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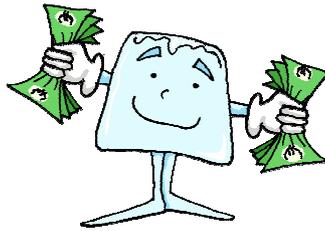
Making business sense
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Project Manager



Carbon Trust Networks Project:

Food & Drink Industry Refrigeration Efficiency Initiative



Guide 1

Appointing and Managing Refrigeration Contractors

Other Project Sponsors



Appointing and Managing Refrigeration Contractors

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The Food & Drink Industry Refrigeration Efficiency Initiative

is a

Carbon Trust Networks Project

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Appointing and Managing Refrigeration Contractors

This guide will help you to save money if you:

1. Appoint and manage refrigeration service / maintenance contractors.
2. Are responsible for service and maintenance which is carried out in house.

1. Introduction

The maintenance and service of refrigeration equipment has a significant impact on its running costs as well as its reliability. Good maintenance can save money by:

- Maximising plant efficiency and therefore reducing electricity costs;
- Reducing equipment failure and the costs associated with plant down time and stock or product loss.

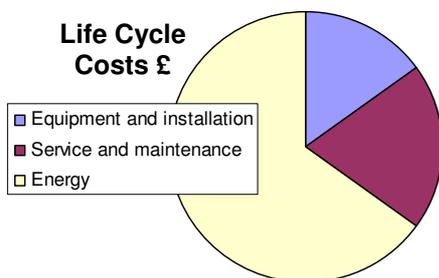
This guide covers the whole process of appointing and managing a refrigeration contractor, from deciding what type of contract is best, through interviewing and selecting the right contractor, to checking the quality of service provided. You do not need to be a refrigeration engineer to use this Guide. The technical terms used are explained in the glossary in Appendix 1 and sources of further information are given in Appendix 2.

The guide outlines different types of maintenance contract and what should be included to minimise energy use. It shows how to appoint the best contractor for your business and includes check lists for tender documents, interview questions and contractor audit forms.

Service – a reactive repair of faults;
Maintenance – proactive, preventative work which should reduce overall plant running costs.

A good refrigeration contractor will:

- Maintain plant effectively to maximise reliability and energy efficiency;
- Provide information to you and your staff on efficient operation of the plant;
- Suggest cost effective improvements which will reduce power consumption and improve reliability.



You will often make investments in refrigeration equipment, either to improve existing plant or to add new. Your overall aim should be to reduce life cycle costs (capital plus energy plus service / maintenance). The energy component of the life cycle cost is the most significant during its lifetime. The department responsible for capital expenditure must understand this. Saving money on capital cost rarely provides equipment with the lowest running costs.

This Guide is one of a series of eight being produced under the Food & Drink Industry Refrigeration Efficiency Initiative, a project sponsored by the Carbon Trust and supported by the Food and Drink Federation, the British Beer and Pub Association, the Cold Storage and Distribution Federation, Dairy UK and the Institute of Refrigeration.

Refrigerant regulations
 There are now regulations that cover the use and management of refrigerants such as R22 and R404A – see Guide 4 for essential information on this.

2. Service and Maintenance Contracts

There are four main types of service and maintenance contract and they are explained in more detail in Appendix 3, with advantages and disadvantages. The table below summarises them and shows which are best for plant energy efficiency.

Contract Type	Impact on Efficiency
Labour and maintenance	😊
Fully comprehensive	😐
Maintenance only	😐
Pay as you go	😞

The duration of the contract is also important. It is recommended that contracts are awarded on at least a three year rolling programme to enable the contractor to make investments which will benefit your equipment.

