

Supplemental Material for

**“Characterizing particle emissions from a direct energy deposition additive manufacturing process and associated occupational exposure to airborne particles”**

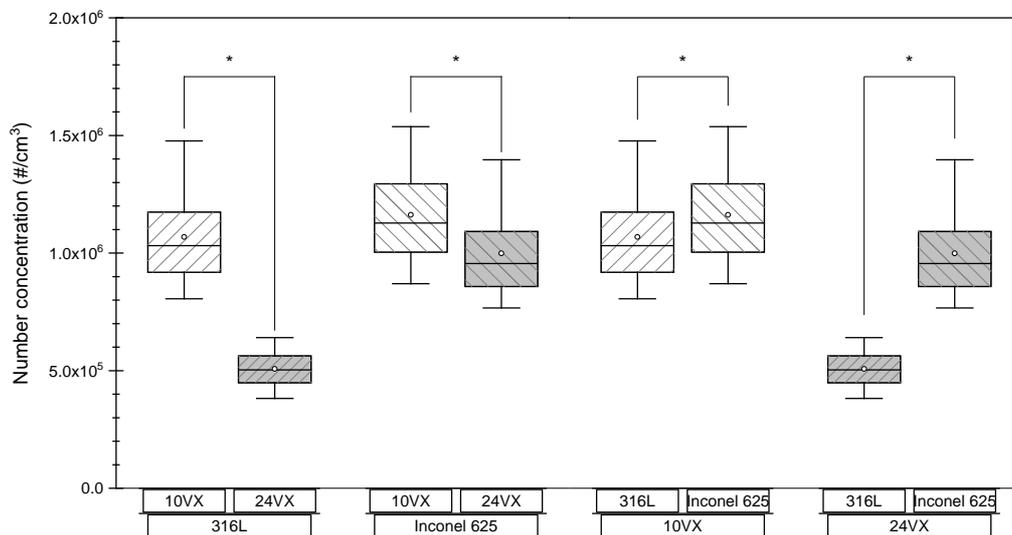


Figure S1: Pairs of data used for statistical analysis (hypothesis testing, two-sample t-test) of the effect of material and nozzle on the number concentration measured by the CPC at the source. Data for each pair was found to be significantly different ( $*p < 10^{-4}$ )

