



**Notes to accompany presentation on Fuel-gas
Involvement in Fire Causation. Presented at the
53rd Annual Northern Ohio Arson Seminar**

**February 26, 2022, at Ashland University,
Ashland, OH**

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**Case Study involving house explosion soon
after a new propane tank replaced an
existing one.**

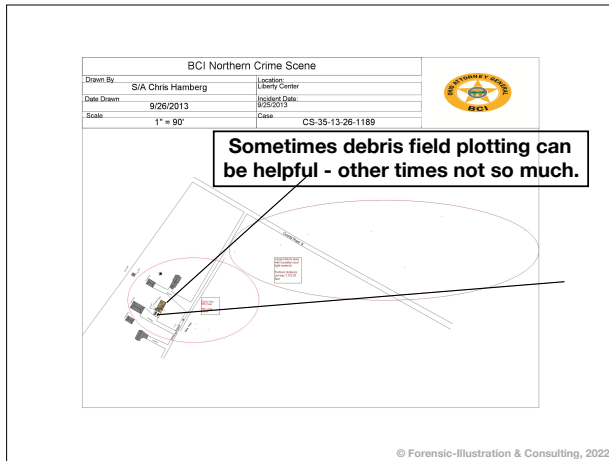
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**Background info is absolutely crucial
to a good investigation.**

**Investigating an explosion according to
NFPA 921**

22.14.2.2 Obtain Background Information. Before beginning any search, all relevant information should be obtained pertaining to the incident. This information should include a description of the incident site and systems or operations involved and of conditions and events that led to the incident. The locations of any combustibles and oxidants that were present and what abnormal or hazardous conditions existed that might account for the incident need to be determined. Any pertinent information regarding suspected explosive materials and causes will be of interest and will aid in the search as well.

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921 Origin & Cause Determination

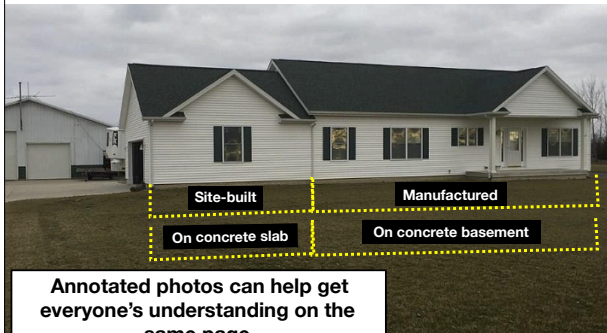
How do you determine the cause and/or origin of an explosion ?

22.14.2.2.1 In developing the evidence, the investigator should examine witness accounts, maintenance records, operational logs, manuals, weather reports, previous incident reports, and other relevant records. Recent changes in equipment, procedures, and operating conditions can be especially significant.

This is, perhaps, the most important section of NFPA 921 as it pertains to explosions - and really any investigation.

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We learn this is a manufactured home with a site-built attached garage and outbuilding.



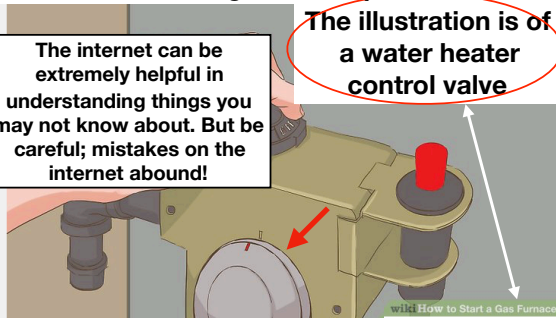
Annotated photos can help get everyone's understanding on the same page.

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What's wrong with this picture ?

The internet can be extremely helpful in understanding things you may not know about. But be careful; mistakes on the internet abound!

The illustration is of a water heater control valve



3 Purge gas in the furnace for unlit pilots. Turn the power switch of the furnace to "Off." The gas supply can usually be found along the furnace bottom, on its control panel, or inside the access panel. Turn the gas supply to "Off" and wait at least five minutes.

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The outbuilding is probably not of concern. But installation of insulation might be.

Was it installed in the attic ?

Was it installed in the basement ?

Was it installed in the walls ?

Did they drill holes to pump insulation in ?

Could they have hit a gas line?

Sometimes information developed in interviews may seem to have no relevance. Like how could insulating a house lead to an explosion? It might!

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The gas furnace is original to the house (at least to present owner.)

The dryer was either replaced or added by the owner. Present unit is electric. (DIY)

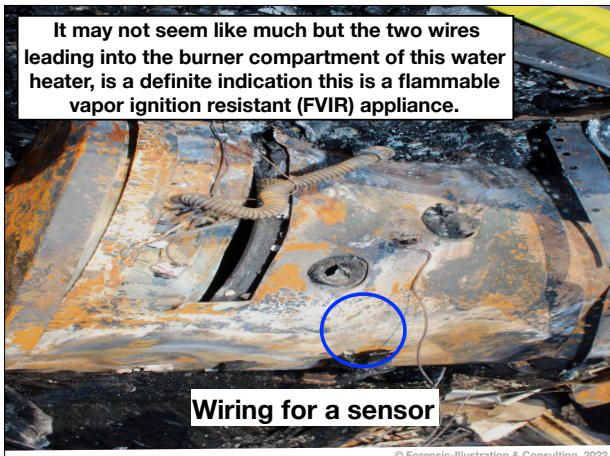
The water heater was changed from an electric model to a gas model about 2 years prior to the explosion. (DIY)

The new water heater was described as “basically electronic.”

