Collaborative Testing Services
Fasteners & Metals Program
Chemical Analysis Overall Flag System

The criteria used to assign an **Action Item** to laboratory results in the chemical tests are different from those in the other tests. These criteria do not introduce any new concepts; rather they combine elements from the existing analysis in a manner that effectively reduces the number of Action Items assigned in the chemical tests. CTS has chosen to apply these different criteria to provide laboratories with a better tool for making decisions on their chemical data.

An **Action Item** will now be assigned to results that have an **"X" Overall Flag**. Overall Flag is a term unique to the chemical analysis tests in the Metals Program. An "X" Overall Flag is only assigned when two criteria have been met.

1. The results must have an "X" Data Flag (results fall outside the 99% T^2 control ellipse)
2. The Lab Mean or Within Sample Variation of either sample must be significantly different from the group.

An "*" Overall Flag is assigned in the following circumstances:

1. The results have an "X" Data Flag (results fall outside the 99% T^2 control ellipse) but whose Lab Mean and Within Sample Variation of both samples are not significantly different from the group.
2. The results have an "*" Data Flag (results fall outside the 95%, but within the 99%, T^2 control ellipse) but whose Lab Mean and Within Sample Variation of either sample are significantly different from the group.

The Overall Flag may be represented by the following formulae:

> "X" *Overall Flag = "X" Data Flag + CPV Flag and/or K Flag*
> *"*" Overall Flag = "X" Data Flag + No CPV Flag and No K Flag OR "*" Data Flag + CPV Flag and/or K Flag*
> *Key: CPV Flag means that the CPV (Comparative Performance Value) of either Lab Mean is greater than the critical limit and K Flag means that the variation within a Lab Mean is greater than the critical limit.*

The CPV values, the K values, and the critical limits are calculated according to the ASTM E691-16 "Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method". CPV in the CTS program is equivalent to "h" statistic in ASTM E691. The critical values for CPV depend on the number of participating laboratories while those of the K Values depend both on the number of laboratories, and on the number of replicate test results per laboratory per sample. The critical limits as well as the K values are not shown in the CTS reports.

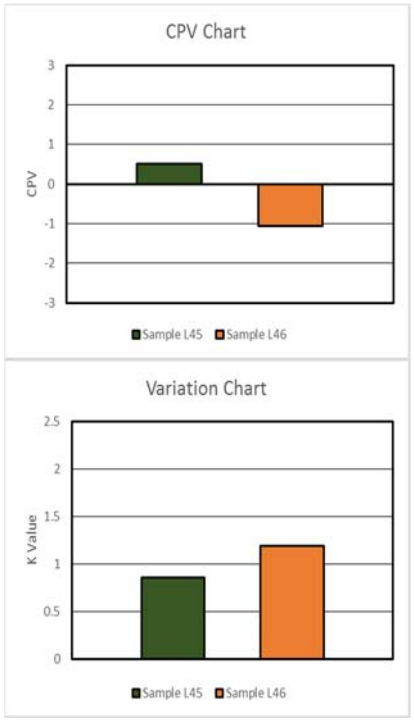
The following pages show a few examples of how the more nuanced Overall Flags are assigned. Prior to that, we can consider the two most basic cases. First, if the laboratory's results have no flags assigned (No Data Flag, No CPV Flags, No K Flags), no Overall Flag is given and the results are considered to agree well with the other participants. Second, if a laboratory has all three types of flags assigned, an Overall Flag will be shown will be shown with an Action Item. These results are considered significantly different when compared with the other participants.

