

CHAPTER I

PREFACE

1.1 Background

The condition of the earth is getting warmer temperature, forcing people to seek various ways to avoid the warm air. Similarly, when driving car, people often felt the warm in the cabin. It makes people try to create the conditions for comfortable and fresh air on his way. Today, lifestyle where people are starting to grow forward, driving comfort becomes a very important requirement. One of solutions to these problems are use a refrigeration system. Work from refrigeration systems, refrigerants require that serves as a heat carrier, which absorbs heat at low temperature and release heat at high temperatures.

More and more found an environmentally friendly refrigerant and a variety of research areas of refrigeration, the refrigeration system applications is growing rapidly and including a variety of sectors. Various types of refrigeration can be found in everyday life, such as vehicles, household appliances, agricultural, industrial gas, petrochemical, oil and so forth.

Air conditioning (A/C) is one of the important applications in refrigeration technology. This technology could result in 2 things are needed in air conditioning and the cooling and heating. Air conditioning works as a cooling referred to as air conditioning, while the heater is called the heat pump.

In terms of driving, the presence of A/C provides two important functions for the user of the vehicle. On the warm day, air conditioning to maintain cabin temperature and humidity in a comfortable condition. Then while the rain condition to keep the windshield surface temperature below dew point, thus preventing formation of dew on the inside of the windshield.

In tropical areas like Indonesia, the summer is happening much longer than in rainy season. Ambient temperature in summer is high, so air conditioning systems in vehicles are needed in different situations.

Therefore, knowledge about the design of air conditioning is very important to be studied in particular by engineering students at university.

1.2 Kinds of Air Conditioning Machine

By type, air conditioning machine can be divided into 3 types that are much known to the public, namely:

1. Refrigerator

One use of the refrigerator is for household needed, which serves to preserve some foods and beverages. Cooling level can be adjusted as needed.

2. Freezer

Freezer is not so far different with refrigerator, only a higher cooling capacity with lower temperature works to makes ice cube.

3. Air Conditioning

Air conditioning is a machine used to become cool air in the room. For the car cabin is closed, offices, bedrooms and so forth.

1.3 Air Conditioning Application of Suzuki APV (GC 415)

Technological developments in the sector of refrigeration led to the idea, so in the car cabin feels cool and comfort. That is why people try to install air conditioning in cars. By using air conditioning, passengers will find comfort. Suzuki APV also paired A/C which has 2 types, namely, single and double blower. Suzuki APV GX, SGX and Luxurious variants have double blower air conditioning.

The air conditioning system of Suzuki APV uses refrigerant HFC-134a (R-134a). Therefore, R-134a does not have destructive nature of the ozone layer. Refrigerant is a heat exchanger medium, it is compound that circulate on air conditioning system which produce cooling effect. None of refrigerant, compressor oil and component parts are interchangeable between two types of A/C was using refrigerant CFC-12 (R-12) and the other using refrigerant HFC-134a (R-134a). Use of incorrect part will result in leakage of refrigerant, damage in parts or other faulty condition. Because, works pressure in the system is different.

1.4 Air Conditioning Work

Air conditioning works to remove unwanted warm temperature from one place to another. To implement the refrigerant flows through a closed system. We can watch what happens in the refrigeration cycle in the figure below.

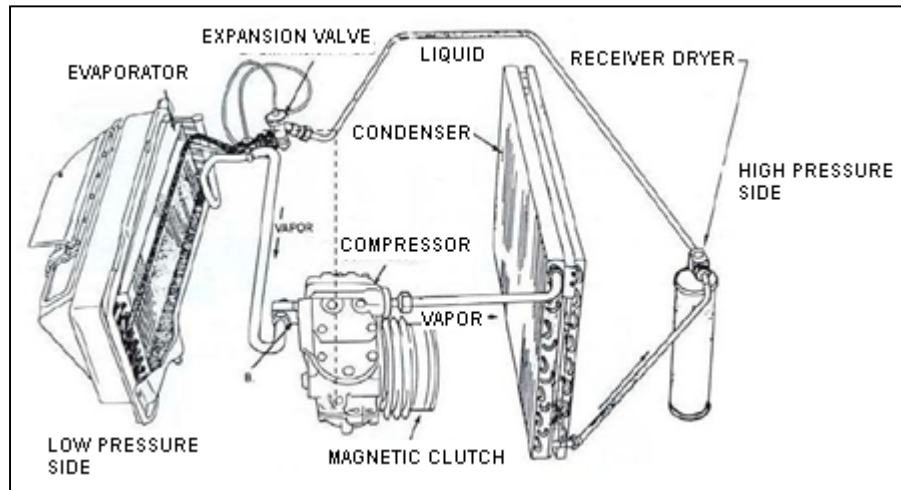


Figure 1.1 Car Air Conditioning System (Source: Basic A/C)

There are 2 different pressure sides which are marked by the hidden line, namely the low pressure side where the evaporator is placed and the high pressure side where the condenser is located. Both sides are separated by 2 pressurized components, control component (expansion valve) which serve to limit the amount of refrigerant flow and reduce pressure and temperature of the refrigerant. Compressor serves to compress the refrigerant gas and raise the temperature of condensation.

Consider it from the control component moving refrigerant around the cycle begins. This control component can be either the expansion valve or capillary tube. Control component (expansion valve) is to limit the high-pressure liquid refrigerant and high temperature into the evaporator. The liquid refrigerant that flows along evaporator, taking the heat from the room where it is evaporator placed while gradually changing into a gas phase. Refrigerant gas has low temperature and low pressure is sucked into the compressor. In the compressor, the gas was compressed into high pressure gas, and then

pressed into the condenser. Condenser serves to remove the heat contained gas and surrounding air will take the heat. Refrigerant gas in the condenser has a higher temperature than the surrounding air temperature. Therefore, heat transfer can occur.

