

CONDUIT - MEASURING, CUTTING AND BENDING

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1. GENERAL

1.1 Scope

1.11 This section covers the requirements and methods to be followed when measuring, cutting or bending conduit. It is to be used with the other conduit sections in the 9 series.

1.2 Cautions

1.21 When working on overhead conduit always place tools or other objects where they are not likely to fall, securing them temporarily if necessary in a convenient place when they are not actually in use.

1.22 Do not use a metal or metal edged rule for measuring, as the metal may come in contact with live equipment.

1.23 Before using a conduit bending hickey having a coupling on the handle be positive that the coupling is approximately half its length on the end of the pipe handle and is tightened to the end of the threads on the handle, and that the coupling is tightened close to half its length onto the bending hickey. If handle has threaded end only, be sure that handle is properly screwed into the hickey. All threaded ends and couplings must be in good repair.

2. INSTALLING EQUIPMENT

- 2.1 The required tools and supplies are shown in Section 9A.

3. MEASURING

3.1 In making measurements for cutting conduit where bends are to be installed, temporarily support the bend or bends, which are to be used, in position before the measurement for the conduit is made. Use the same bends, ells and fittings that the measurements were made with, as bends and fittings may vary in dimensions.

3.2 To measure a length of conduit (N in Figure 1) to connect two fittings proceed as follows:

3.21 Obtain the distance (M) between the centers of the condulets.

3.22 Measure distance from center to the end of each fitting (F1) and (F2) and add these distances.

3.23 Subtract sum of (F1) and (F2) from (M) and add twice the distance (S) which the conduit will enter the fitting.

3.3 When measuring conduit to be bent refer to the conduit bending chart in Figure 5.

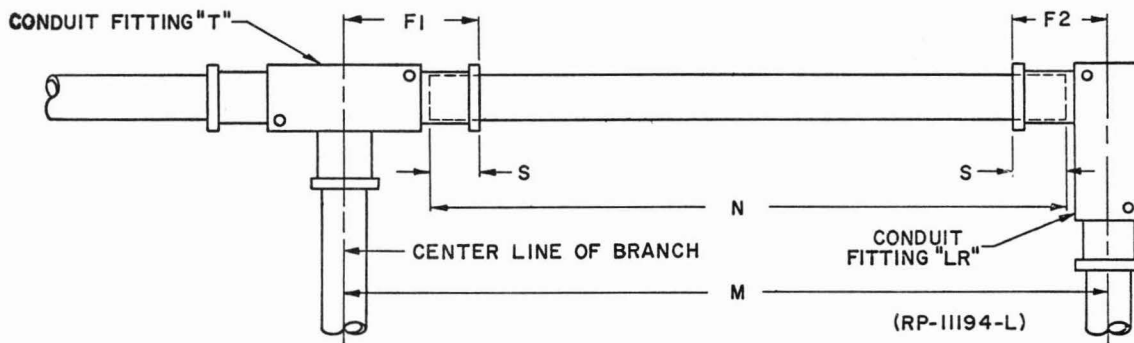


FIG. 1 FINDING THE LENGTH OF CONDUIT REQUIRED BETWEEN TWO FITTINGS (PAR. 3.2)

3.4 If the R-2122 linen tape is used for measuring purposes the space and the conduit shall be measured with the same tape. In this manner any errors due to tape stretching will be the same and the measured conduit will fit the measured space.

4. CUTTING

4.1 The R-2506, portable vise will prove useful for holding conduit up to and including 2 1/2 inches.

4.2 When using the R-2506 vise on linoleum provide a wooden base to protect the flooring from the points on the legs. The roller support can be connected to the vise mount with a 3/4" pipe inserted through the holes provided for that purpose.

4.3 When cutting conduit no lubricant is required on the saw blade.

4.4 Secure conduit to be cut in an R-1530 or R-2506 vise and cut with the R-2881 hand hack saw. Cut squarely through the conduit. As soon as the blade cuts through the first wall slightly lower the handle end of the saw as illustrated in Figure 2. When the holding position becomes awkward rotate the conduit to a new position.

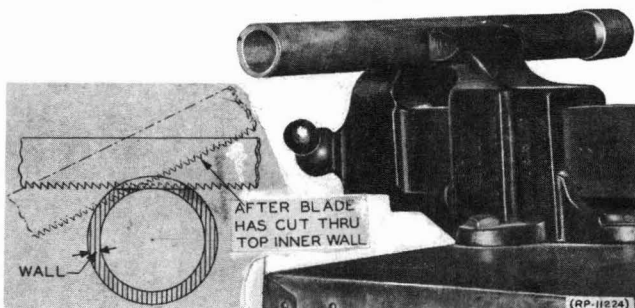


FIG. 2 CUTTING CONDUIT WITH R-2281 HACK SAW (PAR. 4.4)

4.5 If a power hacksaw is available it may be advantageously used when a large number of pieces of conduit are to be cut. If the power saw is used, be sure that the local current supply and that shown on the motor name plate are in

agreement before attempting to start the saw motor. If two or more pieces of conduit are to be cut simultaneously, care should be taken that they are securely tightened in the vise of the power saw.

