TOTEM®

High Performance Cutting Tools

AUTOMOTIVE


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High Performance Cutting Tools

THE TREND

The latest trends in the auto industry are
1) Higher efficiency
2) Lighter materials
3) Small displacements with Max Output
4) Low carbon emissions

This calls for materials which are of high quality; where the strength needs surpass that of Aluminum but do not necessarily require Steel. Ductile Iron, Nodular Iron, SG Iron is very prominently being used in the Auto Industry to make Cylinder blocks and Crankshafts. Machining these new generation materials is a challenge in the auto industry

The presence of graphite particles in Gray Cast Iron, Malleable Cast Iron and Ductile Iron renders these materials to have good machinability by nearly all criteria, especially when compared to steels. Low rates of tool wear, high rates of metal removal, relatively low cutting forces and power consumption are the characteristics of Cast Iron.

When a steel part is replaced with ductile iron, better machinability is considered to be the most important gain. Although there is no definite information in the published literature that Ductile Iron has better machinability than steels, data obtained from manufacturers shows that parts manufactured from ductile iron leads to improvement in tool life by 2 – 8% times when compared to the heat treated Forged Steels.

MATERIALS
THAT MATTER

Conventional Cast Iron has Graphite in the form of flakes which causes stress concentration points within the metal matrix. On the other hand the micro structure of Ductile Iron consists of graphite in the form of rounded nodules which reduces crack propagation within the metal matrix thus providing the enhanced ductility and hence the name

Ductile cast irons have compositional similarities to Gray Cast Iron, but generally contain additions of Silicon, Magnesium, and/or Cerium needed for nodularization of the Graphite content. Typically, Ductile Irons also contain substantial amounts of pearlite. Since there is a close relationship between pearlite content and material hardness, Ductile Iron will, in many cases, be both harder and less machinable than Gray Cast Iron.

When machining either Ductile Irons or Gray Cast Irons with a conventional wear-resistant coated cutting grade, microchipping invariably occurs and the cutting edges rapidly lose their sharpness. On the other hand, use of a conventional tough-coated grade will often result in rapid wear or plastic deformation of the substrate.

Ductile Cast Irons are gaining in popularity and rapidly replacing Gray Cast Iron and some low-strength steels. This increased use, especially in the automotive, heavy-duty equipment, and non-automotive transportation industries, has sparked our development team to design and develop the latest Hole Making solutions to machine this Material.

A) FORGED STEEL

Forging offers uniformity of composition and structure. Forging results in metallurgical recrystalisation and grain refinement as a result of the thermal cycle and deformation process. This strengthens the resulting steel product particularly in terms of impact and shear strength.

Forged steel is generally stronger and more reliable than castings and plate steel due to the fact that the grain flows of the steel are altered, conforming to the shape of the part.

The advantages of forging include:

- Generally tougher than alternatives Cast Iron and Aluminum
- Will handle impact better than castings
- The nature of forging excludes the occurrence of porosity, shrinkage, cavities and cold pour issues.
- The tight grain structure of forgings making it mechanically strong. There is less need for expensive alloys to attain high strength components.

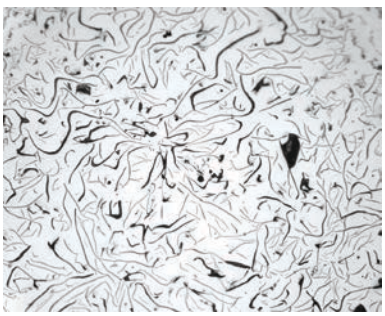
B) CAST IRON

Castings are used for a wide range of wear parts and components that are too large, complicated, intricate or otherwise unsuitable for the forging process. Parts can be forged upto a certain weight but the sheer energy required to forge larger items make casting a much more viable alternative.

Carefully choosing alloys and applying proven methods of heat treatment can produce castings of high quality, strength and wear resistance. The casting process better lends itself to making parts where internal cavities are required.

The advantages of casting include:

- No real upper size limit in casting weight
- Large range of alloy choices
- As forgings remain solid, custom alloys are far more difficult to get into production whereas with casting, alloys including Chrome, Nickel and Molybdenum can be added at the molten stage.
- Tooling is often less expensive than forged dies
- Smaller production “runs” required
- Complicated/complex parts are easy to cast



Gray Iron Microstructure

When machining Cast Irons, the most common problems are flank wear, crater wear, notch wear and built-up-edge caused by abrasion, adhesion and diffusion. Thus, the basic requirements for the cutting tool material for machining cast iron are:

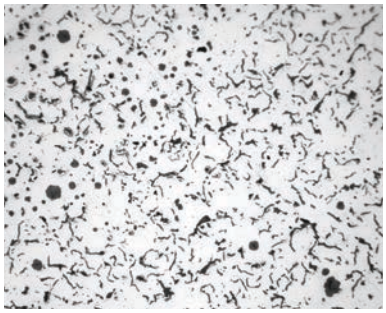
- Resistance to adhesive and abrasive wear caused by the variable microstructures;
- Sufficient toughness for the material to be machined;
- The capability to machine at high speeds and feed rates.

C) COMPACTED GRAPHITE IRON (CGI)

The Graphite in compacted Graphite Iron differs in structure from that in Gray Iron because the Graphite particles are shorter and thicker. This results in stronger adhesion between the Graphite and the Iron giving the material a greater tensile strength.

Compacted Graphite Iron has characteristics midway between Ductile and Gray Iron and combines many of the properties of both. Compacted Graphite Iron is challenging to make with uniformity.

