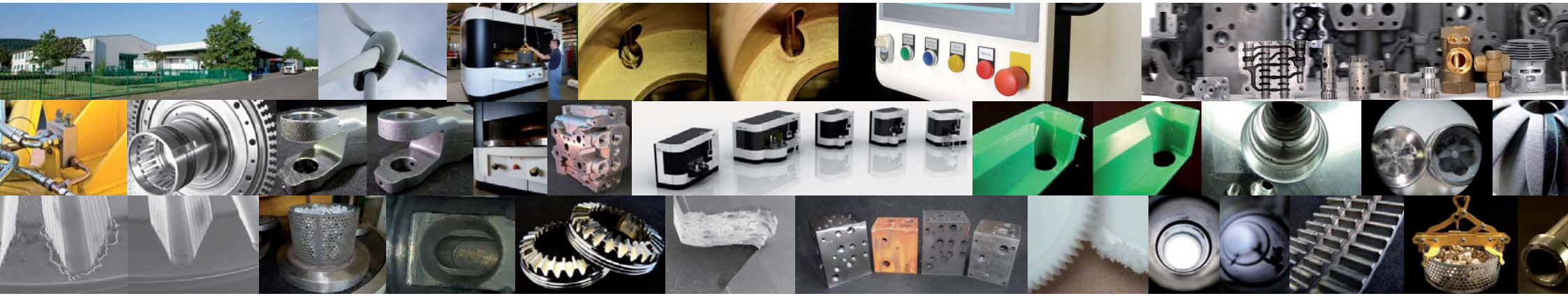
# THERMAL Deburring

ATL Anlagentechnik Luhden GmbH



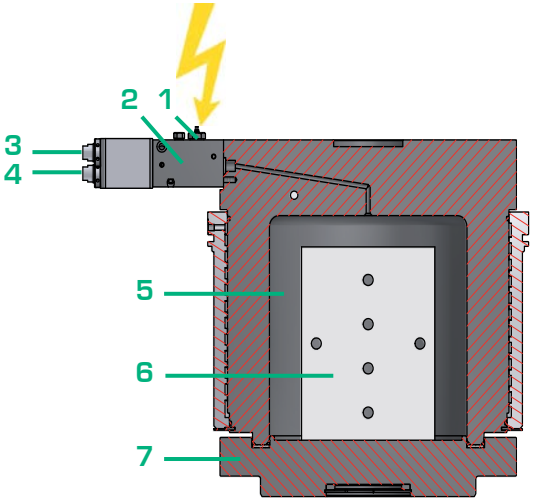
## From the start

In the year 1993, ATL Anlagentechnik Luhden GmbH was founded in Luhden (approx. 60 km south-west from Hanover). Ever since that time, the company offers machines for heat treatment of different materials. Due to a high vertical integration and more than 100 employees, equipment solutions for various applications are developed.

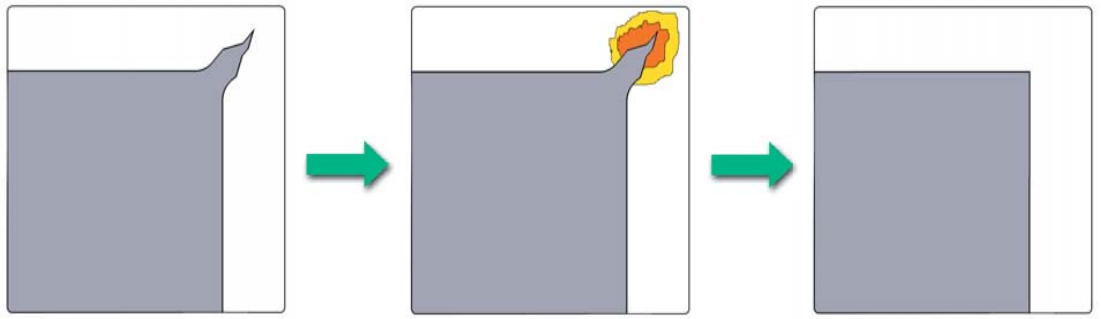
## The TEM method

Thermal deburring (TEM) is a process of removing burrs caused by production (due to milling, drilling, etc.) from various machine parts. For this purpose, the workpieces are placed in a bell-shaped deburring chamber which is hydraulically closed by a closing plate.

An accurately defined mixture of gases is fed into the deburring chamber via a gas metering system and ignited by a spark. The temperature of the subsequent combustion ranges from 2,500 to 3,300 °C (4,532 to 5,972 °F) and rises above the ignition temperature of the burr. The excess oxygen inside the deburring chamber leads to a chemical reaction which vaporizes the burr completely within 20 ms.



