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

Incident Report Report No. 180530002

Central Region

Incident Date: 5/30/2018
Incident Address:
Location United Parcel Service, Inc. maintance facility
Address
City, State Zip Code Lexington , KY,
GPS Coordinates ,

NRC Number:
URI Number:
Mode: Highway

Type of Investigation: Incident Report **Status:**
Supervisor Name: Tiffany Ziemer
Title: Chief, Central Region
Approval Date:

Signature:

PHMSA Personnel:

Name	Title	Region
Terry Pollard	Investigator	HQ
John Heneghan	Region Director	Southern Region
Joshua Doud	Investigator	Southern Region
Keiran Stewart	Accident Investigator	HQ

Witness Address and Detail(s):

Location
Address
City, State, Zip Code , ,
Date Time

Contact Name	Title	Phone (Office)	Phone (Cell)
Dave Howard	Praxair Senior Facility Manager Central IN		

Kurt Koederitz	Praxair Director Engineering		
(b)(6), (b)(7)(C)	Maintenance Technician		
(b)(6), (b)(7)(C)	Maintenance Technician		
(b)(6), (b)(7)(C)	Journeyman Mechanic		
(b)(6), (b)(7)(C)	Journeyman Mechanic		
(b)(6), (b)(7)(C)	UPS		
(b)(6), (b)(7)(C)	UPS Driver		
(b)(6), (b)(7)(C)	UPS Driver		
(b)(6), (b)(7)(C)	UPS Driver		
(b)(6), (b)(7)(C)	journeyman Mechanic		
(b)(6), (b)(7)(C)			
(b)(6), (b)(7)(C)			
(b)(6), (b)(7)(C)			
Joe Plamore	Fleet Service Supervisor UPS		
(b)(6), (b)(7)(C)			
Ms Lynn Reiman			
Mr Isaacs			
(b)(6), (b)(7)(C)			

Regulated Entity Address and Contact(s):

Company Name Global Praxair Em Response
Address
City, State, Zip Code , ,

Contact Name	Title	Phone (Office)	Phone (Cell)
Mr Doug Wilcox	Director	(219)928-8025	(219)391-5140

Company Name Praxair Distribution, Inc.
Address 1400 Polco St.
City, State, Zip Code Indianapolis, IN, 46222

Contact Name	Title	Phone (Office)	Phone (Cell)
Mr Dave Howard	Plant Manager		(317)710-8730

Company Name Praxair, Inc.
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City, State, Zip Code Danbury, CT, 06810

Contact Name	Title	Phone (Office)	Phone (Cell)
Mr Steve Angel	CEO		

Company Name Praxair, inc
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City, State, Zip Code Indianapolis, IN, 4622

Contact Name	Title	Phone (Office)	Phone (Cell)
Mr Dave Sonnemann	Mgr, Transport Regs & Fleet Safety	(203)837-2294	(203)297-1328

Company Name United Parcel Service
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City, State, Zip Code Lexington, KY, 40509

Contact Name	Title	Phone (Office)	Phone (Cell)
Lynn Reiman	Corp. Regulated Goods		

Carrier Address and Contact(s):

Company Name United Parcel Service, Inc.
Address 213 Blue Sky Parkway
City, State, Zip Code Lexington, KY, 40509

Contact Name	Title	Phone (Office)	Phone (Cell)
Ms Lynn Reiman	Corp. Regulated Goods		

Fire/EMS Address and Contact(s):

Agency Name Lexington FD
Address
City, State Zip Code Lexington, KY,

Contact Name	Title	Phone (Office)	Phone (Cell)
Major Larkin		(859)699-1129	
Travis Myers	Captain	(859)455-5718	
John Blaton	LT	(859)455-5714	
Anthony Johnson	LT	(859)455-5719	

Agency Name SEA limited
Address 4665 Allen Road Suite A
City, State Zip Code Stow, OH, 44224

Contact Name	Title	Phone (Office)	Phone (Cell)
Eric Baluch	P.E.	(800)343-4366	(724)984-7990

Executive Summary

On May 30, 2018, a Praxair Distribution, Inc., shipment of forty-five (45) cylinders of acetylene, shipped by common carrier, exploded while a truck mechanic was utilizing a propane torch to performing maintenance on a United Parcel Service, Inc. (UPS) trailer containing the cylinders. Six people received injuries, 2 of which required transportation to

a hospital, in connection with the blast.

First responders from the Lexington police, fire and emergency medical services were dispatched to the explosion. It was noted that substantial damage was sustained to the UPS facility, in addition to the truck and trailer containing the hazardous materials.

The shipment was in route to another Praxair facility located in North Haven, Connecticut, via UPS. The incident occurred at a UPS facility in Lexington, Kentucky. The cylinders involved were specification DOT 8 AL cylinders containing UN101, Acetylene, dissolved, 2.1. Preliminary damage estimates total $1,642,500, minus medical expenses. There was no additional damage to other properties or the environment.

Evidence supports the conclusion that many of the cylinders had valves which had not been fully closed when prepared for shipment and were releasing minute amounts of acetylene gas prior to their departure from the Praxair facility in Louisiana. This conclusion is based on the observations of PHMSA investigators, during the investigation to determine how Praxair employees handled single cylinders while at their Indianapolis facility. What was observed and photographed was Praxair employees moving cylinders by their hand valves. It can be inferred that the Louisiana Praxair employee who last handled the cylinders, a new hire, who conducted a process outside of his routine failed to insure the valves were not leaking on the cylinders prior to shipment.

Incident Summary

Praxair offered for transportation, forty-five (45) DOT 8AL cylinders, weighing 9,315 pounds, of "UN1001, Acetylene, dissolved, Class 2.1". During the initial accident investigation, PHMSA Investigator Pollard determined on May 30, 2018 at approximately 07:45 a.m. Eastern Standard Time a van trailer was involved in an explosion at a UPS (US DOT# 121058) facility in Lexington, Kentucky. UPS's company's unit 268806 owned operated by UPS. The company's driver, and five company employees were involved in the incident.

On May 25, 2018, workers at the Praxair Distribution, Inc., Hahnville, Louisiana Facility, began preparing 45 cylinders of Acetylene in DOT 8AL cylinders, for transportation. The cylinders were filled on the trailer's manifolded system and then removed individually from the manifold system. These cylinders were being shipped as single cylinders. The cylinders were going to be used as spares at another facility in North Haven, CT.

The cylinders were filled to less than full capacity, as they were intended to be placed in a different system. In order for them to stabilize in the other system, they needed to be filled to a capacity which was less than full. The process of filling took approximately twelve hours. Once filled, the cylinders were strapped together on 4 pallets.

The cylinders were shipped using UPS as a carrier as Praxair does not have a truck route for their final destination even though this was an inter-company transfer.

