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ANNEXES 1 to 5

ANNEXES

to the

Proposal for a Regulation of the European Parliament and of the Council

on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC

{SEC(2021) 562 final} - {SWD(2021) 635 final} - {SWD(2021) 636 final}

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ANNEX I

METHODOLOGY FOR ESTABLISHING THE GREENHOUSE GAS INTENSITY LIMIT ON THE ENERGY USED ON-BOARD BY A SHIP

For the purpose of calculating the greenhouse gas intensity limit of the energy used on-board a ship, the following formula, referred to as Equation (1) shall apply:

GHG intensity index	WtT	TtW
GHG intensity index $\left[\frac{gCO2eq}{MJ}\right] =$	$\dfrac{\sum_i^{n\,fuel} M_i \times CO_{2eq\,WtT,i} \times LCV_i + \sum_k^c E_k \times CO_{2eq\,electricity,k}}{\sum_i^{n\,fuel} M_i \times LCV_i + \sum_k^c E_k}$	$+\dfrac{\sum_i^{n\,fuel}\sum_j^{m\,engine} M_{i,j} \times \left[\left(1 - \frac{1}{100}C_{engine\,slip\,j}\right) \times \left(CO_{2eq,TtW,j}\right) + \left(\frac{1}{100}C_{engine\,slip\,j} \times CO_{2eq\,TtW,slippage,j}\right) \right]}{\sum_i^{n\,fuel} M_i \times LCV_i + \sum_k^l E_k}$

Equation (1)

where the following formula is referred to as Equation (2):

$$CO_{2eq,TtW,j} = \left(C_{f\,CO_2,j} \times GWP_{CO_2} + C_{f\,CH_4,j} \times GWP_{CH_4} + C_{f\,N_2O,j} \times GWP_{N_2O}\right)_i$$ Equation (2)

Term	Explanation
i	Index corresponding to the fuels delivered to the ship in the reference period
j	Index corresponding to the fuel combustion units on board the ship. For the purpose of this Regulation the units considered are the main engine(s), auxiliary engine(s) and fired oil boilers
k	Index corresponding to the connection points (c) where electricity is supplied per connection point.
c	Index corresponding to the number of electrical charging points
m	Index corresponding to the number of energy consumers
$M_{i,j}$	Mass of the specific fuel i oxidised in consumer j [gFuel]
E_k	Electricity delivered to the ship *per* connection point k if more than one [MJ]
$CO_{2eq\,WtT,i}$	WtT GHG emission factor of fuel i [gCO$_{2eq}$/MJ]
$CO_{2eq\,electricity,k}$	WtT GHG emission factor associated to the electricity delivered to the ship at berth *per* connection point k [gCO$_{2eq}$/MJ]
LCV_i	Lower Calorific Value of fuel i [MJ/gFuel]
$C_{engine\,slip\,j}$	Engine fuel slippage (non-combusted fuel) coefficient as a percentage of the mass of the fuel i used by combustion unit j [%]
$C_{f\,CO_2,j}, C_{f\,CH_4,j}, C_{f\,N_2O,j}$	TtW GHG emission factors by combusted fuel in combustion unit j [gGHG/gFuel]
$CO_{2eq,TtW,j}$	TtW CO$_2$ equivalent emissions of combusted fuel i in combustion unit j [gCO$_2$eq/gFuel] $$CO_{2eq,TtW,j} = \left(C_{cf\,CO_2,j} \times GWP_{CO_2} + C_{cf\,CH_4,j} \times GWP_{CH_4} + C_{cf\,N_2O,j} \times GWP_{N_2O}\right)_i$$
$C_{sf\,CO_2,j}, C_{sf\,CH_4,j}, C_{sf\,N_2O,j}$	TtW GHG emissions factors by slipped fuel towards combustion unit j [gGHG/gFuel]
$CO_{2eq,TtWslippage,j}$	TtW CO$_2$ equivalent emissions of slipped fuel i towards combustion unit j [gCO$_2$eq/gFuel] $$CO_{2eq,TtW\,slippage,j} = \left(C_{sf\,CO_2,j} \times GWP_{CO_2} + C_{sf\,CH_4,j} \times GWP_{CH_4} + C_{sf\,N_2O,j} \times GWP_{N_2O}\right)_i$$
$GWP_{CO_2}, GWP_{CH_4}, GWP_{N_2O}$	CO$_2$, CH$_4$, N$_2$O Global Warming Potential over 100 years

In the case of fossil fuels, the default values in Annex II shall be used.

