Composite Material K-TEX

Technical Details Brochure

SPECIALISTS IN THE MANUFACTURE & MACHINING OF ENGINEERING COMPOSITE MATERIALS

Index **Page**

Below are just a few of the products which we produce:

1. INTRODUCTION

K-TEX is a Composite Engineering material manufactured from synthetic fibres and thermosetting resins.

All grades of K-TEX are available with solid lubricant incorporated. The various grades contain either Graphite, P.T.F.E. or Molybdenum Disulphide dispersed evenly throughout the material, so that the wear of a components surface continually releases further lubricant.

The physical and mechanical properties of K-TEX make it an excellent bearing material. By varying the fabric reinforcement and the resin used, the physical and chemical properties of the material can be adjusted to suit a wide range of applications.

The chemical resistance of K-TEX allows many process liquors, solvents and sludge's to be used as lubricants, in addition light or heavy mineral oils, vegetable oils, soluble oils and greases are satisfactory. The surface asperities of the fibres in K-TEX tend to hold lubricant and thus assist in the maintenance of a continuous film on the working surface. However the grade K10 in particular has an extremely low rate of moisture absorption and therefore negligible dimensional change, making it ideally suitable for use in submerged water applications.

K-TEX offers the design engineer an attractive economical alternative to traditional materials used throughout industry for bushes, bearings, wear pads and many more applications. K-TEX is only 1/6 the weight of steel, is easily machined, contains no harmful or toxic materials and has exceptional dimensional stability, even in wet conditions.

K-TEX is highly recommended for use where other forms of lubricant are either not desirable or are erratic, intermittent or none existent. In addition, numerous cases where the maintenance of lubricant films is difficult this type of material has been found to give improved performance.

Special performance or properties such as fire retardance and acid resistance can be obtained by variations in either the resin or fabric reinforcement.

FOR GRADES AND MACHINING SERVICES SEE PAGES 6 AND 7.

APPLICATION DETAILS

With most lubricants K-TEX has a natural low coefficient of friction which reduces both bearing power loss and the rate of wear. Satisfactory bearing operation with liquid lubricants depends upon the interaction between the lubricant and the bearing surface. Almost any fluid can be considered for use as a lubricant with K-TEX, although under suitable conditions water and aqueous solutions give the best results. Dynamic friction coefficients in the region of 0.003 have been recorded for K-TEX with water lubrication.

The wear mechanisms found with K-TEX differ from those commonly associated with metals and are usually much less severe. The material is however susceptible to cutting wear when in contact with rough surfaces and consequently a fine machined finish should be given to mating parts. If this precaution is observed and the lubrication is adequate, the metal and the K-TEX will acquire highly polished surfaces whilst in use thus prolonging life and reducing friction.

Although K-TEX is a relatively soft material, because of its thermosetting nature, it acts as a metal polisher and it's none scratch properties make it suitable for many applications where process materials are subject to damage by metal roll surfaces. In particular K-TEX covered rolls have found a wide use in the handling of bright metal strips on run out tables for rolling mills also in electroplating and pickling processes. In the latter cases, the corrosion resistance of K-TEX makes it particularly suitable. K-TEX rolls have been used in handling metal rods and tubes where damage to metal surfaces and excessive wear of roll covering, particularly grooving effects must be avoided.

In the plastics industry K-TEX rolls are used in the handling of thermoplastics in sheet and rod form. In some cases low thermal conductivity of the materials is useful where rapid cooling of the process material is undesirable.

Over many years and thousands of applications K-TEX has given considerable cost savings. In particular it has proven that it does not wear mating components such as shafts and pins.

K-TEX is non-magnetic and is useful where rotating metal rolls interfere with magnetic or electrical fields. An interesting use of this property occurs in the mining industry where K-TEX rolls are used in the tramp iron detection points on conveyor belts.

2. OUR PRODUCTS

- **RAW; SHEETS, RODS, TUBES**



- **BUSHES - FLANGE/ STANDARD/ NON-STANDARD**



- **WASHERS**


- **WEAR PADS**


- **WEARSTRIP**


- **WEAR RINGS – SPLIT/UNSPLIT**


- **SPHERICALS**



- **CUSTOM PARTS**



More pictures can be supplied on request.

3. GRADES

All grades can have a different coloured dye/pigment added if a certain colour product is required. This does not change the physical properties just the appearance.

GRADE	COLOUR	PROPERTIES & TYPICAL APPLICATIONS
K10	White	Dimensionally stable bearing material for use primarily in harmless fluids, e.g. in water, oils etc.
K11	Dark Grey	Self-lubricating version of K10. It is an inexpensive general-purpose hard wearing material to replace most existing metallic or non-metallic bearing materials.
K14	Light Grey	Self-lubricating high performance bearing material.
K15	Light Grey	Low friction marine bearing material.
K1C	Red	PTFE with the addition of ceramic powder, for use in extremely hard wearing applications.
K1D	Dark Grey/ Colour Chosen	Special PTFE layer incorporated in wearing surface which creates a very low co-efficient of friction. Different colours can be added to differentiate between wearing surface.
K21	Dark Grey	Enhanced Temperature version of K11. Has limited chemical resistance, capable of withstanding: 120 degrees Centigrade constant. 130 degrees Centigrade intermittent.
K15	Light Grey	Low friction marine bearing material.
K28	White	High performance hard wearing material. High slip properties most suitable for Wear Pad or Press Slide arm type applications.
K41	Light Grey	Fire retardant, self-lubricating grade. Essential for underground mining applications.
K60	To Order	Superior chemical resistant grade.
K61	Dark Grey	Superior chemical resistance at lower temperatures than K21. Excellent for applications in sewage, acid pickling baths and acid vapour environments.

MACHINING SERVICES

We have a full range of machining services available, from Milling, Turning, Boring, Drilling and Finishing. This ensures that any size, shape and application can be designed and manufactured to the clients exacting standards.

