Recommended maintenance instruction for HPDC dies

1. No direct flames must be used as heating source. The die steel surface would be overheated locally and can lead to undesirable change in microstructure of the die steel. Sticking or metallic compounds on the die surface must be removed carefully mechanically.

2. Pre-load for lock up between the die halves at operating temperature shall not exceed 0.2mm (0.008") between the die halves and 0.3mm (0.012") behind slides. Exceeding these values would increase the risk for stress cracks in the holder blocks.

   Optimal condition is to maintain an even temperature across the die surface as well as between cover and ejector die halves. With temperature differences as low as 20°C (36°F) the holder can expand 0.3 mm (0.012") at a holders block dimension of approx.1.5m (59"). As a result the locking plates need adjustment to even out this difference under die operating temperature to maintain a low-stress lock up.

3. For safety reasons bolts that are part of slide units, submarine cores or squeeze-pin units, including bolts that hold hydraulic cylinders or cylinder brackets / slide bridges, have to be torqued by a torque wrench. The required torque has to be determined by considering the screw bearing surface roughness and the chosen lubricant.

4. The cooling lines must be kept clean. Possible dirt and/or calcium or other deposits should be removed with regular intervals.

5. Before the casting process is started all cooling lines must be tested for correct functionality. In particular it is important that all lines are connected correctly and the correct flow direction is secured. If the cooling channels isn't supplied with sufficient media major damages to the die is possible and potential cracking can occur between the cooling lines and the die contour.

6. For reason of safety and avoidance of damages all channels must be monitored during the casting process. In case of detected leakage the casting process must be stopped immediately and before the next dosing into the shot sleeve.

7. The major benefits of sufficient internal cooling is reduced spray, faster cycle time and better die life. The internal cooling also prevents the die steel to be heated up/down and cooled excessively. As a result of less thermal cycling of the die steel a better die life is to be expected. To minimize the die wear through abrasion or in worst case scenario cavitation the gate velocity should not exceed 50m/sec.

8. In addition, the following directions for stress relieving must be followed if welding repair is required.

Recommended maintenance instruction for HPDC dies

Welding guideline for inserts of die casting dies

The basic characteristics which have to be considered are based on VDG-Data Sheet M 83 –second edition, February 1993. The following remarks define the position of tool steel producers.

1. Nitrided surfaces

If a nitrided insert has to be welded the nitrided surface must be removed before the welding process. This also applies to eroded areas (especially if a graphite electrode was used for eroding = carburization of surface).

2. Pre-heating of the die inserts

Proper pre-heating of the inserts is an essential point for welding operations.
A pre-heating temperature of 350 – 450°C (660 – 840 °F) is required.
On the working station the inserts should be covered with a protection mat or aluminum foil. This not only protects the welder from excessive heat but also prevents the tools from cooling.

In case the inserts cool down to 250°C (480°F) they have to be re-heated again. Temperature control is mandatory.

3. Welding:

The right contact person for the selection of electrodes, amperage etc. is the steel supplier.

We recommend to use an electrode similar to Mat.-No. 1.2567 (e.g. Capilla 65).

If the weld consists of more than 3 plies a "buffer welding" is required. For this operation we recommend a grade
(e.g. CAPILLA 64 KB or CAPILLA 64 KBS)

C	Cr	Mo %	
0,10	2,40	2,40	leading to a strength approx. 1200 N/mm² can be reached.

Three comments on this:

Of course the filler metal can be of the same kind as the die (e.g. W.-No. 1.2343 / 1.2344); besides similar grades (e.g. W.-No. 1.2709) can be used as filler metal. This grade is able to absorb the stresses which result from welding. After the process the hardness values of the welded areas are as following:

After welding

Mat.-No. 1.2709 approx. 40 HRC
Mat.-No. 1.2344 52 – 55 HRC
Mat.-No. 1.2567 approx. 45 HRC

After stress relieving at 480°C (896°F)

Mat.-No. 1.2709 approx. 55 HRC
Mat.-No. 1.2344 52 – 55 HRC
Mat.-No. 1.2567 48 – 52 HRC

Recommended maintenance instruction for HPDC dies

After tempering at 540 – 560°C (1004 – 1040°F) (ine rt gas)

Mat.-No. 1.2709 approx. 48 HRC
Mat.-No. 1.2344 50 – 52 HRC
Mat.-No. 1.2567 45 – 50 HRC

On various occasions we realized that austenitic welding rods were used (can be checked with a magnet – austenitic grades are non-magnetic). This grade achieves a strength of only 600 – 800 N/mm². During the casting process this leads to an early start of thermal fatigue cracks in the welded zones.

The austenitic steel is not suitable as a buffer electrode as its coefficient of thermal expansion is twice as high as that of steels such as W.-Nr. 1.2343, 1.2344 or 1.2367 respectively.

a) After welding the die should cool down on calm air down to 80 – 100°C (175 – 210°F).

b) As soon as hardened and tempered tools have cooled down to 80 – 100°C (175 - 210°F) they have to be tempered at a temperature approx. 30 - 50 °C (ideally 30 °C) lower than its final tempering temperature (refer to the die´s journal). The time of temperature shall be approx. 6 hours. An inert gas atmosphere is required as hot-work tool steels such as W.-Nr. 1.2343, 1.2344 and 1.2367 start to scale at temperatures above 500 °C in a normal atmosphere.

If an inert gas furnace is not available a stress relieving annealing is required at 480 – 500°C (895 – 930°F).
Holding time 6 – 8 h

The welded area and transition zone will keep their hardness (see item 3a).

c) As soon as annealed dies have cooled down to 80 - 100 °C (176 - 212 °F) the die must be soft annealed immediately at 820 - 840 °C (1510 - 1545 °F). The time on temperature shall be 4 - 6 hours followed by a slow cooling in the furnace. In the weld as well as in the transition zone this leads to an annealed microstructure and a corresponding strength.

A concluding comment:
Welding of soft annealed dies bears the great risk that cracks start in the welded zone during hardening (caused e.g. by pores in the weld or by capillary cracks in the weld or transition zone). Therefore it must be guaranteed that the welded area is absolutely free of cracks.

It is our recommendation to start with the pre-machining of the dies, followed by the final hardening and tempering and to weld changes or defects finally.

Recommended maintenance instruction for HPDC dies

Stress relieving of die casting dies

The necessity of stress relieving of die casting dies cannot be answered generally by yes or no. It depends on the conditions during operation. A continuous operation without any interruption is the best prerequisite for a good performance.

In case the inserts were manufactured by spark erosion we recommend a stress relieving before the first shot. In case they were manufactured without spark erosion we recommend a stress relieving after sampling. Additional cycles for a stress relieving process can be after 20.000 shots.

As soon as an insert shows cracks, a stress reliving does not have any advantage because the cracks have already relieved the stresses. After each welding process a stress relieving is required.

<u>We recommend the following temperatures:</u>
540 – 560°C (1005 – 1040°F)

For this range of temperature a furnace with inert gas atmosphere is required. The holding time on this temperature should be approx. 6 h followed by a cooling in the furnace to approx. 300°C (570°F). Afterwards the cooling can be done at calm air. In case a inert gas atmosphere is not available we recommend to stress-relieve the cavity parts at 480°C (890 °F).