RUBBER TIRE BUILDUP REMOVAL AT HARTSFIELD-JACKSON ATLANTA INTERNATIONAL AIRPORT
2010 FAA WORLDWIDE TECHNOLOGY TRANSFER CONFERENCE

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Rubber Tire Buildup Removal at Hartsfield-Jackson Atlanta International Airport

Abstract: Landing areas on each of the five parallel runways at Hartsfield-Jackson Atlanta International Airport experience heavy rubber tire buildup. Ranked as one of the world's busiest airports for more than a decade, the runways experience numerous aircraft landings each day (1,400 operations represent the peak daily arrivals in 2009). The rubber tire buildup caused by these frequent landings causes the surface frictional characteristics to creep towards unsafe conditions, requiring an aggressive maintenance plan. To combat this, the airfield operations unit conducts skid tests every two weeks, and removal of the rubber tire buildup occurs when minimum threshold values are measured. Currently the two primary arrival runways are being cleaned every four months.

Throughout the years, the airfield maintenance unit has removed rubber tire buildup in different ways. From the late 1960's to the mid 1990's, waterblasting was the most utilized method. In the mid 1990's, the use of steel shot blasting became more common. While readily removing rubber tire buildup and restoring safe friction values to the runway surface, both waterblasting and steel shot abrasion have had detrimental affects on the micro-texture, macro-texture and grooves of the concrete pavement.

The runway pavements range from 3 years old to nearly 40 years old. Each runway is concrete-surfaced, and each has subtle differences in the concrete mix constituents comprising the concrete. These differences consist of cementitious materials and proportioning (Portland cement, fly ash, slag cements), mineral aggregates (manufactured sand and natural sands) as well as admixtures. Two of the runways have been regrooved within the last five years due to damage from the rubber removal process. Each concrete surface might perform differently under the different maintenance treatments utilized to remove the rubber buildup from the surface.

Presently, the use of chemicals is used as the primary means of removal. A discussion of advantages and disadvantages of each method is summarized based on cost and schedule impacts as well as the historical friction values and pavement surface loss.

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INTRODUCTION

Braking performance is critical on airport runways. Rubber from aircraft tires can build up on the pavement and cause reduced friction and hydroplaning which results in loss of directional control of aircraft. Areas of major consideration to prevent this friction loss are designing high-skid resistant surfaces and then implementing maintenance procedures to maintain the surface friction. The pavement surface provides skid resistance based on its micro-texture, macro-texture and grooves in the pavement. Maintaining runway friction is a challenge given the surface changes over the pavement's life based on the frequency of aircraft activity, weather, environmental issues and pavement makeup.

Hartsfield-Jackson Atlanta International Airport (H-JAIA) has five parallel runways that experience heavy rubber tire buildup. The pavement network at H-JAIA is shown in Figure 1. The system includes 5 parallel runways; runways 8L-26R and 8R-26L are located on the north side of the midfield concourses, runways 9L-27R and 9R-27L are located on the south side of the midfield concourses, and runway 10-28 is located further south, spanning an 8-lane interstate freeway. The arrival runways at H-JAIA are 8L-26R, 9R-27L and 10-28. They currently handle approximately 400,000 landing operations per year. This equates to about 365 operations per day per runway. The departure runways are 8R-26L and 9L-27R which experience an occasional landing in the morning.

Figure 1: Aerial photo of Hartsfield-Jackson Atlanta International Airport

The runways are 150 feet (45.7 meter) wide and range in length from 9,000 feet (2,743.2 meter) to 12,000 feet (3,657.6 meter). The oldest runways (9L-27R, constructed in 1972 and 8L-26R, constructed in 1984) were built with a 40.6-cm concrete section. The newest Runways (8R-26L, reconstructed in 2006 and 10-28, constructed in 2006) consist of a 20-inch (50.8-cm) concrete section. Runway 9R-27L has a 19-inch (48.3-cm) concrete section that was constructed in 1999. Each runway is concrete-surfaced, and each has subtle differences in the concrete mix constituents comprising the concrete. These differences consist of cementitious materials and proportioning (Portland cement, fly ash, slag cements), mineral aggregates (manufactured sand and natural sands) as well as admixtures. All the runways have Portland Cement but runway 8L-26R also has slag, runways 10-28 and 8R-26L have fly ash and runways 9L-27R and 9R-27L have no additional supplementary cementitious materials.

