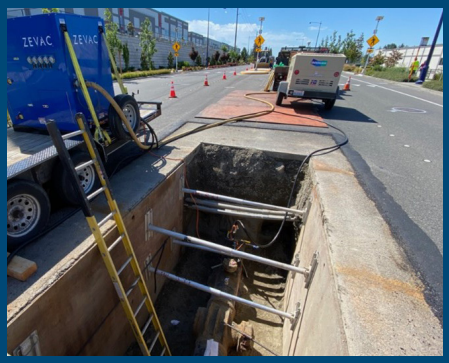
ZEVAC

Net Zero Made Easier.



APPLICATION GUIDE FOR LOCAL DISTRIBUTION COMPANIES

HOW IT WORKS

ZEVAC stands for Zero Emission Vacuum And Compressor. Equipment is available in a variety of form factors and sizes, and has been used by natural gas operators and contractors to perform a myriad of tasks.

This application guide explains how ZEVAC can be utilized to do a wide variety of work without venting gas. These procedures are for informational purposes only and should not be used without good judgment and operational practices. Our goal is to end the practice of intentional venting, and we hope this guide assists you in changing the way you do work for the better.

ZEVAC works by transferring product (liquids and gasses) from one pressurized system to another. In most applications, this takes the form of moving the product from one part of the system to another by compressing gas from one side ("Intake" or "drawdown" side) to the other side ("discharge" or "injection") of a valve or isolation point. Occasionally, transfers from one system to another separate system are performed and those differences are noted in this guide.

ZEVAC is a linear compressor. This means there is no spinning crankshaft or rotating drivetrain which affords the ZEVAC equipment some special functionality and advantages, such as handling 100% gas, mixed gas and liquids, and even 100% liquid service. You will find the ZEVAC to be a simple and robust tool that can be integrated into your daily operations with minimal disruption to normal daily operations.

In the ZEVAC equipment, the actuator is driven in a linear, reciprocating motion. The back-and-forth action of the actuator powers a double-acting compressor section. Together, an actuator and compressor section is called a ZEVAC Core. Each Core can act independently, and multiple Cores can be arranged in parallel to increase flow rate, or cores can be arranged in series to increase the overall compression ratio and discharge pressure. Each core uses an actuator and compressor section to draw in product through a set of 1 way check valves to fill the compressor section, and then pushes the product out on the reverse stroke through another set of 1-way check valves.

Through this simple and robust, patented functionality, ZEVAC is used on a daily basis to transfer pressurized products in a way that enables operators to depressurize systems for operations and maintenance without releasing the product(s) to the environment.

The ZEVAC basic working principle:

FOR DISTRIBUTION SYSTEMS

Natural Gas Local Distribution Companies (LDCs) have unique challenges that are different from other parts of the natural gas supply chain. **Some of the issues related to operations and maintenance of LDC systems include:**

- Weather-Dependent Flow Conditions
- Urban Environments
- Traffic
- Odorized Gas
- Public Utility Commission Approvals
- Public Visibility
- Unionized Workforce
- Long Budget Cycles
- Overpressure Protection Critical
- Old Infrastructure
- Aggressive ESG Ambitions
- Much More

This guide explains how distribution operators are using ZEVAC to perform the following activities without venting gas.

MAIN REPLACEMENTS

Main replacement programs are large scale planned operations where old (usually cast iron and bare steel) pipe is replaced with modern piping systems. Traditionally, the old main would be vented for retirement.

COMMISSIONING NEW LINES

Newly laid distribution piping is traditionally "purged into service" by blowing gas through the lines and venting a gas + air mixture until a suitable gas purity is achieved.

METERS & REGULATORS

Small systems such as meters and regulators have frequent maintenance requirements such as calibration, repair, and replacement that require the equipment to be depressurized prior to the work being performed.

ODORIZATION

Odorization equipment poses unique challenges related to the saturation of mercaptan that frequently results in "leak" calls if any venting occurs.

MAIN REPAIRS

When valve replacements, tie-ins, or cutouts are required, venting is part of the traditional standard procedures.

