Environmental Product Declaration

In accordance with ISO 14025:2006 for:

AHHD-430-4.822-2 GEARBOX

From:

CAF MiiRA

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	EPD-IES-0024868
Publication date:	2025-07-18
Valid until:	2030-07-14

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com.

Programme information

Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
PCR: Rolling Stock and Parts Thereof, PCR 2009:05, version 4.0.2. UN CPC 495
PCR review was conducted by: The Technical Committee of the International EPD® System. A full list of members is available at www.environdec.com. The review panel may be contacted via info@environdec.com Chair of the PCR review: Adriana Del Borghi
Life Cycle Assessment (LCA)
LCA accountability: IK-Ingenieria
Independent third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by accredited certification body Third-party verification**:** CERTINALIA S.L.U. Auditor: Eva Larzabal Aperribay info@certinalia.com Accredited by: ENAC nº125/C-PR283 accreditation
OR
Procedure for follow-up of data during EPD validity involves third-party verifier: ☒ Yes ☐ No

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EPDs within the same product category but from different programmes may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see ISO 14025.

Company information

Owner of the EPD: CAF MiiRA

CONTACT DETAILS	
J.M. Iturrioz, 26 20200 Beasain Gipuzkoa - Spain	T: +34 943 028 660 F: +34 943 189 120 ten.fac@ariimfac

Description of the organisation:

CAF MiiRA is a global reference in providing comprehensive solutions for rolling gear in the railway sector. We offer state-of-the-art engineering, manufacturing, and maintenance solutions for complete wheelsets and portal axles, including gearboxes, for all types of trains. We also provide services such as technological evaluation, inspections, and life cycle optimization analysis.

CAF MiiRA's history dates back to 1929, when it manufactured components for casting, forging, and various assemblies such as wheels, axles, wheelsets, brake blocks, crane wheels, etc. In 1990, it specialized to offer more competitive products by focusing on wheels, axles, and wheelsets. From 2006 to 2016, CAF MiiRA was established as a separate business unit of the CAF Group. New capabilities were developed to improve the product catalogue (e.g., resilient wheels).

CAF MiiRA creates solutions that provide quick and clear ad-hoc responses to each client and project. We offer high-tech products and high-quality engineering services that observe and manage "State of the art" design, manufacturing, testing, maintenance, and management processes from the perspective of innovation, cutting-edge technology, and efficiency for our clients. The company has a Technological Plan aimed at providing quality and efficiency.

The forging and heat treatment facilities assisted by computer simulations, minimize material usage and optimize costs. For the machining process, there are cutting lathes and CNC programs that use advanced dimensional simulation technologies to ensure compliance with the highest standards. For the assembly process, there is an automatic hydraulic press for wheels as well as the necessary facilities to carry out shrink fitting processes. The final quality control operations take place on an automated verification line, in order to assure that the characteristics of the products, meet customer requirements and applicable standards.

CAF MiiRA is fully committed with the environment. The company stands out as a manufacturer of complete wheelsets and axle assemblies, that covers the entire product life cycle, from conception to the end-of-life. The steel used complies with all applicable European standards.

We focus on smart design by creating lightweight, energy-efficient, low-maintenance solutions, in order to minimize the environmental impact of all products. Higher strength materials are used to reduce product volume combined with surface treatments like cold rolling to increase fatigue limits and overall safety. -100% renewable electricity is used in the manufacturing and assembly processes. Additionally, the company is part of SBTI (Science based targets initiative) and Race to Zero 2050. Several standards and recognitions obtained in this field include: ISO 14001; ISO 26000; EMAS; Ecovadis Platinum Category; CDP B rating, among others.

CAF MiiRA's quality systems are rigorously tested and currently comply with major international standards and regulations: ISO 9001; IRIS Certification; ASSOCIATION OF AMERICAN RAILROADS; RISAS...

CAF MiiRA's headquarters are in Beasain (Basque Country), Spain. In addition to its headquarters in Spain, CAF MiiRA also has a plant in Italy dedicated to integral wheelsets maintenance. If you need more information about CAF MiiRA or the CAF Group, you can visit their websites at www.cafmiira.com and www.caf.net, respectively.

