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Applied to Life.™

Technical Catalog 3M™ Precision Grinding & Finishing

3M™ Conventional Vitrified Grinding Wheels

Technical Catalog 2020 – EN
Version 1.0

Conventional grinding – for a good reason with 3M

Modern technology for modern solutions

We have the innovative and technically demanding solution to every problem and requirement for modern precision grinding technology used in industrial settings. With our unique expertise in the manufacture of bonded minerals, we are in the position to optimize the operating and economic efficiency of your individual production processes and increase the value added to your products.

Our solutions are used in numerous branches of industry such as the following:

- Automotive Industry
- Aviation Industry
- Wind Power Industry
- Steel Industry
- Tool Industry
- Bearing Industry

As a provider of wheels, we at 3M are one of the top companies for modern grinding technology. Throughout the entire grinding process on the way to perfect surfaces, we represent the peak of technology in grinding wheels, dressing tools and machines. In addition to the optimization of processes and working speeds, the ability to react quickly to new materials is the primary motivation for most innovations.

The definition of grinding

Grinding is an abrasive, path-based manufacturing process for manual or automatic machining of surfaces or for cutting parts off using minerals and bonded abrasive grain. According to DIN 8580, it belongs to the cutting group and to the subgroup of machining with a geometrically undefined cutting edge.

Why grinding?

To manufacture precise products with corresponding shape or positional tolerances or after heat treating a material, it is essential to fine grind a workpiece in order to obtain the required surface finish quality while staying within the correspondingly low shape, positional and dimensional tolerances. The benefits of the grinding over other types of machining include the ability to machine harder materials well, the high dimensional and geometrical precision, and the low waviness and roughness of the ground surfaces (Rz = 0.5 to 10 µm). Due to the large number of cutting edges compared to other hard fine machining processes, the highest process reliability is guaranteed.

Conventional grinding

In conventional grinding, aluminium oxide (Al_2O_3) and silicium is used as one of the main grinding minerals. Aluminium oxide is extremely reasonably priced, very versatile and can be used for almost every grinding application. 3M has developed a new ceramic grain and combines it with very high-quality technical solutions that are unique. This allows us to support our customers with an optimal ratio between stock removal rate/speed/wheel life cycle and cost. Our highly qualified and experienced application engineers thus ensure higher production productivity.

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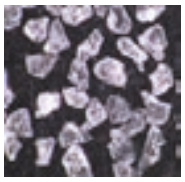
1. Core Portfolio Details

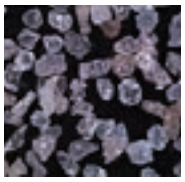
1.1 Abrasive/Grain Types and Grain sizes

1.1.1 Abrasive/Grain Types

3M Abrasives	Grain Type
99DA	3M™ Precision-Shaped Grain
95DA	Mix of white aluminium oxide and 3M™ Precision-Shaped Grain
93DA	Mix of white aluminium oxide and 3M™ Precision-Shaped Grain
91DA	Mix of white aluminium oxide and 3M™ Precision-Shaped Grain
75DA	Mix of white aluminium oxide, **Cr-Ti alloyed Fused Aluminium Oxide** and 3M™ Precision-Shaped Grain
91NDA	Mix of white-, **aluminium oxinitride** and 3M™ Precision-Shaped Grain
93AS	Mix of white aluminium oxide and **white crushed ceramic grain**
93A	Mix of white aluminium oxide and 3M™ Ceramic Grain 321
93NA	Mix of white aluminium oxide and **aluminium oxinitride**
220NA	Mix of white aluminium oxide, **aluminium oxynitride, Cr-Ti alloyed Fused Aluminium Oxide** and **3M™Ceramic Grain 321**
73A	Mix of white- and **Cr-Ti alloyed Fused Aluminium Oxide** and 3M™Ceramic Grain 321
81A	Mix of white- and monocrystalline aluminium oxide and 3M™ Ceramic Grain 321
68A	Ruby aluminum oxide
64A	Mix of monocrystalline- and pink aluminum oxide
62A	Mix of ruby- and white aluminium oxide
57A	Pink aluminum oxide
54A	White aluminum oxide with green bond
41A	Mix of white aluminum oxide and **Cr-Ti alloyed Fused Aluminium Oxide**
40A	White aluminium oxide
31A	Mix of regular, semi-friable and white aluminum oxide
29A	Monocrystalline aluminium oxide
28A	Mix of monocrystalline- and white aluminum oxide



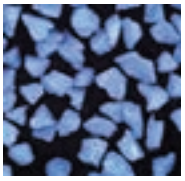
White aluminium oxide



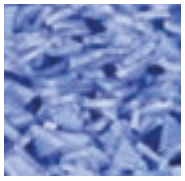
Monocrystalline aluminium oxide

Pink aluminum oxide

Ruby aluminum oxide



3M™ Ceramic Grain 321



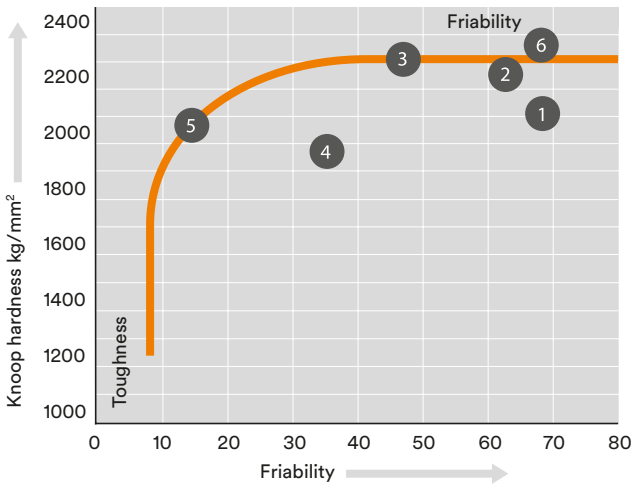
3M™ Precision-Shaped Grain

For more Abrasive/Grain Types, please refer to your 3M contact.

Overview of main conventional Abrasive/Grain Types

Grain Type	Properties	Materials	Application
White aluminium oxide	Hard and friable	Non-alloyed, alloyed, unhardened and hardened steel up to 63 HRc (carbon contents <0.5%, tensile strength around 500 N/mm²); untreated nitriding steel; cast steel; nodular cast iron; annealed cast iron; tool steel; chrome-plated steel	Universal usage in all forms of precision grinding such as gear grinding, OD and ID cylindrical grinding, tool grinding etc. Due to its high friability pure white aluminium oxide is used only rarely for centerless grinding
Mix of mono-crystalline- and white aluminum oxide	Harder and tougher than white aluminium oxide, medium friability, cool cutting	Hardened chrome-plated with hardness >63 HRc and high tensile strength; hardened acit and heat-resistant, stainless steel; high speed steel (HSS)	OD cylindrical grinding, universal usage in reciprocating surface grinding
Monocrystalline aluminium oxide	Harder and tougher than white aluminium oxide	High-alloy and tough steel, tool steel, Inconel	Gear grinding, OD cylindrical grinding, creep-feed grinding
Ruby aluminium oxide	Marginally tougher than white aluminium oxide	High-alloy and tough steel such as tool steel and HSS	Special applications such as profile grinding of high-alloy steel, gear grinding, OD cylindrical grinding
Mix of white aluminium oxide and 3M™ Ceramic Grain 321	Marginally harder than white aluminium oxide, but features better self-sharpening properties	High-alloy and tough steel such as tool steel and HSS up to 65 HRc; grey cast iron	All precision grinding applications such as centerless, gear grinding, cylindrical and surface grinding
Mix of white aluminium oxide and **aluminium oxinitride**	High temperature resistance, low tendency to cold welding of chips	High-alloy and tough steel such as tool steel and HSS up to 65 HRc; grey cast iron; non-ferrous metals	All precision grinding applications such as centerless, gear grinding, cylindrical and surface grinding
3M™ Precision-Shaped Grain	Same grain hardness as ceramic aluminium oxide, but significantly better cutting because of precision shaping	Heat-treated steels; high-alloy steels; stainless steels; nitriding steel; cold working steel; nodular cast iron, grey cast iron	All precision grinding processes, such as gear grinding, cylindrical grinding, surface grinding, surface/creep-feed grinding, centerless grinding

General Applications of Abrasives



1 = White Al_2O_3
2 = Pink Al_2O_3
3 = Mono-crystalline Al_2O_3
4 = Semi-friable Al_2O_3
5 = Regular Al_2O_3
6 = Microcrystalline Al_2O_3

1.1.2 Grain sizes

The assignments of the grain numbers to certain particle size distributions are specified according to an internationally valid grain size standard (see the table). Very fine grains (micrograins starting at about grain no. 230) are obtained from slurries.

The surface finish roughness produced during grinding not only depends on the abrasive grain size, but also on the grinding and dressing method. Coarsely dressed grinding wheels yield higher performance, but also produce a rougher surface. When grinding profiles or small radii, the particle size has a direct influence on the selection of the specification.

The dressing process must be taken into account in this case. The diameter of the abrasive grain should fit 2–3 times inside the smallest concave radius of the workpiece.

Grain Size	Dimensions (mm) from	Dimensions (mm) to	Grain Category
46	0.42	0.30	
54	0.35	0.25	
60	0.30	0.21	Medium
70	0.25	0.18	
80	0.21	0.15	
90	0.18	0.13	
100	0.15	0.11	
120	0.13	0.09	
150	0.11	0.06	Fine
180	0.09	0.05	
220	0.075	0.045	
240	0.047	0.043	Very fine

Availability depends on Abrasive/Grain Type.

Grain size, surface and corner radius

3M™ Cubitron™ II grinding wheels contain precisely shaped triangles made of ceramic aluminium oxide. These self-sharpening triangles cut metal very efficiently with significantly less heat generation in the workpiece. 3M™ Cubitron II wheels also allow for fine surface finishes and the efficient grinding of small corner radii.

The above values are to be understood as guidelines only. Surface finish is not only a function of grain size, but also depends, among other things, on machining parameters, dressing parameters, choice of coolant and the level of coolant filtration.

Likewise, corner radii not only depend on grain size but also on wheel hardness and structure. Generally, the harder the wheel or more dense the grinding wheel the better the edge retention, and vice versa.

R_a	R_z	60	80	120	180	240
0.6	4.0					
0.5	3.2					
0.4	2.5					
0.35	2.2					
0.25	2.0					
0.2	1.25					
0.16	1.0					
0.1	0.6					
0.08	0.5					
0.05	0.32					
0.03	0.2					
0.02	0.14					

Grain size	60	80	120	180	240
Corner radius	0.5	0.4	0.2	0.13	0.1

1.2 Hardness and Structure

Hardness of our core portfolio

The hardness is determined by the following factors:

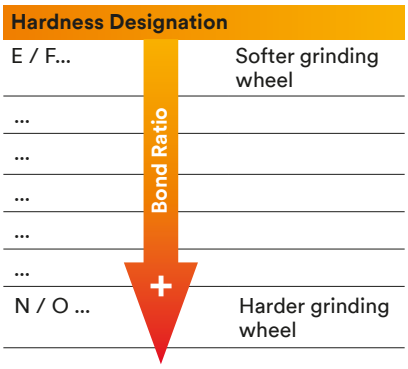
- Abrasive grain size
- Bond ratio
- Bond Type
- Porosity
- Grinding wheel structure

The term ‘grinding wheel hardness’ does not refer to the hardness of the abrasive grain, but to the ability of the bond to resist the breaking off of the abrasive grain. The softer the wheel, the easier it is for the abrasive grain to break off. Letter codes A (soft) to Z (hard) refer to the hardness grade (see the table).

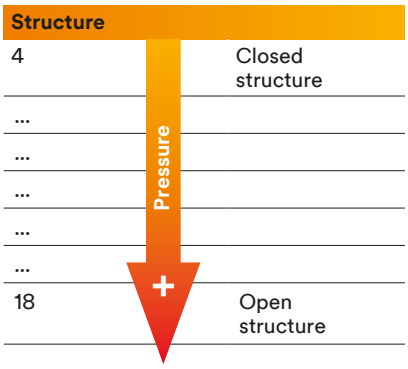
The wheel hardness also depends on the grain size and porosity. In a given wheel hardness range (for example, hardness F), a grinding wheel with small grains and fine pores appears ”harder“ during the grinding process than a wheel with large grains and coarse pores.

Letter Code	Hardness Grade
E / F	Very soft
G / H / I	Soft
J / K / L / M	Medium hard
N / O	Hard

The hardness scale defines the proportion of binder. The further down the specification of the hardness is in the alphabet, the more binder the grinding wheel contains.



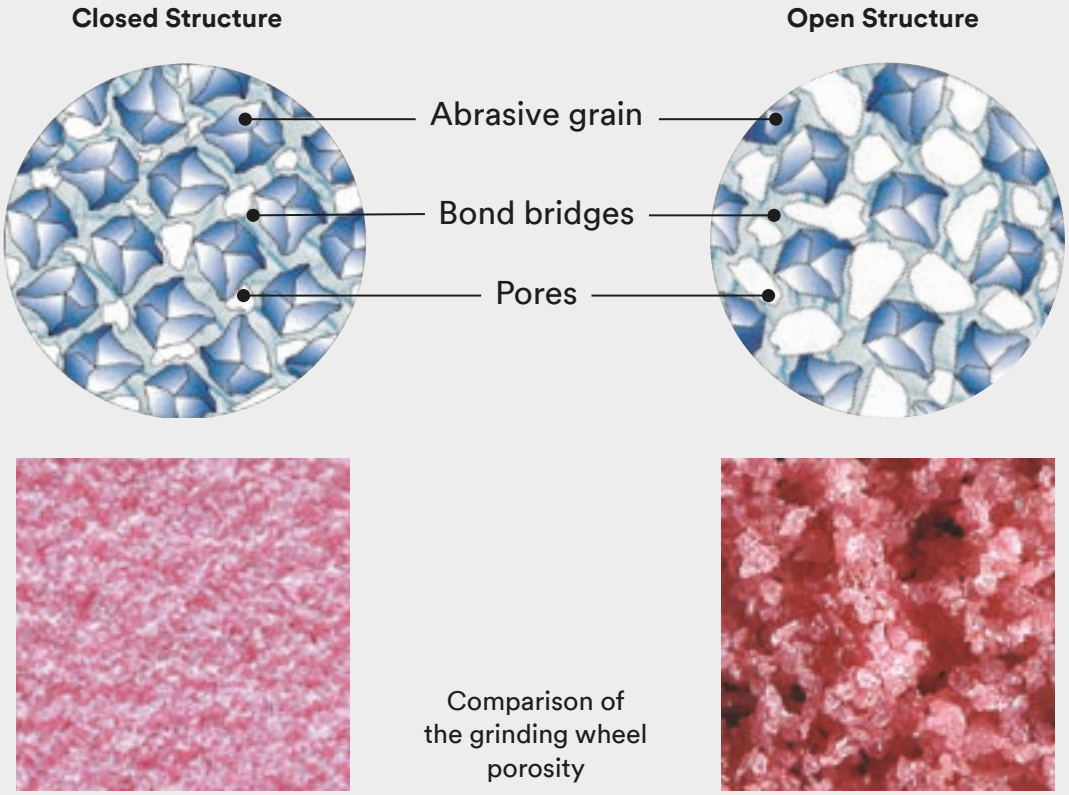
The higher the bond ratio, the harder the grinding wheel!



The structure code on the left describe the hardness of the grinding wheel.

Structure

Every grinding wheel has a natural porosity. At 3M, the porosity is expressed in structure numbers ranging from 1 to 10, which are referred to as normal structures. The higher the structure number, the more porous the grinding wheel. The natural porosity of a grinding wheel can be increased by adding a special pore formation agent that creates additional pore space. This increased porosity is expressed using the structure numbers 11–18, which are referred to as porous structures. During the manufacture of grinding wheels, the numbers 1 and 11 stand for the highest pressure while 9 and 18 stand for the lowest pressures.



Comparison of the grinding wheel porosity

The higher the structure number, the more open the grain.

Closed Structure	Open Structure
4 5 6 7 8 9 (‘10’)	11 12 13 15 18

1.3 Bonds and Shapes

Bonds

The bond does not have any grinding action. Its most important task is to provide the grinding wheel with stability. The bond ratio determines the hardness and influences the free-cutting ability of the grinding wheel.

We manufacture vitrified bonded and synthetic resin bonded grinding wheels for the most demanding applications. In this catalogue we focus on our core portfolio for vitrified grinding wheels. The strength, hardness and cutting ability of a grinding wheel depends on the type of bond used and its percentage of the total volume.

Vitrified bond

(Letter code V)

Our vitrified bonds are manufactured primarily of synthetic, technical glasses referred to as low temperature bonds. They can be manufactured identically again and again. They are insensitive to chemicals and can be stored indefinitely, but abrupt temperature changes, shock and impact are to be avoided, though. The bond hardness is specified by the bond number (300, 450, 600 or 900).

Synthetic resin bond

(Letter code B)

Synthetic resin bonds consist of phenolic resins and various fillers that have a decisive influence on the bonding properties. Synthetic resin bonded grinding wheels are hardened at a temperature of about 180°C. They are less sensitive to sudden temperature changes, shock and impact than vitrified bonded grinding wheels. However, exposure to chemicals and long storage periods should be avoided.

This catalogue is focusing on Vitrified Grinding. If you have questions regarding our Resin Wheels, Cut Off Wheels or Hot Press Portfolio, please contact your Sales Person, Application Engineer or just send an email to 3MVillach@mmm.com. We are happy to support you.

Reformulated 3M 450 and 470 bond

In comparison to conventional bonds on wheels with high-grade aluminium oxide, the 3M 450 and 470 bonding system guarantees higher removal rates in combination with a lower risk of grinding burn. This means improved profile retention and lower rejection rates, enabling the highest possible efficiency and reliable processes.

