



FOOD GRADE COMPRESSED AIR

A code of practice

FOR FURTHER INFORMATION & GUIDANCE CONTACT:

Ingersoll Rand European Sales Ltd

Industrial Technologies
Greenbank House
Swan Lane, Hindley Green
Wigan, WN2 4AR
Tel (+44) 1942 503133
Fax (+44) 1942 503130
its.info@eu.irco.com
www.air.ingersollrand.com



Foreword

Compressed air is an essential part of many aspects of food production and processing from the "farm to table" and with the ever-increasing demands to improve health and hygiene in the food chain this code of practice has been produced to meet those demands.

The British Retail Consortium and the British Compressed Air Society have jointly prepared this code of practice, which will give useful guidance and allow informed decisions on what type of compressed air equipment is required, how it should be installed as well as maintained, and importantly the requirements for the air purity. Following this code of practice in association with the food industry requirements to apply the HACCP process will ensure that the compressed air system will not only meet current legal requirements but also contribute to customer confidence in food supplied to market.

I would like to thank not only the BRC but also those members of the British Compressed Air Society who contributed to the production of this code of practice.

AirChannel

Atlas Copco

Domnick Hunter

Durr Technik

HPC

Compair

Ingersoll Rand

Donaldson

Shell

Walker Filtration

Greg Bordiak
Technical Officer

This document is based upon the best knowledge available to the authors at the time of publication. However, no responsibility of any kind resulting from the use of this code of practice can be accepted by the authors or others involved in the publication.

Contents

0	Introduction	3
1	Scope	4
2	References	4
	2.1 Legislation	4
	2.2 Industry publications	4
	2.3 Standards	4
3	Definitions	5
4	Hazard Analysis and Critical Control Point (HACCP)	5
5	Installation	5
	5.1 General	5
	5.2 New installations	5
	5.3 Existing installations	5
	5.4 Compressor	5
	5.5 Ventilation and cooling	6
	5.6 Storage	6
	5.7 Distribution	6
	5.8 Air treatment	6
	5.9 Condensate	7
6	Air purity	7
	6.1 Food groups	7
	6.2 Microbiological contaminants	7
7	Measurement and testing	8
	7.1 General	8
	7.2 Periodicity	8
	7.3 Dirt (Solid particles)	8
	7.4 Humidity	8
	7.5 Total oil	8
	7.6 Microbiological	8
	7.7 Documentation	8
8	Maintenance	8
	8.1 Manufacturers' specifications	8
	8.2 Preventative maintenance	8
	8.3 Maintenance contamination prevention	8
	8.4 Air outlets	8
	8.5 Documentation	8
	Annex A Bibliography	9

0 Introduction

During the production, processing, handling, packaging and transporting of food at all stages from source to consumer, the safety of the food may become compromised and then subject to a recall. One source of possible contamination is when compressed air is used in conjunction with the food chain.

Contaminants commonly associated with compressed air are categorised in the form of dirt (solid particles), water (as humidity) and oil. Other influences are the presence of microbiological organisms such as bacteria which may be transported through a compressed air system or propagated due to the conditions existing in a compressed air system.

Contaminants that may be a potential hazard in food for human consumption need to be subject to control as a lack of control could result in a potential prosecution. Compressed air may come into direct or indirect contact with food. Where compressed air comes into direct contact with food, in particular during production or processing, this requires a much higher level of contaminant control and particular attention needs to be placed on contaminants added during the compression and the distribution process. e.g. bread packing, fluidised bed in the transfer of flour from a tanker etc.

Due to the variations in design of compressors some require oil in the compression stage and some do not. For food production where the compressed air comes into direct contact the amounts of oil present and type of oil allowed shall be strictly controlled. Some food producers have internal requirements where no oil is allowed to come into contact with food. Maintenance is a key element in ensuring that the compressor(s) and other equipment retain acceptable operating conditions. The controls applied to all types of contaminants may either be a customer requirement or one set by regional or national legislation.

The code will contribute to the process involved with the legal requirement in Hazard Analysis and Critical Control Point (HACCP) principles which the food manufacturer is required to perform and is widely used in food and beverage production and processing. These principles are designed to ensure the quality of the final product by identifying potential contamination areas, known as Critical Control Points (CCP's) and implementing rectification and monitoring procedures.