A UPS ground delivery truck then arrived at the Praxair facility and loaded them into a trailer. The UPS truck then travelled to New Orleans, LA, where it was unloaded at a UPS distributed facility. The cylinders were then loaded onto another trailer (No. 293095) where it was consolidated with other non-hazmat items and then sealed. Trailer No. 293095 then travelled to a UPS facility in Jackson, MS, arriving on May 26, 2018. It then departed the facility, and was transported to Memphis, TN, arriving on the same day. All freight from the trailer was unloaded and the cylinders consolidated into another trailer (No. 268806), which was then closed and sealed the afternoon of May 26, 2018. No other hazardous materials were on board with the cylinders. The trailer remained parked at the facility until it departed on May 29, 2019, headed for Nashville, TN.

The average high and low temperatures in Nashville, TN from May 26 – 29, 2018 were 79 degrees and 75 degrees Fahrenheit, respectively. It then arrived in Nashville, TN, stayed for approximately 1.5 hours, and then departed and subsequently arrived at the UPS facility in Lexington, KY, on the same day, where it was staged for further travel.

On May 30, 20189, at approximately 0645, a UPS driver was assigned a truck and trailer No. 268806 (the trailer containing the cylinders). During the driver's vehicle and trailer pre-operation safety inspection, an inspection sticker was found to be loosely attached to the trailer. Fearing that the required sticker would fall off, the driver arranged to have a UPS mechanic attempt to more permanently attach the sticker to the trailer. At 0703, the truck-trailer combination was driven into the building containing the maintenance facility workshop, to the mechanics' work bay

(OHD-3). Between 0703 and 0740, a propane torch was lit by the mechanic near trailer No. 268806, a subsequent explosion severely injured the nearby driver and mechanic, causing transportation to a hospital. The explosion also injured four (4) others, ripped the trailer completely open and blew a hole into the ceiling of the UPS maintenance facility.

When first responders arrived, they found that the facility had sustained extensive damage, consisting of a partial building collapse. However, there was no active fire.

The UPS building and both vehicles sustained major damage (Photograph Exhibit 1). UPS estimates the damage as $1,642,500 which does not include medical expenses.
Disruption of commerce or impact to the environment was not a factor in this incident.

PHMSA Southern Region Director John Heneghan and Investigator Joshua Doud deployed to the UPS facility in Lexington, Kentucky. While conducting their accident investigation they collected evidence (Exhibit 2) and took photographs of the damage caused by the explosion (Photograph Exhibit 3).

PHMSA Southeast Region dispatched Investigators Shawn Daniels, Tom Lynch, and Felix Gonzalez to Praxair Distribution's facility at 261 Highway 3142, in Hahnville, Louisiana to gather evidence and take photographs. Some of the evidence they collected was Praxair Distributing's Acetylene Trailer Log fill sheet for the cylinders offered for transportation, the material safety data sheet for N, N-Dimethylformamide (DMF), the company's SOP for filling acetylene trailers, and HM training records for the following employees; (b)(6), (b) (7) (C) (b)(6), (b) (7) (C) (Exhibit 4). PHMSA investigators also photographed cylinders that were removed from the acetylene trailer but not shipped with the other cylinders (Photograph Exhibit 5).

Southwest PHMSA investigators at Praxair Distributing were not given the opportunity to interview all witnesses or receive written statements from company employees. They wanted to interview, (b)(6), (b) (7) (C) (b)(6), (b) (7) (C). Praxair later supplied statements from these employees (Exhibit 6).

Emergency Response

On Wednesday, May 30th, 2018, City of Lexington emergency units responded to the UPS Freight - Maintenance Garage located at 513 Blue Sky Parkway for an investigation into a reported explosion. During the initial response, Fire Department apparatus were being notified and/or updated by the Communications Center that a significant explosion had occurred inside their facility with several casualties. According to the Incident Commander, when the 1st Engine Company arrived on scene they reported a large, one-story commercial style mechanics garage with significant structural damage. He goes on to say that although there were numerous employees who were classified as "walking and wounded", two (2) needed immediate transport based on visible injuries and their close proximity to the "blast seat".

Timeline of Major Response (excerpted from Lexington Fire Marshal's Report):

5/30/2018, 0740 – Lexington Public Safety Communications Center receives call from UPS reporting explosion of a trailer at UPS Maintenance facility

5/30/2018, 0744 - Lexington Fire Department dispatched to UPS Freight Terminal, 213 Blue Sky Parkway, Lexington, KY

5/30/2018, 0750 – Lexington Fire, Engine 18 arrives on scene and reports, "a partial collapse of the building with no fire conditions evident."

5/30/2018, 0751 – Company Officer, Engine 18 reports that UPS employees are reporting "everyone is out of the building".

5/30/2018, 0757 – Incident Commander reports "at this time, there is no fire conditions, everyone is accounted for and out of the building."

5/30/2018, 0759 – Platoon Chief reports that "the command post has been established at the rear of the unit 200".

5/30/2018, 0801 – The Incident Commander reports to all units, "we are limiting our exposure inside to SCBA's only; otherwise, we will keep everybody out".

5/30/2018, 0803 – Report that the first patient, UPS driver, is being transported to the University of Kentucky Medical Center.

5/30/2018, 0805 – Report that UPS mechanic was transported to the University of Kentucky Medical Center.

5/30/2018, 0807 – Police take UPS Freight Management to their office to retrieve bills of lading

5/30/2018, 0815 – Incident Commander requests the mobile ambulance bus (MAB) for multiple patient transports.

5/30/2018, 0816 – Hazardous Materials Officer reports "zero readings at this time on the "C" side, the downwind side". Additionally reports visually from the outside, "very small fire on the trailer bed of truck involved, very small fire close to the cylinders". U/220 replies to Command that the fire cannot be extinguished from the exterior. He reports the fire similar to the size of a "lit candle".

5/30/2018, 0818 – Incident Commander cites that 2 patients have been transported via EC-Unit for immediate care, estimated and/or up to ten (10) additional walking wounded will be transported via the "MAB" for observation.

5/30/2018, 0826 – u/220 reports to Command that the "small fire" he reported earlier has been extinguished by streams directed into the building from Engine 9's crew. He additionally reports "zero readings" from just outside the garage door of the truck/trailer (event location).

5/30/2018, 0846 – driver of the MAB reports to Command that all patients are loaded, secure and they are transporting to the University of Kentucky Medical Center.

5/30/2018, 0933 – Company Officer of Rescue 1 reports to the Incident Commander that an exterior structural integrity assessment has been completed, asks for Hazmat personnel (observation only) while they assess the stability of the interior. According to u/230 (Special Operations Major), they are assembling team now.

5/30/2018, 0952 – u/220 (Hazardous Materials Officer) reports he and the Company Officer of Engine 8 (Technical Rescue Company) have entered into the structure for further assessment(s).

5/30/2018, 1030 – personnel from LPD Hazardous Devices Unit

Investigators representing numerous agencies to include Lexington Fire Department - Fire/Arson Investigation Bureau, ATF - Lexington Field Office, LPD - Forensic Services Unit & Hazardous Devices Unit, Department of Transportation (DOT) as well as representatives from "Praxair" and "SEA - Scientific Expert Analysis" released the scene to UPS representatives on Friday, June 1st at approximately 12 noon.