Properties:

- Innovative glass/ceramic bond as a further development of ceramic high temperature bonds
- Higher percentage of grain for longer service lives and better profile retention
- Frame-like crystals that provide stability and act as reinforcement

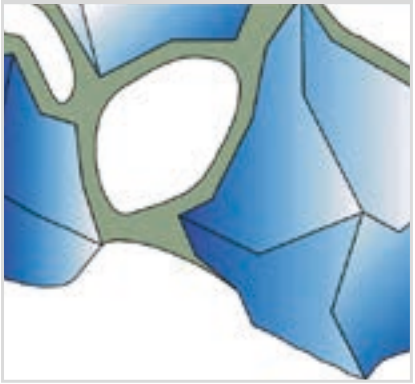
Advantages:

- Greater hardness in spite of less bonding material
- Cooler grinding
- Less wear on the dressing tools
- Greater edge stability
- The reinforcing properties result in improved damping behavior when grinding

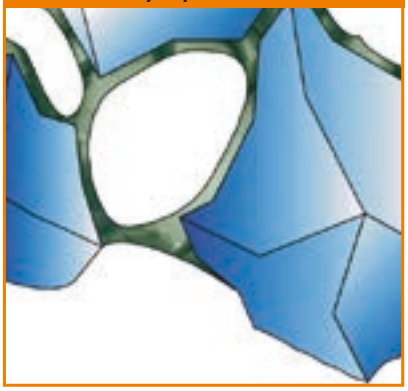
Application examples:

- Gear tooth grinding
- Deep grinding
- OD grinding

Standard bond

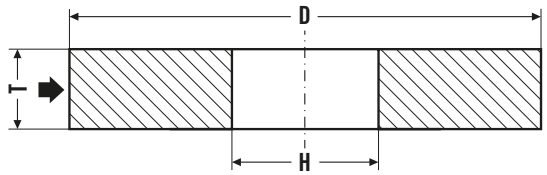


Partially crystallized bond

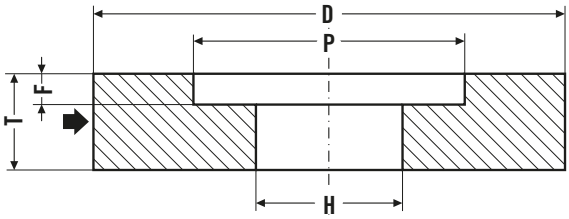


Main Standard Shapes:
T1, T5, T7

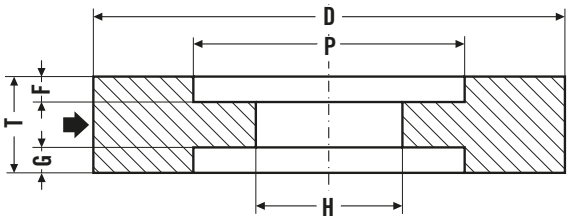
T1 – D x T x H



T5 – D x T x H – 1 – P x F

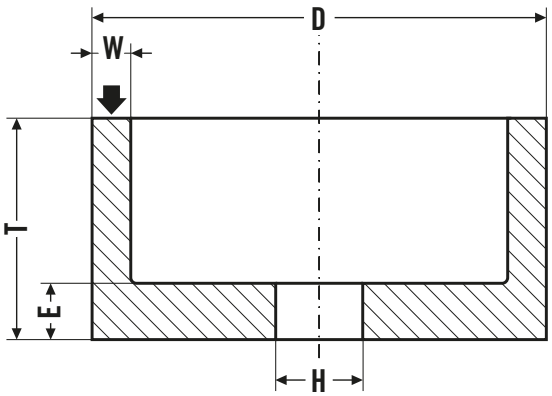


T7 – D x T x H – 2 – P x F

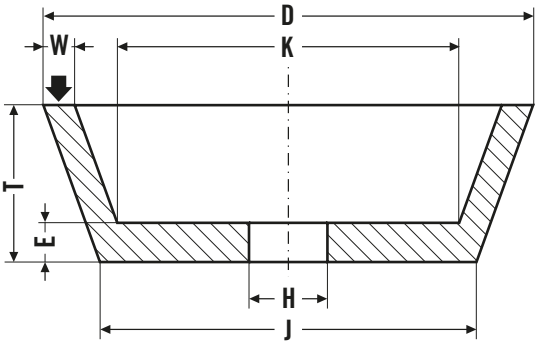


Standard Shapes (only available >250 mm diameter and only on request): T6, T11, T12, T13

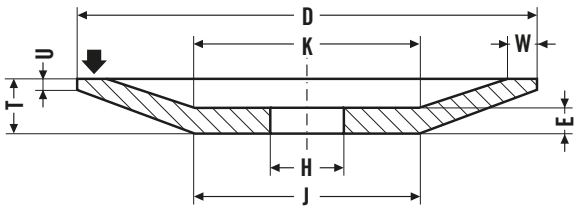
T6 – D x T x H – W – E



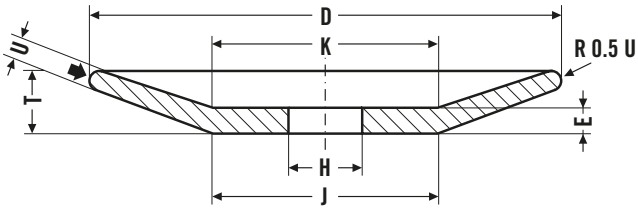
T11 – D/J x T x H – W – E – K



T12 – D/J x T/E/U x H

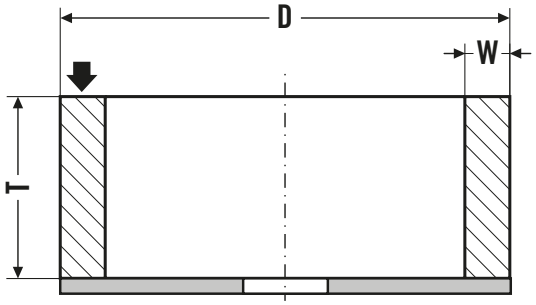


T13 – D/J x T/E/U x H – K

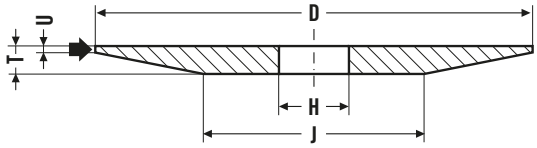


Standard Shapes:
T2, T3, T4, T9, T20, T21, T22, T23, T24, T25, T26, T38, T39

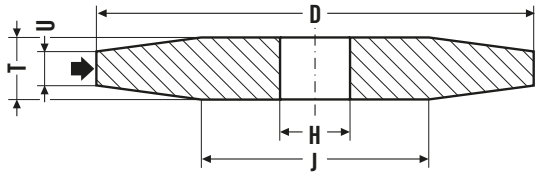
T2 – D x T – W



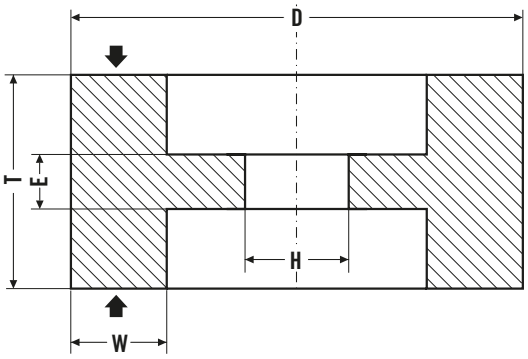
T3 – D/J x T/U x H



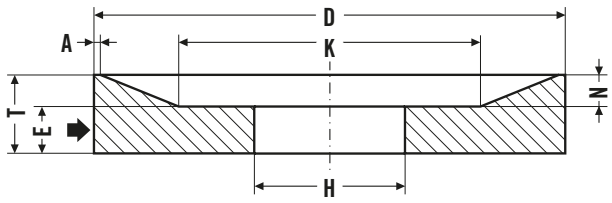
T4 – D/J x T/U x H



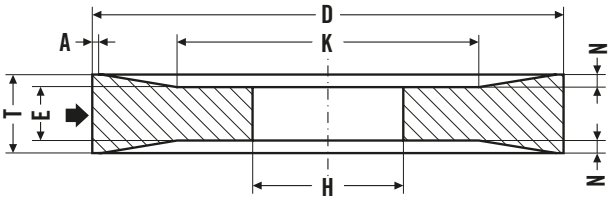
T9 – D x T x H – W x E



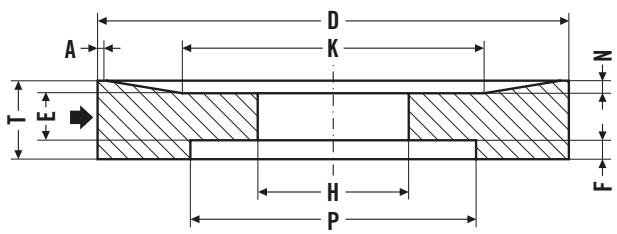
T20 – D/K x T/N x H



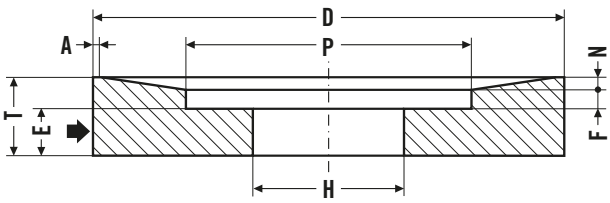
T21 – D/K x T/N x H



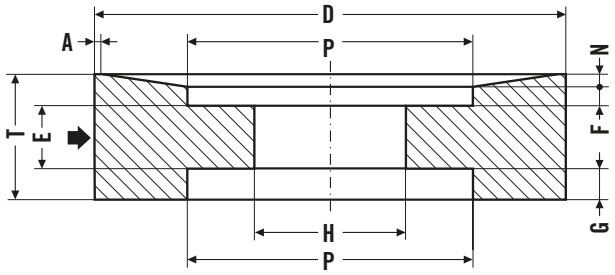
T22 – D/K x T/N x H – P x F



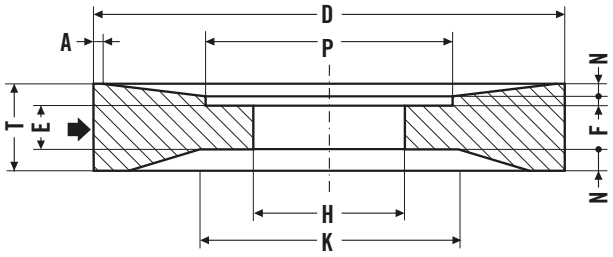
T23 – D x T/N x H – 1 – P x F



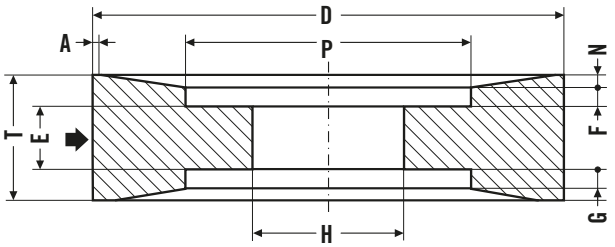
T24 – D x T/N x H – 2 – P x F/G



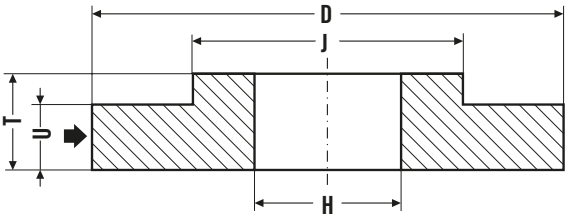
T25 – D/K x T/N x H – 1 – P x F



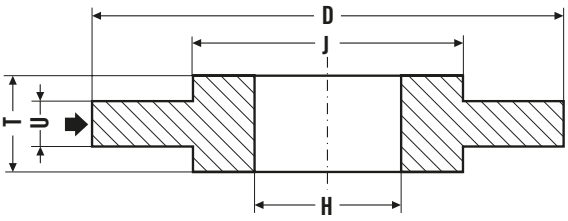
T26 – D x T/N x H – 2 – P x F/G



T38 – D/J x T/U x H



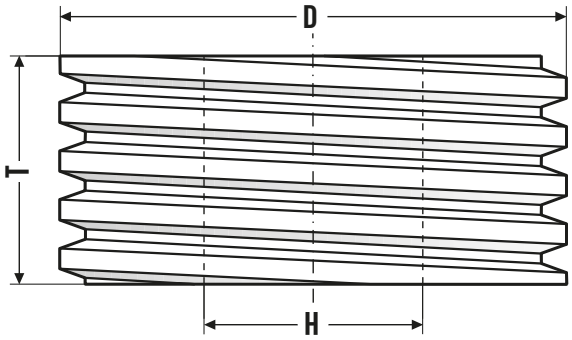
T39 – D/J x T/U x H



Generating gear grinding

T1 (without profile)

T1SP – D x T x H (pre-profiled) Specify the module, pressure angle, number of starts and direction of lead



Module – DP conversion table

Conversion formula: **Module = 25.4 divided by DP**

< finer			
Module – DP	**Module – DP**	**Module – DP**	**Module – DP**
1.0 – 25.40	3.0 – 8.47	5.0 – 5.08	7.0 – 3.63
1.1 – 23.09	3.1 – 8.19	5.1 – 4.98	7.1 – 3.58
1.2 – 21.17	3.2 – 7.94	5.2 – 4.88	7.2 – 3.53
1.3 – 19.54	3.3 – 7.70	5.3 – 4.79	7.3 – 3.48
1.4 – 18.14	3.4 – 7.47	5.4 – 4.70	7.4 – 3.43
1.5 – 16.93	3.5 – 7.26	5.5 – 4.62	7.5 – 3.39
1.6 – 15.88	3.6 – 7.06	5.6 – 4.54	7.6 – 3.34
1.7 – 14.94	3.7 – 6.86	5.7 – 4.46	7.7 – 3.30
1.8 – 14.11	3.8 – 6.68	5.8 – 4.38	7.8 – 3.26
1.9 – 13.37	3.9 – 6.51	5.9 – 4.31	7.9 – 3.22
2.0 – 12.70	4.0 – 6.35	6.0 – 4.23	8.0 – 3.18
2.1 – 12.10	4.1 – 6.20	6.1 – 4.16	8.1 – 3.14
2.2 – 11.55	4.2 – 6.05	6.2 – 4.10	8.2 – 3.10
2.3 – 11.04	4.3 – 5.91	6.3 – 4.03	8.3 – 3.06
2.4 – 10.58	4.4 – 5.77	6.4 – 3.97	8.4 – 3.02
2.5 – 10.16	4.5 – 5.64	6.5 – 3.91	8.5 – 2.99
2.6 – 9.77	4.6 – 5.52	6.6 – 3.85	8.6 – 2.95
2.7 – 9.41	4.7 – 5.40	6.7 – 3.79	8.7 – 2.92
2.8 – 9.07	4.8 – 5.29	6.8 – 3.74	8.8 – 2.89
2.9 – 8.76	4.9 – 5.18	6.9 – 3.68	8.9 – 2.85
			9.0 – 2.82
> coarser			

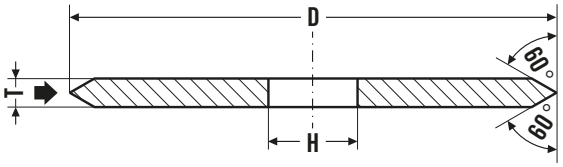
DP – Module conversion table

Conversion formula: **DP = 25.4 divided by module**

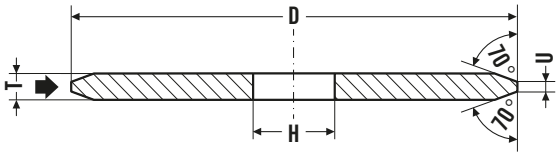
< finer		
DP – Module	**DP – Module**	**DP – Module**
25.0 – 1.02	7.5 – 3.39	3.7 – 06.86
24.0 – 1.06	7.0 – 3.63	3.6 – 07.06
23.0 – 1.10	6.5 – 3.91	3.5 – 07.26
22.0 – 1.15	6.0 – 4.23	3.4 – 07.47
21.0 – 1.21	5.5 – 4.62	3.2 – 07.94
20.0 – 1.27	5.0 – 5.08	3.1 – 08.19
19.0 – 1.34	4.9 – 5.18	2.9 – 08.76
18.0 – 1.41	4.8 – 5.29	2.8 – 09.07
17.0 – 1.49	4.7 – 5.40	2.7 – 09.41
16.0 – 1.59	4.6 – 5.52	2.6 – 09.77
15.0 – 1.69	4.5 – 5.64	2.5 – 10.16
14.0 – 1.81	4.4 – 5.77	2.4 – 10.58
13.0 – 1.95	4.3 – 5.91	2.3 – 11.04
12.0 – 2.12	4.2 – 6.05	2.2 – 11.55
11.0 – 2.31	4.1 – 6.20	2.1 – 12.10
10.0 – 2.54	4.0 – 6.35	2.0 – 12.70
09.0 – 2.82	3.9 – 6.51	1.9 – 13.37
08.0 – 3.18	3.8 – 6.68	1.8 – 14.11
> coarser		

Thread and profile grinding

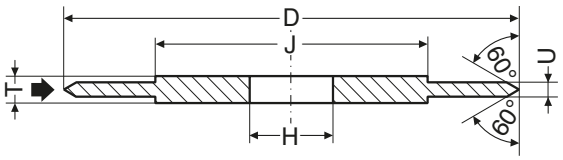
T1E – D x T x H – V°



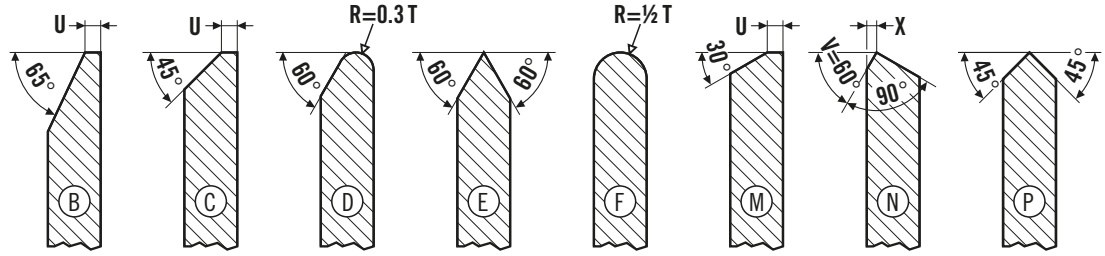
T1ESP – D x T x H – V° – U



T39ESP – D/J x T/U x H – V°



Edge Shapes for Standard Shapes



1.4 Overview

With the following products, 3M has adapted to the requirements of the market. Through the experience of the 3M engineers, all applications can be operated effectively using this portfolio, enabling maximum performance.

Your advantage: more clarity, more practicality and less purchasing of materials. Detailed information about our competent and experienced application engineers can be found in Chapter 4.

Abrasive/Grain Types
99DA
95DA
93DA
91DA
75DA
91NDA
93AS
93A
93NA
220NA
73A
81A
68A
64A
62A
57A
54A
41A
40A
31A
29A
28A

Grain size
46
54
60
80
90
100
120
150
180
200
240

Hardness	
E	very soft
F	
G	soft
H	
I	
J	
K	medium hard
L	
M	
N	hard
O	

Wheel structure		Porosity
4	dense	V
5		
6		
7		
8		
9		
10		
11	open	VP VPH VPHH VPLF VPMF
12		
13		
15		
18		

Bond
300
301
450
470*
601
602
604
722
901
902
904

* coming soon

For more Abrasive/Grain Types, please refer to your 3M contact.

