CeramiX® Abrasive Brushes with 3M™ Abrasive Grain 321

A superior ceramic abrasive grain creates a superior abrasive brush

The technology dates back to 1981, when 3M™ Company (St. Paul, MN) introduced the first commercial application of sol gel abrasive grain. The advantages of this grain stem from how it's manufactured and is evident in the grain's microstructure.

The production of conventional fused abrasive grain (such as aluminum oxide or silicon carbide), is a process in which the raw materials are fused or melted together, cooled and then crushed. This process results in crystal structures that are usually quite large.

In comparison, sol gel abrasive grain is the product of a chemical process in which an alumina precursor is prepared, gelled, dried, crushed into particles and then sintered to form abrasive grains. These ceramic abrasive grains may be embedded in a nylon polymer and the combination extruded into abrasive nylon filaments. The ceramic abrasive particles produced through sol gel processes have a finer crystalline structure than their conventional counterparts. Individual fused aluminum oxide abrasive grains typically comprise one to three alumina crystals; sol gel abrasive grains consist of many multitudes of alumina crystals.

Fractured 321 Grain
(Courtesy of 3M™)

Crystalline Structure

The benefit of this crystalline structure is that as the outermost crystals in the abrasive grain become worn during use they are expelled in very small fragments, leaving a greater amount of grain in the filament to continue abrading the part surface. The nylon filaments containing this special ceramic abrasive grain deliver improved productivity.

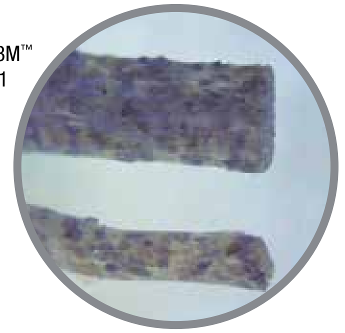
Sol Gel Abrasive Grains

3M™ Ceramic Abrasive Grains with Platelets

Two-Phase Microstructure

The 3M™ ceramic abrasive grain 321 also has a unique two-phase microstructure, a combination of fine crystals and a platelet phase. The platelets serve to reinforce the abrasive grains to withstand greater abrasion forces. The random orientation of the platelets also deflects fractures into multiple directions, creating a jagged irregular surface after the grain fractures. This continuous self-sharpening and jagged grain surface provide superior abrasion for filaments containing 321 ceramic abrasive grains.

Nylon Filament with 3M™ Abrasive Grain 321



Three Key Benefits

Three key traits which contribute to its elevated status: **fracture toughness, hardness, and self-sharpening qualities**. These features equate to increased productivity for CeramiX® abrasive nylon brushes, made with proprietary 3M™ 321 ceramic abrasive grain embedded throughout the filament.

CeramiX® Brushes

CeramiX® nylon abrasive brushes are made by Tanis, Inc. in Delafield, Wisconsin. CeramiX® nylon abrasive brushes are used as flexible filing tools in deburring and surface conditioning applications. Their flexibility allows these brushes to conform to irregular surface shapes. Brush designs have been developed for use in power tools, robotic cells and CNC applications to eliminate the need for time-consuming and inconsistent hand deburring operations. *Custom sizes available upon request.*

Tanis' abrasive nylon brushes are available in multiple configurations: tube or burr brushes (also known as twisted-in-wire), strip brushes and composite formed disc, mini-disc and radial wheels. CeramiX® high-performance brushes cut 3 to 5 times faster on ferrous metal surfaces due to the properties of the 321 ceramic abrasive grain and CeramiX® performs well under high stress and heat conditions.

CeramiX® abrasive nylon filament is available in 320, 220, 180, 120, 80 and 46 grit sizes, in a variety of filament diameters including a heavy-duty rectangular shape. Tanis regularly designs and manufactures custom brushes in CeramiX® and other filaments to suit customers' specific applications.

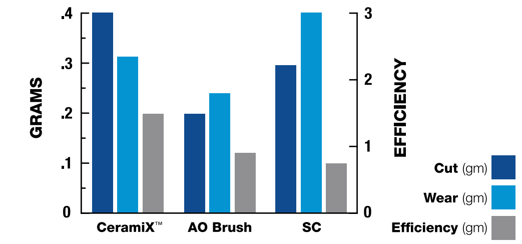
3M™ is a registered trademark of the 3M company. CeramiX® is a registered trademark of Tanis, Inc.

