

# Hygiene with air

THE QUEST FOR IMPROVED HYGIENE AND THE ADVENT OF SERVO-PNEUMATIC SYSTEMS ARE AMONG DRIVING FORCES CURRENTLY AFFECTING FLUID POWER ON PACKAGING MACHINERY.

**H**ygienic in manufacturing processes has always been an important issue in the food, pharmaceutical and toiletries industries, but it is only in recent years that machine manufacturers have been required by law to ensure that machines are hygienically designed. This new requirement poses some interesting problems for machine makers and also for the manufacturers of fluid power components.

The legal requirement to design equipment to be hygienic appears in essential requirement 2.1 of the Machinery Directive (98/37/EC), which has been made into UK law as the Supply of Machinery (Safety) Regulations 1992. The text of this requirement suggests that it only applies to "agri-foodstuffs", a piece of Euro-English, which means food or animal food.

However, the EU Commission has made it clear in its commentary on the Machinery Directive and in the proposed third amendment to the Machinery Directive, that agri-foodstuffs includes all products ingested by people and animals – that is cosmetics, toiletries, proprietary medicines and pharmaceuticals, as well as food and animal food.

The overall objective set out for the machine manufacturer to achieve is that machinery "must be so designed and constructed as to avoid any risk of infection, sickness or contagion", but the regulations then go on to identify key hygienic design issues.

The first of these issues is that surfaces which are likely to come into contact with the food or product must be made from suitable materials and be smooth so that they do not harbour micro-organisms and can be cleaned easily. On the face of it this would not appear to be a problem for fluid power components.

Few if any machines are designed with pneumatic cylinders in places where they will come into direct regular contact with the product. However if food splashes up onto a pneumatic cylinder or piping, festers a while and then falls back into the food, the food will be contaminated. Consequently, European standards define all these parts of a machine as being



**Hygienic design:** Regulations demand attention to components, even if not in contact with food

"food areas" which must be made from food quality materials.

Food product quality ultimately depends on all the materials deployed within the production process, and laws in many countries regulate the composition of materials that can be used for the construction of food processing systems and equipment. They must be mechanically stable, have a smooth surface and be resistant to breakage, fractures, splintering, abrasion and corrosion.

Zinc, lead, cadmium, antimony, plastics that contain phenol, formaldehyde or plasticisers, wood, copper, brass and bronze may not be used in food production. Typically, types of stainless steel, such as AISI-304, AISI-316 and AISI-316L are sufficiently corrosion resistant and are frequently used for this reason. Alternatively, plastics that offer significant weight or cost advantages can be used, so long as they are sufficiently resistant to chemical influences.

The materials most often used for pneumatic components in food areas are austenitic stain-

less steel, aluminium and plastics. The optimum choice comes down to a great extent upon the corrosive characteristics of the product, the operating temperature and the cleaning agents.

## Design considerations

All of the aspects of the hygienic design of machines are discussed in *BS EN 167-2 Food processing machinery – basic concepts – hygienic design* and its international equivalent BS ISO 14159. Both of these standards have been substantially influenced by the hygienic design department of the Campden and Chorleywood Food Research Association, and describe the essential engineering elements that should be deployed in systems design.

High quality surface characteristics for components that come into contact with food products are absolutely essential to prevent microbic contamination. This is assured by adopting the use of a mean peak-to-valley height of 0.8 microns or less for surface finishes in accordance with ISO 468 in the food area.

But what about other areas of the machine? In addition to the food area on a machine BS EN 1672-2 and other food processing machine standards define two other areas, the "splash area" and the "non-food" area.

The "splash area" is any part of the machine that can be splashed with foodstuffs but is in such a position that the foodstuff cannot be reintroduced to the food flow from this area. This inevitably includes many more fluid power components. Surprisingly, components in the splash area must be planned and designed using the same criteria as the food area, even though foodstuffs cannot be returned to the food flow. This is because contamination in the splash areas can quite easily be passed to the food areas during cleaning.

Components with a peak-to-valley height of 3.2 microns or less are often used in the splash area. Beyond this, components with smooth surfaces deliver improved corrosion resistance. In contrast, rough surfaces, fractures and cracks must be avoided.

Fasteners such as screws, bolts and rivets are cause for hygienic concern. Where they are unavoidable in the food or splash areas for technical reasons, they must be easy to clean and disinfect. Open threads are extremely difficult to clean and promote infection. Minute gaps that cannot be cleaned occur between engaged, internal and external metal threads. If threads cannot be avoided, they should be sealed with suitable acorn nuts and seals.

