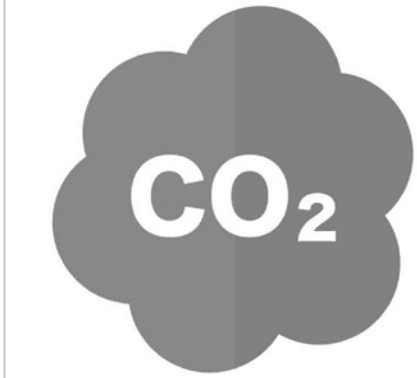
การใช้และดูแลรักษาถังดับเพลิงชนิด CO2 อย่างปลอดภัย



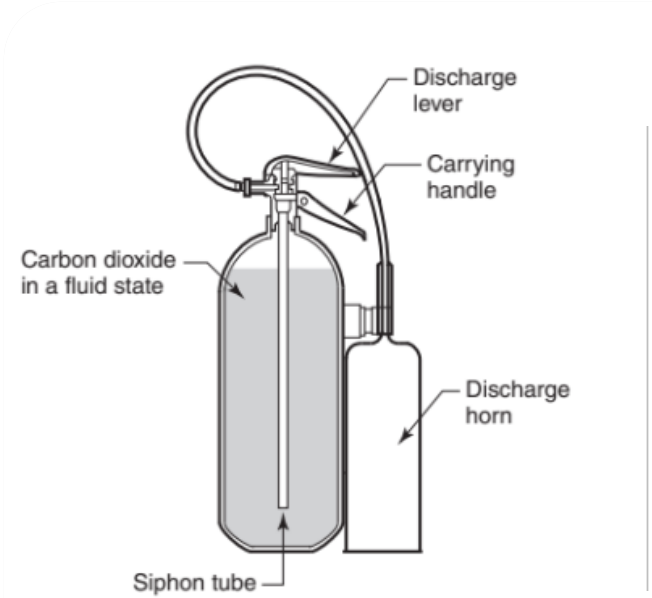
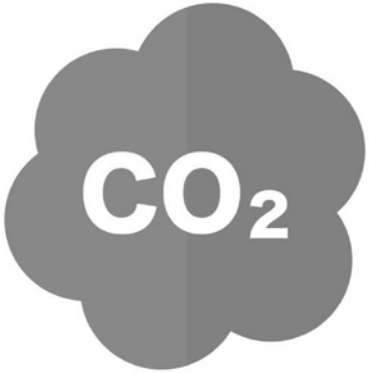


