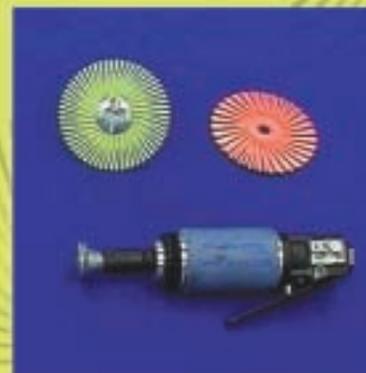




Environmental Program



Radial Bristle Discs



Small Corrosion and Paint Removal Improved Using Bristle Disc Technology

Small corrosion and paint removal tasks are now easier, faster and safer thanks to a new bristle disc technology.

Background

Mechanical and chemical methods to spot-strip finishing systems on aluminum surfaces have been standard practice in the naval aviation community when performing corrosion repair tasks. The mechanical methods employ a flap brush with a low speed pneumatic grinder and wheels that are impregnated with abrasive materials to remove corrosion. These flap brushes can also damage the aircraft skin (substrate). The chemical spot strip procedures include the use of methylene chloride and phenol. The chemical products are known carcinogens and hazardous air pollutants. The Fleet needed new methods that could efficiently and effectively remove corrosion on aircraft surfaces without using blast media and/or hazardous materials.

To overcome this problem, the Office of Naval Research sponsored a joint effort between the Naval Air Systems Command (NAVAIR) and the 3M Corporation to evaluate commercially available radial bristle discs and develop new discs. Guiding criteria for the effort included optimizing parameters such as grit and rotational speed to achieve the quickest repair with least substrate damage.

The new technology that emerged uses a high-speed pneumatic grinder and a 3-inch radial

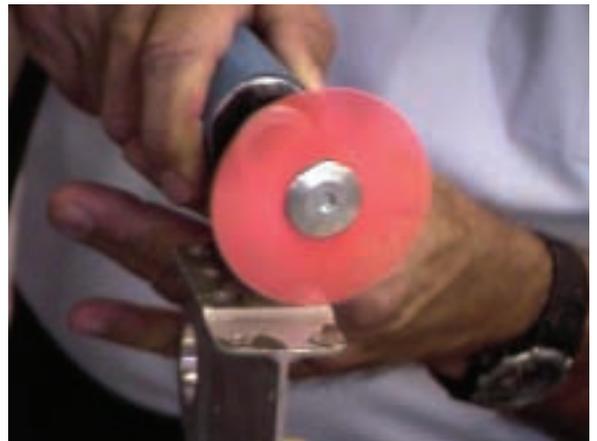
bristle disc impregnated with an abrasive material. These particular bristle discs remove coatings and corrosion without damaging the substrate. Two discs—one for medium to heavy corrosion removal and a second designed for light corrosion removal and edge feathering—were developed.

Laboratory panel testing and small-scale prototype demonstrations on off-aircraft aluminum panels confirmed the effectiveness of the new discs. Fleet maintenance personnel assigned to NAVAIR participated in the demonstrations and provided positive feedback. Several platforms over a wide range of operational missions were targeted for full-scale demonstrations to ensure acceptance of this new technology across the Fleet.

Preliminary Recommendation

The 3M Corporation developed the 3-inch radial bristle discs that are intended to replace the current flap brush method of corrosion removal. These discs provide a continuous fresh supply of abrasive material to the work surface. The bristle disc itself is made of a plastic matrix containing either aluminum oxide or a proprietary particle. Stripping a surface requires only a small amount of pressure. In fact, if applied pressure exceeds two pounds the bristles will fold and render the tool inoperative. With the old abrasive wheels or flap brushes, increased pressure could cause the wheels to create gouges in the metal. The bristle disc makes contact with a smaller repair area and does not damage the surrounding metal. Feathering can be performed easily with the bristle disc.

The two bristle discs, the yellow disc (a 360-grit equivalent) and the orange disc (a 400-grit



The old and the new. The old method (left) utilized a low-speed grinder and either an abrasive wheel or flap brush. The new method (right) employs a high-speed grinder and the radial bristle discs.

equivalent), have been approved for use in the Aircraft Cleaning and Corrosion Control Manual (IRAC 26, NAVAIR 01-1A-509) for selected types of corrosion and paint removal applications. The yellow disc is designed for use on moderate to heavy corrosion on aluminum and low strength steel. Authorization is pending for the 360-grit equivalent bristle disc for use in removal of light surface oxidation on high strength steel.

