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# PIG IRON

## A guide to shipping, handling and storage

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**Document history**
This is Version 2 of IIMA's guide for handling and transportation of pig iron, Version 1 having been published in 2014.

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## Introduction

This guide refers to the handling of merchant pig iron produced in blast furnaces, electric smelting furnaces, and other iron making processes.

The term "**pig iron**" can be traced back to the method of casting liquid blast furnace iron into moulds arranged in sand beds such that they could be fed from a common runner. The group of moulds resembled a litter of suckling pigs; therefore, the ingots became known as "pigs" and the runner as the "sow".

Merchant pig iron is cold, solid iron which has been cast into ingots for sale principally as ferrous feedstock for production of crude steel and ferrous castings. Merchant pig iron is produced both by dedicated merchant plants, all of whose production is sold to external customers, and by integrated steel mills with iron that is surplus to their internal requirements. It is also produced as a co-product of primary smelting of other metallic ores containing iron, particularly ilmenite (titanium, see section 1.1 and Annex 2) and lateritic nickel ores. The latter, known as "nickel pig iron", a low-grade ferronickel product, is not addressed in this guide.

With its well-defined specification (key aspects of which are the absence of metallic impurities such as copper and low gangue content) and closely controlled quality, pig iron is a clean and consistent charge material for both electric arc furnace (EAF) steelmaking and ferrous castings production. It also contains carbon which contributes chemical energy to the smelting process and thereby reduces the external energy consumption of a melt.

For its principal applications, pig iron shipped in bulk, mainly by sea in ocean going vessels. It is also shipped in barges, by rail and by truck. Dry bulk terminals where pig iron is loaded, transhipped or unloaded constitute an important component of the supply chain and have a vital role to play in the safe and efficient handling and transport of pig iron.

Other forms of traded pig iron include various forms of scrap iron and granulated pig iron (GPI).

For further information about pig iron, please refer to IIMA's website www.metallics.org. Fact Sheets on various types of pig iron can be download from here. Information about pig iron production technologies can be found on IIMA's website here.

# 1. Pig Iron Characteristics

### 1.1 Introduction

This chapter is focused on merchant pig iron produced by the main processes: (a) reduction of iron ores in blast furnaces and (b) smelting ilmenite in electric furnaces.

The following are the most common pig iron qualities by type:

- Basic pig iron, used as feedstock for EAF steelmaking;
- Foundry pig iron, also known as hematite pig iron, used as feedstock for production of grey iron castings;
- Nodular pig iron, also known as high purity pig iron or spheroidal graphite (SG) pig iron, used as feedstock for production of ductile iron castings. What is referred to as high purity pig iron (HPPI) is generally produced as a co-product of titanium dioxide slag from electric smelting of ilmenite.

The various grades of pig iron have specific chemical properties designed for their end use and should not be co-mingled in transport and handling processes. Table 1 provides an overview of the typical specifications for the various types of merchant pig iron.

## Table 1: general specifications for pig iron (weight %)

| | Basic | Foundry | Nodular/HPPI |
|---|---|---|---|
| **Fe** | 94.0 – 95.0% | 94.0 – 95.0% | 94.0 – 95.0% |
| **C** | 3.5 – 4.5% | 3.5 – 4.5% | 3.5 – 4.5% |
| **Si** | ≤1.25% | 1.5 – 3.5% | 0.05-2.0% |
| **Mn** | ≤ 1.0% | 0.5 – 1.0% | ≤0.05% |
| **S** | ≤0.05% | ≤0.05% | ≤0.01% |
| **P** | ≤0.15% | ≤0.12% | <0.02% |
| **Ingot weight** | 3.5 – 45 kg | 3.5 – 45 kg | 3.5 – 45 kg |
| **Bulk density** | 3.3 – 3.7 t/m$^3$ | 3.3 – 3.7 t/m$^3$ | 3.3 – 3.7 t/m$^3$ |
| **Stowage factor** | 0.28 – 0.3 t/m$^3$ | 0.28 – 0.3 t/m$^3$ | 0.28 – 0.3 t/m$^3$ |
| **Angle of repose** | 49° | 49° | 49° |

FIGURE 1: VARIOUS PIG IRON INGOT TYPES/SHAPES

Pig iron ingots come in a variety of shapes and dimensions, as shown in Figure 1. Today the most commonly used ingot mould sizes are from 7 x 10 x 15 cm to 8 x 15 x 20 cm in Brazil and 20 x 20 x 15 cm in Russia and Ukraine.

