



Health and Safety Best Practices Guides

Industrial Fire Responses

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Hazard Summary (See specific Safety Data Sheets for more information)

Health Hazards: Respiratory distress. Respiratory failure. Hypoxia. Increase risk of cancer. May cause damage to the brain, blood and blood forming organs.

Physical Hazards: Fire and explosive hazards. Thermal burns. Heat stress. Slip, trip and fall Hazards (Pits, Holes, Sludges). Crushing, pinching, struck-by hazards (Damaged structures). Traumatic injury.

Signs and Symptoms of Exposure (See SDS for more information)

Short-term over-exposures to products of combustion may cause irritation to skin and eyes, difficulty breathing, headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion, or disorientation.

Emergency Actions (See SDS for more information)

First-aid measures general: **If exposed or injured: Get medical advice/attention.**

First-aid measures after inhalation: Remove to fresh air and keep in a position comfortable for breathing. Perform CPR if the victim is in respiratory or cardiac arrest.

First-aid measures for thermal burns: Rapidly cool with cool (not cold) water. Do not break blisters or remove clothing that is stuck to the skin. After cooling, cover with a clean, dry, sterile bandage.

Fire Extinguishment Options & Considerations

Contained Burn	Contain the fire to a specific area and conduct nearby air monitoring. This allows the fire to burn completely and reduces the release of unknown partially combusted chemicals in the air.
Soil Covering	Smothering burning plastic, foams, and some chemicals (media where water is not recommended) with soil is typically the most effective. Smothering the fire requires access to a borrow pit, dump trucks, excavators, and dozers, as well as equipment operators. Continuous air monitoring must occur inside of heavy equipment to assure that the PPE level worn by the operator remains appropriate. Enclosed cabs may have particulate filters; however, filters will not remove carbon monoxide or maintain the proper oxygen concentration.
Water Extinguishment	Water spray has limited effectiveness on fires involving plastics, foams and chemicals. Control and contain runoff. In confined, or urban locations, consider smothering the burning material in a lined/sealed 30-yard dumpster that is filled with water. Water spray can be effective at preventing the spread of the fire to other areas of a facility.
Firefighting Foam	Foam's availability is limited in most rural areas and its runoff increases the potential environmental impacts. AFFF foam typically contains PFAS or PFOAS. Contain and control firefighting foam runoff if possible.
Heavy Equipment	Use Long-Reach Excavators with a thumb attachment to pull apart burning bales, structural steel, roofing panels, etc. to expose burning material. Have water and fire equipment on standby. Continuous air monitoring must occur inside of heavy equipment to assure that the PPE level worn by the operator remains appropriate. Enclosed cabs may have particulate filters; however, filters will not remove carbon monoxide or maintain the proper O ₂ concentration.
Flammable Metals	Flammable metals will require special extinguishing agents such as Class D Fire Extinguishing Chemicals. Smothering with soil will not extinguish the burning metals; they can still burn in an oxygen deficient environment. Water will generate hydrogen gas and create an explosion hazard.

Surface Water Assessment & Protection

Surface Water	Identify any potential drainage pathways that could impact any waterways. Survey and monitor any impacted waterways adjacent to site. If pathways exist, surface water monitoring and sampling may be warranted. Sample for VOCs, SVOCs, metals, and PFAS/PFOA as appropriate. Conduct water quality monitoring. Notify downstream water intake facilities, recreation areas, farms, etc. Involve State or County Health Departments if surface water is impacted.
Containment / Remediation	Construct trenches and earthen berms to contain and collect firefighting runoff water. Block storm drain pipes and grates. Deploy vacuum trucks and temporary storage tanks to collect liquids for treatment and/or disposal. Boom or an underflow dam may be necessary to contain pyrolytic oils. Install aeration systems can help drive VOCs from surface water.

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Instrument Deployment Strategies

Utilize Viper or ProRAE Guardian (PRG) to allow data to be transmitted to the Command Post and real-time analysis of the data.

