Influence of the Fuel Dilution with Combustion Products on the Energy Use

Nattan R. Caetano

Federal University of Santa Maria, Brazil
nattan.caetano@ufsm.br

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Introduction
Aims

General:

- Assess the energy emission by radiation mechanism from the flames diluted with combustion products.

Specifics:

- Measuring the radiation emitted by flames diluted with CO_2 and N_2.

- Measuring the soot production in several dilution proportions.

Introduction
Motivations

- The radiation heat transfer is the predominant mechanism to the energy use in several industrial applications.
- The exhaust gases from combustion and the soot are the main participant media in radiation process.
- The reuse of the combustion products allows to increase the efficiency and to reduce the emissions.
- Safety to operators and equipment, near from the sources.

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Methodology

- Non-premixed natural gas flames were stabilized on a Santoro burner.
- CO_2 and N_2 added in the fuel stream, different proportions of dilution.

Cases	Flow [L/min]					Dilution
	GN	CO2	N2	Diluent	Total	%
A	0,5	0	0	0	0,5	0
B	0,5	0,056	0	0,056	0,56	10
C	0,5	0,125	0	0,125	0,63	20
D	0,5	0,214	0	0,214	0,71	30
E	0,5	0,333	0	0,333	0,83	40
F	0,5	0,5	0	0,5	1	50
G	0,5	0	0,056	0,056	0,56	10
H	0,5	0	0,125	0,125	0,63	20
I	0,5	0	0,214	0,214	0,71	30
J	0,5	0	0,333	0,333	0,83	40
K	0,5	0	0,5	0,5	1	50

