IICRC S700
Standard for Professional Fire and Smoke Damage Restoration

Important Definitions

Throughout this document, the terms “shall,” should,” and “recommend” are used to compare and contrast the different levels of importance attached to certain practices and procedures.

shall: when the term shall is used in this document, it means that the practice or procedure is mandatory due to natural law or regulatory requirement, including occupational, public health, and other relevant laws, rules, or regulations, and is, therefore, a component of the accepted “standard of care” to be followed.

should: when the term should is used in this document, it means that the practice or procedure is a component of the accepted “standard of care” to be followed, while not mandatory by regulatory requirements.

recommend(ed): when the term recommend(ed) is used in this document, it means that the practice or procedure is advised or suggested but is not a component of the accepted “standard of care” to be followed.

In addition, the terms “may” and “can” are also available to describe referenced practices or procedures, and are defined as follows:

may: when the term may is used in this document, it signifies permission expressed by the document, and means that a referenced practice or procedure is permissible within the limits of this document, but is not a component of the accepted “standard of care” to be followed.

can: when the term *can* is used in this document, it signifies an ability or possibility open to a user of the document, and it means that a referenced practice or procedure is possible or capable of application but is not a component of the accepted “standard of care” to be followed.

For the practical purposes of this document, it was deemed appropriate to highlight and distinguish the critical restoration methods and procedures from the less critical, by characterizing the former as the “standard of care.” The IICRC S700 consensus body interprets the “standard of care” to be practices that are common to reasonably prudent members of the trade who are recognized in the industry as qualified and competent. Notwithstanding the foregoing, this Standard is not intended to be either exhaustive or inclusive of all pertinent requirements, methods, or procedures that might be appropriate on a particular fire and smoke damage restoration project.

S700 Standard for Professional Fire and Smoke Damage Restoration

A Scope, Purpose, and Application

A1 Scope

This standard describes the principles, processes, and procedures for assessing the presence, intensity of impact and boundaries of fire residues and odors affecting a building, building systems (e.g., Heating, Ventilating and Air-Conditioning (HVAC)), and contents after a fire event. The fire event can occur within the building, an adjoining building(s), or building(s) in the vicinity impacted by an external or internal fire, other than wildfires. This standard also describes the practical principles, methods, and processes including equipment, tools, and materials, for the restoration cleaning and fire odor management of buildings and contents. This standard also addresses contractor qualifications, administrative requirements, procedures, development of the Restoration Work Plan (RWP), documentation of project-related events, and compliance with Authorities Having Jurisdiction (AHJ).

This standard does not comprehensively address:

- building demolition other than for Fire and Smoke Damage (FSD) assessment, mitigation, or as source removal procedure;
- reconstruction;
- issues occurring from certain situations such as wildfires, chemical fires, or industrial fires that pose environmental hazards;
- buildings (e.g., healthcare, laboratory facilities, clean rooms, life science facilities) with special requirements;
- occupants with special requirements (e.g., immunocompromised, respiratory diseases, heightened sensitivities, elderly, infants); and
  exposures impacting occupants.

This standard does not address all safety concerns associated with performing restoration work. Restorers should establish appropriate safety, health, and environmental practices to determine the applicability of regulations established by AHJ prior to the use of this standard.

Restorers should be aware of the potential for regulated hazardous materials to be present in buildings. When hazardous regulated materials are suspected to be present, restorers shall perform their work in a manner consistent with regulations established by the AHJ.

A2 Purpose

The purpose of this standard is to describe criteria for the restorer to conduct FSD assessment and the methodologies for the removal of fire residues and related odors from building surfaces, systems, and contents. The standard also addresses the improvement of the indoor built environment following a fire event. By understanding the characteristics of fire residues and their effects on materials, the restorer will be able to focus on damage directly caused by a unique fire event and create an accurate and effective RWP.

This Standard is not intended to be either exhaustive or inclusive of all pertinent requirements, methods, or procedures that might be appropriate on a particular FSD restoration project. Restorers should use professional judgment throughout each and every project. A project may have unique circumstances that require deviation from the Standard. Prior to deviation from the standard of care (i.e., “shall” or “should”) the restorer should document the circumstances that led to such a decision, notify the client and the MIPs, and in the absence of a timely objection, document the communication before proceeding.

A3 Application

This Standard is written for restorers involved in the fire and smoke damage restoration industry. This standard does not address all procedures or methodologies used in third-party evaluations. This standard is also intended for use by anyone seeking information on how restorers evaluate fire and smoke damage to building surfaces, systems, and contents and to understand work plan development, implementation, and execution to address the damage.

B. Definitions

Abrasive Blasting (Grit Blasting): The use of compressed air and/or water in conjunction with an abrasive medium to remove discolorations, scorching, charring or other fire residues.

Absorption: The process by which the molecules, atoms and ions enter into a bulk phase (liquid, solid, gas) of the material in which it is taken up.

Adhered Fire Residue: Fire residues that remain following light dry mechanical cleaning procedures such as; dusting (lamb's wool duster or treated cloth), contact vacuuming, cellular rubber sponging and air washing.

(Non)-Adhered Fire Residue: Loose fire residues that are removed by light dry mechanical cleaning procedures (e.g., dusting (lamb's wool duster or treated cloth), contact vacuuming, cellular rubber sponging and compressed air).

Adsorption: The adhesion of atoms, ions or molecules from a gas, liquid or dissolved solid to a surface.

Agglomerate: The tendency of smaller fire residue particles, particularly soot particles, to stick together to form clusters resulting in larger particles. This can occur when particles collide with one another by settling or at random.

Air Filtration Device (AFD): Sometimes referred to as an Air Scrubber. A machine manufactured in various capacities consisting of a housing, a fan, and a filter(s). This device creates an air stream by drawing ambient air into the housing, passing it through the filter and then discharging it. In addition to filtration, adsorbent media (e.g., carbon) or adsorbent filters are often used to remove fire residue odors and other gases.

Airside Surface: The internal surface of an HVAC system, associated ductwork, and components that air contacts while moving within the HVAC system. For the purposes of fire residue removal by the HVAC restoration contractor, ceiling return plenums are excluded from this definition.

Associative (Psychological) Odor: A learned association between an odor and the emotional context in which that odor was first encountered. For example, fire and smoke odor damage to buildings may create an unpleasant emotional response by the building occupant. Simply re-entering the building may elicit an associative response by the occupant whether the odor is present or not.

Authority Having Jurisdiction (AHJ): An entity that has the authority and responsibility for enforcing applicable federal, state, provincial, and local laws and regulations.

Bailee Insurance: A form of inland marine insurance coverage purchased to cover the bailee's legal liability for damage or loss to property belonging to others, while in the bailee's care and custody.

Board Up: The temporary installation of physical barriers on a building to secure roofs, windows, doors and other penetrations against intrusion or weather.

Ceiling Return Air Plenum: The space between a suspended ceiling and the structural surface above it when used as a passageway to return air back to the air handler in a HVAC system. Ceiling return plenums are not considered airside surfaces with regards to the HVAC system.

Char (Charred): Burned or made black by the application of heat.

Chase: A continuous recess or enclosure built into a wall to allow building systems installations (e.g., pipes, wiring, ducts).

Chloride (Fire Related): A corrosive compound of chlorine with another element or group. A salt of hydrochloric acid: Damaging to vulnerable materials (e.g., metals and electronic circuits).

Clean (Restoration): To remove residues or contaminants caused by a specific incident or damage, as distinguished from pre-existing or typical conditions.

Clean For Clean (Clean Only, Final Clean): A term used to describe the satisfactory cleaning of structural (building) surfaces (e.g., walls, ceilings, trim) as the final restoration process without the necessity of painting, in contrast to clean for paint.

Clean For Paint (Prepare For Paint): Removal of residues to a degree sufficient for the proper application of sealer, primer, paint or other coating. A condition that exists when cleaning a previously painted surface and cleaning alone does not meet a visually acceptable result and painting is a required step. The application of a primer or sealer may be a required step prior to painting.

Client: a person or entity who engages the professional advice or services of another.

Combustion: An exothermic reaction in which substances mix with oxygen in the air to produce heat and light (burning).

Composite Materials: Material that is composed two or more constituent materials with dissimilar physical characteristics (combined) merged to create a material with properties unlike the individual elements. (e.g., reinforced concrete, plywood, fiberglass).

Containment: Engineering controls used to minimize cross-contamination from affected to unaffected areas by airborne contaminants, foot traffic, or material handling. Containment systems normally consist of 6-mil polyethylene sheeting, often in combination with air pressure differentials, to prevent cross-contamination.

Contents: The personal property contained in a building or on the client's property, as distinguished from real property, or the building itself.

Corrosion: The deterioration of metal or other material by chemical or electrochemical reaction, acid-induced oxidation resulting in a loss of surface or structural integrity.

Deodorizer: An odor management process, procedure, product, equipment, or material used to mitigate a specific odor. See Odor Management.

Dry, Or Cellular, Sponge: A cellular rubber cleaning material which when drawn across a substrate will remove non-adhered soils by dislodging and retaining soil particles within the matrix of the rubber. These sponges are commonly used in the fire restoration industry for removal of dry, loose fire residues on porous and semi porous building surfaces. Sometimes referred to as a "chem sponge" these sponges contain no active chemicals.

Dry Smoke Residues: Fire residues characterized by dry, loose, non-smeary particles which tend to settle on horizontal surfaces. Dry smoke residue reflects an oxygen rich fire with cellulosic materials as a primary fuel.

Duct Board: Rigid board composed of insulation material with one or both sides faced with a finishing material. (ASHRAE)

Duct Liner: Insulation, usually fiberglass, applied to the inside of metal ducts. It is used for both thermal retention and sound attenuation. (ASHRAE)

Dust (Common): Common dust consists primarily of epithelial (skin) cells, hair (human and animal), textile fibers, insect fragments, wood fibers, crystalline particles (e.g., gypsum), insulation and microbial

fragments. Common dust may also include incomplete combustion residues e.g., candle burning, fireplace use, smoking (vaping), vehicle emissions, etc. Fire residues from specific single events are not included in this definition.

Dust (Site Specific): In addition to the elements found in common dust, particles that deposit and accumulate on surfaces may be present as a result of site-specific production methods (e.g., laundry/dry cleaning plants, wood working).

Engineering Controls: Any process, procedure or equipment that is utilized to reduce or eliminate cross-contamination or exposure in the work environment.

Filtration Soil: A normal condition which appears as dark streaks on carpeting or insulation in the path of continuing air flow. The affected materials filter out airborne particles which accumulate over time.

Fire: The rapid oxidation of a material; an exothermic chemical combustion process, releasing heat, light and various reaction products.

Fire And Smoke Damage (FSD): An alteration from a pre-event state that results in the loss of appearance, utility, or value because of the impact of heat from fire, fire residues and related odors on building surfaces, materials and items. FSD may also include Incidental damage (e.g., fire suppression activity, ventilation, searching for fire spread)

Fire And Smoke Damage (FSD) Assessment: The inspection, investigation and evaluation of the nature and extent of the impact on a building and its contents, when applicable, following a fire or smoke event. A determination of which surfaces, materials, and items (building and contents) can be restored and of those that cannot be restored following a fire or smoke event.

Fire Residue: A soiling, odorous and potentially damaging substance transported as a component of smoke which deposits on or adheres to surfaces in its path of movement.

Fire Restoration Contractor: A business that assesses and provides property repair after a fire or smoke event. Common services include but are not limited to; emergency response, fire residue and smoke odor removal from the property. May also provide mitigation (see definition) services, limited deconstruction, surface modification such as the application of chemical barriers (sealers) and other specialized cleaning and restoration techniques.

Fire Restoration General Contractor: In addition to the services provided by the Fire Restoration Contractor (see definition), services may include: temporary repairs (e.g. tarping, shoring), demolition, re-establishment of utility services, removal and replacement of non-restorable materials and systems. May also serve to coordinate and oversee subcontracted trades as necessary.

Fogging: a process by which an application device aerosolizes liquids into very small droplets which are projected and suspended into the air (targeted area). Fogging devices with variable flow rates produce larger size droplets at higher flowrates and smaller droplets at lower flowrates.

Heat Damage: Changes in the appearance or utility of a material or building system. These changes may be in the form of permanent discoloration, melting, blistering, distortion, deflection, delamination (destruction of adhesives), destruction of protective finishes, scorching, charring, crumbling, spalling, cracking, fracturing, and shattering. Heat damaged materials are generally considered non-restorable.

Heat Line: The visible demarcation on vertical surfaces (walls) where greater heat damage is found above the line, and lesser damage is found below the line.

Heightened Awareness: A tendency, after a fire or other traumatic incident, to experience one's surroundings with greater scrutiny, often mistaking pre-existing conditions for new damage.

HEPA Filter: Abbr. for High Efficiency Particulate Air (or Arresting) filter, one capable of entrapping at least 99.97% of airborne particles 0.3 microns in diameter.

HEPA Vacuum: a vacuum cleaner which has been designed with a High Efficiency Particulate Air (HEPA) filter as the last filtration stage. A HEPA filter is a filter that is capable of capturing particulates of 0.3 microns with 99.97% efficiency. The vacuum cleaner must be designed so that all the air drawn into the machine is expelled through the HEPA filter with none of the air leaking past it before being exhausted out of the machine.

Hidden Damage: Damage which may not be initially visible or detectable (odor) that is revealed or discovered during more exhaustive investigation, demolition, or re-construction.

HVAC Assessor: A person with specialized training and experience in the assessment of the impact of fire residues on an HVAC system's airside surfaces. This person will also be certified by a nationally or jurisdictionally recognized organization and meet any applicable governmental regulations.

HVAC Damp Wiping Method: A method used to wipe an HVAC airside surface component using a slightly dampened cloth with water and a fragrance-free detergent.

HVAC Dry Cleaning Method: Any cleaning process that passes the NADCA ACR Standard Surface Comparison Test but does not require moisture or liquids.

HVAC Restoration Cleaning: The process that removes fire residues and odors using methodologies specified by the HVAC assessor. The NADCA ACR Standard provides the baseline cleaning procedure. Supplemental procedures for the further removal of certain fire residues such as damp wiping, washing or more aggressive removal processes may be required to achieve acceptable results.

Incidental Damage: In addition to direct damage from fire (heat) or fire residues other damage can occur, primarily from fire suppression efforts of fire fighters (e.g., water, creating openings in the building for ventilation, searching for fire spread (extensions).

Indoor Environmental Conditions (IEC): The environmental conditions inside a building.

Ingestion: the process of taking food, drink, or another substance into the body by swallowing or absorbing it.

Investigative Demolition: The opening of cavities or removal of building components required in order to perform an inspection.

Latent Damage: Damage not yet apparent but which may occur at a subsequent time (e.g., inherent fragility, brittleness or instability).

Light Clean: To remove loose residues from a surface using primarily light dry mechanical cleaning methods. May require the use of wet cleaning methods on horizontal surfaces (e.g., flooring, countertops, bathroom fixtures, glass).

Line Item: Work shown as an individual unit of measure entry in a work specification or estimate.

Like Kind and Quality (LKQ): Equivalent in type, function, and value, but not identical, to another item.

Loss: See Fire and Smoke Damage

Materially Interested Parties: an individual or entity substantially or directly affected by, or may influence the outcome of, a fire and smoke restoration project.

Mitigation: Actions and procedures to lessen the severity of damage and to prevent additional damage (e.g., spread of contaminants) as well as secondary damage (e.g., unaddressed moisture laden materials which may begin to support microbial growth).

Negative Air Device (Negative Air Machine): A fan, blower or AFD which creates a condition of negative pressure in an enclosed space, by exhausting air to the outside of that space.

Neutralize: To render something ineffective or harmless by applying an opposite force or effect. To render a substance or its qualities inactive.

Odor: An olfactory sensation experienced by individuals, often assumed to have an unpleasant connotation.

Odor Counteractant: Any substance which mitigates a particular odor.

Odor Management: The application of processes, procedures, equipment, and materials used to make a specific odor imperceptible or undetectable olfactorily to persons of normal sensitivity.

Oxidize (Oxidation): A chemical reaction in which a substance combines or reacts with oxygen to form a different substance.

Ozone: A variant of oxygen which contains an extra oxygen atom, rendering the molecule unstable and highly reactive. In fire and smoke restoration, a powerful gaseous oxidizing agent generated on-site and used in odor management.

Pack Back: The return or delivery of the pack out contents which may include assembly, placement, and unpacking. See Pack Out.

Pack In (Pack Within): The packing and transport of a quantity of personal property (contents) to unaffected or already cleaned areas within the building, or on-site storage containers for the purpose of enabling restoration/repair work to commence without encumbrance. Typically, does not require inventory or processing (cleaning and deodorization) of the personal property.

Pack Out: The inventory, packing and transport of a quantity of personal property to an alternative location (e.g., restoration facility) for purposes of processing (cleaning and deodorization) and climate-controlled storage until such time the property can be returned to the owner.

Particulate Matter: Atmospheric soils, such as dust both common and site-specific (see definitions), that settle and accumulate, in particular, on horizontal surfaces. Fire residues from specific single events are not included in this definition.

Penetration: (1) Any opening in a wall, ceiling, floor or framing e.g., windows, doors, skylights, plumbing, utility chases and runs or lighting. (2) A substance that has been absorbed by another material.

Personal Property: Furnishings and other movable possessions not attached as a part of a building.

Personal Protective Equipment (PPE): Garments and equipment worn by individuals working in toxic or hazardous environments. PPE may include impermeable coveralls, gloves, boots, respirators, hoods, goggles, and other equipment appropriate for the particular hazard and work situation.

Plastic Fire: A fire involving plastic polymers as a primary fuel, producing a strong distinct odor. Residues are generally black in color, smear easily and can form smoke webs (see definition). Note: Burnt PVC plastic residue is known to be highly corrosive (see Chloride).

Poly, Polyethylene Film: A light weight thermoplastic polymer suitable for use as a containment barrier and vapor barrier.

Popcorn (Textured, Blown Acoustic) Ceiling: A type of acoustic treatment applied by a spray process. Primarily used for acoustical characteristics, the texture also hides imperfections in drywall installation.

Porous: A surface or material with numerous small openings that allow the penetration of foreign liquids, vapors, or solids.

Pre-Loss/Pre-Existing Condition: The appearance and state which existed prior to the loss.

Pressurized Smoke Residue: Rapidly expanding gases and fire residues (smoke) driven by heat and pressure through penetrations into adjacent spaces. Often observed as visible staining in the form of streaks emerging from behind baseboards, other interior trim, electrical outlets, switches, etc.

Profit: The difference between the amount earned and the amount spent in buying, operating, or producing something.

Protein Fire: The slow combustion or carbonization of a protein (e.g., meat, fish, or fowl) which produces a nearly invisible greasy residue which generates a highly pungent and rancid odor on the surfaces it is deposited on.

Puff Back: An uncontrolled explosion in a heating system which dislodges, and broadcasts accumulated soot throughout the building.

PVC: Abbr. for Polyvinyl Chloride, a polymer commonly used in many building materials (e.g., plumbing pipe, electrical conduit doors and windows) and many household products (e.g., toys, furniture, water bottles).

Restorable: When the appearance and utility of fire/smoke impacted building surfaces, materials and systems can be returned to pre-loss condition by residue removal, odor removal, refinishing or repair; when economically feasible.

(Non) Restorable: The integrity, appearance and odor of a surface or material is permanently altered and cannot be returned to pre-loss condition by any means.

Restorative Cleaning: The application of procedures designed to remove damaging residues and odors from a particular surface while retaining as much of the original character as possible, often requiring the use of specialized techniques and equipment.

Restoration Work Plan (RWP) : A description of the work to be performed on a specific site to remedy a specific condition based on direct inspection and assessment of the damage. The RWP is a component of the Scope of Work.

Restore: To return to pre-loss condition by the removal of damaging residues or odor; to remedy damage or distress while preserving the original components, appearance, and utility to the fullest possible degree.

Restorer: A person with specialized knowledge, techniques, and equipment of how to remove fire residues and associated odors from buildings and affected surfaces.

Salvor: In restoration, the purchase from the insurer and resale to others by a person or firm of goods that have been declared a loss and to which the policy holder has been compensated for by insurance funds rendering those objects the rightful property of the insurance provider.

Secondary Damage: Damage resulting from the presence of unaddressed conditions that require mitigation usually involving water or water vapor (e.g., saturated materials, excessive humidity)

Scope, Scope of Repair: The enumeration of tasks required to restore or repair a property to pre loss condition. The Scope of Repair is a component of the Scope of Work.

Scope Of Work: The entirety of a restoration project.

Sealers: An odor management product that can also be used as a primer to cover discoloration in the surface to which the sealer is applied. The purpose of a sealer in fire and smoke damage restoration is to cover heat and smoke discoloration, block the transmission of odors, block wood resin bleed through. Sealers may also serve as a primer or be a final treatment (e.g., unfinished wood framing). Type of sealer and performance will vary based on site conditions and applications.

Secondary Damage: Damage which arises out of primary damage, such as airborne moisture, mildew, corrosion, or fire odors.

Shellac: A resin coating originating in the secretions of insects, which are dissolved in alcohol or a similar solvent. White pigmented shellac is often used as a stain and odor sealer in fire restoration. Historically, white pigmented shellac sealer has proven effective in blocking the transmission of fire related odors on surfaces.

Smoke: The visible airborne solid, liquid, and gaseous products created and released as a result of incomplete combustion.

Smoke Damage: The damage to property impacted by fire residues resulting in the loss of use, appearance, value or change from pre-incident odor.

Smoke Residue: Combustion products which remain after the dissipation of smoke.

Smoke Stain: A permanent discoloration caused by the penetration of fire residues into a material or surface.

Smoke Webs: Fire residues which link together to form strands or chains as a function of their polarity. Commonly found after fires involving plastics.

Soot: Fine black colored particles composed principally of carbon, produced by the incomplete combustion of fuel. Individual soot particles may agglomerate to form larger particles, sometimes visible to the naked eye.

Source Removal: A process or procedure used to reduce or eliminate; suspended and settled fire residues or contaminants in buildings and on materials, surfaces and systems. Also, the removal of any burnt, or otherwise, permanently damaged, non-restorable building components and contents.

Specialized Expert: A person or firm that performs functions beyond the knowledge base and core skill set of the restorer or restoration company.

Spoliation (Of Evidence): the act of negligently destroying evidence that is indicated in the cause of the damage (e.g., problems with recently performed services, product failure)

Subrogation: The act of taking on the legal rights of another, such as when an insurance company pays a claim and assumes the rights of the policyholder to seek reimbursement from the party who caused the harm.

Supplemental Estimate: A list of charges for additional work not covered in the original estimate.

Surface Sampling Test: A process used to determine the presence or absence of fire residues or odors.

Temporary Repairs: Emergency work performed after property damage occurs in order to secure and protect the property and/or mitigate the damage (e.g., roof tarping, board up, shoring, etc.).

Test Clean: To determine the extent of damage or the restorability of a material by applying various procedures and observing the result.

Thermal Fogging: A chemical application device that utilizes heat to convert liquid (e.g., odor counteractant) into a smoke-like mist of droplets.

Thermal Fogging: A process by which a chemical application device utilizes heat to convert liquid (e.g., odor counteractant) into very small droplets that are projected and suspended into the air (targeted space). Thermal fogging devices with variable flow rates produce larger size droplets at higher flowrates and smaller droplets at lower flowrates.

Thermal Shock: Dimensional changes (expansion and contraction) in materials induced by abrupt reversal of temperature. For example, cold water from fire suppression activity may destroy superheated masonry that could have survived a gradual cooling down phase.

Third Party Administrator (TPA): A fee-based business that provides property damage claims management services for insurance companies by qualifying service providers to participate in a managed repair program. Claims management generally includes enforcement of response time criteria and pricing guidelines.

Time And Material (i.e., Rate and Material): A method of calculating charges by recording the hours worked, labor rates, material costs, and subcontractor charges, to which are added markups for overhead expenses and profit.

Triage (Restoration Triage): A three-tiered evaluation protocol that prioritizes damaged materials, items, or surfaces in the order of need of corrective action. For example:

a) Those that require immediate attention
b) Those that require attention as soon as possible
c) Those that can be delayed but will require attention as soon as reasonably practicable or feasible.

Unit Price: An amount shown in an estimate or contract as the price for a standard unit of measure of a particular material, service, or both.

Void: An empty space; not valid, canceled, revoked.

Volatile: Tending to evaporate quickly into the environment.

Volatile Organic Compound (VOC): VOCs are gases emitted from certain organic solids or liquids. VOCs include a variety of chemicals, some of which may have short and/or long-term health effects.

Wet Smoke: Airborne combustion products containing a high liquid component in the form of aerosols, usually generated by smoldering, oxygen-starved fires; fire residues which are tacky, penetrating and extremely malodorous.

Winterize: In the absence of normal heating, to provide protection against freeze damage by draining water lines and tanks, introducing anti-freeze into plumbing traps, and other measures required by a particular damage site.

Work Authorization: A document signed by a property owner or agent and delivered to a contractor, requesting that the contractor perform damage repairs and accepting responsibility for paying the contractor for the work.

Work Order: A written communication directing a contractor, subcontractor, or employee to perform certain work, often including a starting date or payment details.

Work Specification: A comprehensive listing of work to be performed, including quantities, material specifications and performance details; often appended as part of a contract.

Section 1: Fire and Smoke Damage (FSD) Restoration Contractor Qualifications

1.1 Introduction

Fire and Smoke Damage (FSD) restoration contractors should be proficient in the identification, evaluation, and restoration of fire and smoke-related structural and contents damage. Proficiency is obtained through specialized education, training, and field experience. In addition, the restoration contractor shall be appropriately licensed as required, comply with all health and safety regulations, and be appropriately insured as established by the Authorities Having Jurisdiction (AHJ).

FSD restoration contractors should be skilled in preparing an accurate and comprehensive Restoration Work Plan (RWP) to address all the necessary phases of the restoration project that may include but are not limited to:

- Fire and Smoke Damage (FSD) assessment;
- mitigation;
- source removal;
- Heating Ventilation and Air Conditioning (HVAC) systems; and
- fire and smoke odor management.

FSD restoration contractors should:

- conduct business in an ethical and professional manner;
- have specialized knowledge and expertise in effective treatments and techniques that specifically address fire and smoke damage;
- be accurate and impartial in evaluating the damage and its effects (e.g., heat, moisture, odor);
- limit any statement or recommendation to their field of expertise;
- determine which equipment, tools, materials will be needed to effectively complete the tasks outlined in the RWP, including any emergency services;
- consult with specialized experts on issues that are outside the restorer's areas of expertise or beyond the restorer's level of expertise; and
- create and maintain thorough supporting documentation and record keeping to respond to inquiries by Materially Interested Parties (MIPs).

1.2 Education and Training

Restoration contractors should have training, knowledge, and field experience in FSD assessment, improving indoor environmental conditions, source removal methods, and odor management. Restorers should acquire requisite restoration skills through field experience, industry technical training programs, or advanced certification programs. It is recommended that restorers be familiar with current and past construction methods, materials, and building assemblies.

Through levels of training, education, and hands-on experience, restorers develop levels of proficiency in fire and smoke damage restoration. The level of proficiency will determine the restorer's ability to produce successful restoration results at the various levels of fire severity. Restorers should be aware of the limits of their capabilities, as related to the complexities of the loss.

Ongoing field experience and training should be integral to the restorer's skill and knowledge development. Achieving satisfactory project results (i.e., the removal of fire-related residues and odors) will constitute a level of competence. As proficiency and field experience increases, so does the competency to handle more complex jobs. Although the effects of fire residues on building surfaces remain consistent, circumstances may vary, such as the building's type, configuration, purpose, and construction material.

Fire and smoke damage severity can be described by typical responses to the various modes of damage including, but not limited to:

- fire residue amount, distribution, and impact on building assemblies (e.g., walls, ceilings) and systems (e.g., HVAC);
- residue type and the resulting effectiveness of fire residue removal procedures;
- effects of heat and moisture;
- the possibility of the need for structural repairs;
- level of fire-related odor, and
- restorability and disposition of contents.

Descriptive examples of the level of fire and smoke damage severity can include, and are not limited to:

- **Light damage** – fire residues can generally be removed by cleaning alone and are confined to specific areas or may be more widespread. Building systems (e.g., HVAC) and assemblies (e.g., walls, ceilings) may be impacted. Painting or replacement may not be required. Smoke odors may range from undetectable to moderate. Contents may not require removal and may be restored in place. There will likely be few non-salvageable contents.

- **Moderate damage** – fire residues and odors are more intense or persistent with greater distribution and deposition. Building systems (e.g., HVAC) and assemblies (e.g., walls, ceilings) are likely impacted to levels that require cleaning. However, some surfaces may require cosmetic repair (e.g., painting, other forms of refinishing, or containment) or replacement. Fire odors may range from faint to strong. Contents may be able to be restored on-site, manipulated to other less damaged areas of the building if possible, or may require removal. There will likely be some non-salvageable contents (e.g., food, other consumables).

- **Heavy damage** – fire may have caused physical damage (e.g., burning, scorching, charring) to structural materials such as framing, millwork, and finishes near the fire source. There may be heavy deposits of fire residues over a wide area and involving building systems (e.g., HVAC) and assemblies (e.g., walls, ceilings) . Enclosed wall and ceiling cavities may be infiltrated by fire residues. Fire residues may require aggressive source removal (e.g., abrasion, media blasting) in localized areas. Fire odors are very strong, particularly those from smoldering, or oxygen-starved fires. Salvageable contents will likely need to be removed for offsite restoration and to allow for building restoration and repair. There will likely be some non-salvageable contents, in addition to those of moderate damage, textiles (e.g., bedding, upholstery, drapery).

- **Severe damage** – fire damage to major building elements such as floor or roof framing, HVAC, and other building systems and assemblies. These fires likely will have extensive water damage from fire suppression or plumbing failures due to high temperatures. Such damage often requires building stabilization and mitigation services (e.g., board-up, roof tarping, shoring). Very aggressive source removal may be required (e.g., demolition, abrasion, media blasting) in substantial portions of the building. In certain severe damage situations, the restorer should be aware that some materials may be damaged beyond restoration and repair, or the cost of restoration may exceed the cost of replacement. Fire odors are very strong and may be difficult to remove or persistent. Use of fixatives and sealers may be required for complete odor control. Salvageable contents may be limited and will require removal for restoration, and so that building repairs can be made. There will likely be a substantial amount of non-salvageable contents.

Potential for incidental damage (e.g., fire extinguisher residue, water from fire suppression, building damage by firefighting activities) exists on all levels of fire severity. Restorers should address incidental damage as part of the RWP, if any.

Refer to *Sections 3: Fire and Smoke damage Assessment, 6: Source Removal, 7: Heating, Ventilation, and Air-Conditioning (HVAC) and Air Conveyance Systems (ACS), 8: Fire and Smoke Odor Management, and 9: Contents Remediation* for additional information on levels of damage, restorative procedures, and contents manipulation procedures.

A successful restoration project is defined as the execution of the agreed scope, and successful implementation of the RWP devised to return the building and contents to the pre-loss condition by effective fire residue removal and odor management procedures. Not all fire and smoke-damaged materials can be fully restored to pre-loss condition. Materials and surfaces may be altered in their appearance but not necessarily in their utility. Porous and semi-porous building materials may sorb fire residues and odors to varying degrees or depths within the material. In these situations, the intended results change from complete removal to restoring a building material or surface for re-use. In order to accomplish this, these materials and surfaces may be prepared for re-use by some form of repair work (e.g., sealing, re-painting, re-finishing). Refer to *Sections 6: Source Removal and 8: Fire and Smoke Odor Management* for additional information.

Education and training on identification, FSD assessment, and removal techniques is available through internationally recognized certification and training bodies such as:

- Institute of Inspection, Cleaning and Restoration Certification (IICRC);
- Restoration Industry Association (RIA);
- Indoor Air Quality Association (IAQA), and
- American Council for Accredited Certification (ACAC).

It is recommended that the restoration contractor have a basic understanding of property insurance including, but not limited to, the following:

- type of coverage; (e.g., fire policy, renter's policy, policy limits, scheduled personal property)
- deductible amounts; (e.g., deductible may exceed costs of restoration)
- rights of subrogation; (e.g., inadvertent spoliation of evidence)
- terms of payment, (e.g., mortgagee, estate claims) and
- claims handling procedures (e.g., exclusions, scheduled personal property).

Restorers should not interpret insurance policies on the client's behalf.

1.3 Licensing and Regulatory Agencies

Restoration contractors shall comply with all licensing requirements set forth by the AHJ in the jurisdiction in which the services are provided. Failure to comply with these requirements may result in fines or other consequences.

1.4 Insurance

Restoration contractors shall comply with all insurance requirements established by the AHJ for each element of their operation. Restoration contractors should ensure that their sub-trades, if utilized, have appropriate insurance coverage as required.

Restoration contractors should seek the advice of an insurance professional who is familiar with their operations and can assist in developing an insurance program that may include, but is not limited to, the following:

- automobile insurance;
- property insurance;
- liability insurance;
- pollution insurance;
- errors and omissions (professional indemnity) insurance;
- workers compensation;
- surety bond insurance; and
- Bailee's insurance (contents).

1.5 Ethics

The restorer's FSD assessment and the associated costs of restoration services will influence the outcome of a project (i.e., insurance claim settlement). While doing this work, restorers should be truthful, impartial, and ethical at all times. Industry associations (e.g., IICRC, RIA) have written codes of ethics which restorers who perform fire and smoke damage restoration should adhere to. Restorers should not interpret insurance policies on the client's behalf.

1.6 Impartiality

Restorers should maintain impartiality in their professional opinions regarding fire and smoke damage and its effects. While doing this type of work, the restorer may be subject to conflicting pressures from the client, MIPs, and other outside forces. Restorers should not be unduly influenced or persuaded by others, unless engaged by the restorer (e.g., specialized expert), to alter their scope of repair or weaken their commitment to impartiality. Conflicts will arise when restorer impartiality is challenged. Restorers should decline projects when they suspect unethical or illegal practices may occur. Refer to *Section 11: Limitations, Complexities, Complications, and Conflicts* for additional information on disagreements between parties.

1.7 Pre-Existing Conditions

During an inspection, restorers may encounter building distress, construction defects, code deficiencies, and other pre-existing conditions which may be unrelated to the damage resulting from the subject loss. Since the restorer's evaluation may influence an insurance settlement, court award, or tax deduction, the restoration Scope of Work (SOW) should only address the damage resulting from the subject loss. Work or improvements not related to the fire damage should be clearly noted as such.

1.8 Professional Judgement

The restorers' opinions should be based on their own professional judgment, as discussed in *Section 1.1.1: Education and Training*. Damage repair is not always consistent with text-book remedies. Alternative procedures are often available for identical conditions. Topical or cosmetic treatments may involve lower costs than replacement yet may provide satisfactory results in some situations. However, the desire to provide a cost-effective repair should not sacrifice long-term performance.