Very small radii and corners in food and splash areas also present a basic hygiene risk. As the flow rates of cleaning and disinfecting agents are greatly reduced by such features, the desired cleanliness cannot be guaranteed. So the minimum radius required is 3mm.

But what about non-food areas, like enclosures for solenoid valves or trunking containing pneumatic pipes? The assumption with non food areas is that food cannot enter them, although experience suggests that food and liquids can find their way into the most unlikely places and, if allowed to accumulate, can become a source of contamination.

The requirements for non-food areas therefore are that there should be no enclosed spaces that cannot be cleaned and inspected for cleanliness and that it should be possible to drain any liquids that may accumulate in non-food areas.

### Contamination from compressed air

It is often assumed that compressed air is sterile and completely hygienic. However, special care is required when working with compressed air, especially when it comes into either direct or indirect contact with foodstuffs, because it is not inherently clean. On the contrary, particles are present almost everywhere in the form of dust. Water is also present in air, occurring naturally as atmospheric humidity, and which is released in large volumes when compressed air cools down.

In some packaging machines compressed air is discharged directly onto packaging materials or containers that will later come in to contact with the food product and so indirectly contaminate the product.

In other machines compressed air is used directly to assist the flow of food products, for mixing ingredients, or at the filling machine. If the air is not clean and sterile in this situation the food will be contaminated.

However, the most common form of indirect contamination in food factories occurs when lubricated compressed air is vented into the atmosphere, carrying with it microscopic parti-



**Ease of cleaning:** Festo CDV1 valve block is able to withstand washdown

cles of moisture and lubricating oil. These particles will move around in the air in the factory and will inevitably find their way onto any uncovered food.

Oddly enough, there is no specific compressed air quality standard for the food processing industry. However advice from pneumatic components specialist Festo, for example, advocates the use of a fine filter (1 micron) upstream from a micro-filter (0.01 micron), followed by an active carbon filter.

Festo says that a micro-filter removes 99.999 per cent of all oil present in the air and reduces solids contamination to a particle size of 0.01 microns or less. This achieves Quality Class 1. The downstream carbon filter further reduces oil content to less than 0.003mg/m<sup>3</sup>, and ensures a completely neutral taste.

Depending on the exact application and the sensitivity of the food product being processed, the automation system designer needs to determine whether additional sterile filtration is required. A sterile filter ensures the retention of bacteria, eliminating the impairment of food and results in a reduction in perishability.

In fact, Festo has produced a booklet *Manual for the Food Processing and Packaging Industry - Theory & Practice* to help users understand the hygienic design issues involved with fluid power systems. It can be obtained from Festo, tel: 01604 667000, e-mail: info\_gb@festo.com

### Further developments

**Selection:** Computer programs to optimise the selection of pneumatic components are now

becoming available to help reduce the costs of over-specification.

Machine designers often oversize pneumatic components to build in a performance margin and mitigate against any performance shortcoming in a new design of machine. However, the new software selection and configuration programs now available allow pneumatic components to be matched closely to the needs of the application, reducing the bill for components, the space required, and energy usage.

Following component selection, performance can be verified by simulation tools. These allow a machine builder to validate machine concepts before prototyping. Festo, for example, has free tools of this type available, and a more advanced package (CACOS) for its in-house use when supporting OEMs and providing system building services.

**Washdown:** A new generation of valves able to withstand washdown have become available to allow machine builders to mount valves closer to the cylinders and reduce the length of piping. Protection ratings extend to IP69K.

**Servo-pneumatics:** Pneumatics suppliers are increasingly venturing into electrical servo product areas, which may seem like a departure from their core business, but reflects the increasing pressure from electrical servo/step-per motor suppliers.

The cost per electrical servo axis has dropped dramatically in recent times and is likely to continue falling as volumes increase. This means that higher performance solutions are now often available at similar costs to those of a pneumatic solution.

Indeed, this may well be a logical progression for pneumatics manufacturers – after all, they have a wealth of linear motion expertise. There are numerous examples of these developments:

- **Interchangeable cylinders:** Pneumatic cylinders and high performance servo cylinders with identical dimensions, allowing direct retrofitting at a later date should higher speeds and accuracies be required.

- **Cylinders have improved axis control and performance with configurable end-of-travel cushioning.** Damaging jolts and impacts present during packing are therefore reduced.

- **Servo-pneumatic solutions are seen in applications such as filling.** For example, the Festo SPC200 closed loop controller is ideally suited to volumetric filling. It can reduce over or under filling by automatically adjusting the filling heads to compensate for changing temperatures or product consistency. ■