Semi-Finished Product	Dimension	mm	Inches
Tube	Minimum I/D	8	3/8"
	Maximum O/D	1000	39 3/8"
	Maximum Length	610	24"
Solid Rod	Minimum O/D	8	3/8"
	Maximum O/D	300	12"
	Maximum Length	500	19 5/8"
Sheet	Minimum Thickness	2	1/8"
	Maximum Thickness	200	8"
	Maximum Length	5000	196 7/8"
	Maximum Width	1000	39"

Finished Product	Dimension	mm	Inches
Bushes	Minimum I/D	10	3/8"
	Maximum O/D	1500	59"
	Maximum Length	610/254	24"/10"
Milled Pads	Minimum Thickness	3	1/8"
	Maximum Thickness	305	12"
	Minimum Width/Length	8 x 8	3/8" x 3/8"
	Maximum Width/Length	850 x 2000	33 ½" x 78 ¾"

Most sizes can be handled by our works, for exceptional sizes, contact our sales department.

We also produce PTFE layered material, as can be seen below:

4. SPECIAL PRODUCTS

Special components can be manufactured to customer's drawings from all grades of K-TEX.

In addition to special wear pads, bearings and bushes. Plain spherical bearings can be manufactured in K-TEX to solve misalignment problems.

Spherical bearings with metallic and K-TEX materials combined can also be produced.

For those applications where a fire risk exists, K-TEX can be produced with exceptional fire retardant properties.

5. DENSITY

K-TEX has a low Density and its Strength/Weight ratio compares favourably with other materials as seen in the table below:

Material	Density gms/cc	Compressive Strength p.s.i. (Kg/cm²)	Strength Weight Ratio
Stainless Steel	7,85	150000,00 (10545)	19100,00
Aluminium Alloy	2,30	40000,00 (2812)	17400,00
Magnesium Alloy	1,18	35000,00 (2460)	19300,00
Typical Hardwood	0,07	9250,00 (650)	13200,00
Typical Softwoods	0,45	6500,00 (457)	14500,00
K-TEX	**1,25 – 1,48**	**30000,00 – 50000,00 (2109 – 3515)**	**24000 - 40000**

6. PHYSICAL AND MECHANICAL PROPERTIES

Tensile Strength	(lb/sq.In.)	13500,00
	(N/mm²)	90,00
Compressive Strength 1. Normal to laminate	(lb/sq.In.)	50000,00
Safe Working Load SWL = 138 N/mm2	(N/mm²)	345,00
2. Parallel to laminate	(lb/sq.In.)	14000,00
	(N/mm²)	97,00
Flexural Strength	(lb/sq.In.)	20000,00
	(N/mm²)	138,00
Flexural Modulus	(lb/sq.In x 10^6)	0.47
	(M/mX10^4)	0.32
Impact Strength Normal to laminate (Notched Izod) B.S. 2782	(ib/sq.)	> 10.0
Shear Strength	(ib/sq. in)	19500,00
	(N/mm²)	134,00
Hardness Rockwell M		100,00
Density (gm/cm 2)	(Gms/cc)	1.25-1,48
Swell in Water (1" Wall thickness)		< 0.1%

7. CHEMICAL AND CORROSION RESISTANCE

S = Satisfactory
L = Satisfactory for limited service
U = Unsatisfactory

		20°C	50°C
Acetic Acid	15%	S	L
Acetic Acid	100%	U	U
Acetone	15%	S	L
Acetone	100%	U	U
Alcohol Ethyl	15%	S	S
Alcohol Ethyl	100%	S	S
Aluminium Sulphate		S	S
Ammonia Liquid		U	U
Ammonia Aqueous		U	U
Ammonium Carbonate		S	L
Ammonium Nitrate		S	S
Benzene		S	L
Bleach Liquors		S	L
Calcium Chloride		S	S
Calcium Hydroxide		U	U
Carbon Tetrachloride		S	S
Chlorine Water		S	L
Creosote		S	S
Citric Acid		S	S
Ethylene Glycol		S	S
Fatty Acids		S	S
Hydrochloric Acid		S	S
Hydrofluoric Acid		U	U
Maleic Acid		S	S
Naphtha		S	S
Nitric Acid	15%	S	L
Nitric Acid	100%	U	U
Oxalic Acid		S	S
Phosphoric Acid		S	S
Phthalic Anhydride		S	S
Potassium Hydroxide		U	U
Sodium Carbonate	25%	S	S
Sodium Carbonate	100%	L	U
Sodium Chloride		S	S
Sodium Hydroxide		U	U
Sodium Nitrate		S	S
Sodium Nitrite		S	S
Sulphuric Acid	50%	S	S
Sulphuric Acid	100%	U	U
Trichlorethylene		U	U

CHEMICAL AND CORROSION RESISTANCE cont.

The previous table refers in particular to K-TEX K20 grade, but in many cases the alternative grades of K-TEX may be used.

K-TEX does not corrode and is unaffected by many solvents, inorganic solutions, fats and weak acids.

It should be noted that water and chemical liquids often act as lubricants on the material giving low coefficients of friction and thereby eliminating the problems commonly encountered by metal bearings.

K-TEX is attacked by keytones, chlorinated solvents, strong alkalis and hot strong oxidising agents.

For acidic and alkaline applications, refer to the K-TEX technical department for recommendations.

"Satisfactory" means that the material retains 50% or over of its original dry strength after immersion for at least six months.

