



Chartered
Institute of
Environmental
Health



Pest control procedures in the food industry

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1

Introduction

The presence of pests in food production and preparation areas has always been unacceptable. Yet while the pest management industry has seen many advances in monitoring and baiting techniques in the past 30 years, some of the practices in the food industry have not kept up with these new techniques.

Concerns for the environment and the requirements by regulators for improved practices in the industry have meant that new methods to control pests have had to be devised.

The Chartered Institute of Environmental Health (CIEH) has assessed these developments and feels that now is the time to consider whether the techniques that have been common in the food and pest management industries need to be revised.

Since many of the people involved in maintaining and regulating food safety are environmental health practitioners (EHPs), the CIEH has taken the lead in devising the standards which it believes should now operate in the food industry.

These guidelines have therefore been drawn up by the National Pest Advisory Panel (NPAP) of the CIEH after full consultation with all those involved in food production, preparation and retailing, together with representatives of the pest management industry. Advice has also been sought from government agencies involved in research and enforcement, as well as the main bodies which lay down auditing standards.

These guidelines are aimed at the food manufacturing sector. While the principles are the same for production (farmers and growers), raw material and ingredient suppliers, warehousing, distribution and retail, the level of pest control contract specification will vary.

The CIEH would like to thank all those who have contributed to the preparation of these draft guidelines.

Dr Stephen Battersby
CIEH President

2 Food safety

2.1 OVERVIEW

The presence of pests in any food handling premises is unacceptable. The risks posed by pests include:

- The spread of disease – pathogens are transferred from the gut or external surface of the pest
- Damage to property
- Contamination of work surfaces and foodstuffs
- Adverse public opinion and loss of reputation
- Prosecution and closure
- Poor staff relations

The objective of the Pest Management Programme should be to prevent, as far as practicable, the introduction of pests onto the site and to reduce the conditions that may encourage their presence.

2.2 FOOD HYGIENE REGULATIONS

2.2.1 Regulation (EC) 178/2002 of the European Parliament

This regulation lays down the principles and requirements of food law.

Article 14 of Regulation (EC) 178/2002 deals with unsafe food. It is an offence not to comply with article 14 under the General Food Regulations 2004. Food shall be deemed unsafe if it is considered to be injurious to health or unfit for human consumption.

2.2.2 Regulation (EC) 852/2004

These regulations lay down general hygiene requirements for all food business operators and state that:

- The layout, design and construction of food premises are to permit good food hygiene practices including protection against contamination and in particular, pest control.
- Adequate procedures should be in place to control pests

2.3 HACCP – HAZARD ANALYSIS CRITICAL CONTROL POINT

According to EC Regulation No 852/2004 on the hygiene of foodstuffs, with the exception of activities at the level of primary production, food business operators are required to put in place procedures, which manage food safety within their establishment.

Article 5 of the regulation requires that the procedure or procedures be based upon the HACCP (Hazard Analysis Critical Control Point) principle.

However, it does not necessarily constrain food business operators to implement a HACCP system if this is not appropriate.

Pest management is part of the Good Manufacturing Practices (GMP) for food businesses, which is a prerequisite for the HACCP-based procedures in place. As an integral part of the GMPs, it should be carried out with due diligence and properly documented.

2.4 PEST MANAGEMENT STANDARDS IN THE FOOD INDUSTRY

Food safety audits may be carried out by auditors from within the company or from an independent organisation. The audit is generally based on a series of criteria set out to ensure the highest standard of compliance with a specific aspect of food safety. The section which deals with pest management will usually require zero infestation and conformity with criteria covering type of pest management programme; permitted materials and techniques and record keeping. Care is essential when setting criteria to ensure that they achieve the required result. Over-prescriptive criteria may place unnecessary restrictions on the pest management programme, extending the period before control is achieved.

2.4.1 Risk-based standards

If standards and guidelines for pest control are to achieve the aim of promoting best practice they must be practical and flexible. The standard should be risk-based in order to address the issues raised by the following:

Risk to public health due to activities of pests

Pests are known to carry a range of pathogens which can be transmitted to humans either through contaminated food or their presence in the environment.

Risk to food safety

This will be the priority for all engaged in the production, storage, transport, processing and sale of food. The risks include:





- Physical contamination of product by rodent droppings, insect parts or other foreign bodies
- Introduction of micro organisms
- Damage to product or packaging

Risk to public safety and the environment

The irresponsible or inaccurate use of pesticides may present a hazard to technicians, site staff and members of the general public, as well as to the environment through contamination of water, damage to plants and the effect on non-target species of animals.

2.4.2 Application of standards

When applying the relevant standard to pest management such as rodent control, reference should be made to the following:

- Are rodents active on site at the time of the inspection? (Evidence of, or bait taken by, field mice or voles away from the buildings should not constitute an infestation)
- Past history of site. Is there documented evidence that rodents have been active in the last two years?
- Site potential for infestation. Does the layout, construction, manufacturing process, hygiene practices or product lend the site liable to infestation? Are there water courses, railways, amenity sites nearby. Is the site situated within or adjacent to a high risk area?
- Status of neighbouring properties. Are the activities of adjacent properties or businesses liable to attract pests into the vicinity?
- Presence of non-target species. Are there records or reported sightings of protected species of birds or mammals? Are there areas away from the buildings where the presence of toxic rodenticide baits may

present a risk of secondary poisoning? A documented comprehensive environmental risk assessment must be undertaken in accordance with the CRRU UK Code of Best Practice & Guidance for Rodent Control & the Safe Use of Rodenticides and alternative control methods appropriate to the site location considered before the use of anticoagulant rodenticides.

2.4.3 Environmental management and pesticide reduction

There should be an increased reliance on environmental management and inspection of the site to reduce the attraction to pests.

Pest management programmes should aim to reduce the use of pesticides, particularly outdoors, by enhanced prevention programmes based on proofing and hygiene as prescribed in the CRRU UK Code of Best Practice. (see 12.4 for further details)

For example, reliance on toxic rodent baits outdoors as a permanent indicator of rat activity is no longer acceptable. Knowledge of the site, its history and potential for infestation through regular and thorough inspections must replace perimeter baiting as the first line of defence.

2.5 PEST AWARENESS AND STAFF TRAINING

Training should be given appropriate to the personnel concerned, for example using the CIEH DVD *Pests on the Menu*.

As a minimum all departmental personnel should be aware of the pests that they are likely to encounter in their part of the process and the importance of pest prevention. Particular attention should be given to incoming goods such as raw materials or packaging.

Pests and their habits

Training on the identification and habits of the more common pests of the food industry can be given by the pest control contractor or through independent consultants. This is best achieved in the form of a brief presentation rather than distribution of literature, and where appropriate can be tailored to particular industry segments for example, bakery or confectionery.

Pest prevention

The importance of pest prevention through good hygiene, stock management and exclusion practices should be emphasised. Site personnel have the day to day responsibility of ensuring a pest management programme is maintained.

Information posters

In addition to training sessions the posting of information at individual workstations or sensitive locations such as rest areas and goods-inwards doorways can act as a reminder of the requirements of the Pest Management Programme. These can remind staff of pest-related risks and preventive measures such as:

- Door and window disciplines
- Hygiene and housekeeping
- Stock storage and rotation

2.6 REPORTING AND RECORD KEEPING

The organisation of a reporting system and maintenance of records is essential if Good Manufacturing Practice (GMP) status is to be achieved.

Records must be kept for the following reasons:

- To highlight any recommendations
- To demonstrate compliance with legislation
- To monitor pest management processes
- As evidence of compliance to third party auditors

2.6.1 Pest sightings log

A record should be kept of any pest sightings, including those made by personnel other than those involved in pest management. This can be in the form of a book or a folder where the following information can be logged:

- Name of person making report
- Date and time
- Location
- Pest seen
- Any other relevant information

In addition to entering the sighting in the book, the sighting must be reported to the appointed manager in charge of pest management who will decide on further action.

Where a pest control contractor is employed the sighting will normally result in a request for service. In the case of an on-going riddance programme the reports will provide information on the success of the treatment.

The pest sightings record should be checked and signed on each contractor visit to the site

and daily where an in-house programme is in place. The contents of the pest sightings record should be part of the management review process.

2.6.2 Pest control report

Inspection reports must be concise and legible and stored in an easily accessible binder. A typical pest control report will contain as a minimum:

- Treatment date
- Details of the pest control contractor and name of technician servicing the site
- Details of the customer and name of the contact person on site
- Type of visit: scheduled, follow-up, callout, etc
- Pests found
- Action taken
- Pesticide used
- Location of baits and monitors (this may be in the form of a checklist or plan)
- Quantities used
- Documented Risk assessments
- Post treatment precautions
- Recommendations on proofing, hygiene and storage
- Details of follow-up inspections

Individual specifications may include additional reports such as analyses and trends for each bait or monitor.

The report must be signed by the pest control technician and the customer.

Where anticoagulant rodenticides are used outdoors the following additional records should be kept:

- A site plan identifying areas where bait has been laid
- Documented Environmental Risk Assessment
- Hierarchical risk assessment describing why anticoagulant rodenticides have been selected as the preferred control method.
- Details of the active ingredient, formulation and quantities used
- Inspection reports, which demonstrate the treatment frequency to check and replace baits and to search for and remove dead rodent bodies where appropriate
- Reports of any effect on non-target species and action taken to reduce risk
- Reports of any interference or removal of baits
- Reports on conditions, which may adversely affect treatment and remedial actions
- Evidence that control has been achieved within the prescribed timescales

2.6.3 Other records

- Safety Data Sheets (SDS) for pesticides used on site
- COSHH Risk Assessments*
- Site Risk Assessments*
- Environmental Risk Assessments*
- Qualifications, insurance membership and accreditation documents
- These may not be relevant for each site or may be in a combined form.



3

Rodents

3.1 RATS

In Britain, there are two species of rat; the Norway or brown rat (*Rattus norvegicus*) and the ship or black rat (*Rattus rattus*). The Norway rat has largely replaced the ship rat over the past 100 years.

Norway rats eat on average one tenth of their body weight each day. They are considered omnivorous but if available, cereals are preferred. Rats must drink water daily unless the food source is extremely moist. Due to their water requirements, runs to a water source may be evident and give an indication of harbours.

They explore locations quite freely but have a fear of new objects. This is known as neophobia and should be taken into account when baits are checked initially after a treatment.

On farms, stored animal feed and crops, bedding, even animal waste will present an ideal environment to support rodent infestations. Rats living and feeding outside may enter buildings with the onset of the winter months.

Ship rats are very good climbers and are usually found indoors, often high up. Although they are rare in the UK, they are still found in some port areas.

3.2 MICE

The house mouse, *Mus domesticus*, is the common pest in urban environments, although field mice (wood mice and yellow-necked mice, *Apodemus* spp) can be a problem in autumn and winter. Where these enter premises, control is the same as for house mice.

Mice will drink water if available but can survive on food with a moisture content of 15 percent. They are omnivorous; feeding from a number of different points during the course of a night's feed. Whole wheat, which has been partly eaten by mice, has a kibbled appearance while whole grain, partly eaten by rats, has a cut or chopped appearance.

In domestic premises, locations favoured by mice are food storage and preparation areas such as kitchens and pantries. Airing cupboards, sub floor areas, enclosed pipes, baths and loft areas are also favoured locations.

3.3 SQUIRRELS

In the UK the grey squirrel (*Sciurus carolinensis*) is regarded as a pest species. The red squirrel (*Sciurus vulgaris*) is fully protected.

The grey squirrel was introduced into the UK in the mid 19th century and has now become a major pest of forestry. In addition they may enter buildings in search of food and shelter resulting in damage to products and structures. Under the Destructive Imported Animals Act 1932 and the Wildlife and Countryside Act 1981 it is illegal to release the grey squirrel into the wild.

3.4 GENERAL BIOLOGY AND BEHAVIOUR

Rodents have the ability to adapt themselves to almost any environment. Their great reproductive potential, natural cunning and survivability puts them among the most successful animals on earth.

Rodents use the five senses of smell, touch, hearing, sight and taste in order to survive.

The sense of touch is considered the most highly developed of the rodents' senses using the vibrissae or whiskers on the muzzle and guard hairs that are found among the fur. These organs help rodents orientate in the dark and help them judge shapes and sizes of objects. After a short learning period on the whereabouts of objects in the immediate environment, runs become well established. Smell will also play a part in the forming of the runs. When danger threatens, automatic use of this information will be vital.

3.4.1 Problems associated with rats and mice

The main reasons for control are to reduce or eliminate:

- Spread of disease
- Contamination of products
- Damage to food stocks and property

Rodents can cause damage to food intended for humans, by consumption, contamination with faeces and urine, as well as other physical and microbiological contaminants.

Rodents have the capability to spread many human pathogens, such as *Salmonella* spp, *Listeria* spp, *Escherichia coli*, *Cryptosporidium parvum*, *Leptospira* spp, Hantaviruses, Bubonic plague and Toxoplasmosis.





All rodents have a pair of incisor teeth in their upper and lower jaws. These teeth continue to grow throughout their life to make good the wear caused by gnawing. Almost every type of food commodity is subject to rodent attack. Damage is also caused to the fabric of buildings, to electric wiring and plumbing.

3.4.2 Problems associated with grey squirrels

Grey squirrels are less cautious than rats and will readily enter buildings during daylight. They are physically larger and stronger and are capable of breaking through poorly fitted proofing materials.

As with rats and mice considerable damage can be caused by their powerful jaws and sharp incisor teeth.

Rodents can cause damage to food intended for humans, by consumption, contamination with faeces and urine

4 Cockroaches

Based on fossil records, cockroaches have remained little changed for 200 million years.

There are over 4000 different species of cockroaches worldwide – not all are regarded as pests. Those species, which are now classed as pests originated in tropical climates but have now become cosmopolitan in temperate zones, having been distributed by commercial activities.

4.1 COMMON COCKROACH SPECIES

The cockroach species commonly found in the UK are:

Oriental cockroach (*Blatta orientalis*)

Males are approximately 25mm long, females approximately 32mm long; shiny and very dark brown, nearly black in appearance, nymphs (immatures) may be reddish brown; they are poor climbers on smooth surfaces, which may limit their distribution within a building; they appear to be cold tolerant in that they are often found outside buildings, in drains, gardens, sewers, external brickwork etc, a factor which should be remembered when controlling them.

German cockroach (*Blattella germanica*)

Adult size 13-16mm; the adult is light brown in colour with two dark almost parallel longitudinal stripes on their pronotal shield; they are found throughout buildings but show a preference for warm humid areas; they are good climbers, being able to climb vertical glass or tiled surfaces; an infestation of these cockroaches can be quickly established once they have entered any premises.

Brown-banded cockroach (*Supella longipalpa*)

Adult size 11-15mm; this cockroach is small, light brown in colour and is often mistaken for the German cockroach; this cockroach needs hot conditions to survive, it prefers 27°C and over but it is becoming more common as a pest in the UK; it is typically found in light switches, electrical appliances, motor housings, etc.