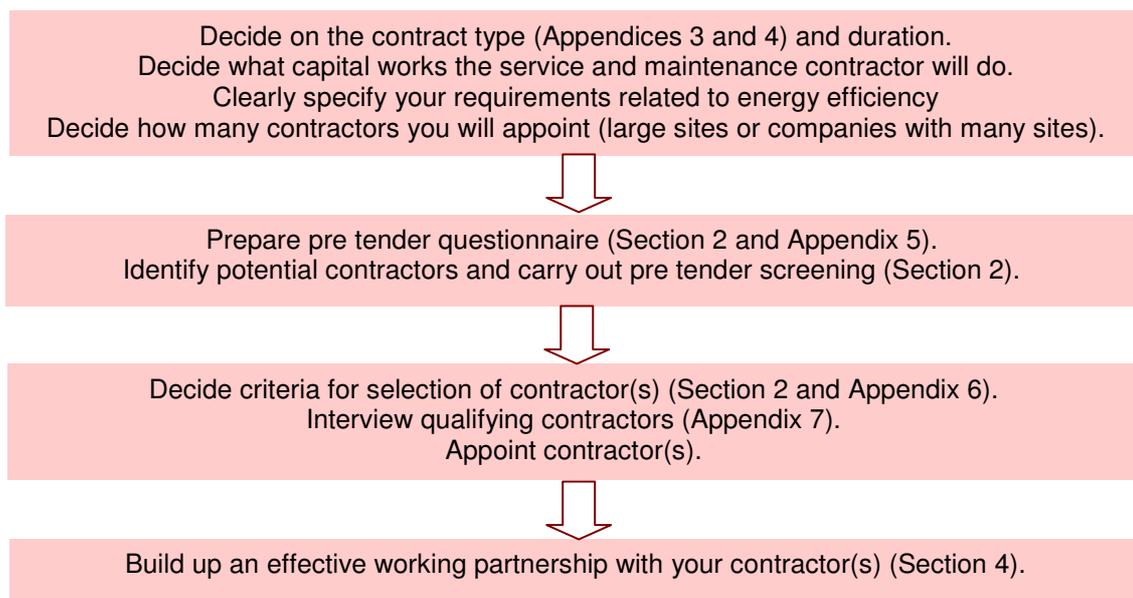
The degree of maintenance required will depend on the equipment type and condition. Appendix 4 includes a checklist of activities required to maximise efficiency and reduce running costs.

Be prepared to spend time on the appointment process – time at this stage improves the effectiveness of the contract and should reduce your refrigerant systems' running costs.

Recommissioning – experience has shown that it is possible to reduce running costs by up to 20% by recommissioning equipment, especially multi compressor systems. Include this in your maintenance contract. Data from recommissioning can help identify improvements needed on a system.

Make it clear that energy efficiency is important!

Many maintenance contracts do not specify any work related to energy efficiency. You need to make it clear in your specification that you want to include energy efficiency in the contract.



3. Pre Tender Qualification

You should contact as many potential contractors as possible (you can find them through word of mouth from other organisations, the RAC Yearbook (published by EMAP), Yellow Pages, the internet, the British Refrigeration Association – see Appendix 2). You need to ensure that potential contractors understand your priorities of low life cycle costs (i.e. that energy costs should be as low as possible). To do this you should ask some key questions before the tender process begins:

Contractor priorities -
Contractors have not traditionally been concerned with energy efficient operation of plant. Ensure the tendering contractors understand your requirements.

- ☑ Does the contractor have an environmental policy?
 - This should cover items such as reducing energy use of systems, reducing refrigerant loss and waste management.
- ☑ Does the contractor understand how their service and maintenance activities effect energy consumption?
 - For example they should understand the concept of low temperature lift and that simple jobs like cleaning condensers significantly reduce condensing temperature, minimise temperature lift and therefore reduce energy use.
- ☑ What are their priorities with regard to refrigerants?
 - They should understand the relationship between refrigerant leakage and increased energy consumption - reducing leakage must be a priority for them.
- ☑ Do they have a refrigerant management policy?
 - They should understand the implications on the use of R22 of the Ozone Depleting Substances regulation and on HFCs such as R404A of the Fluorinated Gas (F Gas) regulation. They should also understand the impact on system performance of the correct refrigerant charge and the importance of identifying and correcting systems which have significant refrigerant losses. For example, do they weigh refrigerant into systems, log the amount used and have a strategy for dealing with systems which leak.
- ☑ What qualifications and equipment do their site engineers have?
 - As a minimum they should have a refrigerant handling qualification such as City and Guilds 2078 or a current CITB refrigerant handling certificate.
- ☑ Does the contractor have experience of monitoring refrigeration systems?
 - This would provide you with energy consumption data and also advance warning of problems which would otherwise result in failure and plant down time.

