

4800

ESTC Prescription No. 4

STORAGE & TRANSPORT

OF

120MM TK APFSDS AMMUNITION

BOTH

L26A1 IN CONTAINER L276A1(ULC)

AND

L27A1 IN CONTAINER L288A1(ACA)

1996

(SUPERSEDING PRESCRIPTION NO. 4, 1993)

THIS DOCUMENT IS THE PROPERTY OF HER BRITANNIC MAJESTY'S GOVERNMENT, and is issued for the information of such persons only as need to know its contents in the course of their official duties. Any person finding this document should hand it in to a British forces unit or to a police station for its safe return to the MINISTRY OF DEFENCE, D MOD SY, LONDON SW1 2HB, with particulars of how and where found.

THE UNAUTHORIZED RETENTION OR DESTRUCTION OF THE DOCUMENT IS AN OFFENCE UNDER THE OFFICIAL SECRETS ACTS OF 1911-89.

(When released to persons outside Government service, this document is issued on a personal basis and the recipient to whom it is entrusted in confidence, within the provisions of the Official Secrets Acts 1911-89, is personally responsible for its safe custody and for seeing that its contents are disclosed only to authorized persons).

Prepared by

THE EXPLOSIVES STORAGE AND TRANSPORT COMMITTEE

MINISTRY OF DEFENCE

FILE: D/ESTC/19/4

ESTC Prescription No. 4

STORAGE & TRANSPORT

OF

120MM TK APFSDS AMMUNITION

BOTH

L26A1 IN CONTAINER L276A1(ULC)

AND

L27A1 IN CONTAINER L288A1(ACA)

1996

PREFACE

PURPOSE

1. This Prescription is intended for use by the UK Ministry of Defence (MOD), its agents, and its contractors in the safe management of storage and transport of CHARM ammunition and as applicable, the execution of related contracts for the MOD.

PREPARATION

2. The detail contained in the Prescription reflects the best judgements of the MOD Explosives Storage and Transport Committee (ESTC) in the light of information available to them at the time of preparation.

3. This Prescription was endorsed and approved for use at the 198th meeting of the ESTC, and supersedes ESTC Prescription No. 4 dated 1983, copies of which should now be destroyed.

BACKGROUND

4. The main emphasis behind the changes included in this revised Prescription is to reflect the introduction of the L27A1 Round.

CONTRACT REQUIREMENTS

5. When the requirements of this Prescription are included in any contract, the contractor(s) is/are responsible for their correct application.


LIABILITY

6. The Crown hereby excludes all liability whatsoever and howsoever arising (including, but without limitation, negligence on the part of the Crown, its servants or agents) for any loss or damage however caused where the Prescription is used for any purpose other than that intended.

QUERIES

7. In the event of any inaccuracies or ambiguities being discovered, or any difficulty in applying the standards in the Prescription, the Secretary ESTC should be contacted.

REVISION

8. This Prescription will be revised when necessary by the issue of either amendments or a revised edition. It is important that users ascertain that they are in possession of the latest edition of the publication. Information on the status of ESTC publications will be published in a DCI General at intervals generally not exceeding 12 months.

ISSUE

9. Distributed by Secretary ESTC; further copies are obtainable with proper authority.

**ESTC PRESCRIPTION NO.4 - THE STORAGE AND TRANSPORT
OF 120MM TK APFSDS AMMUNITION BOTH L26A1 IN
CONTAINER L276A1(ULC) AND L27A1 IN
CONTAINER L288A1(ACA)**

CONTENTS

SECTION I. Introduction	Para
Scope	1.1
General	1.2
Radiological Safety	1.4
Special Radiation Hazard Assessments	1.6
Action in the Event of Fire or Accident	1.7
SECTION II. Transport - General	
General	2.1
SECTION III. Storage and Transport of Shot Packed Together with Charges	
Packages and Markings	3.1
Explosives Classification	3.4
Storage	3.5
Transport by Air	3.9
Transport by Rail	3.10
Transport by Road	3.12
Transport by Sea	3.15
Segregation at Ports	3.16
SECTION IV. Storage and Transport of Shot Packed Separately from Charges	
General	4.1
Transport by Road	4.3
Transport by Rail	4.4
Transport by Sea	4.5
Transport by Air	4.6
Packages, Marking and Mixing	4.7
Storage	4.10
SECTION V. Storage and Transport of Charges Packed Separately from Shot	
Storage and Transport	5.1



