



July 22, 2008

TECHNICAL NOTE 69: HEADSPACE

BACKGROUND: Few topics inspire as much interest and confusion as headspace. It is one of the few technical small arms terms recognized, if not understood, by even beginning shooters. It is seldom firmly understood by even experienced shooters.

FACTS:

1. In a narrow sense, headspace is the size of the cartridge chamber designed to accept a particular cartridge. Headspace is defined as minimum and maximum dimensions from the locked breech to either a contact surface or designated datum in the rifle chamber, or to the rear of the barrel. The points of measurement chosen depend on the type of cartridge case used (rimmed, rimless, semi-rimmed, or belted).
2. In a broader sense, headspace is a far more complex relationship between the cartridge, chamber, and firearm mechanism. The starting point for headspace is the cartridge case. The complex functions of the cartridge case include holding the cartridge components together, aligning the bullet in the bore, expanding to seal high pressure gasses, contracting in time for easy extraction, and removing heat from the chamber. Proper space for the cartridge allows it to function well. Improper space can cause dangerous pressure conditions at worst, or interfere with the function of the action.
3. Headspace ranges are established by industry advisory bodies, government bodies, or by individual manufacturers. In the U.S. the primary advisory body for commercial manufacturers is the Small Arms and Ammunition Manufacturers Institute (SAAMI). Issues of producibility, safety, and mechanism reliability with a particular cartridge must be considered. Firearm manufacturers must produce firearms with chamber headspace dimensions and tolerances that are producible, yet assure safe and reliable operation with all ammunition made to standard even after their firearms have been used extensively. This becomes an extremely difficult challenge when making self-loading firearms.

EXAMPLE: A .308 Winchester rifle with a SAAMI chamber, and ammunition made to SAAMI standard cartridge dimensions and tolerances reveals acceptable headspace ranges of:

Chamber dimensions:	1.630 minimum to	1.640 maximum
Minus case dimensions:	<u>1.634</u> maximum to	<u>1.627</u> minimum
Resulting headspace:	.004 interference to	.013 clearance

In this example, the SAAMI maximum headspace/minimum cartridge allowance produces so much clearance, .013 inch, that it will reduce case life. This much headspace would probably be found only on a used rifle. The SAAMI minimum headspace/maximum case condition produces .004 inch of interference that could make semi-automatic operation unreliable. The challenge for a manufacturer is to find a headspace range large enough to allow reliable operation and small enough to assure accuracy by aligning the cartridge in the chamber uniformly. Dimensions for new firearms should be equal to or larger

than the SAAMI minimum to assure safety, but smaller than the SAAMI maximum to allow safe operation even after long years of use and wear.

4. Different headspace dimensions are defined by different manufacturers and organizations. An excellent example is the 7.62mm/.308 cartridge:

CARTRIDGE	MIN	MAX
SAAMI	1.627	1.634
GOVERNMENT	1.630	1.633

CHAMBER	MIN	MAX
SAAMI	1.630	1.640
GOVERNMENT M-14	1.6355	1.6385
GOVERNMENT M-14 Match	1.631	1.633

Note that the government ranges are for new guns, while the SAAMI range allows for wear.

The government-accepted headspace range of a new M1 Garand is .004", the M60 machine-gun, .003", the M14, .003", and the M14 National Match, .002."

5. Gage manufacturers ordinarily produce headspace gages to the SAAMI specification defining "go" (minimum) as 1.630", "no go" (normal maximum) as 1.636", and "field reject" (the largest safe maximum) as 1.640". It is important to note that technical issues define the headspace acceptable for each design, and that SAAMI'S standards are only a starting point. Customers often use SAAMI-based commercial gages to measure a firearm like an M-14 or an AR-10 and then declare its headspace wrong. That's incorrect because SAAMI's .308 minimum is not appropriate for the M-14 or for AR-10s. In summary, firearms frequently require custom headspace gages suited to their specific design.

MISCONCEPTIONS:

There are a number of popular misconceptions concerning headspace, notably that:

- the tighter the headspace, the better;
- that loose headspace is dangerous;
- and that one particular dimension is best.

None of these common beliefs is totally true.

Insufficient or excessively tight headspace tends to cause malfunctions such as failure to lock. It often makes extraction difficult and can cause dangerous stresses on the mechanism that shorten its life expectancy or lead to failure. Excessive headspace may lead to gas leakage around the case or head separation and the sudden release of high-pressure gas. Most shooters fear excessive headspace, but it is actually insufficient headspace that is more dangerous. A good firearm design can actually tolerate a great deal of excess headspace.

While the SAAMI example above demonstrates that a fairly wide range of dimensions work, manufacturers narrow their tolerances to conservative ranges that allow a reasonable combination of safety, reliable function, accuracy, and useful life.