19 Gaseous Tritium Light Sources (GTLSs) and Gaseous Tritium Light Devices (GTLDs)

Scope

1. A gaseous tritium light source (GTLS) is a sealed glass container filled with radioactive tritium gas. GTLSs may be referred to as betalights, trilux or nuclear lamps and are used to provide illumination.

2. A gaseous tritium light device (GTLD) is equipment containing one or more GTLS. There are many types of GTLDs in service use, including prismatic compasses, defile markers and SUSAT weapon sights.

3. This Chapter describes the radiological requirements for keeping, using and disposing of such equipments. Summaries of the radiation risk and regulatory requirements for examples of GTLSs and GTLDs are provided at the Annexes to this chapter. Summary risk assessments for a comprehensive range of GTLSs and GTLDs are available from the RPA who may also be consulted for further advice regarding the hazards and requirements for these items.

Statutory Requirements

4. In addition to the general requirements of the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999, the following specific legislation applies directly or is applied indirectly through parallel arrangements designed to achieve equivalent standards:

a. Ionising Radiations Regulations 2017 (IRR17) (apply directly);

b. Environmental Permitting (England and Wales) Regulations 2016 (EPR16) (as amended) (parallel arrangements);

c. Environmental Authorisations (Scotland) Regulations 2018 (EASR18) (parallel arrangements);

d. Radioactive Substances Act 1993 (Scotland and Northern Ireland) (as amended) (RSA93) and associated Exemption Orders; and

e. Carriage of Dangerous Goods and Transportable Pressure Equipment Regulations 2009 (apply directly).

Duties

5. Duties as detailed in Chapter 39 apply.

Markings of GTLSs or GTLDs

6. The following markings may be found on GTLSs or GTLDs.

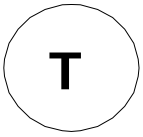


Figure 1 Tritium marking.

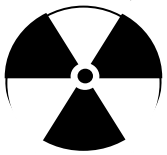


Figure 2 Standard radiation trefoil. Colour of symbol: black on yellow or white background.

7. Where possible GTLSs and GTLDs in storage are to be kept in their original containers or packaging and are to be marked with the following information:

a. NATO stock number;

b. number of GTLSs / GTLDs in package;

c. total activity of GTLSs / GTLDs in package; and

d. the word ‘radioactive’ and the trefoil symbol.

Hazards

8. A GTLS is a glass capsule coated internally with a phosphor and filled with tritium gas, a radioactive isotope of hydrogen. Low energy beta particles, which are emitted during the radioactive decay of tritium, react with the phosphor to produce a continuous emission of light. If a capsule is broken, the escape of tritium could result in a health risk, particularly if the breakage occurs in a confined space. When a GTLS is broken, provided that the area is reasonably well ventilated, the tritium gas will disperse relatively quickly, however some activity will remain bonded to the phosphor and shards. The sources also contain small quantities of tritiated water, which also tend to remain associated with the phosphor and fragments of glass for a considerable time following breakage.

9. Low energy beta radiation is emitted from GTLSs and GTLDs, but the energy of the beta is insufficient to penetrate beyond the casing.

10. Tritium can present a hazard internal to the body if taken in by ingestion, inhalation, or absorption through the skin or through cuts in the skin. Of the two forms of tritium, tritiated water presents the far greater health hazard due to its more significant ability to enter the body both by inhalation and by rapid absorption through the skin.

11. Low levels of Bremsstrahlung radiation (X-rays) are emitted from valves containing beta emitters.

Tritium Monitoring and Detection

12. The radiation dose rate from a GTLS or GTLD will be low due to the very low energy beta radiation emitted and will therefore generally be less than 1 µSv/hr. It is very difficult to detect tritium contamination without the use of specialised monitoring instrumentation. Tritium surveys are therefore generally carried out by indirect means involving the taking and analysis of smears of the surfaces to be monitored.

