

December 4, 1970

MEMORANDUM FOR: THE PRESIDENT
FROM: PAT MOYNIHAN
SUBJECT: Suggested Reading Material

You asked for recommendations of "the ten best political biographies and histories." You may well have read half the list, but I think you would enjoy the others. I have confined the list to biographies -- in two instances autobiographies -- and have listed them chronologically.

John Adams, Autobiography, 1802

A somewhat uneven book, but to my mind the most interesting autobiography of any of your predecessors.

Lord Charnwood, Abraham Lincoln, 1917

For my money still the best volume on Lincoln.

✓ Henry Adams, The Education of Henry Adams, 1918

✓ I suppose this may be the great American book. Surely it is an astoundingly perceptive account of our times, written decades before they commenced.

Duff Cooper, Talleyrand, 1932

The great French diplomatist, viewed by an extraordinarily urbane and perceptive English diplomat.

David Cecil, Melbourne, 1939

I suppose this would be my favorite political biography. I gather it was John Kennedy's also.

Alan Bullock, Hitler, A Study in Tyranny, 1952

By far the best account.

John Morton Blum, The Republican Roosevelt, 1961

A brief but unusually rewarding summary of that life.

Clinton Rossiter, Alexander Hamilton and the Constitution, 1964

An account by a great conservative historian by our great conservative statesman.

Robert Blake, Disraeli, 1966

An even more distinguished English counterpart of Rossiter on Hamilton.

John Womack, Jr., Zapata and the Mexican Revolution, 1969

A new book by a powerful young historian who has managed at last to bring some order out of the chaos of the Mexican Revolution.

I have obtained a copy of each volume and have left them with Alex Butterfield.

DPM/crm

BOOKS RECEIVED FROM LIBRARY OF CONGRESS BY DR MOYNIHAN,
4 DEC 70 --- (TOTAL 28)

- ✓ "James K. Polk, Jacksonian" - 1795-1843, by Charles Grier Sellers, Jr. (Princeton, New Jersey, Princeton University Press, 1957)
- ✓ "Wilson, Campaigns for Progressivism and Peace" - 1916-1917, by Arthur S. Link (Princeton, New Jersey, Princeton Univ. Press, 1965)
- ✓ "Wilson, The New Freedom" by Arthur S. Link (Princeton, New Jersey, Princeton University Press, 1956)
- ✓ "Roosevelt: The Lion and The Fox" by James MacGregor Burns (Harcourt, Brace and Co., New York)
- ✓ "John Adams", II, 1784-1826, by Page Smith (Garden City, New York, Doubleday & Co., Inc., 1962)
- ✓ "Wilson: The Road to the White House," by Arthur S. Link (Princeton, New Jersey, Princeton University Press, 1947)
- ✓ "John Adams", I, 1735-1784, by Page Smith (Garden City, New York, Doubleday & Company, Inc. 1962)
- ✓ "Wilson: The Struggle for Neutrality", 1914-1915, by Arthur S. Link (Princeton, New Jersey, Princeton University Press, 1960)
- ✓ "Wilson: Confusions and Crises", 1915-1916, by Arthur S. Link (Princeton, New Jersey, Princeton Univ. Press, 1964)
- ✓ "Jefferson and Hamilton: The Struggle for Democracy in America" by Claude G. Bowers (Houghton Mifflin Co, Boston & New York)
- "Benjamin Franklin - His Contribution to the American Tradition" by I. Bernard Cohen (The Bobbs-Merrill Co., Inc.)
- ✓ "Fremont: Pathmarker of the West", by Allan Nevins (Longmans, Green & Co)
- X ✓ "Alexander Hamilton and the Constitution" by Clinton Rossiter (Harcourt, Brace, & World, Inc)
- ✓ "Poor Richard's Politicks" Benjamin Franklin and his new American Order, by Paul W. Conner (Oxford University Press, 1965)
- ✓ "John C. Calhoun - edited by Margaret L. Colt (Prentice-Hall, Inc., Englewood Cliffs, NJ)

- X ✓ "Disraeli" by Robert Blake (Oxford University Press, 1969)
- ✓ "Napoleon" by H. Butterfield (Great Lives); (Duckworth, 3 Henrietta Street, London, W.C.2, England)
- X ✓ "Hitler, a Study in Tyranny," by Alan Bullock (Harper & Brothers, NY)
- ✓ "The Age of Jackson" by Arthur M. Schlesinger, Jr. (Boston, Little, Brown & Co., 1946)
- ✓ "James K. Polk, Continentalist," 1843-1846, by Charles Sellers (Princeton University Press, 1966)
- ✓ "Battling for the Right," the life-story of Theodore Roosevelt, by Charles Morris
- ✓ "The Adams Papers," by L. H. Butterfield, Series I, Diaries (The Belknap Press of Harvard University Press, Cambridge, Mass., 1961)
- ✓ "Diary and Autobiography of John Adams," by L. H. Butterfield (Vol 3, Diary 1782-1804) (The Belknap Press of Harvard University Press, Cambridge, Mass., 1961)
- ✓ "Diary and Autobiography of John Adams," by L. H. Butterfield (Vol 2, Diary 1771-1781) (The Belknap Press of Harvard University Press, Cambridge)
- X ✓ "Zapata and the Mexican Revolution," by John Womack, Jr. (Alfred A. Knopf, 1969)
- X ✓ "Abraham Lincoln," by Lord Charnwood (Garden City Public, Co.)
- ✓ "Huey Long," by T. Harry Williams (Alfred A. Knopf, 1969)
- ✓ "The Adams Papers," by L. H. Butterfield, Series I, Diaries (Vol 1, Diary 1755-1770) (The Belknap Press of Harvard University Press, Cambridge, Mass., 1961)

For your information
Nell - I got these
Paul H. J.

THE WHITE HOUSE
WASHINGTON

NA 4
55

Here are the 10 books:

- (1) John Adams, Autobiography, 1802
- (2) Lord Charnwood, Abraham Lincoln, 1917
- (3) Henry Adams, The Education of Henry Adams, 1918
- (4) Duff Cooper, Talleyrand, 1932
- (5) David Cecil, Melbourne, 1939
- (6) Alan Bullock, Hitler, A Study in Tyranny, 1952
- (7) John Morton Blum, The Republican Roosevelt, 1961

THE WHITE HOUSE
WASHINGTON

- (8) Clinton Rossiter, Alexander Hamilton
and the Constitution, 1964
- (9) Robert Blake, Disraeli, 1966
- (10) John Womack, Zapata and the
Mexican Revolution, 1969

These are the books considered
by Mayruman to be the "ten best
biographies and histories."

A
Feb 5, 3:30p

THE CONSERVATION OF ENERGY FUELS THROUGH FULL INSULATION OF STRUCTURES

NATIONAL MINERAL WOOL INSULATION ASSOCIATION

Statement of Sheldon H. Cady, Executive Director

U. S. DEPARTMENT OF THE INTERIOR

July 7, 1970

will take the liberty of quoting a few of his conclusions in order to define the overall problem as it relates to our proposal. Mr. Dole's statement specifically expressed concern with the short-term and long-term supply of natural gas. Three of his conclusions which are immediately relevant are quoted below:

1) "Running out of gas is not the issue. There is plenty of gas to be found, but it will take an intensive improved exploration effort to find it, of the order of two or three times the level of investment we are currently sustaining. It will take at least six years for the results of this effort to be meaningful to consumers and it isn't

This is a typical house. It is typical because, according to current statistics, it is representative of the majority of homes that have been erected in recent years and are presently being erected in the United States. The house is typical in that it is a single family, one-story "ranch" with around 1400 square feet, with 3 bedrooms, 2 baths, and an attached garage. Of course, there are variations on the theme. One variation is in the type of foundation. It may have a full or partial basement, particularly in the Northeast or North Central regions, or it may be built over a crawl space or on a slab on ground, particularly in the Southern or Western regions. It may be fully insulated; it may be partially insulated, or it may have no insulation at all. It may be colonial in style, or contemporary, or reflect Spanish influences. Today, we are mainly concerned with its typicalness, and I will be referring to this typical house frequently in the presentation.

Typical houses contain one of several commonly used heating systems, each of which uses a common energy fuel -- oil, coal, gas or electricity. Our concern today is about the availability of energy fuels to maintain the health and comfort of the occupants of our typical house -- those already occupied and those to be built in the future.

The concern of the members of the National Mineral Wool Insulation Association, was prompted to action (1) after reading a statement by Mr. Hollis M. Dole, Assistant Secretary, Mineral Resources, Department of the Interior made before the Minerals, Materials, and Fuels subcommittee of the Senate Committee on Interior and Insular Affairs, last November. Because of the influence of Mr. Dole's statements on my presence here, I

(1) Appendix "A"

will take the liberty of quoting a few of his conclusions in order to define the overall problem as it relates to our proposal. Mr. Dole's statement specifically expressed concern with the short-term and long-term supply of natural gas. Three of his conclusions which are immediately relevant are quoted below:

- 1) "Running out of gas is not the issue. There is plenty of gas to be found, but it will take an intensive improved exploration effort to find it, of the order of two or three times the level of investment we are currently sustaining. It will take at least six years for the results of this effort to be meaningful to consumers and it isn't clear whether costs will be acceptable or will result in substitution of other fuels for gas."
- 2) "A serious supply problem will be fully upon us by 1975 if current trends persist and immediate corrective action is not taken."
- 3) "That supply problem would be evidenced in the inability of new prospective customers to get service, ----- However, existing customers will have adequate supplies of gas to meet their current needs."

To attempt to display charts, bar graphs and lengthy statistics to this audience to further illustrate current thinking about the future availability of energy in the United States would be presumptuous -- carrying coals to Newcastle. However, a few points should be emphasized.

We must be realistic in determining that the nation's tremendous needs for energy in the years ahead can be accommodated by taking all possible steps now to assure an adequate supply in the face of facts that are not at all reassuring. One reference indicates that the United States will require 75 per cent more energy before 1980 --- more coal, more natural gas, more oil, and more power from nuclear sources. Can we be certain that the domestic supply of energy will be sufficient to meet the needs of our society? This is in serious doubt and poses a problem of such importance to the nation that all citizens should participate in its solution.

From the profusion of newspaper headlines that have appeared in recent months; from the publications that have been issued from both public and private sources; and from statements of the type that Mr. Dole made last

November, it is evident that the problem is recognized. It is also evident, to paraphrase a sentence from a Department of the Interior survey entitled "United States Petroleum Through 1980", that barring demonstrable evidence that the petroleum industry is taking steps to solve the problem, it then becomes not only appropriate but essential to consider what remedial measures offer the best promise of meeting the national objective of a secure, adequate low-cost supply of fossil fuels.

We are representing the insulation industry today to propose remedial measures to conserve sources of energy in the critical times ahead. These measures are practical and attainable at nominal cost. A tremendous amount of energy fuel is being wasted because of inadequate insulation. Therefore, we propose

- 1) that requirements for the insulation of all structures be increased -- new dwelling units, their support facilities, business institutions, commercial buildings ----- all buildings;
- 2) that owners of existing dwelling units be encouraged to insulate, or to increase the amounts of insulation already in place; and
- 3) that existing and future buildings erected by the Federal Government be better insulated

with the end result of conserving up to 50 per cent of the nation's supplies of energy fuels used for heating and cooling.

There are those in the Department of the Interior who will recognize that these proposals are not new. It was with the coming of World War II that the American public was advised of the advantages of insulation by the United States Government. Fuel had to be conserved at that time mainly because of fuel transportation problems and the Government took steps to launch a vigorous campaign to encourage the use of insulation.

The War Production Board set a heat loss limitation of 66 Btu per square foot of floor area on all new residential construction --- the nation's first legislated requirement for insulation.

U. S. GOVERNMENT MESSAGE FROM OFFICE OF WAR INFORMATION



HOW TO KEEP WARM WITH LESS FUEL THIS WINTER

"Winterproof" your home now to prevent heat loss...

- 1. Insulate walls and ceilings**
- 2. Weatherstrip windows...caulk cracks**
- 3. Order storm sash early**
- 4. Have your furnace checked for burning efficiency**

***ACT NOW...WHILE MEN AND
MATERIALS ARE AVAILABLE***

U. S. GOVERNMENT MESSAGE FROM OFFICE OF WAR INFORMATION

The FHA extended its insurance terms to encourage insulation. Limitations on expenditures were removed for insulating; for the installation of weatherstripping and caulking; and for the installation of storm windows.

And the Office of War Information scheduled a government-sponsored fuel conservation drive on the radio assisted by such old friends as Kate Smith, Vic and Sade and John B. Kennedy.

The insulation industry responded by active participation in the program with a series of national information meetings, and the distribution of flyers, literature, and posters such as this one, made available by the Office of War Information.

- In April 1941, September 1942, and October 1946, the Bureau of Mines issued Information Circulars variously titled "Home Insulation -- An Effective Conservation and
- (2) National Defense Measure"; "Home Insulation with Mineral
 - (3) Products -- Conservation of Fuel for War", and "Home Insulation with Mineral Products -- Conserves Fuel,
 - (4) Reduces Costs, Increases Comfort".

In 1946 Mr. Oliver Bowles introduced the Information Circular as follows: "The conservation of fuel became a critical problem during the recent war, particularly in the East. Fuel-oil supplies were short, the demands for coal increased, and householders were called upon to reduce the temperatures in their homes. Homeowners were urged to employ every means available to reduce fuel consumption, the most important of which was to insulate their dwellings. The Bureau of Mines, United States Department of the Interior, took steps to promote the conservation of fuel by issuing a report on home insulation which has been widely circulated. The American populace responded patriotically to the requests of various government agencies for voluntary conservation of fuels; they accepted cheerfully the restrictions imposed; the crisis was weathered and with termination of hostilities, the unhappy situation was relieved."

"Fuel conservation, however, is not merely a war emergency problem; it is a continuous, ever-present issue. Coal and petroleum resources are irreplaceable assets, and when fuel

- (2) Appendix "B"
- (3) Appendix "C"
- (4) Appendix "D"

**"A LONG STEP IN THE DIRECTION OF FUEL
CONSERVATION IS THE GENERAL RECOGNITION
THAT INSULATION IS AN ESSENTIAL
ELEMENT OF DWELLING CONSTRUCTION."**

I.C. 7388, United States Department of the Interior
HOME INSULATION WITH MINERAL PRODUCTS
conserves fuel – reduces costs – increases comfort

(2) Appendix "B"
(3) Appendix "C"
(4) Appendix "D"

is burned it is exhausted -- there is no scrap recovery. Fortunately, the United States has been richly endowed with mineral fuels, but population is growing, industrial demands for fuel are increasing, and mines and oil wells are becoming deeper and more costly to operate. For the sake of generations to come, all national resources, particularly irreplaceable fuels, should be conserved."

"A long step in the direction of fuel conservation is the general recognition that insulation is an essential element of dwelling construction. Fortunately, when the homeowner takes measures to conserve fuel, he is not called upon to make purely unselfish sacrifices to advance the general welfare; he has the added incentives of saving money and promoting more comfortable living in his own home." Those prophetic sentences were written by Mr. Bowles twenty-four years ago and are as valid today as they were then.

May I repeat one sentence in Mr. Bowles' statement: "A long step in the direction of fuel conservation is the general recognition that insulation is an essential element of dwelling construction."

Although I am speaking as a representative of the National Mineral Wool Insulation Association, I am not referring to mineral wool alone when using the term "insulation". There are several major products on the market which have high resistance to heat transmission. These include mineral wool; insulating boards; perlite; vermiculite; aluminum foil; cellulose products; and plastic products such as polyurethane and polystyrene. These products, properly installed, will be effective in varying degrees.

Let us now compare the differences in fuel usages; in an uninsulated house; a house with current Federal requirements for insulation; and a fully insulated house.

I will return to our friend, the "typical house", to illustrate this.

While the "typical house" may be located in Maine, Alabama, Ohio or Montana, it would be beyond the scope of this talk to attempt to define its specific relationship to the many varied climates in the United States. So I have chosen to locate the house in a climate which can be considered average concerning the factors related to the design of heating and cooling equipment and of insulation.

Cities in this average climate include New York; Pittsburgh; Cincinnati; Indianapolis, Dodge City; Topeka; and cities in the Pacific Northwest. Each of these cities has an average of 5000 Degree Days, a measure of the climate used in determining fuel requirements and the cost of heating.

Since natural gas is the most publicized of the fossil fuels in relation to potential shortages, and for the purpose of simplicity, I will use natural gas only in making this analysis of different insulation levels.

The insulation used in determining these figures was mineral wool. The amount of insulation recommended is stated in the form of "R" values. "R", or resistance, values are a measure of the resistance to heat flow through a material. The "R" value for an insulation product clearly shows the heat-stopping ability of the product. The greater the "R" number, the greater

(5) the insulation value.

This "R" value labeling is required by Federal Specification HH-I-521D, in which three R-values: R-7, R-11, and R-19 are specified.

(6)

The uninsulated house, located in the cities shown on the map, will lose approximately 110 thousand Btu/h through the walls, ceilings, and floors. In other words, 110 thousand Btu's per hour must be supplied by the gas heating system. I will convert this figure to an annual basis by referring to quantities in cubic feet. This uninsulated house requires 272 thousand cubic feet per year to heat and it would cost the homeowner about \$423 per year to maintain a 70°F interior temperature during the average heating season. Keep in mind that much of the interior space never attains the 70°F temperature level due to heat loss.

(7)

(8)

If this house were insulated according to current FHA Minimum Property Requirements, as normally enforced by Field Offices, insulation with an R-7 value would be installed in the ceiling, and storm doors and windows would make the glass areas more effective against the penetration of cold. This unquestionably helps -- 180 thousand cubic feet are now required to maintain a 70°F interior temperature, and the heating cost is reduced to \$279. However, comfort has not been achieved, as I will demonstrate later.

- (5) Appendix "E"
- (6) Appendix "F"
- (7) Appendix "G"
- (8) Appendix "H"

Now, raise the standards of insulation and reduce the present FHA limitations of heat loss from 50 Btuh to 36 Btuh per square foot of floor area and the story changes. The house will have insulation with an R value of 19 in the ceilings and R-11 in the walls and floors. 122 thousand cubic feet are all that are required to heat this house at a cost of \$189 per heating season. Compared with the fuel required to heat the uninsulated house, the properly insulated "typical house" has reduced the amount of fuel 45%. Compared with the fuel required to heat the "typical house" with minimum FHA standards, the properly insulated house has reduced the amount of fuel 23%. The occupants will now be comfortable at all times and the effect on the national consumption of natural gas and on the national economy will begin to show.

- (9) Using Secretary Romney's and Congress's projected goal of 26 million housing units for the fiscal decade 1969-1980 as a reference point, we find that 2,000,000 units are projected by HUD for the fiscal year 1971. 545,000 of these are 1-4 family units in the category of "unsubsidized conventional starts". Based on other government statistics, 94% of these 1-4 family units, or 512,000, will be new one-family houses and, assuming that natural gas will represent 69% of the heating market, we are talking about 353,000 units which we assume will be roughly equal to the "typical house", heated (and cooled) with natural gas.

Uninsulated, using natural gas as the fuel, this house uses 272 thousand cubic feet in a year. If all 353 thousand houses were uninsulated, a total of 96 billion cubic feet of natural gas would be needed to heat these houses per year.

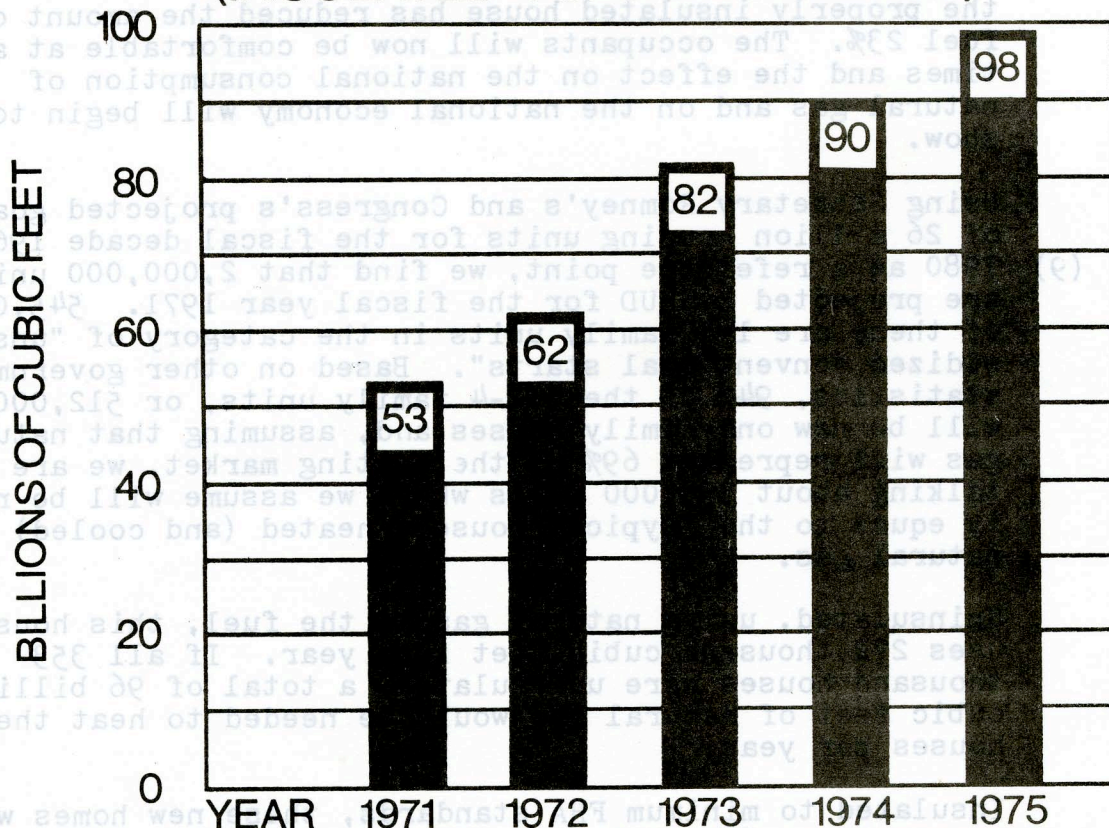
Insulated to minimum FHA standards, these new homes will consume over 63 billion cubic feet of gas per year.

If the standard of insulation of these new houses were raised, and if heat loss limits of 36 BTUH per square foot of floor area were applied, these 353,000 new typical houses could be heated and cooled by about 43 billion cubic feet of gas per year.

We would doubt very seriously if the average typical house is constructed to meet even minimum FHA insulation standards. Even if they were, improved insulation in all new typical homes built in 1970 would conserve 33 billion cubic feet of gas per year.

- (9) Appendix "I"

PROJECTED ANNUAL SAVINGS (INSULATED VS. UNINSULATED)



TOTAL FIVE-YEAR SAVINGS

385 BILLION CUBIC FEET

TOTAL 1-4 FAM.UNITS (M)
BASED ON HUD PROJECTION

545 634 790 927 1007

TOTAL 1-FAM.UNITS (M)
HEATED BY NATURAL GAS

353 411 547 601 653

If, in 1971, 353,000 new typical houses, heated and cooled by gas will be properly insulated, we would be conserving 53 billion cubic feet of natural gas.

We should vigorously undertake a program of insisting on better insulation standards on all new typical houses built. If we act now, a minimum of 385 billion cubic feet of gas can be conserved within the five year period from 1971 to 1975.

