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Texas Air Control Board

REGULATIONS

for the control of AIR POLLUTION

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PROCEDURAL RULES & REGULATIONS OF THE TEXAS AIR CONTROL BOARD

This is the official printed version of the Procedural Rules and Regulations of the Texas Air Control Board originally promulgated by Board Order No. 68-1 on January 3, 1968, pursuant to the Clean Air Act of Texas, 1967 (Article 4477-5, V.T.C.S). This official printed version was approved and adopted in the Board pursuant to Order No. 68-2 passed on April 18, 1968. These Rules and Regulations are effective January 3, 1968 and apply to all sources located within the State of Texas which are subject to the jurisdiction of the Board.

The Procedural Rules & Regulations consist of six (6) parts, each with pages numbered separately:

PROCEDURAL RULES

GENERAL PROVISIONS

CONTROL OF AIR POLLUTION
FROM SMOKE AND SUSPENDED PARTICULATE MATTER

CONTROL OF AIR POLLUTION FROM OUTDOOR BURNING

CONTROL OF AIR POLLUTION FROM SULFUR COMPOUNDS

CONTROL OF AIR POLLUTION FROM MOTOR VEHICLES

Inquires regarding the Procedural Rules & Regulations should be addressed to:

Attention: Executive Secretary
Texas Air Control Board
1100 West 49th Street
Austin, Texas 78756
AC 512 453-6631 Ext. 241

REGULATION III

CONTROL OF AIR POLLUTION FROM SULFUR COMPOUNDS

I. Purpose

It is the purpose of this Regulation to establish air standards for the State of Texas on sulfur dioxide, sulfuric acid, and hydrogen sulfide. It is anticipated that additional provisions covering other sulfur compounds will be adopted as additional data relating to undesirable levels of other sulfur compounds are developed and evaluated.

II. Definitions

A. The section on definitions in the General Provisions of the Board's Regulations applies to this Regulation. The additional terms defined in this Section have the meanings given them herein when used in this Regulation.

B. "Sulfur Compounds". All inorganic or organic chemicals having an atom or atoms of sulfur in their chemical structure.

III. Ambient Air Quality Standards for Sulfur Compounds

A. The Board declares that concentrations of sulfur dioxide, sulfuric acid or hydrogen sulfide in the atmosphere higher than the level specified respectively for each of the compounds in the table in Paragraph B, below, for the designated land use areas constitute undesirable levels, whether the sources are from natural causes or from the activities of man, and that a state of air pollution exists when concentrations of any of the compounds exceed the level specified for that compound.

B. Table of Standards

Compound	Land Use Area Affected	Ambient Air not to Exceed (Maximum Authorized Level)
SO_2	A, B, & D	(1) 0.2 ppm average during any 24-hour period.
		(2) 0.4 ppm average during any 30-minute period, with no more than one such 30-minute period during any 12 hours.

Compound	Land Use Area Affected	Ambient Air not to Exceed (Maximum Authorized Level)
SO_2	C	(1) 0.3 ppm average during any 24-hour period.
		(2) 0.5 ppm average during any 30-minute period of time, with no more than one such 30-minute period during any 12 hours.
H_2SO_4	A, B, C, & D	(1) 20 µg per cubic meter of air average during any 24-hour period of time.
		(2) 80 µg per cubic meter of air average during any one-hour period of time, with no more than one such one-hour period during any 24 hours.
		(3) 100 µg per cubic meter of air maximum at any time.
H_2S	A & B	0.08 ppm average during any 30-minute period of time.
	C & D	0.12 ppm average during any 30-minute period of time.

C. Sampling and analyses to determine the concentration of a sulfur compound in the ambient atmosphere shall be performed in accordance with the procedures outlined in Appendix A for sulfur dioxide, Appendix C for sulfuric acid, and Appendix B for hydrogen sulfide.

IV. Emission Limits for Sulfur Compounds

A. Sulfur compounds occur only infrequently in the atmosphere in nature and then usually in small quantities. The occurrence of these compounds in the atmosphere is generally the result of the activities of man. Because of the extensive use in this State of natural gas as a fuel source, which has a low incidence of sulfur dioxide emission when burned, this compound has not yet approached a significant level in the ambient atmosphere throughout the entire area of any city or town in the State. While there are areas where cumulative effects from several properties can result in undesirable

levels of sulfur dioxide, sulfuric acid and hydrogen sulfide, the problems with these contaminants are generally associated with emissions from a single property. Accordingly, the emission limits do not as a general rule need to be based on upwind levels of these contaminants, and the authorized emission limits can correspond generally to the ambient air quality standards. However, provision is made in this Regulation for instances where a cumulative effect results when there are emissions of these contaminants from two or more properties located in close proximity to each other. If there is a significant shift in the future from the present pattern of fuel usage in the State or if for other reasons the cumulative effects of sulfur compound emissions cause the ambient air quality standards to be exceeded, the emission limits specified in this Regulation will be modified by the Board to prevent the occurrence of undesirable levels of sulfur compounds.

B. Emission limits on Sulfur Compounds

To assist in meeting the ambient air quality standards specified in Section III, the Board hereby establishes respective limits on the emissions of sulfur dioxide, sulfuric acid and hydrogen sulfides which may be made from any property. The contribution of one of these sulfur compounds by a single property to an affected land use area shall be measured by the difference between the upwind level and the downwind level of the sulfur compound for the property, or by stack sampling, calculated to a downwind concentration, in accordance with the procedures outlined in the applicable appendix of this Regulation. If the contribution from the property, determined in accordance with the applicable appendix, exceeds the emission limit set forth below for the sulfur compound, the property is in violation of this Regulation. A property is in compliance if the contribution from the property does not exceed the applicable limits specified in the schedule.

Compound	Land Use Area Affected	Property Emission Limits - Not to Exceed
SO_2	A, B & D	(1) 0.2 ppm average during any 24-hour period of time.
		(2) 0.4 ppm average during any 30-minute period of time, with no more than one such 30-minute period during any 12 hours.

Compound	Land Use Area Affected	Property Emission Limits - Not to Exceed
SO_2	C	(1) 0.3 ppm average during any 24-hour period.
		(2) 0.5 ppm average during any 30-minute period of time, with no more than one such 30-minute period during any 12 hours.
H_2SO_4	A, B, C & D	(1) 15 µg per cubic meter of air average during any 24-hour period of time.
		(2) 50 µg per cubic meter of air average during any one-hour period of time with no more than one such one-hour period during any 24 hours.
		(3) 100 µg per cubic meter of air maximum at any time.
H_2S	A & B	0.08 ppm average during any 30-minute period of time.
	C & D	0.12 ppm average during any 30-minute period of time.

Because of the expected additive effects from emissions of sulfur dioxide in the following counties, the Board hereby establishes lower or more restrictive emission limits on sulfur dioxide for properties in these counties, as follows:

1. In Galveston and Harris Counties, the authorized maximum contribution from a property is set at 70% of each of the values for sulfur dioxide set forth in the schedule under this Paragraph IV.B.

2. In Jefferson and Orange Counties, the authorized maximum contribution from a property is set at 80% of each of the values for sulfur dioxide set forth in the schedule under this Paragraph IV.B.

Where there are additive effects from emissions of sulfur compounds in other areas, the Board may set lower or more restrictive emission limits for those areas than those specified herein.

