

MULTI-PURPOSE CNC SHOT PEENING PLANT WITH HIGH PRODUCTION EFFICIENCY BY BAIKER AG

Steven Baiker
BAIKER AG, Switzerland, Zurich

ABSTRACT

Describes the technical requirements of a Multi-purpose CNC Shot Peening Machine for the airline & aerospace industries. Investigates process times for various applications and explains the benefit of the use of high end technologies in order to reach a higher production rate.

KEYWORDS

internal peening, external peening, reduction of process & set-up times

FOREWORD

The times in which a single blasting or peening equipment was purchased for each size and type of workpiece seem to be over. Especially since the batch number of workpieces in repair and overhaul shops of airline & aerospace industries decreases constantly. Therefore great flexibility in a plant has become an ever-increasing requirement.

Instead of having a large machine park, nowadays customers request machines which are able to process all possible engine parts, e.g. all sizes of blades, airfoils, disks & hubs, shafts etc.. This includes not only external peening, but also the much more demanding processes of internal peening.

PHILOSOPHY OF A "MULTI-PURPOSE" SHOT PEENING PLANT

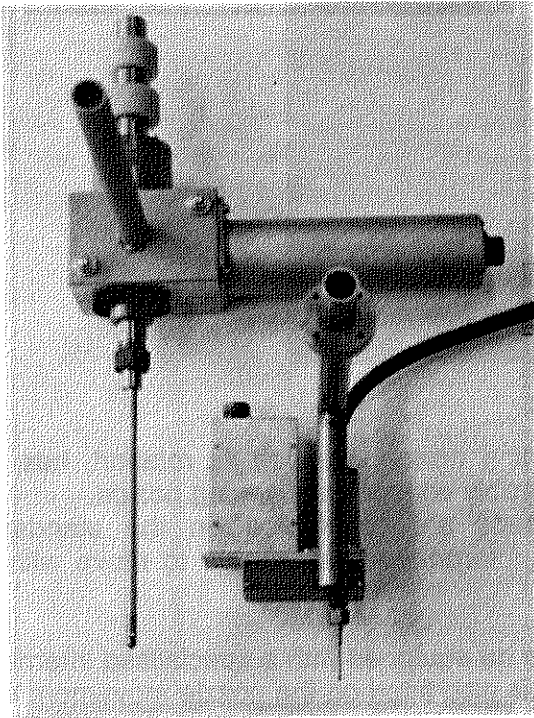
In order to design a multi-purpose shot peening plant for engine overhauling it was not only important to identify all possible peening applications, but also to evaluate various process times. This is because a cost effective plant must have efficient technical solutions especially for those applications which are most time consuming in order to insure a high production rate. BAIKER AG has got a very clear feedback from European engine overhaul workshops as well as engine producers. As soon as shot peening on disks & hubs was involved, the most time consuming operations were

internal peening. Acknowledging such information, all efforts had to be put into reducing the internal peening time. This was in combination with a new solution to minimise the process times for external peening as well as for workpiece handling and set-up. The plant which could realise all those requests in terms of multi-purpose and efficiency is the new multi-purpose CNC peening plant (Series 5).

MULTI-PURPOSE CNC SHOT PEENING PLANT (SERIES 5)

TECHNICAL SOLUTIONS FOR *INTERNAL* PEENING

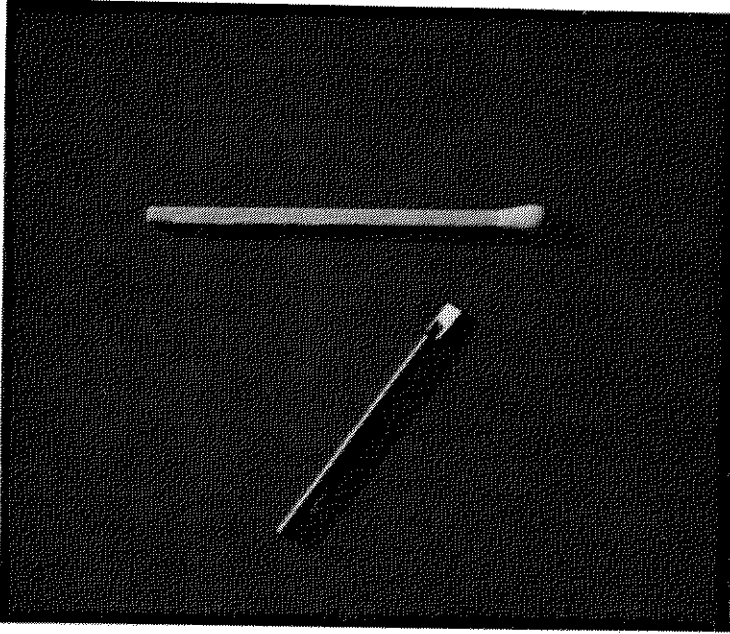
Depending on application it is necessary to be able to use a wide range of different internal peening nozzle diameters. Baiker AG has for its (Series 5) plant a total of 3 different internal peening rotation heads for nozzle outside diameters starting from 0.091" (2.3 mm) up to 0.886" (22 mm).