CeramiX® Performance with 3M™ Abrasive Grain 321

Cutting Action

CeramiX® proprietary abrasive brushes provide enhanced cutting action up to 3 to 5 times faster than traditional abrasive filaments.

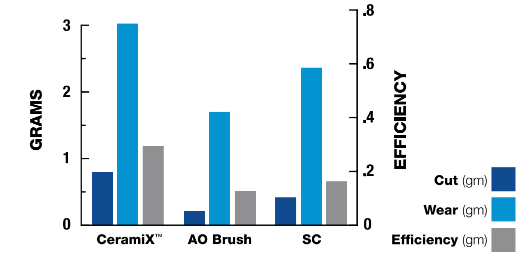
ALUMINUM PLATE
T6 Aluminum Plate,
1750 RPM



Brush Life

The mineral grain in CeramiX® brushes wears away in smaller pieces, leaving more mineral to work on the part surface.

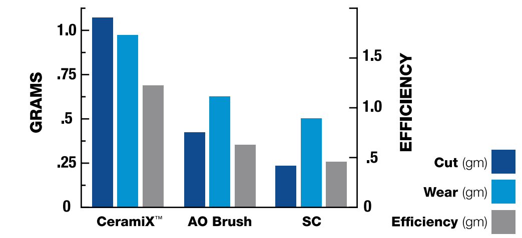
PERFORATED CRS
Perforated CRS A366 Plate,
1750 RPM



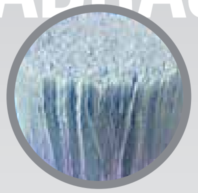
Increased Throughput

CeramiX® abrasive brushes reduce cycle times, enabling you to increase throughput. The controlled surface abrading action provides a consistent surface finish.

CRS STEEL PLATE
1008 CRS Plate,
1750 RPM

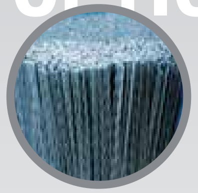


ABRASIVE GRAIN OPTIONS

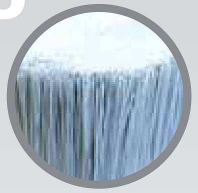


3M™ Grain 321 used in CeramiX® Brushes
cuts 3 to 5 times faster on ferrous metal surfaces compared to traditional abrasive nylons. The mineral grain in CeramiX® brushes wears away in smaller chunks leaving more mineral available to continuously work on the part surface.

Aluminum Oxide
is more impact resistant compared to silicon carbide and less likely to fracture. AO is preferred for finishing soft metals or other materials where a smooth finish is required.



Silicon Carbide
is harder, sharper and more aggressive than aluminum oxide and is preferred for finishing ferrous metals.



Alumina Silicate
is a hard ceramic with low thermal expansion. This fine grain abrasive filament is well-suited for fine finishing and cleaning.

Polycrystalline Diamond
is a hard ceramic with low thermal expansion. This fine grain abrasive filament is well-suited for fine finishing and cleaning.
(See page 103 for more information on Diamond.)

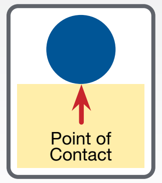
ABRASIVE FILAMENT		GRIT SIZE 46	80	120	180	220	240	320	400	500	600	1000	1800
CeramiX®	Filament Diameter Options (inches)	.065 x .080	.040, .055	.028, .040	.035	.022							
		.068 x .090	.045 x .090										
Silicon Carbide		.060, .045	.040, .050	.022, .040	.035		.030	.022		.018			
		.070	.045 x .090										
Aluminum Oxide					.035		.030	.022		.018	.012	.010	
Diamond				.040		.024	.040		.020		.012	.010	.012

FILAMENT TYPES

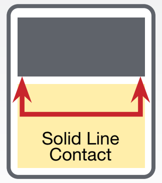
» **Round Crimped:** Optimizes brush conformability

» **Round Level:** Maximizes brush density *(Diamond Only)*

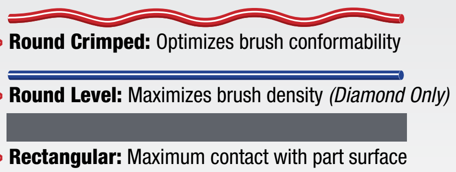
» **Rectangular:** Maximum contact with part surface



