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Road vehicles — Recyclability and recoverability — Calculation method

Véhicules routiers — Recyclabilité et valorisabilité — Méthode de calcul

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22628 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

Annex A forms a normative part of this International Standard. Annex B is for information only.

Introduction

End-of-life road vehicles contribute to the total volume of waste to be treated. As part of the road vehicle life cycle, it is essential that recovery issues be taken into consideration during the design phase for environmentally sound treatment to be ensured.

Today, recycling has to be taken into account in addition to safety, emissions and fuel consumption when designing a road vehicle. Consequently, there is need for an indicator for evaluating the ability and potential of new vehicles to be recovered/recycled.

The method for calculating recyclability and recoverability rates specified by this International Standard is based on four main stages inspired by the treatment of end-of-life road vehicles. Recyclability/recoverability rates depend on the design and material properties of new vehicles, and on the consideration of proven technologies — those technologies which have been successfully tested, at least on a laboratory scale, in this context.

The calculation method of this International Standard cannot reflect the process that will be applied to the road vehicle at the end of its life.

Road vehicles — Recyclability and recoverability — Calculation method

1 Scope

This International Standard specifies a method for calculating the recyclability rate and the recoverability rate of a new road vehicle, each expressed as a percentage by mass (mass fraction in percent) of the road vehicle, which can potentially be

— recycled, reused or both (recyclability rate), or

— recovered, reused or both (recoverability rate).

The calculation is performed by the vehicle manufacturer when a new vehicle is put on the market.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1176, *Road vehicles — Masses — Vocabulary and codes*

3 Terms and definitions

For the purposes of this International Standard, terms and definitions given in ISO 1176 and the following apply (see Figure 1).

3.1
vehicle mass
m_V
complete vehicle shipping mass, as specified in ISO 1176, plus the mass of lubricants, coolant (if needed), washer fluid, fuel (tank filled to at least 90 % of the capacity specified by the manufacturer), spare wheel(s), fire extinguisher(s), standard spare parts, chocks, standard tool-kit

NOTE Adapted from ISO 1176, “complete vehicle kerb mass”.

3.2
re-use
any operation by which component parts of end-of-life vehicles are used for the same purpose for which they were conceived

3.3
recycling
reprocessing in a production process of the waste materials for the original purpose or for other purposes, excluding processing as a means of generating energy

3.4
recovery
reprocessing in a production process of the waste materials for the original purpose or for other purposes, together with processing as a means of generating energy

3.5
dismantlability
ability of component parts to be removed from the vehicle

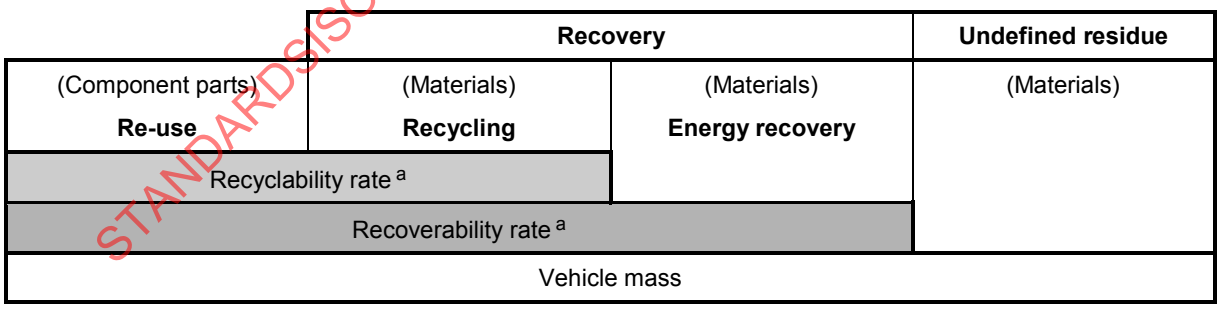
3.6
reusability
ability of component parts that can be diverted from an end-of-life stream to be reused

3.7
recyclability
ability of component parts, materials or both that can be diverted from an end-of-life stream to be recycled

3.8
recyclability rate
R_{cyc}
percentage by mass (mass fraction in percent) of the new vehicle potentially able to be recycled, reused or both

3.9
recoverability
ability of component parts, materials or both that can be diverted from an end-of-life stream to be recovered

3.10
recoverability rate
R_{cov}
percentage by mass (mass fraction in percent) of the new vehicle potentially able to be recovered, reused or both



a As a percentage of vehicle mass.