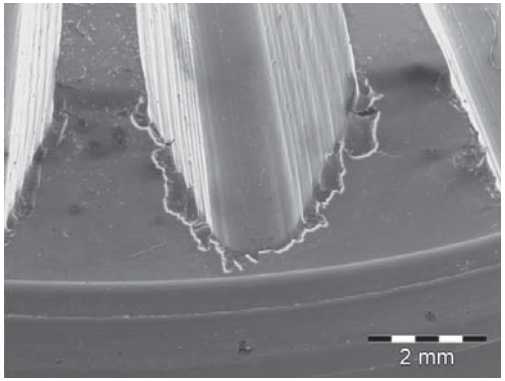

1. Spark plug
2. Mixing unit
3. Fuel gas
4. Oxygen
5. Deburring chamber
6. Workpiece
7. Closing plate

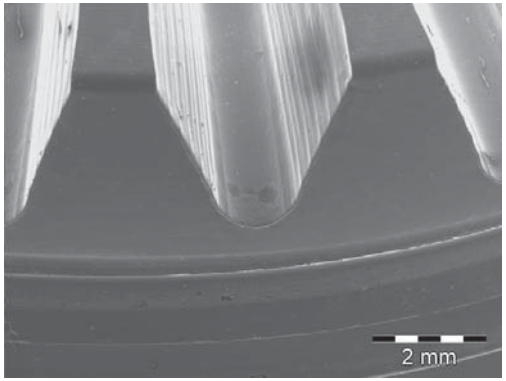


Before deburring

During deburring

After deburring
*burr-free - sharp-edged*



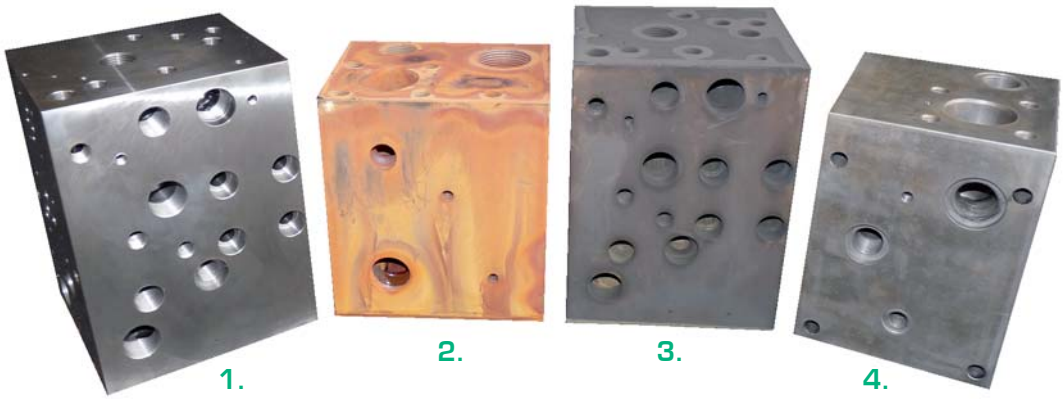

## Close-up view

If you look at a workpiece - before and after thermal deburring - with the scanning electron microscope, abrasion and smoothing of edges are clearly visible. This precision cannot be obtained by conventional methods such as manual deburring.

## The colours of thermal deburring

The colours of thermal deburring are derived from the different process stages.

1. Untreated workpiece
2. Workpiece after the first shot with an excess of oxygen
3. Minimization of oxide via stoichiometrical gas mixture (2. shot)
4. Finished/cleaned part
   Washing of TEM deburred workpiece is - depending on the material - an essential part of a subsequent treatment. Page 13 will provide you with further information.



## Zinc diecasting (ZAMAK)

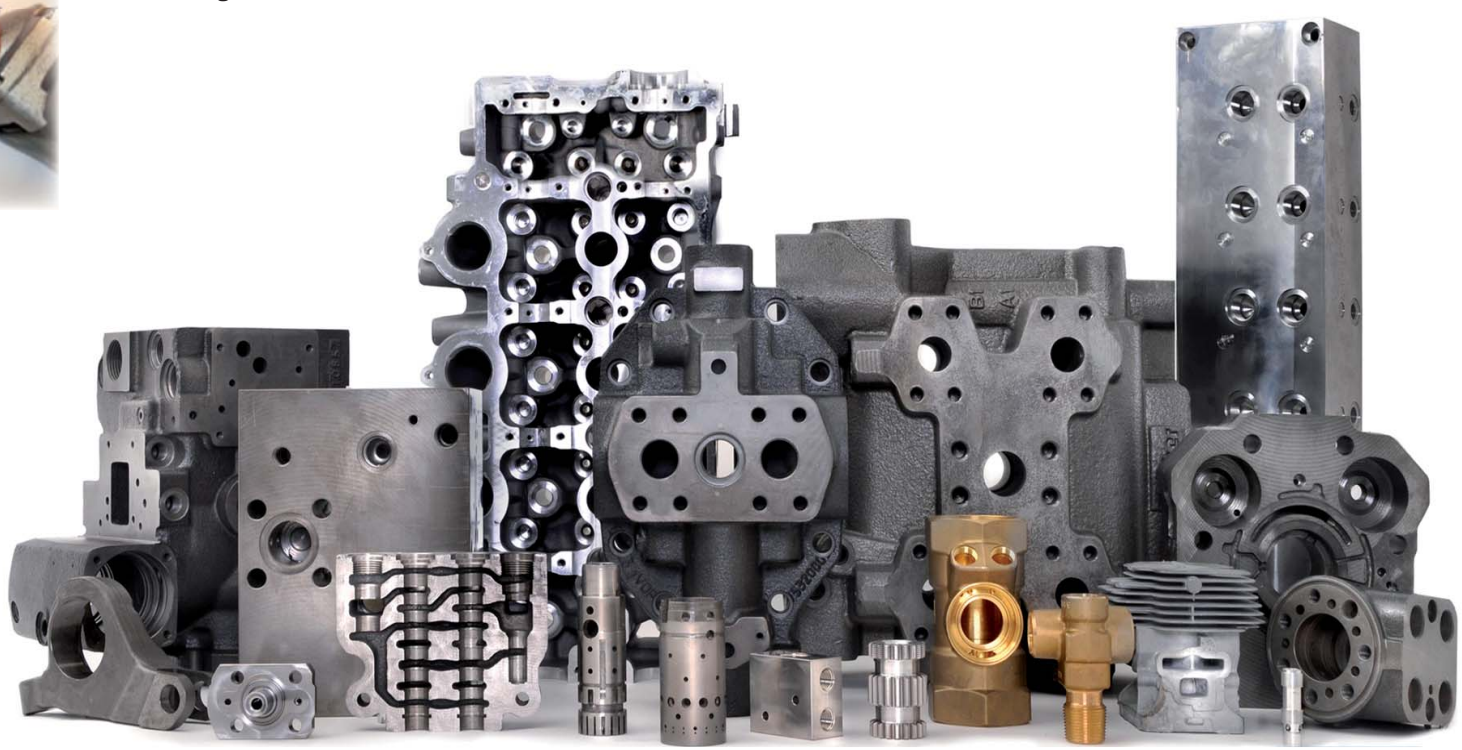
Bulk goods made of zinc diecasting (ZAMAK) can be deburred in a matter of seconds. Within an 8-hour-shift, approximately 6,000 kg of bulk goods can be deburred in a deburring chamber with the size of Ø 250 x 300 mm and with a deburring chamber size of Ø 400 x 300 mm even about 12,000 kg are possible.