Experimental Approach
Soot

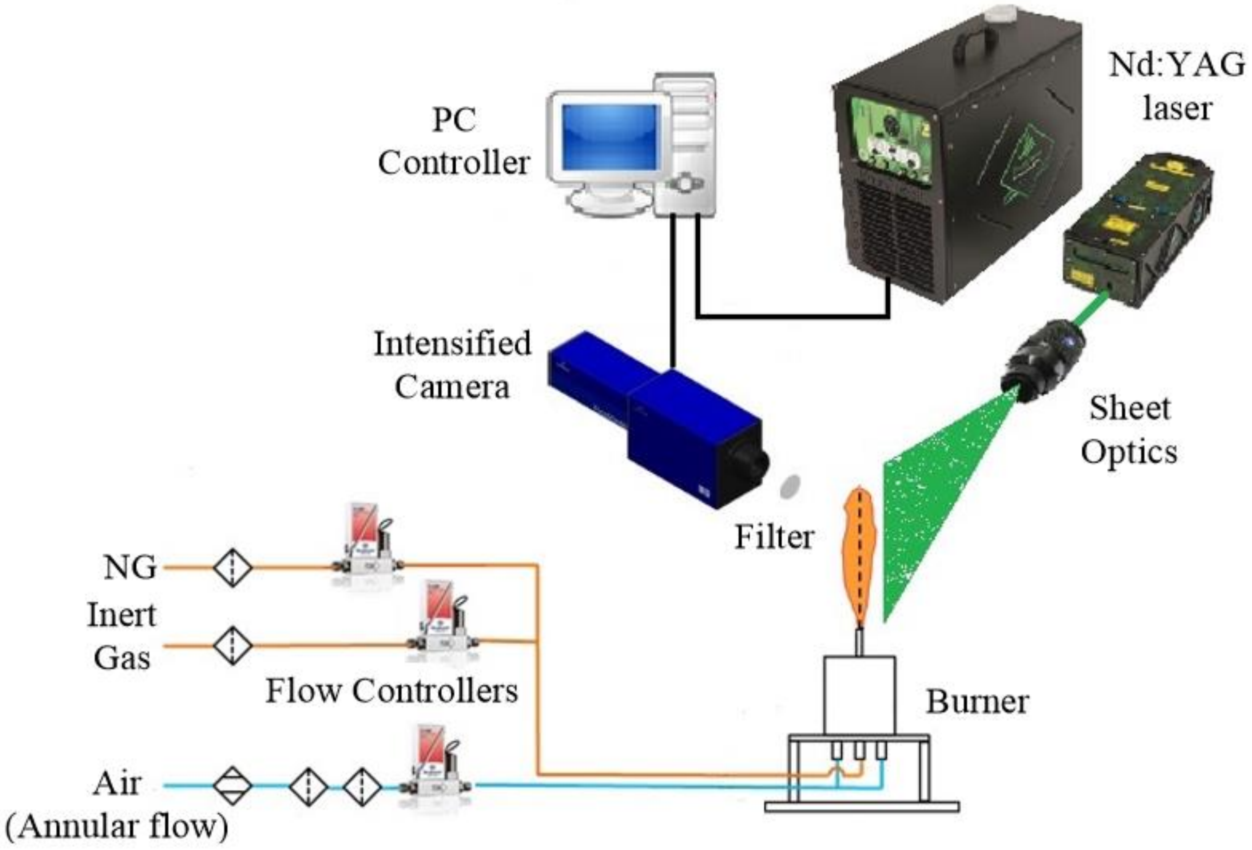

Diagram of facilities to measure soot

