"**All previous Decisions concerning lead-free shot are superseded"**

Base document for ammunition specifications for lead-free shot

1 - Definition of types of shot made of homogeneous or heterogeneous materials

Type A – Lead-free shot made of homogeneous material with a hardness ≤ 40 HV1
Type B – Lead-free shot made of homogeneous material with an average hardness value > 40 but ≤ 110 HV1 (≤ 125 HV1 individual value)
Note – Steel pellets, the first lead-free shot used, fall in this type category.
Type C - Lead-free shot made of heterogeneous material with a deformation ≤ 45%. Heterogeneous shot presenting a deformation less than that of steel pellets of the same diameter may not be loaded into these cartridges.
Type D – Lead-free shot made of heterogeneous material with a deformation > 45%

In the case of cartridges loaded with lead-free shot of types B and C, the pellet load should be equipped with direct and sufficiently resistant protection designed to avoid any friction between the pellets and the wall of the barrel. The protection must resist firing from -20° to + 50° C.

In the case where the lead-free shot cannot be neatly classified as homogeneous or heterogeneous and placed into one of the four types defined above (A, B, C, D) by means of characterisation tests, the Proof House may require the petitioner to conduct further tests in a weapon in order to determine the specifications of the loaded cartridges (velocity – momentum). Characterisation of shot: Methods for defining hardness and deformation (see appendices).

2 - Definition of Ammunition

A) Ordinary ammunition for firearms with ordinary testing

- Cartridges loaded with Type A and D shot, with l < 73 mm and Pmax = 740 bar for 12 gauge calibres, Pmax = 780 for 16 gauge calibres or even Pmax = 830 bar for 20 gauge calibres and smaller, are to be checked as for plain lead shot cartridges, and

- Cartridges loaded with Type B and C shot with l < 73 mm and Pmax = 740 bar for 12 gauge calibres, Pmax = 780 bar for 16 gauge calibres or even Pmax = 830 bar for 20 gauge calibres and smaller, and shot diameter limits, velocities and momentums (see Table I below)

Table I

Calibre	Pellet Diameter mm	Max velocity $V_{2.5}$ m/s	Max momentum $M_{2.5}$ Ns
12	3.25 + 2% max	425	12.0
16	3.00 + 2% max	390	9.5
20	3.00 + 2% max	410	9.3

B) High performance ammunition for firearms with superior testing

Cartridges loaded with shot of Types A and D:

- with l ≥ 73 mm and
- with l < 73 mm and P > 740 bar for 12 gauge calibres, P > 780 bar for 16 gauge calibres or even P > 830 bar for 20 gauge calibres and smaller, but respecting Pmax = 1050 bar, are to be checked as for plain lead shot cartridges.

C) **High performance ammunition for firearms with steel shot testing**

Cartridges loaded with shot of Types B and C:

- with l ≥ 73 mm and
- with l < 73 mm and P > 740 bar for 12 gauge calibres, P > 780 bar for 16 gauge calibres or even P > 830 bar for 20 gauge calibres and smaller or a value exceeding one of the values in Table I, but respecting Pmax = 1050 bar and the values of Table II below, may only be used for weapons with steel shot tests.

Table II

Calibre	Max velocity $V_{2.5}$ m/s	Max momentum $M_{2.5}$ Ns	Choke as a function of pellet diameter
10/89	440	19.0	Choke ≤ 0.5 for diameter > 4 mm
12/70	430	13.5	Choke ≤ 0.5 for diameter > 4 mm
12/73	430	15.0	idem
12/76	430	15.0	idem
12/89	430	19.0	idem
16/70	420	12.0	Choke ≤ 0.5 for diameter > 3.5 mm
20/70	410	11.0	Choke ≤ 0.5 for diameter > 3.25 mm
20/76	430	12.0	idem
28/70	400	7.0	Choke ≤ 0.5 for diameter > 3 mm
28/76	430	8.5	idem
.410/76	430	4.2	Choke ≤ 0.5 for diameter > 2.5 mm

3 - CARTRIDGE MARKING

- **Generalities for all types of cartridges**

All cartridges with steel shot or lead-free shot, whether ordinary or high performance or proof ammunition, must bear the following markings:

- the identification of the cartridge manufacturer or the entity who loaded the cartridge or who is the guarantor (by means of a trademark or mark of origin) and the indication of the nature of the primary component, printed on the base or the tube of the shell (casing) in an indelible manner. This marking may be in one of the languages used by the C.I.P. Member States.
- the calibre of the cartridge according to its TDCC denomination on the base or, if not possible due to technical reasons, on the body of the shell (casing) in an indelible manner.
- the diameter in mm of the steel pellets or lead-free shot.

