

EXHIBIT

*Blasters-1022*



- [Airport R&D](#)
- [Airport Safety](#)
- [Airport Pavement](#)
- [Download](#)
- [Databases](#)
- Search...

Links

[Airport RD Conference Detail](#)     [Airport R&D](#) / [Conference and Workshop](#) / [Airport RD Conference Detail](#)

Airfield Rubber Removal



854 View

2002-01-01

0 Comments

ATTC2002

2002 FAA Airport Technology Transfer Conference

Airport Safety Issues  
S-5 Donna J. Speidel

[2002\\_S5.pdf](#)



[U.S. Department of Transportation](#)  
Federal Aviation Administration  
800 Independence Avenue, SW  
Washington, DC 20591  
1-866-TELL-FAA (1-866-835-5322)

Readers & Viewers

- 
- 
- 
- 
- 
-

## **Web Policies**

- [Web Policies & Notices](#)
- [Privacy Policy](#)
- [Accessibility](#)

## **Government Sites**

- [DOT.gov](#)
- [USA.gov](#)
- [Plainlanguage.gov](#)
- [Recovery.gov](#)
- [Regulations.gov](#)
- [Data.gov](#)

## **Frequently Asked Questions**

- [All Questions](#)

## **Contact Us**

- [Contact FAA](#)
- [OIG Hotline](#)
- [FOIA](#)

# **AIRFIELD RUBBER REMOVAL**

**By: Donna J. Speidel  
President  
Speidel Construction, Inc.**

**PRESENTED FOR THE 2002 FEDERAL AVIATION ADMINISTRATION  
TECHNOLOGY TRANSFER CONFERENCE**

**Date: 02/02**

## AIRFIELD RUBBER REMOVAL

We're here to talk about the removal of rubber deposits from runways . . . how it gets there, how you can tell when it needs to be removed and different ways to remove it.

The most significant reason to be concerned about the build up of rubber deposits is SAFETY. If you operate an airport with large jet aircraft, you will eventually have a deterioration of the pavement skid-resistance, or a reduction in friction coefficients, which is a problem for aircraft tires to grab and safely stop the aircraft. One of the main causes of ground-based accidents is a runoff event. When an aircraft skids off of the runway, whether the pilot is unable to brake soon enough upon landing or when having to abort a takeoff, the pavement surface will be carefully examined as a contributing factor. There are several factors that contribute to surface deterioration, but the one that is easy to recognize, simple to correct and relatively inexpensive to do is *AIRFIELD RUBBER REMOVAL*.

I'm going to speak first about pavement surfaces, because it is that surface that the pilot depends on to be in good condition to properly and safely land the aircraft. We're going to talk about *MICROTEXTURE and MACROTEXTURE*, of pavement surfaces. **FRICTION COEFFICIENTS and FRICTION TESTING** will be discussed, along with a few methods that can be used to restore acceptable levels of friction to the pavement surface to give pilots safe conditions in which to land the airplane.

### *MICROTEXTURE*

Microtexture is the roughness of the surface of the pavement. The fine scale particles on the pavement surface are not readily discernible to the eye, but are apparent to the touch, like the feel of fine sandpaper. In asphalt surfaces, the type of aggregate used will help increase and maintain the microtexture of the pavement. Specifically, the presence of coarse grain sizes and rocks high in silica are the most effective in providing long wear of the pavement and a constantly renewed abrasive surface.<sup>1</sup> A DOT engineer told me a few years ago that the supply of hard, quality aggregate in this country is being depleted; and that finding aggregates for asphalt surfaces to retain high friction coefficients will become more difficult in the future.

On a Portland Cement Concrete surface, brushing or brooming the newly poured concrete before it sets completely can enhance concrete surfaces. (Picture – *Figure 2-3, AC 150/5320-12C*) A burlap drag finish can also produce a rough surface. (Picture – *Figure 2-4, AC 150/5320-12C*) Wire combing, using rigid steel wires, forms a deep texture to the pavement. (Picture – *Figure 2-5, AC 150/5320-12C*). Wire tining using flexible steel wires can be used to form deep texture in concrete pavement. All of these methods produce a rough surface, or high degree of microtexture, that will serve to increase the friction coefficient of the runway surface.

