



AIRPORT RUNWAYS

SKID RESISTANCE & RUBBER REMOVAL



## AIRPORT APPLICATIONS



Today's busy international airports handle ever increasing levels of traffic and the turn around times for aircraft are becoming ever shorter. Modern airport runways have to be capable of safely landing turbojet aircraft with their greater weight and high landing speeds.

The braking performance of pavement surfaces has become far more critical and under certain conditions, hydroplaning or unacceptable loss of traction can occur, resulting in poor braking performance and possible loss of directional control.

Runway surface condition is therefore critical to the safety of the airports operation. There are many elements which can effect this including, structure, materials used, surface type, snow, ice, water, and contamination from various sources, but especially from rubber deposits.

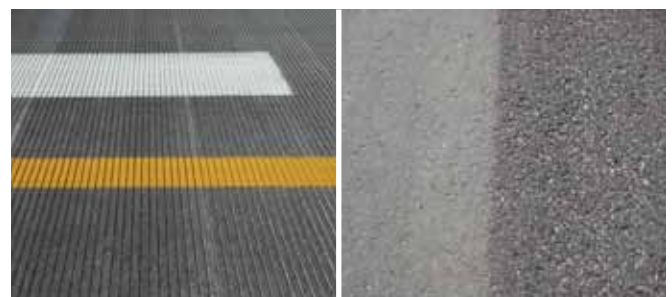
In recent years improvements in surface finishes and design of surfacing materials has greatly improved surface drainage and reduced hydroplaning. Pavement grooving was the first major step in achieving safer pavement surfaces for aircraft operations in wet weather conditions.

Studies in 1983 showed that a high level of friction could be achieved on wet pavement by forming or cutting closely spaced transverse grooves on the runway surface, which would allow rain water to escape from beneath tires of landing aircraft.

Other research conducted both in the United Kingdom and the United States determined that an open graded, thin hot-mix asphalt (HMA) surface course called "porous friction course" (PFC) also could achieve good results. This permits rain water to permeate through the course and drain off transversely to the side of the runway, preventing water build up on the surface and creating a relatively dry pavement condition even during rainfall.

The FAA Technical Center study demonstrated that a high level of friction was maintained on PFC overlays for the entire runway length.

Regardless of pavement type, runway friction characteristics will change over time depending on type and frequency of aircraft activity, weather, environmental issues, and other factors. In addition to ordinary mechanical wear and tear from aircraft tires, contaminants can collect on runway pavement surfaces to decrease their friction properties. Contaminants such as rubber deposits, dust particles, jet fuel, oil spillage, water, snow, ice, and slush all cause friction loss on runway pavement surfaces.





## BIGGEST BENEFITS

- All BLASTRAC techniques are purely mechanical, and therefore very clean
- None of our technologies are using chemical substances or are wasting valuable drinking water
- Perfectly clean (closed circuit process, no waste to dispose)
- Safe (no risk of underground deterioration by the process itself or by frozen water, no damage on built-in lightning devices)
- Very fast evacuation of the airfield if necessary
- Permanent control can be made through grip testing devices / CFME (Continuous Friction Measuring Equipment)
- Can prolong the life by a number of years without the need to immediately invest in new top coat

Tyre rubber while part of the tyre is relatively soft and flexible and designed to absorb some of the shock of the landing aircraft, but as rubber accumulates on the runway surface its characteristics and properties are changed. When the aircraft approaches and lowers the undercarriage the wheels are not turning, but as they make contact with the surface they rapidly gain rotation speed. At this point extreme pressures are involved, considerable friction and heat is generated, this causes polymerisation and chemical change making the rubber deposits hard and tightly bonded to the surface.

With repeated landings of aircraft, this hardened rubber covers the entire surface of the landing area, filling the surface voids and creating loss of both micro-texture and macro-texture thereby causing loss of aircraft braking capability and directional control especially when runways are wet.

Accidents and near accidents can occur from planes overshooting or veering off contaminated runways. It is therefore essential to maintain the airports runways to the highest possible standards and to ensure adequate surface drainage and grip especially in areas of take off and landing.

Work continues by many companies to develop and improve technologies in many areas including, different braking mechanisms to slow aircraft, methods to prevent build up of snow and ice, better technologies for snow and ice removal, more effective removal of rubber

contamination and the effective regeneration of texture and skid resistance to existing surfaces. The development of enclosed mobile blasting systems to remove contamination and at the same time retexture the surface to provide a clean skid resistant free draining runway to land on is now well advanced and becoming the normal method at many international airports.



