NATIONAL Hazardous Materials FUSION CENTER

National Hazardous Materials Fusion Center

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

IAFC INTERNATIONAL FIRE CHIEFS ASSOCIATION ORG 1873

Training Package: Hydrochloric Acid Release

Instructor Guide

v. 07.23.10

National Hazardous Materials Fusion Center

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Copyright Information

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The safety statements, procedures, and guidelines contained in this guide are current as of the publication date. Prior to using the safety statements, procedures, and guidelines contained in the guide, it is advised that you confirm the currency of these statements, procedures, and guidelines with the appropriate controlling authorities.

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Module 0 - Introduction

Module Time: 5 – 10 minutes

Course Goal

This training course is designed to enhance Hazardous Materials (hazmat) responder safety and improve decision making for the prevention and mitigation of hazmat incidents. This course has been developed as part of the National Hazardous Materials Fusion Center.

National Hazardous Materials Fusion Center

The National Hazardous Materials Fusion Center (NHMFC) is the focus of a cooperative agreement between the U.S. Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) and the International Association of Fire Chiefs (IAFC).

The NHMFC is a secure, web-based portal that serves as a data and information network for hazmat teams; first responders; federal, state, and local agencies; and the private sector. Through this portal, they can share critical information to enhance hazmat responder safety and improve decision making for the prevention and mitigation of hazmat incidents. The NHMFC provides a systematic approach to:

- information and data collection,
- information and data analysis, and
- information and data dissemination.

Regional Incident Survey Teams (RIST) gather information for the NHMFC. RISTs are composed of individuals from around the country who are skilled and experienced in hazmat response or experienced in the hazmat industry. RIST members are part of a team invited by a local jurisdiction or state authority to respond to unique hazmat incidents for information gathering. The information is analyzed in order to develop safe hazmat response techniques, lessons learned, and smart practices that are shared with hazmat teams and emergency responders. In no case is the data used to criticize or condemn response actions.

For more information on the NHMFC visit: ***http://www.hazmatfc.com/***

Or send an e-mail: ***hazmatfusion@iafc.org***

Conducting National Hazardous Materials Fusion Center Training Courses

All of the information contained in this course is from an actual hazmat event. A RIST gathered all the information.

This training activity can be conducted using a large class discussion or by dividing the participants into three to four small groups. The benefit of using small groups is to allow greater participant interaction and to draw out differences in opinion for discussion. The instructor should decide which method will work best for the number and type of participants in the class.

This course is designed to be taught as it is in approximately 2 hours; however we encourage you to use this in a manner that best suits your training needs. For example, this material can be covered and expanded on in a single, longer session or over the course of several training sessions.

Administrative Information

Before conducting the class, ensure that participants know the location of exits and any emergency procedures unique to the training area. Remind participants that this information is presented to enhance future response efforts and is not to be used to criticize or condemn response actions contained herein.

Module 1 – The Incident

Module Time: 10 – 15 minutes

Note: All pictures in this course are copyrighted and are used with permission.

Incident Type

Instructor Note:
1. *Review with participants the type of incident they will be studying.* 2. *Ask participants what kinds of hazards and outcomes they might expect from a spill of hydrochloric acid.*

Transportation

Container

Motor Carrier (MC) 312

Hazardous Material

Hydrochloric acid UN #1789

Initial Dispatch Information

Incident Time: **0710**
Location: **Metropolitan area interstate highway**

- Cell caller reports a tractor trailer overturned at 0710.
- Calling party is the driver who is trapped in cab of truck.
- Driver reports the load to be hydrochloric acid.

Initial Incident Size Up

Instructor Note

1. *Have participants read the initial size-up information.*
2. *Ask participants if this additional information is significantly different from what they were expecting based on the initial dispatch information.*
3. *Based only on the information given, ask participants to discuss response considerations including:*
   - *Conditions*
   - *Location*
   - *Time of day*
   - *Initial reports and information*
4. *Ask, what (if any) type of hazardous material might be present.*
5. *Ask, if a hazardous material is present at this time what type of preparations would these responders most likely be making?*

This is the scene as the original responders found it upon their initial arrival and before any actions took place:

- The first arriving officer from the fire department reported an overturned tanker on the interstate bridge leaking product. He initiated command, donned SCBA because of potential

for exposure, and assigned his District Safety Officer (DSO), who was with him, to assess the driver's condition. In addition, he advised all responding fire personnel to don breathing apparatus and began assigning personnel to effect victim rescue, indicating a possible need for evacuation of large numbers of civilians.