### 1.2 Scrap Pig Iron

The supply of molten hot metal from a blast furnace may exceed the demands of the steel plant, e.g. due to problems further downstream. In most integrated steel mills, the blast furnace plants are not equipped with pig casters, meaning that the excess hot metal has to be cast into an open air sand pit, a process known as "pooling" or "beaching." The resultant material is known by several names such as pool iron, plate iron, beach iron and flat iron and is hereinafter referred to as "scrap pig iron" (Figure 2).

FIGURE 2: SCRAP PIG IRON

### 1.3 Granulated Pig Iron (GPI)

GPI is a granular form of pig iron, produced by formation of liquid iron droplets, followed by rapid quenching in water (Figure 3). GPI has the same chemical analysis as the source hot metal, with typical analysis of 4-4.5 % C, 0.5-0.6 % Si and 94-95 % Fe. GPI has a deformed spheroidal shape and a high bulk density of around 4,000 kg/m$^3$. Particle size of GPI is 5 - 25 mm. GPI has a high angle of repose, which allows for effective transport and storage.

FIGURE 3: GRANULATED PIG IRON

### 1.4 Iron nuggets

Iron nuggets are in effect another type of pig iron (Figure 4), produced by smelting iron ore mixed with pulverised carbon in a rotary hearth type furnace, for example using the ITmk3 process. One commercial scale (0.5 mt) plant was built in Minnesota, commissioned in 2010, but subsequently idled indefinitely in 2015.

FIGURE 4: IRON NUGGETS
(IMAGE SOURCE KOBELCO)

## 2. Handling Equipment

This chapter describes a variety of equipment that can be used for handling merchant pig iron.

### 2.1 Introduction

Merchant pig iron is generally handled, transported, and stored a number of times prior to being used for steel or iron castings production:

a) within the production site from caster to temporary storage
b) to trucks and rail cars for transfer to the bulk terminal
c) within outbound bulk terminals for temporary storage
d) to vessels for maritime carriage to inbound bulk terminals
e) to barges, trucks, and rail cars for delivery to customers
f) within stockyard of customer site

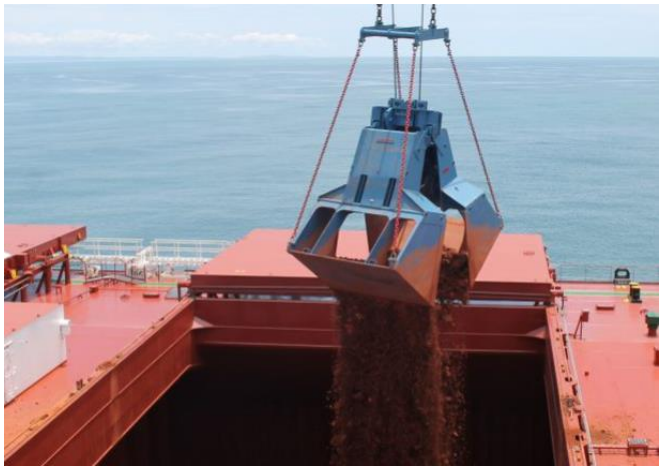
### 2.2 Pig Iron Ingot Handling

At the production site, pig iron ingots can be loaded into trucks or rail cars by the use of traditional equipment, such as front end loaders, mobile cranes with grabs and magnets (Figure 5).

FIGURE 5: PIG IRON HANDLING EQUIPMENT

For heavy and coarse materials, trimming grabs are the most efficient solution. Trimming grabs are in operation for handling coarse materials like stones, ferro-chrome, pig iron, DRI and HBI. Trimming grabs are special grabs with a very wide opening and large footprint which is extremely efficient during cleaning-up operations. Because the shells have a "horizontal closing path" the bulk material is "scraped together", instead of taking a bite out of the material. This makes it possible to ensure a good filling of the grab without having to penetrate the material (Figure 6).

FIGURE 6: TRIMMING GRAB (IMAGE COURTESY OF VERSTEGEN GRABS)



Crane-mounted industrial magnets also are effective devices for moving pig iron from a staging area and for loading it into the designated holds of a vessel.

It is important to minimise the drop height when handling pig iron in order to minimise breakage of ingots and generation of chips and fines and to minimise damage to vessel holds (if dunnage is not used to lessen the impact, for example wooden pallets - see 4.1.5). Commercial contracts generally provide for a maximum content of chips and fines, say 5% by weight, beyond which the excess weight is deducted from the weight of the cargo for invoicing purposes. Contracts can also provide limits for broken pigs, as well as the content of dust, dirt and impurities.