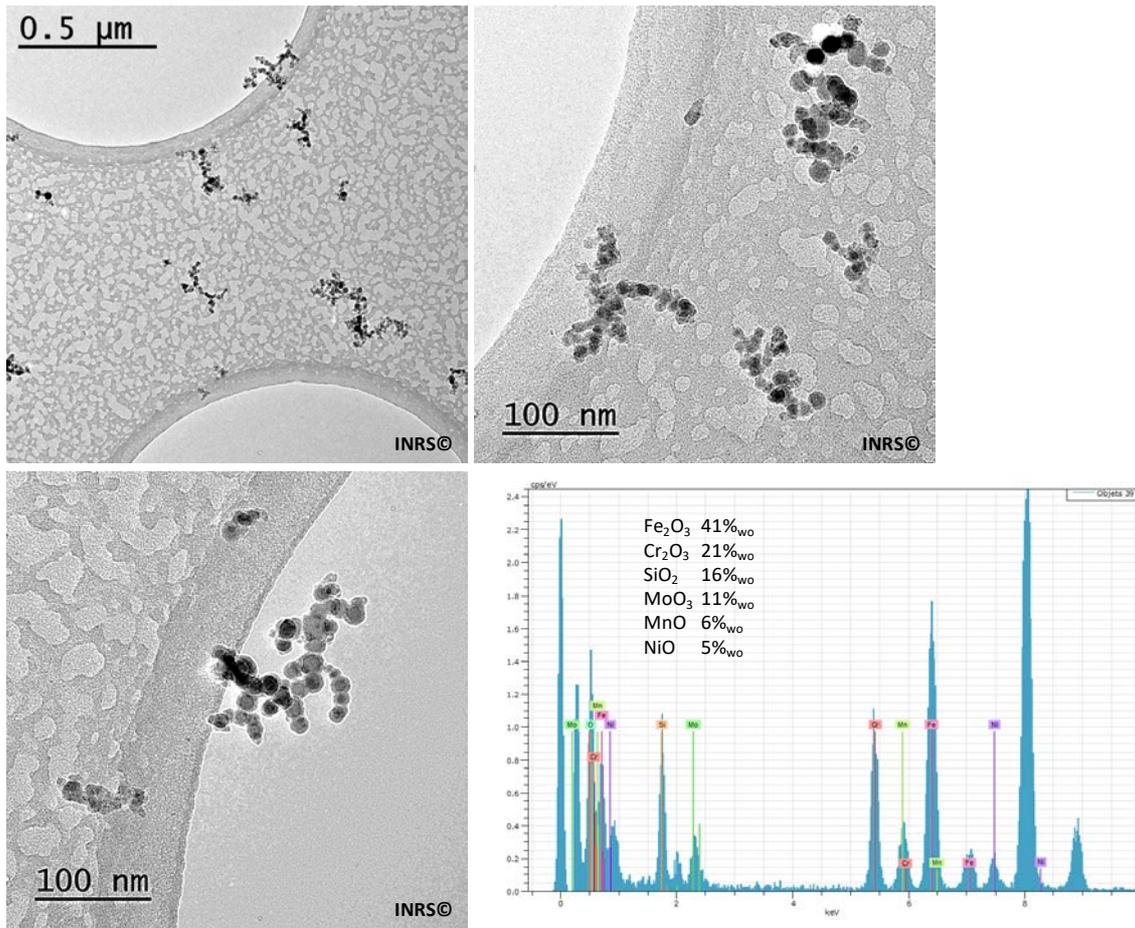


Figure S2: Morphology of aggregates at different magnifications and elemental composition (wo = weight oxides) of representative particles emitted using nozzle 10VX and alloy 316L. Samples collected with MPS and observed by Transmission Electron Microscopy. The elemental composition from EDS analysis is indicative

