CALCULATION GUIDE

Valuing Compressed Air Leak Fixes

Follow the steps below to estimate the potential savings from instituting a compressed air leak detection and repair program at your facility.

Key Variables

The following are variables typically used in valuing leak fixes:

Air flow: cubic feet pre minute (CFM)

Pressure: pounds per square inch gauge (PSIG)

Operating time: hours

Power: horsepower (hp)

Electricity usage: kilowatts (kW) and kilowatt-hours (kWh)

Energy costs and savings: dollars ($)

Step 1: Estimate Leakage

Depending on your facility's compressed-air configuration, air leakage can be estimated at the leak level or at the compressor level. For quantifying at the leak level, estimate the size and estimate the leakage in CFM for each detected leak using a leak chart such as the one shown. Specialized diagnostic tools such as ultrasonic acoustic detectors or acoustic cameras can be used to both find and more precisely measure leak loss from individual leaks. The estimated leakage from all individual leaks can then be totaled up for a plant-level estimate.

Operating Pressure (PSIG)	Diameter of Orifice				
	1/64"	1/32"	1/16"	1/8"	1/4"
60	0.26	1.06	4.23	16.90	67.60
70	0.30	1.20	4.79	19.20	76.70
80	0.34	1.34	5.36	21.40	85.70
90	0.37	1.48	5.92	23.70	94.80
100	0.41	1.62	6.49	26.00	104.00
110	0.44	1.76	7.05	28.20	113.00
120	0.48	1.91	7.62	30.50	122.00

Approximate Flow (CFM)

To estimate system-wide leakage at the compressor level, if your compressors are load/unload, then you can time the load duration versus the unload duration over a specific time frame (such as 10 minutes) and then apply the following formula to estimate the system-level leakage. This method should be performed when production has stopped, and all open blowing applications are valved off.

Leakage (%) = (Loaded time x 100)/(Loaded time + unloaded time)

Total CFM = Sum of the CFM of the compressors running to meet the load

Leakage CFM = Total CFM x leakage (%)

Alternatively, some compressors have percentage capacity gauges that display the percentage of the total output of the compressor. Shut down all machinery and close all open-blowing applications. Check to see what the percentage capacity gauges read. Adjust for total percentage if more than one machine is running. This constitutes the total leakage in the system.

Contact your utility or energy efficiency program provider to see if they can offer resources or assistance for assessing leak load. This may include supplying you with leak-detection equipment and offering incentives to repair leaks based on the potential energy savings.

Your turn:
Total estimated leakage for your facility: _____ CFM

Step 2: Determine Compressor Power Per CFM

Compressor power per CFM is the reciprocal of the compressor CFM per kilowatt. It can be determined from compressor specifications, real-time data supplied by compressor-control instruments and software, or by using a reasonable benchmark. One such benchmark is 5 CFM per kilowatt (or 0.20 kW per CFM).

Your turn:
Total compressor power per CFM (or use benchmark): _____kW/CFM

Step 3: Determine Annual Compressor Operating Time

Annual compressor operating time is simply the number of hours your compressed air system operates each year.

Your turn:
Annual compressor operating time: _____ hours

Step 4: Obtain Kilowatt-hour Cost

Find your facility's electricity cost per kilowatt hour by reviewing your monthly or annual electricity bill or by contacting your electricity provider. Electricity rates can vary regionally; in the Pacific Northwest, an average cost for electricity for manufacturing sites is about $0.05/kWh.

Your turn:
Kilowatt-hour cost: $ _____ /kWh

Step 5: Calculate Estimated Savings

Plug the data collected in the previous steps into the following formula to calculate estimated savings.

Estimated savings = Estimated leakage (CFM) x Compressor power/CFM (kW/CFM) x Operating time (hours) x Electricity cost ($/kWh)

Your turn:
Estimated leakage: _____ CFM

Compressor power/CFM: _____ kW/CFM (or assume benchmark of .20)

Operating time: _____ hours

Kilowatt-hour cost: $_____ /kWh

Estimated savings = _____ CFM x _____ kW/CFM x _____ hours x $_____/kWh

Your estimated savings: $_____

Example Source: U.S. Department of Energy

A chemical plant undertook a leak-prevention program following a compressed air audit at their facility. Leaks were found that approximated the orifice size in the leak table (see Step 1) as follows: 10 leaks of 1/32" at 90 pounds per square inch gauge (psig), 5 leaks of 1/16" at 90 psig, and 1 leak of 1/4" at 100 psig.

Calculate the annual cost savings if these leaks were eliminated. Assume 7,000 annual operating hours, an aggregate electric rate of $0.05 kilowatt-hour (kWh), and a compressed air system efficiency of 5 CFM per kilowatt (or 0.20 kW per CFM).

Cost savings = # of leaks fixed x leakage rate (CFM) x
kW/CFM x # of hours x $/kWh

Using values of the leakage rates from the above table, estimate the cost savings from repairing the leaks:

Cost savings from 1/32" leaks fixed at 90 psig = 10 (leaks) x 1.48 (CFM/leak) x 0.20 (kW/CFM) x 7,000 x 0.05 ($/kWh) = $1,036

Cost savings from 1/16" leaks fixed at 90 psig = 5 x 5.92 x 0.20 x 7,000 x 0.05 = $2,072

Cost savings from 1/4" leaks fixed at 100 psig = 1 x 104.0 x 0.20 x 7,000 x $0.05 = $7,280

Total cost savings from eliminating these leaks = $10,388

Additional Resources

NEEA Resources

Other SEM Hub tutorials. Check out other tutorials on the SEM Hub website that can help you learn and apply SEM at your facility and calculate their estimated savings. In particular, you may wish to view the tutorials on:

- How to Get and Record Energy Data
- How to Perform an Energy Audit
- How to Estimate Costs for Energy Projects
- How to Convert Measurements to Common Units

Toolbox Talk cards. Print-ready talk cards outlining a variety of strategic energy management (SEM) tools, approaches and methods for both industrial and commercial facilities.

Other Resources

Your utility or energy efficiency program provider. Check with utility or program representatives for any assistance, solutions or incentives they offer for identifying and fixing compressed air leaks and implementing other O&M best practices that can achieve energy efficiency goals.

Compressed Air Challenge. This is a voluntary effort of industrial compressed-air users, trade groups, energy efficiency providers such as NEEA, and the U.S. Department of Energy dedicated to improving the performance of compressed-air systems. Visit the website for information on training opportunities and to view a variety of factsheets, manuals and best practices.

Smart Buildings Center. This Seattle-based regional energy efficiency solutions provider offers education, training and resources for building engineers, managers and operators, including a lending library of measurement and diagnostic tools for energy efficiency and demand-reduction projects