American cockroach (*Periplaneta americana*)

Adult size 34-53mm; the adult is reddish brown in colour and is fully winged. Male wings extend beyond the tip of the abdomen; female wings do not. There is a pale brown to yellowish band around the edges of the pronotum. This species is not well established in Britain.

It is not as cold tolerant as *Blatta orientalis* and *Blattella germanica*. Typical infestations in the United Kingdom are port areas, where it is introduced via ships. Sites infested include food premises, greenhouses, zoos, large centrally heated humid environments, etc.

Australian cockroach (*Periplaneta australasiae*)

Adult size 25-35 mm; Adults are reddish brown, fully winged with a yellow to pale brown band around the pronotum and a yellow streak on the outer edge of the base of the front wings. Late instar nymphs have pale yellow markings on the lateral margins of the thorax and abdomen. This species closely resembles *Periplaneta americana*. Not yet widely established in the United Kingdom, it requires hot, moist conditions to survive. It is found in greenhouses, therefore potted plants may be a source of infestation. Pet shops, particularly those with large numbers of heated fish tanks, can also be a source of infestation for this species.

4.1.1 Egg case (oothecae) development in cockroaches

Oriental cockroach (*Blatta orientalis*)

The female Oriental cockroaches carry the oothecae for about 30 hours, after which time she deposits them, dropping or attaching them near to a food source. Each ootheca contains 16 eggs which hatch in approximately six weeks, but this period may be greatly extended in cool conditions. In this situation the egg case represents a biological time bomb waiting to hatch and continue an infestation.

German cockroach (*Blattella germanica*)

The ootheca, containing 35-40 eggs, is carried by the female until it is within one to two days of hatching. Small 1st instar nymphs emerge from the ootheca and easily infest tiny cracks and crevices in the immediate area.

American cockroach (*Periplaneta americana*)

The female deposits oothecae a few hours or up to 4 days before the 1st instars emerge.

The ootheca, containing 10-15 eggs, is dropped or glued to a suitable surface, usually in a pocket of high humidity near a food source.

Australian cockroach (*Periplaneta australasiae*)

The female cockroach deposits the egg case containing around 16 eggs which hatch after a period of approximately 80 days.





4.2 GENERAL BIOLOGY AND BEHAVIOUR

Cockroaches are omnivorous. In addition to conventional foodstuffs, they will feed on a wide range of organic matter including other cockroaches. Their activity peaks during hours of darkness.

They exhibit incomplete metamorphosis; the juvenile stages or nymphs resemble the adults. Each cockroach moults several times in its life cycle producing a larger nymph and eventually moulting to the adult stage. Some species are fully winged in the adults, others may have reduced wings or wing buds. When wings are present, they are leathery and veined.

Cockroaches foul their environment with faeces, regurgitated food and they taint materials with their characteristic smell

The females of those cockroaches classed as pests all produce egg cases or oothecae, which contain eggs, which hatch inside the case from which nymphal cockroaches emerge.

During the daytime, cockroaches spend most of their time in harbourages grouped together.

This behaviour is influenced by them finding the same suitable harbourage. They also produce an aggregation pheromone, which is a chemical messenger to other cockroaches of the same species, who respond by being attracted to the source of the pheromone. As this pheromone is present in cockroach faeces, cockroaches will also be attracted to areas previously contaminated by cockroaches.

The development of cockroaches is affected by food quality, humidity, temperature, and day length.

4.2.1 Food contamination problem

Cockroaches foul their environment with faeces, regurgitated food and they taint materials with their characteristic smell. The air in infested premises may contain fragments of their exoskeletons and cockroach excrement.

Cockroaches also contaminate food directly as they move from filth to food indiscriminately and are therefore implicated in the mechanical transmission of many pathogens, such as those causing food poisoning and wound infections.

Because residual allergens can remain as active contaminants for some time following a treatment, a thorough cleaning regime should be carried out afterwards.

5

Flies

5.1 COMMON FLY SPECIES

Common housefly (*Musca domestica*)

Adults are 6-8mm long, with a wingspan of 13-15mm; the thorax is grey with four longitudinal dark stripes; the sides of the abdomen are yellowish and may be transparent; the larva also known as a maggot – undergoes larval moults, gradually increasing in size and changing colour from white to cream; pupa is about 6mm long and may be yellow, brown or black. Houseflies are potential vectors of a wide range of diseases such as dysentery, gastroenteritis and tuberculosis and can also transmit intestinal worms. These flies move from filth to food indiscriminately and may therefore move pathogens from dirty to clean areas. Fly spotting is produced when feeding and defecating.



Lesser housefly (*Fannia canicularis*)

Adults are 5-6mm long, with a wingspan of 10-12mm and with a grey thorax, which has three indistinct longitudinal stripes on it; the abdomen has an extensive area of yellow at its base. Potential vectors of a wide range of diseases, such as dysentery, gastroenteritis and tuberculosis, they can also transmit intestinal worms. As with the housefly they may move pathogens from dirty to clean areas. Fly spotting is produced when feeding and defecating.



Blowflies (*Calliphora spp*)

Adults are 9-13mm long with a wingspan of 18-20mm; adults are large robust flies with a stout abdomen; the thorax and abdomen are black/blue and dusky in colour. Blow flies are attracted to rotting animal remains on which they lay their eggs. In their search, they can mistake stored meat as a suitable 'host'. The possibility of disease spread is similar to the housefly.

Flesh fly (*Sarcophaga carnaria*)

Adults are 10-18mm long with a wingspan of about 22mm; they are bristly grey with three distinct black stripes on the thorax; the abdomen has checkered patterning, which changes according to the angle of view. The hind end of the larva is rounded and the posterior spiracles are sunk into a deep pit surrounded by fleshy lobes. Flesh flies exploit decaying organic matter for larval feeding sites, for example, rotten meat, open wounds, dung and carrion and they will also parasitise insect larvae and molluscs. They can also utilise

stored meat as a larviposition site. Carcasses of birds and rodents are used by these flies as food sources for their larvae and therefore adults may be encountered as a nuisance in houses, though they are rarely found indoors in normal circumstances.

Fruit flies (*Drosophila spp*)

Adult fruit flies are small, yellowish/brown with a darkly striped abdomen; they have prominent compound eyes that are generally red in colour, although darker variants occur; the wings have two clear notches in the front border, which can clearly be seen with a hand lens. Fruit flies are commonly associated with human food preparation and storage areas. They are a source of annoyance in many kitchens, restaurants, etc. They are attracted to alcohol and waste fruit, and can build up to very large numbers when these food/breeding materials are present.

Moth flies (*Family Psychodidae*)

Adults are 3-4mm long with a wingspan of 10-12mm; they are greyish/brown in colour with wings covered in scales, as is the whole body, giving the fly the appearance of a small moth; the antennae of the moth flies are hairy in appearance with large hairs emanating from the intersegmental junctions. The adult flies are frequently abundant in sewage works. Females lay their eggs in a suitable medium, typically the wet organic matter found in drains. In a kitchen/food processing area these flies are often found breeding in the slime layer in floor traps. As flies are breeding in such areas, there is a possibility that they can transfer bacterial particles. These flies are really only a nuisance pest and not of any great public health significance.

Phorid flies / Scuttle flies (*Family Phoridae*)

Adults are 3-4mm long with a wingspan of 9-10mm; the thorax is usually dark brown/tan in colour with a distinctive humped appearance. Phorid flies are found in association with moist decaying organic matter. They are often indicative of blocked or broken drainage systems. The adult flies have a characteristic habit of scuttling in a fast run instead of immediately taking to wing when disturbed, hence their name 'scuttle flies'. Because they frequent unsanitary sites, there is always the potential of these insects carrying disease-causing bacteria.



5.2 GENERAL BIOLOGY AND BEHAVIOUR

Flies have a complete life cycle, consisting of 4 main stages – egg, larva, pupa and adult. The duration of each developmental stage is very much dependent on temperature and food/moisture availability.

The increase and ease of international travel in the air and on the oceans means that there are very few barriers left to stop the spread of insects worldwide

All true flies (adult stage) can only ingest liquid food. Should they land on a solid food source, they produce large quantities of saliva together with regurgitated gut contents. The mixture, rich in digestive enzymes, is vomited onto the food together with any living bacteria, viruses and protozoa present in the gut. The resulting liquid food is then sucked back up. This process may be repeated several times during which time the fly may defecate to reduce the overall body weight in readiness for flight. This feeding mechanism underlies the principle mode of food contamination with disease pathogens and spoilage organisms.

5.2.1 Pest status of flies

The fly is a highly mobile pest, able to fly from filth to food carrying with it a wide range of disease-causing organisms on its body.

There are many thousands of species of flies; however, relatively few interact with humans. Those that do are among the most destructive of pest species, spreading diseases to man and domesticated animals as well as contaminating food and packaging.

The increase and ease of international travel in the air and on the oceans mean that there are very few barriers left to stop the spread of insects worldwide.

The mobility of flying insects is the primary reason why their status as pests is so important. This allows them to visit many diverse and contaminated habitats within the course of their relatively short life span.

6 Ants

6.1 SIGNIFICANT SPECIES AND HABITS

Ants belong to the order of insects known as Hymenoptera which includes some of the most highly evolved insects such as wasps and bees. They have a caste system by which nest building, nursing of young and foraging for food is undertaken by workers (sterile females). Reproduction is performed by fertile females (queens) and males.

All ants possess:

- Elbowed antennae
- Biting mouthparts
- A narrow waist between the abdomen and thorax

Three main species may be encountered in and around food premises:

Pharaoh's ant (*Monomorium pharaonis*)
Of tropical origin and has taken advantage of heated premises, notably hospitals and high rise flats.

Argentine ant (*Iridomyrmex humilis*)
Also requires high temperatures but can thrive on a variety of foods.

Roger's ant (*Hypoponera punctatissima*)
Prefers damp locations, particularly in crevices around drains, and is not confined to heated premises.

Black garden ant (*Lasius niger*)
Native of the UK and readily enters buildings in search of food.

Ants live in colonies founded by a single, fertile female or queen. In some tropical species, several new queens remain in the parent nest. All spend most of their time laying eggs.

There is generally only one queen in colonies of the garden ant. In contrast with most other insects, the larvae of ants are fed until they become adult.

A particular feature of mating in the garden ant is the swarming which usually occurs in summer, when winged males and females leave the nest. The swarming period of flying ants is of short duration and signifies the beginning of the breakdown of the nest.

Swarming also occurs in the Roger's ant. At such times the winged females (the few males are wingless) may be found in considerable

numbers on window-sills and in fly killer catch trays.

Pharaoh's ant queens have wings, but rarely fly. They form new colonies by "budding", taking a few workers from the parent nest and moving to a new site a short distance away. Both garden ants and pharaoh's ants lay pheromone trails which are then followed by other worker ants to food sources. Proteins (meat, nuts, cheese, and blood) are the preferred foods of Pharaoh's ants.

Garden ants also feed on these foods, together with sweet foods. Like some other insects they also collect seeds and nectar and feed on "honeydew" from aphids.

Roger's ant does not follow scent trails and seems to feed exclusively on protein such as dead insects, also small insect pupae and springtails, which they sting, then drag back to the nest.

6.2 PEST STATUS OF ANTS

Although considered as a nuisance pest, the presence of ants can still have an impact on the safety and saleability of food.

Contamination of foods

Ants find their way into kitchens and production areas and there is a risk that food may become contaminated by ant bodies. Many infectious organisms are present in hospitals and these may be transmitted to patients by ants crawling on infected surfaces and used dressings.

Waste

Food containing ants must be discarded to prevent contaminated product being sold or served.

The presence of ants in packaging will also make the product unsaleable. The disposal of waste food may result in a greater chance of rodent infestations.

Lost reputation and employment

Most food business staff handle foods which are highly attractive to ants. Prosecutions by environmental health departments, stopped production and the adverse publicity from product recalls will lead to damage to the company's reputation and financial loss. It will also lead to job losses if premises are closed down.





7 Stored product insects

Stored product insects (SPI) are significant pests as they spend the majority of their time, including breeding, hidden in their chosen food type. Inspection and early detection can therefore prove difficult. The group known as SPI in this context include mites. Commodities attacked include cereals, nuts, dried fruit and pulses.

7.1 CATEGORIES AND COMMON TYPES OF STORED PRODUCT PESTS

SPI fall into two main categories according to their ability to infest product:

- **Primary** – those having the ability to penetrate whole grains. These are further sub-divided into:
Internal - those species whose life cycle is completed within the grain or bean
The hole left by the exiting adult is characteristic
External - those whose life cycle is completed outside the grain
- **Secondary** – tend to feed on the fungus present in poorly stored or damaged product

Particular species of SPI normally, but not always, infest specific types of product:

Beans, peas and similar foods	Bruchid beetles
Coffee, cocoa	Flour beetles, Merchant grain beetles, Warehouse moths
Cheese	Mites, Larder beetle, Copra beetle
Dried fruit	Indian meal moth, Merchant grain beetles, Tobacco beetle, Dried fruit beetle, Mites
Dried vegetables	Indian meal moth, miscellaneous general feeders
Flour and milled cereal products	Flour beetles, Mill moth, Indian meal moth, Cadelle, Flat grain beetle, Mites
Grain (Wheat, rice, corn and other cereals)	Rice weevil, Grain weevil, Lesser grain borer, Saw-toothed grain beetle, Cadelle, Flour beetle, Indian meal moth, and Mites
Macaroni and spaghetti	Rice and grain weevils, Milled cereal pests
Nuts and confectionery	Indian meal moth, Merchant grain beetle, Mites
Animal materials	Dermestid beetles, Clothes moths, Scavenging moths



7.1.1 Identification

Bruchid beetle (*Acanthoscelides obtectus*)
The adult beetle is 3-4mm long. The elytra (wing cases) are variegated with yellowish and dark brown patches of hairs. The hind femur has one large and two small teeth. The eyes are large and emarginated. The elytra do not entirely cover the abdomen. The antennae are serrate. The larva is 3-4mm long, whitish in colour, and crescent shaped with reduced legs.



Dried fruit beetle (*Carpophilus hemipterus*)

The adult is a flattish beetle, approximately 2-4mm long. The short elytra (wing covers) leave some of the abdominal segments exposed. The body is dark brown with yellowish patches on the wing covers. The larvae are elongated, parallel-sided and lightly pigmented, reaching a length of 9mm before pupation.

Flour mite (*Acarus siro*)

The adult mite is around 0.5-0.7mm in length. It is white in colour with a pearly iridescence, its legs often have a brown or pink colouration. Its body is divided into two clear sections with a distinct line between the two sections known as the proterosoma (the anterior end) and the hysterosoma (the posterior section).

