

3M Abrasive Systems

Abrasive Belt Solutions for the
Casting & Forging Industries



3M

About this Guide

This is a guide to the most effective and efficient products and systems for the grinding, refining and finishing of metal components.

It focuses on each of the main abrasive applications within this industry and offers solutions which are aimed at reducing grinding and finishing costs and improving the quality and consistency of surface finish.

It also includes recommendations on operating speeds, pressures and optimised working practices for all metals.

Featured Products



3M™ Cubitron™ Abrasive products for grinding



3M™ Trizact™ Structured Abrasive products for refining and finishing



Scotch-Brite™ Surface Conditioning products

3M Cubitron Abrasives -

The mineral that makes the difference

3M Trizact Structured Abrasives -

The evolution of abrasives

Scotch-Brite Finishing Products -

The brighter choice for finishing



Grinding -

Product selector

Refining -

Product selector

Finishing -

Product selector



Product Range -

The right solution for any application



Customer Test Centre

3M™ Cubitron™ Abrasive Products

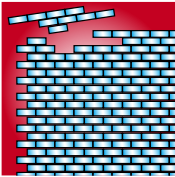
Why will 3M Cubitron™ Abrasive products improve your quality and reduce costs?

Manufactured to last longer

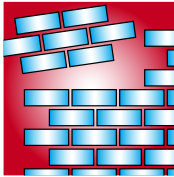
3M Cubitron Abrasive Grains are a family of chemically engineered minerals each individually designed and manufactured to precise physical characteristics to match specific grinding conditions.

Formulated for strength

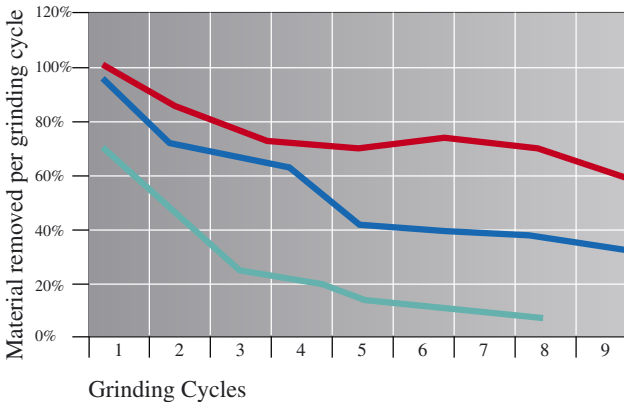
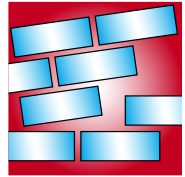
The grinding capability of an abrasive grain depends on its hardness and fracture strength. 3M Cubitron Abrasive Grain is created in a carefully controlled chemical process where these properties are optimised to deliver the ideal grinding characteristics. In the strongest versions tiny spinal platelets bind the microscopic crystals together.



3M™ Cubitron™ Crystals have built-in microfractures that ensure sharp edges are regenerated during use.



Conventional crystals soon wear to a smooth surface or crack catastrophically.



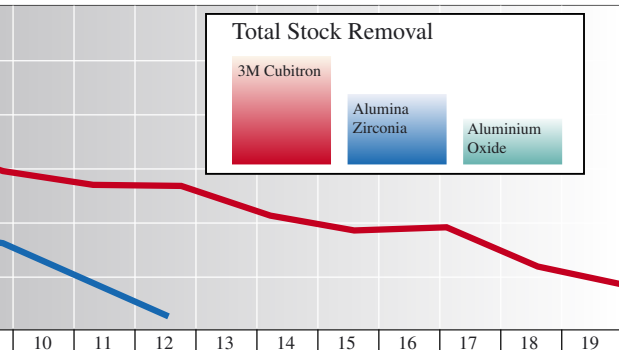
The mineral that makes the difference

Engineered to stay sharp

3M Cubitron Abrasive Grains have a unique “stay sharp” microscopic crystalline structure. They fracture at predetermined points of the crystal boundaries to reveal fresh new cutting edges. Whilst conventional abrasives either dull or fragment during grinding, the 3M Cubitron Mineral continues to self-sharpen to significantly extend the grinding process.

