SNC
Unit S

NON-SAFETY RELATED

NMP-MA-027

Heat Exchanger Tube Plugging

VERSION 2.0

Special Considerations:

Applicable to Corporate, FNP, HNP, VEGP 1-2, VEGP 3-4

PROCEDURE LEVEL OF USE CLASSIFICATION PER NMP-AP-003	
CATEGORY	**SECTIONS**
Continuous	NONE
Reference	ALL
Information	NONE

Approval: _____ _____

Approved By Date

MAINTENANCE

Responsible Department

VERSION SUMMARY
PVR 1.0 **DESCRIPTION**
Revised from procedure NMP-MA-012-002 and re-number as independent Nuclear Management Procedure. Converted to new template. Updated organizational title changes.
PVR 2.0 **DESCRIPTION**
Incorporating RSCN for NMP-MA-027v1.0-FTPC1: Doc. ID: XX100719463 FOR TUBE SHEETS GREATER THAN 3" THICKNESS.

TABLE OF CONTENTS

1.0 PURPOSE/SCOPE/APPLICABILITY

The purpose of this procedure is to provide general fleet instructions for heat exchanger tube plugging. (Steam Generator tube plugging will be controlled by other procedure(s) and/or processes.)

This procedure applies to heat exchanger tube plugging performed at SNC's nuclear power plants. The plug of choice for all plants is the "Pop-A-Plug" (Attachment 1). Where specific site procedures for specific heat exchangers or manufacturer's instructions dictate a different plug, an evaluation should be performed to determine the best plug for the situation. The evaluation and approval of plugging methods not listed in this procedure should be done via a Condition Report. Also, because there are limitations to Pop-A-Plugs, there are three other type plugs listed in Attachments 2, 3, and 4. Use of these alternative plugs requires the approval of the Maintenance Discipline Manager.

2.0 PRECAUTIONS AND LIMITATIONS

1. The Maintenance Discipline Manager is responsible for ensuring the appropriate plug is used. ☐

2. Engineering Support is responsible for providing a map of tubes to be plugged, marking tubes to be plugged, specifying the type of plug to use, and authorizing the plugging to begin. ☐

3. The Maintenance Supervisor is responsible for ensuring:

   - Personnel involved in the task are qualified to perform the task. ☐
   - System owner's releasing authority has granted permission to execute performance of this task. ☐
   - Hydraulic hoses and associated fittings (if required) have been checked for defects and are suitable for service. ☐
   - Any pressure retaining parts repaired, modified, or replaced during performance of this procedure are documented per the requirements of the ASME Section XI, R & R program. ☐
   - FME controls are in place to prevent foreign material from entering or being left in systems and components per the requirements of NMP-MA-009, Foreign Material Exclusion Program. ☐
   - Required notifications are made in accordance with ANII notification policy ☐
   - System and area cleanliness is maintained. ☐
   - Steps marked N/A without procedure direction MUST meet the requirements of section 4.10 of NMP-AP-003, Procedure and Work Instruction Use and Adherence. ☐

3.0 PREREQUISITES AND INITIAL CONDITION

1. Personnel are experienced with the Pop-A-Plug system OR have viewed the vendor instructional video.
2. Component has been tagged and drained
3. Tooling:
   - Tapered Reamer ☐
   - Variable Speed Drill ☐
   - GO/No-GO Gage (supplied with plugs) ☐
   - Tube brush within the same size range as the GO/No-GO Gage ☐
   - Pull Rod Assembly ☐
   - Needle Nose Pliers ☐
   - Removal Tool ☐

4.0 INSTRUCTIONS

NOTE

1. POP-A-PLUG TUBE PLUGS MUST BE INSTALLED INTO THE TUBESHEET AREA OF THE TUBE ONLY. ☐
2. WHENEVER POSSIBLE, INSTALLED POP-A-PLUG(S) SHOULD NEVER PROJECT BEYOND THE TUBE SHEET FACE. ☐
3. FOR TUBE SHEETS GREATER THAN "3" THICKNESS AN INSERTION DEPTH OF 1" FOR POP-A-PLUG CPI/PERMA MEDIUM PRESSURE PLUGS OR 1 ¾" FOR POP-A-PLUG P2 HIGH PRESSURE PLUGS FROM THE TUBE SHEET FACE TO CENTER OF EXPANSION RING IS SUFFICIENT FOR STABILING POP-A-PLUG. ☐