8. RADIATION RESISTANCE

	EXPOSURE			
	Control	1 X 10^6 Grey	3 X 10^6 Grey	10 X 10^6 Grey
		(100 Mrad)	(300 Mrad)	(500 Mrad)
Tensile Strength (lb/sq.In.)	11,150	8,700	6,000	3,250
(N/mm^2)	77	60	41	22
Compressive Strength Parallel to laminate (lb/sq.In.)	14,900	21,700	18,000	13,800
(N/mm^2)	103	150	124	95
Normal to laminate (lb/sq.In.)	49,100	43,400	35,200	26,800
(N/mm^2)	339	299	243	185
Impact Strength Izod Un-notched (ft lbf)	20	20	11.5	4.5
Flexural Strength (lb/sq.In.)	10,700	11,900	11,100	8,350
(N/mm^2)	74	82	76	58
Flexural Modulus (lb/sq.In. X 10^6)	0.485	0.590	0.535	0.487
(N/mm X 10^3)	3.34	4.07	3.69	3.35

RADIATION RESISTANCE cont.

In nuclear engineering applications, bearing materials are required which can operate without oil or grease, retain physical strength under heavy radiation and remain unaffected by immersion in 'pond' water.

When polymers are exposed to gamma radiation, the first result is the activation and crosslinking of linear chains. This mechanism is most marked in the case of thermocomposite polymers which increase in hardness and softening point at the same time losing flexibility. If irradiation is continued scission of linkages becomes significant and degradation of physical properties by depolymerisation results.

Thermosetting polymers are affected in the same way although less opportunity for increased crosslinking occurs in the early stages; depolymerisation generally requires higher radiation levels than with thermoplastics. However when used as bearings, thermosetting polymers are always reinforced by fibre or fabrics, consequently the radiation resistance of the laminates are usually dependent on the properties of the reinforcement.

K-TEX Grade K10 shows excellent resistance to the effects of radiation.
From the table it can be seen that although there is a marked reduction in tensile strength at high radiation levels, the compressive strength normal to laminate shows only a gradual reduction and parallel to the laminate, a considerable increase in strength up to high radiation levels, indicating an improvement in inter-laminate adhesion.

9. ELECTRICAL AND MAGNETIC PROPERTIES

	Grade
	K10
Insulation Resistance (Megohms) BSS. 2782 (Pt.2)	2000,00
Electrical Strength at 90°C BSS. 2782 (Pt.2) Flatwise (Volts / mil)	210,00
Edgewise (kV / inch)	47,00
Power Factor (1 M/c per sec)	0.021
Permittivity (1 M/c per sec)	3.1

All grades of K-TEX are excellent insulating materials and may be used in many electrical applications. Used as bushes or washers, K-TEX is suitable for use in dynamos, electric motors, generators etc.

As flat laminate, it can be used in heavy switchgear, transformers insulating chassis and as general constructional material. Sliprings and other current transfer devices can be also be manufactured from K-TEX.

K-TEX is non-magnetic and does not build-up static charges. These properties may often be exploited to an advantage where interference with magnetic or electrical fields, or where accumulation of static electricity must be avoided.

10. THERMAL PROPERTIES

	Grade
	K10
Linear Expansion Coefficients 20 - 100°C (per °C x 10^{-5}) 1. Parallel to laminate 2. Normal to laminate	2.6 – 3 4.9 – 5
Maximum operating temperature	130°C requirement specified
Minimum operating temperature	-40°C
Thermal Conductivity	0.293
Specific Heat (J/kg °K)	1.005

In common with all resin bonded fabrics K-TEX has a low thermal conductivity and although in normal circumstances frictional heat is removed via the mating metal part, in cases where shafts or housings are conducting heat to the bearing assembly, the lubricant supply must be sufficient to remove both frictional and conducted heat.

The frictional heat generated in a bearing is given by the relation:

$$\text{Heat (in kW)} = \frac{\mu P D N \pi}{6 \times 10^7}$$

Where D = Shaft diameter (in mm)
N = Shaft r.p.m.
P = Total load (in N)
μ = Coefficient of friction

The removal of frictional heat may be improved, particularly in dry running applications by using the housing as the main heat conductor. The wall thickness of bearings should be kept to a minimum in order to improve heat dissipation.

Thermal expansion of K-TEX is greater than that of many metal alloy bearings and this characteristic must be taken into account in designs for higher temperature applications. As K-TEX is a laminated material, coefficients of expansion vary with the direction of measurement.

11. FRICTION VALUES

PV (Pressure / Velocity)

The frictional heat build-up at a journal bearing interface is the principle limiting factor controlling its successful operation.

The rate at which the temperature rise takes place is dependent on the speed and pressure at the bearing, the coefficient of friction and the thermal dissipation rate of the design. Factors such as the surface roughness of the shaft, the type of lubrication system, environmental temperature etc. will also influence the performance of the bearing.

Bearing calculations attempting to take account of all these variables would be unreasonably complex and experience has shown that the use of a simple pressure / velocity (PV) factor when correctly applied is just as effective. The PV value is the product of the applied pressure and the rubbing velocity.

PV values should be calculated for the continuously applied operational conditions ensuring that the P and V limits for the material grade are not exceeded. Where bearings are subjected to intermittent shock or overload conditions for short periods, the pressure should also be calculated at the peak loading; it must not exceed the maximum working compressive stress.

If the calculated PV figure is too high, then the bearing length or shaft diameter should be increased to reduce pressure, or the shaft diameter decreased to reduce velocity.
Note: it is better to keep the bearing length to diameter ratio below 2:1 if possible,

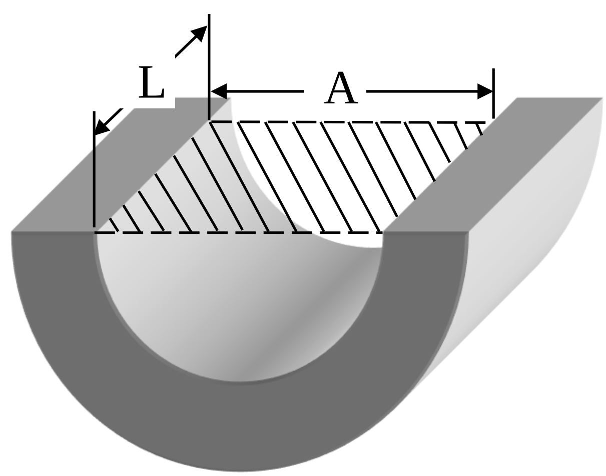
Typical PV curves for each of the basic grades of K-TEX are shown on the next page.

