

CTM Operation and Fueling Workgroup Meeting

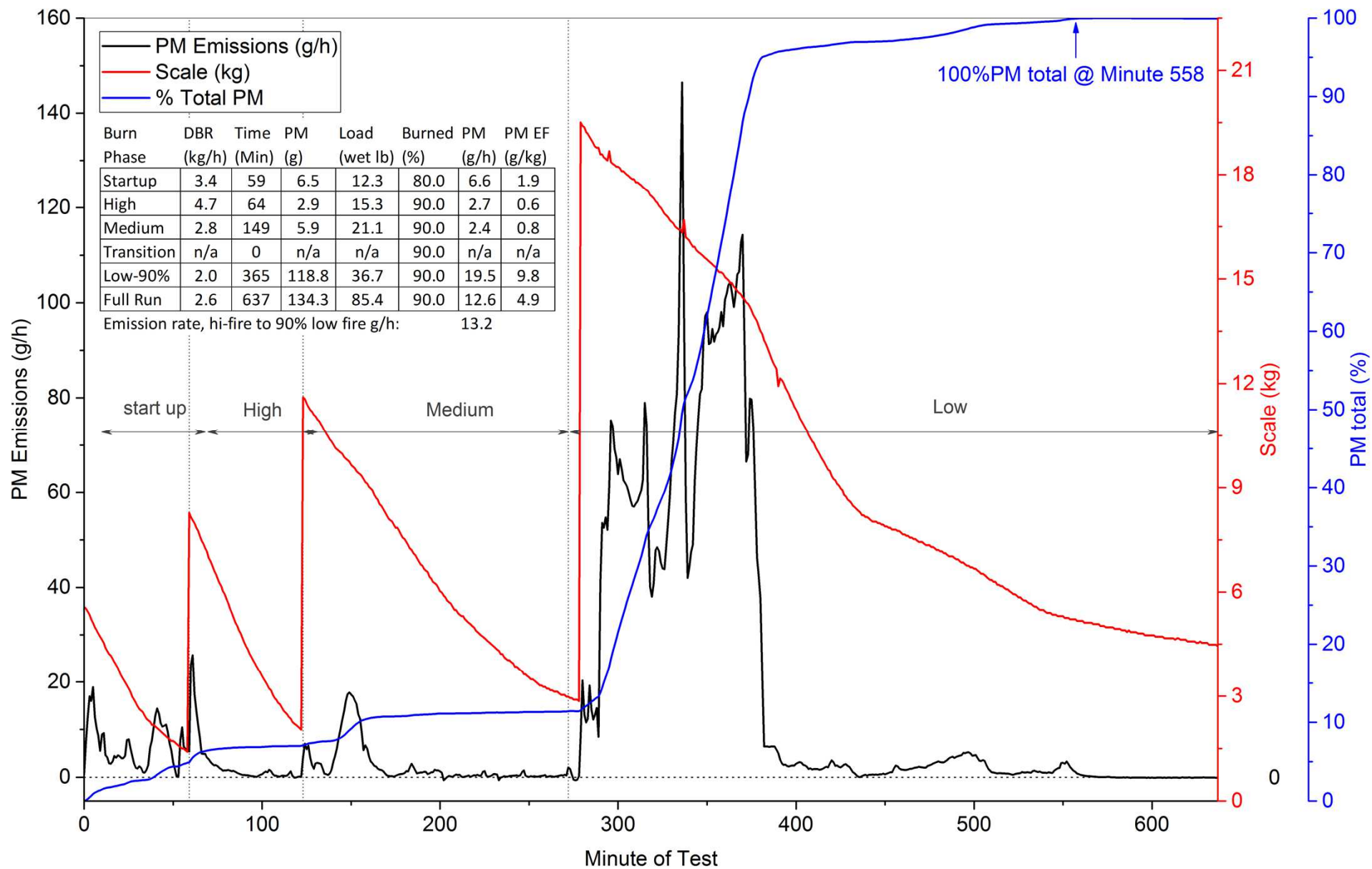
March 6, 2018

IDC TESTING

Stove 1



Stove1: IDC - PM Emissions 1/18/2018

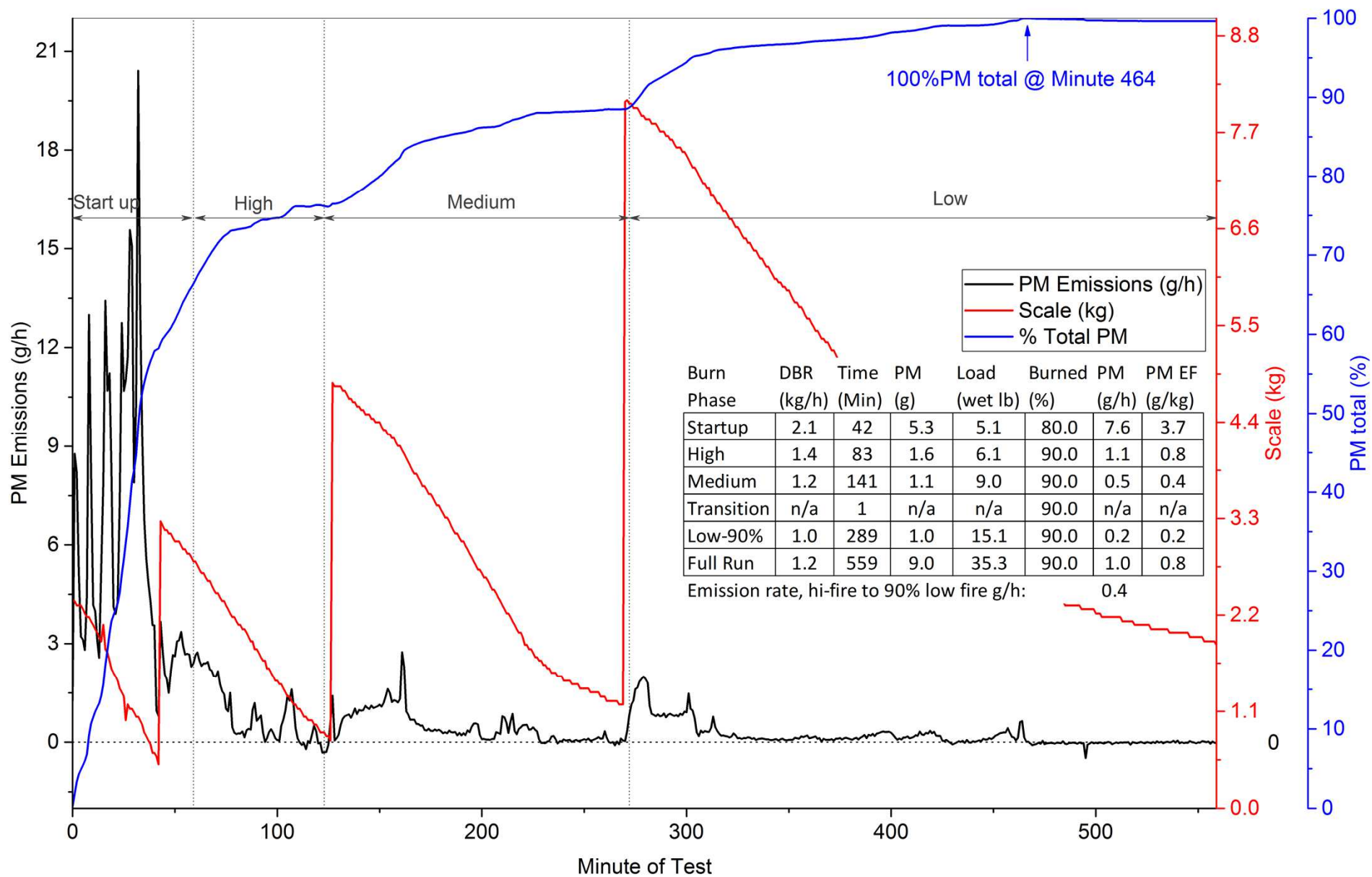


* Real-time PM Measurements obtained with Teom. On average Teom measurements are 10% less than filter measurements.

Stove 2



Stove 2: IDC - PM Emissions 1/24/2018

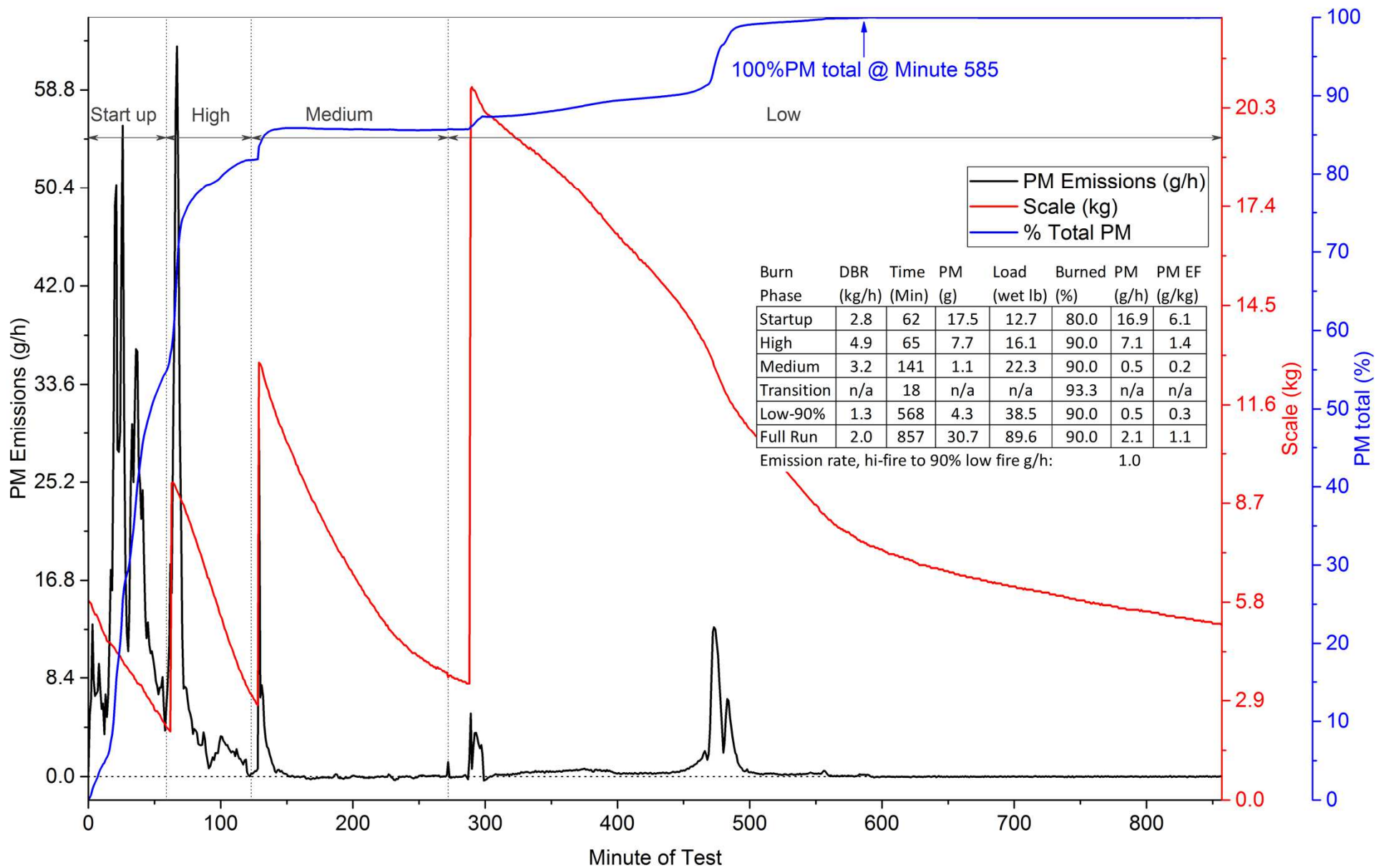


* Real-time PM Measurements obtained with Teom. On average Teom measurements are 10% less than filter measurements.

Stove 3



Stove 3: IDC - PM Emissions 1/26/2018

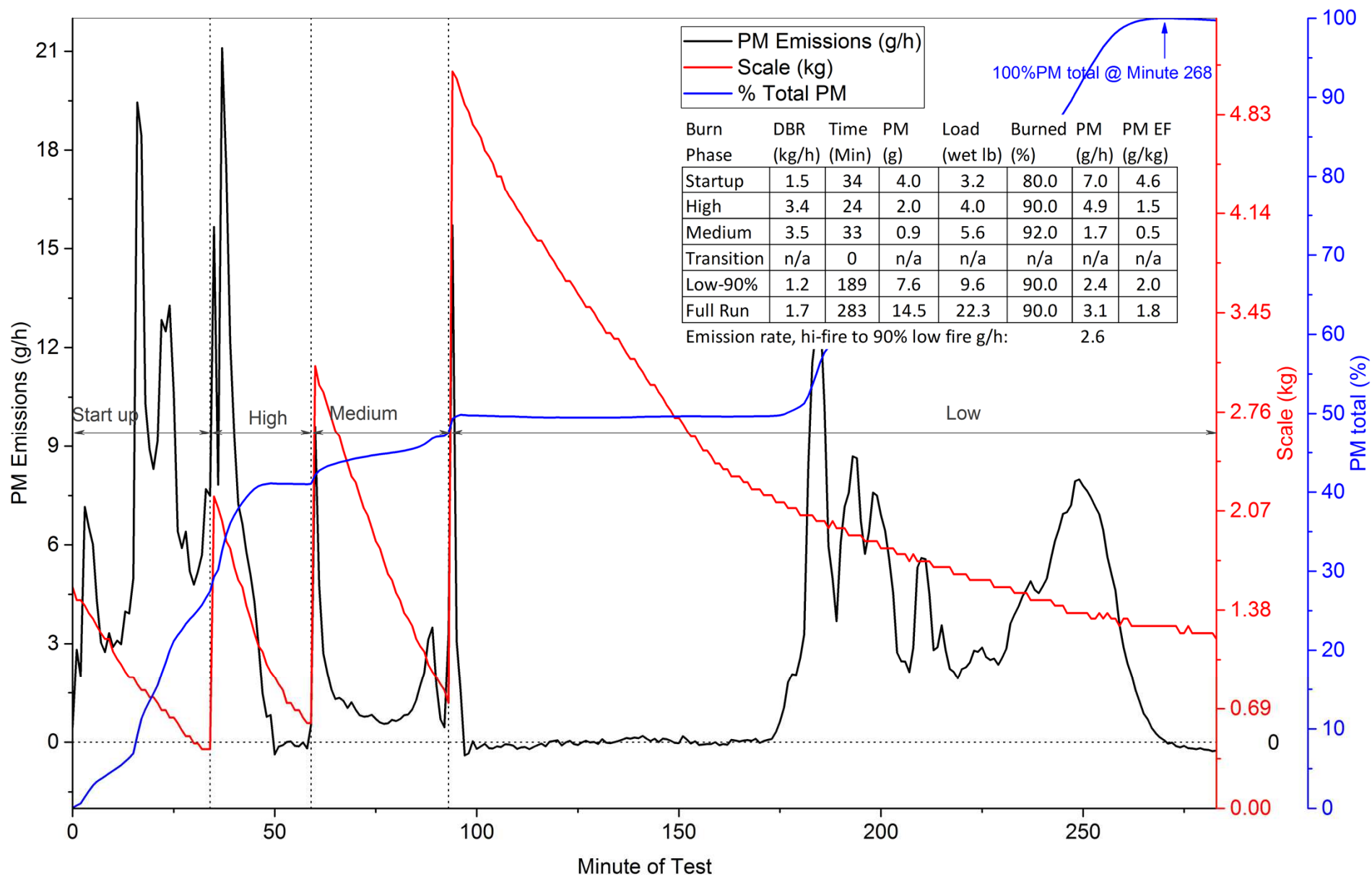


* Real-time PM Measurements obtained with Teom. On average Teom measurements are 10% less than filter measurements.

Stove 4



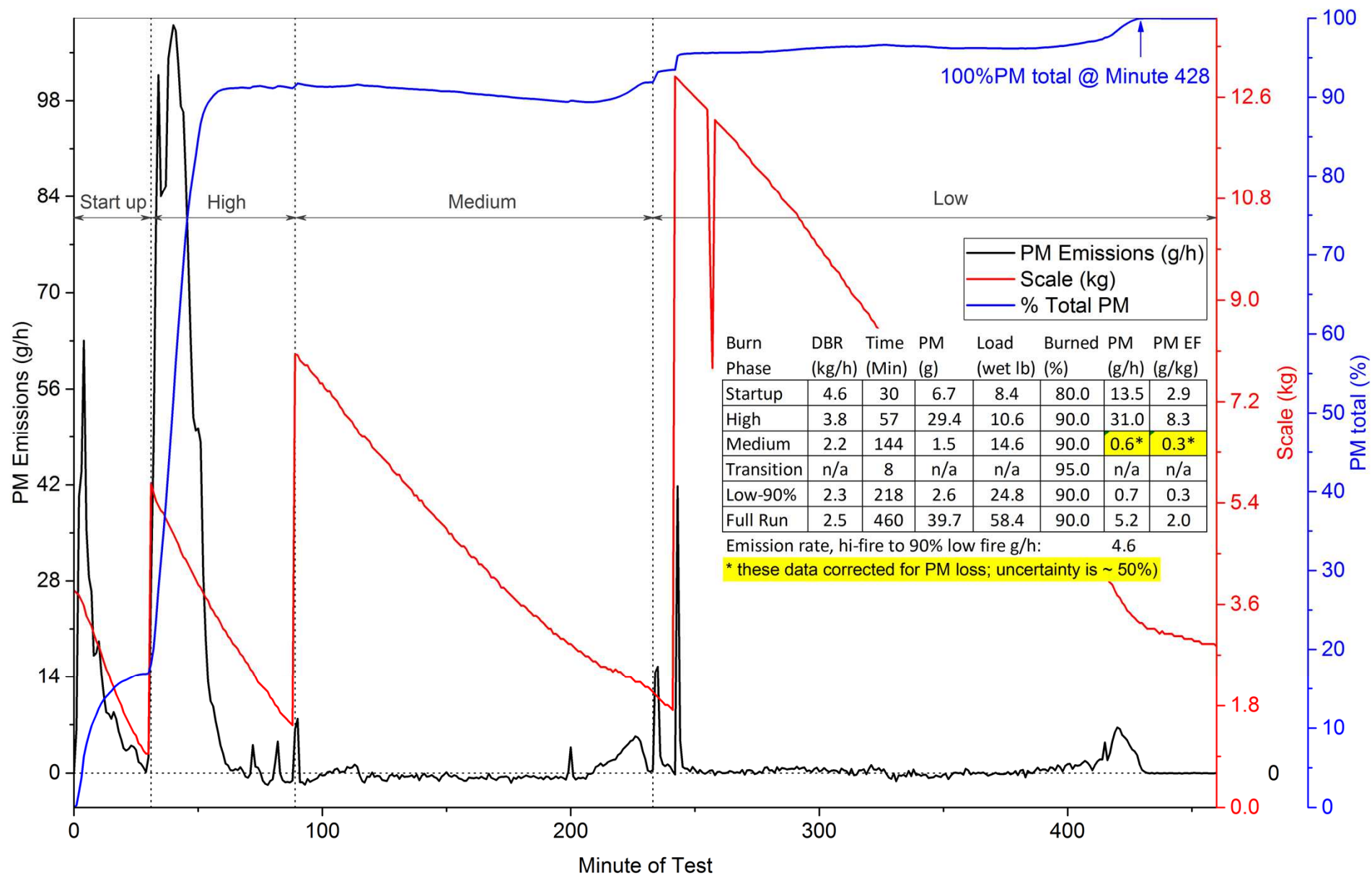
Stove 4: IDC - PM Emissions 1/16/2018



Stove 5



Stove 5: IDC - PM Emissions 1/12/2018

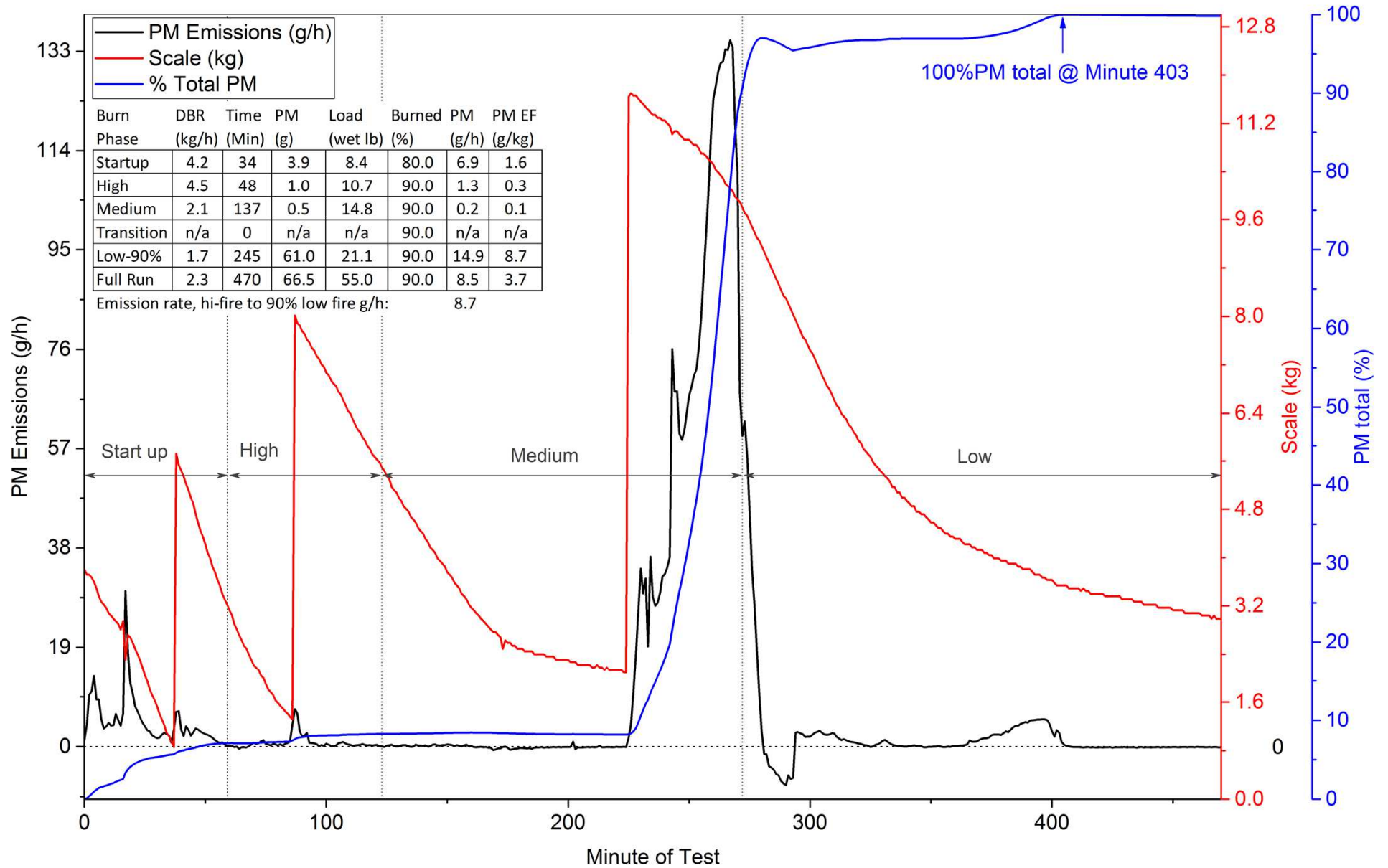


* Real-time PM Measurements obtained with Teom. On average Teom measurements are 10% less than filter measurements.