13. It is also difficult to monitor for tritium in the air and thus assess the internal hazard following a release of tritium into the atmosphere. Therefore, for workers who have potentially been exposed to tritium, it may be necessary to carry out tritium-in-urine

monitoring to assess the amount of tritium taken into the body and the resulting radiation dose.

Risk Assessments for GTLSs and GTLDs

14. The number of GTLSs and GTLDs in service within MOD is too large to list in this publication. Similarly, it is not possible to include risk data for all items. However, summary risk assessments for an example are reproduced at Annexes A to C of this Chapter. These summary risk assessments may be used to scope the hazard and control requirements for a wider range of GTLSs and GTLDs and may be used, where appropriate, as input to the risk assessments and local orders required in accordance with Chapters 2 and 16 respectively. Specific risk assessments would be required where large quantities (> 1000 GBq) of GTLSs and GTLDs are stored. Advice on further detail and assessments may be sought from the RPA.

Handling of GTLSs and GTLDs

15. No protective clothing is required for the routine handling of GTLSs and GTLDs. Specific advice for those involved in repairing GTLSs or GTLDs is given in Annex D.

Breakage of GTLSs and GTLDs

16. All reasonable practical steps are to be taken to prevent any GTLS or GTLD being damaged. Wherever there are reasonable grounds to believe that the glass has been cracked or broken, the GTLS breakage routine as described in Chapter 40 should be followed.

17. A broken GTLS or GTLD is potentially hazardous because loose radioactive material can enter the body by a variety of means including inhalation of gaseous material (if present), inhalation of radioactive dust and absorption through cuts or scratches in the skin.

18. Because GTLSs and GTLDs contain gaseous tritium (H-3), it is important that the room or compartment where the breakage has occurred is vacated for 1 hour to ventilate before dealing with the broken fragments wearing suitable personal protective equipment. Detailed guidance on the procedure for dealing with a broken GTLS or GTLD can be found in Chapter 40.

19. Liquid leaking out of compasses (or other items) containing tritium should be dealt with as a broken GTLS.

Loss or Theft of GTLSs and GTLDs

20. GTLSs of more than 10 GBq are reportable to the HSE via the RPA in the event of any loss or theft. Further guidance can be found in Chapter 14.

Disposal of Damaged GTLSs and GTLDs

21. Within the UK, the disposal of GTLS fragments and associated waste arisings may be undertaken using the normal refuse route. The disposal container is to be securely sealed and must not have any visible markings to indicate the presence of radioactive material. Advice should be sought from the Dstl Radiation Waste Advisor (RWA) or Radiation Protection Adviser (RPA).

22. Broken GTLSs and GTLDs can be disposed of locally provided the activity per item does not exceed 20 GBq of H-3 per dustbin load (0.1m^3) of non-radioactive waste and the amount of tritium disposed of in any 12 months does not exceed 10 TBq.

23. Details of the broken GTLS or GTLD material disposed of and the disposal route should be entered on the radioactive source list and the Dstl Annual Holdings Return.

24. These disposal arrangements cover non-routine occurrences and should not be used for situations where a continuous waste stream is being generated. Unless otherwise advised, intact GTLSs and GTLDs should be returned through stores for recycling.

SA80 Blade Sight Assembly –Summary Radiation Risk Assessment

SA80 Blade Sight Assembly B4	
Description	  Equipment carries no manufacturer “T” or trefoil warning symbol The GTLS aperture is about the size of a pinhead seen at the rear of the blade near the top. The whole sight containing the Blade 1005-99-967-0508 is 1005-99-967-0506 * Note Cadet Version 1005-99-967-4839 does not contain GTLS.
Use	Sight illumination (Gaseous Tritium Light Source).
Supplier	British Aerospace.
NSN	1005-99-967-0508.
IPT Details	Combat Support.
Radionuclide	Tritium (H-3)
Ionising Radiation	Beta (0.019 MeV).
Half Life	12.3 years.
Original Activity	259 MBq.
Hazard	Tritium is a form of Hydrogen and in GTLSs and GTLDs in the form of gas. If destroyed in a fire, the tritium is rapidly converted to tritiated water. The escape of tritium could result in a health risk particularly in a confined space. Of the two forms of tritium, tritiated water presents the greater hazard due to its ability to enter the body both by inhalation and rapid absorption through the skin. Radiation levels on contact are <0.1 µSv/hr.
Risk Assessment	All components containing tritium leak. The degree of risk from tritium leaking out of this component is negligible. The likelihood of accidental damage to this component to such a degree that tritium escapes is low. A more severe accident, for example, crushing, could possibly result in the release of tritium. Internal dose will be dependent on the duration of exposure and concentration of tritium. For further advice contact the RPA..

