Ensuring Representative Conditions for Performance Testing

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Objectives

Using Standard Deviation to Determine Representative Conditions

- Case Studies - Representative conditions in the Glass Container Industry
- Factors to consider in other industries

Clean Air Act National Stack Testing Guidance

- Final guidance issued September 30, 2005 (copy on CD)
- Applies only to NSPS, NESHAP and MACT but the principles in the guidance should be considered for any testing

The guidance addresses:

- Time frames for conducting stack test
- Stack test waivers
- Stack test notifications
- Observation of stack tests
- **Representative testing conditions**
- Stoppages
- Postponements
- Test reports

Remember This

- The Act requires continuous compliance with emission limits
- NSPS, MACT & NESHAP require that performance tests be conducted at conditions specified by the Administrator
- NSPS & MACT require tests be conducted during representative operating conditions

Representative Conditions

- Performance tests should be performed under those representative (normal) conditions that:
  - Represent the range of combined process and control measure conditions under which the facility expects to operate (regardless of the frequency of the conditions): and
  - Are most likely to challenge the emissions control measures of the facility with regard to meeting the applicable emission standards, but without creating an unsafe condition.

Operating Conditions

- If operating conditions are not indicated by the applicable requirements they should be developed as part of the site-specific test plan.

Operating conditions cont.

- For a facility operating under an emission rate standard (e.g., lb/hr) or concentration standard (e.g., $\mu g/m^3$), normal process operating conditions producing the highest emissions or loading to a control device would generally constitute the most challenging conditions with regard to the emissions standard.

Operating conditions cont.

- For a facility operating under a control or removal efficiency standard (e.g., 98% control or removal of a specified pollutant), lower emissions loading at the inlet of a control device within the range of expected process operating conditions may be the most challenging.

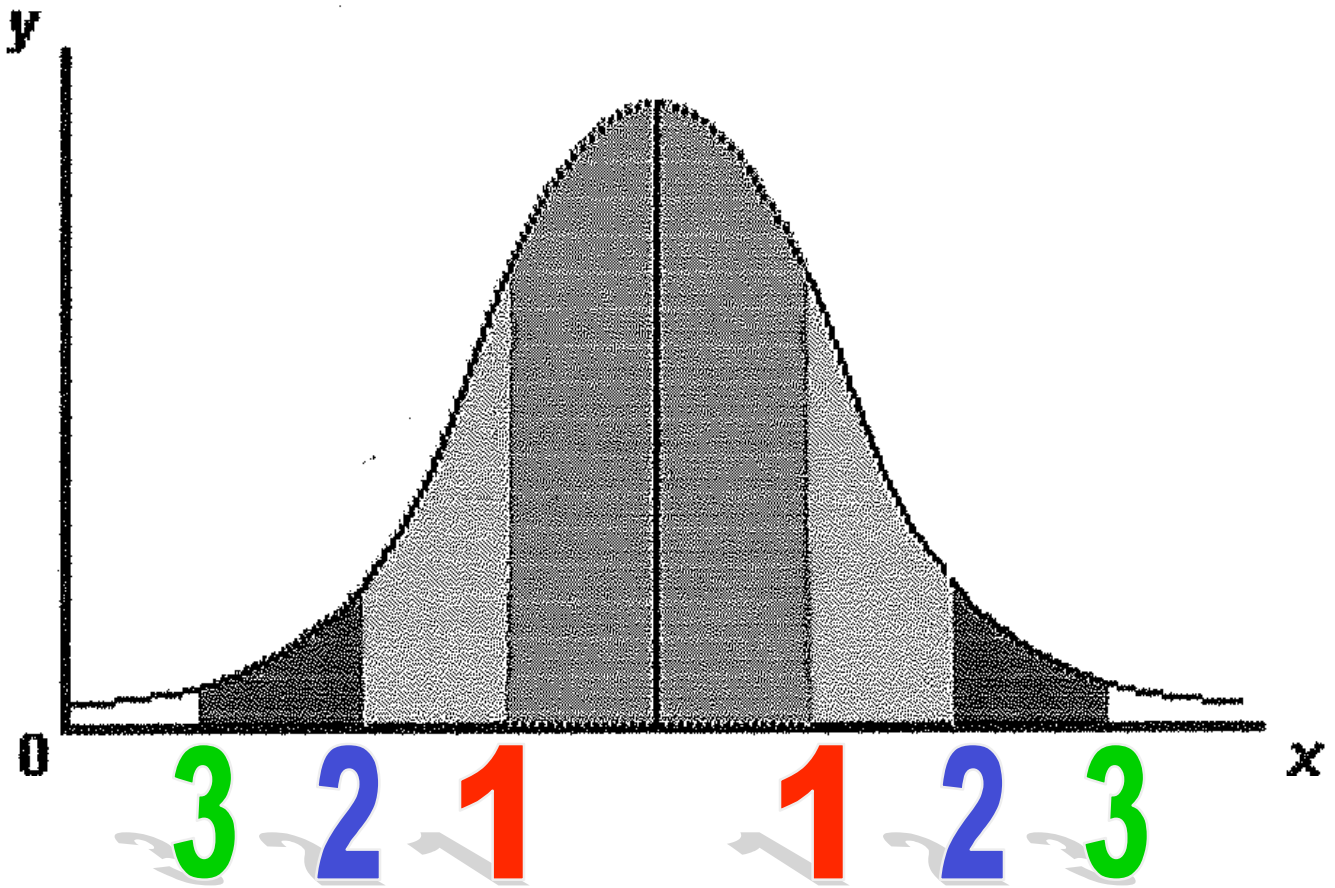
Test plan

- The test plan should generally include the use of fuel, raw materials, and other process/control equipment that the facility expects to use during future operations that would present the greatest challenge in meeting applicable emissions standards.

