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Commission Regulation (EU) No 65/2012 of 24 January 2012 implementing Regulation (EC) No 661/2009 of the European Parliament and of the Council as regards gear shift indicators and amending Directive 2007/46/EC of the European Parliament and of the Council (Text with EEA relevance)

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## ANNEX I

### **SPECIAL REQUIREMENTS FOR VEHICLES EQUIPPED WITH GEAR SHIFT INDICATORS (GSI)**

1. **Characteristic of the GSI appearance**
  - 1.1. The shift recommendation shall be provided by means of a distinct visual indication, for example a clear indication to shift up or up/down or a symbol that identifies the gear into which the driver should shift. The visible indication may be complemented by other indications, including audible ones, provided that these do not compromise safety.
  - 1.2. The GSI must not interfere with or mask the identification of any tell-tale, control or indicator, which is mandated or supports the safe operation of the vehicle. Notwithstanding point 1.3, the signal shall be designed so that it does not distract the driver's attention and to avoid interfering with proper and safe vehicle operation.
  - 1.3. The GSI shall be located in compliance with paragraph 5.1.2 of UNECE Regulation No 121. It shall be designed such that it can not be confused with any other tell-tale, control or indicator the vehicle is equipped with.
  - 1.4. An information display device may be used to display GSI indications provided that they are sufficiently different from other indications so as to be clearly visible and identifiable by the driver.
  - 1.5. Temporarily, the GSI indication may be automatically overridden or deactivated in exceptional situations. Such circumstances are those that may compromise the safe operation or integrity of the vehicle, including activation of traction or stability control systems, temporary displays from driver assistance systems or events relating to vehicle malfunctioning. The GSI shall resume normal operation after the exceptional situations ceased to exist, and within a delay of 10 seconds or longer, if justified by specific technical or behavioural reasons.
2. **Functional requirements for GSI (applicable to all manual modes)**
  - 2.1. The GSI shall suggest changing the gear when the fuel consumption with the suggested gear is estimated to be lower than the current one giving consideration to the requirements laid down in points 2.2 and 2.3.
  - 2.2. The GSI shall be designed to encourage an optimised fuel efficient driving style under reasonably foreseeable driving conditions. Its main purpose is to minimise the fuel consumption of the vehicle when the driver follows its indications. However, regulated tailpipe emissions shall not be disproportionately increased with respect to the initial state when following the indication of the GSI. In addition, following the GSI strategy should not have any negative effect on the timely functioning of pollution control devices, such as catalysts, after a cold start. For this purpose vehicle manufacturers should provide technical documentation to the type-approval authority, which describes the impact of the GSI strategy on the vehicle's regulated tailpipe emissions, under at least steady vehicle speed.
  - 2.3. Following the indication of the GSI must not compromise the safe operation of the vehicle, e.g. to prevent stalling of the engine, insufficient engine braking or insufficient engine torque in the case of high power demand.
3. **Information to be provided**

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- 3.1. The manufacturer shall provide the following information to the type-approval authority. The information shall be made available in the following two parts:
- (a) the ‘formal documentation package’ that may be made available to interested parties upon request;
  - (b) the ‘extended documentation package’ that shall remain strictly confidential.
- 3.1.1. The formal documentation package shall contain:
- (a) a description of the complete set of appearances of the GSIs which are fitted on vehicles being part of the vehicle type with regard to GSI, and evidence of their compliance with the requirements of point 1;
  - (b) evidence in the form of data or engineering evaluations, for example modelling data, emission or fuel consumption maps, emission tests, which adequately demonstrate that the GSI is effective in providing timely and meaningful shift recommendations to the driver in order to comply with the requirements of point 2;
  - (c) an explanation of the purpose, use and functions of the GSI in a ‘GSI section’ of the user manual accompanying the vehicle.
- 3.1.2. The extended documentation package shall contain the design strategy of the GSI, in particular its functional characteristics.
- 3.1.3. Notwithstanding the provisions of Article 5, the extended documentation package shall remain strictly confidential between the type-approval authority and the manufacturer. It may be kept by the type-approval authority, or, at the discretion of the type-approval authority, may be retained by the manufacturer. In the case the manufacturer retains the documentation package, that package shall be identified and dated by the type-approval authority once reviewed and approved. It shall be made available for inspection by the approval authority at the time of approval or at any time during the validity of the approval.
- 3.2. The manufacturer shall provide an explanation of the purpose, use and functions of the GSI in a ‘GSI section’ of the user manual accompanying the vehicle.
4. **The fuel economy impact of GSI recommended gear shift points shall be determined according to the following procedure:**
- 4.1. *Determination of vehicle speeds at which GSI recommends shifting up gears*

This test is to be performed on a warmed up vehicle on a chassis dynamometer according to the speed profile described in Appendix 1 to this Annex. The advice of the GSI is followed for shifting up gears and the vehicle speeds, for which the GSI recommends shifting, are recorded. The test is repeated 3 times.