Designed for thermal stability

Even in the intense heat and stress generated at the grinding interface 3M Cubitron retains its microstructure, its hardness and its cutting mechanism. It is an ideal mineral to grind stainless steels, titanium and heat sensitive nickel alloys.



In plunge grinding tests on tool steel, 3M™ Cubitron™ Abrasive products go on working long after other abrasives wear down.

3M™ Trizact™ Structured Abrasives

How can 3M Trizact Structured Abrasives improve the quality and reduce the costs of your finishing process?

Designed to last

3M Trizact Abrasive products are a micro-replicated coating of precisely positioned structures, full of micron graded mineral particles. As the surface wears away, fresh abrasive is revealed all the way to the base of the structure. The result is a new generation abrasive which lasts several times longer than conventional abrasives.

Designed to produce a predictable & consistent finish

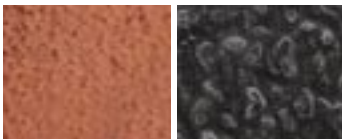
3M Trizact Structured Abrasives are precision finishing tools, as effective on high specification titanium, chromium, nickel and cobalt based alloys as on non-ferrous metals. The continual exposure of mineral ensures continual cut and a high quality finish throughout the product's life cycle.

Evolution of Abrasives

Conventional



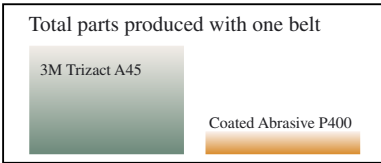
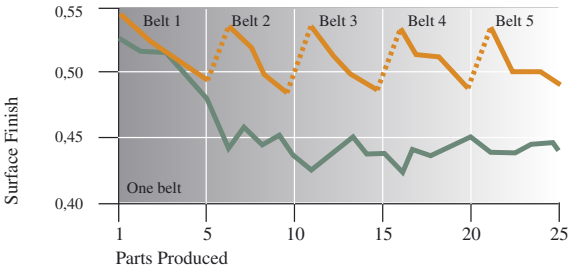
**Trizact
Microreplicated**



Randomly arranged mineral; uneven wear and finish



Tiny, 3D pyramids uniformly distributed over the surface;

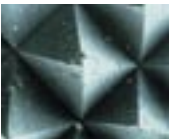


Designed to save process costs by reducing the:

- number of operations in a finishing process
- downtime for changing belts
- number of rejects
- pressure required
- operator fatigue
- time for subsequent polishing, cleaning and plating operations



Trizact Macroreplicated



consistent performance, even wear and extremely fine finishes



Large, 3D structures uniformly distributed over the surface; extends the consistent cut and finish of Trizact into earlier finishing operations for turbine blades

Scotch-Brite™ Finishing Products

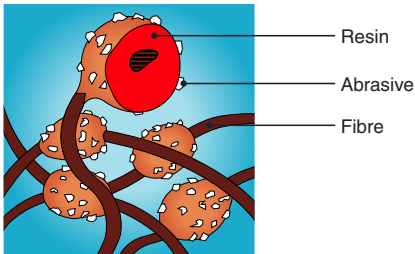
Why will Scotch-Brite products improve your quality and cut your costs?

Unique design

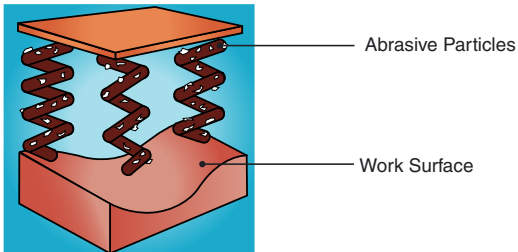
It is the unique nylon web that gives Scotch-Brite Surface Conditioning products the edge. Synthetic fibres and abrasive particles are combined and bonded together to create a comfortable, three-dimensional open nylon web material.