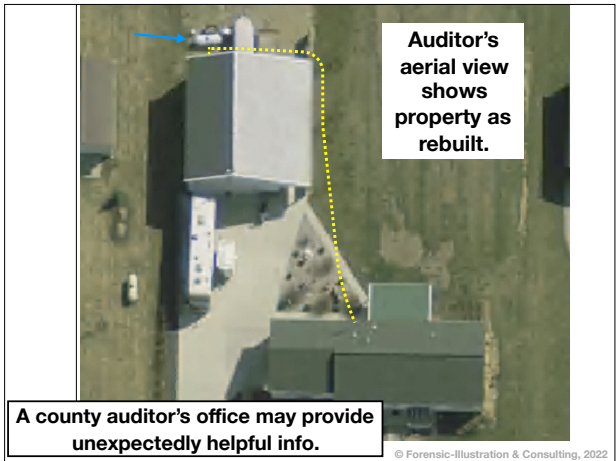
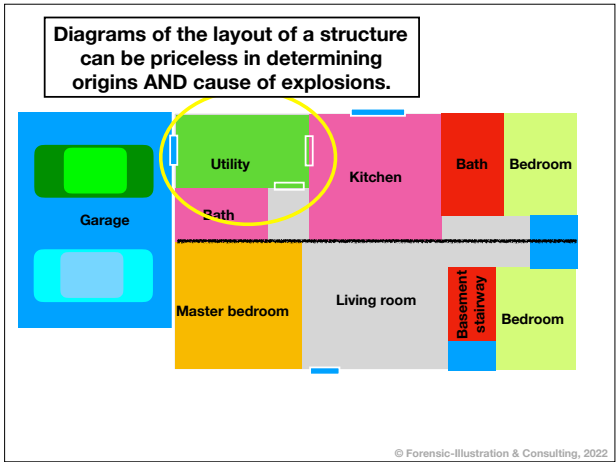
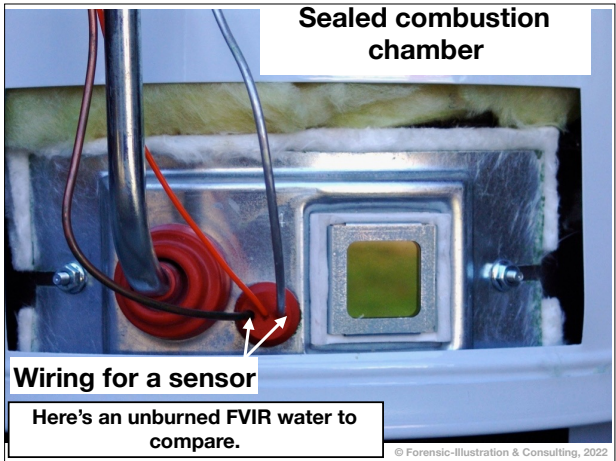
So many things are done wrong by do-it-yourselfers (DIY), always pay close attention to any work done that way.

