भारत सरकार, रक्षा मंत्रालय
रक्षा अनुसंधान एवं विकास संगठन
आयुध अनुसंधान एवं विकास संस्थापन
डॉ. होमी भाभा पथ,
आयुध डाकघर, पाषाण,
पुणे - 411021
भारत

Government of India, Ministry of Defence
Defence R & D Organisation (DRDO)
Armament R&D Estt. (ARDE)
Dr. Homi Bhabha Road,
Armament Post, Pashan,
Pune - 411021
INDIA

आइ.एस.ओ 9001 : 2015 प्रमाणित
ISO 9001 : 2015 Certified

Azadi Ka Amrit Mahotsav

रक्षा मंत्रालयकी सेवामें
Service to Services

वेबसाईट / Website : www.drdo.gov.in

FAX

File No : ARDE/1/1/10-Tech (PS)

Dt. 04 May 2022

To :

The Sr. General Manager
Ordnance Factory, **Chanda - 442 501**
(K.A: Shri Summe Kumar Jindal, WM
Shri Gurpinder singh, AWM)
--Fax No. 07175- 254043 / 254276

Sub: Regarding Procedure of De-plating, Re-plating & Re-rubberising of Steel cup for 120mm Arjun Amn & list of established suppliers.

Ref: Your letter No. 4401/PV/2022 Dtd. 27/04/2022 & U-V/026/HESH Dtd. 25/04/2022

Procedure for De-plating/removal of Zinc plating & Chromate Passivation of Steel Cup for 120mm Arjun Ammn, as received from the vendor, is enclosed herewith for your reference. Re-plating & Re-rubberising is to be carried out as per the relevant specification mentioned in the specification of Steel cup (Already available with OFCH & all concerned stake holders).

Regarding list of established sources for Insitu-moulding of Silicon rubber, our letter Number. ARDE/9/3/xix/74-Tech(TA) dtd. 09/01/2019 to be referred.

Established source for Zinc plating & Chromate passivation, as per given specification including De-plating and Re-plating of reworked cups, is appended below:

Phostwins Processors,
Sr No. 29/3, Plot No. 12,
Kharadi, Off Nagar Road,
Pune-411014 (Maharashtra, India)
Tel : 9158388331 / 9881131707
Contact Person : Shri Akshay Jadhav, MD

This is for your information and necessary action please.

Khedkar

(R D Khedkar, Sc'E')
For Director, ARDE

फोन / Phone : +91-020-25865274
फॅक्स / Fax : +91-020-25865102

ई-डाक / e-mail : director.arde@gov.in

PHOSTWINS PROCESSORS

Procedure for Rework (For material Steel Cup)

1) Segregation of Rework Material Of Steel Cup :-

1. Peel – off.
2. Improper Plating

2) Rework Procedure for Peel-off / Improper plating material of Steel Cup :-

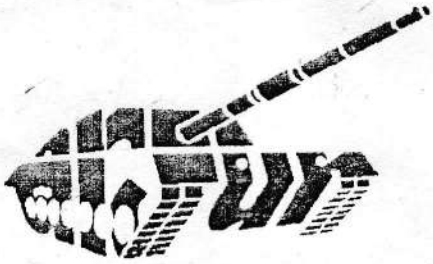
1. Make batches of steel cup as 2 jobs in each batch.
2. Prepare 50% HCL (Hydrochloric Acid) solution at room temperature.
3. Dip 2 jobs at once into solution.
4. Put timer for 1.30 min after dipping material in solution.
5. Remove jobs from solution.
6. Wash jobs with clean water and dry with blower.
7. Polish material from all surfaces.
8. Restart plating process by jigging components as per original process from plating stage.

CONTROLLED COPY NO.:.....

Revision No: 01 (Sept 2016)

SPECIFICATION No: ARDE/SPECN/556 (PROVISIONAL)

SPECIFICATION TO GOVERN MANUFACTURE, INSPECTION AND SUPPLY OF STEEL OBTURATING CUP FOR 120mm AMMUNITION



Issued by

ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT,
ARMAMENT POST, PASHAN, PUNE - 411 021.

SPECIFICATION No: ARDE/SPECN/556 (PROVISIONAL)

SPECIFICATION TO GOVERN MANUFACTURE, INSPECTION AND SUPPLY

STEEL OBTURATING CUP FOR 120mm ARJUN AMMUNITION

THIS SPECIFICATION IS THE PROPERTY OF THE MINISTRY OF DEFENCE AND MUST BE RETURNED TO THE DIRECTOR ARDE, PASHAN, PUNE-21 IMMEDIATELY AFTER TENDER HAS BEEN DECLINED OR ON COMPLETION OF THE CONTRACT OR ON DEMAND.

This Specification or any other information issued in its connection may only be used for specific enquiries, tenders or orders placed by a competent authority on behalf of the Ministry of Defence. It is not to be used for any other purpose, whatsoever without the express written sanction of The Director ARDE, Pashan, Pune - 21.

Any question relating to the drawing, pattern of this specification should be referred to ARDE, Pune or other Inspecting Officer duly authorised to act on behalf of him.

Copies Obtainable from:

The Director
Armament Research and Development Establishment
Armament Post, Pashan,
PUNE - 411 021.

PREFACE

ARDE has indigenously developed the state of art 120 mm Rifled Gun and Ammunition System for the MAIN BATTLE TANK ARJUN. To meet the futuristic challenges of modern warfare, the tank is equipped with FSAPDS as the primary ammunition and HESH as secondary ammunition.