On-Site Monitoring	Deploy direct reading instruments on-site (Exclusion Zone, Command Post, Staging Areas, etc.) to ensure exposures are below Action Levels. Use data to guide PPE decisions, or the relocation of the command post/staging area.
Community Monitoring	<p>A combination of the following provides the best coverage for nearby residents and the highest quality data to drive recommendations and decisions.</p> <p>Fixed Locations –Fixed locations should be deployed near receptors and in an area where there is shore power to alleviate instrument battery maintenance. Location should be selected that are downwind. When using portable generators, assure that generator exhaust does not impact instruments. Fixed locations provide the best analysis of actual human exposure over time, but the data is limited to a small location.</p> <p>Roving Air Monitoring – Roving teams should identify areas downwind to drive through. Roving air monitoring provides coverage of large areas but is limited in its effectiveness to estimate actual human exposure over time. Roving air monitoring is best to deploy and monitor throughout neighborhoods with potential particulate and chemical exposure. Roving air monitoring teams allow flexibility to mobilize to sensitive areas (Schools, Day Care, Etc.) for immediate assessment of compounds of concern.</p>

Air Monitoring/Sampling Equipment

Fires often produce incompletely combusted byproducts that are not detectable in real time or quantifiable with regularly available sampling and laboratory methods. Particulates are easily measured in real-time to estimate the direction and intensity of a smoke plume and guide informed shelter-in-place and evacuation recommendation by the Unified Command. Plastics, foams and rubbers are typically found in all industrial fires. Below is a list of the combustion products, broken down by plastic type or by specific source. **Remember**, per ERRPB SOG, complete a radiation survey at all Emergency Response and Removal Sites.

Radioactive sources may be present at recycling center and scrap yard fires. See the [Radiation Emergency Response Health and Safety Best Practices Guide](#) for details on radiation detection equipment and clearance criteria.

If air sampling is required the best option is to gather a sample through a Polyurethane Foam (PUF) cassette for off-site analysis or collect Tedlar® bags for analysis on the EPA Trace Atmospheric Gas Analyzer (TAGA) bus. Most air sample results will be estimated concentrations of compounds that are not on the typical analyte list, usually called tentatively-identified compounds, and that do not have action levels to compare against.

Plastic Type	Combustion Byproducts	Instruments / Sensors (Linked to ERTG QSG)
<p><u>Type 1.</u> Polyethylene terephthalate (PETE, PET, or polyester). <u>Type 2:</u> High density polyethylene, or HDPE. <u>Type 4:</u> Low density polyethylene LDPE.</p>	<p>Carbon Monoxide (CO), VOCs, BTEX, Acetaldehyde, Particulate matter (PM), SVOCs, PAHs and Straight chain & bent aliphatic hydrocarbons</p>	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Standard Configuration 2. TVA 2020 for compounds with IP greater 10.6ev 3. DustTrak Particulate monitor: PM2.5
<p><u>Type 3.</u> Polyvinyl chloride.</p>	<p>CO, Hydrogen Chloride (HCl), VOCs, chlorinated volatiles, BTEX, Styrene, Phosgene, PM, SVOCs, PAHs, Straight chain & bent aliphatic hydrocarbons, Dioxins</p>	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Install Cl₂ Sensor 2. MultiRAE Benzene: Benzene 3. TVA 2020 for compounds with IP greater 10.6ev 4. DustTrak Particulate monitor: PM2.5 5. SPM FLEX: Phosgene and Acid Gas (HCl) Tapes 6. Draeger CMS: Toluene, Styrene 7. Draeger Tubes (Quant Meter): Formaldehyde
<p><u>Type 5:</u> Polypropylene. Combustion produces</p>	<p>CO, Carbon Dioxide, VOC's, BTEX, Formaldehyde, PM, PAHs, Straight chain and bent aliphatic hydrocarbons</p>	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Standard Configuration 2. MultiRAE Benzene: Benzene 3. TVA 2020 for compounds with IP greater 10.6ev 4. DustTrak Particulate monitor: PM2.5 5. Draeger CMS: Toluene, Styrene 6. Draeger Tubes (Quant Meter): Formaldehyde

