GAS DETECTION

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF MINES, MINERALS AND ENERGY
DIVISION OF MINES

Applicant's Name _____ Social Security Number _____

MINE GAS DETECTION QUALIFICATION

DIVISION OF MINES USE ONLY

This check list is to be completed by a Division of Mines Inspector, Instructor, or Technical Specialist providing training and evaluation of a coal miner for qualification to conduct methane test pursuant to 45.1-161.231 and 45.1-161.252 of the Coal Mine Safety Laws of Virginia. **(FORM DM-BCME-1 APPLICATION FOR CERTIFICATION, MUST BE SUBMITTED WITH THIS CHECKLIST)**

MINE GASES

☐	Properties of Gases
☐	Different Mine Gases- Overview
☐	Methane gas- Detailed review of Properties
☐	Carbon Dioxide (Low Oxygen Hazard)
☐	Carbon Monoxide
☐	Hydrogen Gas
☐	Oxygen

METHANE TEST (State and Federal

☐	How to perform Legal Test
☐	When Testing is Required
☐	Where Testing is Required

ACTIONS FOR EXCESSIVE METHANE

☐	Action required for excessive methane in working

METHANE DETECTORS

☐	Types of Detectors- Overview
☐	Operating Procedures
☐	Maintenance and Permissibility Requirements
☐	Calibration Procedures
☐	Care and Handling of Detectors

PRACTICAL DEMONSTRATION BY MINER

☐	Pre-operation Check of Detector
☐	Calibration of Detector
☐	Conduct test for Methane

I certify that the above named miner has received the instruction in mine gases and methane detection indicated and has demonstrated proficiency in conducting proper tests for methane using a hand-held methane detector.

Signature, DM Representative _____ Date _____

SUBMIT CHECKLIST AND DM-BCME-1 TO THE CERTIFICATION SECTION FOR ISSUANCE OF GAS CARD
REVISED 5/10/99

Board of Coal Mining Examiners
P.O. Drawer 900
Big Stone Gap, VA 24219
(276)523-8149

Application for Certification Examination

Applicants for certification must complete this form and submit a $10.00 non-refundable fee for each exam. Type or print the information in ink or pay the fee with a certified check, cashier's check or money order made payable to the Treasurer of Virginia. Cash will be accepted if paid in person. Submit the application and fee to the board of Coal Mining Examiners at least five working days prior to the date of examination.

1. Full Name_____S.S.#_____

2. Address_____
   Street or P.O. Box City State Zip Code

3. Date of Birth _____Home Phone No. ( )_____
   Month/Day/Year

4. Total year employed at a coal mine: _____ _____
   Underground Surface

4. List your current (or most recent) mining experience

   Company Name _____

   Address _____
   Street or P.O. Box

5. Attach copies of the required documentation needed for each certification.

6. Examination Requested (Check One) *BCME Instructor check the courses you wish to teach

[ ] Advanced first aid	[ ] Automatic elevator operator	[ ] Blaster endorsement-DMLR (no fee)
[ ] Chief electrician (sur/UG or sur)	[ ] Diesel engine mechanic instructor	[ ] Dock foreman
[ ] Electrical maintenance foreman (sur/UG or surface)	[ ] First aid instructor	[ ] First class mine foreman
	[ ] First class shaft or slope foreman	[ ] Gas detection qualification (no fee)
[ ] General coal miner (surf/strips and augers or surf/UG)	[ ] Hoisting Engineer	[ ] Instructor – BCME*
	[ ] MSHA electrical reinstatement	[ ] Preparation Plant Foreman
[ ] Mine inspector	[ ] Surface blaster	[ ] Surface electrical repairman
[ ] Surface facilities foreman for shops, labs, and warehouses	[ ] Surface foreman	[ ] Top person
[ ] Underground diesel engine mechanic	[ ] Underground electrical repairman	[ ] Underground shot firer

I hereby certify that the above answers are true to the best of my knowledge and belief.