Mr. Dole has stated that the annual increase in demand for natural gas is estimated to be one trillion cubic feet per year through 1975. The savings in natural gas, by proper insulation of our typical new houses, of 53 billion cubic feet represents 5 per cent of the total increase. This 5 per cent savings is attainable. It is also a beginning. And it would provide impetus to other savings.

It is important to remember that this 5% figure represents fuel savings in only about one-quarter of the new housing projected for the year 1971. New multi-family housing projects --- from low-cost government-sponsored housing developments to luxury high-rise apartments --- should have similar high standards of insulation applied to them, and proportionate savings of natural gas will result.

The 2 million homes projected for 1971 include unsubsidized multi-family; subsidized units, both rented and owner-occupied; urban renewals, rehabilitated houses, and mobile homes --- in total almost 1.5 million additional units. There is no reason to believe that, at a minimum, these should not contribute an additional 10 per cent reduction in total natural gas consumption, if they are required to meet adequate insulation standards. Concurrently with this residential construction, supporting facilities will be erected -- individual stores, shopping centers, light commercial buildings, theaters, schools, hospitals, motels, and the like. These must be added to the list of buildings which can either waste or conserve natural gas, depending upon their insulation levels.

It is estimated that only 50% of all existing housing in the United States has some degree of insulation. It is relatively easy and relatively inexpensive to insulate an existing house or to reinsulate an inade-

SAFEGUARD FACILITY; Project Office Building

SPECIFIED

"U"

PROPOSED

.07

Ceilings

.045

.17

Sidewalls

.08

SAVINGS—5 YEAR LIFE

Fuel --- 74,405 gallons = \$24,500

quately insulated house. Gas utilities reported a total of over 32 million gas-heated housing units in 1968 which consumed a total of 4.5 trillion cubic feet. By insulating the one-quarter of these 32 million units assumed to be heated by natural gas and uninsulated, and by upgrading an estimated one-quarter assumed to be inadequately insulated, a total additional savings of 1.2 trillion cubic feet is possible. Assuming that this could be accomplished in 10 years, this would represent a savings of 120 billion cubic feet in the first year and 1.2 trillion cubic feet when completed. In terms of the 1 trillion cubic feet annual increase in demand mentioned by Mr. Dole, a savings of 120 billion cubic feet could reduce the anticipated growth by an additional 12 per cent.

Therefore, within the next few years, it is possible to expect conservation of at least 273 billion cubic feet per year by applying higher standards of insulation to existing and new dwelling units and their support facilities.

I mentioned earlier the need to include buildings and housing owned and erected by the Federal Government, as an additional and important factor to be considered in the conservation of energy fuels. This factor has not been included in the 27% savings shown on the slide.

One current job should illustrate the potential in this area. There is a new Safeguard Facility being completed, northwest of Grand Forks, North Dakota. The unit I am discussing is the project office building, with a specified 5-year life expectancy. The design temperature in this location is -30 F. The specifications, which are within current Department of Defense criteria, called for U-values of .07 for the ceilings and .17 for the sidewalls. (A "U" value is a measure of heat transmission through an entire building section. The lower the "U", the more effective the section in resisting the passage of heat). A "U" of .07 for ceilings is fair for the area in question. A "U" of .17 for sidewalls is poor for most areas of the country and terrible for an area with a design temperature of -30 F. The building built as specified would lose 688,000 Btuh through the walls and ceilings.

With enough additional insulation to reduce the "U" for ceilings to .045 and the "U" for sidewalls to .08, the heat loss would be reduced to 346,000 Btuh, a savings of almost 50 per cent, or 342,000 Btuh. Most important, the expenditure of propane gas specified as the fuel, would be reduced from 6.88 gals. per hour to 3.46 gals. per hour at a savings of 74,400 gallons of fuel and a dollar savings of \$24,500 in fuel at 33¢ per gallon over the five-year life of the building or a dollar savings of \$4,900 each year. The cost? The additional cost of insulation, is estimated to be about \$2,100, giving a pay-out of less than six months.

In our experience with government buildings, we have found that, when they are built at the lowest bid, and when items have to be cut, insulation is one of the first items to go. (This is not intended as criticism -- it is a fact of life). Designers, contractors, budget directors, are too often influenced by a first-cost base, not a 5-year or 10-year life base. Some strong education in this area is necessary.

At this point in my statistical oration it is appropriate for me to sum up the potential savings in natural gas that we anticipate can be accomplished with proper insulation. While I can pinpoint with some accuracy anticipated savings in the construction of new one-family houses, multi-family units and the insulation or re-insulation of existing gas-heated houses, arriving at an estimated annual savings of 27 per cent, only an educated guess can be made regarding the support facilities for housing, other light construction, and existing and new governmental construction. It is our belief that between one-third and one-half trillion cubic feet of natural gas can be conserved in each of the next ten years by a program endorsing and enforcing proper insulation of all these structures. This savings could in effect reduce by up to 50 per cent the one trillion cubic feet annual increase in demand for natural gas projected by Mr. Dole.

Proportionately impressive savings are equally valid for fuel oil and coal, neither of which has been specifically considered in this study.

We have proposed, then, one important practical remedial measure that can contribute to the promise of meeting the national objective of a secure, adequate low-cost supply of oil and gas. Implementing this remedial measure will also provide extra dividends to the nation's

residents and, on a broad scale, to the nation itself. For the owner and occupant, proper insulation will provide:

1) Savings in operating costs

It costs around \$200 to install adequate insulation in the typical house over and above that required by FHA Minimum Property Requirements. But, the difference in insulating ability of a typical house located in the cities I have shown previously could save the homeowner over \$2,000 towards payments over the term of a 25-year mortgage. The extra cost of full insulation is offset by a reduction in the sizing of the original heating plant capacity. If the house is to be air-conditioned and is fully insulated, a smaller unit can be installed. The saving in original equipment cost pays for the insulation.

In rental units, savings in first costs and in operating costs of heating and cooling equipment could be passed on to the tenant in the form of lower rentals or by the addition of labor-saving devices or decorative devices which would make the apartment unit more desirable.

2) Improved health and comfort of the occupants is a second advantage. This can best be explained by a brief description of how insulation works.

This is a section through a "typical house", or through any wood-framed building, for that matter. The section illustrated is not insulated. In winter, when the interior is heated to 70°F and the outside temperature is 0°F, heat will escape rapidly through the uninsulated walls, floors, and ceilings.

Heat is transferred through the walls so rapidly that the inner surface of the exterior wall will never be warmer than 59°. Since the human body loses heat by radiation, a person sitting or standing near a 59° wall will be uncomfortably cold. He will move his chair at least 3 feet towards the center of the room, away from the cold wall.

The living room of the typical house is 14' x 22', with two exterior walls. In winter, instead of the 308 square feet of wide open living area boasted by the typical house, the space will shrink to 203

ADDITIONAL ADVANTAGES TO OWNER AND TENANTS

1. SAVINGS IN OPERATING COSTS
2. IMPROVED HEALTH AND COMFORT
3. GREATER UTILIZATION OF SPACE
4. NOISE REDUCTION
5. FIRESTOPPING

square feet of usable comfortable living area, and even this limited space will not really be comfortable.

Heat will still be escaping through the walls, ceiling and floor and, in addition, warm air touching the 59° walls will be cooled and drop to the floor. It displaces warm air at the floor level which rises, is deflected by the ceiling to the wall again, and results in a continuous draft.

If this house were insulated according to current FHA Minimum Property Requirements, insulation with a resistance, or R value of 7 would be installed in the ceiling, and storm doors and windows would make the glass areas more effective against the penetration of cold. It is obvious that the cold walls and floors, with their resulting discomfort from drafts, would remain, although the total amount of heat lost by the house would be reduced. Even this reduction may not be totally effective. If the occupant is still uncomfortable he will raise the thermostat by several degrees. 3 per cent more fuel is used for each degree of temperature that the thermostat is raised!

Adequately insulate the walls, floors, and ceilings and the comfort story is entirely different. The interior surface of a fully insulated wall will remain at about 69°, perfectly comfortable to sit next to. The living room will be a livable space of 308 square feet as originally intended. Floors will be warm. Drafts will disappear. And the heat loss through all sections will be substantially reduced with savings to the owner in operating costs for both heating and cooling.

An air-conditioned house will receive similar advantages where adequate insulation will keep the heat out, in this case, permitting reduction in the sizing of original air-conditioning equipment and resulting economies to the owner.

Having established an understanding of the advantages obtained through adequate insulation -- increased comfort, a healthier climate for the family, and savings in first costs of both heating and cooling

ADDITIONAL ADVANTAGES NATIONALLY

- 1. REDUCE AIR POLLUTION**
- 2. CONTRIBUTE TO CONTROL
OF INFLATION**
- 3. PROVIDE BENEFITS TO FUEL
DISTRIBUTORS**
- 4. INCREASE EMPLOYMENT OF
SEMI-SKILLED LABOR**
- 5. REDUCTION OF PROBLEMS FROM
BROWN-OUTS AND GAS CURTAILMENTS**

equipment as well as in operating costs, let us continue with the remaining advantages that proper insulation will provide for the owner and occupant.

3) Greater utilization of space

Today's small houses demand that effective use of floor areas must include the whole house. We can't afford to waste space near uninsulated walls. Adequate insulation will permit the occupant to be comfortable wherever he is in every room.

4) Noise Reduction

An insulated wall reduces sound transmission, a very desirable factor in crowded developments.

5) Firestopping

Empty stud spaces in walls can serve as flues, rapidly spreading a fire. Many instances are documented in which walls insulated with mineral wool have effectively retarded the spread of fire and in which insulated ceilings have prevented roof or attic fires from penetrating the rooms below.

On a national scale, an insulation program resulting in the reduction of fuel consumed will also:

1) Reduce Air Pollution

The fumes, sulphur, nitrous oxides -- and other pollutants introduced into the air from the burning of fuel, will be reduced as the quantity of fuel is reduced.

2) Contribute to the control of inflation

At an average cost for full insulation of around \$200 per house (around one per cent of the cost of the typical house) and proportionately low costs for larger residential and commercial structures, there should be no large capital investment required on a national level that could contribute to inflation. And I have already cited instances of how the dollars

invested in insulation will stretch the income and the return on investment of the building owner, whether small or large, public or private.

3) Provide benefits to fuel distributors

Transmission facilities, including existing utility lines, would be stretched by 30-40%. The capital investment needed for processing and distribution would be reduced. The supply problem predicted by Mr. Dole relative to service for new customers, then, would be alleviated. And, while actual gas consumed would be reduced per unit, descending rate structures per cubic foot of fuel would permit a given amount of fuel to be sold to more customers.

4) Increase employment of semi-skilled labor

It is relatively easy for an insulation contractor to train men to install insulation. Expanded requirements for insulation would require many additional men for both manufacturing and installing insulation, thereby reducing the unemployment rate.

5) Reduction of problems from brown-outs and gas curtailments

On a short-term basis, consider the effect of air-conditioning on the electric load in a typical city. Ten thousand houses that are fully insulated will make a considerable difference in loads at peaks. The energy and fuel required to keep ten thousand inadequately insulated houses air-conditioned at a peak will be substantially greater than that required to keep an equal number of well insulated houses air-conditioned. The threat of brown-outs and black-outs can be reduced.

Areas and industries can be hurt economically by plant shut-downs as a result of fuel curtailments and brown-outs, as many wage earners whose incomes are derived from facilities dependent on gas for energy can attest. The threat to industries of a shortage of energy was covered in considerable detail in an article entitled "Power Crisis" in the June 2nd issue of the Wall Street Journal.

Gentlemen, we all must agree that the need for action is immediate. The shortage in the short-term and long-term supply of energy fuels is no longer potential. It is in existence right now.

Adequately insulated buildings can reduce the consumption of natural gas by one-third to one-half trillion cubic feet per year. We believe that this is one practical remedial measure that will not only stretch available supplies but will, at the same time, provide the other benefits outlined previously for our nation and its citizens.

We propose that the following action be considered:

- 1) Initiation of a nationwide program to publicize the value of insulation in both new and existing buildings.
- 2) Inclusion of all related industries towards this same goal -- manufacturers and installers of heating and cooling equipment; insulating glass; storm doors and windows; weatherstripping; utilities and distributors supplying energy fuels; and insulation manufacturers.
- 3) Initiation of action to speed up the raising of existing insulation standards established and controlled by agencies of the Federal Government.
- 4) And, finally, the assistance of each one of you in contacting other federal departments and agencies and urging co-operative action from each.

The mineral wool industry has, or can attain, at no cost to the Government, the capacity to meet the demand for mineral wool brought about by higher standards -- a happy combination of good business and ability to serve the needs of the people. Our industry stands ready, with all of our resources, to assist you in this enterprise. Thank you.

APPENDIX "A"

STATEMENT OF HOLLIS M. DOLE, ASSISTANT SECRETARY, MINERAL RESOURCES, DEPARTMENT OF THE INTERIOR BEFORE THE SUBCOMMITTEE ON MINERALS, MATERIALS AND FUELS OF THE SENATE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS ON NOVEMBER 12, 1969

To get over some familiar ground quickly and to fix the Department of the Interior's place in the scheme of things, let me review briefly some of the basic principles and objectives that apply to our Department's role in the energy field as we see them.

Our fundamental national objective regarding energy--not just natural gas, but energy--is to have an assured supply of it, in the forms required, and in adequate amounts for the Nation's peacetime growth and wartime strength. Moreover, that energy ought to be available at the lowest cost consistent with other national objectives, such as security, adequacy, and protection of the environment.

As the chief steward of the Nation's public lands and natural resources, the Department of the Interior has a number of responsibilities relating to oil and gas.

The Department's broad responsibility is the general task of promoting the availability of adequate and low cost domestic supplies of liquid and gaseous fuels wherever they may be found in the United States. This we do by devising and improving tools and techniques for finding and evaluating new mineral fuel resources; developing more efficient methods for extracting and using fuel resources in ways which maintain the quality of the air, water, and other elements of the environment; expanding our general knowledge of the oil and gas resource potentials of both onshore and offshore areas; and developing synthetic and substitute fuels for naturally occurring oil and gas from the large deposits of coal and oil shale in the United States.

Another Departmental responsibility is the proper management of the energy resources that are found on the public lands of the United States and the Outer Continental Shelf. Specifically, we must provide fair and timely access to publicly-owned petroleum resources at prices which fairly reflect their value. We must also insure that proper conservation rules are practiced that prevent waste during their development or extraction and which prevent damage to the environment and other resources.

The Department also has the responsibility for the administration of the mandatory oil import control program.

Next come the tools which have to do with gathering, organizing, and analyzing basic economic and technical data on energy fuels, and making the results available to the

APPENDIX "A"

public sector for its use. The Bureau of Mines collects and publishes a vast amount of economic data on both oil and natural gas. It conducts much technical research on these two resources and makes the results available to the public. In its field, the Geological Survey conducts a continuing program of geologic mapping and related studies of rock formations and minerals and fluids they contain. These investigations provide a great amount of data in the form of published reports on the nature and environment of oil and gas accumulations throughout the country. The Bureau of Land Management utilizes the scientific tools developed by its sister agencies in its economic analyses and leasing policy studies for the purpose of developing leasing policies and practices that create a favorable climate for mineral development.

Before proceeding further, I would like to define the gas supply problem which concerns us.

THE PROBLEM

There are two components of the prospective gas supply situation, a short-term component and a longer-term component. Over the short run, the natural gas demand and supply situation already has produced some local deficiencies for certain types of new service and will result in general deficiencies of gas for certain new service around 1972. Those deficiencies will affect prospective new customers for industrial-type, lower cost service presently and in the future, but most probably will not result in cutbacks in service to existing customers for their present needs and normal increases in their demands.

The longer-term component of the problem is that serious deficiencies of natural gas supplies will develop after 1975 if current demand trends persist and immediate corrective action is not taken. The lack of supply could produce such results as cutbacks in existing service to industrial customers, denial of new service and similar results. In short, the longer term problem is one of demand exceeding the available supply of gas at present prices.

Short Term (present to 1975):

As a result of publicity alleging that a major shortage of gas might occur this winter and that some customers could be denied gas service, the Office of Oil and Gas requested that the Emergency Advisory Committee for Natural Gas (EACNG) assist it in making an authoritative assessment of the immediate outlook for gas supply. The emergency Advisory Committee for Natural Gas is a thirty-member group of top-level officials of the gas transmission and distribution industries formed in 1962 to advise the Secretary of the Interior on measures to assure continuity of gas supply in a natural emergency.

At a meeting held in Washington, D.C., on September 29, 1969, a subcommittee of EACNG advised the Office of Oil and Gas that it saw no gas shortage in prospect for the coming winter season. At the same time, it warned that a serious deficiency in gas supply is developing over the longer term, unless early and positive action is taken. The specific conclusions reached by the group were:

1. Gas supply in the United States will be adequate for all uses over the coming winter heating season.
2. Preliminary indications for next year's heating season (1970-71) are that there will be no shortage, although a firm conclusion cannot be reached at this time. A meeting will be held early next year to obtain a more complete assessment of the outlook at that time.
3. A serious supply problem does exist with respect to the mid-range and long-range outlook, and action must be taken now if adequate gas supplies are to be available to meet the growth in demand during this period.

A few days after the EACNG Subcommittee reported its conclusions, the FPC released its Staff Report on National Gas Supply and Demand. The two reports, developed by entirely separate groups, reached substantially the same conclusions as to the outlook for natural gas supply.

Long Term (after 1975):

Nearly one-third of the total United States energy needs is now provided by natural gas. The demand has increased at an average annual rate of 6.9% over the past twenty years, whereas total energy demand has only increased an average of 3.1%. There is a consumer preference for natural gas because of its cleanliness and adaptability. In its use is also encouraged by environmental control policies. It is only reasonable to assume that in view of increasing concern with environmental conditions, such as air pollution, the demand for natural gas will continue to be high. Many forecasts have been made projecting future demand for natural gas. Even though these projections may vary over the long range, the forecasters are in general agreement that the annual increase in demand through 1975 will be about one trillion cubic feet per year.

If new reserves are to be added each year sufficient to offset production through 1975 and to prevent the reserves-to-production ratio from declining below its present level of 14.8 to 1, then an average of 38 trillion cubic feet must be added annually to proved reserves during the period. If new reserves are to be added sufficient only to offset production, then an

average of 23 trillion cubic feet must be added annually. In this case, the R/P ratio will decline to less than 11 to 1 by the end of 1975. The industry has never added as much as 25 trillion cubic feet to proved reserves in any year. The annual average for the past five years is 19.5 trillion cubic feet and an immediate expansion of effort would be required to develop as much as 25 trillion cubic feet of new reserves. Only 13.8 trillion cubic feet were added in 1968.

It should be noted that natural gas historically has been developed and produced as a byproduct of oil development. Because of disparate rates of growth (2 1/2 - 3% for oil and 6% for natural gas) this byproduct relationship is at an end, and in the future natural gas will have to bear the full cost of its finding and development.

The issue is not that gas supply will falter and then begin a decline within the next decade; it is simply that it cannot grow fast enough under present conditions to satisfy the demands of new customers, who will have to turn elsewhere to satisfy their needs.

At present, no one knows the dimensions of the costs that gas will have to bear as it becomes the principal objective of exploration, but it is clear that these costs will be substantially higher than those that have led to the current price structure.

The supply problem can be influenced by an intensive exploration program and other immediate actions, but it must be remembered, though, that the period from the beginning of natural gas exploration to the time when gas is available to the customer is usually about six years. As I have noted, our projections for the longer term component of the supply problem are based in part on and assume continuation of recent natural gas supply trends which I would like to discuss next.

Recent Natural Gas Supply Trends 1958 - 68

All oil wells contain gas, and any diminution in efforts to find oil will adversely affect the discovery of new gas reserves, not only because of the decline in discovery of gas associated with oil, but also by the decline in the random discovery of non-associated gas fields by operators who are really searching for oil. The drop-off in the gas-well exploratory effort that began in 1963 has had its effect on additions to proved reserves, which for the first time in history fell below withdrawals in 1968. The result was a net decline in proved reserves of natural gas of 5.5 trillion cubic feet. While the sharp decline in reserves added from 21.8 trillion cu. ft. in 1967 to 13.8 trillion cu. ft. in 1968 may have been the happenstance of a bad year, it is no less true that the number of exploratory wells competed as gas producers in 1968 was the

lowest since 1950. Thus, while production increased by 70 percent during the ten years, 1958-68, proved reserves increased by less than 14 percent, with the drop in the reserves to production ratio mentioned earlier.

The first half drilling statistics for 1969 reveal some interesting possibilities, but there is not enough substance to it yet to point to any meaningful conclusion. What we see is an eleven percent increase in both new field wildcat wells and total exploratory drilling. If it holds up, this will be the best gain in exploratory effort since the slide began in 1956. Moreover, the number of new gas fields found increased by 45 percent over the same period. In contrast, the number of new oil fields found was the same as last year. The trouble is that we do not know, and won't know for a year or two, just how big these new gas discoveries are. It should be understood that the problem is not simply a resource shortage, though, as I want to indicate next.

Potential Natural Gas Reserves

At the present time it is estimated that about 350 trillion cubic feet of natural gas has been produced. Present proved reserves are estimated at about 287 trillion cubic feet. Thus, roughly 650 trillion cubic feet of gas in the United States have been discovered and proved.

To estimate the volume of recoverable natural gas remaining in the ground but not yet identified requires both geological knowledge and intuition. The U.S. Geological Survey places the amount of such gas resources recoverable under current technology at about 2,100 trillion cubic feet. The industry's Potential Gas Committee places the figure at 1.227 trillion cubic feet, subdivided as follows:

Potential reserves:

Probable.....	260 trillion cubic feet
Possible.....	335 trillion cubic feet
Speculative.....	632 trillion cubic feet
Total.....	1,227 trillion cubic feet

The probable reserves are included in extensions to known fields. Possible reserves are those contained in structures not yet drilled but located in known producing basins. Speculative reserves are attributed to those basins in which sedimentary rocks occur but which have no prior productive history.

These data indicate that there are large additional supplies of gas which can be discovered and developed given an economic price. Next, I would like to respond for the Department of the Interior to the Chairman's statement in his October 25, 1969, letter that the primary purpose of these hearings

is to ascertain what steps the Congress and other branches of the Federal Government can take to prevent the threatened shortages from occurring.

Management of Federal Lands

The Department of the Interior has management responsibilities for more than 700 million acres of onshore lands and the submerged lands of the Outer Continental Shelf in addition. That the Department of the Interior has encouraged exploration for gas on Federal and OCS lands is confirmed by rising percentage of total domestic production from Federal lands. In 1960, 6.4% of the total domestic gas production was from onshore Federal lands and only about 1% from the OCS. In 1968, 5.6% of the total domestic gas production was from onshore Federal lands and 7.9% from the OCS. Although gas production from onshore lands remains stable, exploration continues and additional gas discoveries are expected. But the Outer Continental Shelf of the United States offers the greatest potential for significant increase in gas reserves.

The department of the Interior not only encourages and supports the expansion of oil and gas exploration and development in known producing provinces of the Outer Continental Shelf but is taking action to identify the possibilities for extending exploration activities into nonproducing provinces. The Departments' OCS leasing policy has been under almost continuous review for the past several years. The Department will continue its studies, institute new ones, and give continuing careful consideration to alternate leasing policies.

The results of OCS developments to date are that 539 leases on the OCS in the Gulf of Mexico have been proven productive of oil or gas. 151 leases have been proven productive of gas but are currently shut-in. 121 are shut-in under approved suspensions of production. It is noteworthy, that of the leases on which production is shut-in, about 3/4 are more than 6 miles from an existing pipeline terminal.