C. Exceptions

1. Emissions of the above sulfur compounds during periods of shut-down and start-up of continuous process operations, during start-up of new continuous process units, and during period of inspections, equipment and process malfunctions, and periodic cleaning and maintenance of air control equipment may exceed the limits specified in Paragraph IV.B. on a temporary basis, if the emissions do not exceed the following:

   a. Emissions of sulfur dioxide may not exceed 0.5 ppm average more than 2 hours in the aggregate during any 24-hour period, nor more than 12 hours in the aggregate during any 30-day period.

   b. Emissions of sulfuric acid may not exceed 100 µg per cubic meter of air more than 3% of the time during any 10-day period and may not exceed 125 ug per cubic meter of air at any time.

   c. Emissions of hydrogen sulfide may not exceed 0.3 ppm at any time.

2. Emissions of sulfur compounds from a property in any of the following instances may exceed the limits specified in Paragraph IV.B. if the Board, or the Executive Secretary acting under guidelines established by the Board, gives prior approval in writing. The approval may specify the emission levels and the pattern and duration of emissions which shall be observed.

   a. Intermittent emissions of the named sulfur compounds from a property during batch operations.

   b. Emissions of the named sulfur compounds from a sulfur recovery plant recovering elemental sulfur.

   c. Emissions of hydrogen sulfide from a property involved in the mining of sulfur.

   d. Emissions of sulfur compounds from a property involved in the processing of sulfur-containing waste materials.

e. Emissions of sulfur compounds resulting from testing and research activities or other lawful activities.

V. Multiple Air Contaminant Properties

The provisions on multiple air contaminant properties, Paragraph V.B. of the General Provisions, apply to this Regulation, as appropriate.

VI. Measuring and Monitoring

A. Measuring

Where stack sampling is feasible, this is the method for measuring and controlling emissions preferred by the Board. Proper and professional engineering judgment shall be the criteria for determining the method of measurement. The property owner shall, upon request of the Board, provide in connection with such stack or flue such sampling and testing facilities and sampling ports, exclusive of instruments and sensing devices, as may be necessary for the Board to determine the nature and quantity of sulfur compounds which are or may be discharged as the result of source operations. Such facilities may be either permanent or temporary, at the discretion of the person responsible for their provision and shall conform to all applicable laws and regulations concerning safe construction or safe practices. Evidence and data based on these stack samples and calculations may be used to substantiate compliance with or violations of this Regulation. Agents of the Board shall be permitted to sample the stacks at any reasonable time.

In situations where stack sampling is not feasible, compliance will be determined by the difference between the upwind level and the downwind level of air contaminants for the property. Usually, this method will be preferred if contaminants are not emitted through a stack but rather through the side of the building or through roof vents or through other ground level sources. This method would also likely be the preferred method if emissions are made through a great number of flues and stacks so that measurement of each flue and stack individually is not practicable.

Nothing herein precludes the Board from using any appropriate method of measurement as circumstances may dictate.

B. Monitoring

1. A property, the emissions of a sulfur compound from which exceed any of the following levels more frequently than four times during any 12-month period, shall conduct sampling of its own emissions in any manner authorized in the Appendices to this Regulation on a periodic, representative basis which will reflect with reasonable accuracy the pattern of the emissions being made:

SO_2	(1)	0.1 ppm average over a 24-hour period.
	(2)	0.3 ppm maximum at any time.
H_2SO_4	(1)	10μg per cubic meter of air average over a 24-hour period.
	(2)	40 μg per cubic meter of air at any time.
H_2S		0.05 ppm average over a 30-minute period.

2. A property, the emissions of a sulfur compound from which do not exceed any of the levels specified in Paragraph VI.B.1. more frequently than four times during any 12-month period, shall conduct such sampling and exercise such control as is necessary to assure that the emissions that are made do not exceed the limits specified in Section IV and that the property does not emit in excess of the levels specified in Paragraph VI.B.1. more than four times during any 12-month period.

3. The results of samples taken pursuant to this Paragraph VI.B. shall be recorded, showing the sampling method and procedure used and the quality of the emissions recorded. The property shall retain records on its samples for a period of not less than twelve months from the date of the sample, and shall make these available to the Board or an agent of the Board on request.

To aid in controlling the overall levels of sulfur compounds in the atmosphere, air pollution control facilities which

are installed by a property shall be used whenever emissions of sulfur compounds are being made which can be controlled by such facilities, even though the ambient air quality standards in affected areas are not exceeded.

VIII. Exclusion from Application of this Regulation

Emissions of sulfur compounds pursuant to and in compliance with the terms of a variance granted by the Board are excluded from the application of this Regulation.

IX. Effective Date and Time for Compliance

A. This Regulation is effective January 3, 1968. Every property on which one or more sources or potential sources of the air contaminants covered in this Regulation is located as of the effective date hereof which can comply with this Regulation from and after its effective date without providing new or additional equipment or facilities or modifying existing equipment or facilities shall so comply.

B. Where new, additional or modified equipment or facilities must be provided before a property can comply with this Regulation, the following procedure, as applicable, shall be observed by the person responsible for the property:

1. If the property will be in compliance with this Regulation by July 1, 1968, no further action with respect to the Board is required and the property shall be in compliance by said date.

2. If the property will not be in compliance with this Regulation by July 1, 1968, and emissions will continue to be made from the property after that date, the person responsible for the property shall file a petition for variance not later than May 1, 1968.

C. No person may cause, suffer, allow or permit the emission of any of the sulfur compounds covered by this Regulation, except as provided in this Regulation.

APPENDIX A

I. Measurement of SO_2 in Ambient Atmosphere

A. The approved methods of measuring SO_2 in the ambient air are the West-Gaeke method and the Conductometric method. Other test methods approved by the Executive Secretary may be used. Samples shall be collected at a height of not less than 3 feet nor greater than 10 feet from ground level.

Ref: (1) West-Gaeke (Colorimetric)
Selected Methods for the Measurement of Air Pollutants, Public Health Service Publication No. 999-AP-11 (May 1965), Determination of Sulfur Dioxide, Page A-1-5.

(2) Conductometric
ASTM Standards on Methods of Atmospheric Sampling and Analysis, 2nd. Edition, Method D 1355-60, Method A Page 11.

B. The level of SO_2 in the ambient atmosphere of a given land use area is considered as having reached an undesirable level if it exceeds any of the time-concentration levels established in Paragraph III.B of Regulation III for the area.

II. Measurement of SO_2 in Stack Gases

The approved procedures for measuring SO_2 in stack gases are the Shell Development Co. Method and the Monsanto Co. Method. Other test methods approved by the Executive Secretary may be used.

Ref: (1) Shell Development Co. Method
Atmospheric Emission from Sulfuric Acid Manufacturing Processes, Public Health Service Publication 999-AP-13 (1965), Appendix B, Page 85-87.

(2) Monsanto Co. Method
Atmospheric Emission from Sulfuric Acid Manufacturing Processes, Public Health Service Publication 999-AP-13 (1965), Appendix B, Page 63-84.

(3) Many new and improved methods of continuous SO_2 monitoring in stacks are now is use. Any method of stack sampling approved by the Executive Secretary may be used in accordance with good professional practice.

III. Method of Measuring

A. Measurement of SO_2 emission levels.
Emission levels are measured at or beyond the property line in accordance with methods of Paragraph I.A., Appendix A above.