Appendix 5 provides a template for this. During this screening process you should be able to gauge the level of understanding of the potential contractors. This procedure allows you to set your budget and decide additional needs such as monitoring.

4. Selecting a Service and Maintenance Contractor

Golden rules:

- ☑ Draw up a tender document which clearly identifies what work is included and on what basis (see Appendix 6 for a template);
- ☑ Interview as many potential contractors as possible (who have passed the pre tender screening process). A suggested interview format is provided in Appendix 7;
- ☑ If appropriate, include capital works related to efficiency improvement in the service and maintenance contract to provide an incentive to carry out improvements which

will reduce energy consumption. Note - high cost improvements or replacements should always be tendered separately;

- ☑ For large sites or multi site organisations consider appointing more than one contractor (ensure there is a clear division of work). This will give you greater flexibility if you need to re-allocate contracts and stop contractors becoming complacent;
- ☑ Give potential contractors access to the refrigeration equipment to ensure they are able to tender to your exact requirements;
- ☑ Include refrigeration equipment electricity consumption as a Key Performance Indicator (KPI). Ensure this takes into account ambient temperature and load – both have a significant effect on power consumption. See the Guide 3 on operational checks for more information on monitoring refrigeration systems.

Key question – can the potential contractor demonstrate a successful strategy for reducing power consumption of refrigeration equipment?

5. Managing the Contract

The tender document will provide the basis for the maintenance contract. Your refrigeration maintenance contracting company is a valuable source of information about refrigeration, so take advantage of this:

- ☑ Ask advice on ways to reduce power consumption;
- ☑ Get recommendations on system upgrade (this need not involve replacing the whole system, in many cases replacing or modifying key components will be very effective);
- ☑ Ask the contractor to provide information for your staff (e.g. training or information sheets) showing how they can reduce plant operating costs;
- ☑ If you are investing in new refrigeration equipment get advice from your contractor as well as seeking independent advice.

In most cases it is the design or project department rather than a site technician who will be most helpful to you. You will find it helpful to provide a forum for discussions to improve your refrigeration plant which should include the contractor (including on site engineers), equipment suppliers where appropriate and managers or operators of cooling equipment such as cold stores and process cooling.

It is beneficial to audit the contractor's work occasionally to check maintenance is being carried out to the required standard. Ideally the audit should be done by an independent refrigeration engineer, but you could also do this. An example audit form is included in Appendix 8. You can find independent consultant to audit plant through the Institute of Refrigeration (see Appendix 2).

Summary

Appropriate plant maintenance will save money through reduced energy bills, reduced service costs and less plant down time. Appointing a good maintenance contractor is key to achieving these savings.

- ☑ Specify a contract which will provide pro-active maintenance;
- ☑ Ensure contractors understand your priorities with regard to energy consumption minimisation;
- ☑ Screen potential contractors to ensure they have the experience, knowledge and approach to be able to improve your plant's efficiency;
- ☑ Work effectively with your contractor and use them as an expert resource to improve your plant's performance and when upgrading your equipment.