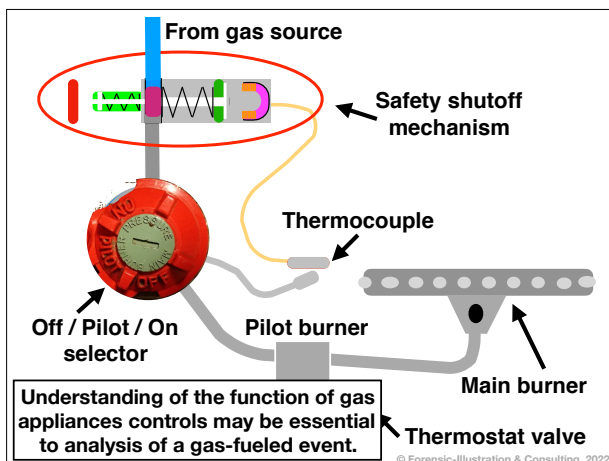
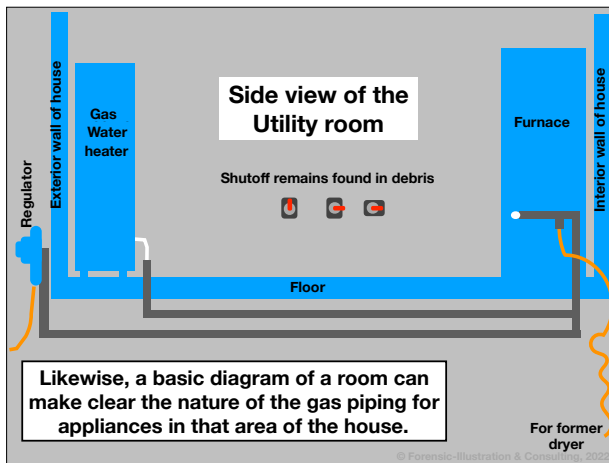
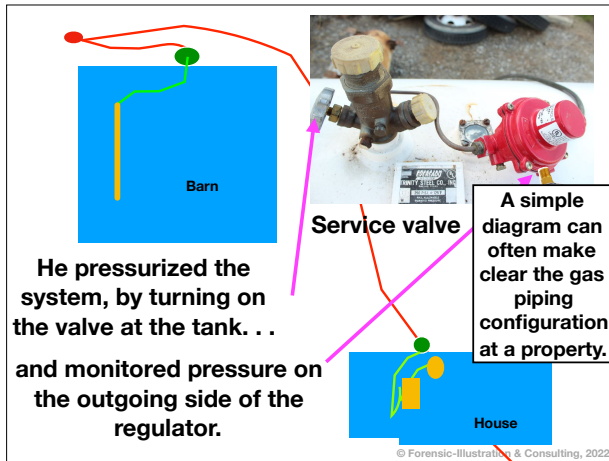
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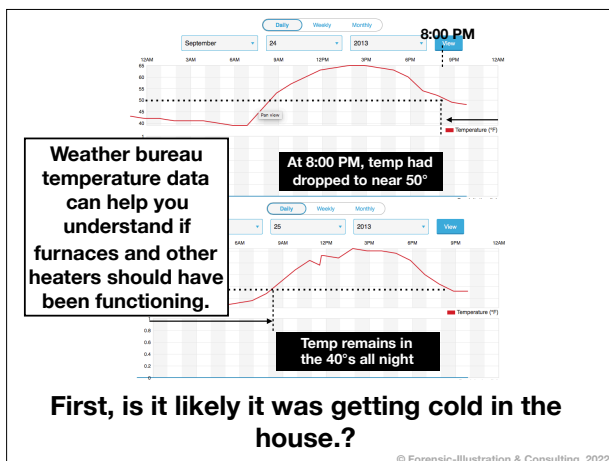
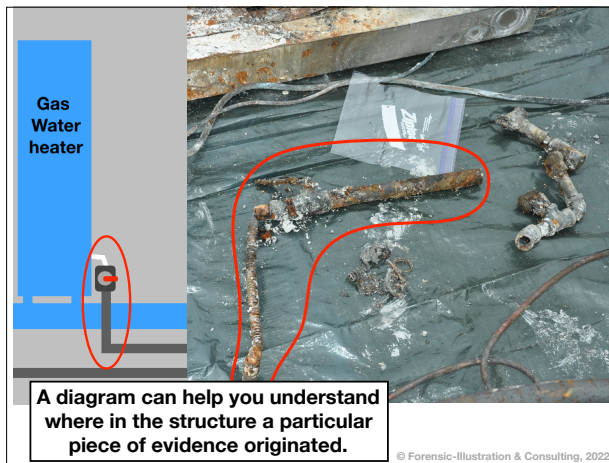
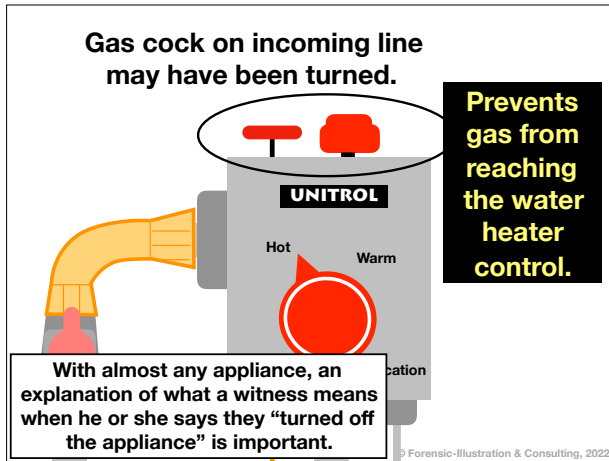
It may not seem like much but the two wires leading into the burner compartment of this water heater, is a definite indication this is a flammable vapor ignition resistant (FVIR) appliance.



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We need to go through his process, step by step. What did you do first, how did you do it, why did you do it, etc.

I asked him to describe his furnace-starting process.

He said he had to turn on the gas to the furnace. I asked where that gas valve was and he said it was outside the furnace, between the furnace and the washer.

Just because you may know how to complete a particular process, it's important to have a witness described in detail how he or she did that job.

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After this procedure, he turned up the thermostat.

He said he heard the furnace come on so he knew it was working. Then he turned the thermostat down some. He did not recall hearing the furnace come on after that, but the occupants were up and working in the computer room until sometime between 11:00 p.m. and 1:00 a.m. and he didn't notice it getting cold in the house.

The weather data we obtained can give us a helpful clue the furnace wasn't the problem: it appeared to have been working because the house didn't get cold!

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Let's look at one more appliance: the dryer. But its electric... now.

The dryer was either replaced or added by the present owner. (DIY)

In my interview, he told me that they replaced the existing gas dryer with an electric model.

In his deposition, he said the previous owners took their dryer with them and so he added the present electric dryer.