FRICTION TESTING METHOD

Friction measurements are regularly conducted by H-JAIA Airport Operations. Runway texture measurement and surface friction assessment are performed on a bi-weekly schedule according to FAA standards for inspection frequency. These are performed in support of the runway surface management and maintenance parameters in the FAA Advisory Circular. The results of these friction measurements have shown quite variable values on sections of the runways, particularly near the threshold and touchdown zones, even after runway rubber removal maintenance activities. Sometimes it is impossible to determine the causes and to determine remedial action for these runway friction issues.

One of the challenges of effective maintenance of runway pavement surfaces for the airport operator is to determine the full extent of any rubber contaminated or reduced-texture areas and to establish the amount/type of treatment required. Visual observations are seldom sufficiently accurate for this purpose. Friction survey measurements combined with surface texture assessments can provide quantitative and objective data in support of this requirement.

The airport currently uses a Saab 9-5 equipped with Scandinavian Airport and Road Systems AB (SARSYS) Friction Tester (SFT) as shown in Figure 2. The SFT is programmed to measure in accordance with regulations issued by FAA. The Saab is equipped with a water system for measuring on wet surface. The airport uses the smooth tire and rubber buildup is measured every other week on the three primary arrival runways.

Runway texture measurements are performed along the full length of the runway at approximately 500 foot (152.4 meter) intervals. The location of the friction surveys is based on the Narrow body and Wide body aircraft to determine the worst case condition. Each set of data consists of measurements at four separate locations positioned transversely across the runway; one at 20 feet (6.1 meter) north, one at 10 feet (3.1 meter) north, one at 10 feet (3.1 meter) south and one at 20 feet (6.1 meter) south of the centerline. The friction surveys are performed at 40 mph (64.4 km/hr) beginning the data recording 500 feet (152.4 meter) from the threshold and terminating 500 feet (152.4 meter) from the threshold at the opposite end. The readings assist in determining the overall macro-texture/contaminant/drainage condition.

The measuring speed and Mu number (friction values) are measured and presented in a diagram. Average friction is calculated for a distance and an overall runway friction value is determined. Poor friction conditions for short distances on the runway do not pose a safety problem but long stretches are a concern. The airport uses the FAA criteria of Mu values below 0.60 for planning maintenance and 0.50 as a minimum acceptable value.

Figure 2: Saab 9-5 equipped with Scandinavian Airport and Road Systems AB (SARSYS) Friction Tester (SFT)

RUBBER REMOVAL METHODS

The recommended rubber deposit removal frequency based on the number of daily turbojet aircraft landing per runway end would require it every 3 to 4 months. In Table 1, the removal frequency varies from year to year. This difference is highly dependent on the weather conditions throughout the year. The airport has used chemical removal and high velocity impact removal (shotblasting) for runway rubber removal over the last five years. Prior to that time it was reported that the airport used only shot blasting from 1999 to 2006 and water blasting prior to 1999.

In 2005 and 2006 two runways were re-grooved due to loss of the grooves from the rubber removal process. The rubber removal process is performed in the 3,000 feet (949.4 meter) touchdown zones on each end of the runway and this is where the grooves were worn.

Chemical Removal –
The airport has been using chemicals to remove the rubber at the airport since 2006. They are currently using Avion 50 for chemical removal. Some of the reasons for using chemical removal include use of in-house maintenance staff and equipment, minimizing impact on operations, satisfaction with the final product and low probability of damage to the pavement. The single most important reason is because of the low probability of pavement damage. They have not

noticed damage to the pavement due to the chemical removal process. Before and after photos of chemical removal can be seen in Figures 3 and 4.

Table 1:
Runway Pavement Maintenance Schedule from 2006 to 2009

Runway	8L/26R	9R/27L	10/28	8R/26L
2005	11/05 (R)			
2006	6/06 (C)	6/06 (C)		
		9/06 (C)		
	12/06 (C)	12/06 (R)	12/06 (S)	12/06 (S)
2007	4/07 (C)	3/07 (C)	4/07 (C)	
	8/07 (C)	8/07 (C)	7/07 (C)	
	11/07 (C)	12/07 (C)	10/07 (S)	
2008	6/08 (C)	6/08 (C)	7/08 (C)	
2009	2/09 (C)	4/09 (C)		
	7/09 (C)	7/09 (C)	7/09 (C)	
	12/09 (S)	12/09 (S)	12/09 (S)	

C- Chemical Removal
S- Shot Blast
R- Regrooved

Figure 3: Runway pavement before chemical removal

Figure 4: Runway pavement after chemical removal

The equipment used to remove the rubber includes two- 4,500 gallon (17,034 liter) liquid deicers, three- Oshkosh Snow Broom and two- 8,500 gallon (32,176 liter) tankers. The average crew size required is seven. The typical production rate is 2,500 square yards (2,090.3 square meter) per hour at an average cost of $0.63 per square yard ($0.75 per square meter). The work is typically completed under multiple six hour runway closures at night.

