P84® Polyimide

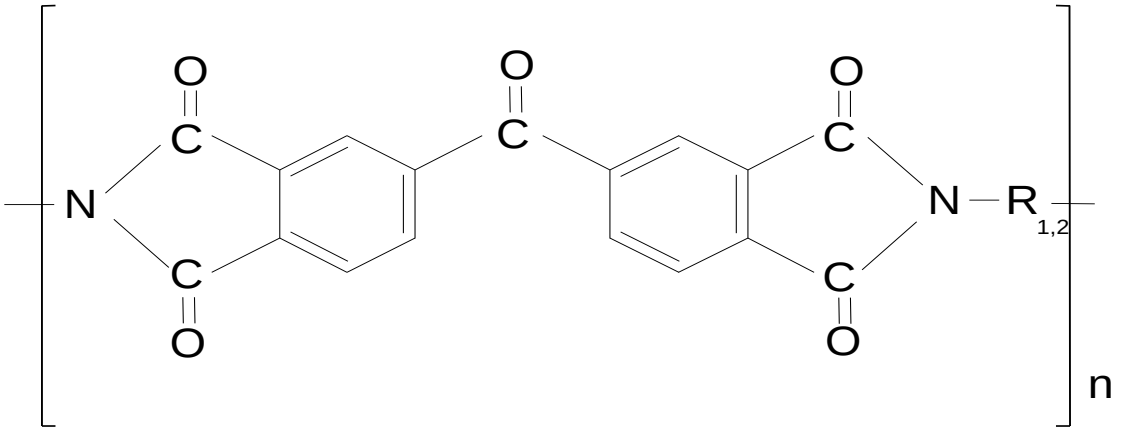
Binding Resin

For

Diamond- and CBN Grinding Wheels

P84 Binding Resin

P84 Polyimide Powder is a fully imidized PI resin. Due to its chemical structure, it is a non meltable, non thermoplastic polymer. Processing is possible only by hot-compression-moulding. Key processing variables are dwell time, temperature and pressure. No post curing is necessary.



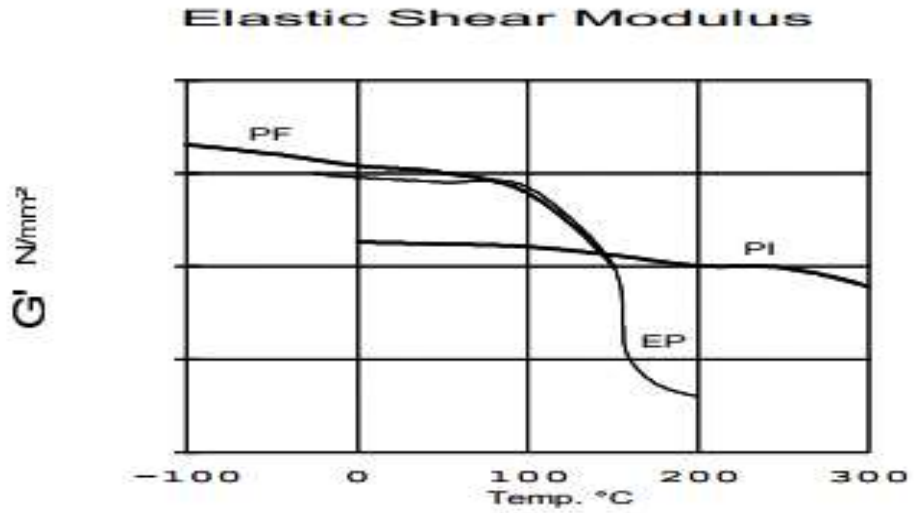
Polyimides in general, offer highest thermal stability in comparison with other polymers such as polyamides, epoxies and polyetherketones. High thermal stability and extremely high strength make P84 polyimide a natural choice for the binding resin in high quality diamond grinding wheels. The demanding strength and temperature requirements of diamond and CBN grinding wheels eliminate practically all other potential polymers.

The physical properties of P84 meet the requirements, which are demanded from grinding wheels.

Density: (Hot compression moulded)	1.34	g/cm^3		
Tensile strength:	17.000	psi	116	N/mm^2
Elongation:	9	%		
E-modulus:	363.000	psi	4000	N/mm^2
Flexural strength:	23.000	psi	174	N/mm^2
Hardness SHORE D:	90			
HDT:	572	°F	300	°C
Continuous Usage Temperature:	536	°F	280	°C
Short Period Maximum:	750	°F	400	°C

The above information is for unfilled P84. Under proper moulding condition P84 has one of the highest tensile strength compared to unfilled, non- orientated plastics.

Elastic Shear Modulus



Features:

Due to it is excellent thermal stability, P84 bonded wheels have extremely high load-bearing capacity. They are particularly well suited for applications involving hard metal (dry) grinding and deep grinding (wet) operations.
P84 resin bonded wheels are capable of very high grinding speeds and, in many cases, outlast standard epoxy or phenolic wheels by a factor of 2.

