0 | 972 | 20.6 |
| 826 | 48.7 | 875 | 53.3 | 924 | 44.2 | 973 | 19.7 |
| 974 | 18.8 |  |  |  |  |  |  |
| 975 | 17.7 |  |  |  |  |  |  |
| 976 | 16.4 |  |  |  |  |  |  |
| 977 | 14.9 |  |  |  |  |  |  |
| 978 | 13.2 |  |  |  |  |  |  |
| 979 | 11.3 |  |  |  |  |  |  |
| 980 | 9.4 |  |  |  |  |  |  |
| 981 | 7.5 |  |  |  |  |  |  |
| 982 | 5.6 |  |  |  |  |  |  |
| 983 | 3.7 |  |  |  |  |  |  |
| 984 | 1.9 |  |  |  |  |  |  |
| 985 | 1.0 |  |  |  |  |  |  |
| 986 | 0.0 |  |  |  |  |  |  |
| 987 | 0.0 |  |  |  |  |  |  |
| 988 | 0.0 |  |  |  |  |  |  |
| 989 | 0.0 |  |  |  |  |  |  |
| 990 | 0.0 |  |  |  |  |  |  |
| 991 | 0.0 |  |  |  |  |  |  |
| 992 | 0.0 |  |  |  |  |  |  |
| 993 | 0.0 |  |  |  |  |  |  |
| 994 | 0.0 |  |  |  |  |  |  |
| 995 | 0.0 |  |  |  |  |  |  |
| 996 | 0.0 |  |  |  |  |  |  |
| 997 | 0.0 |  |  |  |  |  |  |
| 998 | 0.0 |  |  |  |  |  |  |
| 999 | 0.0 |  |  |  |  |  |  |
| 1000 | 0.0 |  |  |  |  |  |  |
| 1001 | 0.0 |  |  |  |  |  |  |
| 1002 | 0.0 |  |  |  |  |  |  |
| 1003 | 0.0 |  |  |  |  |  |  |
| 1004 | 0.0 |  |  |  |  |  |  |
| 1005 | 0.0 |  |  |  |  |  |  |
| 1006 | 0.0 |  |  |  |  |  |  |
| 1007 | 0.0 |  |  |  |  |  |  |
| 1008 | 0.0 |  |  |  |  |  |  |
| 1009 | 0.0 |  |  |  |  |  |  |
| 1010 | 0.0 |  |  |  |  |  |  |
| 1011 | 0.0 |  |  |  |  |  |  |
| 1012 | 0.0 |  |  |  |  |  |  |
| 1013 | 0.0 |  |  |  |  |  |  |
| 1014 | 0.0 |  |  |  |  |  |  |
| 1015 | 0.0 |  |  |  |  |  |  |
| 1016 | 0.0 |  |  |  |  |  |  |
| 1017 | 0.0 |  |  |  |  |  |  |
| 1018 | 0.0 |  |  |  |  |  |  |
| 1019 | 0.0 |  |  |  |  |  |  |
| 1020 | 0.0 |  |  |  |  |  |  |
| 1021 | 0.0 |  |  |  |  |  |  |
| 1022 | 0.0 |  |  |  |  |  |  |

# Table A1/2b

# **WLTC, Class 1 cycle, phase Low12 (Second 1022 is the end of phase Medium1 and the start of phase Low12)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1023 | 0.0 | 1070 | 19.5 | 1117 | 0.0 | 1164 | 35.9 |
| 1024 | 0.0 | 1071 | 20.2 | 1118 | 0.0 | 1165 | 36.6 |
| 1025 | 0.0 | 1072 | 20.9 | 1119 | 0.0 | 1166 | 37.5 |
| 1026 | 0.0 | 1073 | 21.7 | 1120 | 0.0 | 1167 | 38.4 |
| 1027 | 0.0 | 1074 | 22.4 | 1121 | 0.0 | 1168 | 39.3 |
| 1028 | 0.0 | 1075 | 23.1 | 1122 | 0.0 | 1169 | 40.0 |
| 1029 | 0.0 | 1076 | 23.7 | 1123 | 0.0 | 1170 | 40.6 |
| 1030 | 0.0 | 1077 | 24.4 | 1124 | 0.0 | 1171 | 41.1 |
| 1031 | 0.0 | 1078 | 25.1 | 1125 | 0.0 | 1172 | 41.4 |
| 1032 | 0.0 | 1079 | 25.4 | 1126 | 0.0 | 1173 | 41.6 |
| 1033 | 0.0 | 1080 | 25.2 | 1127 | 0.0 | 1174 | 41.8 |
| 1034 | 0.2 | 1081 | 23.4 | 1128 | 0.0 | 1175 | 41.8 |
| 1035 | 3.1 | 1082 | 21.8 | 1129 | 0.0 | 1176 | 41.9 |
| 1036 | 5.7 | 1083 | 19.7 | 1130 | 0.7 | 1177 | 41.9 |
| 1037 | 8.0 | 1084 | 17.3 | 1131 | 1.1 | 1178 | 42.0 |
| 1038 | 10.1 | 1085 | 14.7 | 1132 | 1.9 | 1179 | 42.0 |
| 1039 | 12.0 | 1086 | 12.0 | 1133 | 2.5 | 1180 | 42.2 |
| 1040 | 13.8 | 1087 | 9.4 | 1134 | 3.5 | 1181 | 42.3 |
| 1041 | 15.4 | 1088 | 5.6 | 1135 | 4.7 | 1182 | 42.6 |
| 1042 | 16.7 | 1089 | 3.1 | 1136 | 6.1 | 1183 | 43.0 |
| 1043 | 17.7 | 1090 | 0.0 | 1137 | 7.5 | 1184 | 43.3 |
| 1044 | 18.3 | 1091 | 0.0 | 1138 | 9.4 | 1185 | 43.7 |
| 1045 | 18.8 | 1092 | 0.0 | 1139 | 11.0 | 1186 | 44.0 |
| 1046 | 18.9 | 1093 | 0.0 | 1140 | 12.9 | 1187 | 44.3 |
| 1047 | 18.4 | 1094 | 0.0 | 1141 | 14.5 | 1188 | 44.5 |
| 1048 | 16.9 | 1095 | 0.0 | 1142 | 16.4 | 1189 | 44.6 |
| 1049 | 14.3 | 1096 | 0.0 | 1143 | 18.0 | 1190 | 44.6 |
| 1050 | 10.8 | 1097 | 0.0 | 1144 | 20.0 | 1191 | 44.5 |
| 1051 | 7.1 | 1098 | 0.0 | 1145 | 21.5 | 1192 | 44.4 |
| 1052 | 4.0 | 1099 | 0.0 | 1146 | 23.5 | 1193 | 44.3 |
| 1053 | 0.0 | 1100 | 0.0 | 1147 | 25.0 | 1194 | 44.2 |
| 1054 | 0.0 | 1101 | 0.0 | 1148 | 26.8 | 1195 | 44.1 |
| 1055 | 0.0 | 1102 | 0.0 | 1149 | 28.2 | 1196 | 44.0 |
| 1056 | 0.0 | 1103 | 0.0 | 1150 | 30.0 | 1197 | 43.9 |
| 1057 | 1.5 | 1104 | 0.0 | 1151 | 31.4 | 1198 | 43.8 |
| 1058 | 3.8 | 1105 | 0.0 | 1152 | 32.5 | 1199 | 43.7 |
| 1059 | 5.6 | 1106 | 0.0 | 1153 | 33.2 | 1200 | 43.6 |
| 1060 | 7.5 | 1107 | 0.0 | 1154 | 33.4 | 1201 | 43.5 |
| 1061 | 9.2 | 1108 | 0.0 | 1155 | 33.7 | 1202 | 43.4 |
| 1062 | 10.8 | 1109 | 0.0 | 1156 | 33.9 | 1203 | 43.3 |
| 1063 | 12.4 | 1110 | 0.0 | 1157 | 34.2 | 1204 | 43.1 |
| 1064 | 13.8 | 1111 | 0.0 | 1158 | 34.4 | 1205 | 42.9 |
| 1065 | 15.2 | 1112 | 0.0 | 1159 | 34.7 | 1206 | 42.7 |
| 1066 | 16.3 | 1113 | 0.0 | 1160 | 34.9 | 1207 | 42.5 |
| 1067 | 17.3 | 1114 | 0.0 | 1161 | 35.2 | 1208 | 42.3 |
| 1068 | 18.0 | 1115 | 0.0 | 1162 | 35.4 | 1209 | 42.2 |
| 1069 | 18.8 | 1116 | 0.0 | 1163 | 35.7 | 1210 | 42.2 |
| 1211 | 42.2 | 1260 | 39.9 | 1309 | 24.9 | 1358 | 14.3 |
| 1212 | 42.3 | 1261 | 40.0 | 1310 | 24.5 | 1359 | 14.0 |
| 1213 | 42.4 | 1262 | 40.1 | 1311 | 24.2 | 1360 | 13.0 |
| 1214 | 42.5 | 1263 | 40.2 | 1312 | 24.0 | 1361 | 11.4 |
| 1215 | 42.7 | 1264 | 40.3 | 1313 | 23.8 | 1362 | 10.2 |
| 1216 | 42.9 | 1265 | 40.4 | 1314 | 23.6 | 1363 | 8.0 |
| 1217 | 43.1 | 1266 | 40.5 | 1315 | 23.5 | 1364 | 7.0 |
| 1218 | 43.2 | 1267 | 40.5 | 1316 | 23.4 | 1365 | 6.0 |
| 1219 | 43.3 | 1268 | 40.4 | 1317 | 23.3 | 1366 | 5.5 |
| 1220 | 43.4 | 1269 | 40.3 | 1318 | 23.3 | 1367 | 5.0 |
| 1221 | 43.4 | 1270 | 40.2 | 1319 | 23.2 | 1368 | 4.5 |
| 1222 | 43.2 | 1271 | 40.1 | 1320 | 23.1 | 1369 | 4.0 |
| 1223 | 42.9 | 1272 | 39.7 | 1321 | 23.0 | 1370 | 3.5 |
| 1224 | 42.6 | 1273 | 38.8 | 1322 | 22.8 | 1371 | 3.0 |
| 1225 | 42.2 | 1274 | 37.4 | 1323 | 22.5 | 1372 | 2.5 |
| 1226 | 41.9 | 1275 | 35.6 | 1324 | 22.1 | 1373 | 2.0 |
| 1227 | 41.5 | 1276 | 33.4 | 1325 | 21.7 | 1374 | 1.5 |
| 1228 | 41.0 | 1277 | 31.2 | 1326 | 21.1 | 1375 | 1.0 |
| 1229 | 40.5 | 1278 | 29.1 | 1327 | 20.4 | 1376 | 0.5 |
| 1230 | 39.9 | 1279 | 27.6 | 1328 | 19.5 | 1377 | 0.0 |
| 1231 | 39.3 | 1280 | 26.6 | 1329 | 18.5 | 1378 | 0.0 |
| 1232 | 38.7 | 1281 | 26.2 | 1330 | 17.6 | 1379 | 0.0 |
| 1233 | 38.1 | 1282 | 26.3 | 1331 | 16.6 | 1380 | 0.0 |
| 1234 | 37.5 | 1283 | 26.7 | 1332 | 15.7 | 1381 | 0.0 |
| 1235 | 36.9 | 1284 | 27.5 | 1333 | 14.9 | 1382 | 0.0 |
| 1236 | 36.3 | 1285 | 28.4 | 1334 | 14.3 | 1383 | 2.2 |
| 1237 | 35.7 | 1286 | 29.4 | 1335 | 14.1 | 1384 | 4.5 |
| 1238 | 35.1 | 1287 | 30.4 | 1336 | 14.0 | 1385 | 6.6 |
| 1239 | 34.5 | 1288 | 31.2 | 1337 | 13.9 | 1386 | 8.6 |
| 1240 | 33.9 | 1289 | 31.9 | 1338 | 13.8 | 1387 | 10.6 |
| 1241 | 33.6 | 1290 | 32.5 | 1339 | 13.7 | 1388 | 12.5 |
| 1242 | 33.5 | 1291 | 33.0 | 1340 | 13.6 | 1389 | 14.4 |
| 1243 | 33.6 | 1292 | 33.4 | 1341 | 13.5 | 1390 | 16.3 |
| 1244 | 33.9 | 1293 | 33.8 | 1342 | 13.4 | 1391 | 17.9 |
| 1245 | 34.3 | 1294 | 34.1 | 1343 | 13.3 | 1392 | 19.1 |
| 1246 | 34.7 | 1295 | 34.3 | 1344 | 13.2 | 1393 | 19.9 |
| 1247 | 35.1 | 1296 | 34.3 | 1345 | 13.2 | 1394 | 20.3 |
| 1248 | 35.5 | 1297 | 33.9 | 1346 | 13.2 | 1395 | 20.5 |
| 1249 | 35.9 | 1298 | 33.3 | 1347 | 13.4 | 1396 | 20.7 |
| 1250 | 36.4 | 1299 | 32.6 | 1348 | 13.5 | 1397 | 21.0 |
| 1251 | 36.9 | 1300 | 31.8 | 1349 | 13.7 | 1398 | 21.6 |
| 1252 | 37.4 | 1301 | 30.7 | 1350 | 13.8 | 1399 | 22.6 |
| 1253 | 37.9 | 1302 | 29.6 | 1351 | 14.0 | 1400 | 23.7 |
| 1254 | 38.3 | 1303 | 28.6 | 1352 | 14.1 | 1401 | 24.8 |
| 1255 | 38.7 | 1304 | 27.8 | 1353 | 14.3 | 1402 | 25.7 |
| 1256 | 39.1 | 1305 | 27.0 | 1354 | 14.4 | 1403 | 26.2 |
| 1257 | 39.3 | 1306 | 26.4 | 1355 | 14.4 | 1404 | 26.4 |
| 1258 | 39.5 | 1307 | 25.8 | 1356 | 14.4 | 1405 | 26.4 |
| 1259 | 39.7 | 1308 | 25.3 | 1357 | 14.3 | 1406 | 26.4 |
| 1407 | 26.5 | 1456 | 0.0 | 1505 | 4.6 | 1554 | 48.5 |
| 1408 | 26.6 | 1457 | 0.0 | 1506 | 6.1 | 1555 | 48.7 |
| 1409 | 26.8 | 1458 | 0.0 | 1507 | 7.8 | 1556 | 48.9 |
| 1410 | 26.9 | 1459 | 0.0 | 1508 | 9.5 | 1557 | 49.1 |
| 1411 | 27.2 | 1460 | 0.0 | 1509 | 11.3 | 1558 | 49.1 |
| 1412 | 27.5 | 1461 | 0.0 | 1510 | 13.2 | 1559 | 49.0 |
| 1413 | 28.0 | 1462 | 0.0 | 1511 | 15.0 | 1560 | 48.8 |
| 1414 | 28.8 | 1463 | 0.0 | 1512 | 16.8 | 1561 | 48.6 |
| 1415 | 29.9 | 1464 | 0.0 | 1513 | 18.4 | 1562 | 48.5 |
| 1416 | 31.0 | 1465 | 0.0 | 1514 | 20.1 | 1563 | 48.4 |
| 1417 | 31.9 | 1466 | 0.0 | 1515 | 21.6 | 1564 | 48.3 |
| 1418 | 32.5 | 1467 | 0.0 | 1516 | 23.1 | 1565 | 48.2 |
| 1419 | 32.6 | 1468 | 0.0 | 1517 | 24.6 | 1566 | 48.1 |
| 1420 | 32.4 | 1469 | 0.0 | 1518 | 26.0 | 1567 | 47.5 |
| 1421 | 32.0 | 1470 | 0.0 | 1519 | 27.5 | 1568 | 46.7 |
| 1422 | 31.3 | 1471 | 0.0 | 1520 | 29.0 | 1569 | 45.7 |
| 1423 | 30.3 | 1472 | 0.0 | 1521 | 30.6 | 1570 | 44.6 |
| 1424 | 28.0 | 1473 | 0.0 | 1522 | 32.1 | 1571 | 42.9 |
| 1425 | 27.0 | 1474 | 0.0 | 1523 | 33.7 | 1572 | 40.8 |
| 1426 | 24.0 | 1475 | 0.0 | 1524 | 35.3 | 1573 | 38.2 |
| 1427 | 22.5 | 1476 | 0.0 | 1525 | 36.8 | 1574 | 35.3 |
| 1428 | 19.0 | 1477 | 0.0 | 1526 | 38.1 | 1575 | 31.8 |
| 1429 | 17.5 | 1478 | 0.0 | 1527 | 39.3 | 1576 | 28.7 |
| 1430 | 14.0 | 1479 | 0.0 | 1528 | 40.4 | 1577 | 25.8 |
| 1431 | 12.5 | 1480 | 0.0 | 1529 | 41.2 | 1578 | 22.9 |
| 1432 | 9.0 | 1481 | 0.0 | 1530 | 41.9 | 1579 | 20.2 |
| 1433 | 7.5 | 1482 | 0.0 | 1531 | 42.6 | 1580 | 17.3 |
| 1434 | 4.0 | 1483 | 0.0 | 1532 | 43.3 | 1581 | 15.0 |
| 1435 | 2.9 | 1484 | 0.0 | 1533 | 44.0 | 1582 | 12.3 |
| 1436 | 0.0 | 1485 | 0.0 | 1534 | 44.6 | 1583 | 10.3 |
| 1437 | 0.0 | 1486 | 0.0 | 1535 | 45.3 | 1584 | 7.8 |
| 1438 | 0.0 | 1487 | 0.0 | 1536 | 45.5 | 1585 | 6.5 |
| 1439 | 0.0 | 1488 | 0.0 | 1537 | 45.5 | 1586 | 4.4 |
| 1440 | 0.0 | 1489 | 0.0 | 1538 | 45.2 | 1587 | 3.2 |
| 1441 | 0.0 | 1490 | 0.0 | 1539 | 44.7 | 1588 | 1.2 |
| 1442 | 0.0 | 1491 | 0.0 | 1540 | 44.2 | 1589 | 0.0 |
| 1443 | 0.0 | 1492 | 0.0 | 1541 | 43.6 | 1590 | 0.0 |
| 1444 | 0.0 | 1493 | 0.0 | 1542 | 43.1 | 1591 | 0.0 |
| 1445 | 0.0 | 1494 | 0.0 | 1543 | 42.8 | 1592 | 0.0 |
| 1446 | 0.0 | 1495 | 0.0 | 1544 | 42.7 | 1593 | 0.0 |
| 1447 | 0.0 | 1496 | 0.0 | 1545 | 42.8 | 1594 | 0.0 |
| 1448 | 0.0 | 1497 | 0.0 | 1546 | 43.3 | 1595 | 0.0 |
| 1449 | 0.0 | 1498 | 0.0 | 1547 | 43.9 | 1596 | 0.0 |
| 1450 | 0.0 | 1499 | 0.0 | 1548 | 44.6 | 1597 | 0.0 |
| 1451 | 0.0 | 1500 | 0.0 | 1549 | 45.4 | 1598 | 0.0 |
| 1452 | 0.0 | 1501 | 0.0 | 1550 | 46.3 | 1599 | 0.0 |
| 1453 | 0.0 | 1502 | 0.0 | 1551 | 47.2 | 1600 | 0.0 |
| 1454 | 0.0 | 1503 | 1.6 | 1552 | 47.8 | 1601 | 0.0 |
| 1455 | 0.0 | 1504 | 3.1 | 1553 | 48.2 | 1602 | 0.0 |
| 1603 | 0.0 |  |  |  |  |  |  |
| 1604 | 0.0 |  |  |  |  |  |  |
| 1605 | 0.0 |  |  |  |  |  |  |
| 1606 | 0.0 |  |  |  |  |  |  |
| 1607 | 0.0 |  |  |  |  |  |  |
| 1608 | 0.0 |  |  |  |  |  |  |
| 1609 | 0.0 |  |  |  |  |  |  |
| 1610 | 0.0 |  |  |  |  |  |  |
| 1611 | 0.0 |  |  |  |  |  |  |
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5. WLTC Class 2 cycle

# Figure A1/3

# **WLTC, Class 2 cycle, phase Low2**

# 

# Figure A1/4

# **WLTC, Class 2 cycle, phase Medium2**

# 

# Figure A1/5

# **WLTC, Class 2 cycle, phase High2**

# 

# Figure A1/6

# **WLTC, Class 2 cycle, phase Extra High2**



# Table A1/3

# **WLTC, Class 2 cycle, phase Low2 (Second 589 is the end of phase Low1 and the start of phase Medium1)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0.0 | 47 | 11.6 | 94 | 0.0 | 141 | 36.8 |
| 1 | 0.0 | 48 | 12.4 | 95 | 0.0 | 142 | 35.1 |
| 2 | 0.0 | 49 | 13.2 | 96 | 0.0 | 143 | 32.2 |
| 3 | 0.0 | 50 | 14.2 | 97 | 0.0 | 144 | 31.1 |
| 4 | 0.0 | 51 | 14.8 | 98 | 0.0 | 145 | 30.8 |
| 5 | 0.0 | 52 | 14.7 | 99 | 0.0 | 146 | 29.7 |
| 6 | 0.0 | 53 | 14.4 | 100 | 0.0 | 147 | 29.4 |
| 7 | 0.0 | 54 | 14.1 | 101 | 0.0 | 148 | 29.0 |
| 8 | 0.0 | 55 | 13.6 | 102 | 0.0 | 149 | 28.5 |
| 9 | 0.0 | 56 | 13.0 | 103 | 0.0 | 150 | 26.0 |
| 10 | 0.0 | 57 | 12.4 | 104 | 0.0 | 151 | 23.4 |
| 11 | 0.0 | 58 | 11.8 | 105 | 0.0 | 152 | 20.7 |
| 12 | 0.0 | 59 | 11.2 | 106 | 0.0 | 153 | 17.4 |
| 13 | 1.2 | 60 | 10.6 | 107 | 0.8 | 154 | 15.2 |
| 14 | 2.6 | 61 | 9.9 | 108 | 1.4 | 155 | 13.5 |
| 15 | 4.9 | 62 | 9.0 | 109 | 2.3 | 156 | 13.0 |
| 16 | 7.3 | 63 | 8.2 | 110 | 3.5 | 157 | 12.4 |
| 17 | 9.4 | 64 | 7.0 | 111 | 4.7 | 158 | 12.3 |
| 18 | 11.4 | 65 | 4.8 | 112 | 5.9 | 159 | 12.2 |
| 19 | 12.7 | 66 | 2.3 | 113 | 7.4 | 160 | 12.3 |
| 20 | 13.3 | 67 | 0.0 | 114 | 9.2 | 161 | 12.4 |
| 21 | 13.4 | 68 | 0.0 | 115 | 11.7 | 162 | 12.5 |
| 22 | 13.3 | 69 | 0.0 | 116 | 13.5 | 163 | 12.7 |
| 23 | 13.1 | 70 | 0.0 | 117 | 15.0 | 164 | 12.8 |
| 24 | 12.5 | 71 | 0.0 | 118 | 16.2 | 165 | 13.2 |
| 25 | 11.1 | 72 | 0.0 | 119 | 16.8 | 166 | 14.3 |
| 26 | 8.9 | 73 | 0.0 | 120 | 17.5 | 167 | 16.5 |
| 27 | 6.2 | 74 | 0.0 | 121 | 18.8 | 168 | 19.4 |
| 28 | 3.8 | 75 | 0.0 | 122 | 20.3 | 169 | 21.7 |
| 29 | 1.8 | 76 | 0.0 | 123 | 22.0 | 170 | 23.1 |
| 30 | 0.0 | 77 | 0.0 | 124 | 23.6 | 171 | 23.5 |
| 31 | 0.0 | 78 | 0.0 | 125 | 24.8 | 172 | 24.2 |
| 32 | 0.0 | 79 | 0.0 | 126 | 25.6 | 173 | 24.8 |
| 33 | 0.0 | 80 | 0.0 | 127 | 26.3 | 174 | 25.4 |
| 34 | 1.5 | 81 | 0.0 | 128 | 27.2 | 175 | 25.8 |
| 35 | 2.8 | 82 | 0.0 | 129 | 28.3 | 176 | 26.5 |
| 36 | 3.6 | 83 | 0.0 | 130 | 29.6 | 177 | 27.2 |
| 37 | 4.5 | 84 | 0.0 | 131 | 30.9 | 178 | 28.3 |
| 38 | 5.3 | 85 | 0.0 | 132 | 32.2 | 179 | 29.9 |
| 39 | 6.0 | 86 | 0.0 | 133 | 33.4 | 180 | 32.4 |
| 40 | 6.6 | 87 | 0.0 | 134 | 35.1 | 181 | 35.1 |
| 41 | 7.3 | 88 | 0.0 | 135 | 37.2 | 182 | 37.5 |
| 42 | 7.9 | 89 | 0.0 | 136 | 38.7 | 183 | 39.2 |
| 43 | 8.6 | 90 | 0.0 | 137 | 39.0 | 184 | 40.5 |
| 44 | 9.3 | 91 | 0.0 | 138 | 40.1 | 185 | 41.4 |
| 45 | 10 | 92 | 0.0 | 139 | 40.4 | 186 | 42.0 |
| 46 | 10.8 | 93 | 0.0 | 140 | 39.7 | 187 | 42.5 |
| 188 | 43.2 | 237 | 33.5 | 286 | 32.5 | 335 | 25.0 |
| 189 | 44.4 | 238 | 35.8 | 287 | 30.9 | 336 | 24.6 |
| 190 | 45.9 | 239 | 37.6 | 288 | 28.6 | 337 | 23.9 |
| 191 | 47.6 | 240 | 38.8 | 289 | 25.9 | 338 | 23.0 |
| 192 | 49.0 | 241 | 39.6 | 290 | 23.1 | 339 | 21.8 |
| 193 | 50.0 | 242 | 40.1 | 291 | 20.1 | 340 | 20.7 |
| 194 | 50.2 | 243 | 40.9 | 292 | 17.3 | 341 | 19.6 |
| 195 | 50.1 | 244 | 41.8 | 293 | 15.1 | 342 | 18.7 |
| 196 | 49.8 | 245 | 43.3 | 294 | 13.7 | 343 | 18.1 |
| 197 | 49.4 | 246 | 44.7 | 295 | 13.4 | 344 | 17.5 |
| 198 | 48.9 | 247 | 46.4 | 296 | 13.9 | 345 | 16.7 |
| 199 | 48.5 | 248 | 47.9 | 297 | 15.0 | 346 | 15.4 |
| 200 | 48.3 | 249 | 49.6 | 298 | 16.3 | 347 | 13.6 |
| 201 | 48.2 | 250 | 49.6 | 299 | 17.4 | 348 | 11.2 |
| 202 | 47.9 | 251 | 48.8 | 300 | 18.2 | 349 | 8.6 |
| 203 | 47.1 | 252 | 48.0 | 301 | 18.6 | 350 | 6.0 |
| 204 | 45.5 | 253 | 47.5 | 302 | 19.0 | 351 | 3.1 |
| 205 | 43.2 | 254 | 47.1 | 303 | 19.4 | 352 | 1.2 |
| 206 | 40.6 | 255 | 46.9 | 304 | 19.8 | 353 | 0.0 |
| 207 | 38.5 | 256 | 45.8 | 305 | 20.1 | 354 | 0.0 |
| 208 | 36.9 | 257 | 45.8 | 306 | 20.5 | 355 | 0.0 |
| 209 | 35.9 | 258 | 45.8 | 307 | 20.2 | 356 | 0.0 |
| 210 | 35.3 | 259 | 45.9 | 308 | 18.6 | 357 | 0.0 |
| 211 | 34.8 | 260 | 46.2 | 309 | 16.5 | 358 | 0.0 |
| 212 | 34.5 | 261 | 46.4 | 310 | 14.4 | 359 | 0.0 |
| 213 | 34.2 | 262 | 46.6 | 311 | 13.4 | 360 | 1.4 |
| 214 | 34.0 | 263 | 46.8 | 312 | 12.9 | 361 | 3.2 |
| 215 | 33.8 | 264 | 47.0 | 313 | 12.7 | 362 | 5.6 |
| 216 | 33.6 | 265 | 47.3 | 314 | 12.4 | 363 | 8.1 |
| 217 | 33.5 | 266 | 47.5 | 315 | 12.4 | 364 | 10.3 |
| 218 | 33.5 | 267 | 47.9 | 316 | 12.8 | 365 | 12.1 |
| 219 | 33.4 | 268 | 48.3 | 317 | 14.1 | 366 | 12.6 |
| 220 | 33.3 | 269 | 48.3 | 318 | 16.2 | 367 | 13.6 |
| 221 | 33.3 | 270 | 48.2 | 319 | 18.8 | 368 | 14.5 |
| 222 | 33.2 | 271 | 48.0 | 320 | 21.9 | 369 | 15.6 |
| 223 | 33.1 | 272 | 47.7 | 321 | 25.0 | 370 | 16.8 |
| 224 | 33.0 | 273 | 47.2 | 322 | 28.4 | 371 | 18.2 |
| 225 | 32.9 | 274 | 46.5 | 323 | 31.3 | 372 | 19.6 |
| 226 | 32.8 | 275 | 45.2 | 324 | 34.0 | 373 | 20.9 |
| 227 | 32.7 | 276 | 43.7 | 325 | 34.6 | 374 | 22.3 |
| 228 | 32.5 | 277 | 42.0 | 326 | 33.9 | 375 | 23.8 |
| 229 | 32.3 | 278 | 40.4 | 327 | 31.9 | 376 | 25.4 |
| 230 | 31.8 | 279 | 39.0 | 328 | 30.0 | 377 | 27.0 |
| 231 | 31.4 | 280 | 37.7 | 329 | 29.0 | 378 | 28.6 |
| 232 | 30.9 | 281 | 36.4 | 330 | 27.9 | 379 | 30.2 |
| 233 | 30.6 | 282 | 35.2 | 331 | 27.1 | 380 | 31.2 |
| 234 | 30.6 | 283 | 34.3 | 332 | 26.4 | 381 | 31.2 |
| 235 | 30.7 | 284 | 33.8 | 333 | 25.9 | 382 | 30.7 |
| 236 | 32.0 | 285 | 33.3 | 334 | 25.5 | 383 | 29.5 |
| 384 | 28.6 | 433 | 0.0 | 482 | 2.5 | 531 | 26.0 |
| 385 | 27.7 | 434 | 0.0 | 483 | 5.2 | 532 | 26.5 |
| 386 | 26.9 | 435 | 0.0 | 484 | 7.9 | 533 | 26.9 |
| 387 | 26.1 | 436 | 0.0 | 485 | 10.3 | 534 | 27.3 |
| 388 | 25.4 | 437 | 0.0 | 486 | 12.7 | 535 | 27.9 |
| 389 | 24.6 | 438 | 0.0 | 487 | 15.0 | 536 | 30.3 |
| 390 | 23.6 | 439 | 0.0 | 488 | 17.4 | 537 | 33.2 |
| 391 | 22.6 | 440 | 0.0 | 489 | 19.7 | 538 | 35.4 |
| 392 | 21.7 | 441 | 0.0 | 490 | 21.9 | 539 | 38.0 |
| 393 | 20.7 | 442 | 0.0 | 491 | 24.1 | 540 | 40.1 |
| 394 | 19.8 | 443 | 0.0 | 492 | 26.2 | 541 | 42.7 |
| 395 | 18.8 | 444 | 0.0 | 493 | 28.1 | 542 | 44.5 |
| 396 | 17.7 | 445 | 0.0 | 494 | 29.7 | 543 | 46.3 |
| 397 | 16.6 | 446 | 0.0 | 495 | 31.3 | 544 | 47.6 |
| 398 | 15.6 | 447 | 0.0 | 496 | 33.0 | 545 | 48.8 |
| 399 | 14.8 | 448 | 0.0 | 497 | 34.7 | 546 | 49.7 |
| 400 | 14.3 | 449 | 0.0 | 498 | 36.3 | 547 | 50.6 |
| 401 | 13.8 | 450 | 0.0 | 499 | 38.1 | 548 | 51.4 |
| 402 | 13.4 | 451 | 0.0 | 500 | 39.4 | 549 | 51.4 |
| 403 | 13.1 | 452 | 0.0 | 501 | 40.4 | 550 | 50.2 |
| 404 | 12.8 | 453 | 0.0 | 502 | 41.2 | 551 | 47.1 |
| 405 | 12.3 | 454 | 0.0 | 503 | 42.1 | 552 | 44.5 |
| 406 | 11.6 | 455 | 0.0 | 504 | 43.2 | 553 | 41.5 |
| 407 | 10.5 | 456 | 0.0 | 505 | 44.3 | 554 | 38.5 |
| 408 | 9.0 | 457 | 0.0 | 506 | 45.7 | 555 | 35.5 |
| 409 | 7.2 | 458 | 0.0 | 507 | 45.4 | 556 | 32.5 |
| 410 | 5.2 | 459 | 0.0 | 508 | 44.5 | 557 | 29.5 |
| 411 | 2.9 | 460 | 0.0 | 509 | 42.5 | 558 | 26.5 |
| 412 | 1.2 | 461 | 0.0 | 510 | 39.5 | 559 | 23.5 |
| 413 | 0.0 | 462 | 0.0 | 511 | 36.5 | 560 | 20.4 |
| 414 | 0.0 | 463 | 0.0 | 512 | 33.5 | 561 | 17.5 |
| 415 | 0.0 | 464 | 0.0 | 513 | 30.4 | 562 | 14.5 |
| 416 | 0.0 | 465 | 0.0 | 514 | 27.0 | 563 | 11.5 |
| 417 | 0.0 | 466 | 0.0 | 515 | 23.6 | 564 | 8.5 |
| 418 | 0.0 | 467 | 0.0 | 516 | 21.0 | 565 | 5.6 |
| 419 | 0.0 | 468 | 0.0 | 517 | 19.5 | 566 | 2.6 |
| 420 | 0.0 | 469 | 0.0 | 518 | 17.6 | 567 | 0.0 |
| 421 | 0.0 | 470 | 0.0 | 519 | 16.1 | 568 | 0.0 |
| 422 | 0.0 | 471 | 0.0 | 520 | 14.5 | 569 | 0.0 |
| 423 | 0.0 | 472 | 0.0 | 521 | 13.5 | 570 | 0.0 |
| 424 | 0.0 | 473 | 0.0 | 522 | 13.7 | 571 | 0.0 |
| 425 | 0.0 | 474 | 0.0 | 523 | 16.0 | 572 | 0.0 |
| 426 | 0.0 | 475 | 0.0 | 524 | 18.1 | 573 | 0.0 |
| 427 | 0.0 | 476 | 0.0 | 525 | 20.8 | 574 | 0.0 |
| 428 | 0.0 | 477 | 0.0 | 526 | 21.5 | 575 | 0.0 |
| 429 | 0.0 | 478 | 0.0 | 527 | 22.5 | 576 | 0.0 |
| 430 | 0.0 | 479 | 0.0 | 528 | 23.4 | 577 | 0.0 |
| 431 | 0.0 | 480 | 0.0 | 529 | 24.5 | 578 | 0.0 |
| 432 | 0.0 | 481 | 1.4 | 530 | 25.6 | 579 | 0.0 |
| 580 | 0.0 |  |  |  |  |  |  |
| 581 | 0.0 |  |  |  |  |  |  |
| 582 | 0.0 |  |  |  |  |  |  |
| 583 | 0.0 |  |  |  |  |  |  |
| 584 | 0.0 |  |  |  |  |  |  |
| 585 | 0.0 |  |  |  |  |  |  |
| 586 | 0.0 |  |  |  |  |  |  |
| 587 | 0.0 |  |  |  |  |  |  |
| 588 | 0.0 |  |  |  |  |  |  |
| 589 | 0.0 |  |  |  |  |  |  |
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# Table A1/4