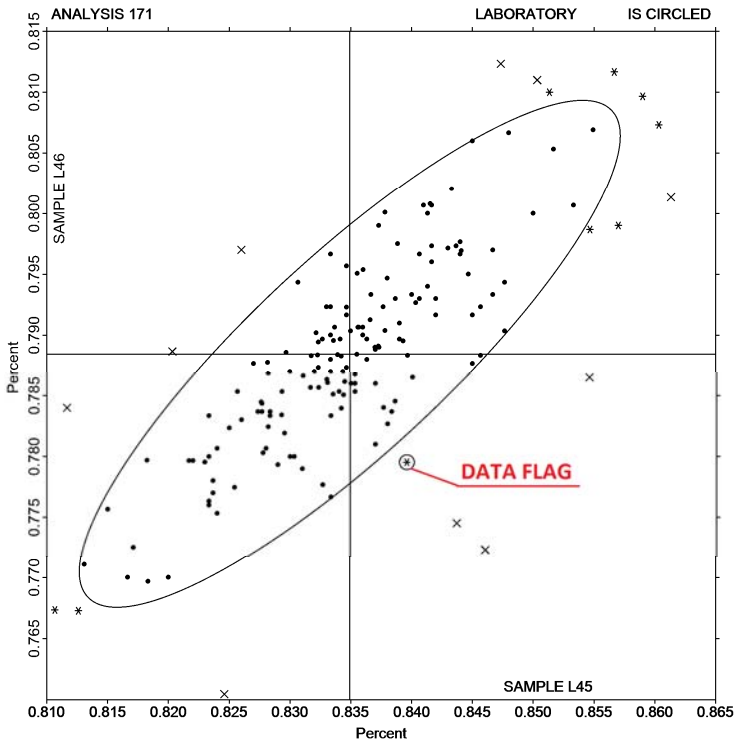
The examples given in the following pages explain the situations when some, but not all, types of flags have been assigned. It is important to remember that the Data Flag is the critical parameter in Overall Flag Assignment. An "X" Data Flag can translate either into an "X" Overall Flag or an "*" Overall Flag. Similarly, an "*" Data Flag can either translate into an "*" Overall Flag or into no Overall Flag. Results that do not have a Data Flag will not have an Overall Flag assigned. The critical limits in these particular examples can be approximated as 2.77 for the CPV charts and 2.29 for the variation charts.

Finally, it must be stated that the Overall Flag does not change the number of included/excluded laboratories and, therefore, has no bearing on the consensus statistics. It is applied only to provide an improved decision making tool for participating laboratories.

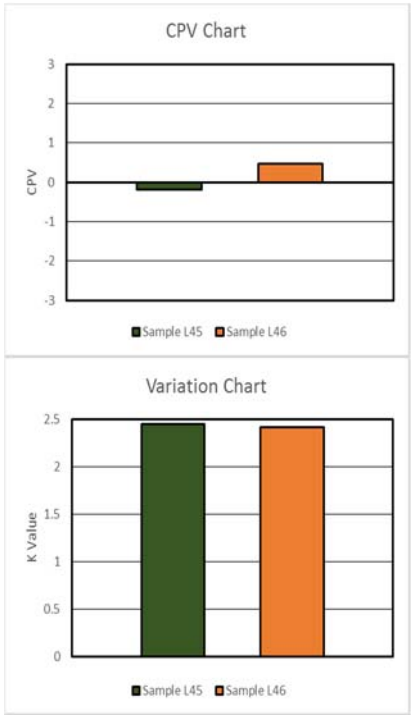
Fasteners & Metals Program
Chemical Analysis Overall Flag System Examples

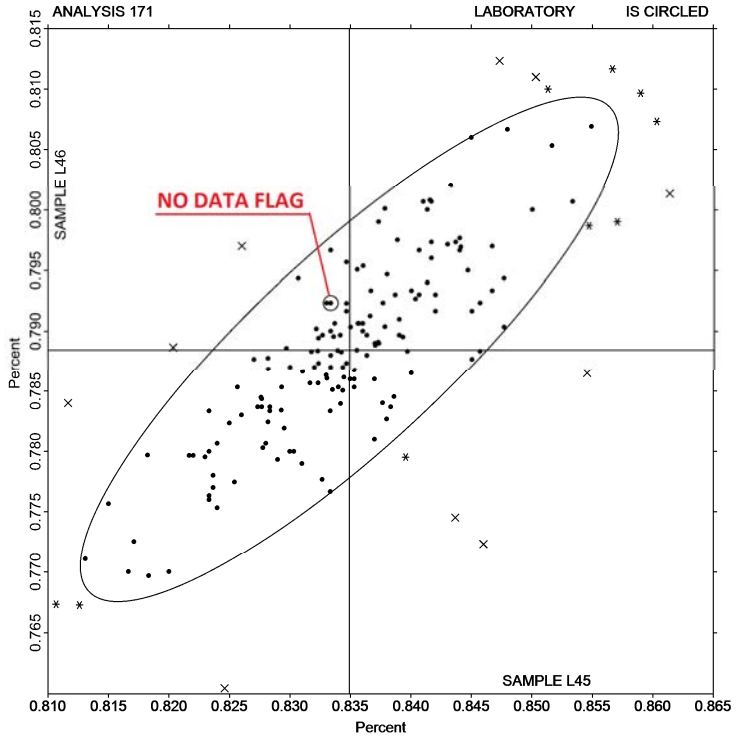
Example 1: "*" Data Flag is assigned (see the graph). No CPV Flags are assigned (see CPV Chart). No K Flags are assigned (see Variation Chart). In this case **No Overall Flag** is assigned.



