Table 2-3
Ash Fusion Temperatures
Laboratory Synthesized Blends

Data Items	Composition, Weight Percents	
	Blend #1	Blend #2
Anthracite Culm	95	95
Limestone	5	2.5
CFB Fly Ash	0	2.5
	Ash Fusion Temperature °F, Reducing Atmosphere	
	Blend #1	Blend #2
Initial Deformation	2,398	2,398
Softening	2,426	2,503
Hemispherical	2,456	2,643
Fluid	2,471	2,696

The as-reported ash compositions from the above data sources were normalized to eliminate undefined ash components before applying the WR correlations to calculate the IT and AFFT.

2.1.2.2 Correlation Assessment and Accuracy

To evaluate the accuracy of the two WR correlations, ash fusion temperatures are calculated using the WR correlations, and then are compared with ash fusion temperature data measured by ASTM Test D-1857. As a comment on the limits of accuracy, the ASTM D-1857 test for ash fusion temperatures under reducing atmosphere has the following inherent accuracy limits:

	Repeatability °F (Same Laboratory)	Reproducibility °F (Different Laboratory)
IT = Initial Deformation Temperature	+/- 50	+/- 125
ST = Softening Temperature	+/- 50	+/- 100
HT = Hemispherical Temperature	+/- 50	+/- 100
AFFT = Fluid Temperature	+/- 50	+/- 150

For comparisons of the laboratory ash fusion temperature data ($AFFT_m$) and the values calculated by the correlations ($AFFT_p$), simple bar graphs are presented to visually display the information. The graphs also show lines for a band plus 150° F and minus 150° F on each side of the laboratory data. These two lines also bracket the inherent reproducibility limits of ASTM D-1857.

In addition to the graphs, the comparison of the correlations and actual data are reported in average deviations and in standard deviations. The deviations are defined below.

$$\text{Average Deviation} = \{ {}_1\Sigma^n \, AFFT_p(i) - AFFT_m(i) \} / n$$

and

$$\text{Standard Deviation} = \{ {}_1\Sigma^n \, [(AFFT_p(i) - AFFT_m(i)]^2 \} / (n - 1)$$

Pennsylvania Coals

To review the correlation methodology, ash fusion fluid temperatures estimated by the WR correlations are compared with the temperatures reported for coals from large deposits in Pennsylvania. The Pennsylvania coal data is from the "Elemental Composition and Fusibility of Ash of Large Deposits of US Coals" section of DOE's "Coal Conversion Systems Technical Data Book". Figure 2-4 compares the direct WR $AFFT_1$ correlation values with the laboratory measurements for Pennsylvania coals listed in the DOE publication. The average deviation is –186° F and the standard deviation is 214° F. As evident in the figure and by the large negative average deviation, the direct WR $AFFT_1$ correlation tends to underestimate the ash fluid temperature compared to measured values.

Figure 2-4
Comparison of Direct WR Correlations and Measured Pennsylvania Coal Data