Often times witnesses' information conflicts -even with him or herself. But don't automatically assume one or the other was right. Remember both and try to deduce which had to have been correct.

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A tubing loop is often used (improperly) as a flexible gas connector. That loop can have meaning when examining debris.



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Here the loops have been stretched out in the explosion but still are obvious in this copper tubing.



This end has a flare nut.



Yep, that's a dryer (or its remains). May not look like much but experts who examine these regularly can tell at a glance who manufactured it.

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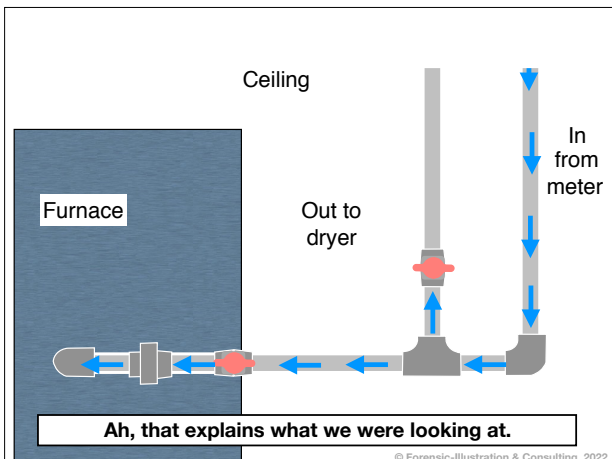
Two shutoffs in what appears to be one supply line are a clue that something is amiss.

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A different view hints that, perhaps, these two shutoffs are actually on different supply lines.

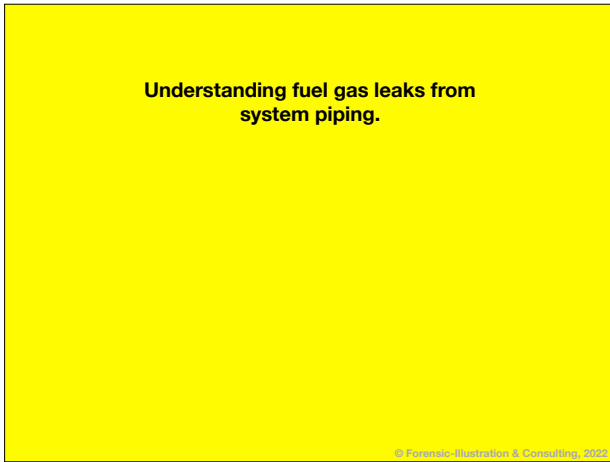
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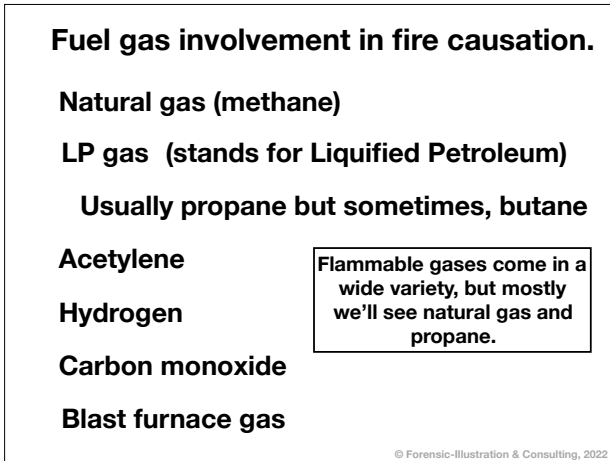


Ah, that explains what we were looking at.

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Misconception #1

Blue flames ~~prove~~ gas involvement.

Lack of blue flames ~~prove~~ no involvement.

✓ Blue flames probably won't accompany a gas ignition-caused event.

✓ Blue flames can be caused by many things, including fire encompassing copper items.

✓ Blue flames only mean that **SOMETHING** is burning.

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Misconception #2

An event caused by a gas vapor ignition ~~ALWAYS~~ causes an explosion.

~~An event caused by a gas vapor ignition NEVER causes an explosion.~~

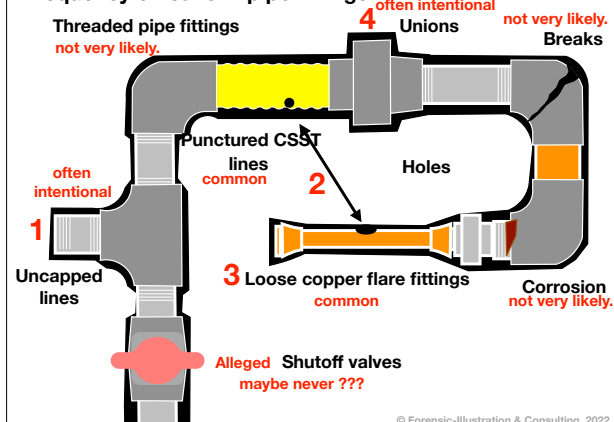
~~An event caused by a gas vapor ignition ALWAYS causes great fire damage.~~