The hardness, brittleness and abrasion capacity of P84 wheels can be influenced by processing. Varying the sintering temperature and dwell time can lead to different mechanical properties of the resin.
As the process temperature and dwell times rise, the grinding area becomes harder and more brittle. This temperature moulding window is between 626 °F (330 °C) and 680 °F (360 °C).

Processing:

To obtain successful grinding results, it is necessary to utilize the appropriate resin and optimize the formulation depending on the end-use.

Listed below are various formulations tested in dry grinding applications.

Composition (Vol.-%)				Grinding-relationship at a table speed of (mm/s)	
Diamond	Metalcoating	PI resin	Filler	10	25
25	0	55	20 Cu-fibres	63	24
25	0	45	30 SiC ca. 30 µ	31	6
25	0	40	35 coarse Cu-powder	29	15
25	12	33	30 dentritic Cu	380	98,4
18,75	9,25	38	34dentritic Cu	235	54
12,5	6,5	42	39 dentritic Cu	156	30

* Source: DE 20 16 349 B2

As shown in the foregoing graph the use of Ni coated diamonds is necessary. We recommend as an example De Beers PDA 321 P 60 which is developed for PI resins. In dry grinding applications, approximately 30 % copper powder should be added.

Extent of delivery:

P84 resin is available in powder grain sizes of -200, -325, -425 and -1200 meshes. Usually powder grain size of -325 mesh HCM is used.

Preparing of the resin:

As polyimide resins are hygroscopic, they have to be predried at 250 °F (120 °C) for a couple of hours before any use. It is always important to have filling proportion in case of "close mould" moulding.

Primer Coating:

The primer solution should be applied thinly to the roughened bonding surface (using a brush) and dried for about 10 hours at 480 °F (250 °C).

Release Agent:

We recommend silicone oil spray to be applied in very thin coating on the mould surfaces.
For example Wacker Chemie/Burghausen or T.H. Goldschmitt (Tegosil)

Wacker Silicons Corp.
3301 Satun Road; Adrian
Michigan 49221-9397
Tel.: 517-264-8500
Fax: 517-264-8246

T.H. Goldschmitt
Goldschmittstr. 100
45127 Essen/Germany
Tel.: 0049-201-173-01
Fax: 0049-201-173-3000

Processing and Manufacturing Routes:

When first learning to process P84, it is recommended to mould the near resin into shaped articles to test mechanical properties. This should lead to an optimized processing of P84 resin.
These mechanical properties can be compared with the properties in the brochure.

In manufacturing grinding wheels, two different methods are commonly used:

- Moulding of the grinding area and adhere this afterwards on to the hub by using epoxy adhesive.

The moulding of the composition can be done in following the cycle in the attached graph.
Grindings with little volume%-part of PI pressure should be raised up to 14.000 psi (1000 kg/cm^2).
The moulding should be done under use of an epoxy adhesive with a high amount of aluminium powder (for example 60 % Al.)

- The moulding of grinding are directly on the prepared hub (roughed and primed) can be done in the same way.

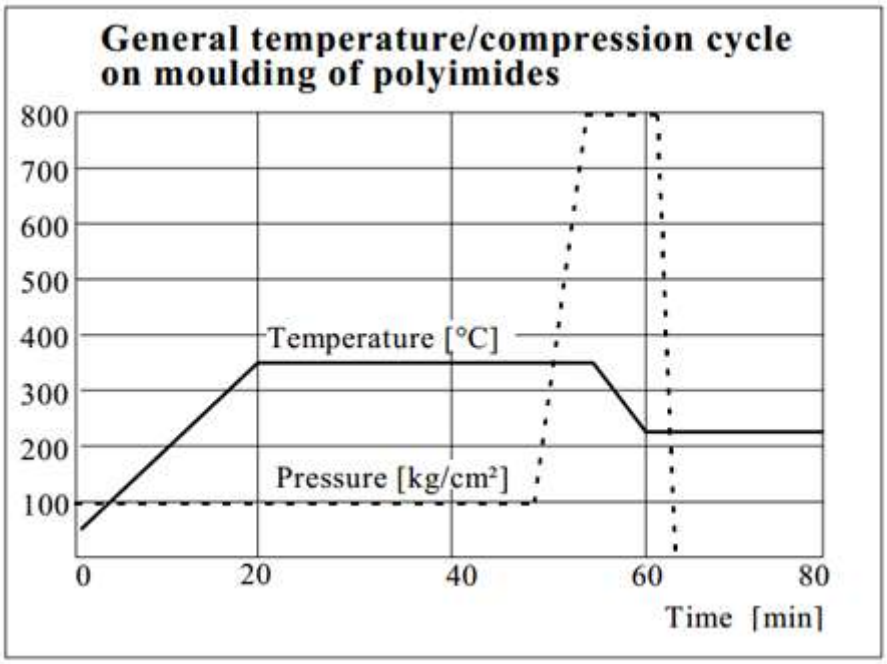
In both cases the sintered wheel can be released at 446 °F (230 °C).

