Bilingual Lesson Plan

Teacher's Name / Affiliation	陳政育 / Department of Refrigeration & Air-Conditioning at Taipei Municipal Nei-Hu Vocational High School		
Course Title	Piping of Refrigerant Lines for A Split-Type Air Conditioner		
Source of Teaching Materials	Chuan Hwa Book Co.全華圖書—Energy and Air Conditioning Practice		
Class Periods	This unit will need 3 class periods. This lesson plan will focus on the 1st period.		
Students' Grade	11th graders of Dept. of Refrigeration & Air-Conditioning	Number of Students	18
Course Summary	1. The lecture adopts didactic instruction method and demonstration method. 2. Teaching the method of connecting the piping for a split-type air conditioner. 3. Understanding the operation and making of copper pipe flaring. 4. Understanding the bending method of insulated copper pipes (refrigerant pipes).		
Course Objectives Critical Issues（If any）	1. Understanding the method of connecting the piping for a split-type air conditioner, indoor unit and outdoor unit. (Cognitive domain) 2. Understanding the operation and making of copper pipe flaring. (Psychomotor domain) 3. Understanding the bending method of insulated copper pipes (refrigerant pipes). (Psychomotor domain)		
Teaching Resources	1. A troller with a split-type air conditioner (including an indoor unit and an outdoor unit, which have been installed on the trolley.)。 2. 2 in. copper pipe (1/4" O.D.) & 3 in. copper pipe (3/8" O.D.), 20 cm long each。 3. Insulated copper pipes (refrigerant pipes), 3 meters long. 4. Tools: swaging tools and torque wrenches。		

Lesson Design			
Teaching Procedure	**Length (mins)**	**Teaching Steps**	**Teaching Strategies/ Special Notes**
1. Warm-up	**20**	1. Ask students if they have watched the process of the installation of a split-type air conditioner. Do they know what kind of pipes are used? (3 mins) 2. Introducing the way the pipes are connected (3 mins) 3. Introducing the method of crafting copper pipe flares. (6 mins) 4. Introducing the bending method and installation of insulated copper pipes (refrigerant pipes). (8 mins)	
2. Present Key Teaching Points	**5**	1. Have students understand the difference of sizes of copper pipes flares and problems that may occur. (2 mins) 2. Have students notice the angle when bending copper pipes and prevent pipe deformation. (3 mins)	
3. Practice	**20**	1. Ask students to work in pair, and each student is required to craft 4 copper pipes flares (2 two inches pipes and 2 three inches pipes). (8 mins) 2. Ask students to work in pair to flare the both sides of an insulated copper pipe (a refrigerant pipe). And then bend the insulated copper pipe into S-shape. (10 mins) 3. When completing the above tasks, students will install the insulated copper pipe (refrigerant pipes) onto the troller with a split-type air conditioner, using a	

		torque wrench to tighten the nut. (2 mins)	
4. Production Activity	**3**	1. Check the copper pipe flares crafted by students.◦ (1 min) 2. Check the bended insulated copper pipes (refrigerant pipes) made by students. (2 mins)	
5. Wrap-up	**2**	1. Remind students of the key point of the lesson. (1 min) 2. Give feedbacks and point out the strengths of the work and things need to be improved. (1 min)	

References

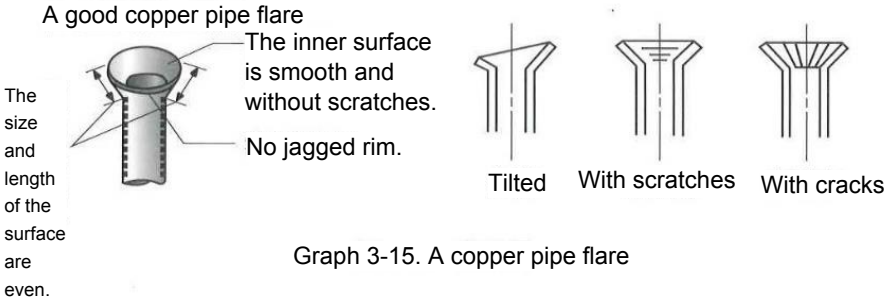
1. 楊海濤、沈崇詩、許明財(2021)。能源與冷凍空調全冊。全華圖書。

2. 林謙育、楊瑋倫(2024 新版)。丙級冷凍空調裝修學術科通關寶典最新版(第十一版)。台科大圖書。

Appendix

Appendix 1：Crafting Copper pipe flares。(An excerpt from Appendix 1)

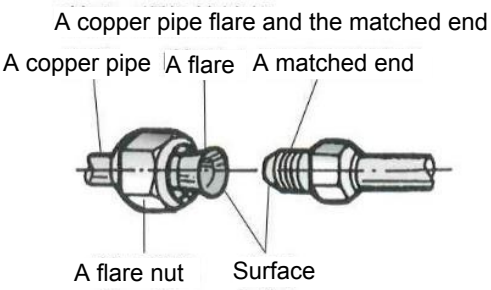
1.•Crafting Copper pipe flares
When connecting, the inner surface of the copper pipe flare and the surface of the matched end should be completely sealed to prevent refrigerant from leaking. (When crafting copper pipe flares, in addition to making sure the size and angle to be correct, copper should be kept soft as well.) As illustrated in Graph 3-15.



