Mold Level Measurement

non-contacting – quick – reliable
Radiometric measurement

Gamma radiation is attenuated as it passes through the mold. This attenuation is measured by a detector. The extent to which the radiation is attenuated depends on the mold level. The higher the level of molten metal in the mold, the less radiation will reach the detector. In this manner, the mold level can be reliably monitored - irrespective of dust, temperature and vibrations.

The radiometric measurement is maintenance-free and applicable for all mold types and sizes. Beside the typical installation on slab and billet casters it is also successfully applied on beam-blank and round casters.

Electromagnetic measurement

A coil inside the sensor generates an electromagnetic field, penetrating deep into the mold. As a result an eddy current is induced in the top layer of the molten metal. This eddy current generates a counteracting electromagnetic field – its strength being proportional to the distance between sensor and molten metal inside the mold. In this way the mold level is determined very precisely – irrespective of casting powder or slag.

Quick and precise mold level measurement in continuous casting applications

A precise and quick measurement of mold level lays the foundation for the production of high quality steel and the reliable prevention of steel overflows and breakouts. The Berthold mold level systems fulfill this role reliably and accurately.

Several thousand strands throughout the world are equipped with Berthold systems.

The level of liquid metal in the mold is measured reliably and precisely. The extremely short cycle time of 5 ms allows for an optimum control of the casting process – both in automatic start-up and in normal operation.

Berthold Technologies is the only supplier providing both radiometric and electromagnetic measuring systems to solve this challenging measurement application. Depending on the requirements and measurement conditions, the optimum technology is selected. A combination of both technologies is also possible and advisable in demanding applications.
**Systems characteristics**

**GAMMAcast**  
Radiometric measurement

- Highest reliability
- Virtually unlimited measuring range
- Very robust
- Applicable for all mold types
- Easy calibration
- Minimum source activity due to high-sensitive detectors
- Maintenance-free
- Constantly high accuracy over the whole measurement range

**ECcast**  
Electromagnetic measurement

- Best accuracy
- High resolution <0.1 mm
- Quick response time
- Not affected by casting powder or slag
- No radioactive source required
- Easy retrofit of existing casters
- Available with a suspended sensor type or with a edge mounted sensor type

**Combination: ECcast plus GAMMAcast**

Two technologies complement each other providing the optimum system for highest demands.

- Large measuring range
- Perfect for automatic start-up
- Highest safety due to redundancy
- Determination of casting powder/slag thickness is possible
The castXpert LB 452 is the mold level measuring system that has been setting standards for years. It provides accurate and reliable measurements, and ensures optimal control of the continuous casting process due to the short cycle time of 5 ms. This evaluation unit is used in both radiometric and electromagnetic systems, without any need of modification. This saves time and enables safe operation.

Evaluation unit with touchscreen

- **Extremely fast**
  The unique short cycle time of 5 ms provides the ideal basis for reliable control.

- **Information Plus+**
  Detector temperature and status are continuously monitored and displayed.

- **Safety**
  Comprehensive self-diagnostics and plausibility checks of measurement and calibration ensure the highest process reliability.

- **Highest accuracy**
  By using several calibration points, non-linearities of the calibration curve are perfectly eliminated, and high accuracy can be achieved over the entire measuring range.

- **Easy to use**
  The large colour touchscreen makes operation and calibration particularly easy. The ability to select from different operating languages facilitates ease of operation. Regardless of where the system is installed.

- **Automatic start-up**
  Benefit from faster response times during start-up of casting, by the ability to set a smaller time constant in the low measuring range.

- **4 measuring channels**
  Up to four strands can be measured simultaneously. Each measurement channel is equipped with its own power supply and CPU. Therefore, the channels are independent of each other and high process reliability is guaranteed.

- **Monitored current output**
  Continuous monitoring of the current output ensures highest reliability and signal stability. This plausibility test is patented.
Unique Berthold Technology

Co-60 rod sources are used as a standard in mold level measurements. The special feature: The rod sources are characterized by a continuous distribution of activity, which can only be realized through the unique manufacturing process from Berthold.

The best measurement accuracy is achieved with these rod sources from Berthold because the accuracy over the entire measuring range is consistently high.

AOS - Activity Optimized Source

In this particular type of rod source the accuracy in the upper part of the measuring range can be increased significantly by optimizing the distribution of activity. Especially for small formats the statistical noise is minimized, without increasing the overall activity of the source.

Or do you already have a satisfying accuracy? In this case AOS can be used to reduce the source activity while maintaining the same accuracy. Depending on the application, the use of smaller shieldings is possible. In many cases the more cost-efficient lead may be used instead of tungsten.

AOS at a glance

- Highest precision in the important part of the measuring range
- Small and cost-effective shieldings
- Low source activity

Robust external housing from stainless steel

Highest mechanical resistance according to ISO 2919, ISO/C 66646

Inner core to carry the activity

Activity distribution over the whole source length by customer-specific winding of the special wire

Special wire containing Co-60

Integrity guaranteed by individual source tests
Berthold detectors are characterized by their excellent sensitivity for gamma radiation, their robust design and the PlugProtect connection technology. The high measurement accuracy achieved combined with the outstanding mechanical stability guarantees for high reliability and a long detector life – perfect for the use in continuous casting.