	Page
Distribution	7
ANNEX	
Annex A. Technical Notes Relating to the Prescription for the Storage and Transport of 120mm TK APFSDS L26A1 Ammunition in Approved Unit Load Container L276A1	A-1


ESTC PRESCRIPTION No. 4

**THE STORAGE AND TRANSPORT
OF 120MM TK APFSDS AMMUNITION BOTH L26A1 IN CONTAINER
L276A1(ULC) AND L27A1 IN CONTAINER L288A1(ACA)**

SECTION I. INTRODUCTION

Scope

1.1. Present ESTC policy is to prescribe separately for each type of ammunition containing depleted uranium (DU). General advice on DU munitions may be found in ESTC Guidance Notes Nos. 1 & 2. This Prescription deals primarily with the storage and transport of the 120mm TK Armour Piercing Fin Stabilised Discarding Sabot (APFSDS) Round under UK regulations and applies to both L26A1 & L27A1 rounds except where specifically stated. It is not intended to cover considerations of the ammunition in production or use either operationally or on trials/tests. As the regulations underlying the UK transport rules are issued by the International Atomic Energy Agency, it is likely that the prescribed transport conditions will be acceptable abroad. This should be verified for each country.


General

1.2. Each round of the ammunition consists essentially of a projectile which comprises DU alloy penetrator or shot (which has a protective coating) within a sabot, and its propelling charge. For operational reasons, complete rounds (shot, charge and tube vent electric (TVE)) are normally stored and transported in combined unit load containers. Exceptionally shot, charges and TVEs may be stored and transported separately. The penetrator in the shot is made from DU. DU is a slightly radioactive metal which if ingested is also chemically toxic to about the same extent as lead, and is likely to be dispersed partly as an aerosol in the event of a fire or explosion.

1.3. The radiation levels at the surface of ULCs and transit packs are low enough to enable safe conditions to be prescribed for both transport and storage. The ULC has been designed so that the radiation level on the external surface is "As Low As Reasonably Practicable" (ALARP) (see also ICRP Publication No. 55 - Optimisation and Decision Making in Radiological Protection). However, as a matter of principle, personnel should spend only the minimum practicable time in the immediate vicinity of shot.

Radiological Safety

1.4. Although prolonged exposure of personnel to the external radiation from any quantity of packed shot under normal conditions of storage and transport will not constitute a significant hazard, arrangements must be made to ensure that any dose rate targets identified during the design phase optimisation studies have been met and that the effectiveness of the radiation shielding does not deteriorate as the ULC ages. There is also a requirement to monitor the radiation levels around stored stacks.



[REDACTED]

1.5. Radiation Protection Advisors (RPA) should be appointed to provide advice and services in the field of Radiological Protection to military units and establishments holding and/or transporting 120mm DU ammunition. Commanding Officers must appoint Radiation Protection Supervisors (RPS), and make sure they have undergone adequate formal training and that they produce local rules to ensure acceptable procedures are maintained wherever DU shot is involved. These rules are to include correct packing and point to point loading. No consignments of 120mm DU ammunition are to be despatched or received without prior notification to the consignors' and consignees' RPS. Further guidance is given in JSP 392.

Special Radiation Hazard Assessments

1.6. A special radiation hazard assessment must be carried out before storing on site, or providing facilities for storage on site, or transporting DU ammunition containing more than a total quantity of 800kg of DU. This mass of DU is contained in about 5 fully loaded ULCs. Instructions for undertaking special hazard assessments are contained in JSP 392; technical assistance is available from the Radiation Protection Adviser appointed for each unit and establishment. Copies of special hazard assessments are to be forwarded through normal single-Service/PE channels to the headquarters authorities with administrative responsibilities for radiological protection (see Annex 1A to JSP392).

Action in the Event of Fire or Accident

1.7. Uranium metal or the alloy used in DU shot when heated in air may ignite at 600°C - 1000°C, a temperature easily attainable in a propellant fire. If the shot becomes involved in a fire, dispersion of uranium oxide aerosol may occur. An area downwind within 22.5° sectors either side of the plume centre-line and whose length is at least the radius of the relevant HD 1.3 Inhabited Building Distance must be evacuated. For fire fighting, copious quantities of water should be applied from a safe position upwind with the object of rapidly cooling the DU and other combustible materials. Fire fighters should wear self contained breathing apparatus and gloves and ensure that before leaving the scene of a fire the residual debris and ashes are cold and thoroughly saturated with water.