Smallest and largest internal peening head for nozzles of different diameters

Since very small nozzles are likely to clog, a patented *low flow rate control* for rates between 0.04 - 1.3 lb/min. (20 - 600 gr./min.) has to be used. The accuracy of this low flow rate dosing device is ± 0.01 lb/min. (± 5 g/min.) or $\pm 0.5\%$. However, besides the dosing device for low flow rates, the plant also includes dosing units (up to 4) for standard flow rates between 1 - 22 lb/min. (0.5 - 10 kg/min.).

Since internal peening does usually either happen in holes or slots a very high positioning accuracy of $\pm 0.004"$ ($\pm 0.1\text{mm}$) for all nozzle movement axis as well as tight indexing tolerances of the turn table of $\pm 0.03^\circ$ are required. Those high accuracy's and repeatability's of all mechanical movements are essential for sophisticated peening application since small "deviations" in movement can be accumulated during a program and than eventually cause a collision between nozzle and workpiece.



Internal peening nozzle for holes down to diameters of 0.1" (2.5 mm).

It is important that an internal peening nozzle, besides its rotation, has the same nozzle movement flexibility as comparably an external peening nozzle. Therefore the internal peening heads are assembled on the standard nozzle movement shaft, which enables the internal peening nozzle to move within 4 CNC controlled axis.

The (Series 5) peening plant can also be equipped with a specialised internal peening device for slots of disk & hubs which is also fitted on the nozzle movement shaft. This internal slot peening fixture can accommodate four internal peening rotation heads. With this unit it is possible to reduce the internal peening time by factor four, since four slots are internally peened simultaneously.

NORSK JETMOTOR in Norway was the first European engine producer, to use this system on SNECMA as well as on PRATT & WHITNEY disks and hubs. Naturally this system works for all kinds of hubs & disks.



Efficient slope slot peening, with four simultaneously moving internal rotation peening heads used on a NORSK JETMOTOR Multi-purpose Shot Peening Plant (Series 5) in Norway.

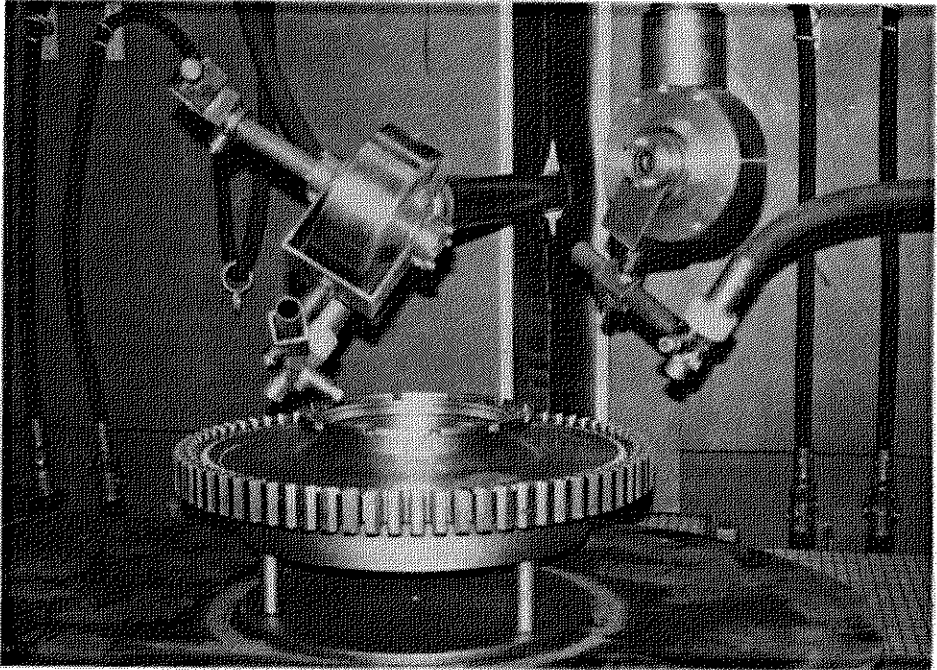
TECHNICAL SOLUTIONS FOR *EXTERNAL* PEENING