With respect to dusting, a thin surface layer of pig iron ingots will tend to oxidise within a period of a couple of weeks, the resultant iron oxide layer being subject to dust generation. When loading trucks or railcars from a pig iron stockpile, it should be kept in mind that the fines and dust will tend to segregate to the bottom of the pile.

### 2.3 Scrap Pig Iron

Larger pieces of scrap pig iron can be handled with equipment similar to that used for pig iron ingots. However, scrap handling grabs and magnets are more suitable (Figure 7). Scrap pig iron is covered by the IMSBC Code schedule for IRON SMELTING BY-PRODUCTS - see Chapter 3.

FIGURE 7: GRAB AND MAGNET FOR HANDLING SCRAP PIG IRON

### 2.4 Granulated Pig Iron

Granulated pig iron (GPI) is much easier to handle than pig iron ingots due to its particle size (5-25 mm). It can be handled with conventional bulk handling equipment in the same manner as many bulk commodities such as lump iron ore.

GPI is transported mainly in bulk, although smaller quantities can be shipped in bulk bags in container. All types of conventional bulk material handling equipment can be used for GPI for yard storage, reclaiming, loading and/or unloading):

- bucket-wheel stacker-reclaimers
- cranes equipped with magnets or clamshell-type buckets
- front-end loaders, backhoes
- fixed or mobile conveyors and conveyor belt systems, including pipe conveyor systems
- fixed or mobile bins and hoppers
- if at port terminal or at anchor for mid-streaming operations to barges, ship travelling bridge cranes, fixed cranes, floating cranes and belt systems
- self-release skips
- railcar straddle carriers and rotary dumpers

GPI can corrode during the course of handling, transport and storage in wet conditions and corroded material can form agglomerates during storage (Figure 8)

FIGURE 8: AGGLOMERATED GPI

GPI is also covered by the IMSBC Code schedule for IRON SMELTING BY-PRODUCTS – see Chapter 3. Back in 2011 Sweden (a GPI producing and exporting country) proposed that GPI should be covered by the IRON ORE schedule, but it was considered that GPI should have its own schedule, for which Sweden made a proposal in 2012 (which stated "no special hazards"). However, in 2016 GPI was included in the new schedule for IRON SMELTING BY-PRODUCTS.

## 3. Pig iron and the IMSBC Code

There is an individual schedule for PIG IRON in the International Maritime Organisation's International Maritime Solid Bulk Cargoes Code (IMSBC Code) which is reproduced in Appendix 1 to this guide. Note that this does not cover scrap pig iron or granulated pig iron, both of which are covered by another individual schedule, that for IRON SMELTING BY-PRODUCTS, reproduced in Appendix 2 to this guide. In the PIG IRON schedule, the description refers only to Foundry pig iron, not basic and other grades, but as the description section is not mandatory, basic and other ingot grades can be shipped under this schedule. Both cargoes are Group C cargoes, i.e. cargoes which are neither liable to liquefy (Group A) nor to possess chemical hazards (Group B). Both schedules state "no special hazards" and that "this cargo is non-combustible or has low fire risk."

**PIG IRON schedule**
There are no special requirements in this schedule for the following standard sections: Stowage and segregation, Hold cleanliness, Weather precautions, Precautions, Ventilation, Carriage and Discharge.

The **Loading** section states:

- "This cargo is usually loaded using tubs. In such case, tubs are usually lowered by a crane into the hold and the contents are spilled out. When this cargo is loaded using tubs, the first few tubs shall be lowered onto the tank top to avoid damage.
- Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.
- As the density of the cargo is extremely high, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo."

The **Clean-up** section states:

- "Prior to washing out the residues of this cargo, the bilge wells of the cargo spaces shall be cleaned."

**IRON SMELTING BY-PRODUCTS schedule**
There are no special requirements in this schedule for the following standard sections: Stowage and segregation, Hold cleanliness, Weather precautions, Ventilation, Carriage and Clean-up.

The **Loading** section states:

- "Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.
- The tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo. Large pieces shall not be dropped in the cargo hold and placement of very large lumps shall be such that the tank top is not overstressed by point loads. The weight distribution in the hold shall be considered during loading."

The **Precautions** section states:

- "Bilge wells of the cargo spaces shall be protected from ingress of the cargo."