Appendix 1: Glossary

CITB refrigerant handling certificate	Construction Industry Training Board training qualification for refrigerant handlers.
City and Guilds 2078	City and Guilds training qualification for refrigerant handlers.
F-Gas	Fluorinated gases which are global warming gases covered by the Kyoto Protocol. F-Gases include HFCs, PFCs and SF ₆ (ibid.)
Food & Drink Industry Refrigeration Efficiency Initiative	Project sponsored by the Carbon Trust that led to production of this Guide
HCFC	Hydrochlorofluorocarbon. HCFCs are ozone depleting substances, being phased out under the Montreal Protocol and the EU Ozone Regulation. This is <u>not</u> a gas covered by the EU F-Gas Regulation.
HFC	Hydrofluorocarbon, one of the types of F-Gas covered by the Kyoto Protocol.
Key Performance Indicator (KPI)	A parameter used to compare performance between different plants or between different time periods.
Life cycle costs	The total cost of a plant over its lifetime, including initial capital costs, energy costs, regular maintenance, end of life decommissioning etc.
Liquid Line Sight Glass	A small window in the liquid line (that carries refrigerant liquid from the condenser to the expansion valve of a refrigeration plant, used to check whether any vapour bubbles are present.
PFC	Perfluorocarbon, one of the types of F-Gas covered by the Kyoto Protocol.
R22	A commonly used HCFC refrigerant, which is being phased out under the the EU Ozone Regulation.
R404A	A commonly used HFC refrigerant, which is affected by the new EU F-Gas Regulation .
RAC Yearbook	Refrigeration Yearbook published by RAC Magazine (Refrigeration and Air-conditioning)
Recommissioning	Setting up a plant for operation after a maintenance shutdown.
SF ₆	Sulphur hexafluoride, one of the types of F-Gas covered by the Kyoto Protocol.

Appendix 2: Sources of Further Information

Food and Drink Federation	Trade association for food and drink manufacturers.	www.fdf.org.uk
Institute of Refrigeration	Professional body for refrigeration and air conditioning engineers.	www.ior.org.uk
British Beer and Pub Association	Trade association for brewing and pub sector.	www.beerandpub.com
Dairy UK	Trade association for dairy sector.	www.dairyuk.org
Cold Storage and Distribution Federation	Trade association for the temperature controlled supply chain.	www.csdf.org.uk
British Refrigeration Association	Trade organisation for companies in the refrigeration and air conditioning industry.	www.feta.co.uk
Carbon Trust	Information and support regarding climate change issues.	www.carbontrust.co.uk
Guide 1	Appointing and managing refrigeration contractors.	www.ior.org.uk
Guide 2	Procurement of new plant.	www.ior.org.uk
Guide 3	Checklist for operational improvements.	www.ior.org.uk
Guide 4	HCFC phase out and F gas regulations.	www.ior.org.uk
Guide 5	Reducing heat loads.	www.ior.org.uk
Guide 6	Avoiding high head pressures.	www.ior.org.uk
Guide 7	Improving part load performance.	www.ior.org.uk
Guide 8	Reducing auxiliary fan and pump power.	www.ior.org.uk
EN378	Refrigerating systems and heat pumps. Safety and environmental requirements.	www.bsi-global.com
Refrigeration and Air Conditioning	Comprehensive text book covering all aspect of refrigeration and air conditioning.	ISBN 0-13-323775-3
GPG 278	Purchasing efficient refrigeration – the value for money option.	www.carbontrust.co.uk www.ior.org.uk
GPG 279	Running refrigeration plant efficiently – a cost saving guide for owners.	www.carbontrust.co.uk www.ior.org.uk
GPG 280	Energy efficient refrigeration technology – the fundamentals.	www.carbontrust.co.uk www.ior.org.uk
GPG 347	Installing and commissioning of refrigeration systems.	www.carbontrust.co.uk www.ior.org.uk
GPG 364	Service and maintenance technicians guide.	www.carbontrust.co.uk www.ior.org.uk
RAC	Monthly subscription trade journal and year book.	www.emap.com

