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**Specifications for Elemental Powders
of
TUNGSTEN ALLOY SPHERE**



ISSUED BY

ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT

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SPECIFICATIONS OF TUNGSTEN POWDER FOR USE IN
MANUFACTURE OF TUNGSTEN Alloy FRAGMENTS

1. Preamble

- 1.0 The Tungsten alloy projectiles / fragments (TAPS) of different types like spheres, cubes & cuboids are used in various types of warheads. These TAPS are manufactured through the Powder metallurgy route using a mixture of three types of Elemental Powders in specific proportions. The major constituent is Tungsten powder, and the AHSP specifications state the composition of W in the Tungsten Alloy as 94 to 96 %.
- 1.1 The necessity of preparing this specification has arisen, as the Quality Assurance plan for the fragments states that the chemical composition of the batch mixture should be within the specified range as per drawing, but does not state anything about the specification of input raw material like Tungsten, to be used for manufacture of these TAPS.
- 1.2 HAPP had been so far manufacturing the TAPS with the Tungsten powder available at HAPP, procured for manufacturing of FSAPDS as per CQA(M)-58 specification. The CQA(M) -58 specifications specifically governs the supply of Elemental Powders for manufacture of FSAPDS projectiles. The specification has been particularly made to cater the manufacture of Penetrator blanks for FSAPDS, incorporating stringent chemical composition, Performance conformity test and Type testing that are required only for Penetrator blanks.
- 1.3 Hence, there is a need to frame separate specification of Tungsten powder for manufacture of the TAPS, incorporating the requirements of TAPS.
- 1.4 Accordingly, this document outlines the specification of Tungsten Powder to be specifically used for manufacture of TAPS of different sizes.

2. Foreword

- 2.1 This specification has been prepared for HAPP, Trichy in consultation with Defence Metallurgical Research Laboratory, Hyderabad and allied establishments.
- 2.2 The specification is approved by Heavy Alloy Penetrator Project, Trichy Ministry of Defence (OFB), and is mandatory for use in defence services.
- 2.3 Supplier of Raw materials are subject to approval by The General Manager, HAPP, Trichy or his authorized representative.
- 2.4 Any queries/ clarification relating to the materials of this specification should be referred to The General Manager, HAPP, Trichy or his authorised representative.

- 2.5 The Inspecting Officer for Raw Material shall be The General Manager, HAPP, Trichy or his authorized representative.

3. Scope and Definition

- 3.1 This specification relates to the Procurement, Inspection and Quality Control of Tungsten Powder for use in manufacture of fragments to be used in warheads.
- 3.2 **Apparent Density** - It is the weight of a unit Volume of Loose Powder expressed in grams per cubic centimeter. This characteristic defines the actual volume of occupied by a mass of loose powder.
- 3.3 **Average particle Size** – Expressed in Microns, when tested as per the specification.

4. General Requirement

- 4.1 The Supplier shall provide the following to the Inspection Officer or his authorized representative, for Inspection and testing of the Powders supplied
- a) Sufficient Quantity of Powders as required for conducting the Tests.
 - b) Test certificates for the Chemical composition test and the physical property tests as per clause 6.1 & 6.2 of this specification, carried out on each batch of powder, by the supplier at his premises before dispatch. The batch/lot size of powder shall be defined by the supplier in his quotation.
- 4.2 **Packing** – The material should be packed in a double polythene film bags duly sealed and shall be packed in weather tight sealed and reinforced steel drums having lifting rings provided at sides and top. The drum should be packed in seaworthy/roadworthy crates, which should be sturdy to withstand any possible damage to the drums during transit and Handling.
- 4.3 **Marking** – Each Drum shall be superscribed with Batch/Lot no. Purchase order no., Quantity in the Drum, date of manufacture, Name of the manufacturer, and date of final Sealing. Each crate shall carry the following details on a Paper duly sealed in a Water proof polythene cover and attached to the crate:
Name of the Manufacturer, Purchase Order No. The Consignee, The Order Quantity, The Batch /Lot no., Date of Manufacture, Date of Crating, Total nos, of drums in the crate, Total Quantity.