1.9 Bias in Estimating

The restorer's description of the damage and its effects should be accurate and impartial. In the immediate aftermath of a fire, the perception of fire and smoke damage and its effects may be exaggerated by underqualified or unethical persons. A restorer minimizing the significance of fire and smoke damage can be equally harmful. Property owners may be influenced by opinions or technical terminology presented as facts, designed to obtain a contract or to increase the amount of a claim. Misrepresentation of facts can result in an allegation of fraud.

An understated description of damage may result in the property owner agreeing to an inadequate settlement or scope only to find that supplemental work will be required to adequately repair the damage. It is unethical for restoration contractors to underestimate the scope to obtain a contract. Understatements of damage sometimes arise from an incomplete inspection or a lack of knowledge and experience. While legitimate differences of opinion may arise over the significance of damage, the presence of damage should be a matter of demonstrable fact.

Restorers should avoid offering opinions unless they are relevant to the situation and factually accurate. Experience in a particular restoration discipline does not automatically confer expertise in other areas. Opinions relating to occupancy, health, insurance coverage, and other client concerns should be left to persons with specialized knowledge of those subjects.

1.10 Restoration Contractors vs. Non-Restoration Contractors

Distinctions exist between fire and smoke damage restoration and general building service trades, most importantly, the ability to recognize and respond to property damage specifically caused by the loss event. In new construction or remodeling projects, emphasis is often placed on building design rather than repairs, whereas restoration is focused on the intent to return the property to its pre-loss condition.

Four major factors differentiate general building contractors from specialized restoration contractors:

1. An understanding of the impact that various fire and smoke damage modalities can have on a building and contents.
2. The knowledge of specialized equipment, product application and treatments, required to accurately address the loss and remedy the resulting damage.
3. The ability to distinguish damage from a specific fire and/or smoke-related event from unrelated building or pre-existing conditions.
4. The understanding of the claim process and the presence of a third party (e.g., insurance company, public adjuster (PA) Third Party Administrator (TPA)).

Other parties who lack the knowledge and understanding of the behavior of fire and smoke are less likely to identify impacted surfaces while inadvertently overlooking relevant areas of impact. Attempts to remove fire residues by undertrained personnel could result in permanent damage to certain building surfaces that could otherwise have been successfully restored by more qualified restoration technicians. In addition, restoration contractors that provide emergency services, but do not understand the nuances of the property insurance process (e.g., cause and origin investigation, rights of subrogation), are more likely to unknowingly discard potential fire causing evidence.

Additionally, restoration contractors may receive requests to provide emergency services 24 hours a day, seven days a week, 365 days a year, and in some situations (e.g., certain commercial losses), perform their work continuously until objectives are met. Employees of these firms should be physically able and safely equipped to work in harsh environments (e.g., severe levels of smoke and odor contamination, structural failure (collapse), flooding from fire suppression, plumbing failures, the presence of mold) and other potentially unsafe and adverse conditions.

Section 2 Administrative Requirements and Documentation

2.1 Introduction

Restoration companies that are contracted to perform fire and smoke damage repair work should understand that following good business practice is essential when navigating these often-complex projects. For example, restorers should not undertake work, including emergency services, without the protection of a properly drawn service agreement (e.g., work authorization, fully executed contract). In addition, restorers should document any activity they perform that will generate costs that are expected to be paid to perform as well as administrative supporting costs that may be needed to respond to inquiries from parties responsible for payment.

Restorers should also know that in some situations they will be accountable to more than one individual (e.g., condominium associations, estates, corporations, insurers). These entities, other than the individual client are referred to as Materially Interested Parties (MIPs).

A listing of MIPs can include, but is not limited to:

- property owner (client);
- policy holder;
- insurance company;
- mortgage company;
- restoration contractor;
- property management companies;
- HOA/COA;
- tenants;
- tenant's insurance company;
- authorities having jurisdiction (AHJ) for environmental compliance and other regulations;
- Cause and Origin Investigators (C&O);
- Third Party Administrators (TPAs);
- Third Party Consultants (TPCs), and
- legal representative or a designated agent.

Fire and smoke damage restoration project administration typically includes, but is not limited to:

- use of written contracts;
- communication with MIPs;
- thorough project documentation and record keeping; and
- risk management (licensing and insurance).

2.2 Service Agreements (Work Authorizations and Contracts)

Restoration contractors should enter into a written agreement before performing emergency services and starting a restoration project. Restoration contractors should seek legal counsel for the development of their work authorizations and contracts to form an enforceable agreement under the laws of the applicable jurisdiction.

Emergency work is often performed on a rate and materials basis using a signed work authorization. Non-emergency (e.g., full restoration) projects, where the restoration contractor will have provided the client with a written and priced work plan, should require a signed work contract. The pricing method by which emergency work is performed, or the full price for the work, should be documented within the type of work authorization or contract proposed.

Examples of pricing methods used in fire restoration include, but are not limited to:

- rate and material - R&M (or Time and Material - T&M);

- unit cost;
- lump sum, and
- hybrid (e.g., combination of any of the above).

2.2.1 Services and Pricing Agreements - Emergency

Restoration contractors who perform emergency services should have an enforceable written agreement known as an emergency work authorization prior to the commencement of work. This agreement should be executed by the property owner or designated agent to authorize and agree to a limited scope of services. It is recommended the language in the authorization include but is not limited to the following:

- a clear explanation and understanding of the party responsible for payment;
- the intent of the work (e.g., mitigate damage, stabilization services, temporary weatherproofing, prevent unauthorized intrusion, restore utility services);
- permission to enter the property, and to proceed with the intended work;
- terms of payment, price of the job, costing method rate schedule, if applicable; and
- remedies for unpaid charges and associated legal fees.

2.2.2 Work Contracts

Non-emergency work should be performed with a fully executed contract between the contractor and the client, or their agent. Projects vary in size and scope and can have unique issues and complications. What constitutes an adequate written contract for any given project or jurisdiction is beyond the scope of this Standard. It is recommended that restoration contractors consult legal counsel to develop contracts. Work contracts may include, but are not limited to the following:

- a clear identification of, and contact information for, the contracting parties;
- a description of the work to be performed, which can include reference to attached project specifications or other documents that specify the details of the work (i.e., scope of work);
- any known limitations, exclusions, assumptions, complexities, or potential complications of the project;
- the party responsible for obtaining permits required for the work, if applicable;
- the project start date and projected time frame for completion of the work;
- the price being charged for the work, and if applicable, costing methods;
- the terms and schedule for payment;
- change orders or variations to the contract considerations;
- warranties and disclaimer provisions, if any;
- exclusion of liability clause for consequential damage;
- the terms upon which the contract may be terminated;
- a force majeure clause;
- a dispute resolution clause, and
- assignment of benefits, if applicable.

When a written contract is executed, it is recommended that each page of the contract be initialed by all parties to the contract. The contract should be dated and signed by all parties to the contract, and each party should be given a copy of the contract as soon as reasonably practical.

By memorializing the understanding of the parties at the beginning of a project, written contracts reduce the potential for dispute, disagreement, or conflict during performance of the proposed work. Contracts should be accurate, complete, and free of ambiguity.

2.2.3 Changes to Contracts

Substantive or material changes from the original contract should be documented in a written and detailed change order, which includes a description of the changes to the work, time for performance, price or fees, and method of payment. It is recommended that the client, or the client's designated agent, and the

restoration contractor accept the change order in writing. Change orders represent additions to or deletions of work specified in the original contract.

Changes to contracts may result from undiscovered conditions such as hidden or latent damage, conditions, or circumstances previously unseen or unknown. Discovery can occur at any time during the inspection and most frequently occurs during the demolition or deconstruction phase of work. Refer to *Section 2.4.3 The Restoration Work Plan (RWP)* for additional information.

2.3 Communication

Communication between all MIPs is paramount in fire restoration projects. It is recommended that MIPs agree on the purpose and subjects of project communication, the frequency and mode of communication, and with whom communications will be distributed. It is recommended that any Limitations, Complexities, Complications, and Conflicts (LCCC) that could affect the project be discussed verbally and then memorialized in writing and distributed to the appropriate MIPs.

Restoration contractors should not give advice, education, or warnings on subjects outside their areas of professional expertise.

2.3.1 Confidentiality Disclosure Agreement (CDA) or Non-Disclosure Agreement (NDA)

Restoration contractors should maintain the confidentiality of their client's affairs. The ownership and management of the restoration company performing the work should ensure that this principle is understood and respected by all personnel involved in the project.

If the client requests specific documentation to support this principle, restoration contractors should seek legal advice prior to signing any CDA or NDA.

2.4 Documentation

It is recommended that restorers perform thorough and detailed documentation on fire and smoke damage losses. Cursory documentation can be insufficient to support inquiries from MIPs. Simply stated, restorers cannot perform too much documentation, particularly photographic. The remaining writing in this section are examples of the various forms of documentation restorers can perform on projects.

2.4.1 Inspection and FSD Assessment

The restorer should understand that on certain emergency work, the window of opportunity for inspection and FSD assessment may be limited or restricted. Restorers should memorialize verbal instructions in writing on the services that need to be performed on an emergency basis, and generally describe and define them in the emergency service agreement, as soon as practical.

All projects should be inspected and assessed to the extent possible before any work is performed. This inspection will allow the restorer to document the procedures required to address the damage, the resources to be used, the schedule in which such procedures and resources are to be applied, and the methods and means by which the restoration will be determined to be successful.

2.4.2 Estimating Documentation

Relevant data should be obtained to the extent it will enable the restorer to calculate the cost of services, regardless of the pricing method (e.g., rate and materials, unit cost, lump sum). The estimate should include a description of the tasks to be performed on a specific site to address specific conditions identified during direct inspections and evaluation of the damage.

The data the restorer collects should reflect the nature of the work based on the pricing method. For example, rate and materials pricing will require an estimated quantity of material to be used and a duration

of time the project will take. Unit cost pricing will require site-specific details (e.g., accurate measurements of areas, listings of per item tasks, inventory of contents). Lump sum pricing may include bids from subcontractors.

2.4.3 The Restoration Work Plan (RWP)

It is recommended that restorers prepare a description of how the project will be performed following the FSD assessment The FSD assessment will determine the boundaries and levels of fire, smoke, and odor impact. It is recommended that documentation of the RWP include but is not limited to:

- forecasting, obtaining, and managing resources;
- establishing and maintaining engineering controls;
- a plan for communication with the client and MIPs;
- a written description of the work that corresponds to the phase of the project;
- a schedule, or sequencing, of the order in which the services are provided;
- a plan outlining the order in which areas/levels of the building will be addressed;
- a plan for the disposition of contents, if applicable;
- a schedule of progress inspections (e.g., visual, odor); and
- sign-offs for work completed based on pre-established acceptance criteria.

The purpose of the RWP is to guide the restorer through to the completion of the objectives outlined in the scope of work portion of the contract/service agreement.

2.5 Project Support Documentation

It is recommended that restorers document all phases of the restoration project. Documentation methods can include; written descriptions, detailed photographs (when applicable), and samples of testing results (e.g., surface wipes, patch testing, representative building component or content item). Various phases of the restoration project include but are not limited to:

- initial FSD assessment;
- emergency response;
- thorough FSD assessment – full restoration;
- information gathering;
- appearance testing; and
- odor testing.

The extent of project documentation and recordkeeping varies with each restoration project. Restoration contractors should record information relevant to the project over the duration of the project to protect their interests in addition to the interests of the client and other MIPs.

Thorough supporting project documentation and recordkeeping are important to the development of a fire damage RWP and the execution and completion of a successful restoration project. This information is also important if there is a need to review or reconstruct the restoration process or project at some time after completion. To properly develop and document a fire restoration project, it is recommended that the restorer attempt to obtain pertinent project information developed before, during, and after the involvement of the restorer in the project. It is also recommended that the restorer document all communications to reduce the potential for misunderstanding and miscommunication.

2.5.1 Initial FSD Assessment Documentation

Damaged buildings shall be evaluated for safe access prior to the commencement of work. Refer to section *5.2 Pre-Mitigation Considerations* for additional information. Any areas deemed unsafe to access that have been cordoned off with signage and caution tape should be documented. The restoration contractor or emergency response manager should perform an initial FSD assessment to determine which emergency

services are required as soon as possible and the order in which they are to be performed. This initial FSD assessment and list of procedures should be memorialized in the emergency phase of the RWP.

It is recommended that field notes and photographs should be taken at the time the services are provided to have a record of the work that was performed.

2.5.2 Information Gathering

It is recommended that relevant information regarding the fire event be obtained and documented by the restoration contractor including but not limited to:

- names and contact information of all MIPs;
- information regarding the property, building type, age, usage, drawings, and plans, if available;
- information about the nature of the fire or smoke event;
- need for and type of mitigation;
- condition of utilities (e.g., functional electricity, water, gas); and
- important information regarding contents, particularly items of high value.

Subjective opinions of damage (e.g., observed changes in surface appearance, detection of smoke odors) described by others should be documented in a factual and impartial manner and considered for inclusion in the development of the RWP.

2.5.3 Pre-Work Photographic Documentation

Photographs should be taken to document building damage including damage from the fire or smoke event as well as obvious unrelated pre-existing conditions of disrepair and damage, when possible. The window of opportunity for this type of documentation may be limited and therefore should be prioritized. It is recommended that restorers include photos of the exterior of the building as well as overall pictures of areas with potential damage prior to the commencement of work.

2.5.3.1 Specialized Photographic Documentation

It is recommended that restoration contractors familiarize themselves with the resources that are available to photograph building damages. Advancements in emerging technologies allow restorers to document the damage using smartphones, infrared, and 3D cameras. Drones may be utilized to provide aerial photographs.

Many of these technologies allow the restorer to provide 360-degree digital views and in some instances may be used to complete or aid in the completion of sketch drawings and measurements.

2.5.4 Emergency Services Documentation

It is recommended that restoration contractors document information about the loss and conditions of the building prior to providing emergency response services. It is recommended that a qualified representative (e.g., a specifically trained field technician or manager) from the restoration company inspect the building to identify and document areas of involvement and priorities for mitigation and building stabilization. Refer to *Section 5: Fire Restoration Mitigation* for additional information.

2.5.5 Full Restoration FSD Assessment Documentation for the RWP

Following any emergency work, if required, the restoration contractor should proceed with the development of full restoration RWP. The restoration contractor should begin to gather and maintain information; field observations, surface evaluations, recommendations from specialized experts (e.g., HVAC), reports from experts, photographs, building drawings/plans, etc. to prepare the RWP.

2.5.5.1 Documenting Damage as Part of the Full Restoration FSD Assessment

Specialized experts should be retained to test for regulated hazardous materials as governed by the AHJ. Restoration contractors should document the necessary observations and surface tests performed during the FSD assessment to determine the presence of fire residues on buildings and contents. All documented relevant information obtained by the restoration contractor during the performance of the observations and surface tests should be utilized in the preparation of the RWP. This documented information should also be retained by the restoration contractor and be used to support the RWP. The results of these observations and testing will assist the restorer in determining the following:

- boundaries of impact (e.g., affected, and unaffected areas);
- intensity of impact;
- disposition of contents; and
- degree of restorability.

2.5.5.2 Documentation of Surface Testing of Fire Residues

The results from surface testing should be photo-documented to include both the target surface as well as the wipe. The restorer should also identify the type of surface tested and the location within the building where the test was performed. Refer to *Section 3.10 In Situ Surface Testing* for additional information regarding surface testing for fire residues.

2.5.5.2.1 Photographs of Fire Residues

As stated above, not all fire residues are readily visible. This makes photographic documentation difficult. However, some forms of residue deposits are easily observed. It is recommended that photo documentation of the following be kept as part of the record-keeping:

- residue fall out on horizontal surfaces;
- initial wipe test results;
- surface test cleaning results;
- selective attraction (e.g., “smoke webs”, “nail pops”);
- thermal bridging (thermophoresis);
- ghosting (electrophoresis); and
- filtration stains.

2.5.5.3 Documentation Related to Odor Testing for Fire Residues

In the event that testing specimens are taken they should be retained in such a manner so the condition of the specimen is not compromised (e.g., a sealable airtight container). The specimen should be further identified by the type of surface or material tested, and the location within the building where the test was performed. This documentation should be clearly written on the outside of the container holding the specimen, signed, and dated by the person taking the specimen. Refer to *Section 3: Fire and Smoke Damage (FSD) Assessment subsections 3.10 In Situ Surface Testing and 3.14 Smoke Odor Testing* for additional information on fire-related odor testing.

2.6 Third Party Sampling/Laboratory Analysis and Other Third Parties

In the event of a dispute regarding the presence or absence of fire residues related to a specific event(s), MIPs may consider using the services of a qualified third party to perform sampling to be independently interpreted by a qualified and accredited laboratory. A Chain of Custody (CoC) should be recorded to document the custody of the sample(s) for the entire process.

Reports made available by third parties may be considered by the restoration contractor in the development of the RWP.

2.7 Other Reports and Documentation

It is recommended that the restoration contractor be aware of and adjust to project documentation requests and requirements from MIPs. Restorers should be prepared to provide documentation to support the contracted tasks outlined in the RWP (e.g., rate and material labor logs, and equipment usage logs). Restorers should inform MIPs that charges may be incurred for administrative time spent that is not related to the execution and completion of the RWP (e.g., detailed inventories of non-salvageable contents, photos of packed boxes confirming the box was packed to capacity, detailed floor diagrams on losses that involve only contents).

2.7.1 Required Documentation

The documents and records obtained and maintained by the restoration contractor shall include documents required by the AHJ. In some cases, permits may need to be obtained to restore utilities disabled as a result of the fire or during firefighting.

2.7.2 Documentation Restorers Should Retain

Records and documents shall be retained for a period of time following the completion of the project as dictated by the AHJ.

The documents and records retained by the restorer should include the following, but is not limited to:

- safety related documentation;
- surface testing samples taken by the restoration contractor;
- periodic progress documentation for the duration of the project;
- project related reports made available to the restoration contractor;
- written fire damage restoration recommendations and technical specifications, if any, from specialized experts, inspectors and others acting in the capacity of consultants;
- contracts, change orders, deviations from this standard, payment schedules;
- detailed work or activity logs, including descriptions of what and when services were performed, who performed the work or activities;
- estimates, invoices and payment receipts;
- subcontractor estimates, invoices, and payment receipts; and
- lien notices and lien releases, if any.

Work performed on a rate and materials basis (e.g., emergency work, pack outs), should be thoroughly and accurately documented to support invoicing. Restoration contractors should keep separate records for labor (i.e., time), subcontractor documentation, materials, Personal Protective Equipment (PPE), consumables, and equipment used on projects. It is recommended that restorers assign field project documentation responsibilities to specific, potentially dedicated people depending on the size and complexity of the project to ensure the accuracy of the documentation. This person(s) should also sign off on any record-keeping documentation upon completion and retainage.

Restoration contractors should record the time of employees and others while actively working on the project. Projects invoiced on a rate and material basis will require such information. Time records may include, but are not limited to:

- worker name and company identification information;
- date of service;
- job title or duties;
- mobilization;
- time in and time out for a specific task;
- description for the task being performed;
- total time worked;
- verification of time by a supervisor, clerk or record keeper; and

- the signature of the worker.

The specific method of tracking, recording, and reporting time records is beyond the scope of this document. It is recommended that the restoration contractor consult with qualified legal or accounting professionals on this issue.

2.7.3 Mobilization and Logistics

When the deployment of personnel is required, restorers should maintain records of job-related costs that do not include time spent physically working on the project. These costs include but are not limited to:

- travel;
- per diem;
- lodging;
- security;
- laundry; and
- communications.

2.7.4 Equipment, Material, PPE, and Consumables Usage Documentation

A list of equipment, materials, and consumables used on a specific job should be created and maintained. Projects invoiced on a time and material basis require such information. Equipment usage logs should be used to record, track and report on the individual pieces of equipment used on a project.

An equipment log can include, but is not limited to:

- the function, capacity, and type of equipment;
- the make, model, and identification number for the piece of equipment; and
- the date, time, and location of the piece of equipment was put into service and removed from service.

A materials log (e.g., PPE, consumables, supplies) can include, but is not limited to:

- product identity and function;
- the quantity and unit of measure of the material used;
- the date of usage;
- the locations of the product usage on the project; and
- regulatory documents and orders (e.g., Safety Data Sheets (SDS)).

2.8 Documentation of Limitations, Deviations, and Disclaimers

The client may request or decline services that prevent the restoration contractor from complying with fire damage restoration work plans, or the requirements and recommendations of this Standard. In these situations, it is recommended the restoration contractor document any deviation from the workplan or this standard.

2.9 Risk Management

A risk is defined as an uncertain event or condition that, if it occurs, has a negative effect on a project's objectives. Risk is inherent on any project. Restoration contractors should assess risks continually throughout the course of a project and develop a risk management plan to address them. Some examples of risks include but are not limited to:

- safety (e.g., workers, occupants);
- legal liabilities (e.g., workmanship, property damage);
- financial (e.g., finance project and getting paid);

- natural causes/disasters (e.g., flooding, power outages); and
- hidden and unpredictable (unsafe building conditions, access to materials and labor).

Strategies to manage risk include, but are not limited to:

- avoidance (e.g., contract clauses);
- control, mitigate, modify, or reduce (e.g., contract work specifications);
- accept or retain (e.g., adjust levels of liability insurance to anticipate the potential risk); and
- transfer/share (e.g., insure).

Restoration contractors should seek advice from a risk management professional or refer to risk management resources for assistance in the development of a risk management plan. Refer to *Section 11: Limitations, Complexities, Complications, and Conflicts* for additional information.

Section 3 Fire and Smoke Damage (FSD) Assessment

Fire and smoke damage (FSD) assessment is the process of investigating, evaluating, and information gathering regarding the nature and extent of the impact on a building and its contents following a fire or smoke event. Every FSD assessment is unique and may require different approaches, methods, and strategies as required by the FSD assessment objectives.

The restorer performing the FSD assessment should have the training, knowledge, and field experience in the application of restoration methodologies to restore the appearance, utility, and value of a building and its contents following a fire or smoke event. The restorer should also have specialized experts to consult with regarding the restoration of specialty materials, surfaces, and items with which they are less familiar.

The FSD assessment provides the necessary information to create a comprehensive RWP. However, the restorer should understand and communicate to MIPs that additional work and supplemental charges may be required after the initial fire and smoke damage assessment. Additional (i.e., hidden) building damage is often discovered during the demolition phase. Additional contents restoration may be required when initial source removal or odor removal procedures are not effective.

3.1 Fire Categories and Residue Characteristics

The restorer performing the FSD assessment should be able to identify the following origin locations; fire types, associated combustion materials, and distinguishing characteristics as it relates to exposure:

- origin location:
  - internal fire (fire occurs in a building);
  - external fire - direct exposure or indirect exposure (e.g., adjacent properties, smoke drawn into the building by HVAC systems that utilize outdoor air, dumpster fires); and
  - adjoining fire (i.e., a fire occurs in an adjoining building with a party wall).
- fire/combustion particle types:
  - natural (e.g., wood, paper);
  - synthetic (e.g., plastic, rubber);
  - protein (e.g., meat, poultry); and
  - other (e.g., explosions incl. oil furnace malfunctions like puff back, rechargeable batteries).
- distinguishing fire/combustion particle residue visual and textural characteristics:
  - natural (e.g., grey to black, dry texture);
  - synthetic (e.g., black, smeary texture);
  - protein (e.g., translucent yellow to brown film, greasy and sticky texture);
  - furnace soot (e.g., large black, oily particle);
  - black Soot Deposition (e.g., extremely small, homogenous particle); and
  - other (e.g., white to dark powdery texture).
- odor characteristics:
  - natural (e.g., burning wood, smoky, campfire);
  - synthetic (e.g., melted plastic smell, burnt rubber);
  - protein (e.g., burnt meat, pungent);
  - furnace soot (e.g., fuel oil odor);
  - black soot deposition – no discernable odor; and
  - other (e.g., burnt chemical, metallic, acidic).

3.1.1 Distinguishing Dry Smoke from Wet Smoke

Restorers should understand that removal procedures for dry and wet smoke vary in the amount of difficulty (e.g., labor and materials) required to remove it. Dry smoke results from oxygen-rich fires that burn fuel more efficiently and completely. Drier, loose residue responds well to removal procedures. Wet smoke results from slower burning, oxygen-starved fires where combustion rates are poor. These residues

condense to form a solid layer or film over a substrate, particularly on horizontal surfaces, appearing as a stain.

Restorers should also understand that determining the extent of wet smoke damage within a building may require a substantial amount of strategic exploratory demolition (e.g., penetration into wall and ceiling cavities, cabinets, and soffits). Wet smoke residues bond to surfaces in varying degrees often requiring different, more aggressive restoration procedures to remove. Source removal protocols in the RWP should reflect this variance. Due to the nature of wet smoke residues, contents items may require cosmetic repair (e.g., refinishing, reupholstering) or replacement which should be noted in the RWP.

3.2 Determination of Building Use and Occupancy

Prior to FSD phase assessments, the restorer should determine the potential for building use and occupancy. Buildings impacted by fire and smoke events fall into the following general categories with regard to usage:

- occupiable;
- partially occupiable;
- unoccupiable;
- usable;
- partially usable; and
- unusable.

Depending on the circumstances and status of use and occupancy, different procedures and sequences of procedures may be required. This information shall be available to restorers in a manner consistent with AHJ.

Prior to any restoration activities, restorers should address conditions that can limit the work. This standard does not address all safety concerns associated with performing restoration work. Restorers should establish appropriate safety, health and environmental practices and determine the applicability of regulations established by AHJ prior to the use of this standard.

Restorers should be aware of the potential for regulated hazardous materials to be present in buildings. When hazardous materials are suspected to be present, restorers shall perform their work in a manner consistent with regulations established by the AHJ.

3.3 FSD Assessment Phases

It is recommended that fire restoration projects be organized into phases depending upon the need for emergency services. These phases can be stand-alone services or performed simultaneously. These phases may include, but are not limited to:

- emergency service phase:
  - preceded by site-specific hazard or risk assessment, if applicable;
  - determine pre-existing health issues of occupants, if any, and
  - plot an appropriate course of action (e.g., building stabilization and mitigation, initiate emergency odor management, contents mitigation).
- post-emergency response phase:
  - preceded by site-specific hazard or risk assessment, if applicable;
  - on-going safety briefing;
  - comprehensive FSD assessment (may require several visits, by different specialized experts);
  - development of RWP.
- ongoing progress phase:
  - verification of the execution of the RWP;
  - evaluation of the efficacy of the RWP;

- address previously unidentified damage.
- project completion phase:
  - final visual and odor inspections
- reconstruction phase:
  - coordination of restoration procedures with repairs
  - reconstruction is beyond the scope of this standard.

3.3.1 FSD Assessment Phase Response Goals

Prior to implementation of any of the above-listed phases, it is recommended the restorer approach each phase with specific goals in mind. The following are examples of varying goals depending on phases and needs that the restorer may consider:

- emergency mitigation response goals;
  - improving indoor environmental quality (e.g., engineering controls, ventilation, AFDs);
  - reduce smoke odors (e.g., odor management);
    - stabilization (e.g., board up, roof tarping, shoring, winterization, restoring utilities as soon as possible); *Refer to the latest edition of ANSI/S500 Section 12.3.5: Humidity Control in Contaminated Structures.*
  - mitigation of building and contents (e.g., containment, moisture displacement, corrosion prevention, speed drying wet materials due to primary water damage and mitigation of secondary damage);
  - evaluation and manipulation of contents (e.g., mitigate on site, pack in, pack out);
  - special handling and processing of wet contents (e.g., freeze drying books and documents); and
  - identification and processing of rush items (e.g., clothing, important papers, textbooks for school).
- restoration response goals – following emergency mitigation when required;
  - evaluate the building for potential use and occupancy;
  - evaluate contents for restorability and disposition (e.g., total loss, restore on site, pack out, pack in);
  - determine the overall boundaries of damage;
  - evaluate the restorability of surfaces, items, systems, and materials; and
  - develop an RWP that accurately and thoroughly addresses all damaged or potentially damaged surfaces, items, systems, and materials.
- ongoing progress goals;
  - verification that prescribed methodologies are effectively correcting the damage;
  - identification of supplemental work, if any; and
  - preparation of supplement.
- project completion phase goals.
  - satisfactory completion of the restoration phase of a project.

3.4 Information Gathering/Occupant Interviews

The restorer performing the FSD assessment should interview potential witnesses and other on-site personnel and document any relevant information regarding building history as well as verbal accounts of the event. Eyewitnesses, such as building occupants, can provide reliable information that may assist the restorer in making field observations as a supplement to the FSD assessment. Relevant information from other reliable sources (e.g., first responders, owners/managers) can also benefit the FSD assessment process.

Occupant health concerns or conditions can be an important part of the information gathering process and may be used to determine the need for additional engineering controls for occupant protection. Refer to *Section 2.4.3: The Restoration Work Plan (RWP*) for additional information on engineering controls.

3.5 Pre-Existing Conditions

The restorer should identify and document pre-existing conditions during the FSD assessment. All building surfaces and materials change with use and age. Property owners may attribute fire damage conditions that an experienced restorer recognizes as consequences of normal use. For example, fresh cracks in plaster, loss or damage to drywall paper, gouges, nicks, and scratches in finished wood, chipped, scratched or broken glass, etc. will generally be lighter in color than the surrounding soiled areas. After a fire or smoke event, pre-existing cracks and other surface defects will be uniform in color to surrounding areas.

Examples of other forms of pre-existing damage on buildings include, but are not limited to:

- excessive amounts of dust or site-specific soils;
- discolorations from tobacco use and recreational smoking;
- visible microbial growth in bathrooms and below grade basements;
- excessive wear (e.g., flooring, cabinets and drawers, doors, windows;
- wall-to-wall carpet conditions (e.g., visible wear, buckling, filtration soil, stains unrelated to the loss); and
- conditions of walls and ceilings (e.g., settlement cracks, rough or shoddy finishing).

Examples of pre-existing conditions on contents include, but are not limited to:

- wear and tear (e.g., scratches, gouges, dents, chipped, peeling, torn);
- prior breakage unrelated to the loss (e.g., missing pieces, loose joints, visible glue repair);
- corrosion of metals;
- loose rug conditions (e.g., thread barren, missing or damaged fringe, color loss)
- textile shrinkage (e.g., sofa skirts, cushions, draperies);
- unrelated damage (e.g., smoking related soiling, fading from UV exposure, insect, rodent);
- softening of wood finishes (e.g., often related to certain polishes); and
- effects of age (e.g., fragility, oxidation).

Restorers performing FSD assessments should also have the training and field experience to distinguish newly deposited fire residues from that of a pre-existing or ongoing condition. One indicator of smoke damage is the visible presence of fire-related residue in the source area and on the uppermost layer of dust or pre-existing soil elsewhere. When fire residue is suspected or is questionable, such as in areas remote from the fire source, the restorer may perform on-site testing to determine the presence of fire residues. Suspect specimens should be visually compared to specimens taken in known source areas. Refer to *Section 3.10 In Situ Surface Testing* for additional information on testing procedures.

The restorer should understand that surface testing may also detect pre-existing residues or dust. These residues may be distinguishable from fire residues. In some cases, fire residues of recent origin are more readily removed than older pre-existing soils. However, if fire residues are found in areas where pre-existing soils are present, the FSD assessor may be responsible for addressing a complete cleaning of any space within their RWP unless otherwise excluded. For example, when source removal procedures are used to remove fire residues, underlying pre-existing and unrelated residues (soils) may also be removed.

3.6 Site Characterization

Damage from fire and the restoration practices to repair the damage is site-specific. Construction materials and methods vary between commercial and residential construction. As an example, building air conveyance (i.e., HVAC) systems that distribute, heat**,** cool or filter air also vary widely. The assessor should have sufficient knowledge of, or utilize the services of specialized experts in various types of construction, materials used, and air movement pathways within the building, in order to thoroughly and accurately determine fire residue contamination.

Buildings can be categorized in various ways, including but not limited to the following types:

- residential;

- complex residential;
- commercial;
- industrial; and
- institutional.

Building types also vary by physical characteristics and use. Assessors should be aware of all relevant information and conditions that may affect the restoration process.

All these building types can be subclassified by variables including but not limited to:

- building size (e.g., number of floors or stories, interior spaces);
- use;
- historical (e.g., historical preservation);
- need for required documentation by third-party pre-testing of contaminants (e.g., healthcare facilities, laboratories, schools, food processing);
- accessibility (e.g., security and other work restrictions); and
- layout – horizontal (e.g., strip mall) and vertical (e.g., multi-story or high rise).

Knowledge of building type and use may assist the restorer regarding; installation, method, and type of engineering controls, determining what level of restoration can be safely performed without permanently altering buildings of historical significance, mobilization efforts, and other critical project requirements.

When restoration practices may affect building codes, regulations, or ordinances, restorers should alert the MIPs and AHJs to such possibilities.

3.7 FSD Assessment Restoration Triage

Restorers should understand that FSD assessment not only includes data collection, but it also involves making recommendations and getting the restoration process started. These recommendations often drive what can be done and, more importantly, how soon it needs to be done to produce the anticipated results with the available resources. These recommendations are based on the qualifications that make restorers unique in their ability to navigate these often-complex situations. Professional judgment based on education, training, and experience is among these qualifications. Refer to *Section 1: Restoration Contractor Qualifications* for additional information.

Restorers should exercise their professional judgment to perform instant evaluations and decisions on moving forward as a restoration triage based on several factors including, but not limited to:

- services that should be initiated immediately;
- services that are urgent and should be performed as soon as possible; and
- services that are required but may be delayed but should be performed as soon as practicable.

Limitations and complexities can affect and influence restoration triage (e.g., access restriction, evidence spoliation, and limited funds to pay for the costs of services). Refer to *Section 11: Limitations, Complexities, Complications, and Conflicts* for additional information.

3.8 Types of FSD Assessments

Restorers should know that FSD assessment varies with the function of the type of building and use, the severity of the fire, the amount and type of fire residue produced, and the extent of structural damage or failures. These variables directly translate into the number and frequency of inspections needed to identify, describe, and address the damage.

The types of FSD assessments performed by the restorer, or specialized experts, may include, but are not limited to:

- worker and occupant safety;
- presence of hazardous materials (e.g., asbestos, lead);
- the need for emergency response services;
- structural fire-related residue and odor;
- contents (e.g., manipulation, disposition, confirm the efficacy of cleaning and deodorizing procedures);
- building systems (e.g., HVAC, electrical, plumbing);
- specialty work (e.g., elevator shafts, aerial work); and
- coordination with other contractors (e.g., reconstruction).

Restorers performing FSD assessments should perform only those services that they are qualified to perform. If situations arise where there is a need to perform services or FSD assessments beyond their expertise, restorers may engage specialized experts or other support services or recommend to clients or clients that appropriate specialized experts be retained, in a timely manner.

3.9 FSD Assessment Inspections

Damage inspections should be conducted thoroughly and include impacted and potentially impacted areas to accurately determine the boundaries and levels of damage. The restorer performing the inspection should have industry-specific education, training, or substantial field experience in:

- building type and construction;
- fire residue type and characteristics;
- fire residue odor characteristics;
- fire restoration triage;
- identification and classification of contents;
- principles of smoke distribution and deposition;
- effects from heat and moisture on building and contents materials, items, and surfaces;
- building and contents material, surface vulnerabilities; and
- methodologies for restoration of impacted surfaces.

