Svenska Jägareförbundet

The European Chemicals Agency

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Field test of .22 LR non-lead ammunition

The Swedish Association for hunting and wildlife management (”the Association”) have been asked by the European Chemicals Agency (“ECHA”) to participate in a third party consultation regarding lead in all ammunition. More specifically, ECHA have asked about the accuracy and suitability of the currently available lead free ammunition in .22 LR and other rimfire calibres for hunting and sports shooting (questions no. 1 & 9 in the consultation).

The Association has not been able to test the ammunition in question during actual hunting, or simulate the internal ballistic effects of the ammunition in alternative tissue test media. The ammunition have only been tested for functionality and accuracy to ascertain if the ammunition have the required accuracy for hitting animals in the vital areas/hitting the center target zone at normal shooting distances during hunting and sport shooting as well fulfil any legal energy requirements for hunting.

There are almost countless manufacturers, brands and versions of .22 LR since it is the most commonly used cartridge in the world, especially for sports shooting. By sport shooting, we use the same definition as in the ECHA proposal – any shooting with a gun at non-living targets. This means that all recreational and practice shooting done by hunters, is also defined as sports shooting. However, we have only found three different versions of non-lead .22 LR ammunition available on the Swedish market. Non-lead rimfire ammunition in other calibres than .22 LR have not been found at the major gun shops in the near area.

For hunting in Sweden with rimfire ammunition, the most common gun is a manually repeating rifle. The energy requirement is 150 J at the muzzle. Normal shooting distances vary considerably depending on the game and type of hunting, but can normally be up to 80 m such as when hunting ptarmigan in the Swedish alpine areas. Most rifle shooting ranges are also 80 m in Sweden. On such game, the vital area of the animal is approximately 2,5 cm in diameter and the accuracy of the ammunition in the particular rifle should be better than that in order to leave room for errors when estimating wind drift and distance.

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Therefore, the test for accuracy using rifles have been conducted with an accurate and high quality manually repeating rifle (Anschütz M1422) with a high quality rifle scope with high magnification (Leupold 6,5-20x40) at 80 m. For the test, in addition to the three lead free loads listed below, a standard type of lead sport shooting ammunition (SK Rifle match) as well as a standard type of lead hunting (+150 J) ammunition (CCI MiniMag) was used as comparison. The shots were fired from a bench rest with very good support by a very experienced shooter.

In some cases, handguns (single shot pistols, revolvers and semi-automatic pistols) in .22 LR are allowed for hunting in Sweden. For example, when hunting badgers under ground and when using a dog that takes a stand against the animal so the hunter can shoot it at close range. Handguns are also allowed when killing animals such as badgers caught in traps. In such instances, the required accuracy is much less since the shooting distance is only a maximum of a few meters. For such hunting and killing there is no formal energy requirement but an effective load for a clean kill is required and of course the ammunition must function properly in the handgun in question.

Consequently, the test also included some handguns in order to verify the functionality, accuracy and performance of the lead free ammunition. The shooting distance used was 25 m, which is the standard shooting distance for sport shooting with pistols. The center ring (10 points) measures 50 mm so the ammunition must have an accuracy that is better than so, otherwise there is no chance of hitting the center of the target during competitions. The accuracy test shots were fired by a highly competitive pistol shooter lying on the ground using a back rest and the gun supported by the body for a good support.

At the first date of the test (March 26, 2021), it was clear that the tested lead free ammunition (Norma Speed) did not recycle the semi-automatic pistol tested (SIG P210 .22LR) and the bullets did not stabilize and gave very poor performance. Therefore, a high quality target shooting revolver (S&W 17-6 with a 21 cm barrel) was used also at a follow- up test (April 15, 2021). Unfortunately, the tested lead free ammunition with the revolver (Norma Power) did not stabilize in the revolver either and gave very poor accuracy. In addition to lead free ammunition and high velocity ammunition (CCI MiniMag), standard type of sport shooting ammunition (SK Flatnose Basic) was used. See more about the results below.

The price per round in the test varies between 3,78 SEK (CCI Copper) to 1,24 SEK (SK Rifle Match) as noted in the table below. However, it is possible to buy cheaper ammunition for recreational shooting such as S&B Club for approximately 0,8 SEK per round and more expensive match ammunition used by high level competitive shooters costs around 3 SEK per round (Lapua Midas).