Name and location of production site: Beasain, Gipuzkoa (Spain)

Product information

Product name: AHHD-430-4.822-2 Gearbox

Product description: AHHD-430-4.822-2 Gearbox for railway applications.

The gearbox serves to transmit the torque produced by the traction motor to the wheelset. The link between the gear-unit shaft and the motor drive shaft is accomplished with a coupling.

The motor bogies consist of motor axles, each of which has a gear-unit. The design of each unit provides a parallel arrangement of the traction motor and wheelset. The transmission is two stages, through the pinion-shaft and two helical cylindrical gears that transmit the torque in parallel.

The gearbox rests on the axle body. In order to prevent the rotation of the gear-unit, it is fixed to the bogie by means of a torque rod. The rod is fixed to the case and to the bogie frame by means of flexible spherical bearing bushes in order to dampen impacts.

Technical characteristic of the gearbox

Gearbox type	Helical Parallel
Weight	445,90 kg
Ratio	4,822
Number of stages	2
Distance between horizontal axes	430 mm
Off-set vertical	10 mm
Maximum torque acceleration	2982 Nm at 1114 rpm
Maximum braking torque	2625 Nm at 2227 rpm
Three-phase short-circuit torque	12000 Nm
Maximum speed	5772 rpm
Traction power	300 kW

UN CPC code: 495 – Railway and tramway locomotives and rolling stock, and parts thereof

Geographical scope: Spain

The gearbox is assembled in Spain, and most of their suppliers are located in Europe. For the distribution of this product, a client located in Sapin has been considered.

LCA information

Declared unit: The declared unit is “the use of a gearbox for 1 km”

According to the reference PCR, the declared unit must quantify the main function of the product. For a rolling stock the declared unit is the transport of 1 passenger/1 tonne of cargo for 1 km, depending on whether it is a passenger or freight rolling stock. However, a declared unit is recommended if the LCA does not cover a full rolling stock but only a product group or a sub-product group.

Gearboxes transmit the engine torque to the wheels and also provides various transmission ratios to enable the speed of the engine to be adapted to different driving situations.

For this study, the considered declared unit is “**the use of a gearbox for 1 km**”. This declared unit takes into account the main function of the gearbox.

The declare unit considers:

- 30 years of service life
- 210.00 km per year of use
- **6.300.000 km of use in 30 years**

Time representativeness: Primary data originated by CAF Miira, corresponds to the year 2024

Database(s) and LCA software used: The databases used were Ecoinvent 3.10 and the software used was SIMAPRO 10.2.0.1.

Description of system boundaries: The system boundaries established in this study have been defined following the guidelines of the PCR 2009:05 version 4.0.2 Rolling Stock and Parts Thereof, applying the "cradle-to-grave" criterion.

System diagram: The scope of life cycle of assessment (LCA) is cradle-to-grave, and therefore, this study includes the information from the Upstream, Core and Downstream stages. The environmental performance of the gearbox is reported separately for each stage.