TOP 3 REASONS OPERATORS USE ZEVAC

There are many reasons LDC operators decide to use ZEVAC, and we break down the three most common here. While different users may have different motivations, the end result is always the same: **Safely eliminate emissions without venting or flaring.**

1 ACHIEVE COMPANY-WIDE ESG GOALS

- **Favors higher numbers of smaller equipment placed with many crews**
- **Impacts as many people as possible**
- **Drives ESG awareness and "culture of gas containment"**
- **Equip a high % of people who vent gas to perform capture & recycle**
- **Address a high % of methane venting occurrences**

This approach usually occurs with operators who are currently under or anticipate regulation that focuses on intentional releases. By equipping a large number of people and crews to do daily work without venting, these operators are focused on preparing their workforce to behave in a way that controls the gas instead of releasing. When larger projects occur, these operators can mobilize several of their smaller machines to work in tandem on a large drawdown, mimicking the performance of the larger ZEVAC equipment.

Sample projects and anticipated results using ZEVAC MINI powered by crew truck air		
1000′ of 2″ pipe, 25 psig » 0	<5 minutes	60 scf recovered
5280′ of 8″ pipe, 25 psig » 0	3 hrs	5mcf recovered
5280′ of 8″ pipe, 100 psig » 0	7 hrs	14.4mcf recovered
Sample projects and anticipated results using ZEVAC TWIN LP powered by 185cfm		
1000′ of 2″ pipe, 25 psig » 0	<5 minutes	60 scf recovered
5280′ of 8″ pipe, 25 psig » 0	2 hrs	5mcf recovered
5280′ of 8″ pipe, 100 psig » 0	4 hrs	14.4mcf recovered
5280′ of 8″ pipe, 230 psig » 0	12 hrs	30.7mcf recovered
5280′ of 12″ pipe, 230 psig » 0	28 hrs	69mcf recovered
5280′ of 12″ pipe, 400 psig » 0	48 hrs	117mcf recovered

"Instead of venting methane when we do maintenance or inspection, we are capturing, recycling and reusing it so it stays in our system and out of the atmosphere."

Gina Rundo
Supervisor Gas Operations
Dominion Energy

2 DELIVER EMISSIONS REDUCTION THROUGH HIGH-PROFILE PROJECTS

- **Favors smaller numbers of larger equipment placed with specialty crews**
- **Impacts large projects with fewer deployments**
- **Drives ESG awareness by making high profile projects emission-less**
- **Equip a focused group of people who vent gas to perform capture & recycle**
- **Address a smaller % of methane venting occurrences, typically larger releases per event**

This approach usually occurs with operators who are currently looking for a solution to address a handful of applications that have large releases associated with them. By concentrating on a small number of people and crews who are involved with high-emission projects, these operators are focused on getting the "low hanging fruit" in terms of the largest releases. When larger projects aren't going on, these specialty crews and large equipment can make short work of smaller drawdowns, which can be a good way to show the other departments how quick & easy it is to recover gas instead of venting.

Sample projects and anticipated results using ZEVAC TWIN LP powered by 185cfm		
1000′ of 2″ pipe, 25 psig » 0	<5 minutes	60 scf recovered
5280′ of 8″ pipe, 25 psig » 0	2 hrs	5mcf recovered
5280′ of 8″ pipe, 100 psig » 0	4 hrs	14.4mcf recovered
5280′ of 8″ pipe, 230 psig » 0	12 hrs	30.7mcf recovered
5280′ of 12″ pipe, 230 psig » 0	28 hrs	69mcf recovered
5280′ of 12″ pipe, 400 psig » 0	48 hrs	117mcf recovered
Sample projects and anticipated results using ZEVAC QUAD powered by 375cfm		
1000′ of 2″ pipe, 25 psig » 0	<5 minutes	60 scf recovered
5280′ of 8″ pipe, 25 psig » 0	1 hrs	5mcf recovered
5280′ of 8″ pipe, 100 psig » 0	2 hrs	14.4mcf recovered
5280′ of 8″ pipe, 230 psig » 0	6 hrs	30.7mcf recovered
5280′ of 12″ pipe, 230 psig » 0	14 hrs	69mcf recovered
5280′ of 12″ pipe, 400 psig » 0	24 hrs	117mcf recovered

3 UTILIZE VALUE OF CONTRACTORS AND NON-COMPANY RESOURCES

- **Favors an engineering and standards approach to ESG effort**
- **Allows flexibility of scale & timeline vs cost on large projects**
- **Drives ESG awareness by standardizing emissions reductions into procedures and standards**

This approach usually occurs with operators who are organized with an engineering-first structure where a standardized approach is developed and then written into the company's O&M manual or bid documents. By deploying standards and procedures, these operators enable each department and operating group to scale their efforts up and down as their workloads go up and down.