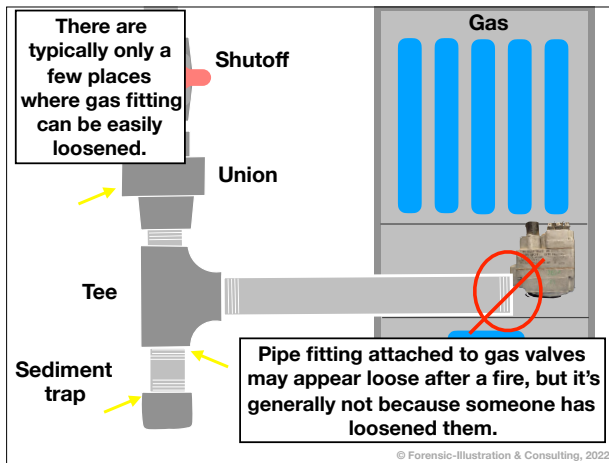
~~An event caused by a gas vapor ignition NEVER causes great fire damage.~~

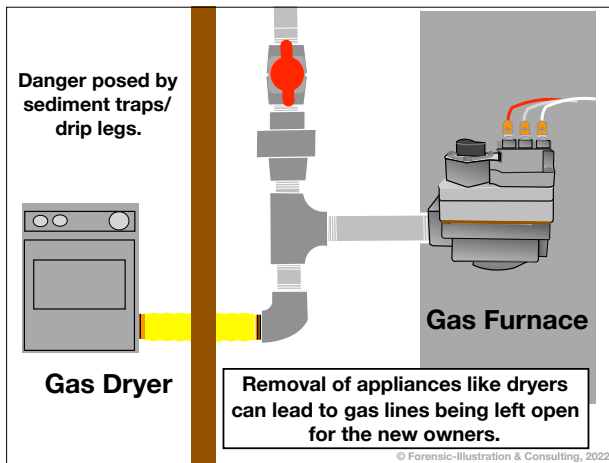
✓ Its unpredictable whether or not an explosion or great fire damage follows a gas ignition event.

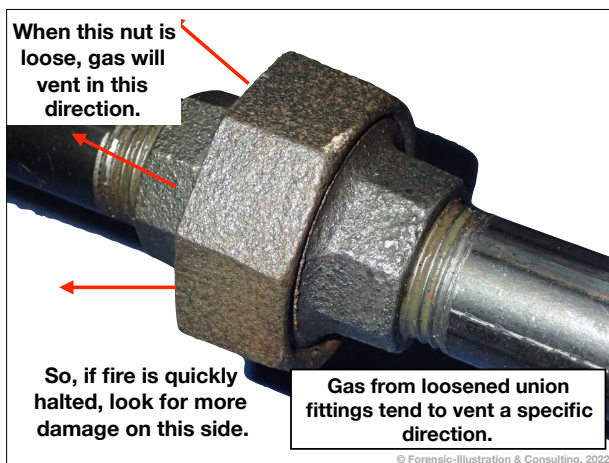
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Frequency of leaks in pipe fittings









**How does a union connection
become loose ?**

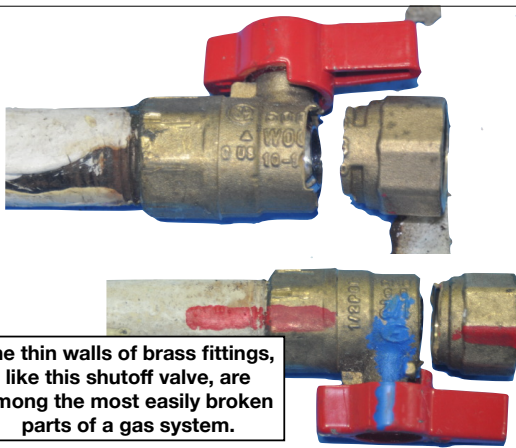
**In my opinion, usually someone
has helped it.**

An arsonist -

Someone attempting suicide -

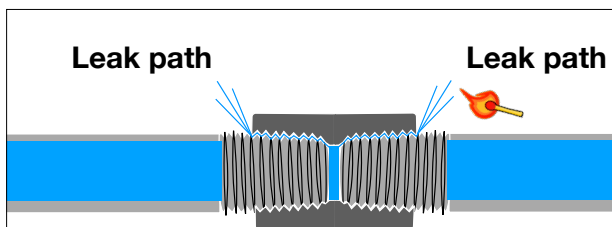
**Improper repairs, not securing the
connection.**

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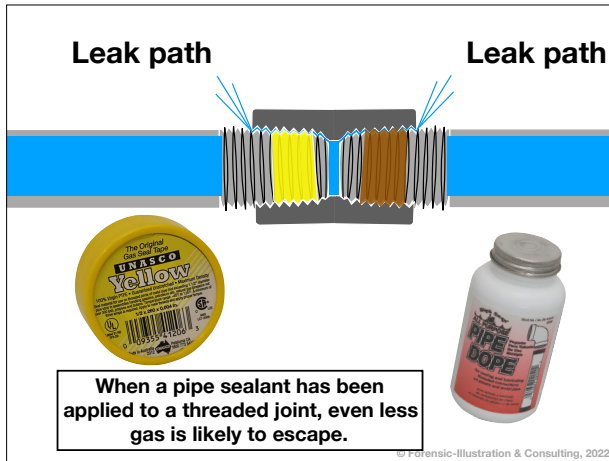
**The thin walls of brass fittings,
like this shutoff valve, are
among the most easily broken
parts of a gas system.**

