EPO No. 16

Appendix B

High-Level Steps to Performing the Increasing-Load Test Using the Substitution or Alternative Substitution Test Method

Listed below are the high-level steps necessary to properly perform an increasing-load test on a scale with digital indication using the substitution or alternative substitution test method. For detailed instructions on how to perform each of these steps refer to Appendix B (Supplement 1) titled "Applying the High-Level Steps of the Substitution and Alternative Substitution Test Method." For additional clarification on determining the amount of scale error and evaluating the results of tests when using the substitution test method, refer to Appendix B (Supplement 2) titled "Determining Scale Error When Applying the Substitution Test Method." For additional clarification on determining the amount of scale error and evaluating the results of tests when using the alternative substitution test method, refer to Appendix B (Supplement 3) titled "Determining Scale Error When Applying the Alternative Substitution Test Method."

Step 1) ***Establish a proper reference at no load****:* With no load on the load-receiving element of the scale, add error weights equal to the value of 0.1 d to establish a proper reference at no load. Make note of the total value of the error weights on the scale; then remove the error weights.

Step 2) ***Apply the test weight and then use error weights to establish a proper reference:*** Apply the first test load consisting entirely of test weight. Then add error weights equal to the value of 0.1 d to adjust the weight of the load so that a proper reference is established between two adjacent increments. Make note of the total value of the error weights on the scale; then remove the error weights.

Step 3) ***Determine the amount of scale error:***
(a) Determine the amount of error in the scale for each test load applied using the error formula:

$$E_n = I_e - I_s - L + R_s - R_e$$

Where:

"E_n" *(Error)* represents the amount of error in the scale relative to the applied test weight portion of the total applied load;

"I_e" *(Indication ending)* represents the scale indication after the test weight has been applied and proper reference established;

"I_s" *(Indication start)* represents the scale indication before the test weight was applied;

"L" *(Load)* represents the value of the applied test weight excluding any substituted load;

"R_s" *(Reference start)* represents the value of the error weights on the load-receiving element that established proper reference prior to the test weight being applied; and

"R_e" *(Reference ending)* represents the value of the error weights on the load-receiving element that established proper reference after the test weight had been applied.

(b) Sum the cumulative errors (ΣE_n) for all steps of the substitutions.

Step 4) ***Remove the test weight and determine the amount of any no-load balance change:*** Remove the first test load and add error weights to return to the proper reference at no load. Any difference in error weights from Step 1 represents a change in the no-load balance reference. Discontinue testing if no-load balance is unstable or does not repeat to within the value of minimum tolerance each time a test load is applied and then removed.

If no change has occurred or the amount of change does not exceed minimum tolerance, testing may continue. However, in the latter case it will be necessary to make note of the value of the error weights needed to re-establish proper no-load reference. Once you've made note of the value of the error weights that establishes the no-load reference, remove the error weights from the scale.

Step 5) ***Create the first substitution test load:*** Create the first substitution test load by loading bulk material onto the load-receiving element of the scale.

Substitution Test
Apply trim weights, as necessary, to increase the weight of the first substitution test load to that which was first indicated when the test weight was first applied in Step 2.

Alternative Substitution Test
Apply trim weights, as necessary, to increase the weight of the first substitution test load so that it's indicated weight is slightly less than (i.e., no more than 5 divisions) the value indicated when the test weight was first applied in Step 2.

Then add error weights equal to the value of 0.1 d to establish a proper reference for the first substitution load. Make note of the total value of the error weights on the scale; then remove the error weights.

Step 6) ***Apply test weight to the first substitution test load and use error weights to establish a proper reference:*** Apply the test weight to the first substitution test load. Then add error weights equal to the value of 0.1 d to adjust the weight of the load so that a proper reference is established between two adjacent increments.

Step 7) ***Determine the amount of scale error:*** Determine the amount of error in the scale using the error formula provided in Step 3. Then remove the test weight, all error weights, and any trim weights that were added in Step 5 from the load-receiving element.

Step 8) ***Create the second substitution test load:*** Create the second substitution test load by loading bulk material onto the load-receiving element of the scale.

Substitution Test
Apply trim weights, as necessary; to increase the weight of the second substitution test load to that which was first indicated when the test weight was applied in step 6.

Alternative Substitution Test
Apply trim weights, as necessary, to increase the weight of the second substitution test load so that it's indicated weight is slightly less than (i.e., no more than 5 divisions) the value indicated when the test weight was first applied in Step 6.

Then add error weights equal to the value of 0.1 d to establish a proper reference for the second substituted load. Make note of the total value of the error weights on the scale; then remove the error weights.

Step 9) ***Apply test weight to the second substitution test load and use error weights to establish a proper reference:*** Apply the test weight to the second substitution test load. Then add error weights equal to the value of 0.1 d to adjust the weight of the load so that a proper reference is established between two adjacent increments.

Step 10) ***Determine the amount of scale error:*** Determine the amount of error in the scale with the test load applied using the error formula indicated in Step 3. Then remove the test weight, all error weights, and any trim weights that were added in Step 8 from the load-receiving element.

Step 11) ***Create the third substitution test load:*** Create the third substitution test load by loading bulk material onto the load-receiving element of the scale.

Substitution Test
Apply trim weights, as necessary; to increase the weight of the third substitution test load to that which was first indicated when the test weight was applied in step 9.

Alternative Substitution Test
Apply trim weights, as necessary, to increase the weight of the third substitution test load so that it's indicated weight is slightly less than (i.e., no more than 5 divisions) the value indicated when the test weight was first applied in Step 9.

Then add error weights equal to the value of 0.1 d to establish a proper reference for the third substituted load. Make note of the total value of the error weights on the scale; then remove the error weights.

Step 12) ***Apply test weight to the third substitution test load and use error weights to establish a proper reference:*** Apply the test weight to the third substitution test load. Then add error weights equal to the value of 0.1 d to adjust the weight of the load so that a proper reference is established between two adjacent increments.

Step 13) ***Determine the amount of scale error:*** Determine the amount of error in the scale using the error formula indicated in Step 3.

Substitution Test
Note: If after completion of three substitutions from the no-load reference, additional test loads are still needed to make possible a test to at least used capacity, it will be necessary to use a strain load to increase the loading of the scale to the appropriate area where additional testing is needed. Once the strain load has been created and proper reference established for the load, up to three substitution test loads can be created from that strain load using the same procedures outlined in this appendix.

Alternative Substitution Test
Note: If after completion of three substitutions from the no-load reference, additional test loads are still needed to make possible a test to at least used capacity, continue applying these same procedures, using as many additional substitution test loads as are needed, to complete the test.