At a glance

- High mechanical stability (verified by Fraunhofer Institute)
- Absolutely secure through high IP protection class IP 66/67
- PlugProtect protected and separate terminal connection zone allows for a safe and easy replacement of cable or detector
- Micro-Controller inside the detector communicates state and temperature
- Heavy duty cable available in various lengths, extremely heat resistant and robust – splash resistant
- Various types of plugs and terminal connections (straight and 90°-angled)
- Water cooling available for all detector types

LB 6739 Perfect for standard applications
- Slim design, low space requirements
- CsI crystal with high sensitivity for gamma radiation
- Highly durable against mechanical shock and vibrations due to elastic bedding of crystal and PMT.

LB 6752 For demanding applications
- Large polymer scintillator for increased sensitivity and precision
- Lower source activities
- Smaller and cost-efficient shields sufficient

LB 6760 With Solid State Silicon Photomultiplier
- No electromagnetic disturbance through breaks or stirrers
- High sensitivity (similar LB 6739)
- Unbreakable detector due to innovative Silicon Solid State Photomultiplier technology
Detector Service Modem

The modem is used to operate the GAMMAcast detectors with a PC via USB connection. Thus, the functional testing of the detector, software updates and parameter settings can be easily performed in the workshop.

**Features**

- Functional testing
- Recording of the plateau curve
- Automatic or manual adjustment of the operating point and high voltage settings
- Error diagnostics
- Set and access parameters
- Temperature control
- Software updates

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**castXpert LB 452**

**General Arrangement**

- Rack: 19", 3 HU
  - Control unit with 7" color display and touch screen
- Max. Load: 4 measuring channels
- Weight: approx. 4.6 kg depending on equipment
- IP code: IP 20
- Power Supply: 100 ... 240 VAC +/- 10%; 50...60Hz
  - Control unit (including one measuring channel) approx. 30 W
  - Every further measuring channel: approx. 15 W
- Ambient temperature
  - Operation: 0 ... +50°C (+32 ... +122°F), no condensation
  - Storage: -20...+70°C (+4 ... +158°F), no condensation

**Each Measuring Channel**

**Basic Module** (mandatory)

- Independent power supply (100 ... 240 VAC +/-10%, 50...60Hz)
- Current output 4...20 mA floating
  - Switchable source- (max. impedance 500 Ω) or sink- (max. 24 VDC, 500 Ω; min. 12 VDC, 250 Ω) mode
- 2 digital inputs:
  - floating, for external empty and full adjust
- Relay output (SPDT) for error signal
  - max. 33 VAC, 46 VDC, 5 A, non-inductive

**Extension Module** (option)

- Current output 4...20 mA floating
  - Switchable source- (max. impedance 500 Ω) or sink- (max. 24 VDC, 500 Ω; min. 12 VDC, 250 Ω) mode
- Possible configurations: Level, detector temperature, detector count rate
- 2 digital Inputs:
  - floating, for external selection of up to 4 calibration curves
  - 2 relay outputs (SPDT, SPST NO) for configurable alarm signal
  - max. 33 VAC, 46 VDC, 5 A, non-inductive

**Bus Module** (Profibus DP or Profinet)

- Output of cyclic data:
  - Level, detector count rate (CPS), detector temperature, actual calibration index, system status, error number
- Input of cyclic data: Calibration index, empty and full adjust, acknowledge errors

**Overall System**

- Software
  - Cycle time: 5 ms
  - Data log on internal memory card or via Ethernet
  - Data export to USB flash drive
- Operating languages
  - Bulgarian, Chinese, Czech, English, French, German, Hungarian, Italian, Korean, Portuguese, Romanian, Russian, Spanish

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**GAMMAcast LB 6739, LB 6760 and LB 6752**

**Mechanics**

- Material: Stainless steel
- Scintillator
  - LB 6739: CsI-crystal; Ø 40 mm or Ø 25 mm; H: 50 mm
  - LB 6760: NaI-crystal; Ø 40 mm; H: 50 mm
  - LB 6752: Organic polymer scintillator, 150x100x50 mm³ or 150x100x25 mm³
- Ambient Temperatures
  - Operation: -20 ... +50°C (+32 ... +122°F)
  - Cooling water required at higher temperatures
- Power
  - 15...32 VDC, approx. 1.2 W
- Output signal
  - Pulses, max. 10 V
- Water cooling
  - Optional for LB 6739 and LB 6760, Standard for LB 6752
  - Connection: K½, max. 6 bar
  - Drinking water quality (or filtered process water without suspended particles)
- IP class
  - IP 66 / IP 67
- Connections
  - Detector – terminal box resp. detector – castXpert LB 452:
    - Special cable with PlugProtect connector; straight or 90°-angled connector plus open ends or HeavyCon plug
  - Terminal box – castXpert LB 452:
    - 6-wired, screened (Ø 0.15 mm²)
    - max. length 500 m
- Weight
  - LB 6739 / LB 6760: approx. 2 kg, with water cooling approx. 3 kg
  - LB 6752: approx. 24 kg
- Vibration / Shock
  - Vibration: 0.2 g / mechanical shock: 100 g
  - according to DIN EN 60068-2-6 and 60068-2-27
ECcast LB 452-EC

The completion to castXpert LB 452

ECcast – Berthold’s electromagnetic measurement systems – measure the mold level reliably and extremely accurately, and is not affected by casting powder or slag. ECcast can be used as a stand-alone system or for even higher process reliability can be combined with the radiometric GAMMAcast systems.