# **WLTC, Class 2 cycle, phase Medium2 (The start of this phase is at second 589)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 590 | 0.0 | 637 | 38.6 | 684 | 59.3 | 731 | 55.3 |
| 591 | 0.0 | 638 | 39.8 | 685 | 60.2 | 732 | 55.1 |
| 592 | 0.0 | 639 | 40.6 | 686 | 61.3 | 733 | 54.8 |
| 593 | 0.0 | 640 | 41.1 | 687 | 62.4 | 734 | 54.6 |
| 594 | 0.0 | 641 | 41.9 | 688 | 63.4 | 735 | 54.5 |
| 595 | 0.0 | 642 | 42.8 | 689 | 64.4 | 736 | 54.3 |
| 596 | 0.0 | 643 | 44.3 | 690 | 65.4 | 737 | 53.9 |
| 597 | 0.0 | 644 | 45.7 | 691 | 66.3 | 738 | 53.4 |
| 598 | 0.0 | 645 | 47.4 | 692 | 67.2 | 739 | 52.6 |
| 599 | 0.0 | 646 | 48.9 | 693 | 68.0 | 740 | 51.5 |
| 600 | 0.0 | 647 | 50.6 | 694 | 68.8 | 741 | 50.2 |
| 601 | 1.6 | 648 | 52.0 | 695 | 69.5 | 742 | 48.7 |
| 602 | 3.6 | 649 | 53.7 | 696 | 70.1 | 743 | 47.0 |
| 603 | 6.3 | 650 | 55.0 | 697 | 70.6 | 744 | 45.1 |
| 604 | 9.0 | 651 | 56.8 | 698 | 71.0 | 745 | 43.0 |
| 605 | 11.8 | 652 | 58.0 | 699 | 71.6 | 746 | 40.6 |
| 606 | 14.2 | 653 | 59.8 | 700 | 72.2 | 747 | 38.1 |
| 607 | 16.6 | 654 | 61.1 | 701 | 72.8 | 748 | 35.4 |
| 608 | 18.5 | 655 | 62.4 | 702 | 73.5 | 749 | 32.7 |
| 609 | 20.8 | 656 | 63.0 | 703 | 74.1 | 750 | 30.0 |
| 610 | 23.4 | 657 | 63.5 | 704 | 74.3 | 751 | 27.5 |
| 611 | 26.9 | 658 | 63.0 | 705 | 74.3 | 752 | 25.3 |
| 612 | 30.3 | 659 | 62.0 | 706 | 73.7 | 753 | 23.4 |
| 613 | 32.8 | 660 | 60.4 | 707 | 71.9 | 754 | 22.0 |
| 614 | 34.1 | 661 | 58.6 | 708 | 70.5 | 755 | 20.8 |
| 615 | 34.2 | 662 | 56.7 | 709 | 68.9 | 756 | 19.8 |
| 616 | 33.6 | 663 | 55.0 | 710 | 67.4 | 757 | 18.9 |
| 617 | 32.1 | 664 | 53.7 | 711 | 66.0 | 758 | 18.0 |
| 618 | 30.0 | 665 | 52.7 | 712 | 64.7 | 759 | 17.0 |
| 619 | 27.5 | 666 | 51.9 | 713 | 63.7 | 760 | 16.1 |
| 620 | 25.1 | 667 | 51.4 | 714 | 62.9 | 761 | 15.5 |
| 621 | 22.8 | 668 | 51.0 | 715 | 62.2 | 762 | 14.4 |
| 622 | 20.5 | 669 | 50.7 | 716 | 61.7 | 763 | 14.9 |
| 623 | 17.9 | 670 | 50.6 | 717 | 61.2 | 764 | 15.9 |
| 624 | 15.1 | 671 | 50.8 | 718 | 60.7 | 765 | 17.1 |
| 625 | 13.4 | 672 | 51.2 | 719 | 60.3 | 766 | 18.3 |
| 626 | 12.8 | 673 | 51.7 | 720 | 59.9 | 767 | 19.4 |
| 627 | 13.7 | 674 | 52.3 | 721 | 59.6 | 768 | 20.4 |
| 628 | 16.0 | 675 | 53.1 | 722 | 59.3 | 769 | 21.2 |
| 629 | 18.1 | 676 | 53.8 | 723 | 59.0 | 770 | 21.9 |
| 630 | 20.8 | 677 | 54.5 | 724 | 58.6 | 771 | 22.7 |
| 631 | 23.7 | 678 | 55.1 | 725 | 58.0 | 772 | 23.4 |
| 632 | 26.5 | 679 | 55.9 | 726 | 57.5 | 773 | 24.2 |
| 633 | 29.3 | 680 | 56.5 | 727 | 56.9 | 774 | 24.3 |
| 634 | 32.0 | 681 | 57.1 | 728 | 56.3 | 775 | 24.2 |
| 635 | 34.5 | 682 | 57.8 | 729 | 55.9 | 776 | 24.1 |
| 636 | 36.8 | 683 | 58.5 | 730 | 55.6 | 777 | 23.8 |
| 778 | 23.0 | 827 | 59.9 | 876 | 46.9 | 925 | 49.0 |
| 779 | 22.6 | 828 | 60.7 | 877 | 47.1 | 926 | 48.5 |
| 780 | 21.7 | 829 | 61.4 | 878 | 47.5 | 927 | 48.0 |
| 781 | 21.3 | 830 | 62.0 | 879 | 47.8 | 928 | 47.5 |
| 782 | 20.3 | 831 | 62.5 | 880 | 48.3 | 929 | 47.0 |
| 783 | 19.1 | 832 | 62.9 | 881 | 48.8 | 930 | 46.9 |
| 784 | 18.1 | 833 | 63.2 | 882 | 49.5 | 931 | 46.8 |
| 785 | 16.9 | 834 | 63.4 | 883 | 50.2 | 932 | 46.8 |
| 786 | 16.0 | 835 | 63.7 | 884 | 50.8 | 933 | 46.8 |
| 787 | 14.8 | 836 | 64.0 | 885 | 51.4 | 934 | 46.9 |
| 788 | 14.5 | 837 | 64.4 | 886 | 51.8 | 935 | 46.9 |
| 789 | 13.7 | 838 | 64.9 | 887 | 51.9 | 936 | 46.9 |
| 790 | 13.5 | 839 | 65.5 | 888 | 51.7 | 937 | 46.9 |
| 791 | 12.9 | 840 | 66.2 | 889 | 51.2 | 938 | 46.9 |
| 792 | 12.7 | 841 | 67.0 | 890 | 50.4 | 939 | 46.8 |
| 793 | 12.5 | 842 | 67.8 | 891 | 49.2 | 940 | 46.6 |
| 794 | 12.5 | 843 | 68.6 | 892 | 47.7 | 941 | 46.4 |
| 795 | 12.6 | 844 | 69.4 | 893 | 46.3 | 942 | 46.0 |
| 796 | 13.0 | 845 | 70.1 | 894 | 45.1 | 943 | 45.5 |
| 797 | 13.6 | 846 | 70.9 | 895 | 44.2 | 944 | 45.0 |
| 798 | 14.6 | 847 | 71.7 | 896 | 43.7 | 945 | 44.5 |
| 799 | 15.7 | 848 | 72.5 | 897 | 43.4 | 946 | 44.2 |
| 800 | 17.1 | 849 | 73.2 | 898 | 43.1 | 947 | 43.9 |
| 801 | 18.7 | 850 | 73.8 | 899 | 42.5 | 948 | 43.7 |
| 802 | 20.2 | 851 | 74.4 | 900 | 41.8 | 949 | 43.6 |
| 803 | 21.9 | 852 | 74.7 | 901 | 41.1 | 950 | 43.6 |
| 804 | 23.6 | 853 | 74.7 | 902 | 40.3 | 951 | 43.5 |
| 805 | 25.4 | 854 | 74.6 | 903 | 39.7 | 952 | 43.5 |
| 806 | 27.1 | 855 | 74.2 | 904 | 39.3 | 953 | 43.4 |
| 807 | 28.9 | 856 | 73.5 | 905 | 39.2 | 954 | 43.3 |
| 808 | 30.4 | 857 | 72.6 | 906 | 39.3 | 955 | 43.1 |
| 809 | 32.0 | 858 | 71.8 | 907 | 39.6 | 956 | 42.9 |
| 810 | 33.4 | 859 | 71.0 | 908 | 40.0 | 957 | 42.7 |
| 811 | 35.0 | 860 | 70.1 | 909 | 40.7 | 958 | 42.5 |
| 812 | 36.4 | 861 | 69.4 | 910 | 41.4 | 959 | 42.4 |
| 813 | 38.1 | 862 | 68.9 | 911 | 42.2 | 960 | 42.2 |
| 814 | 39.7 | 863 | 68.4 | 912 | 43.1 | 961 | 42.1 |
| 815 | 41.6 | 864 | 67.9 | 913 | 44.1 | 962 | 42.0 |
| 816 | 43.3 | 865 | 67.1 | 914 | 44.9 | 963 | 41.8 |
| 817 | 45.1 | 866 | 65.8 | 915 | 45.6 | 964 | 41.7 |
| 818 | 46.9 | 867 | 63.9 | 916 | 46.4 | 965 | 41.5 |
| 819 | 48.7 | 868 | 61.4 | 917 | 47.0 | 966 | 41.3 |
| 820 | 50.5 | 869 | 58.4 | 918 | 47.8 | 967 | 41.1 |
| 821 | 52.4 | 870 | 55.4 | 919 | 48.3 | 968 | 40.8 |
| 822 | 54.1 | 871 | 52.4 | 920 | 48.9 | 969 | 40.3 |
| 823 | 55.7 | 872 | 50.0 | 921 | 49.4 | 970 | 39.6 |
| 824 | 56.8 | 873 | 48.3 | 922 | 49.8 | 971 | 38.5 |
| 825 | 57.9 | 874 | 47.3 | 923 | 49.6 | 972 | 37.0 |
| 826 | 59.0 | 875 | 46.8 | 924 | 49.3 | 973 | 35.1 |
| 974 | 33.0 |  |  |  |  |  |  |
| 975 | 30.6 |  |  |  |  |  |  |
| 976 | 27.9 |  |  |  |  |  |  |
| 977 | 25.1 |  |  |  |  |  |  |
| 978 | 22.0 |  |  |  |  |  |  |
| 979 | 18.8 |  |  |  |  |  |  |
| 980 | 15.5 |  |  |  |  |  |  |
| 981 | 12.3 |  |  |  |  |  |  |
| 982 | 8.8 |  |  |  |  |  |  |
| 983 | 6.0 |  |  |  |  |  |  |
| 984 | 3.6 |  |  |  |  |  |  |
| 985 | 1.6 |  |  |  |  |  |  |
| 986 | 0.0 |  |  |  |  |  |  |
| 987 | 0.0 |  |  |  |  |  |  |
| 988 | 0.0 |  |  |  |  |  |  |
| 989 | 0.0 |  |  |  |  |  |  |
| 990 | 0.0 |  |  |  |  |  |  |
| 991 | 0.0 |  |  |  |  |  |  |
| 992 | 0.0 |  |  |  |  |  |  |
| 993 | 0.0 |  |  |  |  |  |  |
| 994 | 0.0 |  |  |  |  |  |  |
| 995 | 0.0 |  |  |  |  |  |  |
| 996 | 0.0 |  |  |  |  |  |  |
| 997 | 0.0 |  |  |  |  |  |  |
| 998 | 0.0 |  |  |  |  |  |  |
| 999 | 0.0 |  |  |  |  |  |  |
| 1000 | 0.0 |  |  |  |  |  |  |
| 1001 | 0.0 |  |  |  |  |  |  |
| 1002 | 0.0 |  |  |  |  |  |  |
| 1003 | 0.0 |  |  |  |  |  |  |
| 1004 | 0.0 |  |  |  |  |  |  |
| 1005 | 0.0 |  |  |  |  |  |  |
| 1006 | 0.0 |  |  |  |  |  |  |
| 1007 | 0.0 |  |  |  |  |  |  |
| 1008 | 0.0 |  |  |  |  |  |  |
| 1009 | 0.0 |  |  |  |  |  |  |
| 1010 | 0.0 |  |  |  |  |  |  |
| 1011 | 0.0 |  |  |  |  |  |  |
| 1012 | 0.0 |  |  |  |  |  |  |
| 1013 | 0.0 |  |  |  |  |  |  |
| 1014 | 0.0 |  |  |  |  |  |  |
| 1015 | 0.0 |  |  |  |  |  |  |
| 1016 | 0.0 |  |  |  |  |  |  |
| 1017 | 0.0 |  |  |  |  |  |  |
| 1018 | 0.0 |  |  |  |  |  |  |
| 1019 | 0.0 |  |  |  |  |  |  |
| 1020 | 0.0 |  |  |  |  |  |  |
| 1021 | 0.0 |  |  |  |  |  |  |
| 1022 | 0.0 |  |  |  |  |  |  |

# Table A1/5

# **WLTC, Class 2 cycle, phase High2 (Second 1022 is the end of phase Medium2 and the start of phase High2)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1023 | 0.0 | 1070 | 46.0 | 1117 | 73.9 | 1164 | 71.7 |
| 1024 | 0.0 | 1071 | 46.4 | 1118 | 74.9 | 1165 | 69.9 |
| 1025 | 0.0 | 1072 | 47.0 | 1119 | 75.7 | 1166 | 67.9 |
| 1026 | 0.0 | 1073 | 47.4 | 1120 | 76.4 | 1167 | 65.7 |
| 1027 | 1.1 | 1074 | 48.0 | 1121 | 77.1 | 1168 | 63.5 |
| 1028 | 3.0 | 1075 | 48.4 | 1122 | 77.6 | 1169 | 61.2 |
| 1029 | 5.7 | 1076 | 49.0 | 1123 | 78.0 | 1170 | 59.0 |
| 1030 | 8.4 | 1077 | 49.4 | 1124 | 78.2 | 1171 | 56.8 |
| 1031 | 11.1 | 1078 | 50.0 | 1125 | 78.4 | 1172 | 54.7 |
| 1032 | 14.0 | 1079 | 50.4 | 1126 | 78.5 | 1173 | 52.7 |
| 1033 | 17.0 | 1080 | 50.8 | 1127 | 78.5 | 1174 | 50.9 |
| 1034 | 20.1 | 1081 | 51.1 | 1128 | 78.6 | 1175 | 49.4 |
| 1035 | 22.7 | 1082 | 51.3 | 1129 | 78.7 | 1176 | 48.1 |
| 1036 | 23.6 | 1083 | 51.3 | 1130 | 78.9 | 1177 | 47.1 |
| 1037 | 24.5 | 1084 | 51.3 | 1131 | 79.1 | 1178 | 46.5 |
| 1038 | 24.8 | 1085 | 51.3 | 1132 | 79.4 | 1179 | 46.3 |
| 1039 | 25.1 | 1086 | 51.3 | 1133 | 79.8 | 1180 | 46.5 |
| 1040 | 25.3 | 1087 | 51.3 | 1134 | 80.1 | 1181 | 47.2 |
| 1041 | 25.5 | 1088 | 51.3 | 1135 | 80.5 | 1182 | 48.3 |
| 1042 | 25.7 | 1089 | 51.4 | 1136 | 80.8 | 1183 | 49.7 |
| 1043 | 25.8 | 1090 | 51.6 | 1137 | 81.0 | 1184 | 51.3 |
| 1044 | 25.9 | 1091 | 51.8 | 1138 | 81.2 | 1185 | 53.0 |
| 1045 | 26.0 | 1092 | 52.1 | 1139 | 81.3 | 1186 | 54.9 |
| 1046 | 26.1 | 1093 | 52.3 | 1140 | 81.2 | 1187 | 56.7 |
| 1047 | 26.3 | 1094 | 52.6 | 1141 | 81.0 | 1188 | 58.6 |
| 1048 | 26.5 | 1095 | 52.8 | 1142 | 80.6 | 1189 | 60.2 |
| 1049 | 26.8 | 1096 | 52.9 | 1143 | 80.0 | 1190 | 61.6 |
| 1050 | 27.1 | 1097 | 53.0 | 1144 | 79.1 | 1191 | 62.2 |
| 1051 | 27.5 | 1098 | 53.0 | 1145 | 78.0 | 1192 | 62.5 |
| 1052 | 28.0 | 1099 | 53.0 | 1146 | 76.8 | 1193 | 62.8 |
| 1053 | 28.6 | 1100 | 53.1 | 1147 | 75.5 | 1194 | 62.9 |
| 1054 | 29.3 | 1101 | 53.2 | 1148 | 74.1 | 1195 | 63.0 |
| 1055 | 30.4 | 1102 | 53.3 | 1149 | 72.9 | 1196 | 63.0 |
| 1056 | 31.8 | 1103 | 53.4 | 1150 | 71.9 | 1197 | 63.1 |
| 1057 | 33.7 | 1104 | 53.5 | 1151 | 71.2 | 1198 | 63.2 |
| 1058 | 35.8 | 1105 | 53.7 | 1152 | 70.9 | 1199 | 63.3 |
| 1059 | 37.8 | 1106 | 55.0 | 1153 | 71.0 | 1200 | 63.5 |
| 1060 | 39.5 | 1107 | 56.8 | 1154 | 71.5 | 1201 | 63.7 |
| 1061 | 40.8 | 1108 | 58.8 | 1155 | 72.3 | 1202 | 63.9 |
| 1062 | 41.8 | 1109 | 60.9 | 1156 | 73.2 | 1203 | 64.1 |
| 1063 | 42.4 | 1110 | 63.0 | 1157 | 74.1 | 1204 | 64.3 |
| 1064 | 43.0 | 1111 | 65.0 | 1158 | 74.9 | 1205 | 66.1 |
| 1065 | 43.4 | 1112 | 66.9 | 1159 | 75.4 | 1206 | 67.9 |
| 1066 | 44.0 | 1113 | 68.6 | 1160 | 75.5 | 1207 | 69.7 |
| 1067 | 44.4 | 1114 | 70.1 | 1161 | 75.2 | 1208 | 71.4 |
| 1068 | 45.0 | 1115 | 71.5 | 1162 | 74.5 | 1209 | 73.1 |
| 1069 | 45.4 | 1116 | 72.8 | 1163 | 73.3 | 1210 | 74.7 |
| 1211 | 76.2 | 1260 | 35.4 | 1309 | 72.3 | 1358 | 70.8 |
| 1212 | 77.5 | 1261 | 32.7 | 1310 | 71.9 | 1359 | 70.8 |
| 1213 | 78.6 | 1262 | 30.0 | 1311 | 71.3 | 1360 | 70.9 |
| 1214 | 79.7 | 1263 | 29.9 | 1312 | 70.9 | 1361 | 70.9 |
| 1215 | 80.6 | 1264 | 30.0 | 1313 | 70.5 | 1362 | 70.9 |
| 1216 | 81.5 | 1265 | 30.2 | 1314 | 70.0 | 1363 | 70.9 |
| 1217 | 82.2 | 1266 | 30.4 | 1315 | 69.6 | 1364 | 71.0 |
| 1218 | 83.0 | 1267 | 30.6 | 1316 | 69.2 | 1365 | 71.0 |
| 1219 | 83.7 | 1268 | 31.6 | 1317 | 68.8 | 1366 | 71.1 |
| 1220 | 84.4 | 1269 | 33.0 | 1318 | 68.4 | 1367 | 71.2 |
| 1221 | 84.9 | 1270 | 33.9 | 1319 | 67.9 | 1368 | 71.3 |
| 1222 | 85.1 | 1271 | 34.8 | 1320 | 67.5 | 1369 | 71.4 |
| 1223 | 85.2 | 1272 | 35.7 | 1321 | 67.2 | 1370 | 71.5 |
| 1224 | 84.9 | 1273 | 36.6 | 1322 | 66.8 | 1371 | 71.7 |
| 1225 | 84.4 | 1274 | 37.5 | 1323 | 65.6 | 1372 | 71.8 |
| 1226 | 83.6 | 1275 | 38.4 | 1324 | 63.3 | 1373 | 71.9 |
| 1227 | 82.7 | 1276 | 39.3 | 1325 | 60.2 | 1374 | 71.9 |
| 1228 | 81.5 | 1277 | 40.2 | 1326 | 56.2 | 1375 | 71.9 |
| 1229 | 80.1 | 1278 | 40.8 | 1327 | 52.2 | 1376 | 71.9 |
| 1230 | 78.7 | 1279 | 41.7 | 1328 | 48.4 | 1377 | 71.9 |
| 1231 | 77.4 | 1280 | 42.4 | 1329 | 45.0 | 1378 | 71.9 |
| 1232 | 76.2 | 1281 | 43.1 | 1330 | 41.6 | 1379 | 71.9 |
| 1233 | 75.4 | 1282 | 43.6 | 1331 | 38.6 | 1380 | 72.0 |
| 1234 | 74.8 | 1283 | 44.2 | 1332 | 36.4 | 1381 | 72.1 |
| 1235 | 74.3 | 1284 | 44.8 | 1333 | 34.8 | 1382 | 72.4 |
| 1236 | 73.8 | 1285 | 45.5 | 1334 | 34.2 | 1383 | 72.7 |
| 1237 | 73.2 | 1286 | 46.3 | 1335 | 34.7 | 1384 | 73.1 |
| 1238 | 72.4 | 1287 | 47.2 | 1336 | 36.3 | 1385 | 73.4 |
| 1239 | 71.6 | 1288 | 48.1 | 1337 | 38.5 | 1386 | 73.8 |
| 1240 | 70.8 | 1289 | 49.1 | 1338 | 41.0 | 1387 | 74.0 |
| 1241 | 69.9 | 1290 | 50.0 | 1339 | 43.7 | 1388 | 74.1 |
| 1242 | 67.9 | 1291 | 51.0 | 1340 | 46.5 | 1389 | 74.0 |
| 1243 | 65.7 | 1292 | 51.9 | 1341 | 49.1 | 1390 | 73.0 |
| 1244 | 63.5 | 1293 | 52.7 | 1342 | 51.6 | 1391 | 72.0 |
| 1245 | 61.2 | 1294 | 53.7 | 1343 | 53.9 | 1392 | 71.0 |
| 1246 | 59.0 | 1295 | 55.0 | 1344 | 56.0 | 1393 | 70.0 |
| 1247 | 56.8 | 1296 | 56.8 | 1345 | 57.9 | 1394 | 69.0 |
| 1248 | 54.7 | 1297 | 58.8 | 1346 | 59.7 | 1395 | 68.0 |
| 1249 | 52.7 | 1298 | 60.9 | 1347 | 61.2 | 1396 | 67.7 |
| 1250 | 50.9 | 1299 | 63.0 | 1348 | 62.5 | 1397 | 66.7 |
| 1251 | 49.4 | 1300 | 65.0 | 1349 | 63.5 | 1398 | 66.6 |
| 1252 | 48.1 | 1301 | 66.9 | 1350 | 64.3 | 1399 | 66.7 |
| 1253 | 47.1 | 1302 | 68.6 | 1351 | 65.3 | 1400 | 66.8 |
| 1254 | 46.5 | 1303 | 70.1 | 1352 | 66.3 | 1401 | 66.9 |
| 1255 | 46.3 | 1304 | 71.0 | 1353 | 67.3 | 1402 | 66.9 |
| 1256 | 45.1 | 1305 | 71.8 | 1354 | 68.3 | 1403 | 66.9 |
| 1257 | 43.0 | 1306 | 72.8 | 1355 | 69.3 | 1404 | 66.9 |
| 1258 | 40.6 | 1307 | 72.9 | 1356 | 70.3 | 1405 | 66.9 |
| 1259 | 38.1 | 1308 | 73.0 | 1357 | 70.8 | 1406 | 66.9 |
| 1407 | 66.9 | 1456 | 0.0 |  |  |  |  |
| 1408 | 67.0 | 1457 | 0.0 |  |  |  |  |
| 1409 | 67.1 | 1458 | 0.0 |  |  |  |  |
| 1410 | 67.3 | 1459 | 0.0 |  |  |  |  |
| 1411 | 67.5 | 1460 | 0.0 |  |  |  |  |
| 1412 | 67.8 | 1461 | 0.0 |  |  |  |  |
| 1413 | 68.2 | 1462 | 0.0 |  |  |  |  |
| 1414 | 68.6 | 1463 | 0.0 |  |  |  |  |
| 1415 | 69.0 | 1464 | 0.0 |  |  |  |  |
| 1416 | 69.3 | 1465 | 0.0 |  |  |  |  |
| 1417 | 69.3 | 1466 | 0.0 |  |  |  |  |
| 1418 | 69.2 | 1467 | 0.0 |  |  |  |  |
| 1419 | 68.8 | 1468 | 0.0 |  |  |  |  |
| 1420 | 68.2 | 1469 | 0.0 |  |  |  |  |
| 1421 | 67.6 | 1470 | 0.0 |  |  |  |  |
| 1422 | 67.4 | 1471 | 0.0 |  |  |  |  |
| 1423 | 67.2 | 1472 | 0.0 |  |  |  |  |
| 1424 | 66.9 | 1473 | 0.0 |  |  |  |  |
| 1425 | 66.3 | 1474 | 0.0 |  |  |  |  |
| 1426 | 65.4 | 1475 | 0.0 |  |  |  |  |
| 1427 | 64.0 | 1476 | 0.0 |  |  |  |  |
| 1428 | 62.4 | 1477 | 0.0 |  |  |  |  |
| 1429 | 60.6 |  |  |  |  |  |  |
| 1430 | 58.6 |  |  |  |  |  |  |
| 1431 | 56.7 |  |  |  |  |  |  |
| 1432 | 54.8 |  |  |  |  |  |  |
| 1433 | 53.0 |  |  |  |  |  |  |
| 1434 | 51.3 |  |  |  |  |  |  |
| 1435 | 49.6 |  |  |  |  |  |  |
| 1436 | 47.8 |  |  |  |  |  |  |
| 1437 | 45.5 |  |  |  |  |  |  |
| 1438 | 42.8 |  |  |  |  |  |  |
| 1439 | 39.8 |  |  |  |  |  |  |
| 1440 | 36.5 |  |  |  |  |  |  |
| 1441 | 33.0 |  |  |  |  |  |  |
| 1442 | 29.5 |  |  |  |  |  |  |
| 1443 | 25.8 |  |  |  |  |  |  |
| 1444 | 22.1 |  |  |  |  |  |  |
| 1445 | 18.6 |  |  |  |  |  |  |
| 1446 | 15.3 |  |  |  |  |  |  |
| 1447 | 12.4 |  |  |  |  |  |  |
| 1448 | 9.6 |  |  |  |  |  |  |
| 1449 | 6.6 |  |  |  |  |  |  |
| 1450 | 3.8 |  |  |  |  |  |  |
| 1451 | 1.6 |  |  |  |  |  |  |
| 1452 | 0.0 |  |  |  |  |  |  |
| 1453 | 0.0 |  |  |  |  |  |  |
| 1454 | 0.0 |  |  |  |  |  |  |
| 1455 | 0.0 |  |  |  |  |  |  |

