Communities and Local Government

SHELDON REED INSPECTORS

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Air Conditioning Inspection

Enhanced

Certificate of Inspection

FOR

ABCDE Ltd

Road Steet Avenue

NEWCASTLE UPON TYNE, NE1 2AB

Carried out under the methodology of

CLG/CIBSE Guidance Document TM44 of 2012

By : Russ McAnulla

Accreditation Number : BREC100010

Inspected On : 28 November 2012

Valid Until : 28/11/2017

UPRN : 727656610000

RRN : 9712-6069-0627-0690-8521

Digitally Signed by Russ McAnulla @ 28/11/2012 10:20:26
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Understanding your Report

The Purpose of the Report

The purpose of this Air Conditioning Inspection Report (ACI) is purely to provide suggestions to the client regarding potential ways of improving the efficient running of the Air Conditioning system. In order to do this the inspector investigated a sample of the various types of equipment within the system, looking for potential loss of efficiency, and evaluated the overall control strategy employed. This inspection was not a detailed engineering one, as this is unnecessary to pick out the prime possibilities for energy use reduction.

Report Contents

The ACI which follows this note consists of several sections:

1. The building details
2. An executive summary
3. A list of system components existing and inspected
4. A list of documentation examined.
5. A comparison between the install capacity and the estimated cooling requirement.
6. Pages detailing the results of the inspections of the system components.
7. Pages detailing the system components inspected, by type.

The Building Details

This page shows the building address, together with the main contact details of the person responsible for liaison for this report. It also shows similar details for the air conditioning equipment owner or operator. Finally it provides details of the accredited inspector who produced the report.

Both the front Certificate and each page of the report, contain, near the base of the page, both the “UPRN” and the “RRN” which identify this report. The UPRN (Unique Property Reference Number) identifies the building (or part of a building in the case of an office suite for example.) on the Landmark Address Register. The RRN (Report Reference Number) uniquely identifies the report when it is lodged on the Landmark Report Register. There are separate RRNs for the certificate and the report.

The Executive Summary

This is in three parts. The first gives the overall description of the system. The second gives a high level summary of the key recommendations that the inspector feels will make the greatest impact upon system efficiency. The third gives brief guidance from the inspector regarding the possible reduction of load within the building, and the potential use of alternative energy sources.

The System Components

This shows the number of each type of item that exists on the system, and the number of those items that were actually inspected to produce the report.

In the case of the number of existing items of a given type, this may be an estimate for some items (fan coil units in the ceiling void for example) if documentation is not complete, as it would be inappropriate for the inspector to search for every single item in the system in these circumstances.

The number of items actually inspected is defined in the controlling document, TM44, together with the subsequent conventions document. As the objective of the report is simply to provide guidance on possible ways of improving the efficient running of the system, it is not necessary to examine in detail each component, as the inspector can obtain a good feel for the system’s overall state, by inspecting a sample of all components

The Documentation

The regulations require that a variety of documentation is to be provided by the equipment operator to the inspector. This page details what was seen, and give recommendations by the inspector based on what data was available.

The Cooling Requirement Estimate

This page briefly outlines the Inspector's estimate of the required cooling of the conditioned area, and compares it to the installed cooling capacity serving that area. The inspector may have to use his judgement on occasions, for example where the rating of a given item is not available from documentation or equipment mounted labels. The inspector may choose to provide comments in cases where they feel that the match between the installed and calculated loading is outside the normal range.

Results

Each page in the results section details the findings when each item was inspected. When several items were found to be similar they are all covered by one page of report, which details the equipment item references that the results apply to.

Each result page has a list of the checks carried out by the Inspector, followed by the result of this check. Usually this is a simple yes/no/not-applicable answer; occasionally it may provide more detail such as :-

*** What type of heat recovery system is fitted?** ***Run-around***

The lower half of the page gives any clarifications and/or recommendations felt to be required by the inspector. These relate specifically to those equipments covered by the inspection result.

Details of Equipment Inspected

These pages detail the data associated with each individual item of inspected equipment. These are broken down into several different types:

- Controls – time and temperature setting and sensing equipment including BMSs.
- Unitary – small "through the wall" units, or larger self contained units for say server rooms.
- External – "Split System" condensers, and VRF condensers
- Internal – Items such as. FCUs, cassettes, VAV boxes, chilled beams, Versatemp etc. and small ceiling void AHUs with heat recovery.
- Chillers – Generally "packaged" units, but includes compressors using separate heat rejection
- Heat Rejection – Separate water or air cooled units for dissipating condenser heat.
- Air Handling – Equipment responsible for the supply and extract of air to and from the building for the system. Includes any heat recovery equipment present.

Each type is detailed in turn, and each item inspected is given a reference number by which it is referred to in the results section. The details given on these pages are those typically provided by the detailed equipment schedule which should have been provided by the client to the inspector, or from the data labels attached to the individual units. Not all details are always available. If the inspector has organised the system into a series of sub-systems, then the subsystem to which the item has been allocated is also provided.

