OFFICE OF THE GOVERNOR

RICK PERRY
GOVERNOR

September 23, 2008

Mr. R. David Paulison
Administrator
Federal Emergency Management Agency
500 C Street SW
Washington, D.C. 20472

Through: Mr. William Peterson, Regional Administrator
Federal Emergency Management Agency (FEMA), Region VI
Federal Regional Center
Denton, Texas 76209

Through: Ms. Sandy Coachman, Federal Coordinating Officer
Federal Emergency Management Agency (FEMA)
Joint Field Office – DR-1791-TX
6001 Airport Blvd.
Austin, Texas 78752

Dear Administrator Paulison:

Pursuant to my letter of September 21, 2008, in which the State of Texas requested that FEMA create and implement a Direct Housing Mission for Texas, per FEMA's 2008 Disaster Housing Plan, it is critical that Texas has access to suitable temporary, short-term housing in areas impacted by Hurricane Ike.

This letter is to reiterate my previous oral and written requests that FEMA provide temporary transitional housing, to include mobile homes and park models that meet acceptable formaldehyde standards as determined by state health officials. While we had previously been told that FEMA had no transitional housing that meets those standards, my office today was notified that FEMA now has identified transitional housing whose formaldehyde levels do not exceed 0.04 ppm, which state health officials have determined is acceptable. FEMA has also identified mobile homes that meet state health standards.

I am requesting, in addition to the other housing requests of my September 21, 2008 letter, that FEMA work with local officials and deliver as quickly as possible to those who request them mobile homes and park models as transitional housing.

I am also enclosing another copy of State Health Commissioner Dr. David Lakey's report outlining the formaldehyde issues.

If you have any additional questions, please do not hesitate to contact me at once.

Sincerely,

Rick Perry

Rick Perry
Governor

RP:kwp

Enclosure

cc: Mr. Michael Gerber, Executive Director, Texas Department of Housing and Community Affairs

TEXAS DEPARTMENT OF STATE HEALTH SERVICES

DAVID L. LAKEY, M.D.
COMMISSIONER

1100 W. 49th Street • Austin, Texas 78756
1-888-963-7111 • http://www.dshs.state.tx.us
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September 12, 2008

Mr. Jack Colley, Chief
Office of the Governor
Division of Emergency Management
P.O. Box 4087
Austin, Texas 78773-0220

Dear Mr. Colley:

This letter is in response to your request dated July 17, 2008, to determine an acceptable indoor air level for formaldehyde in the temporary housing units that Federal Emergency Management Agency (FEMA) might provide to Texas during a disaster. Texas Department of State Health Services (DSHS) staff has researched the issue and based on available information agrees that maintaining residential levels as low as reasonably possible is desirable. DSHS supports FEMA's position that units purchased from this point forward should be required to have formaldehyde levels less than 16 ppb and agrees that they would be suitable for the intended purpose. For existing FEMA units, should they need to be deployed, we recommend a clearance level of 40 ppb. For temporary housing, this level is without appreciable risk for adverse health effects and is consistent with the levels that one might find in other housing. A full justification of the recommended level is included in the enclosed document.

In addition to recommending the clearance level, my staff has made additional recommendations that they believe are critical with regards to this issue. First, since the levels of formaldehyde measured in the indoor environment are highly dependent upon the conditions under which the measurements are taken, we recommend that the trailers are tested under conditions that mimic a reasonable maximum exposure scenario similar to what might be experienced on the Texas Coast. A recommended sampling protocol for Texas (Texas Protocol) is included in Appendix A of the enclosed report. Second, while the likelihood for adverse health effects at the recommended levels is low, there is always the possibility that hypersensitive individuals could experience effects. We recommend that a plan be established that consists both of institutional and engineering controls designed to identify and assist any potential hypersensitive individuals.

I hope that you find this information is helpful. If you have additional questions regarding the recommended levels, please contact John F. Villanacci, Ph.D., NREMT-I, Manager, Injury Epidemiology and Toxicology Branch at (512) 458-7269 Ext. 6175 or by e-mail at john.villanacci@dshs.state.tx.us

Sincerely,

David L. Lakey, M.D.
Commissioner

Enclosures

Formaldehyde Support Document

Texas Department of State Health Services

September 12, 2008

Executive Summary

In response to a request from the Federal Emergency Management Agency (FEMA), received through the Governor's Division of Emergency Management, the Texas Department of State Health Services (DSHS) has determined an acceptable indoor air level for formaldehyde for the temporary housing units that FEMA might provide to Texas during a disaster event.