Note: The shell (casing) for cartridges for 20 gauge firearms should be yellow in colour.

- **High Performance Cartridges**

In addition to the preceding markings, high performance cartridges must bear:

- the length of the shell (casing) if it exceeds 65 mm for 20 gauge calibres and greater, 63.5 mm for 24 gauge calibres and smaller.
- the identification on either the back side of the base in a different colour, or the inscription "*Max 1050 bar*" or "*For weapon proofed to 1320 bar*" on the body of the shell (casing) in one of the languages used by the C.I.P. Member States.

- **Proof Cartridges**

Proof cartridges must be identifiable by either a serrated/indented base, red colour on the back of the base, or an inscription on the body of the shell (casing) in one of the languages used by the C.I.P. Member States: "*Proof ammunition*" along with the test pressure of the calibre.

4 - CARTRIDGE BOX MARKINGS

- **Generalities for all types of cartridges**

All cartridges with steel shot or lead-free shot must bear distinctive markings with the following components:

- the name or trademark of the manufacturer or the entity who loaded the cartridge and who is the guarantor of its conformity to the specifications in effect.
- the designation according to the TDCC denominations.
- the identification number of the batch and the number of cartridges in the basic packaging.
- the nature of the materials constituting the shot and the type of shot (A, B, C or D). These inscriptions may be in one of the languages used by the C.I.P. Member States.
- the inspection mark attesting that the ammunition has been checked according to the requirements of the C.I.P.
- for cartridges with steel shot or lead-free shot of types B and C, the inscription**:**

"Beware of ricochets, never fire at rigid or hard surfaces."

- **High Performance Cartridges**

- For cartridges loaded with lead-free shot of types A and D, an additional marking clearly indicating that these may only be fired by weapons that have undergone superior testing.
- For cartridges loaded with lead-free shot of types B and C, an additional marking clearly indicating that these may only be fired by weapons that have been undergone steel pellet testing.
- If the diameter of the lead-free shot (of types B and C) in 10 and 12 gauge calibres is > 4 mm, for 16 gauge calibre is > 3.5 mm and in 20 gauge calibres > 3.25 mm, an additional marking indicating that the cartridges may only be fired by weapons that have undergone steel pellet testing and whose barrel(s) have a choke ≤ 0.5 mm.

- **Reloaded Cartridges**

In this case, an additional marking should be affixed to indicate that these are reloaded cartridges.

- **Proof Cartridges**

In this case, the additional marking "*proof ammunition*" must be affixed to the packaging.

5 – Firearms Testing

- Ordinary testing of firearms:

For firearms allowing the firing of ordinary ammunition loaded with lead shot or lead-free shot of types A and D, the ordinary test entails firing at least two cartridges per tube, where the firing of these two cartridges should allow each of the following conditions to be met:

a) maximum mean pressure of at least 930 bar for 12 gauge calibre, 980 bar for 16 gauge calibre and 1040 bar for 20 gauge calibre, is attained in the chamber at the 1st manometer.
b) pressure between 450 and 600 bar is attained in the bore, at the 2nd manometer.

- Superior testing of firearms:

For firearms allowing the firing of high performance ammunition loaded with lead shot or lead-free shot of types A and D, the superior test entails firing at least two cartridges per tube, taking into account the appropriate ordinary test. The firing of these two cartridges should allow each of the following conditions to be met:

a) maximum mean pressure of at least 1320 bar is attained in the chamber at the 1st manometer.
b) pressure between 450 and 600 bar is attained in the bore, at the 2nd manometer.

The conditions defined above for the two preceding tests are performed by two identical cartridges that both meet conditions a) and b).
In the case where the two cartridges are not available, it is allowable to use two cartridges that meet condition a and one cartridge that meets condition b).
The diameter of the lead grain may not exceed 3 mm for the two preceding tests.