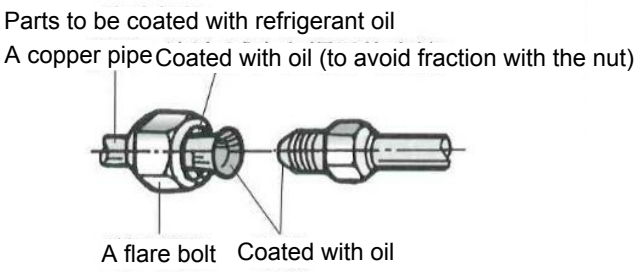
Graph 3-15. A copper pipe flare

Appendix 2：Connection of copper pipes flares。(An excerpt from Appendix 1)

2.•Key points when connecting the copper pipe flare with the matched end:
(1)•Be sure to get rid of dust and foreign bodies on the surface. Make sure that there is no dust, copper debris, water, and sand in the pipe in case that the machine cannot operate because of capillary clogging. As illustrated in Graph 3-16.
(2)•Before tightening the nut, the tip of the copper pipe flare and the surface of the matched end should be coated with refrigerant oil. As illustrated in Graph 3-17.



Graph3-16. Get rid of foreign bodies of the flare



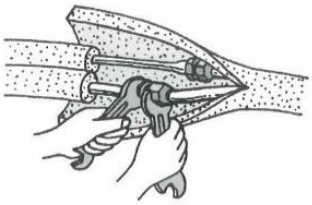
Graph 3-17. Coat the flare with refrigerant oil

Appendix 3：The method of tightening copper pipes flares。(An excerpt from Appendix 1)

(3)•Firstly, hand tight the nut. If it cannot be tightened properly, tight it again. As illustrated in Graph 3-18.

The method of tightening the nut

Align the copper pipe flare and the middle of the copper pipe, and rotate 3 to 5 times.



Graph 3-18. The method to tighten copper pipe flare

Graph 3-19. The method to tighten copper pipe flare

(4)•Tighten the nut with a torque wrench. Avoid tighten the nut too hard but use two torque wrenches as illustrated in Graph 3-19 and Chart 3-3 Proper torch value is listed as followed:

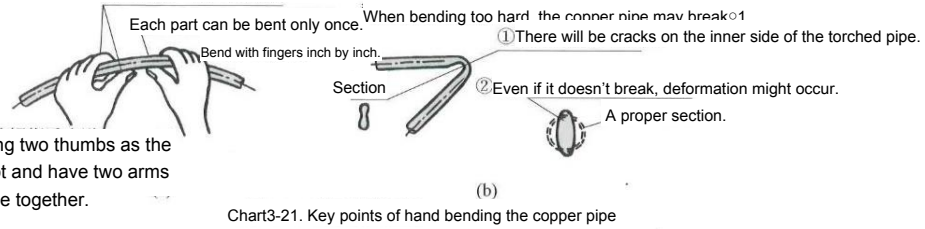
Chart 3-3. Torch Value for Steel Pipe of Different Calibers

Steel Pipe Caliber	Torch Value
ϕ 6.22m、1/4"	140～180
ϕ 9.25m、3/8"	350～420
ϕ 12.7m、1/2"	500～575
ϕ 15.88m、5/8"	750～800

Appendix 4：The method of bending insulated copper pipes (refrigerant pipes). (An excerpt from Appendix 1)

(2)When without a bending tool, press the copper pipe with the thumbs and bend as much as possible. The bending radius should be larger to prevent the pipe from breaking. As illustrated in Chart 3-21.

Bend with fingers inch by inch.



Using two thumbs as the pivot and have two arms close together.

Chart3-21. Key points of hand bending the copper pipe

(3) When hand bending the pipe, the bending radius should be over 100mm.

4.Restriction of refrigerant piping:

(1) The height differences of the indoor and outdoor units should be kept less than 5m.

(2) The extended refrigerant pipe of the indoor and outdoor units should be limited to one commercially available roll of the refrigerant pipe.

(3) There should be no more than ten bended sections of the pipes to the indoor and outdoor unit.

(4) The outlet of the refrigerant pipe should be installed with a cap to prevent dust and moisture from entering the pipe, as illustrated in Graph 3-22.

(5) Be sure to select pipes with correct caliber.

Graph 3-22 Prevent dust and moisture from entering the pipe