There are principally 3 types of texture which are important factors in the performance of a runway surface, Megatexture, Macrotexture and Microtexture. In addition to these the terms Negative texture and Positive texture are often referred to, these are types of Macrotexture and more to do with the method used or type of material laid.

## MEGATEXTURE

is a component of surface profile, how flat the surface is. Poor megatexture increases the demands on the suspension, causes vibration to the aircraft structure and gives an uncomfortable ride, it causes patchy drainage and water ponding. Poor megatexture can be a result of surface deformation, rutting or poor laying technique, and can increase the risk of aquaplaning

## MACROTEXTURE

is effectively the average depth of the gaps or voids between the coarse aggregate particles in a surface, it is relatively stable, and can be measured by laser profilometers traveling at normal speeds. This is recorded as SMTD sensor measured texture depth.

Macrotexture is the depth of the spaces or voids between the aggregate particles.



It is this macrotexture which allows the water to drain away from the surface and greatly contributes to skid resistance in wet conditions

Macrotexture is an important characteristic of surfaces



which affects stopping distances at high speed. There are two mechanisms involved:

## 1. DRAINAGE

Good texture depth assists water drainage, preventing the formation of a patch or sheet of water across the surface which could cause aquaplaning.

## 2. HYSTERESIS

Good texture depth is necessary to allow mechanical deformation of the tyre (hysteresis) which dissipates energy in the form of heat.

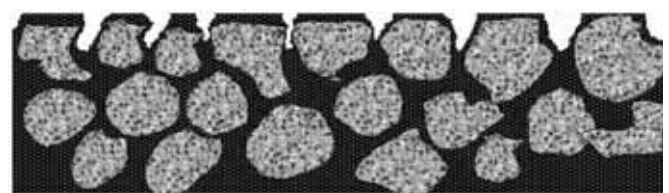
Macrotexture has traditionally been measured by the Sand Patch Test or grease Smear Test which involves spreading a known volume of sand or grease across the surface in a designated pattern until it has all gone into the voids between the aggregate particles. The area of the patch is then measured and a formula used to calculate texture depth. This method is suitable for small areas or trial work but is slow and labour intensive. Current methods are based on laser measuring devices. Infra-red laser pulses are reflected from the road surface onto a diode array. The position of the returned pulses is used to estimate the vertical distance between sensor and road. The root-mean-square distance, a measure of the variation in the vertical distance, is used to calculate the average texture depth, referred to as Sensor Measured Texture Depth (SMTD).

## POSITIVE MACROTEXTURE

is created by the voids or gaps between the raised aggregate particles which protrude from a flat surface Positive Texture typically occurs in HRA + Chips

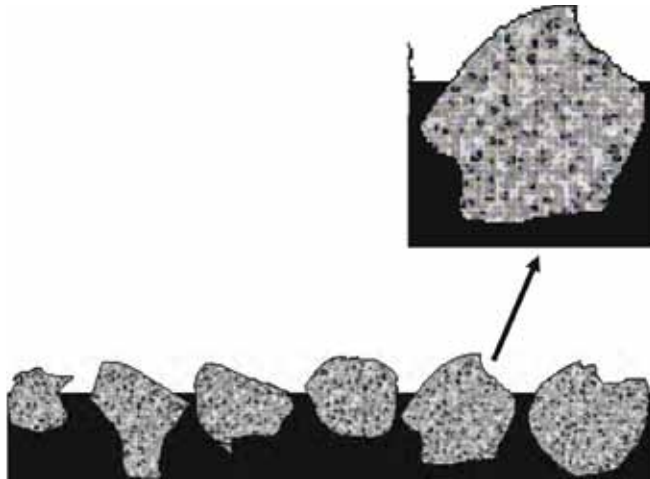


is created by the voids or gaps which indent or go down between aggregate particles from a flat surface. Typically occurs in thin surfacing materials such as SMA's



## MICROTEXTURE

the Microtexture of a surface is provided by the roughness or texture of the surface of the individual aggregate particles.



Microtexture is the fine component of surface texture formed by the tiny interstices on the surface of the aggregate particles. It is the main contributor to providing grip or skid resistance with the tyre, particularly at low speeds. Microtexture is measured by PSV using the British Pendulum Tester or by mobile methods such as the Griptest or ASFT

Aggregates used in asphalt surface courses will typically have PSV figures from 50 to 68, the higher the number the greater the friction or skid resistance

## SKID RESISTANCE

### SURFACE GRIP

is necessary to enable acceleration, deceleration and change of direction on the surface. This grip is provided by the friction generated between the tyres and the surface, and in turn this friction provides the force necessary to transmit the energy into the manoeuvre being attempted. Characteristics of the aircraft and actions of the pilot define the magnitude of the friction force required to complete the manoeuvre successfully. If the friction generated is insufficient, grip is lost and control of the intended manoeuvre is lost. An adequate combination of both Macrotexture and Microtexture is required to provide sufficient frictional properties for aircraft to manoeuvre safely throughout their landing and take off speed range.

