

## Slag Ladles in Steel Mill

### Product definition

The product covered here is a load-bearing device whose sole purpose is to collect molten or solid slag generated during metallurgical or chemical processes, to retain it during transport and to deposit it at a place of disposal.

**Slag ladles** are crucial items as they are part of a lifting equipment and therefore undergo in terms of mechanical design engineering and handling the national safety regulations of the state where they are supposed to be operated. The design of the Dillinger slag pots intended to be used within the European Community meets the requirements of the European Machinery Directive 2006/42/EC: every slag pots is supplied with the CE conformity marking.



### Material

The **slag ladles** are made out of the cast-steel DICAST, trade name owned by DILLINGER HÜTTE for castings: this material is similar to the steels A27/A 27M grade 65-35: April 2003, BS 3100 A1/A2: January 1991 or GS 20Mn5 to DIN 17182: May 1992. DICAST is a fully killed steel, vacuum-degassed and processed to a fine grain size structure with improved properties both in toughness and in elongation.

### Chemical composition verified on product

| Elements | C      | Si     | Mn     | P        | S        |
|----------|--------|--------|--------|----------|----------|
| Required | ≤0.23% | ≤0.55% | ≤1.65% | ≤ 0.025% | ≤ 0.025% |
| Typical  | 0.17%  | 0.40%  | 1.45%  | 0.015%   | 0.002%   |

**1.Mechanical properties** checked at room temperature in the delivery condition i.e.

after completion of the quality heat treatment from cylindrical cast-on test blocks ( 60 mm x 250 mm) available on every slag pot: both the sample preparation and the testing comply with ASTM A 370-96.

| Properties | R <sub>m</sub> | R <sub>eh</sub> | A      | KCV ( average of 3 specimens / individual ) |
|------------|----------------|-----------------|--------|---|
| Required   | ≥ 450 MPa      | ≥ 240 MPa       | ≥ 20 % | ≥ 55 J / 39 J                               |
| Typical    | 490 MPa        | 280 MPa         | 30 %   | 120 J / 85 J                                |

## 2. Delivery condition: normalised

Note regarding the material selection: due to obvious advantages in terms of service life and maintenance cost-efficiency, cast steel has been becoming more significant in the slag pot construction over the last years versus both materials, spheroidal cast-iron and lamellar graphite cast-iron. In contrast to other materials, cast steel offers excellent repair possibilities as it is well-suited to welding.

## The process of casting slag ladles:

### Manufacturing

Except the supply of the forgings for trunnions and the engineering of the pattern, all further operations are carried-out at the in-house foundry plant.

### Moulding

The castings are manufactured in a workman-like manner as required in the German standard DIN EN 1599-1: August 1997, ruling the delivery conditions of castings. The moulding is individually carried out within a modular flask by using a sand preparation based on resin bonding.

### Trunnions

**The trunnions** - when any - are preferably cast-in: they are as a rule manufactured from the steel material S355 J2G3 to DIN EN 10250-2: December 1999 and forged as per DIN 7527 February 1975. Cast-on or hot-fitted trunnions can be also provided.

### Melting

The melting is carried out in the oxygen steel plant ( 2 off 180 t BOF converters ); the ladle capacity allows a continuous bottom pouring process the speed of which is permanently controlled. The metal analysis is checked by using a computer linked spectrograph.



### Heat treatment

Every slag ladle undergoes a combined quality heat treatment (annealing) aiming both to grain refining and to stress relieving i.e.:

Heating to a temperature above AR3, austenitising at about 915°C and controlled cooling in furnace

Intermediate holding at 600°C - 630°C and completion of cooling in furnace down to 300°C

### Fettling and dressing

The inner surface is processed fit-for-purpose so that the surface discontinuities - which might cause some sticking of the slag - are extensively removed. Additionally, the castings are descaled by shot-blasting and the outside is additionally coated for transportation.

The surface quality results from the comprehensive practice of the manufacturer qualified by the requirements of MSS SP-55-1996 (Visual Method for Evaluation of Surface Irregularities).