Figure 1 — Vocabulary of key terms — Overview

4 Variables and their symbols

Table 1 describes the symbols of the mass variables used in calculating the recyclability and recoverability rates.

Table 1 — Masses — Symbols and definitions

Symbol	Description
m_P	mass of materials taken into account at the pre-treatment step
m_D	mass of materials taken into account at the dismantling step
m_M	mass of metals taken into account at the metal separation step
m_{Tr}	mass of materials taken into account at the non-metallic residue treatment step and which can be considered as recyclable
m_{Te}	mass of materials taken into account at the non-metallic residue treatment step and which can be considered for energy recovery
m_V	Vehicle mass
NOTE All masses are expressed in kilograms.	

5 Calculation method

5.1 General

The calculation of the recyclability and recoverability rates is carried out through the following four steps on a new vehicle, for which component parts, materials or both can be taken into account at each step:

a) pretreatment;

b) dismantling;

c) metals separation;

d) non-metallic residue treatment.

A partial mass, m_P, m_D or m_M, is determined, respectively, at each of the first three steps, while the partial masses m_{Tr} and m_{Te} are determined at the final step (see 5.3).

Annexes A and B give data presentation and a schematic representation of the method.

5.2 Materials breakdown

The materials breakdown of the vehicle is established by classifying all the materials composing the vehicle into the following seven categories:

a) metals;

b) polymers, excluding elastomers;

c) elastomers;

d) glass;

e) fluids;

f) modified organic natural materials (MONM), such as leather, wood, cardboard and cotton fleece;

g) others (components, materials or both, for which a detailed material breakdown cannot be established such as compounds, electronics, electrics).

The total mass of each category can then be determined (see annex A).

This breakdown may be done at each step of the calculation for each partial mass mentioned in 5.1.

5.3 Determination of partial masses m_P, m_D, m_M, m_{Tr} and m_{Te}

5.3.1 Pretreatment — Determination of m_P

At this step, the following vehicle component parts, materials or both shall be taken into account:

— all fluids;

— batteries;

— oil filters;

— liquefied petroleum gas (LPG) tanks;

— compressed natural gas (CNG) tanks;

— tyres;

— catalytic converters.

NOTE Fluids include fuel, engine oil, transmission/gearbox oil (including rear differential or transfer box or both), power steering oil, coolant, brake fluid, shock absorber fluid, air conditioning refrigerant, windscreen washer fluid, engine mounting oil and hydraulic suspension fluid.

For the purpose of the calculation, these component parts and materials are considered reusable or recyclable.

Determine the mass, m_P, as the sum of the masses of these component parts and materials.

5.3.2 Dismantling — Determination of m_D

At this step, certain other of the vehicle's reusable or recyclable component parts may be taken into account, based on the following.

As a general requirement, a component part shall be considered as reusable, recyclable or both based on its dismantlability, assessed by

— accessibility,

— fastening technology, and

— proven dismantling technologies.

As a specific requirement, a component part shall be considered as recyclable, based on

— its material composition, and

— proven recycling technologies.

In order to be recyclable, a component part or material shall be linked to a proven recycling technology.

An additional requirement is that the reusability of a component part shall be subject to consideration of safety and environmental hazards.

Determine the mass m_D as the sum of the masses of all parts considered accordingly as reusable or recyclable.

5.3.3 Metals separation — Determination of m_M

At this step, all metals, ferrous and non-ferrous, which have not already been accounted for in the previous steps shall be taken into account. Both ferrous and non-ferrous metals are considered as recyclable.

Determine the mass, m_M, as the mass of the metal remaining in the vehicle after the previous steps.

5.3.4 Non-metallic residue treatment — Determination of m_{Tr} and m_{Te}

The remaining other materials (i.e. materials not taken into account at the pretreatment, dismantling and metals separation steps) constitute the non-metallic residue.

At this step, the residual non-metallic recyclable materials or both these materials and the residual non-metallic recoverable materials may be taken into account.

Determine m_{Tr} as the sum of masses of non-metallic residue considered as recyclable on the basis of proven recycling technologies (see Table A.1);

Determine m_{Te} as the sum of the remaining masses that can potentially be used for energy recovery after determination of m_P, m_D, m_M and m_{Tr}.

NOTE Technologies for energy recovery of polymers and elastomers are industrialized on a large scale world-wide. Therefore polymers, elastomers and other modified organic natural materials can potentially be recovered through those technologies.