The **Discharge** section states:

- "When this cargo is discharged by magnet or spider grab:
  1. the deck and deck machineries shall be protected from falling cargo; and
  2. damages to the ship shall be checked, after the completion of discharge."

# 4. Maritime transport of pig iron (including scrap pig iron)

## 4.1 Preparations for loading

### 4.1.1 Vessel types

The following types of vessel have been used for ocean transport of pig iron:

- dry bulk carriers: single-deck, Handy-size, Handy-max, Supra-max, or Panamax with hydraulically or mechanically operated type or twin-fold type hatch covers of watertight construction.

Double-deck (tween deck) vessels are not recommended for shipment of pig iron.

### 4.1.2 Steps to be taken prior to loading pig iron

a) Appropriate precautions shall be taken to protect machinery, equipment and accommodation spaces from the dust of the cargo. Radars and exposed radio communication equipment of the ship shall be protected from dust.
b) Hold inspection shall be carried out on each hold to carry pig iron. Weather deck closures and hatch covers/coamings shall be inspected and tested to ensure integrity and weather tightness which shall be maintained throughout the voyage (hose testing, ultrasonic testing or equivalent).
c) Ensure that holds to carry pig iron shall be clean, dry and free from salt and residues of previous cargoes.
d) Wash down deck surfaces, etc. to remove any salt present.
e) Prior to loading, wooden fixtures such as battens, loose dunnage, debris and combustible materials shall be removed.
f) Ensure that bilge wells of the holds are clean, dry and protected from ingress of the cargo, using non-combustible material, e.g. burlap. The bilge system of a hold to which pig iron is to be loaded shall be tested to ensure that it is working properly and such tests documented.

### 4.1.3 BLU Code

Loading of bulk cargoes, including pig iron, is governed by the BLU Code i.e. the Code of Practice for the Safe Loading and Unloading of Bulk Cargoes[1]. Section 2 of the BLU Code addresses the suitability of ships and terminals: section 2.2 deals with ships and section 2.3 deals with terminals.

### 4.1.4 Loading and pre-voyage procedures and precautions

a) Check weather conditions, although pig iron can be loaded during precipitation.
b) Sweep holds clean of previous cargo residue or other non-essential materials.
c) Appropriate precautions shall be taken during loading in order to have a cargo composed of essentially whole ingots. The cargo shall be loaded in a manner such as to minimise breakage of ingots, the additional generation of fines/small particles and concentration of fines in any area of the cargo, for example by employing soft loading techniques (see 4.1.5 below).
d) Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent eye-protection and dust filter masks, as necessary.
e) Make sure stow is level and brows are in a straight line athwart ships (i.e. at right angles to the centreline of the ship)
f) As the density of the cargo is extremely high, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due

[1] latest (2011) edition published in 2011 by the International Maritime Organisation

consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

g) Trim in accordance with the relevant provisions required under sections 4 and 5 of the IMSBC Code.

h) On completion of loading and at all times when closing hatch covers, hatch coamings and gaskets should be thoroughly cleaned and inspected to ensure that coamings are free of cargo debris and that an adequate hatch to coaming seal is made.

### 4.1.5 Soft loading

The risk of (a) damage to the hold bottom, commonly known as the tank top and (b) the risk of breakage of ingots with consequent generation of chips, fines and dust can be minimized by minimizing the height from which the cargo falls by using a "soft loading" technique. Figure 9 illustrates the use of a skip which is charged shore-side, lifted to the hold floor by the ship's crane and emptied onto the hold bottom or cargo pile. Once the initial ingots have begun to create a pile in the hold, the impact of subsequent material is cushioned (and drop heights diminish) as the pile builds in the hold.

FIGURE 9: SOFT LOADING OF PIG IRON WITH SKIP

When soft loading equipment is not available, the hold bottom can be covered with an impact-absorbent material, such as wooden pallets, to lessen the impact of the ingots Figure 10). However, the broken wooden pallets tend to add unwanted debris to the pig iron cargo, which must be removed at some point.

Loading of pig iron at Ponta da Madeira port (PDM) in Brazil is done via conveyor belts. PDM can receive cape-size vessels of more than 150,000 dead weight tonnes (DWT). Due to the height from which the material falls onto the tank top for such large vessels and in order to the impact of the ingots avoid damage to the ship's holds, Ponta da Madeira (PDM) Port places ten (10) wooden pallets in the hold to absorb some of the impact.

