This is an explicit expression in the major species and temperature. For HO_2, the full steady state is utilized and can be written as

$$[HO_2] = \frac{k_{11}[H][O_2][M]}{(k_{12} + k_{13} + k_{14})[H] + k_{15}[O] + k_{16}[OH]} = \frac{C_1}{C_2 + k_{15}[O]} \tag{7}$$

the last equality of which defines C_1 and C_2 for algebraic simplicity in later expressions. Because this expression contains the species O, it is not an explicit expression. If, however, one can express O explicitly, then an explicit expression for HO_2 is possible.

For O, we also use the full steady-state expression, which is

$$[O] = \frac{k_1[H][O_2] + k_4[OH][H] + k_7[OH]^2 + k_{14}[HO_2][H]}{k_2[OH] + k_3[H_2] + k_8[H_2O] + k_{15}[HO_2]} = \frac{C_3 + k_{14}[HO_2][H]}{C_4 + k_{15}[HO_2]} \tag{8}$$

and again the last equality defines C_3 and C_4 for later simplicity. The explicit expression for OH can then be introduced (but is not written out here, as it is wholly contained within the constants), as is the preceding expression for HO_2, and a quadratic equation for O is obtained:

$$k_{15}C_4[O]^2 + (C_2C_4 + (C_1 - C_3)k_{15})[O] - (C_2C_3 + C_1k_{14}[H]) = 0 \tag{9}$$

that can be solved using the quadratic formula to determine [O], and that value can then be used to determine the value of $[HO_2]$.

Although the resulting expressions are somewhat complicated, this scheme is explicit, should be as inexpensive to use as that of Rogers and Chinitz,[2] and should provide greater accuracy in profiles of temperature and species concentrations. It would be worthwhile to perform evaluations, similar to those reported,[1] with the improved detailed chemistry and the recent systematically reduced chemistry.

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Reply by the Authors to M. L. Rightley

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WE appreciate M. L. Rightley's comment that points out additional reduced mechanisms for hydrogen/air combustion. It would probably be useful to implement the newest mechanism and test it for geometries of interest to the combustion and/or fluid dynamics communities.

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Received 16 May 1999; accepted for publication 6 August 1999.

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Errata

Screech Tone Noise and Mode Switching in Supersonic Swirling Jets

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[AIAA Journal, 36(11), pp. 1968–1974 (1998)]

TO be consistent with the text, the captions of Figs. 6a and 6b should be exchanged. All other results remain unchanged.