Underground Technology

GTI Keyhole Conference Fall 2013

Operating Instructions for Keyhole Procedures

By Frank Russo

Process Documentation

Every process is documented with the following items

Item 1

Process Description – A brief description of the methods that are utilized to perform the process

Item 2

Tooling Description & Process Features – A description of the tooling and support equipment that will be necessary to support the process

Item 3

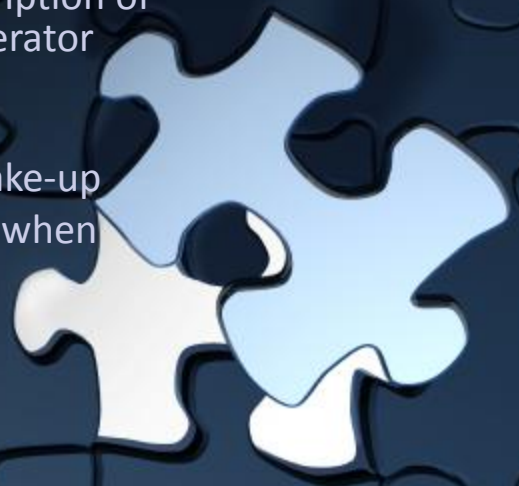
Tooling List – A list of all of the tools necessary to perform the process with part numbers, tool descriptions and photos of each tool

Item 4

Operating Procedure – A step by step description of the entire process with photos to help the operator understand each step of the process

Item 5

Flow Chart – The sequence of steps that make-up the process and provisions for alternate steps when events don't proceed as planned



Keyhole Tools are specially designed devices that enable remote access to gas lines through small excavations

Just like a surgeon needs special tools to perform orthoscopic procedures, the gas mechanic needs special tools to perform Keyhole processes

- A gas mechanic cannot use the same tools to perform a process in a small excavation as in a conventional (3’ x 5’) excavation
  - Pneumatic tools must be small enough to allow a line of sight around the tool.
  - Hand tools must facilitate positive and secure access to the work using extensions that are approximately 6 feet in length.

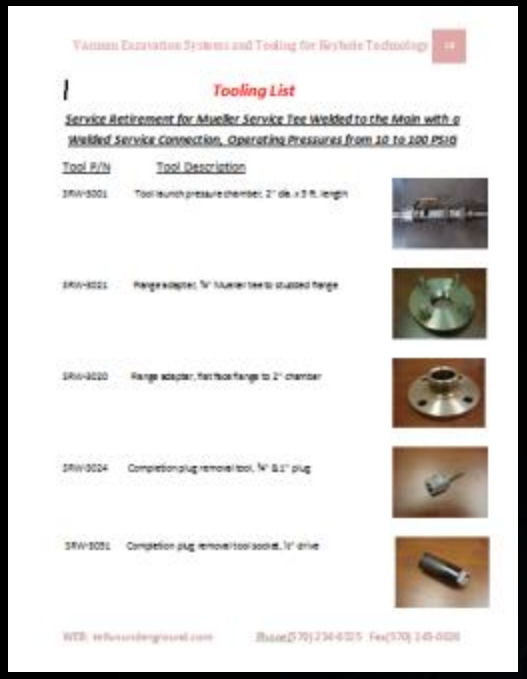
All Keyhole Processes Must Be Properly Tooled

There is no way to gain safe access to the main without proper tooling

- Core cut 18 inch diameter openings demand that all operating procedures are thoughtfully designed and performed using professional tooling

A Tooling List is a part of every process

Tooling lists include a P/N, description and photo for every tool



Tooling List

Service Retirement for Mueller Service Tee Welded to the Main with a Welded Service Connection, Operating Pressures from 10 to 100 PSIG

