

Improvised Freon Extractor as an Innovative Trainer

Tranquilino J. Lucas

Nueva Ecija University of Science and Technology, Gen. Tinio St., Quezon District,
Cabanatuan City, Nueva Ecija, 3100 Philippines

Corresponding author's email: tranquilinolucas0606@gmail.com

Abstract. The decade of the 1990's has been a challenging time for the Heating, Ventilation, Air Conditioning, and Refrigeration (HVAC&R) industry worldwide. Due to its vital role in the destruction of the stratospheric ozone layer, provisions of the Montreal Protocol and its various amendments required the complete phase-out of chlorine-containing refrigerant such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). Appliances such as window type air-conditioners, motor vehicle air-conditioners, and refrigerators, rely on ozone depleting refrigerants and their substitutes. In this case, the regulation of the Environmental Protection Agency (EPA) which prohibits the venting of refrigerants compounds to the atmosphere must be followed. Along this line of concern, educational institutions need to be aware of this technological gap specifically in developing programs in Heating, Ventilation, Air-conditioning and Refrigeration for environmental protection against incorrect disposal of refrigerant. The aim of this study was to develop an Improvised Freon Extractor as an Innovative Trainer to help students and instructors in the Bachelor of Industrial Technology and

Bachelor of Science in Mechanical Engineering courses in their effective teaching-learning of lessons in Refrigeration and Air-conditioning subjects. The results of the study revealed that the developed innovative trainer contains the following parts: electrical parts – includes the dual capacitor, banana plug, compressor, fan motor, air swing motor, air swing motor switch, thermostat switch, and selector switch; nonelectrical parts – frame housing, frame cover, suction and discharge valve, caster wheels, filter receiver drier assembly and condenser. The Improvised Freon Extractor as an Innovative Trainer was also found to be suitable to serve as an alternative learning material that assists the learning of Refrigeration and Air-conditioning subjects in the Bachelor of Industrial Technology and Bachelor of Science in Mechanical Engineering courses

Keywords: Design, Development, Electrical, Improvised Freon Extractor as an Innovative Trainer,

1. Introduction

The decade of the 1990's has been a challenging time for the Heating, Ventilation, Air Conditioning, and Refrigeration (HVAC&R) industry worldwide. Due to its vital role in the destruction of the stratospheric ozone layer, provisions of the Montreal Protocol and its various amendments required the complete phase-out of chlorine-containing refrigerant such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). These latter compounds have been used extensively as refrigerants in heat pumps, air conditioners and refrigeration systems (Ebisu and Torikoshi, 1998). CFCs, which are characterized by a high ozone-depletion potential (ODP), underwent a complete production phase-out in the United States in 1995. Because HCFC-22 (chlorodifluoromethane) has been readily available, inexpensive, and less harmful to the environment than CFCs, HCFC-22 has been widely used in the air-conditioning and heat pump industry, especially in residential unitary and central air-conditioning systems. In the United States, regulations published by the Environmental Protection Agency (EPA) prohibit the production of HCFC-22 after 2010 except for servicing equipment produced prior to 2010.

Appliances such as window type air-conditioners, motor vehicle air-conditioners, and refrigerators, rely on ozone depleting refrigerants and their substitutes. In this case, the regulation of the Environmental Protection Agency (EPA) which prohibits the venting of refrigerants compounds to the atmosphere must be followed. Today, recovery machines are strictly available at the EPA agencies which are under the regulation of the Department of Environment and Natural Resources. Local manufacturers of refrigerators and air-conditioners including small-scale repair shops are obliged to have such recovery machines before issuing license to operate business.

Availability of training models in learning progressions supports curricular training, and assessment design. In order to support the development of integrated understanding, relevant instructional materials are needed to be developed to emphasize not only the learning of individual topics, but also the connections between ideas and across ideas and disciplines. TESDA also proposed that as the Philippines tries to keep up with the technological development in the industrialized nations, the Philippine government must provide directions, policies, programs and standards towards quality technical education and skills development.

The key factor in meeting the demands of the present-day situation is resourcefulness and ingenuity of the vocational-technical instructors in resorting to improvisation through the use of cheap, recycled and locally available materials (Donato, 2012).

Along this line of concern, educational institutions need to be aware of this technological gap specifically in developing programs in Heating, Ventilation, Air-conditioning and

Refrigeration for environmental protection against incorrect disposal of refrigerant.