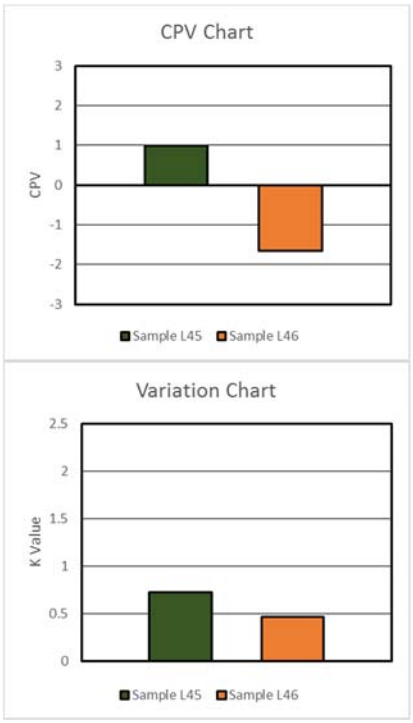


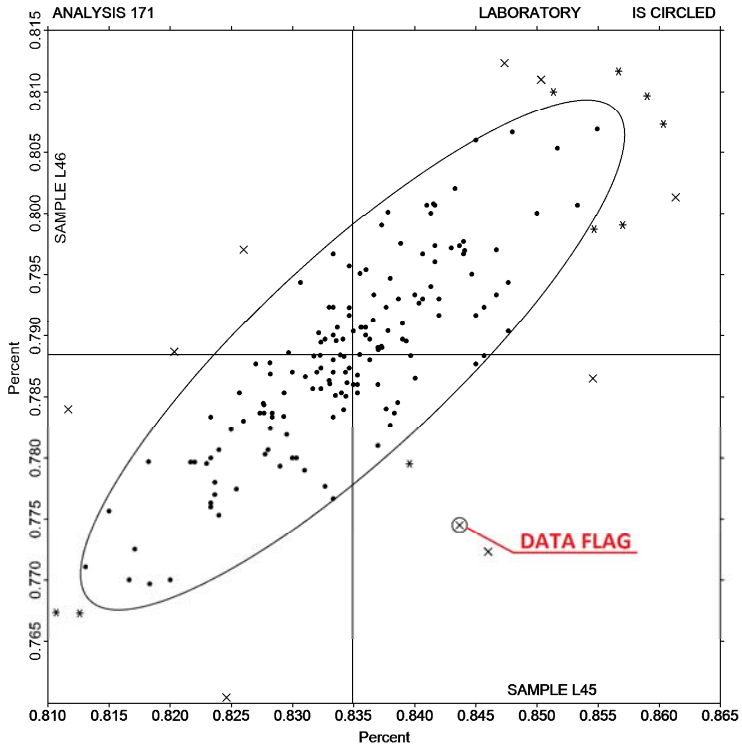
Example 2: No Data Flag is assigned (see the graph). No CPV Flags are assigned (see CPV Chart). Two K Flags are assigned (see Variation Chart). In this case **No Overall Flag** is assigned.