## MAINTENANCE

Over time, the skid-resistance of runway pavement deteriorates due to a number of factors, the primary ones being mechanical wear and polishing action from aircraft tyres rolling or braking on the pavement and the accumulation of contaminants, chiefly rubber, on the pavement surface. The effect of these two factors is directly dependent upon the volume and type of aircraft traffic. Other influences on the rate of deterioration are local weather conditions, the type of pavement (HMA or PCC), the materials used in original construction, any subsequent surface treatment, and airport maintenance practices.



The operator of any airport with significant jet aircraft traffic should schedule periodic friction evaluations of each runway that accommodates jet aircraft. These evaluations should be carried out using continuous friction measuring equipment (CFME). Every runway for jet aircraft should be evaluated at least once each year. Depending on the volume and type (weight) of traffic on the runways, evaluations will be needed more frequently, with the most heavily used runways needing evaluation as often as weekly, as rubber deposits build up.

There are many manufacturers of CFME and these devices can be incorporated within vehicles or trailed behind standard vehicles, as the examples below. All are linked to computer equipment and are able to provide the airport authority with accurate data and graphic formats. This equipment makes regular testing easy and can give the authority important information to show the rate of change for any surface and assist in planning remedial action.

Simply explained the equipment has a wheel which has an exact specification of tyre, load, pressure and resistance. As this wheel moves along the surface at a set speed water is placed in front of the wheel at a measured rate and the resistance of tyre to surface (grip) is measured.

This is referred to as the "friction coefficient" and is usually given as  $\mu$  ( $\mu$ ) typically between 0.4 to 0.7

## SCHEDULING RUNWAY FRICTION SURVEYS

The table below can be used as guidance for scheduling runway friction surveys. As airport operators accumulate data on the rate of change of runway friction under various traffic conditions, the scheduling of friction surveys may be adjusted to ensure that evaluators will detect and predict marginal friction conditions in time to take corrective actions.

RUNWAY FRICTION SURVEYS	
NUMBER OF DAILY MINIMUM TURBOJET AIRCRAFT LANDINGS PER RUNWAY END	MINIMUM FRICTION SURVEY FREQUENCY
less than 15	1 Year
16 to 30	6 Months
31 to 90	3 Months
91 to 150	1 Month
151 to 210	2 Weeks
Greater than 210	1 Week

Research has shown that visual evaluations of pavement friction are not reliable. An operator of an airport that does not support turbojet operations who suspects that a runway may have inadequate friction characteristics should arrange for testing by CFME. Visual inspections are still essential, however, to note other surface conditions.

The table below taken from FAA AC No 150/5320-12C lists various manufacturers equipment accepted for carrying out surface friction testing.

FRICTION LEVEL CLASSIFICATION FOR RUNWAY PAVEMENT SURFACES						
	40 mph			60 mph		
	Minimum	Maintenance Planning	New Design Construction	Minimum	Maintenance Planning	New Design Construction
Mu Meter	.42	.52	.72	.26	.38	.66
Dynatest Consulting, Inc. Runway Friction Tester	.50	.60	.82	.41	.54	.72
Airport Equipment Co. Skiddometer	.50	.60	.82	.34	.47	.74
Airport Surface Friction Tester	.50	.60	.82	.34	.47	.74
Airport Technology USA Safegate Friction Tester	.50	.60	.82	.34	.47	.74
Findlay, Irvine, Ltd. Griptestter Friction Meter	.43	.53	.74	.24	.36	.64
Tatra Friction Tester	.48	.57	.76	.42	.52	.67
Norsemeter RUNAR (operated at fixed 16% slip)	.45	.52	.69	.32	.42	.63

The FAA Advisory Circular 150/5320-12C recommends the following texture depths.

### A. NEWLY CONSTRUCTED PAVEMENTS

The recommended average texture depth to provide good skid- resistance for newly constructed concrete and asphalt pavements is 0.045 inch (1.14 mm). A lower value indicates a deficiency in macrotexture that will require correction as the surface deteriorates.

## B. EXISTING PAVEMENTS

(1) When the average texture depth measurement in a runway zone (i.e., touchdown, midpoint, and rollout) falls below 0.045 inch (1.14 mm), the airport operator should conduct texture depth measurements each time a runway friction survey is conducted.

