IN FORM

NEWSLETTER
Issue I/16 *Page 1*

Dear Friends of the Company, Dear Customers,

this issue of **IN FORM** continues our engineering guidelines for sound casting design. Please pick up the phone and dial Dietermann for a review of your current projects! With a combination of decades of hands-on experience, technological know-how and modern simulation tools we are happy to support you, not only in producing **good castings** but also in designing them.

Our market can be characterized in different ways. I want to point out one important financial aspect: investment and depreciation rates. Our depreciation rate of recent investments today is already more than twice the average of German foundries. On top of that, during the last few years we have invested 25% more than what we depreciate, and this statement does not yet include the substantial investments of 2015 (see further below). In short: since many years we have been investing heavily into our future – which is also your future.

From my point of view, that means three things:

1. The bigger part of our industry is not able or not willing to invest a significant amount of money into its future. This share is only possible, if your other suppliers are part of that, too.

2. Having undergone this substantial investment program, we are technologically well prepared to match your requirements far in the future. On top of that, our investment program is financed in a solid way by a very high share of own funds. Thus you can be sure that we will continue supplying to you many years from now.

3. All investments do not only increase our capabilities but equally our capacities. We are able to grow, and Dietermann does grow.

We look forward to grow with you.

I hope this makes interesting reading!

Yours

Investments I:

Core sand preparation plant

Shortly after sending the last issue of **IN FORM** we began running our new, central core sand preparation and distribution plant. This sand plant replaced three old mixers. Apart from increasing our capacity, guaranteeing high process stability was targeted with the new sand plant. The sand is conditioned and classified prior to entering the mixer. Sand and binder components then are dosed with very high accuracy of maximum deviations of +/-1.0%. This allows us to assign to each core of our production portfolio a specific sand recipe which is produced within very narrow limits.

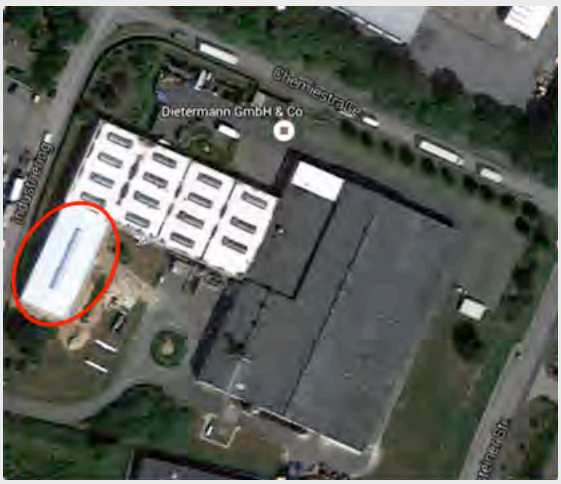
We are convinced that sand quality is one of the decisive quality characteristics in a sand foundry, and we therefore place high attention to it. In 2010 we set up a complete new green sand regeneration and preparation plant. So with these two investments in place, the two sand qualities and sand preparation technologies applied by our plant now are run by equipment that constitutes the state of the art.

Investments II:

Extension of our machining workshop

After a long planning period and change of partners involved, we started and finished building the annex to our machining workshop. By adding another 700m², we have doubled the floor space of the milling, turning and assembly department. This enables us to continue growing during the years to come by adding further machinery. The architecture employed transforms the former building layout into modern design through modern building material. This is meant to be symbol of Dietermann on its way into the future.

Google has already been here, too:



Investments III:

Zeiss coordinate measuring machine Accura II

Part of the new building is an air conditioned inspection room. Inside, we have put into operation a new large coordinate measuring machine of Zeiss in December 2015. Its measuring envelope of 1200 x 1800 x 1000mm allows us not only to measure small but also large parts with highest precision.

Previously, we have been measuring with a hand-guided 3D measuring gage, which so far also worked well. Compared to it, though, we now do a quantum leap:

- Reproducibility of different measurements of the same parts increases strongly and is not user-dependent.
- Precision increases strongly to a maximum accuracy deviation of only 1,8µm! As a comparison: a human hair has 80 times that diameter, about 150µm.
- Unsatisfactory measurements of fits, circularity or cylinder shape are an issue of the past.
- Automatic gauge change during a measurement cycle dissolves any geometrical restrictions one might otherwise have. Even very long (up to 800mm) or very thin devices can be used with the same accuracy.
- Using the Zeiss Calypso measurement application gives us the chance to exchange programs and routines with the many customers that use the same setup.

Whatever machining or measurement challenge there might be, we are ready and capable to tackle it from now - a commitment into the development and into the future of our machining operations.

Investments IV:

Machining center DMU 60 FD duoBLOCK

The purchase of a DMU 60 FD duoBLOCK extends our portfolio of machining centers with a very precise and robust five-axis machine for complex milling tasks of mid-sized components running in medium series. Also this newest addition to our machining operations is

able to run milling and turning tasks in one operation. At the same time, we divested our last older milling center, which means that now all milling centers operated by us are younger than 5 years.

Background:

Design for molding and casting (Part II)

In the first issue of our little series of 2 issues we provided a summary of design guidelines concerning wall thickness, transitions, radii, stress and shrinkage cavities. With this issue, we continue and close this introduction.

A useful overview of this issue can be found on a website provided by the university of Kassel, department of foundry technology. You find this website in the "Links" section of our own website.