Creating a rougher surface with a higher degree of microtexture, however, can also be a problem. About 12 years ago, there was a project at NAS Patuxent River, Maryland where the Navy had specified that the new concrete pavement on the runway end being reconstructed be deeply wire tined. We noticed the roughness of the pavement as our string lines used for laying out the new markings kept breaking. And soon after the runway re-opened, the Navy realized it

was too rough, because tires were blowing when the aircraft touched down. The remedy was to mill the pavement to a smoother microtexture. So the roughness factor can go too far.

The **MICROTEXTURE** of the pavement provides frictional properties for aircraft operating at low speeds. **MACROTEXTURE** provides frictional properties for aircraft operating at high speeds. Together they provide adequate frictional properties for aircraft throughout their landing/takeoff speed range.<sup>1</sup> These two factors are particularly important on airports, which accommodate large commercial or military aircraft. But even on smaller, general aviation airports, as well as on roads and highways, these friction-enhancing properties can prevent many accidents.

## **MACROTEXTURE**

Macrotexture refers to the visible roughness of the pavement surface as a whole. The primary function of the pavement's macrotexture is to provide paths for water to escape so that the landing traffic does not hydroplane.

Cutting or forming grooves in existing or new pavement is a proven and effective technique for providing skid-resistance and prevention of hydroplaning during wet weather. (Picture – Figure 2-6, 2-7 and 2-8, AC 150/5320-12C).

## **HOW RUBBER DEPOSITS ACCUMULATE**

How many of you have large aircraft landing at your airport every day? How many of you have ever had to deal with removal of rubber deposits from your runway surfaces? The material that accumulates on the runway surface is no longer rubber like that on the tires of the airplane that put it there; that rubber is relatively soft and flexible and designed to absorb some of the shock of the landing aircraft. The aircraft tires are stationary just before they touch the ground, but at the moment they touch, literally where the rubber meets the runway, and for about 1000 feet or 300 meters, that tire is gaining rotation speed. During that time, the tires are under thousands of pounds of pressure between the tire and the surface, right at the interface, that causes considerable friction and heat. This time is referred to as “*spin up speed*”. The heat created causes a polymerization of the rubber, or a chemical reaction, turning it into a very hard material that is spread on that 300 meters of runway surface in a thin layer. Seven hundred grams of rubber, or about 1.4 pounds, are deposited per tire per landing of each large aircraft, such as a 747 or an L-1011. With repeated landings of aircraft, this hardened rubber fills the microtexture of the pavement giving it a smooth, almost glass like surface that can make landing the aircraft and stopping difficult, or even dangerous, particularly when the pavement is wet. It will also begin to fill the macrotexture of the pavement surface, which will diminish the ability of the grooves to adequately drain the water during a rain event, increasing the likelihood of hydroplaning.

## **FRICTION DETERIORATION**

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 tires rolling or braking on the surface and accumulation of contaminants, mainly rubber, on the pavement

surface. Other factors such as structural pavement failure contribute to friction deterioration. Many of you are familiar with **pavement condition indexing** (PCI) and know of the correlation between deteriorating pavement and the drop in friction coefficients.

## **FRICTION EVALUATIONS**

The operator of any airport with heavy aircraft traffic should schedule periodic friction evaluations of each runway depending upon the number of daily landings.

**Table 3-1. Friction Survey Frequency**

<b>Number of Daily minimum turbojet aircraft landings per runway end</b>	<b>Minimum Friction Survey Frequency</b>
<b>LESS THAN 15</b>	<b>1 YEAR</b>
<b>16 TO 30</b>	<b>6 MONTHS</b>
<b>31 TO 90</b>	<b>3 MONTHS</b>
<b>91 TO 150</b>	<b>1 MONTH</b>
<b>151 TO 210</b>	<b>2 WEEKS</b>
<b>GREATER THAN 210</b>	<b>1 WEEK</b>

When a friction test identifies a pavement surface with inadequate friction characteristics, the cause, such as rubber accumulation, is often obvious. Friction testing is performed by use of a metered device (CFME = Continuous Friction Measuring Equipment) that can either be towed behind a vehicle or be self-contained. Discussion of the requirements of this equipment is contained in Appendix 3 to the Advisory Circular 150/5320-12C, as well as a listing of FAA approved CFME.

