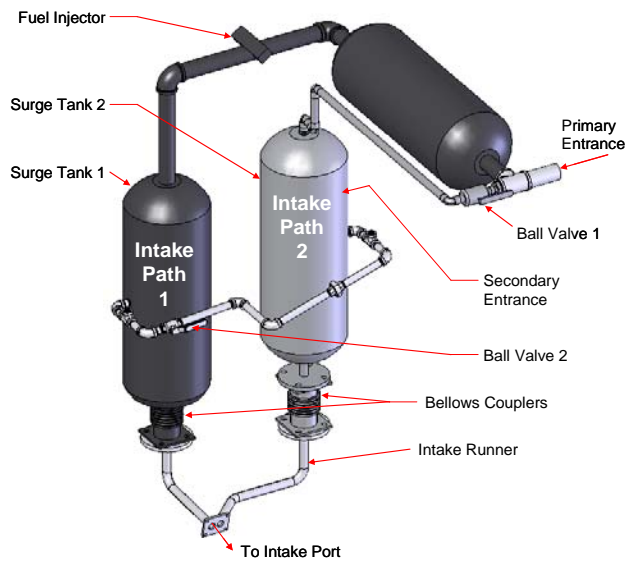
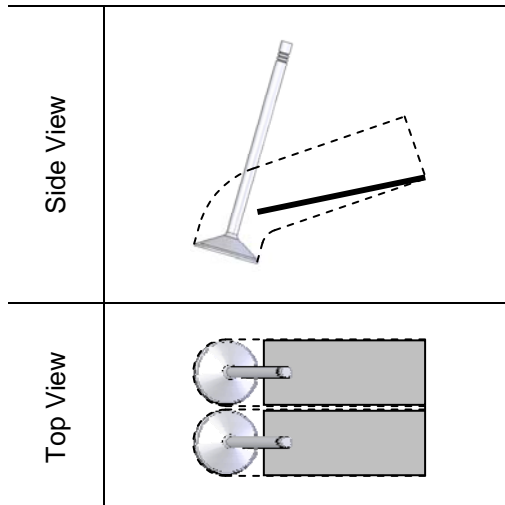


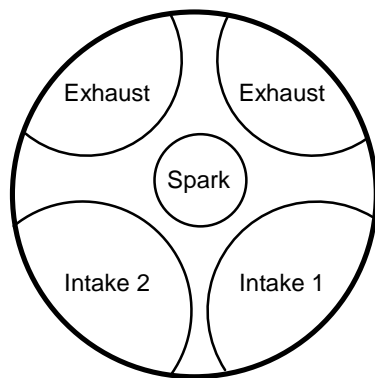
**Figure 1.** Optically accessible engine with drop-down liner assembly.



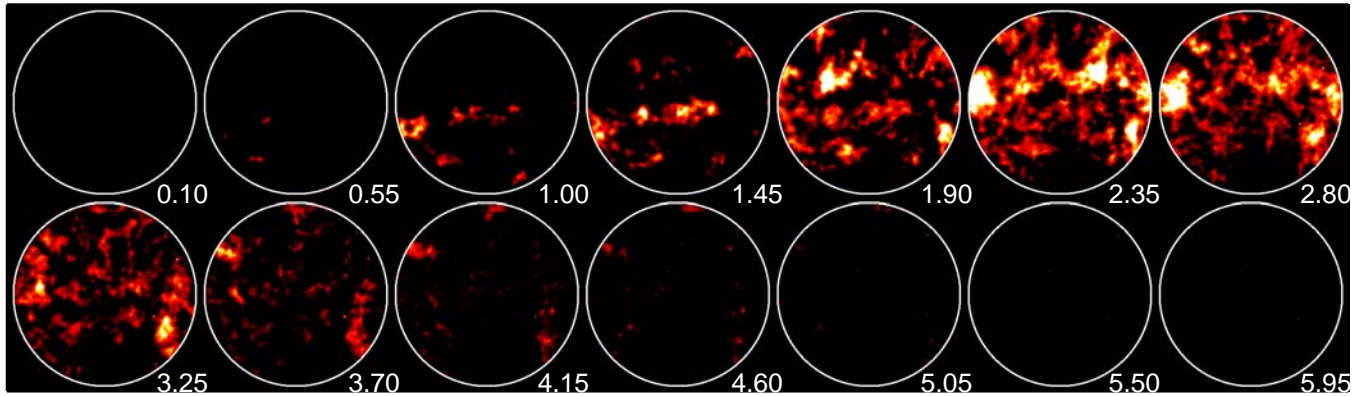
**Figure 2.** Intake system used to feed independent feed the optical engine's intake valves.