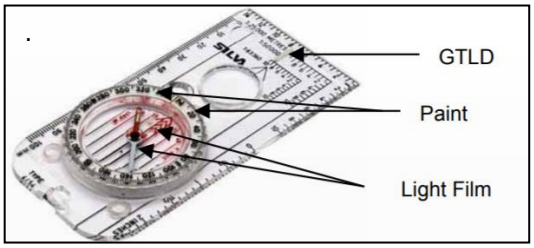
Local orders	Details of the control measures taken from this Chapter are to be included in the local orders for radiation safety (Chapter 16 refers).
Control measures during use	No protective clothing or special precautions required.
Inspection	Annually as well as during routine maintenance. Check to be made for signs of damage.
Leak Testing	Leak testing is not required for this component.
Accounting	This item is to be accounted for on a Radioactive Source List. Chapter 9 refers. All radioactive material is to be mustered monthly. Any change of location is to be entered in the Source Movement Log together with any change in custodian.
EPR1 6 / EASR18 / RSA93	Although exempt from formal notification to the relevant environment agencies, this item is to be included in the Annual Holdings Return to Dstl – Chapter 3 refers.
Storage and Labelling	If uninstalled, this item is to be stored in a dedicated area for radioactive materials – see Chapter 9. The equipment is to display the recognised radiation hazard trefoil warning label on it. The storage / installed area is also to have a sign showing radioactive material within i.e. a radiation warning trefoil including the contact name and telephone number of the RPS or WPS and stating the nature of the radiological hazard in appropriate languages **"Items contain radioactive material. No radiation hazard from intact item. Radioactive contamination hazard if item is damaged."**
Contingency Plans Spills/ Loss	If a breakage occurs the area is to be evacuated and ventilated. Tritium gas will disperse relatively quickly; however, some may remain bonded to the component. Once a suitable amount of ventilation time (one hour) has passed, the broken item can be cleaned up using a breakage kit, see Chapter 40. See below for disposal; if in doubt, seek RPA advice. Reporting of loss and certain other incidents is to be carried out in accordance with procedures described in Chapter 14.
Transport	This item may be transported within an excepted package provided the total package activity does not exceed 8000 GBq.
Disposal	Units and Establishments are to return this item, unbroken, through the stores organisation. Broken items are to be disposed of in accordance with Chapters 12 and 40.

SUSAT Sight Light Assembly –Summary Radiation Risk Assessment

SUSAT Sight Light Assembly B4	
Description	   Equipment marked with trefoil The GTLS light assembly 1240-99-967-0477 is a rod, which is screwed into the Susat sight 1240-99-967-0947 for internal illumination.
Use	Sight internal illumination (Gaseous Tritium Light Device).
Supplier	RO Notts.
NSN	1240-99-967-0477
IPT Details	Combat Support.
Radionuclide	Tritium (H-3)
Ionising Radiation	Beta (0.019 MeV)
Half Life	12.3 years.
Original Activity	4.07 GBq.
Hazard	Tritium is a form of Hydrogen and in GTLSs and GTLDs, in the form of gas. If destroyed in a fire, the tritium is rapidly converted to tritiated water – a more hazardous form of tritium. The escape of tritium will result in an internal radiation dose if taken into the body by inhalation, ingestion or absorption through the skin. Of the two forms of tritium, tritiated water presents the greater hazard due to its ability to enter the body both by inhalation and rapid absorption through the skin. Radiation levels on contact <0.1 µSv /hr.
Risk Assessment	All components containing tritium leak. The degree of risk from tritium leaking out of this component is negligible. The likelihood of accidental damage to this component to such a degree that tritium escapes is low. A more severe accident, for example, crushing, could possibly result in the release of tritium. Internal dose will be dependent on the duration of exposure and concentration of tritium. For further advice contact the RPA.

