



CASE STUDY

EXTRA DEEP-HOLE DRILLING ON STANDARD MACHINES

A success story for technology

ZF Friedrichshafen AG



Drilled on a standard machining centre: the maximum depth is 600 mm, of which 410 mm is currently machined with Mitsubishi's solid-carbide drills. Single-flute type drills take care of the remaining depth.

EXTRA DEEP-HOLE DRILLING ON STANDARD MACHINES

Cost effective, efficient and precise. MHS is the first choice for drilling extreme depth, small diameter holes in case-hardened and heat-treated steel. ZF Friedrichshafen AG in Passau uses Mitsubishi Materials deep-hole drills on standard machining centres instead of using special machines.

30 x D depth drilling was a sensation in 2005 but tools with length/diameter ratios up to 40 x D are already an accepted standard today. "Standard, flute type drills with 50 x D have been a special solution up to now," says Volker Lang, an industrial engineer responsible for planning and projects at the ZF works in Passau-Grubenweg, south Germany. One of his ambitions is to advance the deep-hole drilling process. This advancement has meant that the current depth of hole being drilled on standard machining centres, in heat-treated and case-hardened steel, is 60 x D. This is made possible by using the AlTiN coated and internally cooled drills from Mitsubishi, of which Lang states "the drills are reliable and the financial benefits are considerable."

Passau is the production and development location of ZF Friedrichshafen AG. This is where axles, transmissions and drive components are manufactured for construction and agricultural machinery, buses and cars, including a 700 mm long central drive and transmission output shafts for cars and commercial vehicles. Somewhere between 14,000 and 16,000 are produced annually. The typical material of these shafts are 16MnCr5 (1.7131) and 42CrMo4 (1.7225) steels. The number of deep holes required in each shaft range between one and five. For hole diameters up to 7.5 mm the maximum depth is 600 mm, of which the first 410 mm is currently machined with Mitsubishi's solid-carbide drills. Single flute gun-drill type tools are used for the remaining depth. Standards for tolerance and surface quality are +0.2/-0.1 mm for diameter, 1 mm positional tolerance, 2 mm for depth tolerance and Rz100 max. surface roughness. The tool life of the drill ranges between 40 m and 100 m dependant on the work material.

ABOUT MHS DEEP-HOLE DRILL

The MHS drill was originally developed as a deep-hole drill with internal coolant for hardened materials up to 52 HRC. Ejector pin holes can be manufactured in one operation without reworking. Due to its geometry, MHS is ideal for deep-hole drilling up to 70 x D in steel and stainless steel. The standard range includes drilling depths up to 30 x D, diameter range 0.95 mm to 12.0 mm. Intermediate sizes and non-standard lengths are available on request.

"The drills work with a 50 bar coolant pressure, twice that of a normal tool."

**MANFRED BARTL
MACHINE OPERATOR
ZF FRIEDRICHSHAFEN AG**





Franz Schwarzmüller, Production Manager at ZF Friedrichshafen AG in Passau, holding a finished shaft: standards for tolerance and surface quality are +0.2/-0.1 mm for diameter, 1 mm positional tolerance, 2 mm for depth tolerance and Rz100 max. surface roughness.

RELIABLE STEEL DRILLING UP TO 60 x D

“Rather than switching operations to specialised equipment or investing in a new deep-hole drilling machine, we perform this operation on an existing standard machining centre,” says Production Manager Franz Schwarzmüller. A saving on this investment may not have been possible with other drills. Additionally, Mitsubishi’s drills, with a suitable holder, were stored in the tool magazine and changed at the spindle in the same way as any standard tool. „This saves a considerable amount of time and money and because the deep hole drilling process is now so reliable, it also saves the costs of drill breakage, the workpiece itself and the machine downtime if a breakage should occur. The savings can soon reach the four-figure mark.”

ZF Passau and the application engineers at Mitsubishi have been gradually working towards perfecting this deep-hole technology since 2005, when the beginning of co-operation saw just 30 x D drills. The results of this continuous development have seen a large increase in productivity, to the stage where a Ø6.83 mm (MHS0683-L60C - VP15TF) drill can reach a depth of 410 mm in only 72 seconds.

“Seeing and hearing the ease with which the drill cuts testifies to its quality,” says Manfred Bartl, one of the 25 machining centre operators that oversee deep hole drilling on various machining centres, during a 3 shift system at ZF in Passau. “The drills also work with a 50 bar coolant pressure, twice that of a normal tool”, says Bartl.

Another cost saving feature is that the drills can be reground and coated, approximately 30 pieces undergo this process every week. Problems with fluctuations in performance and quality of the reground drills are unknown. It remains to be seen whether the end of the improvement cycle has been reached or if the process can still be further improved as new technology is developed.

“We perform this operation on an existing standard machining centre. This saves a considerable amount of time and money.”

FRANZ SCHWARZMÜLLER
PRODUCTION MANAGER
ZF FRIEDRICHSHAFEN AG



"We work here with many renowned tool manufacturers, but where deep-hole drilling is concerned, Mitsubishi Materials is the leader."



VOLKER LANG
PLANNING AND PROJECTS
ZF FRIEDRICHSHAFEN AG

PERFECT DESIGN

Wilfried Dyduch and Albert Häring - Application Engineering and Technical Consultants from MMC Hartmetall, have followed the deep-hole drilling project from the very outset. In 2005, 30 x D was the standard and it was far from certain who would become established leader in the area of deep-hole drilling: especially as rivals for this consisted of most of the leading tool manufacturers. Constant development, presence at customers and quick feedback finally paid off. "Every second week throughout this whole process we had a progress meeting with ZF Passau" says Dyduch. "The functionality of the drill is perfect and co-ordination and engineering support is always extremely competent," confirms Planner Volker Lang. "We work here with many renowned tool manufacturers, but where deep-hole drilling is concerned, Mitsubishi Materials is the leader."



Petra Reinhold is the Technical Manager at MMC Hartmetall. She summarises the trend in the area of deep-hole drilling tools: "Every ten years they become 100 mm longer and a total length of 490 mm is now the maximum. The internal coolant pressure has also risen, from 30 to 50 and in the future 60 or 70 bar is expected. The coating is also expected to make similar progress as time goes by." She also adds "Importantly for reliability we also recognise that the specifications of component materials fluctuate, but our drills are capable of coping with those fluctuations and produce almost identical results time after time".

ABOUT ZF

ZF is a global leader in drivetrain and chassis technology with 122 production companies in 26 countries. In 2013, the Group achieved a turnover of EUR 16.8 billion with around 72,600 employees. To remain successful with innovative products in the future, ZF invests around 5 per cent of the turnover each year (2013: 836 million Euro) in research and development. ZF is among the top 10 companies on the ranking list of the largest automotive suppliers worldwide.

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ABOUT MMC HARTMETALL

MMC Hartmetall GmbH is the European headquarters of the Mitsubishi Materials Corporation, Cutting Tools Division, and is based in Meerbusch near Düsseldorf. The company was founded in 1983 and sells precision tools and complete solutions for the automotive and aerospace industry, biomedical engineering, die and mould construction as well as general mechanical engineering. The wide range of products includes tools for turning, milling and drilling. As its European headquarters, the company represents the Japanese parent company in German-speaking countries. A further six national subsidiaries and over 30 trade partners provide a cross-border service throughout Europe.

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