Stove 6



Stove 6: IDC - PM Emissions 1/9/2018

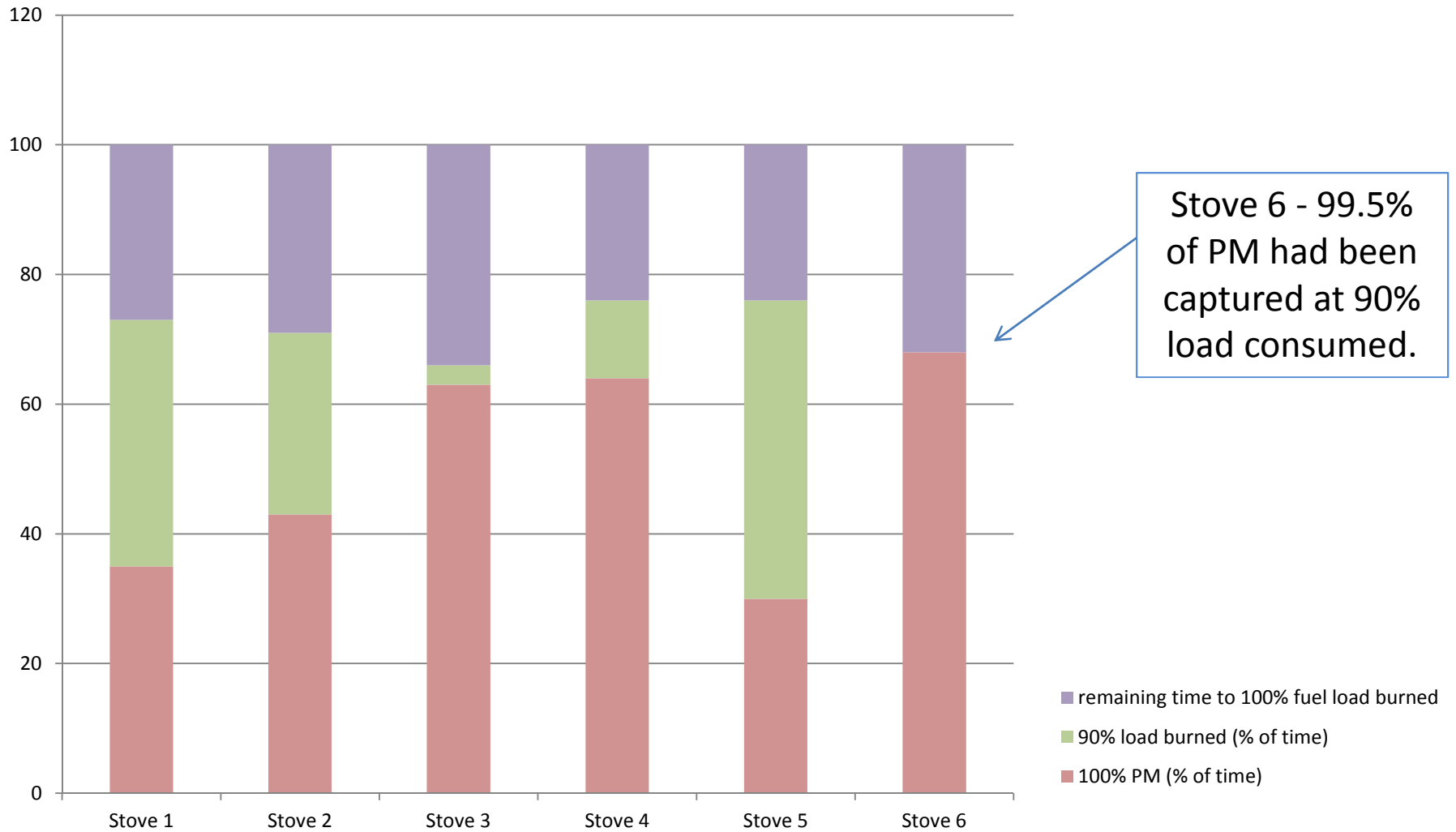


* Real-time PM Measurements obtained with Teom. On average Teom measurements are 10% less than filter measurements.

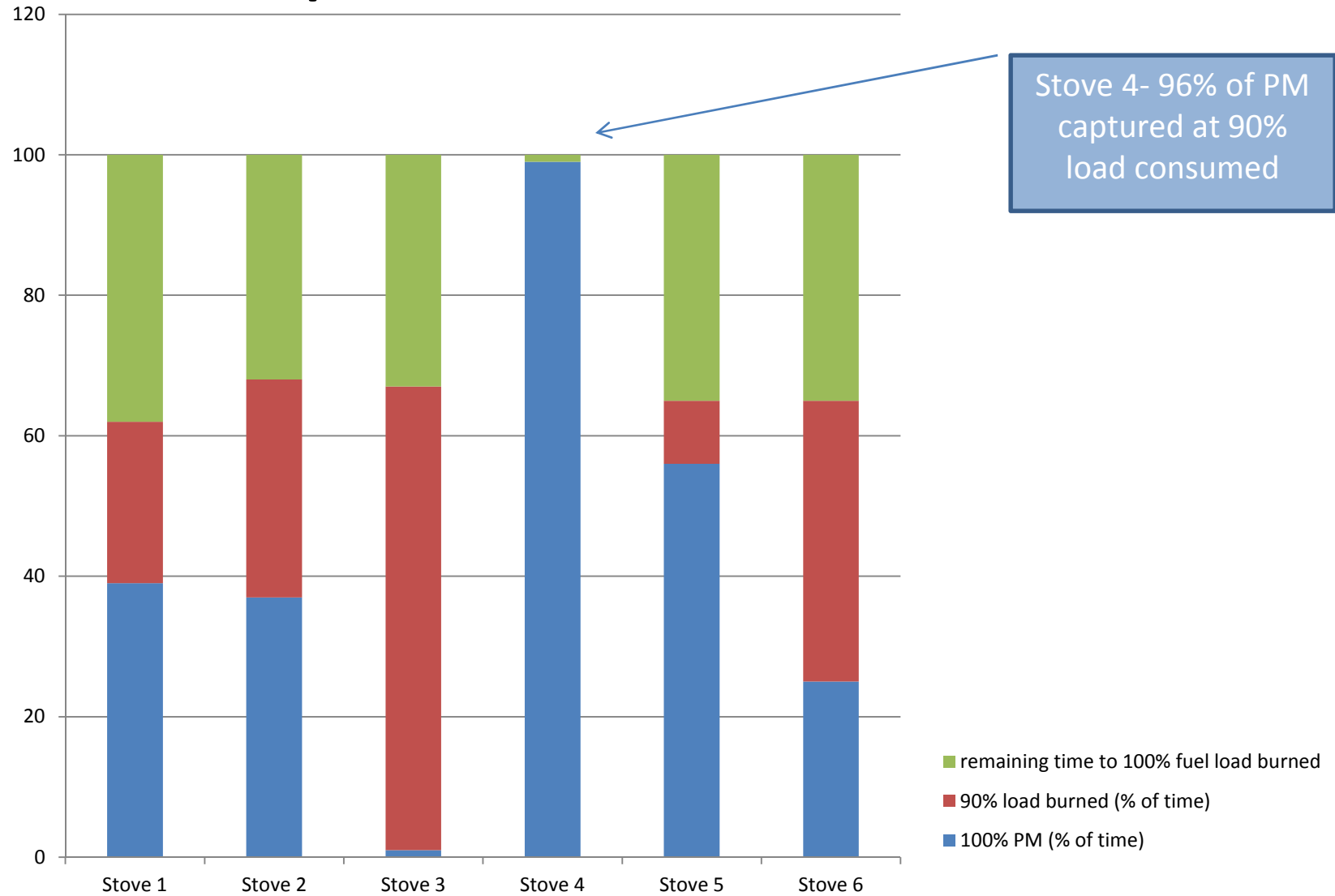
3/3/2018

PM CAPTURE

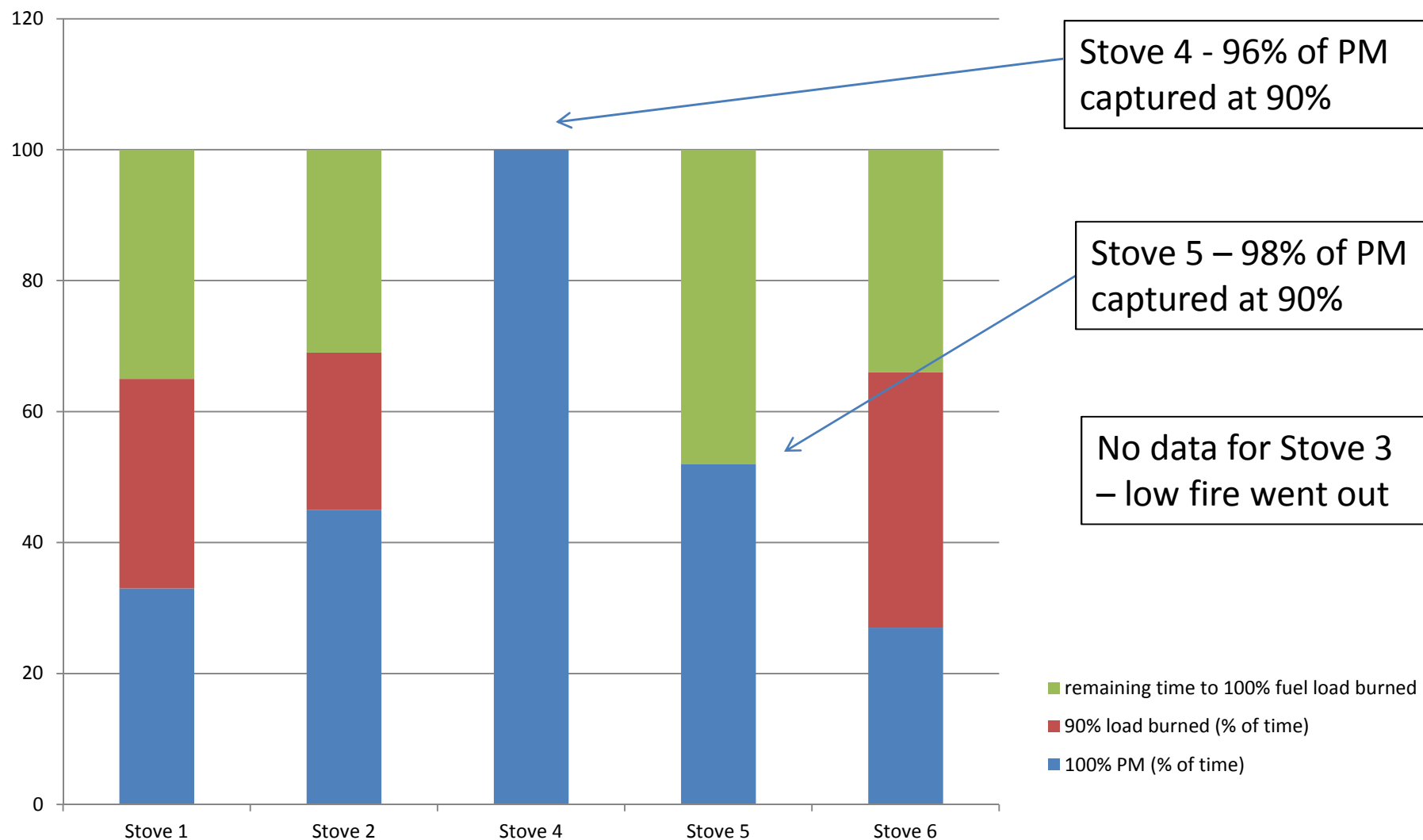
PM Capture M28 High Burn



PM Capture M28 Medium Burn



PM Capture M28 Low Burn

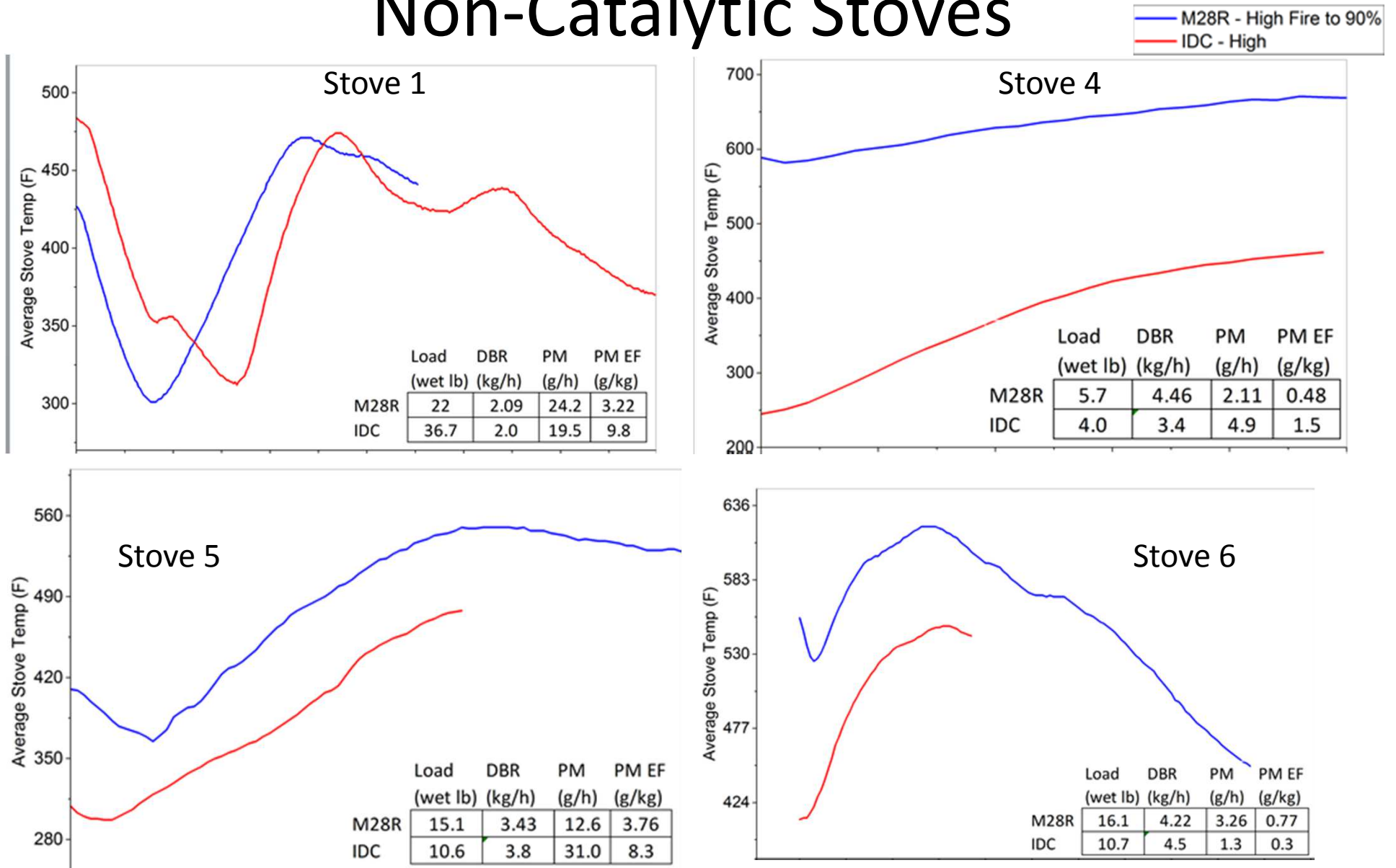


3/3/2018

STOVE TEMPERATURE DATA

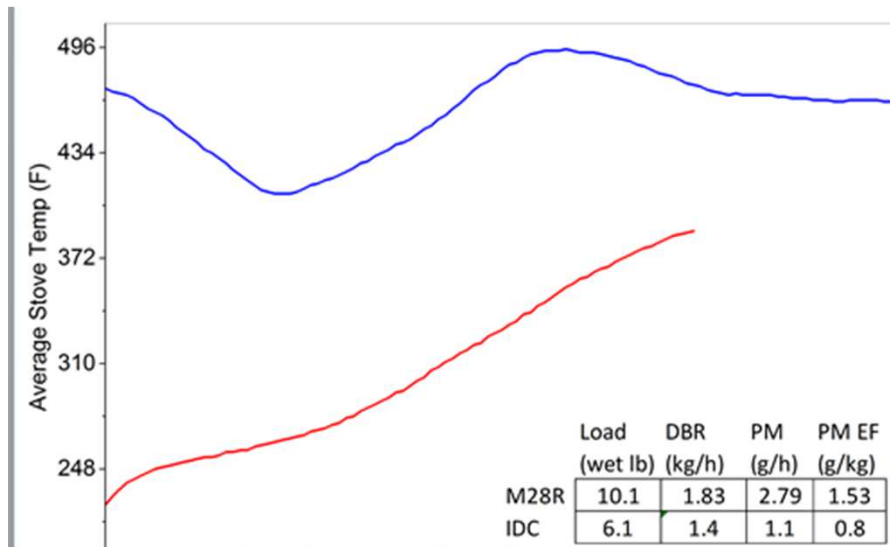
Stove Temp – Max Air Setting

Non-Catalytic Stoves

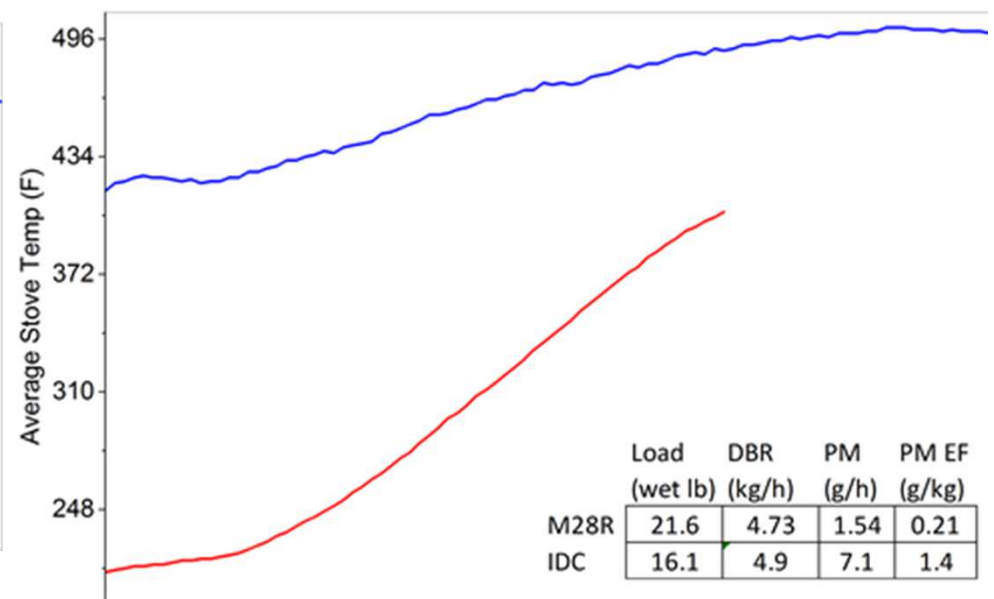


Stove Temp – Max Air Setting Catalytic Stoves

Stove 2



Stove 3

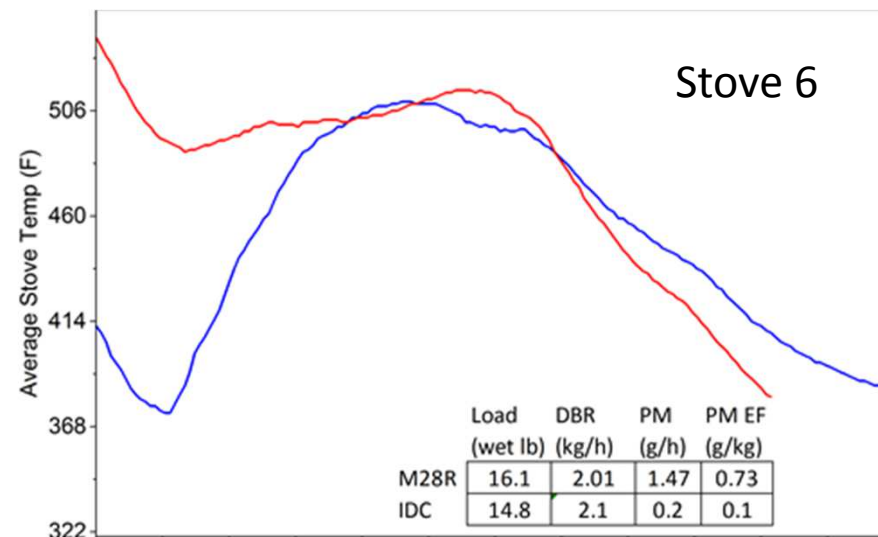
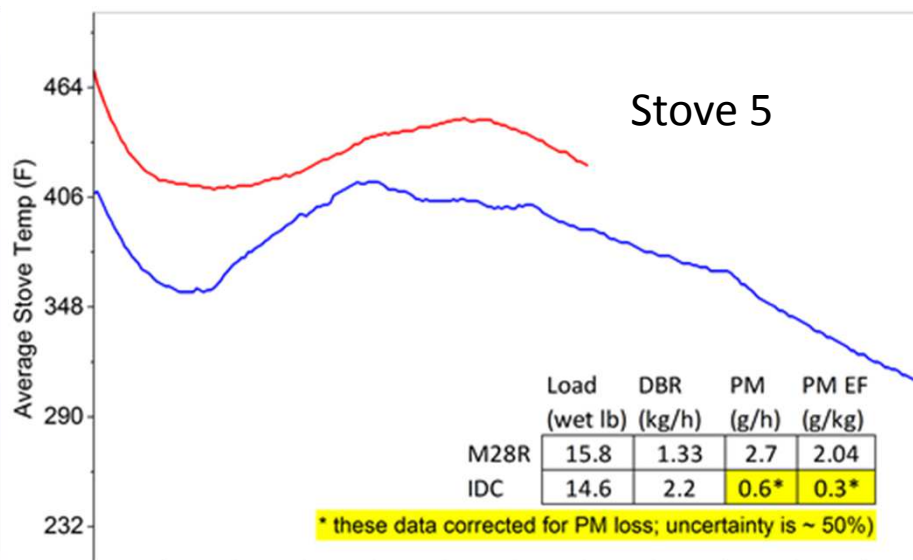
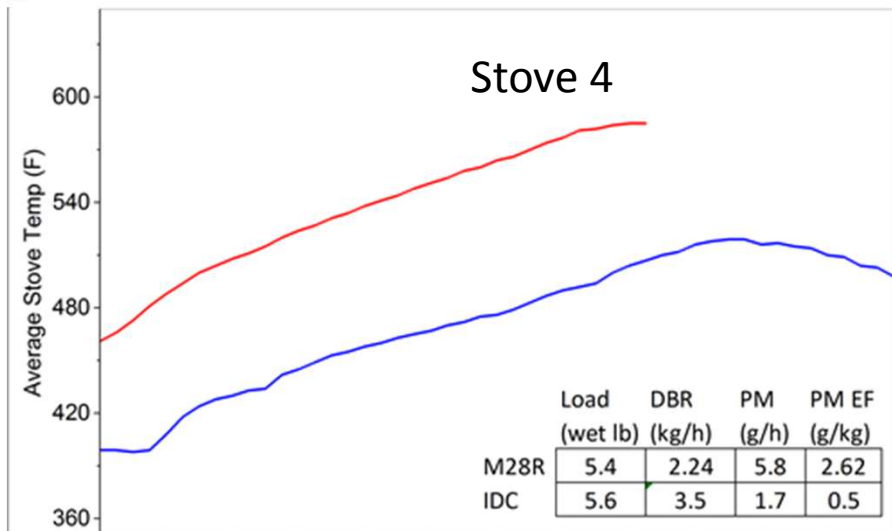
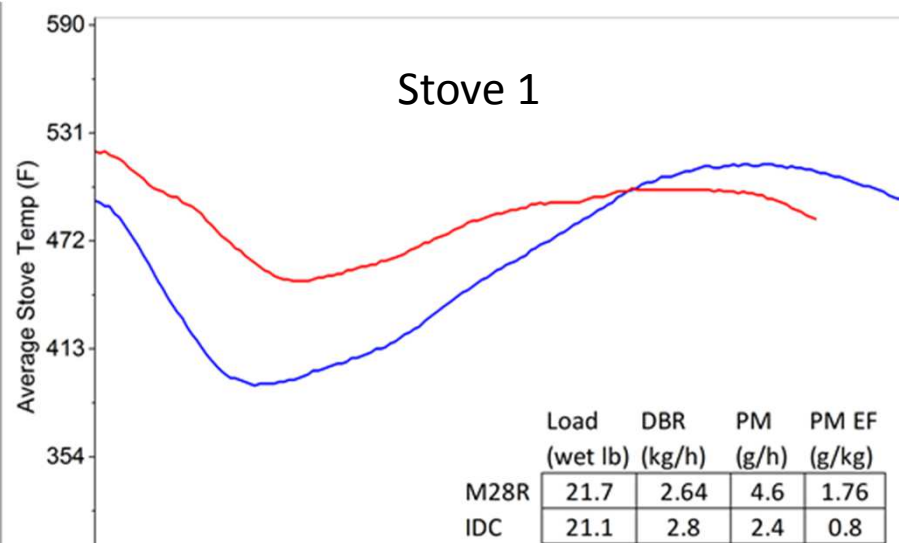


