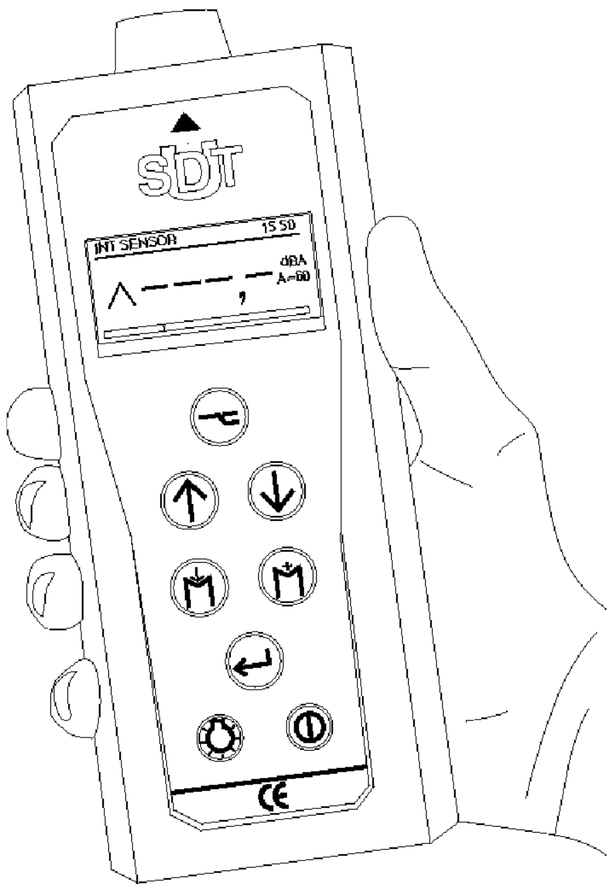
Industrial Compressed Air

Ultrasonic Leak Detection Survey Guide



Introduction

For many manufacturers compressed air represents the second or third highest utility cost in their facility. Without an effective maintenance program in place leaks can account for as much as 40% of the total air system demand. Proactive and preventative maintenance efforts with a minimal investment can see the leak target reduced from 40% to a more reasonable 5%.

Creating an Effective Air Leak Management Program

1. Establish a Strategy

At the heart of any sound strategy lies a goal. What are the goals of your air leak management program? Here are some ideas:

- Maintain a leak rate of 5%
- Increase the life of your compressors
- Heighten employee awareness about energy conservation, and compressed air in general
- Include constant surveillance of the system for integrity and safety issues
- Educate employees about compressed air best practices
- Decrease energy waste

Write the goals down and publish them in an area where they can receive constant review. Surely during the process of strategy making questions will arise about the state of the current compressed air system. Managing the system is more than just finding leaks; it's about reviewing it in its entirety looking for areas where improvements can be made. The web is full of resources and there are several reputable consultant companies that offer training and consulting services strictly for compressed air systems.

2. Create a Procedure

Some procedural elements of a good leak management program to consider are:

- Safety – Publish a safety guidebook for ultrasonic leak detection, leak repairs, and general inspection of the system
- Frequency - A compressed air maintenance program involves a complete inspection of your airlines 3-4 times per year. Regular inspections will ensure that new leaks are found, and also confirm that tagged leaks from past surveys were repaired.
- Know the System – Familiarize everyone with the supply side, demand side, number of compressors, operating pressures, and any additions that were made to the system since it was installed.
- Diagrams – Obtain drawings of the system from engineering and check to see they are up to date. Use these drawings to map out a route that will be followed each time an inspection is done. Use

copies of the drawings for making annotations during the leak survey. At the end of the day will you remember the positioning of over 100 leak tags?

- Equipment – Decide what accessories will best suite the leak inspections demanded by the system. More about accessories and their specific applications later on in this handbook. Be sure whoever uses the ultrasonic equipment has received proper certification training from a reputable trainer.
- Find, Tag, and Fix the Leaks
- Re-Check – Be sure to re check the leak area with ultrasonic detector after the leaks are repaired. Remember the person making the repair may not be the same person who tagged the leak. Also, while making the repair it is possible a new leak was created.
- Document Everything – Make sure management knows the great job done to save company money.