Upstream

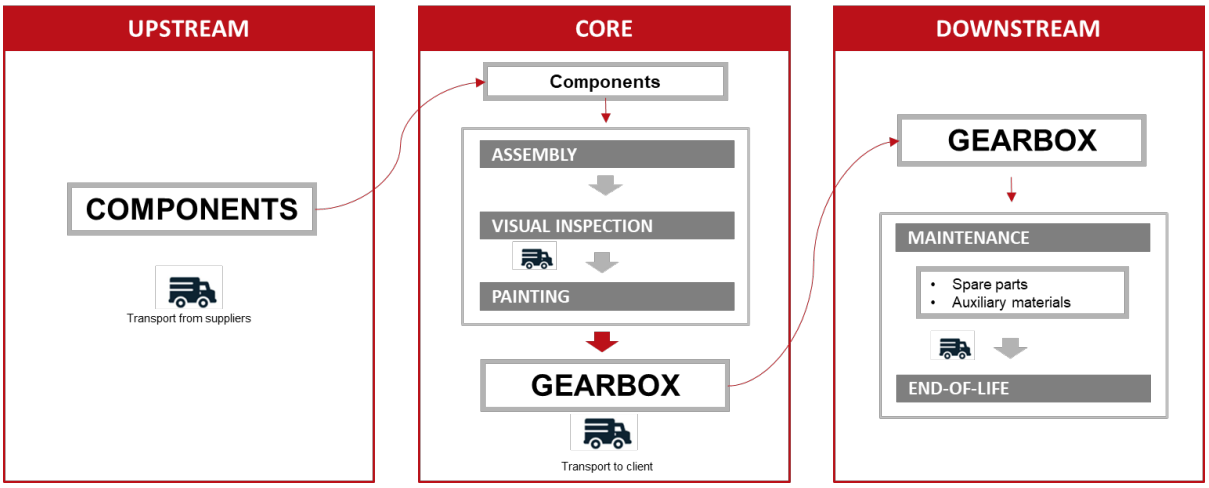
- Extraction and production of raw material for all main parts of the product: 99,73% of the mass was included in the Upstream data inventory
- Secondary transformation of materials
- Transportation from tier 1 (direct) suppliers to the assembly facility, in 99,62% by weight of the product.
- Generation of electricity and production of fuel (default information included in the indicators used)

Core

- Assembly process; including the inflow of auxiliary materials and energy consumptions
- Production and use of know auxiliar materials
- Internal transport between the assembly plant and the painting plant
- Transport to client
- End-of-life treatment of the generated waste
- Generation of electricity and production fuels, steam and other energy carries used

Downstream

- Production of consumables and spare parts
- Waste management of the gearbox and the maintenance materials



Excluded lifecycle stages:

The energy consumption within the downstream stage is not applicable for this study, and therefore, it has not been included.

Cut-off criteria:

For the upstream, the following data has been included in the study:

- 99,73% of the weight of the gearbox
- 99,62 by weight of the transport from suppliers

For the data that was not included in the inventory, a sensitivity analysis has been performed. The contribution of the data not included in the Upstream do not contribute more than 1% for the considered impact categories.

Data quality:

The data related to the inputs and outputs of the assembly process at CAF MiiRA plant in Beasain were obtained during the year 2024.

When there were no data available concerning specific processes and/or materials, theoretical calculations have been made, estimates done or even data from internationally recognized databases of life cycle inventories have been used.

This data is valid as it represents the real assembly year of the product assessed and supplied to the customer.

Additional technical information:
For the electricity consumption during the assembly stage, the corresponding 2024 energy mix was obtained from the data published by the CNMC, which is a public body that oversees the Spanish economic sectors, including electricity (https://gdo.cnmc.es/CNE/accesoEtiquetado.do).

The assembly plant of CAF MIIRA uses energy 100% renewable, generated by wind power and certified by the CNMC with Guarantee of Origin. The electricity is supplied by the electricity company Acciona-Energía

Content declaration

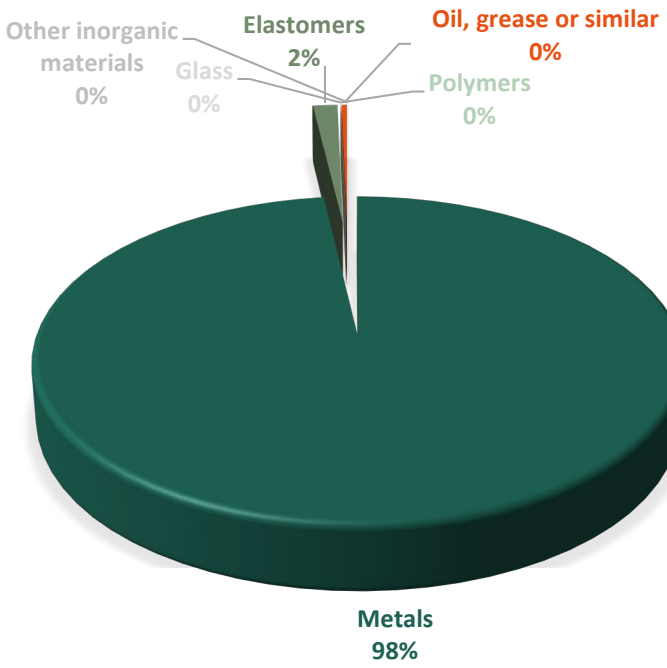
Product

The gearbox materials represent the 99,73% of the total mass of the product and are the ones used for the Life Cycle Assessment calculation. The total weight of the gearbox is 445,90 kg, and inventoried weight 444,69 kg.

