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February 24, 2021

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Astec Burner Performance at HMA Production Facilities

Mr. Quinn,

Astec was initially contacted on February 14, 2020 via email by SCAQMD personnel requesting information on the availability of ultra-low-NOx burners for the Hot Mix Asphalt (HMA) industry. I was informed that the air district intended to revise portions of Rule 1147. At that time, I was asked to comment on the following emission rates since they were from 2015:

Pollutant	Projected Emissions	Burner Performance
NOx	0.035 lb/MMBtu	Low NOx Combustion
CO	0.30 lb/MMBtu	Good Combustion Practices

Our response was to advise SCAQMD that we could guarantee no lower emission rates from our ultra-low-NOx burner, the Phoenix Phantom, as its design had not changed during the interim time period. We did not discuss any other Astec burner models initially.

I received a Zoom meeting request on July 20, 2020 concerning a site visit made by SCAQMD personnel to the Sully-Miller plant site in Sun Valley, California. The purpose of the call was to discuss our burner offerings for the HMA industry. The zoom meeting occurred on July 24, 2020

to discuss what is technologically and economically feasible to target maximum emission reduction from HMA plant burners. SCAQMD requested Information on Astec burner performance and pricing (along with controls) during the July 24th Zoom meeting. Pricing was provided via email on August 4, 2020. Emission performance data was not included at that time.

During the course of that discussion, SCAQMD was made aware of the difficulties faced by HMA facility operators with respect to performance requirements. Asphaltic concrete production is **not** a static process, as other industries may be. Rather, operating conditions are in constant flux. Emission levels achievable under some operating conditions may not be achievable under other conditions. Combustion is affect by numerous factors, including but not limited to, the following parameters:

- Type of mix produced – base, intermediate course, surface, rubberized, recycle/virgin
- Mix temperature
- Ambient conditions
- Material moisture (virgin and recycle)
- Production rate

Stoichiometric combustion is a theoretic, or ideal, combustion in which all available fuel burns completely without air left over, meaning no excess air. All fuel carbon molecules convert to carbon dioxide (CO2), all sulfur molecules to sulfur dioxide (SO2), and all hydrogen molecules to water (H2O). In this theoretical process, combustion air nitrogen is exhausted in its elemental state. However, real combustion processes unfortunately do not operate in this manner. Rather, the air available for combustion must **always** exceed (excess air) the stoichiometric air for complete fuel combustion.

Actual combustion efficiency is dependent on the three “T’s”: time, temperature, and turbulence, which mixes the air and fuel together. Retention time is critical to assure that all fuel is combusted at a high enough temperature. Combustion rates can more than double for an increase in flame temperature by ten percent. Correspondingly, NOx emissions can go up as much as ten times when sufficient oxygen is present for that same ten percent flame temperature increase. Adequate mixing of the fuel and air is imperative to the combustion process. Agitation of the fuel-air mixture serves to ensure that ample oxygen is available when and where needed to completely combust the available fuel. This is an exceedingly difficult balance to achieve.

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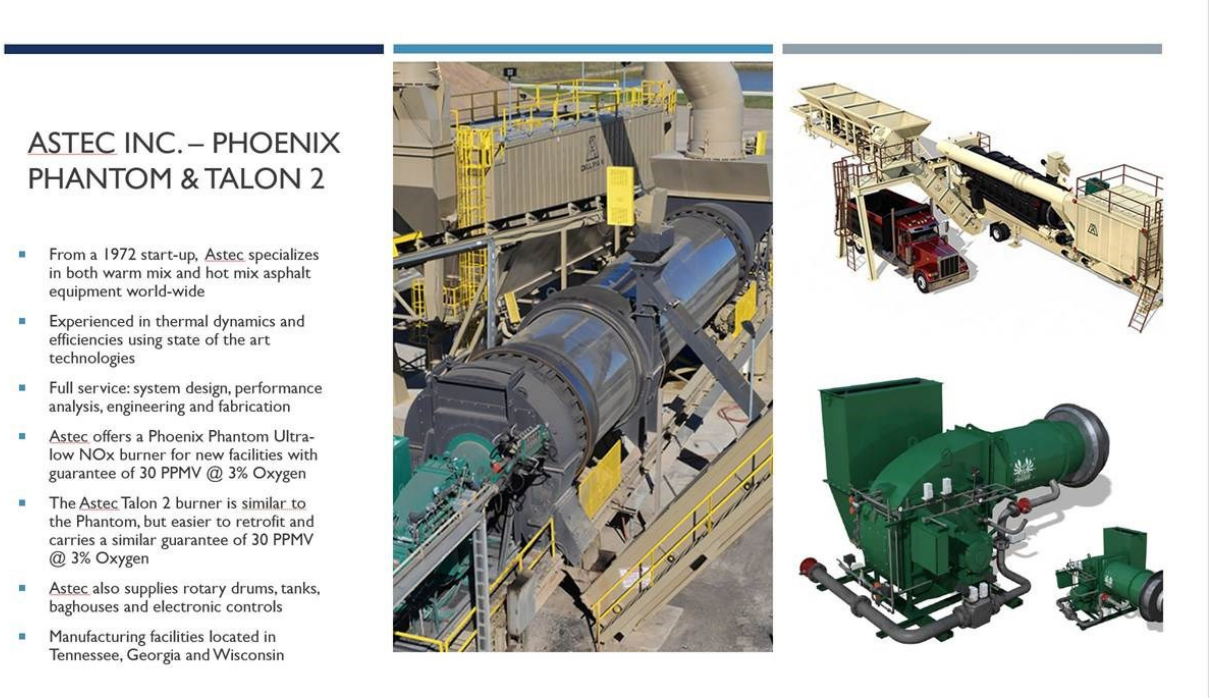
The Astec line of burners includes two models suitable for ultra-low-NOx applications – the Phoenix Talon and the Phoenix Phantom. Both models are highly efficient total-air burners that employ radial gas injectors to thoroughly mix combustion air and gaseous fuels. This enables them to achieve low NOx and CO emission concentrations without the need for flue gas recirculation when combusting natural gas. This combustion technique produces a compact flame that contributes to combustion efficiency by ensuring that all fuel is combusted without reducing heating capacity.