Air Conditioning Inspection Report

TYPE OF SYSTEM : *Combined Centralised and Packaged*

Building Details :

UPRN : *727656610000*

Address : *ABCDE Ltd Road Steet Avenue*
NEWCASTLE UPON TYNE NE1 2AB

Contact Name : *J Bloggs* Tel No. : *01234 567890*

Email :

Type of Building : *Office std* Total Conditioned Area (m2) : *35000*

Total Cooling Installed (kW) : *3690* Total Refrigerant Charge (kg) : *1000*

Equipment Owner Details :

Company : *ABCDE Ltd*

Address : *ABCDE Ltd Road Steet Avenue*
NEWCASTLE UPON TYNE NE1 2AB

Contact Name : *J Soap* Tel No. : *01234 987654*

Email :

Assessor Details :

Name : *Russ McAnulla*

Accreditation Number : *BREC100010*

Accreditation Scheme : *BREC*

Employer : *Sheldon Reed*

Address : *4 Tudor Avenue Watford WD24 7NX*

Email : *russ.mcanulla@sheldonreed.com* Tel No. : *+44 1923 806 007*

PI Insurance Co. : *Hiscox* Policy No. : *1555475*

Start Date : *02/02/2009* End Date : *02/02/2014*

Cover (£) : *2000000*

Related Party Disclosure : *1 - Not related to the owner/occupier or person who has technical control of the system or subcontractor.*

Details of the BREC accreditation scheme can be obtained from the government's website at www.communities.gov.uk/epbd, together with details of the procedures for confirming the authenticity of a certificate and for making a complaint.

Air Conditioning Inspection Report

EXECUTIVE SUMMARY

** This report has been prepared in accordance with Part 4 of the EPBD Regulations 2007.*
** The inspection was carried out using a sample selection of units in the system, based on the DCLG sampling Guidance.*
** Equipment was in place to provide cooling to equipment, rather than comfort cooling to the area occupants. This was excluded from the inspection.*
** This mixed system consisted of 7 Chillers, and 27 AHUs, operating into Chilled beams and FCUs, together with splits supplying mainly comms type areas, but also 5 specialist occupied areas.*

EFFICIENCY RECOMMENDATIONS AND ADVICE

** Consider placing warning signs by the controllers advising the turning off of any operational radiators before starting the comfort cooling.*

MAINTENANCE RECOMMENDATIONS AND ADVICE

** The itemised equipment list and cooling capacity documentation did not provide all the data specified in the regulations. It is suggested that this documentation is brought up to the required level. This will also assist in the assurance of correct maintenance of all the individual items of equipment.*

CONTROL RECOMMENDATIONS AND ADVICE

** Consider ensuring that a higher minimum cooling temperature is set, for example 23-25C. This could result in significant savings.*

MANAGEMENT RECOMMENDATIONS AND ADVICE

** Produce a full HVAC Equipment schedule in order to assist the maintenance regime, and readiness for the next inspection.*

Air Conditioning Inspection Report

SYSTEM COMPONENTS

The following system components were present, and representative samples (as defined in TM44 and subsiquent approved conventions) were inspected :-

ITEM	No. Present	No. Inspected
Control Systems	*1*	*2*
Split System External Units	*5*	*0*
Internal Units - All Types	*200*	*7*
Chillers	*7*	*0*
Air Handling Units	*27*	*10*
Documentation	See details on next page of report	

Air Conditioning Inspection Report

DOCUMENTATION EXAMINED

The following Documents, as specified by TM44, were requested from the client by the Assessor. Those that were provided were inspected. 'N/A' indicates that the requested document was not supplied. N/R indicates that the document was not required by TM44. When essential documents were not provided, the assessor's best effort was made to locate all the equipment, but it is not guaranteed that all items were considered.

ESSENTIAL

Itemised Equipment List	*Provided*	Zone Schematics	*Provided*
Time Control Data	*Provided*	System Schematics	*Provided*
Temp Control Data	*Provided*		

DESIRABLE

Earlier Inspection Reports	*N/A*	Sub-Metering Reports	*N/A*
Maintenance Records	*Provided*	Commissioning Reports	*N/A*
Calibration Records	*Provided*		

OPTIONAL

Cooling Load Design	*N/A*	BMS Statement	*N/A*
Complaints Log	*N/A*	Monitoring Statement	*N/A*

GENERAL QUERIES

Are all required F-gas certificates available?	*Yes*
Is there evidence of regular maintenance?	*No*
Is maintenance carried out by qualified personnel?	*Yes*

Inspector's Clarifications and Recommendations :

The temperature and time setting techniques were described verbally by the client's engineer. The itemised equipment list omitted some important data regarding the equipment which is required for the inspection. It is suggested that this list be improved prior to the next inspection in 5 years time. There was no evidence of the required f-gas leakage testing having been carried out on the cooling plant. This should be investigated, and put in place if not presently carried out.

Air Conditioning Inspection Report

BUILDING COOLING LOAD ESTIMATE(S)

Scope of Estimate	*Whole System*
Estimated Conditioned Area	*35000m2*
Main Activity in Conditioned Area	*Office std*
Benchmark Cooling Load for this activity	*4375kW*
Installed Cooling Power	*3690kW*
Estimated Cooling Load	*4102kW*
Installed Cooling Capacity is	*Approximately as expected*

Any additional Inspector's comments:

The installed capacity of the system appears to be well matched to the estimated cooling load of the building

Scope of Estimate	*SYS001*
Estimated Conditioned Area	*35000m2*
Main Activity in Conditioned Area	*Office std*
Benchmark Cooling Load for this activity	*4375kW*
Installed Cooling Power	*3690kW*
Estimated Cooling Load	*2338kW*
Installed Cooling Capacity is	*Approximately as expected*

Any additional Inspector's comments:

The installed capacity of the system appears to be well matched to the estimated cooling load of the building

Scope of Estimate	*SYS002*
Estimated Conditioned Area	*35000m2*
Main Activity in Conditioned Area	*Office std*
Benchmark Cooling Load for this activity	*4375kW*
Installed Cooling Power	*3690kW*
Estimated Cooling Load	*2632kW*
Installed Cooling Capacity is	*Approximately as expected*

