**FOCUS**

**NDT Awareness Campaign**

**Introduction**
As of 9 June, ASNT member Mark Stowers had driven 18 757 km (11 655 miles). But this has been no typical road trip. Stowers, the founder and director of Crossroads Institute in Oklahoma City, Oklahoma, has embarked on a seven month journey across the country (and possibly beyond) to spread the word of nondestructive testing (NDT). On the website of the self-described “NDT’er” the mission reads: “These few short months will be dedicated to all the unsung heroes of NDT that keep us from potential catastrophic events. Loss of life, damage to the environment, and destruction of property are never far from the minds of these important individuals. Without their careful attention to detail, one shudders to think of the possibilities.”

With the support of his local OKC Section, Stowers’s trip began on 6 April in his hometown of Oklahoma City, and will conclude on 26 October at the 2015 ASNT Annual Conference in Salt Lake City, Utah. Scheduled stops along the way include visits to local ASNT section meetings and the ASNT International Service Center, as well as open houses at NDT facilities and presentations at topical conferences.

**Inspiration**
Many manufacturers, technicians, academicians, and researchers are passionate about NDT and getting the word out about a field that many in the general public are not familiar with. Few, though, have taken this passion a step further by literally bringing NDT to the masses. When asked what inspired this grand undertaking, Stowers said: “There are many things that have influenced me in my NDT career; however, a few really made me stop and think.

“I started as a ‘hand’ (laborer/trainee) at a company that performed inspections of tubular goods and other items on rig sites in rural Oklahoma, Texas, and Kansas. I really did not know very much at first, but I was in good physical shape and eager to learn. I enjoyed the camaraderie, the scenic trips to remote locations, the tackling of seemingly impossible jobs in the best and worst of weather, and the discovery of hidden discontinuities and defects.

“Though, never far from the mind, there was the real possibility of a catastrophic incident occurring should we not perform our duties adequately. As I learned more about NDT, I started to realize how many ways and in how many industries that NDT was employed. I was shocked. How
was it possible that I had never heard of nondestructive testing? The thought of all those individuals, across the globe, performing such critical tasks truly awed me.”

He went on to comment, “The importance of the work that NDT’ers perform each day inspired me to dedicate my life to trying to help wherever able.

“I started by trying to pass along what I had learned to those with whom I worked and who would someday replace me. I studied for my ASNT NDT Level III (MT) while living in Colorado and working in Oklahoma. There were times when I would be gone for seven to ten days and home for two to three days. I spent a good portion of my time on the road between Houston, Oklahoma City, and Peyton. I often found myself in the position of explaining what I did for a living. Most people that I ran across did not know what NDT was.”

Thus, an idea took hold. Stowers continued: “I decided that I needed to find other NDT professionals. Through ASNT conferences, I began to meet fellow NDT’ers. At first, I only attended the educational presentations. Eventually, I was guided to the committee meetings. I learned, and continue to learn, a great deal by attending ASNT conferences. The staff and attendees were equally helpful. The helpfulness of all involved renewed my vigor to help. As ASNT is a volunteer organization, I began volunteering. I became active in the committee meetings that I attended, reviewed technical publications within my method, and helped to form the ASNT OKC Section.

“I had started Crossroads Institute, an NDT training and consulting business in Oklahoma City, in an attempt to help others get the best possible NDT education for the critical tasks ahead of them. Soon, I came face to face with the reality that many inspection companies were actively inspecting even though they were not qualified and certified to do so. This took my breath away and caused me to redouble my efforts. I worked diligently to help these inspection companies, both small and large, understand the importance of qualification and certification. I offered a complimentary ASNT membership to students and invited everyone to attend the local Section meetings. I spoke at local colleges and tech schools about NDT. I volunteered to chair the ASNT OKC Section, MT/PT Committee, and Student Interests Committee.”

Still, Stowers felt like he could do more. “Thankfully, I am now in a position within my career to be able to dedicate my time and efforts to making as many people aware of NDT as possible.”

In response to what he hoped to achieve, Stowers replied, “I hope to let the next generation of NDT’ers know that there is a noble profession available that provides a critical service while allowing them to earn a very comfortable income. Furthermore, I hope to raise the awareness of the importance of NDT as well as where to go to find out more about NDT.”

