

-EXECUTIVE SUMMARY-

REJUVASEAL PERFORMANCE INVESTIGATION

FOR

**ITEM P-632, BITUMINOUS PAVEMENT
REJUVENATION
DOCUMENTATION/CERTIFICATION**

PREPARED FOR

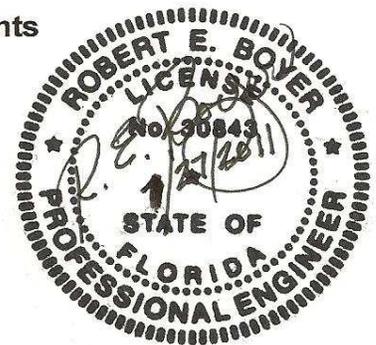
**PAVEMENT REJUVENATION INTERNATIONAL, LP
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1. REJUVENATION CRITERIA. The deterioration of asphalt pavements caused by hardening and inherent changes in the physical properties of the asphalt binder in the aging process has been generally recognized throughout the transportation industry. The influence of chemical composition of asphalts on pavement performance was initially advanced from research in 1959; wherein, it was determined that an asphalt binder consists of five fractional components which govern its behavior. With aging of the asphalt binder, the fractional components were converted from one fractional component to another fractional component in a hierarchy measured by the asphalt binder consistency; thus, with aging, or oxidation process, there was a corresponding increase in the consistency of the asphalt binder. It was reported that “the ratio of chemically more active to less reactive components present in the asphalt binder was a measure of predictive durability.” To affect performance, a rejuvenation material must possess characteristics to restore, or partially restore, the original chemical ratio of the asphalt binder components when applied to the pavement surface. For these phenomena to occur, two general rejuvenation criteria must be satisfied, as follows:

- First, the rejuvenation material has to contain ingredients with chemically active components to decrease the asphalt binder consistency, and
- Second, the rejuvenation material must penetrate the asphalt binder to effect reaction.

Based on these research findings, asphalt rejuvenation products have been developed and used as a pavement preservation technique since the mid 1960s.

2. HISTORICAL BACKGROUND. Based on acceptance and demand for the pavement preservation technique, the U.S. Air Force sponsored an independent evaluation of rejuvenator and rejuvenator/sealer products during 1971-1974 with testing conducted by the U.S. Army Corps of Engineers. This effort culminated in the 1976 Air Force Report and concluded that rejuvenator and rejuvenator/sealer products accomplished rejuvenation of aged asphalt binder materials for different pavement mixtures and different environmental conditions. The first Uniform Facilities Guide Specifications (UFGS) 02787, Bituminous Rejuvenation, was published. The 1976 Air Force Report further concluded that the viscosity testing of the treated asphalt binder was a better indicator of the rejuvenation effect than was the penetration testing.

Subsequently, in 1989, the FAA Engineering Brief No. 44, Cold-Tar Sealer/Rejuvenator, was published as a preliminary sealer/rejuvenator specification that delineated a material composed of coal tar oils and coal tar conforming to the requirements set forth in ASTM D490, Coal Tar Grade 12. Essentially, the specification was a material purchase description with guidelines for general construction procedures. The stated purpose of the material was to provide a fuel resistant surface and to rejuvenate the asphalt binder in an aged pavement.

The 1997 GAO Report concluded that industry consensus validated the success of bituminous pavement rejuvenation. Between 1989 and 1995, the EB-44 was employed to treat 77 airports with cold-tar sealer/rejuvenator products and 36 of these airports were accomplished using federal grant funds under the FAA Airport Improvement Program (AIP). There were no comprehensive independent tests for performance of the sealer/rejuvenator products. A

majority of the airport officials, engineering designers, and product manufacturers favored development of a performance base specification (PBS).

When the EB-44A and the EB-44B superseded the original EB-44, the changes to the specification only involved further restrictions to the hazardous chemicals. The current EB-44B retained the material property attributes as specified in the original EB-44, without reference to PBS requirements.