The MBT ARJUN Ammunition is basically Semi Combustible Ammunition. This is a very special type of ammunition and hence requires special technique/method for its assembly. The methods involved are different from the assembly of conventional ammunition.

The assembly procedure has been evolved and established. Thousands of rounds have been assembled following this procedure and fired satisfactorily. The suggestions from production and inspecting agencies and users have been incorporated in this present specification. The efforts had been to make the ammunition fairly robust to withstand handling by crew in extreme field conditions.

This specification should be proved to be very useful document for manufacture and inspection of the ARJUN FSAPDS Ammunition and also for understanding the use of various tools, gauges and accessories needed for this purpose.

AMENDMENT RECORD

Sl. No.	Page No.	Amendment Details	Authority & date	Remarks

STEEL OBTURATING CUP FOR 120mm ARJUN AMMUNITION

INDEX

1. SCOPE

1.1 This specification governs manufacture/process, assembly, marking, packing, inspection and supply of steel obturating cup for 120 mm Arjun Ammunition to Drg. No. ARDE/2120 Det. 10, for FSAPDS/PS & ARDE/2149 Det. 9 for HESH

2. RELATED DOCUMENTS

2.1 This specification is to be read in conjunction with the drawing/drawings quoted in the contract/order.

2.2 Whenever a reference is to be made to any document in this specification it should be taken as a reference to the latest edition of the documents unless otherwise stated.

2.3 Copies of related documents are obtainable as follows:

a)	Indian Standard Specification	Bureau of Indian Standards, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New-Delhi-110011
b)	British Standard Specification	
c)	IND / ME Specification	The Controller, CQA (ME), Aundh, PUNE-411003
d)	Joint Service Specification	
e)	J.S.S. Specification (Metals)	The Controller, CQA (Metals), Ichapur
f)	DEF Specification / STD	The Manager H.M.S.O. Sales section, British Information Service, Chanakyapuri, New-Delhi-110002

3. STANDARD PATTERN

3.1 Any sample lent/given to the manufacturer shall be used only as a guide to workmanship and not as a guide to detail. However standard pattern, if obtainable from the purchasing or Quality Assurance Authority, shall constitute the standard as regards any particulars or properties noted/defined in this specification.

4. COMPONENTS

4.1 The details of components required for manufacture / assembly of the store are listed below:

No	Component/ Assembly.	Part No./ Specification No.	No. Per set
1	Steel cup with seal	ARDE/2120/Det No.10 for FSAPDS/PS and ARDE/2149 det 9, for HESH	1

5. MATERIALS

5.1 Following materials should conform to the specifications mentioned against each:

No	Material	Specification
1	Silicon rubber	DTD 818 class 'L'
2	Steel	DIN designation : 35 NiCrMoV125

5.1.1 Alternate method for determination of flexibility / brittleness testing of rubber material to specified ASTM method D746 -55 - T Procedure B :

Test pieces of the rubber material size 2.5 x 15 x 120 mm approximately to be conditioned at -55 deg. C for 30 minutes and subject to bending over a mandrel of 10 times the thickness of the test piece and observe visually for cracks / abnormality.

5.2 The manufacturer will also supply any other material required for completion of the order.

6. MANUFACTURE

6.1 The dimensions and form of the store and its components are to be in conformity with the drawing issued. The manufacturer should prepare and supply to the Quality Assurance Officer the process schedule, which is to be followed for the manufacture of store and its components. Any subsequent change in the process schedule should be notified to the Quality Assurance Officer in advance.

6.2 Neither the completed store nor any component part shall be altered or rectified in any way not provided for in the drawing or specification without the prior sanction of the Quality Assurance Officer.

6.3 Where the drawing or specification permits a choice of alternative material or forms for particular components, the manufacturer is required to notify the Quality Assurance Officer in writing, which of the permitted alternative he chooses to produce. If the choice of alternatives is changed during the course of the order, the

manufacturer shall again notify the Quality Assurance Officer of such change.

6.4 No mechanical work, heat treatment or other operation, which may modify the physical properties of the material, will be carried out after it has been submitted for mechanical tests, unless authorized by the Quality Assurance Officer in writing.

6.5 The surface finish of all components shall be as stated on the drawings.

6.6 All sharp edges and corners shall be rounded off unless otherwise stated on the drawings.

6.7. Details regarding the manufacture of all components/ subassemblies are given in succeeding paragraphs.

6.7.1 Various parameters to be examined and defect for the components and assembly are given in Annexure' A' and Annexure 'B'.

6.8 STEEL CUP

6.8.1 Material specified for the manufacture of this component is Steel conforming to DIN Designation 35 Ni Cr Mo V 125.

6.8.2 The cups are to be manufactured by closed die forging as per the drawing No. ARDE/2120 Det. 11 Sht. 1 or drawing prepared by manufacturer with the approval of AHSP.

6.8.3 Rough Machining of steel cup is to be done as per the drawing No. ARDE/2120 Det. 11 Sht 2 or drawing prepared by manufacturer with the approval of AHSP.

6.8.4 The Rough machined steel cups should be heat- treated (Normalised, Hardened and tempered) as per the heat treatment cycle to achieve the specified mechanical properties.

6.8.5 STEEL CUP FOR FSAPDS: The cups cleared at Heat treatment stage are to be further machined as per the drawing No. ARDE/2120 Det. 11 Sht. 3, using CNC machines, leaving tolerances for surface plating.

6.8.6 STEEL CUP FOR HESH: The cups cleared at Heat treatment stage are to be further machined as per the drawing No. ARDE/2149 Det 10 using CNC machines leaving tolerances for surface plating. The groove has been made at the base of steel cup to facilitate easy identification by Tank crew at night in the Tank compartment.

