BRM BRUSH RESEARCH MANUFACTURING
innovators in brush technology

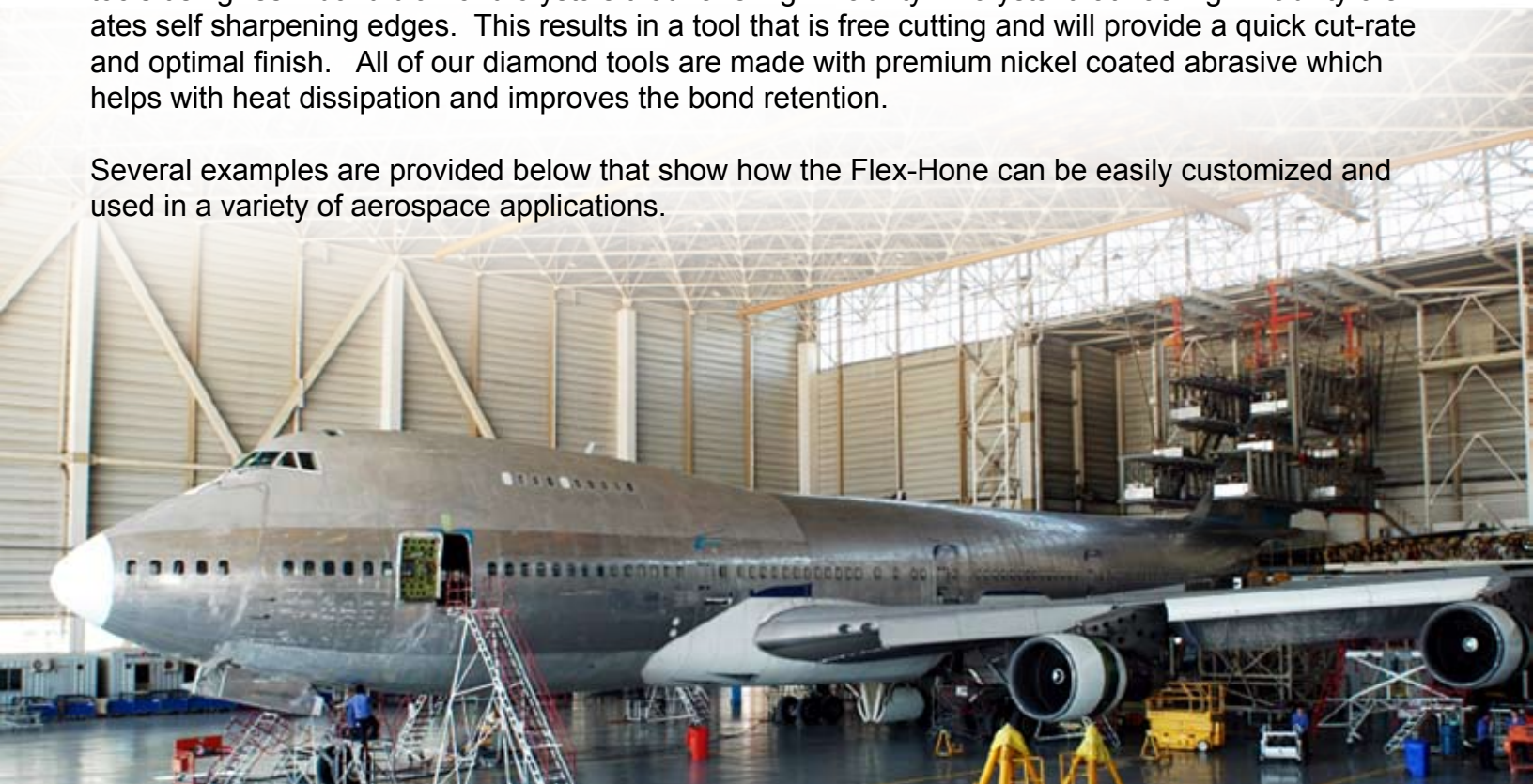
FUTURE IN FINISHING

THE FLEX-HONE® TOOL IN AEROSPACE APPLICATIONS

The Flex-Hone® Tool is a resilient, flexible honing tool with a soft cutting action. The tool's unique construction allows the abrasive globules or "stones" to float, assuring the tool will be self-centering, self-aligning to the bore and self compensating for wear. The Flex-Hone is available in 11 different grits and 9 abrasive types. The Flex-Hone tool is available in standard sizes for bores ranging from 4mm to 36 inches. The Flex-Hone® Tool produces a controlled surface condition unobtainable by any other method. The process involves finish, geometry and metallurgical structure. A high percentage plateau surface is produced free of cut, torn and folded metal. The process is a low temperature, low-pressure abrading system that exposes the undisturbed base metal structure to produce a long wearing surface; one that is metallurgically free of fragmented, amorphous or smeared metal from previous machining operations. A non directional or crosshatched pattern is created on the surface that contains valuable valleys between the plateaus for oil retention.

A variety of abrasive types and a broad selection of grit sizes are available to provide the optimum cutting and finishing characteristics in a wide variety of aerospace materials including type 302, 304, 416 and 17-4 stainless steels, Hasteloy, Monel, Inconel 718, Titanium 6AL-4V , Rene, Waspoloy and aluminum alloys such as 7075, 7050-T7451 and 2124-T8151. Diamond abrasive is the newest addition to the Flex-Hone abrasive line and is diamond available in 170/200, 800 and 2500 mesh sizes. Diamond Flex-Hone tools are designed primarily for deburring, edge blending and surface finishing in hard materials like carbide, ceramic and aerospace steel alloys. We have engineered the diamond tools using resin bond diamond crystals that have high friability. A crystal that has high friability creates self sharpening edges. This results in a tool that is free cutting and will provide a quick cut-rate and optimal finish. All of our diamond tools are made with premium nickel coated abrasive which helps with heat dissipation and improves the bond retention.