— M28R - High Fire to 90%
— IDC - High

Stove Temp – Medium Air Setting

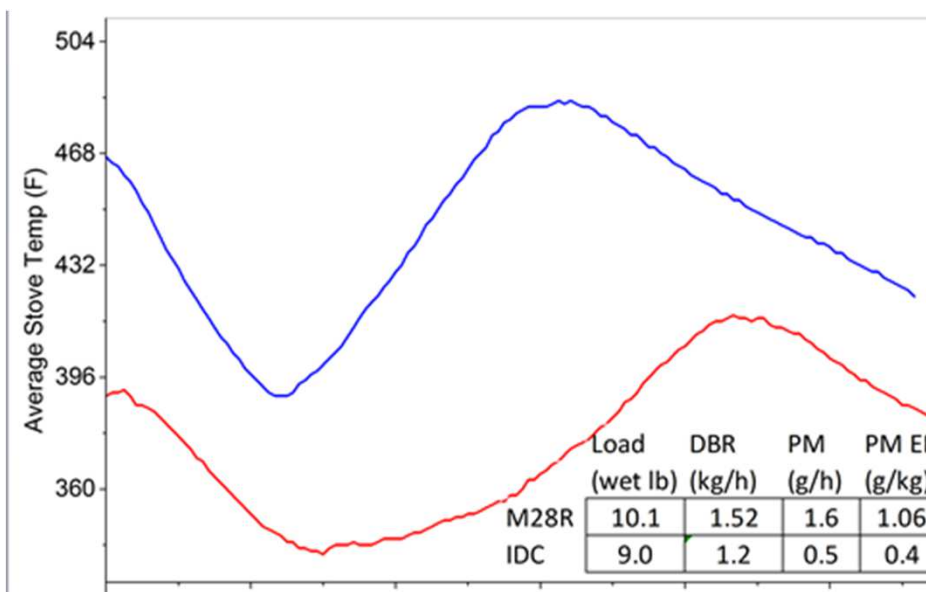
Non-Catalytic Stoves

— M28R - Medium Fire to 90%
— IDC - Medium

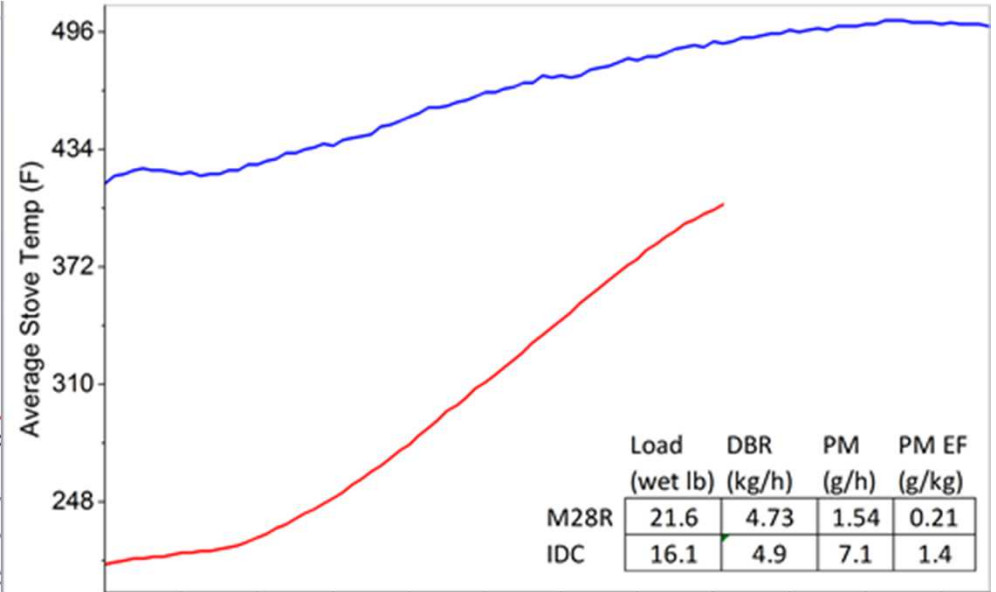


Stove Temp – Medium Air Setting Catalytic Stoves

Stove 2



Stove 3

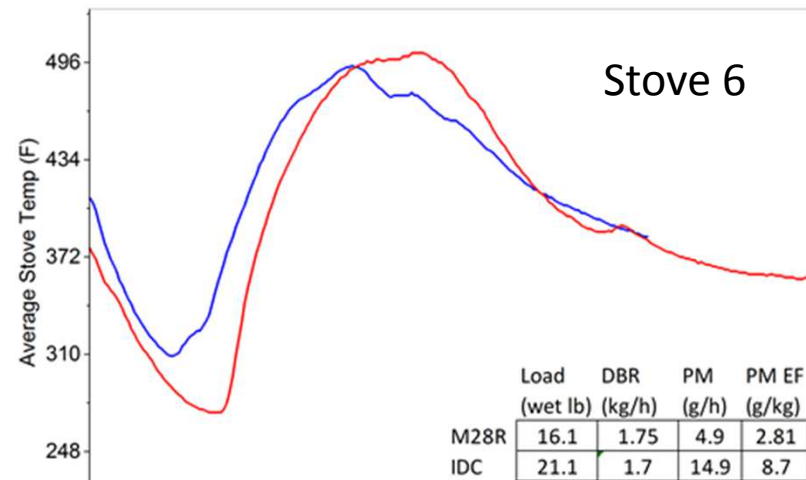
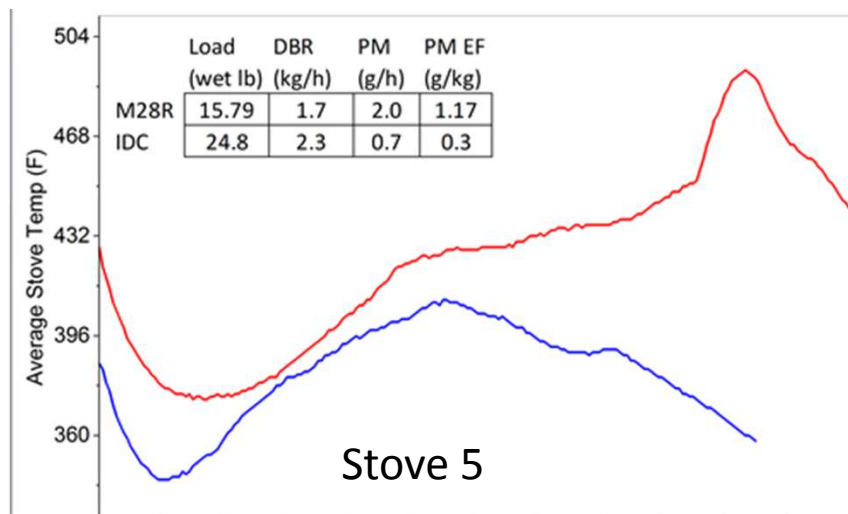
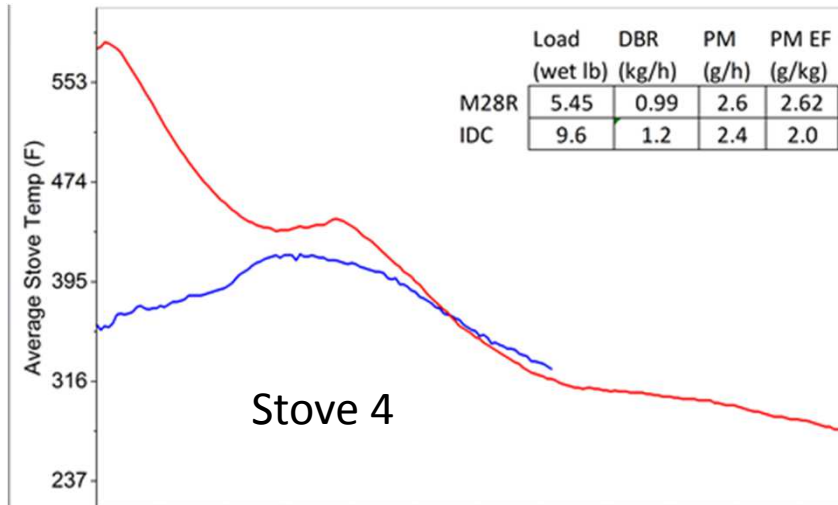
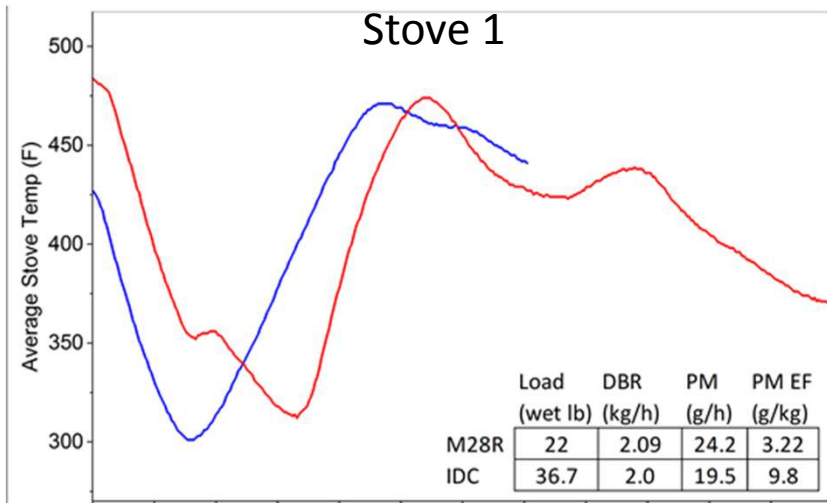


— M28R - Medium Fire to 90%
— IDC - Medium

Stove Temp – Lowest Air Setting

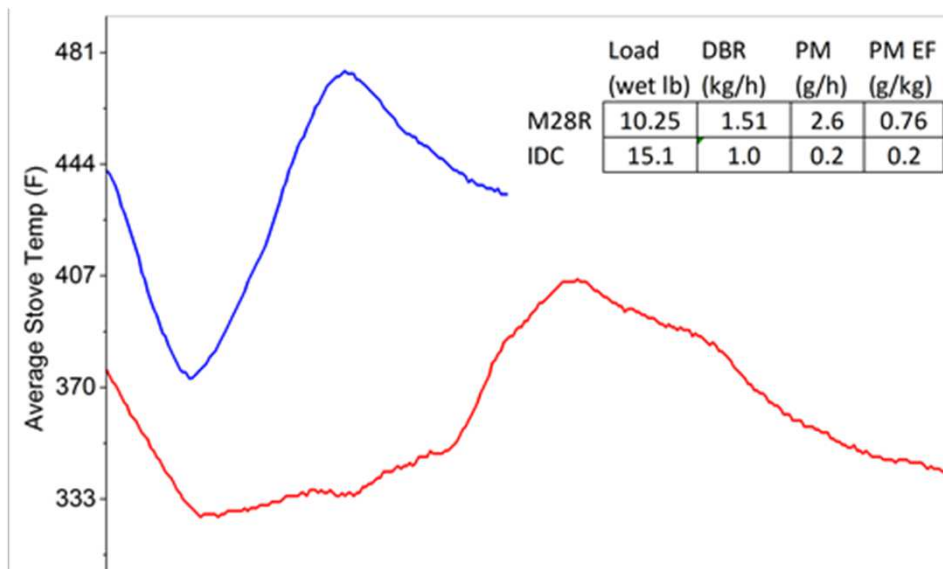
Non-Catalytic Stoves

— M28R - Low Fire to 90%
— IDC - Low

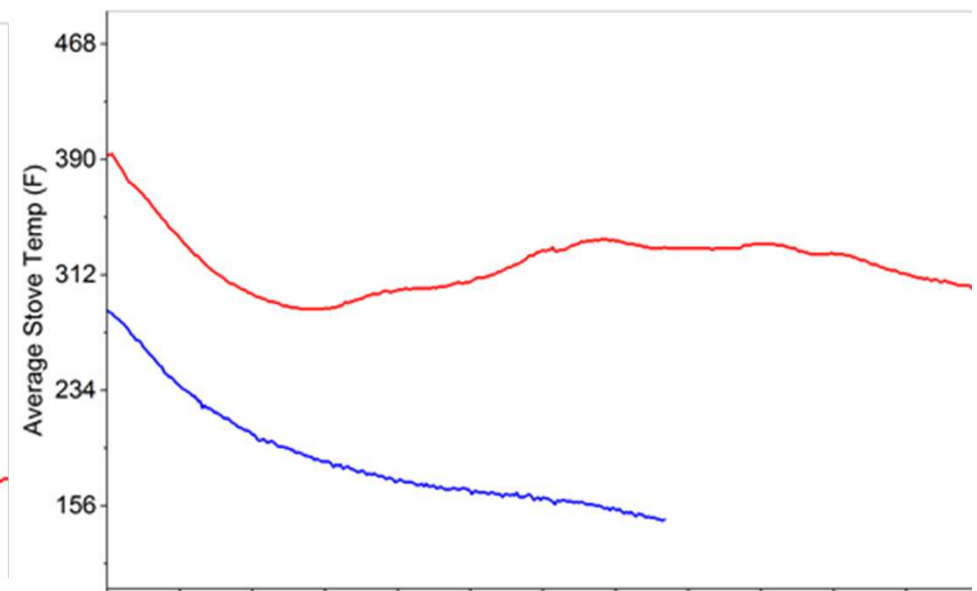


Stove Temp – Lowest Air Setting Catalytic Stoves

Stove 2



Stove 3



— M28R - Low Fire to 90%
— IDC - Low

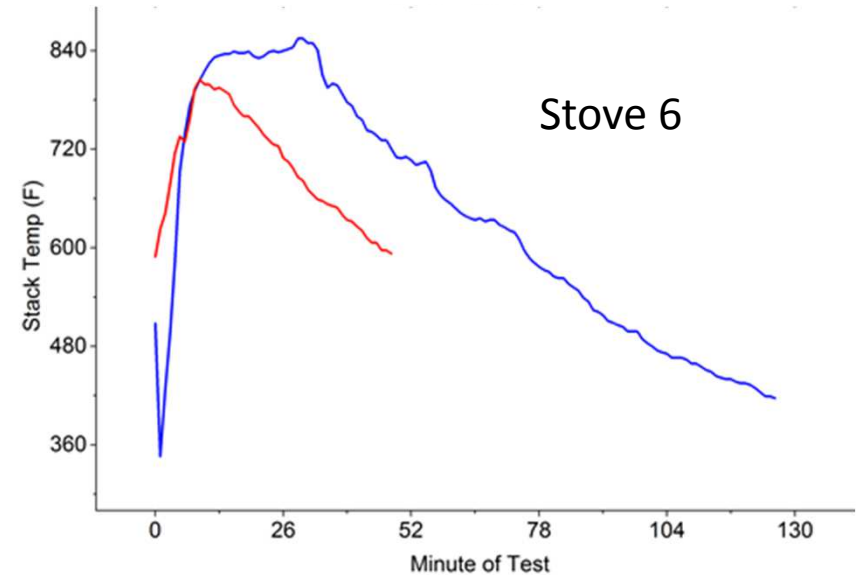
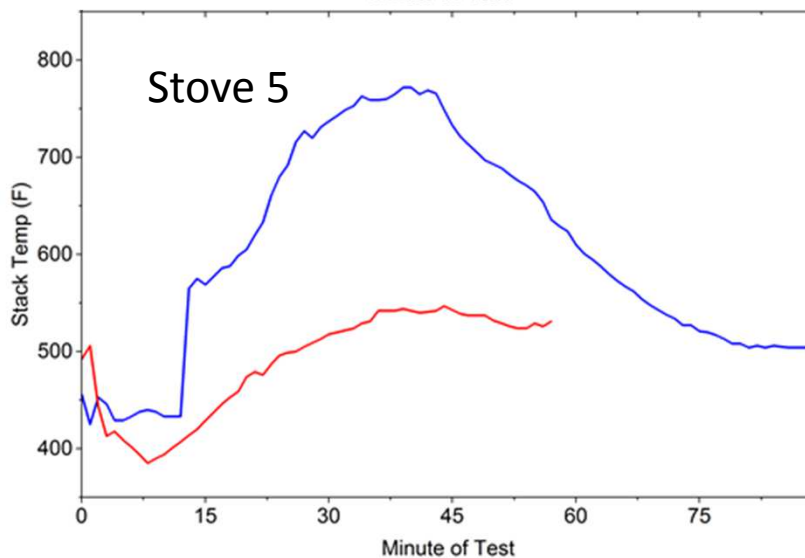
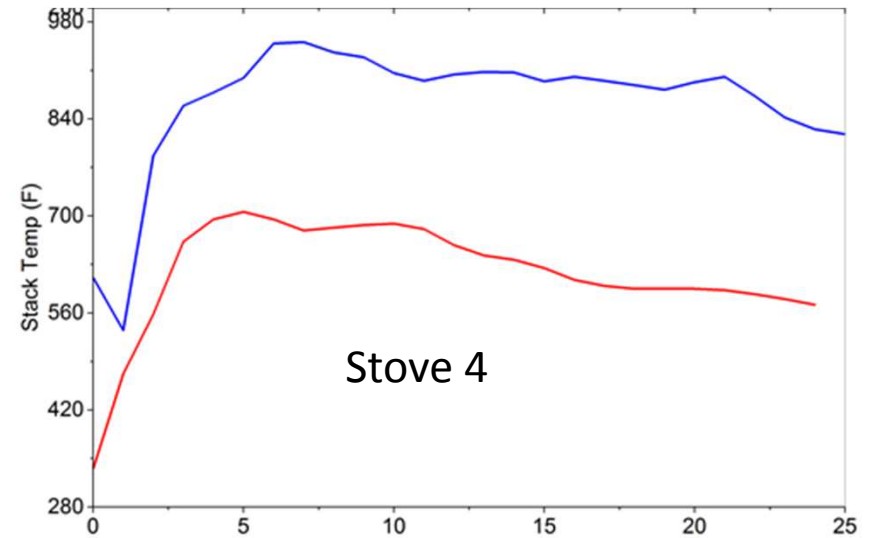
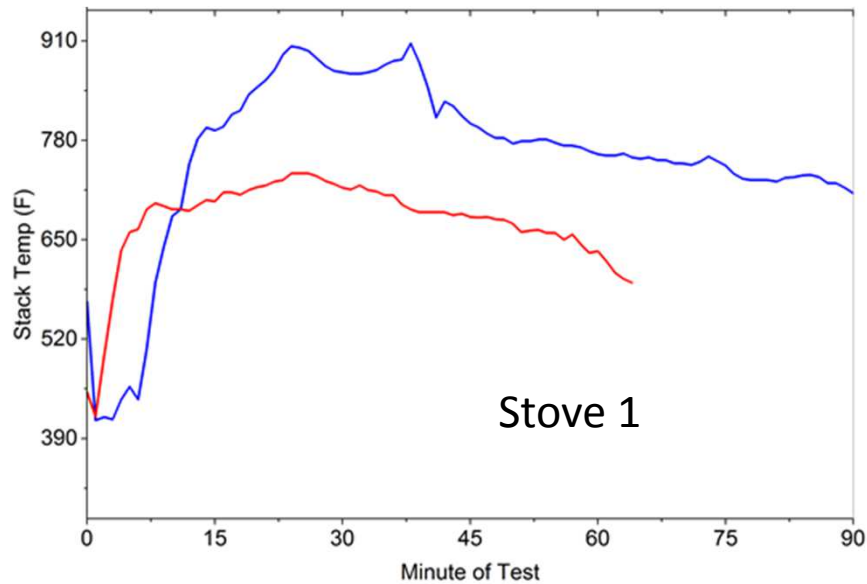
3/32018