# Table A1/6

# **WLTC, Class 2 cycle, phase Extra High2 (Sec 1477 is the end of phase High2 and the start of Extra High2)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1478 | 0.0 | 1525 | 63.4 | 1572 | 107.4 | 1619 | 113.7 |
| 1479 | 1.1 | 1526 | 64.5 | 1573 | 108.7 | 1620 | 114.1 |
| 1480 | 2.3 | 1527 | 65.7 | 1574 | 109.9 | 1621 | 114.4 |
| 1481 | 4.6 | 1528 | 66.9 | 1575 | 111.2 | 1622 | 114.6 |
| 1482 | 6.5 | 1529 | 68.1 | 1576 | 112.3 | 1623 | 114.7 |
| 1483 | 8.9 | 1530 | 69.1 | 1577 | 113.4 | 1624 | 114.7 |
| 1484 | 10.9 | 1531 | 70.0 | 1578 | 114.4 | 1625 | 114.7 |
| 1485 | 13.5 | 1532 | 70.9 | 1579 | 115.3 | 1626 | 114.6 |
| 1486 | 15.2 | 1533 | 71.8 | 1580 | 116.1 | 1627 | 114.5 |
| 1487 | 17.6 | 1534 | 72.6 | 1581 | 116.8 | 1628 | 114.5 |
| 1488 | 19.3 | 1535 | 73.4 | 1582 | 117.4 | 1629 | 114.5 |
| 1489 | 21.4 | 1536 | 74.0 | 1583 | 117.7 | 1630 | 114.7 |
| 1490 | 23.0 | 1537 | 74.7 | 1584 | 118.2 | 1631 | 115.0 |
| 1491 | 25.0 | 1538 | 75.2 | 1585 | 118.1 | 1632 | 115.6 |
| 1492 | 26.5 | 1539 | 75.7 | 1586 | 117.7 | 1633 | 116.4 |
| 1493 | 28.4 | 1540 | 76.4 | 1587 | 117.0 | 1634 | 117.3 |
| 1494 | 29.8 | 1541 | 77.2 | 1588 | 116.1 | 1635 | 118.2 |
| 1495 | 31.7 | 1542 | 78.2 | 1589 | 115.2 | 1636 | 118.8 |
| 1496 | 33.7 | 1543 | 78.9 | 1590 | 114.4 | 1637 | 119.3 |
| 1497 | 35.8 | 1544 | 79.9 | 1591 | 113.6 | 1638 | 119.6 |
| 1498 | 38.1 | 1545 | 81.1 | 1592 | 113.0 | 1639 | 119.7 |
| 1499 | 40.5 | 1546 | 82.4 | 1593 | 112.6 | 1640 | 119.5 |
| 1500 | 42.2 | 1547 | 83.7 | 1594 | 112.2 | 1641 | 119.3 |
| 1501 | 43.5 | 1548 | 85.4 | 1595 | 111.9 | 1642 | 119.2 |
| 1502 | 44.5 | 1549 | 87.0 | 1596 | 111.6 | 1643 | 119.0 |
| 1503 | 45.2 | 1550 | 88.3 | 1597 | 111.2 | 1644 | 118.8 |
| 1504 | 45.8 | 1551 | 89.5 | 1598 | 110.7 | 1645 | 118.8 |
| 1505 | 46.6 | 1552 | 90.5 | 1599 | 110.1 | 1646 | 118.8 |
| 1506 | 47.4 | 1553 | 91.3 | 1600 | 109.3 | 1647 | 118.8 |
| 1507 | 48.5 | 1554 | 92.2 | 1601 | 108.4 | 1648 | 118.8 |
| 1508 | 49.7 | 1555 | 93.0 | 1602 | 107.4 | 1649 | 118.9 |
| 1509 | 51.3 | 1556 | 93.8 | 1603 | 106.7 | 1650 | 119.0 |
| 1510 | 52.9 | 1557 | 94.6 | 1604 | 106.3 | 1651 | 119.0 |
| 1511 | 54.3 | 1558 | 95.3 | 1605 | 106.2 | 1652 | 119.1 |
| 1512 | 55.6 | 1559 | 95.9 | 1606 | 106.4 | 1653 | 119.2 |
| 1513 | 56.8 | 1560 | 96.6 | 1607 | 107.0 | 1654 | 119.4 |
| 1514 | 57.9 | 1561 | 97.4 | 1608 | 107.5 | 1655 | 119.6 |
| 1515 | 58.9 | 1562 | 98.1 | 1609 | 107.9 | 1656 | 119.9 |
| 1516 | 59.7 | 1563 | 98.7 | 1610 | 108.4 | 1657 | 120.1 |
| 1517 | 60.3 | 1564 | 99.5 | 1611 | 108.9 | 1658 | 120.3 |
| 1518 | 60.7 | 1565 | 100.3 | 1612 | 109.5 | 1659 | 120.4 |
| 1519 | 60.9 | 1566 | 101.1 | 1613 | 110.2 | 1660 | 120.5 |
| 1520 | 61.0 | 1567 | 101.9 | 1614 | 110.9 | 1661 | 120.5 |
| 1521 | 61.1 | 1568 | 102.8 | 1615 | 111.6 | 1662 | 120.5 |
| 1522 | 61.4 | 1569 | 103.8 | 1616 | 112.2 | 1663 | 120.5 |
| 1523 | 61.8 | 1570 | 105.0 | 1617 | 112.8 | 1664 | 120.4 |
| 1524 | 62.5 | 1571 | 106.1 | 1618 | 113.3 | 1665 | 120.3 |
| 1666 | 120.1 | 1715 | 120.4 | 1764 | 82.6 |  |  |
| 1667 | 119.9 | 1716 | 120.8 | 1765 | 81.9 |  |  |
| 1668 | 119.6 | 1717 | 121.1 | 1766 | 81.1 |  |  |
| 1669 | 119.5 | 1718 | 121.6 | 1767 | 80.0 |  |  |
| 1670 | 119.4 | 1719 | 121.8 | 1768 | 78.7 |  |  |
| 1671 | 119.3 | 1720 | 122.1 | 1769 | 76.9 |  |  |
| 1672 | 119.3 | 1721 | 122.4 | 1770 | 74.6 |  |  |
| 1673 | 119.4 | 1722 | 122.7 | 1771 | 72.0 |  |  |
| 1674 | 119.5 | 1723 | 122.8 | 1772 | 69.0 |  |  |
| 1675 | 119.5 | 1724 | 123.1 | 1773 | 65.6 |  |  |
| 1676 | 119.6 | 1725 | 123.1 | 1774 | 62.1 |  |  |
| 1677 | 119.6 | 1726 | 122.8 | 1775 | 58.5 |  |  |
| 1678 | 119.6 | 1727 | 122.3 | 1776 | 54.7 |  |  |
| 1679 | 119.4 | 1728 | 121.3 | 1777 | 50.9 |  |  |
| 1680 | 119.3 | 1729 | 119.9 | 1778 | 47.3 |  |  |
| 1681 | 119.0 | 1730 | 118.1 | 1779 | 43.8 |  |  |
| 1682 | 118.8 | 1731 | 115.9 | 1780 | 40.4 |  |  |
| 1683 | 118.7 | 1732 | 113.5 | 1781 | 37.4 |  |  |
| 1684 | 118.8 | 1733 | 111.1 | 1782 | 34.3 |  |  |
| 1685 | 119.0 | 1734 | 108.6 | 1783 | 31.3 |  |  |
| 1686 | 119.2 | 1735 | 106.2 | 1784 | 28.3 |  |  |
| 1687 | 119.6 | 1736 | 104.0 | 1785 | 25.2 |  |  |
| 1688 | 120.0 | 1737 | 101.1 | 1786 | 22.0 |  |  |
| 1689 | 120.3 | 1738 | 98.3 | 1787 | 18.9 |  |  |
| 1690 | 120.5 | 1739 | 95.7 | 1788 | 16.1 |  |  |
| 1691 | 120.7 | 1740 | 93.5 | 1789 | 13.4 |  |  |
| 1692 | 120.9 | 1741 | 91.5 | 1790 | 11.1 |  |  |
| 1693 | 121.0 | 1742 | 90.7 | 1791 | 8.9 |  |  |
| 1694 | 121.1 | 1743 | 90.4 | 1792 | 6.9 |  |  |
| 1695 | 121.2 | 1744 | 90.2 | 1793 | 4.9 |  |  |
| 1696 | 121.3 | 1745 | 90.2 | 1794 | 2.8 |  |  |
| 1697 | 121.4 | 1746 | 90.1 | 1795 | 0.0 |  |  |
| 1698 | 121.5 | 1747 | 90.0 | 1796 | 0.0 |  |  |
| 1699 | 121.5 | 1748 | 89.8 | 1797 | 0.0 |  |  |
| 1700 | 121.5 | 1749 | 89.6 | 1798 | 0.0 |  |  |
| 1701 | 121.4 | 1750 | 89.4 | 1799 | 0.0 |  |  |
| 1702 | 121.3 | 1751 | 89.2 | 1800 | 0.0 |  |  |
| 1703 | 121.1 | 1752 | 88.9 |  |  |  |  |
| 1704 | 120.9 | 1753 | 88.5 |  |  |  |  |
| 1705 | 120.6 | 1754 | 88.1 |  |  |  |  |
| 1706 | 120.4 | 1755 | 87.6 |  |  |  |  |
| 1707 | 120.2 | 1756 | 87.1 |  |  |  |  |
| 1708 | 120.1 | 1757 | 86.6 |  |  |  |  |
| 1709 | 119.9 | 1758 | 86.1 |  |  |  |  |
| 1710 | 119.8 | 1759 | 85.5 |  |  |  |  |
| 1711 | 119.8 | 1760 | 85.0 |  |  |  |  |
| 1712 | 119.9 | 1761 | 84.4 |  |  |  |  |
| 1713 | 120.0 | 1762 | 83.8 |  |  |  |  |
| 1714 | 120.2 | 1763 | 83.2 |  |  |  |  |

6. WLTC Class 3 cycle

# Figure A1/7

# **WLTC, Class 3 cycle, phase Low3**

# 

# Figure A1/8

# **WLTC, Class 3a cycle, phase Medium3a**

# 

# Figure A1/9

# **WLTC, Class 3b cycle, phase Medium3b**



# Figure A1/10

# **WLTC, Class 3a cycle, phase High3a**



# Figure A1/11

# **WLTC, Class 3b cycle, phase High3b**



# Figure A1/12

# **WLTC, Class 3 cycle, phase Extra High3**



# Table A1/7

# **WLTC, Class 3 cycle, phase Low3 (Second 589 is the end of phase Low3 and the start of phase Medium3)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0.0 | 47 | 19.5 | 94 | 12.0 | 141 | 11.7 |
| 1 | 0.0 | 48 | 18.4 | 95 | 9.1 | 142 | 16.4 |
| 2 | 0.0 | 49 | 17.8 | 96 | 5.8 | 143 | 18.9 |
| 3 | 0.0 | 50 | 17.8 | 97 | 3.6 | 144 | 19.9 |
| 4 | 0.0 | 51 | 17.4 | 98 | 2.2 | 145 | 20.8 |
| 5 | 0.0 | 52 | 15.7 | 99 | 0.0 | 146 | 22.8 |
| 6 | 0.0 | 53 | 13.1 | 100 | 0.0 | 147 | 25.4 |
| 7 | 0.0 | 54 | 12.1 | 101 | 0.0 | 148 | 27.7 |
| 8 | 0.0 | 55 | 12.0 | 102 | 0.0 | 149 | 29.2 |
| 9 | 0.0 | 56 | 12.0 | 103 | 0.0 | 150 | 29.8 |
| 10 | 0.0 | 57 | 12.0 | 104 | 0.0 | 151 | 29.4 |
| 11 | 0.0 | 58 | 12.3 | 105 | 0.0 | 152 | 27.2 |
| 12 | 0.2 | 59 | 12.6 | 106 | 0.0 | 153 | 22.6 |
| 13 | 1.7 | 60 | 14.7 | 107 | 0.0 | 154 | 17.3 |
| 14 | 5.4 | 61 | 15.3 | 108 | 0.0 | 155 | 13.3 |
| 15 | 9.9 | 62 | 15.9 | 109 | 0.0 | 156 | 12.0 |
| 16 | 13.1 | 63 | 16.2 | 110 | 0.0 | 157 | 12.6 |
| 17 | 16.9 | 64 | 17.1 | 111 | 0.0 | 158 | 14.1 |
| 18 | 21.7 | 65 | 17.8 | 112 | 0.0 | 159 | 17.2 |
| 19 | 26.0 | 66 | 18.1 | 113 | 0.0 | 160 | 20.1 |
| 20 | 27.5 | 67 | 18.4 | 114 | 0.0 | 161 | 23.4 |
| 21 | 28.1 | 68 | 20.3 | 115 | 0.0 | 162 | 25.5 |
| 22 | 28.3 | 69 | 23.2 | 116 | 0.0 | 163 | 27.6 |
| 23 | 28.8 | 70 | 26.5 | 117 | 0.0 | 164 | 29.5 |
| 24 | 29.1 | 71 | 29.8 | 118 | 0.0 | 165 | 31.1 |
| 25 | 30.8 | 72 | 32.6 | 119 | 0.0 | 166 | 32.1 |
| 26 | 31.9 | 73 | 34.4 | 120 | 0.0 | 167 | 33.2 |
| 27 | 34.1 | 74 | 35.5 | 121 | 0.0 | 168 | 35.2 |
| 28 | 36.6 | 75 | 36.4 | 122 | 0.0 | 169 | 37.2 |
| 29 | 39.1 | 76 | 37.4 | 123 | 0.0 | 170 | 38.0 |
| 30 | 41.3 | 77 | 38.5 | 124 | 0.0 | 171 | 37.4 |
| 31 | 42.5 | 78 | 39.3 | 125 | 0.0 | 172 | 35.1 |
| 32 | 43.3 | 79 | 39.5 | 126 | 0.0 | 173 | 31.0 |
| 33 | 43.9 | 80 | 39.0 | 127 | 0.0 | 174 | 27.1 |
| 34 | 44.4 | 81 | 38.5 | 128 | 0.0 | 175 | 25.3 |
| 35 | 44.5 | 82 | 37.3 | 129 | 0.0 | 176 | 25.1 |
| 36 | 44.2 | 83 | 37.0 | 130 | 0.0 | 177 | 25.9 |
| 37 | 42.7 | 84 | 36.7 | 131 | 0.0 | 178 | 27.8 |
| 38 | 39.9 | 85 | 35.9 | 132 | 0.0 | 179 | 29.2 |
| 39 | 37.0 | 86 | 35.3 | 133 | 0.0 | 180 | 29.6 |
| 40 | 34.6 | 87 | 34.6 | 134 | 0.0 | 181 | 29.5 |
| 41 | 32.3 | 88 | 34.2 | 135 | 0.0 | 182 | 29.2 |
| 42 | 29.0 | 89 | 31.9 | 136 | 0.0 | 183 | 28.3 |
| 43 | 25.1 | 90 | 27.3 | 137 | 0.0 | 184 | 26.1 |
| 44 | 22.2 | 91 | 22.0 | 138 | 0.2 | 185 | 23.6 |
| 45 | 20.9 | 92 | 17.0 | 139 | 1.9 | 186 | 21.0 |
| 46 | 20.4 | 93 | 14.2 | 140 | 6.1 | 187 | 18.9 |
| 188 | 17.1 | 237 | 49.2 | 286 | 37.4 | 335 | 15.0 |
| 189 | 15.7 | 238 | 48.4 | 287 | 40.7 | 336 | 14.5 |
| 190 | 14.5 | 239 | 46.9 | 288 | 44.0 | 337 | 14.3 |
| 191 | 13.7 | 240 | 44.3 | 289 | 47.3 | 338 | 14.5 |
| 192 | 12.9 | 241 | 41.5 | 290 | 49.2 | 339 | 15.4 |
| 193 | 12.5 | 242 | 39.5 | 291 | 49.8 | 340 | 17.8 |
| 194 | 12.2 | 243 | 37.0 | 292 | 49.2 | 341 | 21.1 |
| 195 | 12.0 | 244 | 34.6 | 293 | 48.1 | 342 | 24.1 |
| 196 | 12.0 | 245 | 32.3 | 294 | 47.3 | 343 | 25.0 |
| 197 | 12.0 | 246 | 29.0 | 295 | 46.8 | 344 | 25.3 |
| 198 | 12.0 | 247 | 25.1 | 296 | 46.7 | 345 | 25.5 |
| 199 | 12.5 | 248 | 22.2 | 297 | 46.8 | 346 | 26.4 |
| 200 | 13.0 | 249 | 20.9 | 298 | 47.1 | 347 | 26.6 |
| 201 | 14.0 | 250 | 20.4 | 299 | 47.3 | 348 | 27.1 |
| 202 | 15.0 | 251 | 19.5 | 300 | 47.3 | 349 | 27.7 |
| 203 | 16.5 | 252 | 18.4 | 301 | 47.1 | 350 | 28.1 |
| 204 | 19.0 | 253 | 17.8 | 302 | 46.6 | 351 | 28.2 |
| 205 | 21.2 | 254 | 17.8 | 303 | 45.8 | 352 | 28.1 |
| 206 | 23.8 | 255 | 17.4 | 304 | 44.8 | 353 | 28.0 |
| 207 | 26.9 | 256 | 15.7 | 305 | 43.3 | 354 | 27.9 |
| 208 | 29.6 | 257 | 14.5 | 306 | 41.8 | 355 | 27.9 |
| 209 | 32.0 | 258 | 15.4 | 307 | 40.8 | 356 | 28.1 |
| 210 | 35.2 | 259 | 17.9 | 308 | 40.3 | 357 | 28.2 |
| 211 | 37.5 | 260 | 20.6 | 309 | 40.1 | 358 | 28.0 |
| 212 | 39.2 | 261 | 23.2 | 310 | 39.7 | 359 | 26.9 |
| 213 | 40.5 | 262 | 25.7 | 311 | 39.2 | 360 | 25.0 |
| 214 | 41.6 | 263 | 28.7 | 312 | 38.5 | 361 | 23.2 |
| 215 | 43.1 | 264 | 32.5 | 313 | 37.4 | 362 | 21.9 |
| 216 | 45.0 | 265 | 36.1 | 314 | 36.0 | 363 | 21.1 |
| 217 | 47.1 | 266 | 39.0 | 315 | 34.4 | 364 | 20.7 |
| 218 | 49.0 | 267 | 40.8 | 316 | 33.0 | 365 | 20.7 |
| 219 | 50.6 | 268 | 42.9 | 317 | 31.7 | 366 | 20.8 |
| 220 | 51.8 | 269 | 44.4 | 318 | 30.0 | 367 | 21.2 |
| 221 | 52.7 | 270 | 45.9 | 319 | 28.0 | 368 | 22.1 |
| 222 | 53.1 | 271 | 46.0 | 320 | 26.1 | 369 | 23.5 |
| 223 | 53.5 | 272 | 45.6 | 321 | 25.6 | 370 | 24.3 |
| 224 | 53.8 | 273 | 45.3 | 322 | 24.9 | 371 | 24.5 |
| 225 | 54.2 | 274 | 43.7 | 323 | 24.9 | 372 | 23.8 |
| 226 | 54.8 | 275 | 40.8 | 324 | 24.3 | 373 | 21.3 |
| 227 | 55.3 | 276 | 38.0 | 325 | 23.9 | 374 | 17.7 |
| 228 | 55.8 | 277 | 34.4 | 326 | 23.9 | 375 | 14.4 |
| 229 | 56.2 | 278 | 30.9 | 327 | 23.6 | 376 | 11.9 |
| 230 | 56.5 | 279 | 25.5 | 328 | 23.3 | 377 | 10.2 |
| 231 | 56.5 | 280 | 21.4 | 329 | 20.5 | 378 | 8.9 |
| 232 | 56.2 | 281 | 20.2 | 330 | 17.5 | 379 | 8.0 |
| 233 | 54.9 | 282 | 22.9 | 331 | 16.9 | 380 | 7.2 |
| 234 | 52.9 | 283 | 26.6 | 332 | 16.7 | 381 | 6.1 |
| 235 | 51.0 | 284 | 30.2 | 333 | 15.9 | 382 | 4.9 |
| 236 | 49.8 | 285 | 34.1 | 334 | 15.6 | 383 | 3.7 |
| 384 | 2.3 | 433 | 31.3 | 482 | 0.0 | 531 | 0.0 |
| 385 | 0.9 | 434 | 31.1 | 483 | 0.0 | 532 | 0.0 |
| 386 | 0.0 | 435 | 30.6 | 484 | 0.0 | 533 | 0.2 |
| 387 | 0.0 | 436 | 29.2 | 485 | 0.0 | 534 | 1.2 |
| 388 | 0.0 | 437 | 26.7 | 486 | 0.0 | 535 | 3.2 |
| 389 | 0.0 | 438 | 23.0 | 487 | 0.0 | 536 | 5.2 |
| 390 | 0.0 | 439 | 18.2 | 488 | 0.0 | 537 | 8.2 |
| 391 | 0.0 | 440 | 12.9 | 489 | 0.0 | 538 | 13 |
| 392 | 0.5 | 441 | 7.7 | 490 | 0.0 | 539 | 18.8 |
| 393 | 2.1 | 442 | 3.8 | 491 | 0.0 | 540 | 23.1 |
| 394 | 4.8 | 443 | 1.3 | 492 | 0.0 | 541 | 24.5 |
| 395 | 8.3 | 444 | 0.2 | 493 | 0.0 | 542 | 24.5 |
| 396 | 12.3 | 445 | 0.0 | 494 | 0.0 | 543 | 24.3 |
| 397 | 16.6 | 446 | 0.0 | 495 | 0.0 | 544 | 23.6 |
| 398 | 20.9 | 447 | 0.0 | 496 | 0.0 | 545 | 22.3 |
| 399 | 24.2 | 448 | 0.0 | 497 | 0.0 | 546 | 20.1 |
| 400 | 25.6 | 449 | 0.0 | 498 | 0.0 | 547 | 18.5 |
| 401 | 25.6 | 450 | 0.0 | 499 | 0.0 | 548 | 17.2 |
| 402 | 24.9 | 451 | 0.0 | 500 | 0.0 | 549 | 16.3 |
| 403 | 23.3 | 452 | 0.0 | 501 | 0.0 | 550 | 15.4 |
| 404 | 21.6 | 453 | 0.0 | 502 | 0.0 | 551 | 14.7 |
| 405 | 20.2 | 454 | 0.0 | 503 | 0.0 | 552 | 14.3 |
| 406 | 18.7 | 455 | 0.0 | 504 | 0.0 | 553 | 13.7 |
| 407 | 17.0 | 456 | 0.0 | 505 | 0.0 | 554 | 13.3 |
| 408 | 15.3 | 457 | 0.0 | 506 | 0.0 | 555 | 13.1 |
| 409 | 14.2 | 458 | 0.0 | 507 | 0.0 | 556 | 13.1 |
| 410 | 13.9 | 459 | 0.0 | 508 | 0.0 | 557 | 13.3 |
| 411 | 14.0 | 460 | 0.0 | 509 | 0.0 | 558 | 13.8 |
| 412 | 14.2 | 461 | 0.0 | 510 | 0.0 | 559 | 14.5 |
| 413 | 14.5 | 462 | 0.0 | 511 | 0.0 | 560 | 16.5 |
| 414 | 14.9 | 463 | 0.0 | 512 | 0.5 | 561 | 17.0 |
| 415 | 15.9 | 464 | 0.0 | 513 | 2.5 | 562 | 17.0 |
| 416 | 17.4 | 465 | 0.0 | 514 | 6.6 | 563 | 17.0 |
| 417 | 18.7 | 466 | 0.0 | 515 | 11.8 | 564 | 15.4 |
| 418 | 19.1 | 467 | 0.0 | 516 | 16.8 | 565 | 10.1 |
| 419 | 18.8 | 468 | 0.0 | 517 | 20.5 | 566 | 4.8 |
| 420 | 17.6 | 469 | 0.0 | 518 | 21.9 | 567 | 0.0 |
| 421 | 16.6 | 470 | 0.0 | 519 | 21.9 | 568 | 0.0 |
| 422 | 16.2 | 471 | 0.0 | 520 | 21.3 | 569 | 0.0 |
| 423 | 16.4 | 472 | 0.0 | 521 | 20.3 | 570 | 0.0 |
| 424 | 17.2 | 473 | 0.0 | 522 | 19.2 | 571 | 0.0 |
| 425 | 19.1 | 474 | 0.0 | 523 | 17.8 | 572 | 0.0 |
| 426 | 22.6 | 475 | 0.0 | 524 | 15.5 | 573 | 0.0 |
| 427 | 27.4 | 476 | 0.0 | 525 | 11.9 | 574 | 0.0 |
| 428 | 31.6 | 477 | 0.0 | 526 | 7.6 | 575 | 0.0 |
| 429 | 33.4 | 478 | 0.0 | 527 | 4.0 | 576 | 0.0 |
| 430 | 33.5 | 479 | 0.0 | 528 | 2.0 | 577 | 0.0 |
| 431 | 32.8 | 480 | 0.0 | 529 | 1.0 | 578 | 0.0 |
| 432 | 31.9 | 481 | 0.0 | 530 | 0.0 | 579 | 0.0 |
| 580 | 0.0 |  |  |  |  |  |  |
| 581 | 0.0 |  |  |  |  |  |  |
| 582 | 0.0 |  |  |  |  |  |  |
| 583 | 0.0 |  |  |  |  |  |  |
| 584 | 0.0 |  |  |  |  |  |  |
| 585 | 0.0 |  |  |  |  |  |  |
| 586 | 0.0 |  |  |  |  |  |  |
| 587 | 0.0 |  |  |  |  |  |  |
| 588 | 0.0 |  |  |  |  |  |  |
| 589 | 0.0 |  |  |  |  |  |  |
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# Table A1/8

# **WLTC, Class 3a cycle, phase Medium3a (Second 589 is the end of phase Low3 and the start of phase Medium3a)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 590 | 0.0 | 637 | 53.0 | 684 | 18.9 | 731 | 41.9 |
| 591 | 0.0 | 638 | 53.0 | 685 | 18.9 | 732 | 42.0 |
| 592 | 0.0 | 639 | 52.9 | 686 | 21.3 | 733 | 42.2 |
| 593 | 0.0 | 640 | 52.7 | 687 | 23.9 | 734 | 42.4 |
| 594 | 0.0 | 641 | 52.6 | 688 | 25.9 | 735 | 42.7 |
| 595 | 0.0 | 642 | 53.1 | 689 | 28.4 | 736 | 43.1 |
| 596 | 0.0 | 643 | 54.3 | 690 | 30.3 | 737 | 43.7 |
| 597 | 0.0 | 644 | 55.2 | 691 | 30.9 | 738 | 44.0 |
| 598 | 0.0 | 645 | 55.5 | 692 | 31.1 | 739 | 44.1 |
| 599 | 0.0 | 646 | 55.9 | 693 | 31.8 | 740 | 45.3 |
| 600 | 0.0 | 647 | 56.3 | 694 | 32.7 | 741 | 46.4 |
| 601 | 1.0 | 648 | 56.7 | 695 | 33.2 | 742 | 47.2 |
| 602 | 2.1 | 649 | 56.9 | 696 | 32.4 | 743 | 47.3 |
| 603 | 5.2 | 650 | 56.8 | 697 | 28.3 | 744 | 47.4 |
| 604 | 9.2 | 651 | 56.0 | 698 | 25.8 | 745 | 47.4 |
| 605 | 13.5 | 652 | 54.2 | 699 | 23.1 | 746 | 47.5 |
| 606 | 18.1 | 653 | 52.1 | 700 | 21.8 | 747 | 47.9 |
| 607 | 22.3 | 654 | 50.1 | 701 | 21.2 | 748 | 48.6 |
| 608 | 26.0 | 655 | 47.2 | 702 | 21.0 | 749 | 49.4 |
| 609 | 29.3 | 656 | 43.2 | 703 | 21.0 | 750 | 49.8 |
| 610 | 32.8 | 657 | 39.2 | 704 | 20.9 | 751 | 49.8 |
| 611 | 36.0 | 658 | 36.5 | 705 | 19.9 | 752 | 49.7 |
| 612 | 39.2 | 659 | 34.3 | 706 | 17.9 | 753 | 49.3 |
| 613 | 42.5 | 660 | 31.0 | 707 | 15.1 | 754 | 48.5 |
| 614 | 45.7 | 661 | 26.0 | 708 | 12.8 | 755 | 47.6 |
| 615 | 48.2 | 662 | 20.7 | 709 | 12.0 | 756 | 46.3 |
| 616 | 48.4 | 663 | 15.4 | 710 | 13.2 | 757 | 43.7 |
| 617 | 48.2 | 664 | 13.1 | 711 | 17.1 | 758 | 39.3 |
| 618 | 47.8 | 665 | 12.0 | 712 | 21.1 | 759 | 34.1 |
| 619 | 47.0 | 666 | 12.5 | 713 | 21.8 | 760 | 29.0 |
| 620 | 45.9 | 667 | 14.0 | 714 | 21.2 | 761 | 23.7 |
| 621 | 44.9 | 668 | 19.0 | 715 | 18.5 | 762 | 18.4 |
| 622 | 44.4 | 669 | 23.2 | 716 | 13.9 | 763 | 14.3 |
| 623 | 44.3 | 670 | 28.0 | 717 | 12.0 | 764 | 12.0 |
| 624 | 44.5 | 671 | 32.0 | 718 | 12.0 | 765 | 12.8 |
| 625 | 45.1 | 672 | 34.0 | 719 | 13.0 | 766 | 16.0 |
| 626 | 45.7 | 673 | 36.0 | 720 | 16.3 | 767 | 20.4 |
| 627 | 46.0 | 674 | 38.0 | 721 | 20.5 | 768 | 24.0 |
| 628 | 46.0 | 675 | 40.0 | 722 | 23.9 | 769 | 29.0 |
| 629 | 46.0 | 676 | 40.3 | 723 | 26.0 | 770 | 32.2 |
| 630 | 46.1 | 677 | 40.5 | 724 | 28.0 | 771 | 36.8 |
| 631 | 46.7 | 678 | 39.0 | 725 | 31.5 | 772 | 39.4 |
| 632 | 47.7 | 679 | 35.7 | 726 | 33.4 | 773 | 43.2 |
| 633 | 48.9 | 680 | 31.8 | 727 | 36.0 | 774 | 45.8 |
| 634 | 50.3 | 681 | 27.1 | 728 | 37.8 | 775 | 49.2 |
| 635 | 51.6 | 682 | 22.8 | 729 | 40.2 | 776 | 51.4 |
| 636 | 52.6 | 683 | 21.1 | 730 | 41.6 | 777 | 54.2 |
| 778 | 56.0 | 827 | 37.1 | 876 | 75.8 | 925 | 62.3 |
| 779 | 58.3 | 828 | 38.9 | 877 | 76.6 | 926 | 62.7 |
| 780 | 59.8 | 829 | 41.4 | 878 | 76.5 | 927 | 62.0 |
| 781 | 61.7 | 830 | 44.0 | 879 | 76.2 | 928 | 61.3 |
| 782 | 62.7 | 831 | 46.3 | 880 | 75.8 | 929 | 60.9 |
| 783 | 63.3 | 832 | 47.7 | 881 | 75.4 | 930 | 60.5 |
| 784 | 63.6 | 833 | 48.2 | 882 | 74.8 | 931 | 60.2 |
| 785 | 64.0 | 834 | 48.7 | 883 | 73.9 | 932 | 59.8 |
| 786 | 64.7 | 835 | 49.3 | 884 | 72.7 | 933 | 59.4 |
| 787 | 65.2 | 836 | 49.8 | 885 | 71.3 | 934 | 58.6 |
| 788 | 65.3 | 837 | 50.2 | 886 | 70.4 | 935 | 57.5 |
| 789 | 65.3 | 838 | 50.9 | 887 | 70.0 | 936 | 56.6 |
| 790 | 65.4 | 839 | 51.8 | 888 | 70.0 | 937 | 56.0 |
| 791 | 65.7 | 840 | 52.5 | 889 | 69.0 | 938 | 55.5 |
| 792 | 66.0 | 841 | 53.3 | 890 | 68.0 | 939 | 55.0 |
| 793 | 65.6 | 842 | 54.5 | 891 | 67.3 | 940 | 54.4 |
| 794 | 63.5 | 843 | 55.7 | 892 | 66.2 | 941 | 54.1 |
| 795 | 59.7 | 844 | 56.5 | 893 | 64.8 | 942 | 54.0 |
| 796 | 54.6 | 845 | 56.8 | 894 | 63.6 | 943 | 53.9 |
| 797 | 49.3 | 846 | 57.0 | 895 | 62.6 | 944 | 53.9 |
| 798 | 44.9 | 847 | 57.2 | 896 | 62.1 | 945 | 54.0 |
| 799 | 42.3 | 848 | 57.7 | 897 | 61.9 | 946 | 54.2 |
| 800 | 41.4 | 849 | 58.7 | 898 | 61.9 | 947 | 55.0 |
| 801 | 41.3 | 850 | 60.1 | 899 | 61.8 | 948 | 55.8 |
| 802 | 43.0 | 851 | 61.1 | 900 | 61.5 | 949 | 56.2 |
| 803 | 45.0 | 852 | 61.7 | 901 | 60.9 | 950 | 56.1 |
| 804 | 46.5 | 853 | 62.3 | 902 | 59.7 | 951 | 55.1 |
| 805 | 48.3 | 854 | 62.9 | 903 | 54.6 | 952 | 52.7 |
| 806 | 49.5 | 855 | 63.3 | 904 | 49.3 | 953 | 48.4 |
| 807 | 51.2 | 856 | 63.4 | 905 | 44.9 | 954 | 43.1 |
| 808 | 52.2 | 857 | 63.5 | 906 | 42.3 | 955 | 37.8 |
| 809 | 51.6 | 858 | 63.9 | 907 | 41.4 | 956 | 32.5 |
| 810 | 49.7 | 859 | 64.4 | 908 | 41.3 | 957 | 27.2 |
| 811 | 47.4 | 860 | 65.0 | 909 | 42.1 | 958 | 25.1 |
| 812 | 43.7 | 861 | 65.6 | 910 | 44.7 | 959 | 27.0 |
| 813 | 39.7 | 862 | 66.6 | 911 | 46.0 | 960 | 29.8 |
| 814 | 35.5 | 863 | 67.4 | 912 | 48.8 | 961 | 33.8 |
| 815 | 31.1 | 864 | 68.2 | 913 | 50.1 | 962 | 37.0 |
| 816 | 26.3 | 865 | 69.1 | 914 | 51.3 | 963 | 40.7 |
| 817 | 21.9 | 866 | 70.0 | 915 | 54.1 | 964 | 43.0 |
| 818 | 18.0 | 867 | 70.8 | 916 | 55.2 | 965 | 45.6 |
| 819 | 17.0 | 868 | 71.5 | 917 | 56.2 | 966 | 46.9 |
| 820 | 18.0 | 869 | 72.4 | 918 | 56.1 | 967 | 47.0 |
| 821 | 21.4 | 870 | 73.0 | 919 | 56.1 | 968 | 46.9 |
| 822 | 24.8 | 871 | 73.7 | 920 | 56.5 | 969 | 46.5 |
| 823 | 27.9 | 872 | 74.4 | 921 | 57.5 | 970 | 45.8 |
| 824 | 30.8 | 873 | 74.9 | 922 | 59.2 | 971 | 44.3 |
| 825 | 33.0 | 874 | 75.3 | 923 | 60.7 | 972 | 41.3 |
| 826 | 35.1 | 875 | 75.6 | 924 | 61.8 | 973 | 36.5 |
| 974 | 31.7 |  |  |  |  |  |  |
| 975 | 27.0 |  |  |  |  |  |  |
| 976 | 24.7 |  |  |  |  |  |  |
| 977 | 19.3 |  |  |  |  |  |  |
| 978 | 16.0 |  |  |  |  |  |  |
| 979 | 13.2 |  |  |  |  |  |  |
| 980 | 10.7 |  |  |  |  |  |  |
| 981 | 8.8 |  |  |  |  |  |  |
| 982 | 7.2 |  |  |  |  |  |  |
| 983 | 5.5 |  |  |  |  |  |  |
| 984 | 3.2 |  |  |  |  |  |  |
| 985 | 1.1 |  |  |  |  |  |  |
| 986 | 0.0 |  |  |  |  |  |  |
| 987 | 0.0 |  |  |  |  |  |  |
| 988 | 0.0 |  |  |  |  |  |  |
| 989 | 0.0 |  |  |  |  |  |  |
| 990 | 0.0 |  |  |  |  |  |  |
| 991 | 0.0 |  |  |  |  |  |  |
| 992 | 0.0 |  |  |  |  |  |  |
| 993 | 0.0 |  |  |  |  |  |  |
| 994 | 0.0 |  |  |  |  |  |  |
| 995 | 0.0 |  |  |  |  |  |  |
| 996 | 0.0 |  |  |  |  |  |  |
| 997 | 0.0 |  |  |  |  |  |  |
| 998 | 0.0 |  |  |  |  |  |  |
| 999 | 0.0 |  |  |  |  |  |  |
| 1000 | 0.0 |  |  |  |  |  |  |
| 1001 | 0.0 |  |  |  |  |  |  |
| 1002 | 0.0 |  |  |  |  |  |  |
| 1003 | 0.0 |  |  |  |  |  |  |
| 1004 | 0.0 |  |  |  |  |  |  |
| 1005 | 0.0 |  |  |  |  |  |  |
| 1006 | 0.0 |  |  |  |  |  |  |
| 1007 | 0.0 |  |  |  |  |  |  |
| 1008 | 0.0 |  |  |  |  |  |  |
| 1009 | 0.0 |  |  |  |  |  |  |
| 1010 | 0.0 |  |  |  |  |  |  |
| 1011 | 0.0 |  |  |  |  |  |  |
| 1012 | 0.0 |  |  |  |  |  |  |
| 1013 | 0.0 |  |  |  |  |  |  |
| 1014 | 0.0 |  |  |  |  |  |  |
| 1015 | 0.0 |  |  |  |  |  |  |
| 1016 | 0.0 |  |  |  |  |  |  |
| 1017 | 0.0 |  |  |  |  |  |  |
| 1018 | 0.0 |  |  |  |  |  |  |
| 1019 | 0.0 |  |  |  |  |  |  |
| 1020 | 0.0 |  |  |  |  |  |  |
| 1021 | 0.0 |  |  |  |  |  |  |
| 1022 | 0.0 |  |  |  |  |  |  |