Several examples are provided below that show how the Flex-Hone can be easily customized and used in a variety of aerospace applications.



World Class Manufacturer of FLEX-HONE

Navy Quality Hole Program

In 1993, the US Naval Aviation Depot at North Island set out to establish a specification and process requirements to machine a quality hole in aircraft structures. The specification was revised in 1998 and resulted in Local Process Specification (LPS) No. 466. Machining was defined as the combination of drilling, reaming, flex-honing, deburring and countersinking of holes. The Navy found that stress corrosion cracks were started from improperly machined holes that resulted in the grounding of many of its front line fighters. It has been proven that when a hole is not properly machined the structure of the metal can be severely damaged. Micro-cracks can form, plastic deformation can occur, metal phase transformation can happen that result in over or under tempered martensite, titanium alloys can form a brittle alpha case, and aluminum alloys can lose temper and strength. In order to avoid these problems, the LPS gives the minimum hole quality standards to be used. The Flex-Hone is incorporated into the specification because of its ability to refine the surface finish of the hole and remove micro-burrs left from drilling, reaming and countersinking operations.

Hydraulic Control Mechanisms

A local aerospace company that produces low volume, very high value hydraulic control mechanisms had a requirement to remove a burr from the intersection of the sealing lands and relief grooves. The requirement was to remove the burr while not producing an excessive radius at the land edge. To complicate matters, the process could not degrade the sealing surface and inside diameters were already finished to extremely tight tolerances. A special Flex-Hone tool was developed to provide the solution. The key was increasing the Flex-Hone diameter while reducing the number of globules and providing an 800 grit Silicon Carbide abrasive. The result was consistent burr removal and radius while actually improving the sealing land surface. The aerospace employee who solved this problem received a quality award and was written up in the company newsletter. This example points to the fact that the Flex-Hone tool can be customized to meet a broad range of requirements.

Helicopter Rotor Drive Shaft

A manufacturer of helicopter rotor drive shafts had exacting surface finish requirements on the inside of their finished shafts. The finish was marginal prior to heat treat and the final heat treat process caused excessive mill scale buildup on the I.D. The interior had a contoured surface that required a very flexible finishing tool. A Flex-Hone tool in 400 grit Boron Carbide abrasive was used in 3 different sizes. The results were a surface free of mill scale with a 300% improvement in surface finish. The manufacturer was impressed with the consistency from operator to operator when using the Flex-Hone tool and it has become an integral part of their production process.

Hydraulic Swivel Components

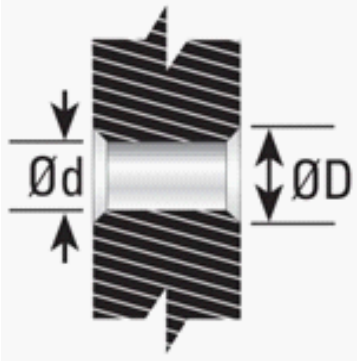
A manufacturer of a new line of hydraulic swivel components needed to deburr and condition bearing surfaces and high stress edges between a countersink and bore. The existing process specified Abrasive Flow Machining but due to the high cost and slow cycle time the manufacturer wanted to develop another method. The specification required a 16 microinch surface at the corner extending to either side by 30°. The requirement was to eliminate stress risers in the corner that can lead to failure under certain loading conditions. This corner also needed to be smoothed and deburred and

have a .002” minimum radius produced. A special Flex-Hone was designed using a larger diameter tool made with lighter gauge filaments. This allowed the tool to finish the countersink area as well as provide the required radius at the bore intersection. 600 grit Boron Carbide abrasive was chosen because of the material hardness and finish requirements. The Flex-Hone produced the desired results and greatly improved production rates.

Mission Critical Hole Preparation for Eddy Current Testing

A major defense contractor received a maintenance contract to refurbish fighter aircraft. Their specification called for eddy current testing of all mission critical holes including rivet holes and holes in landing gear structures. The condition of the holes was such that corrosion and surface oxides made the testing process unreliable. The holes were already to size and in tolerance and a method was needed to polish the holes to remove stress risers and remove the oxides and corrosion without altering the hole geometry. The Flex-Hone tool was selected after extensive testing because of the tool’s unique ability to provide an improved surface finish, remove contaminants and maintain existing bore geometry. An added benefit is that the Flex-Hone does not require sophisticated fixturing and can be used in field applications. Aluminum oxide and boron carbide abrasives were selected to finish bores in a variety of aluminum and titanium materials.

Through Hole Edge Rounding in Aircraft Engine Components



A series of tests were conducted with the finishing laboratory of a major aircraft engine manufacturer to provide an improved surface finish and edge radius on countersunk holes in jet engine parts. Web holes, air holes and flange holes had micro burr left after a countersinking application. Extreme combinations of countersink diameters and through hole I.D.s had to be accommodated. Both the front side burr and backside burr had to be removed, a radius needed to be produced at the intersection of the I.D and countersink. To complicate the process, the tool could only enter from one side. Materials to be finished included high nickel alloy stainless steels and titanium. A special hone construction was devised combining larger diameter hones, lighter gauge stem wire and lighter gauge filaments. This special construction allows the tool to remove the micro entry burr at the part surface, provide a radius at the countersink intersection, improve the finish of the through hole and pass through the bore to provide an edge radius and remove the breakout burr on the back side of the bore. Special operating parameters were developed to maximize tool life and insure repeatable results. Diamond abrasive, silicon carbide and boron carbide were selected for the various base materials.