- Simultaneous arrival of law enforcement began with a rapid size up/assessment and immediate evacuation of cars on the bridge and in the immediate hazard area.

- Initial Emergency Medical Services (EMS) arrival instituted immediate notification of a possible Mass Casualty Incident (MCI) and mobilized resources and protocols in preparation for this event.

- Immediate activation of the Emergency Operations Center (EOC) allowed availability of a multitude of resources and for rapid transfer of information for a potentially large-scale incident.

- Conditions:
  - Early fall morning (beginning of rush hour on major highway)
  - Clear skies
  - Temperature: 26°Fahrenheit (-3°Celsius)
  - Winds: Generally from the west/southwest, at 5–10 miles per hour (8–16 kilometers per hour)
  - Elevated bridge surface (concrete) in construction zone
  - Daybreak, morning sun

Module 2 – Incident Response

Module Time: 30 minutes

Response Narrative

Instructor Note:

1. *Allow participants time to read the narrative of the response.*
2. *After participants have read the narrative, conduct a discussion based on the items in the "Hazardous Materials Behavior" and "Incident Response" sections. The "Hazardous Materials Behavior" section focuses on the hazardous material itself, while the "Incident Response" section focuses on responders, strategies, and tactics.*
3. *The PowerPoint slides for this module contain all of the pictures that go along with the narrative.*
4. *After participants have read the narrative you should show each of the slides so they can see the pictures in greater detail and discuss any elements of interest in more depth.*

This is the full account of the response narrative compiled from the Regional Incident Survey Team (RIST) interviews of the responders involved.

On an early fall morning, in a metropolitan community in the central United States, a modified Motor Carrier (MC) 312 carrying 45,000 pounds (20,411.7 kilograms), or approximately 4,500 gallons (approximately 17,034.5 liters) of hydrochloric acid, United Nations (UN) ID# 1789, lost control and overturned. The vehicle rolled onto its left side, striking approximately 200 feet (61 meters) of concrete divider and came to rest on its side at the crest of a hill. As a result of the crash, product began to leak down the highway creating a significant white cloud that began to envelop the area and move towards the east. The incident location was at the entrance to the downtown community through one of the

most heavily traveled interstates in the region and occurred at the beginning of rush hour on a Monday morning. Local weather conditions were sunny, clear skies, temperature of 26°Fahrenheit (-3°Celsius), light winds from the West/Southwest at 5–10 miles per hour (8–16 kilometers per hour).

At 0710 hours, the local 9-1-1 dispatch center received a report of a tractor trailer rollover. The calling party identified himself as the driver of the vehicle and stated he was trapped in the cab. He advised he was carrying a load of hydrochloric acid. Simultaneous calls from other drivers in the area also reported the wreck to the neighboring jurisdiction, prompting a multi-jurisdictional response to the area. The adjoining jurisdiction, however, did not have the information indicating a chemical vessel, rather a truck accident. Both agencies dispatched resources to the area based on the information provided by the calling parties.

At approximately 0717 hours, local police and fire resources began to arrive on scene. The first arriving fire unit was a Battalion Chief (BC) accompanied by a District Safety Officer (DSO). Initial size-up reported the tractor trailer, later determined to be an MC-312, on its side leaking product and a driver trapped in the cab. They established command, donned SCBA and initiated rescue operations. Simultaneously, police arrived from both jurisdictions, conducted a rapid scene assessment and began shelter in-place (initially) of occupants of the vehicles on the bridge and in the immediate area, quickly followed by evacuation of those persons from the hazard area. Agency Hazardous Materials (hazmat) units were also immediately on the scene as part of the initial dispatch and initiated preparations for a hazmat incident.

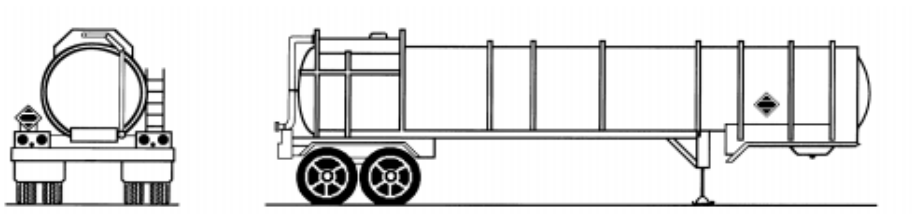
The adjoining jurisdiction (dispatched to a “truck accident”) arrived at the same time as the BC and DSO. They joined with additional rescue personnel who walked in to the accident (due to traffic stoppage) and initiated the rescue of the driver of the truck. They approached the scene and were able to stay out of the expanding vapor cloud as well as the now running product on the ground. Responders successfully leveraged favorable environmental conditions (elevation, wind direction, and an isolated bridge) against possible exposure concerns. This allowed access to the cab of the truck while rescuing firefighters remained clear of the liquid and vapor release. Donning structural fire fighting gear and SCBA, they assessed the entrapment of the driver and discovered he was simply caught in his seat belt in an inverted position. Using an attic ladder through the driver’s door,