For the purpose of this regulation the term $\sum_{k}^{c} E_k \times CO_{2eq\ electricity,k}$ in the numerator of Equation (1) shall be set to zero.

Method for determining [M$_i$]

The [M$_i$] mass of fuel shall be determined using the amount reported in accordance with the framework of the reporting under Regulation (EU) 2015/757 for voyages falling within the scope of this Regulation based on the chosen monitoring methodology by the company.

Method for determining WtT GHG factors

For non-fossil fuels, wherever values different from the default values in Annex II are used, these shall be based on relevant Bunker Delivery Notes (BDNs), for the fuels delivered to the ship in the reference period, for at least equal quantities of fuels as the one determined as being consumed in scope of the regulated journey in accordance with point A.

The WtT GHG ($CO_{2eq\ WtT,i}$) of the fuels (which are not fossils fuels) are established in Directive (EU) 2018/2001. The actual values, contained in the Directive that shall be used for the purpose of this Regulation, in accordance with the methodology, are those without combustion[1]. For those fuels for which pathways are not included in the Directive and for fossil fuels, the WtT GHG emission factors ($CO_{2eq\ WtT,i}$) default values are contained in Annex II.

Fuel Bunker Delivery Note (BDN)

For the purposes of this regulation, relevant BDNs of fuels used on board shall contain at least the following information:

− product identification

− fuel mass [t]

− fuel volume [m^3]

− fuel density [kg/m^3]

− WtT GHG emission factor for CO_2 (carbon factor) [gCO_2/gFuel] and for CO_{2eq} [gCO_{2eq}/gFuel] and related certificate[2]

− Lower Calorific Value [MJ/g]

BDN Electricity

For the purposes of this regulation, relevant BDNs for electricity delivered to the ship shall contain at least the following information:

− supplier: name, address, telephone, email, representative

− receiving ship: IMO number (MMSI), ship name, ship type, flag, ship representative

− port: name, location (LOCODE), terminal/ berth

− connection point: OPS-SSE connection point, connection point details

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[1] Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e$_u$ 'emissions from the fuel in use'

[2] This value is not required in case of fossil fuels referred to in Annex II. For all other fuels, including blends of fossil fuels, this value should be made available together with a separate certificate identifying the fuel production pathway.

–   connection time: date/time of commencement/finalisation

–   energy supplied: power fraction allocated to supply point (if applicable) [kW], electricity consumption (kWh) for the billing period, peak power information (if available)

–   metering

Method for determining TtW GHG factors

The TtW emissions are determined on the basis of the methodology contained in this Annex as provided in Equation (1) and Equation (2)

For the purpose of this Regulation, the TtW GHG emission factors ($CO_{2eq,TtW,j}$) that shall be used to determine the GHG emissions are contained in Annex II. The CO_2 C_f factors shall be the ones established in Regulation (EU) 2015/757 and are reported in the Table for easy reference. For fuels whose factors are not included in the said regulation, default factors as contained in Annex II shall be used.

In accordance with its compliance plan referred to in Article 6 and upon assessment by the verifier, other methods, such as direct CO_{2eq} measurement, laboratory testing, may be used if it enhances the overall accuracy of the calculation.

Method for determining TtW fugitive emissions

Fugitive emissions are emissions caused by the amount of fuel that does not reach the combustion chamber of the combustion unit or that is not consumed by the energy converter because they are uncombusted, vented, or leaked from the system. For the purpose of this Regulation, fugitive emissions are taken into account as a percentage of the mass of the fuel used by the engine. The default values are contained in Annex II.

