SUSTAINABLE WORKPLACE ALLIANCE
216 E Stuart Ave, Lake Wales, FL 33853
Office: (863) 676-4100
Email: info@sustainablewp.org

Instructor: Nick Vent
Email: hazmatvent@gmail.com

During the class we will discuss and use the following. Please download these onto your phone or computer before attending the training.

These are all government provided apps and safe as long as you download them from the proper locations. (No second-hand apps). If they try to charge you for the program you are on the wrong site.

2020 ERG

https://www.phmsa.dot.gov/hazmat/erg/erg2020-mobileapp

Wireless Information System for Emergency Responders (Wiser):

http://wiser.nlm.nih.gov

NIOSH Pocket Guide to Chemical Hazards:

https://www.cdc.gov/niosh/npg/mobilepocketguide.html

I will send you a Firescope Site Safety Plan to use also: **ICS-208HM**

Thank you and we look forward to training with you!

Name:_____ Date:_____

Review the SDS provided and find the following information:

What is the name of the material?

_____

Which ingredient(s) make this hazardous?

_____

What number do you call if a spill occurs for more information?

_____

What should you do if you get this stuff on your skin?

_____

What PPE should be worn when working with this material?

_____

If this material is involved in a fire, how should you put out that fire?

_____

What other materials should NOT be mixed with this product?

_____

How do you properly dispose of waste material you can't reuse?

_____

SITE SAFETY AND CONTROL PLAN ICS 208 HM	1. Incident Name:	2. Date Prepared:	3. Operational Period: Time:

Section I. Site Information

4. Incident Location:

Section II. Organization

5. Incident Commander:	6. HM Group Supervisor:	7. Tech. Specialist - HM Reference:
8. Safety Officer:	9. Entry Leader:	10. Site Access Control Leader:
11. Asst. Safety Officer - HM:	12. Decontamination Leader:	13. Safe Refuge Area Mgr:
14. Environmental Health:	15.	16.

17. Entry Team: (Buddy System) Name:	PPE Level	18. Decontamination Element: Name:	PPE Level
Entry 1		Decon 1	
Entry 2		Decon 2	
Entry 3		Decon 3	
Entry 4		Decon 4	

Section III. Hazard/Risk Analysis

19. Material:	Container type	Qty.	Phys. State	pH	IDLH	F.P.	I.T.	V.P.	V.D.	S.G.	LEL	UEL

Comment:

Section IV. Hazard Monitoring

20. LEL Instrument(s):	21. O_2 Instrument(s):
22. Toxicity/PPM Instrument(s):	23. Radiological Instrument(s):

Comment:

Section V. Decontamination Procedures

24. Standard Decontamination Procedures:	YES:	NO:

Comment:

Section VI. Site Communications

25. Command Frequency:	26. Tactical Frequency:	27. Entry Frequency:

Section VII. Medical Assistance

28. Medical Monitoring:	YES:	NO:	29. Medical Treatment and Transport In-place:	YES:	NO:

Comment:

Section VIII. Site Map

30. Site Map:

Weather ❑ Command Post ❑ Zones ❑ Assembly Areas ❑ Escape Routes ❑ Other ❑

Section IX. Entry Objectives

31. Entry Objectives:

Section X. SOP S and Safe Work Practices

32. Modifications to Documented SOP s or Work Practices:	YES:	NO:

Comment:

Section XI. Emergency Procedures

33. Emergency Procedures:

Section XII. Safety Briefing

34. Asst. Safety Officer - HM Signature:	Safety Briefing Completed (Time):
35. HM Group Supervisor Signature:	36. Incident Commander Signature:

INSTRUCTIONS FOR COMPLETING THE SITE SAFETY AND CONTROL PLAN
ICS 208 HM

A Site Safety and Control Plan must be completed by the Hazardous Materials Group Supervisor and reviewed by all within the Hazardous Materials Group prior to operations commencing within the Exclusion Zone.

Item Number	Item Title	Instructions
1.	Incident Name/Number	Print name and/or incident number.
2.	Date and Time	Enter date and time prepared.
3.	Operational Period	Enter the time interval for which the form applies.
4.	Incident Location	Enter the address and or map coordinates of the incident.
5 - 16.	Organization	Enter names of all individuals assigned to ICS positions. (Entries 5 & 8 mandatory). Use Boxes 15 and 16 for other functions: i.e. Medical Monitoring.
17 - 18.	Entry Team/Decon Element	Enter names and level of PPE of Entry & Decon personnel. (Entries 1 - 4 mandatory buddy system and back-up.)
19.	Material	Enter names and pertinent information of all known chemical products. Enter UNK if material is not known. Include any which apply to chemical properties. (Definitions: ph = Potential for Hydrogen (Corrosivity), IDLH = Immediately Dangerous to Life and Health, F.P. = Flash Point, I.T. = Ignition Temperature, V.P. = Vapor Pressure, V.D. = Vapor Density, S.G. = Specific Gravity, LEL = Lower Explosive Limit, UEL = Upper Explosive Limit)
20 - 23.	Hazard Monitoring	List the instruments which will be used to monitor for chemical.
24.	Decontamination Procedures	Check NO if modifications are made to standard decontamination procedures and make appropriate Comments including type of solutions.
25 - 27.	Site Communications	Enter the radio frequency(ies) which apply.
28 - 29.	Medical Assistance	Enter comments if NO is checked.
30.	Site Map	Sketch or attach a site map which defines all locations and layouts of operational zones. (Check boxes are mandatory to be identified.)
31.	Entry Objectives	List all objectives to be performed by the Entry Team in the Exclusion Zone and any parameters which will alter or stop entry operations.
32 - 33.	SOP s, Safe Work Practices, and Emergency Procedures	List in Comments if any modifications to SOP s and any emergency procedures which will be affected if an emergency occurs while personnel are within the Exclusion Zone.
34 - 36.	Safety Briefing	Have the appropriate individual place their signature in the box once the Site Safety and Control Plan is reviewed. Note the time in box 34 when the safety briefing has been completed.

NIOSH Guide Worksheet

Incident Information	Weather Information
Container type: _____	Temperature: _____
Size of leak:_____	Wind/Direction: _____
Near water? YES NO	Precipitation: _____
Near people? YES NO	
On fire? YES NO	

Chemical Name

State of matter? SOLID LIQUID LIQ.-GAS COMP.-GAS

How far will the gas/vapor cloud move? How toxic is it?

Gas/Vapor Behavior
Vapor pressure (VP): _____
Relative gas density (RGasD): _____
Vapor density for liquids: _____ = MW / 29
Permissible exposure limit (PEL): _____
Immediately dangerous to life and health (IDLH): _____

How flammable is it? Are enough vapors being generated to burn?

Fire Behavior
Flashpoint (Fl P): _____
Lower explosive limit (LEL): _____
Upper explosive limit (UEL): _____

What will happen when the material reaches/touches water?

Water Behavior
Water reactive? YES NO
Product formed (if any): _____
Solubility (SOL): _____
Specific gravity (SpGr): _____

How will it enter the body? How do we recognize & treat exposure?

EMS Information
Routes of entry: INHALATION ABSORPTION INGESTION
Signs and symptoms: _____
_____
Treatment recommendations: _____
_____

Emergency Response Guidebook Worksheet

Incident Information	Weather Information	Product Information
Container type: _____	Temperature: _____	UN/NA #: _____
Size of leak:_____	Wind/Direction: _____	Hazard class: __/_____
Near water? YES NO	Precipitation: _____	Vehicle type: _____
Near people? YES NO		Placard color: _____
On fire? YES NO		

UN/NA Number Information

Chemical name: _____

_____

Highlighted? YES NO

Polymerization hazard? YES NO

If there is no other information, go to Guide # 111.

Guide #:

Is the entry highlighted?

YES **NO**

Is the material on fire?

NO **YES**

GREEN Section Information (FIRST)

Water reactive? YES NO

If so, TIH product formed: _____

Isolation zone (in all directions): _____

Downwind evacuation. Day: _____ Night: _____

ORANGE Section Information (SECOND)

Primary hazard (listed first): FLAMMABILITY HEALTH

Isolation zone (in all directions): _____

First aid info: _____

PPE suggestions: _____

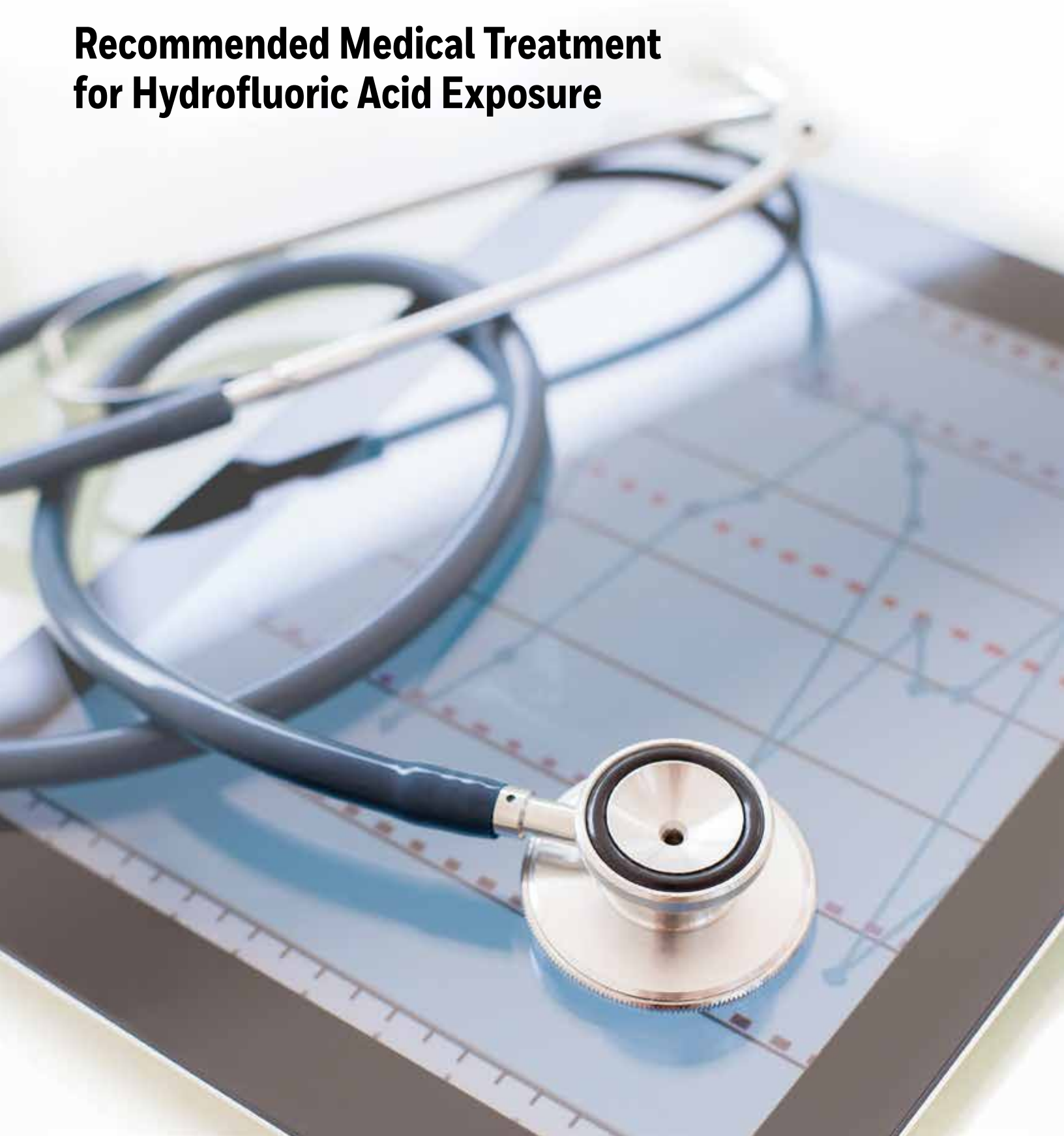
Spill mitigation: _____

Firefighting measures: _____

Honeywell
THE POWER OF CONNECTED

Industrial Fluorines

Recommended Medical Treatment for Hydrofluoric Acid Exposure



This booklet describes the special First Aid and Medical Treatment measures necessary following exposure to or injury from HYDROFLUORIC ACID (HF).