B. Determination of Compliance with Emission Limits.
In most cases downwind samples will suffice for measurements; however if the sampled properties are suspected of being influenced by an upwind source of SO_2 then both upwind and downwind samples will be taken. The concentration of SO_2 in the "downwind sample" less the concentration in the "upwind sample" shall be used in determining whether the emissions from the property comply with the requirements of Paragraph IV.B. of this Regulation. Calculated maximum allowable emission rates or ground level concentrations which are obtained by the Method in Section IV. below may be used in determining whether a property is in compliance with the emission limits specified.

IV. Calculations of SO_2 Concentrations from Stack Samples and Measurements

The maximum allowable SO_2 emission rate which may be made from a stack on a property to comply with the emission limit set forth in Paragraph IV.B. of this Regulation may be calculated by Sutton's equation which has been modified to consider the critical wind speed and to correspond to a 30 minute air sample. Additional credit on stack emissions can be obtained if the distance from the stack to the property line is greater than thirty (30) stack heights. Those properties with greater than 30 stack heights to the property line should contact the Executive Secretary to obtain the proper correction factor. The equations used for SO_2 for cold or hot stacks are:

A. For exit stack gas for temperatures of less than 125°F.

1. Land use Type A, B & D.

$$Q_a = 5.57 \times 10^{-3} V_s d_s^2 \frac{1}{\left[\frac{d_s}{h_s}\right]^{1.29}} \quad (1)$$

where,

Q_a = emission rate, lbs/hr.
V_s = stack exit velocity, ft/sec.
d_s = exit stack diameter, ft.
h_s = physical stack height, ft.

To plot graph I, assume a basic stack height of 100 ft. and plot $\left[\frac{d_s}{100}\right]^{1.29}$ for various stack diameters versus stack velocity.

2. Land use Type C (used in plotting graph I)

$$Q_a = 6.96 \times 10^{-3} V_s d_s^2 \frac{1}{\left[\frac{d_s}{h_s}\right]^{1.29}} \quad (2)$$

B. For exit stack gas for temperatures greater than 125°F.

1. Land use Type A, B & D

$$Q_a = 1.19 \times 10^{-2} V_s d_s \left[1.5 + 0.82\left(\frac{\Delta T}{T_s}\right) d_s\right] h_s \quad (3)$$

Q_a = emission rate, lbs/hr.
V_s = stack exit velocity, ft/sec.
d_s = exit stack diameter; ft.
h_s = physical stack height, ft.
ΔT = temperature difference between stack gas and the outdoor atmosphere in °Rankine. An outdoor temperature of 90°F. (550°R) is assumed in preparing dispersion graphs.
T_s = Stack exit temperature in °Rankine.

To plot graph II, assume a basic stack height of 100 feet and an exit velocity of 20 ft/sec. Let stack gas temperature vary with stack diameter.

2. For land use Type C

$$Q_a = 1.49 \times 10^{-2} V_s d_s \left[1.5 + 0.82\left(\frac{\Delta T}{T_s}\right) d_s\right] h_s \quad (4)$$

Example 1 (Temperature of stack less than 125°F.)

How many lbs/hr of SO_2 can be discharged from a 200 ft. stack having a 4 ft. exit diameter (ID) and a 30 ft/sec. exit gas velocity? The stack gases are less than 125°F. and the distance to the property line is 4200 ft. Emissions into land use Type A.

Solution

1. The ratio of stack diameter to 100 ft. is $\frac{4}{100} = 0.04$

2. Enter ordinate of graph I with 0.04 go horizontally to intersection of 30 ft/sec. velocity curve. At this intersection read on the abscissa 170 lbs/hr. on Type A scale. This is the permitted value for a 100 ft. stack.

3. Correct emissions for a 200 ft. stack. Enter graph III at 200 ft. and obtain correction factor of 2.3. Thus the emissions become 170 x 2.3 = 391 lbs/hr.

4. Since the distance from the stack to the property line is less than 30 stack heights, no credit is allowed and to meet the ambient air standard the allowable emission is 391 lbs/hr.

Example 2 (Temperature of stack gas greater than 125°F.)

How many lbs/hr. of SO_2 can be discharged from a 200 ft. stack having a 4 ft. exit diameter (ID) and a 30 ft./sec. exit gas velocity? The temperature of the exit gases is 600°F. Emission into land use Type A.

Solution

1. Enter ordinate of graph II with 600; go horizontally to intersection of 4 ft. diameter read on the

abscissa on Type A land use 295 lbs/hr. emission. This is permitted value for 100 ft. stack and exit velocity of 20 ft/sec.

2. Correct for stack height of 200 ft. Thus $\frac{200'}{100'} = 2$

   We now have an emission of 295 x 2 = 590 lbs/hr.

3. Correct for stack exit velocity of 30 ft/sec. This correction is $\frac{30}{20} = 1.5$ and we now have an emission of 590 x 1.5 = 885 lbs/hr.

4. Since the distance from the stack to the property line is less than 30 stack heights, no credit is allowed and to meet the ambient air standard the allowable emission is 885 lbs/hr.

APPENDIX B

I. Measurement of H_2S in Ambient Atmosphere

A. The approved method of measuring H_2S in the ambient air is by the Lead-Acetate-Impregnated Filter Paper Procedure. Samples shall be collected at a height of not less than 3 feet nor greater than 10 feet from ground level. Other test methods approved by the Executive Secretary may be used.

Ref: (1) Sesenbaugh, J. D. and Hemeon, W. C. L., A Low Cost Sampler for Measurement of Low Concentrations of Hydrogen Sulfide. Air Repair 4:5 (May 1954).

B. The level of H_2S in the ambient atmosphere of a given land use area is considered as having reached an undesirable level if it exceeds any of the time-concentration levels established in Paragraph III.B. of Regulation III for the area.

II. Measurement of H_2S in Stack Gases

Due to interference of many compounds in a stack test for H_2S, there is no stack testing procedure which is uniformly satisfactory. Test methods for specific industrial processes may be used if approved by the Executive Secretary.

III. Method of Measuring

A. Measurement of H_2S emission levels.

Emission levels are measured at or beyond the property line in accordance with the method of Paragraph I.A., Appendix B above.

B. Determination of compliance with emission limits.
In most cases downwind samples will suffice for measurement; however, if the sampled properties are suspected of being influenced by an upwind source of H_2S then both upwind and downwind samples will be taken. The concentration in the "upwind sample" shall be used in determining whether the emissions from the property comply with the requirements of Paragraph IV.B. of this Regulation. Calculated maximum allowable emission rates or ground level concentrations which are obtained by the Method in Section IV. below may be used in determining whether a property is in compliance with the emission limits specified.

IV. Calculations of H_2S Concentrations from Stack Samples and Measurements.

The maximum allowable H_2S emission rate which may be made from a stack on a property to comply with the emission limit set forth in Paragraph IV.B. of this Regulation may be calculated by Sutton's equation which has been modified to consider the critical wind speed and to correspond to a 30 minute air sample. Additional credit on stack emissions can be obtained if the distance from the stack to the property line is greater than thirty (30) stack heights. Those properties with greater than 30 stack heights to the property line should contact the Executive Secretary to obtain the proper correction factor.

A. For exit stack gas for temperatures of less than 125°F.

1. Land use area A & B. The H_2S ambient air level is 0.08 ppm for 30 minutes.

$$Q_a = 8 \times 10^{-4} V_s d_s^2 \frac{1}{\left[\frac{d_s}{h_s}\right]^{1.29}} \qquad (1)$$

where,

Q_a = emission rate, lbs/hr.
V_s = stack exit velocity, ft/sec.
d_s = exit stock diameter, ft.
h_s = physical stack height, ft.