Shot Blast Removal-

The airport has used a contractor to perform shot blasting on the runways since the late 1990's. The main reasons for using shotblasting was it minimized impact on operations, satisfaction with final product, speed of the operation and it retextured the pavement surface in addition to cleaning it. The single most important reason was the satisfaction with the final product. Before and after photos of shot blast removal can be seen in Figures 5 and 6.

The equipment was typically two shotblasting units with two electro magnet trucks and a crew size of six. The typical production rate is between 5,700 and 7,800 square yards per hour (4,765.9 and 6,521.8 square meter per hour). The typical cost was approximately $0.45 per square yard ($0.54 per square meter). The work is typically completed under multiple seven hour runway closures at night.

There was damage observed to the pavement surface. The grooves were deteriorated on two of the runways. One runway was constructed in 1999 and it was regrooved in 2006. They typically experience loss of the pavement surface during this operation.

Figure 5: Runway pavement before shot blast

Figure 6: Runway pavement after shot blast

NEW CONSTRUCTION FRICTION

In 2006, runways 10-28 and 8R-26L were opened, during the final inspection prior to opening them it was noted that the wet burlap drag finished surface of both runways was quite variable both along the length and width of the facility. In general, there was reasonably good micro-texture present but limited macro-texture. There also appeared to be quite significant areas of the concrete surface where the curing process had resulted in a relatively smooth top coating as can be observed in Figure 7.

Figure 7: Newly constructed runway pavement surface note the micro texture but low presence of macro texture

The friction values were measured prior to opening and they were below the recommended new construction friction values of 0.80. Therefore both the runways were shot blast at the end of 2006 and runway 10-28 again in 2007 to improve the friction values. The values over the past three years can be seen in Figures 8 and 9. The figures show that the friction values have not changed much over the three years since opening runway 8R-26L which is a departure runway.

CONCLUSIONS/RECOMMENDATIONS

Using the chemical and shot blast procedures, the runway friction classification surveys at H-JAIA have determined that on most areas of runways the current FAA Saab SFT Runway-Average Friction Guideline Levels were met or exceeded. One of the five runways is used to show the effects of the two procedures on the friction values. The typical chemical removal friction values are shown in Figures 10 and 11 and the shot blast friction values are shown in Figures 12 and 13.

The chemical removal method results in friction values which are typically below the values using the shot blast method. On the runway surface, particularly near the end of the runways, having regularly been found to have relatively low friction values, in some cases approaching the applicable FAA maintenance planning and minimum action levels. While these friction values improve somewhat after periods of heavy precipitation or runway maintenance activities, the increase is generally small and not long lasting.

There are areas of the newly constructed runways with quite limited micro and macro-texture due to a smooth surface coat. This factor can contribute to reduced runway friction characteristics especially during wet conditions. In addition, the limited underlying texture may contribute to the more rapid buildup of a smooth rubber contaminant overlay, further reducing the pavement's frictional properties, especially in the touchdown zones.

Rubber removal activities on such surfaces using chemical or high-pressure water treatment may be successful at removing most of the contaminant but are often much less effective at restoring runway friction, as there is limited available texture to reveal or restore underneath the contaminants.

From the observations and results of the current methods, it appears that an effective program of runway rubber contaminant removal combined with texture enhancement is required for this runway surface. Among the available runway rubber removal practices (including high pressure water blasting, chemical application, mechanical and shot-blasting), the airport is using a practice of routine chemical removal in combination with occasional shot blast re-texturing as a most practical and effective program. While shot blasting can result in premature runway wear and damage, the technique has demonstrated the effectiveness of treatment and longevity of friction results.

We recommend that consideration be given to evaluate the concrete mix constituents and their influence on the texture on runway pavement by undertaking a program to evaluate historical records available at the airport.

