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of:

Saga Universal Training Corporation

Saga Universal Training Corp. is dedicated to reducing deaths caused by illness and injury. This course follows the established and accepted guidelines, principles and recommendations of internationally recognized safety organizations.

This training manual is intended to supplement employer training programs. Readers should not assume that reviewing this manual alone constitutes complete self-contained breathing apparatus training.

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Saga Universal Training Corp. wishes to acknowledge the efforts of all the people who contributed to the writing, editing, and layout of this manual. It is our hope that this manual and the resulting training program will aide in the reduction of preventable injuries with the necessary knowledge, skills and confidence to use breathing apparatus safely.

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INTRODUCTION TO SCBA (*Self Contained Breathing Apparatus*)

Protective breathing apparatus is extremely crucial to the wellbeing of any worker who has the potential to be exposed to a hazardous environment. Failure to use this equipment could lead to unsuccessful rescue attempts, injuries and/or fatalities. Employees should be knowledgeable of potentially hazardous environments, the requirements for wearing protective breathing apparatus, the proper procedures for donning, doffing and inspecting the apparatus as well as the proper care and maintenance of the equipment. There are two types of SCBA, belt-mounted regulators (BMR) and mask-mounted regulators (MMR). An SCBA can also be an open or closed-circuit unit.

OSHA defines a confined space as a space that is large enough to enter, has limited or restricted means for entry or exit, and has not been designed for continuous human occupancy. One factor that makes entering a confined space hazardous is that the space may contain a hazardous atmosphere. A confined space may contain a toxic gas, such as hydrogen sulfide, in concentrations hazardous to health. Other confined spaces may contain a nontoxic gas, such as nitrogen, in concentrations that displace the oxygen in the air in the space. The air we normally breathe contains about 21% oxygen, 78% nitrogen, and trace amounts of other gases. Nitrogen can act as an asphyxiant, causing suffocation by displacing oxygen-containing air.

It is not necessary for nitrogen to displace all of the 21% of oxygen normally found in the air in order to cause harm to people. OSHA requires that oxygen levels be maintained at or above 19.5% in order to prevent injury to workers. According to the Compressed Gas Association, "exposure to atmospheres containing 8-10 percent or less oxygen will bring about unconsciousness without warning and so quickly that the individuals cannot help or protect themselves." Exposure to an atmosphere containing 6-8 percent oxygen can be fatal in as little as 6 minutes. Exposure to an atmosphere containing 4-6 percent oxygen can result in a coma in 40 seconds and subsequent death.”

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Confined Space Accident at Chemical Plant Leaves One Dead, One Injured

A routine inspection of a pipe at the Union Carbide Taft/Star Manufacturing Plant in Hahnville, LA turned deadly when two workers were overcome due to nitrogen asphyxiation. One plant worker was killed, and an independent contractor was seriously injured when nitrogen gas was trapped and failed to vent safely.

The plant produces ethylene oxide, ethylene glycol, and glycol ethers. At the time of the incident, the plant had been closed for maintenance for about six weeks while workers replaced equipment and cleaned an oxygen feed mixer.
At approximately 12:15 pm, workers on the fifth level of the structure, approximately 60 feet above the ground, were performing a black light inspection at an open end of a 48-inch-wide horizontal pipe, which had been opened for the purpose of maintenance. The two open pipe ends were wrapped with clear plastic sheeting in order to keep the pipe free of debris until the oxygen feed mixer was reinstalled. Nitrogen was being injected into the process, and through some of the piping systems connected to the reactors. The nitrogen was venting from one side of the open pipe where formerly it had been connected to an oxygen feed mixer. No warning sign was posted on the pipe opening identifying it as a confined space or warning that the pipe contained potentially hazardous nitrogen.

Nitrogen is an odorless, tasteless, and invisible gas that can cause asphyxiation at high concentrations. When used in confined spaces, nitrogen is especially hazardous because it cannot be detected by human senses but can cause injury or death within minutes by displacing oxygen within the bloodstream.

