9

Department of Education
National Capital Region
SCHOOLS DIVISION OFFICE
MARIKINA CITY

TLE-Industrial Arts

Electrical Installation and Maintenance

First Quarter-Module 1 Part 2
Rigid Nonmetallic Conduit

Writers: Jeramil G. Moreno (SST I, PHS)
Rogerson J. Pulido (SST II, MNHS)

Cover Illustrator: Christopher E. Mercado

Paano iniiwasan ng ating pamilya ang COVID-19?

MGA PAALALA UPANG MAIWASAN ANG COVID-19

HiNDi PA TAPOS ANG LABAN SA COViD-19:
MGA PAALALA LABAN SA FAMiLY CLUSTER iNFECTiON

Iwasan ang hawaan sa pamilya, gawing ligtas ang tahanan. TANDAAN:

MARIKINA COVID-19 CALL CENTER

SWAB TEST

What I Know

Choose the letter of the best answer. Write your answers on the space provided before the number.

1. Which of the following is the most convenient tool used for bending RNC as it is specifically made for bending PVC pipe?

a. Heat gun b. Heat box c. Blow torch d. Electric stove

2. How can we facilitate faster cooling and hardening of the RNC?
a. putting the soften pipe in front of electric fan. C. let it cool by itself
b. wiping it with damp cloth d. none of the above

3. Which of the following is made to suit the need for installing the conduit system?
a. PVC bend c. Stretch bend
b. Field bend d. Rigid nonmetallic conduit

4. Which of the following can be a result of acute (short-term) exposure to high levels of vinyl chloride in air?
a. liver damage b. cancer c. headache d. infertility

5. What could be the reason for having bend defects such as burn, kinks or groove or reduced diameter in RNC when bending?
a. improper bending techniques c. wrong size of the PVC pipe
b. fluctuation on the power source of heat gun d. All of the above

Lesson 2 Preparing Rigid Nonmetallic Conduit Bends

One of the wiring methods approved by the Philippine Electrical Code is the Rigid Nonmetallic Conduit. In this lesson, you will learn how to prepare and properly bend RNC.

What's In

The previous lesson discussed the provisions on the installation of RNC. To review the lesson, answer the following questions below.

Write true if the statement is correct and false if it is not. Write your answers on the space provided before the number.

_____1. RNC means Rigid Nonmetallic Conduit.
_____2. RNC can be used to support lighting fixtures such as pendant lights.
_____3. Trimming inside and outside the conduit must be done after cutting conduit.
_____4. An integral coupling called hub is necessary when joining PVC conduit.
_____5. RNC shall not be used in underground installation.

What's New

Identify the pictures of tools below and describe its functions on the box across. These tools are necessary in preparing conduit bends.

	1.
	2.
	3.
	4.

	5.

What Is It

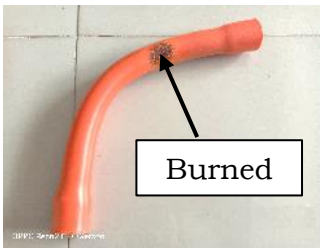
Preparing Rigid Nonmetallic Conduit Bends

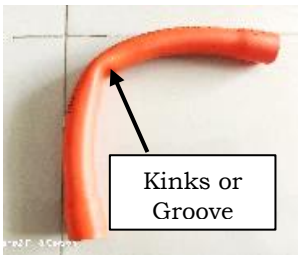
One of the skills that a future electrical practitioner must possess is to bend rigid nonmetallic conduit since it is one of the most used types of wiring method in the field. Though there are other options that can be used like the flexible nonmetallic conduit, a flexible and cheaper type of conduit, we cannot avoid the use of PVC pipe.

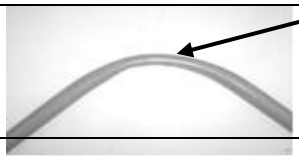
In preparing a non-metallic rigid conduit for installation, an electrician needs to do cutting, heating and bending. Like in metallic rigid conduit offset bends, 90° angle bends and other bends are also made in RNC.

In preparing for the RNC bend, there are things that we should consider. The source of heat is very vital; a heat box is the most convenient tool since it is specifically made for bending RNC but a heat gun is the usual tool used for bending. If an electricity source is not yet available on the site, blow torches or even fire from the stove can be sources of heat.

