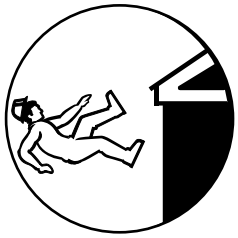
JOURNEY UPGRADE STUDY GUIDE

Top four construction hazards
Aerial lifts
Permit required confined spaces
Carbon monoxide poisoning
Electrical safety
Falls
Scaffolding
Ladders
First Aid
Lockout/Tagout
Hazard communications
Hazardous waste and disposal
Respirators
Lead paint in construction
Effects of lead
Basic surface preparation techniques and paint failures
Common fillers
Common paint sprayers / guns
Airless tips
Common brush types
Paint
Wood stain
Basic steps to wood staining
Some common paint solvents
Schedules
Definitions

OSHA QUICK CARD™

Top Four
Construction Hazards

The top four causes of construction fatalities are: Falls, Struck-By, Caught-In/Between and Electrocutions.



Prevent Falls

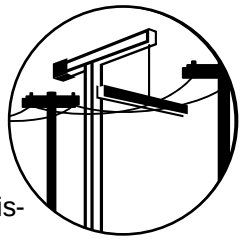
- Wear and use personal fall arrest equipment.
- Install and maintain perimeter protection.
- Cover and secure floor openings and label floor opening covers.
- Use ladders and scaffolds safely.

Prevent Struck-By

- Never position yourself between moving and fixed objects.
- Wear high-visibility clothes near equipment/vehicles.

Prevent Caught-In/Between

- Never enter an unprotected trench or excavation 5 feet or deeper without an adequate protective system in place; some trenches under 5 feet deep may also need such a system.
- Make sure the trench or excavation is protected either by sloping, shoring, benching or trench shield systems.



Prevent Electrocutions

- Locate and identify utilities before starting work.
- Look for overhead power lines when operating any equipment.
- Maintain a safe distance away from power lines; learn the safe distance requirements.
- Do not operate portable electric tools unless they are grounded or double insulated.
- Use ground-fault circuit interrupters for protection.
- Be alert to electrical hazards when working with ladders, scaffolds or other platforms.

For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA

OSHA 3216-6N-06

OSHA® QUICK CARD™

Aerial Lifts

Protect Yourself

Aerial lifts are vehicle-mounted, boom-supported aerial platforms, such as cherry pickers or bucket trucks, used to access utility lines and other above-ground job sites. The major causes of fatalities are falls, electrocutions, and collapses or tip overs. Employers must take measures to ensure the safe use of aerial lifts by their workers if they are required to use this equipment in the course of their employment.

Safe Work Practices

- Make sure that workers who operate aerial lifts are properly trained in the safe use of the equipment.
- Maintain and operate elevating work platforms according to the manufacturer's instructions.
- Never override hydraulic, mechanical, or electrical safety devices.
- Never move the equipment with workers in an elevated platform unless this is permitted by the manufacturer.
- Do not allow workers to position themselves between overhead hazards, such as joists and beams, and the rails of the basket. Movement of the lift could crush the worker(s).
- Maintain a minimum clearance of at least 10 feet, or 3 meters, away from the nearest energized overhead lines.
- Always treat power lines, wires and other conductors as energized, even if they are down or appear to be insulated.
- Use a body harness or restraining belt with a lanyard attached to the boom or basket to prevent the worker(s) from being ejected or pulled from the basket.
- Set the brakes and use wheel chocks when on an incline.
- Use outriggers, if provided.
- Do not exceed the load limits of the equipment. Allow for the combined weight of the worker, tools and materials.

For more information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)

OSHA 3267-04R-13

OSHA® DATOS RÁPIDOS

Plataformas de trabajo a áreas

Las plataformas de trabajo a áreas son vehículos montados, plataformas elevadas de aguilón sostenido, como lo son las de puntal extensible con canasta (mejor conocidas como “cherry pickers”) o los camiones canasta, usados para acceder lineas de utilidades y otros trabajos sobre el terreno del lugar de trabajo. Las principales causas de muertes son por caídas, electrocuciones y colapsos o volteos. Los empleadores deben tomar medidas para garantizar el uso seguro de las plataformas de trabajo a áreas por sus trabajadores si ellos están obligados a utilizar este equipo durante el curso de su trabajo.

Prácticas de trabajo seguras

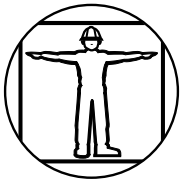
- Asegúrese que los trabajadores que operan plataformas de trabajo a áreas estén adecuadamente adiestrados en el uso seguro del equipo.
- Mantenga y opere las plataformas de trabajo elevadas de acuerdo con las instrucciones del manufacturero.
- Nunca invalide los dispositivos de seguridad hidráulicos, mecánicos o eléctricos.
- Nunca mueva el equipo con trabajadores en una plataforma elevada, a menos que sea permitido por el manufacturero.
- No permita a los trabajadores ponerse entre riesgos que estén por encima de la cabeza, como viguetas y vigas, y las barandas del canasto. El movimiento de la plataformas de trabajo a áreas puede aplastar al trabajador.
- Mantenga una distancia mínima segura de las líneas eléctricas aéreas energizadas más cercanas de al menos 10 pies o 3 metros.
- Siempre trate a las líneas de energía eléctrica, alambres y otros conductores como si estuvieran energizados (vivos), aún si están fuera de servicio o parece que están aislados.
- Use un arnés de cuerpo o correa que restringa el movimiento con una cuerda de seguridad atada al aguilón o canasto para prevenir que el trabajador salga disparado o sea tirado del canasto.
- Ponga los frenos y use calzos cuando esté en un área inclinada.
- Use estabilizadores, si son provistos.
- No exceda la carga límite del equipo. Tome en cuenta el peso combinado del trabajador, herramientas y materiales.

Para más información:

OSHA® Administración de Seguridad y Salud Ocupacional
Departamento de Trabajo de los EE. UU.
www.osha.gov (800) 321-OSHA (6742)

OSHA® QUICK CARD™

Permit-Required Confined Spaces in General Industry



A confined space has limited openings for entry or exit, is large enough for entering and working, and is not designed for continuous worker occupancy. Confined spaces include underground vaults, tanks, storage bins, manholes, pits, silos, underground utility vaults and pipelines. See 29 CFR 1910.146.

Permit-required confined spaces are confined spaces that:

- May contain a hazardous or potentially hazardous atmosphere.
- May contain a material which can engulf an entrant.
- May contain walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant.
- May contain other serious physical hazards such as unguarded machines or exposed live wires.
- Must be identified by the employer who must inform exposed employees of the existence and location of such spaces and their hazards.

What to Do

- Do not enter permit-required confined spaces without being trained and without having a permit to enter.
- Review, understand and follow employer's procedures before entering permit-required confined spaces and know how and when to exit.
- Before entry, identify any physical hazards.
- Before and during entry, test and monitor for oxygen content, flammability, toxicity or explosive hazards as necessary.
- Use employer's fall protection, rescue, air-monitoring, ventilation, lighting and communication equipment according to entry procedures.
- Maintain contact at all times with a trained attendant either visually, via phone, or by two-way radio. This monitoring system enables the attendant and entry supervisor to order you to evacuate and to alert appropriately trained rescue personnel to rescue entrants when needed.

You have a right to a safe workplace.
If you have questions about workplace safety and health, call OSHA. It's confidential. We can help!