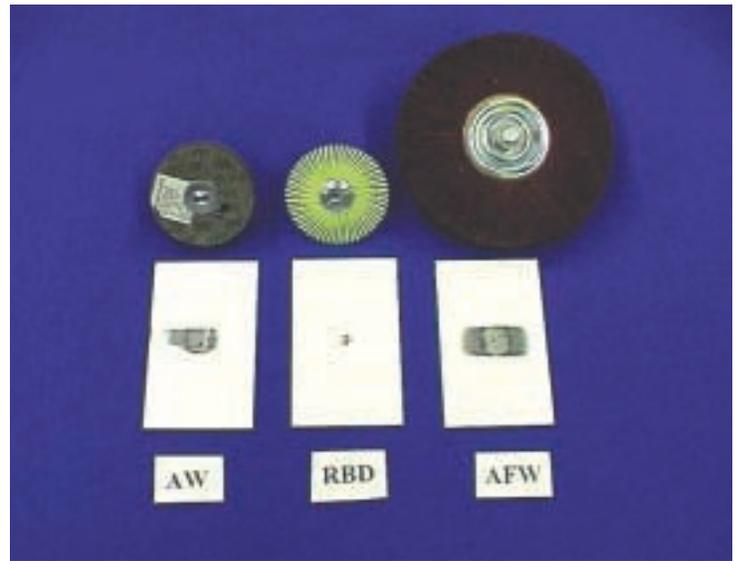
The orange 400-grit equivalent bristle disc is designed for use on light to moderate surface corrosion, such as filiform, and edge feathering. It is also effective for organic coatings removal on aluminum and steel surfaces.

The Materials Laboratory at NADEP Jacksonville recently evaluated the radial bristle disc technology and recommended it for approval on high strength steel. Further investigations are underway for possible use on titanium surfaces. A formal IRAC to the NA 01-1A-509 will be issued shortly to include the utilization of both discs for use on high strength steel.

Key Features

The new discs offer several improvements:

- Up to a 50 percent reduction in labor for small corrosion and paint removal applications on aluminum. The uniform concentration of mineral provides a high cut rate for a faster, more uniform finish.
- Reduced damage and the need for rework. The flexible bristles conform to the contours of the part for consistent results without abrading or gouging bare metal like flap brushes.
- Reduced surface temperature. The bristle disc generates less than 100 degree Fahrenheit (F) surface temperatures while the abrasive wheels may yield temperatures in excess of 200 degrees F.
- Reduced treatment area. The bristle discs are more precise, thus do not remove excess paint or enlarge the treatment area.
- Approved for use on external aluminum surfaces for small corrosion and paint removal applications. Approval is pending for high-strength steel and titanium surfaces.
- Easier to use. The bristle disc requires 1.5 pounds of hand pressure to be applied to the grinder to remove corrosion. Abrasive wheels require up to 12 pounds of hand pressure to do the same job.



Comparison of the strip area between the abrasive wheel, the radial bristle disc and the abrasive flap wheel.

Supply System Considerations

The bristle discs can be ordered directly from 3M or through the Federal stock system under the EMALL contract SP0410-01-D-E006. Bristle discs typically will arrive within 30 days from the date of purchase. The bristle discs come in case quantities, which include 4 boxes of 10 discs (40 discs per case). The current price for the Navy is \$3.05 per disc. The associated mandrel assembly price is currently \$7.81 and the cost of the grinder is approximately \$79.00. The following are NSNs for the products:

- Pneumatic die grinder: NSN 5130-00-293-2797.
- Mandrel assembly for grinder: NSN 3460-01-493-7924, 3M part number: 61-5000-7334-3 (Note: The existing abrasive wheels tooling is not adequate because the tooling spins at 3200 revolutions per minute (RPM), while the new bristle discs tooling spin at 22,000–25,000 RPM.)
- Radial bristle disc for light corrosion removal and surface preparation (orange or salmon in color): NSN 4920-01-493-2510, 3M part number: 61-5001-8792-9.
- Radial bristle disc for heavy corrosion removal and surface preparation (yellow in color): NSN 4920-01-493-2514, 3M part number: 61-5001-8790-3.

Operational Requirements/Specifications

The bristle disc requires an air source of 90-110 pounds per square inch along with a high-speed pneumatic die grinder rated from 22,000–25,000 RPM and a mandrel assembly (Note: The existing abrasive wheel's tooling is not adequate because it only spins at about 3200 RPM). Operating the pneumatic grinder at its maximum rated speed is required to ensure maximum efficiency and effectiveness of the radial bristle disc. Light hand pressure during operation is required to achieve the best stripping results. The tips of the bristles are the working element of the tool. Maintaining

light pressure on the grinder and moving the grinder back and forth over the affected area will achieve the best results.

Training

Representatives from the Naval Air Technical Data and Engineering Service Command (NATEC) will include training on the proper use of bristle discs as part of their regular training to the Fleet. The bristle disc technology will be included in the Naval Aviation Maintenance Training (NAMTRA) curriculum. A training video is being developed by NAVAIR to help the end-user with a description and demonstration of the use.