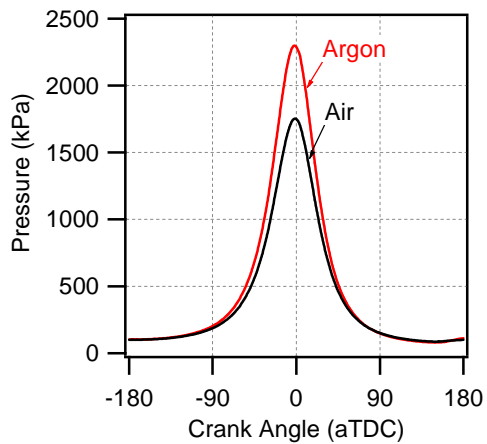
**Figure 3.** Top-directing flow baffles used to direct intake flows towards the top of the intake valves. The baffles were found to enhance the stratification maintained through compression [14].



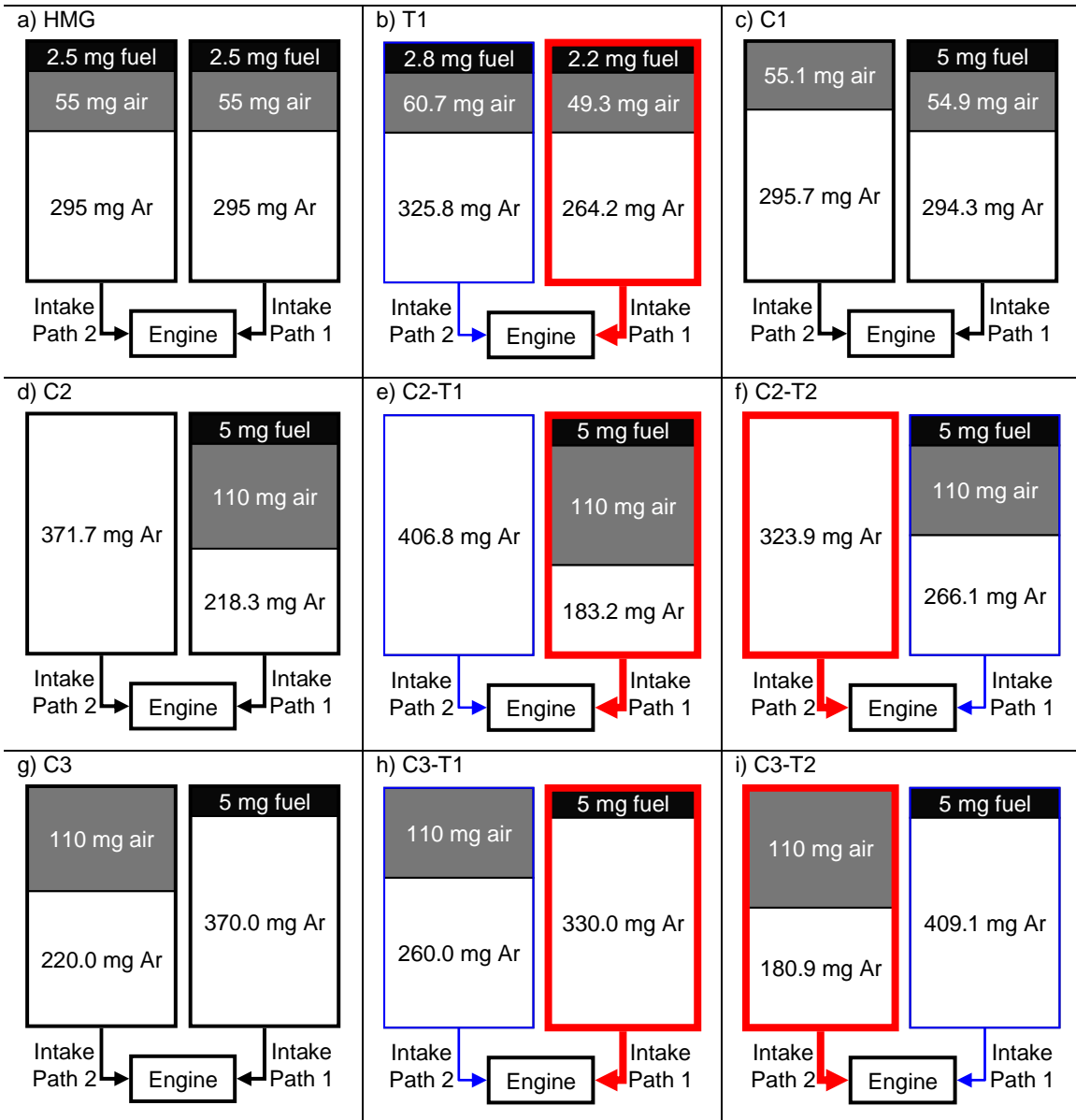
**Figure 4.** Field of view imaged by the Phantom camera when acquiring the chemiluminescence movies. As shown, the field of view is roughly centered within the combustion chamber and is approximately 60 mm in diameter.



