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BAND AND TOTAL EMISSIVITY OF AMMONIA

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INFRARED radiation of ammonia has received considerable attention in the past because of its common presence in industry and in planetary atmospheres [1–6]. Port [1] measured total radiation from ammonia vapor–nitrogen mixtures at a total pressure of 1 atm and a pathlength of 51·2 cm by use of a complex but ingeniously designed system involving a windowless high-temperature absorption cell. On the basis of these measurements in the range of temperature from 300°K to 1000°K and ammonia partial pressure from 0·006 atm to 1 atm, a total-emissivity chart has been constructed [1, 2]. Recently, extensive measurements of infrared band absorption of ammonia have been made at 300°K by France and Williams [5]. The purpose of the present work is (1) to correlate the recent France–Williams band data to yield Edwards wide-band parameters [7, 8] and (2) to predict the total emissivity and to compare with the early measurements of Port.

The major infrared band-absorption regions of ammonia consist of the ν_2 band located around 950 cm^{-1} (10·5 μ), the $(\nu_4 + 2\nu_2)$ bands around 1628 cm^{-1} (6·15 μ), and the $(\nu_1 + \nu_3 + 2\nu_4)$ bands around 3300 cm^{-1} (3 μ) [5]. The overtone bands, $2\nu_2$ and $2\nu_4$, are much weaker than their respective overlapping fundamental bands. Infrared bands between 20 and 35 μ have also been measured [6], but their contributions to the total radiation of ammonia in the temperature range of practical interest (300–1000°K) are negligible. Relevant information regarding the four fundamental bands is given in Table 1.

Table 1. Fundamental bands of ammonia

Band	Band center (cm^{-1})	Transition	Degeneracy	Band intensity (cm^{-2} atm^{-1})		
				[3]	[4]	[5]
ν_1(3·0 μ)	3337	0000–1000	1	—	20	(47 for $\nu_1 + \nu_3 + 2\nu_4$)
ν_2(10·5 μ)	950	0000–0100	1	677	600	790
ν_3(2·9 μ)	3448	0000–0010	2	—	13	(47 for $\nu_1 + \nu_3 + 2\nu_4$)
ν_4(6·15 μ)	1627	0000–0001	2	133	110	(150 for $\nu_4 + 2\nu_2$)

In accordance with the Edwards exponential wide-band model [7, 8], the France–Williams room temperature data can be correlated to yield the basic wide-band parameters as shown in Table 2. The correlation procedure as well as the definition of these parameters can be found in numerous previous investigations [7–10]. For extrapolation to higher temperatures, the formulas given by Edwards and Balakrishnan [8] are used. The total emissivity of ammonia

Table 2. Wide-band parameters of ammonia (300°K)

Parameters	$\nu_1 + \nu_3 + 2\nu_4$	$\nu_4 + 2\nu_2$	ν_2
C_1 (cm^{-2} atm^{-1})	47	150	790
C_2 (cm$^{-\frac{3}{2}}$ atm$^{-\frac{1}{2}}$)	73	100	134
C_3 (cm^{-1})	106	97·4	106·3
n	0·7	0·7	0·7
B	6·0	5·77	6·2

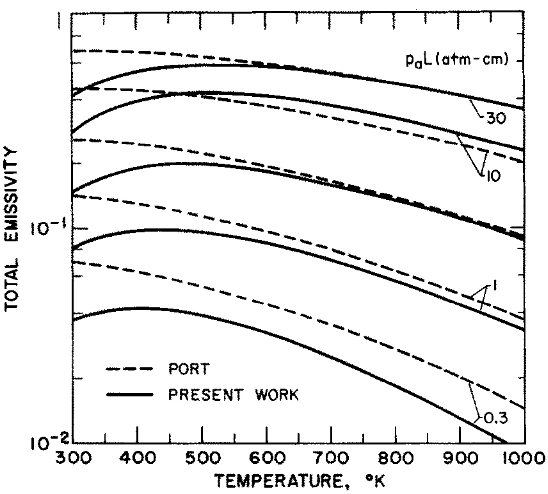

FIG. 1. Total emissivity of ammonia.

as calculated from this correlation and extrapolation procedure is shown in Fig. 1 in comparison with the early findings of Port. It should be noted that in Fig. 1 p_a stands for the ammonia partial pressure, and L for the geometric mean beam length. The agreement between the suggested values of Port and the present prediction is quite good indeed. It is a little surprising, however, to see that the agreement in the extrapolated (higher temperatures) region is better than that at 300°K, since the prediction at 300°K should be most reliable as it is purely based on the France–Williams band absorption data.

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HEAT TRANSFER PARAMETERS OF A PARALLEL PLATE HEAT EXCHANGER

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NOMENCLATURE

a, distance between the plates through which laminar flow occurs;
b, wall thickness;
C_i, specific heat of fluid, i;
g, dimensionless velocity distribution of the laminar —side fluid, $u/\bar{u}$;

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