A drainage sale of approximately 96,000 acres has been announced for offshore Louisiana to be held on December 16. Many of the tracts offered offset gas discoveries. Another drainage sale in the same area is planned for early next year and will also include tracts for additional gas development. A general sale off the western half of Louisiana is scheduled for the first half of 1970. This area is known for extensive gas resources which, hopefully, will be converted into substantial recoverable reserves.

However, we cannot put our full faith in the simple provision of incentives for increased production of natural gas. We must look to alternative sources to which I will refer in a moment, including imported LNG and synthesis gas, as a matter of high national priority.

Alaskan Gas

It now is obvious that Alaska has large gas resources. Beginning this year, in addition to supplying Anchorage, the gas production in the Cook Inlet area will be liquified and transported to Japan by ship. On the North Slope of Alaska, DeGolyer and MacNaughton, a consulting firm, estimates that the Prudhoe Bay Field on the North Slope contains several trillion cubic feet of gas and a total of 280 trillion cubic feet of gas is not an unreasonable estimate for the whole State.

However, the location of this gas is far from markets in the 48 contiguous States. A pipeline from the North Slope to Chicago would be over 3,000 miles, twice the distance of our present long pipelines from the Gulf Coast to New York. Estimates of the cost of such a pipeline run about two billion dollars. Another alternative would be a pipeline to Southern Alaska and movement of liquified natural gas to the West Coast area or possible the movement of LNG by ice-breaking tanker to the East Coast. However, the economic attractiveness of tanker transport of LNG is substantially affected by the Jones Act. It appears that all these alternatives put the delivery of Alaskan gas to the "lower 48" some time away. It seems unlikely that any such projects will be in operation much before 1980. Thus, Alaskan gas will hold promise for long term, beyond 1975, but it will not solve the near term problem.

Canadian Imports

The undiscovered natural gas reserves of Canada are estimated to be about equal to that of the United States, excluding Alaska. The Canadian gas industry is at an early stage of development resembling that of the U.S. gas industry of 1945, a year when the U.S. gas industry was on the threshold of a long period of spectacular growth. The export market will be essential if the Canadian natural gas industry is to reach its full development. Currently, new gas is selling for about 30 cents per MCF delivered at the border and after being transported a long distance. During 1968, the average value of Canadian gas imports was about 24 cents per MCF. Under present policies gas cannot be exported from Canada unless the reserves are sufficient to supply future Canadian requirements for thirty years. If Canadian gas becomes available to the U.S. market, it may offer a possible contribution to alleviating the short-term problem.

LNG Imports

The delivered cost of LNG to either the eastern or western seaboard will be about 40 to 55 cents per MCF, depending on the distance transported, exclusive of purchased gas cost which may be from 10 to 15 cents MCF. Thus, the total delivered cost may range from 55 to 70 cents/MCF. to import one trillion cubic feet per year of LNG, which is about the U.S. annual increase in demand, would require a total investment of about 1.5 billion

dollars and would involve a fleet of thirty tankers. LNG may help mitigate peak demands, but a significant contribution from it is several years away.

Synthetic Gas From Coal

Total United States coal resources are sufficient for the manufacture of 15-25 thousand trillion cubic feet of synthetic gas depending on processing and mining recovery efficiency. Each trillion cubic feet of annual gas capacity will require about 70 million tons of coal and a total investment of about \$1.5 billion in the physical plant and the associated time. The Department's Office of Coal Research is constructing two experimental coal gasification plants. The first is scheduled for completion in June of 1970 at the Institute of Gas Technology in Chicago, Illinois. The second plant will be ready for test operation at Rapid City, South Dakota, in early 1971. If these experimental projects are successful, we believe that commercial plants could produce gas for a 20-year average selling price from 35 cents to 50 cents per MCF at the plant. An additional cost for transportation would have to be added for transportation ranging from 600 miles to 800 miles.

The Bureau of Mines also is engaged in a program of coal conversion and other synthetic gas research. The Bureau is concerned with the gas supply problem from the standpoints of augmented production of natural gas, cost reductions in production and movement of LNG, and coal-to-gas synthesis.

Nuclear Stimulation

There are an estimated 300 trillion cubic feet of gas reserves in tight, low permeability reservoirs that potentially could be unlocked by the use of nuclear devices. So far two such devices have been successfully detonated in the Plowshare Program in which the Department has participated. They are Gasbuggy and Rulison. Evaluation of the results produced by these tests is still many months away, and no judgment can be made of their feasibility at this time. However, to supply one trillion cubic feet of gas per year would require more than 50 nuclear shorts per year.

CONCLUSION

In summary I would like to make these observations of the nature of the natural gas supply problem and the outlook for its solution.

1. Running out of gas is not the issue. There is plenty of gas to be found, but it will take an intensive, improved exploration effort to find it, of the order of two or three times the level of investment we are currently sustaining. It will take at least six years

for the results of this effort to be meaningful to consumers, and it isn't clear whether costs will be acceptable or will result in substitution of other fuels for gas.

2. There will be an adequate supply of gas for all present uses over the coming winter heating season, and probably so for the winter of 1970-71.
3. A serious supply problem will be fully upon us by 1975 if current trends persist and immediate corrective action is not taken.
4. That supply problem would be evidenced in the inability of new prospective customers to get service. Residential customers would have to use oil or electricity to heat their homes, while industrial customers would have to obtain their energy needs from oil, coal, or electricity. However, existing customers will have adequate supplies of gas to meet their current needs.
5. Canadian gas may be available, as determined the Canadian Government. Increased imports from this source by pipeline can help mitigate the effects of the U.S. supply problem.
6. Large volume of gas will be available on the Alaskan North Slope. Over the longer term (after 1975) it may become available to the Lower 48 in either liquid or gaseous form.
7. Imports of liquified natural gas offer a partial solution over the medium and longer term, depending upon the size of the investment, cost of the service and the effort required for large-volume imports.
8. Synthetic gas from coal is in pilot plant construction stage. While offering great promise over the long term it is not available in the critical years immediately following 1973.
9. In the meantime, the Department is immediately offering to lease areas of the OCS in gas provinces and will increase its efforts to develop viable alternative solutions to help alleviate both the shorter and longer term problem.

NATURAL GAS SUPPLY TRENDS

PRESENT

1. Proved Reserves 12/31/68^a - - - - - 287.4 TCF
(Declined for first time in modern history
from 292.9 TCF at the end of 1967)

2. Reserves added

1958	18.9
1968	13.8 - decrease of 27%

3. Production of Natural Gas in 1968

1958	11.4
1968	19.4 - increase of 70%

4. Reserves to Production Ratio (Reserve Life Index)

1958	22.2
1968	14.8 - decrease of 33.0%

5. Ratio of Annual Reserve Additions to Production

1958	1.7
1968	0.7 - decrease 59%

6. Exploratory Wells Drilled^b

	<u>Total</u>	
1958	13,199	
1968	8,879	33% decrease

7. New Well Completions^b

	<u>Total</u>	
1958	50,039	
1968	32,914	34% decrease

8. Natural Gas Pipeline and Utility Sales to Ultimate Consumers^c
(Millions of Therms)

1958	77,807
1968	144,258 increase of 85% or an average of 6.4% per year

a/ AGA Gas Reserves Committee, Report, April 7, 1969.

b/ American Association of Petroleum Geologists

c/ Gas Facts - AGA

Office of Oil & Gas
11/3/69

EXHIBIT # 1

EXPLORATION STATISTICS

<u>YEAR</u>	<u>Total Well Completions</u>		<u>Exploratory Wells</u>	
	<u>All Wells</u>	<u>Gas Wells</u>	<u>Total</u>	<u>Gas Wells</u>
1945	26,879	N.A.	5,613	374
1950	43,279	N.A.	10,306	431
1955	56,682	N.A.	14,937	869
1956	58,160	4,543	16,173	822
1957	55,024	4,620	14,702	865
1958	50,039	4,803	13,199	822
1959	51,764	5,029	13,191	912
1960	46,751	5,258	11,704	868
1961	46,962	5,664	10,992	813
1962	46,179	5,848	10,797	771
1963	43,653	4,751	10,664	664
1964	45,236	4,855	10,747	587
1965	41,432	4,724	9,466	515
1966	37,881	4,377	10,313	578
1967	33,558	3,619	9,059	556
1968	32,914	3,329	8,879	486

Source: American Association of Petroleum Geologists

Office of Oil and Gas
11/3/69

EXHIBIT # 2

U.S. NATURAL GAS RESERVE - PRODUCTION HISTORY
TCF @ 14.73 PSIA - 60°F

<u>Year</u>	<u>Net Production</u>	<u>% From Oil Wells</u>	<u>Gross Added to Reserve</u>	<u>Proved Reserve Year-End</u>	<u>Proved Reserve to Production</u>	<u>Ratio Annual Reserve Added to Production</u>
1945	4.9	34	-	146.9	30.0	-
1950	6.9	34	12.0	184.6	26.8	1.69
1955	10.1	33	21.9	222.5	22.1	1.95
1956	10.8	33	24.7	236.5	21.8	2.29
1957	11.4	32	20.0	245.2	21.4	1.75
1958	11.4	30	18.9	252.8	22.2	1.66
1959	12.4	29	20.6	261.2	21.1	1.68
1960	13.0	28	13.9	262.3	20.2	1.07
1961	13.4	28	17.2	266.3	19.8	1.28
1962	13.6	27	19.5	272.3	20.0	1.43
1963	14.5	26	18.2	276.2	19.0	1.25
1964	15.3	25	20.3	281.3	18.4	1.33
1965	16.3	25	21.3	286.5	17.6	1.31
1966	17.5	27	20.2	289.3	16.5	1.15
1967	18.4	26	21.8	292.9	15.9	1.18
1968	19.4	24	13.8	287.4*	14.8	0.71

* 22% of reserves @ 12/31/68 were associated-dissolved.

SOURCE: AGA Gas Facts
U.S. Bureau of Mines

Office of Oil & Gas
11/3/69

EXHIBIT # 3

APPENDIX "B"

I. C. 7166

APRIL 1941

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

HOME INSULATION,

AN EFFECTIVE CONSERVATION AND NATIONAL-DEFENSE MEASURE



BY

PAUL M. TYLER

AFTER THIS REPORT HAS SERVED YOUR PURPOSE AND IF YOU HAVE NO FURTHER NEED FOR IT, PLEASE RETURN IT TO
THE BUREAU OF MINES, USING THE OFFICIAL MAILING LABEL ON THE INSIDE OF THE BACK COVER.

I.C. 7166,
April 1941.

APPENDIX "B"
INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR
UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

BUREAU OF MINES
HOME INSULATION,
AN EFFECTIVE CONSERVATION AND NATIONAL-DEFENSE MEASURE 1/

By Paul M. Tyler 2/

Low-cost housing, like automobiles, should be appraised in the light not merely of first cost but of upkeep as well. Even more important than the number of miles the family car will go on a gallon of gasoline is the number of days the family home can be kept comfortable on a ton of fuel. A furnace tender who tossed every third shovelful of coal into the ashcan would lose his job promptly, but the effect is the same when homes continue year after year to pour out precious heat through uninsulated roofs and walls.

Greater economy in household heating means even more to the national economy than to the individual, especially now that we are preparing for defense. Our fuel resources, although large, should be conserved. If less fuel is used for civilian needs, augmented requirements for defense can be met without unduly increasing the number of men needed at the coal mines and oil wells or adding new producing units that might complicate ultimate readjustment to peacetime conditions when the emergency is past and over-expansion of many industries brings new problems. If unnecessary demands for transportation facilities are reduced, public carriers will be able to haul more munitions, and manpower needed for national defense will be released; and by protecting workers from health hazards in their homes additional man-hours of productive effort will be gained. Moreover, reducing the running expenses of houses by proper heat insulation helps home owners to maintain payments on property, and by minimizing foreclosures helps to stabilize the financial structure of the country. In short, here is a situation where the interests of the individual and the Nation are identical and the greatest good for the greatest number is obtained without sacrifice to anyone.

POSSIBLE SAVINGS

Ours is a lavish land. In contrast with the poverty general in other parts of the world, the life in any large American city seems wasteful in the extreme - the blaze of lights, the profligate consumption of gasoline in driving half-empty cars, the abundance of food, the extravagant clothing, and the overheated homes and offices. Much of this waste, however, is merely

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7166."

2/ Chief engineer, Nonmetal Economics Division, Bureau of Mines.

I.C. 7166

on the surface. The real enemy of abundant living is not so much visible as invisible waste. Because our homes are better-heated than foreign homes it does not mean that Americans are extravagant. In fact, a single central-heating unit may keep a whole house warm with less coal, or its equivalent in oil or gas, than our grandfathers burned in scattered fires in open grates that left chilly corners in every room.

Fuel saving naturally begins at the source, and to produce heat efficiently for a given dwelling means selecting the proper fuel and burning it in a furnace designed to release as much as possible of the full heating value of the fuel where it will do the most good. This process is complicated and involves not only proper burning of fuel but also capture of the heat in a suitable transmitting medium - steam, water, or air. Efficient production of heat, therefore, is still a fruitful field for research in fuel saving. Studies of the efficient use of heat cover another vast technologic field and have proved invaluable to the commercial success of many process industries. True heat economy in the home, however, has never commanded the attention that it deserves.

The United States today contains some 37,000,000 dwelling units, and during the next few years fully a half a million more should be added annually, in addition to replacements. Defense housing alone is scheduled to provide 160,000 to 200,000 units, mostly frame structures costing an average of \$3,500 each.

Supplies of fuel for domestic purposes, chiefly heating, are drawn from various sources. In 1939, for example, sales of fuel for domestic heating or for heating offices, apartments, hotels, schools, hospitals, and other buildings in which people must be warm in the United States, as estimated by the Bureau of Mines, included approximately 35,000,000 tons of anthracite, 55,000,000 to 75,000,000 tons of bituminous and other classes of coal, 9,000,000 tons of coke, 175,000,000 barrels of oil, and 760 billion cubic feet of gas. The total value of these fuels as reported by producers was more than \$670,000,000. Including transportation charges and retailers' expenses and profits, the American people pay over \$1,500,000,000 a year to keep themselves warm in their homes. Moreover, this figure does not cover the large quantities of wood used in fireplaces and stoves, much of which is cut and chopped by boys on the farm and thus escapes statistical analysis in dollar values. On the basis of the foregoing quantities, the average family uses nearly 5 tons of coal or equivalent fuel a year, and this estimate is low.

Average savings in coal-using efficiency in industry range from 20 percent in steel making to 56 percent in electric public-utility plants since 1918. Similar savings can be made in domestic heating. It has been estimated conservatively that fuel to heat the average American home in accordance with modern standards of comfort would cost about \$75 a year without insulation and only about \$40 a year with insulation. On the basis of an average saving of even \$25 a year with insulation, 200,000 defense houses would save the Nation well over \$5,000,000 a year if insulated. This saving

is equivalent to 12,000 carloads of coal or 8,400 tank cars of oil. Additional savings might result from insulating cantonment buildings and other structures required to help make this country the "arsenal for democracy."

Most of the 500,000 new houses to be added annually will be financed by Government-insured loans. On the basis of \$25 a unit as the possible saving due to insulation, the potential wastage, if the houses were not insulated, would be \$12,500,000 in 1941, \$25,000,000 in 1942, \$37,500,000 in 1943, and so on until by the end of the tenth year it would amount to \$125,000,000 annually. As the capital cost of insulation now can be repaid by the savings on fuel each year, no good reason is apparent for tolerating such waste in new construction. If similar savings could be applied to the 37,000,000 existing dwelling units in the United States, potential savings would be approximately \$1,000,000,000 a year.

HOW INSULATION WORKS

James Watt insulated his primitive steam engine and its boiler with strips of wood, a proof that even then industry had begun to appreciate the economy of conserving heat energy. Mineral wool was used as steam-plant insulation as early as 1840. Whenever heat or refrigeration is used in industry, insulation guards against waste. In many modern industrial processes based upon reactions that take place only within a narrow temperature range, insulation not only is economical but necessary, because close temperature control is almost impossible without insulation.

Years ago, the National Bureau of Standards (T. I. B. M. 15, May 18, 1936) showed that frame construction, with wood shingles over building paper and 3/4-inch wood sheathing outside and 3/4-inch plaster and metal lath (or 1/2-inch plasterboard or wallboard alone) inside, had an insulating value^{3/} of 4.6, when the 3-5/8-inch air space was unfilled. When this space was filled with mineral wool the value rose to 16.0. Corresponding figures for a 4-inch brick-veneer wall over the same paper and sheathing and the same interior wall finish were 3.7 when the air space was unfilled and 15.1 when it was filled (T. I. B. M. 14)

Another interesting Bureau of Standards tabulation (T. I. B. M. 3, March 4, 1936) shows estimated fuel savings up to 40 percent due to the application of simple heat-loss preventives to walls and roof of an unprotected house, and with suitable weatherstripping and storm sash applied to doors and windows the total savings were boosted to 60 percent.

To the ordinary home owner insulation is simply a more or less effective barrier to retain heat in winter and keep it out in summer.

Heat is transferred in three ways - by conduction, convection, and radiation. With reference to insulation, conduction is the most important, and as heat is dissipated first through conduction a well-insulated surface automatically reduces convection and radiation losses to a minimum.

^{3/} The unit in these tests was the number of hours required for passage of 1 B. t. u. of heat through 1 sq. ft. of wall area per 1° F. temperature difference between air on one side to air on other side.

Conduction, or the flow of heat through a solid, may be noted along a silver spoon when it is used to stir coffee. Convection is a more complicated phenomenon but is often manifested by "drafts" or movement of air, as well as by air leakage around window and door frames. Radiation is the process that carries the sun's heat to the earth and is familiar to anyone who has sat by an open fire; it also takes place between the objects in a room and the outside walls.

Although air is a poor conductor of heat, open air spaces in the hollow walls of a building do not afford much insulation, largely because of radiation from one wall to the other. Some heat also is lost by convection (the term "dead-air space" is a misnomer), but not so much as many suppose.

In any enclosed structure where human beings should be comfortable in winter - home, factory, office building, or school - the principal function of the heating system is to prevent body heat from being dissipated too rapidly for health. If walls, ceilings, or floors become too cold discomfort results, and even with the finest heating plant in the world exposed surfaces are likely to become too cold unless they are heavily insulated. The same insulation helps to keep surfaces cool in summer.

Heat is measured in British thermal units; 1 B. t. u. is the heat required to raise 1 pound of water 1° F. under specified conditions (from 39° to 40° F. at sea level). Heat losses are measured in B. t. u. per square foot per hour per ° F. temperature difference; in other words, in terms of the quantity of heat that will pass through a section of given material, 1 square foot in area and 1 inch thick, in an hour, divided by the difference between the outside and inside temperatures. This quantity is sometimes called the k-factor, and as it is the measure of heat loss the smaller this constant is for a given material the better the insulating properties of the material. The thermal conductivity or k-factor of most light, fibrous materials sold primarily as insulators ranges from 0.25 to 0.35 B. t. u. per hour.

Heating requirements are measured by engineers in degree-days. The heating season in the United States is roughly October 1 to May 1, but it varies greatly in different parts of the country. Degree-days, however, are published in heating handbooks and in United States Weather Bureau reports for nearly every city in the United States and Canada. They are based upon mean-temperature data. One degree below 65° F. for a 24-hour period equals 1 degree-day. The assumption is that no artificial heat is required when the mean daily outside temperature is 65° F.

SERVICE TESTS

Laboratory tests can be conducted under ideal circumstances, but many field tests have been made to prove the resistance of walls and roofs to passage of heat in houses of different types, subject to variable wind velocity and sharp changes in temperature and humidity. One of the first series of practical field tests on house insulation ever conducted by the

Federal Government is reported in an official bulletin of the Tennessee Valley Authority, entitled "Studies in the Heating of Small Houses," published in June 1939. These tests revealed that complete wall, floor, and roof insulation may cut the fuel bill of a typical house in a relatively moderate climate as much as 44.75 percent. They further indicate that the saving might be increased to 50 percent. The tests were conducted in two adjoining basementless houses in the Hiawasee Dam community of North Carolina with occupants actually living in the house.

In these small houses the extra cost of insulation was only \$113, about one-half of which might be saved under normal circumstances in a newly built house because of the smaller heating plant that would be required. In a hypothetical northern locality with what is technically known as a 6,000-degree-day heating season, yearly dividends would be \$45.50 heating with electricity at 1 cent a kilowatt-hour, \$13.20 using oil at 8 1/2 cents a gallon, and \$11.93 for coal at \$12 a ton.

Even in the mild climate of Hiawasee, N. C., the savings in dollars and cents were worthwhile. The tests proved that insulation, in this case mineral wool, does not cost the house owner a cent. It begins to pay for itself the day it is installed and continues to do so as long as the house is occupied. John B. Rodee, of the Pierce Laboratory of Hygiene, Hartford, Conn., addressing architects and builders (Architectural Forum, March 1940), points out that if someone broke a window the owner of the house would replace it as quickly as possible, as the heat that would escape through the broken pane would soon cost more than replacing the glass. Although the heat that escapes through an uninsulated wall is not so obvious, the principle is the same. Rodee then shows that the cost of insulation, divided over the period of an ordinary loan, is much less than the saving in fuel. For example, it will cost \$75 to heat a small, uninsulated house in Milwaukee, Wis., but heat plus deferred payments on insulation with full-thick mineral wool will cost only \$42 annually for the same house, when paid for like the rest of the house over a 20-year period, including interest. This means a saving of \$33 a year until the loan is paid off, after which the saving goes up to \$42.

Vouched for by vermiculite producers is a test conducted in twin houses on Pennington Drive, Detroit. One house, uninsulated, was sheltered on both sides by other houses. The other house, a few doors away, was exposed on three sides but was insulated. Throughout the winter of 1935 and 1936 an attempt was made to keep both houses at a constant temperature of 74° F. During October 1935 the insulated home burned only 93 gallons of oil compared with 168 gallons burned in the uninsulated home, and for the entire heating season the average monthly saving on fuel bills was 38 percent. As a further "dividend," temperatures in the insulated home never fluctuated more than 2° F., whereas in the other home they varied as much as 18° F. in a 24-hour period.

"EXTRA DIVIDENDS" TO HOME OWNERS

Modern transportation enables the wealthy and many of the poor to migrate with the birds south in winter and north in summer, but for middle-class folks who have regular jobs and must "stay put", insulation is a

thrifty means of maintaining homes at comfortable temperatures both summer and winter. Combined with automatic heating in cold weather, insulation does away with early-morning shivers, eliminates chilly drafts along the floors, and cuts down on house cleaning due to dirt and dust from overworked furnaces. In summer it may make the difference in an upstairs bedroom between temperatures insufferable for sleeping and reasonable comfort. Uninsulated houses frequently are hotter than outdoors, as they trap the heat on long sunny days.

Extra sleeping hours may be gained through another means - sound absorption. Street noises, unfortunately, come in principally through the windows but other disturbing sounds transmitted through walls are deadened by the materials used to bar heat.

Each year, according to the National Fire Protection Association, fires occur in nearly 400,000 places where people live and cause the death of 7,500 persons, mostly women and children. Incombustible heat-insulating barriers in roofs and walls make even frame buildings slow burning. In earlier years, when insulation cost more, salesmen stressed its fire-resistance more than its comfort and fuel-saving properties. The George Washington shrine at Mount Vernon was insulated on the recommendation of the National Bureau of Standards because mineral wool installed between rafters and in the walls around dormer windows would inhibit the spread of fire. Recent tests at the National Bureau of Standards show that a wood-lath partition filled with mineral wool will stop the passage of fire for 1 hour. After this long period of exposure the studs were still able to carry their load.

