The Uniform Burner Rating Method For Aggregate Dryers

NAPA

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PAVEMENT ASSOCIATION

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ACKNOWLEDGMENTS

The Uniform Burner Rating Method for Aggregate Dryers
was developed by the
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Participating companies of the BAEB
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Allis-Chalmers Corporation
Astec Industries, Inc.
Barber-Greene Company
CMI Corporation
General Combustion Corporation
Iowa Manufacturing Company
Portec Inc./Pioneer Division
Standard Havens, Inc.

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Developed by
The Bituminous
Mixing Plant
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I. OBJECTIVES

It is the purpose of the BAEB Uniform Burner Rating Method for Aggregate Dryers to provide reliable rating data for combustion units used in asphalt mixing plant applications that take into account the operating conditions under which the equipment will perform. Heretofore, burner manufacturers, having no alternative, have provided so-called "maximum" ratings which correctly state Btu/Hr. production under "test-stand" or laboratory conditions but which systematically overstate Btu/Hr. production under operating conditions pertinent to aggregate dryer applications. Thus, the BAEB Uniform Burner Rating Method has been developed to accomplish the following objectives:

- To provide equipment users with more accurate and reliable information for matching the burner's capacity with the plant's requirements.
- To save energy, an automatic side-effect of more accurate burner sizing decisions.
- To avoid, in these energy conscious times, the potentially negative public image of the asphalt industry that could result from the continued use of "maximum" burner ratings which depict burner use as a far more fuel-consuming process than it is in fact.

II. RATING CRITERIA

The BAEB Uniform Burner Rating Method for Aggregate Dryers is offered for the voluntary implementation of burner and dryer manufacturers. It will rate burners and dryers together as a system according to eight constant criteria typical of operating conditions and one variable criterion based on dryer system air flow (ACFM).

The rating method is based on scientific data employed in an authoritative publication of the National Asphalt Pavement Association (NAPA) entitled, *Maintenance and Operation of Exhaust Systems in the Hot Mix Plant* (Information Series 52 and 52A). Table II of that publication displays data which conform to mathematical and physical expressions only and which describe conditions that are common for aggregate dryer operations. The eight constant rating criteria, which utilize the same parameters applied in developing Table II data, are as follows:

1. 25% excess air
2. 5% leakage air
3. 10% casing loss
4. 350°F fan gas temperature
5. 5% moisture (removal from material)

6. 300° F material temperature
7. #2 fuel oil (138,000 Btu/Gal.)
8. Specific heat of aggregate is .2

In addition to applying these parameters, the system's actual cubic feet per minute (ACFM) must be specified to determine the maximum Btu/Hr. that the burner will be required to produce under normal operating conditions. Table II of the NAPA publication referenced above provides data in 10,000 ACFM increments for several material moisture ranges. The BAEB Uniform Burner Rating Method for Aggregate Dryers has expanded these data within the 5% material moisture range to provide ratings for each 1,000 ACFM increment. The expanded Table II data are displayed in Exhibit A of this document. Consistent with good engineering practice, burner and dryer manufacturers must allow for peaking and start-up in excess of ratings determined through this method.

III. CONVERSION

In order to rate a burner, the ACFM of the draft system at 350° F is to be used. In the case of different draft system temperatures, an approximate conversion will be through use of a ratio of the varying factors using the ideal gas law: $PV = NRT^*$ (P, N and R remain constant). The temperature must be specified as an absolute temperature.

An example of this would be as follows:

Convert 25,000 ACFM at 250° F to 350° F

V_1 = 25,000 ACFM

T_1 = 250° F + 460° F = 710° Rankin

V_2 = (Unknown)

T_2 = 350° F + 460° F = 810° Rankin

$$\frac{V_1}{V_2} = \frac{T_1}{T_2}$$

$$\frac{25{,}000}{V_2} = \frac{710° \text{ Rankin}}{810° \text{ Rankin}}$$

V_2 = 28,521 ACFM

The basic physical rules utilized are:

1. It takes 14.4 lbs. of air to burn 1 lb. of oil stoichiometrically.
2. It takes 1 Btu to raise 1 lb. of water 1° F and 0.2 Btu to raise 1 lb. of aggregate 1° F.
3. A pound of water occupies 32.6 ft.^{3} as steam at an exhaust temperature of 350° F and atmospheric pressure.
4. 14.4 lbs. of air and 1 lb. of oil occupy 321.7 ft.^{3} of volume as products of combustion at 350° F.
5. Excess air, leakage air and casing losses have been numerically arrived at and agreed upon over the years (cf., NAPA Information Series 52 and 52A).
6. Adequate combustion volume for the fuel used is assumed.