Planning

Planning for a trip of any length can be time consuming and stressful, but coordinating a seven month journey with nothing more than a truck/trailer (Figure 1) and list of scheduled stops requires extra attention to detail, to say the least.

“There are many aspects of planning a trip like this,” said Stowers. “Each piece of equipment must be chosen carefully for usefulness and space requirements. Help must be enlisted for coordination and logistics. Availability and location of visits must be carefully studied. Above all, one must realize that no matter what one does to prepare, there will be unforeseen obstacles to overcome along the way.”

The Exhibit

What exactly goes into a mobile NDT demonstration trailer (Figure 2)? Stowers explained, “The trailer is set up to provide general information about NDT through digital media, to provide an introduction to web resources for more specific information about NDT, and to demonstrate NDT via magnetic particle testing (MT).”

The following list gives a general overview of the trailer’s capabilities:

- Smart TV
  A smart TV plays NDT videos, examples of NDT flaws, and an “Introduction to NDT” presentation. The screen can be mirrored via onboard smartphone and

![Figure 1. Truck and trailer.](image-url)
tablet to help further explain when specific questions are posed and explored; the screen is also mirrored for remote video conferences with notable NDTers when available.

- **Computers**
  Two dual touchscreen laptops are set up for the use of those visiting to explore NDT.

- **Projectors**
  There are two projectors onboard for NDT presentations at small and large events. One projector is conventional while the other is a wireless pocket sized projector that doubles as a Wi-Fi hotspot.

- **Magnetic Particle Testing Equipment**
  Thanks to the sponsorship of Magnaflux, the onboard MT equipment has been upgraded to better demonstrate NDT in action. The demonstrations aim to show how, as one method of NDT, MT is used to find hidden flaws.

- **Cameras**
  Three wireless GoPro cameras are onboard to help viewing of practical demonstrations, broadcast events, and allow attendees to record their thoughts and stories.

- **Reading Materials**
  Thanks to ASNT, the trailer is also stocked with hard copy and digital information about NDT for attendees to take with them.

- **Extra Amenities**
  For convenience, the trailer is equipped with a coffee pot, a refrigerator full of water bottles, and an onboard restroom.

**The Road So Far**

At the time of his interview, Stowers was less than a month into his journey, but already he had made a number of stops.

“So far, I have attended the Miami Valley Section (West Chester, Ohio), Chicago Section (Elmhurst, Illinois) (Figure 3a), OKC Section (Oklahoma City, Oklahoma), and St. Louis Section (Maryland Heights, Missouri) (Figure 3b). I also visited ASNT (Columbus, Ohio) twice for advice and guidance.”

Events are coordinated in advance and entail opportunities to network and share knowledge.

“At the section meetings, thus far, I have introduced myself, let the section know...
People Along the Way

In his mission statement, Stowers speaks of the “unsung heroes of NDT,” many of whom he has already had the chance to meet, who come from a broad spectrum of industries and experience levels.

“I have met a diverse assortment of NDT’ers,” began Stowers. “The technician that started as an intern while in high school, the student enrolled in the local college’s NDT program, the beginning technician who has learned one method and has a hunger to learn another, the NDT instructor with the challenging task of training our next generation of NDT’ers, and the technician that just became an ASNT NDT Level III with all the responsibilities that the designation entails. I have met technicians who work within aerospace, manufacturing, energy, research, equipment supply, and so on.”
Student Outreach

A major component of the NDT Awareness Campaign is student outreach. Across all endeavors students are the future, but in a field like NDT where the current job force is aging, it is especially important to appeal to younger generations to fill in the gaps as positions become available and advancing technologies necessitate new breeds of practitioner. As part of his efforts, Stowers hopes to reach out to students, especially those involved with science, technology, engineering, and mathematics programs.

“At each section visited, an offer is made to coordinate to speak about NDT at local high schools, tech schools, colleges, universities, and any other suggested venue,” said Stowers.

The Road Ahead

By the time this issue of The NDT Technician comes out, Stowers will be halfway through his trip, but it seems there is still a lot to do on the road ahead.

Stowers concluded by saying, “I am looking forward to meeting fellow NDT’ers, hearing their stories, and learning from them. I am looking forward to the familiar expressions of disbelief followed by interest on the face of someone introduced to NDT for the first time. I am looking forward presenting at an educational session at ICPIIT [the International Chemical and Petroleum Industry Inspection Technology conference] in June. I am looking forward to the ASNT Annual Conference in October where I will be able to personally thank those that encouraged me to go forward with the NDT Awareness Campaign. I am looking forward to a formidable but scenic trip.”