Experimental Approach
Radiation

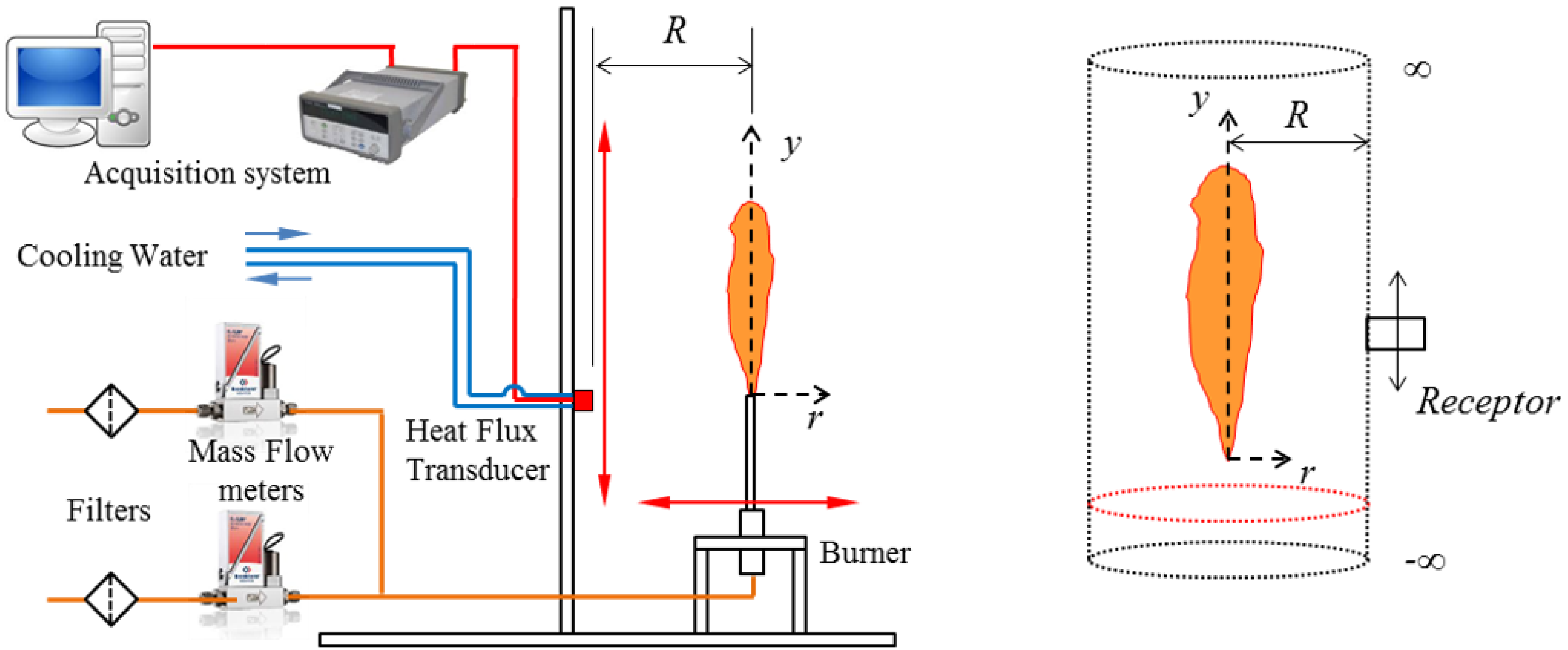

Diagram of facilities