Flashes and cutting burrs are reliably removed as well as loose chips and inaccessible burrs. Short cycle times and low personnel and process costs are further, but not negligible advantages.

## Do you still deburr by hand?

The TEM process is applicable for all inside burrs and soilings. The key benefits of TEM are a saving of time and money at high quality and repeatability.

Example: Hydraulic manifold
**Manual deburring** of a hydraulic manifold takes **1 hour per part**. **Thermal deburring** requires only **1 minute per part** at 100% process guarantee.

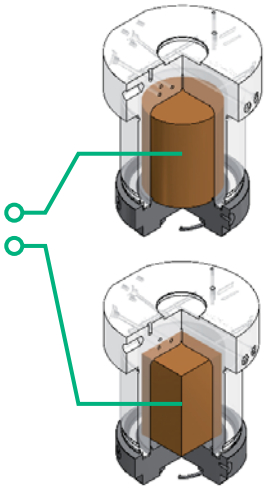


TEM is applicable for almost all materials

- Steel
- Stainless steel
- Cast iron
- Aluminium
- Zinc diecasting
- Brass/bronze

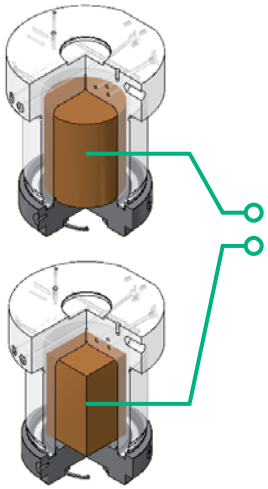
## iTEM250 Single Chamber / iTEM320 Single Chamber

| | | |
|---|---|---|
| **Dimensions** | | |
| Length | 3,100 mm | |
| Width | 2,400 mm | |
| Height | 2,600 mm | |
| Weight | 10,000 kg | |
| **Max. component size** | | |
| Cylindric components | Ø 310 x H 280 mm | |
| Quadratic components | 220 x 220 x 280 mm | |
| **Electric power supply** | | |
| Power requirement | approx. 30 kVA | |
| Line voltage | 400 V/N/PE ~ 50 Hz | |
| **Deburring chamber** | | |
| Diameter | 250 mm | 320 mm |
| Height | 300 mm | 300 mm |
| Max. gas inflated pressure | 23 bar | 16 bar |




**Standard equipment**

- Control system: SIEMENS PLC with touch-screen
- Cycle times single shot: 60 - 90 seconds
- Cycle times double shot: 110 - 150 seconds
- Operating gas: Oxygen and methane (or hydrogen)
- Safety arrangement: TÜV certified, ATEX, CE marking, gas monitoring system

## iTEM400

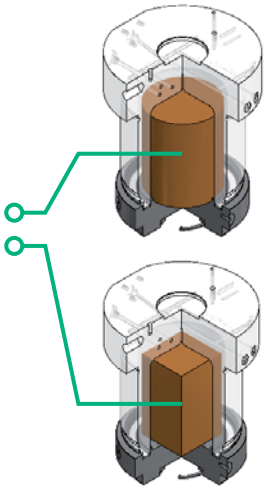
| | | | |
|---|---|---|---|
| **Dimensions** | | | |
| Length | 3,800 mm | | |
| Width | 2,500 mm | | |
| Height | 2,600 mm | | |
| Weight | 15,000 kg | | |
| **Max. component size** | | | |
| Cylindric components | Ø 395 x H 280 mm | | |
| Quadratic components | 275 x 275 x 280 mm | | |
| **Electric power supply** | | | |
| Power requirement | approx. 30 kVA | | |
| Line voltage | 400 V/N/PE ~ 50 Hz | | |
| **Deburring chamber** | | | |
| Diameter | 250 mm | 320 mm | 400 mm |
| Height | 300 mm | 300 mm | 300 mm |
| Max. gas inflated pressure | 23 bar | 16 bar | 12 bar |