Any additional Inspector's comments:

The installed capacity of the system appears to be well matched to the estimated cooling load of the building

Air Conditioning Inspection Report

CONTROL SYSTEMS INSPECTION RESULTS - Page 1

Inspection Results Reference :- *CTR1*

This data applies to the following control units :-
CT1, CT2

Inspector's Responses to TM44 Checklist Questions :-

* Has there been any user disatisfaction with conditions recorded?	*No*
* Is this controller a BMS system?	*Yes*
* Does this controller integrate with the system?	*No*
* Can this controller provide out of range alarms?	*Yes*
* Is there an interlock preventing simultaneous heating and cooling?	*No*
* Is there a shortfall in controller capability?	*No*
* What Timer functionality is present?	*Automatic - Time and day settings*
* Are the clock settings correct?	*Yes*

* Detail typical Weekday and Weekend timer settings:-
  Weekday On - *07:30* Weekday Off - *17:00*
  Weekend On - *00:00* Weekend Off - *00:00*

* Is this a single setpoint controller?	*No*
* Is the dead-band adjustable?	*No*
* What is the present deadband?	*1C*
* What is the cooling setpoint?	*22*
* What is the heating setpoint?	*21*
* Is the sensor location deemed appropriate?	*Yes*
* Is the zoning area for the sensor deemed appropriate?	*Yes*
* Is there a window/hvac interlock in operation?	*Unknown*
* Are there window/hvac mixed-use guidance notices in place?	*No*
* How does the controller modulate the airflow?	*Fan Speed*

Inspector's Clarifications and Recommendations :

There is little deadband between the heating and cooling temperature settings. A deadband of at least 2-3C is recommended to minimise hunting between heating and cooling. Most windows locked closed. Consider allowing opening windows in spring and autumn to reduce energy consumption, but have warning notices by windows advising turning off of local heating/cooling before opening widows. Alternatively a simple "traffic light" system installed on the ceiling of open office areas showing green when the chillers/boilers were not running and red when they were, to indicate to staff when windows could be opened.

Air Conditioning Inspection Report

INTERNAL UNIT INSPECTION RESULTS - Page 1

Inspection Results Reference :- *INR1*

This data applies to following units :-
IN1

Inspector's Responses to TM44 Checklist Questions :

* What is the conditioning medium of this type of unit?	*All-Air*
* Is the unit in generally good condition?	*Yes*
* Does the unit appear to be operating correctly?	*Yes*
* Is there good air distribution from this unit?	*Yes*
* Are there any partitions obstructioning the airflow from this unit?	*Yes*
* Could there be a significant problem with recirculation of output air?	*No*
* Is there evidence of tampering with the diffuser outlet?	*Yes*
* Have there been any complaints regarding the unit?	*Yes*
* Is this all-air terminal in satisfactory condition?	*No*
* Is the visible ductwork in satisfactory condition?	*No*

Inspector's Clarifications and Recommendations :

The chilled beams served all open plan office areas and the inspection revealed no obvious problems.

Air Conditioning Inspection Report

INTERNAL UNIT INSPECTION RESULTS - Page 2

Inspection Results Reference :- *INR2*

This data applies to following units :-
IN6

Inspector's Responses to TM44 Checklist Questions :

* What is the conditioning medium of this type of unit?	*All-Air*
* Is the unit in generally good condition?	*Yes*
* Does the unit appear to be operating correctly?	*Yes*
* Is there good air distribution from this unit?	*Yes*
* Are there any partitions obstructioning the airflow from this unit?	*Yes*
* Could there be a significant problem with recirculation of output air?	*No*
* Is there evidence of tampering with the diffuser outlet?	*Yes*
* Have there been any complaints regarding the unit?	*Yes*
* Is this all-air terminal in satisfactory condition?	*No*
* Is the visible ductwork in satisfactory condition?	*No*

Inspector's Clarifications and Recommendations :

The FCUs served meeting room areas and the inspection revealed no obvious problems.

Air Conditioning Inspection Report

INTERNAL UNIT INSPECTION RESULTS - Page 3

Inspection Results Reference :- *INR3*

This data applies to following units :-
IN2, IN3, IN4, IN5, IN7

Inspector's Responses to TM44 Checklist Questions :

* What is the conditioning medium of this type of unit?	*All-Air*
* Is the unit in generally good condition?	*Yes*
* Does the unit appear to be operating correctly?	*Yes*
* Is there good air distribution from this unit?	*No*
* Are there any partitions obstructioning the airflow from this unit?	*Yes*
* Could there be a significant problem with recirculation of output air?	*No*
* Is there evidence of tampering with the diffuser outlet?	*No*
* Have there been any complaints regarding the unit?	*Yes*
* Is this all-air terminal in satisfactory condition?	*No*
* Is the visible ductwork in satisfactory condition?	*No*

Inspector's Clarifications and Recommendations :

The DX cassettes served specialist areas and the inspection revealed no obvious problems.

Air Conditioning Inspection Report

AIR HANDLING INSPECTION RESULTS - Page 1

Inspection Results Reference :-	*AHR1*
Applies to following units :-	*AH1,AH2,AH3,AH4,AH5,AH6,AH7,AH8,AH9,AH10*

Inspector's Responses to Checklist Questions :-

* Does the unit appear to be in generally good condition?	*Yes*
* Are the input and output grills clear of obstructions and debris?	*Yes*
* Is there a significant possibility of external recirculation of air?	*No*
* Are the filters in a satisfactory condition?	*No*
* Are the filter pressure gauges in a satisfactory condition?	*No*
* Are the heat exchanger fins in a satisfactory condition?	*Yes*
* Is the air handling ductwork a satisfactory condition?	*Yes*
* What type of heat recovery system is fitted?	*Run-around*
* Is the heat recovery system in a satisfactory condition?	*Yes*
* Was the SFP figure Estimated, or known from data?	*Known*
* What was the SFP of the system?	*Not Known*
* What was the fan type?	*Centrifugal*
* What was the fan speed control type?	*Not Known*

Inspector's Clarifications and Recommendations :

The filter changing regime is presently to only change filters when indicated by the BMS pressure differential warnings. However, many of the filters examined were actually in need of changing, while the gauges were well into the green, Some of the gauges were obviously not functioning correctly, or indeed at all. It is suggested that a regular visual inspection be carried out to check on both the filter condition, and the gauge functionality. No data was available on the SFP of the units.

Air Conditioning Inspection Report

DETAILS OF CONTROL SYSTEMS INSPECTED

Control ID	*CT1*	Area Served	*Z1_Whole Building*
Type	*BMS*	Location	*Remote BMS*
Manufacturer	*N/A*	Model	*N/A*
Part of subsystem	*/SYS001 - First description*		
Inspector's comments:	*No further comments noted*		

Control ID	*CT2*	Area Served	*Z1_Whole Building*
Type	*BMS*	Location	*Remote BMS*
Manufacturer	*N/A*	Model	*N/A*
Part of subsystem	*/SYS001 - First description*		
Inspector's comments:	*No further comments noted*		

Air Conditioning Inspection Report

DETAILS OF INTERNAL UNITS INSPECTED

Internal Unit ID *IN1* Area Served *Block 2, 2nd floor* Age *2001*
Type *Chilled Beam* Serving *ffg sdynn* Location *Ceiling Void*
Manufacturer *Trox* Model *araerbaerb* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Internal Unit ID *IN2* Area Served *Post Room* Age *2002*
Type *Cassette* Serving *gsfgnrnmjr* Location *Ceiling Mounted*
Manufacturer *Daikin* Model *qerqeve* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Internal Unit ID *IN3* Area Served *FM room* Age *2004*
Type *Cassette* Serving *rtsrgtnsrftn* Location *Ceiling Mounted*
Manufacturer *Daikin* Model *eqrgevfd* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Internal Unit ID *IN4* Area Served *Security* Age *2005*
Type *Cassette* Serving *N/A* Location *Ceiling Mounted*
Manufacturer *Daikin* Model *35ty24v* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Air Conditioning Inspection Report

INTERNAL UNIT DETAILS - Page 2

Internal Unit ID *IN5* Area Served *Staff* Age *2006*
Type *Cassette* Serving *N/A* Location *Ceiling Mounted*
Manufacturer *Hitachi* Model *wegrwer* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Internal Unit ID *IN6* Area Served *Block 4, 2nd floor* Age *2010*
Type *Fan Coil - Water - 4p* Serving *N/A* Location *Ceiling Void*
Manufacturer *Lennox* Model *rgaerbgaerg* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Internal Unit ID *IN7* Area Served *gbwfrghjhy* Age *2009*
Type *Cassette* Serving *rbbgsfgb* Location *Wall Mounted*
Manufacturer *Denco* Model *asgasdfb* Serial Number *dsfbad*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Air Conditioning Inspection Report

DETAILS OF AIR HANDLING PLANT INSPECTED

Air Handler ID *AH1* Area Served *0DVwdvwV* Served by unit
Age *2004* Location *Plant Room - Inside 4a*
Manufacturer *N/A* Model *wqeasdv* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Air Handler ID *AH2* Area Served *retbwerb* Served by unit
Age *2004* Location *Plant Room - Inside 4b*
Manufacturer *N/A* Model *WERWDBV* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Air Handler ID *AH3* Area Served *r5tbsrgbfg* Served by unit
Age *2004* Location *Plant Room - Inside 3a*
Manufacturer *N/A* Model *wrebfds* Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Air Handler ID *AH4* Area Served *0* Served by unit
Age *2004* Location *Plant Room - Inside 3b*
Manufacturer *N/A* Model Serial Number *N/A*
Part of subsystem */SYS001 - All Components*
Inspector's comments: *No further comments noted*

Air Conditioning Inspection Report

AIR HANDLING DETAILS - Page 2

Air Handler ID *AH5* Area Served *0* Served by unit
Age *2004* Location *Plant Room - Inside 2b*
Manufacturer *N/A* Model Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Air Handler ID *AH6* Area Served *0* Served by unit
Age *2004* Location *Plant Room - Inside 2a*
Manufacturer *N/A* Model Serial Number *N/A*
Part of subsystem */SYS001 - All Components*
Inspector's comments: *No further comments noted*

Air Handler ID *AH7* Area Served *asdfbasbvas* Served by unit
Age *2004* Location *Plant Room - Inside 1a*
Manufacturer *N/A* Model Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Air Handler ID *AH8* Area Served *0* Served by unit
Age *2004* Location *Plant Room - Inside 1b*
Manufacturer *N/A* Model Serial Number *N/A*
Part of subsystem */SYS001 - All Components*
Inspector's comments: *No further comments noted*

Air Conditioning Inspection Report

AIR HANDLING DETAILS - Page 3

Air Handler ID *AH9* Area Served *0* Served by unit
Age *2004* Location *Plant Room - Inside 5b*
Manufacturer *N/A* Model Serial Number *N/A*
Part of subsystem */SYS001 - All Components*
Inspector's comments: *No further comments noted*

Air Handler ID *AH10* Area Served *0* Served by unit
Age *2004* Location *Plant Room - Inside 5a*
Manufacturer *N/A* Model Serial Number *N/A*
Part of subsystem */SYS001 - First description*
Inspector's comments: *No further comments noted*

Explanatory notes for building owners and managers

The following is abstracted from section 6 of CIBSE TM44, by permission of the Chartered Institution of Building Services Engineers

Background

Inspection, maintenance and cleaning programmes to maintain efficiency and to alleviate potential health hazards should be part of the normal activities associated with the ownership and operation of air conditioning systems. Owners and managers are reminded of their statutory obligations and duties of care in the operation and maintenance of air conditioning systems, and their attention is also drawn to the legislation and guidance mentioned in this section.

The major reasons for undertaking maintenance could be categorised as maintaining the ability of the system to provide healthy and comfortable environments for building occupants, limiting the escape of refrigerant gases, ensuring the safety of equipment, minimising the use of energy and maintaining the value of the capital asset. The practices and procedures needed to achieve these aims will be more extensive in complex systems and much simpler in instances where a single unit air conditioner is used. It is outside the scope of this document to describe such procedures in detail, but an introduction to available professional and industry good practice guidance is included at the end of this document.

It should be noted that a good practice inspection and maintenance regime would not normally include all of the issues addressed by the Energy Performance of Buildings Regulations 2007(1); in particular, those aspects relating to the sizing of the system in relation to the cooling load, and to the provision of advice.

The inspection process

The inspection process required under the EPB Regulations, and carried out to produce this report, examined the refrigeration equipment and air movement systems that are part of air conditioning systems, and their controls. It also examined any documentation that helps understand the systems, or indicates the extent to which the systems have been maintained. The inspector was also required to estimate whether the system is suitably sized for the cooling loads in the treated spaces, and to provide advice on ways in which improvement might be made.

Owners and managers should not expect the report to alert them to all hazards or aspects of the installation, operation or maintenance of systems that are unsafe.

The inspection report

The purpose of the inspection and the resulting report are to ensure that building owners or managers are provided with basic information that gives an indication of the likely efficiency of the air conditioning systems for which they have responsibility, together with some initial advice on how energy efficiency or effectiveness might be improved.

The inspection and report will benefit the owner or manager only if its findings are acted upon. It is recommended that the advice be considered, and that appropriate rectification or improvement be made where this is attractive and cost effective. Following up the advice in the report could often result in immediate improvements to the effectiveness of air conditioning systems and/or to reduction in the operating costs. In some cases the costs of providing both heating and cooling may be reduced, where it may have been identified that these two systems are unnecessarily in use at the same time due to inappropriate controls or settings.

In many buildings it will be clear that the building and systems are already well understood and well maintained, and records may be available showing that the equipment has been well commissioned and is already being regularly maintained to a good standard. In such cases the inspection will have been reduced in extent and the report will be brief with the main content advising on opportunities for load reduction or on alternative solutions that may not have been previously considered. However, in other cases the inspector may have found it necessary to suggest relatively basic maintenance such as cleaning or repairs to equipment whose efficiency has evidently suffered through neglect.

It should be noted that cleaning operations or adjustment to controls do not form part of the inspection procedure, even where they might be carried out simply and with significant immediate effect in improving efficiency. This is simply because the inspection itself is not intended, or expected, to carry out any physical work of this nature and to do so could change the level of professional risk to the inspector. Most reports are likely to contain advice between the two extremes, in that there may be a combination of simple low, or no, cost measures and measures where some investment may be required either to apply the measures, or to investigate the potential to apply measures in more detail. The manager should be aware of the available advice on the ongoing management of air conditioning systems, particularly that contained in existing free publications such as the Carbon Trust's Good Practice Guides (available from http://www.carbontrust. co.uk).

Record Keeping

This report should be kept in a safe place so that it can be used to inform subsequent inspections. An ideal location would be to keep the report together with ongoing maintenance and/or energy records in a building log book.

More recent buildings may already be provided with a building log book satisfying the provisions introduced in the 2006 amendment to Building Regulations Part L. For example, **CIBSE TM31: Building log book toolkit** provides guidance and a template for the preparation of the log book, and also on its subsequent use by the building manager. The building log book would be the most suitable place to keep records of the air conditioning inspection, together with other such inspection results. Where such a log book has not already been prepared, it would be most helpful to begin a file in which to keep and use these records.

In addition to the requirement to undertake regular inspection of air conditioning systems, the Energy Performance of Buildings Directive and, in England and Wales, the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007, also include requirements for the preparation of a building **Energy Performance Certificate** for certain building types. This is to be made available to prospective buyers or leasers of buildings, and is intended to inform them of the energy efficiency properties of the building. The Energy Performance Certificate will need to be

prepared following an inspection of the building to identify key characteristics that influence the energy efficiency. These would include the building fabric properties (walls and glazing), details of the installed heating, ventilation and cooling systems, and factors influencing the loading on heating and cooling systems such as the likely heat gain from occupants and the use of energy consuming equipment in the building. Some of this information is also needed for the air conditioning inspection, and so it would be of benefit to share information between the inspections wherever possible.

From July 2007 the 'F-Gas Regulation'(9) requires regular testing for leakage of fluorinated greenhouse gas refrigerant from some systems. Some refrigeration systems containing CFC or HCFC refrigerant may already be subject to regular leakage testing under Regulation (EC) 2037/2000 on substances that deplete the ozone layer.

Some air conditioning installations fall under the scope of the Pressure Systems Safety Regulations 2000'11', which may apply to systems with an input power in excess of 25 kW.
The information that would be helpful to keep in the building log book, or in a separate file if a formal log book is not available, includes:

- The Equipment Schedule
- A copy of the inspector's full signed report from the air conditioning inspection
- The preparatory details and report from any inspection carried out to provide the building energy performance certificate, and
- The reports of any other regular inspections (such as inspections for refrigerant leakage) involving the building's air conditioning or heating systems.
- Any future inspections can then be provided with this information easily, and the time needed to carry out future inspections can be minimised.

The scope of the inspection

Refrigeration

Refrigeration equipment and its associated heat exchange systems are checked only briefly. The inspection looks primarily for indicators of damage, or lack of maintenance, that would significantly reduce their efficiency from their 'as new' state. This is not intended to provide a high level of detail.

Effective heat rejection is necessary to maintain the efficiency of the refrigeration system. If outdoor heat rejection equipment is damaged, or its access to adequate flow of air is otherwise reduced by blockage due to dirt and debris, its effectiveness in rejecting heat is reduced and its temperature will be unnecessarily high. The consequent increased temperature at the outdoor unit increases the temperature difference that the refrigeration system has to maintain, which has the effect of reducing refrigeration efficiency and reducing the cooling capacity of the system. It may cause the refrigeration equipment to turn off and on under the action of its own high temperature or pressure cut-out, often without satisfying the building cooling load.

Similarly, effective indoor heat exchange is necessary to maintain the efficiency of the refrigeration system. If this heat exchange equipment is damaged, or its access to adequate airflow is otherwise reduced, is effectiveness in transferring heat to the refrigeration system is reduced and its temperature will be unnecessarily low. The consequent reduced temperature at the indoor unit increases the temperature

difference that the refrigeration system has to maintain, which has the effect of reducing refrigeration efficiency, and reducing the cooling capacity of the system. It may cause the refrigeration equipment to turn off and on under the action of its low temperature or pressure cut-out, often without satisfying the building cooling load.

Air movement systems

Where installed as part of the system to provide cooling, air movement systems are important factors in the inspection. The contribution that fans make to the total annual energy consumption of the combined cooling system is likely to be higher than that of the refrigeration plant itself, and there may be a greater potential for improvement.

The effectiveness of delivery of air can play a part in determining the overall efficiency of the air conditioning system. Where delivery systems are ineffective, plant that is otherwise efficient may operate for longer periods than necessary. However, the reverse may also be true, in that some delivery systems may interact unfavourably with occupants or with control sensors, leading to reduced operation and consequent lack of adequate cooling. Improving some systems, even at good efficiency, could decrease annual energy use.

Important factors to observe are the condition of, damage to, or blockage of filters and heat exchangers, and the fan type and method of control. Ventilation air delivery systems need free access to outdoor air. Where grilles, screens or pre-filters are obscured by damage or debris, additional energy will be needed to overcome the extra resistance caused by the restriction to flow, or the system may underperform in other ways due to reduced airflow rates.
Where systems provide cooled air, then admitting air from locations where the local air temperature may be higher than ambient will add to the energy required to achieve cooling to the required temperature. Such locations might include positions near busy roads, in car parks, or where exhaust air from the building could be drawn into the air inlet.

Controls

System controls are inspected in more detail. There could be considerable scope to identify inefficiency due to inappropriate control methods, incorrect control settings and poorly located sensors, and there could be much potential for improvement at low cost. Although discovered 'faults' might be as simple as time switches, or cooling or heating thermostats, being incorrectly set, the inspector would not have any authority to reset them but only to report to the manager.

An investigation of the realised effectiveness of system controls over any significant period of operation would be outside the scope of a simple inspection regime, but a series of physical observations of their layout and operation could give an indication of potential inefficiency, ineffectiveness or misuse.

It may not be possible to investigate all aspects of the layout and operation of controls, particularly in more complex systems. However, some or all of the following important issues might be accessible to a brief examination:

- the set temperatures to which the treated spaces are to be conditioned
- the time periods during which they are to be conditioned
- the appropriateness of the control zones, control sensors and their locations

the potential for cooling to be operated at the same time as heating
the method of refrigeration capacity control the method of airflow rate control.

Documentation

A number of the issues to be assessed as part of the procedure may be found by examining documentation describing the installed systems and their commissioning results. As example, the specific fan power (SFP) of air supply and exhaust systems may be calculated from details of the installed plant and commissioning flow-rates, for comparison with current guidance.

Maintenance

Evidence is sought of any existing planned maintenance schedule, or of other recent maintenance activities. Where documentation clearly shows that equipment and systems are already the subject of regular good practice checking and maintenance procedures, a number of aspects of the required inspection and provision of advice may be omitted.

Advice on improvement options

Three levels of practice are likely to be encountered when systems are inspected:

- Systems where efficiency is clearly impaired due to faults, neglect or misuse
- Systems where efficiency is likely to be lower than currently 'accepted' due to aspects of design or use
- Systems that are acceptably efficient.

Corresponding to these, there are three 'levels' at which advice might be given, for example:

(a) to advise on the rectification of faults in any system that would have impaired its efficiency from the design intent
(b) to offer improvement advice to bring existing systems broadly to a standard of 'inherent' efficiency consistent with the minimum provisions of Building Regulations Approved Document
(c) to offer best practice improvement advice to raise standards even where systems are fully compliant with the current minimum provisions of Building Regulations Approved Document

Given the need for simplicity and consistency, the approach aims to achieve a combination of aspects of (a) and (b) only. However, best practice aspects may be provided on a generalised basis by providing reference to other published guidance sources.

Good practice inspection and maintenance of air conditioning equipment

BRE and CIBSE, in common with other professional and industry bodies, recommends that air conditioning equipment be regularly inspected and maintained to good practice standards. This is considered necessary for a variety of important reasons, including;

- Maintaining healthy and comfortable conditions for building occupants

- Minimising loss of refrigerant gases that may damage the atmosphere or contribute to global warming
- Ensuring the continued safe and efficient operation of the equipment and extend its life.

To support these aims, a number of industry and professional bodies have developed guidance on good practice for the inspection and maintenance of most air conditioning equipment, and support training schemes to provide the technical skills necessary to carry out the work. Among these bodies, CIBSE, the Heating and Ventilation Contractors' Association (HVCA), the Institute of Refrigeration (IoR), the Air Conditioning and Refrigeration Industry Board (ACRIB) and the Sector Skills Council (Summit Skills) are widely recognised as setting the industry standard. The frequency with which air conditioning equipment should be inspected and maintained is another important factor. Manufacturers will normally recommend the particular intervals they consider appropriate for their own equipment, although this may sometimes be considered on the conservative side and others might recommend longer intervals.

It must be stressed that the inspection and assessment procedures described in this document provide only an initial survey of equipment designed to alert the owner or manager to the more obvious needs to maintain or modify air conditioning systems. These inspections will only be capable of identifying instances where performance is likely to have been significantly affected, based on fairly superficial inspection and observation, and are intended to fulfil the requirements of the EPB Regulations. These are not a substitute for the inspection and maintenance regimes recommended by CIBSE, industry and the professions, and considered necessary for the safe and correct operation of equipment.
Guidance on good and best practice inspection and maintenance of air conditioning equipment, and controls, has been published by the CIBSE and the HVCA. It includes both strategic advice for the building owner or operator, and specific detailed advice for the maintenance contractor.
The CIBSE's Guide to ownership, operation and maintenance of building services covers most aspects of building services maintenance both from the standpoint of the services designer and of the building owner or operator. It reviews the procurement of maintenance services and legal issues as well as providing an overview of the maintenance needs of building services systems including air conditioning systems and their controls.

The HVCA's Standard Maintenance Specification for Services in Buildings, provides advice on the maintenance of a wide range of engineering services from the standpoint of the building services engineer. It provides advice, in checklist form, indicating the specific components that should be inspected, and the recommended frequencies of inspection for each component. It is divided into equipment categories that include the whole range of air conditioning system components and controls.

Both documents are extensive, and it is not suggested that a building owner or manager should read them entirely. However, they provide useful sources of reference in planning a maintenance strategy and selecting a suitable contractor to undertake the work. They do not supplant equipment suppliers' own recommendations for inspection and maintenance, which may be more demanding and which the owner or manager may consider need to be carried out in order to preserve equipment guarantees. They

do provide a consensus view of standards that are appropriate to the safe working and efficiency of systems where manufacturer guidance may be absent.

Also relevant are BS 8210: Guide to building maintenance management, and the BSRIA AG 4/2000: Condition survey of building services. These documents address the whole range of building fabric and services equipment and include some general guidance on simpler inspections that would be carried out as part of asset and condition surveying, and maintenance planning. The guidance is aimed primarily at maintaining or reviewing the value of the building and its systems as assets, but includes aspects that could affect energy efficiency among the factors to be reviewed.

Other information supporting the operation and maintenance of building services include BSRIA publications:-

- BG 7/2004: Business focused maintenance toolkit,
- AG 24/97: Operation and maintenance audits
- AG 13/99: HVAC troubleshooting — a guide to solving indoor environmental and energy consumption problems.

It is not possible, in this document, to specify the content or frequency of good practice inspection and maintenance. Such a specification should ideally be arrived at as an individual decision for the owner or manager, based on the good practice guidance described above, additional relevant guidance that may have been provided by particular equipment suppliers, and the specific aims and needs of the organisation. However, at a minimum, the owner or manager seeking good practice maintenance of air conditioning systems may specify more simply by asking organisations to quote for maintenance to the HVCA's Standard Maintenance Specification for Services in Buildings for the relevant equipment. Organisations should also be asked to demonstrate that their personnel are suitably qualified to undertake work of that nature.

General Advice on Cooling Load Reduction and Alternative Cooling Solutions

The following is abstracted from section 5 of CIBSE TM44, by permission of the Chartered Institution of Building Services Engineers

Introduction

Detailed cost effectiveness studies are outside the scope of this inspection, but a number of opportunities may be considered worthwhile for further study by specialists. These should generally include alterations that could be made at relatively low cost, particularly those that might be considered when older equipment is due for replacement, which would allow the loading on cooling equipment to be reduced or would increase the opportunity to make use of natural ventilation, or lower energy alternatives to mechanical cooling, for at least part of the time.

Cooling load reduction

The effects of reducing cooling loads are not straightforward as there can be instances where reducing the load on plant could reduce efficiency and might also have an adverse effect on the reliability and life of the refrigeration plant. It will be more effective where equipment is inherently able to operate reliably and efficiently at reduced loading either as a result of its type and form of capacity control, or in modular systems comprising multiple compressors. The worst situation could be where cooling is provided by an older individual unit with only simple on/off control. However, there will also be instances where reducing cooling loads may allow mechanical cooling systems to be turned off altogether for longer periods of the year. Cooling loads generally are influenced by:

- solar gains through glazing
- heat gains from artificial lighting .
- heat gains from the occupants
- heat gains from IT and other equipment
- heat gains from ventilation air.

Provided the air conditioning system is considered suitable to benefit from the reduction of cooling load, then opportunities should specifically be sought in each of these areas.

Solar shading, fixed or movable

South facing glazing can make a significant, and in some cases the largest, contribution to cooling load, particularly in perimeter spaces where glazing areas exceed 40%. Internal blinds have limited effect in reducing such gains, which are better treated by the use of overhangs or external shading. Some film window treatments can be effective in reducing solar gains, although treatments that could produce a darkened indoor environment should not generally be recommended as these may also increase the use of artificial light and thus fail to reduce the cooling load.

Higher efficiency, better controlled, lighting

Older lighting systems may be relatively inefficient and may also provide higher illumination levels than are recommended in current guidance. Such systems may contribute a significant proportion of the cooling load, and could be improved relatively

easily. The appropriateness of illumination levels can be simply measured using a lux meter, and the result compared with current guidance for the particular activity in the Society for Light and Lighting's Code for lighting. The type of lamp and luminaire predominantly in use should also be identified, and the efficiency compared with the current guidance of Building Regulations Approved Document L2. Switching and lighting control arrangements should also be assessed and compared with current guidance, as there may be significant opportunities to reduce average loads through localised switching and/or occupancy or daylight level controls. Guidance is provided in CIBSE Lighting Guide LG10: Daylighting and window design.

IT equipment energy

Where IT and other equipment is relatively old, and particularly where such equipment is being considered for replacement, opportunities should be encouraged to replace with low energy equipment. Much IT equipment, such as personal computer monitors, printers and copiers, is now available with a low energy 'sleep' facility to reduce energy use, and hence heat gains, when not in use for significant periods.

Co-location and separate treatment of shared equipment

There may be opportunities to move certain heat generating equipment, such as printers and copiers, away from the general work areas into separate rooms where the heat gains may be dealt with either by the use of opening windows or by providing simple extract ventilation.
Advice for specific sectors is available free of charge in various publications from the Carbon Trust (www. carbontrust.co.uk).

Ventilation air

In considering equipment sizing, it should be noted that a consequence of providing significantly more ventilation air than necessary during hot weather would be increased loading on cooling systems (and probably increased loading on associated heating systems in cold weather).

Where cooling systems are used in spaces with access to opening windows, the building owner or manager should be aware that windows should normally be closed (although trickle vents should be open as necessary) when the cooling equipment is in use, as opening windows would have a large effect on energy use. The manager is advised to ensure that occupants are made aware of this need, or to consider installing interlocks between windows and cooling equipment in the associated spaces. However the use of open windows in Spring and Autumn, when weather conditions are favourable, and where the heating/cooling system can be turned off, can be a good way to save on energy costs.

Alternative cooling techniques

Free cooling

Larger, centralised, systems using a cooling tower or dry air cooler may be suitable for conversion to employ free cooling techniques for some proportion of the time. In mid-season conditions, such as in spring and autumn, air temperatures may be sufficiently low that heat may be rejected from the chilled water circuit to atmosphere, through the

cooling tower or dry air cooler, without operating mechanical cooling plant. One method involves the introduction of an intermediary heat exchanger to the chilled water circuit, transferring heat to a separate water circuit which rejects heat through the cooling tower or dry air cooler. Guidance on the potential use of such free cooling techniques is provided in chapter 4 of CIBSE Guide B(18). Further information and guidance is also available in BSRIA BG 8/2004: Free cooling systems.

Absorption cooling with CHP

Where buildings are provided with combined heat and power systems to generate electricity and to service winter heating loads, and where 'waste heat' temperatures are suitable, there may be opportunities to employ absorption cycle refrigeration systems. These make use of the heat generated by the CHP plant in summer, when there is little or no heat demand, to provide cooling. This would offset the use of electric vapour compression refrigeration systems and may increase the proportion of the year where the CHP might usefully be operated. Guidance on the potential to use absorption cooling in CHP applications is provided in chapter 4 of CIBSE Guide B.

Efficient cooling and heating units

Some central cooling plant and many of the currently available unitary and packaged split and multi-split equipment can operate to provide cooling and, in heat pump mode, heating. For unitary and packaged units the likely efficiency of the installed units in comparison with that achievable using similar new equipment that meets the current standards for inclusion in the Energy Technology List (ETL) should be considered when planning possible replacement. Products included in the ETL meet specific efficiency standards in both cooling and heating modes, and can result in considerable running cost savings.

Packaged chillers that offer both cooling and (heat pump mode) heating must also meet specific efficiency standards in both cooling and heating modes for inclusion on the ETL.
Such equipment may represent an attractive option when units are being considered for replacement, and where the heating function may be more efficient that the method currently used.

Further information and support

AUDITAC is the acronym for an EU-funded project 'Field Benchmarking and Market Development for Audit Methods in Air Conditioning' which has studied air conditioning inspections. The core aims of the AUDITAC project are to provide tools and information that will enable air conditioning system inspectors, auditors, owners and operators across Europe confidently to identify actions that will save them money, and reduce greenhouse gas emissions.
The AUDITAC project has produced a 'Customer Advising Tool' which allows the basic effects of thermal mass and plan depth to be assessed. It also allows the input of window and fabric U-values, solar heat gain coefficient, infiltration rate and internal gains. This tool can be downloaded free of charge from the AUDITAC website (www.cardiff.ac.uk/archi/research/auditac/index.html).