**ENVIRONMENTAL** PRODUCT DECLARATION

# HOT ROLLED COIL/CHECKERED COIL

STRUCTURAL STEEL

TOKYO STEEL MANUFACTURING CO.,LTD.

TOKYO STEEL MANUFACTURING CO., LTD. started out as a small steel maker in Tokyo almost 80 years ago. It has since grown into Japan's leading electric-arc-furnace steelmaker with an annual production of several million tons.

Tokyo Steel prides itself as a recycler of steel scrap - its primary raw material - letting it protect the environment and thus contribute to society. Recycling of steel products with the electric arc furnace process is truly the most effective in terms of achieving a recycling-based society and low-carbon society at the same time. To contribute to Japan's target of reducing greenhouse gas (GHG) emissions by 80% by 2050 while making advanced use of steel scrap that, in aggregate, amounts to several decades' worth of domestic steel demand, Tokyo Steel will work, with strong determination, to provide even more diverse customers with a wide range of products.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

# ENVIRONMENTAL PRODUCT DECLARATION

TOKYO STEEL MANUFACTURING CO.,LTD.

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

**Hot Rolled Coil/Checkered Coil**
Structural Steel

**According to ISO 14025, EN 15804, and ISO 21930:2017**

| | |
|---|---|
| EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE | UL Environment 333 Pfingsten Road Northbrook, IL 60611 https://www.ul.com/ https://spot.ul.com |
| GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER | General Program Instructions v.2.4 July 2018 |
| MANUFACTURER NAME AND ADDRESS | Tokyo Steel Manufacturing Co. Ltd. |
| DECLARATION NUMBER | 4788852729.101.1 |
| DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT | Hot Rolled Coil/Checkered Coil Structural Steel, 1 metric ton |
| REFERENCE PCR AND VERSION NUMBER | - Product Category Rules for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL Environment, Standard 10010, Version 3.1<br>- Part B: Requirements on the EPD for Structural steels Version 1.6 November 1027<br>- Product Category Rules for preparing an environmental product declaration for Part B: Requirements on the EPD for Structural steels (ADDENDUM, VERSION 1.1, December, 2017) |
| DESCRIPTION OF PRODUCT APPLICATION/USE | Structural steel “Hot Rolled Coil/Checkered Coil” is used in most buildings and civil works, mainly in structural steel constructions. In addition to the construction sector there are numerous applications in very diverse sectors. |
| PRODUCT RSL DESCRIPTION (IF APPL.) | The Reference service life is not specified |
| MARKETS OF APPLICABILITY | Japan |
| DATE OF ISSUE | October 1, 2019 |
| PERIOD OF VALIDITY | 5 Years |
| EPD TYPE | Product-Specific |
| EPD SCOPE | Cradle to gate |
| YEAR(S) OF REPORTED PRIMARY DATA | April 2017 and March 2018 |
| LCA SOFTWARE & VERSION NUMBER | IDEAv2.1.3 database (2017) |
| LCI DATABASE(S) & VERSION NUMBER | IDEAv2.1.3 database (2017) |
| LCIA METHODOLOGY & VERSION NUMBER | LIME2 |

| | |
|---|---|
| This PCR review was conducted by: | Institut Bauen und Umwelt e.V (IBU)<br>PCR Review Panel<br>PCR tested and approved by the SVR |
| This declaration was independently verified in accordance with ISO 14025: 2006.<br>☐ INTERNAL ☒ EXTERNAL | Grant R. Martin<br>Grant R. Martin, UL Environment |
| This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: | Thomas P. Gloria<br>Thomas P. Gloria, Industrial Ecology Consultants |

LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible”. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

# ENVIRONMENTAL PRODUCT DECLARATION

TOKYO STEEL MANUFACTURING CO.,LTD.

