



PMC LONE STAR



Gages, Calibration & Instruments

API Gaging Practice

PMC Lone Star Technical Brief Doc. 100 Rev. C

David R. Maisch
Director of Engineering & Industrial Affairs
PMC Lone Star
June 4, 2008



The American Petroleum Institute (API), headquartered in Washington, DC, USA is a world leader in the development of standards for all aspects of the oil and natural gas industry. When using API sanctioned gages for the inspection of products or calibration of other gages, it is critical that the user have a high quality gage, manufactured using the latest manufacturing and inspection technology available. Gages should be manufactured so that they meet or exceed API specifications.

Each API working gage shall be accompanied by a certification listing the values with dimensions measured for each critical element, as well as a measured standoff to a certified master gage. Each API master gage shall be accompanied by a certification from an API qualified agency such as the National Institute of Standards and Technology (NIST) located in Gaithersburg, Maryland, USA, the National Physical Laboratory (NPL) located in the United Kingdom, or the National Institute of Metrology (NIM) located in Beijing, The People's Republic of China, as described in the API specifications. For API Specification 5B, the API approved certifying agency shall perform a full inspection on all critical elements as well as a mating standoff, and provide a report detailing the results of the inspection. For API Specification 7, the API approved certifying agency shall perform a full inspection on all critical elements as well as a standoff against the appropriate regional or grand master gages and a mating standoff. A certification shall be provided detailing the results of the inspection.



The gage tolerancing defined by API is designed to allow the gage manufacturer tolerance for manufacturing the gage while still providing the end user with tolerance for wear of the gage. Due to the desire for maximum wear life of gages, it is often requested that gages be manufactured on the plus side of the tolerance. Manufacturing to the plus side of the tolerance does not always provide desirable results. It is possible that manufacturing to the plus side of the tolerance will lead to one laboratory performing inspection and standoff near the maximum limit while another laboratory, using different master gages will find that the gages exceed the allowable tolerances and they will question the validity of the gages. This situation can arise very easily for API Specification 5B gages because the taper ratio is 16:1 and even small differences in diameter can result in large differences in standoff. For this reason, it is PMC Lone Star's practice to manufacture all gages as close to nominal size as possible. When there is a difference between the API accredited manufacturer's reported results and another API accredited laboratory's reported results, it does not mean that the gages are out of tolerance and should be rejected. It simply means that the two inspecting laboratories have master gages which differ in size from one another. In cases such as this, the inspection results provided by the API accredited manufacturing and inspection facility should be accepted and used with the gages. It is also recommended that the results provided by the local laboratory be recorded for future comparison when checking for wear. Manufacturers of product threads shall conform to the gaging requirements as



stated in API Specification 5B, Fifteenth Edition, April 2008 Paragraph 6.1.2. See

Figure 1.

The manufacturer of product threads shall also provide working gauges conforming to the requirements of 7.1.2 for use in gauging the product threads, and shall maintain all working gauges in such condition as to ensure that product threads, gauged as required herein, are acceptable under this specification. The manufacturer shall establish and document a program of measuring the wear (interchange standoff of working gauges with master gauges) on each working ring and plug gauge that is used in the production of API threads. Included in this program shall be detailed procedures, frequency of measuring wear, and criteria of rejection that completely decommission a working ring or plug gauge from any further use. The results of each required measurement for each working ring or plug gauge shall be documented. The records of procedures and measurements shall be maintained for not less than 3 years following the last usage of each gauge. The manufacturer shall also establish and document a frequency for inspecting product threads with working gauges based on his control of the manufacturing process.

Figure 1. - API Specification 5B Paragraph 6.1.2, Gauge Requirements

The tolerances and standoff criteria for API Specification 5B are often misunderstood.

When a set of API Specification 5B masters are manufactured, the report that accompanies the gages includes a mating standoff value “S” which is used to monitor wear. As stated in API Specification 5B, Fifteenth Edition, April 2008, Paragraph 6.1.6, the mating standoff value “S” is acceptable as long as it falls within the tolerances specified by API Specification 5B. See Figure 2. **A mating standoff value “S” which is at low limit of the tolerance range is not an indication of reduced wear life, just like a standoff value “S” which is at the high limit of the tolerance range is not an indication of increased wear life**



A pair of master gauges (master plug and mating master ring) which have been tested as prescribed in 8.1.4 may be considered acceptable for continued use provided the mating standoff remains equal to the original certified standoff “S” (as stamped on the ring gauge), or does not change from this original value more than that shown below.

