ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

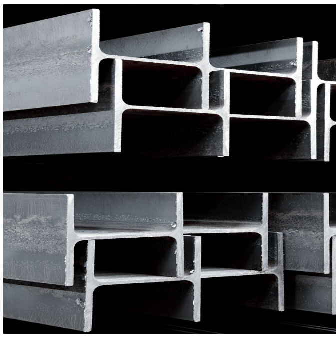
Owner of the Declaration	
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-CEL-20130219-IBD1-EN
Issue date	25.03.2014
Valid to	24.03.2019

Structural section steel

CELSA Group

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com / https://epd-online.com



1. General Information

CELSA Group	Structural section steel
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** **CELSA Barcelona, S.L.** Carrer de la Ferralla, 2, Poligono Industrial San Vicente 08755 Castelbisbal Barcelona (Spain) **CELSA HUTA OSTROWIEC SP. Z.O.O.** ul. Samsonowicza 2 27400 OSTROWIEC SWIETOKRZYSKI POLAND
Declaration number EPD-CEL-20130219-IBD1-EN	**Declared product / Declared unit** Structural steel section/ 1 ton
This Declaration is based on the Product Category Rules: Structural steels, 07-2012 (PCR tested and approved by the independent expert committee)	**Scope:** This EPD represents a weighted average of the production of structural steel sections by the CELSA Group at the 2 sites: Huta Ostrowiec, Poland and Barcelona, Spain. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 25.03.2014	
Valid to 24.03.2019	**Verification** The CEN Norm EN 15804 serves as the core PCR Independent verification of the declaration according to ISO 14025 ☐ internally ☒ externally
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dr. Burkhart Lehmann (Managing Director IBU)	Dr. Frank Werner (Independent tester appointed by SVA)

2. Product

2.1 Product description

The product declared is 'structural section steel'. The production process used is the Electric Arc Furnace (EAF). This route, used by CELSA for the production of structural steel, is based on the direct melting of scrap with an Electric Arc Furnace, which is subsequently processed in rolling mills in order to obtain the finished products

The steel section is hot rolled into structural steel in various shapes (I, H, L, U, flats, etc.)

Technical properties (strength level) are: S235 to S960. No metallic or organic coating.

2.2 Application

Steel products are used in the majority of buildings and civil works, mainly in reinforced structural concrete and structural steel constructions. In addition to the construction sector there are numerous applications in very diverse sectors, such as transport, agriculture, automotive, livestock farming, electricity pylons and cranes, etc.

Examples:

- Bridges (railway bridge, road bridge, pedestrian bridge, etc.)
- Multi-storey buildings (offices, residential, shops, car parks, high rise, etc.)
- Single-storey buildings (industrial and storage halls, etc.)
- Other structures (warehouses, industrial and commercial buildings)

2.3 Technical Data

Constructional data

Basic product characteristics according to relevant product standards: /EN 10025/, /ASTM A36/, /A572/ and /A992/, etc.

Name	Value	Unit

Density	7850	kg/m^3
Modulus of elasticity	210000	N/mm^2
Thermal conductivity at 20º	49	W/(mK)
Shear modulus Ga	81000	N/mm^2
Modulus of linear thermal expansion	1.2E-05	K^-1

2.4 Placing on the market / Application rules

For the placing on the market in the EU/EFTA the Regulation (EU) No 305/2011 dated from 9 March 2011 applies. The products need a Declaration of Performance taking into consideration the harmonised European standard /EN 10025 - Hot rolled products of structural steels/ and the CE-marking.
Further product standards:
/EN 10056-1/, /EN 10058/, /EN 10059/, /EN 10060/, /EN 10024/, /EN 10034/, /EN 10279/.

For the application and use the respective national provisions apply.

2.5 Delivery status

Delivery conditions in accordance with customer requirements, intended use, and possible technical regulations and certification requirements, when applicable.

2.6 Base materials / Ancillary materials

Structural steels produced by the CELSA Group are low-alloy steel products. The typical content of carbon is between 0.08 and 0.1%. The share of other elements besides iron is typically below 1%.

Auxiliary substances / additives
Calcium oxide, anthracite, HBI (hot briquetted Iron), coke from coal, and ferroalloys (ferrosilicon silicomanganese, calcium fluoride, ferroniobium, ferrovanadium, ferrotitanium, ferroboron and silicocalcium)
Percentages in weight of these additives depend on the required quality of the finished product.