FIGURE D.4.3(a) Large Carbon Dioxide Extinguisher



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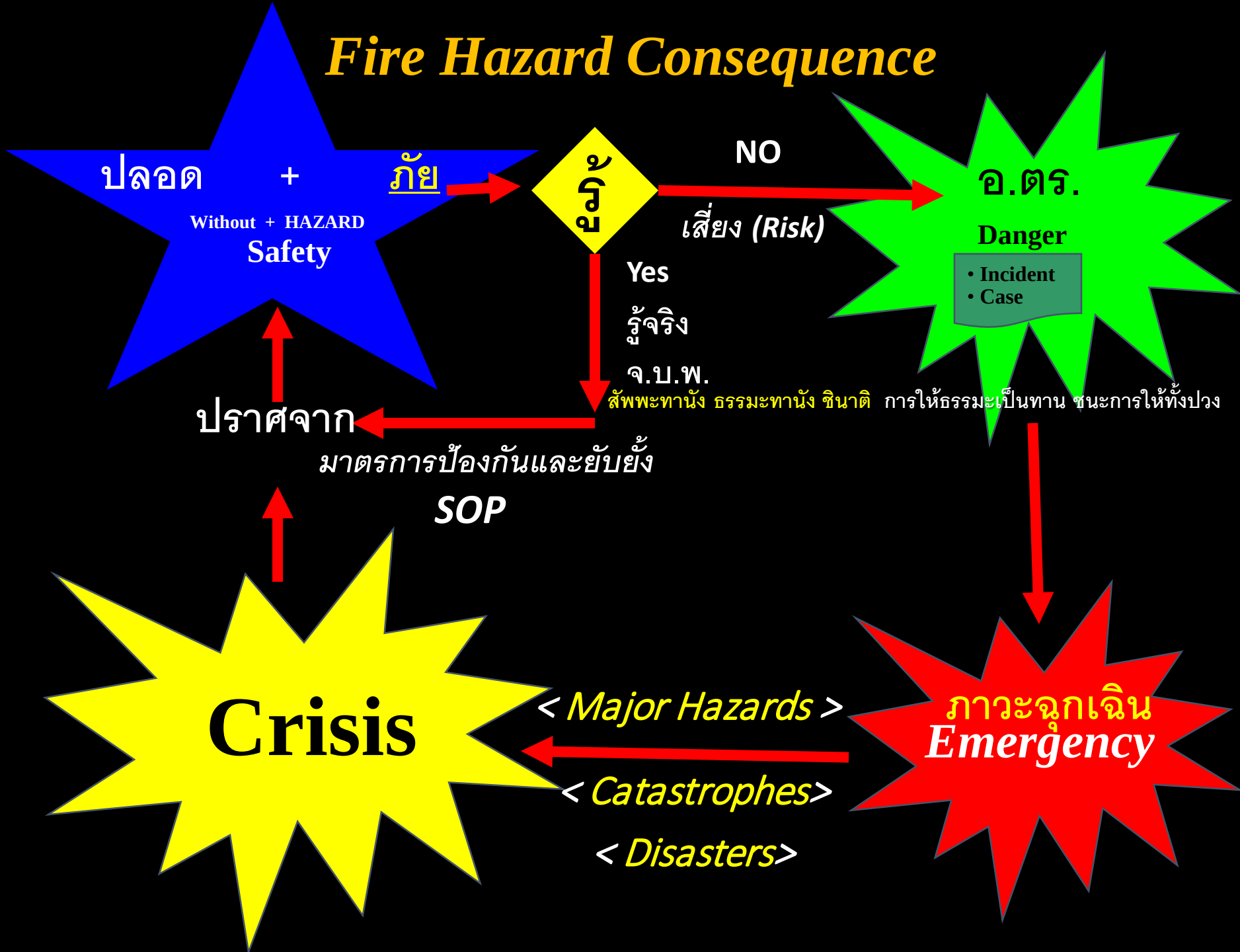
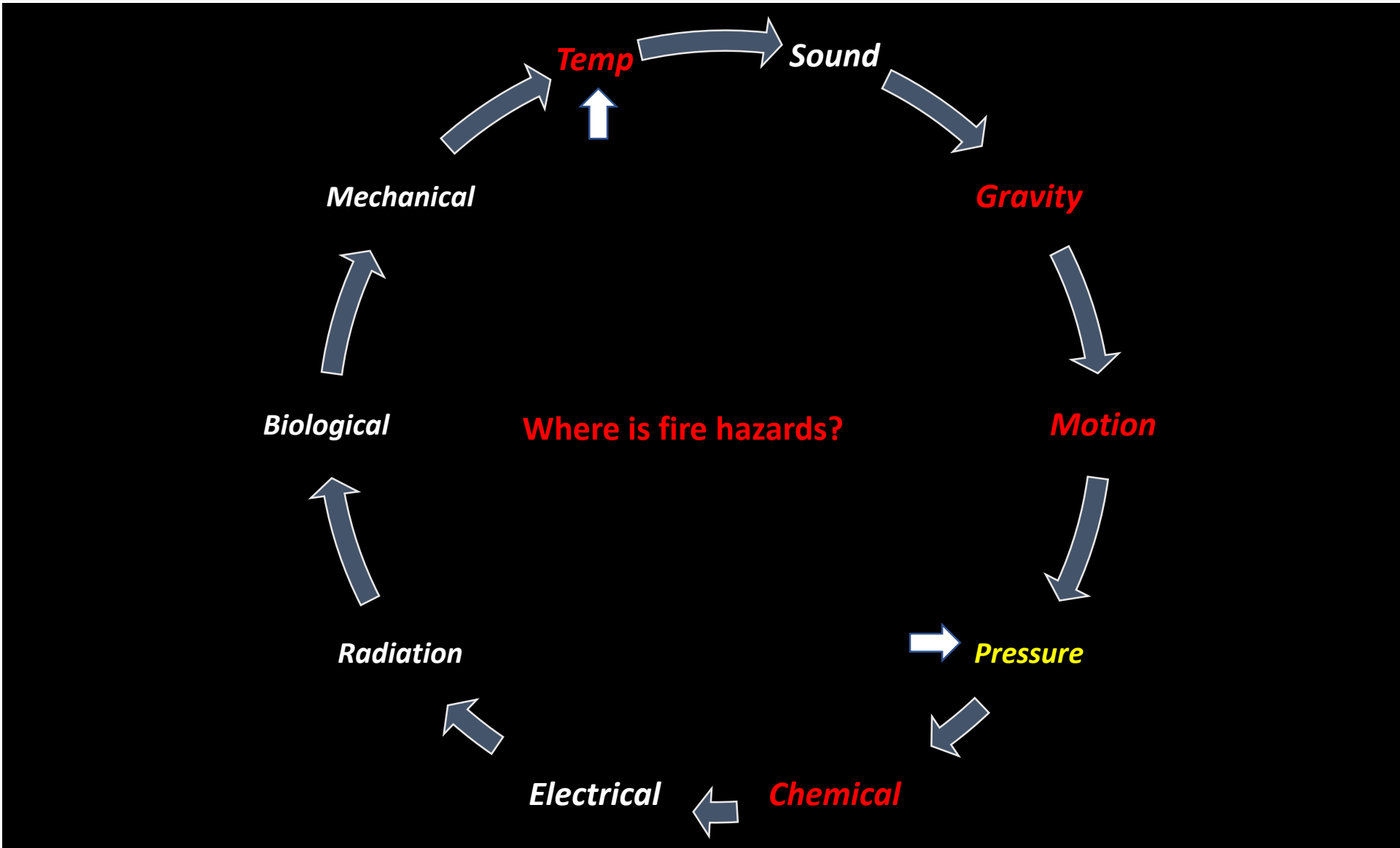
Fire Hazard Consequence



Where is the HAZARD?