Many LDCs are not doing much venting during the winter due to the slowdown in maintenance activity, and they do lots of work in the summer – so a standards approach allows the operator to avoid being locked into a certain set of equipment and instead places the burden of fleet and manpower onto the crews who are doing that work anyway. These crews, by being on site already as part of a project, can use ZEVAC in a cost-effective way.

Sample Specification Language:

"This work has the potential to emit approx. ____ scf of natural gas if performed with a blowdown. All bidders are expected to utilize ZEVAC to reduce actual emissions to <5% of the potential to emit".

"In support of our sustainability and ESG goals, the company requires the use of ZEVAC or similar emission recovery equipment to reduce all emissions to less than ____ scf"

"Contractor will perform the pipeline cleaning work. During this pipeline cleaning and in-line inspection work a filter/separator unit with frac tank will be utilized to separate and collect any debris or liquids that are present in the pipeline. Additionally, on as needed basis, ZEVAC units will be used to recover natural gas eliminating blowdown to atmosphere. Bidder may provide separate quote for filter/separator and frac tank, ZEVAC units, and/or combinations of equipment."

"Contractor is expected to perform this work using tools such as ZEVAC to meet the company's goal of ____% emission reduction this year. Any work that does not meet this goal should be approved through the project manager for an exception."

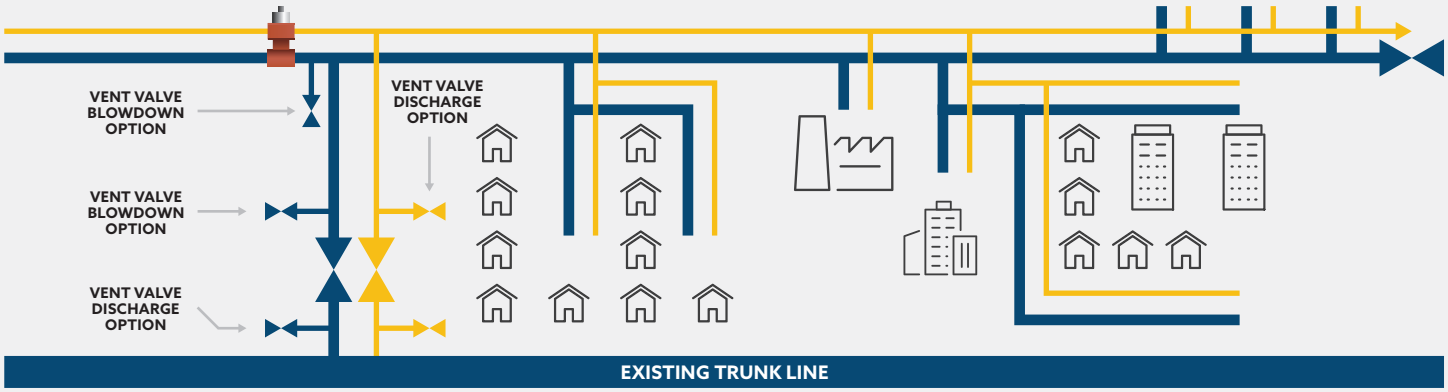
NEW HDPE MAIN

LEGACY MAIN (TO BE ABANDONED)

1) Move all customers and service lines onto new HDPE supply.

2) Isolate legacy main.

3) Identify suitable "blowdown" vent point and "discharge" injection point.