4.6 Use an R-1457 round file as shown in Figure 3, or the R-1505 Reamer to remove any burr or sharpness that may be on the inner edge of the conduit after cutting.

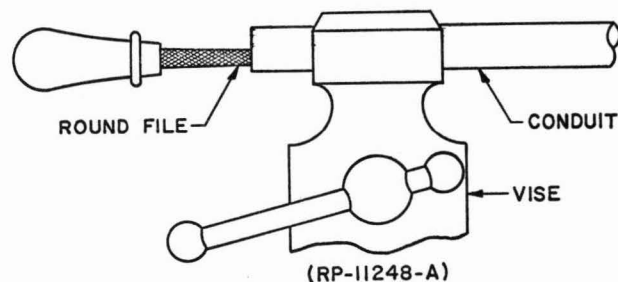


FIG. 3 REMOVING BURR OR SHARP EDGE ON INSIDE OF CONDUIT (PAR. 4.6)

5. BENDING

5.1 Radius

5.11 Conduit from fitting to fitting or outlet to outlet shall not contain more than the equivalent of 4 quarter bends (360° total). If more are required insert pull boxes in the run.

5.12 Make bends of rigid or flexible conduit so that they will not be injured or the internal diameter will not be effectively reduced. The radius of the curve of the inner edge of any field bend shall not be less than that shown in the following table.

Conduit Size	Min. Bend Radius In Inches
1/2	4
3/4	5
1	6
1 1/4	8
1 1/2	10
2	12
2 1/2	15
3	18
3 1/2	21
4	24
5	30

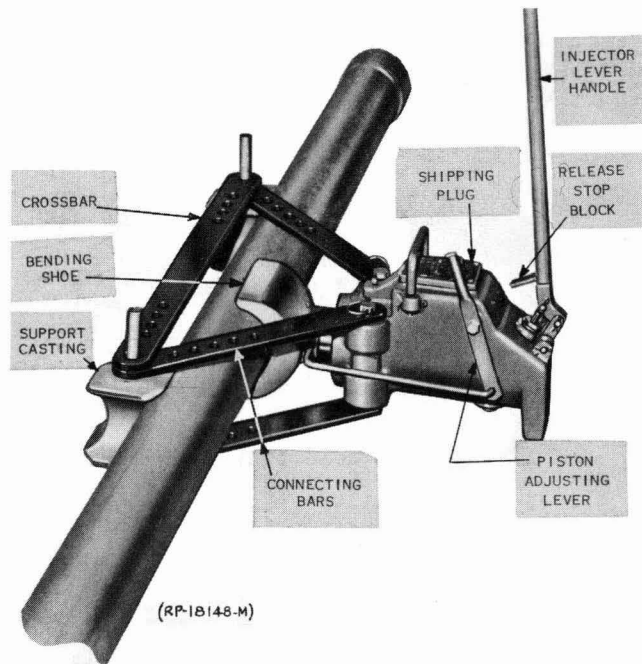


FIG. 4 R-2863 HYDRAULIC CONDUIT BENDER
(PAR. 5.31)

5.2 Use of Hickeys

5.21 Conduit up to 1" can be conveniently bent either by holding the hickey stationary and applying leverage on the conduit or by holding the conduit stationary and applying leverage on the hickey.

5.22 When bending sizes over 1", less effort will be necessary if the hickey is made stationary and the bending is done with the conduit, the conduit usually being longer than the hickey handle, allowing greater leverage to be applied.

5.23 It is advantageous to use a pipe sleeve on the conduit while bending. The sleeve should be of slightly larger inside diameter than the outside diameter of the conduit to be bent and should be slipped over the conduit to a point as near the head of the hickey as possible. The hickey may be supported either on the side of the work bench, with the handle resting on the floor, or a wooden support may be made for this purpose.

5.24 Where leverage is applied to the hickey it should be slipped over the conduit at the point where the bend is to start, bend conduit slightly at that point, then slide the hickey along the portion being bent approximately 1" and bend some more and repeat until the correct bend is obtained. This changing of hickey position while bending will tend to prevent conduit from flattening.

5.25 Use handles of conduit or pipe for hiccys. The R-2757 hickey is tapped to receive the threaded end of handle,

which should be set up the full depth of the threads in the hickey. The handle arrangements required for hiccys are as follows:

R-6630 requires 2" pipe and coupling, R-2758 1 1/2" pipe and coupling and the R-2757 1" pipe threaded at one end.