Signed _____Date _____

GAS DETECTION TRAINING

When conducting gas detection training you are requested to thoroughly review with the individual the following:

- The properties of mine gases, including discussions on specific gravity & effects of temperature and pressure.
- The list of mine gases with emphasis on methane, oxygen, hydrogen, and carbon dioxide and carbon monoxide.
- Proper procedures for taking a gas test. NOTE: "Hands On" participation by student.
- When and where gas tests are required.
- Procedures when methane is detected in a working place.
- Calibration of gas detection instrument. NOTE: "Hands On" participation by students.
- Duties and responsibilities as a miner under Mine Safety Act.

 45.1-161.229

 45.1-161.231

 45.1-161.232

 45.1-161.233

PROPER PROCEDURES FOR TAKING A GAS TEST

- √ Check instrument for mechanical condition. (per manufacturer's recommendation)
- √ Check battery for proper voltage level. (per manufacturer's recommendation)
- √ Check mechanical "zero". (per manufacturer's recommendation)
- √ Calibrate (per manufacturer's recommendation) – must be calibrated monthly and more often if needed.
- √ Conduct test for methane by activating detector and reading concentrations 12" from mine roof, face, and floor in the area being examined.
- √ Avoid holding methane detectors in a bleeder for extended periods of time as this will render the sensor defective.
- √ When higher concentrations of methane have been encountered, calibrate your detector as soon as possible.
- √ Avoid synthetic fuels when conducting methane checks since these materials can affect readings and damage sensors.
- √ Protect methane detectors from water and other adverse environmental conditions.

METHANE TESTS ARE REQUIRED

- → Prior to energizing equipment in and inby the last open crosscut
- → Prior to taking equipment into working place and at 20 minute intervals
- → Prior to cutting and welding and continuously during this activity
- → Prior to and after detonation of explosives
- → During required examinations:

    1. Pre-shift and on-shift examinations of working places.
    2. Required examinations of immediate returns.
    3. Places where methane is likely to accumulate.
    4. Return side of each set of seals.
    5. Weekly examinations of ventilation and bleeder system.

NOTE: Oxygen Deficiency Tests are required during examinations. If oxygen is below 19.5% by volume, ventilation must be improved. Oxygen tests should be made frequently when approaching or around old works.

WHEN METHANE IS DETECTED IN YOUR WORKING PLACE!!

- At 1% - stop operations, deenergize at the machine breaker and improve ventilation to reduce below 1%.

- At 1.5% or greater – stop operations, deenergize at the source (power center) and withdraw personnel from affected area except for those needed to improvements to reduce methane levels**.**

- At 5%+, notify your foreman promptly. This will be treated as an imminent danger situation which could require withdrawal from the mine. Do not attempt to move or ventilate high concentrations of methane unless you are designated to correct the problem and then only at the direction of certified persons and following precautions to avoid potential ignition sources.

MEMORANDUM

DATE: August 25, 1997

TO: All DM Personnel Conducting Gas Detection Training

FROM: _____
Frank A. Linkous, Chief

The requirement for all miners who work in face areas to be trained in gas detection is an important provision of the Coal Mine Safety Laws of Virginia. From time to time, you may be required to perform instruction and hands-on training to qualify miners for performing gas tests. This packet of information has been developed to assist you in your efforts to train miners in the properties of mine gases, proper procedures for conducting gas tests, and response to excessive levels of methane.

All gas detection qualification training must include these basic areas of instruction to be considered complete. You should review and discuss each outline as developed, provide hands-on demonstration in the proper use, maintenance and calibration of the methane detector, and present the completed packet of information to the miner for his further review and reference as needed.

Upon completion of instruction, you should ensure that the two required BCME forms included in the packet are completed and delivered to the DM Certification Section.