(2) When the average texture depth measurement in a runway zone is below 0.030 inch (0.76 mm) but above 0.016 inch (0.40 mm), the airport operator should initiate plans to correct the pavement texture deficiency within a year.

(3) When the average texture depth measurement in a runway zone (i.e., touchdown, midpoint, and rollout) falls below 0.010 inch (0.25 mm), the airport operator should correct the pavement texture deficiency within 2 months.

## C. RETEXTURING

Retexturing of the pavement surface should improve the average texture depth to a minimum of 0.030 inch (0.76 mm). The FAA Advisory Circular 150/5320-12C refers to the Blastrac method of removing rubber and retexturing as the HVIM (High Velocity Impact Method) and describes it as follows:

### HIGH VELOCITY IMPACT REMOVAL

This method employs the principle of throwing abrasive particles at a very high velocity at the runway pavement surface, thus blasting the contaminants from the surface. Additionally, the machine that performs this operation can be adjusted to produce the desired surface texture, if so required. The abrasive is propelled mechanically from the peripheral tips of radial blades in a high speed, fan like wheel

The entire operation is environmentally clean in that it is self-contained; it collects the abrasive particles, loose contaminants, and dust from the runway surface; it separates and removes the contaminants and dust from the abrasive; and it recycles the abrasive particles for repetitive use. The machine is very mobile and can be removed rapidly from the runway if required by aircraft operations.



THE FAA RECOMMENDS THE FOLLOWING FREQUENCY FOR RUBBER REMOVAL.

NUMBER TURBOJET AIRCRAFT LANDING DAILY PER RUNWAY END	MINIMUM RUBBER DEPOSIT REMOVAL FREQUENCY
less than 15	2 Years
16 to 30	1 Year
31 to 90	6 Months
91 to 150	4 Months
151 to 210	3 Months
Greater than 210	2 Months



# BLASTING TO REMOVE RUBBER AND IMPROVE SURFACE TEXTURE



The basic blasting process has been around for over 100 years and Blastrac was the inventor of the first mobile shot blasting process in the early 80's. Blastrac are now the undisputed global leader in this field.

Operating in over 80 countries the Blastrac product range now has some 65 machines, from handheld products to truck mounted and fully remote controlled blasters. The Blastrac system is a mechanical process which is designed to remove surface contaminants, surface imperfections and coatings. The process is fully controlled, safe and environmentally sound. It uses no water, no chemicals or solvents, emits no pollutants or dust to the atmosphere and the removed material can often be fully recycled.

Steel shot is fed by gravity through a control valve into an impellor. The impellor turning at high speed throws the steel shot through an adjustable opening at high velocity and at a specific angle on to the surface over which the self propelled machine is traveling.

The steel shot impacts the surface and bounces off, as it does so material from the surface whether this is contaminants, coatings or the surface material itself is abraded and loose material together with the shot is drawn up into the machine by the airflow created by the vacuum unit.

Brush seals enclose the blast head to the surface and air is drawn in through and under the brushes from the surface to ensure no shot or material from the blast head escapes to atmosphere. This is around 99% efficient but when the machine goes over any bumpy or uneven surface some shot particles can escape, especially therefore Blastrac has designed fully dedicated magnetic sweepers.



Accurate control of the blast pattern and the degree of removal or texture created is controlled using various machine settings and operational practices.

These include:

- Shot type
- Shot size
- Shot delivery control valve setting
- Impellor / Rotor speed
- Dust collector vacuum (airflow) setting
- Number and direction of passes
- Forward speed of machine

Other variables outside of the control of the operator include:

- Humidity
- Temperature
- Type of surface
- Type of aggregate in surface
- Type and depth of contaminant
- Required finish

It is therefore clear that while the required finish to the surface can 99% of the time be achieved, to initially set the machine correctly and find the best practice for each site requires time and test areas before work begins.

Of course experienced operators are frequently able to identify all these things and set off almost immediately after arriving on site with the correct settings.