Calculation:

Bearing pressure (P) = $\frac{W}{A \times L}$ kgf/cm²

Rubbing Velocity (V) = $\pi \times d \times N$ Metres/min

Pressure / Velocity (PV) = P x V kgf/cm² m/min

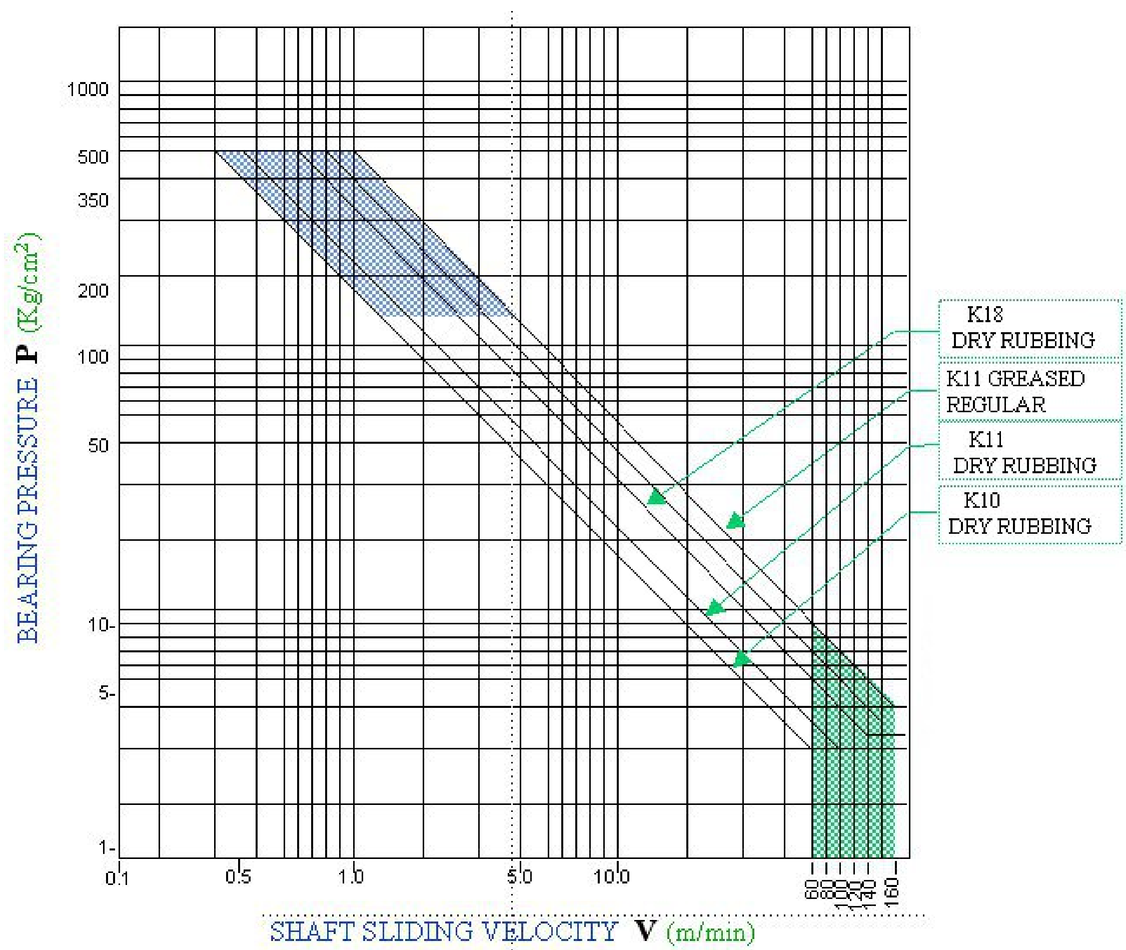


FRICTION VALUES cont.

The lowest PV rating in each case is for a completely dry running application. The addition of lubricant and / or cooling medium will permit this to be considerably increased.

The rubbing velocity limit set in these graphs can be increased by a considerable margin when hydrodynamic conditions exist. Where a bearing is required to run hydrodynamically PV values become meaningless and new criteria apply. Speeds in excess of 300 metres / minute are frequently used on pump bearings with negligible wear.

K-TEX GRADES LIMITING PV VALUES



Material Type	Dry Rubbing	Regular Grease
K10	160 (7470)	480 (22400)
K11	200 (9340)	600 (28000)
K18	250 (11675)	

PV VALUES IN kg/cm2. M/MIN (lbf/in2 - ft/min)
TEST PIECES MILD STEEL SHAFTS - EN3B SURFACE FIN. 0.8 mm Ra.

PRP THE SEALING EXPERTS

FRICTION VALUES cont.