To plot graph IV, assume a basic stack height of 100 ft. and plot $\left[\frac{d_s}{100}\right]^{1.29}$ for various stack diameters versus stack velocity.

2. Land use areas C & D. The H_2S ambient air level of 0.12 ppm for 30 minutes.

$$Q_a = 12 \times 10^{-4} V_s d_s^2 \frac{1}{\left[\frac{d_s}{h_s}\right]^{1.29}} \qquad (2)$$

Symbols same as in equation (1) above.

B. For exit stack gas for temperatures greater than 125°F.

1. Land use areas A & B. The H_2S ambient air level is 0.08 ppm for 30 minutes.

$$Q_a = 1.68 \times 10^{-3} V_s d_s \left[1.5 + 0.82\left(\frac{\Delta T}{T_s}\right) d_s\right] h_s \quad (3)$$

where,

Q_a = emission rate, lbs/hr.
V_s = stack exit velocity, ft/sec.
d_s = exit stack diameter, ft.
ΔT = temperature difference between stack gas and the outdoor atmosphere in °Rankine. An outdoor temperature of 90°F. (550°R) is assumed in preparing dispersion graphs.
T_s = stack exit temperature in °Rankine.

To plot graph V, assume a basic stack height of 100 ft. and an exit velocity of 20 ft/sec. Let stack gas temperature vary with stack diameter.

2. Land use area C & D. The H_2S ambient air level is 0.12 ppm for 30 minutes.

$$Q_a = 2.52 \times 10^{-3} V_s d_s \left[1.5 + 0.82\left(\frac{\Delta T}{T_s}\right) d_s\right] h_s \quad (4)$$

Symbols same as used in equation (3) above.

<u>Example 1</u> (Temperature of stack gas less than 125°F.)

How many lbs/hr. of H_2S can be discharged from a 200 ft. stack having a 4 ft. exit diameter (ID) and a 30 ft/sec exit gas velocity? The stack gases temperature is 100°F. and the distance to property line is 3000 ft. Emissions into land use Type A.

<u>Solution</u>

1. The ratio of stack diameter to 100 ft. is $\frac{4}{100} = 0.04$

2. Enter ordinate of graph IV with 0.04; go horizontally to intersection of 30 ft/sec. velocity curve. At the intersection read on the abscissa 24 lbs/hr on Type A & B scale. This is the permitted value for a 100 ft. stack.

3. Correct emissions for a 200 ft. stack. Enter graph III at 200 ft. and obtain correction factor of 2.3. Thus the emissions become 24 x 2.3 = 55 lbs./hr.

Note: Less than 30 stack heights to property line. No credit.

<u>Example 2</u> (Temperature of stack gas greater than 125°F.)

How many lbs/hr. of H_2S can be discharged from a 200 ft. stack having a 4 ft. exit diameter (ID) and a 30 ft/sec. exit gas velocity? The temperature of the exit gases is 400°F. Emissions into land use Type A.

<u>Solution</u>

1. Enter ordinate of graph V with 400; go horizontally to intersection of 4 ft. diameter, read on the abscissa on Type A land use 36 lbs/hr. emission. This is permitted value for 100 ft. stack and exit velocity of 20 ft/sec.

2. Correct for stack height of 200 ft. This is direct ratio and becomes $\frac{200'}{100'} = 2$. The emission now becomes 36 x 2 = 72 lbs/hr.

3. Correct for stack exit velocity of 30 ft/sec. This is a direct ratio and becomes $\frac{30}{20} = 1.5$. The allowed emission now becomes 72 x 1.5 = 108 lbs/hr.

Note: Less than 30 stack heights to property line. No credit.

I. Measurement of H_2SO_4 in Ambient Atmosphere

A. The method of measuring sulfur trioxide and sulfuric acid or any combination thereof suspended in the ambient atmosphere shall be as prescribed in the following publication:

Particulates (H_2SO_4)
Ref: Commons, B.T., Determination of Particulate Acid in Town Air, Analysis, 88, 364-67. (May 1963)

Other test methods approved by the Executive Secretary may be used. Samples shall be collected at a height of not less than 3 feet nor greater than 10 feet from ground level.

B. The level of H_2SO_4 in the ambient atmosphere of a given land use area is considered as having reached an undesirable level if it exceeds any of the time-concentration levels established in Paragraph III.B. of Regulation III for the area.

II. Measurement of H_2SO_4 in Stack Gases

The approved procedures for measuring H_2SO_4 in stack gases are the Shell Development Co. Method and the Monsanto Co. Method. Other test methods approved by the Executive Secretary may be used.

Ref: (1) Shell Development Co. Method
Atmospheric Emissions from Sulfuric Acid Manufacturing Processes, Public Health Service Publication 999-AP-13 (1965), Appendix B, Pages 85-87.

(2) Monsanto Co. Method
Atmospheric Emission from Sulfuric Acid Manufacturing Processes, Public Health Service Publication 999-AP-13 (1965), Appendix B, Pages 63-84.

III. Method of Measuring

A. Measurement of H_2SO_4 emission levels, are measured at or beyond the property line in accordance with methods of Paragraph I.A., Appendix C., above.

B. Determination of Compliance with Emission Limits. In most cases downwind samples will suffice for measurements; however, if the sampled properties are suspected of being influenced by an upwind source of H_2SO_4 then both upwind and downwind samples will be taken. The concentration of H_2SO_4

in the "downwind sample" less the concentration in the "upwind sample" shall be used in determining whether the emissions from the property comply with the requirments of Paragraph IV.B. of this Regulation. Calculated maximum allowable emission rates or ground level concentrations which are obtained by the Method in Section IV. below may be used in determining whether a property is in compliance with the emission limits specified.

IV. Calculations of H_2SO_4 Concentrations from Stack Samples and Measurements

The maximum allowable H_2SO_4 emission rate which may be made from a stack on a property to comply with the emission limit set forth in Paragraph IV.B. of this Regulation may be calculated by Sutton's equation which has been modified to consider the critical wind speed and to correspond to one hour sample. Additional credit on stack emissions can be obtained if the distance from the stack to the property line is greater than 30 stack heights. Those properties with greater than 30 stack heights to the property line should contact the Executive Secretary to obtain the proper correction factor.

A. For exit stack gas for temperatures of less than 125°F.

1. Land use areas A, B, C & D. The H_2SO_4 ambient air level of 80 $\mu g/M^3$ for one hour is used.

$$Qa = 5.56 \times 10^{-4} V_s d_s \frac{1}{\left[\frac{d_s}{h_s}\right]^{1.29}} \qquad (1)$$

Symbols are the same used in equation (1) of Appendix A of this regulation.

B. For exit stack gas for temperature greater than 125°F.

1. Land use areas A, B. C & D. The H_2SO_4 ambient air level of 80 $\mu g/M^3$ for 1 hr. is used.

$$Q_a = 12.32 \times 10^{-4} V_s d_s \left[1.5 + 0.82 \left(\frac{\Delta T}{T_s}\right) d_s\right] h_s \qquad (2)$$

Symbols are the same used in equation (3) of Appendix A of this Regulation.

<u>Example 1</u> (Temperature of stack gas less than 125° F.)