3. *Choose the Right Equipment*

Select the airborne ultrasound sensor to best suit the inspection. Different sensors are designed for different types of inspections. The sensors commonly available include:

a. Internal sensor
b. Flexible sensor
c. Extended Distance sensor
d. Parabolic sensor

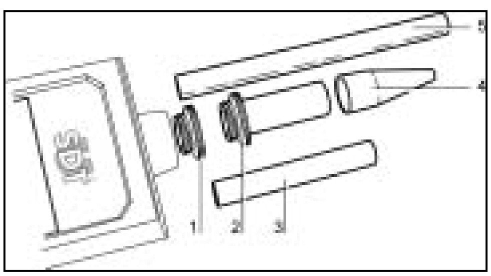


Figure 1 - Internal Sensor of SDT 170

All SDT 170 ultrasonic detectors are equipped with an internal airborne sensor for detection of pressure and vacuum leaks. This sensor is ideal for day to day leak detection where the source of the leak is within reach of the inspector. Use in conjunction with the precision indicator kit (shown in Fig 1) to pinpoint the exact source of leakage.

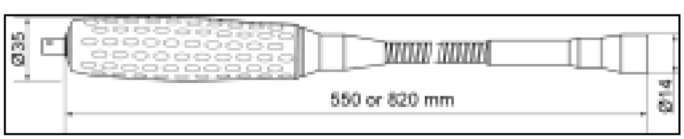
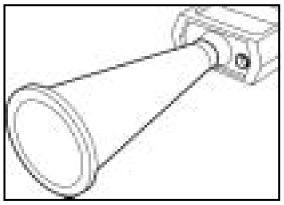


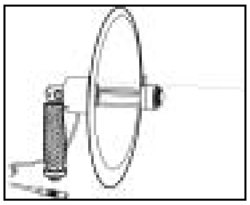
Figure 2 - Flexible Sensor - 21" or 36" or custom

For inspections in hard to reach areas, choose the Flexible sensor available in 21" and 36" lengths. It can be bent, twisted and shaped to go into any area that is inaccessible by hand.



Overhead piping in ceilings are prone to leakage but normally inaccessible without a ladder or scissor lift. Inspection is now possible with the EDS Extended Distance Sensor. The unique taper-shape funnels medium distance ultrasonic waves (50’ – 100’) onto the internal sensor of the SDT 170 providing the inspector with extended distance sensing and extreme directionality.

Figure 3 - EDS Extended Distance Sensor



Select the parabolic sensor if the leaks you are detecting are outside the range of the EDS (Fig 3). The parabolic shape focuses faint ultrasonic waves onto a super sensitive ultrasonic crystal amplifying and thereby extending the detection range by up to 250’. The laser sight pinpoints the exact source of the leakage, or use the rifle sight in bright daylight.

Figure 4 - Parabolic Sensor with Laser Sight

4. Setting up the SDT 170 Ultrasonic Detector

1. Attach whichever sensor that was chosen for the inspection to sensor input on SDT 170 (Fig 6, #12), attach headphones to audio output (Fig 6, #10) of 170. Always wear the headphones in the plant. You can’t find leaks without them, and they help shield your ears from damaging high level of audible noise.
2. Switch SDT 170 equipment on (Fig 6, #6)
3. Ensure that the sensor is correctly connected to SDT 170 by identifying the sensor in the top left corner of LCD screen (Fig 5, Type of Sensor)
4. Ensure battery charge is sufficient to take measurements by viewing icon in top right hand corner of LCD screen (Fig 5, Battery Load Icon)
5. After ensuring all safety procedures for your facility have been followed, proceed to the required inspection method described on next page.