(A) Effects of Lubrication on Co-Efficient of Friction

	Lubrication				
	None	Water	Soluble Oil	Grease	Oil
K10	0.18 - 0.20	0.010	0.019	0.013	0.020

Material: Standard K-TEX grade running against 18/8 Stainless Steel
Bearing pressure – 15.4N/mm² (2240lb/sq inch)
Surface Speed – 2.25m/sec (450feet/min)

(B) Co-Efficient of Friction Dry

Material: K-TEX grade K10 running against stainless steel

Stainless Steel

SURFACE SPEED (mm/sec)	BEARING PRESSURE (N/mm²)											
	5		10		15		20		25		30	
	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic
1	0.187	0.179	0.184	0.183	0.189	0.178	0.201	0.180	0.201	0.184	0.191	0.175
5	0.186	0.175	0.177	0.175	0.189	0.178	0.191	0.186	0.193	0.187	0.192	0.181
10	0.177	0.173	0.181	0.167	0.195	0.180	0.191	0.178	0.192	0.182	0.190	0.178

K-TEX

SURFACE SPEED (mm/sec)	BEARING PRESSURE (N/mm²)											
	5		10		15		20		25		30	
	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic
1	0.138	0.124	0.132	0.128	0.129	0.125	0.131	0.125	0.130	0.125	0.125	0.124
5	0.145	0.140	0.140	0.136	0.135	0.132	0.132	0.129	0.132	0.130	0.132	0.131
10	0.154	0.146	0.147	0.143	0.141	0.137	0.136	0.133	0.137	0.136	0.138	0.137

12. MACHINING

K-TEX is readily machinable by conventional engineering techniques and as a general guide may be treated as brass or lignum vitae, but should be machined dry without coolant.

Turning

Tungsten carbide tipped tools should be used to obtain a fine finish.
High-speed steel tools can be used for machining where accuracy below 0.005” (0.127mm) is not required. The can also be used on small quantity production.

Tool cutting angles

Top rake	0 to 5 degrees
Side rake	5 to 7 degrees
Front rake	5 degrees

Cutting speeds

For good surface finish	1,200 f.p.m. (6.1m/sec)
For longer tool life	1,000 - 1,100 f.p.m. (5.1 - 5.6m/sec)
For form tools	900 - 1,000 f.p.m. (4.6 - 6.1m/sec)

Cutting feeds

Rough turning	0.020” - 0.030” (0.51 - 0.76mm) per rev.
Finishing cut	0.010” - 0.015” (0.25 - 0.38mm) per rev.

Milling

This follows metal machining techniques and cutting speeds as for turning. Feeds should be limited to 0.010” - 0.015” (0.25 - 0.38mm) per tooth, to prolong cutter life and reduce excessive heat build-up.

Drilling

This should be carried out with high-speed tungsten twist drills at 100 - 120 f.p.m. (0.5 - 0.6m/sec) peripheral speed. The feed should be limited to 2” - 3” (51 - 76mm) per minute.

MACHINING cont.

Shaping (Planning)

This method of machining should be avoided if possible, but if used the machining should be carried out parallel to the laminations of the material.

Grinding & Sanding

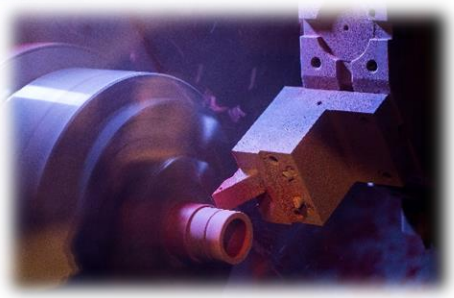
While good surface finishes can be obtained with turning and it is seldom necessary to finish by grinding, K-TEX can be successfully ground and sanded. High surface speeds should be used and cuts limited to 0.001" (0.025mm) for final surfacing.

Toxicity

No phenolic resins or Asbestos are used in the manufacture of K-TEX products and the material is completely non-toxic.

Dust

It is advisable to use adequate dust extraction when machining K-TEX.



13. DESIGN AND INSTALLATION OF BUSHES AND BEARINGS

A. Bearing Design

Flanges:

The best results are obtained when the bearing surface is parallel to, or concentric with the layers of the material and at right angles (normal) to the load direction.

Radial bushes: Are manufactured from K-TEX material with the layers concentric with the axis of the rotating or sliding journal or pin.

End or Thrust bearings: Are made from flat laminate with the laminations at right angles (normal) to the journal axis and the end load.

It is recommended that where bushes have integral flanges, axial loads (i.e. on the face of the flange) are kept to a minimum. Similarly consideration must be given to the design of any component (e.g. pulleys) where there are likely to be bending or shear loads applied along the direction of lamination.

Surface finish:

The surface finish of the mating component has a major effect on the performance of the bearing. Surface roughness should ideally be between 0.8 μm (32 μ-in) and 0.1 μm (4 μ-in) Ra.

Suitable materials for shafts, thrust faces etc… would be hardened steels, stainless and gunmetal. Hard chrome plated surfaces cause high wear rates under certain conditions, therefore furnishing or other specialist surface finish treatments should be considered as an alternative.

The main criteria is that the mating surface should be free of cutting edges. Similarly journals or thrust faces should be free of lubrication grooves or holes, except where matched to non-loaded grooves in the bearing.

<u>**DESIGN AND INSTALLATION OF BUSHES AND BEARINGS cont.**</u>

Fig. 1,0.

