

MIL-A-81335(WP)
8 November 1965

MILITARY SPECIFICATION

ALUMINUM POWDER, SPHERICAL

This specification has been approved by the Bureau of Naval Weapons, Department of the Navy.

1. SCOPE

1.1 This specification covers one grade of atomized spherical aluminum powder.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

RR-S-366 Sieves, Standard, For Testing Purposes

Military

MIL-A-512 Aluminum, Powdered, Flaked, Grained, and Atomized

STANDARDS

Military

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-129 Marking for Shipment and Storage

(When requesting any of the applicable documents, refer to both title and number. All requests should be made via the cognizant Government inspector. Copies of this specification and other unclassified specifications and drawings required by contractors in connection with specific procurement functions should be obtained upon application to the Commanding Officer, Naval Supply Depot (Code 1051), 5801 Tabor

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Avenue, Philadelphia, Pennsylvania 19120. All other documents should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 No data is required by this specification or by applicable documents referenced in Section 2, unless specified in the contract or order.

3.2 Material - The spherical aluminum powder shall be a product of high quality, suitable for the purpose intended, and so manufactured as to meet the requirements specified herein.

3.3 Chemical and physical properties - The spherical aluminum powder shall conform to the chemical and physical properties listed in Table I.

TABLE I

Chemical and Physical Properties

Characteristic	Requirement	Test Paragraph
Free Metallic Aluminum, percent by weight, min.	99.0	4.4.2
Volatiles at 105°C, percent by weight, max.	0.1	4.4.3
Oil and Grease, percent by weight, max.	0.2	4.4.4
Iron, percent by weight, max.	0.2	4.4.5
Copper, percent by weight, max.	0.5	4.4.6
Alkalinity as $Mg(OH)_2$, percent max.	0.07	4.4.7
Average particle size, microns	22±5	4.4.8
Bulk density, min.	1.65	4.4.9
Sieve test, percent by weight		4.4.10
through 100 sieve, min.	99.0	
through 200 sieve, min.	90.0	
through 325 sieve, min.	80.0	

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3.4 Shape - The shape of the aluminum powder shall be spherical when examined as specified in 4.4.11.

3.5 Workmanship - This material shall be uniform in quality and shall conform to the requirements of this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Acceptance inspection - Conformance of the spherical aluminum powder to the requirements of this specification shall be determined entirely by means of acceptance inspection. The acceptance inspection shall consist of an examination for acceptability of quality control methods used by the manufacturer, examining and testing the acceptance samples (4.3.2) for all of the requirements of this specification, and an examination of the sample of filled containers (4.3.3) for conformance to the packaging, packing, and marking requirements.

4.3 Sampling -

4.3.1 Size of lot - For the purpose of sampling, a lot of spherical aluminum powder shall consist of a manufacturer's batch. If the material cannot be identified by batch, a lot shall consist of not more than 1,000 pounds of spherical aluminum powder offered for delivery at one time.

4.3.2 Sample for tests - From each lot offered for acceptance under contract, two one-pound samples of spherical aluminum powder shall be removed from separate unit containers taken at random.

4.3.3 Sample for examination of filled containers - A random sample of filled containers shall be selected from each lot of spherical aluminum powder offered for acceptance under contract, in accordance with MIL-STD-105 at Inspection Level I and acceptable quality level (AQL) = 2.5 percent defective.

4.4 Inspection methods -

4.4.1 Visual inspection - Conformance of the spherical aluminum powder to the requirements for material (3.2) and workmanship (3.5) shall be determined by visual inspection.

4.4.2 Free metallic aluminum - Weigh 0.900 gm of the sample and transfer to a 500 ml flask containing 50 ml distilled water. Add

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20 ml conc. HCl in 5 ml increments and heat to boiling. Cool and dilute to 1 liter with distilled water in a volumetric flask. Remove a 50 ml aliquot, warm to 70° -80°F and add about 25 ml 5 percent 8-hydroxyquinoline (in acetic acid). Slowly add 40 ml 2M ammonium acetate (154 gms ammonium acetate in 1 liter distilled water). If supernatant liquid is yellow, enough reagent has been added. Collect precipitate in a tared fritted glass crucible. Wash well with distilled water. Dry for three hours at 120°C, cool in a desiccator and weigh. Calculate as follows:

$$\text{Percent Aluminum} = \text{Weight precipitate} \times 130.5.$$

4.4.3 Volatiles - Heat a weighing bottle in a drying oven at 105°C for 45 minutes. Cool in a desiccator for 30 minutes with the cover off. Weigh bottle and cover to the nearest 0.1 mg. Record as W1. Add approximately 5 gms of sample to weighing bottle and weigh to nearest 0.1 mg with cover in place. Record as W2. Remove cover and place bottle and cover in drying oven at 105°C for 3 hours. Remove bottle and cover from oven and allow to cool in desiccator for 30 minutes. Place cover on bottle and reweigh to nearest 0.1 mg. Record as W3. Calculate as follows:

$$\text{Percent Volatiles} = \frac{W2-W3 \times 100}{W2-W1}$$

4.4.4 Oil and grease - Dry a clean 400 ml flask in an oven at 90°C, and cool in a desiccator to constant weight. Weigh to nearest 0.1 mg and record as W1. Weigh about 10 gm of sample to the nearest 0.1 mg and extract with 100 ml ethyl ether using an extraction apparatus with a Whatman single thickness, fat free extraction thimble. After extraction has been completed, evaporate ethyl ether almost to dryness on hot plate. Dry residue in oven at 90°C to a constant weight. Cool in desiccator, weigh and record as W2. Run a blank with each group of tests and record as W3. Calculate as follows:

$$\text{Percent Oil and grease} = \frac{(W2-W1) - W3 \times 100}{\text{Weight of sample}}$$

4.4.5 Iron - Weigh about 5 gm of sample to the nearest 0.1 mg and transfer to a 500 ml flask. Add 200 ml of 1:5 sulfuric acid (iron free) slowly to avoid spattering. Cover with a watch glass and allow solution to stand until all aluminum is dissolved. Titrate immediately with 0.02N potassium permanganate solution. Calculate as follows:

$$\text{Percent Iron} = \frac{5.584 \times \text{ml KMnO}_4 \text{ used} \times \text{normality KMnO}_4}{\text{Weight of sample}}$$

4.4.6 Copper - The amount of copper present shall be determined using the test method specified in MIL-A-512.

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4.4.7 Alkalinity - The alkalinity shall be determined using the test method specified in MIL-A-512.

4.4.8 Average particle size - The average particle size shall be determined using the Fisher Sub-Sieve Sizer with sample tubes, porous plugs, plug manipulator and paper discs. The Fisher Sub-Sieve Sizer Calibrator (Fisher Cat. No. 14-313-7) shall be used as a secondary standard.

4.4.8.1 Checking of apparatus - Check water level in standpipe of pressure regulator. Adjust water level as required. Check drying agent in rear of cabinet. Remove and dry in oven if indicator is pink. Check sample packing assembly to see that pointer tip coincides with the base line on the calculator chart. Check calibration with Fisher Sub-Sieve Sizer Calibrator. If calibration is off, adjust flowmeter wires according to calibration instructions.

4.4.8.2 Procedure - Attach porous plug to plug manipulator, center a paper disc over end of sample tube and push plug into sample tube with perforated surface against paper disc. Remove plug manipulator and place sample tube in vertical position on metal post of support stand to force plug to proper height inside sample tube. Weigh to nearest 0.01 gm a sample of powder equal in grams to the true density of sample (2.7 gms). With a funnel, transfer weighed sample to sample tube. Tap side of tube to settle powder. Center another paper disc over the top of the tube and force a second plug (perforated surface against paper disc) into tube. Push plug and disc downward until powder is compacted against lower plug and disc. Place sample tube on post under rack and pinion with lower plug in contact with post. Lower rack until upper plug is in contact with bottom of the rack. Turn pinion knob firmly until sample is packed to minimum porosity. Shift Calculator Chart laterally until tip of pointer coincides with the Sample Height Curve. Place sample tube (without disturbing sample) between rubber cushion supports. Clamp upper tube down until air-tight seal is obtained at both ends. Turn on switch. When liquid level in manometer has reached maximum height turn pinion knob until bar on rack is at bottom of meniscus in manometer. Read particle size at tip of pointer. Fine powders may require five minutes or more running time before maximum height is reached. If the APS is 0.2 to 20 microns, read chart directly. If APS is between 20 and 50 microns, turn range control indicator to left and double chart readings.