The gearbox is classified as a propulsion and electric equipment according to EN 15380-2. The materials of the gearbox are classified according to ISO 21106.

Gearbox composition (according to ISO 21106)	
Material group	**%**
Metals	98,12%
Elastomers	1,51%
Polymers	0,004%
Glass	0,02%
Oil, grease or similar	0,33%
Other inorganic materials	0,01%

The gearbox is mainly made out of metals (98% of the materials).



CAF MiiRA follows the RECH Regulation regarding toxic substances, which aligns with the Railway Industry Substance List.

Packaging

The product is delivered without packaging to the place of use.

Results of the environmental performance indicators

Impact category indicators

Life cycle assessment results per declared unit: “the use of a gearbox for 1 km”:

ENVIRONMENTAL IMPACT The use of a gearbox for 1 km	UNIT	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP) - Fossil	kg CO2 eq.	2,64E-04	6,41E-06	3,42E-04	6,12E-04
Global Warming Potential (GWP) - Biogenic	kg CO2 eq.	1,16E-06	4,14E-08	8,78E-07	2,08E-06
Global warming potential (GWP) - Land use	kg CO2 eq.	1,91E-07	3,45E-09	1,89E-07	3,83E-07
Global warming potential (GWP) - Total	**kg CO2 eq.**	**2,65E-04**	**6,46E-06**	**3,43E-04**	**6,14E-04**
Ozone depletion (ODP)	kg CFC-11 eq.	2,08E-12	2,24E-13	2,88E-12	5,19E-12
Acidification (AP)	mol H+ eq.	1,31E-06	1,69E-08	2,90E-06	4,22E-06
Eutrophication (EP), freshwater	kg P eq.	1,02E-08	1,18E-10	1,84E-08	2,87E-08
Eutrophication (EP), marine	kg N eq.	2,48E-07	4,11E-09	3,17E-07	5,69E-07
Eutrophication (EP), terrestrial	mol N eq.	2,80E-06	4,51E-08	3,71E-06	6,56E-06
Photochemical ozone creation potential (POCP)	kg NMVOC eq.	9,31E-07	2,14E-08	1,54E-06	2,49E-06
Abiotic depletion potential (ADP) - minerals and metals*	kg Sb eq.	3,92E-09	3,31E-11	2,60E-08	3,00E-08
Abiotic depletion potential (ADP)- fossil fuels*	MJ	1,76E-03	1,76E-05	2,02E-03	3,80E-03
Water deprivation potential (WDP)*	m3 eq depriv.	6,78E-05	8,49E-07	8,31E-05	1,52E-04

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

The results for the Total Global Warming Potential (GWP) impact for the declared unit are:

ENVIRONMENTAL IMPACT The use of a gearbox for 1 km	Upstream	Core	Downstream	TOTAL
Global warming potential (GWP) - Total (kg CO2 eq)	0,00027	0,00001	0,00034	0,000614
Climate warming potential (GWP) - Total (%)	43,15%	1,05%	55,80%	100,00%

The total Global warming potential for the declared unit is 0,000614 kg CO2 eq.