# Table A1/9

# **WLTC, Class 3b cycle, phase Medium3b (Sec 589 is the end of phase Low3 and the start of phase Medium3b)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 590 | 0.0 | 637 | 53.0 | 684 | 18.9 | 731 | 41.9 |
| 591 | 0.0 | 638 | 53.0 | 685 | 18.9 | 732 | 42.0 |
| 592 | 0.0 | 639 | 52.9 | 686 | 21.3 | 733 | 42.2 |
| 593 | 0.0 | 640 | 52.7 | 687 | 23.9 | 734 | 42.4 |
| 594 | 0.0 | 641 | 52.6 | 688 | 25.9 | 735 | 42.7 |
| 595 | 0.0 | 642 | 53.1 | 689 | 28.4 | 736 | 43.1 |
| 596 | 0.0 | 643 | 54.3 | 690 | 30.3 | 737 | 43.7 |
| 597 | 0.0 | 644 | 55.2 | 691 | 30.9 | 738 | 44.0 |
| 598 | 0.0 | 645 | 55.5 | 692 | 31.1 | 739 | 44.1 |
| 599 | 0.0 | 646 | 55.9 | 693 | 31.8 | 740 | 45.3 |
| 600 | 0.0 | 647 | 56.3 | 694 | 32.7 | 741 | 46.4 |
| 601 | 1.0 | 648 | 56.7 | 695 | 33.2 | 742 | 47.2 |
| 602 | 2.1 | 649 | 56.9 | 696 | 32.4 | 743 | 47.3 |
| 603 | 4.8 | 650 | 56.8 | 697 | 28.3 | 744 | 47.4 |
| 604 | 9.1 | 651 | 56.0 | 698 | 25.8 | 745 | 47.4 |
| 605 | 14.2 | 652 | 54.2 | 699 | 23.1 | 746 | 47.5 |
| 606 | 19.8 | 653 | 52.1 | 700 | 21.8 | 747 | 47.9 |
| 607 | 25.5 | 654 | 50.1 | 701 | 21.2 | 748 | 48.6 |
| 608 | 30.5 | 655 | 47.2 | 702 | 21.0 | 749 | 49.4 |
| 609 | 34.8 | 656 | 43.2 | 703 | 21.0 | 750 | 49.8 |
| 610 | 38.8 | 657 | 39.2 | 704 | 20.9 | 751 | 49.8 |
| 611 | 42.9 | 658 | 36.5 | 705 | 19.9 | 752 | 49.7 |
| 612 | 46.4 | 659 | 34.3 | 706 | 17.9 | 753 | 49.3 |
| 613 | 48.3 | 660 | 31.0 | 707 | 15.1 | 754 | 48.5 |
| 614 | 48.7 | 661 | 26.0 | 708 | 12.8 | 755 | 47.6 |
| 615 | 48.5 | 662 | 20.7 | 709 | 12.0 | 756 | 46.3 |
| 616 | 48.4 | 663 | 15.4 | 710 | 13.2 | 757 | 43.7 |
| 617 | 48.2 | 664 | 13.1 | 711 | 17.1 | 758 | 39.3 |
| 618 | 47.8 | 665 | 12.0 | 712 | 21.1 | 759 | 34.1 |
| 619 | 47.0 | 666 | 12.5 | 713 | 21.8 | 760 | 29.0 |
| 620 | 45.9 | 667 | 14.0 | 714 | 21.2 | 761 | 23.7 |
| 621 | 44.9 | 668 | 19.0 | 715 | 18.5 | 762 | 18.4 |
| 622 | 44.4 | 669 | 23.2 | 716 | 13.9 | 763 | 14.3 |
| 623 | 44.3 | 670 | 28.0 | 717 | 12.0 | 764 | 12.0 |
| 624 | 44.5 | 671 | 32.0 | 718 | 12.0 | 765 | 12.8 |
| 625 | 45.1 | 672 | 34.0 | 719 | 13.0 | 766 | 16.0 |
| 626 | 45.7 | 673 | 36.0 | 720 | 16.0 | 767 | 19.1 |
| 627 | 46.0 | 674 | 38.0 | 721 | 18.5 | 768 | 22.4 |
| 628 | 46.0 | 675 | 40.0 | 722 | 20.6 | 769 | 25.6 |
| 629 | 46.0 | 676 | 40.3 | 723 | 22.5 | 770 | 30.1 |
| 630 | 46.1 | 677 | 40.5 | 724 | 24.0 | 771 | 35.3 |
| 631 | 46.7 | 678 | 39.0 | 725 | 26.6 | 772 | 39.9 |
| 632 | 47.7 | 679 | 35.7 | 726 | 29.9 | 773 | 44.5 |
| 633 | 48.9 | 680 | 31.8 | 727 | 34.8 | 774 | 47.5 |
| 634 | 50.3 | 681 | 27.1 | 728 | 37.8 | 775 | 50.9 |
| 635 | 51.6 | 682 | 22.8 | 729 | 40.2 | 776 | 54.1 |
| 636 | 52.6 | 683 | 21.1 | 730 | 41.6 | 777 | 56.3 |
| 778 | 58.1 | 827 | 37.1 | 876 | 72.7 | 925 | 64.1 |
| 779 | 59.8 | 828 | 38.9 | 877 | 71.3 | 926 | 62.7 |
| 780 | 61.1 | 829 | 41.4 | 878 | 70.4 | 927 | 62.0 |
| 781 | 62.1 | 830 | 44.0 | 879 | 70.0 | 928 | 61.3 |
| 782 | 62.8 | 831 | 46.3 | 880 | 70.0 | 929 | 60.9 |
| 783 | 63.3 | 832 | 47.7 | 881 | 69.0 | 930 | 60.5 |
| 784 | 63.6 | 833 | 48.2 | 882 | 68.0 | 931 | 60.2 |
| 785 | 64.0 | 834 | 48.7 | 883 | 68.0 | 932 | 59.8 |
| 786 | 64.7 | 835 | 49.3 | 884 | 68.0 | 933 | 59.4 |
| 787 | 65.2 | 836 | 49.8 | 885 | 68.1 | 934 | 58.6 |
| 788 | 65.3 | 837 | 50.2 | 886 | 68.4 | 935 | 57.5 |
| 789 | 65.3 | 838 | 50.9 | 887 | 68.6 | 936 | 56.6 |
| 790 | 65.4 | 839 | 51.8 | 888 | 68.7 | 937 | 56.0 |
| 791 | 65.7 | 840 | 52.5 | 889 | 68.5 | 938 | 55.5 |
| 792 | 66.0 | 841 | 53.3 | 890 | 68.1 | 939 | 55.0 |
| 793 | 65.6 | 842 | 54.5 | 891 | 67.3 | 940 | 54.4 |
| 794 | 63.5 | 843 | 55.7 | 892 | 66.2 | 941 | 54.1 |
| 795 | 59.7 | 844 | 56.5 | 893 | 64.8 | 942 | 54.0 |
| 796 | 54.6 | 845 | 56.8 | 894 | 63.6 | 943 | 53.9 |
| 797 | 49.3 | 846 | 57.0 | 895 | 62.6 | 944 | 53.9 |
| 798 | 44.9 | 847 | 57.2 | 896 | 62.1 | 945 | 54.0 |
| 799 | 42.3 | 848 | 57.7 | 897 | 61.9 | 946 | 54.2 |
| 800 | 41.4 | 849 | 58.7 | 898 | 61.9 | 947 | 55.0 |
| 801 | 41.3 | 850 | 60.1 | 899 | 61.8 | 948 | 55.8 |
| 802 | 42.1 | 851 | 61.1 | 900 | 61.5 | 949 | 56.2 |
| 803 | 44.7 | 852 | 61.7 | 901 | 60.9 | 950 | 56.1 |
| 804 | 48.4 | 853 | 62.3 | 902 | 59.7 | 951 | 55.1 |
| 805 | 51.4 | 854 | 62.9 | 903 | 54.6 | 952 | 52.7 |
| 806 | 52.7 | 855 | 63.3 | 904 | 49.3 | 953 | 48.4 |
| 807 | 53.0 | 856 | 63.4 | 905 | 44.9 | 954 | 43.1 |
| 808 | 52.5 | 857 | 63.5 | 906 | 42.3 | 955 | 37.8 |
| 809 | 51.3 | 858 | 64.5 | 907 | 41.4 | 956 | 32.5 |
| 810 | 49.7 | 859 | 65.8 | 908 | 41.3 | 957 | 27.2 |
| 811 | 47.4 | 860 | 66.8 | 909 | 42.1 | 958 | 25.1 |
| 812 | 43.7 | 861 | 67.4 | 910 | 44.7 | 959 | 26.0 |
| 813 | 39.7 | 862 | 68.8 | 911 | 48.4 | 960 | 29.3 |
| 814 | 35.5 | 863 | 71.1 | 912 | 51.4 | 961 | 34.6 |
| 815 | 31.1 | 864 | 72.3 | 913 | 52.7 | 962 | 40.4 |
| 816 | 26.3 | 865 | 72.8 | 914 | 54.0 | 963 | 45.3 |
| 817 | 21.9 | 866 | 73.4 | 915 | 57.0 | 964 | 49.0 |
| 818 | 18.0 | 867 | 74.6 | 916 | 58.1 | 965 | 51.1 |
| 819 | 17.0 | 868 | 76.0 | 917 | 59.2 | 966 | 52.1 |
| 820 | 18.0 | 869 | 76.6 | 918 | 59.0 | 967 | 52.2 |
| 821 | 21.4 | 870 | 76.5 | 919 | 59.1 | 968 | 52.1 |
| 822 | 24.8 | 871 | 76.2 | 920 | 59.5 | 969 | 51.7 |
| 823 | 27.9 | 872 | 75.8 | 921 | 60.5 | 970 | 50.9 |
| 824 | 30.8 | 873 | 75.4 | 922 | 62.3 | 971 | 49.2 |
| 825 | 33.0 | 874 | 74.8 | 923 | 63.9 | 972 | 45.9 |
| 826 | 35.1 | 875 | 73.9 | 924 | 65.1 | 973 | 40.6 |
| 974 | 35.3 |  |  |  |  |  |  |
| 975 | 30.0 |  |  |  |  |  |  |
| 976 | 24.7 |  |  |  |  |  |  |
| 977 | 19.3 |  |  |  |  |  |  |
| 978 | 16.0 |  |  |  |  |  |  |
| 979 | 13.2 |  |  |  |  |  |  |
| 980 | 10.7 |  |  |  |  |  |  |
| 981 | 8.8 |  |  |  |  |  |  |
| 982 | 7.2 |  |  |  |  |  |  |
| 983 | 5.5 |  |  |  |  |  |  |
| 984 | 3.2 |  |  |  |  |  |  |
| 985 | 1.1 |  |  |  |  |  |  |
| 986 | 0.0 |  |  |  |  |  |  |
| 987 | 0.0 |  |  |  |  |  |  |
| 988 | 0.0 |  |  |  |  |  |  |
| 989 | 0.0 |  |  |  |  |  |  |
| 990 | 0.0 |  |  |  |  |  |  |
| 991 | 0.0 |  |  |  |  |  |  |
| 992 | 0.0 |  |  |  |  |  |  |
| 993 | 0.0 |  |  |  |  |  |  |
| 994 | 0.0 |  |  |  |  |  |  |
| 995 | 0.0 |  |  |  |  |  |  |
| 996 | 0.0 |  |  |  |  |  |  |
| 997 | 0.0 |  |  |  |  |  |  |
| 998 | 0.0 |  |  |  |  |  |  |
| 999 | 0.0 |  |  |  |  |  |  |
| 1000 | 0.0 |  |  |  |  |  |  |
| 1001 | 0.0 |  |  |  |  |  |  |
| 1002 | 0.0 |  |  |  |  |  |  |
| 1003 | 0.0 |  |  |  |  |  |  |
| 1004 | 0.0 |  |  |  |  |  |  |
| 1005 | 0.0 |  |  |  |  |  |  |
| 1006 | 0.0 |  |  |  |  |  |  |
| 1007 | 0.0 |  |  |  |  |  |  |
| 1008 | 0.0 |  |  |  |  |  |  |
| 1009 | 0.0 |  |  |  |  |  |  |
| 1010 | 0.0 |  |  |  |  |  |  |
| 1011 | 0.0 |  |  |  |  |  |  |
| 1012 | 0.0 |  |  |  |  |  |  |
| 1013 | 0.0 |  |  |  |  |  |  |
| 1014 | 0.0 |  |  |  |  |  |  |
| 1015 | 0.0 |  |  |  |  |  |  |
| 1016 | 0.0 |  |  |  |  |  |  |
| 1017 | 0.0 |  |  |  |  |  |  |
| 1018 | 0.0 |  |  |  |  |  |  |
| 1019 | 0.0 |  |  |  |  |  |  |
| 1020 | 0.0 |  |  |  |  |  |  |
| 1021 | 0.0 |  |  |  |  |  |  |
| 1022 | 0.0 |  |  |  |  |  |  |

# Table A1/10

# **WLTC, Class 3a cycle, phase High3a (Second 1022 is the start of this phase)**

| *Time in s* | *Speed in km/h* |  | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1023 | 0.0 |  | 1070 | 29.0 | 1117 | 66.2 | 1164 | 52.6 |
| 1024 | 0.0 |  | 1071 | 32.0 | 1118 | 65.8 | 1165 | 54.5 |
| 1025 | 0.0 |  | 1072 | 34.8 | 1119 | 64.7 | 1166 | 56.6 |
| 1026 | 0.0 |  | 1073 | 37.7 | 1120 | 63.6 | 1167 | 58.3 |
| 1027 | 0.8 |  | 1074 | 40.8 | 1121 | 62.9 | 1168 | 60.0 |
| 1028 | 3.6 |  | 1075 | 43.2 | 1122 | 62.4 | 1169 | 61.5 |
| 1029 | 8.6 |  | 1076 | 46.0 | 1123 | 61.7 | 1170 | 63.1 |
| 1030 | 14.6 |  | 1077 | 48.0 | 1124 | 60.1 | 1171 | 64.3 |
| 1031 | 20.0 |  | 1078 | 50.7 | 1125 | 57.3 | 1172 | 65.7 |
| 1032 | 24.4 |  | 1079 | 52.0 | 1126 | 55.8 | 1173 | 67.1 |
| 1033 | 28.2 |  | 1080 | 54.5 | 1127 | 50.5 | 1174 | 68.3 |
| 1034 | 31.7 |  | 1081 | 55.9 | 1128 | 45.2 | 1175 | 69.7 |
| 1035 | 35.0 |  | 1082 | 57.4 | 1129 | 40.1 | 1176 | 70.6 |
| 1036 | 37.6 |  | 1083 | 58.1 | 1130 | 36.2 | 1177 | 71.6 |
| 1037 | 39.7 |  | 1084 | 58.4 | 1131 | 32.9 | 1178 | 72.6 |
| 1038 | 41.5 |  | 1085 | 58.8 | 1132 | 29.8 | 1179 | 73.5 |
| 1039 | 43.6 |  | 1086 | 58.8 | 1133 | 26.6 | 1180 | 74.2 |
| 1040 | 46.0 |  | 1087 | 58.6 | 1134 | 23.0 | 1181 | 74.9 |
| 1041 | 48.4 |  | 1088 | 58.7 | 1135 | 19.4 | 1182 | 75.6 |
| 1042 | 50.5 |  | 1089 | 58.8 | 1136 | 16.3 | 1183 | 76.3 |
| 1043 | 51.9 |  | 1090 | 58.8 | 1137 | 14.6 | 1184 | 77.1 |
| 1044 | 52.6 |  | 1091 | 58.8 | 1138 | 14.2 | 1185 | 77.9 |
| 1045 | 52.8 |  | 1092 | 59.1 | 1139 | 14.3 | 1186 | 78.5 |
| 1046 | 52.9 |  | 1093 | 60.1 | 1140 | 14.6 | 1187 | 79.0 |
| 1047 | 53.1 |  | 1094 | 61.7 | 1141 | 15.1 | 1188 | 79.7 |
| 1048 | 53.3 |  | 1095 | 63.0 | 1142 | 16.4 | 1189 | 80.3 |
| 1049 | 53.1 |  | 1096 | 63.7 | 1143 | 19.1 | 1190 | 81.0 |
| 1050 | 52.3 |  | 1097 | 63.9 | 1144 | 22.5 | 1191 | 81.6 |
| 1051 | 50.7 |  | 1098 | 63.5 | 1145 | 24.4 | 1192 | 82.4 |
| 1052 | 48.8 |  | 1099 | 62.3 | 1146 | 24.8 | 1193 | 82.9 |
| 1053 | 46.5 |  | 1100 | 60.3 | 1147 | 22.7 | 1194 | 83.4 |
| 1054 | 43.8 |  | 1101 | 58.9 | 1148 | 17.4 | 1195 | 83.8 |
| 1055 | 40.3 |  | 1102 | 58.4 | 1149 | 13.8 | 1196 | 84.2 |
| 1056 | 36.0 |  | 1103 | 58.8 | 1150 | 12.0 | 1197 | 84.7 |
| 1057 | 30.7 |  | 1104 | 60.2 | 1151 | 12.0 | 1198 | 85.2 |
| 1058 | 25.4 |  | 1105 | 62.3 | 1152 | 12.0 | 1199 | 85.6 |
| 1059 | 21.0 |  | 1106 | 63.9 | 1153 | 13.9 | 1200 | 86.3 |
| 1060 | 16.7 |  | 1107 | 64.5 | 1154 | 17.7 | 1201 | 86.8 |
| 1061 | 13.4 |  | 1108 | 64.4 | 1155 | 22.8 | 1202 | 87.4 |
| 1062 | 12.0 |  | 1109 | 63.5 | 1156 | 27.3 | 1203 | 88.0 |
| 1063 | 12.1 |  | 1110 | 62.0 | 1157 | 31.2 | 1204 | 88.3 |
| 1064 | 12.8 |  | 1111 | 61.2 | 1158 | 35.2 | 1205 | 88.7 |
| 1065 | 15.6 |  | 1112 | 61.3 | 1159 | 39.4 | 1206 | 89.0 |
| 1066 | 19.9 |  | 1113 | 61.7 | 1160 | 42.5 | 1207 | 89.3 |
| 1067 | 23.4 |  | 1114 | 62.0 | 1161 | 45.4 | 1208 | 89.8 |
| 1068 | 24.6 |  | 1115 | 64.6 | 1162 | 48.2 | 1209 | 90.2 |
| 1069 | 27.0 |  | 1116 | 66.0 | 1163 | 50.3 | 1210 | 90.6 |
| 1211 | 91.0 |  | 1260 | 95.7 | 1309 | 75.9 | 1358 | 68.2 |
| 1212 | 91.3 |  | 1261 | 95.5 | 1310 | 76.0 | 1359 | 66.1 |
| 1213 | 91.6 |  | 1262 | 95.3 | 1311 | 76.0 | 1360 | 63.8 |
| 1214 | 91.9 |  | 1263 | 95.2 | 1312 | 76.1 | 1361 | 61.6 |
| 1215 | 92.2 |  | 1264 | 95.0 | 1313 | 76.3 | 1362 | 60.2 |
| 1216 | 92.8 |  | 1265 | 94.9 | 1314 | 76.5 | 1363 | 59.8 |
| 1217 | 93.1 |  | 1266 | 94.7 | 1315 | 76.6 | 1364 | 60.4 |
| 1218 | 93.3 |  | 1267 | 94.5 | 1316 | 76.8 | 1365 | 61.8 |
| 1219 | 93.5 |  | 1268 | 94.4 | 1317 | 77.1 | 1366 | 62.6 |
| 1220 | 93.7 |  | 1269 | 94.4 | 1318 | 77.1 | 1367 | 62.7 |
| 1221 | 93.9 |  | 1270 | 94.3 | 1319 | 77.2 | 1368 | 61.9 |
| 1222 | 94.0 |  | 1271 | 94.3 | 1320 | 77.2 | 1369 | 60.0 |
| 1223 | 94.1 |  | 1272 | 94.1 | 1321 | 77.6 | 1370 | 58.4 |
| 1224 | 94.3 |  | 1273 | 93.9 | 1322 | 78.0 | 1371 | 57.8 |
| 1225 | 94.4 |  | 1274 | 93.4 | 1323 | 78.4 | 1372 | 57.8 |
| 1226 | 94.6 |  | 1275 | 92.8 | 1324 | 78.8 | 1373 | 57.8 |
| 1227 | 94.7 |  | 1276 | 92.0 | 1325 | 79.2 | 1374 | 57.3 |
| 1228 | 94.8 |  | 1277 | 91.3 | 1326 | 80.3 | 1375 | 56.2 |
| 1229 | 95.0 |  | 1278 | 90.6 | 1327 | 80.8 | 1376 | 54.3 |
| 1230 | 95.1 |  | 1279 | 90.0 | 1328 | 81.0 | 1377 | 50.8 |
| 1231 | 95.3 |  | 1280 | 89.3 | 1329 | 81.0 | 1378 | 45.5 |
| 1232 | 95.4 |  | 1281 | 88.7 | 1330 | 81.0 | 1379 | 40.2 |
| 1233 | 95.6 |  | 1282 | 88.1 | 1331 | 81.0 | 1380 | 34.9 |
| 1234 | 95.7 |  | 1283 | 87.4 | 1332 | 81.0 | 1381 | 29.6 |
| 1235 | 95.8 |  | 1284 | 86.7 | 1333 | 80.9 | 1382 | 28.7 |
| 1236 | 96.0 |  | 1285 | 86.0 | 1334 | 80.6 | 1383 | 29.3 |
| 1237 | 96.1 |  | 1286 | 85.3 | 1335 | 80.3 | 1384 | 30.5 |
| 1238 | 96.3 |  | 1287 | 84.7 | 1336 | 80.0 | 1385 | 31.7 |
| 1239 | 96.4 |  | 1288 | 84.1 | 1337 | 79.9 | 1386 | 32.9 |
| 1240 | 96.6 |  | 1289 | 83.5 | 1338 | 79.8 | 1387 | 35.0 |
| 1241 | 96.8 |  | 1290 | 82.9 | 1339 | 79.8 | 1388 | 38.0 |
| 1242 | 97.0 |  | 1291 | 82.3 | 1340 | 79.8 | 1389 | 40.5 |
| 1243 | 97.2 |  | 1292 | 81.7 | 1341 | 79.9 | 1390 | 42.7 |
| 1244 | 97.3 |  | 1293 | 81.1 | 1342 | 80.0 | 1391 | 45.8 |
| 1245 | 97.4 |  | 1294 | 80.5 | 1343 | 80.4 | 1392 | 47.5 |
| 1246 | 97.4 |  | 1295 | 79.9 | 1344 | 80.8 | 1393 | 48.9 |
| 1247 | 97.4 |  | 1296 | 79.4 | 1345 | 81.2 | 1394 | 49.4 |
| 1248 | 97.4 |  | 1297 | 79.1 | 1346 | 81.5 | 1395 | 49.4 |
| 1249 | 97.3 |  | 1298 | 78.8 | 1347 | 81.6 | 1396 | 49.2 |
| 1250 | 97.3 |  | 1299 | 78.5 | 1348 | 81.6 | 1397 | 48.7 |
| 1251 | 97.3 |  | 1300 | 78.2 | 1349 | 81.4 | 1398 | 47.9 |
| 1252 | 97.3 |  | 1301 | 77.9 | 1350 | 80.7 | 1399 | 46.9 |
| 1253 | 97.2 |  | 1302 | 77.6 | 1351 | 79.6 | 1400 | 45.6 |
| 1254 | 97.1 |  | 1303 | 77.3 | 1352 | 78.2 | 1401 | 44.2 |
| 1255 | 97.0 |  | 1304 | 77.0 | 1353 | 76.8 | 1402 | 42.7 |
| 1256 | 96.9 |  | 1305 | 76.7 | 1354 | 75.3 | 1403 | 40.7 |
| 1257 | 96.7 |  | 1306 | 76.0 | 1355 | 73.8 | 1404 | 37.1 |
| 1258 | 96.4 |  | 1307 | 76.0 | 1356 | 72.1 | 1405 | 33.9 |
| 1259 | 96.1 |  | 1308 | 76.0 | 1357 | 70.2 | 1406 | 30.6 |
| 1407 | 28.6 |  | 1456 | 0.0 |  |  |  |  |
| 1408 | 27.3 |  | 1457 | 0.0 |  |  |  |  |
| 1409 | 27.2 |  | 1458 | 0.0 |  |  |  |  |
| 1410 | 27.5 |  | 1459 | 0.0 |  |  |  |  |
| 1411 | 27.4 |  | 1460 | 0.0 |  |  |  |  |
| 1412 | 27.1 |  | 1461 | 0.0 |  |  |  |  |
| 1413 | 26.7 |  | 1462 | 0.0 |  |  |  |  |
| 1414 | 26.8 |  | 1463 | 0.0 |  |  |  |  |
| 1415 | 28.2 |  | 1464 | 0.0 |  |  |  |  |
| 1416 | 31.1 |  | 1465 | 0.0 |  |  |  |  |
| 1417 | 34.8 |  | 1466 | 0.0 |  |  |  |  |
| 1418 | 38.4 |  | 1467 | 0.0 |  |  |  |  |
| 1419 | 40.9 |  | 1468 | 0.0 |  |  |  |  |
| 1420 | 41.7 |  | 1469 | 0.0 |  |  |  |  |
| 1421 | 40.9 |  | 1470 | 0.0 |  |  |  |  |
| 1422 | 38.3 |  | 1471 | 0.0 |  |  |  |  |
| 1423 | 35.3 |  | 1472 | 0.0 |  |  |  |  |
| 1424 | 34.3 |  | 1473 | 0.0 |  |  |  |  |
| 1425 | 34.6 |  | 1474 | 0.0 |  |  |  |  |
| 1426 | 36.3 |  | 1475 | 0.0 |  |  |  |  |
| 1427 | 39.5 |  | 1476 | 0.0 |  |  |  |  |
| 1428 | 41.8 |  | 1477 | 0.0 |  |  |  |  |
| 1429 | 42.5 |  |  |  |  |  |  |  |
| 1430 | 41.9 |  |  |  |  |  |  |  |
| 1431 | 40.1 |  |  |  |  |  |  |  |
| 1432 | 36.6 |  |  |  |  |  |  |  |
| 1433 | 31.3 |  |  |  |  |  |  |  |
| 1434 | 26.0 |  |  |  |  |  |  |  |
| 1435 | 20.6 |  |  |  |  |  |  |  |
| 1436 | 19.1 |  |  |  |  |  |  |  |
| 1437 | 19.7 |  |  |  |  |  |  |  |
| 1438 | 21.1 |  |  |  |  |  |  |  |
| 1439 | 22.0 |  |  |  |  |  |  |  |
| 1440 | 22.1 |  |  |  |  |  |  |  |
| 1441 | 21.4 |  |  |  |  |  |  |  |
| 1442 | 19.6 |  |  |  |  |  |  |  |
| 1443 | 18.3 |  |  |  |  |  |  |  |
| 1444 | 18.0 |  |  |  |  |  |  |  |
| 1445 | 18.3 |  |  |  |  |  |  |  |
| 1446 | 18.5 |  |  |  |  |  |  |  |
| 1447 | 17.9 |  |  |  |  |  |  |  |
| 1448 | 15.0 |  |  |  |  |  |  |  |
| 1449 | 9.9 |  |  |  |  |  |  |  |
| 1450 | 4.6 |  |  |  |  |  |  |  |
| 1451 | 1.2 |  |  |  |  |  |  |  |
| 1452 | 0.0 |  |  |  |  |  |  |  |
| 1453 | 0.0 |  |  |  |  |  |  |  |
| 1454 | 0.0 |  |  |  |  |  |  |  |
| 1455 | 0.0 |  |  |  |  |  |  |  |