- **Accurate and reliable**
  The measured signal is very smooth and not affected by casting powder or slag.

- **Excellent measurement performance**
  With a resolution smaller 0.1 mm and a fast response time of approx. 50 ms, the system offers best conditions for optimum mold level control.

- **Easy System Integration**
  The ECcast LB 452-EC unit is installed as an add-on module to the castXpert LB 452 evaluation unit. It is responsible for signal generation and primary signal processing.

- **Known operating concept**
  The unit is operated using the castXpert LB 452 evaluation unit.

- **Compensation of mold oscillation**
  The ECcast add-on module has the ability to compensate for mold oscillation. The output signal is then corrected for the oscillation.
ECcast Sensors

### Suspended Sensor
- Air cooling
- Measuring range: 150 mm from sensor bottom edge
- For virtually all formats
- Installation on manipulator, above the mold
- Only one system per strand required
- Integrated pre-amplifier – no additional electronics in the field
- Optimum heat protection through changeable sensor cover
- Not affected by electromagnetic brakes or stirrers and mold coatings

### Edge-Type Sensor
- Water cooling
- Measuring range: 200-250 mm from edge of the mold
- For slab and thin-slab formats
- Easy mechanical installation at the mold
- Preparation of the system in the workshop possible
- No mechanically interfering parts above the mold
- Wide area is measured
- Integrated acceleration sensor for oscillation compensation
Calibration rig

The calibration rig ensures easy and quick set-up and commissioning of the electromagnetic measurement. A plate representing the level of hot metal is moved up and down the mold stepwise by an electrical mechanism. The measured response is recorded for each step, resulting in a representative calibration curve.

- Fully automatic recording of calibration points
- Easy calibration during set-up and commissioning
- Maximum safety through verification of the measuring points

ECcast LB 452-EC

<table>
<thead>
<tr>
<th>Spec</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack</td>
<td>19&quot;, 2 HU, depth=423 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 5 kg</td>
</tr>
<tr>
<td>IP code</td>
<td>IP 20</td>
</tr>
<tr>
<td>Power Supply</td>
<td>100 ... 240 VAC +/-10%, 50...60 Hz</td>
</tr>
<tr>
<td>Ambient temp.</td>
<td>Operation: 0 ... +40°C (+32 ... +104°F), no condensation</td>
</tr>
<tr>
<td></td>
<td>Storage: -20 ... +70°C (-4 ... +158°F), no condensation</td>
</tr>
<tr>
<td>Reaction time</td>
<td>max. 50 ms</td>
</tr>
</tbody>
</table>
Manipulator

The manipulator incorporates the suspended sensor. It ensures accurate and automatic positioning of the sensor over the mold. In the event of problems (e.g. overflow, breakthrough etc.) the sensor is quickly brought to safety, thus creating free space above the mold. Signal cables and the influx for the cooling air are guided via the manipulator.

Different versions of manipulators can be realized, depending on the space requirements and the desired directions of movement. Two examples are shown here. We will gladly inform you or others!

<table>
<thead>
<tr>
<th>Edge-Type Sensor</th>
<th>Suspended Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer dimensions</td>
<td>Width: 500 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 5 kg</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>Operation: 0 ... +50°C (+32 ... +122°F)</td>
</tr>
<tr>
<td></td>
<td>Storage: -20 ... +70°C (-4 ... +158°F)</td>
</tr>
<tr>
<td>Cooling</td>
<td>Water, approx. 4-6 l/min, max. 15 bar, max. 30°C Drinking water quality (or filtered process water without suspended particles)</td>
</tr>
<tr>
<td>Assembly</td>
<td>On edge of mold</td>
</tr>
<tr>
<td>Cables</td>
<td>Sensor – Pre-amplifier max. length 15m, special cable connected to sensor Pre-amplifier – ECcast LB 452-EC max. length 150 m, according to specification</td>
</tr>
</tbody>
</table>
We are here for you! Worldwide

Berthold Technologies, your partners in mold level measurement with unparalleled expertise. Thousands of Berthold systems are worldwide in operation. We produce the most reliable and finest instruments to optimally support your continuous casting process. Our systems combine modern technology with over 60 years experience. Together we will find the optimum solution for your system. Our sales engineers are looking forward to your inquiry.

BERTHOLD TECHNOLOGIES perfect solutions from a single source.

The engineers and service technicians of Berthold Technologies are always there when they are needed. Thanks to our worldwide network of branch offices we are able to provide you with quick and competent support if necessary. Site visits are promptly organized to ensure minimum downtime.

You can take our word for it.