Refer to *Section 5: Fire and Smoke Damage Mitigation* for additional information on building surface vulnerabilities. Refer to *Sections 6: Source Removal and 8: Fire and Smoke Odor Management* for additional information on restoration methodologies. Refer to *Section 9: Contents Remediation* for additional information on contents.

3.9.1 General Inspection

Restorers performing the FSD visual assessment should begin their inspection on the exterior of the building, looking for evidence of heat damage or smoke discoloration prior to extending their inspection indoors.

A smoke odor evaluation should be conducted by the restorer as early in the process as safe access permits, ideally prior to installation of AFDs, fans, or fire and smoke odor management procedures. Upon entering the building, the restorer should note the presence, or absence, of smoke odor and the intensity of the odor, if detected.

Beginning at the site of fire origin, the restorer should note any visual damage in the form of burnt materials, heat damage, fire residue deposits, and damage resulting from fire suppression. Any fire residue specimens, in the form of surface wipes, collected from the site of origin should be retained in individually labeled bags and used for comparative purposes to other areas to assist in the creation of the RWP. Specimens may also be used to help characterize the fire residues. The inspection should then progress systematically outwards from the fire source to determine other areas that may also be damaged.

The restorer should also be able to identify visual clues, such as fire residue deposit patterns on walls and ceilings (e.g., smoke webs, ghosting, thermal bridging, nail pop) and heat damage, most noticeably viewed

as a demarcation (heat) line on vertical surfaces. Fire residue deposit patterns can often be construed by property owners as other forms of damage which may lead to questions regarding the restorability of building surfaces.

The heat demarcation line (aka, heat line) provides the restorer with a visible gradient of heat impact to one or more surface(s) for consideration in the RWP. The restorer performing the inspection should be able to determine that surface materials above this demarcation may be severely impacted and materials below this demarcation may be significantly less impacted. Restorers may compare areas on horizontal surfaces directly exposed to heat and smoke to areas shielded by the presence of an overlying item (e.g., loose area rugs over a larger hardwood floor).

In addition to observed fire residue damage, the restorer may perform on-site test cleaning to determine the restorability of building surfaces to prepare repair specifications. Identification of surfaces that can be restored from those that cannot be restored, is a primary goal of the FSD assessment phase. Refer to *Section 3.10: In Situ Surface Testing* for information on on-site testing.

3.9.2 Smoke Odor Inspection

It is recommended that the initial FSD odor assessment inspection begin at the point of fire origin, where areas of the heaviest fire damage, the greatest amount of odor-laden residue, and the most intense smoke odor will typically be found. As the restorer performing the inspection moves to adjacent areas, smoke odors may be detected wherever fire residues are observed. However, it is not uncommon for fire-related odors to be present in the absence of visible residues.

When presented with visual clues (e.g., smoke residue emerging from behind electrical switch plates, wood trim) the restorer should be properly equipped to perform invasive inspections (e.g., making access openings in walls or ceiling, removing base trim and molding, lifting the corner of wall-to-wall carpet) while searching for the source of hidden smoke odors. Different forces and factors (e.g., temperature and pressure, building design) may influence the distribution of smoke into interstitial spaces (e.g., enclosed wall and ceiling cavities) through penetrations, and construction defects.

The restorer should understand how surface porosity affects exposed material surfaces by retaining and emitting smoke odors. Fire residues do not deposit evenly. Likewise, smoke odors are not retained evenly. A material's potential to retain and later emit smoke odor is based on its surface porosity. Porous materials (e.g., ceiling tile, concrete, wood framing, carpeting, fibrous insulation) retain more odor than less porous materials (e.g., ceramic tile, porcelain, or polished granite).

Fire residues can continue to emit odor, sometimes intermittently, for extended periods of time, depending on environmental conditions (e.g., temperature, humidity, airflow). Low levels of fire residue covering a large area can emit significant levels of the accumulative smoke odor.

For purposes of quantifying the intensity levels of smoke odor detected, restorers can find it helpful to use a simple, practical, and systematic process. Using a range of comparative descriptors such as; "not detected" to "strong" may aid in the creation of the RWP that associates each level with the proposed protocol. For example, areas found to have a slight odor may only require light cleaning, ventilation, and air filtration. Alternatively, areas found to have strong odors may require removal of non-restorable materials followed by aggressive cleaning in addition to the use of multiple odor management processes (e.g., smoke odor counteractants, adsorbents, gaseous treatments, and sealers). The restorer should apply these findings to develop the RWP.

Restorers should understand that it may not be possible to attain complete smoke odor removal until damaged (burnt) materials and residues have been removed.

The intensity of smoke odor initially encountered on a project is often an unreliable predictor of the severity or persistence of lingering smoke odor. Experienced restorers should understand that effective smoke odor

removal frequently requires multiple processes and procedures to be effective. Refer to *Section 8: Fire and Smoke Odor Management* for additional information on fire and smoke odor management procedures.

3.9.3 Contents Inspection

Restorers should know that fire residues and odors deposit onto contents by the same mechanisms that cause them to deposit onto building surfaces. Contents evaluation should include, but may not be limited to:

- emergency mitigation treatment (e.g., removal of standing water, reduction of excessive moisture, fallen plaster/drywall/insulation, corrosion prevention/inhibiting);
- restoration triage;
- on-site preventative pre-cleaning prior to manipulation (e.g., to minimize or prevent incidental damage);
- surface material characteristics (e.g., degree of porosity, vulnerabilities);
- the degree of fire residue adhesion to the surface material;
- surface material response to the application of restoration processes; and
- the need to consult with specialized experts (e.g., specialty items or high value items).

Fire or smoke impacted contents that are not addressed may continue to emit fire related odors and absorbed gases (e.g., VOCs). Contents that are present at project sites may be obstacles to mitigation and source removal activity. Contents manipulation and restoration should be included in the RWP. Refer to *Section 9: Contents Restoration* for additional information.

3.9.4 Incidental Damage Inspection

Fire suppression activities are what generally create the need for some forms of emergency services (e.g., mitigation, building stabilization.) The restorer may include services to respond to incidental damage as part of the emergency service phase of the FSD assessment.

Depending on the severity of the fire, restorers performing the FSD assessment may determine building damage has resulted from firefighting and fire suppression efforts. Aside from obvious firefighting damage (e.g., use of water, breaking windows), firefighters often create holes in roofs, walls, floors, and ceilings checking for extensions of fire spread. These services may include, but are not limited to:

- board up;
- roof tarping;
- shoring;
- water extraction and structural drying;
- corrosion mitigation;
- clean-up of dry and wet chemical residues used in fire suppression;
- removal of wet building materials (e.g., fallen ceiling and insulation);
- winterization of plumbing; and
- restoring utilities (e.g., electricity, water, gas) to operation.

Refer to *Section 5: Fire Restoration Mitigation for additional information on emergency services.* Refer to the latest edition of *ANSI/IICRC S500 Standard for Professional Water Damage Restoration* for information regarding water damage evaluation and corrective procedures.

Restorers performing FSD assessments should also be familiar with the following fire suppression systems, other than water:

- dry chemical;
- wet chemical; and
- gaseous.

The dry chemical discharged from systems or portable hand-held fire extinguishers may be damaging to certain surfaces, irritating to occupants, and workers, and require specialized cleanup procedures. Restorers should contact the manufacturer of the extinguisher to obtain Safety Data Sheets (SDSs) for the dry powder and any cleanup instructions. These instructions should be included as part of the emergency service phase of the RWP.

3.9.4.1 Secondary Moisture Damage

Restorers should understand that while primary water damage results from direct fire-related water contact, the presence of moisture (water vapor) in a building can result in secondary damage in the form of biological activity (or microbial growth), accelerated corrosion, and physical damage (e.g., delamination, swelling). Time is an important factor after water damage; therefore, the stabilization of wet environments should be addressed in the emergency response phase of the project.

3.9.5 HVAC Assessment

During and after a fire, operational HVAC systems can become a reservoir for fire related residue, particularly on the return side, and an efficient distribution mechanism for smoke odor by the supply side. When practical, restorers performing FSD assessment should examine the HVAC system filter(s) for the presence of fire residues and smoke odors. If visual and olfactory evidence supports that the system is affected, as part of the emergency service phase, restorers may recommend replacing the system filter(s) and having similar filter media installed over return and supply HVAC diffusers until such time that a qualified HVAC assessor can inspect the system.

Full FSD assessment of the HVAC system airside surfaces should only be performed by a qualified HVAC assessor. Refer to *Section 7: Heating Ventilation and Air Conditioning (HVAC) and Air Conveyance Systems* for additional information.

3.10 In Situ Surface Testing

Restorers who perform FSD assessments should have knowledge of various on-site surface testing methods and understand what the tests reveal as part of the evaluation process. Depending on the project demands and requirements, restorers may employ the following on-site testing methods to assist in the evaluation of fire residues not readily apparent by visual observation:

3.10.1 Wipe Testing

Restorers who perform FSD assessments should know that wipe testing is a common method for determining the presence of event related residues. Combustion residues from background sources such as cooking, grilling, candle burning, and vehicle emissions, are ubiquitous. Difficulties exist when attempting to determine the point of separation between where discovery of event related residue ends, and pre-existing background contamination levels begin. For example, residue of the same color (including lighter tints) as suspected event related residue may also be removed in the wiping process.

When the absence or presence of a fire residue is uncertain or there is a dispute among the MIPs, the suspect particulate can be collected by personnel at the site and sent to an accredited independent laboratory for a determination. However, restorers should understand the absence or presence of a fire residue equates to a determination to clean or not to clean, and that using a laboratory can add additional scheduling and cost complications. At the time of the writing of this standard, there are no generally accepted standards for contaminant levels with respect to fire and smoke damage restoration.

3.10.1.1 Dry Wipe Testing

Collection mediums for dry wipe testing may include, but are not limited to:

- white non latex cosmetic sponges (preferred media);

- non embossed white paper towels; and
- cellular latex rubber sponge (i.e., chem sponge).

White paper towels can be folded and wiped over the target area, then unfolded to reveal the contrast between the test area and the unexposed portion. The degree of contrast on the wipe media indicates the level of the fire residues. In addition, the contrast on the surface where the specimen was taken can also be used to help determine the level of fire residues.

When wiping across a small area shows marked contrast, the fire residue may be considered significant. When lesser residues or lighter colored residues are present, it may be necessary to wipe a larger surface area to determine residue levels. These methods of testing may also pick up pre-existing residues or dust. Field experience is necessary to distinguish between dust and fire residue since both collect on horizontal surfaces.

Test specimens may be preserved by storage in individually labeled zip closure or sealed bags.

3.10.1.2 Wet wipe testing

After identifying a suitable surface to be tested (hard, nonporous), an alcohol prep wipe or alternate absorbent media impregnated with suitable solvent solution is lightly swiped across the subject surface(s). This method is typically used by the restorer for visual comparisons onsite between the wiped surface aera and the unwiped surface.

When test specimens are being sent to an outside laboratory for determination the specimens should be taken in accordance with laboratory instructions.

3.11 Test Cleaning of Impacted Surfaces

The restorer should have industry specific education, training, and field experience in restorative cleaning processes. The most accurate method to determine whether or not surfaces and materials impacted by heat and fire-related particulate will respond to restorative cleaning procedures, is by evaluating the cleanability and restorability of materials through the process of test cleaning on site. Results of test cleaning will provide necessary information to determine probability of salvageability, develop cleaning specifications for the RWP and accurate labor and material costs.

The restorer should begin test cleaning procedures at the point of origin or areas with the highest levels of visible fire damage. It is recommended that the restorer:

- perform test cleaning procedures on representative sample materials found in the affected areas;
- progress from least aggressive to more aggressive cleaning methods;
- after first testing method/product is applied carefully increase intensity (friction, abrasion or cleaning agent) of cleaning method until it is determined if the tests are satisfactory, or they are not. Materials that do not respond to test cleaning methods described above may respond to alternative treatments that are not addressed in this standard; and
- notate individual test cleaning procedures and results.

The restorer should make it known to property owners and other MIPs that the ability to remove certain fire related residues from surfaces diminishes in effectiveness over time. Vulnerable surfaces and certain residue types (e.g., wet smoke, corrosive) should be addressed without delay, when possible.

3.12 Inspections for Hidden Smoke Damage

It is recommended that restorers who perform FSD assessments be familiar with the various methods of physical inspections that may need to be performed in the investigation of hidden damage; non-invasive, minimally invasive, and semi-invasive. Pressurized smoke can enter wall cavities via penetrations from a fire that are not visible to the restorer. Restorers should not overlook areas of potential hidden smoke

damage and odor (e.g., interstitial spaces, ceiling cavities, interior and exterior wall cavities, soffits, floor joist cavities, mechanical chases and opening).

As discussed in Section 3.4, restorers performing FSD assessments should attempt to distinguish event related fire residues from pre-existing background soils including those discovered while performing inspections for hidden damage. Restorers should understand that certain hidden cavities, particularly exterior wall cavities in buildings are places where dust and other soils may accumulate and reach observable quantities over time. It is recommended the presence of non-event related background soils be recognized and documented.

3.12.1 Non-invasive

An inspection method that may require minor disassembly or reassembly and generally does not cause surface damage or distress: (e.g., detach and reset of electrical switch plate, system access door/panel).

3.12.2 Minimally Invasive

Investigation of concealed areas potentially pressurized during the fire can be achieved with a borescope, an optical device that permits inspection through a small hole in the surface material. Other tools (e.g., inspection mirror) can also be used to inspect hidden areas.

3.12.3 Semi-invasive

Small access holes or openings are cut into the material to investigate for hidden damage. If the possibility exists of smoke penetration into concealed spaces, either by visual or olfactory confirmation, the restorer should remove building material as needed to access these spaces in order to make a thorough investigation. This controlled removal of building materials should continue until such time that all event related impacted surfaces are exposed, or no further evidence of fire residues are discovered.

The restorer shall be aware that before disturbing any surface or material it shall be evaluated for regulated and hazardous materials in a manner consistent with the AHJ.

3.13 In Situ Chloride Contamination Testing on Metals

When polyvinylchloride (PVC), a common plastic is burned, hydrochloric acid (HCL), a highly corrosive substance is produced. In conjunction with other fire residues, HCL is transported within the smoke, deposited on surfaces and materials. Consideration should be given to in situ testing of surfaces and materials that are subject to chloride corrosion (e.g., most metals, electronics including those with cooling fans). Affected surfaces and materials should be identified by the assessor as items that may require anti-corrosive treatments be performed during the emergency (mitigation) phase of the project. One common method of in situ testing for chloride contamination is performed using silver chromate chloride test strips with color indications corresponding to various concentrations of surface chloride contamination according to the manufacturer's instructions.

3.14 Smoke Odor Testing

The restorer should know that since physical fire damage (e.g., burnt, charred wood, melted plastics) and deposited fire residues are the leading source of fire related odors, it may not be practical to perform thorough smoke odor testing until such time that complete source removal and fire and smoke odor management procedures have been performed. If smoke odor is detected after thorough source removal and fire and smoke odor management procedures, the restorer should test for odor emissions from surfaces and materials. *Refer to Sections 6: Source Removal and 8: Fire and Smoke Odor Management* for information on fire and smoke odor management procedures.

Restorers should investigate smoke odors that persist following source removal and fire and smoke odor management or are detected in otherwise unaffected rooms in an attempt to locate and identify the probable cause. The two principal methods of testing for smoke odor involve:

1. isolation;
    a. surface isolation;
    b. specimen isolation; and
2. odor transfer (patch test).

Areas isolated in which smoke odor was detected should be documented. It is recommended that isolated specimens including patch test media onto which the odor may have transferred be retained in an airtight sealable container, labeled and properly documented to include the location of the test and degree of odor detected. Refer to *Section 7 Heating Ventilation and Air Conditioning HVAC) and Air Conveyance Systems sub section 7.5 Odor Retention Test for Evaluation of Porous and Non-Porous Materials (Semi Invasive) through 7.5.3.2 Accelerating Stress Test* for information regarding preparing and testing of Odor Emitting Surfaces and Materials (OESM).

3.14.1 Subjectivity of Odor Detection

The effectiveness of fire related odor removal is subjective and should be based on the judgement of individuals of normal olfactory sensitivity. Odor detection is more important than odor recognition. The odor detection threshold is the lowest concentration that someone can smell. The odor recognition threshold is the concentration at which someone can identify an odor. Among a group of people, at any given odor concentration, individuals may perceive the same odor differently; one person may smell an odor, another may smell and be able to identify the odor, and others may be unable to smell or identify an odor.

Opposing views may arise over the presence or absence of fire related odor; complicated further if the odors are claimed to arise intermittently. Other issues that may factor into differences in odor detection include but are not limited to:

- environmental (e.g., heat, moisture, airflow);
- physiological (e.g., gender, olfactory fatigue, hypersensitivity);
- psychological (e.g., emotional, suggestion); and
- monetary (e.g., parties seeking financial gain or avoidance).

When addressing any of the above listed conditions that may influence odor detection, it is recommended that the restorer exercise discretion and remain emotionally neutral and factually accurate.

3.14.2 Odor Testing Evaluation and Dispute Resolution

It is recommended that the evaluation of odor detection testing include the client or the complainant who originally perceived the odor, and the restorer. Restorers may streamline the odor evaluation process by limiting the number of individuals involved in the evaluation process. However, in some situations or when there are disputes, it may be necessary to include others (e.g., MIPs, impartial unbiased third parties) as part of an investigative odor panel to further investigate the detection of odor. Odor test evaluations should be performed in a manner so as not to influence the decisions of others on the panel. Individual test results of each panelist should be documented.

To provide additional validity to the odor tests, the restorer may include a control group (placebo) of new or unused like and kind material specimens or patch media. The restorer should reveal that a certain number of placebos may be included in the evaluation process to be sniffed along with test specimens. It is recommended the restorer not reveal the identity of the actual specimens or the placebo until the test is completed.

Once suspected OESM are identified, the restorer should test various additional odor management procedures. The restorer should first confirm the effectiveness of the procedure on the specimens prior to

wide range application. Once satisfactory results are obtained it may be advisable to test an area larger than the test specimen to confirm the results before finalizing the procedure for wide range application.

3.15 Ongoing FSD Progress Assessment and Quality Control

FSD assessment on a fire restoration project is an ongoing process. Clients have both the right and the responsibility to check the work being performed on their property. Restorers should periodically check on effectiveness of cleaning and odor control as part of the ongoing FSD progress assessment. The restorer should promptly respond to concerns from the client and at critical points in the restoration process to identify problems and facilitate corrections to avoid failure at the end.

Satisfactorily completed restoration work (e.g., cleaning and fire and smoke odor management) areas should be inspected and signed off by the client prior to being released for reconstruction (e.g., work by others), use or occupancy. Engineering controls or other methods should be utilized to prevent cross contamination into completed areas from areas not yet completed (e.g., containment, floor protection, negative air machines). Exceptions to this may be areas commonly used by occupants and restoration workers (e.g., washrooms, supply storage areas).

3.16 Post Restoration Evaluation

When the restorer is satisfied that their RWP has been completed, a comprehensive site evaluation should be conducted with their client and other MIPs, where applicable. Confirmation of acceptance criteria may include visual observation, (e.g., surface wipes, white glove), smoke odor testing and completion of work processes. Where the general restoration contractor is not responsible for contents remediation, those responsible parties should also be included to ensure comprehensive site mitigation and clearance for reconstruction or other third-party work.

Where surface contamination, detectable odor or other conditions representing incomplete cleaning and fire and smoke odor management are found, a punch-list should be created for closer evaluation for corrective action, and subsequent reinspection.

Section 4 Fire Restoration Equipment, Tools, and Materials (ETM)

4.1 Introduction

As part of the development of the RWP, the restorer should identify the ETM that may be required to perform the tasks outlined in the RWP. The amount and type of ETM to be used by the restorer on any given project will vary depending on the level of fire severity, the size and complexity of the loss, building type, and use. Prior to the commencement of any services being provided, the restorer should have access to certain equipment, tools, and materials and be trained in their usage to accomplish the task(s) as outlined in the RWP.

Restorers should know that the terms 'equipment' and 'tools' are often used interchangeably, however for the purposes of this standard, it is important to draw a distinction. In fire and smoke restoration, equipment is employed to perform a specific task, whereas tools are usually multipurpose. In addition, as with other equipment used in restoration (e.g., drying equipment, portable generators), it is considered typical and customary for restoration contractors to charge for the use of equipment required to perform the job.

Restorers should know how the job pricing method can determine the way the restorer charges for ETM usage. For example, in unit pricing, it is typical and customary for most tools and materials to be included in the per item, or line item, price. In rate (time) and materials (R&M) pricing, all tools and materials should be charged separately from the labor charges. Regardless of the pricing method and as stated in the above paragraph, equipment charges are not included in unit or R&M pricing. Refer to *Section 2: Administrative Requirements and Documentation* for additional information on contracts and pricing methods.

Restorers should be familiar with a basic description, and have access to the following examples of ETM:

4.1.1 Equipment

Mostly mechanical items, non-handheld items, and specialty items employed to complete a specific task. Examples include but are not limited to:

- air compressors;
- portable power generators;
- air filtration devices;
- powered machinery;
- gaseous oxidation generators (e.g., ozone, hydroxyl);
- scaffolding;
- temporary containment systems;
- air movers;
- dehumidifiers;
- protective equipment (e.g, furniture moving pads, padded traffic lane protection);
- forklifts; and
- durable PPE.

4.1.2 Tools

Tools mechanical or non-mechanical items, mostly small, handheld items and with multiple applications or purposes used to accomplish various tasks. Examples include but are not limited to:

- vacuum cleaners;
- pump or trigger sprayers;
- foggers (e.g., ULV, thermal);
- general clean up tools (e.g., shovels, brooms, dustpan, mop handles, bucket, mop wringer);
- handheld non-powered tools (e.g., hammer, screwdrivers, wrenches, pliers, prybar, utility knife, tape measure);

- handheld power tools (e.g., circular saw, reciprocating saw, drill);
- extension cords; and
- ladders.

4.1.3 Materials

Materials are items consumed during a restoration process or procedure. Examples include but are not limited to:

- cellular rubber sponges;
- cleaning products;
- fire and smoke odor management products;
- containment (e.g., zippers, poly film);
- cloths (e.g., terry, microfiber);
- disposable drop cloths and floor protection;
- trash bags;
- equipment filters (e.g., pre-filters, HEPA);
- single-use PPE (e.g., protective suits, nitrile gloves);
- adsorbent media (e.g., activated carbon); and
- blasting media.

4.2 Equipment, Tools, and Materials Usage

The use of fire restoration equipment, tools, and materials requires training and experience. Restorers should review ETM operating and use instructions prior to use. Restorers should exercise caution and rely upon their own professional judgment while working with ETM. ETM usage, maintenance, transport, and storage shall conform to all safety and inspections set forth by the AHJ. Equipment and tools should be regularly inspected and maintained in good operating condition. Equipment and tools that have been altered, damaged, or have missing or broken parts shall be immediately taken out of service.

Product supplier labels, secondary labels, and Safety Data Sheets (SDSs), including information on proper disposal, should be read thoroughly, and understood prior to use. The restorer shall be aware of and follow all regulations set forth by the AHJ governing use and disposal.

Restorers should maintain control over how the ETM is brought onto the job site, where they will be placed, and where and how they will be stowed when not in use, if necessary, as part of providing environmental controls.

4.3 ETM Purpose and Application

Restoration technicians should be trained in the appropriate use of fire and smoke damage related ETM. Restoration technicians should know which ETMs are commonly used on typical fire and smoke damage projects (e.g., cellular rubber sponges, detergents, ladders, vacuum cleaners). In addition to the commonly used ETM, the RWP should include any specialty ETM that will be needed on a specific job. The list of possible ETM that could be used on fire and smoke restoration projects is extensive but not static. Product improvements and advancements in the manufacturing of ETM continue to bring innovative technology to the fire and smoke damage restoration industry.

5 Fire Restoration Mitigation

Following a fire or smoke event in a building and as soon as it is deemed safe to enter and released by the AHJ, restoration services should be performed without delay to mitigate the degenerative effects of fire residues, stabilize building components, improve indoor environmental conditions, and determine the potential for building use.

Prompt corrective action should be performed to mitigate the damaging effects of suspended and settled fire residues. Suspended fire residues are malodorous and contain chemical compounds that may present a health risk to occupants and workers by inhalation, ingestion, or dermal absorption. Settled fire residues may contain chemical compounds that potentially degrade building surfaces in the form of corrosion and permanent staining of vulnerable building materials. Mitigation services should be prioritized and provided as part of a comprehensive emergency RWP.

5.1 Prioritizing Emergency Services

The restorer should tailor the emergency RWP to meet the specific needs of the client or MIPs. The priorities of the client may differ between residential and commercial losses. An initial FSD assessment should be performed to evaluate the potential for building use and occupancy. Examples of distinctions between priority mitigation services on residential and commercial losses include but are not limited to:

5.1.1 Residential Priorities

Mitigation services in a residential property involve evaluating the potential for restoring the structure to a usable condition by prioritizing occupant health, safety, and comfort. These services include, but are not limited to:

- removal of fallen and collapsed building materials;
- removal of resulting effects of fire suppression (e.g., water, fire extinguisher residue);
- removal of fire residues from surfaces subject to degradation (e.g., corrosion, staining) from prolonged exposure;
- removal of fire residues from high touch areas (e.g., kitchen, bathroom, bedroom);
- improvement of indoor environmental conditions (e.g., ventilation, use of AFDs, HVAC system filter replacement and cleaning, odor management); and
- engineering controls (e.g., containment, floor protection).

5.1.2 Commercial Priorities

Mitigation services in commercial losses include those bullet points listed in residential losses with an emphasis on returning the business to an operational standpoint as quickly as possible to minimize business interruption. Improvement of indoor environmental conditions and, when required, thorough removal of fire residues from all affected surfaces should commence as soon as possible. In certain situations, emergency mitigation service may continue 24/7 until such time that the affected building space is in a useable and occupiable condition.

Restorers should recognize that metals can be integral to commercial construction. The presence of fire residues may cause immediate corrosion of certain metals, which left untreated, can potentially have long-term damaging effects. Under these circumstances, restorers should prioritize mitigation of fire residues from building metals (e.g., steel bar joist, support beams, framing) as soon as practical.

5.2 Pre-Mitigation Considerations

Prior to any restoration activities, restorers should address conditions that can limit the mitigation work. This standard does not address all conditions that can limit mitigation work. Examples of pre-mitigation considerations include but are not limited to:

- potential presence of regulated hazardous materials;
- effects from moisture (e.g., fire suppression, plumbing failures due to heat);
- safe access; and
- general worker safety.
- unsafe conditions;
- undetermined financial considerations; and
- ongoing investigations by others (e.g., cause and origin, arson).

5.2.1 Asbestos

Restorers should be aware that older buildings are more likely to have been built using asbestos containing materials. Restorers should not assume that more modern buildings do not have asbestos containing materials. Restorers shall abide by the requirements of the applicable AHJ regarding testing prior to performing demolition, scraping, sanding or any other service that causes the asbestos containing materials to be released into the air.

Building materials that may contain asbestos include but are not limited to:

- gypsum board (drywall)
- joint compound;
- plaster;
- ceiling tiles;
- insulation;
- spray fireproofing;
- vinyl composition tile, sheeting, mastic, adhesives;
- caulk and spackle;
- architectural coatings;
- floor backing;
- roof material (i.e., tars, felts, shingles);
- siding materials;
- acoustic finishes (i.e., popcorn or acoustic ceilings);
- thermal spray;
- textured paints;
- texturing compounds; and
- HVAC flexible duct connectors.

Asbestos abatement, inspection and sampling shall be performed in accordance with the requirements from the applicable AHJ, to include requirements for appropriate training, licensing, and certification.

5.2.2 Lead

Restorers should be aware of the types of building materials and finishes that can contain lead. In some countries, including the US, lead containing building materials are still in use today. Restorers shall abide by applicable requirement from AHJs regarding testing of coated surfaces (e.g., painted) prior to performing demolition, scraping, sanding or any other service that may cause lead dust to be released into the air.

Building materials and finishes that may contain lead include but are not limited to:

- paint;
- lead contained in certain contents items (e.g., ammunition, fishing and diving weights)
- commercial and industrial metal coatings; and
- structural materials containing lead.

Lead inspection, sampling and testing shall be performed in a manner consistent with requirements from the AJH to include appropriate training, licensing, and certification. Removal or abatement of lead

containing materials shall be performed in a manner consistent with the requirements from the appropriate AJH.

Restorers in the United States shall know that buildings built before 1978 require notification and adherence to the Lead Renovation, Repair and Painting (RRP) Rule established by the EPA.

5.2.3 Moisture

Restorers should know that water used in fire suppression or plumbing failures may result in elevated moisture content of materials and elevated indoor humidity. This standard does not specifically address water mitigation although restorers that provide mitigation services for fire and smoke damage are often involved in water mitigation activity.

Restorers should treat fire-generated water damage as, at a minimum, Category 2 water. Refer to the latest edition of the *ANSI/IICRC S500 Standard and Reference for Professional Water Damage Restoration* for additional information regarding mitigation of water damage. Increased moisture content may cause an amplification of microbial and other biological growth. Refer to the latest edition of the *ANSI/IICRC S520 Standard for Professional Mold Remediation* for information regarding concerns related to microbial growth.

5.3 Building Stabilization and Securing the Structure

Building stabilization should occur prior to mitigation services. Damaged buildings may require temporary repairs prior to the commencement of mitigation services. The following list of temporary repairs due to structural failures or building damage caused by fire or by firefighting activity includes, but are not limited to:

- shoring or stabilization of collapsed flooring, ceiling, or walls;
- tarping of damaged roofing;
- board-ups of broken windows and doors;
- installation of barricades and warning signs;
- installation of security perimeter fencing;
- winterization of plumbing (in cold weather climates); and
- restoration of utilities (e.g., electrical , life safety systems, water, heat).

Restorers should know that it may be necessary to obtain inspections, and in some situations permits issued by the AHJ to perform demolition and temporary repairs. Certain situations may require the use of specialized experts (e.g., structural engineer, landscape architect) to ascertain the structural integrity of the building and functionality of non-structural features. Documented inspection reports by these parties should be retained by the restorer. Refer to *Section 2 Administrative Requirements and Documentation* for additional information.

Procedures for stabilizing and securing a structure can include, but are not limited to:

- shoring - temporary structural support(s) may be required to allow safe access to structures or areas of structures and to prevent further collapse;
- roof tarping - roof tarping should be installed, if possible or practical, to prevent water intrusion when a roof has been compromised. Roof tarping should be installed so that it will stay affixed under normal weather conditions for a temporary period of time;
- board ups - board ups are the process of securing a structure following a fire. The primary function of boarding up a property is to prevent intrusion of any kind. In addition, covering broken windows and doors acts to preserve damaged and undamaged areas from tampering by others and from the potential for additional damage due to weather-related events;
- barricades and warning signs - areas determined to be structurally unsafe for use shall be identified with readily observable signage and barricaded with warning tape or some other obvious means to prevent entrance into the area. Mitigation activity should not be attempted in these areas until they have been released by the AHJ;

- plumbing winterization - in cold weather climates, buildings that are badly damaged by fire often have no functioning utilities (i.e., gas, electric). In that event, winterization of the plumbing systems and fixtures should occur as part of the building stabilization process. In certain situations, a licensed plumber may be required to properly complete winterization of plumbing; and
- temporary power - In buildings where the electrical service has been compromised, establishing temporary electrical service with portable equipment can provide the means to power dehumidification equipment, air filtration equipment, provide light and permit use of cleaning and fire and smoke odor management equipment. All electrical service work shall only be performed by a licensed electrical contractor.

Restoration contractors shall abide by permit regulations set forth by the AHJ before attempting to restore power.

5.4 Protection and Preservation of Property

Restoration contractors who perform building stabilization and mitigation services should be aware of the risk of incidental damages these activities can present to the building and contents left onsite. Restorers should take the necessary action to prevent incidental damage by utilizing engineering controls and other safeguards, when applicable. Restoration contractors should understand the importance of preserving potential evidence with regards to the cause and origin of the fire. The following list of procedures for the restoration contractor to limit these risks may include:

- installation of flooring protection;
- installation of drying equipment;
- protection of personal property;
- installation of containment barriers; and
- preservation of forensic evidence.

5.4.1 Protective Floor Covering

Cooled fire residues tend to primarily deposit on horizontal surfaces. It is recommended that flooring, being the greatest horizontal surface in a building, be protected from the effects of foot traffic and general use to prevent further damage to the floor. Pre-cleaning, such as vacuuming, mopping, even cleaning of carpet by extraction methods to remove settled smoke particles and smoke odors, may be necessary to preserve the flooring material. Once pre-cleaned and sufficiently dry, the floors can be covered with interim floor protection to allow for use. Depending on the type of floor, the floor protection material should be heavy-duty, non-staining to the material being protected and spill resistant yet offer some degree of vapor permeability.

5.4.2 Protection of Contents

Restorers should know that fire residues and odors deposit onto contents by the same mechanisms that cause them to deposit onto building surfaces. Contents can also be damaged by the degenerative effects of settled fire residues and can be subject to discoloration and corrosion. In addition, contents can be subject to incidental damage (e.g., moisture from fire suppression activity, building collapse, broken glass, fallen drywall and insulation, contamination by regulated hazardous materials). Affected contents can require their own mitigation procedures (e.g., removal of standing water, pre-cleaning to allow for safe handling). Refer to *Section 9: Contents Restoration subsection 9.7.2.2 On-Site Preservative Pre-Cleaning and 9.11.1 Wet Contents (Mitigation)* for additional information regarding safe handling and mitigation of contents.

Restorers providing mitigation services should evaluate and determine the appropriate disposition of contents (e.g., remain in place, relocate to unaffected areas, pack out, discard). Manipulation of contents provides two benefits:

- prevention of incidental damage to the contents from building demolition and other debris generated by mitigation or stabilization activity; and
- allowing access to building areas in need of structural mitigation or stabilization activities that may be otherwise be obstructed by the presence of contents.

As a result of the significant time required to perform documentation, it is not unusual for contents, including non-salvageable contents, to remain at the loss site for an extended period of time after the fire. Restorers should utilize containment of untreated contents while waiting for the determination of disposition as an odor management procedure and to prevent cross contamination of fire residues to areas of the building that have been mitigated or undergone odor management procedures. Refer to *Section 9: Contents Restoration, Subsections 9.13: Non-Salvageable/Non-Restorable Inventory and 9.13.1: Disposal of Non-Salvageable/Non-Restorable Items* for more information.