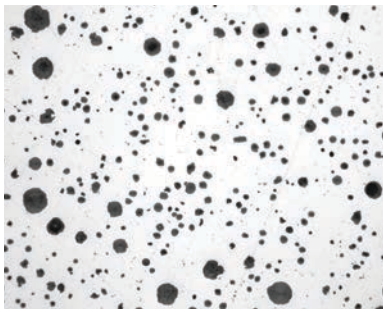
The advantages of CGI are:
- Easy to Machine
- Graphite acts as a lubricant layer



Compacted Graphite Iron Microstructure

D) DUCTILE IRON (SG IRON)

In Ductile iron the Graphite is like a pillow and acts as "crack-arresters" to give Ductility and toughness superior to all other Cast Irons. In SG Iron the Graphite is in the form of spherical nodules (hence the name Spheroidal Graphite) rather than flakes as in Grey Iron.



Ductile Iron Microstructure

E) DUCTILE IRON (NODULAR IRON)

In Nodular Iron Graphite is in the form of nodules rather than flakes as in Grey Iron. Whereas sharp Graphite flakes create stress concentration points within the metal matrix, rounded nodules inhibit the creation of cracks, thus providing the enhanced ductility that gives the alloy its name.

Nodule formation is achieved by adding nodulizing elements, most commonly magnesium and, less often Cerium, Tellurium and Yttrium

The advantages of Ductile are:
- Excellent tensile strength
- Increased ductility which ensures finished materials will bend before breaking
- Excellent impact properties
- Good machinability
- High modulus of elasticity which measures the degree of “stiffness” in the material

F) AUSTEMPERED DUCTILE IRON (ADI)

Austempered Ductile Iron (ADI)—Developed by adding alloying elements such as Cu, Mb and Nickel (Ni) to Ductile Iron and then performing a special heat treatment (Austempering), ADI has increased Ductile Iron's ductility to 12-22%. Thus, ADI is a stronger and tougher material than conventional ductile iron. The required mechanical properties of ADI are achieved by controlling the heat treatment parameters. Austempering heat treatment significantly enhances the mechanical properties of ductile iron. This material has an Ausferrite matrix (ADI has a different metal matrix than as-cast or conventional quench and tempered Ductile Iron. The matrix consists of acicular ferrite and carbon-stabilized Austenite, also known as Ausferrite.) and offers improved strength and toughness in comparison to ductile iron. Understanding this matrix is key to understanding why it machines differently than other materials. ADI has a better strength to weight ratio when compared to Forged steel and Aluminium

ADI has been assumed to be un-machinable by many manufacturers. This is often due to its high hardness values. It has also been brought about by inappropriate machining practices. If one attempts to machine ADI as if it were as-cast ductile iron, the attempt will be unsuccessful.

ADI is not as easily machined as pearlitic or ferritic Ductile Iron, but is comparable to a 30Rc hardened steel in metal removal rates. One of the benefits of machining ADI is that the chips are discontinuous. Unlike steel, which creates a continuous coil-like chip while it is being machined, ADI produces a discontinuous chip that is easier to handle and recycle. This proves to be beneficial especially for highly automated machining centers, where the small machine chips tend to not clog the equipment.

When a high normal force is applied to ADI, a phase transformation occurs on the surface of the part. The force of the tool during cutting, drilling, or turning, can cause a localized transformation in the material in front of the tool. The Austenite on the surface undergoes a strain induced transformation to Martensite. This Martensite structure is harder and more brittle than the Ausferrite structure.

Therefore, while you are machining ADI, this transformation right in front of the tool face makes it even more difficult to machine. Because of this effect, it is suggested that ADI be machined with a deeper cut at a slower speed to help the tool avoid this new, hardened surface. When compared to as-cast ductile iron, the speed of the tool should be 50% less, and the depth of cut should be increased by 50%.

Since ADI is more prone to work hardening and built-up-edge than ductile iron, the TiN-coated tools are the best choice for machining because TiN reduces friction, work hardening and built-up-edge. Considerable research has been done on the use of different tool materials for machining ADI. Due to ADI's high strength and ductility, cutting tools often suffer flank wear and crater wear when machining ADI.

Totem has a complete series of TiN Coated Taps, Drills and End Mills to machine this challenging work piece material. These cutting tools have high wear resistance and require the use of cutting fluids.

Studies show that the Surface finish of the machined ADI is better than that of CGI and CI. Our studies show that using a positive geometry with coolant of the right concentration can give you the best results for machining ADI.

CRANKSHAFT

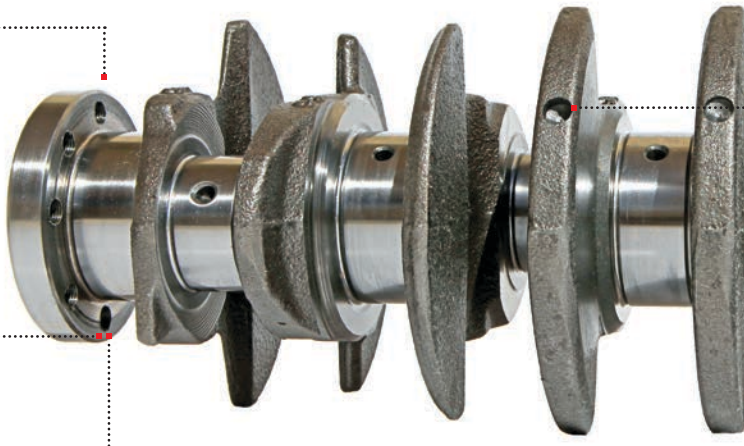
The crankshaft is one of the most important parts of the engine and is considered as the heart of the engine. Design and Manufacturing of a crankshaft is very critical as it undergoes several load cycles during its working. Therefore, the material of the crankshaft has to have high strength and toughness, high wear resistance, high resistance to fatigue stresses, impact loads and hardness.

Crankshafts manufacturers world over are moving from Forged Steel to Ductile Cast Iron and now to the new age Austempered Ductile Iron which offers a high strength to weight ratio when compared to forged steel and ductile iron. Totem's TD Series of Solid carbide drills and High Performance Taps are the right choice for machining these materials.