For more information:

OSHA® Occupational Safety and Health Administration
U.S. Department of Labor
www.osha.gov (800) 321-OSHA (6742)

OSHA 3214-09R-11

OSHA® DATOS RÁPIDOS

Permisos-Requeridos Espacios Confinados en la Industria General

Un espacio confinado tiene aperturas de entrada y salida limitadas, es lo suficientemente grande para un empleado entrar y trabajar y no esta designado para la ocupación de trabajo continuo. Espacios confinados incluyen bóvedas subterráneas, tanques, recipientes de almacenaje, registros, pozos, silos, bóvedas de servicio subterráneas y tuberías de distribución. Ver 29 CFR 1910.146.

Permisos requeridos para espacios confinados son espacios confinados que:

- Pueden contener una atmósfera peligosa o potencialmente peligrosa.
- Pueden contener un material que puede sumergir a un empleado.
- Pueden contener paredes que convergen hacia adentro o piso que la pendiente desciende y se estrechan en un área mas pequeña en la cual puede atrapar o aficiar al trabajador.
- Pueden contener otros peligros serios físicos tales como máquinas sin protección o cables vivos expuestos.
- Deben ser identificado por el empleador el cual debe informar a los empleado expuestos de la existencia y localización de tales espacios y sus peligros.

Que hacer

- No entre a un espacio confinado con permiso requerido sin estar capacitado y sin tener un permiso para entrar.
- Estudie, comprenda y siga los procedimientos del empleador antes de entrar al espacio confinado con permiso requerido y sepa como y cuando entrar y salir.
- Antes de entrar, identifique cualquier peligro físico.
- Antes y durante la entrada, examine y controle el contenido de oxígeno, flamabilidad, toxicidad o peligros de explosión como sea necesario.
- Use el equipo de protección contra caída, rescate, monitoreo de aire, ventilación, equipo de comunicación de acuerdo con los procedimientos de entrada.
- Mantenga contacto en todo momento con un asistente entrenado asi sea visualmente, a travez de teléfono o por radio de communicación direccional. Este sistema de monitoreo le permite al asistente y al supervisor de la entrada ordenar evacuar y alertar apropiadamente al personal de capacidad de rescate para rescatar al trabajador cuando sea necesario.

Usted tiene derecho a un lugar de trabajo seguro.
Si usted tiene preguntas acerca de seguridad y salud en el lugar de trabajo, llame a OSHA
Es confidencial. Te podemos ayudar!

Para más información:

OSHA® **Administración de Seguridad y Salud Ocupacional**
Departamento del Trabajo de EE.UU.
www.osha.gov (800) 321-OSHA (6742)

OSHA QUICK CARD™

Protect Yourself

Carbon Monoxide Poisoning

Carbon monoxide (CO) is a colorless, odorless, toxic gas which interferes with the oxygen-carrying capacity of blood. CO is non-irritating and can overcome persons without warning. Many people die from CO poisoning, usually while using gasoline powered tools and generators in buildings or semi-enclosed spaces without adequate ventilation.

Effects of Carbon Monoxide Poisoning

- Severe carbon monoxide poisoning causes neurological damage, illness, coma and death.

Symptoms of CO exposure

- Headaches, dizziness and drowsiness.
- Nausea, vomiting, tightness across the chest.

Some Sources of Exposure

- Portable generators/generators in buildings.
- Concrete cutting saws, compressors.
- Power trowels, floor buffers, space heaters.
- Welding, gasoline powered pumps.

Preventing CO Exposure

- Never use a generator indoors or in enclosed or partially enclosed spaces such as garages, crawl spaces, and basements. Opening windows and doors in an enclosed space may prevent CO buildup.
- Make sure the generator has 3-4 feet of clear space on all sides and above it to ensure adequate ventilation.
- Do not use a generator outdoors if placed near doors, windows or vents which could allow CO to enter and build up in occupied spaces.
- When using space heaters and stoves ensure that they are in good working order to reduce CO buildup, and never use in enclosed spaces or indoors.
- Consider using tools powered by electricity or compressed air, if available.
- If you experience symptoms of CO poisoning get to fresh air right away and seek immediate medical attention.

For more complete information:

OSHA Occupational Safety and Health Administration
U.S. Department of Labor
www.osha.gov (800) 321-OSHA

OSHA 3282-10N-05

OSHA® QUICK CARD™

Electrical Safety

Electrical hazards can cause burns, shocks and electrocution (death).

- Assume that all overhead wires are energized at deadly voltages. Never assume that a wire is safe to touch even if it is down or appears to be insulated.
- Never touch a fallen overhead power line. Call the electric utility company to report fallen electrical lines.
- Stay at least 10 feet (3 meters) away from overhead wires during cleanup and other activities. If working at heights or handling long objects, survey the area before starting work for the presence of overhead wires.
- If an overhead wire falls across your vehicle while you are driving, stay inside the vehicle and continue to drive away from the line. If the engine stalls, do not leave your vehicle. Warn people not to touch the vehicle or the wire. Call or ask someone to call the local electric utility company and emergency services.
- Never operate electrical equipment while you are standing in water.
- Never repair electrical cords or equipment unless qualified and authorized.
- Have a qualified electrician inspect electrical equipment that has gotten wet before energizing it.
- If working in damp locations, inspect electric cords and equipment to ensure that they are in good condition and free of defects, and use a ground-fault circuit interrupter (GFCI).
- Always use caution when working near electricity.

For more information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)

OSHA 3294-04R-13

OSHA® DATOS RÁPIDOS

Seguridad eléctrica

Los riesgos eléctricos pueden causar quemaduras, choques eléctricos y electrocución (muerte).

- Sepa que probablemente todos los cables aéreos están energizados (vivos) a voltajes fatales. Nunca asuma que se puede tocar un cable de manera segura aún si está fuera de servicio o parece que está aislado.
- Nunca toque una línea de energía eléctrica que se haya caído. Llame a la compañía de servicio eléctrico para reportar líneas eléctricas caídas.
- Manténgase al menos 10 pies (3 metros) alejado de los cables aéreos durante limpiezas y otras actividades. Si está trabajando desde alturas o manejando objetos largos, antes de comenzar a trabajar evalúe el área para detectar la presencia de cables aéreos.
- Si un cable aéreo cae sobre su vehículo cuando esté guiando, manténgase dentro del vehículo y continúe guiando, alejándose del cable. Si el motor de su vehículo se detiene, no salga del vehículo. Adviértale a las personas que no toquen el vehículo o el cable. Llame, o pídale a alguien que llame, a la compañía local de servicio eléctrico y a servicios de emergencia.
- Nunca opere equipos eléctricos mientras esté parado sobre agua.
- Nunca repare cables o equipo eléctrico a menos que esté calificado y autorizado.
- Antes de energizar el equipo eléctrico que se ha mojado, haga que un electricista calificado lo inspeccione.
- Si está trabajando en áreas húmedas, inspeccione los cables y equipo eléctrico para asegurarse que estén en buenas condiciones y sin defectos, y use un interruptor de circuito con pérdida a tierra (GFCI, por sus siglas en inglés).
- Siempre tenga cuidado cuando esté trabajando cerca de electricidad.

Para más información:

OSHA® Administración de Seguridad y Salud Ocupacional
Departamento de Trabajo de los EE. UU.
www.osha.gov (800) 321-OSHA (6742)

OSHA® QUICK CARD™

Hazard Communication Safety Data Sheets

The Hazard Communication Standard (HCS) requires chemical manufacturers, distributors, or importers to provide Safety Data Sheets (SDSs) (formerly known as Material Safety Data Sheets or MSDSs) to communicate the hazards of hazardous chemical products. As of June 1, 2015, the HCS will require new SDSs to be in a uniform format, and include the section numbers, the headings, and associated information under the headings below:

Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.

Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.

Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.

Section 4, First-aid measures includes important symptoms/effects, acute, delayed; required treatment.

Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.

Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.

Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.

(Continued on other side)

U.S. Department of Labor

For more information:

OSHA® Occupational Safety and Health Administration

www.osha.gov (800) 321-OSHA (6742)

OSHA 3493-12R 2013

OSHA® QUICK CARD™

Hazard Communication Safety Data Sheets

Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); ACGIH Threshold Limit Values (TLVs); and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the SDS where available as well as appropriate engineering controls; personal protective equipment (PPE).

Section 9, Physical and chemical properties lists the chemical's characteristics.

Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.

Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.

Section 12, Ecological information*
Section 13, Disposal considerations*
Section 14, Transport information*
Section 15, Regulatory information*

Section 16, Other information, includes the date of preparation or last revision.

*Note: Since other Agencies regulate this information, OSHA will not be enforcing Sections 12 through 15 (29 CFR 1910.1200(g)(2)).

Employers must ensure that SDSs are readily accessible to employees.
See Appendix D of 29 CFR 1910.1200 for a detailed description of SDS contents.

For more information:

U.S. Department of Labor

OSHA® Occupational Safety and Health Administration

www.osha.gov (800) 321-OSHA (6742)

FALLS

Historically, falls are the leading cause of fatalities in construction, accounting for about one-third of all fatalities in the industry. For example, the Bureau of Labor Statistics reported that there were 291 fatal falls to a lower level in construction in 2013, out of 828 total fatalities. OSHA recognizes that incidents involving falls are generally complex events, frequently involving a variety of factors. Consequently, the standard for fall protection deals with both the human and equipment related issues in protecting workers from fall hazards.

If workers need to use a Personal Fall Arrest System (PFAS), the employer must provide a full body harness, lanyard and/or lifeline, for each worker, and an anchorage point independent of supporting any other platforms, but capable of supporting 5,000 lbs. per each attached worker. Anchorage points must be approved by a qualified person. Standpipes, vents, drainpipes and electrical conduits on buildings are not considered proper anchorage points. Make sure the PFAS fits the worker, and regularly inspect all fall protection equipment to ensure that it's still in good condition. If workers do not routinely use their PFAS, they may neglect routine daily inspection of their equipment — and when required to use their PFAS, a component part may fail! Falls are the leading cause of death in the construction industry, and even experienced workers can be hurt and killed in falls. Regularly wear your PFAS, stay connected and tie-off to a proper anchorage point at the job site.

Train workers in hazard recognition and the OSHA Fall Protection standard to properly identify and understand the severity of fall hazards and certify through a written record. Provide and use safety monitor systems, warning line systems, or controlled access zones, in accordance with the OSHA Fall Protection standard. A controlled access zone is a work area designated and clearly marked in which certain types of work (such as over- hand bricklaying) may take place without the use of conventional fall protection systems, guardrail, personal arrest or safety net—to protect the employees working in the zone.

Almost all sites have unprotected sides and edges, wall openings, or floor holes at some point during construction. If these sides and openings are not protected at your site, injuries from falls or falling objects may result, ranging from sprains and concussions to death. Use at least one of the following whenever employees are exposed to a fall of 6 feet or more above a lower level: A guardrail system, safety net system or a fall arrest system. In general, it is better to use fall prevention systems, such as guardrails, than fall protection systems, such as safety nets or fall arrest devices.

Cover or guard floor holes as soon as they are created. Guard or cover any openings or holes immediately. Construct all floor hole covers so they will effectively support two times the weight of employees, equipment, and materials that may be imposed on the cover at any one time.

SCAFFOLDING

All scaffolds must be erected, moved dismantled, or altered only under the supervision of a competent person who is qualified.

The most common types of scaffolding hazards electricity, falls and falling objects.

A minimum clearance to maintain from all electrical lines up to 50 kv (50,000 volts) is 10 feet, unless the line is insulated and carrying less than 300 volts, in which case the minimum clearance to maintain is 3 feet.

Fall arrest systems, guardrails or safety netting should be provided on any scaffold that is expected to be elevated to more than six feet above the ground.

The height of the top rail for scaffolds manufactured and placed in service after January 1, 2000 must be between 38 inches and 45 inches. The height of the top rail for scaffolds manufactured and placed in service before January 1, 2000 can be between 36 inches and 45 inches.

When the cross point of cross bracing is used as a top rail, it must be between 38 inches and 48 inches above the work platform.

It is not okay to use the cross braces as a means to climb up the scaffolding.

Midrails must be installed approximately halfway between the top rail and the platform surface. When a cross point of cross bracing is used as a mid rail, it must be between 20 inches and 30 inches above the work platform.

Support scaffold footings shall be level and capable of supporting the loaded scaffold. The legs, poles, frames, and uprights shall bear on base plates and mud sills.

The platform should be fully planked, and the gaps between the planks should not exceed one inch. The platform should not be more than 14 inches from the structure being worked on.

Wooden planks used for scaffolding need to be stamped plank grade by the lumber association. The planks cannot have paint overspray on them. The condition of the plank needs to be seen.

Supported scaffolds with a height-to-base of more than 4:1 shall be restrained from tipping by guying, tying, bracing, or the equivalent.

Scaffolds and scaffold components must support at least 4 times the maximum intended load. Suspension scaffold rigging must at least 6 times the intended load.

Unless they have been designed for that specific purpose, scaffolds should not be moved horizontally while employees are on them.

Ladders not designed for use with the scaffolding are not allowed to be used on the scaffold

If you have scaffolds from two or more manufacturers, do not under any circumstances try to mix and match the components.

It is important to make sure that while erecting scaffolding the first stage is plumb, aligned and level.

LADDERS

When you want to reach a higher work area, think about the best equipment to use. While a ladder or stepladder is commonly used, it may not always be the best option. Ask yourself these questions before deciding on a ladder. Will I have to hold heavy items while on the ladder? Is the elevated area high enough that it would require a long ladder that can be unstable? Will I be working from this height for a long time? Do I have to stand on the ladder sideways in order to do this work? If your answer is yes to one of the above questions, consider using something other than a ladder. If possible, bring in other equipment like a scissor lift.

Use the right ladder for the job. For example, ensure the ladder is high enough for you to reach your work area without having to stand on the top two rungs.

Never use metal ladders near electrical sources.

When using ladders to access another level, secure and extend the ladder at least 3 feet above the landing point to provide a safe handhold.

The base of the ladder should be secured.

Place the ladder on stable and level ground. DO NOT place it on an uneven surface.

Ensure that a step ladder is fully opened and braces are engaged before starting work. Make certain that when using an extension ladder that it's rung locking mechanisms are engaged before climbing.

Maintain three points of contact with the ladder at all times.

Always use the 4 to 1 ratio rule when using an extension ladder. For every 4 feet the ladder goes up the wall the base needs to come out 1 foot from that wall. For example, if the ladder reaches 12 feet its base needs to be out 3 feet from that wall.

Position the ladder so that your work is in front of you and do not straddle a ladder.

Check, Maintain and Store Ladders Well Before using a ladder, check it carefully to ensure there are no visible defects and that it is in good working condition. Check the ladder according to the manufacturer's instructions. Maintain and store the ladder according to the manufacturer's instructions.

