

## **Shotgun Barrel Failures Caused by Accidentally Mixing 12 bore and 20 bore Cartridges**

This report is a precis of work undertaken at Cranfield University, Royal Military College of Science as part of the requirement for the award of a Masters Degree in Forensic Engineering and Science, and was sponsored by the Birmingham Proof House and the British Association for Shooting and Conservation. The original report written by Mr. Sam Shayegan is available from Cranfield University at the Royal Military College of Science from Dr. DF Allsop who supervised the work and prepared this precis.

### **Introduction**

Mixing 12 bore and 20 bore cartridges is a very dangerous practice. If a 20 bore cartridge is loaded into the chamber of a 12 bore shotgun the 20 bore cartridge will slip down into the forcing cone where it will lodge. When the gun is fired nothing will happen. Upon opening the gun it will appear that the chamber is empty and the Gun may assume that he forgot to load the weapon, especially if there is a long delay between loading and firing. A 12 bore cartridge may then be loaded on top of the 20 bore cartridge with potentially catastrophic results. Each year the Proof Houses are asked to investigate a significant number of barrel failures occurring as a result of mixing 20 bore and 12 bore cartridges. These accidents are increasing due to the increasing popularity of 20 bore weapons. Tests were carried out to investigate the potential hazard from this type of incident. The results are reported below.

### **Test Procedure**

Previous tests carried out at the Royal Military College of Science showed that one of three results occurred from firing a 12 bore with a 20 bore cartridge lodged in the forcing cone. The weapon may be unaffected, the barrel may bulge at a point 115mm from the breech face or the barrel may burst at 115mm from the breech face. These occurrences were in approximately equal proportions. To quantify the actual peak pressure generated during firing under these conditions a robust single barreled 12 bore was fitted with a reinforcing collar and a pressure transducer fitted 115mm from the breech face. Tests were conducted with the 20 bore cartridge touching the 12 bore cartridge and with the 20 bore cartridge pushed as far as possible into the forcing cone of the chamber as shown in Fig 1. Debris from each test firing was collected and examined.

For all of the tests the 12 bore cartridges were 67.5mm long with plastic cases and crimp closure. Lead shot of 28 gram, shot size English 6½, with fibre wads and cardboard over powder and under shot cards was the cartridge loading. For comparison purposes the chamber pressure for the test cartridge and a proof loaded cartridge was measured at 25mm and 115mm from the breech face. The 20 bore cartridges used for the obstruction were 67.5mm long with a plastic case and roll over closure (plastic over shot card). Lead shot of 20 grams, shot size English No. 7, with fibre wads and cardboard over powder and under shot cards was the cartridge loading.