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Gas Detection Chart

Gas	Detection Methods	When to Test
Oxygen (0_2)	Oxygen indicator. Flame safety lamp. Chemical analysis	During any examination.
Nitrogen (N_2)	Chemical analysis	When an oxygen deficient atmosphere is suspected. In mines where nitrogen issues from rock strata. In inactive areas where ventilation has been inadequate.
Carbon Dioxide (CO_2)	Carbon dioxide detector. Multi-gas detector.	After a fire or explosion. When entering abandoned areas. When reopening sealed areas.
Methane (CH_4)	Methane detector. Chemical analysis	During any examination. When normal ventilation is disrupted. When entering abandoned workings.
Carbon Monoxide (CO)	Carbon monoxide detector. Multi-gas detector. Chemical Analysis.	After a fire or explosion. When entering abandoned areas of the mine. When reopening sealed areas.
Nitrogen Dioxide (NO_2)	Nitrogen dioxide detector. Multi-gas detector. Chemical analysis. Color.	After mine fires or explosions. When diesel equipment is used. After detonation of explosives.
Hydrogen (H_2)	Multi-gas detector. Chemical analysis foam in firefighting	After mine fire or explosion. Near battery charging stations. When steam is produced by water, mist or foam in firefighting.
Hydrogen Sulfide (H_2S)	Hydrogen sulfide detector	In poorly ventilated areas. During unsealing operations. Following mine fires.
Sulfur Dioxide (SO_2)	Multi-gas detectors. Chemical analysis. Odor, taste, and respiratory tract irritation.	When standing water is disturbed.
Heavy Hydrocarbons Ethane (C_2H_6) Butane (C_2H_8) Propane(C_4H_{10})	Multi-gas detector. Chemical analysis.	Following fires or explosions when methane is present. Following accidental entry into adjacent oil or gas well casings.
Acetylene (C_2H_2)	Multi-gas detector, chemical analysis, odor.	Following a methane explosion in air which is low in oxygen or from disruption/opening of acetylene tank.

Gas	Chemical Symbol	Specific Gravity	Explosive Range	Health Hazards	Solubility	Colors	Odor	Taste
Air	- -	1.000	- -	- -	- -	- -	- -	- -
Oxygen	0_2	1.1054	Supports combustion	Oxygen deficiency: 17% panting, 15% dizziness and headache, 9% unconsciousness, 6% death	Moderate	- -	- -	- -
Nitrogen	N	0.9674	- -	Asphyxiation (oxygen depletion)	Slight	- -	- -	- -
Carbon Dioxide	CO_2	1.5241	- -	Increases breathing rate. May cause death in high concentration.	Soluble	- -	- -	Acid in high concentration
Methane	CH_4	0.5545	5 to 15%	Asphyxiant (rare)	Slight	- -	- -	- -
Carbon Monoxide	CO	0.9672	12.5 to 74.2%	Highly toxic. Can be an asphyxiant.	Slight	- -	- -	- -
Nitrogen Dioxide	NO_2 N_20_4	1.5894	- -	Highly toxic. Corrosive effect on lungs. May be asphyxlant.	Slight	Reddish brown	Blasting powder fumes	Blasting powder fumes
Hydrogen	H_2	0.0695	4.0 to 74.02% Highly explosive	Asphyxiant (oxygen depletion).	- -	- -	- -	- -
Hydrogen Sulfide	H_2S	1.1906	4.3 to 45.5%	Highly toxic. Can be an asphyxiant.	Soluble	- -	Rotten eggs	Sweetish
Sulfur Dioxide	SO_2	2.2678	- -	Highly toxic. Can be an asphyxiant.	Highly	- -	Sulfurous	Acid (bitter)
Ethane	C_2H_6	1.0193	3.0 to 12.5%	Asphyxiant (rare)	Slight	- -	- -	- -
Propane	C_3H_8	1.5625	2.12 to 9.35%	Asphyxiant (rare)	Slight	- -	“Carry” in high concentrations	- -
Butane	C_4H_{10}	2.0100	1.86 to 8.41%	Asphyxiant (rare)	Slight	- -	“Carry” in high concentrations	- -
Acetylene	C_2H_2	0.9107	2.5 to 80%	Only slightly toxic. Asphyxiant (rare)	Only slight	- -	- -	Garlic