The two workers had secured a sheet of black plastic over the end of the pipe where they were working to provide shade to make it easier to conduct the black light test during daylight. While working just outside the pipe opening and inside of the black plastic sheet, the two workers were apparently overcome by nitrogen. At approximately 12:20 pm, a contractor noticed blood on one of the worker's hands when he looked through a gap in the plastic sheet. He alerted his foreman. The foreman called to the two workers behind the sheet and, getting no reply, removed the sheet. Witnesses said that one worker was found in front of the pipe, unconscious and slumped over with his head lying inside the open pipe. The other was found seated beside the pipe opening, dazed and leaning against the side of the pipe.

The plant emergency response team arrived and removed the two men from the scene and administered cardiopulmonary resuscitation until the two workers were transported by ambulance to hospital. One man was dead on arrival; the other was admitted to the hospital in critical condition and given oxygen therapy over the next several days.

The use of breathing apparatus could have prevented this incident.

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LEGISLATION

Part 8 of British Columbia's Occupational Health and Safety Regulation outlines the criteria for Personal Protective Equipment – Sections 8.32 through 8.45.

Part 8, of the regulation also lists several sections and subsections regarding the specific use of Respiratory Protective Equipment. These sections include 8.32 *When respirators required,* 8.35 *IDLH or oxygen deficient atmosphere,*8.39 *Face seal*, 8.40 *Fit tests,* and 8.45 *Maintenance and inspections*, just to list a few.

In accordance with Part 8.33, *Selection of Respirators*, we must also refer to the Canadian Standard Association standard Z94.4-93 for proper selection of equipment and effective facial seal and the CSA standard Z180.1-00 for quality of breathing air.

As part of an effective respiratory protective program employers should ensure their programs reference both the BC OH&S Regulation and the CSA standards.

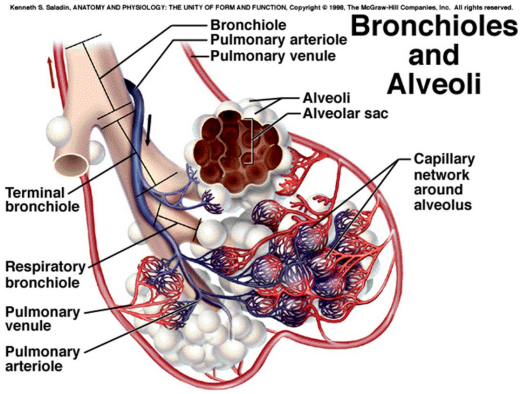
PHYSIOLOGY

A number of physiological factors come into effect when using self-contained breathing apparatus.

One of the major differences between wearing self-contained breathing apparatus and not, is the constant positive pressure that is applied throughout your lungs and in the face piece.

The positive pressure in the face piece causes your lungs to become hyper-inflated as a result of breathing out against pressure. This hyper-inflation of the lungs is not felt by the user but causes the user to have a more efficiently absorb oxygen into the blood. This factor counterbalances the fact that an SCBA user has a 20% decrease in physical performance as a result of wearing SCBA.

As a result of this positive pressure in the face piece the SCBA also prevents toxic gases from entering your face piece.



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Wearing positive pressure SCBA results in more effective breathing, which is countered by the fact you have a 20% decrease in physical performance as a result of you wearing it.

Working while wearing SCBA can be both physically and mentally demanding.

Your physical fitness has a direct effect on your ability to recover from these demands, as well as your performance.

Healthy cardiovascular and respiratory systems are your keys to helping meet the physical requirements of working with breathing apparatus.

In addition to the physical and mental restraints caused by wearing SCBA, the wearer should also have good balance and be slightly agile, contributing to enhanced performance while wearing the apparatus.

Factors that may limit air supply include:

- your physical condition
- the nature and degree of work being performed
- your emotional stability
- condition of the self-contained breathing apparatus
- cylinder pressure
- your experience with using SCBA.

Controlled breathing is a conscious effort to reduce your air consumption by inhaling through your nose and exhaling through your mouth. Using a nose cup in your mask forces exhalation directly out the exhalation valve reducing carbon dioxide inhalation.