Resource use indicators

The results for the primary energy resources (renewable and non-renewable) declared unit are included below:

RESORUCES The use of a gearbox for 1 km		UNIT	Upstream	Core	Downstream	TOTAL
Primary energy resources – Renewable	Used as energy carrier	MJ	4,61E-04	6,05E-05	4,38E-04	9,59E-04
	Used as raw materials	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	TOTAL	**MJ**	4,61E-04	6,05E-05	4,38E-04	9,59E-04
Primary energy resources – Non-renewable	Used as energy carrier	MJ	1,74E-03	1,76E-05	2,02E-03	3,78E-03
	Used as raw materials	MJ	2,05E-05	0,00E+00	0,00E+00	2,05E-05
	TOTAL	**MJ**	1,76E-03	1,76E-05	2,02E-03	3,80E-03

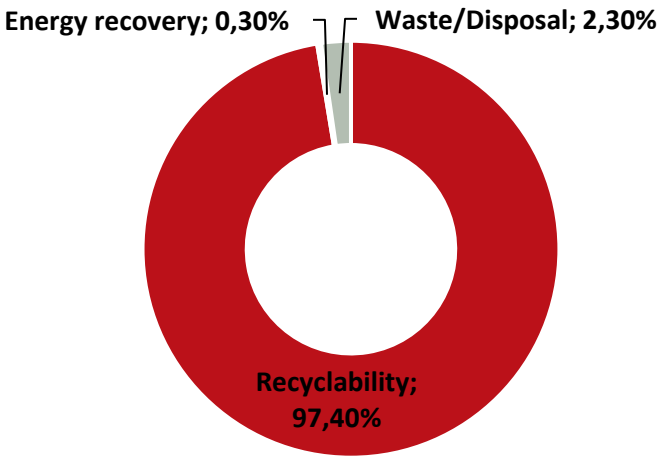
Additional environmental information

Recyclability and recoverability

The recyclability potential has been calculated according to:

- ISO 21106: 2019 Railway applications — Recyclability and recoverability calculation method for rolling stock, for the methodological approach.
- UNIFE Railway Rolling Stock, 2013 - Recyclability and Recoverability Calculation Method, for the material recyclability and energy recovery factors.

Recyclability rate	97,40%
Recoverability rate	97,70%



Global Warming Potential (GWP) of a gearbox manufacturing

The GWP-total of the manufacturing of an AHHD-430-4.822-2 gearbox is 1.711 kg CO2 eq. The manufacturing includes the materials, the transformation of materials, the transport of materials to the manufacturing facilities, and the manufacturing/assembly processes.

DEFINITIONS

GLOBAL WARMING POTENTIAL (GWP)
Global Warming is caused by the emission of greenhouse gases (GHG) to the atmosphere. Global Warming Potential, GWP100, translates the quantity of emission of gases into a common measure to compare their contributions – relative to carbon dioxide. There are four GWP indicators, which differentiate the greenhouse gases based on the origin: GWP-fossil, GWP-biogenic, GWP-land use, and GWP- total (the sum of all). The result is expressed in kg CO2 equivalent. GWP100, EN 15804. Version: August 2021. Original reference: IPCC (2013).

ACIDIFICATION POTENTIAL (AP)
Acidification originates from the emissions of sulphur dioxide and oxides of nitrogen. This indicator calculates the atmospheric acidification caused by the emission of gas with an acidifying effect. It is expressed in mol H+ eq. AP, accumulated exceedance, EN 15804. Version: August 2021. Original references: Seppälä et al. 2006, Posch et al. 2008.

EUTROPHICATION POTENTIAL (EP)
This environmental indicator calculates the eutrophication of water caused by the emission of specific substances (discharge of phosphoric, nitrogenous and organic matter). There are three different EP indicators, expressed in different units: EP, aquatic freshwater (kg P eq.); EP, aquatic marine (kg N eq.); and EP, terrestrial (kg N eq.). EP, aquatic freshwater & aquatic marine, EUTREND model, EN 15804. Version: August 2021. Original reference: Struijs et al. 2009 as implemented in ReCiPe. EP, terrestrial, accumulated exceedance, EN 15804. Version: August 2021. Original reference: Seppälä et al. 2006, Posch et al. 2008.