Local Orders	Details of the control measures taken from this chapter are to be included in the local orders for radiation safety (Chapter 16 refers).
Control measures during use	No protective clothing or special precautions required. Item not to be carried on the person.
Inspection	Annually as well as during routine maintenance. Check to be made for signs of damage.
Leak Testing	Leak testing is not required for this component.
Accounting	This item is to be accounted for on a Radioactive Source List. Chapter 9 refers. All radioactive material is to be mustered monthly. Any change of location is to be entered in the Source Movement Log together with any change in custodian.
EPR16/EASR18/RSA 93	Although exempt from formal notification to the relevant environment agencies, this item is to be included in the Annual Holdings Return to Dstl – Chapter 3 refers.
Storage and Labelling	If uninstalled, this item is to be stored in a dedicated area for radioactive materials – see Chapter 9. The equipment is to display the recognised radiation hazard trefoil warning label on it. The storage / installed area is also to have a sign showing radioactive material within, i.e. a radiation warning trefoil including the contact name and telephone number of the RPS or WPS and stating the nature of the radiological hazard in appropriate languages **"Items contain radioactive material. No radiation hazard from intact item. Radioactive contamination hazard if item is damaged."**
Contingency Plans Breakage / Loss / Incident	If a breakage occurs the area is to be evacuated and ventilated. Tritium gas will disperse relatively quickly; however, some may remain bonded to the component. Once a suitable amount of ventilation time (one hour) has passed, the broken item can be cleaned up using a breakage kit, see Chapter 40. RPA advice is to be sought regarding disposal of the fragments. Reporting of loss and certain other incidents is to be carried out in accordance with procedures described in Chapter 14.
Transport	This item may be transported within an excepted package provided the total package activity does not exceed 8000 GBq.
Disposal	Ships, Units and Establishments are to return this item, unbroken, through the Stores Organisation. Broken items are to be disposed of in accordance with Chapters 12 and 40.
Local Orders	Details of the control measures taken from this chapter are to be included in the local orders for radiation safety (Chapter 16 refers).