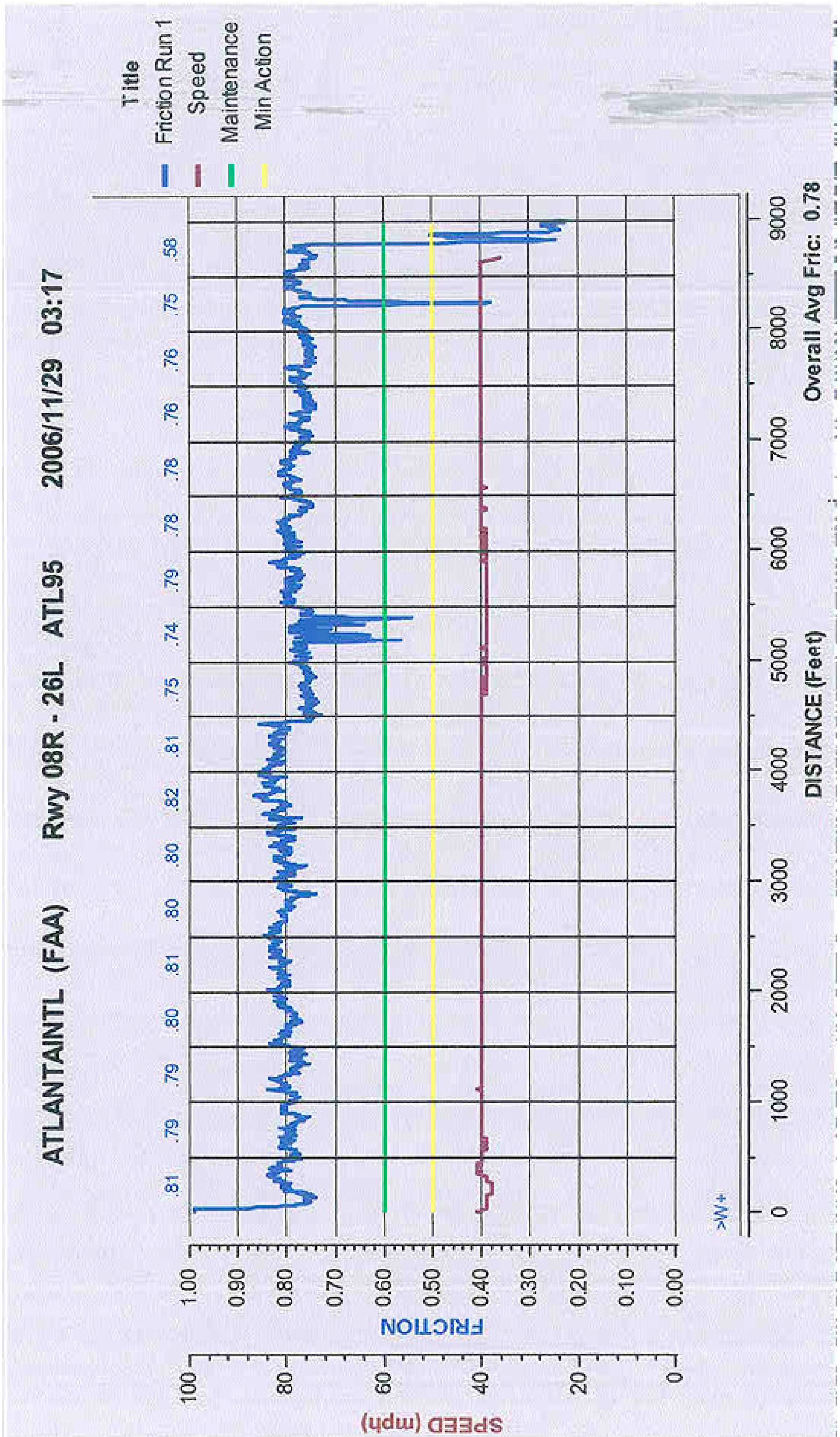

Figure 8: Runway 8R-26L friction values at runway opening in 2006

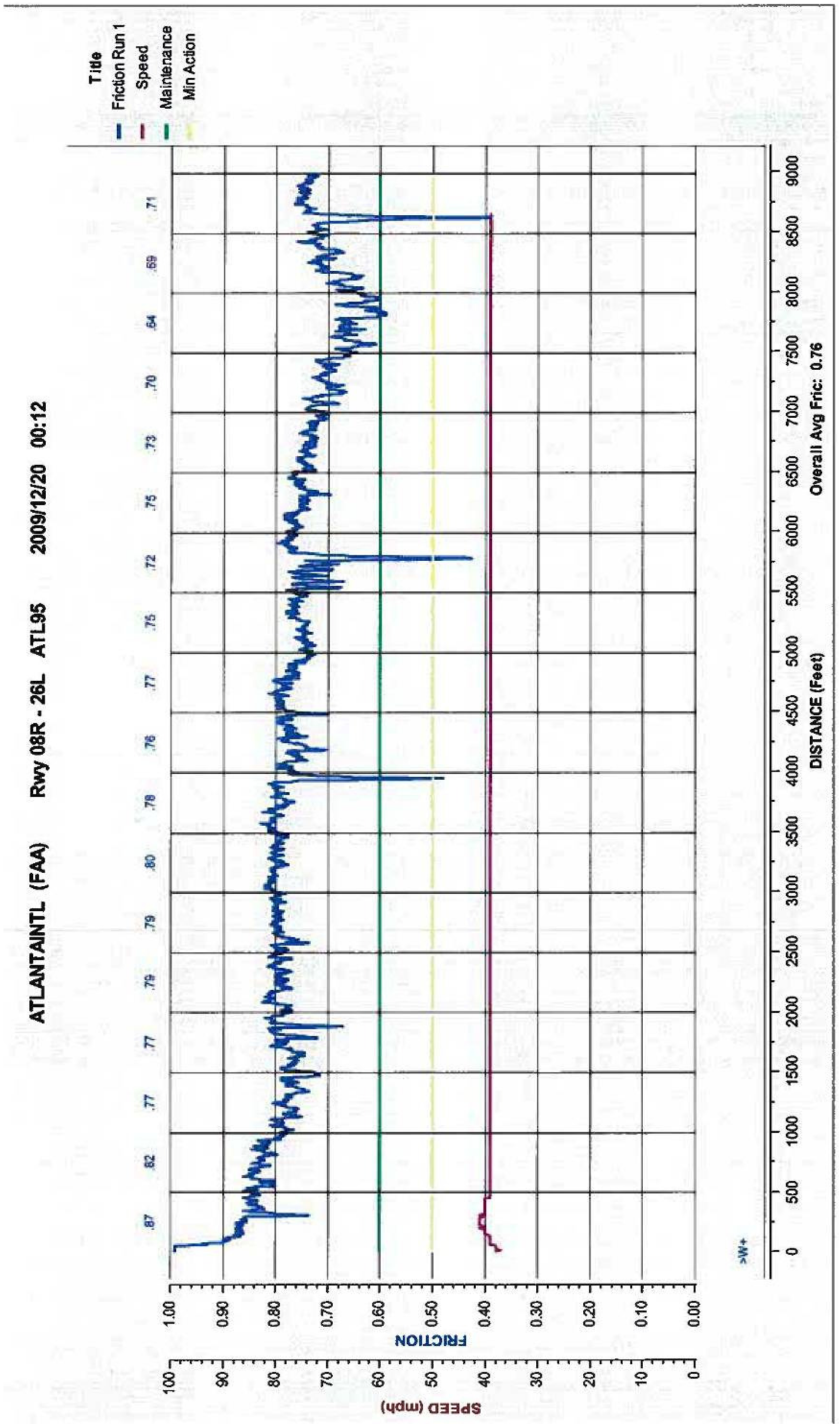