Still another "extra dividend," seldom stressed but well-recognized by mortgage lenders, is the fact that insulation in side walls and ceilings reduces the number of times that the interior of a house must be redecorated during the lifetime of a loan. With wallpaper and paint in better condition the house is not only a better place in which to live but a better mortgage risk; it is easier to rent or sell, and as redecorating costs as well as fuel costs come out of the borrower's income the chances of delinquent payments are reduced. Dust patterns and alternate light and dark strips along lath and beam locations are less likely to occur in well-insulated homes. In the first place there is less movement of air to carry particles of dust along unevenly heated surfaces and in the second place there is less condensed moisture on the surfaces to catch the dust. Moreover, as cold walls are likely to be damp, condensed moisture alone may cause discoloration.

HOW TO INSULATE

Insulation is no better than the man who installs it. Any competent architect or builder can furnish figures as to the type and thickness of insulation that will save the most fuel-dollars in a given building. Generally, mineral materials are preferable because of their resistance to fire, electrical short circuits, moisture, termites, vermin, and decay. Full-thick insulation ordinarily is most economical, and most manufacturers

recommend 3-5/8 inches, which is the thickness of the hollow space in most walls. No insulation is expensive in first cost, but some are expensive later. Mineral wool or vermiculite furnished by reliable manufacturers is of standard quality and usually is as cheap and efficient as any material, but in places aluminum foil, metallic paint, or various other good insulating mediums or combinations of these with mineral wool or vermiculite may be indicated. It should be remembered also that heat may be lost through single-glass panes in windows, thin and badly fitted doors, and general leakage of air.

For typical suburban homes it has been estimated that 60 percent of the heat lost in winter filters through the side walls and 40 percent through the roof. About one-third of the heat gained in summer enters through the side walls and two-thirds through the roof. Obviously both should be insulated for maximum year-round comfort and economy.

Everyone is familiar with condensation of moisture on window panes in cold weather. So-called "steamy" windows signify overhumidification (too much moisture) in the air. Often this condition can be controlled or eliminated by opening the windows or, better, by the use of ventilating fans to draw off water vapor from laundry, bathrooms, or kitchen. Much the same problems arise in respect to insulation, and instances have been recorded where interior sweating of walls and even damage from freezing of water condensed in walls have resulted from improperly placed insulation. In field examinations, however, United States Forest Products Laboratory research workers have "not found serious conditions in full-thick insulation blown into older houses where reasonable humidities were maintained." Overhumidification affects many building materials, hence the National Paint, Varnish & Lacquer Association has recommended that the inside relative humidity should never exceed 40 percent and that when the outside temperature is below zero it should not exceed 20 percent.

Although hundreds of thousands of insulation jobs have been successful without vapor barriers, modern types of mineral wool for new construction are sold with vapor barrier attached. The batts or strip have a moisture-proof paper on one side which is applied, inside the studs or under the rafters, nearest the warm side, thus preventing moisture carried by the warm air inside from reaching the hollow spaces or the outer sheathing where it might condense. Attic ventilation also helps to prevent condensation and should always be provided above insulation; it has the further function of eliminating excessive summer heat. For natural ventilation louvers having a minimum free opening of 12 1/2 square inches for every 100 feet of ceiling area should be placed at opposite ends of the building.

Another cause of complaint is slumping. Occasionally walls that presumably were filled with mineral wool or vermiculite have been found to contain open spaces, and horizontal layers originally supposed to be 4 inches thick have slumped to say 3 inches after standing a year or two. Ordinarily these conditions come about only when the original installation was made by inexperienced or irresponsible contractors.

The natural time to install insulation is when the house is first build, as it costs less then; however, insulation can be added to existing homes at any time with relatively little expense compared with the resulting saving in fuel costs and gain in comfort. Fully 800,000 old homes had been insulated by the end of 1940, and 20 to 30 times this number could be so modernized with advantage to the owners and to the Nation.

MISCELLANEOUS PRODUCTS

The most widely used material for effectively insulating houses is mineral wool, which is manufactured in 75 plants in various States. The raw material used in its manufacture determines whether it is rock wool, slag wool, or glass wool. It may be sold packed loose in 4-cubic foot bags, just as it comes from the receiving chamber. This form can be placed by hand into open spaces or spread between the ceiling joists. Modulated or granulated wool has been freed from shot and rolled into small pellets so that it can be blown into place through an air hose; it is used chiefly for insulating houses already built. Increasing quantities of wool are fabricated into soft, flexible quilts, confined between layers of vapor-proofed paper. "Batts" are rectangular shapes made from loose wool mixed with suitable binders, compressed, and cut to the thickness and size demanded by consumers. Batts may have one or two paper covers or none at all. They are used for insulating new houses, being inserted in walls, floors, or roofs between studs, joists, or rafters. Roll wool is wool matted like cotton batting and rolled with paper. Blankets, used largely for insulation in industrial furnaces, are made of loose wool treated with various binders and are of various rectangular shapes and thicknesses, sewed between wire, metal lath, or other confining media. Loose wool with suitable binders also is compressed into blocks for use in refrigerator, stove, and furnace insulation and into various shapes for pipe and boiler coverings. Loose wool mixed with bentonite or plastic fire clay and asbestos fiber is sold as an insulating cement for filling joints between insulating blocks, as plastic insulation for irregularly shaped objects, and for general heat-conservation use.

Another important mineral insulating material commonly used is vermiculite, which is mined mostly in Montana and processed in plants situated at various strategic points in the United States, Canada, and even Europe. It is a mica-like mineral which expands greatly when heated, forming feather-light, resilient pellets which, when screened or sized to remove particles that are too large or too small, are used as loose fill. It can be poured from the bag. Insulating cements made from expanded vermiculite screenings and bentonite or other binder are manufactured by several firms, and at least one manufacturer has produced a compressed vermiculite wallboard. Plaster and concrete, in which vermiculite takes the place of sand or other aggregate, are being used in rapidly increasing quantities; in addition to their heat-insulating value, they have acoustic properties and are light in weight. Vermiculite precast concrete slabs for roof, floor, or wall construction weigh as little as 25 pounds per cubic foot and are easy to install. If necessary they can be sawed, cut with a knife, drilled, or nailed

in much the same way as wood lumber. Vermiculite concrete (1 part portland cement, 8 parts "Zonolite") has almost half the heat-insulating value of loose vermiculite.

Stiff, fibrous insulating boards having considerable structural strength usually are not as good insulators as lighter and looser materials, and dense, highly compressed wallboards made of wood or other organic fiber are even poorer insulators than less-compressed boards of the same general composition. Heavy wallboards containing some form of gypsum, although excellent building materials, are relatively poor insulators.^{4/}

Aluminum foil is used to increase the value of air spaces by reducing heat transfer by radiation. Clean metallic surfaces usually are good reflectors and poor emitters of radiant heat, and as much of the transfer of heat across open spaces in buildings takes place by radiation, the use of aluminum on one or both sides of the space may reduce heat losses substantially. Aluminum foil also is applied in crumpled form to be self-spacing.

Diatomite, pumice, and other porous rocks or earths have been used for wall insulation, and diatomite, asbestos, and magnesia (chiefly a mixture of 85 percent technical carbonate and 15 percent asbestos or other fiber) are used extensively for boiler and pipe coverings. Balsam wool, animal hair, cork, and sundry vegetable fibers also are listed among materials used to impede the transfer of heat.

Density is a factor in all building materials, not only because freight rates boost their cost delivered on the job but also because lighter loads do not require costly framework. Ordinarily, the lower the density, the better the insulating value.

Available data for specified materials are summarized in the accompanying table.

^{4/} National Bureau of Standards, Technical Information on Building Materials: No. 16, May 22, 1936.

Thermal conductivity of various materials ^{1/}

Material tested	Density, lb. per cu. ft.	Conductivity
Air space between walls (3 1/2-in.)	0.081	0.86 to 1.10
Cotton, compressed.....	6.3	.21 to .29
Pure wool	6.24	.26 to .32
Silk	6.24	.28 to .34
Hair felt	13.0	.26
Flax fiber	13.0	.31 to .33
Cork, ground	8.1	.27 to .31
Sugarcane fibers	13.5	.34
Pine wood	34.3	.8 to 1.0
Wood-pulp board, plaster base	16.2	.3 to .4
Mineral wool	21.2	.27 to .30
Asbestos sheet	48.3	.29
Magnesia (85 percent magnesia, 15 percent asbestos)	19.3	.47 to .51
Expanded vermiculite	6.0	.26
Diatomite powder	10.6	.3 to .5
Diatomite blocks	28.1	.53
Pumice gravel	18.8	.64
Tile (clay and plaster)	12.7	.60
Glass, plate	15.5	3.5 to 5.5
Bricks, dry	125.0	3.0 to 6.0
Brickwork (mortar bond)	132.0	4.0 to 5.0
Gypsum plaster	46.2	2.0 to 5.0
Concrete, 1-2-4	150.0	5.0 to 6.0
Slate shingles	162 to 205	10.0 to 10.4
Building stone	165.0	12.5
Steel, 1 percent carbon	489.0	314.0 to 328.0
Copper pure	558.0	2,580.0 to 2,670.0
Silver, (greatest conductivity) ...	655.0	2,860.0 to 2,920.0

1/ Authorities: National Bureau of Standards, Federal Housing Administration, and university and research laboratories.

2/ Conductivity = British thermal units transmitted per hour per square foot of material 1 inch thick, per ° F. difference in temperature of the two faces.

BIBLIOGRAPHY

Much of the data embodied in the foregoing paper was abstracted from the following publications and trade literature:

- DOMINION FUEL BOARD, CANADA. Why You Should Insulate Your Home; Insulation of New and Old Houses; Humidity in House Heating. Ottawa.
- FEDERAL HOUSING ADMINISTRATION. Calculation of Building Section Heat Transmission Coefficients: Tech. Circ. 7, May 24, 1940, 26 pp.
- NATIONAL BUREAU OF STANDARDS. Thermal Insulation of Buildings. Circ. 376, 1929, 11 pp.
- NATIONAL MINERAL WOOL ASSOCIATION (1270 Sixth Ave., New York, N. Y.) Performance (published monthly). Various papers presented at centennial meeting, May 16, 1940.
- TENNESSEE VALLEY AUTHORITY. Heating at Norris, Tenn. January 1, 1938, 43 pp.
- UNIVERSAL ZONOLITE INSULATION CO. (2601 W. 107th St., Chicago, Ill.)
- U. S. DEPARTMENT OF AGRICULTURE, BUREAU OF AGRICULTURAL CHEMISTRY AND ENGINEERING. Ext. Service Rev., vol. 11, No. 8, August 1940, p. 103.
- U. S. DEPARTMENT OF COMMERCE, NATIONAL COMMITTEE OF WOOD UTILIZATION. House Insulation, Its Economies and Application, 1931, 52 pp.

APPENDIX "C"

Home Insulation WITH MINERAL PRODUCTS

Conservation of Fuel for War

BY OLIVER BOWLES

United States Department of the Interior

Harold L. Ickes, Secretary

Bureau of Mines - R. R. Sayers, Director

Information Circular 7220 - Sept. 1942



CONSERVATION OF FUEL FOR WAR

Home Insulation

WITH MINERAL PRODUCTS

By Oliver Bowles

Chief, Nonmetal Economics Division

United States Bureau of Mines

Introduction

THE exigencies of a world war have brought home to the American public, especially the people of the Eastern States, the urgent need for conserving fuel. Transportation problems in the East have created an unprecedented situation wherein fuel-oil supplies are greatly restricted, and the consequent increase in demand for coal further complicates the problem of transporting and storing that commodity. People should awaken to the need for utilizing every means of conserving fuel, even to the extent of reducing the temperature in their homes.

There never was a time in the history of our Nation when it was more necessary to practice economy in household heating. Such economy is not merely the instrumentality whereby physical comfort and wellbeing may be maintained; it has attained the dignity of a patriotic duty, because every ton of coal or gallon of oil saved conserves these fuels for military needs and releases facilities for transporting munitions, the raw materials required for their manufacture, or a multitude of other products involved in the war program. Aside from this unusual emergency in the East, conservation of fuel resources is desirable at all times and in all localities.

Readers are referred to a recent Bureau of Mines information circular by J. F. Barkley entitled "HOW TO SAVE FUEL AT HOME," which should be consulted with regard to economical use of solid fuels.

NOTE: Some of the data given in this paper were taken from Bureau of Mines Inf. Circ. 7166, HOME INSULATION, by Paul M. Tyler, a report now out of print.

How Fuel May Be Saved

FUEL saving naturally begins at the source, and to produce heat efficiently for a given dwelling requires selecting the proper fuel and burning it in a furnace designed to release as much as possible of the heating value of the fuel. This process is complicated and involves not only proper burning of fuel but also capture of the heat in a suitable transmitting medium—steam, water, or air. Efficient production of heat, therefore, is still a fruitful field for research in fuel saving. Studies of the efficient use of heat cover another vast technologic field and have proved invaluable to the commercial success of many process industries. True economy in heating the home, however, has never commanded the attention it deserves.

In the field of new-home construction the use of high-grade, substantial building materials, careful planning, and skilled workmanship are important in fuel conservation. Weatherstripping and storm windows and doors are contributory means of conserving heat.

One of the chief elements in fuel saving is insulation. To the ordinary home owner, insulation is simply a more or less effective barrier to retain heat in winter and keep it out in summer. Common insulating materials are mineral wool (also called rock wool, glass wool, and slag wool), vegetable and wood fiber in various forms, asbestos, insulating boards made of vegetable or mineral products, vermiculite, diatomite, pumice and other porous rocks or earths, magnesia, aluminum foil, sawdust, animal hair, and cork; in this paper those of mineral origin only will be considered. Insulation is achieved by using such materials to fill the open spaces in walls and ceilings.

Advantages of Insulation

ASIDE from conservation of fuel, home insulation has many advantages. If in the process of saving fuel home temperatures may be maintained at comfortable levels without subjecting the occupants to chills and drafts, public health will be promoted and additional man-hours of productive effort will be gained.

Protection against fire is another advantageous function of insulation. Incombustible heat-insulating barriers in roofs and walls make even frame buildings slow-burning. Years ago, when insulation cost more, salesmen stressed its fire-resistance more than its comfort-giving

and fuel-saving properties. The George Washington shrine at Mount Vernon was insulated upon the recommendation of the National Bureau of Standards, because mineral wool placed between rafters and in the walls around dormer windows would inhibit the spread of fire. Recent tests at the National Bureau of Standards showed that a wood-lath partition filled with mineral wool will stop the passage of fire for 1 hour, at the end of which time the studs were still able to carry their load.

Still another advantage, seldom stressed but well-recognized by mortgage lenders, is the fact that insulation in side walls and ceilings reduces the number of times the interior of a house must be redecorated during the lifetime of a loan. With wallpaper and paint in better condition, the house is not only a better place in which to live but a better mortgage risk; it is easier to rent or sell; and since redecorating costs as well as fuel costs come out of the borrower's income, the chances of delinquency in meeting payments are reduced. Dust patterns and alternate light and dark strips along laths and beams are less likely to occur in well-insulated homes. First, there is less movement of air to carry particles of dust along unevenly heated surfaces, and second, there is less condensed moisture on the surfaces to catch the dust. Moreover, as cold walls are likely to be damp, condensed moisture may cause discoloration.

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In any enclosed structure where human beings should be comfortable in winter—home, factory, office building, or school—the principal function of the heating system is to prevent body heat from being dissipated too rapidly for health. If walls, ceilings, or floors become too cold, discomfort results; and even with the finest heating plant in the world, surfaces exposed to the weather are likely to become too cold unless they are heavily insulated. The same insulation helps to keep surfaces cool in summer.

Heat is measured in British thermal units; 1 B.t.u. of heat is required to raise 1 pound of water 1° F. under specified conditions (from 39° to 40° F. at sea level). Heat losses are measured in B.t.u. per square foot per hour per °F. temperature difference—in other words, in terms of the quantity of heat that will pass through a section of given material 1 square foot in area and 1 inch thick in an hour, divided by the difference between the outside and inside temperatures. This quantity is sometimes called the k-factor; and as it is the measure of heat loss, the smaller this constant is for a given material the better the insulating properties of the material. Thermal conductivity or k-factor of most light, fibrous materials sold primarily as insulators ranges from 0.25 to 0.35 B.t.u. per hour.

The following table shows the thermal conductivity of a variety of materials, many of which are used in home construction.

Thermal Conductivity of Various Materials¹

MATERIAL TESTED	DENSITY lb. per cu. ft.	CONDUCTIVITY ²	
Air space—walls (3½") .	0.081	0.86 to	1.10
Cotton, compressed	6.3	.21 to	.29
Pure wool	6.24	.26 to	.32
Silk	6.24	.28 to	.34
Hair felt	13.0	.26	
Flax fiber	13.0	.31 to	.33
Cork, ground	8.1	.27 to	.31
Sugarcane fibers	13.5	.34	
Pine wood	34.3	.8 to	1.0
Wood-pulp board, plaster base	16.2	.3 to	.4
Mineral wool	2 to 7	.27 to	.30
Magnesia (85% magne- sia, 15% asbestos) . .	19.3	.47 to	.51
Expanded vermiculite . .	6 to 7	.48	
Diatomite powder	10.6	.3 to	.5
Diatomite blocks	28.1	.58	
Pumice gravel	18.8	.64	
Tile (clay and plaster)	12.7	.60	
Glass, plate	15.5	3.6 to	7.3
Bricks, dry	125.0	3.0 to	6.0
Brickwork (mortar bond)	132.0	4.0 to	5.0
Gypsum plaster	46.2	2.0 to	5.0
Concrete, 1-2-4	150.0	5.0 to	9.0
Slate shingles	162 to 205	10.0 to	10.4
Building stone	165.0	12.5	
Steel, 1 percent carbon . .	489.0	314.0 to	328.0
Copper pure	558.0	2,580.0 to	2,670.0
Silver (greatest conduc- tivity)	655.0	2,860.0 to	2,920.0

Heating requirements are measured by engineers in degree-days. The heating season in the United States is, roughly, October 1 to May 1, but it varies greatly in different parts of the country. Degree-days, however, are published in heating handbooks and in United States

¹Authorities: National Bureau of Standards, Federal Housing Administration, and university and research laboratories.

²Conductivity = British thermal units transmitted per hour per square foot of material 1 inch thick, per °F. difference in temperature of the two faces.

Weather Bureau reports for nearly every city in the United States and Canada. They are based upon mean-temperature data. One degree below 65° F. for a 24-hour period equals 1 degree-day. The assumption is that no artificial heat is required when the mean daily outside temperature is 65° F.

Saving Accomplished by Insulation

ENORMOUS quantities of fuel are used for heating buildings. The following data for the United States for 1941 have been compiled by the Coal Economics Division of the Bureau of Mines from various sources. The total anthracite used for space-heating purposes was approximately 44,000,000 tons. The quantity of bituminous and other classes of coal so used is somewhat uncertain but was about 66,000,000 tons. Coke for space heating amounted to about 9,000,00 tons and fuel oil so used aggregated 209,000,000 barrels. The quantity of gas used for space heating is uncertain but approximates 250 billion cubic feet. The total value of these products at the point of origin was approximately \$800,000,000. The price paid by the consumer, including transportation charges and retailers' expenses and profits, was roughly \$2,000,000,000. This prodigious figure for keeping people warm indicates the enormous potential field for saving when economies are introduced.

The National Bureau of Standards has demonstrated (T.I.B.M. 15, May 18, 1936) that frame construction, with wood shingles over building paper, ¾-inch wood sheathing outside, and ¾-inch plaster and metal lath (or ½-inch plasterboard or wallboard alone) inside, had an insulating value³ of 4.6 when the 3⅝-inch air space was unfilled. When this space was filled with mineral wool the value rose to 16.0. Corresponding figures for a 4-inch brick-veneer wall over the same paper and sheathing and the same interior wall finish were 3.7 when the air space was unfilled and 15.1 when it was filled (T.I.B.M. 14).

Another interesting Bureau of Standards tabulation (T.I.B.M. 3, March 4, 1936) estimates fuel savings up to 40 percent due to the application of simple heat-loss preventives to walls and roof of an unprotected house,

³The unit in these tests was the number of hours required for passage of 1 B.t.u. of heat through 1 square foot of wall area per 1° F. temperature difference between air on one side to air on other side.

and with suitable weatherstripping and storm sash applied to doors and windows the total savings were boosted to 60 percent.

To judge the saving that may be achieved with insulation, reference may be made to a Canadian report⁴ embodying the results of a study made on the distribution of heat losses in homes. The study was made on 200 average homes of wood-frame construction, uninsulated, and without weatherstripping or storm windows or doors. It was found that of the heat lost, 16.2 percent was lost through the roof, 27.0 percent through the walls, 25.8 percent through the glass, 24.6 percent by air infiltration, 4.3 percent through the door, and 2.1 percent through other sources, including the floor. When 2 inches of insulating material was applied to the walls of these houses, the heat loss was reduced 17.4 percent; and the addition of 2 inches of insulation to the second-floor ceiling brought about a further reduction of 13.3 percent. Thus, complete insulation saved 30.7 percent of the heat loss.

There is, of course, definite relationship between heat conservation and fuel saving. The quantity of fuel that may be saved by insulation has been determined by many investigators, and the results vary considerably, but in every instance the figures obtained are remarkably large. One of the most complete and dependable studies is that conducted by the Engineering Experiment Station, University of Illinois, on a three-story residence of standard frame construction in Urbana, Ill. Both ceiling and walls of the house were insulated with mineral-wool batts wherever they could be applied conveniently, and in other places nodulated mineral wool having a density of about 5 pounds per cubic foot was blown into place. The results of the tests, which have been described in detail,⁵ indicate that insulation produced an average saving of approximately 30 percent in consumption of fuel. This figure agrees closely with the

⁴Babbitt, J. D., and Hyland, John J., HOUSE INSULATION IN ITS RELATION TO CANADA'S WAR EFFORT: Document N.R.C. 1055, National Research Council of Canada and National Housing Administration, Department of Finance, Ottawa, Canada, 1942.

⁵Kratz, A. P., and Konzo, S., EFFECT OF INSULATION ON PLANT PERFORMANCE IN THE RESEARCH RESIDENCE: Heating, Piping, and Air-Conditioning, May 1941, pp. 318-324.

30.7 percent of heat loss saved by insulation given in the Canadian report to which reference has been made.

It is difficult to estimate the actual saving in tons of coal, gallons of oil, and cubic feet of gas that can be accomplished by insulation, because a large percentage of the new homes built in the United States during recent years were insulated when built. Furthermore, during the past 12 or 15 years multitudes of existing homes have been insulated by blowing the insulating medium into the walls and between floor joists and rafters. Undoubtedly millions of homes still lack insulation, and if 30 percent of the fuel used in such homes can be saved by insulation, the total saving can be measured in terms of millions of tons of coal and vast quantities of other fuels.