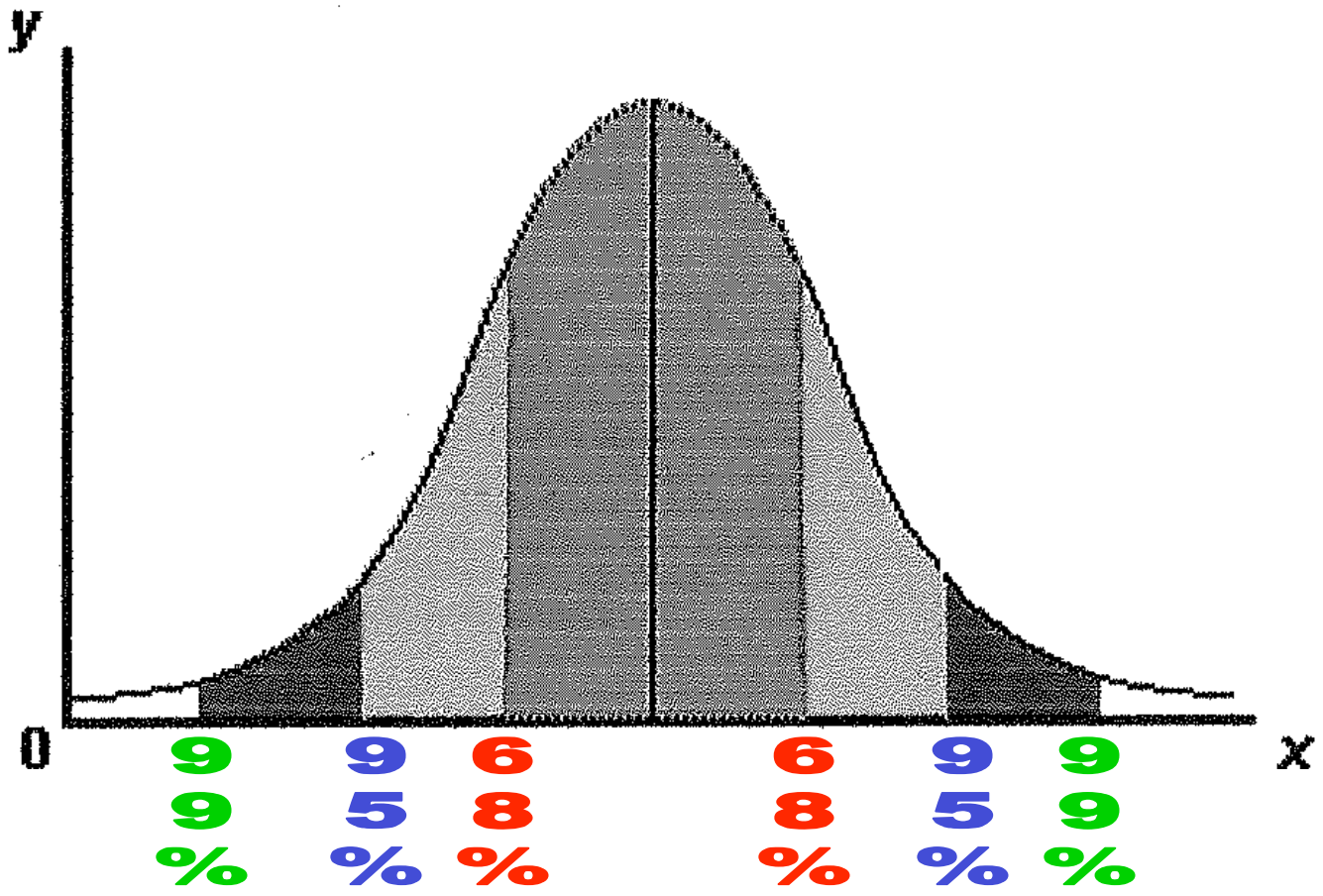
Using Standard Deviation

- “mean of the mean”
- Normal Distribution of data

Graph of Standard Deviation



Standard Deviation as a % of Probability



Standard Deviation cont.

- One Standard Deviation from the mean in both directions accounts for about 68% of the data.
- Two Standard Deviation accounts for about 95%.
- Three Standard Deviations accounts for about 99%.

How to use Standard Deviation

- Collect data
- Use excel to determine standard deviation (tutorial available within the Help menu)
- Compare test data to standard deviation