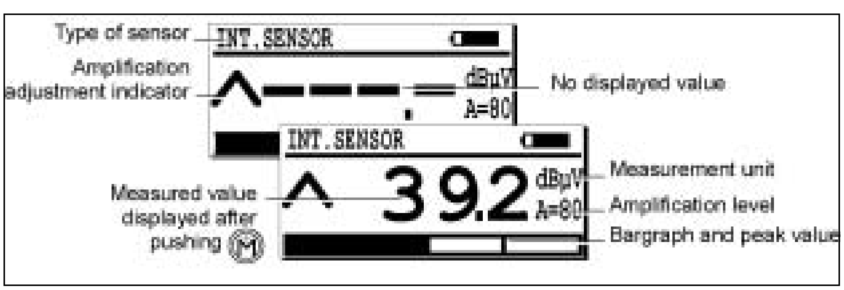


Figure 5 - LCD Display

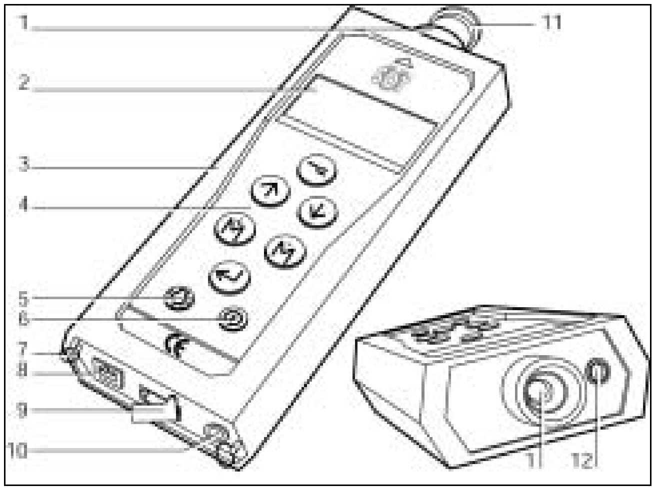


Figure 6 - Functions of the SDT 170

Leaks can occur at a number of points in a compressed air distribution system. Some of these are:

1. Branch line connection	7. Rubber hose
2. Automatic drain trap	8. Quick coupler
3. Desiccant filter	9. Isolating valve
4. Filter/regulator/lubricator assembly	10. Control valve
5. Filter/regulator/coalescent filter assembly	11. Coil hose
6. Regulator	12. Pneumatic cylinders

5. METHOD FOR LEAK TESTING

1. Set sensitivity using the up or down arrows to adjust the 170 to the environment you will be working in. With the amplitude as high as allowable for that environment, scan with an up and down, back and forth motion. Scan the possible leak area for a hissing sound. Listen and watch the signal. If hissing sound is too loud, decrease the sensitivity of the SDT 170 by pressing the down arrow to a comfortable level.

2. If a hissing sound is heard, get closer to the source of the hissing sound. Press the down arrow to decrease amplitude sensitivity as you get closer if hissing sound gets too loud.

3. When you are near the leak, you may attach the localization probe to pinpoint the source of the leak. Scan back and forth, up and down, to confirm. Watch the SDT screen increase or decrease in signal as you scan. Listen to the sound get louder and fainter as you scan. The spot where the sound is loudest is the leak site.

4. Mark the leak source and repair on spot or tag for later repair.

5. Document leak information (location, type of leak, size of leak, inspector, etc...). The following pages show sample charts that can be used to document and estimate leak size.

The following chart demonstrates how supply side air is used on the demand side for industry that does not employ a proper compressed air management strategy.

