



# Chapter 13 – Scrap Metal

## 13.1 Borings, Shavings, Cuttings and Turnings

Ferrous materials (those that contain iron), in the form of iron swarf, steel swarf, borings, shavings or cuttings, are classified in the IMO *International Maritime Solid Bulk Cargoes Code* (IMSBC Code) as materials liable to self-heating and spontaneous ignition (Reference 17).

Turnings are produced by the machining, turning, milling, drilling, etc of steel. When produced, the turnings may be long and will form a tangled mass, but they may be passed through a crusher or chip breaker to form shorter lengths. Both forms of turnings are shipped and shipments are frequently a mixture of short and long chips. The density of short chips is approximately 60 pounds per cubic foot, twice the density of longer chips as they tend to compact more readily.

Borings are produced when iron castings are made. Because of the nature of the parent metal, borings break up more readily than turnings, tend to be finer and have a greater bulk density.

Turnings and borings may be contaminated with oils, such as the cutting oils used in the manufacturing processes. Oily rags and other combustible matter may also be found among the loads.

Iron will oxidise (rust), and in a finely divided form will oxidise rapidly. This oxidation is an exothermic reaction, ie it will release heat. In a shallow, level mass of turnings, this heat will be lost to the surrounding atmosphere. However, in large compact quantities, such as would be found in a cargo hold, this heat will be largely retained and, as a result, the temperature of the mass will increase. The oxidation process is accelerated if the material is wetted or damp or contaminated with cutting oils, oily rags or combustible matter.

The turnings may heat to high temperatures but will not necessarily produce flames. In one incident, temperatures in excess of 500°C were observed 6 ft below the surface of the cargo. Temperatures of this order may cause structural damage to the steelwork of the carrying vessel. Flames are frequently seen in cargoes of metal turnings, but they are usually the result of ignition of the cutting oils, rags, timber and other combustible materials that are mixed with the turnings.

Spontaneous heating of metal turnings has caused several major casualties. In one incident, the ship was moved from port to port in attempts to agree discharge. After weeks of delay, all the holds were eventually flooded to reduce the heating for safe discharge of the cargo. Following discharge, the ship loaded a cargo of conventional scrap. During the subsequent voyage, rough weather was encountered and cracks developed in the shell plating. The holds flooded and the ship was lost with 29 lives.

In another incident, heated turnings formed a solid mass in the hold and had to be mechanically broken into pieces before discharge by grab. In a further incident, following a normal passage, it was not possible to discharge the cargo by grabs as the surface of the stow had crusted to a hard mass. Bulldozers were used to loosen the surface of the cargo and, several hours later, fire was observed in all of the holds.

The *International Maritime Solid Bulk Cargoes Code* (IMSBC Code) (Reference 17) has special requirements for the loading of turnings and borings, including:

- Prior to loading, the temperature of the material should not exceed 55°C. Wooden battens, dunnage and debris should be removed from the cargo space before the material is loaded
- the surface temperature of the material should be taken prior to, during and after loading and daily during the voyage. Temperature readings during the voyage should be taken in such a way that entry into the cargo space is not required, or alternatively, if entry is required for this purpose, sufficient breathing apparatus, additional to that required by the safety equipment regulations, should be provided.

If the surface temperature exceeds 90°C during loading, further loading should cease and should not recommence until the temperature has fallen below 85°C. The ship should not depart unless the temperature is below 65°C and has shown a steady or downward trend in temperature for at least 8 hours. During loading and transport, the bilge of each cargo space in which the material is stowed should be as dry as practicable

- during loading, the material should be compacted in the cargo space as frequently as practicable with a bulldozer or other means. After loading, the material should be trimmed to eliminate peaks and should be compacted.

While at sea, any rise in surface temperature of the material indicates a self-heating reaction problem. If the temperature rises to 80°C, a potential fire is developing and the ship should make for the nearest port.

Early application of an inert gas to a smouldering fire may be effective. If possible, the Master should not use water to fight fire at sea and instead should proceed to a port of refuge. In port, copious quantities of water may be used but due consideration should still be given to stability

- entry into cargo spaces containing this material should be made only with the main hatches open, after adequate ventilation and when using breathing apparatus.

Compacting the cargo by loading with a bulldozer is recommended as this creates a dense mass, pushing the short turnings into the bundles of long turnings and tending to exclude air from the stow. However, some authorities argue that compacting the stow tends to break up the long turnings, creating greater surface area for the oxidation process. Shorter turnings should compact more readily than the longer forms, reducing the area exposed to oxidation.

Trimming level ensures that there is less cargo surface exposed to the air than cargo in a peaked condition. In addition, while air will theoretically pass across the top of a level trim, it can pass through the stow if loaded in a peaked condition, creating a 'chimney' effect that accelerates the heating process.

The requirements for safe entry into cargo spaces must be followed at all times. Many lives have been lost as a result of officers and crew members entering a hold to inspect a heating problem without taking adequate precautions.