However, it must be emphasized that PREVENTION of exposure or injury must be the primary goal.

If you have questions, comments or suggestions, please write to:

Technical Service Manager – Hydrofluoric Acid
Honeywell Performance Materials and Technologies
115 Tabor Road
Morris Plains, NJ 07952

Preventive measures include:

1. Making everyone who handles or uses HF aware of its properties and dangers.
2. Training everyone who uses HF in proper handling and safety precautions.
3. Utilizing all appropriate engineering controls, and making sure that the controls are maintained and functioning properly.
4. Requiring everyone who handles or uses HF to have available the proper safety and personal protective equipment, to be trained to use the equipment, and to always use the equipment when necessary.
5. Arranging ahead of time to provide first aid or medical treatment measures if necessary.

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Introduction

Because the medical treatment of hydrofluoric acid (HF) is so specialized and differs from the treatment of other inorganic acid exposures, physicians may be unaware of appropriate treatment measures. It is recommended that HF users ensure that their local medical resources are familiar with the toxicity of HF and the treatment of HF exposure. This would include, at a minimum, thoroughly reviewing this booklet and making sure that treatment facilities and supplies are available.

Hydrofluoric Acid (CAS # 7664-39-3) is very aggressive physiologically because of the fluoride ion. Both anhydrous hydrofluoric acid (hydrogen fluoride) and its solutions are clear, colorless liquids. When exposed to air, concentrated solutions and anhydrous HF acid produce pungent vapors which are especially dangerous. Unless heated, dilute concentrations of HF acid in water (e.g., less than 40% HF) do not produce significant vapor concentrations.

NOTE: Persons unfamiliar with hydrofluoric acid often mistake it for, or confuse it with, hydrochloric acid. Although hydrofluoric acid (HF) and hydrochloric acid (HCl) have similar sounding names, the toxicity of these two acids is very different. To decrease or avoid confusion, we recommend that **hydrofluoric acid** and **hydrogen fluoride** be referred to as "HF".

HF is primarily an industrial raw material. It is used in fluorocarbon production, stainless steel manufacturing, metal finishing, aluminum manufacturing, inorganic and organic chemical manufacturing, petroleum refining, mineral processing, glassmaking, and electronic components manufacturing. It is also used in certain industrial and consumer cleaning compounds. The use of HF in consumer products is discouraged because of its potential toxicity.

Most non-industrial burns are caused by dilute concentrations of HF (e.g., less than 15% HF). Most of the HF used in the electronics industry is less than 50%. However, many industrial uses of HF involve concentrated (50-100%) HF.

WARNING:
Burns with concentrated HF are usually very serious, with the potential for significant complications due to fluoride toxicity. Concentrated HF, liquid or vapor, may cause severe burns, metabolic imbalances, pulmonary edema, and life threatening cardiac arrythmias. Even moderate exposures to concentrated HF may rapidly progress to fatality.

The recommended medical procedures described in this brochure are based on a review of the available literature, shared experiences with others who have dealt with the health effects of HF, the personal knowledge and experiences of Honeywell physicians, nurses and other professionals in dealing with the unique hazards of this product, and experimental laboratory work sponsored by Honeywell.

Every effort must be made to prevent exposure to HF. If exposure does occur, the specialized procedures which follow are recommended to avoid the very serious consequences that might otherwise occur.

Exposure Limits

The Permissible Exposure Limit (PEL) set by the U.S. Occupational Safety and Health Administration (OSHA) is a time weighted average exposure for 8 hours of 3 ppm. *(25)* The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a ceiling level of 2 ppm (1.53 mg/m^3) with a 0.5 ppm TLV-TWA. *(26)* The National Institute for Occupational Safety and Health (NIOSH) has established the level that is immediately dangerous to life and health (IDLH) at 30 ppm. *(27, 28)* The American Industrial Hygiene Association (AIHA) has published an Emergency Response Planning Guideline setting 50 ppm as the maximum level below which nearly all individuals could be exposed for one hour without experiencing or developing life-threatening health effects (ERPG-3), 20 ppm as the maximum level below which nearly all individuals could be exposed for one hour without

developing irreversible health effects or symptoms which would impair taking protective action (ERPG-2), and 2 ppm as the maximum level below which nearly all individuals could be exposed up to one hour without experiencing other than mild, transient adverse health effects (ERPG-1). *(29)* The California Occupational Safety and Health Standards Board has established a PEL of 0.4 ppm 8hr TWA [.33mg/m³] with a STEL (Short term exposure level) of 1 ppm [0.83mg/m³]. *(32)*

Acute Toxicity

Skin Contact

HF can cause serious, painful burns of the skin. Specialized first aid and medical treatment is required. Burns larger than 25 square inches (160 square cm) may result in serious systemic toxicity.

HF is a highly corrosive acid which can severely burn skin, eyes, and mucous membranes. The vapors from anhydrous HF acid or its concentrated solutions can also burn these tissues.

HF is similar to other acids in that the initial extent of a burn depends on the concentration, the temperature, the duration of contact with the acid and the size of the burn. **HF acid differs, however, from other acids because the fluoride ion readily penetrates the skin, causing destruction of deep tissue layers. Unlike other acids which are rapidly neutralized, this process may continue for days if left untreated.**

Strong acid concentrations (over 50%), and particularly anhydrous HF (AHF or 100% HF), cause immediate, severe, burning pain and a whitish discoloration of the skin often followed by blister formation. Skin exposure to HF vapors can result in similar burns.

HF skin burns are usually accompanied by severe, throbbing pain which is thought to be due to irritation of nerve endings by increased levels of potassium ions entering the extracellular space to compensate for the reduced levels of calcium ions.

The usual initial signs of an HF burn are redness, edema, and blistering. With more concentrated acids, a blanched white area appears. The fluoride ion penetrates the upper layers of the skin. A thick granular exudate may form under blisters due to liquefaction necrosis. In rare (and untreated) cases, there may be penetration to underlying bone with decalcification. **HF burns require immediate and specialized first aid and medical treatment** *(2, 3, 4, 5, 6, 7)* differing from the treatment of other chemical burns. If untreated or if improperly treated, permanent damage, disability or death may result. *(8)* If, however, the burns are promptly and properly recognized and managed, the results of treatment are generally favorable.

Treatment is directed toward binding the fluoride ions to prevent tissue destruction. High molecular weight quaternary ammonium compounds, such as benzalkonium chloride, are used as soaking agents. *(9, 10, 11)* Calcium gluconate gel can be applied locally, and calcium gluconate solution may be injected (subcutaneously, intravenously, or intra-arterially) or used as an irrigant. *(3, 12, 13, 14, 15)*

Speed is of the essence. Delays in first aid care or medical treatment or improper medical treatment will likely result in greater damage or may, in some cases, result in a fatal outcome. **During transportation to a medical facility or while waiting for care within a facility, the initial treatment (whether with benzalkonium chloride or topical calcium gluconate) should be continued.**

In contrast to the immediate effects of concentrated HF, the effects of contact with more dilute HF acid or its vapors may be delayed, and this is one of the problems with the recognition of some HF burns. Skin contact with acid concentrations in the 20% to 50% range may not produce clinical signs or symptoms for 1 to 8 hours. With concentrations less than 20%, the latent period may be up to 24 hours. HF concentrations as low as 2% may cause symptoms if the skin contact time is long enough. *(1)*

Eye Contact

HF acid can cause severe eye burns with destruction or opacification of the cornea. Blindness may result from severe or untreated exposures. Immediate first aid and specialized medical care is required. *(3,13)*

Inhalation

HF acid vapors may cause laryngospasm, laryngeal edema, bronchospasm, and/or acute or delayed pulmonary edema. Acute symptoms may include coughing, choking, chest tightness, chills, fever, and cyanosis. Many reported fatalities from HF exposures have been due to severe pulmonary edema (coupled with systemic toxicity) that did not respond to usual medical treatment.

Burns from vapors or liquid contact to the oropharyngeal mucosa or upper airway may cause severe swelling to the point of requiring a tracheostomy. It is recommended that all patients with such exposures be hospitalized for observation and/or treatment.

Because of the strong irritant nature of HF, an individual inhaling HF vapors will usually experience upper respiratory injury, with mucous membrane irritation and cough. All individuals suspected of having inhaled HF should be observed for pulmonary effects. This would include those individuals with significant upper respiratory irritation, bronchoconstriction by pulmonary auscultation or spirometry, and any individual with HF exposure to the head, chest, or neck areas. It has been reported that pulmonary edema may be delayed for several hours and even up to 2 days. If there is no initial upper respiratory irritation, significant inhalation exposure is unlikely.

Ingestion

Ingestion of HF may result in severe burns to the mouth, esophagus, and stomach. Severe systemic effects are common. Ingestion of even small amounts of dilute HF have resulted in death. *(30)*

Burns of the Skin – General Treatment Principles

Burns from dilute acid are difficult to distinguish from other chemical burns and usually appear as areas of erythema. However, they may progress, if not treated, to areas of blistering, necrosis, or ulceration. Burns from more concentrated acid have a characteristic appearance and present as severely reddened, swollen areas with blanched, whitish regions which rapidly progress to blistering and necrosis. A thick granular exudate usually appears under these blisters and requires debridement and removal.

Concentrated HF burns cause extreme pain. The pain is thought to result from nerve ending irritation due to increased levels of potassium ions in extracellular spaces to compensate for the reduced levels of calcium ions which have been bound by the fluoride. **Relief of pain is an excellent indication of the success of treatment and therefore, local anesthetics should be avoided if possible.**

Many different types of therapies have been suggested for HF burns. The aim of all treatment is to chemically sequester the fluoride ion and to prevent extensive, deep-tissue destruction. *(37, 38)*

After treatment of recognized burned areas is begun, the victim should be carefully examined to ensure there are no other burn sites which may have been overlooked.

Quaternary Ammonium Compounds

Most HF burns can be satisfactorily treated by immersion of the burned part in an iced, aqueous solution of a quaternary ammonium compound. The most experience is with a solution of 0.13% benzalkonium chloride. Benzalkonium chloride is currently (Spring, 2018) available as a nonprescription drug in the United States, however, this status may change, so readers are advised to check the current regulatory status. In December, 2017 the U.S. Food and Drug Administration (FDA) issued a final rule establishing that certain active ingredients used in nonprescription (also known as over-the-counter or OTC) antiseptic products intended for use by health care professionals in a hospital setting or other health care situations outside the hospital are not generally recognized as safe and effective (GRAS/GRAE). Although benzalkonium chloride was considered as part of this FDA ruling, the FDA deferred rule making on it (and 5 other OTC antiseptics) to allow for further study. *(56)*

The solutions should be cooled with ice cubes. **Shaved or crushed ice may cause excessive cooling, with the danger of frostbite.**

If immersion in the solution is not practical, soaked compresses of the same iced solution should be applied to the burned area. The immersion or compresses should be used for **at least 2 hours.** Compresses should be changed or soaked with additional solution approximately every 2 to 4 minutes.