Silva Compass –Summary Radiation Risk Assessment

3	**Silva Compass NATO 4B**
Description	 Equipment marked with a trefoil **GTLD** = 0.74 GBq (end of direction arrow). **Paint** = 0.33 GBq (Inside capsule – 2 dots, 1 each side of red arrow) **Light Film** =0.22 GBq (needle and scale). Note: Silva Compass Type 4 NSN 6605-99-188-5146 is not radioactive
Use	Luminous dial for Compass (Gaseous Tritium Light Device)
Supplier	Silva Sweden AB, BOX 998, 191 29 Sollentuna, SWEDEN
NSN	0691-99-529-3731 or 6605-99-582-5812
NAV CAT Details	Combat support IPT
Radionuclide	Tritium H-3
Ionising Radiation	Beta (0.019 MeV)
Half Life	12.3 years
Original Activity	1.29 GBq
Hazard	Tritium is the radioactive form of hydrogen and is a highly flammable gas. Tritium within the compass is in the form of gas and solid. If destroyed in a fire, the tritium is rapidly converted to tritiated water. Tritiated water presents the greater hazard due to its ability to enter the body both by inhalation and rapid absorption through the skin. In an enclosed space this constitutes an extra risk to personnel in the immediate vicinity.
Risk Assessment	The likelihood of accidental damage to this compass is low, because it would require a strong and directional force to break the face. There is a low probability of release of tritium. In some highly unlikely circumstances, there is a potential for an internal dose to be received. For further advice contact the RPA
Control measures	Follow the local orders for the use of a GTLD under appointed WPS / RSO supervision. Chapter 16 refer.
During Use	No special precautions are required when handling this component.
Inspection	Annually as well as during routine maintenance. Check should be made for signs of damage.
Leak Test	Leak testing is not required for this component.
Accounting	Each item is to be accounted for on a Radioactive Source List under the care of an appointed WPS (RAM). See JSP 392 Chapter 9. All radioactive material is to be mustered at least monthly. Any change of location should be entered in the Source Movement Log together with any change in custodian.
EPR16 / EASR18 / RSA93	Although exempt from formal notification to the relevant environment agencies it should be included in the annual holding return to Dstl. JSP 392 Chapter 9.
Storage and Labelling	This item is to be stored in a dedicated area for radioactive materials. JSP392 Chapter 9 refers. The equipment is to have the radioactive trefoil on it. The storage / installed area is also to have a sign showing radioactive material within i.e. a trefoil including the contact name and telephone number of the WPS / RSO and stating the nature of the radiological hazard "**Items contain radioactive material. No radiation hazard from intact item. Radioactive contamination hazard if item damaged".**

Contingency Plans Spills / Loss	If a breakage occurs the area is to be evacuated and ventilated. Tritium gas will disperse relatively quickly. However, some will remain bonded to the component. Once an hour has passed the broken item can be cleaned up using a Breakage Kit. JSP 392 Chapter 19 refers. If this item is lost, damaged or stolen, JSP 392 Chapters 14 and 40 refer. Personnel exposed to leaking Tritium should report to the WPS or RSO.
Transport	This item may be transported as an excepted item provided the total package does not exceed 8000 GBq and the surface dose rate of the package is less than 5 µSv/h Dangerous Goods Manual refers.
Disposal	Ships, Units, and Establishments should return this item to the Stores Organisation.

SPECIFIC GUIDANCE FOR GTLD REPAIR WORKSHOPS

1. In workshops where GTLDs are repaired, the number of radioactive items held in the work area is to be kept to a workable minimum. Equipment's held in temporary storage within the workshop pending completion of repair are to be stored on fireproof racking marked with a radioactive warning trefoil and a suitable legend (e.g. RADIOACTIVE ITEMS CONTAINING TRITIUM). The number of spare GTLSs held within the room is to be kept to the minimum required for the work in hand, stocks being replenished from the main store on a daily basis. Where practicable, all items containing a GTLS are to display a radiation hazard trefoil, the symbol "T" and the activity of the GTLS.

2. Doors providing access to the building and to the workshop area are to display a sign incorporating the radiation warning trefoil and giving details of the radiation hazard and the appropriate radiation protection point of contact. Such signs are available through the appropriate service channels or may be obtained locally and should be in relevant foreign languages.

3. The fire officer is to be kept fully informed of the quantity and locations of all radioactive materials within the workshop. These locations are to be described in local radiation safety rules, preferably as a diagram.

4. In order to prevent the accumulation of tritium contamination, areas where equipment containing GTLSs / GTLDs is repaired / maintained or stored are to be cleaned at regular intervals. Bench tops are to be of a non-permeable material (e.g. Formica) with sealed edges and joints or covered in a non-permeable material (e.g. polythene sheet). Work surfaces are to be wiped down with damp tissues at the end of each work period. The tissues may be disposed of with domestic waste. Once per month, bench tops are to be thoroughly cleaned using a detergent solution.

5. Large stores or workshops which occasionally have to deal with broken GTLSs are to seek specific advice from their RPA in relation to the procedures and control measures that they need to adopt with regard to monitoring work areas for tritium. A GTLS breakage kit (put together locally), with instructions for its use (Chapter 40) is to be available in each work area. These instructions are to be included in local radiation safety orders.