While on-scene during first response efforts the LFD, found that the cylinders were in-tact, but all the cylinders were leaking acetylene from the valves, fire crew members were directed to only monitor and not move, disturb or alter any of the contents of the building, fire crew proceeded to number and determine the degree of leaking from cylinders, once Praxair representatives were present leaking cylinders were tightened and secured by fire crew personnel. PHMSA investigators had to conduct their observations at the Indianapolis Praxair facility where the shipment was sent following the accident.

Collectively, our preliminary findings suggest a flammable gas explosion occurred as a result of leaking acetylene cylinders being stored inside an on-the-road trailer. Associated with this investigation, case# 2018-98687 which represents the employees "personal injury" report(s) sustained during the explosion. This continues to be an ACTIVE/OPEN investigation.

Lt. John Blanton
Fire/Arson Investigation Bureau

Product Classification

UN1001, Acetylene, dissolved, 2.1) is a Class 2.1 flammable gas, that is colorless and has a garlic like smell. It has no subsidiary hazard classes associated with it. Acetylene is a gas at normal room temperature and pressure.

Interviews of personnel at Praxair Distributing Inc. in Indianapolis, Indiana and inspection of DOT-8AL Acetylene Cylinders involved in explosion in Lexington, Kentucky

On June 26 and 27, 2018 PHMSA Senior Investigator Sean Lynum and Investigator Terry Pollard conducted a follow-up investigation at Praxair Distribution, Inc. at 1400 Polco Street, Indianapolis, Indiana 46222. This was in reference to the incident that occurred at a UPS facility in Lexington, Kentucky on May 30, 2018.

Persons present, Senior Investigator Sean Lynum, Investigator Terry Pollard, Dave Howard, Senior Facility Manager Central Indiana, and Kurt Koederitz Director Engineering Praxair Distribution, Inc.

Mr. Howard stated he was at the incident in Lexington, KY. (b)(6), (b) (7) (C) Maintenance Technician and (b)(6), (b) (7) (C), Maintenance Technician from the Praxair Indianapolis facility were also at the incident. Mr. Howard stated they both have over thirty years of acetylene experience.

While they were at the incident they visually inspected the cylinders involved for damage, completed C-13 inspections and weighed the cylinders with a beam scale they brought from Indianapolis.

Mr. Howard stated the cylinders looked like they were in very good condition and he mentioned he noted the cylinders showed no signs of flame impingement. All fusible plugs were intact.

Mr. Howard stated these cylinders did not contain acetone as a solvent, but contained dimethylformamide (DMF) instead. He explained DMF would remain in the cylinder longer, making it more economical to use. Investigators obtained a SDS for the product (Exhibit #32).

Mr. Howard explained the forty-five cylinders shipped were part of a bank of cylinders on an acetylene trailer based at their facility in Hahnville, Louisiana. This trailer was designed for use when large amounts of acetylene were needed. This system avoids constant switching out cylinders. These cylinders were part of a system that was outdated and the cylinders were being salvaged as they were still in good condition.

Mr. Howard explained the cylinders were filled on the trailer's manifolded system and then removed. These forty-five cylinders were being shipped as single cylinders. The cylinders were going to be used as spares at another facility in North Haven, CT.

The cylinders were filled to less than full capacity because they were destined to be placed in a different system. In order for them to stabilize in the different system they needed to be filled less than full. They reported the cylinders took approximately twelve hours to fill.

The cylinders were shipped using UPS as a carrier as Praxair does not have a truck route for this Lexington location even though this was an inter-company transfer. Because of this type of transfer, a common carrier with an enclosed trailer was used in lieu of a Praxair open trailer.

Mr. Keoderitz and Mr. Howard were confident the cylinders were leak checked at least three times and were not leaking when they left Praxair's Hahnville facility.

Mr. Keoderitz and Mr. Howard speculated freight may have been placed on top of the cylinders causing the valve(s) to open. Another possibility was that transferring pallets from one trailer to another could have caused leaks, or personnel may have inadvertently opened a valve slightly creating a leak. They also stated the cylinders had been transferred several times before arriving in Lexington, Kentucky. They felt the hand valves could have been loosened while being handled in transportation by the carrier.

Company officials stated they didn't think the incident was the result of a "fuzz leak". Company officials explained "fuzz leaks" as leaks that could not sustain combustion if an ignition source was introduced to the source of the leak, but still emitting acetylene (Photograph Exhibit 3 pages 7 and 8).

Praxair officials at the scene in Lexington took possession of the propane torch hand torch used in Lexington, Kentucky involved in the incident. The torch was photographed (Photograph Exhibit #7). It was wrapped in green transparent shrink wrap. Investigators did not disturb the shrink wrap during the investigation.

Company officials and PHMSA investigators numbered, inspected, marked, photographed and weighed all of the cylinders involved in the incident, taking 711 photographs. Investigator Lynum constructed a cylinder weight chart for comparison (Exhibit #8).

During the investigation investigators notated one cylinder was marked with an X and the word "leak" (Photograph Exhibit #9). This cylinder was logged in as cylinder number 11 on the chart. Mr. Howard explained this cylinder was marked in Lexington by responders.

Another cylinder had a damaged hand valve (Photograph Exhibit #10). Praxair officials claimed that freight over the cylinders may have fallen on the hand valves and caused the leak. This cylinder was logged in as cylinder number 14 on the chart.

Mr. Howard and Mr. Keoderitz pointed out that UPS used a yellow freight rack to double stack freight in the trailer. They contended freight dropped on the cylinder(s) loosening the hand valves and causing the acetylene leak.

They also stated UPS's moving the freight may have caused the hand valve to become loose.

Investigators examined the hand valves on the cylinders to check for free travel in the hand valves. During this time, tests were performed and it was determined most hand valves were capable moving counter clockwise approximately a quarter of an inch from the tight closed position before the valve opened and released acetylene (Photograph Exhibit #11 and Video Exhibit 12).

Both Investigators noted that all the hand valves on the cylinders were above the plane of the protection ring on the cylinder (Photograph Exhibit 13).

Investigators observed several Praxair employees rolling/moving the cylinders utilizing the hand valve. They were twisting the cylinder in a clock-wise direction while moving them (Photograph Exhibit #14).

Interviews of personnel and inspection of Praxair Distributing Inc. in Hahnville, Louisiana

On July 16 and 17, 2018 PHMSA Investigators Tom Lynch and Terry Pollard conducted a follow-up investigation at Praxair Distribution, Inc. at 261 Highway 3142, Hahnville, Louisiana 70057. This was in reference to the incident that occurred at a UPS facility in Lexington, Kentucky on May 30, 2018.

Present for the investigation were; PHMSA Investigators Tom Lynch Terry Pollard, Kurt Koederitz Director Engineering Praxair Distribution, Inc., George Schlinck, Safety and Environmental Director, Carl Cantrelle, Jr., Senior Facility Manager.