6.8.7 Surface Treatment: Machined steel cups thus CNC machined, are to be Zinc plated followed by chromate

Passivation to specn. IS:1573-1986 classification No. FeZn 12.5 so as to increase the storage life of the cups.

6.8.8 Steel cups that have passed dimensional check, gauging as well as coating thickness are cleared for further insitu rubber moldings.

6.9 STEEL CUP AND SEAL ASSEMBLY

6.9.1 The Steel cups which have been processed as above are insitu moulded with silicone rubber using suitable moulds, as per the Drawing No.ARDE/2120 Det. 10 for FSAPDS cups and Drg No. ARDE/2149, Det 9 for HESH Cups.

6.9.2 The Steel cup is never to be treated with acid as it destroys the cup and decreases the properties of the rubber material.

6.9.3 The cup after moulding is removed from the mould and set for cooling at room temperature for 8 hrs where the mechanical strength of vulcanized rubber is stabilized.

6.9.4 The cooled cup with excess vulcanized rubber is to be trimmed and finished.

7. WORKMANSHIP AND FINISH

7.1 The surface finish and dimensions of the components should be in accordance with the relevant store drawings. The components should be clean and free from scales, laminations, cracks, blowholes, inclusions or any other defects. The surfaces should be smooth all over and edges are free from burrs.

8. MARKING & STENCILLING

8.1 Marking and stenciling will be done as per the relevant drawings.

9. QUALITY ASSURANCE

9.1 The manufacturer will notify the Quality Assurance Officer (QC/QA) when he is in a position to start work and will inform him of all sub orders placed in connection with the main order at the same time, as and when they are placed.

9.2 The Quality Assurance Officer (QC/QA) shall have access, at all times, to all departments of manufacturing plants which are concerned with the production and storage of materials or components under the order at the works either of manufacturer or

of the sub manufacturer and shall arrange for Quality Assurance as to be carried out by his representative as considered necessary.

9.3 QUALITY ASSURANCE DOCUMENTS

9.3.1 Manufacturer shall maintain complete QC Documentation at all stages of manufacture / assembly and submit same along with batches / lot of components to the QAO to enable him to take correct decision and to decide the need for reduction / tightening QC/QA procedures. All QC/QA documents for the first five lots shall be made available to AHSP for reviewing guidelines for further QC/QA follow-up.

9.4 QUALITY ASSURANCE OF MATERIALS & COMPONENTS

9.4.1 Before proceeding to manufacture, all materials shall be submitted to the Quality Assurance Officer in batches along with QC Documents. Each batch shall contain a quantity of material prepared under uniform conditions in respect of compositions and manufacturing process. In case of imported material, procedure currently being followed by DGQA would continue.

9.4.2 The manufacturer shall not take into use any material or component until it has been accepted for its purpose by the Quality Assurance Officer, who may require the bulk of the material or the component to be sealed or bonded until results of test or analysis of samples are available.

9.4.3 Samples for testing: The manufacturer shall supply and prepare free of charge the materials or components required by the Quality Assurance Officer for testing purpose and shall provide the necessary facilities and apparatus which may be required for carrying out the test called for by the drawing or by this specification and other standard specifications.

9.4.4 Test pieces or samples will invariably be selected by the Quality Assurance Officer or his representative and will remain the property of Govt. of India.

9.4.5 All material testing to be carried out by ISO accredited agencies.

9.4.6 All the apparatus which may be required for carrying out test as called for by relevant drawings & other standard specifications will be provided by the manufacturer. All such apparatus must be calibrated by authorised ISO accredited agencies and certificates to be rendered to

inspection agencies before undertaking any test / operation.

9.5 QUALITY ASSURANCE OF COMPONENTS & ASSEMBLY

9.5.1 The manufacturer is expected to submit material or components for ensuring satisfactory Quality Assurance and he is required to assume full responsibility for any material or components submitted which is found to be unsatisfactory.

9.5.2 The manufacturer shall submit for acceptance the material, components or assemblies called for in order in suitably sized batches. The Quality Assurance Officer in consultation with the manufacturer/ AHSP will decide the amount of material or number of units that comprises a batch.

9.5.3 Any change or departure in the material composition & its properties, established process control parameters, process of manufacture and machining facilities from those specified or established shall be done in consultation with QAO and the approval of AHSP. Complete record of details of changes/departure made shall be maintained and performance monitored. The specific change made shall also be recorded in the QAO report while forwarding the proof samples.

9.6 RESUBMISSION OF REJECTED BATCH

9.6.1 Rejected batches may be resubmitted with the approval of the Quality Assurance Officer. Where resubmission is permitted and the manufacturer elects to resubmit, the manufacturer shall first inspect the rejected batches, either for particular types or class of defects that cause the batch to be rejected or for all types and classes of defects, as directed by the Quality Assurance Officer and shall rectify or remove all defectives of these types or classes. The Quality Assurance Officer shall rigidly examine a resubmitted batch for these types or classes of defects.

9.7 DISPOSAL OF REJECTED MATERIALS, COMPONENTS AND ASSEMBLY

9.7.1 All the material, components and steel cup assemblies finally rejected at any stage of manufacture shall immediately be deformed suitably and disposed off to avoid mix-up with the serviceable items and complete record of the same shall also be maintained.

9.8 Utilisation of components made for a specific lot but not subjected to proof, the manufacturer with the clearance from CQA, may utilise the batches of components (which were not subjected to proof firings in assembled conditions) in the formation of new lots.

