General

Turcite®-B Slydway® is a high performance thermoplastic material for use on linear bearing application as found on the guideways of machine tools and other linear bearing applications.

Guideways on machine tools ensure the exact direction of motion of components such as slides, sleeves, quills, plungers, etc. At the same time, guideways must bear the weight of the guided components and workpieces and absorb the machining forces without deformation.

This places critical demands on the machine tool guideways:

- high positional accuracy and repeatability of the working movements
- high performance over many years
- low production costs
- low friction without stick-slip as a precondition for positional accuracy at differing velocities
- low wear, even in the event of poor or failed lubrication
- backlash-free or minimum backlash for high repeatability even under load
- good damping behaviour even with interrupted cutting operations to minimize chatter.

Turcite®-B Slydway® has been well proven worldwide for many years in many sectors of machine tool and other heavy duty engineering industries (see Figure 1).

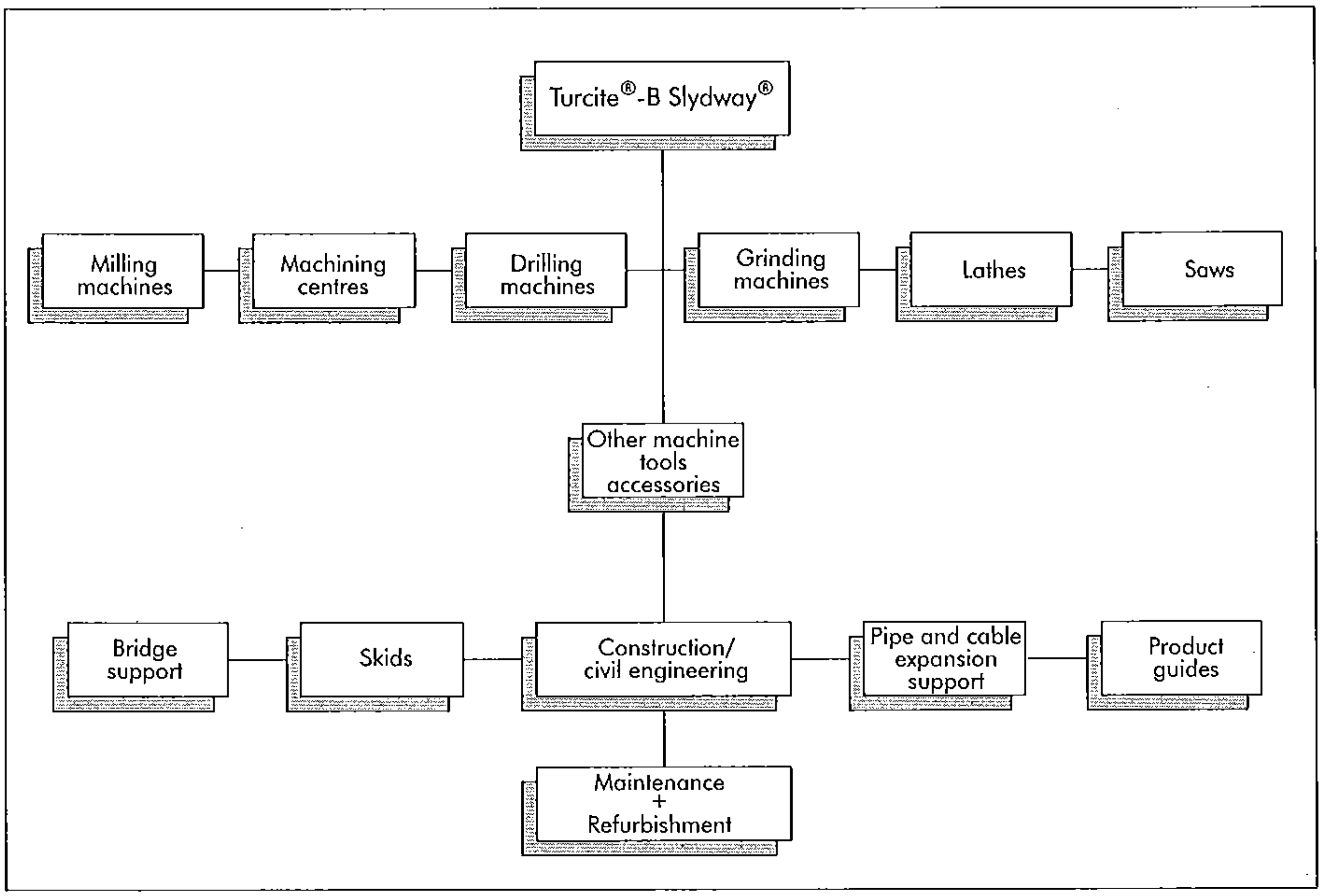


Figure 1 Fields of Application for Turcite®-B Slydway®

Application

Slydway® can be used in a wide variety of applications. The application examples show forms of sliding slydways coated with Turcite® already in use in in the machine tool industry (figure 2 on page 4).

Slydway® is also applicable to other heavy duty linear bearings in the construction or civil engineering markets including bridge supports, skids, pipe or cable expansion supports, telescopic arms or any other linear application. Slydway® is normally bonded to the moving surface only of a linear bearing application. It is subsequently finish machined by milling, grinding and/or scraping to provide a suitable counterface to the cast iron, steel or other static face.

Designs