When Investigator Pollard asked the company officials if they would like to give their account of what they thought caused the accident.

Company officials were adamant that the acetylene cylinder's valves were closed when the left the facility in Hahnville.

Mr. Schlinck talked about expansion of acetylene, its flash point, the parts per million (PPM) that a person has the ability to smell acetylene, and acetylene's flammability range.

Company officials stated the cylinders contained dimethylformamide (DMF) as a solvent in the cylinder instead of acetone as an added safety and economic feature.

Company officials stated On May 18, 2018 Praxair filler employees began filling their acetylene trailer comprised of 200 cylinders at the Praxair facility in Hahnville, LA. using the company's filling procedure. On May 19, 2018, the acetylene trailer filling process was complete.

Investigators Pollard and Lynch asked the company to go through the procedures of filling the cylinders and preparing them for transportation. When asked, who was the person that closed the hand valve on the cylinders that were involved in the explosion company officials showed the investigators the Acetylene Trailer Log signed by (b)(6), (b)(6), (b) (7)(C) (Exhibit 4).

Investigator Pollard asked if the company had a policy that specifically covered closing the valves on the acetylene cylinders that (b)(6), (b) (7) (C) closed for the shipment. Company officials stated no.

When asked if (b)(6), (b) (7) (C) had documented training for closing the acetylene cylinders, company officials stated no, that type of training is on the job training.

Investigator Pollard tried numerous times to interview (b)(6), (b) (7) (C), but was unsuccessful. Evidence showed (b)(6), (b) (7) (C) was the last person to handle the cylinders prior to UPS picking up the shipment.

Phone interview with (b)(6), (b) (7) (C)

On July 31, 2018 PHMSA Investigator Pollard texted (b)(6), (b) (7) (C) and requested a telephone interview after trying several times to telephone (b)(6), (b) (7) (C). (b)(6), (b) (7) (C) texted back and the interview was conducted on July 31, 2018 at 08:48 (CST).

(b)(6), (b) (7) (C) was asked to relate his version of filling the acetylene cylinders and shutting down the filling process, and preparing the cylinders for transportation. (b)(6), (b) (7) (C) stated that he followed the company procedures for filling them while manifolded on the trailer as well as the shutdown procedure and leak test procedure. (b)(6), (b) (7) (C) stated that he removed the cylinders from the manifold system and the trailer. (b)(6), (b) (7) (C) stated that he did not do any more leak tests prior to shipment.

(b)(6), (b) (7) (C) stated he was the last person to handle the cylinders prior to them being loaded on the UPS trailer. He signed the Acetylene Trailer Log report on May 19, 2018 (Exhibit 4 page 12).

Interviews and Evidence Gathering at UPS Facility near Lexington, KY

On August 8 and 9, 2018 PHMSA Investigator Terry Pollard conducted a follow-up investigation at UPS Freight Facility at 213 Blue Sky Parkway, Lexington, Kentucky 40509, in reference to the incident that occurred there on May 30, 2018.

Investigator Pollard asked Ms. Reiman and Mr. Isaacs to give UPS Freight's account of the circumstances of the explosion.

Investigator Pollard also interviewed the following UPS employees; Mr. Joe Plamore, Fleet Services Supervisor (b)(6), (b) (7) (C) (b)(6), (b) (7) (C), for their account of the incident.

The following is a combination of the aforementioned interviewees account of what happened:

A shipment of forty-five acetylene cylinders placed on 4 pallets originated on 05/25/2018 from Praxair Distribution in Hahnville, Louisiana and was taken to the UPS facility in New Orleans, Louisiana (Exhibit 2 pages 6 and 7). The load was picked up at approximately 16:30 to 16:40 (EST) by a UPS driver gathering freight. The driver and trailer returned to the UPS facility in New Orleans at approximately 18:54 (EST). The trailer's freight was unloaded onto the facility dock.

From there the cylinders were loaded onto UPS trailer unit 293095 at 20:00 (EST) and dispatched at 22:46 (EST) bound for Jackson, Mississippi.

The driver and power unit for the trailer was switched at UPS's facility in Jackson, Mississippi when it arrived on

05/26/2018 at 02:40 (CST). The trailer departed the same day at 03:13 (CST) bound for Memphis, Tennessee.

Trailer unit 293095 arrived at UPS's facility in Memphis, Tennessee on 05/26/2018 at 06:22 (CST). It was cross-docked on 05/26/2018 into empty trailer unit 268806. The cylinders were loaded near the front of the trailer. A yellow "stack rack" was used by UPS to load additional freight, however this device was loaded near the rear of the trailer. The cylinders were the only hazardous materials loaded on the trailer. The trailer loading process for unit 268806 was completed approximately five hours later.

Trailer unit 268806 was placarded, sealed and staged for transportation but was not dispatched until it left the facility on 05/29/2018 at 09:10 (CST) bound for Nashville, Tennessee. The UPS driver was (b)(6), (b) (7) (C). The trailer was sealed at this facility with UPS door seal number 5421190. (b)(6), (b) (7) (C) confirmed the door seal was present.

(b)(6), (b) (7) (C) arrived at the UPS facility in Nashville, Tennessee with trailer unit number 268806 on 05/29/2018 at 12:52 (CST). (b)(6), (b) (7) (C) dropped trailer unit number 268806 at the UPS facility in the staging area.

UPS driver, (b)(6), (b) (7) (C) hooked up the truck tractor he was operating to trailer unit 268806 at this facility (b)(6), (b)(6), (b) confirmed the door seal was present and undisturbed on trailer unit 268806 before leaving the facility bound for Lexington, Kentucky.

(b)(6), (b) (7) (C) arrived at UPS's Lexington, Kentucky facility on 05/29/2018 at 18:24 (EST) and parked the trailer in the facility's staging area.

On 05/30/2018 at approximately 07:13 (EST) UPS driver (b)(6), (b) (7) (C) started his work at the UPS facility in Lexington, Kentucky. (b)(6), (b) (7) (C) connected trailer unit 268806 to his truck tractor and started performing his pre-trip inspection. Prior to doing his pre-trip inspection (b)(6), (b) (7) (C) checked his bill of lading and verified the trailer contained a hazardous material. During his interview, (b)(6), (b) (7) (C) stated he observed the trailer was placarded with red flammable placards but he didn't recall if it was flammable gas or flammable liquid placards. As he was inspecting the power unit and trailer he noticed a periodic inspection sticker was missing half of the sticker. (b)(6), (b) (7) (C) proceeded to move the truck tractor semi-trailer into the facility's maintenance shop where he contacted (b)(6), (b) (7) (C), a Journeyman Mechanic, to have him replace the periodic inspection sticker.

(b)(6), (b) (7) (C) was working on removing the inspection decal when he came to a point where he decided to use a propane torch with an ignitor to help with the process. When he struck the ignitor for the torch an explosion ensued.

