Revisions to NOVC-FCHV & OVC-FCHV Test Methods (Level 1B and 3-phase WLTP test in Level2)

Revision for UN R154-04 Proposal
(ECE-TRANS-WP29-GRPE-2025-15e)

Level 1B and 3-phase WLTP test in Level2 Updates:

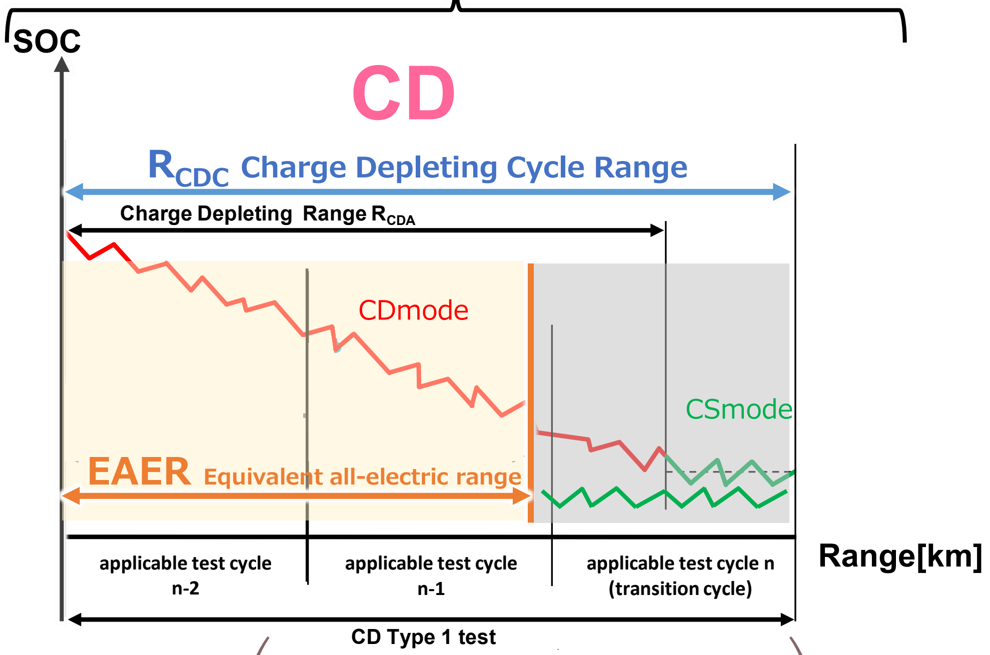
- **NOVC-FCHV Driving Range Test Method（Editorial corrections）**
- **OVC-FCHV Test Method（Added Driving Range test, EAER, FE_{CD} and EC）**

OVC-FCHV Total Driving Range

OVC-FCHV test

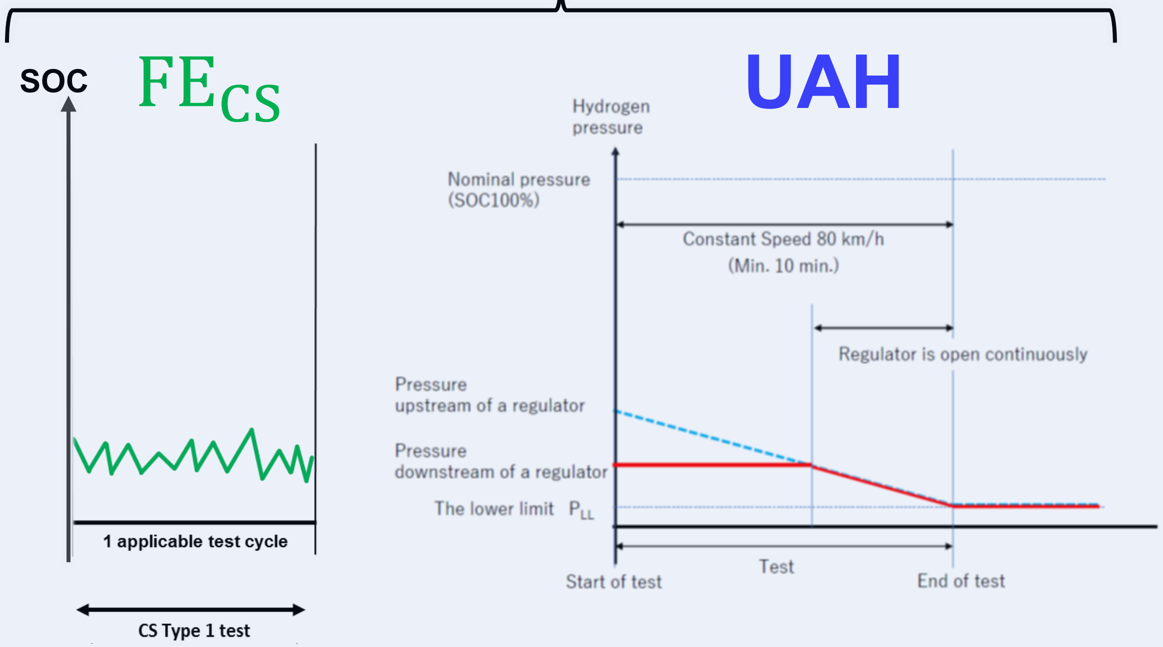
GRPE-92-09e (Proposed in March 2025 GRPE)

Similar concept to OVC-HEV(Level1B)



$$\mathrm{EAER} = \left(\frac{\frac{1}{FE_{CS,declared}} - \frac{1}{FE_{CD,avg}}}{\frac{1}{FE_{CS,declared}}} \right) \times \mathrm{R_{CDC}}$$

Same as NOVC-FCHV



$$\mathrm{DR_H} = \mathrm{FE_{CS}}\ (\mathrm{km/kg}) \times \mathrm{UAH(kg)}$$

$$\boldsymbol{DR_{H+E} = EAER + DR_H}$$

2.Abbreviations

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2. Abbreviations

2.1. General abbreviations

P_{LL}	**Lower limit pressure**

Amendment

2. Abbreviations

2.1. General abbreviations

Added DR, DR_H, DR_{H+E} and UAH

DR	**Driving Range**
DR_H	**Driving Range of hydrogen**
DR_{H+E}	**Driving Range of hydrogen and electric**
P_{LL}	**Lower limit pressure**
UAH	**Usable Amount of Hydrogen**

6.3.12. Lower limit pressure family

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[6.3.12. Lower limit pressure family for NOVC-FCHVs
Only NOVC-FCHVs that are identical with respect to the following specifications may be part of the same family of:
(a) Operation strategy of all components determining the lower limit pressure of on-board hydrogen tank (pressure value set to initiate shutdown of fuel supply system etc.)..
(b) If no specific operation strategy determining the lower limit pressure of on-board hydrogen tank, all items of interpolation family listed in paragraph 6.3.2.4.]

6.3.2.4. Interpolation family for OVC-FCHVs and NOVC-FCHVs

Amendment

Added OVC-FCHV

[6.3.12. Lower limit pressure family for OVC-FCHVs and NOVC-FCHVs

Only OVC-FCHVs and NOVC-FCHVs that are identical with respect to the following specifications may be part of the same family of:

(a) Operation strategy of all components determining the lower limit pressure of on-board hydrogen tank (pressure value set to initiate shutdown of fuel supply system etc.)..

(b) If no specific operation strategy determining the lower limit pressure of on-board hydrogen tank, all items of interpolation family listed in paragraph 6.3.2.4.]

Annex A1 Information document

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Annex A1
Engine and vehicle characteristics and information concerning the conduct of tests (‘information document’)

3.	PROPULSION ENERGY CONVERTER ([k])
・・・	・・・
3.5.	Manufacturer’s declared values for determination of CO_2 emissions/fuel consumption/electric energy consumption/electric range
3.5.7.	Manufacturer’s declared values
・・・	・・・
3.5.7.4.	Fuel consumption (FC_{CS}) for FCHVs
3.5.7.4.1.	Charge-Sustaining fuel consumption for NOVC-FCHVs and OVC-FCHVs (as applicable)
3.5.7.4.1.1.	Vehicle high: … kg/100 km
3.5.7.4.1.2..	Vehicle low (if applicable): … kg/100 km
3.5.7.4.1.3.	Vehicle M (if applicable): … kg/100 km
3.5.7.4.2.	Charge-Depleting fuel consumption for OVC-FCHVs (as applicable)
3.5.7.4.2.1.	Vehicle high: … kg/100 km
3.5.7.4.2.2.	Vehicle low (if applicable): … kg/100 km
3.5.7.5.	Electric energy consumption for electrified vehicles
・・・	・・・
3.5.7.6.	Fuel efficiency
・・・	・・・
3.5.7.6.4.	Fuel efficiency for NOVC-FCHVs
3.5.7.6.4.1.	Vehicle high: … km/kg
3.5.7.6.4.2.	Vehicle low (if applicable): … km/kg
3.5.7.6.4.3.	Vehicle M (if applicable): … km/kg
[3.5.7.6.4.4.	Driving range (if applicable):…. km]
3.6.	Temperatures permitted by the manufacturer
・・・	・・・

- **Added OVC-FCHV**
- **Correct 'Driving Range' to 'Driving Range of hydrogen'**
- **Correct 'FCHVs' to ' NOVC-FCHVs and OVC-FCHVs'**

Amendment

Annex A1
Engine and vehicle characteristics and information concerning the conduct of tests (‘information document’)

3.	PROPULSION ENERGY CONVERTER ([k])
・・・	・・・
3.5.	Manufacturer’s declared values for determination of CO_2 emissions/fuel consumption/electric energy consumption/electric range /driving range of hydrogen
3.5.7.	Manufacturer’s declared values
・・・	・・・
3.5.7.4.	Fuel consumption (FC_{CS}) for ~~FCHVs~~ NOVC-FCHVs and OVC-FCHVs (as applicable)
3.5.7.4.1.	Charge-Sustaining fuel consumption for NOVC-FCHVs and OVC-FCHVs (as applicable)
3.5.7.4.1.1.	Vehicle high: … kg/100 km
3.5.7.4.1.2..	Vehicle low (if applicable): … kg/100 km
3.5.7.4.1.3.	Vehicle M (if applicable): … kg/100 km
3.5.7.4.2.	Charge-Depleting fuel consumption for OVC-FCHVs (as applicable)
3.5.7.4.2.1.	Vehicle high: … kg/100 km
3.5.7.4.2.2.	Vehicle low (if applicable): … kg/100 km
3.5.7.5.	Electric energy consumption for electrified vehicles
・・・	・・・
3.5.7.6.	Fuel efficiency and Driving Range of hydrogen
・・・	・・・
3.5.7.6.4.	Fuel efficiency and Driving Range of hydrogen for NOVC-FCHVs and OVC-FCHVs
3.5.7.6.4.1.	Charge-Sustaining fuel efficiency and Driving Range of hydrogen for NOVC-FCHVs and OVC-FCHVs (as applicable)
3.5.7.6.4.1.1.	Vehicle high: … km/kg
3.5.7.6.4.1.2.	Vehicle low (if applicable): … km/kg
3.5.7.6.4.1.3.	~~Vehicle M (if applicable): … km/kg~~ P_{LL} for determination of Driving Range of hydrogen (if applicable): … MPa
[3.5.7.6.4.1.4	Driving Range of hydrogen (if applicable):…. km]
3.5.7.6.4.2.	Charge-Depleting fuel efficiency for OVC-FCHVs (as applicable)
3.5.7.6.4.2.1.	Vehicle high: … km/kg
3.5.7.6.4.2.2.	Vehicle low (if applicable): … km/kg
3.6.	Temperatures permitted by the manufacturer

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[2.1.1.4.3. Ranges for NOVC-FCHVs - driving range (if applicable)

Test 1

$P_{LL,}$ Lower limit pressure (MPa)	–
Measured value P_{LL}	
Declared value P_{LL}	

Test 2 (if applicable)
Record test results in accordance with the table of Test 1

Test 3 (if applicable)
Record test results in accordance with the table of Test 1

Conclusion

P_{LL} (MPa)	–
Final value P_{LL}	

Driving range (km)	Combined
Calculated value	

Amendment

Correct 'Driving Range' to 'Driving Range of hydrogen'

[2.1.1.4.3. Ranges for OVC-FCHVs and NOVC-FCHVs - ~~D~~driving ~~R~~range of hydrogen (if applicable)

Test 1

$P_{LL,}$ Lower limit pressure (MPa)	–
Measured value P_{LL}	
Declared value P_{LL}	

Test 2 (if applicable)
Record test results in accordance with the table of Test 1

Test 3 (if applicable)
Record test results in accordance with the table of Test 1

Conclusion

P_{LL} (MPa)	–
Final value P_{LL}	

Driving ~~R~~range of hydrogen (km)	Combined
Calculated value	

Annex A2 - Communication

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2.5.3.4. Fuel consumption Charge-Sustaining

	Vehicle High					
Fuel consumption (l/100 km or m³/100 km or kg/100 km) (¹) or fuel efficiency (km/l or km/kg) (¹) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined 4 phase cycle*	*Combined 3 phase cycle*
Final values $FC_{p,H}$ / $FC_{c,H}$ or $FE_{p,H}$, $FE_{c,H}$						

Vehicle Low (if applicable)						
Fuel consumption (l/100 km or m³/100 km or kg/100 km) (¹) or fuel efficiency (km/l or km/kg) (¹) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined 4 phase cycle*	*Combined 3 phase cycle*
Final values $FC_{p,L}$ / $FC_{c,L}$ or $FE_{p,L}$, $FE_{c,L}$						

	Vehicle M (if applicable)					
Fuel consumption (l/100 km or m³/100 km or kg/100 km) (¹) or fuel efficiency (km/l or km/kg) (¹) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined 4 phase cycle*	*Combined 3 phase cycle*
Final values $FC_{p,M}$ / $FC_{c,M}$ or $FE_{p,M}$, $FE_{c,M}$						

Amendment

1. ADDITIONAL INFORMATION
2. TEST RESULTS

2.1. Tailpipe emissions test results

2.5.3. Externally chargeable (OVC) Hybrid Electric Vehicle an Fuel Cell Hybrid Vehicle (as applicable):

...