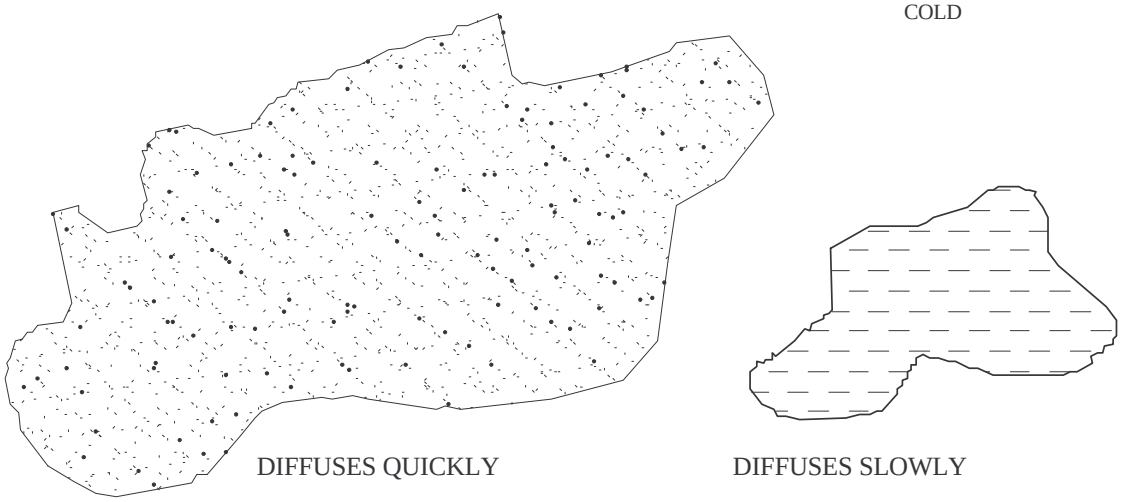
MINE GAS CHART

Effects of Temperature and Pressure on Gas

Effects of Temperature on Gas

HOT

COLD



DIFFUSES QUICKLY

DIFFUSES SLOWLY

temperature increases - gas expands

temperature decreases - gas contracts