Methods for determining the reward factors linked to substitute sources of energy

In case substitute sources of energy are installed on board, a reward factor for substitute sources of energy can be applied. In case of wind power such reward factor is determined as follow:

Reward factor for substitute sources of energy- WIND (f$_{wind}$)	$\dfrac{P_{Wind}}{P_{Tot}}$
0,99	0,1
0,97	0,2
0,95	$\geqslant 0,3$

The ship GHG intensity index is then calculated by multiplying the result of Equation (1) by the reward factor.

Verification and Certification

Fuel Class	WtT	TtW
Fossil	Default values shall be used as provided in Table 1 of this Regulation	MRV Regulation CO_2 carbon factors shall be used for fuels for which such factor is provided

| | | For all other emissions factors, default values can be used as provided in Table 1 of this Regulation, alternatively

Certified values by mean of laboratory testing or direct emissions measurements |
|---|---|---|
| Sustainable Renewable Fuels

(Bio Liquids, Bio Gases, e-Fuels) | CO_{2eq} values as provided in RED II (without combustion) can be used for all fuels whose pathways are included in RED II, alternatively

RED II approved certification scheme can be used | Emissions factors, default values can be used as provided in Table 1 of this Regulation, alternatively

Certified values by mean of laboratory testing or direct emissions measurements. |
| Others (including electricity) | CO_{2eq} values as provided in RED II (without combustion) can be used for all fuels whose pathways are included in RED II, alternatively

RED II approved certification scheme can be used | Emissions factors, default values can be used as provided in Table 1 of this Regulation, alternatively

Certified values by mean of laboratory testing or direct emissions measurements. |

<u>ANNEX II</u>

The emissions factors for fossils fuels contained in this Annex shall be used for the determination of the greenhouse gas intensity index referred to in Annex I of this Regulation.

The emissions factors of biofuels, biogas, renewable fuels of non-biological origin and recycled carbon fuels shall be determined according to the methodologies set out in Annex 5 part C of Directive (EU) 2018/2001.

In the table:

– TBM stands for To Be Measured

– N/A stands for Not Available

– The dash means not applicable

Table 1 – Default factors

1	2	3	4	5	6	7	8	9
	WtT			TtW				
Class / Feedstock	**Pathway name**	LCV $\left[\frac{MJ}{g}\right]$	$CO_{2eq\,WtT}$ $\left[\frac{gCO2eq}{MJ}\right]$	**Energy Converter Class**	$C_{f\,CO_2}$ $\left[\frac{gCO2}{gFuel}\right]$	$C_{f\,CH_4}$ $\left[\frac{gCH_4}{gFuel}\right]$	$C_{f\,N_2O}$ $\left[\frac{gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine
Fossil	HFO ISO 8217 Grades RME to RMK	0,0405	13,5	ALL ICEs / Gas Turbine / Steam Turbines and Boilers / Aux Engines	3,114 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	LSFO	0,0405	13,2, crude 13,7 blend	ALL ICEs / Gas Turbine / Steam Turbines and Boilers / Aux Engines	3,114	0,00005	0,00018	-
	ULSFO	0,0405	13,2	ALL ICEs	3,114	0,00005	0,00018	-

1	2	3	4	5	6	7	8	9
		WtT		TtW				
	VLSFO	0,041	13,2	ALL ICEs	3,206 MEPC245 (66) MRV Regulation	0,00005	0,00018	-
	LFO ISO 8217 Grades RMA to RMD	0,041	13,2	ALL ICEs	3,151 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	MDO MGO ISO 8217 Grades DMX to DMB	0,0427	14,4	ALL ICEs	3,206 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	LNG	0,0491	18,5	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuel slow speed)				0.2
				LBSI				N/A
	LPG	0,046	7,8	All ICEs	3,03 Buthane 3,00 Propane MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	
	H2 (natural gas)	0,12	132	Fuel Cells	0	0	-	-
				ICE	0	0	TBM	
	NH3 (natural gas)	0,0186	121	No engine	0	0	TBM	-
	Methanol (natural gas)	0,0199	31,3	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
Liquid biofuels	Ethanol E100	0,0268	Ref. to Directive (EU) 2018/2001	All ICEs	1,913 MEPC245 (66) Regulation (EU)	TBM	TBM	-