It is for the above reasons that the researcher attempted to design and develop Freon Extractor to help students and instructors in the Bachelor of Industrial Technology and Bachelor of Science in Mechanical Engineering courses. It aims not only to make students become oriented to the harmful effects of improper disposal of refrigerants in the atmosphere, but most importantly to use the developed innovative Freon extractor trainer in refrigerator and air-conditioning unit during the teaching-learning of lessons in Heating, Ventilation, Air-conditioning and Refrigeration subject.

2. Methodology

The developmental method of research was used, since this method was found most suited for this study which is directed at producing new materials, products and/or devices (Aquino, 1992). This method is also considered as a systematic study of planning, developing, and evaluating instructional programs, processes and products that must meet the criteria of consistency and effectiveness (Richey, 1994). The most common types of developmental research involve situations in which the product development is analyzed and described, and the final product is evaluated.

3. Results and Discussion

Plan and construction of the Improvised Freon Extractor as Innovative Trainer in terms of its:

3.1.1 Electrical Parts

Table 1 shows the nine electrical parts of the Freon Extractor Trainer, as follows: panel board, dual capacitor, banana plug, motor compressor, fan motor, air swing motor, air swing motor switch, thermostat switch, and the selector switch.

Table 1 Electrical Parts of the Freon Extractor Trainer

Qty	Unit	Materials	Unit Price	Amount
1	piece	Angle bar, 1/8" x 1" x 20'	300.00	300.00
1	piece	Flat bar, 1/8" x 1" x 20'	200.00	200.00
50	pieces	Blind rivet, 1/8" x 1/4"	0.50	25.00
1	piece	Plane Sheet, GI, 40" x 48"	150.00	150.00
1	piece	Dual Capacitor, 35x7mfd, 470V	450.00	450.00
3	pieces	Discharge and Suction Valve	85.00	170.00
1	piece	Panel Board, 20" x 24"	600.00	600.00
10	meters	Electric Wires, #14 AWG, stranded	15.00	150.00
2	meters	Copper Tube	55.00	110.00
15	pieces	Banana Female Plug	7.00	105.00
30	pieces	Banana Male Plug	7.00	210.00
1/4	kilos	Welding Rod, 1/8", Fuji	46.25	46.25
2	pieces	Silver Rod	20.00	40.00
1	set	Motor Compressor 2hp.	2,200.00	2,200.00
1	set	Fan Motor	900.00	900.00
4	pieces	Caster Wheels	30.00	120.00
3	pieces	Filter Strainers	150.00	450.00
1	set	Thermostat switch	350.00	350.00
1	set	Air swing motor	150.00	150.00
1	piece	Air swing motor switch	25.00	25.00
1	piece	Selector switch	400.00	400.00
1	roll	Teflon tape	20.00	20.00
16	pieces	bolt	1.50	24.00
1/4	litre	Paint, QDE	40.00	40.00
		TOTAL COST	6,751.25	

Panel Board

Figure 3 shows the plan for the panel board. It measures 17 1/2 inches in length and 12 1/2 inches in width. Its purpose is to cover the top portion of the trainer and hold all the electrical terminals of all components. Likewise, the panel board holds the following electrical parts: 24 plugs, thermostat switch, air swing motor switch, and selector switch.

Table 2
Materials, Tools and Equipment Used in Constructing the Panel Board

Unit	Qty	Specification of Materials, Tools and Equipment
1	piece	Fiber glass, 17 ½” x 12 ½”
1	piece	Steel tape measure
1	piece	L-square
1	unit	Portable electric drill
1	unit	Drill press
1	unit	Soldering iron, 36 watts
1	piece	Long nose pliers
1	piece	Riveter
1	piece	Philip screw driver
1	set	Box wrench

Design Phase

In this phase of the development, several diagrams were constructed to visualize the logical designs and conceptual frameworks of the Improved Freon Extractor as Innovative Trainer. In this stage of development, the researcher made a mobile trainer that could suit the needs of the students.

