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Study of Drilling and Trimming Fixture for Shim Used In Aerospace Industry for Joining Two Components. (A Literature Review)

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There are various jig and fixtures available nowadays to hold the work piece at proper location for machining raw material or semi finished components.

We are dealing with the composite material phenolic polyamide Kapton which is a aerospace grade material. This is exclusively used for aerospace grade because the strength to weight ration is very high as compared to certain materials which are easily available.

This Phenolic Polyamide Kapton is material with thin laminated sheets having machinability not easy. Water jet machine is used for the machining of this material currently.

Fig 1: Finished Shim component

A layer by layer development of laminated thin sheet along with the suitable adhesives bonding material gives the required strength to the component which is required for the aerospace grade products.

In this project we are going to study jig and fixture for machining composite material phenolic polyamide Kapton to produce a aerospace grade product "Shim".

By studying different Literatures we compare the process of water jet and end milling operation.
According to the M. M. Korat , Dr. G.D. Acharya [1] in their paper "A review on current research and development in abrasive water jet machining(AWJM)"

Given Parts which are extremely difficult to machine are machined by using Water jet machining. Water jet machining is a environment friendly machining process. This paper reviews the research work carried out from the inception to the development of AWJM within the past decade. This paper reports on the AJWM research relating to improving performance measures, monitoring and control of process , optimizing the process variables.

According to Abhishek Dikshit , Vikas Dave, M.R. Baid [2] in their paper "Water jet machining : An advance Manufacturing Process " describes role of water jet machining in heavy construction and general and particularly how it affects the regional contractors in northeast. The paper presents aspects regarding an innovative nonconventional technology, abrasive water jet machining. The paper also gives regarding other technological operations possible to be performed with abrasive water jet.

According to paper "A review on abrasive water jet Cutting " Sreekesh K, Dr. Govindan P [3]. This paper includes work on Water jet Machine. Omni directional cutting potential as well as minimal thermal and mechanical loading are few advantages of water jet machining. Material removal rate (MRR) and surface roughness (Ra), taper of cut, Width of cut are important quality parameters of AJWM.

According Sudhakar R. Lohar , Pravin R. Kubde [4]"Current research and development in abrasive Water Jet Machining (AWJM) : A Review "This paper reviews the research work carried out from the inception to the development of AWJM within past few years. It reports on the AJWM research relating performance measures improvement, monitoring, and process control, process control variable optimization. This paper also discusses the future trends of research work in the area of AJWM

According to the research paper titled as "Design and Analysis Fixtures for Aluminium Die Casting Component " published by B.Maharajan, Dr.S.Balasubramanian [5] given that Fixture in tooling industry contributes more to improve economy of production. It ensures quality and quick transition of parts. A novel design on a fixture for tapping holes for complicated profile petrol pump body made of aluminum die casting material. The fabricated fixture used for trials. The time study conducted with samples and the results we compared with manual cycle time. Improvement in reduced cycle time shown 50% and the rejection quantity due to unmatured threads, shifting of axis and end damage are reduced 1/50 batch. Fixtures like this can adopt to the mass production components in automobile, Aeronautics and manufacturing units.

Ushasta Aich [8] carried out experiments on cutting of borosilicate glass by AWJM. Depth of cut is measured with different machine parameter settings as water pressure, abrasive flow rate, traverse speed and standoff distance**.** Optimum condition of control parameter setting is also searched through particle swarm optimization (PSO).Also, scanning electron microscopic (SEM) image reveals to some extent, and the nature of cut surface and erosion behavior of amorphous material qualitatively.

K.S. Jai Aultrin and M. Dev Anand [9] investigated work on Optimization of Machining Parameters in abrasive water jet machining (AWJM) Process for Copper Iron Alloy Using RSM and Regression Analysis. The process parameters considered was water pressure, abrasive flow rate, orifice diameter, focusing nozzle diameter and standoff distance. They studied the effect of five process parameters on metal removal rate (MRR) and surface roughness (SR) of the Copper Iron alloy using regression analysis.