Calculation

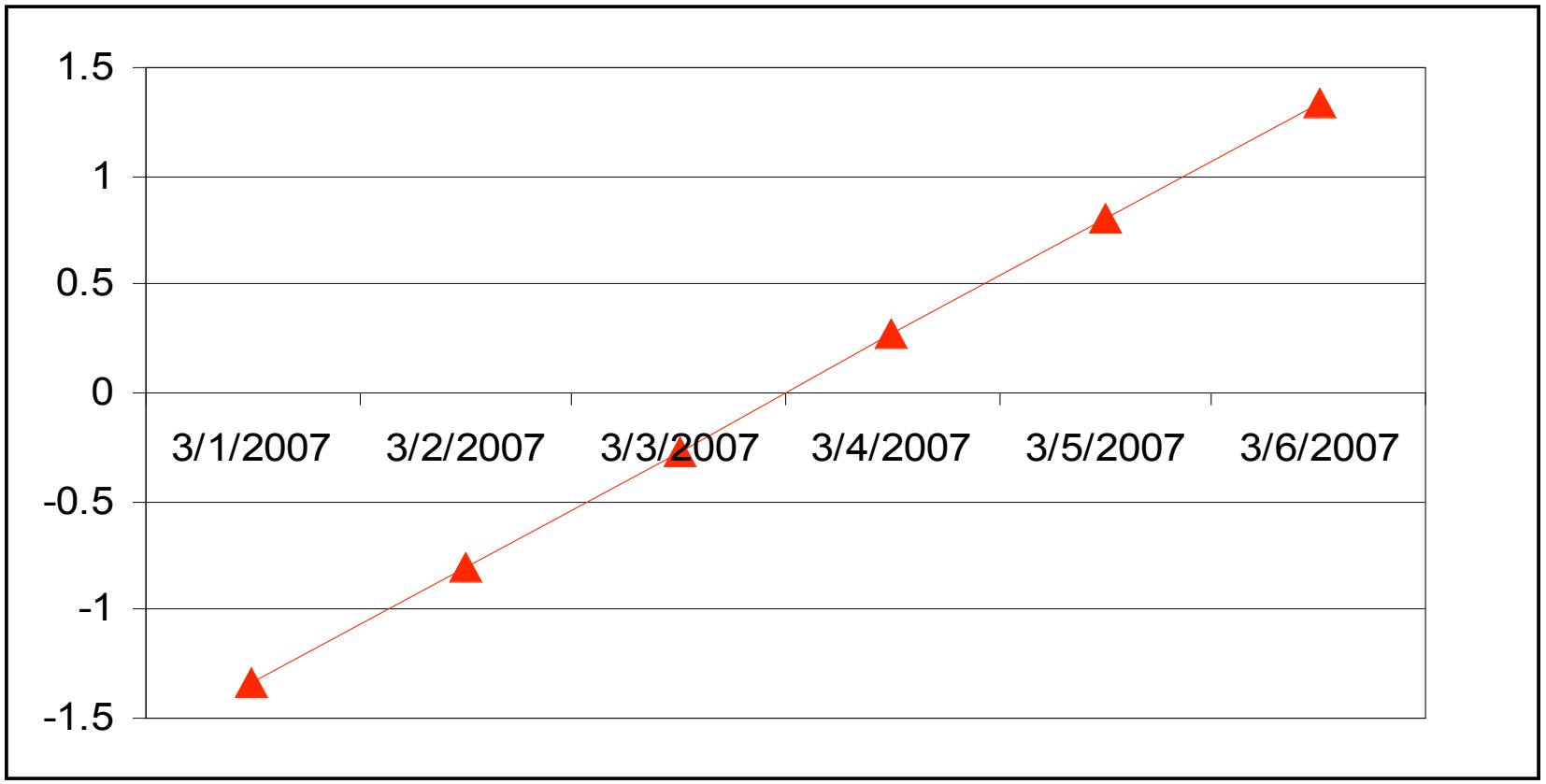
- 1st column is the date
- 2nd column is sample data
- Calculate the mean of the data =Average(x,y)
- Calculate the Standard Deviation =STDEVA(x,y)
- 3rd column is the difference between the sample value and the mean
- 4th column is the 3rd column divided by the standard deviation

Example

Date	Value	Dif. From Mean	
3/1/2007	123	-2.5	-1.33631
3/2/2007	124	-1.5	-0.80178
3/3/2007	125	-0.5	-0.26726
3/4/2007	126	0.5	0.267261
3/5/2007	127	1.5	0.801784
3/6/2007	128	2.5	1.336306

SD	1.870829
Mean	125.5

Example Graph



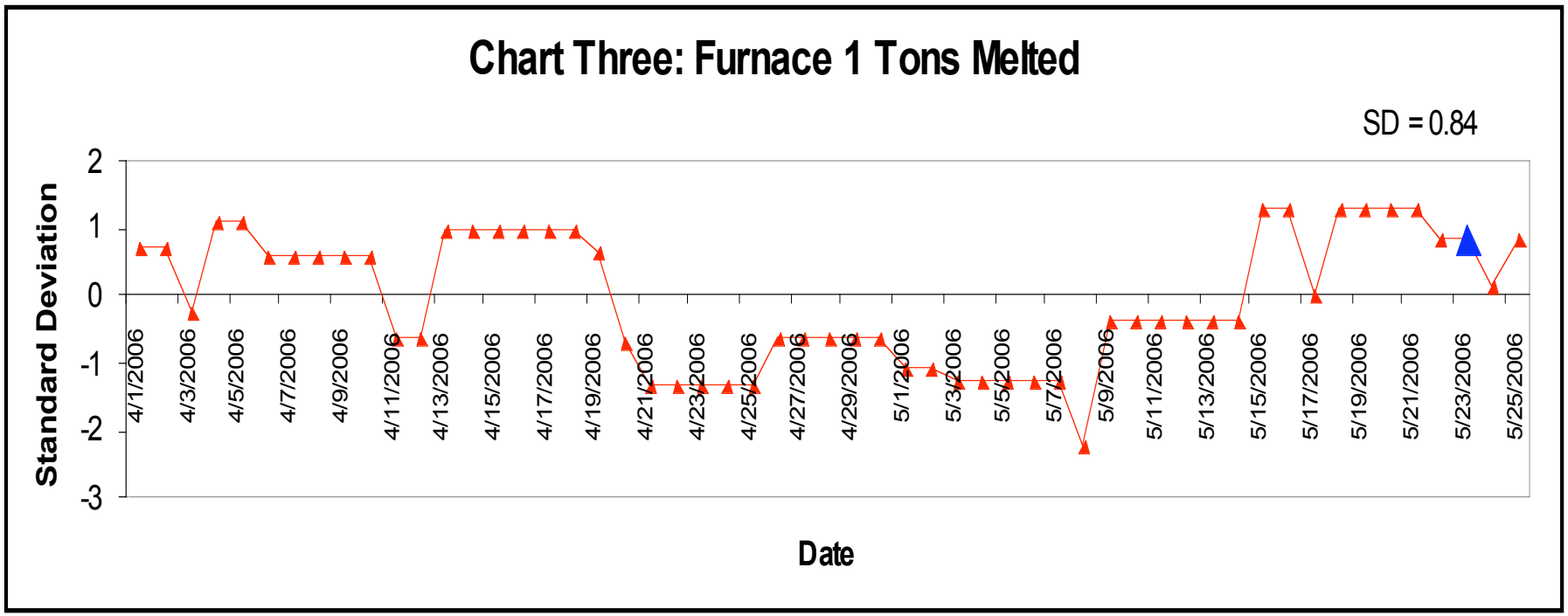
Glass Container Manufacturing

- Factors that affect emissions for the same furnace without design or burner changes
  - **Fuel**
    - **Natural gas**
    - **Electric Boost**
    - Oxygen boost
  - **Glass recipe**
    - Fining agents – Sodium Sulfate
    - **Cullet**
  - **Temperature of melt**
    - **Optical Bridgewall**
  - Age of furnace
  - Production Rate