This open web design allows cool air to circulate, so there is less risk of warping or discolouring the part. It also resists loading, which helps improve the finishing or polishing action.

Three Dimensional Open Web



Spring Action



The brighter choice for surface conditioning

Consistent results

The unique design of the Scotch-Brite web ensures that fresh abrasive is continually exposed to the work surface, so that you can produce consistent, uniform results time after time.

Thanks to the spring-like web, there is less risk of over-working the part and disturbing critical tolerances. Stock removal is minimised and undercutting or gouging is reduced.

Substantial savings

By ensuring a consistently high quality finish, Scotch-Brite Surface Conditioning products can eliminate production steps and save time and labour costs.




Because they resist loading, Scotch-Brite Surface Conditioning products work and last longer. Replacement costs and downtime are reduced because the wheel or belt needs changing less often.

In addition, because Scotch-Brite Surface Conditioning products are cool running, there is less chance of warping and discoloration. This means fewer rejects, less rework time and less rework expense.

Scotch-Brite Surface Conditioning products:

- last longer
- give consistent results
- cut production costs
- reduce waste and reworking

Grinding

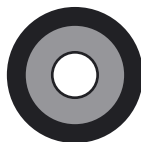
Metal:	Stainless Steel	Nickel Alloy	Carbon Steel & SG Iron	Aluminium	Titanium
Rapid Grinding System	3M 977F	3M 967F 3M 977F	3M 577F 3M 964F 3M 967F	3M 974F	3M 967F
 Backstand	3M 947D	3M 947D 3M 967F 3M 977F	3M 577F 3M 964F 3M 967F	3M 964F 3M 974F	3M 967F
 Wet Applications	3M 977F		3M 964F		
 File Belt	3M 777F 3M 947D	3M 777F 3M 947D	3M 577F	3M 577F	3M 947D

Ideal Contact Wheel for Grinding

Diameter: small diameter
50mm
for smaller scratches



Hardness: hard
70-90 shore A



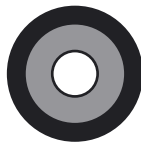
Serration: 1:2
Land to groove ratio



Serration Angle: 75°



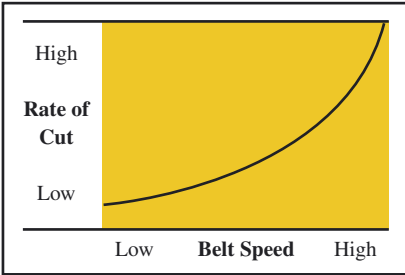
Elasticity: high
eg. polyurethane



A number of factors affect grinding performance. The main factors are illustrated below:

Effect of belt speed on cut

The higher the belt speed the higher the rate of the cut. This is because as the belt speed increases, more cutting edges are presented to the workpiece.

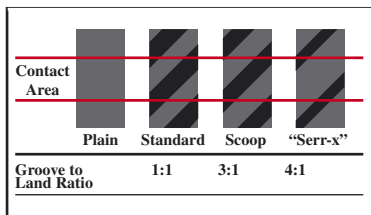


Optimum belt speed for grinding





Metal:	Optimum belt speed:
Aluminium	20 - 25 m/sec
Carbon Steel	20 - 25 m/sec
Nickel Alloy	25 - 35 m/sec
Stainless Steel	25 - 35 m/sec
Titanium	10 - 15 m/sec

Effect of contact wheel area on pressure

The amount of pressure exerted against a workpiece will affect the rate of cut & belt life. The higher the unit pressure, the greater the stock removal.