Slydway® meets the modern demands made by different guide systems and dimensions. It is available in thicknesses of .40 to 6.35 mm and widths up to 600 mm. It can be supplied cut to the specified length or as off-the-roll material.

Slydway® is especially applicable to the refurbishment of worn machine tools. Worn linear bearings can be machined back and brought to the original working tool heights and centre lines by the application of Slydway® material of suitable thickness.

Characteristics

Slydway® is manufactured from the specially developed high-performance thermoplastic Turcite® and modified for the special requirements for linear bearing applications. In order to achieve good adhesion when bonding with the machine components, the surface is chemically treated.

Advantages

- low friction, no jamming, no stick-slip, particularly at low sliding speeds
- good mechanical properties, wear-resistant and dimensionally stable
- safety against dry running in the event of poor or no lubrication
- high wear resistance, thus ensuring a long service life
- good emergency running properties, no tendency to seize
- damps and absorbs vibrations
- impervious to soiling and moisture
- chemically resistant to aggressive cooling lubricants
- dimensions available from stock, simple and cost-effective handling.

Material Characteristics

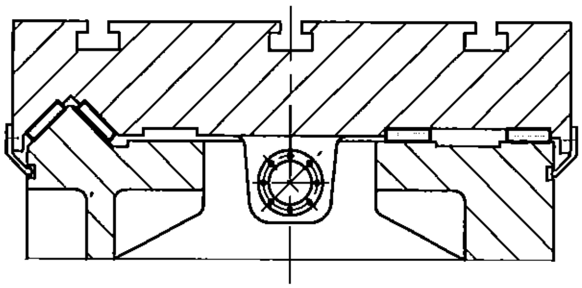
Material No.	TB
Colour in etched delivery condition:	medium to dark brown
Colour after mechanical machining:	green-grey
Water absorption:	< 0.01 %
Linear coefficient of expansion:	6×10^{-5} 1/K
Thermal conductivity at 20 °C:	0.8 W/m • K
Max. pressure load for 1% deformation:	930 N/cm^2
Hardness:	60 ± 5 Shore D
Modulus of elasticity:	1.000 N/mm^2

Chemical resistance:
Material TB has a very good chemical resistance and is resistant to coolants, clear coolants and lubricants.

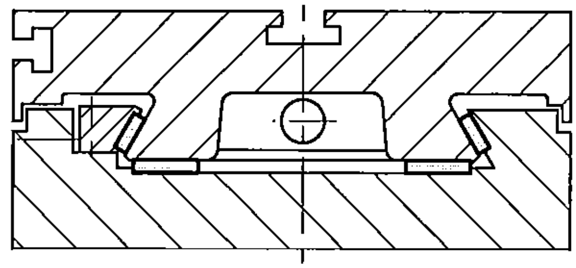
Storage Instructions

Slydway® should be stored in dry rooms protected from light at room temperature for not more than two years. Before further processing Slydway® must be cleaned. See chapter "Installation instructions".