**Standard equipment**

- Rotary indexing table: 5 stations
- Control system: SIEMENS PLC with touch-screen
- Cycle times 5 stations single shot: 30 - 60 seconds
- Cycle times 5 stations double shot: 90 - 120 seconds
- Operating gas: Oxygen and methane (or hydrogen)
- Safety arrangement: TÜV certified, ATEX, CE marking, gas monitoring system

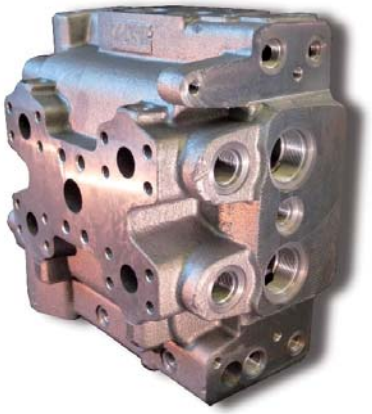
## iTEM400/600

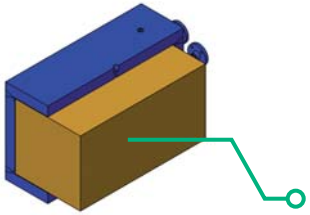
| Dimensions | |
|---|---|
| Length | 3,800 mm |
| Width | 2,500 mm |
| Height | 2,850 mm |
| Weight | 17,000 kg |
| **Max. component size** | |
| Cylindric components | Ø 395 x H 580 mm |
| Quadratic components | 275 x 275 x 580 mm |
| **Electric power supply** | |
| Power requirement | approx. 30 kVA |
| Line voltage | 400 V/N/PE ~ 50 Hz |
| **Deburring chamber** | |
| Diameter | 400 mm |
| Height | 600 mm |
| Max. gas inflated pressure | 16 bar |




**Standard equipment**

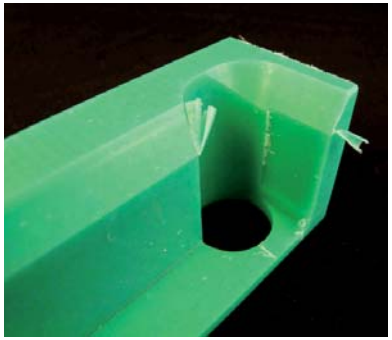
- Rotary indexing table: 2 stations
- Control system: SIEMENS PLC with touch-screen
- Cycle times 2 stations single shot: 45 - 70 seconds
- Cycle times 2 stations double shot: 90 - 120 seconds
- Operating gas: Oxygen and methane (or hydrogen)
- Safety arrangement: TÜV certified, ATEX, CE marking, gas monitoring system



## iTEMPlastics

| | |
|---|---|
| **Dimensions** | |
| Length | 2,600 mm |
| Width | 1,610 mm |
| Height | 2,600 mm |
| Weight | 4,000 kg |
| **Max. component size** | |
| Cylindric components | 400 x 400 x 800 mm |
| **Electric power supply** | |
| Power requirement | approx. 20 kVA |
| Line voltage | 400 V/N/PE ~ 50 Hz |
| **Deburring chamber** | |
| Volume | 420 x 420 x 800 mm |
| Max. gas inflated pressure | 2 bar absolut |



**Standard equipment**

- Control system: SIEMENS PLC with touch-screen
- Cycle times: 60 - 120 seconds
- Operating gas: Oxygen and hydrogen
- Safety arrangement: TÜV certified, ATEX, CE marking, gas monitoring system

**Applicable plastics**

- PMMA (polymethylmethacrylate), acryl glass, POM (polyoxymethylene), PA (polyamide), PA casting, PUR (Polyurethane), ABS (acrylnitrile-butadiene-styrene), PE (polyethylene), PP (polypropylene), silicone, laser sinter substances, NBR, Viton

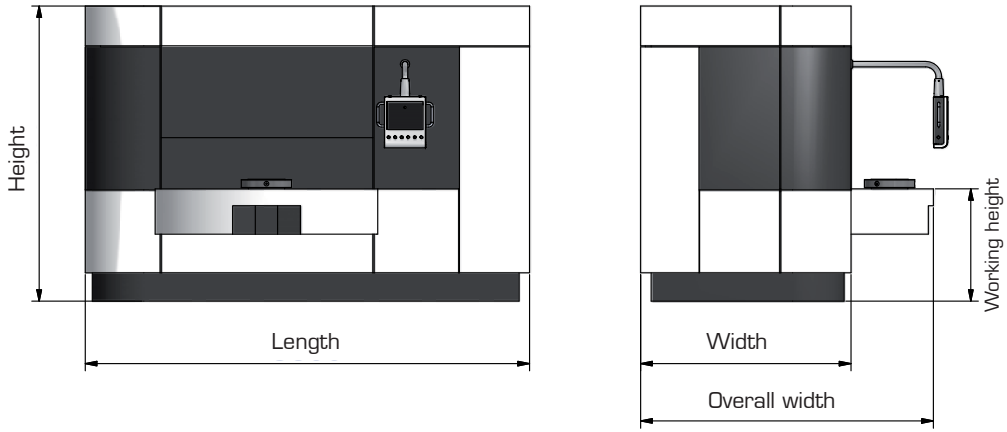
**Plastics applicable to a limited degree**