ROUND
FILAMENT



RECTANGULAR
FILAMENT



Abrasive Nylon Disc Brushes

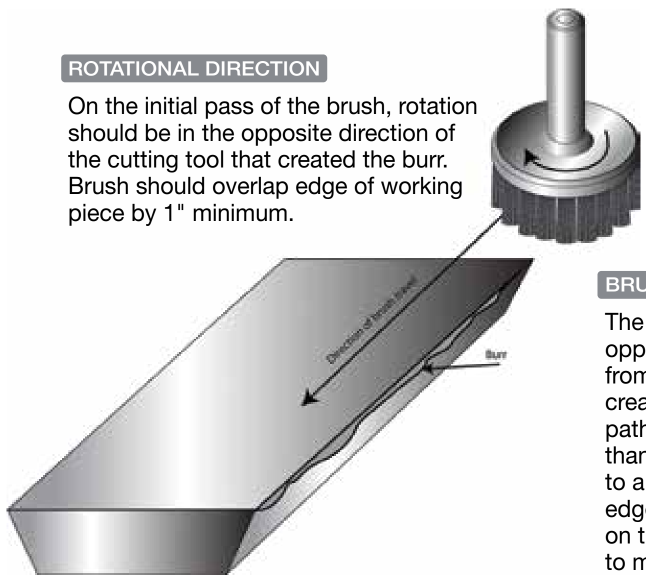
DISC DIAMETER	DRY APPLICATION STARTING RPM	RECOMMENDED MOTOR SIZE (BASED ON A 1" BRUSH FACE)
2"	1,750 - 2,500	1/4 HP
3"	1,750 - 2,500	1/4 HP
4"	1,750 - 2,500	1/4 HP
5"	1,500 - 1,750	1/4 HP
6"	1,250 - 1,750	1/2 HP
8"	800 - 1,200	3/4 HP
10"	700 - 800	1 HP
12"	600 - 700	1 HP
14"	500 - 600	1 HP

DISC DIAMETER	FEED RATE STAINLESS STEEL / ALLOY STEELS	FEED RATE MILD STEEL / CAST IRON	FEED RATE ALUMINUM / NON-FERROUS
2"	12 - 18" /min	25 - 30" /min	35 - 50" /min
3"	12 - 18" /min	25 - 30" /min	35 - 50" /min
4"	12 - 18" /min	25 - 30" /min	35 - 50" /min
5"	12 - 18" /min	25 - 30" /min	35 - 50" /min
6"	12 - 18" /min	25 - 30" /min	35 - 50" /min
8"	12 - 18" /min	25 - 30" /min	35 - 50" /min
10"	12 - 18" /min	25 - 30" /min	35 - 50" /min
12"	12 - 18" /min	25 - 30" /min	35 - 50" /min
14"	12 - 18" /min	25 - 30" /min	35 - 50" /min

Abrasive nylon disc brushes work best at speeds allowing fairly deep penetration of the work piece into the brush filaments. Faster speeds do not typically work as well as slower speeds, since the maximum RPM listed on the brush is not the optimum working speed. A good rule of thumb is to stay below 2,500 SFPM in dry applications and 3,500 SFPM with coolant.

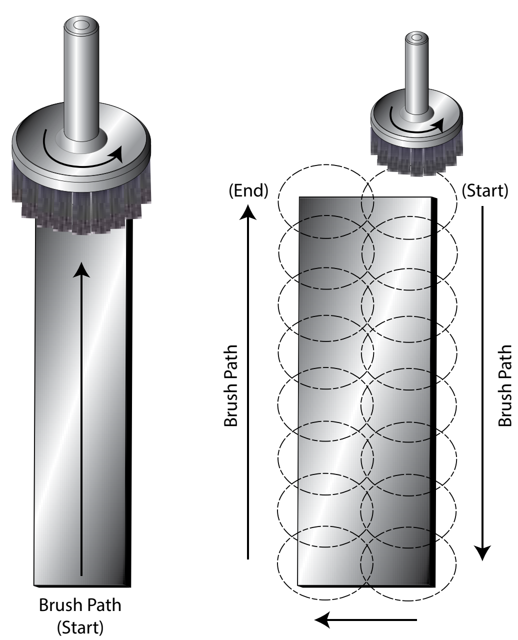
ROTATIONAL DIRECTION

On the initial pass of the brush, rotation should be in the opposite direction of the cutting tool that created the burr. Brush should overlap edge of working piece by 1" minimum.