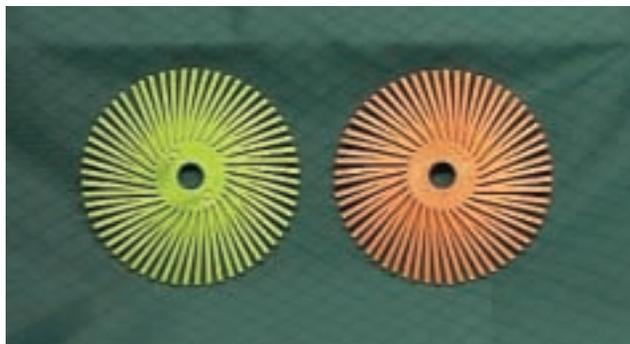
Environmental, Safety and Health Issues

The bristles are securely fastened to the backing virtually eliminating the projection of loose wires or other abrasive debris. Use of the radial bristle disc generates dust particles that may contain chromates from primers. Therefore, eye and respiratory

protection equipment is required when operating the tool.

The discs cannot be used on composite surfaces. Such use will cause severe fiber damage to composites.

Currently, no other commercial off-the-shelf bristle discs meet NAVAIR requirements. Use of non-approved discs can result in serious damage to the aluminum substrate.



The yellow disc is designed for use on heavy corrosion and light to moderate surface pitting. The orange/salmon disc is intended for use on light surface corrosion discrepancies and edge feathering.



One command, the Lancers of Electronic Attack Squadron (VAQ-131) have been effectively using the radial bristle discs during their 2003 deployment to the Persian Gulf. The Lancers were embarked with CVW-2 aboard the USS Constellation CV-64) in support of Operation Iraqi Freedom. Front: AM3 Shane Lee, AM3 Joy Timpog. Back: AM3 Jason Clark, AM3 Josh Lawson.

Bristle Discs Endorsements Based on Fleet Testing

- **AMCS Jay Shannon**, COMVAQWINGPAC Whidbey Island Washington stated the following: "The disc cut the maintenance time in half compared to the flap brush. We are now using the disc to prep the landing gear area specifically, the center section wing in the wheel well area, for compliance with AFB 548. Normally, it would take 4 hours to clean this area using the flap brush. However, we are able to complete the job in approximately 2 hours using the radial bristle disc." He also stated that "the radial bristle discs cut the corrosion treatment time in half on the EA-6B Prowler compared to the flap brush."
- **AMC Ronald Higham**, COMAEWINGLANT Norfolk VA stated, "With the flap brush we were processing 502 corrosion discrepancies per treatment cycle on the E-2C Hawkeye averaging 1.86 man-hours per item processed. Utilizing the radial bristle disc enables us to process 1,862 items while averaging .88 man-hours per item processed." Additionally, Chief Higham stated, "corrosion spot repairs are kept to a minimum as compared to the flap brush." He also stated "the corrosion control work center is able to process the aircraft faster through the corrosion cycle and back out on the flight line at a faster rate with the bristle discs."



The orange/salmon radial bristle disc is shown being utilized on an E-2C engine nacelle at VAW-120 Norfolk, VA.

Impact Analysis

An impact analysis estimated the possible economic and environmental benefits of implementing the bristle disc technology across NAVAIR. The analysis compares the annual economic and environmental considerations of the proposed bristle discs versus the abrasive wheels (flap brushes) currently used.

The major savings will be realized in military labor. Labor costs will be cut in half and substrate damage costs will be avoided. The impact analysis shows an annual savings of \$8.5M for NAVAIR-wide implementation of the bristle disc technology. It also indicates a net reduction of roughly 7,500 hours in annual labor (a 50 percent savings). The results also indicate the avoidance of damage costs associated with the abrasive wheels (flap brushes). It was determined that the Navy will avoid about \$9.4M in costs associated with damage caused by the abrasive wheels and flap brushes. The damage repair costs will primarily be realized at the Depot-level. The Operational and Intermediate levels should expect to realize a slight increase in material costs, however 50 percent savings in labor will be realized based on actual Fleet testing. These results strongly support the decision to implement the bristle discs for small corrosion and paint removal applications on aluminum surfaces.

Impact Analysis Metrics: Benefits of 3M Radial Bristle Discs Versus Conventional Abrasive Wheels (Flap Brushes)

Environmental, Safety and Health Benefits

NAVAIR-Wide

Chromate Dust Particle Reduction	80%
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Economic Benefits

Payback (years)	Immediate (.006)
Military Labor Savings (hours/year)	7,578
Initial Cost	\$53,382
Annual Savings	\$8,566,375
Net Present Value	\$70,463,656

Annual Operating Cost Elements

	Conventional Abrasive Wheels	3M Radial Bristle Discs
CONSUMABLES	\$159,583	\$1,036,708
DAMAGE REPAIR	\$9,443,500	\$0
Total Annual Costs	\$9,603,083	\$1,036,708

Conclusion

Compared to conventional flap brush used for small paint and corrosion removal, bristle discs eliminate the damage to the aircraft substrate, reduce labor, and save time and money.

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For more information about the NAVAIR environmental program, please visit our web site at <https://www.enviro-navair.navy.mil>.



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