*P = pressure; V = volume; R = universal gas constant; N = number of moles; and T = temperature.

Obviously, the variables and values of ACFM, moisture removal, stack temperatures, ability of burner to function on 25% excess air, ability of burner to supply requirements for peaking, draft system leaks, incomplete combustion and efficiency will continue to be debatable matters, but will not as such affect the theoretical rating method or the ability of a proper system to function as specified under the rating system.

IV. RATING PLATES

Dryer manufacturers (including drum mix dryers) who apply the same basic burning system to two or three different air range applications will order burners from their burner supplier with blank rating plates. This will allow burner manufacturers to stock these systems without committing them to specific dryers. When the burner is applied, the dryer manufacturers will stamp the appropriate data on the rating plate. This would, of course, be within the range of operation specified by the burner manufacturer.

Burner manufacturers would generally be expected to supply either a blank rating plate with separate burner operating data or a pre-stamped, attached burner plate based on conditions specified by the dryer manufacturer, or in the case of a retrofit system, by end user.

Burner manufacturers wishing to use the BAEB rating method can purchase rating plates at cost (contact BAEB Secretary for ordering information) which will include the following information:

Based upon the Uniform Burner Rating Method of the

Bituminous and Aggregate Equipment Bureau

of the

Construction Industry Manufacturers Association

The burner and dryer manufacturers recommend this combustion unit for applications requiring _____ Btu/Hr. at _____ ACFM, Calculated @ 350° F

COMBUSTION SYSTEM MODEL _____
and SERIAL NUMBER _____

EXHIBIT A

BAEB UNIFORM BURNER RATING METHOD FOR AGGREGATE DRYERS

PARAMETERS*

25% excess air
5% leakage air
10% casing loss
350° F fan gas temperature
5% moisture (removal from material)
300° F material temperature
#2 Fuel oil (138,000 Btu/Gal.)
Specific heat of aggregate is .2
and
ACFM (see chart below)

EXPANDED CHART OF RATINGS PER 1000 ACFM INCREMENTS**

Exhaust Fan ACFM (000's)	Maximum Btu/Hr. (000's)	Exhaust Fan ACFM (000's)	Maximum Btu/Hr. (000's)	Exhaust Fan ACFM (000's)	Maximum Btu/Hr. (000's)	Exhaust Fan ACFM (000's)	Maximum Btu/Hr. (000's)
10	17,600	33	58,084	56	98,567	79	139,050
11	19,360	34	59,844	57	100,327	80	140,810
12	21,122	35	61,605	58	102,088	81	142,571
13	22,882	36	63,365	59	103,848	82	144,330
14	24,642	37	65,125	60	105,608	83	146,091
15	26,402	38	66,885	61	107,368	84	147,851
16	28,162	39	68,645	62	109,128	85	149,611
17	29,922	40	70,406	63	110,888	86	151,371
18	31,683	41	72,165	64	112,648	87	153,131
19	33,442	42	73,925	65	114,408	88	154,891
20	35,203	43	75,686	66	116,169	89	156,652
21	36,963	44	77,446	67	117,929	90	158,412
22	38,723	45	79,205	68	119,688	91	160,172
23	40,483	46	80,966	69	121,449	92	161,932
24	42,243	47	82,726	70	123,210	93	163,692
25	44,003	48	84,486	71	124,969	94	165,452
26	45,763	49	86,246	72	126,729	95	167,212
27	47,524	50	88,007	73	128,490	96	168,973
28	49,284	51	89,767	74	130,250	97	170,733
29	51,044	52	91,527	75	132,010	98	172,493
30	52,804	53	93,287	76	133,770	99	174,253
31	54,564	54	95,047	77	135,530	100	176,013
32	56,324	55	96,807	78	137,290		

*Parameters are those used to calculate the balance between air flow and available heat in Table II of a National Asphalt Pavement Association publication, *The Maintenance and Operation of Exhaust Systems in the Hot Mix Plant* (Information Series 52 and 52A).

**Table II data within the 5% material moisture range are expanded for this chart to provide ratings for each 1000 ACFM increment.

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