Material explanation
Steel scrap is a secondary raw material, defined in different qualities, depending on the composition (Fe content) and certain characteristics (plate, section steel, galvanized sheets, etc.).
Anthracite and calcium oxide are natural raw materials, in different qualities, depending of course on their composition and structure available. The various alloys and coke from coal are natural resources, partially treated for use in steel production.
Alloys are, among other things made from recycled material.

Raw material extraction and origin
Scrap metal and, in part, the alloys are compiled following the dismantling and crushing plants, other ultimate consumers (post-consumer), steel production and manufacturing process of steel products (pre-consumer) and the internal preparation of scrap for steelmaking. Calcium oxide, carbon and ferroalloys are usually extracted from the soil as natural raw materials.

Availability of raw materials
Recycling of steel scrap saves primary material. Steel scrap is available and traded globally. Europe is in fact net exporter of steel scrap.

2.7 Manufacture

Manufacturing the building product
Scrap metal is melted in electric arc furnace to obtain liquid steel. Refinement is used (reduction of sulphur and phosphorus) and can be alloyed (e.g. approx. 1% Mn, 0.2% Si) and micro alloyed (e.g., 0.01% V) to give the steel specific properties.
At the end of the production of steel, molten steel is transformed into a semi-finished product with a continuous casting system. The semi-finished product (billet) is hot rolled to obtain the final product.

2.8 Environment and health during manufacturing

Health protection Production
Sostenibilidad Siderúrgica Management System: independent third party certification scheme which covers health and safety aspects, among other sustainability aspects beyond national regulations (http://sostenibilidadsiderurgica.com).

Environmental protection Production
Environmental management (EM) in accordance with /ISO 14001/ and Sostenibilidad Siderúrgica Management System (http://sostenibilidadsiderurgica.com).

2.9 Product processing/Installation

Processing recommendations
Processing and proper use of steel products depends on the application and should be made in accordance with generally accepted practices, standards and manufacturers recommendations.
National technical regulations (e.g. CTE.), as well as the Euro-codes
/EN 1993 and EN 1994/ as well as /EN 1090/ apply to the design and construction of steel structures. They deal with requirements for performance, sustainability, durability and fire resistance of steel and steel structures.
During transport and storage of steel products the usual requirements for securing loads should be observed.
For the further processing of steel products, the applicable standards, guidelines and general practice are to be considered.

Occupational safety/Environmental Protection
When handling and using the products, no additional means to protect health are required beyond the usual occupational safety measures.
No environmental impacts occur when working with or using these products under normal conditions of use.
No special measures are necessary for the protection of the environment.

Residual material
Residual materials are separated for in-house recycling. The steel scrap can be recycled almost completely.

2.10 Packaging

Products are delivered without packaging.

2.11 Condition of use

The main constituent of structural steel sections is iron. Carbon steel, which is an alloy that consists mostly of iron, has carbon as alloying element in a percentage by weight depending on the required steel grade of the finished product. In minor quantities other alloying elements are used, such as manganese, chromium and vanadium.
The constituents are those referred to in Chapter 2.6.

2.12 Environment and health during use

Health aspects:
Steel products, under normal conditions of use, do not cause adverse health effects.

Environmental aspects:
If the steel products are used according to their intended use, under normal conditions, there will be no significant environmental impact to water, air/atmosphere and soil.

2.13 Reference service life

The use and maintenance requirements are not based on the steel products but on the specific design and application.
Design of construction elements using steel products usually considers the specific atmospheric and corrosive environment, and provides the necessary corrosion protection for the desired useful life.

2.14 Extraordinary effects

Fire

Fire resistance class A1 (non-combustible)) according to /EN 13501/.
Steel does not produce smoke.

Fire protection

Name	Value

Water

Steel is stable, insoluble and does not emit substances into water. In the presence of oxygen in the water, steel is corroded (= slow oxidation).

Mechanical destruction

No relevant information.

2.15 Re-use phase

Structural steel can be reused after its recovery. In particular when steel constructions are properly designed to facilitate disassembly and re-use at the end of their useful lives.
Currently, around 11% of the considered steel products are re-used after dismantling /European Commission Technical Steel Research/.
Recycling:
Steel is 100% recyclable and scrap can be converted to the same (or higher or lower) quality of steel depending upon the metallurgy and processing of the recycling route.
Currently, around 88% of the products are recycled/European Commission Technical Steel Research/.