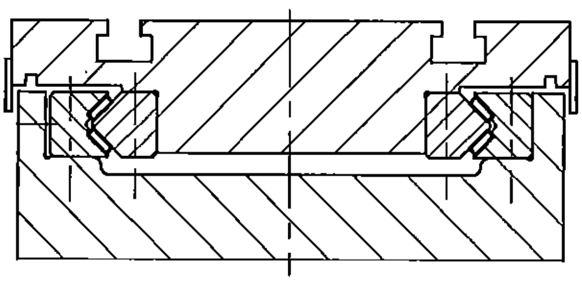
Designs



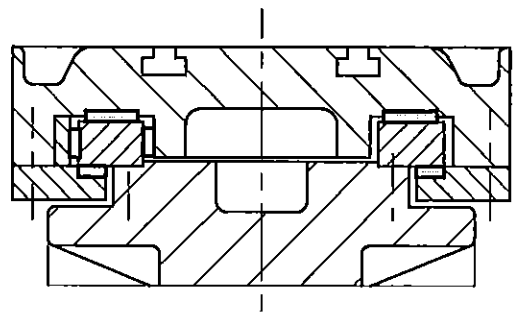
Flat tapered Guideway



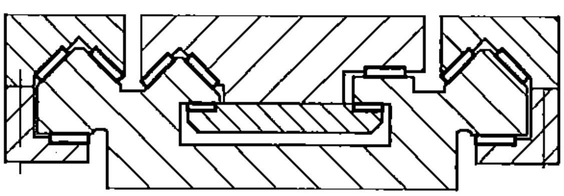
Dovetail Guideway



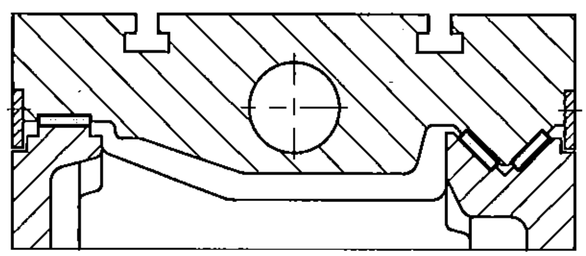
V-Guideway



Flat Guideway



Double V-Guideway



Flat V-Guideway

Figure 2 Slydway® installation examples

Design Instructions

Load and Contact Deformation

In conjunction with the contact deformation, the load is of great significance for the operating precision of the linear bearing. The surface pressures for Slydway® in machine tool construction are generally selected between 20 and 200 N/cm^2.

The load-carrying capacity is dependent on the thickness of the bearing material and the surface roughness.

Figure 3 shows the contact deformation as a function of different material thicknesses t for slydways with a surface roughness of R_a = 0.6 µm. As can be seen from the diagram, Slydway® can be subjected to even more than the optimum range.

Within the working range depicted, the coefficient of friction of the Turcite® TB material remains practically unchanged.

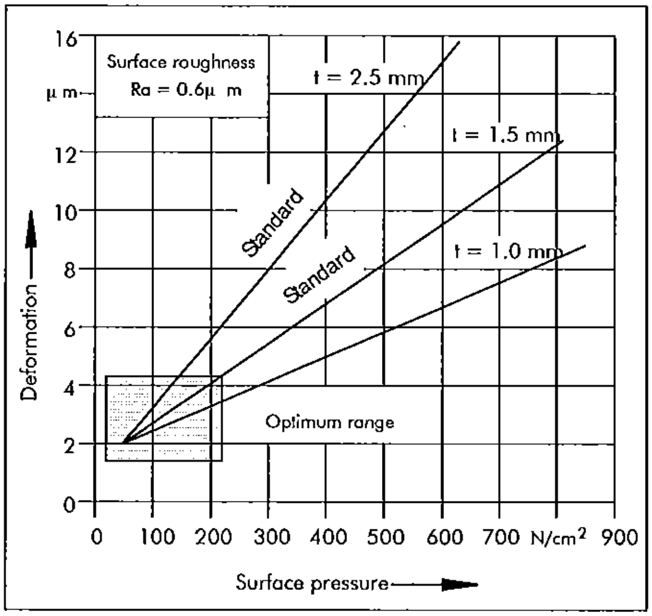


Figure 3 Deformation as a function of surface pressure and thickness t of the Turcite-B Slydway® material

Surface Roughness

Turcite®-B sliding surfaces can be finish machined by milling, grinding and/or scraping. The surface quality should be R_a = 0.6 µm. Minor deviations such as shown in figure 4 have an insignificant effect on the friction behaviour. However, with greater surface roughnesses the contact deformation and wear would increase. An insufficient surface roughness influences the sliding behaviour as the sliding surfaces stick together (adhesion).