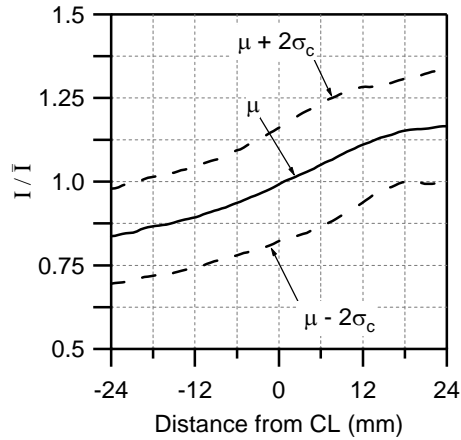
**Figure 5.** Sample image sequence of a chemiluminescence movie acquired under homogeneous operation. The number at the lower right of each frame indicates the crank angle at which the frame was acquired (aTDC).



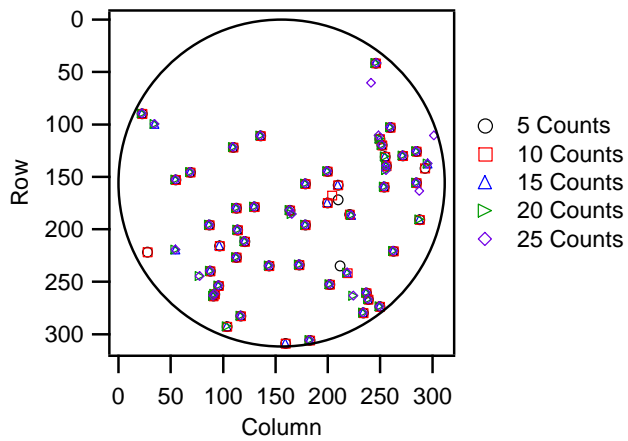
**Figure 6.** Measured cylinder pressure versus crank angle when feeding the engine with air or argon. Argon dilution results in a ~500 kPa increase in peak motored cylinder pressure than with air dilution because of its higher  $\gamma$  value ( $\gamma_{Ar} = 1.67$ ;  $\gamma_{air} = 1.4$ ).



**Figure 7.** Schematics showing the mass flow rates per cycle delivered through each intake path for the stratified operating conditions. The bold line indicates the higher temperature path for the thermal stratification, and the narrow line indicates the lower temperature path.

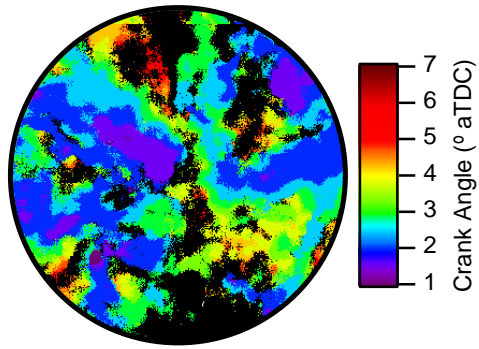


**Figure 8.** Probability density function (PDF) contour tabulated used to estimate local in-cylinder conditions. The mean ( $\mu$ ) contour was used to estimate local mixture properties after compression.



**Figure 9.** The detected location of first autoignition for each of the 50 movies acquired in a data set for various threshold values.

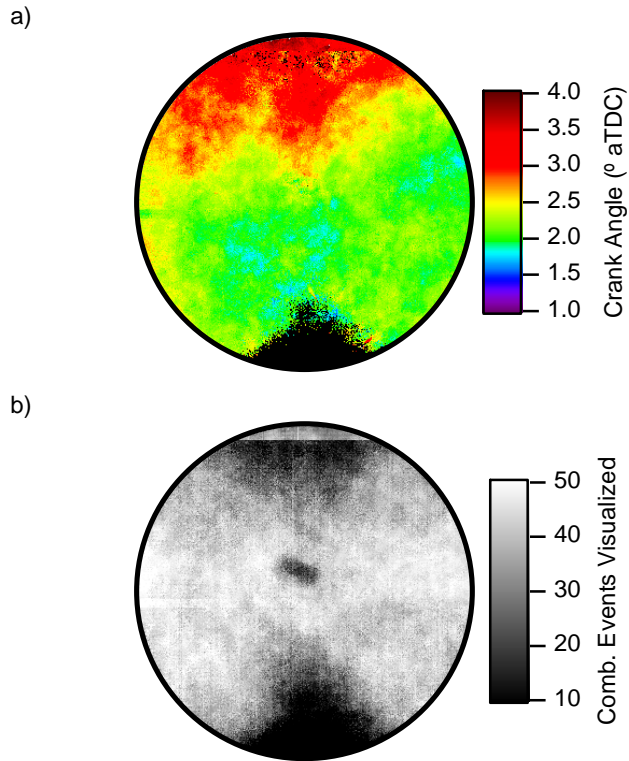
a)