FIRE FIGHTING EQUIPMENT RELIABILITY PRINCIPLE ELEMENTS

Co2 is the one element of those

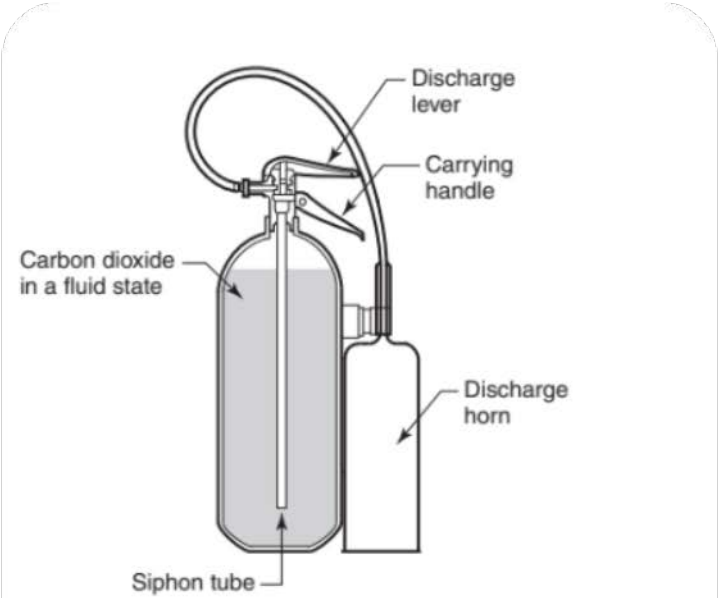


FIGURE D.4.3(a) Large Carbon Dioxide Extinguisher

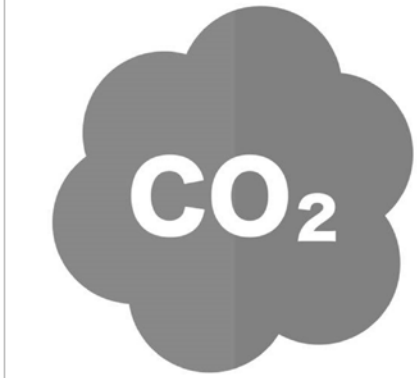
จานดาว

Fire Fighting Equipment (FFE) Management

การจัดทำมาตรการ การจัดการ เพื่อกำหนดแนวทาง ขั้นตอนให้ฝ่ายที่เกี่ยวข้องที่ระบุไว้ในหลักการนี้ไปปฏิบัติอย่างเต็มที่ในการทดสอบประสิทธิภาพ การตรวจสอบ และการบำรุงรักษาทั้งหมดควรดำเนินการโดยบุคลากรที่มีคุณสมบัติ ได้แสดงความสามารถในการปฏิบัติงานซึ่งประกอบไปด้วยข้อมูลต่างๆ ดังนี้:-

- **ขั้นตอนการติดตั้งและขั้นตอนการยอมรับ**
- **การทดสอบประสิทธิภาพการทำงานของอุปกรณ์ดับเพลิง**
- **แนวทางปฏิบัติมาตรฐานในการปฏิบัติงาน รวมถึงคู่มือการใช้งานและขั้นตอนการทดสอบ/ตรวจสอบ/บำรุงรักษา**
- **การเก็บเอกสารและการบันทึก**
- **การจัดโปรแกรมการฝึกอบรมเกี่ยวกับการใช้อุปกรณ์การดับเพลิง**
- **การติดต่อเชื่อมโยงกับหน่วยงานภายนอก ที่เกี่ยวข้องที่มีความเป็นไปได้ที่จะสนับสนุนในการดำเนินการที่เกี่ยวกับอุปกรณ์ดับเพลิงในกรณีที่จำเป็น**

การใช้และดูแลรักษาถังดับเพลิงชนิด CO2 อย่างปลอดภัย



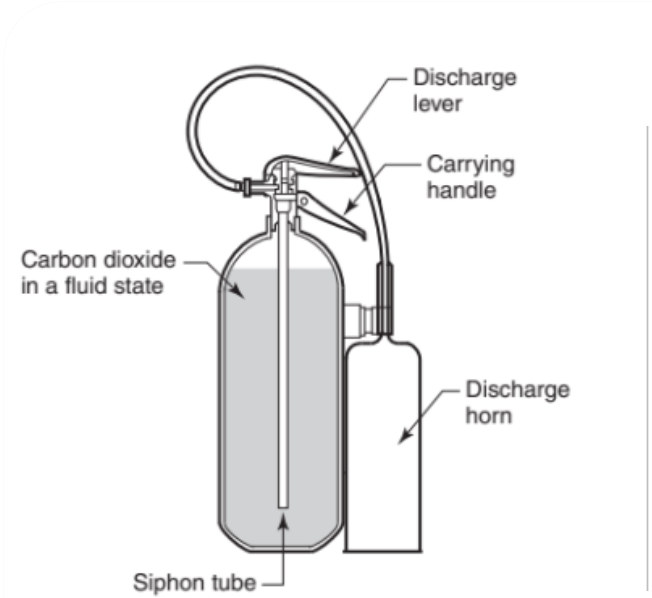
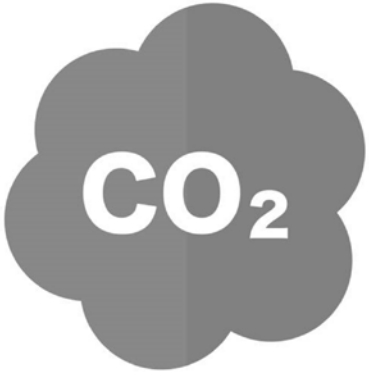