4.1 Identification of tubes(s) and Plug Selection.

1. Positively identify the tube(s) to be plugged.

_____/_____/_____
Print Sign Date

NOTE

VERIFICATION FOR Section 4.1 Step 2 MAY BE PERFORMED BY MAINTENANCE SUPERVISION OR ENGINEERING SUPPORT PERSONNEL. ☐

2. Verify tube(s) to be plugged are properly identified. ☐

_____/_____/_____
Print Sign Date

3. Document below the tube plug type per selected Attachment to be used. ☐

- ☐ POP-A-PLUG, Attachment 1
- ☐ Expandable, Attachment 2
- ☐ Ring and Pin, Attachment 3
- ☐ Tapered Pin, Attachment 4

4.2 Pop-A-Plug Removal Instructions

CAUTION

Tube may contain pressure. When hammering pin, keep face and body away from tube opening. ☐

1. Fully engage male thread on tip of spear of removal tool into Pop-A-Plug pin. ☐
2. Hit the end of the Removal Tool or use a slide hammer to drive pin back into the tube. ☐
3. Thread spear into ring using ¾ inch hex cap on rod end (about 4 – 6 turns). Use slide hammer or ram to remove ring. ☐
4. If spear pulls out of the ring, repeat Section 4.2 Step 3 using additional turns when threading spear into ring. ☐

_____/_____/_____
Print Sign Date

5.0 ACCEPTANCE CRITERIA

- None

6.0 RECORDS

Completed Attachments shall be inserted into the work order package and retained as specified for the work order.

7.0 REFERENCES

- NNMP-ES-004-003,Steam Generator Program Tube Plugging
- NMP-MA-009,Foreign Material Exclusion Program
- FNP-0-GMP-24.0, Main Condenser Tube Plugging
- 52CM-N61-002-0, Main Condenser Tube Repair
- 52CM-N21-004-0, Feed-water Heater Corrective Maintenance

8.0 COMMITMENTS

- None

POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS

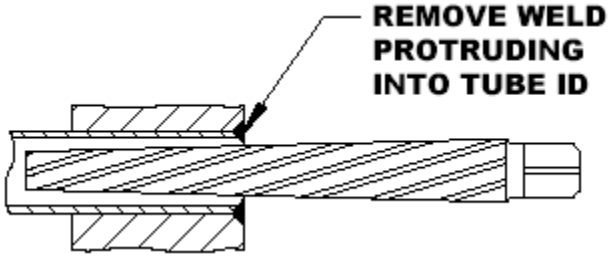
NOTE

The Pop-A-Plug should be installed in the rolled section within the tube-sheet. The installed plug should never project beyond the tube-sheet face unless it is on the perimeter or in a thin tube-sheet. If the tube-sheet is not thick enough or the roll length is insufficient, install ring in rolled portion within the tube-sheet even if pin projects beyond tube-sheet. Any tube sleeves or shields must be removed from tube-sheet plugging area prior to tube preparation and plugging. The only exception to this note is in a cooler where there is no tube-sheet (i.e., a header pipe on an air-to-water cooler). In this case a specific procedure shall be developed by the tube plugging vendor for each application. ☐

CAUTION

NEVER HIT THE PIN WITH A HAMMER OR HEAVY OBJECT. POP-A-PLUGS SHOULD NOT BE USED IN ANY HEATER IF THE TUBE IS NOT EXPANDED TO THE TUBESHEET. ☐

1. For a tube that is welded to the tube sheet, remove the weld droop with a TAPERED REAMER. If not welded, proceed to Step 2. The reamer should be operated in the following manner: ☐



CAUTION

REMOVING THE WELD DROOP IS A FAIRLY QUICK STEP AND SHOULD ONLY TAKE 15 TO 30 SECONDS TO REMOVE. A STRAIGHT REAMER SHOULD NEVER BE USED. ONLY REMOVE THE WELD (BURR) PROJECTING INTO THE TUBE INSIDE DIAMETER. ☐

a. Install tapered reamer in a variable speed drill and lightly lubricate. ☐

NOTE

- The small end of the tapered reamer should fit into the tube inside diameter (ID) and the large end should not.
- Keep reamer axis parallel to tube axis.

b. Use an on/off method. Lightly squeeze the trigger on the drill to a low rpm and then release. Use very slight forward pressure. ☐

POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS (continued)

NOTE

The reamer may catch if too much pressure is used. Let the reamer do the work. Never force the reamer into the ID. ☐