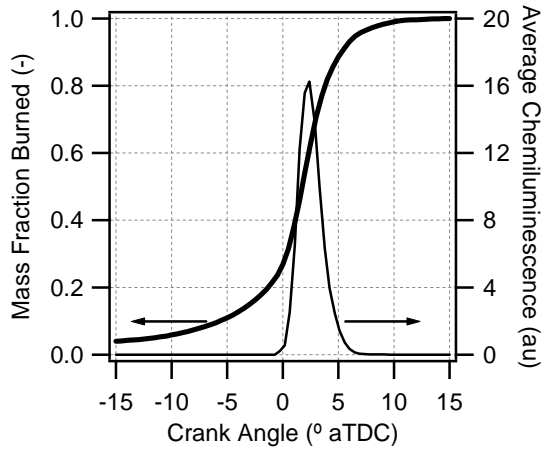
b)



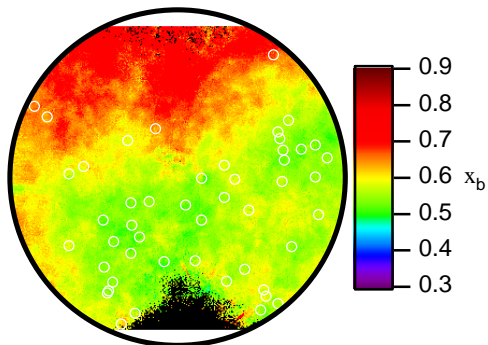
**Figure 10.** Image plots showing (a) the crank angle at which combustion was first visualized and (b) locations, shown in white, where combustion was able to be visualized for a single combustion event.



**Figure 11.** Image plots showing (a) the average crank angle at which the pixel intensity went from low to high and (b) the number of times combustion was visualized at a given pixel location for a 50-movie data set acquired under homogeneous operation.

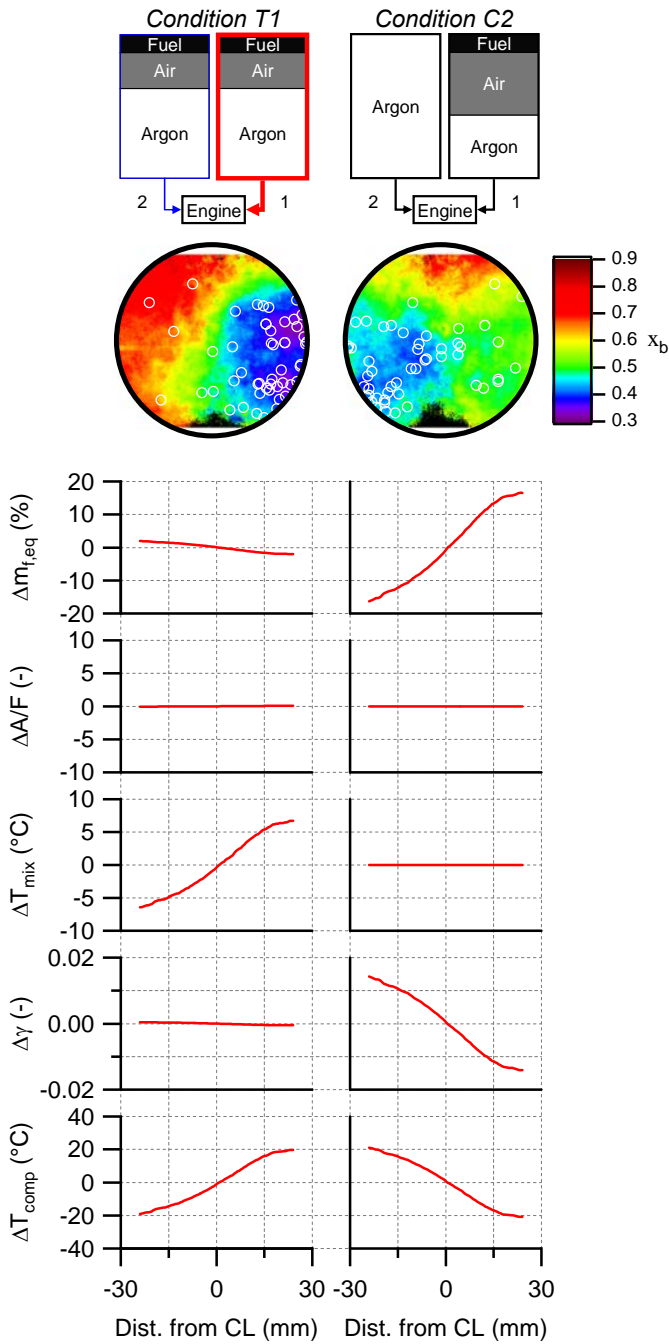


**Figure 12.** Mass fraction burn data used to transform the crank angle at which combustion was first visualized to the average mass fraction burned at which combustion was first visualized.