Follow Stower’s journey through the travel journal blog on his website, www.ndtaware.com, or through social media on Instagram (ndtaware), Twitter @ndtaware, Facebook, and Google Plus.

ACKNOWLEDGMENTS

Photos provided by Mark Stowers.

INBOX | Q&A

Q.

I have held an ASNT NDT Level III for nearly 10 years now and I have continued to work in the methods that I am certified in. I took a few initial Level III refresher courses just prior to taking my exams and did this through a prominent NDT training company. When I did this a decade ago, the instructors were two individuals who held ASNT NDT Level IIIs in the respective methods for those classes. They each also held additional Level IIIs in one other method at that time. As the years have passed, I noticed that these instructors now hold four and five Level IIIs and are still employed at the training facility.

So, how does ASNT grant them the right to test for the new methods when they are not obtaining any actual hands-on method experience and they are not working under other Level IIIs for guidance in those new methods? I will assume that the “lab time” they conduct for their classes will be a likely answer, but that does not mean they can develop a technique in those methods that correlates to an actual “real” inspection.

A.

Eligibility to sit for a Level III exam is based on time as a Level II in the applicable test method (based on the candidate’s level of formal education) and that must be documented when the application is submitted. Since no company gives training all year, I suspect that these personnel performed Level II functions in between training sessions, or they may have only taken a few of the Level III exams at one sitting and taken others at a later date. Also keep in mind that experience, just like training, never expires and they may have had prior Level II experience in the other test methods and just not needed Level III certification in those test methods until a later date.

Regarding their still being at the same employer, as a technician I worked for the same company three separate times, so they may have done the same.

Respectfully,

James W. Houf, Senior Manager,
ASNT Technical Services Dept.

E-mail questions for the “Inbox” to the editor: tkervina@asnt.org.
As we approach ASNT’s 75th anniversary, let us consider how a typical Midwestern United States single-family house has changed through the years. In 1941, houses were much smaller. They were often heated by coal furnaces with ductwork typically insulated with asbestos, or boilers and radiators with asbestos wrapped pipes. The walls were painted with lead-based paint, and the tile used for floors typically contained asbestos. The exterior walls were often un-insulated balloon frame or constructed with solid two- or three-course brick with interior plaster. The 1930s had seen the introduction of platform framing and gas furnaces. Ventilation was controlled primarily by opening and closing windows and doors. The 1960s followed with installation of air conditioning and installation of insulation in the exterior walls.

The year 1978 marked another critical time as crude oil increased from $13 to $34 per barrel and gasoline went from $0.35 to $1.00 per gallon. The increasing price of oil began the upward spiral of the cost of energy. Notice that this occurred immediately following the popularization of air conditioning in houses.

With air conditioning and increased energy prices came the paradigm change to strive to maintain comfortable temperature and humidity levels in homes year-round by closing the doors and windows. We also learned that heating, ventilating, and air conditioning (HVAC) means much more than simply installing a furnace and air conditioner. Houses previously intended to breathe now needed to be properly ventilated, meaning that warm or cold air needed to be properly circulated, and exchanged with fresh air in an efficient manner in order to ensure healthy indoor air quality.

Today’s typical house is a complicated system of seemingly independent components that are integral pieces of a system when installed in a house. The most common components are:

- The building shell,
- The heat source,
- The cooling source,
- The air distribution/circulation system.

The ideal house today would function like a space shuttle. The living space is separated from the outside by a pressure boundary and a thermal boundary, while the air inside is controlled and ventilated. Understanding the terms “thermal boundary,” “pressure boundary,” and “ventilation” are essential.

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**Figure 1.** Photo showing the dirt collected from the air as it passed through the fiberglass.
The thermal boundary is the most obvious to home occupants and is the least understood. The thermal boundary is the exterior shell of the living space (walls, ceilings, and floors). Thermal boundary refers to that which separates the living space from the uncontrolled outside space. It is intended to keep heat from flowing from one to the other. As such, a layer of insulation is placed around this space. But the insulation often does not function as a thermal barrier, as most insulation allows air to flow through it (Figure 1).