OPERATIONS

DOWEL HOLE DRILLING AND FLANGE HOLE DRILLING

Totem's TD Series Solid Carbide Drills available in both through coolant and non-through coolant.



DOWEL HOLE REAMING

Totem's Custom solution Solid Carbide Reamers are available in H6, H7 and H8 tolerances with both through coolant or non-through coolant options.

FLANGE HOLE TAPPING

For Forged steel crankshaft, we propose following Totem's high performance Taps

- SBF7 series- with special coating for blind hole tapping

- SAF7 series- with special coating for through hole tapping

For Ductile Cast Iron crankshafts and ADI Crankshafts, we propose Totem's High Performance Taps SC4 series- with TiAlN coating.

OIL HOLE DRILLING

FLAT PREPARATION

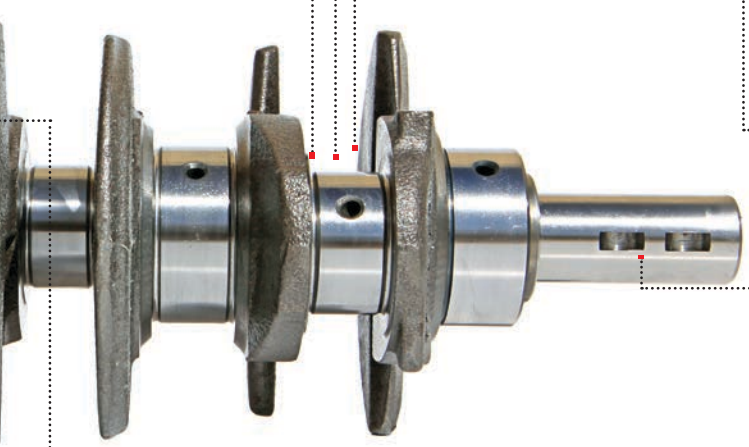
Totem's Solid carbide end mill- TR Series with a mixed Helix design will ensure a flat is prepared with the least vibrations and maximum tool life.

PILOT DRILLING

Totem's TD Series custom solution solid carbide pilot drills are manufactured with positive tolerances to ensure smooth entry of the oil-hole drill. These pilot drills are available in both through coolant and non-through coolant.

OIL HOLE DRILL

Totem's custom solution oil hole solid carbide drills are manufactured with the Nano-grain structure carbide with the latest geometry and coating which delivers superior tool life and less breakage. These drills are manufactured as per the components requirement upto L/D 35.



KEY WAY CUTTER

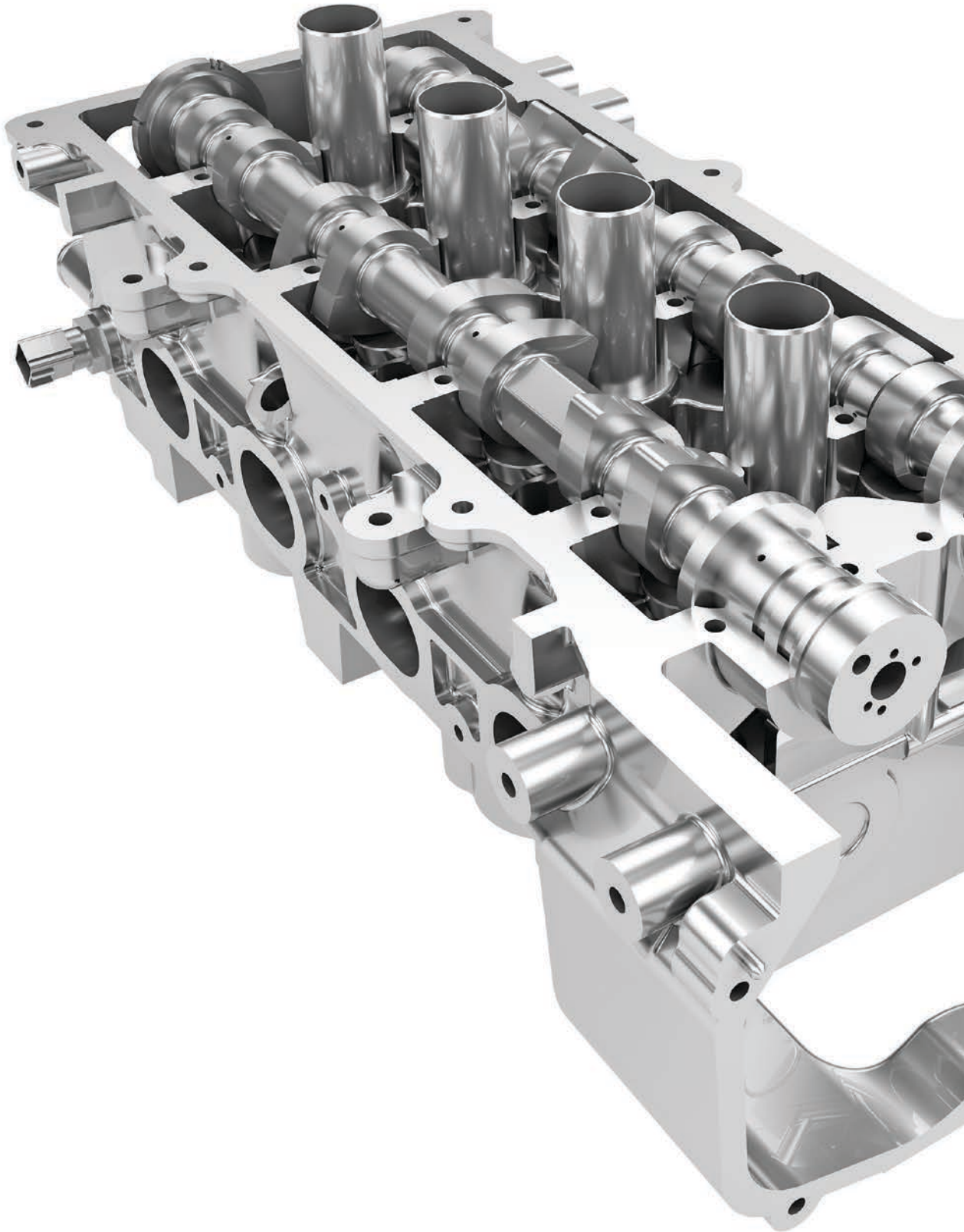
Totem's offers solid carbide Key way cutters as per the crankshaft requirement.