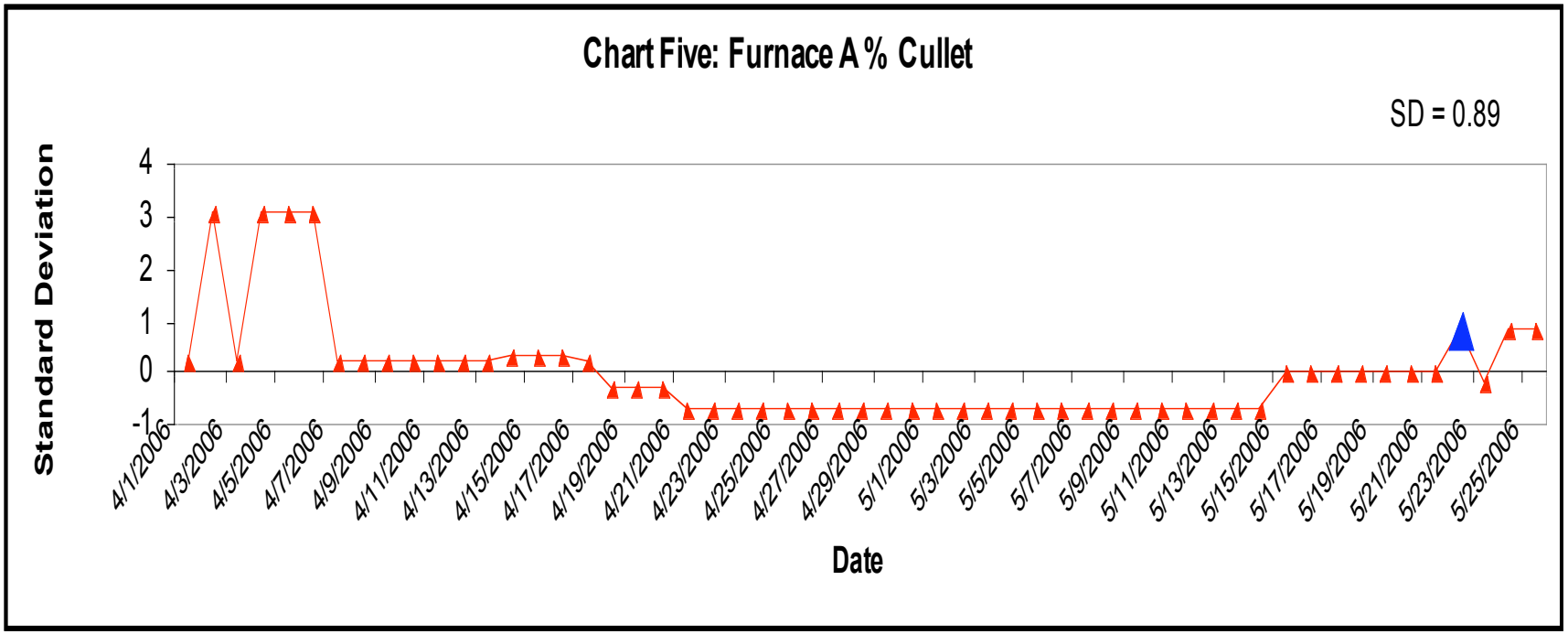
Knights Facility

- Manufactures Container Glass
- Test Date May 23, 2006
- Electric Boost
- Natural Gas
- Oxygen Boost
- Flint and colored glass