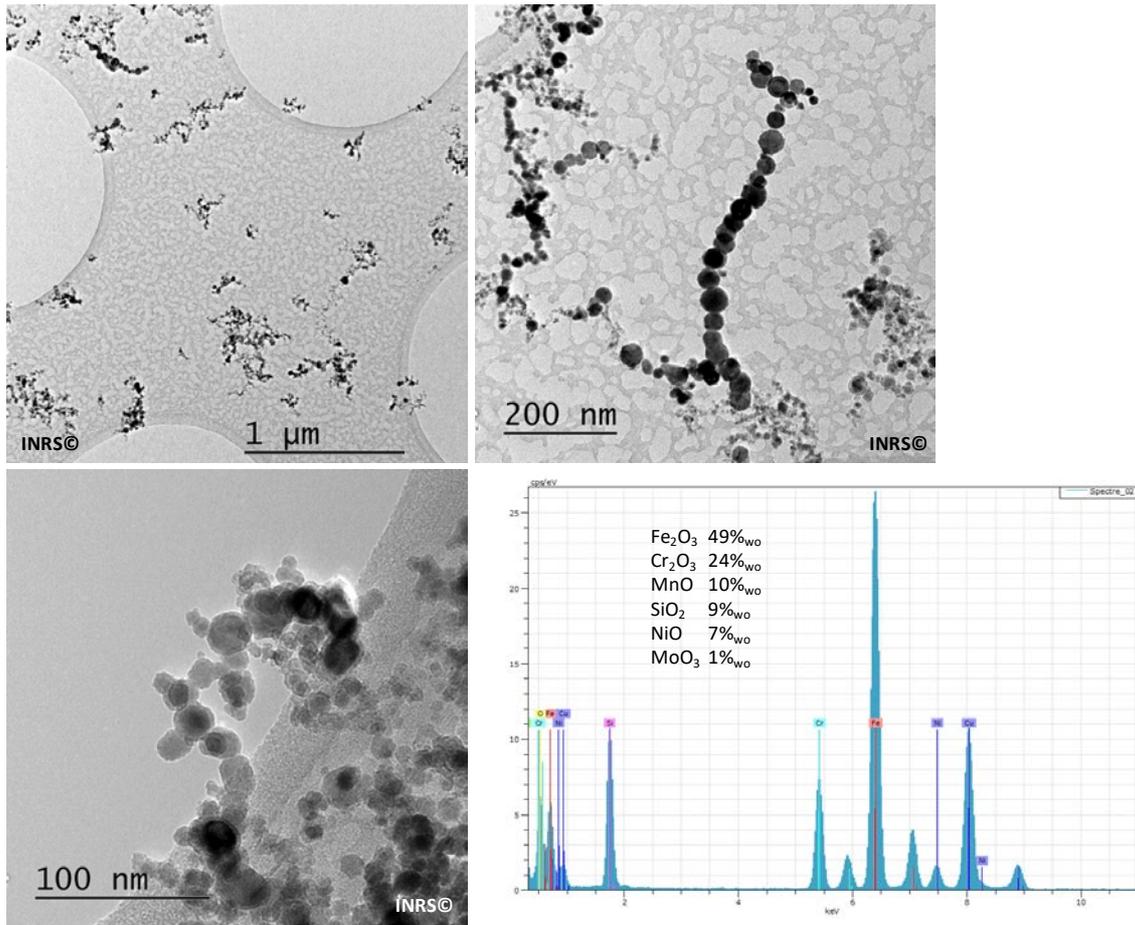


Figure S3: Morphology of aggregates at different magnifications and elemental composition (wo = weight oxides) of representative particles emitted using nozzle 24VX and alloy 316L. Samples collected with MPS and observed by Transmission Electron Microscopy. The elemental composition from EDS analysis is indicative.