9.9 REPLACEMENT BY MANUFACTURER

9.9.1 Formal acceptance of material or components by the Quality Assurance Officer shall not relieve the manufacturer of his responsibility or any parts, which may subsequently prove to be defective. If material or components from batches accepted after sampling inspection proved to be subsequently defective during examination or assembly, the manufacturer shall be required to replace the defective material or components free of cost.

9.9.2 If the material of finished or partly finished steel cup are expended or damaged in examination or test as stipulated in this specification or elsewhere as a condition for acceptance, the manufacturer will be required to replace or repair free of charge the number as expended or damaged which become the property of Government.

9.9.3 Where finished store are expended in proof, reproof or double reproof as stipulated in the specification or else where as a condition of acceptance, the cost of samples so expended will be borne by the consignee, if the samples representing the lot, have passed satisfactorily where a reproof or any other type of proof is requested by the manufacturer, a written request for such a proof should be obtained from the manufacturer including his willingness to bear entire cost of such proof, including that of all proof stores. In case of rejected lots, cost of all the samples spent in all the proofs should be borne by the manufacturer.

9.10 METHOD OF QUALITY ASSURANCE

9.10.1 For the first 5,000 Nos., the components, subassemblies as well as trial assemblies shall be subjected to 100% inspection, either by gauging or by GE method. During Quality Assurance, data will be collected lot wise, so as to finalize sampling plans. The acceptance inspection shall then be switched over to the sampling inspection as per DEF 131A.

9.10.2 In case of dispute about the quality assurance characteristics of any item, the verdict of the AHSP shall be final and it will be binding upon the manufacturer.

10. LOTTING PROCEDURE

10.1 Each lot shall be formed into a convenient size between 500-600 using 8 accepted batches of Heat Treated steel cups.

10.2 Lot size has been restricted to minimise the chance of rejection of larger lot size as salvaging of components are difficult/costly.

11. PROOF

11.1 The store will be proved and sentenced in accordance with relevant proof schedule ARDE/PS/257 (Provisional).

12. PACKING

12.1 The store will be delivered in lots / batches as per requirement.

12.2 The steel cups will be packed in approved box to Drg. No. ARDE/9759 Det.30 to give effective protection from damage during transit, dirt or moisture and to ensure that the store will reach the consignee in perfectly serviceable condition.

12.3 Each package will be clearly marked with nomenclature, lot No, quantity in the package, manufacturer's monogram or recognized trade mark, month and year of manufacture and any other marking which the Quality Assurance Officer may direct.

13. RESPONSIBILITY FOR SAFETY

13.1 Nothing in this specification shall relieve the manufacturer of the responsibility for the safety during the manufacture.

ANNEXURE 'A'

INSPECTION SCHEDULE FOR STEEL CUP

1. At the Billet Stage

(a) The primary manufacturer (viz. supplier of cup forgings), while procuring basic steel material should endorse a copy of sub-contract to the inspecting authority and ARDE, and get the material inspected by the Area Inspector concerned.

(b) The steel manufacturer should clearly mark the top and bottom portion of billet from first, middle and last ingots of each heat in order to carry out Macro test to ensure cleanliness and freedom from piping and any harmful defect.

(c) The chemical composition of the material should be tested and certificate given as per Appendix 'A' regarding its conformity to following limits: -

Material: Steel conforming to DIN Designation 35NiCrMoV 12 5

Chemical Composition:

C = 0.30-0.40%	Si = 0.15-0.25%	Mn = 0.40-0.70%
S = 0.015% Max	P = 0.015% Max	Ni = 2.50-3.50%
Cr= 1.20-1.40%	Mo = 0.35-0.60%	V = 0.08-0.15%

2. At the Forging Stage

(a) The manufacturer should indicate to the Inspector, well in advance before the commencement of cup forgings.

(b) 100% cup forgings should be visually examined for any surface defects.

(c) 100% cups should be subjected to Magnetic Particle Inspection (MPI) to check external and sub surface cracks.

NOTE: This test is essential in case Contractor for supplying the forgings and fully machined cups are different. However, if a single contractor does both the operations, this test is not essential. However, Contractor is at liberty to do the same.

(d) 100% cup forgings should be checked for dimensions as per the relevant approved drawing by the manufacturer. However, 5% checking to be carried out by QA inspector.

(e) Qty. 2 forgings should be selected to check the grain flow lines by Macro examination from each lot. The flow lines should be as per the Sketch-I (Fig. No. 2) attached.

NOTE: Lot means, Qty of cup forgings manufactured under identical conditions, in one go.

(f) Qty. 2 forgings from each lot are selected. Two test pieces, as shown in the Sketch-II (Fig.2), from the base of each cup forgings, so selected would be prepared with grinding allowance, and subjected to a cycle of heat treatment so as to get the mechanical properties as shown below: -

(i)	UTS	=	1350 MPa min.
(ii)	% Reduction in area	=	45% min.
(iii)	% Elongation	=	12% min.

NOTE:

1. This test will be done in the presence of Area Inspector and Certificate obtained.
2. The cycle of heat-treatment would be evolved by the firm. For dimensions of test pieces please refer BS 18 (latest edition) OR Fig. No. 3 attached.
3. Inspection report for forging will be submitted as per APPENDIX 'B'.

3. At the Semi finished Steel cup stage after Heat Treatment

(a) Generally 500 to 600 nos are taken as lot. 50 to 75 Nos semi finished steel cups be heat treated at a time. Hence there will be 8 batches viz, A, B, C, D, E, F, G, H.

(b) 100% of semi finished heat-treated steel cups should be tested for hardness. The hardness should be within 425±15 VPN. The position on steel cup for hardness test should be as per the Sketch-III (Fig.2), attached.