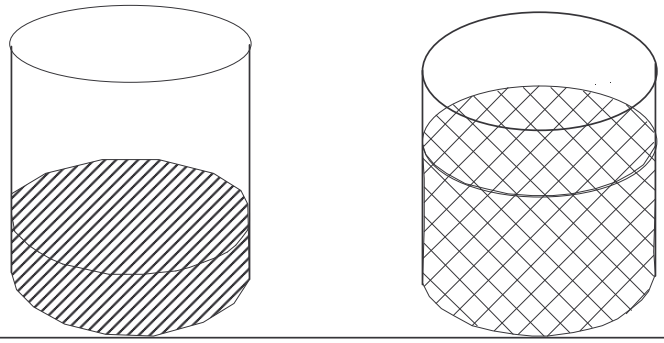
pressure increases - gas contracts

pressure decreases - gas expands

Effects of Pressure on Gas

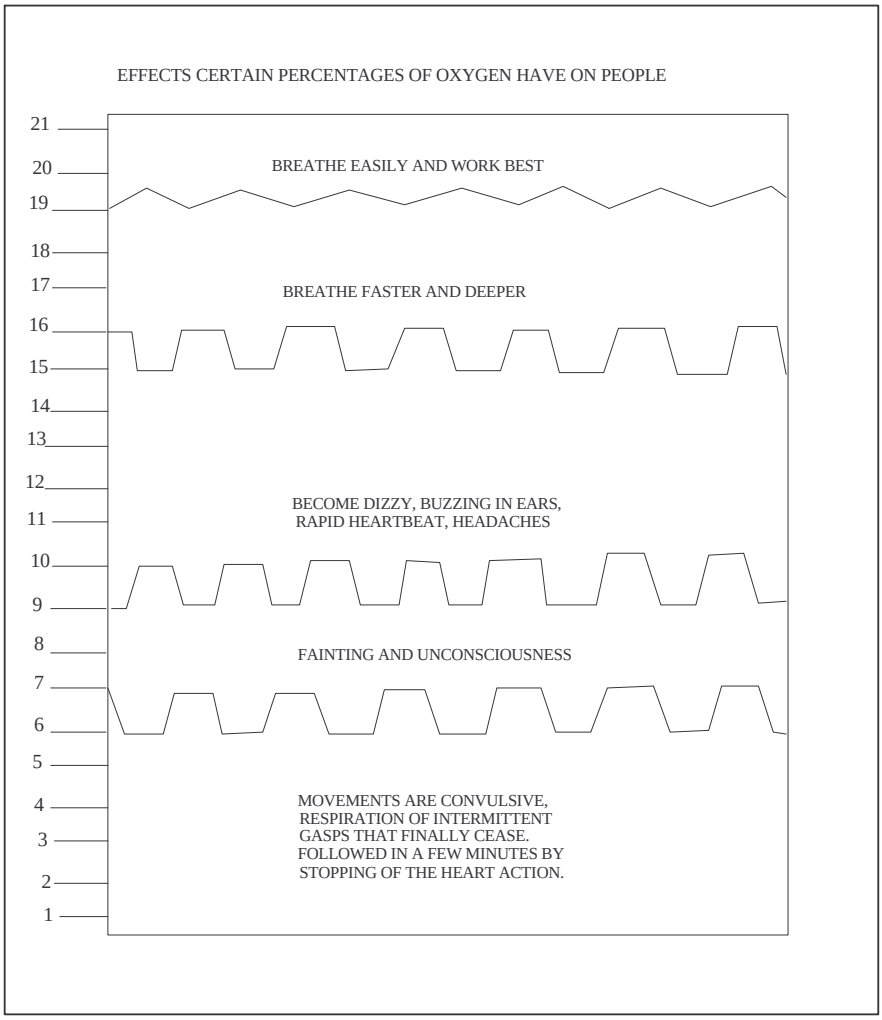
Pressue Increases

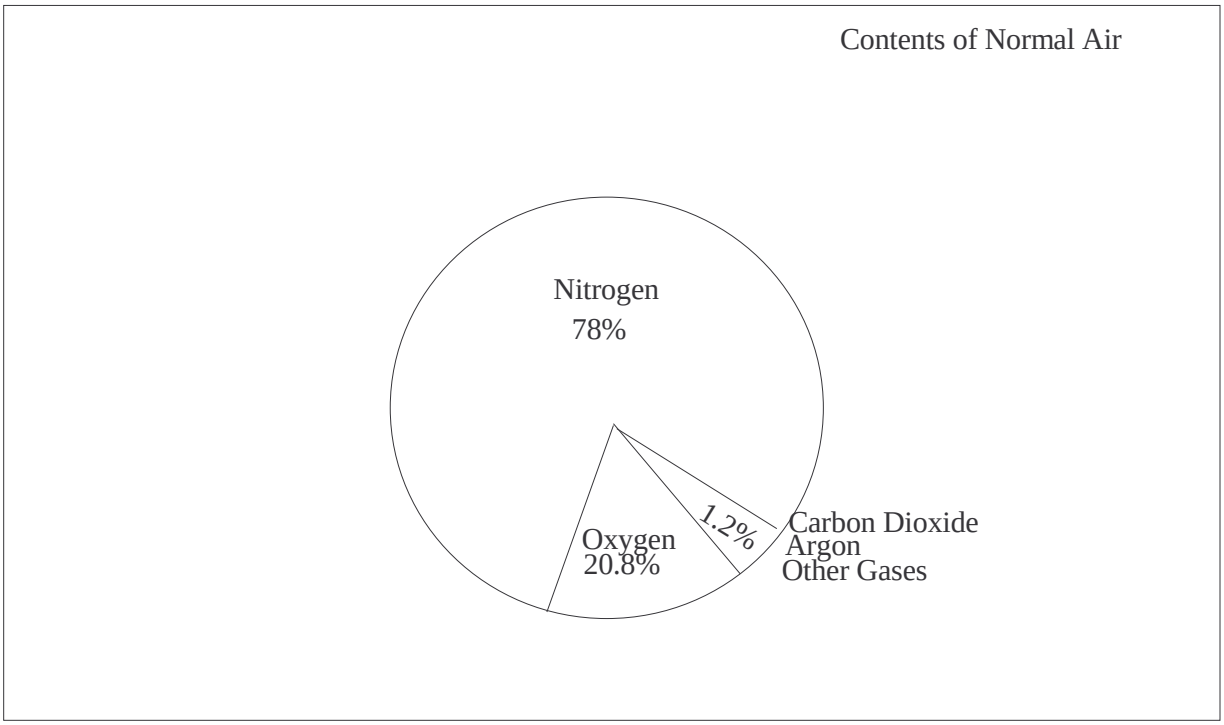
Pressure Decreases