# Table A1/11

# **WLTC, Class 3b cycle, phase High3b (Second 1022 is the start of this phase)**

| *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* | *Time in s* | *Speed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1023 | 0.0 | 1070 | 26.4 | 1117 | 69.7 | 1164 | 52.6 |
| 1024 | 0.0 | 1071 | 28.8 | 1118 | 69.3 | 1165 | 54.5 |
| 1025 | 0.0 | 1072 | 31.8 | 1119 | 68.1 | 1166 | 56.6 |
| 1026 | 0.0 | 1073 | 35.3 | 1120 | 66.9 | 1167 | 58.3 |
| 1027 | 0.8 | 1074 | 39.5 | 1121 | 66.2 | 1168 | 60.0 |
| 1028 | 3.6 | 1075 | 44.5 | 1122 | 65.7 | 1169 | 61.5 |
| 1029 | 8.6 | 1076 | 49.3 | 1123 | 64.9 | 1170 | 63.1 |
| 1030 | 14.6 | 1077 | 53.3 | 1124 | 63.2 | 1171 | 64.3 |
| 1031 | 20.0 | 1078 | 56.4 | 1125 | 60.3 | 1172 | 65.7 |
| 1032 | 24.4 | 1079 | 58.9 | 1126 | 55.8 | 1173 | 67.1 |
| 1033 | 28.2 | 1080 | 61.2 | 1127 | 50.5 | 1174 | 68.3 |
| 1034 | 31.7 | 1081 | 62.6 | 1128 | 45.2 | 1175 | 69.7 |
| 1035 | 35.0 | 1082 | 63.0 | 1129 | 40.1 | 1176 | 70.6 |
| 1036 | 37.6 | 1083 | 62.5 | 1130 | 36.2 | 1177 | 71.6 |
| 1037 | 39.7 | 1084 | 60.9 | 1131 | 32.9 | 1178 | 72.6 |
| 1038 | 41.5 | 1085 | 59.3 | 1132 | 29.8 | 1179 | 73.5 |
| 1039 | 43.6 | 1086 | 58.6 | 1133 | 26.6 | 1180 | 74.2 |
| 1040 | 46.0 | 1087 | 58.6 | 1134 | 23.0 | 1181 | 74.9 |
| 1041 | 48.4 | 1088 | 58.7 | 1135 | 19.4 | 1182 | 75.6 |
| 1042 | 50.5 | 1089 | 58.8 | 1136 | 16.3 | 1183 | 76.3 |
| 1043 | 51.9 | 1090 | 58.8 | 1137 | 14.6 | 1184 | 77.1 |
| 1044 | 52.6 | 1091 | 58.8 | 1138 | 14.2 | 1185 | 77.9 |
| 1045 | 52.8 | 1092 | 59.1 | 1139 | 14.3 | 1186 | 78.5 |
| 1046 | 52.9 | 1093 | 60.1 | 1140 | 14.6 | 1187 | 79.0 |
| 1047 | 53.1 | 1094 | 61.7 | 1141 | 15.1 | 1188 | 79.7 |
| 1048 | 53.3 | 1095 | 63.0 | 1142 | 16.4 | 1189 | 80.3 |
| 1049 | 53.1 | 1096 | 63.7 | 1143 | 19.1 | 1190 | 81.0 |
| 1050 | 52.3 | 1097 | 63.9 | 1144 | 22.5 | 1191 | 81.6 |
| 1051 | 50.7 | 1098 | 63.5 | 1145 | 24.4 | 1192 | 82.4 |
| 1052 | 48.8 | 1099 | 62.3 | 1146 | 24.8 | 1193 | 82.9 |
| 1053 | 46.5 | 1100 | 60.3 | 1147 | 22.7 | 1194 | 83.4 |
| 1054 | 43.8 | 1101 | 58.9 | 1148 | 17.4 | 1195 | 83.8 |
| 1055 | 40.3 | 1102 | 58.4 | 1149 | 13.8 | 1196 | 84.2 |
| 1056 | 36.0 | 1103 | 58.8 | 1150 | 12.0 | 1197 | 84.7 |
| 1057 | 30.7 | 1104 | 60.2 | 1151 | 12.0 | 1198 | 85.2 |
| 1058 | 25.4 | 1105 | 62.3 | 1152 | 12.0 | 1199 | 85.6 |
| 1059 | 21.0 | 1106 | 63.9 | 1153 | 13.9 | 1200 | 86.3 |
| 1060 | 16.7 | 1107 | 64.5 | 1154 | 17.7 | 1201 | 86.8 |
| 1061 | 13.4 | 1108 | 64.4 | 1155 | 22.8 | 1202 | 87.4 |
| 1062 | 12.0 | 1109 | 63.5 | 1156 | 27.3 | 1203 | 88.0 |
| 1063 | 12.1 | 1110 | 62.0 | 1157 | 31.2 | 1204 | 88.3 |
| 1064 | 12.8 | 1111 | 61.2 | 1158 | 35.2 | 1205 | 88.7 |
| 1065 | 15.6 | 1112 | 61.3 | 1159 | 39.4 | 1206 | 89.0 |
| 1066 | 19.9 | 1113 | 62.6 | 1160 | 42.5 | 1207 | 89.3 |
| 1067 | 23.4 | 1114 | 65.3 | 1161 | 45.4 | 1208 | 89.8 |
| 1068 | 24.6 | 1115 | 68.0 | 1162 | 48.2 | 1209 | 90.2 |
| 1069 | 25.2 | 1116 | 69.4 | 1163 | 50.3 | 1210 | 90.6 |
| 1211 | 91.0 | 1260 | 95.7 | 1309 | 75.9 | 1358 | 68.2 |
| 1212 | 91.3 | 1261 | 95.5 | 1310 | 75.9 | 1359 | 66.1 |
| 1213 | 91.6 | 1262 | 95.3 | 1311 | 75.8 | 1360 | 63.8 |
| 1214 | 91.9 | 1263 | 95.2 | 1312 | 75.7 | 1361 | 61.6 |
| 1215 | 92.2 | 1264 | 95.0 | 1313 | 75.5 | 1362 | 60.2 |
| 1216 | 92.8 | 1265 | 94.9 | 1314 | 75.2 | 1363 | 59.8 |
| 1217 | 93.1 | 1266 | 94.7 | 1315 | 75.0 | 1364 | 60.4 |
| 1218 | 93.3 | 1267 | 94.5 | 1316 | 74.7 | 1365 | 61.8 |
| 1219 | 93.5 | 1268 | 94.4 | 1317 | 74.1 | 1366 | 62.6 |
| 1220 | 93.7 | 1269 | 94.4 | 1318 | 73.7 | 1367 | 62.7 |
| 1221 | 93.9 | 1270 | 94.3 | 1319 | 73.3 | 1368 | 61.9 |
| 1222 | 94.0 | 1271 | 94.3 | 1320 | 73.5 | 1369 | 60.0 |
| 1223 | 94.1 | 1272 | 94.1 | 1321 | 74.0 | 1370 | 58.4 |
| 1224 | 94.3 | 1273 | 93.9 | 1322 | 74.9 | 1371 | 57.8 |
| 1225 | 94.4 | 1274 | 93.4 | 1323 | 76.1 | 1372 | 57.8 |
| 1226 | 94.6 | 1275 | 92.8 | 1324 | 77.7 | 1373 | 57.8 |
| 1227 | 94.7 | 1276 | 92.0 | 1325 | 79.2 | 1374 | 57.3 |
| 1228 | 94.8 | 1277 | 91.3 | 1326 | 80.3 | 1375 | 56.2 |
| 1229 | 95.0 | 1278 | 90.6 | 1327 | 80.8 | 1376 | 54.3 |
| 1230 | 95.1 | 1279 | 90.0 | 1328 | 81.0 | 1377 | 50.8 |
| 1231 | 95.3 | 1280 | 89.3 | 1329 | 81.0 | 1378 | 45.5 |
| 1232 | 95.4 | 1281 | 88.7 | 1330 | 81.0 | 1379 | 40.2 |
| 1233 | 95.6 | 1282 | 88.1 | 1331 | 81.0 | 1380 | 34.9 |
| 1234 | 95.7 | 1283 | 87.4 | 1332 | 81.0 | 1381 | 29.6 |
| 1235 | 95.8 | 1284 | 86.7 | 1333 | 80.9 | 1382 | 27.3 |
| 1236 | 96.0 | 1285 | 86.0 | 1334 | 80.6 | 1383 | 29.3 |
| 1237 | 96.1 | 1286 | 85.3 | 1335 | 80.3 | 1384 | 32.9 |
| 1238 | 96.3 | 1287 | 84.7 | 1336 | 80.0 | 1385 | 35.6 |
| 1239 | 96.4 | 1288 | 84.1 | 1337 | 79.9 | 1386 | 36.7 |
| 1240 | 96.6 | 1289 | 83.5 | 1338 | 79.8 | 1387 | 37.6 |
| 1241 | 96.8 | 1290 | 82.9 | 1339 | 79.8 | 1388 | 39.4 |
| 1242 | 97.0 | 1291 | 82.3 | 1340 | 79.8 | 1389 | 42.5 |
| 1243 | 97.2 | 1292 | 81.7 | 1341 | 79.9 | 1390 | 46.5 |
| 1244 | 97.3 | 1293 | 81.1 | 1342 | 80.0 | 1391 | 50.2 |
| 1245 | 97.4 | 1294 | 80.5 | 1343 | 80.4 | 1392 | 52.8 |
| 1246 | 97.4 | 1295 | 79.9 | 1344 | 80.8 | 1393 | 54.3 |
| 1247 | 97.4 | 1296 | 79.4 | 1345 | 81.2 | 1394 | 54.9 |
| 1248 | 97.4 | 1297 | 79.1 | 1346 | 81.5 | 1395 | 54.9 |
| 1249 | 97.3 | 1298 | 78.8 | 1347 | 81.6 | 1396 | 54.7 |
| 1250 | 97.3 | 1299 | 78.5 | 1348 | 81.6 | 1397 | 54.1 |
| 1251 | 97.3 | 1300 | 78.2 | 1349 | 81.4 | 1398 | 53.2 |
| 1252 | 97.3 | 1301 | 77.9 | 1350 | 80.7 | 1399 | 52.1 |
| 1253 | 97.2 | 1302 | 77.6 | 1351 | 79.6 | 1400 | 50.7 |
| 1254 | 97.1 | 1303 | 77.3 | 1352 | 78.2 | 1401 | 49.1 |
| 1255 | 97.0 | 1304 | 77.0 | 1353 | 76.8 | 1402 | 47.4 |
| 1256 | 96.9 | 1305 | 76.7 | 1354 | 75.3 | 1403 | 45.2 |
| 1257 | 96.7 | 1306 | 76.0 | 1355 | 73.8 | 1404 | 41.8 |
| 1258 | 96.4 | 1307 | 76.0 | 1356 | 72.1 | 1405 | 36.5 |
| 1259 | 96.1 | 1308 | 76.0 | 1357 | 70.2 | 1406 | 31.2 |
| 1407 | 27.6 | 1456 | 0.0 |  |  |  |  |
| 1408 | 26.9 | 1457 | 0.0 |  |  |  |  |
| 1409 | 27.3 | 1458 | 0.0 |  |  |  |  |
| 1410 | 27.5 | 1459 | 0.0 |  |  |  |  |
| 1411 | 27.4 | 1460 | 0.0 |  |  |  |  |
| 1412 | 27.1 | 1461 | 0.0 |  |  |  |  |
| 1413 | 26.7 | 1462 | 0.0 |  |  |  |  |
| 1414 | 26.8 | 1463 | 0.0 |  |  |  |  |
| 1415 | 28.2 | 1464 | 0.0 |  |  |  |  |
| 1416 | 31.1 | 1465 | 0.0 |  |  |  |  |
| 1417 | 34.8 | 1466 | 0.0 |  |  |  |  |
| 1418 | 38.4 | 1467 | 0.0 |  |  |  |  |
| 1419 | 40.9 | 1468 | 0.0 |  |  |  |  |
| 1420 | 41.7 | 1469 | 0.0 |  |  |  |  |
| 1421 | 40.9 | 1470 | 0.0 |  |  |  |  |
| 1422 | 38.3 | 1471 | 0.0 |  |  |  |  |
| 1423 | 35.3 | 1472 | 0.0 |  |  |  |  |
| 1424 | 34.3 | 1473 | 0.0 |  |  |  |  |
| 1425 | 34.6 | 1474 | 0.0 |  |  |  |  |
| 1426 | 36.3 | 1475 | 0.0 |  |  |  |  |
| 1427 | 39.5 | 1476 | 0.0 |  |  |  |  |
| 1428 | 41.8 | 1477 | 0.0 |  |  |  |  |
| 1429 | 42.5 |  |  |  |  |  |  |
| 1430 | 41.9 |  |  |  |  |  |  |
| 1431 | 40.1 |  |  |  |  |  |  |
| 1432 | 36.6 |  |  |  |  |  |  |
| 1433 | 31.3 |  |  |  |  |  |  |
| 1434 | 26.0 |  |  |  |  |  |  |
| 1435 | 20.6 |  |  |  |  |  |  |
| 1436 | 19.1 |  |  |  |  |  |  |
| 1437 | 19.7 |  |  |  |  |  |  |
| 1438 | 21.1 |  |  |  |  |  |  |
| 1439 | 22.0 |  |  |  |  |  |  |
| 1440 | 22.1 |  |  |  |  |  |  |
| 1441 | 21.4 |  |  |  |  |  |  |
| 1442 | 19.6 |  |  |  |  |  |  |
| 1443 | 18.3 |  |  |  |  |  |  |
| 1444 | 18.0 |  |  |  |  |  |  |
| 1445 | 18.3 |  |  |  |  |  |  |
| 1446 | 18.5 |  |  |  |  |  |  |
| 1447 | 17.9 |  |  |  |  |  |  |
| 1448 | 15.0 |  |  |  |  |  |  |
| 1449 | 9.9 |  |  |  |  |  |  |
| 1450 | 4.6 |  |  |  |  |  |  |
| 1451 | 1.2 |  |  |  |  |  |  |
| 1452 | 0.0 |  |  |  |  |  |  |
| 1453 | 0.0 |  |  |  |  |  |  |
| 1454 | 0.0 |  |  |  |  |  |  |
| 1455 | 0.0 |  |  |  |  |  |  |

# Table A1/12

# **WLTC, Class 3 cycle, phase Extra High3 (Second 1477 is the start of this phase)**

| *Time in s* | S*peed in km/h* | *Time in s* | S*peed in km/h* | *Time in s* | S*peed in km/h* | *Time in s* | S*peed in km/h* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1478 | 0.0 | 1525 | 72.5 | 1572 | 120.7 | 1619 | 113.0 |
| 1479 | 2.2 | 1526 | 70.8 | 1573 | 121.8 | 1620 | 114.1 |
| 1480 | 4.4 | 1527 | 68.6 | 1574 | 122.6 | 1621 | 115.1 |
| 1481 | 6.3 | 1528 | 66.2 | 1575 | 123.2 | 1622 | 115.9 |
| 1482 | 7.9 | 1529 | 64.0 | 1576 | 123.6 | 1623 | 116.5 |
| 1483 | 9.2 | 1530 | 62.2 | 1577 | 123.7 | 1624 | 116.7 |
| 1484 | 10.4 | 1531 | 60.9 | 1578 | 123.6 | 1625 | 116.6 |
| 1485 | 11.5 | 1532 | 60.2 | 1579 | 123.3 | 1626 | 116.2 |
| 1486 | 12.9 | 1533 | 60.0 | 1580 | 123.0 | 1627 | 115.2 |
| 1487 | 14.7 | 1534 | 60.4 | 1581 | 122.5 | 1628 | 113.8 |
| 1488 | 17.0 | 1535 | 61.4 | 1582 | 122.1 | 1629 | 112.0 |
| 1489 | 19.8 | 1536 | 63.2 | 1583 | 121.5 | 1630 | 110.1 |
| 1490 | 23.1 | 1537 | 65.6 | 1584 | 120.8 | 1631 | 108.3 |
| 1491 | 26.7 | 1538 | 68.4 | 1585 | 120.0 | 1632 | 107.0 |
| 1492 | 30.5 | 1539 | 71.6 | 1586 | 119.1 | 1633 | 106.1 |
| 1493 | 34.1 | 1540 | 74.9 | 1587 | 118.1 | 1634 | 105.8 |
| 1494 | 37.5 | 1541 | 78.4 | 1588 | 117.1 | 1635 | 105.7 |
| 1495 | 40.6 | 1542 | 81.8 | 1589 | 116.2 | 1636 | 105.7 |
| 1496 | 43.3 | 1543 | 84.9 | 1590 | 115.5 | 1637 | 105.6 |
| 1497 | 45.7 | 1544 | 87.4 | 1591 | 114.9 | 1638 | 105.3 |
| 1498 | 47.7 | 1545 | 89.0 | 1592 | 114.5 | 1639 | 104.9 |
| 1499 | 49.3 | 1546 | 90.0 | 1593 | 114.1 | 1640 | 104.4 |
| 1500 | 50.5 | 1547 | 90.6 | 1594 | 113.9 | 1641 | 104.0 |
| 1501 | 51.3 | 1548 | 91.0 | 1595 | 113.7 | 1642 | 103.8 |
| 1502 | 52.1 | 1549 | 91.5 | 1596 | 113.3 | 1643 | 103.9 |
| 1503 | 52.7 | 1550 | 92.0 | 1597 | 112.9 | 1644 | 104.4 |
| 1504 | 53.4 | 1551 | 92.7 | 1598 | 112.2 | 1645 | 105.1 |
| 1505 | 54.0 | 1552 | 93.4 | 1599 | 111.4 | 1646 | 106.1 |
| 1506 | 54.5 | 1553 | 94.2 | 1600 | 110.5 | 1647 | 107.2 |
| 1507 | 55.0 | 1554 | 94.9 | 1601 | 109.5 | 1648 | 108.5 |
| 1508 | 55.6 | 1555 | 95.7 | 1602 | 108.5 | 1649 | 109.9 |
| 1509 | 56.3 | 1556 | 96.6 | 1603 | 107.7 | 1650 | 111.3 |
| 1510 | 57.2 | 1557 | 97.7 | 1604 | 107.1 | 1651 | 112.7 |
| 1511 | 58.5 | 1558 | 98.9 | 1605 | 106.6 | 1652 | 113.9 |
| 1512 | 60.2 | 1559 | 100.4 | 1606 | 106.4 | 1653 | 115.0 |
| 1513 | 62.3 | 1560 | 102.0 | 1607 | 106.2 | 1654 | 116.0 |
| 1514 | 64.7 | 1561 | 103.6 | 1608 | 106.2 | 1655 | 116.8 |
| 1515 | 67.1 | 1562 | 105.2 | 1609 | 106.2 | 1656 | 117.6 |
| 1516 | 69.2 | 1563 | 106.8 | 1610 | 106.4 | 1657 | 118.4 |
| 1517 | 70.7 | 1564 | 108.5 | 1611 | 106.5 | 1658 | 119.2 |
| 1518 | 71.9 | 1565 | 110.2 | 1612 | 106.8 | 1659 | 120.0 |
| 1519 | 72.7 | 1566 | 111.9 | 1613 | 107.2 | 1660 | 120.8 |
| 1520 | 73.4 | 1567 | 113.7 | 1614 | 107.8 | 1661 | 121.6 |
| 1521 | 73.8 | 1568 | 115.3 | 1615 | 108.5 | 1662 | 122.3 |
| 1522 | 74.1 | 1569 | 116.8 | 1616 | 109.4 | 1663 | 123.1 |
| 1523 | 74.0 | 1570 | 118.2 | 1617 | 110.5 | 1664 | 123.8 |
| 1524 | 73.6 | 1571 | 119.5 | 1618 | 111.7 | 1665 | 124.4 |
| 1666 | 125.0 | 1715 | 127.7 | 1764 | 82.0 |  |  |
| 1667 | 125.4 | 1716 | 128.1 | 1765 | 81.3 |  |  |
| 1668 | 125.8 | 1717 | 128.5 | 1766 | 80.4 |  |  |
| 1669 | 126.1 | 1718 | 129.0 | 1767 | 79.1 |  |  |
| 1670 | 126.4 | 1719 | 129.5 | 1768 | 77.4 |  |  |
| 1671 | 126.6 | 1720 | 130.1 | 1769 | 75.1 |  |  |
| 1672 | 126.7 | 1721 | 130.6 | 1770 | 72.3 |  |  |
| 1673 | 126.8 | 1722 | 131.0 | 1771 | 69.1 |  |  |
| 1674 | 126.9 | 1723 | 131.2 | 1772 | 65.9 |  |  |
| 1675 | 126.9 | 1724 | 131.3 | 1773 | 62.7 |  |  |
| 1676 | 126.9 | 1725 | 131.2 | 1774 | 59.7 |  |  |
| 1677 | 126.8 | 1726 | 130.7 | 1775 | 57.0 |  |  |
| 1678 | 126.6 | 1727 | 129.8 | 1776 | 54.6 |  |  |
| 1679 | 126.3 | 1728 | 128.4 | 1777 | 52.2 |  |  |
| 1680 | 126.0 | 1729 | 126.5 | 1778 | 49.7 |  |  |
| 1681 | 125.7 | 1730 | 124.1 | 1779 | 46.8 |  |  |
| 1682 | 125.6 | 1731 | 121.6 | 1780 | 43.5 |  |  |
| 1683 | 125.6 | 1732 | 119.0 | 1781 | 39.9 |  |  |
| 1684 | 125.8 | 1733 | 116.5 | 1782 | 36.4 |  |  |
| 1685 | 126.2 | 1734 | 114.1 | 1783 | 33.2 |  |  |
| 1686 | 126.6 | 1735 | 111.8 | 1784 | 30.5 |  |  |
| 1687 | 127.0 | 1736 | 109.5 | 1785 | 28.3 |  |  |
| 1688 | 127.4 | 1737 | 107.1 | 1786 | 26.3 |  |  |
| 1689 | 127.6 | 1738 | 104.8 | 1787 | 24.4 |  |  |
| 1690 | 127.8 | 1739 | 102.5 | 1788 | 22.5 |  |  |
| 1691 | 127.9 | 1740 | 100.4 | 1789 | 20.5 |  |  |
| 1692 | 128.0 | 1741 | 98.6 | 1790 | 18.2 |  |  |
| 1693 | 128.1 | 1742 | 97.2 | 1791 | 15.5 |  |  |
| 1694 | 128.2 | 1743 | 95.9 | 1792 | 12.3 |  |  |
| 1695 | 128.3 | 1744 | 94.8 | 1793 | 8.7 |  |  |
| 1696 | 128.4 | 1745 | 93.8 | 1794 | 5.2 |  |  |
| 1697 | 128.5 | 1746 | 92.8 | 1795 | 0.0 |  |  |
| 1698 | 128.6 | 1747 | 91.8 | 1796 | 0.0 |  |  |
| 1699 | 128.6 | 1748 | 91.0 | 1797 | 0.0 |  |  |
| 1700 | 128.5 | 1749 | 90.2 | 1798 | 0.0 |  |  |
| 1701 | 128.3 | 1750 | 89.6 | 1799 | 0.0 |  |  |
| 1702 | 128.1 | 1751 | 89.1 | 1800 | 0.0 |  |  |
| 1703 | 127.9 | 1752 | 88.6 |  |  |  |  |
| 1704 | 127.6 | 1753 | 88.1 |  |  |  |  |
| 1705 | 127.4 | 1754 | 87.6 |  |  |  |  |
| 1706 | 127.2 | 1755 | 87.1 |  |  |  |  |
| 1707 | 127.0 | 1756 | 86.6 |  |  |  |  |
| 1708 | 126.9 | 1757 | 86.1 |  |  |  |  |
| 1709 | 126.8 | 1758 | 85.5 |  |  |  |  |
| 1710 | 126.7 | 1759 | 85.0 |  |  |  |  |
| 1711 | 126.8 | 1760 | 84.4 |  |  |  |  |
| 1712 | 126.9 | 1761 | 83.8 |  |  |  |  |
| 1713 | 127.1 | 1762 | 83.2 |  |  |  |  |
| 1714 | 127.4 | 1763 | 82.6 |  |  |  |  |

7. Cycle identification

In order to confirm if the correct cycle version was chosen or if the correct cycle was implemented into the test bench operation system, checksums of the vehicle speed values for cycle phases and the whole cycle are listed in Table A1/13.

# Table A1/13

# **1Hz checksums**

|  |  |  |
| --- | --- | --- |
| *Cycle class* | *Cycle phase* | *Checksum of 1 Hz target vehicle speeds* |
| Class 1 | Low | 11988.4 |
| Medium | 17162.8 |
| Low | 11988.4 |
| Total | 41139.6 |
| Class 2 | Low | 11162.2 |
| Medium | 17054.3 |
| High | 24450.6 |
| Extra High | 28869.8 |
| Total | 81536.9 |
| Class 3a | Low | 11140.3 |
| Medium | 16995.7 |
| High | 25646.0 |
| Extra High | 29714.9 |
| Total | 83496.9 |
| Class 3b | Low | 11140.3 |
| Medium | 17121.2 |
| High | 25782.2 |
| Extra High | 29714.9 |
| Total | 83758.6 |

8. Cycle modification

This paragraph shall not apply to OVC-HEVs, NOVC-HEVs and NOVC-FCHVs.

8.1. General remarks

Driveability problems may occur for vehicles with power to mass ratios close to the borderlines between Class 1 and Class 2, Class 2 and Class 3 vehicles, or very low powered vehicles in Class 1.

xxxxx Since these problems are related mainly to cycle phases with a combination of high vehicle speed and high accelerations rather than to the maximum speed of the cycle, the downscaling procedure shall be applied to improve driveability.

8.2. This paragraph describes the method to modify the cycle profile using the downscaling procedure. The modified vehicle speed values calculated according to paragraphs 8.2.1 to 8.2.3 shall be rounded according to paragraph 7. of this UN GTR to 1 place of decimal.

8.2.1. Downscaling procedure for Class 1 vehicles

Figure A1/14 shows an example of a downscaled medium speed phase of the Class 1 WLTC.

# Figure A1/14

# **Downscaled medium speed phase of the Class 1 WLTC**



For the Class 1 cycle, the downscaling period is the time period between second 651 and second 906. Within this time period, the acceleration for the original cycle shall be calculated using the following equation:

where:

is the vehicle speed, km/h;

i is the time between second 651 and second 906.

The downscaling shall be applied first in the time period between second 651 and second 848. The downscaled speed trace shall be subsequently calculated using the following equation:

with .

For , .

In order to meet the original vehicle speed at second 907, a correction factor for the deceleration shall be calculated using the following equation:

where 36.7 km/h is the original vehicle speed at second 907.

The downscaled vehicle speed between second 849 and second 906 shall be subsequently calculated using the following equation:

For .

8.2.2. Downscaling procedure for Class 2 vehicles

Since the driveability problems are exclusively related to the extra high speed phases of the Class 2 and Class 3 cycles, the downscaling is related to those time periods of the extra high speed phases where driveability problems are expected to occur (see Figures A1/15 and A1/16).

# Figure A1/15

# **Downscaled extra high speed phase of the Class 2 WLTC**



For the Class 2 cycle, the downscaling period is the time period between second 1520 and second 1742. Within this time period, the acceleration for the original cycle shall be calculated using the following equation:

where:

is the vehicle speed, km/h;

i is the time between second 1520 and second 1742.

The downscaling shall be applied first to the time period between second 1520 and second 1725. Second 1725 is the time when the maximum speed of the extra high speed phase is reached. The downscaled speed trace shall be subsequently calculated using the following equation:

for .

For , .

In order to meet the original vehicle speed at second 1743, a correction factor for the deceleration shall be calculated using the following equation:

90.4 km/h is the original vehicle speed at second 1743.

The downscaled vehicle speed between second 1726 and second 1742 shall be calculated using the following equation:

for .

8.2.3. Downscaling procedure for Class 3 vehicles

Figure A1/16 shows an example for a downscaled extra high speed phase of the Class 3 WLTC.

# Figure A1/16

# **Downscaled extra high speed phase of the Class 3 WLTC**



For the Class 3 cycle, the downscaling period is the time period between second 1533 and second 1762. Within this time period, the acceleration for the original cycle shall be calculated using the following equation:

where:

is the vehicle speed, km/h;

i is the time between second 1533 and second 1762.

The downscaling shall be applied first in the time period between second 1533 and second 1724. Second 1724 is the time when the maximum speed of the extra high speed phase is reached. The downscaled speed trace shall be subsequently calculated using the following equation:

For .

For , .

In order to meet the original vehicle speed at second 1763, a correction factor for the deceleration shall be calculated using the following equation:

82.6 km/h is the original vehicle speed at second 1763.

The downscaled vehicle speed between second 1725 and second 1762 shall be subsequently calculated using the following equation:

For .

8.3. Determination of the downscaling factor

The downscaling factor is a function of the ratio between the maximum required power of the cycle phases where the downscaling is to be applied and the rated power of the vehicle, .

The maximum required power (in kW) is related to a specific time i and the corresponding vehicle speed vi in the cycle trace and is calculated using the following equation:

where:

, , are the applicable road load coefficients, N, N/(km/h), and N/(km/h)² respectively;

is the applicable test mass, kg;

vi is the speed at time i, km/h;

ai is the acceleration at time i, km/h².

The cycle time i at which maximum power or power values close to maximum power is required is second 764 for the Class 1 cycle, second 1574 for the Class 2 cycle and second 1566 for the Class 3 cycle.

The corresponding vehicle speed values, and acceleration values, , are as follows:

 km/h,  m/s² for Class 1,

 km/h,  m/s² for Class 2,

 km/h,  m/s² for Class 3.

shall be calculated using the following equation:

The downscaling factor, , shall be calculated using the following equations:

if , then

and no downscaling shall be applied.

If , then .

The calculation parameter/coefficients, , and , are as follows:

Class 1 , ,

Class 2 , , .

Class 3 , .

The resulting shall be rounded according to paragraph 7. of this UN GTR to 3 places of decimal and shall be applied only if it exceeds 0.010.

The following data shall be recorded:

(a) fdsc;

(b) vmax; km/h

(c) dcycle (distance driven), m.

The distance shall be calculated ~~as the sum of v~~~~i~~ ~~in km/h divided by 3.6 over the whole cycle tracexxxxx~~ using the following equation:

dcycle = (, for

i = tstart + 1 to tend

tstart is the time at which the applicable test cycle starts (see paragraph 3 of annex 1 of this Regulation), s;

tend is the time at which the applicable test cycle ends (see paragraph 3 of annex 1 of this Regulation), s.

8.4. Additional requirements

For different vehicle configurations in terms of test mass and driving resistance coefficients, downscaling shall be applied individually.

If, after application of downscaling, the vehicle’s maximum speed is lower than the maximum speed of the cycle, the process described in paragraph 9. of this annex shall be applied with the applicable cycle.

If the vehicle cannot follow the speed trace of the applicable cycle within the tolerance at speeds lower than its maximum speed, it shall be driven with the accelerator control fully activated during these periods. During such periods of operation, speed trace violations shall be permitted.

9. Cycle modifications for vehicles with a maximum speed lower than the maximum speed of the cycle specified in the previous paragraphs of this annex

9.1. General remarks

This paragraph applies, if required by regional legislation, to vehicles that are technically able to follow the speed trace of the applicable cycle specified in paragraph 1. of this annex (base cycle) at speeds lower than its maximum speed, but whose maximum speed is limited to a value lower than the maximum speed of the base cycle for other reasons. For the purposes of this paragraph, this applicable cycle shall be referred to as the "base cycle" and is used to determine the capped speed cycle.

In the cases where downscaling according to paragraph 8.2. of this annex is applied, the downscaled cycle shall be used as the base cycle.

The maximum speed of the base cycle shall be referred to as vmax,cycle.

The maximum speed of the vehicle shall be referred to as its capped speed vcap.

If vcap is applied to a Class 3b vehicle as defined in paragraph 3.3.2. of this annex, the Class 3b cycle shall be used as the base cycle. This shall apply even if vcap is lower than 120 km/h.

In the cases where vcap is applied, the base cycle shall be modified as described in paragraph 9.2. of this annex in order to achieve the same cycle distance for the capped speed cycle as for the base cycle.

9.2. Calculation steps

9.2.1. Determination of the distance difference per cycle phase

An interim capped speed cycle shall be derived by replacing all vehicle speed samples vi where vi > vcap by vcap.