CAUTION

FAILURE TO REMOVE THE WELD DROOP WILL CAUSE THE GO/NO GO GAGE TO GIVE A FALSE READING. THIS FALSE GO/NO GO GAGE READING WILL DIRECT USER TO INSTALL AN UNDERSIZED PLUG. THIS WILL CAUSE A LEAK EITHER INITIALLY OR LATER. ☐

2. On the outlet end of the heat exchanger, take initial tube ID measurements with the GO/No-GO Gage supplied with the Pop-A-Plug using the small end of the gage. Small end of the gage should fit in tube to installation depth and the large end should not. ☐

3. Using a tube brush within the same size range as the GO-No GO gage, prepare tube ID to the required installation depth. ☐

   a. IF a power operated brush is used, operate for at least 30 seconds (5 seconds for Cu/Ni and Brass Tubes), moving the brush in and out of the tube opening to the installation depth evenly to prevent a tapered condition.

Signature _____ Date _____
(Print/Sign)

NOTE

If as a result of uneven brushing the tube entrance is smaller, the installed plug may be undersized and leak. ☐

CAUTION

Do not use an oversized brush, force the brush into the tube, or bend the stem. These actions will break the stem and cause deep grooves in the tube. Do not reverse drill because bristles will fall out. A Brush lubricant / Spark inhibitor Lube-A-Tube is available from the factory if required. This must be used when brushing stainless steel tubes or brush may wear out quickly. ☐

4. Inspect tube for scale, pitting or other defects.

   a. If defects still exist, further preparation may be necessary requiring use of larger brushes.

   b. Brushing could remove enough tube material to require larger gage and plug size(s) for measurements in Step 5. ☐

POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS (continued)

4. (continued)

c. Ensure debris is removed from the tube. ☐

Section 1.4 Complete

Signature _____ Date _____
(Print/Sign)

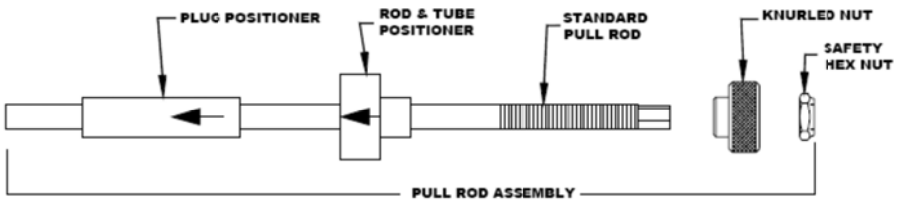
5. Take a second measurement to determine plug size and installation depth. ☐

CAUTION

1. THIS PROCEDURE REQUIRES THE USE OF PORTABLE HIGH PRESSURE HYDRAULIC TOOLING. TAKE CARE TO PREVENT PERSONNEL INJURIES WHILE UTILIZING THIS EQUIPMENT. ☐
2. IMPROPER INSTALLATION OF TOOLING COULD RESULT IN DAMAGE TO EQUIPMENT. TAKE CARE TO PREVENT INCORRECT TOOL INSTALLATION. ☐

6. Using plug size as determined in Step 5, install plug as follows:

a. With the indicating arrows of the pull rod assembly pointing toward the plug, thread the plug that matches the correct Go/No-Go gage onto the pull rod assembly. ☐



NOTE

Ensure threaded stud is only threaded finger tight to allow for easy removal after plug installation. ☐

CAUTION

ENSURE SAFETY CABLE IS INSTALLED AROUND THE SAFETY HEX NUT. FAILURE TO UTILIZE THIS SAFETY MEASURE COULD RESULT IN INJURY. ☐

b. Remove safety hex nut and knurled nut and insert pull rod assembly into ram. Thread knurled nut onto pull rod removing all slack in the assembly. Secure safety cable on rod and thread safety hex nut onto pull rod ☐

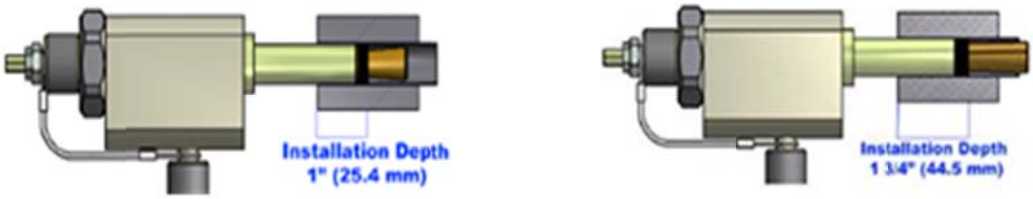
POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS (continued)