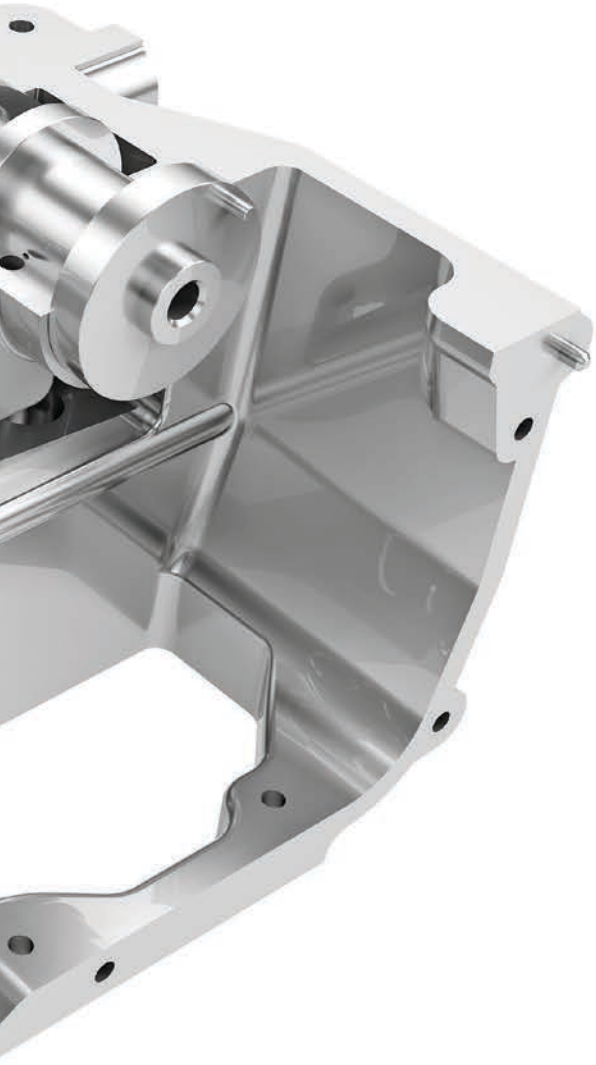
BALANCING HOLE

Totem's TD Series solid carbide drills available in both through coolant and non-through coolant.

CYLINDER HEAD

As the automotive industry has evolved the demand of efficient light automobiles have become the latest trend. Auto manufactures have moved to lighter options from the traditional Cast Iron Cylinder Head to the new generation Cast Aluminium with over 12% of Silicon. Totem's Solid carbide end mills, drills and Forming Taps are the best solution for machining this material.





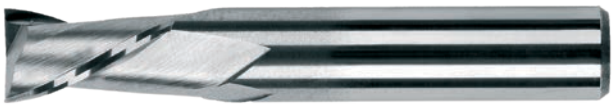
OPERATIONS

DRILLING

We have the complete range of drilling for cylinder heads of Cast Iron and Aluminium from small depths to deep-hole drilling: Totem's straight flute burnishing drills for Aluminium ensures the best surface finish and accuracy for core hole drilling.

MILLING

On Cast iron, Totem General Purpose F111 Series whereas for Aluminium, Totem F135 & F136 series – uncoated series for optimum cost-benefit ratio.