5.4.3 Containment of Affected Building Areas

Installation of containment is an effective method to help prevent fire residues and associated odors from migrating from one part of a building to other unaffected areas. Containment material, usually polyethylene (poly) sheeting, should be made of flame-retardant material, be of sufficient thickness and durability and installed in such a way so as not to tear or fall for the duration of its intended purpose. Poly sheeting is often supported by tension poles and can be sealed with tape on the edges. HEPA-filtered AFDs installed within the containment area and ducted outside can be an additional process for odor management. Zippers can be installed on the poly sheeting to allow access to and from the containment area. In commercial applications, containment areas should be well marked with appropriate signage to identify points of ingress and egress. Refer to *Section 8: Fire and Smoke Odor Management* for additional information on emergency odor management procedures and *Subsection 5.5.1.1: Ventilation with Outdoor Air*.

5.4.4 Preservation of Evidence (Cause and Origin Investigation)

Restoration contractors who provide mitigation services should understand the process of subrogation and the ramifications caused by inadvertent spoliation of evidence. Subrogation is a legal term used in the insurance repair industry that describes a process that gives authority to the primary insurer to hold responsible parties legally liable for damages caused by others (i.e., persons or businesses associated with a provided service), product failure or suspected arson.

In many fire scenes, the fire marshal or fire investigator will seek out the potential site(s) of the fire's origin. These areas are typically cordoned off with caution tape prohibiting access. Restorers should not perform mitigation work or disturb the scene of a fire prior to it being released by the AHJ and MIPs.

5.5 Mitigation Services

Following building stabilization procedures, mitigation services should be performed to minimize further damage to the structure. During the emergency FSD assessment phase, restorers should develop an RWP that identifies the at-risk building surfaces and describes a mitigation procedure to treat the ensuing condition. This activity enables the owner and MIPs to evaluate the efficacy of such services that directly impact repair or replacement decisions. Fire mitigation includes, but is not limited to:

- improve environmental conditions ;
- identification and treatment of surfaces susceptible to permanent staining by fire residues;
- identification of building surfaces subject to corrosion;
- ceasing the degenerative effects of fire residues on building surfaces subject to corrosion (e.g., certain metals);
- restoring the serviceability of building components essential for use (e.g., areas of human contact); and
- restoring the serviceability of building utilities and systems (e.g., electricity, water, HVAC, ACS).

5.5.1 Improving Environmental Conditions

Restorers should perform and utilize mitigation procedures to dilute or remove airborne contaminants from the workspace air and improve environmental conditions. Building materials have the potential to continue to off-gas residual chemicals and smoke odors for an extended period. Following a fire or smoke event, fire residues that have not completely settled may remain suspended in the indoor air for an extended period. In addition, debris from structural failures and certain human activity including emergency work and mitigation services, have the potential to re-suspend settled fire-related residues into the air.

The following are examples of procedures that can improve environmental conditions, when applicable:

- perform ventilation aided by fans or blowers;
- utilize Air Filtration Devices (AFDs);
- cleaning of HVAC and ACS;
- utilize auxiliary environmental control units (e.g., temporary heating or cooling, accelerated fresh air exchange);
- utilize dehumidification; and
- perform odor containment.

5.5.1.1 Ventilation with Outdoor Air

Whenever outdoor air is used for ventilation purposes, the restorer should consider the effects of temperature variances, humidity, and other environmental conditions of outdoor air, which can have a negative effect on the interior surfaces. After a fire is extinguished, firefighters often use positive pressure ventilation or negative pressure ventilation as a procedure to help reduce suspended and heated fire residues. Electric or gas-powered fans or blowers exchange indoor and outdoor air when strategically placed in windows and doorways. Upon arrival at a fire scene, restorers may utilize the same procedure to mitigate or reduce suspended fire residues that may be present indoors after firefighters have departed.

5.5.1.2 Air Filtration Devices (AFDs)

Restorers should understand how Air Filtration Devices (AFDs) function and how they are used to improve indoor environmental quality and reduce fire related odors. AFDs can prevent further deposition of suspended contaminants on surfaces AFDs draw air into the device by suction created by a fan, then discharging it after passing the air through filter(s). AFDs that incorporate HEPA filters, often referred to as air scrubbers, are more efficient at removing suspended fire particulate. AFDs equipped with an odor adsorbing filter stage (e.g., activated carbon, other adsorbent media) are more effective in reducing fire related odors in ambient air.

AFDs can also be used to create negative or positive pressure differentials within containment areas as an odor management method. When AFDs create negative pressure differentials within containment areas by exhausting filtered air from within the containment to the outdoors or other areas outside of the containment area, they are referred to as Negative Air Machines (NAMs). When using negative air containment consideration should be given to the source of make-up air.

5.5.1.3 Auxiliary Environmental Control Units

Restorers should have knowledge of auxiliary equipment that can provide accelerated exchange of air in buildings with fresh outdoor air, heat, cool, or dry the air, and provide filtration of airborne particles. This equipment may be portable (i.e., used within buildings) or remote (i.e., supplied to buildings from on-site truck-powered equipment).

5.5.1.4 Humidity Control

When excess moisture is present after a fire, the restorer should exercise humidity management procedures to reduce the potential for corrosion and microbial growth. Refer to the latest edition of

ANSI/IICRC S500 Standard and Reference Guide for Professional Water Damage Restoration Subsection 12.3.5 Humidity Control in Contaminated Structures .

5.5.1.5 Emergency Odor Management

Restorers should perform odor management procedures to provide prompt relief to occupants, if present, after a malodorous fire or smoke event. Prior to full and thorough source removal and odor management, procedures that can provide immediate relief for occupants, which may not be permanent, include but are not limited to:

- ventilation;
- use of AFDs (i.e., air scrubbers) equipped with an adsorbent media filtration stage;
- limited and selective source removal (e.g., demolition of charred materials, non-salvageable contents);
- fogging the affected area (e.g., ULV, thermal);
- saturation spraying of odor counteractants on odorous surfaces and materials;
- installation of containment barriers around heavily damaged and highly malodorous building surfaces and contents. When used with NAMs, this procedure also helps to isolate and prevent fire residues and odors from migrating to surrounding and unaffected areas;

Refer to *Section 8: Fire and Smoke Odor Management, subsection 8.4.3 Odor Management* for additional information on fogging, and *subsection 8.4.4.2 Source Containment* for additional information on the containment of odors.

5.5.2 Identification of at-Risk Building Components and Contents Subject to Discoloration

Restorers should understand that varying types of fires produce different residues depending upon what fuel is burning and the rate in which the fuel is consumed. Many building components are vulnerable to discoloration due to the chemical bonding properties of certain fire residues. High temperatures generated by combustion also factor into surface discoloration, which can range from slight to severe. Discoloration is most readily detected when visually comparing the affected surface to a covered or unexposed portion of the surface.

Restorers should prioritize treatment of vulnerable surfaces. Vapors and residues produced by smoldering (low heat) fires, including protein fires, can discolor vulnerable surfaces where staining can occur quickly and may worsen over time. Removal of fire residues can be performed to assess the level of discoloration. Staining or discoloration typically impacts only the appearance of a material or an item, not the utility and may not require emergency mitigation other than for odor abatement, even if those materials are eventually going to be replaced.

Restorers should be aware that staining or discoloration caused by fire residues may be permanent and while efforts should be made to test clean surfaces, the number of resources put into removal of staining or discoloration should be consistent with the practicality of the intended purpose. Discolored building components and contents that are finished surfaces and cannot accept repair or resurfacing procedures should be considered non-restorable. Surfaces and materials that can be cleaned but retain an altered appearance and can accept cosmetic repair (e.g., painted, refinished, reupholstered) may not be considered non-salvageable.

Attempts to remove the discoloration for appearance purposes alone may not be cost effective, particularly on contents. Aggressive methods to replace finishes or chemically alter the discoloration will not be addressed in this section. Refer to *Section 6.5.1: Dry Mechanical Processes* and *Section 9.6 Restorability of Damaged Contents* for additional information on levels of aggressiveness of removal procedures and surface vulnerabilities.

Materials, surfaces, and items subject to permanent discoloration by fire residues can include, but are not limited to:

- cultured marble (i.e., vanity tops);
- fiberglass tubs, surrounds, and shower pans;
- plastics (e.g., PVC, laminates, toys, sporting goods, electronics housings);
- vinyl (flooring, window trim);
- marble and granite (i.e., natural stone);
- ceramic tile and grout;
- paint and wall coverings;
- bathroom fixtures;
- wood;
- fabrics and textiles (e.g., upholstery, window treatments, clothing, rugs, carpet);
- aluminum;
- concrete;
- iron/steel;
- stainless steel; and
- composites.

5.5.3 Identification of at-Risk Building Components and Contents Subject to Corrosion

Regardless of any visual evidence indicating the onset of corrosion, mitigation efforts to cease the degenerative effects on vulnerable surfaces should be performed without delay and to the fullest degree possible.

Corrosion, mostly referred to as rust and the pitting of metals, indicates the degradation of the material. Degradation from fire residues can also affect ceramics, glass, and plastics. Not all fire residues can be classified as corrosive. For example, fire residues from burned plastics (PVC) are highly corrosive because they contain chlorides, sulfides, and other acid precursors. Other fire residues, including those from protein sources (e.g., smoldering meat, poultry), are non-corrosive.

Corrosion can occur on metals when fire residues begin to interact with exposed surfaces and may create an adverse chemical reaction. Restorers should understand that certain fire residues, when combined with water or conditions of high humidity may exponentially increase acidic strength.

The onset of corrosive activity is not always evident by visual inspection. The surface may be obscured by settled fire residues making visual identification difficult. In addition, the affected surface may be of similar color with the fire residues which would also affect visual inspection.

The most destructive form of corrosion found in fire-related events on structural metals is pitting corrosion. Pitting corrosion can occur when there is damage to the protective coating on some metals. Acidic fire residues containing chlorides are considered extremely corrosive.

In some situations, the restorer may need to confirm the presence of corrosive fire residues on critical surfaces to support the need for corrective action. Acidity can be measured using pH indicator strips (litmus paper) and pH meters. Chloride concentrations can be measured using silver chromate chloride test strips with color indications corresponding to various concentrations of surface chloride contamination according to the manufacturer's instructions.

Restorers should be aware of building components and contents items that are subject to corrosion. Examples of which include but are not limited to:

- electrical panel boxes, breakers and wiring (high voltage, line voltage and low voltage);
- electronics (e.g., printed circuit boards, security and control systems, sensors, communication systems, computers, AV systems);
- structural support metals (I-beams, bar joist, gusset plates);
- switches and outlets;

- light fixtures;
- metal tools and equipment (e.g., hand, powered);
- exhaust and ceiling fans;
- kitchen appliances;
- metal sinks;
- faucets (i.e., sink, tub, shower);
- window metal (trim, tracks, locks, screens);
- building and furniture hardware (e.g., hinges, pulls, screws);
- bathroom accessories (e.g., towel bars, shower rods);
- aluminum;
- non-galvanized sheet metal;
- electrical staples, strapping for plumbing lines;
- glass, mirrors; and
- stainless steel.

5.5.3.1 Hidden Corrosion Awareness

Restorers providing emergency mitigation should be aware of vulnerable metals may not always be visible or easily accessible. For example, steel bar joists, steel I beams, electronic sensors, etc., are often located behind finished or partially finished surfaces (e.g., walls, ceilings). It is recommended that restorers perform invasive inspection of hidden areas, as allowed, during mitigation.

5.5.3.2 Treatments to Mitigate Corrosion

Procedures to limit the degenerative effects of certain fire residues on vulnerable surfaces and materials should include but are not limited to:

- application of rust inhibitor or moisture-displacing oil - rust inhibitors and moisture displacers should be directly applied as an emergency treatment to cease the degenerative effects of the fire residues and act to seal the surface from exposure to oxygen and humidity on vulnerable surfaces such as polished metal. This temporary stabilization should be performed as soon as possible, and if the material is restorable, always be followed by a thorough cleaning to neutralize the acids;
- physical removal of fire residues on vulnerable surfaces - cleaning with ammoniated or other alkaline-based detergents combined with surface agitation can neutralize acidic fire residues. Moderate to heavy accumulations may require more aggressive methods of removal. Regardless of the quantity of fire residue, cleaning mitigation of any metallic surface should be performed as soon as possible following a fire when conditions are conducive to corrosion; and
- moisture removal and lowering humidity - removing standing water and water-saturated materials should be part of the emergency RWP when performing fire and smoke damage mitigation activity. Environmental controls such as ventilation and dehumidification greatly reduce the effects of acidic fire residues on vulnerable surfaces. For example, moisture-laden air can cause metals to flash rust. Refer to the latest edition of *ANSI/IICRC S500 Standard for Professional Water Damage Restoration* for additional information about building humidity and use of dehumidification.

Electrical components (e.g., electronics, fan motors, appliances) that have been impacted by corrosive fire residues or show visible signs of corrosion after a fire or smoke event should be inspected by specialized experts. Restorers should not perform mitigation services on electrically energized systems or components.

5.5.4 Restoring the Serviceability of Essential Building Areas

When partial building use and occupancy is preferred by clients or occupants and approved by the AHJ and the MIPs, restorers may provide emergency cleaning, or pre-cleaning, to certain materials, surfaces, and items. Restoring a level of serviceability allows building occupants to have limited use of those areas, as well as the contents located in those areas, as soon as possible.

Restorers should know that cleaning for mitigation purposes has specific goals (e.g., limit the degenerative effects of certain fire residues) and may not fully address all forms of fire related damage. Mitigation cleaning should be followed by restorative cleaning as part of the full (non-emergency) restoration phase of RWP.

5.5.5 Restoring the Serviceability of Building Systems (HVAC/ACS)

Restorers should understand that during a fire event, suspended fire residues and odors can be drawn into the HVAC/ACS system via the return side before being recirculated via the supply side. Most forced air conveyance systems have removable filters that filter the air on the return side of the system prior to conditioning. The purpose of return side filters is to reduce the impact of particulate contamination on the system components and the airside surfaces within the system. The amount of particulate trapped by the filter depends upon both the efficiency range of the filter and proper installation of the filter(s). During a fire or smoke event, larger particles in smoke are trapped by the filter while smaller particles and gases may pass through contaminating both the system and areas condition by the system. As a precautionary or time sensitive response, the restorer may attempt to mitigate re-distribution of fire related particles by changing system filters and installing filter material on, or sealing off, system registers in specific areas. Refer to *Section 7: Heating, Ventilation, and Air-Conditioning (HVAC) and Air Conveyance Systems* (ACS) for additional information.

6 Source Removal

Introduction

The restorative cleaning and removal of fire residues and odor is the principal element that distinguishes fire restoration from other types of damage repair. Structural and contents cleaning following a fire or smoke event is the physical removal of fire residues from affected materials, surfaces, and items. Fire residue damage ranges from light to severe, source removal procedures will vary in levels from gentle to aggressive, consequently, results will vary from complete removal to a determination of a non-restorable condition. The goal of successful restoration cleaning is to restore the appearance and utility of buildings and contents to pre-loss condition. Restoration contractors should employ source removal procedures that return the affected materials, items, and surfaces to pre-loss condition or to a condition where fire residues have been removed to the extent possible. Successful smoke odor removal is often reliant on effective source removal. Refer to *Section 8: Fire and Smoke Odor Management* for additional information.

Fire residues may be adhered or non-adhered to materials, items, and surfaces. The effects of heat, smoke, and chemical compounds found in certain fire residues have the potential to permanently bond to or alter the surface appearance, often proving destructive to these surfaces. Certain surfaces and materials that cannot be restored to pre-loss condition by cleaning alone may be able to be treated by alternative surface preparation procedures (e.g., media blasting, sanding) to accept cosmetic repairs or modifications. Building and contents surfaces and materials that cannot accept cosmetic repairs and where the appearance has been permanently altered by fire related damage (e.g., staining, corrosion, heat) may be considered non-restorable.

Source removal procedures include but are not limited to:

- reduce circulation and redistribution of airborne particulates (e.g., exhaust ventilation, HEPA filtration). It is recommended that this procedure continue for the duration of the source removal process so long as this particulate redistribution is a concern;
- demolition and disposal of burnt or non-salvageable materials if present; and
- cleaning and/or abrasion of affected surfaces and materials.

Prior to commencement of source removal work, thorough inspection and FSD assessment should be completed by the restoration contractor identifying all impacted areas including the levels of impact. The restoration contractor should provide restoration personnel (e.g., the project manager, or restoration crew team leader) with a RWP that is specific to that project. Instructions should also be provided indicating the sequence in which source removal services are to be performed and in which areas. Refer to *Section 2: Administrative Requirements and Documentation, Subsection 2.4.3: The Restoration Work Plan (RWP)* for additional information.

6.1 Pre-Work Considerations

Prior to any restoration activities, restorers should address conditions that can limit the work. This standard does not address all safety concerns associated with performing restoration work. Restorers shall establish appropriate safety, health and environmental practices and determine the applicability of regulations established by AHJ prior to the use of this standard.

Restorers should be aware of the potential for regulated hazardous materials to be present in buildings. When hazardous materials are suspected to be present, restorers shall perform their work in a manner consistent with regulations established by the AHJ.

Source removal of fire residues may need to be performed in occupied buildings. Unaffected areas should be isolated from affected areas using engineering controls. Restoration personnel shall designate work areas using signage, containment barriers (with clearly marked points of ingress and egress), caution tape or other measures to restrict access by building occupants in accordance with the AHJ. Restorers should

provide prior notification to occupants of the planned work that may cause disruptive noise, vibration, or odors, when possible. It is recommended that restoration personnel limit their presence in unaffected areas to minimize disruption to building occupants and reduce the potential for cross-contamination.

6.2 Work Site Preparation and Maintenance

It is recommended that restorers install appropriate floor protection in work areas and work access areas to prevent flooring damage. All flooring should be pre-cleaned (e.g., vacuumed, mopped) prior to the installation of floor protection materials. When present, contents items should be removed from the area or covered (e.g., plastic painter's drop cloths) to protect and prevent damage. Furniture prohibiting access to walls and ceilings should be carefully moved by lifting or the use of glides designed for moving furniture specific to the type of flooring (e.g., carpet, hardwood).

The RWP should identify the order in which specific areas are to be cleaned. Work areas should be maintained in a safe and orderly manner, which includes daily storage of equipment, tools, and materials.

6.3 Demolition

Demolition can take place as part of emergency services but is not always performed solely as emergency work. For example, emergency mitigation and stabilization work can include removal of building materials (i.e., demolition) and manipulation of contents (e.g., disposal, relocation, pack out). Emergency work is often performed under challenging conditions (e.g., wet drywall, unstable materials and assemblies in danger of collapse). Source removal demolition as part of a RWP should be safely performed in a dry, well-lit environment where engineering controls can be utilized.

Removal of fire and smoke damaged building materials that have been identified as unrestorable should be performed during the pre-cleaning phase of source removal. Restoration contractors should be capable of performing basic levels of demolition (e.g., drywall, trim, flooring, finishes). Materials that are to be removed by the restoration contractor should be clearly identified in the RWP. It is recommended that representative samples of unique, unusual, and high quality materials to be demolished be retained and documented.

Prior to demolition, materials that could be reused should be identified for detachment with the intention of subsequent reinstallation. These materials should be carefully removed, inventoried, and safely stored.

Removal of structural framing, plumbing and electrical fixtures, and systems (e.g., HVAC) shall be addressed in the permitting process obtained by, and performed by a licensed contractor, where required by the AHJ.

Disposal of all demolition debris shall be in compliance with regulations set forth by the AHJ.

6.4 Cleaning and Removal of Fire Residues

Restoration contractors should understand the effects of fire residues on materials, items, and surfaces based on their characteristics as well as the vulnerabilities of the building surface beneath the fire residues. Restoration contractors should understand the appropriate fire residue removal techniques based on sorption and porosity as related to the level of impact.

Restoration contractors should understand how cleaning products interact with materials, items, and surfaces and how cleaners and degreasers work to remove surface contaminants. Restorers should know that when performing source removal cleaning procedures, underlying and unrelated residues (soils) may also be removed. Refer to *Section 3: FSD Damage Assessment Subsection 3.5 Pre-Existing Conditions.* In certain situations, this may present complications to the project. For example, certain metals and older wooden finishes (e.g., copper building components, wooden banisters, ornate door casings), over time, develop a patina, which is a desirable discoloration due to oxidation and use. Restorers should discuss a

proposed method of fire residue source removal with the property owner before proceeding and risking the removal of the patina possibly diminishing the items value.

Cleaners and degreasers specially formulated for the removal of fire residues are typically alkaline. Restorers should always read and follow the manufacturers product instructions prior to using. The restorer should also refer to the manufacturer's product instructions regarding the recommended application process, dilution ratios, where applicable, that correspond to the level of fire residue contamination, and rinsing requirements. The restorer shall refer to the product label and Safety Data Sheets (SDSs) for safety information.

6.4.1 Cosmetically Altered Materials and Surfaces

Restorers should understand and communicate to clients that removal of fire residues does not always imply that the affected surfaces are fully restored. While fire residue removal is the intended result, surfaces can be cosmetically altered (e.g., smeared, stained) either by fire related conditions (e.g., heat, type of fire residue) or attempted removal procedures (e.g., vulnerable surfaces, surface porosity). When source removal cleaning procedures fail to restore appearance, certain surfaces and materials may be treated by alternative surface preparation procedures (e.g., media blasting, sanding) to accept cosmetic repairs or modifications (e.g., sealing, painting, or refinishing) if that surface or material allows. Refer to *Section 3.11: Test Cleaning of Impacted Surfaces* for information on evaluation of restorability of surfaces and materials.

Building materials that are severely damaged (e.g., non-restorable due to: being burnt, heat damaged) should be removed, when practical, prior to initiating any restorative surface cleaning procedures. Source removal and associated surface cleaning preparation procedures should render building surfaces and contents items as free and clear of fire residues and odors as practical or be left in a condition to accept cosmetic repair.

6.5 Treatments to Remove Fire Residues

Removal methods fall into two main categories: mechanical action (dry) and liquid (wet). These categories are further divided by varying forms of mechanical action and liquid procedures or combined as part of a source removal system based on the levels of impact. Restoration contractors should have knowledge and understanding of the way mechanical procedures and the use of liquids work to develop and implement effective removal methods.

6.5.1 Dry Mechanical Processes

Mechanical source removal processes range from gentle cleaning to very aggressive surface removal. Fire residues should be removed from impacted surfaces using the least aggressive and effective mechanical dry process that will not adversely affect the underlying surface. In certain situations, involving severe fire and smoke impact, moderate to very aggressive dry mechanical methods may be required to remove the residues. These procedures are likely to alter the surface or appearance creating the need for additional restoration or repair services. Restorers shall refer to all applicable local, state, federal or provincial safety regulations when using any of the following mechanical methods.

Examples of mechanical methods using the following tools for fire residue removal in order of aggressiveness include but are not limited to:

- dry process source removal by cleaning
  - compressed air – gentle; <30 PSI
  - dusting tools (lamb's wool duster, feather duster microfiber cloths) – gentle;
  - HEPA vacuum with appropriate attachments- gentle;
  - roller brush (sticky tape) – gentle;
  - cellular rubber sponge – moderate, and
  - steel wool, abrasive pads – moderate to aggressive;
- dry process surface removal by abrasion

- wire brushing or scraping – aggressive to very aggressive; and
- media blasting, or laser ablation – very aggressive.

6.5.1.1 Cellular Dry Rubber Sponge use in Non-Adhered Fire Residue Removal

The cellular dry rubber sponge is often referred to as a 'chem sponge' though it contains no added cleaning chemicals. These sponges should be used dry and without the addition of liquids or other products. These sponges are the most common tool used for removal of non-adhered fire residues on porous and semi-porous materials and surfaces. In certain situations (e.g., oily residues, protein residue), and on specific surfaces (e.g., semi-gloss paint, gloss paint, glass), the use of cellular dry rubber sponges may smear residues and is not recommended.

6.5.2 Liquid (Wet) Processes

Use of liquid cleaning processes should be performed after evaluation of the target surface and progressively increase the level of aggressiveness (i.e., strength of the liquid solution, the application media and energy) then proceeding in greater levels of aggressiveness until the desired results are obtained, if possible. To determine which liquid method is to be used, the restoration contractor should test various products for their effectiveness. Methods for applying liquid procedures include but are not limited to:

- trigger sprayer;
- wetted absorbent media;
- brushing, rolling;
- pressure sprayer;
- airless sprayer;
- foamer;
- water-based media blasting;
- pressure washing; and
- vapor and steam cleaning.

6.5.2.1 Preparation and Application of Wet Processes

On porous and semi-porous materials and surfaces wet processes may be used after mechanical dry processes have been performed and did not achieve pre-loss appearance. Restorers should know that liquids used during wet processes have variable properties and may have a detrimental effect on certain surfaces and materials. When cleaning with any type of wet processes, restorers should evaluate the product to determine if it can be effectively used on the target surface.

Liquid detergents and deodorizers specially formulated for fire residue and odor removal are typically concentrated and will need to be diluted in warm water to be most effective. In most cases, when mixing concentrated cleaning products with water, the water should be added to the container before the cleaning concentrates.

6.5.3 Combination of Dry and Wet Processes

Restorers should understand that the characteristics of the fire residue, surface material composition, and conditions beneath the fire residue determine the level of aggressiveness of the source removal processes. Source removal methods should be determined by test cleaning during the FSD assessment phase. In certain situations, dry mechanical action methods are sufficient, other materials and surfaces may only require liquid processes to remove fire residues (e.g., ceramic tile, porcelain, glass). Restoration contractors should understand that often, the sequence of dry mechanical followed by wet processes will yield the best results in the removal of fire residues and odors.

6.6 Source Removal Cleaning Principles

The cleaning principles for the removal of fire residues can be broken down into four categories:

- mechanical action;
- solvent action (i.e., liquid, wet procedures);
- lubrication (i.e., wet mechanical action); and
- chemical action.

6.6.1 Mechanical Action

Dry mechanical procedures do not involve the use of liquids and are based on friction, static attraction, and abrasion to remove fire residues from building surfaces. Restorers should understand that the level of impact of fire residue contamination and the underlying surface will dictate the most effective dry removal procedure. For example, materials and surfaces with light levels of fire residues may be fully restored to pre loss condition by dry mechanical action alone. Dry processes may not mitigate the corrosive action of acidic fire residues on vulnerable surfaces.

In moderate levels of impact, fire residue removal may also require procedures involving water-based cleaners and degreasers. Non-adhered fire residues should be fully removed from absorbent surfaces possible using dry mechanical action before applying liquid cleaners or more intensive cleaning procedures. Restorers should understand that dry mechanical removal is an essential preliminary step to avoid absorption of fire residues when liquids are subsequently applied. Wet mechanical action involves the use of towels, brushes, mop heads, natural sponges, etc.

Heavy levels of fire residue impact may require aggressive removal procedures (e.g., scraping, sanding, wire brushing and the use of abrasives). Restorers should be aware that aggressive procedures may alter the underlying surface appearance. It is recommended that restorers first test the use of aggressive methods in inconspicuous places, where possible, to determine if the surface and material may be damaged by this process. Restorers should request written approval from clients and other MIPs before broadly applying aggressive removal methods to materials and surfaces if the appearance may be altered.

6.6.2 Solvent Action (Wet)

Solvents are liquids that dissolve other substances. Water is often referred to as the universal solvent because more substances are soluble in water than in any other liquid. Restorers should utilize a variety of solvents and cleaning products containing water, added solvents, and other ingredients to loosen, suspend, dissolve, and flush fire residues from materials and surfaces.

Non-water-based solvents may be used on building surfaces that are vulnerable to water (e.g., odorless mineral spirits used on finished wood, non-flammable “safety solvent” for electric switches, and outlets).

Wet cleaning methods vary in the amount of liquid used, the method of application, desired dwell time and requirement to rinse. Restorers should read and follow manufacturer’s product instructions prior to using solvents and liquids.

6.6.3 Lubrication (Wet Mechanical Action)

In some situations, restorers should understand that it may be advantageous to combine a liquid solution functioning as a lubricant with an abrasive material to minimize surface friction during the cleaning process. For example, finest (0000) steel wool used in conjunction with a soapy detergent or wood restoration gel for cleaning finished wood (e.g., kitchen cabinets, wood furniture including antiques, doors, paneling).

6.6.4 Chemical Action

Restorers should know that chemical action is a surface modification process not a source removal process. Bleaching is an example of chemical action. The bleach itself does not remove the substance that makes the stain, only the color of the stain.

Solutions containing oxalic acid are often used in rust removal on metals, rust stain removal on metals and other surfaces, and water stain removal on wood. Oxalic acid works under the same principle as bleaches.

6.7 Source Removal by Abrasion

When source removal by cleaning is not effective in removing surface damage (e.g., scorching, charring) or staining (e.g., bonded, sorbed fire residues) restorers should attempt source removal by abrading the surface. Restorers should alert the client and other MIPs that the process of abrasion may alter the underlying surface. Restorers should only perform abrasive processes with the consent of the client and other MIPs before beginning. Frequently encountered materials that can accept some form of abrasive removal without affecting the structural integrity include but are not limited to:

- wood and metal framing;
- cookware, dishes*, silver*;
- roof sheathing;
- masonry (brick, block, concrete);
- structural steel (bar joists, I beams, supports); and
- finished metals (plumbing fixtures, appliances).

*Not including dishes that are hand painted, have gold leaf applied or are plated metals.

6.7.1 Gentle Abrasion Methods

Some surfaces can accept gentle abrasive removal processes without causing noticeable damage to the underlying material. These processes often combine mechanical action with a substance. The abrasive can be either the substance used, or the application media. Both the substance and the media can vary in aggressiveness. Examples of substances and media, as well as the surfaces they can be used on include but are not limited to:

- abrasive substances:
  - Liquid and powdered cleansers (e.g., for bathroom fixtures and kitchen appliances);
  - Metal polishes (may remove some forms of plating);
  - Rubbing compounds (e.g., for porcelain, fiberglass reinforced panels, appliances);
- abrasive media:
  - Finest steel wool (0000): used with wood restoration cleaner – finished wood (may soften some finishes); and
  - Abrasive pad: used with floor cleaner or finish remover (aggressiveness varies by application media).

6.7.2 Abrasion by Wire Brushing and Scraping

Methods for surface removal suitable on smaller or localized affected areas can be done using a hand tool or power tool. These processes are best suited for scorching, minimal charring, and flaking paint applications. These procedures may alter the appearance of underlying materials and surfaces and should only be used on items that allow cosmetic repair.

6.7.3 Abrasion by Media Blasting

Methods for heavy residue removal include a surface abrasion process known as media blasting. Media blasting is performed using compressed air to propel minute pieces of media at a surface with the intent of removing bonded and absorbed smoke residue by surface abrasion. Blasting equipment can be adjusted to increase or decrease surface removal rates. Blasting media range in level of aggressiveness and include, but are not limited to (listed in no particular order):

- sodium bicarbonate (baking soda);
- ground walnut shells;

- ground recycled glass;
- sand; and
- dry ice.

The restoration contractor should understand the variables such as where and when to (or not to) attempt abrasive media blasting as a source removal procedure. The very nature of dry media blasting implies that a portion of the affected surface may also be removed. Blasting processes can be destructive to certain materials (e.g., wood, brick veneers, and dye in masonry and mortar materials) resulting in an irregular appearance. The amount of surface removal is directly proportional to the type of substrate and the depth of heat damage (e.g., charring). For example, on wood framing, when charring is deep, abrasive blasting may be impractical to attempt. Where framing sustains a significant loss of surface due to charring its continued use shall be approved by the AHJ.

Dislodged building surface materials and spent media create a significant amount of dust and debris. The compressed air driving the media will force and distribute this dust and debris into adjacent spaces. Restorers should utilize engineering controls such as containment barriers, and powered ventilation equipment to reduce the spread of the blasting process related dust and debris. Extensive clean-up is required after completion of media blasting.

Media blasting has proven to be an effective remedy to restore use for building materials with heat and smoke damage (e.g., staining, scorching, charring) though it is rarely a standalone treatment. Surface discoloration and odors may remain after bulk scorched or charred material has been removed. Additional fire and smoke odor management processes can aid in odor control and should be performed prior to any application of sealers and paint. Refer to *Section 8: Fire and Smoke Odor Management* for additional information on fire and smoke odor management procedures including the use of desorbents.

Media blasting of non-porous and semi-porous contents should be performed by trained personnel with knowledge, experience and an understanding of what surfaces, materials, and items this process can be used on, and which media blasting system to use.

The restorer shall follow applicable regulations set forth by the AHJ when engaged in any blasting activity.

6.8 Source Removal Cleaning Applications

Upon completion of the FSD assessment, the restoration contractor should specify in the RWP the source removal cleaning treatments to be applied to obtain the restoration goals.

The restorer should realize a single category of source removal cleaning may not satisfy the goal of the RWP. Most often, projects will involve a combination of processes from all three categories and in no particular order. The restorer should know that the order in which these services are to be applied must be tailored to each specific project.

Source removal cleaning applications fall into 3 general categories:

Mitigation: Services performed to improve indoor environmental conditions, to prevent continued degradation of building and contents materials and surfaces, prevent incidental damage of contents items by handling and to minimize the interruption of building use. Mitigation services may include, but are not limited to:

- engineering controls such as outside air ventilation, use of AFD's (equipped with filters and bulk odor and gas adsorbent media), dust barriers (containment), odor management;
- dry removal processes (e.g., HEPA vacuuming, cellular rubber sponging, dusting tools) on most building surfaces. Cellular rubber sponging is not as effective on some non-porous surfaces (e.g., high gloss paint, stainless steel, glass);
- wet removal processes to prevent permanent staining of vulnerable solid surfaces (e.g., marble, stone, slate, vinyl, painted furniture); and

- pre-cleaning (e.g., high touch surfaces, upholstery, bathrooms, kitchen, flooring) and corrosion mitigation.

Refer to *Section 5: Mitigation and Section 8: Fire and Smoke Odor Management* for additional information.

Clean Only: Restorative cleaning alone will be the sole remedy required. Cleaning processes may include, but are not limited to:

- porous surfaces – dry removal mechanical action is the initial process. In some situations, if required, wet removal processes
- non-porous surfaces – wet removal processes, in some situations preceded by dry removal processes.

Clean or Prep for Paint (Cosmetic Repair): Source removal cleaning alone will not restore appearance, only prepare the surface for application of coating(s). These processes may include, but are not limited to:

- both dry mechanical and wet processes are required;
- may require multiple and repeated source removal cleaning processes (resulting in increased production labor and material cost)
- may require aggressive source removal abrasion processes (e.g., scraping, sanding, media blasting).

6.9 Post Source Removal Evaluation

The primary method to evaluate the effectiveness of source removal from accessible surfaces should be by visual evaluation. The restorer should establish attainable goals of source removal, including the post-removal surface appearance with the property owner and other MIPs before the work begins, which should be documented as part of the RWP. Areas of uncertainty can cause individuals, that do not understand the principles and goals of restoration, to form opinions that may be arbitrary or unrealistic. Restorers should apply their own skills gained by specialized training, knowledge, field experience and performance (project successes) to address concerns brought on by the evaluation of source removal effectiveness by MIPs.