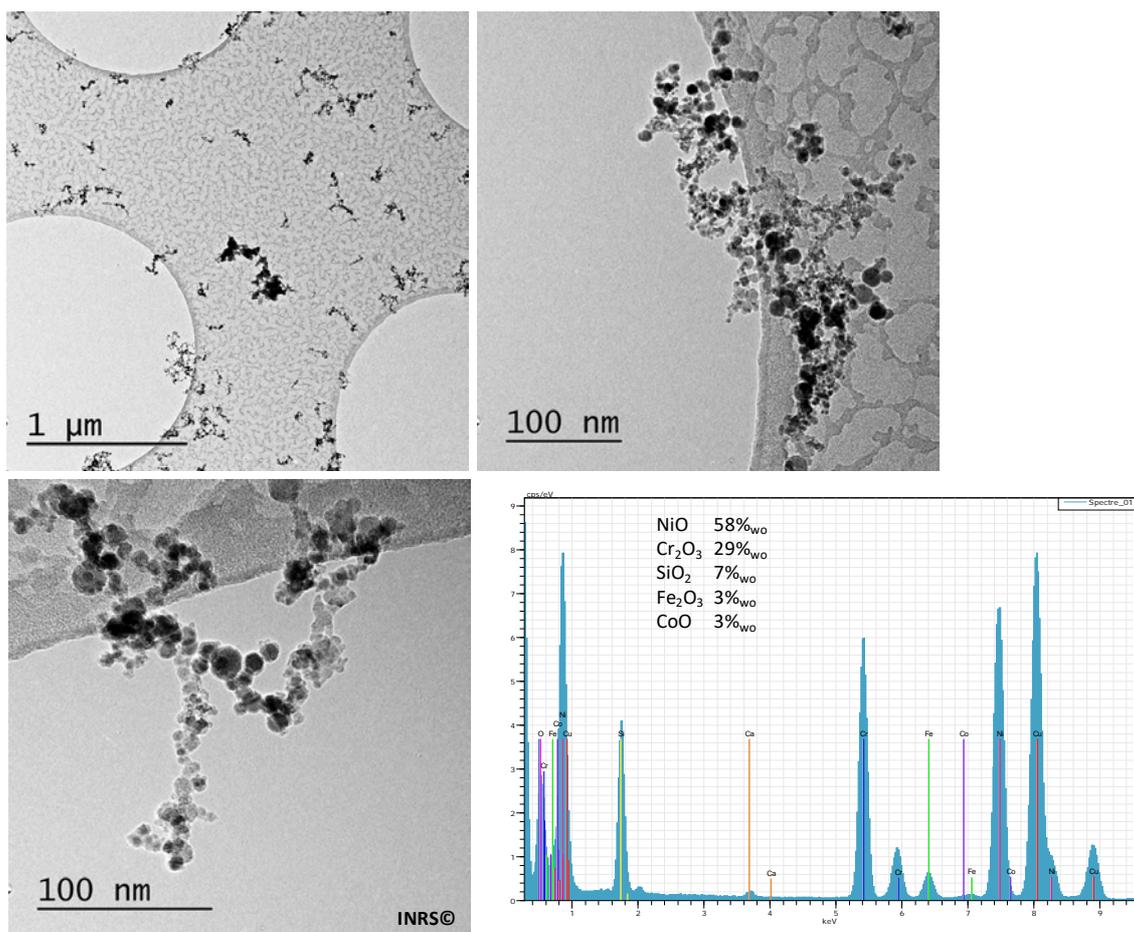


Figure S4: Morphology of aggregates at different magnifications and elemental composition (wo = weight oxides) of representative particles emitted using nozzle 10VX and alloy Inconel 625. Samples collected with MPS and observed by Transmission Electron Microscopy. The elemental composition from EDS analysis is indicative.

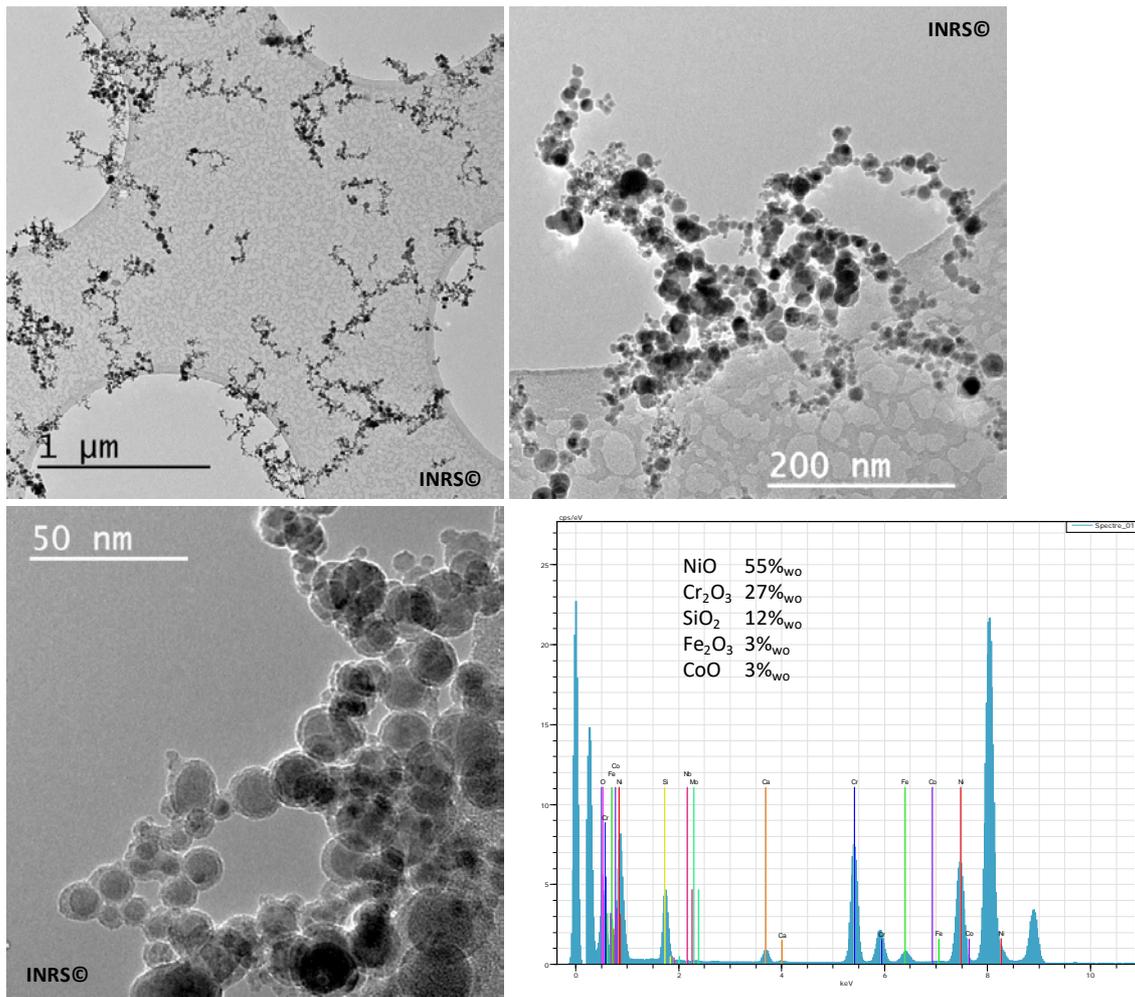


Figure S5: Morphology of aggregates at different magnifications and elemental composition (wo = weight oxides) of representative particles emitted using nozzle 24VX and alloy Inconel 625. Samples collected with MPS and observed by Transmission Electron Microscopy. The elemental composition from EDS analysis is indicative.