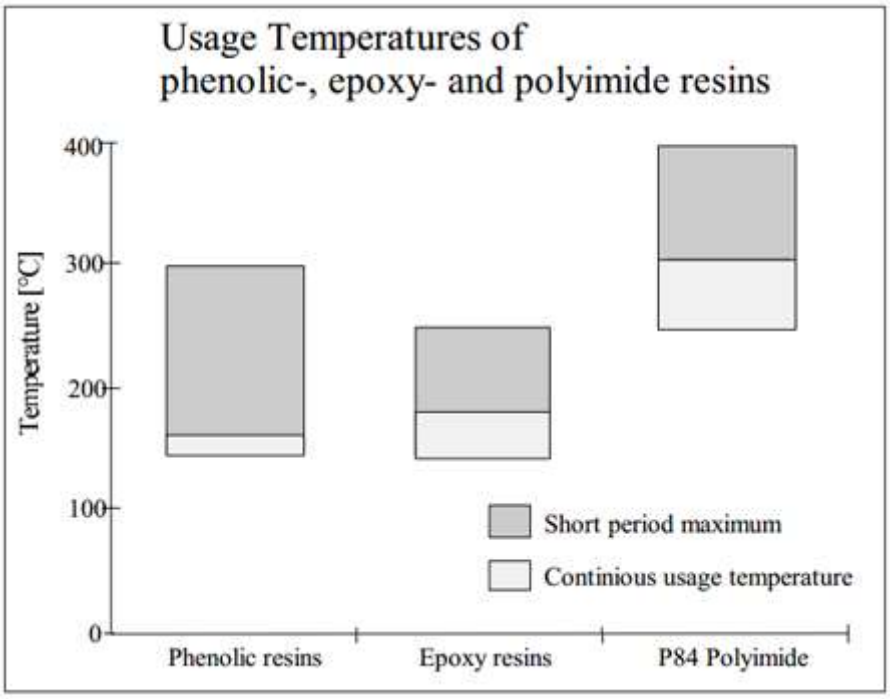
Post curing is not necessary!
Especially in the production of lAl wheels, a resin bounded hub is used often. We split into

- Phenolic-prepreg hubs
- PI/metal blended types

In case of phenolic prepreg hubs the grinding area is moulded before. The prepreg is added afterwards into the outside ring and moulded as recommended for this resin. Due to the high thermal stability of P84 no damage of the grinding area will be obtained.

Under the use of metal/Resin blends we recommend the use of a 70 % metal and 30 % resin composition. The metal component can be a blend of bronze and aluminium.
This hub has to be sintered as an independent part of the wheel; afterwards the grinding area is added by sintering it on to the disc.





Properties of hot compression moulded P84 powder (appr. Values)

Property

Mechanical propertis			**DIN**		**Test Standar ISO/IEC**
Ultimate tensile strength	N/mm^2	116	53455		527
Failure strain	%	9	53455		527
Tensile modulus	N/mm^2	4000	53457		
Ultimate compressive strength	N/mm^2	700	53454		
0,1 % Offset	N/mm^2	177			
10 % Offset	N/mm^2	240			
Compressive strain at failure	%	45	53454		
Compressive modulus	N/mm^2	4100	53457		
Ultimate flexural strength	N/mm^2	174	53452		
Flexural modulus	N/mm^2	4000	53457		
Hardness					
Rockwell M		120			
Share D		89			
Impact strength	kJ/m^2	75			179
Impact strength; notched	kJ/m^2	4,9	53453		
Impact strength Izod, Method A	J/m	37	ASTM 256		180
Thermal properties					
Linear thermal expansion coefficient	l/K	50.10^{-6}			
Glass transition temperature	°C	330	53752		
Heat defelction temperature					
Load 1,85 N/mm^2	°C	300	53461	R75	
Thermal conductivity	W/m K	0,22	52612		
Specific heat	J/gK	1,04			
Electrical properties					
Volume resistivity at 23 °C	? Cm	10^{17}	53482		167
Surface resistivity	?	10^{15}	53482		167
Dielectric strength	kV/mm	20	53481		243
Dielectric constant					
50 Hz	-	3,5	53483		250
27 MHz	-	3,1	53483		250
Dissipation factor					
tan ? 50 Hz	-	1.10^{-3}	53483		250
tan ? 27 MHz	-	3.10^{-3}	53483		250
Other properties					
Density	Kg/m^3	$1,34.10^3$	53479		1183
Water absorption					
at 23 °C,65 % RH, 121 days	%	2,6	53714		1110
in water, 23 °C, 42 days	%	3,6	53495		
Limiting Oxygen Index	%	44	ASTM 2863		