FIGURE 10: USE OF PALLETS TO ABSORB THE IMPACT OF FALLING INGOTS

### 4.1.6 Grade separation

When loading multiple grades of pig iron, grade separation is an important consideration. For example, never stow Foundry and/or Basic Pig Iron with Nodular Pig Iron without good separation of the lots.

Methods of grade separation within a hold:

a) Paint marking on tank top to identify different grades, providing free space between grades (Figure 11)
b) Stow different grades at opposite ends of the hold (Figure 12)
c) Separate grades with rope across hold covered by tarpaulin (Figure 13)
d) Use wood sheets, double-run chicken wire, or plastic sheets between the grades (Figure 14)
e) Use zinc sheets between the grades (Figure 15)

It is preferable to separate grades by a vertical face athwart ships rather than by horizontal separation. Mark each grade with white cloth labels bearing grade numbers printed in black and ensure that trucks servicing each hold are accurately marked. If more than one grade is loaded in a hold, cover each grade as it is completed to avoid mixing during subsequent loading. Front end loaders or bulldozers can be used in the hold to separate the grades of pig iron (Figure 16).

FIGURE 12: PAINT MARK

FIGURE 11: OPPOSITE ENDS

FIGURE 14: ROPE SEPARATION

FIGURE 13: WOODEN SHEET

FIGURE 16: SEPARATION WITH ZINC SHEETS

FIGURE 15: VERTICAL FACE

### 4.1.7 During carriage

No special precautions are necessary during carriage as pig iron is non-hazardous.

### 4.1.8 Unloading of pig iron

#### 4.1.8.1 Discharge to barges

Discharge of pig iron in North American ports such as New Orleans, LA, Mobile, AL, and Charleston, SC is typically carried out at mid-stream anchorages where high capacity floating cranes are placed alongside the vessel (Figure 16) and discharge directly to river barges for delivery of the pig iron to the end user (Figure 17). A typical barge can

transport approximately 1,500 tonnes pig iron (Figure 18). In the principal European ports (in Italy and Turkey) pig iron is discharged directly to docks rather than via mid-streaming.

The discharge of all forms of pig iron from bulk carrier-type vessels is normally done by use of clam shell grabs for smaller, pyramid-shaped ingots and orange peel grab for the larger stick or loaf shaped ingots (Figure 19). Steel scrap is generally handled with orange peel grabs. For handling materials like pig iron, extra heavy orange peel grabs are required. To ensure a good penetration and good filling, the grabs have high dead weight. The spaces between the shells are relatively small to minimise the risk of material loss.

FIGURE 17: MID-STREAM DISCHARGE

FIGURE 19: MIDSTREAM DISCHARGE TO BARGES

FIGURE 18: BARGE LOAD OF APPROX 1,500 TONNES

FIGURE 20: CLAM SHELL GRAB FOR SMALLER INGOTS/PIECES (LEFT) AND ORANGE PEEL GRAPPLE FOR LARGER INGOTS/PIECES (RIGHT)

While discharging pig iron from vessel cargo holds, care should be used in protecting the topside deck of the vessel. When the crane transfers the pig iron out of the ship and swings over into the barge or to dockside, pieces of pig iron may fall out of the grabs with the consequent risk of damage to the vessel. Figure 20 shows plywood used to cover and protect on-deck piping and valves (wooden pallets may also be used).

FIGURE 21: EXPOSED ABOVE DECK PIPING/VALVES (LEFT) AND PLYWOOD USED TO PROTECT ABOVE DECK PIPING AND VALVES (RIGHT)


Different pig iron grades in the same barge hold should be separated and covered to avoid co-mingling. Care is required when approaching separated grades to avoid clam shell buckets and orange peel grabs from tearing through the separation material.

**4.1.8.2 Discharge to trucks, railcars or to storage pad**

When discharging pig iron into trucks, rail cars or to a storage pad, always check for and remove residues of other cargoes and other extraneous material in order to avoid contaminating the pig iron with unwanted debris.

Direct discharge of pig iron to trucks or rail cars is preferable to indirect discharge via the jetty or storage pad in order to avoid the risk of damage to the latter's concrete surfaces. When discharging to storage pad or dockside it is important to ensure the dock or pad is strong enough to withstand the weight of the pig iron.

Ensure that trucks, rail cars and barges are clearly marked with the grade they are carrying and the hold they are working.

When grabs or magnets are used to load trucks, rail cars or barges, the material should be dropped the minimum distance possible or "soft loaded" in order to avoid damage, breakage and the generation of chips and fines (Figures 21 - 23).