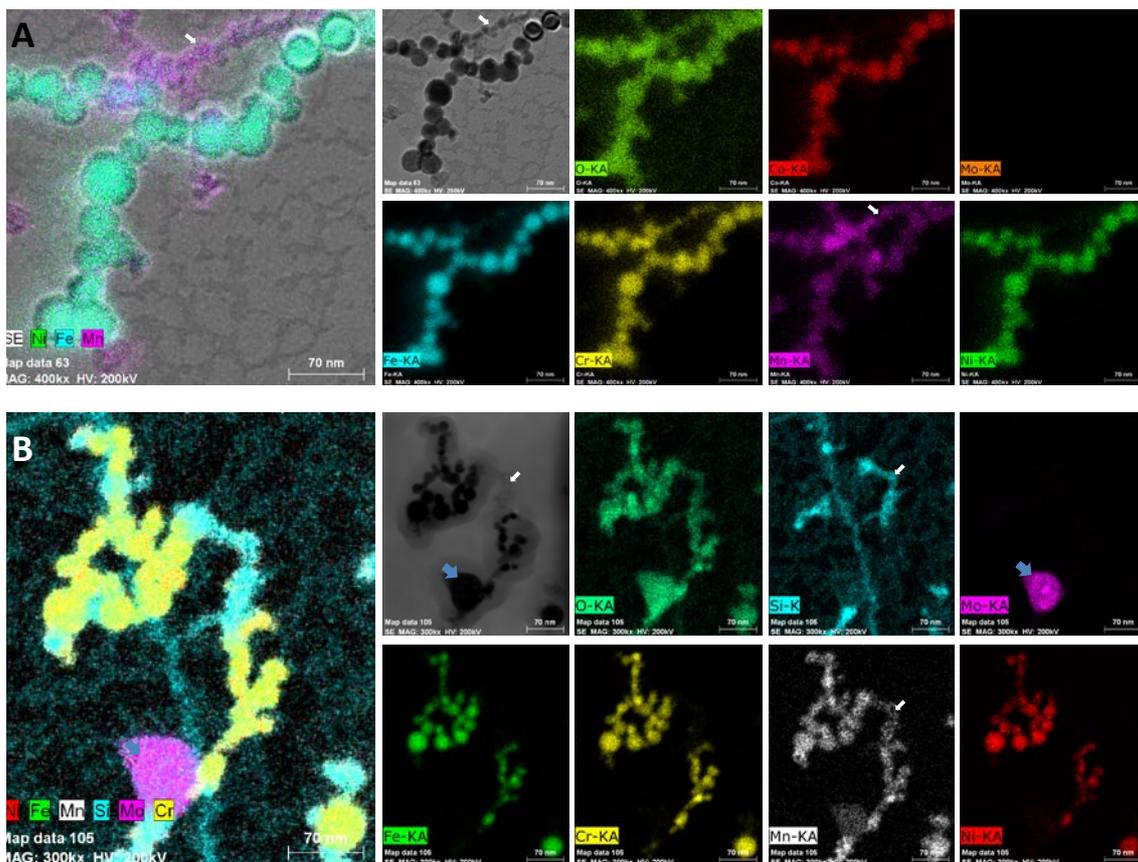


Figure S6: STEM observation and elemental mapping (relative abundance) of representative particles emitted using nozzle 24VX and the 316L alloy. Most of the aggregates exhibit a stainless steel composition (Fe, Cr, Mn, Ni, Co). A) Occurrence of poorly crystallized structures containing mainly Mn oxides (white arrows). B) Observations of (i) badly defined zones containing mainly Mn and silica (white arrows) and (ii) particles of Mo oxides (blue arrows). Samples collected with MPS.