“Pressure boundary” refers to the ability of the house shell to keep the inside air in and the outside air out. Notice the change from heat flow in the thermal boundary to air flow in the pressure boundary. It does not matter how much insulation a house (or space shuttle) has if the doors and windows of the structure are open.

During the heating and cooling seasons, no one intentionally leaves their doors and windows open; however, there are innumerable holes or penetrations in the structure of the house that permit uncontrolled airflow. The U.S. Department of Energy identifies uncontrolled air infiltration as the largest single source of energy loss in most houses (DOE, 2010). The identification and measurement of these holes is where leak testing (LT), in this case a blower door test, plays a very important role.

A calibrated fan and pressure manometer are installed in an exterior doorway. With all other doors and windows closed, the fan is energized to create a pressure difference of 50 Pa between the inside and outside. This pressure difference is equal to the pressure exerted on a house by a 32 km/h (20 mph) wind blowing against the structure. This is the industry yardstick for quantifying air leakage in a house.

Air infiltration is measured in cubic feet per minute at 50 Pa (commonly CFM50). This air leakage measurement is used to calculate the air changes per hour at 50 Pa. Multiply the CFM50 measurement by 60 to obtain cubic feet per hour, and divide by the interior volume of the house to determine air changes per hour (ACH50).

For example, a house measures 3500 CFM50 with the blower door. The house has 232.3 m³ (2500 ft³) of living space with a 2.4 m (8 ft) ceiling, yielding 566.3 m³ (20 000 ft³).

\[
\text{ACH50} = \frac{3500 \text{ CFM50} \times 60}{20000 \text{ ft}^3} = 10.5 \text{ ACH50}
\]

That means, when a winter storm comes through with a 32 km/h (20 mph) wind, all the air in the house is forced out of the house 10 times per hour, or once every 6 min, and the furnace is constantly heating the cold outside air that is being sucked into the house. This was the case with my own house, which was built in 1981.
Houses built utilizing balloon frame construction often measure 15 to 20 ACH50. Typical energy efficient houses today measure approximately 3.5 ACH50 or better, while super energy efficient houses will measure less than 1 ACH50 and incorporate more sophisticated HVAC equipment such as heat recovery ventilators or energy recovery ventilators to keep the energy inside the house while exchanging the stale air for fresh air.

Finally, houses need ventilation. “But isn’t the house supposed to breathe?” This is a common misconception. Ventilation is very different from uncontrolled air leakage. Exchanging stale air for fresh air is only one aspect of ventilation. It is also important to expel humid and odorous air from kitchens, bathrooms, and laundry areas.

So how are the results of the blower door test used? There are two primary applications. The blower door test result is a key input for sizing the furnace and air conditioner for a house. Certified HVAC contractors are usually certified by the Air Conditioning Contractors Association. This certification requires that a house be modeled in order to measure and calculate the heating and cooling British Thermal Unit (BTU) requirements. Modeling requires measuring the exposed exterior wall area and insulation, window and door area and thermal ratings, and the air infiltration rate. These data, combined with weather data for the location of the house, are used to calculate the heating and cooling BTU requirements for the furnace and air conditioner.

A house can be fairly airtight and well insulated and still have areas that are not comfortable. The air distribution system, also referred to as ductwork, is the second application. There are two aspects to this test. First is to ensure that the heated or cooled air is delivered to the designated rooms. Second is to measure the quantity of air being delivered to ensure that each room receives what it needs. The ductwork in houses is often poorly designed, resulting in excessive air losses, as well as significant thermal losses from duct runs through crawl spaces and attics.

LT takes a slightly different form when examining houses with combustion appliances such as a gas or oil furnace, gas water heater, gas kitchen appliances, and wood-burning fireplaces.

I recently examined a 100-year-old house with all gas appliances and found gas leaks at each appliance. The natural draft water heater vent was completely blocked by years of accumulated debris. The blockage causes the water heater to backdraft, meaning all of the exhaust goes into the house. But the house measured over 15 ACH50, meaning it was excessively leaky, enough to negate the hazard caused by the backdraft.

