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## TA-COMPACT-P (DN10-32) & TA Modulator (DN15-32) valves



### Owner of the EPD:

IMI International Sp. z o.o.  
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### EPD Program Operator:

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ITB is the verified member of The European Platform for EPD program operators and LCA practitioner [www.eco-platform.org](http://www.eco-platform.org)

### Basic information

This declaration is the Type III Environmental Product Declaration (EPD) based on EN 15804+A2 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment and their aspects verified by the independent body according to ISO 14025. Basically, comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804+A2.

**Life cycle analysis (LCA):** A1-A3, A4-A5, C1-C4 and D modules in accordance with EN 15804+A2 (Cradle-to-Gate with options)

**The year of preparing the EPD:** 2023

**Product standards:** EN 12266-1

**Service Life:** >20 years

**PCR:** ITB-PCRA

**Declared unit:** 1 kg

**Reasons for performing LCA:** B2B

**Representativeness:** Poland, Europe, 2021

### MANUFACTURER

As IMI Hydronic Engineering is a leading HVAC company with a valves montage plant located in Olkusz (Poland). Company is provider of technologies that deliver energy efficient water-based heating and cooling systems for the residential and commercial building sectors. Throughout the history, company have been at the forefront of HVAC industry innovation. The portfolio of brands has what is needed – a complete range of unique, industry-leading products and services. IMI Hydronic Engineering is a part of IMI PLC Group, listed on the London Stock Exchange on FTSE 100 list.



Figure 1 The view of IMI International Sp. z o.o. manufacturing plant located in Olkusz

### PRODUCTS DESCRIPTION

Products covered by this EPD are TA-COMPACT-P pressure independent balancing and control valves (PIBCV), as well with LF and NPT thread variants and due to design similarities document covers as well TA-Modulator pressure independent balancing and control valve for modulating control as well with HP and NPT thread variants. Brass alloys used for valves (89% mass input) comply with standard EN 12165 are produced in Sweden. AMETAL® and stainless steel guarantee high corrosion resistance and reduce the risk of leakage. Both valves are designed to provide highly precise temperature control and eliminate overflows for accurate hydronic control. The pressure independent balancing and control valve TA-COMPACT-P ensures optimum performance over a long life. Valves together with balancing instruments enables advanced measuring and diagnostics. Slim and compact shape simplifies installation, one side access to all functions simplifies operation. Exact flow measuring and unique diagnostic functions for ultimate energy savings and highly reliable system. Product's application is heating and cooling systems. Functions are:

- Control (EQM for Modulator)
- Pre-setting (max. flow)
- Differential pressure control
- Measuring ( $\Delta H$ , T, q)
- Isolation (for use during system maintenance – see also Leakage rate)

Dimensions: DN 10-32 (DN 15-32 for Modulator)

Pressure class: PN 16

Connection: Male thread according to ISO 228 (NPT according to ANSI/ASME B1.20.1-1983).

Connection to actuator: M30x1.5

All additional technical information about the product is available on the manufacturer's website and [catalogues](#).

## **LIFE CYCLE ASSESSMENT (LCA) – general rules applied**

### **Unit**

The declared unit is 1 kg of valve products. Declared unit refer to different numbers and types of valves; every valve typology contains valves with different dimensions and weights. However, the same manufacturing process and the similarities of valves allow a declared unit based on mass unit of products.

### **System boundary**

The life cycle analysis of the declared products covers “Product Stage” A1-A3, A4, C2-C4+D modules in accordance with EN 15804 and ITB PCR A (cradle to gate with options). Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included in the calculation. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804+A2, machines and facilities (capital goods) required for the production as well as transportation of employees were not included in LCA.

### **Allocation**

The allocation rules used for this EPD are based on general ITB 's document PCR A. In the modules A1-A3, material losses in the assembly of the products in the factory are defined on the averaged specific values for the site. Input and output data from the production is inventoried and allocated to the production on the mass basis. The declaration covers a wide range of products (averaged). Their production resources and processing stages are basically similar, so it is possible to average the production by product volume.