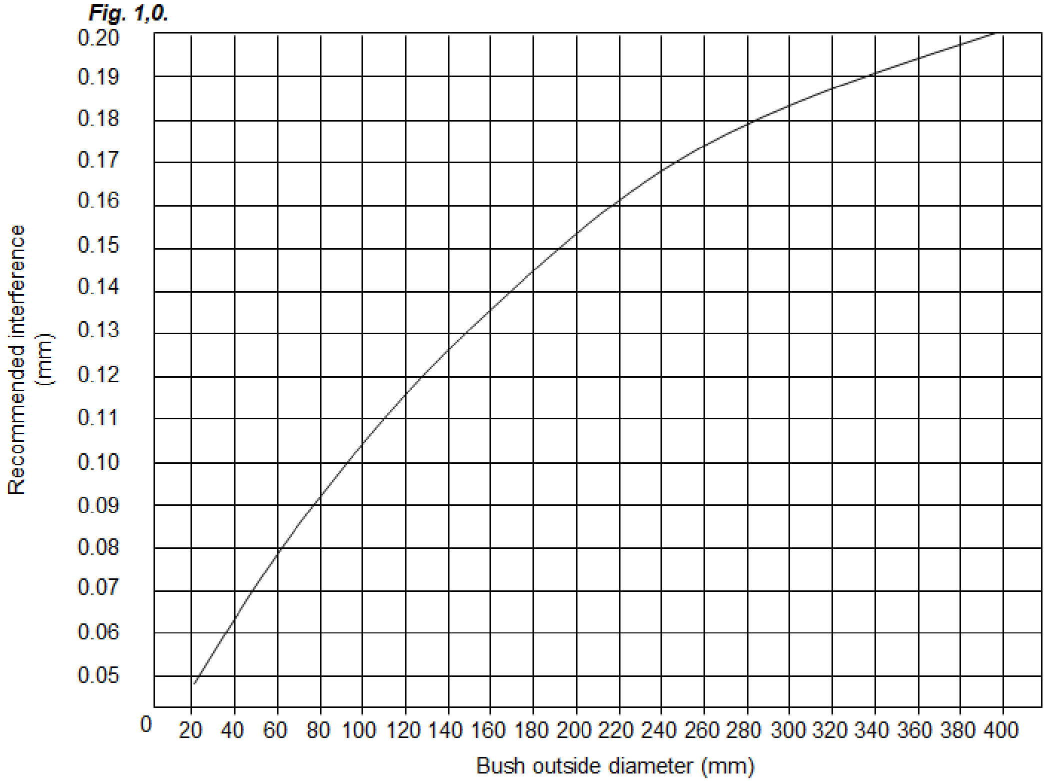
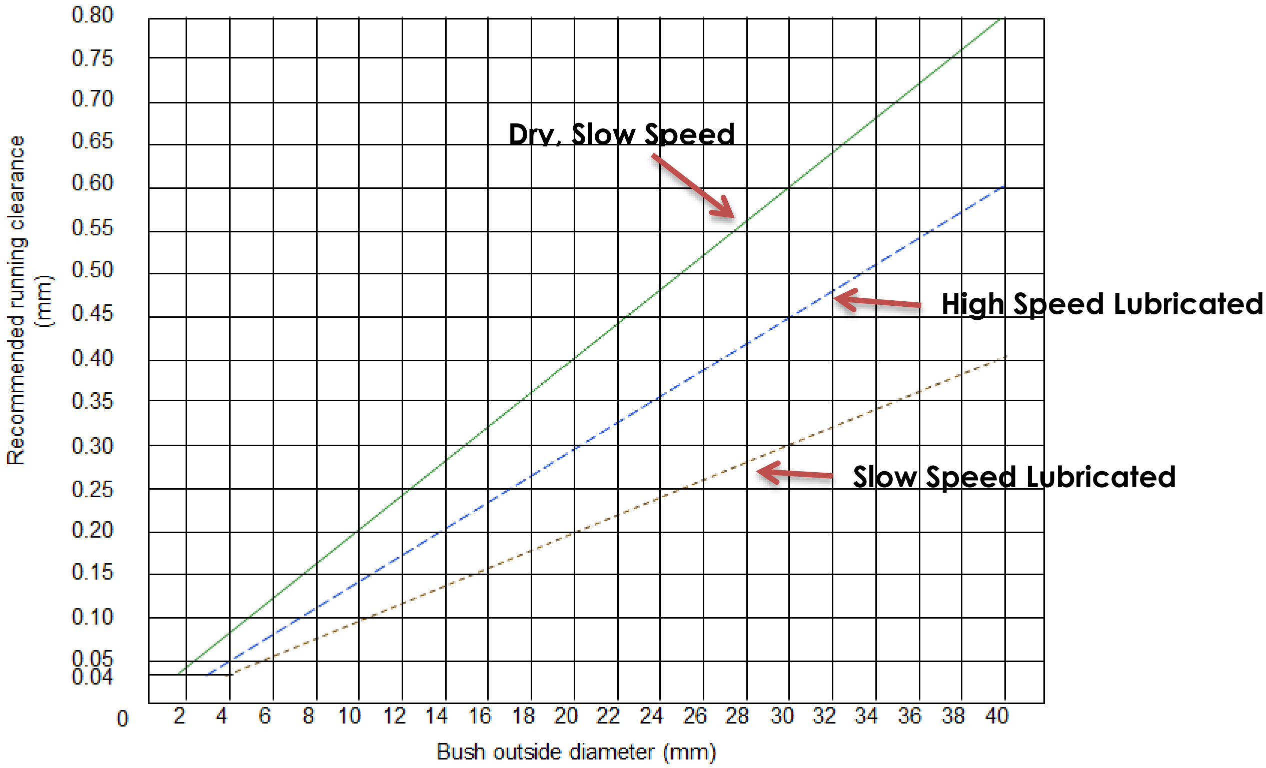


Fig. 2,0.



DESIGN AND INSTALLATION OF BUSHES AND BEARINGS cont.

Fig. 3,0.

Manufacturing tolerances for K-TEX K10 bushes.

Shaft Outside Diameter	Manufacturing Tolerance
Millimetres (mm)	Millimetres (mm)
10 – 200	0.05
201 – 400	0.10
over 400	Consult Tech Department

Fig. 4,0.

Recommended wall thickness for K-TEX K10 bushes.

Shaft Outside Diameter	Recommended Wall Thickness
Millimetres (mm)	Millimetres (mm)
6 – 25	1.50
26 – 50	2.50
51 – 75	3.50
76 – 100	5.00
101 – 150	6.50
151 – 200	8.00
201 – 280	10.00
281 – 400	12.00

Note: If special running clearances are required (e.g. for highly loaded static applications) please contact K-TEX technical department.

All test results are based on a standard temperature of 20°C.

DESIGN AND INSTALLATION OF BUSHES AND BEARINGS cont.