Another newer house measured only 3 ACH50, hence fairly tight. But the homeowners had remodeled their kitchen and installed a commercial gas range and range hood. This house also had a wood-burning fireplace. When performing the LT measurements we discovered that turning the range hood on would cause the fireplace to backdraft. This presented a carbon monoxide poisoning hazard to the occupants. This is a classic example of the interdependence of seemingly independent components.

As nondestructive testing (NDT) professionals, we predominantly think of NDT as being a practice that applies to our work with high tech materials. I encourage you to think how NDT can and should play an important role in our personal residences as well.

AUTHOR

REFERENCES

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Practitioner Profile

James “Mac” McCoy

When his active duty in the United States Navy ended, James “Mac” McCoy transitioned to industrial NDT in the Cherry Point, North Carolina area, where he worked as a member of the regular production NDT crew for Fleet Readiness Center East. Last year McCoy was selected to take over the training aspect of the program.

Q: How did you first become involved in NDT?
A: I was in the U.S. Navy when I began my career in [nondestructive inspection] NDI. In 1994, I was sent to Navy Aviation Nondestructive Inspection Technician Class in Millington, Tennessee, followed by two years onboard the USS America (CV-66) in the NDI lab. I got out of the Navy in 1996 and worked for several NDT testing labs in the southeastern U.S. over the next eight years. In 2004, I began working for Fleet Readiness Center East (formerly NADEP), Cherry Point, North Carolina in the NDI shop.

Q: Tell us about your certifications and training.
A: I currently hold NAS-410 Level II certifications in penetrant, magnetic particle, eddy current, ultrasonic, radiography, and an IRRSP X-ray certification. I also routinely perform temper etch, bond master, and some phased array inspections.

The majority of my formal training hours are from naval aviation NDI school. The school comprehensively covered the theory and application of penetrant, magnetic particle, eddy current, ultrasonic, radiation safety, radiography, and sonic bond testing. The school provided a strong foundation in NDI as well as prepared NDI technicians to take care of Navy and Marine Corps aircraft. After I got out of the Navy, I was in for a lot more training—formal and [on the job training] OJT.

The first testing lab I worked for introduced me to the non-aviation side of NDI where I learned about visible dye penetrants, dry powder magnetic particle, shear wave ultrasonic weld inspection, and gamma radiography. A great deal of OJT was involved in developing proficiency in NDT, and I am thankful that I had some excellent trainers. After safely developing proficiency with X-ray and gamma radiography, I took the test and received the State of Georgia Radiography Certification.

My employment with testing labs provided me with diversified experience. The materials commonly inspected include concrete, welds, castings, pipe/tubing, tanks, boilers, paper machines, structural steel, sonar domes, and composite materials—all from a variety of industries and standards. This diversity was instrumental to my professional development. After years of weld inspection experience, I earned an American Welding Society Certified Welding Inspector certification.

More recently, I have attended Thermography Level I and Navy Instructor Training Course, which allows me to provide refresher training and recertification to Navy/Marine Corps NDI technicians. Having the opportunity to teach my profession has been the most rewarding.

Q: Describe the type of work you do. What are your responsibilities?
A: At Fleet Readiness Center East, I wear several hats. First, I am an NDI technician who supports the H-53, AV-8B, V-22, and H-1 aircraft platforms. This includes the structures, engines, auxiliary power units, components, and locally manufactured parts. Second, I am the NDI training leader—tasked with scheduling, providing, and documenting all training and certifications for the NDI and bearing shops. Finally, I am the FRC East Fleet NDI instructor. Through scheduled rotations with my
counterpart instructors at FRC Southeast (Jacksonville, Florida) and FRC Southwest (San Diego, California), I provide refresher training and recertification to Navy/Marine Corps NDI technicians.

**Q: Describe your work environment.**
A: During a typical week, approximately 40% of my time is on inspections, while the rest of the time is devoted to training administration and trainee development.

**Q: What kind of structures and materials are you testing?**
A: Structures that we test are airframes, skins/panels, landing gear, rotor blades/prop rotors, engines, and various other components. There is a wide variety of materials used in these structures, such as aluminum alloys, steel alloys, titanium, nickel-based alloys, and composite materials.

**Q: What innovations have you noticed in inspection technology? How do you keep up with these changes?**
A: The biggest innovations that I have noticed have been in automated inspection equipment, and the advancement of most of the inspection equipment. FRC East recently purchased a new automated penetrant line, and we have been very pleased with the increased throughput and consistent quality that the technology provides. Procedures are currently being developed to use a portable roll/C-scan ultrasonic machine for some composite inspections. We are also in work on upgrading our automated eddy current equipment used for the engine turbine disks.