- PEEK (polyetheretherketone), PVDF, natural latex

## At a glance

| | *iTEM250* SC | *iTEM320* SC | *iTEM400* | *iTEM400/600* | *iTEMPlastics* |
|---|---|---|---|---|---|
| **Dimensions (mm)** | | | | | |
| Length | 3,100 | 3,100 | 3,800 | 3,800 | 2,600 |
| Width | 1,800 | 1,800 | 1,800 | 1,800 | 1,610 |
| Overall width | 2,400 | 2,400 | 2,500 | 2,500 | 1,610 |
| Height | 2,600 | 2,600 | 2,600 | 2,850 | 2,600 |
| Working height | 1,100 | 1,100 | 990 | 1,380 | 810 |
| Weight (kg) | 10,000 | 10,000 | 15,000 | 17,000 | 4,000 |
| **Max. component size** | | | | | |
| Cylindric components (mm) | Ø 240 x H 280 | Ø 310 x H 280 | Ø 395 x H 280 | Ø 395 x H 580 | - |
| Quadratic components (mm) | 170 x 170 x 280 | 220 x 220 x 280 | 275 x 275 x 280 | 275 x 275 x 580 | 400 x 400 x 800 |
| **Electric power supply** | | | | | |
| Power requirement | approx. 30 kVA | approx. 30 kVA | approx. 30 kVA | approx. 30 kVA | approx. 20 kVA |
| Line voltage | 400 V/N/PE ~ 50 Hz | | | | |
| Control voltage | 24 V DC | | | | |
| **Operating media** | | | | | |
| Medium 1 | methane* | methane* | methane* | methane* | hydrogen |
| Medium 2 | oxygen | oxygen | oxygen | oxygen | oxygen |

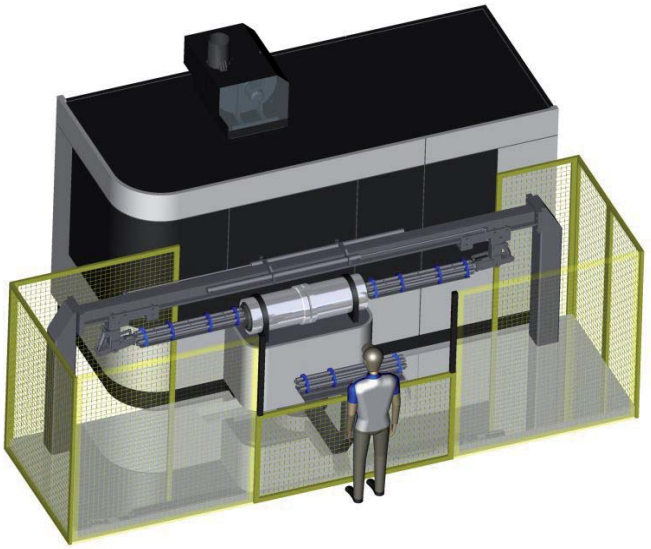
* Hydrogen and natural gas are also applicable. Natural gas may not contain more than 2% of inert gas and in addition, a natural gas compressor is needed.



## Beyond the standard

We offer you the highest possible equipment competence and develop your individual TEM solution.

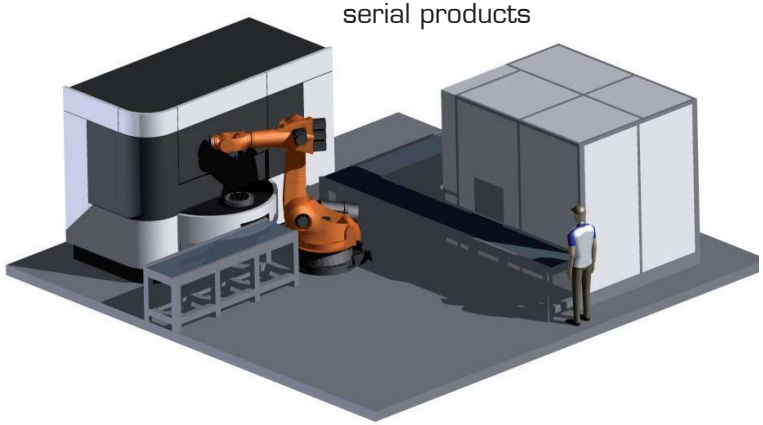
*iTEM400 HP*
Deburring chamber Ø 400 x H 400 mm
Max. gas inflated pressure 20 bar



*iTEM Long Chamber*
Deburring chamber Ø 200 x H 1,200 mm

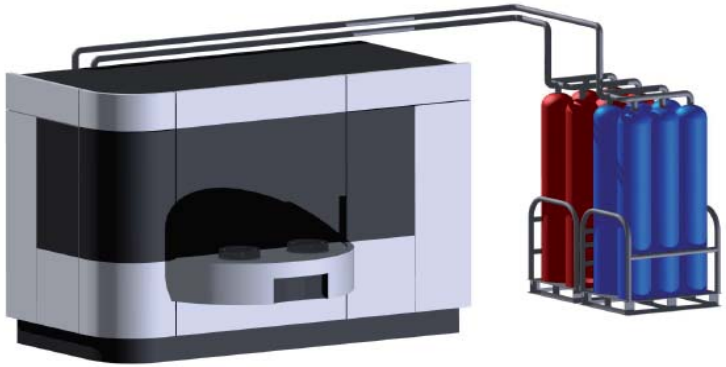
*iTEM Long Chamber*
Deburring chamber Ø 320 x H 1,400 mm