Figure 9: Runway 8R-26L friction values after 3 years in service

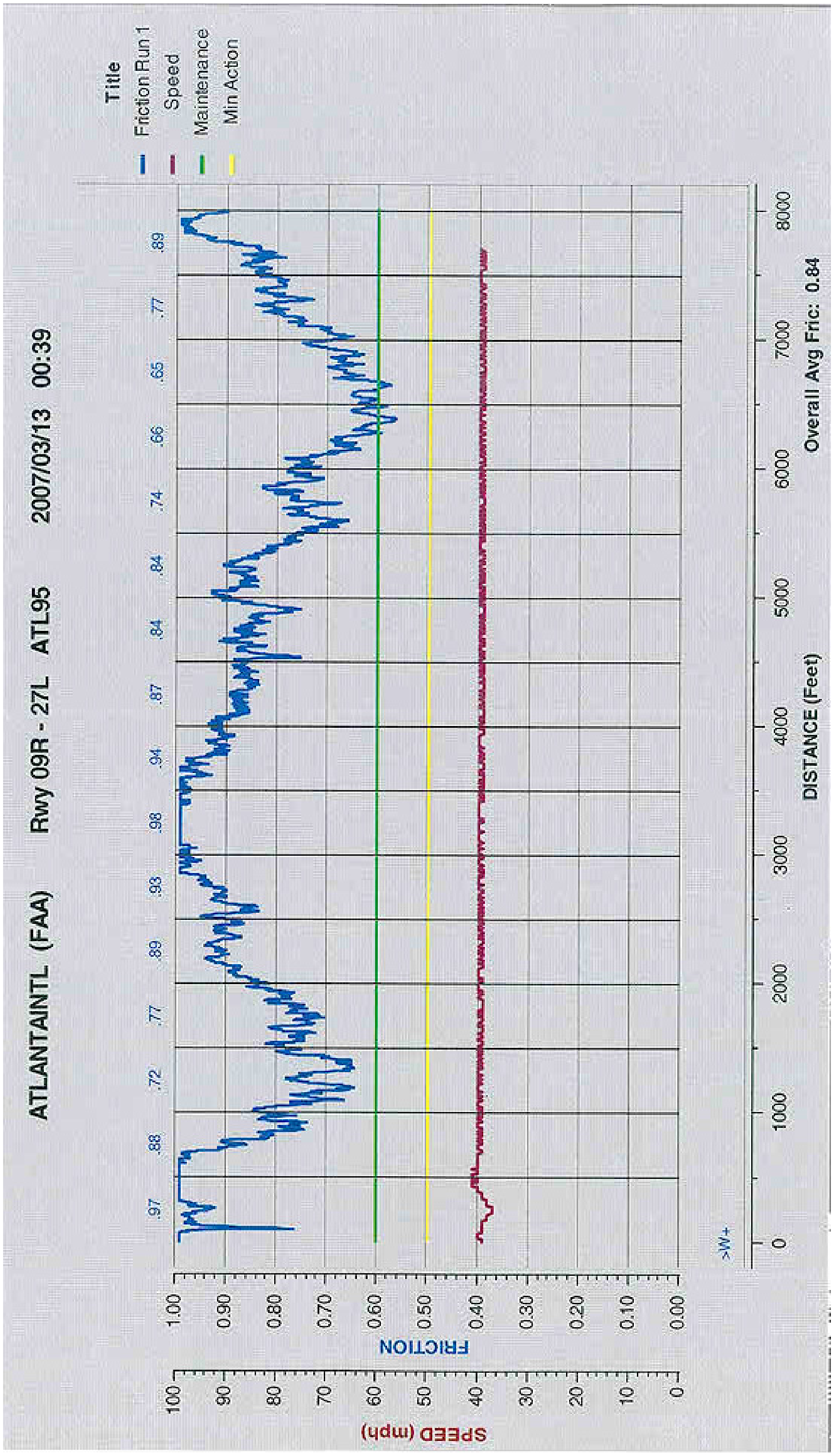

