

## **TOOLING TECHNICAL BRIEF – OVERALL AND WORKING LENGTHS**

A Reference Guide to Pharmaceutical Industry Standards for Tablet Press Tooling: **Overall and Working Lengths of Punches.**

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Perhaps the most misunderstood dimensional standards contained in the TSM are those concerning the overall and working lengths of punches. The intent of this technical brief is to clarify exactly how these dimensions are defined along with the allowable variation provided by TSM specifications.

The critical nature of tablet press tooling dimensions and the need for an industry governing these dimensions was recognized long ago. Since 1971, The American Pharmaceutical Association has published a booklet called the Tableting Specification Manual (TSM) which is a compilation of all the dimensions and tolerances pertaining to tablet press tooling. TSM standards have been universally adopted by both manufacturers of tooling and pharmaceutical end users as the final authority when it comes to dimensions and tolerances for punches and dies.

### **What is the TSM specification for working length?**

The TSM specification says that the difference in working length between the longest punch and the shortest punch within a set must be .002 inches (.05mm) or less. Furthermore, upper and lower punches should be considered as separate sets for the purpose of measuring working length.

### **What is the most common misconception concerning the TSM specification for working length?**

Because all the detailed punch drawings in the TSM show an overall length of 5.250 inches (133.35mm) and an undimensioned blank with a tolerance of +/- .001 inch (.05mm), it is commonly assumed that the nominal working length for a set of punches must be equal to 5.250 inches minus the nominal cup depth.

As an example, consider a punch with a nominal cup depth of .050 inches. Using the above interpretation, the TSM specification would be taken to mean that all the punches from that set must have a working length of 5.250 - .050 or 5.200 inches with a tolerance of +/- .001 inch. Any punch shorter than 5.199 inches or longer than 5.201 inches would be viewed as being out of specifications.

This, in fact, is not the case. TSM specifications only limit the allowable variation in working length, not the nominal length about which the individual lengths are distributed. Using the above example, a set which measures 5.200 to 5.202 inches in working length is within TSM specifications since the total variation for the set is within .002 inches.

### **Why is the TSM specification for working length defined in this way?**

The primary reason for only limiting the variation in length and not the actual length dimension is so that tools which have been reworked in working length can be covered by the same specification used for new tooling. Thus, pharmaceutical inspection departments do not need to have one spec for new tooling and another one for used tooling.

Another reason for not specifying a given length has to do with the presence of bisects and engraving on the surface of the punch cup. These features may make it impossible to take a measurement at the bottom of the cup. Some other point on the cup must, therefore, be referenced making the working length different than it would normally be.

### **What can I expect from my tooling supplier in terms of nominal working length?**

Tooling suppliers use the TSM reference dimension for overall length (5.250 inches) minus the nominal cup depth as their target value for working length. Using the previous example of the punches with a nominal cup depth of .050 inches, the manufacturing target would be 5.200 inches for the nominal working length. In most cases the tooling you receive would have a nominal working length that is within +/- .001 inch of that value.

### **What is the TSM specification for overall punch length?**

The TSM does not contain a specification for overall length but rather one that pertains to the allowable variation in cup depth (+/- .003 inches, +/- .075mm). The 5.250 inch (133.35mm) dimension shown on TSM punch drawings is marked as a reference dimension.

This means that it is untoleranced and does not govern inspection operations. TSM specifications do not indicate that overall length should be 5.250 inches +/- .002 or +/- .003 inches as is commonly thought.

Overall length is actually a result of working length plus cup depth. The nominal overall length for a given set of punches is equal to the nominal working length for that set plus the nominal cup depth dimensions. Again, referring to the earlier example of punch set having a .050 inch cup depth, if the nominal working length for that set is 5.201 inches, the nominal overall length for the set would be 5.201 + .050 inches, not 5.250 inches.

### **If there isn't a TSM specification for overall punch length, why is this dimension typically checked?**

With the exception of plain faced punches, a measurement indicator with a pointed stylus is necessary for finding the bottom of a punch cup whereas a rounded or flat stylus is needed to touch off on the punch land. As a result, cup depth cannot be measured directly. By having a specification for overall length that properly takes into account the actual nominal working length for the set being measured, a meaningful specification for overall length can be developed that permits a direct check of TSM cup depth compliance.

### **What is a reasonable overall length specification that will ensure punch cup depths meet the TSM standard?**

A tolerance of +/- .002 inches (+/- .05mm) applied to a nominal overall length which has been calculated using the measured nominal working length for the set being inspected is a good guideline. If all the punches meet this criteria, you are guaranteed that the TSM specification of +/- .003 inches (+/- .075mm) for cup depth is satisfied.

Another method that can be used to accomplish the same result is to first subtract the shortest working length measurement taken from the longest overall length measurement. If the difference is less than or equal to the nominal cup depth plus .003 inches, the maximum cup depth for any punch in the set is guaranteed to be below the TSM high limit for acceptance. Next, subtract the longest working length measurement. If the difference is greater than or equal to the nominal cup minus .003 inches, the minimum cup depth for any punch in the set will be above the TSM limit for acceptance.

**Are there any limitations in using the above overall length specifications to test for TSM cup depth compliance?**

The simplicity of the above two methods is that the cup depth for each individual punch does not have to be calculated by subtracting its working length from its overall length. The pass/fail test is applied to the set as a whole on the basis of average or mean dimensions.

However, there is a restriction in applying these methods that should be mentioned. While it is true that any punch set that passes the above tests is definitely within TSM specifications, the reverse is not necessarily true. In analyzing the above two testing methods it should be noted that the pass/fail criteria employed assumes the worst case scenario of the punches having the longest working length also having the shortest working length (deepest cup) and the punches having the shortest overall length also having the longest working length (shallowest cup).

Statistically speaking, the worst possible combinations do not usually occur. As a result, it is advisable to check the actual cup depth on a punch which appears to be out of specifications before it is rejected to make sure that the cup depth is in fact too shallow or too deep.

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