4.4.9 Bulk density - The bulk density shall be determined using a 100 ml graduated cylinder and a test stand consisting of ring supports for the cylinder, a motor driven cam which raises cylinder one inch, rotates cylinder one-half turn and drops cylinder onto hard rubber pad 60 times per minute. Weigh 50 gm of sample to nearest 0.01 gm and transfer to 100 ml graduated cylinder. Place cylinder in ring supports so that base rests on hard rubber pad and outer edge of base extends over cam. Turn on motor and allow to run for ten minutes. Record height of packed sample and calculate as follows:

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Bulk density =
$$\frac{\text{Weight of sample in gm}}{\text{Volume of sample after agitation, ml}}$$

4.4.10 Sieve test - The sieve test shall be conducted using a Tyler Ro-Tap Testing Sieve Shaker and US Standard sieves (PR-S-366). Stack required sieves with coarsest sieve on top and finer sieves on bottom. Place a catch pan at bottom of stack. Weight to nearest 0.01 gm a 50 gm sample and brush onto uppermost sieve. Place a sieve cover on top of stack and lock stack on sieve shaker. Shake for 15 minutes. Carefully brush material passing through the 325 mesh sieve onto weighing pan and weigh to nearest 0.01 gm. Add material from next higher sieve and weigh. Continue until all material has been weighed. Multiply each weight by 2 to obtain weight percent at each sieve level. Repeat analysis if total recovered weight is less than 99 percent.

4.4.11 Shape - A small portion of each sample shall be examined under a microscope to determine conformance to the shape requirement.

4.5 Rejection criteria - If a sample fails to meet any of the test requirements of this specification, the lot represented by the sample shall be rejected.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging -

5.1.1 Level A - Not applicable.

5.1.2 Level B - Not applicable.

5.1.3 Level C -

5.1.3.1 Cleaning, drying and preservation application - Not applicable.

5.1.3.2 Unit packaging - Unless otherwise specified, unit packaging of the material shall be in clean, dry containers of the size and type specified by the purchase order.

5.2 Packing -

5.2.1 Level A - Not applicable.

5.2.2 Level B - Not applicable.

5.2.3 Level C - Material packaged in accordance with 5.1.3.2 shall be packed to afford protection against damage during shipment from the supply source to the first receiving activity for immediate use. Containers shall comply with Consolidated Freight Classification Rules or other common carrier regulations applicable to the mode of transportation.

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5.3 Marking - In addition to the markings required by contract or order, unit packages and shipping containers shall be marked in accordance with the requirements of MIL-STD-129.

6. NOTES

6.1 Intended use - Spherical aluminum powder covered by this specification is intended for use in explosives.

6.2 Ordering data - Procurement documents should specify the following:

- (a) Title, number and date of this specification
- (b) Quantity required in pounds.
- (c) Applicable levels of packing and marking with requirements in detail, if other than as specified in Section 5.
- (d) Size and type of container desired.

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

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ALUMINUM POWDER, SPHERICAL

ORGANIZATION (Of submitter)

CITY AND STATE

CONTRACT NO.

[illegible]

DOLLAR AMOUNT	
1	100
2	200
3	300
4	400
5	500
6	600
7	700
8	800
9	900
10	1000
11	1100
12	1200
13	1300
14	1400
15	1500
16	1600
17	1700
18	1800
19	1900
20	2000
21	2100
22	2200
23	2300
24	2400
25	2500
26	2600
27	2700
28	2800
29	2900
30	3000
31	3100
32	3200
33	3300
34	3400
35	3500
36	3600
37	3700
38	3800
39	3900
40	4000
41	4100
42	4200
43	4300
44	4400
45	4500
46	4600
47	4700
48	4800
49	4900
50	5000
51	5100
52	5200
53	5300
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60	6000
61	6100
62	6200
63	6300
64	6400
65	6500
66	6600
67	6700
68	6800
69	6900
70	7000
71	7100
72	7200
73	7300
74	7400
75	7500
76	7600
77	7700
78	7800
79	7900
80	8000
81	8100
82	8200
83	8300
84	8400
85	8500
86	8600
87	8700
88	8800
89	8900
90	9000
91	9100
92	9200
93	9300
94	9400
95	9500
96	9600
97	9700
98	9800
99	9900
100	10000

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT



☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES☐ NO

IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED (Printed or typed name and activity)

TABLE 1

FOLD

DEPARTMENT OF THE NAVY
Naval Air Engineering Center
Philadelphia, Pennsylvania 19112

POSTAGE AND FEES PAID
NAVY DEPARTMENT

OFFICIAL BUSINESS

BuWeps Engineering Standardization Office (Code X)
Naval Air Engineering Center
Philadelphia, Pennsylvania 19112

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