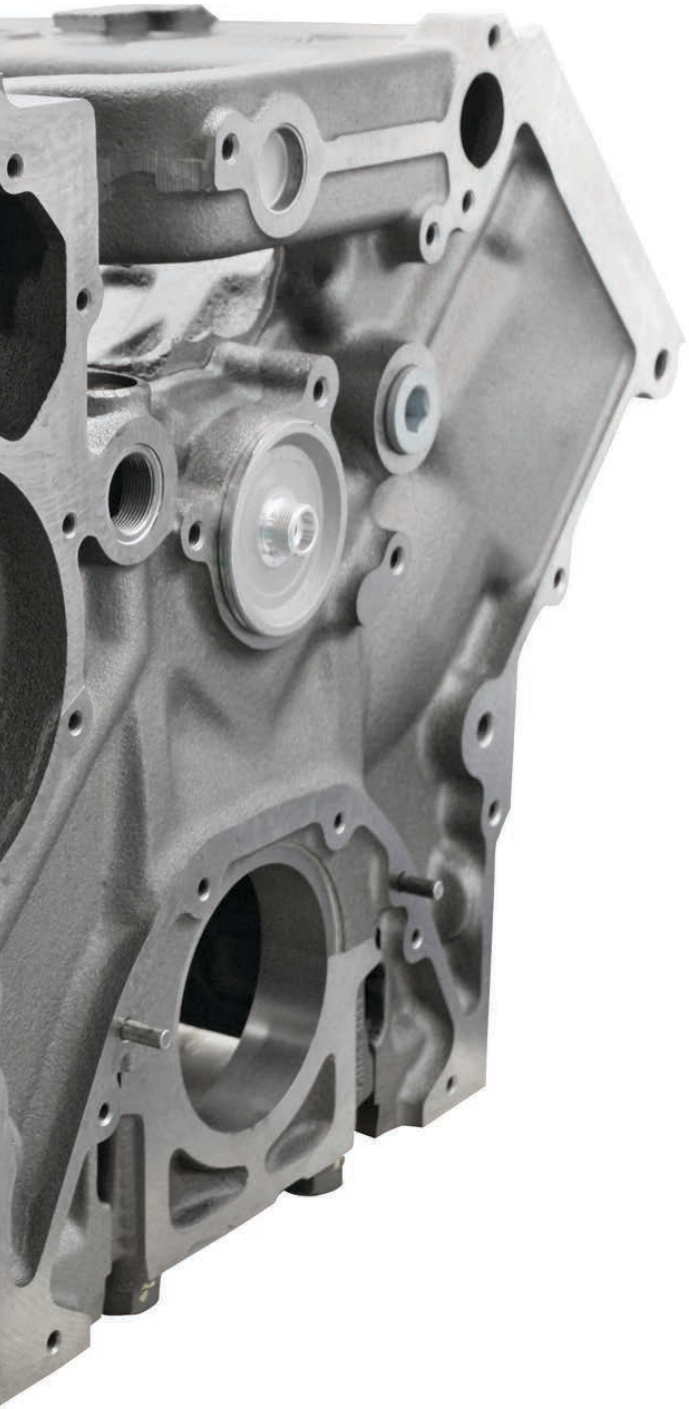
TAPPING

For tapping of cylinder head on Cast Iron, Totem offers the latest High Performance Taps SC4 series- TiAlN coated, through-coolant or non-through coolant.

For Aluminium, Totem High Performance Taps SD3 series- TiN coated.

CYLINDER BLOCK

Similar to Cylinder Head, the material for Cylinder Block too has moved from Cast Iron to Ductile Iron and ADI Austempered Ductile Iron due to its high strength to weight ratio. New age material such as Spheroidal Grey Iron & Nodular Iron and ADI is gaining ground.



OPERATIONS

DRILLING

For Drilling on cylinder blocks from small depths to deep-hole drilling, Totem's TD Series Solid carbide drills are the best recommended to higher parameters and low CPC.

TAPPING

To address the challenge of high speed tapping on Cylinder Blocks made of Cast Iron, Totem High Performance Taps SC4 series- TiAlN coated are an industry benchmark.

CONNECTING ROD

Connecting rod connects the piston to the crankshaft. As the engine power increases, there is an exponential increase in dynamic stress on the connecting rod. Modern Day manufacturers of Connecting rod manufacture from Forged steel with high alloying content. There is research in process to find better alternatives but as of now, Forged steel is most widely used and accepted.

OPERATIONS

FLAT PREPARATION (CAP MILLING)

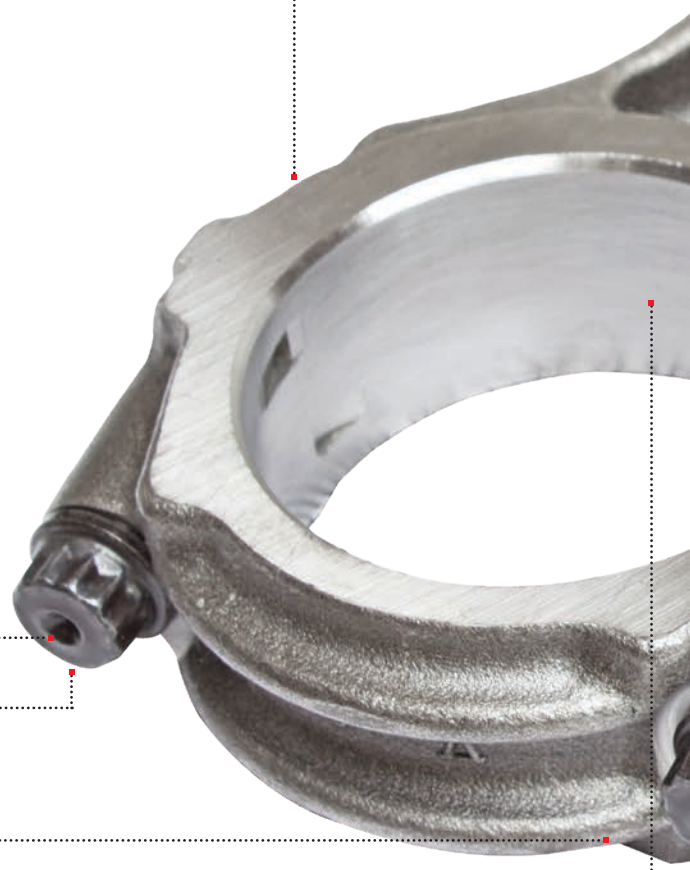
Totem's Solid carbide end mill- TR Series with a mixed Helix design will ensure a flat is prepared with the least vibrations and maximum tool life.

ROD TAPPING

For the Connecting Rod tapping Totem has got a proven solution which is now being used by many of our top customers. Totem High Performance Tap SDF5 series in HSSE PM has become the industry fore-runner for this application.

CAP DRILLING/ ROD DRILLING/ DOWEL DRILLING

Totem's TD Series Solid Carbide Drills available in both through coolant and non-through coolant with a special modified geometry for the long chipping material. It is also available with a special wear resistance coating as a special.



NOTCH MILLING

Offers solid carbide Notch Milling cutters as per the customer requirement.