6. (continued)

c. For CPI / Perma Medium Pressure Pop-A-Plugs insert Pop-A-Plug into prepared tube to 1" installation depth measured from the tube sheet face to the center of the expansion ring. For P2 High pressure Pop-A-Plugs insert Pop-A-Plug into prepared tube to 1 ¾" installation depth measured from the tube sheet face to the center of the expansion ring. If the thickness of the tubesheet or the expanded length of the tube cannot accommodate at the recommended installation depth based on plug type, install the plug as deep as possible while keeping the Pop-A-Plug positioned within the tube sheet. ..... ☐

CPI/Perma Medium Pressure **P2 High Pressure**



CAUTION

Ensure air and hydraulic hoses are properly connected. Failure to correctly seat and tighten hydraulic fittings will cause ram piston to lock in extend position after activation. ☐

~~c.~~d. Depress pump pedal, stroking ram while monitoring hydraulic gauge. ☐

~~d.~~e. Plug should make distinctive "pop" when installed properly. If so, then proceed to Step 7. ☐

(1) IF gauge reading exceeds 7000 psi before plug makes an indicating "pop", STOP installation and proceed with Step 6.e(2). ☐

(2) Release pump pressure and retract ram. ☐

(3) Tighten the knurled nut on the plug and repeat pressurizing the ram to install plug. ☐

(4) Remove the breakaway stub piece from the installed plug. ☐

POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS (continued)

6. e. (continued)

CAUTION

Failure to remove the breakaway from the installed plug could result in the breakaway becoming dislodged during operation and becoming a potential FME concern. ☐

(5) IF installation is unsuccessful at this point, contact Maintenance Supervision for resolution. ☐

Section 1.6 Complete
Signature _____ Date _____
(Print/Sign)

NOTE

STABILIZER BARS MAY NOT BE REQUIRED ON ALL TUBE PLUGGING OPERATIONS. ☐

7. **IF** required, install brass stabilizing bars as follows:

a. Install brass stabilizing rods from the inlet end. ☐

b. Measure from the installed sections of stabilizer rods to the end of the tube. ☐

c. Subtract one half the tube sheet thickness **plus** distance from expandable ring to the end of the tapered plug (shown as 'B' below) **plus** the projection of the tube (shown as 'A' below), from measurement in Step 7.b to determine length of remaining section of brass stabilizer rod to be installed. ☐

Measurement (1.7b) _____

minus

(1/2 tube sheet + "B" + "A") _____

=

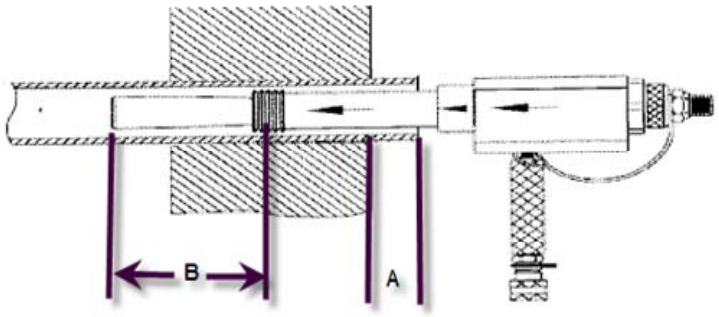
Remaining Stabilizer _____

Bar Length

POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS (continued)

7. c. (continued)



d. Install the final section of stabilizer rod.

e. Ensure Pop-A-Plug inserts half way into tube sheet.

Section 1.7 Complete

Signature _____ Date _____
(Print/ Sign)

POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS (continued)

8. Install the inlet end 'Pop-A-Plug following directions outlined in Step 6. ☐

Signature _____ Date _____
(Print/Sign)

9. Repeat Step 1 through Step 8 for all tubes requiring tube plugging. ☐

Signature _____ Date _____
(Print/Sign)

NOTE

For every tube requiring plugging write the pipe number in the blank provided. Then, after the inlet or outlet is plugged, check the corresponding blank and let it be verified by a signature and date. ☐

Pipe Number	Inlet Plugged	Outlet Plugged	Signature	Date

Signature _____ Date _____
(Print/Sign)

10. Ensure work area left clean after completion of work. ☐

Signature _____ Date _____
(Print/Sign)

11. Notify Engineering Support, their designee, or Maintenance Supervision to perform a verification that the intended tubes have been plugged. ☐

Signature _____ Date _____
(Print/Sign)

POP-A-PLUG INSTALLATION

1.0 INSTRUCTIONS (continued)

11. (continued)

TEST EQUIPMENT	ID NO.	