If blisters are present, they should be opened and drained and necrotic tissue should be debrided by a physician or qualified health care practitioner as soon as possible. However, immersion in benzalkonium chloride or use of compresses should not be delayed if debridement cannot be accomplished immediately.

Immersion in the iced benzalkonium chloride bath may result in discomfort due to excess chilling. Relief may be obtained by removing the burned part from the bath every 10 to 15 minutes. If pain in the burned area recurs, resume soaking in the iced benzalkonium solution. After the initial 30 to 60 minutes of treatment, less ice can be used so the bath is cool rather than cold.

The success of this treatment is indicated by relief of the severe pain in the burned area. If there is no significant relief of pain within 30 to 40 minutes, the use of 2.5-5% calcium gluconate injections may be necessary. If pain recurs when the treatment is stopped at the end of the first 2 hours, immersion or compresses should be resumed until pain is relieved. A total of 4 to 6 hours of immersion or use of compresses of benzalkonium chloride may be required for the treatment of most burns. No further treatment will be required in many instances. Iced quaternary ammonium compound solutions offer several advantages over topical calcium gluconate gel:

- Ability to treat burns on multiple surfaces, such as the hand, more efficiently;
- Reduction of local pain due to the cooling effect of ice;
- Possible slowing of the passage of the fluoride ion into deeper tissues and into the bloodstream due to local vasoconstriction;
- Does not require continuous massaging

Quaternary ammonium compounds should not be used for burns on the face, ears or other sensitive areas due to their irritating nature. It is preferable to use calcium gluconate gel or calcium gluconate injection in these areas.

Calcium Gluconate Gel

Calcium gluconate gel, consisting of 2.5% USP calcium gluconate in a surgical water soluble lubricant, is widely used for first aid and/or primary treatment of HF burns of the skin. The gel is convenient to carry and can be used to initially treat small burns that might occur away from medical care. (The gel is not recommended for burns with concentrated HF except as a first aid measure). The gel is used by massaging it promptly and repeatedly into the burned area, until pain is relieved. Surgical gloves should be worn during initial application of the gel, so the person providing treatment will not receive a secondary HF burn. This treatment can be started without waiting for medical direction. Several commercially available calcium gluconate gel formulations have been evaluated and found to give comparable outcomes. *(35)*

If used as the only method of treatment, liberal quantities of calcium gluconate gel must be massaged into the burned area continuously for up to several hours. Relief of pain can be used to assess the efficacy of this treatment. If good relief of pain is not obtained after 30 to 40 minutes, alternate methods of treatment, such as calcium gluconate injections or benzalkonium chloride soaks, should be considered.

The gel is especially useful for burns on the face, particularly near the mouth, eyes, on the ears, or for small, dilute acid burns elsewhere. It may be convenient to use the gel for very small burns where the victim can easily apply and massage the gel into the burned area. Use of the gel may be more convenient for dilute acid burns such as those that can occur with commercial products like rust removers, aluminum cleaners, or etching solutions.

First Aid Treatments

Skin Contact

1. Move victim immediately under safety shower or other water source and flush affected area thoroughly with large amounts of running water. Speed and thoroughness in washing off the acid is of primary importance.

2. Begin flushing even before removing clothing. Remove all contaminated clothing while continuing to flush with water under a safety shower.

3. While the victim is being rinsed with water, someone should alert first aid or medical personnel and arrange for subsequent treatment.

4. If the exposure is limited to HF and other water soluble substances, 5 minutes of water decontamination after the removal of all PPE, clothing, and jewelry should be sufficient. Concomitant exposure with hydrocarbons or other substances with limited water solubility may require longer water decontamination or the use of other decontaminating agents. If a more definitive treatment (0.13% benzalkonium chloride solution or 2.5% calcium gluconate) is not available, water irrigation should continue until one of these agents is available or transportation to a medical facility is initiated.

5. Immediately after thorough washing, use one of the measures below:

   a. Begin soaking the affected areas in iced 0.13% benzalkonium chloride solution.
   Use ice cubes, *not* shaved ice, to prevent frostbite.
   If immersion is not practical, towels should be soaked with iced 0.13% benzalkonium chloride solution and used as compresses for the burned area. Compresses should be changed every 2 to 4 minutes. Do not use benzalkonium chloride solution for irrigation of the eyes. Exercise caution when using benzalkonium chloride solution near the eyes as it is an eye irritant. Benzalkonium chloride soaks or compresses should be continued until pain is relieved or until more definitive medical treatment is provided.

   b. Start massaging 2.5% calcium gluconate gel into the burn site.
   Apply gel frequently and massage continuously until pain and/or redness disappear or until more definitive medical care is given. The individual applying the calcium gluconate gel should wear surgical gloves to prevent a secondary HF burn.

NOTE:
Clinical experience has shown that both benzalkonium chloride and calcium gluconate gel are effective when used correctly in appropriate situations. In an animal model, benzalkonium chloride soaks were superior to calcium gluconate gel under the experimental conditions used. *(37, 38)*

6. After treatment of burned areas is begun, the victim should be examined to ensure there are no other burn sites which have been overlooked.

7. Arrange to have the victim seen by a physician. If burns are small and/or caused by weak acid, and treatment has been provided by an experienced individual, evaluation by a physician may not be necessary. **During transportation to medical care and while waiting to see a medical provider, it is extremely important to continue the first aid care, whether with benzalkonium chloride or massaging calcium gluconate gel**. In many situations, particularly for minor burns covering a small skin area or for burns caused by dilute HF, continued treatment with soaks or gel may be effective as the sole type of medical care. All persons with extensive burns or burns with significant blister formation or with the appearance of whitish or dead skin need to be seen by a physician. All persons with HF burns which do not respond to either calcium gluconate gel or benzalkonium chloride soaks or compresses within 30 minutes should be evaluated by a physician.

Eye Contact

1. **Immediately** flush the eyes for at least 15 minutes with large amounts of gently flowing water. Hold the eyelids open and away from the eye during irrigation to allow thorough flushing of the eyes. **Do not use the benzalkonium chloride solutions described for skin treatment**. If the person is wearing contact lenses, the lenses should be removed, if possible. However, flushing with water should not be interrupted, and the lenses should be removed by a person who is qualified to do so. If sterile 1% calcium gluconate solution is available, **water washing may be limited to 5 minutes**, after which the 1% calcium gluconate solution should be used to irrigate the eye using a syringe or a continuous irrigation device.

2. Take the victim to a doctor, preferably an eye specialist, as soon as possible. Ice water compresses may be applied to the eyes while transporting the victim to the doctor.

3. If a physician is not immediately available, apply one or two drops of 0.5% tetracaine hydrochloride, 0.5% proparacaine, or other aqueous, topical ophthalmic anesthetic and continue irrigation. Use no other medications unless instructed to do so by a physician. Rubbing of the eyes is to be avoided.

Inhalation

1. Immediately move victim to fresh air and get medical attention.
2. Keep victim warm, quiet, and comfortable.
3. If breathing has stopped, start artificial respiration at once.
4. 100% oxygen should be administered as soon as possible by a trained individual. Continue oxygen while awaiting medical attention unless instructed otherwise by a physician.
5. A nebulized solution of 2.5% calcium gluconate may be administered with oxygen by inhalation.
6. Do not give stimulants unless instructed to do so by a physician.
7. The victim should be examined by a physician and held under observation for at least a 24-hour period.

Ingestion

1. Do not induce vomiting.
2. Get immediate medical attention. Ingestion of HF is a life-threatening emergency.

Medical Treatments

Initial medical treatment for HF exposures is a continuation of first aid treatments. For the skin, this would include continued use of iced benzalkonium chloride soaks/compresses, or use of topical calcium gluconate gel.

NOTE:
Because prolonged immersion in the ice bath may result in discomfort, relief may be obtained by removing the part from the bath every 10 minutes for a minute or so and then reimmersing it. After the initial 30 to 60 minutes of treatment, less ice can be used so the bath is cool, rather than cold.

If the physician advises continued treatment with benzalkonium chloride soaks or compresses, the soaks or compresses may be required for 2 to 4 hours. Significant relief of pain should be noted within the first 30 minutes. If this does not occur, more definitive care should be instituted. If the pain is substantially relieved within the first 30 minutes, continue the treatment for a total of 2 hours. After that time, discontinue treatment and observe for the recurrence of pain. If pain recurs, continue soaks or compresses until relief of pain occurs. Soaking for 6 hours is sometimes needed.

Calcium gluconate gel may be used for several hours or even repeated over a period of a few days. However, if significant relief of pain does not occur within 30 to 40 minutes, more definitive treatment such as calcium gluconate injections or iced benzalkonium chloride is required.

Calcium Gluconate Injections

After first aid measures have been taken, injection of a 2.5%-5% calcium gluconate solution is indicated as the primary medical treatment for larger burns. For smaller burns, if benzalkonium chloride soaks or calcium gluconate gel do not result in significant relief of pain within 30 to 40 minutes, injection of calcium gluconate solution is indicated. Injection of calcium gluconate solution may also be indicated for burns in which treatment has been delayed. The physician should inject

NOTE:
Calcium chloride solution should not be used for local injection. Injection of calcium chloride into muscle or into subcutaneous or perivascular tissue may cause severe necrosis and sloughing.

sterile 2.5-5% aqueous calcium gluconate beneath, around, and into the burned area. Calcium gluconate is packaged as a 10% solution, and must be diluted 50:50 or 25:75 with normal saline to make 5% or 2.5% solutions.

If subcutaneous calcium gluconate injections are used, the amount injected initially is small and should not exceed 0.5 cc per square centimeter of affected skin surface. The injections should not distort the appearance of the skin. A small-gauge needle (27-30 gauge) should be used, and the burned area should be injected through multiple sites. With successful treatment, pain relief following injection of 2.5%-5% calcium gluconate solution is very rapid. The patient can usually advise when the pain stops, and this is an indicator of adequate treatment. Multiple injections in skin that has compromised integrity may increase the risk of infection, and the use of a topical antibiotic cream or ointment should be considered following such treatment. Local anesthetics should not be used since they mask pain relief which is an important indication of adequacy of treatment.

Calcium Gluconate Solution

In some instances, a 5% or 10% calcium gluconate solution may be used in compresses or for irrigation. For example, irrigating with a calcium gluconate solution may be the best treatment should HF enter the external ear canal. In this instance, referral to an otolaryngologist is recommended.

Burns of the Fingers and Nails

Burns of the fingers often create special problems in treatment. Finger and toe nails permit penetration of fluoride ions but prevent soaks or gels from being effective. It may be necessary to drill, split, or even remove nails to allow the topical methods of treatment to be effective. One author has cautioned that removal of the nail should rarely be necessary in the case of dilute HF acid (less than 10%) burns. *(40)* The treating physician must consider the morbidity associated with removal of the nail versus the need to treat the HF exposure.