**Hot Rolled Coil/Checkered**
Coil Structural Steel

According to ISO 14025

## Product Information

### Product Description

The product declared is structural steel “Hot Rolled Coil/Checkered Coil”, which is classified as “Floor plates” in the Section 2, Classification of Material of the AISC 303‐10 Code of Standard Practice for Steel Buildings and Bridges. The production process used is the Electric Arc Furnace. This route, used by TOKYO STEEL 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 plate shape. No metallic or organic coating.

The product is provided for Japan market and complies with JIS G 3101/JIS G 3106/JIS G 3136/JIS G 3113/JIS G 3125/JIS G3132/JIS G 3131 (Regional designation code: JIS).

### Application

Structural steel “Hot Rolled Coil/Checkered Coil” is used in most buildings and civil works, mainly in structural steel constructions. In addition to the construction sector there are numerous applications in very diverse sectors.

### Technical Data

| Name | Value | Unit |
|---|---|---|
| Density | 7,874 | $kg/m^3$ |
| Modulus of elasticity | 2.1 | $N/mm^2$ |
| Coefficient of thermal expansion | 11.7 | $10^{-6}K^{-1}$ |
| Thermal conductivity | 80.2 | W/(mK) |
| Melting point | 1370 | °C |
| Electrical conductivity at 20C | 1,030 | $\Omega^{-1}m^{-1}$ |
| Minimum yield strength | 215 | $N/mm^2$ |
| Minimum tensile strength | 315 | $N/mm^2$ |
| Minimum elongation | 16 | % |
| Tensile strength | 436 | $N/mm^2$ |
| Compressive strength | 235 | $N/mm^2$ |
| Grade of material according to the delivery standards | SS400 etc | - |

TOKYO STEEL MANUFACTURING CO.,LTD.

**Hot Rolled Coil/Checkered Coil**
Structural Steel

According to ISO 14025

## Delivery Dtatus

The delivery conditions and dimension may vary according to the intended application.

## Base Materials / Ancillary Materials

Structural steel “Hot Rolled Coil/Checkered Coil” is a low-alloy steel product. The typical content of carbon is lower than 0.18%. The share of other elements besides iron is typically below 1%. 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.).

The principal material is Steel and alloying elements are added on the form of ferroalloys and metals.

Any hazardous substances defined in Basel Convention and/or regulated by Japanese laws are not included in raw materials.

## Manufacturing

The steel scrap is melted in an electric arc furnace to obtain liquid steel, which is then refined in a ladle furnace with addition of ferroalloys and metals to obtain the required steel characteristics. The steel is then casted at a continuous caster to obtain semi-finished products. The semis are then rolled to the desired size.

TOKYO STEEL MFG produces the structural steel “Hot Rolled Coil/Checkered Coil”.

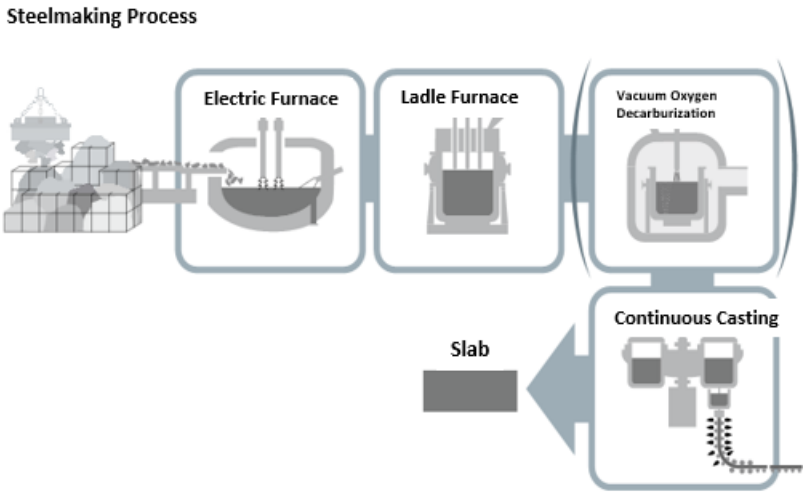
| Factory | Address |
|---|---|
| TOKYO STEEL MFG<br>Tahara Plant | 2-1-3, Shirahama,Tahara-shi, Aichi 441-3436, Japan |