Remarks:_____

_____

Reviewed By:_____/_____

Maintenance Superintendent/Supervisor (Print/Sign) Date

EXPANDABLE PLUG INSTALLATION

1.0 INSTRUCTIONS

1.1 Expandable Plug Installation

1. Take initial tube ID measurements to determine plug size and verify tube ID measurement. ☐

2. Verify tube plug size to be used as specified by Vendor manual or Maintenance Supervision. ☐

Signature _____ Date _____
(Print/Sign)

3. Using tube brush, prepare tube ID to the required installation depth. ☐

   a. IF a power operated brush is used, operate for at least 30 seconds, moving the brush in and out of the tube. ☐

Signature _____ Date _____
(Print/Sign)

4. Inspect tube for scale, pitting or other defects. ☐

   a. If defects still exist, further preparation may be necessary requiring use of larger brushes. ☐

   b. Ensure tube end is dry as reasonably possible. ☐

Section 1.4 complete

Signature _____ Date _____
(Print/Sign)

5. Install the correct size plug as determined by Step 1 into the tube. ☐

6. Tighten the compression nut until plug is finger tight. ☐

7. Using a torque wrench, tighten the compression nut to the installation torque indicated for the plugs below. ☐

Plug Size (Inches)	Ft-lbs.
.280 - .499	Finger tight + (2) turns
.500 - .869	2.5
.870 – 1.309	9

Signature _____ Date _____
(Print/Sign)

EXPANDABLE PLUG INSTALLATION

1.1 Expandable Plug Installation (continued)

CAUTION

DO NOT TURN COMPRESSION NUT WHEN TIGHTENING THE LOCK NUT.7..... ☐

8. Tighten the lock nut to the back of the compression nut. ☐

Signature _____ Date _____
(Print/Sign)

9. Repeat Step 1 through Step 8 for all tubes requiring that end being plugged.

NOTE

For every tube requiring plugging write the pipe number in the blank provided. Then, after the inlet is plugged, check the corresponding blank and let it be verified by a signature and date. ☐

Pipe Number:	Inlet Plugged	Signature	Date

10. Repeat Step 1 through Step 8 for opposite end of tube to be plugged.

Signature _____ Date _____
(Print/Sign)

11. Repeat Step 1 through Step 9 for all tubes requiring opposite end of the tube to be plugged.

Signature _____ Date _____
(Print/Sign)

EXPANDABLE PLUG INSTALLATION

1.1 Expandable Plug Installation (continued)

11. (continued)

NOTE

For every tube requiring plugging write the pipe number in the blank provided. Then, after the outlet is plugged, check the corresponding blank and let it be verified by a signature and date. ☐

Pipe Number:	Inlet Plugged	Signature	Date

12. Ensure work area left clean after completion of work. ☐

Signature _____ Date _____
(Print/Sign)

TEST EQUIPMENT	ID NO.	