Description porosity

V = Vitrified bond

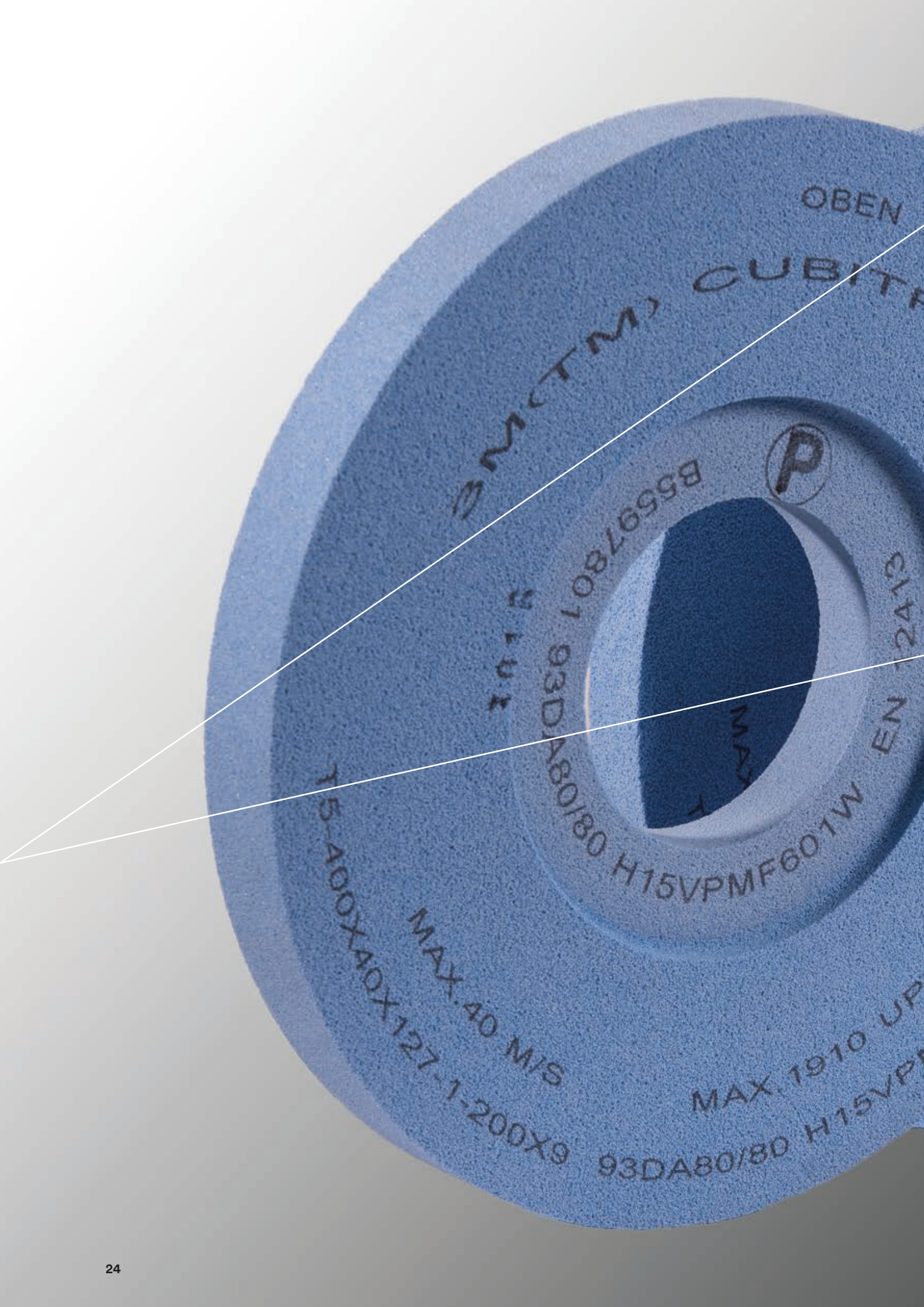
VP = Vitrified bond, Porous structure

VPH = Vitrified bond, Porous structure, High porosity

VPHH = Vitrified bond, Porous structure, Very high porosity

VPLF = Vitrified bond, Porous structure, Low porosity, Fine pores

VPMF = Vitrified bond, Porous structure, Medium porosity, Fine pores


OBEN
CUBITRON™ II
T5-400X40X127-1-200X9
MAX. 40 M/S
93DA80/80 H15VPMF601W EN 12413
MAX. 1910 UPM

2. 3M Products

2.1 3M™ Conventional Vitrified Grinding Wheels

High porosity grinding wheels

The porosity of a grinding wheel is created artificially using pore formation agents in the bond/grain mixture since high porosity grinding wheels enable improved cooling lubricant supply and chip removal.

In particular, though, highly porous structures optimize the self-sharpening process in order to prevent and protect against grinding burn.

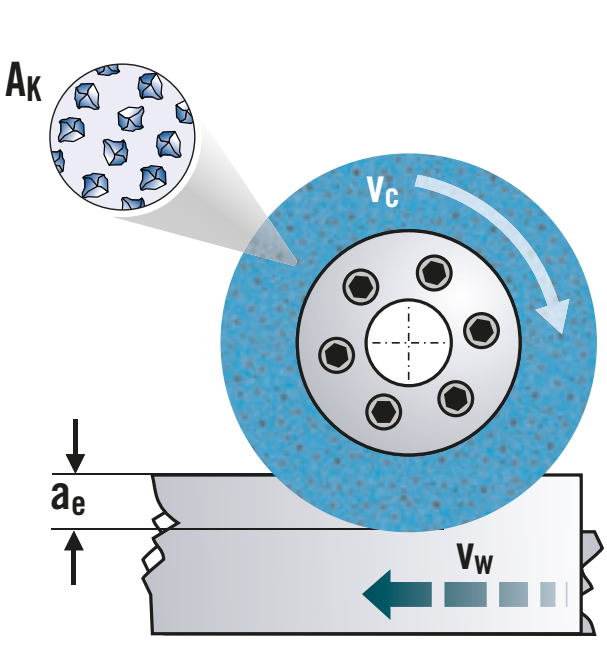
During deep grinding and the higher feed increments associated with it, there are larger contact surfaces (Ak) between the grinding wheel and workpiece, which in turn generally leads to lower grinding forces (normal force Fn) on the abrasive grain.

The diagram below shows how the grains on high porosity grinding wheels are separated from each other in order to use fewer grains per mm^2 on a given contact surface. These grains are thus easier to splitter when subjected to a perpendicular force, enabling the wheel to self-sharpen.

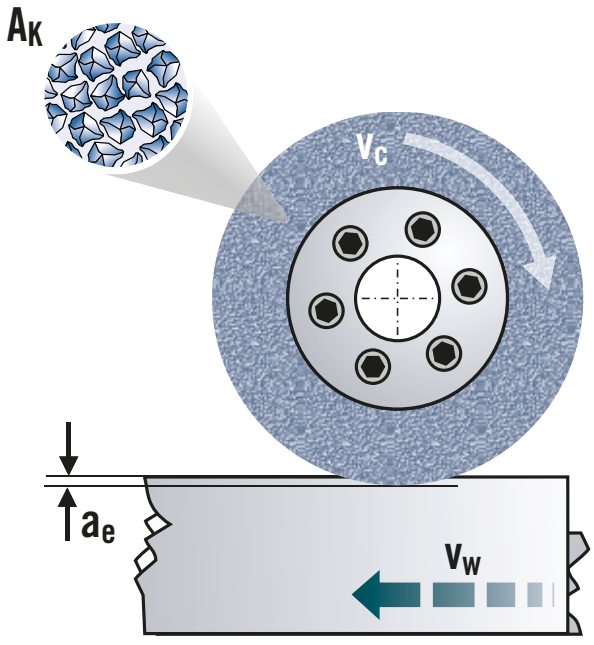
To obtain a self-sharpening effect, the abrasive grain must splitter in every grinding process. Due to its numerous advantages, we use naphthalene as the pore formation agent:

- No chemical traces in the finished grinding wheel
- No expansion during firing (no stresses)
- Good mixability with the abrasive grain and binder (no imbalances)
- Consistent porosity (connected pores for high levels of coolant transport)

Contact surface (Ak): Deep grinding compared to reciprocating grinding

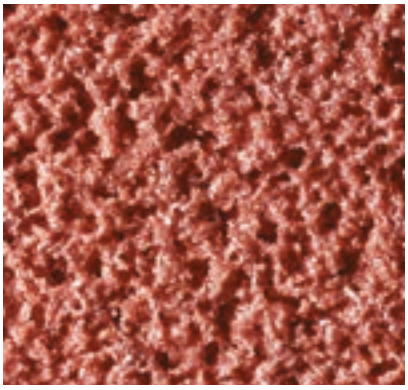


Artificial porosity



Standard structure

Compound wheel with artificial porosity



Medium-fine porosity for OD grinding

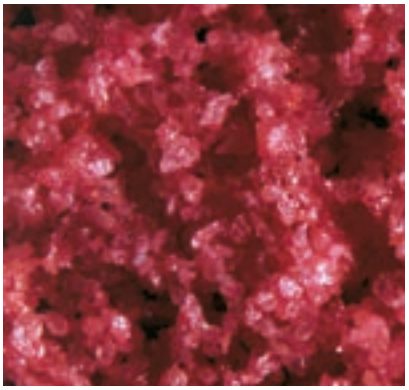
Microcrystalline 3M™ Ceramic Grain 321 (81A, 93A, among others)

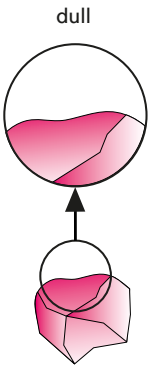
The enormous performance of 3M™ Ceramic Grain 321 as a mineral when compared to conventional aluminium oxides is due to its unique microstructure. Using a special manufacturing process, we are able to obtain crystals smaller than 1 µm in size. The resulting pressure during grinding leads to microsplittering, which continuously produces new, sharp cutting edges. To fully utilize the performance potential of this grain, we have developed a bonding system that fully exploits these self-sharpening properties.

Features

- High removal rates, and therefore shorter cycle times
- Longer service life of the wheel; fewer wheel changes
- Constant grinding performance and grinding forces
- Low shape deviation, and therefore consistent quality
- Longer intervals between dressing operations due to the longer service life

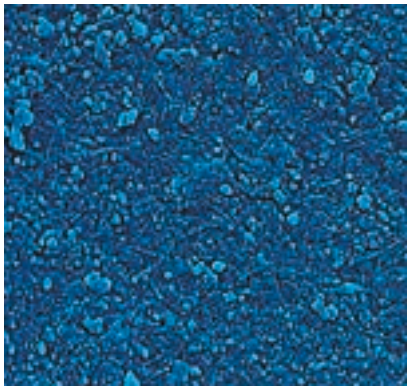
Conventional aluminium oxides

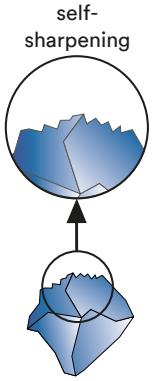




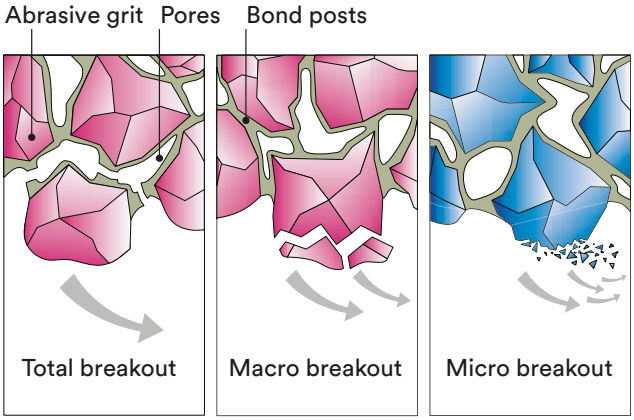
Highly porous structure with large pores for the highest material removal rates; mainly for hard-to-grind parts from aerospace industry

3M™ Ceramic Grain 321





Scanning electron microscope image; magnified 10,000x



High-grade aluminium oxide

3M™ Ceramic Grain 321

Benefits

- Improved process capability
- Improved price/performance ratio

2.2 3M™ Cubitron™ II Vitrified Grinding Wheels

With the invention of the 3M™ Cubitron™ II Vitrified Grinding Wheel, 3M has completely redefined the grinding process. Due to the new generation of 3M™ Precision-Shaped Grain, we have brought high-performance ceramic grain into a defined, geometric form.

A stroke of genius: 3M™ Precision-Shaped Grain

The individual precision abrasive grains of the 3M™ Cubitron™ II ceramic vitrified wheels are identical in size and precision-formed triangles made of ceramic grain. These self-sharpening triangular cutters cut like a knife through the workpiece. The heat generated is extracted directly in the chips, which greatly minimizes the risk of overheating. The very sharp grinding surface will convince you with never seen before material removal rates and service lives.

Precision-formed abrasive grain for excellent results

The tips of the triangular grains break off during the grinding process, creating new, sharp edges. The surface of the material is processed cleanly by new cutting edges. The result is fast, cool grinding and a longer mineral lifespan. Every single abrasive grain is shaped identically to generate a precisely defined grinding pattern.

Revolutionary advantages:

- Risk of overheating is almost nil
- Up to 50% shorter grinding times due to significantly higher material removal rates
- Perfect form and surface finish quality in spite of extreme material removal
- Highly reduced dressing requirements
- Wheel (worm) lifespans of up to twice as long
- Continuously constant grinding performance
- Significantly reduced cost per workpiece

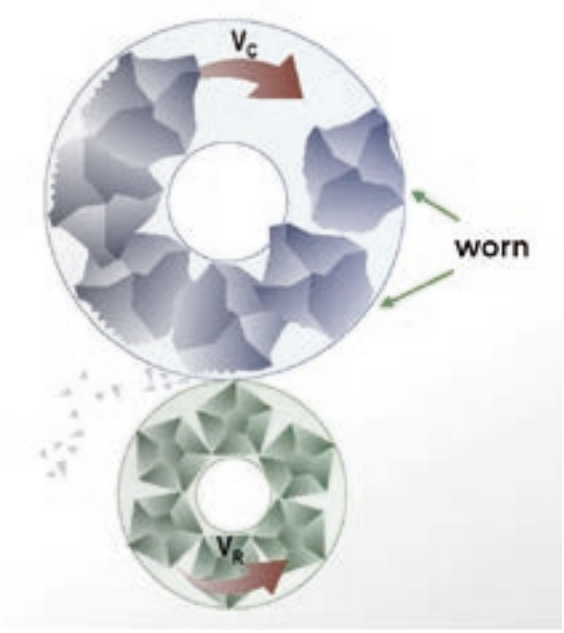
The result: higher productivity and lower part costs!

Dressing 3M™ Cubitron™ II Vitrified Grinding Wheels

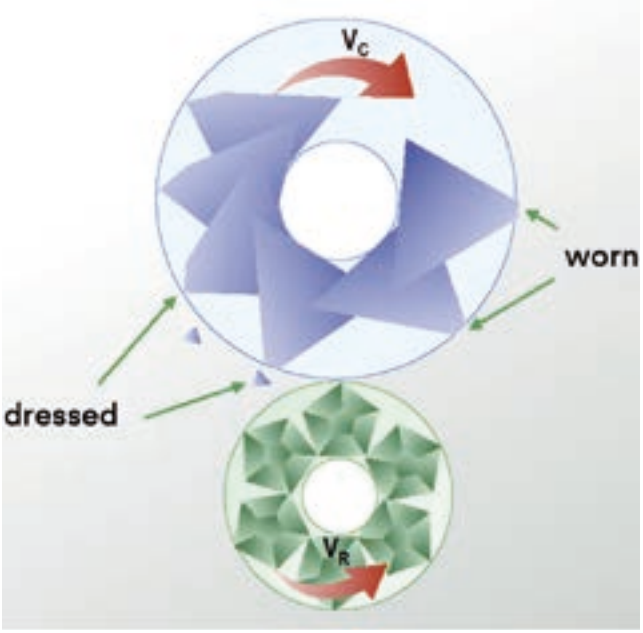
The precision-shaped abrasive grains of the 3M™ Cubitron™ II also demonstrate their clear advantages when dressing since much less force is needed when dressing PSG abrasive grain. The dressing roller contacts the triangular grain and the predetermined breaking point integrated into the grain allows a segment of the grain to break off. This creates a new cutting edge while significantly reducing the load on the dressing roller. This permits a significantly longer lifespan of the dressing roller. 3M™ Cubitron™ II is a real all-rounder amongst grinding wheels. Volumetric removal rates Q_w of over 30 mm³/mm/s are achieved when roughing, and surface roughnesses of Ra <0.3 are achieved when finishing. Due to the new grain geometry, wear on the dressing tools is reduced to a minimum. Maximum performance with a perfect geometry and surface.

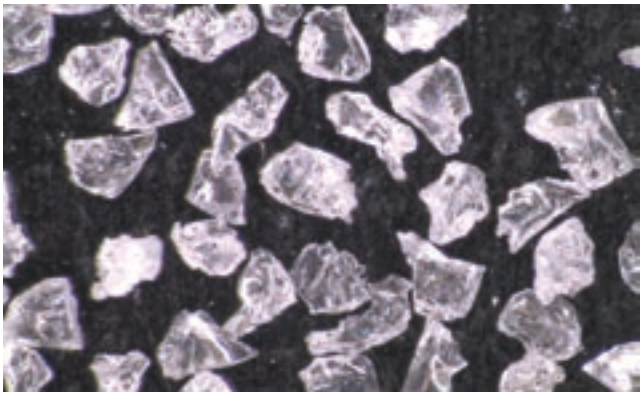
Perfect dressing in half the production time!