A Friction Testing Workshop is held at the Wallops Island NASA facility near Chincoteague, Virginia in the spring each year. At this workshop, friction testing equipment, equipment used in pavement profiling and equipment used to measure pavement textures, among other tests, are put through their paces for several days. The carefully measured and recorded results are tabulated and compared at the end of the week for further analysis and evaluation.

A friction test involves a vehicle-mounted system equipped with a computer to record the data, a measuring device to accurately record distances traveled, a treadless tire of specific size and air pressure and a spray of metered water in advance of the “drag” wheel to simulate wet pavement, conditions under which friction readings would be the worst. The drag wheel mechanism can be mounted internally in the vehicle, like the SAAB where it is in the backseat of the car; or it can be trailer mounted and towed behind the vehicle.

Tests are taken on all ends of runways where friction deterioration is expected. The test is taken on a non-contaminated surface, such as along the edge of the pavement at both 40 mph and 60 mph to get a base reading for the “clean” pavement. Then readings are taken in the landing area, or touchdown zone, of the runway where rubber build up and other surface contaminants may be. The touchdown zone measurement must be at least 80% the value of the clean pavement to be considered having a sufficient friction coefficient. If the measurement falls below the 80% value, then the cause of the drop in friction must be determined and measures must be taken to

restore the friction coefficient to acceptable levels. As mentioned earlier, the most common cause for a reduction in friction coefficients is rubber accumulation, it is easy to recognize, simple to correct and relatively inexpensive to do.

## **RUBBER REMOVAL TECHNIQUES**

- **High-pressure waterblasting**
- **Ultra-high pressure waterblasting**
- **Chemical removal**
- **High Velocity Impact Removal (Shotblasting)**
- **Mechanical Removal**

## **HIGH PRESSURE WATERBLASTING**

High-pressure waterblasting removes rubber by means of rotary device, which moves slowly along the surface to be cleaned, using pressures from *2,000-15,000 PSI* and up to 30 gallons of water per minute. There is a hydraulic effect of the water that actually penetrates the surface, effectively cleaning the rubber deposits as well as helping to improve the friction characteristics of the pavement surface. The *benefits* of using this equipment are:

- the speed with which rubber is removed (at least 10,000 SF per hour),
- the cost efficiency of the process (water is generally provided)
- the improved friction characteristics of the pavement due to the penetration of the water,
- the ease of getting off the runway in the event of an emergency.

When accompanied by a sweeper which picks up the rubber debris as the operation proceeds, the runway can be returned to the owner within minutes of notification to exit the area, thus giving airport operations maximum flexibility and control.

## **ULTRA-HIGH-PRESSURE WATERBLASTING**

Ultra-high-pressure waterblasting also uses a rotary device which is a truck-mounted system and moves slowly along the surface to be cleaned. Pressures up to 40,000 PSI are attained and only 8 gallons of water per minute are used. With this method, there is literally a milling effect, which cleans the rubber deposits and anything else within its path, leaving a very clean, but often smoother surface. Since rubber removal is an often-repeated process at an airport to maintain proper friction coefficients, this particular method of rubber removal may result in a “polishing effect”. When that happens, a wholesale retexturing of the pavement will be needed to restore the friction to acceptable levels. Similar to high-pressure waterblasting, the benefits are:

- the speed of the removal process (10,000 SF per hour),
- cost efficiency
- capable of evacuating the runway quickly in the event of an emergency.
- less water consumption