Compressed Air Usage in Industrial Plants (International Average)	
End users or equipment requirements	43%
Leakage to atmosphere	34 %
Inappropriate uses of compressed air	16 %
Purge air for dryers	5 %
Failed drain traps	2 %
The above data is an average of information accumulated by Plant Support & Evaluations Inc – Audit Division	
Compressed Air Leakage is the largest loss of Compressed Air in any system.	
www.plantsupport.com	

Sample Leak Survey Log

Date	Department	Leak No.	Description (Location)	Line Pressure	Line Size	Line Temp.	Leak Size or dBµV	Leak Type	CFM

Legend for Leak Survey Log	
Date	date the inspection was done
Department	area user of compressed air, i.e., Powerhouse, Packaging, etc.
Leak No.	tag number
Description (Location)	general location description, i.e., above Heat Exchanger, B2312 Instrument Air Line, rusty fitting on line east of separator tank
Line Pressure	operating pressure of the line
Line Size	1 ft diameter header, ¼ -inch line, etc.
Line Temp.	Taken from the bare piping surface if no temperature gauge is installed, not the surface of an insulation
Leak Size	pinhole, 1/32 inch, or take a decibel reading.
Leak Type	pinhole, weld leak, fitting, gasket, etc.
SCFM	reading from the mass flow sensor or calculated using dB estimator.

Volume Flow of Free Air

Quantifying leak rates (flow of air) by drawing a correlation between the Decibel and SCFM should only be done by a qualified and certified ultrasound inspector. Since many factors affect the decibel level of a leak it is important that the operator understand each factor and consider them strongly before final quantification.

The following table indicates measured decibel levels for a compressed air leak at various pressures. The dBµV levels were observed using the internal sensor of an SDT Ultrawave 170MD Ultrasonic Data Collector. As an additional control 10 SDT 170MD instruments were used for the test to ensure repeatability and accuracy of the data. All ultrasonic units were operating at a center frequency of 38.4 kHz. The dBµV measurement was registered at the loudest point of the leak. In industrial applications, because orifice shape can vary, the loudest point is not always perpendicular to the orifice. It can also be confirmed that any SDT 170MD with current calibration certificate can validate itself to this chart.

Test Orifice Details
Leak orifice: 0.0047” x 0.036”
Area: 0.00016 inch^2
Distance from Receiver: 15”

Notice
The values presented in this table are indicative. They are given solely for convenience and should only be used as a guideline.

System Pressure		Ultrasound	Flow		
Bar	**PSI**	**dBµV**	**SCFM**	**SCCM**	**l/h**
0.35	**5**	41	0.062	1756	105
0.42	**6**	43	0.068	1926	116
0.49	**7**	45	0.073	2067	124
0.63	**9**	47	0.083	2350	141
1.05	**15**	48	0.105	2973	178
1.75	**25**	58	0.140	3964	238
2.8	**40**	62	0.194	5493	330
3.5	**50**	64	0.229	6485	389
4.2	**60**	66	0.264	7476	449
5.6	**80**	67	0.335	9486	569
6.3	**90**	69	0.370	10477	629