6.9.1 Clean Only Evaluation

Surface evaluation where cleaning alone was the sole remedy should be wiped with a dry absorbent media (e.g., folded paper or terry towel, white cosmetic sponge, cellular rubber sponge) then visually inspected for any residue transfer. This evaluation is colloquially called the “White Glove” test. A successful “White Glove” test results in no transfer of visible fire residue onto the dry absorbent media.

6.9.2 Clean in Preparation for Paint Evaluation

As previously discussed in the introduction to this section, restorers should understand that removal of fire residues does not imply that the affected surfaces are fully restored. For example, cleaning source removal procedures may not fully return the surface to its pre-loss appearance or utility. Penetrated fire residues often cause surface staining. Smearing may occur when loose or penetrated residues are disturbed accidentally or intentionally (e.g., inappropriate removal processes).

In situations where fire residue staining is dark, the use of a primer, or sealer, as a first coat may be used to prevent bleed-through of the discoloration to the painted surface.

6.9.3 Repairable Treatment Evaluation

Abrasive source removal processes can remove portions of the affected surface yet some fire related discoloration may remain. The restorer should know that in most abrasive removal procedures, while the goal of the procedure may be attained (i.e., removal of scorched, charred, peeling surface layers) the appearance may not be fully restored. Like cleaning processes that do not return the surface to pre-loss

appearance, these surfaces will also require repair treatments (e.g., refinishing, reupholstering, sealing, painting). Prior to the application of the repair treatment there should be no loose residues, charred, scorched or peeling layers of the surface present.

6.9.4 Evaluation Objectivity

A sample area can be created by the application of the repair treatment(s) to a small representative area (e.g., a one square foot section of the affected surface). This sample area can then be used as a visual comparison to areas that have undergone source removal procedures but have not yet undergone repair treatments which demonstrates the end results of the restoration process.

Restorers should communicate to all MIPs that repair treatments (e.g., sealers, paints) should not be applied until after the post source removal evaluation has been completed and accepted. Application of these treatments (e.g., sealing, painting) without surface evaluation may obscure visual inspection, surface evaluation (where applicable) and potentially create undesirable conditions on the project. To help avoid these situations, the restorer should monitor the effectiveness of the removal processes at critical stages throughout the project. *Refer to Section 3: Fire and Smoke Damage (FSD) Assessment subsection 3.3 FSD Assessment Phases,3.3.1 FSD Assessment phase Response Goals* and *3.15 Ongoing Progress FSD Assessment and Quality Control* for further information regarding ongoing inspections on projects.

Section 7 Heating Ventilation and Air-Conditioning (HVAC) and Air Conveyance Systems (ACS)

7.1 Introduction

HVAC and ACS (hereafter both acronyms will be referred to solely as HVAC) include any mechanical systems that heat, cool, ventilate, clean, filter, treat, induce, or exhaust air. During a fire or smoke event, systems that recirculate or distribute indoor air, or a combination of indoor and outdoor air, can be impacted by heat, fire residues and odors. The source of the fire or residue may be within HVAC system (e.g., shorted or burnt fan motors). Impacted systems compromise indoor environmental air conditions and can act as a conduit for the distribution of fire residues and odors from the source areas to otherwise unaffected areas.

Following a fire or smoke event, the HVAC system should be assessed for impact by fire and smoke residues and odors. The HVAC assessment should be performed prior to continued operation and any form of restorative cleaning by a qualified HVAC assessor in accordance with this section.

7.1.1 Primary Purpose

This HVAC section has been written in conjunction with ACR, The National Air Duct Cleaners Associations for the Assessment, Cleaning and Restoration (NADCA) Standard for Assessment, Cleaning, and Restoration of HVAC Systems. The primary purpose of this section is to define HVAC assessment and remediation procedures beyond those already established in the NADCA Standard with specialized focus on how fire related residue and odor impacts the HVAC system. HVAC restoration is a specialized subset of property restoration.

By following the testing procedures outlined in this section, the HVAC assessors can provide recommendations to restoration contractors on how to proceed with HVAC restoration and in the development of the RWP.

HVAC assessments provide a preliminary determination of visible fire residue and related odor damage to HVAC systems following a fire event. The HVAC assessment and procedures are integrated with the latest edition of ACR, Assessment, Cleaning and Restoration of HVAC Systems by NADCA, National Air Duct Cleaners Associations.

Application

This standard section is written primarily for HVAC assessment companies, and secondarily, for those who assess HVAC systems for post-event damage.

7.1.2 HVAC System

The HVAC system includes any interior airside surface of the air distribution system for conditioned spaces and/or occupied zones. This includes the airside surfaces of the entire heating, air-conditioning, and ventilation system from the points where the air enters the system to the points where the air is discharged from the system.

HVAC system components include, but are not limited to:

- return and supply registers;
- return duct (including make-up air ducts) to the Air Handling Unit (AHU);
- the interior surfaces of the AHU;
- mixing box;
- coil compartment;
- condensate drain pans;

- humidifiers and dehumidifiers;
- fans, fan housing, fan blades;
- supply air ducts;
- air wash systems;
- spray eliminators;
- turning vanes;
- filters, filter housings;
- reheat coils; and
- supply diffusers.

The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems. For purposes of this standard, non-ducted ceiling plenums of all types and designs are not considered part of the HVAC system.

7.1.3 Additional Air Conveyance Systems

Mechanical systems may include but are not limited to:

- exhaust and extraction systems (e.g., dryer vents, bathroom exhausts, laundry exhausts);
- outside air intakes;
- elevator shafts;
- grease hood systems; and
- garbage chutes.

7.1.4 Exclusions to HVAC Systems

In addition to non-ducted open ceiling type plenums, the following surfaces are also excluded:

- non-airside surfaces of the system (e.g., exterior of a furnace and ductwork in a non-conditioned space); and
- insulating material on the outside of the ductwork.

7.1.5 Damage Mechanisms

Fire and smoke damage to HVAC ranges from very light to total destruction. Airside surfaces within these systems are subject to various forms of damage following a fire or smoke event. For the purposes of this standard, these forms of damage will be referred to as damage mechanisms. The principal damage mechanisms encountered when assessing the HVAC to determine the course of restoration, or replacement, include:

- physical damage to the system;
- characteristics, distribution, and deposit patterns of fire residues (e.g., adhered, non-adhered, odor, type of fuel, intensity of the fire, corrosiveness, etc.);
- effects from exposure to high heat;
- the presence of moisture (e.g., condensation from heat, fire suppression activity); and
- types of materials used in the construction of the system.

7.2 The HVAC Assessment

Restorers should understand that HVAC may be impacted by combustion particulates regardless of whether the unit was operational or off at the time of the fire or smoke event. Conversely, the presence of fire residues in a building does not necessarily indicate the event impacted the HVAC system components. In some applications, during a smoke or fire event, HVAC systems are designed to extract and exhaust smoke through the same ductwork. Due to these and other reasons, the initial HVAC assessment should be conducted by a qualified HVAC assessor to determine the impact of fire residues and odors and create the scope of restoration and repair.

HVAC assessors should document pertinent information found during the HVAC assessment which may be used by the restorer in the development of the RWP. These findings include but are not limited to:

- building usage type:
  - residential;
  - light Commercial;
  - heavy commercial;
  - industrial;
  - health care facilities; and
  - historically significant buildings.
- project considerations:
  - mechanical system configuration and component types;
  - age and serviceability of the components;
  - Project scheduling requirements;
  - engineering controls;
  - identifying areas where air turbulence will likely cause particles to accumulate; and
  - non-event related systems deficiencies.

7.2.1 The HVAC Assessor

The qualified HVAC assessor should have formal training and relevant experience in HVAC assessments of systems and airside components that have been impacted by a fire or smoke event. The qualified HVAC assessor should be proficient in performing testing procedures that will determine the restoration protocols that will assist the restoration contractor in the development of the RWP. In some situations, the restoration contractor may be a qualified HVAC assessor. Industry designations that determine a qualified HVAC assessor include but not limited to:

- NADCA Air Systems Cleaning Specialist (ASCS);
- NADCA Certified Ventilation Inspector (CVI);
- RIA's Certified Mechanical Hygienist (CMH);
- ACAC's Certified Indoor Environmentalist Consultant (CIEC);
- Certified Industrial Hygienist (CIH) with specialty focus on HVAC system assessment; and
- any other designation used should have a specialty focus on HVAC restoration.

7.2.2 Fire or Smoke Damage HVAC Assessment

The HVAC assessor should perform visual and odor inspections to evaluate the impact of fire residues on the airside surfaces of HVAC components. On any size project, an HVAC assessment should be made prior to restoration work being performed on that system. An HVAC assessment should integrate into the overall building restoration FSD assessment. HVAC specialists performing the HVAC assessment should be knowledgeable of and experienced in evaluating damage caused by direct fire, heat, fire residue, and associated odors to determine if the components are restorable or non-restorable.

To ensure effective RWP considerations and recommendations, the HVAC assessor should plan residue and odor removal sequencing with the restoration contractor regarding affected HVAC surfaces, airside and exterior. When a separate restoration contractor and HVAC contractor are used on a project, both contractors should agree on who is responsible for servicing affected surfaces, and the final evaluation methods to determine cleanliness and odor removal.

7.2.3 Fire Residue Concentration Points

After a fire event, fire residues and odors can accumulate in areas of the system where pre-existing particulate matter are known to accumulate under normal conditions. The HVAC assessor should prioritize visual inspections of known areas of pre-existing particulate matter. These areas include but are not limited to:

- air filters;
- evaporator and heating coils;
- control boxes such as mixing boxes and VAV boxes;
- turning vanes;
- base of a vertical riser; and
- fibrous lined return and supply plenums.

7.2.4 Determining Restorable and Non-Restorable HVAC Components

The characteristics and deposition of fire residue on airside surfaces often determine component restorability. For example, fire residues may be settled, adhered, or corrosive to the airside surfaces. The HVAC system components should be accessed for evaluation from multiple representative locations to determine the level of fire residue and odor impact. A thorough HVAC assessment may require some degree of disassembly of the HVAC components*.

In some situations, the mechanical operation and functionality of system components may need to be determined by a licensed mechanical contractor independent of the HVAC assessor. The restoration contractor should determine the HVAC restoration requirements of the RWP based on the assessment made by the HVAC assessor and the mechanical contractor.

*Note: AHJ regulations may require that a licensed HVAC contractor create any penetration or access into the HVAC systems.

HVAC assessors should include, but not be limited to, the following criteria when evaluating the restorability of components:

- HVAC components proximity to the fire;
- the age and serviceability of the components;
- type of materials used to manufacture the components;
- physical and material changes to the components as a result of the heat (e.g., deformation, melting, scorching, corrosion);
- the presence and effects of moisture (e.g., condensation, water from fire suppression efforts);
- the presence and effects of chemical deposits from fire suppression efforts (e.g., dry powder fire extinguishers);
- the impact of fire residues on porous materials (e.g., duct liner, duct board, and fibrous insulation) including but not limited to adhered residues, absorbed residues, non-visible residues (e.g., protein fire), fire or event related odors;
- the impact of fire residues on non-porous materials including but not limited to corrosion, adhered residues (e.g., oxygen-starved fires), non-visible odorous residues (e.g., protein fire), fire or event related odors; and
- cost-effectiveness of the proposed restoration.

7.3 Test Cleaning and Photo Documentation of Component Surfaces

Test cleaning of representative impacted surfaces should be conducted during the HVAC assessment to establish if the component is restorable, what condition it can be restored to and the recommended process(es) necessary for restoration. Test cleaning can also be used as a quality control criterion for final cleanliness. A flow chart is included within this document to enable the reader to visualize pathways for testing and aid in decision making for the RWP. Photos of the test cleaning should be taken of the existing condition and of the post-cleaning results side by side in the same photo, if practicable, for dry cleaning or damp wiping type restoration methods. Photo documentation of HVAC airside surfaces includes but is not limited to:

- sheet metal;
- duct liner;

- duct board;
- flexible duct;
- wooden pan joists;
- wall cavities used as HVAC airside surfaces;
- foamboard; and
- other airside surfaces. Refer to *Chart 1.1 in HVAC Assessment Flowchart.*

7.3.1 Restoration Considerations

The HVAC assessor should prepare samples that demonstrate the viability of the methods proposed in this section. All recommendations can be presented to the restoration contractor and MIPs for cost evaluation and development of the RWP. Friable materials (e.g., duct liner, duct board, fibrous insulation) should be evaluated for restorability from fire residue and odor damage without causing erosion to the fiberglass airside surface. This determination is made using the fibrous insulation erosion test. Refer to *Section 7.4.*

The HVAC assessor should perform the duct liner adhesion test to determine if the duct liner can support the additional weight of coating products. After performing dry mechanical source removal cleaning, duct liner and duct board with retained odors should require further testing and evaluation of proposed deodorization or coating products.

After performing dry cleaning, metal duct surfaces that have retained residues and odors should require further evaluation of proposed use of deodorizers or wet cleaning options, where applicable.

7.3.2 Non-Adhered or Adhered Fire Residues and Odors

Non-adhered residues are determined using the dry-cleaning method test. Event related residues that remain on a component surface after a dry-cleaning process is performed are considered “adhered residues”. Some adhered residues are permanent and not removable. Restorability of HVAC system components is primarily determined by the successful or unsuccessful removal of these residues and associated odors. The following methodologies will help resolve which surfaces can be restored and deodorized as well as those that cannot. Refer to *Chart 1.1 in HVAC Assessment Flowchart.*

7.3.3 Visual Comparison of Fire Residue Removal Methodologies

The HVAC assessor should identify representative areas impacted or not impacted by the fire or smoke event within HVAC systems for test cleaning and photo documentation. The photos should show the condition of the representative area upon first encounter then again after test cleaning. These photos will document the visual effectiveness of the various restoration methods. These results guide recommendations to restore, replace or take no action on a component. The final visual appearance of the components should be used by project decision-makers to create the site-specific scope for the HVAC systems. To perform these tests small portions of the component’s airside surface may have to be removed from the HVAC for odor testing.

7.3.4 Dry Cleaning Test (NADCA)

The NADCA procedure known as ACR Standard 2021 Surface Comparison Test Method 2 Protocol will be henceforth referred to in this document as the NADCA dry cleaning method. As stated in the NADCA Standard the test protocol is as follows: “*A vacuum brush shall be attached to a contact vacuum, and the device shall be running. The brush shall be passed over the surface test area four (4) times, with the brush depressed against the surface being tested using light to moderate pressure (as used in routine cleaning). The testing contact vacuum shall be HEPA-filtered and capable of achieving a minimum of 80 inches of static lift (WC). The contact vacuum shall be fitted with a 2.5-inch round nylon brush attached to a 1.5-inch diameter vacuum hose.” (NADCA Citation).*

The following decisions on how to proceed with HVAC restoration following the NADCA dry method are described below and can be visualized on the HVAC assessment flowchart. Refer to *Chart 1.1 in HVAC Assessment Flowchart.*

7.3.4.1 Evaluation of Metal components

Restoration evaluation of metal components indicating visible event related particulate that can be removed with dry cleaning methods should refer to Odor Retention Testing. Refer to *Chart 1.7 in HVAC Assessment Flowchart.*

- **Metal Components Visible Residue:** Restoration evaluation of metal airside surfaces with visible residue after the dry method testing should refer to the Damp Wiping Method Testing. Refer to *Chart 1.4 in HVAC Assessment Flowchart.*
- **Fibrous Insulation Components:** Restoration evaluation of fibrous insulation components suggesting event related particulate that can be removed with the dry-cleaning method such as duct liner and duct board should refer to the Insulation Erosion Test. Refer to *Chart 1.4 in HVAC Assessment Flowchart.*
- **Fibrous Insulation Components Visible Residue:** Restoration evaluation of fibrous airside insulation such as duct liner and duct board with visible residue after the dry-cleaning method test should refer to the insulation erosion test and the duct liner adhesion test before consideration of coating or replacement. Refer to *Chart 1.2 in HVAC Assessment Flowchart.*

7.3.5 Damp Wiping Method Test (non-porous surfaces)

The damp wiping method test should be performed on suspected adhered fire residues after the NADCA dry method has failed to remove the residues. Wet method tests are performed on metal airside and other non-porous surfaces. Wet test methods should be used to determine the effectiveness of a proposed cleaning solution for the removal of fire-related residues. These tests will also confirm when visual fire residues cannot be removed by damp wiping methods. Fire related residues not removed with wet methods are considered bonded to the metal surface. The effectiveness of each method is tested on selected representative airside surfaces to establish scope considerations and recommendations. Refer to *Chart 1.3 in HVAC Assessment Flowchart.*

7.4 Fibrous Insulation Erosion Test

Fiberglass insulation surface conditions vary from friable to stable. The fibrous insulation erosion test should be performed to determine if duct liner or duct board fiberglass surfaces can be restored using the dry cleaning method without abrading, fraying, or eroding the airside surface. Several factors can have an effect on the condition of duct liners and duct boards (e.g., age, product type, moisture, insulation location, thermal conditions). Insulated surfaces that cannot withstand the dry-cleaning method test without abrading, fraying, or eroding should be evaluated for the application of a repair coating or for replacement. The HVAC assessor should report the insulation erosion test results to the restoration contractor and MIPs. Refer to *Chart 1.4 in HVAC Assessment Flowchart.*

When the erosion tests indicate visual abrading or eroding surfaces, the duct liner adhesion test should be performed as part of the HVAC assessment. The adhesion test is required on duct liner but not typically applicable on duct board. Refer to *Chart 1.4 in HVAC Assessment Flowchart.*

7.4.1 Duct Liner Adhesion Test

When the erosion tests indicate visually abraded or eroded airside surfaces, application of a fiberglass repair coating may be considered. The HVAC assessor should determine if metal ductwork with a fiberglass liner is properly fabricated, glued and mechanically fastened to the metal duct. Prior to application of a coating, a duct liner adhesion test should be performed to determine the adhered condition of the duct liner to the metal surface to confirm that the duct liner can support the additional weight of the coating product.

The adhesion test is required on duct liner but not typically applicable on duct board.

Other common conditions that should be reported causing duct liners to delaminate, abrade, fray, or erode include but are not limited to:

- the proximity to the air handler;
- high velocity airflow;
- increased weight from adsorbed moisture
- close proximity to UV lights
- high temperatures from a combustion furnace (higher temperatures dry out resins and binders in the fiberglass over time).
- added weight from existing coatings;
- unfinished butt joints (unfinished joints collect particulate and can emit fiberglass fibers into the airstream);
- age of the duct liner (older duct liners surfaces can become highly brittle and not capable of supporting coating repair products);
- size of the duct and the air velocity at the location of the liner;
- deferred maintenance or neglect; and
- proper installation of the duct liner*

* Improperly installed duct liner may have missing mechanical fastener pins or inadequate glue coverage. Refer to *Chart 1.5: HVAC Assessment Flowchart.*

7.4.1.1 Duct Liner Adhesion Test Procedure

The HVAC assessor should select a minimum of a 400 square inch area of duct liner to be cut and removed from the metal duct surface the liner was attached to. A visual inspection of the exposed metal surface should be performed as to the amount of glue coverage applied by the original fabrication contractor securing the liner to the metal surface. The North American Insulation Manufacturers Association (NAIMA) states, *"Fibrous Adhesive shall be applied to the sheet metal with a minimum coverage of 90%. Mechanical fasteners shall be used to secure the duct liner to the sheet metal and shall be spaced in accordance with NAIMA FGDLS or SMACNA HVAC DCS". Citation Fibrous Glass Duct Liner Standard Design, Fabrication, and Installation Guidelines Third Edition, 2002 (Chart 1).* The restorer should document and report the results of the duct liner adhesion test to the MIPs.

An additional visual inspection of the exposed metal surface should be conducted to determine if fiberglass fibers from the duct liner are bound to the glue on the metal surface. This inspection will determine if the adhesive has lost its bond to the duct liner. The absence of bound fibers to the metal surface indicates that, even with appropriate glue coverage, the duct liner may not be capable of being coated.

In some cases, fiberglass liners and duct board may require replacement due to deterioration or a loss of structural integrity. Refer to *Chart 1.5 in HVAC Assessment Flowchart.*

7.4.2 Fiberglass Repair Coating

Fiberglass repair coatings should be considered on duct liner or duct board when the airside surface is eroding or friable or if the dry-cleaning method cannot remove the event related particulate and event related (smoke) odor without causing erosion. In addition to repairing the fiberglass airside surface, application of coating products can aid in blocking the transmission of fire related odors. All coating products considered for use should be specifically formulated by the manufacturer for use on airside surfaces and comply with appropriate fire and smoke spread rating according to applicable governmental regulations.

7.4.3 Coating Cost Considerations

When duct liner fails the erosion test but passes the duct liner adhesion test, the restoration contractor

should discuss the cost of coating versus replacement of the components with the MIPs. The restoration contractor should document the client's decision to apply coating products or to replace the components. Refer to *Chart 1.6 in HVAC Assessment Flowchart.*

7.4.4 Coating Compliance

HVAC coatings should be water-based, and meet or surpass:

- VOC content less than 100 g/l (as measured per ASTM D 6886 [American Society for Testing and Materials])
- Odor: 7 or greater (as measured per CRGI TM 78 Odor [Coatings Research Group International])
- Application: 4 or better scores for Appearance, Sag, and Spatter (as measured per CRGI TM 64 Application/Touch-up)
- Fire/Combustion & Superheated Air Testing (Compliance with building code and NFPA 101 Life Safety Code 90A/90B [National Fire Protection Association]):
    - Flame Spread: 0-25 (as measured per the latest edition of ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials)
    - Smoke Development:0-450 (as measured per the latest edition of ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials)
    - Exposure to Superheated Air: No combustion or major deterioration (as measured per the latest edition of ASTM C 411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation).

7.5 Odor Retention Test for Evaluation of Porous and Non-Porous Materials (Semi-Invasive)

HVAC assessors should know that even after professional methods of HVAC cleaning, metal, and fibrous insulated components may retain fire-related odors. HVAC assessors should perform odor retention testing to determine if detectable event-related odors are present on metal and fibrous insulated HVAC airside surfaces. These tests can be used to determine the effectiveness of cleaning methods, deodorization, and coating procedures. Test results establish recommended options for the restoration contractor. When there is a dispute among the MIPs over the absence or presence of event-related odors, it is suggested that independent third-party evaluation be considered to develop the RWP. Refer to *Chart 1.7: HVAC Assessment Flowchart.*

7.5.1 Odor Retention Testing Sample Protocols

Fibrous insulation: The HVAC assessor should select four samples of potentially affected duct liner or duct board for odor and visual testing. It is recommended that each sample be at least 10" x 10". These sections shall be permanently removed and replaced with an approved equal insulation. The test sections of duct liner and duct board should be removed from the same general area of the HVAC system and prepared for a retained odor evaluation. To retain the system's thermal integrity, the HVAC assessor should replace the test sections with a piece of like, kind, and quality insulation in accordance with applicable governmental regulations. Refer to *Chart 3.1 and Chart 3.2 in HVAC Assessment Flowchart.*

Metal components: The HVAC assessor should select four samples of potentially affected metal duct for odor and visual testing. It's recommended each sample be at least 10" x 10". The test sections should be removed from the same general area of the system and prepared for evaluation. To maintain the system's integrity, the HVAC assessor should replace the test sections with a piece of like, kind, and quality metal in accordance with applicable governmental regulations.

*Note: AHJ regulations may require that a licensed HVAC contractor create any penetration or access into the HVAC systems.

7.5.2 Sample Preparation for Odor and Visual Evaluation

Fibrous insulation and metal component samples should be individually placed inside an airtight container (e.g., zip closure plastic bag or a site made enclosure fashioned from polyethylene sheeting or aluminum foil and tape) no larger than twice the dimensions of the sample. All project specific sample enclosures should be similar.

Numbered samples should be prepared as follows:

1. **Baseline Untreated**: one sample should be retained as first encountered.
2. **Dry Cleaning Method Only**: sample should be vacuumed using the NADCA protocol known as ACR Standard Surface Comparison Test Method 2 Protocol.
3. **Dry Cleaning Method and Deodorize:** sample should be vacuumed using the NADCA protocol known as ACR Standard Surface Comparison Test Method 2 Protocol then a deodorizer will be applied in accordance with manufacturers recommendations.
4. **Dry Cleaning, Deodorize, and Coated** (**Duct Liner-Duct board Only**): sample should be treated the same as item #3, with the addition of a coating applied in accordance with manufacturers recommendations.
5. **Dry Cleaning, Deodorize, and Damp Wiping Method – (Non-Porous Only):** sample should be treated the same as item #3, with the addition of a damp wiping. Refer to *Chart 3.1 and Chart 3.3 in HVAC Assessment Flowchart.*

All products should be applied to the airside surface of the test sample and allowed to dry and cure in accordance with the manufacturer's directions.

7.5.2.1 Sample Documentation

Each sample test area should be photo documented. The sample location, test process(es), assessor ID, and the date should be written on the sample container for the chain of custody.

7.5.3 Odor Evaluation of Repair Coating

A sample should be prepared (coated) and cured in accordance with manufacturer's instructions before being inserted into the airtight container. After a minimum of 24 hours but no later than 72 hours the sample collection should be opened in an odor neutral area and odor evaluated by the MIPs. Refer to *Chart 1.7 in HVAC Assessment Flowchart and Flowchart 3.*

7.6 Test Results and Recommendations

The odor evaluation of all samples (e.g., baseline, porous, non-porous, coated, non-coated) should follow the same procedures performed in the same order. Odor evaluations by MIPs should be performed in a manner so as not to influence decisions of others. Individual results should be documented. Any fire related suspected odor impact beyond these test result evaluations should be determined by an independent third party. Odor evaluations of samples should determine the course of restoration as follows:

7.6.1 Baseline Sample (Sample1) Evaluation

Baseline samples should be evaluated as follows:

- When no event related odor is detected and no event related residue is observed, the component should not be restored.
- When an event related odor is detected, proceed to sample 2.
- When an event related residue is observed, proceed to sample 2.

7.6.2 Dry Cleaning Method Only (Sample 2) Evaluation

Dry method samples should be evaluated when:

- no event related odor is detected, recommend dry cleaning method process.
- an event related odor is detected, proceed to dry method and deodorizing (Sample 3).
- event related residue is observed after dry method vacuuming, proceed to Sample 4 or 5 method. Refer to 7.4 and 7.5 for information.

7.6.3 Dry Cleaning Method and Deodorized (Sample 3) Evaluation

Dry cleaned and deodorized samples should be evaluated when:

- event related odor is detected, follow dry method process and the application of proposed deodorizer.
- an event related odor is detected (Duct Liner Duct board), proceed to sample 4 dry method and coated sample process.
- an event related odor is detected (metal), proceed to sample 5 dry method damp wipe sample process.

7.6.4 Dry Cleaning Method and Coated (Duct Liner-Duct board) (Sample 4)

Dry cleaned and coated samples should be evaluated when:

- no event related odor is detected – and cured coating related odors are acceptable. Recommend coating of the component.
- event related odor is detected – Recommend replacement of the insulation or component

7.6.5 Dry Cleaning Method Damp Wiping (Metal components only) (Sample 5)

Dry Cleaned method and damp wiping samples should be evaluated when:

- no event related odor is detected, clean the system by dry cleaning method followed by damp method.
- an event related odor is detected, replace metal components.

7.5.3.2 Accelerating Stress Test

Consideration may be given to accelerating the off gassing of event related odors on the samples. To perform this acceleration, the sample should be subjected to similar environmental conditions of heat and moisture that the HVAC airside surfaces may encounter under normal heating and cooling cycles.

Fire related odors that are detected by one person, but not necessarily by others, should be further evaluated. Internal temperatures of localized components in operational HVAC systems can reach high temperatures. Heat reacts with substances on surfaces to increase molecular movement (e.g., off gassing). In humid climates, the moisture content of air may also factor into the detection of odors. One test method for the MIPs to consider may be to artificially promote the release of odors from the surface by the targeted application of heat and moisture to the samples.

7.6 Optional Evaluation Methods for Fire Residue Distribution

When situations arise where the presence of fire residues must be validated, restoration contractors may use additional methods for testing of fire residue distribution in HVAC systems. In these situations, evaluation by an independent third-party laboratory may be required. Information regarding test strategy by third-party analysis can be found in the IESO/RIA Standard 6001 Evaluation of Heating, Ventilation and Air Conditioning HVAC Interior Surfaces to Determine the Presence of Fire-related Particulate as a Result of a Fire in a Structure latest edition.

7.7 Regulatory Requirements

The restorer shall either be or use a licensed HVAC and duct cleaning contractor in adherence to regulations set forth by the AHJ.