Just wearing SCBA can be stressful enough. Some wearers can experience claustrophobia, which causes you to breathe faster and use up air sooner. Therefore, the wearer must exert control over their breathing and try to breathe as normally as possible.

One of the most important aspects of wearing breathing apparatus is to breath normally!

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LIMITATIONS OF SELF-CONTAINED BREATHING APPARATUS

There are several factors that create limitations for the SCBA.

Limitations of the Wearer:

Physical:

a) **Physical condition** – the wearer should be in sound physical condition in order to maximize that work that can be performed.

b) **Agility** – wearing breathing apparatus restricts movement and affects balance.

c) **Facial features** – the shape and contour of the face affects the ability to get a good seal.

Medical:

a) **Neurological function** – good motor coordination is necessary for operating breathing apparatus.

b) **Muscular/Skeletal condition** – the wear must have some physical strength and size to wear and perform required tasks.

c) **Cardiovascular conditioning** – poor cardiovascular conditioning can result in harmful medical conditions due to strenuous activity.

d) **Respiratory functioning** – proper respiratory function will maximize the wearer's operating time.

Mental:

a) **Adequate training** – the wearer must be knowledgeable in every aspect of breathing apparatus.

b) **Self-confidence** – belief in the wearer's ability.

c) **Emotional stability** – the ability to maintain control in excited or high stress situations will reduce the chance of a serious mistake.

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Limitations of the Equipment:

a) **Limited visibility** – the face piece reduces peripheral vision and face piece fogging can reduce overall vision.

b) **Decreased ability to communicate** – the face piece hinders communication.

c) **Increased weight** - breathing apparatus adds approximately 25 to 35 pounds of weight to the wearer.

d) **Decreased mobility** – the increase weight and balance reduce the wearer's mobility.

Limitations of Air Supply:

a) **Physical condition of user** – the poorer the physical condition, the faster the air supply is expended.

b) **Degree of physical exertion** – the higher the physical exertion the faster the air supply is expended.

c) **Condition of apparatus** – minor leaks and/or poor adjustment of regulator result in excess air loss.

d) **Cylinder pressure before use** – if the cylinder is not at full capacity, the amount of working time is reduced proportionately.

e) **Training and experience of user** – highly experienced users will be able to the maximum air supply from the cylinder.

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HAZARDOUS ENVIRONMENTS

SCBA is a necessary part of the protective system required for entrance to hazardous atmospheres.

The respirator is intended to protect the user only from the effects of an oxygen deficient atmosphere and/or atmospheres containing toxic or hazardous substances by providing a supply of respirable breathing air to a face piece sealed to the user's face. In Alberta workplaces, the oxygen level in the air permitted for human occupancy is 19.5% - 23%.

SCBA cylinders must be capable of providing breathable air for 30 minutes. A 2216 psi cylinder provides for this minimum whereas a 4500 psi cylinder can provide breathable air for up to 1 hour, depending on user experience and degree of stress involved.

Duration time of the respirator will depend on such factors as:

1. Degree of physical activity of the user;
2. The physical condition of the user;
3. Degree to which the user's breathing is affected by emotional factors;
4. Degree of training or experience which the user has with this or similar equipment;
5. Whether or not the cylinder is fully charged at the start of the work periods;
6. The possible presence in the compressed air of CO2 concentrations greater than .04% normally found in atmospheric air;
7. The atmospheric pressure; for example, if used in a pressurized tunnel or caisson at 2 atmospheres (15 psi guage or approx. 30 psi absolute) the duration will be ½ as long as when used at 1 atmosphere; and at 3 atmospheres will be 1/3 as long;
8. Loose or improper fitting facepiece;
9. Condition of the respirator.

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A properly fitted mask is essential in ensuring the safety of the wearer of SCBA. To ensure an effective seal, a documented fit test must be completed. The user must ensure that they have a clean-shaven face. This will contribute to the most effective seal of the face piece around the user's face.

