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The World Health Organization is grateful to the specialists listed below who collaborated in the preparation of this manual. Their comments on various chapters were taken into consideration during the revision of those chapters and the finalization of the manuscript.

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# OTHER WHO PUBLICATIONS AND DOCUMENTS DEALING WITH AIR POLLUTION

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## Publications

- BARKER, K. ET AL. *Air pollution*. Geneva, World Health Organization, 1961 (Monograph Series, No. 46)
- Health hazards of the human environment*. Geneva, World Health Organization, 1972, chapter 1, pp. 19-46
- IZMEROV, N. F. *Control of air pollution in the USSR*. Geneva, World Health Organization, 1973 (Public Health Papers, No. 54)
- KATZ, M. *Measurement of air pollutants: guide to the selection of methods*. Geneva, World Health Organization, 1969
- LAWTHER, P. J. ET AL. *Epidemiology of air pollution: report on a symposium*. Geneva, World Health Organization, 1962 (Public Health Papers, No. 15)
- Selected methods of measuring air pollutants*, edited by the WHO Collaborating Centre on Air Pollution Control, National Environmental Research Center, Research Triangle Park, NC, USA (in press)
- WHO Technical Report Series, No. 157, 1958 (Fifth report of the Expert Committee on Environmental Sanitation)
- WHO Technical Report Series, No. 271, 1964 (Report of a WHO Expert Committee on Atmospheric Pollutants)
- WHO Technical Report Series, No. 410, 1969 (Report of a WHO Expert Committee on Urban Air Pollution, with Particular Reference to Motor Vehicles)
- WHO Technical Report Series, No. 506, 1972 (Report of a WHO Expert Committee on Air Quality Criteria and Guides for Urban Air Pollutants) (see Chapter 3)
- WHO Technical Report Series, No. 554, 1974 (Report of a WHO Expert Committee on Health Aspects of Environmental Pollution Control: Planning and Implementation of National Programmes)
- WORLD HEALTH ORGANIZATION. *Air pollution; a survey of existing legislation*. Geneva, 1963 (Reprint from the *International Digest of Health Legislation*, vol. 14, No. 2, 1963)

## Documents<sup>a</sup>

- The health effects of air pollution*. Report on a symposium held in Prague, Czechoslovakia, from 6 to 10 November 1967 (document EURO 1143)
- Trends and developments in air pollution control in Europe*. Report of a Working Group held in Copenhagen, Denmark, from 19 to 22 January 1971 (document EURO 3103)
- The long-term effects on health of air pollution*. Report of a Working Group held in Copenhagen, Denmark, from 14 to 18 February 1972 (document EURO 3114(1))
- Manual on air quality management in Europe*. Report of a Working Group held in Düsseldorf, Federal Republic of Germany, from 27 to 29 March 1972 (document EURO 3106(1))
- Manual on air quality management in Europe*. Report of a Working Group held in Frankfurt-am-Main, Federal Republic of Germany, from 13 to 15 September 1972 (document EURO 3106(2))
- Study on chronic respiratory diseases in children in relation to air pollution*. Report of a Working Group held in Rotterdam, Netherlands, from 26 to 28 February 1973 (document EURO 3114(2))
- Working protocol and recording forms*. Copenhagen, March 1973 (document EURO 3114)
- Study on chronic respiratory diseases in children in relation to air pollution*. Report of a Working Group held in Düsseldorf, Federal Republic of Germany, from 17 to 19 April 1974 (document EURO 3114(3))
- Pollution by lead and other non-ferrous metallurgical industries*. Report of a Working Group held in Brussels, Belgium, from 2 to 4 July 1974 (document EURO 3106(3))
- Air pollutants from industrial sources*. Report of a Planning Meeting held in Düsseldorf, Federal Republic of Germany, from 28 to 29 April 1975 (document ICP/CEP 303)

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<sup>a</sup> Single copies of these documents are available to professionally interested persons free of charge from the World Health Organization Regional Office for Europe, 8 Scherfigsvej, 2100 Copenhagen, Denmark.



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