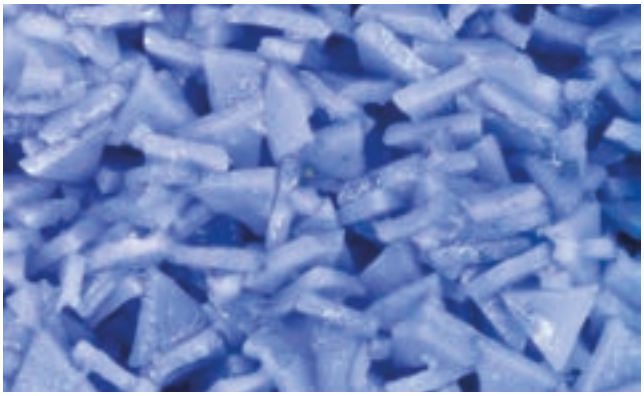
Dressing behavior of standard aluminium oxide



Dressing behavior with **3M™ Precision-Shaped Grain**







Major usage of 3M™ Abrasive Types in segments

Overview						
Product Name		**Mineral**	**Transportation**		**General Industry**	
			Powertrain	**Gear Grinding**	**Turbines**	**Bearings**
						
3M™ Cubitron™ II Vitrified Grinding Wheel	93VE	99DA	X	X	X	X
	93VD	95DA		X		
	92VC	93DA	X	X	X	X
	91VA	91DA	X	X		
3M™ Vitrified Grinding Wheel	91VB	91NDA		X		
	92VA	93A	X	X		X
	22VA	93NA	X	X		
	33VH	64A	X			
	33VG	57A	X			
	33VC	54A	X		X	X
	33VA	40A	X	X		
	33VF	29A	X		X	

2.3 3M™ Cubitron™ II Vitrified Grinding Wheel 93VE

Key Facts	
Abrasive Grain Type	• 99DA 3M™ Precision-Shaped Grain
Key Industries	• Transportation: Gear • General Industry: Turbines and Bearings
Winning Applications	• Single rib profile grinding of gears • Bevel Gear Grinding • Constant velocity joints' inner race grinding operation, grinding of turbine disks, and honeycomb parts for the aerospace industry • Bearing Industry: Internal grinding of inner rings, bore and linear guide, component grinding
Bonds	• 901
Corresponding Products	• 3M™ Dressing Tools
Positioning	• These grinding wheels achieve optimal performances when being used with robust and rigid machines having a strong spindle power

Features	Advantages	Benefits
• 3M™ Precision-Shaped Grain: 99DA	• Free cutting ability to help deliver a high material removal rate	• Increased overall productivity
	• Provide an increased in-feed and feed rate while reducing the number of grinding passes to improve grinding operation cycle times	• Reduced costs and increased productivity without sacrificing quality
	• Cool grinding effect delivering lower thermal load on workpieces	• Reduced risk of burning, even during demanding grinding conditions
	• Self-sharpening technology decreases the need for dressing, extending both diamond roller and conventional wheel lifetime	• Improved total cost of grinding operations

95DA

2.4 3M™ Cubitron™ II Vitrified Grinding Wheel 93VD

Key Facts	
Abrasive Grain Type	• 95DA Mix of white aluminium oxide and 3M™ Precision-Shaped Grain
Key Industries	• Transportation: Gear
Winning Applications	• Single rib profile grinding of gears • Profile grinding of big industrial gears with module > 10
Bonds	• 901
Corresponding Products	• 3M™ Diamond Rotary Dresser 6HMI
Positioning	• Single rib profile grinding product line extension • Specifically developed for machines with an intermediat spindle power and lower stiffness • Cost efficient

Features	Advantages	Benefits
• Mix of white aluminium oxide and 3M™ Precision-Shaped Grain: 95DA	• Free cutting ability to help deliver a high material removal rate	• Increase overall productivity
	• Provide an increased in-feed and feed rate while reducing the number of grinding passes to improve grinding operation cycle times	• Reduced costs and increased productivity without sacrificing quality
	• Cool grinding effect delivering lower thermal load on workpieces	• Reduced the risk of burning, even during demanding grinding conditions
	• Self-sharpening technology decreases the need for dressing, extending both diamond roller and conventional wheel lifetime	

2.5 3M™ Cubitron™ II Vitrified Grinding Wheel 92VC

Key Facts	
Abrasive Grain Type	• 93DA Mix of white aluminium oxide and 3M™ Precision-Shaped Grain
Key Industries	• Transportation: Gear and Powertrain • General Industry: Turbines and Bearings
Winning Applications	• Profile grinding of single rib gears and CV joints • Generating grinding of gear box modules 1.5-10: spur gears, pinion shafts, pinions, planet gears • Bevel gear grinding in various applications such as automotive, aviation, agriculture, construction, and industrial machinery • Cylindrical grinding of Powertrain transmission components: e.g. rear axle shafts, turbo chargers • Centerless grinding of Powertrain transmission components: e.g. piston pins, and engine valves • Bearing Industry: Linear guides guideway profile grinding, ball screw thread grinding, ID grinding of external bearings' rings, centerless plunge grinding of outer rings, and centerless throughfeed grinding of bearings' outer rings • Aerospace Industry, including grinding of root of turbine, compressor blades, vane profile, shroud fin profile, wedge face profile, notch profile, roughing and finishing of hirth couplings, OD and inner diameter (ID) of turbine shafts, and spline grinding of turbines' shaft
Bonds	• 601, 901
Corresponding Products	• 3M™ Diamond Rotary Dresser 6HMI
Positioning	• Ideal for all gearboxes' module sizes • Its lower PSG concentration means it suits high performances universal and versatile grinding needs • Suitable for machines with lower spindle power

Features	Advantages	Benefits
• Mix of white aluminium oxide and 3M™ Precision-Shaped Grain: 93DA	• Free cutting ability that helps to deliver a high material removal rate helping to reduce grinding operation cycle time	• Drastically increase overall productivity
	• Cool grinding effect delivering lower thermal load on workpieces	• Reduced risk of burning, even during demanding grinding conditions
	• Self-sharpening technology decreases the need for dressing, extending both diamond roller and conventional wheel lifetime	• Improved total cost of grinding operations

91DA

2.6 3M™ Cubitron™ II Vitrified Grinding Wheel 91VA

Key Facts	
Abrasive Grain Type	• 91DA Mix of white aluminium oxide and 3M™ Precision-Shaped Grain
Key Industries	• Transportation: Gear
Winning Applications	• Profile Grinding of Single Rib Gears
Bonds	• 601
Corresponding Products	• 3M™ Diamond Rotary Dresser 6HMI
Positioning	• Ideal for machines with a lower spindle power • For universal and versatile grinding needs of single rib gear parts' profile grinding operation because of lower PSG concentration

Features	Advantages	Benefits
• Mix of white aluminium oxide and 3M™ Precision-Shaped Grain: 91DA	• Higher stock removal rate	• Improved productivity
	• Longer intervals between dressing	• Reduces overall costs per part
	• Better cutting ability	• Better surface and profile quality
	• Delivers durability	• Substantial cost reduction
	• Reducing thermal load on the work parts	• Reduce risk of burning marks

2.7 3M™ Vitrified Grinding Wheel 91VB

Key Facts	
Abrasive Grain Type	• 91NDA Mix of white-, aluminium oxinitride and 3M™ Precision-Shaped Grain
Key Industries	• Transportation: Gear
Winning Applications	• To optimize the roughing and finishing grinding steps in generating grinding of gear parts • Generating grinding of gear box modules up to module 3: spur gears, pinion shafts, pinions, planet gears
Bonds	• 602
Corresponding Products	• 3M™ Positive Plated Dressers
Positioning	• Ideal for critical workparts, temperature sensitive, or with tight shape tolerances • These wheels are suitable for assisting machines with balancing issues

Features	Advantages	Benefits
• Mix of white-, aluminium oxinitride and 3M™ Precision-Shaped Grain: 91NDA	• Delivers durability	• Higher productivity, substantial cost savings
	• High stock removal rate ability leading to drastic improvement of the grinding operations cycle time	
	• Longer intervals between dressing, lower wear of the dressing unit	• Cost reduction of the overall grinding process
	• Self sharpening, early chip creation	• Much lower risk of creating burning marks, high process stability and constant quality
	• Improved surface quality	
	• Extreme profile retention	
	• Low thermal damages on the work parts	
	• Absence of chips cold welding	

93A

2.8 3M™ Vitrified Grinding Wheel 92VA

Key Facts	
Abrasive Grain Type	• 93A Mix of white aluminium oxide and 3M™ Ceramic Grain 321
Key Industries	• Transportation: Gear and Powertrain transmission systems • General Industry: Bearing
Winning Applications	• Centerless grinding • Gear grinding • Cylindrical grinding • Surface grinding operations • Bearing Industry: Bore grinding, inner and outer ring grinding
Bonds	• 601, 722
Corresponding Products	• 3M™ Dressing Tools
Positioning	• Ideal for use with low and high alloyed steels, toughened up to 65 HRc • Grey cast iron material • High speed steel (HSS) • Good price/performance ratio

Features	Advantages	Benefits
• Mix of white aluminium oxide and 3M™ Ceramic Grain 321: 93A	• Moderately harder than white aluminium oxide	• Substantial cost reduction of the overall grinding process thanks to productivity increase and both grinding wheels‘ and dressers‘ cost of usage reduction
	• Provides a durable and long lasting abrasiveness leading to longer intervals between dressing	
	• Self-dressing properties, lower need for dressing	
	• High removal rates and therefore shorter cycle times	
	• Cooling effect decreases thermal damage to workpieces	• Improved process capabilities, stable quality constant and repetitive performances
	• Low shape deviation	
	• Constant grinding performance and grinding forces	

2.9 3M™ Vitrified Grinding Wheel 22VA

Key Facts	
Abrasive Grain Type	• 93NA Mix of white aluminium oxide and aluminium oxinitride
Key Industries	• Transportation: Gear
Winning Applications	• Single rib profile grinding of gears • Threaded gear grinding and generating grinding of gears
Bonds	• 602, 902
Corresponding Products	• 3M™ Dressing Tools
Positioning	• For every workpiece requiring a smooth material removal and ideal for small gearbox modules (1.26-6)

Features	Advantages	Benefits
• Mix of white aluminium oxide and aluminium oxinitride: 93NA	• Enhanced profile retention	• Stable profile quality
	• Lower mechanical deformation of workpieces	• Excellent surface finish quality
	• The grains prevent from metallising which helps to stabilise and monitor temperature sensitive grinding processes, reducing heat	• Ensuring thermal damage to workpieces is virtually non-existent
	• Provide self-sharpening, early chip formation, and reduction of chip cold welding	
	• High thermal stability during grinding process	
	• High stock removal rate reducing grinding operation cycle time	• Cost reduction of the overall grinding operation
	• Excellent dressing ability	

64A

2.10 3M™ Vitrified Grinding Wheel 33VH

Key Facts	
Abrasive Grain Type	• 64A Mix of monocrystalline- and pink aluminum oxide
Key Industries	• Transportation • General Industries
Winning Applications	• OD cylindrical grinding • Universal solution for Reciprocating surface grinding
Bonds	• 300
Corresponding Products	• 3M™ Dressing Tools
Positioning	• Ideal for grinding materials with high tensile strength

Features	Advantages	Benefits
• Mix of monocrystalline- and pink aluminum oxide: 64A	• Medium friability and cool cutting	• Provides a long lasting, consistent abrasiveness
	• Good cutting ability	
	• Cooling effect decreases thermal damage to workpieces	• Reduced risk of burnings, improving workparts quality

2.11 3M™ Vitrified Grinding Wheel 33VG

Key Facts	
Abrasive Grain Type	• 57A Pink aluminum oxide
Key Industries	• Transportation: Powertrain
Winning Applications	• Cylindrical grinding • Outer diameter (OD) cylindrical grinding
Bonds	• 300
Corresponding Products	• 3M™ Dressing Tools
Positioning	• Ideal for grinding specific materials of higher tensile strength, such as high alloyed and toughened steels used in the tooling industry including high speed steel and hardened steel

Features	Advantages	Benefits
• Pink aluminum oxide: 57A	• Moderately tougher than standard white aluminium oxide minerals • These minerals are strong, but also offer a medium friability • Cool cutting	• Long lasting and consistent abrasiveness and excellent edge stability

54A

2.12 3M™ Vitrified Grinding Wheel 33VC

Key Facts	
Abrasive Grain Type	• 54A White aluminum oxide with green bond
Key Industries	• Transportation: Powertrain transmission systems • General Industry: Turbines
Winning Applications	• Outside diameter grinding e.g. turbo chargers • Internal diameter grinding • Surface grinding • Profile grinding • Creep-feed grinding of turbine fir-tree roots • Bearing Industry: Bore grinding, inner ring and outer ring track grinding
Bonds	• 604, 904
Corresponding Products	• 3M™ Dressing Tools
Positioning	• Durable with longer lifetime than standard white Alumina grinding wheel • More specifically used for grinding non-alloyed or low alloyed non-hardened steels, or alloyed steels, hardened up to 60-63 HRc • Outperform while grinding for cast iron, or stainless steel materials

Features	Advantages	Benefits
• White aluminum oxide with green bond: 54A	• Low friability • High wear resistance grains	• Durable and provide a longer lifetime against standard aluminium oxyde solutions

2.13 3M™ Vitrified Grinding Wheel 33VA

Key Facts	
Abrasive Grain Type	• 40A White aluminium oxide
Key Industries	• Transportation: Gear and Powertrain
Winning Applications	• Outer diameter plunge grinding • Bevel grinding • Cylindrical grinding: e.g. turbo charger impeller grinding, rear axle shafts; CV joint cages • Worm grinding • Thread grinding
Bonds	• 300, 450
Corresponding Products	• 3M™ Dressing Tools
Positioning	• As universal grinding solution, they're ideal for small number manufacturing, or when grinding different work parts on the same machine, without adapting the grinding wheel to specific applications. • For use with non-alloyed or low alloyed non-hardened steels, or alloyed steels, hardened till 60-63 HRc • Can also be used with cast iron, or stainless steel materials

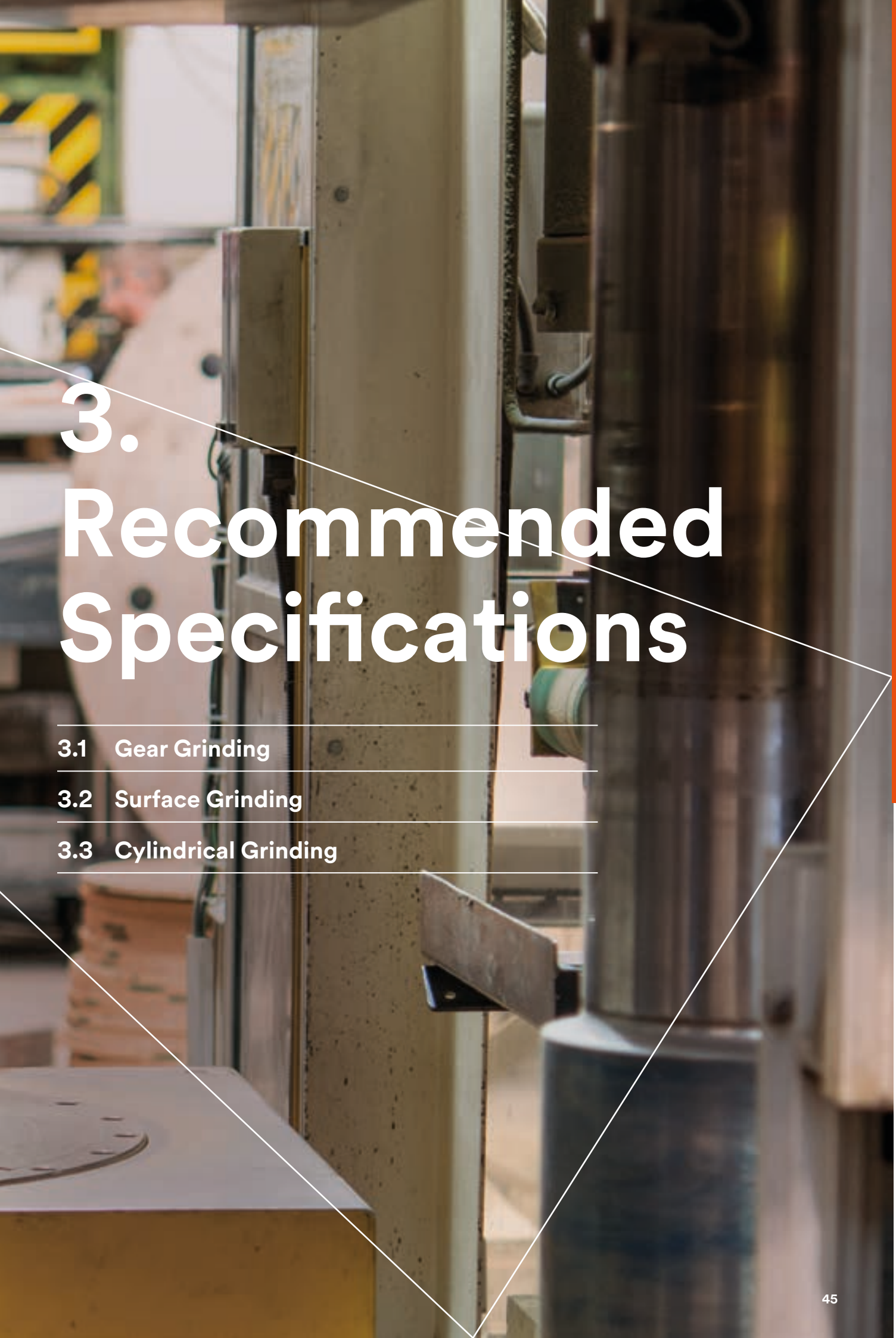
Features	Advantages	Benefits
• White aluminium oxide: 40A	• Medium friability • Medium wear resistance	• Universal grinding solution

29A

2.14 3M™ Vitrified Grinding Wheel 33VF

Key Facts	
Abrasive Grain Type	• 29A Monocrystalline aluminium oxide
Key Industries	• General Industry: Turbine Components • Transportation: Powertrain
Winning Applications	• Creep feed grinding • Profile grinding of thin workparts like engines' valves • For Outer diameter cylindrical grinding operations e.g. Turbo charger slot grinding
Bonds	• 300, 450
Corresponding Products	• 3M™ Dressing Tools
Positioning	• Use with high alloyed or toughened steels, tools' steel and Inconel®

Features	Advantages	Benefits
• Monocrystalline aluminium oxide: 29A	• Moderately harder and tougher than standard aluminium oxide minerals • Provide higher friability and low wear resistance	• Universal and versatile grinding solution



3. Recommended Specifications

3.1.1 Generating Grinding – Universal/Specific

Usage	Workpiece Family Detail	Workpiece Material	Workpiece Hardness
Universal	Helical-, Spur-, Planet gear, Pinion, Pinion shaft	Case hardened Steel	58-64 HRc