## 13.2 Metal Dross and Residues

### Aluminium dross

Aluminium dross is formed during the recovery of aluminium from scrap and in the production of ingots. Dross may constitute about 5% of the metal where clean mill scrap is involved, but will constitute greater quantities where painted or litter scrap is recovered. The main components of dross are aluminium oxide and entrained aluminium. Small amounts of magnesium oxide, aluminium carbide and nitride are also present.

The dross is recovered and re-melted under controlled conditions to provide aluminium metal, which is then treated to remove hydrogen and other impurities, including trace elements. Storage or transport of aluminium dross should be conducted under carefully controlled conditions.

Contact with water may cause heating and the evolution of flammable and toxic gases, such as hydrogen, ammonia and acetylene. Hydrogen and acetylene have wide ranges of flammability and are readily ignited.

Aluminium dross, aluminium salt slags, aluminium skimmings, spent cathodes and spent potliner are included in the IMSBC Code (Reference 17), categorised as aluminium smelting by products.

The Code recommends that hot or wet material should not be loaded and a relevant certificate should be provided by the shipper stating that the material was stored under cover, but exposed to the weather in the particle size in which it is to be shipped, for not less than 3 days prior to shipment. The material should only be loaded under dry conditions and should be kept dry during the voyage. The material should only be stowed in a mechanically ventilated space. The ventilation equipment should be intrinsically safe.

### **Zinc dross**

Zinc dross, zinc skimmings, zinc ash and zinc residues are all materials obtained from the recovery of zinc. They may be recovered from galvanised sheets, batteries, car components, galvanising processes, etc. Zinc ashes are formed on the surface of molten zinc baths and, while primarily zinc oxide, particles of finely divided zinc will also adhere to the oxide. The different types of zinc are processed to produce pure zinc metal.

The ashes, dross, skimmings and residues are all reactive in the presence of moisture, liberating the flammable gas hydrogen and various toxic gases.

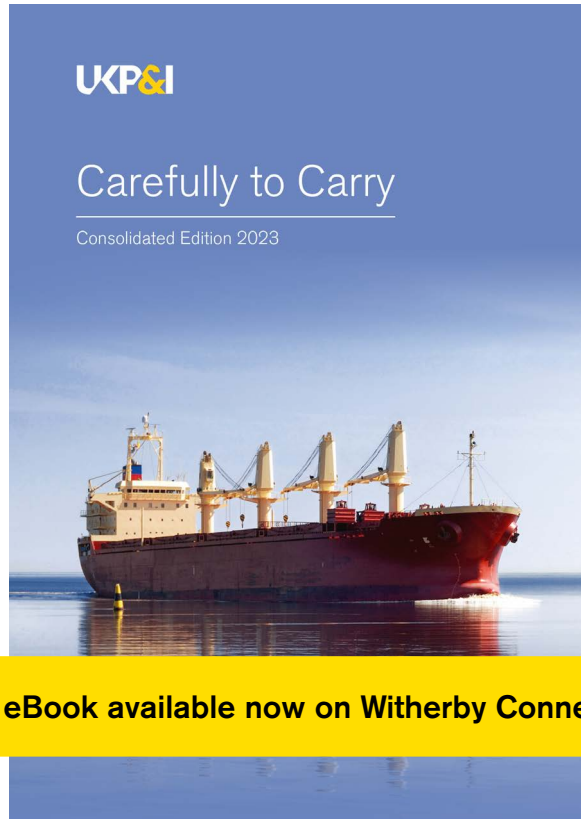
The materials are also listed in the IMSBC Code, which states that any shipment of the material requires approval of the competent authorities of the countries of shipment and the flag State of the ship.

The Code recommends that any material that is wet, or is known to have been wetted, should not be accepted for carriage. Furthermore, the materials should only be handled and transported under dry conditions. Ventilation of the holds should be sufficient to prevent build-up of hydrogen in the cargo spaces. All sources of ignition should be eliminated, including naked light work such as cutting and welding, smoking, electrical fittings, etc.

An incident where an explosion occurred in a hold containing zinc ashes was said to have been caused by a lamp used to warm the sealing tape to seal the hatch covers. The flame of the lamp ignited hydrogen gas leaking from the hold. The flame flashed back into the hold, igniting an explosive concentration of hydrogen/air. The explosion lifted the hatch covers and collapsed a deck crane. There was also loss of life. The hydrogen had been generated by reaction of the zinc ashes with water as the zinc ashes had been loaded in a damp condition. They were discharged and later spread on the quayside in a thin layer to dry. Seven days later, hydrogen gas was still being detected.



**Price: £95**



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Outlining and expanding on all major international cargo regulations and guidelines, it also includes detailed checklists, information on draught surveys and guides to preparing cargo plans. Cargoes covered include timber, gas, grain, steel and other metals, bulk goods and refrigerated goods.