FIGURE 23: BARGE "SOFT LOADING"

FIGURE 22: TRUCK "SOFT LOADING"

FIGURE 24: RAIL CAR SOFT LOADING

Due to the high bulk density of pig iron, care must be taken to avoid overloading trucks, rail cars, and barges. Pig iron should be evenly distributed in order to minimize the risk of damage or accidents. Terminals handling multiple bulk materials should take into account the high density of pig iron relative to other materials.

When discharging scrap pig iron, be aware that this cargo may contain large pieces which can damage conveyors and transfer points.

### 4.1.9. Clean-up

Prior to washing out the residues of a pig iron cargo, the bilge well of the cargo spaces must be cleaned.

### 4.1.10 Shipment in containers

For smaller lot consignments pig iron can be shipped in containers, either loose bulk in container or in bulk bags. Containers are typically loaded using front end loaders, as shown in Figure 24. For loose bulk in container the floor and sides of the containers can be lined with a suitable protective material, as shown in Figure 25.

FIGURE 26: CONTAINER LOADING

FIGURE 25: BULK IN CONTAINER

# Appendix 1: IMSBC Code schedule for PIG IRON[2]

## Pig Iron

**Description**
Foundry pig iron is cast in 28 grades into 20 kg pigs. In a random heap, pig iron occupies approximately 50% of the apparent volume.

**Characteristics**

| Physical properties | | | |
|---|---|---|---|
| **Size** | **Angle of repose** | **Bulk density ($kg/m^3$)** | **Stowage factor ($m^3/t$)** |
| 550 mm x 90 mm X80 mm | Not applicable | 3,333 to 3,571 | 0.28 to 0.30 |
| **Hazard classification** | | | |
| **Class** | **Subsidiary hazard(s)** | **MHB** | **Group** |
| Not applicable | Not applicable | Not applicable | Not applicable |

**Hazard**
No special hazards.
This cargo is non-combustible or has a low fire risk.

**Stowage and segregation**
No special requirements.

**Weather precautions**
No special requirements.

**Loading**
This cargo is usually loaded using tubs. In such case, tubs are usually lowered by a crane into the hod and the contents are spilled out. When this cargo is loaded using tubs, the first few tubs shall be lowered onto the tank top to avoid damage.

Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

As the density of the cargo is extremely high, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

**Precautions**
No special requirements.

**Ventilation**
No special requirements.

**Carriage**
No special requirements.

**Discharge**
No special requirements.

**Clean-up**
Prior to washing out the residues of this cargo, the bilge wells of the cargo spaces shall be cleaned.

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# Appendix 2: IMSBC Code schedule for IRON SMELTING BY-PRODUCTS[2]

## Iron smelting by-products

**Description**
This cargo is a by-product from the smelting of iron ore and titanomagnetite. Grey or black, small to large lumps (up to 45 tonnes), granulated iron included. Depending on the dominant size, iron by-prodcuts from smelting or iron ore, ilmenite and titanomagnetite is called variously@

Iron pan edges K1-K3 bears
Separation of iron
Granulated iron
Plate iron
Pool iron
Flat iron
Steel bears
Pig iron by-product
Beach iron
Iron skulls

**Characteristics**

| Physical properties | | | |
|---|---|---|---|
| **Size** | **Angle of repose** | **Bulk density ($kg/m^3$)** | **Stowage factor ($m^3/t$)** |
| Various | Not applicable | Various | Various |
| **Hazard classification** | | | |
| Class | **Subsidiary hazard(s)** | **MHB** | **Group** |
| Not applicable | Not applicable | Not applicable | C |

**Hazard**
No special hazards.
This cargo is non-combustible or has a low fire risk.

**Stowage and segregation**
No special requirements.

**Hold cleanliness**
No special requirements.

**Weather precautions**
No special requirements.

**Loading**
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

The tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo. Large pieces shall not be dropped in the cargo hold and placement of very large lumps shall be such that the tank top is not overstressed by point loads. The weight distribution in the hold shall be considered during loading.

**Precautions**
Bilge wells of the cargo spaces shall be protected from ingress of the cargo.

**Ventilation**
No special requirements.

**Carriage**
No special requirements.

**Discharge**
When this cargo is discharge by magnet or spider grab:
1. the deck and dect machineries shall be protected from falling cargo; and
2. damages to the ship shall be checked after the completion of discharge.

**Clean-up**
No special requirements.