Figure 10: Runway 9R-27L friction values before chemical removal

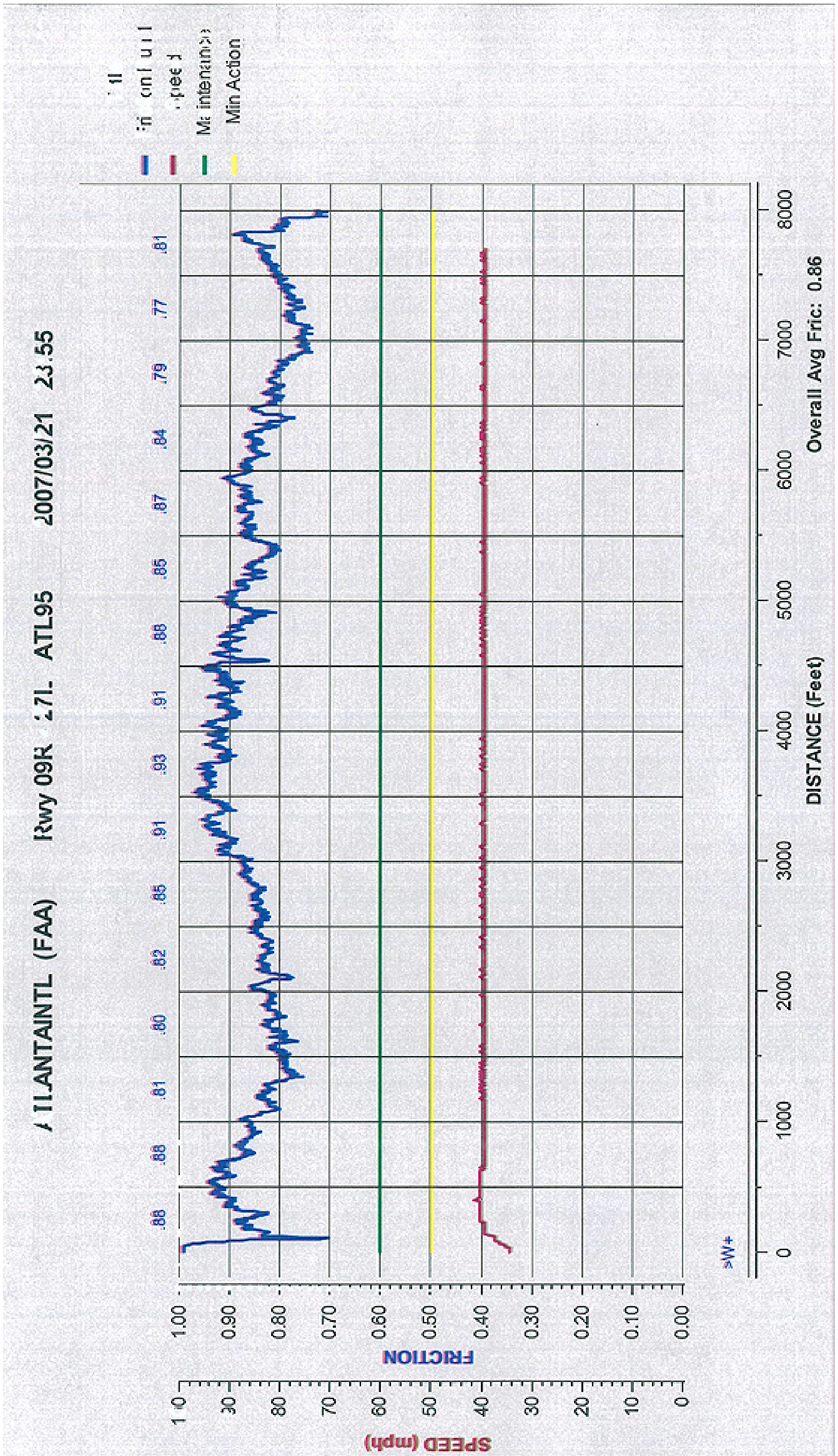

Figure 11: Runway 9R-27L friction values after chemical removal