Discontinue the use of any ladder that shows any signs of damage.

FIRST AID

CPR

Cardiopulmonary resuscitation, commonly known as CPR, is an emergency procedure performed in an effort to manually preserve intact brain function until further measures are taken to restore spontaneous blood circulation and breathing in a person who is in cardiac arrest. It is indicated in those who are unresponsive with no breathing or abnormal breathing, for example, agonal respirations.

According to the International Liaison Committee on Resuscitation guidelines, CPR involves chest compressions for adults between 5 cm (2.0 in) and 6 cm (2.4 in) deep and at a rate of at least 100 to 120 per minute. The rescuer may also provide breaths by either exhaling into the subject's mouth or nose or using a device that pushes air into the subject's lungs. This process of externally providing ventilation is termed artificial respiration. A universal compression to ventilation ratio of 30:2 is recommended. Current recommendations place emphasis on high-quality chest compressions over artificial respiration; a simplified CPR method involving chest compressions only is recommended for untrained rescuers. In children only doing compressions may result in worse outcomes.[3]

CPR alone is unlikely to restart the heart. Its main purpose is to restore partial flow of oxygenated blood to the brain and heart. The objective is to delay tissue death and to extend the brief window of opportunity for a successful resuscitation without permanent brain damage. Administration of an electric shock to the subject's heart, termed defibrillation, is usually needed in order to restore a viable heart rhythm.

CPR is likely to be effective only if commenced within 6 minutes after the blood flow stops.

CHECK FOR RESPONSIVENESS - Tap the shoulder and shout, “Are you OK?”

CALL 9-1-1 - if no response, CALL 9-1-1 or the local emergency number. If an unconscious person is face-down, roll face-up, supporting the head, neck and back in a straight line. If the person responds, obtain consent and CALL 9-1-1 or the local emergency number for any life-threatening conditions. CHECK the person from head to toe and ask questions to find out what happened.

OPEN THE AIRWAY – Tilt head, lift chin.

CHECK FOR BREATHING - CHECK quickly for breathing for no more than 10 seconds. Occasional gasps are not breathing.

QUICKLY SCAN FOR SEVERE BLEEDING

NO BREATHING – Begin compressions.

FIRST AID KITS

Make sure that first aid kits are industry specific and meet or exceed OSHA requirements.

FINDING AN INJURED PERSON

Check the surroundings. Evaluate the situation. Are there things that might put you at risk of harm? Are you or the victim threatened by fire, toxic smoke or gasses, an unstable building, live electrical wires or other dangerous scenario? Do not rush into a situation where you could end up as a victim yourself. If approaching the victim will endanger your life, seek professional help immediately; they have higher levels of training and know how to handle these situations. First aid becomes useless if you can't safely perform it without hurting yourself.

Call authorities or emergency services immediately if you believe someone to be seriously injured. If you are the only person on the scene, try to establish breathing in the patient before calling for help. Do not leave the victim alone for an extensive amount of time.

Caring for someone who has just gone through serious trauma includes both physical treatment and emotional support. Remember to stay calm and try to be reassuring; let the person know that help is on its way and that everything will be alright.

LOCKOUT/TAGOUT

"Lockout/Tagout" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities. This requires, in part, that a designated individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock or tag the energy-isolating device(s) to prevent the release of hazardous energy and take steps to verify that the energy has been isolated effectively. If the potential exists for the release of hazardous stored energy or for the re-accumulation of stored energy to a hazardous level, the employer must ensure that the employee(s) take steps to prevent injury that may result from the release of the stored energy. Lockout devices hold energy-isolation devices in a safe or "off" position. They provide protection by preventing machines or equipment from becoming energized because they are positive restraints that no one can remove without a key or other unlocking mechanism, or through extraordinary means, such as bolt cutters. Tagout devices, by contrast, are prominent warning devices that an authorized employee fastens to energy-isolating devices to warn employees not to reenergize the machine while he or she services or maintains it. Tagout devices are easier to remove and, by themselves, provide employees with less protection than do lockout devices.

Only authorized personnel can remove a lock and tag.

HAZARD COMMUNICATION

THE HAZARD COMMUNICATION STANDARD

The purpose of the hazard communication standard, also referred to as the Right-to-Know standard, is to communicate the potential health and safety hazards and safe work practices required for the chemicals used on your work site.

HAZARD

Failure to recognize the hazards associated with chemicals can cause minor skin irritations to serious chemical burns, nerve damage, different forms of cancer, respiratory problems, fires, explosions, and death.

SOLUTION

Maintain a Safety Data Sheet (SDS) for each chemical in the facility. Make this information accessible to employees at all times in a language or formats that are clearly understood by all affected personnel. Train employees on how to read and use the SDS. Follow manufacturer's SDS instructions for handling hazardous chemicals. Train employees about the risks of each hazardous chemical being used. Provide spill clean-up kits in areas where chemicals are stored. Have a written spill control plan. Train employees how to clean up spills, protect themselves and properly dispose of used materials. Provide proper personal protective equipment and enforce its use. Store chemicals safely and securely. Always make sure labels on containers are easily read and accurately describe the contents of said containers. Labels need to include the chemical identity, hazard warnings and the name and the address of the manufacturer.

SDS

Employers must keep chemical fact sheets called Safety Data Sheets (SDSs) at the work site. All employees using the chemicals need to understand the dangers and how to protect themselves from them.

EMPLOYEE TRAINING

Employers must train employees on the hazardous chemicals on the work site and how to recognize the exposures. The employee needs to know how to read the SDS sheets.

THE SEVEN MAIN TYPES OF HAZARDS

Corrosive:

A chemical that causes very bad burns to the skin. Examples include sulfuric acid, nitric oxide and ammonia.

Explosive: A chemical that causes a sudden release of pressure, gas and heat when subjected to sudden shock, pressure or high temperature.

Flammable: A flammable liquid is a chemical with a flash point below 100 degrees F. The flash point is the temperature at which liquid will give off enough flammable vapor to ignite. Some solid materials are also flammable.

Irritant: A chemical that causes swelling and skin rashes from chemical contact.

Radioactive: Any substance that will self-explode or react violently when mixed with another substance or under certain temperatures, pressure or shock.

Toxic: A toxic or poisonous chemical can cause illness and sometimes death. The amount of harm depends on what chemical you were exposed to, how long you were exposed to it, and how it reacts to the environment. A toxic material can harm the body through the skin, by breathing it in, by swallowing it, or by contact with body openings such as the eyes.

THE FOUR ROUTES OF ENTRY INTO THE BODY

- Through the skin
- Through the lungs
- Contact with body openings
- Through the digestive system

CONTAINER LABELING

Shipped containers require special labels. Department of Transportation (DOT), American National Standards Institute (ANSI), National Fire Protection Association (NFPA), National Paint and Coating Association (NPCA). These labeling systems will clearly display the content hazards that are being shipped.

SDS SHEETS

The detailed information needed to meet the SDS standards are:

- Identification of the manufacture
- Hazardous ingredients and components
- Physical chemical characteristics
- Fire and explosion hazard
- Reactivity data
- Health hazard data
- Spill or leak procedures

- Special protection
- Special precautions

Flammable and combustible liquids are liquids that can burn. They are classified, or grouped, as either flammable or combustible by their flashpoints. Generally speaking, flammable liquids will ignite (catch on fire) and burn easily at normal working temperatures. Combustible liquids have the ability to burn at temperatures that are usually above working temperatures.