DOWEL HOLE REAMING

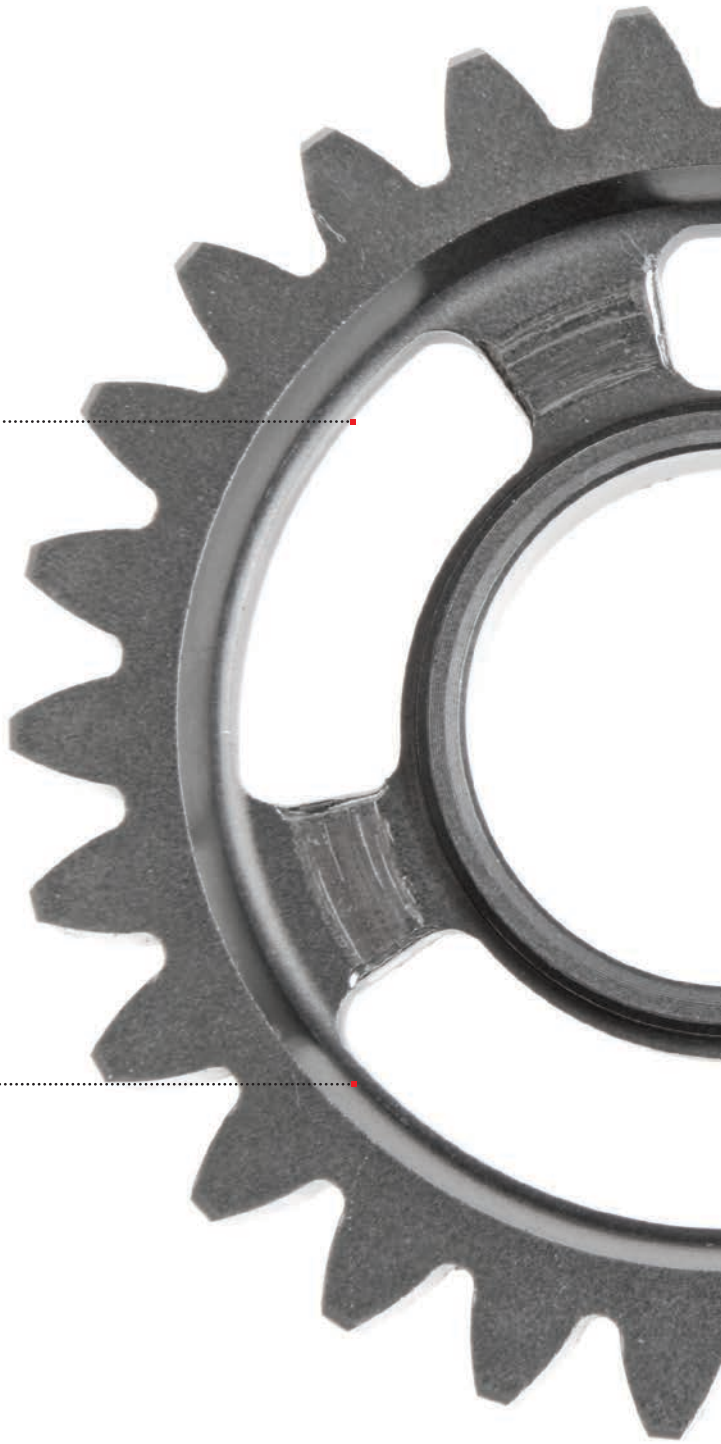
Totem's Custom solution Solid Carbide Reamers are available in h6, h7 and h8 tolerances with both through coolant or non-through coolant options.

OIL HOLE DRILLING

Totem's custom solution oil hole solid carbide drills are manufactured with the Nano-grain structure carbide with the latest geometry and coating which delivers superior tool life and less breakage. These drills are manufactured as per the components requirement upto L/D 35.

GEAR AND FLANGE MACHINING

Modern day gear and flange are manufactured from high alloy steel either by hot forging or cold forging, Typical materials are 16MnCr5, 20MnCr5, 42MoCr4.



OPERATIONS

PILOT DRILLING / CORE DRILLING

Totem's TD Series Solid Carbide Drills available in both through coolant and non-through coolant.

KIDNEY SLOTTING ROUGHING

Totem offers High Performance Custom solution Solid Carbide Roughing End mills which are used at a wide variety of Gear Manufacturers on SPM's with Right Hand and Left Hand helix combinations.

KIDNEY SLOTTING FINISHING

Totem offers a High Performance Custom solution Solid Carbide Finishing End mill which has got a unique flute geometry which ensures the best surface finish on the component.

DEBURRING

Totem offers a unique solution for Gear Deburring; we offer Gear Deburring SPM's and the Tungsten carbide rotary burrs for this operation – STD Sizes A3 & A2 are manufactured with a modified rake geometry to provide excellent surface finish.

INTAKE MANIFOLD

Intake Manifolds have changed over the years and become lighter and manufacturers have moved to Cast Aluminium Alloys to manufacture it. It is a very essential part of the engine which delivers the air fuel mixture to the cylinders.

OPERATIONS

FLANGE DRILLING/ PILOT HOLE DRILLING/ MOUNTING FACE DRILLING/ LOCATION HOLE DRILLING/ PORT HOLE DRILLING

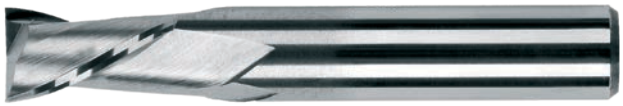
We have the complete range of drilling for Intake manifolds made of Aluminium from small depths to deep-hole drilling: Totem's straight flute burnishing drills for Aluminium ensures the best surface finish and accuracy for core hole drilling.