Automated *iTEM* equipment for serial products

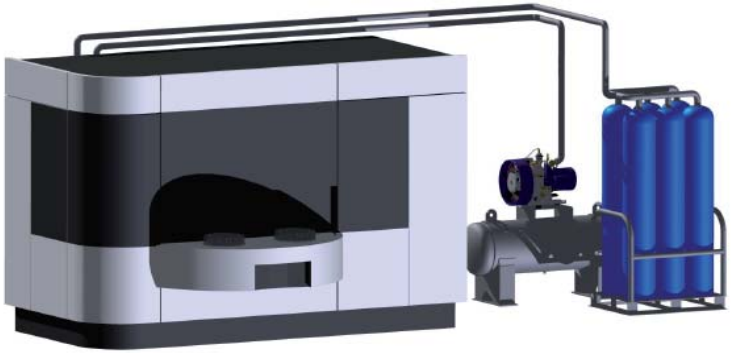


## Supply versions

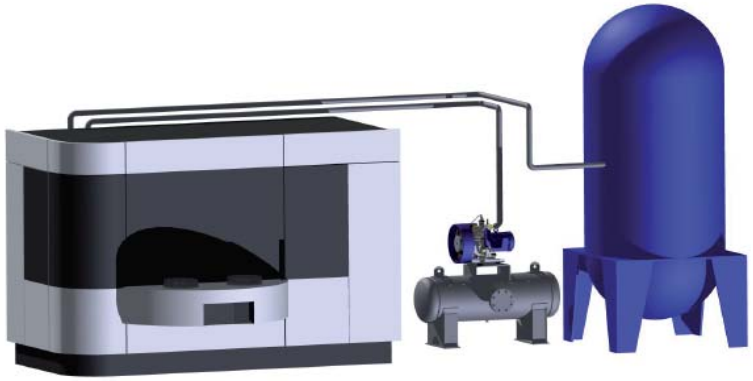
Supply of the machine with fuel gas and oxygen can occur in various ways. Methane, natural gas and hydrogen can be used as fuel gas for thermal deburring. Natural gas may not contain more than 2% of inert gas and in addition, a natural gas compressor is needed.



Version 1: Bundle of gas and oxygen cylinders



Version 2: Natural gas compressor and bundle of oxygen cylinders



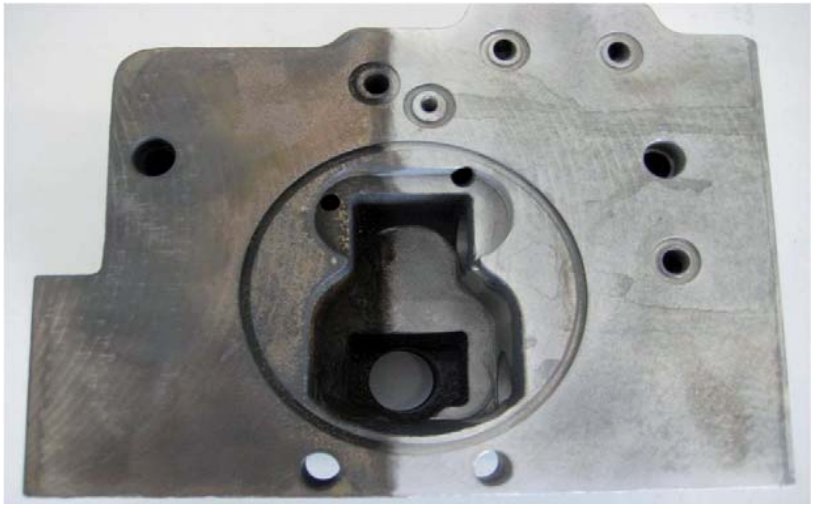
Version 3: Natural gas compressor and oxygen tank

## Subsequent to TEM

After the TEM process, a subsequent treatment is necessary as a rule, because the burnt down material in the form of ferric oxide deposits on the whole workpiece surface. Exceptions exist if the workpieces are subject to subsequent galvanization, nitration or hardening.

For steel and steel casting parts, an appropriate washing technology should be promptly - between 1 to max. 3 days - applied. If the ferric oxide remains on the processed areas for a long period of time, corrosion pits can be the result. The following washing technologies can be used:

1. **Pickling by acid**
   The workpieces are treated in a phosphoric-sulphuric bath. This method is effective, but entails a few drawbacks:
   - Heavy burden on environment and humans
   - High disposal costs
   - Secondary damages to the workpiece caused by acid residuals are possible
   - Hydrogen embrittlement cannot be excluded



2. **pH-neutral cleaning with ultrasonic support**
   The workpieces are placed in cages in so-called single chamber systems and cleaned in a bath by means of ultrasonic. Additionally, the parts are hosed down with high pressure (16 - 18 bar). Following this, the workpieces are passivated and dried under vacuum. In recent years, this technology has gained worldwide acceptance - particularly worthy are:
   - Due to lower energy costs - compared to the above-mentioned method - the higher machine costs amortize
   - pH-neutral cleaner reliably clean at a temperature of 40 °C, acid not until 60 - 70 °C

For components made of aluminium or zinc diecasting, the subsequent treatment depends on the application. After the TEM process, many workpieces are ready to install. But if the customer requires a low content of residual dirt for parts such as pneumatic valves, you cannot do without cleaning.

## Questions upon questions

**What are the key benefits of TEM deburring?**
Achievement of high quality and repeatability; a reliable removal of burrs, adherent particles, and deposit. Furthermore, it is one of the cheapest and fastest abrasive processes. The treatment of one complex or many smallish workpieces is possible after a short changeover time at low tool and set-up costs.