$V_{GSI}^n$  shall denote the average speed at which the GSI recommends shifting up from gear  $n$  ( $n = 1, 2, \dots, \#g$ ) into gear  $n + 1$ , determined from the 3 tests, where  $\#g$  shall denote the vehicle’s number of forward gears. For this purpose only GSI shift instructions in the phase before the maximum speed is reached are taken into account and any GSI instruction during the deceleration is ignored.

For the purposes of the following calculations  $V_{GSI}^0$  is set to 0 km/h and  $V_{GSI}^{\#g}$  is set to 140 km/h or the maximum vehicle speed, whichever is smaller. Where the vehicle cannot attain 140 km/h, the vehicle shall be driven at its maximum speed until it rejoins the speed profile in Figure I.1.

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Alternatively, the recommended GSI shift speeds may be analytically determined by the manufacturer based on the GSI algorithm contained in the extended documentation package provided according to point 3.1.

#### 4.2. *Standard gear shift points*

$V_{std}^n$  shall denote the speed at which a typical driver is assumed to shift up from gear  $n$  into gear  $n + 1$  without GSI recommendation. Based on the gear shift points defined in the type 1 emission test<sup>(1)</sup> the following standard gear shift speeds are defined:

$V_{std}^0$	= 0 km/h;
$V_{std}^1$	= 15 km/h;
$V_{std}^2$	= 35 km/h;
$V_{std}^3$	= 50 km/h;
$V_{std}^4$	= 70 km/h;
$V_{std}^5$	= 90 km/h;
$V_{std}^6$	= 110 km/h;
$V_{std}^7$	= 130 km/h;
$V_{std}^8$	= $V_{GSI}^{\#g}$ ;

$V_{min}^n$  shall denote the minimum vehicle speed the vehicle can be driven in the gear  $n$  without stalling of the engine and  $V_{max}^n$  the maximum vehicle speed the vehicle can be driven in the gear  $n$  without creating damage to the engine.

If  $V_{std}^n$  derived from this list is smaller than  $V_{min}^{n+1}$ , then  $V_{std}^n$  is set to be  $V_{min}^{n+1}$ . If  $V_{std}^n$  derived from this list is greater than  $V_{max}^n$ , then  $V_{std}^n$  is set to be  $V_{max}^n$  ( $n = 1, 2, \dots, \#g - 1$ ).

If  $V_{std}^{\#g}$  determined by this procedure is smaller than  $V_{GSI}^{\#g}$ , it shall be set to  $V_{GSI}^{\#g}$ .

#### 4.3. *Fuel consumption speed curves*

The manufacturer shall supply the type-approval authority with the functional dependence of the vehicle's fuel consumption on the steady vehicle speed when driving with gear  $n$  according to the following rules.

$FC_i^n$  shall denote the fuel consumption in terms of kg/h (kilograms per hour) when the vehicle is driven with the constant vehicle speed  $v_i = i \times 5 \text{ km/h} - 2,5 \text{ km/h}$  (where  $i$  is a positive integer number) in the gear  $n$ . These data shall be provided by the manufacturer for each gear  $n$  ( $n = 1, 2, \dots, \#g$ ) and  $v_{min}^n \leq v_i \leq v_{max}^n$ . These fuel consumption values shall be determined under identical ambient conditions corresponding to a realistic driving situation that may be defined by the vehicle manufacturer, either by a physical test or by an appropriate calculation model agreed between the approval authority and the manufacturer.

#### 4.4. *Vehicle speed distribution*

The following distribution should be used for the probability  $P_i$  that the vehicle drives with a speed  $v$ , where  $v_i - 2,5 \text{ km/h} < v \leq v_i + 2,5 \text{ km/h}$  ( $i = 1, \dots, 28$ ):

<b>i</b>	<b>P<sub>i</sub></b>
1	4,610535879

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2	5,083909299
3	4,86818148
4	5,128313511
5	5,233189418
6	5,548597362
7	5,768706442
8	5,881761847
9	6,105763476
10	6,098904359
11	5,533164348
12	4,761325003
13	4,077325232
14	3,533825909
15	2,968643201
16	2,61326375
17	2,275220718
18	2,014651418
19	1,873070659
20	1,838715054
21	1,982122053
22	2,124757402
23	2,226658166
24	2,137249569
25	1,76902642
26	1,665033625
27	1,671035353
28	0,607049046

Where the maximum speed of the vehicle corresponds to step  $i$  and  $i < 28$ , the values of  $P_{i+1}$  to  $P_{28}$  shall be added to  $P_i$ .