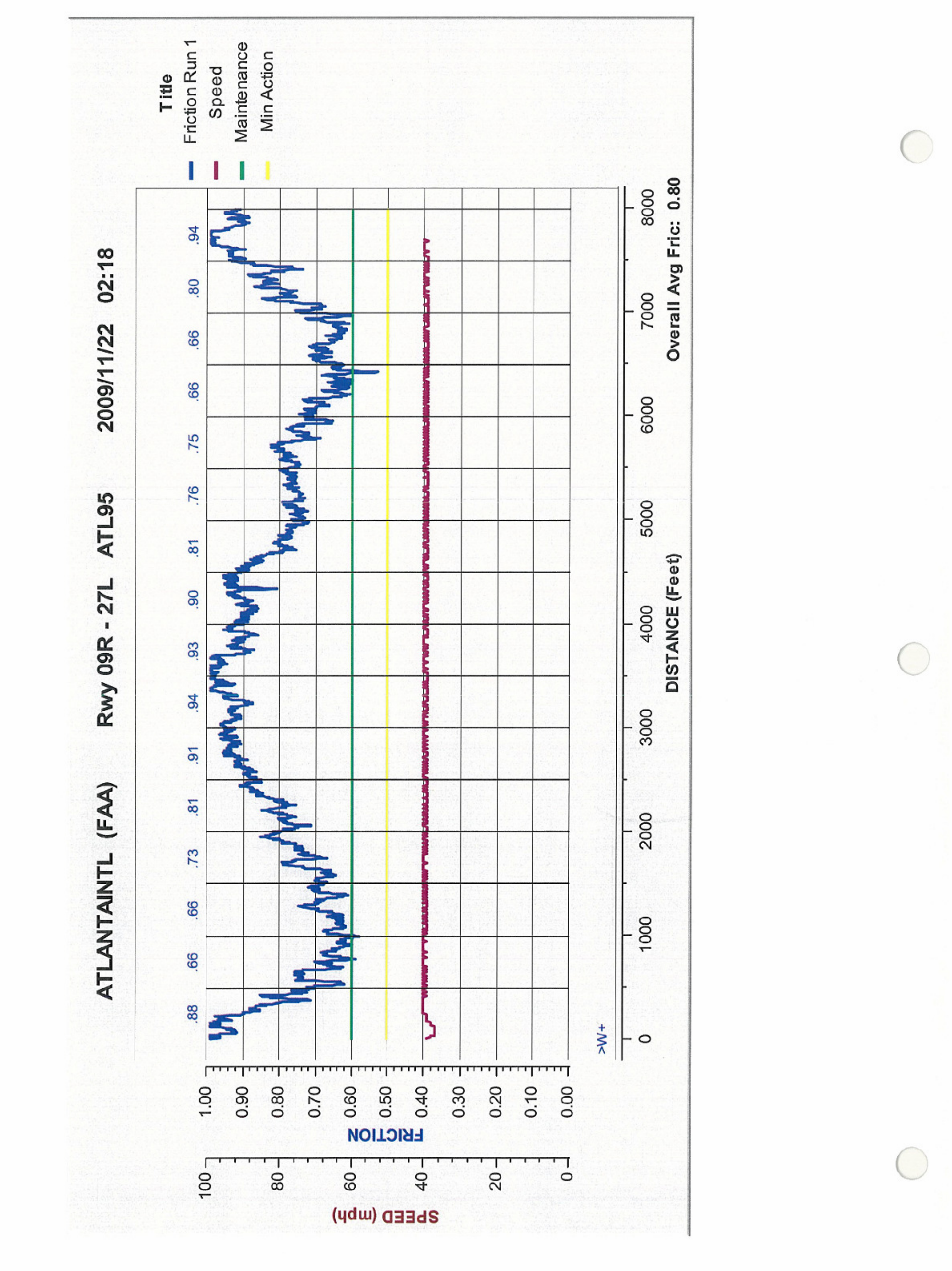

Figure 12: Runway 9R-27L friction values before shot blasting