STACK TEMPERATURE DATA

Stack Temp – Max Air Setting

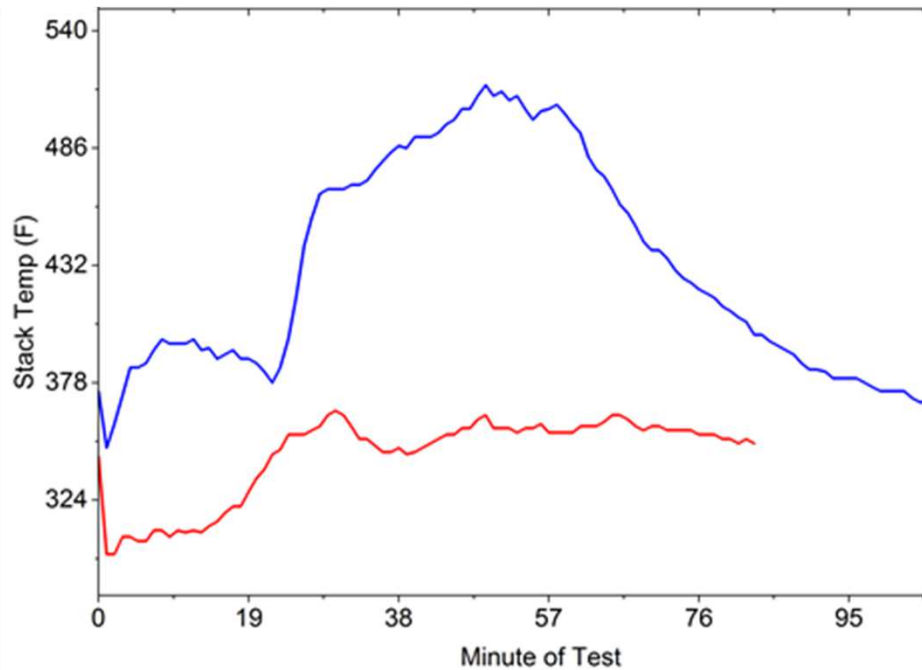
Non-Catalytic Stoves

M28R - High Fire to 90%
IDC - High

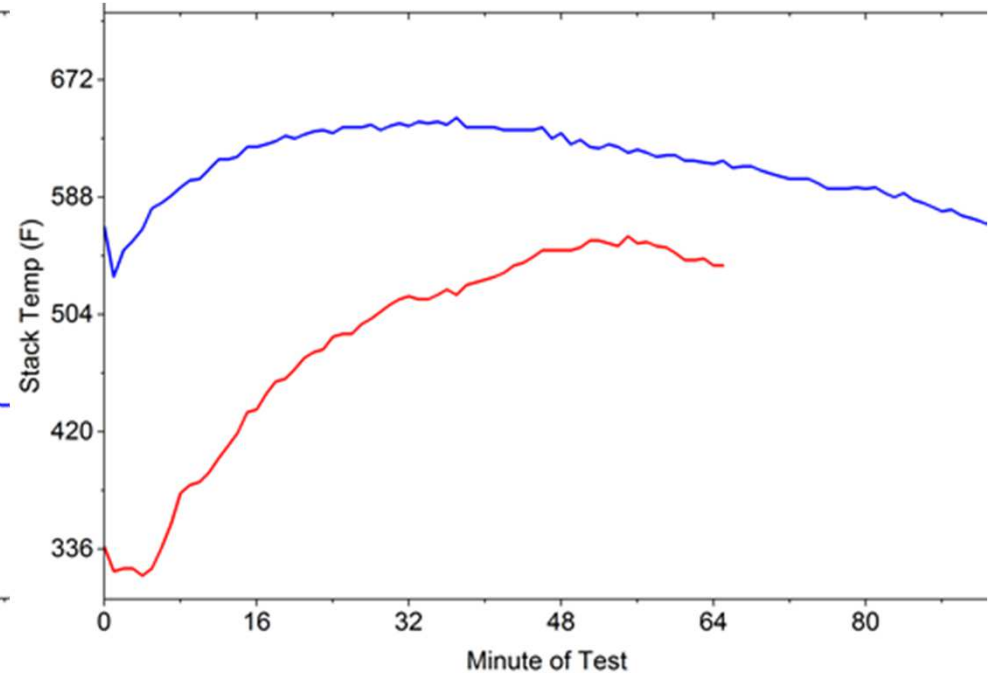


Stack Temp – Max Air Setting Catalytic Stoves

Stove 2



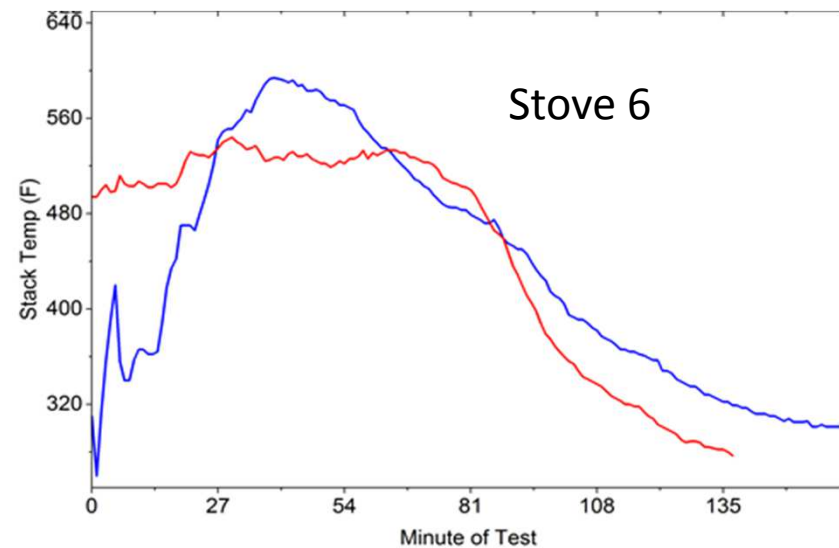
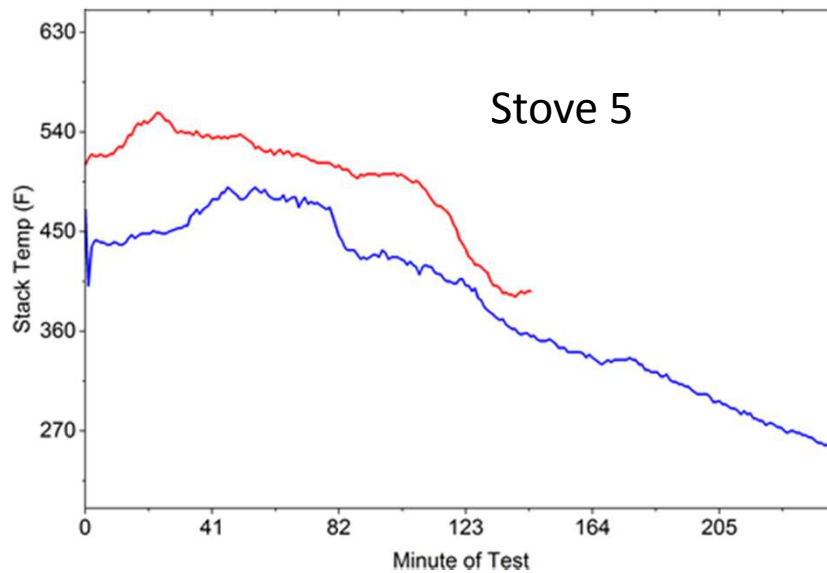
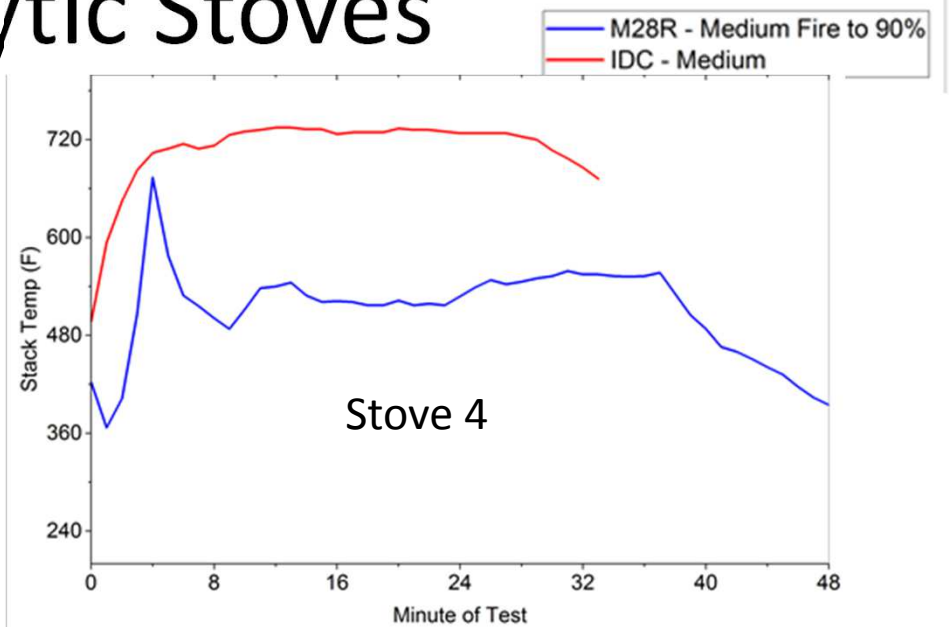
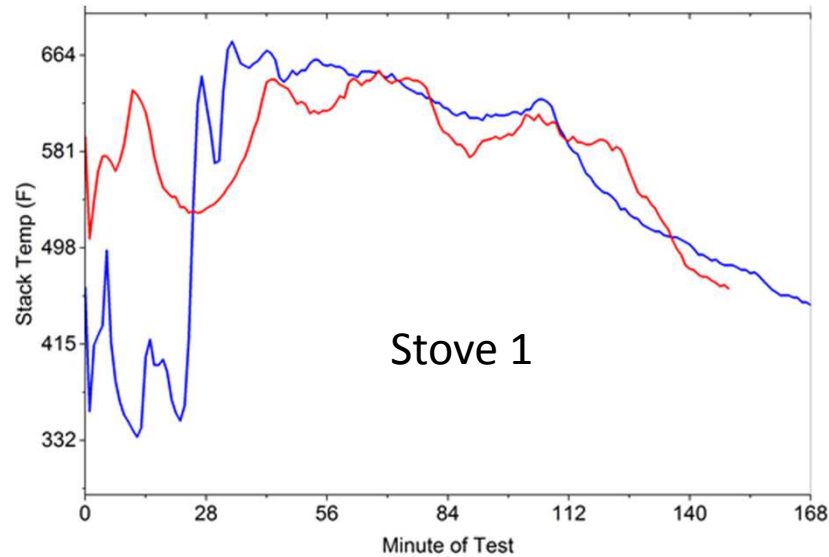
Stove 3



— M28R - High Fire to 90%
— IDC - High

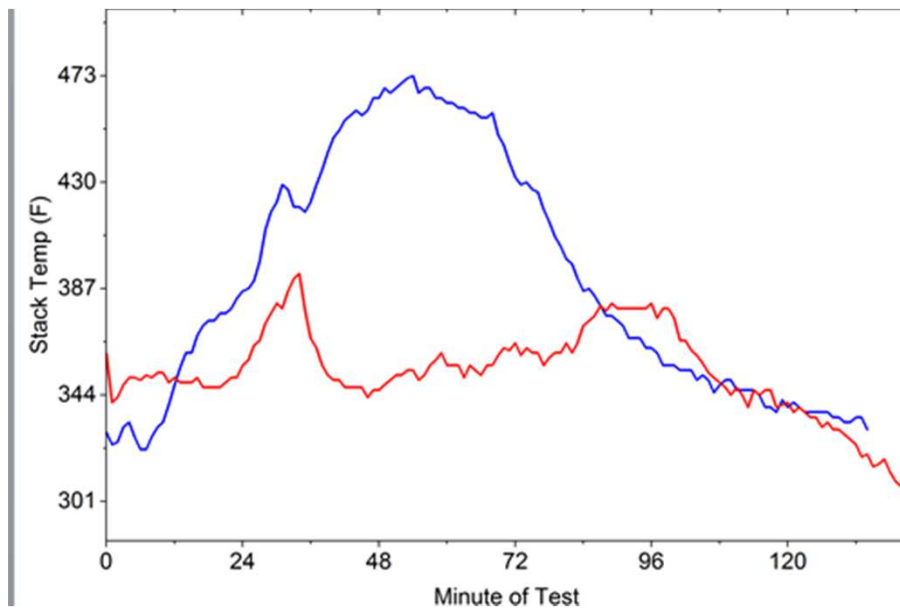
Stack Temp – Medium Air Setting

Non-Catalytic Stoves

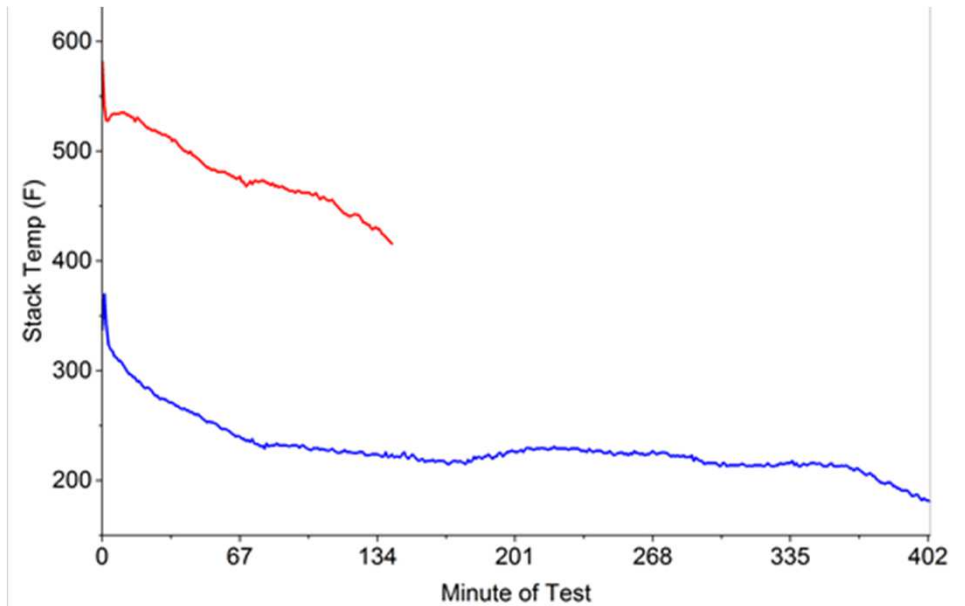


Stack Temp – Medium Air Setting Catalytic Stoves

Stove 2



Stove 3

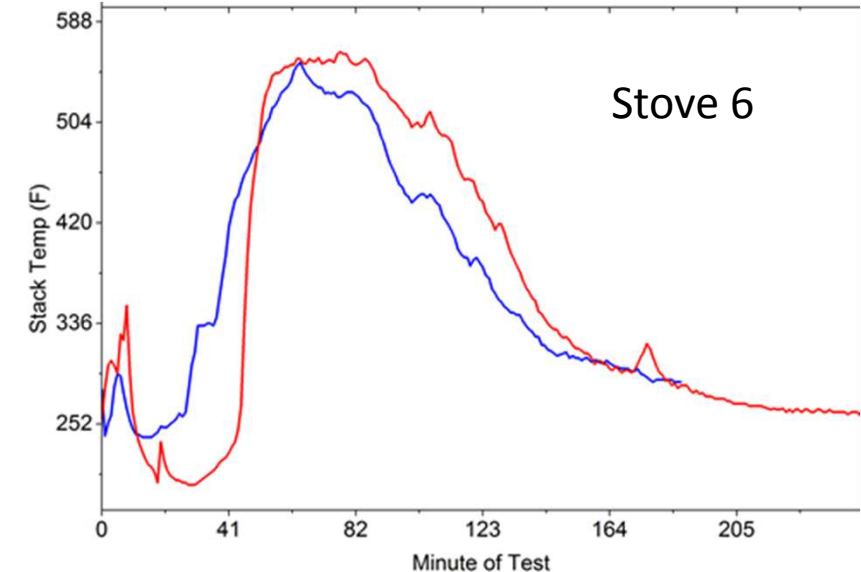
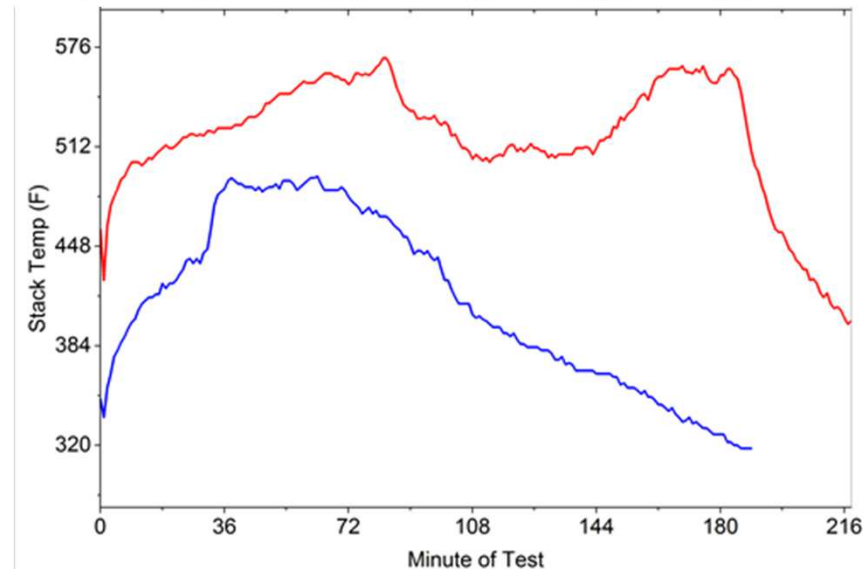
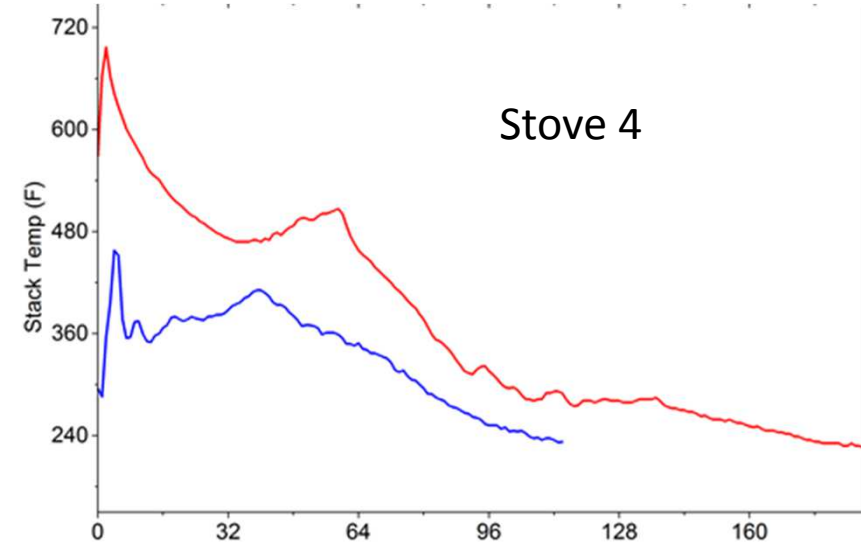
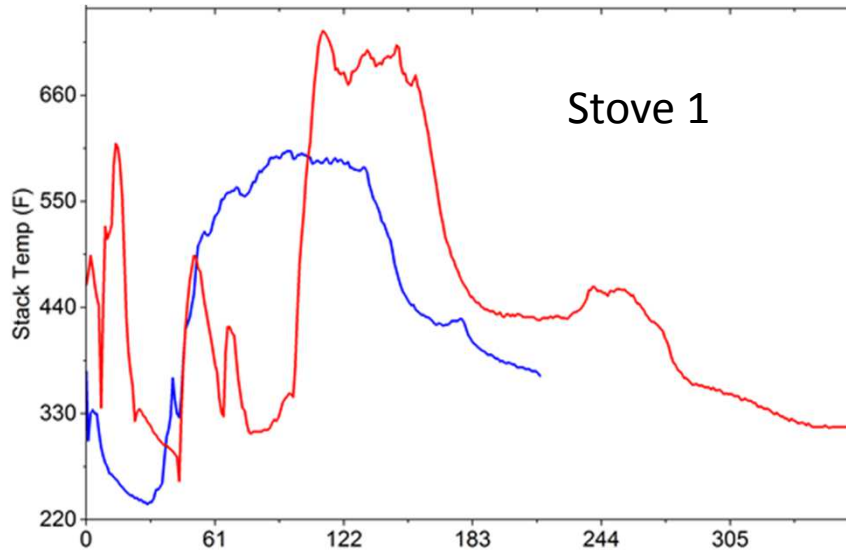


— M28R - Medium Fire to 90%
— IDC - Medium

Stack Temp – Lowest Air Setting

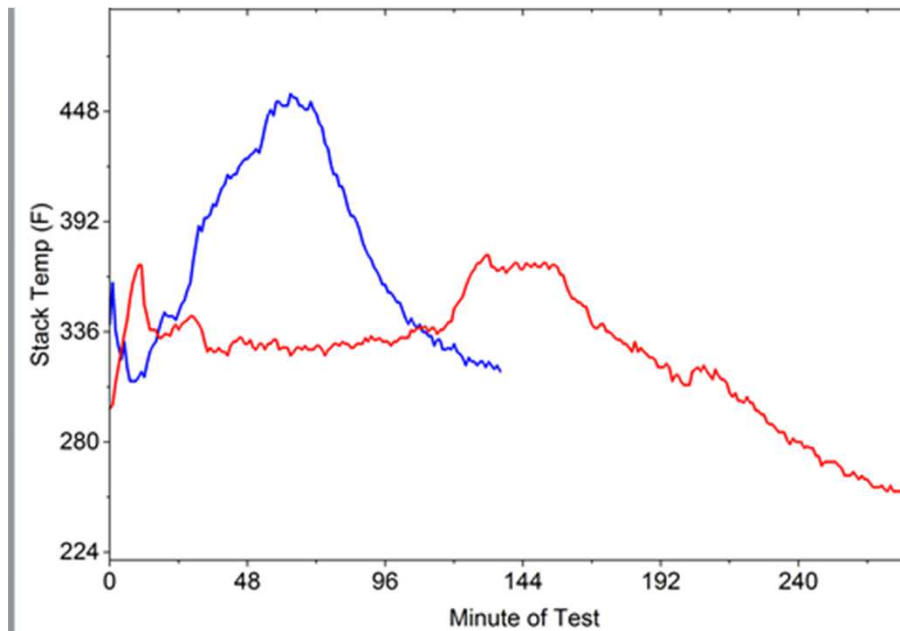
Non-Catalytic Stoves

M28R - Low Fire to 90%
IDC - Low

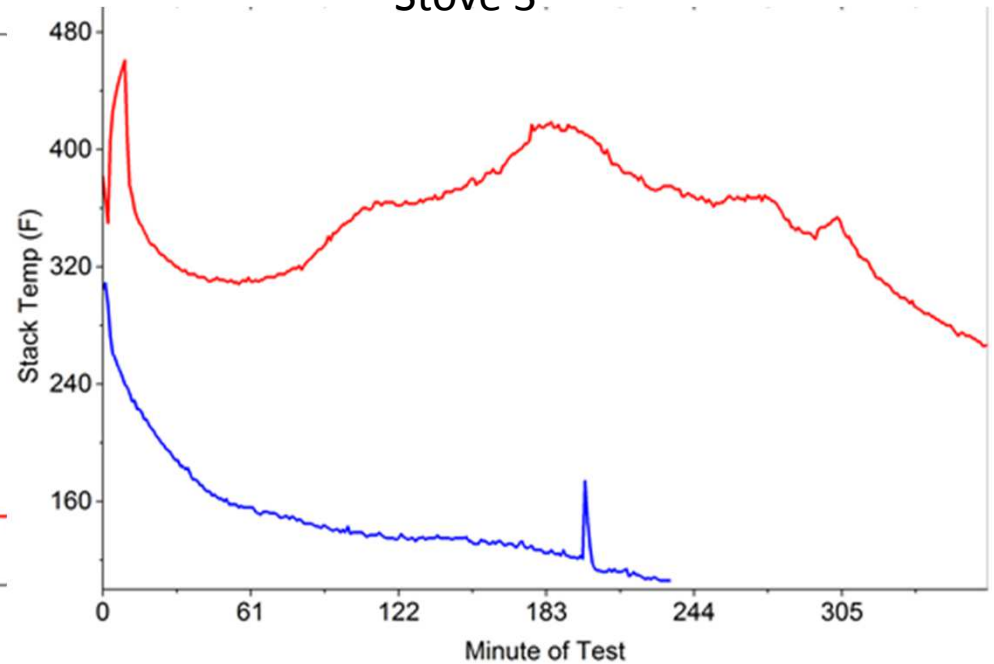


Stack Temp – Lowest Air Setting Catalytic Stoves

Stove 2



Stove 3



— M28R - Low Fire to 90%
— IDC - Low

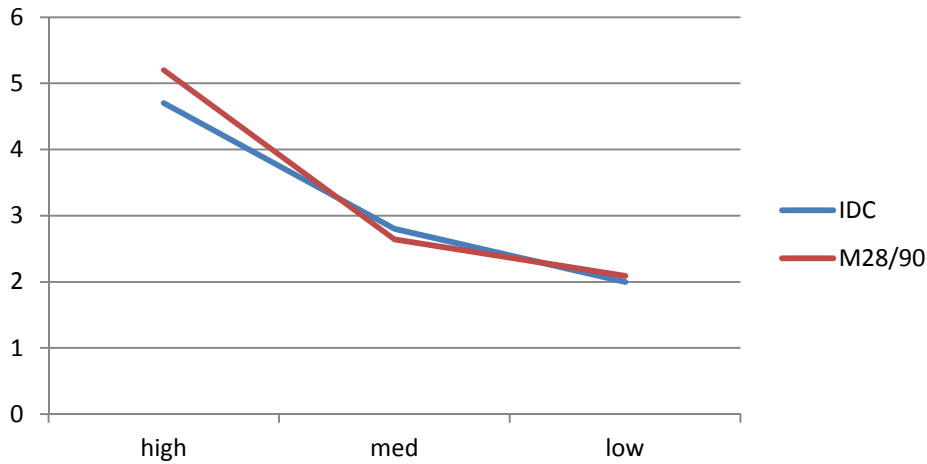
3/3/18

BURN RATE DATA

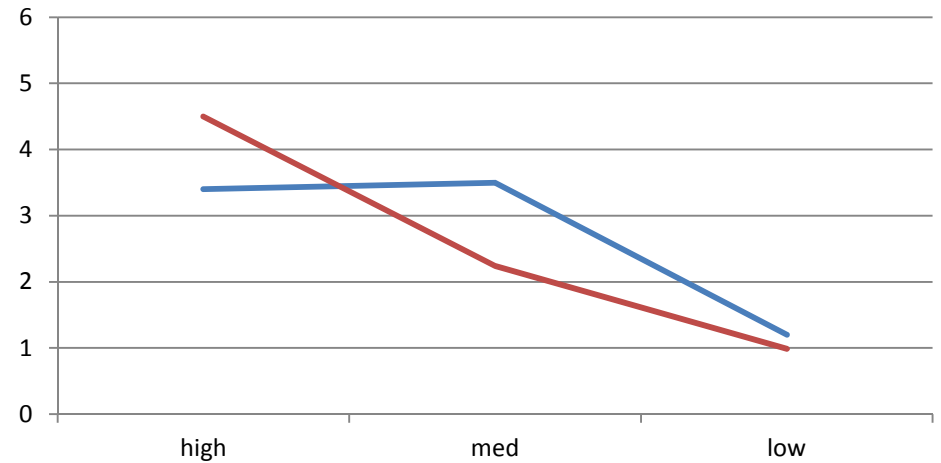
M28 vs. IDC Burn Rates

Non-Catalytic Stoves (kg/hr.)