Added P_{LL} to OVC-FCHV

2.5.3.4. Fuel consumption Charge-Sustaining

	Vehicle High					
Fuel consumption (l/100 km or m³/100 km or kg/100 km) (¹) or fuel efficiency (km/l or km/kg) (¹) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined 4 phase cycle*	*Combined 3 phase cycle*
Final values $FC_{p,H}$ / $FC_{c,H}$ or $FE_{p,H}$, $FE_{c,H}$						

Vehicle Low (if applicable)						
Fuel consumption (l/100 km or m³/100 km or kg/100 km) (¹) or fuel efficiency (km/l or km/kg) (¹) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined 4 phase cycle*	*Combined 3 phase cycle*
Final values $FC_{p,L}$ / $FC_{c,L}$ or $FE_{p,L}$, $FE_{c,L}$						

	Vehicle M (if applicable)					
Fuel consumption (l/100 km or m³/100 km or kg/100 km) (¹) or fuel efficiency (km/l or km/kg) (¹) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined 4 phase cycle*	*Combined 3 phase cycle*
Final values $FC_{p,M}$ / $FC_{c,M}$ or $FE_{p,M}$, $FE_{c,M}$						

Lower limit pressure of hydrogen (MPa) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined 4 phase cycle*	*Combined 3 phase cycle*
Final value P_{LL}	-	-	-	-	-	

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2.5.4. Not Off Vehicle Charging Fuel Cell Hybrid Vehicles (NOVC-FCHV)

	Fuel Consumption (kg/100 km) *Combined* *4 phase cycle*	*Fuel Efficiency (km/kg) and lower limit pressure of hydrogen (if applicable) (MPa)* *Combined* *3 phase cycle*
Final values FC_c or FE_c		
Final value P_{LL}		

Amendment

Added V_h and V_L

2.5.4. Not Off Vehicle Charging Fuel Cell Hybrid Vehicles (NOVC-FCHV)

Vehicle High						
Fuel consumption (kg/100 km) or fuel efficiency (km/kg) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined* *4 phase cycle*	*Combined* *3 phase cycle*
Final values $FC_{p,H}$ / $FC_{c,H}$ or $FE_{p,H}$, $FE_{c,H}$						

Vehicle Low (if applicable)						
Fuel consumption (kg/100 km) or fuel efficiency (km/kg) (as applicable)	*Low*	*Medium*	*High*	*Extra High*	*Combined* *4 phase cycle*	*Combined* *3 phase cycle*
Final values $FC_{p,L}$ / $FC_{c,L}$ or $FE_{p,L}$, $FE_{c,L}$						

Lower limit pressure of hydrogen (MPa) *(as applicable)*	*Low*	*Medium*	*High*	*Extra High*	*Combined* *4 phase cycle*	*Combined* *3 phase cycle*
Final value P_{LL}	-	-	-	-	-	

Type 1 test procedures and test conditions

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1.2.3.2. Depending on the vehicle type, the manufacturer shall declare as applicable the total cycle values of the CO_2 emission, the electric energy consumption, fuel consumption, fuel efficiency, as well as PER, EAER and AER [and P_{LL}] according to Table A6/1.

1.2.3.3. The declared value of the equivalent all electric range for OVC-HEVs shall not be determined according to Figure A6/1. The declared value shall be taken as the type approval value if it is less than the calculated EAER value according to paragraph 4.4.4.1. If that is not the case, the calculated EAER shall be taken as the type approval value.

For Level 1A and 4-phase WLTP test in Level 2:

The declared value of the electric energy consumption for OVC-HEVs under charge-depleting operating condition shall not be determined according to Figure A6/1. It shall be taken as the type approval value if the declared CO_2 value is accepted as the approval value. If that is not the case, the measured value of electric energy consumption shall be taken as the type approval value. Evidence of a correlation between declared CO_2 emission and electric energy consumption shall be submitted to the responsible authority in advance, if applicable.

For Level 1B and 3-phase WLTP test in Level 2:

The declared value of the fuel efficiency for OVC-HEVs under charge-depleting operating condition shall not be determined according to Figure A6/1. It shall be taken as the type approval value if the declared electric energy consumption value is accepted as the approval value. If that is not the case, the measured value of fuel efficiency shall be taken as the type approval value. Evidence of a correlation between declared fuel efficiency and electric energy consumption shall be submitted to the responsible authority in advance, if applicable.

Amendment

Typo correction

1.2.3.2. Depending on the vehicle type, the manufacturer shall declare as applicable the total cycle values of the CO_2 emission, the electric energy consumption, fuel consumption, fuel efficiency, as well as PER, EAER ~~and~~ , AER [and P_{LL}] according to Table A6/1.

1.2.3.3. The declared value of the equivalent all electric range for OVC-HEVs and OVC-FCHVs shall not be determined according to Figure A6/1. The declared value shall be taken as the type approval value if it is less than the calculated EAER value according to paragraph 4.4.4.1. If that is not the case, the calculated EAER shall be taken as the type approval value.

For Level 1A and 4-phase WLTP test in Level 2:

The declared value of the electric energy consumption for OVC-HEVs and OVC-FCHVs under charge-depleting operating condition shall not be determined according to Figure A6/1. It shall be taken as the type approval value if the declared CO_2 value is accepted as the approval value. If that is not the case, the measured value of electric energy consumption shall be taken as the type approval value. Evidence of a correlation between declared CO_2 emission and electric energy consumption shall be submitted to the responsible authority in advance, if applicable.

For Level 1B and 3-phase WLTP test in Level 2:

The declared value of the fuel efficiency for OVC-HEVs and OVC-FCHVs under charge-depleting operating condition shall not be determined according to Figure A6/1. It shall be taken as the type approval value if the declared electric energy consumption value is accepted as the approval value. If that is not the case, the measured value of fuel efficiency shall be taken as the type approval value. Evidence of a correlation between declared fuel efficiency and electric energy consumption shall be submitted to the responsible authority in advance, if applicable.

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Table A6/1

Applicable rules for a manufacturer’s declared values (total cycle values)[a] (as applicable)

Powertrain		Level 1A and 4-phase WLTP test in Level 2 *M_{CO2}* [b] *(g/km)*	Level 1A and 4-phase WLTP test in Level 2: *FC* *(kg/100 km)*	Level 1B and 3-phase WLTP test in Level 2: *FE (km/l or km/kg)*	*Electric energy consumption*[c] *(Wh/km)*	*All electric range / Equivalent all-electric range/ Pure Electric Range* [c] *(km)*	[Level 1B Lower limit pressure (MPa)
Vehicles tested according to Annex B6 (pure ICE)		M_{CO2} Paragraph 3. of Annex B7.	-	FE Paragraph 1.4. of Annex B7.	-	-	-
NOVC-FCHV		-	FC_{CS} Paragraph 4.2.1.2.1. of Annex B8.	FE_{CS} Paragraph 4.2.1.2.1. of Annex B8.	-	-	P_{LL} Paragraph of 4.8.1 of Annex B8
OVC-FCHV	CD	-	FC_{CD}	N/A	For Level 1A: $EC_{AC,CD}$	AER	-
	CS	-	FC_{CS}	FE_{CS}	-	-	-
	CD/CS weighted	-	-	-	For Level 1B EC	EAER Paragraph 4.4.6.1. of Annex B8	-
NOVC-HEV		$M_{CO2,CS}$ Paragraph 4.1.1. of Annex B8.	-	FE_{CS} Paragraph 4.1.1.1. of Annex B8.	-	-	-
OVC-HEV	CD	$M_{CO2,CD}$ Paragraph 4.1.2. of Annex B8.	-	FE_{CD} Paragraph 4.6.1. of Annex B8.	For Level 1A and 4-phase WLTP test in Level 2: $EC_{AC,CD}$ Paragraph 4.3.1. of Annex B8.	For Level 1A [and 4-phase WLTP test in Level 2]: AER Paragraph 4.4.1.1. of Annex B8.	-
	CS	$M_{CO2,CS}$ Paragraph 4.1.1. of Annex B8.	-	FE_{CS} Paragraph 4.1.1.1. of Annex B8.	-	-	-
	CD/CS	-	-	-	For Level 1B and 3-phase WLTP test in Level 2: EC Paragraph 4.6.2. of Annex B8	EAER[d] Paragraph 4.4.4.1. of Annex B8	-
PEV		-	-	-	EC_{WLTC}[d] Paragraph 4.3.4.2. of Annex B8.	PER_{WLTC}[d] Paragraph 4.4.2. of Annex B8.	-]

Amendment

Table A6/1

Applicable rules for a manufacturer’s declared values (total cycle values)[a] (as applicable)

Powertrain		Level 1A and 4-phase WLTP test in Level 2 *M_{CO2}* [b] *(g/km)*	Level 1A and 4-phase WLTP test in Level 2: *FC* *(kg/100 km)*	Level 1B and 3-phase WLTP test in Level 2: *FE (km/l or km/kg)*	*Electric energy consumption*[c] *(Wh/km)*	*All electric range / Equivalent all-electric range/ Pure Electric Range* [c] *(km)*	[Level 1B and 3-phase WLTP test in Level 2: Lower limit pressure (MPa)
Vehicles tested according to Annex B6 (pure ICE)		M_{CO2} Paragraph 3. of Annex B7.	-	FE Paragraph 1.4. of Annex B7.	-	-	-
NOVC-FCHV		-	FC_{CS} Paragraph 4.2.1.2.1. of Annex B8.	FE_{CS} Paragraph 4.2.1.2.1. of Annex B8.	-	-	P_{LL} Paragraph of 4.8.1 of Annex B8
OVC-FCHV	CD	-	FC_{CD} Paragraph 4.6.3. of Annex B8	~~N/A~~ FE_{CD} Paragraph 4.6.3. of Annex B8	For Level 1A: $EC_{AC,CD}$ Paragraph 4.3.1. of Annex B8.	AER Paragraph 4.4.1.1. of Annex B8.	
	CS	-	FC_{CS} Paragraph 4.2.1.2. of Annex B8.	FE_{CS} Paragraph 4.2.1.2. of Annex B8.	-	-	- P_{LL} Paragraph of 4.8.1 of Annex B8
	CD/CS weighted	-	-	-	For Level 1B EC Paragraph 4.6.3. of Annex B8	EAER Paragraph 4.4.6.1. of Annex B8	-
NOVC-HEV		$M_{CO2,CS}$ Paragraph 4.1.1. of Annex B8.	-	FE_{CS} Paragraph 4.1.1.1. of Annex B8.	-	-	-
OVC-HEV	CD	$M_{CO2,CD}$ Paragraph 4.1.2. of Annex B8.	-	FE_{CD} Paragraph 4.6.1. of Annex B8.	For Level 1A and 4-phase WLTP test in Level 2: $EC_{AC,CD}$ Paragraph 4.3.1. of Annex B8.	For Level 1A [and 4-phase WLTP test in Level 2]: AER Paragraph 4.4.1.1. of Annex B8.	-
	CS	$M_{CO2,CS}$ Paragraph 4.1.1. of Annex B8.	-	FE_{CS} Paragraph 4.1.1.1. of Annex B8.	-	-	-
	CD/CS	-	-	-	For Level 1B and 3-phase WLTP test in Level 2: EC Paragraph 4.6.2. of Annex B8	EAER[d] Paragraph 4.4.4.1. of Annex B8	-
PEV		-	-	-	EC_{WLTC}[d] Paragraph 4.3.4.2. of Annex B8.	PER_{WLTC}[d] Paragraph 4.4.2. of Annex B8.	-]

Added OVC-FCHV

Table A6/2 Criteria for number of tests

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Table A6/2
Criteria for number of tests

- For OVC-FCHVs charge-depleting Type 1 test.

	Test	*Judgement parameter*	*FC,CD*	*$EC_{AC,CD}$*	*AER*
Row 1	First test	First test results	≤ Declared value x 1.0	≤ Declared value x 1.0	≥ Declared value × 1.0
Row 2	Second test	Arithmetic average of the first and second test results	≤ Declared value x1.0	≤ Declared value x 1.0	≥ Declared value × 1.0
Row 3	Third test	Arithmetic average of three test results	≤ Declared value x 1.0	≤ Declared value x 1.0	≥ Declared value × 1.0

- For NOVC-FCHVs and OVC-FCHVs in CS condition (as applicable)

	Test	*Judgement parameter*	For Level 1A and 4-phase WLTP test in Level 2: FC_{CS}	For Level 1B and 3-phase WLTP test in Level 2: FE_{CS}	[For Level 1B: P_{LL}
Row 1	First test	First test results	≤ Declared value × 1.0	≥ Declared value × 1.0	≤ Declared value × 1.0
Row 2	Second test	Arithmetic average of the first and second test results	≤ Declared value × 1.0	≥ Declared value × 1.0	≤ Declared value × 1.0
Row 3	Third test	Arithmetic average of three test results	≤ Declared value × 1.0	≥ Declared value × 1.0	≤ Declared value × 1.0]

Reference OVC-HEV

For OVC-HEVs charge-depleting Type 1 tests.

	Test	*Judgement parameter*	*Criteria emissions*	For Level 1A and 4-phase WLTP test in Level 2: $M_{CO2,CD}$	For Level 1B and 3-phase WLTP test in Level 2: *EC*	For Level 1A and 4-phase WLTP test in Level 2: *AER*
Row 1	First test	First test results	≤ Regulation limit × 0.9[(a)]	≤ Declared value × $dCO2_1$[(c)]	≤ Declared value ×1.0	≥ Declared value × 1.0
Row 2	Second test	Arithmetic average of the first and second test results	≤ Regulation limit × 1.0[(b)]	≤ Declared value × $dCO2_2$[(c)]	≤ Declared value ×1.0	≥ Declared value × 1.0
Row 3	Third test	Arithmetic average of three test results	≤ Regulation limit × 1.0[(b)]	≤ Declared value × $dCO2_3$[(c)]	≤ Declared value ×1.0	≥ Declared value × 1.0

Amendment

Added OVC-FCHV

Table A6/2
Criteria for number of tests

For OVC-FCHVs charge-depleting Type 1 test.