9.2.1.1. If vcap < vmax,medium, the distance of the medium speed phases of the base cycle dbase,medium and the interim capped speed cycle dcap,medium shall be calculated using the following equation for both cycles:

dmedium = (, for i = 590 to 1022

where:

vmax,medium is the maximum vehicle speed of the medium speed phase as listed in Table A1/2 for the Class 1 cycle, in Table A1/4 for the Class 2 cycle, in Table A1/8 for the Class 3a cycle and in Table A1/9 for the Class 3b cycle.

9.2.1.2. If vcap < vmax,high, the distances of the high speed phases of the base cycle dbase,high and the interim capped speed cycle dcap,high shall be calculated using the following equation for both cycles:

dhigh = (, for i = 1023 to 1477

vmax,high is the maximum vehicle speed of the high speed phase as listed in Table A1/5 for the Class 2 cycle, in Table A1/10 for the Class 3a cycle and in Table A1/11 for the Class 3b cycle.

9.2.1.3. The distances of the extra high speed phase of the base cycle dbase,exhigh and the interim capped speed cycle dcap,exhigh shall be calculated applying the following equation to the extra high speed phase of both cycles:

dexhigh = (, for i = 1478 to 1800

9.2.2. Determination of the time periods to be added to the interim capped speed cycle in order to compensate for distance differences

In order to compensate for a difference in distance between the base cycle and the interim capped speed cycle, corresponding time periods with vi = vcap shall be added to the interim capped speed cycle as described in paragraphs 9.2.2.1. to 9.2.2.3. inclusive of this annex.

9.2.2.1. Additional time period for the medium speed phase

If vcap < vmax,medium, the additional time period to be added to the medium speed phase of the interim capped speed cycle shall be calculated using the following equation:

Δtmedium =

The number of time samples nadd,medium with vi = vcap to be added to the medium speed phase of the interim capped speed cycle equals Δtmedium, rounded according to paragraph 7. of this UN GTR to the nearest integer.

9.2.2.2. Additional time period for the high speed phase

If vcap < vmax,high, the additional time period to be added to the high speed phases of the interim capped speed cycle shall be calculated using the following equation:

Δthigh =

The number of time samples nadd,high with vi = vcap to be added to the high speed phase of the interim capped speed cycle equals Δthigh, rounded according to paragraph 7. of this UN GTR to the nearest integer.

9.2.2.3. The additional time period to be added to the extra high speed phase of the interim capped speed cycle shall be calculated using the following equation:

Δtexhigh =

The number of time samples nadd,exhigh with vi = vcap to be added to the extra high speed phase of the interim capped speed cycle equals Δtexhigh, rounded according to paragraph 7. of this UN GTR to the nearest integer.

9.2.3. Construction of the final capped speed cycle

9.2.3.1. Class 1 cycle

The first part of the final capped speed cycle consists of the vehicle speed trace of the interim capped speed cycle up to the last sample in the medium speed phase where v = vcap. The time of this sample is referred to as tmedium.

Then nadd,medium samples with vi = vcap shall be added, so that the time of the last sample is (tmedium + nadd,medium).

The remaining part of the medium speed phase of the interim capped speed cycle, which is identical with the same part of the base cycle, shall then be added, so that the time of the last sample is (1022 + nadd,medium).

9.2.3.2. Class 2 and Class 3 cycles

9.2.3.2.1. vcap < vmax,medium

The first part of the final capped speed cycle consists of the vehicle speed trace of the interim capped speed cycle up to the last sample in the medium speed phase where v = vcap. The time of this sample is referred to as tmedium.

Then nadd,medium samples with vi = vcap shall be added, so that the time of the last sample is (tmedium + nadd,medium).

The remaining part of the medium speed phase of the interim capped speed cycle, which is identical with the same part of the base cycle, shall then be added, so that the time of the last sample is (1022 + nadd,medium).

In a next step, the first part of the high speed phase of the interim capped speed cycle up to the last sample in the high speed phase where v = vcap shall be added. The time of this sample in the interim capped speed is referred to as thigh, so that the time of this sample in the final capped speed cycle is (thigh + nadd,medium).

Then, nadd,high samples with vi = vcap shall be added, so that the time of the last sample becomes (thigh + nadd,medium + nadd,high).

The remaining part of the high speed phase of the interim capped speed cycle, which is identical with the same part of the base cycle, shall then be added, so that the time of the last sample is (1477 + nadd,medium + nadd,high).

In a next step, the first part of the extra high speed phase of the interim capped speed cycle up to the last sample in the extra high speed phase where v = vcap shall be added. The time of this sample in the interim capped speed is referred to as texhigh, so that the time of this sample in the final capped speed cycle is (texhigh + nadd,medium + nadd,high).

Then nadd,exhigh samples with vi = vcap shall be added, so that the time of the last sample is (texhigh + nadd,medium + nadd,high + nadd,exhigh).

The remaining part of the extra high speed phase of the interim capped speed cycle, which is identical with the same part of the base cycle, shall then be added, so that the time of the last sample is (1800 + nadd,medium + nadd,high+ nadd,exhigh).

The length of the final capped speed cycle is equivalent to the length of the base cycle except for differences caused by the rounding process according to paragraph 7. of this UN GTR for nadd,medium, nadd,high and nadd,exhigh.

9.2.3.2.2. vmax, medium ≤ vcap < vmax, high

The first part of the final capped speed cycle consists of the vehicle speed trace of the interim capped speed cycle up to the last sample in the high speed phase where v = vcap. The time of this sample is referred to as thigh.

Then, nadd,high samples with vi = vcap shall be added, so that the time of the last sample is (thigh + nadd,high).

The remaining part of the high speed phase of the interim capped speed cycle, which is identical with the same part of the base cycle, shall then be added, so that the time of the last sample is (1477 + nadd,high).

In a next step, the first part of the extra high speed phase of the interim capped speed cycle up to the last sample in the extra high speed phase where v = vcap shall be added. The time of this sample in the interim capped speed is referred to as texhigh, so that the time of this sample in the final capped speed cycle is (texhigh + nadd,high).

Then nadd,exhigh samples with vi = vcap shall be added, so that the time of the last sample is (texhigh + nadd,high + nadd,exhigh).

The remaining part of the extra high speed phase of the interim capped speed cycle, which is identical with the same part of the base cycle, shall then be added, so that the time of the last sample is (1800 + nadd,high+ nadd,exhigh).

The length of the final capped speed cycle is equivalent to the length of the base cycle except for differences caused by the rounding process according to paragraph 7. of this UN GTR for nadd,high and nadd,exhigh.

9.2.3.2.3. vmax, high ≤ vcap < vmax, exhigh

The first part of the final capped speed cycle consists of the vehicle speed trace of the interim capped speed cycle up to the last sample in the extra high speed phase where v = vcap. The time of this sample is referred to as texhigh.

Then, nadd,exhigh samples with vi = vcap shall be added, so that the time of the last sample is (texhigh + nadd,exhigh).

The remaining part of the extra high speed phase of the interim capped speed cycle, which is identical with the same part of the base cycle, shall then be added, so that the time of the last sample is (1800 + nadd,exhigh).

The length of the final capped speed cycle is equivalent to the length of the base cycle except for differences caused by the rounding process according to paragraph 7. of this UN GTR for nadd,exhigh.

10. Allocation of cycles to vehicles

10.1. A vehicle of a certain class shall be tested on the cycle of the same class, i.e. Class 1 vehicles on the Class 1 cycle, Class 2 vehicles on the Class 2 cycle, Class 3a vehicles on the Class 3a cycle, and Class 3b vehicles on the Class 3b cycle. However, at the request of the manufacturer and with approval of the responsible authority, a vehicle may be tested on a numerically higher cycle class, e.g. a Class 2 vehicle may be tested on a Class 3 cycle. In this case the differences between Classes 3a and 3b shall be respected and the cycle may be downscaled according to paragraphs 8. to 8.4. inclusive of this annex.

Annex 2

Gear selection and shift point determination for vehicles equipped with manual transmissions

1. General approach

1.1. The shifting procedures described in this annex shall apply to vehicles equipped with manual shift transmissions.

1.2. The prescribed gears and shifting points are based on the balance between the power required to overcome driving resistance and acceleration, and the power provided by the engine in all possible gears at a specific cycle phase.

1.3. The calculation to determine the gears to use shall be based on engine speeds and full load power curves versus engine speed.

1.4. For vehicles equipped with a dual-range transmission (low and high), only the range designed for normal on-road operation shall be considered for gear use determination.

1.5. The prescriptions for clutch operation shall not be applied if the clutch is operated automatically without the need of an engagement or disengagement of the driver.

1.6. This annex shall not apply to vehicles tested according to Annex 8.

2. Required data and precalculations

The following data are required and calculations shall be performed in order to determine the gears to be used when driving the cycle on a chassis dynamometer:

(a) , the maximum rated engine power as declared by the manufacturer, kW;

(b) nrated, the rated engine speed declared by the manufacturer as the engine speed at which the engine develops its maximum power, min-1;

(c) , idling speed, min-1.

nidle shall be measured over a period of at least 1 minute at a sampling rate of at least 1 Hz with the engine running in warm condition, the gear lever placed in neutral, and the clutch engaged. The conditions for temperature, peripheral and auxiliary devices, etc. shall be the same as described in Annex 6 for the Type 1 test.

The value to be used in this annex shall be the arithmetic average over the measuring period and rounded according to paragraph 7. of this UN GTR to the nearest 10 min-1;

(d) ng, the number of forward gears.

The forward gears in the transmission range designed for normal on-road operation shall be numbered in descending order of the ratio between engine speed in min-1 and vehicle speed in km/h. Gear 1 is the gear with the highest ratio, gear ng is the gear with the lowest ratio. ng determines the number of forward gears;

(e) (n/v)i, the ratio obtained by dividing the engine speed n by the vehicle speed v for each gear i, for i = 1 to ng, min-1/(km/h). (n/v)i shall be calculated according to the equations in paragraph 8. of Annex 7;

(f) , , , road load coefficients selected for testing, N, N/(km/h), and N/(km/h)² respectively;

(g) nmax

nmax1 = n95\_high, the maximum engine speed where 95 per cent of rated power is reached, min – 1;

If n95\_high cannot be determined because the engine speed is limited to a lower value nlim for all gears and the corresponding full load power is higher than 95 per cent of rated power, n95\_high shall be set to nlim.

xxxxx nmax2 = (n/v)(ngvmax) × vmax,cycle

nmax3 = (n/v)(ngvmax) × vmax,vehicle

where:

vmax,cycle is the maximum speed of the vehicle speed trace according to Annex 1, km/h;

vmax,vehicle is the maximum speed of the vehicle according to paragraph 2.(i) of this annex, km/h;

(n/v)(ngvmax) is the ratio obtained by dividing engine speed n by the vehicle speed v for the gear ngvmax, min-1/(km/h );

ngvmax is defined in paragraph 2.(i) of this annex;

nmax is the maximum of nmax1, nmax2 and nmax3, min-1.

(h) Pwot(n), the full load power curve over the engine speed range

The power curve shall consist of a sufficient number of data sets (n, Pwot) so that the calculation of interim points between consecutive data sets can be performed by linear interpolation. Deviation of the linear interpolation from the full load power curve according to Regulation No. 85 shall not exceed 2 per cent. The first data set shall be at nmin\_drive\_set (see (k)(3) below) or lower. The last data set shall be at nmax or higher engine speed. Data sets need not be spaced equally but all data sets shall be reported.

The data sets and the values Prated and nrated shall be taken from the power curve as declared by the manufacturer.

The full load power at engine speeds not covered by Regulation No. 85 shall be determined according to the method described in Regulation No. 85;

(i) Determination of ngvmax and vmax

ngvmax, the gear in which the maximum vehicle speed is reached and shall be determined as follows:

If vmax(ng) ≥ vmax(ng-1) and vmax(ng-1) ≥ vmax(ng-2), then:

ngvmax = ng and vmax = vmax(ng).

If vmax(ng) < vmax(ng-1) and vmax(ng-1) ≥ vmax(ng-2), then:

ngvmax = ng-1 and vmax = vmax(ng-1),

otherwise, ngvmax = ng -2 and vmax = vmax(ng-2)

where:

vmax(ng) is the vehicle speed at which the required road load power equals the available power Pwot in gear ng (see Figure A2/1a).

vmax(ng-1) is the vehicle speed at which the required road load power equals the available power Pwot in the next lower gear (gear ng-1). See Figure A2/1b.

vmax(ng-2) is the vehicle speed at which the required road load power equals the available power Pwot in the gear ng-2.

Vehicle speed values rounded according to paragraph 7. of this UN GTR to one place of decimal shall be used for the determination of vmax and ngvmax.

The required road load power, kW, shall be calculated using the following equation:

where:

vis the vehicle speed specified above, km/h.

The available power at vehicle speed vmax in gear ng, gear ng - 1 or gear ng-2 shall be determined from the full load power curve, Pwot(n), by using the following equations:

nng = (n/v)ng × vmax(ng);

nng-1 = (n/v)ng-1 × vmax(ng-1);

nng-2 = (n/v)ng-2 × vmax(ng-2),

and by reducing the power values of the full load power curve by 10 per cent.

The method described above shall be extended to even lower gears, i.e. ng- 3, ng-4, etc. if necessary.

If, for the purpose of limiting maximum vehicle speed, the maximum engine speed is limited to nlim which is lower than the engine speed corresponding to the intersection of the road load power curve and the available power curve, then:

ngvmax = ng and vmax = nlim / (n/v)(ng).

Figure A2/1a

**An example where ngvmax is the highest gear**



Figure A2/1b

**An example where ngvmax is the 2nd highest gear**



(j) Exclusion of a crawler gear

Gear 1 may be excluded at the request of the manufacturer if all of the following conditions are fulfilled:

(1) The vehicle family is homologated to tow a trailer;

(2) (n/v)1 × (vmax / n95\_high) > 6.74;

(3) (n/v)2 × (vmax / n95\_high) > 3.85;

(4) The vehicle, having a mass mt as defined in the equation below, is able to pull away from standstill within 4 seconds, on an uphill gradient of at least 12 per cent, on five separate occasions within a period of 5 minutes.

mt = mr0 + 25 kg + (MC – mr0 – 25 kg) × 0.28

(factor 0.28 in the above equation shall be used for category 2 vehicles with a gross vehicle mass up to 3.5 tons and shall be replaced by factor 0.15 in the case of category 1 vehicles),

where:

vmax is the maximum vehicle speed as specified in paragraph 2. (i) of this annex. Only the vmax value resulting from the intersection of the required road load power curve and the available power curve of the relevant gear shall be used for the conditions in (2) and (3) above. A vmax value resulting from a limitation of the engine speed which prevents this intersection of curves shall not be used;

(n/v)(ngvmax) is the ratio obtained by dividing the engine speed n by the vehicle speed v for gear ngvmax, min-1/(km/h);

mr0 is the mass in running order, kg;

MC is the technically permissible maximum laden mass of the combination (see paragraph 3.2.27. of this GTR), kg.

In this case, gear 1 shall not be used when driving the cycle on a chassis dynamometer and the gears shall be renumbered starting with the second gear as gear 1.

(k) Definition of nmin\_drive

nmin\_drive is the minimum engine speed when the vehicle is in motion, min-1;

(1) For ngear = 1, nmin\_drive = nidle,

(2) For ngear = 2,

(i) for transitions from first to second gear:

nmin\_drive = 1.15 ×nidle,

(ii) for decelerations to standstill:

nmin\_drive = nidle,

(iii) for all other driving conditions:

nmin\_drive = 0.9 × nidle.

(3) For ngear > 2, nmin\_drive shall be determined by:

nmin\_drive = nidle + 0.125 × (nrated -nidle).

This value shall be referred to as nmin\_drive\_set.

The final results for nmin\_drive shall be rounded according to paragraph 7. of this UN GTR to the nearest integer.

Values higher than nmin\_drive\_set may be used for ngear > 2 if requested by the manufacturer. In this case, the manufacturer may specify one value for acceleration/constant speed phases (nmin\_drive\_up) and a different value for deceleration phases (nmin\_drive\_down).

Samples which have acceleration values ≥ -0.1389 m/s² shall belong to the acceleration/constant speed phases. This phase specification shall only be used for the determination of the initial gear according to paragraph 3.5. of this annex and shall not be applied to the requirements specified in paragraph 4. of this annex.

In addition, for an initial period of time (tstart\_phase), the manufacturer may specify higher values (nmin\_drive\_start or nmin\_drive\_up\_start and nmin\_drive\_down\_start) for the values nmin\_drive or nmin\_drive\_up and nmin\_drive\_down for ngear > 2 than specified above.

The initial time period shall be specified by the manufacturer but shall not exceed the low speed phase of the cycle and shall end in a stop phase so that there is no change of nmin\_drive within a short trip.

All individually chosen nmin\_drive values shall be equal to or higher than nmin\_drive\_set but shall not exceed (2 × nmin\_drive\_set).

All individually chosen nmin\_drive values and tstart\_phase shall be recorded.

Only nmin\_drive\_set shall be used as the lower limit for the full load power curve according to paragraph 2(h) above.

(l) , test mass of the vehicle, kg.

3. Calculations of required power, engine speeds, available power, and possible gear to be used

3.1. Calculation of required power

For each second j of the cycle trace, the power required to overcome driving resistance and to accelerate shall be calculated using the following equation:

where:

is the required power at second j, kW;

is the vehicle acceleration at second j, m/s², and is calculated as follows:

;

j = tstart to tend – 1,

tstart is the time at which the applicable test cycle starts (see paragraph 3 of annex 1 of this Regulation), s;

tend is the time at which the applicable test cycle ends (see paragraph 3 of annex 1 of this Regulation), s;

The acceleration value at second tend (second 1611 for class 1 cycle and 1800 for class 2 and 3 cycles) may be set to 0 in order to avoid empty cells.

is a factor taking the inertial resistances of the drivetrain during acceleration into account and is set to 1.03.

3.2. Determination of engine speeds

For any  km/h, it shall be assumed that the vehicle is standing still and the engine speed shall be set to .The gear lever shall be placed in neutral with the clutch engaged except 1 second before beginning an acceleration from standstill where first gear shall be selected with the clutch disengaged.

For each  km/h of the cycle trace and each gear i, to , the engine speed, ,shall be calculated using the following equation:

The calculation shall be performed with floating point numbers; the results shall not be rounded.

3.3. Selection of possible gears with respect to engine speed

The following gears may be selected for driving the speed trace at vj:

(a) All gears i < ngvmax where nmin\_drive ≤ ni,j ≤ nmax1;

(b) All gears i ≥ ngvmax where nmin\_drive ≤ ni,j ≤ nmax2;

(c) Gear 1, if ni,j < nmin\_drive.

If aj < 0 and ni,j ≤ nidle, ni,j shall be set to nidle and the clutch shall be disengaged.

If aj ≥ 0 and ni,j < max(1.15 × nidle ; min. engine speed of the Pwot(n) curve), ni,j shall be set to the maximum of (1.15 × nidle) or ((n/v)i × vj), and the clutch shall be set to “undefined”.

“Undefined” covers any status of the clutch between disengaged and engaged, depending on the individual engine and transmission design. In such a case, the real engine speed may deviate from the calculated engine speed.

With regard to the definition of nmin\_drive in paragraph 2 (k) the requirements (a) to (c) specified above can be expressed as follows for deceleration phases:

During a deceleration phase, gears with ngear > 2 shall be used as long as the engine speed does not drop below nmin\_drive.

Gear 2 shall be used during a deceleration phase within a short trip of the cycle (not at the end of a short trip) as long as the engine speed does not drop below (0.9 × nidle).

If the engine speed drops below nidle, the clutch shall be disengaged.

If the deceleration phase is the last part of a short trip shortly before a stop phase, the second gear shall be used as long as the engine speed does not drop below nidle.

Xxxxx A deceleration phase is a time period of more than 2 seconds with a vehicle speed ≥ 1 km/h and with strictly monotonic decrease of vehicle speed (see paragraph 4 of this annex).

3.4. Calculation of available power xxxxx

For each possible gear i and each vehicle speed value of the cycle trace (j as specified in paragraph 3.1 of this annex) and each engine speed value ni,j ≥ nmin of the full load power curve the available power shall be calculated using the following equation:

where:

is the rated power, kW;

is the power available at ni,j at full load condition from the full load power curve;

is a safety margin accounting for the difference between the stationary full load condition power curve and the power available during transition conditions. SM shall be set to 10 per cent;

ASM is an additional power safety margin which may be applied at the request of the manufacturer.

When requested, the manufacturer shall provide the ASM values (in per cent reduction of the wot power) together with data sets for Pwot(n) as shown by the example in Table A2/1. Linear interpolation shall be used between consecutive data points. ASM is limited to 50 per cent.

The application of an ASM requires the approval of the responsible authority.

Table A2/1

| *n* | *Pwot* | *SM*  *per cent* | *ASM*  *per cent* | *Pavailable* |
| --- | --- | --- | --- | --- |
| *min-1* | *kW* | *kW* |
| 700 | 6.3 | 10.0 | 20.0 | 4.4 |
| 1000 | 15.7 | 10.0 | 20.0 | 11.0 |
| 1500 | 32.3 | 10.0 | 15.0 | 24.2 |
| 1800 | 56.6 | 10.0 | 10.0 | 45.3 |
| 1900 | 59.7 | 10.0 | 5.0 | 50.8 |
| 2000 | 62.9 | 10.0 | 0.0 | 56.6 |
| 3000 | 94.3 | 10.0 | 0.0 | 84.9 |
| 4000 | 125.7 | 10.0 | 0.0 | 113.2 |
| 5000 | 157.2 | 10.0 | 0.0 | 141.5 |
| 5700 | 179.2 | 10.0 | 0.0 | 161.3 |
| 5800 | 180.1 | 10.0 | 0.0 | 162.1 |
| 6000 | 174.7 | 10.0 | 0.0 | 157.3 |
| 6200 | 169.0 | 10.0 | 0.0 | 152.1 |
| 6400 | 164.3 | 10.0 | 0.0 | 147.8 |
| 6600 | 156.4 | 10.0 | 0.0 | 140.8 |

3.5. Determination of possible gears to be used

The possible gears to be used shall be determined by the following conditions:

(a) The conditions of paragraph 3.3. of this annex are fulfilled, and

(b) For ngear > 2, if

The initial gear to be used for each second of the cycle trace is the highest final possible gear, imax. When starting from standstill, only the first gear shall be used.

The lowest final possible gear is imin.

4. Additional requirements for corrections and/or modifications of gear use

The initial gear selection shall be checked and modified in order to avoid too frequent gearshifts and to ensure driveability and practicality.

Xxxxx An acceleration phase is a time period of more than 2 seconds with a vehicle speed ≥ 1 km/h and with strictly monotonic increase of vehicle speed. A deceleration phase is a time period of more than 2 seconds with a vehicle speed ≥ 1 km/h and with strictly monotonic decrease of vehicle speed. A constant speed phase is a time period of more than 2 seconds with a constant vehicle speed ≥ 1 km/h. ~~Acceleration, deceleration or constant speed sections include also time periods of 2 seconds.~~

The end of an acceleration/deceleration phase is determined by the last time sample in which the vehicle speed is higher/lower than the vehicle speed of the previous time sample.

Corrections and/or modifications shall be made according to the following requirements:

(a) The modification check described in paragraph 4.(a) of this annex shall be applied to the complete cycle trace twice prior to the application of the following paragraphs of this annex.

If a one step higher gear (n+1) is required for only 1 second and the gears before and after are the same (n) or one of them is one step lower (n – 1), gear (n + 1) shall be corrected to gear n.

Examples:

Gear sequence i - 1, i, i - 1 shall be replaced by:

i - 1, i - 1, i - 1;

Gear sequence i - 1, i, i - 2 shall be replaced by:

i - 1, i - 1, i - 2;

Gear sequence i - 2, i, i - 1 shall be replaced by:

i - 2, i - 1, i - 1.

~~Gears used during accelerations or constant speed sections at vehicle speeds ≥ 1 km/h shall be used for a period of at least 2 seconds.~~

If, during acceleration or constant speed phases or transitions from constant speed to acceleration or acceleration to constant speed phases where these phases only contain upshifts, a gear is used for only one second, the gear in the following second shall be corrected to the gear before, so that a gear is used for at least 2 seconds.

Examples:

Gear sequence 1, 2, 3, 3, 3, 3, 3 shall be replaced by:

1, 1, 2, 2, 3, 3, 3.

Gear sequence 1, 2, 3, 4, 5, 5, 6, 6, 6, 6, 6 shall be replaced by:

1, 1, 2, 2, 3, 3, 4, 4, 5, 5, 6.

This requirement shall not be applied to downshifts during an acceleration phase or if the use of a gear for just one second follows immediately after such a downshift or if the downshift occurs right at the beginning of an acceleration phase. In these cases, the downshifts shall be first corrected according to paragraph 4.(b) of this annex.

Example:

Gear sequence 4, 4, 3, 4, 5, 5, 5, where the first second or the third second determines the start of an acceleration phase and where paragraph 4.(b) does not apply in the further course of the acceleration phase, shall be replaced by:

4, 4, 4, 4, 5, 5, 5.

However, if the gear at the beginning of an acceleration phase is one step lower than the gear in the previous second and the gears in the following (up to five) seconds are the same as the gear in the previous second but followed by a downshift, so that the application of 4.(c) would correct them to the same gear as at the beginning of the acceleration phase, the application of 4.(c) should be performed instead.

Xxxxx Example:

For a speed trace ~~section~~ sequence

19.6 18.3 18.0 18.3 18.5 17.9 15.0 km/h

with an initial gear use of

3 3 2 3 3 2 2,

the gears in the fourth and fifth second shall be corrected to a one step lower gear (which would be done by an application of 4.(c)) instead of a correction of the gear at the beginning of the acceleration phase (second three), so that the correction results in the following gear sequence

3 3 2 2 2 2 2

Furthermore, if the gear in the first second of an acceleration phase is the same as the gear in the previous second and the gear in the following seconds is one step higher, the gear in the second second of the acceleration phase shall be replaced by the gear used in the first second of the acceleration phase.

Example:

For a speed trace ~~section~~ sequence

30.9 25.5 21.4 20.2 22.9 26.6 30.2 km/h

with an initial gear use of

3 3 2 2 3 3 3,

the gear in the fifth second (the second second of the acceleration phase) shall be corrected to a one step lower gear in order to ensure the use of a gear within the acceleration phase for at least two seconds, so that the correction results in the following gear sequence

3 3 2 2 2 3 3

Gears shall not be skipped during upshifts within acceleration phases.

However, an upshift by two gears is permitted at the transition from an acceleration phase to a constant speed phase if the duration of the constant speed phase exceeds 5 seconds.

(b) If a downshift is required during an acceleration phase or at the beginning of the acceleration phase, the gear required during this downshift shall be noted (iDS). The starting point of a correction procedure is defined by either the last previous second when iDS was identified or by the starting point of the acceleration phase if all time samples before have gears > iDS. The highest gear of the time samples before the downshift determines the reference gear iref for the downshift. A downshift where iDS = iref – 1 is referred to as a one step downshift, a downshift where iDS = iref – 2 is referred to as a two step downshift, a downshift where iDS = iref – 3 is referred to as a three step downshift. The following check shall then be applied.

xxxxx

(i) One step downshifts

Working forward from the starting point of the correction procedure to the end of the acceleration phase, the latest occurrence of a 10 second window containing iDS for either 2 or more consecutive seconds, or 2 or more individual seconds, shall be identified. The last usage of iDS in this window defines the end point of the correction procedure. Between the start and end of the correction period, all requirements for gears greater than iDS shall be corrected to a requirement of iDS.

From the end of the correction period (in case of 10 second windows containing iDS for either 2 or more consecutive seconds, or 2 or more individual seconds) or from the starting point of the correction procedure (in case that all 10 second windows contain iDS only for one second or some 10 second windows contain no iDS at all) to the end of the acceleration phase all downshifts with a duration of only one second shall be removed.

(ii) Two or three step downshifts

Working forward from the starting point of the correction procedure to the end of the acceleration phase, the latest occurrence of iDS shall be identified. From the starting point of the correction procedure all requirements for gears greater than or equal to iDS up to the latest occurrence of iDS shall be corrected to (iDS + 1).

(iii) If one step downshifts as well as two step and/or three step downshifts occur during an acceleration phase, three step downshifts shall be corrected before two or one step downshifts are corrected and two step downshifts shall be corrected before one step downshifts are corrected. In such cases, the starting point of the correction procedure for the two or one step downshifts is the second immediately following the end of the correction period for the three step downshifts and the starting point of the correction procedure for the one step downshifts is the second immediately following the end of the correction period for the two step downshifts. If a three step downshift occurs after a one or two step downshift, it shall overrule these downshifts in the time period before the three step downshift. If a two step downshift occurs after a one step downshift, it shall overrule the one step downshift in the time period before the two step downshift.

~~From the end of the correction period (in case of 10 second windows containing i~~~~DS~~ ~~for either 2 or more consecutive seconds, or 2 or more individual seconds) or from the starting point of the correction procedure (in case that all 10 second windows contain i~~~~DS~~ ~~only for one second or some 10 second windows contain no i~~~~DS~~ ~~at all) to the end of the acceleration phase, if the downshift was a one-step downshift, all downshifts with a duration of only one second shall be removed. If the downshift was a two-step downshift, all requirements for gears greater than or equal to i~~~~DS~~ ~~up to the latest occurrence of i~~~~DS~~ ~~shall be corrected to (i~~~~DS~~ ~~+ 1).~~

Examples are shown in Tables A2/2 to A2/6.

Table A2/2



Table A2/3



Table A2/4



Table A2/5



Table A2/6



This correction shall not be performed for gear 1.

(c) The modification check described in paragraph 4.(c) of this annex shall be applied to the complete cycle trace twice prior to the application of paragraphs 4.(d) to 4.(f) of this annex.

If gear is used for a time sequence of 1 to 5 seconds and the gear prior to this sequence is one step lower and the gear after this sequence is one or two steps lower than within this sequence or the gear prior to this sequence is two steps lower and the gear after this sequence is one step lower than within the sequence, the gear for the sequence shall be corrected to the maximum of the gears before and after the sequence.

Examples:

(i) Gear sequence i -1, , i -1 shall be replaced by:

i -1, i -1, i -1;

Gear sequence i - 1, i, i - 2 shall be replaced by:

i - 1, i - 1, i - 2;

Gear sequence i - 2, i, i - 1 shall be replaced by:

i - 2, i - 1, i - 1.

(ii) Gear sequence i - 1, , , i - 1 shall be replaced by:

i - 1, i - 1, i - 1, i - 1;

Gear sequence i - 1, i, i, i - 2 shall be replaced by:

i- 1, i - 1, i - 1, i - 2;

Gear sequence i - 2, i, i, i - 1 shall be replaced by:

i - 2, i - 1, i - 1, i - 1.

(iii) Gear sequence i - 1, , ,, i - 1shall be replaced by:

i – 1, i – 1, i – 1, i – 1, i - 1;

Gear sequence i-1, i, i, i, i - 2 shall be replaced by:

i - 1, i - 1, i - 1, i - 1, i - 2;

Gear sequence i - 2, i, i, i, i - 1 shall be replaced by:

i - 2, i - 1, i - 1, i - 1, i - 1.

(iv) Gear sequence i - 1, ,, , , i - 1 shall be replaced by:

i - 1, i - 1, i - 1, i - 1, i - 1, i - 1;

Gear sequence i - 1, i, i, i, i, i - 2 shall be replaced by:

i - 1, i - 1, i - 1, i - 1, i - 1, i - 2;

Gear sequence i - 2, i, i, i, i, i - 1 shall be replaced by:

i - 2, i - 1, i - 1, i - 1, i - 1, i - 1.

(v) Gear sequence i - 1, ,,, , , i - 1 shall be replaced by:

i - 1, i - 1, i - 1, i - 1, i - 1, i – 1, i - 1;

Gear sequence i-1, i, i, i, i, i, i - 2 shall be replaced by:

i - 1, i - 1, i - 1, i - 1, i - 1, i - 1, i - 2;

Gear sequence i - 2, i, i, i, i, i, i - 1 shall be replaced by:

i - 2, i - 1, i - 1, i - 1, i - 1, i - 1, i - 1.

In all cases (i) to (v), i-1 ≥ imin shall be fulfilled.