to measure radiation

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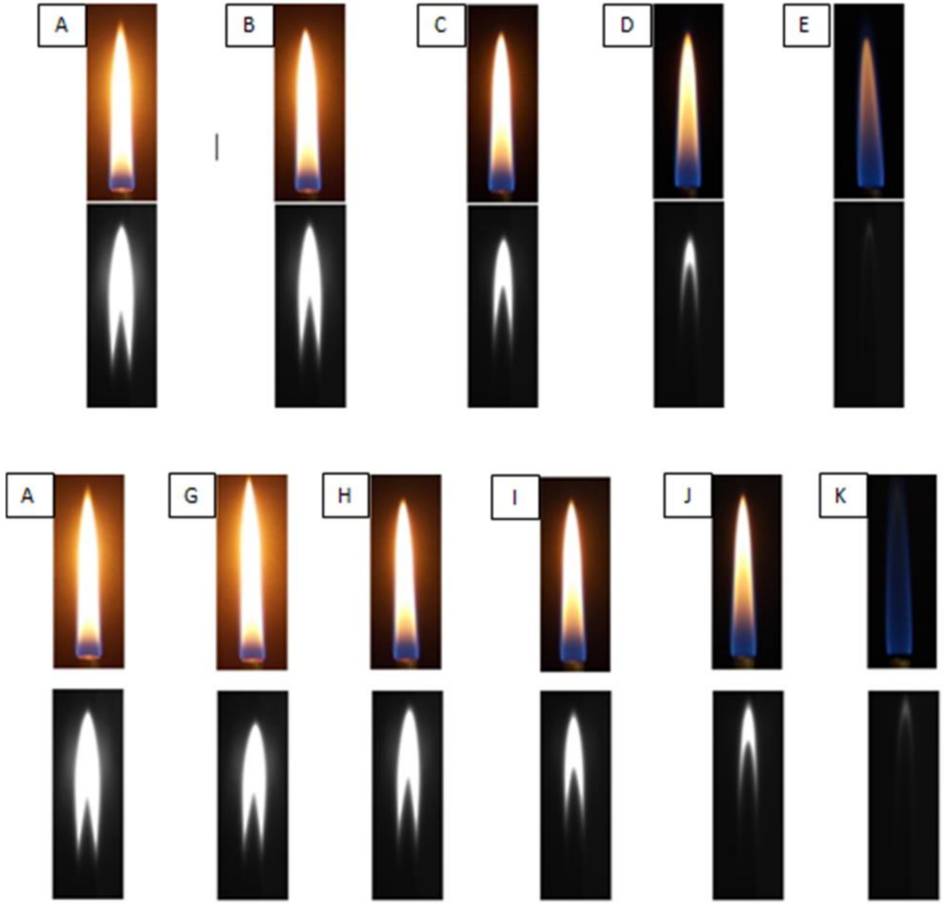