B. Installation

The K-TEX material should be fully supported over its loaded area, with uniform interference fit in the case of bushes.

A suitable lead-in chamfer should be provided in the housing and drawing or pressing-in methods should be used. **Hammer blows should be avoided.**

It is recommended that bearings be retained by shoulders whenever possible. Flat components such as wear pads can be retained by countersunk screws and located by keeper plates.

Where high lateral or shearing loads are anticipated K-TEX can also be bonded using two-part epoxy resin adhesives, but manufacturers recommendations must be strictly followed, particularly with reference to pre-treatment of the surfaces.

Where possible, unless being used as lubricants, contaminating or corroding liquids should be excluded from the bearing interface, as should abrasive particles. Sealing will also help to retain lubricants.

Calculating bush sizes

To calculate the bush O.D.:

Bush O.D. (min) = Housing (max) + Interference (min) see *Fig. 1,0.*

Bush O.D. (max) = Bush O.D. (min) + Manufacturing tolerance see *Fig. 3,0.*

To calculate the bush I.D.:

Bush I.D. (min) = Shaft dia (max) + Bore closure + running clearance (min) see *Fig. 2,0.*

NOTE: see bore closure details.

To calculate the wall thickness:

$$\text{Wall thickness (max)} = \frac{\text{Bush O.D. (max)} - \text{Bush I.D. (min)}}{2}$$

Wall thickness (min) = wall thickness (max) - manufacturing tolerance

DESIGN AND INSTALLATION OF BUSHES AND BEARINGS cont.

Bore closure

For wall thickness shown in *Fig. 4,0.* 100% of the bush / housing interference will be transmitted to the bush internal diameter, causing a corresponding reduction in the bore size when fitted.

For temperatures above 20°C and thick wall bushes above the recommended wall thickness, thermal expansion should be taken into account.

Typical examples:

1. For shaft size of 55.0 mm diameter, the recommended wall thickness from Fig. *4,0.* would be 3.5 mm, therefore the bush O.D. would be 55 + (2 X 3.5) = 62.0 mm nominal.

The recommended wall thickness, bore closure would be 100% of the bush housing interference from *Fig. 1,0.* = 100% X 0.080 = 0.080 mm

2. For shaft size of 55.0 mm diameter, wall thickness 25.0 mm, the bush O.D. would be 55 + (2 X 25) = 105 mm nominal. Bore closure due to bush housing interference from *Fig. 1,0.* = 0.105 mm.
For a temperature of 90°C, increase from standard = 90 - 20 = 70°C temperature change.

Wall thickness X temperature change X linear expansion co-efficient:

= 25 X 70 X 12 X 10^{-5}
= 21000 X 10^{-5}
= 0.21 mm

Bore closure due to expansion = 2 X 0.21 = 0.42 mm

Bore closure due to bush / housing interference = 0.105 mm.

Total bore closure = 0.105 + 0.42 = 0.525 mm

DESIGN AND INSTALLATION OF BUSHES AND BEARINGS cont.

Press-Fit interference allowance

An allowance must be made in calculating the free bush bore diameter and as a general rule, bushes with a wall thickness up to 12mm, the full 100% transfer of interference is reflected in the bearing bore.

For bushes over 12mm wall thickness, an allowance of 80% transfer is reflected in the bearing bore.

Keying and mechanical location of K-TEX is not normally required. Due to its low modulus of elasticity, moderate interference fits can be applied and these are normally sufficient to locate and hold the bush. The recommended interference fits for all grades are given in table *Fig. 5,0.*

Fig. 5,0.

Shaft Diameter	**Bearing pressures up to 2000 p.s.i. interference fit on outside diameter**
Millimetres (mm)	Millimetres (mm)
13	+ 0.050
25	+ 0.060
38	+ 0.076
51	+ 0.076
64	+ 0.076
76	+ 0.076
89	+ 0.010
102	+ 0.010
114	+ 0.010
127	+ 0.010
140	+ 0.013
152	+ 0.013
203	+ 0.015
254	+ 0.015
305	+ 0.015
356	+ 0.018