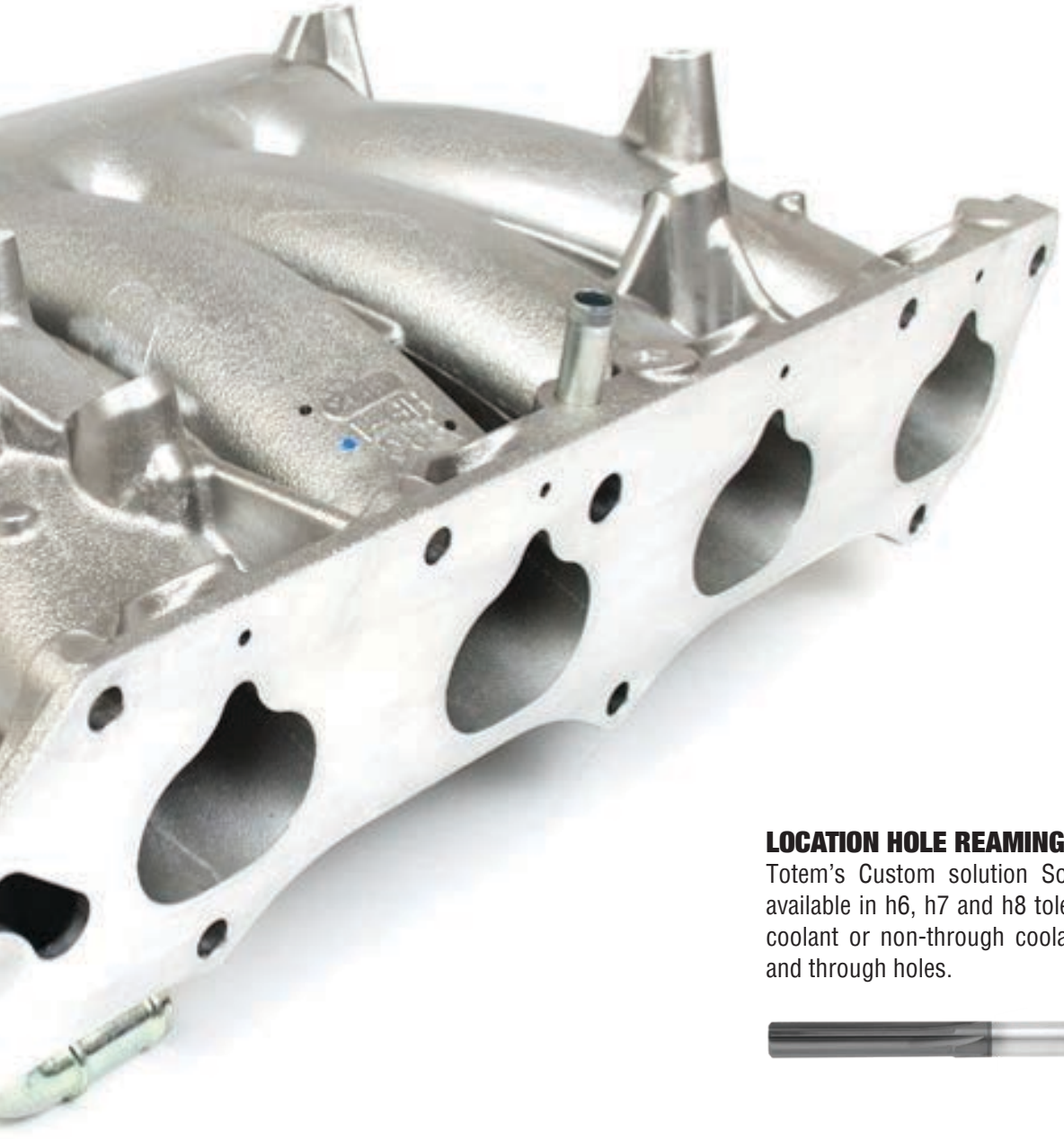
FLANGE TAPPING/MOUNTING FACE TAPPING

Totem High Performance Tap- SB3 series is a benchmark for tapping this Al Alloy.

FLAT END MILLING (FLAT PREPARATION)

Totem F135 & F136 series – uncoated series is a unique high helix solution which is used for superior surface finish and optimum cost-benefit ratio.





LOCATION HOLE REAMING

Totem's Custom solution Solid Carbide Reamers are available in h6, h7 and h8 tolerances with both through coolant or non-through coolant options for both blind and through holes.

BRAKE CALIPER

Brake calipers are essential to your car's ability to stop and are arguably one of the most important automobile brake parts. Most cars today have disc brakes, at least for the front wheels, anyway. But a lot of cars and trucks are now using disc brakes in the rear, too. In a disc-braking system the car's wheels are attached to metal discs, or rotors, that spin along with the wheels. The job of the caliper is to slow the car's wheels by creating friction with the rotors.

The brake caliper fits over the rotor like a clamp. Inside each caliper is a pair of metal plates bonded with friction material -- these are called brake pads. The outboard brake pads are on the outside of the rotors (toward the curb) and the inboard brake pads on the inside (toward the vehicle). When you step on the brake, brake fluid from the master cylinder creates hydraulic pressure on one or more pistons in the brake caliper, forcing the pads against the rotor. The brake pads have high-friction surfaces and serve to slow the rotor down or even bring it to a complete halt. When the rotor slows or stops, so does the wheel, because they're attached to one another.

Older cars and trucks used drum brakes, where the motion of the wheels is slowed by friction between a rotating drum and brake shoes mounted inside the drum. This friction caused heat and gases to build up inside the drum, which often resulted in a loss of braking power known as brake fade. Because the brake pads in disc brake systems are external to the disc rather than contained within a drum, they are more easily ventilated and heat doesn't tend to build up quite as fast. For this reason, drum brakes have been largely replaced in modern vehicles by disc brakes; however, some less expensive cars still use drum brakes for the rear wheels, where less stopping power is required.

There are two main types of calipers: floating (or sliding) calipers and fixed calipers. Floating calipers move in and out relative to the rotor and have one or two pistons only on the inboard side of the rotor. This piston pushes the entire caliper when the brakes are applied, creating friction from the brake pads on both sides of the rotor. Fixed calipers, as the name implies, don't move, but rather have pistons arranged on opposing sides of the rotor. Fixed calipers are generally preferred for their performance, but are more expensive than the floating kind. Some high-performance fixed calipers have two or more pairs of pistons (or "pots") arranged on each side of the rotor -- some have as many as six pairs total.