a firefighter was able to climb down into the cab, free the victim, and assist in helping him up out of the cab. Though largely uninjured, upon exiting the cab, the victim collapsed to his knees and was carried by two firefighters, with police officer assistance, out of the danger area and into a waiting ambulance where he was transported for evaluation to an area hospital.

As additional units arrived on scene, the focus of the incident progressed to address the expanding vapor cloud that was drifting to a commercial area and a casino complex with several hundred civilians on the premises. Police and fire units from both agencies mobilized to enact a shelter in-place strategy at the casino and establish hot, warm, and cold zones. Concurrently, an Emergency Medical Services (EMS) response from the Authority Having Jurisdiction (AHJ) enacted protocols to bring additional resources to the scene from multiple directions and prepare the hospital community for a Mass Casualty Incident (MCI). Resources were sent to the command post/staging area erected across the highway upwind of the incident (due west) as well as the casino area where one patient was transported as a precaution for symptoms consistent with minor vapor exposure to hydrochloric acid.

As a result of the initial reports of a potential evacuation, fire department command staff activated the Emergency Operations Center (EOC). The opening of the EOC brought resources in from multiple agencies including the mayor's office, police, fire, EMS, hazmat, the Environmental Protection Agency (EPA), state and local emergency management, public health, information technology, water services, general services, and the medical director. Staffing the EOC allowed for the rapid collection and dissemination of information to field personnel as well as media representatives who had gathered from every local media outlet in the area.

Established partnerships with representatives from local and state departments of transportation, in conjunction with an intact regional traffic incident management system, allowed for the rapid rerouting of traffic in a heavily congested urban area. The prepositioning of resources, from camera monitoring systems that observe the highways to electronic message boards utilized to alert drivers well ahead of traffic incidents, allowed for a rapid rerouting of traffic from the affected area, alleviating congestion for emergency response resources. This also minimized additional danger to the community from the vapor release and allowed for effective monitoring stations to be established to measure any downwind hazard presented by the release.



MC 312 Corrosive Liquid Tank

Unified Command (UC) was established to allow for more effective interagency communications. In the command structure, several branches were established to streamline scene operations. The medical branch was mobilized and prepared to initiate triage, treatment, and transport of victims as well as support fire operations. A hazmat branch allowed hazmat responders to focus on product containment, release stoppage, and air monitoring operations. The law enforcement branch managed traffic control functions as well as the accident investigation. Personnel at the command post—being readily available and coordinating with the EOC and dispatch—allowed for a coordinated response effort to be undertaken.

With emergency operations in full swing, fire crews worked to contain the hydrochloric acid leaking from the damaged rupture disc and air pad valve. Liquid product was running down the highway into a storm water drain that emptied onto the lower road surface. Directives were received from the EOC to work at all practical costs to keep product from entering the combined waste water/storm water sewer system. The EOC believed that product running into the sewer system could have resulted in a failure of the sewage treatment plant rendering it inoperable for a significant portion of the city for several weeks.

Local construction crews operating on and around the bridge approached a second arriving battalion chief with an offer for equipment and assistance. Directed by command, construction crews brought nearby earth moving equipment into the area and worked with fire personnel to erect three redundant dikes to capture and contain product and prevent sewer contamination. Sand and dirt—readily available due to the construction—were used to create the dikes. Diking the product resulted in pooling of the product, reducing the surface area of the spill and minimizing fuming and

vapor production.

While diking operations were underway below the roadway, fire crews were working with local police who were in communication with a safety representative from the shipper en route to the scene. Rapid information sharing allowed the hazmat branch to develop a plan of action to stop the leak. Hazmat crews from the AHJ donned Level A Personal Protective Equipment (PPE) and utilized wooden plugs to drive into the holes of the leaking vessel, effectively stopping the release. No fire personnel were injured or exposed in any response operations. Air monitoring in the area continued until the incident was terminated at 1101 hours and sheltered personnel were allowed to leave the area.

