BSRIA

APPLICATION GUIDE AG 3/89.3

Commissioning Air Systems

Application procedures for buildings

By Chris Parsloe

ACKNOWLEGEMENTS

BSRIA would like to thank the following sponsors for their contribution which, led to the production of the first edition of the Application Guide, *Commissioning of air systems in buildings*.

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The project was undertaken under the guidance of an industry steering group. BSRIA would like to thank the following organisations and individuals for their help and guidance:

P Harvey	N Sweeting
R Clark	D Coleman
D Russell	L J Wild
C Izzard	K Beck
C Tatlock	J Carruthers
R Pelling	C Breddy
H Buchanan	D Stradwick
K Jones	D Jenkins
S Leach	R Wilkins

This third edition of the guide has been produced by BSRIA as part of a contract placed by the Department of Trade and Industry. The contract was let under the collaborative research programme, Partners in Innovation. Any views expressed in this publication are not necessarily those of the DTI.

©BSRIA 78310 November 2001 ISBN 0 86022 591 7 Printed by The Chameleon Press Ltd.

PREFACE

Now into its third edition, this guide covers the four major aspects of the commissioning process: design, installation, commissioning and documentation. These four areas are bound by the guidance given on the management of the process. The principal objective of commissioning management is to ensure that the division of responsibility at the interfaces of design with installation, and of installation with commissioning, is clearly understood and made explicit in the appropriate terms of engagement and conditions of contract.

How well systems are commissioned depends greatly on the designer. The designer's perception and understanding of the design requirements of commissionable systems, together with resourcefulness in helping to ensure that the total process is correctly managed, is of paramount importance. Creating an environment for good management will enable the installer and commissioning specialists to contribute fully in achieving the designer's objective.

For all but the simplest projects, designers and installers will benefit from the involvement of a commissioning specialist at an early stage. Engaged as soon as possible and given the appropriate authority and responsibility, the commissioning specialist can give assurance to clients that air systems will operate satisfactorily.

The commissioning process does not include setting up the system to prove that the environmental performance criteria can be achieved. Seasonal climatic variations make it difficult, and in some cases impossible, for specified conditions to be simulated at the time of commissioning. Designers may specify criteria for system proving at particular modes of operation, but this is separate from the commissioning process and is not dealt with in this manual nor in the BSRIA Application Guide, AG 2/89.3: *Commissioning water systems*.

This manual is intended to be used in conjunction with the CIBSE's *Commissioning Code A: Air distribution systems*[1].

Procedures for commissioning variable air volume air conditioning systems are discussed in BSRIA Application Guide, AG 1/91: *Commissioning of VAV systems in buildings*[2].

CONTENTS

FIGURES AND TABLES

TABLES

Commissioning	The advancement of an installation from the stage of static completion to working to specified requirements.
Commissioning specialist	The firm or person appointed to carry out specified duties in connection with commissioning the engineering services.
Designer	The firm or person appointed to design the heating ventilating and air conditioning systems.
Commissioning specification	The document that prescribes in detail the requirements with which the commissioning service has to comply. (Specification must refer to drawings, schedules and the relevant parts of codes, manuals, guides and other standards.)
Commissionable systems	Systems designed, installed and prepared to specified requirements in such a manner as to enable commissioning to be carried out.
System	A heating, ventilation or air conditioning concept of equipment, distribution ducts, pipes and terminals, associated or independent, forming a complex unit.
Installation	A system placed in position.
Environmental performance criteria	The specified, numerically quantifiable, characteristics and tolerances of an internal environment to be achieved by the heating ventilating and air conditioning system.
Design criteria	Those measurements and quantities selected as the basis for the design of a system.
Testing	The measurement and recording of specified quantifiable characteristics of an installation or parts thereof. (This includes off site-testing.)
Pressure and leakage testing	The measurement and recording of pressure retention, and fluid losses or gains in the plant, equipment, distribution ways and terminals.
Static completion	The state of the system, installed in accordance with the specification, clean and ready for setting to work.
Pre-commissioning checks	Specified systematic checking of a completed installation to establish its suitability for commissioning.
Setting to work	The process of setting a static system into motion.
Regulation	The process of adjusting the rates of fluid flow in a distribution system to achieve specified values.
Environmental testing	Measurement and recording of internal environmental conditions.
System proving	Measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values.
Fine tuning	The adjustment of a system where usage and system proving has shown such need. This may include the re-assessment of design values and control set points to achieve the required system performance.

PART A: THE DESIGN OF COMMISSIONABLE SYSTEMS

A1 INTRODUCTION

A1.1 MANAGEMENT

As soon as possible, and no later than upon entering the scheme design stage, the designer should address the strategy for commissioning the scheme and the level of commissioning expertise required. The designer should address the following questions.

- Does the designer require external commissioning expertise in support of the design role required?
- Will the services sub-contractor have the capability in-house to carry out commissioning?
- Will the services sub-contractor have commissioning expertise available during the installation?

In consideration of these aspects, the designer will advise if a commissioning specialist is required and when the appointment should be made.

The degree to which the designer influences decisions on these matters and advises the project management team will greatly affect the commissionability of the installed systems.

A1.2 COMMISSIONING INFORMATION

To enable an air distribution system to be successfully commissioned the designer must provide adequate information, documented in the form of drawings, schedules and specifications. The technical requirements of the commissioning works should be developed by the designer to define clearly:

1. The scope of the works, ie the systems to be commissioned, their functions and duration of operation, and an explanation of their operational inter-relationship with other engineering services systems.

2. The setting out of the responsibilities of the various parties (client, design team, main or managing contractor, installation contractor and commissioning specialist). BSRIA Technical Memorandum, TM 1/88: *Commissioning HVAC systems – Division of responsibilities* [3] and Technical Note, TN 21/97: *The allocation of design responsibilities for building engineering services – A code of conduct to avoid conflict*[4], give useful guidance.

3. The technical specification of the commissioning work. For example:

   - the standards (eg relevant parts of CIBSE codes and BSRIA manuals) to which the works should be carried out
   - the tolerances for regulation and test results
   - the reporting procedures required
   - the witnessing procedures to be observed.

4. Design drawings showing the layout of the system in relation to the building form and, if required, other engineering services.

5. Schematic diagrams clearly illustrating the design intent and including all the design information required to commission the system. For example:

Volumetric flow rates	Fans Terminals Branches Sub-branches
Design total pressure	Throughout the system: Main ducts Branch ducts Sub-branches Behind terminals
Total pressure loss	Filters Heating and cooling batteries Air washers Silencers Regulating dampers
Sizes	Duct cross-sectional areas Gross cross-sectional area of grilles
Locations	Dampers In-duct measuring positions
Identification	Number all terminals Number all branch and sub-branch ducts

Figure 1 summarises the requirements for schematic drawings. An example information check list is given in Part D.

The reference identification should be unique to each individual component to permit cross referencing and to enable a component to be identified in correspondence and telephone discussions.

If the schematics are prepared at the same time as the design drawings, potential difficulties in regulation may often be revealed and rectified prior to installation.

6. Schedules of major plant, equipment and components, cross-referenced to the design drawings and schematic diagrams.

7. Additional design information required for commissioning, which may not be available until after the appointment of the building services installer, and which may include:

   - electrical wiring diagrams of associated plant and equipment
   - control system diagrams
   - fan performance curves.

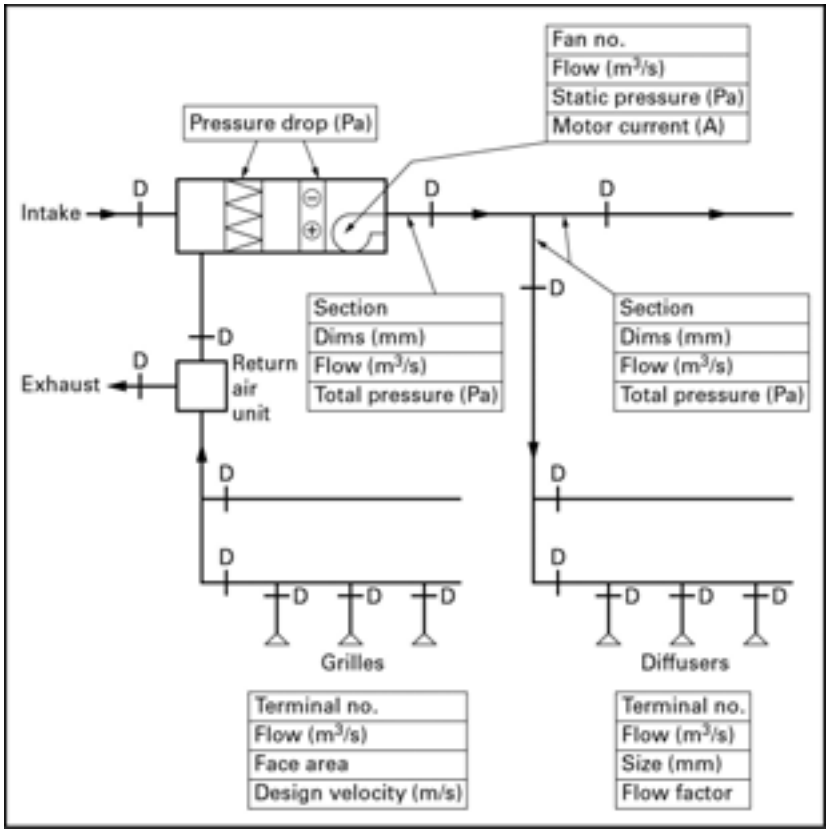

Figure 1: Basic schematics for system regulation showing damper positions.

The specification of management requirements must be related to specific contractual conditions. Although the designer will strongly influence whether the commissioning specialist is to be employed by the main, managing or installing contractor, it is the last who will specify:

- forms of contract
- programme constraints
- resource levels
- method statements
- quality assurance procedures
- insurance requirements
- site establishment details
- compliance with site safety and industrial relations protocol
- bonds, warranties and guarantees.

The different sources of project information required to fully specify commissioning should not, however, preclude the early appointment of a commissioning specialist. The specialist could be appointed on a consultant basis during the design phase, converting to a contractor later.

C2 SITE TEST INSTRUMENTS

The site test instruments outlined in this guide are available from:

BSRIA Instrument Solutions
Old Bracknell Lane West
Bracknell Berkshire
RG12 7AH UK

Tel: 01344 459314
Fax: 01344 714868
Web: www.bis.fm
E-mail: sales@bis.fm

A great deal of time can be wasted by using the wrong kind of instrument or by trying to manage with too few instruments. In this section guidance is given on the suitability of instruments for commissioning.

Although manufacturers' detailed instructions must always be observed, the following instructions will generally apply to all instruments used to commission air systems:

- Select an instrument which has an operating range greater than the maximum expected reading (if the approximate value of a particular reading is unknown, the selected instrument should be set initially to its maximum range).
- Read the operating instructions before using the instrument.
- Visually inspect the instrument to see that it is undamaged.
- Check that the instrument has a calibration certificate which is not more than 12 months old.
- Record the reading on the relevant pro forma together with the range setting and the information which may be needed to correct or interpret the results.

C2.1 ROTATIONAL SPEED MEASUREMENT

Mechanical tachometers are generally used to measure rotational speeds where the shaft of the fan or motor is accessible. Provision should be made for the insertion of the tachometer spindle through an access aperture in the guard, as measurements must never be made on an unguarded drive.

Where it is not possible to use a mechanical tachometer, indirect methods using instruments such as the optical tachometer or stroboscope can be employed.

Mechanical tachometer

There are two basic types of mechanical tachometer; one gives a direct reading of speed (rev/min) and the other reads the number of revolutions.

1. AIR DISTRIBUTION SYSTEM – DESIGN INFORMATION CHECKLIST			BSRIA
Client:			
Project:			
System:			
Check that the design documentation includes:		✓/×	Comments / Follow-up references
System information			
1. Description of system operation			1.
2. Drawing showing air distribution system layout			2.
3. Numbering system for all main ducts and terminals			3.
4. Location of dampers and flow measuring positions			4.
5. Fan characteristic curves for each fan duty			5.
6. Controls schematic and description of operation			6.
Schematic drawings incorporating:			
7. Volumetric flow rates and cross sectional areas at:	* supply fan		7.
8.	* extract fan		8.
9.	* air handling units		9.
10.	* main ducts		10.
11.	* branch ducts		11.
12.	* sub-branches		12.
13.	* terminals		13.
14. Static pressure loss:	* filters		14.
15.	* cooling batteries		15.
16.	* heating batteries		16.
17.	* air washers		17.
18.	* silencers		18.
Wiring diagrams covering			
19. System			19.
20. Method of operation			20.
21. Fans			21.
22. Controls			22.
23. Interlock arrangements			23.
24. Fuse ratings			24.
25. Design times for staged starting and motor run up control			25.
26. Voltages for electrostatic filters			26.
27. Design times for staged starting and motor run up control			27.
28. Design values for reduced voltage starting or speed control			28.
Filters			
29. * Identity of filter media			29.
30. * Tolerances on air velocity distribution across electrostatic filters			30.
Fans			
31. * Clearances for fan impeller			31.
32. Static deflection at vibration mountings			32.
33. Grade of lubricant for fan and fan motor bearings			33.
Date: / /	Engineer:	Approved by:	Sheet: /

* These items will sometimes be the installer's responsibility

2. AIR DISTRIBUTION SYSTEM – CONTINUOUS INSPECTION CHECKLIST		BSRIA
Client:		
Project:		
System:	Dampers	

Reference	**Type**	**Correct size and type** **Date**	**Freedom of movement** **Date**	**Signed**

Date: / /	Engineer:	Approved by:	Sheet: /