An annotated bibliography on residential chimneys serving solid- or liquid-fuel fired heating appliances

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reinforced • reveal • roof • sand • sheathing • specification • stress • vermiculite • wallboard • weathering • window • wire • wood

BIBLIOGRAPHY

CANADA

AN ANNOTATED BIBLIOGRAPHY ON RESIDENTIAL CHIMNEYS SERVING SOLID- OR LIQUID-FUEL FIRED HEATING APPLIANCES

compiled by

C. Wachmann

This annotated bibliography has been compiled as part of a research program into the performance of residential chimneys carried out at the Division of Building Research.

The bibliography includes references to the important papers and articles published in the technical literature in the U.S.A. and Canada, and deals only with chimneys which serve solid- and liquid-fuel fired heating appliances. It does not include references on chimneys serving gas fired heating appliances or installations in high buildings, nor does it include references to university theses, circulars, specifications, text books, handbooks, or building codes.

The references are listed in alphabetical order. Author's summaries are given in quotation marks.

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DIVISION OF BUILDING RESEARCH • NATIONAL RESEARCH COUNCIL • OTTAWA, CANADA

No 12

1. Achenbach, Paul R. Physics of chimneys. Physics Today, vol. 2, no. 12, December 1949, p.18-23.

This article deals with physical factors involved in design, draft, considerations of efficiency, requirements of height and cross-sectional area, smoke problem, and fire hazard.

2. Achenbach, Paul R. and Selden D. Cole. Performance of fourteen masonry chimneys under steady state conditions. Heating, Piping and Air Conditioning, vol. 20, no. 10, October 1948, p.119-128.

Tests were conducted at the National Bureau of Standards on chimneys of different construction at flue gas temperatures of 200, 600, and 1000°F and flow rates of 20, 45, and 70 cfm, the flow rates corresponding to fuel oil burning rates of $\frac{1}{2}$, 1 and $1\frac{1}{2}$ gph. Comparison of performance was on the basis of draft produced in chimneys of brick, shale tile and cinder concrete blocks with fire clay or metal liners. Conclusions drawn from the tests provide information for selection of chimney material and type of construction.

3. Alodizing makes aluminum ideal for chimney liners. Modern Metals, vol. V, no. 12, January 1950, p.30-32.

Alodized and plastic paint coated aluminum chimney liners can withstand the action of corrosive compounds condensed from flue gas, repeated freezing and thawing, and rough handling during installation. The paint is not affected by temperature at 500°F and will only char at 1200°F. The manufacturer claims a durability comparable to that of good quality stainless steel liners. Installation in finished masonry chimneys is also possible.

4. Brown, W.G. and W.G. Colborne. Fundamentals of chimney performance. Canadian Journal of Technology, vol. 34, no. 5, September 1956, p.354-365.

"Tests on geometrically identical, thin-walled, non-radiating chimneys and considerations for other kinds of chimneys showed design data can be obtained from model tests. Methods are outlined for preparing design charts and using models to study wind effects. The performance of the thin-walled non-radiating chimneys (or similar heat exchangers) is shown to depend on the same variables encountered in isothermal flow theory."

5. Chimney fires. Safety Engineering, vol. 80, No. 3, September 1940, p.28.

This article stresses the serious hazards of a fire in a deteriorated unlined masonry chimney and describes methods of combating and of preventing such fires.

6. Cox, Paul E., and H. Ford Muecke. Progress report on improvement of clay flue liners. The American Ceramic Society Bulletin, vol. 19, no. 1, January 1940, p.19-22.

Commercial and laboratory-made chimney liners were built into lightweight refractory brick chimneys. Flue gas was supplied from a special furnace at temperatures varied between 100 and 600°F with several maxima of 800°F and one peak of 1300°F during 45-minute cycles. The commercial liners cracked during the first cycle, whereas liners in which flint-clay grog or fire sand was used had greater resistance.

7. Demary, R.C. Practical points on chimney construction. The Heating and Ventilating Magazine, vol. 26, no. 1, January 1929, p.88-89.

A number of common chimney faults are enumerated: clogged sloping flue, leaks, and insufficient flue area. Smoke testing of a chimney is considered most useful.

8. Dill, Richard S., Paul R. Achenbach and Jesse T. Duck. Observed performance of some experimental chimneys. Heating, Piping and Air Conditioning, vol. 14, no. 4, April 1942, p.252-259.

"Two small experimental chimneys arranged to operate at various stack heights were tested at several rates of gas flow and inlet temperature to simulate residential performance. Temperature gradients throughout the height of each chimney are reported, together with draft conditions and friction losses."

9. Dropp, Henry J. Chimney flues, vent piping and drains. Gas Age Record, vol. 61, no. 11, March 1928, p.361-364.

Condensation from flue gas on inside surfaces in relatively cold chimneys is discussed and methods of lining chimneys to alleviate condensation trouble are given. For gas fuel, asbestos or lead liners are suggested, for other fuels glazed sewer pipe with bell and spigot joint.

10. Fischer, W.F. Repairing break between two flues. Heating and Ventilating, vol. 29, no. 2, February 1932, p.46-47.

This article describes how a leak in the partition wall between two unlined flues was located and repaired.