Derzija Begic-Hajdarevic. [10] studied the effects of material thickness, traverse speed and abrasive mass flow rate during abrasive water jet cutting of aluminum on surface roughness. They analyzed that traverse speed has great effect on the surface roughness at the bottom of the cut and the correlation between the surface roughness and other abrasive water jet cutting variables.

B. Satyanarayana and G. Srikar [11] investigated work on optimization of abrasive water jet machining process parameters using Taguchi grey relational analysis (TGRA). The process parameters are chosen as abrasive flow rate, pressure, and standoff distance. From ANOVA it is found that water jet pressure has more significant effect on kerf width and MRR rather than abrasive flow rate and standoff distance. They analyzed that predicted S/N ratio is nearest to the conformation test S/N ratio; this conclude that the TGRA process adopted for optimization of parameters is accurate.

Deepak Doreswamy . [12] carried out work to find the effect of stand-off distance and feed rate on kerf width and surface roughness for machining of D2 heat treated steel using abrasive water jet.They observed that, in single pass machining, for the same increase in standoff distance, the top kerf width increases (≈18%) whereas the bottom kerf width decreases (≈25%). Also, the increase in standoff distance and feed rate increases the surface roughness (Ra) value.

T. V. K. Gupta et al. [13] investigated the role of process parameters on pocket milling on SS 304 material with abrasive water jet machining (AWJM) technique. They considered process parameters are Abrasive size, flow rate, standoff distance and traverse speed. Pockets of definite size are machined to investigate surface roughness (SR), material removal rate (MRR) and pocket depth. ANOVA for individual output parameter has been studied to know the significant process parameters. It was observed that higher traverse speeds gives a better finish because of reduction in the particle energy density and lower depth is also observed. Also, Increase in the standoff distance and abrasive flow rate reduces the rate of material removal as the jet loses its focus and occurrence of collisions within the particles.

G.A Escobar-Palafox et al. [14] carried out work on characterization of abrasive water-jet process for pocket milling in Inconel 718. They considered a design of experiments approach and process variables as water pressure, nozzle stand-off distance, traverse speed, nozzle orifice diameter, abrasive mass flow rate and tool-path step over distance. Statistical analysis was carried out in order to develop mathematical models which include process variable interactions and quadratic terms. The results showed that water pressure has a non-linear behavior and is of paramount importance for controlling the depth of cut and geometrical errors. In addition, nozzle diameter and the interaction between feed rate and abrasive mass flow are critical factors affecting the depth of cut.

P. R. Kubade and V. S. Jadhav [15] investigated the influence of EDM process parameters on electrode wear rate, material removal rate and radial overcut while machining of AISI D3 material. It was found that the MRR is mainly influenced by (Ip). Electrode wear rate was mainly influenced by peak current (Ip) and pulse on time (Ton), duty cycle (t) and gap voltage (Vg) has very less effect on electrode wear rate. Peak current (Ip) has the most influence on radial overcut then followed by duty cycle (t) and pulse on time (Ton) with almost very less influence by gap voltage (Vg).

P. R. Kubade [16**]** had carried out work on parametric study and optimization of wire electrical discharge machining (WEDM) parameters for Titanium diboride (TiB2) component. The experiments were conducted using Taguchi's L27 orthogonal array. It was found that pulse-on time and pulse-off time has most significant effect on MRR whereas wire feed rate is insignificant. In addition, pulse-off time has most effect on surface roughness followed by pulse-on time and wire feed rate.

Kashid D. V., P. R. Kubade [17] investigated the effect of process parameters on material removal rate in wire-cut electrical discharge machining of steel grade EN9 component. Three process parameters selected for this study; Pulse-on time, Pulse-off time and wire feed. Taguchi's method, analysis of variance (ANOVA) and signal to noise ratio (SN Ratio) are used for investigation. It was concluded that pulse-on time and pulse-off time are the most significant influencing machining parameters affecting material removal rate. The wire feed parameter have very less effect on material removal rate.

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