## CHEMICALS

Chemicals have been developed that are environmentally safe and effective in cleaning rubber deposits from contaminated surfaces. The chemicals are sprayed onto the surface and then scrubbed, brushed and worked into the rubber for approximately four hours or more. The chemicals break down the polymerized rubber into a soft, almost jelly-like substance that is then flushed off the runway by waterblasting upon completion of the process. Once the process begins, the runway cannot be reopened until the process is complete because it is “soapy” and slippery. Additionally, with many of the chemicals used, the debris cannot be swept up with conventional sweepers since the chemical reacts adversely with the rubber seals in the sweeper equipment. Although the chemical is not considered to be biodegradable, the debris is not. The method of clean up for the chemical removal operation is to flush off the soapy residue at the completion of the work, along with the rubber debris, onto the shoulders and into the surrounding soil. Over time the debris accumulates and may eventually cause an environmental problem requiring remediation. Additionally, the cost of chemical rubber removal is approximately double that of high pressure or ultra high pressure waterblasting, due to the cost of the chemicals themselves, whereas water is usually readily available at no cost to the contractor. The benefits of using the chemical process is:

- rubber is cleaned at approximately the same rate of speed as high-pressure waterblasting (10,000 SF per hour)
- it only softens and removes the polymerized rubber
- the work can be accomplished using your own airfield staff and equipment, thus possibly justifying the cost of the chemical

The downside of using chemicals is that once the operation begins, the runway must remain closed until the clean up is complete.

## HIGH VELOCITY IMPACT REMOVAL or SHOTBLASTING

High Velocity Impact Removal or Shotblasting propels abrasive particles onto the runway surface, which blasts the contaminants from the surface. The shotblaster can be adjusted to produce the desired surface texture, is environmentally clean since the entire operation is self-contained. On a non-grooved surface, it collects the abrasive particles, loose contaminants and dust from the runway surface, and then recycles the steel shot for re-use. The primary reason for using a shotblaster would normally be for another purpose other than removal of rubber deposits. Generally, it is used for resurfacing or retexturing pavement surfaces, specifically roads and bridge decks. Most shotblasters are small, riding units capable of cutting six to twenty inches at a pass and are better suited for paint removal operations. However, there is a very large shotblaster called the “Skid-a-brator” that cuts six feet in a single pass and is actually used at Atlanta Hartsfield International Airport because of the speed with which it not only cleans the rubber, but retextures the pavement in one operation. Due to the type of work the “Skid-a-Brator” is designed to do, it is very expensive to mobilize and operate. However the benefits are:

- can retexture the pavement and remove rubber deposits in excess of 10,000 SF per hour,
- the machine is truck-mounted and can be removed quickly from the runway as the needs of airport operations dictate,

- the equipment cleans the surface as it works,
- it retextures the surface by removing a thin layer of the pavement and coincidentally removes the rubber deposits with the pavement

## MECHANICAL REMOVAL (GRINDING OR MILLING)

Mechanical Removal is accomplished by either grinding or milling of the surface. While the process will remove rubber deposits, it, like shotblasting, has a primary reason for selecting this equipment. Grinders and milling machines

- remove high areas, such as bumps, on pavement surfaces or at joints where slabs have shifted or faulted, called **profiling**
- mill asphalt surfaces in preparation for asphalt overlays,
- improves the pavement surface friction characteristics by removing a surface layer between 1/8 and 3/16 inch in depth. However, when this process is used on a grooved surface, the grooves may need to be redone to return the grooves to 1/4-inch depth to effectively drain water from the surface.

On highways, the equipment is most effective at smoothing out a rough ride! When used on a runway to profile high spots, it will coincidentally remove rubber deposits in its path.

## TO SUMMARIZE

SAFETY is what it's all about. If you have large aircraft using your airport, you need to perform friction testing on a scheduled basis. Once the friction coefficient drops below 80%, you will need to determine the cause. If the reason is due to the accumulation of rubber deposits, you must plan for surface maintenance. Rubber deposits on runways are one of the most obvious reasons for a reduction in friction coefficients, and one of the easiest to remedy.

I have provided a copy of the FAA Advisory Circular to which I have been referring. If you have any questions, I would be happy to answer them at this time. Additionally, I will mention that our website [www.cleanrunways.com](http://www.cleanrunways.com) includes an estimating program that allows you, the engineering consultant, airport manager or maintenance engineer to obtain a "budgetary" estimate for using waterblasting to remove rubber deposits.

---

<sup>1</sup> FAA, Advisory Circular 150/5320-12C