Figure 4 shows an optimum surface roughness range which should be achieved during final machining of the surface.

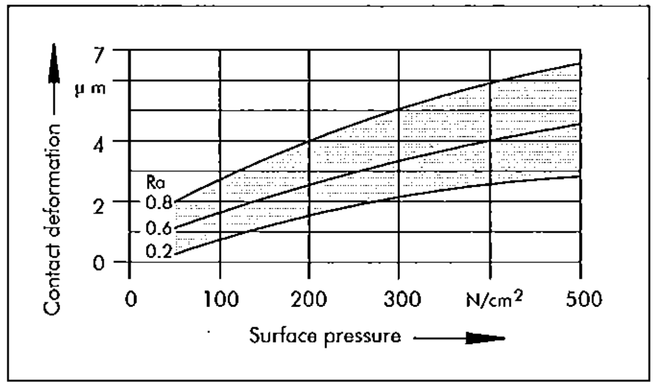


Figure 4 Deformation as a function of surface pressure for different surface roughness

Coefficients of Friction

In use Slydway® displays only a slight difference between static friction and dynamic friction, thus eliminating any stick-slip. When used in numerically controlled machines, this produces higher positioning and reproduction precision.

Static Friction

The coefficient of static friction for a Slydway® bearing depends on the material pairing in question and on the surface roughness of the Turcite®-B sliding surface, on the mating surface and on the lubrication.

Figure 5 shows the range of static friction when using different oils. The values were determined on a scraped Turcite®-B sliding surface with a surface contact pressure of 35 N/cm^2 and a surface roughness of the guide of $R_a = 0.6\ \mu m$.

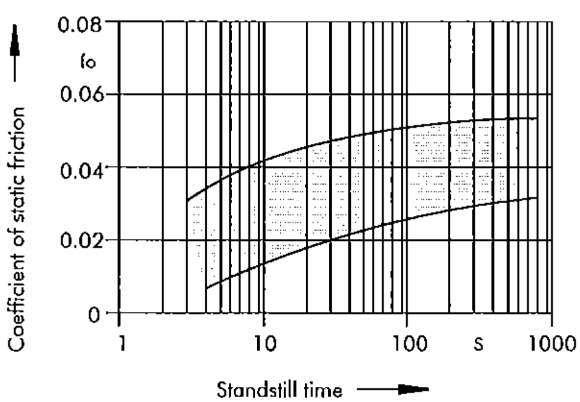


Figure 5 Range of the coefficient of static friction (fo) as a function of the standstill time when using different lubricants

Dynamic Friction

The dynamic friction for a Slydway® has a practically linear pattern over the whole speed range. The good material pair of Turcite®-B and hardened steel guides can be clearly seen in the mixed friction zone. With a combination of a surface load of 35 N/cm^2 and a scraped Turcite®-B surface, the coefficient of friction reaches

$$f = 0.022 - 0.055.$$

Figure 6 shows the least differences at the transition to the hydrodynamic range. With higher surface pressures of up to 200 N/m^2, the sliding behaviour changes only insignificantly.

Good lubrication is of paramount importance in order to achieve a controlled level of dynamic friction.

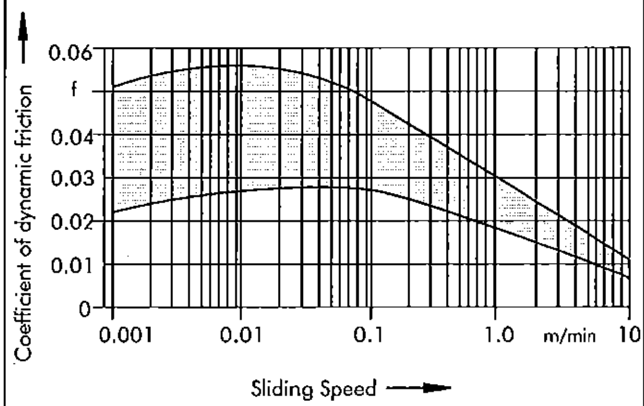


Figure 6 Range of the coefficient of dynamic friction (f) as a function of the sliding speed when using different lubricants

Wear

The service life and the continuous precision of a Slydway® is determined primarily by its wear behaviour. Slydway® linear bearing are generally supplied with adequate lubrication.