How to Insulate

CHOICE of insulating materials depends largely on relative availability and cost. Generally, mineral products are preferable because of their resistance to fire, electrical short circuits, moisture, termites, vermin, and decay. In new-home construction, if the home owner employs a competent and responsible building contractor, he may expect to have the insulating done properly. The application of insulation to existing homes is a special art. It is important that all open spaces in ceilings and walls be completely filled with the insulating medium. If barriers prevent movement of the fill material, a new opening should be made beyond the barrier. Obviously, leaky roofs and walls should be repaired, so that moisture will not accumulate in the fill. Problems involving the relative merits of various insulating materials and their proper application are not within the province of the Bureau of Mines. The National Bureau of Standards has conducted many studies on insulating problems, and various insulating firms have developed knowledge and skill in application.

Attention may be directed to a new motion-picture film in sound produced by the Bureau of Mines, United States Department of the Interior, in cooperation with a large industrial concern. Under the title "Heat and Its Control: The Story of Rock-Wool Home Insulation" it tells how insulation of homes may conserve the Nation's fuel supply and thereby contribute to the success of the military program.

Insulation Products of Mineral Origin

Mineral Wool

MINERAL WOOL consists of fine, interlaced mineral fibers having the appearance of loose wool or cotton. It is a fibrous, glasslike material composed principally of silicates of calcium and aluminum. Mineral wool is a generic term covering a number of similar products differentiated chiefly by the raw materials from which they are made. "Rock wool" is made from natural rock (a calcareous shale) or from combinations of various natural minerals or rocks, such as limestone and shale. "Slag wool" is made from iron, copper, or lead blast-furnace slag alone or mixed with fluxing materials. "Glass wool" is made from silica sand, soda ash, and limestone with or without scrap glass or other materials.

The first step in the process of making rock wool is to melt the raw materials, consisting of a properly proportioned mixture of alumina, silica, and lime or magnesia, in a cupola furnace. The molten material is then drawn from the bottom of the cupola in a small stream, the flow and temperature of which are regulated carefully. The slag, as it falls, is broken up by a steam jet (at 80 to 100 pounds pressure) into minute droplets, which, while still molten, are propelled rapidly through the air. During their comet-wise course fine threads of glasslike material form as tails and fall in a fluffy mass on the floor of the wool room. When freed from glassy shot grains, it is ready for use or for manufacture into mineral-wool products. Molten furnace slag or glass is made into wool by similar processes. If molten slag can be blown into wool just as it comes from the metallurgical furnace the cost of melting is saved.

Mineral wool is marketed in various forms. Loose wool is the raw product as blown and without subsequent treatment. This is the material from which all mineral-wool products are made. Nodulated or granulated wool has been freed from shot and rolled into small pellets, so that it can be blown into place through an air hose; it is used chiefly for insulating houses already built. Increasing quantities of wool are fabricated into soft, flexible quilts confined between layers of vapor-proofed paper. "Batts" are rectangular shapes made from loose wool mixed with suitable binders, com-

pressed, and cut to the thickness and size demanded by consumers. Batts may have one or two paper covers or none at all. They are used for insulating new houses, being inserted in walls, floors, or roofs between studs, joists, or rafters. Roll wool is wool matted like cotton batting and rolled with paper. Blankets, used largely for insulation of industrial furnaces, are made of loose wool treated with binders and are of various rectangular shapes and thicknesses, sewed between wire, metal lath, or other confining mediums. Loose wool with suitable binders also is compressed into blocks for use in refrigerator, stove, and furnace insulation and into various shapes for pipe and boiler coverings. Loose wool mixed with bentonite or plastic fire clay and asbestos fiber is sold as an insulating cement for filling joints between insulating blocks, as plastic insulation for irregularly shaped objects, and for general heat-conservation use.

Vermiculite

VERMICULITE is another important mineral insulating material. It received its name from its peculiar property of expanding and unfolding into wormlike forms when heated. The name is applied to a group of micaceous minerals that generally are alteration products of biotite, phlogopite, and other varieties of mica. The most pronounced characteristic of vermiculite is its extraordinary expansion in heating; the volume may increase up to 16 times the original. The porous nature of the expanded mineral makes it an ideal heat insulator. It is mined chiefly in Montana, but also in Wyoming and North Carolina, and is processed in plants situated at various strategic points in the United States. It takes the form of feather-light, resilient pellets, which, when screened or sized to remove particles that are too large or too small, are used as loose fill. Insulating cements made from expanded vermiculite screenings and bentonite or other binder are manufactured by several firms, and at least one manufacturer has produced a compressed vermiculite wallboard. Plaster and concrete, in which vermiculite takes the place of sand or other aggregate, are being used in rapidly increasing quantities; in addition to their heat-insulating value, they have acous-

tic properties and are light in weight. Vermiculite precast-concrete slabs for roof, floor, or wall construction weigh as little as 25 pounds per cubic foot and are easy to install. If necessary, they can be sawed, cut with a knife, drilled, or nailed in much the same way as wood.

Other Mineral Insulators

DIATOMITE, pumice, and other porous rocks or earths have been used for wall insulation, and diatomite, asbestos, and magnesia (chiefly a mixture of 85 percent technical carbonate and 15 percent asbestos fiber) are used extensively for boiler and pipe coverings.

Aluminum foil is used to increase the value of air spaces by reducing transfer of heat by radiation. Clean metallic surfaces usually are good reflectors and poor emitters of radiant heat, and as much of the transfer of heat across open spaces in buildings takes place by radiation, the use of aluminum on one or both sides of the space may reduce heat losses substantially. Aluminum foil also is applied in crumpled form to be self spacing.

Stiff, fibrous insulating boards having considerable structural strength usually are not as good insulators as lighter, looser materials. Heavy wallboards containing some form of gypsum, although excellent building materials, are relatively poor insulators.^a Ordinarily, the lower the density, the better the insulating value.

Production Statistics

THE production of mineral wool (home insulation only) during recent years, as reported by the National Mineral Wool Association, is indicated in the following table:

Mineral Wool (*Home Insulation Only*)

Sold in the United States

1937-1941

YEAR	SHORT TONS	VALUE
1937.....	129,335	\$ 8,896,823
1938.....	87,596	6,314,408
1939.....	100,771	7,323,476
1940.....	157,460	11,346,650
1941.....	215,422	14,001,203

^aNational Bureau of Standards, TECHNICAL INFORMATION ON BUILDING MATERIALS: No. 16, May 22, 1936.

APPENDIX "D"

I. C. 7388

OCTOBER 1946

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

HOME INSULATION WITH MINERAL PRODUCTS--

CONSERVES FUEL - REDUCES COST - INCREASES COMFORT



BY

OLIVER BOWLES

I. C. 7388,
October 1946.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

HOME INSULATION WITH MINERAL PRODUCTS - CONSERVES FUEL -
REDUCES COST - INCREASES COMFORT^{1/}

By Oliver Bowles^{2/}

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INTRODUCTION

The conservation of fuel became a critical problem during the recent war, particularly in the East. Fuel-oil supplies were short, the demands for coal increased, and householders were called upon to reduce the temperatures in their homes. Home owners were urged to employ every means available to reduce fuel consumption, the most important of which was to insulate their dwellings. The Bureau of Mines, United States Department of the Interior, took steps to promote the conservation of fuel by issuing a report^{3/} on home insulation which has been widely circulated. The American populace

^{1/} The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7388."

^{2/} Chief, Nonmetal Economics Division, Bureau of Mines.

^{3/} Bowles, Oliver, Home Insulation with Mineral Products - Conservation of Fuel for War: Bureau of Mines Inf. Circ. 7220, 1942, 11 pp.

responded patriotically to the requests of various Government agencies for voluntary conservation of fuels; they accepted cheerfully the restrictions imposed, the crisis was weathered, and with termination of hostilities the unhappy situation was relieved.

Fuel conservation, however, is not merely a war emergency problem; it is a continuous, ever present issue. Coal and petroleum resources are irreplaceable assets, and when fuel is burned it is exhausted - there is no scrap recovery. Fortunately, the United States has been richly endowed with mineral fuels; but population is growing, industrial demands for fuel are increasing, and mines and oil wells are becoming deeper and more costly to operate. For the sake of generations to come all national resources, particularly irreplaceable fuels, should be conserved.

A long step in the direction of fuel conservation is the general recognition that insulation is an essential element of dwelling construction. Fortunately, when the home owner takes measures to conserve fuel, he is not called upon to make purely unselfish (altruistic) sacrifices to advance the general welfare; he has the added incentives of saving money and promoting more comfortable living in his own home.

THE HEATING PLANT AND ITS OPERATION

The furnace is the first point where fuel economy may be sought. Each furnace is designed for a particular type and grade of fuel. Certain heating plants function best on fuel oil, others on select sizes and types of coal. Unless the proper fuel is used, improper combustion ensues, and heating efficiency declines. By careful study each home owner should learn to care for his heating plant and operate it efficiently. For practical advice on domestic heating problems the reader is referred to Bureau of Mines Information Circular 7229, How to Save Fuel at Home, by J. F. Barkley; copies may be obtained on request from the Bureau of Mines.

INSULATION AS AN AID IN CONSERVING FUEL

Weatherstripping, storm windows, and storm doors are widely recognized as important means for conserving heat. Wall, floor, ceiling, or roof insulation are more essential if maximum results are to be attained, because greater heat-loss areas are involved. The actual saving of fuel that may be accomplished by insulation is discussed later. Common insulating materials are mineral wool (a term which in its broader sense includes rock wool, slag wool, and glass wool), vermiculite, asbestos, diatomite, pumice and other porous rocks or earths, magnesia, aluminum foil, sawdust, vegetable and wood fibers in various forms, insulating boards made of vegetable or mineral products, animal hair, and cork. These materials may be placed in the hollow spaces of walls, between studding or furring strips, between ceiling or floor joists, or between roof rafters. In this report consideration is given only to those materials that are of mineral origin.

SUPPLEMENTARY BENEFITS OF INSULATION

Aside from the conservation of fuel resources, which is of ultimate benefit to everyone, insulation has certain definite advantages to the householder, as follows:

Health and Comfort

By reducing heat transfer through walls, ceilings, and floors in winter insulation raises the inside wall and ceiling surface temperatures in a heated house to such an extent that the falling currents of air (drafts) resulting from warm air coming in contact with chilled surfaces are noticeably diminished. Thus, all areas of living quarters become comfortable for the occupants, and the danger of colds brought on by drafty conditions is reduced. The same barrier will bring about indoor summer comfort. Heat is present in every object that we touch or see and can be defined as that form of energy which flows from one body to another by virtue of a difference in temperature between the two bodies. Thus, the walls and roof of a house, exposed to the direct radiant heat of the sun, begin to deliver this heat to the interior. Insulation retards this process and thus reduces indoor summer temperatures.

Dollar Savings

As pointed out in a later section of this report devoted to Fuel Saving Accomplished by Insulation nearly a billion dollars could be saved each year in existing dwellings of the United States by fuel-conservation measures (including insulation, storm windows and doors, weather stripping, caulking, and other means). Such enormous savings would substantially reduce the fuel budget of innumerable householders. A newer source of heat for homes not mentioned before is electricity which has definite possibilities. It is especially dependent upon insulation and all other heat-saving measures for economical performance.

Fire Protection

Incombustible heat-insulating barriers in roofs and walls make even frame buildings slow-burning, and this advantage has been recognized in the fire-prevention codes of many cities. The George Washington home, Mount Vernon, was insulated upon the recommendation of the National Bureau of Standards, because mineral wool placed between rafters and in the walls around dormer windows would inhibit the spread of fire. Tests at the National Bureau of Standards showed that a wood-lath partition filled with mineral wool would stop the passage of fire for 1 hour, at the end of which time the studs were still able to carry the load. Photographs of burned houses have illustrated the fact that flames, originating in the attic space from lighting, defective flues, or crossed wiring, have been checked at the line where the mineral wool lay between the joists of the second floor ceiling until the arrival of the fire department saved the balance of the house.

Reduced Redecoration Expense

The decrease in drafts within the rooms of an insulated house reduces the play of particles of dirt and dust upon walls and ceilings, and the more even temperatures of room-side surfaces, resulting from the limitation of heat escape (thermal transfer), make unlikely the appearance of disfiguring lath and beam marks. The life-expectancy of all types of interior decoration is thus increased, and redecoration becomes necessary less frequently.

Increased Resale Value

There is such a widespread demand for insulated houses as living quarters that in the event of resale an insulated house is more easily marketed. The insulated house is also a better mortgage risk for the lender, since the borrower's cash position is improved by decreased fuel expenditures and because of the less frequent need for redecoration.

PERFORMANCE OF INSULATION

Insulation reduces the transfer of heat units from one side to the other of the insulating medium, irrespective of the side on which the heat is generated. In winter it reduces the escape of heat produced by fuel combustion on the inside; and in summer, in reverse action, it reduces the penetration of the radiant energy of the sun. The result is to increase human comfort both in summer and winter.

Heat is transferred in three ways - by conduction, convection, and radiation. Insulation affects each means of transfer.

Conduction is the flow of heat through a solid, such as the heat from boiling water passing along the handle of a silver spoon. So, in lesser degree, the heat generated inside or outside a room flows through walls, ceilings, and floors. When a barrier of insulation is interposed, the flow diminishes.

Convection is a transfer of heat by moving currents of air. As such currents move past a warm surface they pick up the heat and carry it with them. Although hollow spaces in walls may be partly sealed, a difference in temperature between top and bottom of the sealed areas creates currents of air, which always carry heat from the warmer side to the colder.

Radiation is the process by which the sun's energy is carried to the earth. Any warmer surface transfers heat by radiation to any cooler neighboring surface. This radiant transfer even takes place within a room and between the walls of a room; thus the warmer walls of a house radiate heat to the colder ones. The human body also radiates heat. When this radiation is too rapid due to the low temperature of surrounding objects, personal discomfort and chills will result at ordinary room air temperatures. When walls and other surroundings are at a reasonable temperature, comfort will ordinarily ensue under the same air-temperature conditions.

Units of Heat

To measure the extent of heat transfer the British thermal unit is used: 1 B.t.u. is required to raise 1 pound of water 1° F. under specified conditions (from 39° to 40° F. at sea level). Heat losses are measured in British thermal units per square foot of material 1 inch thick per hour per degree Fahrenheit temperature difference. This quantity is sometimes called the k-factor; and, as it is the measure of heat loss, the smaller this constant is for a given material the better the insulating properties of the material.

The following table shows the thermal conductivity of a variety of materials, many of which are used in home construction. As indicated in this table the thermal conductivity or k-factor of most light, fibrous, or porous materials sold primarily as insulators ranges from 0.25 to 0.50 B.t.u. per hour.

Thermal conductivity of various materials^{1/}

Material tested	Density, lb. per cu. ft.	Conductivity ^{2/} (mean temp. 90° F.)
Sealed hollow-spaces:		
Air space - walls (3-1/2 in.)	0.081	0.86 to 1.10
Animal and vegetable insulations:		
Cork, ground	8.1	.27 to .31
Cotton	.85	.29
Flax fiber	13.0	.31 to .33
Hair felt	13.0	.26
Pine wood	34.3	.8 to 1.00
Pure wool	6.24	.26 to .32
Silk	6.24	.28 to .34
Sugarcane fibers	13.5	.34
Wood-pulp board, plaster base	16.2	.3 to .4
Mineral insulations:		
Diatomite powder	10.6	.3 to .5
Diatomite blocks	28.1	.58
Expanded vermiculite	7 to 10	.38 to .48
Magnesia (85 percent magnesia, 15 percent asbestos)	13 to 16	.40 to .46
Mineral wool	2 to 7	.27 to .30
Pumice gravel	18.8	.64
Structural materials:		
Bricks, dry	125.0	3.0 to 6.0
Brickwork (mortar bond)	132.0	4.0 to 5.0
Building stone	165.0	12.5
Concrete, 1-2-4	150.0	5.0 to 9.0
Glass, plate	15.5	3.6 to 7.3
Gypsum plaster	46.2	2.0 to 5.0
Slate shingles	162 to 205	10.0 to 10.4
Steel, 1 percent carbon	489.0	314.0 to 328.0
Tile (clay and plaster)	12.7	.60

Thermal conductivity of various materials^{1/} (Cont'd.)

Material tested	Density, lb. per cu. ft.	Conductivity ^{2/} (mean temp. 90° F.)
Pure metals:		
Copper	558.0	2,580.0 to 2,670.0
Silver (greatest conductivity)	655.0	2,860.0 to 2,920.0

1/ Authorities: National Bureau of Standards, Federal Housing Administration, and university and research laboratories.

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SAVING ACCOMPLISHED BY INSULATION

Enormous quantities of fuel are used for heating buildings. The following data for the United States for 1944 have been compiled by the Anthracite and Coke Section of the Bureau of Mines Coal Economics Division from various sources. The total anthracite used for space-heating purposes was approximately 45,000,000 net tons. The quantity of bituminous coal, lignite, and fuel briquets so used is somewhat uncertain but was about 82,000,000 net tons. Coke for space heating amounted to about 7,000,000 net tons, and fuel oil so used aggregated 200,000,000 barrels. The total value of these products at the point of origin was approximately \$940,000,000. The price paid by consumers, including transportation charges and retailers' expenses and profits, was roughly \$2,175,000,000. The quantity of gas used for space heating is not available but is known to be considerable and would add materially to the above figures. This prodigious figure for keeping people warm indicates the enormous potential field for saving when economies are introduced.

The National Bureau of Standards demonstrated (T.I.B.M. 15, May 18, 1936) that frame construction, with wood shingles over building paper 3/4-inch wood sheathing outside, and 3/4-inch plaster and metal lath (or 1/2-inch plasterboard or wallboard alone) inside, had an insulating value^{4/} of 4.6 when the 3-5/8-inch air space was unfilled. When this space was filled

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with mineral wool the value rose to 16.0. Corresponding figures for a 4-inch brick-veneer wall over the same paper and sheathing and the same interior wall finish were 3.7 when the air space was unfilled and 15.1 when it was filled (T.I.B.M. 14).

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To judge the saving that may be achieved with insulation, reference may be made to a Canadian report^{5/} embodying the results of a study made on the distribution of heat losses in homes. The study was made on 200 average homes of wood-frame construction, uninsulated, and without weatherstripping or storm windows or doors. It was found that of the heat lost, 16.2 percent was lost through the roof, 27.0 percent through the walls, 25.8 percent through the glass, 24.6 percent by air infiltration, 4.3 percent through the door, and 2.1 percent through other sources, including the floor. When 2 inches of insulating material was applied to the walls of these houses, the heat loss was reduced 17.4 percent; and the addition of 2 inches of insulation to the second-floor ceiling brought about a further reduction of 13.3 percent. Thus, complete insulation saved 30.7 percent of the heat loss.

Heat conservation and fuel saving go hand in hand. The actual quantities of fuel that may be saved by insulation are under constant study by technical schools and colleges. While there is some variation in the results of different tests, the savings obtained are always remarkably large. One of the most complete and dependable studies is that conducted by the Engineering Experiment Station, University of Illinois, on a three-story residence of standard frame construction in Urbana, Ill. Both ceiling and walls of the house were insulated with mineral-wool batts wherever they could be applied conveniently, and in other places nodulated mineral wool having a density of about 5 pounds per cubic foot was blown into place. The results of the tests, which have been described in detail,^{6/} indicate that insulation produced an average saving of approximately 30 percent in consumption of fuel. This figure agrees closely with the 30.7 percent of heat loss saved by insulation given in the Canadian report to which reference has been made. Another series of tests made by the Tennessee Valley Authority on two identical houses, one insulated with 3-5/8-inch mineral wool and the other without that insulation, revealed a heat-saving differential in the insulated house of 44.75 percent.

^{5/} Babbitt, J. D., and Hyland, John J., House Insulation in Its Relation to Canada's War Effort: Document N.R.C. 1055, National Research Council of Canada and National Housing Administration, Department of Finance, Ottawa, Canada, 1942.

^{6/} Kratz, A. P., and Konzo, S., Effect of Insulation on Plant Performance in the Research Residence: Heat., Pip., and Air Cond., May 1941, pp. 318-324.

To determine exactly the amount of national fuel saving potentially obtainable as of a given period is impossible. Many, if not most, of the homes recently built are completely or partly insulated, and vast numbers of existing homes have been insulated by blowing the insulating medium into walls and between joists and rafters. However, in the millions of homes still lacking insulation, great economies in fuel consumption can be achieved.

HOW TO INSULATE

Choice of insulating materials depends largely on relative availability and cost. Generally, mineral products are preferable because of their resistance to fire, electrical short circuits, moisture, termites, vermin, and decay. In new-home construction, if the home owner employs a competent and responsible insulation applicator he may expect to have the insulating done properly. The application of insulation to existing homes requires adequate equipment and special skill. No job is better than the man who installs it. It is important that all open spaces in ceilings and walls be completely filled with the insulating medium. If barriers prevent movement of the fill material, a new opening should be made beyond the barrier. Obviously, leaky roofs and walls should be repaired, so that moisture will not accumulate in the fill. Problems involving the relative merits of various insulating materials and their proper application are not within the province of the Bureau of Mines. The National Bureau of Standards has conducted many studies on insulating problems, and various insulating firms have developed knowledge and skill in application.

MINERAL INSULATION MATERIALS

Mineral Wool

Mineral wool consists of fine, interlaced mineral fibers having the appearance of ordinary loose wool. It is a fibrous, intermeshing material composed principally of silicates of calcium and aluminum. Mineral wool is a generic term covering a number of similar products differentiated chiefly by the raw materials from which they are made. "Rock wool" is made from natural rock (a calcareous shale) or from combinations of various natural minerals or rocks, such as limestone and shale. "Slag wool" is made from iron, copper, or lead blast-furnace slag alone or mixed with fluxing materials. "Glass wool" is made from silica sand, soda ash, and limestone with or without scrap glass or other materials.

The first step in making rock wool is to melt the raw materials, consisting of a properly proportioned mixture of alumina, silica, and lime or magnesia, in a cupola furnace. The molten material is then drawn from the bottom of the cupola in a small stream, the flow and temperature of which are regulated carefully. This molten stream is broken up by a steam jet (at 80 to 100 pounds pressure) into minute droplets, which, while still molten, are propelled rapidly through the air. During their cometlike course, fine threads of material form as tails and fall in a fluffy mass on the floor of the wool room. The fibers are then ready for use or for manufacture into mineral-wool products. Molten furnace slag or glass is made into wool by similar processes.

Mineral wool is marketed in various forms. Loose wool is the raw product as blown and without subsequent treatment. This is the material from which all mineral-wool products are made. Nodulated or granulated wool largely freed from shot is rolled into small pellets, so that it can be blown into place through an air hose. It is used chiefly for insulating houses already built. Increasing quantities of wool are fabricated into soft, flexible quilts reinforced on one or both sides by specially treated paper. The paper surface designed to be placed on the interior side of the structure is vaporproofed. "Batts" are rectangular shapes made from loose wool mixed with suitable binders and cut to the thickness and size demanded by consumers. Batts are usually reinforced by special paper covers in the same way as blankets. They are generally used for insulating houses during construction, being inserted in walls, floors, or roofs between studs, joists, or rafters. Blankets, used frequently for insulation of industrial furnaces, are made of loose wool treated with binders and are of various rectangular shapes and thickness, sewed between wire, metal lath, or other confining mediums. Loose wool with suitable binders also is compressed into blocks for use in refrigerator, stove, and furnace insulation and into various shapes for pipe and boiler coverings. Loose wool mixed with bentonite or plastic fire clay and asbestos fiber is efficient as an insulating cement for filling joints between insulating blocks, as plastic insulation for irregularly shaped objects, and for general heat-conservation use.