FIGURE D.4.3(a) Large Carbon Dioxide Extinguisher



ความอันตราย	
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INSTRUCTIONS
1 PULL PIN. HOLD UNIT UPRIGHT.
2 STAND BACK 8 FEET. AIM AT BASE OF FIRE.
3 SQUEEZE LEVER.
4 SWEEP SIDE TO SIDE.
CARBON DIOXIDE
Badger
fire protection

แก๊สคาร์บอนไดออกไซด์

- **<u>ลักษณะทางกายภาพ</u>**
- **ในสภาวะปกติจะเป็นแก๊ส ไม่มีสี ไม่มีกลิ่น ไม่มีรส หนักกว่าอากาศ หากถูกอัดด้วยความดันและทำให้เย็นลง จะอยู่ในสถานะของเหลวและของแข็งได้ ถ้าอยู่ในรูปของเหลว จะเรียกว่าคาร์บอนไดออกไซด์เหลว (Liquid carbon dioxide) ถ้าอยู่ในรูปของแข็งเป็นผลึกเย็น จะเรียกว่าน้ำแข็งแห้ง (Dry ice)**
- หากได้รับแก๊สนี้เข้าไปในปริมาณมาก จะทำให้หายใจเร็ว ชีพจรเร็ว หัวใจเต้นเร็ว กดสมอง ซึม มึนงง สับสน หมดสติ และอาจเสียชีวิตได้

แก๊สคาร์บอนไดออกไซด์

- **เป็นชื่อแก๊สชนิดหนึ่ง ไม่มีสี**
- **สูตรเคมี CO_2 มีปรากฏในบรรยากาศ ที่เกิดจากการเผาไหม้โดยสมบูรณ์ของธาตุคาร์บอนหรือสารอินทรีย์**
- **เป็นแก๊สหนักกว่าอากาศและไม่ช่วยการเผาไหม้** (มีความหนาแน่น 1.98 kg/m^3 ซึ่งเป็นประมาณ 1.5 เท่าของอากาศ)
- **จึงใช้ประโยชน์ในการดับเพลิง ข้อดีคือไม่ทิ้งคราบสกปรก ฉีดแล้วระเหยหายไป**
- **ใช้ในอุตสาหกรรมเครื่องดื่มอัดลม เช่น น้ำโซดา น้ำหวาน**
- **ใช้ทำน้ำแข็งแห้ง ซึ่งเป็นตัวทำความเย็น**
- จะกลายเป็นของแข็งที่มีสีขาวอุณหภูมิ -78 องศาเซลเซียส โดยไม่ผ่านการเป็นของเหลวก่อน หากต้องการทำให้คาร์บอนไดออกไซด์เป็นของเหลว ต้องใช้ความดันไม่น้อยกว่า 5.1 บรรยากาศ

CO_2 [ppm]	Air Quality
2100	BAD Heavily contaminated indoor air Ventilation required
2000	
1900	
1800	
1700	
1600	
1500	MEDIOCRE Contaminated indoor air Ventilation recommended
1400	
1300	
1200	
1100	
1000	FAIR
900	
800	GOOD
700	
600	EXCELLENT
500	
400	

ความสามารถในการดับเพลิง

- เป็นก๊าซที่ไม่ช่วยในการติดไฟ ไปแทนที่ออกซิเจน หนักกว่าอากาศ1.5 เท่า
- ดับไฟ **CLASS B** ประเภทน้ำมันฯ และ แก๊ส
- ดับไฟ **CLASS C** ประเภทไฟฟ้าที่เกิดจากอุปกรณ์ไฟฟ้าหรือเครื่องใช้ไฟฟ้าที่ยังมีกระแสไฟฟ้าอยู่

- **Fire Rating**
- **5 lbs Fire Rating 5BC** เหมาะสำหรับใช้ในห้องควมคุมไฟฟ้า
- **10 lbs Fire Rating 10BC** สำหรับใช้ในห้องควมคุมไฟฟ้า อาคารสำนักงาน, โรงงานอุตสาหกรรม ฯลฯ
- **15, 20 lbs Fire Rating 10BC** สำหรับใช้ในห้องควมคุมไฟฟ้า อาคารสำนักงาน, โรงงานอุตสาหกรรม ฯลฯ

NFPA®

10

Standard for
Portable Fire Extinguishers

2022

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NFPA®

25

Standard for the
Inspection, Testing,
and Maintenance
of Water-Based Fire
Protection Systems

2023

NFPA®

NFPA 10
Prohibition on Use of Fire Extinguishers and conversion of fire extinguisher types

7.12 Prohibition on Uses of Extinguishers and Conversion of Fire Extinguisher Types.

7.12.1 Fire extinguishers shall not be used for any purpose other than that of a fire extinguisher.

7.12.2 Fire extinguishers shall not be converted from one type to another, modified, or altered.

7.12.3 Fire extinguishers shall not be converted for the use of a different type of extinguishing agent.

NFPA 10
Concern Carbondioxide

7.8.3.9* Carbon Dioxide.

7.8.3.9.1 The vapor phase of carbon dioxide shall be not less than 99.5 percent carbon dioxide.

7.8.3.9.2 The water content shall be not more than 60 parts per million (ppm) by weight at −52°F (−47°C) dew point.

7.8.3.9.3 Oil content shall not exceed 10 ppm by weight.

7.1.2 Personnel.

7.1.2.1* Persons performing maintenance and recharging of extinguishers shall be certified.