Subsequent communications with industry personnel representing the shipper commended the fire department response. They indicated their actions to stop the release and contain the leak were identical to activities their own personnel would have attempted had the release occurred in the plant. Further discussion with the shipper revealed that training programs had previously been delivered by industry representatives to responders where this incident occurred on this very product. This remarkable discovery provides additional evidence that relationships developed between industry and emergency responders during training can pay huge dividends in emergency response efforts.

Cleanup efforts were affected by an independent contractor and representatives from the shipper. Contained pools of product were covered with soda ash and pumped into recovery vessels for disposal. Air-powered diaphragm pumps were also utilized to off-load the damaged trailer into a similar steel body, rubber-lined MC-312. After the vehicle was up-righted and removed, the bridge was re-opened to vehicular traffic. Cleanup efforts in the area continued for another day to remove contaminated soil from the area. In all, approximately 1,240 gallons (4,694 liters, which is roughly 12,000 pounds or 5,443.1 kilograms) of product was lost in the release.

Industry personnel revealed that the tank truck rupture likely occurred when the acid in the tank created a hammer effect by the force of the liquid in the tank rolling over when hitting the concrete barriers, resulting in failure of the rupture disc (set at 401 pounds per square inch [psi]). Additionally, the air pad valve was sheared off in the accident, creating an additional opening from

which liquid could escape. (The air pad valve is the air inlet valve used to help “blow off” product when off-loading.) It is noteworthy that the vessel itself (manufactured in May, 1989) did not sustain any significant damage.

Hazardous Material Behavior

Instructor Note:
1. *Conduct a discussion based on the items in the "Hazardous Materials Behavior" section.*
2. *This section focuses on the hazardous material in this incident, so keep the discussion centered on the hazardous material and its container.*

1. Did the hazardous material involved behave as expected in this situation? Why or why not?
2. Did the hazardous material and container behave as predicted?
3. Are the behaviors happening out of the predicted order?
4. Are the behaviors happening differently than anticipated?
5. What were the initial response objectives? Were they appropriate? Why or why not?
6. Was there anything else significant about the material or container involved in this incident?

Incident Response

Instructor Note
1. *Conduct a discussion based on the items in the "Incident Response" section.*
2. *This section focuses on the response efforts, so keep the discussion centered on the responders, strategies, and tactics.*

1. Were the strategies and tactics appropriate? Why or why not?
2. Were there any unforeseen issues that played a part in this incident or response (for example, weather, unexpected material behavior, or bystanders)?
3. Were there any injuries to responders? If so, what were the causative factors? Could this have been avoided? If so, how?
4. Was there an impact to the environment? If so, what were the causative factors? Could this have been avoided? If so, how?
5. Was there any significant equipment damaged? If so, what were the causative factors? Could this have been avoided? If so, how?
6. Discuss the risks versus benefits in this incident.

7. List any response issues related to:
   - Response time
   - Personnel
   - Personal Protective Equipment (PPE)
   - Established control zones
   - Safety measures
   - Mutual aid
   - Communications
   - Resources
   - Decontamination

Module 3 – Lessons Learned

Module Time: 30 minutes

Lessons Learned/Smart Practices

These are the lessons learned as stated by the responders to the incident and smart practices derived by the Regional Incident Survey Team (RIST).

Instructor Note
1. *Have participants read through the list of lessons learned and smart practices.* 2. *Ask them to pick out two or three and discuss those that are unique, innovative, potentially dangerous, or most relevant to them and their jurisdictions.*

- **The staffing of the battalion vehicles with two command staff – a Battalion Chief (BC) and District Safety Officer (DSO) – was a critical component in the rescue.** While the BC established command and directed incoming units, the DSO was able to perform a rapid scene size-up and determine the feasibility of the rescue. This resulted in a coordinated rescue of a viable victim within minutes and an effective command and control structure being established immediately. In the absence of the DSO, the BC would have had to make a decision to either assess patient viability by donning full Personal Protective Equipment (PPE) or establish command and wait for the next arriving units to assess rescue options, thereby delaying the rescue efforts.

- **The early establishment of the Emergency Operations Center (EOC) brought key decision makers together quickly which resulted in identification of a critical threat to the city sewer systems.** The EOC, acting as the AHJ, directed the Unified Command (UC) team to prevent the spilled material from entering the drainage system. The EOC believed that if product entered the system, the impact would shut down sewage treatment to a large part of the city for several weeks. This high priority objective was given to the second due BC who partnered with local construction crews to establish three containment dikes which effectively prevented the flow of product into the sewer system.