Considerations should also be made for the use of full PPE, specific to the exposure of hazards or hazardous materials.

Tracking the location of people in hazardous atmospheres who are on SCBA is an integral component of the safety of these individuals. An accountability system should be used whenever people are on SCBA.

An accountability system should indicate user's name, location, cylinder pressure and time the user enters the location.

OXYGEN DEFICIENCY CHART

Oxygen Concentrations	**Effects**
23% and above	**Increased flammability of materials. Entry is not allowed.**
21%	**Ideal.**
20.9%	**Normal.**
18 – 19.5%	**Minimum required to maintain safe working conditions. Consult provincial regulations.**
16%	**Increased pulse, no coordination, some impairment of thinking.**
14%	**Very poor judgment and co-ordination may cause poor respiration that can lead to permanent heart damage.**
Less than 12%	**Nausea, vomiting, unconsciousness, convulsions and death.**

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TOXIC GASES CHART

Product	Flash - Point	Flam. Ranges	Physical Description	Main Danger	*Maximum Level Permitted in Air	**IDLH	Spec. Gravity Water= 1	Vap. Dens. Air=1
Carbon Dioxide (CO_2)	N/A	N/A	Colourless/ Odourless	Displaces Oxygen	5000 ppm	50 000 ppm	1.52	1.5
Carbon Monoxide (CO)	N/A	12.5%-74%	Colourless/ Odourless	Toxic- Asphyxiate	25 ppm	1200 ppm	1.25	0.97
Diesel Fuel	>40°C	0.7%-6.5%	Clear to yellow / Brown	Toxic- System Depress	N/A	N/A	N/A	4
Unleaded Gasoline	-30°C	1.3%-7.6%	Colourless/ Sweet odor	Toxic- System Depress	300 ppm	Avoid Explosive Levels	0.75	3 -4
Hydrogen Sulfide (H_2S)	N/A	4%-46%	Colourless/ Sulfur-odorless	Very Toxic- Respiratory Failure	10 ppm	100 ppm	N/A	1.2
Methane (CH_4)	188°C	5%-15%	Colourless/ Odourless	Displaces Oxygen/ Fire & Explosion	1000 ppm	Displaces Oxygen/ Avoid Explosive Levels	0.3	0.6
Nitrogen (N_2)	N/A	N/A	Colourless/ Odourless	Displaces Oxygen	Ensure oxygen is at 19.5%	Displaces Oxygen	0.808	0.97
Nitrogen Dioxide (NO_2)	N/A	N/A	Reddish Brown Colour/ Pungent Odour	Toxic-Severe Respiratory Irritant	3 ppm	50 ppm	1.44	1.6
Propane (C_3H_8)	104°C	2.1%-9.5%	LPG- Colourless Sulfur odour	Fire & Explosion	2100 ppm	Avoid Explosive Levels	N/A	1.5
Sulfur Dioxide (SO_2)	N/A	N/A	Colourless/ Suffocating Odour	Toxic-Severe Respiratory Irritant	2 ppm	100 ppm	1.43	2.2

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PRE-USE INSPECTIONS

A pre-use inspection should be completed daily if the apparatus has the potential to be used for emergency purposes. Otherwise the pre-use inspection should be completed prior to every use. Documentation of the pre-use inspection should be maintained and track to ensure the apparatus has no deficiencies and to ensure proper maintenance has been carried out when required.

Here's what to do for a pre-use inspection:

1) Ensure you have all required components: Mask, air cylinder at full pressure, regulator complete and harness.
2) Check for tag to indicate date of last refill of air cylinder.
3) Check face piece complete – is the head harness intact and straps extended. Is the face piece clean, dust free, clear and free of scratches?
4) Is the nose cup installed correctly?
5) Check regulator – exhalation valve intact and clean, hose in good repair, intact and tight?
6) Check harness to ensure straps are in good repair, clean and fully extended.
7) Open cylinder valve. Does regulator pressure gauge show same pressure as air cylinder pressure gauge? Allow 100 psi or 10% discrepancy.
8) Close air cylinder valve.
9) Does bypass valve work?
10) Does low air alarm work? Should sound at approximately 500 psi or 25% air pressure remaining.
11) Store apparatus in appropriate place until needed or use as set out by companies breathing apparatus policies.