### **System limits**

99.0% materials and 100% energy consumption were inventoried in a factory and were included in calculation. In the assessment, all significant parameters from gathered production data are considered, utilized energy, and electric power consumption, direct production waste, and available emission measurements. The total of neglected input flows per module A1-A3 does not exceed the permitted maximum of 1 % of energy usage and product mass. Tires consumption for transport was not taken into account. The components like: foils, papers, labels, tapes with a percentage share of less than 0.1% were not included in the calculations. It is assumed that the total sum of omitted processes does not exceed 1% of all impact categories. In accordance with EN 15804 machines and facilities (capital goods) required for and during production are excluded, as is transportation of employees.

### **Modules A1 and A2: *Raw materials supply and transport***

The modules A1 and A2 represent the extraction and processing of raw materials (mainly brass stainless steel and plastic elements) and transport to the production site. The process starts with the manufacturing of raw brass and bronze pieces for valves obtained from casting and hot-moulding (activities carried out by IMI in Sweden); For A2 module (transport- inventoried) European averages for fuel data are applied. Production of metal and plastic elements (inputs to production in Olkusz) were inventoried and assessed.

### **Module A3: *Production***

The product specific manufacturing process is presented in Figure 2. The production process is partially automated and is based on receiving metallurgical materials for production. Components previously made go to the factory in Olkusz where they are assembled into one final product. The pieces are mechanically worked and assembled with valves components (e.g. handles, gaskets, balls, fittings, etc.). Some pieces and valve components are coated with chrome and powder, according to the valve typologies in which they are used.

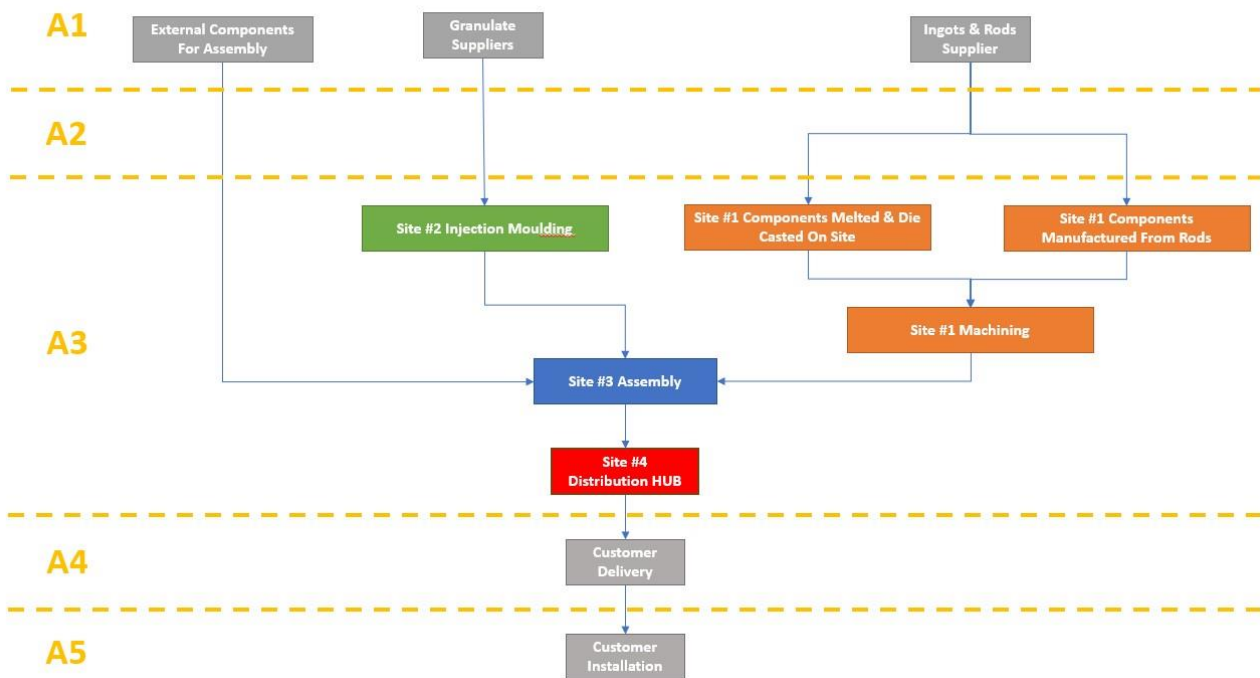


Figure 2 Manufacturing process scheme (A1-A3), with forming/assembly process in Olkusz (A3)

**Module A4: transport to consumer**

Vehicle transport at distance 500 km is considered (emission standard: Euro 5) with 100% load capacity.