For line pipe gages the mating standoff shall not increase from the original “S” value by more than the equivalent of 1/10 thread turn for all pitches and sizes, and shall not decrease from this original value by more than 1/8 thread turn for 27-thread and 18-thread (per in.) gauges, 5/32 thread turn for 14-thread and 11-1/2 thread gauges, or 5/32 thread turn for 8-thread gauges for line pipe in nominal sizes 8 and smaller, and 1/5 thread turn for 8-thread gauges for line pipe in nominal sizes 8 and larger. See Table 1.

For round thread casing and tubing gauges, the mating standoff shall not increase from the original S value by more than the equivalent of 1/10 thread turn for all pitches and sizes and shall not decrease from this original value for 8-thread gauges by more than 5/32 thread turn for sizes 8-5/8 and smaller, 1/5 thread turn for sizes 9-5/8 and larger, and 1/5 thread turn for all 10-thread gauges. See Table 2.

For buttress thread casing gauges the mating standoff shall not increase from the original S value by more than the equivalent of 1/16 thread turn for all sizes and shall not decrease from this original value by more than 1/10 thread turn for sizes 8-5/8 and smaller, and 1/8 thread turn for sizes 9-5/8 and larger. See Table 3.

Figure 2. – Gauge API Specification 5B Paragraph 6.1.6, Gauge Acceptance



Table 1. – “S” Value Wear Limits for Line Pipe

Line Pipe		
Pitch	"S" Value Increase	"S" Value Decrease
27 T.P.I.	0.0037	0.0046
18 T.P.I.	0.0056	0.0069
14 T.P.I.	0.0071	0.0112
11-1/2 T.P.I.	0.0087	0.0136
8 T.P.I. (8 and Smaller)	0.0125	0.0195
8 T.P.I. (8 and Larger)	0.0125	0.0250

Table 2. – “S” Value Wear Limits for Round Thread Casing and Tubing

Round Thread Casing and Tubing		
Pitch	"S" Value Increase	"S" Value Decrease
8 T.P.I. (8-5/8 and Smaller)	0.0125	0.0195
8 T.P.I. (9-5/8 and Larger)	0.0125	0.0250
10 T.P.I.	0.0100	0.0200

Table 3. – “S” Value Wear Limits for Buttress Thread Casing

Buttress Thread Casing		
Pitch	"S" Value Increase	"S" Value Decrease
5 T.P.I. (8-5/8 and Smaller)	0.0125	0.0200
5 T.P.I. (9-5/8 and Larger)	0.0125	0.0250



The requirements for recertification of API gages vary by specification. For API Specification 5B, an interchange standoff between working gages and master gage shall be periodically performed in order to monitor and track wear of the working gages. Master gages shall be periodically tested for mating standoff. In both cases the time interval between calibrations is based on the frequency of use of the gages, however, PMC Lone Star recommends that calibration be performed a minimum of once per year. For API Specification 7 working gages, gages shall be periodically retested for mating and interchange standoff against certified reference master gages. The time interval between calibrations is based on the frequency of use of the gages, however, PMC Lone Star recommends that calibration be performed a minimum of once per year. API Specification 7 regional and reference master gages shall be retested for mating and interchange standoff at least once every seven years, reference master gages shall be retested against certified regional master gages, and regional mater gages shall be retested against certified grand master gages. A certification including the mating and interchange standoff shall be provided by the laboratory performing the calibration.

In conclusion, it is critical that only the highest quality gages are used to check product. All gages should be manufactured and certified by an A.P.I accredited facility which maintains A.P.I certified master gages. It is equally important that API gaging practices are fully understood and followed at all times to ensure the highest quality product possible.



Bibliography

American Association for Laboratory Accreditation
A2LA ISO 17025

American Petroleum Institute
API Specification 5B, Fifteenth Edition: Specification for Threading, Gauging
and Thread Inspection of Casing, Tubing, and Line Pipe Threads
Washington, DC: April, 2008

American Petroleum Institute
API Specification 7, Fortieth Edition, Addendum 1: Specification for Rotary Drill
Stem Elements
Washington, DC: November, 2001

American Petroleum Institute
API Specification Q1, Eighth Edition: Specification for Quality Programs for the
Petroleum, Petrochemical and Natural Gas Industry
Washington, DC: December, 2007