The following table gives the most recent available statistics of the mineral-wool industry:

Production of mineral wool in the United States, 1943-44, by products

Product	Home insulation		Industrial insulation		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Loose wool (sold as such)	62,978	\$1,720,375	6,600	\$191,584	69,578	\$1,911,959
Granulated wool (sold as such) ..	277,833	10,257,797	6,704	219,975	284,537	10,477,772
Batts	56,737	4,386,006	3,416	659,799	60,153	5,045,805
Rolls	10,117	541,256	65	2,819	10,182	544,075
Felt	6,781	791,781	34,764	5,236,679	41,545	6,028,460
Blocks	453	40,960	11,068	1,900,450	11,521	1,941,410
Boards	-	-	26,003	12,495,640	26,003	12,495,640
Mineral-wool insulating cement ...	3,432	238,006	18,839	1,230,681	22,271	1,468,687
Blankets	402	68,862	9,111	1,246,908	9,513	1,315,770
Pipe covering	11	1,522	6,875	1,443,969	6,886	1,445,491
Other	4,029	91,024	5,306	904,617	9,335	995,641
Grand total ..	422,773	18,137,589	128,751	25,533,121	551,524	43,670,710

Production of mineral wool in the United States, 1943-44, by products (Cont'd.)

Product	Home insulation		Industrial insulation		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1944						
Loose wool (sold as such)	59,787	\$1,609,235	5,410	\$188,876	65,197	\$1,798,111
Granulated wool (sold as such)	308,411	11,344,433	5,178	160,509	313,619	11,504,942
Batts	52,007	3,633,878	7,446	1,203,245	59,453	4,837,123
Rolls	6,394	372,938	565	30,955	6,959	403,893
Felt	4,683	427,393	38,998	5,154,208	43,681	5,581,601
Blocks	-	-	14,633	1,927,618	14,633	1,927,618
Boards	-	-	36,728	24,635,485	36,728	24,635,485
Mineral-wool insulating cement	1,823	135,861	10,695	825,906	12,518	961,767
Blankets	1	148	7,353	1,021,819	7,354	1,021,967
Pipe covering	-	-	5,240	958,692	5,240	958,692
Other	1,344	54,921	1,570	796,676	2,914	851,597
Grand total	434,480	17,578,807	133,816	36,903,989	568,296	54,482,796

Vermiculite

Vermiculite is another important mineral insulating material. It received its name from its peculiar property of expanding and unfolding into wormlike forms when heated. The name is applied to a group of micaceous minerals that generally are alteration products of biotite, phlogopite, and other varieties of mica. The most pronounced characteristic of vermiculite is its extraordinary expansion in heating; the volume may increase up to 16 times the original. The porous nature of the expanded mineral makes it an excellent heat insulator. It is mined chiefly in Montana, but also in Colorado, North Carolina, South Carolina, and Wyoming, and is processed in plants at various strategic points in the United States. It takes the form of feather-light, resilient pellets, which, when screened or sized to remove particles that are too large or too small, are used as loose fill. Insulating cements made from expanded vermiculite screenings and bentonite or other binder are manufactured by several firms, and at least one manufacturer has produced a compressed vermiculite wallboard. Plaster and concrete, in which vermiculite takes the place of sand or other aggregate, are being used in rapidly increasing quantities; in addition to their heat-insulating value, they have acoustic properties and are light in weight. Vermiculite precast-concrete slabs for roof, floor, or wall construction weigh as little as 25 pounds per cubic foot and are easy to install. If necessary, they can be sawed, cut with a knife, drilled, or nailed in much the same way as wood lumber. Tests by the Underwriters Laboratories, Inc., indicate that vermiculite plasters are effective in preventing the spread of fire from one part of a building to another.

Production of vermiculite in the United States during recent years is indicated in the following table. The values given in the third column for the exfoliated product are based on the assumptions of an average value of \$75 a ton, f.o.b. works, and a 10-percent loss during the exfoliation process.

Screened and cleaned vermiculite sold or used by
producers in the United States, 1940-45

Year	Short tons	Value, screened and cleaned	Value, exfoliated
1940	22,299	\$137,698	\$1,505,000
1941	23,438	125,444	1,582,000
1942	57,848	319,931	3,905,000
1943	46,645	471,595	3,149,000
1944	54,116	541,744	3,653,000
1945	64,808	648,077	4,375,000

Other Mineral Insulators

Diatomite, pumice, and other porous rocks or earths have been used for wall insulation; and diatomite, asbestos, and magnesia (chiefly a mixture of 85 percent technical carbonate and 15 percent asbestos fiber) are used extensively for boiler and pipe coverings.

Aluminum foil is used to increase the value of air spaces by reducing transfer of heat by radiation. Clean metallic surfaces usually are good reflectors of radiant heat, and as much of the transfer of heat across open spaces in buildings takes place by radiation, the use of aluminum on one or both sides of the space may reduce heat losses substantially. Aluminum foil also is applied in crumpled form to be self-spacing.

Stiff, fibrous insulating boards having considerable structural strength usually are not as good insulators as lighter, looser materials. Ordinarily, the lower the density, the better the insulating value.

APPENDIX "E"

INSULATION FOR HEATING AND COOLING

DEFINITION OF TERMS

- BTU - British Thermal Unit. The quantity of heat required to raise one pound of water one degree Fahrenheit.
- "k" - The thermal conductivity of a homogeneous material one inch in thickness.
- "C" - The thermal conductance of non-homogeneous materials or of homogeneous materials of a specified thickness other than one inch.
- "U" - The coefficient of heat transmission through a building section, such as a wall, floor, or ceiling. "U" is expressed in BTU per hour per square foot per degree Fahrenheit difference in temperature on the two sides of the section.
- "R" - The resistance to heat flow. R is the reciprocal of U, k, or C.

$$R = \frac{1}{U} ; R = \frac{1}{k} ; R = \frac{1}{C}$$

The higher the R-value, the more resistant the material or section is to the flow of heat. Materials with high R-values have low heat losses.

REFERENCE

ASHRAE Handbook of Fundamentals, 1967
The American Society of Heating, Refrigerating and
Air-Conditioning Engineers, Inc.
Chapter 26; "Design Heat Transmission Coefficients".

APPENDIX "G"

HEAT LOSS CALCULATIONS - TYPICAL HOUSE

Location In cities in which average design outdoor condition is -5°F . Indoor temperature is assumed to be 70°F . The attic is unheated. One-half the basement, under the bedrooms and baths, is an unfinished crawl space. The remaining one-half of the basement has a 7'-0" ceiling height. Infiltration losses are estimated by the air change method.

The building is constructed as follows (heat transmission coefficients, U, are in parentheses).

Walls: Wood shingles, building paper, plywood sheathing on studding;
1/2" gypsum wallboard. (U = 0.23)

Attic Wall: Same as above. (U = .23)

Basement Walls: 10" Concrete. (U = 0.10)

Roof: Asphalt shingles; 15# building paper, 25/32" wood sheathing on rafters.
(U = 0.44)

Ceiling: 1/2" gypsum wallboard. (U = 0.60)

Windows: Double-hung wood windows (80% glass area). (U = 1.02)

Aluminum sliding doors, Dining Room: (U = 1.13)

Floors: Maple on yellow pine sub-floor (U = 0.28)

Floor (Basement and garage): 4" concrete on 4" porous fill (U = 0.11)

Floor Area 1474 sq. ft.

Reference: ASHRAE Handbook of Fundamentals, 1967
The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
Chapter 27, "Heating Load" pp. 463-465.

UNINSULATED (No storm doors or sash)

Room or Space	Walls	Ceiling & Roof	Floor	Glass & Door	Infiltra- tion	Totals
Bedroom 1, Hall & Closets	3,140	6,190	2,290	2,370	1,900	15,890
Bath 2	880	950	350	460	390	3,030
Bath 1, and Linen	760	1,220	450	460	500	3,390
Bedroom 2 & Closets	1,260	4,020	1,490	1,220	1,230	9,220
Bedroom 3 & Closets	2,500	3,920	1,450	1,910	1,200	10,980
Hall	-	1,880	700	-	590	3,170
Foyer, Vestibule & Closet	230	2,730	-	1,750	1,670	6,380
Dining Room	290	2,990	-	5,420	1,830	10,530
Living Room	3,240	7,140	-	4,210	4,370	18,960
Kitchen	1,030	3,650	-	1,910	2,240	8,830
Laundry & Closet	1,740	2,910	-	1,300	2,400	8,350
Garage	1,520	2,330	1,210	2,150	3,230	10,440
Design Totals	16,590	39,930	7,940	23,160	21,550	109,170
Operating Totals	16,590	39,930	7,940	23,160	10,775	98,395
Percentages	16.9	40.5	8.1	23.5	11.0	100.0

INSULATED
FHA MINIMUM =
50 Btuh/sq.ft. floor area

(With storm doors and sash)

Room or Space	Walls	Ceiling & Roof	Floor	Glass & Door	Infiltra- tion	Totals
Bedroom 1, Hall & Closets	3,140	1,650	2,290	1,120	1,900	10,100
Bath 2	880	250	350	220	390	2,090
Bath 1, and Linen	760	320	450	220	500	2,250
Bedroom 2 & Closets	1,260	1,070	1,490	580	1,230	5,630
Bedroom 3 & Closets	2,500	1,040	1,450	900	1,200	7,090
Hall	-	500	700	-	590	1,790
Foyer, Vestibule & Closet	230	720	-	960	1,670	3,580
Dining Room	290	790	-	3,170	1,830	6,080
Living Room	3,240	1,900	-	1,980	4,370	11,490
Kitchen	1,030	970	-	900	2,240	5,140
Laundry & Closet	1,740	770	-	840	2,400	5,750
Garage	1,520	2,990	1,210	2,150	3,230	11,100
Design Totals	16,590	12,970	7,940	13,040	21,550	72,090
Operating Totals	16,590	12,970	7,940	13,040	10,775	61,315
Percentages	27.0	21.2	12.9	21.3	17.6	100.0

INSULATED
NMWIA RECOMMENDATIONS

(With storm doors and sash)

Room or Space	Walls	Ceiling & Roof	Floor	Glass & Door	Infiltra- tion	Totals
Bedroom 1, Hall & Closets	960	790	570	1,120	1,900	5,340
Bath 2	270	120	90	220	390	1,090
Bath 1, and Linen	230	150	110	220	500	1,210
Bedroom 2 & Closets	380	510	370	580	1,230	3,070
Bedroom 3 & Closets	760	500	360	900	1,200	3,720
Hall	-	240	170	-	590	1,000
Foyer, Vestibule & Closet	70	350	-	960	1,670	3,050
Dining Room	90	380	-	3,170	1,830	5,470
Living Room	950	910	-	1,980	4,370	8,210
Kitchen	310	460	-	900	2,240	3,910
Laundry & Closet	480	370	-	840	2,400	4,090
Garage	550	1,430	1,210	2,150	3,230	8,570
Design Totals	5,050	6,210	2,880	13,040	21,550	48,730
Operating Totals	5,050	6,210	2,880	13,040	10,775	37,955
Percentages	13.3	16.3	7.6	34.4	28.4	100.0

APPENDIX "H"

PROCEDURE FOR ESTIMATING ANNUAL HEATING CONSUMPTION OF "TYPICAL" HOUSE

METHOD USED

"Degree Day Method" as detailed on pp. 12/106-12/107 in
"Gas Comfort Heating and Cooling & Fuel Comparisons",
American Gas Association, Inc.

FORMULA

$$F = (U.C.F.) \times N_b \times (^{\circ}D) \times C_f$$

F = fuel consumption for the estimated period.

U.C.F. = unit consumption factor, or quantity of fuel
used per day. Based on Utilization Efficiency
(E) of 67%, U.C.F. = .00548 (Interpolated).
(Table 12-48a, p. 12/107)

N_b = calculated hourly heat loss.

$^{\circ}D$ = number of degree days for the estimated period.
5000 degree days used in examples.

C_f = temperature correction factor; Table 12-48b,
p. 12/107). C_f = .942 (Interpolated for
outside design temperature of $-5^{\circ}F$).

COMMENTS

1. Results, in therms, converted to cubic feet by multiply-
ing by 96.62.
2. Cost of heating estimated at $\phi 0.15$ per therm.

* Utilization Efficiency (E) values for oil and gas systems
vary in references from 40% to 80%. An E of 67% was selected
for illustrative purposes, with deliberate intent towards
conservativeness in this selection.

April 24, 1969

SUPERSEDING

Fed. Spec. HH-I-521C(In part)

October 10, 1946

(See 6.6)

FEDERAL SPECIFICATION

INSULATION BLANKETS, THERMAL
(MINERAL FIBER, FOR AMBIENT TEMPERATURES)

This specification was approved by the Commissioner, Federal Supply Service,
General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION.

1.1 Scope. This specification covers mineral fiber thermal insulation blankets for use in housing and other buildings at ambient temperatures.

1.2 Classification.

1.2.1 Types. Thermal insulation blankets shall be of the following types, as specified (see 6.2):

Type I - Blankets with no membrane coverings.

Type II - Blankets with a non-reflective membrane covering one principal face.

Type III - Blankets with a reflective membrane covering on one principal face.

1.2.2 Sizes and thermal resistance (R) values. Sizes and thermal resistance (R) values of insulation blankets shall be in accordance with table I, as specified (see 6.2).

TABLE I. Sizes^{1/} and thermal resistance (R) values

Type	R values ^{2/}	Width, inches ^{3/} excluding flanges	Length
I	11, 19	15, 23	96 inches or less
II, III	7, 11, 19	11, 15, 19, 23	Lengths of 96 inches or less in precut pieces. Lengths over 96 inches in rolls.

^{1/} All size listed are not available from all manufacturers. For other sizes, consult manufacturers.

^{2/} Insulation blankets of the same R value, but from different manufacturers, may vary appreciably in thickness (see 6.4). For R values other than those listed, consult manufacturers. Thermal resistance (R) values apply to the mineral fiber only, as defined in 3.5.

^{3/} For buildings utilizing steel studs, widths of 16 and 24 inches are available.

2. APPLICABLE DOCUMENTS.

2.1 Specifications and standards. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein:

Federal Specifications:

- UU-P-268 - Paper, Kraft, Untreated, Wrapping.
- PPP-B-636 - Box, Fiberboard.
- PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall.
- PPP-B-1055 - Barrier Material, Waterproofed, Flexible.

FSC 5640

Federal Standard:

Fed. Std. No. 123 - Marking for Domestic Shipment (Civilian Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, Wash.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Publications:

- C 167 - Methods of Test for Thickness and Density of Blanket-or-Batt-Type Thermal Insulating Materials.
- C 177 - Methods of Test for Thermal Conductivity of Materials by Means of the Guarded Hot Plate.
- C 445 - Methods of Test for Normal Total Emittance of Surfaces of Materials 0.01 in. or less in Thickness at Approximately Room Temperature.
- E 84 - Method of Test for Surface Burning Characteristics of Building Materials.
- E 96 - Methods of Test for Water Vapor Transmission of Materials in Sheet Form.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.)

Underwriters' Laboratories, Inc.:

Building Materials List.

(Application for copies should be addressed to the Underwriters' Laboratories, Inc., Walt Whitman Road, Melville, N.Y. 11749; 207 E. Ohio Street, Chicago, Ill. 60611; and 1655 Scott Boulevard, Santa Clara, Calif. 95050.)

National Classification Board:

National Motor Freight Classification Rules.

(Application for copies should be addressed to the National Classification Board, 1616 P St., N.W., Washington, D.C. 20036.)

Uniform Classification Committee:Uniform Freight Classification Rules.

(Application for copies should be address to the Uniform Classification Committee, 202 Union Station, 516 W. Jackson Blvd., Chicago, Illinois 60606.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS.

3.1 Material. The basic material shall be fibers made from mineral substances such as rock, slag, or glass processed from a molten state into fibrous form.

3.2 Construction. The insulation blankets shall consist of flexible units composed of felted mineral fibers in rolls or flat cut pieces, with or without various combinations of attached membrane coverings, as required.

3.2.1 Type I. Type I insulation blankets shall have no membrane coverings and shall have dimensions and physical properties to be self supporting when placed between structural members having standard spacings. A partial covering for identification purposes shall be permissible.

3.2.2 Types II and III. Types II and III insulation blankets shall have a non-reflective or reflective membrane covering, as applicable, on one principal face. The membrane coverings shall be vapor resistant and shall extend beyond the longitudinal edges of the insulation to provide flanges for attachment to structural members. When required, a vapor permeable membrane covering shall be provided on the opposite face as specified (see 6.2). When not specified in the contract or purchase order, a vapor permeable membrane covering on the opposite face may be provided at the supplier's option.

3.3 Membrane coverings.

3.3.1 Vapor permeance. When tested in accordance with 4.4.2.1, vapor resistant membrane coverings shall have a vapor permeance of not more than 1 perm and vapor permeable membrane coverings shall have a vapor permeance of not less than 5 perms.

3.3.2 Surface emittance. When tested in accordance with 4.4.2.2, reflective membrane coverings shall have a surface emittance of 0.05 or less.

3.4 Dimensional data. The dimensions of insulation blankets shall be determined in accordance with 4.4.3.1.

3.4.1 Thickness. The thickness of insulation shall be not less than that required to provide the thermal resistance (R) value specified (see table I, 3.5 and 4.4.3.2). When thickness limitations are imposed by the size of structural members, the maximum acceptable thickness of insulation to provide the required thermal resistance (R) value shall be as specified (see 6.2).

3.4.2 Dimensional tolerance.

3.4.2.1 Length. The tolerance on the specified length shall be as follows:

96 inches or less	-1/2 inch
over 96 inches	-0.5 percent

3.4.2.2 Width. The tolerance on the specified width, excluding any attaching flanges, shall be as follows:

Type I	+ 1/2 inch - 0
Type II and III	±1/4 inch

3.5 Thermal resistance. When determined in accordance with 4.4.3.2 the thermal resistance (R) value of insulation blankets, excluding membrane coverings, expressed as a reciprocal of thermal conductance (C) shall be not more than 10 percent below the R value specified (see 1.2.2 and 6.3).

3.6 Surface burning characteristics. Insulation blankets, excluding membrane coverings, shall have a flame spread classification not greater than 25 and a smoke developed classification not greater than 50 (see 4.4.3.3).

3.6.1 The label of Underwriters' Laboratories, Inc., or listing with reexamination in the Underwriters' Laboratories, Inc. Building Material List, may be accepted as evidence that the insulation blankets conform to the above requirement.

3.6.2 In lieu of the UL label, or listing with reexamination, the contractor may submit independent proof, satisfactory to the contracting agency, that the insulation blankets conform to the above requirement.

3.7 Identification marking.

3.7.1 Insulation blankets. Insulation blankets shall be marked with the manufacturer's name or trademark, the thermal resistance (R) value of the insulation (see 6.3), and the thickness to obtain this thermal resistance (R) value. On each type I insulation blanket, the identification marking shall be printed on a partial facing, branded, or indelibly marked. On types II and III insulation blankets, the identification marking shall be printed on the vapor resistant membrane covering at intervals not exceeding 8 lineal feet.

3.7.2 Shipping bags and wrapping. Shipping bags and wrapping (see 5.1) for insulation blankets shall be marked with the manufacturer's name or trademark, the length, width, thickness, the R value of the insulation, and the square feet of insulation.

3.7.3 Shipping containers. Shipping containers (see 5.2) for insulation blankets shall be marked with the manufacturer's name or trademark, the length, width, and the R value of the insulation.

3.8 Workmanship. Insulation shall be clean, dry, and free of extraneous materials. Fibers shall be evenly distributed and insulation and facings shall be sufficiently coherent to be unaffected by handling and installation.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Sampling.

4.2.1 Lot. Unless otherwise specified (see 6.2), a lot shall consist of all insulation of the same type and size submitted for inspection at the same time.

4.2.2 Visual and dimensional examination of end item. Sampling for this examination shall be in accordance with level S-2 in MIL-STD-105. The Acceptable Quality Level (AQL's) for defects listed in table II shall be 2.5 percent defective for major defects and 6.5 percent defective for minor defects.

4.2.3 Sampling for tests. Sampling for tests shall be in accordance with level S-2 in MIL-STD-105. The AQL for tests shall be 4.0 percent defective.

4.2.4 Sampling unit. The sample unit for visual and dimensional examination and tests shall consist of 8 lineal feet of insulation.

4.3 Examination.

4.3.1 End item. Insulation selected in accordance with 4.2.2, shall be examined for defects listed in table II. Dimensions shall be determined in accordance with 4.4.3.1.

TABLE II. Classification of defects, end item

Defects	Major	Minor
Type of insulation not as specified-----	x	
Dimensions not as specified or not within tolerances-----	x	
Unclean or wet insulation-----	x	
Foreign material in insulation-----	x	
Identification marking not as required (see 3.7)-----	x	
Facing material missing, badly torn, punctured, or inadequately bonded to insulation-----	x	
Damage or defects affecting function or serviceability----	x	
Damage or defects not affecting function or serviceability-		x

4.3.2 Inspection of preparation for delivery. An inspection shall be made to determine that packaging, packing and marking requirements of section 5 are complied with. Defects shall be scored in accordance with table III. For examination of contents the sample unit shall be one shipping container fully prepared for delivery selected just prior to the closing operations. Defects of closure listed shall be examined on shipping containers fully prepared for delivery. The lot size shall be the number of shipping containers in the end item inspection lot. The inspection level shall be S-2 and the AQL shall be 4 defects per hundred units.

TABLE III. Classification of preparation for delivery defects

Examine	Defects
Markings (exterior)	Omitted; incorrect; illegible; or improper size, location, sequence, or method of application.
Materials	Any component missing, or damaged.
Workmanship	Inadequate application of components such as incomplete closure of container flaps, loose strapping, inadequate stapling. Bulging or distortion of container.

4.4 Test methods.

4.4.1 Specimens. Membrane coverings and insulation blankets shall be separated from each other and tested separately as indicated.

4.4.2 Tests for membrane coverings.

4.4.2.1 Vapor permeance. Vapor permeance shall be determined in accordance with procedure A of ASTM E 96 (see 3.3.1).

4.4.2.2 Surface emittance. Surface emittance shall be determined in accordance with ASTM C 445 (see 3.3.2).

4.4.3 Tests for insulation blankets.

4.4.3.1 Dimensions. Dimensions shall be determined in accordance with ASTM C 167 (see 3.4).

4.4.3.2 Thermal resistance. Thermal resistance shall be calculated from thermal conductivity or thermal conductance as determined in accordance with ASTM C 177. When specimens exceed 4 inches in thickness, the specimens may be split in halves and average test results of the upper and lower halves totaled for calculation of the R value (see 3.5).

4.4.3.3 Surface burning characteristics. The flame spread and smoke developed classifications shall be determined in accordance with ASTM E 84 (see 3.6).

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A, B, or C, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Precut pieces. Precut pieces of insulation furnished in widths, lengths and quantities as specified (see 6.2), shall be packaged in a bag or wrapped with material meeting the requirements of PPP-B-1055, B-1 or B-2. The wrap or bag shall be secured by stitching, tape, adhesive, or staples.

5.1.1.2 Rolls. Rolls of insulation furnished in widths, lengths, and quantities as specified (see 6.2), shall be packaged in a bag or wrapped with material meeting the requirements of PPP-B-1055, B-1 or B-2. The wrap or bag shall be secured by stitching, tape, adhesive, or staples.

5.1.2 Level B(see 6.7).

5.1.2.1 Precut pieces. Precut pieces of insulation furnished in widths, lengths, and quantities as specified (see 6.2), shall be packaged in a bag or wrapped with material meeting the requirements of UU-P-268, grade B. The wrap or bag shall be secured by stitching, tape, adhesive, or staples.