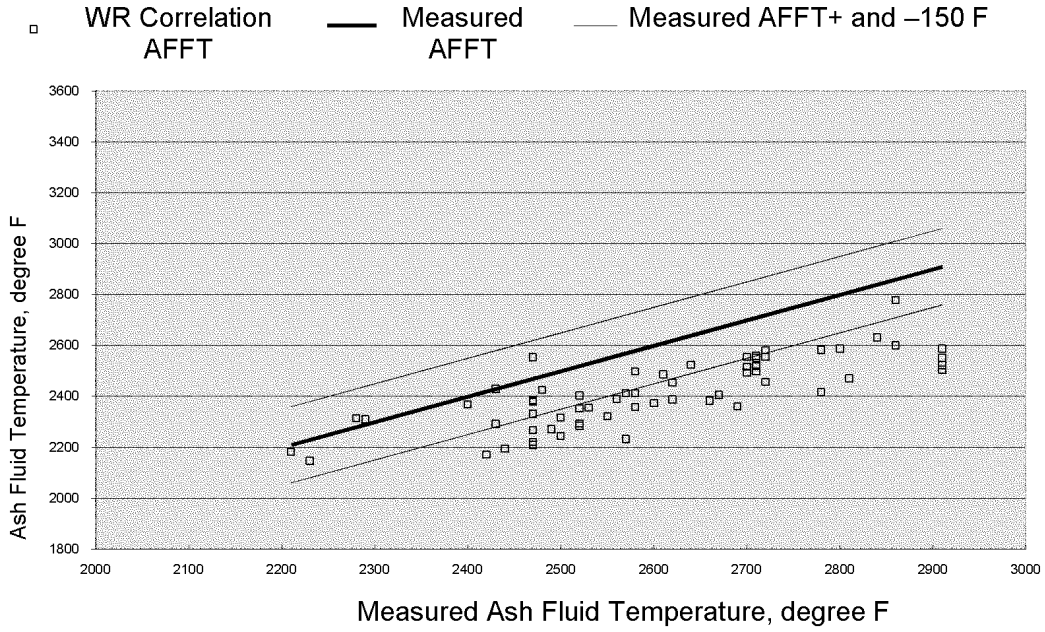
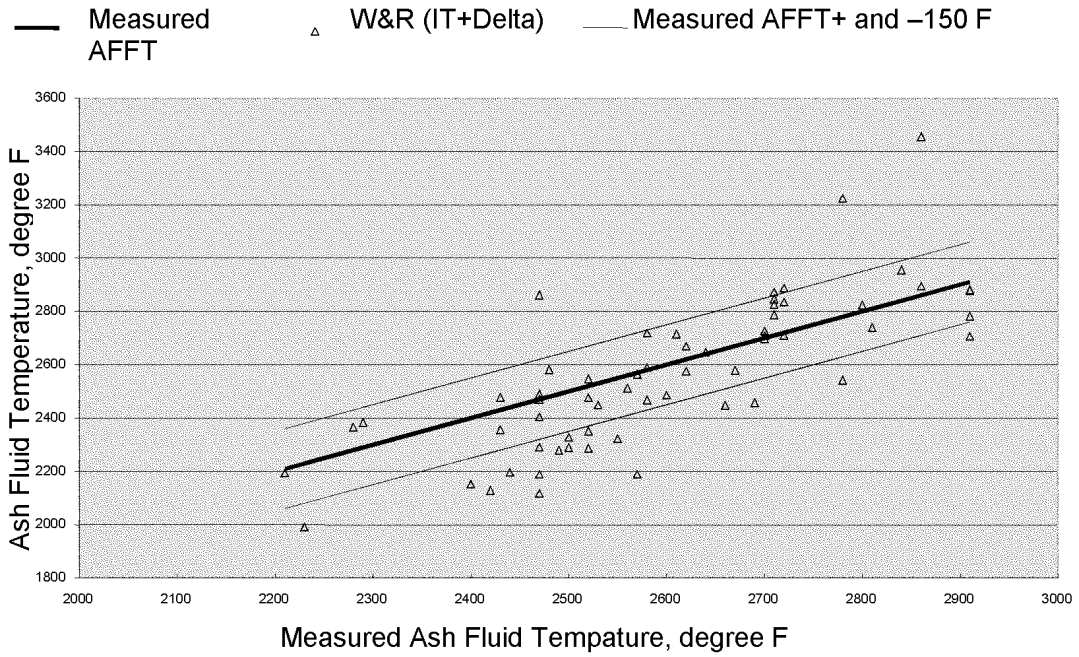


Figure 2-5 compares the indirect WR $AFFT_2$ correlation against the measured AFFT values. The average deviation is –36° F and the standard deviation is 185° F. As shown in Figure 2-4, the indirect WR $AFFT_2$ predictions appear more scattered than the direct WR $AFFT_1$ correlations. The negative average deviation indicates that the indirect WR $AFFT_2$ correlation also tends to underestimate the ash fluid temperatures, but not by as much as the direct WR $AFFT_1$.

Figure 2-5
Comparison of Indirect WR Correlations and Measured Pennsylvania Coal Data



Ideally, the direct WR $AFFT_1$ correlation and the indirect WR $AFFT_2$ correlation should give the same estimates since both were regressed from the one set of data. But the figures show they are somewhat different. As a compromise, averages of the two estimates (AFFTavg = ($AFFT_1$ + $AFFT_2$) / 2) were also plotted. Figure 2-6 compares the average WR estimates of AFFT against the measured AFFT. The average deviation in this case is -111° F and the standard deviation is 168° F. As shown in Figure 2-6, the averages of the $AFFT_1$ and $AFFT_2$ estimates are less scattered than the indirect WR $AFFT_2$ predictions. The negative average deviation shows that the average correlation value still underestimates the measured ash fluid temperatures.