**What effect does thermal deburring have on threads?**
The leading edge, which could damage seals caused by breaking or lifting, will be deburred and finest burrs will be removed. Pitches won't be chamfered, flattened or affected on the surfaces. The result of the process is a clean, tight and easy mountable thread.

**Does the process reaction impair the workpieces?**
The process does not impair the workpieces. Small workpieces are placed and fixed in jigs to avoid minor nicks and dings. Bigger workpieces, such as hydraulic manifolds, do not need to be fixed in the majority of cases.

**Which are the main areas of application?**
Main application areas of the TEM process are castings and turned parts as well as manifold blocks. Substantial savings can be achieved on, e.g. bodies for hydraulic and pneumatic valves, and castings with bore intersections. The process also removes treatment and casting burrs of zinc diecasting parts concurrently. Furthermore, turned and milled parts can be deburred in a matter of seconds.

**Is it possible to keep up the sharp edges after deburring?**
Yes. It is possible to regulate the process to keep up the sharp edges after deburring.

**Is a subsequent treatment of the workpieces necessary after the TEM process?**
Yes, as a rule. The ferric oxide constitutes a visual and functional flaw and must be removed. One can only do without, if the parts are subject to a subsequent galvanic treatment.

**What temperatur do the workpieces reach?**
Workpieces made of steel can reach temperatures in the range of 150 - 180 °C (302 - 356 °F). Workpieces made of aluminium heat up to temperatures in a range of 60 - 90 °C (140 - 194 °F).

**Which areas of a workpiece can be deburred?**
All areas! The energy source for this process is gas which distributes evenly throughout the deburring chamber and the workpiece. For gas, there is no opening too small for it to penetrate - particularly if it is under pressure. Therefore, every burr, edge, flash, and particle is covered.

**Do all metals work equally well?**
There are some characteristics, but in general, yes. It depends on the thermal conductivity and the specific thermal absorption of the metal. Ferrous metals, aluminium and zinc alloys work well. Treatment of stainless steel is limited possible.

**Is it possible to remove burrs and flashes from plastics?**
Yes. As the gas pressures and process temperatures of the various plastics are much lower than those of metals and melting points are low, the process demands specific process parameters for small energy densities. Our machines are equipped with high-quality control and feedback control systems. This enables us to set the process parameters for plastics as well as to control them sensitively and reproducibly.

**Is it possible to chamfer edges?**
A minimal rounding of edges can be achieved, but a specific rounding is not feasible. Unlike other methods, the TEM process is not selective controllable to particular edges.

**Which combustion gases can be used?**
Methane, hydrogen and natural gas are applicable. Natural gas may not contain more than 2% of inert gas and in addition, a natural gas compressor is needed.

**What effect does thermal deburring have on small bored holes?**
Small bored holes will be deburred as safe as other areas, too.

## Convincing quality

Owing to the continuous development of our proficiency, the TEM process has proved its worth in very many areas of application. Our customers from various industries benefit from the reliable and high-quality results of this method.

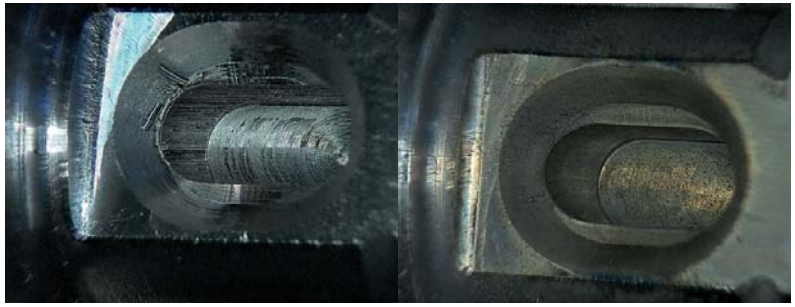
| | | |
|---|---|---|
| Construction machinery | **Industry** | Hydraulic system (forklift truck) |
| Hydraulic distributor | **Workpiece** | Valve block |
| Complete removal of all burrs and loose swarf | **Requirement** | Complete removal of all burrs |
| High pressure water-jet deburring, manual deburring | **Replaced process** | Manual deburring, duration approx. 1.5 h/workpiece |
| *iTEM400*, double shot, cycle time 150 sec | **ATL improvement** | *iTEM400*, double shot, cycle time 150 sec |

| | | |
|---|---|---|
| Wind energy | **Industry** | Automotive industry (fuel injection) |
| Hydraulic oil-filter housing made of aluminium | **Workpiece** | Extruded aluminium sheath |
| Workpiece cleaning prior to assembly | **Requirement** | Complete removal of all burrs and loose swarf |
| Manual deburring, duration approx. 1 h/workpiece | **Replaced process** | High pressure water-jet deburring, ECM deburring |
| *iTEM400/600*, double shot, cycle time 150 sec | **ATL improvement** | *iTEM250* SC, cycle time 120 sec/8 workpieces |

| | | |
|---|---|---|
| HGV engines | **Industry** | HGV engines |
| Rocker arm | **Workpiece** | Axis for rocker arms |
| Removal of all burrs (in-/outside) | **Requirement** | Accurate, repeatable removal of detachable burrs |
| Deburring by robot, manual deburring | **Replaced process** | Manual deburring |
| *iTEM320* SC, cycle time approx. 11 sec/workpiece | **ATL improvement** | *iTEM Long Chamber* (special design) deburring chamber Ø 200 x H 1,200 mm |