5.1.2.2 Rolls. Rolls of insulation furnished in widths, lengths, and quantities as specified (see 6.2), shall be packaged in a bag or wrapped with material meeting the requirements of UU-P-268, grade B. The wrap or bag shall be secured by stitching, tape, adhesive, or staples.

5.1.3 Level C. The insulation shall be packaged to afford protection against deterioration and damage from the supplier to the initial destination.

5.2 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level A. When specified (see 6.2), insulation of like description shall be packed in a close-fitting box conforming to PPP-B-636, class weather-resistant or PPP-B-640, class 2, grade A. The boxes shall be closed and strapped in accordance with the applicable specification or appendix thereto. The gross weight of the triple wall box shall not exceed 200 pounds. The gross weight of the PPP-B-636 box shall not exceed the weight limitations of the box specification.

5.2.2 Level B. When specified (see 6.2) insulation of like description shall be packed as required for level A except that boxes shall be domestic or class 1 as applicable.

5.2.3 Level C. The insulation shall be packed in a manner which will insure arrival at destination in satisfactory condition and be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification Rules or with National Freight Classification Rules.

5.3 Marking.

5.3.1 Civil agencies. In addition to markings required by the contract or order, the packages shall be marked in accordance with Fed. Std. No. 123.

5.3.2 Military agencies. In addition to markings required by the contract or order, the packages and shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. All types of insulation are intended for use as thermal insulation in housing and other buildings at ambient temperatures.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Type (see 1.2.1).
- (c) Length, width, and R value (see 1.2.2 and table I).
- (d) Requirements for vapor permeable membrane covering (see 3.2.2).
- (e) When required, the maximum acceptable thickness to provide the specified R value (see 3.4.1).
- (f) Size of lot, if different from 4.2.1.
- (g) Selection of applicable level of packaging and packing required (see 5.1 and 5.2).
- (h) Quantity of insulation required (see 5.1.1 and 5.1.2).
- (i) When fiberboard boxes are required for shipping containers (see 5.2.1).

6.3 Thermal resistance R value. R is the reciprocal of the thermal conductance (C) and can be calculated as follows:

$$R = \frac{1}{C} = \frac{t}{k}$$

Where:

- t = Thickness of insulation in inches.
- k = Thermal conductivity value in Btu in./hr. sq. ft. °F. at 75°F. mean temperature.
- C = Thermal conductance value in Btu/hr.sq.ft.°F.

6.4 Insulation thicknesses. Insulation is produced by different manufacturers at different densities, therefore, there is a wide variation in thickness for the same R value between various manufacturers. No effort should be made to relate any specific R value to any specific thickness. The commercial thicknesses generally available range from 1-1/2 to 7 inches.

6.5 Industrial insulation blankets. Mineral fiber insulation blankets for industrial application are covered by HH-I-558.

6.6 Supersession data. Blowing and pouring wool, formerly covered by this specification, are now covered by HH-I-1030.

6.7 Level B packaging (see 5.1.2) has been developed by GSA for Civil agency procurement, For Navy procurement, details of Level B packaging, when required, should be developed at the time of procurement when all conditions are known.

6.8 Improved total thermal performance may result from products employing reflective surface membrane(s) when installed according to the manufacturer's specifications. Ideal resistance values of reflective air spaces are shown in the ASHRAE Guide and Data Book, "The Handbook of Fundamentals".

6.8.1 Building Materials and Structures Report 151, "Thermal Resistance of Airspaces and Fibrous Insulations Bounded by Reflective Surfaces", published by the National Bureau of Standards under date of November 14, 1957, includes data indicating that combinations of fibrous insulation and air spaces having one or both sides reflective may depart from the values for the ideal type of air space. Copies of BMS 151 may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

MILITARY CUSTODIANS:

Navy - YD
Air Force - 84

Review activities:

Navy - YD
Air Force - 84

User activities:

Army - ME, CE
Navy - None
Air Force - None

Military Coordinating Activity:

Army - ME

Preparing activity:

GSA-FSS

★ U.S. GOVERNMENT PRINTING OFFICE: 1970 - 395-553/135

Order for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein. Price 10 cents each.

FEDERAL SPECIFICATION**INSULATION, THERMAL (MINERAL FIBER, FOR
PNEUMATIC OR POURED APPLICATION)**

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers mineral fiber thermal insulation for use in housing and other buildings by pneumatic or pouring application.

1.2 Classification. Insulation shall be of the following types and classes, as specified (see 6.2):

Type I—Pneumatic application.

Type II—Poured application.

Class a—Loss on ignition 1 percent or less.

Class b—Loss on ignition 12 percent or less.

2. APPLICABLE DOCUMENTS

2.1 Specifications and standards The following specifications and standards, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Specification:

UU-S-48—Sacks, Shipping, Paper.

Federal Standard:

Fed. Std. No. 123—Marking for Domestic Shipment (Civilian Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, and Seattle, Wash.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standards:

MIL-STD-105—Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-129—Marking for Shipment and Storage.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Publications:

C 177—Thermal Conductivity of Materials by Means of the Guarded Hot Plate.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa., 19103.)

U. S. Department of Commerce Commercial (CS) Standard:

CS131—Industrial Mineral Wool Products, All Types, Testing and Reporting.

(Application for copies should be addressed to the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 20402.)

3. REQUIREMENTS

3.1 Material. Mineral fiber insulation shall be rock, slag, or glass processed from molten state into fibrous form.

3.1.1 Type I. Type I insulation shall be mineral fibers as originally processed or further mechanically processed, to produce a mineral fiber insulation suitable for pneumatic application.

3.1.2 Type II. Type II insulation shall be mineral fibers mechanically granulated for pouring application.

3.2 Physical requirements. Insulation shall conform to the requirements in table I (see 4.4).

R value	Minimum thickness	Maximum net coverage	Minimum weight per square foot
To obtain an insulation resistance R of:	Installed insulation should be not less than:	Contents of this bag should not cover more than:	The weight per square foot of installed insulation should be not less than:
R = 24	 inches thick	 square feet	 lbs. per sq. foot
R = 19	 inches thick	 square feet	 lbs. per sq. foot
R = 13	 inches thick	 square feet	 lbs. per sq. foot
R = 9	 inches thick	 square feet	 lbs. per sq. foot

(f) Builder's statement. "This insulation has been installed in conformance with the above recommendations to provide a value of R=..... using bags of this insulation to cover square feet of area."

(g) Place for builder's signature, company name, and date.

3.4 Workmanship. Insulation shall be free of extraneous materials, and shall be clean and air dry.

TABLE I. *Physical requirements*

Requirement	Types I and II	
	Class a	Class b
Thermal conductivity, maximum Btu/hr. sq. ft. (deg. F./in.) at 75°F. mean temperature	0.32	0.32
Moisture adsorption, maximum percent by weight	2	1
Nonfibrous content, maximum percent by weight	20	20
Density, p.c.f.	4 or less	4 or less
Loss on ignition, percent	1 or less	12 or less

3.3 Marking. Each bag of insulation shall be marked with the following:

- Name of manufacturer.
- Type of insulation, pouring or pneumatic.
- Weight of insulation per bag.
- The statement, "The manufacturer recommends these maximum coverages at these minimum thicknesses to provide the levels of installed insulation resistance (R) values shown".
- Filled-in table on insulation including the following:

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification

where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Sampling.

4.2.1 *Lot.* Unless otherwise specified (see 6.2), a lot shall consist of each type and class of insulation in sacks that are submitted for inspection at the same time.

4.2.2 *For examination.* Sampling for visual examination shall be according to level S-4 in MIL-STD-105.

4.2.3 *For tests.* Sampling for tests shall be according to level S-1 in MIL-STD-105.

4.3 Examination.

4.3.1 *End item.* Insulation shall be examined for defects listed in table II. The acceptable quality levels (AQL's) for defects shall be 2.5 percent defective for major defects and 4.0 percent defective for minor defects.

TABLE II. *Classification of defects, end item*

Defects	Major	Minor
Type and class not as specified ..	X	
Extraneous materials in the insulation	X	
Dirty or damp insulation	X	
Sacks not marked		X

4.3.2 *Examination of preparation for delivery requirements.* An inspection shall be made to determine that the packing and marking comply with the requirements in section 5. Defects shall be scored in accordance with table III. The sample unit shall be one shipping container fully prepared for delivery. Sampling shall be in accordance with MIL-STD-105. The lot size shall be the number of shipping containers in the end item inspection lot. The inspection level shall be S-2 with an AQL of 4.0 defects per hundred units.

TABLE III. *Classification of preparation for delivery defects*

Examine	Defects
Markings	Omitted; incorrect; illegible, improper size, location, sequence, or method of application.
Materials	Sacks missing, damaged, or not completely filled.
Workmanship	Inadequate or improper closure of sacks.

4.4 Tests (see 3.2).

4.4.1 *Acceptance.* The AQL for tests shall be 6.5 percent defective.

4.4.2 *Thermal conductivity.* The K factor shall be determined in accordance with ASTM C 177 using the density determined in 4.4.5.

4.4.3 *Moisture adsorption.* Amount of moisture absorption shall be determined in accordance with section VII of CS131.

4.4.4 *Nonfibrous content.* Amount of shot shall be determined in accordance with section IX of CS131, except that the specimen shall be heated to 800°F. for 20 minutes prior to test.

4.4.5 *Density.* Prepare a wood box having inside dimensions of 12 by 12 by 12 inches. Fill box loosely, by blowing or pouring, with insulation and screed or level flush with the top of the box. Drop the box on a firm surface from a height of 6 inches; repeat three times, and the residual space thus obtained after each drop shall be filled loosely by blowing or pouring and leveled with the top of the box. After the third drop, the box and contents shall be weighed and the tare weight of the empty box deducted. Express the net weight of the insulation in pounds per cubic foot (p.c.f.).

4.4.6 *Loss on ignition.* Remove moisture by heating in an oven at 220°F. for 30 minutes. Place a 10 gram specimen in a porcelain crucible, then place the crucible in a cool muffle furnace, and expose to a tempera-

ture of 800°F. for a period of 2 hours. Remove the crucible from the furnace, cool to room temperature, and weigh the crucible. Deduct the weight of the crucible, and then calculate the loss in weight as a percent of the original specimen weight.

5. PREPARATION FOR DELIVERY

5.1 Packing. Packing shall be level A, B, or C as specified (see 6.2)

5.1.1 Level A. Insulation shall be packed in sacks conforming to UU-S-48, 6-6x(1). The gross weight shall not exceed 40 pounds.

5.1.2 Level B. Insulation shall be packed in sacks conforming to UU-S-48, 3-3x. The gross weight shall not exceed 40 pounds.

5.1.3 Level C. Insulation shall be packed to insure carrier acceptance and safe delivery at destination in containers complying with the rules and regulations applicable to the mode of transportation.

5.3 Marking.

5.3.1 Civil agencies. In addition to markings required by the contract or order, the sacks and shipping containers shall be marked in accordance with Fed. Std. No. 123.

5.3.2 Military activities. In addition to markings required by the contract or order, the sacks and shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. Both types and classes of mineral fiber insulation are intended for use as thermal insulation in housing and buildings at ambient temperatures.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Type and class (see 1.2).
- (c) Size of lot, if different from 4.2.1.
- (d) Level of packing required (see 5.1).

6.3 R value. R is the amount of resistance a material has to flow of heat, and can be calculated as follows:

$$R = \frac{t}{k}$$

Where:

t = Thickness of insulation in inches.

k = Thermal conductivity factor in Btu/hr. sq. ft. (deg. F./in.) at 75°F. mean temperature.

CUSTODIANS:

Army—MO(ERDL)

Navy—YD

Air Force—69

Review activities:

Army—MO

Navy—YD

Air Force—69

Review/user information is current as of the date of this document. For future coordination of changes to this document, draft circulation should be based on the information in the current Federal Supply Classification Listing of DOD Standardization Document.

APPENDIX "I"

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

HOUSING PRODUCTION SCHEDULE FOR FISCAL 1969-1978 DECADE

April, 1970

Fiscal Year	Total Starts and Subsidized Rehab.	Unsubsidized New Units	Mobile Homes	Subsidized New and Rehab.
1969	2,001	1,803	363	198
1970	1,850	1,540	450	310
1971	2,040	1,535	475	505
1972	2,330	1,680	450	650
1973	2,650	1,955	450	695
1974	2,930	2,200	400	730
1975	3,085	2,355	400	730
1976	3,060	2,330	350	730
1977	3,060	2,330	350	730
1978	2,994	2,272	312	722
TOTALS	26,000	20,000	4,000	6,000

(All figures in thousands)

APPENDIX "J"

REFERENCES

- p 1 a) Typical House. Plans purchased from House Plan Headquarters, New York City.
- b) Characteristics of Typical House. Bureau of the Census and Department of Housing and Urban Development, based on latest annual data (1967).
- p 2 a) Statement of Mr. Hollis M. Dole, Assistant Secretary, Mineral Resources, Department of the Interior; Before the Subcommittee on Minerals, Materials and Fuels of the Senate Subcommittee on Interior and Insular Affairs, on November 12, 1969.
- b) "Outlook for Energy in the United States" The Chase Manhattan Bank, Energy Division, p 947.
- p 3 "United States Petroleum Through 1980"
United States Department of the Interior; p xiii
- p 4 a) I.C. 7166 April 1941 "Home Insulation; An Effective Conservation and National Defense Measure", by Paul M. Tyler - United States Department of the Interior
- b) I.C. 7220 September 1942 "Home Insulation with Mineral Products - Conservation of Fuel for War", by Oliver Bowles
United States Department of the Interior.
- c) I.C. 7388 October 1946 "Home Insulation with Mineral Products---Conserves Fuel - Reduces Cost - Increases Comfort", by Oliver Bowles
United States Department of the Interior.
- p 6 a) Federal Specification HH-I-521D, April 24, 1969
Commissioner, Federal Supply Service,
General Services Administration.
- b) ASHRAE Handbook of Fundamentals, 1967
Chapter 27, "Heating Load", pp 463-465
The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
- c) "Gas Comfort Heating and Cooling & Fuel Comparisons"
American Gas Association, Inc., pp 12-97 ff.
- p 7 "Housing Production Schedule for Fiscal 1969-1978 Decade"
United States Department of Housing and Urban Development.
- p 9 "Gas Facts"
American Gas Association, Inc.; Table 110., p 121.

APPENDIX "K"

NATIONAL MINERAL WOOL INSULATION ASSOCIATION
211 East 51st Street, New York, N. Y. 10022
Executive Director: Sheldon H. Cady

Membership List

L. C. Cassidy & Son, Inc., Indianapolis, Indiana
Certain-teed/Saint Gobain Insulation Corp., Bala Cynwyd, Pa.
Forty-Eight Insulations, Inc., Aurora, Illinois
Industrial Products Co., Inc., Mount Pleasant, Tenn.
Johns-Manville Sales Corporation, New York, N. Y.
N. L. Morell Company, Bethlehem, Pennsylvania
National Rock Wool Sales, Inc., Lagro, Indiana
Owens-Corning Fiberglas Corporation, Toledo, Ohio
Rock Wool Manufacturing Company, Leeds, Alabama
Premium Brand Insulation Group of Susquehanna Corp., Pueblo, Colo.
Tex-Ark Rockwool Corporation, Texarkana, Arkansas
United States Mineral Products Company, Stanhope, New Jersey
United States Pipe and Foundry Company, Birmingham, Alabama

TELEPHONE:
531-5432

John J. Driscoll & Co., Inc.

DEWEY DRIVE AT MACGILL AVENUE
ELLICOTT CITY, MARYLAND 21043

Sep't-18th-1970

Mr. C. G. Rebozo
Chm of Board
Key Biscayne Bank
95 West McIntire Street
Miami, Florida...33149.

Dear Mr. Rebozo:

While I realize your time is extremely valuable, taking time out to read the attached clipping could throw considerable light on the obstacles confronting the best PRESIDENT we have had to govern us in years.

I am in possession of something very valuable to this administration, which I would like to discuss personally with you and it is my hope that you may have to come north to either Washington, D.C., or New York City real soon.

Hoping to have the pleasure of a short conference with you at your convenience, I beg to remain,

Respectfully yours,

JOHN J. DRISCOLL & Co., Inc.,

by

John J. Driscoll
Pres.

encl
jjd/ad

Factions on Nixon Team Pulling GOP Party

A slow burn is suffusing the White House on the tactics of holdovers from previous Democratic administrations in sabotaging Nixon programs.

The revolt of Justice Department lawyers against the Nixon administration's civil rights policy in the delay on enforcing desegregation orders in 30 Mississippi school districts is only one case in point.

White House insiders have run down another case in the foreign aid program. They say this involves trickiness and deception by Democratic administration holdovers in claiming White House approval for a questioned program.

Nixon Cabinet members and administrators are now on notice to watch more carefully the actions of holdover offi-

cials. Republican congressmen and senators complain that they are dealing with the same old officials on programs and projects of concern to their states and districts.

In some cases, it is claimed, advance information on local projects is "leaked" by holdover officials to Democratic congressmen and senators who get the jump on their Republican colleagues in announcing the projects.

In other cases, according to the White House complainants, the details of Nixon programs are taken up with staff members in the offices of Sen. Edward M. Kennedy or Sen. Edmund S. Muskie for modification before being put in final form for submission to the White House.

In still other cases, the at-

tempt of some liberal Republicans to bridge over differences with the liberal Democratic establishment has caused trouble. The office of Welfare Secretary Robert H. Finch, one of Nixon's closest associates, comes under criticism in this respect from White House conservatives. This is in part a legacy of Finch's attempt to appoint a doctor opposed by the American Medical Association as chief medical officer of the Health, Education and Welfare department.

All this merely emphasizes the point that two factions are growing up in the Nixon administration, paralleling the division which still continues in the Republican party. The White House group, for the most part, is either non-

involved or on the conservative side.

Recent appointees to the White House staff, former newsmen Clark R. Mollenhoff and Lyn Nofziger, tend to reinforce the position of Harry Dent, former administrative assistant to Sen. Strom Thurmond, who is emerging as a formidable figure in White House affairs.

Higher-ranking officials such as H. R. Haldeman, assistant to the President, and John D. Erlichman, counsel to the President, are less knowledgeable about the inner workings of the Washington political system. Some of the new Cabinet members have been far removed from the inner turmoil of the Republican party. Such Presidential advisers as Dr. Henry A. Kissinger and Daniel P. Moynihan are novices at the political game and insensitive to the nuances of the long struggle in the GOP between the conservatives and the liberals from which Nixon has emerged as the common denominator.

But the President has shown that he is not insensitive to his middle man position, and it is reported that he shares the concern of some of the White House staffers on two points: The problem of the holdover officials of the Kennedy-Johnson administration and the effects on the conservatives of bridging the gap with Democratic and Republican liberals.

It is an old story in the Republican party that many of its nominees in the past 25 years might as well have been Democrats. That resentment led to the nomination of Sen. Barry Goldwater in the do-and-die attempt of 1964 which alienated the liberal wing of the GOP in even greater degree than conservatives had previously been alienated by the Willkie, Dewey and Eisenhower nominations.

Nixon was the best compromise both sides could find in 1968. But the old fires of mutual contempt and suspicion have not died out. Resolving the inner conflicts of the Republican party is a continuing problem for Nixon.

MEMORANDUM

THE WHITE HOUSE

WASHINGTON

September 26, 1970

Determined to be an
Administrative Marking
Not National Security Information
By JLS NARA Date 3/16/2016

CONFIDENTIAL

MEMORANDUM FOR:

PETER FLANIGAN
HARRY FLEMMING
GEORGE SHULTZ
ARNOLD WEBER

The President has requested that representatives of organized labor (not those who are labor experts; actual representatives of organized labor) be appointed to every Commission that we announce. Chuck Colson has been given the responsibility for our efforts to win the support of the union leadership and the rank and file. You should work with him on implementing the President's request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
✓ A. Butterfield
C. Colson

MEMORANDUM

THE WHITE HOUSE

WASHINGTON

September 26, 1970

Determined to be an
Administrative Marking
Not National Security Information
By J45 NARA Date 3/16/2016

CONFIDENTIAL

MEMORANDUM FOR: MR. KLEIN

Chuck Colson has been given responsibility for our effort to win the support of the union leadership and the rank and file. The press treatment will be a very major part of our effort. The President would like you to work with Colson on getting out the word about how the President is winning the workingman vote and how this Administration is pro-workingman, not anti-labor as other Republican Administrations have appeared to be. In particular, you should arrange to have regular media briefings for the labor press particularly on key economic issues.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
✓ A. Butterfield
C. Colson
R. Finch
D. Moynihan
D. Rumsfeld

September 26, 1970

CONFIDENTIAL

MEMORANDUM FOR:

HARRY DENT
MURRAY CHOTINER

It has been requested that you see to it that all of our Republican candidates address themselves to the subject of the "working man" and the "build America" theme on a regular basis. You should work with Jim Keogh and Chuck Colson on having some good position papers prepared and distributed to the candidates.

Please submit a report to the Office of the Staff Secretary on what actions are taken to comply with the above request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
A. Butterfield
C. Colson
J. Keogh

September 26, 1970

MEMORANDUM FOR:

PETER FLANIGAN
HARRY FLEMMING

It has been requested that you work with Chuck Colson on arranging for the appointment of a trade unionist to a top level post in the Administration.

Please submit a report on what actions are taken to comply with this request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
✓A. Butterfield
C. Colson

Determined to be an
Administrative Marking
Not National Security Information

By JHS NARA Date 3/16/2016 September 26, 1970

CONFIDENTIAL

MEMORANDUM FOR:

JOHN EHRLICHMAN

It has been requested that you assign someone to work with Secretary Hodgson, Director Shultz and Chuck Colson in an effort to try to identify some area in which we can clearly pre-empt the field with a pro-labor cause.

Please submit a report on what actions are taken to comply with the above request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
✓ A. Butterfield
C. Colson

Determined to be an
Administrative Marking
Not National Security Information
By JMS NARA Date 3/16/2016

September 26, 1970

CONFIDENTIAL/EYES ONLY

MEMORANDUM FOR:

JOHN DEAN

It has been requested that you arrange for the Department of Justice to initiate and sustain a major attack on left wing/Communist infiltration of the labor movement (the National Rank and File Conference, State, County, and Municipal Employees in New York, etc.) You should coordinate this with Chuck Colson who has responsibility for our effort to win the support of the union leadership and the rank and file.

Please submit a report on what actions are taken to comply with the above request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
A. Butterfield
C. Colson

Determined to be an
Administrative Marking
Not National Security Information
By JAS NARA Date 5/16/2016

September 26, 1970

CONFIDENTIAL

MEMORANDUM FOR:

CHUCK COLSON

The President has requested that you meet with the Attorney General to discuss the Seafarers matter currently in the Justice Department.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
✓ A. Butterfield

Determined to be an
Administrative Marking
Not National Security Information
By 545 NARA Date 3/16/2016

September 26, 1970

CONFIDENTIAL

MEMORANDUM FOR:

DWIGHT CHAPIN

The President requested that a meeting be arranged with
Usery and Colson to discuss our efforts to win the support
of the union leadership and the rank and file.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
A. Butterfield
C. Colson

Determined to be an
Administrative Marking
Not National Security Information
By 345 NARA Date 3/16/2006

September 26, 1970

CONFIDENTIAL

MEMORANDUM FOR: GEORGE SHULTZ

The President has requested that we proceed with some initial implementation of the Rosow blue collar report even if it is only symbolic. Would you please coordinate this with Chuck Colson who has been assigned the responsibility to coordinate our effort to win the support of the union leadership and the rank and file.

