



Inspecting Screw and Bolt Straightness

by Larry Borowski

When a screw or bolt's length exceeds eight times its body diameter (example: ½-13 X 4") straightness becomes a concern for many end users. If a long screw or bolt is not sufficiently straight it can create significant assembly problems for the end user, which can then result in customer complaints or rejects for the fastener supplier.

ISO 4759-1 as well as ASME B18.2.9 describe gaging for straightness at maximum material condition (MMC). **The difference is that ISO describes a plain sleeve style gage while ASME defines a rail type gage. The sleeve style gage requires a different gage for each diameter and length of fastener while the ASME gage is limited only by the maximum opening and length defined by the manufacturer.** For the purposes of this article we will be addressing the ASME rail style gage.

Straightness Gages in ASME standards

Several of the American Society of Mechanical Engineers (ASME) B18 standards appendices contain an attribute type of gage for determining part straightness. Each standard contains slightly different wording. Although not all standards have been updated, there is a clear path for each standard to refer to ASME B18.2.9 for uniform guidance on straightness gaging. The gage picture below consists of a base plate with one stationary side rail and one adjustable side rail. The gap between the rails is set with a pair of micrometer heads. This style of gage is quite versatile and cost effective, as it will accommodate a range of diameters and lengths.

Most of the ASME standards are consistent in their straightness specifications. Screws and bolts up to and including 12 inches in length can be bowed .006 inches per inch of length. Parts exceeding 12 inches can be bowed .008 inches per inch of length. If a user's application requires a part straighter than these limits, they must specify their required straightness limits on their print and/or purchase order.

In the case of our ½-13 x 4" long example, the maximum allowable bow would be .024" (4" length x .006" per linear inch). When using this attribute type gage, you would add the allowable bow (.024") to the basic diameter (.500") of the bolt, and set the gap in the jaws at .524" (MMC). You would then rotate the fastener 360° in between the jaws. If the part binds, you have exceeded your maximum bow or camber. If it rotates freely, you are within your allowable bow or camber.



The camber gage illustrated in the ASME standards and shown in this

article is an attribute gage. It will only indicate to the user whether or not the part being inspected is within the specified limits for straightness, but will not indicate the exact magnitude of the camber or bow in the part.

Indicating Gage for Measuring the Amount of Screw or Bolt Camber

To determine the magnitude of the bow in a part used for either gathering statistical process control (SPC) data or for final inspection documentation, an indicating, variable type of gage such as the CamberChek® is needed.

The CamberChek® gage is similar to the rail-type gage illustrated in the ASME standards except for the non-stationary top rail slides on two precision bearings instead of maintaining a fixed position. The gage is designed so that gravity provides a constant closing pressure against the product being measured. A digital indicator contacts the outside of the sliding rail for indicating the exact amount of bow in the parts being inspected by the gage.

To determine the exact amount of camber or bow, the part is placed between the rails so that the sliding rail is at its closest position to the stationary rail. To find this spot, the bolt would be rotated 360° to determine the lowest indicator reading. The indicator is then "zeroed out".

The part is then rotated until the maximum indicator reading is achieved. The reading on the indicator is the exact amount of camber or bow in the measured part. Unlike the fixed jaw style of gage, you do not add the screw diameter to the allowable bow. Using this style of gage and our ½-13 x 4" fastener, you cannot exceed the .024" max allowable bow in the screw or bolt to determine if it is within the acceptable straightness limits of the standard.

When measuring bolt straightness, areas under the head that would adversely affect the straightness should be excluded. ASME specifically states in B18.2.9 – 2010, *the excluded length...is the length, if any, that is to be excluded from the straightness gage, as specified by the product standards.* What this means is to avoid or exclude allowable under head swells, fins, serrations, shoulders, irregular shapes, radii, etc. What it also means is that some fasteners may not have an "excluded length" and must be gaged the full length as close to the head as you can get. Refer back to the individual product standards to determine what to exclude from the straightness measurement.

Inspect Straightness to Avoid Complaints

Bent screws and bolts can cause their users major assembly problems. **When supplying screws and bolts that have lengths greater than eight times their body diameter, suppliers should inspect them for straightness to avoid potential customer complaints and/or rejects.**

The style of gage used should be determined according to the standards of the fastener and/or the requirements of the customer. ■