- **The establishment of relationships and training between law enforcement, fire departments, Emergency Medical Services (EMS), and the private sector were critical in limiting the effects of the incident**. The immediate notification to all responding units that respiratory protection was required upon arrival was relayed to all agencies, effectively reducing the chances for significant exposure to responders. Dozens of vehicles had to be evacuated and only a few minor exposures were reported by civilians and responders who lacked appropriate protection. During cleanup operations, certain responders recognized an employee of the shipping company as one of their trainers from a previous program on hydrochloric acid response. Undoubtedly, this training program was a successful enterprise with the private sector as evidenced by the response effort. The shipping company representatives were quoted as saying, "the responders' actions were very effective and kept the incident from worsening."

- **The creative use of available resources reduced the amount of vapor being produced, protected vulnerable infrastructure, and confirmed the effectiveness of sheltering in-place**. The dikes built by construction crews stopped the flow of product into the drain water/sewer system. This stoppage effectively pooled the liquid hydrochloric acid—reducing the surface area of the spill—and significantly decreased the vapor production. Air monitoring crews used biological indicators (a group of turkeys on the shore line north of the release) as confirmation that the vapor was not reaching the adjacent community at Immediately Dangerous to Life or Health (IDLH) concentration. Colorimetric technology was used to confirm any contamination inside the casino. In addition, the use of four gas (Oxygen [O_2], Lower Explosive Limit [LEL], Carbon Monoxide [CO], and Hydrogen Sulfide [H_2S]) technology as detection devices was also unique in this incident. Fire crews knew the monitor was incapable of detecting the product, but also knew it would provide device failure indictors if exposed to significant levels of the corrosive vapor. Finally, a robust traffic incident management system was in place and used to gain situational awareness and quickly reroute rush hour traffic away from the scene.

For more information on this and other incidents visit the National Hazardous Materials Fusion Center at http://www.hazmatfc.com/

Hazardous Material Information

This section is provided to give responders a very brief overview of information about the hazardous material involved in this incident. This section is not comprehensive but points out some of the more notable hazards and chemical characteristics.

Hydrochloric Acid

Hydrochloric acid is a colorless to light yellow corrosive fuming liquid with a pungent, irritating odor. It forms vapor clouds if released. Both liquid and vapor can cause severe burns to all parts of the body. Medical treatment is recommended for all exposures.

Physical and Chemical Properties of Hydrochloric Acid 36% solution	
Appearance	Colorless to slight yellow liquid
Physical State	Liquid
Molecular Weight	36.46
Chemical Formula	HCl
Odor	Pungent, Irritating Odor
Specific Gravity	1.18
Solubility in Water	Soluble (100%)
pH	<1
Boiling Point/Range	140–221°F (60–105°C)
Melting Point	-30°C

Vapor Pressure	80 mmHg at 68°F (20°C)
Vapor Density (Air=1.0)	1.3
Evaporation Rate	< 1.00 (N-butyl acetate)
Volatility	9–36% by volume
Ionization Potential	12.74 eV
Flash Point	Not Flammable

Module 4 – Moving Forward/Planning Ahead

Module Time: 30 minutes

Planning Activity

Instructor Note:
1. *The planning worksheet is designed to take the information the participants have discussed about the specific Hazardous Materials (hazmat) incident and allow them to think of ways to incorporate knowledge and lessons learned in terms of their own jurisdiction and response efforts.* 2. *Try to have participants focus on what they have learned from this incident and how they might respond in similar incidents.* 3. *Some of the areas below might not be applicable in all cases.* 4. *Allow the participants about 15 minutes to make notes on the worksheet either individually or in their groups.* 5. *Call time and hold a class discussion covering the items on the worksheet.*

Incident Time: 0905

Location: Local highway through town

- A 9-1-1 caller reported an overturned truck.
- The truck is leaking a liquid that is making it difficult for those in the area to breathe.
- The dispatcher advised the caller to leave the immediate vicinity and to encourage others to do the same.
- An engine company dispatched three people (one officer and two firefighters) all trained as Hazardous Materials (hazmat) technicians.
- An Advanced Life Support (ALS) medic unit from a private ambulance company was also dispatched.

Planning Worksheet

How can we incorporate what we have learned from this specific Hazardous Materials (hazmat) incident to improve our future responses? In particular the areas of:

Surveying the incident:

Container identification/markings:

Monitoring Equipment:

Response objectives:

Incident command:

Communication:

Personal protective equipment (PPE):

Decontamination:

Policies and procedures:

Mutual aid:

Training:

Resources:

What are some smart practices we can take away from this incident?