2.16 Disposal

Due to its high value as a resource, steel scrap is not disposed of, but instead in a well-established cycle fed to reuse or recycling. However, in case of disposal (disposal code: 17 04 03 /ECW/) no environmental impacts result.

2.17 Further information

Additional information on structural steel and can be obtained from CELSA GROUP™.
(www.celsagroup.com).

3. LCA: Calculation rules

3.1 Declared Unit

The declaration refers to the declared unit of 1 ton of structural section steel. The LCA is calculated based on averaged volume production data of the contributing plants.

Declared unit

Name	Value	Unit
Declared unit	1	t
Density	7850	kg/m³
Conversion factor to 1 kg	0.001	-

3.2 System boundary

This is an EPD based on a cradle-to-gate life cycle assessment. The selected system boundaries of this study encompass the following steps:

- Production of raw materials and energy (upstream), production /manufacture of the product (production of steel by EAF & section rolling stages), waste water treatment [Module A1-A3]

Principally the inventory data include material, energy, auxiliary as well as water consumption and waste productions (foreground data). The foreground data derive from the participating plants (CELSA Hutta Polan and CELSA Barcelona). Further, they include LCA data sets (cradle to gate) for raw materials, energies, and other auxiliaries linked to the foreground data of various stages of the life cycle (background data). Steel scrap is assumed to reach end of waste following a sorting and shredding process that takes place at demolition sites or waste processing facilities.

3.3 Estimates and assumptions
For all major Input- and Output materials the actual transport distances were applied or assumptions were made.

3.4 Cut-off criteria
All information from the data collection process has been considered, covering all used and registered materials, thermal energy, electrical energy and diesel consumption. Measurement of on-site emissions took place and those emissions were considered. The specific emissions that are linked to the provision of thermal and electrical energy are considered in the specific processes.
Data for different sites were cross-checked with one another to identify potential data gaps. No processes, materials or emissions that are known to make a significant contribution to the environmental impact of the products studied have been omitted. On this basis, there is no evidence to suggest that input or outputs contributing more than 1% to the overall mass or energy of the system or that are environmentally significant have been omitted.
It can be assumed, that all excluded flows contribute less than 5% to the impact assessment categories. The manufacturing of required machinery and other infrastructure is not considered in the LCA.

3.5 Background data

All background data relevant to the selected system boundaries – such as material and energy production – are taken from the GaBi 6 database /GaBi 6 2013/. Respective cut-off criteria (system boundaries) are given in the documentation of the data sets /GaBi 6 2013/.

3.6 Data quality
The production is modeled based on averaged volume production data of the contributing CELSA plants (Huta Ostrowiec and Barcelona). All relevant background datasets are taken from the GaBi 6 software database /GaBi 6 2013/. The study is based on high quality data.

3.7 Period under review
The considered primary data for the input and output of energy and materials is based on production data from 2012. The last revision of the used data sets (background data) took place less than 8 years ago.

3.8 Allocation
The allocation method used here was developed by the *Worldsteel* Association and *EUROFER* to be in line with /EN 15804/. The methodology is based on physical allocation and takes account of the manner in which changes in inputs and outputs affect the production of co-products. The method also takes account of material flows that carry specific inherent properties. This method is deemed to provide the most representative partitioning of the processes involved. Economic allocation was considered, as slag is considered a low-value co-product under /EN 15804/, however, as neither hot metal nor slag are tradable products upon leaving the BF, economic allocation would most likely be based on estimates. Similarly BOF slag must undergo processing before being used as a clinker or cement substitute. *Worldsteel* and *EUROFER* also highlights that companies purchasing and processing slag work on long-term contracts which do not follow regular market dynamics of supply and demand.
According to *Worldsteel,* the allocation rules for the EAF are generally the same as for the BOF. The energy rule is slightly different and the % to the EAF slab is 87.7% to the slab and 12.3% to the slag.

3.9 Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

4. LCA: Scenarios and additional technical information

Since no scenarios are declared, no additional technical information is required.