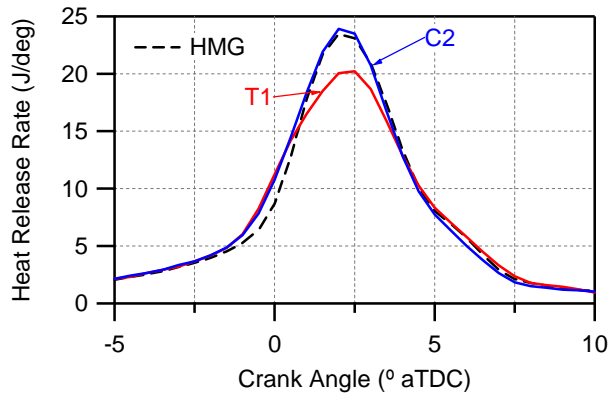


**Figure 13.** Average combustion progression (*i.e.* mass fraction burned at which combustion was first visualized) and location of first autoignition (circles) for the compositionally and thermally homogeneous (HMG) condition.

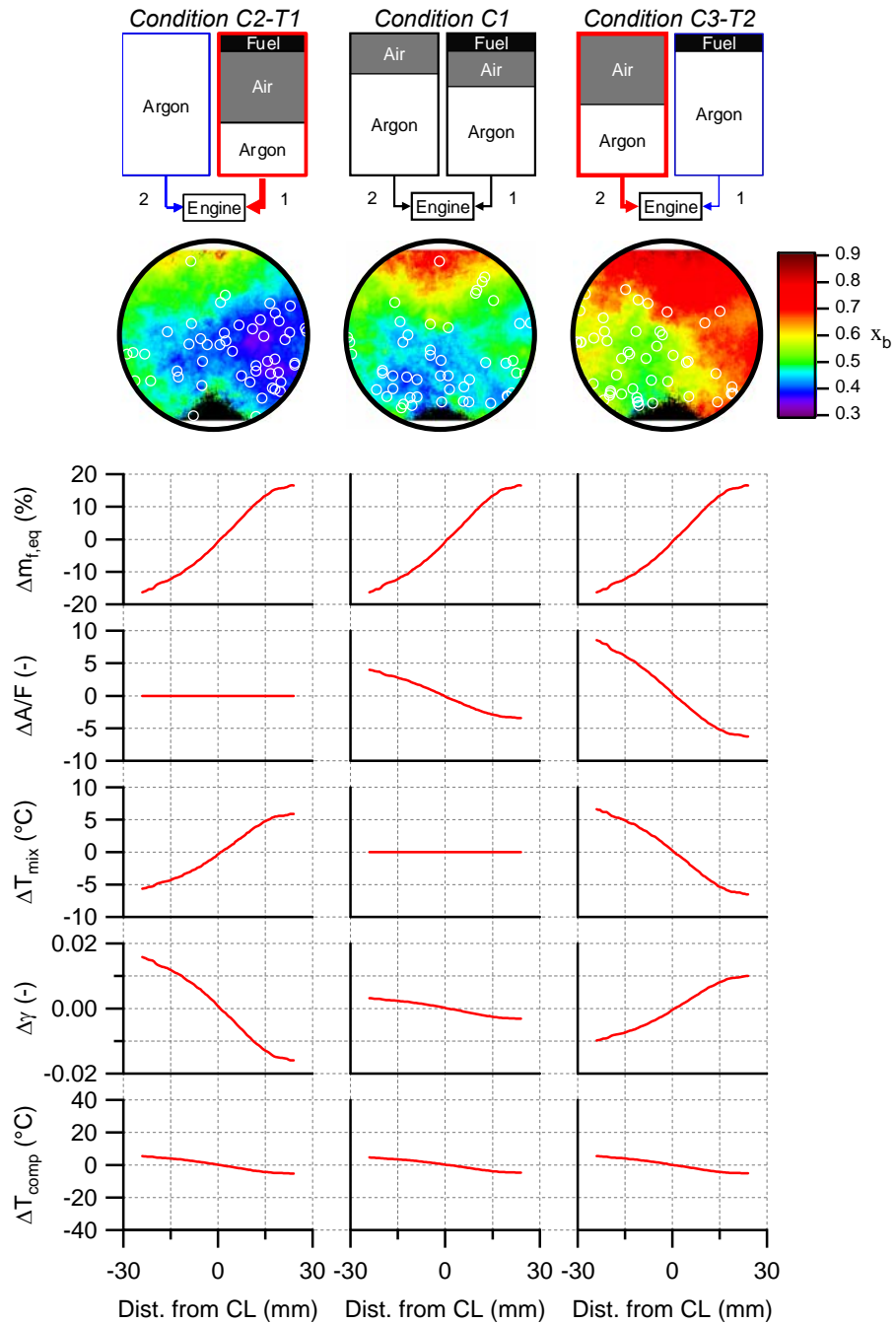