If immersion in benzalkonium chloride solution is started immediately, it may be possible to avoid removing the nail. Sometimes better penetration under the nail can be accomplished by splitting the nail or by drilling several burr holes in the nail using a large gauge needle or a nail drill. If calcium gluconate injection is used as treatment, the nail may still need to be split or removed. If nail removal is necessary, using a short acting regional or ring-block anesthetic may facilitate this procedure and not interfere with using pain relief as an indicator of effective treatment. When using calcium gluconate injections in the digits, the volume injected must be limited to avoid compromising the circulation in the digit.

If benzalkonium chloride soaks are not available, finger or hand burns can be treated by using a glove filled with calcium gluconate gel. Initially, calcium gluconate gel should be massaged into the burned area. Following this, the hand is inserted into an oversize surgical glove partially filled with calcium gluconate gel. The gloved hand may be immersed in ice water, if available, which may aid pain relief. This treatment works best for burns where there is no blistering, or after the burns have been debrided. As in other cases where calcium gluconate gel is used, alternate methods of treatment should be considered if good relief of pain is not achieved within 30 to 45 minutes. If pain is relieved, the glove should remain in place for 3 to 4 hours.

Calcium Infusion Intra-arterial and Intravenous

Reports in the literature have described the use of intra-arterial injection or infusion of dilute calcium gluconate solutions to treat HF burns of the hand and digits. This method, although rather involved, should be considered in selected cases, especially where inadequate or delayed treatment has occurred. The method is described as follows:

> "A long catheter was inserted percutaneously into the radial artery using standard aseptic technique. Intra-arterial catheter placement was confirmed by pressure transducer and oscilloscope. If the burn involved only the thumb, index, or long fingers, the catheter was advanced only a few centimeters proximally in preparation for digital subtraction arteriography. If the burn involved the ring or small fingers, the catheter was advanced proximally into the brachial artery because access to the ulnar circulation was necessary.
>
> Following satisfactory placement of the arterial catheter, digital subtraction arteriography was performed on all patients in our series to identify the origin of vascular supply to digits involved.
>
> Once the tip of the arterial catheter was in the desired location, a dilute preparation of calcium gluconate (10 ml of a 10% solution mixed in 40 to 50 ml 5% dextrose) was infused with a pump apparatus into the catheter over 4 hours. Each patient was observed closely during the infusion period for progression of symptoms and potential complications of the procedure, such as alterations of distal vascular supply.
>
> Following the 4-hour infusion, the arterial catheter was maintained in place in the usual manner while the patient underwent an observation period. If typical HF pain returned within 4 hours, a second calcium infusion was repeated until the patient was pain free 4 hours following completion of the calcium infusion." *(14)*

A case series from China reports the use of intra-arterial infusion in 118 patients over the period 2008-2011, with use in both the upper and lower extremity. Of note, more than 50% of their cases were first treated more than 12 hours after the HF injury. HF concentrations were not reported. Burns ranged from 1-3% body surface area. (55)

Calcium gluconate infusion via the Bier Block method has been used to treat HF burns of the upper extremity. (41, 42, 43) Graudins, et al. describe their method:

> "An intravenous catheter was placed on the dorsum of the affected hand. The superficial veins were exsanguinated by elevation. A double-cuffed pneumatic tourniquet was applied above the elbow, inflated to 100 mm Hg above systolic blood pressure, and 10 ml of 10% calcium gluconate diluted with 30 to 40 ml of 0.9% saline solution was then infused. Ischemia was maintained for 25 minutes; the cuff was sequentially released over 3 to 5 minutes."

This Bier Block method was most successful for burns due to dilute acid. If the use of intravenous calcium gluconate was not successful in relieving pain (which occurred with burns due to 49% HF, the highest concentration seen in the series of patients), Graudins et al. turned to intra-arterial calcium gluconate infusion without repeating the Bier Block infusion. More recent articles have described repeat use of the Bier Block infusion technique, as well as use in the lower extremity. *(57)* Articles describing intra-arterial calcium gluconate infusions have described repeated infusions for initial treatment failures. *(14, 55)*

Eye Injuries

As with skin exposures, medical treatment of HF eye burns is a continuation of the first aid treatment. After water irrigation, the eyes are irrigated with a 1% calcium gluconate solution. Use of local anesthetic eye drops is recommended. Irrigation devices, such as a Morgan Lens®, or an inverted two-pronged nasal oxygen cannula, may be utilized to instill the solution over a period of 1 to 2 hours. Consult an ophthalmologist regarding additional treatment.

Inhalation Injuries

Patients with inhalation exposures are at high risk for systemic toxicity in addition to local effects on the respiratory tract.

Exposure to HF acid vapors can cause acute respiratory irritation, bronchospasm, and/or pulmonary edema. Medical personnel should also be alert to the possibility of inhalation injury when extensive burns of the face, neck, or chest have occurred.

The victim should be removed from exposure and administered 100% oxygen immediately. The use of 2.5% aqueous calcium gluconate given by nebulizer with 100% oxygen, or with intermittent positive pressure, is recommended. In addition to its local effect on the respiratory tract, nebulized calcium gluconate provides a significant source of calcium and can reduce the risk of systemic toxicity from inhalation exposure. Repeated use of nebulized calcium gluconate, every 4 hours for 48 hours after a significant inhalation exposure, has been described. *(51)* As advanced treatments for inhalation injuries become more widely available, such as extracorporeal membrane oxygenation (ECMO), their use for HF inhalation injuries will be more common. *(58)*

Due to the high risk of systemic toxicity from inhalation exposures to HF, starting an IV and providing supplemental calcium and magnesium should be considered.

Ingestion

HF ingestion is not anticipated in industrial settings. The presence of HF in consumer products increases the likelihood of ingestions, either intentional or accidental. The concentration of HF in consumer products is generally less than 10%. In addition to local effects in the mouth and esophagus, HF ingestion poses a serious risk for systemic toxicity. Numerous fatalities have been reported from HF ingestions, both intentional and accidental.

Previous recommendations were to give patients who had ingested HF milk or water to drink, followed by oral administration of a calcium or magnesium containing compound. Most patients who have ingested HF vomit spontaneously. Giving anything by mouth raises the risk of vomiting, with concurrent risk of aspiration of acidic vomitus. In addition, limited experimental studies have not supported the efficacy of oral calcium or magnesium agents in improving survival from HF ingestions. *(39)* This is likely due to providing insufficient calcium and magnesium to affect the systemic electrolyte disturbances.

Therefore, current recommendations are to give oral treatments only to conscious patients and under the direct advice of a physician. Patients with HF ingestion need immediate transport to a hospital for further treatment and evaluation. If supplies and trained personnel are available, starting an intravenous line and administering IV calcium gluconate is recommended as preemptive treatment for impending systemic toxicity.

Systemic Absorption and Toxicity

To produce HF, calcium fluoride is reacted with sulfuric acid:

$$CaF_2 + H_2SO_4 \longrightarrow 2HF + CaSO_4$$

This production process requires a great deal of energy to accomplish. On the other hand, in the body:

$$2HF + Ca^{++} \longrightarrow CaF_2$$

This process releases energy, and therefore occurs very readily. The toxic effect of HF on body calcium is certainly more complicated than this. There is some evidence that fluoride may combine with calcium and phosphate, so that 5 calcium ions are tied up for each fluoride ion (e.g., $Ca_5F(PO_4)_3$), rather than two. There is also some evidence that there may be high intracellular levels of calcium in some tissues, rather than low levels, as would intuitively be expected. *(16)* However, the reaction of fluoride with body calcium is one of the major toxic effects and forms the basis for many treatment recommendations.

One of the most serious consequences of severe exposure to HF by any route is the marked lowering of serum calcium (hypocalcemia) and other metabolic changes, which may result in a fatal outcome if not recognized and treated. Hypocalcemia should be considered a potential risk in all instances of inhalation or ingestion, and **whenever skin burns exceed 25 square inches** (160 square centimeters). Serum magnesium may also be lowered, and elevations in serum potassium have been reported to further complicate the metabolic imbalances which need to be monitored and corrected. *(16, 17, 18)* High levels of fluorides have been noted both in the blood and body organs. Hemodialysis has been reported to be effective therapy for cases of severe systemic fluoride intoxication. *(19, 20, 21)* Treatment for shock may also be required as for other severe injuries.

Other effects reported from fluoride exposure include coagulation defects and inhibition of a number of enzymes, including preglycolytic enzymes, phosphatases, and cholinesterase. The results of this enzyme inhibition include inhibition of cellular glucose phosphorylation and subsequent glycolysis, inhibition of respiration, and increased sensitivity of cholinergic mechanisms to acetyl cholinesterase. *(22)*

While hypocalcemia has been traditionally considered the major systemic effect of severe poisoning with HF, it is apparent that hypomagnesemia, hyperkalemia, the cardiodepressing and vasodilating effects of fluoride, and effects on pulmonary hemodynamics and systemic capacitance vessels, including an increase in pulmonary vascular resistance, all play a role in systemic toxicity. Although some of these effects have been described, the implications for therapeutic measures have not been well defined. *(23, 24)*

Significant amounts of fluoride ion may be absorbed by skin contact, inhalation, or by ingestion. If systemic absorption of fluoride occurs, hypocalcemia, hypomagnesemia, and hyperkalemia may also occur. These parameters need to be monitored and appropriate therapeutic measures instituted. The patient should be observed for clinical signs of hypocalcemia following any ingestion or inhalation exposure.

The following has been proposed as framework for risk of systemic toxicity *(53)*:

- HF burns with a high risk to develop lethal electrolyte imbalances
- 1% BSA burn with anhydrous HF
- 5% BSA burn with >70% concentrated HF
- 7% BSA burn with 50–70% concentrated HF
- 10% BSA burn with 20–50% concentrated HF
- 20% BSA burn with <20% concentrated HF
- Prolonged exposure or long delay for treatment in minor HF burns
- Ingestion of HF at concentrations >5%
- Inhalation of HF at concentrations >5%

Note: BSA (body surface area).

Serum calcium determinations must be performed immediately and periodically to monitor and treat hypocalcemia. Severe lowering of serum calcium levels can occur within 1 to 2 hours, even with HF burns covering less than 2.5% of body surface area. *(8)* Electrolyte disturbances of calcium, magnesium, and potassium leading to asystole were reported in a worker who had a 3% body surface area exposure to 20% HF, despite prompt irrigation and use of topical calcium gluconate gel. *(54)* Continuous EKG monitoring to observe prolongation of the QT interval may be useful to detect early changes in serum calcium, although profound hypocalcemia following HF exposure has been reported in the absence of EKG changes or in the absence of other signs of tetany. In addition, EKG tracings may continue to be abnormal even after serum calcium, magnesium, and potassium have normalized. It is suggested that electrocardiographic monitoring should be continued beyond electrolytes normalization. *(16)*

The fall in serum calcium may occur precipitously following HF exposure. In 2 reported cases of exposure to anhydrous HF, the serum calcium fell to levels around 3 milliequivalents per liter (mEq/L) [normal = 8.8-10.3 mEq/L] within 1 to 3 hours of exposure. *(8)*

If necessary, aqueous calcium gluconate may be given intravenously. Calcium gluconate as a 10% solution must be given slowly since excess calcium can produce vagal bradycardia, ventricular arrhythmias, and ventricular fibrillation. The IV calcium gluconate should be repeated until serum calcium levels return to, and remain at, normal levels. In one fatal case, 280 mEq of calcium over 4 hours was not sufficient to correct the profound hypocalcemia. *(8)* Without additional measures such as hemodialysis, it may not be possible to correct extreme hypocalcemia.