Leather beetle (*Dermestes maculatus*)

The adult is an oval-shaped beetle, approximately 6-10mm long. The antennae are short and clubbed. The colour is black with patches of white hairs on the sides of the thorax and underside of the body. The larvae are hairy, have six legs, and a pair of curved projections, urogomphi, on the penultimate abdominal segment.

White shouldered house moth

(*Endrosis sarcitrella*)

Open wingspan 10-23 mm. Readily distinguished from other stored product moths by the covering of white scales on the head and thorax. The shining buff upper side of the forewing is speckled with dark brown.

Tropical warehouse moth (*Ephestia cautella*)

The adult is a greyish moth with a pattern of two bands across the forewings. It has a

wing span of 12-18mm. The mature larva is 12-14mm long and is creamy white with a brown head capsule and brown body markings. Larvae have three pairs of jointed thoracic legs and five pairs of abdominal prolegs.

Warehouse moth (*Ephestia elutella*)

The adult is a greyish moth with a pattern of two obscure bands across the forewings. It has a wingspan of 12-18mm. The mature larva is 10-15mm long and is creamy white with a brown head capsule and brown body markings.

Mill moth (*Ephestia kuehniella*)

The adult is a greyish moth with a pattern of two obscure bands across the forewings. It has a wingspan of 18-28mm. The mature larva is 15-20mm long and is creamy white with a brown head capsule and brown body markings.

Brown house moth

(*Hofmanophila pseudospretella*)

Open wing span 15-25mm. Upper side of forewing bronze-brown in colour with several dark brown to black flecks or spots.

Tobacco beetle (*Lasioderma serricorne*)

Length 2-3mm, reddish brown, domed ovoid beetle. Head hidden under hood-like prothorax. Easily mistaken for the common furniture beetle, *Anobium punctatum*, or the biscuit beetle, *Stegobium paniceum*.

Copra beetle (*Necrobia rufipes*)

Adults are 4-6mm long. They are shiny, metallic blue with reddish legs and clubbed antennae. The larva is 10mm long when fully grown and has a dark brown head and dorsal thoracic segments.



Merchant grain beetle (*Oryzaephilus mercator*)

The adult is an active, slim-bodied, dull reddish brown beetle between 2.5 and 3.5mm in length. The thorax has six distinct teeth on each margin, giving a saw-like edge. Wings are well developed; adults can fly and are attracted to light.

It resembles the saw-toothed grain beetle, *Oryzaephilus surinamensis* - care is needed in differentiating the two species.

Saw-toothed grain beetle

(*Oryzaephilus surinamensis*)

The adult is an active, slim-bodied, dull reddish brown beetle between 2.5 and 3.5mm in length. The thorax has six distinct teeth on each margin, giving a saw-like edge. Wings are well developed but it has not been observed to fly.

It resembles the merchant grain beetle, *Oryzaephilus mercator* - care is needed in differentiating the two species.

Indian meal moth (*Plodia interpunctella*)

Open wing span about 16mm. The forewing has a broad grey band across the bronze brown wings.

Rice weevil (*Sitophilus oryzae*)

The cylindrical body has the head produced to form a snout-like proboscis; the antennae are elbowed and clubbed. The elytra (wing cases) have four dull reddish spots. Adults are 2-3.5mm long, averaging 2.5mm and can fly at high temperatures.

Grain weevil (*Sitophilus granarius*)

The adult is 2-4mm long with a dark brown, elongated, cylindrical body. The head has a snout-like prolongation with mouthparts at the tip. The antennae are elbowed with a club. It is similar in appearance to the rice weevil but lacks the dull brown spots on the elytra (wing covers). Unlike the rice weevil, the elytra are fused, flight is therefore not possible. The larva is 3-4mm long, with a white, fleshy, crescent-shaped body, and has no legs.

Biscuit beetle (*Stegobium paniceum*)

Length 2-3mm. Reddish brown, oval beetles, with a dense covering of yellowish hairs. The head is hidden under the hood-like prothorax. Easily mistaken for the common furniture beetle, *Anobium punctatum*, or the cigarette beetle, *Lasioderma serricorne*. The larvae are active initially but become fat, sluggish and eventually incapable of movement. A fully-grown larva is about 5mm long.

Rust-red flour beetle (*Tribolium castaneum*)

The adult length is 3-4.5mm. The shape is elongated, the antennae have a distinct three-segmented club. The colour is reddish brown. Easily mistaken for *Tribolium confusum*, the confused flour beetle. The cylindrical wiry larva is 4-5mm long when fully grown and is white tinged with yellow. It has a pair of immovable projections, urogomphi, on the final abdominal segment.

Confused flour beetle (*Tribolium confusum*)

The adult length is 3-4.5mm. The shape is elongated, the antennae have a gradual five-segmented club. Easily mistaken for *Tribolium castaneum*, the rust-red flour beetle. The cylindrical wiry larva is 4-5mm long when fully grown and is white tinged with yellow. It has a pair of immovable projections, urogomphi, on the final abdominal segment.

7.1.2 Life Cycles of common stored product insects in the food industry

See table on page 19.

7.1.3 Preventive measures

Due to their close relationship with the product, an infestation of stored product insects can often remain undetected in the initial stages. In order to prevent spread of SPI the following steps should be taken:

- All incoming raw materials should be sampled for the presence of insects
- Strict stock rotation must be implemented
- Thorough cleaning is required to prevent build up of product within plant and machinery
- Monitoring procedures should be in place to identify early signs of infestation
- Staff must be aware of the high-risk areas and products on site
- Accurate identification is essential in order to pinpoint the likely source of the infestation

Stored product insects are significant pests as they spend the majority of their time, including breeding, within their chosen food type

7.1.2 Life cycles of common stored product insects in the food industry

Number of days spent as (dependent on temperature)				
Species	Egg	Larva / nymph	Pupa	Adult
Bruchid beetle <i>Acanthoscelides obtectus</i>	5	14 - 21	5 - 6	7 - 28+
Dried fruit beetle <i>Carpophilus hemipterus</i>	1 - 4	7 - 10	7	90 - 120
Flour mite <i>Acarus siro</i>	3 - 4	15 - 20 days through nymphal stages	N/A	Egg to adult 30 - 140 days.
Leather beetle <i>Dermestes maculatus</i>	5	44	14	100+
White shouldered house moth <i>Endrosis sarcitrella</i>	6 - 23	38 - 102	7 - 31	2 - 4 (male), 3 - 9 (female)
Tropical warehouse moth <i>Ephestia cautella</i>	3 - 15	20 - 64	5 - 12	4 - 20
Warehouse moth <i>Ephestia elutella</i>	10 - 14	20 - 200	10 - 28	9 - 21
Mill moth <i>Ephestia kuehniella</i>	4 - 28	22 - 128	1 - 16	7 - 21
Brown house moth, <i>Hofmanophila pseudospretella</i>	8 - 110	70 - 150 (plus 20 - 155 diapause)	13 - 98	10 - 20
Tobacco beetle <i>Lasioderma serricorne</i>	6 - 21	18 - 69	4 - 12	25 - 45
Copra beetle <i>Necrobia rufipes</i>	6 - 21	18 - 70	4 - 21	20 - 45
Merchant grain beetle <i>Oryzaephilus mercator</i>	8 - 17	28 - 49	6 - 21	180 - 3 years +
Saw-toothed grain beetle <i>Oryzaephilus surinamensis</i>	3 - 17	14 - 49	6 - 21	180 - 3 years +
Indian meal moth <i>Plodia interpunctella</i>	2 - 8	13 - 288	12 - 43	7 - 43
Rice weevil <i>Sitophilus oryzae</i>	4 - 14	20 - 70	4 - 10	Up to 150
Grain weevil <i>Sitophilus granarius</i>	3 - 21	20 - 143	4 - 23	210 - 360
Biscuit beetle, <i>Stegobium paniceum</i>	8 - 37	5 - 150	9 - 18	In cocoon 7 - 12 (Non-feeding 42 - 56)
Rust – red flour beetle <i>Tribolium castaneum</i>	3 - 14	12 - 60	4 - 14	450 (female), 600 (male)
Confused flour beetle <i>Tribolium confusum</i>	4 - 30	15 - 98	5 - 22	435 (female), 540 (male)

8

Birds and other vertebrates

8.1 BIRDS

Under the European Wild Birds Directive 1979, all wild birds, including their nests and habitat, are protected. In the UK the relevant legislation is the Wildlife and Countryside Act 1981.

However, birds that are recognised as pests can have that protection removed and are listed on the General Licences, issued by Natural England each year. Equivalent licences are issued in Scotland, Wales and Northern Ireland.

The General Licences list the birds that can be controlled, for specific reasons (for example, for the purpose of preserving public health and public safety) and by specific methods. It is a condition of the General Licences that all non-lethal methods must be considered first.

The main species of interest in a food safety context are:

- The feral pigeon, collared dove
- The house sparrow and starling, although these are presently removed from the licence in England
- The three species of large gull; herring gull, greater black-backed gull and lesser black-backed gull

The remaining species of pest bird on the General Licence are predominantly pests of agriculture.

8.1.1 Distinguishing features of common pest birds

The feral pigeon (*Columba livia*) is of medium size (32cm long); normally blue grey in colour with a white rump and black wing bars.

The collared dove (*Streptopelia decaocto*), is about 27cm long, fawn-grey in colour with a narrow black band at the back of the neck and a white tail tip.

The male house sparrow is 14.5cm and recognised by its grey crown, black bib, light grey cheeks and under parts, and brown wings with black streaks. The female is dull brown.

The starling is 22cm and has a summer plumage of glossy black with metallic purple and green tints. Generally found in large flocks, the numbers of starlings has decreased over the last few decades.

The only gulls, which may be killed, are the greater black-backed, the lesser black-backed and the herring gull. All three are large – in excess of 50cm long, but as gulls can be difficult to identify expert opinion should be sought.

8.1.2 Problems associated with pest birds

Product damage

The droppings of sparrows and other birds spoil finished products and packages in loading bays and warehouses.

Maintenance costs

Nests and droppings block gutters and down pipes. The resulting overflowing water leads to timber decay, broken rendering, ruined decorations and even structural damage.

Contamination

Pigeons in grain handling establishments consume large quantities of food. In addition, pigeon droppings, regurgitated pellets (produced by gulls), feathers and nesting materials are common contaminants of grain destined for human consumption. Sparrow and pigeon droppings and feathers contaminate food both in production and awaiting dispatch.

Spread of disease agents

The close association of birds with man gives rise to the possibility of disease transmission. Sparrows, pigeons and gulls may carry bacteria causing *Salmonellosis*. Pigeons carry Ornithosis, a disease similar to viral pneumonia that can be transmitted to man through infected droppings or respiratory droplets. Ornithosis is often mistaken for flu in humans and so is possibly far more common than is realised.

Sources of insect infestation

Birds' nests harbour insects and mites which live as scavengers on the nest material or droppings or as external parasites on the birds. Prevention of nest building on premises reduces this damage. The following insects and mites are known to occur in birds' nests. Carpet beetle; fur beetle; case-bearing clothes moth; brown house moth; white shouldered house moth; Dermestid beetles; yellow mealworm beetle; biscuit beetle; Australian spider beetle; cheese mite; flour mite; dust mites; lesser housefly; blowflies and bird mites.





8.2 OTHER VERTEBRATES

Most British mammals apart from rats and mice pose insignificant risk to food safety. Several such as all bat species, water voles, red squirrels and badgers are fully protected and may not be harmed.

Foxes and rabbits, through their burrowing, may cause structural problems to buildings and the former may be drawn to the food opportunities presented by waste areas.

Moles are generally considered a pest of agriculture and amenity sites where their tunnels and spoil heaps can damage growing crops and machinery and may pose a risk of injury to livestock and horses.

The grey squirrel, American mink and edible dormice may also enter buildings in search of food and shelter.

Control of the above requires specialist knowledge of available control techniques and should only be undertaken by persons with the necessary experience of this type of work.

Sparrow and pigeon droppings and feathers contaminate food both in production and awaiting dispatch

9 Inspection and auditing of food premises

9.1 INTEGRATED PEST MANAGEMENT

The phase out of methyl bromide in 2005 removed one of the most reliable tools available to the food industry for control of insects in raw materials. When correctly applied, a kill in excess of 99 percent could be achieved – usually over a 24-hour exposure period.

A major consequence in the food industry of the phase out has been the switch from a reactive control strategy to one of Integrated Pest Management (IPM).

IPM is a systematic approach to pest management, which comprises:

- Building, machinery and materials design
- Building maintenance and exclusion practices
- Advice on good housekeeping practices.
- Inspections and monitoring
- Physical control methods
- Chemical control methods
- Habitat/environmental management

Early detection of pest activity is essential if the impact of corrective control measures is to be optimised. A combination of thorough regular inspections and on-going monitoring using a variety of detectors will provide the information upon which to build control strategies.

9.2 INSPECTION TECHNIQUES AND EQUIPMENT

The inspection should identify anything that might cause or allow contamination of food by pests or their activity.

9.2.1 Proper pest identification

For good pest control, accurate identification is essential. Correct identification of pest species and a practical knowledge of pest behaviour will determine the source and therefore the target area for control.

The more common pests can usually be identified from textbooks. In some cases however, particularly relating to flies or stored product insects, more specialised identification may be required.

9.2.2 Use of generic or historical information

The pest control report book should be examined prior to commencing the inspection. A site plan and the last report should be carried during the survey.

Reference to reports covering the previous twelve months may be useful in determining seasonal variations in pest activity or focal points of infestations.

9.2.3 Pest sightings or “complaints”

Pest sightings or complaints made by personnel other than those involved in pest management should be investigated.

See section 2.6.1 Pest Sightings Log

9.2.4 Thorough inspection

The extent of the inspection and the areas included should cover the entire site including grounds within the perimeter, all buildings and all areas within buildings.

Each site should be divided into high-intermediate-low risk areas.

High risk areas

Areas where there is a greater risk of compromising food safety from pest activity or where the product is particularly high risk.

Typical high risk areas and potential pests would be:

- Incoming raw and packaged food and stored product pests
- Finished goods warehouses and mice
- Food preparation areas and flying insects

Intermediate risk

Areas where there is a risk of compromising food safety from pest activity but where the product is not particularly high risk.

Low risk areas

Areas where there is minimal risk of compromising food safety from pest activity or where the product is low risk.

9.2.5 Types of information gathered on-site

The information gathered can be divided into two areas.

Information on the pests:

- Species present
- Location
- Numbers
- Extent of infestation
- Risk to food safety
- Proposed control methods





Information on the premises:

- Potential entry routes of pests
- Exclusion recommendations
- Hygiene and housekeeping requirements
- Storage and stock rotation processes
- Risk assessments

9.2.6 Sources of information

Information can be collected from four sources during the inspection:

From the Pest Sightings Log – this is likely to be historical, as the reported sighting would in most cases have resulted in a call-out to address the problem.