The bends made on site are called field bends. It is made to suit the need for installing the system. During the process of making field bend, improper bending techniques may cause bend defects. The following are the common bend defects:







The diameter of the conduit is greatly reduced

Health Consideration

Most vinyl chloride is used to make polyvinyl chloride (PVC) plastic and vinyl products. Acute (short-term) exposure to high levels of vinyl chloride in air has resulted in central nervous system effects (CNS), such as dizziness, drowsiness, and headaches in humans. Chronic (long-term) exposure to vinyl chloride through inhalation and oral exposure in humans has resulted in liver damage. Cancer is a

major concern from exposure to vinyl chloride via inhalation, as vinyl chloride exposure has been shown to increase the risk of a rare form of liver cancer in humans. The U.S. Environmental Protection Agency (EPA) has classified vinyl chloride as a Group A, human carcinogen. (Vinyl Chloride. N.d.)

Bending Rigid Non-metallic Conduit

When bending RNC/PVC do not forget to consider the minimum radius of bend as discussed in the previous lesson. As you remember a conduit with 20mm diameter must have at least 115mm radius of bend. Following this radius will help in easier pulling of wires during the installation.

The types of RNC bend such as elbow, offset bend, and saddle bend will be very useful during the installation. Proper preparation of RNC bend will eliminate the resistance of inserting-pulling of wires.

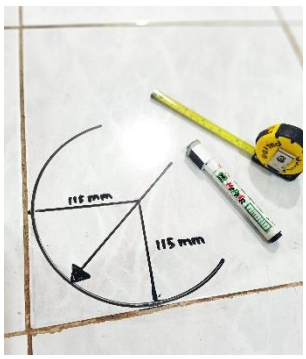
Procedure in Preparing a 90° Bend

The following steps should be followed to make a 90° Bend without bend defects.

1. Wear appropriate PPE. Wear your hand gloves, mask and if possible, your goggles. Wearing these PPE will ensure your safety at all times.

2. Prepare all the necessary tools, equipment and materials for the job.

3. Draw a right angle on the floor using a try square or L-square. This will serve as your guide when bending your conduit to 90° angle. Bisect the angle and draw an arc with a 115 mm radius (115 mm is the minimum radius for a 20mm PVC Conduit)



Radius is a straight line from the center of a circle or sphere to any point on the outer edge. Another option as a guide is using any 90-degree angle available in your surroundings. Best example is the edge of a tile.

An experienced electrician may not use this guide, but for beginners, this guide will be very helpful.

4. Determine and mark the center of the bend at approximately 6 inches from the center mark to both ends of it.

Remember this.

Extra precaution should be applied when using a heat gun. Hot tools when accidentally contacted your skin may cause serious burn. Be mindful with the power

cord, it should also not touch the hot surface of the heat gun as it may burn the insulation and cause electric shock.

5. Apply heat to soften the marked part. Rotate the conduit while swaying the heat gun to apply heat evenly.

Remember this...

Safety is our priority. Do not forget to cover your nose and mouth with a mask when applying heat to the RNC. The fume generated by the heated conduit, if inhaled, is dangerous to health.

6. When the marked portion is already softened evenly, lay the conduit on the floor with one-foot stepping on one end of it.

7. Using one hand, hold the other end of the conduit and make a 90° bend. Use the other hand to wipe the conduit. If the elbow flattens, push the flatten area with a damp cloth until the desired shape is attained.

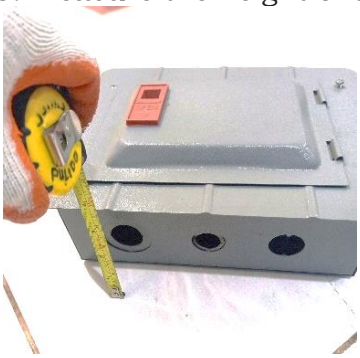
8. Wipe the conduit entirely with a damp cloth to facilitate faster cooling.

9. Check the finished work and do the necessary housekeeping.

Procedure in Preparing an Off-set Bend

To prepare an off-set bend, the steps below should be followed. The off-set bend that will be discussed is intended for the panel box.