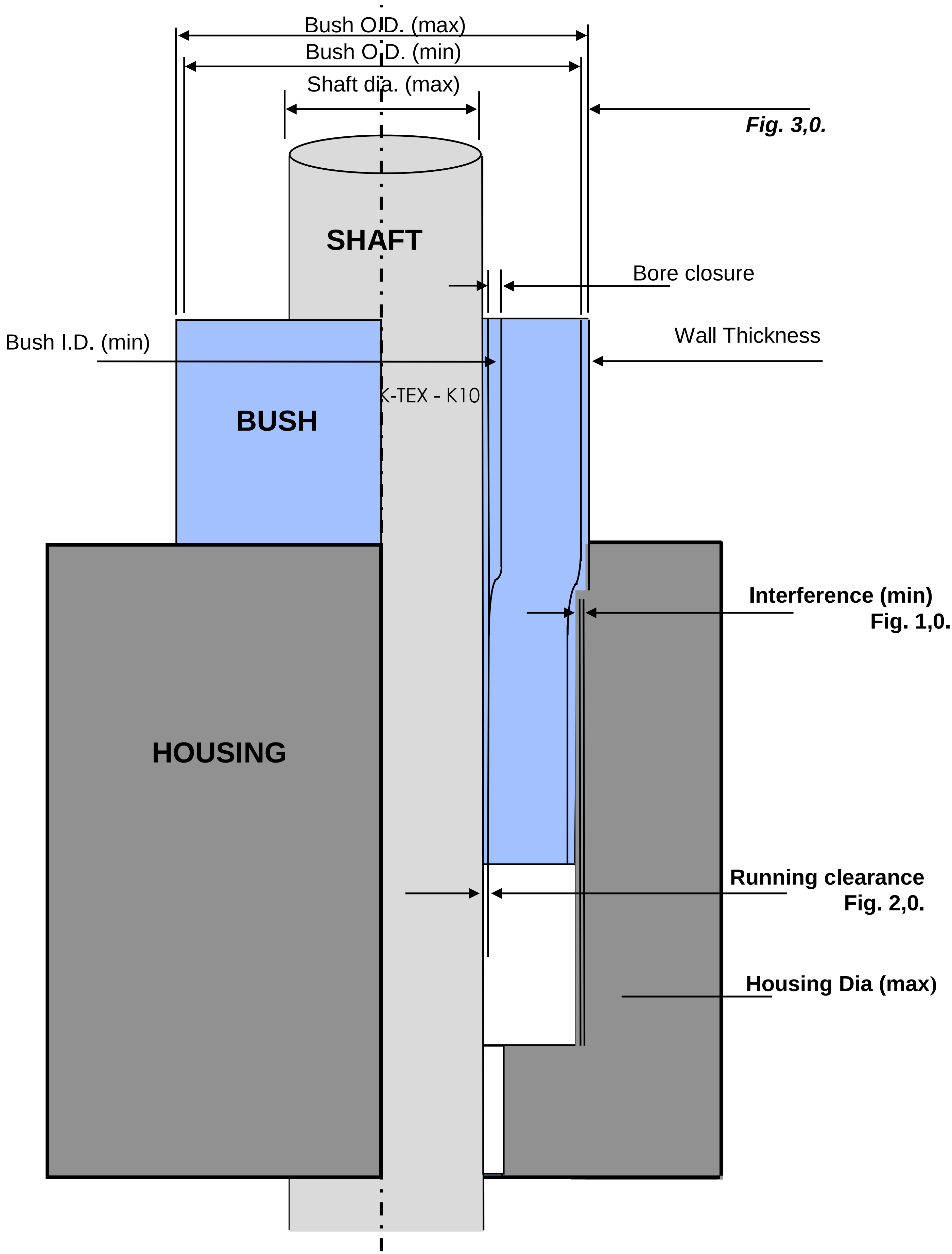
DESIGN AND INSTALLATION OF BUSHES AND BEARINGS cont.

Journal clearance - Running fits

Fig. 6,0. below lists the recommended bore allowances for a range of bush sizes under load conditions. These include factors for final running clearance and transfer of interference fit.

Shaft Diameter	**Bore allowances on I/D up to 1000 p.s.i. 70kg/cm²**
Millimetres (mm)	Millimetres (mm)
13	+ 0.15
25	+ 0.15
38	+ 0.20
51	+ 0.23
64	+ 0.28
76	+ 0.30
89	+ 0.33
102	+ 0.33
127	+ 0.38
152	+ 0.40
203	+ 0.46
Shaft Diameter	**Bore allowances on I/D up to 1000 - 2000 p.s.i. 70 - 140kg/cm²**
Millimetres (mm)	Millimetres (mm)
13	+ 0.20
25	+ 0.20
38	+ 0.25
51	+ 0.28
64	+ 0.33
76	+ 0.36
89	+ 0.38
102	+ 0.38
127	+ 0.41
152	+ 0.46
203	+ 0.51

DESIGN AND INSTALLATION OF BUSHES AND BEARINGS cont.



14. MATERIAL SAFETY DATA

SAFETY DATA SHEET – K-TEX K10

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Name : PRECISION RUBBER PRODUCTS ITALIA SRL

Product Name: K-TEX - K10

Chemical Name: Polyester Composite

2. HAZARDS IDENTIFICATION

Main Hazards: Dust Inhalation,
Particles in the Eyes,
Manual Handling.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Identification of the Preparation: Manufacture of Composite Materials

Chemical Name	Weight (%)	Other
POLYESTER RESIN		
CATALYST		
ACCELERATOR		
POLYESTER CLOTH		

4. FIRST AID MEASURES

Ingestion: Non-hazardous.

Inhalation: Irritant above recommended exposure limits.

Skin: Non-hazardous.

Eyes: Remove affected person to fresh air, wash with copious water/eye wash, seek medical attention.

5. FIRE-FIGHTING MEASURES

Flash Point:	N/A
Method Used:	N/A
Extinguishing Media:	Foam, ABC powder, Carbon dioxide.
Extinguishing Media NOT to Use:	N/A
Special Fire Fighting Procedure:	None.
Unusual Fire and Explosion Hazards:	Non-combustible but flammable when exposed to direct flame. Avoid breathing fumes.

6. ACCIDENTAL RELEASE MEASURES

Steps if Material is Released or Spilled: Sweep up spillage and avoid creating dust.

7. HANDLING AND STORAGE

Safe Handling:	Follow Manual Handling guides.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection: *(Specify type)*	Dust mask recommended.
Ventilation:	Local exhaust.
Protective Gloves:	N/A
Eye Protection:	Safety goggles worn.
Other Protective Suggestions:	Hair tied back, sleeves rolled up.

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity (H2O = 1):	1,25	*Vapour Density (Air = 1):*	N/A
Melting Point (°C):	N/A	*Vapour Pressure (mm Hg):*	N/A
Boiling Point (°C):	N/A	*Percent Volatile:*	N/A
Solubility in Water:	INSOLUBLE	*Evaporation Rate:*	N/A

10. STABILITY AND REACTIVITY

Material Stability: Good.

Conditions / Materials to Avoid: Highly concentrated acids, Keytones.

Hazardous Decomposition Products: None.

11. TOXICOLOGY INFORMATION

No Information

12. ECOLOGICAL INFORMATION

No Information

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method: Commercial landfill.

14. TRANSPORT INFORMATION

No Information

15. REGULATORY INFORMATION

No Information

16. OTHER INFORMATION

No Information

Via Ugo Foscolo, 2 20060 Basiano (Mi) (+39) 02 48702970