However, these burners are not identical in design. Phoenix Talon burners are designed to operate at up 25% excess air when firing on gaseous fuels. Phoenix Phantom burners operate at up to 55% excess air. They fire exclusively on gaseous fuels. Given the difference in airflow, the burners differ in terms of NOx generation. I was asked specifically about performance guarantees in a follow-up email on August 20, 2020. It was relayed to me at that time that SCAQMD had conflicting data associated with our anticipated burner performance. The following graphic was provided to me:



My email response on August 21, 2020 indicated that we do not publish our guarantees. By this I mean that we do not include emission rate guarantees in our distributed public documents. I have been unable to corroborate that the graphic provide to me even came from Astec originally.

No one in our organization recognizes it. Our policy at Astec has been for many years to provide customized guarantees to individual customers based on an engineering analysis of their project, particularly for retrofit applications. Based on discussion during the July 24th Zoom meeting, Astec agreed to guarantee the following emission rates for Phantom burners in new installations, meaning greenfield projects. Those guarantees will be made **directly to our customers.** The following emission rates are not to be considered a blanket guarantee of our burner performance in *all* applications:

- NOx: 25 ppmvd @ 3% O2
- CO: 150 ppmvd @ 3% O2

Astec no longer offers the Phantom burner for installation at existing facilities. This burner requires additional airflow to achieve the specified performance levels. Existing baghouses typically do not have sufficient capacity to provide a sufficient volume of airflow to support the burner requirements. There are also specific requirements concerning drum diameter and length. Length is critical to ensuring there is a sufficient combustion zone as well as showering flights for aggregate drying. Astec drums are specifically designed to accommodate the burners installed in them. Drums by other manufacturers are not. Existing facilities may also have fugitive VOC systems routed to the drum. These systems are completely incompatible with conditions required in the combustion zone by the Phantom burner.

I additionally indicated that we would guarantee the following emission rates for the Phoenix Talon burners for ***most*** retrofit applications. Again, we will provide customized guarantees **directly to our customers** when appropriate upon completion of a thorough engineering analysis. As with the Phantom burner, the following values are not to be considered a blanket guarantee of our burner performance in *all* applications:

- NOx: 30 ppmvd @ 3% O2
- CO: 150 ppmvd @ 3% O2

The Talon burner likewise has specific drum diameter and length requirements. **Each** retrofit project must be thoroughly analyzed to evaluate the Talon burner' *capability* of performing as intended in an existing drum at the thermodynamically required heat output given the facility's rated production capacity.

I further indicated that we would have to evaluate facilities with fugitive VOC control systems routed to an existing burner. Systems such as these could negatively impact burner performance

and render the Talon burner incapable of achieving the emission rates specified above. Astec would decline to even quote our burner for use at *any* existing site that does not meet the design parameters required for guaranteed performance levels.

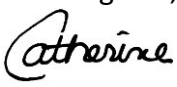
Please note that the aforementioned NOx emission rates are for combustion only and do not include NOx formation due to impurities that could be present in the feed materials due to blasting nitrates or agricultural fertilizers. No burner is capable of controlling NOx formation originating through processes other than combustion. Because nitrates are known to be present in some feed materials, we counsel customers to investigate the potential influence those materials will have on the stack NOx concentrations prior to conducting any stack tests.
I received another email from SCAQMD staff on September 29, 2020. It contained the following graphic from a PowerPoint presentation to be used by SCAQMD:

The graphic indicates that the Phantom and Talon burners have "been demonstrated to achieve 25 and 30 ppm, respectively." The slide included no caveats such as those listed above for our burners, which were clearly outlined in a previous email. In particular, **we will not guarantee** this

level of performance for the Phoenix Talon burner for *any* existing facilities that do not meet our specifications during the required engineering evaluation. Further, we will not install a Phoenix Phantom at any existing facilities, as has been suggested by SCAQMD to an HMA facility operator.

As the manufacturer of the Phoenix line of burner models for aggregate drying applications, we must safeguard our reputation. Both burner models have been built for about 20 years. We are well aware of the capabilities of our burners under a variety of operating scenarios. We are also very well aware of how difficult it can be to achieve and sustain the aforementioned levels of performance under all potential operating scenarios. With that in mind, we will not be able to support burner retrofit requests from any existing facilities not meeting our standards. To do otherwise would result in an HMA facility operator unable to comply with the applicable combustion regulations.

Best Regards,



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