From site management and staff – while this is a worthwhile source, any information should be confirmed by a thorough inspection of the area. Third party reports may not be accurate concerning the type of pest, numbers seen or timescale due to the vagaries of the human memory.

From evidence found on detectors – this can be a valuable source of evidence of recent pest activity. On the presumption that the detectors were refreshed on the last inspection, any pests found will have emerged in the intervening period. Sticky traps, Electric Fly Killer (EFK) catch trays and pheromone traps have the advantage over an inspection in that they

are active 24 hours per day over an extended period.

From visible evidence – while detectors can provide evidence of pest activity, they rely in the main on the pest coming to them. The information may not be defined whereas an experienced inspector has the knowledge of pest behaviour and biology to find and identify the source of an infestation. A physical inspection also allows a risk assessment on any proposed treatment to be carried out in addition to fulfilling a quality control function on the pest management programme.

9.2.7 Trend analysis

Inspection checklists and other documentation can be used to record any trend in pest activity and highlight particular problem areas.

The information used in the analysis can be obtained from:

- Recorded take from rodent monitoring stations
- Catch tray or adhesive trap counts from EFKs
- Moth pheromone traps
- Adhesive insect traps

The analysis can assist in targeting control strategies, reacting to seasonal increases in pest activity or identifying shortcomings in site procedures such as door discipline.



9.2.8 Surveillance of adjacent properties and suppliers

Adjacent properties whether occupied or not and open sites should be monitored as possible sources of infestation. Both insects and rodents have the ability to migrate from adjacent sites – in the case of flying insects this can involve movement over considerable distances.

Due to environmental considerations the use of permanent perimeter bait stations containing toxic rodenticide baits can no longer be justified.

Long-term baiting in and around buildings may be necessary at sites where there is a constant source of reinvading rats that cannot be dealt with at source. However, long-term perimeter baiting should never be used as a routine rodent control measure. Long-term baiting of strategic points in and around a building may be justified when dealing with sites that are at high risk of re-infestation or the health risk associated with a particular site is considered high, such as a food manufacturing facility or hospital. Bait stations positioned outdoors may be visited by non-target small

Both insects and rodents have the ability to migrate from adjacent sites – in the case of flying insects this can involve movement over considerable distances

mammals, such as field mice and voles, and present a significant risk of exposure for a wide variety of nontarget wildlife that takes these animals as a food source. Remove rodenticide baits from outdoor bait points that show significant feeding by small mammals.

This is recognisable by the size and colour of droppings found in bait stations. Consider any

long-term baiting programme carefully and be justified in your risk assessments for each location where this strategy is used.

The preferred approach is to use either traps or non-toxic baits as a guide to the presence of an infestation of pest rodents that may then trigger the use of a rodenticide. Check baits regularly to establish whether rodents are present. It is not best practice to visit long-term bait points less frequently than recommended on product labels.

Inspection and the use of a non-toxic monitoring system should be preferred with toxic bait being used only when signs of rats are found. Suppliers should be frequently audited. Close monitoring of all supplier practices should be carried out. Appropriate sampling techniques of received goods should be implemented.

Laundering agents should be closely monitored. As they receive garments from a wide range of industries and premises, the possibility of cross-infestation of garments should be considered. Most notable is the transfer of cockroaches.

9.2.9 Suggested inspection tools

- Torch (with spare battery and bulb) – pests are by nature secretive and may be deep within recesses or below fixtures where natural light may not penetrate
- Spatula – many Stored Product Insect pests will be found in compressed residues below machinery or in gaps at the wall/floor junction. The narrow blade of a spatula is required to scrape out residues in order to examine the contents for larvae or adults
- x10 lens – many pest insects are small and the distinguishing features not apparent to the naked eye
- Supply of specimen tubes – where identification cannot be made at the time of inspection, samples can be labelled and removed either for identification at a later date or to send for professional advice
- Bait box keys – where a pest control contractor is undertaking the pest management access to bait stations may be required for monitoring purposes between scheduled calls. Care must be taken when handling bait stations and rodenticides and all baits must be re-sealed to prevent unauthorised access
- Supply of cable ties – where bait stations are secured by means of cable ties replacement ties are required to re-secure the bait station lids

Other items may include:

- Folding ladder – for access to overhead areas, loft hatches, false ceilings, electric fly killers etc
- Endoscope – to allow inspection of concealed areas, ducting, closed voids etc
- Insect specimen set – for comparison with samples found during the inspection

9.3 INSPECTING FOR RODENTS

The following evidence can be used to identify the species and location of both mice and rats.

Droppings

The shape and size of droppings will help you to identify the species. Rat droppings are approximately 10-12mm long, up to 5mm in diameter and spindle shaped. The droppings produced by mice are approximately 4mm long and much thinner at around 1mm.

Are they soft and glistening? This will tell you that live rodents are still present. The presence of large droppings (from adults) and small droppings (from young) indicates a breeding population.

How are the droppings distributed (scattered or in groups)? Norway rats regularly use latrine areas to deposit droppings. This will indicate the species and whether the rodents are moving extensively.

How many fresh droppings are there? This will indicate the size of the infestation. Rats produce about 40 droppings each day and mice about 80.

Live/dead rodents

Both rats and mice are in the main nocturnal. If you see live rodents during the daytime then they are short of food, or there is a heavy infestation or a harbourage has been disturbed. Large numbers of rodents, particularly mice, have a characteristic smell.

Smears

The smears left by rodents are formed when the animal's fur deposits a dark, greasy film on surfaces with which it makes regular contact. In heavy infestations, grease from the body, combined with dirt and urine may even build up into "urine pillars". These may remain on surfaces indefinitely and may not indicate a current infestation.

Tracks

Footprints and tail swipes can be found in deposits of dust or flour and in soft mud. Apart from size there is little to distinguish between rat and mouse footprints.

The size and appearance of the footprints may not allow an accurate assessment to be made of current infestation. Footprints and tail marks may remain visible for many months in undisturbed dust and it can be difficult to distinguish between fresh tracks and old ones.

Gnawing damage

Damage to wood may be caused by both rats and mice when trying to gain access to a building. They will also gnaw as a means of keeping their continuously growing incisors worn down and sharp. Freshly-gnawed wood is generally light in colour.

Damage to recently stacked goods can give information on the duration and size of an infestation. Paper including labels is often

shredded by mice for nesting purposes.

Runs and burrows

Rats may feed within a building and live outside. Frequently used runs can be seen where they are travelling between areas. These runs may terminate in a hole, often with a fresh soil heap outside. Dust and cobwebs over the entrance to a harbourage show that it is un-used.

9.4 INSPECTING FOR INSECTS

9.4.1 Cockroaches

Marks

Large infestations of cockroaches may be completely hidden during the day but the marks left by cockroaches are evident on surfaces. These brown, irregular streaks are liquid excreta produced by cockroaches when water is readily available. They are usually most noticeable near cockroach harbourages.

Harbourages

German cockroaches especially favour the following locations:

- In kitchens, behind and under ovens, sinks and kitchen units
- Around water pipes and radiators, particularly where pipes pass through walls. Inside cupboards, under tables, behind wall tiles. In kitchens and catering areas they can be found inside plugs and the sockets into which 3-pin plugs fit
- Ventilation and service ducts

Oriental cockroaches especially favour the following locations

- Cellars, pipe ducts, store rooms, boiler houses, oven footings and floor cavities
- Brickwork and cracks in concrete
- Outbuildings, drains, rough ground and rubbish tips

Live cockroaches

- Live cockroaches can be detected using a torch shone into harbourages or flushed using an aerosol spray. Care must be taken to avoid contact with the propellant and any naked flames
- A night inspection may identify areas where cockroaches are foraging
- Sticky traps placed overnight may produce better results than a visual night inspection

9.4.2 Flies

Adults

A localised congregation of adults often indicates the presence of a nearby breeding site.

Water

The larval food of flies must be moist. Thoroughly inspect all drainage channels and gully traps. Where floors are washed, look for places where residues collect: under cookers, refrigerators, machinery and equipment of all kinds.



Debris

Examine all possible locations where animal or vegetable waste tends to accumulate. Inspect under or behind machinery, equipment, pallets, in the bottom of lift shafts, and in dustbin and waste disposal areas.

Check whether dustbins and waste skips are clean, or if a wet residue is left on the sides and the bottom when emptied.

Marks

Favoured alighting surfaces can be identified by fly marks left on fluorescent lights, lampshades, windows and doorframes, picture rails, beadings, pipes and pipe chasings, and projecting corners of walls.

9.4.3 Ants

Garden ants

In manufacturing premises the presence of ants is indicated by trails formed by worker ants of the garden ant. These are often found around door thresholds, and around sinks and cupboards. The nests can be located by following the trails to the source, perhaps through the brickwork or airbricks, to the outside. The soil around nest exit holes is usually finely powdered. The nest may be located under slabs outside or inside under the floor.

Roger's ants

Roger's ants are found in damp debris, around floor drains and gulleys, in crevices behind tiles, and in cracks along machine footings.

9.4.4 Stored product insects

Identification

Most insects of stored products are small and require a lens (x 10 magnification) to see identifying characteristics.

Biology

Once identified, knowledge of the insect's biology will help to locate the source of infestation. Grain weevils observed on walls must be breeding in whole grains or on highly compressed food debris in cracks and crevices. Leather beetles and larder beetles infest materials of animal origin, and if they are found in a cereal processing plant they are likely to be feeding on dead rodents or birds. Webbing indicates an infestation of one of the moth species.

Damage

Many insects of stored products infest a range of commodities, but others confine their attack to particular foods.

Systematic inspection

In a factory, start with the raw materials store, and finish at the despatch department. Inspect inside machinery (ensuring all machinery has been isolated and a Permit to Work issued), under machines, between the floorboards, behind cupboards, between sacks and pallets and in all undisturbed areas. Use a spatula to

praise residues from between floorboards, and any other possible insect harbourages.

Beetles

Adult beetles and the tracks left by their movement through dust may be seen outside of the stored product. Turn over bags, lift paper sacks, scrape beneath pallets, and separate bags to examine the hidden surfaces. The larvae of beetles are often within the commodity and not easily visible.

Moths

Look for free-flying adults; these fly mostly at dusk and in the early morning. Disturb the surfaces of bags to make the moths fly, making them more visible. Look for webbing on the surfaces of bags and for larvae, which may be wandering on the walls and on the produce.

Mites

Mites usually occur where foods are stored under damp conditions or where the moisture content of the product is high. Mites are very small, a x10 lens is needed to detect them. Mites are not usually noticed until an infestation reaches a high level. A first indication of mites is a fine layer of dust on the surface of goods. If this dust is gathered into a small pile, the heap will quite quickly collapse as the result of the movement of the mites. If the dust is pinched between the fingers, or the surface of a sack is struck with the open palm, the presence of flour mite can be recognised by the 'minty' smell.

9.5 MONITORING

9.5.1 The use of monitoring traps/detectors

The main benefit to be gained from the use of monitoring devices is that of time. Physical inspections are by nature time-consuming and rely on the skill of the inspector. Monitors such as electric fly killer (EFK) units, pheromone traps and adhesive detectors are able to collect information from a range of locations over a greater time scale.

9.5.2 Range of monitoring devices

Monitoring devices can be broken down into four main categories:

- Those using ultraviolet light to attract flying insects to be trapped on an adhesive film or electrocuted on a live grid
- Those attracting insects by means of a sex pheromone
- Those attracting insects using a food attractant
- Pitfall traps

Adhesive detectors may be used un-baited in order to pick up insects, which are moving in the vicinity. These are sometimes referred to as "blunder traps".

9.5.3 The use of the EFK as an effective pest monitoring tool

Catch tray or adhesive film analysis of fly killing units can provide information on:



Adhesive detectors are the most cost effective method of remote detection of insects throughout all areas of a site

- The species of insect present
- Numbers – particularly increases which should trigger a change in control strategy
- Seasonal fluctuations
- Likely foci of infestations
- Related hygiene or process shortcomings

Frequency of analysis will depend on the nature of the site, the potential risk of contamination and the contract specification. Monthly counts would be the norm but the period between counts may be extended during the winter months. In a high-risk operation weekly counts may be required during the peak insect activity season.

Units should not be placed near open doors where they may attract insects into the premises.

9.5.4 The use of pheromone traps

Pheromone traps are available as funnel traps and as adhesive traps. The pheromone lures consist of dispensers impregnated with a dose of the pheromone specific to the group of target insects. Traps are placed in high-risk areas in order to intercept male insects. The smaller adhesive detectors have the advantage over the larger suspended traps in that they can be placed within machinery and can assist in pinpointing the source of the infestation. Lures must be replaced at intervals of 2, 6 or 12 weeks depending on the loading.



When used to identify the presence of insects or monitor the success of a treatment programme, the use of pheromone traps falls outside the scope of the Biocidal Products Directive. The exception to this is the use of pheromones to attract insects as a means of control, for example as a lure in electric fly killer units or to cause large scale mating disruption.

9.5.5 The use of traps using food attractants

Apart from fly and wasp traps, which use a liquid bait to attract and drown the insects, there are two types of detectors employing bait as an attractant.

- Adhesive traps using a food attractant pellet or flavouring (oil may replace the adhesive in SPI beetle traps). These do not have the range of attraction that pheromone traps have and the insects in most cases must be in the reasonably close vicinity of the trap to have any other than a “blunder” effect
- Bait bags used for detection of SPI in grain storage areas. These would not be used in areas other than grain stores due to their ability to attract and harbour live insects

9.5.6 Pitfall traps

Pitfall traps are used solely to detect SPI in stored grain. They can be placed just below the surface or deep in the grain. Crawling insects enter the traps through downward facing holes and are unable to return.

9.5.7 The use and limitations of adhesive traps

Adhesive detectors are the most cost effective method of remote detection of insects throughout all areas of a site. If the full benefit of their deployment is to be achieved they must be checked regularly and replaced when rendered ineffective through dust or damp.

They must be employed in sufficient number to give adequate cover as most insects have a relatively small range.

9.5.8 Rodent monitoring using non-toxic bait blocks

Where there is no current infestation of rodents non-toxic bait blocks (or grain) should be placed in bait stations. It is not acceptable to use toxic bait as census baits. This has the advantage that any rats foraging in the area will become accustomed to feeding from the bait station and may more readily take subsequent toxic bait.

Regular inspection of monitoring blocks is essential as any subsequent baiting programme must be commenced as soon as possible after detection.

Refer to Chapter 12, Paragraph 12.4.

9.5.9 Rodent monitoring using tracking dust

Tracking dust can be used to determine the presence and direction of travel of rats and mice. When either walks over the smooth surface, a clear imprint of feet and occasionally tails can be seen. The material used should be finely ground and unscented. Flour can be used but a non-food alternative such as china clay would be preferable.

Several fluorescent versions of tracking powder are available. Traces of the dust carried by the feet of the rodent leave a trace, which is illuminated when exposed to ultra-violet light from a special lamp.