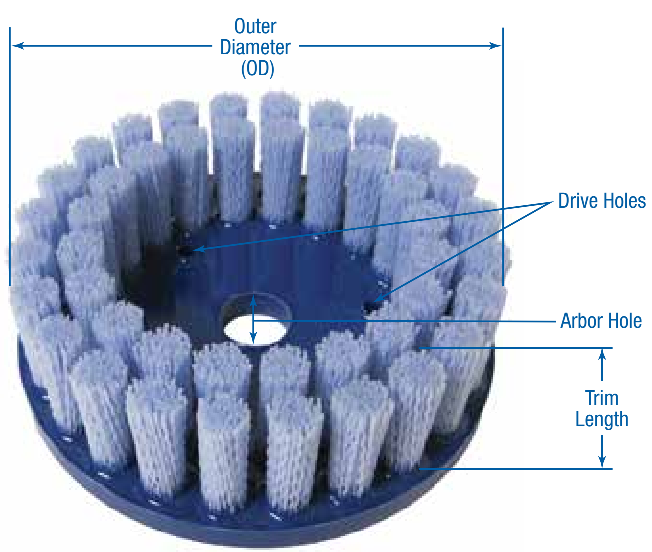


BRUSH PATH

The ideal brush path is in the opposite direction of travel from the cutting tool that created the burr. The brush path should also be longer than the cutting tool path, to a point where the trailing edge of the brush is effective on the end of the part. Lastly, to maximize the amount of filament that is striking the part, the center line of the brush should be offset from the center of the part.



Disc Brush Terminology



PENETRATION (POINT OF CONTACT)

The abrasive action occurs when the sides of the brush filament slide across the part surface or edge of the part. When the correct balance between speed (RPM), penetration, dwell time and abrasive grit size are achieved, then optimum life and cut can be obtained.

Recommended penetration rates for abrasive nylon disc brushes are from .075"–.100". This will allow long brush life with aggressive abrasive action.

CORRECT
Point of Contact

INCORRECT
Point of Contact

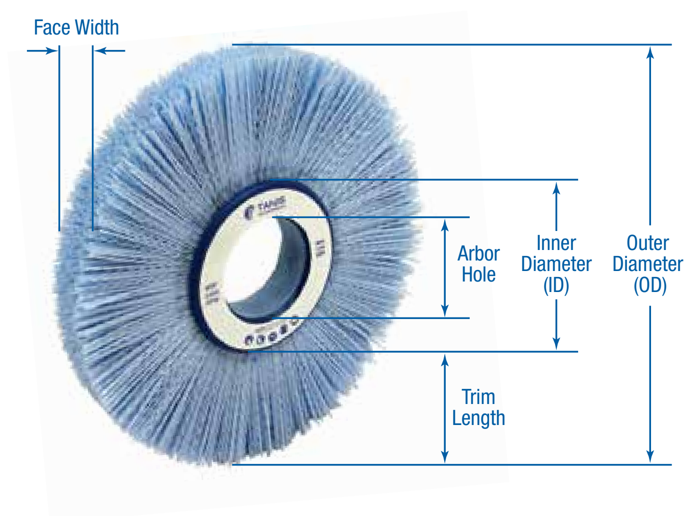
Abrasive Nylon Wheel Brushes

WHEEL DIAMETER	DRY APPLICATION STARTING RPM	RECOMMENDED MOTOR SIZE (BASED ON A 1" BRUSH FACE)
4"	2,000 - 3,000	1/4 HP
5"	2,000 - 3,000	1/4 HP
6"	1,500 - 2,000	1/2 HP
8"	1,200 - 1,500	3/4 HP
10"	1,000 - 1,200	1 HP
12"	800 - 1,000	1 HP
14"	800 - 900	1 HP

Abrasive nylon wheel brushes work best at speeds allowing fairly deep penetration of the work piece into the brush filaments. Faster speeds do not typically work as well as slower speeds, since the maximum RPM listed on the brush is not the optimum working speed. A good rule of thumb is to stay below 2,500 SFPM in dry applications and 3,500 SFPM with coolant. When operating multiple wheel brushes on a common shaft, multiply the HP requirements listed above times the number of brushes in use.