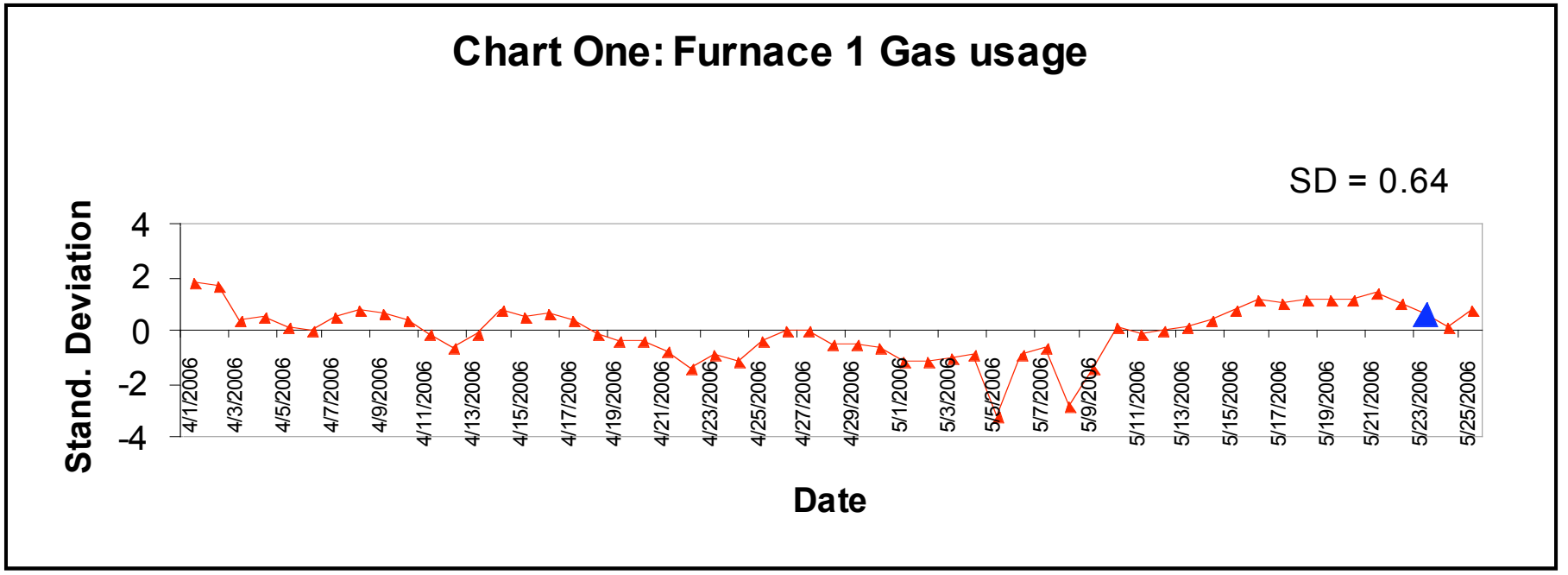
Knights Facility



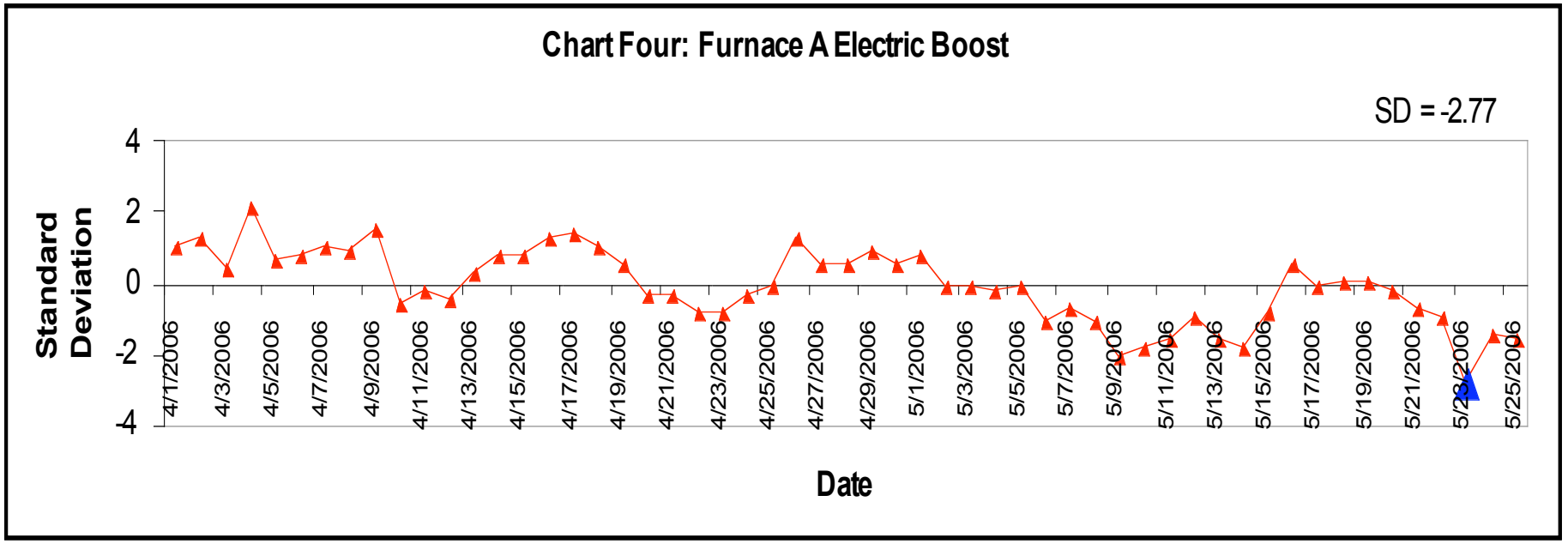
Knights Facility – Cont.



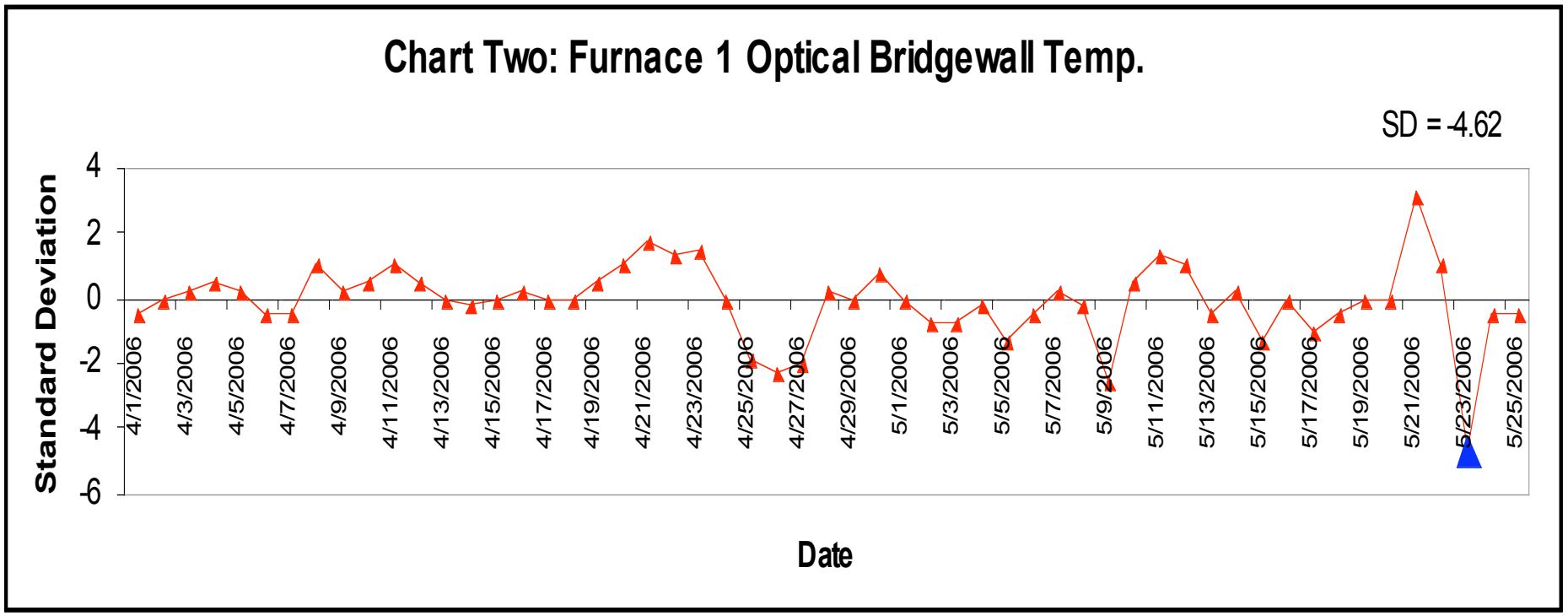
Knights Facility – cont.