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SCBA COMPONENTS

The Self-Contained Breathing Apparatus consists of four components; the face piece assembly or mask, the air supply or air cylinder, the regulator assembly or regulator and finally the harness assembly.

A simple acronym one can use to remember all four components is:

H – Harness
A – Air
R – Regulator
M – Mask

The harness is the backpack type frame that allows the user to carry all required components of the SCBA. This harness usually consists of a steel or aluminum frame with two shoulder straps and one waist strap.

The air supply or cylinder consists of three components. The air cylinder itself can have a variety of pressures and rated times. One of the most common cylinders is the 2216 psi, which is rated to last approximately 30 minutes. Other pressures and times include 3000 psi, 4500 psi and times can vary from 30 minutes upwards to 1 hour.

The regulator consists of six components including the high-pressure system, pressure gauge, bypass/purge valve, donning switch, low air alarm and the exhalation valve.

The face piece or mask consists of three components. The face piece, the lens and the head harness. The face piece is the rubber portion of the mask. **The seal this creates with the user's face is the most important aspect of the face piece. The user should be clean-shaven to ensure he gets a proper seal.**

To tighten the head harness the user must pull back on the straps towards the ears, to ensure a snug fit and an effective seal around the user's face. A negative pressure check is then completed to ensure proper seal has been obtained.

To do a negative pressure check, the user dons his or her face piece and then using the regulator covers over the opening and inhales (breaths in). The user should feel the mask suck into the face not hearing or feeling any air rushing into the mask around the afterpiece seal. To ensure the face piece has the optimal seal, all users should have been properly fit tested for the mask they are wearing.

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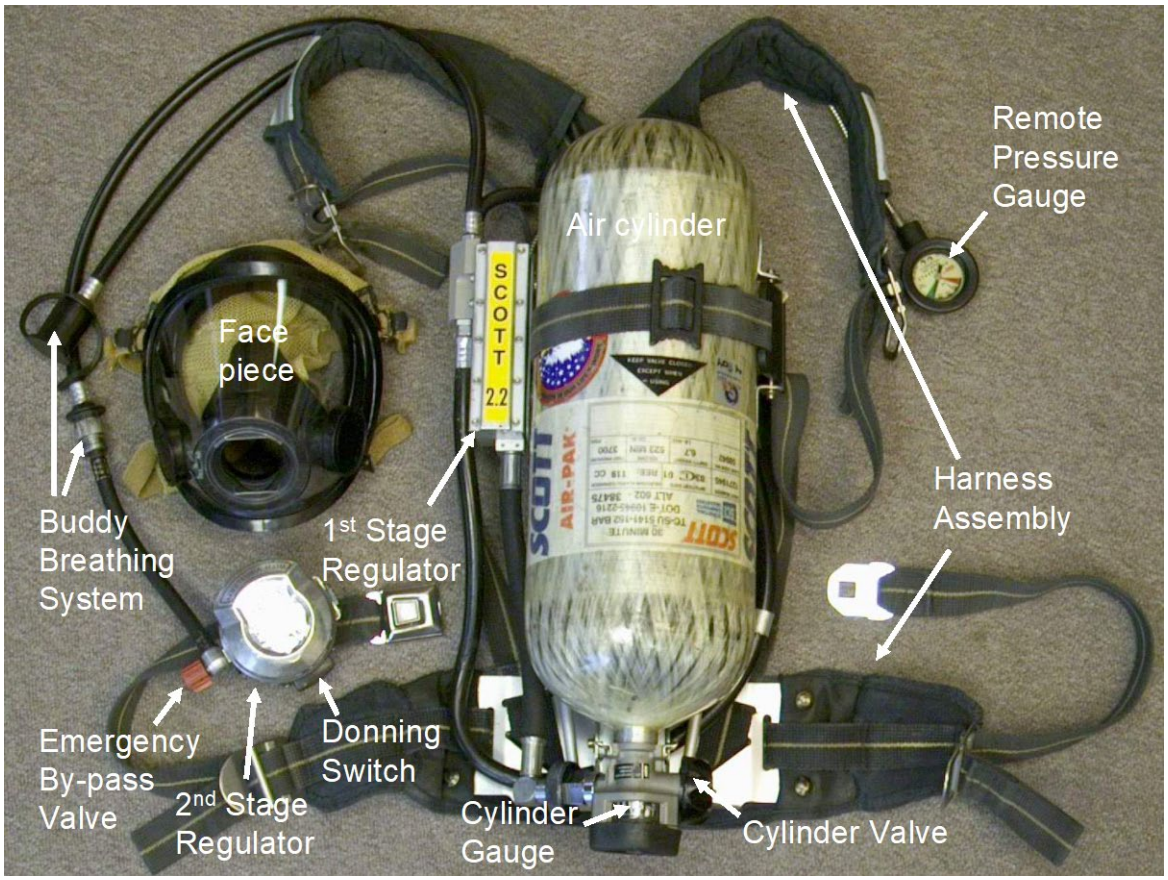