SURFACE SPEED (PERIPHERAL SPEED IN FEET PER MINUTE)						
RPM	4" DIA	6" DIA	8" DIA	10" DIA	12" DIA	14" DIA
900	950	1,400	1,900	2,350	2,800	3,350
1,150	1,200	1,800	2,400	3,000	3,600	4,200
1,200	1,250	1,900	2,500	3,200	3,800	4,400
1,500	1,550	2,350	3,150	3,900	4,700	5,500
1,750	1,800	2,750	3,650	4,550	5,500	6,400
2,000	2,100	3,100	4,200	5,200	6,300	7,300
2,400	2,500	3,800	5,000	6,100	7,500	8,800
2,800	2,900	4,400	5,850	7,300	8,800	10,200
3,000	3,100	4,700	6,300	7,800	9,400	11,000
3,200	3,350	5,000	6,700	8,400	10,200	11,700
3,450	3,600	5,400	7,200	9,000	11,000	12,600
3,750	3,900	5,900	7,800	9,800	11,800	13,700
4,000	4,200	6,300	8,400	10,500	12,500	N/A
4,500	4,700	7,200	9,400	11,900	14,100	N/A
5,000	5,200	7,800	10,500	13,100	π Dia (inches) X RPM /12	
5,400	5,600	8,500	11,300	N/A	π Dia (inches) X RPM /12	
6,000	6,300	9,400	12,500	N/A	π Dia (inches) X RPM /12	

Wheel Brush Terminology



PENETRATION (POINT OF CONTACT)

The abrasive action occurs when the sides of the brush filament slides across the part surface or edge of the part. When the correct balance between speed (RPM), penetration, dwell time and abrasive grit size are achieved, then optimum life and cut can be obtained.

Recommended penetration rates for abrasive nylon wheel brushes are maximized up to 10% of trim length. This will allow long brush life with aggressive abrasive action.

CORRECT
Point of Contact

INCORRECT
Point of Contact

Considerations when Selecting Filament for a Tanis Abrasive Nylon Brush

GRIT SIZE

120 grit is our recommended starting point for most applications. From there you can move either down or up in grit size, for a more aggressive cutting action or more of a polishing action. The chart on page 73 shows our abrasive nylon filament/grit size options.

TRIM LENGTH AND BRUSH DENSITY

A brush with a short trim length is rigid and used for high speed cutting. Longer trim lengths are more flexible and used for conforming to irregular surfaces. Likewise, a brush with a lower fill density has greater flexibility and ability to conform, as well as increased resiliency. High fill density brushes are used for deburring and when high speed cutting is required.

Long Trim, Low Density

Short Trim, High Density

Twisted Brush Stem Construction

Single Stem/Single Spiral (SS/SS)
Filament is twisted between two stem wires with a single layer of filament.

Double Stem/Single Spiral (DS/SS)
Filament is twisted between four stem wires, with two stem wires on each side for additional strength and higher density fill.

Double Stem/Double Spiral (DS/DS)
Filament is twisted between four stem wires with two layers of bristles. Each layer is perpendicular to the other with a single stem wire in each quadrant. The highest brush density and highest strength twisted wire brush available.

Brush Tip Styles

Continuous End

Cut Off End

Operating Recommendations

When mounting a twisted brush in a collet or chuck, it is recommended to minimize the overhang of the stem to under an inch. This is particularly true with power tube brushes, and it is important to avoid any load conditions and operating speeds that can cause stem deflections and destructive bending. A safe operating speed from 100-500 RPM is recommended for most twisted brushes.

To reach into deeper holes we recommend the use of collet-ready shank mounted brushes or drill extension rods rather than increasing stem overhang.

Before Starting the Twist Brush Rotation

- Secure the brush in the chuck.
- Ensure clockwise brush rotation—counter clockwise rotation can cause the brush to come apart and release the filament.
- Securely clamp the workpiece. Make sure all machine guards are in position.
- Align the brush with the workpiece to ensure the brush rotates on its true center line and avoid stem deflection.
- Guide the brush into the hole before starting the brush rotation.
- Always wear eye protection and protective clothing!