Appendix 3: Maintenance and Service Contracts

Type of contract	What's included	Advantages	Disadvantages
Labour & Maintenance (Semi comprehensive) 	All reactive service visits and all planned maintenance visits. Excludes all parts. Note: sometimes calls out of hours are chargeable.	Possibly the best option as the contractor concentrates on maintenance and will make suggestions about your plant knowing that he does not have to pay for part replacement out of his budget. The best option for energy efficient plant operation.	You do not have total control over the budget.
Fully comprehensive 	All reactive service visits and all planned maintenance visits. All parts and materials. Note: sometimes excludes refrigerant and/or compressors.	Appears the highest cost option, but could be the most cost effective. It does allow you to budget for the year.	The older your equipment the higher the cost will be. The contractor takes all the risk so will not necessarily spend the money required to keep your plant running at its optimum, especially if the contract runs over budget or is close to renewal.
Maintenance Only 	All planned maintenance visits and materials. Reactive service visits and materials are chargeable.	A good option on new plant where the emphasis is on maintenance.	Careful control needs to be exercised on the control of material expenditure.
Pay As You Go 	All chargeable.		Careful management of the contractor is required and you need to ensure you budget for Planned maintenance. This looks the cheapest option, but will be the worst for system efficiency – regular maintenance is very important.

Appendix 4: Maintenance Check List

Condensers:	<p>Clean them regularly, especially air cooled types. The frequency of cleaning will depend on the condenser location and its surrounding environment;</p> <p>Check fan / pump motors all work;</p> <p>Check fans are not loose on motors.</p>
Compressors:	<p>Carry out standard maintenance if required;</p> <p>Recover oil and re charge compressors as necessary (ammonia systems).</p>
Air coolers:	<p>Clean them regularly;</p> <p>Check the defrost (where necessary) is working correctly;</p> <p>Check the defrost control allows the optimum time for defrost;</p> <p>Check fan / pump motors all work;</p> <p>Check fans are not loose on motors.</p>
Liquid chillers:	<p>Check water pump operation.</p>
Refrigerant charge:	<p>Check liquid level in receiver or check for bubbling in the liquid line sight glass;</p> <p>Check for leaks all round the system and repair (note – this is required under the Fluorinated Gas Regulations – see Guide 4 for full information).</p>
Liquid line filter drier:	<p>Check for blockage and replace if necessary.</p>
Control:	<p>Ensure the discharge pressure as low as possible – in particular check that Head Pressure Control Settings are not too high;</p> <p>Check that the suction pressure is as high as possible;</p> <p>Check cold room / process temperature set points (they should not be lower than required);</p> <p>Check superheat setting of expansion valves and adjust if necessary.</p>
Insulation:	<p>Replace suction line insulation if necessary;</p> <p>Replace chilled liquid line insulation if necessary;</p> <p>Repair or replace cold store insulation if necessary.</p>
Cold store doors:	<p>Ensure doors are not left open unnecessarily;</p> <p>Repair or replace door seals if necessary;</p> <p>Repair or replace strip curtains if necessary;</p> <p>Repair or replace air curtain if necessary.</p>
Investigate Energy Wasting Faults	<p>See Guide 3 for more details on how this can be done.</p>

Appendix 5: Pre Tender Screening Template

Introduction

The purpose of this document is to screen potential contractors to ensure they understand the requirements of the contract, and to ensure they have the necessary resources and procedures to provide a service that will minimise energy consumption of refrigeration equipment.

The contractor should provide:

Item	Check list	?
Environmental policy	Understand the impact of ozone depleting substance and fluorinated gas regulations.	
	Reference to EN378 as the basic standard for refrigeration systems.	
	Systems designed, installed and maintained for minimum energy consumption.	
	Systems designed, installed and maintained for minimum refrigerant usage.	
	Training provided to design and site engineers covering environmental awareness.	
	Disposal of equipment, components and fluids in accordance with environmental legislation.	
Link between service / maintenance and energy consumption	Understand that condensing temperature and evaporating temperature effect efficiency.	
	Understand that poor condenser condition increases condensing temperature and hence energy use.	
	Understand the impact of set points on efficiency.	
	Identify and improve high energy usage systems.	
Refrigerant priorities	Understand that low refrigerant levels increase energy use.	
	Know how to reduce leakage.	
	Use effective leak detection methods.	
Refrigerant management	Log refrigerant usage per system.	
	Identify and improve high refrigerant usage systems.	
Engineer qualifications and equipment	All site engineers have either City and Guilds 2078 or the CITB refrigerant handling qualification	
	How many engineers are equipped with vacuum pump, recovery machines, weighing scales, leak detection equipment?	
Monitoring	Have experience with system monitoring as a tool for fault prediction and diagnosis.	