During the process in the condenser, after the heat of refrigerant is removed then it will turn into a liquid phase, high temperature and high pressure. Furthermore, the refrigerant is flowing through the receiver dryer is to be filtered, cleaned of dirt or other substances content and are temporarily saved before entering the expansion valve and evaporator. In the expansion valve, refrigerant is forced to flow through a small hole, so the temperature and the pressure to be down again in accordance with conditions acceptable to the evaporator. The reason is, after passing a small hole and then flows into a large hole in the evaporator, the refrigerant that is easy to evaporate in the form of spray. Air Conditioning system requires major component evaporator, condenser, compressor and expansion valve and junctions in the form of pipes with different diameter. Pipe is what makes it a closed system. Connecting pipes between the evaporator with the compressor called the suction line, between the compressor and condenser is called discharge line, between the condenser and expansion valve is called the liquid line.

1.5 Refrigerant Most Used

Suzuki APV is using refrigerant R-134a (HFC-134a) to support the air conditioning system. R-134a is the most widely used refrigerant for car air conditioning. R-134a has a boiling point -21.6°F (-29.8°C) at an atmospheric

pressure. Vapor pressure at 11.8 psig 5°F (15°C) and 93.3 psig condensing pressure at 86°F (30°C). Latent heat of vapor is 71.74 Btu/lb at the boiling point. R-134a refrigerant is very safe, not corrosive, non-toxic, environmental friendly, non-flammable or combustible gas or liquid form, also when mixed with air. R-134a is no color, even transparent, no smell and no taste at concentrations below 20% of the volume. R-134a is not harmful to plants and animals and does not affect the smell, taste or color of the water or food that are saved in the refrigerator.

R-134a will remain stable at low working temperature, and at high working temperature, no reaction and is not corrosive to metal that is widely used in refrigeration and air conditioning systems, such as: aluminum, copper, brass, zinc, tin and others. When refrigerant mixed with water at high temperatures can be corrosive because of the halogen acid formed. If we use the system with R-134a, not until there is water left in the system.

The advantages of R-134a can be mixed with lubricating oil under all circumstances, not only facilitates lubricating oil drain back into the compressor, but also can increase the efficiency and capacity of the system. Evaporator and condenser will be free of lubricants that can reduce heat transfer capabilities of these two components. When R-134a mixed with the fire that burnt can form a highly toxic gas. Leaks can be identified by halide detector, electronic detector, soapy water and others. Refrigerant made by several countries from several companies using the trade name (brand) their own. Some of them that have been soling in Indonesia are:

Table 1.1 Some Trademark of Refrigerant

Name	Company	Country
Freon	E.I. du Pont de Nemours & Company	U.S.A
Genetron	Allied Chemical Corporation	U.S.A
Frigen	Hoechst AG	German
Arcton	Imperial Chemical Industries Ltd.	England
Asahi Fron	Asahi Glass Co., Ltd.	Japan
Forane	Pacific Chemical Industries Pty.	Australia
Daifon	Osaka Kinzoku Kogyo Co., Ltd.	Japan
Ucon	Union Carbide Chemicals Corporation	U.S.A
Isotron	Pennsylvania Salt Manufacturing Co.	U.S.A

Refrigerant is stored in a container or cylinder. To know the contents, the containers were given a variety of colors, labels and captions on refrigerant containers. Color refrigerant containers from “Du Pont” are as follows:

Table 1.2 Refrigerant Container Colors of “Du Pont” Brand

Refrigerant	Container Color
Freon 11	Orange
Freon 12	White
Freon 22	Green
Freon 113	Purple
Freon 114	Dark Blue
Freon 134a	Light Blue
Freon 500	Yellow
Freon 502	Orchid



Figure 1.2 Refrigerant Containers

1.6 Objectives

Analyzing about air conditioning system of Suzuki APV (GC 415) is used central cooling system of vapor compression type. This analysis discusses the calculation of cooling load to determine of refrigeration capacity and heat transfers analysis of air conditioning units supporting components.

1.7 Scope Area

Scope Area of this final project contains:

1. Suzuki APV air conditioning unit uses the refrigerant HFC-134a (R-134a).
2. Analyzing of refrigeration capacity is used to Suzuki APV air conditioning system.
3. Analyzing Coefficient of Performance (COP) and heat transfers through main components include: condenser, evaporator, compressor, and expansion valve.

1.8 Methodology

In carrying out this air conditioning design, done by several methods, namely:

1. Observation methods: by observing, analyzing and searching the data directly in the subject.
2. Literature methods: to obtain the basic of theory using equations or formulas from an existing reference.
3. Internet searching: to search the data components of air conditioning this can be accessed by internet.
4. Interview method: to obtain information and data by asking directly to the related resource.

1.9 Systematic Writing

This final project consists of several chapters. In broad outline of each chapter contain the following:

Chapter I PREFACE

This chapter contains background, types of air conditioning machine, air conditioning application of Suzuki APV, objective, scoop area, methodology and systematic writing.

Chapter II REFRIGERATION THEORY

This chapter contains basic parameters in refrigeration system include heat, pressure, temperature, humidity and basic theory from thermodynamics and heat transfers.

Chapter III CALCULATION ANALYSIS

This chapter describes the cooling load analysis for Suzuki APV includes total sensible and latent heat load from heat transfers of body into the cabin to determine refrigeration capacity.

Chapter IV MAIN COMPONENT ANALYSIS

Analyzing about heat transfers of evaporator, compressor, condenser, and expansion valve, include calculation of each component and efficiency of refrigeration system.

Chapter V CONCLUSION

This chapter contains the conclusions and suggestions.