	Test	*Judgement parameter*	*For Level 1A and 4-phase WLTP test in Level 2: FC,CD*	*For Level 1A and 4-phase WLTP test in Level 2: $EC_{AC,CD}$*	*For Level 1B and 3-phase WLTP test in Level 2: EC*	*For Level 1A and 4-phase WLTP test in Level 2: AER*
Row 1	First test	First test results	≤ Declared value x 1.0	≤ Declared value x 1.0	≤ Declared value x 1.0	≥ Declared value × 1.0
Row 2	Second test	Arithmetic average of the first and second test results	≤ Declared value x1.0	≤ Declared value x 1.0	≤ Declared value x 1.0	≥ Declared value × 1.0
Row 3	Third test	Arithmetic average of three test results	≤ Declared value x 1.0	≤ Declared value x 1.0	≤ Declared value x 1.0	≥ Declared value × 1.0

For NOVC-FCHVs and OVC-FCHVs in CS condition (as applicable)

	Test	*Judgement parameter*	For Level 1A and 4-phase WLTP test in Level 2: FC_{CS}	For Level 1B and 3-phase WLTP test in Level 2: FE_{CS}	[For Level 1B and 3-phase WLTP test in Level 2: P_{LL}
Row 1	First test	First test results	≤ Declared value × 1.0	≥ Declared value × 1.0	≤ Declared value × 1.0
Row 2	Second test	Arithmetic average of the first and second test results	≤ Declared value × 1.0	≥ Declared value × 1.0	≤ Declared value × 1.0
Row 3	Third test	Arithmetic average of three test results	≤ Declared value × 1.0	≥ Declared value × 1.0	≤ Declared value × 1.0]

3.2. OVC-HEVs and OVC-FCHVs test procedure

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3.2. OVC-HEVs and OVC-FCHVs
3.2.1. Vehicles shall be tested under charge-depleting operating condition (CD condition), and charge-sustaining operating condition (CS condition)
3.2.2. Vehicles may be tested according to four possible test sequences:
3.2.2.1. Option 1: charge-depleting Type 1 test with no subsequent charge-sustaining Type 1 test.
3.2.2.2. Option 2: charge-sustaining Type 1 test with no subsequent charge-depleting Type 1 test.
3.2.2.3. Option 3: charge-depleting Type 1 test with a subsequent charge-sustaining Type 1 test.
3.2.2.4. Option 4: charge-sustaining Type 1 test with a subsequent charge-depleting Type 1 test.
...
3.2.4. Charge-depleting Type 1 test with no subsequent charge-sustaining Type 1 test (Option 1)
...
3.2.5. Charge-sustaining Type 1 test with no subsequent charge-depleting Type 1 test (Option 2)
...
3.2.6. Charge-depleting Type 1 test with a subsequent charge-sustaining Type 1 test (Option 3)
...
3.2.7. Charge-sustaining Type 1 test with a subsequent charge-depleting Type 1 test (Option 4)
...

Amendment

3.2. OVC-HEVs and OVC-FCHVs
3.2.1. Vehicles shall be tested under charge-depleting operating condition (CD condition), and charge-sustaining operating condition (CS condition)
3.2.2. Vehicles may be tested according to four possible test sequences:
3.2.2.1. Option 1: charge-depleting Type 1 test with no subsequent charge-sustaining Type 1 test.
3.2.2.2. Option 2: charge-sustaining Type 1 test with no subsequent charge-depleting Type 1 test.
3.2.2.3. Option 3: charge-depleting Type 1 test with a subsequent charge-sustaining Type 1 test.
3.2.2.4. Option 4: charge-sustaining Type 1 test with a subsequent charge-depleting Type 1 test.
...
3.2.4. Charge-depleting Type 1 test with no subsequent charge-sustaining Type 1 test (Option 1)
...
3.2.5. Charge-sustaining Type 1 test with no subsequent charge-depleting Type 1 test (Option 2)
...
3.2.6. Charge-depleting Type 1 test with a subsequent charge-sustaining Type 1 test (Option 3)
...
3.2.7. Charge-sustaining Type 1 test with a subsequent charge-depleting Type 1 test (Option 4)
...

CS test

3.2.8. Driving Range of hydrogen (DR_H) for OVC-FCHV

This paragraph is applicable to Level 1B and 3 phase WLTP test in Level 2 only

3.2.8.1 The lower limit pressure of hydrogen tank shall be measured for OVC-FCHVs according to paragraph 3 of appendix 7 to this annex.

3.2.8.2. Usable amount of hydrogen (UAH) shall be calculated according to paragraph 3 of appendix 7 to this annex.

3.2.8.3. Driving Range of hydrogen shall be calculated with fuel efficiency and usable amount of hydrogen

P_{LL} test

Added OVC-FCHV (The same sentence as NOVC-FCHV)

3.5. NOVC-FCHVs test procedure

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3.5. NOVC-FCHVs

The test sequence, described in paragraphs 3.5.1. to 3.5.3. inclusive of this annex, as well as the corresponding REESS state of charge profile, is shown in Figure A8.App1/5 in Appendix 1 to this annex.

3.5.1. Preconditioning and soaking

Vehicles shall be conditioned and soaked according to paragraph 3.3.1. of this annex.

3.5.2. Test conditions

3.5.2.1. Vehicles shall be tested under charge-sustaining operating conditions as defined in paragraph 3.3.6. of this Regulation.

3.5.2.2. Selection of a driver-selectable mode

For vehicles equipped with a driver-selectable mode, the mode for the charge-sustaining Type 1 test shall be selected according to paragraph 3. of Appendix 6 to this annex.

3.5.3. Type 1 test procedure

3.5.3.1. Vehicles shall be tested according to the Type 1 test procedure described in Annex B6 and fuel consumption calculated according to paragraph 1 and paragraph 2 Appendix 7 to this annex.

3.5.3.2. If required, fuel consumption shall be corrected according to Appendix 2 to this annex.

[3.5.3.3. Driving range of hydrogen (DR_H) for NOVC-FCHV

This paragraph is applicable to Level 1B only

3.5.3.3.1. The lower limit pressure of hydrogen tank shall be measured for NOVC - FCHVs according to paragraph 3 of Appendix 7 to this annex.

3.5.3.3.2. Usable amount of hydrogen (UAH) shall be calculated according to paragraph 3 of Appendix 7 to this annex.

3.5.3.3.3. Driving range of hydrogen shall be calculated with fuel efficiency and usable amount of hydrogen.]

Amendment

3.5. NOVC-FCHVs

The test sequence, described in paragraphs 3.5.1. to 3.5.3. inclusive of this annex, as well as the corresponding REESS state of charge profile, is shown in Figure A8.App1/5 in Appendix 1 to this annex.

3.5.1. Preconditioning and soaking

Vehicles shall be conditioned and soaked according to paragraph 3.3.1. of this annex.

3.5.2. Test conditions

3.5.2.1. Vehicles shall be tested under charge-sustaining operating conditions as defined in paragraph 3.3.6. of this Regulation.

3.5.2.2. Selection of a driver-selectable mode

For vehicles equipped with a driver-selectable mode, the mode for the charge-sustaining Type 1 test shall be selected according to paragraph 3. of Appendix 6 to this annex.

Typo correction

3.5.3. Type 1 test procedure

3.5.3.1. Vehicles shall be tested according to the Type 1 test procedure described in Annex B6 and fuel consumption calculated according to paragraph 1 and paragraph 2 of Appendix 7 to this annex.

3.5.3.2. If required, fuel consumption shall be corrected according to Appendix 2 to this annex.

CS test

[3.5.3.3. Driving range of hydrogen (DR_H) for NOVC-FCHV

This paragraph is applicable to Level 1B and 3 phase WLTP test in Level 2 only

3.5.3.3.1. The lower limit pressure of hydrogen tank shall be measured for NOVC - FCHVs according to paragraph 3 of Appendix 7 to this annex.

3.5.3.3.2. Usable amount of hydrogen (UAH) shall be calculated according to paragraph 3 of Appendix 7 to this annex.

3.5.3.3.3. Driving range of hydrogen shall be calculated with fuel efficiency and usable amount of hydrogen.]

P_{LL} test

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[4.1.4

Charge-depleting H_2 emission for OVC-HEVs

This paragraph is applicable for Level 1B only:

The charge-depleting H_2 emission $M_{H2,CD}$ shall be calculated using the following equation:

$$M_{H2,CD} = \frac{\sum_{j=1}^{k}(M_{H2,CD,j} \times d_j)}{\sum_{j=1}^{k} d_j}$$

where:

$M_{H2,CD}$	is the charge-depleting H_2 emission, g/km;
$M_{H2,CD,j}$	is the H_2 emission determined according to paragraph 3.2.1. of Annex B7 of phase j of the charge-depleting Type 1 test, g/km;
j	is the index number of the considered phase;
k	is the number of phases driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex.

Amendment

Deleted $M_{H2,CD}$

"M_{H2} are unnecessary, as FE_{CD} will be used as the declared value."

~~[4.1.4~~

~~Charge-depleting H2 emission for OVC-HEVs~~

~~This paragraph is applicable for Level 1B only:~~

~~The charge-depleting H2 emission MH2,CD shall be calculated using the following equation:~~

$$\cancel{M_{H2,CD} = \frac{\sum_{j=1}^{k}(M_{H2,CD,j} \times d_j)}{\sum_{j=1}^{k} d_j}}$$

~~where:~~

~~$M_{H2,CD}$~~	~~is the charge-depleting H2 emission, g/km;~~
~~$M_{H2,CD,j}$~~	~~is the H2 emission determined according to paragraph 3.2.1. of Annex B7 of phase j of the charge-depleting Type 1 test, g/km;~~
~~j~~	~~is the index number of the considered phase;~~
~~k~~	~~is the number of phases driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex.~~

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Table A8/7

Calculation of final charge-sustaining fuel consumption for NOVC-FCHVs and OVC-FCHVs and fuel efficiency for NOVC-FCHVs and OVC-HEVs
(FE applicable for Level 1B and results after 3 phases in Level 2 only)

Level 1A and results after 4 phases in Level 2 – all the calculations in this table shall be for the complete cycle only

Level 1B and results after 3 phases in Level 2 - all the calculations in this table shall be for the 3-phase cycle and also for individual phases for NOVC-FCHVs; all the calculations in this table shall be for the complete cycle only for OVC-FCHVs;

Step No.	*Source*	*Input*	*Process*	*Output*
1	Appendix 7 to this annex.	Non-balanced charge-sustaining fuel consumption $FC_{CS,nb}$, kg/100km	Charge-sustaining fuel consumption $FC_{CS,c,1}$ according to paragraph 2.2.6. of Appendix 7 to this annex. The calculation of fuel consumption shall be performed separately for the applicable cycle and its phases. For that purpose, the applicable phase or cycle FC values shall be used; Phase-specific values according to paragraph 2.2.7. of Appendix 7 to this annex).	$FC_{CS,p,1}$, kg/100 km; $FC_{CS,c,1}$, kg/100 km.
2	Output step 1	$FC_{CS,p,1}$, kg/100 km; $FC_{CS,c,1}$, kg/100 km.	REESS electric energy change correction.	$FC_{CS,c,2}$, kg/100 km; For Level 1B and

Amen dment

Typo correction

Table A8/7

Calculation of final charge-sustaining fuel consumption for NOVC-FCHVs and OVC-FCHVs and fuel efficiency for NOVC-FCHVs and OVC-~~HEVs~~FCHVs
(FE applicable for Level 1B and results after 3 phases in Level 2 only)

Level 1A and results after 4 phases in Level 2 – all the calculations in this table shall be for the complete cycle only

Level 1B and results after 3 phases in Level 2 - all the calculations in this table shall be for the 3-phase cycle and also for individual phases for NOVC-FCHVs; all the calculations in this table shall be for the complete cycle only for OVC-FCHVs;

Step No.	*Source*	*Input*	*Process*	*Output*
1	Appendix 7 to this annex.	Non-balanced charge-sustaining fuel consumption $FC_{CS,nb}$, kg/100km	Charge-sustaining fuel consumption $FC_{CS,c,1}$ according to paragraph 2.2.6. of Appendix 7 to this annex. The calculation of fuel consumption shall be performed separately for the applicable cycle and its phases. For that purpose, the applicable phase or cycle FC values shall be used; Phase-specific values according to paragraph 2.2.7. of Appendix 7 to this annex).	$FC_{CS,p,1}$, kg/100 km; $FC_{CS,c,1}$, kg/100 km.
2	Output step 1	$FC_{CS,p,1}$, kg/100 km; $FC_{CS,c,1}$, kg/100 km.	REESS electric energy change correction.	$FC_{CS,c,2}$, kg/100 km; For Level 1B and

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Step No.	Source	Input	Process	Output
5 If the interpolation method is not applied, step No. 6 is not required and the output of this step is the final result. Results of a Type 1 test for a test vehicle.	Output step 4	$FC_{CS,p,4}$, kg/100 km; $FC_{CS,c,4}$, kg/100 km; $FC_{CS,c,declared}$, kg/100 km. $FE_{CS,p,4}$, km/kg. $FE_{CS,c,4}$, km/kg; $FE_{CS,c,declared}$, km/ kg.	Alignment of phase values. Paragraph 1.2.4. of Annex B6, [For Level 1B, alignment of phase values $FE_{cs,p,5} = FE_{CS,p,4}$ "Phase combined value" of FC shall be derived from the formula in paragraph 1.2.4. of Annex B6. CO_2 shall be replaced by FC.] [Equation above to be checked] and: $FC_{CS,c,5} = FC_{CS,c,declared}$ $FE_{CS,c,5} = FE_{CS,c,declared}$ FC values and FE values shall be rounded according to paragraph 6.1.8. of this Regulation. FC values shall be rounded to the third place of decimal FE values shall be rounded to the first place of decimal. In the case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation. FC values shall be rounded to the second place of decimal. FE values shall be rounded to the second place of decimal.	$FC_{CS,p,5}$, kg/100 km; $FC_{CS,c,5}$, kg/100 km $FE_{CS,p,5}$, km/kg. $FE_{CS,c,5}$, km/kg.