1. Wear appropriate PPE. Wear your hand gloves, mask and if possible, your goggles. Wearing these PPE will always ensure your safety.
2. Prepare all the necessary tools and materials.
3. Measure the height of the box's knockout.



4. Draw the height of elevation on the floor. This will serve as your guide as you bend the conduit pipe.

5. Measure and mark at least 5 inches from the end of the conduit. Note: This

measurement is intended for the panel box. If you are going to make an offset bend intended for smaller boxes, the measurement can be at least 2 inches

6. From the first mark, measure, and mark 6 inches. Note: This measurement is intended for the panel box. If you are going to make an offset bend intended for smaller boxes or obstacles, the measurement can be shorter depending on the height of the box's knockout or height of the obstacle. For smaller boxes, 3 inches will do.

Remember this...

Extra precaution should be applied when using a heat gun. Hot tools when accidentally contacted your skin may cause serious burns. Be mindful with the power cord, it should also not touch the hot surface of the heat gun as it may burn the insulation and cause electric shock.

7. If the conduit is already softened evenly, turn off the heat gun and lay down the pipe on the guide drawn on the floor. Pull both ends on the opposite side while following your guide as shown below.

8. If the desired shape is formed, put one of your feet on one side and wipe the conduit with a damp cloth applying pressure on top of it if ever it flattens.
9. Check the finished work. The offset must be like the picture on the right. Do the necessary housekeeping.

What's More

Rearrange the steps in making 90-degree elbow and off-set bend. Write 1-9 for the corresponding steps on the space provided before the number. Answer this activity with honesty.

A. Procedure in Preparing a 90° Bend

_____1. Check the finished work and do the necessary housekeeping.
_____2. Wear appropriate PPE. Wearing these PPE will always ensure your safety.
_____3. Apply heat to soften the marked part.
_____4. Prepare all the necessary tools, equipment, and materials for the job.
_____5. Draw a guide on making a 90-degree bend on the floor.
_____6. When the marked portion is already softened evenly, lay the conduit on the floor with one foot stepping on one end of it.
_____7. Determine and mark the center of the bend at approximately 6 inches from the center mark to both ends of it.
_____8. Using one hand, hold the other end of the conduit and make a 90° bend. Use the other hand to wipe the conduit. If the elbow flattens, push the flatten area with a damp cloth until the desired shape is attained.

_____9. To facilitate faster cooling, wipe the conduit with a damp cloth.

B. Procedure in Preparing an Off-set Bend intended for a utility box

_____1. If the desired shape is formed, put one of your feet on one side and wipe the conduit with a damp cloth applying pressure on top of it if ever it flattens.
_____2. Wear appropriate PPE. Wear your hand gloves, mask and if possible, your goggles. Wearing these PPE will always ensure your safety.
_____3. Prepare all the necessary tools and materials.
_____4. If the conduit is already softened evenly, turn off the heat gun and lay down the pipe on the guide drawn on the floor. Pull both ends on the opposite side while following your guide as shown below.
_____5. Measure the height of the box's knockout.
_____6. Draw a guide of off-set bend on the floor.
_____7. From the first mark, measure, and mark 3 inches.
_____8. Check the finished work. Do the necessary housekeeping.
_____9. Measure and mark at least 2 inches from the end of the conduit.

What I Have Learned

Fill in the blanks with the correct word/s to complete the paragraphs. Write your answers on the space provided after the number.

In preparing a rigid nonmetallic conduit for installation, an electrician needs to do (1) _____, (2) _____and (3) _____. Like in metallic rigid conduit offset bends, 90^{o} angle bends and other bends are also made on RNC.

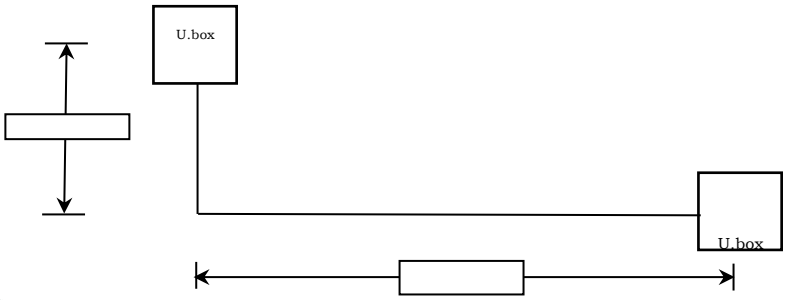
The source of heat is very vital, (4) _____is the most convenient tool since it is specifically made for bending PVC but (5) _____is the usual tool used for bending. If an electricity source is not yet available on the site, (6) _____or even fire from the stove can be sources of heat.

