ALASKA LEGISLATURE COMMITTEE FILES 1983 - 1984 8672

2637 SLC SB 214 (FILE 2) - (FILE 3) 2637

B. Insignificant Effects

The following environmental effects of expanded uses for plastic plumbing pipe may occur but are probably insignificant by any reasonable interpretation of CEQA:

- Plastic pipe systems may fail slightly more frequently than metal systems until a body of experience with installation errors has accumulated.

- Plastic pipe will consume slightly more petroleum than metal pipe, but slightly less energy overall.

- Plastic pipe will contribute a slightly different load of pollutants to public waste water treatment systems, but the direction of impact, let alone its magnitude, is uncertain.

- Plastic DWV pipe will be slightly noisier than metal systems if installed so as to contact wall surfaces; this may be more significant than otherwise in the multifamily, fire-rated construction that is affected in the DWV code changes.

- Plastic DWV pipe could be damaged by pipe cleaning equipment, but because of its resistance to corrosion, the frequency of such cleaning should be low.

- Plastic pipe will slightly decrease the life-cycle cost of plumbing and therefore of housing, but not enough to change demand patterns or growth.

- Small shifts in employment from metal pipe manufacturing to plastic pipe manufacturing will occur.

- A small reduction in the work of plumbers will occur, mostly as a result of repair and renovation work by do-it-yourselfers.

C. Effects of Alternative Actions

In addition to the proposed project, e.g., the proposed change to the 1982 Uniform Plumbing Code (UPC) allowing certain new uses of plastic plumbing pipe as described in the Project Description, this environmental review has examined the potential effects of alternatives to the proposed project on the quality of the natural and human environment. The eventual EIR will consider alternatives as well as the project itself to provide a baseline for evaluating the significance of the impacts and to provide possible alternative courses of action should the proposed project create significant adverse impacts that cannot be successfully mitigated. With this goal in mind, the alternatives we have selected for analysis are no changes to the state code, partial approval of plastic pipe use, and complete rejection of all plastic pipe (that is, reversal of earlier provisions allowing certain uses of plastic pipe).

Under the no-action alternative, there would be no changes in the state code regarding the use of plastic plumbing pipe. All currently approved uses for plastic pipe would continue to be permitted and no new uses of plastic pipe would be allowed. None of the impacts attributable to the use of plastic pipe in expanded applications would be observed; any public health and worker safety and health effects of currently allowed plastic and metal piping systems would persist.

The partial approval alternative would amend the state code to permit certain new uses of plastic pipe, but not all of the new uses proposed under the project. Counting cold and hot water supply in a given application as one new use, the proposed project would change the code to permit 11 new uses of plastic pipe (i.e., 1 new use for ABS pipe, 3 for PB pipe, 1 for PVC pipe, and 6 for CPVC pipe). Considering all the possible combinations of these uses, over 2,000 partial approval alternatives are possible.

Our analyses of the environmental consequences of the proposed project have guided our selection of the subset of the partial approval alternatives to be considered in the EIR. That is, we define the partial approval alternative(s) to permit those new uses of plastic plumbing pipe that are least likely to have significant adverse effects on the quality of the natural and human environment. At present, the only partial alternative that seems reasonably certain to meet this requirement is to allow PB for hot and cold water supply both outside buildings and inside buildings that are not fire-rated or within the fire-resistive construction of fire-rated buildings. No other new uses of plastic pipe would be allowed. Parenthetically, there seems little reason to prohibit PB in exposed locations of fire-rated buildings as long as the penetrations of fire-resistant construction are designed to maintain the rating of that construction. The state of information on the impacts of this alternative is generally the same as on those of the metal water pipe currently allowed for these two uses. Although PB will certainly burn and metal will not, the additional risk of fire spread appears minimal, as does that of smoke toxicity. Leachates from PB have not been shown to be risk-free, but neither have those from copper or galvanized steel. Of the two plastic alternatives, PB is somewhat less likely to be a public health hazard than CPVC, although the relative ratings of PB, CPVC, copper, and galvanized steel will not be clear without further testing (see Section VI). PB is clearly a preferred material, from the worker safety and health viewpoint, compared both with metal systems and with plastics that require cementing.

Under the option of disallowing currently allowed uses of plastic pipe, any impacts of these materials would disappear and those of metal systems reappear. The possibility of permeation of water supply piping by organic contaminants would decrease to the extent that PVC and PE supply lines would be replaced by metal with impermeable joints (but even metal pipe joints can be permeable). Leachates from PVC and PB would be replaced by those from copper, with no clear impact, positive or negative, on public health. The metal pipes would be somewhat more likely to corrode in soil than plastic (galvanized steel is not recommended for buried supply lines). Only small changes in worker safety and health would result from the changes in water supply piping.

Any major impacts of disallowing current uses of plastic pipe would be associated with the widespread use of ABS (and less widespread use of PVC) in DWV applications. Fire load and fire spread would be reduced in nonfire-rated construction. It is probable that few fatalities or little property damage would be avoided by this action, but both are possible benefits. Smoke toxins would also decrease somewhat, especially if PVC were replaced. The decrease in plumbers' exposures to solvent cements would be offset by increased work-related injuries from working with cast iron and, to some extent, with soldered joints in copper DWV. Whether the net effect on worker safety and health would be positive or negative is difficult to predict, given the current lack of information on plumbers' exposures.

Finally, the alternative that would disallow current uses of plastic would transfer some profits and jobs from the plastics to the metal pipe industries. Since large quantities of DWV are involved, these impacts would probably be greater than those for the prime project alternative of allowing expanded uses of plastic pipe. Houses could become more expensive, depending on the prices of cast iron and copper, but probably not enough to significantly affect the demand for housing.

In summary, the alternative of approving only the expanded uses of PB appears to pose fewer environmental risks than does the full proposed project given the state of current information. Because metal systems also pose some unique risks and may be comparable to plastic systems in other risk areas, we are not prepared to say that the no-project alternative or the alternative that would disallow current uses of plastic are environmentally preferable to the partial approval alternative, or even to the full proposed project.

D. Cumulative and Long-Term Implications

Increased use of plastic plumbing pipe can contribute to cumulative environmental impacts in two ways.

First, the sum of the environmental impacts of plastic pipe could be significant even when no one individual impact is deemed significant. In the case of plastic pipe, the most plausible example is for the various leachates that could each contribute to public health impacts. For example, no one leachate might reach the level of 10^{-6} lifetime risk for cancer, but the cumulative risk of all leachates acting together might exceed that level. Given the current uncertainties about the public health impacts, especially those concerning the long-term levels of leachates in drinking water, we are unable to determine whether the cumulative impact is significant. A similar situation is found with worker health impacts, where the risk of one solvent might be insignificant, but that of two or more could be significant. For fire safety, the cumulative impact of all the proposed new uses for plastic pipe are likely to be dominated by the new DWV uses; the contribution of PW pipe is likely to be negligible. The same is true of smoke toxicity, except that the combined affect of HCl, CO, and other toxicants could be significant even when the effects of any one alone were not.

A second issue of cumulative impact is the question of whether the expanded use of plastic water pipe would add to the impacts of other similar actions and in total create a significant effect even though the use of plastic water pipe is not itself significant. We can consider two levels of cumulative impacts:

- Cumulative impact of expanded and existing use of plastic plumbing pipe.
- Contribution of plastic plumbing pipe to total use of plastic products.

As has been made clear earlier, the expanded uses of plastic pipe are in many ways rather small in comparison to existing approved use of plastic pipe. Most new California houses are already being plumbed with ABS DWV if they are not fire-rated; the addition of 10% (by weight) more plastic pipe as PB or (less likely) CPVC water pipe will be of little consequence for fire safety, especially as water piping is less sensitive. The increase for plastic pipe in fire-rated construction, of course, is total since no plastic is being used now; however, if ways of maintaining the rating are developed as required by code, little fire safety impact would be expected. Similarly, the cementing of plastic potable water pipe is probably much less of a problem for workers than the cementing of already approved ABS DWV. Thus, the greatest issue of cumulative impact involves public health impacts, in which plastic in residences can add to plastic in public utility distribution systems. We have no way of estimating the relative contribution of each to the total hazard, as the source of contaminants found in the water supply (control) during leaching tests is not known. We doubt that the combined effects of distribution and residential piping would be significant if neither one alone were, but we cannot rule out that possibility. Similarly, permeation of plastic distribution pipes by toxic substances is more likely than it is for residential piping systems, but the significance of either, in terms of an overall risk assessment, will not be clear for a long time.

With regard to plastics in total, the expanded uses of plastic pipe will be a relatively small contribution in most respects. Plastics are by now endemic in our society. Most of the contaminants of PVC and CPVC that could be public health hazards will be ingested in much greater quantities from other PVC products such as food containers or, in the case of some of the chlorinated methanes, simply from waste products reaching the raw water supply. Those from PB and PE are similar to those from PE food contact materials. If plasticizers do contaminate plastic pipe, they will still do so at much lower levels than they do in any number of plasticized products to which people are regularly exposed, such as flexible vinyl upholstery (where they would yield inhalation rather than ingestion exposures). But equally clearly, plastic pipe does contribute to the total load of plastic-related hazards in California--for example, to the total of all combustible plastics in residences. The hazards from the total use of plastics are undoubtedly appreciable, even though nearly impossible to estimate. Whether or not they are greater or less than the hazards of the materials they replace is perhaps even more difficult to state. About all that can be said is that plastic pipe is not an unusually prominent or special case among plastics in general.

CEQA also requires an assessment of whether long-term environmental costs will be incurred as a result of short-term economic or other benefits. Certainly, any public health impacts of plastic pipe that do occur will probably be delayed for decades, as will some of the worker health or smoke toxicity impacts. However, for the purpose of determining the environmental consequences of the expanded uses of plastic pipe, those should be counted as current impacts, and not discounted in comparison with current benefits. We believe that, when it is viewed from this perspective, this CEQA issue is irrelevant to the decision at hand.

E. Significant Irreversible Changes

CEQA also requires an assessment of environmental changes or consumption of resources that would be permanent and irreversible. For example, the mining of a mountain is an essentially irreversible impact, whereas most air pollutants and their impacts would disappear once the source of pollution is removed.

In the case of the expanded use of plastic plumbing pipe, there would be a small permanent commitment of petroleum resources (but not other energy sources) to the manufacture of the pipe constituents. Total energy resources would be conserved to a slight degree. If any deaths occurred as a result of diseases caused by leachates or occupational exposures, or from fire or smoke toxicity, they would also be irreversible. If plastic pipe were later disapproved, the occurrence of new fatalities would gradually disappear. Some of the leachates from plastic pipe are mutagens and some mutations can be heritable. Thus, it is possible that a heritable--and more likely than not adverse--mutation could persist in the population as a result of drinking from plastic water pipes. Neither the specifics of the leachates in water from plastic pipe nor the overall state of the art of genetic risk assessment allows an evaluation of this possibility at present. If the impacts of plastic pipe eventually were judged unacceptable, it is possible that the metal pipe industry would have declined by that time to the point at which it would prove difficult to revive, but that possibility is also extremely speculative. Overall, we believe that the reversibility of the impacts is not as important an issue to resolve as the magnitude and significance of current impacts.

F. Growth-Inducing Impacts

California's population is projected to increase from the 1980 total of 23.8 million people to 25.2 million by 1985 and to 27.5 million by 1990 (California Department of Finance, 1981). The proposed code change is not likely to significantly affect this forecast population growth for the following reasons. First, the reduction in the cost of housing construction that would result from use of the newly permitted plastics in place of currently approved plumbing materials is so small that it would have virtually no effect on the sales price or rent of dwelling units in the state. Therefore, there will be no change in the demand for housing and consequently no additional in-migration of residents who would be attracted by a drop in the price of housing. Second, the plumbing material substitutions that are likely to result from the proposed code change would not significantly affect employment opportunities in the state and so would not affect the in-migration and out-migration forecasts. Nor would either housing prices or employment opportunities significantly affect shifts in population from one part of California to another.

SB

214

#3

STATE OF ALASKA
FISCAL NOTE

Revision Date Original, 1983

I. REQUEST

Bill/Resolution No.: Senate Bill 214
Title: "An act relating to the plumbing Code"
Sponsor: Senator P. Fischer
Requestor: Labor and Commerce

II. FISCAL DETAIL

Agency Affected: Labor
Program Category Affected: Worker Protection
BRU, Program of Subprogram(s) Affected: Labor Standards and Safety

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88
100 PERSONAL SERVICES						
200 TRAVEL						
300 CONTRACTUAL						
400 COMMODITIES						
500 EQUIPMENT						
600 LAND & STRUCTURES						
700 GRANTS, CLAIMS, ETC						
TOTAL OPERATING	.	0	0	0	0	0
CAPITAL						
REVENUE						

FUNDING: (Thousands of Dollars)

GENERAL FUND		0	0	0	0	0
FEDERAL FUNDS						
OTHER (Specify Source)						

POSITIONS:

FULL-TIME						
PART-TIME						
TEMPORARY						

III. SOURCE OF FUNDS TO OFFSET FISCAL IMPACT OF BILL:

N/A

IV. ANALYSIS: Attach a separate page for any Analysis

Prepared By: Robert J. Bacolas, Sr. [signature] Phone 465-4870
Division: Labor Standards and Safety Date: April 1, 1983

Approved by Commissioner: Jim Robison [signature] Date: April 1, 1983
Department: Labor
LEG:A:38

Distribution:
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Shell Chemical Company

GENERAL

Q. What is DURAFLEX™ polybutylene?

A. DURAFLEX is Shell's trademark for the polybutylene resin it produces from crude oil. Polybutylene is a high molecular weight polymer, made by polymerizing butene-1, a common chemical feedstock.

Q. What are polybutylene resins used for?

A. The primary use for polybutylene resins has been in hot water piping applications. It is currently in this use in over 25 countries around the world and has accumulated over a decade of successful service in the U.S. and Europe. In addition, polybutylene resins are tough enough to be used as industrial piping for handling highly abrasive slurries and safe enough to be used as films for food cooking applications.

Q. Why have polybutylene resins found such wide use in hot water piping?

A. Polybutylene piping offers a large number of advantages over metal and other plastic piping systems: corrosion, scale, and electrolysis resistance; freeze tolerance; high temperature pressure carrying capabilities; and ease of installation due to its flexibility.

O. How long will polybutylene piping last?

A. Tests by independent testing laboratories and authorities project a normal life of at least 50 years under common use conditions. Within the last ten years, over three million houses and recreational vehicles have been built or manufactured using polybutylene plumbing pipe. Service problems have been virtually nil.

Q. Have polybutylene plumbing systems received wide approval?

A. Yes, polybutylene is approved by every major national and regional code in the United States and Canada and by agencies of the U.S. and numerous foreign governments. In addition, over 65% of the major metropolitan areas in the United States have approved polybutylene plumbing systems.

Q. There are a number of polybutylene hot water piping systems on the market. Are there any differences in them?

A. All pipe is manufactured to meet the appropriate ASTM standard and is equivalent in performance. Insert, compression, and stab fittings are used for pipes up to 3/4-inch in diameter. Although the fittings vary in design, all meet the same pressure test requirements. For pipes with diameters of one inch or greater, polybutylene heat fusion fittings are used.

Q. Polybutylene tubing is available in several different colors. What do the colors mean?

A. The pipes are color coded for different end use applications. Gray is the standard color for hot and cold water plumbing pipe. Blue tubing is used for cold water service only. Black is used for applications that require long-term exposure to sunlight. Black resins are available for both water service piping and for hot water piping.

TECHNICAL

Q. What is the burst pressure of polybutylene?

A. SDR 11 polybutylene pipes have a burst pressure of 575 psi at room temperature and well over 300 psi at 180°F.

Q. How high a temperature can the pipe tolerate?

A. The most common size of polybutylene pipes (SDR 11) carry a 100 psi continuous use pressure rating at 180°F. This is a long term pressure rating and incorporates a 100% safety factor. In addition, polybutylene pipes also carry a 200°F continuous use pressure rating, the only thermoplastic pipe to carry this high a rating. For short term excursions, even higher temperatures can be tolerated.

Q. What is the melting point of polybutylene resins?

A. Polybutylene pipe resins melt at 255-259°F.

Q. Isn't that a problem for fire sprinkler piping?

A. It could potentially be if the piping were installed exposed in areas with high fuel loadings like chemical warehouses. However, when installed with quick response residential heads, either exposed or concealed, the piping has repeatedly demonstrated in laboratory and real life tests across the United States that it can easily survive the heat generated by room fires.

Q. What if you get a fire in the space behind the wallboard where there are no sprinkler heads? Won't the pipe be damaged under these circumstances?

A. If a fire is allowed to burn next to a polybutylene pipe, it will eventually cause the pipe to leak. Tests at the University of Maryland Fire School have shown that the leak will be in the form of a small hole in the pipe wall, typically less than one quarter inch in diameter. The leak will allow water in the pipe to spray out, potentially controlling the fire and certainly tripping the flow alarm switch on the sprinkler system to warn the occupants of the danger. In contrast, metal piping systems would not leak when exposed to a wall fire and the occupants would not discover the fire until they smell the smoke or the fire bursts through the wall.

Q. How sensitive is the pipe to freezing and what will happen to it if water does freeze in it?

A. Although no fire sprinkler piping should be allowed to freeze (this will inactivate the system), freezing can occur in extreme conditions. Since polybutylene pipes are poor conductors of heat, water in them would freeze more slowly than it would in metal pipes. If the pipe should freeze, the flexibility of the polybutylene piping allows it to expand to accommodate the ice. Upon thawing, the pipe returns to its original size without losing any of its strength.

It should be pointed out, however, that the use of a section of polybutylene pipe in a system of rigid pipe may not protect the entire system. Under these circumstances, a freeze failure will most likely occur in the pipe with the lowest yield point: the polybutylene pipe.

Q. Polybutylene pipe thermally expands and contracts more than metal piping. Is this a problem?

A. It could be in areas of extreme temperature changes if it were not for the flexibility of polybutylene pipes. Because of their flexibility, the thermal expansion force is easily dissipated by a flexing of the line.

Q. What are the flow characteristics of polybutylene pipes?

A. With their smooth bore, polybutylene pipe systems are designed using a Hazen Williams flow factor of 150. This is a conservative value as the data indicate that a value of 160 is more appropriate. Because of their chemical inertness, polybutylene pipes will resist corrosion and liming. As a result, the high flow factor of polybutylene pipes will not have to be derated over the life of the system.

Q. How long can polybutylene be exposed to the sun?

A. The grey hot water pipe and blue water service pipe are not harmed by the normal short exposures to the sun characteristic of normal construction practice, but should be protected from the sun during storage. The black pipe has excellent resistance to ultraviolet radiation and can be used in the sun for extended periods of time.

Q. Polybutylene looks heavy. What does it weigh?

A. Polybutylene is a strong but very light pipe. For example, a 20 ft length of 1-1/2 inch IPS polybutylene piping weighs just 8 pounds. In contrast, a 20 foot length of 1-1/2 inch schedule 40 black iron pipe weighs 50 pounds and 20 feet of 1-1/2 inch copper type M tubing weighs 19 pounds.

Q. How flexible is polybutylene?

A. Polybutylene can be bent to a radius of 10 times its diameter without affecting its performance, e.g., (1-1/2 inch IPS pipe can be bent in a 19 inch radius.)

INSTALLATION

Q. Will the flexibility of polybutylene piping make it look like garden hose when it is installed?

A. Not at all. Being much more flexible than metal pipe, plastic pipe will require more supports and will show some deflection between supports (deviation from perfect horizontal alignment). This does not place any undue stress on the pipe and will not shorten its expected service life.

For comparison purposes, polybutylene pipes are ten times stiffer than garden hose and, of course, are worlds different in performance.

Q. What support spacing is needed with polybutylene pipe?

A. The support spacing will vary with pipe diameter, larger sizes requiring less frequent supports. Although supports must be used more frequently than with metal pipe, the requirement is not excessive, e.g., 1-1/2 inch polybutylene pipe has a recommended support spacing of over five feet.

Q. Are special hangers required?

A. Hangers should have a smooth surface with no sharp edges that could lead to surface abrasion over long periods of time. Plastic coatings have been used on hangers in the plumbing field to eliminate external abrasion.

Q. What about wall penetrations? Must these also be protected?

A. Wall or stud penetrations should be sleeved at the beginning and end of horizontal runs and on both sides of any significant change of direction. As before, low friction plastic sleeves are preferable.

Q. With a burst pressure of 575 psi, is there any chance that the pipe will be broken by the pressure surge caused when fire pumps kick on?

A. NFPA 13E prescribes procedures that should be used when making a connection to the siamese connection on the building. These procedures call for the first responding company to begin pumping at 150 psi pressure with an increase in pressure to 175-200 psi if a serious fire is in progress. Since both these pressures are far less than the pipe's capability, there should be no problem.

Q. Can polybutylene pipes be installed in return air plenums?

A. NFPA regulations state that only noncombustible or low combustibility materials that have a smoke density value of less than 50 as measured by the ASTM E-84 tunnel test can be used in return air plenums.

As polybutylene pipes are used, pressurized with water, they will be virtually impossible to ignite and do not constitute a fire hazard. They may in fact assist in extinguishing any fires that could be generated in return air plenums.

The smoke density requirement should not cause a problem either. Although relevant smoke density values cannot be obtained on plastics by the E-84 tunnel test, a National Bureau of Standards smoke chamber test measurement is available. Comparison of this value to the NBS smoke chamber values for common building materials for which E-84 tunnel test values are also available, shows that smoke generated by polybutylene has an acceptably low density.

COSTS

Q. What about future costs of polybutylene?

A. Polybutylene is made from butene-1, a common chemical feedstock. With gasoline sales forecast to continue dropping, adequate supply and a predictable price for hydrocarbons can be expected. In fact, because of its energy efficient manufacture, polybutylene systems should be less affected by changes in energy prices than metal piping.

Q. What about fitting costs?

A. Although they presently cost more than competitive fittings, fewer of them are required due to the flexibility of polybutylene. In addition, the benefits of mass production as the market continues to grow should reduce their cost in the future.

Q. What cost savings can be expected compared to competitive products?

A. Cost comparisons are subject to many variables but a study by the N.A.H.B. Research Foundation in 1980 showed a 44 percent total installed cost saving compared to a copper plumbing system. In addition, as part of the fire sprinkler tests at Scottsdale in 1982, it was demonstrated that the total costs of retrofitting a polybutylene fire sprinkler system into a single family house was 40% lower than that obtained on retrofitting a black iron system. In addition, recent San Clemente retrofit tests indicated labor savings of more than 50% compared to rigid piping material.

"POLYBUTYLENE FIRE SPRINKLER PIPING"

Meeting the NFPA's goal of halving the number of fire deaths in this country will require action in many areas. The widespread use of residential fire sprinkler systems is one area where significant improvements can be made. However, for residential fire sprinklers to be widely used, they must be demonstrated to be affordable and that has not been the case. Recognizing this, the United States Fire Administration initiated a program in 1980 to develop a low cost residential fire sprinkler system. The program involved the development of fast response sprinkler heads and demonstration of the ability of easy to install polybutylene pipe to meet all of the performance requirements for these systems. That program was successful on both counts as demonstrated by numerous tests at Factory Mutual. As a result, roughly 1000 living units will have residential fire sprinkler systems installed with polybutylene pipe this year.

Because polybutylene is new to this application, I imagine that most of you are unfamiliar with its history of use and performance properties. Accordingly, I would like to give you a very brief history of the development and use of polybutylene pipe and to discuss its properties relative to those of the competitive materials.

Polybutylene came into existence in the 1950's and was first used commercially as a piping material in 1967. Its first major use came in cold water service lines and it has continued in successful use in this application with major utilities for 15 years.

Next polybutylene moved into the mobile home industry. Because of its ability to virtually eliminate in-transit breakage due to vibration, polybutylene rapidly became the primary hot and cold water plumbing pipe used in this industry. Starting from its first use in 1972, it has progressed to the point where it is now used in well over 80% of the mobile homes and recreational vehicles produced in this country.

With expanded availability of polymer resulting from a plant expansion in 1979, an effort was begun to broaden plumbing code acceptance and increase polybutylene's use in residential plumbing systems. At present, polybutylene is approved for hot and cold water plumbing applications in every major national and regional plumbing code in this country - the only plastic pipe so approved. In addition, it has been approved for use in over 65% of the major metropolitan areas in the United States with additional approvals being gained constantly. Acceptance in areas where it has been approved has been excellent. For instance, in Fairfax County, Virginia, where it has been approved for two years, 60% of the new residential construction currently uses polybutylene plumbing.

HW2277018

A residential fire sprinkler pipe should ideally have several characteristics. Since it is tied to the drinking water system, it should be approved for potable water use. It should have good long term flow properties. It should have the ability to withstand many years of exposure to the high temperatures that can occur in an attic during the summer or if the pipe passes next to a recessed lighting fixture. It should be resistant to freeze breakage. And it should have a low installed cost, even in the most difficult retrofit situations.

Polybutylene meets all of these requirements. Every three feet of polybutylene carries the National Sanitation Foundation logo denoting approval for potable water applications. In addition, numerous foreign countries including Canada, Great Britain, Israel, New Zealand, and Finland have also approved polybutylene pipe for drinking water uses.

Although the Hazen Williams flow factor for polybutylene pipes is listed at 150, experimental evidence indicates a value of 160 is more appropriate. Testing is in progress to confirm this. Even more important than short term flow characteristics however, are those exhibited over the long term. Because of its inertness, polybutylene pipes will not suffer a loss in flow capacity over time By contrast, many metal pipes can corrode or lime up causing a noticeable loss in flow factor. This is particularly critical in systems where the water in the sprinkler piping is not stagnant. Such systems are being used in Cobb County, Georgia, to eliminate the use of back flow preventors and thus reduce overall system cost.

As you would expect from its widespread approval for use as hot water plumbing pipe, polybutylene pipe has excellent high temperature properties. The pipes used in plumbing applications carry a long term continuous use pressure rating of 100 psi at 180°F and 200 psi at room temperature. Since these ratings have a 100% safety factor, the long term burst pressures are actually 200 psi and 400 psi, respectively. The short term burst pressure for polybutylene pipes at room temperature is 575 psi. In addition, polybutylene pipes have also been granted a 200°F pressure rating - the highest rating of any thermoplastic pipe.

For shorter periods of time, polybutylene pipes can tolerate temperatures significantly higher than these. In tests conducted at the University of Maryland Fire School, pressurized polybutylene pipes were exposed to a 1500°F radiant wall at a distance of only eight inches. With a stagnant water pressure of 40 psi, the pipes went 8-20 minutes before a rupture occurred. When it finally occurred, the surface of the pipe was close to 500°F. The rupture that occurred was in the form of a small hole (typically 1/4 inch in diameter) that released a spray of water that could cool the pipe surface preventing further damage. For fires inside a wall next to the sprinkler piping, this behavior would actually be of benefit to the homeowner - the fire would cause a small rupture in the pipe at the point of the fire, possibly controlling it, at least in part, and certainly tripping the flow switch to warn the homeowner of the danger.

Polybutylene's ability to survive very high temperatures was clearly demonstrated in the recent series of tests conducted by the NFPA in Fort Lauderdale. In several of those tests, the polybutylene sprinkler piping was exposed to fires set directly below it. Flames were actually licking at the pipes before the sprinkler heads were activated. In every case, the systems performed acceptably and the fire was completely extinguished. There was no damage to the pipe. It should be noted that we recommend shielding of pipes from flames by wallboard or other acceptable materials. However, even if this precaution is not followed, these tests clearly demonstrate the system can perform acceptably.

Because of its flexibility, polybutylene pipes can be repeatedly frozen and thawed with no loss in strength. Although a sprinkler system should always be designed to avoid freezing as that would inactivate the system, such conditions can nonetheless occur and would result in water damage if the piping system were not freeze tolerant, like polybutylene.

Last, and perhaps most important to the acceptance of these systems, is the ability to install them at a low cost. Clearly, unless fire sprinkler systems are affordable they will not be used and their life saving potential will not be realized. Any meaningful cost comparison must look at the total installed costs, the sum of all material and labor costs.

In general, on a foot-to-foot basis, polybutylene pipes are as inexpensive as the competing metal pipes. However, as production increases, costs of polybutylene pipes should be reduced. Over time, increases in the cost of energy will actually benefit polybutylene since its manufacture involves less total energy usage than any of the metal systems. Long term, polybutylene pipes should be less expensive than any metal pipes.

The installation of pipes made of polybutylene will be significantly faster and easier than that of rigid metal pipes. Because of its flexibility (100 times greater than copper and 400 times greater than steel), it is not necessary to use a fitting to change directions nor is it required to do all of the assembly work in tight spaces. This was graphically shown in the installation work done prior to the fire sprinkler tests conducted by the Rural/Metro Fire Department in Scottsdale, Arizona, this past spring. For those tests, two completed homes were retrofitted with fire sprinkler systems - one in polybutylene and one in black iron. The polybutylene system was assembled on the garage floor, snaked into the attic through a 2 foot square access hole, and dropped into place. Total labor charges for the crew's first polybutylene installation amounted to $744, far less than the $1422 for the standard black iron system. As you might expect, further cost reductions are reported with additional experience. No comparisons between polybutylene and copper fire sprinkler systems are available, although total cost savings of 44% have been documented when the National

Association of Home Builders Research Foundation compared the costs of polybutylene and copper in plumbing systems in 1980.

Because of its inertness, polybutylene cannot be joined by solvent cements. In practice, polybutylene piping systems are either heat welded or mechanically joined. The heat welding method is used for diameters greater than 3/4 inch and involves melting a thin layer of polymer on the outside of the pipe and another on the inside of the fitting, pressing the pipe into the fitting, and allowing the molten polymer to solidify together, forming a joint stronger than the pipe itself. This same technique has been used extensively throughout the world with polyethylene gas pipes.

Mechanical joints most commonly utilize an insert fitting and a metal crimp ring. These systems are tight, easy to make, and can provide an easy transition to the screwed fitting needed for the sprinkler head.

To date, the fire sprinklers installed with polybutylene pipes have been done specifically under local approval. However, polybutylene pipes and fittings should soon be approved under NFPA 13D. That approval should be forthcoming when the testing to Factory Mutual's standard on plastic pipe in residential fire sprinklers is completed.

Polybutylene has demonstrated that it can do the job in burn tests at San Clemente, California; Carmichael, California; Scottsdale, Arizona; Springdale, Arkansas; Cobb Country, Georgia; Fort Lauderdale, Florida; and at Factory Mutual. With its high performance properties and low installed cost, we believe that polybutylene can and should become the premier piping material for residential fire sprinkler systems.

A. H. Schroer /CBM

A. H. Schroer
October 6, 1982

cc: S. J. Elstad
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HW2277018

Reprinted from
HOTEL & RESORT INDUSTRY OCTOBER 1982

HOTEL & RESORT INDUSTRY special report

Operation Hotel-Safe: Are You Part Of It?

by John Spina

More than 200 people gathered on prime Fort Lauderdale, Florida beach property recently for a very strange event. Hotel and motel dignitaries met on-site with insurance and code officials, product manufacturing representatives, nationally recognized fire officials and government officers. A very large contingent of the media was present also — all three national TV networks, three affiliate network TV crews, and four local TV stations, as well as print and trade media from across the nation.

They came to deliberately set a hotel afire and watch what would happen. Their plan called for doing so ten different times over the three-day period.

They gathered September 8, 9, and 10 to test the operation of new automatic fire sprinklers — a system which could save lives in hotel and motel fires, reduce serious injuries, and dramatically reduce property losses. All this, experts said, can be done at lower costs thanks to modern technology and a unique partnership of federal, private-sector, and fire service leaders.

Hotel & Resort Industry magazine was in Ft. Lauderdale to cover the event. Our goal is to make you feel as if you were there too. We're confident that you cannot investigate this subject without realizing its importance to our clients — the general public.

The Target: Safer Hotel/Motel Properties

Why all the publicized concern over fire safety in hotels and motels? An examination of the facts tells the whole story.

In the time it takes to read this article, one American will likely die and 22 others will be seriously injured as a result of residential fire in the United States. In that same amount of time, thousands of dollars in property damage will result from these fires.

The death toll and property loss from fires in hotels and motels are included in these grim statistics and, whether or not you choose to investigate the issues involved, you should be aware of the industry's — and your property's — vulnerability to fire.

No longer is the owner and manager of a hotel, motel, or resort property involved in a simple, low-stakes game of chance when it comes to the threat of fire. Odds are that one out of every four hotel/motel properties will experience a fire annually. Besides the possible life loss and civil suits that can result, the loss of room revenue while reconstruction takes place, and the certain, though unmeasurable, effect on the property's image, the average cost of that hotel/motel fire in property damage is $6,300.

While tragic fires which claim multiple deaths and injuries — like the MGM Grand fire — result in considerable news coverage, this should not lead you to believe that fires in hotel/motel structures are rare events. According to statistics from the Federal Emergency Management Agency (FEMA), about 1,000 hotel/motel fires occur monthly. Claimed in these 12,000+ fires yearly are an estimated 150-200 hotel guests or employees and more than $75 million in property loss, again exclusive of the loss of revenue, possible legal costs, of difficult-to-calculate "image" costs.

In 1981, for example, FEMA's preliminary estimates show approximately 12,200 fires in hotels and motels were reported (a considerable number of fires are not reported to the fire service); 165 people died in those fires; approximately 550 people were injured; and more than $77 million in property damage occurred.

"These grim statistics," said Ed Wall, deputy superintendent of FEMA's Natonal Fire Academy, "become even more alarming when close examination reveals that many of the fires were preventable or could have been controlled if certain technological and behavioral lessons had been applied beforehand."

One objective which FEMA and the National Fire Protection Research Foundation hoped to accomplish in the tests, said Wall, was "to provide visual evidence of the value of advances in automatic fire sprinkler systems." A review of the tests and remarks of the audience indicate that the goal was certainly achieved.

The Tests: Visual Proof Of Sprinkler Detector Value

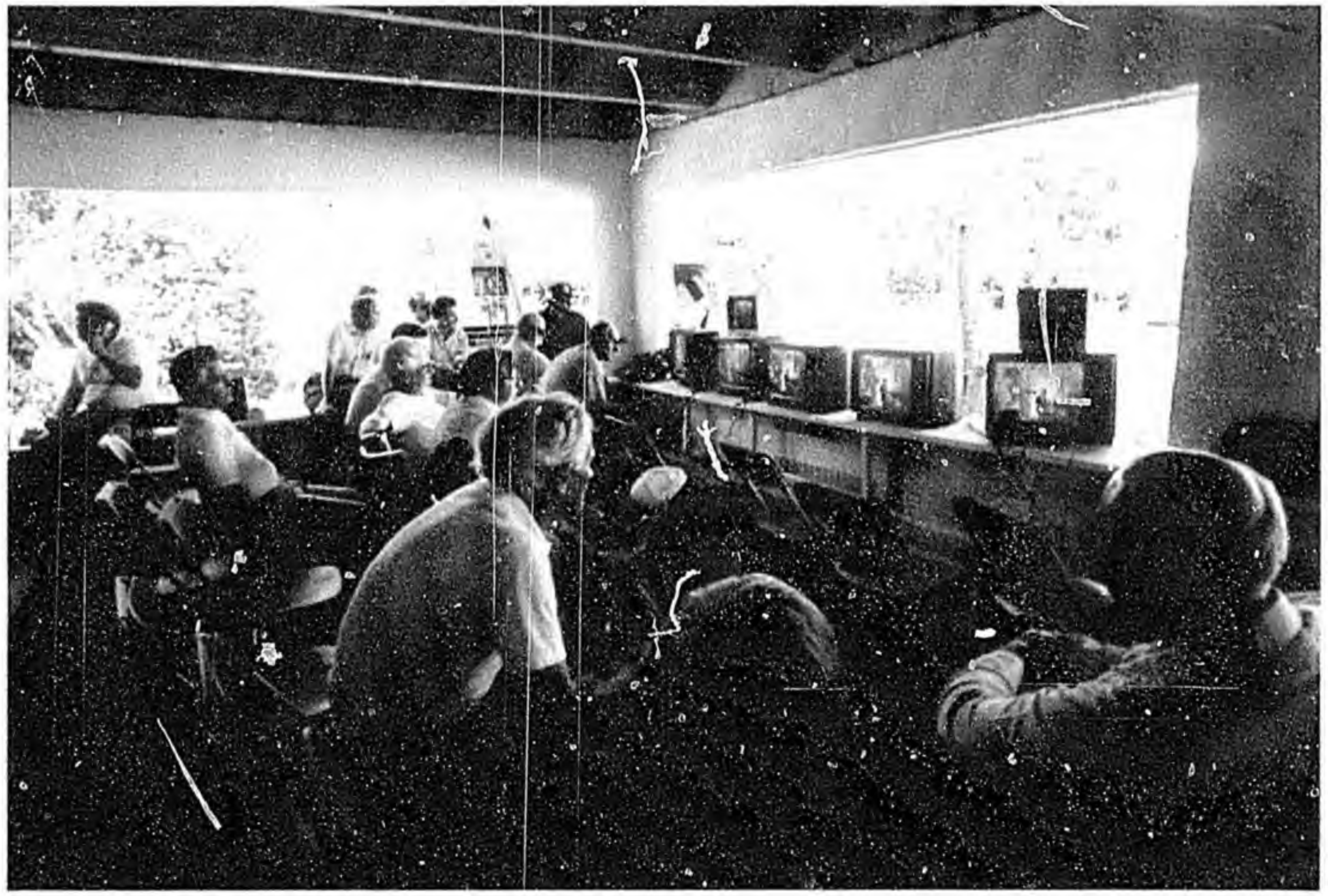
From the outset, the tests were designed to replicate actual hotel and resort industry property conditions. Besides the use of a vacant hotel rather than a laboratory setting for the tests, several steps were taken to insure actual hotel/motel conditions. For example, furniture, drapes, bedding, wall coverings, and window and door arrangements were all specified based on what is found today in the average hotel or motel guest room.

Conditions during the fires also were varied to account for differences that might occur in real-life settings. In some tests, for example, doors were left open rather than closed, accelerants used in the arson-type fires varied, and the piping systems in the rooms were tested both protected and unprotected by drywall or wood construction which is common to resort industry properties.

Perhaps the most important planning step taken to insure a real-life test, however, was selection of the fire scenarios by the sponsors of the tests. Ten different scenarios were used, each drawn from real-life fire incidents in resort industry property. Simulated accidental and arson fires were tested in hotel guest rooms, corridors, linen closets, and in maid carts. Both active fire situations and smoldering fire situations were included in the scenario designs, since both are common to the hotel/motel fire problem in the United States.

Arrangements also were made for installation of scientific measuring equipment in each of the test areas that samples could be collected to measure heat levels, carbon monoxide buildup, and concentrations of hydrogen chloride (HCL) and hydrogen cianade (HCN) given off in the fires. HCL and HCN are common toxic gases given off from burning plastics. Many of the furnishings in the average hotel/motel room are produced from this type of material.

Finally, to complete the realistic design of the hotel/motel setting, clusters of various types of heat and smoke detectors were placed in several locations in the rooms. Since such detectors are placed in the rooms by the manager of the hotel or specified members of his staff and not by manufacturers who are more aware of the proper placement, the detector clusters were scattered to allow for readings of fire danger from several different locations. Wiring used in central detector and alarm systems, as well as in electronic voice communications systems, also was installed both protected and unprotected to test survivability of the systems over time.



The researchers and reporters watch the staged fires through television monitors. Sophisticated equipment measures the heat and toxic gases produced in the fire.

A smouldering fire in a wastebasket begins to produce smoke.

The wastebasket bursts into flame.

The wastebasket is totally engulfed in flame and the smoke becomes thick.

Test Results

Raw data from the tests follow:

Test #1: Arson fire in hotel guest room

- **Setting:** A hotel guest room, furnished with shag carpeting, foam mattress, two chairs, table and lamp. Doors and windows were closed for the test. Polybutylene pipe was protected by wooden soffit.
- **Source of Fire:** Arson fire, ignited with a paper wick on a mineral spirits compound. The flammable liquid was spread around the room on the shag carpeting. The fire spread immediately into approximately ¾ of the room.
- **Raw Data Results:** First smoke detector alert: 7 seconds. Sprinkler flow: 39 seconds. Maximum temp. level: 298°F. Fire extinguished: 4 minutes following ignition.

Test #2: Wastebasket fire in guest room

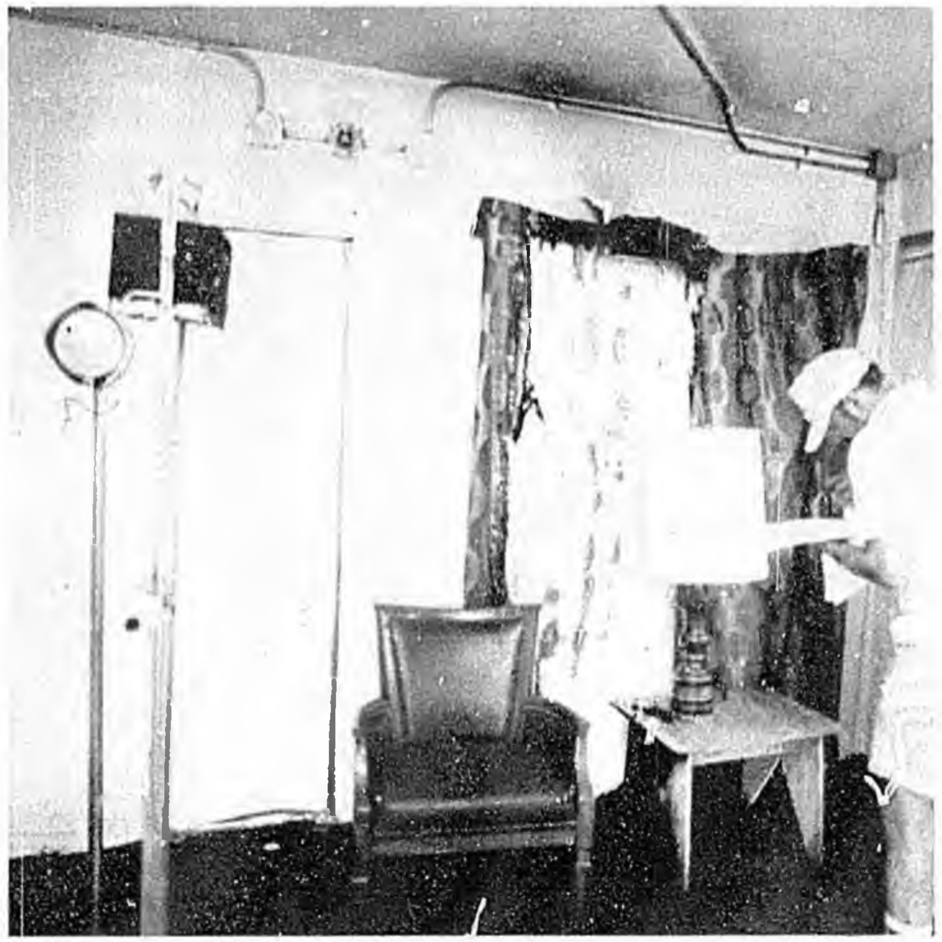
- **Setting:** Hotel guest room furnished as in previous test. Fiberglass construction drapes with sheer lining added. Vinyl wall coverings added. Pipe is protected by soffit.
- **Source of Fire:** Match thrown into wastebasket containing newspaper and other trash. Basket placed between chair and bed. After several minutes, the fire spread from the wastebasket to the bed.
- **Raw Data Results:** First smoke detector alert: 52 seconds. Sprinkler flow: 6 minutes, 5 seconds after ignition. Maximum temp. level: 165°F. Fire extinguished: 10 minutes after ignition.

Test #3 — Arson fire in corridor

- **Setting:** Corridor of hotel floor is carpeted. Doors and windows in corridor are closed. Maid's cart containing sheets and other bedding material is set afire in center of corridor. Pipe is protected by soffit.
- **Source of Fire:** Arson fire, ignited with a paper wick on a mixture of acetone and mineral oil.
- **Raw Data Results:** First smoke detector: 7 seconds, Sprinkler flow: 15 seconds. Max. temp. level: 130°F. Fire extinguished: 4 minutes.

Test #4 — Smoldering fire in guest room

- **Setting:** Hotel guest room fur-



The damage from this fire is minimal because the sprinkler was activated.

nished as in previous tests. Doors and windows closed. Pipe is protected by soffit.

• **Source of Fire:** Guest leaves hot iron on bed. Due to very high humidity conditions at test site, test was aborted after three hours. While information for sprinkler analysis was not provided, valuable smoke detector data will be available when scientific analysis is completed.

Test #5 — Arson fire in guest room

• **Setting:** Hotel guest room furnished as in previous tests. Drapes and linings are added. Plastic pipe is unprotected. Doors and windows are closed.

• **Source of Fire:** Half gallon of gasoline is poured onto bed and lit with a paper wick.

• **Raw Data Results:** Heat detector alert: 6 seconds. Sprinkler flow: 6 seconds. Max. temp. level: 119°F. Fire extinguished: 5 minutes.

Test #6 — Fire in maid's cart in storage room

• **Setting:** Small storage room off hotel corridor. No windows in room, door is closed. Maid's cart is placed in room. Plastic pipe is unprotected.

• **Source of Fire:** This was a simulation of an accidental fire. Source was cigarette left in lower trash bag of maid's cart. Because of earlier smoldering test problems, the smoldering stage was passed by and a match was used to light trash bag.

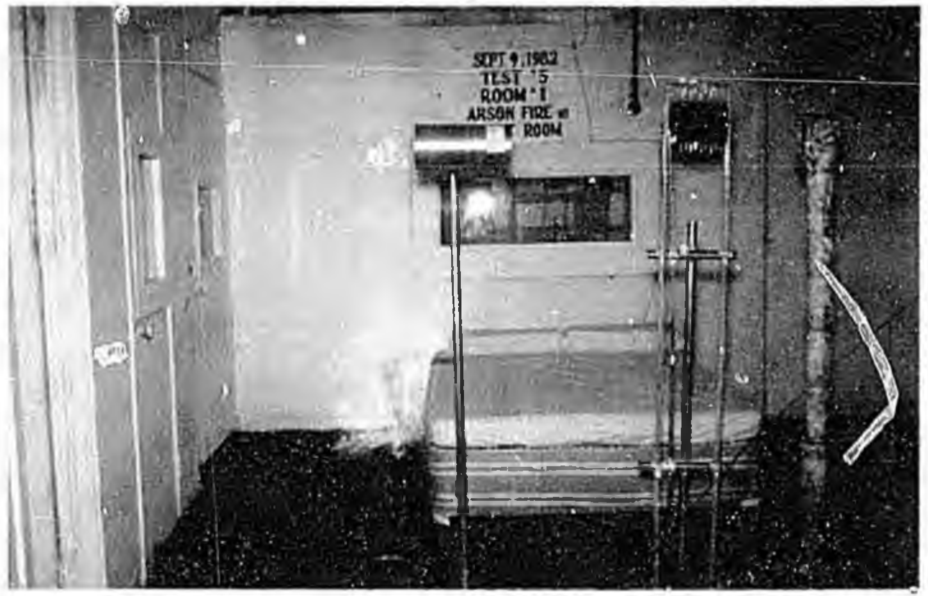
• **Raw Data Results:** First smoke detector: 33 seconds. Sprinkler flow: 2 minutes, 12 seconds. Max. temp. level: 98°F. Fire extinguished: 5 minutes, 28 seconds.

Test #7 — Wastebasket fire in guest room

• **Setting:** Guest room furnished as in previous tests. Wastebasket placed between table and vinyl-covered chair. Rayon/acetone/polyester drapes used in the room. Walls covered with vinyl coverings. Plastic pipe is unprotected. Window is closed. Door is left open.

• **Source of Fire:** Match is thrown into wastebasket containing newspaper and trash. Fire spreads from wastebasket to vinyl chair, then to vinyl wall coverings.

• **Raw Data Results:** First smoke detector: 1 minute, 11 seconds. Sprinkler flow: 14 minutes, 45 seconds. Max. temp. level: 130°F. Fire extinguished: 19 minutes.



In this controlled fire, gasoline is ignited next to the bed.

Detail of the damage to the bed and wall following activation of the sprinkler system.

Test #8 — Fire in maid's cart in corridor

• **Setting:** Maid's cart in carpeted hotel corridor. Cart contains sheets and other bedding materials. Doors in corridor are closed. Pipe is protected.

• **Source of Fire:** Simulation of accidental fire as in Test #6, except maid's cart is in hotel corridor. Ignition of fire as in Test #6.

• **Raw Data Results:** Smoke detector alert: 24 seconds. Sprinkler flow: 1 minute, 53 seconds. Max. temp. level: 93°F. Fire extinguished: 5 minutes, 17 seconds.

Test #9 — Smoldering fire in guest room

• **Setting:** Same as in test #4. Repeat of trial for smoldering fire situation. Same humidity problems were encountered. Test was aborted after two hours. No smoke was present, very little char of bed occurred.

Test #10 — Arson fire in guest room, luggage and contents ignited

• **Setting:** Luggage case is opened and contents (clothing, etc.) is dumped onto bed in guest room of the hotel. The room is furnished as in previous tests. Pipe is not protected.

• **Source of Fire:** Nail polish remover is spread on contents, luggage and bed. Paper wick used to ignite fire.

• **Raw Data Results:** Smoke detector alert: 12 seconds. Sprinkler flow: 1 minute, 9 seconds. Max. temp. level: 158°F. Fire extinguished: 4 minutes, 21 seconds.

Test #11 — Arson fire in guest room, luggage and contents ignited

• **Setting:** Same scenario as in Test #10, except the sprinkler in the corridor was capped and the sprinkler and all pipe and sprinkler hardware in the guest room was removed. The room therefore resembled an unsprinklered hotel room.

• **Source of Fire:** Mixture of nail polish remover and acetone is spread on contents, luggage, and bed as in Test #10.

• **Raw Data Results:** Heat detector: 4 seconds. No sprinkler present. Max. temp. level: 540°F. Fire extinguished: by Ft. Lauderdale fire department (present during all tests) in approximately 8–10 minutes.

General Conclusions Of The Tests

The raw data results noted for each of the above tests should not be interpreted in any way to be absolute numbers. Because of minor adjustments that may be necessary due to equipment placement, varying computer conditions and the like, these numbers may slightly change as full analysis of the Ft. Lauderdale tests takes place over time. A full report on the tests will be issued when this analysis is completed. Copies of this report will be made available by writing: National Fire Protection Research Foundation, Capital Gallery, Suite 220, 600 Maryland Ave., SW, Washington, DC 20024. Levels of toxic gases (CO, HCL and HCN) are now being analyzed and will be covered in the project report. Because laboratory analysis is required to determine toxicity levels, general conclusions covered below do not cover the effect of these toxic gases.

Several general conclusions can be drawn from the tests, however, even without benefit of the final data analysis.

By simple comparison of the two similar scenarios of tests #10 and #11, it is obvious that a sprinkler system adds a significant life safety potential to the average hotel room. This same assumption can be extended to all other tests which were completed, in that — even in the longest running fire test — the sprinklers reacted and extinguished the fire *in the room of origin* within 19 minutes.

Because the fire was extinguished in the room of origin by the sprinkler system, threat of fire death and serious injury to those in surrounding areas of the room is greatly reduced. Final determination of life safety in the test room or area itself must await the issuance of the final report, though the rapid extinguishment of many of the test fires, and raw data on maximum temperature levels indicates promise of positive results in even these areas.

It is also reasonable to conclude that there is definite need for a fire alarm system in hotel rooms whether or not a sprinkler system is present. Again, while final data can only indicate the presence of life-threatening situations at the time of smoke or heat detector alert, it seems that the early warning alert given in all of the fire tests significantly added to increased life safety potential.

Finally, it appears that the polybutylene system used for installation of the sprinkler systems sustained no damage during the Ft. Lauderdale testing and therefore still holds promise as a lower-cost alternative for retrofitting hotels, motels and resort properties. The Ft. Lauderdale tests, however, were not part of a formal "listing" procedure for the plastic pipe and should not be interpreted as laboratory evidence of system performance.

In summary, then, it appears from the raw data results that a sprinklered hotel is indeed an inherently safer building structure and that the use of plastic pipe systems for accomplishing sprinkler installation deserves further examination by both code officials and hotel/motel owners facing retrofit decisions.

Hotel/Motel Fire Safety: Now A Consumer Concern

The MGM Grand and Hilton Hotel fires led to a great deal of public interest in hotel/motel fire safety. Fire service organizations, as well as individual owners and managers of resort property, have witnessed an increase in the number of consumer questions dealing with fire safety. Questions involving the presence of smoke detectors and "sprinklering" of hotels are often asked.

It is estimated that only two percent of the nation's hotels or motels are now sprinklered. Even a casual glance at fire data on the problem, though, indicates that there are no assurances of safety because the bulk of the industry hasn't yet made the commitment to sprinklers.

Ed Wall, deputy superintendant of the FEMA's National Fire Academy and chief government official at the Ft. Lauderdale site, remarked that "according to FEMA data estimates, property damage as a result of a fire in a sprinklered hotel is only one-fourth of the damage resulting from fire in a non-sprinklered hotel."

With this data as a starting point, it seems appropriate for the industry to begin a cost-benefit analysis of sprinkler systems in various types of resort properties.

Esso Plaissance, a director of fire prevention of New Orleans who was present at the Ft. Lauderdale fire sprinkler tests, said he gets calls and letters daily from the tour industry, convention planners, and everyday citizens asking about safety standards in hotel properties in his city. "I've gotten to the point," says Plaissance, "where I maintain a listing of the safety features—sprinklers, smoke detectors, alarm systems, staff training, and the like. The questions aren't always easy to answer. People are much more aware of fire danger than they used to be."

Plaissance added that he personally knows of hotel and motel properties that have lost business because of the absence of safety systems. This has resulted, he said, "in property managers and owners asking what they *need* to do, not only what they *have* to do."

Echoes of Plaissance's statements were heard throughout the audience at the Ft. Lauderdale test site. When asked about the resort industry's rising interest in increasing its fire safety, John Veelenturf, a vice president of the Sheraton Corporation and its director of safety, said "the introduction of foam plastics and many fuel-derived materials in the last several decades have led to a very changed fire problem than that of the early 20th century." While there's no doubt that code changes will force many owners and managers to install sprinkler systems and take other steps, Veelenturf said leaders in the industry have already begun fire safety programs, like increased staff training, inspection of materials procured for the hotels, and other projects. He added that all of Sheraton's new hotels will be sprinklered and that the corporation is "vigorously pursuing possibilities for retrofitting existing properties."

Another representative from a major hotel chain, who asked not to be identified, added that hotel/motel industry leaders are indeed making progress toward improved fire safety. "All of the major chains are taking steps," he said, "because the pressure to do so from the clientele has forced the issue. Many people come in and ask not to stay above the second or third floor. We know their reasons for the request, so we do not have to question them further."

Tony DeStephano, a fire service representative from Maryland and a former restaurant/hotel manager who was present at the site, summed up the public concern in a challenge. He said that guests booking rooms in a hotel or motel frequently ask about the level they will be booked on, location of exit doors, and presence of smoke detectors and sprinklers. On the latter point, he added:

"Conduct the test yourself. Walk up and ask someone if they like their hotel room. The answer is yes. And the hotel in general? Yes again. And the pool, restaurant, and bar? Again, the guest is satisfied. But ask if their room has a smoke detector of if the room is sprinklered, and suddenly, they are reluctant to answer. Doubts about the safety of the hotel because of these omissions bring visions of a towering inferno to the average person. The average guest may not understand the workings, technology, or sophistication of fire protection systems. He may not even know what that silver-looking thing in the ceiling is, but he knows what he wants — and that's built-in protection."

Sonny Scarff, director of fire protection for Marriott Corporation, agrees with those sentiments. "The public has become increasingly aware of fire safety. Today, all of Marriott's 109 hotels are at least partly sprinklered, and about two-thirds are completely sprinklered. The company has budgeted to retrofit the hotels it owns which are not now fully sprinklered, and is pursuing a goal of having 100 percent sprinklering system-wide within 18 months."

Despite the fact that several of the larger hotel and motel chains are taking steps to increase fire safety, authorities in the fire service are still concerned about the great number of hotels and motels that are not actively pursuing the issue.

John Gerard, executive director of the National Fire Protection Research Foundation and former fire chief in Los Angeles, said that many people may mistakenly believe that it's rare when a guest investigates available hotels for qualities other than space, comfort, location and affordability. "But they are doing just that," said Gerard, "and one sure measure being weighed today is that of personal safety — fire safety — during their stay in a place away from home. If you speak with leaders in the industry, you'll find that people are not only asking those questions, but they're doing so in greater and greater numbers."

Gerard and other fire service and code officials at the test site expressed hope that the positive results of the sprinkler tests would spur interest from both the smaller and larger members of the resort industry trade.

Issues For Review

After three days on-site, the audience became increasingly aware of several factors which have kept resort property owners and managers from immediately adding sprinkler systems to their structures. These boil down to three central issues: codes; change and the fear associated with it; and costs.

Codes: Despite the one in four odds of a fire occurring in a hotel-type property, the general feeling in the audience was that a greater incentive would be necessary to induce an owner to take action. Of course, the obvious incentive is a code requirement.

Because both codes and the enforcement of codes varies from jurisdiction to jurisdiction, it is difficult to address the question of code problems in general or national terms. It is safe to say, however, that the hotel/motel owners or managers have a difficult time, technically and financially, dealing with provisions of local building and life safety codes and view the addition of sprinkler systems as something which will be accomplished "when it *has to be done*," as several stated during the tests.

Sonny Scarff, director of fire protection for Marriott, agrees that this opinion likely prevails in the industry, but is quick to point out that "a single incidence of fire often forces a change of opinion, particularly if facts about the reliability of sprinkler systems are studied by those making the decisions."

Those changes of opinions for both the hotel owner and the code official are the direct result of public pressure. Where sprinkler systems are required, the local officials will be more active in enforcing the code than ever before because the awareness of the public about hotel/motel fire safety is higher than ever before.

Local code officials, cognizant of cost considerations facing a hotel owner and public pressure, sometimes have the option of allowing changes to the strict letter of the law when the code allows for "alternate means of achieving fire protection." Such code allowances may permit a local official to approve use of a conduit not mentioned in the code itself (such as polybutylene) or adopt other measures which may be less expensive alternatives for the owner committed to sprinkler installation.

Richard Johnson, a former code official from Memphis, believes that "unique conditions" previously had to exist before the average code official would exercise this authority freely.

In some cases, Johnson explained, a city may be operating under an antiquated code. If the building owner came in with a sprinkler design because he's experienced a fire and wants to upgrade his fire protection, the code official faces a "Catch 22" situation. If he allows an "alternative means" system, he could be charged with malfeasance; if the holds tight to the letter of the law and another fire occurs, he and the city could be criticized, said Johnson.

Nonetheless, code officials around the country realize the position in which the hotel owner is placed, says Bill Tomes, assistant fire marshal of San Diego. "Many are now aggressively pursuing tradeoffs to increase fire protection and to make it attractive enough for individuals to sprinkler their properties whether or not it's called for in the code."

While it is true that codes present a problem for the hotel owner facing a requirement or perhaps even a voluntary decision to sprinkler a building, there is significant evidence supporting increased cooperation between hotel owners and code officials on tradeoff options.

With this environment, it is possible that it may not be in the hotelman's best interest to "wait until we have to sprinkler buildings." In fact, voluntary action now could be to the hotelman's benefit since his property will be very marketable when the forseeable code change occurs.

Change and the fear associated with it: Any change in resort industry property management — whether it directly affects the property or only the employee side of the business — is accomplished by an undeniable measure of reluctance or fear of the outcome.

• *Disruption of operations/aesthetic concerns.* Regarding the issue of sprinkler system installation in existing buildings, a number of fears are self-evident and were discussed during the Ft. Lauderdale testing.

An immediate concern raised is that of disruption of hotel operations during the retrofit period. Naturally, the amount of time a room or floor is out-of-service is important to the hotel management, as is the looks of the new sprinkler system in the hotel environment.

With black iron and copper piping systems, a longer downtime per room is obviously necessary because the system requires soldering, welding, and similar procedures at or near the place of installation. Nonetheless, experts the test site estimated only 3–4 days per floor (30+ rooms per floor) for complete installation. In off-season, this may not be difficult to arrange.

For polybutylene systems, the pipe connections are made by a mold system which does not require soldering or welding, and the lightweight, flexible nature of the pipe allows it to be curved and snaked around obstacles. These features also permit much of the set-up and molding work to be accomplished in a distant location, so disruption only occurs in the actual pipe hanging and soffit covering stages, which are necessary with either type of conduit.

Aesthetic considerations are easily handled in retrofit situations by installation of wooden or wall board soffit along the length of the hallway, with protrusions into each room entrance. Soffit on interior pipes also hides the piping and is easily accomplished.

The media in attendance at the Ft. Lauderdale tests were not aware of the recent soffit installation until it was pointed out to them, indicating that the fear of aesthetic concerns may be unjustified.

• *Plastic pipe damage.* While use of a black iron or copper system avoids the issue of the sprinkler system itself burning, several in the Ft. Lauderdale audience expressed concern about the performance of plastic pipe under fire and extreme water pressure.

Tony Schroer, a polybutylene manager for Shell Chemical Company, reviewed scientific test results of the polybutylene system for the audience and many misconceptions were addressed. "Unlike other plastics on the market, polybutylene has very high temperature properties," said Schroer. It is the only plastic pipe carrying a 200°F temperature rating, and has a 914°F igniting point.

Testing conducted at the University of Maryland indicated that Schroer is correct. Researchers believed that "the piping can withstand the ceiling temperatures that can be generated in light hazard occupancy long enough for the sprinkler heads to activate, and thus control the fire and reduce room temperatures that will be generated down to a tolerable level that will not threaten the piping system."

Tests in Ft. Lauderdale under actual fire conditions also indicated no apparent damage to the polybutylene system, when either protected or unprotected by the soffit.

Questions from the audience also dealt with the "addition of another plastic material in an already toxic environment." Schroer noted that when polybutylene is burned in the laboratory, it "burns as clean as a candle." Hydrogen chloride and hydrogen cianide, common toxic gases from burning plastics, are not given off by polybutylene. "Chances of the fire reaching this level of intensity where the pipe would burn are rare, and if it ever did occur, almost any kind of system would be in danger," Schroer added.

• *Maintenance fears.* A final "fear" noted by some in the audience concerned the amount of maintenance or staff training which may be required in a decision to retrofit hotels with automatic sprinkler systems.

According to John Gerard, executive director of the National Fire Protection Reserach Foundation, these fears are again unfounded. "The systems require no more maintenance than the normal water distribution system and the monitoring of pressure levels and system checks are generally performed by the fire service or insurance industry officials," Gerard said. Checks of the sprinklers he added, are really no more complex than those required for boiler or water heater systems.

Costs: Undoubtedly, the major drawback to retrofitting hotels and motels with sprinkler systems involves cost of the systems, cost of labor, and cost of downtime for installation.

Bill Testa, a manager for engineering with the Grinnell Fire Protection Systems Company, estimated the cost of retrofitting hotels or motels "in the ballpark of $1.50 to $2.50 per square foot for a steel pipe system, or about the cost of good carpeting."

In independent tests performed for

Shell Chemical Company, a 44 percent cost savings was realized in the use of polybutylene over copper conduit. Shell claims the savings are principally derived from material and labor time differences in this private residence test, which is viewed as representative of possible savings available in hotel/motel retrofit settings.

In either system, though, the costs are significant. As one hotel manager stated, "there is no doubt that the systems can reduce injury and property losses by controlling a fire in the room of origin and that the state-of-the-art will be applied as resources permit the industry to do so. The question remains "when?"

John Veelenturf, a vice president of Sheraton Corporation and chairman of the American Hotel & Motel Association's Fire and Safety Committee, summed up the cost issue in this way: "We will be exploring time and installation benefits of plastic pipe in our process to evaluate retrofitting. But, at the same time, the industry can significantly upgrade its fire safety through rigorous staff training, examination of the furnishings placed in hotels for their fire safety ratings, and placement of smoke detectors and alarm systems which give warning of fire danger."

Insurance industry representatives on-site echoed Veelenturf's statements, again stressing that sprinkler systems represent the state-of-the-art in fire prevention and therefore should be a goal of property owners. Phil Schiff, an account engineer with Allendale Insurance Company, stated that from an engineering point of view, insurance companies will look at anything that will decrease losses. "We're not keeping our heads in the sand. The technology is going in the right direction to achieve insurance rate decreases, though there are still many areas to attack before the fire problem is defeated."

In summary, then, the hotel/motel owner facing an order to install sprinkler systems will encounter high costs. Discussions with code officials, manufacturers, and insurance representatives, however, may result in tradeoff savings not otherwise available.

Assistance for this Hotel & Resort Industry *special report was provided by David A. Denne, public affairs officer, Federal Emergency Management Agency, Washington, D.C.*

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Sponsors Of The Tests

Federal Emergency Management Agency director Louis O. Giuffrida said the Fort Lauderdale fire sprinkler project "is exemplary of the efforts being undertaken by this administration to promote and enhance federal government and private sector cooperation on life safety efforts . . . The rewards for our efforts will be measured for years to come by an increased measure of protection made available to the American public."

Those sponsoring the event were:

- *Federal Emergency Management Agency (FEMA):* FEMA's mission is to prepare for and respond to a wide variety of emergencies and disasters, including the threat of fire. The agency has no regulatory powers, but instead has served as a catalyst in the development of automatic sprinkler technology as a mitigation measure to reduce residential fire losses. Over the past five years, FEMA has sponsored several million dollars worth of research and development projects for the fire service and private industry to spur development of sprinkler systems.
- *National Fire Protection Research Foundation:* The Foundation coordinated the event under a FEMA cooperative agreement. The Foundation was established in 1982 to respond to the continuing need for research and development of practical technologies and solutions to the fire problem. It plays a broad role in funding and directing fire research through cooperative projects with the government, business, industry and individuals interested in reducing fire losses.
- *Grinnell Fire Protection Systems Company:* Grinnell, one of several manufacturers of sprinkler heads, made a significant breakthrough in the development of a quick-reaction sprinkler head as a result of FEMA-sponsored resarch. This head reacts five times faster than traditional sprinkler heads. Grinnell provided the sprinkler equipment and completed all installation work necessary for the Ft. Lauderdale tests.
- *Marriott Corporation:* Marriott made all the arrangements for the use of a vacant hotel in the Ft. Lauderdale tests, and provided furnishings necessary for the rooms used in the burns. The corporation has assumed a leadership role in retrofitting hotel and motel structures with advanced automatic sprinkler systems and has sponsored many life-safety sprinkler promotions in the past.
- *Shell Chemical Company:* Shell produced the polybutylene resin used in manufacturing the plastic pipe employed in these sprinkler tests. The pipe will be undergoing formal lab tests for listing as an approved conduit for sprinkler application.
- *Simplex Time Recorders Company:* Simplex is a leading manufacturer of state-of-the-art fire detection and alarm systems and provided all of the smoke and heat detection systems used in the tests. In addition, Simplex provided components of an emergency voice communicatons system and its multiplex panel system for monitoring activity in each of the test fires.

FEMA neither endorses nor implies endorsement of any product or service offered by the various sponsors of the Ft. Lauderdale tests. Their participation was coordinated by the National Fire Protection Research Foundaton.

Sprinkler Systems: Are They Worth It?

On the final morning of the Ft. Lauderdale tests, a speaker from the hotel industry came to the front of the room and spelled out a fire scenario very familiar to most hotelmen who have studied the industry's fire problem: "A cigarette was mistakenly left on the hotel bed. A smoldering fire gradually flamed, covering the bed and spreading to the walls."

He then stated that this very situation recently occurred in two hotel properties, one sprinklered and one not sprinklered.

The sprinklered hotel in Oregon sustained approximately $6,000 damage, no one was killed or seriously injured, and the room was out of service for only three days.

The fire in the unsprinklered hotel in Texas resulted in 12 deaths, a number of injuries, and, as yet, an amount of property damage not being discussed due to pending lawsuits. The damaged section of the hotel lost more than three days of service.

DURAFLEX™ POLYBUTYLENE

PERFORMANCE REPORT

SHELL CHEMICAL COMPANY

Duraflex™ polybutylene pipe helps make lifesaving residential fire sprinkler systems easily affordable and practical.

DURAFLEX™ POLYBUTYLENE

PERFORMANCE REPORT

SHELL CHEMICAL COMPANY

In the time it takes you to read this report, someone in the United States will die or be seriously injured in a residential fire. Here's how Duraflex* polybutylene pipe can help reduce the growing number of deaths, injuries and property losses due to fire.

When combined with smoke detectors and low-temperature set-off residential fire sprinkler heads, Duraflex polybutylene pipe helps form an in-home fire protection system that's been proven effective in controlling common household fires within seconds. Duraflex pipe makes the system easy and fast to install in both new and existing construction, and easily affordable to most homeowners.

Recent studies reveal that on the average, someone dies or is seriously injured in a fire in the United States every 12 minutes. Another study indicates that residential fires in homes, townhomes, condominiums, apartments and mobile homes, account for 77% of the deaths, 68% of the injuries, and 46% of the property losses annually due to fires.

In what's to serve as a model installation for future systems and code ordinances, the first approved and inspected residential fire sprinkler system was recently installed in San Clemente, California. The city has included polybutylene pipe in its Residential Fire Sprinkler Code as an approved material. San Clemente Fire Chief, Ron Coleman, said, "Polybutylene pipe can help in holding costs down. The pipe permits fast and inexpensive installation. So it holds the costs of a home sprinkler system to an affordable level, which helps to reduce resistance from homeowners."

*Duraflex™ is a trademark for polybutylene resin made by Shell Chemical Company and for polybutylene pipe manufactured under license from Shell.

Low cost, fast installing Duraflex makes system affordable.

It took less than one day to complete the first installation of this new type fire sprinkler system in a new home located in the San Clemente subdivision of Cypress Shores. Although the home is valued at over $500,000, the fire sprinkler system was not expensive, representing less than 1% of the home's total construction cost. Because the size of the system installed is proportional to the home's size, the same average percentage cost of less than 1% of the home's construction cost is a good estimate for most new home installations.

Fire Inspector Ed Harrod checks installation of fire sprinkler specifically designed for residential use.

Installation is fast and simple for fire sprinkler systems using Duraflex pipe. Plastic mechanical fittings that can be easily and quickly assembled are used. The connections are made without soldering, welding, gluing, solvents, pipe dope or flux. Lightweight, flexible, Duraflex pipe can be curved and snaked around obstacles, through walls and ceilings, between floors and across attics.

Flexible Duraflex pipe speeds installation.

The pipe's flexibility was a real asset in the first installation because the house was close to completion. The Duraflex pipe could be curved around obstacles and routed easily, minimizing the extent to which the new construction was disturbed. This demonstrated another advantage of the pipe: its applicability to retrofitting the system into existing homes. "We like the pipe," Ron Coleman said, "and it's especially good for retrofitting. With the expansion and wide-spread acceptance we see for residential sprinkler systems, the ability to retrofit existing homes is going to be just as important as new home installations."

Durable Duraflex stands up to temperatures and time.

Reduced maintenance is another plus with Duraflex pipe. Because Duraflex doesn't corrode and it resists scale build-up, it isn't necessary to flush the system out periodically, which must be done with metal pipe systems. Duraflex pipe can stand up to high attic heat in the summer, and doesn't crack if water freezes in it during the winter. Although it isn't necessary to drain down a Duraflex pipe system, it should still be checked periodically for proper functioning of the automatic alarm devices.

Proper installation is important for maximum effectiveness. Except for the sprinkler heads, all installation materials are plastic. Metal connections and installation parts should not be used as they could act as a heat sink during a fire and damage the system. Both the Duraflex pipe and sprinklers are laid out and located for maximum protection and fast response to a fire anywhere in the building.

San Clemente leads the way to in-home fire protection.

The City of San Clemente Fire Department has been progressive and instrumental in developing a practical and inexpensive residential fire sprinkler system. San Clemente Fire Department officials have been working with manufacturers of fire protection equipment, the United States Fire Administration, and other private companies and public agencies, to establish a national code and an effective, affordable system.

San Clemente originally became interested in residential fire sprinkler systems as a way to compensate for the possible reduction in city services such as fire protection, resulting from lower tax revenues following California tax reforms. The Residential Fire Sprinkler Code was implemented with a city ordinance requiring sprinkler systems in all new construction, both residential and commercial. The ordinance may be expanded to include some existing buildings, as well.

San Clemente code has four specific objectives.

According to Ron Coleman, there is a four-fold set of objectives the city and the Fire Department hope to accomplish with their fire sprinkler code. First, to minimize residential fires and reduce property loss. Second, to limit and control fire before it reaches flashover. Flashover occurs when an area becomes superheated (800–1,000°F) in developing fires and the oxygen in the air suddenly explodes in a fireball. Flashover is lethal to anyone in the vicinity and it can involve the entire building in flames within minutes. Third, to accomplish these objectives with sprinkler systems. Coleman quoted a Johns Hopkins University study which says, "residential fire sprinkler systems can irrefutably bring about a significant reduction in loss of life and property due to fire." And fourth, to hold down the cost of this fire protection so most homeowners can afford it.

Controlling flashover was particularly important in developing a sprinkler system for residential use. Compared to industrial fires, residential fires pose several special problems for control by automatic sprinkler systems. Residential properties have smaller room sizes and lower ceilings which cause temperatures and toxic gases to soar to lethal levels more rapidly than in industrial fires. Studies show that temperatures nearly double between the fourth and fifth minutes of a fire. Smaller rooms and lower ceilings also require a different spray pattern for the sprinkler to be effective. The system also has to be unobtrusive, inexpensive and virtually maintenance free to be totally acceptable to homeowners.

The design and test of the system.

Special low-temperature set-off sprinkler heads that release at 165°F have been developed by Grinnell Fire Protection Systems. These respond five times faster than industrial type sprinklers. An improved, wider spray water distribution pattern developed for residential rooms knocks down fire within seconds before it can grow. The cooling effect keeps other sprinklers from being set-off unnecessarily, keeping water pressure at maximum levels. The design and size of the heads keeps them from being too obtrusive. By combining these sprinkler heads with Duraflex pipe, and smoke detectors, fire officials have put together an effective system that can be easily and affordably installed and maintained in most homes.

Tests were conducted by the San Clemente Fire Department on this system prior to writing the city's fire sprinkler code. The tests were designed to demonstrate and check the system's effectiveness in controlling typical household fires, and to identify special considerations to be included in the code. Using an abandoned house planned for demolition, fire officials set three separate test fires inside and in the gar-

Tests conducted on this system proved it can control common household fires in seconds. Time lapse in photos: 20 secs. Test fire builds in photos one and two, and is rapidly extinguished in photo three.

age using common household furnishings and materials. In each of the test fires, the sprinkler heads responded rapidly and halted the fire's growth in seconds. The tests proved that the system, which is now the one described in the city's code, will control most common household fires in less than three minutes. Similar tests conducted by the California State Fire Marshall's office confirmed these results. (See photos page 3.)

Other studies have shown that a system like the one installed in San Clemente will knock down a fire fast enough to save a person lying in a bed next to the fire. In the room of origin, the sprinkler prevented eye-height temperatures and carbon monoxide gas from reaching lethal levels, while adequate amounts of oxygen remained to keep the air breathable.

"Trend of the future" for homes.

Ron Coleman sees the system's advantages catching on fast. He said, "Residential sprinkler systems are the trend of the future. In most new homes, we'll probably see built-in sprinkler systems becoming standard features. The major safety and loss prevention benefits of sprinkler systems will make them very popular, fast. We'll probably see more systems installed in the next 10 years than in the last 100 years."

"Over 400 cities have asked for copies of our standards," Coleman reported, "and many are using us as a model for their own standards." In many areas, voluntary standards for residential sprinkler systems are being implemented, and a growing number of municipalities are enacting mandatory codes. In the near future, these standards may become virtually a nationwide mandatory building code requirement.

Left to Right: Mr. Charles Brent President of BJS Corporation, consulting engineers on the installation and supplier of the polybutylene pipe; San Clemente's Fire Chief, Ron Coleman, and Fire Inspector, Ed Harrod; and polybutylene plumbing representative, John Rosso.

Coleman concluded, "Another major factor in the growing demand for residential fire sprinkler systems is a change in the philosophy by modern fire managers. They're now looking at built-in technology as a means of improving overall fire safety and protection effectiveness, rather than relying solely on expert fire department personnel and their equipment."

Shell Chemical Company
Sales Offices Polybutylene

Northeast (914) 694-1116	2 Corporate Park Drive, Suite White Plains, New York 10604
Southeast (404) 955-4600	320 Interstate N. Parkway Atlanta, Georgia 30339
Central (713) 241-3897	One Shell Plaza Houston, Texas 77002
West (209) 952-1908	P.O. Box 7637 Stockton, California 95207

For international sales contact:

Pecten Chemicals, Inc. (713) 241-6161	One Shell Plaza Houston, Texas 77002

Warranty

SC 685-81
Printed in U.S.A. 12/81 5M

Fire Ratings

Unlike metal pipes, all plastic pipes will burn if exposed to a high enough temperature for a long enough period of time. In actual practice, however, ignition of water filled DURAFLEX polybutylene pipes will be virtually impossible. Because of polybutylene's high ignition temperature (914°F) relative to its melting point (255-259°F), exposure of the pipe to a flame will result in a melting of the surface of the pipe. With time, this could eventually lead to the formation of a small hole in the pipe wall that would spray water in the area of the fire. If, despite the flow of water, the fire continues to impinge on the pipe, the hole would enlarge releasing even more water. Only if the flame continued to impinge on the pipe until the pipe was completely broken would there be a possibility of setting fire to the pipe.

In the highly unlikely event that the polybutylene pipes would catch fire, they would burn slowly and cleanly. DURAFLEX polybutylene has an Underwriters Laboratories 94HB rating indicating that it will burn at a rate of less than 1-1/2 inches per minute. Bioassay tests by the method developed by the Fire Safety Center of the University of San Francisco have shown that the smoke from polybutylene is less toxic than that from Douglas fir.

Installation of fire sprinkler systems could necessitate running pipe in return air plenums. Based on the assumption that they will create a fire hazard, NFPA regulations limit the combustibility of materials in these spaces to a fuel loading of less than 3,500 BTU per pound. Although dry polybutylene has a higher fuel loading than this, as installed pressurized with water, it will have a much lower fuel content and will not represent a hazard.

In addition, NFPA regulations also require that materials used in return air plenums have a specific smoke density less than 50 as determined by the ASTM E-84 tunnel test or its equivalent, Underwriters Laboratories method 723. Because plastics melt before they burn, the E-84 tunnel test is not applicable to them. Comparisons can however be drawn to values of maximum smoke density as determined by the National Bureau of Standards smoke chamber test. These comparisons (attached) show that there should be no problem with polybutylene.

Project Number 2621.16
December 18, 1979

TEST REPORT

Prepared For:	Shell Development Company P. O. Box 1380 Houston, Texas 77001
Attention Of:	Mr. M. P. Schard
Authorized By:	P. O. #RE331TE62

MATERIAL TESTED

1. PB 4101 - Lot 4ACP-004, 124 mils
2. PB 4101 - Lot 4ACP-004, 77 mils
3. PB 4121 - Lot 6ACP-006, 119 mils
4. PB 4121 - Lot 6ACP-006, 78 mils

TEST PERFORMED

Flammability - UL94

TEST RESULTS

Sample Identification	Classification	Burn Rate (mm/min.)
PB 4101 - Lot 4ACP-004, 124 mils	94HB	27.0 (27.0, 27.0)
PB 4101 - Lot 4ACP-004, 77 mils	94HB	32.4 (34.8, 30.0)
PB 4121 - Lot 6ACP-006, 119 mils	94HB	28.5 (27.6, 29.4)
PB 4121 - Lot 6ACP-006, 78 mils	94HB	36.6 (37.2, 36.0)

TEST PROCEDURE

The procedure followed was that as outlined in the UL94 Standard. Materials classed 94HB shall:

A. Not have a burning rate exceeding 1.5 inches (38.1 mm) per minute over a 3.0 inch (76mm) span for specimens having a thickness of 0.120 to 0.125 inch (3.05 to 3.18 mm), (1/8 inch (3.2 mm) nominal) or

B. Not have a burning rate exceeding 2.5 inches (63.5 mm) per minute over a 3.0 inch (76 mm) span for specimens having a thickness less than 0.120 inch (3.05 mm), or

Test Procedure cont.

C. Cease to burn before the flame reaches the 4.0 inch (101.6 mm) reference mark, but shall not comply with the requirements given in paragraphs 3.2, 3.3, or 3.4 for 94 V-0, 94 V-1, or 94 V-2 materials, respectively.

SL TESTING INSTITUTE

Alyce E. Mayer
Physical Testing Technician

:mp

Approved by:

William W. Tenero
Project Manager

GENERAL

1. Scope

1.1 These requirements cover tests for flammability of plastic materials used for parts in devices and appliances. They are intended to serve as a preliminary indication of their suitability with respect to flammability for a particular application.

1.2 The methods described in this Standard involve standard size specimens and are intended to be used solely to measure and describe the flammability properties of materials, used in devices and appliances, in response to heat and flame under controlled laboratory conditions. The actual response to heat and flame of materials depends upon the size and form, and also on the end-use of the product using the material. Assessment of other important characteristics in the end-use application includes, but is not limited to, factors such as ease of ignition, burning rate, flame spread, fuel contribution, intensity of burning, and products of combustion.

1.3 The final acceptance of the material is dependent upon its use in complete equipment which conforms with the Standards applicable to such equipment. The flammability classification considered for a material may vary, depending on the equipment or device involved and the particular use of the material. The performance level of a material by these methods should not be assumed to correlate with its performance in end-use application.

1.4 The requirements may be applied to other nonmetallic materials if found to be appropriate.

1.5 These requirements do not cover plastics when used as materials for building construction or finishing.

TESTS

2. Horizontal Burning Test for Classifying Materials 94HB

Test Criteria

2.1 Materials shall be classified 94HB on the basis of test results obtained on small bar specimens when tested as described in paragraphs 2.4–2.12.

2.2 Materials classed 94HB shall (also see paragraph 2.3):

A. Not have a burning rate exceeding 1.5 inches (38.1 mm) per minute over a 3.0 inch (76.2 mm) span for specimens tested in a thickness of 0.120–0.500 inch (3.05–12.7 mm), or

B. Not have a burning rate exceeding 3.0 inches (76.2 mm) per minute over a 3.0 inch (76.2 mm) span for specimens having a thickness less than 0.120 inch (3.05 mm).

C. Cease to burn before the flame reaches the 4.0 inch (102 mm) reference mark. See paragraph 2.10.

2.3 If only one specimen from a set of three specimens fails to comply with the requirements, another set of three specimens shall be tested. All specimens from this second set shall comply with the requirements in order for material in that thickness to be classified 94HB.

Apparatus

2.4 The apparatus employed is to consist of the following:

A. Test chamber, enclosure, or laboratory hood free of induced or forced draft during tests.

B. Laboratory Burner – A Bunsen or Tirrill burner having a tube with a length of 4 inches (102 mm) and an inside diameter of 0.370 plus 0.06–0.0 inch (10 plus 1.6–0.0 mm). The tube shall not be equipped with end attachments, such as a stabilizer.

C. Wire Gauze – A 20 mesh (20 openings per 25.4 mm), 0.017 inch (0.43 mm) diameter iron wire gauze, 5 inches (127 mm) square.

D. Gas Supply – A supply of Technical Grade methane gas with suitable regulator and meter for uniform gas flow. Natural gas having a heat content of approximately 1000 Btu per cubic foot (37 MJ/m^3) has been found to provide similar results. Other suitable fuel gases, such as butane, propane and acetylene (which have a higher heat value) may also be used. However, Technical Grade methane gas shall be used in case of question.

E. Ring Stand – A ring stand with clamps, or the equivalent, for horizontal positioning of the specimen and the wire gauze.

F. Stopwatch or other suitable timing device.

G. Conditioning room or chamber capable of being maintained at 23±2°C and a relative humidity of 50±5 percent.

Test Specimens

2.5 Test specimens are to be limited to a maximum thickness of 0.500 inch (12.7 mm). Test specimens of a 5.0 inch (127 mm) length by 0.500 inch (12.7 mm) width are to be provided in the minimum thickness and in the 0.125±0.005 inch (3.18±0.13 mm) thickness. The 0.125±0.005 inch (3.18±0.13 mm) thick specimens are not necessary if the minimum thickness is greater than 0.125±0.005 inch (3.18±0.13 mm) or the maximum thickness is less than 0.125±0.005 inch (3.18±0.13 mm).

Exception: Materials classified 94HB in the 0.125±0.005 inch (3.18±0.13 mm) thickness shall automatically be classed 94HB down to a 0.062 [illegible] (1.57 mm) minimum thickness without addi[illegible]al testing.

2.6 The specimens shall comply with the following:

A. The maximum width is to be 0.52 inch (13.2 mm).

B. The edges are to be smooth, and the radius on the corners is not to exceed 0.05 inch (1.3 mm).

2.7 If the material is to be considered in a range of colors, melt flows, or reinforcements, specimens representing these ranges are also to be provided. Specimens in the natural (if used in this color) and in the most heavily pigmented light and dark colors are to be provided and considered representative of the color range, if the test results are essentially the same. An additional set of specimens will be required in the heaviest organic pigment loading, unless the most heavily pigmented light and dark colors include the highest organic pigment level. When certain color pigments (e.g. red, yellow, or the like) are known by experience to have particularly adverse effects, they are also to be provided. Specimens in the extremes of the melt flows and reinforcement contents are to be provided and considered representative of the range, if the test results are essentially the same. If the burning characteristics are not essentially the same for all specimens representing the range, evaluation is to be limited only to the material in the colors, melt flows, and reinforcement contents tested, or additional specimens in intermediate colors, melt flows, and reinforcement contents are to be provided for tests.

Specimen Conditioning

2.8 The specimens are to be conditioned for at least 48 hours at 23±2°C and a relative humidity of 50±5 percent prior to testing.

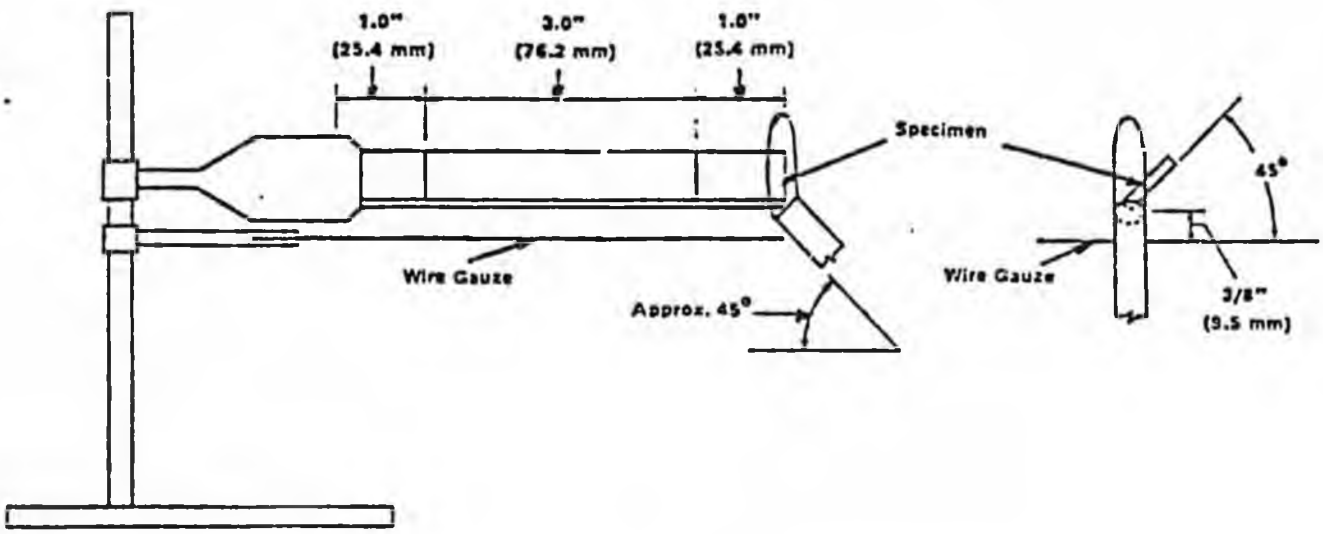
Test Method

2.9 The Burning Test is to be conducted in a chamber, enclosure, or laboratory hood free of induced or forced draft. An enclosed laboratory hood with a heat resistant glass window and an [illegible] fan for removing the products of com[illegible] [illegible]fter the test is recommended.

2.[illegible] [illegible]ch specimen is to be marked across its width with two lines, 1.0 and 4.0 inches (25.4 and 102 mm) from one end of the specimen. The specimen is to be clamped at the end farthest from the 1.0 inch (25.4 mm) mark, with its longitudinal axis horizontal and its transverse axis inclined 45 degrees. The wire gauze is to be clamped horizontally beneath the specimen, with a distance of 3/8 inch (9.5 mm) between the lowest edge of the specimen and the gauze, and with the free end of the specimen even with the edge of the gauze. See Figure 2.1.

*Replaces page 6 dated January 24, 1980

FIGURE 2.1
HORIZONTAL BURNING TEST FOR 94HB CLASSIFICATION



2.11 The burner is then to be placed remote from the specimen, ignited, and adjusted to produce a blue flame 1 inch (25 mm) high. The flame is to be obtained by adjusting the gas supply and the air ports of the burner until a 1 inch (25 mm) yellow tipped blue flame is produced and then the air supply is to be increased until the yellow tip disappears. The height of the flame is to be measured again and corrected if necessary. The flame is to be applied to the free end at the lower edge of the specimen. The center axis of the burner tube is to be in the same vertical plane as the longitudinal bottom edge of the specimen (and inclined toward the end of the specimen) at an angle of approximately 45 degrees to the horizontal. See Figure 2.1. The flame is to be applied so that the front edge of the specimen, to a depth of approximately 1/4 inch (6.4 mm), is subjected to the test flame for 30 seconds without changing the position of the burner, and is then removed from the specimen. If the specimen burns to the 1.0 inch (25.4 mm) mark before the flame has been applied for 30 seconds, the flame application is to be discontinued when the flame reaches the 1.0 inch (25.4 mm) mark.

2.12 If the specimen continues to burn after removal of the test flame, the time for the flame front to travel from the mark 1.0 inch (25.4 mm) from the free end to the mark 4.0 inches (102 mm) from the free end, is to be determined and the rate of burning is to be calculated.

3. Vertical Burning Test for Classifying Materials 94V-0, 94V-1, or 94V-2

Test Criteria

3.1 Materials shall be classified 94V-0, 94V-1, or 94V-2 on the basis of results obtained on small bar specimens when tested as described in paragraphs 3.6–3.15.

3.1A Some materials, due to their thinness, distort, shrink, or are consumed up to the holding clamp when subjected to this test. These materials may be tested according to the Vertical Burning Test for Classifying Materials 94VTM-0, 94VTM-1 or 94VTM-2, Section 5A, provided specimens can be properly formed.

*Replaces page 7 dated January 24, 1980

BOEING COMMERCIAL AIRPLANE COMPANY

P.O. Box 3707
Seattle, Washington 98124

A Division of The Boeing Company

May 31, 1978
B-8800-1146L

Mr. Pat Hughes
Witco Chemical Corp.
Polymer Division
291 Fairfield Ave.
Fairfield, N.J. 07006

Dear Mr. Hughes:

Per your telephone discussion May 22 with Mr. Alan Fenstermaker, enclosed are the data we have obtained regarding your Witco white and Witco clear polybutylene films.

We are encouraged with the flammability and toxic gas characteristics of these films and will continue their evaluation.

Thank you for your cooperation and we look forward to receiving further Witco white samples.

Very truly yours,

BOEING COMMERCIAL AIRPLANE COMPANY

J M Peterson for

Roy A. Anderson
Organization B-8811
Mail Stop 73-43
Phone (206) 237-9725

Enclosure

FILM	2.5 WATTS/CM² NBS SMOKE CHAMBER (FLAMING MODE)										
	D_S (OPTICAL DENSITY)						TOXIC GAS (PPM) @ 4 MIN.				
	1.5 Min.	STD. DEV.	4.0 Min.	STD. DEV.	Max.	STD. DEV.	SO_2	HCN	NO_x	CO	HCl
.0018" Witco Clear Polybutylene	6.37	1.31	11.40	1.39	22.47	3.76	0	0	0	18	1
.0010" Witco White	3.40	1.78	7.33	2.45	16.53	0.55	0	0	0	20	0

FILM	LIMITING OXYGEN INDEX ASTM D2863 ▷	
	LOI	STD. DEV.
.0018" Witco Clear	31	1.4
.0010" Witco White	--	--

▷ Film sample used was 1/4" wide

TENSILE PROPERTIES ASTM D882 (RATE OF GRIP SEPARATION 2 IN/MIN)	.0018" WITCO CLEAR				.0010" WITCO WHITE			
	* # SPECIMENS AVERAGED = 5		** # SPECIMENS AVERAGED = 5		* # SPECIMENS AVERAGED = 5		** # SPECIMENS AVERAGED = 5	
	AVE.	STD. DEV.	AVE.	STD. DEV.	AVE.	STD. DEV.	AVE.	STD. DEV.
Thickness (ins)	0.0018	0.0000	0.0018	0.0000	0.0010	0.0001	0.0011	0.0000
Breaking Factor (lb/in of width)	10.3	1.3	12.2	0.7	4.6	0.5	9.1	1.9
Ultimate Tensile Strength (lb/in²)	5.71×10^3	714	6.95×10^3	164	1.09×10^3	154	2.08×10^3	451
Yield Tensile Strength (lb/in²)	1.82×10^3	154	2.14×10^3	79	565	23	734	83
Ultimate Elongation (%)	262.8	39.9	237.2	9.0	214.9	27.7	89.7	29.5
Elongation at Yield (%)	10.7	3.2	14.3	1.5	18.1	1.4	14.5	1.9
Tensile Modulus (lb/in²)	2.88×10^4	1.13×10^3	2.57×10^4	885	6.76×10^3	710	6.55×10^3	287

* = 90° to longest dimension

** = 0° to longest dimension

COMPARISON OF NBS SMOKE CHAMBER AND ASTM E-84 SMOKE DENSITY VALUES

MATERIAL	SMOKE DENSITY VALUES* NBS (FLAMING MODE)	E-84
1/2" gypsum board painted	33	7
vinyl covered gypsum board	54	55
5/8" particle board	398	160
1/4" Douglas fir plywood - prefinished	146	86
11/64" Lauan plywood - unfinished	50	67
1/8" melanine finished hardboard	89	230
1/2" acoustical tile (wood fibreboard type)	113	61
1/2" acoustical tile (mineral based)	73	20
Polybutylene**	16 - 22	

* National Bureau of Standards Technical Note 879, "Fire Build-up in a Room and the Role of Interior Finish Materials" by Jin B. Fang.

**Boeing Aircraft Company

Reprinted courtesy of Western Fire Journal

EXECUTIVE SUMMARY

Widespread use of plastics has added both convenience and hazards to modern living. Below is a study of the dangers of toxic gases produced by the combustion of plastic pipes . . .

Toxicity of Gases From Polybutylene And Douglas Fir

By CARLOS J. HILADO &
PATRICIA A. HUTTINGER
Product Safety Corporation

Because of their versatility and performance advantages, plastics have found their way into numerous applications. This widespread use has inevitably brought them into many applications in which safety upon exposure to heat or fire is an important consideration, and their response characteristics need to be known.

One aspect of safety which has caused considerable concern is the possible generation of toxic gases upon exposure to heat or fire. It is impossible to simulate all possible conditions under which such exposures could occur, but manufacturers conscious of their responsibilities to the consumer and to the general public nonetheless make an effort to evaluate their products by means of available technology to obtain some degree of assurance that there would be no unreasonable risk. Screening of materials is needed, because investigation of every possible formulation for every possible exposure is not feasible.

A laboratory toxicity screening test method has been developed by the authors to serve as a means for comparing materials on the basis of relative toxicity under specified test conditions, using apparatus, facilities and personnel which would be within the capabilities of most laboratories. With the purpose of screening in mind, this method is intended to indicate which materials are more toxic under spe-

Table 1. Toxicity Test Data on Polybutylene Pipe and Douglas Fir (PSC Condition 1 or NASA-USF Procedure B)

material	test no.	time to staggering min	time to convulsions min	time to collapse min	time to death min
DURAFLEX 4127	1	16.32 ± 0.88	17.75 ± 1.02	20.22 ± 2.44	24.35 ± 3.20
	2	16.53 ± 0.27	17.54 ± 1.34	18.70 ± 1.73	22.39 ± 2.77
	mean	16.42 ± 0.15	17.64 ± 0.15	19.46 ± 1.07	23.37 ± 1.39
DURAFLEX 4121	1	16.45 ± 0.45	16.88 ± 0.73	18.47 ± 0.14	21.49 ± 0.95
	2	16.33 ± 1.08	17.77 ± 0.96	18.45 ± 0.88	21.93 ± 0.54
	mean	16.39 ± 0.08	17.32 ± 0.63	18.46 ± 0.01	21.71 ± 0.31
Douglas fir	1	10.92 ± 2.18	14.98 ± 0.58	16.09 ± 1.05	18.57 ± 0.79
	2	12.29 ± 0.69	14.04 ± 0.52	14.41 ± 0.42	16.77 ± 0.40
	mean	11.60 ± 0.97	14.51 ± 0.66	15.25 ± 1.19	17.67 ± 1.27

cified test conditions and not necessarily to explain why they are more toxic (1-11).

A large selection of test conditions can be used. The toxicity screening program used by the Product Safety Corporation employs 16 different sets of test conditions: the rising temperature program at 40°C/min from 200 to 800°C and seven fixed temperatures at 100°C intervals (200, 300, 400, 500, 600, 700, and 800°C), both without forced air flow and with nominal 1 L/min air flow. This program has been used with polyethylene (12), polypropylene (13), polystyrene (14), polycarbonate (15), polyoxymethylene (16), polyethersulfone (17), polyetherimide (18), polytetrafluoroethylene (19) and Douglas fir (20).

Experiments at a succession of fixed temperatures have research value in that they determine the material responses at particular temperatures. The rising temperature method offers the potential for more cost-effective screening by attempting to integrate the effect of successive temperatures, and provides the ability to compare test results with those obtained for over 300 materials previously evaluated under the same rising-temperature conditions.

This report presents the toxicity test data obtained for two samples of polybutylene pipe and one sample of Douglas fir wood, evaluated under the routine screening test conditions of rising temperature at 40°C/min from 200 to 800°C without forced air flow. These test conditions have been described as Procedure B of the NASA-USF toxicity screening test method, and are included in the BART specifications for seat cushioning materials (21).

MATERIALS

The materials evaluated were two samples of polybutylene pipe received from Shell Oil Company, Houston, Texas. The samples were identified as follows:

DURAFLEX Polybutylene 4127 (grey)

DURAFLEX Polybutylene 4121 (black)

For purposes of comparison, a sample of Douglas fir wood was obtained from Underwriters Laboratories, Santa Clara, California. This material met the requirements of UL Standard 127 for testing of fireplace inserts.

DATA AND DISCUSSION

The times to various animal responses are presented in Table 1. Reproducibility was generally good.

Average times to death with the polybutylene pipe samples ranged from 21.5 to 24.4 minutes, compared to 16.8 to 18.6 minutes for Douglas fir wood. On the basis of time to death, the polybutylene pipe samples appeared to be significantly less toxic than Douglas fir under these particular test conditions.

CONCLUSIONS

The polybutylene pipe samples evaluated appeared to exhibit significantly less toxicity than Douglas fir under these particular test conditions.

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courtesy of Shell Chemical Company

SC: 754-82
12/82 5M

Potability

As a result of the continued competition between metal pipes and labor-saving polybutylene pipes in plumbing, charges have been made by the California Pipe Trades Council (CPTC) that polybutylene pipes contain an allegedly toxic material known as DEHP. This is patently untrue! In fact, every component of polybutylene plumbing pipe is approved for food contact applications under the Food and Drug Administration regulations.

As a result of these irresponsible charges, a total of ten additional laboratories have analyzed polybutylene pipes and found them to be free of DEHP. Even the laboratory that conducted the analyses for the CPTC has issued a joint statement with Shell saying that "we have no opinion whether polybutylene pipes in general contain DEHP."

It is Shell's position that the use of DURAFLEX polybutylene plumbing pipe in potable water applications is completely safe.

Schuer

Tribune/TODAY Sunday, May 3, 1981

EBMUD says lab tests prove plastic pipes don't cause cancer

From Tribune and wire reports

Fears that plastic water pipes may contain elements that leak into the water causing cancer and sterility are unfounded, according to new laboratory tests results of samples from the East Bay Municipal Utility District released Friday.

"I think the basis for crying wolf on the cancer issue is premature," said Dr. Marc Lappe, a health hazard expert with the state Health Department. "There is a lot of misinformation."

Tests of the plastic polybutylene pipes that have supplanted in large scale the tradional steel water pipes were ordered April 18 after the State Commission on Housing and Community Development delayed authorizatin for expanded use of the plastic pipe in California. The commission was told that the chemical DEHP detected in some pipe samples could dissolve into the water causing sterility and cancer.

EBMUD responded immediately by taking samples of water in representative areas served by polybutylene pipes.

EBMUD sent samples to the state and private labs and conducted tests on its own for possible ill effects.

"We didn't find any in the water," said David Spath, senior sanitary engineer for EBMUD. "The sensitivity in the test instrument would have picked up anything more than 6 parts (of DEHP) per billion of water."

Lappe said DEHP was a threat only if found in concentrations of 200 parts per billion. He added that the study that triggered the controversy detected DEHP only in pipe, but included no evidence of its dissolving in water.

Lappe also said he had written the Commission on Housing and Community Development reiterating previous testimony before the commission that pilot studies on polybutylene pipe indicated no health hazard.

Roger Dickinson, an attorney for the Department of Consumer Affairs, said the studies of plastic and other types of pipe, with longer exposure times of up to 90 days, should settle the issue.

The stakes in the controversy are high, not only for consumers, but for the construction industry, the plumbers who have generally opposed widespread use of plastic pipe, and the petrochemical industry which produces materials for the pipe.

EBMUD spokesman Jim Lattie said the plastic pipe is used because it is easier to handle, is more versatile, resists corrosion and the electrolysis problems of the steel and copper pipes.

The plastic pipe is used primarily for connections from EBMUD's water mains to household connections. Of the 275,000 residential connections serving about 1 million people in the East-bay, about 45,000 to 50,000 are plastic.

Lattie said the tests consisted of samples of water from the pipes to see if any chemical was getting into the water. "If nothing comes from the pipes, then it's all right," he said.

EBMUD

EAST BAY MUNICIPAL UTILITY DISTRICT

May 11, 1981

Mr. Myron Moskovitz
2371 Eunice
Berkeley, CA 94708

Dear Mr. Moskovitz:

As we discussed in our recent telephone conversation, the District provided water samples to the State Department of Health Services and to a private commercial laboratory for independent testing for DEHP. I am pleased to inform you that no DEHP could be detected in any of the water samples collected from polybutylene pipe.

Enclosed is the original laboratory report and the memorandum describing the samples which were analyzed. Even water which had been sitting in a dormant section of polybutylene pipe for three months did not contain any DEHP.

Detectable amounts of several other organic compounds were found. This was expected since they are commonly found in chlorinated drinking water. As per your request, I have enclosed a short paper describing the formation of these compounds, the trihalomethanes. The occurrence of trace amounts (less than one part per billion) of other non-priority organics found in water taken from new polybutylene pipe which was dormant for approximately 120 days is judged to be insignificant.

Based on our sampling and investigations, we at EBMUD are convinced that no health hazard exists due to the use of polybutylene water service pipe. We intend to continue using it in the water system as before. Please let me know if you have any further questions.

Sincerely,

K. E. CARNS, Manager
Water Quality Division

Attachments

KEC/pcs

STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES/DEPARTMENT OF INDUSTRIAL RELATIONS
2151 BERKELEY WAY
BERKELEY, CA 94704
(415) 540-2115

April 27, 1981

Mr. Myron Moskovitz
Chairman
Commission on Housing and
Community Development
921 - 10th Street
Sacramento, CA 95814

Dear Mr. Moskovitz:

I have been substantially reassured by the initial testing done by the Radian Laboratory for Shell Chemical Company on the issue of health hazards from DEHP (di-ethyl-hexylphthalate) in one kind of polybutylene pipe. As I indicated in my letter of January 28, 1981, this chemical was of concern because of recently completed cancer tests which had shown it to be carcinogenic when fed in high doses (3,000 to 12,000 ppm) to two species of rodents, and initial data (which we have confirmed) showing some DEHP in one kind of PB pipe.

It now appears from the preliminary data of Radian that the pipe proposed for in-home use in California (PB 4127) neither contains appreciable amounts (i.e., < 1 ppm) nor leaches detectable levels (i.e., > 1 ppb) of DEHP into deionized water. While these results are provisional in that they require duplication under standard leaching test conditions, they provide substantial evidence that a health hazard from DEHP does not exist in polybutylene pipe.

I hope that the remaining issues regarding any possible health effects from other chemicals I identified in my testimony may now be speedily resolved by appropriate testing.

Sincerely,

Marc Lappé, Ph.D.
Staff Toxicologist
Hazard Evaluation System and
Information Service

cc: William G. Holliman, Jr.
McDonough, Holland & Allen
Beverlee A. Myers, Director
Department of Health Services
Donald Turner, Director
Department of Housing & Community Development
Richard Spohn, Director
Department of Consumer Affairs
Ephraim Kahn, M.D., Chief
Epidemiological Studies Section
Richard Schimbor, Shell Chemical Company

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY
EDMUND G. BROWN JR., Governor

DEPARTMENT OF HEALTH SERVICES
2151 BERKELEY WAY
BERKELEY, CA 94704
(415) 540-2172

August 12, 1981

Marvin Boutwell, Chief
Building & Zoning Inspection Division
Dept. of Public Works
220 E. Bay Street
Jacksonville, FL 32202

Dear Mr. Boutwell:

Enclosed please find a copy of the laboratory results from tests conducted to determine if polybutylene water service pipe leaches Diethylhexylphthalete (DEHP) into drinking water. As you can see the tests demonstrated that DEHP was not leached.

If I can be of any further assistance please do not hesitate to contact me.

Sincerely,

David P. Spath

David P. Spath
Senior Sanitary Engineer
Sanitary Engineering Section

Enclosure

DEPARTMENT OF THE NAVY

NAVAL FACILITIES ENGINEERING COMMAND
XX STOVALL STREET
ALEXANDRIA VIRGINIA

OSD/RBB
1 July 81

From: Commander, Naval Facilities Engineering Command
To: Commanding Officer, Southern Division, Naval Facilities Engineering Command

Subj: Use of Polybutylene Pipe in Potable Water Systems

Ref: (a) NAVFACENGCOM ltr OSD/RBB of 5 May 1981
(b) NAVENVIRHLTHCEN ltr 71:JPC:hfc 6261 Ser 05071 of 7 May 1981

Encl: (1) Shell Oil Company ltr of June 16, 1981 w/attachments and Mead CompuChem report

1. References (a) and (b) discussed the alleged presence of diethyl hexyl phthalate (DEHP) in polybutylene (PB) pipe which is used for potable water systems.

2. Samples of PB pipe from the Naval Station, Mayport were sent to Mead CompuChem laboratories at Research Triangle Park, NC for testing. Enclosure (1) provides the report of the extraction tests which show that polybutylene pipe does not contribute to the presence of DEHP in water. Additionally, Shell Oil Company states that DEHP is not added at any stage during polymerization, compounding, or fabrication of the pipe; and they confirm their position that the use of polybutylene pipe for potable water does not pose any known hazard to human health.

3. A copy of this letter and the enclosure are being forwarded to the Naval Environmental Health Center, Norfolk, VA and to the National Sanitation Foundation, Ann Arbor, MI who have a continuing interest in the use of plastic pipe for potable water systems.

R.B. BERSSON
By direction

Copy to:
WESTNAVFACENGCOM
PWC San Diego
ROICC Jacksonville
ROICC San Diego
NAVENVIRHLTHCEN Norfolk, VA (Occupational Toxicology Service) w/encl (1
NATIONAL SANITATION FOUNDATION, Ann Arbor, MI (Attn: Mr. R. Collins) w/encl (1)
SHELL OIL COMPANY, HOUSTON, TX (Attn: Mr. R.E. Hanson, Product Safety & Compliance)

DEPARTMENT OF THE ARMY
OFFICE OF THE SURGEON GENERAL
WASHINGTON, D.C. 20310

REPLY TO
ATTENTION OF

DASG-PSP-E

18 August 1981

Mr. A. H. Schroer
Sales Development Manager
Shell Chemical Company
One Shell Plaza
P. O. Box 2463
Houston, TX 77001

Dear Mr. Schroer:

This is in reply to your letter of July 29, 1981. This office does not approve specific commercial products.

Our policy on the use of polybutylene pipe was contained in the message you have requested. A copy of the message is attached.

Sincerely,

LEE C. HERWIG, JR.
Colonel, MSC
Sanitary Engineering Consultant

1 3 211705Z JUL 81 PP RR

CDRUSAEHA EA MD//HSE-EW//

DA WASHDC//DASG-PSP-E//

INFO CDRFORSCOM FT MCPHERSON GA//AFEN-FEU-S//

CDRFORSCOM FT MCPHERSON GA//AFMD//

CDRHSC FT SAM HOUSTON TX//HSPA-P//

UNCLAS

SUBJ POLYBUTYLENE PIPE

1. AT THE REQUEST OF FORSCOM (AFEN-FEU-S), AND THE PRIOR CONCURRENCE OF THIS ADDRESSEE, THIS AGENCY HAS EXAMINED THE MEDICAL CONCERNS OF POLYBUTYLENE (PB) PIPE FOR USE WITH HOT AND COLD POTABLE WATER APPLICATIONS.

2. IN THE RECENT PAST, HEARINGS HAVE BEEN HELD ON THIS SUBJECT IN CALIFORNIA. CONCERN WAS RAISED THAT DIETHYLHEXYL-PHTHALATE (DEHP) WAS LEACHING FROM THE PIPE MATERIAL INTO TRANSPORTED POTABLE WATER.

3. SUBSEQUENT STUDIES HAVE BEEN CONDUCTED TO CONFIRM THAT DEHP IS NOT A PROBLEM (NOT PRESENT) IN potable water in contact w/ PB PIPE. THESE STUDIES SET ASIDE AN INITIAL STUDY THAT RAISED THE PUBLICIZED CONCERNS. GF 27 Jul

4. THIS AGENCY CONTACTED SEVERAL ORGANIZATIONS TO OBTAIN THEIR OPINIONS ABOUT THE USE OF PB PIPE FOR POTABLE WATER APPLICATIONS.

M. B. KELLEY, CPT, MSC, HSE-EW
SM/584-3816, 20 JUL 81

KENNETH R. BOYD, CPT, HSE-AP, 584-4375

A. EPA HAS NOT BEEN ASKED TO COMMENT FORMALLY ABOUT PB PIPE. HOWEVER, THE EPA POC HAS NO BASIS TO SAY ANYTHING NEGATIVE. THE EPA POC RECOMMENDS USING NATIONAL SANITATION FOUNDATION (NSF) CERTIFIED PB MATERIALS.

B. FDA - IN 21 CFR 177.1570 POLY-1-BUTENE RESIN, THE MAIN COMPONENT OF PB PIPE, IS APPROVED FOR REPEATED USE FOOD CONTACT SITUATIONS.

C. AWWA REFERENCES NSF STD 14 FOR ACCEPTABILITY OF PB PIPE FOR POTABLE WATER APPLICATIONS. AWWA POC WAS AWARE OF PB PIPE CONTROVERSY AND MAINTAINS THAT PB PIPE IS SUITABLE FOR USE IN POTABLE WATER APPLICATIONS IF CERTIFIED FOR POTABLE WATER USE BY NSF.

D. NSF POC STATES THAT ALL PB MATERIALS DESIGNATED AS SUITABLE FOR USE WITH POTABLE WATER IN THEIR "LISTING OF PLASTIC PIPING SYSTEM COMPONENTS AND RELATED MATERIALS" ARE APPROPRIATE.

5. IT IS THE OPINION OF THIS AGENCY THAT THE NEGATIVE PUBLICITY GENERATED OVER THE LEACHING OF DEHP FROM PB PIPE IS UNFOUNDED. FURTHER, THAT NSF CERTIFIED, POTABLE WATER GRADE PB PIPE, USED IAW THE MANUFACTURERS GUIDANCE IS SUITABLE, FROM A MEDICAL POINT OF

VIEW, FOR POTABLE WATER APPLICATION BY THE ARMY. CARE SHOULD BE EXERCISED, HOWEVER, IN THE SELECTION OF ALL PLASTIC BUILDING MATERIALS DUE TO THEIR POTENTIAL FIRE HAZARD.

6. FURTHER COORDINATION ON THIS SUBJECT MAY BE MADE BY CONTACTING THE CHIEF, WATER QUALITY ENGINEERING DIVISION, THIS AGENCY, AUTOVON 584-3816/3554. THE POC FOR THIS CONSULTATION IS MR. J. VALCIK.

Economic Benefits

A great deal of information has been accumulated on the cost savings associated with using polybutylene tubing instead of copper tubing in plumbing applications. The most definitive study on the comparative costs was done by the National Association of Home Builders Research Foundation in 1981 and showed that polybutylene systems could be installed at a 44% lower cost than copper systems.

Because of its newness to the fire sprinkler industry, less information is available on comparative costs. However, the comparisons that have been made are very encouraging. For instance, in the residential retrofit demonstration conducted by the Rural/Metro Fire Department in Scottsdale in 1981, the installed costs of the polybutylene piped system was 40% lower than that of the system piped with black iron. In addition, a recent test in San Clemente showed that a complete polybutylene piped fire sprinkler system could be retrofit in a time of slightly over one man hour per sprinkler head (installation times for metal systems would have been a multiple of this).

OPERATION FIRESTOP

San Clemente Test Series 13-1982

Conducted December 2, 1982

ABSTRACT: The following report is a summary of information generated by a residential sprinkler technology demonstration conducted in San Clemente, California. The report contains details of a demonstration retrofit of a single family dwelling using polybutylene pipe and Residential Sprinkler heads by Central Sprinkler Corporation. An overview of the process is provided as well as observation and recommendation for further research.

Ron Coleman
Director of Fire Protection
San Clemente Fire Department
100 Avenida Presidio
San Clemente, CA 92672
(714) 361-8240

OPERATION FIRE STOP

(San Clemente Tests Series 13-1982

OVERVIEW

The following information is an overview of a Retrofit Demonstration. This is an element of the Operation Fire Stop Experiment Series. This project is being conducted by the San Clemente Fire Department to evaluate various concepts of providing built-in fire protection in residential occupancies. This specific document relates to an experiment conducted on December 2, 1982 on the Forster Ranch, located in San Clemente, California. The purpose of this demonstration was to retrofit an existing single family dwelling using state of the art technology, quick responding residential sprinkler heads and polybutylene pipe. The series was also part of a week long course on residential sprinkler system technology. This 36 hour course is a California Accredited Training Course.

OBJECTIVE

The objective of the retrofit test was as follows: To determine if a single family dwelling could be retrofit with existing materials and technology in a reasonable period of time; at a reasonable cost to the property owner, AND result in a system that in aesthetically acceptable to the home occupant.

Polybutylene has already been proven successful as a water conveyance in tests conducted in Scottsdale, Arizona; Ft. Lauderdale, Florida; Cobb County, Georgia; Springsdale, Arkansas; Carmichael, California; and Factory Mutual.

It should be noted that this was not a test of sprinkler head performance. This has been more than adequately proven by other tests, such as the tests required for listing of sprinkler heads.

LIMITATION

In this test we did not evaluate any copper, steel or PVC Systems that required piece by piece installation. Further tests must be done to evaluate that technology.

DESCRIPTION OF THE FACILITY

The retrofit was going to be conducted on a single family dwelling that was constructed approximately in 1967. The building was Type V wood frame structure. It was approximately 1,300 square feet in area. The walls were dry wall. The ceiling were dry wall. The building had a small attic space over most of the habitable areas of the building. The attic space provided a number of 8" clearances to a maximum of 30" of clearance. The roof covering was built-up composition. The building was donated for the experiment by the Estrella property owners. It was due to be destroyed as part of the grading for a major land development to be built in that area.

SPONSORING AGENCIES

Operation Fire Stop and this specific retrofit experiment was a jointly sponsored project. The sponsoring agencies were:

San Clemente Fire Department, Ron Coleman, Fire Chief
Santa Ana College, Fire Technology Division, Dr. Leonard Marks
Central Sprinkler Corporation, Mr. Bill Meyers
Shell Chemical Company, Mr. Marty O'Brien

In addition, participating agencies that assisted in conducting the retrofit were:

Orvin Engineering, Mr. Jack Shaughnessy
Grinnell Sprinklers, John Viniello
Estrella Properties, Inc, Mr. Boyd Ames
California Fire Training & Education System, Inc., Mr. Dick Whanton

PERSONNEL INVOLVED

Orvin Engineering was requested to come to the site a couple of days in advance of the demonstration to evaluate the building for possible retrofit problems. At the time, a plot plan was constructed of the building and a basic schematic prepared regarding head placement, location of the riser and identifying potential problems for installation.

Orvin was not given any specific instructions on how to approach the job of installing the system. As professionals in the field, they were requested to assess the situation as that would if they were faced with a request for retrofit by a property owner. They were given a short workshop on how to use the heat fushion equipment on the polybutylene pipe. This took about 1 hour.

A material list was derived from the schematic by the two primary participating agencies; Shell Chemical and Central Sprinkler Corporation A complete listing of materials that was brought to the site was prepared from that schematic with about a 10% coverage allowed to adjust for potential errors. All materials for the retrofit were placed onsite the day prior to the actual retrofit demonstration.

Invitations were sent out to all potentially interested parties. These included Fire Departments, sprinkler installers, plumbing contractors, building developers and the media. The day of the retrofit approximately 126 individuals came to the site. (It should be noted that the existence of these large number of participants did have an effect on the time sequence of the installation. Allowing large numbers of people to go in and out of the building and observe the retrofit process did delay the installation by approximately one hour, according to Orvin Engineering.)

At approximately 0630 on the morning of the retrofit, Orvin Engineering was allowed to enter the building. They began their installation by cutting the polybutylene pipe into the links according to the schematic and beginning the assembly process outside of the building. A heat fusion method was used to join all pipe fittings involved in this retrofit. Approximately 90% of the joints were made while the piping was outside of the structure. The crew consisted of two men. There were other members of Orvin Engineering involved in the retrofit as observers. However, they do not contribute manpower or labor to the process.

The sprinkler heads were Central Residential Omega Pendant (1350, 3/8" NPT. 20 TAU). (Cost approx. 10.95 perhead-discounts available 100 heads They were located in the respective rooms and holes drilled with a hole saw for installation. The hole that was cut 2" diameter (Central Escutcheon Plate is 2½"). Observers who had come to the retrofit were allowed in and out of the building during the period of time that contractors were making the installation.

After approximately 2 hours the assmebly of the main stem of the system was completed. The main stem was then inserted into the overhead and the system connected to a riser. The bulk of the pipe assembly and work on the structure was accomplished by approximately 11:30 that morning.

At approximately 12:30, all installation. Participants were allowed to walk through the building taking a look at the general configuration of the retrofit and observing what effects the retrofit had on the ability of the occupant to remain in the structure while the retrofit process was going on.

BURN TESTING

Burn tests were conducted at approximately 1:15. It should be noted that this experiment did not involve testing the validity of quick response sprinkler heads. The burns were conducted only for purposes of providing visibility to the concept. Sprinkler heads are tested in accordance with criteria of UL and FM and are not to be considered part of the experimental process during this retrofit. Nonetheless, a series of fire scenarios were developed to literally test whether or not a retrofit has provided an increased level of protection in the residential occupancy.

The first burn was conducted in a living room situation. The second burn was conducted in a bedroom, the third burn was conducted in a kitchen, the forth burn was conducted in an open area dining room and the last burn was conducted in a room with no sprinkler head installed.

OBSERVATIONS BY FIRE PERSONNEL

The following observations were made regarding the retrofit process by those individuals who are responsible for conducting the excercise and/or participating as observers:

1. It is possible to conduct a retrofit using polybutylene, in a residential occupancy within one single working day, that is functional and aesthetically pleasing.

2. It is possible to conduct the retrofit of a residential occupancy using existing state of the art technology with a reasonable cost factor associated with it. Based in data collected in this demonstration tha entire system was less than $1,000.00.

3. It is extremely important that in retrofit applications that the structure be adequately assessed in its entirety prior to the start of the installation. That is to say, that the structural features in the attic, crawl spaces and framed out areas be assessed for the movement of installing personnel.

4. One of the most important factors to assess is the underground water supply. It is highly possible that in older buildings, especially those that have suffered water problems in the past, that the replacement of the underground valves and meters may be an important part of the cost effectiveness of the installation.

5. a. The installers must have a thorough and comprehensive understanding of the installation condition prior to arrival on the scene. It is most important that a three dimensional schematic be prepared of the retrofit situation to avoid causing extensive delays. The biggest single factor in this entire process is that of manpower.

   b. Installers must develop a fail-safe system of cutting holes that prevents false holes from hitting ceiling joists or coming up under other fixtures.

6. There are problems associated with adequately locating and

holding sprinkler heads in place in a retrofit application. One of the most noticeable aspects of a retrofit is that you cannot change the structural configuration of the building. You have to work with what is existing. In our particular case, there were several times where delays occurred because of ceiling joists that were installed right where heads should be spaced. This points to the fact that it is possible that in a retrofit situation, the head spacing will not be exactly as it would have been in a new installation.

7. Another problem in a retrofit situation is how to adequately conduct hydrostatic tests of the plumbing. In new installations, hydrostatics are conducted when the plumbing is in the overhead and there is limited amount of concern about a possible rupture. However, in a retrofit application, techniques most be worked out to assure the integrity of the system prior to it being installed. This appears to be one of the distinct advantages of the flexible polybutylene piping system. A system of conduting hydrostats outside of the structure appears conceivable.

8. a. Another problem that was witnessed was that adequate bracing and control of the sprinkler drops themselves. Two problems appear to be apparent. The first is that when you are screwing the sprinkler head into the pipe, the pipe is flexible and can, therefore, torque as the head is put in unless properly secured. It becomes very important that systems be worked out to assure that the heads will not leak around tha threads. Additionally, a problem can occur

when the installer is torquing the head down. Someone has to be up in the attic holding on to the other end to avoid misaligning the plumbing and its hangers.

b. The second problem here appears to be the fact that the hangers used in retrofit must be designed to keep the head from having nozzle reaction when activated. In one of the experimental fires, the head was compromised by the fact that the plumbing system "bucked up" into the overhead once the pressure was applied. This becomes extremely important as far as the pattern of the head is concerned. Adequate hangers are available to solve this problem.

9. a. A burn-out of one of the rooms was conducted with the polybutylene drained of water. It was protected by the ceiling. The pipe was not damaged after a 14-15 minute fire, dispite flashover on the room of origin.

INSTALLER OBSERVATIONS

The following comments were provided by Orvin Engineering Corporation. These observations are form the installer's point of view. They were as follows:

1. The installers found that the heat fusion process produced good results. There were fifty plus fused joints made in the system and there were no leads of the fused joints. (Leaks did occur around the sprinkler head.) This was due to lack of information on the type of thread sealant to be used.

2. The actual heat fusion procedure was considered to be very simple by the contractors. Most of it was performed outside at the ground level. However, the final connections had to be fused while the men worked off ladders and this part seemed a bit awkward. The ability to prefabricate the system outside, on the ground, is a key factor in keeping costs down.

3. As far as a retrofit aspect went, Orvin Engineering felt that this was not much different than they had ever experienced before. Smaller attic spaces equal a lot of moving around and sub-

subsequently increased manpower costs.

4. The actual material that was used in this retrofit was as follows: 144 feet of one inch polybutylene pipe. There were ten one inch tees, nine 1"x½" R.C., there were three 1" elbows, there were nine Central Residential Sprinkler Head utilized, there were twenty-one 1" hangers or pipe straps installed.

5. It should be noted that the riser that was used in this experiment was provided by the San Clemente Fire Department and was of a test configuration utilized in previous test burns.

6. According to Orvin Engineering, the actual time of installation was six hours for two men, plus an additional two hours for one man. Beyond this time, they spent an additional hour on laying out the sprinkler head location and general orientation of the structure. (This was conducted the day prior to the retrofit experiment.)

7. Orvin Engineering honestly feels that a full hour of installation time was lost due to the number of on-lookers milling around in the house during the installation.

According to Jack Shaugnessy, the Executive Vice-President of Orvin Engineering, "All in all, I would say the demonstration was successful as it accomplished what I believe it is intended to accomplish. The material proved worthy and relatively simple to install and the residential sprinkler head proved highly effective in the fire test."

Mr. Shaugnessy agreed with the observers from the Fire Department's point of view that any future fire tests that water supply is most important to the effectiveness of the systems and must by thoroughly analyzed.

SUMMARY

In summary, the sponsors of Operation Fire Stop, the retrofit test (San Clemente Test Burn Series 13-83) was successful. It established that the concept of retrofit application in residential occupancies is technologically feasible. It further, however, identifies the fact that a considerable amount of research must be done in the field of installation criteria, the education process of a structure for a retrofit application.

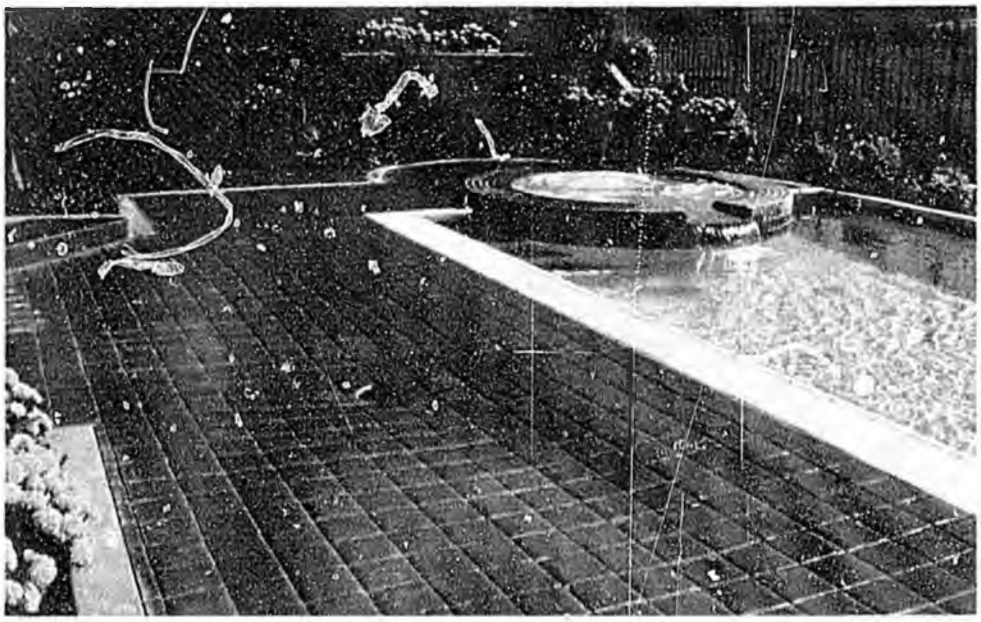
All participants who are in receipt of this particular documentation are encouraged to submit any observations, points of view, differences of opinion, or additional data for the continued development of this concept. Please feel free to direct your comments to: Ronny J. Coleman, Director of Fire Protection, San Clemente Fire Department, 100 Avenida Presidio, San Clemente, California 92672 (714)361-8240.

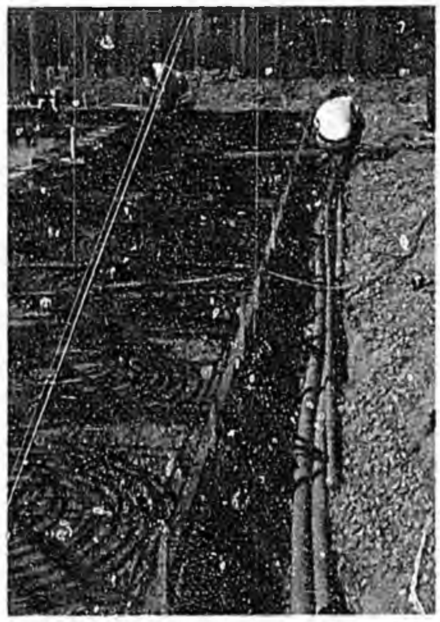
DURAFLEX POLYBUTYLENE

PIPER

Published by Shell Chemical Company

Volume III, Number 2, 1982





Unique solar system for heating pools features pipe made from DURAFLEX™ polybutylene resin

An innovative solar swimming pool heater that simultaneously cools the pool deck has been developed by Bomanite Corporation of Palo Alto, California. The Solarpave® system utilizes approximately 3000 feet of polybutylene pipe embedded in a colored, sculptured concrete pool deck.

Water from the pool is circulated through the pipe, cooling the otherwise hot deck and warming the pool water. Since concrete stores heat, the system can continue to heat the pool even after dark.

The Solarpave system is available in a variety of patterns and colors that provide an attractive alternative to solar panels. Bomanite says the Solarpave systems are priced competitively with other solar systems and require little maintenance. Only the pool filter pump is required to circulate water through the low pressure system.

Polybutylene pipe's light weight, flexibility, and resistance to corrosion, scale and electrolytic actions have led to its extensive use in slab radiant heating systems. More than 50,000 miles of polybutylene tubing have been installed in concrete slabs in Europe over the past decade.

Bomanite has reported that the Solarpave system qualifies for solar energy tax credits in several states. Readers interested in obtaining more information on the Solarpave system or learning the name of their local franchised contractor should contact Bomanite Corp. at 81 Encina Avenue, Palo Alto, CA 94301.

**Duraflex™ is a trademark of Shell Chemical Company for its polybutylene resins. Shell Chemical does not manufacture pipe.*

Polybutylene pipe helps make fire sprinkler systems affordable

Low cost, fast installing pipe made from DURAFLEX™ polybutylene resin combined with smoke detectors and more efficient sprinkler heads form a fire protection system that can control household fires within seconds.

This is the system selected for installation in San Clemente, California, in what is considered a model for future systems and code ordinances. San Clemente is one of the first communities in the U.S. to mandate residential sprinklers.

"Polybutylene pipe can help in holding costs down. The pipe permits fast and inexpensive installation. So it holds the costs of a home sprinkler system to an affordable level, which helps to reduce resistance from homeowners," says Ron Coleman, San Clemente Fire Chief.

Above photo shows testing of a sprinkler system that combines polybutylene pipe, metal sprinkler heads and smoke detectors. The San Clemente Fire Department conducted the test prior to revising the city's fire sprinkler code.

It took less than one day to complete the first installation of this new type of fire sprinkler system in a new home in San Clemente. Since the home was valued at more than $500,000, the fire sprinkler system represented less than 1% of the construction cost. Because the size of the system is proportional to the home's size, an installed cost of less than 1% of the construction cost is a good estimate for most new home installation.

The pipe's flexibility was a real asset in the installation because the house was close to completion. The pipe could be curved around obstacles and routed easily, minimizing the extent to which the new construction was disturbed. This advantage would also be of prime importance in retrofitting the system into existing homes.

Pipe ideal for retrofitting

"The pipe is especially good for retrofitting. With the widespread acceptance and expanded use we see for residential sprinkler systems, the ability to retrofit existing homes is going to be just as important as new home installations," Coleman says.

Because the pipe doesn't corrode and resists scale build-up, it isn't necessary to flush out the system periodically, which must be done with metal pipe systems. Duraflex pipe can stand high attic heat in the summer and doesn't crack if water freezes in it during the winter.

Proper installation is important for maximum effectiveness. Except for the sprinkler heads, all installation materials are plastic. Metal connections and installation parts should not be used as they could act as a heat sink during a fire and damage the system. Both the polybutylene pipe and sprinkler heads are laid out and located for maximum protection and fast response.

Special low-temperature set-off sprinkler heads that release at 165°F have been developed by Grinnell Fire Protection Systems. These respond five times faster than industrial type sprinklers. An improved, wider spray water distribution pattern developed for residential rooms extinguishes fire within seconds before it can grow. The cooling effect keeps other sprinklers from being set-off unnecessarily, keeping water pressure at maximum levels.

By combining these sprinkler heads with polybutylene pipe and smoke detectors, fire officials have put together an effective system that can be easily and affordably installed and maintained in most homes.

Tests were conducted by the San Clemente Fire Department on this system prior to revising the city's fire sprinkler code. The tests were designed to demonstrate and check the system's effectiveness in controlling typical household fires, and to identify special considerations to be included in the code.

(left to right) Charles Brent (president of B.J.S. Corp., distributor for Rahn/Western Pipe Corp.); John Rosso (of Paul S. Robinson Co., manufacturer's representative for Rahn/Western Pipe Corp.); Inspector Ed Harrod and Fire Chief Ron Coleman (both of the San Clemente Fire Department).

"Trend of the future" for homes

Ron Coleman sees the system's advantages catching on fast. He says, "Residential sprinkler systems are the trend of the future. In most new homes, we'll probably see built-

continued on p. 4

DURAFLEX™ pipe unaffected by Atlanta's sub-zero temperatures

The record setting cold in Atlanta, Georgia early in 1982 provided the acid test for a plumbing system using pipe made from DURAFLEX™ polybutylene resin. Experiencing −5°F temperatures with water in the pipes, an unfinished house outfitted with a polybutylene pipe plumbing system experienced no leaks or cracked pipes.

Built as a pilot project using Duraflex pipe by High Country Homes, Inc. of Marietta, GA, the house is located in an Atlanta suburb. The gas line for space heating had not been run and some of the outside doors were not yet installed when temperatures plummeted. The water pressure had, however, been turned on prior to the cold spell. Despite freezing solid, the plumbing system experienced no leaks or failures.

Joe A. McHarg of High Country Homes, Inc., in a letter to W. T. Anderson, Director of Inspections, Cobb County, Georgia, said, "I can't help but think of the inconvenience, expense and misery that would have been avoided if this product (polybutylene pipe) had been available 20 years earlier."

As a result of the extreme cold, the Cobb County inspectors office had received over 1700 calls from residents requesting information on how to shut off their water systems because of leaking pipes. These calls and the subsequent hardships of water damage prompted proposed changes in the construction codes to prevent a recurrence of the problems faced this year.

One of the proposed changes forwarded by Anderson to the County Administrator and Cobb County Commissioners recommends: "Grant the use of polybutylene pipe on water pressure lines in Cobb County."

EDITORS NOTE:
A properly designed and installed plumbing system utilizing Duraflex pipe can be expected to withstand the extreme conditions described above. However, under certain conditions, Duraflex polybutylene pipe may be pushed beyond its limit and fail. These conditions occur when short sections of Duraflex pipe are used between sections of rigid pipe. For best results, precautions should be taken to prevent such conditions.

in sprinkler systems becoming standard features. The major safety and property loss prevention benefits of sprinkler systems will make them very popular, fast. We'll probably see more systems installed in the next 10 years than in the last 100 years."

"Over 400 cities have asked for copies of our standards," Coleman reports, "and many are using us as a model for their own standards." In many areas, voluntary standards for residential sprinkler systems are being implemented, and a growing number of municipalities are enacting mandatory codes. In the near future, these standards may become virtually a nationwide mandatory building code requirement."

Inspector Ed Harrod of the San Clemente Fire Department checks a sprinkler system that uses polybutylene pipe.

Code bodies grant approval for polybutylene pipe.

Recent code approvals for Duraflex polybutylene pipe for use in hot and cold water plumbing service include:

Commonwealth of Puerto Rico
Oklahoma City, Oklahoma
Arlington, Texas
Peoria, Arizona
State of North Dakota
Jefferson Parish, Louisiana
Lubbock, Texas
Nassau County, Florida
Clark County, Washington
Glendale, Arizona

Where to buy polybutylene pipe

Shell Chemical does not manufacture pipe, but the following independent manufacturers produce pipe from polybutylene resin:

AB&I Plastics
7825 San Leandro Street
Oakland, California 94621
415/632-3467
Attn: Mr. Mel Gray

Bristol Products Co.
P. O. Box 278
Bristol, Indiana 46507
219/848-4402
Attn: Mr. Tony Ernst

Delta Faucet Co.
55 East 111th Street
P. O. Box 40980
Indianapolis, Indiana 46280
317/848-1812
Attn: Mr. George Davis

Trojan Plastics, Inc.
2211 N. 38th Street
Tampa, Florida 33605
813/242-4211
Attn: Mr. Brand Laseter

U. S. Brass
Qest Plumbing Systems
P. O. Box 37
Plano, Texas 75074
214/423-3576
Attn: Mr. B. E. Smith

Vanguard Plastics, Inc.
P. O. Box 346
McPherson, Kansas 67460-0346
316/241-6369
Attn: Mr. Keith Swinehart

Western Products Company
P. O. Box 803
Union City, California 94587
415/471-8856
Attn: Mr. W. J. McGlinchy

Wrightway Mfg. Co.
Beatrice Plumb Products Group
1050 Central Avenue
Park Forest So., Illinois 60466
312/534-0500
Attn: Mr. Ralph W. Arboe

Details of the San Clemente test and installation are available in a new publication, SC:685-81, from Shell.

The Duraflex Polybutylene Piper is published periodically by the Plastics Business Center of Shell Chemical and is available to anyone wishing to receive it. Comments and questions are welcome.

Address correspondence, including requests for additional copies, to Shell Chemical Communications, Room 1227, One Shell Plaza, Houston, Texas 77002.

Printed in U.S.A. 1982, Shell Chemical Company.

D U R A F L E X   P O L Y B U T Y L E N E

PIPER

Published by Shell Chemical Company — Volume IV, Number 1, 1983

Corrosion-resistant Duraflex™ polybutylene pipe specified for Florida medium-rise.

The water in Jacksonville, Florida, is so corrosive that it can eat through copper and galvanized metal pipe.

"In Jacksonville, the only way you can use copper or galvanized metal pipe is to treat the water first," says David Batzka.

Batzka served as owner's representative for Sundale Manor, a six-story apartment building currently under construction. To avoid installing a costly water treating system, Batzka specified corrosion-resistant Duraflex* polybutylene pipe for Sundale Manor's potable water system and PVC pipe for the drainage system.

Sundale Manor will be the first medium-rise building in Jacksonville with all-plastic plumbing. Polybutylene pipe received Jacksonville city code approval in late 1981.

W. W. Gay Mechanical Contractor, Inc. is handling the polybutylene pipe installation at the 90-apartment complex.

Job superintendent Jimmy Lasco is the key installer for the polybutylene pipe, which ranges in size from ½ inch to three inches in diameter. Heat fusion is used to install the larger (one-inch to three-inch) diameter pipe. Insert/compression ring fittings are used for the smaller diameter pipe. The installers can pressure-test the pipe and fittings immediately.

Billy Knight, who handles all of the heat fusion, says, "Once you learn to heat-weld the pipe, it's really quick and easy. We had some trouble with the first couple of welds, but now it's really simple."

According to Lasco and Knight, the larger diameter polybutylene pipe's flexibility and light weight provided unique advantages over rigid pipe; installation of Duraflex polybutylene pipe became a simple two-man operation. Risers for the pipe were shop-fabricated in an open area outside the building, coiled up for

(Continued on page 4)

*"Duraflex" is a trademark of Shell Chemical Company for its polybutylene resins. Shell Chemical does not manufacture pipe.

Duraflex pipe installed in California solar-based housing project.

In an effort to provide substantially lower utility bills for heating, cooling and hot water, a farsighted county housing authority has initiated the development of the first solar-based public housing project in California.

"Solar housing benefits all the taxpayers by conserving energy for other uses. We believe that these homes will serve as a model for other public agencies and for private developers who seek to respond to the energy realities of the 80s," said Roger Salquist, president of Trident Energy Systems, Davis, CA, the developers and installers of the solar system.

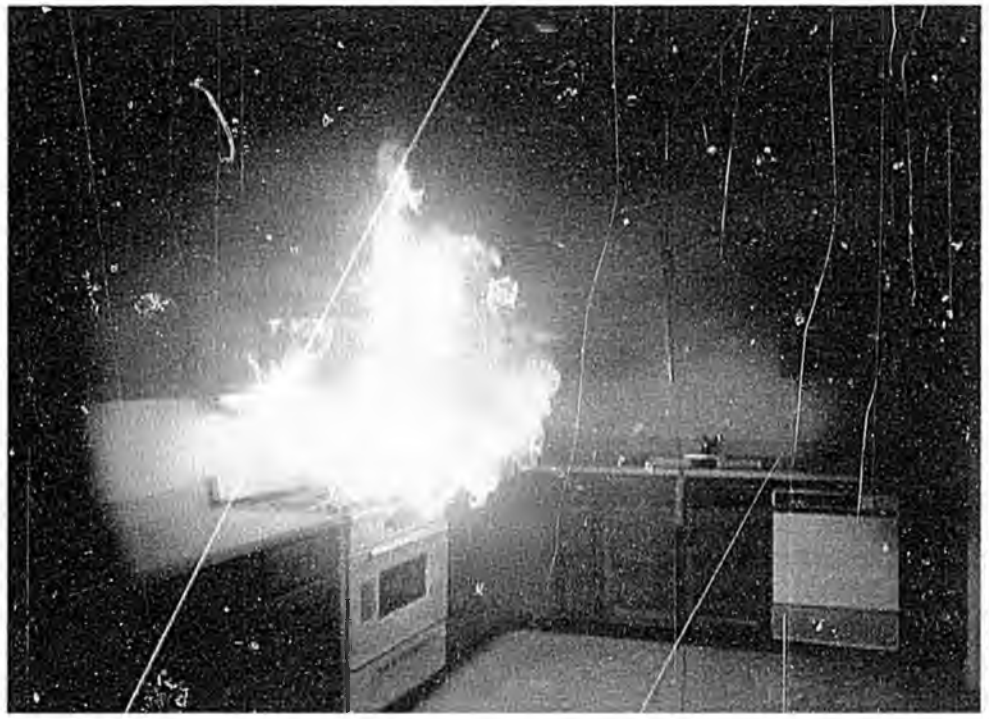
The systems are being installed in sixty-two 3 and 4 bedroom single family homes in the Rancho Algoden project outside Delano in Kern County. Completion is scheduled for late 1982.

For heating, Trident uses roof-mounted solar collectors to heat water which is then circulated through coils of flexible pipe made from Duraflex polybutylene resin embedded in the slab of each house. For cooling, a radiant chiller with a counterflow heat exchanger provides three tons of cooling capacity

(Continued on page 3)

DURAFLEX POLYBUTYLENE

Fire sprinkler system tested in Scottsdale.



Fire sprinkler systems retrofitted into two new Scottsdale, Arizona homes quickly extinguished deliberately-set test fires, thereby dramatically reducing the potential damage to the homes.

Federal and local fire officials monitored the tests which ranged from wastebasket fires to kitchen grease fires and burning dry Christmas trees.

Insurance officials estimated damages in the series of duplicated fires in the two homes and compared the losses to the property damage that would have occurred without sprinkler systems.

On the basis of eight tests, damages in the sprinklered fires were estimated at $17,200 while the average damage estimate without sprinklers totaled $116,000, a savings of $98,000 or 85 percent.

"The answer to reducing the number of lives lost in residential fires is in-place protection with automatic suppression systems and smoke detectors," said Harry Shaw of the U.S. Fire Administration (USFA) in Washington, D.C. following the tests.

Sprinkler systems were installed after the two $70,000 subdivision homes were built. One house was retrofitted with a standard iron pipe system and the second house used flexible pipe made from Duraflex polybutylene resin and a black iron pipe system. Both systems employed newly developed fast response sprinkler heads.

Grantham Fire Protection, Inc. of Phoenix, Arizona, installed both sprinkler systems in the second house and tabulated material and labor costs. The system using the flexible polybutylene pipe required only half as many man hours to install as the system with the metal pipe.

"The house was retrofitted with polybutylene in three days using two men and it took four and one-half days and three men to complete the black iron pipe system," said Terry Glenn of Grantham.

In order to install the black iron system, it was necessary to cut a hole in the roof. Sections of the pipe were cut outside the home, brought in through the roof, then threaded into position in the sprinkler head installation.

The lightweight Duraflex polybutylene pipe was assembled in a garage. Sections of the pipe were heat fused and then easily snaked through an attic opening. In addition to installation advantages, the pipe will not crack if water should freeze inside the pipe and it has the highest heat rating of any thermoplastic pipe, a particular advantage in the "Sun Belt" where attic temperatures soar in the summer.

Scottsdale Administrative Fire Chief Bob Edwards said the cost of installing the polybutylene system was about one percent of the cost of the homes; about 40 percent less than for the iron system.

The tests were conducted by the Rural/Metro Fire Department, an independent corporation contracted by the city, and were financed by the USFA. Factory Mutual, a national testing laboratory, monitored the results.

In a demonstration of confidence in both systems, executives of Rural/Metro

sat on couches in the living rooms as fires were started in nearby wastebaskets. In one house the sprinkler was actuated in 1:17 minutes and in the other house, at 2:55 minutes.

Sentry Insurance Company observers estimated that the damage would have averaged about $3,500 in each home (in this specific fire test) had there been no sprinkler systems. In actuality, damage was estimated at only $1,000 in one home in which the sprinkler was actuated first and $1,500 in the other.

In another comparative test, cake pans of cooking oil were heated on an electrical stove with open flames occurring three to four minutes later. After the sprinkler heads were actuated to extinguish the fires, damage was estimated at $2,400 in one house and $3,600 in the second house. If sprinkler systems had not been installed, the insurance company estimated damage would have been $6,500 in the first house and $12,500 in the second house. (Estimates of losses without sprinkler equipment were based on normal fire department responses in terms of time, manpower and equipment. Estimates of damage with sprinkler operation were based on review of actual conditions after each test.)

Besides local media coverage, more than 170 representatives of fire departments, local governments and builder associations witnessed the tests. The test descriptions were recorded and posted for the audience while videotape replays were also shown. In a majority of the tests, only one sprinkler head was actuated.

Among the interested observers were representatives of the Cobb County (Georgia) Fire Department. Cobb County recently conducted extensive fire sprinkler tests that resulted in building code amendments for multi-family dwellings authorizing the use of polybutylene pipe in sprinkler systems.

The tests demonstrated that effective protection against extensive damage and deaths caused by fires can be economically added to an existing home.

(Continued from cover)

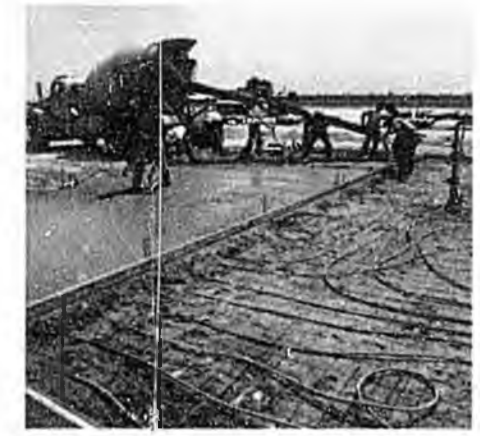
which, if needed, can drop the water temperature as low as 38 degrees during the summer. The chilled water is circulated through the pipe in the slab to cool the house.

Not only does the radiant heating system provide an excellent means of using the medium temperature heat from the solar panels, but it also reduces the total energy requirements. The radiant slab and water storage tank can store enough heat in winter to maintain desired room temperatures for several sunless days before requiring back-up from the flash boilers which are installed as part of the overall system.

"Rancho Algodon vividly demonstrates that solar is not just a tool of the affluent," said Salquist. "It is even more essential in situations where tight incomes cannot compensate for rocketing utility bills, and the Housing Authority of the County of Kern is one of the first agencies to take this into account." Trident estimates a utility savings of about 75%.

The radiant slabs are constructed by placing a plastic vapor barrier over a sand base eight inches above the grade. This is covered with another inch of sand and a wire mesh. Before the coils of half-inch Duraflex polybutylene pipe are placed into the desired position for each zone, lime is sprinkled over the sand to show crews where to set the prefab walls.

Approximately one linear foot of one-half-inch CTS polybutylene pipe per square foot of space was embedded in the slab of each house. Trident chose Duraflex polybutylene pipe for its combination of high temperature properties and flexibility.



"A three man team can lay the pipe for the slabs of four houses in a day," said Geoff McNeilly, Trident crew manager at Rancho Algodon. Ties were used to attach the pipe to the wire mesh and maintain desired zone spacing.

There are four or five zones in each of the houses with positive shut-off valves controlling the flow through each zone. Continuous coils of pipe used in each zone were connected to return and supply valves in a manifold box installed just below the concrete surface in the garage. The pipe was laid so that the supply water circulates from the perimeter of the zone to the center before returning to the manifold box.

The Kern County Building Inspection Department tested the system by applying an air pressure of 30 psi for 30 minutes. Under operating conditions, only 3 psi pressure is needed to circulate about four gallons per minute of water throughout the 1000-1200 feet of pipe. Following inspection, about 25 cubic yards of concrete were poured for the standard 4" slab of each house and its garage.

A computerized controller will monitor the air inside the home, the water in the storage tanks and the collectors on the roof. A digital readout indicates the temperature of each. The controller automatically operates the system to collect and store all available solar energy and to maintain the desired setting on a solar dial. Another dial setting establishes the lowest acceptable inside air temperature and maintains it during periods of low solar conditions.

The California Department of Housing and Community Development is providing construction funding of about $3.2 million, including the cost of installing the Trident Energy Systems' solar heating and cooling. Kern County Community Development block grant funds will be used for the land purchase cost of about $207,000.

Elimination of a central air conditioning system, furnace and ductwork will offset a portion of the installation cost for the system. The net installation cost for the Trident system at Rancho Algodon is about $2,000 a house more than a conventional system.

Rancho Algodon is a project of Lewis Development Inc. of Carmichael, California. Lucky Bell Corporation, also of Carmichael, is the contractor.

(Continued from cover)

transport, and installed by pulling them all the way up through a shaft in the middle of the building. Anchor plates provide a clamp on each floor. Thermal expansion and contraction are accommodated by the flexibility of the pipe.

Duraflex polybutylene pipe's light weight enables one man to carry up to a 500-foot coil of pipe over his shoulder. Project manager Al Boree, of W. W. Gay, has not calculated the time savings for installation yet, but he states, "We are just learning to use polybutylene and, in the long run, we do expect there will be considerable savings in installation time."

Boree views the polybutylene pipe installation as a pilot project to test the pipe's corrosion-resistance and simple, low-cost installation.

According to Boree, "Many normal domestic systems in Jacksonville, using copper or galvanized steel, will leak through electrolysis or corrosion within a few months after initial operation."

Boree mentions an additional benefit offered by polybutylene: its elasticity lessens the effects of water shock. "On this job we are using two shock stops per floor; normally we need two in each bedroom." And, although freeze damage to pipes is not a major problem in Jacksonville, Boree says that the pipe's freeze resistance provides another extra benefit in that the pipe will "never break because of bad weather."

Sundale Manor was completed in October, 1982, with a total of 8,480 feet of Duraflex polybutylene pipe in place at that time. The long-term benefits of polybutylene pipe in this particular building are not yet proven. But, says Jimmy Lasco, "If this works as well as we hope, we'll be using it all the time."

Code bodies grant approval for polybutylene pipe.

Recent code approvals for Duraflex polybutylene pipe for use in hot and cold water plumbing service include:

State of New Hampshire
State of New Mexico
Bay County, Florida
Montgomery County, Maryland
Prince George County, Maryland
Clark County, Nevada
Watcom County, Washington
Bellingham, Washington
Sioux City, Iowa
Las Vegas, Nevada
Scottsdale, Arizona

Where to buy polybutylene pipe

Shell Chemical does not manufacture pipe, but the following independent manufacturers produce pipe from polybutylene resin:

Bristolpipe
P.O. Box 184
Bristol, Indiana 46507
219/848-4402
Attn: Mr. Tony Ernst

Delta Faucet Co.
55 East 11th Street
P.O. Box 40980
Indianapolis, Indiana 46280
317/848-1812
Attn: Mr. George Davis

Trojan Plastics, Inc.
2211 N. 38th Street
Tampa, Florida 33605
813/242-4211
Attn: Mr. Brand Laseter

U.S. Brass
Qest Plumbing Systems
901 Tenth Street
Plano, Texas 75074
214/423-3576
Attn: Mr. B.E. Smith

Vanguard Plastics, Inc.
P.O. Box 346
McPherson, Kansas 67460-0346
316/241-6369
Attn: Mr. Keith Swinehart

Wesflex Manufacturing Co.
P.O. Box 1009
Richmond, California 94802
415/233-6670
Attn: Mr. J. Nusbaum

Western Products Company
P.O. Box 803
Union City, California 94587
415/471-8856
Attn: Mr. W. J. McGlinchy

Wrightway Mfg. Co.
Beatrice Plumb Products Group
1050 Central Avenue
Park Forest So., Illinois 60466
312/534-0500
Attn: Mr. Ralph W. Arboe

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Printed in U.S.A. 1983, Shell Chemical Company.

A Shell Chemical Company Report

The Duraflex polybutylene line was attached to the existing water supply lines and run below the roof.

Springdale Mobile Home Test

A low-cost automatic fire sprinkler system utilizing lightweight, flexible polybutylene pipe made from Duraflex TM resign and a new type of sprinkler head was successfully demonstrated by federal officials in a recent test designed to simulate typical mobile home fire scenarios.

The resin for the pipe is the same as used by most mobile home manufacturers for hot and cold water plumbing systems. The high temperature properties of this pipe are particularly important in resisting the heat generated by a fire. Resistance to freeze breakage also is an important consideration in specifying a pipe for a fire sprinkler system.

The test in northwestern Arkansas was the first federal government-sanctioned test in which this kind of pipe was used to transport water to sprinkler heads in a mobile home. An earlier fire test in an abandoned permanent structure in California proved the system worked efficiently. These inexpensive systems have since been incorporated in new homes as well as added to existing homes.

The Arkansas "residential fire sprinkler test" was conducted by the National Bureau of Standards (NBS) for the Federal Emergency Management Agency. Cooperating in the test were Shell Chemical Company (manufacturer of the Duraflex resin), Grinnell Fire Protection Systems Co. (manufacturer of the sprinkler heads), the Northwest Arkansas Vocational Technical School, Springdale, (Ark.) Fire Department and the Arkansas Fire Academy.

"The test went extremely well," according to Edward Budnick, Head, Fire Protection Systems Research, Center for fire Research of the NBS. He said it demonstrated that such a system would quickly extinguish a typical mobile home fire with minimal fire and water damage. His views were echoed by Harry Shaw, Director of the U.S. Fire Administration's Home and Public Building Safety Division, who witnessed the tests.

Approximately 100 feet of 1-inch SDR 11 polybutylene pipe was snaked beneath the ceiling insulation of the mobile home. Four arteries branched off from the main line.

Highly sensitive Grinnell sprinkler heads, approved by Underwriters Laboratories, were used in the test. These heads operate about five times faster than the fastest sprinklers used in commercial and industrial buildings and provide a spray pattern higher on the walls.

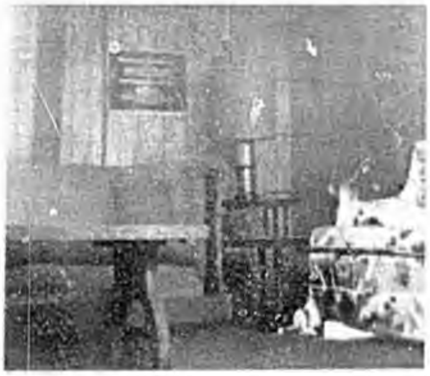
The pattern cools air around adjacent sprinklers to reduce the possibility of activation of additional heads, thereby preserving adequate water flow to the initial sprinkler head. This also prevents unnecessary water damage to the home and its contents. U.S. Fire Administration fire tests in recent years indicated the need for faster responding sprinkler devices with improved water distribution patterns to douse typical residential fire conditions.

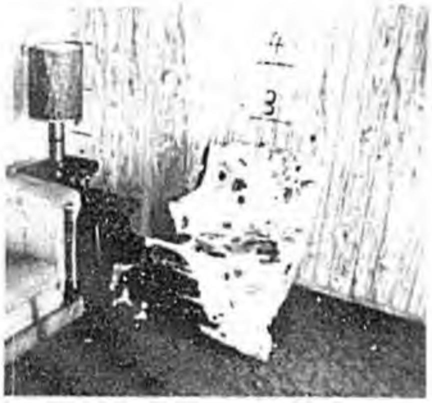
A paper filled waste basket was ignited in a bedroom of the mobile home. As the fire spread to nearby drapes, the sprinkler head sensed the rising temperature and doused the blaze. Total elapsed time: approximately 40 seconds. The basket and a portion of the drapes were the only casualties.

Within one minute of the fire, the heat activated the sprinkler. Approximately one minute later, eye level temperatures returned to normal.

Reprinted from The Automatic Sprinkling of News Quarterly

A second fire was ignited in the living room with similar results. Fire damage was limited to the waste basket and an adjacent overstuffed chair.





These photos show that al[illegible] a waste basket and chair were dama[illegible] on the living room test, there was no structural damage or damage to the nearby couch.

Both tests were monitored by thermocouple sensing devices with the temperature and times recorded for later computer printouts.

To show the benefit of installing such a system, officials set fires in an old, donated mobile home which had no effective sprinkler system. Within a few minutes, the spectators saw the home burning out of control.

The demonstration was a feature of the "Operation Dixieland" project sponsored by the NBS to increase public awareness of the dangers of home fires and to educate the public about fire prevention.

The need for effective fire sprinkler systems is clearly shown by USFA figures for 1979: 2.7 million reported fires causing 8,400 civilian deaths with 31,000 civilian injuries at a $5 billion property loss. Residential fires account for 77% of the deaths.

"The U.S. Fire Administration is dedicated to reducing fire losses throughut the country, and the widespread use of improved fire suppression technologies could go a long way toward helping reach that goal," Shaw said.

"Now, for the first time," he added, "we know enough about the characteristics of the residential fire to allow us to design a residential sprinkler system to combat it, contain it or control it or even extinguish it. In 1975 when the previous NFPA 13D standard was adopted we did not have this knowledge and, as a result, have had problems in utilizing available sprinkler hardware in the residential setting."

In late 1980, the National Fire Protection Association (NFPA) adopted a new residential sprinkler installation standard based on tests sponsored by the USFA. One of its prime objectives is a low-cost, fast-acting, reliable system that protects lives and property adjacent to the fire by containing it within the room of origin.

The USFA said an entire system can be installed for about one percent of the cost of a new home. By using flexible and inexpensive pipe made from Duraflex resin, adding a system to an older home also is substantially simplified by the light weight of the pipe, the reduced number of fittings, and the ease of handling of the pipe in tight spaces.

Federal officials hope that additional evidence will convince insurance companies to discount fire insurance rates for residences and mobile homes protected by such systems. ◊

A fire in a donated mobile home which had no sprinkler system quickly destroyed it. Spectators view the blaze between the two mobile homes.

Performance at Elevated Temperatures

When placed under a load, all materials are subject to creep or cold flow that will decrease their pressure carrying capability over time. Among the thermoplastic materials, DURAFLEX* polybutylene resin is distinguished by its resistance to creep, particularly at temperatures up to and beyond the boiling point of water. The high creep resistance at elevated temperatures is the basis for the use of DURAFLEX polybutylene pipes in hydronic heating and plumbing systems in over 25 countries worldwide.

ASTM testing techniques are used to determine the long term pressure carrying capabilities of thermoplastic pipes. These techniques involve measuring, over an extended period of time, the burst pressures of pipes at various test temperatures. To minimize any danger of failure, 50% of the long term pressure carrying capability is used as the design pressure. DURAFLEX polybutylene plumbing pipes (SDR-11) carry a 200 psi long term pressure rating at room temperature, a 100 psi rating at 180°F, and an 80 psi rating at 200°F. Polybutylene is the only thermoplastic pipe to carry a 200°F pressure rating from the Plastic Pipe Institute. It should be borne in mind that these ratings are for continuous use at these temperatures. If the use at these elevated temperatures is discontinuous, much higher pressure carrying capabili· will result. For instance, the short term burst pressure for SD 11 polybutylene pipes at room temperature is 575 psi; at 180°F, 350 psi; and at 200°F, 240 psi.

Numerous tests have shown that the pipe will perform satisfactorily in a sprinkler system in both concealed and exposed installations. In the latter, more extreme case, tests at Ft. Lauderdale have shown that pipe exposed directly to a fire was undamaged in the time required to activate a fast response sprinkler head. Radiant panel tests at the University of Maryland Fire School have shown how the pipe could respond in areas that are not protected by the sprinkler system, i.e., behind a wall or ceiling. In these tests, exposure of water filled polybutylene pipes to a 1,500°F radiant panel first melted the outer surface of the pipe. With time, as more of the pipe wall became molten, a small hole formed (less than 1/4 inch in diameter). Because the hole was even smaller than a sprinkler orifice, it would not materially decrease the capabilities of the sprinkler system. In actual service, the water flow resulting from such a hole would trip the flow switch warning the building's residents, and as a result, the life saving capabilities of the system could actually be enhanced when DURAFLEX polybutylene piping is used.

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*Shell Trademark

DURAFLEX™ POLYBUTYLENE

PERFORMANCE REPORT

SHELL CHEMICAL COMPANY

Comparison tests confirmed:
Installed cost
of polybutylene plumbing
was 44% less than that
of copper.

DURAFLEX™ POLYBUTYLENE PERFORMANCE REPORT

SHELL CHEMICAL COMPANY

Recent quantitative comparison tests have concluded that the total labor and material costs to install a plumbing system with Duraflex™ polybutylene pipe were 44% less than those of copper in virtually identical installations.

The tests were conducted in the Pleasant Valley subdivision located west of Fairfax, Virginia and Washington, D.C., by the National Association of Homebuilders Research Foundation, Inc., an independent research firm. Homes in the subdivision range from modest to luxury offering a variety of handsome energy efficient designs.

For the tests, plumbing installations in two similar, 2½ bath, single-family homes were compared. One home had a full basement and was plumbed with copper plumbing using the traditional cut, fit and solder installation method. The other home had a crawl space and was plumbed with Duraflex* polybutylene plumbing pipe, using insert fittings and aluminum crimp ring connections. The houses were plumbed by a plumber who was experienced in copper installation and who had previously installed five plumbing systems using Duraflex polybutylene.

The polybutylene plumbed house had more cramped working conditions in one area and required slightly more pipe than the copper house because the crawl space limited direct routing. This meant a slight advantage for the copper installation. The only other difference in the two houses was the location of the water heater and the water meter.

Duraflex™ is a trademark of Shell Chemical Company for its polybutylene resins. Shell Chemical does not manufacture pipe.

Objective and fair testing yields relevant results

The 44% cost savings realized in the polybutylene plumbed house are based on the material and time savings. Total installed material and labor costs for the polybutylene plumbed house were $138 less than the copper installation. It took 7 hours and 39½ minutes to plumb the copper house, but only 5 hours and 55½ minutes to plumb the polybutylene house. Material costs included all indoor supply piping and fittings running from the meter yokes to the fixture connections, but did not include valves.

Armed with a stop watch, a specially ruled recording book, a camera and a pen, Hila Anderson, Senior Industrial Engineer with NAHB Research Foundation, Inc., observed, measured, counted and recorded the work performed, actions made, and materials used by the plumber.

To ensure objective, comparable and applicable results, Anderson used several established sampling and factoring methods common in gathering and compiling this type of research data. These included an averaging of the plumber's efforts and conditions with other plumbers in general. Thus, the results are applicable for an adequately trained plumber to perform the installation with an acceptable amount of personal time and breaks.

NAHB Research Foundation, Rockville, Maryland, a wholly-owned subsidiary of the National Association of Home Builders which operates separately as an autonomous unit, conducted the study. Over 80% of their work is for clients other than the NAHB and its members. Anderson said, "We're interested in anything that helps the building industry, verifying a new product or technique, and telling the industry about it."

Strength and flexibility set Duraflex pipe apart.

The real difference between polybutylene pipe and other plastic pipe is the Duraflex polybutylene resin. Duraflex is a durable, tough plastic. But unlike many other plastics, polybutylene is flexible rather than stiff or brittle. As a result, the pipe made from Duraflex resin can easily withstand household water pressures at elevated temperatures and its flexibility and light weight allow plumbers to curve it around obstacles and bends with fewer connections. Because it is chemically inert, there will be no problems with corrosion, electrolysis, or scale buildup.

Hila Anderson observed and recorded the plumber's actions and materials used.

Connections and fittings can be made by one of several mechanical methods which are easily learned and performed. Gary Peed, the plumbing contractor for the test houses, said, "The first time I put the pipe (polybutylene) in was slow, but you pick up how to work with it pretty easily. My time is much better now." Each of the installation methods takes advantage of the flexible nature of polybutylene to make quick, strong, and permanent connections. As Gary Peed puts it, "You don't have to solder anything or use any glue. There's less time, energy and equipment involved."

A durable pipe full of advantages.

How does Peed feel about polybutylene pipe in general? "I like it better than copper. It's easier, faster and it's lower in cost. I use it for almost all of my work now."

Other advantages to polybutylene pipe, both builders and plumbers cite: corrosion and scale resistance; self-insulating, thus energy efficient for hot water lines; and if water freezes in it, the pipe won't break.

Those were the reasons Don Crosen, Superintendent for R.J.L. Associates' Pleasant Valley subdivision, selected polybutylene pipe. Crosen has realized the cost savings which the NAHB Research Foundation tests revealed, stating:

"We're saving on the average of about $150 to $200 per house." Another big advantage Crosen cited… "is customer satisfaction. That's very important to us. We want our owners to be happy with the house they buy. This polybutylene pipe helps us supply that satisfaction."

Comparison Tests—Results:

Materials	Copper System	Polybutylene System
Pipe	$156.93	$64.84
Solder & Flux	$ 20.73	negligible
Fittings	$ 21.79	$19.12
Suspension Clamps	$ 1.98	$ 4.81
TOTALS	$201.43	$8[illegible]
Labor at $15/hr		
Cut & install pipe & fittings	(176.0 min.) $ 44.00	(146.5 min.) $36.63
Connect pipes & fittings	(162.5 min.) $ 40.62	(88.0 min.) $22.00
Misc.	(51.5 min.) $ 12.88	(53.5 min.) $13.37
Mounting Blocks	(41.5 min.) $ 10.37	(39.5 min.) $ 9.87
Set-up & Layout job	(28.0 min.) $ 7.00	(28.0 min.) $ 7.00
TOTALS	(459.5 minutes) $114.87	(355.5 minutes) $88.87
	Copper System	**Polybutylene System**
Total Costs Material & Labor for supply piping installation	$316.30	$177.64
Polybutylene Savings		
Time		104.0 minutes less to install than copper
Money (includes labor costs savings)		$138.66

Note: For each $1.00 wage rate differential increase above the $15/hour figure used in the comparison, polybutylene's advantage increases $1.73 in savings.

Test homes' subdivision superintendent, Don Crosen, cited customer satisfaction as a polybutylene pipe advantage.

Polybutylene pipe supplies customer satisfaction.

"One of the biggest complaints in a new house is noise in the plumbing," Crosen continued. "This pipe is quiet, no hammer, no vibration. You don't even hear water running. So polybutylene eliminates that source of complaints, and satisfies our customers."

Another problem solved by polybutylene pipe involves hanging the sheet rock. According to Crosen, occasionally a rigid pipe will get bumped hard enough during sheet rock installation to cause it to break, crack and leak. "Often that leak won't show up until after the construction is completed, or worse... after the owner moves in. That's an expensive repair. But because this polybutylene pipe is so flexible, it doesn't break if it gets bumped or knocked. So once again, customer satisfaction," he said.

Satisfaction for builders, too.

Crosen has found satisfaction with polybutylene pipe in many ways, summing up, "It's less expensive. Better for customers. Easier to install, repair and add extra fixtures to later. It won't corrode and minerals won't adhere to it. We get less call-backs for repairs because of polybutylene pipe. It's another way to please our customers."

Crosen added, "It's good for builders and supervisors, too. Supervisors have to deal with the problems. They're less problems with polybutylene pipe."

Come to Shell for answers

Warranty

Polybutylene pipe is manufactured from a material produced by Shell Chemical Company. All products purchased from Shell are subject to terms and conditions set out in the contract, order acknowledgement and/or bill of lading. Shell warrants only that its product will meet those specifications designated as such herein or in other publications. All other information supplied by Shell is considered accurate but is furnished upon the express condition that the customer shall make its own assessment to determine the product's suitability for a particular purpose. **No warranty is expressed or implied regarding such other information, the data upon which the same is based, or the results to be obtained from the use thereof; that any product shall be merchantable or fit for any particular purpose; or that the use of such other information or product will not infringe any patent.**

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September 1981

SC: 550-81
Printed in U.S.A. 9/81 50M

AN OLD IDEA WITH A NEW TECHNOLOGY

I Historical Background

Automatic sprinkler systems have enjoyed an enviable record of protecting life and property for over one hundred years. Statistics demonstrate there has never been any multiple loss of life in a fully sprinklered building when the system is properly supervised.

According to the National Fire Protection Association (NFPA), the only fatalities in fully sprinklered properties were caused by explosions or flash fires. Self immolation by a person who was too young, too old, too intoxicated or too handicapped in some other way to protect himself properly, has been the cause of death. Unfortunately, the closure of a water supply valve controlling the sprinkler system has rendered the system ineffective in some fire conditions.

During the mid 1970s, the National Commission on Fire Prevention and Control conducted exhaustive research in examining the fire problems in the United States. They published "America Burning" which concluded that this nation, a world leader in technological advancement, suffered from one of the highest death rates and injuries due to fire. As a result of the Commission's work, legislation was enacted in the Congress of the United States which created the U.S. Fire Administration. This Administration's objective was to reduce deaths from fire by 50% before the decade of the 1990s. Although large life loss fires, such as those occurring in hotels and motels, become national media events, statistics clearly show that the residential fire has been, and presently is, what we have characterized as the fire communities public enemy No. 1. From 1977 to 1981 the National Fire Protection Association (NFPA) reported that there was an average of 7,700 civilian fatalities attributed to fire. This would be comparable to having two 747's crash in midair each month. As one fire protection expert commented: "In the course of a normal lifetime, almost a half a million people will die in the United States from fire."

II A New Technology

In cooperation with the U.S. Fire Administration, Factory Mutual Research Corporation conducted a series of fire tests in 1978 in an effort to study current sprinkler technology and its application in residential type fire scenarios. The result of this research concluded that commercial/industrial type sprinkler devices were simply not adequate to protect the type of fire loading expected in residences. The commercial/industrial sprinklers were too slow in their operation and did not provide a high enough wetting pattern to cut off the perimeter fire which can be expected in homes. Additional test programs, funded by the U.S. Fire Administration, in cooperation with the National Fire Protection Association and Factory Mutual, were conducted. These tests substantiate the initial research at Factory Mutual and demonstrated, without question, the need for a sprinkler device