10 Pest prevention

10.1 OVERVIEW – THE PRINCIPLE OF E-R-D

The objective of the Pest Management Programme is the maintenance of pest-free conditions in all areas of the site. The following systematic approach should be taken to all pest control and pest prevention issues, that being:

- **Exclusion** – refers to the methods adopted in preventing pest entry into a building. Exclusion is often neglected or ignored with entire reliance being placed on destruction, in many cases after infestation has occurred. The use of pesticides may then fail to achieve the desired result because building structure and conditions within are incompatible
- **Restriction** – refers to the methods used in creating unfavourable conditions for pests to harbour and breed
- **Destruction** – refers to the physical and chemical methods that are commonly used to control pests

Although one type of pest is not specific to one type of manufacturing process, product or building type or design, some are more attracted than others.

Based on the assumption that no building can be rendered entirely pest-proof, the following building and machinery design best practices will reduce the risk of infestation and aid in the eradication of pests as early as possible should they occur.

10.2 BUILDING DESIGN AND PEST PROOFING

10.2.1 The requirements of pests

Most buildings provide three main attractions for pests:

- **Food** – Most pests actually require very small amounts of food – an adult mouse for example, can survive on as little as 3 grams a day. The amount of food material required in order to provide adequate conditions for survival and breeding of insects can generally be met by less than scrupulous cleaning
- **Warmth** – A few degrees increase in temperature may be sufficient to encourage infestation, particularly in winter months. Conversely, ultra-low temperatures are no insurance against pests. With most species of pests an increase in temperature generates a corresponding increase in breeding frequency and numbers

- **Shelter** – All buildings provide some degree of shelter or harbourage for pests. It is commonly assumed that older buildings are more prone to infestation, but new buildings with enclosed roof spaces, suspended ceilings, wall cavities, panelling, raised floors, service ducts and lift shafts provide a myriad of harbourages – many interconnecting – allowing a wide range of internal movement for pests

10.2.2 Location

Where a new build is being considered, an assessment of activities and the environment in proximity to the proposed site must be made. Landfill sites, watercourses, marshlands, derelict sites, farms and railway lines are examples of activities that often generate regular pest activity.

Consider the previous use of the site and the pest history (if any). Where an existing building is being renovated consider what the building was used for previously since pests may still be resident. Buildings that have previously been used in the food industry are most likely to have a pest history.

10.2.3 Choice of vegetation

See under Section 10.5 environmental management

10.2.4 Water

Ornamental ponds should not be considered. Standing water may give rise to insects that rely on water to breed.

A readily available source of water is a requirement for successful rat populations.

Piscivorous wildlife (gulls, etc.) may be attracted to the site and may then at sometime roost or nest on the building. This will then lead to problems with fouling and eventually problems with insects as the two are often linked.

Good drainage of land is required to avoid waterlogged soil. Certain insect pests rely on a water source for breeding.

10.2.5 Lighting

Type of lighting

Many insects are attracted to ultra violet (UV) light: some may be brought in from as far away as 100 metres (especially night-flying species); others may be attracted to light when they are only a few metres away (day-flying species).





Night-flying moths have been found to fly actively only an hour or two either side of sunset, and again (to a lesser extent) in the morning twilight. Many other insects also fly at dusk.

The type of lighting at a premise will, to a certain extent, determine the attractiveness of the site to flying insects.

Most attractive are mercury-vapour lamps and special fluorescent lamps used for perfect colour rendition.

Next come “ordinary” commercial and household fluorescent tubes. These all emit some UV light.

Incandescent (tungsten filament) bulbs emit a large amount of IR light and are therefore good sources of warmth. The warmth of infrared (IR) light is also attractive to insects, although the area of attraction surrounding the source will probably extend only for a few metres.

High-pressure sodium-vapour lamps, however, emit very little UV or IR and are currently thought to be the least attractive to insects. Unfortunately, these lamps give an orange light and cannot be used where the recognition of colours is important. However, they are perfectly adequate for general lighting of parking areas, loading bays, etc

Siting of lights

It is recommended that an absolute minimum amount of lighting is physically attached to the building, instead, position lights 5 or 6 metres away and direct lighting towards doorways. Apart from the obvious benefits of attracting insects away from the building, there are also benefits to be obtained in making the building less attractive to birds that often roost and nest on such lighting structures due to their warmth.

Lighting just inside doorways and in loading bays should be high-pressure sodium-vapour or low wattage incandescent bulbs. Several small bulbs placed at intervals are better than one large one because the warmth produced is spread over a larger area.

Mercury-vapour lamps could, however, be used as decoy lighting around the extreme perimeter of a site (ideally 60 metres from the building). A lighting technique such as this would effectively attract flying insects away from a building that has localised low UV emitting lamps to it to an area of high UV.

The power conduit for external lights must be designed so that it does not provide roosting or nesting sites for nuisance birds.

The design of the external light fixture can be significant in pest activity. Overhead lights with a flat upper surface can provide a nesting or roosting site for birds.



10.2.6 Building perimeter

Immediate building perimeter

Perimeter pathways should be concrete and have a gradient away from the building fabric to allow rainwater run-off.

Concrete pathways are preferable to gravel pathways as gravel could be burrowed into by rodents despite of the ability of gravel to back fill on itself. Pea gravel could be considered since it can back fill more readily. Concrete is more easily cleaned and weeds are less likely to grow on them.

Patio areas, for example, outside of canteen facilities should be sited away from main buildings.

Paving slabs are often laid on sand, which is conducive to infestation by ants. If solid foundations are used for laying slabs consideration must be taken of rainwater drainage to avoid standing water.

Extreme building perimeter

Perimeter security fences are generally of chain-link, wire mesh, weld-mesh or metal railing construction. These should be set into concrete footings to prevent mammals gaining entry under the fence. Smaller mesh may be required along the lower section of a fence to exclude rabbits.

Fencing designed to exclude rabbits must be at minimum height 750mm high with an out-turn of 150mm at the base and of 18 gauge x 31mm hexagonal mesh netting.



Waste drainage channels should not be fitted with grids that do not allow waste to pass through and consequently clog

10.2.7 Waste areas

Waste areas should be sited 10 metres from the main building in order that any pests that may be attracted are kept at a distance.

Waste area flooring should be recessed to create a banded effect and should have a sufficient gradient to allow good run off of water to drainage points.

Drainage points tend to be too narrow to cope with the volumes of water created through cleaning. Pooling water from overflow will encourage various pests, particularly flies.

Waste drainage channels should not be fitted with grids that do not allow waste to pass through and consequently clog.

Grids should be designed so that waste materials can pass through easily and they can be removed easily for cleaning.

Underground drainage should be configured so that it does not pass directly beneath areas of excess weight i.e. directly below where skip-carrying vehicles may park.

Excess weight may damage the drainage pipes and allow rats to exit the sewerage system. Phorid flies may also breed in the effluent resulting in an infestation above ground, which will prove time consuming and costly to eradicate.

10.2.8 Ancillary buildings

Compounds such as sub stations often accumulate leaf litter and rubbish as a result of their locations. Restricted access due to safety means that they rarely feature on cleaning programmes.

Insect and rodent pests may take advantage of leaf litter and rubbish accumulations and these areas should therefore feature on cleaning schedules, especially during autumn when leaf fall is high.

The construction of a quarantine building is recommended for the isolation of infested commodities or commodities that are being received from a suspect supplier.

10.2.9 New buildings and extensions

A snagging list should be generated and dealt with before formal receipt of a new building or extension.

Retrospective repair is far harder to accomplish once production is up and running and the construction company no longer has a presence on site.

No food should be allowed on to the site being constructed. Crew canteens should be sited at the perimeter to avoid pests being attracted to waste foods.

10.2.10 Building colour schemes

It should also be recognised that building colours will be attractive to insects depending on where they fall in the colour spectrum.

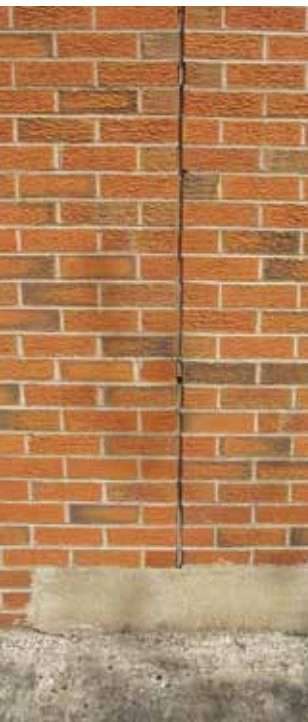
White or light yellow surfaces should be avoided due to their ability to reflect UV light. This should be considered when deciding the overall building colour scheme but can, however, be relevant to smaller scale studies such as the colour of surfaces around entryways. Darker blue or green colours are preferable.

10.2.11 Building structure

Walls

Wall foundations must be taken down to a solid bottom at least 900mm below ground level and concrete laid between the walls to prevent rodents burrowing into the building.

The addition of a concrete curtain wall to a depth of 600mm will protect the foundations against rodent ingress.



It may be appropriate to apply a band of “non-friction” material 1 metre above ground level to prevent rodents climbing external walls.

Airbricks supply ventilation to walled cavities but may allow mice and insect pests access. They should thus be fitted only where necessary and protected with a 2mm stainless steel mesh. Alternatively, the airbrick could be moved to a higher point on the wall.

Cavities airbricks can be used as harbourages by rats and mice. Ensure the open cavities of cavitied building blocks are totally sealed.

Brickwork should not be installed around vertical stanchions. This creates a cavity that can be utilised by pests as harbourage. If this is unavoidable then open tops should be totally sealed. Ground floor areas of the brickwork should be adequately protected against vehicular damage, i.e. forklift truck movements.

Fire retardant cladding around vertical stanchions creates a cavity that can be utilised by pests as harbourage.

Consider spray on fire retardant material instead, or alternatively, remove cladding to a height of 1m.

Pre-formed corrugated cladding should be avoided as corrugations are difficult to seal adequately against pest entry at the point where they meet conventional walling.

All areas of cladding where there is vehicular movement should be suitably guarded. Damaged panels are often difficult to repair and may allow rodents entry if left unrepaired.

Vertical external expansion joints should be sealed against pest entry into the wall cavity.

Careful selection, use of and maintenance of materials is required to provide a smooth, impervious surface devoid of cracks and crevices.

Insects can hide, breed and feed in accumulations of product and dirt. Tiling is not recommended. An epoxy-resin type material should be considered.

Unused boltholes in cladding bracings can provide entry and exit holes to wall cavities for mice.

To prevent pests gaining access to cavity walls from above the wall should be capped with cavity closers.

The external surface of walling should have no ledges. Ledges may provide suitable day or nighttime roosts for pest bird species. For the same reason over-developed external wall fascia should be avoided.

The internal surface of walling should have no ledges. Ledges provide suitable areas

for product residues to accumulate and are difficult to access for cleaning.

10.2.12 Services

Earthing straps to stanchions should be well fitted and sealed so that the ducting cannot be utilised by pests as harbourage.

Supply pipes and cables, i.e. gas, electric and water must be tightly sealed where they pass through walls as rodents may gain entry via this route.

Sub floor ducting should be made accessible. Pipe and cable ducting are potential pest harbourages and act as communication highways between areas.

Ducts can be sub-divided to prevent rodents gaining access along their length. Fire barriers may provide this feature but must be of non-flexible nature and pipes and cables tightly sealed where they pass through the barrier. Inspection hatches will be required for each compartment.

All drains should be accessible and facilitate flushing and rodding.

Waste build-ups must be easily accessed for clearance since certain pest infestations may arise.

Special attention must be given to vertical ducts that pass between floors. Ducting may allow rodent and insect pests free movement between floors.

Lift shafts should be drained. High water tables may lead to water build up in lift shafts, which may in turn lead to fly problems.

Drains that pass under the foundations of the building should be suitably reinforced so that they may not fracture due to subsidence. Heavy vehicular movement in areas such as compactor-skip collection points will have a similar effect.

Rat activity in drains is commonplace and fracturing of drains may lead to rats gaining access to wall cavities.

10.2.13 Flooring

All expansion joints should be well sealed and consist of a material that allows for movement. This will deny rats and mice access to floor cavities where they could access other areas of the building.

Particular attention should be paid to the integrity of expansion joints that run through the centre of product racking. Rodent and insect pests will take advantage of the concealed location.

Materials should be carefully selected to provide a smooth, impervious surface devoid of cracks and crevices in which insects can hide and breed.

Flooring under equipment should be completely smooth to allow thorough removal of waste material.

Tiled flooring is not recommended. Excessive heat degrades grouting and causes tiles to lift and allow debris to collect below. Various types of insect pest may breed in the resulting accumulations including several species of fly where wet and stored product insects if dry.

Fractures in tiling, perhaps due to heavy objects falling on them, allow moisture to collect below them, again creating areas where insect infestation may develop.

Covings at wall to floor junctions reduce the accumulation of debris and assist effective cleaning. Covings should be of a solid construction and have no cavity behind them where insects may harbour. All cracks and crevices should be sealed to prevent the accumulation of product residues that provide insect breeding sites.

Points where roof-supporting ironwork meets with the floor should be buttressed to prevent the accumulation of debris and allow for effective cleaning. Fixing points should be embedded into the flooring material. Accumulations of product will increase the likelihood of pest activity.

Drainage channels should be sufficiently wide to accommodate expected volumes. They should be fitted with drainage grills that do not clog with waste and are easily removed for cleaning. The ends of drainage channels should be buttressed so that waste does not accumulate. Sufficient fall is required so that waste flows freely to drainage points.

Regular access into lift shaft pits should be catered for to enable regular cleaning and inspection.

Wet process areas should be bunded and have self-draining floors. Pooling water may increase the overall relative humidity of process areas, which in turn may be beneficial to the breeding cycles of certain insects.

As a guide, floor surfaces should be sloped 1:50 to the floor drains.

10.2.14 Doorways

Fire exit doors should be constructed of metal, or have sheet metal over their outward facing surface. Rats and mice are easily able to gnaw through the bases of wooden doors and therefore gain access.

Pests are opportunists and will make the most of an open door. Exit doors should be a good fit, self-closing; with a sensor to detect if the door has been propped open.

Doors should have raised thresholds, sufficient to prevent pest entry but still allow safe passage to users without the risk of tripping. Without compromising safety, a minimum number of fire exits should exist. Rats and mice can move around within a building via gaps that exist below doors. All internal doors should have a working clearance of 2mm (1/8").

Louvered vent doors to sub stations, etc. should be avoided where possible and other methods of ventilation sought. Rodents gaining access to sub stations may then be able to access the main building via pipe and cable routes.





Roll-up doors should be fitted with a flexible bottom “seal” and T extensions to fit rail tracks.