PHOTOCHEMICAL OZONE CREATION POTENTIAL (POCP)
The potential for creating tropospheric ozone is caused by the discharge of specific gases which have an oxidizing action under the effect of solar radiation. This indicator calculates the potential for the creation of photochemical ozone from the emission of about a hundred substances. The result is expressed in kg NMVOC eq. POCP, LOTOS-EUROS as applied in ReCiPe, EN 15804. Version: August 2021. Original reference: Van Zelm et al. 2008, ReCiPe 2008.

OZONE DEPLETION POTENTIAL (ODP)
The ozone layer depletion potential is the contribution of some substances to the depletion of the ozone layer compared with the impact caused by CFC-11. It is expressed in kg CFC 11 eq. ODP, EN 15804. Version: August 2021. Original reference: WMO 2014.

ABIOTIC DEPLETION POTENTIAL (ADP)
The abiotic depletion is the decrease in the availability of mineral resources and fossil fuels in the environment. The indicator for ADP of mineral& metal resources is expressed in kg of Sb eq., and the indicator for ADP of fossil fuels is expressed in MJ. ADP, EN 15804. Version: August 2021. Original references: Guinée et al. 2002, van Oers et al. 2002, CML 2001 baseline (Version: January 2016).

WATER DEPRIVATION POTENTIAL (WDP)
This indicator quantifies the potential for water deprivation, either for humans or ecosystems. The results of this environmental impact indicator shall be used with care as the uncertainties of the results are high and as there is limited experience with the indicator. It is expressed in m3 eq. depriv. Available water remaining (AWARE) method. Original reference: Boulay et al (2017).

RECYCLABILITY RATE
It refers to the percentage mass of the product that can potentially be recycled, reused or both.

RECOVERABILITY RATE
It refers to the percentage mass of the product that can potentially be recovered, reused or both.

References

- CAF MiiRA: http://www.cafmiira.com/
- ISO 14040:2006. Environmental management — Life cycle assessment — Principles and framework.
- ISO 14044:2006. Environmental management — Life cycle assessment — Requirements and guidelines.
- ISO 14025:2006: Environmental labels and declarations. Type III environmental declarations. Principles and procedures.
- General Programme Instructions of the International EPD® System. Version 4.0
- Product Category Rules PCR 2009:05 version 4.0.2 Rolling Stock and Parts Thereof: UN CPC 495
- ISO 21106: 2019 Railway applications — Recyclability and recoverability calculation method for rolling stock
- UNIFE Railway Rolling Stock, 2013 - Recyclability and Recoverability Calculation Method
- LCA report AHHD-430-4.822-2 GEARBOX

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VERIFICATION STATEMENT CERTIFICATE

CERTIFICADO DE DECLARACIÓN DE VERIFICACIÓN

Certificate No. / Certificado nº: EPD09404

CERTINALIA S.L.U., confirms that independent third-party verification has been conducted of the Environmental Product Declaration (EPD) on behalf of:
CERTINALIA S.L.U., confirma que se ha realizado verificación de tercera parte independiente de la Declaración Ambiental de Producto (DAP) en nombre de:

CONSTRUCCIONES Y AUXILIAR DE FERROCARRILES (CAF), S.A.
J.M. Iturrioz, 26
20200 BEASAIN (GIPUZKOA) - SPAIN

for the following product:
para el siguiente producto:

AHHD-430-4.822-2 GEARBOX
REDUCTOR AHHD-430-4.822-2

with registration number **EPD-IES-0024868** in the International EPD® System *(www.environdec.com).*
*con número de registro **EPD-IES-0024868** en el Sistema International EPD® (www.environdec.com).*

it´s in conformity with:
es conforme con:

- **ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations**
- **General Programme Instructions for the International EPD® System v4.0**
- **PCR 2009:05 Rolling stock and parts thereof v4.0.2**
- **UN CPC 495 Railway and tramway locomotives and rolling stock, and parts thereof**

Issued date / *Fecha de emisión:*	17/07/2025
Update date / *Fecha de actualización:*	17/07/2025
Valid until / *Válido hasta:*	14/07/2030
Serial Nº / *Nº Serie:*	EPD0940400-E

Organismo de certificación CERTINALIA

Carlos Nazabal Alsua
Manager

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Nº125 / C-PR283

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