Serum magnesium levels should also be monitored and magnesium loss should be replaced intravenously. Yamaura, et al. have reported a case of HF exposure in which prolonged QT interval was observed while ionized calcium levels were relatively high, but the magnesium level was low. *(49)* Serum potassium must also be carefully monitored. Significant elevations of serum potassium have been noted in cases of fluoride toxicity and in laboratory studies. Hyperkalemia has also been implicated as a causative factor in cardiovascular collapse, and should be treated appropriately. Several authors have reported clinically significant hypokalemia resulting from significant

HF exposures. This may be a result of hypomagnesemia, as magnesium plays a pivotal role in maintenance of intracellular potassium concentration by regulating potassium movement through myocardial cell membranes. The correction of hypomagnesemia will reduce potassium excretion to the urine and help correct hypokalemia.

Even with normalization of serum calcium and potassium, life threatening ventricle arrhythmia may occur, possibly due to a direct toxic effect of the fluoride ion on the myocardium. *(36)*

Additional Treatment Options

Hemodialysis with fluoride free water (and normal to low potassium and slightly higher calcium concentrations), in conjunction with other treatments mentioned, should be considered in all cases of serious burns and may need to be repeated if indicated. *(19, 20, 21)* Serum fluoride levels should be monitored. Normal plasma fluoride levels may differ because of various methodologies and analytical techniques. The decision to use dialysis should be based on the HF exposure (concentration, body surface area) and the clinical condition of the patient, including the serum levels of fluoride, calcium, and potassium. Continuous Renal Replacement Therapy (CRRT) has been utilized in a patient with systemic toxicity due to a significant (60%) total body surface area burn from HF and concomitant inhalation injury. CRRT is a mode of renal replacement therapy for hemodynamically unstable, fluid overloaded patients and patients with sepsis and septic shock in management of acute renal failure, especially in the intensive care unit setting. *(58)*

Primary excision or surgical removal of tissue has been recommended by some practitioners as a method of reducing systemic absorption of fluoride. *(50)* While this is potentially life-saving, it is a drastic measure. It is likely that renal dialysis could be used to effectively treat systemic toxicity and would not result in the disfigurement, disability, or morbidity which would result from primary excision.

Chronic Toxicity

Chronic toxicity from long term, high exposure to fluoride salts (e.g., SnF_2, NaF, Na_2FPO_3) has been reported to result in tooth mottling in children, bone fluorosis, and sometimes osteosclerosis in adults and children. Because of its irritant properties, repeated exposures to HF sufficient to pose a risk of chronic toxicity are unlikely.

Skeletal fluorosis is known to be associated with excessive exposure to fluoride compounds. Cases of skeletal fluorosis have been reported in populations exposed to naturally occurring drinking water containing greater than 10 ppm of fluoride ion and in individuals exposed to high levels of fluoride containing dusts. However, skeletal fluorosis has not been reported as a consequence of HF exposure.

Because of the use of fluoride to prevent dental caries, there is ongoing evaluation of fluorides for the potential to cause cancer. There is no evidence that fluoride is genotoxic except in some in vitro assays at cytotoxic concentrations. Epidemiological studies have not demonstrated an association between fluoride in drinking water and an increase in cancer. The International Agency for Research on Cancer (IARC) has not classified hydrogen fluoride as to its human carcinogenicity, and neither fluorides nor HF are listed by IARC, NTP, OSHA, ACGIH, NIOSH, the State of California, or other governmental agencies as causing cancer. *(31, 32)* In animal studies, fluoride salts have caused effects in off-spring only at high, maternally toxic levels. Some animal studies have shown effects on

male fertility, e.g. decreased sperm counts. Fluoride exposures should be kept below recommended levels to assure no adverse effects to the developing fetal skeletal system or teeth.

Monitoring of urine for fluorides is an accepted method of determining exposure. (34) Urine fluoride levels above 2 mg/liter at the beginning of a work shift, or above 3 mg/liter at the end of a work shift, may indicate excessive absorption of fluoride. As fluorides are present in drinking water and foods, there may be significant background levels in persons without occupationally exposure. Thus, urine fluoride determination is not specific for HF. *(26)*

A case of toxic myocarditis has been reported, occurring about 4 months after an intentional HF ingestion. While it was impossible to prove beyond doubt that the HF systemic toxicity was the cause, the timeline and absence of other evident causes of myocarditis led the authors to conclude that the HF exposure was the most plausible and probable explanation. *(52)*

Additional and Unproven Therapies

Both Williams, et al. *(44)* and Cox, et al. *(45)* have investigated the use of intravenous magnesium sulfate to treat localized HF skin burns in animal models. Cox showed that intravenous magnesium sulfate resulted in shallower wound depth and faster wound healing than HF skin burns treated only with 5 minutes of water washing. The rabbits in this study were exposed to 49% HF for 5 minutes before the water washing, and magnesium sulfate administration was not initiated until 30 minutes after acid application. In the Williams study, using rats, the exposure duration was 1 minute (52% HF) followed by 5 minutes of water irrigation. A significant number of control rats (37%) died within 24 hours, presumably due to adverse effects from HF, although no electrolyte values are presented to support this. Rats treated with high dose intravenous magnesium sulfate had fewer high grade (penetration of lower dermis, subcutaneous tissue, or skeletal muscle) burns than controls or those treated with subcutaneous injected 10% calcium gluconate.

Seyb, et al. *(47)* performed an experiment in rats using a topically applied solution of 50% aqueous dimethyl sulfoxide (DMSO) containing calcium gluconate (20% wt./vol.). This treatment gave results comparable to injecting 10% calcium gluconate or 10% magnesium sulfate, and was superior to calcium gluconate gel in treating experimental HF burns. DMSO is not approved for human use in the United States, so this treatment has not been pursued.

A product developed in France, "Hexafluorine" *(46)*, has been marketed in Europe and the United States for use as a decontamination solution for HF skin and eye exposure. Honeywell has conducted animal studies on this product with equivocal test results for skin exposures. Given the equivocal results and the cost of the product (versus decontamination with water), we feel that there is insufficient evidence to recommend its use. *(48)*

Researchers in Turkey investigated the use of Epidermal Growth Factors (EGF) to promote healing of HF burns, noting that EGF has shown efficacy in wound healing and treatment of thermal burns. While their study did show improved healing of HF burns with EGF, it does not seem generalizable to industrial settings. Of note, this study did not involve any efforts at skin decontamination (water washing) prior to proceeding to the experimental treatments. The authors also noted the expense and limited availability of EGF, at least at the time of their study in 2014. *(33)*

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Appendix

First Aid And Medical Supplies

The following supplies should be maintained in a dispensary or first aid station near hydrofluoric acid handling and storage areas:

1. Benzalkonium chloride solution

a. For soaks and compresses, 3 to 4 gallons of 0.13% water solution of benzalkonium chloride. The 0.13% solution is available as a non-prescription drug in gallon containers. The solution should be obtained in advance. It should replaced before the expiration date on the label. It is recommended that it be stored in properly labeled light-resistant containers.

Benzalkonium chloride is also available as a 17% solution. If this concentrate is used to make a 0.13% (1:750) solution, the dilution should be performed by a qualified individual, such as a registered pharmacist. The shelf life of the diluted solution is uncertain, and it should be replaced annually.

Benzalkonium chloride should be available as a non-prescription drug through most local pharmacies. The local pharmacies obtain it from pharmaceutical wholesale distributors.

b. Ice cubes (not crushed or shaved ice)

c. Assorted basins (for immersing burned areas in benzalkonium chloride (solution)

d. Towels (for use as wet compresses)

2. Calcium gluconate gel, 2.5% Calcium gluconate gel is available commercially.

It may also be made by mixing one ampule of 10% calcium gluconate solution for each ounce of a water-based lubricating jelly using 40 cc per 4 ounce tube. This has the advantage that the ingredients may be readily available. In addition, the ingredients may be stored separately until needed, and shelf life is less of a concern.

In an emergency, calcium gluconate gel (2.5% calcium gluconate in a water soluble base) may also be formulated by a pharmacist by dissolving 3.2 grams of calcium gluconate USP in 5 cc of sterile water, and then mixing with 120 cc (4 oz. tube) of water soluble lubricant (2.5 grams per 100 cc lubricant).

3. **Aqueous calcium gluconate, 10% USP, 10 cc ampules (4.5 mEq calcium or 93 mg elemental calcium per 10 cc)**

   a. To make calcium gluconate gel, or

   b. To mix with sterile saline for eye irrigation (5 ampules 10% calcium gluconate per 500 cc sterile normal saline for a 1% solution), or

   c. To mix with sterile saline for administration with oxygen by nebulization (10 cc 10% calcium gluconate in 30 cc sterile saline for a 2.5% solution), or

   d. To be administered by a physician. When injected subcutaneously, 10% calcium gluconate must be diluted 50:50 or 25:75 with normal saline to make 5% or 2.5% solutions.

4. **Sterile 0.9% saline**

   a. Vials, (e.g. 10 cc, 30 cc, or 50 cc) to dilute 10% calcium gluconate to 2.5% - 5% for injection, or to 2.5% for nebulization

   b. 500 cc IV to dilute 10% calcium gluconate to 1% for eye irrigation

5. **0.5% tetracaine hydrochloride** solution to counteract blepharospasm and facilitate eye irrigation

6. **Medical oxygen**

7. **Nebulizer,** to administer 2.5% calcium gluconate with oxygen

8. **Beta adrenergic bronchodilators and steroids** for inhalation

9. **Surgical gloves**

10. **Syringes and needles** (27-30 gauge)

The FIRST AID AND MEDICAL TREATMENTS AND SUPPLIES recommended in this brochure are based on information reported in the medical literature and the personal experience of Honeywell physicians. It should be noted that there are no medications in the U.S. for which the specific indication is the treatment of HF burns. The physician has the dilemma of using prescription drugs in a non-approved manner, or of using substances which are not approved drugs but which have been proven effective for medical treatment. Given the choice between recommending effective treatment, or recommending the use of only drugs which are approved, we have chosen to recommend the effective treatment.

Benzalkonium chloride is available in the U.S. as a non-prescription drug. It is a surface active agent sold for use as a disinfectant. It is available in a 1:750 (0.13%) aqueous solution, a 17% concentrate, and a tinted tincture. The concentrated 17% solution must be diluted. The tinted tincture is not recommended to treat HF exposures.

CALCIUM GLUCONATE INJECTION, USP (one gram in 10 ml, 10% solution) is labeled for intravenous use only. Experience has shown that when diluted to 2.5% - 5% with normal saline, and used as described in this brochure, it is a safe and effective treatment for HF skin exposure. When diluted to 2.5% and used as described, it is safe for nebulization and inhalation, and when diluted to 1.0% and used as described, it is safe for eye irrigation.

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Sustainable Opportunity Policy
Honeywell's Commitment to Health, Safety and the Environment

By integrating health, safety and environmental considerations into all aspects of our business, we protect our employees, our communities and the environment, achieve sustainable growth and accelerated productivity, drive compliance with all applicable regulations and develop technologies that expand the sustainable capacity of our world. Our health, safety and environmental management systems reflect our values and help us meet our business objectives.