Recommendations are set for compressors and associated equipment in terms of their location, air intake, ventilation and maintenance.

This code sets out the minimum recommendation for compressed air quality in new installations. Consideration has been given into the potential contamination issues surrounding compressed air and details acceptable measuring methods for testing the air quality.

NOTE: - This code does not cover other gases commonly used in the food industry (such as nitrogen and carbon dioxide), which should be controlled, as they will have an impact on the quality of the final food or beverage.

1 Scope

This code of practice identifies the requirements for compressed air systems used in the production and processing including packaging and transportation for safe food production.

It also identifies the air purity requirements for compressed air for both contact and non-contact applications.

Measurement and testing procedures are identified to verify the purity of the compressed air.

Recommendations on the types of equipment to be used in all areas of food production are indicated.

Maintenance activities are identified to retain continued performance of the compressed air system.

Guidance on the Hazard Analysis and Critical Control Points identifying the elements needed to meet the users' health and hygiene requirements for compressed air systems are included as identified in The Food Hygiene (England) Regulations 2005, Schedule 2. It identifies contributory elements associated with food safety standards as identified in BRC requirements.

This code of practice does not cover the use of compressed air as a food ingredient. In addition the production of beverages is not covered by this code with the exception of the bottling and canning processes.

2 References

2.1 Legislation

- S. I. 2005 No. 2059 The Food Hygiene (England) Regulations 2005
 Pressure Systems Safety Regulations S.I. 128:2000
 CONSLEG: 2000D0532 - 01/01/2002 European Waste Catalogue - Consolidated text

2.2 Industry publications

- BRC Global Standard Food (Issue 4)
 EHEDG Doc. 23:2002 Production and Use of Food-Grade Lubricants
 BCAS – CAC9407 Compressed air condensate
 BCAS Installation Guide (5th Edition)

2.3 Standards

- ISO 6743 Lubricants, industrial oils and related products (class L) -- Classification -- Part 3: Family D (Compressors)
- ISO 8573-1:2001 Compressed air - Contaminants and purity classes
- ISO 8573-2:1996 Compressed air for general use. Test methods for aerosol oil content
- ISO 8573-3:1999 Compressed air - Test methods for measurement of humidity
- ISO 8573-4:2001 Compressed air - Test methods for solid particle content
- ISO 8573-5:2001 Compressed air - Test methods for oil vapour and organic solvent content
- ISO 8573-7:2003 Compressed air - Test method for viable microbiological contaminant content
- BS 4825:1991 Stainless steel tubes and fittings for the food industry and other hygienic applications.
 Part 1 Specification for tubes
 Part 2 Specification for bends and tees
 Part 3 Specification for clamp type couplings
 Part 4 Specification for threaded (IDF type) coupling
 Part 5 Specification for recessed ring joint type couplings
- BS EN 12449:1999 Copper and copper alloys. Seamless, round tubes for general purposes

3 Definitions

3.1 Contact

the process where compressed air is used as a part of the production and processing including packaging and transportation of safe food production.

3.2 Critical Control Point

a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

3.3 Food-grade lubricants

lubricants where under intended use contact with the product cannot be fully excluded.

Note 1 They are used for example for the lubrication, thermo transfer, load transmission or corrosion protection of machinery, machine elements and equipment for manufacturing and processing foodstuffs, food commodity goods, cosmetics, tobacco products, pharmaceutical products and animal feeding stuffs.

Note 2 If applicable, they usually meet the general technical requirements for lubricants based on ISO 6743 and the indicated requirements.

Note 3 Food grade lubricants are not intended for human consumption or for contact with the skin or mucous membranes.

3.4 Non contact

the process where compressed air is exhausted into the local atmosphere of the food preparation, production, processing, packaging or storage.

4 Hazard Analysis and Critical Control Point (HACCP)

The Hazard Analysis and Critical Control Point process shall follow the recommendations identified in the British Retail Consortium publication, BRC Global Standard – Food.

The distinction between high risk and low risk shall be decided by a competent person.