Amen dment

Step No.	Source	Input	Process	Output
5 If the interpolation method is not applied, step No. 6 is not required and the output of this step is the final result. Results of a Type 1 test for a test vehicle.	Output step 4	$FC_{CS,p,4}$, kg/100 km; $FC_{CS,c,4}$, kg/100 km; $FC_{CS,c,declared}$, kg/100 km. $FE_{CS,p,4}$, km/kg. $FE_{CS,c,4}$, km/kg; $FE_{CS,c,declared}$, km/ kg.	Alignment of phase values. Paragraph 1.2.4. of Annex B6, ~~[~~For Level 1B and 3-phase WLTP test in Level 2, alignment of phase values $\cancel{FE_{cs,p,5} = FE_{CS,p,4}}$ $FE_{CS,p,5} = FE_{CS,p,4} \times \frac{\frac{FE_{CS,c,declared}}{100}}{Phase\ combined\ value}$ "Phase combined value" of FC shall be derived from the formula in paragraph 1.2.4. of Annex B6. CO_2 shall be replaced by FC.~~] [Equation above to be checked]~~ and: $FC_{CS,c,5} = FC_{CS,c,declared}$ $FE_{CS,c,5} = FE_{CS,c,declared}$ FC values and FE values shall be rounded according to paragraph 6.1.8. of this Regulation. FC values shall be rounded to the third place of decimal FE values shall be rounded to the first place of decimal. In the case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation. FC values shall be rounded to the second place of decimal. FE values shall be rounded to the nearest whole number~~second place of decimal~~.	$FC_{CS,p,5}$, kg/100 km; $FC_{CS,c,5}$, kg/100 km ~~$FE_{CS,p,5}$~~, km/kg. ~~$FE_{CS,c,5}$~~, km/kg.

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4.2.2. The charge-depleting fuel consumption and charge-depleting fuel efficiency for OVC-HEVs and OVC-FCHVs

• • •

For Level 1B and 3-phase WLTP test in Level 2

The charge-depleting fuel efficiency FE_{CD} shall be calculated using the following equation:

$$FE_{CD} = \frac{R_{CDA}}{\sum_{c=1}^{n-1} d_c \times \frac{1}{FE_{CD,c}} + d_n \times \frac{k_{CD}}{FE_{CD,avg,n-1}}}$$

where:

FE_{CD} is the charge-depleting fuel efficiency, km/l;

R_{CDA} actual charge-depleting range defined in paragraph 4.4.5. of this annex, km;

$FE_{CD,c}$ is the fuel efficiency for cycle c of the charge-depleting Type 1 test, determined according to paragraph 6. of Annex B7, km/l;

$FE_{CD,avg,n-1}$ $FE_{CD,avg,n-1} = \frac{\sum_{c=1}^{n-1} d_c}{\sum_{c=1}^{n-1} d_c \times \frac{1}{FE_{CD,c}}}$;

c is the index number for the considered cycle;

n is the number of applicable WLTP test cycles driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex

d_c is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;

d_n is the distance driven in the applicable WLTP test cycle n of the charge-depleting Type 1 test, km;

k_{CD} $kcd = \frac{MCO2,CS,declared - MCO2,CD,n,}{MCO2,CS,declared - MCO2,CD,avg,n-1}$

Amendment

4.2.2. The charge-depleting fuel consumption and charge-depleting fuel efficiency for OVC-HEVs and OVC-FCHVs

• • •

For Level 1B and 3-phase WLTP test in Level 2

The charge-depleting fuel efficiency FE_{CD} shall be calculated using the following equation:

$$FE_{CD} = \frac{R_{CDA}}{\sum_{c=1}^{n-1} d_c \times \frac{1}{FE_{CD,c}} + d_n \times \frac{k_{CD}}{FE_{CD,avg,n-1}}}$$

where:

FE_{CD} is the charge-depleting fuel efficiency, km/l in the case of OVC-HEVs and kg/km in the case of OVC-FCHVs;

Added OVC-FCHV

R_{CDA} actual charge-depleting range defined in paragraph 4.4.5. of this annex, km in the case of OVC-HEVs and in paragraph 4.4.7. of this annex in the case of OVC-FCHVs, km;

$FE_{CD,c}$ is the fuel efficiency for cycle c of the charge-depleting Type 1 test, determined according to paragraph 6. of Annex B7, km/l in the case of OVC-HEVs and kg/km in the case of OVC-FCHVs;

$FE_{CD,avg,n-1}$ $FE_{CD,avg,n-1} = \frac{\sum_{c=1}^{n-1} d_c}{\sum_{c=1}^{n-1} d_c \times \frac{1}{FE_{CD,c}}}$;

c is the index number for the considered cycle;

n is the number of applicable WLTP test cycles driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex

d_c is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;

d_n is the distance driven in the applicable WLTP test cycle n of the charge-depleting Type 1 test, km;

k_{CD} For OVC-HEV

$$kcd = \frac{MCO2, CS, declared - MCO2, CD, n,}{MCO2, CS, declared - MCO2, CD, avg, n-1}$$

For OVC-FCHV

$$k_{CD} = \frac{\frac{1}{FE_{CS,declared}} - \frac{1}{FE_{CD,n}}}{\frac{1}{FE_{CS,declared}} - \frac{1}{FE_{CD,avg,n-1}}}$$

$FE_{CS,declared}$ is the charge-sustaining fuel efficiency declaration according to Table A8/7 Step5, km/kg;

$FE_{CD,n}$ is the fuel efficiency of the applicable WLTP test cycle n of the charge-depleting Type 1 test, km/kg;

$FE_{CD,avg,n-1}$ is the arithmetic average fuel efficiency of the charge-depleting Type 1 test from the beginning up to and including the applicable WLTP test cycle (n-1), km/kg;

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4.4.6.1. Determination of cycle-specific equivalent all-electric range

The cycle-specific equivalent all-electric range shall be calculated using the following equation:

For Level 1A

$$EAER = \left(\frac{FC_{CS,ave} - FC_{CD,avg,ave}}{FC_{CS,ave}}\right) \times R_{CDC,ave}$$

For Level 1B

$$EAER = \left(\frac{1/FE_{CS,declared} - M_{H2,CD,avg}}{1/FE_{CS,declared}}\right) \times R_{CDC}$$

where:

$EAER$ is the cycle-specific equivalent all-electric range, km;

$FC_{CS,ave}$ is the charge-sustaining fuel consumption according to Table A8/7 Step 4, kg/100km;

$FC_{CD,avg,ave}$ is the arithmetic average of the charge-depleting fuel consumption $FC_{CD,avg}$ calculated for all individual charge-depleting tests according to the equation below, kg/100km;

$FE_{CS,declared}$ is the charge-sustaining fuel efficiency declaration according to Table A8/7 Step5, km/kg;

$R_{CDC,ave}$ is the arithmetic average of charge-depleting cycle range (R_{CDC}) calculated for all individual charge-depleting tests according to paragraph 4.4.3. of this annex, km;

R_{CDC} is the charge-depleting cycle range (R_{CDC}) according to paragraph 4.4.3 of this annex, km;

and

$$FC_{CD,avg} = \frac{\sum_{j=1}^{k}(FC_{CD,j} \times d_j)}{\sum_{j=1}^{k} d_j}$$

where:

$FC_{CD,avg}$ is the charge-depleting fuel consumption, kg/100 km;

$FC_{CD,j}$ is the fuel consumption of phase j of the charge-depleting Type 1 test, kg/100km;

d_j is the distance driven in phase j of the charge-depleting Type 1 test, km;

j is the index number of the considered phase;

k is the number of phases driven up to the end of the transition cycle n according to paragraph 3.2.4.4. of this annex.]

$$M_{H2,CD,avg} = \frac{\sum_{j=1}^{k}(M_{H2,CD,j} \times d_j)}{\sum_{j=1}^{k} d_j}$$

where:

$M_{H2,CD,avg}$ is the charge-depleting H_2 emission, g/km;

$M_{H2,CD,j}$ is the H_2 emission determined according to paragraph 3.2.1. of Annex B7 of phase j of the charge-depleting Type 1 test, g/km;

d_j is the distance driven in phase j of the charge-depleting Type 1 test, km;

j is the index number of the considered phase;

k is the number of phases driven up to the end of the transition cycle n according to paragraph 3.2.4.4. of this annex.]

The considered phase j shall be the applicable WLTP test cycle only.

Amendment

4.4.6.1. Determination of cycle-specific equivalent all-electric range

The cycle-specific equivalent all-electric range shall be calculated using the following equation:

For Level 1A and 4-phase WLTP test in Level 2

$$EAER = \left(\frac{FC_{CS,ave} - FC_{CD,avg,ave}}{FC_{CS,ave}}\right) \times R_{CDC,ave}$$

For Level 1B and 3-phase WLTP test in Level 2

$$\cancel{EAER = \left(\frac{1/FE_{CS,declared} - M_{H2,CD,avg}}{1/FE_{CS,declared}}\right) \times R_{CDC}}$$

$$EAER = \left(\frac{\frac{1}{FE_{CS,declared}} - \frac{1}{FE_{CD,avg}}}{\frac{1}{FE_{CS,declared}}}\right) \times R_{CDC}$$

Replace M_{H2} with FE_{CD}

where:

$EAER$ is the cycle-specific equivalent all-electric range, km;

$FC_{CS,ave}$ is the charge-sustaining fuel consumption according to Table A8/7 Step 4, kg/100km;

$FC_{CD,avg,ave}$ is the arithmetic average of the charge-depleting fuel consumption $FC_{CD,avg}$ calculated for all individual charge-depleting tests according to the equation below, kg/100km;

$FE_{CS,declared}$ is the charge-sustaining fuel efficiency declaration according Table A8/7 Step5, km/kg;

$R_{CDC,ave}$ is the arithmetic average of charge-depleting cycle range (R_{CD} calculated for all individual charge-depleting tests according paragraph 4.4.3. of this annex, km;

R_{CDC} is the charge-depleting cycle range (R_{CDC}) according paragraph 4.4.3 of this annex, km;

and

$$FC_{CD,avg} = \frac{\sum_{j=1}^{k}(FC_{CD,j} \times d_j)}{\sum_{j=1}^{k} d_j}$$

where:

$FC_{CD,avg}$ is the charge-depleting fuel consumption, kg/100 km;

$FC_{CD,j}$ is the fuel consumption of phase j of the charge-depleting Type 1 test, kg/100km;

d_j is the distance driven in phase j of the charge-depleting Type 1 test, km;

j is the index number of the considered phase;

k is the number of phases driven up to the end of the transition cycle n according to paragraph 3.2.4.4. of this annex.]

$$\cancel{M_{H2,CD,avg} = \frac{\sum_{j=1}^{k}(M_{H2,CD,j} \times d_j)}{\sum_{j=1}^{k} d_j}}$$

$$FE_{CD,avg} = \frac{\sum_{j=1}^{k} d_c}{\sum_{j=1}^{k}(d_c \times \frac{1}{FE_{CD,c}})}$$

where:

~~$M_{H2,CD,avg}$ is the charge-depleting H_2 emission, g/km;~~

~~$M_{H2,CD,j}$ is the H_2 emission determined according to paragraph 3.2.1. of Annex B7 of phase j of the charge-depleting Type 1 test, g/km;~~

$FE_{CD,avg}$ is the charge-depleting fuel efficiency, km/kg;

$FE_{CD,c}$ is the fuel efficiency of phase j of the charge-depleting Type 1 test, km/kg;

d_j is the distance driven in phase j of the charge-depleting Type 1 test, km;

j is the index number of the considered phase;

k is the number of phases driven up to the end of the transition cycle n according to paragraph 3.2.4.4. of this annex.]

The considered phase j shall be the applicable WLTP test cycle only.

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4.4.7. This paragraph is applicable only for Level 1A;

Actual charge-depleting range for OVC-FCHVs

The actual charge-depleting range shall be calculated using the following equation:

$$R_{CDA} = \sum_{c=1}^{n-1} d_c + \left(\frac{FC_{CS,declared} - FC_{n,cycle}}{FC_{CS,declared} - FC_{CD,avg,n-1}} \right) \times d_n$$

where:

R_{CDA}	is the actual charge-depleting range, km;
FC_{CS}	is the charge-sustaining fuel consumption according to Table A8/7, step no. 5, kg/100km;
$FC_{n,cycle}$	is the fuel consumption of the applicable WLTP test cycle n of the charge-depleting Type 1 test, kg/100km;
$FC_{CD,avg,n-1}$	is the arithmetic average fuel consumption of the charge-depleting Type 1 test from the beginning up to and including the applicable WLTP test cycle (n-1), kg/100km;
d_c	is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;
d_n	is the distance driven in the applicable WLTP test cycle n of the charge-depleting Type 1 test, km;
c	is the index number of the considered applicable WLTP test cycle;
n	is the number of applicable WLTP test cycles driven including the transition cycle according to paragraph 3.2.4.4. of this annex;

and

where $$FC_{CD,avg,n-1} = \frac{\sum_{c=1}^{n-1}(FC_{CD,c} \times d_c)}{\sum_{c=1}^{n-1} d_c}$$

$FC_{CD,avg,n-1}$	is the arithmetic average fuel consumption of the charge-depleting Type 1 test from the beginning up to and including the applicable WLTP test cycle (n-1), kg/100 km;
$FC_{CD,c}$	is the fuel consumption of the applicable WLTP test cycle c of the charge-depleting Type 1 test, kg/100km;
d_c	is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;
c	is the index number of the considered applicable WLTP test cycle;
n	is the number of applicable WLTP test cycles driven including the transition cycle according to paragraph 3.2.4.4. of this annex.