- We protect the safety and health of our employees, and minimize the environmental footprint of our operations through efforts to prevent illness, injury and pollution.
- We actively promote and develop opportunities for expanding sustainable capacity by increasing energy and water efficiency, improving security and safety, and reducing emissions of harmful pollutants.
- We are committed to compliance with all of our health, safety, environmental and legal requirements everywhere we operate.
- Our commitment to health, safety and the environment is an integral aspect of our design of products, processes and services, and of the lifecycle management of our products.
- Our management systems apply a global standard that provides protection of both human health and the environment during normal and emergency situations.
- We identify, control and endeavor to reduce emissions, waste and inefficient use of resources, including energy and water.
- We are open with stakeholders and work within our communities to advance laws, regulation and practices that safeguard the public.
- We abide by the company's own strict standards in cases where local laws are less stringent.
- Our senior leadership and individual employees are accountable for their role in meeting our commitments.
- We measure and periodically review our progress and strive for continuous improvement.

These are our commitments to health, safety, and the environment, and to creating Sustainable Opportunity everywhere we operate.

Darius Adamczyk
Chairman and CEO

Honeywell
THE POWER OF CONNECTED

Honeywell Performance Materials and Technologies
Responsible Care® Commitment

At Honeywell Performance Materials and Technologies, we are committed to the safety of our employees, the quality of our products, and being responsible stewards for the protection of our environment, the communities in which we operate, and our customers. We are a member company of the American Chemistry Council, and Responsible Care® is the foundation for sustainability in our business. Our Responsible Care® Management System is used to support our full commitment to comply with legal and other Health, Safety and Environmental (HS&E) requirements to which we subscribe and to drive continual improvement in these areas.

We achieve global operational excellence and reliability through the integration of Responsible Care® principles into the way we operate and work with our commercial partners – from our contractors and other suppliers to our customers. We conduct thorough product risk assessments prior to commercialization and we apply necessary resources and best practices in the development and handling of chemical products and materials. We promote process safety through our management systems for the design, construction, installation and maintenance of our facilities. We use quantitative and qualitative methodologies to evaluate enterprise risk and develop risk mitigation measures. As we strive toward environmental excellence and the prevention of pollution, we protect individual and public safety by manufacturing, transporting and storing our materials in a secure manner.

We invest in and improve the compliance processes for our products, processes and services using quantifiable goals to drive sustained safety and environmental excellence. We continue to see marked improvement in our safety and environmental performance and we will achieve and maintain HS&E third party certification at the business and operational levels of the organization wherever this commitment has been made.

As responsible corporate citizens, we continue to renew our commitment to the public through outreach activities, and by proactively communicating with our surrounding communities.

Rajeev Gautam
President and CEO
Performance Materials and Technologies

April 25, 2016

Honeywell
THE POWER OF CONNECTED | Industrial Fluorines

Recommended Medical Treatment for Hydrofluoric Acid (HF) Exposure

Quick Reference

NOTE: In addition to the usual medical history, the physician should obtain the following information:

- Concentration of HF
- Date and time of exposure
- Duration of exposure
- How exposure occurred
- Body parts exposed/affected
- First aid measures instituted (what, when, how long)

Injuries due to dilute HF solutions or low concentrations of vapors may result in delays in clinical presentation up to 24-hours following exposure.

SKIN BURNS		EYE EXPOSURE	INHALATION		INGESTION
FIRST AID					
CONCENTRATED HF Water Wash *THEN...* Iced Benzalkonium Chloride 0.13% Soaks *OR...* Calcium Gluconate 2.5% Gel	**DILUTE HF** Water Wash *THEN...* Iced Benzalkonium Chloride 0.13% Soaks *OR...* Calcium Gluconate 2.5% Gel	**ALL HF** Water Wash *OR...* Saline Wash	**CONCENTRATED HF** Oxygen *AND...* 2.5% Calcium Gluconate by Nebulizer Consider Starting an IV with 10% Calcium Gluconate	**(Mild Exposures)** **DILUTE HF** Oxygen *THEN...* Consider 2.5% Calcium Gluconate by Nebulizer	**ALL HF** DO NOT INDUCE VOMITING Consider Starting an IV with 10% Calcium Gluconate
MEDICAL TREATMENT					
CONCENTRATED HF Debride (if necessary) *THEN...* Continue Soaks *OR...* Calcium Gluconate 2.5% - 5% Injection *AND...* Observe for/Treat Systemic Effects (especially if > 25 sq. in.)	**DILUTE HF** Debride (if necessary) *THEN...* Continue Soaks *OR...* Calcium Gluconate 2.5% Gel *OR...* Calcium Gluconate 2.5% - 5% Injection Systemic Effects Unlikely	**ALL HF** Topical Tetracaine Hydrochloride *THEN...* 1% Calcium Gluconate Irrigation *AND...* Consult Opthamologist	**CONCENTRATED HF** Continue Calcium Gluconate by Nebulizer Observe and Treat for Respiratory Distress, Bronchoconstriction, Pulmonary Edema, Systemic Effects (Inhaled Steroids and/or Bronchodialators as Needed)	**DILUTE HF** Continue Calcium Gluconate by Nebulizer Observe Serious Effects Unlikely Inhalation of HF Vapors from Diluted Acid is Uncommon	**ALL HF** Lavage with Calcium Chloride or Calcium Gluconate *AND...* Treat Systemic Effects

This Quick Reference Chart is also available as a laminated wall poster
To order call 800-622-5002

HF Acid

For more information, contact:

Honeywell Industrial Products
115 Tabor Road
Morris Plains, NJ 07950
800-622-5002
www.honeywell-hfacid.com

Medical Assistance:
Call the 24-hour Honeywell emergency telephone number:
800-498-5701

Transportation Emergencies:
USA (CHEMTREC)
CANADA (CANUTEC)
800-424-9300
613-996-6666

Responsible Care®
Our Commitment to Sustainability

27.34 FP HF v3 | May 2018

HF Acid

For additional assistance, including technical information covering all aspects of hydrofluoric acid safe handling, use, and disposal write:

Honeywell Industrial Products
115 Tabor Road
Morris Plains, NJ 07950

Medical Assistance: Call the 24-hour Honeywell emergency telephone number:
800-498-5701

Transportation Emergencies:
USA (CHEMTREC) **800-424-9300**
CANADA (CANUTEC) **613-996-6666**

Customer Service:
800-553-9749

Honeywell Industrial Products
115 Tabor Road
Morris Plains, NJ 07950
800-622-5002
www.honeywell-hfacid.com

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2734 FP HF v7 | June 2018

Honeywell

ERG and Hazard classes 8 questions

Live • Hosted by NickVent

60%	5/19	3	0
Correct answers	Didn't finish	Need help	Difficult questions

Players (19)

Nickname	Rank	Correct answers	Unanswered	Final score
js	1	100%	0	6072
JH	2	87%	0	5575
Angie	3	87%	0	5140
Claire	4	87%	0	4927
Wes Yett	5	75%	0	4676
JV	6	75%	0	4445
LM	7	75%	0	4237
Sam Porras	8	75%	0	4119
KP	9	75%	0	3915
MC	10	62%	0	3632
Kristen	11	62%	0	3590
Sheila	12	62%	0	3438
EM	13	62%	1	3064
KJ	14	50%	0	2662
Brent White	15	50%	0	2597
HRob	16	50%	3	2465
MD	17	0%	8	0
Simone	18	0%	8	0
Janet	19	12%	5	0

Questions (8)

	Question	Type	Correct answers
1	Find the blue area	Quiz	89%
2	This hazard class contains Bullets, Bom...	Quiz	57%
3	The color of the pages that provide bas...	Quiz	63%
4	The placards in this Hazard Class can b...	Quiz	42%
5	Fissile material would be transported a...	Quiz	52%
6	Some items within this hazard class ca...	Quiz	47%
7	The ERG application for your phone ha...	True or false	78%
8	Products within this Hazard Class need...	Quiz	52%

Fluorosilicic Acid (FSA)

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 03/25/2021 Version: 1.0

SECTION 1: Identification

1.1. Identification

Product form	:	Substance
Substance name	:	Fluorosilicic Acid (FSA)
Chemical name	:	Hydro Fluorosilicic Acid (HSA)
Product code	:	M17200

1.2. Recommended use and restrictions on use

1.3. Supplier

JR Simplot Company

P.O. Box 70013

Boise, ID 83707

T 1-208-336-2110

1.4. Emergency telephone number

Emergency number : CHEMTREC 1-800-424-9300

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Corrosive to metals, Category 1	H290	May be corrosive to metals.
Acute toxicity (oral), Category 4	H302	Harmful if swallowed.
Skin corrosion/irritation, Category 1	H314	Causes severe skin burns and eye damage.

Full text of H statements : see section 16

2.2. GHS Label elements, including precautionary statements

GHS US labelling

Hazard pictograms (GHS US) :

Signal word (GHS US) : Danger

Hazard statements (GHS US) :
H290 - May be corrosive to metals.
H302 - Harmful if swallowed.
H314 - Causes severe skin burns and eye damage.

Precautionary statements (GHS US) :
P234 - Keep only in original container.
P260 - Do not breathe dust/fume/gas/mist/vapours/spray.
P264 - Wash hands, forearms and face thoroughly after handling.
P270 - Do not eat, drink or smoke when using this product.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.
P301+P312 - If swallowed: Call a poison center/doctor/… if you feel unwell
P301+P330+P331 - If swallowed: rinse mouth. Do NOT induce vomiting
P303+P361+P353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 - Immediately call a poison center/doctor/…
P321 - Specific treatment (see supplemental first aid instruction on this label)
P330 - Rinse mouth.
P363 - Wash contaminated clothing before reuse.
P390 - Absorb spillage to prevent material damage.
P405 - Store locked up.
P406 - Store in corrosive resistant container with a resistant inner liner.
P501 - Dispose of contents/container to hazardous or special waste collection point, in accordance with local, regional, national and/or international regulation

2.3. Other hazards which do not result in classification

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substances

Name : Fluorosilicic Acid (FSA)

Name	Product identifier	%	GHS-US classification
Water	(CAS-No.) 7732-18-5	75 – 78	Not classified
hexafluorosilicic acid	(CAS-No.) 16961-83-4	23 – 25	Skin Corr. 1B, H314

Full text of hazard classes and H-statements : see section 16

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures general : If you feel unwell, seek medical advice. Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible). Call a physician immediately.

First-aid measures after inhalation : Remove person to fresh air and keep comfortable for breathing. Allow affected person to breathe fresh air. Allow the victim to rest.

First-aid measures after skin contact : Remove affected clothing and wash all exposed skin area with mild soap and water, followed by warm water rinse. Rinse skin with water/shower. Take off immediately all contaminated clothing. Call a physician immediately.

First-aid measures after eye contact : Rinse immediately with plenty of water. Obtain medical attention if pain, blinking or redness persists. Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a physician immediately.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention. Call a POISON CENTER/doctor if you feel unwell. Do not induce vomiting. Call a physician immediately.

4.2. Most important symptoms and effects (acute and delayed)

Potential adverse human health effects and symptoms : Based on available data, the classification criteria are not met. Harmful if swallowed.

Symptoms/effects after skin contact : Burns.

Symptoms/effects after eye contact : Serious damage to eyes.

Symptoms/effects after ingestion : Swallowing a small quantity of this material will result in serious health hazard. Burns.

4.3. Immediate medical attention and special treatment, if necessary

Treat symptomatically.