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**Threaded pipe fittings tend to leak
very little gas. You may smell it (up
close) but it may not be enough
volume to sustain a fire.**

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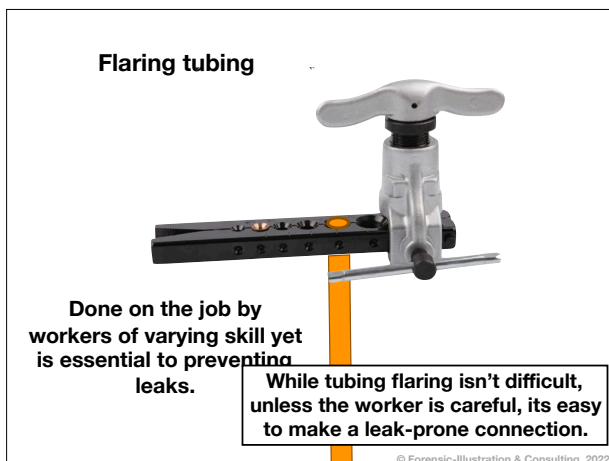


The bottom line is, well-threaded and adequately tightened black pipe joints don't leak much.

Perhaps that's why I've never seen a leaking black pipe joint that's caused a fire.

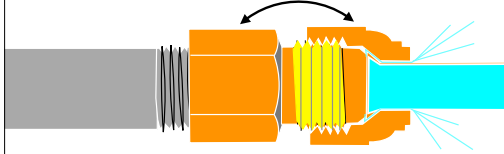
And its certainly why I've never seen one that's caused and explosion.

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This connection has to be
REALLY tight or it will leak !

Leak path

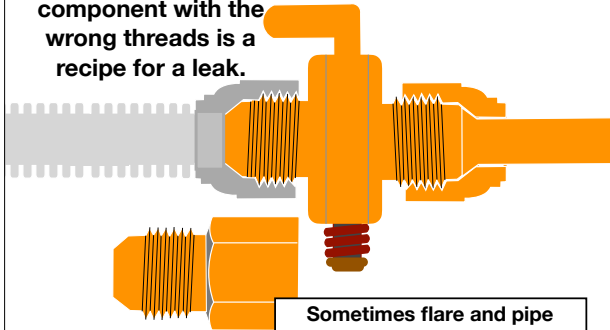


Thread sealant here does no good.

The leak path at a very slight
loosened flare fitting has a
directional leak path.

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Slipping in an extra
component with the
wrong threads is a
recipe for a leak.



Sometimes flare and pipe
fittings are improperly
intermixed with leaks resulting.

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the biggest
Open - uncapped - lines, ~~a big~~ problem.

Threaded pipe connections don't leak
much.

Unions and flare fitting, not totally tight
can leak a bunch.

Flare fittings are usually created on site
and depend on quality workmanship to
avoid leaks.

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How to and the value of Interviewing.

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Background information

On the day of the explosion/fire, the homeowner's LP gas supplier was replacing the home's existing 250 gallon LP tank with a new 500 gallon LP tank.

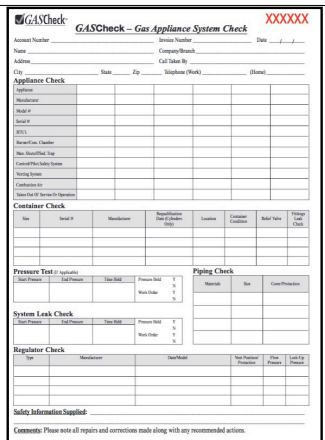
The LP gas company's owner came to the home bringing with him a new employee he was training.

The first order of business was to move the old tank to the homeowner's nearby work shop where the homeowner intended to use it to fuel a heater to warm the shop.

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The  **GASCheck** form is a checklist published by the propane industry for use by their members.

Helpful information like that contained on an LP gas supplier's GASCheck form, can help you identify many components of a gas system.



The image shows a sample of the GASCheck form, which is a checklist for gas appliance system checks. The form includes sections for:

- Account Number, Service Number, Date, Name, Company/Branch, Address, City, State, Zip, Telephone (Work), and (Home).
- Appliance Check: A table with columns for Appliance, Manufacturer, Model #, Serial #, BTU's, Gas Valve, Gas Control, and a column for the check status (Pass, Fail, or N/A).
- Gas Piping Check: A table with columns for Size, Material, Date of Installation, Location, Condition, and a column for the check status.
- Pressure Test: A section for recording the test results, including the test pressure, test duration, and the test results.
- System Leak Check: A section for recording the leak check results, including the test pressure, test duration, and the test results.
- Regulator Check: A section for recording the regulator check results, including the test pressure, test duration, and the test results.
- Notes: A section for recording any additional information or notes.

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Which gas appliances were present ?