There are several specific technical criteria and test methods for identifying flammable and combustible liquids. Flammable liquids have a flashpoint below 100°F. Combustible liquids have a flashpoint at or above 100°F.

HAZARDOUS WASTE AND DISPOASAL

All solvent waste, oily rags, and flammable liquids shall be kept in fire resistant covered containers until removed from worksite.

RESPIRATORS

Wearing respiratory protective devices to reduce exposure to airborne contaminants is widespread in industry. An estimated 5.0 million workers wear respirators, either occasionally or routinely. Although it is preferred industrial hygiene practice to use engineering controls to reduce contaminant emissions at their source, there are operations where this type of control is not technologically or economically feasible or is otherwise inappropriate.

There are many variables that affect the degree of protection afforded by respiratory protective devices, and the misuse of respirators can be hazardous to employee safety and health. Selection of the wrong equipment, one of the most frequent errors made in respiratory protection, can result in the employee being exposed to increased concentrations of the harmful contaminant. This error may result in a broad range of health effects caused by the harmful contaminants, including silicosis, asbestosis, permanent lung damage, and cancer. Respirators that are not maintained and inspected can be less effective at reducing exposure to the harmful contaminants, and can place a greater burden on the respiratory system. Respirators that are not clean can cause dermatitis or skin irritation. Because respirator use may give the employee a false sense of security and presumed protection, an improper respirator program can actually present a high degree of hazard for the employee.

Respirators can only provide adequate protection if they are properly selected for the task; are fitted to the wearer and are consistently donned and worn properly; and are properly maintained so that they continue to provide the protection required for the work situation. These variables can only be controlled if a comprehensive respiratory protection program is developed and implemented in each workplace where respirators are used. When respirator use is augmented by an appropriate respiratory protection program, it can prevent fatalities and illnesses from both acute and chronic exposures to hazardous substances.

Not all workers can wear respirators. Individuals with impaired lung function, due to asthma or emphysema for example, may be physically unable to wear a respirator. Individuals who cannot get a good facepiece fit, including those individuals whose beards or sideburns interfere with the facepiece seal, will be unable to wear tight-fitting respirators. An adequate fit is required for a respirator to be effective. In addition to these problems, respirators may also be associated with communication problems, vision problems, fatigue, and reduced work efficiency.

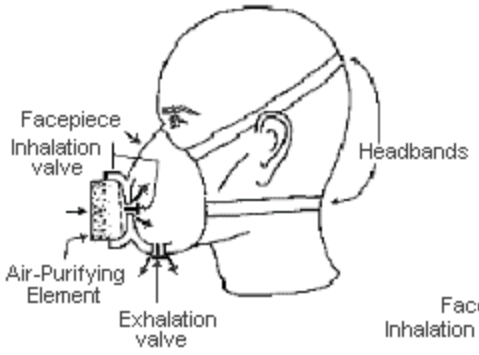
In principle, respirators usually are capable of providing adequate protection. However, problems associated with selection, fit, and use often render them less effective in actual application; these problems prevent the assurance of consistent and reliable protection, regardless of the theoretical capabilities of the respirator. Occupational safety and health experts have spent considerable effort over the years developing fit-testing procedures and methods of measuring respirator effectiveness, thereby improving protection for those employees required to wear them.

PURPOSE

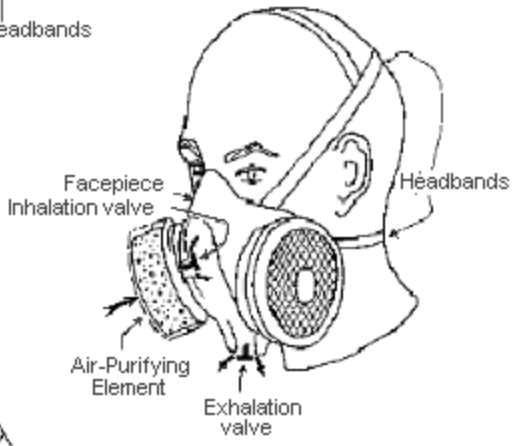
The purpose of a respirator is to prevent the inhalation of harmful airborne substances and/or an oxygen-deficient atmosphere. Functionally, a respirator is designed as an enclosure that covers the nose and mouth or the entire face or head. Respirators are of two general "fit" types, *tight-fitting* and *loose-fitting.*

1. *The tight-fitting respirator* (Figure VIII:2-1) is designed to form a seal with the face of the wearer. It is available in three types: quarter mask, half mask, and full facepiece. The quarter mask covers the nose and mouth, where the lower sealing surface rests between the chin and the mouth. The half mask covers the nose and mouth and fits under the chin. The full facepiece covers the entire face from below the chin to the hairline.
2. *The loose-fitting respirator* (Figure VIII:2-2) has a respiratory inlet covering that is designed to form a partial seal with the face. These include loose-fitting facepieces, as well as hoods, helmets, blouses, or full suits, all of which cover the head completely. The best known loose-fitting respirator is the supplied air hood used by the abrasive blaster. The hood covers the head, neck, and upper torso, and usually includes a neck cuff. Air is delivered by a compressor through a hose leading into the hood. Because the hood is not tight-fitting, it is important that sufficient air is provided to maintain a slight positive-pressure inside the hood relative to the environment immediately outside the hood. In this way, an outward flow of air from the respirator will prevent contaminants from entering the hood.

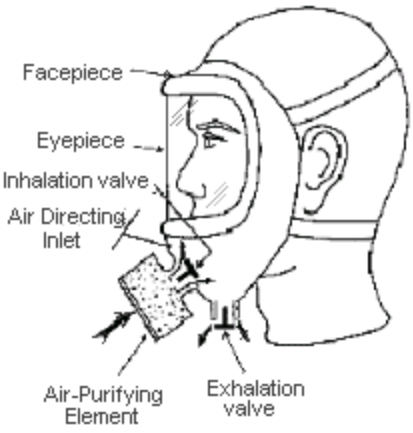
FIGURE VIII:2-1. TIGHT-FITTING RESPIRATORS