7.1.2.1.1 Persons training to become certified shall be permitted to perform maintenance and recharging of extinguishers under the direct supervision and in the immediate presence of a certified person.

7.1.2.1.2* Certification requires that a person pass a test administered by an organization acceptable to the AHJ.

7.1.2.1.3 The test shall, at a minimum, be based upon knowledge of the chapters and annexes of this standard.

7.1.2.1.4 The testing process shall permit persons to use the standard during the test.

7.1.2.1.5 Persons passing the test required in 7.1.2.1.2 shall be issued a document or a certificate.

7.1.2.1.6 The document or certificate shall be made available when requested by the authority having jurisdiction.

7.1.2.2 Persons performing maintenance and recharging of extinguishers shall be trained and shall have available the appropriate manufacturer's servicing manual(s), the correct tools, recharge materials, lubricants, and manufacturer's replacement parts or parts specifically listed for use in the fire extinguisher.

Table 7.3.3.1 Maintenance Involving Internal Examination

Extinguisher Type	Internal Examination Interval (years)
Stored-pressure loaded stream and antifreeze	1
Pump tank water and pump tank, calcium chloride based	1
Dry chemical, cartridge- and cylinder-operated, with mild steel shells	1*
Dry powder, cartridge- and cylinder-operated, with mild steel shells	1*
Wetting agent	1
Stored-pressure water	5
AFFF (aqueous film-forming foam)	3†
FFFP (film-forming fluoroprotein foam)	3†
Stored-pressure dry chemical, with stainless steel shells	5
Carbon dioxide	5
Wet chemical	5
Dry chemical stored-pressure, with mild steel shells, brazed brass shells, and aluminum shells	6
Halogenated agents	6
Dry powder, stored-pressure, with mild steel shells	6

*Dry chemical and dry powder in cartridge- or cylinder-operated extinguishers are examined annually.

7.8 Extinguisher Recharging and Extinguishing Agents.

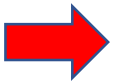
7.8.1* General.

7.8.1.1 All rechargeable-type fire extinguishers shall be recharged after any use or when the need is indicated by an inspection or servicing.

7.8.1.2* When recharging is performed, the manufacturer's service manual shall be followed. *(For recharge agents, see 7.8.3.)*

7.8.1.3* The amount of recharge agent shall be verified by weighing.

7.8.1.3.1 For those fire extinguishers that do not have the gross weight marked on the nameplate or valve, a permanent label that indicates the gross weight shall be affixed to the cylinder.



7.8.1.3.2 The added label containing the gross weight shall be a durable material of a pressure-sensitive, self-destruct type. *(For stored-pressure water-type extinguishers, see 7.8.3.10.)*

7.8.1.3.3 Pump tank water and pump tank calcium chloride–based antifreeze types shall not be required to have weight marked.

7.8.1.3.4* After recharging, a leak test shall be performed on stored-pressure and self-expelling types of fire extinguishers.

7.8.1.3.5 In no case shall an extinguisher be recharged without hydrostatic testing if it is beyond its specified hydrostatic test date.

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7.8.4.8 Recharge Record Keeping.

7.8.4.8.1 Labels.

7.8.4.8.1.1 Each fire extinguisher shall have a tag or label securely attached that indicates recharging was performed.

7.8.4.8.1.2 The tag or label, as a minimum, shall identify the following:

(1) Month and year charging was performed
(2) Person performing the work
(3) Name of the agency performing the work

7.8.4.8.2 Each extinguisher that has been recharged shall have a verification-of-service collar located around the neck of the container, except as identified in 7.13.4.

NFPA 10

Chapter 8 Hydrostatic Testing

8.1* General.

8.1.1 Pressure vessels used as fire extinguishers and specified components of fire extinguishers shall be hydrostatically tested in accordance with this chapter.

8.1.2 Cylinders and cartridges bearing U.S. Department of Transportation (DOT) or Transport Canada (TC) markings shall be retested in accordance with the applicable DOT or TC regulations.

8.1.2.1 Hydrostatic testing shall be performed by persons who are trained in pressure testing procedures and safeguards

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8.1.2.1.2 Hydrostatic testing facilities with a DOT certification [requalification identification number (RIN)] or a TC certification shall be permitted to perform the task of hydrostatic testing without having additional certification as a fire extinguisher technician as outlined in 7.1.2.

8.1.2.1.3* Where hydrostatic testing is subcontracted to a facility described in 8.1.2.1.1, an extinguisher technician complying with 7.1.2 shall perform assembly and disassembly of valves and cylinders, replacement of any parts or components, and all other extinguisher service work.

8.1.3 A hydrostatic test shall always include both an internal and an external visual examination of the cylinder.

8.1.4 Hydrostatic testing shall be conducted using water or another compatible noncompressible fluid as the test medium.

8.1.4.1 Air or other gases shall not be used as the sole medium for pressure testing.

8.1.4.2 All air shall be vented prior to hydrostatic testing, to prevent violent and dangerous failure of the cylinder.

8.1.5* Fire extinguishers having aluminum cylinders or shells suspected of being exposed to temperatures in excess of 350°F (177°C) shall be removed from service and subjected to a hydrostatic test.