**Modules C and D: End-of-life (EOL)**

Due to the fact that the declaration covers a wide range of products for various purposes and usage scenarios, it is not possible to directly specify the de-construction technology and the amount of energy for disassembly in C1 module (so this module is very generic based on literature). In the adapted end-of-life scenario, the de-constructed steel products are transported to a metal mill distant by 100 km on > 16t lorry EURO 5 where are used as scrap to produce a new metals. The recycling potential of C3 module is 98% and it is assumed that only 2% of the products will end up in a landfill – C4 module (Table 1). Module D presents credits resulting from the recycling of the scrap (used for steel production), calculated in accordance with the approach developed by World Steel Association.

Table 1 End-of-life scenario for the TA-COMPACT-P valve

| Material | Material recovery | Recycling | Landfilling |
|----------|-------------------|-----------|-------------|
| metals   | 100%              | 98%       | 2%          |
| plastcis | 100%              | 98%       | 2%          |

Electricity at end-of-life (module C) has been modelled using an average Polish electricity mix as the location where the product reaches end-of-life is unknown.

**Data collection period**

The data for manufacture of the declared products refer to period between 01.01.2021 – 31.12.2021 (1 year). The life cycle assessments were prepared for Poland and Europe as reference area.

## Type III Environmental Product Declaration No. 559/2023

### Data quality

The data selected for LCA originate from ITB-LCI questionnaires completed by IMI International Sp. z o. o. and verified during data audit (Sweden, Poland and Germany). No data collected is older than five years and no generic datasets used are older than ten years. The representativeness, completeness, reliability, and consistency is judged as good. The background data for the processes come from the following resources database Ecoinvent v.3.9.1 (metal ores, copper recyclates, stainless steel, EPDM, PPS, PP TPE, EUR-flat pallet, paper, carton). Specific (LCI) data for Brass production was a part of the input data verification, some specific data comes from Erwitte located plant.

### Assumptions and estimates

The impacts of the representative products were aggregated using weighted average.

### Calculation rules

LCA was performed using ITB-LCA tool developed in accordance with EN15804+A2. Emission of greenhouse gases was calculated using the IPCC 2013 GWP method with a 100-year horizon. Emission of acidifying substances, Emission of substances to water contributing to oxygen depletion, Emission of gases that contribute to the creation of ground-level ozone, Abiotic depletion, and ozone depletion emissions where all calculated with the CML-IA baseline method

### Additional information

The manufacturer provided certificates of origin of electricity from renewable energy sources based on the biomass. Electricity (Eocinvent v.3.9.1 data) emission factor (bio based electricity production for Poland) used is 0.056 kg CO<sub>2</sub>/kWh. As a general rule, no particular environmental or health protection measures other than those specified by law are necessary. The product may contain dangerous substances (lead), more than 0,1% by weight, given by the REACH Candidate List.

## LIFE CYCLE ASSESSMENT (LCA) – Results

### Declared unit

The declaration refers to declared unit (DU) – 1 kg of TA-COMPACT-P valves produced in Europe. The following life cycle modules (Table 2) were included in the analysis. The following tables 3-6 show the environmental impacts of the life cycle of selected modules (A1-A5+C1-C4+D).

Table 2 System boundaries for the environmental characteristic of the product.

| Environmental assessment information (MD – Module Declared, MND – Module Not Declared, INA – Indicator Not Assessed) |           |               |                                |                                   |           |             |        |             |               |                        |                       |                           |           |                  |          |   |
|--|-----------|---------------|--------------------------------|-----------------------------------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|---------------------------|-----------|------------------|----------|---|
| Product stage  |           |               | Construction process           |                                   | Use stage |             |        |             |               |                        |                       | End of life               |           |                  |          | Benefits and loads beyond the system boundary |
| Raw material supply  | Transport | Manufacturing | Transport to construction site | Construction-installation process | Use       | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction 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   |
| MD   | MD        | MD            | MD                             | MD                                | MND       | MND         | MND    | MND         | MND           | MND                    | MND                   | MD                        | MD        | MD               | MD       | MD  |