#### 4.5. Determination of the model fuel consumption

$FC_{GSI}$  shall denote the fuel consumption of the vehicle when the driver follows the advice of the GSI:

$FC_{GSI}^{n-1} = FC_{GSI}^n$ , where  $V_{GSI}^{n-1} \leq v_i < V_{GSI}^n$  (for  $n = 1, \dots, \#g$ ) and  $FC_{GSI}^{n-1} = 0$  if  $v_i \geq V_{GSI}^{\#g}$

$$FC_{GSI} = \sum_{i=1}^{28} P_i \times FC_{GSI}^i / 100$$

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$FC_{std}$  shall denote the fuel consumption of the vehicle when standard gear shift points are used:

$$FC_{std}^{std} = FC_i^n, \text{ where } V_{std}^{n-1} \leq v_i < V_{std}^n \text{ (for } n = 1, \dots, \#g) \text{ and } FC_{std}^{std} = 0 \text{ if } v_i \geq V_{GSI}^{\#g}$$

$$FC_{std} = \sum_{i=1}^{i=n-1} P_i \times FC_{std}^i / 100$$

The relative saving of fuel consumption by following the advice of the GSI of the model is calculated as:

$$FC_{rel. \text{ Save}} = (1 - FC_{GSI} / FC_{std}) \times 100 \%$$

#### 4.6. Data records

The following information shall be recorded:

- the values of  $V_{GSI}^n$  as determined according to point 4.1,
- the values  $FC_i^n$  of the fuel consumption speed curve as communicated by the manufacturer according to point 4.3,
- the values  $FC_{GSI}$ ,  $FC_{std}$  and  $FC_{rel. \text{ Save}}$  as calculated according to point 4.5.

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## Appendix 1

### Description of vehicle speed profile referred to in point 4.1

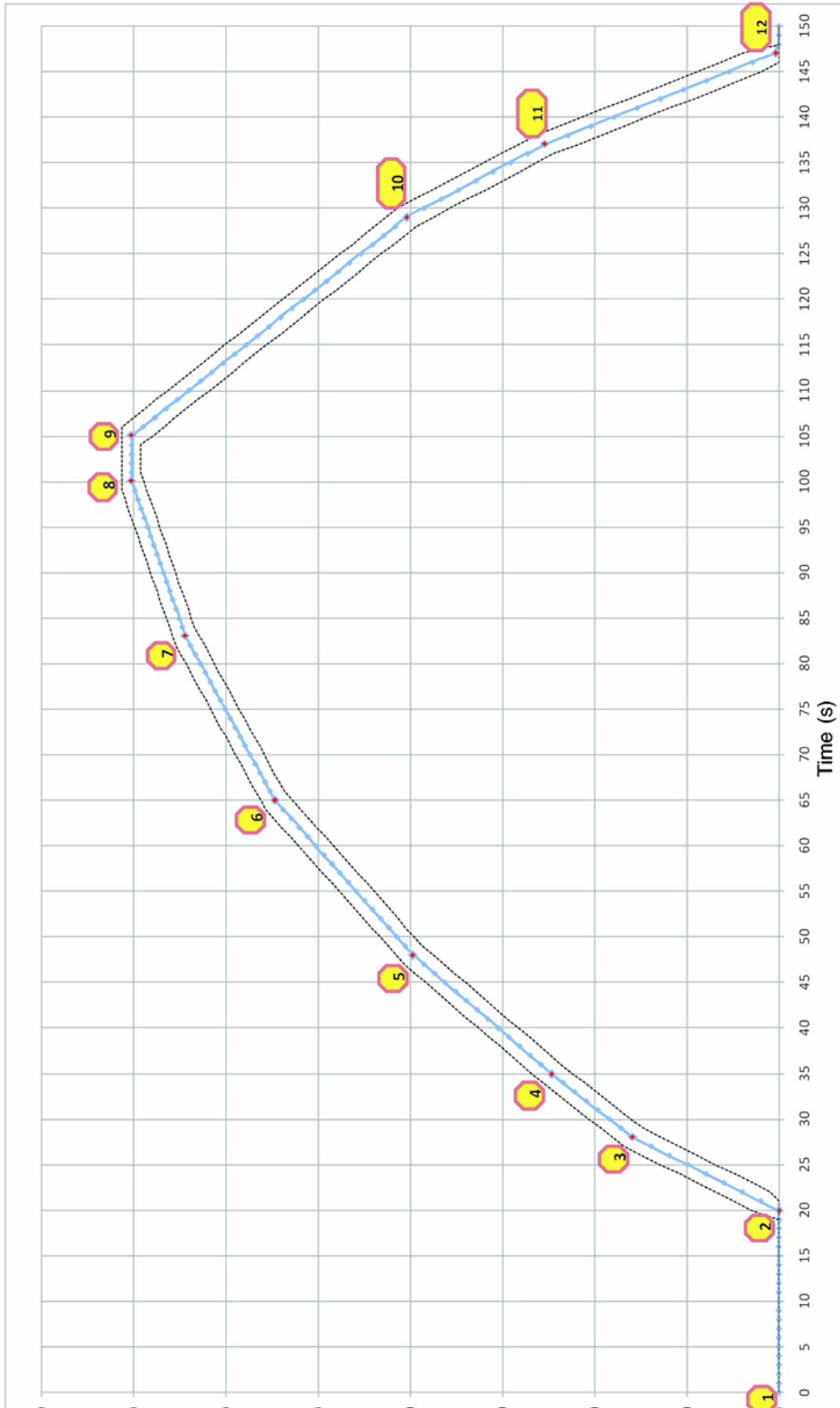
No of operation	Operation	Acceleration(m/s <sup>2</sup> )	Speed(km/h)	Cumulative time(s)
1	Idling	0	0	20
2	Acceleration	1,1	0-31,68	28
3		0,7	31,68-49,32	35
4		0,64	49,32-79,27	48
5		0,49	79,27-109,26	65
6		0,3	109,26-128,70	83
7		0,19	128,70-140,33	100
8	Steady state	0	140,33	105
9	Deceleration	-0,69	140,33-80,71	129
10		-1,04	80,71-50,76	137
11		-1,39	50,76-0	147
12	Idling	0	0	150