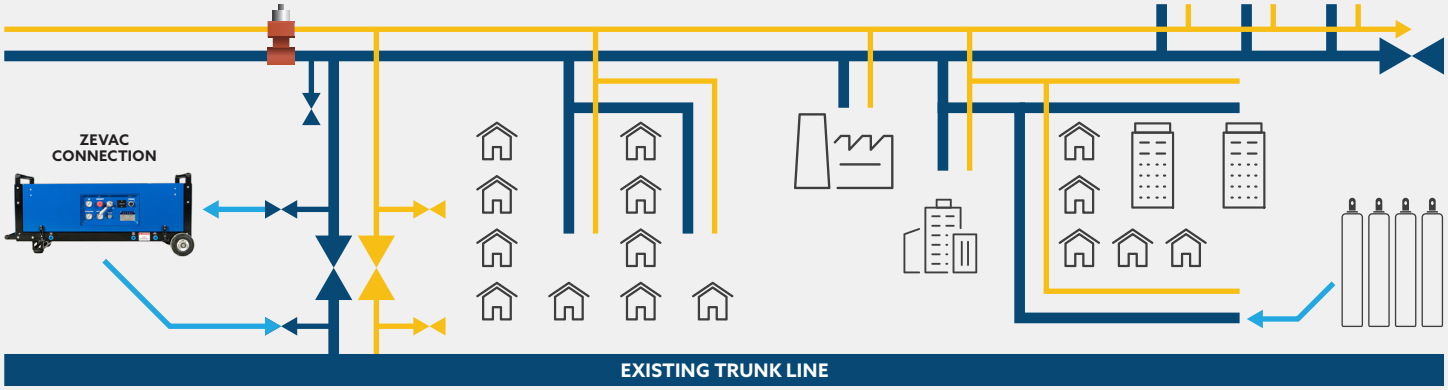


4) Connect ZEVAC to drawdown gas from legacy main and discharge into live system.

5) Proceed with depressurization of legacy main.

PRO TIP: After the first 10% of the depressurization, pause the drawdown to verify positive isolation.

6) When the legacy main is at or near 0.0 psig, proceed with final abandonment.



7) To inert the pipe prior to cut and cap, continue to run ZEVAC while injecting nitrogen at far end(s) until gas mix is below LEL.

PRO TIP: Using this method, it is likely that some nitrogen will eventually be processed in the gas mix passing through the ZEVAC into the live system. Verify the system can accept some nitrogen intrusion.

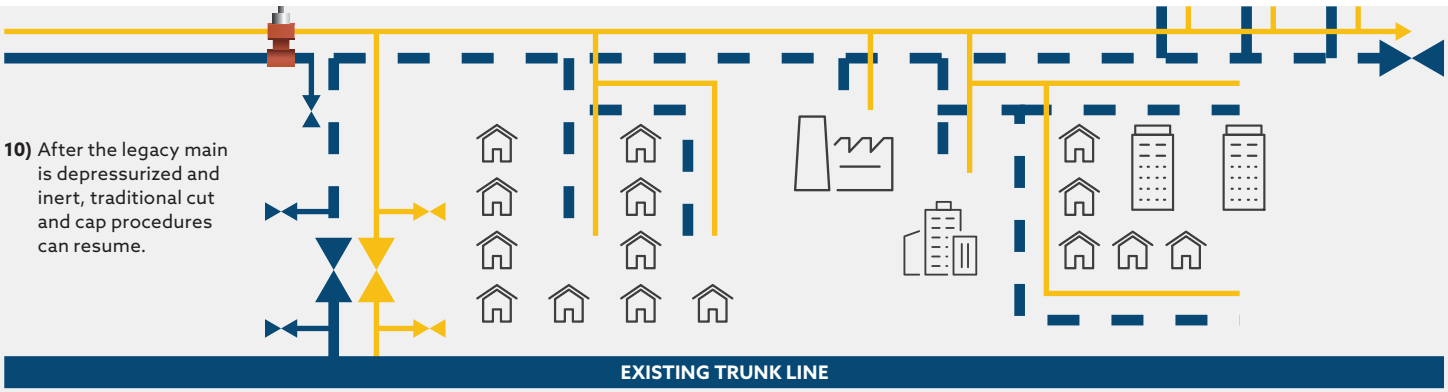
8) At 0.0 psig, 1 atmospheric line fill of methane remains in the pipe. Depending on the project goals, this may be considered de minimis and a sweep of inert this gas venting the remaining methane to atmosphere may be acceptable.

PRO TIP: After the first 10% of the depressurization, pause the drawdown to verify positive isolation.

9) To empty the pipe without risk of nitrogen carryover, the operator can use ZEVAC to pull the remaining gas in "vacuum" mode with the ZEVAC.

PRO TIP: Whenever pulling a vacuum on the piping, consider the isolation methods as well as the reversal of any leak points in the system.

10) After the legacy main is depressurized and inert, traditional cut and cap procedures can resume.



918.514.3166 | 7830 S 87th West Ave, Tulsa, OK 74131
GetZEVAC.com