## Type III Environmental Product Declaration No. 559/2023

*Table 3 Life cycle assessment (LCA) results for specific product – environmental impacts of (DU: 1 kg)*

| Indicator   | Unit                   | A1       | A2       | A3       | A1-A3    | A4       | A5       | C1       | C2       | C3       | C4       | D         |
|---|------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|
| Global Warming Potential  | eq. kg CO <sub>2</sub> | 1.06E+00 | 2.54E-01 | 1.04E+00 | 2.36E+00 | 8.34E-02 | 4.69E-05 | 7.04E-03 | 1.67E-02 | 8.03E-02 | 1.06E-04 | -3.65E+00 |
| Greenhouse potential - fossil                                       | eq. kg CO <sub>2</sub> | 1.04E+00 | 2.53E-01 | 9.76E-01 | 2.27E+00 | 8.31E-02 | 4.69E-05 | 7.04E-03 | 1.66E-02 | 2.72E-02 | 1.05E-04 | -7.33E+00 |
| Greenhouse potential - biogenic                                     | eq. kg CO <sub>2</sub> | 1.87E-02 | 8.64E-04 | 5.39E-02 | 7.35E-02 | 2.84E-04 | 1.23E-07 | 1.85E-05 | 5.68E-05 | 2.50E-04 | 2.68E-07 | -2.25E-01 |
| Global warming potential - land use and land use change             | eq. kg CO <sub>2</sub> | 3.69E-03 | 9.92E-05 | 1.09E-02 | 1.47E-02 | 3.26E-05 | 7.14E-09 | 1.07E-06 | 6.52E-06 | 6.51E-06 | 9.94E-08 | -3.77E-02 |
| Stratospheric ozone depletion potential                             | eq. kg CFC 11          | 4.81E-08 | 5.85E-08 | 1.62E-07 | 2.69E-07 | 1.92E-08 | 2.51E-13 | 3.77E-11 | 3.85E-09 | 3.23E-10 | 4.26E-11 | -1.76E-07 |
| Soil and water acidification potential                              | eq. mol H+             | 7.09E-03 | 1.03E-03 | 3.75E-02 | 4.56E-02 | 3.37E-04 | 4.83E-07 | 7.25E-05 | 6.75E-05 | 9.28E-05 | 9.90E-07 | -7.67E-02 |
| Eutrophication potential - freshwater                               | eq. kg P               | 4.03E-04 | 1.70E-05 | 3.24E-04 | 7.44E-04 | 5.59E-06 | 7.87E-08 | 1.18E-05 | 1.12E-06 | 1.29E-05 | 9.81E-09 | -6.21E-03 |
| Eutrophication potential - seawater                                 | eq. kg N               | 1.83E-03 | 3.10E-04 | 1.10E-02 | 1.32E-02 | 1.02E-04 | 6.84E-08 | 1.03E-05 | 2.04E-05 | 1.74E-05 | 3.45E-07 | -1.35E-02 |
| Eutrophication potential - terrestrial                              | eq. mol N              | 1.82E-02 | 3.38E-03 | 1.83E-01 | 2.04E-01 | 1.11E-03 | 5.97E-07 | 8.95E-05 | 2.22E-04 | 1.60E-04 | 3.77E-06 | -1.33E-01 |
| Potential for photochemical ozone synthesis                         | eq. kg NMVOC           | 6.37E-03 | 1.03E-03 | 3.17E-02 | 3.91E-02 | 3.40E-04 | 1.72E-07 | 2.57E-05 | 6.80E-05 | 4.58E-05 | 1.10E-06 | -4.14E-02 |
| Potential for depletion of abiotic resources - non-fossil resources | eq. kg Sb              | 1.45E-04 | 8.96E-07 | 2.75E-06 | 1.49E-04 | 2.95E-07 | 1.72E-11 | 2.58E-09 | 5.89E-08 | 8.16E-08 | 2.42E-10 | -3.09E-03 |
| Abiotic depletion potential - fossil fuels                          | MJ                     | 9.04E+01 | 3.75E+00 | 1.18E+01 | 1.06E+02 | 1.23E+00 | 7.21E-04 | 1.08E-01 | 2.47E-01 | 1.45E-01 | 2.89E-03 | -1.36E+02 |
| Water deprivation potential   | eq. m <sup>3</sup>     | 2.70E+00 | 1.73E-02 | 9.49E-01 | 3.66E+00 | 5.70E-03 | 1.38E-05 | 2.07E-03 | 1.14E-03 | 5.49E-03 | 9.16E-06 | -4.29E+01 |