Please submit a report on what actions are taken to comply with the above request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
A. Butterfield
C. Colson

Determined to be an
Administrative Marking
Not National Security Information
By JCS NARA Date 3/16/2016

September 26, 1970

CONFIDENTIAL

MEMORANDUM FOR:

JEB MAGRUDER

It has been requested that you insure that all of our speakers address themselves to the subject of the "working man" and the "build America" theme with regularity. You should work with Jim Keogh and Chuck Colson on having some good position papers prepared and distributed to the Administration spokesmen.

Please submit a report to the Office of the Staff Secretary on what actions are taken to comply with the above request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman

✓ A. Butterfield

J. Keogh

C. Colson

Determined to be an
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Not National Security Information
By JUS NARA Date 3/16/2016

September 26, 1970

CONFIDENTIAL

MEMORANDUM FOR:

HARRY FLEMMING

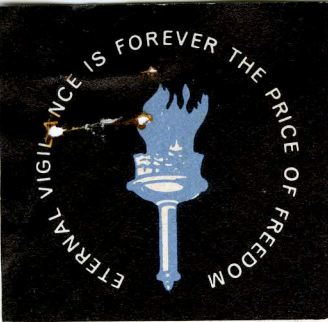
It has been requested that you insure that representatives of organized labor are appointed to virtually every Commission that we announce. Would you please work with Chuck Colson on devising a plan to insure that this request is implemented.

Please submit a report on what actions are taken to comply with the above request.

Thank you.

JOHN R. BROWN III

cc: H. R. Haldeman
A. Butterfield
C. Colson

*Alet*

CHURCH LEAGUE OF AMERICA

422 NORTH PROSPECT STREET • WHEATON, ILLINOIS 60187

October 12, 1970

NATIONAL LAYMEN'S COUNCIL

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Miss Rose Mary Woods
Secretary to the President of the
United States
The White House
Washington, D. C.

Dear Rose Mary:

Here is one of the most shocking reports ever brought
to our attention and compiled by our undercover
intelligence agents in recent years!

A copy of this must be put into the hands of the
President and the Vice President of the United States.

This seems to be the planning center for most of the
revolutionary activity which is taking place within
the United States, and it is operating within the
shadow of the Capitol dome!

Sincerely yours,

Edgar Bundy

Edgar C. Bundy
Executive Secretary

ECB:jp

THE INSTITUTE FOR POLICY STUDIES

During the past seven years, the theory behind many anti-war protests and disruptive activities designed to force social change - activities which in Latin America would be termed revolutionary - can be traced directly to the Institute for Policy Studies.

During the same period, the Institute for Policy Studies has operated a major peace offensive among Senators and Congressmen in Washington, attacking government spending on defense and the war in Southeast Asia.

And, concomitantly, many of those supported financially by the Institute have been among the leaders of self-styled revolutionary movements in many segments of our society. The Students for a Democratic Society and New Mobe through Jews for Urban Justice and the Committee for Returned Volunteers to the New Party and the underground press in Washington, D.C. have benefited from the largess distributed by the Institute.

The Institute for Policy Studies (IPS) occupies a four-story town house at 1520 New Hampshire Avenue, N.W., Washington, D.C. 20036 (202/AD 4-9382), and was organized in a six-month period in 1963 by Marcus Raskin and Richard Barnet. Soon after its formation, the Peace Research Institute, operating in Washington with funds from the Institute for International Order, also known as the Earl D. Osborn (EDO) Foundation, under the direction of Arthur Waskow merged with IPS.

The *Encyclopedia of Associations* describes IPS in its own words as a "center of intellectual activity in which scholars and government officials can exchange ideas and collaborate on some of the problems most critically in need of new thought." The entry for IPS continues:

"Appoints fellows who frame the research questions they pursue and are able to take independent and critical positions. Work of the fellows has three basic goals: 'to study the governmental process at first hand to describe more adequately the social, political, and economic reality within which major public problems must be considered; to fashion possible solutions to some of these problems; and to consider how these solutions might be put into effect through the institutions of society.' Sponsors seminars, conferences, and lectures."

A more realistic statement of IPS's purpose is given by one of its co-directors, Arthur Waskow. Writing in the Spring 1968 issue of *New University Thought*, he states:

"The Institute is not just an ordinary research center because it's committed to the idea that to develop social theory one must be involved in social action and in social experiment. And therefore, the Institute stands on the bare edge of custom in the United States as to what an educational research institution is, as against what a political institution is. By standing on that bare edge, it creates tension."

Waskow makes his personal preference plain in this article explaining, "I have a gut preference for disorder....," and in academic terms details

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IPS (CONT.)

his rationale for action as:

"If one has identified an end goal which one considers desirable, then if one translates that good bodily into the present as a means to the achievement of the end, one has avoided the problem of judging whether certain means are legitimate to achieve certain ends." (Editorial emphasis added).

IPS is a non-profit, tax exempt institution incorporated in the District of Columbia with an annual budget variously estimated to be between \$225,000 and \$400,000.

Massive support has been given to IPS by various foundations. These include the Edgar Stern Family Fund, the Samuel Rubin Foundation, the Ford Foundation, the Milbank Foundation, the Commonwealth Fund, the Jacob Ziskind Trust, the Palisades Foundation, the National Board of Missions of the Presbyterian Church, the Field Foundation, the Edward Janss Foundation, the Cudaby Fund, Community Research and Development, Inc., and the Louis M. Rabinowitz Foundation. Private donations have also been given to IPS by individuals including Michael Gellert, Walter E. Meyer, Jennifer Cafritz, Irving Lauck, and the late James P. Warberg.

IPS is overseen by nineteen trustees under the chairmanship of Philip Stern of Washington, D.C. Other trustees are Robert Hertzstein of the law firm of Arnold, Fortas & Porter; Arthur Larson, an Undersecretary of Labor in the Eisenhower Administration; Gerard Piel, editor of *Scientific American*; James Dixon, president of Antioch College; and Hans Morgenthau of the University of Chicago.

Other trustees, according to the *Washingtonian*, December, 1969, are drawn from among the founders of IPS and include:

Richard J. Barnet, who formerly worked for the State Department and the Arms Control and Disarmament Agency. After becoming co-director of the Institute, he wrote two books, *Intervention and Revolution* and *The Economy of Death*.

Robb Burlage, who was a research director for the Planning Office of the State of Tennessee. Since becoming a fellow, he has undertaken a study of urban health problems and analyzed the use of resources in Appalachia.

Christopher C. Jencks, a writer on education and poverty issues for *The New Republic* and other magazines. With David Riesman, Jencks published *The Academic Revolution*, a study of higher education. Presently he directs an allied institute in Cambridge, Massachusetts.

Milton Kotler was a lecturer at the Urban Training Center for Christian Missions in Chicago before joining IPS. He was instrumental in founding a community corporation in a Columbus, Ohio neighborhood which gave him the material for his book, *Neighborhood Government*.

Donald N. Michael, who was a senior staff member at the Brookings Institution, joined IPS to study the political impact of technological change; he is now at the University of Michigan.

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Numbered among the trustees are the co-directors, appointed annually by the nine "resident fellows" and earning between \$10,000 and \$20,000 for the academic year. [Resident fellows are: Milton Kotler, Arthur Waskow, Frank Smith, Marvin Hollow, Christopher Jencks, Gar Alperovitz, Robb Burlage, Marcus Raskin, and Richard Barnet (phonetic spellings)].

Additional to the "resident fellows," a term "borrowed" from the English university system, IPS has a number of "visiting fellows" who are mostly former Institute students given a year's tenure and a salary of something under \$10,000 each. [At present the "visiting fellows" include Leonard Rodberg; James Garrit; Betty Garman; Cherif Guellal, former Algerian Ambassador to the United States; Ralph Stavins and Motal Moccibi (phonetic spellings)].

Next in IPS's hierarchy are the very numerous "associate fellows" who are involved with specific lectures, seminars, projects, etc. At the bottom are the Institute students. Until the fall of 1969, the Institute had some twenty students each academic year; but with no curriculum and no traditional teaching, the practice has been ended. However, students are still a part of IPS's structure and are recruited from Antioch College, the University of California at Berkeley, the University of Illinois, Reed College, and the Virginia Theological Seminary. These students are called "research fellows" and receive a stipend for a specific project.

The original Board of Trustees in 1963, as listed by IPS, consisted of Thurman Arnold, formerly a Court of Appeals judge, now senior partner of Arnold, Fortas & Porter, Washington, D.C.; Richard J. Barnet; David F. Cavers, a law professor formerly an assistant dean at Harvard; James Dixon, President of Antioch College; Freeman Dyson, Physicist, Princeton, N.J.; Robert M. Herzstein, attorney; Arthur Larson, Director of the World Rule of Law Center; Hans J. Morgenthau, Professor of Political Science, University of Chicago; Steven Muller, Director of the Center of International Studies, Cornell University; Gerard Piel, publisher of the *Scientific American*; Marcus Raskin; David Riesman, Professor of Political Science, Harvard University; Philip M. Stern, formerly Deputy Assistant Secretary of State; and James P. Warburg, author and foreign policy analyst.

Over the past seven years, the list of those involved in IPS activities has grown to vast proportions and include many of our best known radical militants. For example, a June 1965 conference "Youth in Politics" attracted as participants Robert Parris [Moses], Donna Richards and Courtland Cox of SNCC; Tom Hayden, Phil Hutchings, Terry Jefferson, Mrs. Bessie Smith and Connie Brown of the Newark Community Union Project (NCUP).

Other names which appear in various IPS publications as taking an active role as either staff or seminar leaders include:

Rev. Channing E. Phillips	Jack Heller	Julian Bond
Harold Taylor	Arthur Miller	Charles Osgood
Don Michael	David Rioch	I.F. Stone
David Bazelon	Donald Michael	Rick Margolies
Emile Benoit	Carolyn McKnight	Michael Tigar
Oscar Gass	Karl Hess	Ralph Featherstone
Paul Goodman	Richard Kaufman	Ivanhoe Donaldson
Harvey Perloff	Frank Smith	Stephen Hess (now a Special
Felipe Pazos	Topper Carew	Assistant to President Nixon
		for Urban Affairs)

IPS (CONT.)

Co-directors of IPS since its formation have been Richard J. Barnett and Marcus G. Raskin, while the most vocal of the "fellows" has been Arthur I. Waskow.

Richard Barnett, 41, a visitor to Hanoi in 1969, was graduated from Harvard Law School in 1954. After working for the Boston law firm of Choate, Hall & Stewart, Barnett joined the U.S. Department of State, working in the U.S. Disarmament Administration as a GS 15, and serving at one time as the deputy director of political research for the U.S. Arms Control and Disarmament Agency. In 1963, prior to the formation of IPS, Barnett gained some attention in a broadcast over Radio Moscow when he stated that the banning of nuclear weapons tests was in the common interest of both the U.S. and the U.S.S.R. - the date of the broadcast very appropriately, April 1.

Marcus G. Raskin, 36, who has been associated with the SDS Radical Education Project (REP), was indicted and acquitted in the Boston anti-draft conspiracy trial in which he was a co-defendant with Dr. Benjamin Spock, Rev. William Sloane Coffin, Jr., Mitchell Goodman and Michael Ferber.

With the title, "Chairman, The Committee for the Formation of a New Party," Raskin was instrumental in forming the "New Party," in the immediate aftermath of the 1968 Democratic Party Convention.

An informed article on the Institute for Policy Studies by Shirley Scheibla in *Barron's* (10/6/69) provides the following information:

"Mr. Raskin's Washington career began in 1960, when he served as clerk and free lance writer to several Congressmen, including Representatives Kastenmeier, Herman Toll (D., Pa.), James Roosevelt (D., Calif.) and William S. Moorhead (D., Pa.). Mr. Raskin soon co-authored a report with Mr. Waskow for Representative Kastenmeier. Copyrighted in 1961, it was titled 'Deterrence and Reality,' and so far as can be determined, constituted the first advocacy of U.S. unilateral disarmament on Capitol Hill. Mr. Waskow subsequently expanded the report into a book, *The Limits of Defense*.

"According to a press release by Representative Kastenmeier, Mr. Raskin also served as group secretary for the *Liberal Papers*, a collection of essays written by more than a dozen professors for a number of Democratic Congressmen, made public early in 1962. Among other things, the essays urged the U.S. to allow Russia to plug into this country's warning defense system (DEW); recognize and admit to the United Nations Communist East Germany, Red China, North Korea and North Vietnam; unilaterally abandon nuclear tests; break up NATO; abandon Berlin and neutralize central Europe under terms proposed by Communist Poland.

"With the advent of the New Frontier, Mr. Raskin was called to the White House to join the special staff of the National Security Council as an aide to McGeorge Bundy, who now heads the Ford Foundation. Mr. Raskin also served as a member of the American delegation to the 18-nation disarmament conference at Geneva.

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"Mr. Raskin subsequently became chairman of the Committee for the Formation of a New Party. On August 1, 1968, the Committee issued a statement by the chairman in which he said the New Party 'will stand for the dismantling of an obsolete, dangerous military establishment that is over-extended and over-reaching. It will insist that there be an arms control and disarmament law in the U.S. applicable to citizen and police as well.... It will insist that revolution in other nations or insurgencies therein should not cause interventions and suppressions by the American military.'"

Arthur I. Waskow, 37, now described as the "senior resident fellow" of IPS, is the link between the area of so-called "responsible dissent" and the storm troopers of the New Left.

A native of Baltimore, Maryland, Waskow was educated at John Hopkins University and subsequently the University of Wisconsin. From 1959 to 1961, he was a legislative assistant to Representative Robert W. Kastenmeier (D., Wisc.); and from 1961 until he joined IPS in 1963, Waskow was a senior staff member of the Peace Research Institute.

Waskow has become a familiar figure at anti-war demonstrations since those at the Pentagon in 1967 through the Chicago riots of 1968 to the Cambodian/Kent State demonstrations in Washington. [At this latter event, Waskow tried to organize civil disobedience at a "street level," but was speedily and with some physical violence rejected as lacking sufficient knowledge of street fighting tactics!]

A full documentation of Art Waskow's radical activities is beyond the scope of this article; however these activities include active membership in Jews for Urban Justice [Waskow authored a special freedom haggadah - Passover prayerbook], the New Mobilization Committee to End the War in Vietnam, and in the National Committee for a Sane Nuclear Policy.

In August, 1965, Waskow represented IPS at a meeting at the Center for the Study of Democratic Institutions, Santa Barbara, California, which led the following year to a National Conference for a New Politics (NCNP) in Chicago. In 1967, Waskow attended the first NCNP convention in Chicago; subsequently he was identified on the floor of the U.S. House of Representatives as "one of the founders and leaders of the NCNP."

Associated with the SDS Radical Education Project, Waskow wrote to the SDS New Left Notes in 1967, taking issue with an aspect of SDS "philosophy" but stating that "since joining SDS in 1963 I have had nothing to complain about." And in 1969, the obviously still satisfied Waskow contributed \$500 to the Weatherman bail fund for those arrested during the "Days of Rage" in Chicago.

In 1968, according to the Washington Post, Waskow helped plan the demonstrations at the Democratic National Convention. After the Convention he wrote:

"The lesson of Chicago is guerrilla politics - not guerrilla war. The urban guerrilla in a developed country is the man who uses his social niche and involvement as a base of action, the way Mao used Yenan - not the man who

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IPS (CONT.)

throws a rock and ducks into the alley.... Our armies of the night need new recruits - to get them we must invent a political course of action, not new street tactics."

And following the 1968 Waskow directive, IPS has indeed moved toward a political course of action by developing the New Party; but at the same time, new street tactics for disruption have been planned, developed and promulgated!

The New Party was announced in a press statement by Marcus Raskin on August 1, 1968, with Patricia Saltonstall handling the public relations. After a flurry of activity around the 1968 presidential elections which involved, among others, a national executive consisting of Raskin; Christopher Jencks; Daniel Fivel, D.C. Democratic National Committeeman; Cornelius Gibbons, New York; Gentry Fowler, SCLC; Gore Vidal; Dr. Benjamin Spock; Rev. Andrew Young and David Frost of New Jersey. [Others involved included Mario Savio, one-time Berkeley Free Speech Movement leader, and Peter Yarrow, member of the Peter, Paul and Mary folk group, convicted and jailed in 1970 on a morals charge].

The New Party became dormant after the election leaving IPS with the time to concentrate on escalating dissent at two different levels.

On one level, seminars, briefings and research were made available to liberal legislators and their aides providing them with anti-war, anti-defense spending materials and theories.

On another level, IPS takes credit for taking leadership roles in such diverse activities as the formation of Federal Employees for a Democratic Society (FEDS), the Washington chapter of the Committee of Returned Volunteers (CRV), the Drum and Spear Bookstore (managed by former SCLC organizer Ralph Featherstone who died in a bomb explosion immediately prior to the commencement of the H. Rap Brown trial in Maryland), Jews for Urban Justice, and various community control of police projects.

The growth of Washington's two underground newspapers, the *Free Press* and the *Quicksilver Times*, was encouraged by IPS (despite this support, the *Free Press* folded this year) as a part of its "supporting social experiments" approach. In 1969, the Institute worked with Washington's Urban Law Institute and the United Church of Christ in an attempt to deny license renewal to station WMAL-TV on the grounds that it failed to serve Washington's black community.

In June, 1970, the New Party was revived at the Milwaukee Strategy Action Conference, a conference at which the New University Conference (NUC), an SDS-oriented group, and the Communist-dominated Chicago Peace Council took active organizing roles.

A New Party workshop became official on the proposal of Professor Sidney M. Peck, a former member of the Wisconsin State Committee of the Communist Party, U.S.A. More than forty delegates attended the workshop, and it was agreed to set up "Regional Action Conferences" to further the New Party. It was announced that Sidney Lens, a leader in the Chicago Peace Council and a former leader of the Revolutionary Workers League, cited as subversive and communist by the Attorney General of the United States, would serve on the New Party advisory board.

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In a subsequent release signed by Lou Renfrow and Bob Terpstra announced that Dr. Spock and Gore Vidal "have rejoined the New Party as honorary Chairmen."

And with the stated goal of destroying the two-party system and "the aggressive militarization of the Nation," the New Party continues to organize.

Arthur Waskow was also at the Milwaukee conference; and with Rennie Davis of the Chicago Conspiracy trial and Michael Lerner, a former SDS activist now working with the Seattle Liberation Front, presented a plan to "liberate Washington" as a protest against the war in Southeast Asia. The proposal to "liberate" the capital is linked to five demands:

1. The immediate withdrawal of all U.S. troops from Southeast Asia.
2. The immediate provision of \$5,500 a year guaranteed income for every family of four.
3. The immediate liberation of all political prisoners, including the Black Panthers, the Conspiracies, draft resisters, and G.I. deserters.
4. The immediate liberation of the people of Washington from their special colonial status.
5. The immediate end of the complicity of all American institutions - colleges, universities, corporations, synagogues, churches - with the war machine and the machinery of police repression at home.

Preparations for the "liberation" action include the formation of "new Liberation Collectives and Brigades, and strengthen those collectives already in existence so as to do local organizing against local institutions of genocide and to prepare for the Disruption/Liberation of Washington." The date the various brigades are to converge on Washington is as yet undetermined.

The Liberation Brigades intend to spend "at least a week" in Washington and to achieve their ends write that "stopping Washington means:

1. Holding teach-ins with Federal employees, inside their agencies, on the real effects of their agency's policies.
2. Demanding to meet with the General Staffs of genocidal agencies like the Army, CIA, HEW, etc., so as to receive full disclosure, with documents, of their policies and decisions over the last 20 years - that demand to be enforced by closure of the agencies if necessary.
3. Holding public, televised interviews on the Capitol lawn of Members of Congress who have supported genocide at home or abroad - that process to be enforced by sit-downs at the Capitol if necessary.
4. Blocking the bridges and highways to the pentagon and the CIA.

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IPS (CONT.)

5. Halting the machinery of conscription and enlistment.
6. Stopping the collection of taxes for war and repression.
7. Opening up all the government's hospitals, cafeterias, etc. to all people.
8. Liberating some Federal agencies, as the Peace Corps was in May, to serve the real needs of real people.
9. Turning over military reservations to people who need housing.

And many many other actions.

Throughout this process, the Movement will work and act not as an atomized mass of thousands of lonely individuals under the command of an Executive Committee, but as a multitude of collectives, each of which has decided how to carry out its own commitments. Some collectives may decide to act in classic Gandhian style, to fill the jails; others may seek to remain sufficiently mobile as to avoid arrest. But all will be dedicated to stop the work of genocide."

Doubtless this plan is designed to implement a Waskow theory published in the *Saturday Review* in 1965 when he wrote that as revolutionists force tyranny to stop them, they will gain increasing acceptance.

Another 1970 project of the Institute for Policy Studies is designed to study industrial security. Over the signature of Marcus Raskin, a letter went to some 500 corporations, most of them working on secret government contracts, seeking information "as a starting point" on the "person or persons in charge of your security program." According to Raskin, some 200 corporations replied, and in the context of the plan to "liberate" Washington, it is frightening to speculate as to the use this information will be put.

Not content with the Washington base, IPS is spreading its organizational network and already has the Cambridge Institute under the direction of Gar Alperovitz and Christopher Jencks, the San Francisco Institute with Barry Weisberg and Alan Haber taking a leadership role. Studies are continuing apace related to an Institute in Toronto with Gerry Hunnius involved in the planning, and in Atlanta with Julian Bond actively involved.

The influence of IPS on government at the highest levels is never stated, incapable of exact analysis but can be evaluated against such random items as:

* Stanley L. Newman, an IPS associate fellow is Chief of the Planning and Relocation and Public Administration Branch of the Division of Program Development and Evaluation in the Model Cities and Governmental Relations office of the Office of Housing and Urban Development.

* Art Waskow was asked by American University to serve as an "expert consultant" to the federally funded AU Center for the Administration of Justice. An American University spokesman said that Mr. Waskow "may occasionally lecture on police problems."

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* Jack Heller, an associate fellow, is director of the Office of Development Programs for the Bureau for Latin America of the Agency for International Development.

* Richard Barnet and Hans Morgenthau are advisors to the Council for a Livable World. Art Waskow and "fellow" Leonard Rodberg, former bureau chief with the Arms Control and Disarmament Agency, have worked for the Council. The Council is the third highest spender of the lobbying organizations which filed reports in 1968, and takes credit for assuring the original election victory of Senator George McGovern, by having its membership contribute \$22,000 to his campaign.

* Representatives Bradford Morse, Rosenthal and Kastenmeier, all members of the group called Members of Congress for Peace Through Law whose vice-chairman is Senator McGovern, have attended "seminars" at IPS headquarters.

* Since 1963, the publishing industry has printed more than 20 books and 2,000 articles on IPS or by IPS "fellows." Garry Wills will be responsible for the next in the December, 1970 issue of *Esquire* which is provisionally entitled, "Does IPS Know Something We Don't Know?" A "sneak preview" indicates another favorable to IPS eulogy.

The Institute of Policy Studies provides a link between distinguished elected and appointed officials and the psychotic revolutionaries of the New Left. If ever the New Party, through the actions of its SDS and SNCC storm Troopers seizes power, or through academic subterfuge steals power, for surely they will never attain power through the democratic process, then at that time we can expect the Fellows of the Institute of Policy Studies to become the Commissars of the regime.

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October 9, 1970