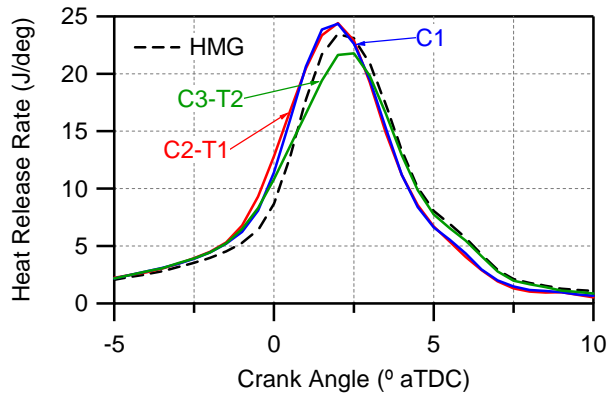
**Figure 14.** Average combustion progression, locations of first autoignition, and estimated mixture properties for conditions T1 and C2.



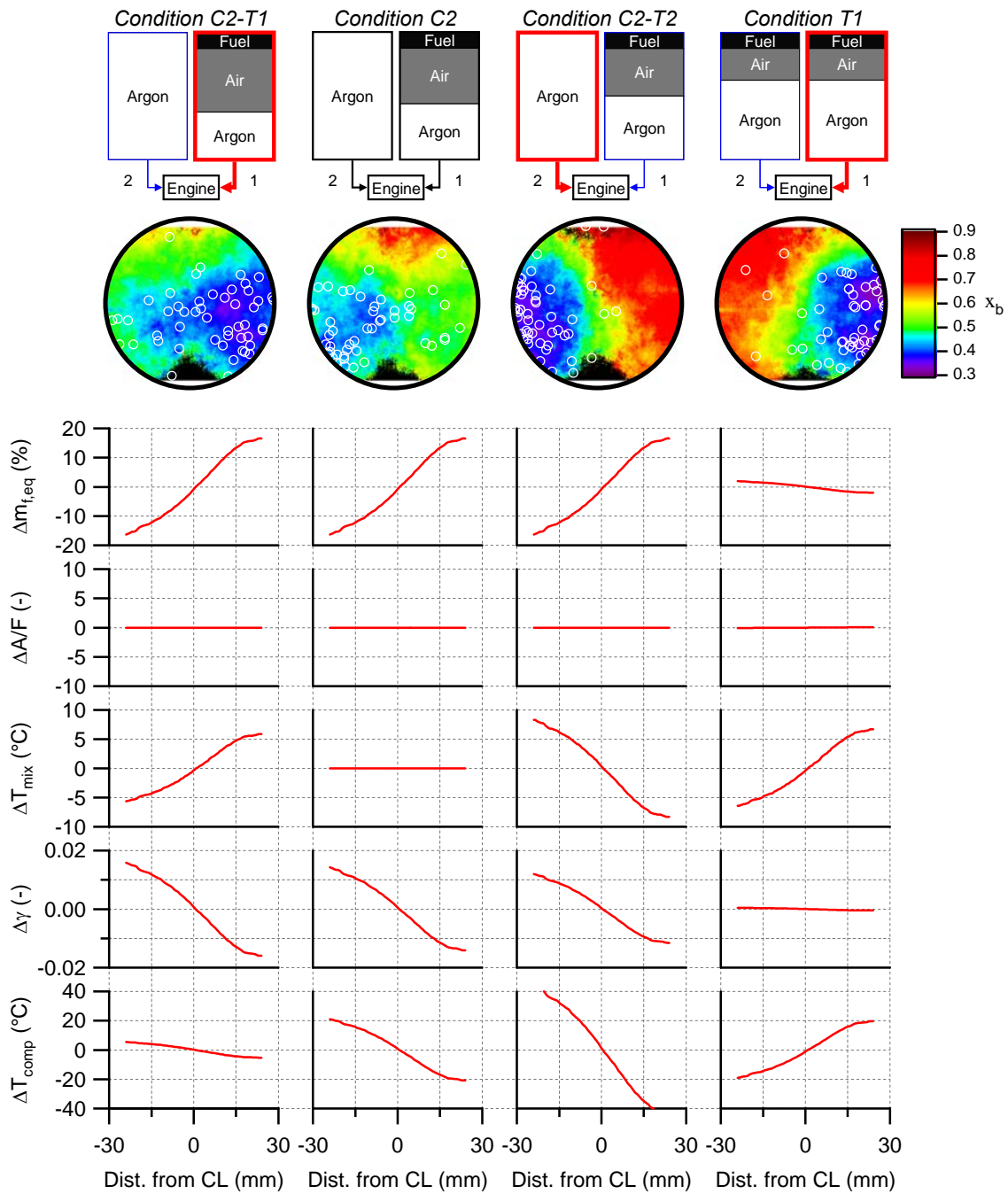
**Figure 15.** Calculated heat release rate for the homogeneous (HMG) and stratified conditions T1 and C2.