## BLASTRAC MACHINES



There are several blast machines suitable for both rubber removal and retexturing of airport runways, these include:

## BLASTRAC 2-20DT

Working width	550mm
Blasting capacity	Up to 450m <sup>2</sup> /h on concrete
Motor	2 x 11kW / 400V - 50Hz or 60Hz / 63A
	- Three phase
Weight	575 kg
Dimensions L / W / H	1950 mm / 720mm / 1400mm
Drive system / speed	Electric / 0.5 – 33 m/min



## BLASTRAC BMR-85D

Working width	550mm
Blasting capacity	Up to 600 m <sup>2</sup> /hr on concrete
Abrasive consumption	100-200 g/m <sup>2</sup>
	(depending on surface)
Weight	700 kg (without drive unit)
Dimensions L / W / H	1680mm / 720mm / 1050mm
Drive system / speed	Hydraulic / 24 km/h



## BLASTRAC 2-45DTM

Working width	1150mm
Blasting capacity	Up to 3000m <sup>2</sup> /h on concrete or asphalt
	(depending on hardness, regulation requirements and pollution)
Weight	1750kg (without side shift and drive unit)
Dimensions L / W / H	1680mm / 720mm / 1050mm
Drive system / speed	Hydraulic / 0 to 4.7 km/hr
Working speed	0,5 to 40 mtr/min



Blastrac equipment has been used extensively at international airports throughout the world for:

- Rubber Removal
- Line & Markings Removal
- Improving Texture & Skid Resistance.
- Surface Preparation prior to Sealer Application.

Recent examples include:

- Maputu Airport / Mozambique
- Tulsa Airport / Tulsa – Oklahoma / USA
- Las Vegas Airport / Texas / USA
- Roissy / Charles de Gaul / Paris / France
- Tours military Airport / Tours / France
- Airport Point a Pitre / Guadalupe / French overseas region
- Monte Real military airbase / Portugal
- Pau Airport / France
- Ezeiza Airport / Buenos Aires / Argentina
- Houari Boumedienne Airport / Algiers / Algeria

Other Airports using Blastrac equipment in the past:

- |                          |                            |                |
|--------------------------|----------------------------|----------------|
| ▪ Alicante               | ▪ Gibraltar                | ▪ Monastir     |
| ▪ Baghdad                | ▪ Hong Kong                | ▪ Montpellier  |
| ▪ Barcelona EL Prat      | ▪ In Anemas                | ▪ Nice         |
| ▪ Beijing Airport        | ▪ Istres                   | ▪ Orly, Paris  |
| ▪ Bordeaux               | ▪ Las Palmas de G. Canaria | ▪ Palerma      |
| ▪ Bristol                | ▪ Leeds Bradford           | ▪ Porto        |
| ▪ Casablanca             | ▪ Lisboa                   | ▪ Taipei       |
| ▪ Chongqing              | ▪ Lyon                     | ▪ Tenerife Sur |
| ▪ CKS                    | ▪ Madrid Barajas           | ▪ Toulouse     |
| ▪ College Station, Texas | ▪ Malaga                   | ▪ Tozeur       |
| ▪ Doncaster (Robin Hood) | ▪ Manchester International | ▪ Tunis        |
| ▪ Gatwick                | ▪ Marseille                |                |

## IN CONCLUSION

The shot blasting process provided by Blastrac equipment has significant benefits when used for rubber removal and surface retexturing of airport runways. The system can effectively remove rubber deposits without the need for water, solvents or chemicals.

The process is dry, enclosed and removes all debris from the surface, leaving a clean dry surface ready for immediate use, or for application of sealers or coatings/lines.

Removed material can be recycled at asphalt or concrete production factories. The Macrotexture can be significantly improved bringing it up to the required level and improving surface drainage.

The microtexture is brought back to that of the original aggregate property. The Blastrac process exposes the aggregate particle with a completely fresh surface, as it was when quarried, thus providing its full properties. This sharpness of the aggregate is important to penetrate through any water film and connect with the tyre. Other cleaning processes do not achieve this.

The Blastrac process is safe, environmentally friendly, fast, clean and very cost effective.

In the event of the work having to be interrupted for airport operational reasons, the truck can simply leave site and the runway can be in use moments later.

BLASTRAC IS CONTINUALLY WORKING WITH CLIENTS AND CONTRACTORS TO DEVELOP AND IMPROVE ITS PRODUCTS IN ORDER TO ASSIST THE AIRPORT AUTHORITIES WITH THEIR OBJECTIVE TO ELIMINATE RUNWAY SLIPPERINESS AS A CAUSE OF ACCIDENTS AND TO STOP ALL AIRCRAFT WITHIN THE EXTENT OF THE RUNWAY.

### References

1. U.S. Department of Transportation. Federal Aviation Administration. Advisory Circular 150/5320-12C. Measurement Construction and Maintenance of Skid-Resistant Airport Pavement Surfaces.
2. U.S. Department of Transportation. Federal Aviation Administration. Advisory Circular 150/5380-6A. Guidelines and Procedures for Maintenance of Airport Pavements.
3. I.Torralba. Lima Airport Partners. LAP-M&IT-2005-04: 2005 Runway Maintenance Report.





**RIDE-ON UNITS**



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