During the process of bending, do not forget to cover your nose and mouth with (7) _____when applying heat to the RNC. The fume generated by the heated conduit, if inhaled, is dangerous to (8) _____.

What I Can Do

OFFLINE ACTIVITY

If you are going to bend a 90-degree elbow and an off-set bend intended for a panel box following the dimensions given by your teacher, list down the steps you are going to do. Write your answer on the space provided.



A. Procedure in Preparing a 90° Bend

1. _____
_____
2. _____
_____
3. _____
_____
4. _____
_____
5. _____
_____
6. _____
_____
7. _____
_____
8. _____
_____
9. _____
_____

B. Procedure in Preparing an Off-set Bend intended for a panel box.

1. _____
_____
2. _____
_____
3. _____
_____
4. _____
_____
5. _____
_____
6. _____
_____
7. _____
_____
8. _____
_____
9. _____
_____

ONLINE ACTIVITY

Create a PowerPoint presentation. Showing the steps on how to bend a rigid non-metallic conduit. Choose whether you will discuss the procedure in bending a 90-degree bend or an off-set bend. Your output will be graded based on the following criteria.

Assessment Criteria Checklist

Put a check mark on the description that best describes their output.

Criteria	Excellent (5)	Good (4)	Needs some Improvement (3)	Needs Much Improvement (2)	Not Applicable (1)
1. Creativity Design, color, and style of the presentation					
2. Originality Created an original presentation					
3. Content The content is appropriate on the chosen topic					
4. Timebound The output is submitted within the given time					
				TOTAL	

Assessment

Write **CORRECT** if the statement is true about RNC and **INCORRECT** if it is not. Write your answers on the space provided before the number.

_____1. Wiping the softened PVC pipe with a damp cloth will facilitate faster cooling and hardening.
_____2. 115 mm should be the minimum radius of elbow with 20mm diameter RNC.
_____3. Burning pipes made from PVC does not have any effect on our health.
_____4. We should wear gas masks to avoid the inhalation of fumes coming from the heated RNC.
_____5. Rotating the conduit while swaying the heat gun when bending will help you apply heat evenly on the pipe.
_____6. Bend defect is a result of improper bending techniques.
_____7. Using the drawn guide for bending will be very helpful for beginners.
_____8. Hot tools when accidentally contacted your skin may cause serious burns.
_____9. Electric stove CANNOT be used for bending RNC.
_____10. Heat box is the most convenient tool since it is specifically made for bending RNC.

Enumerate what is being asked.

a. Three common bend defects.
1. _____
2. _____
3. _____

b. Two tools that can be used for bending RNC.
1. _____
2. _____

Additional Activities

Briefly answer the following questions. Write your answer on the space provided.

a. Why is it important to follow procedure in bending RNC?

b. Why is it important to have knowledge and skills on bending different types of RNC bends?

c. Why is it important to use proper PPE when bending RNC?

References

Books

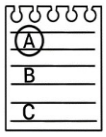
Mogado, Jomar P. (2015). *Technology and Livelihood Education (TLE) 9 Electrical Installation & Maintenance (Specialization).* Philippines: Trinitas Publishing Inc.

Module no. 3 Installing Electrical Protection. 2008. Philippines: Department of Education

Websites, Journals, Magazines and others

Vinyl Chloride. (n.d.). Retrieved June 19, 2020, from https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/vinyl-chloride.pdf

Electrical Installation and Maintenance NCII – Grade 9
Alternative Delivery Mode
Quarter 1 – Module 1Part 2: Rigid Nonmetallic Conduit
Lesson 2: Preparing Rigid Nonmetallic Conduit Bends
First Edition, 2020



Answer Key

Lesson 2

What's In

1. True
2. False
3. True
4. True
5. False

What's More

What I Have Learned

1. Cutting
2. heating
3. bending
4. heat box
5. heat gun
6. blow torch
7. mask
8. health

Assessment

Additional Activities

Answers may vary

What I Know	What's new
1. B 2. B 3. B 4. C 5. A	1. Heat gun – used for applying heat to RNC/used for bending RNC 2. Blow torch - used for applying heat to RNC/used for bending RNC 3. PVC pipe cutter – Tool specially made for cutting PVC pipe. 4. Hack saw – can be used for cutting PVC to its required length 5. Metric rule – used for measuring the length of PVC pipe/ used for measuring short and long distances.