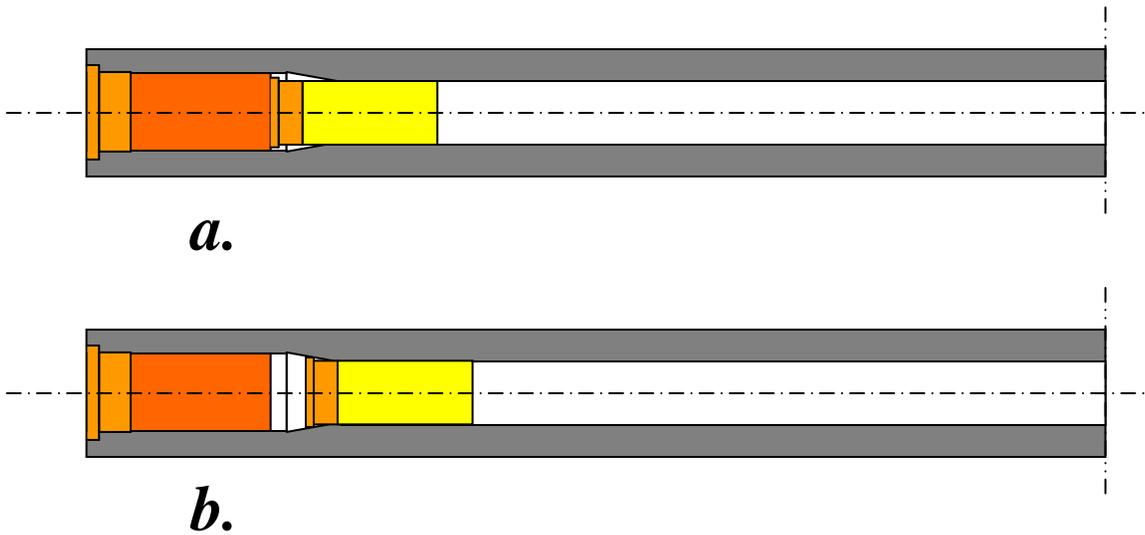


Fig.1. Position of the 20 bore cartridge relative to the 12 bore cartridge prior to firing,  
 a.) With the 20 bore cartridge touching the 12 bore cartridge,  
 b.) With 20 bore cartridge pushed as far as possible into the forcing cone.

**Test Results**

Table 1 shows the average pressures measured at 25mm and 115mm from the breech face for the 12 bore test cartridge and the 12 bore cartridge loaded to proof pressures (average of five cartridges fired for each position).

Table 1 Average pressure measured at 25mm and 115mm from the breech face for standard test cartridge and proof loaded cartridge.

Position	Test cartridge Pressure, bar	Proof loaded cartridge Pressure, bar
25mm from breech	430	753
115mm from breech	313	522

Table 2 shows the pressures measured at 115mm from the breech face for a 12 bore cartridge loaded behind a 20 bore cartridge for the 20 bore touching the 12 bore cartridge and for the 20 bore cartridge pushed all the way into the forcing cone.

Table 2. Peak pressures measured at 115mm from the breech face for a 12 bore cartridge loaded on top of a 20 bore cartridge.

Shot number	20 bore touching cartridge 12 bore cartridge: Peak pressure, bar	20 bore cartridge pushed into the forcing cone: Peak pressure, bar
1	*1026	501
2	*2792	*1967
3	* 909	*860
4	698	*928
5	593	454
6	574	*1630
7	464	*736
8	*988	*839

9	462	* 821
10	898	533
11	618	514
12	510	*1940
13	524	*1178
Average	850	992

The debris from the 20 bore cartridge collected from down range was of two distinct patterns. If the 20 bore cartridge had not been fired then the cartridge case was complete and in several the propellant and wads were still in place. If the 20 bore cartridge had been fired the case was burnt in half. Typical examples are shown in Fig 2. In Table 2 those twenty bore cartridges that had fired are indicated \*.



Fig 2. Typical debris from 20 bore cartridges recovered from down range showing a cartridge that had not fired and one that had fired.

It can be seen that when the 20 bore cartridge fired the peak pressure developed was greater than when firing did not occur. Firing occurred four times when the 12 bore and twenty bore cartridges were touching. Firing occurred nine times when the cartridges were not touching. If firing occurred the peak pressure was always considerably greater than the proof pressure measured at the same point.

It would at first sight seem surprising that the 20 bore cartridge was not fired on every occasion but significant effort is made in the design of cartridges to ensure that they can only be fired when safely load into the chamber of a gun. The anvil in the primer must be struck absolutely correctly for it to fire. When it is in directed contact with the 12 bore cartridge the crimp closure prevents the shot contacting the primer directly so there is less chance of the 20 bore cartridge being fired. When the 20 bore cartridge is loaded further forward there is no protection from the shot in the 12 bore cartridge. A 12 bore cartridge

with a turn over closure and cardboard overshot card is likely to produce a different proportion of 20 bore cartridges being fired, as would a 12 bore with roll over closure and frangible plastic over shot card.

**Recommendations**

The accidental loading of a 20 bore cartridge into the chamber of a 12 bore is one of the most hazardous weapon failures likely to happen by the user of shotguns. The effect is likely to be catastrophic and cause serious injury to the head and hands because of the position of the weapon failure. It is essential therefore that 20 bore and 12 bore cartridges are kept apart *at all times*.