Typical Quarter-Mask Respirator

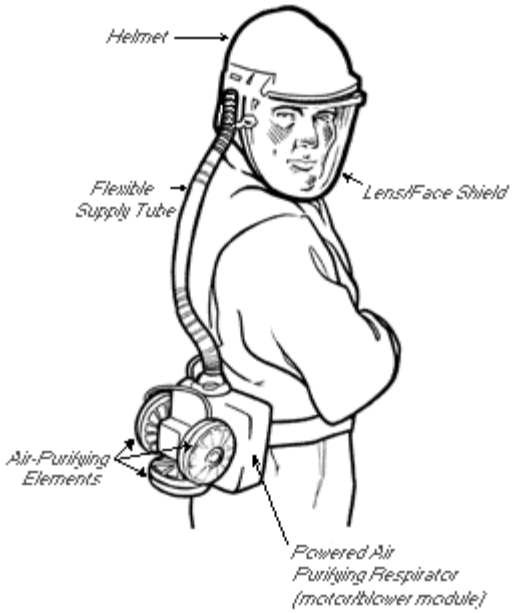


Typical Half-Mask Respirator

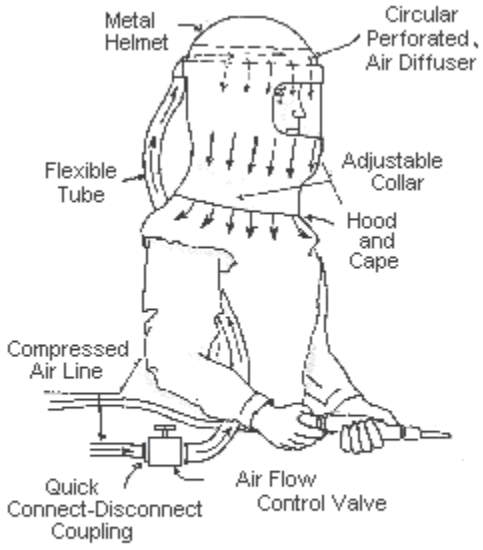


Typical Full-Facepiece Respirator

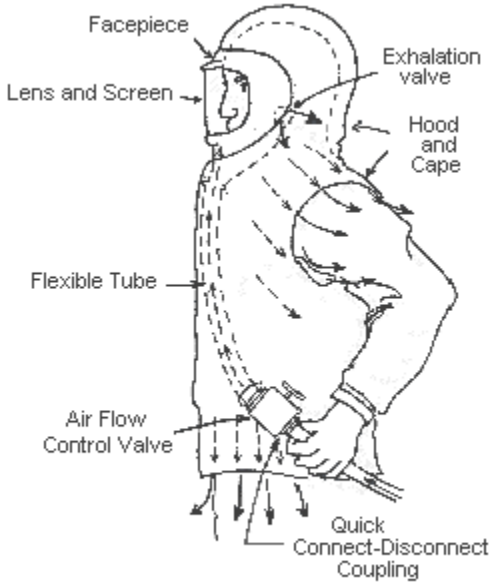
FIGURE VIII:2-2. LOOSE-FITTING RESPIRATORS



3. **Loose-Fitting Facepiece**



Abrasive Blasting Respirator (Hood Respirator)



Loose-Fitting Hood with Blouse

AIRBORNE (OR RESPIRATORY) HAZARDS

May result from either an oxygen deficient atmosphere or breathing air contaminated with toxic particles, vapors, gases, fumes, or mists. The proper selection and use of a respirator depend upon an initial determination of the concentration of the hazard or hazards present in the workplace, or the presence of an oxygen deficient atmosphere.

Airborne hazards generally fall into the following basic categories:

1. DUSTS. Particles that are formed or generated from solid organic or inorganic materials by reducing their size through mechanical processes such as crushing, grinding, drilling, abrading, or blasting.
2. FUMES. Particles formed when a volatilized solid, such as a metal, condenses in cool air. This physical change is often accompanied by a chemical reaction, such as oxidation. Examples are lead oxide fumes from smelting, and iron oxide fumes from arc-welding. A fume can also be formed when a material such as magnesium metal is burned or when welding or gas cutting is done on galvanized metal.
3. MISTS. A mist is formed when a finely divided liquid is suspended in the air. These suspended liquid droplets can be generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state, such as by splashing, foaming, or atomizing. Examples are the oil mist produced during cutting and grinding operations, acid mists from electroplating, acid or alkali mists from pickling operations, paint spray mist from spraying operations, and the condensation of water vapor to form a fog or rain.
4. GASES. Gases are formless fluids that occupy the space or enclosure and which can be changed to the liquid or solid state only by the combined effect of increased pressure and decreased temperature. Examples are welding gases such as acetylene, nitrogen, helium and argon; and carbon monoxide generated from the operation of internal combustion engines. Another example is hydrogen sulfide, which is formed wherever there is decomposition of materials containing sulfur under reducing conditions. They are invisible at room temperatures.
5. VAPORS. Vapors are the gaseous form of substances that are normally in the solid or liquid state at room temperature and pressure. They are formed by evaporation from a liquid or solid, and can be found where parts cleaning and painting takes place and where solvents are used. Vapors can enter the blood stream.
6. SMOKE. Smoke consists of carbon or soot particles resulting from the incomplete combustion of carbonaceous materials such as coal or oil. Smoke generally contains droplets as well as dry particles.
7. OXYGEN DEFECIENCY. An oxygen deficient atmosphere has an oxygen content below 19.5% by volume. Oxygen deficiency may occur in confined spaces, which include, but are not limited to, storage tanks, process vessels, towers, drums, tank cars, bins, sewers, septic tanks, underground utility tunnels, manholes, and pits.

RESPIRATOR CLASSIFICATIONS

Respirators provide protection either by removing contaminants from the air before they are inhaled or by supplying an independent source of respirable air. There are two major classifications of respirators:

1. Air purifying respirators (devices that remove contaminants from the air); and
2. Atmosphere-supplying respirators (Air-Supplying Respirators) - Those devices that provide clean breathing air from an uncontaminated source.

Each class of respirator may have tight-fitting and loose-fitting facepieces. An important aspect of respirator operation and classification is the air pressure within the facepiece. When the air pressure within the facepiece is negative during inhalation with respect to the ambient air pressure, the respirator is termed a negative-pressure respirator. When the pressure is normally positive with respect to ambient air pressure throughout the breathing cycle, the respirator is termed a positive-pressure respirator. The concept of negative and positive pressure operation is important when considering potential contaminant leakage into the respirator.

AIR PURIFYING RESPIRATORS

Are grouped into three general types: *particulate removing, vapor and gas removing,* and *combination.* Elements that remove particulates are called filters, while vapor and gas removing elements are called either chemical cartridges or canisters. Filters and canisters/cartridges are the functional portion of air-purifying respirators, and they can generally be removed and replaced once their effective life has expired. The exception would be filtering facepiece respirators (commonly referred to as "disposable respirators," "dust masks," or "single-use respirators"), which cannot be cleaned, disinfected, or resupplied with an unused filter after use.

HEPA FILTER CARTRIDGES

high-efficiency particulate arrestance (HEPA), also sometimes called high-efficiency particulate arresting or high-efficiency particulate air, is a type of air filter. Filters meeting the HEPA standard have many applications, including use in medical facilities, automobiles, aircraft and homes. The filter must satisfy certain standards of efficiency such as those set by the United States Department of Energy (DOE). To qualify as HEPA by US government standards, an air filter must remove (from the air that passes through) 99.97% of particles that have a size of 0.3 µm. Particulate-removing respirators are designed to reduce inhaled concentrations of nuisance dusts, fumes, mists, toxic dusts, radon daughters, asbestos-containing dusts or fibers, or any combination of these substances, by filtering most of the contaminants from the inhaled air before they enter the breathing zone of the worker. They may have single-use or replaceable filters. These respirators may be non-powered or

powered air-purifying. A powered air-purifying respirator (PAPR) uses a blower to force the ambient atmosphere through air purifying elements to the inlet covering.

ORGANIC VAPOR CHEMICAL CATRIDGE

Chemical cartridges are used on respirators to help remove and lower worker exposures to harmful gases and vapors in the workplace. There are several types of chemical cartridges: organic vapor, ammonia, formaldehyde, mercury vapor and acid gases, such as hydrogen chloride, chlorine and sulfur dioxide. All chemical cartridges consist of a container filled with a sorbent to filter gases or vapors from the air. Typically, this sorbent is activated carbon or activated charcoal. Activated carbon is an amorphous form of carbon characterized by high adsorptivity for many organic vapors. Adsorption is the adherence of gas or vapor molecules to the surface of the activated carbon. The attractive force between the activated carbon and the chemical molecule is a relatively small, weak physical force. To make cartridges more effective for filtering gases and volatile organic vapors, sorbents can be impregnated with chemical reagents. Impregnated activated carbon removes specific gas and vapor molecules by chemisorption. Chemisorption is the formation of bonds between molecules of the impregnant and the chemical contaminant. These bonds are much stronger than the attractive forces of physical adsorption. The binding is usually irreversible.