The conclusions and recommendations below are based on the assumption of temporary housing consisting of short-term to intermediate-duration (not likely to exceed one-year) occupancies. Based on this assumption we concluded that the non-carcinogenic endpoints that might be experienced by sensitive or hypersensitive portions of the population outweigh any potential small theoretical increased lifetime risks for cancer; thus, these recommendations are based on the irritant properties of formaldehyde that affect the mucous membranes of the eye and upper respiratory system. We were able to identify several short-term and long-term screening values for these effects. The screening values for acute exposures are all around 40 ppb. The screening values for chronic exposures are all below 10 ppb.

Conclusion 1: While it might be possible to achieve air levels below 10 ppb in outdoor air, until such time that formaldehyde is eliminated from building products, it would be impractical to recommend a level this low for indoor air. Average indoor air levels for formaldehyde of 30 to 40 ppb are not uncommon (5), and based on available evidence, levels in this range would not pose any appreciable risk for observable adverse health effects. Levels in this range are: 1) well below the odor threshold; 2) less than the level at which some people are able to sense formaldehyde (50 ppb); less than the level associated with asthma in young children six-months to three-years of age (48 ppb); and 3) below the NOAEL (90 ppb) and the LOAEL (240 ppb) used to establish the chronic health-based screening values.

Recommendation 1: Based on available information, we believe that it is desirable to maintain residential levels as low as reasonably possible, as such; Texas fully supports FEMA's position to go forward with the requirement that new units have formaldehyde levels less than 16 ppb. For existing units, we recommend that a maximum indoor air level consistent with what might be expected in other housing; thus, we are recommending a clearance level no greater than 40 ppb for the existing FEMA trailers. A level of 40 ppb also would not be likely to result in observable adverse health effects.

Conclusion 2: The levels of formaldehyde measured in the indoor environment are highly dependent upon the conditions under which the measurements are taken; temperature, humidity, and ventilation are the primary effectors. High temperatures, high humidity, and low ventilation rates can all increase indoor air concentrations of formaldehyde.

Recommendation 2: The levels of formaldehyde in the FEMA trailers should be measured under conditions that mimic a reasonable maximum exposure scenario for the Texas Coastal region. We have included a recommended sampling protocol for Texas (Texas Protocol) in Appendix A.

Conclusion 3: While the likelihood for adverse health effects at the recommended levels is low, other than recommending a level of zero, we can not with 100 percent certainty establish a level that would be certain to protect 100 percent of the population. Hypersensitive individuals, persons with existing disease, young infants, etc., all are potential populations who still could report health problems.

Recommendation 3: We recommend that a plan be established and put in place to identify and assist any individuals who experience formaldehyde related symptoms. This plan should consist of both Institutional and Engineering controls designed to reduce formaldehyde exposures in the housing units.

Purpose and Statement of Issues

During a disaster event it may be necessary for states to provide temporary housing for displaced persons. Under the 2008 Disaster Housing Plan, the Federal Emergency Management Agency (FEMA) has committed to provide states with safe viable temporary housing should it be required. FEMA has established a hierarchy of solutions which range in order of priority from using existing housing resources to the utilization of manufactured housing such as mobile homes and as a last resort, travel trailers. Although according to the 2008 Disaster Housing Plan, FEMA can provide states with manufactured housing, it can do so only when said housing meets the respective states standard for formaldehyde levels. Thus, FEMA will only provide temporary housing units that have been properly vented and have formaldehyde levels at or below the levels approved by the recipient state. In response to a request from the Governor's Division of Emergency Management, the Texas Department of State Health Services (DSHS), Environmental and Injury Epidemiology and Toxicology Branch has evaluated the available literature to determine an acceptable indoor air level for formaldehyde for the temporary housing units that FEMA might provide to Texas during a disaster event.

Formaldehyde – Sources and Environmental Fate

Formaldehyde (HCHO) is a very common natural substance that is found in both indoor and outdoor air. It is produced by the body during metabolism and is present in most living organisms as a metabolic intermediate. It also is widely used in numerous industrial and commercial products and processes. Formaldehyde found in outdoor air comes from both natural and man-made sources. Prior to the mid 1980s, urea foam formaldehyde insulation (UFFI) was a major source of the formaldehyde found in indoor air. Today the primary source of formaldehyde in indoor air are the urea formaldehyde (UF) resins used as adhesives in pressed wood products; however, tobacco smoke also can be another major source. Formaldehyde is removed from the air by photolysis and oxidation and has an estimated half-life in air that ranges from 1.6 to 19 hours depending on environmental factors.

Formaldehyde levels inside a home do not remain constant; ventilation rates, loading (amount of formaldehyde containing products in the home), temperature, humidity, and the age of the home are factors that can affect the levels of formaldehyde in indoor air. Mobile homes generally have poorer ventilation and higher loading factors (more pressed wood products containing UF resins per cubic meter of indoor air) than conventional homes resulting in higher formaldehyde levels indoors. A rise in temperature from 25 to 35 degrees centigrade, the type of rise that might occur when the wall of a mobile home is heated by the sun, can cause a three-fold increase in the rate of release of formaldehyde into the air (1). A 20 degree change in wall temperature (from 16 to 36 degrees centigrade) was associated with a five-fold increase in the levels of formaldehyde in a mobile home in Florida (1). High humidity, such as what might be experienced along the Texas coast, can increase the hydrolysis of UF resins increasing the release of formaldehyde into the air. The age of the home also affects formaldehyde levels in

indoor air with levels in mobile homes decreasing exponentially with time with an estimated half-life of between 4 to 5 years (1).

Levels Measured in the Environment

In 2007, the Texas Commission on Environmental Quality (TCEQ) found average formaldehyde levels in outdoor air from seven areas in Texas below 10.0 ppb (2). These levels are consistent with what has been found in Canada (2.7 ppb) and Europe (2.6 ppb) (5). The levels measured in indoor environments are often much higher than outdoor levels. The corresponding indoor levels measured in the Canadian and European studies were 29.2 ppb and 33.3 ppb, respectively (5). Between 1979 and 1982, when UFFI was still in use, the Texas Department of Health, predecessor of DSHS, tested the air in 443 mobile homes and found formaldehyde levels as high as 8,000 ppb (3). In 1985, about the time that UFFI was being phased out, the indoor air levels of formaldehyde found in 560 randomly selected conventional homes, and 1,200 randomly selected mobile homes ranged from <5.0 to 480 ppb and <10.0 to 2,900 ppb, respectively (3).

Toxicokinetics

Inhaled formaldehyde is easily absorbed from the respiratory tract; nearly 100 percent of it is absorbed from nasal mucosa down through the trachea and bronchi; however, the absorption appears to be limited to the cells in the immediate vicinity of the point of contact. Formaldehyde also is metabolized rapidly with an estimated half-life in the body of 1 ½ minutes. It is metabolized by the enzyme formaldehyde dehydrogenase to formate in the cells at the point of contact. Because of this rapid metabolism, blood levels in both humans and animals stay relatively constant at approximately 2.5 milligrams of formaldehyde per liter of blood (mg/L). People who were exposed to 1,900 ppb of formaldehyde for 40 minutes did not show any appreciable changes in the levels found in their blood and tissues (2). Formaldehyde also is produced by the body during metabolism with an estimated production and metabolism of over 50,000 milligrams of formaldehyde each day (4). The high metabolic turnover of formaldehyde by the body at the site of contact is toxicologically significant and suggests that formaldehyde may not be a systemic toxicant; rather it is a highly reactive compound that directly irritates the tissues with which it comes into direct contact (4). Although there are scattered studies suggesting that effects may occur at sites distant from the site of exposure, such effects might be limited to high concentrations when the capacity of the local tissues to metabolize the formaldehyde is exceeded. Cell turnover or cytotoxicity was not observed at levels as high as 2,000 ppb (2).

Toxicity

The toxicity of formaldehyde has been reviewed extensively by others (2,5,6,7,8); thus, only a brief summary of key findings is presented below.

Non-Cancer Effects

Formaldehyde is a highly reactive compound that directly irritates the tissues with which it comes into direct contact (4). There is little controversy that high doses are cytotoxic and cause necrosis of tissues. It has been hypothesized that the toxic effects of formaldehyde are caused by the substance itself and not its metabolites; thus, toxicity may occur when the intracellular mechanisms for metabolizing formaldehyde are overwhelmed. In addition to a local cytotoxic response, it is possible that formaldehyde also causes sensory irritation in that it directly stimulates nerve endings producing undesirable effects on the eyes, nose, or throat.

Some people can sense formaldehyde in the air at concentrations as low as 50 parts per billion (50 ppb), although most people smell it at concentrations ranging from 500 ppb to 1,000 ppb. It is highly soluble in water and acts as an irritant gas primarily affecting the mucous membranes of the eye and upper respiratory system (from the nostrils to the vocal cords). This has been corroborated by studies and observations on both humans and animals. People exposed to relatively high levels (400 ppb) for short periods of time (2-hours) experienced sneezing and nasal and eye irritation (2).

Similar exposures also have been associated with increased eosinophil counts and protein in nasal lavage fluid in people with purported formaldehyde-induced bronchial asthma (9). Approximately one-fifth of the people who were exposed to 200 ppb for 4-hours reported eye and nasal irritation (10) and cross-sectional studies of workers chronically exposed to formaldehyde at concentrations ranging from 100 to 600 ppb reported mild histological damage to the nasal epithelial tissue. (11,12,13). Clinical symptoms of mild irritation of the eyes and upper respiratory tract and mild damage to the nasal epithelium were observed in workers exposed for an average of 10.4 years to a time weighted average concentration of 240 ppb of formaldehyde (2).

Results from animal studies support the effects observed in people in that they clearly identify the upper respiratory tract as the primary target for airborne formaldehyde exposure. Cynomolgus monkeys exposed to 2,950 ppb formaldehyde for 22 hours per day, 5 days per week, for 26 weeks showed clinical signs of nasopharyngeal irritation with lesions in the nasal epithelium (14). Similar effects were observed in Rhesus monkeys exposed to 6,000 ppb for 6-hours per day, 5-days per week, for 6 weeks (15), in rats subchronically exposed to concentrations greater than 2,000 ppb (14, 16, 17) and in mice exposed to concentrations greater than 4,000 ppb (18,19,20).

There is limited positive evidence that exposure to formaldehyde may be associated with bronchial asthma in workers. Case reports of two renal dialysis nurses, a plastic molder, a printer, a worker in a phenol formaldehyde plant, and a carpenter all reported marked changes in (Forced Expiratory Volume) (FEV_1) or airflow rates in response to challenges with formaldehyde at levels less than 3,000 ppb (2). In a study of 230 patients who had previously been occupationally exposed to formaldehyde and reported symptoms consistent with asthma, only 12 of the 230 patients exhibited decreased airflow rates when acutely exposed to 2,000 ppb formaldehyde (2).

Workers with known skin hypersensitivity to formaldehyde and people with no known history of allergies were exposed to 0.0 ppb (control condition) and 400 ppb of formaldehyde for 2-hours. The workers evaluated for a variety of symptoms of irritation and nasal washings were evaluated for eosinophil, neutrophil, basophil, mononuclear cells, and albumin content. During the 2-hour exposure to formaldehyde both groups showed statistically significant increased average symptom scores compared with placebo scores; however, based on the findings from the nasal washings the authors concluded that the symptoms that were observed were the result of non-specific, non-allergic response to low-level formaldehyde exposure (21).

Serum from formaldehyde exposed people has been analyzed for formaldehyde-specific IgE antibodies (2). While the results of these studies are not consistent, there is suggestive evidence that children may have an increased tendency to develop specific antibodies after exposure to formaldehyde in indoor air (2).

Evidence of formaldehyde induced asthma in children has been documented. After ruling out other potentially confounding indoor air pollutants, an increased risk or allergic hypersensitivity in children associated with exposure to formaldehyde in homes was found (22,23). After controlling for other potential indoor pollutants, formaldehyde levels in homes were found to be significantly associated with hospitalizations for asthma in children aged six months to three years (24). No effects were found in children exposed to levels from 8 to 40 ppb, a non-significant increased risk was found in children exposed to levels ranging from 41 to 48 ppb, and a significant increased risk was reported in children exposed to concentrations above 49 ppb.

Cancer Effects

The Environmental Protection Agency (EPA) classifies formaldehyde as a B1 probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals. The International Agency for Research on Cancer (IARC) has classified formaldehyde as carcinogenic to humans (Group I), based on sufficient evidence in both humans and animals. The human data that EPA has used includes nine studies that show statistically significant associations between site-specific respiratory neoplasms and exposure to formaldehyde or formaldehyde-containing products. The animal data includes an increased incidence of nasal squamous cell carcinomas observed in long-term inhalation studies in rats and in mice. The classification of formaldehyde as a carcinogen also is supported by in-vitro genotoxicity data and formaldehyde's structural relationships to other carcinogenic aldehydes such as acetaldehyde. It has been hypothesized that the sustained increased cell proliferation and subsequent regenerative proliferation resulting from the high cytotoxicity of formaldehyde is essential for mutations in the development of formaldehyde induced tumors (5). A mechanism of action requiring cytotoxicity would imply that high levels of exposure would be required to induce tumors; some have suggested levels greater than 1,000 ppb.

Previously Established Health-Based Screening Values

Non-Cancer Effects

The Agency for Toxic Substances and Disease Registry (ATSDR) has developed acute, intermediate, and chronic inhalation Minimal Risk Levels (MRLs) for formaldehyde. These MRLs are derived for non-cancer effects using a no-observable-adverse-effect level/uncertainty factor (NOAEL/UF) approach and are considered to be below levels that might cause adverse effects in people who might be most sensitive to the effects. Acute MRLs are derived for exposures that might last 1-14 days, intermediate MRLs are derived for exposures that might last 15-365 days, and chronic MRLs are derived for exposures that might last 365 days or longer. In general MRLs contain a degree of uncertainty that by design errs on the side of protecting public health. They are not predictive of adverse effects and are only intended to be used as screening tools. The acute inhalation MRL of 40 ppb is based on human studies involving people who were occupationally exposed to formaldehyde. These studies identified a lowest observable adverse effects level (LOAEL) of 400 ppb for eye and nasal irritation. The MRL was derived by dividing the LOAEL by an uncertainty factor of 3 for use of a LOAEL and again by 3 to account for human variability. The intermediate MRL of 30 ppb is based on a 26-week inhalation toxicity study in monkeys, rats, and hamsters and an identified no observable adverse effects level (NOAEL) of 980 ppb. The intermediate MRL was derived by dividing the NOAEL by an uncertainty factor of 3 for extrapolation from animals to humans and again by 10 to account for human variability. The chronic MRL of 8 ppb is based on histological changes in the nasal mucosa of people occupationally exposed to formaldehyde with an identified LOAEL of 240 ppb divided by an uncertainty factor of 30.

Recently TCEQ determined Reference Values (ReVs) for acute and chronic exposure to formaldehyde in ambient air. An acute ReV of 41 ppb was determined based on a study of human volunteers (some of whom had skin hypersensitivity to formaldehyde, some with bronchial asthma and suspected respiratory formaldehyde sensitization, and some with no known sensitization to formaldehyde). The critical effects for the ReV were eye and nose irritation resulting from a 2-hour exposure to 400 ppb formaldehyde (the LOAEL) which was divided by a total uncertainty factor of 10. The chronic ReV established by the TCEQ of 8.9 ppb is based on the critical effects of eye, nasal, and lower airway discomfort observed in 66 workers occupationally exposed to an average formaldehyde concentration of 210 ppb for an average of 10-years compared to a control group of 36 office workers exposed to an average formaldehyde concentration of 70 ppb. The control group average exposure of 70 ppb was assumed to be a NOAEL and was adjusted from an 8-hour workday/5-day per week exposure to a continuous exposure of approximately 26 ppb. The adjusted NOAEL was then divided by a total uncertainty factor of 3 to obtain the chronic ReV of 8.9 ppb. California's Office of Environmental Health and Hazard Assessment used the same study to derive a chronic inhalation exposure level of 2 ppb.

Although not a health-based screening value, FEMA's 2008 Disaster Housing Plan – Revision 1, now states; "with respect to mobile homes and park models manufactured for

FEMA going forward, FEMA now requires, by contract, such units to have indoor air levels of formaldehyde less than 0.016 parts per million (16 ppb)."

Cancer Effects

A variety of predictive models – biologically-based models, linear low-dose extrapolation models, linear benchmark dose models, non-linear benchmark dose models – have been proposed to estimate the increased lifetime risk for developing cancer due to formaldehyde exposure.

Conclusions and Recommendations

FEMA asked Texas to identify a level of formaldehyde for temporary housing; thus, these conclusions and recommendations are based on the assumption of short-term to intermediate-duration occupancies (not likely to exceed one-year). FEMA will only authorize travel trailers for a maximum of six-months. Based on this assumption it is our opinion that the subchronic non-carcinogenic endpoints that might be experienced by sensitive or hypersensitive portions of the population outweigh the small potential theoretical increased lifetime risks for cancer that we might associate with exposures of this duration. The screening values for non-carcinogenic endpoints are all based on the irritant properties of formaldehyde that affect the mucous membranes of the eye and upper respiratory system. The non-carcinogenic screening values for acute exposures are all around 40 ppb. The non-carcinogenic screening values that we identified for chronic exposures are all below 10 ppb.

While it might be possible to achieve levels below 10 ppb in outdoor ambient air, until such time that formaldehyde is eliminated from building products, recommending a level this low for indoor air would not be practical. It would be a reasonable approach to recommend a formaldehyde level for indoor air that would pose a risk that is no greater than the risk that someone might experience when moving into a new residence.

Recommendation 1: Based on available information, we believe that it is desirable to maintain residential levels as low as reasonably possible, as such; Texas fully supports FEMA's position to go forward with the requirement that new units have formaldehyde levels less than 16 ppb. For existing units, we recommend that a maximum indoor air level consistent with what might be expected in other housing; thus, we are recommending a clearance level no greater than 40 ppb for the existing FEMA trailers.

Formaldehyde levels around 40 ppb pose no appreciable risk for adverse health effects. They are well below the odor threshold and are less than 50 ppb, the level at which some people are able to sense formaldehyde. Levels in this range also are less than 48 ppb, the level associated with asthma in a very sensitive subpopulation, and young children six-months to three-years of age. With respect to the health based screening values, they are below the NOAEL (90 ppb) used to establish two of the chronic screening values and the LOAEL (240 ppb) used to establish the third chronic screening value. They also are

consistent with the level (40 ppb) recommended by the Texas Voluntary Indoor Air Quality Guideline for Governmental Buildings.

Recommendation 2: The levels of formaldehyde in the FEMA trailers should be measured under reasonable maximum exposure scenario conditions for the Texas Coast.

The levels of formaldehyde measured in the indoor environment are highly dependent upon the conditions under which the measurements are taken with temperature, humidity, and ventilation rates being the primary effectors. A recommended sampling protocol for Texas (Texas Protocol) is provided in Appendix A.

Recommendation 3: Establish a plan consisting of institutional and engineering controls in housing for potential hypersensitive individuals.

While the likelihood for adverse health effects at the recommended level is low, based on the available information, other than recommending a level of zero, we can not with 100 percent certainty establish a level that would be certain to protect 100 percent of the population. Hypersensitive individuals, persons with existing disease, young infants, etc., all are potential populations who still could report health problems. Mechanisms need to be established through which these individuals can report potential health problems, so that they can be identified, and a plan should be in place to implement institutional or engineering controls so that the exposures can be mitigated. Engineering controls, for example, could consist of installing a fan to provide fresh air ventilation to the residence 24-hours per day, 7-days per week.

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Appendix A

Formaldehyde Sampling Guidance for Acceptance/Clearance of
FEMA Temporary Housing in Texas (**Texas Protocol**)

Starting methods for acceptance testing for Texas are included in the *Final Report on Formaldehyde Levels in FEMA-Supplied Travel Trailers, Park Models, and Mobile Homes; From the Centers for Disease Control and Prevention; July 2, 2008* as laid out in Appendix F. CDC final Report link: http://www.cdc.gov/nceh/ehhe/trailerstudy/pdfs/FEMAFinalReport.pdf

Texas Protocol changes or substitutions for **ENVIRONMENTAL SAMPLING PROTOCOL, Formaldehyde Samples,** *Analysis Method:*

Analytical testing need not be performed by the Bureau Veritas laboratory, as specified in the CDC document.

1. However, a single source laboratory must be used for all samples performed in temporary housing that may be allocated for use in Texas.
2. The contract laboratory must be currently IHLAP accredited by the American Industrial Hygiene Association[1], and perform NIOSH Method 2016 according to the NIOSH Manual of Analytical Methods[2]
3. Sampling media will consist of Waters Sep-Pak XpoSure Aldehyde or Supelco S10LpDNPH cartridges, but only one type of sampler will used in testing for the **Texas Protocol.**

[1] AIHA Accredited Labs link: http://www.aiha.org/Content/LQAP/accred/AccreditedLabs.htm
[2] NIOSH 2016 method link: http://www.cdc.gov/niosh/nmam/pdfs/2016.pdf

Texas Protocol changes in sampling parameters adding to or substituting for **Formaldehyde Samples,** *Sample Collection:*

- As the temporary housing is anticipated to be in FEMA holding areas, instructions regarding occupancy, normal housing configuration, or internal conditions stated in *Sample Collection:* should be disregarded for the **Texas Protocol.**
- The temporary housing will be unoccupied; all windows, doors, and other structures for ventilation purposes will be closed for a minimum of 12 hours before the indoor air is sampled.
- Each housing unit must be measured at an indoor air temperature (IAT) in the range of 80-85° F. When the IAT is below 80° F, the HVAC system for the housing unit must be used to heat and hold between 80-85° F for at least eight-hours before sampling is to occur. When the IAT is above 85 ° F, the HVAC system for the housing unit must be used to cool and hold the IAT between 80-85° F for at least one-hour before sampling is to occur.
- During clearance sampling relative humidity (RH) of ambient air must be greater than 40 percent.

Texas Protocol changes in sampling parameters adding to or substituting for **ENVIRONMENTAL SAMPLING PROTOCOL, Temperature and Relative Humidity** and **SAMPLING STANDARD OPERATING PROCEDURE, Preparation prior to site visit:, Temperature and Relative Humidity**

1. Outdoor air (ambient) and indoor air temperatures and relative humidity (RH) measurements, using a suitable direct-reading, data-logging instrument, must be specified for the **Texas Protocol.** Several manufacturers produce commercially available

instruments that will substitute for and qualify for the **Protocol** by meeting the same criterion as the HOBO® instrument. Henceforth when HOBO® is mentioned, contractors will specify a qualified instrument and model to perform temperature and RH measurements.

2. The qualified temperature and RH units must meet the HOBO® criterion, as noted in **Temperature and Relative Humidity,** Operational checks: and must have been calibrated by the manufacturer within the last six months.

Texas Protocol changes in sampling parameters adding to or substituting for **SAMPLING STANDARD OPERATING PROCEDURE,** ***Site Visit:*** **Formaldehyde,**

1. Add one outdoor air (ambient) formaldehyde sample to **Formaldehyde**, 5, taken for 60 ± 2 minutes, commencing during the first hour and the last sampling hours of a sampling day.

Texas Protocol changes in sampling parameters adding to or substituting for **SAMPLING STANDARD OPERATING PROCEDURE,** ***Site Visit:*** **Temperature and Relative Humidity**

1. Outdoor air (ambient) measurements must be taken for a five minute window within 10 minutes prior to starting indoor air sampling, and within 10 minutes after the completion of indoor sampling.
2. Indoor air sampling will include temperature and RH measurements for at least five minutes at the start of air formaldehyde sampling and for at least five minutes at the end of formaldehyde sampling. Temperature and RH instrument placement will be at the same breathing zone height as specified in *Sample Collection:*, of Appendix F.