Tool P/N	Tool Description
SRW-5001	Tool launch pressure chamber, 2" dia. x 5 ft. length
SRW-5021	Flange adapter, 4" Mueller tee to studded flange
SRW-5020	Flange adapter, flat face flange to 2" chamber
SRW-5024	Completion plug removal tool, ¾" & 1" plug
SRW-5031	Completion plug removal tool socket, ¾" drive

Tool P/N	Tool Description
SRW-5003	Expansion plug installation tool
SRW-1010	Pneumatic extension saw, up to 2" pipe x 6' length
SRW-5009	Steel pipe chamfer tool, ¾" pipe size
SRW-5062	Steel pipe chamfer tool, 1" pipe size
SRW-5027	Cap installation tool, ¾" Mueller cap x ¾" drive
SRW-5064	Cap installation tool, 1" Mueller cap x ¾" drive

- Keyhole tools are not the same tools that would be used in conventional excavations
  - Most operators are not familiar with the tools that are needed for Keyhole processes.
  - Some tools are specially designed to handle non-standard fittings.

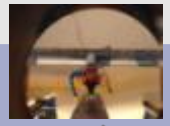
Four Standard Keyhole Processes

These four standard keyhole processes make-up the basis upon which most procedures and tools are designed.

- Retirement of a gas service on a low pressure cast iron main
- (Low pressure service cut-off)

Process 1

- Retirement of a welded gas service on medium or high-pressure main
- (High & medium pressure retirement)



Process 2

- Plastic Service Line and Service Tee Installation
- (Service renewal)

Process 3

- Retirement of a Service Tee on a "U" Bolt Saddle
- (Medium pressure retirement)

Process 4

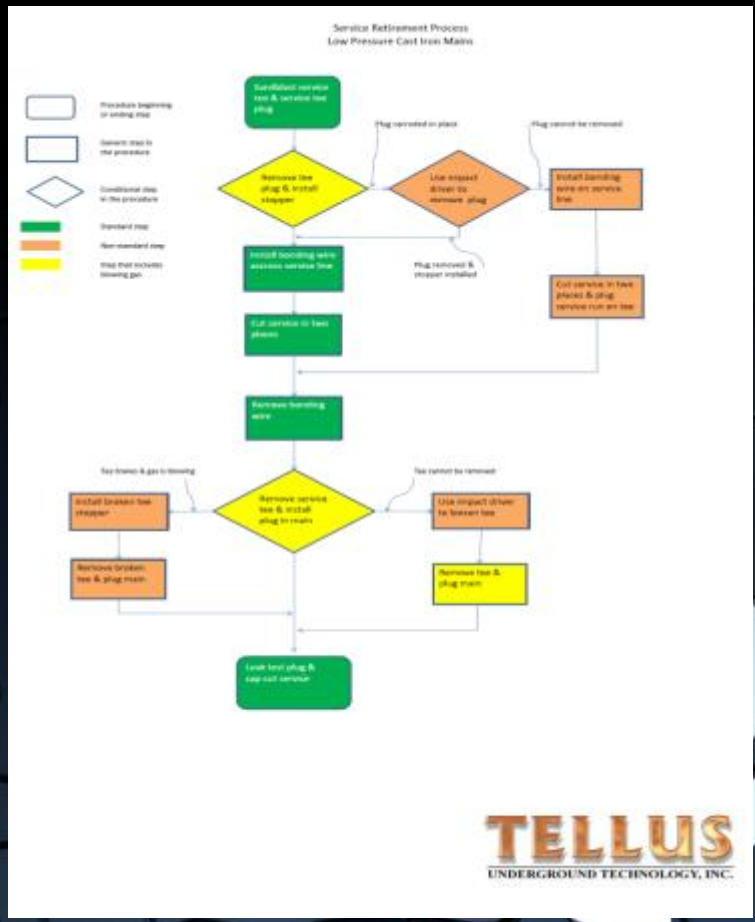
All keyhole processes are designed around a few basic procedures. Once you have trained and tooled for these basic processes you can preform a multitude of keyhole procedures.