Remarks: _____

_____

_____

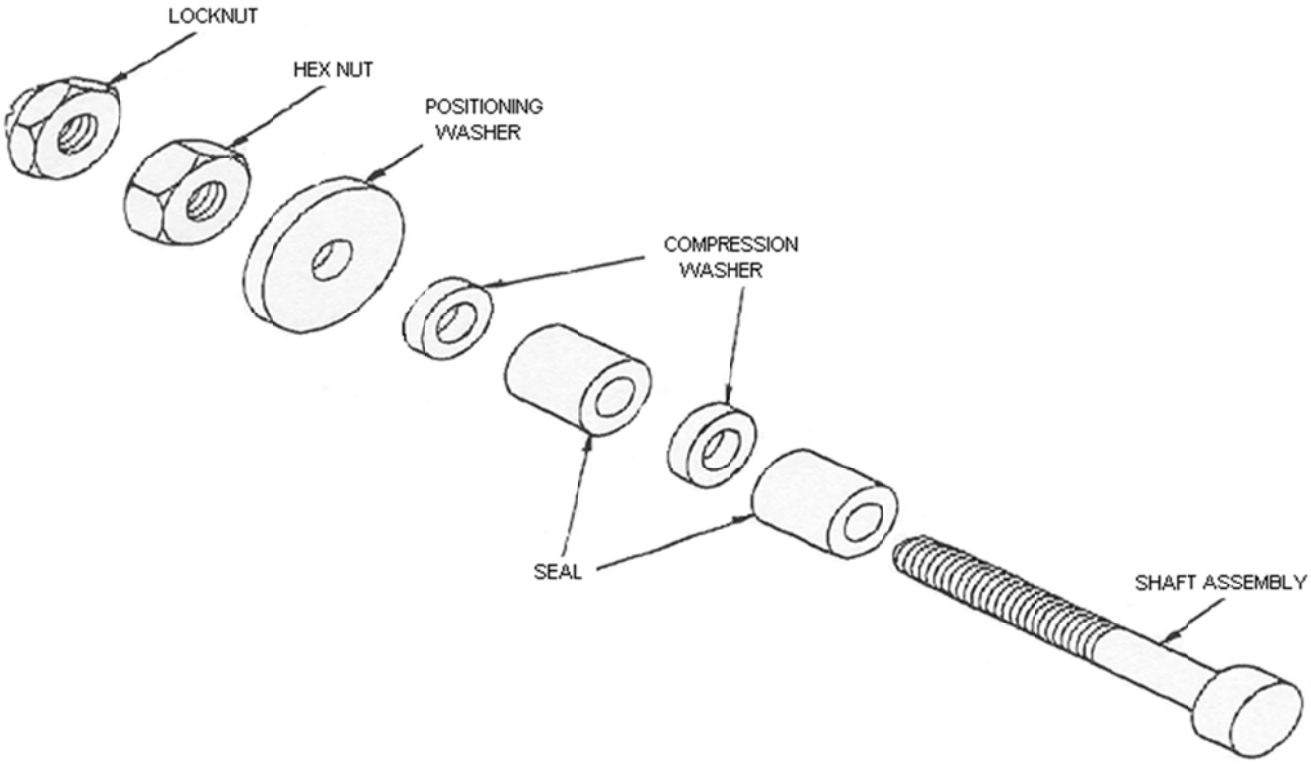
Reviewed By: _____/_____
Maintenance Superintendent/Supervisor (Print/Sign) Date

EXPANDABLE PLUG INSTALLATION

1.1 Expandable Plug Installation (continued)

12. (continued)

FIGURE 1
TYPICAL EXPANDABLE TUBE PLUG



"RING AND PIN" PLUG INSTALLATION

1.0 INSTRUCTIONS

1.1 Ring and Pin" Plug Installation

1. Take initial tube ID measurements to verify tube ID measurement. ☐
2. Verify tube plug size to be used as specified by Vendor manual or Maintenance Supervision. ☐

Signature _____ Date _____
(Print/Sign)

3. Using tube brush, prepare tube ID to the required installation depth. ☐
   a. IF a power operated brush is used, operate for at least 30 seconds, moving the brush in and out of the tube. ☐

Signature _____ Date _____
(Print/Sign)

4. Inspect tube for scale, pitting or other defects. ☐
   a. If defects still exist, further preparation may be necessary requiring use of larger brushes. ☐

Signature _____ Date _____
(Print/Sign)

5. Insert the ring into the tube to be plugged, ensuring the ring is flat against the tube sheet. ☐
6. Position the pin in the ring. Ensure the pin "flat" is parallel to the surface of the ring. ☐

CAUTION

DAMAGE TO TUBE SHEET OR ADJACENT TUBES MAY OCCUR IF EXCESSIVE FORCE IS USED TO SECURE PIN TO RING POSITION ☐

NOTE

THE PIN SHOULD PROTRUDE A MINIMAL AMOUNT SO AS NOT TO INTERFER WITH REASSEMBLY OF UNIT AFTER DRIVING INTO RING ☐

7. Using the appropriate size hammer, drive the pin securely into the ring to expand the ring to fit the tube. ☐
8. Ensure pin is secure in ring. ☐

"RING AND PIN" PLUG INSTALLATION

1.1 Ring and Pin" Plug Installation (continued)

9. Repeat Step 1 through Step 8 for opposite end of tube to be plugged. ☐

Signature _____ Date _____
(Print/Sign)

10. Repeat Step 1 through Step 9 for all tubes requiring tube plugging. ☐

Signature _____ Date _____
(Print/Sign)

11. Ensure work area left clean after completion of work. ☐

Signature _____ Date _____
(Print/Sign)

TEST EQUIPMENT	ID NO.	