7.8 HVAC Assessment Flowcharts

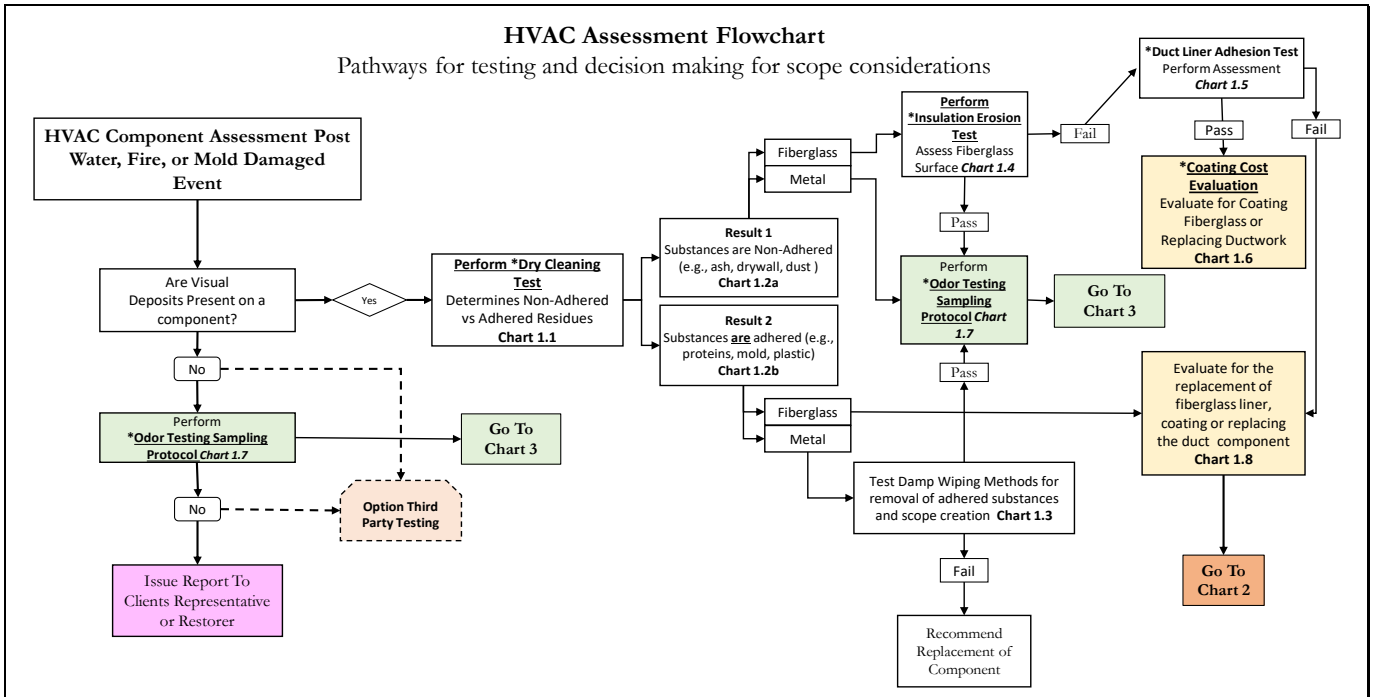

Chart 1 HVAC Assessment Detail

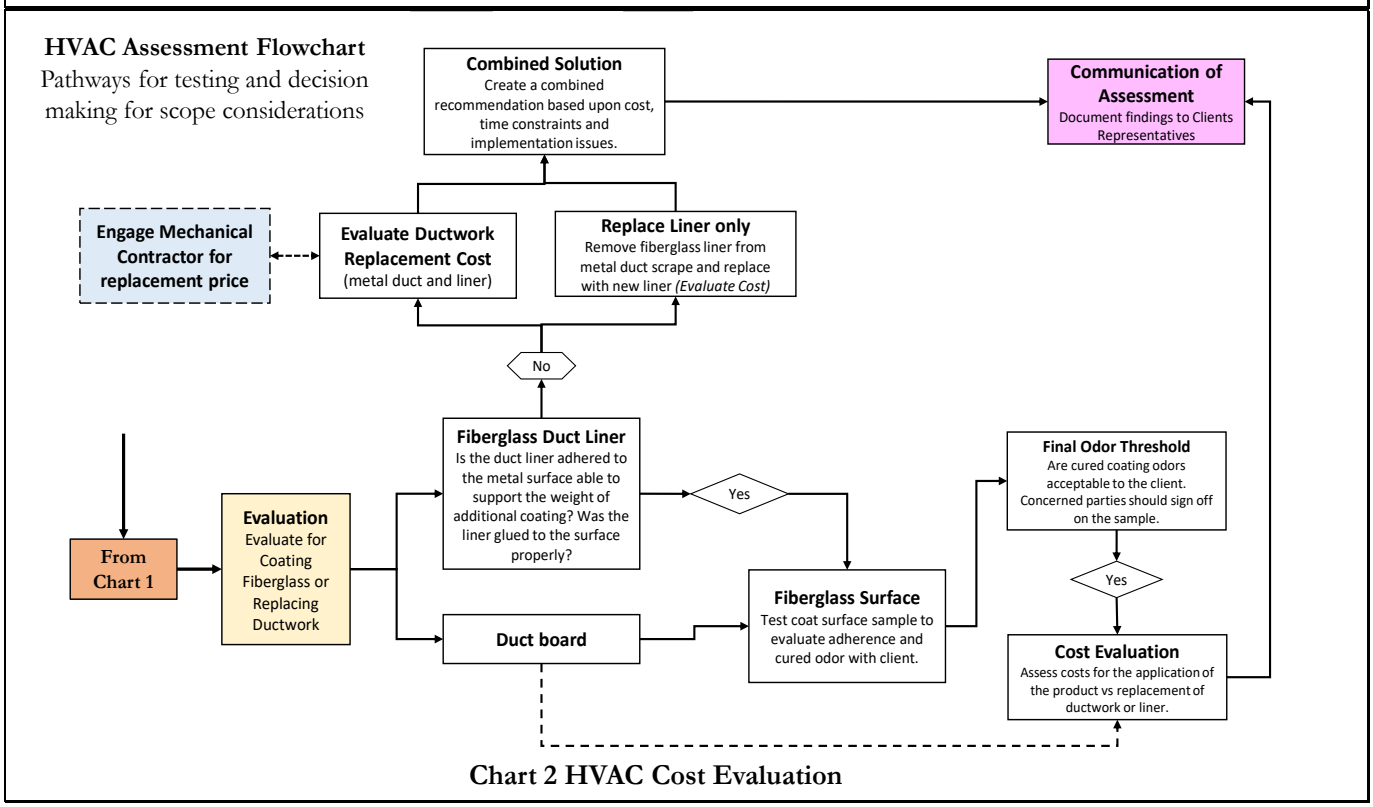

Chart 2 HVAC Cost Evaluation

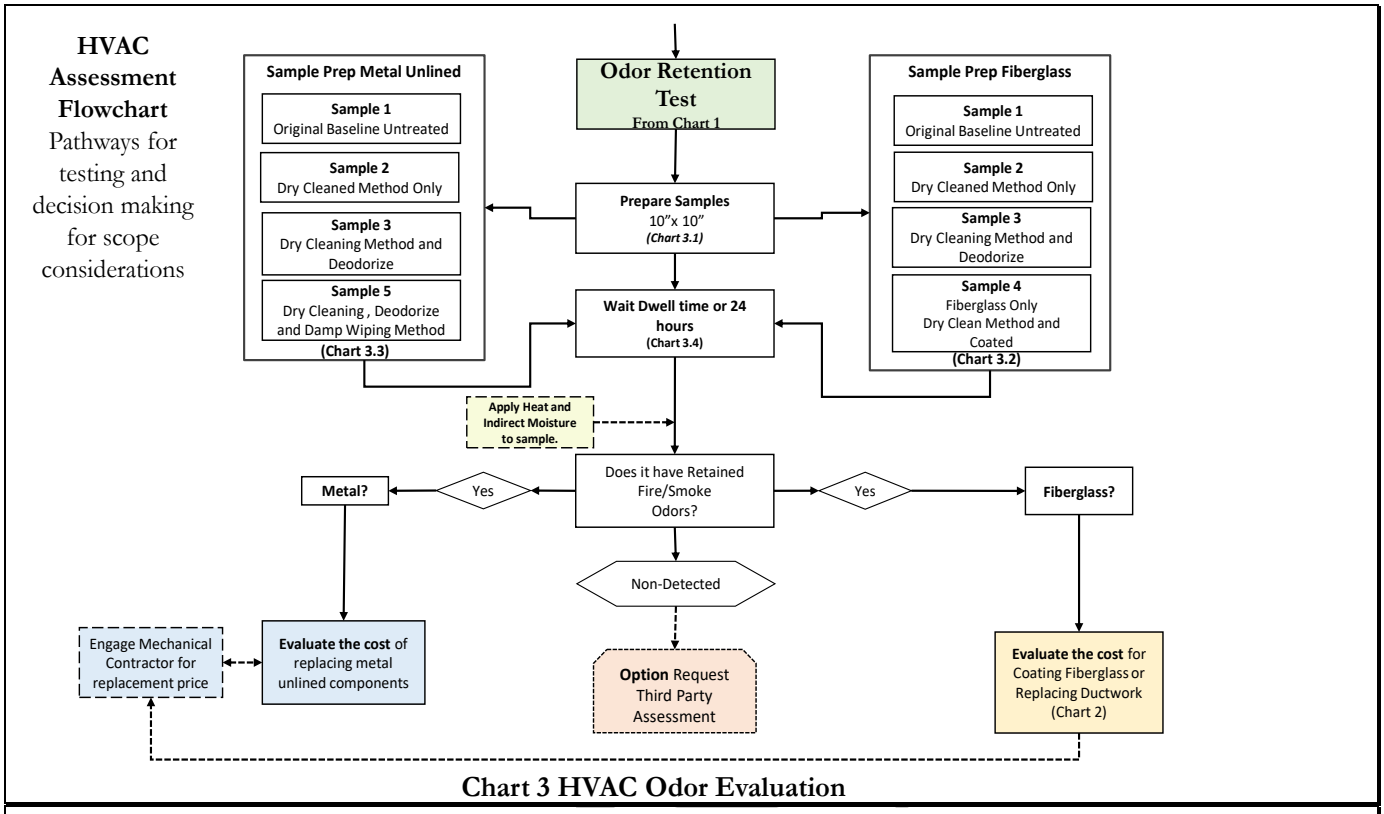

Chart 3 HVAC Odor Evaluation

HVAC Assessment Flowchart

Pathways for testing and decision making for scope considerations

Assessment flow on Ductboard and Duct Liner

Structural Fire and Wildfire Related

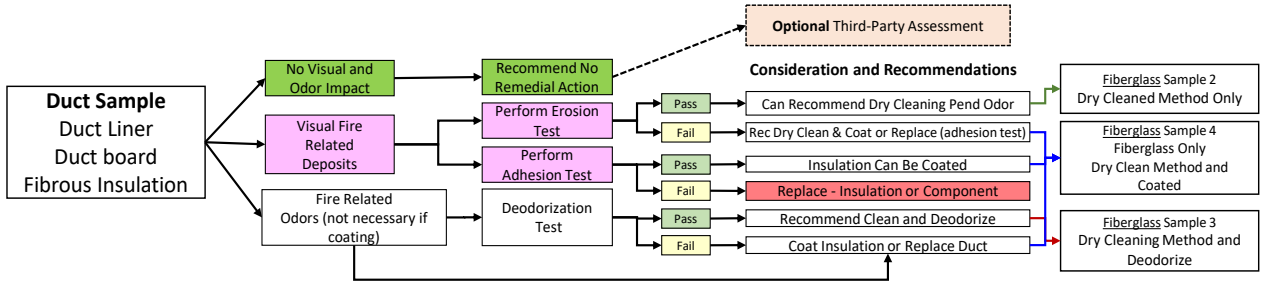

Chart 4 HVAC Quick Assessment Guide Fire Related

8 Fire and Smoke Odor Management

8.1 Introduction

The principal objectives in addressing damage following a fire or smoke event are to restore appearance, utility, and value to a building and its contents. Though not specifically addressed by those terms, the 'smell' of a building following a fire is of great consequence to the property owner and occupants. Fire-related odors are malodorous and compromise indoor environmental conditions. A building that smells of fire-related odors is an indicator that fire residue contaminants are present and therefore may not be deemed suitable for occupancy, indicating a loss of use and consequently, value.

Fire-related smoke odors are complex odors due to the combination of materials burning and the availability of heat and oxygen. Fire-related odors range in intensity from very faint to very strong. Restorers should know that no single method of fire and smoke odor management applies to all situations. Restorers should apply the appropriate fire and smoke odor management process(es) to address the intensity of the odor present. For example, in some situations of very faint fire odor, ventilation alone may remove the odor. Conversely, strong concentrations of odor will require a combination of odor management methods. Restorers should also know that smoke odors may not be removable from all surfaces and materials; particularly those that are inaccessible or are not economically feasible to restore.

8.1.1 Contributing Factors to the Severity of Fire-Related Odors

Restorers should understand that smoke odors are complex and that effective fire and smoke odor management after a fire or smoke event requires requisite knowledge of the factors that affect the severity of fire residue odor. These factors include but are not limited to:

- substances (fuels) burned in the fire;
- amount of available oxygen (rate of combustion);
- duration of the fire;
- heat and pressure produced;
- physical fire damage (e.g., melting, scorching, charring):
- smoke distribution, deposition and penetration into cavities;
- building design and layout;
- type of heating/cooling/ventilation system;
- method of extinguishment;
- residue attraction to statically charged surfaces, cooler surfaces, and metal surfaces
- surface material composition; and
- sorption and surface material level of porosity.

8.1.2 Fire Residue Characteristics

Restorers should know that different materials that burn produce residues and related odors that are unique to that fuel (e.g., natural, synthetic, protein, fuel oil). The following are examples of the characteristics of fire types and related odors:

- natural substance fire (e.g., burnt wood, paper, cotton, wool);
  - residue texture is dry, ashy, powdery and is dark gray/black in color
  - smells like a campfire
- synthetic substance fire (e.g., burnt plastics, PVC, nylon, polypropylene);
  - residue is sticky, smears easily and is black in color
  - smells like burnt plastic
- protein substance fire (e.g., carbonization of meat, beans, bones);
  - residue forms greasy, sticky film which may not be readily visible, and generally yellow-ish or orange-ish in color
  - pungent, rancid odor
  - persistent, stubborn odor

- fuel oil (e.g., puff back)

Restorers should also know that in most internal fires, multiple types of materials (fuels) have burned resulting in widely variable residues and odors.

8.2 Inspections

Successful removal of fire related odor is dependent upon identification of all impacted areas and surfaces. In order to prepare a comprehensive RWP restorers should perform inspections to identify areas, surfaces and materials within the building that require fire and smoke odor management procedures. The restorer should also perform on-going progress inspections at critical points to evaluate the effectiveness of the fire and smoke odor management procedures. It is recommended that odor evaluations be performed in conditions that are similar to the normal temperature and RH conditions, when feasible. Restorers should perform a final odor inspection prior to re-occupancy or reconstruction (e.g., walls, ceilings, floors, insulation). Refer to *Section 3: Fire and Smoke Damage (FSD) Assessment subsection 3.14 Smoke Odor Testing* for additional information on odor inspections.

8.3 Odor Management Resources

Restorers should know that residual fire-related odor is a combination of primary and secondary odor sources, Burnt and charred materials are the primary odor sources. Fire-related particulate and smoke odor sorbed by materials and surfaces are secondary smoke odor sources.

Restorers should understand that the removal of fire-related odors from a structure and its contents, is usually not completed by a single treatment application. As restoration projects progress, restorers should evaluate and adjust the types of fire and smoke odor management treatments being applied. For example, in the aftermath of a fire an emergency response is often required to stabilize buildings, mitigate damage, secure/remove personal property, etc. As part of an emergency response phase, restorers should deploy odor management techniques that can improve indoor environmental conditions (e.g., fresh air ventilation, installation of AFDs equipped with adsorbent media filters). During FSD damage assessment, exploratory demolition may uncover hidden damage previously unseen. Smoke may have penetrated cracks and crevices (e.g., staircase assemblies, the space between and behind wall-mounted cabinetry). Treating inaccessible or economically prohibitive areas may require alternative processes to render the odor undetectable (e.g., application of chemical barriers, sealers, expandable foam, caulk). Persistent fire-related odor is an indicator that odor sources and fire residues are still present. Fire and smoke odor management of a project is not complete until the absence of fire-related odor is confirmed during post-restoration evaluation.

Examples of odor management procedures include but are not limited to:

- dilution and ventilation to exchange contaminated indoor air with outdoor air;
  - aided by blowers or exhaust fans
- HEPA filtered AFDs
  - used with adsorbent media (e.g., carbon) for odor removal
- odor suppressing contact spraying of odor sources with smoke odor counteractants*;
- ULV misting*;
- thermal fogging*;
- isolation of odorous materials (e.g., non-permeable containment barriers);
- oxidizing generators*; and
- vapor release (e.g., gels, granules, impregnated media).

*Special considerations when using these procedures require occupants, pets, and sometimes plants to vacate the areas being treated until such time that it is deemed safe to re-enter. Restorers should post 'Do Not Enter' warning signs (including "safe re-occupancy" time) at all points of ingress and egress during any on-site fire and smoke odor management process that emits liquids, gases, or vapors into the air.

Restorers should be advised due to the unknown nature of background chemicals present in the indoor environment before the fire event and the unknown nature of combustion byproducts created during the event, the addition of reactive oxidizing chemistry to indoor spaces should be done with caution.

8.4 Fire Odor Management Procedures

Based upon the levels of damage, fire residues and related odors on material surfaces and in ambient air, restorers should determine which remedial procedure(s) to employ. Restorers should rely on their training, experience, and in some instances onsite product or process trials. Examples include light concentrations of fire-related odor with no residues that may be removed by air treatment alone (e.g., exhaust ventilation, adsorption, vapor phase treatment, oxidation phase treatment). Light to moderate levels of fire-related odor and residues may be removed by air treatment coupled with dry mechanical source removal methods and wet cleaning processes. Heavy levels of fire residues may require aggressive source removal and residue removal procedures combined with multiple or more aggressive air treatments. Surface materials that are burnt, scorched, or charred may require aggressive procedures such as media blasting or physical removal.

Physical removal of sorbed smoke odors from material surfaces and ambient air is a multi-step procedure. The following are examples of odor management procedures:

- source removal;
- source containment and odor suppression;
- smoke odor counteractants;
- vapor phase treatments;
- oxidation; and
- sealers.

8.4.1 Source (Physical) Removal

Restorers should know that source removal is an important component of odor management. However, there are effective fire and smoke odor management techniques that do not involve removal which restorers should consider, particularly when fire odor sources are inaccessible, or removal is economically prohibitive. Fire odor removal processes include but are not limited to:

- air washing using forced air blowers;
- use of adsorbing compounds (activated carbon);
- cleaning;
    - dry mechanical (e.g., lamb's wool duster, HEPA vacuum, cellular rubber sponge)
    - liquid (e.g., contact cleaning with detergents and degreasers)
        - Pressure washing
        - Immersion
- removal (demolition) of charred or burnt building materials;
- surface abrasion (e.g., scraping, sanding, media blasting); and
- application of desorbents to accelerate off-gassing (e.g., alcohol and water solutions).

8.4.1.1 Air Washing

Air washing is the use of forced air blowers directed at a specific surface to accelerate off-gassing and to remove loosely adhered fire residues. Equipment is available which will allow the restorer to carry the device while moving from area to area. It is recommended that use of an AFD (e.g., air scrubber) be used in conjunction with air washing equipment. Alternatively, restorers should open windows and/or doors to ventilate while air washing, when possible. It is recommended that restorers perform air washing procedures in unoccupied spaces.

8.4.1.2 Adsorbers

When fire and smoke odor management of occupied spaces is required, restorers should utilize AFDs that are equipped with odor adsorbent media (e.g., activated carbon). These substances sorb odor vapors onto their surfaces. Air filtration with adsorbents may be used in occupied spaces and should be run continuously so long as ongoing improvement is noticeable and then until the desired results have been achieved. Adsorbers may be effective as a standalone fire and smoke odor management treatment for some odors or as a complimentary procedure to other odor removal methods. Use of adsorbers to improve indoor environmental conditions and may be beneficial on all projects.

8.4.1.3 Cleaning

Fire related residues are the most common source of smoke odor, Fire residues are particles of carbon and other substances that have been deposited by smoke on material surfaces. When particles collide with surfaces with sufficient velocity caused by heat and pressure, they will attach and remain on that surface until physically removed. As smoke cools the particles lose velocity and the fallout of the air stream onto horizontal surfaces. Air filtration (i.e., air scrubbing) using adsorbent media of air, gaseous oxidation, thermal fogging, and ULV fogging do not remove the settled particles from material surfaces. This process is accomplished by source removal cleaning.

The intent of fire residue removal cleaning is two-fold. Restoring the surface material appearance or leaving the surface materials in a condition to accept cosmetic repair and removing or reducing the odor by removing the odor emitting residues.

Refer to *Section 6: Source Removal* for additional information regarding dry mechanical and liquid cleaning processes.

8.4.1.4 Removal from Building/Demolition

Removal of charred or burnt materials, when present, should be the primary procedure in effective fire and smoke odor management. Burnt, scorched, heat damaged, and charred structural materials should be evaluated for integrity by a qualified professional. Those materials that fail structural integrity evaluation should be removed from the building at the direction of a qualified professional. Demolition, removal, and disposal of non-salvageable materials should be performed by the restorer prior to other source removal procedures.

8.4.1.5 Removal by Abrasion

Structural materials that have been impacted by fire may show signs of severe damage (e.g., significant smoke staining, scorching, charring) yet may still be structurally sound. For example, wooden floor joists are considered structurally sound until burnt char reaches a depth where significant reduction of structural integrity occurs. The point at which wooden framing needs to be removed or reinforced is governed by local building codes or pursuant to a structural engineer's recommendation. These materials should be identified for restoration cleaning or abrasion processes, depending on the level of damage. When structural building materials show signs of severe damage, restorers should consult with qualified professionals or the AHJ.

Restorers should know that when surfaces and materials that are determined to be structurally sound yet show visible signs of fire and smoke damage also emit fire-related odor. When deeply penetrated fire residues and odors in wooden framing are encountered, restorers should continue abrasion of severe damage up to the point, identified by the specialized expert or AHJ, where any further abrasion may compromise the structural integrity of the material. When the structural integrity of framing is determined to be compromised by a specialized expert or AHJ, the restorer may suggest restorative options. The options may include treating and then structurally reinforcing the compromised framing. The remaining option, which like the reinforcing of the compromised framing, would fall to the reconstruction contractor, would be removal and replacement. The final determination, including the cost effectiveness of restoration, should include agreement among the restorer, the specialized expert, and the MIPs.

When visual charring or scorching remains after abrasion, restorers may consider applying liquid process (e.g., saturation spraying with smoke odor counteractant, desorption to ensure fire-related odor emissions from these materials have been managed. Abrasion processes are likely to alter the appearance of the material being abraded to the extent that repair treatments (e.g., paint, refinishing) may be necessary.

8.4.1.6 Desorption

Desorption is the opposite of absorption. In fire restoration, desorption is a direct contact spraying procedure that promotes the release of adsorbed odors from the surfaces using a mixture of a volatile liquid (e.g., isopropanol or ethyl alcohol) and water. Restorers when confronted with a persistent (deeply absorbed) fire-related odor into porous materials (e.g., framing lumber, underlayment, wall and roof sheathing, masonry, ceiling tiles, contents) following aggressive removal procedures may consider using desorption. Desorption solutions that contain alcohol are flammable. Restorers shall adhere to all safety protocols set forth by the AHJ.

Restorers who perform desorption procedures should incorporate intensive exhaust ventilation into the process to remove the desorbed odors and substances from the interior of a building.

8.4.2 Source Containment and Odor Suppression

Restorers should know that after a fire has been extinguished, impacted surfaces where either physical damage has occurred (e.g., burnt, scorched, charred) or where fire residues were deposited will continue to emit fire-related odors. Certain situations may prevent thorough removal (e.g., economic feasibility, restricted access). In these situations, restorers should contain odor-emitting sources. This can be effectively completed by odor suppression spraying (e.g., saturation spraying with odor counteractants) or by using plastic film to isolate the sources. Surface odor suppression saturation spraying reduces or prevents further emission of smoke odor from a surface. Restorers should understand that it may be necessary to repeat the process of suppression spraying until the desired results have been achieved prior to additional odor management procedures (e.g., application of sealers).

8.4.3 Liquid Smoke Odor Counteractants

When fire related odors are present, it is recommended restorers include the use of smoke odor counteractants to the extent possible when cleaning affected surfaces and, when required, entire spaces. Smoke odor counteractants reduce and may eliminate smoke odors on target material surfaces and ambient air.

Restorers should understand the functionality of liquid smoke odor counteractants and their constituents. Examples may include, but are not limited to:

- water - acts as a carrier, diluent, penetrant;
- lighter volatility constituents (e.g., alcohols ethyl/isopropyl) desorb less volatile substances and speed evaporation and drying;
- heavier constituents (e.g., propylene glycol) slow down evaporation;
- surfactant - emulsifies fragrance oils, emulsifies odor counteractant, and assists surface penetration by decreasing surface tension;
- odor counteractants - counteraction is an opposing effect by a contrary action that causes a change. Odor counteractants interact with malodorous molecules effectively reducing or eliminating their odor below olfactory detection. Odor counteractants vary in their function (e.g., molecular bonding, trapping, lowering vapor pressure); and
- fragrance - provide a uniform, and temporary, sensory gauge of performance.

Note: Restorers should know that the use of smoke odor counteractants and other restoration products may involve the introduction of another odor, whether through the inherent odor of a chemical constituent of the formulation (e.g., solvent, or liquid oxidizer) or as an added fragrance material.

After all the inherent odors of fire restoration-related products have dissipated, no fire-related odors should be detectable. Refer to *Section 3: Fire and Smoke Damage (FSD) Assessment subsection 3.14.2 Odor Testing Evaluation and Dispute Resolution* for information on post-restoration evaluation.

8.4.3.1 Direct Contact Application of Liquid Smoke Odor Counteractants

As discussed in section 6.4.4.2 direct contact spraying with aqueous smoke odor counteractant can be an effective smoke odor suppression as a form of odor containment. In this application. Liquid smoke odor counteractants should be applied in sufficient quantity and in direct contact with the target surface.

Restorers should know that sprayers that apply odor counteractants come in a variety of types depending on the needs of the project:

- trigger sprayers - used for individual target surfaces (e.g., contents items);
- manual pump sprayers - uses pneumatic (air) pressure to produce spray droplets (requires continuous re-pumping to maintain adequate compression);
- electric/battery powered sprayers can produce continuous spray until the liquid odor counteractant requires replenishment; and
- electrostatic sprayers use a liquid, combined with air, atomized and electrostatically charged by an electrode inside the device. The electrostatically charged droplets can overcome gravity and adhere to any surface they are directed towards. These sprayers are particularly desirable for spraying oddly shaped objects and hard to reach places.

8.4.3.2 Other Liquid Smoke Odor Counteractant Applications

Liquid smoke odor counteractants can be applied by a variety of mechanisms including but not limited to:

- as an additive to detergents and degreasers;
- fogging (cold misters, thermal); and
- as a vapor phase odor treatment.

8.4.3.2.1 Smoke Odor Counteractants as an Additive to Detergents and Degreasers

Restorers should know that detergents and degreasers that are effective in source removal can be augmented to provide effective smoke odor removal on many odorous surfaces and materials by adding the odor counteractant to the cleaning solution. Restorers should follow manufacturer recommendation on dilution ratios and application rates.

Restorers should choose the appropriate method of application of odor counteractants based on several factors. These can include, but are not limited to:

- the type and porosity of materials and surfaces impacted by fire related odors;
- the size of the affected space;
- jobs that require a fast turnaround; and
- economic feasibility.

8.4.3.2.2 Smoke Odor Counteractants Used in Fogging

Restorers that respond to emergency fire losses should know that turn-around time and cost-effective odor abatement may also be a critical component of the job. For example, large spaces (e.g., big-box-stores, gymnasiums, auditoriums, places of worship, airplane hangars) that require immediate response to fire related odor for occupancy and potential use can be treated in a matter of hours using thermal fogging technology.

Restorers should understand that thermal fogging formulations are not interchangeable between different types of thermal fogging equipment. Restorers should:

- be trained in the proper safe operation and use of thermal foggers in accordance with the manufacturer's instructions;
- follow chemical manufacturer's instructions;
- be aware that any spraying, misting, or fogging in the proximity of smoke alarms may trigger smoke alarms; and
- notify the local fire department prior to thermal fogging, in the event that white fog escaping from a building during treatment may be mistaken for a fire.

8.4.4 Dry Vapor Phase Smoke Odor Treatment

Dry Vapor phase odor management processes rely upon evaporation to circulate vapor phase odor treatment within the area to be treated. Vapor phase odor management processes do not involve misting or fogging. Distribution occurs naturally on available air currents or may be augmented by low CFM air movers (fans) or HVAC system blowers.

The following are examples of vapor phase odor treatment:

- liquid odor treatment with evaporative wicks;
- odor treatment granules;
- odor treatment gels; and
- odor treatment impregnated (e.g., with essential oils) with porous materials.

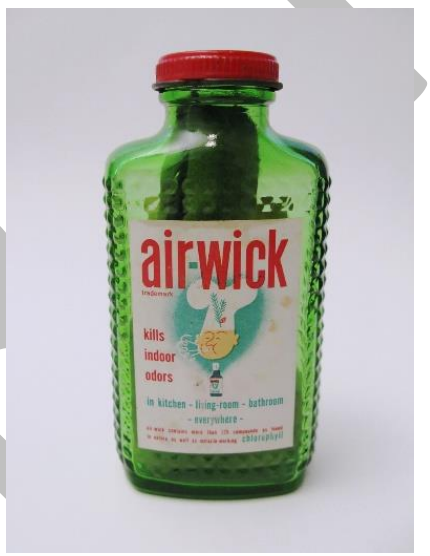

Figure 1: Circa 1940s evaporative vapor phase technology

Restorers should know that fire related smoke odors do not distribute equally within buildings and that greater impacted areas and materials, often retain more smoke odor, than others. A disadvantage of general ambient vapor phase treatments is that the entire area is treated equally, meaning that some areas receive less treatment than needed while other areas receive more than needed.

8.4.5 Odor Removal by Oxidation

Restorers should know that oxidation is an odor management method proven effective on fires with natural fuels (e.g., wood, paper) but may be less effective on other fuels (e.g., synthetic, protein). Oxidizers used in fire restoration are either in a dry powder or liquid form and designed to be mixed with water, or an oxidizing gas generated by a device.

Liquid oxidizers include, but are not limited to:

- hydrogen peroxide;
- sodium hypochlorite (i.e., chlorine bleach);
- chlorine dioxide; and
- hypochlorous acid.

Liquid oxidizers may be applied directly onto target surfaces (sprayed, wiped, misted) or cold fogged into air spaces. The advantages of using oxidizers as liquids is to provide precise controlled application on target surfaces and allow deeper penetration into odor sources, cracks, and crevices. Restorers should exercise caution when working with liquid oxidizers and follow dilution instructions per the manufacturer. Oxidizers can; be dangerous irritants, react violently with other chemicals, be destructive to certain materials (corrosion), and discolor fabrics and carpet.

Gaseous oxidation generation includes:

- chlorine dioxide added to water, an activator and a reactor;
- ozone;
- hydroperoxide;
- hydroxyls; and
- a combination of any of the above.

As stated in section 8.3, restorers should be advised due to the unknown nature of background chemicals present in the indoor environment before the fire event and unknown nature of combustion byproducts created during the event, the addition of reactive oxidizing chemistry to indoor spaces should be done with caution.

8.5 Fire-Related Particulate and Odor Abatement by the Application of Fixatives and Sealers

Restorers should understand that smoke odors may not be fully removable from all surfaces and materials. In addition, not all surfaces can be sufficiently accessed for source removal cleaning processes (e.g., void spaces above suspended ceilings, the exterior of ductwork, elevator shafts, industrial buildings, foundries). In situations where restorers cannot completely remove or access the source for removal, alternative odor management process (e.g., use of fixatives and sealers) may be utilized, r*efer to Section 11 Limitations, Complexities, Complication and Conflicts* to address any deviations from this standard. Decisions to try alternative odor management processes should be pre-approved by the client and other MIPs and documented.

Sealers are used in buildings damaged by fire and smoke primarily for two reasons:

- as a stain-blocking primer in cosmetic repair, and
- for blocking potential smoke odor emissions.

It is recommended that sealers be applied to building surfaces and materials that are permanently stained by smoke yet remain structurally sound. Sealers should only be used after thorough cleaning and fire and smoke odor management procedures have been applied to the surface to the extent possible**.** Sealers may also be applied to building surfaces and materials as a precaution when there is a potential for smoke odors to re-emerge.

Sealers should be applied in sufficient quantities to create a continuous, non-permeable membrane over the surface. Sealers are applied in a similar fashion as paint, most often by airless paint sprayer, but can also be brushed and rolled on. Inadequate or insufficient coverage will result in the failure to block smoke odor emissions. In some situations, more than one application of a sealer may be required for satisfactory results. Gaps in building construction may require the application of caulk and expandable foam, particularly in heavy contaminations of framing (e.g., attic systems, wooden floor joist systems, wall framing, and residential staircases) prior to sealing.

Restorers should be aware of the properties, effectiveness, and limitations of various sealer products regarding stain and odor blocking abilities. Historically, natural shellac sealers have stood the test of time as being an effective smoke stain and odor-blocking coating.

Sealers are commonly tinted white to help with stain blocking and to help verify that all surfaces are uniformly addressed. Some sealers are tinted for application purposes but dry clear. It is recommended that the use of clear sealers be applied only on those surfaces that have not sustained visual fire or smoke damage to the appearance or on surfaces where a white finish would be (cosmetically) inappropriate. Close inspection, often aided by spotlight, magnification, and paint gauge is required for verification of the thorough application of clear sealers. Restorers should refer to the manufacturer's recommendations for application rates and coverage.

Considerations must be made as to the surface and intent for using a particular type of sealer prior to the application including but not limited to:

- surface conditions – sealer should not be applied over charred wood that has not been abraded to remove as much charcoal as possible and treated with a desorbent or liquid smoke odor counteractant;
- degree of surface adhesion – surfaces should be dry, clean, and clear of untreated combustion particles, rust (untreated rust may continue to degrade metal under the sealer coating), grease, wax, oil, and mold; and
- appearance – application of tinted sealers on unfinished building surfaces permanently alters the visual appearance.
- degree of vapor permeability of various materials

8.6 Quality Control Inspection

Thorough source removal and professional fire and smoke odor management following a fire should result in a building that is free and clear of smoke odors. As described in *Section 3: Fire and Smoke Damage Assessment*, restorers should perform ongoing odor inspections throughout the duration of the project and address any smoke odor related issues as they arise. Restorers should perform odor inspections in conjunction with the client. It is recommended that odor evaluations be performed in conditions that are similar to the normal temperature and RH conditions, when feasible. Finishes (e.g., drywall, flooring) should not be installed prior to a successful smoke odor inspection of a specific area.

When smoke odors are detected during any inspection, restorers should take and address them accordingly. Verification that the RWP has been accurately and thoroughly executed should be the restorer's first response to these concerns. Using subsequent surface testing methods, persistent smoke odors can often be traced to a specific area, or areas. Even if the area emitting fire-related odor is small in size and remote, odors can accumulate over time to a level where the odor is detectable in other areas.

8.6.1 Persistent Fire-Related Odors

Restorers should understand that areas likely to retain smoke odors are areas that are sometimes overlooked when performing damage assessment.

These areas include but are not limited to:

- wall, ceiling, and floor cavities and voids (e.g., soffits, chases);
- HVAC systems and components (refer to *Section 7*);
- wooden stair assemblies (staircases can allow large quantities of smoke to move from one floor to another); and
- steel or porcelain bathtubs (heated smoke is attracted to the cooler underside of tubs).

Restorers should understand that persistent odors can also be attributed to:

- incomplete source removal of building and contents surfaces and materials (no post restoration cleaning and odor inspection was performed); and
- incomplete, incorrect, inadequate application of odor management procedures or sealers.

Fig. 2 Shadowing effect

Fig. 3 Shadowing effect

Figures 2 and 3 show the result of inadequate applications of white pigmented sealer. Sealers spray applied from only one direction (e.g., standing on the floor spraying upwards) can result in a shadowing effect leaving portions of the surfaces in the 'shadow' of the intended target untreated.

Refer to *Section 3: Fire and Smoke Damage (FSD) Assessment, Subsection 3.12 Persistent Odor Testing* for additional information on methods for identification of potential locations of persistent smoke odors.

8.7 Other Contributing Factors in Smoke Odor Detection

The restorer should not assert that clients (e.g., property owner, policyholder) are unjustified when they claim to smell smoke odors others cannot. The sense of smell is subjective, with varying sensitivity between individuals. Therefore, it is possible that one person may detect an odor when others cannot. Smoke odors can be faint and remain undetected until someone smells something they identify as smoke. Smoke odor detection is further complicated when the odor is intermittent or becomes more or less intense in different environmental conditions such as temperature, humidity, and ventilation.

Additionally, restorers should understand there may be psychological and physiological factors that affect smoke odor perception. Knowing these factors exist, restorers may need to apply procedures in an attempt to locate and then treat, or re-treat odor sites. For information relating to locating potential persistent fire-related odor sites, restorers should refer to *Section 3 Fire and Smoke Damage Assessment*, subsection *3.14 Persistent Odor Testing.* For information relating to procedures for treating persistent fire-related odor, restorers should refer to *Section 6: Source removal subsection 6.2.4 Cleaning and Removal of Fire Residues, and Section 8: Fire and Smoke Odor Management, subsection 8.4.4 Fire Odor Removal Procedures.*

In the evaluation process, disagreements may arise between restorers, clients, and MIPs with regard to the presence or absence of fire-related odor. To address these disagreements restorers should refer to *Section 3: Fire and Smoke Damage Assessment*, *subsection 3.14.2 Odor Testing Evaluation and Dispute Resolution*. In some situations, the restorer may need to obtain surface samples of the material in question for evaluations as described in *Section 7: HVAC and Air Conveyance Systems*, *subsection 7.5.2 Sample Preparation for Odor and Visual Evaluation.*

It is recommended that placebos (e.g., materials that are either brand new or have not been subjected to exposure from fire residues) be included as part of the sample population. Identifying smoke odors in placebos (false positive) suggests odor is perceived only and not present. For example, this individual may be experiencing a psychological response (e.g., heightened awareness, associative odor).

For additional information on odor testing and evaluation Refer to *Section 7: Heating Ventilation and Air Conditioning (HVAC) and Air Conveyance Systems (ACS), subsection 7.5.2: Sample Preparation for Odor and Visual Evaluation.*

9 Fire and Smoke Damage Contents Restoration

9.1 Introduction

The term 'contents' is an industry term used to describe the combined personal or business personal property owned by the owner or tenant of a building. Contents can also be described as things that are not permanently attached to the building. Personal property is unique to the building owner or tenant. With the possible exception of chain stores and the lodging industry, no two buildings will contain exactly the same amount and type of personal property. Personal property is variable in not only quantity but also in quality.

The goal of contents restoration is to return an object to its pre-loss condition. In fire and smoke damage restoration, restorers should be aware that commonly there is a level of improvement in the overall condition (e.g., cleanliness, finish enhancement) after restoration services are provided. However, property insurance coverage, when applicable, permits the owner of the property to declare items that have been devalued, due to a loss in appearance or utility, eligible for financial compensation by the insurance carrier. Items that have been deemed non-restorable by either the restorer or the insurance company representative may be eligible for this same compensation.

Restorers should understand that their initial evaluation of fire damaged contents often drives the decision to restore versus replace. This evaluation can be simplified by answering the basic questions of contents restoration; can the item be cleaned and deodorized to the satisfaction of the owner and does the owner want the property restored? For example, even though items of clothing may be restorable, the clothing may be outgrown or out of style and no longer of use to the owner.

Restorers should understand, at times, the cost of restoration of an item can exceed the replacement value of the item. This determination can be complicated by the sentimental, antique, artistic, and historical value associated with an item. In these cases, before any restoration efforts begin, all MIPs should come to an agreement on the cost of restoration efforts that will be applied to these types of items.

Restorers should understand that the content restoration process often entails multiple procedures. Items affected by fires that produce low levels of residue and odor can often be cleaned and deodorized in place. The contents work is often performed concurrently with structural cleaning and fire and smoke odor management. On more severe losses with heavier residues, poor environmental conditions (e.g., unstable structure, loss of utilities) or other extenuating circumstances may require the entirety of a content's restoration project to include; removal of the contents, inventory, packing, moving, off-site cleaning, and storage of contents. This process is commonly called a "pack out". Documentation should be performed during each of these procedures to identify condition issues and track the location within the restoration facility or other facility and project status.

Restoration procedures may parallel some conservation procedures. Restorers should recognize the limitations of their service capabilities on content restoration and bring in specialized experts or conservators when necessary.