Anschütz 1422 (60 cm barrel)

Ammunition	Velocity No.1 (m/s)	Velocity No.2 (m/s)	Velocity No.3 (m/s)	Velocity No.4 (m/s)	Velocity No. 5 (m/s)	Group size 80m (mm)	Average Energy V3 (J)	Price per round (SEK)
Norma Power 1,6 gram	459	429	457	485	455	94	167	2,1
Norma Speed 1,6 gram	457	481	464	483	449	64	174	1,86
CCI Copper 1,4 grams	472	519	489	513	511	92*	176	3,78
CCI MiniMag 2,3 grams	405	401	401	401	410	17	187	1,55
SK Rifle Match 2,6 grams	324	317	321	324	315	19	133	1,34

*Did not stabilize. Only 3 shots out of 5 hit the entire target background so it was not possible to measure the 5 shout group size. The measurement is for the 3 shots that were on the target/background.

SIG P210 (12,7 cm barrel)

Ammunition	Velocity No.1 (m/s)	Velocity No.2 (m/s)	Velocity No.3 (m/s)	Velocity No.4 (m/s)	Velocity No. 5 (m/s)	Group size 25m (mm)	Average Energy V3 (J)	Price per round (SEK)
Norma Speed 1,6 grams	309	310	332	350	325	90*	85	1,86
CCI MiniMag 2,3 grams	330	303	306	325	337	32	118	1,55

*Did not stabilize.

S&W 17-6 (21 cm barrel)

Ammunition	Velocity No.1 (m/s)	Velocity No.2 (m/s)	Velocity No.3 (m/s)	Velocity No.4 (m/s)	Velocity No. 5 (m/s)	Group size 25m (mm)	Average Energy V3 (J)	Price per round (SEK)
Norma Power 1,6 grams	326	352	379	273	315	185*	87	2,1
CCI Copper 1,4 grams	376	413	414	391	359	54	107	3,78
SK Flatnose Basic 2,6 grams	268	261	263	264	264	29	91	1,24

*Did not stabilize

The temperature during the tests was between 8-10 degrees Celsius and the winds were mild between 3-5 m/s from the rear left. The velocity was recorded by a Pro Chrony chronograph. Pictures of the test targets are available on request.

Comments and conclusions

In the rifle, the energy requirement for hunting in Sweden with a .22 LR was met with all loads except, as expected, the standard subsonic sport shooting round (SK Rifle Match). For sport shooting, the velocity is normally kept subsonic in order to obtain better accuracy. In addition, the noise will be lower for subsonic loads.

However, the advertised muzzle velocities was not met in the rifle with the non-lead loads and they showed a fairly high extreme spread between the slowest and fastest shot in the 5-shot group. The Norma loads are both advertised at 520 m/s but only reached 457 m/s (Norma Power/-12%) and 467 m/s (Norma Speed/-10%) and had an extreme spread of 56 and 34 m/s respectively. CCI Copper is advertised at 563 m/s but only reached 501 m/s (-11%) and had an extreme spread of 47 m/s.

In comparison, the lead hunting load (CCI MiniMag) is advertised at 384 m/s but exceeded that in the test rifle with an average of 404 m/s (+5%) and low extreme spread of only 9 m/s. SK Rifle Match is advertised at 327 m/s (66 cm barrel) and that number was almost achieved – a loss of 7 m/s in a slightly shorter barrel should be normal (-2,1%) and with a low extreme spread of only 9 m/s too.

Consequently, the lead loads showed low extreme spread between shots and exceeded or almost equalled advertised velocities, whereas all non lead loads showed fairly high extreme spread and a farily high loss of velocity.

The accuracy in the rifle was very good (5 shots within 17 mm – as compared to the vital area of a ptarmigan) for the supersonic lead hunting load (CCI MiniMag) and sufficient for hunting at the tested distance on the game in question. This ammunition is also one of

the most commonly used loads for hunting in Sweden and has a proven effect on game. The accuracy of the sport shooting load was also good and suitable for normal sport shooting (5 shots within 19 mm).

However, the non-lead loads did not perform well in the rifle. CCI Copper did not stabilize in the rifle and only three bullets out of five hit the entire target background at 80 m so a 5 shot group size could not even be measured. CCI copper can therefore not at all be used in the particular rifle and is also questionable in other rifles. According to some unverified information, CCI Copper is no longer available from the manufacturer. The reasons are not clear.