Knights Facility – Cont.



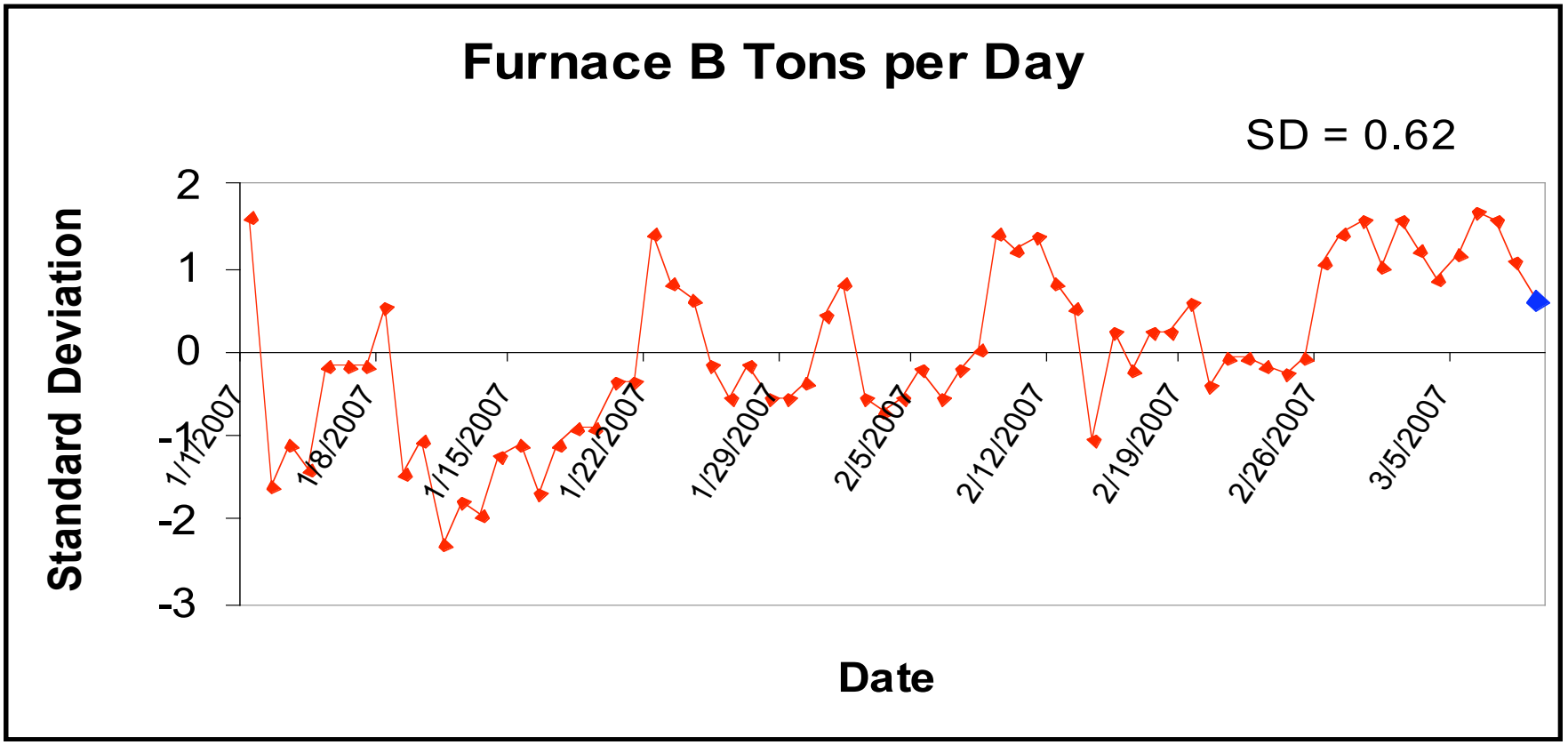
Knights Facility – cont.