The eddy current, ultrasonic, and radiographic equipment we use is periodically upgraded, and it has come a long way from the analog, knob-turning cathode ray tube equipment that I cut my teeth on. They have a lot more “bells and whistles” today. The NDI shop is usually notified of technology advancements by our Materials Engineering/NDI Program management group.

**Q: How important is a background in engineering or mechanical systems to NDT technicians?**
A: Extremely important! Understanding the part—how it was made, the material used, what the part does—is crucial to the NDI technician when developing a technique and interpreting the inspection results. I have seen several NDI trainees who lack this knowledge, and it took a great deal more effort to achieve the minimum proficiency than the trainees who already have this knowledge. Not having this background can easily lead to missed defects or misinterpretations.

**Q: What characteristics do you think define a good NDT technician?**
A: Strong integrity; the courage to stand your ground, and the willingness to listen to other interpretations; ability to think outside the box; and ability to bring the abstract into reality.
Q: What do you consider the growth areas of NDT?
A: With composite technology advancing, I have also seen a significant advancement in ultrasonic inspection technology. However, I have also read about significant progress with both active and passive thermography inspection equipment.

Q: What areas of NDT would you like to learn more about?
A: Without question, it’s advanced ultrasonic testing. I find the growth in this technology amazing, and would love more advanced training in this area.

Q: What are your professional goals?
A: Continuing to progress as a NDI trainer. Other than that, I am a work in progress.

Q: What part of your work do you enjoy most?
A: I enjoy teaching the most. It is most rewarding when I see the expression of understanding in the faces of my students. As a close second, I enjoy learning new equipment and prototyping inspections.

Q: What’s the best career advice you’ve received?
A: Be your own person and go with your instincts.

Q: What advice would you offer to individuals considering careers in NDT/NDI?
A: Do some research and talk to NDT professionals. NDT is a broad field encompassing many industries, technologies, and lifestyles that can range from a 40-hour week to seven 12-hour days to living on the road. Take the opportunities that match your preferences, or you could end up miserable. Then, once you begin your career in NDI, never stop being a student of your profession. There is always more to learn in NDI, and it is always evolving.

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Across
3. Phenomenon where, while pressure downstream is gradually lowered, velocity through an orifice increases until it reaches the speed of sound in the fluid (also known as sonic flow). ______ flow.
6. Change in output reading of an instrument, usually due to temperature change. (electronic) ______ action
8. The positive force that causes movement of certain liquids along narrow or tight passages. ______ action
10. Device that condenses vapors and prevents oil or water molecules from entering a vacuum chamber. ____ trap
11. Gas that does not readily combine with other substances, such as helium, neon, or argon. _____ gas.
12. Monomolecular, noble gas with atomic weight of four, commonly used as tracer gas in leak testing.
13. In the helium mass variety, the basic device that sorts the charged gaseous particles by species in accordance with molecular weight.
14. Unit of pressure nearly equal to 133.322 Pa (1.000 mm Hg).
15. Reactive material that traps gas and removes it from a vacuum chamber.
18. Movement of pumping fluids from the pump back to the vacuum chamber.
19. Lowest temperature at which vapors above a volatile, combustible substance ignite in air when exposed to an ignition source. ______ point.

Down
1. Ratio of mean free path to characteristic dimension of the system. ____ number.
2. Meter that uses a float and a tapered glass bore to measure flow. ____ meter.
4. Coherent characteristic of fluids that causes resistance to flow.
5. System component, typically a plate, that condenses pump fluids before they reach the vacuum chamber and returns fluid to the pump.
7. Gaseous form of, for instance, water, or oil.
9. Passage of fluid into, through and out of a solid barrier having no holes large enough to permit more than a small fraction of molecules to pass through any one hole.
16. Forms of gas coming from material in a vacuum system. Includes gases adsorbed on the surface, dissolved in material, and trapped in pockets and those due to evaporation. ___gassing.
17. Average distance a gas molecule travels between successive collisions with other molecules in the gas or vapor state. mean ____ path.
18. Alternate term for ambient or atmospheric temperature. dry ____ temperature.
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