Special tools are used to manufacture these brake calipers due to the accuracy needed to machine the pots and the mounting holes.

Brake Calipers are made of Cast Iron, SG Iron and Aluminum.

OPERATIONS

MOUNTING HOLE DRILLING

Totem's TD Series custom solution Solid Carbide Drills offer the best performance.

TAPPING

Totem's High Performance Taps from SC4 series- TiAlN coated tap with through-coolant or non-through coolant offer the best tapping solution.

CLEARANCE MILLING

For Cast Iron, Totem's Solid carbide end mill- TR Series with a mixed Helix design will ensure clearance milling with the least vibrations and maximum tool life. For Aluminium, Totem F135 series – uncoated series for optimum cost-benefit ratio.

STEERING KNUCKLES

STEERING KNUCKLES are made from Cast Iron or Aluminium or Forged Steel.

OPERATIONS

BRAKE CALIPER MOUNTING HOLE

Totem's TD Series custom solution Solid Carbide Drills offer the best performance.

ABS SENSOR LOCATION HOLE

Totem's TD Series custom solution Solid Carbide Drills are manufactured with ultimate precision and close tolerance for this specific operation.

FLAT MACHINING

For Cast Iron, Totem's Solid carbide end mill- TR Series with a mixed Helix design will ensure that the Flat is prepared with the least vibrations and maximum tool life. For Aluminium, Totem F135 series – uncoated series for optimum cost-benefit ratio.

TAPPING

For Cast Iron, Totem's High Performance Taps from SC4 series- TiAlN coated tap with through-coolant or non-through coolant give optimum performance.

For Forged steel, we propose two alternatives of Totem's High Performance Taps.

SBF7 series- with special coating for blind hole tapping

SAF7 series- with special coating for through hole tapping to avoid chip clogging

TRANSMISSION HOUSING

Typically they are made from Aluminum ADC12

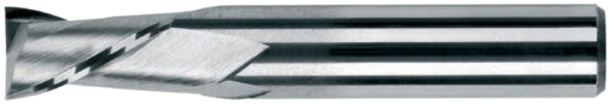
OPERATIONS

CORE HOLE DRILLING

Through Coolant Step Drills custom made for this application - with the latest coating combined with the latest High Performance Geometry, sub micron substrate and superior coating give the lowest cost per part.

FLAT PREPARATION / COUNTER BORE MACHINING

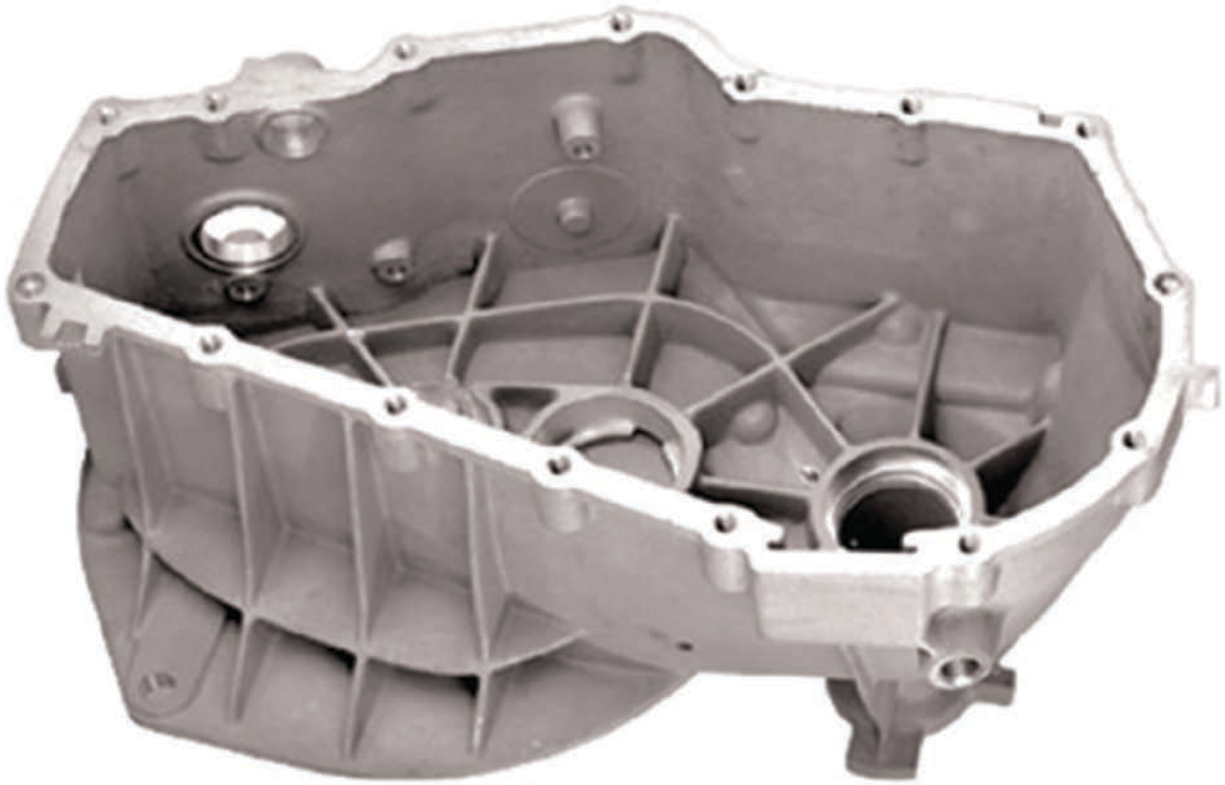
Totem's Aluminium specific end mill 135 series HP gives the perfect flat profile.



TAPPING

For Aluminium, Totem's High Performance Roll Taps- SD3 series- TiN coated Forming Tap for stronger threads.

For Cast Iron, Totem's High Performance SC4 series- TiAlN coated tap with through-coolant or non-through coolant.



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