- Steel shot weapons test:

Firearms allowing the firing of high performance ammunition loaded with lead-free shot of types B and C are tested with 3 cartridges per tube with the following specifications:

- loading with steel pellets with a hardness HV1 between 80 and 110,
    - pressure of ≥ 1320 bar at the 1st manometer
    - and between 450 and 600 bar at the 2nd manometer
- respecting the specifications within Table III below:

Table III

Calibre	Mini Diameter of Pellets mm	Mini Momentum $M_{2,5}$ Ns
10/89	4.6	22.0
12/70	4.6	15.0
12/73 – 12/76	4.6	17.5
12/89	4.6	21.5
16/70	3.8	13.5
20/70	3.8	12.5
20/76	3.8	14.0
28/70	3.8	8.5
28/76	3.8	9.0
.410/76	2.8	4.5

In the case where the three cartridges respecting all the conditions mentioned above are not available, it is allowable to fire three cartridges meeting the pressure conditions at M1 and the momentum allowances of Table III above and a cartridge meeting the pressure condition at M2. This latter cartridge may be fired with lead pellets.

6 – Characterisation of shot

- **Method of execution of hardness test**

Homogeneous lead-free shot (metal or metal alloy) of types A and B are characterised by a Vickers hardness test at their core following ISO International Norms and European CEN Reference EN ISO 6507-1 Metallic Materials – Vickers Hardness Test Method (see Appendix 1).

- **Method of execution of deformation test**

Heterogeneous lead-free shot (composite metallic powder and resin) of types C and D are characterised by a deformation test (see Appendix 2).

7 – Table

A summary table covering the C.I.P. specifications for lead-free shot cartridges of types B and C is included in the “Information” documents of C.I.P. texts.

Appendix 1

INSPECTION ***OF AMMUNITION LOADED WITH LEAD-FREE SHOT***

1. Core Vickers Hardness Test Method

This method is applicable to homogeneous shot (metal – alloy)

1.1. Applicable Norm

- International (ISO) and European (CEN)
- EN ISO 6507-1: Metallic Materials – Vickers Hardness Test – Part 1: test method.

1.2. Procedure for lead-free shot

- The measurement is carried out at the core of the shot, which requires drilling to obtain a half-sphere with a flat and smooth surface for testing.
- A simple of 10 shot pellets must be tested from each batch: one measurement per pellet.
- Hardness is measured pursuant to the Vickers method specified above with the test load F set at 9.807 N, using the symbol HV 1.
- An arithmetic mean of the hardness of the sample of 10 pellets is calculated:
- It should be ≤ 110 HV 1 with no individual value > 125 HV 1.

Then a classification of shot pellets can be established as a function of the mean value measured:

- Type A: ≤ 40 HV 1
- Type D: > 40 HV 1.

INSPECTION *OF AMMUNITION LOADED WITH LEAD-FREE SHOT*

2. Deformation measurement method

This method applies to heterogeneous shot (composite metallic powder + binder…)

2.1. Principle

Shot is subjected to a crush test using a steel metal pellet with a mass of 500 ± 1 g from a height of 500 ± 2 mm (distance between the base of the pellet and the base of the metallic piston above the shot).

The device includes a metallic base supporting the shot pellet, a bracket that supports the 500 g metal pellet, a cylindrical metallic piston and a magnetic release system for the pellet (the hardness of the pellet, the support platform and the piston should be 60 ± 5 HRC).

The diameter of the shot pellet is measured before and after the test and the deformation is calculated as a percentage of change in the diameter:

$$\text{Deformation } D = \frac{\text{Initial diameter - Diameter after crushing}}{\text{Initial diameter}} \times 100\ (\%)$$

2.2. Procedure for lead-free shot

- The measurement is carried out on a single shot pellet.
- A sample of 10 shot pellets should be tested from each batch.
- The deformation is measured pursuant to the method specified above.
- The shape of the shot pellet after crushing is noted: presence of fissures – fragmentation…
- An arithmetic mean of the deformation of 10 shot pellets is calculated.

  It is compared to those known for lead and steel shot pellets of the same diameter.

  A classification of shot pellets can be established as a function of their deformation:

  - Type C: Deformation ≤ 45 %
  - Type D: Deformation > 45 %