A few minor tooling changes are usually the only thing necessary to expand to other processes.

Flow Chart for Low Pressure Service Cut-off

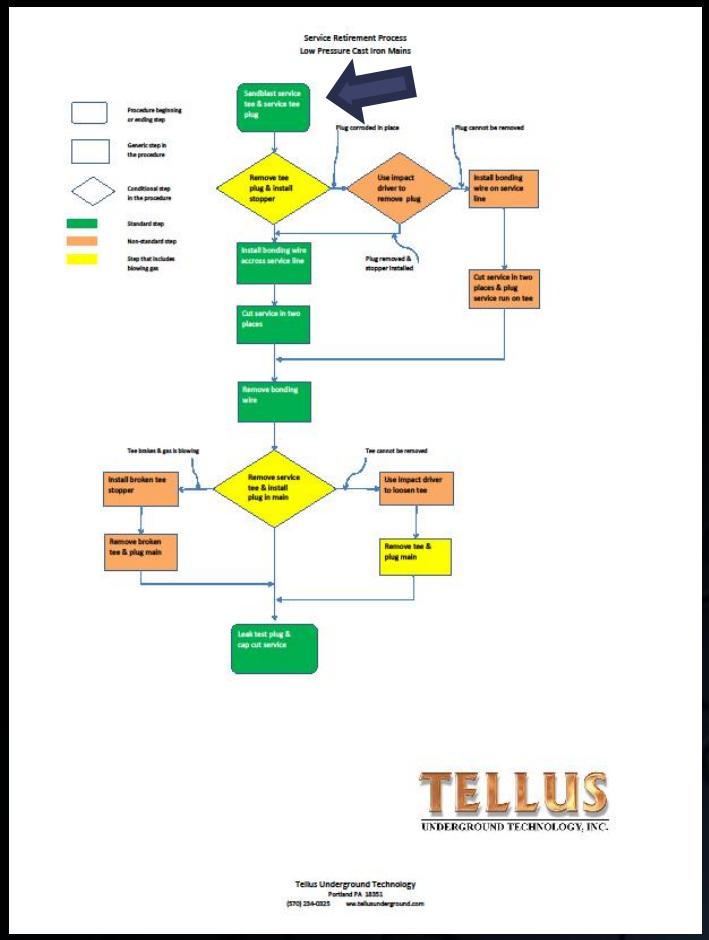
If the process were to proceed without problems there would be a single chain of events

But when problems occur there must be a plan to address the problems that arise



Low pressure service cut-off procedure

After the service and main are exposed the service tee and tee plug must be cleaned to allow tool access.



Stopping-off gas flow to the service line

Well designed tools are constructed to prevent cracking or rounding of the tee plug.

- This is a two man operation to reduce the amount of blowing gas.
  - As the first operator removes the tee plug the second operator installs the stopper into the tee.

- If the plug cannot be removed:
  - A rotary impact tool can be used to break the plug free.
  - or
  - Cut the service line and install a 90 degree stopper

Cutting the service line

Bonding clamps must be installed across the section that is about to be cut

- With the stopper in place there is no flow of gas into the service line.
  - The extension tool that was used to install the stopper into the tee is released from the stopper so that the service tee can be removed with a tee socket

- The service line must be cut in two places to allow rotation of the tee and cut stub.
  - The first cut must be made at outer edge of the excavation away from the service tee
  - The second cut is made as close to the tee as possible

When the flow of gas into the service cannot be stopped

The service line must be plugged

- If the tee plug cannot be removed
  - The service line is cut in two places.
  - A 90 degree stopper is installed in the service line.

- Services that do not contain tees
  - The procedure is the same as above

Removing the service tee from the main

The risk of breaking the tee can be very high if poorly designed tooling is utilized

- Special tee sockets that fit snugly over the service tee create torque forces that are transmitted directly through the centerline of the fitting thus reducing the possibility of breaking the fitting.