*Table 4 Life cycle assessment (LCA) results for specific product – additional impacts indicators (DU: 1 kg)*

| Indicator  | Unit              | A1-A3 | A4-A5 | C1-C4 | D   |
|--|-------------------|-------|-------|-------|-----|
| Particulate matter   | disease incidence | INA   | INA   | INA   | INA |
| Potential human exposure efficiency relative to U235             | eg. kBq U235      | INA   | INA   | INA   | INA |
| Potential comparative toxic unit for ecosystems                  | CTUe              | INA   | INA   | INA   | INA |
| Potential comparative toxic unit for humans (cancer effects)     | CTUh              | INA   | INA   | INA   | INA |
| Potential comparative toxic unit for humans (non-cancer effects) | CTUh              | INA   | INA   | INA   | INA |
| Potential soil quality index                                     | dimensionless     | INA   | INA   | INA   | INA |

## Type III Environmental Product Declaration No. 559/2023

Table 5 Life cycle assessment (LCA) results for specific product - the resource use (DU: 1 kg)

| Indicator  | Unit           | A1       | A2       | A3       | A1-A3    | A4       | A5       | C1       | C2       | C3        | C4       | D         |
|--|----------------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|-----------|
| Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials     | MJ             | 1.79E+01 | 5.38E-02 | 1.87E+02 | 2.05E+02 | 1.77E-02 | 5.93E-05 | 8.90E-03 | 3.54E-03 | 2.23E-02  | 2.51E-05 | -1.18E+02 |
| Consumption of renewable primary energy resources used as raw materials  | MJ             | 1.60E-01 | 0.00E+00 | 0.00E+00 | 1.60E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  | 0.00E+00 | 0.00E+00  |
| Total consumption of renewable primary energy resources  | MJ             | 1.82E+01 | 5.38E-02 | 1.87E+02 | 2.05E+02 | 1.77E-02 | 5.93E-05 | 8.90E-03 | 3.54E-03 | 2.23E-02  | 2.51E-05 | -1.18E+02 |
| Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials | MJ             | 8.43E+01 | 3.75E+00 | 1.18E+01 | 1.07E+02 | 1.23E+00 | 7.21E-04 | 1.08E-01 | 2.47E-01 | -3.25E+00 | 2.89E-03 | -1.33E+02 |
| Consumption of non-renewable primary energy resources used as raw materials                                    | MJ             | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.40E+00  | 0.00E+00 | -2.62E+00 |
| Total consumption of non-renewable primary energy resources  | MJ             | 9.16E+01 | 3.75E+00 | 1.18E+01 | 1.07E+02 | 1.23E+00 | 7.21E-04 | 1.08E-01 | 2.47E-01 | 1.45E-01  | 2.89E-03 | -1.36E+02 |
| Consumption of secondary materials   | kg             | 1.13E-00 | 1.26E-03 | 1.39E-02 | 4.78E-02 | 4.14E-04 | 6.27E-08 | 9.40E-06 | 8.27E-05 | 2.09E-04  | 6.07E-07 | 9.80E-01  |
| Consumption of renew. secondary fuels  | MJ             | 5.56E-05 | 1.39E-05 | 7.54E-03 | 7.61E-03 | 4.56E-06 | 3.16E-10 | 4.75E-08 | 9.11E-07 | 2.63E-06  | 1.59E-08 | -5.54E-04 |
| Consumption of non-renewable secondary fuels   | MJ             | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  | 0.00E+00 | 0.00E+00  |
| Net consumption of freshwater  | m <sup>3</sup> | 6.31E-02 | 4.72E-04 | 1.09E-02 | 7.45E-02 | 1.55E-04 | 2.07E-06 | 3.11E-04 | 3.10E-05 | 3.79E-04  | 3.16E-06 | -8.87E-01 |

