The Productivity Enhancer

Cutting Edge Solutions

Crank Shaft die machining with Millstar extra long tool

Carbide Brazed Shank– Extra Long

Objective

The trial was conducted to demonstrate the engineering capabilities of Millstar & high-speed machining capabilities of Millstar insert type and Millstar Carbide brazed extra long shank.

Machining Summary

Crank Shaft die impression was finish machined in DIN 1.2714 material of hardness 42HRC using a 3D NC program to demonstrate the high-speed capabilities of Millstar insert type and Brazed carbide shank – extra long type.

HSM*cil* & Millstar was invited by a leading forge shop in India to solve their problem of longer machining time for the deep crank shaft dies with small corner radii. The challenge was to finish machine full depth of the crank shaft using one single overhang tool and at the same time maintain high feed rates to shorten the finish machining time. Millstar accepted the challenge and designed a new tool from their existing design of Solid carbide brazed shank which is a very rigid and accurate shank, by design.

The cavity machined was a 4 cylinder crank shaft die with a depth of 65mm and a wall taper of 0.5 degrees up to a length of 40mm from the bottom and then increased to 2 degrees till the of the die.

View of the Die after completion of machining

The tool was originally designed to take care of a draft of 1 degree on the wall but it had no problems with the modified design on the die. Finish machining was done with the extra long Millstar Carbide brazed shank having an overhang of 75 mm from start till end. The RPM used was 9000 and Feed rate was 2000 mm / min !!!

The previous machining process used 6 No.s of solid carbide tools of different overhangs owing to lesser life of the tools and long overhang requirements. The RPM used was 6000 and federate was 1000 mm / min.

The machine used was HAAS – VF2 machining center with a 10000RPM spindle. HAAS control was used on the machine.

Process Chart

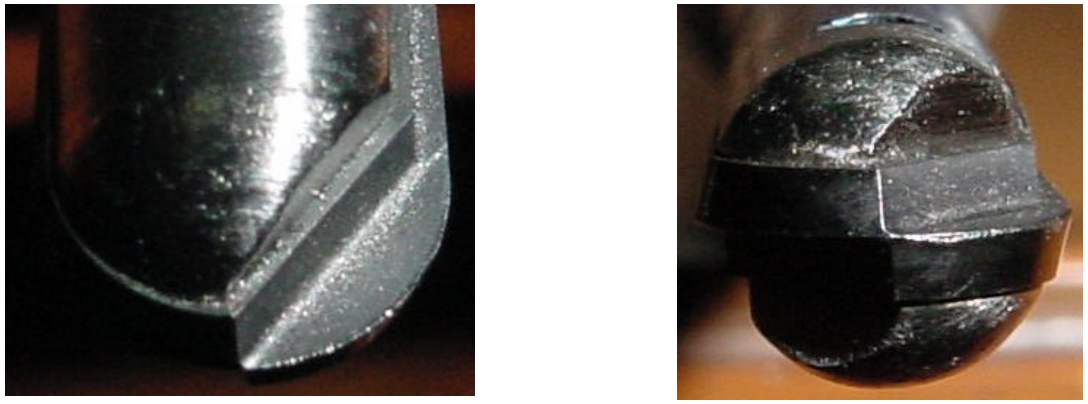
Tool Adapter	Collet Chuck
Tool Shank	**CBTAV 06 - 150 - 12 – Special (MILLSTAR)**
Shank material	Carbide
Neck diameter	D2=6 mm
Neck length	L1=75 mm
Insert, back draft	**VRBS 6.0 TLN (MILLSTAR)**
Tool coating	**Exalon™ (AlTiN)**
Tool path Strategy	Z level machining
Cutting Depth	0.26 mm / pass
Stock remaining	0.06 mm
Feed	**2000 mm/min**
Spindle speed	**9000 RPM**
Machining time	**12 Hours 30 minutes (2 impressions) !!!**

View of machining

Summary

Prior to this test the machining time for this cavity was 12 hours 50 minutes for one impression using solid carbide tools (TiAlN coated) of various overhangs to avoid chatter marks and to increase the tool life.

HSM*cil* conducted this test with the **Millstar** Insert type tool which can cut at very high cutting parameters as demonstrated. **The impression was finish machined in 6 hours and 25 minutes. This reduced the machining time by 50% from the previous machining time.** The finish achieved was excellent owing to the superior geometric accuracies on Millstar tools and the **Exalon™ (AlTiN)** coating. The reduction in machining time gives the customer an opportunity to use the machine to produce more dies and reduces the cost of machining by a large margin.



