COPY

CC: R. E. Evans
F. B. Clay

Bridgeport, Connecticut
March 20, 1956

TO: C. S. CUMMINGS

FROM: J. J. O'CONNOR

SUBJECT: 22 MATCH CARTRIDGE AND RIFLE DIMENSIONS

The present match situation is complicated by a number of interacting factors which require clarification before the best solution can be arrived at. The difficulty arises primarily from matching the dimensions of bullet and bore. Because no standard terminology exists the following definitions are given:

High Pressure Bore:

A bore which has a predominance of the following characteristics: (1) small bore cross sectional area; (2) relatively deep grooves; (3) relatively rough surface; (4) relatively large leade angle and short chamber body.

Low Pressure Bore:

A bore which has a predominance of the following characteristics: (1) large bore cross sectional area; (2) relatively shallow grooves; (3) relatively smooth surface; (4) relatively small leade angle and long chamber body.

High Pressure Cartridge:

A cartridge which has a predominance of the following characteristics: (1) bullet with hard alloy, large swaged diameter; long bearing no grooves or small grooves, large sized diameter; (2) relatively large quantity of relatively fast powder, high bullet pull.

Low Pressure Cartridge:

A cartridge which has a predominance of the following characteristics: (1) bullet with soft alloy, small swaged diameter, short bearing, prominent knurls, small sized diameter; (2) relatively small quantity of relatively slow powder; (3) low bullet pull.

Subject: 22 MATCH CARTRIDGE AND RIFLE DIMENSIONS

Some but not all of the characteristics mentioned above directly affect the pressure as measured in the standard ballistic test. In general a relatively high pressure bore should have a relatively low pressure cartridge and vice versa. If a relatively high pressure cartridge is shot in a relatively high pressure bore, tight centers, bad flyers and excessive fouling result. If a relatively low pressure cartridge is shot ina relatively low pressure bore, loose centers, vertical stringing, and drop shots result.

Some specific examples can be given. The 40X bore is the lowest pressure bore on the market. It was developed to shoot the Palma cartridge, Mark II, and the new match cartridge with ungrooved bullet. It has an average bore cross sectional area of .03836 in^2 and an average groove depth of .0020 in. It also has an exceptionally smooth interior finish. When put on the market it shot all of these cartridges exceptionally well and also Mark III. By far the best accuracy ever seen at Bridgeport was effected by the combination of the high pressure new match cartridge and the 40X rifle. A number of ten shot groups shot from sand bag rest over 100 yards measured less than zero according to the conventional edge to edge measurement. With very fast 7022 powder the accuracy was even better. Lack of adaptability of the cartridge to other rifles lead to its obsolescence. Any ungrooved bullet is necessarily less adaptable, but on the other hand when a good combination of such a bullet with a rifle is obtained it permits extraordinary accuracy.

Our next match cartridge included a bullet swaged to a smaller diameter and having small shallow grooves cut with a stack of sharp knives at the crimping operation. This was a lower pressure cartridge because it was loaded to a lower velocity, and it had a smaller swaged diameter. Thisswaged diameter is a major accuracy variable even of greater importance than the finished size diameter. The cartridge was more adaptable and it had a successful history in the field. It was still a relatively high pressure cartridge and consistently gave better results in the 40X rifles than in M52's and Johnsons. The tools were quite complicated and the crimper setup very difficult. Successive rotations of the cartridge past the knife resulted in failure of the knives to track and thus impairment of the appearance. The cartridge was obsoleted.

Subject: 22 MATCH CARTRIDGE AND RIFLE DIMENSIONS

The next cartridge is the current one. Conventional knurling technique was adopted which improved the appearance and simplified the operation. The knurl dimensions required further reduction in the swaged diameter so that now we have a relatively low pressure cartridge. The accuracy in Model 52's is consistently superb, but we are getting vertical stringing and drop shots in the 40X. A small number of Johnson barrels should also show this defect. The Model 52 is relatively a higher pressure barrel than the 40X and slightly more than the Johnson.

The solution to our present difficulty is not obvious. The following points are offered as a basis for discussion:

1. Higher velocities should not be considered. If anything the velocity should be lower since loud reports are too common.

2. 7022 powder might be reinvestigated.

3. The penetration and/or width of our present knurl might be reduced to permit an increase in the swaged diameter and thus strike a better compromise between the barrels.

4. Since all present match loads tend toward lower pressure than formerly, perhaps the bore dimensions of the 40X rifle should be immediately modified to approach M52 dimensions. In particular the bore diameter might be decreased. It would be most helpful if agreement in the industry could be reached on mean dimensions for the barrel interior dimensions.

5. As a side issue the forearm on the M2 rest should be strengthened to permit firing the 40X free floating. Experience indicates that the vibration characteristics of this barrel are most usually optimum when free floating. Some of the vertical stringing in the control tests is due to off-optimum bedding of the barrel.

6. In the present situation our cartridge outshoots competition in the M52, but is worse than competition in the 40X. Universal agreement to this statement may not be possible, but it seems to be the consensus. The 40X rifle is probably the most accurate on the market with Mark III but is inferior to M52 with our present cartridge.

JJOC:jbm

/s/ John J. O'Connor