RISK ASSESSMENT FOR THE ELEMENT COLLECTION

Overview:	This document provides a health and safety risk assessment for the boxed set of real samples of the natural elements produced and distributed by RGB Ltd under the name "The Element Collection".
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Product description:	A boxed set of sealed specimen tubes containing samples of the 92 naturally occurring elements from the periodic table.
Intended Use:	Educational display and teaching aid for the physical sciences.
Physical:	452 x 237 x 57 mm (main box) 42 x 20 mm (92 No. specimen tubes) 2.4 kg in total
Manufacturer:	RGB Research Ltd 1 Underwood Row London N1 7LZ England See contact details above
Packaging:	Box made of felt-lined 3mm plywood in 10mm wooden frame with internal wooden dividers creating cells for each sample. Specimen tubes are borosilicate glass with black urea plastic tops. All specimen tubes are permanently sealed and hazardous samples (see below) are further protected inside a second inner borosilicate ampoule or glass vessel with stopper. Radioactive samples (see below) are further protected by permanent embedding in an extremely tough, chemically resistant clear polyurethane resin matrix.

Contents: See table attached for complete listing of materials with quantities, hazard assessment and categorisation of individual risk and control measures.

Hazardous materials: Approximately half the samples in the set carry some degree of risk. These fall into three principal areas: toxic substances (18 samples), reactive/flammable substances (22 samples) and radioactive substances (11 samples). In total 19 of the samples carry a UN number and require special provisions for transporting by air.

Toxicity: the most toxic substances included in the set are arsenic (oral LD50 = 145 mg/kg), thallium (lowest published toxic oral dose: 5.7 mg/kg) and mercury (lowest published lethal toxic oral dose: 43 mg/kg). The amount of thallium provided is <= 100mg and this sample is the only one in the set that could be lethal if opened and entirely consumed by a small child.

Reactivitity and flammability: the alkali metals lithium, sodium, potassium, rubidium and caesium are the most hazardous samples in this regard. All of them react explosively with water, releasing hydrogen gas and in the cases of all except lithium, spontaneously igniting. Rubidium and caesium can ignite on contact with atmospheric oxygen. The risk associated with the other metals listed as flammable are low if – as is the case with all the samples in the sets – finely divided powders are avoided.

Radioactivity: three types of radioactive material are included in the sets where these samples are provided. Uranium and thorium are supplied as the metals; radium and promethium are supplied as small dabs of luminous paint on watch hands; all the remaining radioactive samples are supplied in the form of a small piece of low activity uranium or thorium bearing mineral in which a few atoms of the relevant element will exist.

Control measures: The following general measures have been adopted to control the general risks associated with the above hazardous materials.

1) Sale only to responsible persons
All purchasers must sign and return to RGB a customer end use agreement in advance of receiving the Element Collection which describes the potentially hazardous nature of the contents and which requires written confirmation that the safety instructions will be followed. Sale is restricted to persons over 18 and a signed undertaking must be given to keep the sets safe and to supervise any use by children.

2) Limited quantities and safe form of hazardous materials

The main risk control measure is to provide only very small quantities of the more hazardous elements and to ensure that where possible these are provided in the safest available form. For example, beryllium is supplied as a solid piece of metal rather than powder and this effectively eliminates the principle risk of inhalation. Similarly, phosphorus is provides as the relatively non-toxic and un-reactive red allotrope.

In the case of the radioactive elements, the specific activity of the samples is below the exemption threshold for sending materials through the normal post. Combined with the packaging (described below) radiation levels at the surface of the sealed vials is considerably below 5 microSv/hr and less than the natural background in some parts of the UK.

Formal guidance was obtained from the NRPB (National Radiological Protection Board) when designing the sets.

3) Packaging

All the samples are permanently sealed in robust vials using chemically resistant epoxy glue. Potentially hazardous samples are further ampouled in a second vessel and stored under argon and/or mineral oil. Considerable force or a drop from a height greater than 2 metres onto a hard surface is required to break both vial and ampoule.

The radioactive samples are permanently embedded in tough clear resin inside the glass vials. This packaging is resistant to hammer blows and to any non-intentional fall. Although the outer glass may fracture, the resin will continue to protect the sample from release.

4) Documentation

A safety card with detailed instructions for cleaning up any spills is provided with the sets and the hazardous samples are clearly identified on an illustrated laminated card. Both items are designed to be kept in the lid of the set.

Risks:

Accidental breakage by dropping
CONTROLS: Double vessels including a robust inner ampoule are used for the most toxic, reactive and flammable samples; quantities are limited to minimise hazards in the event of escape; instructions are provided for action in the case of a spill.

Accidental swallowing by small child
CONTROLS: vials are permanently sealed; customer undertaking to supervise use and safeguard sets under lock and

key where necessary; radiation exposure as a result of swallowing will still be below recommended limits.

Reactions or escapes due to leaks
CONTROLS: the more hazardous elements are sealed in double vessels; quantities are limited so that in the event of accidental release the amount is unlikely to cause serious harm; in the event of a leak exposing reactive materials to oxygen or water tarnishing will occur but the risk of spontaneous combustion is low unless the vials are smashed with great force. Even in the latter case, the potential energy release is less than that from a single match-head.

Theft
CONTROLS: customer undertaking to supervise use and safeguard sets under lock and key where necessary; limited quantities mean that malevolent potential is considerably less than for other more readily available materials (gasoline, caustic soda, propane, vermin poisons).

Attachments: Schedule of samples
Safety instruction card