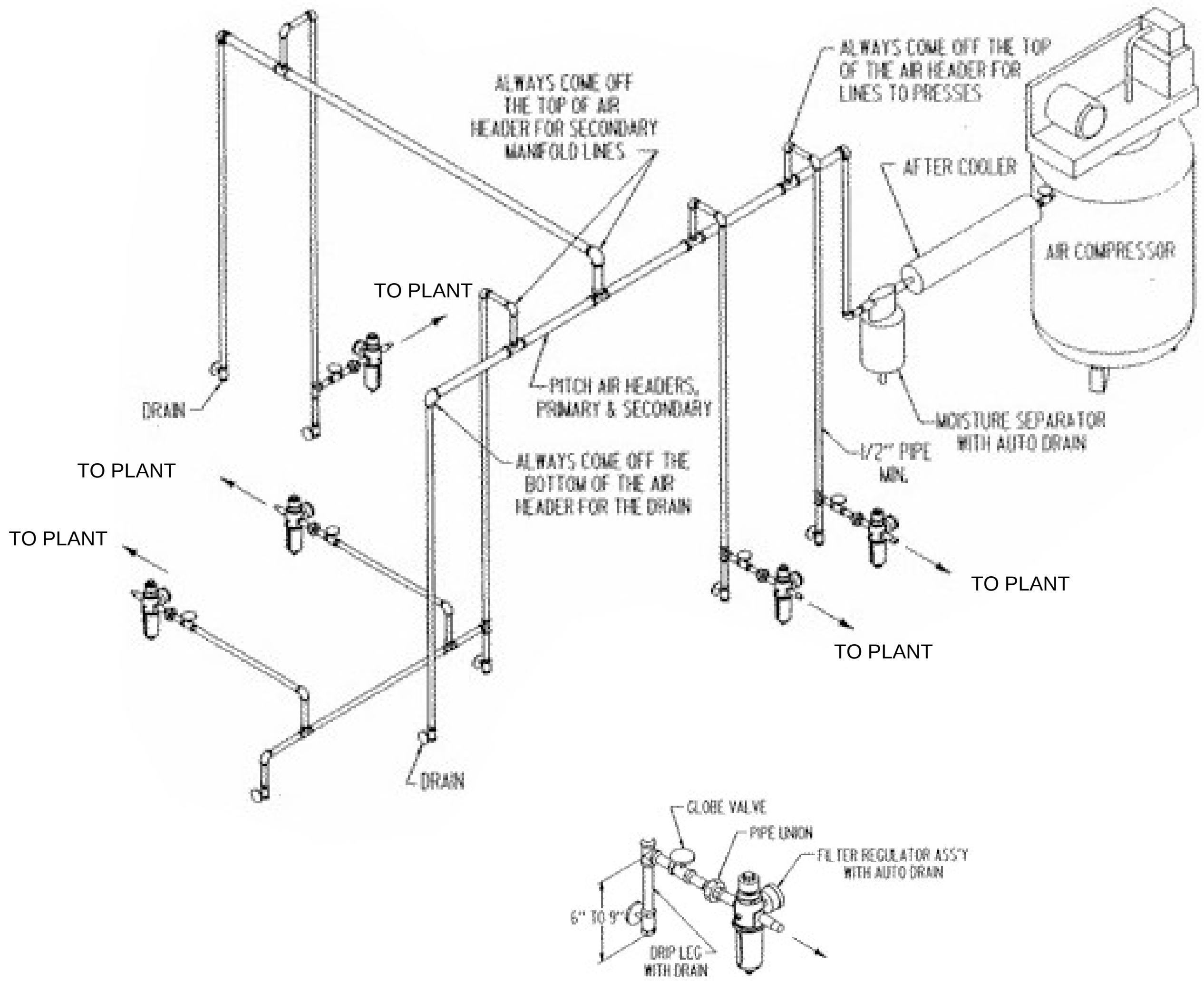
Factors Effecting Results
Leak orifice size, shape, and configuration
Turbulence and parasite ultrasound
Distance of the ultrasonic sensor from the leak
Angular position of the ultrasonic sensor with respect to the direction of the leak jet of air
Receiver transducer characteristics, condition, and calibration
Temperature and moisture of the air escaping from the leak
…… these factors, and others, can significantly affect the measurements

Table Showing Hole Size, Leakage and Power Loss

Hole Diameter		Air Leakage at 90 pSIG	Power Required for Compression
Actual Size	Dimension	SCFM	kW
	1/16”	2.11	0.3
	1/8”	21.18	3.1
	1/4	57.2	8.3
	3/8	222.48	33
Information from this chart provided by Atlas Copco Compressed Air Manual, 3rd Edition, August 7, 1981			

Electrical Cost for an Air Compressor operating for One (1) Year @ $ .045 per kWh	
Horsepower	**Dollar Cost (USA)**
5	$ 1,414.74
10	$ 2,829.48
20	$ 5,575.74
30	$ 8,405.22
60	$ 16,727.22
100	$ 27,961.92
150	$ 41,942.88
300	$ 83,802.54
500	$ 139,643.16
700	$ 195,567.00
1000	$ 279,369.54
Information supplied by Plant Support & Evaluations, Inc Audit Division www.plantsupport.com	

Typical Configuration of a Compressed Air System



General Compressed Air Piping Diagram