During the incident, (b)(6), (b) (7) (C), a UPS truck mechanic, was knocked to the floor and received a laceration on the top of his head, temporary hearing loss, and amnesia as the result of the explosion. (b)(6), (b) (7) (C) was operating a propane torch when the explosion occurred.

Ms. Reiman was asked for (b)(6), (b) (7) (C) HM training records and any company policies that would involve the circumstances involved with this incident (Exhibit 15). She when on to say (b)(6), (b) (7) (C) had been re-trained and advised of the policy requirements.

Also affected by the blast was (b)(6), (b) (7) (C) a driver for UPS. He was near (b)(6), (b) (7) (C) when the accident occurred. (b)(6), (b) (7) (C) received a laceration on his head, hearing loss, bruising on his chest, and amnesia as the result of the explosion.

(b)(6), (b) (7) (C) was working near the front of the trailer at the time of the incident. He was knocked to the floor and received minor injuries.

(b)(6), (b) (7) (C) was approximately sixty feet from the trailer when the explosion occurred. He was knocked to the floor but received minor injuries.

(b)(6), (b) (7) (C) was present and within thirty-five feet of the incident. He received minor injuries during the incident. (b)(6), (b) (7) (C) was not available to be interviewed during the time Investigator Pollard was in Lexington.

UPS officials provided a diagram of the employee's location at the time of the incident, building arrangement, the vehicles, and the cylinders the company had on site (Exhibit 16).

Investigator Pollard received a copy of the 5800.01 incident report from Ms. Reiman (Exhibit 17).

The photographs Ms. Reiman provided shows the building and both vehicles sustained major damage (Photograph Exhibit 18). UPS's estimate the damage as $1,642,500 which does not include medical expenses.

Interview of (b)(6), (b) (7) (C), Journeymen Mechanic for UPS in Lexington, Kentucky

On August 8, 2018 at 09:48 (EST) Investigator Pollard interviewed (b)(6), (b) (7) (C), Truck Mechanic at the UPS facility in Lexington, Kentucky.

(b)(6), (b) (7) (C) identified himself using his driver's license.

Investigator Pollard asked (b)(6), (b) (7) (C) to give his recount of what happened at the shop the morning of May 30th.

He stated he went to work the morning May 30, 2018 at approximately 0600 (EST). The company has a fifteen to twenty-minute meeting and exercise period before they start work in the shop area.

He was working on the duties his supervisor had assigned him that morning when (b)(6), (b) (7) (C) pulled into the truck bay and exited the vehicle. He made contact with (b)(6), (b) (7) (C) and asked what he needed. (b)(6), (b) (7) (C) stated he needed the periodic vehicle inspection decal replaced as half of it was missing.

While (b)(6), (b) (7) (C) was working on the decal when he made the decision to use a handheld propane torch to help with the process. The last thing he remembers is activating the auto ignitor on the torch. That's when the explosion happened.

When asked by Investigator Pollard, (b)(6), (b) (7) (C) did not recall anything unusual that morning while in the shop. Investigator Pollard asked if anyone was using the acetylene and oxygen cutter/welder that morning. He recalled it had been several days since anyone in the shop had used it.

When asked if he could describe the smell of acetylene (b)(6), (b) (7) (C) described it as the smell of rotten eggs. He was asked by Investigator Pollard if he had smelled rotten eggs that morning in the shop. He responded no.

(b)(6), (b) (7) (C) estimated the time between (b)(6), (b) (7) (C) entering into the shop and the explosion being about three to five minutes.

Investigator Pollard asked (b)(6), (b) (7) (C) to bring a representative of the propane torch to the interview which he did (Photograph Exhibit 19).

Interview of (b)(6), (b) (7) (C), Journeymen Mechanic for UPS in Lexington, Kentucky

On August 8, 2018 at 10:18 (EST) Investigator Pollard interviewed (b)(6), (b) (7) (C), Truck Mechanic at the UPS facility in Lexington, Kentucky.

(b)(6), (b) (7) (C) identified himself using his company identification.

Investigator Pollard asked (b)(6), (b) (7) (C) to give his recount of what happened at the shop the morning of May 30th.

He stated he went to work the morning of May 30 at approximately 0600 (EST). The company has a fifteen to twenty-minute meeting before he starts work in the shop area.

He was working on his assignment for the day when he observed a truck tractor semi-trailer pull into the shop and (b)(6), (b) (7) (C) exit the truck and make contact with (b)(6), (b) (7) (C). Seeing that his needs were being attended to, he went back to work.

Shortly thereafter the explosion happened. When asked about the acetylene and oxygen torch/welder's use. He stated no one was using it the day of the accident. (b)(6), (b) (7) (C) stated he knows what acetylene smells like, and he didn't notice any acetylene smell. He was closest to the cylinders of acetylene stored along the wall in the shop.

Interview of Mr. Joe Plamore, Fleet Services Supervisor for UPS shop in Lexington, Kentucky

Mr. Plamore identified himself using his driver's license.

Investigator Pollard asked Mr. Plamore to give his recount of what happened at the shop the morning of May 30th.

Mr. Plamore stated he was in his office on the far end of the building. He estimated the distance from the incident to be seventy feet.

He heard the blast and went running out to the shop yelling for everyone to get out of the building. As he was moving around the site of the explosion he observed (b)(6), (b) (7) (C) lying on the floor with his eyes rolled back in his head. He also observed (b)(6), (b) (7) (C) with a fire extinguisher fighting a fire near the trailer. One of the things he noticed was the clocks on the wall were stopped on 07:20 (EST), the time of the explosion.

On August 23, 2018, at approximately 09:19 (CST) Mr. Plamore contacted Investigator Pollard by telephone and advised him during the interview he had misspoke during the interview about the time the explosion occurred.

Mr. Plamore stated the explosion occurred at the 07:40 "mark" instead of 07:20. Mr. Plamore provided a photograph of one of the clocks taken from the shop which shows the time of 07:41 to Ms. Reiman. She in turn forwarded the photograph to Investigator Pollard (Photograph Exhibit 20).

Interview of (b)(6), (b) (7) (C), Journeymen Mechanic for UPS in Lexington, Kentucky

(b)(6), (b) (7) identified himself using his driver's license.

(b)(6), (b) (7) stated he was talking to (b)(6), (b) (7) (C) when the explosion occurred. He was near the front of the trailer doing some maintenance work just before the explosion. The explosion caused him to lose consciousness and awoke on the shop floor. He was afraid debris would fall on him, so he crawled under a trailer for safety. When he looked around he saw fire coming from the cylinders so he moved to the fire extinguisher and started extinguishing the flames. During this time, he spotting (b)(6), (b) (7) lying on the floor not moving. He thought he was seriously hurt or worse so he decided he was going to his rescue. He could hear Mr. Palmore yelling for him to get out of the building but he replied he wouldn't go without (b)(6), (b) (7). Mr. Palmore came to his location and helped move (b)(6), (b) (7) out of the building.