1.8. In the event of an accident resulting in damage to the protective coating of the penetrator, it must be assumed that release of DU particulate may have occurred, eg by abrasion.

1.9. Contingency plans for accidents of fire in which dispersion of radioactive material is possible, are to be included in local rules for site storage. Guidance on contingency planning is given in ESTC Guidance Notes No. 5. The plans are to be based on site specific conditions and prepared under guidance from the RPA.

SECTION II. TRANSPORT - GENERAL

General

2.1. The packaged ammunition, as presented for transport, should preferably be such that it qualifies as an excepted package under the terms of the International Atomic Energy Agency, IAEA, Regulations for the Safe Transport of Radioactive Materials, or otherwise be labelled as necessary after advice and/or measurement by the consignors' RPS. When the conditions for excepted packages cannot be met DU ammunition must be transported as Low Specific Activity material (LSA-1) in industrial packages Type 1.

NOTE 1: Details of the requirements for excepted packages are also given in ESTC Guidance Notes No.1 .

NOTE 2: If necessary, any measures to ensure that the conditions for excepted packages are fulfilled must be taken by the consignor before loading the packages.

2.2. 120mm DU ammunition should, when carried by road in the UK as a complete round (essentially shot and charge) be treated as instruments of war in accordance with SI 1996 No. 1350 Radioactive Material (Road Transport)(Great Britain) Regulations 1996. For the transport of the ammunition by other modes either in UK or elsewhere the international Regulations applicable to the mode of transport concerned shall apply. The transport of DU ammunition by road in countries other than the UK will be governed by the relevant Regulations in the country concerned and GB Regulations where these latter are in concert with the host country Regulations but more stringent in their requirements.

2.3. All consignments must at all times be under the direct supervision of at least one suitably trained Government (MOD) person who must be capable of giving the necessary information concerning the hazards of the loads to the emergency services as required.

**SECTION III. STORAGE AND TRANSPORT OF SHOT PACKED
TOGETHER WITH CHARGES**

Packages and Markings

- 3.1. To meet the conditions required for the transport of radioactive (RA) material, ULCs are to be cared for and be inspected to ensure that effective containment, and radiation shielding are maintained.
- 3.2. If the radiation level at the external surface of the ULC exceeds $5\mu\text{Sv/h}$ the ULC must carry the external markings required for the propellant charges and LSA-1 packages. If the radiation at the external surface of the ULC is less than $5\mu\text{Sv/h}$ the ULC will carry the appropriate explosives marking only.
- 3.3. In the case of excepted packages the external marking is limited to that required for the propellant charges but additionally an internal surface of the ULC must be marked in accordance with the F Pkg 197 in such a way that the Trefoil is clearly visible when the ULC is opened.

Explosives Classification

- 3.4. The ammunition is classified HCC 1.3C.

Storage

- 3.5. Acceptability of 120MM TK DU ammunition must be determined on a case by case basis by conventional HCC 1.3C explosives storage considerations (ESTC Report No. 2/93), but see also the radiological safety measures called for in paragraphs 1.4 to 1.6 above.
- 3.6. In any external stack or within any storage building, the number of shot must not exceed 14,000 L26A1 or 12800 L27A1 and no more than 12,800 mixed. The ammunition may be stored with other ammunition of HD 1.3 and HD 1.4, but not with any HD 1.1 or 1.2.
- 3.7. At buildings or stores, the supplementary fire symbol for radioactive material (trefoil) must be displayed so that they would be readily visible to attending emergency services. Within this overriding requirement discretion may be used in their siting to avoid observation by the public.
- 3.8. Normal Category C electrical safety requirements for explosives storehouses apply.

Transport by Air

- 3.9. Transport in passenger carrying commercial aircraft is prohibited. Air transport of DU ammunition in UK military aircraft will be as authorised by the DACC. Packages and markings must comply with the requirements for RA and explosives packaging and labelling.



Transport by Rail

3.10 Transport will be in accordance with "Conditions of Acceptance" for HCC 1.3C explosives, but only in wagons containing no other explosives. Railtrack have accepted that DU munitions may be transported as excepted packages under the terms of Sections V & VI of the International Atomic Energy Agency Safety Standards, Safety Series No.6, "Regulations for the Safe Transport of Radioactive Material" 1996 edition.