The high flexibility of 4 CNC controlled nozzle axis allows to follow almost any shape and therefore the plant can process various different parts. Furthermore such a flexibility can guarantee a constant surface-nozzle distance and nozzle-workpiece angle in order to obtain the best peening results. To improve the efficiency also for external peening applications, a 2nd nozzle movement unit for the (Series 5) was introduced. The 2nd nozzle movement unit is in terms of function and tolerances exactly the same as the 1st one.

However, it is installed in a horizontal direction instead of having a vertical layout. The additional 4 CNC axis, will achieve an even higher flexibility. The productivity of the plant will be increased to a great extend. With such an arrangement the actual peening time can be reduced. In some cases even by factor 2.

In addition, depending on application, set-up times can be minimised since for example the 1st nozzle movement unit can be reserved for external peening, while the other nozzle movement unit is equipped with *internal* peening devices.

MTU Daimler Benz Aerospace in Munich has a high end multi-purpose CNC shot peening plant (Series 5) equipped with a 2nd nozzle movement unit. For the first time Baiker AG could evaluate whether a high flexibility of 8 CNC nozzle axis really "pays off" in terms of higher productivity. A comparison was made by peening a HPT disk using only 1 nozzle movement unit and then repeating the same process using 2 nozzle movement units. MTU Munich could report a decrease of the process time of 45%.



BAIKER AG Multi-purpose Shot Peening Plant (Series 5) with a total of 8 CNC controlled nozzle axis for MTU Daimler Benz Aerospace in Germany

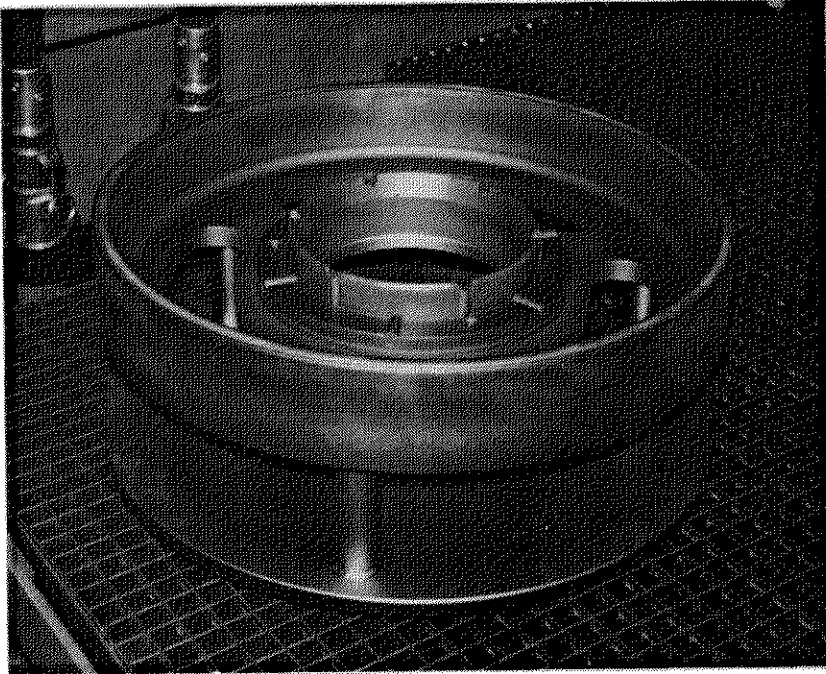
TECHNICAL SOLUTIONS TO REDUCE SET-UP TIMES

Using special centring devices for nozzle and workpiece fixtures, set-up times will be reduced to a minimum. A certain nozzle and workpiece fixture does belong to a certain part.

Special "peening resistant" rubber components have been developed to protect those surface areas which do not require peening treatment. Baiker AG has designed fixtures in such a way, that they correspond with the machine's flexibility.

Since two loading stations are available, the setting up of a workpiece can be done while the plant is in operating condition. This in order to reduce the shut down time and to insure highest productivity of the plant.

In addition, a special laser beam installed in the same way like a nozzle is used in combination with the CNC "TEACH IN" system to simplify programming of the different workpieces.



workpiece holder for disk

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