

Hello, welcome to the CAR 11 - Critical Activity Requirements: Molten Metal.

Expand your knowledge, review your activities and behaviors. The obsession with safety and risk management is one of our key behaviors.

Good course.

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Watch the video in full to continue.

Lesson 2 of 7

## Context



Click on the following video start your journey of knowledge!



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Watch the full video to continue.

Lesson 3 of 7

## Applicability





The CAR 11 is applicable for operational activities **in all processes with molten metal presence**.

Like:





Furnace

Converter

Granulator

Transportation by crane or by road (haul master)

Lesson 4 of 7

### **General concepts**

Safety is everyone's responsibility! To work in safe way, it is essential to know general concepts, understand them, respect them and apply them in your daily routine.

What are metals?



Metals are lustrous element which are at solid phase at room temperature (25°C).

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Mercury is the only metal found in nature in a liquid state.

Metals make up the majority of the elements in the Periodic Table, representing two thirds of them, making a total of 87

Some examples of metals are: SILVER, GOLD, COPPER, ZINC, IRON (STEEL), ALUMINUM, PLATINUM, NICKEL, among others.

#### CONTINUE

#### What are molten metals?

Molten metals are metals and slags that are **molten into the liquid phase at high temperatures**.

A molten state of the metal is needed to remove impurities from the ore that is extracted from mining process.



Lesson 5 of 7





The main risk involved in the activity with molten metal arise from:



#### CONTINUE

#### **Risky Situation!**

It is necessary to know the risks to avoid them and make your activity safer. See below for examples of situations with risks related to activities with liquid metals:

#### Water/metal explosion

A dangerous situation is a steam explosion. When molten metal comes into contact with water, moisture or material containing liquids, it rapidly turns to vapor, expanding sixteen hundred times its original volume and producing a violent explosion. This occurs without warning, putting workers and surrounding equipment at risk.

#### Hazardous dust

Another serious health hazard from the activity will be the contact with hazardous dust, which compromises the worker's health, resulting occupational illnesses. At nickel smelter, we might have exposure of nickel dust and cobalt dust which are present in the surrounding facility.

Crystalline silica

Crystalline silica is present in foundries that use sand in their molding process, in ferrous and non-ferrous foundries. Worker exposure in this sector must be controlled by collective protection measures, such as an efficient exhaust system to exhaust the dust, vapors, and gases generated in the process.



The main consequence of incident from this type of activity is **burn injuries as a result of contact with molten metal at high temperatures.** Some employees spend part of their daily journey in front of molten metal, they are exposed to **adverse** 

## conditions that pose certain risk to their health and safety.

## **In Practice**



The areas where there are hazards from molten metal must have controlled access.

An access control system must be provided for areas with the presence of molten metal (e.g. furnace, converter, granulator, etc.)

Thus, only authorized personnel allowed to enter the area.



#### CONTINUE

Employees involved in the activity with molten metals must be authorized and have the necessary training.



In the specific area where only authorized worker or authorized field operator shall be present for handling the molten metal, additional **barricade and signages must be provided**.

(i) Thus, only those authorized workers or field operators can access further to that specific area.

# The use of engineering control to reduce the exposure of molten metal splashes towards the workers are preferred

Equipment must be designed and provided to protect the workers from molten metal splashes, such as:



**Splashing shield** to protect the worker from molten material splashes during skimming and tapping process;



Launder covers after slag or matte flowing (protection from the splashes);

**Appropriate sampling tools**, with adequate length to enable the sample man perform the task from safe distance.



# The tools for the work involving molten metal materials must be maintained properly.

Equipment or tools used for molten metal activity must be properly maintained and inspected.

#### Some examples of the tools below:



#### **Molten Metals Transportation**



**Defined routes and traffic rules** for moving equipment with molten material (e.g. the use of haul master to transport skimming slag inside the pots to the dumping area).

If the transportation of molten metal is involving the use of cranes, then the requirement in RAC 5 (Lifting) is also applicable.

For transportation using crane, **additional engineering control** such as movement alarm and proximity alert is also **recommended to prevent crane collision**.



#### CONTINUE

Control dust and emissions within enclosures and exhaust ventilation.

Gas detector (e.g. CO and SO2) must be installed in the location and alarm for evacuation must be activated when the gas presence is above the defined limit (e.g. Above 400 ppm for

#### CO).

- Personal gas detector (pocket detector) can be provided if deemed necessary.
- Exhaust ventilation must be provided to reduce the dust and gas emission in the respective area.



#### CONTINUE

# Control of water to prevent contact with molten metal (prevention of steam explosion)





Rain can be source of unwanted water presence in the molten metal area. The roof integrity must be prioritized.

Inspection and preheating of equipment (tundish, pot, ladle, etc.) prior to use is required to ensure no water remains.

Cooling water system must be monitored to ensure free from leakages. Operator needs to check the local inspection point periodically to ensure water is flowing on the local inspection point.

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The Control Room must Monitor control operating parameters including pressure, temperature and level of molten materials, temperature and flow rate of the cooling water; etc.







#### CONTINUE

Inspection and monitoring the integrity of equipment containing molten material to prevent molten material leakage. Mechanical inspection program is required periodically to early detect shell deformation of the equipment.

Online monitoring of the shell is required to detect the hot spot (in case of refractory issue).

Visual refractory inspection must also be conducted periodically. Replacement must be conducted in accordance with the recommendation from refractory manufacturer.



CONTINUE

# Keep an eye on the **CAR!**





# As a visitor, what you must do when visiting an area with molten metal?



## Conclusion



Also check out the courses of the other CARs. Apply the knowledge acquired here in your day to day, and good work.





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