3.11 Neither the outer packages nor the wagons are to bear the trefoil symbol. (See paragraph 3.3 above).

Transport by Road

3.12 DU ammunition is transported as instruments of war under MOD control with safeguards according to ESTC Guidance Notes No. 1. All road transport arrangements must comply with regulations for HD 1.3 explosives and the HD 1.3 symbol must be displayed together with the supplementary trefoil unless the ammunition is packed as excepted packages. Further advice is available from the RPA and JSP 392.

3.13 Civilian vehicles used for the consignment of 120mm DU ammunition by road must conform with the Approved Vehicle Requirements of The Carriage of Explosives by Road Regulations 1996, SI 1996 No. 2093 and the duties placed by the SI relevant to the carriage of Hazard Classification Code (HCC) 1.3C explosives are to be met. However, whenever, reasonably practicable, the vehicles used are to be Government (MOD) owned and comply with the vehicles requirements in JSP 445, and be driven by Government (MOD) drivers. The consignment note must state that the load includes DU and the driver and attendant must be able to give necessary information to emergency services in the event of accident or fire; this latter should be in the form of the F Mov 936A.

3.14 The 120mm DU ammunition is to be transported in separate vehicles from other ammunitions and explosives.

Transport by Sea

3.15 Transport is to be in accordance with regulations for HCC 1.3C explosives. In addition DU ammunition should be segregated from articles of HD 1.1 or 1.2 by means which are effective in the prevention of propagation from the 1.1 or 1.2 to the DU ammunition. Transport must be exclusively in MOD controlled vessels.

Segregation at Ports

3.16 On arrival at a port, the 120mm DU ammunition is to be segregated from other ammunition.

**SECTION IV. STORAGE AND TRANSPORT OF SHOT PACKED
SEPARATELY FROM CHARGES**

General

4.1 Shot on their own should be stored and transported in accordance with regulations for the radioactive material, DU. If stored or transported in ULCs/ACAs, the number of shot in each ULCs/ACAs should be limited to that normally packed in a combined load.

4.2 Transit Packs containing shot must be transported under control. They may, if necessary, be mixed in transport with their associated propelling charges only. When stored in an explosives area, the same rules apply as for shot only ULCs.

Transport by Road

4.3 When transported by road shot should be sent in accordance with Section 2 of ESTC Guidance Notes No 2, "ESTC Recommendations for the Carriage by Road in the UK of Radioactive Materials Pertaining to Instruments of War - 1989".

Transport by Rail

4.4 Consignments by rail should be in accordance with the International Regulations concerning the Carriage of Dangerous Goods by Rail.

Transport by Sea

4.5 Consignments by sea should be in accordance with the Merchant Shipping (Carriage of Dangerous Goods and Marine Pollutants) SI 1990 No 2605 which calls up the International Maritime Dangerous Goods Code.

Transport by Air

4.6 Consignments by air (civil carrier) should be in accordance with IATA Restricted Articles Regulations or, in the case of military aircraft, as authorised by the DACC.

Packages, Marking and Mixing

4.7 Each penetrator will be packed in its approved container and an outer package which may be either a ULC or a transit pack. If the radiation level at the external surface of the outer package exceeds $5\mu\text{Sv/h}$, the package must bear the appropriate category label for LSA-1 material, but should not do so otherwise.

4.8 Shot packed separately from charges must wherever practicable be transported and stored separately from charges or any other explosives. However, where this is not practicable, ULCs/ACAs containing shot only, but limited to the number of shot normally packaged in a ULC/ACAs containing shot and charge, may be mixed in storage and in transport with combined loads or other HD1.3 or HD1.4 explosives.

[REDACTED]

4.9 If shot and explosives are transported or stored together, though packed separately, the display of fire symbols should be as though they were packed together.

Storage

4.10 When stored in explosives areas:

4.10.1 14,000 L26A1 rounds or 12,800 L27A1 rounds and no more than 12,800 mixed L26A1 & L27A1.

4.10.2 The appropriate Inter Magazine Distance is to apply with respect to all explosives.

**SECTION V. STORAGE AND TRANSPORT OF CHARGES PACKED
SEPARATELY FROM SHOT**

Storage and Transport

5.1 The charges will be stored and transported in accordance with normal HD 1.3 conditions, except that when they accompany shot, the requirements of Sections II and III of this Prescription will apply.