9.2 Administrative Requirements and Documentation

It is recommended that restorers establish a system of project documentation that can support inquiries by the MIPs for the duration of the contents restoration project. Within the contents restoration industry, computer software has been developed to allow the restorer to identify, document, photograph, and track by location the entirety of a contents restoration project. In many cases, this software has a mobile friendly workflow that provides the opportunity for real-time data capture while at the fire site, as well as a desktop portal to allow MIPs access to the captured data. To help manage the contents within this software, restorers can use software-specific user-printed self-adhesive labels (e.g., barcodes) to quickly create a project contents catalog. Restorers should not attach adhesive labels to sensitive surfaces.

Personal property is insured separately from the dwelling with its own coverages and limits. Service agreements and contracts for contents restoration services can be substantially less complicated than those

of dwelling repair, even though work on contents can be performed under similar contracts. However, restorers should know the difference between unscheduled and scheduled personal property. Policy Unscheduled personal property are belongings subject to the standard policy limits and are subject to specific perils. Clients that have items of high value (e.g., art, antiques, musical instruments, jewelry, stamp or coin collections) may purchase additional insurance that affords broader coverage, including additional risks. Restorers should be aware that Insurers may require separate documentation regarding the costs of restoration of scheduled personal property. It is recommended that restorers ask their clients if they have any scheduled personal property prior to performing restoration procedures.

Refer to *Section 2: Administrative Requirements and Documentation* for additional information.

9.2.1 The Restorer's Business Insurance

Restoration contractors shall comply with all jurisdictional insurance requirements for each element of their operation. It is recommended that restorers who perform contents restoration services, which include content removal, transportation, and storage; maintain a policy that provides coverage for the client's personal property while in their care, custody, and control. In North America and the United Kingdom, this is called a Bailee's policy. Restorers should understand the difference between first- and third-party claims. Third-party claims, even with Bailee's (transit insurance), are settled based on depreciation, not replacement, sometimes referred to as Actual Cash Value (ACV).

Restoration contractors should seek the advice of a knowledgeable insurance professional who is familiar with their operations and the inherent risks and can assist in developing an insurance program for their operations.

Refer to *Section 1: Contractor Qualifications* for additional information on insurance.

9.3 Contractor Qualifications for Contents Restoration

Contents restoration contractors should have training, knowledge, and field experience in FSD contents assessment and restoration. Restoration contractors acquire requisite FSD contents assessment and restoration proficiency through industry technical training programs, advanced certification programs, and field experience.

Qualified contents restorers should be proficient in the following:

- correct identification and classification of contents items;
- ability to categorize contents items by purpose and use;
- understanding the effects of the various damage modalities on contents;
- performing on-site FSD damage assessment of contents;
- determining the restorability of damaged contents;
- use and application of contents restoration processes; and
- proper handling of contents based on site conditions, efficient processing, and warehouse management of contents that have been packed out.

Ongoing field experience and training is integral to the restorer's skill and knowledge development. As experience increases, so does the competency to handle more complex jobs. Qualified contents restorers may be able to make a visual evaluation of whether an item can be successfully restored. However, in many situations, surface test cleaning should be relied upon to determine the likelihood of successful restoration.

Contents restorers should know that when the effects of fire damage (e.g., heat, discoloration by fire residues, moisture) on an item are beyond the capacity of restorative cleaning to correct, a more intensive level of restoration in the form of repair may be available (e.g., refinishing, reupholstery, replating, conservation). Restorers should have knowledge of or the ability to source specialized experts to consult on items respective to the area of their needed expertise.

Refer to *Section 1: Contractor Qualifications* for additional information.

9.3.1 Evaluating Contents - Client Priorities and Content Restoration Ethics

Restorers should evaluate items based on the anticipated outcome of restoration procedures, the costs of those procedures, and the expressed wants and needs of the owner. The restorer should understand the following FSD assessment, and based on the conclusions with regards to restorability, the client has options to consider on how to proceed. The following are examples of these options:

- restorable - restoration accepted by client (items that can be returned to pre-loss condition in a cost-effective manner so as not to exceed the replacement costs);
- restorable - restoration declined by client (items that can be returned to pre-loss condition in a cost-effective manner so as not to exceed the replacement costs) yet the client is indifferent to having the work done (e.g., clothing that no longer fits, items no longer desired by the owner);
- partially restorable - (items that have sentimental/historic value to the owner may influence decisions to attempt restoration regardless of outcome or costs); and
- non-restorable - (Items that cannot be returned to pre-loss condition without exceeding the replacement cost of the item and have no sentimental or historical value).

It is recommended that restorers be familiar with local insurance adjusting principles as related to fire claims involving contents losses and how that may influence the client and outcome of the job. The fact that insurance proceeds may be available should not sway a recommendation to restore, only the costs of the restoration versus replacement.

Refer to *Section 3: Fire and Smoke Damage (FSD) Assessment, subsection 3.9.3 Contents Inspection* for additional information.

9.3.1.1 Client Content Restoration Priorities

Restorers should understand that residential client priorities may differ from commercial client priorities. Restorers should discuss restoration priorities from clients then provide realistic expectations of their ability to meet those wants and needs, including the anticipated costs of restoration. The following are examples of influencing factors that the restorer should understand when attempting to meet the needs of the client:

- Residential clients:
  - monetary (e.g., costs of services, available funds);
  - important documents (e.g., legal, medical, taxes);
  - sentimentality (e.g., family heirlooms, photographs, yearbooks);
  - collectibles (e.g., one-of-a-kind items, unique); and
  - indifference (e.g., client declines restoration, even though items are restorable).
- Commercial clients:
  - monetary (e.g., costs of services, available funds);
  - important documents (e.g., business records, legal, personnel);
  - business interruption considerations (e.g., keeping the business open, employees);
  - inventory (e.g., finished goods ready for sale);
    - retail businesses (e.g., could the inventory of goods be restored to a like-new condition where it could be sold as new, could the goods be sold discounted, as in a “fire sale”?);
  - fixtures (e.g., office furniture, warehouse shelving racks); and
  - equipment (e.g., manufacturing equipment, tools, office electronics, machinery).

9.3.1.2 Contents Restoration Ethics

The restorer's recommendations should be based on item restorability in conjunction with professional judgment and not influenced by the opinions of others. Items of questionable restorability should be noted,

and the costs of attempted restoration agreed upon by MIPs prior to proceeding. Restorers should know that attempts to restore damaged contents items is done solely at the direction and risk of the personal property owner. Restorers should avoid overpromising when discussing anticipated results with MIPs. Restorers should be factual with MIPs when discussing results and maintain open lines of communication throughout the contents restoration process. Lack of communication (e.g., documentation, status updates) can lead to distrust and confidence issues between the restorer, the client, and the insurer. It is recommended that restorers accept responsibility for mistakes (e.g., breakage, accidents, workmanship) that occur during the normal processing of contents and take appropriate actions to reconcile.

9.4 Identification and Classification of Contents

When documenting a loss, contents should be identified as accurately as possible by description or purpose. This Standard does not address every item or type of content that restorers may encounter on a project. However, contents can be categorized by their general or unique characteristics. The following examples of material types that may require specific restoration procedures include, but are not limited to:

- wood (e.g., finished/sealed, unfinished/unsealed, painted);
- metal (e.g., steel, brass, aluminum, copper, tin, gold, silver, platinum);
- textiles, natural and synthetic (e.g., silk, wool, nylon, cotton, polyester);
- ceramic (e.g., glazed, unglazed);
- animal hides (e.g., skins, leather, suede, furs, reptile skin);
- taxidermy;
- glass (e.g., crystal, pressed/molded, coated, etched/cut, hand-blown);
- art (e.g., oil paintings, sculpture);
- artwork on paper (e.g., photographs, lithographs, silkscreen, watercolors, pastels);
- stone (e.g., marble, granite);
- plastic (e.g., toys, vinyl, phonograph records, clear polycarbonate);
- paper (e.g., prints, books, documents, cardboard); and
- composites (see below).

It is common to encounter contents items that are comprised of multiple materials. (e.g., wood cabinet with metal drawer pulls, leather-bound books, musical instruments, sports equipment). These items are referred to as composites.

Restorers should know that while one material may be primary in composition, each secondary material can require different and unique restoration processes.

In addition to material types, contents items can also be described by the general or unique physical characteristics of the item including but not limited to:

- age (e.g., modern, old, antique, ancient artifacts);
- style (may be associated with a specific period in time from classical to contemporary (e.g., Queen Anne – late 18th century, Victorian furniture mid to late 19th century, Art Deco – early 20th century);
- design (e.g., jewelry, garments, may be defined by form and function); and
- quality of construction (e.g., wood joinery/dovetail/dado/fixing screws and locking cams (see figs. 1 and 2), upholstery suspension/8-way hand tied coil spring/sinuous spring (see figs. 3 and 4)).
- finishes (e.g., veneer, marquetry/inlay, laminate, plating, lacquering (see figs.5 and 6));
- finish condition (e.g., the presence of patina, crazing); and
- purpose (tools, sporting goods, musical instruments, electronic devices, food preparation and consumption).

Fig. 4 Dovetail joinery

Fig. 5 Fixing screw and locking cam

Fig. 6 8 -Way hand tied coil springs

Fig. 7 Sinuous springs

Fig. 8 Fine detailed inlay on mahogany

Fig. 9 Geometric inlay on veneer

The qualified restorer should be familiar with these material categories and descriptive characteristics to correctly identify contents. It is recommended that restorers research contents items that are unfamiliar to them. For example, valuable information regarding an item's identification can often be found in markings located on the underside or back of the item (e.g., china, porcelain, silver, pewter). Learning about the markings may reveal who made the item and during what period of time. By performing research on unfamiliar items, the restorer may not only learn the proper identification (correct name) of the item but also what the material the item is made from and its value.

9.4.1 Categories of Contents

Contents can be categorized by their intended purpose and use. Examples of these categories include, but are not limited to:

- functional, purposeful, and necessary (e.g., furniture, clothing, appliances, electronics, tools);
- sentimental (e.g., family heirlooms, photographs, yearbooks);
- monetary value (e.g., jewelry, artwork, collectibles);
- durable (e.g., reusable);
- non-durable (consumable) - items intended to be used up then replaced (e.g., cleaning products, paper products, disposable tableware);
- ingestible - items intend for ingestion (e.g., food, drink, medicine, dietary supplements, lotions, and ointments); and
- non-functional, obsolete, cost-prohibitive to restore (e.g., outdated electronics, outdated or ill-fitting and out-grown clothing, broken or worn-out tools or appliances).

Restorers should understand the importance of these categories as it relates to the cost-effectiveness of restoration, particularly in the event the contents need to be removed and cleaned off-site. In most cases, it is not considered cost-effective, and therefore not recommended for restorers to pack, move, store, clean, and deodorize non-durable goods when the restoration of contents cannot be performed on-site.

In some situations, when the restorative cleaning is performed on-site (e.g., light fire residues, low odor), it may be considered cost-effective, and therefore recommended, for restorers to remove fire residues from the exterior surfaces of unopened non-durable, consumable goods. When considering the different characteristics of fire residues and associated odors, it is recommended that the restorer make decisions to clean non-durable, consumable goods on-site on an individual case-by-case basis. When presented with a pack out where high-value consumable or ingestible goods are present, it is recommended that the restoration contractor discuss these items with the MIPs and reach a mutual agreement on the disposition of these items.

It is not recommended that restorers attempt to clean ingestible or absorptive items that are likely to be directly contaminated by fire residues (e.g., items that are not effectively sealed or packaged).

When encountering non-functional, cost-prohibitive, or obsolete personal property, restorers should discuss restoration with the owner and other MIPs before performing restoration procedures. This is of particular importance when decisions to remove the contents for off-site restoration due to the added costs of packing, moving, and storage.

9.5 FSD Assessment of Personal Property

When determining the restorability of contents, restorers should evaluate the type of damage, the nature of the material which has been impacted, and the length of time that has passed since the fire event. Some fire residues may become more difficult or impossible to remove with the passage of time (e.g., horizontal surfaces, smoke impacted painted surfaces).

9.5.1 Types of Damage to Contents

Damage to contents following a fire or smoke event should be described by the nature of the damage. The following types of active fire damage include but are not limited to:

- heat (e.g., charred, scorched, melted, delaminated, stress fractured);
- fire residue type (e.g., plastic fire, wet/dry smoke);
- intensity of fire residue odor (e.g., faint, moderate, strong)
- incidental damage (e.g., building collapse, glass shards from broken windows, breakage that occurs during firefighting); and

- moisture (e.g., condensation, fire suppression efforts, plumbing failures).

9.5.1.1 Heat Damage on Contents

Restorers should identify heat damage to the extent possible by visual inspection. When heavy levels of fire residues prohibit visual inspection of the surface, restorers may have to perform fire residue removal procedures to reveal effects from heat. For example, latent heat effects such as internal stress fractures in crystal and ceramic objects may cause the objects to shatter when immersed in a cleaning solution. Restorers should inform clients and other MIPs that, unlike fire residues, damage to contents from heat is not removable. However, on certain objects (e.g., furniture, oil paintings), it may be repairable (e.g., refinishing, reupholstering, revarnishing).

9.5.1.2 Fire Residue/Odor Type and Level of Intensity Damage to Contents

Restorers should understand that both fire residue types and the mechanisms by which they deposit onto surfaces may vary. Restorers should know there is no single restoration treatment that addresses all the damage conditions restorers may encounter at fire sites. Restorers should apply the appropriate removal procedures based on the type and level of residue and the intensity of the associated odor. Some of the situations the restorer may encounter when evaluating types and levels of fire residues are as follows:

- items that require pre-cleaning before being handled;
- the degree of fire residue adhesion to the surface material;
- surface material response to the application of restoration processes (e.g., vulnerable, resilient, durable, fragile);
- items emitting very strong fire related odors:
- the need for neutralization of chemical residues (e.g., corrosion from acidic residues), and
- items that the restorer is uncertain how to treat and may require a specialized expert.

9.5.1.2.1 Fire Residue Type

Restorers should understand that the characteristics of fire residues and associated odors are based on the type of fuel burnt (e.g., natural, synthetic) and the rate of combustion (e.g., amount of available oxygen). It is recommended that restorers try to determine the nature of the residue before attempting to remove it.

9.5.1.2.2 Fire Residue Levels

Restorers should use descriptive terms to notate various visible levels of fire residues during FSD assessment to assist in the development of the RWP. Following surface test cleaning procedures performed during FSD assessment, restorers should be able to determine whether the residues are adhered or non-adhered.

9.5.1.2.2.1 Residues and Particles

Restorers should know that a residue is a substance carried by air, smoke or water that remains on a surface after the transporting medium has been removed or has dissipated. Particles are residues in the form of varyingly sized minute fragments. In this standard, the terms ‘residues’ and ‘particles’ are often used interchangeably. However, a distinction can be made between them to make the discussion on residue levels more relevant.

9.5.1.2.2.2 Fire Residues – Adhered and Non-Adhered

Restorers should understand that when fire residues deposit, they can attach to surfaces by various levels of adhesion. Loosely adhered or non-adhered residues can be removed using light dry mechanical cleaning procedures (e.g., compressed air washing, lamb’s wool dusting, microfiber cloths, contact vacuuming, cellular rubber sponging). Adhered fire residues are defined as residues that remain on a surface after light dry mechanical cleaning procedures. Non-adhered residues can typically be observed as black specks, or

particles, which may agglomerate making them more easily seen. Adhered residues tend to deposit as a uniform coating where it may not be possible to discern individual particles.

9.5.1.2.2.3 Levels of Fire Residue Deposition

Restorers should know that, in most fire or smoke events, fire residues deposit in greater quantities on horizontal surfaces than on vertical surfaces. This resulting condition can aid in visual inspection of the surface, particularly when objects resting on those surfaces conceal a portion of the surface below. Removal of those objects will reveal an unaffected surface which will contrast with affected surfaces. For purposes of this discussion, the term particle will be used to describe deposit levels of residues. The levels of particle residues can be described by the following terms and examples:

- Light - Fire residue particle level is low and does not obscure underlying surface appearance; Wiping the surface with a dry absorbent media (e.g., folded paper towel, cellular rubber sponge) may be required to confirm the presence of fire residue particles;
- Moderate - Fire residue particle level is greater than in light levels. Surface appearance is visible through the residue. Removal of objects can reveal a contrast with surrounding surfaces; and
- Heavy - Fire residue particle levels cover the surface such that the surface appearance is not discernable.

The restorer should understand that regardless of the level of fire residue deposit, the degree of adhesion that occurs between the particle (i.e., residue) and the surface material is of greater importance. For example, heavy residues that are non-adhered may be more easily removed than lesser levels of adhered residues.

Refer to *Section 3: Fire and Smoke Damage Assessment, subsection 3.10: In Situ Surface Testing, subsection 3.9: FSD Assessment Inspections and Introduction: Fire and Smoke Damage Restoration Theory, Section 2: Distribution of Fire Residues in Buildings, Section 4: Smoke Particle and Residue Identification, subsection 4.1 Smoke Particle and Residue Classification Based on Visual Characteristics, and subsection 5: Deposit Patterns* for additional information.

9.5.1.3 Incidental Damage to Contents

Restorers should expect to find other forms of damage to contents following a fire or smoke event. For the purpose of this standard, this type of damage will be referred to as incidental damage. In some cases, the extent of incidental damage may outweigh the damage caused by the heat and fire residues. Examples of this type of damage include, but are not limited to:

- water from firefighting or sprinkler systems;
- water from plumbing failures due to heat (e.g., melted PVC pipes, soldered joints);
- residues from powder fire extinguishers;
- fallen structural debris (e.g., drywall, plaster, roofing materials, framing);
  broken glass (e.g., breaking windows during firefighting, stress fractured glass from heat); and
- breakage from firefighting activities (e.g., stacking wood furniture, covering with tarps).

9.5.1.4 Contents Damage from Moisture

In addition to heat and fire damage, restorers should anticipate finding various forms of water damage to contents, some of which may be unique to fire damage. This damage may include but is not limited to:

- swelling and deformation of wood and wood composites (e.g., solid wood joinery, particle board);
- raising or peeling of veneers (delamination);
- absorption of water into items in contact with wet flooring (capillary action);
- water spotting and staining from condensation - hot smoke condenses when it impinges on cool surfaces (e.g., mirrors and wall hangings) creating sufficient moisture to mix with fire residue and drip down vertical surfaces leaving streaks (see figs. 10 and 11));

Fig. 10 Condensation streaks of glass

Fig. 11 Condensation streaks on mirrors

- blushing of wood finishes (e.g., hazy white discoloration in wood finishes from moisture trapped on or in the finish (refer to fig. 12));

Fig. 12 Blushing of finish on seat

- warping and cupping;
- rust and corrosion;
- color run or bleeding; and
- wetting of cushioning materials in upholstery and bedding with contaminated water.

Severe damage caused by water to contents can be permanent. Even though additional procedures may repair these forms of damage (e.g., refinishing, reupholstering), repairs of this type are beyond the scope of this standard.

Refer to the latest edition of the ANSI/IICRC S500 Standard for Professional Water Damage Restoration for additional information regarding water damage to contents.

9.5.2 The Nature of the Surface Material

Cleaning decisions made by the restorer should be based on the underlying material to which fire residues have impacted. Restorers should understand that the nature of certain materials can influence the method and application of removal processes or whether the items can even accept restoration procedures. Contents restorers should be proficient in working with a wide range of materials that have varying surface characteristics and damage levels. Restorers should evaluate, and test if needed, residue removal

procedures before attempting cleaning restoration to verify the surface material will not be adversely affected. Refer to *Section 6.4 Cleaning and Removal of Fire Residues* for additional information on patina.

9.6 Restorability of Contents

Restorers should know, as with other forms of restoration cleaning, the best restoration procedure to use on contents is the least aggressive method that obtains a satisfactory result. The less aggressive the procedure, the less likely any significant change from the original appearance may occur. However, to achieve satisfactory results several procedures of progressing aggressiveness may be required to achieve the best result. If the procedure negatively alters the appearance of the object, it is recommended that the restorer discontinue the procedure. Restorers should discuss, and document, restorability of content items with the owner and other MIPs prior to progressing to procedures that may alter the appearance.

9.6.1 Restorer Limitations, Precautions and Utilizing Specialized Experts

Contents restorers should subscribe to a concept "first do no harm" meaning that in certain cases, it may be better to do only safe procedures (e.g., light dry mechanical removal) rather than attempting more aggressive restoration procedures that may potentially cause more harm than good. In content restoration, particularly when it comes to fine art or antiques, using the wrong product or procedure on an item may cause unintentional irreversible damage. For example, antiques often have provenance (i.e., documented history of ownership) and makers marks that should not be altered or removed by any restoration procedure.

When possible, restorers should test clean the item in an inconspicuous place to determine if the procedure will cause additional damage to the material. Damage to contents from improper cleaning may be in the form of, but not limited to:

- color and finish removal;
- scratches, or other forms of wear;
- delamination;
- shrinkage;
- corrosion; and
- removal of protective coatings.

Restorers should also know their limitations of restorative cleaning with objects of great monetary value, particularly artwork, antiques, and other collectibles. It is recommended that restorers refer items they are not qualified to restore to specialized experts in the respective category or class of objects. For example, oil paintings are often coated with clear varnish to protect the paint. After a fire, the varnish may be damaged (e.g., soiled or discolored by fire residues, scorched by heat) but will have protected the painted surface. Professional art conservators can remove the old varnish, professionally clean and, if necessary, repair the paint then apply a fresh coat of varnish. Other contents items that may require the services of specialists include but are not limited to:

- artwork (e.g., framed art, signed pieces, authentic paintings, sculpture);
- fine jewelry;
- weapons;
- sterling silver (e.g., flatware, serving pieces);
- electronics;
- antiques;
- musical instruments;
- textiles;
- taxidermy;
- clocks; and
- billiards tables and other gaming devices (e.g., pinball, slot machines).

9.7 Fire Residue Removal Procedures for Contents

Restorers should apply the least aggressive removal procedure(s) to the item that will provide the desired result. In some situations, a single procedure of fire residue removal may achieve the desired results. In other situations, due to the uniqueness of items and the vulnerability of varying types of surface materials, restoration of contents often requires a combination of removal procedures to obtain the desired results.

9.7.1 Application of Dry Mechanical Processes

Restorers should apply dry mechanical processes to contents as an essential preliminary step in fire residue removal. Non-adhered fire residues should be removed to the extent possible on all porous and semi-porous contents prior to the use of any liquid processes, if required. This of particular importance on items that have heavy accumulations of fire residues on surfaces or fire residues that are greasy and likely to smear. Dry mechanical fire residue removal alone can often yield satisfactory visual results. Dry mechanical processes vary in the level of aggressiveness and may not be effective in fire residue odor removal.

9.7.2 Application of Liquid Processes

Restorers should understand that dry mechanical processes may not be sufficient in restoring appearance or removing odors. Detergents and degreasers have a greater effect on adhered residues by loosening the residue from the underlying surface, dissolving the residue, or suspending it until it can be removed. Liquids also function as lubricants reducing friction and reducing the aggressiveness of some abrasive processes (e.g., wetted scrubbing pads and 0000 steel wool). On some items, immersion by direct contact with a liquid cleaning solution for extended (dwell) time may increase the effectiveness of the process. Ultrasonic cleaning combines immersion in a cleaning solution with agitation from high-frequency sound waves. Restorers may utilize mechanical air drying and controlled drying following liquid cleaning processes (e.g., wet extraction cleaning, immersion) to avoid potential negative effects of over-wetting (e.g., dimensional or textural change, color loss).

9.7.2.2 On-Site Preventative Pre-Cleaning

Preventative pre-cleaning (e.g., dry mechanical removal) should be performed on vulnerable items at the project site in order to reduce the degenerative effects of fire residues (e.g., staining, smearing) regardless of whether the item will be fully processed on-site or off-site.

It is recommended that restoration technicians wear gloves when handling personal property with untreated fire residues. Smoke residues when combined with body oils and/or perspiration, may change the properties of the residue resulting in permanent staining, smearing or discoloration on certain items.

Preventative pre-cleaning by gentle dry mechanical removal on the exposed surfaces of vulnerable contents should be performed prior to manipulation to prevent incidental damage by handling. For example, preparation for handling procedures such as wrapping in stretch film or padded furniture blankets may further damage the object by forcing fire residues deeper into an absorbent (porous or semi-porous) surface. Preventative efforts can provide the restorer a much higher likelihood of achieving satisfactory results during full restoration processes.

9.7.3 Cleaning Finished Hard Furniture (Metal/Wood)

Finishes applied to surfaces not only enhance the appearance but also provide a layer of protection. Coated metals and finished (sealed) wood are often more tolerant to residue removal processes than uncoated metals and unfinished woods. Restorers should exercise caution when applying liquids to unfinished wood, which is porous and can absorb liquids. Liquids used to clean wooden items should be applied uniformly then forced air-dried. Loss of finish through wear removes some protection which can increase porosity of the surface and vulnerability to removal processes. Restorers should test the surface by applying a water-dampened cotton swab to the area in question. If the area becomes darker in appearance than adjacent areas, it should be deemed unsealed.

Spraying with dilute detergent/degreaser and wiping using a dry towel or cleaning with absorbent media (e.g., terrycloth towel, microfiber cloth, 0000 steel wool saturated with dilute detergent/degreaser) is a primary method of fire residue removal. Wood often has grain characteristics that are readily apparent. Surface processes on finished wood should be performed in the direction of, or with, the grain, not across the grain. Restorers should apply to replenish oils, creams, and waxes to finished wood following residue removal procedures, particularly when aqueous detergents have been used.

9.7.3.1 Appearance Enhancement (Application of Polishes)

Wood furniture is subject to drying out over time due to exposure to sunlight, lack of maintenance polishing, environmental conditions including those found following a fire or smoke event, etc. Restoration cleaning using aqueous detergents can also contribute to drying out of the wood. It is recommended that following fire residue and odor removal, restorers perform appearance enhancement procedures by applying creams, oils, or wax polishes to finished wood.

Certain metals tarnish (dull or discolor) when exposed to air, moisture, soils, and fire residues. There are numerous products for removing tarnish some of which can contain acids or abrasives. Restorers should know that when polishing certain metals (e.g., silver, copper, brass) with abrasives a minute amount of the surface may be removed.

Plated metals, particularly silver plates, should not be polished using abrasives. Likewise, metals that have been lacquered to prevent tarnishing should not be polished with abrasives.

9.7.4 Cleaning Soft Goods (Upholstery)

Restorers should have a high degree of technical skill, training, and experience when assessing and cleaning fire residue damaged upholstery. Fabric is susceptible to damage (e.g., color loss, shrinkage, stretching, textural change) from improper cleaning.

Pre-cleaning of upholstery using gentle dry mechanical processes (e.g., lambswool duster, compressed air, roller brush/sticky tape) should precede moderate dry mechanical processes (e.g., deep vacuuming, vigorous wiping with cellular rubber sponge). The restorer should identify the type and nature of the fabric, and apply the appropriate cleaning agent (e.g., aqueous, non-aqueous, absorbent powder) and by the appropriate process (e.g., spray and wipe, spray and agitate with soft brush, wetted towel). Following the use of aqueous detergents, it is recommended that upholstery fabric be extracted by using a mildly acidic aqueous rinsing agent. If the procedure negatively alters the appearance of the object, it is recommended that the restorer discontinue the procedure.

Restorers should select an inconspicuous place on the upholstery to test for color transfer and shrinkage. Likewise, fabrics that contain silk may leave a ring if wetted using aqueous solutions. When in doubt as to the content of the fabric, restorers should consider alternatives to aqueous cleaning such as dry solvent, absorbent compounds, or the dry-wet-dry method.

The use of dry liquid process may prohibit the use of water-based odor counteractants. Alternative fire and smoke odor management methods should be used when cleaning with non-aqueous detergents.

Refer to the *latest edition of IICRC S300 Standard for Professional Upholstery Cleaning* for more information on the identification and handling of fabrics.

9.7.5 Cleaning Documents, Books and Photographs (Paper)

Documents, books, and photographs are usually paper products. Paper, being highly vulnerable to the effects of heat and staining by fire residues must be evaluated based on the characteristics of the loss (e.g., proximity to the fire, amount of heat, type of fire residue, moisture). In addition to the characteristics of the loss, the location and orientation of the paper at the time of impact (e.g., in a drawer, file folder in a file cabinet, on a bookcase, lying flat on a table) will contribute to the level of damage to the paper.

Restorers should use dry mechanical removal processes in gentle to moderate levels of aggressiveness (e.g., art gum, plastic erasers, kneaded rubber, wallpaper dough, cellular rubber sponges) to clean paper, books, and photographs. When dry mechanical processes have been attempted yet failed to provide the desired results and following testing, restorers may use limited quantities of liquid (e.g., dilute detergent and non-aqueous solvents applied with cotton balls) on certain paper products (e.g., book bindings, laminated covers, photographs). Paper, books, and photographs should not be cleaned by immersion or be overly wetted.

When satisfactory results cannot be obtained by cleaning, restorers may consider restoration alternatives (e.g., photocopying, trimming, or abrading the burnt edges of paper) or consult with a specialized expert. For example, damaged photographs can often be digitally reproduced then enhanced using computer software programs. It is recommended that restorers obtain costing information from the specialized expert and client approval before proceeding with any repair treatments.

9.7.7 Textile Restoration (Clothing, Household Fabrics)

Due to the differences in the characteristics of textiles (e.g., type of fabric, quality of fabric, applique) restorers should evaluate the likely outcome based on the severity of the damage, the cost-effectiveness of the cleaning, and the available funds for the project. Clients may have a substantial amount of textiles whose restoration represents a substantial cost. It is recommended that restorers provide their client and MIPs a preliminary estimate for the costs of textile restoration prior to performing the work.

Restorers should perform preventive cleaning, when indicated, to increase the probability of successful restoration. Textiles are particularly vulnerable to fire residues distributed as aerosols (i.e., wet smoke). It is recommended that restorers take representative samples of textiles from various locations within the building with varying degrees of damage to test clean for the client. The restorer should obtain client acceptance approval of the sample pieces before proceeding with any further cleaning of textiles.

9.7.7.1 Procedures for Safe Handling of Damaged Textiles

Due to potential additional damage from manipulation (e.g., exacerbated soiling from handling with bare hands), textiles with visible loose residues should be HEPA vacuumed or lightly dusted (e.g., lamb's wool duster, feather duster).

Restorers should transport textiles with strong fire-related odors in ventilated containers (e.g., mesh bags) rather than non-ventilated containers (e.g., plastic bags) which tend to force fire-related odors deeper into the fabric. Textiles with heavy fire residues and odors should be packaged and stored separately from slightly damaged textiles. Textiles that are wet or damp should be labeled as such and bagged separately from dry textiles and processed immediately upon arrival at their destination after removal.

9.7.7.2 Draperies and other Window Treatment Textiles

Draperies and other window treatment textiles are often the most vulnerable textiles found in a building and should be assessed individually. Due to exposure to UV sunlight and other environmental conditions (e.g., residues from cooking, smoking, heating), these textiles may fade, yellow, and become brittle over time. The weakened material may lack the strength to withstand the agitation involved with removal procedures.

Restorers should test window treatments, particularly lining fabrics, for signs of wear. Pre-existing conditions should be well documented by the restorer.

Due to how and where they are installed over windows, they are prone to trap soils and fire residues. Restorers should inspect window covering textiles for a variety ways fire residues may deposit that include but are not limited to:

- filtration of residues at contact points with walls and textile floor coverings;

- attraction of fire residues to the still, cooler air between the rear of the drapery and an exterior wall;
- height of the installation in relation to the height of the room, fire residues carried in smoke tend to rise as they distribute; and
- textile window coverings are multi-sided, all surfaces (e.g., front, back, side, tops) should be addressed.

It is recommended that restorers use caution before attempting to clean drapery and other window textiles and may consider using the services of a qualified expert to measure, evaluate condition issues, and consult on the likelihood of successful restoration cleaning.

9.7.7.3 Preventive Treatments for Textiles Prior to Full Immersion Cleaning Processes

Restorers may attempt pretreatments prior to submitting textiles to professional laundry or dry-cleaning firms. Preventative efforts can provide the restorer with a much higher likelihood of achieving satisfactory results during full restoration processes.

It is recommended that restorers perform gentile dry mechanical processes to remove loose fire or greasy non-absorbed fire residues prior to any liquid process cleaning. In certain situations, particularly where strong fire odors are present, gaseous oxidation fire and smoke odor management of textiles may be performed prior to cleaning. In other situations, fire and smoke odor management may be performed as part of the cleaning process using liquid odor counteractants as additives to detergents.

9.8 Fire and Smoke Odor Management of Contents

Odor management is a combination of processes, procedures, equipment and products designed to reduce or eliminate fire related odors. Restorers should utilize source removal of fire residues from contents as a primary step in fire related odor management. The following are examples of structural fire and smoke odor management processes that can apply to contents fire and smoke odor management:

- source removal;
- direct contact (sprayed on or mixed with aqueous detergents) aqueous odor counteractants;
- fogging (thermal or ULV);
- gaseous oxidation;
- liquid oxidation;
    - hydrogen peroxide;
    - sodium hypochlorite (chlorine bleach), and
    - chlorine dioxide.
- absorbent media; and
- vapor release.

When practical and permissible, restorers can leave contents in place while deodorizing structural components (e.g., walls, ceilings, floors, fixtures) to provide the added benefit that the process being used on the structure to also treat the contents. Malodorous contents that have been removed from the loss site (e.g., packed out) should be taken to a facility that has the capability to use the firms preferred deodorizing processes. Many restoration firms have a dedicated space in which items can be specially processed using heat, moisture, oxidizing gas, UV light, odor counteractants, chemicals, adsorbents, dehumidification, etc.

Severe fire and other secondary damages may result in conditions impacting contents that cannot be remedied by cleaning alone. If the decision is made to attempt further repair (e.g., refinishing, reupholstering), a fire and smoke odor management process may still be required to remove fire-related odors.

Refer to Section 8: Fire and Smoke Odor Management, subsection 8.4.3 Odor Management Resources for additional information.

9.9 Cleaning Restoration of Antiques

Restorers should understand that antiques with original finishes cannot be improved by restoration, only returned to the condition prior to the loss. Antique contents are handmade objects of at least 100 years of age and authentically embody the style of the period in which it was made. Some experts define antiques as handmade pieces produced prior to the industrial revolution, on or about 1825. There are a wide variety of contents that fit this description (e.g., furniture, oil paintings, rugs, jewelry, glass, bone china, silver, pewter, porcelain, earthenware, books, documents). When encountering items that may be antique the restorer should be appropriately trained in identification and cleaning processes that will not diminish the value of the item. When encountering items where the restorer is unsure of the nature of the item, or what potential harm may be caused by improper cleaning procedures, the restorer should consult with a specialized expert before proceeding with fire residue removal procedures.

Refinishing or other forms of finish repair may improve appearance while adversely affecting value. It is recommended that restorers adhere to the following:

- restorers should utilize the least aggressive methods of fire residue and odor removal when attempting restoration cleaning and fire and smoke odor management of antiques;
- antiques with wooden components should be cleaned using low moisture processes;
- antiques should not be cleaned using harsh detergents, volatile solvents, aggressive mechanical action, or any other process that may damage the finish, and
- restorers should consider using specialized experts.