Grinding Process	Module	Comments	Product Name
finishing	1.0-2.8	3M™ Cubitron™ II Vitrified Grinding Wheel universal specification for all processes	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing	1.0-2.8	Standard ceramic wheel	3M™ Vitrified Grinding Wheels 92VH
finishing	1.0-2.8	Specification for universal use	3M™ Vitrified Grinding Wheels 22VA
finishing	1.0-2.8	450 bond for high performance and quality	3M™ Vitrified Grinding Wheels 33VI
finishing	1.5-10.0	3M™ Cubitron™ II Vitrified Grinding Wheel universal specification for all processes	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing	2.0-8.0	Standard ceramic wheel	3M™ Vitrified Grinding Wheels 92VH
finishing	2.0-8.0	Specification for universal use	3M™ Vitrified Grinding Wheels 22VA
finishing	2.0-8.0	450 bond for high performance and quality	3M™ Vitrified Grinding Wheels 33VI
finishing	2.0-8.0	Wheel for job-shops with diffrent workpieces and low lot-size and old machines	3M™ Vitrified Grinding Wheels 33VI

Usage	Workpiece Family Detail	Workpiece Material	Workpiece Hardness
Specific	Helical-, Spur-, Planet gear, Pinion, Pinion shaft	Case hardened Steel	58-64 HRc

Grinding Process	Module	Comments	Product Name
fine-finishing	0.4-1.0	Fine grinding specification for high surface and profile quality	3M™ Vitrified Grinding Wheels 22VA
finishing	1.0-2.8	3M High Performance wheel	3M™ Cubitron™ II Vitrified Grinding Wheels 91VA
finishing	1.0-2.8	Maximum performance for big gear sizes (mn>6). Strong machiners needed	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing	1.0-2.8	Small worm wheel sizes (baby worm) <150mm	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing	1.0-2.8	NDA specification for automotive application ≤ mn 2.8	3M™ Vitrified Grinding Wheels 91VB
finishing	1.0-6.0	Specification for older machine types like RZ301/ RZ362	3M™ Vitrified Grinding Wheels 92VA
finishing	1.5-10.0	3M High Performance wheel	3M™ Cubitron™ II Vitrified Grinding Wheels 91VA
finishing	4.0-16.0	Maximum performance for big gear sizes (mn>6). Strong machiners needed	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA120/120 J18VPLF29/601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93AS120 J18VPLF29/601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA120 J18VPLF68/602WS1	★★★★★	★★★★☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
68A120 G9V450XSR1P	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★
93DA80/80 J18VPLF29/601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93AS80 J18VPLF29/601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA80 J18VPLF68/602WS1	★★★★★	★★★★☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
68A80 F9V450XSR1P	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★
68A80 J18VPLF68/601WS1	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93NA180 J18VPLF68/602WS1	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
91DA120/120 J18VPLF29/601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
99DA120/120 H15VPMF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★★☆	★★★☆☆
99DA120/120 H8V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
91NDA120/120 J18VPLF68/602W	★★★★★	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★☆☆
93A90/2 H11VP601	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
91DA80/80 J18VPLF29/601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
99DA80/80 H15VPMF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★★☆	★★★☆☆

3.1.1.1 OEM Wheel Dimensions

OEM	Shape	D	T	H
LIEBHERR	T1	110	200	32
	T1	90	200	32
	T1	120	200	40
	T1	110	200	40
	T1	175	200	50,8
	T1	240	200	50,8
	T1	200	200	50,8
	T1	150	200	50,8
	T1	240	200	76,2
	T1	220	200	76,2
	T1	200	200	76,2
	T1	200	200	90
	T1	320	250	110
	T1	320	230	110
	T1	240	250	110
	T1	240	230	110
	T1	320	160	160
	T1	275	160	160
KAPP NILES	T1	300	160	145
	T1	250	125	145
	T1	280	160	115
	T1	320	115	115
	T1	320	80	115
	T1	200	180	65
	T1	145	180	49
	T1	110	180	34
GLEASON	T1	300	160	160
	T1	220	180	90
	T1	240	125	120
KLINGELNBERG	T7	350	150	160
	T1	320	200	177,8
REISHAUER	T1	350	84	160
	T1	350	104	160
	T1	400	104	160
	T1	300	145	160
	T1	300	125	160
	T1	275	160	160
	T1	275	125	160
SAMPUTENSILI	T1	275	160	160
	T1	250	180	120

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3.1.1.2 OEM Specification

OEM	Machine Type	Standard Specification		2nd Specification		3rd Specification	
		Module	Spec. description	Module	Spec. description	Module	Spec. description
LIEBHERR	LCS xxxx LGG xxx	1.5 - 8.0	93AS80 J18VPLF29/601W	1.0 - 6.0	93NA80 J18VPLF68/602WS1	1.5 - 8.0	68A80 F9V450XSR1P
		0.9 - 2.0	93AS120 J18VPLF29/601W	0.6 - 2.0	93NA120 J18VPLF68/602WS1	1.0 - 4.0	68A90-2 F9V450XSR1P
KAPP NILES	KX xxx	1.5 - 10.0	93DA80/80 J18VPLF29/601W	1.0 - 6.0	93NA80 J18VPLF68/602WS1	1.5 - 8.0	68A80 F9V450XSR1P
		1.0 - 4.0	93DA120/120 J18VPLF29/601W	0.6 - 2.0	93NA120 J18VPLF68/602WS1	1.0 - 4.0	68A90-2 F9V450XSR1P
GLEASON	TWG xxx GX xxx	1.5 - 10.0	93DA80/80 J18VPLF29/601W	1.0 - 6.0	93NA80 J18VPLF68/602WS1	1.5 - 10.0	91DA80/80 J18VPLF29/601W
		1.0 - 4.0	93DA120/120 J18VPLF29/601W	0.6 - 2.0	93NA120 J18VPLF68/602WS1	1.0 - 4.0	91DA120/120 J18VPLF29/601W
KLINGELNBERG	Viper xxx Speed Viper xxx	1.5 - 10.0	91DA80/80 J18VPLF29/601W	1.0 - 6.0	93NA80 J18VPLF68/602WS1	1.5 - 10.0	93DA80/80 J18VPLF29/601W
		1.0 - 4.0	91DA120/120 J18VPLF29/601W	0.6 - 2.0	93NA120 J18VPLF68/602WS1	1.0 - 4.0	93DA120/120 J18VPLF29/601W
REISHAUER	Rz xxx	1.0 - 6.0	93NA80 J18VPLF68/602WS1	1.5 - 10.0	93DA80/80 J18VPLF29/601W	1.5 - 8.0	68A80 F9V450XSR1P
		0.6 - 2.0	93NA120 J18VPLF68/602WS1	1.0 - 4.0	93DA120/120 J18VPLF29/601W	1.0 - 4.0	68A90-2 F9V450XSR1P

OEM	Machine Type	Special Application			Polishing/Duowheel			
		Module	Application	Spec. description	Type	Wheel color	Grain	Polishing
LIEBHERR	LCS xxxx LGG xxx	1.0 - 2.8	automotive	91NDA120/120 J18VPLF68/602W	standard	blue	93AS/ A800	93AS120 J18VPLF29/601W/A800 PL6966
		6.0 - 14.0	big module	99DA60/120 H15VPMF901W	baby worm	blue	99DA/ A800	99DA120/120 H8V901W/A800 PL6966-63m/s
		0.4 - 0.9	micro gear	93NA180 J18VPLF68/602WS1	baby worm	blue	93DA/ A800	93AS120 J18VPLF/601W/A800 PL6966-63m/s
KAPP NILES	KX xxx	1.0 - 2.8	automotive	91NDA120/120 J18VPLF68/602W	standard	red	93DA/ A800	93DA120/120 J18VPLF29/601W/ KNSF801
		0.4 - 0.9	micro gear	93NA180 J18VPLF68/602WS1				
GLEASON	TWG xxx GX xxx	1.0 - 2.8	automotive	91NDA120/120 J18VPLF68/602W	standard	red	93DA/ A800	93DA120/120 J18VPLF29/601W/ A800 PL8966
		0.4 - 0.9	micro gear	93NA180 J18VPLF68/602WS1				
KLINGELNBERG	Viper xxx Speed Viper xxx	1.0 - 2.8	automotive	91NDA120/120 J18VPLF68/602W	standard	red	93DA/ A800	93DA120/120 J18VPLF29/601W/ A800 PL5966
		0.4 - 0.9	micro gear	93NA180 J18VPLF68/602WS1				
REISHAUER	Rz xxx	1.0 - 2.8	automotive	91NDA120/120 J18VPLF68/602W	standard	red	93DA/ A800	93DA80/80 J18VPLF29/601W/ A800 PL1966
		0.4 - 0.9	micro gear	93NA180 J18VPLF68/602WS1				

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3.1.2 Single Rib Grinding – Universal/Specific

Usage	Workpiece Family Detail	Workpiece Material
Universal	Planet-, Ring-, Helical-, Spur gear, Pinion, Pinion Shaft	All Steel

Grinding Process	Workpiece Hardness	Module	Comments	Product Name
finishing/ solid grinding	≤64 HRc	>2.0	Universal maximum performance for all processes like solid grinding, soft grinding and for hardened material	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing	58-64 HRc	>2.0	Standard wheel for machines on non 3M™PSG	3M™ Vitrified Grinding Wheels 92VA
finishing	58-64 HRc	>2.0	Standard ceramic wheel for all machines and processes	3M™ Vitrified Grinding Wheels 92VA
finishing	58-64 HRc	>1.5	Standard specification with lesser 3M™ PSG concentration	3M™ Cubitron™ II Vitrified Grinding Wheels 91VA
finishing	58-64 HRc	>2.0	Standard specification with lesser 3M™ PSG concentration	3M™ Cubitron™ II Vitrified Grinding Wheels 91VA
finishing	58-64 HRc	>2.0	Standard specification in profile grinding	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing	58-64 HRc	>1.0	Fine grinding specification for better surface quality	3M™ Vitrified Grinding Wheels 22VA
finishing	58-64 HRc	>1.5	Good specification for job-shops with diffrent workpieces and low lot-sizees	3M™ Vitrified Grinding Wheels 22VA

Usage	Workpiece Family Detail	Workpiece Material
Specific	Planet-, Ring-, Helical-, Spur gear, Pinion, Pinion Shaft	All Steel

Grinding Process	Workpiece Hardness	Module	Comments	Product Name
finishing/ solid grinding	≤64 HRc	>2.0	Universal maximum performance specification for hardened material grinding	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing	58-64 HRc	0.3-0.6	Internal grinding (ring gear) for e-drive and very small modules	3M™ Vitrified Grinding Wheels 92VA
finishing	58-64 HRc	>2.0	Standard ceramic wheel for all machines, ceramic spec for ring gear grinding	3M™ Vitrified Grinding Wheels 92VA
finishing	58-64 HRc	>2.0	Alternative to 99DA for hardened gears, usable for machines with lower spindle power	3M™ Cubitron™ II Vitrified Grinding Wheels 93VD
finishing	58-64 HRc	1.5-4.0	Universal wheel outer diameter < 200mm	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing	58-64 HRc	>0.6	Fine grinding specification for high surface quality	3M™ Vitrified Grinding Wheels 22VA

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Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
99DA54/80 F15VPLF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93A46 H15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 F15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
91DA120/120 F15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
91DA80/80 F15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93NA120 H15VPMF902W	★★★★★	★★☆☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
93NA80 F15VPH902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
99DA80/80 F15VPMF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93A240 K5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 H15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
95DA54/80 F15VPLF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
99DA120/120 H8V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93NA180 H15VPMF902W	★★★★★	★★☆☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆

3.1.3 Bevel Gear Grinding – Universal/Specific

Usage	Workpiece Family Detail	Workpiece Material
Universal	Pinion shaft, Crown gear	Case hardened Steel

Grinding Process	Workpiece Hardness	Wheel diameter	Comments	Product Name
finishing	58-62 HRc	all	Maximum performance 3M™ Cubitron™ II Vitrified Grinding Wheel for all hardened grinding processes	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing	58-64 HRc	all	Standard ceramic specification for pinion and crown gear grinding	3M™ Vitrified Grinding Wheels 92VA
finishing	58-64 HRc	all	standard 3M™ Cubitron™ II Vitrified Grinding Wheel II specification for pinion and crown gear grinding	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing	58-64 HRc	all	standard 3M™ Cubitron™ II Vitrified Grinding Wheel II specification for pinion and crown gear grinding	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC

Usage	Workpiece Family Detail	Workpiece Material
Specific	Pinion shaft, Crown gear	Case hardened Steel

Grinding Process	Workpiece Hardness	Wheel diameter	Comments	Product Name
finishing	58-62 HRc	all	Harder 3M™ Cubitron™ II Vitrified Grinding Wheel specification for higher profile stability	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing	58-64 HRc	all	3M™ Cubitron™ II Vitrified Grinding Wheels specification for lager gear sices (truck manufacturing)	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing	58-64 HRc	all	Harder 3M™ Cubitron™ II Vitrified Grinding Wheel specification for higher profile stability	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
solid grinding	unhardened	<5.0 Inch	Standard for solid grinding processes	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
solid grinding	unhardened	≥5 Inch	Standard for solid grinding processes	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE

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Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
99DA80/80 H12VP901	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93A80 H12VP601	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA120/120 H12VP601	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H12VP601	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA120/120 K11VP601	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 K11VP601	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
99DA120/120 K11VP901	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
99DA80/80 K11VP901	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆

3.2.1 Reciprocating Grinding – Universal

Usage	Workpiece Material
Universal	Steel

Workpiece Hardness	Wheel diameter	Product Name
hardened	>300 mm (12inch)	3M™ Vitrified Grinding Wheels 92VA
hardened	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 92VA
hardened		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened	≤300 mm (12inch)	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened	>300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
hardened	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
unhardened	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
unhardened	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VC

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Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93A46 H15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 F15VP601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA46/60 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA60/80 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/120 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
64A46 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A46 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A46 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.2.1 Reciprocating Grinding – Specific

Usage	Workpiece Material
Specific	Steel

Workpiece Material Detail	Workpiece Hardness	Wheel diameter	Product Name
	unhardened		3M™ Vitrified Grinding Wheels 22VA
	unhardened		3M™ Vitrified Grinding Wheels 33VC
	hardened		3M™ Vitrified Grinding Wheels 33VC
	unhardened		3M™ Vitrified Grinding Wheels 33VC
	hardened		3M™ Vitrified Grinding Wheels 33VC
annealed cast iron, nodular cast iron		≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
case-hardened, quenched and tempered steel	hardened, low-alloy up to 62 HRc	>300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
cast steel		>300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
cast steel		≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
flame-hardened and induction hardened steel	hardened, low-alloy up to 62 HRc	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
high performance	hardened, low-alloy up to 62 HRc	>300 mm (12inch)	3M™ Vitrified Grinding Wheels 92VA
high performance	hardened, low-alloy up to 62 HRc	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 92VA
high speed steel	high-alloy, hardened, > 62 HRc	≤300 mm (12inch)	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
high speed steel	high-alloy, hardened, > 62 HRc	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 22VA
machining or construction steel	soft	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
nitriding steel	hardened < 62 HRc (gas-nitrided)	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 92VA
nitriding steel, untreated		>300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
nitriding steel, untreated		≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VH
Stainless steel (e.g. INOX), acid and heat resistant steel	hardened, high alloy	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 92VA
Stainless steel (e.g. INOX), acid and heat resistant steel	hardened, high alloy	>300 mm (12inch)	3M™ Vitrified Grinding Wheels 22VA
Stainless steel (e.g. INOX), acid and heat resistant steel	hardened, high alloy	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VC
Stainless steel (e.g. INOX), acid and heat resistant steel	unhardened	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 33VC
tool steel	high-alloy, hardened, > 62 HRc	≤300 mm (12inch)	3M™ Vitrified Grinding Wheels 92VA

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93NA80 H15VPMF902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A180 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 F15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A46 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A46 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A46 H15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 F15VP601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93NA60 H15VPMF902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
64A46 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A60 F15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
64A46 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A46 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A60 F15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA60 F15VPMF902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A60 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A60 F15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆

3.2.2 Creep-Feed Grinding – Universal

Usage	Application Detail	Workpiece Material
Universal	Profile Grinding	Steel

Grinding Process	Workpiece Hardness	Product Name
roughing	unhardened	3M™ Vitrified Grinding Wheels 33VC
roughing	hardened	3M™ Vitrified Grinding Wheels 33VC
finishing	hardened	3M™ Vitrified Grinding Wheels 33VC
	hardened	3M™ Vitrified Grinding Wheels 33VC
	unhardened	3M™ Vitrified Grinding Wheels 33VC
	hardened	3M™ Vitrified Grinding Wheels 33VC
	unhardened	3M™ Vitrified Grinding Wheels 33VC
	hardened	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC

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Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
54A60 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA60/80 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆

3.2.2 Creep-Feed Grinding – Specific

Usage
Specific

Application Detail	Grinding Process	Workpiece Family	Workpiece Family Detail	Workpiece Material	Workpiece Material Detail	Workpiece Hardness
Profile Grinding	finishing	Slot Grinding with Calibrated Wheels		Steel		hardened
Profile Grinding	finishing	Turbine	Hirth Coupling			
Profile Grinding	finishing	Slot Grinding with Calibrated Wheels		Steel		hardened
Profile Grinding	finishing	Slot Grinding with Calibrated Wheels		Steel		unhardened
Profile Grinding	roughing	Turbine	Hirth Coupling			
Profile Grinding	roughing	Slot Grinding with Calibrated Wheels		Steel		unhardened
Profile Grinding		Linear Guideways	Guidways	Steel		hardened
Profile Grinding		Linear Guide Rail	Linear guid carrier			
Profile Grinding		Linear Guideways	Guidways	Steel		hardened
Profile Grinding		Turbine	Fir-tree root- and dovetail profile			
Profile Grinding		Turbine	Fir-tree root- and dovetail profile			
Profile Grinding		Linear Guide Rail	Linear guide rail			
Profile Grinding		Turbine	Vane			
Profile Grinding		Turbine	Fins & Wedge Face			
Profile Grinding		Turbine	Notch Grinding			
Profile Grinding		Linear Guide Rail	Linear guid carrier			
Profile Grinding		Linear Guide Rail	Linear guid carrier			
Profile Grinding		Turbine	Fir-tree root- and dovetail profile			
Profile Grinding		Turbine	Vane			
Profile Grinding		Machine Guideways	Guidways	Cast Steel		
Profile Grinding		Machine Guideways	Guidways	Cast Steel		
Profile Grinding		Grinding of Gas Turbine and Aerospace Components		Stainless Steel	acid and heat resistant (e.g. Inconel, Nimonic)	
Profile Grinding		Linear Guideways	Guidways	Steel		hardened
Profile Grinding		Grinding of Gas Turbine and Aerospace Components		Stainless Steel	acid and heat resistant (e.g. Inconel, Nimonic)	
Profile Grinding		Linear Guideways	Guidways	Steel		hardened
VIPER Grinding		Turbine	Gas Turbine and Aerospace Components	Stainless Steel		
VIPER Grinding		Turbine	Gas Turbine and Aerospace Components	Stainless Steel		