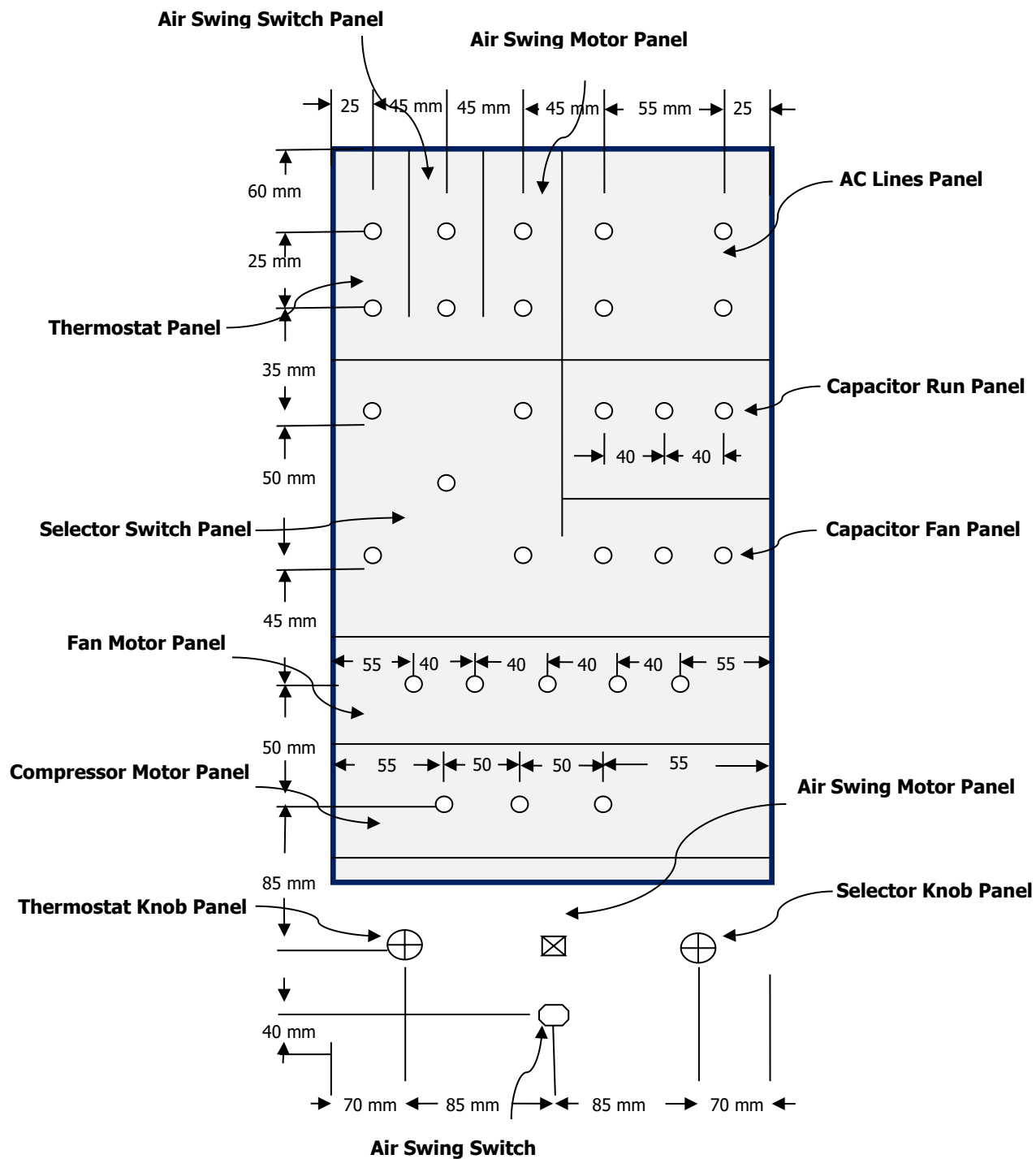


figure 3
Plan of the Panel Board

3.1.1. Development Phase

Steps in Constructing the Panel Board:

1. Prepare the panel board's drawing plan to serve as guide for its construction.
2. Prepare the necessary materials, tools and equipment as enumerated below:
3. Measure the required dimension of the fiber glass ($\frac{1}{4}$ " x $12 \frac{1}{2}$ " x $17 \frac{1}{2}$ ") by using steel tape meter and L-square. Refer to the working drawing/plan to mark all the places where all the parts will be placed.
4. Make necessary holes on the fiber glass using portable electric drill.
5. Refer to the working drawing to attach plugs, thermostat, swing switch, selector switch and air swing motor using soldering iron, long nose, riveter, and Philip screw driver.



The Finished "Improved Freon Extractor as an Innovative Trainer

4. Conclusions

The following are the conclusions of the study:

- 1.The developed innovative trainer contains the following parts: electrical parts – includes the dual capacitor, banana plug, compressor, fan motor, air swing motor, air swing motor switch, thermostat switch, and selector switch; nonelectrical parts – frame housing, frame cover, suction and discharge valve, caster wheels, filter receiver drier assembly and condenser.
2. The faculty and student respondents gave high assessment ratings on the trainer’s plan, functionality and safety provisions.
3. Based on the ratings on functionality and safety provisions of the innovative trainer, the faculty and student respondents have recognized that the innovative trainer passes the standards of a good instructional training device and hence, beneficial to the target users – the students of College of Industrial Technology and Department of Mechanical Engineering.