5 Installation

5.1 General

The requirements for the equipment included in a compressed air system for food production shall be such that the air purity specifications identified in clause 6 are maintained. For guidance on general compressor installation the user should consult the British Compressed Air Society "Installation Guide". Specific information on particular aspects of a chosen compressor shall be obtained from the supplier. As a reminder it is a requirement that the HACCP process should be reviewed.

5.2 New installations

For new installations the considerations for the equipment to be installed will be based solely on the application and the chosen air purity specification given in clause 6. The combination of equipment will then be chosen in accordance with the general advice on compressed air systems given in the British Compressed Air Society "Installation Guide" and the advice from the supplier as well as any specific requirements given in this code of practice.

5.3 Existing installations

Where existing installations are modified to improve the operation of the compressed air system then it should be recognised that where equipment is introduced to reduce the levels of any particular contaminant the benefits to the system may not be immediate. The contaminants, including oil, water and solids as well as bacterial growths may still be present in the system and will take some time to be removed.

This will then affect the desired air purity specification and point of use air treatment may need to be considered as an expedient measure.

The HACCP process should be applied to determine the level of contamination by the use of the tests identified in clause 7 and then to verify if these levels are within the values identified in clause 6. If the values are outside of those in clause 6 then remedial action shall be taken.

5.4 Compressor

The compressor requirements shall include the following;

5.4.1 Inlet filtration

Inlet filtration shall be in accordance with the suppliers recommendations based on site conditions specified at the time of the contract agreement with at least the following provision - the air intake must be placed in a position away from sources of steam, chemical vapour, engine exhaust (hydrocarbons), dust and other contaminants and where possible the air intake shall be positioned upwind of these sources.

5.4.2 Location

Where the compressor is located outdoors it may require additional considerations, including weatherproofing in accordance with the manufacturers recommendations.

5.4.3 Location and air treatment

Additional air treatment equipment may be required downstream of the compressor if the location has a detrimental effect on the required air purity.

5.4.4 Lubricants

References to lubricants in this code of practice will in general identify the contamination of the compressed air itself. The following points shall be considered in a risk assessment;

- a. Where lubricated or oil-injected compressors are in use and non-food grade oil is used and the HACCP process identifies a risk then the oil shall be replaced with food grade oils in-line with the procedures identified in the EHEDG Document 23.
- b. Where oil-free compressors are used no lubricant is involved in the compression process therefore the procedures identified in the EHEDG Document 23 will not be required.
- c. Compressors that employ lubricants in those parts not involved in the actual compression of the air will be subject to the HACCP process to determine the risks if any to the food production process.

5.5 Ventilation and cooling

Compressors produce heat when in operation and therefore they should be provided with sufficient ventilation to operate efficiently, within safety margins and be able to meet air purity requirements. Depending on the location of the compressor plant ventilation and cooling arrangements will need to meet not only the compressor requirements but also the constraints of the location. Therefore the following points should be noted and be in accordance with manufacturers' requirements;

- a. The compressor will require cooling air or an adequate water supply to maintain the optimum operating temperature
- b. The compressor inlet will require air at a temperature low enough to maintain manufacturers' performance.

The facilities necessary to meet these conditions shall be agreed with the supplier at the time of the contract agreement.

5.6 Storage

The air receivers used shall be in compliance with either the Simple Pressure Vessels Directive or the Pressure Equipment Directive or other codes where the application is outside of the EU OR EFTA. The materials of construction of the air receiver shall not contribute to the contamination of the compressed air which may either come into direct or indirect contact with food in any food production area. Where a carbon steel air receiver is in use it will deteriorate due to rusting. See 5.9 regarding the draining of condensate.

HACCP shall indicate the need to maintain an appropriate level of stored air purity. (Based on selection of air purity as specified in clauses 6.1.1 and 6.1.2.)

5.7 Distribution

Compressed air is commonly distributed through carbon steel pipes that corrode in the presence of water in the compressed air. Considerations in the use of other piping materials readily available include energy efficiency which points to the use of smooth bore pipes in aluminium, copper, stainless steel or a number of plastic alternatives. Where hygiene is of prime consideration then stainless steel to relevant standards, e.g. BS 4825, is an option. Copper pipes to BS EN 12449 can also be used although these are generally limited to systems where the pipe bore does not exceed 40mm. The use of pure copper pipes can also inhibit the growth of bacteria.