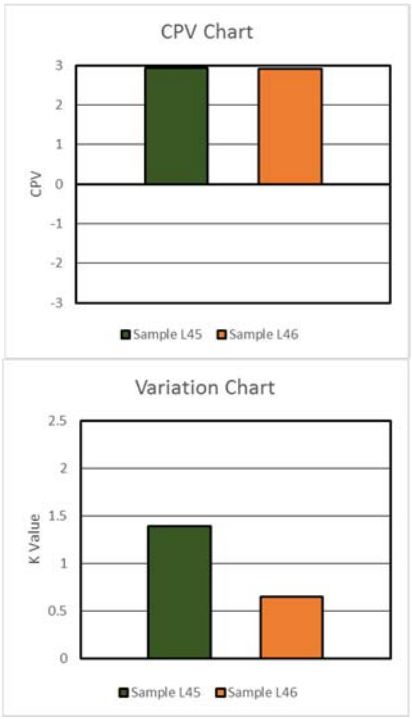


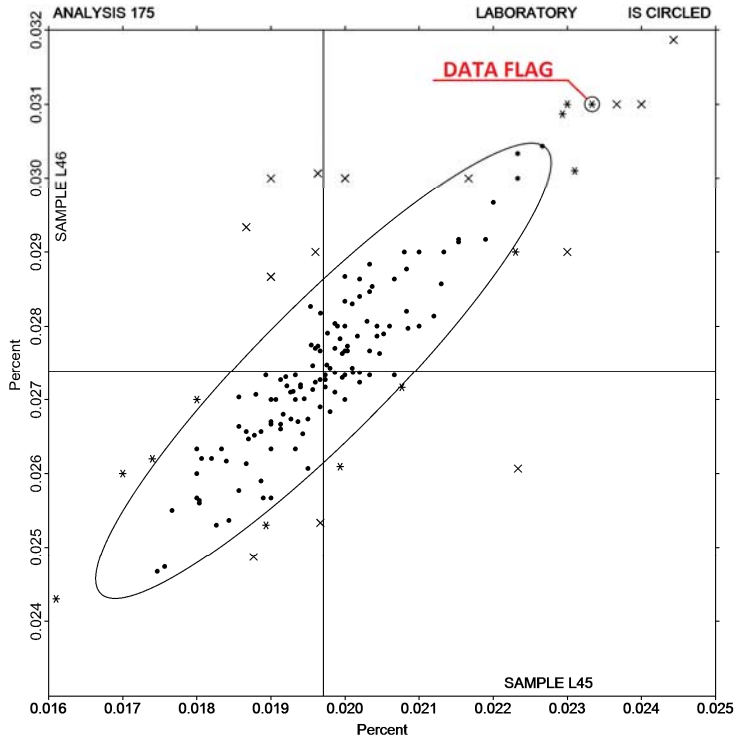
Example 3: "X" Data Flag is assigned (see the graph). No CPV Flags are assigned (see CPV Chart). No K Flags are assigned (see Variation Chart). In this case an **"*" Overall Flag** is assigned.