- If the service tee breaks, a specially designed “EZ Out” tool can be installed on the ¾” extension drive to remove the broken tee stub

If the service tee breaks

Gas is blowing and must be controlled

- A rubber stopper is installed into the broken service tee to stop the blowing gas.
  - Tapered rubber stoppers with a ¼" hex drive can be pressed into the broken tee to stop the blowing gas while the crew fits the correct size "EZ-Out" onto the ¾" extension drive.

- Using the "EZ-Out" the broken stub can be removed.
  - With both gas mechanics on the tee handle a torque force of 500 lbs.-ft. can be applied to the "EZ-Out" tool.

Plugging the main

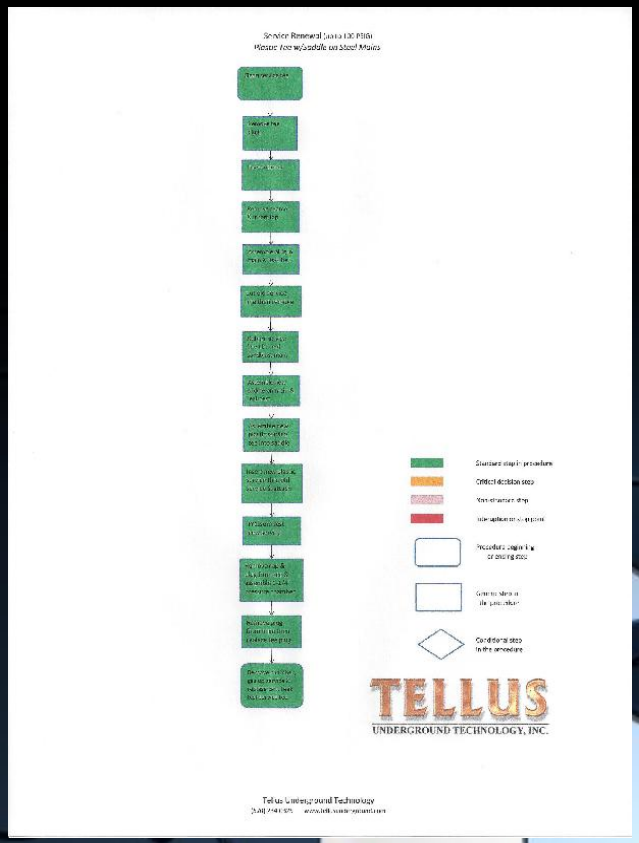
The tools are designed to reduce the possibility of cross threading the plug in the main

- This step is also a two man operation to reduce the amount of blowing gas
  - As one operator removes the service tee from the main the second operator starts threading the pipe plug into the threaded hole in the main.

- After the pipe plug has been successfully started into the main the plug is tightened using the pipe plug socket on the ¾” drive extension.