Acknowledgements

The researchers would like to acknowledge Prof. Marcelo B. Bulalayao, our dean at the College of Industrial Technology and Prof. Billie Jack Pasion, CIT Research, Extension and Training coordinator, for the moral support, guidance, accommodation, and assistance all throughout the completion of this study.

References

- Althouse, Andrew D. et.al., 1996, “Modern Refrigeration and Air-conditioning”
- Angeles, M.(2013). Development and Validation of K12 Aligned Activity Book in Grade 7 Mathematics. Doctoral Dissertation. EARIST. Sta Mesa, Manila, Philippines.
- Bernard, Grob, 1996 “Basic Electronics, 7th Edition.
- Boiser, Diosdada Castillon et. Al, 2000 “Strategies for Teaching a Modular Approach”, Rex Bookstore Inc.
- Cabangun, Joy Job,1994, “Refrigeration and Air-conditioning: Basic and Troubleshooting Guide”.
- Calderon, Jose F. 2000,“Foundation of Education”, Manila: Rex Bookstore
- Corpuz, Brenda B., Ph.D. and Lucido, Paz I, Ph.D. 2008 “Educational Technology 1”, Published by Lorimar Publishing Inc
- Corpuz, Brenda B., Ph.D. and Salandanan, Gloria G. Ph.D. Copyright 2007, “Principles of Teaching 1”, , Lorimar Publishing Inc

- Dela Cruz, Rodrigo et.al, 2000"Technology and Home Economics III", Instructional Material Corporation,DepEd, Printed in the Philippines by Raquel Commercial Press
- Donato, J. (2012) "Trainer" Master's Thesis. Unpublished. Nueva Ecija University of Science and Technology
- Dr. Ritika Malik, Dr. Aarushi Kataria and Dr. Naveen Nandal, Analysis of Digital Wallets for Sustainability: A Comparative Analysis between Retailers and Customers, International Journal of Management, 11(7), 2020, pp. 358–370.
- Garupa, Melchor A. Copyright 2003," Window Air-con Specialist Book 14", Published by M and L Licudine Enterprises, 152 Teotisto St. Michael Village Talon II, Las Piñas, Metro Manila
- Garupa, Melchor A. Copyright 2005," Window Air-con Specialist Book 15", published by M and L Licudine Enterprises, 152 Teotisto St. Michael Village Talon II, Las Piñas, Metro Manila.
- Giesecke, Frederick et.al., 2001, "Technical Drawing, 10th Edition", Pearson Education Asia Pacific Ltd.
- Java, S., Rao, T. P., & Rao, G. P. (1985). Simultaneous determination of lead and thallium by potentiometric stripping. *Talanta*, 32(11), 1061–1063.
- Kumar, S. (2022). A quest for sustainium (sustainability Premium): review of sustainable bonds. *Academy of Accounting and Financial Studies Journal*, Vol. 26, no.2, pp. 1–18
- Macaso, J. (2017) "Electronic Low Voltage Power Supply Trainer" Master's Thesis. Unpublished. Nueva Ecija University of Science and Technology
- McHale C.R. (2015) "Education is not preparation for life – University of Canterbury" Accessed March 17, 2021 from https://ir.canterbury.ac.nz/bitstream/handle/10092/11354/thesis_full_text.pdf;sequence=1
- Opinion Research, 5(3), 250–265.
- Ornstein, Allan C. Philippine Copyright 2000 Revised Edition, "Strategies for Effective Teaching", pages 319–322, Harper Collins Publishers Inc.
- Ornstein, P. A., & Coffman, J. L. (2020). Toward an Understanding of the Development of Skilled Remembering: The Role of Teachers' Instructional Language. *Current Directions in Psychological Science*, 29(5), 445–452. <https://doi.org/10.1177/0963721420925543>
- P.Maungmeesri, K. Kantananon, B. Maungmeesri, D. Maneetham, (2022). The Innovation for Smart Patient Screening Platform via IoT System International

Journal of Engineering Trends and Technology, 70(2), 192–200.

Palaleo, J. J. P., & Srikrajang, J. (2018). English Anxiety among Thai Nursing Students of Boromarajonani College of Nursing, Nakhon Lampang, Thailand. Asian Journal for Public

Salandanan, Gloria G., Ph.D, 2000, "Teaching Approaches and Startegies", Katha Publishing Inc.

Salandanan, Gloria G., Ph.D, 2009 Revised Edition,"Methods of Teaching" ,Published by Lorimar Publishing Inc.