Amendment

4.4.7. ~~This paragraph is applicable only for Level 1A;~~

Actual charge-depleting range for OVC-FCHVs

The actual charge-depleting range shall be calculated using the following equation:

Added OVC-FCHV

For Level 1A and 4-phase WLTP test in Level 2

$$R_{CDA} = \sum_{c=1}^{n-1} d_c + \left(\frac{FC_{CS,declared} - FC_{n,cycle}}{FC_{CS,declared} - FC_{CD,avg,n-1}} \right) \times d_n$$

For Level 1B and 3-phase WLTP test in Level 2

$$R_{CDA} = \sum_{c=1}^{n-1} d_c + \left(\frac{\frac{1}{FE_{CS,declared}} - \frac{1}{FE_{n,cycle}}}{\frac{1}{FE_{CS,declared}} - \frac{1}{FE_{CD,avg,n-1}}} \right) \times d_n$$

R_{CDA}	is the actual charge-depleting range, km;
FC_{CS}	is the charge-sustaining fuel consumption according to Table A8/7, step no. 5, kg/100km;
FE_{CS}	is the charge-sustaining fuel efficiency according to Table A8/7, step no. 5, km/kg;
$FC_{n,cycle}$	is the fuel consumption of the applicable WLTP test cycle n of the charge-depleting Type 1 test, kg/100km;
$FE_{n,cycle}$	is the fuel efficiency of the applicable WLTP test cycle n of the charge-depleting Type 1 test, km/kg;
$FC_{CD,avg,n-1}$	is the arithmetic average fuel consumption of the charge-depleting Type 1 test from the beginning up to and including the applicable WLTP test cycle (n-1), kg/100km;
$FE_{CD,avg,n-1}$	is the arithmetic average fuel efficiency of the charge-depleting Type 1 test from the beginning up to and including the applicable WLTP test cycle (n-1), km/kg;
d_c	is the distance driven in the applicable WLT the charge-depleting Type 1 test, km;
d_n	is the distance driven in the applicable WLT the charge-depleting Type 1 test, km;
c	is the index number of the considered applic cycle;
n	is the number of applicable WLTP test including the transition cycle according to pa of this annex;

and

where $$FC_{CD,avg,n-1} = \frac{\sum_{c=1}^{n-1}(FC_{CD,c} \times d_c)}{\sum_{c=1}^{n-1} d_c}$$

$FC_{CD,avg,n-1}$	is the arithmetic average fuel consumptic depleting Type 1 test from the begin including the applicable WLTP test cyc km;
$FC_{CD,c}$	is the fuel consumption of the applicable WLTP test cycle c of the charge-depleting Type 1 test, kg/100km;
d_c	is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;
c	is the index number of the considered applicable WLTP test cycle;
n	is the number of applicable WLTP test cycles driven including the transition cycle according to paragraph 3.2.4.4. of this annex.

$$FE_{CD,avg,n-1} = \frac{\sum_{c=1}^{n-1} d_c}{\sum_{c=1}^{n-1} d_c \times \frac{1}{FE_{CD,c}}}$$

$FE_{CD,avg,n-1}$	is the arithmetic average fuel efficiency of the charge-depleting Type 1 test from the beginning up to and including the applicable WLTP test cycle (n-1), km/kg;
$FE_{CD,c}$	is the fuel efficiency of the applicable WLTP test cycle c of the charge-depleting Type 1 test, km/kg;
d_c	is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;
c	is the index number of the considered applicable WLTP test cycle;
n	is the number of applicable WLTP test cycles driven including the transition cycle according to paragraph 3.2.4.4. of this annex.

4.5.5.1.4 Interpolation of FE_{CS}

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4.5.5. Interpolation of the fuel consumption and fuel efficiency for individual vehicles

4.5.5.1. Individual charge-sustaining fuel consumption and fuel efficiency for OVC-HEVs, NOVC-HEVs, NOVC-FCHVs and OVC-FCHVs

4.5.5.1.3. This paragraph is applicable for OVC-FCHVs and NOVC-FCHVs in Level 1A and for NOVC-FCHVs in Level 1B:

Individual charge-sustaining fuel consumption for OVC-FCHVs and NOVC-FCHVs

The charge-sustaining fuel consumption for an individual vehicle shall be calculated using the following equation:

$$FC_{ind,CS,p} = FC_{L,CS,p} + K_{ind,p} \times (FC_{H,CS,p} - FC_{L,CS,p})$$

where:

$FC_{ind,CS,p}$ is the charge-sustaining fuel consumption for an individual vehicle of the considered period p according to Table A8/7, step No. 6, kg/100km;

$FC_{L,CS,p}$ is the charge-sustaining fuel consumption for vehicle L of the considered period p according to Table A8/7, step No. 5, kg/100km;

$FC_{H,CS,p}$ is the charge-sustaining fuel consumption for vehicle H of the considered period p according to Table A8/7, step No. 5, kg/100km;

$K_{ind,p}$ is the interpolation coefficient for the considered individual vehicle for period p;

p is the index of the individual peri… WLTP test cycle.

The considered periods shall be the low phase, medi… extra high phase, and the applicable WLTP test cycle.

[4.5.5.1.4. Individual charge-sustaining fuel consumption for NOVC-FCHVs.

This paragraph is applicable to Level 1B only

The charge-sustaining fuel efficiency for an individual vehicle shall be calculated using the following equation:

$$FE_{ind,CS,p} = 1/[\, 1/FE_{L,CS,p} + K_{ind,p} \times (1/FE_{H,CS,p} - 1/FE_{L,CS,p})]$$

where:

$FE_{ind,CS,p}$ is the charge-sustaining fuel efficiency for an individual vehicle of the considered period p according to Table A8/7, step No. 6, km/kg;

$FE_{L,CS,p}$ is the charge-sustaining fuel efficiency for vehicle L of the considered period p according to Table A8/7, step No. 5, km/kg;

$FE_{H,CS,p}$ is the charge-sustaining fuel efficiency for vehicle H of the considered period p according to Table A8/7, step No. 5, km/kg;

$K_{ind,p}$ is the interpolation coefficient for the considered individual vehicle for period p;

P is the index of the individual period within the applicable WLTP test cycle.

The considered periods shall be the low phase, medium phase, high phase and the applicable WLTP test cycle.]

Amendment

4.5.5. Interpolation of the fuel consumption and fuel efficiency for individual vehicles

Level 1B is described in 4.5.5.1.4

4.5.5.1.3. This paragraph is applicable for OVC-FCHVs and NOVC-FCHVs in Level 1A and 4-phase WLTP test in Level 2 only: ~~and for NOVC-FCHVs in Level 1B:~~

Individual charge-sustaining fuel consumption for OVC-FCHVs and NOVC-FCHVs

The charge-sustaining fuel consumption for an individual vehicle shall be calculated using the following equation:

$$FC_{ind,CS,p} = FC_{L,CS,p} + K_{ind,p} \times (FC_{H,CS,p} - FC_{L,CS,p})$$

where:

$FC_{ind,CS,p}$ is the charge-sustaining fuel consumption for a… individual vehicle of the considered period p accordin… to Table A8/7, step No. 6, kg/100km;

$FC_{L,CS,p}$ is the charge-sustaining fuel consumption for vehicle… of the considered period p according to Table A8/7, ste… No. 5, kg/100km;

$FC_{H,CS,p}$ is the charge-sustaining fuel consumption for vehicle H of the considered period p according to Table A8/7, step No. 5, kg/100km;

$K_{ind,p}$ is the interpolation… individual vehicle for…

p is the index of the indi… WLTP test cycle.

- **Added OVC-FCHV**
- **Correct 'Fuel consumption' to 'Fuel efficiency'**
- **Adjusted the order of sentences to match 4.5.5.1.3.**

[4.5.5.1.4. This paragraph is applicable ~~to Level 1B only~~ for OVC-FCHVs and NOVC-FCHVs in Level 1B and 3-phase WLTP test in Level 2 only:

Individual charge-sustaining fuel efficiency~~consumption~~ for OVC-FCHVs and NOVC-FCHVs.

~~This paragraph is applicable to Level 1B only~~

The charge-sustaining fuel efficiency for an individual vehicle shall be calculated using the following equation:

$$FE_{ind,CS,p} = 1/[\, 1/FE_{L,CS,p} + K_{ind,p} \times (1/FE_{H,CS,p} - 1/FE_{L,CS,p})]$$

where:

$FE_{ind,CS,p}$ is the charge-sustaining fuel efficiency for an individual vehicle of the considered period p according to Table A8/7, step No. 6, km/kg;

$FE_{L,CS,p}$ is the charge-sustaining fuel efficiency for vehicle L of the considered period p according to Table A8/7, step No. 5, km/kg;

$FE_{H,CS,p}$ is the charge-sustaining fuel efficiency for vehicle H of the considered period p according to Table A8/7, step No. 5, km/kg;

$K_{ind,p}$ is the interpolation coefficient for the considered individual vehicle for period p;

P is the index of the individual period within the applicable WLTP test cycle.

The considered periods shall be the low phase, medium phase, high phase and the applicable WLTP test cycle.]

4.5.5.2 Interpolation of FE_{CD}

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4.5.5. Interpolation of the fuel consumption and fuel efficiency for individual vehicles

4.5.5.2. Individual charge-depleting fuel consumption for OVC-HEVs and OVC-FCHVs and individual charge-depleting fuel efficiency for OVC-HEVs

For Level 1A and 4-phase WLTP test in Level 2

The utility factor-weighted charge-depleting fuel consumption for an individual vehicle shall be calculated using the following equation:

$$FC_{ind,CD} = FC_{L,CD} + K_{ind} \times (FC_{H,CD} - FC_{L,CD})$$

where:

$FC_{ind,CD}$ is the utility factor-weighted charge-depleting fuel consumption for an individual vehicle, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

$FC_{L,CD}$ is the utility factor-weighted charge-depleting fuel consumption for vehicle L, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

$FC_{H,CD}$ is the utility factor-weighted charge-depleting fuel consumption for vehicle H, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle.

For Level 1B and 3-phase WLTP test in Level 2

The charge-depleting fuel efficiency for an individual vehicle shall be calculated using the following equation:

$$FE_{ind,CD} = \frac{1}{1/FE_{L,CD} + K_{ind,p} \times (1/FE_{H,CD} - 1/FE_{L,CD})}$$

where:

$FE_{ind,CD}$ is the charge-depleting fuel efficiency for an individual vehicle, km/l;

$FE_{L,CD}$ is the charge-depleting fuel efficiency for vehicle L, km/l;

$FE_{H,CD}$ is the charge-depleting fuel efficiency for vehicle H, km/l;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle.

Amendment

4.5.5. Interpolation of the fuel consumption and fuel efficiency for individual vehicles

4.5.5.2. Individual charge-depleting fuel consumption for OVC-HEVs and OVC-FCHVs and individual charge-depleting fuel efficiency for OVC-HEVs

For Level 1A and 4-phase WLTP test in Level 2

The utility factor-weighted charge-depleting fuel consumption for an individual vehicle shall be calculated using the following equation:

$$FC_{ind,CD} = FC_{L,CD} + K_{ind} \times (FC_{H,CD} - FC_{L,CD})$$

where:

$FC_{ind,CD}$ is the utility factor-weighted charge-depleting fuel consumption for an individual vehicle, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

$FC_{L,CD}$ is the utility factor-weighted charge-depleting fuel consumption for vehicle L, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

$FC_{H,CD}$ is the utility factor-weighted charge-depleting fuel consumption for vehicle H, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle.

For Level 1B and 3-phase WLTP test in Level 2

The charge-depleting fuel efficiency for an individual vehicle shall be calculated using the following equation:

$$FE_{ind,CD} = \frac{1}{1/FE_{L,CD} + K_{ind,p} \times (1/FE_{H,CD} - 1/FE_{L,CD})}$$

where:

$FE_{ind,CD}$ is the charge-depleting fuel efficiency for an individual vehicle, km/l in case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

$FE_{L,CD}$ is the charge-depleting fuel efficiency for vehicle L, km/l in case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

$FE_{H,CD}$ is the charge-depleting fuel efficiency for vehicle H, km/l in case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle.

Added OVC-FCHV to the Level 1B FE_{CD} interpolation formula

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Table A8/9a
Calculation of final charge-depleting values for OVC-FCHVs

All the calculations in this table shall be for the complete cycle only

Step no.	*Source*	*Input*	*Process*	*Output*
1	Annex B8	Charge-depleting test results	Results measured according to Appendix 3 to this annex, pre-calculated according to paragraph 4.3. of this annex. Usable battery energy according to paragraph 4.4.1.2.2. of this annex. Recharged electric energy according to paragraph 3.2.4.6. of this annex. Cycle energy according to paragraph 5. of Annex B7. Fuel consumption and H_2 emission according to paragraph 6. of Annex B7. All-electric range determined according to paragraph 4.4.1.1. of this annex. In the case that the applicable WLTC city test cycle was driven: all- electric range city according to paragraph 4.4.1.2.1. of this annex. H_2 fuel consumption $K_{fuel,FCHV}$ correction coefficient might be necessary according to Appendix 2 to this annex. Output is available for each test.	$\Delta E_{REESS,j}$, Wh; d_j, km; UBE_{city}, Wh; E_{AC}, Wh; E_{cycle}, Ws; $FC_{CD,j}$, kg/100 km; $M_{H2,CD,j}$, kg/km; AER, km; AER_{city}, km. $K_{fuel,FCHV}$, (kg/100km)/(Wh/100km).
2	Output step 1	$\Delta E_{REESS,j}$, Wh; E_{cycle}, Ws.	Calculation of relative electric energy change for each cycle according to paragraph 3.2.4.5.2. of this annex. Output is available for each test and each applicable WLTP test cycle.	$REEC_i$.

Amendment

Table A8/9a
Calculation of final charge-depleting values for OVC-FCHVs

All the calculations in this table shall be for the complete cycle only

Step no.	*Source*	*Input*	*Process*	*Output*
1	Annex B8	Charge-depleting test results	Results measured according to Appendix 3 to this annex, pre-calculated according to paragraph 4.3. of this annex. Usable battery energy according to paragraph 4.4.1.2.2. of this annex. Recharged electric energy according to paragraph 3.2.4.6. of this annex. Cycle energy according to paragraph 5. of Annex B7. Fuel consumption and ~~H_2 emission~~ fuel efficiency according to paragraph 6. of Annex B7. All-electric range determined according to paragraph 4.4.1.1. of this annex. In the case that the applicable WLTC city test cycle was driven: all- electric range city according to paragraph 4.4.1.2.1. of this annex. H_2 fuel consumption $K_{fuel,FCHV}$ correction coefficient might be necessary according to Appendix 2 to this annex. Output is available for each test.	$\Delta E_{REESS,j}$, Wh; d_j, km; UBE_{city}, Wh; E_{AC}, Wh; E_{cycle}, Ws; $FC_{CD,j}$, kg/100 km; ~~$M_{H2,CD,j}$, kg/km;~~ $FE_{CD,j}$, km/ kg; AER, km; AER_{city}, km. $K_{fuel,FCHV}$, (kg/100km)/(Wh/100km).
2	Output step 1	$\Delta E_{REESS,j}$, Wh; E_{cycle}, Ws.	Calculation of relative electric energy change for each cycle according to paragraph 3.2.4.5.2. of this annex. Output is available for each test and each applicable WLTP test cycle.	$REEC_i$.