How many lbs/hr. of H_2SO_4 can be discharged from a 200 ft. stack having 4 ft. exit diameter (ID) and a 30 ft./sec. exit gas velocity? The temperature of the exit gases is 100°F.

Solution

1. The ratio of stack diameter to 100 ft. is $\frac{4}{100} = 0.04$.

2. Enter ordinate of graph VI with 0.04; go horizontally to intersection of 30 ft/sec. velocity curve. At this intersection read on the abscissa 17 lbs/hr. This is the permitted value for a 100 ft. stack.

3. Correct emissions for a 200 ft. stack. Enter graph III at 200 ft. and obtain correction factor of 2.3. Thus the emissions become 17 x 2.3 = 39 lbs/hr.

Example 2 (Temperature of stack gas greater than 125° F.)

How many lbs/hr. of H_2SO_4 can be discharged from a 200 ft. stack having a 4 ft. exit diameter (ID) and a 30 ft/sec. exit gas velocity. The temperature of the exit gases is 400°F.

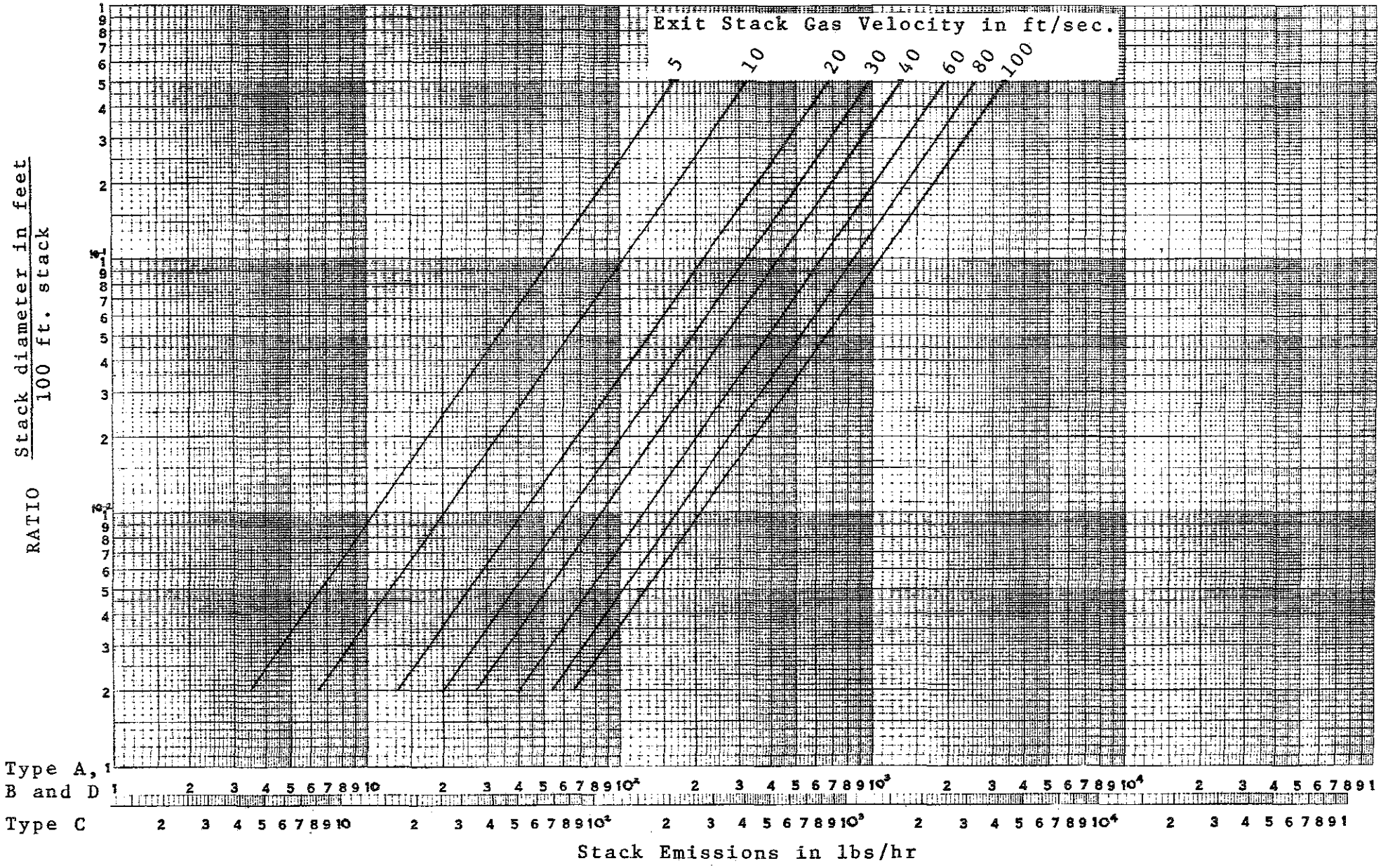
Solution

1. Enter ordinate of graph VII with 400; go horizontally to intersection of 4 ft. diameter and read on abscissa 26 lbs/hr. emission. This is permitted value for 100 ft. stack and exit velocity of 20 ft/sec.

2. Correct for stack height. Thus $\frac{200}{100} = 2$. We now have

   26 x 2 = 52 lbs/hr.

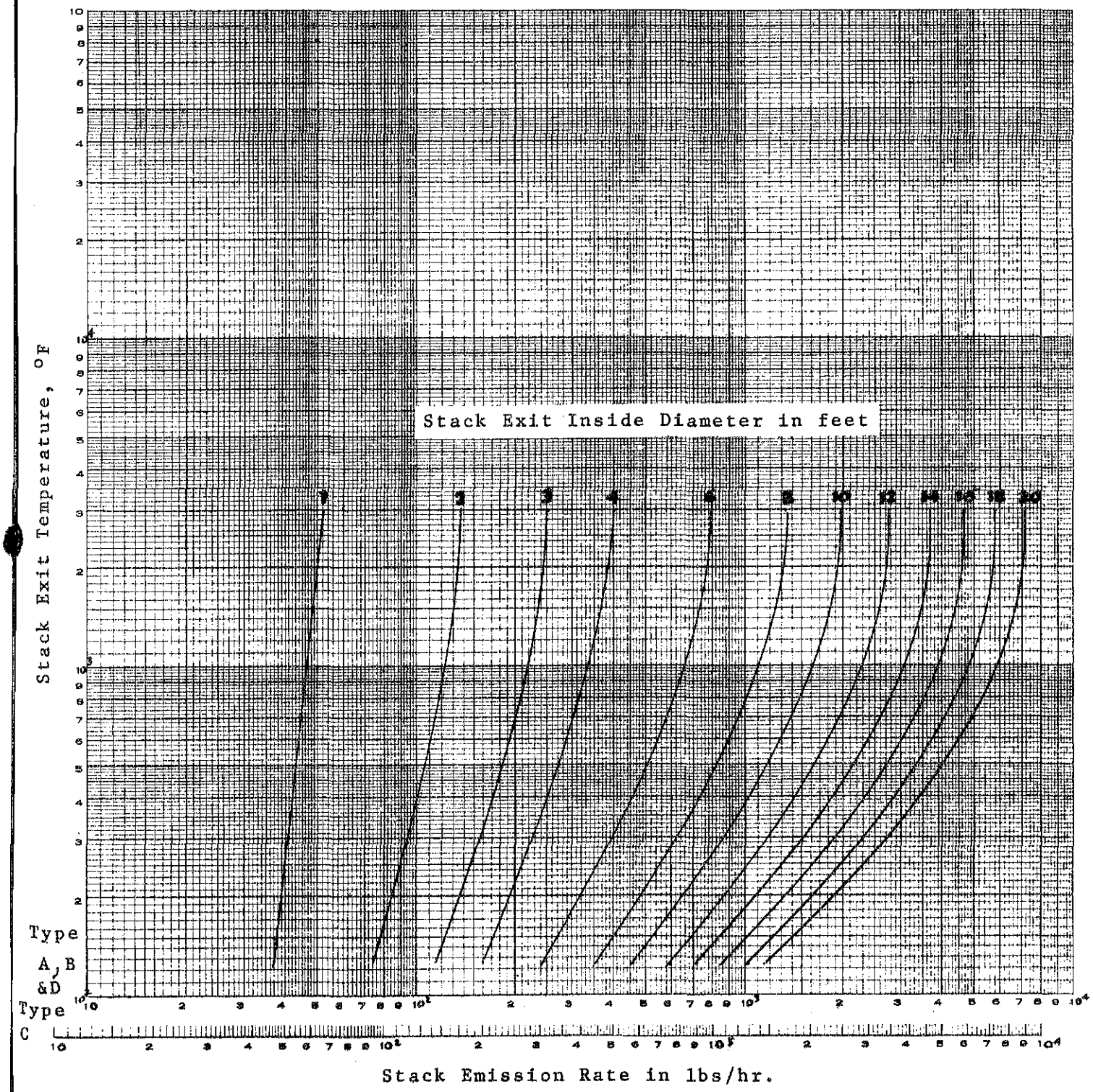
3. Correct for stack exit velocity of 30 ft/sec. This is a direct ratio and becomes $\frac{30}{20} = 1.5$. The emission now is 52 x 1.5 = 78 lbs/hr.