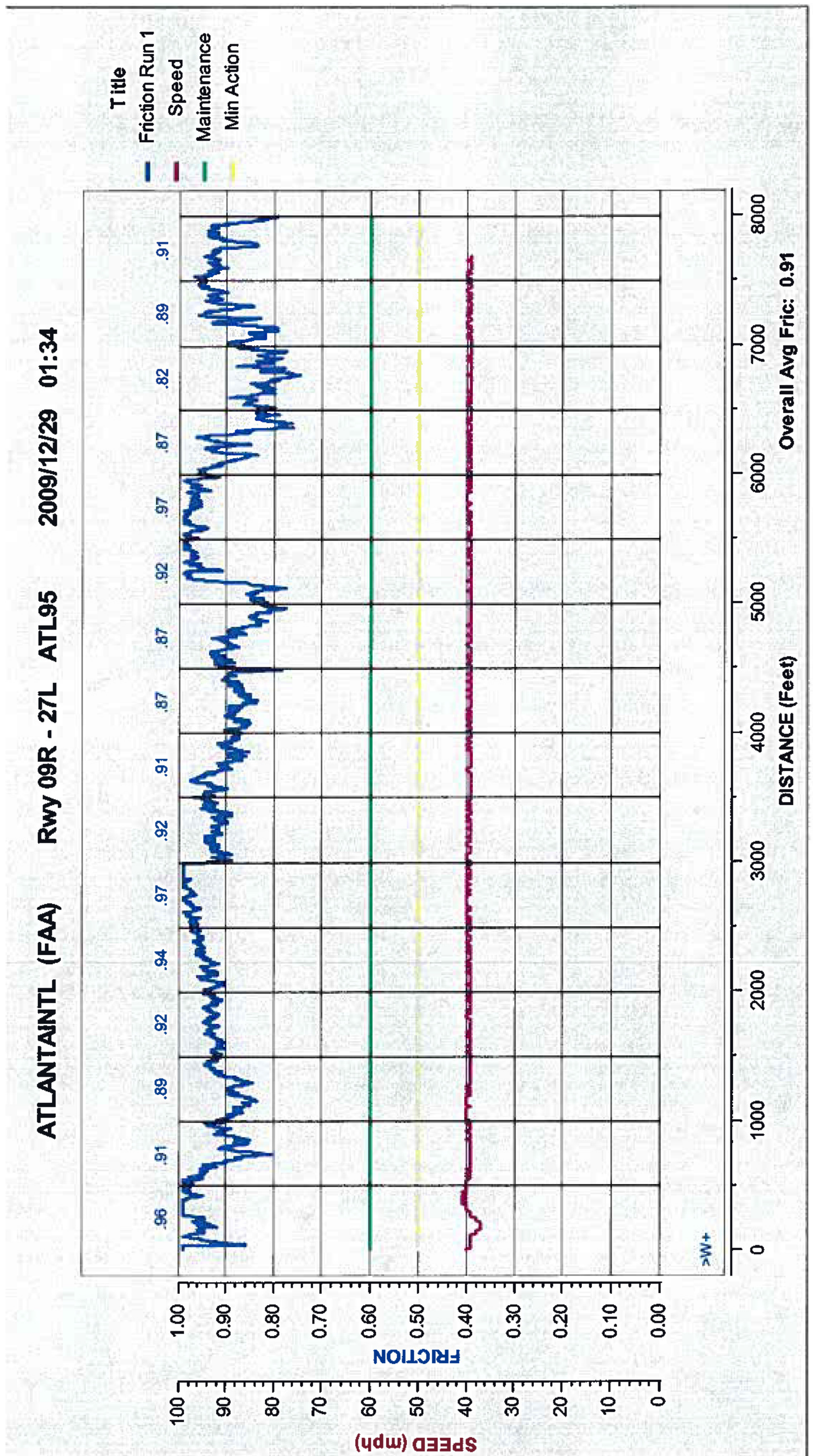

Figure 13: Runway 9R-27L friction values after shot blasting

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