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 ton structural steel

Parameter	Unit	A1 - A3
Global warming potential	[kg CO_2-Eq.]	6.32E+2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	9.8E-8
Acidification potential of land and water	[kg SO_2-Eq.]	3.08E+0
Eutrophication potential	[kg $(PO_4)^{3-}$- Eq.]	1.93E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	2.15E-1
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	1.59E-4
Abiotic depletion potential for fossil resources	[MJ]	7.56E+3

RESULTS OF THE LCA - RESOURCE USE: 1 ton structural steel

Parameter	Unit	A1 - A3
Renewable primary energy as energy carrier	[MJ]	1.16E+3
Renewable primary energy resources as material utilization	[MJ]	0.0E+0
Total use of renewable primary energy resources	[MJ]	1.16E+3
Non renewable primary energy as energy carrier	[MJ]	8.43E+3
Non renewable primary energy as material utilization	[MJ]	0.0E+0
Total use of non renewable primary energy resources	[MJ]	8.43E+3
Use of secondary material	[kg]	1.15E+3
Use of renewable secondary fuels	[MJ]	0.0E+0
Use of non renewable secondary fuels	[MJ]	0.0E+0
Use of net fresh water	[m^3]	3.19E+0

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 ton structural steel

Parameter	Unit	A1 - A3
Hazardous waste disposed	[kg]	4.69E-2
Non hazardous waste disposed	[kg]	3.83E+1
Radioactive waste disposed	[kg]	3.59E-1
Components for re-use	[kg]	0.0E+0
Materials for recycling	[kg]	0.0E+0
Materials for energy recovery	[kg]	0.0E+0
Exported electrical energy	[MJ]	0.0E+0
Exported thermal energy	[MJ]	0.0E+0

6. LCA: Interpretation

This chapter contains an interpretation of the Impact Assessment categories with regards to the functional unit. It focuses on the dominant contributions during the product stage.
The interpretation presented is subject to the data quality, representativeness, completeness, limitations and assumptions made during the study. Some of the key elements that may have a potential effect on the results are listed below:

- Data quality: Primary data was used to model all on-site processes. This data was cross-checked to identify and eliminate data gaps. High quality secondary data from the GaBi database was used to model upstream material and energy flows.
- Representativeness: Primary data was gathered to ensure maximum technological and temporal representativeness for the product studied. Secondary data was as technologically and geographically representative as possible, however, for some auxiliary materials such as limestone German data was used in place of local data for non-German sites. However, in these cases the data was still considered to be technologically representative for the production.
- Completeness: No processes, materials or emissions known to contribute significantly to the environmental impact of the product were omitted.
- Limitations and assumptions: Transport to customer, installation, the use phase and demolition/transport at EoL were not modelled. These

are not believed to make a significant contribution to the product stage results, so the interpretation presented is unlikely to be significantly affected.

The chief contributors to the GWP are usually consumption of electricity wherever it occurs in the product stage. The burning of fuels, in grid mixes that rely on it, is associated with emissions that contribute to this impact category. Therefore the hotspots for GWP within the structural section steel product stage are the EAF (31%) followed by the consumption of energy during rolling process (~10%). Significant upstream contributors to the GWP are the ferro-alloys such as ferro-manganese, whose production in turn is energy intensive. Additionally, these alloys are often produced in countries where the electricity grid-mix is less efficient, which affects their average environmental profile.
ODP contributions are primarily related to the halogenic emissions from cooling towers in power plants among the processes included in the product stage and are thereby associated with the power consumption from the grid mixes.
ADPe is a measure of resource depletion in the earth. The greater the non-replacable resources used up, the greater the value of the ADPe impact indicator would be. When greater quantities of ferro-alloys with metals that are relatively rare in the earth's crust are huge, this impact category is dominated by these inputs – in this case, materials like ferro-manganese and ferro-vanadium are significant upstream material contributors (~40%).
POCP is also dominated by on-site emissions (e.g. CO) in the EAF and the production of ancillary materials/pre-products (such as Ferro-Manganese) as well as the power grid mix.
AP is strongly dominated by the extraction and processing of raw materials and the generation of electricity, steam and heat from primary energy resources, including extraction, refining and transport. Sulphur content of burning fuels and emissions contributes heavily to this category. Upstream energy intensive processes get highlighted under this indicators such as the production of ferro-manganese.
Similarly EP & ADPf is also strongly dominated by the extraction and processing of raw materials and the generation of electricity, steam and heat from primary energy resources, including extraction, refining and transport.
The indicators for PERT and PENRT, as numerically indicated in Section 5, illustrate the amount of renewable and non-renewable energy used in the manufacture of the product.
This is a significant indicator for the reason that production of electricity is a dominant factor for many of the other impact categories and thereby its composition and usage can influence the overall profile of the products significantly.