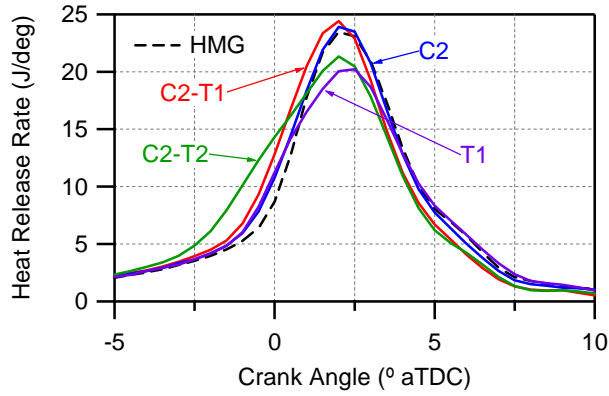
**Figure 16.** Average combustion progression, locations of first autoignition, and estimated mixture properties for conditions C2-T1, C1, and C3-T2.



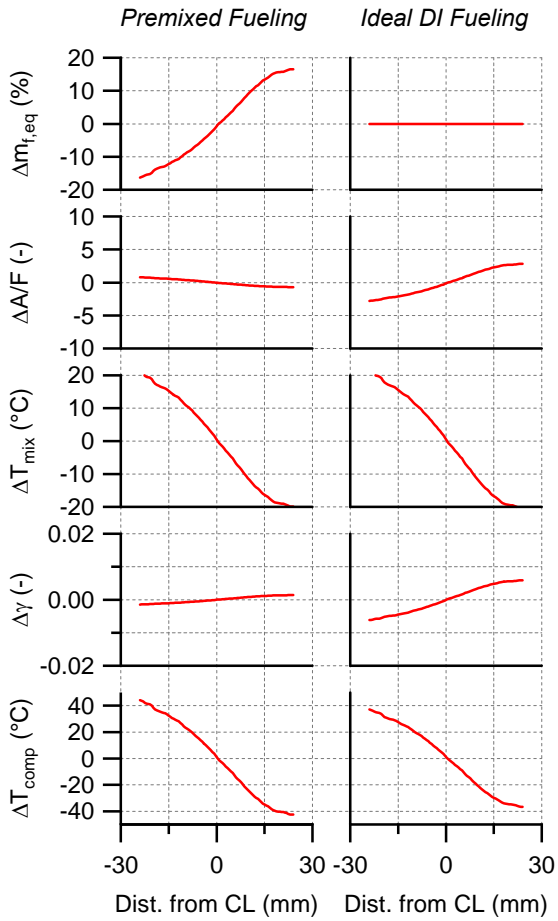
**Figure 17.** Calculated heat release rate for the homogeneous (HMG) and stratified conditions C2-T1, C1, and C3-T2.