Interview of (b)(6), (b) (7) (C), Truck Driver for UPS in Lexington, Kentucky

(b)(6), (b) (7) identified himself using his driver's license.

(b)(6), (b) (7) was asked to recount the chain of events that led up to the explosion on May 30, 2018.

He stated he checked into work approximately 07:00 (EST). He proceeded to the parking lot and starting preparing his vehicles for his trip. While checking the trailer, he noticed the periodic inspection decal was torn in half. He got into the tractor and pulled the truck tractor and semi-trailer into the facilities maintenance shop.

He came into to contact with (b)(6), (b) (7) (C). (b)(6), (b) (7) (C) asked him what he needed. (b)(6), (b) (7) (C) explained the decal needed to be replaced before he started his trip. (b)(6), (b) (7) (C) indicated he would start on it right away. (b)(6), (b) (7) (C) stayed close to the front left hand side of the trailer while (b)(6), (b) (7) (C) worked on the decal. (b)(6), (b) (7) (C) stated his back was towards (b)(6), (b) (7) (C) as he was talking to (b)(6), (b) (7) (C).

He felt the blast but was knocked to the floor and doesn't remember anything until he was in the ambulance. He said his head hurt so bad he asked the medical technicians to give him something for the pain in his head.

Investigator Pollard asked (b)(6), (b) (7) (C) if the trailer had hazardous materials on board. (b)(6), (b) (7) (C) responded yes it did. He said he saw the red placards which mean either flammable gas or flammable liquid was on the trailer.

Investigator Pollard asked if he reviewed the hazardous materials shipping paper before he started his inspection of the vehicle. He replied yes.

(b)(6), (b) (7) (C) was asked if he noted anything unusual in the shop as he got of the truck. He stated no. investigator Pollard asked if he knew what acetylene smelled like. He replied no.

(b)(6), (b) (7)(C) was asked the amount of time that passed from the time he stopped the vehicle in the shop to the time of the explosion. (b)(6), (b) (7)(C) responded five minutes.

(b)(6), (b) (7)(C) was asked if he checked the UPS door seal on the trailer before moving the trailer into the shop. He said no. He was asked if he checked the door seal on the trailer when he picked up the trailer in Nashville, Tennessee. He stated yes.

Investigator Pollard asked (b)(6), (b) (7)(C) if he checked the door seal on the trailer before pulling into the shop to which he said no.

Inspection of UPS maintenance building, truck tractor, and trailer involved in explosion at Lexington, Kentucky

After intervening witnesses to the explosion Investigator Pollard, Ms. Reiman, and Mr. Isaacs inspected the building involved during the explosion.

As part of the inspection Investigator Pollard requested a trailer the company provide a trailer identical to the one involved in the explosion be made for inspection. The company provided UPS trailer unit number 268688 (Photograph Exhibit 21).

The outside dimensions of the trailer were twenty-eight feet in length, eight feet six inches wide and thirteen feet six inches tall. The inside dimensions are eight feet two and one-half inches wide, nine feet one and one-half inches in height, and twenty-seven feet eight inches in length.

Investigator Pollard next inspected and photographed UPS trailer unit 268806 involved in the explosion (Photograph Exhibit 22).

Investigator Pollard photographed two of UPS's stack racks. These are representative examples of what the company uses (Photograph Exhibit 23).

Investigator Pollard, Ms. Reiman, and Mr. Isaacs searched the perimeter of the facility looking for additional evidence but was unsuccessful.

During the investigation, the question of security of the cylinders came up. Investigator Pollard asked these questions; who had access to the cylinders while they were in UPS's possession and how was access to the cylinders protected?

Ms. Reiman stated UPS researched the possibility of sabotage and shared their findings. The cylinders were only at the New Orleans facility approximately ten hours. While in New Orleans they were placed on trailer 293095 and sealed with a company door seal. The trailer remained in the company's fenced facility until it was dispatched. All of UPS's facilities are protected by an exterior fence and an electrified inner fence with 7,000 volts when no one is on the property. A photograph of the UPS facility's fence in Lexington, KY was taken (Photograph Exhibit 24).

Ms. Reiman provided a memo as to the movement, sealing of the trailer, its opening, and attendance (Exhibit 25).

Prior to, and since the incident, no employees have been disciplined or terminated at any of the facilities where the shipment of cylinders passed through.

Investigator Pollard asked Ms. Reiman to provide a written statement from (b)(6), (b) (7)(C) indicating door seal 5421190 was verified by him when he connected up his truck tractor to trailer unit 268806 and delivered it to the UPS facility in Lexington, Kentucky (Exhibit 26).

Interviews of personnel and inspection of Praxair Distributing Inc. in Hahnville, Louisiana

On July 16 and 17, 2018 PHMSA Investigators Tom Lynch and Terry Pollard conducted a follow-up investigation at Praxair Distribution, Inc. at 261 Highway 3142, Hahnville, Louisiana 70057. This was in reference to the incident that occurred at a UPS facility in Lexington, Kentucky on May 30, 2018.

Present for the investigation were; PHMSA Investigators Tom Lynch Terry Pollard, Kurt Koederitz Director Engineering Praxair Distribution, Inc., George Schlinck, Safety and Environmental Director, Carl Cantrelle, Jr., Senior

Facility Manager.

When Investigator Pollard asked the company officials if they would like to give their account of what they thought caused the accident.

Company officials were adamant that the acetylene cylinder's valves were closed when the left the facility in Hahnville.

Mr. Schlinck talked about expansion of acetylene, its flash point, the parts per million (PPM) that a person has the ability to smell acetylene, and acetylene's flammability range.

Company officials stated the cylinders contained DMF as a solvent in the cylinder instead of acetone.

Investigators Pollard and Lynch asked the company to go through the procedures of filling the cylinders and preparing them for transportation. When asked, who was the person that closed the hand valve on the cylinders that were involved in the explosion company officials showed the investigators the Acetylene Trailer Log signed by (b)(6), (b) (7) (C) (Exhibit 4 page 12).

Investigator Pollard asked if the company had a policy that specifically covered closing the valves on the acetylene cylinders that (b)(6), (b) (7) (C) closed for the shipment. Company officials stated no.

When asked if (b)(6), (b) (7) (C) had documented training for closing the acetylene cylinders, company officials stated no, that type of training is on the job training.
Investigators viewed the filling station and the dock used to prepare the cylinders for transportation.

Investigators were shown a new acetylene trailer the company recently placed into service. Both investigators noticed the hand valves were above the protection ring on the cylinder. Investigator requested the company photograph the cylinders (Photograph Exhibit 27).

Company officials arranged to release a small amount of acetylene in the company's parking lot for the investigators to smell.

Investigator Pollard surmised the aroma was similar to garlic, a lite smell not pungent like ammonia or a strong sulfur.

Investigator Pollard tried numerous times to interview (b)(6), (b) (7) (C), the last person to handle the cylinders before loading them before UPS picked up the shipment but was unsuccessful.