5.3 Use of R-2863 Hydraulic Conduit Bender

5.31 Conduit sizes 1 1/4" to 5" may be bent with the R-2863 hydraulic bender. Refer to Figure 4 which illustrates an assembled bender in proper condition for bending.

5.32 The bender will operate satisfactorily when it conforms to the operating instructions and other information as indicated in Handbook 28. To check and test the machine prior to using always remove the shipping plug and store in shipping case. Then determine that there is sufficient oil in the oil reservoir. Replace the shipping plug with the vent plug.

5.33 The cross and connecting bars have a series of holes marked to indicate the position in which the bars are to be assembled with the support castings for the various sizes of conduit to be bent. On early designs of bars having three instead of six holes the outside holes are for 5", 4", and 3 1/2" conduit. The next set for 3" and 2 1/2". The third position is used for the smaller sizes of conduit only. When assembling the connecting bars make certain that the cavities of support castings at the junction of the bars are placed in the right facing for the conduit it will accommodate.

5.34 Prior to making a bend of 3" or larger conduit, apply a small amount of grease to the surface of the shoe and support castings where they come into contact with the conduit, in order to reduce friction at these points.

5.35 To prevent flattening and distortion of a conduit, during the bending process, piston pressure should be applied through the shoe which has the proper curvature to fit the conduit to be bent.

5.36 The portion of a conduit required to make a full 90° bend is equal to 1.5 times the proposed radius. For example, the minimum bending radius of a 2 1/2 inch conduit being 15 inches (See Paragraph 5.12), the section of conduit marked off for the bend would be (15 x 1.5) 22 1/2 inches. See Figure 5.

5.37 Mark off equal spaces 1.5 inches apart in the straight section to be bent. The number of spaces therefore would be the same as the number of inches in the radius.

5.38 Fit the conduit to the bending machine so that the shoe is in the portion to be bent and the edge of the shoe coinciding with the first mark on the conduit. Apply pressure at this point. The bend is made at the outer spaces last. The

piston travel for each space should be equal to "D" (Figure 5) divided by the number of spaces or approximately 1/2 inch of travel for the 2 1/2 inch conduit ($7.7 \div 15$). Release the pressure and move the conduit along the shoe to the next space mark and reapply the pressure until the bend is made. Be careful not to rotate the conduit in the shoe during the bending process. The maximum stroke is 6 1/4 inches, therefore extreme bends cannot be made in one stroke due to the limited curve of the shoe.

5.39 For bends to be made with a radius in excess of 28 inches, mark off spaces 3 inches apart. For radii up to 46 inches and for radii up to 60 inches make the spaces 4 inches apart. The portion of a conduit to be marked off for making a 60° bend, for offsets, is equal to the length of the radius and for a 45° bend it is 3/4 of the radius. It is advisable to mark the floor for various offsets and bend the conduit accordingly.

5.391 To prepare the set for shipping the piston should be in the full "in" position, the vent plug removed and the shipping plug placed tightly in the hole from which the vent plug was removed.

➔ 5.4 Use of R-4213 One Shot Hydraulic Conduit Bender

5.41 Contrary to the R-2863, which is a segment bender, the R-4213 is a one shot bender which can accomplish a 90° bend in one application.

5.42 Since complete operating instructions are furnished by the manufacturer with each R-4213 Bender, it is not considered necessary to repeat them here in detail, except for some preliminary assembly instructions and precautions which should be observed at all times.

NOTE: Any lost or mutilated operating instructions may be reordered from the functional Service Center.

5.43 To set up the R-4213 Bender, proceed as follows, also see Figure 6.

1. Insert ram cylinder block into the frame. When doing so, be absolutely sure the cylinder block is clear up to the shoulder. Then anchor it in the frame with 1-1/8 x 8" cylinder pin units. They should drop in loosely - never pound them. The end with the fixed pin should be up. Stand frame on large end, insert 3/16" quick change spring clips in the bottom hole cylinder block pins. Lay bender in horizontal position.

2. Select the required shoe support and place it on the ram. (Use large support for 2 1/2" thru 4" sizes.) Insert large support pin size 11/32" x 3-11/16" in one of two holes to hold shoe support to the ram. Shoe support has two holes. Only one pin is needed. For sizes 2" and smaller, use the small shoe support. Anchor it with the small support pin.

3. Select the required bending shoe and place it in the shoe support, counterbored holes up, on 2 1/2" and larger. Insert shoe support pin size 15/16" x 3-3/4" through lined-up holes of shoe support and bending shoe. To hold shoes on small support, use 1/4" x 3-1/4" pin.

4. Connect high pressure hose to the female quick-coupler on the end of the ram and the other end to the high pressure pump female coupler. Be sure to screw couplers all the way. This is important.

5. Start the motor and operate pump.

CAUTION: Read pump operating instructions before operating pump. Always place control lever in return position before starting the electric motor pump.