(d) No upshift to a higher gear shall be performed within a deceleration phase.

(e) No upshift to a higher gear at the transition from an acceleration or constant speed phase to a deceleration phase shall be performed if one of the gears in the first two seconds following the end of the deceleration phase is lower than the upshifted gear or is gear 0.

xxxxx Example:

If vi ≤ vi+1 and vi+2 < vi+1 and gear i = 4 and gear (i + 1 = 5) and gear (i + 2 = 5), then gear (i + 1) and gear (i + 2) shall be set to 4 if the gear for the phase following the deceleration phase is gear 4 or lower. For all following cycle trace points with gear 5 within the deceleration phase, the gear shall also be set to 4. If the gear following the deceleration phase is gear 5, an upshift shall be performed.

If there is an upshift during the transition and the initial deceleration phase by 2 gears, an upshift by 1 gear shall be performed instead. In this case, no further modifications shall be performed in the following gear use checks.

~~No upshift to a higher gear shall be performed within a deceleration phase.~~

~~(e) During a deceleration phase, gears with n~~~~gear~~ ~~> 2 shall be used as long as the engine speed does not drop below n~~~~min\_drive~~~~.~~

~~Gear 2 shall be used during a deceleration phase within a short trip of the cycle (not at the end of a short trip) as long as the engine speed does not drop below (0.9 × n~~~~idle~~~~).~~

~~If the engine speed drops below n~~~~idle~~~~, the clutch shall be disengaged.~~

~~If the deceleration phase is the last part of a short trip shortly before a stop phase, the second gear shall be used as long as the engine speed does not drop below n~~~~idle~~~~.~~

(f) Other gear modifications for deceleration phases

If the deceleration phase is the last part of a short trip shortly before a stop phase and the last gear > 0 before the stop phase is used only for a period of up to 2 seconds, gear 0 shall be used instead and the gear lever shall be placed in neutral and the clutch shall be engaged.

Examples:

A gear sequence of 4, 0, 2, 2, 0 for the last 5 seconds before a stop phase shall be replaced by 4, 0, 0, 0, 0.

A gear sequence of 4, 3, 3, 0 for the last 4 seconds before a stop phase shall be replaced by 4, 0, 0, 0.

A downshift to first gear is not permitted during those deceleration phases. If such a downshift would be necessary in the last part of a short trip just before a stop phase, since the engine speed would drop below nidle in 2nd gear, gear 0 shall be used instead and the gear lever shall be placed in neutral and the clutch shall be engaged.

Xxxxx If the first gear is required in ~~the section of a short trip~~ a time period of at least 2 seconds immediately before ~~prior to~~ ~~the~~ a deceleration to stop, this gear should be used until the first sample of the deceleration phase. For the rest of the deceleration phase, gear 0 shall be used and the gear lever shall be placed in neutral and the clutch shall be engaged.

Xxxxx If during a deceleration phase the duration of a gear period (a time sequence with constant gear) between two gear periods of 3 seconds or more is only 1 second, it shall be replaced by gear 0 and the clutch shall be disengaged.

If during a deceleration phase the duration of a gear period between two gear periods of 3 seconds or more is 2 seconds, it shall be replaced by gear 0 for the 1st second and for the 2nd second with the gear that follows after the 2 second period. The clutch shall be disengaged for the 1st second.

Example: A gear sequence 5, 4, 4, 2 shall be replaced by 5, 0, 2, 2.

This requirement shall only be applied if the gear that follows after the 2 second period is > 0.

If several gear periods with durations of 1 or 2 seconds follow one another, corrections shall be performed as follows:

A gear sequence i, i, i, i - 1, i - 1, i - 2 or i, i, i, i - 1, i - 2, i - 2 shall be changed to i, i, i, 0, i - 2, i - 2.

A gear sequence such as i, i, i, i - 1, i - 2, i - 3 or i, i, i, i - 2, i - 2, i - 3 or other possible combinations shall be changed to i, i, i, 0, i - 3, i - 3.

This change shall also be applied to gear sequences where the acceleration is ≥ 0 for the first 2 seconds and < 0 for the 3rd second or where the acceleration is ≥ 0 for the last 2 seconds.

For extreme transmission designs, it is possible that gear periods with durations of 1 or 2 seconds following one another may last up to 7 seconds. In such cases, the correction above shall be complemented by the following correction requirements in a second step.

A gear sequence j, 0, i, i, i - 1, k with j > (i + 1) and k ≤ (i – 1) but k > 0 shall be changed to j, 0, i - 1, i - 1, i - 1, k, if gear (i – 1) is one or two steps below imax for second 3 of this sequence (one after gear 0).

If gear (i – 1) is more than two steps below imax for second 3 of this sequence, a gear sequence j, 0, i, i, i - 1, k with j > (i + 1) and   
k ≤ (i –1) but k > 0 shall be changed to j, 0, 0, k, k, k.

A gear sequence j, 0, i, i, i-2, k with j > (i + 1) and k ≤ (i – 2) but k > 0 shall be changed to j, 0, i - 2, i - 2 , i - 2, k, if gear (i – 2) is one or two steps below imax for second 3 of this sequence (one after gear 0).

If gear (i – 2) is more than two steps below imax for second 3 of this sequence, a gear sequence j, 0, i, i, i - 2, k with j > (i + 1) and   
k ≤ (i – 2) but k > 0 shall be changed to j, 0, 0, k, k, k.

In all cases specified above in this sub-paragraph (paragraph 4.(f) of this annex), the clutch disengagement (gear 0) for 1 second is used in order to avoid too high engine speeds for this second. If this is not an issue and, if requested by the manufacturer, it is allowed to use the lower gear of the following second directly instead of gear 0 for downshifts of up to 3 steps. The use of this option shall be recorded.

~~If the deceleration phase is the last part of a short trip shortly before a stop phase and the last gear > 0 before the stop phase is used only for a period of up to 2 seconds, gear 0 shall be used instead and the gear lever shall be placed in neutral and the clutch shall be engaged.~~

~~Examples: A gear sequence of 4, 0, 2, 2, 0 for the last 5 seconds before a stop phase shall be replaced by 4, 0, 0, 0, 0. A gear sequence of 4, 3, 3, 0 for the last 4 seconds before a stop phase shall be replaced by 4, 0, 0, 0.~~

~~A downshift to first gear is not permitted during those deceleration phases. If such a downshift would be necessary in the last part of a short trip just before a stop phase, since the engine speed would drop below n~~~~idle~~ ~~in 2~~~~nd~~ ~~gear, gear 0 shall be used instead and the gear lever shall be placed in neutral and the clutch shall be engaged.~~

~~If the first gear is required in the section of a short trip prior to the deceleration to stop, this gear should be used until the first sample of the deceleration phase. For the rest of the deceleration phase, gear 0 shall be used and the gear lever shall be placed in neutral and the clutch shall be engaged.xxxxx~~

5 Final requirements

(a). Paragraphs 4.(a) to 4.(f) inclusive of this annex shall be applied sequentially, scanning the complete cycle trace in each case. Since modifications to paragraphs 4.(a) to 4.(f) inclusive of this annex may create new gear use sequences, these new gear sequences shall be checked twice and modified if necessary.

(b) After the application of paragraph 4.(b) of this annex, a downshift by more than one gear could occur at the transition from a deceleration or constant speed phase to an acceleration phase.

In this case, the gear for the last sample of the deceleration or constant speed phase shall be replaced by gear 0 and the clutch shall be disengaged. If the “suppress gear 0 during downshifts” option according to paragraph 4.(f) of this annex is chosen, the gear of the following second (first second of the acceleration phase) shall be used instead of gear 0.

~~This modification shall be applied immediately after the modifications according to paragraph 4.(d) of this annex.~~

(c) In order to enable the assessment of the correctness of the calculation, the average gear for v ≥ 1 km/h, rounded according to paragraph 7. of this UN GTR to four places of decimal, shall be calculated and recorded.

Annex 7

Calculations

1. General requirements

1.1. Unless explicitly stated otherwise in Annex 8, all requirements and procedures specified in this annex shall apply for NOVC-HEVs, OVC-HEVs, NOVC-FCHVs and PEVs.

1.2. The calculation steps described in paragraph 1.4. of this annex shall be used for pure ICE vehicles only.

1.3. Rounding of test results

1.3.1. Intermediate steps in the calculations shall not be rounded unless intermediate rounding is required.

1.3.2. The final criteria emission results shall be rounded according to paragraph 7. of this UN GTR in one step to the number of places to the right of the decimal point indicated by the applicable emission standard plus one additional significant figure.

1.3.3. The NOx correction factor shall be reported rounded according to paragraph 7. of this UN GTR to two places of decimal.

1.3.4. The dilution factor shall be reported rounded according to paragraph 7. of this UN GTR to two places of decimal.

1.3.5. For information not related to standards, good engineering judgement shall be used.

1.4. Stepwise procedure for calculating the final test results for vehicles using combustion engines

The results shall be calculated in the order described in Table A7/1. All applicable results in the column "Output" shall be recorded. The column "Process" describes the paragraphs to be used for calculation or contains additional calculations.

For the purpose of this table, the following nomenclature within the equations and results is used:

c complete applicable cycle;

p every applicable cycle phase;

i every applicable criteria emission component, without CO2;

CO2 CO2 emission.

Table A7/1

**Procedure for calculating final test results**

| *Source* | *Input* | *Process* | *Output* | *Step No.* |
| --- | --- | --- | --- | --- |
| Annex 6 | Raw test results | Mass emissions  Paragraphs 3. to 3.2.2. inclusive of this annex. | Mi,p,1, g/km;  MCO2,p,1, g/km. | 1 |
| Output step 1 | Mi,p,1, g/km;  MCO2,p,1, g/km. | Calculation of combined cycle values:  where:  Mi/CO2,c,2 are the emission results over the total cycle;  dp are the driven distances of the cycle phases, p. | Mi,c,2, g/km;  MCO2,c,2, g/km. | 2 |
| Output step 1 and 2 | MCO2,p,1, g/km;  MCO2,c,2, g/km. | RCB correction  Appendix 2 to Annex 6. | MCO2,p,3, g/km;  MCO2,c,3, g/km. | 3 |
| Output  step 2 and 3 | Mi,c,2, g/km;  MCO2,c,3, g/km. | Emissions test procedure for all vehicles equipped with periodically regenerating systems, Ki.  Annex 6, Appendix 1.  Mi,c,4 = Ki × Mi,c,2  or  Mi,c,4 = Ki + Mi,c,2  and  MCO2,c,4 = KCO2 × MCO2,c,3  or  MCO2,c,4 = KCO2 + MCO2,c,3  Additive offset or multiplicative factor to be used according to Ki determination.  If Ki is not applicable:  Mi,c,4 = Mi,c,2  MCO2,c,4 = MCO2,c,3 | Mi,c,4, g/km;  MCO2,c,4, g/km. | 4a |
| Output step 3 and 4a | MCO2,p,3, g/km;  MCO2,c,3, g/km;  MCO2,c,4, g/km. | If Ki is applicable, align CO2 phase values to the combined cycle value:  for every cycle phase p;  where:  If Ki is not applicable:  MCO2,p,4 = MCO2,p,3 | MCO2,p,4, g/km. | 4b |

| *Source* | *Input* | *Process* | *Output* | *Step No.* |
| --- | --- | --- | --- | --- |
| Output step 4 | Mi,c,4, g/km;  MCO2,c,4, g/km;  MCO2,p,4, g/km. | Placeholder for additional corrections, if applicable.  Otherwise:  Mi,c,5 = Mi,c,4  MCO2,c,5 = MCO2,c,4  MCO2,p,5 = MCO2,p,4 | Mi,c,5, g/km;  MCO2,c,5, g/km;  MCO2,p,5, g/km. | 5  Result of a single test. |
| Output step 5 | For every test:  Mi,c,5, g/km;  MCO2,c,5, g/km;  MCO2,p,5, g/km. | Averaging of tests and declared value.  Paragraphs 1.2. to 1.2.3. inclusive of Annex 6. | Mi,c,6, g/km;  MCO2,c,6, g/km;  MCO2,p,6, g/km.  MCO2,c,declared, g/km. | 6 |
| Output step 6 | MCO2,c,6, g/km;  MCO2,p,6, g/km.  MCO2,c,declared, g/km. | Alignment of phase values.  Paragraph 1.2.4. of Annex 6.  and:  MCO2,c,7 = MCO2,c,declared | MCO2,c,7, g/km;  MCO2,p,7, g/km. | 7 |
| Output steps 6 and 7 | Mi,c,6, g/km;  MCO2,c,7, g/km;  MCO2,p,7, g/km. | Calculation of fuel consumption.  Paragraph 6 of this annex.  The calculation of fuel consumption shall be performed for the applicable cycle and its phases separately. For that purpose: (a) the applicable phase or cycle CO2 values shall be used;  (b) the criteria emission over the complete cycle shall be used.  and:  Mi,c,8 = Mi,c,6  MCO2,c,8 = MCO2,c,7  MCO2,p,8 = MCO2,p,7 | FCc,8, l/100 km;  FCp,8, l/100 km;  Mi,c,8, g/km;  MCO2,c,8, g/km;  MCO2,p,8, g/km. | 8  Result of a Type 1 test for a test vehicle. |
| Step 8 | For each of the test vehicles H and L:  Mi,c,8, g/km;  MCO2,c,8, g/km;  MCO2,p,8, g/km;  FCc,8, l/100 km;  FCp,8, l/100 km. | If a test vehicle L was tested in addition to a test vehicle H, the resulting criteria emission values of L and H shall be the arithmetic average and are referred to as Mi,c.  At request of a contracting party, the averaging of the criteria emissions may be omitted and the values of H and L remain separated.  Otherwise, if no vehicle L was tested,  Mi,c = Mi,c,8  For CO2 and FC, the values derived in step 8 shall be used, and CO2 values shall be rounded according to paragraph 7. of this UN GTR to two places of decimal, and FC values shall be rounded according to paragraph 7. of this UN GTR to three places of decimal. | Mi,c, g/km;  MCO2,c,H, g/km;  MCO2,p,H, g/km;  FCc,H, l/100 km;  FCp,H, l/100 km;  and if a vehicle L was tested:  MCO2,c,L, g/km;  MCO2,p,L, g/km;  FCc,L, l/100 km;  FCp,L, l/100 km. | 9  Interpolation family result.  Final criteria emission result. |

| *Source* | *Input* | *Process* | *Output* | *Step No.* |
| --- | --- | --- | --- | --- |
| Step 9 | MCO2,c,H, g/km;  MCO2,p,H, g/km;  FCc,H, l/100 km;  FCp,H, l/100 km;  and if a vehicle L was tested:  MCO2,c,L, g/km;  MCO2,p,L, g/km;  FCc,L, l/100 km;  FCp,L, l/100 km. | Fuel consumption and CO2 calculations for individual vehicles in an interpolation family.  Paragraph 3.2.3. of this annex.  Fuel consumption and CO2 calculations for individual vehicles in a road load matrix family  Paragraph 3.2.4. of this annex.  CO2 emissions shall be expressed in grams per kilometre (g/km) rounded to the nearest whole number;  FC values shall be rounded according to paragraph 7. of this UN GTR to one place of decimal, expressed in (l/100 km). | MCO2,c,ind g/km;  MCO2,p,ind, g/km;  FCc,ind l/100 km;  FCp,ind, l/100 km. | 10  Result of an individual vehicle.  Final CO2 and FC result. |

2. Determination of diluted exhaust gas volume

2.1. Volume calculation for a variable dilution device capable of operating at a constant or variable flow rate

The volumetric flow shall be measured continuously. The total volume shall be measured for the duration of the test.

2.2. Volume calculation for a variable dilution device using a positive displacement pump

2.2.1. The volume shall be calculated using the following equation:

where:

is the volume of the diluted gas, in litres per test (prior to correction);

is the volume of gas delivered by the positive displacement pump in testing conditions, litres per pump revolution;

is the number of revolutions per test.

2.2.1.1. Correcting the volume to standard conditions

The diluted exhaust gas volume, V, shall be corrected to standard conditions according to the following equation:

where:

is the test room barometric pressure, kPa;

is the vacuum at the inlet of the positive displacement pump relative to the ambient barometric pressure, kPa;

is the arithmetic average temperature of the diluted exhaust gas entering the positive displacement pump during the test, Kelvin (K).

3. Mass emissions

3.1. General requirements

3.1.1. Assuming no compressibility effects, all gases involved in the engine's intake, combustion and exhaust processes may be considered to be ideal according to Avogadro’s hypothesis.

3.1.2. The mass of gaseous compounds emitted by the vehicle during the test shall be determined by the product of the volumetric concentration of the gas in question and the volume of the diluted exhaust gas with due regard for the following densities under the reference conditions of 273.15 K (0 °C) and 101.325 kPa:

Carbon monoxide (CO)  g/l

Carbon dioxide (CO2)  g/l

Hydrocarbons:

for petrol (E0) (C1H1.85)  g/1

for petrol (E5) (C1H1.89O0.016)  g/1

for petrol (E10) (C1H1.93 O0.033)  g/l

for diesel (B0) (C1Hl.86)  g/1

for diesel (B5) (C1Hl.86O0.005)  g/1

for diesel (B7) (C1H1.86O0.007)  g/l

for LPG (C1H2.525)  g/l

for NG/biomethane (CH4)  g/l

for ethanol (E85) (C1H2.74O0.385)  g/l

Formaldehyde (if applicable)

Acetaldehyde (if applicable)

Ethanol (if applicable)

Nitrogen oxides (NOx)  g/1

Nitrogen dioxide (NO2) (if applicable)  g/1

Nitrous oxide (N2O) (if applicable)  g/1

The density for NMHC mass calculations shall be equal to that of total hydrocarbons at 273.15 K (0 °C) and 101.325 kPa, and is fuel-dependent. The density for propane mass calculations (see paragraph 3.5. of Annex 5) is 1.967 g/l at standard conditions.

If a fuel type is not listed in this paragraph, the density of that fuel shall be calculated using the equation given in paragraph 3.1.3. of this annex.

3.1.3. The general equation for the calculation of total hydrocarbon density for each reference fuel with a mean composition of CXHYOZ is as follows:

where:

ρTHC is the density of total hydrocarbons and non-methane hydrocarbons, g/l;

MWC is the molar mass of carbon (12.011 g/mol);

MWH is the molar mass of hydrogen (1.008 g/mol);

MWO is the molar mass of oxygen (15.999 g/mol);

VM is the molar volume of an ideal gas at 273.15 K (0° C) and 101.325 kPa (22.413 l/mol);

H/C is the hydrogen to carbon ratio for a specific fuel CXHYOZ;

O/C is the oxygen to carbon ratio for a specific fuel CXHYOZ.

3.2. Mass emissions calculation

3.2.1. Mass emissions of gaseous compounds per cycle phase shall be calculated using the following equations:

where:

is the mass emission of compound i per test or phase, g/km;

is the volume of the diluted exhaust gas per test or phase expressed in litres per test/phase and corrected to standard conditions (273.15 K

(0 °C) and 101.325 kPa);

is the density of compound i in grams per litre at standard temperature and pressure (273.15 K (0 °C) and 101.325 kPa);

is a humidity correction factor applicable only to the mass emissions of oxides of nitrogen, NO2 and NOx, per test or phase;

is the concentration of compound i per test or phase in the diluted exhaust gas expressed in ppm and corrected by the amount of compound i contained in the dilution air;

is the distance driven over the applicable WLTC, km;

n is the number of phases of the applicable WLTC.

3.2.1.1. The concentration of a gaseous compound in the diluted exhaust gas shall be corrected by the amount of the gaseous compound in the dilution air using the following equation:

where:

is the concentration of gaseous compound i in the diluted exhaust gas corrected by the amount of gaseous compound i contained in the dilution air, ppm;

is the measured concentration of gaseous compound i in the diluted exhaust gas, ppm;

is the concentration of gaseous compound i in the dilution air, ppm;

is the dilution factor.

3.2.1.1.1. The dilution factor shall be calculated using the equation for the concerned fuel:

for petrol (E5, E10) and diesel (B0)

for petrol (E0)

for diesel (B5 and B7)

for LPG

for NG/biomethane

for ethanol (E85)

for hydrogen

With respect to the equation for hydrogen:

CH2O is the concentration of H2O in the diluted exhaust gas contained in the sample bag, per cent volume;

CH2O-DA is the concentration of H2O in the dilution air, per cent volume;

CH2 is the concentration of H2 in the diluted exhaust gas contained in the sample bag, ppm.

If a fuel type is not listed in this paragraph, the DF for that fuel shall be calculated using the equations in paragraph 3.2.1.1.2. of this annex.

If the manufacturer uses a DF that covers several phases, it shall calculate a DF using the mean concentration of gaseous compounds for the phases concerned.

The mean concentration of a gaseous compound shall be calculated using the following equation:

where:

is mean concentration of a gaseous compound;

is the concentration of each phase;

is the Vmix of the corresponding phase;

n is the number of phases.

3.2.1.1.2. The general equation for calculating the dilution factor DF for each reference fuel with an arithmetic average composition of CxHyOz is as follows:

where:

is the concentration of CO2 in the diluted exhaust gas contained in the sample bag, per cent volume;

is the concentration of HC in the diluted exhaust gas contained in the sample bag, ppm carbon equivalent;

is the concentration of CO in the diluted exhaust gas contained in the sample bag, ppm.

3.2.1.1.3. Methane measurement

3.2.1.1.3.1. For methane measurement using a GC-FID, NMHC shall be calculated using the following equation:

where:

is the corrected concentration of NMHC in the diluted exhaust gas, ppm carbon equivalent;

is the concentration of THC in the diluted exhaust gas, ppm carbon equivalent and corrected by the amount of THC contained in the dilution air;

is the concentration of in the diluted exhaust gas, ppm carbon equivalent and corrected by the amount of contained in the dilution air;

is the FID response factor to methane determined and specified in paragraph 5.4.3.2. of Annex 5.

3.2.1.1.3.2. For methane measurement using an NMC-FID, the calculation of NMHC depends on the calibration gas/method used for the zero/calibration adjustment.

The FID used for the THC measurement (without NMC) shall be calibrated with propane/air in the normal manner.

For the calibration of the FID in series with an NMC, the following methods are permitted:

(a) The calibration gas consisting of propane/air bypasses the NMC;

(b) The calibration gas consisting of methane/air passes through the NMC.

It is highly recommended to calibrate the methane FID with methane/air through the NMC.

In case (a), the concentration of CH4 and NMHC shall be calculated using the following equations:

If RfCH4 < 1.05, it may be omitted from the equation above for CCH4.

In case (b), the concentration of CH4 and NMHC shall be calculated using the following equations:

where:

is the HC concentration with sample gas flowing through the NMC, ppm C;

is the HC concentration with sample gas bypassing the NMC, ppm C;

RfCH4 is the methane response factor as determined per paragraph 5.4.3.2. of Annex 5;

is the methane efficiency as determined per paragraph 3.2.1.1.3.3.1. of this annex;

is the ethane efficiency as determined per paragraph 3.2.1.1.3.3.2. of this annex.

If < 1.05, it may be omitted in the equations for case (b) above for CCH4 and CNMHC.

3.2.1.1.3.3. Conversion efficiencies of the non-methane cutter, NMC

The NMC is used for the removal of the non-methane hydrocarbons from the sample gas by oxidizing all hydrocarbons except methane. Ideally, the conversion for methane is 0 per cent, and for the other hydrocarbons represented by ethane is 100 per cent. For the accurate measurement of NMHC, the two efficiencies shall be determined and used for the calculation of the NMHC emission.

3.2.1.1.3.3.1. Methane conversion efficiency, EM

The methane/air calibration gas shall be flowed to the FID through the NMC and bypassing the NMC and the two concentrations recorded. The efficiency shall be determined using the following equation:

where:

is the HC concentration with CH4 flowing through the NMC, ppm C;

is the HC concentration with CH4 bypassing the NMC, ppm C.

3.2.1.1.3.3.2. Ethane conversion efficiency, EE

The ethane/air calibration gas shall be flowed to the FID through the NMC and bypassing the NMC and the two concentrations recorded. The efficiency shall be determined using the following equation:

where:

is the HC concentration with C2H6 flowing through the NMC, ppm C;

is the HC concentration with C2H6 bypassing the NMC, ppm C.

If the ethane conversion efficiency of the NMC is 0.98 or above, EE shall be set to 1 for any subsequent calculation.

3.2.1.1.3.4. If the methane FID is calibrated through the cutter, EM shall be 0.

The equation to calculate CCH4 in paragraph 3.2.1.1.3.2. (case (b)) in this annex becomes:

The equation to calculate CNMHC in paragraph 3.2.1.1.3.2. (case (b)) in this annex becomes:

The density used for NMHC mass calculations shall be equal to that of total hydrocarbons at 273.15 K (0 °C) and 101.325 kPa and is fuel-dependent.

3.2.1.1.4. Flow-weighted arithmetic average concentration calculation

The following calculation method shall only be applied for CVS systems that are not equipped with a heat exchanger or for CVS systems with a heat exchanger that do not comply with paragraph 3.3.5.1. of Annex 5.

When the CVS flow rate, , over the test varies by more than ±3 per cent of the arithmetic average flow rate, a flow-weighted arithmetic average shall be used for all continuous diluted measurements including PN:

where:

is the flow-weighted arithmetic average concentration;

is the CVS flow rate at time , m³/min;

is the concentration at time , ppm;

sampling interval, s;

total CVS volume, m³;

is the test time, s.

3.2.1.2. Calculation of the NOx humidity correction factor

In order to correct the influence of humidity on the results of oxides of nitrogen, the following calculations apply:

where:

and:

is the specific humidity, grams of water vapour per kilogram dry air;

is the relative humidity of the ambient air, per cent;

is the saturation vapour pressure at ambient temperature, kPa;

is the atmospheric pressure in the room, kPa.

The KH factor shall be calculated for each phase of the test cycle.

The ambient temperature and relative humidity shall be defined as the arithmetic average of the continuously measured values during each phase.

3.2.1.3. Determination of NO2 concentration from NO and NOx (if applicable)

NO2 shall be determined by the difference between NOx concentration from the bag corrected for dilution air concentration and NO concentration from continuous measurement corrected for dilution air concentration

3.2.1.3.1. NO concentrations

3.2.1.3.1.1. NO concentrations shall be calculated from the integrated NO analyser reading, corrected for varying flow if necessary.

3.2.1.3.1.2. The arithmetic average NO concentration shall be calculated using the following equation:

where:

is the integral of the recording of the continuous dilute NO analyser over the test (t2-t1);

is the concentration of NO measured in the diluted exhaust, ppm;

3.2.1.3.1.3. Dilution air concentration of NO shall be determined from the dilution air bag. A correction shall be carried out according to paragraph 3.2.1.1. of this annex.

3.2.1.3.2. NO2 concentrations (if applicable)

3.2.1.3.2.1. Determination NO2 concentration from direct diluted measurement

3.2.1.3.2.2. NO2 concentrations shall be calculated from the integrated NO2 analyser reading, corrected for varying flow if necessary.

3.2.1.3.2.3. The arithmetic average NO2 concentration shall be calculated using the following equation:

where:

is the integral of the recording of the continuous dilute NO2 analyser over the test (t2-t1);

is the concentration of NO2 measured in the diluted exhaust, ppm.

3.2.1.3.2.4. Dilution air concentration of NO2 shall be determined from the dilution air bags. Correction is carried out according to paragraph 3.2.1.1. of this annex.

3.2.1.4. N2O concentration (if applicable)

For measurements using a GC-ECD, the N2O concentration shall be calculated using the following equations:

where:

CN2O is the concentration of N2O, ppm;

and:

3.2.1.5. NH3 concentration (if applicable)

The mean concentration of NH3 shall be calculated using the following equation:

where:

is the instantaneous NH3 concentration, ppm;

n is the number of measurements.

3.2.1.6. Ethanol concentration (if applicable)

For ethanol measurements using gas chromatography from impingers and diluted gas from a CVS, the ethanol concentration shall be calculated using the following equations:

CC2H5OH = PeakAreasample × Rf C2H5OH

where:

Rf C2H5OH = Rf C2H5OH (ppm) / PeakAreastandard

3.2.1.7. Carbonyl mass (if applicable)

For carbonyl measurements using liquid chromatography, formaldehyde and acetaldehyde shall be calculated as follows.

For each target carbonyl, the carbonyl mass shall be calculated from its 2,4−dinitrophenylhydrazone derivative mass. The mass of each carbonyl compound is determined by the following calculation:

where:

B is the ratio of the molecular weight of the carbonyl compound to its 2,4-dinitrophenylhydrazone derivative;

Vsample is the volume of the sample, ml;

Rf is the response factor for each carbonyl calculated during the calibration using the following equation:

Rf = Cstandard (µg 2,4-DNPH species/ml) / PeakAreastandard

3.2.1.8. Determining the mass of ethanol, acetaldehyde and formaldehyde (if applicable)

As an alternative to measuring the concentrations of ethanol, acetaldehyde and formaldehyde, the MEAF for ethanol petrol blends with less than 25 per cent ethanol by volume may be calculated using the following equation:

MEAF = (0.0302 + 0.0071 × (percentage of ethanol)) × MNMHC

where:

MEAF is the mass emission of EAF per test, g/km;

MNMHC is the mass emission of NMHC per test, g/km;

percentage of alcohol is the volume percentage of ethanol in the test fuel.

3.2.2. Determination of the HC mass emissions from compression-ignition engines

3.2.2.1. To calculate HC mass emission for compression-ignition engines, the arithmetic average HC concentration shall be calculated using the following equation:

where:

is the integral of the recording of the heated FID over the test (t1 to t2);

is the concentration of HC measured in the diluted exhaust in ppm of and is substituted for in all relevant equations.

3.2.2.1.1. Dilution air concentration of HC shall be determined from the dilution air bags. Correction shall be carried out according to paragraph 3.2.1.1. of this annex.

3.2.3. Fuel consumption and CO2 calculations for individual vehicles in an interpolation family

3.2.3.1. Fuel consumption and CO2 emissions without using the interpolation method (i.e. using vehicle H only)

The CO2 value, as calculated in paragraphs 3.2.1. to 3.2.1.1.2. inclusive of this annex, and fuel consumption, as calculated according to paragraph 6. of this annex, shall be attributed to all individual vehicles in the interpolation family and the interpolation method shall not be applicable.

3.2.3.2. Fuel consumption and CO2 emissions using the interpolation method

The CO2 emissions and the fuel consumption for each individual vehicle in the interpolation family may be calculated according to paragraphs 3.2.3.2.1. to 3.2.3.2.5. inclusive of this annex.

3.2.3.2.1. Fuel consumption and CO2 emissions of test vehicles L and H

The mass of CO2 emissions, , and and its phases p, and , of test vehicles L and H, used for the following calculations, shall be taken from step 9 of Table A7/1.

Fuel consumption values are also taken from step 9 of Table A7/1 and are referred to as FCL,p and FCH,p.

3.2.3.2.2. Road load calculation for an individual vehicle

In the case that the interpolation family is derived from one or more road load families, the calculation of the individual road load shall only be performed within the road load family applicable to that individual vehicle.

3.2.3.2.2.1. Mass of an individual vehicle

The test masses of vehicles H and L shall be used as input for the interpolation method.

TMind, in kg, shall be the individual test mass of the vehicle according to paragraph 3.2.25. of this UN GTR.

If the same test mass is used for test vehicles L and H, the value of shall be set to the mass of test vehicle H for the interpolation method.

3.2.3.2.2.2. Rolling resistance of an individual vehicle

3.2.3.2.2.2.1. The actual RRC values for the selected tyres on test vehicle L, RRL, and test vehicle H, RRH, shall be used as input for the interpolation method. See paragraph 4.2.2.1. of Annex 4.

If the tyres on the front and rear axles of vehicle L or H have different RRC values, the weighted mean of the rolling resistances shall be calculated using the equation in paragraph 3.2.3.2.2.2.3. of this annex.

3.2.3.2.2.2.2. For the tyres fitted to an individual vehicle, the value of the rolling resistance coefficient RRind shall be set to the RRC value of the applicable tyre energy efficiency class according to Table A4/2 of Annex 4.

If the tyres on the front and rear axles belong to different energy efficiency classes, the weighted mean shall be used and calculated using the equation in paragraph 3.2.3.2.2.2.3. of this annex.