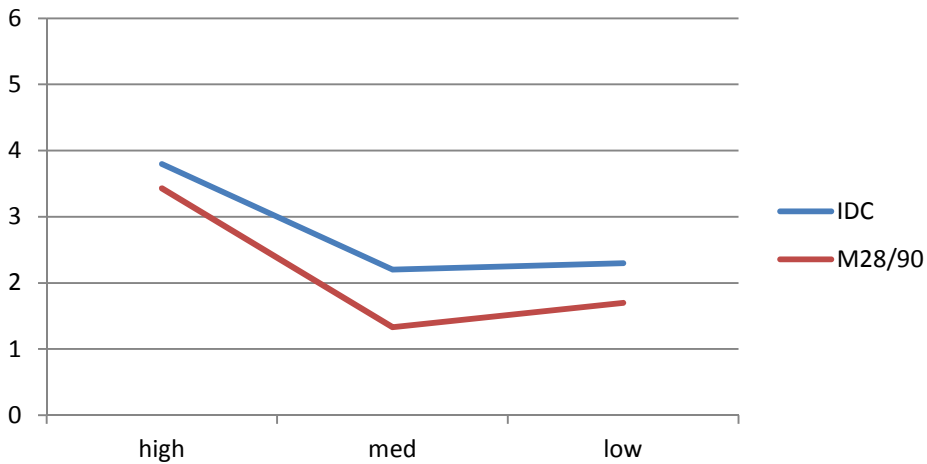
Stove 1



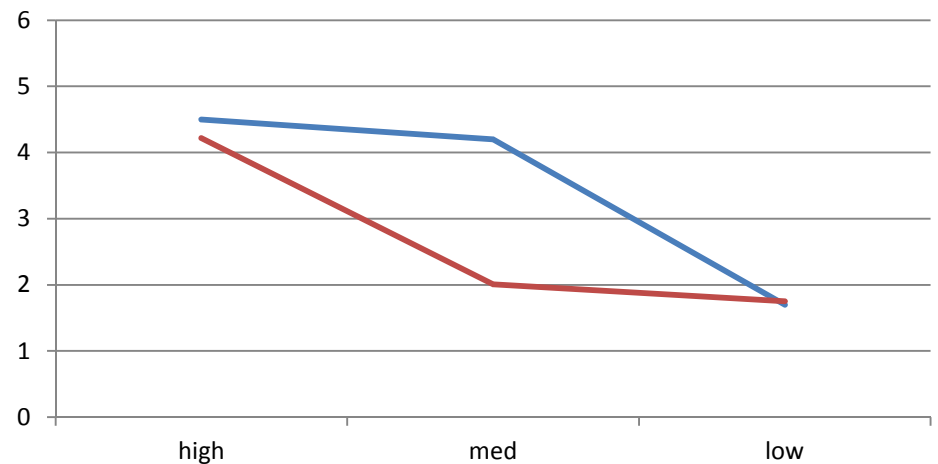
Stove 4



Stove 5

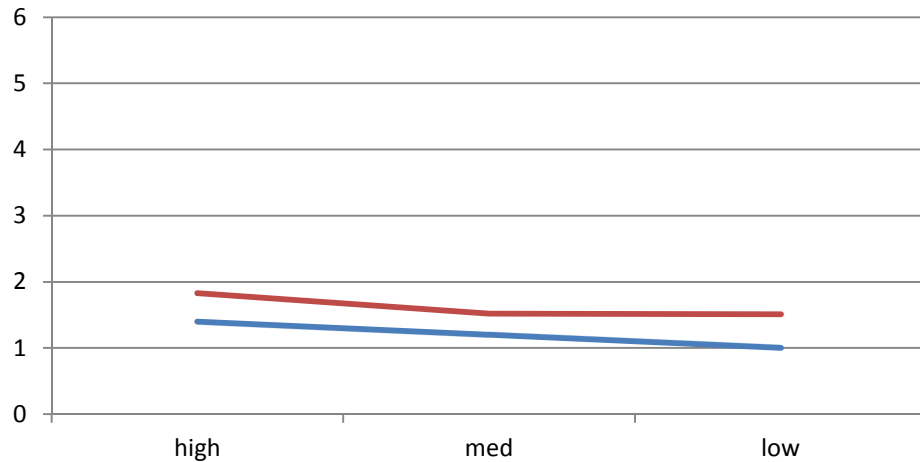


Stove 6

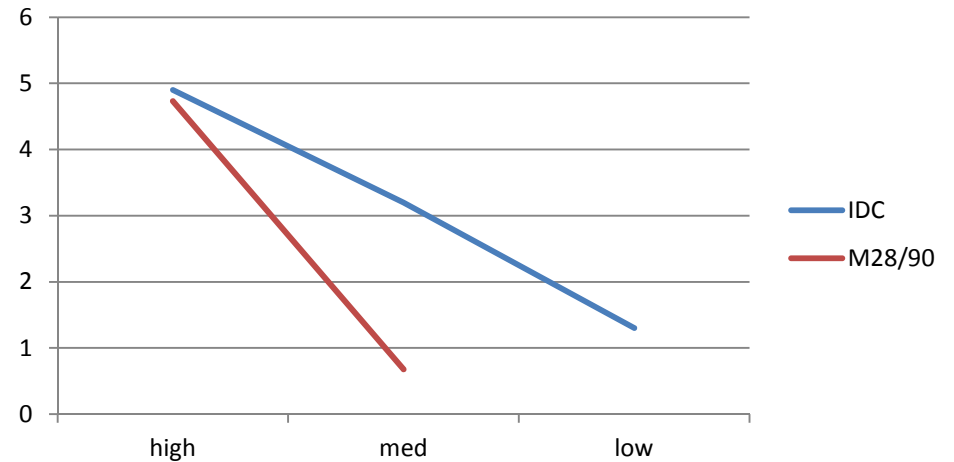


M28 vs. IDC Burn Rates Catalytic Stoves (kg/hr.)

Stove 2

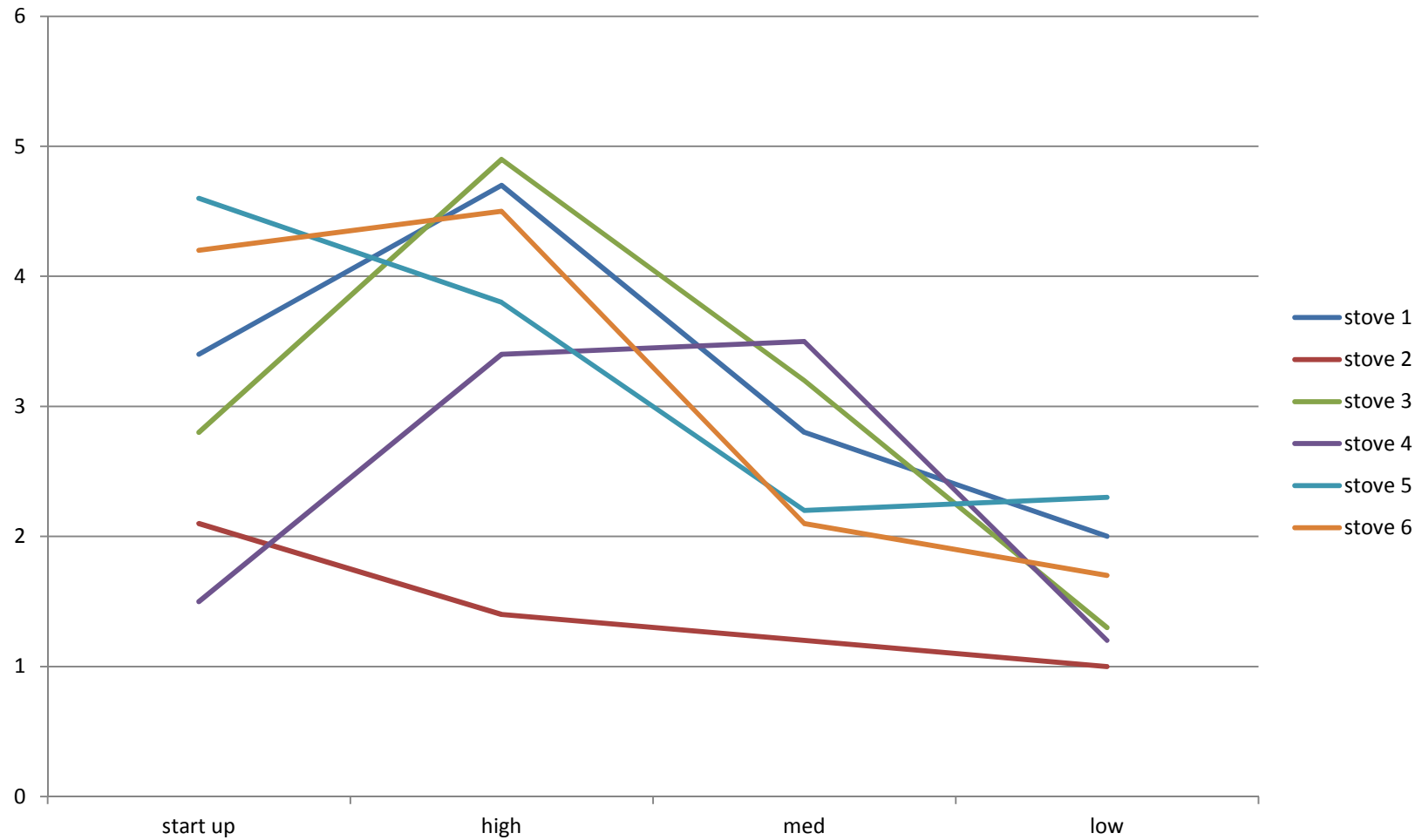


Stove 3



IDC Protocol

Burn Rate by Stove



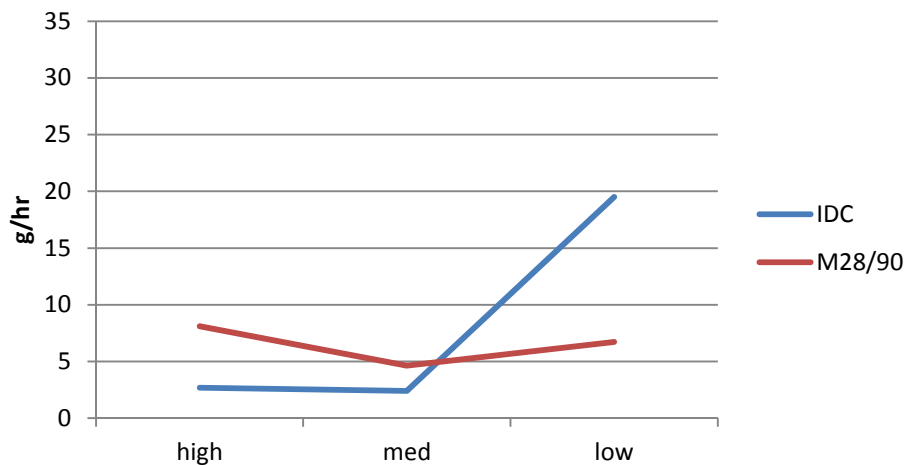
3/3/2018

EMISSION FACTOR

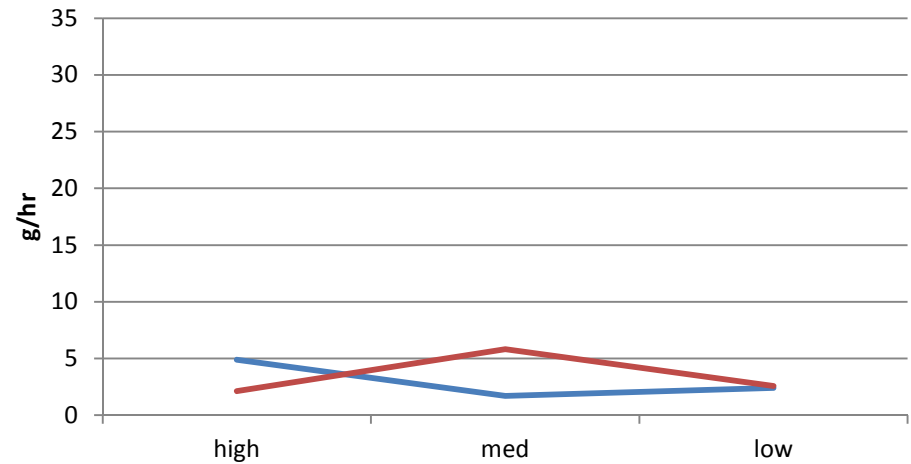
M28 vs. IDC Emission Rates

Non-Catalytic Stoves (g/hr.)

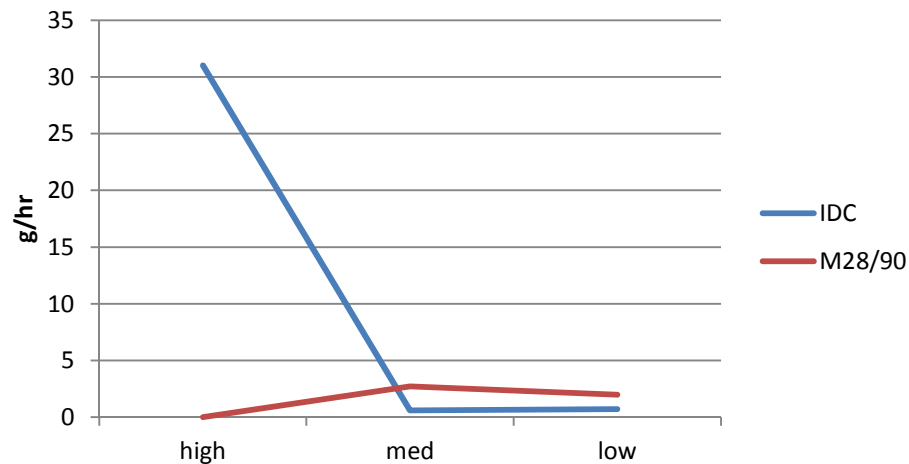
Stove 1



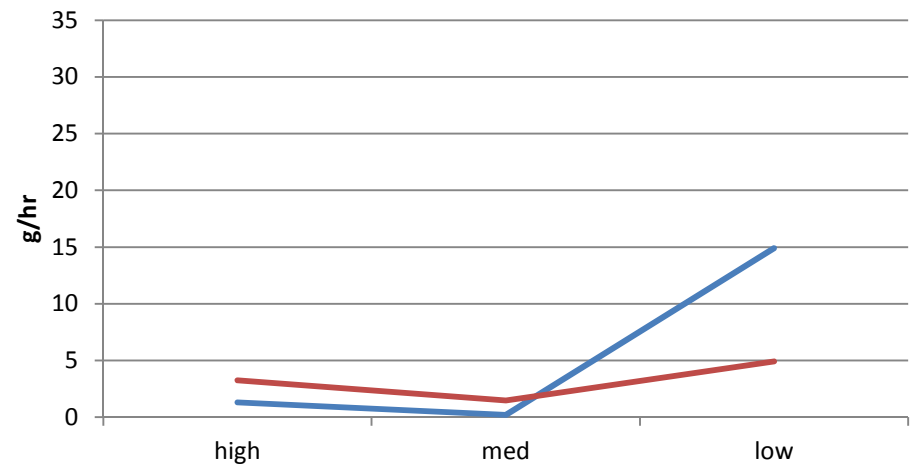
Stove 4



Stove 5

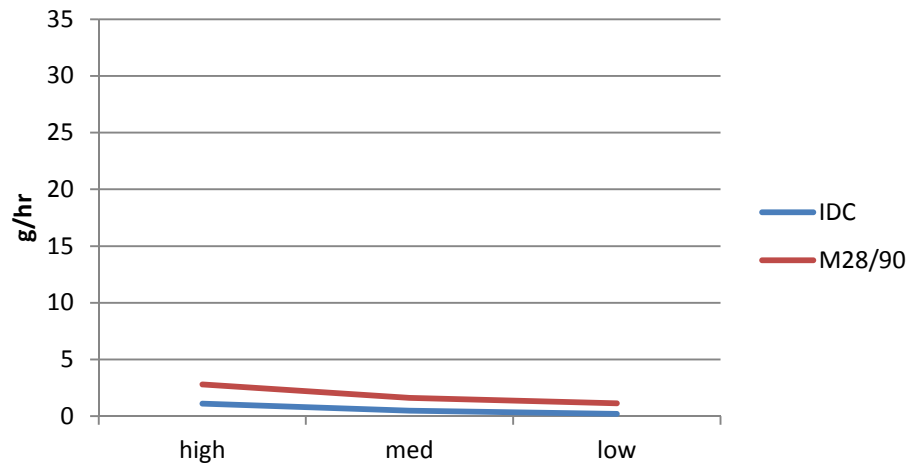


Stove 6

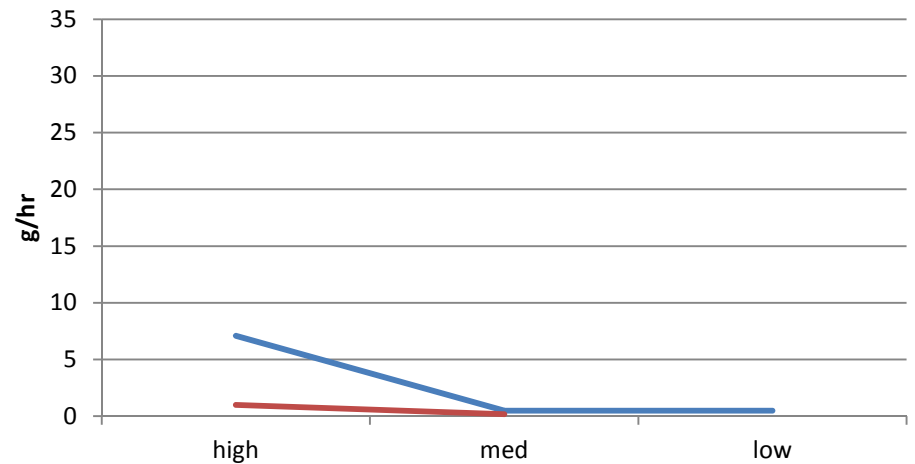


M28 vs. IDC Burn Rates Catalytic Stoves (g/hr)