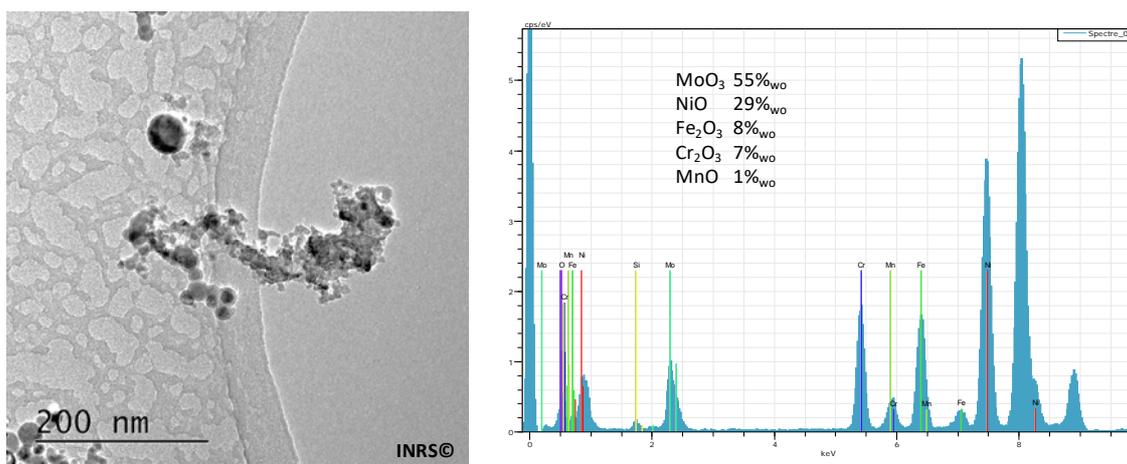


Figure S7: Morphology and elemental composition (wo = weight oxides) of Mo- and Ni-enriched aggregates in particles emitted using nozzle 24VX and the 316L alloy. Samples collected with MPS and observed by Transmission Electron Microscopy. The elemental composition from EDS analysis is indicative.

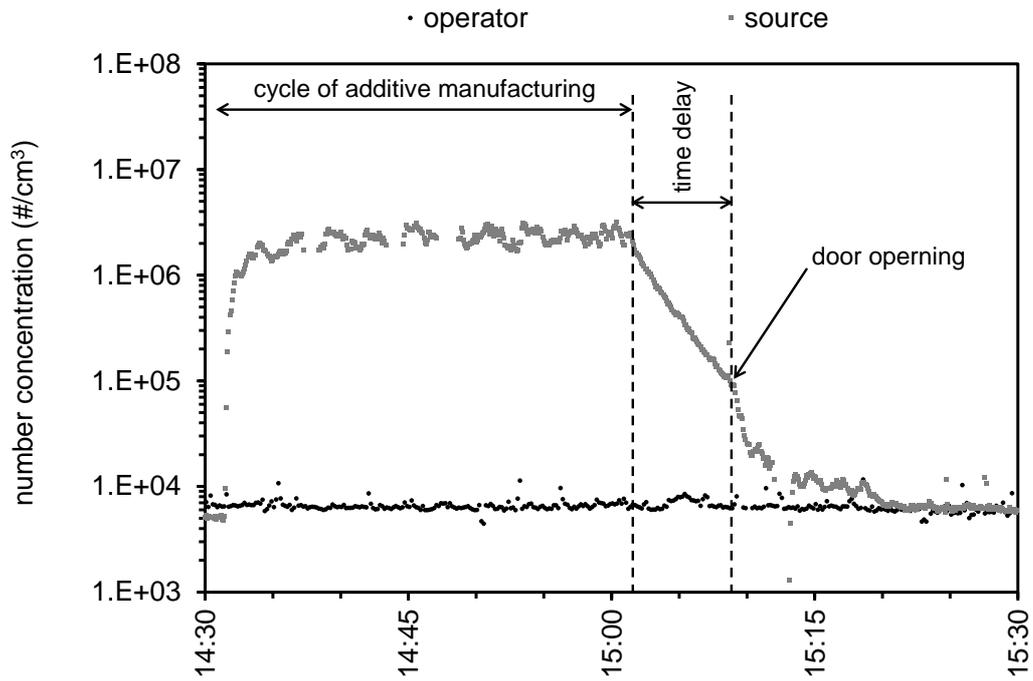


Figure S8. Time series of the number concentration measured at the source (in grey) and by the DiSCmini worn by the operator (in black) for the case where a time delay between the end of the manufacturing cycle and opening of the door was implemented.