1	2	3	4	5	6	7	8	9
		WtT		TtW				
					2015/757			
	Bio-diesel Main products / wastes / Feedstock mix	0,0372	Ref. to Directive (EU) 2018/2001	ALL ICEs	2,834	0,00005 TBM	0,00018 TBM	-
	HVO Main products / wastes / Feedstock mix	0,044	Ref. to Directive (EU) 2018/2001	ALL ICEs	3,115	0,00005	0,00018	-
	Bio-LNG Main products / wastes / Feedstock mix	0,05	Ref. to Directive (EU) 2018/2001	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66), Regulation (EU) 2015/757	0,00005	0,00018	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A
Gas biofuels	Bio-H2 Main products / wastes / Feedstock mix	0,12	N/A	Fuel Cells	0	0	0	-
				ICE	0	0	TBM	
Renewable Fuels of non-Biological Origin (RFNBO) - (e- fuels)	e-diesel	0,0427	Ref. to Directive (EU) 2018/2001)	ALL ICEs	3,206 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-methanol	0,0199	Ref. to Directive (EU) 2018/2001	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-LNG	0,0491	Ref. to Directive (EU) 2018/2001	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3.1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A

1	2	3	4	5	6	7	8	9
	WtT			TtW				
	e-H2	0,12	3,6	Fuel Cells	0	0	0	-
				ICE	0	0	TBM	
	e-NH3	0,0186	0	No engine	0	N/A	TBM	N/A
Others	Electricity	-	106,3 EU MIX 2020 72 EU MIX 2030	OPS	-	-	-	-

Column 1 identifies the class of the fuels namely Fossils, Liquid Biofuels, Gaseous Biofuels, e-Fuels;

Column 2 identifies the name or the pathway of the relevant fuels within the class. For the Liquid Biofuels, Gaseous Biofuels, RFNBO (e-Fuels) the values for the WtT section shall be taken from Directive (EU) 2018/2001 (without combustion[3]); for fossils fuels only the default values in the table shall be used.

Column 3 contains the Lower Calorific Value of the fuels expressed in [MJ/g].

Column 4 contains the CO_{2eq} emissions values in [gCO_{2eq}/MJ]. For fossils fuels only the default values in the table shall be used. For all other fuels, (except were expressly indicated), values shall be calculated by using the methodology or the default values as per in Directive (EU) 2018/2001 deducted of the combustion emissions considering full oxidation of the fuel[4].

Column 5 identifies the main types/classes of energy converters such as 2 and 4 strokes Internal Combustion Engines (ICE) Diesel or Otto cycle, gas turbines, fuels cells etc.

Column 6 contains the emission factor C_f for CO_2 in [gCO_2/gfuel]. Emissions factors values as specified in the Regulation (EU) 2015/757 (or IMO MEPC245 (66) as amended) shall be used. For all those fuels not contained in Regulation (EU) 2015/757, the default values contained in the table should be used. Values certified by a by a trusted certifier (under the relevant provisions made in Directive (EU) 2018/2001) can be used in place of the default values.

Column 7 contains the emission factor C_f for methane in [gCH_4/gfuel]. Default values as contained in the table shall be used. Values certified by mean of testing can be used in place of the default values. For LNG fuels C_f for methane are set to zero.

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[3]   Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e_u 'emissions from the fuel in use'.

[4]   Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e_u 'emissions from the fuel in use'

Column 8 contains the emission factor C_f for nitrous oxide in [gN_2O/gfuel]. Default values as contained in the table shall be used. Values certified by mean of testing can be used in place of the default values.