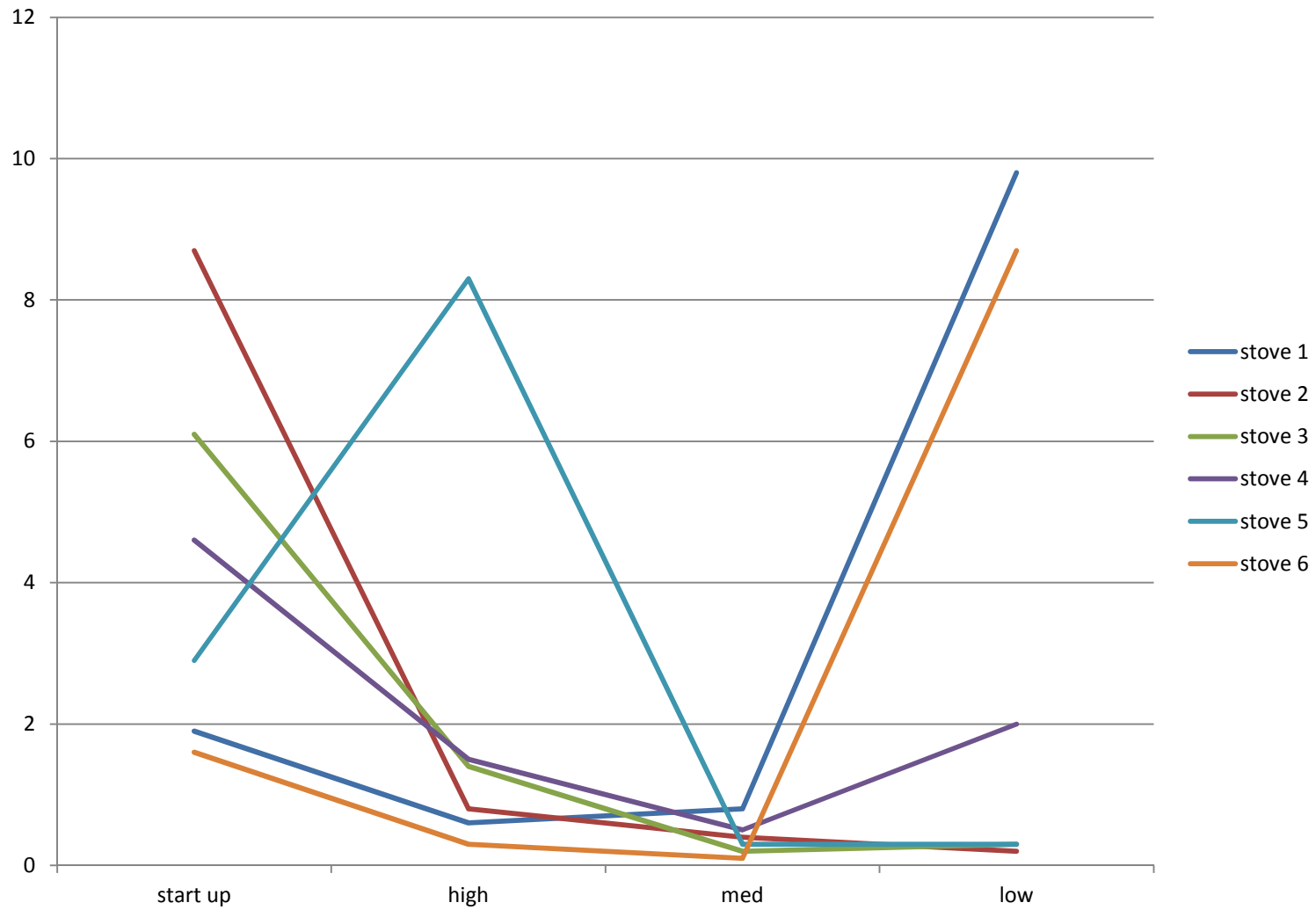
Stove 2



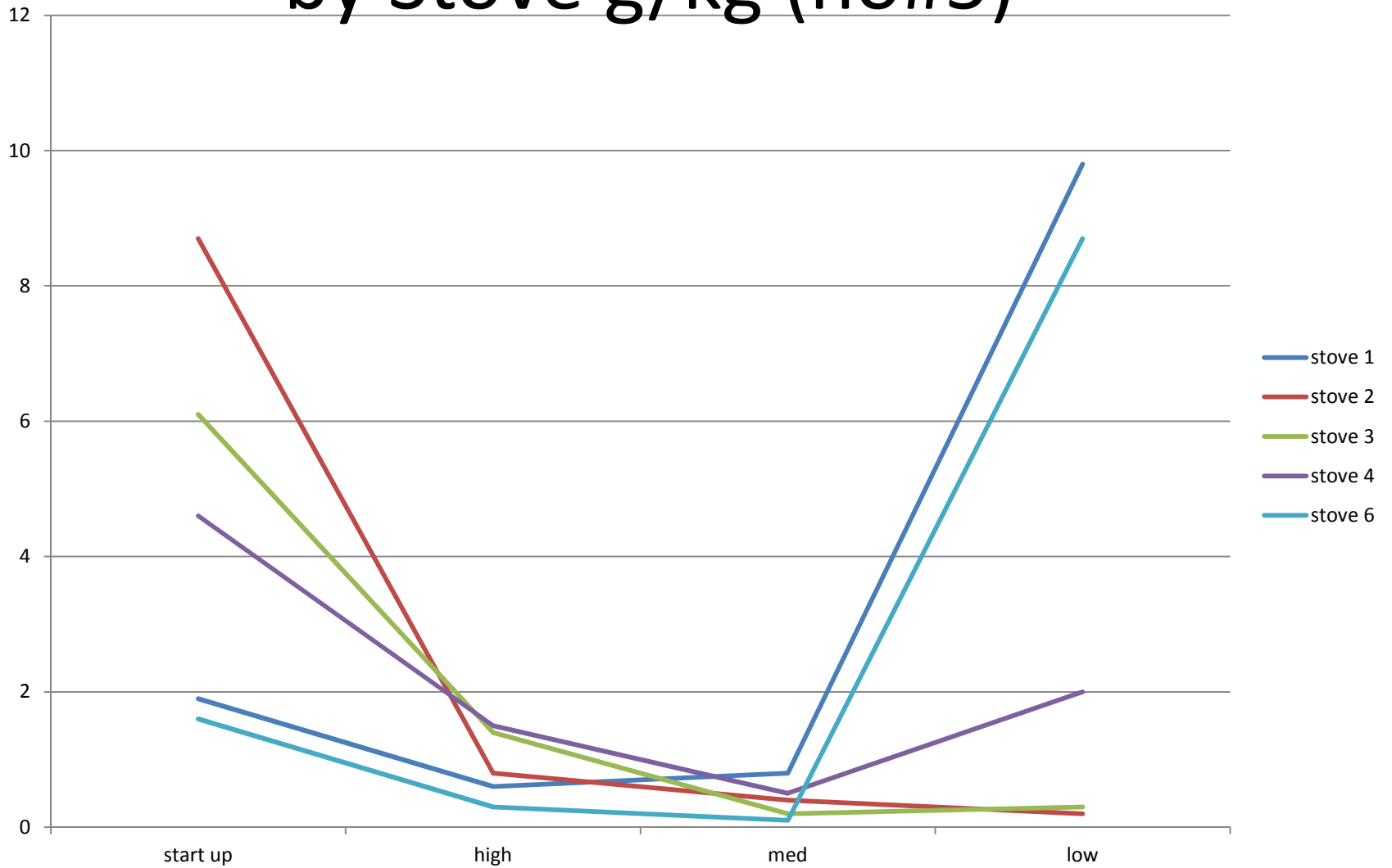
Stove 3



IDC Protocol g/kg by Stove



IDC Protocol by Stove g/kg (no#5)



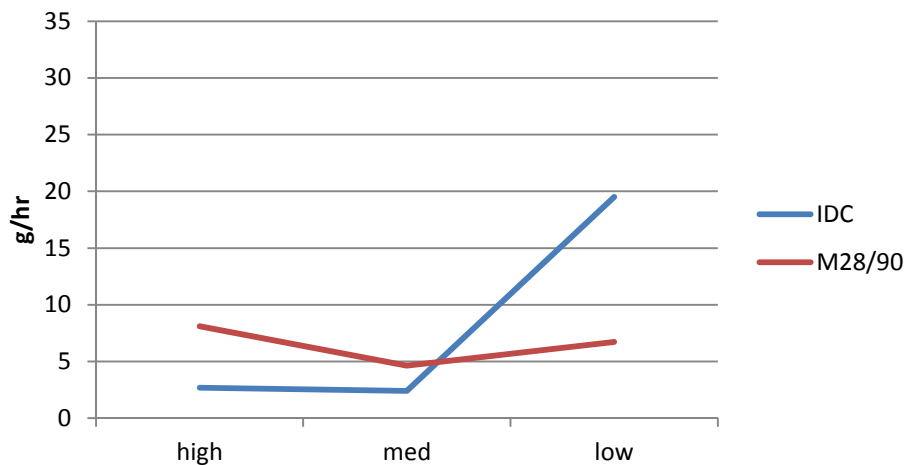
3/3/2018

EMISSION RATE DATA

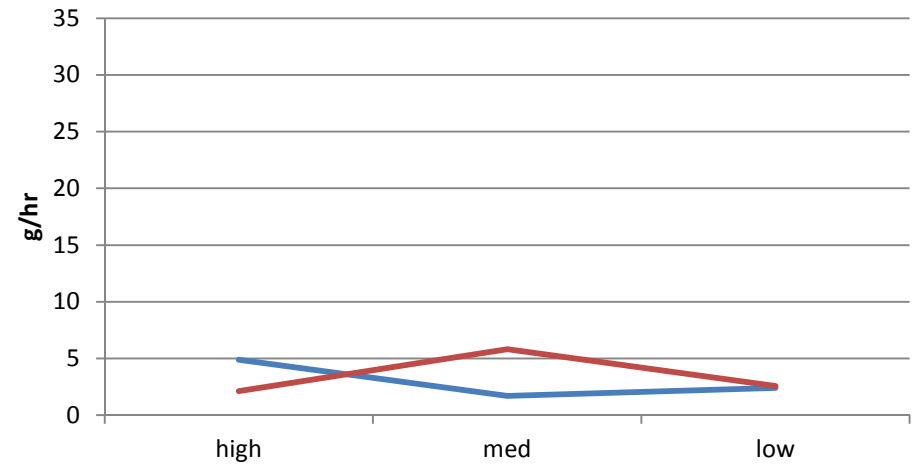
M28 vs. IDC Emission Rates

Non-Catalytic Stoves (g/hr)

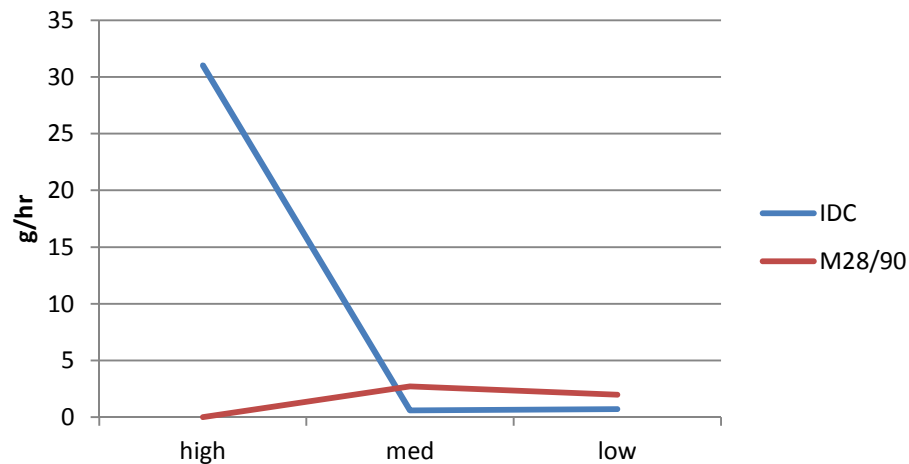
Stove 1



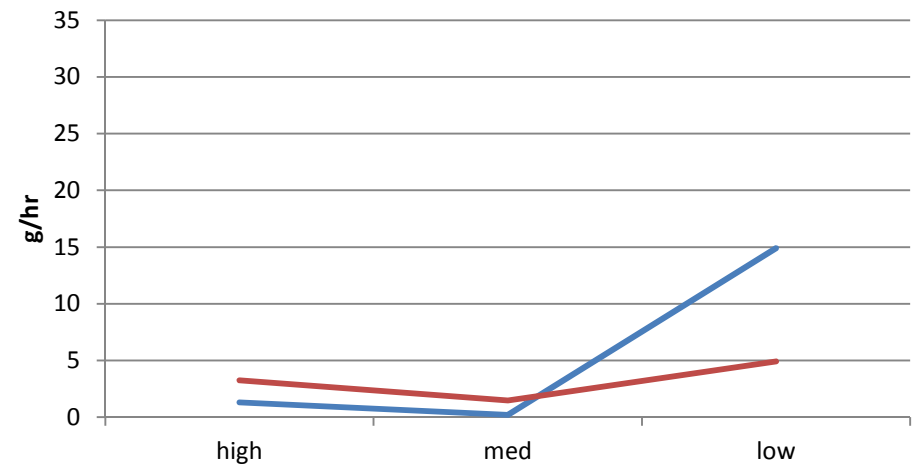
Stove 4



Stove 5

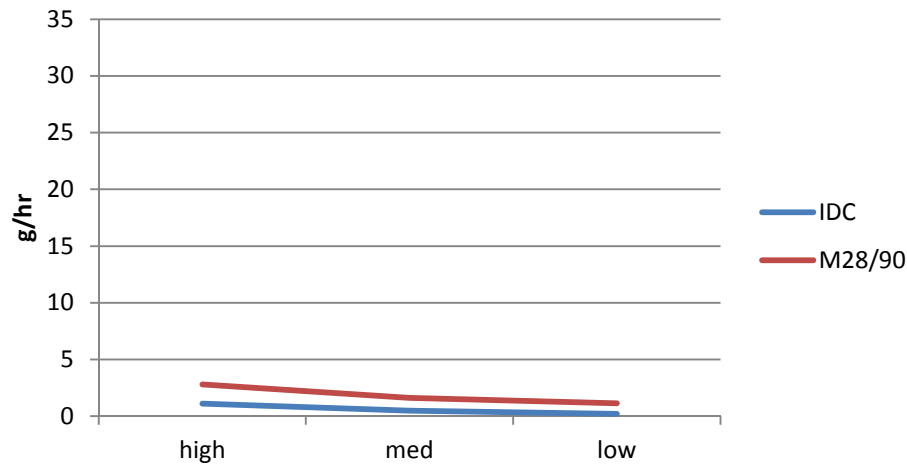


Stove 6

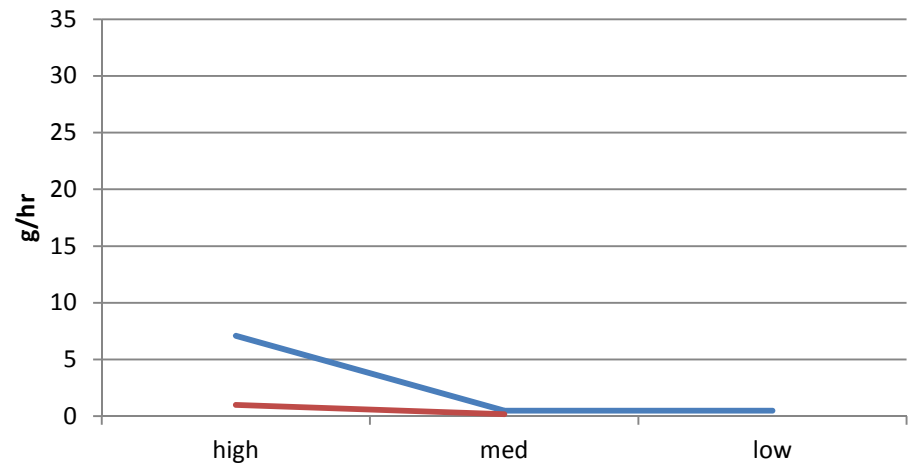


M28 vs. IDC Burn Rates Catalytic Stoves (g/hr)

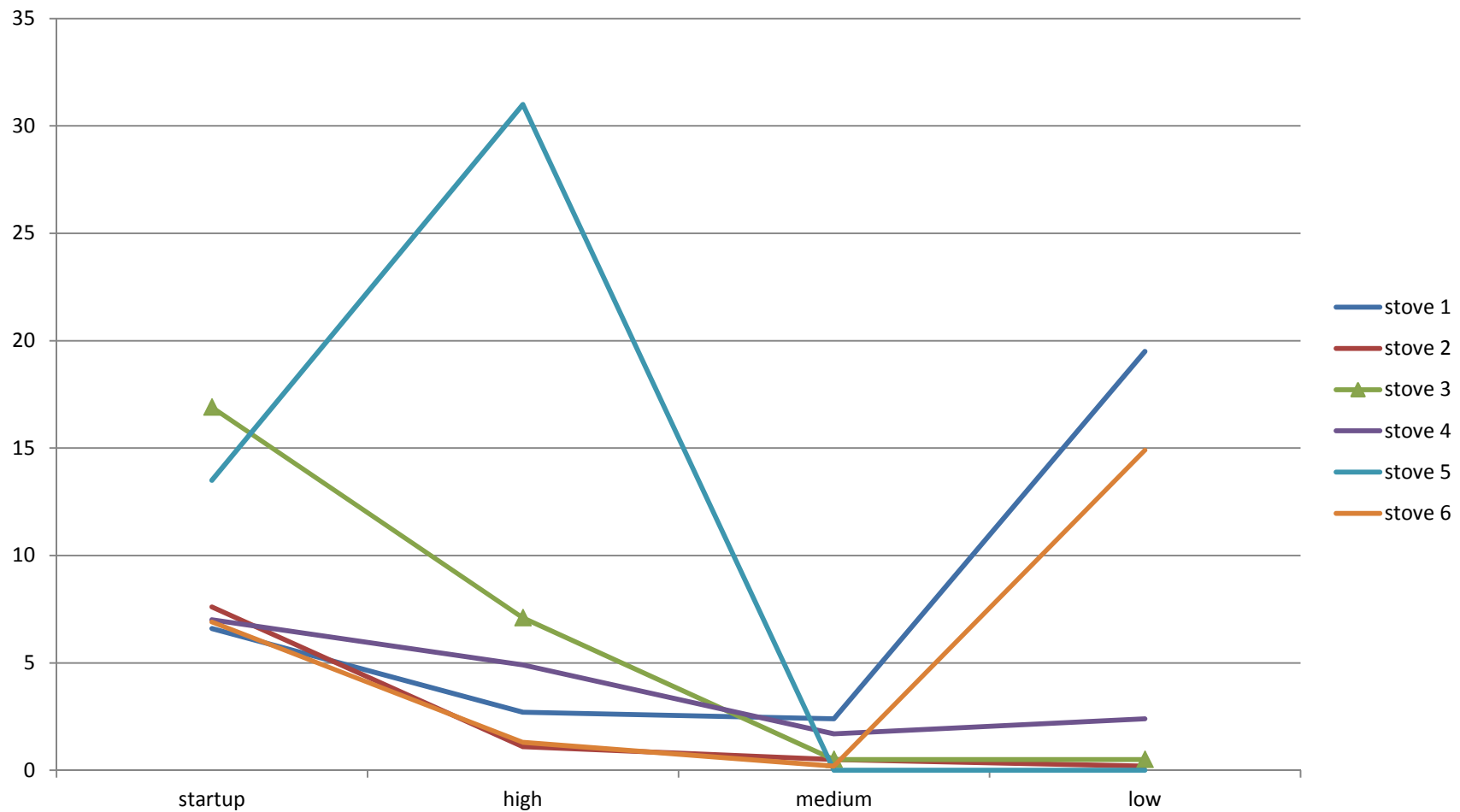
Stove 2



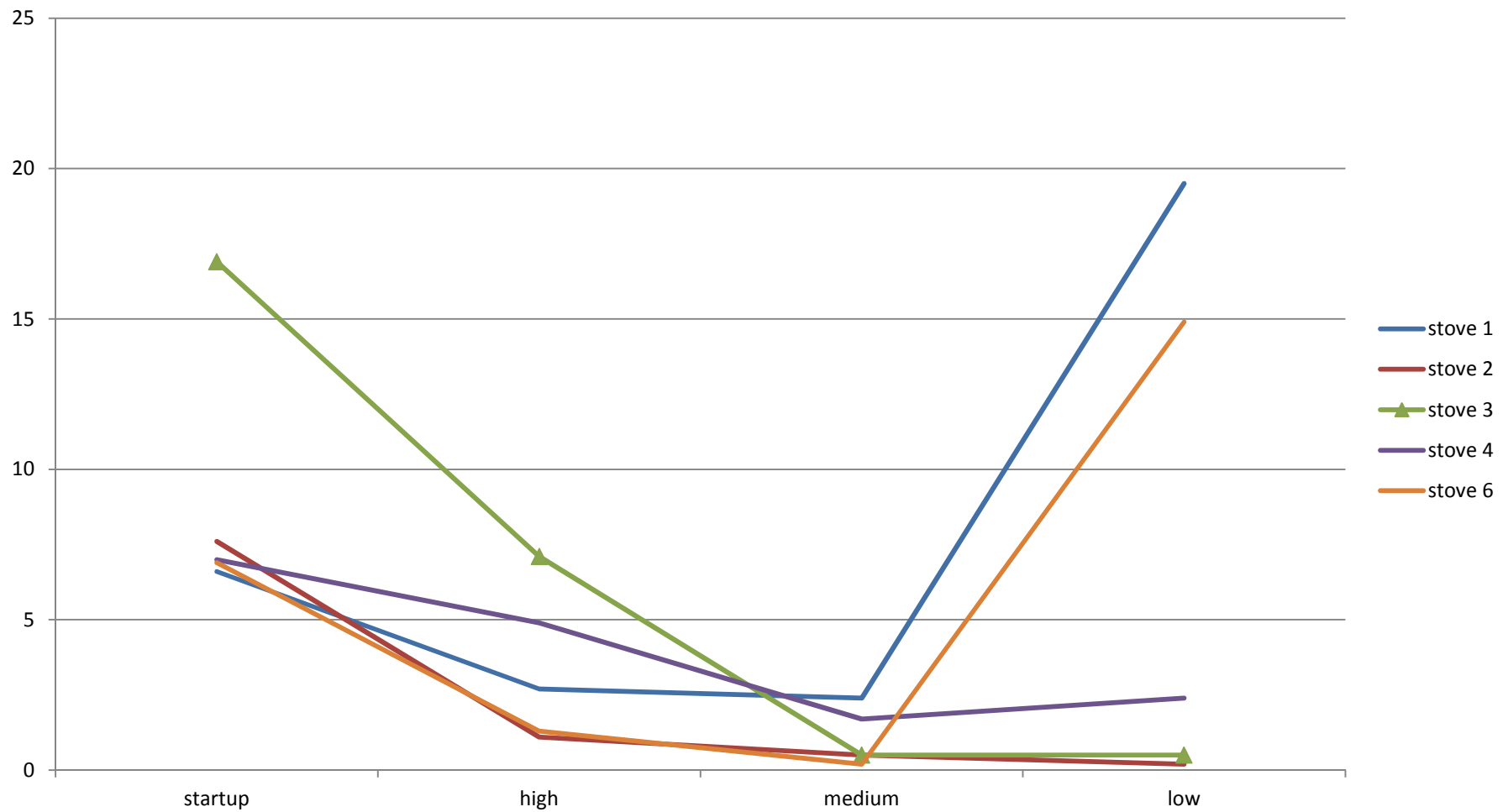
Stove 3



IDC Protocol g/hr by Stove

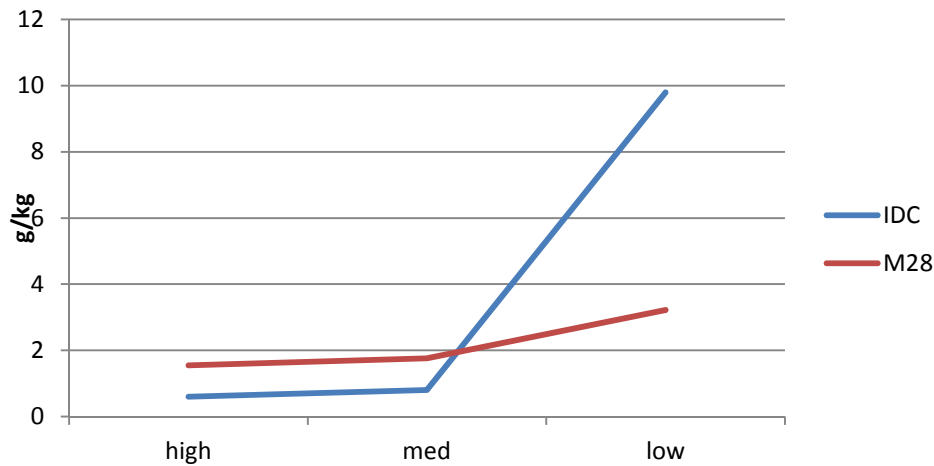


IDC Protocol by Stove g/hr (no#5)