Should the lubricant supply suddenly be interrupted, Slydway® will remain functional with low wear even for prolonged periods due to the self-lubricating properties of the material. Very low wear rates are achieved using the combination of Slydway® and hardened mating surface.

The wear behaviour is determined to a great extent by the ambient influences. It is important to protect the guides from external soiling by using covers and seals.

The Slydway® has the great advantage of being able to absorb and embed small dirt particles, thus preventing immediate seizing, damage and extreme wear of the guides.

Start-up Phase

A linear bearing application, using Slydway® should always be well lubricated during the start-up phase. During the start-up phase, very fine particles of the Turcite®-B material are deposited on the mating surface.

This leads to a slight shading of the metallic running surfaces. The start-up phase is then concluded with the smoothing phase. A very low level of friction and wear is then reached which remains essentially constant (Figure 7).

The guides can then be used for continuous operation.

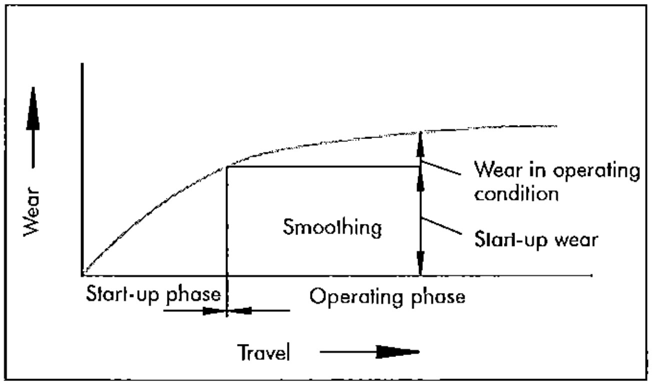


Figure 7 Wear as a function of the operating condition

Sliding Wear

Slydway® are set backlash-free or even slightly preloaded, thus ensuring a very high continuous precision even over many years. The sliding behaviour is then determined primarily by the lubricant and the surface finish.

Figure 8 shows the wear behaviour of a scraped Slydway® with a mean load of 50 N/cm^2 with adequate lubrication.

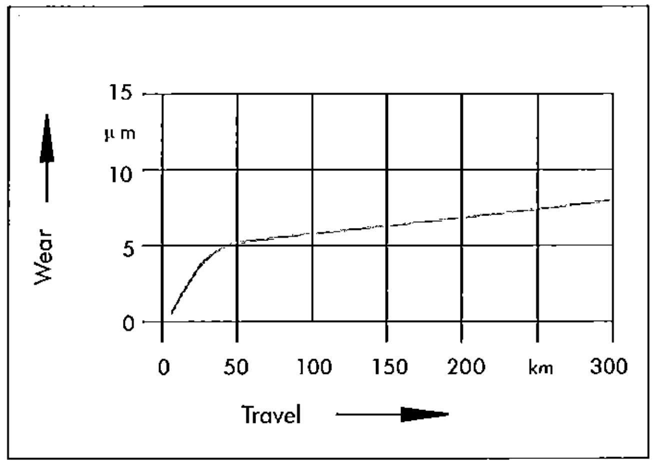


Figure 8 Wear behaviour of Turcite-B Slydway®

Mating Surfaces

In order to ensure a long service life, demands must also be made on the surface finish of the mating surface. The following values are recommended:

for steel	R_a	= 0.2 to 0.4 µm
	R_z	= 1.6 to 3.2 µm
	R_{max}	= 2.5 to 5.0 µm
for grey cast iron	R_a	= 0.2 to 0.8 µm
	R_z	= 1.6 to 6.3 µm
	R_{max}	= 2.5 to 10.0 µm

(These figures are only valid for Turcite®-B Slydway® applications).

Steel and cast iron are frequently used as materials for mating surfaces. Hardened mating surfaces are generally preferred for precision guides subject to high loads. In practice, hardnesses of approx. 60 HRc for steel and approx. 240 HB for cast iron have been found to be effective.