(c) 100% cups should be subjected to Magnetic Particle Inspection (MPI) or any other suitable method mutually agreed upon, to check external and surface cracks.

4. At the Machined finished Steel Cup Stage. (Before insitu moulding) Ref drg. No. ARDE 2120 Det 11 Sht 3 for FSAPDS cups and ARDE 2149 Det 10 for HESH cups

(a) 100% visual examination to check any surface defects viz. tool marks, feed marks, sharp edges, surface finish, protective finish etc.

(b) Protective finish, thickness of zinc plating followed by chromate passivation and uniformity to be checked.

(c) 100% steel cups should be checked for dimensions. The dimensions should be checked with gauges as per Annexure 'C'.

(d) The steel cups will be inspected only after surface treatment as the gauging and dimensions as per drawing are applicable only after surface treatment i.e. zinc plating, followed by passivation.

(e) The inspection team to ensure the following additional points, by sampling inspection.

(i) Uniform surface finish of 1.6 Micrometer all over. No feed mark is acceptable.

(ii) Sharp edge near lip portion at 75 mm from base has been eliminated by providing nominal radius of R 0.3 to 0.5.

(iii) Internal blending for R 8 is smooth.

(iv) Radius R 1 at front face of flange.

(f) 4% of the finished steel cups preferably before plating should be tested for hardness. The hardness should be within 425±15 VPN. The position on steel cup for hardness test should be as per the Sketch (III) (Fig No. 2) attached.

(g) One cup each from any four batches of A to H be selected by QA inspector for mechanical testing by the firm. Position from where the test pieces to be made is shown in sketch II (Fig No. 2). Mechanical properties obtained by the firm from an approved laboratory be submitted to INSPECTING AUTHORITY.

(h) One cup each from the other four batches of A to H be selected and test pieces to be made according to FIGURE NO.3. Position from where the test pieces to be made is shown in sketch II (Fig No.2). And these test pieces to be delivered for mechanical testing at approved laboratory by inspecting authority.

NOTE: Rejected steel cups on account of machining may be utilized for Para (g) and (h). But this test is must.

(i) All the results of machined steel cups before and after moulding should be tabulated and countersigned by the Area Inspector and submitted along with the finished product.

(j) The final inspection report will be submitted as per format at Appendix 'C'.

(k) Serration/threads are to be cut on lip portion covering entire width of 10 mm. However, actual dimensions be taken on 2% of the cups offered for inspection.

(l) Quantity 2 cups finish machined per lot will be checked for volume of the cup by a suitable method for information.

(m) Reworked finished cups be offered for inspection immediately along with the subsequent batch. If it is not offered along with next batch, it will not be considered for inspection.

(n) The accepted cups will be stamped.

5. **After In-situ Moulding. (Ref Drg No. ARDE 2120 Det 10 for FSAPDS and ARDE 2149 Det 9 for HESH Cups)**

(a) Contractor will inform Inspecting Authority soon after receipt of steel cups duly insitu moulded.

(b) The steel cups will be visually examined and ensure that moulding is correct and no cracks or voids over sealing ring.

(c) 100% of the cups will be checked by Receiver Gauge and GO & NOGO primer hole screw gauge.

(d) Firm who is doing insitu moulding will offer inspection report of rubber confirming to specification.

(e) Each steel cup will be weighed.

(f) The accepted cups will be stamped.

(g) Then the cups be released for packing and dispatch. Packing note will be enclosed for each box indicating Cup Nos, Ht Lot No., date of manufacture duly signed by inspecting officer.

6. **Cost of forging so selected for flow lines or for preparation of test pieces or semi finished steel cups or cost of preparation of test pieces will be borne by the contractor**

APPENDIX 'A'

TEST CERTIFICATE FOR BILLETS

1. Certified that MACRO Examination of the top and bottom portion of billet from the first, middle and last ingots of Heat No._____ have been examined and steel/ingot have been found to be clean and is free from piping and any harmful defects.

2. Chemical composition of the material:

Elements	C	Si	Mn	S	P	Ni	Cr	Mo	V
Maximum%	0.40	0.25	0.70	0.015	0.015	3.50	1.40	0.60	0.15
Minimum%	0.30	0.15	0.40	-	-	2.50	1.20	0.35	0.08
Actual%									

Signature of Examiner: ----------

Name of Examiner : ----------

Designation :----------

Office of Examiner :----------

Seal of Office :----------

APPENDIX 'B'

TEST CERTIFICATE FOR CUP FORGINGS

1. Certified that Qty._____ Cup forgings as per relevant approved drawing have been visually examined and they are free from any surface defects.

2. Certified that Qty._____ cup forging already found free from surface defects carried out visually, at Para 1 above have been further subjected to Magnetic Particle Inspection and all/Qty._____ have been found free from any external or sub-surface cracks.

3. Certified that Qty._____ have been examined for dimension and found to be correct as per relevant approved drawing.

4. Certified that Qty. Two forgings from the Para above were selected and same were subjected to MACRO Examination for checking the flow lines as per Sketch No. I (Fig No. 2) and have been found to be same.