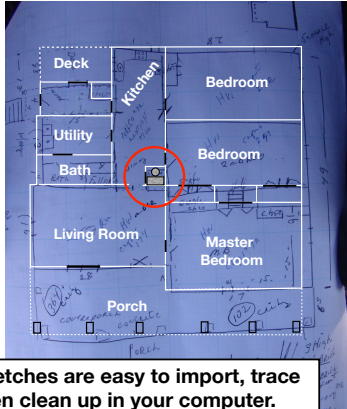
How many shutoffs were there ?

Which was on, which was off ?

This fire occurred in a rural area of Kentucky in early November. The overnight temperatures were in the 30's although afternoon temperatures rose to near 60°.

Data like this, tells us we'd expect the furnace to be operating or occupants would notice dropping temperatures in the structure.

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Rough sketches are easy to import, trace over then clean up in your computer.

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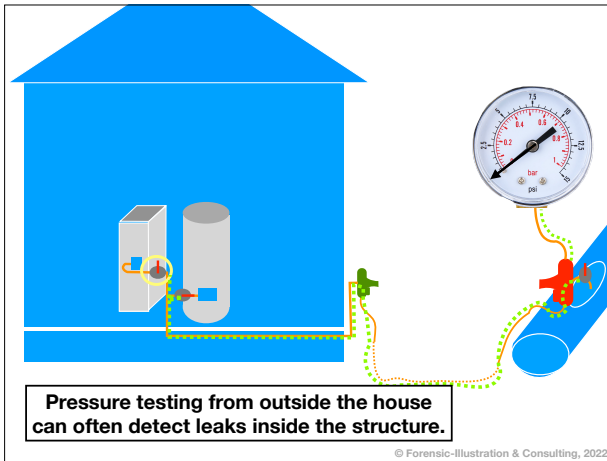
What does it mean when someone says he turned off the water heater ?

How DO you turn off the gas at the water heater ?

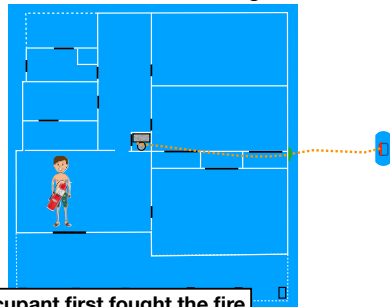
There are at least 3 obvious ways to do so - each has different implications.

Remember it's important to have your interviewee explain exactly how he or she did something. Don't assume because you know how you'd do that job that someone else would do it the same way.

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He immediately runs to the kitchen for a fire extinguisher and runs to the LIVING ROOM to fight the fire.



Where an occupant first fought the fire or where it was first seen, can reveal vital information for your investigation.

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Simply looking at a burned gas configuration in a photo, may not help you recall or explain how things were.



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Tracing gas lines using engineers tape.



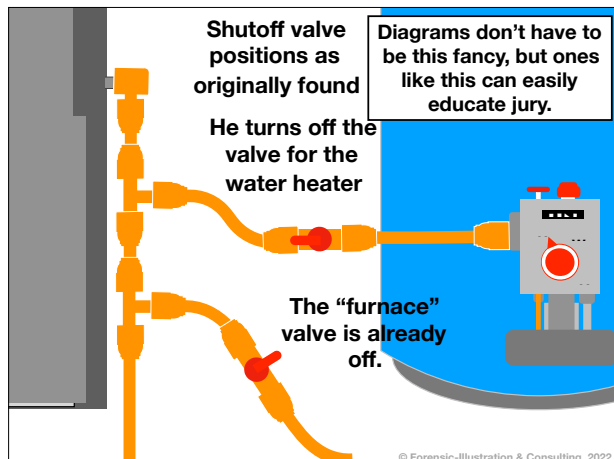
An assortment of various colors of engineers tape can help make sense of scene photos long afterwards.

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The yellow tape in this photo outlines the route of the mysterious gas line.

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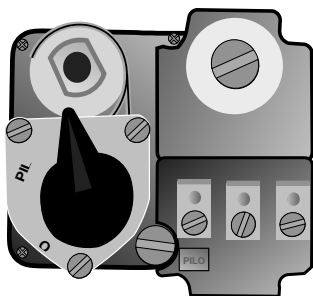
Shutoff valve positions as originally found

He turns off the valve for the water heater

The "furnace" valve is already off.

Diagrams don't have to be this fancy, but ones like this can easily educate jury.

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Learning a little about gas appliance control valves can help immensely in sorting out gas leakage problems.

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921 Origin & Cause Determination

How do you determine the cause and/or origin of an explosion ?

22.14.2.2.1 In developing the evidence, the investigator should examine witness accounts, maintenance records, operational logs, manuals, weather reports, previous incident reports, and other relevant records. Recent changes in equipment, procedures, and operating conditions can be especially significant.

You've seen this before, but its a mighty helpful quote from NFPA 921.

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A good recorded interview with participants as soon as possible is often crucially important.

But how do you interview someone about something with which you have no familiarity ?

Good interviews (in all types of fire investigations) can do more to assist you that perhaps any other one technique.

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Gas leaks around the meter.

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FACTS OF THE CASE

Son left on the school bus at 6:15.

He saw nothing amiss prior to leaving.