Appendix 6: Tender Document Template

Introduction

To include summary of what you want from the contract:

- Improved energy efficiency;
- Reduced service costs;
- Reduced plant down time.

And the basis of the contract:

- e.g. fully comprehensive, etc;
- e.g. rolling three year contract.

Equipment

- A brief description of your business;
- A brief description of the refrigeration equipment, type, age, condition and environment;
- Whether the maintenance contractor will also install new equipment.

The Maintenance and Service Contract

- What equipment is included (e.g. all refrigeration and air conditioning equipment, or just specific refrigeration equipment);
- Start date and hand over procedure;
- Outline of what maintenance is to be included in the contract (see ?? for more detail);
- Outline of how reactive service is to be provided;
- Recommissioning of equipment where appropriate;
- Communication and contacts.

Performance Indicators

- Refrigeration system energy consumption (taking into account load and ambient temperature);
- Refrigerant usage;
- Fix time and first fix rate;
- Plant down time.

Equipment Improvement

- Identify equipment which needs major improvement;
- Outline how contractor would deal with equipment in need of major improvement.

Appendix 7: Interview Format

Before the interview:

- Provide details of the information you will require;
- Provide an opportunity for the contractor to visit site to see the refrigeration equipment.

Short presentation about your company (for example as a 10 minute presentation):

- Refrigeration applications;
- Equipment type, age and condition;
- Management of refrigeration.

Information to be provided by the contractor (for example as a 30 minutes presentation):

- General company information:
 - Size and turnover;
 - Number of refrigeration engineers – design and site – and apprentices;
 - Geographical area covered;
 - Training of engineers;
 - Quality assurance systems;
 - Extent of experience of installation, commissioning as well as service and maintenance;
 - Where the business aims to be in three years.
- How the maintenance schedule will be devised (contractor should demonstrate ability to put together a schedule specifically for the plant, e.g. by specifying condenser cleaning frequency appropriate to the age, condition and environment of air cooled condensers);
- How the contractor will provide pro active service (e.g. by monitoring plant to provide information about fault development before failure or a significant power consumption increase occurs);
- How the contractor will reduce power consumption (examples of previous success in this area would be beneficial);
- How the contractor will reduce refrigerant leakage (including previous examples);
- Communication between your company and the contractor (e.g. will there be a specific account manager);
- Discussion of performance indicators, specifically energy consumption.

Question and answer session for both parties (15 minutes).

Appendix 8: Refrigeration Contractor Audit

This is a suggested tick sheet to be used by a non refrigeration engineer when carrying out a visual audit on the work done by service and maintenance contractors. It is not a full audit, but concentrates on areas which affect energy efficiency. For a more detailed audit an independent refrigeration expert should be used.

Plant room	Is ventilation working correctly?	
Plant	Is pipe work secure and free from vibration?	
	Is all suction pipe work well insulated (the cold pipes connected to compressors)?	
	Are liquid line sight glasses clear when the system is running (bubbles indicate low refrigerant charge)?	
	Do liquid refrigerant receivers show a level of at least 10% when the system is running (a lower level indicates low charge)?	
Air cooled condensers	Are the fin blocks clean and in good condition?	
Water cooled condensers	Is the water inlet temperature less than 6K below the water outlet temperature.	
	Is the water pump working correctly.	
Cold rooms	Are the evaporators continually iced up?	
	Are the evaporator fans working?	
	Are the door seals in good condition?	
	Are strip curtains in good condition?	
Cooled liquid	Is the process liquid pipe work insulation in good condition?	
	Are the pumps working correctly?	
Contract	Is maintenance carried out according to the schedule?	
	Is refrigerant usage documented?	