What I Can Do

Procedure in Preparing a 90° Bend

The following steps should be followed to make a 90° Bend without bend defects.

1. Wear appropriate PPE. Wear your hand gloves, mask and if possible, your goggles. Wearing these PPE will always ensure your safety.
2. Prepare all the necessary tools, equipment, and materials for the job.
3. Draw a right angle on the floor using a try square or L-square. This will serve as your guide when bending your conduit to 90° angle. Bisect the angle and draw an arc with a 115 mm radius (115 mm is the minimum radius for a 20mm PVC Conduit)
4. Determine and mark the center of the bend at approximately 6 inches from the center mark to both ends of it.
5. Apply heat to soften the marked part. Rotate the conduit while swaying the heat gun to apply heat evenly.

Remember this…

Safety is our priority. Do not forget to cover your nose and mouth with mask when applying heat to the RNC. The fume generated by the heated conduit, if inhaled, is dangerous to health.

6. When the marked portion is already softened evenly, lay the conduit on the floor with one foot stepping on one end of it.
7. Using one hand, hold the other end of the conduit and make a 90° bend. Use the other hand to wipe the conduit. If the elbow flattens, push the flatten area with a damp cloth until the desired shape is attained.
8. Wipe the conduit entirely with a damp cloth to facilitate faster cooling.
9. Check the finished work and do the necessary housekeeping.

Procedure in Preparing an Off-set Bend

The steps in preparing an off-set bend intended for panel box are the following

1. Wear appropriate PPE. Wear your hand gloves, mask and if possible, your goggles. Wearing these PPE will always ensure your safety.
2. Prepare all the necessary tools and materials.
3. Measure the height of the box's knockout.
4. Draw the height of elevation on the floor. This will serve as your guide as you bend the conduit pipe.
5. Measure and mark at least 5 inches from the end of the conduit. Note: This measurement is intended for panel box. If you are going to make an offset bend intended for smaller boxes, the measurement can be at least 2 inches
6. From the first mark, measure, and mark 6 inches. Note: This measurement is intended for panel box. If you are going to make an offset bend intended for smaller boxes or obstacles, the measurement can be shorter depending on the height of the box's knockout or height of the obstacle. For smaller boxes, 3 inches will do.
7. If the conduit is already softened evenly, turn off the heat gun and lay down the pipe on the guide drawn on the floor. Pull both ends on the opposite side while following your guide as shown below.
8. If the desired shape is formed, put one of your feet on one side and wipe the conduit with a damp cloth applying pressure on top of it if ever it flattens.
9. Check the finished work. The offset must be like the picture on the right. Do the necessary housekeeping

Development Team of the Module

Writers: JERAMIL G. MORENO (SST-I, PHS)
ROGERSON J. PULIDO (SST-II, MNHS)

Editors: Jose Ferdinand B. Nisperos (SST-II, MHS)
Joffre N. Albiento (Head Teacher-III, MNHS)
Lauro Z. De Guzman (PRINCIPAL-IV, MHS)

Internal Reviewer: Joseph T. Santos (EPS – EPP/TLE/TVL)
Cover Illustrator: Christopher E. Mercado

Management Team: **Sheryll T. Gayola**
Assistant Schools Division Superintendent
OIC, Office of the Schools Division Superintendent

Elisa O. Cerveza
Chief, Curriculum Implementation Division
OIC, Office of the Assistant Schools Division Superintendent

Joseph T. Santos
Education Program Supervisor – EPP/TLE/TVL

Ivy Coney A. Gamatero
EPS – Learning Resource Management and Development System

For inquiries or feedback, please write or call:

Schools Division Office – Marikina City
Email Address: sdo.marikina@deped.gov.ph
191 Shoe Ave., Sta. Elena, Marikina City, 1800, Philippines
Telefax: (02) 682-2472 / 682-3989