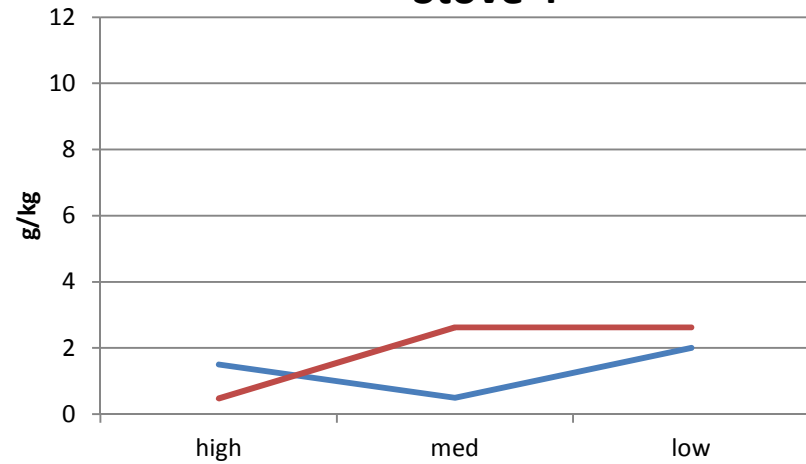


M28 vs. IDC Emission Rates Non-Catalytic Stoves (kg/hr)

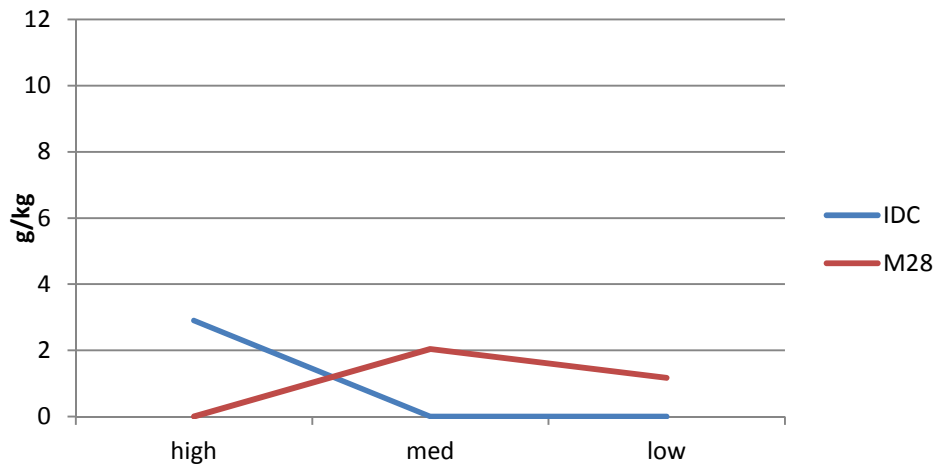
Stove 1



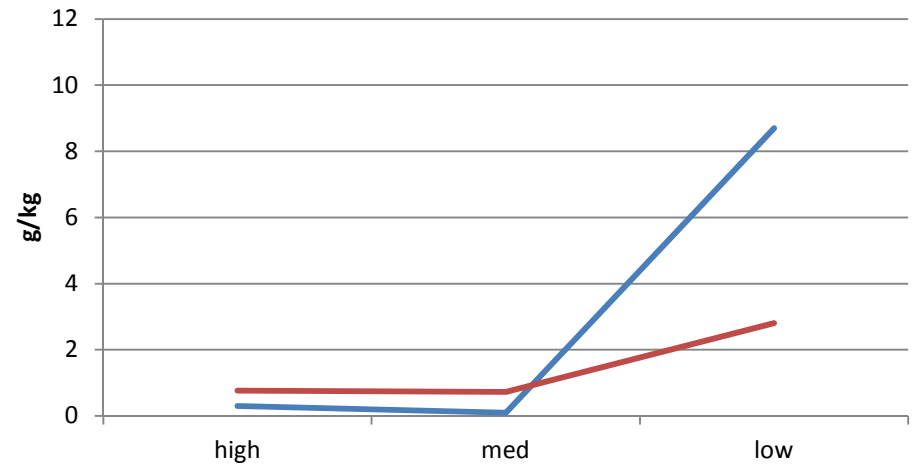
Stove 4



Stove 5

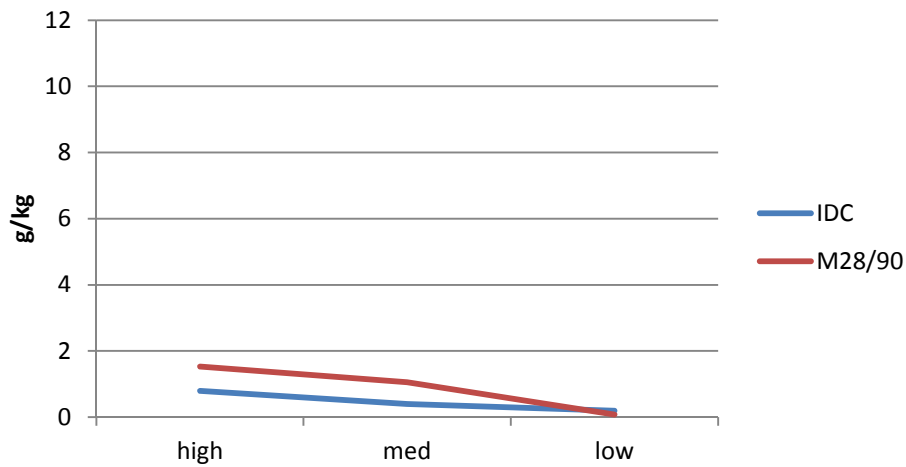


Stove 6

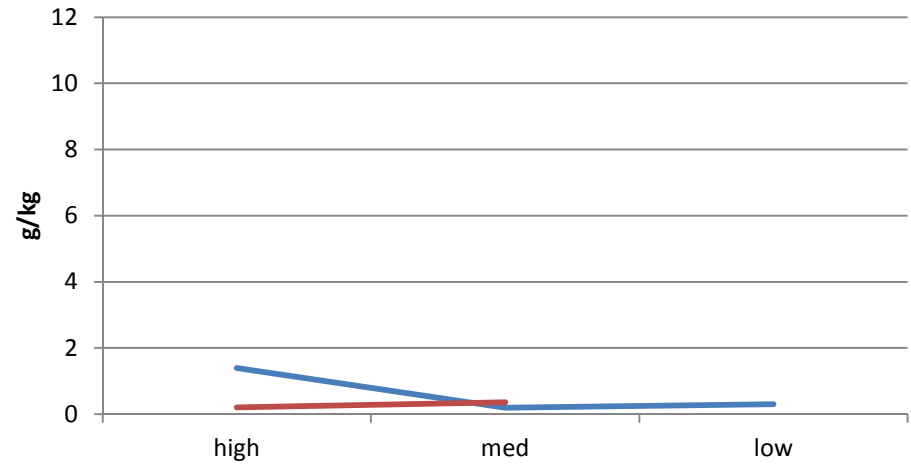


M28 vs. IDC Burn Rates Catalytic Stoves (kg/hr)