Phone interview with (b)(6), (b) (7) (C)

On July 31, 2018 PHMSA Investigator Pollard texted (b)(6), (b) (7) (C) and requested a telephone interview after trying several times to telephone (b)(6), (b) (7) (C). (b)(6), (b) (7) (C) texted back and the interview was conducted on July 31, 2018 at 08:48 (CST).

(b)(6), (b) (7) (C) was asked to relate his version of filling the acetylene cylinders and shutting down the filling process, and preparing the cylinders for transportation.

(b) (6), (b) (7)(C) He when on to say his primary job was working with filling cylinders, mainly ethylene and acetylene.

(b) (6), (b) (7)(C)

(b)(6), (b) (7) (C) stated he was the last person to handle the cylinders prior to them being loaded on the UPS trailer. He signed the Acetylene Trailer Log report on May 5, 2018 (Exhibit 4 page 12).

Summary of incident report filed by Lexington, Kentucky Fire Department in relation to the acetylene incident at the UPS facility in Lexington, Kentucky.

Lexington, Kentucky Fire Department's incident report (Exhibit 28).

Package Behavior

A DOT 8AL cylinder is a seamless steel cylinder with a service pressure of 250 p.s.i.g. The forty-five (45) DOT-8AL acetylene cylinders were manufactured by Tragessor between May 1958 and December 1989. The cylinders were tested to 49 CFR 178 subpart C specifications.

They were originally part of a bank of cylinders on an acetylene trailer based at their facility in Hahnville, Louisiana. This trailer was designed to be used when large amounts of acetylene will be used. This system avoids constant switching out cylinders. These particular cylinders were part of a system that was outdated and being retired. The cylinders themselves were being salvaged, as they were still in good condition.

The most recent requalification by NexAir report #4251, started the requalification process on March 17, 2016, indicates that the cylinders passed the shell inspection and porous mass inspections and were requalified between March 17 through March 23, 2016 (Exhibit 32).

PHMSA investigators determined through the Louisiana, Lexington and Indianapolis site visits that the packaging does not appear to be the contributing factor that lead to the accident.

Analysis

Investigator Pollard forwarded a series of questions to Senior Investigator Sean Lynum for answers and calculations. Investigator Lynum requested Engineer Refaat Shafkey in PHH- 20 calculate the amount of acetylene it would take to the fill the UPS trailer to reach the flammability range.

Mr. Shafkey offered this response (Exhibit 29). Mr. Shafkey also forwarded the e-mail one of PHMSA's chemist, Mr. Britain C. Bruner, PhD for comment.
In Mr. Shafkey's opinion was that 3.4 pounds of acetylene vapors would fill the space of a trailer like UPS trailer unit 268806 with enough flammable vapors to cause an explosion if an ignition source was introduced.

Dr. Bruner offered his remarks to these questions (Exhibit 30). Dr. Bruner offered his opinion that it would take approximately 3.6 pounds of acetylene to fill the inside of a trailer with the same dimensions of UPS trailer unit 268806 with vapors that would be flammable enough for combustion.

Findings and Contributing Factors

A definite probable cause cannot be determined based on the evidence collected or study of the forensic evidence inspected.

However, based on the physical evidence, witness interviews, documentation, the training and experience of the investigator the most likely cause of the incident was the hand valves on the cylinders were not properly closed allowing the cylinders to weep acetylene.

Praxair officials have a term for these types of leaks, which they call "fuzz leaks". These leaks are so minor that they are hard to detect and the vapors may not sustain combustion when subjected to an ignition source. This may be the case here as after the explosion photographs show one cylinder with an extremely small fire emitting from the valve.

If these cylinders would have been shipped on a trailer that was not enclosed, it is doubtful the accident would have happened. This was not the case. The cylinders were shipped in an enclosed trailer with no venting to the outside. While not leak-proof, the trailer offered an opportunity for the flammable vapors to pool and become concentrated enough for them be ignited. The fact that the trailer was capable of releasing vapors was the reason the vapors found

an ignition source from the outside of the trailer.

An analysis of cylinder weights was conducted to estimate the amount of gas that may have leaked during transportation. The weight of the cylinders at the beginning of the shipment was determined by information provided by the shipper. The weight of the cylinders after the explosion was determined by weighing each individual cylinder (Exhibit 30).

Based on the evidence gathered this is the probable scenario; the cylinders were filled on May 19, 2018; however, we don't know what time. If we start our time clock on midnight (EST) on May 20, 2018 we can start our countdown to the time of the explosion on May 30, 2018 at 7:40 (CST). The amount of time that transpired between these dates is roughly 248.5 hours.

The evidence shows that approximately 314.585 pounds of acetylene were lost between the time the cylinders were filled and the time the cylinders were weighed.

Reports indicate responders tightened the hand valves soon after the explosion. We also know the leaking cylinders would not maintain combustion with the exception of one cylinder which shows the flame was very minimal as shown in (Photograph Exhibit 3 pages 7 and 8).

If we calculate the total amount of acetylene lost from the forty-five cylinders and the number of hours from the filling to the explosion, that calculation is approximately 3.41 pounds of acetylene that escaped the cylinders per hour.

UPS trailer #268806 was closed for approximately ninety-two hours. This calculation rate of acetylene loss per hour is more than enough time to fill the trailer if it only takes losing 3.4 to 3.6 pounds per hour of acetylene to make the atmosphere inside the trailer flammable, and certainly concentrated enough to provide flammable vapors on the outside of the trailer.

The introduction of an ignition source from the handheld propane torch ignited the flammable vapors emitting from the trailer caused the explosion injuring the UPS employees, damaging UPS's building and motor vehicles. All the forensic evidence indicates the source of the flammable vapors were in UPS trailer unit 268806.

Bringing the trailer into the building helped concentrate the flammable vapors outside the trailer by cutting down on external air movement thus reducing the dissipation of vapors.

The Praxair employee that shut down the filling process on the acetylene trailer did not check the individual cylinders for leaks after the cylinders were removed from the manifold system and prior to shipment. The PHMSA Investigator was not provided documentation to show the Praxair employee had a leak test procedure to follow for cylinders being removed from a manifolded system and prepared for transportation.

Several leak checks were performed on the cylinders while on the Praxair trailer with manifolded cylinders, however no leak checks were performed on the cylinders after their removal. A lack of company policy for this scenario and assurance the valves were closed tight is believed to be a contributing factor in this case.

Prior to providing the shipment for transportation, Praxair would have handled and moved each cylinder individually while building four pallets, and securing the cylinders to each pallet. During the investigation, PHMSA investigators observed and photographed Praxair employees moving cylinders by twisting the hand valve on the cylinder.

Praxair officials contend the valves were tightly closed prior to transportation and freight falling on the valve(s) or persons at UPS handling the cylinders caused the leak(s) and that UPS was responsible for the valve(s) opening. None of the PHMSA Investigators working this incident observed any evidence to substantiate this theory. UPS video and photographs shows forklifts were used to move the cylinders secured to the pallets from trailer to trailer. The statement of the carrier's handling the cylinders and inadvertently opening the hand valves lacks credibility as the cylinders were lashed to a steel pallet. UPS officials supplied photographs of the cylinders being cross-dock transferred to trailer unit number (Photograph Exhibit 31).