NFPA 10

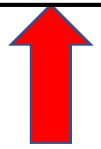
7.4* Carbon Dioxide Hose Assembly Conductivity Test. A conductivity test shall be conducted annually on all carbon dioxide hose assemblies.

7.4.1 Carbon dioxide hose assemblies that fail the conductivity test shall be replaced.

7.4.2 Record Keeping for Conductivity Testing of Carbon Dioxide Hose Assemblies.

NPFA 10, with Specifications of CGA- 1

8.2.3 Test Equipment for High-Pressure Cylinders. The equipment for hydrostatic testing of high-pressure cylinders and cartridges (DOT 3 series) shall meet the specifications of CGA C-1, *Methods for Pressure Testing Compressed Gas Cylinders.*



A.7.1.2.1 Persons performing maintenance and recharging of extinguishers should meet one of the following criteria:

(1) Factory training and certification for the specific type and brand of portable fire extinguisher being serviced
(2) Certification by an organization acceptable to the authority having jurisdiction
(3) Registration, licensure, or certification by a state or a local authority having jurisdiction

Certification confirms that a person has fulfilled specific requirements as a fire extinguisher service technician and has earned the certification. For the purpose of this standard, certification is the process of an organization issuing a document confirming that an applicant has passed a test based on the chapters and annexes of this standard. The organization administering the test issues an official document that is relied upon as proof of passing the test. Ultimately, the document issued by the organization administering the test must be acceptable to the authority having jurisdiction. Some authorities having jurisdiction do not rely on outside organizations and establish their own local licensing programs that include a test.

NPFA 10

A.7.4 Carbon dioxide hose assemblies have a continuous metal braid that connects to both couplings to minimize the static shock hazard. The reason for the conductivity test is to determine that the hose is conductive from the inlet coupling to the outlet orifice. A basic conductivity tester consists of a flashlight having an open circuit and a set of two wires with a conductor (clamps or probe) at each end.

Figure A.7.4 provides a guide to the design of a conductivity test label.

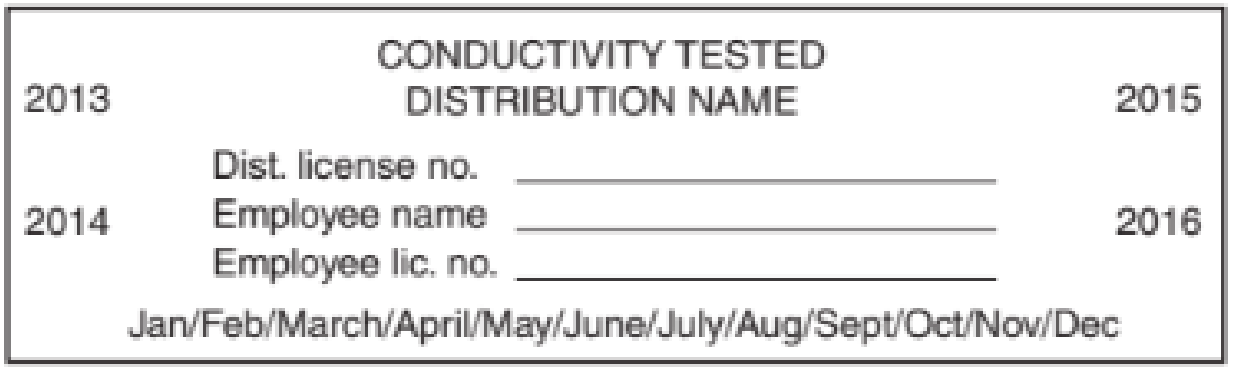


FIGURE A.7.4 Conductivity Test Label.

NPFA 10

A.8.7.2 Figure A.8.7.2 provides a guide to the design of a hydrostatic test label. All print should be black on a silver background.