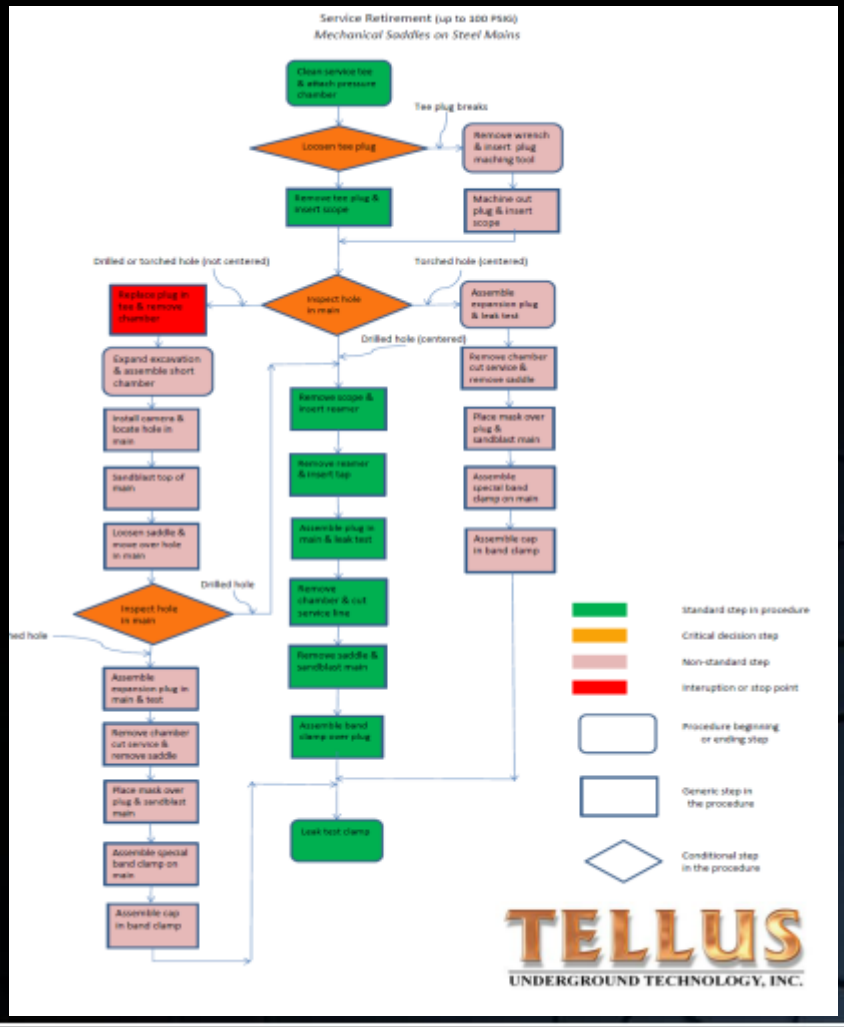
Medium & High-Pressure Service Cut-off Procedure

A no-blow service retirement process to remove saddle mounted services mounted on steel mains.



Using a fully mapped flow chart for medium & high-pressure service cut-offs

When performance of the process does not follow the standard sequence of events alternate steps must be planned into the procedure.



Pressure chamber design

All no-blow chambers consist of a "launch chamber" & "sealing chamber"

- The "launch chamber" is a pressure vessel that provides the ability to place the tools onto the gas fittings inside a pressure chamber that has been elevated to the gas main pressure.

- The "sealing chamber" provides a pressure tight connection between the pressure chamber and the live gas line.