5. Certified that Qty.2 cup forgings out of Qty. so passed at Para 3 above are selected and test pieces prepared as per BS 18 (latest edition), location as per Sketch II (Fig No. 2), and subjected to heat-treatment for achieving the following mechanical properties:

Mechanical Property	Minimum	Achieved
UTS	1350 MPa	
% Reduction in area	45%	
Elongation	12%	

The following heat treatment cycle was followed:

Signature of Examiner :----------

Name of Examiner :----------

Designation :----------

Office of Examiner :----------

Seal of office :----------

APPENDIX 'C'

FINAL INSPECTION REPORT

STEEL CUP LOT NO.:
S.O. NO.: QTY: FSAPDS / HESH
PDC:

Heat Batch		A	B	C	D	E	F	G	H	Total	Remarks
Batch Size											
Forging clearance Visual/Dim. Insp./MPI											
Hardness after HT (100%)											
MPI after HT (100%)											
Mechanical Properties	UTS										
	% El										
	% R of A										
Inspection of machined cups before moulding	Qty. Offered										
	Qty. Rejected										
	Qty. accepted										
Surface Finish (4%)											
Hardness Testing of Machined cups (4%)											
Protective finish Thk. (4%)											
Serration of Lip (2%)											
Rubber Material Test											

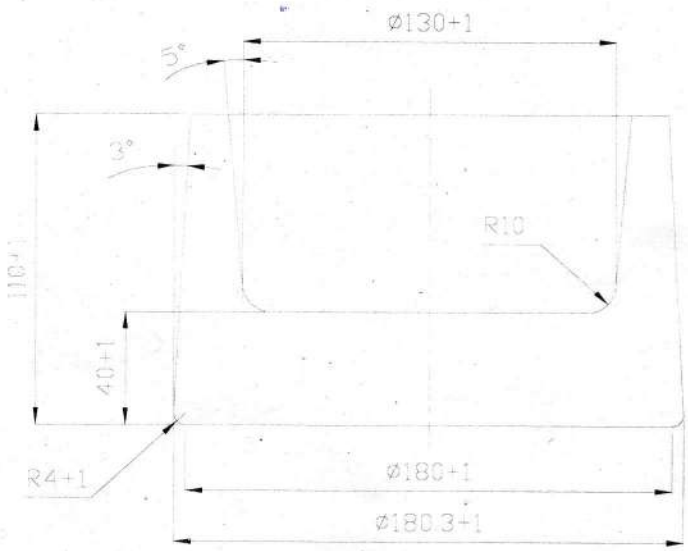
Inspection after moulding	Qty. Offered										
	Qty. accepted										
Proof Samples to PXE											
Qty. to OFCH											

Certified that the lot consisting of Qty.____ Nos. of finished cups has been inspected and accepted.

(Rep. AHSP) **(Rep. SQAE)** **(Rep. Firm)**

FIGURE No. 1

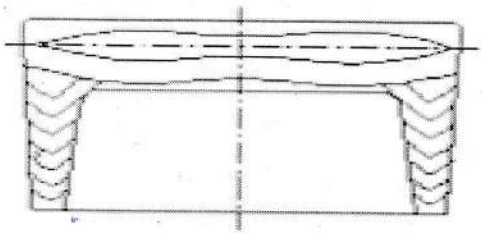
CUP- FORGING



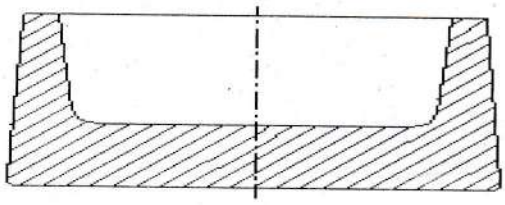
NOTES:

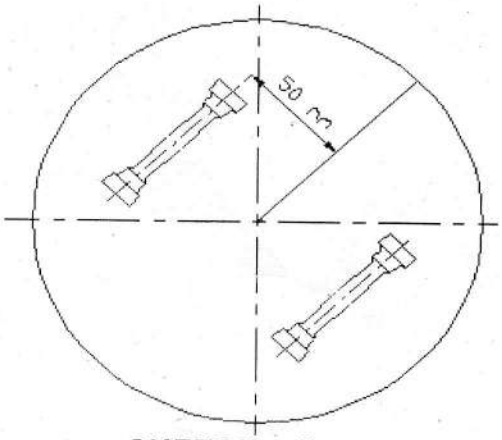
1. Tolerances as per the practice of manufacturer acceptable.
2. Forging should be trimmed normal.
3. Forging should be free from defects such as scabs, laps etc.
4. To be annealed and sand blasted. Hardness-280VPN approximately.
5. For acceptance, standard refer Para 1 & 2 of specification.
6. For test certificate refer Appendix 'A' and Appendix 'B'.

INSPECTION SCHEDULE FOR STEEL CUP (FIG NO 2)

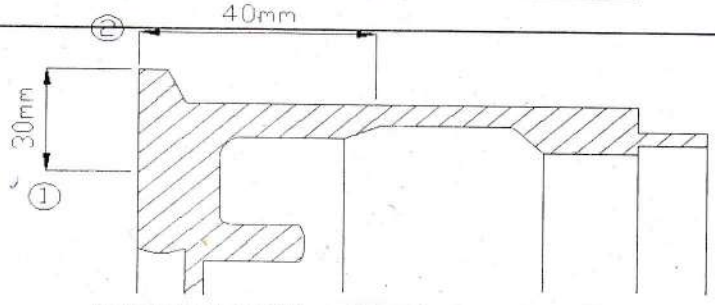


SKETCH –I (FOR MACRO TEST)