Avoid the use of air curtain doors, strip curtain doors or rubber flap-back doors around external wall door openings. Most are poor at excluding pest ingress. Automatic high-speed roller doors are preferable but their timing needs to be adjusted so that they are open for the minimum amount of time. They should also be fitted to create an air lock.

Vehicle loading points (dock levellers) should have the void containing the hydraulic lifting gear completely sealed to the outside. Sealing will prevent pest ingress and litter accumulation.

Adequate measures to protect against vehicular damage should be taken. Access for cleaning and maintenance to the hydraulic lifting gear void should be provided internally

Vehicle loading ports should be adequately sealed once trailers have docked, and the port doors should not be opened until trailers are completely in position. Open loading ports will allow pest entry. Those equipped with lights will attract night flying and daytime flying insects.

Avoid installing doors that have hollow frames. Mice may use hollow doorframes as harbourage. Insects can breed in the accumulated food debris inside the base of the frame.

10.2.15 Windows

Although opening windows can be adequately screened against flying insect ingress, air conditioning is preferable.

Air conditioning intakes should not be situated on roof areas where rainwater may accumulate. The system should be fully filtered.

Outside air containing flying insects can be drawn into buildings that have negative pressures. Aim to maintain an internal positive pressure.

Design out window ledges. Pest birds may use window ledges as day or nighttime roosts.

Extract fans should not blow directly out on to roof areas or down walls. Powder deposits will attract insect rodent and bird pests.

10.2.16 Roofing

Rainwater down pipes should be fitted externally to the building and be suitably guarded against vehicular damage.

Rodent entry into a down pipe from the ground can be prevented by the use of a back inlet gully.

Rainwater run-off from the roof can attract and support pests around the building exterior.

Design down spouting so that it is sealed where it passes through into underground drains.

Certain flying insects require stagnating water to breed in. Guttering should have sufficient fall to allow good run off of rainwater.

Avoid extensive overhead gantries between buildings. Pests will often use such metal work as runs between buildings.

Gantries will also be used by birds as day and night time roosts.

10.2.17 Ceilings

Ceiling voids are potential harbourages for pests. Enclosed voids can also make inspection for pests difficult.

Suspended ceilings have the benefit of being aesthetically pleasing, however, access into them may be limited.

Where suspended ceilings are used then comprehensive access for pest inspection should be present.

10.2.18 Warehousing

The loading and unloading of vehicles can mean that pests are able to enter via the loading bays because of the amount of time doors are left open, or because of the inadequate barriers that are presented to pest ingress.

Packaging material and general waste is often compacted in proximity to loading bays. Materials of this nature are often attractive to pests if they are not properly stored or regularly collected.

Because of the heavy use of these areas, damage to the fabric of the building is likely. A lack of maintenance in this area can therefore be a contributing factor in pest infestation.

Adequate storage facilities sufficient to cope with expected volumes should be provided. Insufficient space may lead to goods being stored in undesirable areas where they may become infested, damaged or fouled.

Racking should be used to keep all goods off the floor. Raising goods will also allow effective cleaning.

Adequate space around racking should be allowed. This will allow for good pest control inspection and allow for thorough cleaning.

Adequate space between racking bays should be provided. This will allow for good pest control inspection and allow for thorough cleaning.

A 20cm strip should be painted white at internal wall/floor junctions. Sighting of debris and insect pests will be heightened due to the contrast in colour.

Good stock rotation methods should be enforced. A minimum quantity of ingredients/packaging should be kept in stock; it is preferable to have suppliers who are flexible enough to supply on demand.

Little used ingredients and packaging are more likely to have pest activity develop in them and be used by pests as harbourage.

Pests can easily be introduced into buildings through poor handling of returned or damaged goods. Returned goods should be stored in their own quarantine area away from ingredients, packaging and finished goods - ideally in a separate building unconnected to main production and warehousing areas.

Insufficient space may lead to goods being stored in undesirable areas where they may become infested, damaged or fouled

10.2.19 Incoming goods

Avoid the use of pallets constructed of wood. Wooden pallets often harbour insect pests. Since there is no passport system for pallets, their previous whereabouts cannot be determined. Consider the use of a pallet inverter so that wooden pallets can be exchanged for plastic prior to storage.

Storage shelving should not have concealed cavities. Spillages cannot be cleaned easily and pests may make use of them to conceal their harbourages.

10.3 HYGIENE

Effective cleaning is essential to the operation if pest activity is to be minimised. The increased use of "wet cleaning" due to allergens has the potential for a rise in insect infestations.

The following lists management practice that can be deployed to prevent pest infestation. The attention of all staff should be drawn to the importance of cleanliness and their duty to adhere to these recommendations.

10.3.1 Attraction of pests due to poor hygiene

The following can provide a food source or breeding site:

- Food exposed for long periods, particularly overnight
- Unwashed food containers left overnight
- Accumulated food debris. (High risk areas include spaces under shelves or behind cookers and refrigerators)
- Used or empty packing materials including bottles and cans

10.3.2 Identifying hygiene shortfalls

- Hold regular inspections of buildings noting areas that might harbour pests and take

remedial action

- Pay particular attention to waste locations and returned or damaged goods areas
- Inspect waste containers, tote bins, vacuum cleaners for accumulation of debris
- Include ancillary areas such as perimeter, roofs and ducts in the inspection process

10.3.3 Minimising pest attraction

- Install integrated inspection and cleaning programmes
- Ensure hygiene and maintenance departments cooperate over cleaning programmes
- Clearly define the responsibilities of production and hygiene operators over the removal of working spillages and end-of-day cleaning
- Make staff aware of potential pest locations.
- Implement a strict cleaning rota of staff rest areas and identify a member of the management team to monitor its adherence

10.3.4 Storage areas

- Keep rubbish storage areas tidy, using only close-fitting containers and empty regularly
- In storerooms, stack goods about 12-18" (0.3-0.5m) away from walls to allow free access to the area behind for inspection and cleaning
- Strict segregation is required between raw materials, packaging and finished goods to prevent cross-contamination
- Ensure stock is rotated and that any slow moving items are subjected to closer inspection, as these will be more likely to harbour pests

10.3.5 De-commissioned equipment

Plant and other equipment must be free of infestation before being brought on site. A pre-delivery inspection with a site engineer should be carried out.

Equipment which is to be taken out of production for a period of time must be thoroughly cleaned to remove all food residues.

Following cleaning, physical isolation can be achieved by shrink-wrapping the machinery.

10.3.6 Drains and water

As rodents and birds rely on a supply of drinking water, sources of free water should be avoided.

Seal off any disused water supplies and be aware of any roof leaks or rising damp. Remove any pools on concrete bases or on flat roofs. Ensure gutters are free flowing and water cisterns are covered.

10.4 WASTE MANAGEMENT

10.4.1 Location and design of waste collection areas

Waste areas should be sited more than 10 metres away from the main building in order that any pests that may be attracted are kept at a distance.



All waste bins should have tight fitting lids which must be kept closed at all times.

If individual bins or skips are not covered then the area should be enclosed within a mesh cage to prevent access by birds.

10.4.2 Waste containers

Dirty waste areas will attract many pest species to their freely available food sources.

Waste skips should be placed on a concrete pad to prevent rats burrowing underneath and be situated on rails of a height that will allow for thorough cleaning below.

The concrete should be capable of carrying rainwater and run-off from cleaning to a foul sewer drain.

Where small refuse bins are used they should be lined with strong polythene liners. The area between the bin and the liner should be cleaned regularly to remove residues.

10.5 ENVIRONMENTAL MANAGEMENT

Denial of suitable harbourage will assist in the control of pests should they be attracted to the site. Aesthetic measures such as landscaping can provide suitable conditions for sustaining pests if not undertaken with fore-thought and attention to detail.

10.5.1 Types of plants and design

Plants that are known to have a history of pest problems should be avoided.

- *Berberis spp.*
Numerous thorns collect litter, and the spines can make treatment dangerous
- *Cotoneaster spp.*
Flowers encourage queen wasps
- *Potentilla spp.*
Flowers encourage Varied Carpet Beetle (*Anthrenus spp.*)
- *Spiraea spp.*
Flowers encourage Varied Carpet Beetle (*Anthrenus spp.*)
- *Salix spp.*
Prone to aphids that attract wasps

10.5.2 Trees and shrubbery

Preference should be given to plants that shed the least seeds and fruits. Seeds and fruit may initially attract and then support insects, rats and mice and various pest birds.

Shrubs and trees should be of a coniferous type.

Leaf fall from deciduous trees that accumulates in guttering will restrict the run-off of rainwater and may give rise to localised infestations of insects that rely on standing water to breed, for example. midges and mosquitoes.



Wind-blown leaves often have the eggs of outdoor species of insects cemented to them, these may enter the factory.

Leaves that accumulate along foundations provide harbourage and sheltered runs for rats and mice.

Tree limbs and branches should be least six feet away from building exteriors (ten feet if squirrels are a problem).

Over hanging branches might provide vertebrate pests access to buildings. Very occasionally, some species of ants will enter a building along a branch that touches the building.

Where possible shrub planting should be through weld mesh in order to limit burrowing by rats and rabbits.

10.5.3 Ground cover

Plants should not be planted too densely. Dense ground cover will provide cover and harbourage for rodent pests.

Access in between shrubs is important for pest control inspection.

The preferred landscape is a parkland type, made up of various trees and shrubs that grow vertically. These plants should not be cut down to keep them low, but maintained in such way as to keep the ground area open. The ground underneath should be mulched with bark gravel or shingle.

10.5.4 Landscaping materials

Avoid the use of materials that may be a source of food or provide cover for pests.

If paving slabs are laid on a sand foundation they are likely to be colonised by ants.

Piles of rocks will provide harbourage for rats.

10.5.5 Location adjacent to buildings

Vegetation should not encroach within five metres from any outside wall of a building.

Rural vegetation can aggravate both rodent and insect pests.

Climbing plants should not be planted against the walls of buildings. These could create entry routes for pest rodents, harbourage for pest bird species and entry routes for some insect pests.

Grass should be kept closely cut at all times. Long grass will offer cover and harbourage for rodent pests.

11 Non-chemical control methods

11.1 PHYSICAL CONTROL OVERVIEW

In certain situations the use of chemical methods in controlling pests is not permitted or not advisable.

Sites or producers holding an organic accreditation are restricted in the types of pesticides approved for use.

The use of pesticides, particularly rodenticide baits, in food production areas may present a risk of product contamination or sabotage.

In areas where there are protected species of animal or plant life, the use of physical methods of control may be selected in preference to pesticides.

The use of pesticides, particularly rodenticide baits, in food production areas may present a risk of product contamination or sabotage



11.2 RODENT AND OTHER VERTEBRATE TRAPPING

11.2.1 Mammal traps

Spring traps, which are designed to kill the rodent, as well as live traps, are available for rats and mice. Sticky or glue board traps are also available for both rats and mice, although their sale and use is covered by an industry code of practice agreed between the Pest Management Alliance (BPCA, NPTA and CIEH NPAP) and government departments and agencies. Traps are extremely useful in areas where it is not possible to use rodenticides, for example, in sensitive food production areas.

11.2.2 Spring traps

Only spring traps approved under the Pests Act 1954 may be used for killing and taking animals. These are listed in Spring Traps Approval Orders issued from time to time by Defra and details are available on their website. Such traps must be used in accordance with their conditions of approval in order to meet legal requirements and avoid risks to non-target wildlife and persons, particularly children. Break-back traps commonly used for the destruction of rats, mice and other small ground vermin and spring traps of the kind commonly used for catching moles in their runs are exempted from the requirement to be approved.

11.2.3 Live traps

Live catch mouse traps are available in either single or multi catch versions. They can be used as an alternative to toxic baits in high risk/production areas, although the presence of a bait attractant may pose a contamination risk.

Cage traps which catch the target animal live are of limited use as a control measure but may be employed when there is a risk to protected species from other methods. Any animal caught should be despatched humanely. Non-target species must be released unharmed.

11.2.4 Inspection periods

To avoid causing unnecessary suffering, all traps must be inspected regularly and where these traps are specified, contracts need to allow for this increased level of inspection. This applies to spring and, break-back traps as well as live catch or cage traps because even these traps do not always dispatch the rodent cleanly. In the UK, the Animal Welfare Act 2006 defines categories of 'protected animals' and includes



animals that are under the control of man. An animal caught in a trap as a result of a pest control treatment is covered by this definition and so the provisions of the Act apply.

As a general rule, it is considered good practice to inspect all traps at least once in every 24 hour period. Where traps are placed outdoors, this may need to be increased to at least twice in every 24 hour period for example, in cases where adverse weather or other factors could lead to increased distress.

It is acceptable for site personnel to inspect the traps on behalf of the pest control company, provided that they are suitably trained and carry out the inspections as laid down by the pest control contractor. Delegating checking to third parties, for example customers does not absolve pest controller from their responsibility under the provisions of the Animal Welfare Act 2006.

Guidance on the use of vertebrate traps is contained in the CIEH NPAP guidance document entitled "Code of Practice in the use of Vertebrate Traps"

11.2.5 Bird traps

Cage traps are usually constructed from wire mesh, into which birds are enticed using a decoy, or suitable bait. Once inside, the bird is prevented from leaving by a cone entrance, bob wires or non-return door.

It is a legal requirement that birds are caught alive; non-pest species can then be released and the remaining birds can be humanely dispatched. Traps must be visited at least daily to release or dispatch birds. Food and water must be available in the trap to prevent undue stress.

11.2.6 Other (non-lethal) bird control methods

Traditional anti-perching systems consist of sprung wire or spike systems and are designed to prevent birds from alighting on ledges or similar surfaces. Electric wire systems are also available.

UV stable polyethylene or polypropylene netting with an appropriate mesh size for the species concerned:

- 19mm for house sparrows
- 28mm for starlings
- 50mm for pigeons
- 75mm for gulls

will provide permanent exclusion from areas such as loading bay canopies.

Bird scaring can be effective using either digitally produced warning and distress calls or birds of prey to deter birds from open areas.

11.3 INSECT TRAPPING

The use of insect traps can rarely be relied on as a method of control but can provide evidence of the presence of insect pests and may in some cases reduce numbers.

11.3.1 Insect traps

The main types of insect traps are:

Electric Fly Control Units (EFK)

Flying insects are attracted to the ultra-violet light emitted by the unit and are either trapped on an adhesive board or killed by means of a high voltage electric charge.

As UV emission from the unit degrades rapidly lamps should be replaced at between 6-12 months, preferably in spring.

Traditional anti-perching systems consist of sprung wire or spike systems and are designed to prevent birds from alighting on ledges or similar surfaces

EFK units should not be placed:

- Outside or by open windows and doors where they will catch non-target species and may attract pests to the site
- Beside windows or fluorescent lighting where they will compete with natural sources of UV light
- Over food preparation surfaces where there will be a risk of fall-out from the unit

Adhesive pads

The term “detector” better describes the function of adhesive traps. Insects are encouraged to enter the trap by either a food source attractant or pheromone lure and are held on the adhesive surface.