5.4 Calculation of recyclability/recoverability rate

5.4.1 Recyclability rate

Calculate the recyclability rate, R_{cyc}, of the vehicle, as a percentage by mass (mass fraction in percent), using the formula:

$$R_{cyc} = \frac{m_P + m_D + m_M + m_{Tr}}{m_V} \times 100$$

5.4.2 Recoverability rate

Calculate the recoverability rate, R_{cov}, of the vehicle, as a percentage by mass (mass fraction in percent), using the formula:

$$R_{cov} = \frac{m_P + m_D + m_M + m_{Tr} + m_{Te}}{m_V} \times 100$$

Annex A
(normative)

Data presentation

The data for the calculation shall be reported using the following table, either on paper or in electronic form (the materials breakdown section is optional).

Table A.1 — Presentation of data

Brand name:					**Vehicle mass, m_V:**		kg
Model (type/ variant):							
Materials breakdown	**Metals**	**Polymers** (excl. elastomers)	**Elastomers**	**Glass**	**Fluids**	**MONM**	**Others**
	Mass (kg)						

Pretreatment (m_P)			**Mass** (kg)
	Fluids	m_{P1}	
	Battery	m_{P2}	
	Oil filters	m_{P3}	
	LPG tanks	m_{P4}	
	CNG tanks	m_{P5}	
	Tyres	m_{P6}	
	Catalytic converters	m_{P7}	
		m_P total (sum m_{P1} to m_{P7}) =	

Dismantling (m_D)

Part number	**Name**	**Mass** (kg)	**Part number**	**Name**	**Mass** (kg)	**Mass (part 11 to x)** (kg)	
1			6			m_{Dx} [a]	
2			7				
3			8				
4			9				
5			10				
m_{D1} total (sum 1 to 5) =			m_{D2} total (sum 6 to10) =			m_D total (m_{D1} + m_{D2} + m_{Dx}) =	

Metals separation (m_M)		**Mass** (kg)
	Remaining vehicle metallic content:	m_M =

Non-metallic residue treatment (m_{Tr} and m_{Te})	**Recyclable materials** (m_{Tr})		**Mass** (kg)	
	Technology no.	Name		
	1		m_{Tr1}	
	2		m_{Tr2}	
	3		m_{Tr3}	
	4 to x [a]		$m_{Tr4–x}$	
			m_{Tr} total (sum m_{Tr1} to m_{Trx}) =	
	Energy recoverable materials (m_{Te})		**Mass** (kg)	
	Remaining quantity of organic materials (polymers, elastomers, MONM etc.):		m_{Te} =	

	Recyclability rate	$R_{cyc} = \frac{m_P + m_D + m_M + m_{Tr}}{m_V} \times 100$	%
	Recoverability rate	$R_{cov} = \frac{m_P + m_D + m_M + m_{Tr} + m_{Te}}{m_V} \times 100$	%

[a] Please add a separate list for additional parts or technologies.

Annex B
(informative)

Calculation method

Figure B.1 shows the calculation method schematically.

Calculation steps (subclause) ↓	**Vehicle elements** General character	List	**Assumptions**	**Mass of vehicle elements** [a] kg Reusable or Recyclable	Energy recoverable	Undefined residue
1 Pre-treatment (5.3.1)	Component parts and fluids	All fluids Batteries Oil filters LPG tanks CNG tanks Tyres Catalytic converters	Reusable recyclable or both	m_P		
2 Dismantling (5.3.2)	Component parts	As declared by vehicle manufacturer	Reusable recyclable or both	m_D		
3 Metal separation (5.3.3)	Materials	Metals (ferrous and non- ferrous)	Recyclable	m_M		
4 Non-metallic residue treatment (5.3.4)	Materials	Glass	Recyclable	m_{Tr}	m_{Te}	
		Polymers (excluding elastomers)	Recyclable, recoverable or both [a]			
		Elastomers	Recyclable, recoverable or both [a]			
		MONM	Recyclable, recoverable or both [a]			
		Others	[a]			
				Vehicle mass, m_V		
		Recyclability rate, R_{cyc} (%) =		$\frac{m_P + m_D + m_M + m_{Tr}}{m_V} \times 100$		
		Recoverability rate, R_{cov} (%) =		$\frac{m_P + m_D + m_M + m_{Tr} + m_{Te}}{m_V} \times 100$		

[a] In step 4, the apportionment among the three treatment possibilities is as declared by the vehicle manufacturer.

Figure B.1 — Calculation method