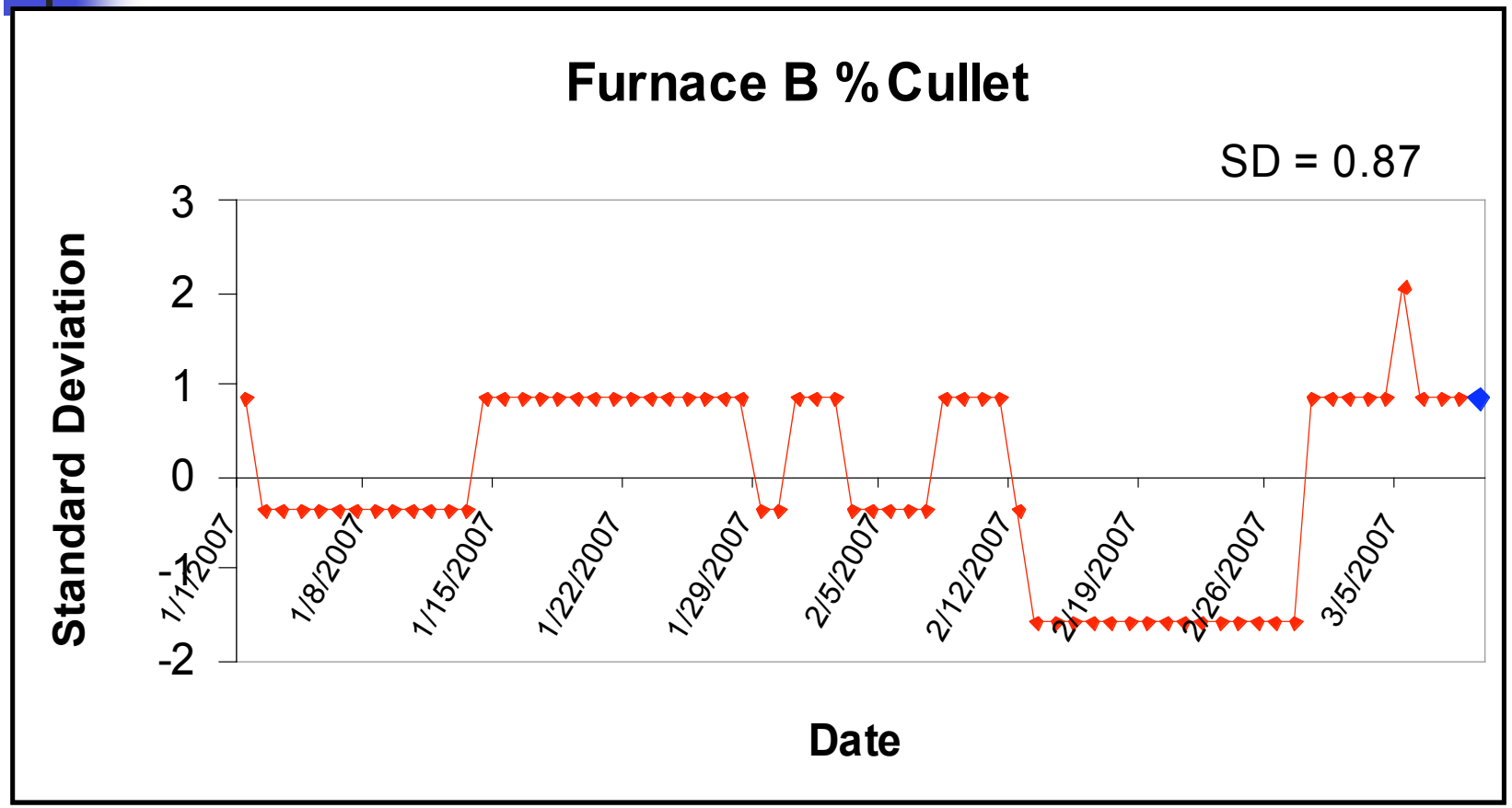
Chieftain Facility

- Glass Container Manufacturing
- Test Dates March 9, 2007
- Flint glass
- Natural Gas
- Optional Oxygen boost