5. Mold and core production

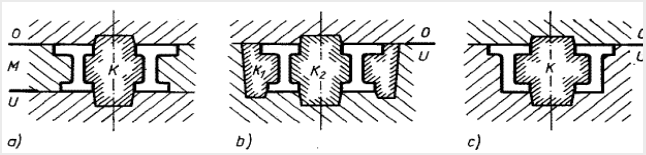
5.1. General guidelines

Complexity, dimension, quantities and tolerances define which molding process is most suitable for the part in question. Generally speaking, sand casting should be your first choice for rather complex parts, typically involving one or multiple cores, for rather large or heavy parts or for those parts that are required in small and medium batch sizes. Furthermore, sand casting offers advantages in cases where the microstructure requires use of chill irons for controlled solidification, or where efficient and fast removal of air is crucial, e.g. for rib geometries. Gravity or pressure die casting may be better suited molding technologies for small, simple and coreless parts in large quantities.

Remaining raw casting tolerances and required machining surplus are derived from the molding technology chosen by the designer. Both are dependent on the sand molding process suitable for the part: hand molding, mechanized molding or automated molding, which again are dependent on size and quantity. Norm EN ISO 8062 defines reasonable values for tolerances and machining surplus.

5.2. Mold parting lines

The casting designer has to bear in mind, that she/he designs parts with few and preferably flat parting lines. While multiple molds are feasible in hand molding, this is not possible for automated molding. Areas that cannot be de-molded vertically are called undercut. Undercuts require placing external cores into the mold which increase part price as well as pattern cost substantially.



a) and b) unfavorable, three-part mold or two-part mold with external core required

c) favorable, two-part mold without external core after design change

O… upper flask; U… lower flask; M… middle flask

K… core; K1, K2, … core inserting sequence

The parting line should run horizontally. As long as vertical de-molding is feasible, a certain offset of the parting line to the horizontal is permissible. Parting lines that are not horizontal should preferably run at constant angle rather than with sharp corners. If a sharp angle in the parting line cannot be avoided, the remaining partial mold should be large enough to avoid the need for a core (see below, partial mold).

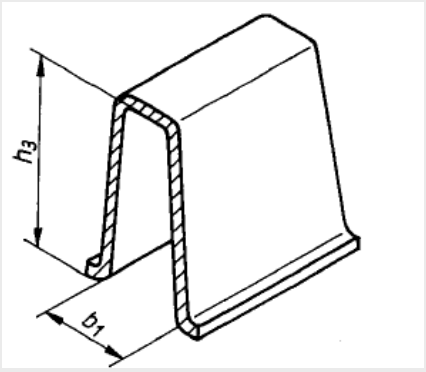
5.3. Cores

Hollow spaces in castings are built by cores. Cores require one or more wall openings in the adjacent walls. Their task is to a) secure the position of the core in the mold, b) evacuating the core gases from the molten metal and c) enable core shake-out and cleaning. A safe positioning of the core is required to achieve little wall thickness deviations. Therefore, these wall openings ideally should i) be located in or close to the mold parting line, ii) be large enough, dependent on the core size and iii) be at least two of them, located opposite to each other. If such arrangement is not possible, auxiliary openings might be required, which after casting and machining can be closed permanently.

5.4. Partial, pointed molds

In order to achieve economic part prices, as few cores as possible should be used and as much of the geometry as possible should be built by the mold itself. This is not only true for undercuts (see above, parting line). If theoretically, de-molding should be possible, this can still be impossible in practice if the geometry and the resulting partial mold is too pointed. Large draft angles, large radii and the use of a modern molding machine using "Seiatsu" technology are pre-requisites for de-molding of difficult geometries.

A rule of thumb tells us, that if the height is more than two times the width of a geometry, a core is required for safe de-molding:



Mold ← h3 / b1 < 2 < h3 / b1 → Core

6. Cleaning, grinding, deburring

Burrs are a result of the mold parting line or of mold and core parting lines. They are removed through grinding after casting and core shake-out. In the same operation, the ingate and feeding system is removed. Burrs must be accessible for de-burring tools.

Preferably, parting lines are formed in the shape of edges or ribs which remain on the casting. This creates a defined area in which grinding is necessary and acceptable while decreasing the time required for the grinding. They are optically preferable since extensive grinding on the part's surface is omitted.

If casting and feeding system can be placed on areas which subsequently will be machined anyways, this further reduces the amount of grinding required. If geometry and function permit, these areas should be provided already in the design process.

It is imperative that clamping and fixing points for milling and turning operations are areas where no grinding is required and where no grinding is possible. Otherwise, the machining contour compared to the raw casting will have a different offset for every single casting, or every casting will require individual measurement and set-up in the machining center.

With this, we end our short introduction of design principles for molding and casting. The design process is decisive in allowing the foundry to economically produce castings that match high quality criteria.

Please feel free to involve us at an early stage during your design process, if you wish to use foundry professionals as sparring partners for the ideas to your next project!

by Thomas Zöbisch, Operations Manager

Outlook: The latest news from Dietermann…

- Simulation: Mold filling and solidification simulation supports sound part design and stable process design
- Core shop: modern core shooting machines support efficient and accurate core production
- Formula Student: supporting the race team of University of Stuttgart
- High school Süchteln: Partnership for the promotion of apprenticeships and occupational orientation in technical professions

We will report on these issues soon.

Dietermann:

A good choice for good castings.