7. Requisite evidence

This EPD covers semi-finished structural steel of hot-rolled construction products. Further processing and fabrication depends on the intended application. Therefore further documentation is not applicable.

8. References

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin (pub.): Generation of Environmental Product Declarations (EPDs);

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013-04
www.bau-umwelt.de

PCR Part A
Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report. April 2013
www.bau-umwelt.de

ISO 14025
DIN EN ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

EN 15804
EN 15804:2012-04: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR 2013, Part B
Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part B: Calculation Rules for the Life Cycle Assessment of structural steel products. July 2013.

GaBi 6 2013
PE INTERNATIONAL AG; GaBi 6: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Leinfelden-Echterdingen, 1992-2013.

GaBi 6 2013D
GaBi 6: Documentation of GaBi 6: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2013.
http://documentation.gabi-software.com/

Worldsteel & EUROFER 2013
A methodology to determine the LCI of steel industry co-products (February 2013)

Sansom & Meijer 2002
Life-cycle assessment (LCA) for steel construction 2002

European Commission Technical Steel Research, Sansom, M. and Meijer, J.: Life-cycle assessment (LCA) for steel construction, European Commission technical steel research,. 2001-12

Standards and laws

EN ISO 13501
DIN EN 13501-1:2010-01 Fire classification of

construction products and building elements - Part 1: Classification using data from reaction to fire tests
EN ISO 14044
EN ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines
EN ISO 14040
EN ISO 14040:2006, Environmental management - Life cycle assessment - Principles and framework
CEN/TR 15941
CEN/TR 15941:2010-11 Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data
EN 15804
EN 15804:2012-04 Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products
CPR
REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
ISO 14025
DIN EN ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures
EN 10025:2005-2, Hot rolled products of structural steels
EN 1090:2009, Execution of steel structures and aluminium structures
ASTM A 36:2008, Standard specification for carbon structural steel
ASTM A 283:2012, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A514:2009, Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A572:2012, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A573:2009, Standard Specification for Structural Carbon Steel Plates of Improved Toughness
ASTM A588:2010, Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A633:2011, Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A709:2011, Standard Specification for Structural Steel for Bridges
ASTM A913:2007, Standard specification for high-strength low-alloy steel shapes of structural quality, produced by quenching and self-tempering process (QST)
ASTM A992:2011, Standard specification for structural steel shapes
ASTM A1066:2011, Standard Specification for High-Strength Low-Alloy Structural Steel Plate Produced by Thermo-Mechanical Controlled Process (TMCP)
AWS D1.1:2010, Structural Welding Code – Steel
AISC 303-05, Code of Standard Practice for Steel Buildings and Bridges
EWC, European Waste Catalogue, 2000/532/EC
EN 1993:2010-12/ Eurocode 3,
Design of steel structures
EN 1994:2010-12 / Eurocode 4, Design of composite steel and concrete structures
ANSI/AISC 360-10, Specification for Structural Steel Buildings

	Publisher Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	Tel Fax Mail Web	+49 (0)30 3087748- 0 +49 (0)30 3087748- 29 info@bau-umwelt.com **www.bau-umwelt.com**
	Programme holder Institut Bauen und Umwelt e.V. Panoramastr 1 10178 Berlin Germany	Tel Fax Mail Web	+49 (0)30 - 3087748- 0 +49 (0)30 – 3087748 - 29 info@bau-umwelt.com **www.bau-umwelt.com**
	Author of the Life Cycle Assessment PE International AG Hauptstraße 111 70771 Leinfelden-Echterdingen Germany	Tel Fax Mail Web	+49 711 341817-0 +49 711 34 18 17-25 info@pe-international.com **http://www.pe-international.com**
	Owner of the Declaration Celsa Huta Ostrowiec Sp. z o.o. Jana Samsonowicza 2 27-400 Ostrowiec Poland	Tel Fax Mail Web	+48 41 249 23 02 +48 41 249 22 22 celsaho@celsaho.com **http://www.celsaho.com/**