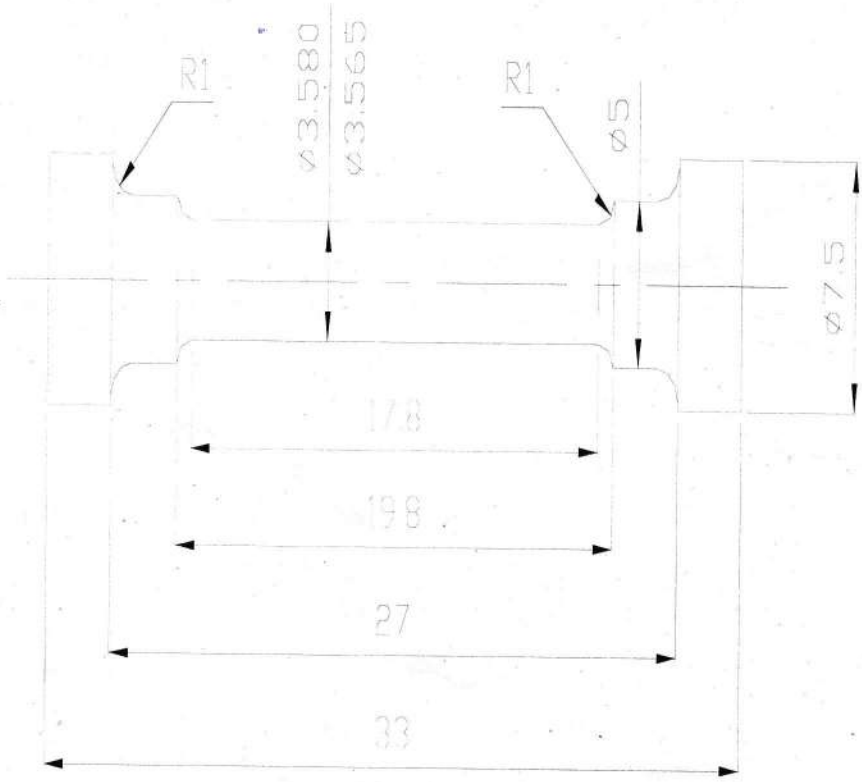
SKETCH – II
(FOR POSITION OF TEST PIECES)



SKETCH-III (For Hardness Checking)

FIGURE NO. 3

TEST PIECE (FOR HEAT TREATED COMPONENTS



ANNEXURE 'B'

SPECIFICATION ARDE/SPECN/556/1996 (PROVISIONAL)

QUALITY ASSURANCE PROVISIONS
VISUAL, DIMENSIONAL AND TEST-DEFECTS

1. DEFECTS: DEFINITIONS

1.1 Defect: A defect is any non-conformance of the unit of product to specified requirements.

1.2 Critical Defect: A critical defect is defect that judgment and experience indicate is likely to result in hazardous or unsafe conditions for individual using/maintaining/or depending upon the product/or a defect that judgment and experience indicate is likely to prevent performance of the tactical functions of a major end item such as a ship/aircraft/tank/missile or space vehicle.

1.3 Major Defect: A major defect is a defect other than critical that is likely to result in failure or to reduce materially the usability of the unit of product for its intended purpose.

1.4 Minor Defect: A minor defect is a defect that is not likely to reduce materially the usability of the unit of product for its intended purpose or is a departure from established standards having little bearing on the effective use or operation of the unit.

2. EXAMINATION

2.1 Examination shall be performed as indicated in the following sub Para. :

2.1.1 Critical Defects: 100 % examination shall be performed for critical defects. All components containing such defects shall be rejected. Similarly, batch or lot shall also be rejected if it fails in a test classified as critical.

2.1.2 Major defects: Examination for major defects shall be performed on a class basis in accordance with classification of defects using applicable sampling plans and acceptance criteria of specification IS: 2500 Part I or DEF 131 A Apr. 1963 General Inspection Level II (initially).

2.1.3 Minor Defects: Examination for minor defects shall be carried out for information and improvement of future production.

3. ACCEPTANCE QUALITY LEVEL

The AQL for defects shall be as follows:

Defect Class	Lot Size	Sample size	Accept	Reject	% AQL
Major	500	50	3	4	2.5

Note: After the production of first 5000 Nos. of cups, which are to be subjected to 100% inspection, for subsequent lots the above inspection levels may be followed.

4. CLASSIFICATION OF DEFECTS

4.1 The visual, dimensional, & test defects shall be classified as follows:

Group No.1

Component: Steel Cup with Seal

Assy: ARDE/2120 DET. 10 or ARDE/2149 Det.9
Classification & Feature:

Defect	Visual	Gauging
i) Critical (100% inspection)	a) Cracked/split/ damaged cups	a) Cup outer profile b) Primer hole screw & recess combination. (1 ¼ - 12 UNF - 2B) dia 36.96 +0.25 length 6.4 + 0.152 dia. 32.258 + 0.127 length 2.41 + 0.25 c) Primer hole screw NO-GO (1 ¼ - 12 UNF–2B)
ii) Major (2.5 AQL)	a) Dented steel cup b) Loose or detached / damaged Rubber seal c) Over lapping of	

	rubber d) Vent holes or cut marks/ pin holes in rubber e) Protective finish/coating	
iii) Minor	a) Presence of sharp edges and burrs b) Absence of markings c) Minor scratches	

Group No.2

Component: Steel cup (Final machining)

ARDE/2120 DET. 11 Sht. 3 or ARDE/2149 Det 10
Classification & Feature:

Defect	Visual	Gauging
i) Critical (100% Inspection)	a) Cracked/split/ damaged cups b) Deep tool marks	a) Outer profile b) Primer hole screw & recess combination c) Primer hole threads NO-GO
ii) Major (2.5 AQL)	a) Dented steel cups b) Improper plating	a) Thread features of primer hole threads b) Dia 36.96 +0.25 c) Dia 32.258 +0.127 d) Dia 171.96 –0.3 e) Dia 161.00 –0.2 f) Dia 160.00 –0.2 g) Dia 147.64 +0.2 h) Length 6.4 + 0.152 i) Length 2.41 +0.25 j) Length 6.96 –0.2 k) Length 12.00 –0.5 l) Length 85.00 –0.2 m) Dia 156.00 +0.2 n) Concentricity of first recess with minor dia of threads o) Concentricity of second recess with minor dia of threads p) Concentricity of head

		with outer dia of flange 0.25 at MMC q) Mass of the steel cup 3.400 ±0.100 kg r) Protective coating thickness 12.5 to 25 micrometers s) Surface roughness 1.6 micrometers
Minor	a) Smooth blending of R8 b) Marking	a) Dia 52.00 -0.5 b) Length 14.00 –0.5 c) Groove dimensions at base (for HESH cups) d) Lip serrations

ANNEXURE 'C'

Specification ARDE/SPECN/556/1996(Provisional)

GAUGE SCHEDULE FOR STEEL CUP FOR ARJUN AMMUNITION

STEEL CUP WITH SEAL TO DRG. No. ARDE/2120 DET 10 OR ARDE/2149 DET 9

Defect Category	Feature	Dimensions	Gauge Type	Remark
Critical	Primer hole screw & recess combination	1 ¼ 12 UNF-2B Dia 36.96 +0.25 6.4 + 0.152, (dia 32.258 +0.127) Depth 2.41 +0.25	Screw/ Plug	
	Primer hole screw effective diameter NO-GO	1 ¼ 12 UNF-2B	Screw	
	Receiver Gauge	Taper 1:20 Dia 160.00 –0.2 Dia 171.96 –0.3 Depth 6.96 –0.2	Ring	

STEEL CUP (FINAL MACHINING) TO DRG. No. ARDE/2120 DET. 11 SHT. 3 OR ARDE/2149 DET. 10

Defect Category	Feature	Dimensions	Gauge Type	Remark
Critical	Primer hole screw & recess combination	1 ¼ 12 UNF-2B Dia 36.96 +0.25 6.4 + 0.152, (dia 32.258 +0.127) Depth 2.41 +0.25	Screw/ Plug	
	Primer hole screw effective diameter NO-GO	1 ¼ 12 UNF-2B	Screw	

	Receiver Gauge	Taper 1:20 Dia 160.00 –0.2 Dia 171.96 –0.3 Depth 6.96 –0.2	Ring	
Major	Primer hole 1st recess dia GO & depth GO	Dia 36.96 +0.25 Depth 6.4 +0.152	Plug	
	Primer hole 1st recess dia NO-GO	Dia 36.96 +0.25	Plug	
	Primer hole 2nd recess dia NO-GO	Dia 32.258 +0.127	Plug	
	Primer hole 2nd recess dia GO	Dia 32.258 +0.127	Plug	
	Primer hole 2nd recess dia depth GO & NO-GO	Depth 2.41 +0.25	Plug	
	Primer hole screw core dia GO	1 ¼ 12 UNF-2B	Plug	
	Primer hole screw core dia NO-GO	1 ¼ 12 UNF-2B	Plug	
	Head dia GO	Dia 171.96 –0.3	Ring	
	Head dia NO-GO	Dia 171.96 –0.3	Ring	
	Dia at 30 datum from flange GO	Dia 161.0 –0.2	Ring	
	Dia at 30 datum from flange GO & NO-GO	Dia 161.0 –0.2	Snap	
	Dia at 50 datum from flange GO	Dia 160.0 –0.2	Ring	
	Dia at 50 datum from flange GO & NO-GO	Dia 160.0 –0.2	Snap	
	Gauge for flange thickness GO & NOGO	6.96 –0.2	Plate	
	Internal dia GO & NO-GO	Dia 147.64 +0.2	Plug	
	Internal dia	Dia 156.0 +0.2	Bore Gauge	

	Concentricity gauge for 1st recess dia GO		Plug	
	Concentricity gauge for 1st recess dia NO-GO	--	Plug	
	Concentricity gauge for 2nd recess dia GO	--	Plug	
	Concentricity gauge for 2nd recess dia NO-GO	--	Plug	
	Concentricity gauge for head dia GO	0.25 at MMC	Plug/ Ring	
	Concentricity gauge for head dia NO-GO	0.25 at MMC	Plug/ Ring	
	Combination gauge for Base thickness Total height Lip height from base	12.00 –0.5 85.00 –0.2 75.00 –0.2	Plug/ Ring	
	GO gauge for internal dia	Dia 147.64 +0.2	Plug	
	Weight	3.400 ±0.100 kg	Weighing M/c	
	Protective coating thickness	12.5 micrometer	Conel/ DIPEL coating thickness gauge	
	Surface roughness	1.6 micrometer	Surf test gauge	
Minor	Lip serration	Depth 0.3 Pitch 1.0 Angle 60 deg.	Shadow graph	
	Primer boss H&L	Depth 14.0 –0.5	Ring	
	Primer boss dia	52.0 –0.5	Ring	

SPECIFICATION No. ARDE/SPECN/556 (PROVISIONAL)

SPECIFICATION TO GOVERN MANUFACTURE, INSPECTION AND SUPPLY

STEEL OBTURATING CUP FOR 120mm ARJUN AMMUNITION

Compiled By	Reviewed By	Approved By
(RD PUJARI)	(RD KHEDKAR)	(COL. PC PUSTI)
TECH. OFFICER 'B'	SCIENTIST 'B'	DEPUTY DIRECTOR

Revised on 30 Sept 2016.

Reviewed and approved :