Column 9 identifies the part of fuel lost as fugitive emissions (C_{slip}) measure as % of mass of fuel used by the specific energy converter. Default values as contained in the table shall be used. Values certified by mean of testing can be used in place of the default values. For fuels such as LNG for which the fugitive emissions (slip) exists, the amount of fugitive emissions as presented in Table 1 is expressed in % of the mass of fuel used (Column 9). The values contained in Column 9 shall be used, in accordance with equation (1). The values of C_{slip} in Table (1) are calculated at 50% of the engine load.

ANNEX III

CRITERIA FOR THE USE OF ZERO-EMISSION TECHNOLOGY AS REFERRED TO IN ARTICLES 5(3)(b) and 7(3), points (d) and (f)

The following table provides a list of zero-emission technologies as referred to in Article 5(3)(b), as well as, specific criteria for their use as applicable.

Zero-emission technology	Criteria for use
Fuel cells	Fuel cells used on board for power generation while at berth should be fully powered by renewable and low carbon fuels.
On-board Electricity Storage	The use of on-board electricity storage is allowed irrespective on the source of energy that produced the stored power (on-board generation or on-shore in case of battery swapping).
On-board Electricity production from wind and solar energy	Any ship that is capable to sustain energy needs at berth through the use of wind and solar energy.

The use of these zero-emission technologies shall continuously achieve emissions that are equivalent to the emissions reductions that would be achieved by using on-shore power supply.

<u>ANNEX IV</u>

CERTIFICATE TO BE ISSUED BY THE MANAGING BODY OF THE PORT OF CALL IN CASES WHERE SHIPS CANNOT MAKE USE OF OPS FOR JUSTIFIED REASONS (ARTICLE 5(5)) - MINIMUM ELEMENTS TO BE INCLUDED IN THE CERTIFICATE

For the purposes of this Regulation, the certificate referred to in Article 5(5) shall contain at least the following information:

(1)   Ship identification

      (a)   IMO number

      (b)   Ship name

      (c)   Call sign

      (d)   Ship type

      (e)   Flag

(2)   Port of call

(3)   Location/terminal name

(4)   Arrival date and time (ATA)

(5)   Departure date and time (ATD)

The confirmation from the managing body of the port that the ship was found among any of the following cases:

– the ship made an unscheduled port call for reasons of safety or saving life at sea (Article 5(2), point (c))

– the ship was unable to connect to on-shore power supply due to unavailable connection points in the port (Article 5(2), point (d))

– the on-shore power supply equipment on board was found to be incompatible with the shore installation at the port (Article 5(2), point (e))

– that the ship used, for a limited period of time on-board energy generation, under emergency situations representing immediate risk to life, the ship, or the environment (Article 5(2), point (f)).

(6)   Details of the managing body of the port

      (a)   Name

      (b)   contact (phone, email)

(7)   Date of issue

ANNEX V

FORMULAS FOR CALCULATING THE COMPLIANCE BALANCE AND PENALTY
LAID DOWN IN ARTICLE 20(1)

Formula for calculating the ship's compliance balance

For the purpose of calculating the compliance balance of a ship the following formula shall
apply:

Compliance balance $[gCO_{2eq}/MJ]$ =	$(GHGIE_{target} - GHGIE_{actual}) \times [\sum_{i}^{n\ fuel} M_i \times LCV_i + \sum_{i}^{l} E_i\ ]$

Where:

gCO_{2eq}	Grams of CO_2 equivalent
$GHGIE_{target}$	Greenhouse gas intensity limit of the energy used on-board a ship according to Article 4(2) of this Regulation
$GHGIE_{actual}$	Yearly average of the greenhouse gas intensity of the energy used on-board a ship calculated for the relevant reporting period

Formula for calculating the penalty laid down in Article 20(1)

The amount of the penalty laid down in Article 20(1) shall be calculated as follows:

Penalty =	*(Compliance balance / $GHGIE_{actual}$) x conversion factor from MJ to tonnes of VLSFO (41.0 MJ / kg) x EUR 2400*