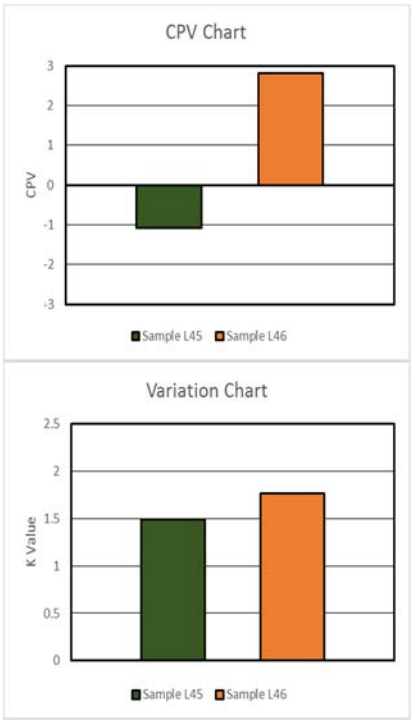


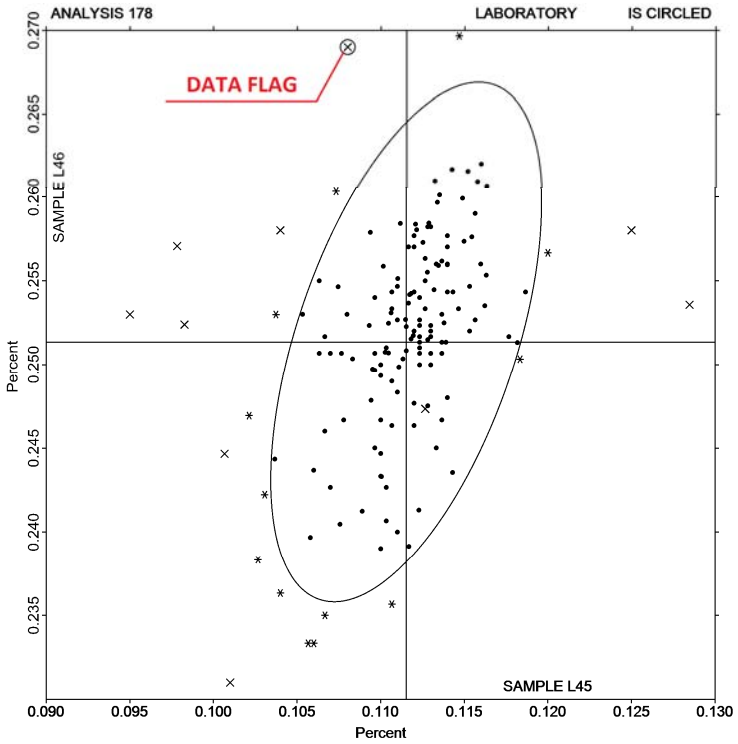
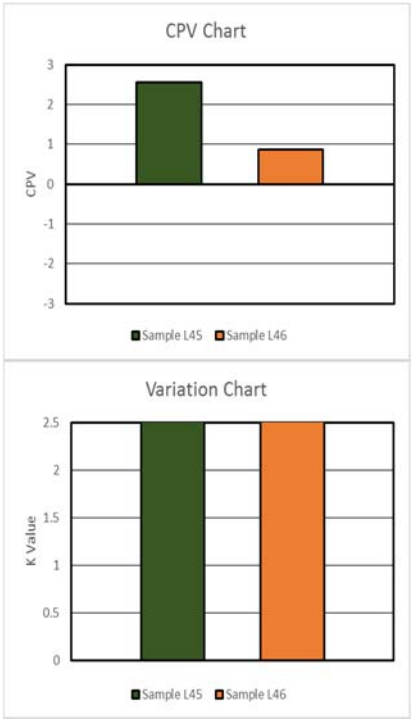
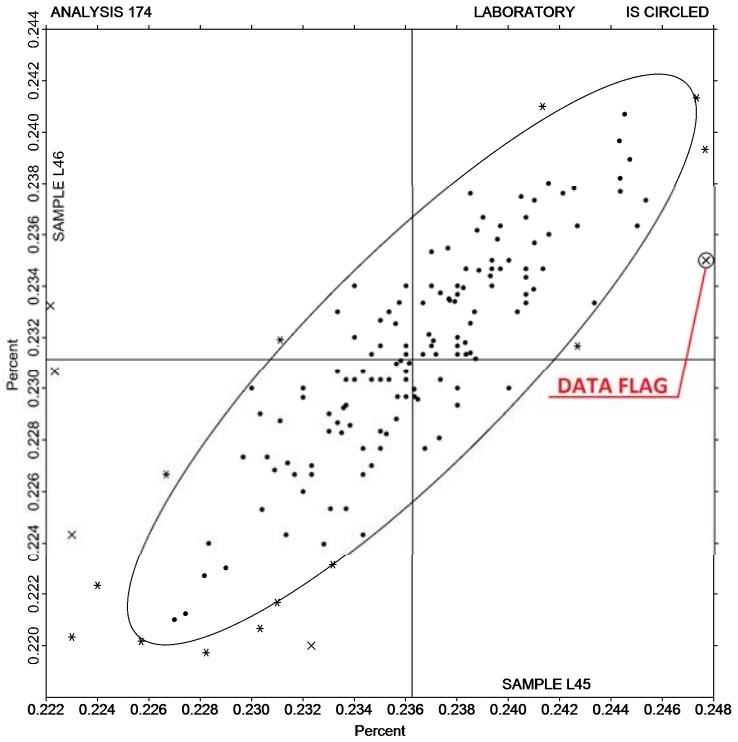
Example 4: "*" Data Flag is assigned (see the graph). Two CPV Flags are assigned (see CPV Chart). No K Flags are assigned (see Variation Chart). In this case an **"*" Overall Flag** is assigned.





Example 5: "X" Data Flag is assigned (see the graph). One CPV Flag is assigned (see CPV Chart). No K Flags are assigned (see Variation Chart). In this case an **"X" Overall Flag** is assigned.





Example 6: "X" Data Flag is assigned (see the graph). No CPV Flags are assigned (see CPV Chart). Two K Flags are assigned (see Variation Chart). In this case an **"X" Overall Flag** is assigned.