3. REJUVASEAL CERTIFICATIONS. Random samples of manufacturer's certification test records from 2006 through 2011 were reviewed. The records for 2005 and early 2006 indicated certifying tests for the original EB-44; the latter part of 2006 through 2008 records covered certifying tests for the EB-44A; and the 2009 through 2011 records covered certifying tests for the EB-44B. The Rejuvaseal manufacturer's certification testing demonstrated strict compliance with the cold-tar property requirements of the EB-44B specification.

4. REJUVENATION PERFORMANCE REQUIREMENT. The FAA Advisory Circular (AC) 150/5370-10E, Item P-632, Bituminous Pavement Rejuvenation, was published on September 30, 2009; hereinafter, referred to as "Item P-632." The objective of the Item P-632 was to provide a PBS for an asphalt concrete pavement rejuvenator and/or rejuvenator/sealer intended to retard disintegration of an asphalt pavement surface due to aging and optionally to protect the pavement from chemical attack (e.g., jet fuel).

The Item P-632 specified that the rejuvenation product must be capable of reducing the viscosity [ASTM D 2171 or AASHTO T 315] of the recovered asphalt binder from the top 3/8-inch layer of the asphalt pavement by 40%, or greater, calculated, as follows:

- Percent Decrease in Viscosity = $100 \times \frac{[(\text{absolute viscosity of untreated sample}) - (\text{absolute viscosity of treated sample})]}{(\text{absolute viscosity of untreated samples})}$.

5. REJUVASEAL PERFORMANCE. The RejuvaSeal performance investigation provided documentation for RejuvaSeal test protocols at MacDill AFB, FL; McGuire AFB, NJ; Grand Canyon Airport, AZ; Bismarck Municipal Airport, ND; Canadian Forces Base Trenton, Canada; and La Aurora International Airport, Guatemala. The test protocols were conducted by AMRL certified testing laboratories and covered the period from 1999 through 2010. These RejuvaSeal test protocols demonstrated consistent performance that exceeded the requirements of FAA AC 150/5370-10, Item P-632, Bituminous Pavement Rejuvenation, September 30, 2009. This RejuvaSeal documentation/certification covered more than 10 years of performance data, 10 different mix designs, and the major geographical climatic regions of the United States.

Formal documentation of the protocol test results are contained in the Final Report, RejuvaSeal Performance Investigation for Bituminous Pavement Rejuvenation Documentation/Certification, by Dr. Robert E. Boyer, P.E., Asphalt Consultant – Airport Pavements, July 27, 2011, and on file with Pavement Rejuvenation International (PRI), LP.

6. CONCLUSIONS

Scope of Rejuvenation Documentation/Certification Requirements. To comply with all know rejuvenator and/or sealer/rejuvenator specifications, the Rejuvaseal product must demonstrate compliance with performance criteria and documentation/certification

requirements of the Item P-632 specification and the coal-tar sealer/rejuvenator material property requirements of the EB-44B specification.

EB-44B, Coal-Tar Sealer/Rejuvenator, Property Requirements Compliance. The authentic records of RejuvaSeal quality control testing demonstrate documentation/certification for EB-44B has been established since the specification was published, May 28, 2008. The PRI, LP, has fully complied with the provisions of Contractor's responsibility and all manufacturers' certification testing has been in strict compliance with EB-44B coal-tar sealer/rejuvenator material property requirements.

Item P-632 Documentation/Certification Performance Requirements. Rejuvaseal Performance Test Protocols, 1999 through 2010, demonstrates consistent satisfactory performance and documentation/certification for Rejuvaseal in accordance with FAA AC 150/5370-10, Item P-632, Bituminous Pavement Rejuvenation, September 30, 2009. This Rejuvaseal documentation/certification includes more than 10 years of performance, 10 different mix designs, and the major geographical climatic regions of the U.S.

Final Conclusion. The RejuvaSeal product, coal-tar sealer/rejuvenator, meets all known material property requirements, rejuvenation performance criteria, and rejuvenation documentation/certification requirements for FAA AC 150/5370-10, Item P-632, Bituminous Pavement Rejuvenation and FAA Engineering Brief No. 44B, Coal-Tar Sealer/Rejuvenator.