Neither did the school bus driver see anything out of the ordinary.

A little background info to remind you of the case study involving a fire at the home's gas meter.

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The fire occurred right outside this kitchen window while the homeowner was inside the kitchen and unaware.

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The bus driver who seems likely to have seen something burning if it were, didn't. . .

The homeowners who seem quite credible saw fire **ONLY** at the meter. . .

The fire department tends to support the homeowners' observations . . .

And even burn patterns indicate the fire began outside.

Putting together various observations helps to reveal the big picture.

Possible sources of gas

Damage to the meter/regulator

from ice/snow falling off the roof ?

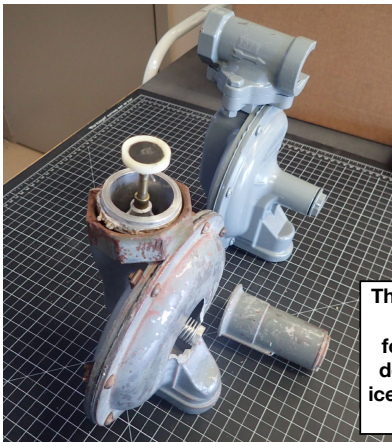
from snow being plowed against the meter/
regulator ?

freezing ?

pipe breakage due to frost movement?

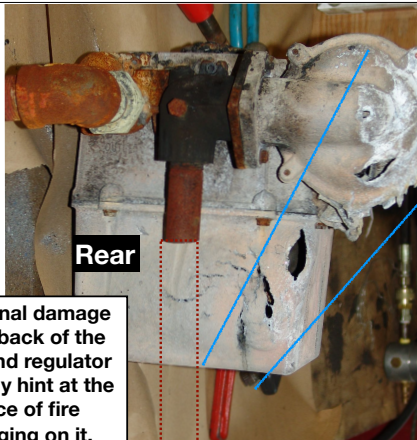
Try to make lists of all the possible
scenarios that may have occurred, then
see which, if any, you can eliminate.

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The gas regulator
shown in the
foreground was
destroyed when
ice fell off the roof
onto it.

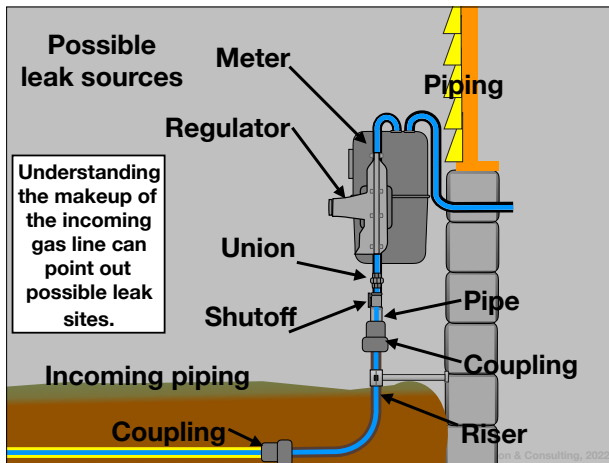
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Rear

Directional damage
on the back of the
meter and regulator
assembly hint at the
source of fire
impinging on it.

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In the mid 2000s, the Public Utilities Commission of Ohio (PUCO) initiated an Investigation of Installation, Use and Performance of Natural Gas Service Risers throughout Ohio.

Case 05-463-GA-CO1

It may take some searching to find this PUCO Investigation Report.

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PUCO found 3 service riser “incidents” from 2000-2003. Additionally, they found numerous other “non-incidents.”

One gas company found it was having an average of 18 gas service riser failures per month over a period of 34 months.

Another gas company reported it had experienced 5 failures per month over 59 months.

One company reported 31 failures in January 2005 alone.

That’s quite a lot of “incidents.”

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IV. Consultant Conclusions

The consultants in their "Final Discussion and Analysis: For Results Reported by ARDL In June 14, 2006 Test Report" stated four main issues are evident:¹⁹

- 1. Leaking risers have gaskets, which were deemed deteriorated, based on the CSR % Force Retained (%FR) measurements made by the laboratory.
- 2. Cracks in gaskets and deformed retainer ring(s) were observed more in leaking risers in comparison to removed no-leak risers. These outcomes may be major contributors to the lower %FR outcome for leaking risers.
- 3. Riser leak failures are more likely to occur at low environmental temperature (15°F), when the supply pipe is loaded by tensile pull (200 lb).
- 4. Between 4.1% and 4.6% of all leaking risers examined were missing components and were assembled wrong (respectively), and can lead to riser failures. This observation points to some installers not following the manufacturers' installation directions in the field.

Conclusions reached indicate there is more than one problem involved with leaking riser assemblies.

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CSST Fittings



PE Pipe Fittings

CSST fittings located immediately next to PE fittings at a "big box" home improvement store raise the possibility of them being intermixed with predictable leakage resulting.

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Riser

The DIY risers for PE pipe come completely assembled, likely reducing the risk of leakage.

PE pipe

Pipe thread connection

Steel - shielded PE pipe

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Good luck with your investigations. Feel free to email me with your questions. Perhaps I can help.

**You can contact me via email at
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