View of Insert wear after completion of machining and tool life

The even wear on the cutting edge at the end of the cut demonstrates the rigidity of the tool shank as well as the run out and control which is due to the unidirectional accuracy of Millstar tools. This provides the customer an opportunity to cut more number dies per cutting tool in less time!!!. This brings down the actual tooling cost incurred per die.

Using Millstar tools also results in uninterrupted cutting operation due to less number of insert changes per operation. **In the above test case the insert change was NIL.**

Machining process as well as CAM process becomes more secure when only a single tool is used for finishing which also brings down the rate of accidental breakages which occur due to dividing of progra ms into many segments and also due to ATC and tool length mishaps.

Finish achieved is more uniform than a multiple tool finishing cut.

The uniform finish on the Die surface reassures us about the matter of tool shank rigidity.

The cost analysis attached with this report proves the drastic reduction in tool cost as well as total machining cost achieved by using Millstar tools.

This test cut proves that Millstar technology can come out with a solution for any critical problem in implementing high speed machining and increase the level of productivity by leaps and bounds.

This test cut has again proved that using Millstar tools results in enhancing productivity with lesser cost per die.

With Millstar at work, tomorrow's technology is at work for you...Today !!!

Millstar Performance Report & Cost analysis.

Component Machined	Ford 4 Cylinder Crank Shaft Die
Material	DIN 1.2714
Hardness	42 HRC
Machine	HAAS - VF2

Existing Process :

Tool	Depth Of Cut	Stepover	RPM	Feedrate	Machining time	Tool Life
Diameter 6 Solid Carbide TiAlN Coated Ballnose Endmill - 6 No.s	0.06mm	0.26 mm	6000	1000 mm/min	770 mins	**Tool life is considered as 150 meters of cutting length.**

Millstar Parameters :

Tool	Depth Of Cut	Stepover	RPM	Feedrate	Machining time	Tool Life
Millstar Diameter 6 Indexable Precision ballnose insert (Exalon Coated) Used with Millstar solid carbide shank - special extra long.	0.5 mm (1st die) 0.06mm (2nd Die)	0.26mm	9000	**2000 mm/min**	385 mins	**1500 meters based on the wear pattern observed on the insert after machining 2 dies.**

Cost Analysis

Tooling cost per meter by using existing tooling.

	Cost	Machined length	Machine cost @ 900 per Hour
Taegutec Diameter 6 Ballnose endmill - Reground 6 No.s per die	Rs. 900/- per regrind Rs 5,400/- Total tool Cost excluding the cost of Solid carbide tool	150 Meters / regrind	Rs 15 / Meter

Total	Rs. 5,400/-	770 Meters of total cutting length

Tooling Cost / Meter — 5,400 / 770 = **Rs 7.01**

Total Cost / Meter — Rs 7.01 + Rs 15 = **Rs 22.01**

Tooling cost per meter using Millstar tool.

	Cost for 50 Inserts	Cost / Insert	Machined length	Machine cost @ 900 per Hour
Millstar Diameter 6 Ballnose insert - VRBS	Rs 1,00,000/-	Rs 2000/-	750 Meters	**Rs 7.5 / Meter**
Millstar Solid Carbide Shank - Special	Rs 36,000/-			

Total	Rs. 1,36,000/-	37,500 Meters of total cutting length

Tooling Cost / Meter — 1,36,000 / 37,500 = **Rs. 3.62**

Total Cost / Meter — Rs 3.62 + Rs 7.5 = **Rs 11.12**

Reduction in direct Tool cost per Meter	**49%**
Reduction in Total cost per machined meter	**50%**

Note :

The cost of the solid carbide tool has not been considered which if considered can drive up the tool cost and the actual cost by another 20%

The amortizing of shank is considered for 50 insert changes. The actual life is much higher which is approximate minimum 200 insert changes in normal overhang tools and can be at the most half of it which is 100 insert changes in the extra long overhang.

The tool cost reduction is to such a big margin that even if one shank is consumed for 25 inserts (which can never be the case) the tooling cost per meter still remains at about 50% of the present tool cost which breaks the myth that the Carbide Brazed shank is expensive. The tool shank earns for itself.

The opportunity cost which is not quantifiable is very high in the above test case.

Machining process as well as CAM process becomes more secure when only a single tool is used for finishing which also brings down the rate of accidental breakages which occur due to dividing of programs into many segments and also due to ATC and tool length mishaps.

Finish achieved is more uniform than a multiple tool finishing cut.

It has to be noted that the tool cost per se does not contribute much to the total machining cost but at the same time the total cost does reflect on the opportunity cost too.

The even wear on the insert assures us of the rigidity of the tool shank even at the extra long overhang length. The uniform finish on the Die suface reassures us about the matter of tool shank rigidity.