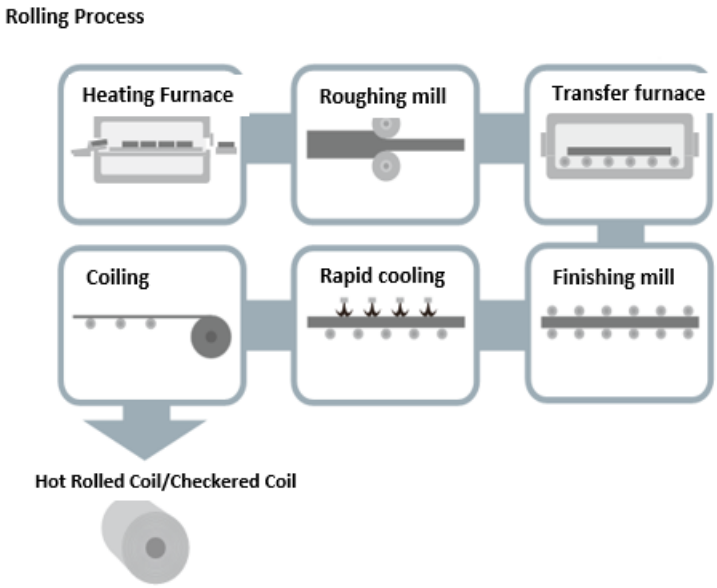
TOKYO STEEL MANUFACTURING CO.,LTD.

Hot Rolled Coil/Checkered Coil
Structural Steel

According to ISO 14025

Manufacturing process flow



TOKYO STEEL MANUFACTURING CO.,LTD.

**Hot Rolled Coil/Checkered Coil**
Structural Steel

According to ISO 14025

## Quality Management System

TOKYO STEEL MFG Tahara Plant is certified according to ISO9001 Quality Management System.

## Environment and Health During Manufacturing

TOKYO STEEL MFG Tahara Plant is certified according to ISO14001 Environment Management System.

## Product Processing/ Installation

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 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.

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

## Packaging

Structural steel “Hot Rolled Coil/Checkered Coil” is delivered unpacked.

## Condition of Use

During use no changes in material composition shall occur. Maintenance requirement will depend on specific design and application.

## Environment and health During Use

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

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.

TOKYO STEEL MANUFACTURING CO.,LTD.

**Hot Rolled Coil/Checkered Coil**
Structural Steel

According to ISO 14025

## Reference Service Life

The Reference service life is not specified. This LCA study covers only Module A1 to A3 and there are many different applications.

## Extraordinary Effect

Fire: Structural steels are classified as incombustible materials according to Notification No. 1400 by Ministry of Construction Japan

Water: Not relevant

Mechanical destruction: Not relevant

## Re-use Phase

H beam 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.

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.

## 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 no environmental impacts result.

The disposal pathway in Japan: Recycling (99%), Landfill (1%), Incineration (0%)

Waste code according to Basel convention is

A1010: Metal wastes

And Waste classification according to Japanese national law “Waste Management Law” is

Industrial Waste: 1210 Steel scrap

Industrial Waste shall be collected by a licensed collector.

## Further Information

Additional information can be obtained from http://www.tokyosteel.co.jp/

TOKYO STEEL MANUFACTURING CO.,LTD.

**Hot Rolled Coil/Checkered Coil**
Structural Steel

According to ISO 14025

## LCA Rules

### Declared Unit

| Name | Value | Unit |
|---|---|---|
| Declared unit | 1 | metric ton |
| Density | 7,874 | kg/m$^3$ |
| Conversion factor to 1kg | 0.001 | - |
| Thickness | 1.45 - 25.0 | mm |

### System Boundary

| 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 | Refurbishment | 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 |

This is an EPD based on a cradle-to-gate life cycle assessment. The selected system boundaries of this study encompass the following steps:
A1: Production of raw materials and energy
A2: Transport of resources to the production site
A3: Production of the product

### Estimates and Assumptions

Regarding the transportation of materials, 80% of steel scraps is collected within 75km of the plant. The distance of transportation was set as 75km. 20% of steel scrap is transported from San Francisco port to Tokyo port. Assumed Coal coke would be transported from Melbourne port to Tokyo port because of the largest exporting country Australia.