SULFUR DIOXIDE

GRAPH I

(Exit Stack Gas Temperature Less Than 125°F)



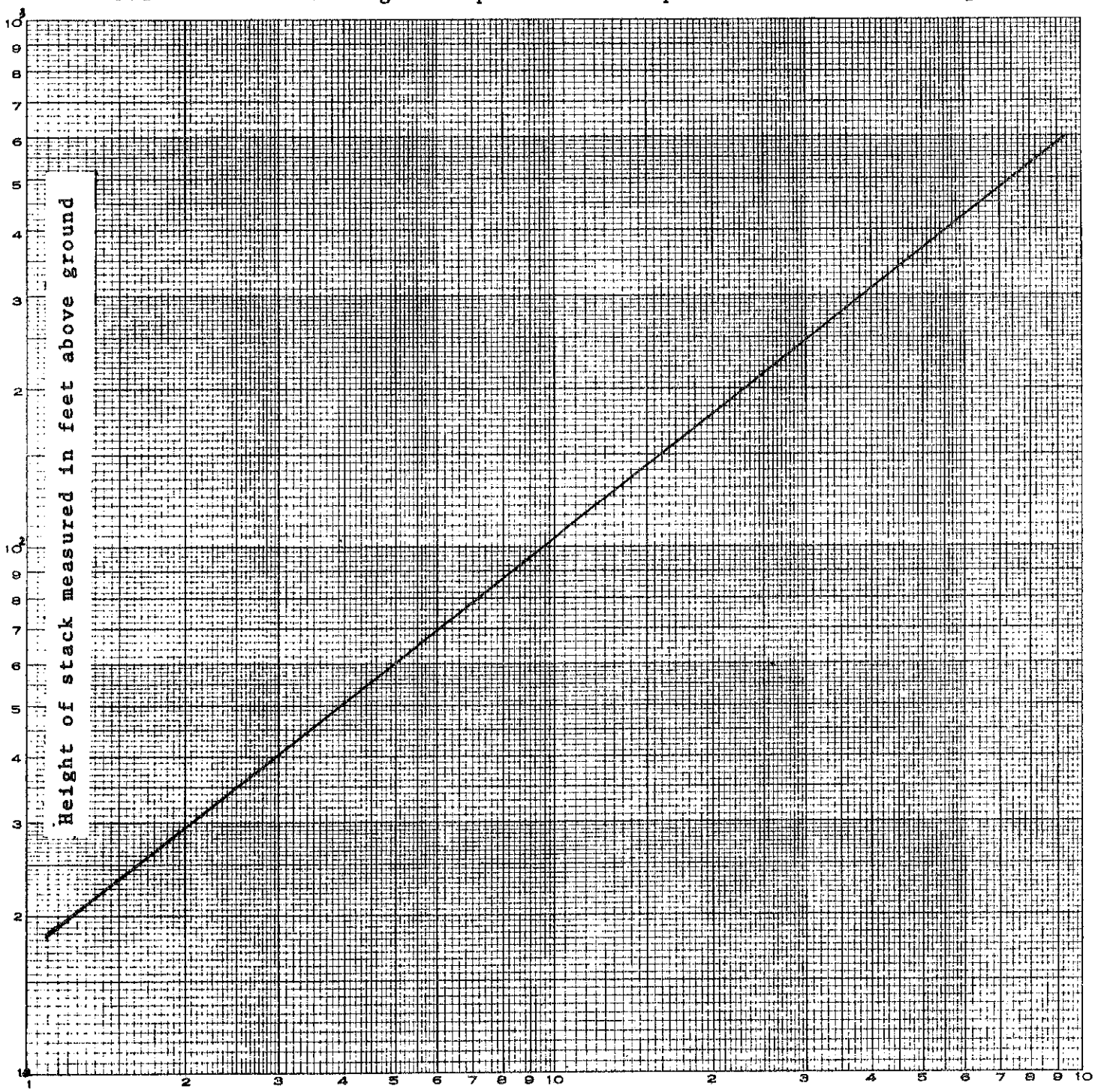
For Use When The Exit Temperature is greater than 125°F