5. Quality Assurance

- 5.1 The supplier shall provide a Tungsten powder sample of 2 kgs representing a homogenized batch/ Lot, from each batch/lot of Tungsten powder as a Pilot Sample for inspection, testing and approval of the purchaser prior to bulk dispatch. The Pilot sample should comply to the chemical composition and Physical properties stipulated at Clause 6.1 and Clause 6.2 respectively.

- 5.2 The supplier shall provide a Test Certificate to this effect from a National/International Accredited Laboratory for the each batch of powder supplied.
- 5.3 One sample of 500 gms (max.) of powder shall be drawn from each pilot batch and subjected to Chemical composition and Physical properties testing.
- 5.4 The Chemical Composition test shall be carried out by adopting standard methods for compliance with the requirements of this specification as stipulated at Clause 6.1.
- 5.5 The sample shall be tested for physical properties like Apparent/bulk Density and Average Particle Size using Standard Testing methods for compliance with the requirements of this specification as stipulated at Clause 6.2.
- 5.6 On successful completion of the tests, the purchaser shall accord clearance for supply of Bulk lots/batches.
- 5.7 Each Bulk lot/batch shall be subjected to chemical composition and physical properties testing. Three representative samples of 500 gms (max) each shall be taken randomly from each batch and tested for the above parameters using standard methods for compliance with the requirements of this specification as stipulated at Point Clause 6.1 and Clause 6.2 respectively. In case the batch size is more than 10000 kgs, for every 10000 kgs three representative samples shall be taken.

6.0 ACCEPTANCE CRITERIA

6.1 Chemical Composition (Tungsten Powder)

The chemical composition shall conform to :

W	-	99.90 % min. (by difference on Gas free Basis)
Ca	-	50 ppm max
Al	-	20 ppm max
Mg	-	15 ppm max
K+Na	-	30 ppm max
Cu	-	20 ppm max
Mn	-	20 ppm max
Sn	-	20 ppm max
As	-	20 ppm max
Bi	-	20 ppm max
Si	-	40 ppm max
C	-	40 ppm max
S	-	10 ppm max
P	-	20 ppm max
O	-	2000 ppm max

6.1.1 Physical Properties

The Physical Properties of the Powder shall conform to :

Average Particle Size	-	3.0 to 6.0 Microns FSS
Apparent Density	-	3.0 to 5.0gm/cc

6.2 Chemical Composition (Nickel Powder)

The chemical composition shall conform to :

Ni	-	99.70 % min.
Sn	-	10 ppm max
Sb	-	10 ppm max
S	-	10 ppm max
P	-	20 ppm max
C	-	3000 ppm max
O	-	2000 ppm max

6.2.1 Physical Properties

The Physical Properties of the Powder shall conform to :

Average Particle Size	-	2.2 to 3.3 Microns
Apparent Density	-	0.5 to 0.95 gm/cc

6.3 Chemical Composition (IRON Powder)

The chemical composition shall conform to :

Fe	-	99.5 % min.
Cr	-	150 ppm max
Pb	-	10 ppm max
Ca	-	40 ppm max
Mn	-	50 ppm max
S	-	10 ppm max
P	-	20 ppm max
C	-	500 ppm max
O	-	2500 ppm max

6.3.1 Physical Properties

The Physical Properties of the Powder shall conform to :

Average Particle Size	-	5.0 to 7.5 Microns
Apparent Density	-	2.0 to 3.5 gm/cc

18 Dec 12

Amendment Sheet

Amendment Number	Date	Details of Amendment	Authority
01	14/12/12	Cr. Content in Iron powder , which was erroneously typed is corrected as below. For : 10 ppm Read : 150 ppm	

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