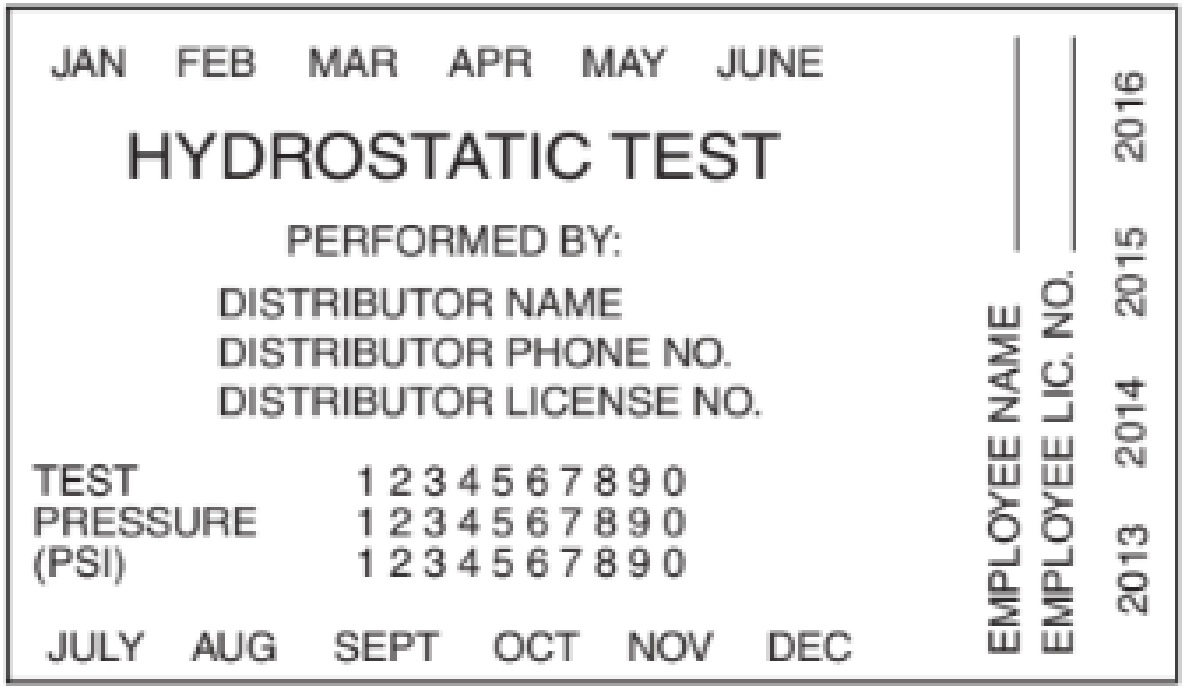


FIGURE A.8.7.2 Design of a Hydrostatic Test Label.

The following list is a sample of maintenance procedures that should be followed to determine deficiencies that require additional attention to remediate the condition of the extinguisher as appropriate for carbon dioxide hand portable fire extinguishers:

(1) Visually examine the extinguisher for damage by removing the extinguisher from the hanger or cabinet, and visually examine the extinguisher for damage, including cylinder dents, repairs, general corrosion, hose or nozzle threads, handles, and levers.
(2) Verify that the bracket or cabinet is the proper one for the extinguisher.
(3) Verify that the bracket or cabinet is secure, undamaged, and properly mounted.
(4) Verify that the nameplate operating instructions are legible and facing outward.
(5) Confirm that the extinguisher model is not subject to recall and is not obsolete.
(6) Verify the extinguisher records to determine hydrostatic test intervals.
(7) Verify the pull pin functions properly and examine for damage or corrosion by removing the pull pin.
(8) Examine the handle and levers to ensure that they are undamaged and operable.
(9) Verify that the valve stem is correctly extended and not corroded or damaged.
(10) Verify that the nozzle or hose assembly, or both, is unobstructed, by removing and examining the nozzle.
(11) Confirm that the nozzle and hose assembly are correct for the model of extinguisher.

NPFA 10

C.3.4 Carbon Dioxide (CO_2) Fire Extinguishers. The principal advantage of CO_2 fire extinguishers is that the agent does not leave a residue after use. This can be a significant factor where protection is needed for delicate and costly electronic equipment. Other typical applications are food preparation areas, laboratories, and printing or duplicating areas. Carbon dioxide extinguishers are listed for use on Class B and Class C fires. Because the agent is discharged in the form of a gas/snow cloud, it has a relatively short range of 3 ft to 8 ft (1 m to 2.4 m). This type of fire extinguisher is not recommended for outdoor use where windy conditions prevail or for indoor use in locations that are subject to strong air currents, because the agent can rapidly dissipate and prevent extinguishment. The concentration needed for fire extinguishment reduces the amount of oxygen (air) needed for life safety when the discharge is in a confined area (space).

F.7.3 Maintenance and Servicing.

F.7.3.1 Maintenance and servicing of fire extinguishers should be performed by fire extinguisher servicing companies that have the proper tools, recharge materials, lubricants, manufacturer's servicing instructions, and replacement parts.

F.7.3.2 Manufacturer's instructions specify servicing of rechargeable fire extinguishers after any use. The frequency of internal maintenance and hydrostatic testing is specified in the owner's manual and in Table F.7.3.2.

Table F.7.3.2 Frequency of Internal Maintenance and Hydrostatic Testing of Fire Extinguishers

Type of Extinguisher	Internal Maintenance Interval (years)	Hydrostatic Testing Interval (years)
Dry chemical*	6	12
Water, AFFF, FFFP, antifreeze	5	5
Halogenated agent†	6	12
Carbon dioxide	5	5