Distribution:

CSO D Def H&S	2 copies
D Def H&S HP	2 copies
DWSS(Nuc)	2 copies
NBSA (Infrastructure)	2 copies
NBSA(S)	3 copies
CESO(N) AD(S)	1 copy
SS, NA124/125(and Sec MSC)	2 copies
Log Sp Svcs 2	2 copies
DTMX Sea Ops	2 copies
DTMX Land Ops	3 copies
DLSA	12 copies
DDSM(Wpns)(RAF)	5 copies
SMG, SM Wpns15(RAF), WYT	1 copy
HQLC, Sup Pol 2c, BRA	2 copies
DGTS, AD Safety Pol, ABW #67	2 copies
DGTS, Explosives and Range Safety Civilian, ABW #67	5 copies
DRPS	5 copies
ESTC Part 1 Members	1 copy
Sec NWDUASC (for Chairman and Members)	20 copies
Sec OB	1 copy
Sec DACC	1 copy
Spare ESTC	25 copies
DRIC	2 copies (no further distribution without reference to Sec ESTC)

**TECHNICAL NOTES RELATING TO THE PRESCRIPTION FOR
THE STORAGE AND TRANSPORT OF 120mm TK APFSDS L26A1
AMMUNITION IN APPROVED UNIT LOAD CONTAINER L276A1**

NOTE: AWE assessment reference AWE/DWE31/96/21D/127 Dated 10/9/96 confirms that the advice provided here in paragraphs 6 & 7 is relevant to arrangements specified for the L27A1 round".

Potential Health Risk to the Public

1. The potential health risk to the public resulting from a fire in a explosive storage facility containing DU ammunition or during transit would be caused by:
 - a. inhalation of a uranium oxide aerosol in the form of smoke escaping from the building or vehicle; and
 - b. contamination of property, foodstuffs, livestock, etc by deposition of uranium oxide particulate from the smoke plume, leading to a long-term inhalation and ingestion risk.

Hazard Estimate Specific to 120mm APFSDS Ammunition

2. Storage Conditions. The Explosive Store House (ESH) and vehicle loadings used in the hazard estimate (Ref 1) are as follows.

Typical Situations	Number of ULCS	DU Mass (Tonnes)	Propellant Mass (Tonnes)
Lorry	8	1.1	2.3
Unit Store	20	2.8	5.7
Garrison Store	120	16.6	34.1
Main Store	240	33.2	68.1
Main Store	600	83.2	170.3

3. Accident conditions. The worst credible accident has been assumed (1) to be a fire which consumes the entire DU inventory in ESH or vehicle.
4. Assumed dispersion conditions. The smoke plume height was calculated assuming the slowest reasonable rate of burning (2 hours), to produce the minimum height and hence maximum calculated concentrations. The plume diameter at ground level was conservatively limited to the range 3-10m, corresponding to the minimum dimension of a vehicle or ESH containing 1-100 tonnes of DU in the form of 120mm ammunition in ULC.

[REDACTED]

In order to maximise inhalation exposures atmospheric dispersion is assumed to occur under adverse stability conditions (Pasquill Category F) with a low wind speed (lms). Calculations further maximise predicted exposures by assuming no wind variations during the passage of the plume and that the exposed subject remains stationary on the plume "hot-line".

5. Hazard criteria. It is highly probable that a single inhalation intake of 2.5 mg of DU would have no adverse chemical toxicity effect. This intake would result in a 50yr committed effective dose equivalent of 2mSv, corresponding to an individual risk of 10^{-4} for latent cancer death. [The limit imposed by toxicity effects is therefore less than the lower NRPB Emergency Reference Level for sheltering as a counter-measure to avert dose (3mSv).]

Predictions and Countermeasures

6. Dose from passing cloud. For the transport accident, the worst case DU release would result in a 2.5mg intake level (=2mSv) extending to $\approx 50m$. Although not strictly necessary, sheltering to reduce this intake would be advisable.

7. Surface Contamination. For the transport accident, the worst case release would result in DU deposition levels requiring consideration of evacuation (30mSv from resuspension/inhalation) and long term clean-up ($30KBq m^{-1}$) at distances of 100 and 350m respectively. For the largest ESH inventory release, these levels would extend to about 300m and 2Km respectively.

Ref I SDTN No 7/81 (AWE), [REDACTED], 1981 [REDACTED S40]