9.10 Site Conditions - On-Site vs. Off-Site Cleaning

In some cases, the entire building may not be affected by the fire and will allow personal property to be moved to unaffected areas within the building for on-site restoration cleaning and storage. This relocation procedure is sometimes referred to as a 'pack-in'. In other cases, it may be necessary to remove contents from the building. This is referred to as a "pack-out".

Before any content restoration process begins, the restorer should decide regarding the efficiency of on-site verses off-site restoration. It is recommended that contents restoration be performed in a well-lit, climate-controlled environment with functioning utilities. Often, structural repairs to the building dictate the need to pack out. In other cases, environmental conditions may not be conducive to restoration of contents.

When considering a "pack in" RWP, the restorer should evaluate site conditions that may prevent the on-site restoration of personal property. These factors may include but are not limited to:

- safe access (e.g., collapsed ceiling or flooring, presence of hazardous materials);
- functional utilities (e.g., electricity, water);
- environmental controls (e.g., heating, cooling, humidity);
- risk of cross or re-contamination; and
- security concerns.

9.11 Inventory Documentation

It is recommended that restorers document all contents to be restored by accompanying representative photographs. Individual photographs should be of sufficient quality and clarity to identify event related damage (e.g., burnt, scorched, soiled, stained, broken, scratched, dented, gouged, rusted, peeling, damaged from moisture) and non-related, pre-existing damage.

Restoration cleaning that is to be performed on-site with minimal need for manipulation may require less extensive documentation than items that must be moved within or removed from the building. It is recommended that items of furniture be listed individually by name, or with a brief description of their purpose. Smaller items may be categorized for documentation (e.g., dishes, glassware, cookware, utensils, books, decorative items, pictures, CDs, games, toys) on work that is to be priced by a labor and materials

rate. General categories may be used in the preparation of the RWP for on-site restoration and for identification of items packed in boxes for off-site processing (e.g., cleaning, fire and smoke odor management, short-term storage).

Items that require relocation (e.g., moved to other areas, taken offsite) should be extensively documented to include name, or purpose and photographed (multiple if required). Documentation of individual (non-boxed) items (e.g., furniture, large tools, major appliances) should be accompanied by descriptive notations for event and non-event related condition issues. Documentation of smaller contents items that will be consolidated (e.g., packed in a box or similar container), should also be categorized by purpose (see above paragraph) for condition issues prior to placement in the box or container. For accountability purposes it is recommended that restorers photograph the contents that will be packed in a box for relocation, off-site processing, and short-term storage. Where applicable, it is further recommended that restorers include manufacturer information about the item (e.g., make, model, serial number, capacity).

Items that are found to be damaged beyond restoration cleaning that may require supplement services (e.g., framed art repair, surface discolorations) should be correspondingly documented showing the damage upon discovery. Repair estimates should be provided to the client prior to making any further restoration or repairs that are not included in the RWP.

Restorers should provide clients with copies of the inventory documentation and request a documentable acknowledgment of receipt. Restorers should retain this documentation in the event they will need to support or defend concerns from MIPs.

9.11.1 Wet Contents (Mitigation)

Restorers should make addressing moisture damaged contents a priority when first arriving on the scene to assess the damage. Porous and semi-porous materials are vulnerable to water damage, which may progress in degrees of damage if left unaddressed. Wood products can swell and deform, textiles can absorb and retain water for long periods of time, particularly internal cushioning materials. Certain metals can rust from direct contact with moisture and from high humidity conditions frequently found following a fire event.

During a fire event, water from firefighting, suppression systems, or plumbing failures, can be contaminated with fire residues and odors to varying degrees. Water migrating through building assemblies, materials, and systems can transport fire residues and odors beyond the fire source to proximate and remote locations. Restorers should treat fire-generated water damaged contents as, at a minimum, Category 2 water. Refer to the latest edition of the *ANSI/IICRC S500 Standard for Professional Water Damage Restoration* for more information.

Mitigation procedures to attempt to restore wet contents should commence without delay. Contents should be removed from the areas where they are in continuous contact with water (e.g., dripping water from above), removed or placed on blocks that raise the item off the floor in the case of standing water. Restorers should use absorptive media (e.g., cotton towels, paper towels) to remove any water that is pooling on the surface of the item. Contents that have absorbed moisture that cannot be dried in place should be removed to a location where the environment is controlled and where drying equipment can be effectively utilized (e.g., air movers, dehumidification).

Upon arrival at the environmentally controlled space, wet papers and photos should be separated if stacked together, if possible, and without causing any additional damage. Photographs mounted in photo albums should be removed from the album and dried flat. Books should be dried in a vertical orientation so that the pages will allow forced or directed air to penetrate to the spine. Framed art should be removed from the frame and laid flat to dry.

Advanced drying of documents and books (e.g., freeze-drying) is beyond the scope of this standard. Refer to the latest edition of *ANSI/IICRC S500 Standard for Professional Water Damage Restoration* for additional information addressing wet contents.

9.12 Pack Outs

Pack outs may vary from the removal of a single item top all of the contents of a building. The decision to remove the contents from a building for restoration treatment should be agreed to by the client and all other MIPs. Restoration contractors should base the decision to remove contents from the loss site contingent upon on-site conditions and other variables including but not limited to:

- onsite safety;
- substantial damage to the building (e.g., the presence of contents impedes structural repairs, potential risk of additional damage if the contents are left in place);
- jobsite conditions (e.g., utilities are not functional, lack of environmental controls, unstable/unsecured building, presence of hazardous materials, high levels of humidity);
- severity of fire residue damage (e.g., heavy levels of fire residues and odors are present on contents);
- water damage (e.g., contents have been exposed to direct water damage from fire suppression efforts, plumbing failure, condensation);
- cost effectiveness (e.g., available funds to pay for these services may be limited, the cost of these services may exceed the value of the personal property), and
- construction method of items (e.g., furniture assembled in place).

It is recommended restoration contractors who perform partial and complete pack outs have, or have access to, facilities with adequate space to process and, if needed, store client property. Contents to be packed out should be inventoried and documented including; location within the building, photographing and accurately describing the condition, including any pre-loss condition issues. It is recommended that restoration contractors who perform pack outs also use computer-based programs to track the contents throughout the process (e.g., barcoding, printable spreadsheets).

9.12.1 Psychological Considerations of Pack Outs

The decision to pack out a building can be an indicator of the severity of a fire resulting in significant damage to both the building and the contents. A severe fire can also negatively impact the property owner's emotional wellbeing (e.g., personal injury, loss of life, loss of sentimental items, family heirlooms). It is recommended that the restorer be honest, sincere, and empathetic when discussing the degree of restorability that restoration processes can provide to damaged contents, especially those of sentimental value. In situations where the client is faced with severe damage to sentimental item(s), they may prefer any level of improvement over none at all. Restorers should provide the fire victim with a clear, cost-effective, and itemized plan for recovery and restoration of damaged contents.

9.12.2 Pack Out Crew

Restoration technicians who perform the work should be adequately prepared with supplies and equipment (e.g., PPE, portable generators, temporary lighting, potable water, temporary toilet, portable heating/cooling machines) when performing pack outs in poor environmental conditions. Some examples of poor environmental conditions include:

- the presence of suspended fire residues;
- off gassing of VOCs;
- extreme temperatures - hot and cold;
- lack of functioning utilities (e.g., electric, plumbing);
- poor lighting, and
- the presence of compromised structural components and debris (e.g., fallen drywall, insulation, collapsed flooring).

It is recommended that restorers who perform pack outs train their employees on the proper inventorying and handling of contents. Restoration technicians who also perform pack outs should apply the requisite

skills, technical knowledge, and experience from the restoration cleaning and handling of contents to identify problematic issues with contents that may not have been observed during the initial FSD assessment.

It is recommended that the crew performing the pack out include a working restoration supervisor on-site for the duration of the pack out to manage the project. This supervisor's management responsibilities include but are not limited to:

- be the primary source of communication with the client;
- answer specific job-related questions from the client;
- make final decisions on restorability of contents (e.g., what to and what not to take for restoration, what may require the services of a specialized expert); and
- to alert the company when potential problems arise (e.g., LCCC).

It is recommended that technicians assisting in the pack out redirect project related questions from clients to the onsite supervisor. This includes making decisions and solving problems.

The restoration pack out crew should operate in a professional manner at all times. This includes being respectful of the property of others, particularly in severe losses (e.g., roof has burnt off, ceilings collapsed, extreme water damage) where much of the personal property is not salvageable.

9.12.3 Pack Out Considerations

Restorers should explain to clients and MIPs that contents handling charges are often calculated on a labor rate and materials basis and that providing an accurate estimate may not be possible. It is recommended that when restorers are providing estimates for pack outs, they make it clear to the client and MIPs that the estimate is exactly that and not a true reflection of the actual costs of performing all phases of a pack out project because of unknown variables based on limitations, complexities, complications, and conflicts.

Restorers should be aware that the possibility exists where the financial impact of the loss exceeds the amount of funds available for the restoration and repair of contents. In this event, the restorer should discuss options with the client so that the client may prioritize services, accept the services they want the restoration contractor to perform and decline those they do not. Restorers should document the client's decisions before proceeding.

9.12.4 Removal of Personal Property

Restorers should make every effort to protect and safeguard client property when removing contents for off-site processing. Protection includes prevention of breakage from handling and inventory controls. It is recommended that restorers utilize tracking software (e.g., barcodes, spreadsheets) to track the property of their clients from the moment it leaves the property until its return. Restorers should photo document the condition of all items prior to any content restoration activities and supplement with written notes as needed. Restorers should protect the building itself during the move by installing protective padding (e.g., furniture moving pads) on doors, door openings (trim casing), banisters, and rails. Restorers should strive to prevent situations that may arise if precautionary and accountability systems are not in place such as:

- damage to items from handling (breakage);
- damage to the structure (door, door casings, banisters and rails);
- delivering another clients property to the intended client; and
- losing an item(s).

9.12.4.1 Packing of Contents in Preparation for Moving

It is recommended that restorers wear gloves to protect contents during packing. Cardboard boxes or other suitable containers are recommended for smaller and fragile contents to increase the efficiency of the pack-out process. Contents should be packed, transported, and stored in an appropriate-sized box to limit

damage and prevent loss or misplacement. Packing with boxes and protective materials may include furniture (e.g., small chairs and tables).

To prevent damage, items should be wrapped in packing paper (non-printed newspaper), tissue paper or bubble wrap before placement into a box. Moving boxes are available in a variety of sizes to maximize efficiency while packing. It is not recommended to pack only one item per box unless that item is fragile, of high value, or heavy. When packing and loading items into boxes, heavier items should be at the bottom, and lighter, more fragile items at the top.

When packing framed artwork restorers should avoid touching the image area and pack it in such a way the surface of the image is protected but not in contact with protective materials. It is recommended that restorers consider engaging the services of a specialized expert when encountering artwork that is believed to be of high value, is badly damaged, very old, or has other condition issues.

9.12.4.1.1 Crating

It is recommended that restorers crate items that are too large or too fragile to by packed in boxes. Custom wooden crates or similar sturdy containers should be constructed to safely hold large mirrors, large glass tabletops, marble tops to furniture and other objects (e.g., taxidermy, crystal chandeliers) Heavy and large breakable items should be wrapped in protective materials prior to crating.

9.12.4.2 Handling Hard Furniture (Wood and Metal)

Wood furniture should be prepped for moving by wrapping in protective pads that can be held in place with stretch wrap, elastic moving bands or tape. Furniture pads should be constructed of sufficient density and cushioning to protect the furniture as well as interior walls and door casings. It is recommended that restorers launder moving pads after each use to prevent cross contamination between projects. Restoration technicians should lift furniture completely off the floor to move it.

Restorers should take necessary precautions when handling furniture that has breakable or removeable components (e.g., glass doors, drawers, protruding hardware). For example, additional protective materials (e.g., cardboard, stretch film) can be used to cover exposed glass and to keep drawers in place. It is recommended that, when present and possible, furniture with removable components (e.g., table legs, drawer hardware, tall case clock weights and pendulums) be affixed in some fashion to the item, or packaged separately from the furniture piece, tagged (labeled) and secured for reassembly.

When preparing wood furniture for moving, restorers should include a layer of material (i.e., protective pad) to act as a barrier between the wood and any plastic wrapping material (i.e., stretch film) and not allow stretch film to be in direct contact with the finished surface. Moving blankets that are smooth and not quilted should be utilized on certain pieces (e.g., tabletops, high-gloss furniture and pianos) as a first layer of protection. Quilted pads can leave their stitching pattern impression on, or potentially scratch the surface of vulnerable finishes.

It is recommended that restorers use non-adhesive tags for inventory and accountability purposes that can be affixed to items safely and securely (e.g., manilla tags, rubber bands) that can easily be removed during cleaning procedures then re-attached.

9.12.4.3 Soft Furniture (Upholstery and Bedding)

Restorers should pre-clean upholstery when loose particulate residues (e.g., fire residues, fallen drywall or debris) are present by dry mechanical action (e.g., HEPA vacuum, lambswool duster, sticky tape, cellular rubber sponge) prior to handling.

Before lifting and moving skirted upholstered furniture, it is recommended that the skirts (flounces) be folded upward and secured to the body of the piece with stretch film. Grasping and lifting the underside of the piece through the skirt can cause permanent impressions in some fabrics. Upholstered furniture should be

prepped for moving by wrapping it in protective pads that can be held in place with stretch wrap, elastic moving bands, or tape. On overstuffed upholstery with non-removeable cushions, it may be necessary to first wrap the piece in stretch film to lightly compress the cushions to enable the piece to fit through doorways and narrow stairways.

It is recommended that restorers first wrap mattresses in plastic (e.g., poly, stretch film) for removal from the project site. Mattress construction allows for the mattress to be gently compressed to move them in and out of doorways and stairwells. Excessive bending can damage the mattress. Carboard containers can be used to move and store mattresses to maintain their shape once removed from the building.

9.12.5 Warehouse/Plant Management of Removed Goods

Restorers should utilize inventory control (e.g., barcodes, printable spreadsheets) so that client property can be tracked from the moment it leaves the loss site to the time it is returned. This form of trackable identification should be initiated prior to its removal from the loss site. Restorers should create identifiable locations within their facility where the property of clients will be held. Tracking of the property of others should be performed at any time the location of the property changes for any reason. The following are examples of changes of locations that may occur in a typical pack out:

- receiving goods at restorers' facility;
- placement into identified storage location awaiting processing;
- brought from storage location to processing area(s);
- return to storage location after processing; and
- release of goods in storage to delivery truck.

It is recommended that restorers establish and maintain recordkeeping systems for the labor hours and equipment used while manipulating and processing the contents within the facility to include, but not be limited to:

- mobilization;
- moving, packing, unpacking;
- transit;
- cleaning and repacking;
- partial deliveries of special requests by clients;
- client inspections at the restorer's facility;
- access by specialized experts, and
- decontamination of equipment and materials (e.g., moving pads, crates, trucks).

9.12.6 Contents Storage

Restorers should be capable of providing a secure, supervised facility with a stable environment in which to store the personal property of their clients**.** It is recommended that restorers that have multiple pack outs stored in their facility, keep each client's property separated from other clients' property. To prevent cross contamination of fire residues and odors, restorers should separate restored contents from non-restored contents. Warehouse tracking systems should be used so that restorers can know where the property of a particular client is located within the storage facility during the restoration process and short-term storage.

It is recommended that the storage facility be equipped with short term storage capabilities (e.g., moveable storage containers, racked shelving) and the necessary equipment to safely manipulate the contents within the facility to facilitate cleaning, fire and smoke odor management, staging, etc. (e.g., forklifts, pallet jacks). It is recommended that contents manipulation within the processing facility be documented for potential charges the client will be expected to pay (e.g., putting contents into temporary storage locations, retrieving items from storage locations for restoration processes).

Storage facilities should be well organized to allow items to be located and retrieved on reasonable advanced notice. Restorers should notify the client and, in certain situations, the MIPs when additional

labor charges are to be incurred to facilitate locating and retrieving items of personal property (e.g., partial delivery, staging items for in-plant inspection, order of delivery).

9.12.7 Return of Contents (Delivery / Pack Back)

Restorers should provide documented evidence that all items in their care and custody have been loaded onto the truck for delivery. Providing this documentation to the client upon delivery allows the client to review the list to confirm that all the contents have been received. Restorers should obtain a signed acknowledgement of receipt for goods from the client at the time of delivery. It is recommended that this documentation be made available to MIPs and accompany invoicing to the party responsible for the payment.

Restorers should prepare buildings to accept the delivery of restored contents by installing protective materials on vulnerable flooring surfaces (e.g., carpeting, new or newly refinished wood flooring), stairs and other high traffic areas. It is recommended that doors, door casings, banisters and railings be covered by protective pads (e.g., quilted moving pads) to prevent damage from furniture being manipulated within the building.

It is recommended that restorers use the photographic documentation taken during pack-out showing the location where contents were located within the building so that they can be returned to those locations upon delivery, unless otherwise requested by the client. Furniture that was disassembled to be removed should be re-assembled upon delivery, if this service is within the skill set of the restorer. Some re-assembly of furniture may require the use of specialized experts. It is recommended that unpacking and placement of boxed contents be offered to the client and documented when declined. If requested by the client or MIPs, the restorer should provide the projected costs for unpacking prior to providing that service.

9.13 Non-Salvageable/Non-Restorable Inventory

Restorers may be tasked (hired by the owner, insurance carrier, or other MIPs) with creating an inventory of items that have been determined through FSD assessment to be non-salvageable. The restorer should also provide documentation for items where restoration efforts were attempted but failed and no additional form of repairs are able to correct in a cost-effective manner. It is recommended that when restorers are tasked with inventorying non-restorable contents, they provide photographic and available descriptive and quantitative information that includes but is not limited to:

- the name of the room or area within the building the item was found;
- a description of the item, or category of item, by name;
- any manufacturers information available (e.g., name of the manufacturer, model, serial number, capacity);
- quantity of the item(s) lost (e.g., single items should be individually listed. Numerous like-kind items should be counted and, if specified by the party paying for this service, categorized in some fashion (e.g., hardbound books, paperback books, spices, canned goods, dry goods, perishable goods, plastic ware). Like-kind items may be grouped together and a per-piece-per-category of item assigned;
- approximate age of the item, if possible;
- any visible pricing information (e.g., attached price tag); and
- replacement cost information, if applicable or requested by the MIPs.

In fires where the damage is severe (e.g., the damage to the item from the fire may prevent complete identification and documentation of that item), restorers should interview the owner of the property to obtain as detailed a description as possible, including those listed above.

It may be possible to remove smoke odor and residues, restoring inventory items to like new condition in retail and commercial losses. It is a common practice for insurance carriers to use the service of a salvor to minimize the loss by removing and liquidating the inventory when this level of restoration is not possible.

9.13.1 Disposal of Non-Restorable Items

Restorers should obtain written disposal authorization from the property owner or their designated agent prior to removal and disposal. This authorization should specifically address the items designated for disposal (i.e., per room) and include a place for the owner to list any exceptions, if necessary. It is recommended that items determined to be non-restorable and that have been properly documented be removed from the loss site as soon as practical so as not to impede other restoration work (e.g., demolition, structural cleaning).

Property designated for disposal should not be sold, donated, or diverted to other use unless so directed by written instruction by the property owner. Personal property designated for disposal should be disposed of in a manner in compliance with the AHJ. When the insurance carrier is compensating the property owner for the non-salvageable property, the damaged item(s) may be considered the property of the insurer, who may authorize disposal or retention.

Section 10 Post Restoration Evaluation

10.1 Introduction

It is recommended that restorers include clients, and MIPs, if applicable, in the evaluation of performance results at various stages of the restoration project to address any situations that could potentially affect the outcome of the project. Upon project completion, restorers should perform final inspections, review project requirements, and documentation, if applicable, to confirm the satisfactory completion of the RWP. After the restorer has confirmed that the RWP has been fully executed, a comprehensive site evaluation should be conducted with the client, and MIPs if applicable.

Confirmation that removal of fire related residues and odors from surfaces is complete is based on clearance criteria that should include visual observation, (e.g., surface wipes, white glove), smoke odor testing and can include the surface preparation procedures required for repair treatments, where applicable (e.g., sealing, painting, refinishing). When a restoration contractor has not contracted for the entirety of the restoration project and all the phases, those other responsible parties should also be included in the comprehensive site evaluation.

Where surfaces and materials do not meet clearance criteria (e.g., detectable residue transfer onto surface wipe, detectable fire related odor) or other conditions representing incomplete cleaning, surface preparation, fire and smoke odor management or repair treatments, a punch-list should be created for further evaluation and a plan developed for corrective action to be taken. Following corrective action(s), restorers should perform subsequent reinspection(s) until clearance criteria of documented objectives have been met or items are declared non-restorable.

10.2 Post Source Removal Surface Evaluation

The primary method to evaluate the effectiveness of source removal from accessible surfaces should be visual evaluation supplemented by the “White Glove Test”. The restorer should establish attainable goals of source removal, including the post-removal surface appearance, with the property owner and other MIPs before the work begins. As part of the RWP, Restorers should document those surfaces which respond well to repair treatment, however, cannot be fully restored to pre-loss condition. Areas of uncertainty can cause individuals, that do not understand the principles, processes, and goals of restoration, to form opinions that may be arbitrary or unrealistic. Restorers should apply skills gained by specialized training, knowledge, field experience and performance (i.e., project successes and failures) to address MIP concerns regarding source removal effectiveness.

10.2.1 Clean Only Clearance Criteria

Where cleaning alone was the sole remedy for fire residue removal, restorers should wipe target surfaces of representative areas of the project with a dry absorbent media (e.g., white cosmetic sponge, or folded paper or cellular sponge) then visually inspected for any residue transfer.

Clearance Criteria should be that no visible transfer of fire residues from the sampled surface onto the wipe media the surface is considered satisfactorily restored. This evaluation is colloquially called the “White Glove” test.

10.2.2 Prep (Clean) for Paint or Repair Clearance Criteria

Fire residues do not deposit uniformly. Restorers should understand that removal of fire residues does not always imply that the affected surfaces are fully restored when staining, streaking, discoloration remains present. For example, cleaning source removal procedures may not fully return the surface to its pre-loss appearance or utility. Adhered fire residues often result in surface staining or discoloration. Smearing may occur when loose or penetrated residues are disturbed (e.g., handling prior to residue removal, inappropriate removal processes used). The non-adhered residues should be removed to the level where the surface is able to accept cosmetic repair treatments (e.g., sealing, painting, refinishing).

Clearance criteria should reveal no visible transfer of fire residues appears on dry absorbent media (i.e., the white glove wipe evaluation as stated above). Cosmetic repair processes should follow satisfactory dry wipe testing.

10.2.2.1 Repair Treatments Following Aggressive Source Removal (e.g., Media Blasting)

Restorers should know that in addition to the smearing that can occur during certain fire residue removal processes, aggressive source removal can also alter the surface appearance. For example, certain aggressive source removal processes (e.g., heavy duty cleaners, media blasting, sanding, scraping) can remove portions of the affected surface. The restorer should know that in most abrasive removal procedures, while the goal of the procedure may be attained (i.e., removal of scorched, charred, peeling surface layers) further alteration of appearance may occur. Like liquid cleaning processes that do not return the surface to pre-loss appearance, these surfaces will also require repair treatments (e.g., sealing, painting, refinishing).

Clearance criteria following aggressive source removal processes should reveal no loose residues, charred, scorched or peeling layers of the surface present even though some discoloration from penetrated fire residues or scorching may remain. This is particularly common in the media blasting of wood framing materials. Restorers should apply odor management processes (e.g., application of desorbent, saturation spraying with smoke odor counteractant) to wood framing with deeply penetrated fire residues. Application of caulk, spray foam insulation and sealers may be required to attain visual and odor clearance criteria. Refer to *Section 6: Source Removal* for additional information of fire residue removal processes. Refer to *Section 8: Fire and Smoke Odor Management* for information on odor management processes.

10.2.2.2 Evaluation Objectivity of Repair Treatments

When requested by the client or MIPs, restorers should prepare a visual sample of surfaces that have been cosmetically repaired. Visual sample areas can be created by the application of the repair treatment(s) to a suitably sized representative area (e.g., a one square foot section of the affected wall, ceiling, floor surface). This sample area can then be used as a visual comparison to areas that have undergone source removal procedures but have not yet undergone repair treatments which demonstrate the end results of the restoration process.

Restorers should communicate to all MIPs that repair treatments (e.g., sealers, paints) are not to be applied until after the post source removal evaluation has been completed and acceptance criteria has been met. Premature application of repair treatments (e.g., sealing, painting) without prior surface evaluation may obscure visual inspection and complicate surface evaluation in the event of detectable smoke odors. These situations can lead to additional investigative work to locate the potential source of the odors (e.g., the need for removal of unauthorized coating(s) or treatment(s). To help avoid these situations, the restorer should monitor the effectiveness of the removal processes at critical stages throughout the project. Refer to Section *3: Fire and Smoke Damage Assessment, subsection 3.14 Smoke Odor Testing and subsection 3.15 Ongoing Progress Assessment and Quality Control* for additional information.

10.3 Project Odor Evaluation

The evaluation of odors is subjective and varies among individuals. Restorers should be attentive to client concerns regarding residual fire related odor even when the restorer does not smell the odor. The introduction of new odors is inherent in the restoration process (e.g., cleaning products, odor management products and processes, saw cutting, adhesives, off-gassing of materials and building products). Differences of opinions can arise over the existence of fire related odors. Restorers should employ odor evaluation techniques to establish their presence or absence. Restorers should know that there are two categories of odor inspections; surface and air. Odor evaluations should be performed periodically during the restoration process (interim) and again (final) at the end of the project to obtain clearance.

10.3.1 Ongoing Quality Control (Interim) Odor Inspections and Evaluation

Thorough source removal, professional odor management, and appropriate repair treatment, if applicable (e.g., use of sealers), following a fire should result in a building that is free and clear of smoke odors. As described in *Section 3: Fire and Smoke Damage (FSD) Assessment*, restorers should perform ongoing odor evaluations throughout the duration of the project and address any smoke odor related issues as they arise. Restorers should encourage the client, and any MIPs, if applicable, to participate in interim odor evaluations. It is recommended that odor evaluations be performed in conditions that are similar to the normal temperature and RH conditions, when feasible. Reconstruction of any kind (e.g., installation of insulation, drywall, flooring) should not be performed in areas that have not successfully met odor acceptance criteria.

10.3.2 Final Quality Control (Post Restoration) Odor Evaluation

Once the project is completed restorers should schedule a final odor evaluation that includes the client, and MIPs if applicable, to obtain clearance of the overall project. It is recommended that restorer's pre-condition the space to be evaluated for an agreed period of time. Pre-conditioning of spaces can include but is not limited to the following steps:

- closing windows and doors;
- discontinuing use of air moving or filtration equipment; and
- turning off HVAC system(s), if operable.

Overall project evaluation should also include normal functioning of mechanical systems (e.g., HVAC system running) if operable.

In certain situations (e.g., elevated client concern, someone believes they smell something consistent with smoke odor), restorers may consider increasing temperature and humidity to accelerate the release of otherwise undetectable fire related odors from surfaces. To accomplish this, restorers may consider:

- increase temperature using auxiliary heat (e.g., portable, preferably electric heaters, heat gun); and
- increase humidity using portable humidification devices.

Acceptance criteria should be the absence of fire-related odors after evaluation by individuals with normal sensitivities. When acceptance criteria fail, restorers should re-investigate, re-treat and continue odor evaluations until acceptance criteria is met or the matter enters dispute resolution.

10.3.3 Evaluation of Project Work when Fire Related Odors are Detected

When smoke odors are detected during any inspection, restorers should first verify that the RWP has been properly executed. Using air and surface testing methods, persistent smoke odors can often be traced to a specific area(s), using a variety of techniques (e.g., isolation using plastic containment, patch testing). Restorers should know that even if the area of the Odor Emitting Materials (OEM) is small and remote, odors can spread and accumulate over time to a level where the odor is recognizable in other areas.

Once located, OEM should be re-evaluated for alternative odor treatments. Restorers should re-inspect OEM following re-treatment until acceptance criteria has been met, or the decision to replace the OEM has been made by the MIPs when feasible. The restorer may consider using representative specimens of OEM that have been prepared in sealed airtight containers that have undergone alternative odor treatments as an odor detection method. The restorer should first confirm the effectiveness of the procedure on the specimens prior to wide range application.

10.3.4 Odor Testing Evaluation and Dispute Resolution

Odor detection and odor recognition are not the same. Odor detection level is the lowest concentration at which someone can smell an odor. Odor Recognition is the level at which someone can identify an odor.

The evaluation of odor detection and recognition testing should include the client or the concerned party who originally recognized the odor and the restorer.

When broader odor testing evaluation is needed, restorers may streamline the odor evaluation process by limiting the number of individuals involved in the evaluation process. In some situations, or when there are disputes over the presence of smoke and other work-related odors, it may be necessary to include others (e.g., MIPs, impartial unbiased third parties) as part of an investigative odor panel. Blind odor testing evaluations should be performed in a manner so as not to influence the decisions of others on the panel. Effective blinding can reduce or eliminate biases that arise from a participants' expectations, observers' effect on participants, observer bias, confirmation bias, and other influences. Individual test results of each panelist should be documented.

10.3.4.1 Odor Evaluation and Dispute Resolution Procedures

In the evaluation process, disagreements may arise between restorers, clients, and MIPs about the presence or absence of fire related odor. To address these disagreements restorers should refer to *Section 3: Fire and Smoke Damage Assessment*, *subsection 3.14.2: Odor Testing Evaluation and Dispute Resolution, Section 7: Heating Ventilation and Air Conditioning (HVAC) and Air Conveyance Systems, sub section 7.5.2 Sample Preparation for Odor Evaluation, and Section 8: Fire and Smoke Odor Management, subsections 8.6 Quality Control Inspection and 8.6.1 Persistent Fire-Related Odors for* additional information.

When the presence or absence of fire related odor is in dispute restorers may consider patch testing and patch stress testing that include a control group (placebo) of new or unused like and kind material specimens or patch media. The restorer should reveal that a certain number of placebos may be included in the evaluation process to be sniffed along with test specimens. It is recommended the restorer not reveal the identity of the actual specimens or the placebo until the test is completed. Identifying smoke odors in placebos (false positive) suggests odor is perceived only and not present. For example, this individual may be experiencing a psychological response (e.g., heightened awareness, associative odor).

10.3.5 Other Contributing Factors in Smoke Odor Detection

The restoration contractor should not assert that clients (e.g., property owner, policy holder) are unjustified when they claim to smell smoke odors others cannot. The sense of smell is subjective, with varying sensitivity between individuals. Therefore, it is possible that one person may detect an odor when others cannot. Smoke odors can be faint and remain undetected until someone smells something they identify as smoke. Smoke odor detection is further complicated when the odor is intermittent or becomes more or less intense in different environmental conditions such as temperature, humidity, and ventilation. To respond to concerns, restorers may need to apply procedures (e.g., isolation testing, patch testing, increase temperature and humidity) in an attempt to locate and then treat, or re-treat odor sites. Refer to *Section 3: FSD Assessment*, subsection *3.14: Smoke Odor Testing f*or information relating to procedures for treating persistent fire related odor, *Section 6: Source Removal, subsection 6.4: Cleaning and Removal of Fire Residues and Section 8: Fire and Smoke Odor Management, subsection 8.4: Fire Odor Removal Procedures.*

Additionally, restorers should understand there may be psychological and physiological factors that affect smoke odor perception. If clients maintain they detect fire related odor when others, including independent evaluators, do not, restorers should apply similar odor testing procedures as described above with an emphasis on patch testing that includes the use of placebos.

10.4 Post Contents Restoration Evaluation

Contents clearance acceptance evaluation should be performed in a similar fashion to those in structural evaluation, including the need for repair treatments when applicable. The goal of successful contents restoration is to obtain satisfactory results (e.g., the removal of fire related residues and odors) which can be confirmed by visual inspection, wipe testing and sniffed.

Restorers should know that in fire and smoke damage restoration cleaning, commonly there is a level of improvement in the overall condition of the item being restored (e.g., general cleanliness, finish enhancement, pleasant 'clean' smell). Substantial documentation is required when establishing the pre-loss condition. Clients often state their property is in 'perfect' condition, close inspections can usually reveal some form of pre-existing damage (e.g., scratches, dents, unrelated soiling). Restorers should perform thorough documentation (i.e., photographic and written) prior to extensive handling (e.g., manipulation, removal) of contents. It is recommended that restorers qualify and, when appropriate, demonstrate and document the anticipated results of restoration of contents with the owner prior to overall restoration. This documentation can be useful to the restorer when evaluating post restoration results, particularly when there are disputes.

11 Limitations, Complexities, Complications and Conflicts

11.1 Introduction

Restorers can be faced with project conditions that present challenges. These challenges can produce limitations, complexities, complications, and conflicts. Restorers should have an understanding of these issues and communicate them to the appropriate parties (e.g., clients, MIPs). The following is a definition of each of these challenges that restorers may encounter on fire and smoke projects.

Limitations and complexities are often known or anticipated prior to the start of the project. Restorers should discuss these challenges and the potential consequences of both actions and inactions with the client and MIPs. The restorer should document these challenges and get approval(s) when not directly addressed in the contract. To the extent possible, approval(s) should be obtained prior to the commencement of work.

11.2 Limitations

Limitations are restrictions placed upon the project that limit the execution of the FSD assessment, scope, RWP or their anticipated performance outcomes. Limitations that prevent or alter services to be rendered in compliance with this standard should be documented. Limitations placed on any project that are inconsistent with this standard can result in a conflict.

11.3 Complexities

Complexities are conditions likely to cause a project to become more difficult or complex and do not prevent the execution of the FSD assessment, scope, RWP, or anticipated performance outcomes. Complexities are generally apparent or predictable prior to the commencement of the restoration project and should be addressed in the scope and included in the RWP.

11.4 Complications

Complications are conditions that are not apparent or predictable that arise after the start of work. Complications should result in an amendment to the FSD assessment which may necessitate an alteration to the scope, RWP, and may generate a change order. The client and MIPs should be notified in writing, as soon as practical, of any complication that develops.

11.5 Conflicts

Limitations, complexities, and complications that result in a disagreement between the parties involved in the FSD assessment, scope, RWP or their anticipated performance outcomes are called conflicts. When limitations, complexities or complications develop or are placed on the project by the client which prevent compliance with this standard, restorers can choose to negotiate an acceptable agreement, decline the project, stop work, or accept the project with appropriate releases and disclaimers. Conflict resolution should be documented and retained. Refer to *Section 2: Administrative Requirements and Documentation, Section 2.8 Documentation of Limitations, Deviations and Disclaimers and Section 2.9 Risk Management.*

References

Portions of the following documents are referenced herein and thereby constitute provisions of this Standard. At the time of publication, the references cited were current. All cited references are subject to revision, and those using this Standard should reference the most recent editions.

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