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Specific hazards arising from the chemical

Hazardous decomposition products in case of fire : Toxic fumes may be released.

5.3. Special protective equipment and precautions for fire-fighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire fighting water from entering the environment.

Protection during firefighting : Do not attempt to take action without suitable protective equipment. Self-contained breathing apparatus. Complete protective clothing. Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Emergency procedures : Ventilate spillage area. Evacuate unnecessary personnel. Avoid contact with skin and eyes. Do not breathe dust/fume/gas/mist/vapours/spray.

6.1.2. For emergency responders

Protective equipment : Do not attempt to take action without suitable protective equipment. For further information refer to section 8: "Exposure controls/personal protection". Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Avoid release to the environment. Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Take up liquid spill into absorbent material. Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials. Absorb spillage to prevent material damage.

Other information : Dispose of materials or solid residues at an authorized site.

6.4. Reference to other sections

For further information refer to section 13. See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed : May be corrosive to metals.

Precautions for safe handling : Ensure good ventilation of the work station. Wear personal protective equipment. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapour. Avoid contact with skin and eyes. Do not breathe dust/fume/gas/mist/vapours/spray.

Hygiene measures : Always wash hands after handling the product. Do not eat, drink or smoke when using this product. Wash hands, forearms and face thoroughly after handling. Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store in a well-ventilated place. Keep cool. Keep only in the original container in a cool, well ventilated place away from : Keep container closed when not in use. Store in corrosive resistant container with a resistant inner liner. Keep only in original container. Store locked up.

Incompatible products : Strong bases. Strong acids.

Incompatible materials : Sources of ignition. Direct sunlight. Metals.

Packaging materials : Store in corrosive resistant container with a resistant inner liner.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Fluorosilicic Acid (FSA)	
No additional information available	

Water (7732-18-5)	
No additional information available	

hexafluorosilicic acid (16961-83-4)	
USA - ACGIH - Occupational Exposure Limits	
ACGIH TWA (mg/m³)	2.5 mg/m³

8.2. Appropriate engineering controls

Appropriate engineering controls : Ensure good ventilation of the work station.

Environmental exposure controls : Avoid release to the environment.

8.3. Individual protection measures/Personal protective equipment

Personal protective equipment:

Avoid all unnecessary exposure.

Materials for protective clothing:

Use chemically protective clothing

Hand protection:

Acid proof gloves should be worn to prevent contact

Eye protection:

Splash proof goggles and full-face shield should be worn at all times. Safety glasses

Skin and body protection:

Wear suitable protective clothing

Respiratory protection:

Wear appropriate mask

Other information:

Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Appearance	:	Clear, colorless to pale straw liquid.
Colour	:	Colourless
Odour	:	characteristic
Odour threshold	:	No data available
pH	:	1
Melting point	:	Not applicable
Freezing point	:	No data available
Boiling point	:	105 °C
Flash point	:	No data available
Relative evaporation rate (butylacetate=1)	:	No data available
Flammability (solid, gas)	:	Non flammable.
Vapour pressure	:	No data available
Relative vapour density at 20 °C	:	No data available
Relative density	:	No data available
Solubility	:	Soluble.
Partition coefficient n-octanol/water (Log Pow)	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosive limits	:	No data available
Explosive properties	:	No data available
Oxidising properties	:	No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

The product is non-reactive under normal conditions of use, storage and transport.

10.2. Chemical stability

Stable. Not established.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Extremely high temperatures. Direct sunlight. Extremely high or low temperatures.

10.5. Incompatible materials

Alkalis. Chlorites. Combustible solids and organic peroxides. Strong acids. Strong bases. metals. May be corrosive to metals.

10.6. Hazardous decomposition products

Corrosive fumes of fluorides. fume. Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity (oral) : Harmful if swallowed.
Acute toxicity (dermal) : Not classified
Acute toxicity (inhalation) : Not classified

Fluorosilicic Acid (FSA)	
LD50 oral rat	430 mg/kg
ATE US (oral)	430 mg/kg bodyweight

Skin corrosion/irritation : Causes severe skin burns.
pH: 1
Serious eye damage/irritation : Assumed to cause serious eye damage
pH: 1
Respiratory or skin sensitisation : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified

hexafluorosilicic acid (16961-83-4)	
IARC group	3 - Not classifiable

Reproductive toxicity : Not classified

STOT-single exposure : Not classified

STOT-repeated exposure : Not classified

Aspiration hazard : Not classified
Viscosity, kinematic : No data available

Potential adverse human health effects and symptoms : Based on available data, the classification criteria are not met. Harmful if swallowed.
Symptoms/effects after skin contact : Burns.
Symptoms/effects after eye contact : Serious damage to eyes.
Symptoms/effects after ingestion : Swallowing a small quantity of this material will result in serious health hazard. Burns.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : The product is not considered harmful to aquatic organisms nor to cause long-term adverse effects in the environment. Before neutralisation, the product may represent a danger to aquatic organisms.

hexafluorosilicic acid (16961-83-4)	
LC50 fish 1	> 10 mg/l (96 h; Brachydanio rerio)
Threshold limit algae 1	10 mg/l (96 h; Scenedesmus quadricauda; Cell numbers)

12.2. Persistence and degradability

Fluorosilicic Acid (FSA)	
Persistence and degradability	Not established.

Water (7732-18-5)	
Persistence and degradability	Not established.

hexafluorosilicic acid (16961-83-4)	
Persistence and degradability	Biodegradability: not applicable. Reacts with water: release of toxic/harmful substances. No (test)data on mobility of the components available. Not established.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

12.3. Bioaccumulative potential

Fluorosilicic Acid (FSA)	
Bioaccumulative potential	Not established.

Water (7732-18-5)	
Bioaccumulative potential	Not established.

hexafluorosilicic acid (16961-83-4)	
Bioaccumulative potential	Not bioaccumulative. Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Other information : Avoid unintentional release to the environment.

SECTION 13: Disposal considerations

13.1. Disposal methods

Waste treatment methods : Dispose of contents/container in accordance with licensed collector's sorting instructions.

Product/Packaging disposal recommendations : Dispose in a safe manner in accordance with local/national regulations. Dispose of contents/container to hazardous or special waste collection point, in accordance with local, regional, national and/or international regulation.

Ecology - waste materials : Avoid unintentional release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN1778 Fluorosilicic acid, 8, II

UN-No.(DOT) : UN1778

Proper Shipping Name (DOT) : Fluorosilicic acid

Class (DOT) : 8 - Class 8 - Corrosive material 49 CFR 173.136

Packing group (DOT) : II - Medium Danger

Hazard labels (DOT) : 8 - Corrosive

DOT Packaging Non Bulk (49 CFR 173.xxx) : 202

DOT Packaging Bulk (49 CFR 173.xxx) : 242

DOT Special Provisions (49 CFR 172.102)	:	A6 - For combination packagings, if plastic inner packagings are used, they must be packed in tightly closed metal receptacles before packing in outer packagings. A7 - Steel packagings must be corrosion-resistant or have protection against corrosion. B2 - MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks are not authorized. B15 - Packagings must be protected with non-metallic linings impervious to the lading or have a suitable corrosion allowance. IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized. N3 - Glass inner packagings are permitted in combination or composite packagings only if the hazardous material is free from hydrofluoric acid. N34 - Aluminum construction materials are not authorized for any part of a packaging which is normally in contact with the hazardous material. T8 - 4 178.274(d)(2) Normal..... Prohibited TP2 - a. The maximum degree of filling must not exceed the degree of filling determined by the following: (image) Where: tr is the maximum mean bulk temperature during transport, tf is the temperature in degrees celsius of the liquid during filling, and a is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (tf) and the maximum mean bulk temperature during transportation (tr) both in degrees celsius. b. For liquids transported under ambient conditions may be calculated using the formula: (image) Where: d15 and d50 are the densities (in units of mass per unit volume) of the liquid at 15 C (59 F) and 50 C (122 F), respectively. TP12 - This material is considered highly corrosive to steel.
DOT Packaging Exceptions (49 CFR 173.xxx)	:	None
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27)	:	1 L
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75)	:	30 L
DOT Vessel Stowage Location	:	A - The material may be stowed ‘‘on deck’’ or ‘‘under deck’’ on a cargo vessel and on a passenger vessel.
Other information	:	No supplementary information available.

Transportation of Dangerous Goods

Transport by sea

Air transport

SECTION 15: Regulatory information

15.1. US Federal regulations

Fluorosilicic Acid (FSA)
Not listed on the United States TSCA (Toxic Substances Control Act) inventory

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

15.2. International regulations

CANADA

Water (7732-18-5)
Listed on the Canadian DSL (Domestic Substances List)

hexafluorosilicic acid (16961-83-4)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

No additional information available

National regulations

No additional information available

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

Component	State or local regulations
hexafluorosilicic acid(16961-83-4)	U.S. - Massachusetts - Right To Know List; U.S. - New Jersey - Right to Know Hazardous Substance List

SECTION 16: Other information

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Other information : None.

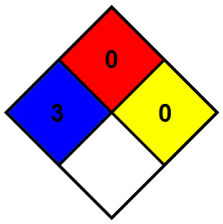
Full text of H-statements:

H290	May be corrosive to metals.
H302	Harmful if swallowed.
H314	Causes severe skin burns and eye damage.

NFPA health hazard : 3 - Materials that, under emergency conditions, can cause serious or permanent injury.

NFPA fire hazard : 0 - Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand.

NFPA reactivity : 0 - Material that in themselves are normally stable, even under fire conditions.



Hazard Rating

Health : 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given

Flammability : 0 Minimal Hazard - Materials that will not burn

Physical : 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

SDS US (GHS HazCom 2012)

Disclaimer: This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE CONCERNING THE INFORMATION HEREIN PROVIDED. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

Intermediate Bulk Containers (IBCs)
General FAQs

WHAT IS NFPA 30?

NFPA 30 is the Flammable and Combustible Liquids Code published by the National Fire Protection Association. The code provides safeguards to reduce the hazards associated with the storage, handling and use of flammable and combustible liquids. NFPA 30 is the law in most states.

WHERE IS NFPA 30 THE LAW?

NFPA 30 is enforceable under building and fire prevention codes in the following states: Ala., Ariz., Ark., Calif., Colo., Conn., Fla., Hawaii, Iowa, Ill., Ind., Kan., Ky., Mass., Maine, Mich., Minn., Mo., Mont., N.D., Neb., N.J., N.M., Nev., Ohio, Ore., R.I., Texas, Utah, Va., Vt. and Wis. It is also enforceable in several local jurisdictions. Other avenues of enforcement may include Occupational Safety and Health Administration (OSHA) regulations.

WHAT IS AN INTERMEDIATE BULK CONTAINER (IBC)?

Intermediate bulk containers are closed shipping vessels with a liquid capacity from 450 up to 3,000 L (119 to 793 gallons). They are intended for storing and transporting liquids defined in the Code of Federal Regulations and the United Nations' *Recommendations on the Transport of Dangerous Goods*, which include combustible and flammable liquids.* These rules, however, do not require any fire testing of IBCs.

WHAT TYPES OF IBCS ARE COMMONLY USED?

IBCs can be constructed of metal, plastic or a composite of materials. Composite IBCs are commonly a combination of blow-molded plastic containers in a metal cage or a plastic bag in a corrugated box.

WHAT TYPES OF IBCS ARE ALLOWED BY NFPA 30?