Pheromone traps

As with adhesive traps the male insect is attracted by the pheromone released by the lure. Once in the trap the insect may be trapped with an adhesive insert or simply be unable to find its way out. The pheromone is specific to one or a number of related species and acts as an indicator rather than a control method.

Pitfall traps

Generally used in bulk grain, the pitfall trap relies on foraging insects to drop into the trap whose smooth sides make escape impossible. This technique cannot be considered a control method.

Fly and wasp traps

Included in this group are various fly and wasp traps, which attract the insects by means of liquid bait. Having entered the trap the insects are then unable to escape and drown.

11.4 OTHER PHYSICAL CONTROL METHODS

Biological control

The use of predatory insects in food production sites would not be considered due to the risk of contamination by the otherwise beneficial organism.

Entoleter

Used predominately in the milling industry, the entoleter consists of two horizontal steel discs bearing steel rods. While one disc remains stationary, the upper disc revolves at 2000-3000 rpm. Product is fed into the middle of the upper disc where centrifugal action forces the flour against the steel rods destroying all stages of insect life.

Temperature Control

- **Heat treatment** – Raising the core temperature of a space or product above 55°C will result in the death of all insect life cycle stages. Care must be taken to prevent structural or commodity damage while attempting to achieve a uniform temperature throughout.
- **Freezing** – Tests have shown that freezing of stored product insects to -35°C is an effective method of control. Increasing the cooling rate reduces the temperature at which the insect will die.
- **Modified/controlled atmosphere** – By sealing commodities in an oxygen barrier film they can be treated using carbon dioxide or nitrogen. The techniques require specialist equipment, training and due to the length of the exposure period are generally reserved for high value finished products

12 Chemical control methods

12.1 PESTICIDES IN FOOD PLANTS OVERVIEW

While the aim of an Integrated Pest Management programme is to minimise pest risk through proofing, hygiene and environmental management, there will be occasions when pesticides will be employed to eradicate an infestation on site.

The use of pesticides can present a risk of product contamination, risks to the health of users and third parties and a risk to the environment.

For these reasons the use of pesticides will be a last resort and their use will strictly adhere to the requirements of current legislation, in particular:

- The Control of Pesticides Regulations 1986 (as amended) (COPR)
- EU Biocides Regulation 528/2012 (EU BPR).
- The Control of Substances Hazardous to Health 2002 (COSHH)

Where possible pesticides should not be stored on site as the following risks may be present:

- The handling and use of pesticides by untrained people
- Pesticides being handled or misused by unauthorised people, children, domestic or other animals
- Pesticides being stolen and dispersed due to forced entry to stores
- Continued storing of pesticides that have become unapproved by Government for storage and use
- Storage of excessive quantities which may be inherently hazardous to staff using the store
- Storage of different chemicals that could become hazardous by interaction
- Lack of segregation, for example, of flammable materials or of pesticides, which could taint pesticide baits

Where pesticides are stored on site, the store should be located away from food production and storage areas, kept securely locked and accessed only by authorised personnel.

12.2 INSECTICIDES

Chemical control of arthropods involves the use of insecticides or acaricides. These are chemicals that kill insects and mites or prevent their development, thus preventing the

production of the next generation.

Many insecticides and acaricides are poisons. Therefore their use in public health and industry should be as a last resort after all other methods have been considered. A full risk assessment should be carried out and a COSHH assessment undertaken before using insecticides or acaricides.

12.2.1 Mode of action

Most modern insecticides work on contact with the target organism. The insects have either to be exposed to the pesticide in the air or as a deposit on the substrate. Some insecticides, often those used as baits, need to be ingested by the insect.

Insecticides can be classified by their mode of action. Most insecticides affect one of five biological systems in insects. These include:

- the nervous system
- the production of energy
- the production of cuticle
- the endocrine system
- water balance

This method of classification is preferred among scientists.

12.2.2 Insecticides that affect the nervous system

Most traditional insecticides, such as organochlorines, organophosphates, pyrethroids and carbamates fit into this category. However, of these groups only pyrethroid and carbamate insecticides are used in the food industry today..

Insecticides that affect the nervous system can be divided into two groups; axonal poisons, which adversely affect the nerve fibre; and synaptic poisons that disrupt the synapse, which is the junction between two nerve connection points

Pyrethroids are synthetic chemicals whose structures mimic the natural insecticide pyrethrin. Pyrethrins are found in the flower heads of plants belonging to the family Compositae (eg: chrysanthemums). These insecticides have a unique ability to knock down insects quickly.

Synthetic pyrethrins (also known as pyrethroids) have been chemically altered to make them more stable. Examples of





pyrethroids are, alpha-cypermethrin, bifenthrin, cypermethrin, deltamethrin, d-phenothrin, lambda-cyhalothrin, permethrin, and tetramethrin. Pyrethroids are axonal poisons.

Carbamate insecticides also affect the nervous system. They are moderately residual and relatively more effective at higher temperatures. They are also readily broken down especially in situations of high alkalinity. The most common of this group used in the EU is bendiocarb. Carbamates are synaptic poisons.

Avermectins belong to a group of chemicals called macrolactones. These chemicals are derived from a fungus and acts on insects by interfering with neural and neuromuscular transmission. Abamectin is an example of one of the Avermectins. Avermectins are axonal poisons.

Imidacloprid belongs to the chloronicotinyl chemical class of insecticides. Imidacloprid is also a synaptic poison but is more specific for insect nervous tissue than mammalian nervous tissue.

Fipronil is a phenylpyrazole chemical class insecticide. These chemicals are axonic poisons.

Indoxacarb belongs to the oxadiazine chemical family and is considered a reduced-risk organophosphate replacement. It disrupts the nervous system by blocking the sodium channels.

12.2.3 Insecticides that inhibit energy production

The most well-known energy inhibiting insecticide is hydramethylnon. Insects that ingest this compound literally run out of the energy needed to maintain life.

12.2.4 Insecticides that affect the insect endocrine system

These chemicals are typically referred to as insect growth regulators or IGRs. IGRs act on the endocrine or hormone system of insects. These insecticides are specific for insects, have very low mammalian toxicity, are non-persistent in the environment and cause death slowly.

Most of the currently registered IGRs mimic the juvenile hormone produced in the insect brain. Juvenile hormone tells the insect to remain in the immature state. When sufficient growth has occurred, the juvenile hormone production ceases triggering the moult to the adult stage. IGR chemicals, such as S-methoprene and pyriproxyfen, mimic the action of juvenile hormone and keep the insect in the immature state. Insects treated with these chemicals are unable to moult successfully to the adult stage and cannot reproduce normally.

12.2.5 Insecticides that inhibit cuticle production

These chemicals are known as chitin synthesis inhibitors or CSIs. They are often grouped with the IGRs. The most notable chemical being used as a CSI is the benzoylureas. This class of insecticides includes flufenoxuron. These chemicals inhibit the production of chitin. Chitin is a major component of the insect

exoskeleton. Insects poisoned with CSIs are unable to synthesize new cuticle, thereby preventing them from moulting successfully to the next stage.

12.2.6 Insecticides affecting water balance

Insecticides with this mode of action include diatomaceous earth and certain aromatic oils. Insects have a thin covering of wax on their body that helps to prevent water loss from the cuticular surface. Diatomaceous earth is very effective at absorbing oils. Therefore, when an insect contacts one of these chemicals, it absorbs the protective waxy covering on the insect, resulting in rapid water loss from the cuticle and eventually death from desiccation. Unfortunately, insects that live in environments with high relative humidities, or that have ready access to a water source show an increased tolerance to diatomaceous earth. This is because water loss can be minimised by either of these conditions and the insect may survive despite the absence of a wax layer.

Insecticide baits have a very low mammalian toxicity, making them safer to use where humans and other non-target organisms are present

12.2.7 Inorganic insecticides

The inorganic insecticides are some of the earliest to have been developed and, in many cases, they have been superseded by organic equivalents. The most common inorganic compound still used is aluminium phosphide.

12.2.8 Formulation

Insecticides are formulated in a carrier material that serves to keep the active ingredient (the ingredient that kills the pest) stable and sometimes aids in the distribution of the active ingredient in the pests' environment. There are a number of different ways to formulate insecticides and acaricides. The most appropriate formulation is determined by the method of application and the chemical characteristics of the insecticide.

Typical formulations are:

Wettable powders (WP) and water dispersible powders (WDP)

WPs consist of an inert powder impregnated with the active ingredient and usually incorporating a wetting agent to aid dispersion in water. WPs can be used on all surfaces but are particularly useful on absorbent surfaces where the insecticide particles remain on the surface, making it available to insects walking over it.

Suspension concentrates / flowables (SC)

The active ingredient is ground to a fine form in a liquid base and when diluted with water forms a fine suspension of particles. This formulation combines the ease of liquids with the efficacy of powder-based formulations.

Emulsion concentrates (EC)

These are oily liquids in a solvent. When diluted with water a milky emulsion forms in which the oily droplets of insecticide are finely dispersed. They should not be used on absorbent surfaces.

Dusts

These contain a low concentration of active ingredient mixed with an inert powder. In domestic and food premises they should be applied only to inaccessible places.

Ultra low volume (ULV)

ULV formulations use much less chemical than other formulations. They are intended for space spraying large areas. They must be applied with specialist ULV application equipment.

Smokes

The active ingredient is formulated with pyrotechnic compounds which when ignited burn to produce smoke which carries the insecticide through space. Smoke generators are a useful method of applying insecticide in confined spaces where other methods are not practical.

Baits

The active ingredient is formulated in edible bait that is consumed by the target pest.

12.2.9 Application techniques

The most appropriate application technique must be chosen to achieve a good kill of the target organism while minimising the effect on non-target organisms and the environment.

Spraying

Spraying is usually the chosen application method where a surface treatment is required.

Spraying is also the chosen technique for crack and crevice treatments. Many insects spend the daytime in harbourages, such as cracks and crevices in the fabric of buildings, away from the light. Spraying into these areas takes small but effective doses of insecticide direct to the insects.

Dusting

An insecticide dust can be used to give a long (residual) period of control in areas not usually entered by humans, such as basements and roof spaces, ducts, cavities and electrical conduits etc.

Space treatment

The use of insecticidal smoke, misting or fogging all fill the space to be treated with small particles of insecticide on a carrier or in the case of a thermal fogger, vaporized insecticide. These formulations are effective against flying insects.

Ultra low volume (ULV) applications

Ultra low volume (ULV) dispersal systems use insecticides more efficiently by presenting them in optimum-sized particles. True ULV applicators should produce over 90 percent of their droplets at under 50 microns with the VMD (volume median diameter being between 10 and 15 microns).

Space and ULV applicators provide limited penetration of insecticides into harbourages and cracks and crevices. As the droplets are carried on air currents insects may be flushed out into contact with more insecticide.

Baits

The use of insecticide baits is becoming increasingly common especially against cockroaches and ants. Insecticide baits have a very low mammalian toxicity, making them safer to use where humans and other non-target organisms are present. Some insects will return to their harbourages having ingested bait and after they have died their carcasses will be consumed by other insects, which are also subsequently poisoned (a domino or cascade effect).

Baits are not suitable where a quick kill is required and are therefore usually used combined with other treatments.

12.3 RODENTICIDES

Rodenticides usually need to be ingested in the form of baits. Contact products are also available which are rodents ingest via grooming. Rodenticides fall into two categories; acute: these are quick acting and effective but often painful in their action, and chronic: these are slow acting, often multi-feed baits that generally cause minimal pain in their action.

At present the only acute rodenticide bait available in the EU is alphachloralose which acts by lowering the body temperature of the target animal causing death by hypothermia. It is most effective at temperatures below 16°C. Currently this product is only approved for use against mice.

A tablet formulation containing aluminium phosphide for the control of rats outdoor is also available for application to rat holes.



The chronic rodenticides are almost wholly represented by the anticoagulants. They work by interfering with the blood clotting mechanism in the body. When used as a rodenticide the rodents die of internal haemorrhages (blood loss) resulting from minor damage to blood vessels caused as a result of their daily activities.

The success of these anticoagulants is that they have a chronic effect. When eaten by rodents at low concentrations in baits, symptoms of illness develop slowly and so the animals do not associate the symptoms with the bait. The symptoms, and death, appear to be relatively painless and so feeding continues until a lethal dose has been consumed which may take several days.

There are now two generations of anticoagulant baits:

- **First generation** – Warfarin, and coumatetralyl. It is generally accepted that a wide degree of resistance has built up against these compounds
- **Second generation** – Includes brodifacoum, bromadiolone, difenacoum, difethialone and flocoumafen. The second generation anticoagulant baits are very effective, even against warfarin-resistant rodents. They are very potent and a single feed can be sufficient to provide a lethal dose but they still have the chronic anticoagulant action. The purchase and use of both First and Second Generation anticoagulant baits for professional use is now strictly controlled.

12.3.1 Rodenticide formulations

Formulations are the ways in which the rodenticide is presented to the target animal. Knowledge of the advantages and disadvantages of different formulations is important when selecting a rodenticide for a particular species and habitat.

Baits are the most common way to present a rodenticide. Edible baits generally contain coloured dyes. This is principally a safety measure used to indicate product contamination or when a non-target organism has eaten bait. Anticoagulant rodenticides are usually coloured red, blue, purple, grey or green.

Rats and mice have very wide-ranging tastes, feeding on whatever is available. However, they do have a general preference for cereal-based foodstuffs and so these usually form the base of edible baits.

Edible baits

Edible baits come as loose cereals; wax, extruded or compressed blocks; pellets; pastes or gels. These are still cereal-based and usually also contain a mould inhibitor (paranitrophenol or dehydroacetic acid). Certain formulations appear to be more palatable than others with whole grain baits being preferred to blocks.

Contact Products

Rodents spend up to 20 percent of their waking time grooming. By placing contact products in areas where rodents are active, the rodent running through them will collect it on its fur and later ingest it while grooming. If the runs are not obvious in the first place, tracking dust (an inert preparation containing no rodenticide) should be used.

12.3.2 Gassing

This technique is only available for use outdoors at a minimum distance of three metres from buildings. Tablets containing aluminium phosphide are applied to the rodent burrows, which are then sealed.

Phosphine gas is liberated from the tablet on contact with moisture and, unable to escape through the blocked entrance, travels through the burrow system, asphyxiating the rodents. Operators using this technique must have received full and specific product training and know and observe the necessary safety precautions. The use of gas-liberating tablets should be avoided in wet weather.

12.4 ENVIRONMENTAL CONSIDERATIONS

Historically the use of permanent rodenticide bait points has been an essential part of rodent control strategy since the introduction of anticoagulants in the early 1950s. On farms, and around the perimeter of food factories, these permanent baits using natural cover provided a ready source of food for incoming rodents especially rats, often killing them before they could become well established.