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Product Name	Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
3M™ Vitrified Grinding Wheels 92VA	93A120 F15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 93VE	99DA120/120 F15VPLF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VC	54A80 F15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VC	54A60 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA120/120 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA46/60 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA60/80 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA60/80 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 F15VPH601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 J7V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 93VE	99DA120/120 H8V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VF	29A60 E15VPH450W	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★
3M™ Vitrified Grinding Wheels 33VF	29A60 E15VPH450W	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★
3M™ Vitrified Grinding Wheels 22VA	93NA60 H15VPH902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VH	64A60 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A120 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA60/80 F15VPH901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VF	29A60 E15VPH450W	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★

3.3.1 OD Grinding – Universal

Usage
Universal

Grinding Process	Workpiece Material	Workpiece Hardness	Product Name
roughing	Steel	hardened	3M™ Vitrified Grinding Wheels 92VA
roughing	Steel	hardened	3M™ Vitrified Grinding Wheels 33VG
roughing	Steel	unhardened/ hardened	3M™ Vitrified Grinding Wheels 33VG
roughing	Steel	unhardened	3M™ Vitrified Grinding Wheels 33VG
roughing	Steel	hardened	3M™ Vitrified Grinding Wheels 33VC
high precision			3M™ Vitrified Grinding Wheels 33VA
high precision			3M™ Vitrified Grinding Wheels 33VC
finishing	Steel	unhardened/hardened	3M™ Vitrified Grinding Wheels 92VA
finishing	Steel	hardened	3M™ Vitrified Grinding Wheels 92VA
finishing	Steel	hardened	3M™ Vitrified Grinding Wheels 22VA
finishing	Steel	unhardened/hardened	3M™ Vitrified Grinding Wheels 92VA
finishing	Steel	unhardened	3M™ Vitrified Grinding Wheels 33VC
finishing	Steel	hardened	3M™ Vitrified Grinding Wheels 33VC
finishing	Steel	hardened	3M™ Vitrified Grinding Wheels 92VA
finishing	Steel	hardened	3M™ Vitrified Grinding Wheels 22VA

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Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93A80 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
57A80 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
40A180 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
93A60 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆

3.3.1 OD Grinding – Specific

Usage	Grinding Process
Specific	roughing

Workpiece Family	Workpiece Material	Workpiece Material Detail	Workpiece Hardness	Wheel diameter	Product Name
Rolls, others	Rubber		universal	>100 mm	3M™ Vitrified Grinding Wheels 33VG
Others	Non iron material		universal		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
	Annealed cast- and nodular cast iron				3M™ Vitrified Grinding Wheels 33VH
	Cast Steel				3M™ Vitrified Grinding Wheels 33VH
	Coarser surfaces				3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
	Finer surfaces				3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
	Gray cast iron				3M™ Vitrified Grinding Wheels 92VA
	Hardcrome plated Steel	solid pieces			3M™ Vitrified Grinding Wheels 92VA
	Hardcrome plated Steel	solid pieces			3M™ Vitrified Grinding Wheels 22VA
	Hardcrome plated Steel	thin walled pieces			3M™ Vitrified Grinding Wheels 33VC
	nitriding Steel	untreated			3M™ Vitrified Grinding Wheels 22VA
	nitriding Steel	untreated			3M™ Vitrified Grinding Wheels 33VC
	Rubber				3M™ Vitrified Grinding Wheels 33VG
	Stainless Steel	acid and heat resistant	hardened		3M™ Vitrified Grinding Wheels 33VJ
	Stainless Steel	acid and heat resistant	unhardened		3M™ Vitrified Grinding Wheels 33VC
	Stainless Steel	acid and heat resistant	hardened		3M™ Vitrified Grinding Wheels 33VC
	Steel	case hardened, quenched and tempered steel	hardened, low-alloy up to 62 HRc		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
	Steel	case hardened, quenched and tempered steel	hardened, low-alloy up to 62 HRc		3M™ Vitrified Grinding Wheels 33VC
	Steel	flame hardened and induction hardened steel	hardened, low-alloy up to 62 HRc		3M™ Vitrified Grinding Wheels 22VA
	Steel	flame hardened and induction hardened steel	hardened, low-alloy up to 62 HRc		3M™ Vitrified Grinding Wheels 33VC
	Steel	machining of contructional steel	unhardened		3M™ Vitrified Grinding Wheels 33VG
	Steel	machining of contructional steel	unhardened		3M™ Vitrified Grinding Wheels 33VC
	Steel	tool steel, HSS, etc.	hardened, high-alloy 62 HRc		3M™ Vitrified Grinding Wheels 92VA
	Steel	tool steel, HSS, etc.	hardened, high-alloy 62 HRc		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC

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Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
57A60 H18VPHHGG900W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
64A60 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA60/60 H8V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA120/120 H8V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93A60 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA80 H15VPMF902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A60 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93NA60 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A60 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A60 F15VPHH300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
28A80 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★☆☆
54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 J7V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H8V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆

3.3.1 OD Grinding – Specific

Usage	Grinding Process	Workpieces Family
Specific	roughing	Shafts, Spindle, others

Workpiece Material	Workpiece Hardness	Wheel diameter	Comments	Product Name
All Steel	58-62 HRc	>100 mm	Shoulder grinding ≥ 7mm	3M™ Vitrified Grinding Wheels 92VA
All Steel	unhardened	>100 mm		3M™ Vitrified Grinding Wheels 33VG
All Steel	58-62 HRc	>100 mm		3M™ Vitrified Grinding Wheels 33VG
All Steel	58-62 HRc	>100 mm		3M™ Vitrified Grinding Wheels 33VC
Case hardened Steel	58-62 HRc	>100 mm	Shoulder grinding <7mm	3M™ Vitrified Grinding Wheels 92VA
Case hardened Steel	58-62 HRc		Universal PSG	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Cast iron	universal	>100 mm	Cast iron GG	3M™ Vitrified Grinding Wheels 92VA
Cast Steel	universal	>100 mm	Cast steel GS	3M™ Vitrified Grinding Wheels 33VH
Chrome plated Steel	universal	>100 mm	Full material	3M™ Vitrified Grinding Wheels 22VA
Chrome plated Steel	universal	>100 mm	Thin walled	3M™ Vitrified Grinding Wheels 33VC
Construction Steel	58-62 HRc	>100 mm	Shoulder grinding <7mm	3M™ Vitrified Grinding Wheels 33VG
HSS	>62 HRc	>100 mm	Shoulder grinding <7mm	3M™ Vitrified Grinding Wheels 92VA
Induction hardened Steel	58-62 HRc	>100 mm	Finer surface finish	3M™ Vitrified Grinding Wheels 22VA
Induction hardened Steel	58-62 HRc	>100 mm	Finer surface finish	3M™ Vitrified Grinding Wheels 22VA
Induction hardened Steel	58-62 HRc	>100 mm		3M™ Vitrified Grinding Wheels 33VC
Machining Steel	58-62 HRc	>100 mm	Shoulder grinding <7mm	3M™ Vitrified Grinding Wheels 33VG
Nitrided Steel	≤62 HRc		Gas nitriding	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Nitrided Steel	>62 HRc		Liquid nitriding	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Nitrided Steel	unhardened	>100 mm	Untreated	3M™ Vitrified Grinding Wheels 22VA
Nitrided Steel	unhardened	>100 mm	Untreated	3M™ Vitrified Grinding Wheels 33VC
Nodular iron	universal	>100 mm	Nodular iron GGG	3M™ Vitrified Grinding Wheels 33VH
Stainless Steel	≤62 HRc	>100 mm	Shoulder grinding ≥ 7mm	3M™ Vitrified Grinding Wheels 33VC
Stainless Steel	≤62 HRc	>100 mm	Shoulder grinding <7mm	3M™ Vitrified Grinding Wheels 33VC
Tool Steel	>62 HRc	>100 mm	Shoulder grinding <7mm	3M™ Vitrified Grinding Wheels 92VA

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93A80 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93A60 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
64A60 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93NA80 H15VPMF902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
54A60 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆

3.3.1 OD Grinding – Specific

Usage	Grinding Process	Workpiece Material
Specific	high precision	Steel

Workpiece Material Detail	Workpiece Hardness	Product Name
case hardened, quenched and tempered steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VA
machining and constructional steel	unhardened	3M™ Vitrified Grinding Wheels 33VH

Usage	Grinding Process
Specific	finishing

Workpiece Material	Workpiece Hardness	Product Name
Annealed cast- and nodular cast iron		3M™ Vitrified Grinding Wheels 22VA
Annealed cast- and nodular cast iron		3M™ Vitrified Grinding Wheels 22VA
Cast iron and Steel		3M™ Vitrified Grinding Wheels 92VA
Cast iron and Steel		3M™ Vitrified Grinding Wheels 92VA
Cast Steel		3M™ Vitrified Grinding Wheels 33VC
Rubber	shore hardness >70	3M™ Vitrified Grinding Wheels 33VG
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 92VA
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 22VA
Steel	unhardened	3M™ Vitrified Grinding Wheels 22VA
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 22VA
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VG
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VG
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC
Steel	unhardened	3M™ Vitrified Grinding Wheels 33VC
Steel	Hardened, low-alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
40A240 K4V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A180 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93NA120 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
93A80 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A60 F15VPHH300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93NA120 H15VPMF902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
57A80 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.1 OD Grinding – Specific

Usage
Specific

Workpiece Material	Product Name
Corrosion-resistant Steels, chromeplated, thin-walled workpieces, grinding of high shoulders, noncircular grinding, high metal removal rate	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Soft materials coarse	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Soft materials fine	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Soft materials normal	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Universal applications, cementation Steel, heat-treated Steel, inductionhardened Steels, cast iron	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA60/60 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA120/120 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H8V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆

3.3.1.1 OD Grinding Angle Plunge Grinding – Specific

Usage	Workpiece Material
Specific	Steel

Workpiece Hardness	Shoulder high „x“	Product Name
soft	>7 mm	3M™ Vitrified Grinding Wheels 92VA
soft	≤7 mm	3M™ Vitrified Grinding Wheels 92VA
soft	≤7 mm	3M™ Vitrified Grinding Wheels 33VG
soft	>7 mm	3M™ Vitrified Grinding Wheels 33VA
soft	≤7 mm	3M™ Vitrified Grinding Wheels 33VC
hardened	>7 mm	3M™ Vitrified Grinding Wheels 92VA
hardened	≤7 mm	3M™ Vitrified Grinding Wheels 92VA
hardened	≤7 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened	>7 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened	≤7 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened	>7 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
hardened	≤7 mm	3M™ Vitrified Grinding Wheels 22VA
hardened	≤7 mm	3M™ Vitrified Grinding Wheels 33VG
hardened	≤7 mm	3M™ Vitrified Grinding Wheels 33VC
hardened	>7 mm	3M™ Vitrified Grinding Wheels 33VC

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93A60 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
40A80 L15VPMF300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A80 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 H8V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H8V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 H8V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93NA120 H15VPMF902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
57A80 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.1.2 OD Grinding Profile Grinding – Specific

Usage	Workpiece Material	Workpiece Hardness
Specific	Steel	hardened

Product Name	Suggested Specification
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 H15VPMF601W
3M™ Vitrified Grinding Wheels 22VA	93NA80 F15VPMF902W
3M™ Vitrified Grinding Wheels 33VA	40A120 F15VPMF450W
3M™ Vitrified Grinding Wheels 33VC	54A80 F15VPMF904W

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★
	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.1.3 OD Grinding Roll Grinding – Specific

Usage	Workpieces Family
Specific	Rolls

Workpiece Material	Workpiece Hardness	Product Name
Steel, cast iron coated	hard chrome plated	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel, cast iron coated	hard chrome plated	3M™ Vitrified Grinding Wheels 33VG
Steel, cast iron coated	hard chrome plated	3M™ Vitrified Grinding Wheels 33VA
Steel, cast iron coated	hard chrome plated	3M™ Vitrified Grinding Wheels 33VC
Steel, cast iron coated	hard chrome plated	3M™ Vitrified Grinding Wheels 33VC
Steel, cast iron coated	hard chrome plated	3M™ Vitrified Grinding Wheels 92VA
Steel, cast iron coated	hard chrome plated	3M™ Vitrified Grinding Wheels 92VA
Steel	unhardened	3M™ Vitrified Grinding Wheels 92VA
Steel	hardened up to 62 HRc	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	unhardened	3M™ Vitrified Grinding Wheels 33VG
Steel	hardened up to 62 HRc	3M™ Vitrified Grinding Wheels 33VG
Steel	hardened up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC
Steel	hardened up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC
Steel	unhardened	3M™ Vitrified Grinding Wheels 33VC
Steel	unhardened	3M™ Vitrified Grinding Wheels 33VC
Steel	hardened up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC
Steel	hardened up to 62 HRc	3M™ Vitrified Grinding Wheels 92VA
Steel	unhardened	3M™ Vitrified Grinding Wheels 92VA
Steel	hardened up to 62 HRc	3M™ Vitrified Grinding Wheels 92VA
Steel	hardened up to 62 HRc	3M™ Vitrified Grinding Wheels 92VA
Stainless Steel		3M™ Vitrified Grinding Wheels 33VG
Stainless Steel		3M™ Vitrified Grinding Wheels 33VC
Stainless Steel		3M™ Vitrified Grinding Wheels 33VC
Rubber rolls	>70 shore	3M™ Vitrified Grinding Wheels 33VG
Cast Steel		3M™ Vitrified Grinding Wheels 33VH
Cast Steel		3M™ Vitrified Grinding Wheels 33VH

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA60/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
40A60 E15VPLF450W	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★
54A120 F15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 F15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A60 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA60/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 F15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A60 F15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 H15VPH601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 F15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H15VPH904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H15VP300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
64A60 H15VPH300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.1.4 OD Grinding Camshaft Grinding / Crankshaft Grinding

Usage	Workpieces Family
Specific	Camshaft

Grinding Process	Workpiece Material	Workpiece Material Detail	Workpiece Hardness	Product Name
roughing		casting alloy		3M™ Vitrified Grinding Wheels 92VA
roughing	Chilled iron	casting alloy		3M™ Vitrified Grinding Wheels 92VA
roughing	Steel		hardened	3M™ Vitrified Grinding Wheels 92VA
roughing	Chilled iron	casting alloy		3M™ Vitrified Grinding Wheels 33VK
roughing	Steel		hardened	3M™ Vitrified Grinding Wheels 33VK
roughing		casting alloy		3M™ Vitrified Grinding Wheels 33VC
finishing		casting alloy		3M™ Vitrified Grinding Wheels 33VG
finishing	Steel		hardened	3M™ Vitrified Grinding Wheels 33VA
finishing	Chilled iron	casting alloy		3M™ Vitrified Grinding Wheels 33VC
	Steel		hardened	3M™ Vitrified Grinding Wheels 33VG
	Steel		unhardened	3M™ Vitrified Grinding Wheels 33VG

Usage	Workpieces Family
Specific	Crankshaft

Grinding Process	Product Name
roughing	3M™ Vitrified Grinding Wheels 92VA
roughing	3M™ Vitrified Grinding Wheels 33VA
finishing	3M™ Vitrified Grinding Wheels 22VA
finishing	3M™ Vitrified Grinding Wheels 33VG

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93A60 J7V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 L5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A60 L5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 J7V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
40A120 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 L5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
57A80 K5V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93A60 L5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
40A60 K5V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93NA80 H8V902W	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
57A80 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.1.5 OD Grinding Non-Round Grinding – Universal

Usage
Universal

Product Name	Suggested Specification
3M™ Vitrified Grinding Wheels 33VA	40A120 F15VPMF450W
3M™ Vitrified Grinding Wheels 22VA	93NA80 F15VPMF902W
3M™ Vitrified Grinding Wheels 33VC	54A80 F15VPMF904W

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★★☆	★★★★★
	★★★★★	★★★☆☆	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆
	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.2 ID Grinding – Specific

Grinding Process	Workpiece Material	Comments	Product Name
roughing	Stainless Steel		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
roughing		Interrupted cut	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
roughing	Soft materials > 20mm,		3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing			3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing		Interrupted cut	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
finishing			3M™ Cubitron™ II Vitrified Grinding Wheels 93VE
finishing		Interrupted cut	3M™ Cubitron™ II Vitrified Grinding Wheels 93VE

Workpiece Material	Workpiece Material Detail	Workpiece Hardness	Wheel diameter	Comments
Steel	nitrided, tool and case-hardened steel, HSS	Steel hardened up to 62 HRc	≤40 mm	
Steel	nitrided, tool and case-hardened steel, HSS	Steel hardened up to 62 HRc	>40 mm	
Steel	nitrided, tool and case-hardened steel, HSS	hardened up to 64 HRc (using micro-crystalline specs.	≤16 mm	
Steel	nitrided, tool and case-hardened steel, HSS	hardened up to 64 HRc (using micro-crystalline specs.	16-25 mm	
Steel	nitrided, tool and case-hardened steel, HSS	Steel hardened up to 62 HRc	≤40 mm	Interrupted cut
Steel	nitrided, tool and case-hardened steel, HSS	hardened up to 64 HRc (using micro-crystalline specs.	16-25 mm	Interrupted cut
Steel	nitrided, tool and case-hardened steel, HSS	hardened up to 64 HRc (using micro-crystalline specs.	>25 mm	
Steel	nitrided, tool and case-hardened steel, HSS	hardened up to 64 HRc (using micro-crystalline specs.	≤16 mm	Interrupted cut
Steel	nitrided, tool and case-hardened steel, HSS	Steel hardened up to 62 HRc	≤40 mm	
Steel		soft and hard steel up to 62 HRc (Universal spec.)	>40 mm	
Steel		soft steel		Interrupted cut
Steel	nitrided, tool and case-hardened steel, HSS	Steel hardened up to 62 HRc		Interrupted cut
Steel		soft and hard steel up to 62 HRc (Universal spec.)	≤40 mm	
Steel	nitrided, tool and case-hardened steel, HSS	Steel hardened up to 62 HRc	≤40 mm	
Soft materials <20mm				
Bores >20 mm, stainless Steel, cast iron				
Bore <20 mm, Steel	heat treated	case hardened		Interrupted cut