NFPA 30 only permits three types of IBCs in an industrial building. Metal, rigid plastic and composite. Only liquids with a closed cup flash point of 38 C (100 degrees F) or greater

are permitted to be stored in these containers. However, the composite IBCs must be listed and labeled. The complete rules on what types of IBCs are allowed in buildings can be found in Chapter 9 of NFPA 30 (visit *www.nfpa.org/30* to access the chapters for free).

WHAT IS THE FIRE HAZARD OF A COMPOSITE IBC?

When composite IBCs containing combustible or flammable liquids are stored together in warehouses or other facilities, they can cause dangerous pool fires. These fire hazards have two components:

1. **Release of combustible and flammable liquids.** When IBCs containing flammable or combustible liquids fail, they can release a large pool of these liquids. If ignited, the extreme heat release rates can overtax most fire sprinkler systems. This hazard exists regardless of how the IBC is constructed.

2. **Composite IBCs can be easily breached and then the IBC itself contributes to the fire hazard.** Composite IBCs can be easily breached by exposure to even a small fire. Additionally, once the unit is emptied, the composite may ignite and contribute to the liquid pool. Pool fires caused by composite IBCs can be catastrophic events and are capable of destroying the building where the event occurs. A spreading pool fire can also threaten adjacent buildings.

HOW BIG OF A PROBLEM IS THIS?

While there have only been a few fires that were caused or escalated by this hazard, those fires have led to the complete destruction of the buildings involved. It also

*See: Title 49, Code of Federal Regulations, Parts 100 through 199 and Part 6 of the United Nations' Recommendations on the Transport of Dangerous Goods.

must be recognized that this hazard might be found in any community with industrial, manufacturing or warehouse operations. Of the dozens of composite IBCs on the market, there is currently only a very small fraction of listed and labeled composite IBCs in use. The vast majority of composite IBCs that are used to store combustible or flammable liquids are creating a serious hazard.

DOES NFPA 30 PROVIDE A "PROTECTED STORAGE" OPTION FOR COMPOSITE IBCS?

Chapter 16 of NFPA 30 provides protection criteria for palletized and rack storage of composite IBCs. However, the IBCs must be listed and labeled.

HOW CAN YOU IDENTIFY A LISTED AND LABELED COMPOSITE IBC?

NFPA 30 recognizes IBCs that have successfully passed testing to standards listed in Chapter 2 as acceptable listed IBCs and requires all listed units to be clearly labeled by the listing agency to confirm they meet the criteria set in the standard.

HOW ARE COMPOSITE IBCS NOT IN COMPLIANCE WITH NFPA 30 GETTING INTO PROTECTED FACILITIES?

U.S. Department of Transportation (DOT) and United Nations regulations permit the shipping of combustible liquids and some flammable liquids in many types of IBCs. However, transportation regulations do not require IBCs to be fire tested and DOT has no jurisdiction over commodities in storage. Yet, many producers and customers alike believe that a shipping container approved by DOT is also approved for storage in a warehouse. This is not the case. NFPA 30 rules limit the types of IBCs allowed in buildings and also set limits on the liquid types permitted in them. Additionally, warehouse or facility personnel responsible for accepting or storing goods are often unaware of the serious fire hazard created by composite IBCs containing combustible and flammable liquids. As a result, improper storage and potentially dangerous conditions often go unrecognized.

HOW AND WHY SHOULD WAREHOUSES COMPLY WITH NFPA 30?

It is not only the law in most parts of the United States, but it also reduces the risk that catastrophic pool fires will destroy a building. Risk can be reduced by following the four steps of compliance:

- **One: Determine whether the IBC is in or will eventually enter a protected facility.**
- **Two: Identify the liquids to be stored.**
- **Three: Identify the IBC material.**
- **Four: Determine if the IBC material is appropriate for storage of its contents in the protected facility.**

HOW MUCH SAFER IS A LISTED COMPOSITE IBC COMPARED TO ONE THAT IS UNLISTED?

Listed Composite IBCs have been designed, built and certified to last in a fire for at least 20 minutes. Unlisted composite IBCs have not been inspected or certified to provide any fire endurance and have been shown to fail quickly in a fire.

WHAT IS BEING DONE TO FIX THIS PROBLEM?

There is currently an ongoing public education effort aimed at decreasing the pool fire risk posed by composite IBCs. Groups, and individuals who have the ability to help reduce this risk will be encouraged to take several steps in making a commitment to safe storage. Tailored information is available for container manufacturers, chemical manufacturers, code and fire officials, warehouse owners, managers and staff, insurance representatives, procurement and supply chain specialists, risk managers and firefighters. Generally these steps include: education, identification and correction.

Changes between the 2016 and 2020 editions of the Emergency Response Guidebook (ERG)

The Emergency Response Guidebook 2020 (ERG2020) is finally here! Over the last four years, an international group of scientists, engineers, and regulatory experts have worked together to improve the guidebook and publish the latest edition.

We've listed the most important changes from the 2016 edition to the 2020 edition. They're listed based on the colour of their section in the guidebook.

White pages

- Reviewed the guidebook and changed these sections to make them easier to read and understand:
    - Introduction to Green Tables
    - Protective Actions
    - Background on Table 1 - Initial Isolation and Protective Action Distances
    - How to use Table1- Initial Isolation and Protective Action Distances
    - User's Guide
    - Protective Clothing
    - Fire and Spill Control
    - Criminal or Terrorist Use of Chemical, Biological and Radiological Agents
- Added a new decontamination section to describe basic contamination theory and proper decontamination techniques
- Reworked the BLEVE section into the BLEVE and Heat Induced Tear section. This section now shows the cause and hazards of BLEVEs and Heat Induced Tears
- Added:
    - Lithium battery label and marking, and gasoline placard to the Table of Markings, Labels, and Placards
    - New terms and their definitions to the Glossary:
        - Adsorbed gas
        - Boil over
        - Flooding quantities
        - High expansion foam
        - Organic peroxide
        - Refrigerated liquefied gas
    - Basic information on Improvised Explosive Devices (IED) in the Criminal or Terrorist Use of Chemical, Biological and Radiological Agents section
    - A top view illustration of the TC117/DOT117 to the Rail Car Identification Chart
    - Illustration of an Intermodal Freight Container to the Road Trailer Identification Chart
- Improved the illustrations in the Rail Car and Road Trailer Identification Charts

Yellow and Blue pages

- Removed the UN numbers for Chemical Warfare Agents and moved them to the beginning of the yellow pages and Table 1. They're still in alphabetical order in the blue pages
- Added fifteen new materials (UN3535 to UN3549) listed in the UN Recommendations on the Transport of Dangerous Goods (up to the 21st revised edition)
- Deleted out of date materials based on the UN Recommendations on the Transport of Dangerous Goods and North American regulations
- Re-evaluated the polymerization hazard criteria for some high-risk materials, and added the polymerization marking **(P)** to 13 materials:

UN1051	UN1129	UN1989	UN2482	UN2486
UN1099	UN1275	UN2048	UN2483	
UN1100	UN1988	UN2480	UN2485	

- Re-analyzed the chemical properties of many materials to make sure that they're assigned to the appropriate Orange Guide. Also moved thirty-four materials to a different Orange Guide:

UN1006 (Guide 121 to 120)	UN1848 (Guide 132 to 153)	UN2806 (Guide 138 to 139)
UN1046 (Guide 121 to 120)	UN1865 (Guide 131 to 128)	UN2983 (Guide 129 to 131)
UN1056 (Guide 121 to 120)	UN1872 (Guide 141 to 140)	UN3084 (Guide 140 to 157)
UN1065 (Guide 121 to 120)	UN1928 (Guide 135 to 138)	UN3093 (Guide 140 to 157)
UN1066 (Guide 121 to 120)	UN1990 (Guide 129 to 171)	UN3257 (Guide 128 to 171)
UN1112 (Guide 140 to 128)	UN1994 (Guide 131 to 136)	UN3304 (Guide 123 to 125)
UN1199 (Guide 132 to 153)	UN2036 (Guide 121 to 120)	UN3308 (Guide 123 to 125)
UN1450 (Guide 141 to 140)	UN2209 (Guide 132 to 153)	UN3379 (Guide 128 to 113)
UN1494 (Guide 141 to 140)	UN2211 (Guide 133 to 171)	UN3380 (Guide 133 to 113)
UN1500 (Guide 140 to 141)	UN2381 (Guide 130 to 131)	UN3463 (Guide 132 to 153)
UN1649 (Guide 131 to 152)	UN2438 (Guide 132 to 131)	
UN1802 (Guide 140 to 157)	UN2721 (Guide 141 to 140)	

Orange pages

- Added an introduction called “How to use the Orange Guides”. This new section explains the 4 parts of an Orange Guide. In this section, the terms “evacuate” and “isolate” are defined

- Merged Guide 121 with Guide 120. Guide 121 now states: “Page intentionally left blank”. Products that referred to Guide 121, now refer to Guide 120

- The Canadian Nuclear Safety Commission re-evaluated the Orange Guides for radioactive materials (Guide 161 to Guide 166) for technical accuracy

- The Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) validated the Orange Guide for infectious substances (Guide 158)

- Moved the safety distances that were in the Public Safety section to the Evacuation section. Now all safety distances in an Orange Guide fall under the same heading

- Added safety distances for ammonium nitrate on fire to Guide 140

- Increased safety distances for materials on fire in Guide 114 from 500 m (1/3 mile) to 800 m (1/2 mile). This was based on consultations with stakeholder subject matter experts

- Added CAUTION sentences for specific compounds. These sentences:

    - Describe inhalation toxicity concerns due to hydrogen sulphide gas in petroleum crude oil:
        - in Guide 128
    - Describe proper firefighting and spill remediation techniques for liquefied natural gas (LNG):
        - in Guide 115
    - Describe the explosive nature, even in the absence of air, of:
        - Acetylene in Guide 116
        - Ethylene oxide in Guide 119
    - Describe the hazards of an invisible flame for:
        - Ethanol in Guide 127
        - Methanol in Guide 131
        - Carbon monoxide in Guide 168
    - Describe the toxicity of pentaborane
        - In Guide 135
    - Describe the flammability hazards of some aerosols
        - In Guide 126

- With the help of instructors from the United States National Fire Academy (NFA), did a comprehensive review of the Orange Guides

    - Some sentences were added, deleted, or changed to give the best available advice and use consistent and clear language

- Separated the references to highlighted and non-highlighted materials in the Evacuation section and simplified the language to make it easier to understand

Green pages

- Revised the distances in Table 1 and Table 3:

- Organized Table 3 by ID number (numerical order of material) instead of alphabetical order

- Revised “How to use Table 2” to clearly explain that the information in Table 2 is for **information purposes only**. Table 2 doesn’t change the suggested response strategies listed in the related Orange Guide, Table 1 and Table 3

- Added Table 3 container capacities in the section called “How to use Table 3”

- Added a visual tab in the green page border to make it easier to see the differences between Table 1, 2 and 3. The tables are all still the same green color but the side margins now include a series of white boxes that go down the page with the words Table 1, Table 2, or Table 3

- Added more Toxic Inhalation Hazard (Poison Inhalation Hazard in the U.S.) materials in Table 1 and Water-Reactive Materials in Table 2:

    - UN1390 to Table 1 and Table 2
    - UN2965 to Table 1 and Table 2
    - UN3539 to Table 1