Refining

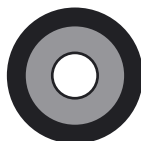
Metal:	Stainless Steel	Nickel Alloy	Carbon Steel & SG Iron	Aluminium	Titanium
 Robot	3M 217EA 3M 307EA 3M 907E 3M CF01A	3M 237AA 3M 307EA 3M 907E 3M CF01A	3M 964F 3M CF01A	3M 217EA 3M CF01A	3M 407EA 3M CF01A
 Backstand	3M 217EA 3M 307EA 3M 947D 3M CF01A	3M 237AA 3M 907E 3M 947D 3M 977F 3M CF01A	3M 964F 3M CF01A	3M 217EA 3M 964F 3M CF01A	3M 407EA 3M CF01A
 Wet Applications	3M 977F 3M 953FA	3M 953FA	3M 953FA	3M 953FA	3M 953FA
 File Belt	3M 707E 3M 947D 3M CF01A	3M 707E 3M 947D 3M CF01A	3M 577F 3M CF01A	3M CF01A	3M CF01A

Ideal Contact Wheel for Refining

Diameter: medium diameter
200mm



Hardness: medium
40-65 shore A



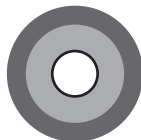
Serration: 1:1
Land to groove ratio



Serration Angle: 45°



Elasticity: medium
eg. rubber



Abrasives represent only a part of the total cost of a grinding, refining and finishing process.

Optimising the application process by selecting the right abrasives:

- reduces total process costs
- releases capacity
- reduces rejects
- reduces rework
- saves labour costs

Coolants and Lubricants:





Water (rust inhibitor) is the most effective coolant

Mineral Oil is best for grinding steel and to prevent discoloration on non-ferrous alloys

Soluble Oil improves the cutting rate on most metals and is less flammable

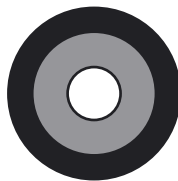
Grease reduces loading of softer metals and improves surface finish

Finishing & Surface Conditioning

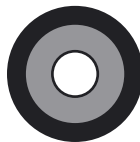
Metal:	Stainless Steel	Nickel Alloy	Carbon Steel & SG Iron	Aluminium	Titanium
 Robot	3M 217EA 3M CF01A SC-BL	3M 217EA 3M CF01A SC-BL	3M CF01A SC-BL	3M 217EA 3M CF01A SC-BL	3M 407EA 3M CF01A SC-BL
 Backstand	3M 237AA 3M 307EA 3M 707E 3M CF01A SC-BL	3M 237AA 3M 307EA 3M 707E 3M CF01A SC-BL	3M CF01A SC-BL	3M 217EA 3M CF01A SC-BL	3M 407EA 3M CF01A SC-BL
 Wet Applications	3M 953FA	3M 953FA	3M 953FA	3M 953FA	3M 953FA
 File Belt	3M 217EA 3M 307EA 3M CF01A SC-BS	3M 217EA 3M 307EA 3M CF01A SC-BS	3M CF01A SC-BS	3M CF01A SC-BS	3M CF01A SC-BS

Ideal Contact Wheel for Finishing

Diameter: large diameter
300mm
for longer scratches



Hardness: soft
20-35 shore A



Serration: plain
Land to groove ratio



Serration Angle: 15°



Elasticity: low



eg. cotton felt

The quality of finishing is influenced by a variety of factors as indicated below:

- **Belt speed :**
The higher the belt speed, the finer the finish.
- **Contact wheel hardness:**
The softer the contact wheel, the finer the finish.
- **Contact wheel diameter:**
The larger diameter contact wheel, the finer the finish.

Surface Roughness

The following table gives the average roughness in micrometer generated by each 3M Trizact™ Structured Abrasive grade on various metals.

Ra micron

Roughness Ra values may vary within a $\pm 20\%$ range depending on working conditions