The tolerances for deviation from this speed profile are defined in point 6.1.3.4 of Annex 4a of UNECE Regulation No 83, 05 series of amendments.

*Figure I.1*

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**Graphical representation of the speed profile referred to in point 4.1; solid line: speed profile; dashed lines: tolerances for deviation from this speed profile**





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The following table provides a second by second description of the speed profile. Where the vehicle is unable to attain 140 km/h, it shall be driven at its maximum speed until it rejoins the above speed profile.

<b>Time (s)</b>	<b>Speed (km/h)</b>
0	0,0
1	0,0
2	0,0
3	0,0
4	0,0
5	0,0
6	0,0
7	0,0
8	0,0
9	0,0
10	0,0
11	0,0
12	0,0
13	0,0
14	0,0
15	0,0
16	0,0
17	0,0
18	0,0
19	0,0
20	0,0
21	3,96
22	7,92
23	11,88
24	15,84
25	19,8
26	23,76
27	27,72
28	31,68
29	34,2
30	36,72

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31	39,24
32	41,76
33	44,28
34	46,8
35	49,32
36	51,62
37	53,93
38	56,23
39	58,54
40	60,84
41	63,14
42	65,45
43	67,75
44	70,06
45	72,36
46	74,66
47	76,97
48	79,27
49	81,04
50	82,8
51	84,56
52	86,33
53	88,09
54	89,86
55	91,62
56	93,38
57	95,15
58	96,91
59	98,68
60	100,44
61	102,2
62	103,97
63	105,73
64	107,5

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65	109,26
66	110,34
67	111,42
68	112,5
69	113,58
70	114,66
71	115,74
72	116,82
73	117,9
74	118,98
75	120,06
76	121,14
77	122,22
78	123,3
79	124,38
80	125,46
81	126,54
82	127,62
83	128,7
84	129,38
85	130,07
86	130,75
87	131,44
88	132,12
89	132,8
90	133,49
91	134,17
92	134,86
93	135,54
94	136,22
95	136,91
96	137,59
97	138,28
98	138,96

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99	139,64
100	140,33
101	140,33
102	140,33
103	140,33
104	140,33
105	140,33
106	137,84
107	135,36
108	132,88
109	130,39
110	127,91
111	125,42
112	122,94
113	120,46
114	117,97
115	115,49
116	113,0
117	110,52
118	108,04
119	105,55
120	103,07
121	100,58
122	98,1
123	95,62
124	93,13
125	90,65
126	88,16
127	85,68
128	83,2
129	80,71
130	76,97
131	73,22
132	69,48

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133	65,74
134	61,99
135	58,25
136	54,5
137	50,76
138	45,76
139	40,75
140	35,75
141	30,74
142	25,74
143	20,74
144	15,73
145	10,73
146	5,72
147	0,72
148	0,0
149	0,0
150	0,0

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- (1) Defined in Annex 4a of UNECE Regulation No 83, 05 series of amendments.

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