DONNING SCBA

There are five steps to properly donning SCBA.

1) Prepare or inspect all required equipment.
2) Put on harness/cylinder/unit. Put on the face piece.
3) Complete a negative pressure check.
4) Connect air supply (attach regulator to mask – first breath will open valve).

One of the most important things to remember when using Breathing Apparatus, is to **Breath Normally**. Inhaling through the nose and exhaling through the mouth also conserves air consumption.

In the event of a loss of air supply, the user of the mask mounted regulator may:

- ✓ Connect to partner with “buddy-breathing” system.
- ✓ Open Emergency By-Pass valve.
- ✓ Remove regulator and cover the hole with gloved hand. However, this is not recommended for IDLH atmospheres.

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DOFFING SCBA

1) Disconnect regulator from mask.
2) Remove mask.
3) Remove harness/cylinder/unit.
4) Turn off air supply.
5) Inspect equipment.

AFTER-USE INSPECTION

After using breathing apparatus complete an after-use inspection. To complete an after-use inspection run through the same steps as a pre-use inspection however change or refill the cylinder, wash the mask and log the results.

To wash the mask simply submerge the mask in water with anti-bacterial soap, rinse well and allow to air dry, hanging. Do not use harsh chemicals as they can create dry rot or damage the seal portion of the face piece. They can also cause damage to the lens or stain the lens.

Once after-use inspection is competed store apparatus in appropriate place.

CHANGING THE CYLINDER

1) Ensure there is no pressure in the system.
2) Lift and turn latch wing to loosen cylinder clamp.
3) Unscrew coupling from high-pressure system to cylinder.
4) Depress locking tab and slide empty cylinder off carrier.
5) Slide fully charged cylinder onto carrier, with gauge facing out.
6) Engage locking tab.
7) Re-screw coupling, ensuring not to cross thread, only hand tight, no tools required.
8) Depress cylinder clamp and ensure cylinder is snug on the harness.

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Course Evaluation Form

Western Canada Fire & First Aid Inc. is committed to providing quality educational programs. Your satisfaction is our greatest concern. Please take a moment and candidly comment on the following questions related to the program you have attended.

Type of Course: _____

Date: _____

Instructor(s): _____

1. **Were the topics presented to the group adequately covered?**

   _____

   _____

   _____

   _____

2. **What did you find the most helpful to you in the course?**

   _____

   _____

   _____

   _____

3. **Please comment on the instructors overall presentation. Give any recommendations you may have for improvement in their teaching methods.**

   _____

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4. **Additional comments (i.e. Suggestions for future programs.)**

   _____

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5. **How did you hear about our company?**

Employer ☐	**Sales Rep. ☐**	**Internet ☐**	**Fax ☐**
Referral ☐	**Yellow Pages ☐**	**Brochure ☐**	**Other** _____

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