## Cut-off Rules

Regarding the transportation of resources, the transportations of primary materials (Steel scrap, Coal coke, Calcium oxide) have been considered. However, the transportations of other resources (1% of total resources) were ignored. The impact of this cut-off was reviewed in the section of Interpretation.

Except the above cut-off, all information from the data collection process has been considered, covering all used and registered materials, thermal energy, electrical energy and diesel consumption.

## Background Data

Principally the inventory data include material, energy, auxiliary, water consumption (foreground data). The foreground data are derived from the Tahara Plant.

Further, LCA data sets (background data) linked to the foreground data of various stages of the life cycle (cradle to gate) were obtained from IDEAv2.1.3 database (2017).

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.

## Data Quality

All foreground data were collected at Utsunomiya Plant Between April 2017 and March 2018 (One year average data).

Background data were used from IDEAv2.1.3 database (The data version is 2017).

## Allocation

The manufacturing process generates by-products, Slag and internal circulation waste. All slag and internal circulation wastes outputs are input to this main product.

The measured Electricity was for all activities at Tahara plant, including structural steel manufacturing and other office activities. However, since electricity for other office activities was less than 1% of total electricity consumption, no electricity allocation was considered.

Tahara plant produce only Hot Rolled Coil/Checkered Coil. So all resources were allocated to this product Hot Rolled Coil/Checkered Coil. There was no co-product allocation.

## 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 /ISO 21930, EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

TOKYO STEEL MANUFACTURING CO.,LTD.

Hot Rolled Coil/Checkered
Coil Structural Steel

According to ISO 14025

## Life Cycle Assessment Results

| Environment Impact (Assessment Method: LIME2) | | |
|---|---|---|
| Impact Category | Units | A1-A3 |
| Global warming (GWP) | kg-$CO_2$eq | 7.64E+02 |
| Acidification (AP) | kg-$SO_2$eq | 5.82E-01 |
| Eutrophication (EP) | kg$PO_4^3$-eq | 4.19E-03 |
| Ozone depletion (ODP) | kg-CFC-11eq | 1.90E-06 |
| Photo Chemical Ozone Creation (POCP) | kg-$C_2H_4$eq | 1.23E-02 |

| Resource Use | | |
|---|---|---|
| Parameter | Units | A1-A3 |
| Renewable primary energy as energy carrier | MJ | 2.26E+02 |
| Renewable primary energy resources as material utilization | MJ | 1.32E+01 |
| Total use of renewable primary energy resources | MJ | 2.40E+02 |
| Nonrenewable primary energy as energy carrier | MJ | 2.17E+02 |
| Nonrenewable primary energy as material utilization | MJ | 4.18E+01 |
| Total use of nonrenewable primary energy resources | MJ | 2.59E+02 |
| Use of secondary material | kg | 1.12E+03 |
| Use of renewable secondary fuels | MJ | - |
| Use of nonrenewable secondary fuels | MJ | - |
| Use of net fresh water | $m^3$ | 6.18E+02 |

| Output Flows and Waste Categories | | |
|---|---|---|
| Parameter | Units | A1-A3 |
| Hazardous waste disposed | kg | 1.60E+01 |
| Nonhazardous waste disposed | kg | 9.02E-02 |
| Radioactive waste disposed | kg | - |
| Components for reuse | kg | - |

| | | |
|---|---|---|
| MFR Materials for recycling | kg | 1.52E+02 |
| MER Materials for energy recovery | kg | - |
| Exported Energy | MJ | - |