SULFUR DIOXIDE

GRAPH II

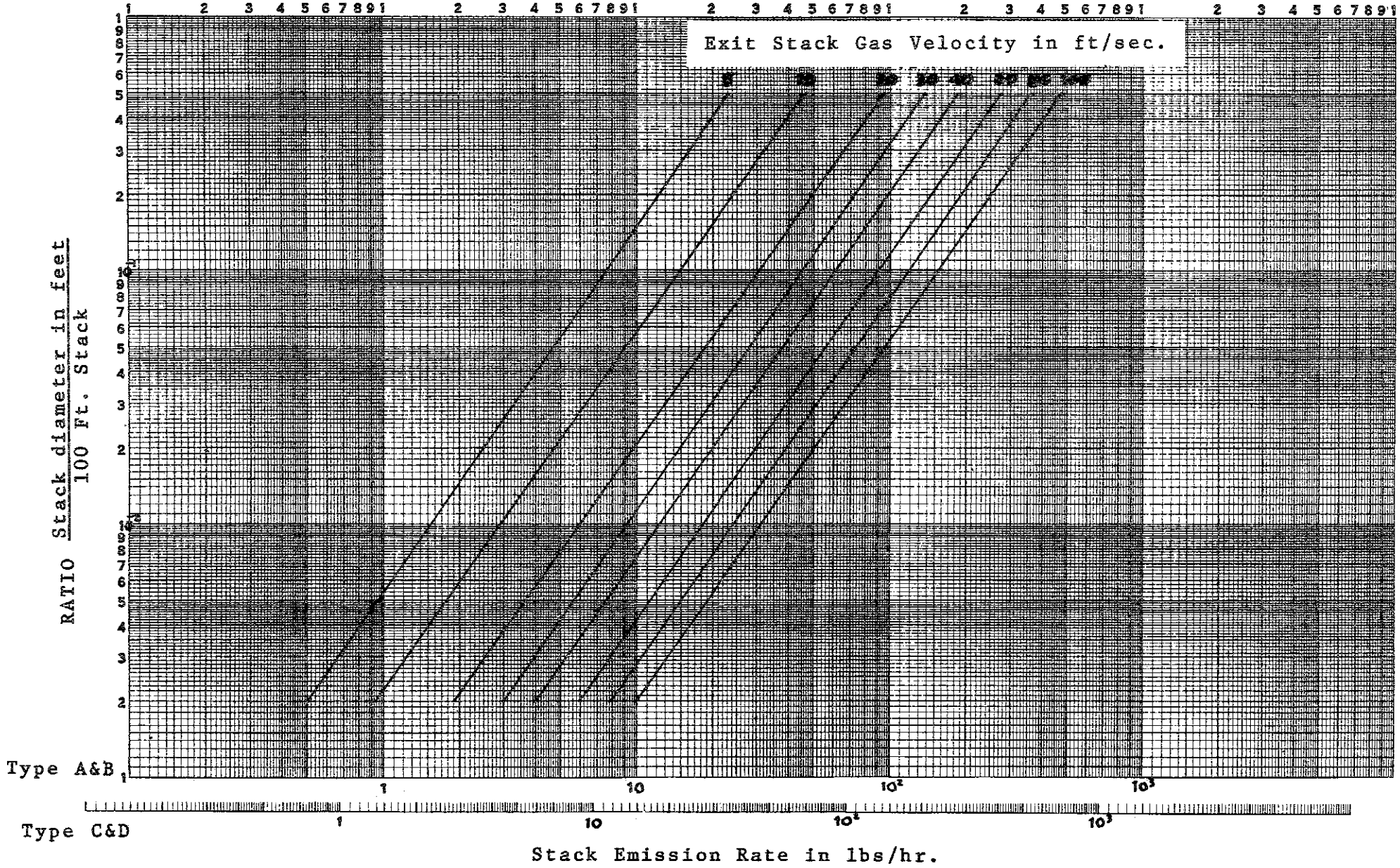
Correction Factors for Stack Height

For use when stack gas temperature is equal or less than 125°F



CORRECTION FACTORS

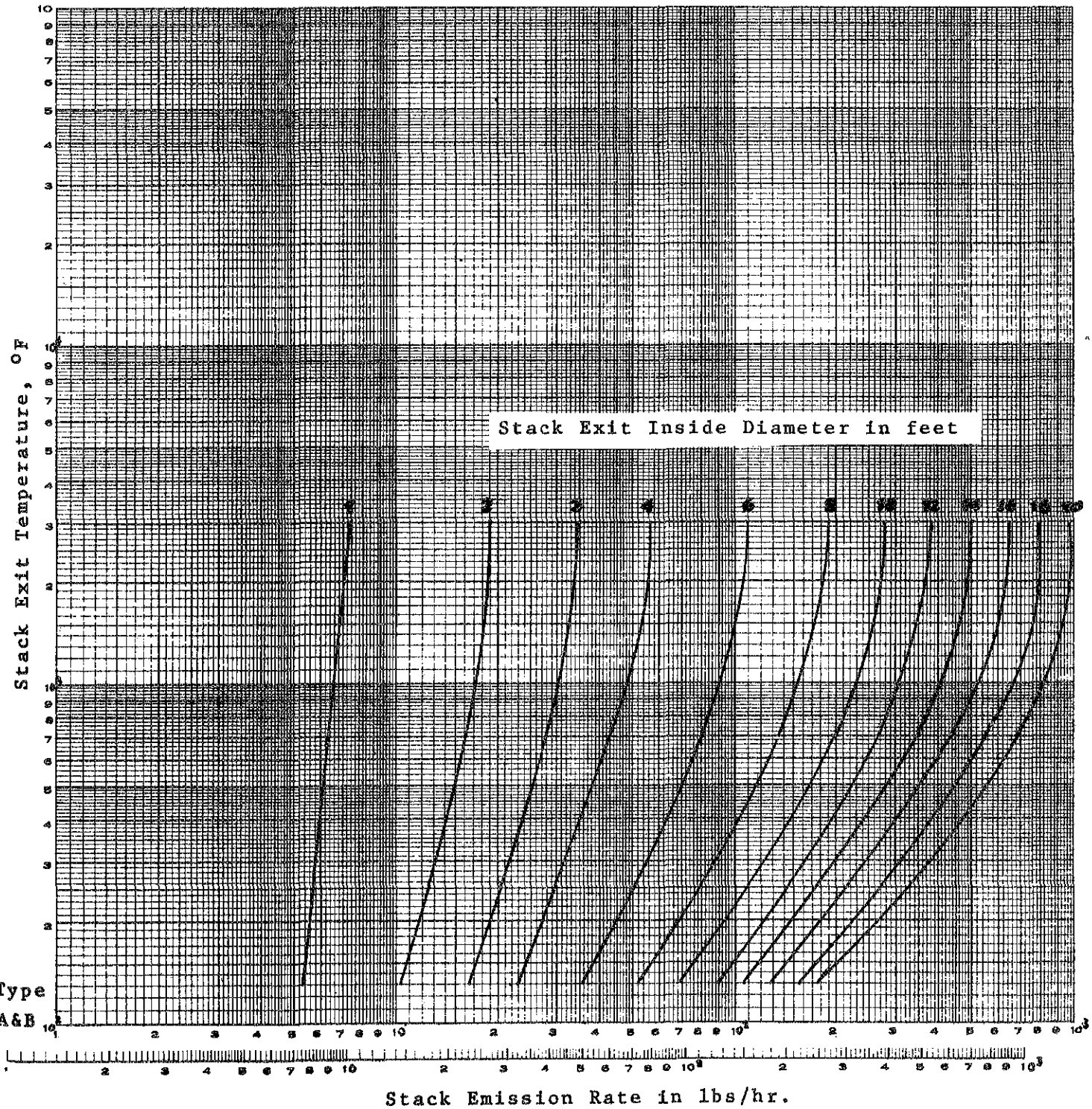
GRAPH III



HYDROGEN SULFIDE

GRAPH IV

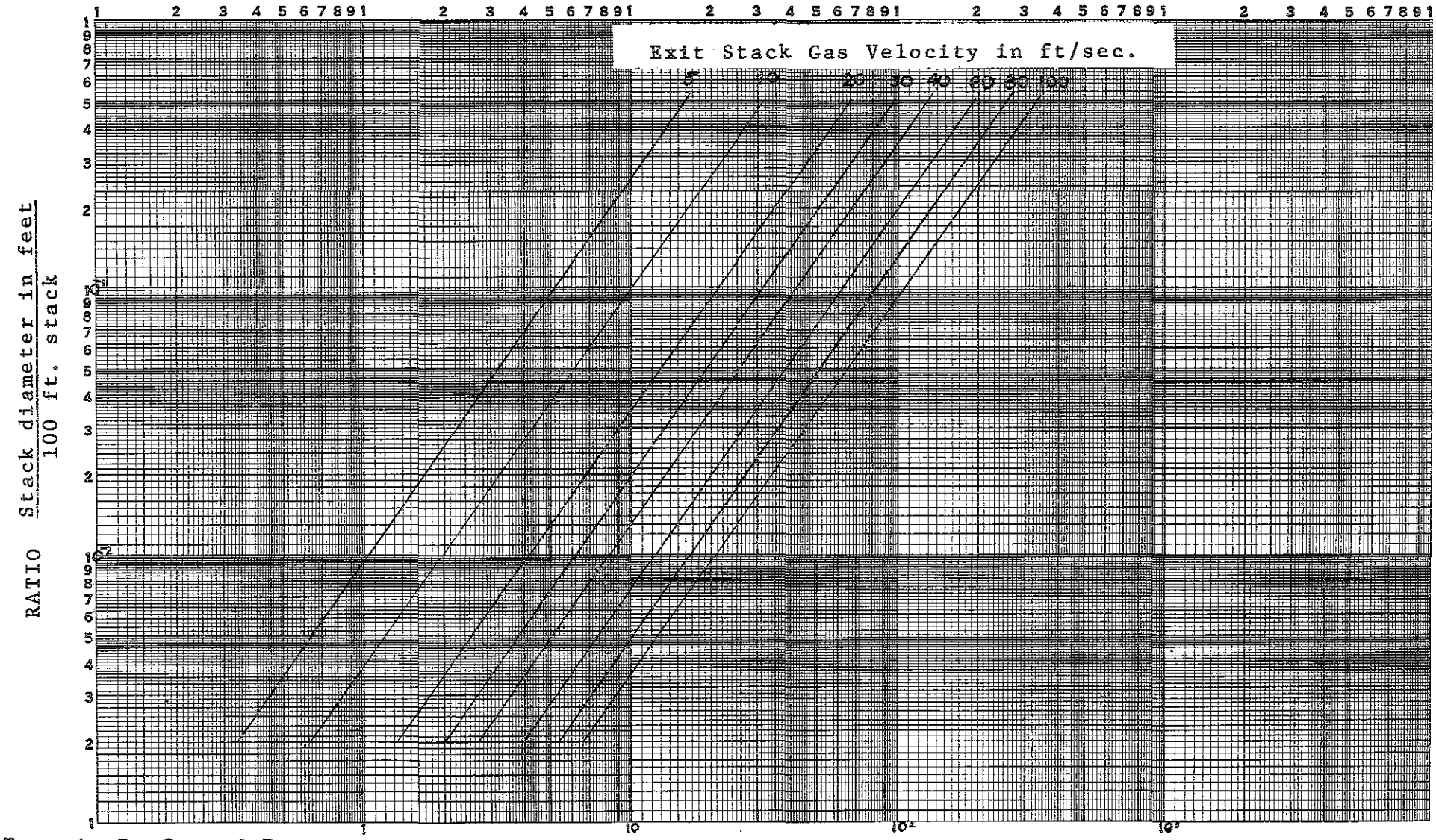
(Exit Stack Gas Temperature Less Than 125°F)