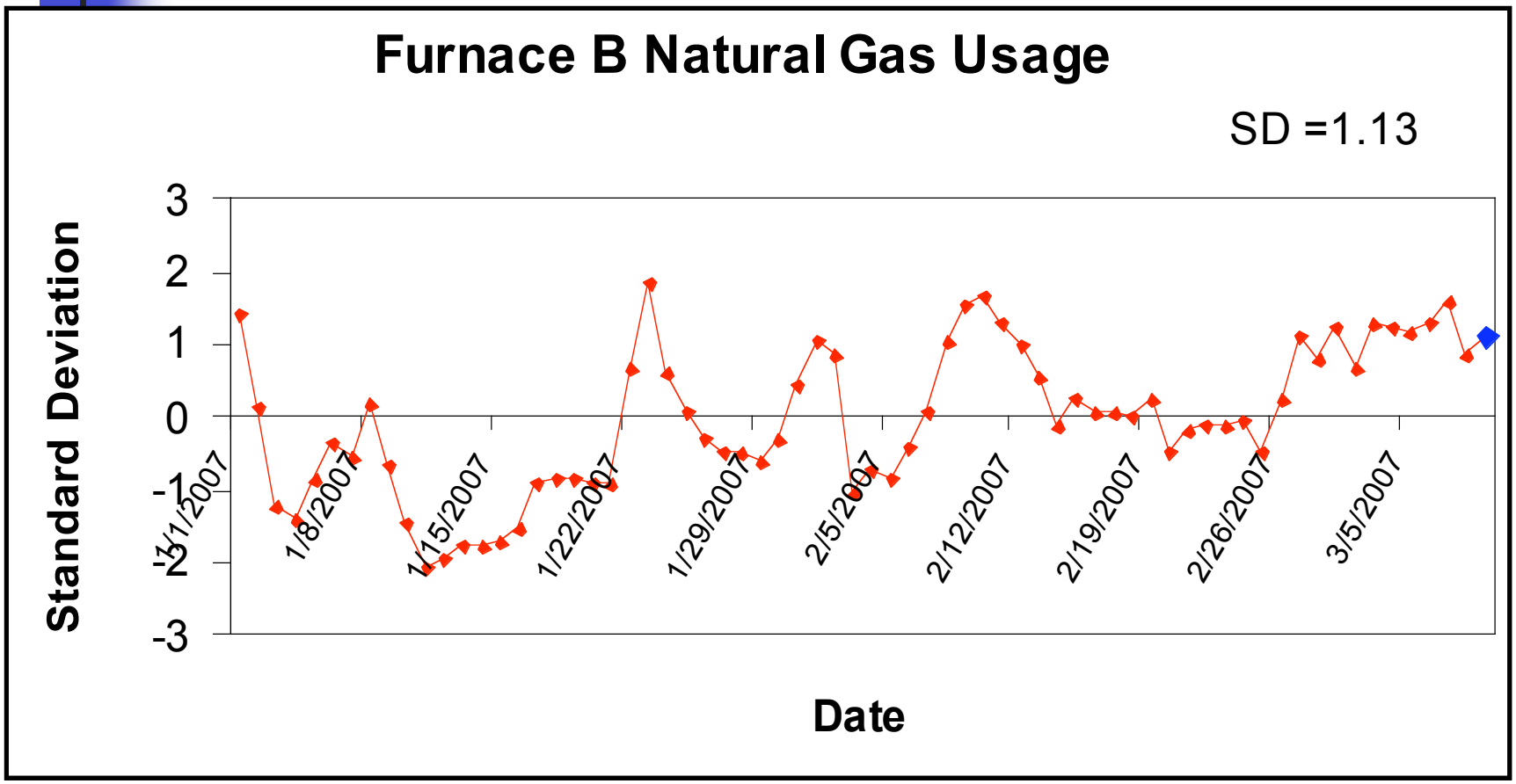
Chieftain Furnace B



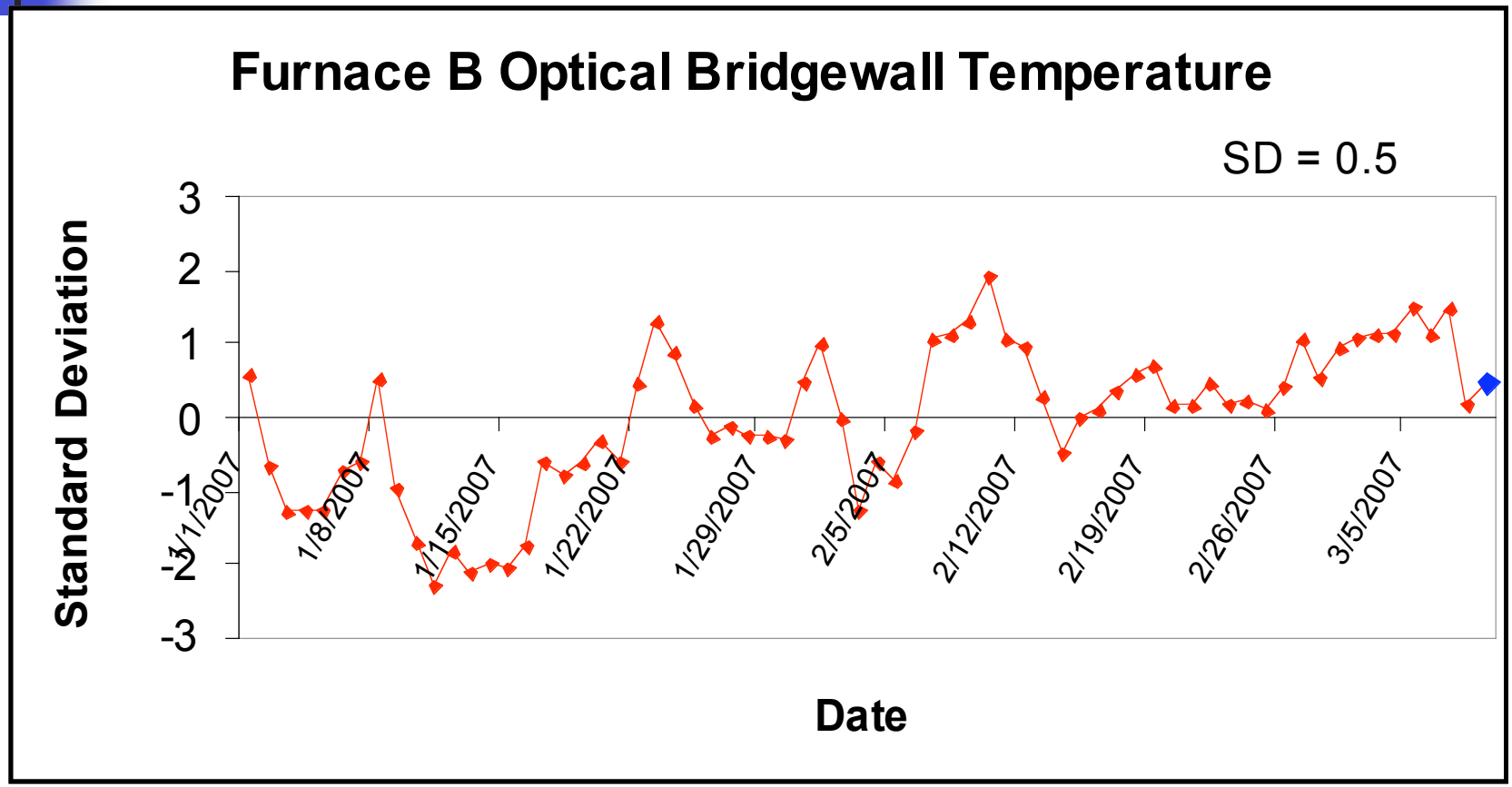
Chieftain Furnace B



Chieftain Furnace B



Chieftain Furnace B



Retesting

- A facility is not required to automatically retest if the initial test does not represent the range of combined process and control measure conditions.
- A facility is not required automatically to retest if the facility's operating conditions subsequently vary from those in place during the performance test.
- The delegated agency must determine whether retesting is warranted; however, in both instances, the facility is responsible for demonstrating continuous compliance.

Lime Kilns

- Recipe
- Fuel
  - Coal
  - Natural gas
- Temperature
- Production Rate

Secondary Aluminum

- Capture efficiency
- Raw materials
- Flux rate and recipe

RTO

- Temperature
- Capture efficiency
- Paint usage

Summary:

- Each test must be evaluated individually
- The inspector has to know or determine what factors are important
- Standard deviation can be used to determine if the test was representative
- If the test is not representative did the deviation cause higher emissions?