6. To move bender any distance, place the pipe supports and pins in 4" hole position. Stand it up and roll it.

5.44 Bending conduit is accomplished in the following manner:

1. Make a mark on the pipe where the center of the bend is required.
2. Place pipe in the bending shoe with the mark on the pipe in line with the shoe center mark.
3. Place pipe supports in the correct location for the size of pipe to be bent. Pipe sizes are marked on the pipe supports and on the frame. Insert pipe support pins and lock in position by turning the T-lever on the top of pin to the right.

CAUTION: Before bending pipe, make sure the quicklock pins are through the holes in the bottom frame and the eccentric pin is turned clockwise past the ball lock. Also make sure the correct sides of the pipe support pins are in the proper holes.

4. Apply pressure on the ram with power pump until the required degree of bend is made. The quickest way to stop the advance of the ram is to stop the motor of the power pump.
5. When the bend is completed, release the pressure on the ram just enough to free the pipe supports. Remove pins and pipe supports. Advance or return the ram until the shoe support pin can be readily removed. Remove the shoe, with the pipe still in it, and check degree of bend. If the pipe requires more bending, replace shoe, pipe supports and pins in the bender and continue bending to desired degree.

6. When 90° bends are accurately made on sizes 2 1/2" thru 4", one can remove the pipe by driving the pipe removal pins (flat side against the pipe) through the top of the two counterbored pin holes in the shoe. The pipe can also be removed from the shoe by releasing ram pressure just enough to free the support pins. Then remove one pin. Now apply pressure slowly until pipe is loose. Return ram by releasing pressure.

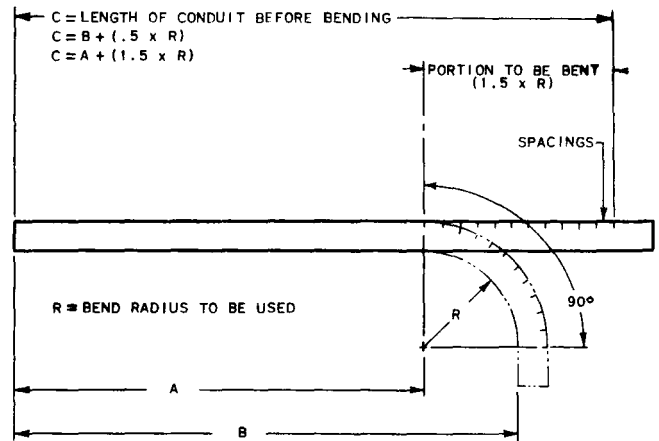
7. The power pump vent is closed when the lever is upward. When in operation, move it to a horizontal position.

CAUTION: To check the oil level, unscrew the oil stick and make sure that the level is not below the mark on the end of the stick. Never operate the pump with the oil level below this mark.

5.45 If there is an insufficient amount of oil in the reservoir, add trans-
mission fluid Type "A", purchased locally.

→ Arrowed lines indicate new or changed information.

[Vertical line at side of paragraph indicates requirements.



CONDUIT SIZE	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5
D	6.4	6.4	6.4	6.4	6.4	6.4	7.7	9.0	9.0	10.3	13.3

FIG. 5 CONDUIT BENDING CHART
(PARS. 3.3, 5.36, 5.38)

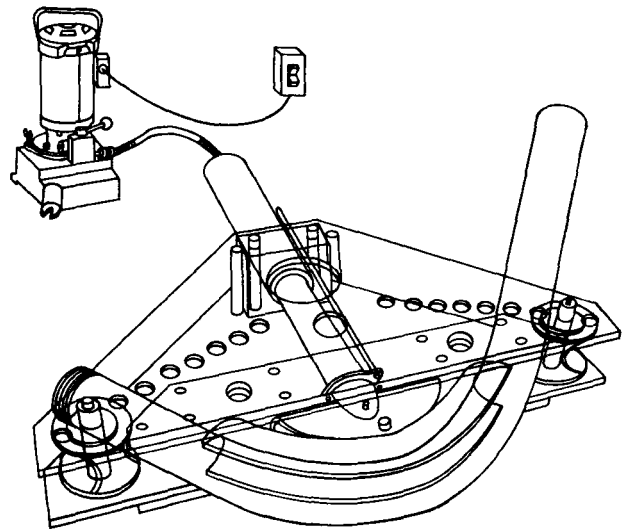


FIG. 6 R-4213 ONE SHOT CONDUIT BENDER
(PAR. 5.43)

Manager, Product Engineering

Reason for Reissue:

- (1) To bring bending radii up to date. (Par. 5.12)
- (2) To include information on the new R-4213 Conduit Bender. PARS. 5.41 to 5.45 and Fig. 6.
- (3) To bring BSP references up to date and make minor changes throughout section.