If the same tyres, or tyres with the same rolling resistance coefficient were fitted to test vehicles L and H, the value of for the interpolation method shall be set to .

3.2.3.2.2.2.3. Calculating the weighted mean of the rolling resistances

where:

represents vehicle L, H or an individual vehicle.

and RRH,FA are the actual RRCs of the front axle tyres on vehicles L and H respectively, kg/tonne;

is the RRC value of the applicable tyre energy efficiency class according to Table A4/2 of Annex 4 of the front axle tyres on the individual vehicle, kg/tonne;

RRL,RA, and RRH,RA  are the actual RRCs of the rear axle tyres on vehicles L and H respectively, kg/tonne;

RRind,RA is the RRC value of the applicable tyre energy efficiency class according to Table A4/2 of Annex 4 of the rear axle tyres on the individual vehicle, kg/tonne;

is the proportion of the vehicle mass in running order on the front axle;

RRx shall not be rounded or categorised to tyre energy efficiency classes.

3.2.3.2.2.3. Aerodynamic drag of an individual vehicle

3.2.3.2.2.3.1. Determination of aerodynamic influence of optional equipment

The aerodynamic drag shall be measured for each of the aerodynamic drag-influencing items of optional equipment and body shapes in a wind tunnel fulfilling the requirements of paragraph 3.2. of Annex 4 verified by the responsible authority.

For the purpose of the interpolation method, the aerodynamic drag of optional equipment within one road load family shall be measured at the same wind speed, either vlow or vhigh, preferably vhigh, as defined in paragraph 6.4.3. of Annex 4. In the case that vlow or vhigh does not exist, (e.g. the road load of VL and/or VH are measured using the coastdown method), the aerodynamic force shall be measured at the same wind speed within the range ≥ 80 km/h and ≤ 150 km/h. For Class 1 vehicles, it shall be measured at the same wind speed ≤150 km/h.

3.2.3.2.2.3.2. Alternative method for determination of aerodynamic influence of optional equipment

At the request of the manufacturer and with approval of the responsible authority, an alternative method (e.g. simulation, wind tunnel not fulfilling the criteria in Annex 4) may be used to determine Δ(CD×Af) if the following criteria are fulfilled:

(a) The alternative method shall fulfil an accuracy for Δ(CD×Af) of ±0.015 m² and, additionally, in the case that simulation is used, the CFD method should be validated in detail such that the actual air flow patterns around the body, including magnitudes of flow velocities, forces, or pressures, are shown to match the validation test results;

(b) The alternative method shall be used only for those aerodynamic-influencing parts (e.g. wheels, body shapes, cooling system) for which equivalency was demonstrated;

(c) Evidence of equivalency shall be shown in advance to the responsible authority for each road load family in the case that a mathematical method is used, or every four years in the case that a measurement method is used, and in any case shall be based on wind tunnel measurements fulfilling the criteria of this UN GTR;

(d) If the Δ(CD × Af) of a particular item of optional equipment is more than double the value of the optional equipment for which the evidence was given, aerodynamic drag shall not be determined by the alternative method; and

(e) In the case that a simulation model is changed, a revalidation shall be necessary.

3.2.3.2.2.3.3. Application of aerodynamic influence on the individual vehicle

is the difference in the product of the aerodynamic drag coefficient multiplied by frontal area between an individual vehicle and test vehicle L due to options and body shapes on the vehicle that differ from those of test vehicle L, m2;

These differences in aerodynamic drag, Δ(CD×Af), shall be determined with an accuracy of ±0.015 m².

Δ(CD×Af)ind may be calculated according to the following equation maintaining the accuracy of ±0.015 m² also for the sum of items of optional equipment and body shapes:

where:

is the aerodynamic drag coefficient;

is the frontal area of the vehicle, m2;

is the number of items of optional equipment on the vehicle that are different between an individual vehicle and test vehicle L;

is the difference in the product of the aerodynamic drag coefficient multiplied by frontal area due to an individual feature, i, on the vehicle and is positive for an item of optional equipment that adds aerodynamic drag with respect to test vehicle L and vice versa, m2.

The sum of all Δ(CD×Af)i differences between test vehicles L and H shall correspond to Δ(CD×Af)LH.

3.2.3.2.2.3.4. Definition of complete aerodynamic delta between test vehicles H and L

The total difference of the aerodynamic drag coefficient multiplied by frontal area between test vehicles L and H shall be referred to as Δ(CD×Af)LH and shall be recorded, m².

3.2.3.2.2.3.5. Documentation of aerodynamic influences

The increase or decrease of the product of the aerodynamic drag coefficient multiplied by frontal area expressed as Δ(CD×Af) for all items of optional equipment and body shapes in the interpolation family that:

(a) have an influence on the aerodynamic drag of the vehicle; and

(b) are to be included in the interpolation,

shall be recorded, m².

3.2.3.2.2.3.6. Additional provisions for aerodynamic influences

The aerodynamic drag of vehicle H shall be applied to the whole interpolation family and Δ(CD×Af)LH shall be set to zero, if:

(a) the wind tunnel facility is not able to accurately determine Δ(CD×Af); or

(b) there are no drag-influencing items of optional equipment between the test vehicles H and L that are to be included in the interpolation method.

3.2.3.2.2.4. Calculation of road load coefficients for individual vehicles

The road load coefficients , and (as defined in Annex 4) for test vehicles H and L are referred to as , and ,and , and respectively. An adjusted road load curve for the test vehicle L is defined as follows:

Applying the least squares regression method in the range of the reference speed points, adjusted road load coefficients and shall be determined for with the linear coefficient set to . The road load coefficients , and for an individual vehicle in the interpolation family shall be calculated using the following equations:

or, if = 0, the equation for f0,ind below shall apply:

or, if , the equation for F2,ind below shall apply:

where:

In the case of a road load matrix family, the road load coefficients f0, f1 and f2 for an individual vehicle shall be calculated according to the equations in paragraph 5.1.1. of Annex 4.

3.2.3.2.3. Calculation of cycle energy demand

The cycle energy demand of the applicable WLTC Ek and the energy demand for all applicable cycle phases shall be calculated according to the procedure in paragraph 5. of this annex for the following sets k of road load coefficients and masses:

k=1:

(test vehicle L)

k=2:

(test vehicle H)

k=3:

(an individual vehicle in the interpolation family)

These three sets of road loads may be derived from different road load families.

3.2.3.2.4. Calculation of the CO2 value for an individual vehicle within an interpolation family using the interpolation method

For each cycle phase p of the applicable cycle the mass of CO2 emissions g/km, for an individual vehicle shall be calculated using the following equation:

The mass of CO2 emissions, g/km, over the complete cycle for an individual vehicle shall be calculated using the following equation:

The terms E1,p, E2,p and E3,p and E1, E2 and E3 respectively shall be calculated as specified in paragraph 3.2.3.2.3. of this annex.

3.2.3.2.5. Calculation of the fuel consumption FC value for an individual vehicle within an interpolation family using the interpolation method

For each cycle phase p of the applicable cycle, the fuel consumption, l/100 km, for an individual vehicle shall be calculated using the following equation:

The fuel consumption, l/100 km, of the complete cycle for an individual vehicle shall be calculated using the following equation:

The terms E1,p, E2,p and E3,p, and E1, E2 and E3 respectively shall be calculated as specified in paragraph 3.2.3.2.3. of this annex.

3.2.3.2.6. The individual CO2 value determined in paragraph 3.2.3.2.4. of this annex may be increased by the original equipment manufacturer (OEM). In such cases:

(a) The CO2 phase values shall be increased by the ratio of the increased CO2 value divided by the calculated CO2 value;

(b) The fuel consumption values shall be increased by the ratio of the increased CO2 value divided by the calculated CO2 value.

This shall not compensate for technical elements that would effectively require a vehicle to be excluded from the interpolation family.

3.2.4. Fuel consumption and CO2 calculations for individual vehicles in a road load matrix family

The CO2 emissions and the fuel consumption for each individual vehicle in the road load matrix family shall be calculated according to the interpolation method described in paragraphs 3.2.3.2.3. to 3.2.3.2.5. inclusive of this annex. Where applicable, references to vehicle L and/or H shall be replaced by references to vehicle LM and/or HM respectively.

3.2.4.1. Determination of fuel consumption and CO2 emissions of vehicles LM and HM

The mass of CO2 emissions of vehicles LM and HM shall be determined according to the calculations in paragraph 3.2.1. of this annex for the individual cycle phases p of the applicable WLTC and are referred to as and respectively. Fuel consumption for individual cycle phases of the applicable WLTC shall be determined according to paragraph 6. of this annex and are referred to as FCLM,p and FCHM,p respectively.

3.2.4.1.1. Road load calculation for an individual vehicle

The road load force shall be calculated according to the procedure described in paragraph 5.1. of Annex 4.

3.2.4.1.1.1. Mass of an individual vehicle

The test masses of vehicles HM and LM selected according to paragraph 4.2.1.4. of Annex 4 shall be used as input.

TMind, in kg, shall be the test mass of the individual vehicle according to the definition of test mass in paragraph 3.2.25. of this UN GTR.

If the same test mass is used for vehicles LM and HM, the value of TMind shall be set to the mass of vehicle HM for the road load matrix family method.

3.2.4.1.1.2. Rolling resistance of an individual vehicle

3.2.4.1.1.2.1. The RRC values for vehicle LM , RRLM, and vehicle HM, RRHM, selected under paragraph 4.2.1.4. of Annex 4, shall be used as input.

If the tyres on the front and rear axles of vehicle LM or HM have different rolling resistance values, the weighted mean of the rolling resistances shall be calculated using the equation in paragraph 3.2.4.1.1.2.3. of this annex.

3.2.4.1.1.2.2. For the tyres fitted to an individual vehicle, the value of the rolling resistance coefficient RRind shall be set to the RRC value of the applicable tyre energy efficiency class according to Table A4/2 of Annex 4.

If the tyres on the front and the rear axles belong to different energy efficiency classes, the weighted mean shall be used and shall be calculated using the equation in paragraph 3.2.4.1.1.2.3. of this annex.

If the same rolling resistance is used for vehicles LM and HM, the value of shall be set to for the road load matrix family method.

3.2.4.1.1.2.3. Calculating the weighed mean of the rolling resistances

where:

represents vehicle L, H or an individual vehicle;

and RRHM,FA are the actual RRCs of the front axle tyres on vehicles L and H respectively, kg/tonne;

is the RRC value of the applicable tyre energy efficiency class according to Table A4/2 of Annex 4 of the front axle tyres on the individual vehicle, kg/tonne;

RRLM,RA, and RRHM,RA are the actual rolling resistance coefficients of the rear axle tyres on vehicles L and H respectively, kg/tonne;

RRind,RA is the RRC value of the applicable tyre energy efficiency class according to Table A4/2 of Annex 4 of the rear axle tyres on the individual vehicle, kg/tonne;

is the proportion of the vehicle mass in running order on the front axle.

RRx shall not be rounded or categorised to tyre energy efficiency classes.

3.2.4.1.1.3. Frontal area of an individual vehicle

The frontal area for vehicle LM, AfLM, and vehicle HM, AfHM, selected under paragraph 4.2.1.4. of Annex 4 shall be used as input.

Af,ind, in m2, shall be the frontal area of the individual vehicle.

If the same frontal area is used for vehicles LM and HM, the value of Af,ind shall be set to the frontal area of vehicle HM for the road load matrix family method.

3.2.5. Alternative interpolation calculation method

Upon request of the manufacturer and with approval of the responsible authority, a manufacturer may apply an alternative interpolation calculation procedure in the case that the interpolation method creates unrealistic phase-specific CO2 results or an unrealistic road load curve. Before such permission is granted, the manufacturer shall check and where possible correct:

(a) The reason for having small differences between the road load relevant characteristics between vehicle L and H in the case of unrealistic phase- specific CO2 results;

(b) The reason for having an unexpected difference between the f1,L and f1,H coefficients in the case of an unrealistic road load curve.

The request of the manufacturer to the responsible authority shall include evidence that such a correction is not possible, and that the resultant error is significant.

3.2.5.1. Alternative calculation to correct unrealistic phase-specific CO2 results

Alternatively to the procedures defined in paragraphs 3.2.3.2.4. and 3.2.3.2.5. of this annex, calculations of phase CO2 and phase fuel consumption may be calculated according to the equations in paragraphs 3.2.5.1.1., 3.2.5.1.2. and 3.2.5.1.3. below.

3.2.5.1.1. Ratio determination for each phase of VL and VH

where:

are from step 9 in Table A7/1 in this annex.

3.2.5.1.2. Ratio determination for each phase for vehicle Vind

where:

is from step 10 in Table A7/1 in this annex and shall be rounded to the nearest whole number.

3.2.5.1.3. Phase per phase mass emission of vehicle Vind

3.2.5.2. Alternative calculation to correct an unrealistic road load curve

Alternatively to the procedure defined in paragraph 3.2.3.2.2.4. of this annex, road load coefficients may be calculated as follows:

Applying the least squares regression method in the range of the reference speed points, alternative adjusted road load coefficients f\*0,i and f\*2,i shall be determined for Fi(v) with the linear coefficient f\*1,i set to f1,A. f1,A is calculated as follow:

where:

E is the cycle energy demand as defined in paragraph 5. of this annex, Ws;

i is the subscript denoting vehicles L, H or ind;

HR is test vehicle H as described in paragraph 4.2.1.2.3.2. of Annex 4;

LR is test vehicle L as described in paragraph 4.2.1.2.3.2. of Annex 4.

3.3. PM

3.3.1. Calculation

PM shall be calculated using the following two equations:

where exhaust gases are vented outside tunnel;

and:

where exhaust gases are returned to the tunnel;

where:

is the volume of diluted exhaust gases (see paragraph 2. of this annex), under standard conditions;

is the volume of diluted exhaust gas flowing through the particulate sampling filter under standard conditions;

is the mass of particulate matter collected by one or more sample filters, mg;

is the distance driven corresponding to the test cycle, km.

3.3.1.1. Where correction for the background particulate mass from the dilution system has been used, this shall be determined in accordance with paragraph 2.1.3.1. of Annex 6. In this case, particulate mass (mg/km) shall be calculated using the following equations:

in the case that the exhaust gases are vented outside the tunnel;

and:

in the case that the exhaust gases are returned to the tunnel;

where:

is the volume of tunnel air flowing through the background particulate filter under standard conditions;

is the particulate mass from the dilution air, or the dilution tunnel background air, as determined by the one of the methods described in paragraph 2.1.3.1. of Annex 6;

is the dilution factor determined in paragraph 3.2.1.1.1. of this annex.

Where application of a background correction results in a negative result, it shall be considered to be zero mg/km.

3.3.2. Calculation of PM using the double dilution method

where:

is the volume of diluted exhaust gas flowing through the particulate sample filter under standard conditions;

is the volume of the double diluted exhaust gas passing through the particulate sampling filters under standard conditions;

is the volume of the secondary dilution air under standard conditions.

Where the secondary diluted sample gas for PM measurement is not returned to the tunnel, the CVS volume shall be calculated as in single dilution, i.e.:

where:

is the measured volume of diluted exhaust gas in the dilution system following extraction of the particulate sample under standard conditions.

4. Determination of PN (if applicable)

PN shall be calculated using the following equation:

where:

is the particle number emission, particles per kilometre;

is the volume of the diluted exhaust gas in litres per test (after primary dilution only in the case of double dilution) and corrected to standard conditions (273.15 K (0 °C) and 101.325 kPa);

is a calibration factor to correct the PNC measurements to the level of the reference instrument where this is not applied internally within the PNC. Where the calibration factor is applied internally within the PNC, the calibration factor shall be 1;

is the corrected particle number concentration from the diluted exhaust gas expressed as the arithmetic average number of particles per cubic centimetre from the emissions test including the full duration of the drive cycle. If the volumetric mean concentration results from the PNC are not measured at standard conditions (273.15 K (0 °C) and 101.325 kPa), the concentrations shall be corrected to those conditions ;

is either the dilution air or the dilution tunnel background particle number concentration, as permitted by the responsible authority, in particles per cubic centimetre, corrected for coincidence and to standard conditions (273.15 K (0 °C) and 101.325 kPa);

is the mean particle concentration reduction factor of the VPR at the dilution setting used for the test;

is the mean particle concentration reduction factor of the VPR at the dilution setting used for the background measurement;

is the distance driven corresponding to the applicable test cycle, km.

shall be calculated using the following equation:

where:

is a discrete measurement of particle number concentration in the diluted gas exhaust from the PNC; particles per cm³ and corrected for coincidence;

is the total number of discrete particle number concentration measurements made during the applicable test cycle and shall be calculated using the following equation:

where:

is the time duration of the applicable test cycle, s;

is the data logging frequency of the particle counter, Hz.

5. Calculation of cycle energy demand

Xxxxx Unless otherwise specified, the calculation shall be based on the target speed trace given in discrete time sample points.

~~For the calculation, each time sample point shall be interpreted as a time period. Unless otherwise specified, the duration ∆t of these periods shall be 1 second.~~

The total energy demand E for the whole cycle or a specific cycle phase shall be calculated by summing over the corresponding cycle time between tstart+1 and tend according to the following equation:

where:

if

if

and:

tstart is the time at which the applicable test cycle or phase starts (see paragraph 3 of annex 1 of this Regulation), s;

tend is the time at which the applicable test cycle or phase ends (see paragraph 3 of annex 1 of this Regulation), s;

is the energy demand during time period (i-1) to (i), Ws;

is the driving force during time period (i-1) to (i), N;

is the distance travelled during time period (i-1) to (i), m.

where:

is the driving force during time period (i-1) to (i), N;

is the target velocity at time ti, km/h;

is the test mass, kg;

is the acceleration during time period (i-1) to (i), m/s²;

, , are the road load coefficients for the test vehicle under consideration (, or ) in N, N/km/h and in N/(km/h)² respectively.

where:

is the distance travelled in time period (i-1) to (i), m;

is the target velocity at time , km/h;

is time, s.

where:

is the acceleration during time period (i-1) to (i), m/s²;

is the target velocity at time , km/h;

is time, s.

6. Calculation of fuel consumption

6.1. The fuel characteristics required for the calculation of fuel consumption values shall be taken from Annex 3 of this UN GTR.

6.2. The fuel consumption values shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide using the results of step 6 for criteria emissions and step 7 for CO2 of Table A7/1.

6.2.1. The general equation in paragraph 6.12. of this annex using H/C and O/C ratios shall be used for the calculation of fuel consumption.

6.2.2. For all equations in paragraph 6. of this annex:

FC is the fuel consumption of a specific fuel, l/100 km (or m³ per 100 km in the case of natural gas or kg/100 km in the case of hydrogen);

H/C is the hydrogen to carbon ratio of a specific fuel CXHYOZ;

O/C is the oxygen to carbon ratio of a specific fuel CXHYOZ;

MWC is the molar mass of carbon (12.011 g/mol);

MWH is the molar mass of hydrogen (1.008 g/mol);

MWO is the molar mass of oxygen (15.999 g/mol);

ρfuel is the test fuel density, kg/l. For gaseous fuels, fuel density at 15 °C;

HC are the emissions of hydrocarbon, g/km;

CO are the emissions of carbon monoxide, g/km;

CO2 are the emissions of carbon dioxide, g/km;

H2O are the emissions of water, g/km;

H2 are the emissions of hydrogen, g/km;

p1 is the gas pressure in the fuel tank before the applicable test cycle, Pa;

p2 is the gas pressure in the fuel tank after the applicable test cycle, Pa;

T1 is the gas temperature in the fuel tank before the applicable test cycle, K;

T2 is the gas temperature in the fuel tank after the applicable test cycle, K;

Z1 is the compressibility factor of the gaseous fuel at p1 and T1;

Z2 is the compressibility factor of the gaseous fuel at p2 and T2;

V is the interior volume of the gaseous fuel tank, m³;

d is the theoretical length of the applicable phase or cycle, km.

6.3. For a vehicle with a positive ignition engine fuelled with petrol (E0)

6.4. For a vehicle with a positive ignition engine fuelled with petrol (E5)

6.5. For a vehicle with a positive ignition engine fuelled with petrol (E10)

6.6. For a vehicle with a positive ignition engine fuelled with LPG

6.6.1. If the composition of the fuel used for the test differs from the composition that is assumed for the calculation of the normalised consumption, on the manufacturer's request a correction factor cf may be applied, using the following equation:

The correction factor, , which may be applied, is determined using the following equation:

where:

is the actual H/C ratio of the fuel used.

6.7. For a vehicle with a positive ignition engine fuelled with NG/biomethane

6.8. For a vehicle with a compression engine fuelled with diesel (B0)

6.9. For a vehicle with a compression engine fuelled with diesel (B5)

6.10. For a vehicle with a compression engine fuelled with diesel (B7)

6.11. For a vehicle with a positive ignition engine fuelled with ethanol (E85)

6.12. Fuel consumption for any test fuel may be calculated using the following equation:

6.13. Fuel consumption for a vehicle with a positive ignition engine fuelled by hydrogen:

For vehicles fuelled either with gaseous or liquid hydrogen, and with approval of the responsible authority, the manufacturer may choose to calculate fuel consumption using either the equation for FC below or a method using a standard protocol such as SAE J2572.

The compressibility factor, Z, shall be obtained from the following table:

Table A7/2

**Compressibility factor Z**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | p(bar) |  |  |  |  |  |
|  |  | *5* | *100* | *200* | *300* | *400* | *500* | *600* | *700* | *800* | *900* |
|  | 33 | 0.859 | 1.051 | 1.885 | 2.648 | 3.365 | 4.051 | 4.712 | 5.352 | 5.973 | 6.576 |
|  | 53 | 0.965 | 0.922 | 1.416 | 1.891 | 2.338 | 2.765 | 3.174 | 3.570 | 3.954 | 4.329 |
|  | 73 | 0.989 | 0.991 | 1.278 | 1.604 | 1.923 | 2.229 | 2.525 | 2.810 | 3.088 | 3.358 |
|  | 93 | 0.997 | 1.042 | 1.233 | 1.470 | 1.711 | 1.947 | 2.177 | 2.400 | 2.617 | 2.829 |
|  | 113 | 1.000 | 1.066 | 1.213 | 1.395 | 1.586 | 1.776 | 1.963 | 2.146 | 2.324 | 2.498 |
|  | 133 | 1.002 | 1.076 | 1.199 | 1.347 | 1.504 | 1.662 | 1.819 | 1.973 | 2.124 | 2.271 |
|  | 153 | 1.003 | 1.079 | 1.187 | 1.312 | 1.445 | 1.580 | 1.715 | 1.848 | 1.979 | 2.107 |
|  | 173 | 1.003 | 1.079 | 1.176 | 1.285 | 1.401 | 1.518 | 1.636 | 1.753 | 1.868 | 1.981 |
| T(K) | 193 | 1.003 | 1.077 | 1.165 | 1.263 | 1.365 | 1.469 | 1.574 | 1.678 | 1.781 | 1.882 |
|  | 213 | 1.003 | 1.071 | 1.147 | 1.228 | 1.311 | 1.396 | 1.482 | 1.567 | 1.652 | 1.735 |
|  | 233 | 1.004 | 1.071 | 1.148 | 1.228 | 1.312 | 1.397 | 1.482 | 1.568 | 1.652 | 1.736 |
|  | 248 | 1.003 | 1.069 | 1.141 | 1.217 | 1.296 | 1.375 | 1.455 | 1.535 | 1.614 | 1.693 |
|  | 263 | 1.003 | 1.066 | 1.136 | 1.207 | 1.281 | 1.356 | 1.431 | 1.506 | 1.581 | 1.655 |
|  | 278 | 1.003 | 1.064 | 1.130 | 1.198 | 1.268 | 1.339 | 1.409 | 1.480 | 1.551 | 1.621 |
|  | 293 | 1.003 | 1.062 | 1.125 | 1.190 | 1.256 | 1.323 | 1.390 | 1.457 | 1.524 | 1.590 |
|  | 308 | 1.003 | 1.060 | 1.120 | 1.182 | 1.245 | 1.308 | 1.372 | 1.436 | 1.499 | 1.562 |
|  | 323 | 1.003 | 1.057 | 1.116 | 1.175 | 1.235 | 1.295 | 1.356 | 1.417 | 1.477 | 1.537 |
|  | 338 | 1.003 | 1.055 | 1.111 | 1.168 | 1.225 | 1.283 | 1.341 | 1.399 | 1.457 | 1.514 |
|  | 353 | 1.003 | 1.054 | 1.107 | 1.162 | 1.217 | 1.272 | 1.327 | 1.383 | 1.438 | 1.493 |

In the case that the required input values for p and T are not indicated in the table, the compressibility factor shall be obtained by linear interpolation between the compressibility factors indicated in the table, choosing the ones that are the closest to the value sought.

7. Drive trace indices

7.1. General requirement

The prescribed speed between time points in Tables A1/1 to A1/12 shall be determined by linear interpolation at a frequency of 10 Hz.

In the case that the accelerator control is fully activated, the prescribed speed shall be used instead of the actual vehicle speed for drive trace index calculations during such periods of operation.

The on-board diagnostics (OBD) or engine control unit (ECU) monitoring (data collection) system may be used in order to detect the position of the accelerator control. The collection of OBD and/or ECU data shall not influence the vehicle's emissions or performance.

7.2. Calculation of drive trace indices

The following indices shall be calculated according to SAE J2951(Revised JAN2014):

(a) IWR : Inertial Work Rating, per cent;

(b) RMSSE : Root Mean Squared Speed Error, km/h.

7.3. Criteria for drive trace indices

In the case of a type approval test, the following indices shall fulfil the following criteria:

(a) IWR shall be in the range of (- 2.0 < IWR < + 4.0) per cent;

(b) RMSSE, at the option of the Contracting Party, shall be less than 0.8 km/h or less than 1.3 km/h.

7.4. Vehicle-specific application of drive trace indices

7.4.1. Pure ICE vehicles, NOVC-HEVs, NOVC-FCHVs

The drive trace indices IWR and RMSSE shall be calculated for the applicable test cycle and comply with the limits specified in paragraph 7.3. of this annex.

7.4.2. OVC-HEVs

7.4.2.1. Charge-sustaining Type 1 test (paragraph 3.2.5. of Annex 8)

The drive trace indices IWR and RMSSE shall be calculated for the applicable test cycle and comply with the limits specified in paragraph 7.3. of this annex.

7.4.2.2. Charge-depleting Type 1 test (paragraph 3.2.4.3. of Annex 8)

If the number of charge-depleting Type 1 test cycles is less than four, the drive trace indices IWR and RMSSE shall be calculated for each individual applicable test cycle of the charge-depleting Type 1 test and comply with the limits specified in paragraph 7.3. of this annex.

If the number of charge-depleting Type 1 test cycles is greater than or equal to four, the drive trace indices IWR and RMSSE shall be calculated for each individual applicable test cycle of the charge-depleting Type 1 test. In this case, the average IWR and the average RMSSE for the combination of any two cycles within the charge-depleting test shall comply with the respective limits specified in paragraph 7.3. of this annex, and the calculated IWR of any individual cycle within the charge-depleting test shall not be less than

-3.0 nor greater than +5.0 per cent.

7.4.2.3. City cycle test (paragraph 3.2.4.3. of Annex 8 replacing WLTC with WLTCcity)

For the application of the drive trace index calculation, two consecutively driven city test cycles (L and M) shall be considered as one cycle.

For the city cycle during which the combustion engine starts to consume fuel, the drive indices IWR and RMSSE shall not be calculated individually. Instead, depending on the number of completed city cycles before the city cycle during which the combustion engine start, the incomplete city cycle shall be combined with the previous city cycles as follows and shall be considered as one cycle in the context of the drive trace index calculations.

If the number of completed city cycles is even, the incomplete city cycle shall be combined with the previous two completed city cycles. See the example in Figure A7/1 below.

Figure A7/1

**Example with an even number of completed city test cycles before the city cycle where the combustion engine start**



If the number of completed city cycles is odd, the incomplete city cycle shall be combined with the previous three completed city cycles. See the example in figure A7/2 below.

Figure A7/2

**Example with an odd number of completed city test cycles before the city cycle where the combustion engine start**

****

If the number of cycles derived according to Figure A7/1 or Figure A7/2 is less than four, the drive trace indices IWR and RMSSE shall be calculated for each individual cycle and comply with the limits specified in paragraph 7.3. of this annex.

If the number of cycles derived according to Figure A7/1 or Figure A7/2 is greater than or equal to four, the drive trace indices IWR and RMSSE shall be calculated for each individual cycle. In this case, the average IWR and the average RMSSE for the combination of any two cycles shall comply with the respective limits specified in paragraph 7.3. of this annex and the IWR of any individual cycle shall not be less than -3.0 or greater than +5.0 per cent.

7.4.3. PEV

7.4.3.1. Consecutive cycle test

The consecutive cycle test procedure shall be performed according to paragraph 3.4.4.1. of Annex 8. The drive trace indices IWR and RMSSE shall be calculated for each individual test cycle of the consecutive cycle test procedure and shall comply with the limits specified in paragraph 7.3. of this annex. The test cycle during which the break-off criterion is reached, as specified in paragraph 3.4.4.1.3. of Annex 8, shall be combined with the preceding test cycle. The drive trace indices IWR and RMSSE shall be calculated considering this as one cycle and shall comply with the limits specified in paragraph 7.3. of this annex.

7.4.3.2. Shortened Type 1 test

The drive trace indices IWR and RMSSE for the shortened Type 1 test procedure, as performed according to paragraph 3.4.4.2. of Annex 8, shall be calculated separately for each dynamic segment 1 and 2, and shall comply with the limits specified in paragraph 7.3. of this annex. The calculation of drive trace indices during the constant speed segments shall be omitted.

7.4.3.3. City cycle test procedure (paragraph 3.4.4.1. of Annex 8 replacing WLTC with WLTCcity)

For the application of the drive trace index calculation, two consecutively driven city test cycles shall be considered as one cycle.

For the city cycle during which the break-off criterion is reached as specified in paragraph 3.4.4.1.3. of Annex 8, the drive trace indices IWR and RMSSE shall not be calculated individually. Instead, depending on the number of completed city cycles before the city cycle when the break-off criterion is reached, the incomplete city cycle shall be combined with previous city cycles and shall be considered as one cycle in the context of the drive trace index calculations.

If the number of completed city cycles is even, the incomplete city cycle shall be combined with the previous two completed city cycles. See the example in Figure A7/3 below.

Figure A7/3

**Example with an even number of completed city test cycles before the city cycle with the break-off criterion**



If the number of completed city cycles is odd, the incomplete city cycle shall be combined with the previous three completed city cycles. See the example in Figure A7/4 below.

Figure A7/4

**Example with an odd number of completed city test cycles before the city cycle with the break-off criterion**

****

If the number of cycles derived according to Figure A7/3 or Figure A7/4 is less than four, the drive trace indices IWR and RMSSE shall be calculated for each of these cycles and comply with the limits specified in paragraph 7.3. of this annex.

If the number of cycles derived according to Figure A7/3 or Figure A7/4 is greater than or equal to four, the drive trace indices IWR and RMSSE shall be calculated for each of these cycles. In this case, the average IWR and the average RMSSE for the combination of any two cycles shall comply with the respective limits as specified in paragraph 7.3. of this annex and the IWR of any individual cycle shall not be less than -3.0 or greater than +5.0 per cent.

8. Calculating n/v ratios

n/v ratios shall be calculated using the following equation:

where:

n is engine speed, min-1;

v is the vehicle speed, km/h;

ri is the transmission ratio in gear i;

raxle is the axle transmission ratio.

Udyn is the dynamic rolling circumference of the tyres of the drive axle and is calculated using the following equation:

where:

H/W is the tyre’s aspect ratio, e.g. "45" for a 225/45 R17 tyre;

W is the tyre width, mm; e.g. "225" for a 225/45 R17 tyre;

R is the wheel diameter, inch; e.g. "17" for a 225/45 R17 tyre.

Udyn shall be rounded according to paragraph 7. of this UN GTR to whole millimetres.

If Udyn is different for the front and the rear axles, the value of n/v for the mainly powered axle shall be applied. Upon request, the responsible authority shall be provided with the necessary info

1. \* In accordance with the programme of work of the Inland Transport Committee for 2018–2019 (ECE/TRANS/274, para. 123 and ECE/TRANS/2018/21 and Add.1, Cluster 3), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate. [↑](#footnote-ref-2)