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Type 6: Polystyrene or Styrofoam.	CO, VOC's, BTEX, Styrene, PM, PAHs, Straight chain and bent aliphatic hydrocarbons	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Standard Configuration 2. MultiRAE Benzene: Benzene 3. TVA 2020 for compounds with IP greater 10.6ev 4. DustTrak Particulate monitor: PM2.5 5. Draeger CMS: Toluene, Styrene
Type 7: Group includes Phenolics, ABS (acrylonitrile butadiene styrene), polycarbonate, BAP (bisphenol A), Polyphenylene Sulfide (PPS), Polymethylmethacrylate (Plexiglas or Perspex), rubber & other moldable plastic.	CO, BTEX, Styrene, PM, PAHs and other SVOCs. Also produce Phenol, formaldehyde, Cyanide (CN), Ammonia (NH ₄), Nitrogen Dioxides (NO _x), Sulfur Dioxides (SO _x)	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Install CN, NH₄, & SO 2. MultiRAE Benzene: Benzene 3. TVA 2020 for compounds with IP greater 10.6ev 4. DustTrak Particulate monitor: PM2.5 5. SPM FLEX: Isocyanate Tape 6. Draeger Tubes (Quant Meter): Formaldehyde
Specific Sources	Combustion Byproducts	Instruments / Sensors (Linked to ERTG QSG)
Plating Shop Fires	CO, BTEX, Styrene, PM, PAHs and other SVOCs. These plastics also produce Phenol, formaldehyde, Cyanide, Ammonia, NO _x , SO _x	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Install CN, NH₄, & SO 2. MultiRAE Benzene: Benzene 3. TVA 2020 for compounds with IP greater 10.6ev 4. DustTrak Particulate monitor: PM2.5 5. SPM FLEX: Phosgene and Acid Gas (H₂SO₄) Tapes
Oil Refinery Fires/Oil In-situ Controlled Burns	CO, NO _x , SO _x , PM, BTEX	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Install SO Sensor 2. MultiRAE Benzene: Benzene 3. TVA 2020 for compounds with IP greater 10.6ev 4. DustTrak Particulate monitor: PM2.5
Agriculture Chemical Fires (Fertilizer, Herbicides, Insecticides, etc.)	CO, NO _x , SO _x , Phosphorus Oxides (PO _x), PM, NH ₄ , Phosgene, Cyanuric Acid, Phosphoric Acid, HCl	<ol style="list-style-type: none"> 1. AreaRAE /MultiRAE Pro: Install CN, NH₄ & SO 2. TVA 2020 for compounds with IP greater 10.6ev 3. DustTrak Particulate monitor: PM2.5 4. SPM FLEX: Phosgene and Acid Gas Tapes

Exposure Limits

Contaminant	IDLH	OSHA Exposure Limits	ACGIH Exposure Limits	Explosive Range	Ionization Potential	PID Correction Factors (10.6 eV Lamp) ^a
Ammonia	300ppm	TWA: 50ppm	TWA: 25ppm, STEL: 35ppm	16-25%	10.16 eV	10.9
Acetaldehyde	2000ppm	TWA: 200 ppm	Ceiling: 25ppm	4.0-60%	10.23 eV	6
Benzene	500ppm	TWA: 1 ppm, STEL: 5ppm	TWA: 0.5ppm, STEL: 2.5ppm	1.2-7.8%	9.24 eV	0.47
Carbon Monoxide	1200ppm	TWA: 35ppm, Ceiling: 200ppm	TWA: 25ppm	12.5-74%	--	--
Chlorine	10ppm	Ceiling: 1ppm	TWA: 0.5ppm, STEL: 1ppm	--	11.48 eV	--
Ethyl Benzene	800ppm	TWA: 100ppm	TWA: 20ppm	0.8-6.7%	8.76 eV	0.65
Formaldehyde	20ppm	TWA: 0.75ppm, STEL: 2ppm	Ceiling: 0.3ppm	7.0-73%	10.87 eV	--
Hydrogen Cyanide	50ppm	TWA: 10ppm	Ceiling: 10ppm	5.6-50%	13.6 eV	--
Hydrogen Chloride	50ppm	Ceiling 5ppm	Ceiling: 2ppm	--	12.74 eV	--
Hydrogen Sulfide	100ppm	Ceiling: 20ppm	TWA: 1ppm, STEL: 5ppm	4.0-44%	10.46 eV	3.3
Nitrogen Dioxide	20ppm	Ceiling: 5ppm	TWA: 0.2ppm	--	--	--
PNOS/PNOR ^b (PM)	--	TWA: 15 mg/m ³	TWA: 10 mg/m ³	--	--	--
Phenol	250ppm	TWA: 5ppm	TWA 5ppm	1.8-8.6%	8.51 eV	1.0
Phosgene	2ppm	TWA: 0.1ppm	TWA: 0.1ppm	--	11.55 eV	--
Styrene	700ppm	TWA: 100ppm, Ceiling: 200ppm	TWA: 50ppm, STEL: 100ppm	0.9-6.8%	8.40 eV	0.43
Sulfur Dioxide	100ppm	TWA: 5ppm	STEL: 0.25ppm	--	--	--
Toluene	500ppm	TWA: 200ppm, Ceiling: 300ppm	TWA: 20 ppm	1.1-7.1%	8.82 eV	0.45
Xylenes	900ppm	TWA: 100ppm	TWA: 100ppm, STEL: 150ppm	0.9-7.0%	8.56 eV	0.40