A typical organic vapor respirator cartridge is a metal or plastic case containing from 25 to 40 grams of sorption media. The service life of the cartridge varies based, among other variables, on the carbon weight and molecular weight of the vapor and the cartridge media, the concentration of vapor in the atmosphere, the relative humidity of the atmosphere, and the breathing rate of the respirator wearer. When filter cartridges become saturated or particulate accumulation within them begins to restrict air flow, they must be changed.

If the concentration of harmful gases is IDLH (Immediately Dangerous to Life or Health), a U.S. law and NIOSH prohibits the use of any air-purifying respirators.

COMBINATION CARTRIDGES

These protect against particulates, as well as vapors and gases. (piggyback, a HEPA filter cartridge is set above an organic vapor chemical cartridge)

ATMOSPHERE-SUPPLYING RESPIRATORS (AIR-SUPPLYING RESPIRATORS)

Are respirators that provide air from a source independent of the surrounding atmosphere instead of removing contaminants from the atmosphere. These respirators are classified by the method that is used to supply air and the way in which the air supply is regulated. Basically, these methods are: self-contained breathing apparatus (air or oxygen is carried in a tank on the worker's back, similar to SCUBA gear); supplied-air respirators (compressed air from a

stationary source is supplied through a high-pressure hose connected to the respirator); and combination self-contained and supplied-air respirators.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH IDLH ATMOSPHERES

Atmospheres are IDLH when they pose an immediate threat to life, would cause irreversible adverse health effects, or would interfere with an individual's ability to escape from a dangerous atmosphere. Care must be exercised in these situations since failure of the respirator to provide the appropriate protection may result in serious injury or death. Consequently, the employer must develop and implement specific procedures for the use of respirators in IDLH atmospheres that include the following provisions:

1. At least one employee (referred to as the "standby employee") is to be located outside the IDLH atmosphere and maintain visual, voice, or signal line communication with the employee(s) in the IDLH atmosphere;
2. The standby employee(s) located outside the IDLH atmosphere must be trained and equipped to provide effective emergency rescue;
3. The employer or authorized designee is to be notified before the standby employees(s) enter the IDLH atmosphere to provide emergency rescue;
4. The employer or authorized designee, once notified of such entry, must provide the necessary assistance appropriate to the situation;
5. Standby employee(s) must be equipped with pressure demand or other positive pressure SCBA, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and
6. Standby employee(s) must be equipped with appropriate retrieval equipment for lifting or removing the employee from the hazardous atmosphere, or, when such retrieval equipment cannot be used because it would increase the overall risk resulting from entry, ensure that equivalent provisions for rescue have been made.

For atmospheres that are immediately dangerous to life and health (IDLH), the highest level of respiratory protection and reliability is required. These atmospheres, by definition, are the most dangerous environments in which respirators are used. In these atmospheres, there is no tolerance for respirator failure. Consequently, only the following respirators must be provided and used: full-facepiece pressure demand self-contained breathing apparatus (SCBA) certified for a minimum service life of thirty minutes, or a combination full-facepiece pressure demand supplied-air respirator (SAR) with an auxiliary self-contained air supply.

FIT TESTING

It has long been recognized that respirators must fit properly to provide protection. To obtain adequate respiratory protection, there must be a proper match between respirator and wearer. Respirators that don't seal properly around the face offer only the illusion of protection. To accommodate the variability of face size characteristics among individuals, a number of manufacturers offer facepieces in several sizes and models.

Purpose

The primary purpose of fit testing is to identify the specific make, model, style, and size of respirator best suited for each employee. In addition, fit testing also provides an opportunity to check on problems with respirator wear and reinforces respirator training by having wearers review the proper methods of donning and wearing the respirator.

Requirement

Fit testing is required for all negative or positive pressure tight-fitting facepiece respirators. The OSHA respiratory protection standard requires that fit testing be performed before an employee first starts wearing a respirator in the work environment, whenever a different respirator facepiece is used, and at least annually thereafter.

Method

Prior to the actual fit test, the employee must be shown how to put on a respirator, position it on the face, set strap tension, and determine an acceptable fit. Next, the employee must be allowed to choose a respirator from a sufficient number of models and sizes so that the employee can find an acceptable and correctly fitting respirator. Once an acceptable respirator has been found -- which takes into account the position of the mask on the face, nose, and cheeks; room for eye protection; and room to talk -- a user seal check must be conducted (refer to on "Use of Respirators").

Types of Fit Testing

Fit testing may either be *qualitative (QLFT)* or *quantitative (QNFT),* and must be administered using an OSHA-accepted QLFT or QNFT protocol. Prior to the commencement of the fit test, the employee must be given a description of the fit test and a description of the exercises that he or she will be performing during fit testing. The respirator to be tested must be worn for at least five minutes before the start of the fit test. The employee must be fit tested with the same make, model, style, and size of respirator that will be used in the workplace.

1. Qualitative fit testing (QLFT). Qualitative fit testing involves the introduction of a gas, vapor, or aerosol test agent into an area around the head of the respirator user. A determination is then made as to whether or not the wearer can detect the presence of the test agent through means such as odor, taste, or nasal irritation. If the presence of the test agent is detected inside the mask, the respirator fit is considered to be inadequate. There are four qualitative fit test protocols approved in OSHA's standard.

The isoamyl acetate (IAA) test determines whether a respirator is protecting a user by questioning whether the user can smell the distinctive odor of IAA. Both the saccharin and Bitrex™ tests involve substances with distinctive tastes that should not be detected through an effective respirator. The irritant smoke (e.g., stannic chloride) test involves a substance that elicits an involuntary irritation response in those exposed to it. Before conducting a qualitative test, the worker must undergo a sensitivity test to determine if he or she can taste, smell or react to the substance. When performing the isoamyl acetate test, the protocol requires that separate rooms be used for the odor screening and fit tests, and that the rooms be sufficiently ventilated to ensure that there is no detectable odor of IAA prior to a test being conducted. This will prevent olfactory fatigue among workers being fit tested by preventing a buildup of IAA in the general room air.

2. Quantitative fit testing (QNFT). In a quantitative fit test, the adequacy of respirator fit is assessed by numerically measuring the amount of leakage into the respirator. This testing can be done by either generating a test aerosol as a test atmosphere, using ambient aerosol as the test agent, or using controlled negative pressure (CNP) to measure the volumetric leak rate. Appropriate instrumentation is required to quantify respirator fit.

Fit test exercises

The following test exercises must be performed for all fit testing methods described in the OSHA standards, except the CNP method which has its own fit testing exercise regimen:

1. Normal breathing in a normal standing position, without talking;
2. Deep breathing in a normal standing position, breathing slowly and deeply, taking precaution not to hyperventilate;
3. Turning the head slowly from side to side, while standing in place, with the employee holding his/her head momentarily at each extreme so that the employee can inhale at each side;
4. Moving the head up and down slowly, while standing in place, inhaling in the up position when looking toward the ceiling;
5. Talking out loud slowly, reading from a prepared text such as the Rainbow Passage (see Appendix A of the standard), counting backward from 100, or reciting a memorized poem or song;
6. Grimacing by smiling or frowning (only for QNFT testing);
7. Bending at the waist as if to touch toes (jogging in place can be done when the fit test enclosure doesn't permit bending at the waist); and
8. Normal breathing (as described above).