These sliding surfaces are not normally subject to any wear. For guide systems subject to less wear, unhardened and wear-resistant mating surfaces can also be used.

Mating surfaces of bronze, aluminium (untreated) or plastics are **not** suitable for use with Slydway®.

Temperature

The temperature at the sliding surfaces should be kept as constant as possible. In the event of elevated temperatures, an adequate heat dissipation must be assured by means of lubrication.

■ Installation Instructions

Securing the Slydway® Material

Slydway® material is secured by bonding. Performed with the necessary care, bonding is a reliable and inexpensive securing method.

Surface Preparation:

The preparation of the parts to be bonded together is of ultimate importance for achieving a good bond.

Machining of the adhesive surface is crucial for optimum bonding of Slydway®. To a certain extent, the surface roughness assists the bonding ability of the adhesive.
Surface Roughness R_a = 0.8 to 3.2 μm.

Additional possibilities of roughening the surface are sandblasting and rubbing with emery cloth (grain size: 100).

Cleaning the Bonding Surface

Before applying the adhesive, the bonding surfaces must be cleaned thoroughly and freed from oil, grease, dust and rust. Impurities can be removed by washing with a commercially available degreasing agent such as acetone, etc. When refurbishing machine tools with cast iron surfaces, flame treating of the porous surface to remove embedded oil deposits may be beneficial.

Bonding the Slydway®

Slydway® should be bonded in a clean environment and at normal room temperature, ideally 20 °C. A good two-component epoxy-resin adhesive is used. After mixing, apply the adhesive components to both parts to be bonded using a serrated spatula. Place the Slydway® material onto the surfaces to be joined and load them uniformly to eliminate any air and excess adhesive.

The parts should not shifted relative to one another during the prescribed hardening time. Finish machining of the Slydway® surface is carried out after the adhesive has hardened. We recommend the use of a Busak+Shamban two-component epoxy-resin adhesive.

Please send for our detailed bonding instructions.

Safety Precautions

When bonding Slydway® with epoxy-resin adhesives, the safety precautions in accordance with DIN 52900 must be observed. The working areas should be adequately ventilated. Smoking should be avoided during bonding and machining.

Machining

Slydway® can be machined mechanically after the bonding point has set. Turcite®-B materials can be machined quite easily.

Machining Methods

Precision Milling

For precision milling tools such as face cutters with one or more cutting edges made from high-speed steel, tungsten carbide or ceramic materials can be used.

Surface qualities such as those achievable when grinding can be produced with high cutting rates (up to 800 m/min) and low feed rates. In order to achieve a good surface finish, two cuts with small chip thicknesses are to be recommended.

No cooling is generally needed when milling Slydway®.

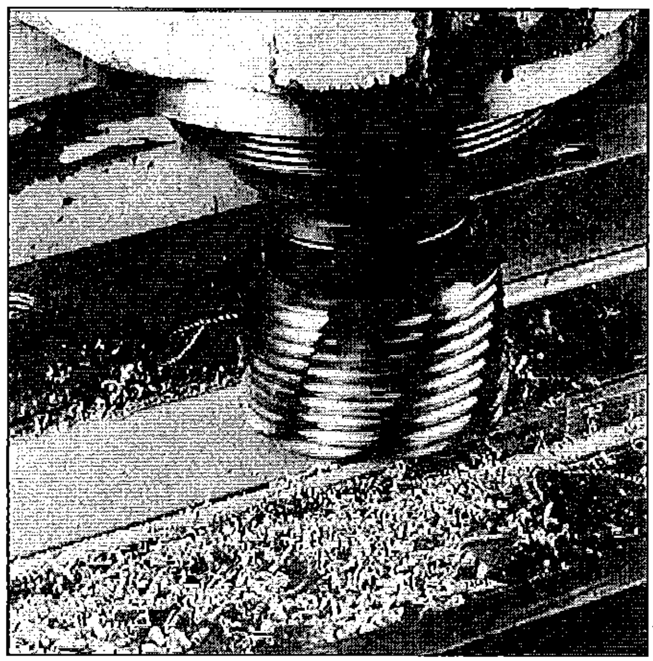


Figure 9 Precision Milling

Grinding

Grinding wheels with normal abrasives (e.g. special fused alumina, silicon carbide) can be used for grinding. The grinding wheels should have a medium grain (36) and a low hardness (I). The method of bonding can be ceramic (Ke) or may contain synthetic resin (Ba). Wet grinding is always recommended for grinding of Slydway®. The coolant dissipates the heat of grinding and provides a better surface finish. Grinding wastes have to be removed.