^a - See [RAE Systems Technical Note TN-106](#) for information on PID and use the proper correction factors

^b - PNOS – Particulates not otherwise specified (ACGIH Definition), PNOR – Particulates not otherwise regulated (OSHA Definition)

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Action Levels	
Contaminant/Hazard	Action
Fire or Explosion Hazard, LEL > 10%	Leave the work zone and implement engineering controls. Engineering controls used in a potentially explosive atmosphere must be rated explosion proof.
Exceed an OSHA or ACGIH Exposure Limit	Leave the work zone and implement engineering controls. Don Level C or Level B PPE. Replace cartridges at the end of each work shift and/or based on manufacturers recommendations.
Exceed the Maximum Use Concentration of Respirator	Leave the work zone and implement engineering controls. Increase respiratory protection. For example: Full Face APR to PAPR or APR/PAPR to SCBA/SAR.
Oxygen Deficient Atmosphere	Leave the work zone and implement engineering controls. Don B PPE.
Exceed PM2.5 Criteria for Very Unhealthy - >300 – 500 µg/m3	Using the PEL and TLV for PNOS/PNOR may not be appropriate for industrial fires since there are VOCs, SVOCs, and other toxic compounds in the products of combustion that cannot be quantified in real time. Consider moving command operations, implementing remote extinguishing, donning respiratory protection, etc. if the criteria are exceeded.
Personal Protection Equipment	
Level D:	Safety Toe/Shank Work Boots, Safety Glasses, Flame Resistant Coveralls (as needed), Work Gloves (as needed), Hard Hat, High-Vis Vest (as needed), Hearing Protection (as needed).
Level C:	Safety Toe/Shank Work Boots, Flame Resistant Coveralls (as needed), Full Face APR with Appropriate Cartridges, Appropriate Chemical Protective Gloves, Work Gloves (as needed), Hard Hat, High-Vis Vest (as needed), Hearing Protection (as needed).
Level B:	Safety Toe/Shank Boots, Flame Resistant Coveralls (as needed), SCBA, Work Gloves (as needed), Hard Hat, Hearing Protection (as needed)
Structural firefighting gear may be needed if crews need to work near the fire. Flame resistant coveralls cannot be used for structural firefighting activities. Continuous air monitoring must occur inside of heavy equipment to assure that the PPE level worn by the operator is appropriate. Enclosed cabs may have particulate filters; however, filters will not remove carbon monoxide or maintain the proper O ₂ concentration. During fires involving plastics and tires, a pyrolytic oil may be produced, avoid contact or upgrade to appropriate chemical protective clothing. Exposure to carcinogens should be as low as reasonably achievable. Implement engineering controls even if air monitoring indicates respiratory protection is not required.	
Decontamination	
Dry removal of PPE following standard contamination control techniques is typically appropriate. Wash hands and face with soap and water after exiting the contaminate reduction zone. Use a degreasing solution to decontaminate boots, tools and equipment. Launder coveralls, hi-vis vest, etc. to remove potential carcinogens -.	
Resources/References:	
<ol style="list-style-type: none"> Emergency Response and Removal Operations Job Hazard Analysis Emergency Response, Removal and Prevention Health and Safety Standard Operating Guidelines SOG#: T106 - Particulate Monitoring Guideline at Fires Emergency Response, Removal and Prevention PPE Selection Guides Emergency Response Air Monitoring Guidance Tables (EPA ERTG, 2012, Version 3) Hazard Evaluation Flow Chart for Unknowns (EPA ERTG, 2005, Version 6) NIOSH Pocket Guide to Chemical Hazards RAE Systems Technical Note TN-106 SCOTT Safety SureLife Cartridge Calculator MSA Emergency Response Application (Respirator Cartridge Calculator) 	