Remarks:_____
_____
_____
_____

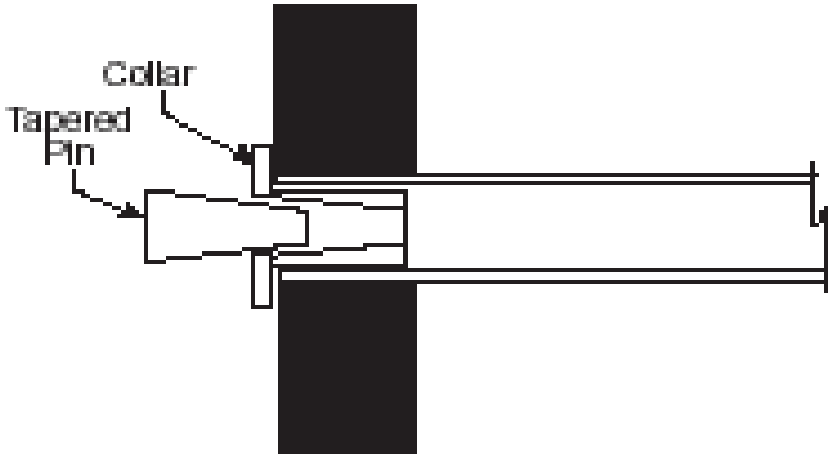
Reviewed By:_____/_____
Maintenance Superintendent/Supervisor (Print/Sign) Date

"RING AND PIN" PLUG INSTALLATION

1.1 Ring and Pin" Plug Installation (continued)

11. (continued)

FIGURE 2
TYPICAL "RING and PIN" TUBE PLUG



b. Two-Piece Tapered Plug

TAPERED PLUG INSTALLATION

1.0 INSTRUCTIONS

1.1 Tapered Plug Installation

1. Take initial tube ID measurements to verify tube ID measurement. ☐

NOTES

- SHOP PRODUCED PLUGS SHOULD HAVE A RECOMMENDED INCLUDED ANGLE OF APPROXIMATELY 5-1/2 DEGREES. ☐
- THE LARGER END OF TAPERED PLUGS SHOULD BE 0.010" (0.25 MM) GREATER THAN THE TUBE INNER DIAMETER ☐

2. Verify tube plug size to be used as specified by Vendor manual or Maintenance Supervision. ☐

Signature _____ Date _____
(Print/Sign)

3. Using tube brush, prepare tube ID to the required installation depth. ☐

   a. IF a power operated brush is used, operate for at least 30 seconds, moving the brush in and out of the tube. ☐

Signature _____ Date _____
(Print/Sign)

4. Inspect tube for scale, pitting or other defects. ☐

   a. If defects still exist, further preparation may be necessary requiring use of larger brushes. ☐

Signature _____ Date _____
(Print/Sign)

5. Position the tapered plug in the tube. Maintain the “flat end ” of the tapered plug is parallel to the surface of the tube sheet. ☐

TAPERED PLUG INSTALLATION

1.1 Tapered Plug Installation (continued)

CAUTION

DAMAGE TO TUBE SHEET OR ADJACENT TUBES MAY OCCUR IF EXCESSIVE FORCE IS USED TO SECURE TAPERED PLUG IN POSITION ☐

NOTE

THE TAPERED PLUG SHOULD PROTRUDE A MINIMAL AMOUNT SO AS NOT TO INTERFER WITH REASSEMBLY OF UNIT AFTER DRIVING INTO TUBE. ☐

6. Using the appropriate size hammer, drive the tapered plug securely into the tube. ☐

7. Ensure tapered plug is secure in tube. ☐

8. Repeat Step 1 through Step 7 for opposite end of tube to be plugged. ☐

Signature _____ Date _____
(Print/Sign)

9. Repeat Step 1 through Step 8 for all tubes requiring tube plugging. ☐

Signature _____ Date _____
(Print/Sign)

10. Ensure work area left clean after completion of work. ☐

Signature _____ Date _____
(Print/Sign)

TEST EQUIPMENT	ID NO.	

Remarks:_____
_____
_____
_____
_____

Reviewed By:_____/_____
Maintenance Superintendent/Supervisor (Print/Sign) Date