Table 6 Life cycle assessment (LCA) results for specific product – waste categories (DU: 1 kg)

| Indicator                     | Unit | A1       | A2       | A3       | A1-A3    | A4       | A5       | C1       | C2       | C3       | C4       | D         |
|-------------------------------|------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|
| Hazardous waste               | kg   | 6.29E-02 | 4.21E-03 | 2.44E-02 | 9.16E-02 | 1.38E-03 | 5.59E-06 | 8.38E-04 | 2.77E-04 | 1.60E-03 | 3.07E-06 | -6.30E-01 |
| Non-hazardous waste           | kg   | 4.61E+00 | 7.47E-02 | 8.31E-01 | 5.51E+00 | 2.46E-02 | 3.76E-04 | 5.65E-02 | 4.92E-03 | 6.78E-02 | 4.32E-05 | -1.78E+01 |
| Radioactive waste             | kg   | 9.97E-04 | 2.80E-07 | 1.42E-05 | 1.01E-03 | 9.21E-08 | 1.08E-10 | 1.62E-08 | 1.84E-08 | 2.67E-07 | 1.92E-08 | -5.04E-04 |
| Components for re-use         | kg   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  |
| Materials for recycling       | kg   | 8.69E-01 | 1.16E-05 | 1.01E+00 | 1.88E+00 | 3.82E-06 | 4.84E-09 | 7.26E-07 | 7.64E-07 | 7.24E-02 | 5.78E-09 | -1.45E-02 |
| Materials for energy recovery | kg   | 8.72E-04 | 9.39E-08 | 1.00E-03 | 1.87E-03 | 3.09E-08 | 7.78E-12 | 1.17E-09 | 6.18E-09 | 2.13E-08 | 6.85E-11 | -5.14E-05 |
| Exported Energy               | MJ   | 5.12E-01 | 0.00E+00 | 1.76E-02 | 5.29E-01 | 0.00E+00 | 2.31E-06 | 3.46E-04 | 0.00E+00 | 8.84E-02 | 0.00E+00 | -1.43E-01 |

## Type III Environmental Product Declaration No. 559/2023

### Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification, this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

|   |
|---|
| The basis for LCA analysis was EN 15804 and ITB PCR A   |
| Independent verification corresponding to ISO 14025 (sub clause 8.1.3.)<br><input checked="" type="checkbox"/> external <input type="checkbox"/> internal   |
| External verification of EPD: Halina Prejzner, PhD. Eng.<br>LCI audit and verification: Michał Chwedaczuk, M.Sc. Eng.<br>LCA, LCI audit and input data verification: Michał Piasecki, PhD., D.Sc., eng. |

Note 1: The declaration owner has the sole ownership, liability, and responsibility for the for the information provided and contained in EPD. Declarations of construction products may not be comparable if they do not comply with EN 15804+A2. For further information about comparability, see EN 15804+A2 and ISO 14025.

Note 2: Note: ITB is a public Research Organization and Notified Body (EC Reg. no 1488) to the European Commission and to other Member States of the European Union designated for the tasks concerning the assessment of building products' performance. ITB acts as the independent, third-party verification organization (see ISO 17025/17065/17029). ITB-EPD program is recognized and registered member of The European Platform - Association of EPD program operators and ITB-EPD declarations are registered and stored in the international ECO-PORTAL.

### Normative references

- ITB PCR A General Product Category Rules for Construction Products (v.1.6.,2023)
- PN-EN 12266-1:2012 - Badania armatury metalowej -- Część 1: Próby ciśnieniowe, procedury badawcze i kryteria odbioru -- Wymagania obowiązkowe
- ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- ISO 14067:2018 Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification
- PN-EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- ISO 20915:2018 Life cycle inventory calculation methodology for steel products
- KOBiZE Wskaźniki emisyjności CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO i pyłu całkowitego dla energii elektrycznej. December 2021
- World Steel Association 2017 Life Cycle inventory methodology report for steel products





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**CERTIFICATE № 559/2023**  
**of TYPE III ENVIRONMENTAL DECLARATION**

Products:

**TA-COMPACT-P valve**

Manufacturer:

**IMI International Sp. z o.o.**

Olewin 50A, 32-300 Olkusz, Poland

confirms the correctness of the data included in the development of  
Type III Environmental Declaration and accordance with the requirements of the standard

**EN 15804+A2**

**Sustainability of construction works.**

**Environmental product declarations.**

**Core rules for the product category of construction products.**

This certificate, issued on 16<sup>th</sup> November 2023 is valid for 5 years  
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physics, Acoustics  
and Environment Department

Agnieszka Winkler-Skalna, PhD



Deputy Director  
for Research and Innovation

Krzysztof Kuczyński, PhD

Warsaw, November 2023