Where non-metallic piping is used for distribution systems then it should be noted that this material is subject to temperature limitations and that it should not be used at or close to the compressor discharge. Advice should be sought from the pipe supplier as to the temperature acceptance of the pipe material.

5.8 Air treatment

The requirement for air treatment will depend on the application and the air purity specification. In addition the ambient conditions, type of compressor used and the material of the equipment to the point of use will all have a bearing on the combination of air treatment required.

5.9 Condensate

The air receiver and other points around the compressed air system act as collection points for condensate deposited from the air. The condensate will contain dissolved and emulsified contaminants from the compressed air and will need to be drained and disposed of on a regular basis.

Where oil lubricated/injected compressors are used the resulting condensate discharge will need to comply with local legislative provisions governing disposal. Guidance is given in the BCAS publication "Compressed air condensate".

It shall be established that compressed air condensate containing food grade lubricants is suitable for disposal as a trade effluent to foul sewer or the food grade lubricant is identified in the European Waste Catalogue as a hazardous waste. If the food grade lubricant is identified as a hazardous waste then proper disposal shall be identified.

6 Air purity

6.1 Food groups

Compressed air used in the production of the food products is divided into two groups. The outlet compressed air must be designated as one of the following:

- air that comes into direct contact with the food (Contact);
- air that could come into contact with the food (Non-Contact).

The contaminant values for dirt and oil given in clauses 6.1.1 and 6.1.2 below are those at the 'Reference Conditions' in ISO 8573-1 at a temperature of 20°C, absolute atmospheric pressure of 1 bar and relative water vapour pressure of zero.

6.1.1 Contact recommendation

Compressed air coming into direct contact with food shall meet or exceed the following recommendation;

- dirt the maximum number of particles in the following size ranges shall not exceed

Particle size, d µm	0,10 < d ≤ 0,5	0,5 < d ≤ 1,0	1,0 < d ≤ 5,0
Maximum number of particles; per m ³	100 000	1000	10

- humidity ≤-40°C pdp (at air line pressure)
- total oil less than 0,01mg/m³

6.1.2 Non-contact recommendation

Compressed air purity not in direct contact with food shall meet or exceed the following recommendation;

- dirt the maximum number of particles in the following size ranges shall not exceed

Particle size, d µm	0,10 < d ≤ 0,5	0,5 < d ≤ 1,0	1,0 < d ≤ 5,0
Maximum number of particles; per m ³	100 000	1000	10

- humidity ≤+3°C pdp (at air line pressure)
- total oil ≤0,01mg/m³

where the HACCP shows a high risk area then the air purity shall be;

- dirt the maximum number of particles in the following size ranges shall not exceed

Particle size, d µm	0,10 < d ≤ 0,5	0,5 < d ≤ 1,0	1,0 < d ≤ 5,0
Maximum number of particles; per m ³	100 000	1000	10

- humidity ≤-40°C pdp (at air line pressure)
- total oil ≤0,01mg/m³

an example of a high risk area would be in the area of ready to eat food such as cut fruit salad etc.

6.2 Microbiological contaminants

HACCP shall establish the risk of contamination by microbiological contaminants. The level of viable microbiological contaminants in the compressed air shall not be detectable using the method described in clause 7.6.

7 Measurement and testing

7.1 General

In general the methods to be employed to verify the level of contaminants shall follow those test methods described in the appropriate part of ISO 8573. In addition to these methods other methods using chemical indicator tubes may be used, where appropriate, to establish the general levels of oil and humidity. Guidance should be sought from the original equipment manufacturer of the compressed air equipment on testing procedures. The maintenance of the required air purity shall be related to HACCP.

7.2 Periodicity

The compressed air purity shall be tested and verified at least twice per year or in accordance with manufacturers recommendations using the methods identified in the following clauses.

These test procedures require qualified personnel and specialised equipment consult your supplier for advice on suitable sources.

Note - Whenever maintenance work or any activity that may affect the air purity is performed on the compressed air system then as a simple check on the air purity chemical indicator tubes may be used. This method may be employed where the next scheduled periodic test is not imminent.