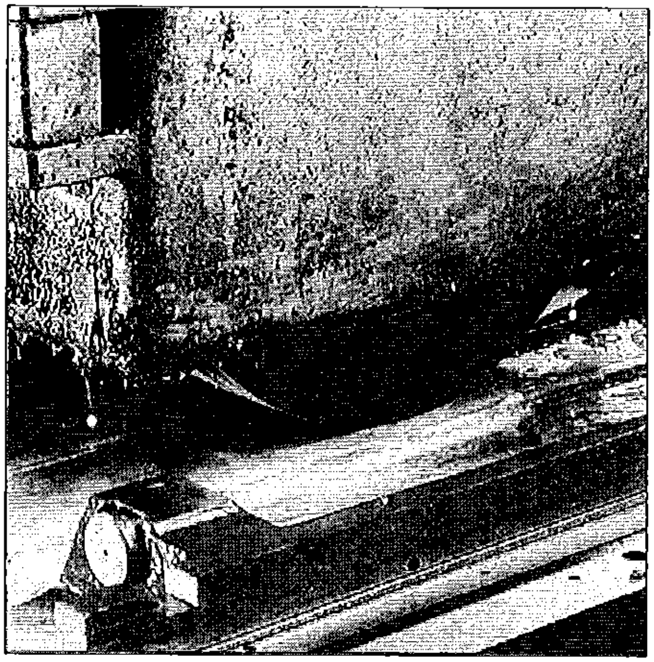


Figure 10 Grinding

Scraping

Milled and ground surfaces can be remachined by scraping to improve the surface quality and dimensional accuracy. Only sharply ground scraping tools should be used. Scraping can be performed manually or with a scraping machine. A grade of 2 is required for a precision surface, corresponding to 2 to 3 points per cm^2. A perfectly scraped or patterned surface enhances the tribological properties of the guides.

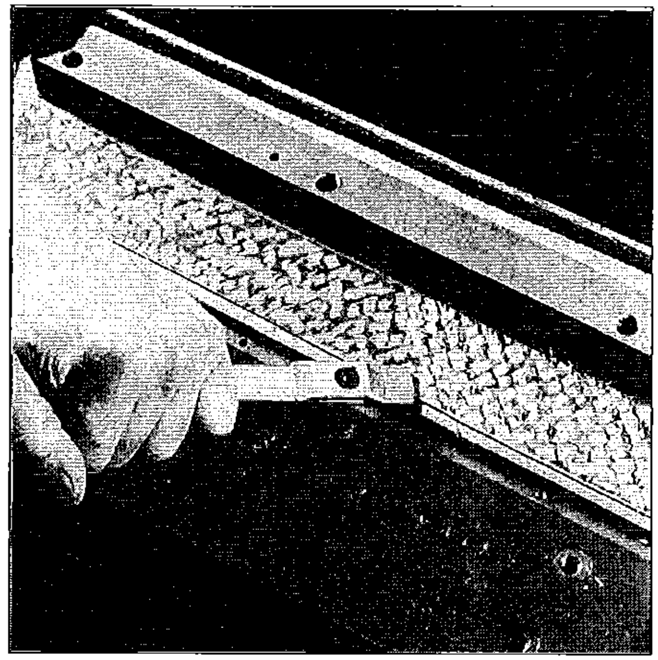


Figure 11 Scraping

Oil Grooves

Slydway® can be machined to incorporate oil or lubrication groove patterns. The configuration of the groove is optional. Is is best to mill the oil grooves into the material to a depth of 0.5 - 0.6 mm. Milling completely through the material into the metal saddle is not recommended. For any pattern chosen, it is extremely important that the milled grooves maintain a generous, smooth radius which blends the top of the groove back to the surface of the material without creating any sharp edges. Oil grooves should never be machined closer than 6 mm to the edge and 15 mm from the ends of the bearing material.