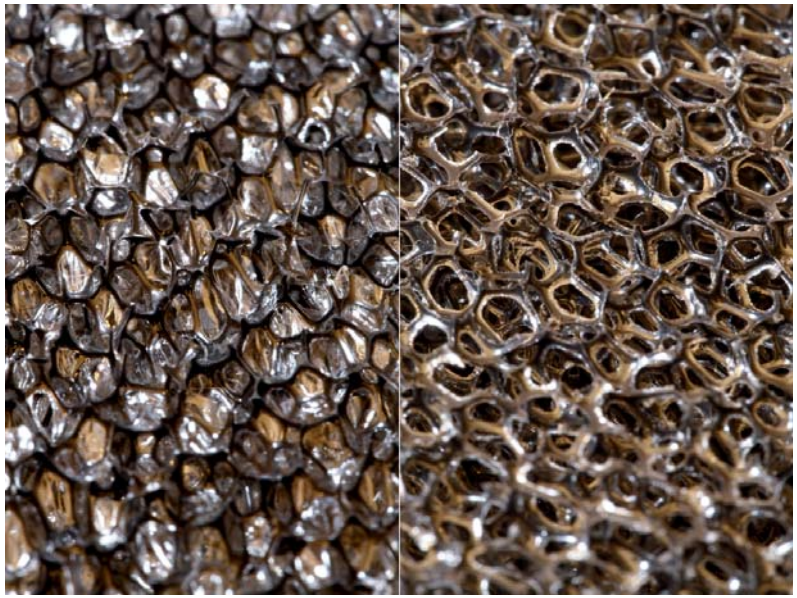
## Before and after comparison

In the comparison of ‘before TEM’ and ‘after TEM’, the differences and hence the advantages compared to other methods are clearly visible. The shown examples demonstrate workpieces from different industries and made of various materials.



## Reticulated foam

In addition to *iTEM* machines, ATL produces gas-reticulation units for polyether and polyester foam. Reticulation is a secondary process which uniformly removes the membranes from the cell structures. The air within the foam is removed and replaced by an explodable gas mixture. Ignition of the mixture results in a controlled explosion, which removes the thinner membranes. The explosion is most conveniently carried out in a special designed chamber.

Before After

For further information please visit: www.reticulation.de.

## We are your partner

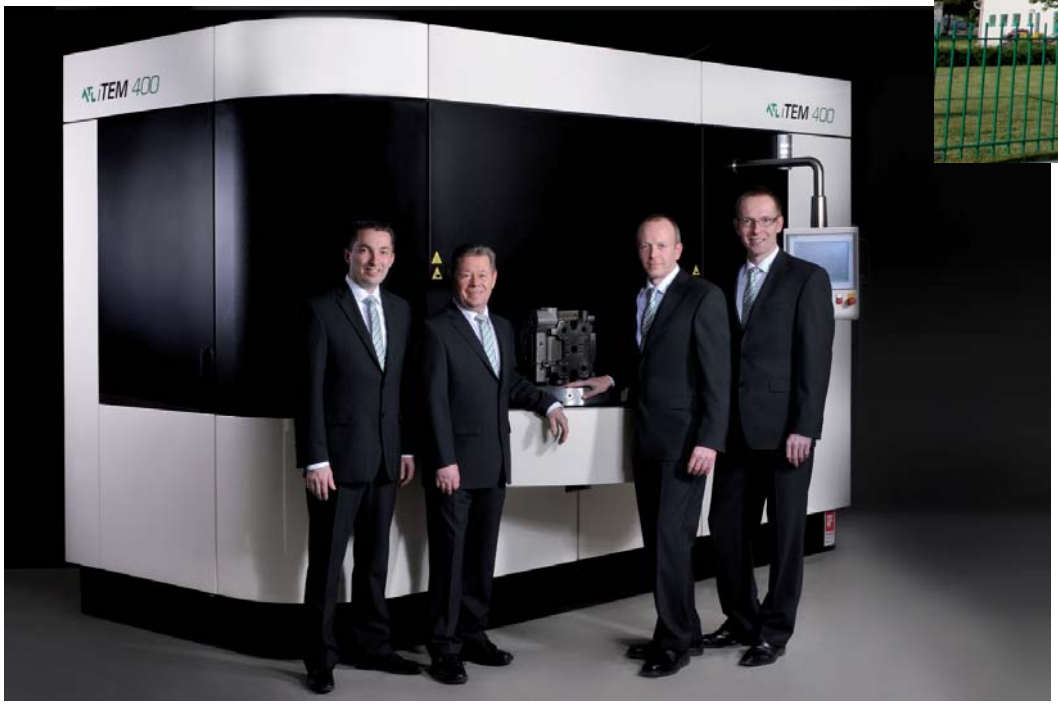
We gladly welcome you at our headquarters in Luhden or from winter 2011 at our new final assembly. Convince yourself of the advantages of the TEM process at the ATL test and demonstration center.

We are also represented at the following international exhibition:

AMB Stuttgart, Germany 18. - 22.09.2012

You can find the current dates on our website at www.atl-luhden.de/contact/exhibitons.

Stammhaus in Luhden




From the left: Jörn Struckmann (CEO), Axel Kieser (Process Consulting), Martin Köllner (Sales Engineer) and Marc Völker (Project Leader)

The ATL expert team is at your disposal. Our sound advice will solve your complex deburring requirements.

*„We didn't invent the thermal deburring -*
*but we made something special of it!"*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