Both Norma non-lead loads did stabilize in the rifle but showed inferior accuracy. Norma Power recorded a 5 shot group of 94 mm and Norma Speed 64 mm – clearly larger than the normal vital area of 2,5 cm. Using such ammunition for general hunting would inevitably lead to missed shots or wounded game and cannot be recommended. However, it may be possible to use these loads for hunting certain allowed game where the hunting form provides for shots fired on very short distances depending on the load used. Sport shooting in the form of recreational "fun" on the shooting range would also be possible with the Norma loads, but not even the lowest level of competition shooting.

In the semi-automatic pistol, the lead high velocity load (CCI MiniMag) functioned properly and gave good accuracy (32 mm at 25 m) with potential to hit the center ring (50 mm diameter), despite fairly high velocity extreme spread between shots (34 m/s). Since this load is primarily designed as a rifle load for hunting which can explains the velocity compared to the rifle – 320 m/s compared to 404 m/s as noted above. For the short distances used during hunting with handguns, this load has regardless of this been proven to be effective on game and is normally recommended for hunting when it is allowed.

However, the first non lead load (Norma Speed) tested did not recycle the action in the semi-automatic pistol and did not stabilize. Velocity was recorded in the chronograph by manually cycling the action, as well as during the accuracy test at 25 m. The tested load showed a high extreme spread between shots (41 m/s) and a velocity of 325 m/s. Compared with the rifle, Norma Speed did also, relatively speaking, loose much more velocity than CCI MiniMag (30% versus 21%).

More importantly, the bullets did not stabilize in the pistol barrel and showed very bad accuracy at 25 m (90 mm). Even at the short distances when hunting with handguns the animal would probably be hit. However, the Norma Speed load can not be recommended for hunting/killing animals since an unstable bullet may not penetrate the animal properly and can behave "irrational" when hitting the animal. Of course, the load cannot be used at all for sport shooting due to bad accuracy/functionality. The test with non lead loads was therefore aborted with the semi-automatic pistol.

With a hope to achieve better results, a target revolver (loaded manually) was therefore tested at a later date. First a standard subsonic sport shooting load with a lead bullet was used (SK Flatnose Basic) which recorded good accuracy (29 mm at 25 m) and low extreme spread between shots fired (7 m/s). The muzzle velocity is advertised at 328 m/s with a 66 cm barrel so the recorded average of 264 m/s should be considered normal in

the shorter revolver barrel, especially considering the gas leakage between the cylinder and the barrel. This load can be recommended for sport shooting and also for the hunting applications mentioned above, considering the energy levels produced.

Testing the other Norma non lead load (Norma Power) in the revolver also produced disappointing results. The revolver functioned properly since it is reloaded manually, but the bullets did not stabilize and recorded a 185 mm group on 25 m, barely hitting the entire target, let alone the center ring of 50 mm. The extreme spread was very high at 106 m/s with an average velocity of 329 m/s, very similar to Norma Speed in the semi-automatic pistol. For the reasons set out above, this load cannot be used for hunting nor target shooting.

CCI copper was also tested in the revolver, this time with better results. The bullets stabilized and produced a 54 mm group at 25 m. The recorded average velocity was 391 m/s, significantly higher than the two Norma loads, although the extreme spread was high with 55 m/s. This is not adequate for any type of competitive sport shooting (50 mm center score), but is sufficient for recreational "fun" shooting.

Considering the energy level and the fact that the bullet stabilizes, the CCI Copper load could also be useful for the hunting applications mentioned above, when shooting on short distances with the revolver. However, since we have not been able to test the performance of the bullet upon impact on the animal, and the level of penetration and expansion/deformation, it is not possible to confirm it is suitable. Moreover, if the product is no longer available from the manufacturer, it will be difficult to perform any such tests.

In conclusion, we have found two non lead load that stabilized in a .22 LR hunting rifle (and one that did not). However, the accuracy was inferior to lead loads and should not be used for this reason alone for general hunting, only on very short distances limiting its suitability for hunting considerably. It is possible however to use it for recreational "fun" sport shooting, but not for any form of competitive sport shooting. The same non lead loads stabilizing in the rifle did not stabilize in the handguns tested. To the contrary, the one non-lead load that did not stabilize in the rifle did stabilize in a revolver. The accuracy was inferior to lead loads, but could be used for limited hunting applications with handguns on short distances, or, recreational non competitive "fun" sport shooting. No non lead load was found that functioned or stabilized in the tested semi-automatic pistol. ***Consequently, there are not sufficiently functional and accurate non lead alternative .22 LR ammunition available on the market today.***

THE SWEDISH ASSOCIATION FOR HUNTING AND WILDLIFE MANAGEMENT

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