Replace M_{H2} with FE_{CD}

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Step no.	*Source*	*Input*	*Process*	*Output*
3	Output step 2	$REEC_i$.	Determination of the transition and confirmation cycle according to paragraph 3.2.4.4. of this annex. In the case that more than one charge-depleting test is available for one vehicle, for the purpose of averaging, each test shall have the same transition cycle number n_{veh}. Determination of the charge-depleting cycle range according to paragraph 4.4.3. of this annex. Output is available for each test.	n_{veh}; R_{CDC}; km.
4	Output step 3	n_{veh};	In the case that the interpolation method is used, the transition cycle shall be determined for vehicle H, L and, if applicable, M. Check whether the interpolation criterion according to paragraph 6.3.2.2. of this Regulation is fulfilled.	$n_{veh,L}$; $n_{veh,H}$; if applicable $n_{veh,M}$.
5	Output step 1	$\Delta E_{REESS,j}$, Wh; d_j, km; UBE_{city}, Wh.	In the case that AER_{city} is derived from the Type 1 test by driving the applicable WLTP test cycles, the value shall be calculated according to paragraph 4.4.1.2.2. of this annex. In the case of more than one test, $n_{city,pe}$ shall be equal for each test. Output is available for each test. Averaging of AER_{city}.	AER_{city}, km; $AER_{city,ave}$, km.
6	Output step 1 Output step 3 Output step 4	d_j, km; n_{veh}; $n_{veh,L}$;	Phase-specific and cycle-specific UF calculation. Output is available for each test.	$UF_{phase,j}$; $UF_{cycle,c}$;
7	Output step 1 Output step 3 Output step 4	$\Delta E_{REESS,j}$, Wh; d_j, km; E_{AC}, Wh; n_{veh}; $n_{veh,L}$;	Calculation of the electric energy consumption based on the recharged energy according. to paragraphs 4.3.1. and 4.3.2. of this annex. In the case of interpolation, $n_{veh,L}$ cycles shall be used. Therefore, due	$EC_{AC,weighted}$, Wh/km; $EC_{AC,CD}$, Wh/km;

Amendment

No additional revisions

Table A8/9a
Calculation of final charge-depleting values for OVC-FCHVs

Revised sections are **brown**

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Step no.	Source	Input	Process	Output
	Output step 6	$UF_{phase,j}$;	to the required correction of the fuel consumption, the electric energy consumption of the confirmation cycle and its phases shall be set to zero. Output is available for each test.	
8	Output step 1	$FC_{CD,j}$, l/100 km $M_{H2,CD,j}$, kg/km $K_{fuel,FCHV}$, (kg/100km)/(Wh/100 km);	Calculation of the charge-depleting fuel consumption according to paragraph 4.2.2. of this annex. Calculation of the charge-depleting H_2 emission according to paragraph 4.1.4. of this annex. In the case that the interpolation method is applied, $n_{veh,L}$ cycles shall be used. With reference to paragraph 4.1.2. of this annex, the confirmation cycle shall be corrected according to Appendix 2 to this annex. Output is available for each test.	For Level 1A: FC_{CD}, kg/100km; For Level 1B: $M_{H2,CD}$, kg/km;
	Output step 3	$\Delta E_{REESS,j}$, Wh;		
	Output step 4	d_j, km;		
	Output step 6	n_{veh}; $n_{veh,L}$; $UF_{phase,j}$;		
(Reserved)				
10	Output step 7 Output step 8	$EC_{AC,weighted}$, Wh/km; $EC_{AC,CD}$, Wh/km; FC_{CD}, kg/100 km. $M_{H2,CD}$, kg/km;	Averaging of tests for each vehicle. In the case that the interpolation method is applied, the output is available for each vehicle H, L and, if applicable, M.	For Level 1A: $EC_{AC,weighted,ave}$, Wh/km; $EC_{AC,CD,ave}$, Wh/km; $FC_{CD,ave}$, kg/100 km. For Level 1B: $M_{H2,CD,avg}$, kg/km;
For Level 1A: 11	Output step 10	$EC_{AC,CD,ave}$, Wh/km; $FC_{CD,ave}$, kg/100 km;	Declaration of charge-depleting electric energy consumption and fuel consumption for each vehicle. In the case that the interpolation method is applied, the output is available for each vehicle H, L and, if applicable, M.	$EC_{AC,CD,declared}$, Wh/km; $FC_{CD,declared}$, kg/100 km;
(Reserved)				
For Level 1A: 13	Output step 11	$EC_{AC,CD,declared}$, Wh/km;	In the case that the interpolation method is applied, intermediate rounding shall be performed	$EC_{AC,CD,final}$, Wh/km; $EC_{AC,weighted,final}$, Wh/km;

Amendment

Step no.	Source	Input	Process	Output
	Output step 6	$UF_{phase,j}$;	to the required correction of the fuel consumption, the electric energy consumption of the confirmation cycle and its phases shall be set to zero. Output is available for each test.	
8	Output step 1	$FC_{CD,j}$, l/100 km ~~$M_{H2,CD,j}$, kg/km~~ $FE_{CD,j}$, km/ kg; $K_{fuel,FCHV}$, (kg/100km)/(Wh/100 km);	Calculation of the charge-depleting fuel consumption and fuel efficiency according to paragraph 4.2.2. of this annex. ~~Calculation of the charge-depleting H_2 emission according to paragraph 4.1.4. of this annex.~~ In the case that the interpolation method is applied, $n_{veh,L}$ cycles shall be used. With reference to paragraph 4.1.2. of this annex, the confirmation cycle shall be corrected according to Appendix 2 to this annex. Output is available for each test.	For Level 1A: FC_{CD}, kg/100km; For Level 1B: ~~$M_{H2,CD}$, kg/km;~~ FE_{CD}, km/ kg;
	Output step 3	$\Delta E_{REESS,j}$, Wh;		
	Output step 4	d_j, km;		
	Output step 6	n_{veh}; $n_{veh,L}$; $UF_{phase,j}$;		
(Reserved)				
10	Output step 7 Output step 8	$EC_{AC,weighted}$, Wh/km; $EC_{AC,CD}$, Wh/km; FC_{CD}, kg/100 km. ~~$M_{H2,CD}$, kg/km;~~ $FE_{CD,ave}$, km/ kg;	Averaging of tests for each vehicle. In the case that the interpolation method is applied, the output is available for each vehicle H, L and, if applicable, M.	For Level 1A: $EC_{AC,weighted,ave}$, Wh/km; $EC_{AC,CD,ave}$, Wh/km; $FC_{CD,ave}$, kg/100 km. For Level 1B: ~~$M_{H2,CD,avg}$, kg/km;~~ $FE_{CD,ave}$, km/ kg;
For Level 1A: 11	Output step 10	$EC_{AC,CD,ave}$, Wh/km; $FC_{CD,ave}$, kg/100 km; $FE_{CD,ave}$, km/ kg;	Declaration of charge-depleting electric energy consumption and fuel consumption for each vehicle. In the case that the interpolation method is applied, the output is available for each vehicle H, L and, if applicable, M.	$EC_{AC,CD,declared}$, Wh/km; $FC_{CD,declared}$, kg/100 km; For Level 1B, $FE_{CD,declared}$, km/ kg
(Reserved)				
For Level 1A: 13	Output step 11	$EC_{AC,CD,declared}$, Wh/km; $FE_{CD,declared}$, km/ kg;	In the case that the interpolation method is applied, intermediate rounding shall be performed	For Level 1A, $EC_{AC,CD,final}$, Wh/km;

Replace M_{H2} with FE_{CD}

Table A8/9a
Calculation of final charge-depleting values for OVC-FCHVs

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Step no.	*Source*	*Input*	*Process*	*Output*
If the interpolation method is not applied, step No. 17 is not required and the output of this step is the final result.	Output step 10	$EC_{AC,weighted,ave}$, Wh/km; $FC_{CD,ave}$, kg/100 km;	according to paragraph 6.1.8. of this Regulation. FC_{CD} shall be rounded to the third place of decimal. $EC_{AC,CD}$ and $EC_{AC,weighted}$ shall be rounded to the first place of decimal. Output is available for vehicle H and for vehicle L and, if applicable, for vehicle M. In case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation. $EC_{AC,CD}$ and $EC_{AC,weighted}$ shall be rounded to the nearest whole number. FC_{CD} shall be rounded to the second place of decimal.	$FC_{CD,final}$, l/100 km;
For Level 1A: 14 Result of an individual vehicle. Final test result.	Output step 13	$EC_{AC,CD,final}$, Wh/km; $EC_{AC,weighted,final}$, Wh/km; $FC_{CD,final}$, kg/100 km;	Interpolation of individual values based on input from vehicles H and L and, if applicable, vehicle M. Final rounding of individual vehicle values shall be performed according to paragraph 6.1.8. of this Regulation. $EC_{AC,CD}$, $EC_{AC,weighted}$ shall be rounded to the nearest whole number. FC_{CD} shall be rounded to the second place of decimal. Output is available for each individual vehicle.	$EC_{AC,CD,ind}$, Wh/km; $EC_{AC,weighted,ind}$, Wh/km; $FC_{CD,ind}$, kg/100 km;

Amendment

Step no.	*Source*	*Input*	*Process*	*Output*
If the interpolation method is not applied, step No. 17 is not required and the output of this step is the final result.	Output step 10	$EC_{AC,weighted,ave}$, Wh/km; $FC_{CD,ave}$, kg/100 km;	according to paragraph 6.1.8. of this Regulation. FC_{CD} shall be rounded to the third place of decimal. $EC_{AC,CD}$ ~~and~~ $EC_{AC,weighted}$ and FE_{CD} shall be rounded to the first place of decimal. Output is available for vehicle H and for vehicle L and, if applicable, for vehicle M. In case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation. $EC_{AC,CD}$ ~~and~~ $EC_{AC,weighted}$ and FE_{CD} shall be rounded to the nearest whole number. FC_{CD} shall be rounded to the second place of decimal.	$EC_{AC,weighted,final}$, Wh/km; $FC_{CD,final}$, l/100 km; For Level 1B, $FE_{CD,final}$, km/ kg;
~~For Level 1A:~~ 14 Result of an individual vehicle. Final test result.	Output step 13	$EC_{AC,CD,final}$, Wh/km; $EC_{AC,weighted,final}$, Wh/km; $FC_{CD,final}$, kg/100 km; $FE_{CD,final}$, km/ kg;	Interpolation of individual values based on input from vehicles H and L and, if applicable, vehicle M. Final rounding of individual vehicle values shall be performed according to paragraph 6.1.8. of this Regulation. $EC_{AC,CD}$, $EC_{AC,weighted}$ and FE_{CD} shall be rounded to the nearest whole number. FC_{CD} shall be rounded to the second place of decimal. Output is available for each individual vehicle.	$EC_{AC,CD,ind}$, Wh/km; $EC_{AC,weighted,ind}$, Wh/km; $FC_{CD,ind}$, kg/100 km; $FE_{CD,ind}$, km/ kg;

Replace M_{H2} with FE_{CD}

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Table A8/9b

Calculation of final charge-depleting and charge-sustaining weighted values for OVC-FCHVs

(FE is applicable for Level 1B only:)

All the calculations in this table shall be for the complete cycle only

Step no.	*Source*	*Input*	*Process*	*Output*
1	Output step 1, Table A8/9a	$FC_{CD,j}$, kg/100 km $\Delta E_{REESS,j}$, Wh; d_j, km; AER, km; E_{AC}, Wh; $M_{H2,CD,j}$ kg/km;	Input from CD and CS postprocessing. The arithmetic average of E_{AC} for all individual charge-depleting tests shall be calculated. Output in the case of CD is available for each CD test. Output in the case of CS is available once due to CS test averaged values. In the case that the interpolation method is applied, the output (except of $K_{fuel,FCHV}$) is available for vehicle H, L and, if applicable, M.	$FC_{CD,j}$, kg/100 km; $\Delta E_{REESS,j}$, Wh; d_j, km; AER, km; E_{AC}, Wh; $M_{H2,CD}$, kg/km; $AER_{city,ave}$, km; n_{veh}; R_{CDC}, km; $n_{veh,L}$; $n_{veh,H}$; $UF_{phase,j}$; $UF_{cycle,c}$; $FC_{CS,declared}$, kg/100km; $FC_{CS,p}$, kg/100km; $FE_{CS,declared}$, kg/100km; $FC_{CD,declared}$, kg/100km $FC_{CD,ave}$, kg/100km; $M_{H2,CD,avg}$ kg/km;
	Output step 5, Table A8/9a	$AER_{city,ave}$, km;		
	Output step 3, Table A8/9a	n_{veh}; R_{CDC}, km;		
	Output step 4, Table A8/9a	$n_{veh,L}$; $n_{veh,H}$;		
	Output step 6, Table A8/9a	For Level 1A: $UF_{phase,j}$; $UF_{cycle,c}$;		
	Output step 5 Table A8/7	$FC_{CS,declared}$, kg/100km; $FC_{CS,p}$, kg/100km; $FE_{CS,declared}$ kg/100km;		
	Output step 11, Table A8/9a	$FC_{CD,declared}$, kg/100km;		
	Output step 10, Table A8/9a	$FC_{CD,ave}$, kg/100km; $M_{H2,CD,avg}$ kg/km;		
		$K_{fuel,FCHV}$ (kg/100km)/(Wh/100km).	H_2 correction coefficient $K_{fuel,FCHV}$ might be necessary according to Appendix 2 to this annex.	$K_{fuel,FCHV}$ (kg/100km)/(Wh/100km).