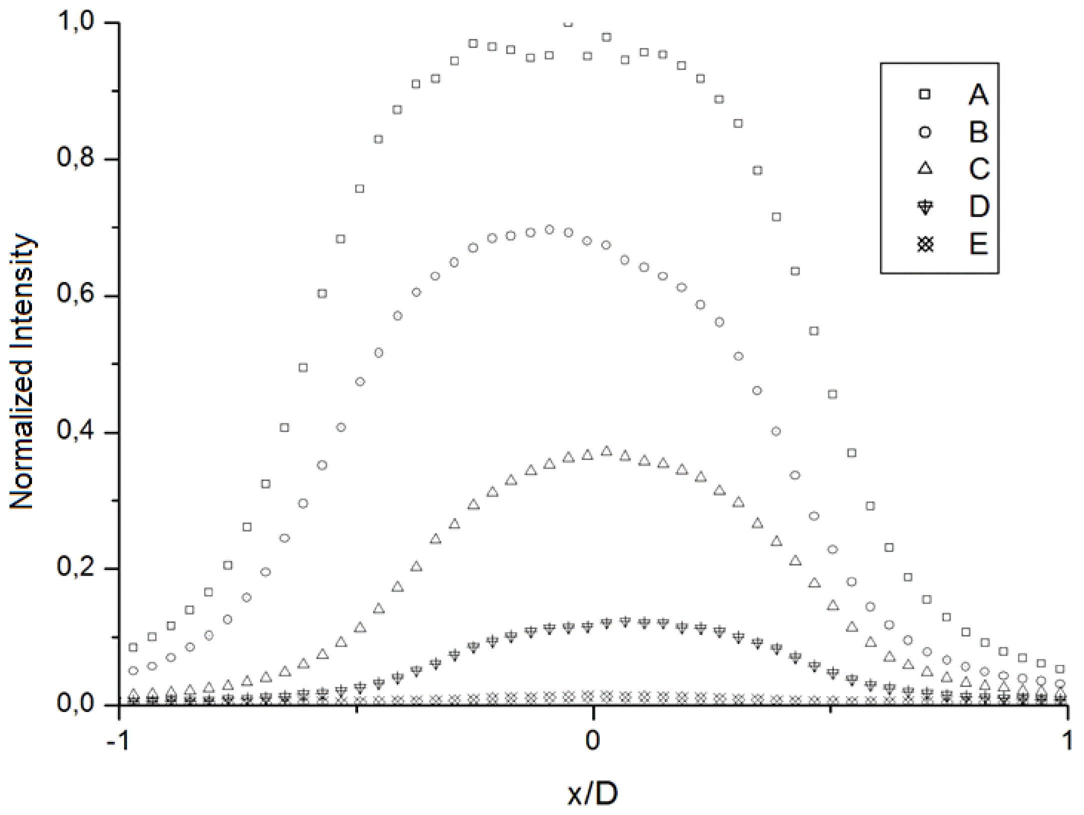
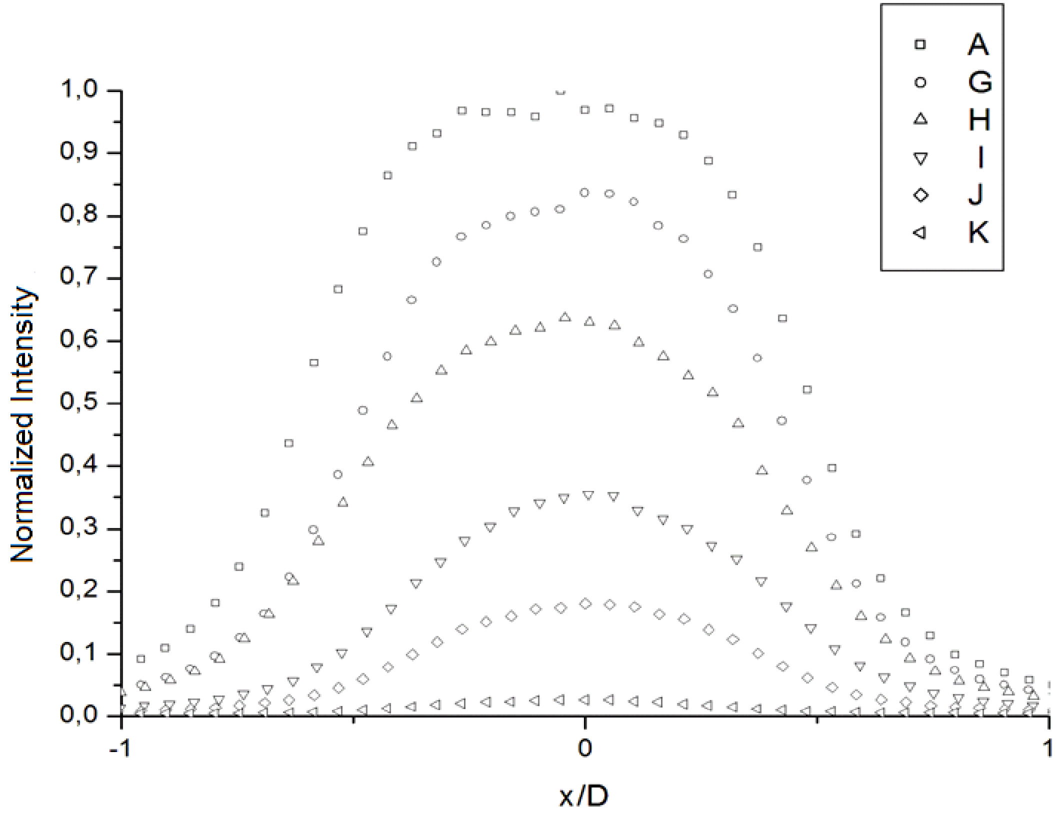
Results