	A110	A100	A90	A80	A65	A60	A45	A30	A16	A6
Hard Chrome Plating	0.55	0.50	0.48	0.45	0.40	0.34	0.25	0.15	0.08	0.03
Tempered Stainless Steel	0.58	0.53	0.50	0.47	0.42	0.36	0.27	0.17	0.08	0.04
Tool Steel	0.55	0.53	0.51	0.50	0.45	0.40	0.30	0.20	0.10	0.04
Titanium	0.90	0.65	0.60	0.50	0.45	0.40	0.30	0.25	0.18	0.09
Stainless Steel 304	1.10	1.00	0.92	0.85	0.70	0.60	0.45	0.29	0.15	0.06
Carbon Steel	1.25	1.10	1.00	0.90	0.78	0.70	0.48	0.35	0.16	0.08
Brass	1.40	1.20	1.05	0.95	0.80	0.75	0.55	0.38	0.22	0.09
Copper	1.45	1.25	1.10	0.98	0.85	0.80	0.59	0.39	0.24	0.10
Nickel	1.30	1.15	1.10	1.00	0.80	0.65	0.55	0.40	0.20	0.12
Aluminium	1.60	1.40	1.30	1.20	1.10	1.00	0.90	0.65	0.40	0.30

The above values have been obtained statistically under the following working parameters:

belt surface speed: 30metres/second

smooth rubber contact wheel: 40 shore A

working pressure: $20 \cdot 10^4 \text{Pa}$ (2 kgf/cm²)

feed speed: 4 metres/minute 2 passes

3M™ Abrasive Belt Product Range

Whatever the task, 3M has the abrasive solution

Product	Mineral	Backing	P24	P36	P40	P50	P60
3M 977F	CU	YF XF		■	■	■	■
3M 974F	CU	XF		■			
3M 967F	CU	YF	■	■	■	■	■
3M 964F	CU	YF XF	■	■	■	■	■
3M 947D	CU	XF			■		■
3M 907E	CU	JE					■
3M 777F	CU	YF		■	■	■	■
3M 707E	CU	JE					
3M 577F Orange	AZ	YF		■			■
3M 303D	AO	JE					■

Product	Mineral	Backing	A300	A160	A110	A100	A90
3M CF01A	AO	XF	■	■		■	
3M 217EA	AO	XF				■	
3M 237AA	AO	XF		■		■	
3M 307EA	AO	JE				■	
3M 407EA	SC	JE			■		■
3M 953FA	CU	XF	■	■		■	

Product	Mineral	Backing	SE Coarse	Coarse	Medium
SE-BL	AO	Low stretch	■		
SC-BL	AO	Low stretch		■	■
SC-BL	SC	Low stretch			
SE-BL	T	Low stretch			
SE-BS	AO	Scrim backed	■		
SC-BS	AO	Scrim backed		■	■
SC-BS	SC	Scrim backed			

P80	P100	P120	P150	P180	P220	P240	P320	P400
■	■	■						
■								
■	■	■						
■	■	■						
■	■	■	■					
■	■	■	■	■				
■	■	■	■	■	■	■		
■	■	■	■	■	■	■	■	■

A80	A65	A60	A45	A40	A30	A20	A16	A6
	■		■					
■	■		■		■		■	■
■	■		■		■		■	■
■	■		■		■		■	■
		■		■		■		
	■		■		■		■	■

Fine	Super Fine	Type T
■		
	■	
		■
■		
	■	

Key:

Mineral

- AO Aluminium Oxide
- AZ Aluminium Zirconia
- CU 3M Cubitron™
- SC Silicon Carbide
- T Type T

Backing

- JE Flexible
- XF Semi-flexible
- YF Stiff

3M™ Trizact™ Abrasive Grades

3M Trizact Grade	FEPA (P-Grade)
A5	P3000
A6	P2000
A16	P1400
A20	P1200
A30	P800
A40	P600
A45	P400
A60	P360
A65	P280
A80	P240
A90	P220
A100	P200
A110	P180
A160	P120
A300	P80

UK Customer Test Centre

The UK Abrasive Customer Test Centre is a unique facility located in the Midlands, which offers a broad range of innovative, specialised technical support and abrasive methods development and services.



Customers, distributors, machine builders and sales representatives can utilise the centre to experience new products, enhance methods of production and increase worker safety.

3M technical experts work on a wide range of joint projects, with our industry partners including:

- process engineering
- customer visits
- research and development
- sales training
- machinery evaluations
- specialist projects

If you wish to find out more about how your company can benefit from the Customer Test Centre, please contact your local 3M representative.



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