Amendment

Table A8/9b

Calculation of final charge-depleting and charge-sustaining weighted values for OVC-FCHVs

(FE is applicable for Level 1B and 3-phase WLTP test in Level 2 only:)

All the calculations in this table shall be for the complete cycle only

Step no.	*Source*	*Input*	*Process*	*Output*
1	Output step 1, Table A8/9a	$FC_{CD,j}$, kg/100 km $\Delta E_{REESS,j}$, Wh; d_j, km; AER, km; E_{AC}, Wh; ~~$M_{H2,CD,j}$ kg/km;~~ $FE_{CD,j}$, km/ kg;	Input from CD and CS postprocessing. The arithmetic average of E_{AC} for all individual charge-depleting tests shall be calculated. Output in the case of CD is available for each CD test. Output in the case of CS is available once due to CS test averaged values. In the case that the interpolation method is applied, the output (except of $K_{fuel,FCHV}$) is available for vehicle H, L and, if applicable, M.	$FC_{CD,j}$, kg/100 km; $\Delta E_{REESS,j}$, Wh; d_j, km; AER, km; E_{AC}, Wh; ~~$M_{H2,CD}$, kg/km;~~ $FE_{CD,j}$, km/ kg; $AER_{city,ave}$, km; n_{veh}; R_{CDC}, km; $n_{veh,L}$; $n_{veh,H}$; $UF_{phase,j}$; $UF_{cycle,c}$; $FC_{CS,declared}$, kg/100km; $FC_{CS,p}$, kg/100km; $FE_{CS,declared}$, kg/100km; $FC_{CD,declared}$, kg/100km; $FC_{CD,ave}$, kg/100km; ~~$M_{H2,CD,avg}$ kg/km;~~ $FE_{CD,ave}$, km/ kg;
	Output step 5, Table A8/9a	$AER_{city,ave}$, km;		
	Output step 3, Table A8/9a	n_{veh}; R_{CDC}, km;		
	Output step 4, Table A8/9a	$n_{veh,L}$; $n_{veh,H}$;		
	Output step 6, Table A8/9a	For Level 1A: $UF_{phase,j}$; $UF_{cycle,c}$;		
	Output step 5 Table A8/7	$FC_{CS,declared}$, kg/100km; $FC_{CS,p}$, kg/100km; $FE_{CS,declared}$, kg/100km;		
	Output step 11, Table A8/9a	$FC_{CD,declared}$, kg/100km;		
	Output step 10, Table A8/9a	$FC_{CD,ave}$, kg/100km; ~~$M_{H2,CD,avg}$ kg/km;~~ $FE_{CD,ave}$, km/ kg;		
		$K_{fuel,FCHV}$ (kg/100km)/(Wh/100km).	H_2 correction coefficient $K_{fuel,FCHV}$ might be necessary according to Appendix 2 to this annex.	$K_{fuel,FCHV}$ (kg/100km)/(Wh/100km).

Replace M_{H2} with FE_{CD}

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Step no.	*Source*	*Input*	*Process*	*Output*
2	Output step 1,	$FC_{CD,i}$, kg/100 km; $\Delta E_{REESS,i}$, Wh; $M_{H2,CD}$, kg/km; d_j, km; n_{veh}; R_{CDC}, km ; $FC_{CS,p}$, kg/100km $FE_{CS,declared}$, kg/100km; $M_{H2,CD,avg}$ kg/km;	Calculation of equivalent all-electric range according to paragraphs 4.4.6.1. and 4.4.6.2. of this annex. For Level 1B: Output is available for each CD test. Calculation of actual charge-depleting range according to paragraph 4.4.7. of this annex. R_{CDA} is available for each CD test. The arithmetic average of R_{CDA} for all individual charge-depleting tests shall be calculated and shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number.	EAER, km; R_{CDA}, km.
3	Output step 1 Output step 2	AER, km; R_{CDA}, km.	Output is available for each CD test. In the case that the interpolation method is applied, check the availability of AER interpolation between vehicle H, L and, if applicable, M according to paragraph 4.5.7.1. of this annex. If the interpolation method is used, each test shall fulfil the requirement.	AER-interpolation availability.

Amendment

Step no.	*Source*	*Input*	*Process*	*Output*
2	Output step 1,	$FC_{CD,i}$, kg/100 km; $\Delta E_{REESS,i}$, Wh; ~~$M_{H2,CD}$, kg/km;~~ $FE_{CD,i}$, km/ kg; d_j, km; n_{veh}; R_{CDC}, km ; $FC_{CS,p}$, kg/100km $FE_{CS,declared}$, kg/100km; ~~$M_{H2,CD,avg}$ kg/km;~~ $FE_{CD,avg}$, km/ kg;	Calculation of equivalent all-electric range according to paragraphs 4.4.6.1. and 4.4.6.2. of this annex. For Level 1B: Output is available for each CD test. Calculation of actual charge-depleting range according to paragraph 4.4.7. of this annex. R_{CDA} is available for each CD test. The arithmetic average of R_{CDA} for all individual charge-depleting tests shall be calculated and shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number.	EAER, km; R_{CDA}, km.
3	Output step 1 Output step 2	AER, km; R_{CDA}, km.	Output is available for each CD test. In the case that the interpolation method is applied, check the availability of AER interpolation between vehicle H, L and, if applicable, M according to paragraph 4.5.7.1. of this annex. If the interpolation method is used, each test shall fulfil the requirement.	AER-interpolation availability.

Replace M_{H2} with FE_{CD}

Table A8/9b Calculation of final charge-depleting and charge-sustaining weighted values for OVC-FCHVs

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Step no.	*Source*	*Input*	*Process*	*Output*
4 If the interpolation method is not applied, step No. 9 is not required and the output of this step is the final result.	Output step 1 Output step 2	AER, km. EAER, km;	Averaging AER and AER declaration. Average EAER (for Level 1B only) and EAER declaration The declared AER (for Level 1A only) and EAER shall be rounded according to paragraph 6.1.8. of this Regulation to the number of decimal places specified in Table A6/1 of Annex B6. In the case that the interpolation method is applied and the AER interpolation availability criterion is fulfilled, AER shall be rounded according to paragraph 6.1.8. of this Regulation to the first place of decimal. In the case that the interpolation method is applied, EAER shall be rounded according to paragraph 6.1.8. of this Regulation to the first place of decimal. The output is available for each vehicles H and L and, if applicable, for vehicle M. If the case that the interpolation method is applied but the criterion is not fulfilled, AER of vehicle H shall be applied for the whole interpolation family and shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number. In the case that the interpolation method is not applied, AER and EAER shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number.	AER_{dec}, km; $EAER_{dec}$, km; For Level 1A only AER_{dec}, km.

Step no.	*Source*	*Input*	*Process*	*Output*
For Level 1A: 5	Output step 1	$FC_{CD,j}$, kg/100 km n_{veh}; $n_{veh,L}$; $UF_{phase,j}$; $FC_{CS,declared}$, kg/100km; $FC_{CD,declared}$, kg/100km; $FC_{CD,ave}$, kg/100km;	Calculation of weighted fuel consumption according to paragraph 4.2.3. of this annex. Output is available for each CD test. In the case that the interpolation method is applied, $n_{veh,L}$ cycles shall be used. With reference to paragraph 4.2.2. of this annex, $FC_{CD,j}$ of the confirmation cycle shall be corrected according to Appendix 2 to this annex.	$FC_{weighted}$, kg/100 km;
6	Output step 1 Output step 2	E_{AC}, Wh; EAER, km;	Calculation of the electric energy consumption based on EAER according to paragraphs 4.3.3.1. and 4.3.3.2. of this annex. For Level 1B; Output is available for each CD test.	EC, Wh/km;

Amendment

No additional revisions

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Step no.	*Source*	*Input*	*Process*	*Output*
7 If the interpolation method is not applied, step No. 9 is not required and the output of this step is the 'Final result'.	Output step 1 Output step 5 Output step 6 Output step 4 Output step 5	$AER_{city,ave}$, km; $FC_{weighted}$, kg/100 km; EC, Wh/km; EAER, km; AER_{dec}, km; AER_{ave}, km.	For Level 1B: Averaging EC and EC declaration. For Level 1A: Averaging of all values except EAER and EC and intermediate rounding of all values according to paragraph 6.1.8. of this Regulation. In the case that the interpolation method is applied, intermediate rounding shall be performed according to paragraph 6.1.8. of this Regulation. $AER_{city,final} = AER_{city,ave} \times \frac{AER_{dec}}{AER_{ave}}$ $AER_{city,final}$ and EAER shall be rounded to the first place of decimal. $FC_{weighted}$ shall be rounded to the third place of decimal. EC shall be rounded to the first place of decimal. The output is available for each vehicle H, vehicle L and, if applicable, vehicle M. In case that the interpolation method is not applied, final rounding of the test results shall be applied according to paragraph 6.1.8. of this Regulation. $AER_{city,ave}$, EAER and $EAER_p$ shall be rounded to the nearest whole number. $FC_{weighted}$ shall be rounded to the second place of decimal. EC shall be rounded to the nearest whole number.	For Level 1B: EC_{dec}, Wh/km; $EAER_{final}$, km; For Level 1A: $AER_{city,final}$, km; $FC_{weighted,final}$, kg/100 km; EC_{final}, Wh/km; $EAER_{final}$, km;
8	Output step 5 Output step 7	AER_{dec}, km; $AER_{city,final}$, km; $FC_{weighted,final}$, kg/100 km; EC_{final}, Wh/km; $EAER_{final}$, km;	Interpolation of individual values based on input from vehicle low, medium and high according to paragraph 4.5. of this annex, and	AER_{ind}, km; EC_{ind}, Wh/km; $EAER_{ind}$, km; For Level 1A: $AER_{city,ind}$, km; $FC_{weighted,ind}$, kg/100 km;

Amendment

No additional revisions

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Step no.	*Source*	*Input*	*Process*	*Output*
	Output step 4	AER-interpolation availability.	final rounding according to paragraph 6.1.8. of this Regulation. AER_{ind}, $AER_{city,ind}$ and $EAER_{ind}$ shall be rounded to the nearest whole number. $EC_{weighted,ind}$ shall be rounded to the first place of decimal. $FC_{weighted,ind}$ shall be rounded to the second place of decimal. EC_{ind} shall be rounded to the nearest whole number. Output is available for each individual vehicles.	
	Output step 1	R_{CDC}	R_{CDC} shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number.	$R_{CDC,final}$

Amendment

No additional revisions

Table A8/12 Calculation of the driving range of hydrogen fuel for NOVC-FCHVs (for Level 1B only)

Revised sections are **brown**

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[4.8. Calculation of driving range of hydrogen (DRH) for NOVC-FCHVs

This paragraph is applicable to Level 1B only;

4.8.1. Stepwise procedure for calculating driving range of hydrogen for NOVC-FCHVs.

The results shall be calculated in the order described in Table A8/12. 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.

Table A8/12

Calculation of the driving range of hydrogen fuel for NOVC-FCHVs (for Level 1B only)

Step No.	*Source*	*Input*	*Process*	*Output*
1 Result of single test	Paragraph 3.2 of appendix 7 to this annex.	The lower limit pressure of hydrogen tank	The lower limit pressure P_{LL} according to paragraph 3.2 of appendix 7 to this annex.	$P_{LL,1}$, MPa
2	Output step 1	For every test: $P_{LL,1}$, MPa	Averaging of tests and declared value according to paragraphs 1.2. to 1.2.3. inclusive of Annex B6.	$P_{LL,2}$, MPa
3 Result of P_{LL}	Output step 2	$P_{LL,2}$, MPa $P_{LL,\ declared}$, MPa	$P_{LL,2} = P_{LL,\ declared}$ P_{LL} values shall be rounded according to paragraph 6.1.8. of this Regulation. P_{LL} shall be rounded to the first place of decimal.	$P_{LL,3}$, MPa
4 Usable amount of hydrogen	Output step 3 Paragraph 3.3 of appendix 7 to this annex.	$P_{LL,3}$, MPa	Usable amount of hydrogen according to paragraph 3.3 of appendix 7 to this annex.	UAH, kg
5 Result of driving range of hydrogen	Output step 4 Output step 5 Table A8/7	UAH, kg $FE_{cs,c,5}$, km/kg	Calculation of driving range of hydrogen according to paragraph 4.8.2. of this annex. DR_H shall be rounded down to the nearest 20km.	DR_H, km

Added OVC-FCHV

Amendment

[4.8. Calculation of driving range of hydrogen (DRH) for NOVC-FCHVs and OVC-FCHVs.

This paragraph is applicable to Level 1B and 3-phase WLTP test in Level 2 only;

4.8.1. Stepwise procedure for calculating driving range of hydrogen for NOVC-FCHVs and OVC-FCHVs.

The results shall be calculated in the order described in Table A8/12. 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.

Table A8/12

Calculation of the driving range of hydrogen fuel for NOVC-FCHVs and OVC-FCHVs (for Level 1B and 3-phase WLTP test in Level 2 only)

Step No.	*Source*	*Input*	*Process*	*Output*
1 Result of single test	Paragraph 3.2 of appendix 7 to this annex.	The lower limit pressure of hydrogen tank	The lower limit pressure P_{LL} according to paragraph 3.2 of appendix 7 to this annex.	$P_{LL,1}$, MPa
2	Output step 1	For every test: $P_{LL,1}$, MPa	Averaging of tests and declared value according to paragraphs 1.2. to 1.2.3. inclusive of Annex B6.	$P_{LL,2}$, MPa
3 Result of P_{LL}	Output step 2	$P_{LL,2}$, MPa $P_{LL,\ declared}$, MPa	$P_{LL,3}$ ~~2~~ $= P_{LL,\ declared}$ P_{LL} values shall be rounded according to paragraph 6.1.8. of this Regulation. P_{LL} shall be rounded to the first place of decimal.	$P_{LL,3}$, MPa
4 Usable amount of hydrogen	Output step 3 Paragraph 3.3 of appendix 7 to this annex.	$P_{LL,3}$, MPa	Usable amount of hydrogen according to paragraph 3.3 of appendix 7 to this annex.	UAH, kg
5 Result of driving range of hydrogen	Output step 4 Output step 5 Table A8/7	UAH, kg $FE_{cs,c,5}$, km/kg	Calculation of driving range of hydrogen according to paragraph 4.8.2. of this annex. DR_H shall be rounded down to the nearest 20km.	DR_H, km
6	Output step 5 Output step 6 of Table A8/7	UAH, kg $FE_{cs,[illegible],5}$, km/kg	DR calculation according to paragraph 4.8.2. of this annex for individual vehicles in an interpolation family. $DR_{H\text{-}ind}$ shall be rounded to the nearest whole number, and then rounded down at intervals of 20km.	DR[illegible], km

Correct $P_{LL,2}$ to $P_{LL,3}$

Add interpolation calculation

Revised sections are **brown**

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4.8.2. The driving range for NOVC-FCHVs shall be calculated as the following equations:

$DR_H = FE_{cs,c,5} \times UAH$

For individual vehicles,

$DR_{H-ind} = FE_{cs,c,ind} \times UAH$

where

DR_H	is the driving range of the vehicle, km;
$DR_{H\text{-}ind}$	is the driving range for an individual vehicle, km;
$FE_{CS,c,5}$	is the charge-sustaining fuel efficiency determined according to step 5 of Table A8/7, km/kg
$FE_{cs,c,ind}$	is the charge-sustaining fuel efficiency for an individual vehicle determined according to step 6 of Table A8/7, km/kg
UAH	is the usable amount of hydrogen, kg]

Amendment

4.8.2. The ~~D~~driving ~~R~~range of hydrogen for NOVC-FCHVs and OVC-FCHVs shall be calculated as the following equations:

Added OVC-FCHV

$DR_H = FE_{cs,c,5} \times UAH$

For individual vehicles,

$DR_{H-ind} = FE_{cs,c,ind} \times UAH$

where

DR_H	is the driving range of the vehicle, km;
$DR_{H\text{-}ind}$	is the driving range for an individual vehicle, km;
$FE_{CS,c,5}$	is the charge-sustaining fuel efficiency determined according to step 5 of Table A8/7, km/kg
$FE_{cs,c,ind}$	is the charge-sustaining fuel efficiency for an individual vehicle determined according to step 6 of Table A8/7, km/kg
UAH	is the usable amount of hydrogen, kg]

4.8.3. The Driving Range of hydrogen and electric for OVC-FCHVs may be calculated as the following equations:

Added DR_{H+E} of OVC-FCHV

$DR_{H+E} = EAER + DR_H$

For individual vehicles,

$DR_{H+E-ind} = EAER_{ind} + DR_{H-ind}$

where

DR_{H+E}	is the Driving Range of hydrogen and electric of the vehicle, km;
$DR_{H+E\text{-}ind}$	is the driving range of hydrogen and electric for an individual vehicle, km;
DR_H	is the Driving Range of hydrogen of the vehicle according to paragraph 4.8.2 of this annex, km;
$DR_{H\text{-}ind}$	is the driving range of hydrogen for an individual vehicle according to paragraph 4.8.2. of this annex, km;
EAER	is the equivalent all-electric range according to paragraph 4.4.6.1. of this annex, km;
$EAER_{ind}$	is the equivalent all-electric range according to step 4 of Table A8/9b, km;

4.8.4. Driving Range may be calculated as the following equations:

Added formula for total driving range

For NOVC-FCHV

$DR = DR_H$

For OVC-FCHV

$DR = DR_{H+E}$

For individual vehicles,

For NOVC-FCHV

$DR_{ind} = DR_{H-ind}$

For OVC-FCHV

$DR_{ind} = DR_{H+E-ind}$

where

DR	is the driving range of the vehicle, km;
DR_{ind}	is the driving range for an individual vehicle, km;
DR_H	is the Driving Range of hydorogen of the vehicle according to paragraph 4.8.2 of this annex, km;
DR_{H+E}	is the Driving Range of hydrogen and electric of the vehicle according to paragraph 4.8.3 of this annex, km;

Annex B8 - Appendix 1 REESS state of charge profile
Figure A8.App1/8

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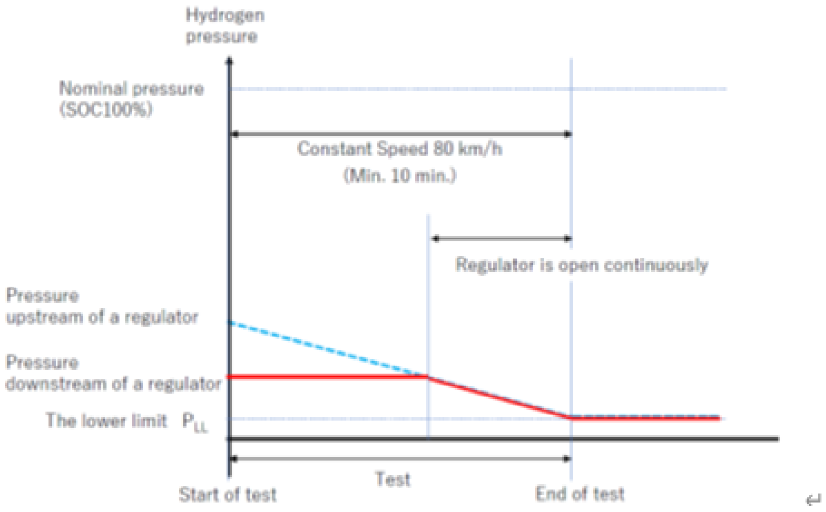
[4. Test sequence NOVC-FCHVs the lower limit pressure test (Figure A8.App1/8)

Figure A8.App1/8

NOVC-FCHVs, the lower limit pressure test



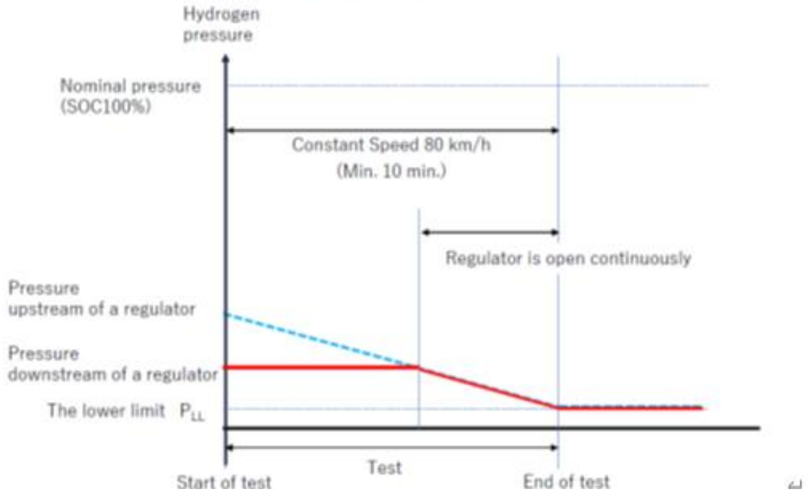
Amendment

Added OVC-FCHV

[4. Test sequence NOVC-FCHVs and OVC-FCHVs the lower limit pressure test (Figure A8.App1/8)

Figure A8.App1/8

NOVC-FCHVs and OVC-FCHVs, the lower limit pressure test



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Annex B8 - Appendix 7

Fuel consumption and usable amount of hydrogen measurement of compressed hydrogen fuel cell hybrid vehicles

[3. Usable amount of hydrogen

This paragraph is only applicable for Level 1B;

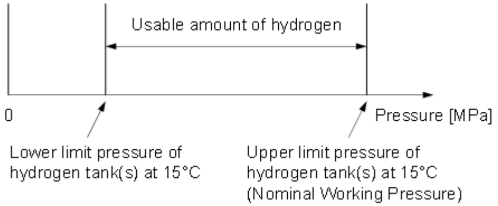
This test may be carried out after the fuel consumption test.

3.1 Principles

Usable amount of hydrogen is defined as shown in the [Figure A8/x]. The lower limit pressure of hydrogen tank is the pressure when the vehicle stops running because of interruption of hydrogen supply.

Figure A8.App7/2

Schematic diagram of "usable amount of hydrogen

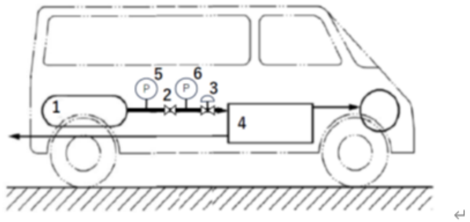


3.2 Measurement of lower limit pressure of hydrogen tank(s)

The lower limit pressure of hydrogen tank(s) shall be measured.

Figure A8.App7/3

Example of measuring pressure of hydrogen tank(s)



1: is the hydrogen tank(s)
2: is the pressure regulator
3: is the control valve to supply hydrogen to fuel cell system
4: is the fuel cell system
5: is the pressure sensor upstream of a pressure regulator
6: is the pressure sensor downstream of a pressure regulator

Amendment

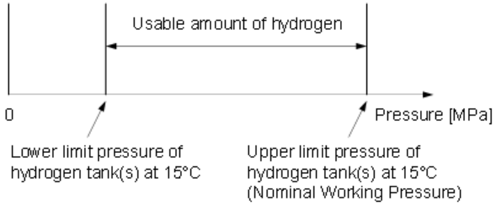
Typo correction

3.1 Principles

Usable amount of hydrogen is defined as shown in the [Figure A8~~/x~~ App7/2]. The lower limit pressure of hydrogen tank is the pressure when the vehicle stops running because of interruption of hydrogen supply.

Figure A8.App7/2

Schematic diagram of "usable amount of hydrogen



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In the case that a vehicle was tested for measurement of lower limit pressure of hydrogen tank(s), the lower limit pressure may be applied to vehicles that fulfil the same family of Lower limit pressure defined in paragraph 6.3.12. of this regulation.

Vehicle H shall be tested when a vehicle was selected from an interpolation family as defined in paragraph 6.3.12.(b) of this regulation.

3.2.1. Units, accuracy and resolution

Units, accuracy and resolution of measurements shall be as shown in Table A8.App7/3.

At the request of the manufacturer and with approval of the responsible authority, the on-board pressure sensor may be used.

Table A8.App7/3

Parameters, units, accuracy and resolution of measurements

Parameter	*Units*	*Accuracy*	*Resolution*
Pressure of the hydrogen tank	MPa	±1 MPa	0.1 MPa

3.2.2. Equipment and setting

The pressure of the on-board hydrogen tank(s) shall be adjusted to the manufacturer's recommended value to meet the requirement of the minimum driving time in the paragraph 3.5.

3.2.3. The test cell temperature at the start of the test shall be within ± 5 °C of the set point of 23 °C. The test vehicle shall be pushed onto a dynamometer.

3.2.4. Vehicle preparation

3.2.4.1. Soaking

The test vehicle shall be soaked for a minimum of 6 hours before the test. However soaking may be omitted in following cases.

- Temperature sensors of on-board tank(s) are applicable, and the temperatures are already within ±5 °C of 23 °C.
- The test is carried out to follow Type 1 in the test cell where the temperature has been kept within ±5 °C of 23 °C.

3.2.4.2. When a test vehicle of this test is not used for Type 1 test of fuel consumption described in paragraph 1 and paragraph 2 of this appendix, at the request of manufacturer, run-in requirement of paragraph 2.2 of this annex and preconditioning described in paragraph 2.6.4.3. of annex B6 may be omitted.

3.2.5. Constant speed

The minimum speed of the constant speed segments shall be set to 80 km/h. At the request of manufacturer and with approval of the responsible authority, a higher constant speed in the constant speed segments may be selected.

The acceleration to the constant speed level shall be smooth and accomplished within 1 minute after initiating the powertrain start procedure.

The vehicle shall be driven more than 10 minutes in the constant speed segments.

The pressure of the hydrogen tank(s) shall be measured at a sampling rate of a least 5 Hz.

Amendment

Typo correction

3.2.2. Equipment and setting

The pressure of the on-board hydrogen tank(s) shall be adjusted to the manufacturer's recommended value to meet the requirement of the minimum driving time in the paragraph 3.2.5.

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3.2.6. Break-off criterion

The break-off criterion is as follows:

(a) when the vehicle exceeds the prescribed speed trace tolerance as specified in paragraph 2.6.8.3.1.2. of Annex B6 for 4 consecutive seconds or more;

(b) or when manufacturer declares the end of the constant speed segment.

The accelerator control shall be deactivated. The vehicle shall be braked to standstill within 60 seconds.

3.3. Calculation of the Usable amount of hydrogen (UAH)

3.3.1. Equation of UAH

The pressure and if applicable the temperature of the hydrogen tank(s) at the end of the constant speed segment shall be employed for calculation of the usable amount of hydrogen.

The usable amount of hydrogen is calculated by using the following equation:

UAH = V × (ρ[P_{NWP}, T15] – ρ[P_{LL}, T15]) / 1 000

where:

UAH is the usable amount of hydrogen, expressed in kg;

V is the volume of hydrogen tank(s), expressed in m^3;

ρ[P_{NWP}, T15] is the gas density at the given pressure and temperature for 100% of SOC, g/m^3;

P_{NWP} is the gas pressure at the nominal working pressure, Mpa;

T15 is 283,15 K (15 °C) as reference temperature of the nominal working pressure;

P_{LL} is the lower limit pressure measured in the test, expressed in MPa.

Nominal working pressure and volume of hydrogen tank(s) are specified by the report of Model I, Annex 1 Part 1, UN R134. The total volume is applied if multiple tanks are loaded on the vehicle.

Gas density of hydrogen is determined by the following equation.

$$\rho(p,T) = \frac{pM}{RT}\left(\frac{1}{Z(p,T)}\right)$$

where:

ρ[p, T] is the gas density at the given pressure and temperature, g/m^3;

p is the pressure of the hydrogen tank at the end of the constant speed segment, MPa

T is hydrogen gas temperature of the hydrogen tank. 283,15 (15 °C) in K at the end of the constant speed segment.

R is the gas constant, 8.314472x 10^{-6} in m^3 MPa K^{-1} mol^{-1};

M is the molar mass of hydrogen, 2.01588, g/mol;

Z(p,T) is the compressibility factor.

The Compressibility factors of hydrogen gas are listed in Table A7/2 to Annex B7.

3.3.2. Simplified approach to calculate UAH for 70MPa system

When P_{NWP} is 70MPa, the density of hydrogen can be derived from the equations above.

ρ[70MPa, 15°C] = 40.22×10^3 (g/m^3)

At the request of manufacturer, the density of hydrogen of the tank(s) at the end of the constant speed segment and UAH may be derived from approximate equations as follows,

$$Z(pLL, 15°C) = 1$$

$$\rho(pLL, 15°C) = \frac{PLL \times M(\frac{g}{mol})}{RT} = 8.4 \times 10^2 \times P_{LL}(MPa)$$

UAH = V × (40.17×10^3 – 8.4 × 10^2 × P_{LL}) / 1 000]

Amendment

Typo correction

P_{NWP} is the gas pressure at the nominal working pressure, M~~p~~Pa;

Typo correction

$$Z(pLL, 15°C) = 1$$

$$\rho(pLL, 15°C) = \frac{PLL \times M(\frac{g}{mol})}{RT} = 8.4 \times 10^2 \times P_{LL}(MPa)$$

UAH = V × (40.22~~17~~×10^3 – 8.4 × 10^2 × P_{LL}) / 1 000]