Energy Efficiency & Capacity Building

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Mechanism of AC by demonstration
Mechanism of cooling/heating

Refrigerant is circulating between indoor unit and outdoor unit with phase change.

Indoor Unit | Connecting Pipes | Outdoor Unit
---|---|---
Heat exchanger (Evaporator) | | Heat exchanger (Condenser)
Gas | Refrigerant flow | Gas
Liquid | | Liquid
Low Pressure | | High Pressure
Expansion Valve / Capillary tube | Compressor
Typical troubles with AC

- No cooling/ No heating
- Noisy Operation
- Difficult to Operate
- Water Leakage
- Earth leakage
- Delay of Installation

Installation & Maintenance qualities are deeply related to AC performance
Important 4 Stages for AC usage

Manufacturing of AC products

R&D and Quality Control

Application Design

Optimal selection of Products and layout

Installation

Installation Quality

Field Maintenance

Preventing Maintenance & Trouble shooting
What is Energy Efficiency?
Case of Electric Bicycle

Different Conditions
Speed, wind, slope, Temperature, Weight and so on
Gross efficiency and Net Efficiency of AC

We should focus on “Net Efficiency”

4 Stages in Industrial side

1. Factory
   - Gross Efficiency
2. Application
3. Installation
4. Maintenance

Energy Loss

Total Efficiency drop

100%

Usage stage

Operation

Energy Efficiency

Gross Efficiency

Net Efficiency

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Reality of AC units in the field is,
Which unit is more efficient?

Good Installation & Maintenance

Poor Installation & Maintenance
Typical Energy Loss
Dusty filters & Heat Exchangers
Typical Energy Loss

No room for Air flow
Typical Energy Loss

Corrosion
Typical Energy Loss

Small animals inside

Spider web
Snake
Pigeon

Mouse biting hose, cable and Insulating material
[REF] Good Practices for Cleaning

Cleaning DIY

Automatic Cleaning

Anti corrosion treatment

Professional Cleaning Service

Indoor Cleaning Services

Outdoor Cleaning Services
Sample Data of Energy Loss
Power Consumption Increase due to poor Maintenance

Power Consumption simulation for heating mode

- Power Consumption without regular maintenance during 4 years
- Average Power Consumption without maintenance
- Power Consumption with regular maintenance

Initial Power Consumption

1st year 2nd year 3rd year 4th year

SOURCE : JRAIA
Product Life Time Degradation due to poor maintenance

- **Initial Level**
- **Function Performance**
- **Use Limit**
- **Start operation**
- **Repair & replace**
- **Preventive maintenance**
- **Periodic maintenance**
- **Repair**
- **corrective maintenance**

**Passed Years**

**SOURCE:** JRAIA
Application Design
What is Application design?

Selection of adequate capacity & type of ACs and optimal layout of each units

✓ Maximum comfort
✓ Maximum Energy Performance
✓ Maximum Cost Performance
✓ Easy Operation
✓ Easy installation
✓ Easy maintenance

Case of general household
Examples of system design

General office
- ✓ Maximum comfort
- ✓ Maximum Energy Performance
- ✓ Maximum Cost Performance

Complex office
- ✓ Easy Operation
- ✓ Easy installation
- ✓ Easy maintenance

Factory

Medium Size Office Building
Over capacity Issue

Which uses less energy?

Bigger capacity

Adequate capacity
[REF] Partial Load Characteristic of Inverter AC

Oversized systems will operate relatively more in the degradation area and even in the compressor cycling area, resulting in a low seasonal efficiency.

Figure: Estimation of the cooling efficiency of VRF system at different part-load conditions (SOURCE: Final report of Task 4 Lot 6–Air Conditioning products July 2012).
[REF] Good Practices during usage

Sensor ON/OFF Control

Stop

Restart

Thermal Area Sensor

Additional Air Circulator or cooling fan

Peak cut Control

Energy Consumption

Time

Remote Control
Installation Quality
Basic precautions for AC unit installation

Basic precautions for AC unit installation should be followed to exert maximum performance of AC unit.

**Outdoor unit**
- Select the location should be robust and stable, where outdoor unit installed.
- Shut away material flammable or corrosive.
- Avoid strong wind or heavy rain around unit.
- Keep enough space for installation.
- Take proper care for nuisance by the noise or blowing air from the unit.
- Ambient temperature should be within allowable limit.

**Foundation**
- Select the location should be robust and stable, where outdoor unit installed.
- vibration insulation work should be applied if surrounding environment is sensitive to vibration.
- Apply additional mount if wet location.

**Indoor unit**
- Ceiling or wall should have adequate strength for weight of indoor unit.
- Ceiling or wall should be horizontal or vertical adequately.
- Enough space for servicing.
- Indoor unit should be installed horizontal adequately.
- Enough Space for Drain should be kept.
- Noise or blowing air from the unit.
- Ambient temperature should be within allowable limit.

**Remote control Unit**
- Keep the ambient temperature within the limit around remote control unit.

**Piping work**
- Pipe route should be decided to minimize the pipe length, bending points and bending radius.
- Liquid pipe and vapor pipe should be thermally isolated respectively.
- Suitable location should be selected for drain water release.
AC subsystems and their impacts when installed

<table>
<thead>
<tr>
<th>Sub system</th>
<th>Global Warming</th>
<th>Energy Efficiency</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td>–</td>
<td>–</td>
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<tr>
<td>Electrical</td>
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<tr>
<td>Refrigerant</td>
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</tbody>
</table>

- **Mechanical**
  - Little
  - Not heavy
  - Serious

- **Electrical**
  - Little
  - Little
  - Serious

- **Refrigerant**
  - Not heavy
  - Serious
  - Serious

- **Poor Leveling**
- **Air flow circulation**
- **Direct sunlight**
- **Small Service Space**
- **Unstable Base**
- **multi-outlet extension cord**
- **Poor treatment Of Power Cable**
- **Fire Accident**
- **Earth Leakage**
- **Poor Flare Processing**
- **Poor pipe thermal insulation**
- **Diesel Expansion due to oxygen mixing**

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Real installation sites are tough !!!

[REF] Good Practices for Safe Installation

Various Safety Devices should be applied

http://www.smile-sup.com/gyoumuaircon.html
http://blog-ropeworkatheight.com/what-is-ropework-at-height/
https://kyoueigroup.hp-ez.com/page38
https://www.quattro-hp.jp/cont12/58.html

http://www.hikaridk.com/?p=8116
Many manuals & textbooks provided for field service technologies
Field Service requires,

No patent

No chemical plant

No R&D

No Assembly Factory

No license

Only some tools, Manuals, Mater Trainers and Certification
Daikin’s Contribution
Training Center in A5s ～Location and Capacity

Result of 2017
26 training centers
14 Languages
30,140 service engineers
“Better Field Service” is the lowest hanging fruit

Energy efficiency Tree

New Technology

Inverter Technology

New refrigerant

Better Field Service

“Better Field Service” can save Energy and Money!!
We, Daikin, contribute to capacity building and encourage the set up of qualification/certification schemes for installers in A5s.
Thank you very much for your attention