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA60/60 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA60/60 J7V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
99DA80/80 H15VPMF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA120/120 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA120/120 J7V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
99DA80/80 H15VPMF901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
99DA80/80 J7V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆

Product Name	Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
3M™ Vitrified Grinding Wheels 92VA	93A80 H13VP601	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A80 H13VP601	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A120 H13VP601	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A80 H13VP601	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A80 J7V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A80 J7V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 J7V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VH	64A80 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A120 H15VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A60 J7V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A60 J7V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Cubitron™ II Vitrified Grinding Wheels 93VE	99DA80/80 J7V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 H15VPMF601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Cubitron™ II Vitrified Grinding Wheels 92VC	93DA80/80 J7V601W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆

3.3.3 Centerless plunge grinding – Universal

Usage
Universal

Workpiece Material	Workpiece Hardness	Wheel diameter	Product Name
General		≤300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
General		>300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	unhardened	≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	unhardened	>300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	hardened	>300 mm	3M™ Vitrified Grinding Wheels 33VC
Steel	hardened	≤300 mm	3M™ Vitrified Grinding Wheels 33VC

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Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A120 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A180 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.3 Centerless plunge grinding – Specific

Workpiece Material	Workpiece Material Detail	Workpiece Hardness	Product Name
Cast iron and cast Steel	Cast steel		3M™ Vitrified Grinding Wheels 92VA
Cast iron and cast Steel	Cast steel		3M™ Vitrified Grinding Wheels 92VA
Cast iron and cast Steel	annealed cast iron and nodular cast iron		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Cast iron and cast Steel	annealed cast iron and nodular cast iron		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Cast iron and cast Steel	Cast steel		3M™ Vitrified Grinding Wheels 33VK
Cast iron and cast Steel	annealed cast iron and nodular cast iron		3M™ Vitrified Grinding Wheels 33VK
Cast iron and cast Steel	Cast steel		3M™ Vitrified Grinding Wheels 33VK
Cast iron and cast Steel	annealed cast iron and nodular cast iron		3M™ Vitrified Grinding Wheels 33VK
Nitriding Steel	untreated		3M™ Vitrified Grinding Wheels 92VA
Nitriding Steel	untreated		3M™ Vitrified Grinding Wheels 92VA
Nitriding Steel	untreated		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Nitriding Steel	untreated		3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Nitriding Steel	untreated		3M™ Vitrified Grinding Wheels 33VK
Nitriding Steel	untreated		3M™ Vitrified Grinding Wheels 33VK
Stainless Steel	acid and heat resistant	unhardened	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Stainless Steel	acid and heat resistant	unhardened	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Stainless Steel	acid and heat resistant	unhardened	3M™ Vitrified Grinding Wheels 33VK
Stainless Steel	acid and heat resistant	unhardened	3M™ Vitrified Grinding Wheels 33VK
Steel	machining or constructional steel	unhardened	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	machining or constructional steel	unhardened	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	case hardened, quenched and tempered steel	hardened, low alloy up to 62 HRc	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	case hardened, quenched and tempered steel	hardened, low alloy up to 62 HRc	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	machining or constructional steel	unhardened	3M™ Vitrified Grinding Wheels 33VK
Steel	flame and induction hardened steel	hardened, low alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VK
Steel	flame and induction hardened steel	hardened, low alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VK
Steel	machining or constructional steel	unhardened	3M™ Vitrified Grinding Wheels 33VK
Steel	solid pieces	hardchrome plated	3M™ Vitrified Grinding Wheels 33VC
Steel	case hardened, quenched and tempered steel	hardened, low alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC
Steel	case hardened, quenched and tempered steel	hardened, low alloy up to 62 HRc	3M™ Vitrified Grinding Wheels 33VC
Steel	thin-walled pieces	hardchrome plated	3M™ Vitrified Grinding Wheels 33VC
Steel	solid pieces	hardchrome plated	3M™ Vitrified Grinding Wheels 33VC
Steel	thin-walled pieces	hardchrome plated	3M™ Vitrified Grinding Wheels 33VC

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93A120 K5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 K5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A120 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A120 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93A120 K5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93A80 K5V601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A120 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A120 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A120 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A120 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A180 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 J7V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A120 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A180 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 L13VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 L13VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.3 Centerless through feed grinding – Universal

Usage
Universal

Workpiece Material	Workpiece Hardness	Wheel diameter	Product Name
General		≤300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
General		>300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	unhardened	>300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	unhardened	≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	hardened	>300 mm	3M™ Vitrified Grinding Wheels 33VC
Steel	hardened	≤300 mm	3M™ Vitrified Grinding Wheels 33VC

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.3 Centerless through feed grinding – Specific

Usage
Specific

Workpiece Material	Workpiece Material Detail	Workpiece Hardness	Wheel diameter	Product Name
Cast iron and cast Steel	Cast steel		≤300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Cast iron and cast Steel	Cast steel		>300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Cast iron and cast Steel	annealed cast iron and nodular cast iron		≤300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Cast iron and cast Steel	annealed cast iron and nodular cast iron		>300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Cast iron and cast Steel	Cast steel		>300 mm	3M™ Vitrified Grinding Wheels 33VK
Cast iron and cast Steel	annealed cast iron and nodular cast iron		>300 mm	3M™ Vitrified Grinding Wheels 33VK
Cast iron and cast Steel	Cast steel		≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Cast iron and cast Steel	annealed cast iron and nodular cast iron		≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Nitriding Steel	untreated		≤300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Nitriding Steel	untreated		>300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Nitriding Steel	untreated		>300 mm	3M™ Vitrified Grinding Wheels 33VK
Nitriding Steel	untreated		≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	machining or constructional steel	unhardened	≤300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	machining or constructional steel	unhardened	>300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	stainless, acid and heat resistant	unhardened	≤300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	stainless, acid and heat resistant	unhardened	>300 mm	3M™ Cubitron™ II Vitrified Grinding Wheels 92VC
Steel	machining or constructional steel	unhardened	>300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	stainless, acid and heat resistant	unhardened	>300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	machining or constructional steel	unhardened	≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	case hardened, quenched and tempered steel	hardened steel, low alloy up to 62 HRc	≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	case hardened, quenched and tempered steel	hardened steel, low alloy up to 62 HRc	>300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	stainless, acid and heat resistant	unhardened	≤300 mm	3M™ Vitrified Grinding Wheels 33VK
Steel	thin-walled pieces	hardchrome plated	>300 mm	3M™ Vitrified Grinding Wheels 33VC
Steel	solid pieces	hardchrome plated	>300 mm	3M™ Vitrified Grinding Wheels 33VC
Steel	flame and induction hardened steel	hardened steel, low alloy up to 62 HRc	>300 mm	3M™ Vitrified Grinding Wheels 33VC
Steel	thin-walled pieces	hardchrome plated	≤300 mm	3M™ Vitrified Grinding Wheels 33VC
Steel	solid pieces	hardchrome plated	≤300 mm	3M™ Vitrified Grinding Wheels 33VC
Steel	flame and induction hardened steel	hardened steel, low alloy up to 62 HRc	≤300 mm	3M™ Vitrified Grinding Wheels 33VC

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
93DA80/80 L6V901W	★★★★★	★★★★★	★★★★★	★★★☆☆	★★★☆☆	★★★☆☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A60 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
31A80 L6V301W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 H13VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 J7V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A60 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 H13VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 J7V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
54A80 K5V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆

3.3.4 Thread- and Worm Grinding

Usage
Specific

Grinding Process	Workpieces Family	Workpiece Material	Workpiece Material Detail	Workpiece Hardness	Wheel diameter
solid grinding	Extruder Screw, Supply Pump parts	Steel	700-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
solid grinding	Extruder Screw, Supply Pump parts	Steel	700-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
solid grinding	Extruder Screw, Supply Pump parts	Steel	700-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
solid grinding	Extruder Screw, Supply Pump parts	Steel	700-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
solid grinding	Extruder Screw, Supply Pump parts	Steel	700-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
solid grinding	Extruder Screw, Supply Pump parts	Steel	700-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
solid grinding	Extruder Screw, Supply Pump parts	Steel	700-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
finishing		Steel	800-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
finishing		Steel	800-1000 (Newton/mm²)	58-62 HRc	up to 500 mm
fine-finishing		Steel	700-800 (Newton/mm²)	58-62 HRc	up to 500 mm
fine-finishing		Steel	700-800 (Newton/mm²)	58-62 HRc	up to 500 mm
fine-finishing		Steel	700-800 (Newton/mm²)	58-62 HRc	up to 500 mm
fine-finishing		Steel	700-800 (Newton/mm²)	58-62 HRc	up to 500 mm
fine-finishing		Steel	700-800 (Newton/mm²)	58-62 HRc	up to 500 mm
		Steel	700-800 (Newton/mm²)	58-62 HRc	up to 500 mm
	Thread				
		Steel	700-800 (Newton/mm²)	58-62 HRc	up to 500 mm
	Screw	Steel		58-62 HRc	
	Screw	Steel		58-62 HRc	
	Screw	Steel		58-62 HRc	

Please consider, that the choice of a specification is a highly complex decision, with a lot of influencing factors in your responsibility. Please validate your choice with your 3M contact. 3M is not liable for the usage of their products.

Product Name	Suggested Specification	Lower burn risc	Material removal	Life time	Surface quality	Shape, profile accuracy	Less dresser wear
3M™ Vitrified Grinding Wheels 92VA	93A120 F15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A80 F15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VC	54A120 H15VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A180 H15VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A46 H15VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A60 H15VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H15VPMF604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A240 F13VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A46 H8V604W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 92VA	93A120 H13VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A150 H13VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 92VA	93A180 H13VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VA	40A180 H8V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VA	40A240 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 92VA	93A80 H15VPMF601W	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
3M™ Vitrified Grinding Wheels 33VA	40A240 K5V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VA	40A60 J7V300W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A120 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A60 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆
3M™ Vitrified Grinding Wheels 33VC	54A80 H15VPMF904W	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★★☆☆	★★★★☆


3M
Villach
Austria

4. 3M Production and Services

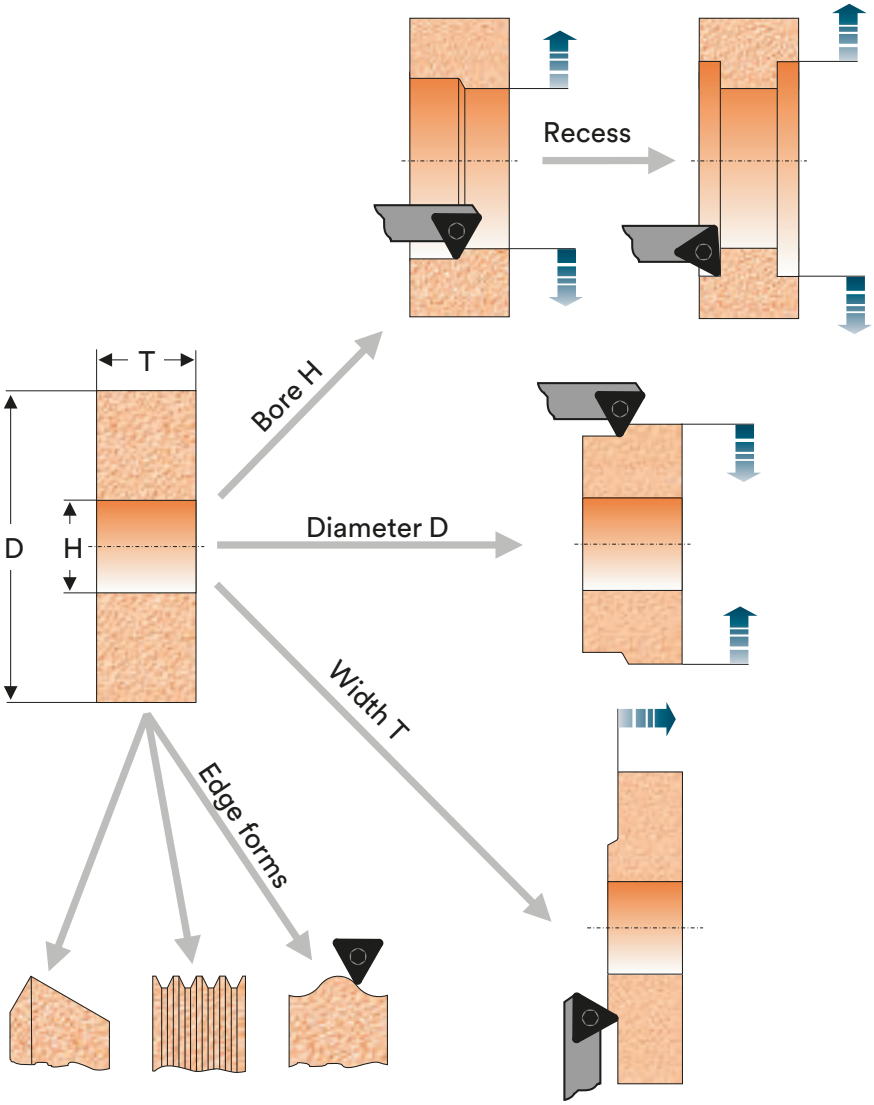
4.1 Modern Production and comprehensive Services

Quality requires commitment

To manufacture our grinding wheels to an outstanding quality, we only use the highest quality raw materials and work with the most modern machines and systems. We meet the expectations of our demanding customers every day to manufacture premium quality grinding wheels using state-of-the-art manufacturing technology.

High availability, shortest delivery times

Through our inventory management, we can guarantee high availability of blank grinding wheels, which we then use to quickly manufacture a custom grinding wheel for you. They can be equipped with edge profiles, the hole widened to the depth, or formed along the diameter or along the side.



4.2 Process Optimization

Grinding process optimization with 3M OPTIMA software

Today there are highly developed machines and tools available even for the most demanding processes in grinding technology. In the framework of conducting scientific research into the grinding process, more than one hundred different factors with an influence on the grinding time were identified (VDI Guideline 03398).

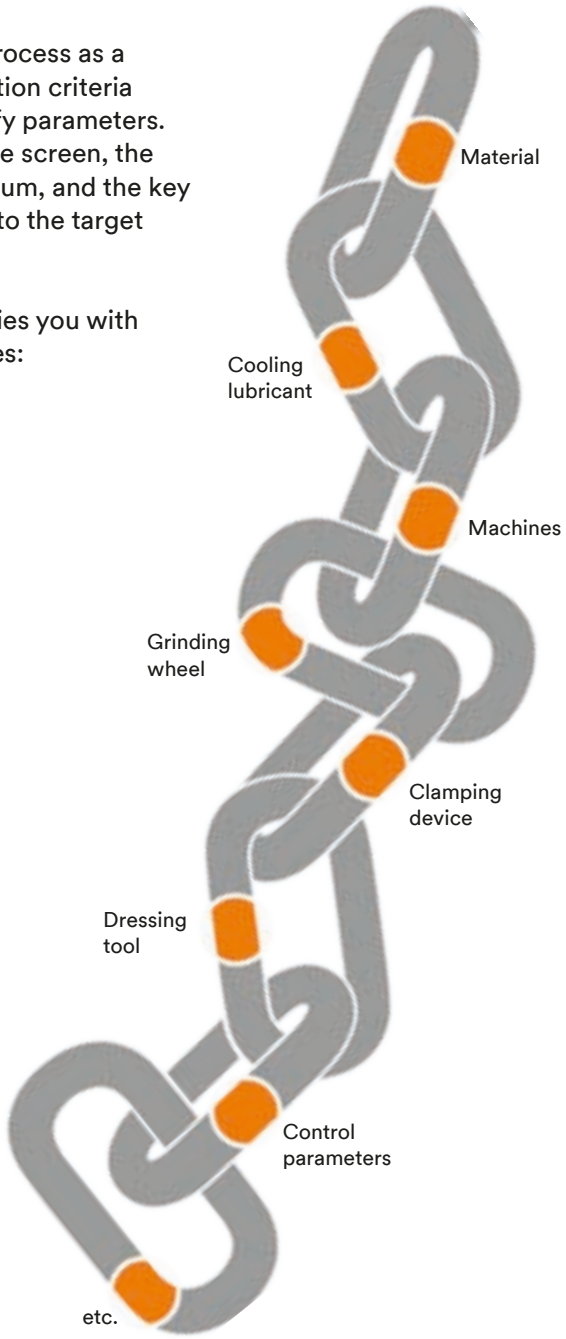
With our OPTIMA software, we optimize the grinding process as a user by adjusting individual parameters. Thirteen evaluation criteria are determined automatically from seven easy-to-specify parameters. Through limited simulation of the grinding process on the screen, the number of practical tests required is reduced to a minimum, and the key data for an optimized process are calculated according to the target parameters specified.

Our innovative 3M process optimization software supplies you with process parameters for many relevant grinding processes:

- OD and ID grinding
- Deep grinding (creep-feed grinding)
- Gear grinding (generative and profile grinding)
- Centerless grinding

Also for in-process measures such as:

- Dressing with stationary and rotary diamond dressing tools
- Cooling lubricant flow rate, nozzle design and cooling lubricant system capacity



For further information, contact our application technicians!