11. Fitzsimmons, C.C. New developments in chimneys and flues. National Fire Protection Association quarterly, October 1944, 6 p.

With low temperature flue gas as coming from modern efficient heating appliances, masonry chimneys may not produce sufficient draft and may suffer from excessive condensation. Factory-built chimneys can overcome these faults, but may constitute a fire hazard, particularly if improperly installed. A procedure is given for analysing and testing the alternate chimney assemblies to determine their safety in use.

12. Harris, Warren S. and Ross J. Martin. Heat supplied to I=B=R research home from the inside chimney. University of Illinois, Engineering Experiment Station, Bulletin no. 407, January 1953, 47 p.

An investigation covering two consecutive winters was carried out to determine how much heat was supplied to a house from an inside masonry chimney serving an oil-fired central hot water heating system. Two methods of calculation indicated that house heating from the chimney amounted to 15% of the total heat loss of the house for normal winter temperatures or 31% of the total heat available in the flue gas. Allowance should be made for this heat gain when balancing the heat distribution system in a house. With outside chimneys such house heating does not take place.

13. Long, H.T. Two chimneys for one. Domestic Engineering, vol. 144, no. 6, December 1934, p.46-48.

A method of utilizing two adjacent flues to vent the same heating appliance is given. In addition a number of common chimney defects are listed.

14. Maconachie, J.E. Deterioration of domestic chimneys. Canadian Chemistry and Metallurgy, vol. 16, no. 11, November 1932, p.270-274, and no. 12, December 1932, p.292-295.

Condensation and the formation of H_2SO_3 and H_2SO_4 on the inside surface of chimneys, when this surface has a temperature below flue gas dew point, is considered to be the chief cause of deterioration of residential chimneys. An asphalt and chromate emulsion was found to be a particularly suitable acid-resisting coating. Flue gas turbulence should be avoided since it leads to greater heat exchange with the chimney walls.

15. Mitchell, Nolan D. Fire hazard tests with masonry chimneys. National Fire Protection Association quarterly, October 1949, 20 p.

Tests were carried out on 21 masonry chimneys of different conventional construction to determine the hazard of ignition of adjacent woodwork when conducting flue gas at various temperatures. Comparative temperature rise on the chimney surface, on wood grounds in contact with the chimney surface, and on wood joints 2 inches from chimney in relation to flue gas temperature at ground floor level are given.

16. Morgan, W.R. Condensation of moisture in flues. Engineering Experiment Station, University of Illinois, Circular No. 22, February 1934, 22 p.

Moisture content of flue gases for several coals, oils, and gaseous fuels was determined assuming 100% excess air used with coals and 50% excess air with oils and gaseous fuels. Condensation to be expected with anthracite, soft coal, and with manufactured gas was calculated using these data together with experimentally determined flue gas temperatures.

17. Possibilities for profit in the prefabricated chimney market. Sheet Metal Worker, August 1950, p.44-46.

This article gives a few details of the design and installation of a number of factory prefabricated chimneys.

18. Schmitt, L.B. and R.B. Engdahl. Performance of residential Chimneys. Heating, Piping and Air Conditioning, vol. 20, no. 11, November 1948, p.111-118.

"Four different types of residential chimneys", two of brick and two of lightweight material, "were tested for

performance under laboratory conditions. Some tests were run with simulated wind over the chimney top. Chimney performance varied only slightly with the differences in construction tested. Wind effects were large under some conditions, and were only partially counteracted by the chimney ventilator tested. Recirculation of gases in the chimney and its effect on performance are discussed. A method for calculation of available draft for a small residential chimney is given."

19. Senner, Arthur H. Chimney design. Heating and Ventilating, vol. 38, no. 9, September 1941, p.45-47.

Design calculations for residential chimneys are given and the assumptions made are indicated. The relationship of flue diameter and chimney height is discussed with the help of an example.

20. Smallwood, Julian C. An analysis of chimney draft equations. Mechanical Engineering, vol. 55, no. 1, January 1933, p.32-34.

Formulae relating draft, chimney height and internal diameter, and mass flow are developed and the influence of accuracy of fundamental data is shown. The need for further research is indicated.

21. These principles are important in chimney construction. Brick and Clay Record, vol. 97, no. 2, August 1940, p.29-30.

This article summarizes a number of design and construction considerations. Inside chimneys are considered better than outside chimneys since they are warmer.

22. Thulman, Robert K. Performance of masonry chimneys for houses. Housing and Home Finance Agency. Housing Research Paper No. 13, November 1952, 46 p.

This is a comprehensive report on tests on masonry chimneys carried out by several workers at the National Bureau of Standards. It includes performance data, criteria for fire safety, code requirements, and test methods. Conclusions are drawn from the test results and recommendations are made.

23. When building chimneys check these points. Brick and Clay Record, vol. 103, no. 3, September 1943, p.46-48.

This article summarizes a number of design and construction considerations: proper height and flue area are stressed as important, and a 4-inch wall thickness of masonry and liner is recommended. Chimneys for specific use with a particular heating unit and fuel are not advocated, since the householder may want to change the heating system at a later date.