In the 80s the introduction of external bait boxes saw increased use of permanent baits in areas previously thought to be unsuitable for reasons of safety. There has been an increasing focus during the last decade on the impact on wildlife of anticoagulant rodenticide use. The two main factors resulting from the continued use of anticoagulant rodenticides outdoors, particularly in rural areas are:

- Direct poisoning of non-target species through spilled or exposed bait
- Secondary poisoning through dead or dying rats being eaten by birds of prey such as owls and red kites, and mammals such as foxes, stoats and weasels

Under the Biocidal Product Directive, the EU recently reviewed second generation anticoagulant rodenticides (SGARs) containing the active ingredients brodifacoum, bromadiolone, difenacoum, flocoumafen and difethialone. UK scientists found residues of these compounds in the bodies of a number of predatory and scavenging species of birds and mammals. EU and UK regulatory risk assessments concluded that the use of SGARs outdoors presented a higher level of risk to non-target animals such as mammals, predatory birds and the environment than would normally be considered acceptable. The use of these products under normal circumstances would therefore not be authorised. The UK government, however,

recognised that despite these risks, and in the absence of suitable alternatives which are as equally effective and pose less risk to humans, non targets and the environment, it would be necessary for the continued use of anticoagulant rodenticides outdoors.

They further required that properly managed rodent control strategies with acceptable stewardship were developed to control rodent infestations that may for example pose a risk to public health.

The Health & Safety Executive (HSE), the Competent Authority for the UK, proposed that anticoagulant rodenticides should continue to be authorised for use in the UK by both professional and non-professional users with, however, restrictions in their use outdoors. The Campaign for Responsible Rodenticide Use (CRRU) was given the task by HSE to develop and implement a Stewardship Regime for the responsible use of these products using these rodenticides to minimise the impact of these compounds on wildlife and the wider environment.

The CRRU UK Code Of Best Practice: Guidance for Rodent Control & the Safe Use of Rodenticides (CoBP) was subsequently developed and later endorsed by HSE and the UK's government's Oversight Group. This CoBP gives advice on issues such as rodent control strategies and treatments, risk hierarchy-selecting non chemical control measures etc. before considering the use of anticoagulant rodenticides, avoiding rodent infestations through environmental management, carrying out environmental assessments prior to treatments, and rodenticide resistance.

As a consequence the use of anticoagulant rodenticides in the UK is now strictly controlled. With the exception of the amateur market all major users (Professional Pest Control & Local Authority, Game Keepers and Agricultural users) now have to demonstrate competency before they are able to purchase product from suppliers and apply the product, particularly in open spaces. Full details on the control of rodents are contained in the CRRU UK of Best Practice publication "Best Practice & Guidance for Rodent Control & the Safe Use of Rodenticides". This document can be downloaded for CRRU website www.thinkwildlife.org It is therefore important, where possible, to reduce the availability of these compounds where there is a risk to non-target species.

The first consideration for the control of outdoor rat infestation should no longer be the automatic installation of tamper resistant bait stations around buildings. Permanent baiting neither takes account of the actual source of the infestation nor attempts to identify the quickest means of controlling the problem. Improved training, management and discipline are required to provide a knowledgeable and professional approach to rat control outdoors.



For example, rodent baiting should be carried out where the rodents are most likely to be found i.e. in shrubberies and wasteland surrounding buildings, which can be determined by a thorough inspection. Furthermore, research has shown that hole or burrow baiting, where loose bait is applied directly into holes or burrows, can give the best results in encouraging bait uptake, resulting in quicker control.

Pest control should at all times consider the humaneness of control methods and maintain the balance between the need to control rodent activity by hierarchical control options (This is termed the 'risk hierarchy', as outlined CRRU UK Code of Best Practice) and the opportunity to achieve the same result by other means such as habitat management.

12.4.1 Environmental management

Any vegetation in direct contact with the building, which would provide harbourage for rodents, should be removed.

Any trees or shrubs that lean over and make high level contact providing rodents with a bridge into the building should be cut back.

Any ivy or other creepers growing up the walls should be removed, as these would provide an access route for rodents. Select ground cover plants carefully. The use of ground-hugging or thorny plants and shrubs should be avoided because they inhibit access for inspection and treatment. As far as possible all available sources of food and water should be removed.

12.4.2 Gassing

Where burrows outdoors are beyond the minimum distance of ten metres from buildings, the use of aluminium phosphide tablets can provide a rapid reduction in rat numbers.

12.4.3 Environmental assessment

In order to ensure that toxic baits, when used outdoors, are available only where essential, an assessment should be carried out to determine:

- The history of rat infestation around the site
- The location and seasonal differences of infestations
- Possible routes of re-infestation from adjacent areas. A risk assessment may indicate that permanent baiting with toxic bait should be retained in these areas. The subterranean bait station may become the permanent bait station of choice, providing an improved feeding environment for rats while reducing the number of bait locations
- The most effective means of monitoring activity. Monitoring stations placed on site, with non-toxic indicator blocks must replace toxic baits. These will serve two purposes:
- Record any rodent activity between visits
- Encourage the rats to eat from the rodent monitoring station – when a suitable risk assessment indicates the use of anticoagulant rodenticide and therefore replaces the non-toxic blocks, the rats will feed confidently,

resulting in a shorter control period. This will reduce the neophobic reaction of the rats

The use of enclosed break-back or spring traps may provide a means of monitoring infestation and a first line of defence between service visits. Care must be taken to ensure the traps are correctly set to ensure a clean kill and in locations where the risk to non-target species is minimised.

12.4.4 The most environmentally acceptable methods of controlling future infestations

The checking of rodent monitoring stations as a major part of the service would supplement a thorough inspection of the site. As the monitoring stations remain on site rats will more readily accept rodenticide placed in the event of an infestation being found. A greater emphasis on providing advice on preventive measures and habitat management will be required.

Visits must be made to check for exposed/spilled bait and to search for and dispose of any rodent bodies. In most cases, anticoagulant bait should have achieved control within 35 days. Should activity continue beyond this time, the likely cause should be determined."

All bodies found should be disposed of via an authorised disposal facility. Incineration or landfill are appropriate disposal methods. When no further signs of activity are found the treatment is deemed to have been completed and all anticoagulant rodenticide baits must be removed to prevent the risk of secondary poisoning to non-targets.

These guidelines are aimed at the food manufacturing sector. Smaller food handling outlets may not require the same level of specification or reporting. However the same principles of pest prevention and hygiene will apply. It is essential that a pest management programme is in place and that action is taken to prevent conditions existing within the premises or adjoining which will prove attractive to pests.

Where the business does not carry out pest control in-house, the services of a pest control contractor are often engaged as a means of demonstrating "due diligence". It is important that responsibility for pest control and related matters is not abdicated entirely to the contractor. A senior manager from the customer management team should be appointed to work with the contractor in ensuring that the terms of the contract are met.

Where the responsibility for ensuring that the premises remains pest free is being delegated to an outside contractor certain criteria should be met. It is essential that UK Assurance Schemes carry out audits of food manufacturing and retail food outlets in accordance with the requirements of the CRRU UK Code of Best Practice when assessing rodent control arrangements at the facility.

13 Pest control contracts

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13.1 REQUIREMENTS IN SELECTING A CONTRACTOR

When selecting a contractor the decision must not be based on price alone. The aim is to appoint a contractor with a commitment to quality service, at a competitive price based on the level of customer specification.

There are several pre-requisites to the appointment of a contractor:

- The pest control company should be able to provide evidence to demonstrate that they can provide a service to the level required in the site specification. Geographical coverage, number and stability of workforce, and experience of carrying out similar work in the food industry are factors which should be considered
- The pest control company should have staff qualified to the required level
- The pest control company should carry adequate insurance cover, such as Employers Liability Insurance, and Public and Products Liability Insurance
- The pest control company should be a member of a recognised trade association or body

13.2 TRAINING AND QUALIFICATIONS

In addition to formal qualifications, the pest control technicians attending the site should possess the following abilities:

- An understanding of the site production processes
- Knowledge of the particular pest risk associated with the process/product
- Good inspection technique and equipment
- Ability, using evidence and information, to detect the source of an infestation
- Ability to identify or arrange for identification of insects
- Problem solving skills
- Confidence to follow intuition
- Good verbal and written communication skills

The formal qualifications required will depend upon the work to be carried out and the country in which the premises are situated.

In the UK, there is no statutory certification scheme governing the application of pesticides for public health use. However, it is a requirement under the Control of Pesticides Regulations 1986 and 1987 (as amended) (COPR) that:

1. All employers must ensure that persons in their employment who may be required during the course of their employment to use pesticides are provided with such instruction, training and guidance as is necessary to enable those persons to comply with any requirements provided in and under these regulations; and
2. No person in the course of his business or employment shall use a pesticide, or give an instruction to others on the use of a pesticide, unless that person (a) has received adequate instruction, training and guidance in the safe, efficient and humane use of pesticides; and (b) is competent for the duties for which that person is called upon to perform.

All staff involved in the application of pesticides who are not under direct supervision, must therefore be adequately trained. The recognised industry entry-level qualification includes the RSPH/BPCA Level 2 Award in Pest Control, the BPCA Diploma Part 1, the RSPH Certificate in Pest Control and the NVQ in Pest Control.

A list of certification demonstrating compliance with UK rodenticide stewardship regime requirements is available from CRRU. This approved certification is required for purchase and use of professional-use rodenticides approved under stewardship conditions.

Inspectors and field biologists are expected to be qualified to a higher standard. Evidence should be provided to demonstrate advanced knowledge of:





- Pest identification
- Communication skills
- Food safety
- Food manufacturing processes
- Quality Assurance
- Food industry standards and auditing bodies

All contractors' staff servicing food production sites should also have a basic Food Hygiene qualification, such as Level 2 Food Safety.

Additional qualifications exist for specialist work such as fumigation, ie the use of gassing compounds, and licences may be required for specific aspects of bird control.

The application of agricultural pesticides by contractors, such as herbicides used to control grass and bushes around buildings, requires a qualification issued by the National Proficiency Test Council.

In some other EU countries, it is a legal requirement that pest control technicians have a particular qualification. Details are available from the relevant competent authorities or trade associations in these countries.

13.3 SERVICE LEVEL AGREEMENT (SLA) - OBJECTIVE

The owner or manager of a business is ultimately responsible for maintaining pest-free conditions on site. A key factor in this duty is the action on recommendations made by the pest control contractor.

13.3.1 Job work

Where there is no contract in place but work is undertaken on a fixed treatment job basis, the level of service required is that which will bring the infestation under control. This will usually require the cooperation of the owner or manager and their staff, especially after the treatment has finished.

13.3.2 Service contracts

Where a contract is in place, a service level agreement should be drawn up to represent the commitment between the pest control company and the customer in order to:

- Promote a full understanding of what is required to make the partnership successful and beneficial to both companies
- Establish and maintain pest free conditions
- Agree Key Performance Indicators

There should also be:

- Regular reviews of contract and performance trends
- Regular reporting of management information
- Defined response to service requests

13.3.3 Contract structure

The core pests covered by the agreement should be:

Rodents - Rats and mice
Insects - Public health and food storage

Generally the following services would be excluded from the agreement, unless by specific inclusion:

- Tropical ants
- Bird control
- Bird proofing materials and equipment
- Bird scaring equipment
- Access equipment
- Fly screens
- Supply of electronic fly control units
- Fumigation
- Controlled atmosphere treatments
- Heat treatment
- Wildlife management



13.3.5 Site assessments

The contract should cover the entire site including grounds within the perimeter, all buildings and all areas within buildings. The contract will include a number of scheduled site inspections by trained technicians and, where appropriate, additional inspections by a field biologist. The number of treatments carried out will be that required to resolve the initial problem and maintain pest free conditions.

For food production and high-risk facilities a higher level of specification will be required. The number and frequency of site inspections should be agreed for the following areas.

Internal - high risk areas

Areas where there is a greater risk to food safety from pest activity or where the product is particularly high risk more frequent visits may be required. These should be identified in the contract service specification.

Internal - low risk areas

Areas where there is minimal risk to food safety from pest activity or where the product is low risk less frequent visits may be necessary. These should be identified in the contract service specification.

External buildings and peripheral areas

All areas within the site should be inspected at agreed intervals of no less than eight per annum. These should be identified in the contract service specification.

Field biologist inspectors

These should not be combined with the regular technician inspection and will produce a comprehensive report on pest status, remedial action taken and action required to address potential future risks.

13.3.4 Key personnel and contact information

The following contact information should be held:

Contractor head office	Local or branch office
Address	Address
Postcode	Postcode
Telephone number	Telephone number
Fax No	Fax No
E-mail	E-mail
Website if appropriate	Branch normal opening hours

Key personnel and out of hours contact numbers are required for all contractors' personnel who attend the site. It is up to both parties to maintain up to date information on the identity of all key contacts for the SLA.

13.3.6 Contractor response times matrix

Response to:	Imperative and business critical	Imperative and time negotiable	Important and time negotiable
Reported pest infestations			
Follow-ups			
External audit			
Written reports submission			
Sales quotations			
Meeting request			

13.3.7 Customer response times matrix

Response to:	Imperative and business critical	Imperative and time negotiable	Important and time negotiable
Reporting infestations			
Hygiene and storage recommendations			
Proofing recommendations			
Habitat management			

13.3.6 Contractor response times

Response times and priority scales should be agreed using the example below:

13.3.7 Customer response times

Response times and priority scales should be agreed using the example below:

13.3.8 Contractor key performance indicators

Up to five key performance indicators should be agreed stating for each:

- The particular service activity, for example call-outs to agreed response times
- The performance target, for example 95 percent
- The overall weighting between one to five

13.3.9 Review meetings

If the size and nature of the manufacturing plant requires it, a review meeting should take place at agreed intervals. This may be quarterly, six-monthly or annually depending on the type of business or product exposure risk.

The review meetings should as a minimum incorporate the following agenda items:

- Action points from the last review
- Key performance indicators
- Service level agreement review
- Escalations
- Additional services

13.3.10 Issue resolution and escalation procedures

In the event that any elements within the

SLA fail to meet the specified timescales, an escalation process should be implemented. The levels of escalation, responsible individuals and associated action periods should be agreed with the contractor.

13.4 QUALITY ASSURANCE

The pest control contractor should have in place a quality assurance system which monitors the work carried out on site.

The quality check should ensure that:

- Work on site is carried out in a safe manner
- Pests are identified, reported and eliminated within the required timescales
- Inspections and follow up visits meet the terms of the specification
- Pesticides are applied safely
- Rodent and insect monitoring stations are clean, adequately serviced and correctly sited
- Rodent monitoring stations are securely fixed and locked where necessary
- Additional baits/traps are laid when an infestation is identified
- The report folder is well organised and up-to-date
- Necessary recommendations on preventive action are significant and legible

Further monitoring of the contract should be undertaken by a nominated member of site management or, where deemed necessary, by an independent auditor.



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