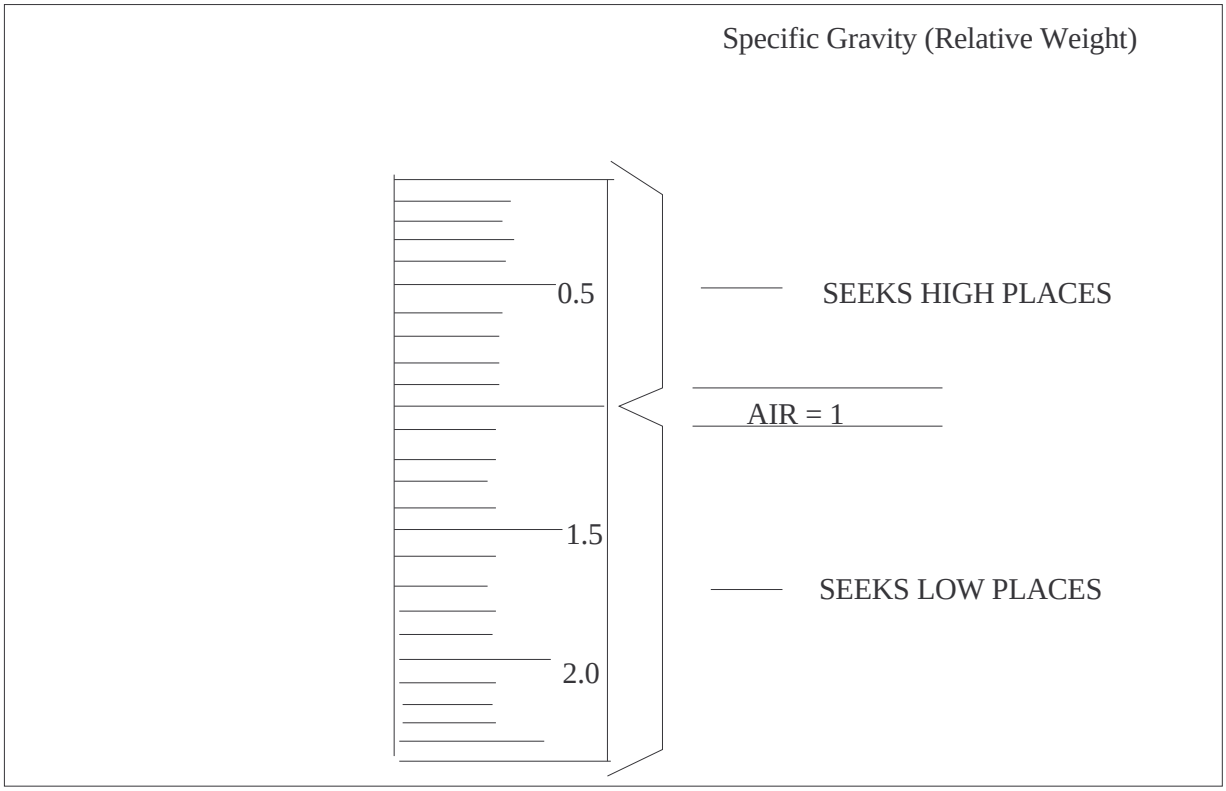


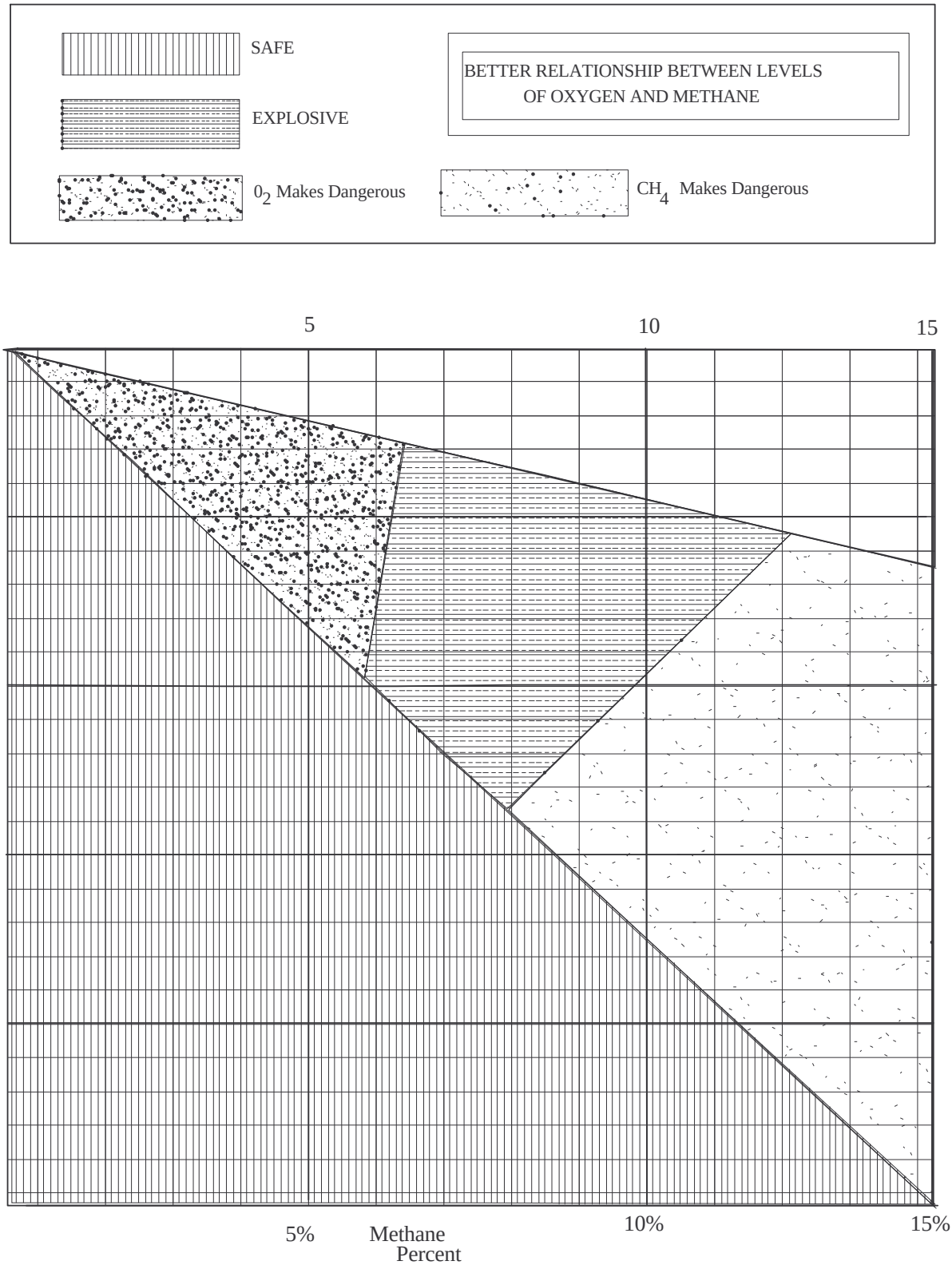
EFFECTS OF TOXIC GAS DEPEND ON:

1. CONCENTRATION
2. TOXICITY
3. LENGTH OF EXPOSURE




Contents of Normal Air
Nitrogen
78%
Oxygen
20.8%
1.2%
Carbon Dioxide
Argon
Other Gases


Specific Gravity (Relative Weight)
0.5
1.5
2.0
SEEKS HIGH PLACES
AIR = 1
SEEKS LOW PLACES


SAFE
EXPLOSIVE
0_2 Makes Dangerous
BETTER RELATIONSHIP BETWEEN LEVELS OF OXYGEN AND METHANE
CH_4 Makes Dangerous
5
10
15
20
15
10
5
5%
Methane Percent
10%
15%