7.3 Dirt (Solid particles)

Solid particles shall be measured in accordance with ISO 8573-4. In addition to using this method to measure particles ISO 8573-7 as indicated in clause 6.6 shall also be done to confirm whether there are any microbiological colonies present in the solid particles from the compressed air.

7.4 Humidity

Water vapour and humidity shall be measured in accordance with ISO 8573-3.

7.5 Total oil

Oil concentration shall be measured using with ISO 8573-2 (oil aerosol); Method B1 and ISO 8573-5 (oil vapour). The stated concentration shall be the sum of the oil aerosol and oil vapour.

7.6 Microbiological

The presence of microbiological contaminants shall be established by the test method specified in ISO 8573-7.

Note – microbiological particles are considered to be solid particles and therefore will be included as a measurement for solid particles. ISO 8573-7 is a method to detect if the solid particles contain any viable (living) units.

7.7 Documentation

All measurements shall be recorded and documented.

8 Maintenance

The compressors and all ancillary components that are involved in producing compressed air to the purity levels stated in this code shall be maintained to the level identified by the original equipment manufacturer. It is a requirement of this code of practice that maintenance shall be done by qualified personnel.

Replacement parts used should be those as recommended by the manufacturer to provide the confidence that the performance can be maintained.

8.1 Manufacturers' specifications

All equipment involved in producing compressed air shall be maintained in accordance with manufacturers' specifications to maintain the operating requirements of the user.

8.2 Preventative maintenance

A planned preventative maintenance programme shall be in place for all equipment involved in providing compressed air. The maintenance programme shall meet the requirements of regulation 12 of Pressure Systems Safety Regulations plus any additional hygiene requirements.

8.3 Maintenance contamination prevention

Procedures shall be put into place that establish the practices to be adopted by persons undertaking maintenance activities on equipment involved in the production of compressed air. Those procedures shall as far as is practicable ensure that no contamination of the compressed air, pipe work or associated equipment occurs.

8.4 Air outlets

When any maintenance to equipment is complete, a representative selection of air outlets shall be tested to confirm that the compressed air meets clause 6.

8.5 Documentation

All maintenance work shall be documented and recorded.

Annex A

Bibliography

A.1 Legislation

9CFR 417	Hazard Analysis And Critical Control Point Systems, 2002 (US FDA specification)
1935/2004/EC	Regulation of the European Parliament and of the council of 27 October 2004 - Materials and articles intended to come into contact with food.
852/2004/EC	Regulation of the European Parliament and council of 29 April 2004 - Hygiene of Foodstuffs.
S.I. 128/2000	Pressure System Safety Regulations
87/404/EEC	Simple Pressure Vessels Directive
97/23/EC	Pressure Equipment Directive

A.2 Standards

BS EN ISO 22000:2005	Food safety management systems. Requirements for any organization in the food chain
ISO/FDIS 21469	Safety of machinery - Lubricants with incidental product contact - Hygiene requirements
ISO 8573-8:2004	Compressed air - Test methods for solid particle content by mass concentration
ISO 8573-4:2004	Compressed air - Test methods for liquid water content

A.3 Codes of practice

Carbon Trust GPG 385	Good Practice Guide - Energy efficient compressed air systems
----------------------	---

A.4 Publication sources

Standards

BSI, for BS, EN and ISO standards	Tel:+44(0)20 8996 9001 - http://www.bsonline.bsi-global.com/server/index.jsp
BCAS	33-34 Devonshire Street, London, W1G 6PY, UK - Tel: +44 (0)20 7935 2464 E-mail: society@bcas.org.uk
BRC	http://www.brc.org.uk/standards/index.htm
EHEDG	CCFRA Technology Ltd, Chipping Campden, Glos. GL55 6LD, UK: Tel: +44 (0)1386 842000 E-mail: pubs@campden.co.uk

Legislation

UK - <http://www.opsi.gov.uk/>

EU - <http://europa.eu.int/eur-lex/en/>



British Compressed Air Society Ltd

33/34 Devonshire Street
London W1G 6PY
Telephone [0]20 7935 2464
Facsimile [0]20 7935 3077
Email: society@bcas.org.uk

www.bcas.org.uk

Price: £25.00

© British Compressed Air Society Ltd 2006
Publication Reference: CP/005/ Rev. 001