HYDROGEN SULFIDE

GRAPH V

For Use When The Exit Temperature is greater than 125°F

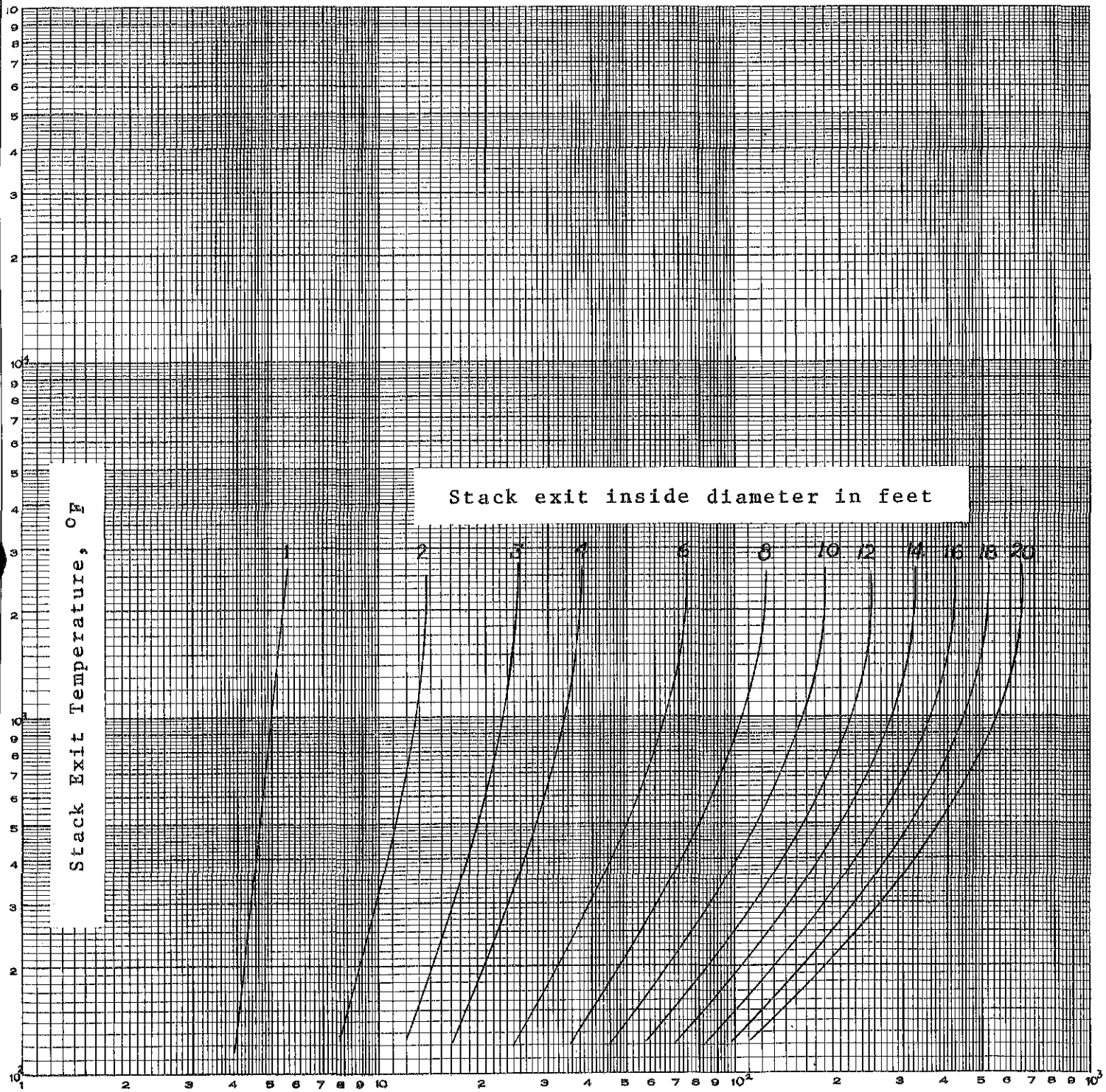


Type A, B, C, and D

SULFURIC ACID MIST

(Exit Stack Gas Temperature Less Than 125°F)

GRAPH VI



Type A,B,C,&D

SULFURIC ACID MIST

GRAPH VII

Stack Emission Rate in lbs/hr.

For Use When The Exit Temperature is greater than 125°F