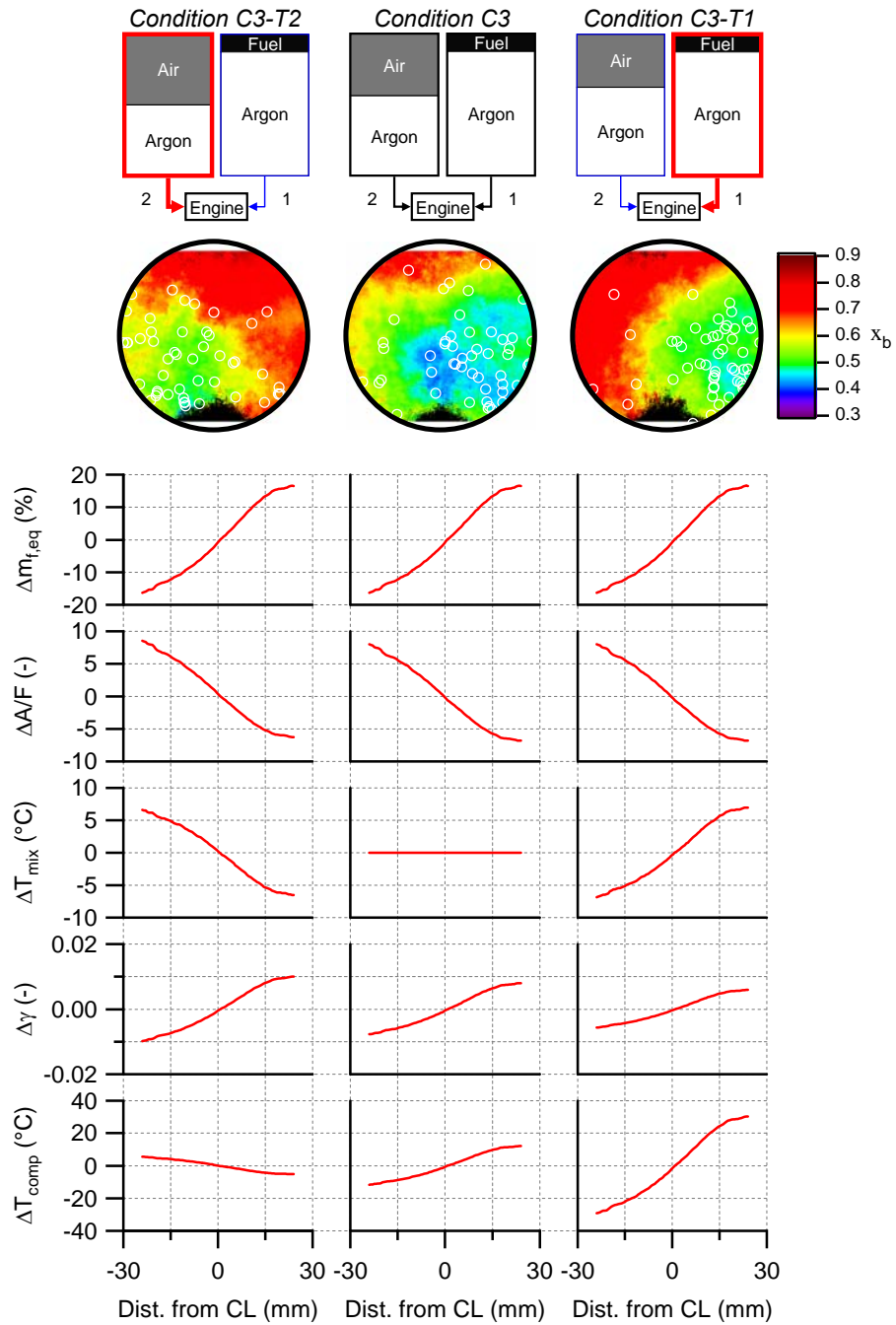
**Figure 18.** Average combustion progression, locations of first autoignition, and estimated mixture properties for conditions C2-T1, C2, C2-T2, and T1.



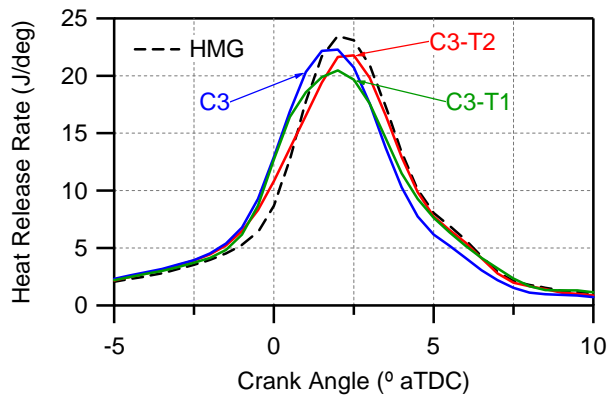
**Figure 19.** Calculated heat release rate for the homogeneous (HMG) and stratified conditions C2-T1, C2, C2-T2, and T1.



**Figure 20.** Estimated mixture properties after compression for the idealized HCCI engine using a recompression valving strategy.



**Figure A.** Average combustion progression, locations of first autoignition, and estimated mixture properties for conditions C3-T2, C3, and C3-T1.



**Figure B.** Calculated heat release rate for the homogeneous (HMG) and stratified conditions C3-T2, C3, and C3-T1.