Other Considerations:

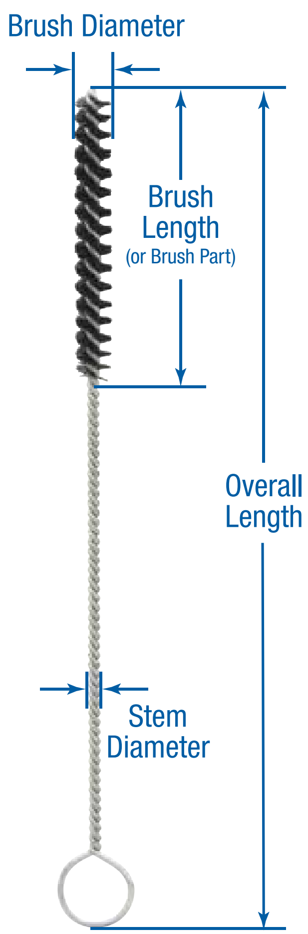
Wire Options
- Coated
- Galvanized
- Stainless Steel

Filament Options
- Abrasive Nylon
- CeramiX®
- Brass
- Carbon Steel
- Horse Hair
- Nylon
- Stainless Steel
- Crimped, Level or Color Options

Gauge
- Stem Diameter

Other
- Shank Type
- Tubing
- Coupling
- Loop
- No Loop

Twist Brush Terminology



Troubleshooting – Abrasive Nylon Brushes

Brush too aggressive
- Reduce filament diameter and/or grit size
- Reduce surface speed by reducing RPM
- Increase trim length and decrease fill density
- Increase feed rate
- Use a smaller diameter brush

Brush not aggressive enough
- Increase filament density and/or grit size
- Increase surface speed by increasing RPM
- Decrease trim length
- Reduce feed rate
- Use a larger diameter brush

Brush not conforming enough to part
- Increase trim length
- Reduce filament density
- Use a smaller diameter brush
- Reduce surface speed by reducing RPM
- Reduce feed rate

Final finish too rough
- Increase surface speed by increasing RPM
- Use a larger diameter brush
- Use a finer abrasive filament
- Use a coolant or cutting oil
- Use a buffing compound

Final finish too smooth
- Reduce surface speed by reducing RPM
- Use a smaller diameter brush
- Increase filament density and/or grit size

Filament smearing/melting
- Reduce surface speed by reducing RPM
- Decrease brush diameter
- Use a coolant or lubricant

More action needed on edges parallel to brush axis
- Reduce surface speed by reducing RPM
- Reduce feed rate
- Keep longer brush contact on problem area

More action needed on edges perpendicular to brush axis
- Reduce surface speed by reducing RPM
- Increase feed rate
- Oscillate brush on problem area

Brush action not uniform enough
- Increase trim length
- Reduce filament density
- Use automated equipment for brush motion

Short brush life
- Increase filament density
- Reduce pressure/depth of interference

SUGGESTIONS FOR MAXIMIZING BRUSH PERFORMANCE

FEATURE	INCREASE	DECREASE
Diameter	Increasing outside diameter at a constant RPM increases surface speed: SFPM (Surface Feet Per Minute). Increasing surface speed increases work results.	Assuming constant RPM, a decrease in tool diameter decreases surface speed.
RPM	Increasing RPM at a constant outside diameter increases surface speed.	Assuming same diameter brush, decreasing RPM decreases surface speed.
Trim Length	Allows the filament to be more flexible and to conform more readily to irregular surfaces.	Stiffens filament action, thereby increasing work accomplished.
Filament Size	Provides faster cutting action and thereby increases work accomplished. ***NOTE:*** *Coarser filament/grit sizes work faster than finer filament/grit sizes, with faster wear.*	Provides superior surface finish and maximize tool life. ***NOTE:*** *For best results, choose minimum diameter and increase as needed.*
Grit Size	Provides faster cutting action and thereby increases work accomplished. ***NOTE:*** *Coarser filament/grit sizes work faster than finer filament/grit sizes, with faster wear.*	Provides superior surface finish and maximize tool life. For best results, choose minimum grit size and increase as needed.
Filament Density	Provides more filament to do work, thereby increasing work accomplished.	Provides greater brush flexibility; leaving more room for individual filaments to conform to irregular workpiece shapes.