Flame and soot images. Cases A to E, consider CO_2 and; cases G to K, N_2.

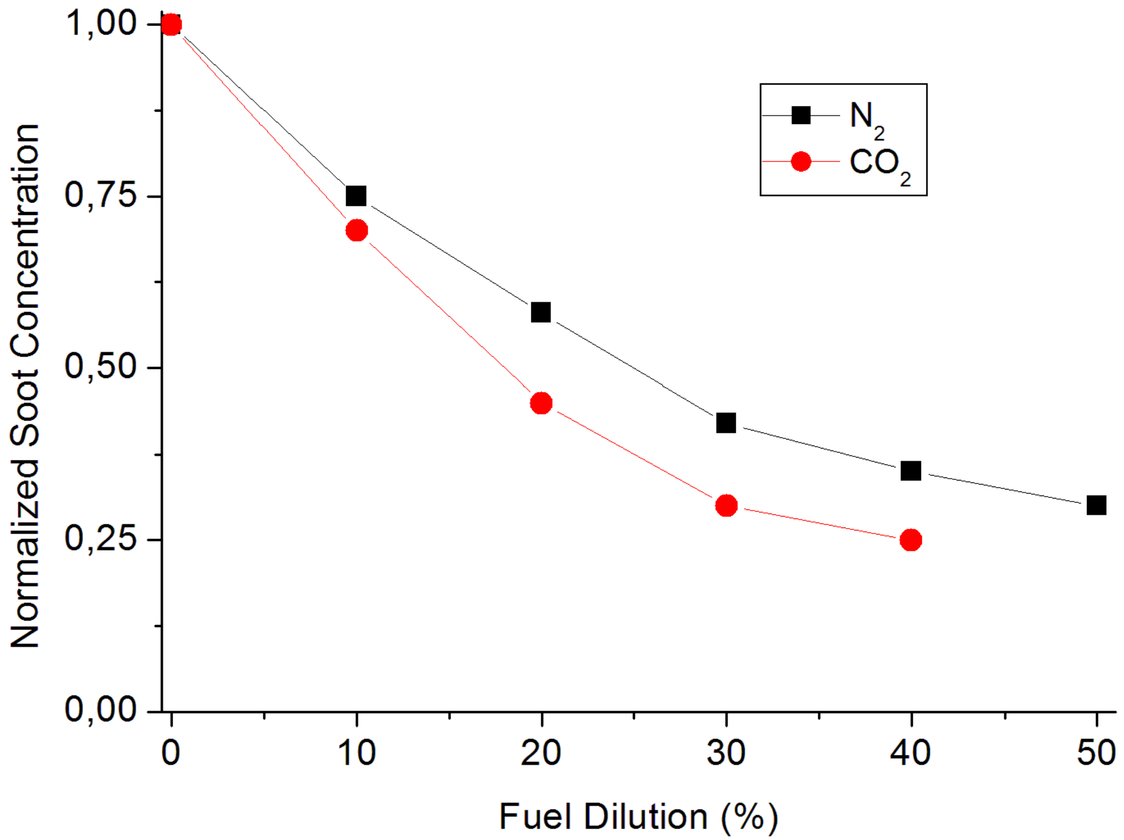
Soot Profiles





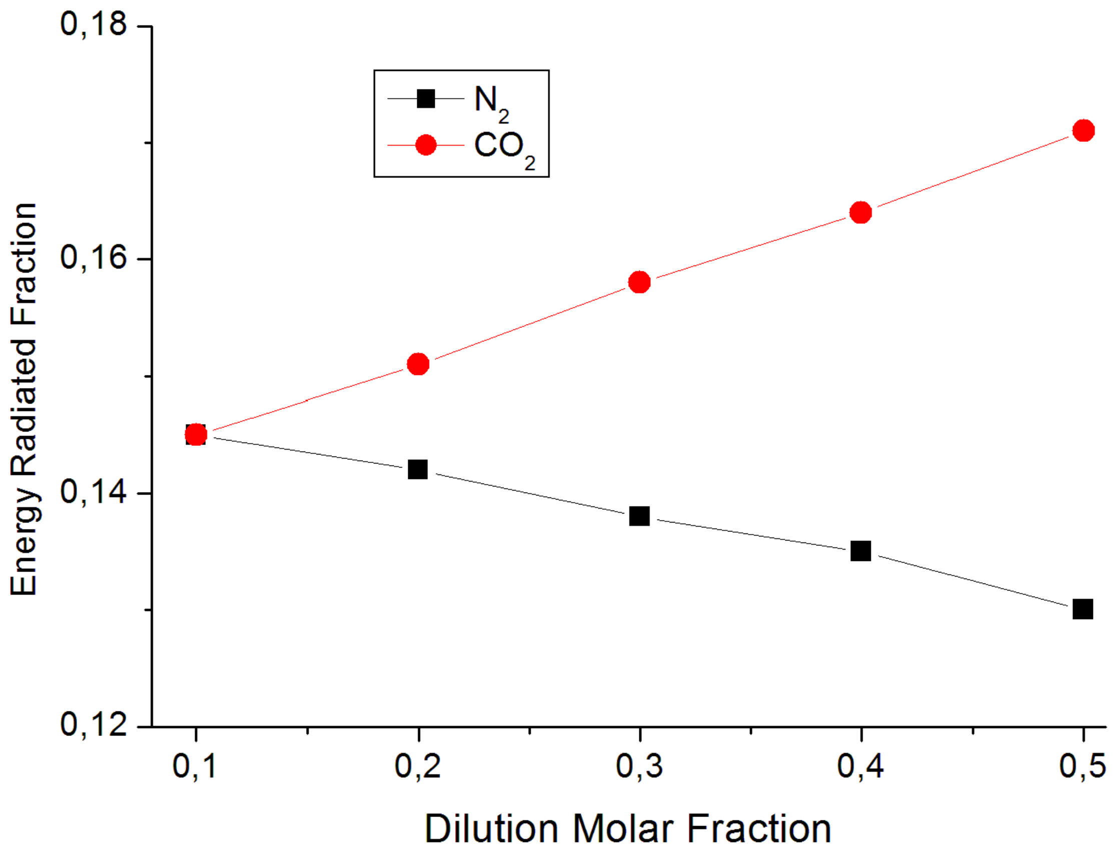
Transversal profiles of soot, in each dilution case, (left) to CO_2 and; (right) to N_2.

Soot amount



Integral of LII signal for the diluted cases.

Energy irradiated



Radiation fraction as function of dilution to both inert, CO_2 and N_2.

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FINAL REMARKS

- The soot distribution is similar to both, N_2 and CO_2.
- CO_2 diluted flames produces lower soot amounts than N_2.
- The CO_2 dilution increases the radiation fraction. Instead, a decrease was observed for N_2 cases.
- The soot presence does not domains the radiation emission.
- Future works intend to consider another fuels, inert dilutions, initial reactants temperature and flame power.

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