## Interpretation

### Completeness

Regarding the transportation of resources, the transportations of 1% resources (1% of total resources) were ignored. The impacts at the A2 transportation stage are below. If average 1% of impact at A2 transportation stage will be added, 0.0206% of GWP, 0.1365% of AP and 0.0954% of POCP could be increased.

| Environment Impact (Assessment Method: LIME2) | | | | | |
|---|---|---|---|---|---|
| Impact Category | Units | A1-A3 | A2 | A2 impact of total | 1% of A2 impact |
| GWP | kg-$CO_2$eq | 7.64E+02 | 1.57E+01 | 2.06% | 0.0206% |
| AP | kg-$SO_2$eq | 5.82E-01 | 7.94E-02 | 13.65% | 0.1365% |
| EP | kg$PO_4^3$-eq | 4.19E-03 | 9.08E-14 | 0.00% | 0.0000% |
| ODP | kg-CFC-11eq | 1.90E-06 | 1.03E-10 | 0.01% | 0.0001% |
| POCP | kg-$C_2H_4$eq | 1.23E-02 | 1.18E-03 | 9.54% | 0.0954% |

### Sensitivity

Proxies were used for Ferro-chromium, Ferroboron, fluxing lime, Calcium aluminate, Calcium silicon because appropriate datasets were missing in IDEA database. The impacts of proxies are below. Especially Calcium aluminate (proxies: Aluminum) has most of the impact and and 99.38% of ODP impact.

| Environment Impact (Assessment Method: LIME2) | | | | | |
|---|---|---|---|---|---|
| Impact Category | Units | A1-A3 | Proxies | Impact of proxies | 10% of proxies impact |
| GWP | kg-$CO_2$eq | 7.64E+02 | 1.39E+01 | 1.82% | 0.182% |
| AP | kg-$SO_2$eq | 5.82E-01 | 7.70E-03 | 1.32% | 0.132% |
| EP | kg$PO_4^3$-eq | 4.19E-03 | 4.41E-07 | 0.01% | 0.001% |
| ODP | kg-CFC-11eq | 1.90E-06 | 2.20E-07 | 11.57% | 1.157% |
| POCP | kg-$C_2H_4$eq | 1.23E-02 | 1.75E-04 | 1.41% | 0.141% |

## Consistency

All manufacturing data was gathered with the same level of detail and all background data were sourced from IDEA database selecting most appropriate geography.

## Representativeness

There are three factories to produce Structural steel “H beam”. All are located in Japan and three factories use the same manufacturing equipment/process/materials. Only a difference is the distance of domestic transportation for materials. The impact of transportation was reviewed in Completeness section.

It shows foreground data from one factory Utsunomiya Plant can be used as representative of three factories.

# References

Institut Bauen und Umwelt e.V., Berlin(pub.) General Principles for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04 www.ibuepd.de

DIN EN /ISO 14025:201110: Environmental labels and declarations - Type III environmental declarations - Principles and procedures

ISO 14040:2006 - Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006 - Environmental management – Life cycle assessment – Requirements and guidelines

ISO 21930:2017 - Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

EN 15804:201204+A1 2013: Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products

ISO 14001:2015 - Environmental management systems -- Requirements with guidance for use

ISO 9001:2015 - Quality management systems – Requirements

JIS G 3101: Rolled steels for general structure

JIG G 3106: Rolled steels for welded structure

JIG G 3136: Rolled steels for building structure

Notification No. 1400 by Ministry of Construction Japan: Classification of incombustible materials

Product Category Rules for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL Environment, Standard 10010, Version 3.1 December 2018

IBU Part B: Requirements on the EPD for Structural steels Version 1.6 November 2017

UL Product Category Rules for preparing an environmental product declaration for Part B: Requirements on the EPD for Structural steels (ADDENDUM, VERSION 1.1, December, 2017)

North American Product Category Rule for Designated Steel Construction Products: SGS Services, Version 1.0. May 2015 Layout guidelines for photos: