

1 AIR CONDITIONING

Air Conditioning & Heat Pumps

M O D U L E

► 1.0 OBJECTIVES

In this Module, you will learn how **air conditioning** and **heat pump systems** work, and how to identify the common energy sources and heat transfer media used in central air conditioning. We'll talk about the common system configurations. You will learn how to determine the age and capacity of the cooling system, and how to approximate the adequacy of the system.

*Not The
Last Word*

It is not our goal to turn you into a technician or service person. You will not be able to troubleshoot or repair air conditioning and heat pump systems based on what you will learn in this Module. There are many places to go to learn more about air conditioning and heat pumps and we encourage you to continue to expand your knowledge.

By the time you have finished the Module, you will be able to spot the common performance-related problems with systems and their components. You will be able to follow a testing procedure for central air conditioning and heat pump systems.

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STUDY SESSION 1

1. The first Study Session outlines the Scope of air conditioning inspections as set out in the ASHI® Standards of Practice.

Note: **ASHI**® stands for the American Society of Home Inspectors.

This Session also includes some comments on the Standards and a discussion of the basic principles of central air conditioning.

2. Please read the Cooling/Heat Pumps chapter of **The Home Reference Book** before starting this session.
3. At the end of the Study Session you should be able to –
 - name the two basic components of the air conditioning system that have to be inspected to meet the Standards
 - name the two areas that have to be included in your report
 - list three things that are not required in an air conditioning inspection according to the Standards
 - describe what happens to Freon in an evaporator coil
 - describe what happens to Freon in a condenser coil
 - outline the approximate temperatures of the refrigerant in various parts of the air conditioning system
 - define in one sentence each the function of the compressor, condenser, evaporator and expansion device

- define in one sentence **sensible heat**
 - define in one sentence **latent heat**
 - define the **latent heat of vaporization** in one sentence
 - describe in two sentences how air conditioners dehumidify
 - describe the relative temperature of the suction and liquid lines on an operating air conditioning system
 - list two types of air conditioners other than air-cooled
4. This Study Session may take you roughly one hour.
5. Quick Quiz 1 is included at the end of this Session. Answers may be written in your book.

Key Words:

- **Air conditioning**
- **Refrigerant**
- **Condenser coil**
- **Evaporator coil**
- **Compressor**
- **Expansion device**
- **Sensible heat**
- **Latent heat**
- **Latent heat of vaporization**
- **Dehumidification**
- **Condensate collection**
- **Evaporator fan**
- **Condenser fan**
- **Suction line**
- **Liquid line**
- **Water-cooled systems**
- **Ground-cooled systems**
- **Evaporative coolers**
- **Whole-house fans**

► 2.0 SCOPE AND INTRODUCTION

2.1 SCOPE

THE ASHI® STANDARDS OF PRACTICE

The following are excerpted from the ASHI® Standards of Practice effective January 1, 2000.

2. PURPOSE AND SCOPE

2.1 The purpose of these Standards of Practice is to establish a minimum and uniform standard for private, fee-paid home *inspectors* who are members of the American Society of Home Inspectors. *Home Inspections* performed to these Standards of Practice are intended to provide the client with information regarding the condition of the *systems* and *components* of the home as inspected at the time of the *Home Inspection*.

2.2 The *inspector* shall:

A. *inspect*:

1. *readily accessible systems* and components of homes listed in these Standards of Practice.
2. *installed systems* and *components* of homes listed in these Standards of Practice.

B. *report*:

1. on those *systems* and *components* inspected which, in the professional opinion of the *inspector*, are *significantly deficient* or are near the end of their service lives.
2. a reason why, if not self-evident, the *system* or *component* is *significantly deficient* or near the end of its service life.
3. the *inspector's* recommendations to correct or monitor the reported deficiency.
4. on any *systems* and *components* designated for inspection in these Standards of Practice which were present at the time of the *Home Inspection* but were not inspected and a reason they were not inspected.

2.3 These Standards of Practice are not intended to limit *inspectors* from:

- A. including other inspection services, *systems* or *components* in addition to those required by these Standards of Practice.
- B. specifying repairs, provided the *inspector* is appropriately qualified and willing to do so.
- C. excluding *systems* and *components* from the inspection if requested by the client.

9. AIR CONDITIONING SYSTEMS

9.1 The *inspector* shall:

- A. *inspect* the *installed* central and through-wall cooling equipment.
- B. *describe*:
 1. the energy source
 2. the cooling method by its distinguishing characteristics.

9.2 The *inspector* is NOT required to:

- A. *inspect* electronic air filters.
- B. determine cooling supply adequacy or distribution balance.

13. GENERAL LIMITATIONS AND EXCLUSIONS

13.1 General limitations:

- A. Inspections performed in accordance with these Standards of Practice
 1. are not *technically* exhaustive.
 2. will not identify concealed conditions or latent defects.
- B. These Standards of Practice are applicable to buildings with four or fewer dwelling units and their garages or carports.

13.2 General exclusions:

- A. The *inspector* is not required to perform any action or make any determination unless specifically stated in these Standards of Practice, except as may be required by lawful authority.
- B. *Inspectors* are NOT required to determine:
 1. the condition of *systems* or *components* which are not *readily accessible*.
 2. the remaining life of any *system* or *component*.
 3. the strength, adequacy, effectiveness, or efficiency of any *system* or *component*.
 4. the causes of any condition or deficiency.
 5. the methods, materials, or costs of corrections.
 6. future conditions including, but not limited to, failure of *systems* and *components*.
 7. the suitability of the property for any specialized use.
 8. compliance with regulatory requirements (codes, regulations, laws, ordinances, etc.).
 9. the market value of the property or its marketability.
 10. the advisability of the purchase of the property.
 11. the presence of potentially hazardous plants or animals including, but not limited to wood destroying organisms or diseases harmful to humans.
 12. the presence of any environmental hazards including, but not limited to toxins, carcinogens, noise, and contaminants in soil, water and air.
 13. the effectiveness of any *system installed* or methods utilized to control or remove suspected hazardous substances.
 14. the operating costs of *systems* or *components*.

15. the acoustical properties of any *system* or *component*.
- C.** *Inspectors* are NOT required to offer:
1. or perform any act or service contrary to law.
 2. or perform *engineering* services.
 3. or perform work in any trade or any professional service other than *home inspection*.
 4. warranties or guarantees of any kind.
- D.** *Inspectors* are NOT required to operate:
1. any *system* or *component* which is *shut down* or otherwise inoperable.
 2. any *system* or *component* which does not respond to *normal* operating controls.
 3. shut-off valves.
- E.** *Inspectors* are NOT required to enter:
1. any area which will, in the opinion of the *inspector*, likely be dangerous to the *inspector* or other persons or damage the property or its *systems* or *components*.
 2. The *under-floor crawl spaces* or attics which are not *readily accessible*.
- F.** *Inspectors* are NOT required to *inspect*:
1. underground items including, but not limited to underground storage tanks or other underground indications of their presence, whether abandoned or active.
 2. *systems* or *components* which are not installed.
 3. *decorative* items
 4. *systems* or *components* located in areas that are not entered in accordance with these Standards of Practice.
 5. detached structures other than garages and carports.
 6. common elements or common areas in multi-unit housing, such as condominium properties or cooperative housing.
- G.** *Inspectors* are NOT required to:
1. perform any procedure or operation which will, in the opinion of the *inspector*, likely be dangerous to the *inspector* or other persons or damage the property or its *systems* or *components*.
 2. move suspended ceiling tiles, personal property, furniture, equipment, plants, soil, snow, ice, or debris.
 3. *dismantle* any *system* or *component*, except as explicitly required by these Standards of Practice.

GLOSSARY OF ITALICIZED TERMS*Alarm Systems*

Warning devices, installed or free-standing, including but not limited to; carbon monoxide detectors, flue gas and other spillage detectors, security equipment, ejector pumps and smoke alarms

Architectural Service

Any practice involving the art and science of building design for construction of any structure or grouping of structures and the use of space within and surrounding the structures or the design for construction, including but not specifically limited to, schematic design, design development, preparation of construction contract documents, and administration of the construction contract

Automatic Safety Controls

Devices designed and installed to protect *systems* and *components* from unsafe conditions

Component

A part of a *system*

Decorative

Ornamental; not required for the operation of the essential *systems* and *components* of a home

Describe

To *report* a *system* or *component* by its type or other observed, significant characteristics to distinguish it from other *systems* or *components*

Dismantle

To take apart or remove any component, device or piece of equipment that would not be taken apart or removed by a homeowner in the course of normal and routine homeowner maintenance

Engineering Service

Any professional service or creative work requiring engineering education, training, and experience and the application of special knowledge of the mathematical, physical and engineering sciences to such professional service or creative work as consultation, investigation, evaluation, planning, design and supervision of construction for the purpose of assuring compliance with the specifications and design, in conjunction with structures, buildings, machines, equipment, works or processes

Further Evaluation

Examination and analysis by a qualified professional, tradesman or service technician beyond that provided by the home inspection

Home Inspection

The process by which an *inspector* visually examines the *readily accessible systems* and *components* of a home and which *describes* those *systems* and *components* in accordance with these Standards of Practice

Household Appliances

Kitchen, laundry, and similar appliances, whether *installed* or free-standing

Inspect

To examine *readily accessible systems* and *components* of a building in accordance with these Standards of Practice, using *normal operating controls* and opening *readily openable access panels*

Inspector

A person hired to examine any *system* or *component* of a building in accordance with these Standards of Practice

Installed

Attached such that removal requires tools

Normal Operating Controls

Devices such as thermostats, switches or valves intended to be operated by the homeowner

Readily Accessible

Available for visual inspection without requiring moving of personal property, dismantling, destructive measures, or any action which will likely involve risk to persons or property

Readily Openable Access Panel

A panel provided for homeowner inspection and maintenance that is within normal reach, can be removed by one person, and is not sealed in place

Recreational Facilities

Spas, saunas, steam baths, swimming pools, exercise, entertainment, athletic, playground or other similar equipment and associated accessories

Report

To communicate in writing

Representative Number

One *component* per room for multiple similar interior *components* such as windows and electric outlets; one *component* on each side of the building for multiple similar exterior *components*

Roof Drainage Systems

Components used to carry water off a roof and away from a building

Significantly Deficient

Unsafe or not functioning

Shut Down

A state in which a *system* or *component* cannot be operated by *normal operating controls*

Solid Fuel Burning Appliances

A hearth and fire chamber or similar prepared place in which a fire may be built and which is built in conjunction with a chimney; or a listed assembly of a fire chamber, its chimney and related factory-made parts designed for unit assembly without requiring field construction

Structural Component

A *component* that supports non-variable forces or weights (dead loads) and variable forces or weights (live loads)

System

A combination of interacting or interdependent *components*, assembled to carry out one or more functions

Technically Exhaustive

An investigation that involves dismantling, the extensive use of advanced techniques, measurements, instruments, testing, calculations, or other means

Under-floor Crawl Space

The area within the confines of the foundation and between the ground and the underside of the floor

Unsafe

A condition in a *readily accessible, installed system or component* which is judged to be a significant risk of personal injury during normal, day-to-day use. The risk may be due to damage, deterioration, improper installation or a change in accepted residential construction standards

Wiring Methods

Identification of electrical conductors or wires by their general type, such as “non-metallic sheathed cable” (“Romex”), “armored cable” (“bx”) or “knob and tube”, etc.

► NOTES ON THE STANDARDS

Inspect

The Standards are clear on the meaning of **inspect**. When we inspect we have to look at and test the components listed in the Standards. We look at them if they are **readily accessible** or if we can get at them through **readily openable access panels**. These are panels designed for the homeowner to remove. They are within normal reach, can be removed by one person, and are not sealed in place.

<i>Testing</i>	We test components and systems by using their normal operating controls , but not the safety controls. We turn thermostats up or down, open and close doors and windows, turn light switches and water faucets on and off, flush toilets, etc. We do not test heating systems on high limit switches, test pressure relief valves on water heaters and boilers, overload electrical circuits to trip breakers, etc.
<i>Systems Shut Down</i>	We do not start up systems that are shut down. If the furnace pilot is off, we don't light it. If the electricity, water or gas is shut off in the home, we don't turn it on. If the disconnect for the air conditioner is off, we don't turn it on.
<i>Deficiencies</i>	We have to report on systems that are significantly deficient . This means they are unsafe or not performing their intended function.
<i>End Of Life</i>	We are required to report on any system or component that in our professional opinion is near the end of its service life . This is tricky since we don't know whether inspectors will be held accountable for failed components on the basis that we should have known the component was near the end of its life. With the wisdom of hindsight, it may be hard to argue that the component could not have been expected to fail, when in fact, it did. Time will tell. The situation is also tricky because it includes not only systems but individual components as well. For many systems there are broadly accepted life expectancy ranges, but these aren't available for some individual components.
<i>Remaining Life</i>	We are not required to determine the remaining life of systems or components. This is related to, but different than, the end of service life issue. If the item is new or in the middle part of its life, we don't have to predict service life, even though the same broadly accepted life expectancy ranges would apply. It's only when the item is near the end, in your opinion, that you have to report it.
<i>Reporting Implications</i>	We have to tell people in writing the implications of conditions or problems unless they are self-evident. A cracked heat exchanger on a furnace has a very different implication for a homeowner than a cracked windowpane, for example.
<i>Tell Client What To Do</i>	We have to tell the client in the report what to do about any conditions we found. We might recommend they repair, replace, service or clean the component. We might advise them to have a specialist further investigate the condition. It's all right to tell the client to monitor a situation, but you can't tell them that their roof shingles are curled and leave it at that.
<i>What We Left Out</i>	We have to report anything that we would usually inspect but didn't. We also have to include in our report why we didn't inspect it. The reasons may be that the component was inaccessible, unsafe to inspect or was shut down. It may also be that the occupant or the client asked you not to inspect it.
<i>Installed Systems Only</i>	The Standards tell us that we have to observe installed air conditioning systems. We do not have to inspect portable air conditioners including window-type systems.
<i>Controls</i>	We have to look at the normal operating controls, which are the thermostat and electrical disconnect.