

## INSTRUCTIONS FOR USE

### OF STOPPERS AND NOZZLES IN THE FOUNDRY AND STEELMAKING INDUSTRY

1. The supplied stoppers and nozzles should be handled with care to avoid damaging their structure or working surface by impact.
2. On delivery the stoppers and nozzles should be carefully inspected for visible surface defects caused by transport.
3. The stoppers and nozzles are stored in dry, if possible heated, rooms.
4. Before attaching the stoppers to stopper rods the stoppers should again be thoroughly inspected to see whether they reach the required quality standard and the vent is not blocked and whether in screwing the stopper into the nozzle the stopper moves in a perfect circle. It is also important to check the thread of the stopper rods for wear. Excessive wear of the thread could lead to the stopper breaking away from the stopper rod when opening the ladle during metal pouring.
5. Attaching the stoppers to stopper rods  
The thread of the stopper is filled with refractory cement (ground refractory clay + water). Then the stopper is screwed on the rod and tightened, excessive clay escapes through the air vent. (Due to the heat expansion of the stopper rod in high temperatures it is recommended after tightening the stopper to loosen it by approximately half a turn.)  
Following that, fireclay or high-alumina tubes fixed by refractory cement are inserted onto the rod.
6. Before use, completed stopper rods are dried at a temperature of max. 300°C. During drying, the completed stopper rods are placed in special racks with holes for the stoppers. Only perfectly dry completed stopper rods can be used in the ladle mechanism for pouring.
7. Ladle preparation  
Before building the nozzle into the ladle both the working and the non-working surface of the nozzle should be inspected.  
During the lining work on the ladle the contact surface of the nozzle is ground in for a perfect fit. Special machinery is used for the grinding job and the fit of the contact surface is checked by putting the stopper in place. The lined ladles are dried for 3 hours at a temperature of 800°C.
8. After mounting the stopper rod to the closing mechanism and closing the ladle the tightness of the fit is checked by filling the ladle with graphite or ash and any possible leak is monitored on a metal plate placed under the ladle nozzle.
9. General rules for using the stoppers and nozzles:
  - use graphite-fireclay stoppers with fireclay nozzles
  - use fireclay stoppers with graphite-fireclay nozzles
  - use high-alumina graphite-corundum stoppers with high-alumina fireclay nozzles

- use high-alumina fireclay stoppers with high-alumina graphite-corundum nozzles

Graphite-fireclay or graphite-corundum stoppers or nozzles with low carbon content are used to avoid adding carbon to the molten metal. The lower the carbon content in the stopper or nozzle, the shorter the pouring time or the lower frequency of opening and closing the ladle.

Fireclay and graphite-corundum stoppers and nozzles with 35%  $\text{Al}_2\text{O}_3$  content are recommended for use up to a temperature of 1550°C.

Higher temperatures require the use of stoppers and nozzles with higher  $\text{Al}_2\text{O}_3$  content (SICAL - min. 67%  $\text{Al}_2\text{O}_3$  content, GRAFITOKORUND - min. 65%  $\text{Al}_2\text{O}_3$  content)

The temperature of use depends on:

- ladle volume
- pouring time
- frequency of closing the ladle
- metal temperature
- type of metal (its corrosive effect)

Any increase in the above factors i.e.

- 1) use of stoppers for large-volume ladles
- 2) prolonged pouring time
- 3) increased frequency of closing the ladle
- 4) pouring of more "corrosive" metal  
means decreasing the working temperature - the more demanding the conditions for using the stoppers and nozzles the lower the temperature.

**OBSERVING THE ABOVE INSTRUCTIONS IS A PRECONDITION FOR SAFE AND ECONOMICAL POURING OF METALS!**