Table H.2 Characteristics of Extinguishers

Extinguishing Agent	Method of Operation	Capacity	Horizontal Range of Stream	Approximate Time of Discharge	Protection Required Below 40°F (4°C)	UL or ULC Classifications[a]
Water	Stored-pressure	1⅔ gal (6 L)	30–40 ft (9.1–12.2 m)	40 sec	Yes	1-A
	Stored-pressure or pump	2½ gal (9.5 L)	30–40 ft (9.1–12.2 m)	1 min	Yes	2-A
	Pump	4 gal (15.1 L)	30–40 ft (9.1–12.2 m)	2 min	Yes	3-A
	Pump	5 gal (19.0 L)	30–40 ft (9.1–12.2 m)	2–3 min	Yes	4-A
Water (wetting agent)	Stored-pressure	1½ gal (5.7 L)	20 ft (6.1 m)	30 sec	Yes	2-A
	Stored-pressure	25 gal (95 L) (wheeled)	35 ft (10.7 m)	1½ min	Yes	10-A
	Stored-pressure	45 gal (170 L) (wheeled)	35 ft (10.7 m)	2 min	Yes	30-A
	Stored-pressure	60 gal (227 L) (wheeled)	35 ft (10.7 m)	2½ min	Yes	40-A
Loaded stream	Stored-pressure	2½ gal (9.5 L)	30–40 ft (9.1–12.2 m)	1 min	No	2-A
	Stored-pressure	33 gal (125 L) (wheeled)	50 ft (15.2 m)	3 min	No	20-A
Water mist	Stored-pressure	1.8–2.5 gal (6.8–9.5 L)	5–12 ft (1.5–3.7 m)	50–80 sec	Yes	2-A:C
AFFF, FFFP	Stored-pressure	2½ gal (9.5 L)	20–25 ft (6.1–7.6 m)	50 sec	Yes	3-A:20 to 40-B
	Stored-pressure	1⅔ gal (6 L)	20–25 ft (6.1–7.6 m)	50 sec	Yes	2-A:10-B
	Nitrogen cylinder	33 gal (125 L)	30 ft (9.1 m)	1 min	Yes	20-A:160-B
Carbon dioxide[b]	Self-expelling	2½–5 lb (9.5 L)	3–8 ft (0.9–2.4 m)	8–30 sec	No	1 to 5-B:C
	Self-expelling	10–15 lb (4.5–6.8 kg)	3–8 ft (0.9–2.4 m)	8–30 sec	No	2 to 10-B:C
	Self-expelling	20 lb (9 kg)	3–8 ft (0.9–2.4 m)	10–30 sec	No	10-B:C
	Self-expelling	50–100 lb (23–45 kg) (wheeled)	3–10 ft (0.9–3 m)	10–30 sec	No	10 to 20-B:C

Carbon Dioxide - 10 lbs./15 lbs./20 lbs. **Inspection**

•**MONTHLY**

- Confirm that the extinguisher is in the proper place
- Confirm access and visibility of the extinguisher is not obstructed.
- Confirm the operating instructions are legible.
- Check to make sure any seals or tamper are intact.
- Make sure the inspection tag, seal and pin are in place.
- Carry out a visual check to ensure there is no damage to the extinguisher.
- Record for monthly inspection and indicate if repair required.

FFE MASTER PLAN INSPECTION, TEST AND MAINTENANCE

For Area : XXXX

No.	DESCRIPTION	Ref. No.	INSPECTION				BY	TEST								BY	MAINTENANCE					BY
			Monthly	Quarterly	Semi-Annually	Annually		Monthly	Quarterly	Semi-Annually	Annually	Hydro/Year 3	5	12	15		Monthly	Quarterly	Semi-Annually	Annually	Year 5	
1.	Co2, 10 lbs.(Stored-Pressure) X		☒	☒	☐	☐		☐	☐	☐	☒	☐	☒	☐	☐		☐	☐	☐	☐	☐	

Carbon Dioxide - 10 lbs./15 lbs./20 lbs.
QUARTERLY & Test

- **QUARTERLY**
- Check all above steps and
- Weigh the extinguisher

  Record for the monthly inspection and indicate if repairs are required.
- **Test**
- **EVERY 5 YEARS**

  Perform a hydrostatic test on extinguisher every five years

FFE MASTER PLAN INSPECTION, TEST AND MAINTENANCE

For Area : XXXX

No.	DESCRIPTION	Ref. No.	INSPECTION				BY	TEST								BY	MAINTENANCE					BY
			Monthly	Quarterly	Semi-Annually	Annually		Monthly	Quarterly	Semi-Annually	Annually	Hydro/Year 3	5	12	15		Monthly	Quarterly	Semi-Annually	Annually	Year 5	
1.	Co2, 10 lbs.(Stored-Pressure) X		☒	☒	☐	☐		☐	☐	☐	☒	☐	☒	☐	☐		☐	☐	☐	☐	☐	

Carbon Dioxide - 10 lbs./15 lbs./20 lbs.
Maintenance

•**ANNUALLY**
- Confirm that the extinguisher is in the proper place
- Confirm access and visibility of the extinguisher is not obstructed.
- Confirm the operating instructions are legible.
- Check to make sure any seals or tamper indicators are intact.
- Make sure the inspection tag, seal and pin are in place.
- Carry out a visual check to ensure there is no damage to the extinguisher.
- Make sure the hose and horn is not cracked, broken or damaged.
- Weigh the extinguisher, check the weight against the stamped weight.

•Check and record hydrostatic test date.
- Record by bar code for annual inspection and indicate if repair required.
- Install a tag with the date of the inspection to certify that the extinguisher is in condition for use.
- Ensure the pressure hose and horn is clean and free flowing and the gas tube is in good condition.
- Perform conductivity test on hose assembly
- Record for annual inspection and indicate if repair required.

FFE MASTER PLAN INSPECTION, TEST AND MAINTENANCE

For Area : XXXX

No.	DESCRIPTION	Ref. No.	INSPECTION				BY	TEST								BY	MAINTENANCE					BY
			Monthly	Quarterly	Semi-Annually	Annually		Monthly	Quarterly	Semi-Annually	Annually	Hydro/Year 3	5	12	15		Monthly	Quarterly	Semi-Annually	Annually	Year 5	
1.	Co2, 10 lbs.(Stored-Pressure) X		☒	☒	☐	☐		☐	☐	☐	☒	☐	☒	☐	☐		☐	☐	☐	☐	☐	

Fire Training Safety Analysis

Type of Exercise _____ **Planned Date** _____

Exercise Events	HAZARD	Cause	Control