One leak theory reviewed was the damaged hand valve with the bent stem on cylinder number fourteen. The stem was bent towards the valve opening, indicating the direction of force. The striation marks were on the right-hand side of the hand valve wheel. The striation marking was towards the valve which means the exertion of force was clockwise.

This would have tightened the valve instead of opening it.

This particular cylinder contained 19.68 pounds of acetylene. This was one of the cylinders with the most acetylene still in the cylinder. It's most likely this cylinder was damaged during the explosion instead of it being the cause of the leak.

Praxair officials stated the shipment of cylinders were filled on the acetylene trailer that was being placed out of service and the trailer portion being dismantled. They went on to say the cylinders were not filled to capacity. No one was able to give an exact filled weight, however; twenty-four pounds was given as an approximate net weight of acetylene for each cylinder. Investigators observed Praxair employees moving the cylinders from place to place by rolling the cylinder on the edge of the bottom foot ring. These employees were spinning the cylinders clockwise by turning the cylinder by the hand valve. While movement in a clockwise motion would be tightening the valve, counter clockwise movement or suddenly stopping the cylinder from moving would loosen the valve and may cause a leak.

The evidence suggests the shipment of these cylinders were part of a systemic issue. Praxair officials stated approximately twenty-four pounds of acetylene was filled into each cylinder. Of the forty-five cylinders that were shipped, twenty cylinders contained less than twenty pounds each of acetylene. This calculates to 91.11% of the cylinders shipped were missing product, some significantly.

These figures suggest the some of the valves were not entirely closed when offered for transportation, and that these leaks were very slow in nature. Company officials called this a "fuzz leak". This theory is supported by the evidence on the "Praxair – Acetylene Cylinder Weights" chart (Exhibit 8). This chart was created by PHMSA Investigators to demonstrate the potential loss of gas from each cylinder. Each cylinder was weighed after the incident and data included in this chart.

Reports from the responders at the site say there was an explosion but relatively no fire. Photographs from the scene do not show any fire damage on articles that would have burned if subjected to prolonged heat. UPS employees involved in the incident reported a small fire and a quick extinguishment of the flames. Only one or two cylinders continued to burn after the explosion, and only one was photographed. This photograph shows a sustained flame less than one-half of an inch in length. The photograph shows carbon black on the valve opening. This indicates a leak possibly considered what Praxair described as a "fuzz leak".

Responders discovered a cylinder at the scene and marked it with an "X" and "leak". This cylinder was marked as cylinder number 11, inspected and weighed in Indianapolis, Indiana and still contained twenty-one pounds of acetylene, but was considered leaking at the scene in Lexington, Kentucky.

Filling the cylinders to contain approximately twenty-four pounds of acetylene each would make the total net weight of the acetylene in the cylinders 1,080 pounds. Upon weighing the cylinders in Indianapolis, the total net of the acetylene was 765.415 pounds. Which means 314.585 pounds of acetylene was lost since the cylinders left the Praxair facility in Hahnville, Louisiana.

A number of hand valves were tightened on site by first responders following the incident. The hand valves were marked by the first responders to show they had tightened them. These actions indicate those valves were not closed as tight as they could have been, and may have been the cause of the leaks.

Another consideration is the outside temperature and the temperature inside the trailer due to the thermal heat generated by the sun on the trailer, as this will cause the pressure in the cylinder to be higher on a day in May than a day in December.

Moving a leaking package into a building affords the opportunity for the vapors to concentrate instead of mixing with the wind, diluting the concentration and blowing it away. Having leaking packages in an enclosed trailer provided for the perfect conditions for this incident. With a flammable gas like acetylene that has a large flammability range, the opportunity to find an ignition source increases. Introducing an ignition source close to the leaking trailer caused the trailer to explode and subsequent injuries and damage at the UPS facility on May 30, 2018.

Conclusions

Forty-five cylinders of acetylene, a flammable compressed gas with a wide flammability range, some with small leaks, were loaded into an enclosed trailer which was not opened for several days. This allowed the buildup of flammable vapor inside UPS trailer unit 268806. The trailer was then moved into a building where flammable vapors escaping from the trailer found an ignition source causing the explosion. This ignition source was introduced while a UPS employee was servicing this trailer. Using a propane torch inside the facility, when a commercial motor vehicle is placarded flammable gas, is prohibited by UPS's written policy.

This accident most likely would not have occurred had one or more of the contributing factors listed above were missing.

Praxair should develop a policy and train employees on how to dismantle a trailer with manifolded cylinders, and prepare those cylinders for transportation. This policy and training should include a leak test for each cylinder prior to transportation.

UPS should emphasize during recurrent training for drivers and mechanics system-wide with this incident highlighted as an example of the consequences of not following company policy.

Packaging Detail(s)

Type	Size	Capacity	Hazmat Type	Category	Labels	Placards	Markings
Cylinder			Class 2.1		Flammable gas		DOT A AL

Hazmat Classification

Class	UN Number	Proper Shipping Name	Packing Group	Subsidiary Hazards	Label Codes
2.1	UN1001	Acetylene, dissolved			2.1

Exhibits

Description	Name, Title	Company	City, State
SDS for acetylene	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 1 - UPS Photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 2 Manifest - shipping paper	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 3 - SO Region Photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 4 - Praxair Training Record	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 5 - SW Region Photos	Terry Pollard, Senior Hazardous Materials	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO

	Investigator		
Exhibit 6 - UPS Employee Statements	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 7 - Pollard Photo of hand held torch	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 8 - Cylinder weight sheet	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 9 - Cylinder Photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 10 - Pollard cylinder photo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 11 - Pollard valve photo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 12 - Video on N drive	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 13 - Pollard Cylinder Photo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 14 - Pollard Praxair Distribution Photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 15 - UPS Training for (b) (6)	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 16 - UPS facility diagram and personnel	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 17 - DOT 5800.1	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 18 - UPS facility photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 19 - Pollard Torch example photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 20 - Stopped clock Photo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 21 - Pollard Trailer Photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 22 - Pollard Damaged Trailer Photo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 23 - Pollard Stack Rack Photo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 24 - Pollard Exterior UPS Fence	Terry Pollard, Senior Hazardous Materials	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO

photo	Investigator		
Exhibit 25 - UPS E-mail to Pollard	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 26 - UPS Driver Statement	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 27 - Praxair manifolded cylinder trailer photo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 28 - Lexington Fire Report	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 29 -LEL Question/answers	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 30 - Dr. Britain Bruner Memo	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 31 - UPS Security Cam Photos	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO
Exhibit 32 - PraxAir inspection log	Terry Pollard, Senior Hazardous Materials Investigator	US DOT/PHMSA/OHMS/Central Region	Kansas City, MO