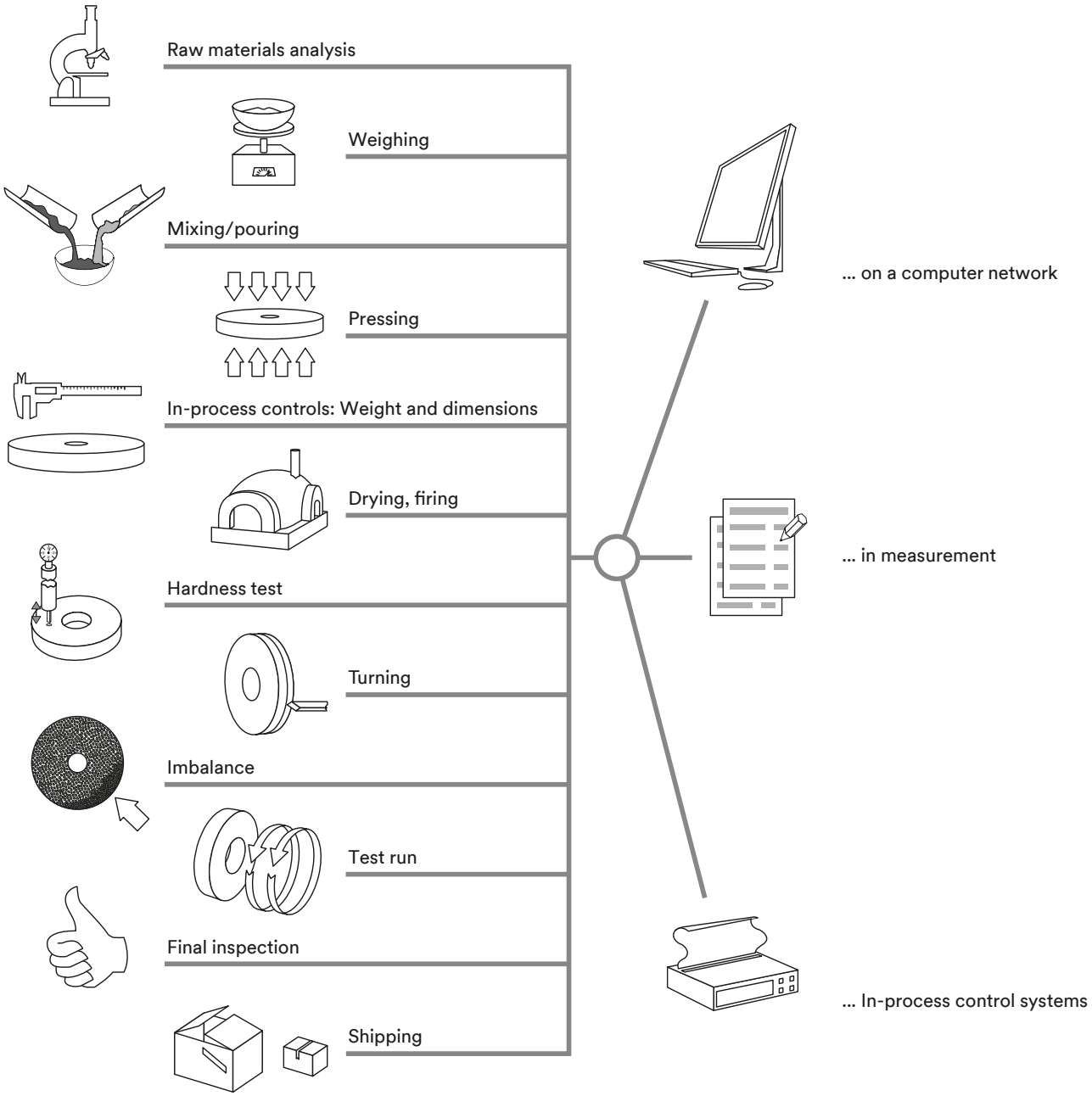
4.3 Quality Control according to ISO 9001 & ISO 14001

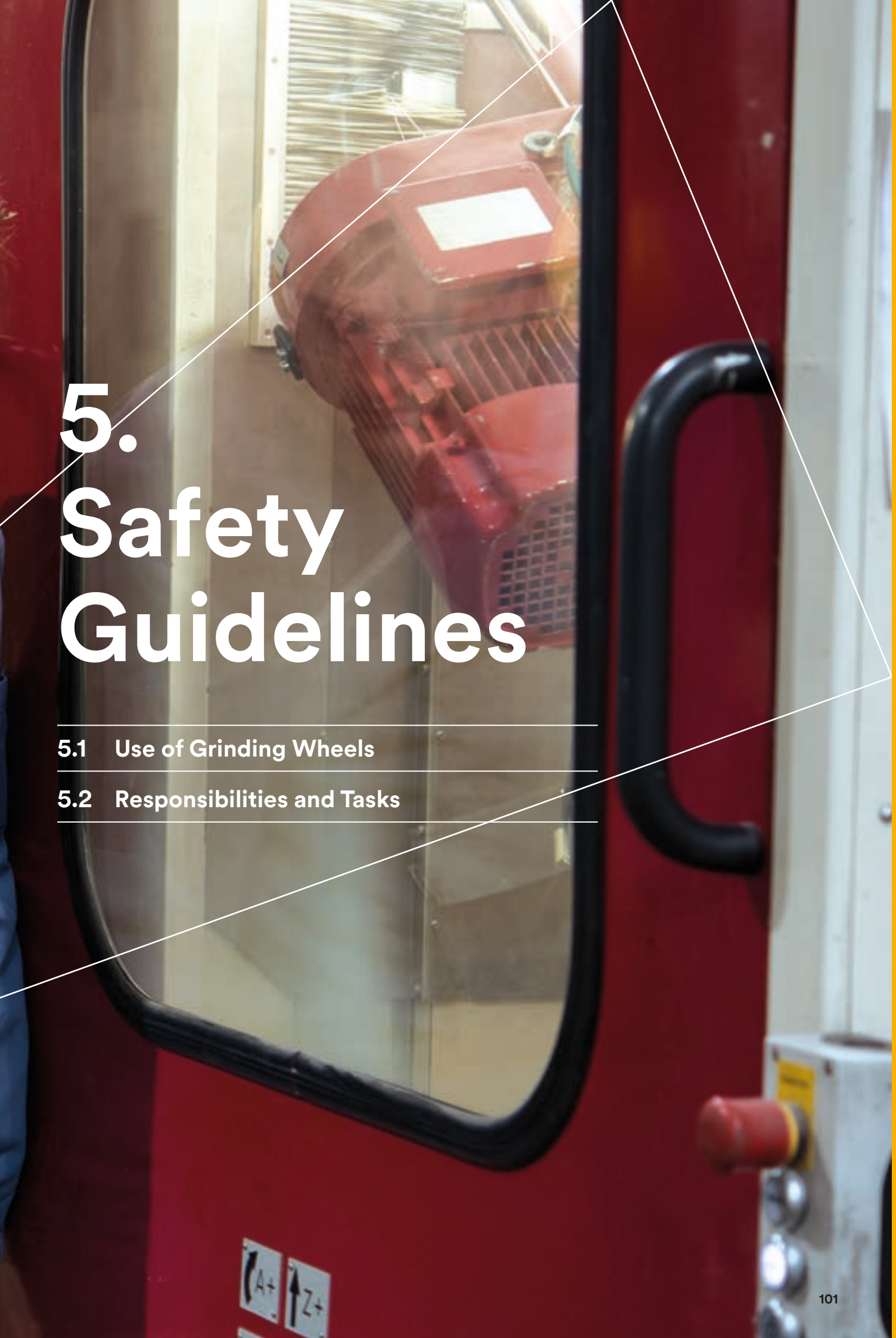
ISO 14001 environmental certification

Due to our responsibility for nature and the environment, we consistently ensure the following:

- Raw materials and production processes are non-toxic
- End products are non-toxic
- We use energy efficiently
- We recycle the consumable materials in the factory

ISO 9001
ISO 14001





5. Safety Guidelines

5.1 Use of Grinding Wheels

Safety when grinding

We have summarized the most important safety measures for you in the following recommendations. Please note that you as a user are required to be familiar with the regulations applicable in your country.

Guidelines for Europe

The applicable safety codes are available in your local language from the FEPA (Federation of the European Producers of Abrasives). We recommend you visit the FEPA home page to become more familiar with the safety code. You will find an excellent collection of the relevant regulations there. Every grinding wheel delivery sent by us includes a copy of the guidelines "SAFETY RECOMMENDATIONS FOR THE USE OF ABRASIVE PRODUCTS". We would be happy to send you additional copies of these guidelines and other binding recommendations published by FEPA at any time.

FEPA

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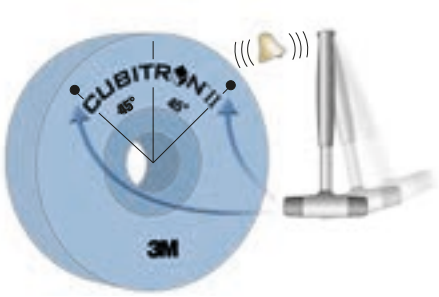
fepa@fepa-abrasives.org
www.fepa-abrasives.org

The sound check

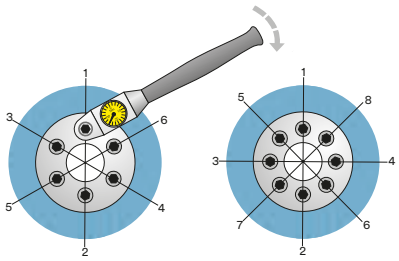
A sound check must be conducted immediately before mounting a new or used vitrified grinding wheel. To conduct the sound check, lightly tap the grinding wheel to the right and left of the center line using a non-metallic hammer. Place lighter wheels on your finger or an awl for the sound check. Heavy wheels are placed upright on the floor. A crack-free wheel makes a clear sound while a cracked wheel makes a dull thudding sound. Synthetic resin bonded wheels do not make the same clear sound as vitrified wheels.



Essential:
The sound check before mounting.

Properly mounting on the flange

You must first check if the wheel is imbalanced and balance the wheel if necessary. The machine speed should not be set higher than the permissible rotational speed (for new wheels) or circumferential speed. According to the applicable safety regulations (ISO, DIN, FEPA) and safety recommendations, the new wheel must be subjected to a test run (without a load) after mounting at a speed no higher than the max. operating speed. The hazardous area must be secured accordingly. Caution: Our grinding wheels must never be operated at speeds higher than the specified maximum operating speed or rotational speed (for new wheels).



Order	
1/2/3/4/5/6	1/2/3/4/5/6/7/8

Tighten the mounting bolts uniformly in a crosswise pattern using a torque wrench.

Recommendations and prohibitions

The proper use of grinding wheels

Always:

- Read the safety regulations for your country!
- Inspect the wheel upon delivery and before mounting for damage during transport!
- Store the wheels properly in the racks specified for this purpose!
- Check if the wheel is suitable and authorized for use at the circumferential speed of the machine!
- Use a paper or plastic blotter as a middle layer! Make sure to wet the paper flange with cooling lubricant!
- Use a torque wrench to tighten the flange nuts!
- Check to make sure all safety devices are functioning properly!
- Wear protective goggles!
- Start the machine and let it idle for a minute before you actually start grinding!
- Only start operation of the machine when operation is in accordance with the rules for use of the machine and grinding wheel!

Never:

- Never exceed the maximum working speed specified by the manufacturer!
- Never mount a ceramic grinding wheel without conducting a sound check! Do not use the wheel if it makes a dull thudding sound!
- Never force the wheels onto an arbor (flange)!
- Never remove or bypass the safety devices on the machine!

If you are unsure of anything, please contact our service technicians!

Balancing

Any imbalances in the rotating parts will have a negative impact on the surface finish quality of the workpieces, the service life of the grinding wheel and the results produced on the machine. Only a properly balanced grinding wheel will achieve an optimal surface finish quality. In general, static balancing of the grinding wheel is sufficient if it has already been mounted on a flange.

To statically balance a grinding wheel, mount it on a polished shaft and place it on the balancing unit. Depending on how worn the grinding wheel is, it may be necessary to repeat the balancing procedure.

3M™ Grinding Wheels are subjected to a strict balancing test in the factory and are rejected if damaged. Our internal imbalance tolerances are much lower than the corresponding DIN or ISO standards.

Imbalances can also arise when mounting the grinding wheel on a flange and are eliminated by shifting the balancing weights accordingly.

The wheels can be balanced dynamically and continuously provided that the grinding machine is equipped with an automatic balancing system. Modern quality requirements for ground workpieces and increased circumferential speeds often require use of continuous dynamic balancing. This is especially true when the wheel thickness is greater than 1/6 of the diameter of the wheel.

In accordance with DIN, ISO, FEPA and ANSI standards, every grinding wheel must idle for at least one minute before grinding, and the circumferential speed during this time must never exceed the recommendations of the wheel manufacturer. During the idle phase, the operator should pay special attention to the wheel.

International Standard Dimensions

D Diameter (mm)	T Thickness (mm)	H Bore [1] (mm)
3	0.5	1.6
6	0.8	2.5
8	1	4
10	1.25	6
13	1.6	9.53
16	2	10
20	2.5	13
25	3.2	16
32	4	20
40	6	22.23
50	8	25
63	10	32
80	13	40
100	16	50.8
150	32	203.2
200	50	406.4
225	63	
250	100	
300	125	
350	160	
400	200	
450	250	
500	315	
600	400	
750	500	
800		
900		
1,000		
1,060		

[1] **Bore tolerances:**

H12 Bore diameters up to 50.8 mm

H11 Bore diameters of 76.2 mm or larger

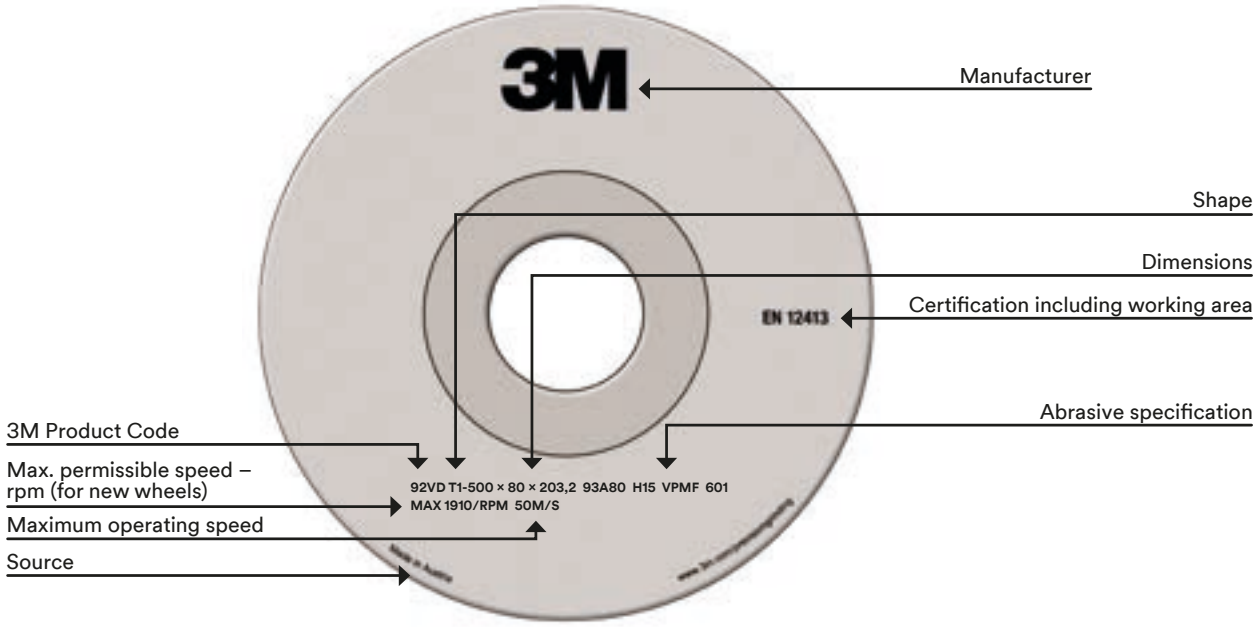
Minimum thickness for vitrified bonded grinding wheels = 2% of the outer diameter.

Required labels on our grinding wheels

In accordance with ISO, DIN and CEN standards as well as with FEPA regulations, our grinding wheels are marked with the following information and specifications:

- Manufacturer; trade mark
- Max. permissible rotational speed (rpm)
- Max. operating speed (m/s)
- Serial number and article number
- Type
- Dimensions
- Composition

Wheel labels and markings



5.2 Responsibilities and Tasks

Who is responsible for what?

Grinding wheels manufacturer

- Guarantee multiple levels of safety of the grinding wheel against breakage. The corresponding safety factors vary depending on the working method and design of the grinding machine
- Test run conducted in the factory at high circumferential speed
- Breakage tests in the factory
- Labelling of the grinding body with specification of the permissible rotational speed (for new wheels)

The responsibility extends to include proper packaging for shipment, but not for damage occurring during transport or through improper storage.

Grinding machine manufacturer

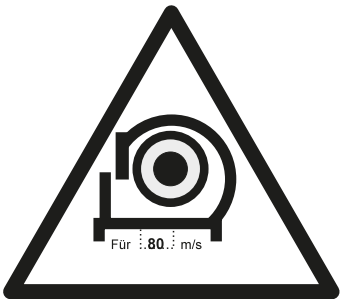
- Easy adjustment of the workpiece support and safety covers that adjust as the diameter of the wheel decreases
- Forced locking of the speed levels
- Securing continuously variable speed regulators
- Suitable safety cover made of a rugged material that will retain the pieces of the grinding wheel in case of breakage
- Proper design of the grinding wheel flange

User, operator

- Sound check and inspection for external damage during transport before mounting the grinding wheel
- Starting a grinding wheel
- Flanging and mounting
- Checking for imbalances and balancing the grinding wheel when necessary
- Checking the permissible speed (for new wheels)
- Readjusting the workpiece support and safety covers
- Idling the newly mounted grinding wheel while operating at full speed
- It is prohibited to carve the grinding wheel

What is a closed working area?

Grinding tools requiring authorization for use are now subject to certain usage restrictions. These usage restrictions are written by 3M in the factory either directly on the grinding tool, its flange or on an enclosed label. The following restriction, for example, always leads to calls to our technicians:



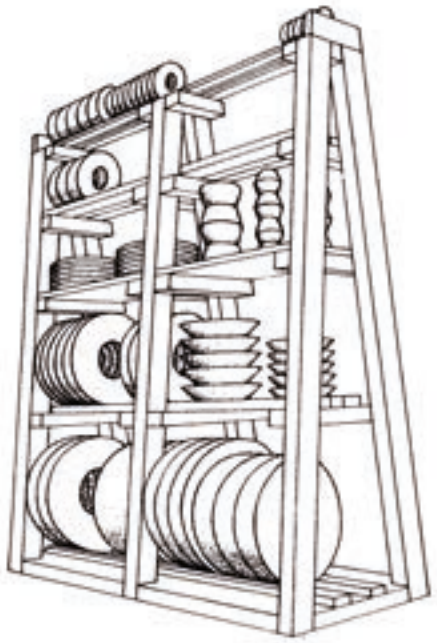
RE 4: Only authorized for use in closed working areas

In a closed working area, the grinding wheel is enclosed on all sides by machine components to ensure broken pieces are completely retained inside the machine in case of wheel breakage.

When grinding bodies are labelled with this usage restriction, then they may only be used on stationary grinding machines on which the retaining safety devices are approved as a ”closed working area“ and correspondingly marked with the symbol shown together with the specification of the maximum circumferential speed.

Standard or normal operating speeds

The maximum operating speed for each wheel must be established by the wheel manufacturer.



Storage of grinding wheels

Grinding bodies require careful handling and proper storage.

Every delivery you receive should be checked upon receipt for damage during transport (sound check).

Grinding bodies must be stored so that they will not be damaged. The storage room must be dry, frost-free and protected against excess heating and vibration.

Vitrified bonded grinding wheels can be stored indefinitely.

Synthetic resin bonded grinding wheels should not be stored for more than three years because otherwise the strength of the wheel could drop due to embrittlement.

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