Stove 2



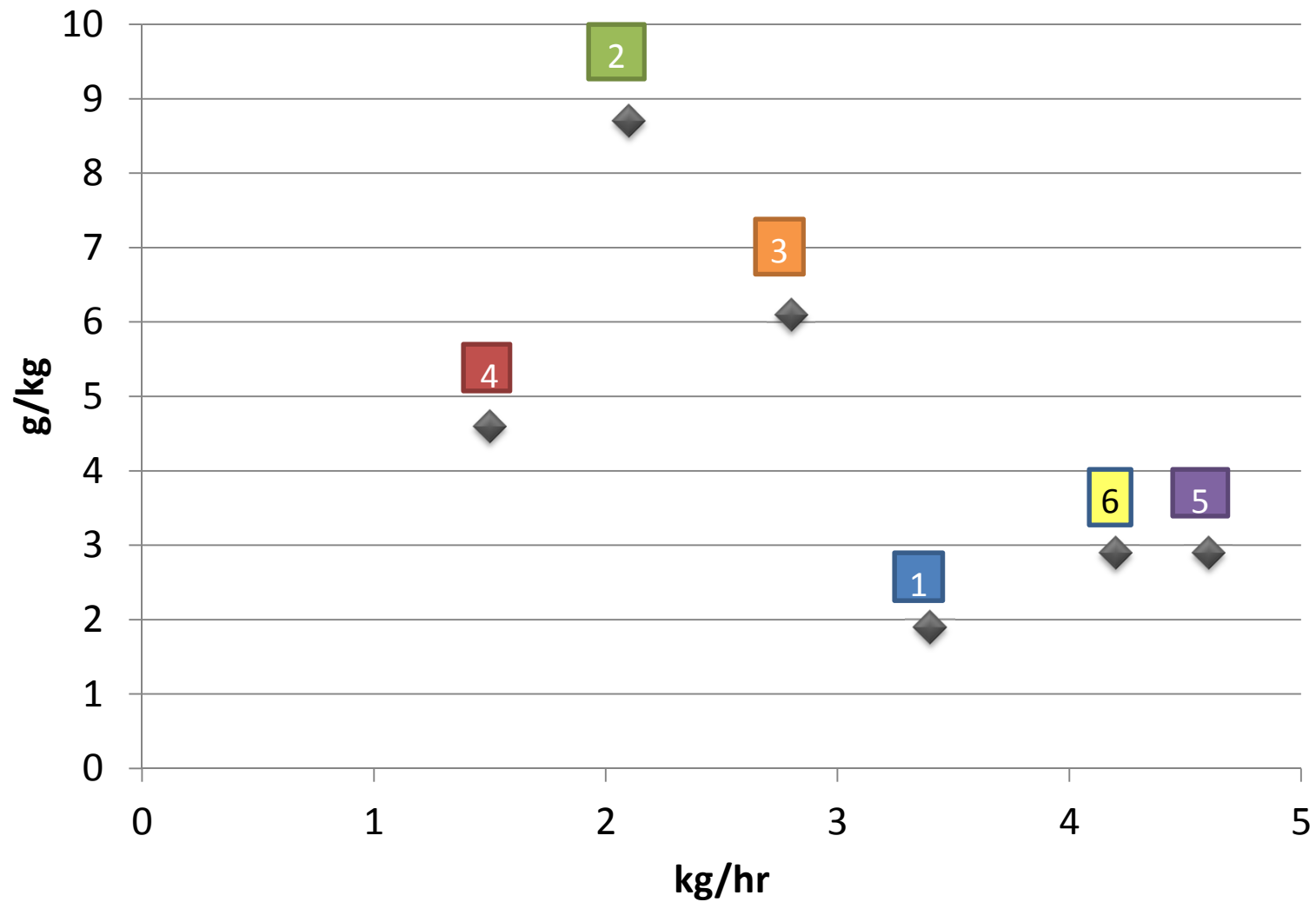
Stove 3



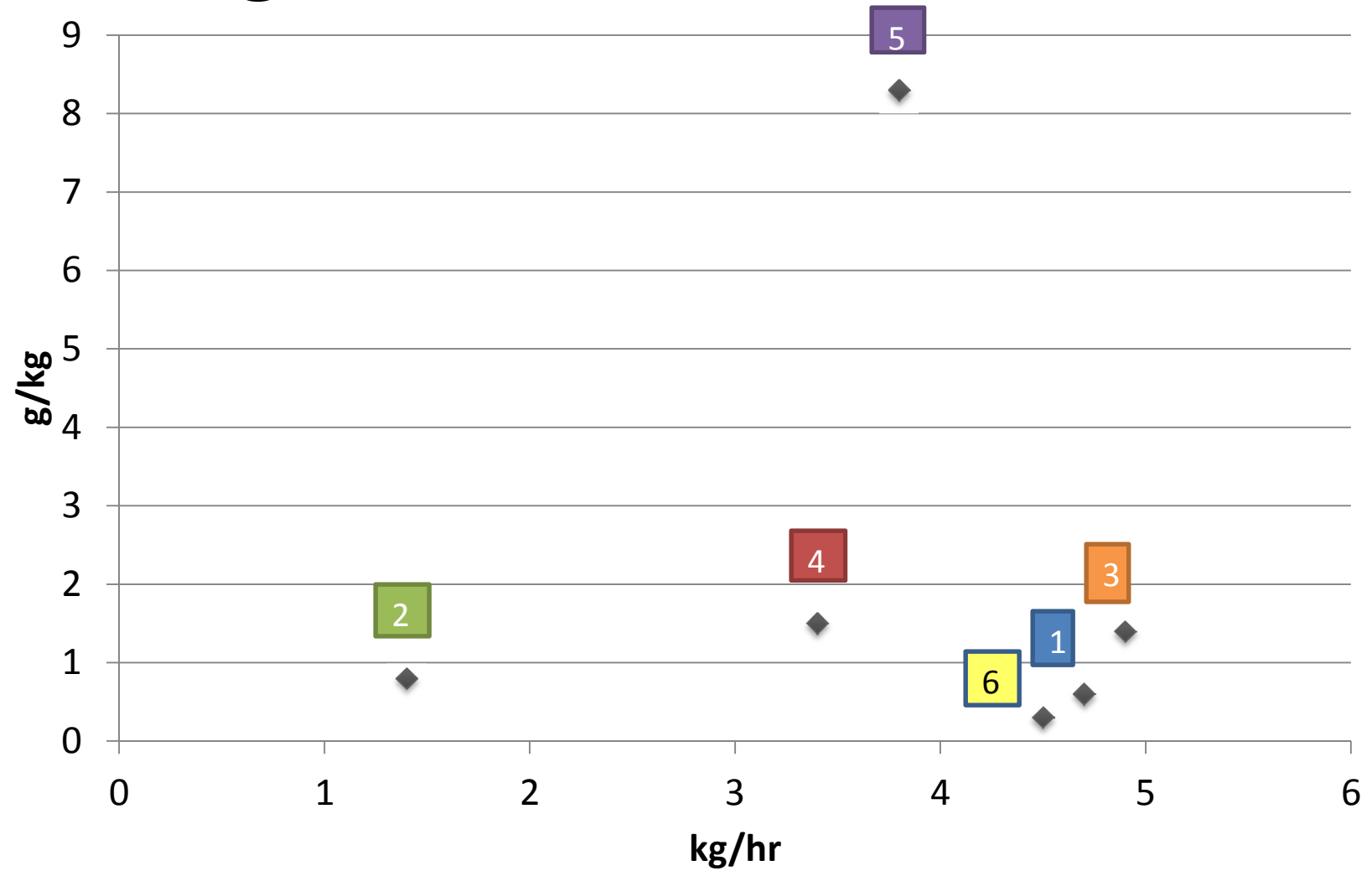
3/3/2018

BURN RATE /EMISSION FACTOR ANALYSIS

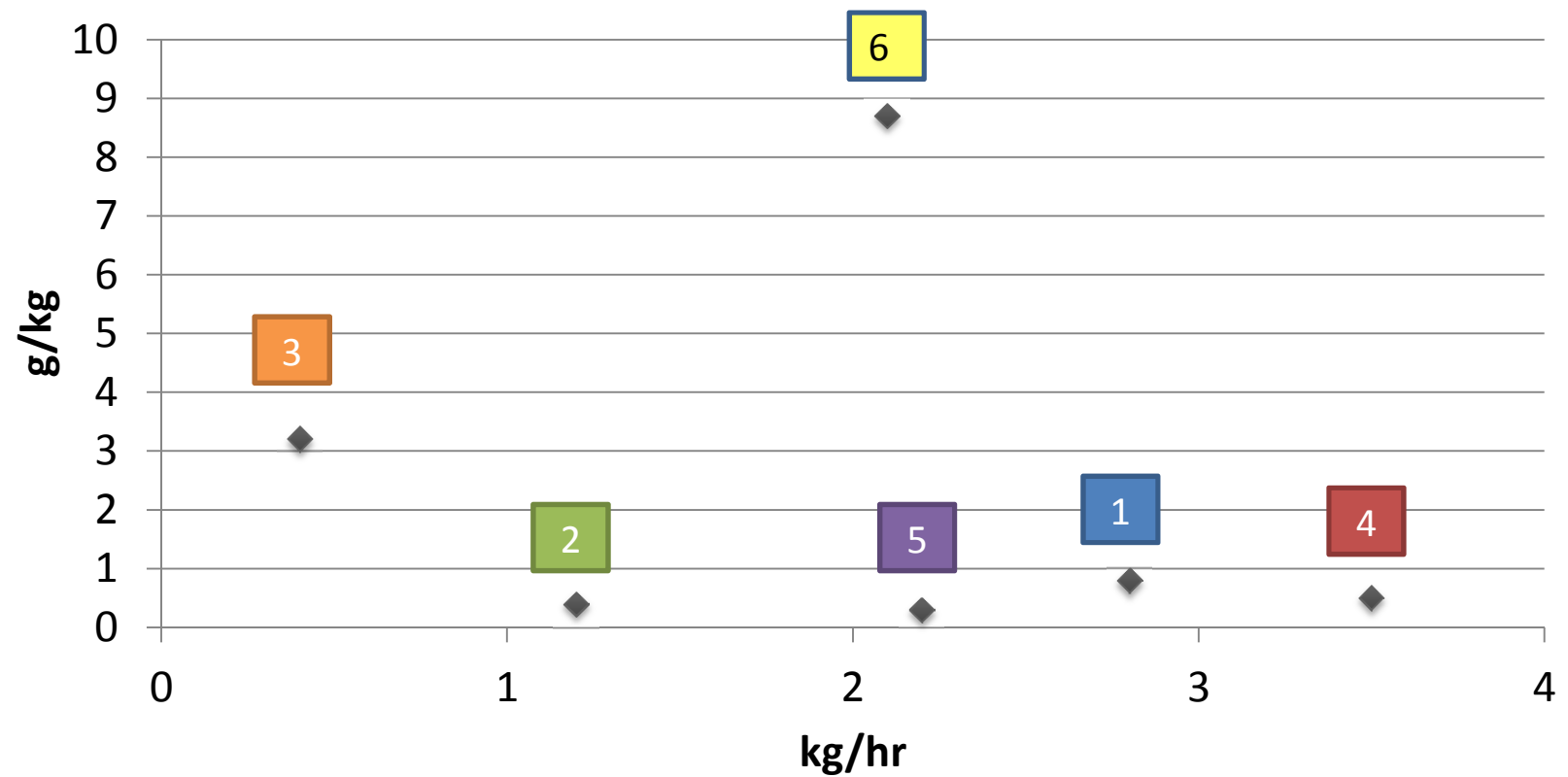
Start-Up Phase – IDC Runs



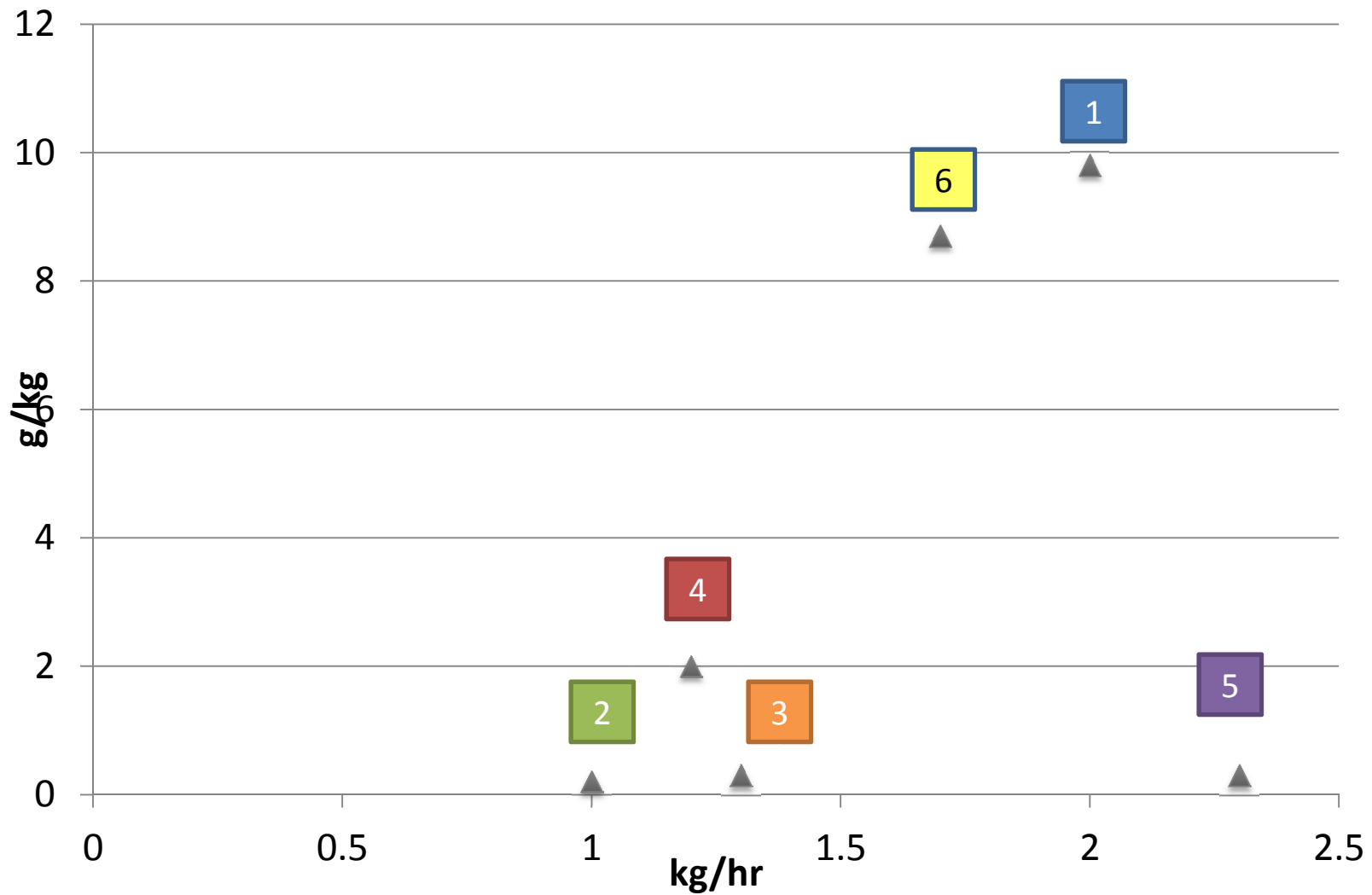
High Fire Phase – IDC Runs



Medium Air Phase – IDC Runs



Low Air Phase – IDC Runs



3/3/18

START-UP ANALYSIS

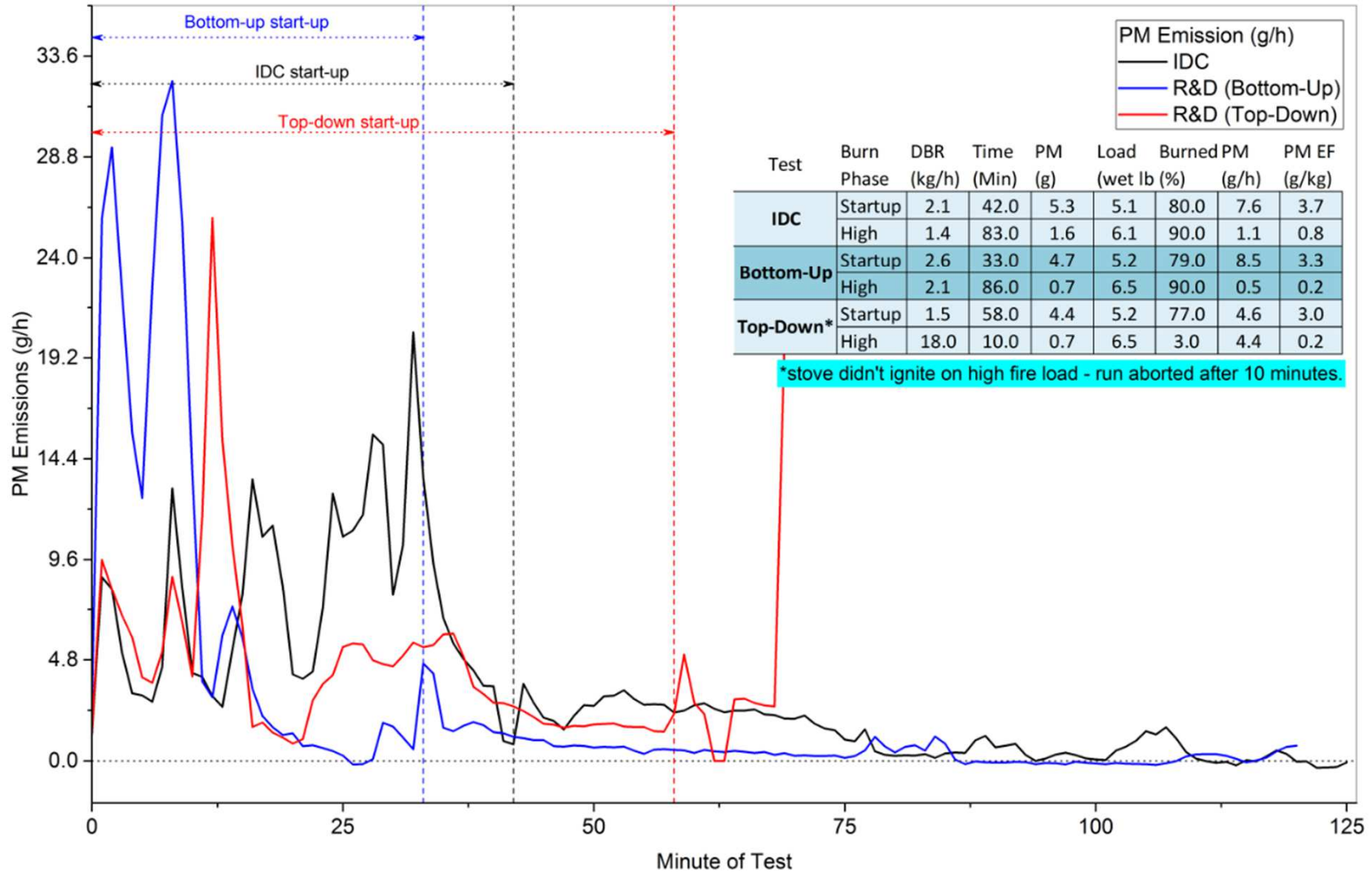
Bottom Up Start-up Load
March 1, 2018



Stove 2 – Top Down
start-up Load 2/27



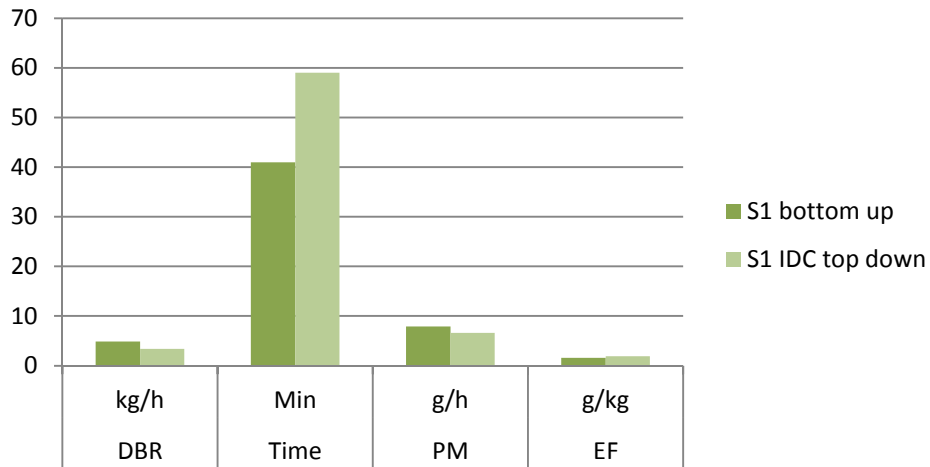
Stove 2: PM Emissions - IDC (1/24/18) vs Bottom-Up (2/27/18) vs Top-Down* (2/28/18)



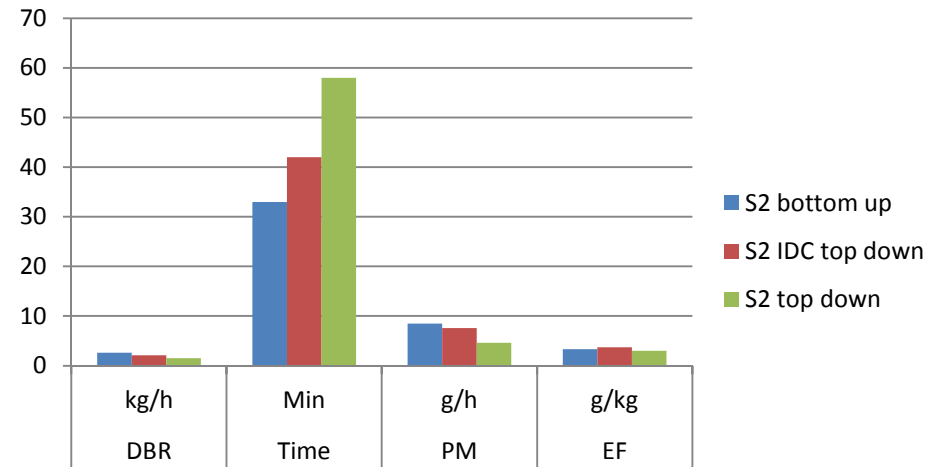
* Real-time PM Measurements obtained with Teom. On average Teom measurements are 10% less than filter measurements.

Comparison of SU Test Runs

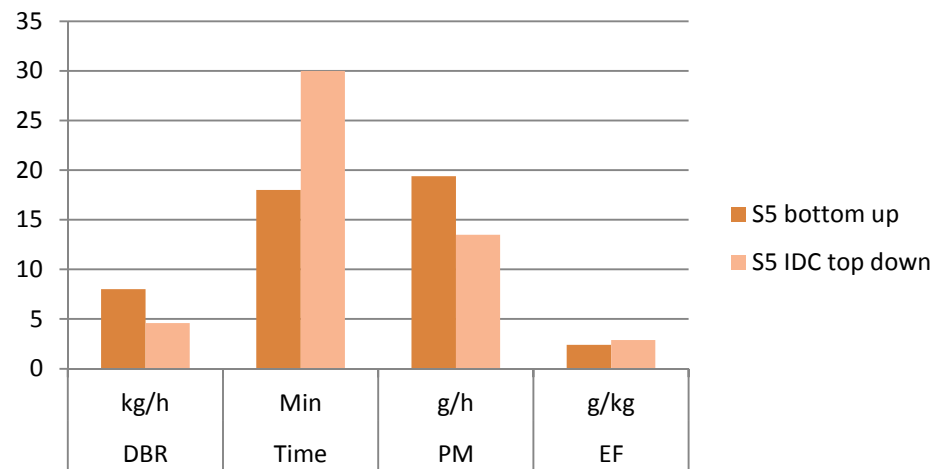
Stove 1



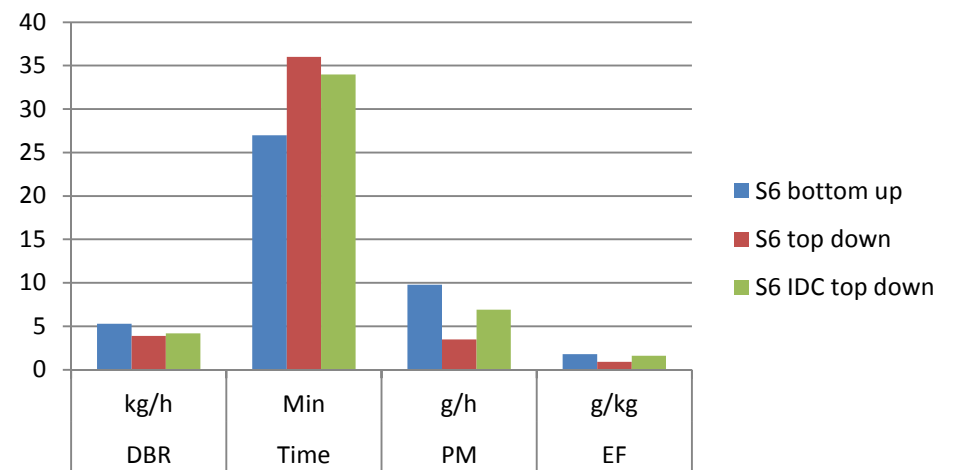
Stove 2



Stove 5

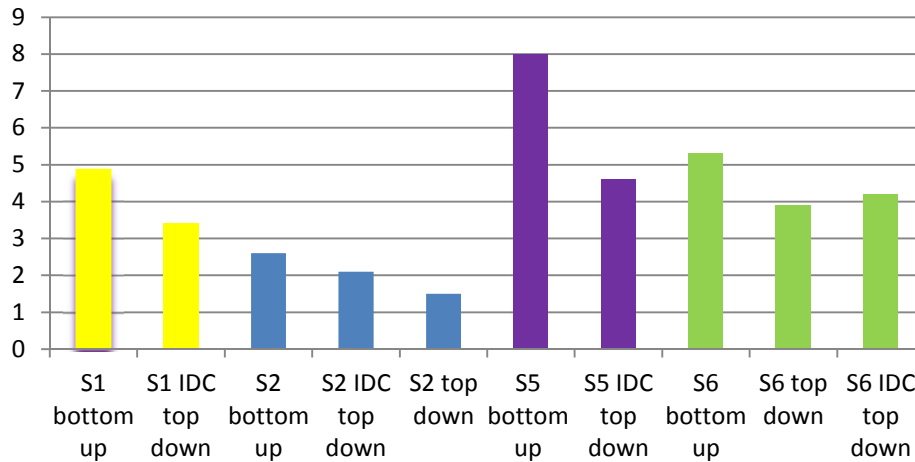


Stove 6

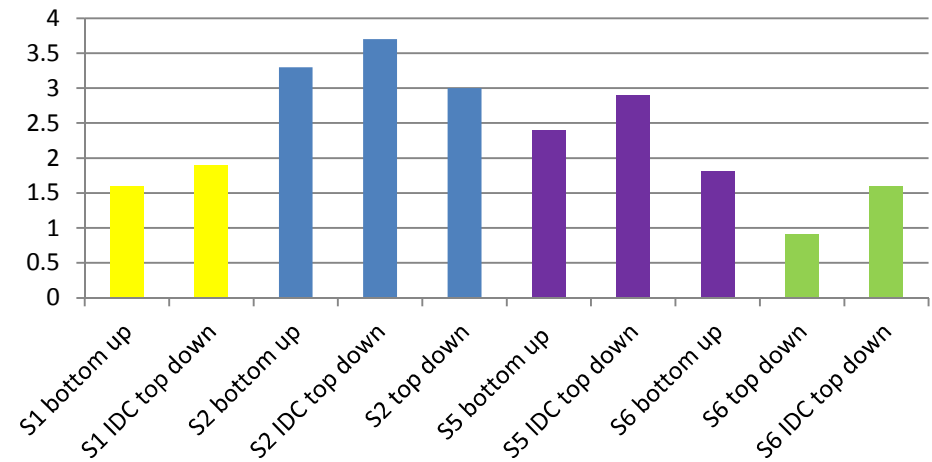


Comparison of SU Test Runs

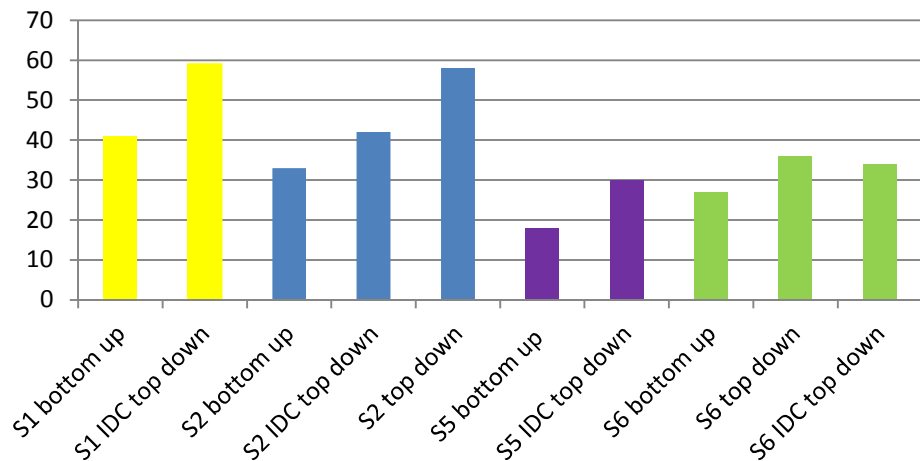
DBR kg/h



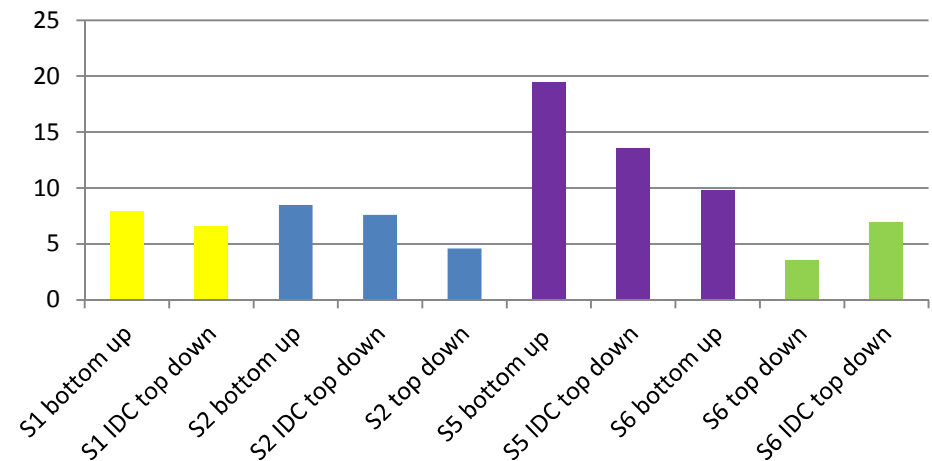
EF g/kg



Time Min



PM g/h



3/3/2018

IMPACT OF INCREASING HIGH FIRE LOAD

Changing High Fire Fuel Load

Full IDC load – HF at 5lbs/ft³

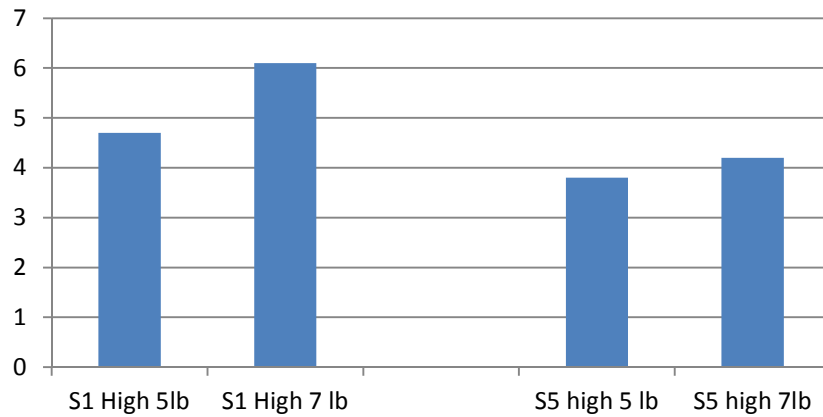


Start-up and HF load at 7lbs/ft³

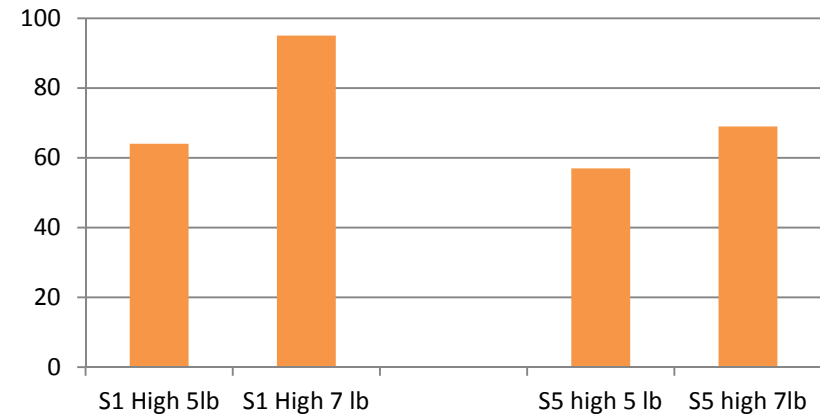


Impact of Increasing High Fire Load

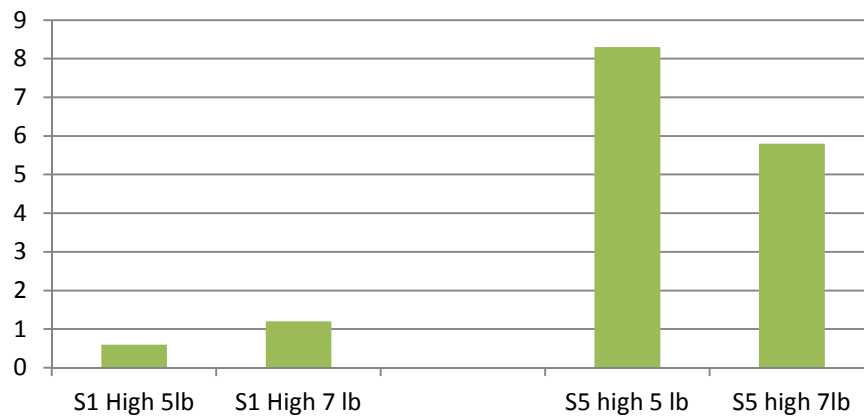
kg/h



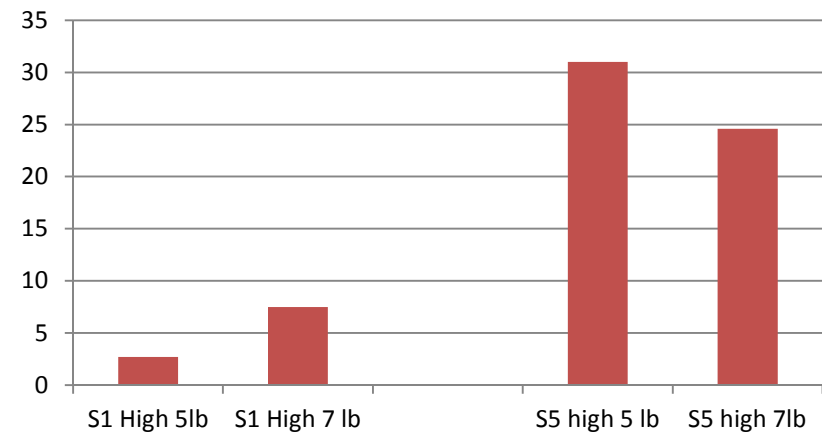
Min



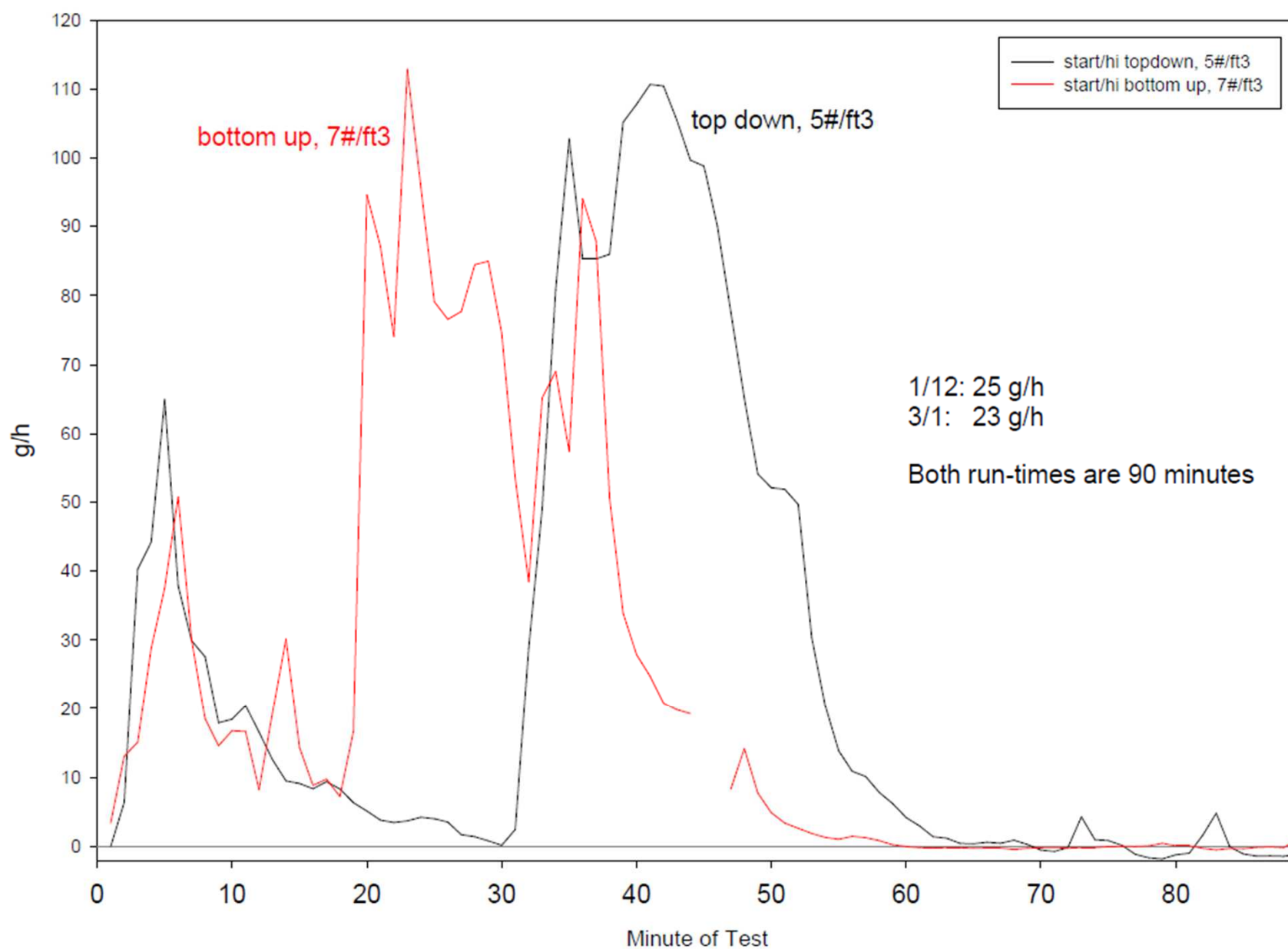
g/kg



g/h



Stove 5, Startup and Hi Fire, Jan. 12 (IDC) and March 2 (R&D)



Discussion/Next Steps