The chamber is sealed to the service tee and the tee plug is removed

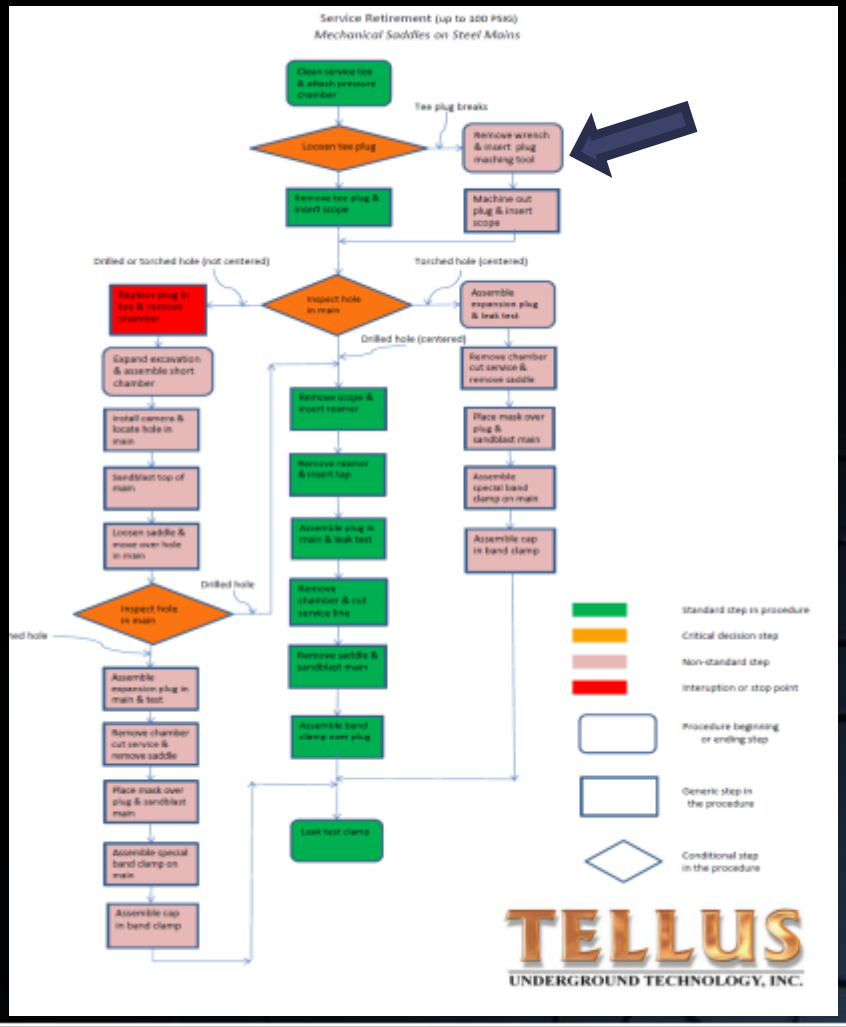
The tee plug is loosened thru the pressure chamber

- A special magnetic plug socket is used to remove the tee plug from the service tee.

- If the plug breaks there is no blowing gas because it is inside the chamber.
  - A cutting tool is assembled into the chamber and the plug is machined away to allow access into the service tee.

If the tee plug breaks a hole is cut thru the plug to permit access into the tee

The operating procedure is designed to deal with this type of event by establishing a secondary course of actions to address the situation.



Inspecting the opening in the main

The hole in the main may have been drilled or torched thru the pipe wall.

- A fiber-optic scope is installed into the pressure chamber to inspect the opening in the main.
  - If the hole has been drilled it can be threaded to accept a special steel plug.
  - If the hole has been torched it can be plugged with a special rubber seal plug.

- When the opening in the main is off center and cannot be accessed thru the service tee the saddle must be moved.

Tapping the main for a steel plug

Most mains were drilled using a drilling fixture

- The opening is cut to size using a special reaming tool to produce a hole that is an exact diameter.
  - When the operator sizes the hole to the proper diameter the reaming tool will turn freely.

- The hole is then tapped by hand.
  - Since these are straight threads the operator can feel the when the tap is cutting threads and will feel no resistance when tapping is complete.

Installing the plug in the main

A fine thread plug is installed into the main

- Using a magnetic hex key a threaded steel plug is installed in the main.
  - The threads are sealed using pipe thread sealing tape that is applied prior to installation.

- These plugs are designed to fit flush with the top of the main and have a small round protrusion into the inside of the main.

Install a band clamp over the plug

A stainless steel band clamp is installed over the plug.

- A section of the main on both sides of the plug is sandblasted to create a good seal surface for the band clamp.

- Standard keyhole tools are used to install and tighten the band clamp in place.
  - For those installations that require corrosion protection, a corrosion kit is available.

Unexpected events must be addressed if keyhole technology is to be successful

If Keyhole processes get out of control the safety of the operator is compromised and the operation is placed in danger

- When we fail to plan we have a plan for failure.

Benjamin Franklin

Tooled & Documented Keyhole Processes

- Leak location & repair
- Service retirement (service cut-offs)
- Corrosion control
- Service renewals
- Anode installation
- Service installation
- Camera launch & inspection
- Underground plant location
- Meter replacement &relocation
- Tracer wire repair
- Test station installation
- Gas evacuation: emergency leaks
- Tie-overs on main replacements