Each test exercise must be performed for one minute, except for the grimace exercise which must be performed for 15 seconds. The respirator must not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

The employee must perform exercises in the test environment while wearing any applicable safety equipment that may be worn during actual respirator use and that could interfere with respirator fit. If the employee exhibits breathing difficulty during the fit test, he or she must be referred to a physician or other licensed health care professional to determine whether the employee can wear a respirator while performing his or her duties.

USER SEAL CHECKS

Positive Pressure Check

Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators, this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve, and then carefully replacing it after the test.

Negative Pressure Check

Close off the inlet opening of the canister or cartridge(s) by covering it with the palm of the hand(s) or by replacing the filter seal(s). Inhale gently so that the facepiece collapses slightly, and hold your breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand, which requires that the test be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition, and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

Manufacturer's Recommended User Seal Check Procedures

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures, provided that the employer demonstrates that the manufacturer's procedures are equally effective in detecting seal leakage compared to the positive pressure and negative pressure checks described above.

CLEANING AND STORAGE OF RESPIRATORS

Basic cleaning method

Use wet wipes for a quick basic cleaning method. Wipe the inside and around the seal.

Advanced cleaning method

Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand or pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

Wash components in warm (43°C/110°F maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

Rinse components thoroughly in clean, warm (43°C/110°F maximum), preferably running, water. Drain the components.

When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in:

- Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43°C/110°F; or
- Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodine/100 cc of 45% alcohol) to one liter of water at 43°C/110°F; or
- Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

Rinse components thoroughly in clean, warm (43°C/110°F maximum), preferably running, water. Drain the components. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

Components should be hand-dried with a clean, lint-free cloth, or air-dried.

Reassemble face piece, replacing filters, cartridges, and canisters where necessary.

STORAGE

Store the face piece separately from the cartridges in a Ziploc bag. Tape cartridges so contaminants aren't able to escape. All respirators must be stored so that they are protected against damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. When respirators are packed or stored, the facepiece and exhalation valve must be stored in a manner that will prevent deformation. Each respirator should be positioned so that it retains its natural configuration. Synthetic materials and even rubber will warp if stored in an unnatural shape, thus affecting the fitting characteristics of the facepiece.

LEAD PAINT IN CONSTRUCTION

Before you begin a job, consider whether lead-based paint will be an issue. Find Out the Age of the structure. The age of a structure can tell you a lot about whether lead-based paint is likely to be present. If it was built before 1978, it may have lead-based paint. The older the structure, the greater the likelihood that lead is present in the paint and accumulated dust. Lead-based paint may be found either inside or outside the structure and is most common with high gloss paint on trim, such as on window sills, door frames, and railings.

Consider Lead Testing. If a structure was built before 1978, all surfaces affected by a renovation covered by the Renovation, Repair and Painting Rule must either be tested for lead-based paint or presumed to contain lead-based paint. Testing must include all affected surfaces coated with paint, shellac, varnish, stain, coating or even paint covered by wallpaper, if it will be disturbed during the renovation work. A report documenting the testing must describe the test used, the surfaces tested, and the results of the testing. If lead-based paint is present on an affected surface, then the lead safe work practices must be used on the job. There are two options for testing paint under the Renovation, Repair and Painting Rule:

1. Paint testing by a Certified Lead-based Paint Inspector or Lead-based Paint Risk Assessor—These licensed professionals conduct a surface-by surface investigation for lead-based paint by collecting paint chips for laboratory analysis or by testing painted surfaces with a machine called an X-Ray Fluorescence Analyzer (XRF) which measures the amount of lead in the paint.

2. Paint testing by a Certified Renovator—Certified Renovators, at the request of the owner, can use EPA-recognized test kits or collect paint chips for laboratory analysis to test all painted surfaces affected by the renovation.

When you work on a job with lead-based paint, you must contain the work area to prevent the escape of dust and debris. The goal of proper setup of the work area is to keep dust in the work area and non-workers out. The work area is the area that may become contaminated during the work. The size of the work area may vary depending on the method used to disturb lead based paint and the amount of dust and debris that is generated as a result. Whenever lead-based paint is disturbed, the work area must be protected by plastic sheeting applied to the floor, ground or other applicable surfaces to prevent contamination of the home or exterior, from dust generated by the work. The Renovation, Repair and Painting Rule requires that the work area be protected by plastic sheeting that extends a minimum of 6 feet for interior projects and 10 feet for exterior projects in all directions from the location where paint will be disturbed. For exterior renovations within 10 feet of the property line, vertical containment or equivalent extra precautions are required. The Rule further requires that protective plastic sheeting extend far enough from the location of paint disturbance so that all dust or debris generated by the work remains within the area protected by the plastic. The entire portion of the structure or exterior that is protected by plastic sheeting, however large, is the work area.

Unauthorized persons must be prevented from entering the work area. This can be accomplished by posting warning signs and by establishing barriers around the work area such as barrier tape, fencing, plastic barriers in doorways, etc.

Post Signs You must post signs clearly defining the work area and warning occupants and other persons not involved in renovation activities to remain outside of the work area. These signs should be in the primary language of the occupants and should say “Warning – Lead Work Area” and “Poison, No Smoking or Eating.”

For inside jobs remove all objects from the work area. Cover the floor surface with taped-down plastic sheeting in the work area 6 feet from the area of paint disturbance or a sufficient distance to contain the dust, whichever is greater. If a vertical containment system is employed, floor covering may stop at the vertical barrier, providing it is impermeable, extends from floor to ceiling, and is tightly sealed at floors, ceilings, and walls. Close windows and doors in the work area. Doors must be covered in plastic sheeting. When the work area boundary includes a door used to access the work area it must be covered in a way that allows workers to pass, but also confines dust and debris to the work area. One method is to cover the door with two layers of protective sheeting as described here: Cut and secure one layer of sheeting to the perimeter of the door frame. Do not pull the sheeting taut. Rather, leave slack at the top and bottom of the door before taping or stapling. Cut a vertical slit in the middle of the sheeting leaving 6” uncut at the top and bottom. Reinforce with tape. Cut and secure a second layer of sheeting to the top of the door. Close and cover all ducts opening in the work area with taped-down plastic sheeting. Ensure that all personnel, tools, and other items, including the exteriors of containers of waste, are free of dust and debris before leaving the work area.

For outside jobs cover the ground with plastic sheeting or other disposable impermeable material extending 10 feet beyond the perimeter of surfaces undergoing renovation or a sufficient distance to collect falling paint debris, whichever is greater. If the renovation will affect surfaces within 10 feet of the property line, then vertical containment or equivalent extra precautions must be erected to prevent contamination of adjacent buildings and property. Close all doors and windows within 20 feet of the renovation. On multi-story buildings, close all doors and windows within 20 feet of the renovation on the same floor as the renovation, and close all doors and windows on all floors below that are the same horizontal distance from the renovation. Ensure that doors within the work area that will be used while the job is being performed are covered with plastic sheeting or other impermeable material in a manner that allows workers to pass through while confining dust and debris to the work area. In certain situations, the renovation firm must take additional precautions in containing the work area to ensure that dust and debris from the renovation does not contaminate other buildings or other areas of the property or migrate to adjacent properties. When working on the 2nd story or above, you should extend the sheeting farther out and to each side where paint is being disturbed. It is also a good idea to use vertical containment if work is close to a sidewalk,

street, or property boundary, or the building is more than three stories high. Avoid working in high winds if possible. EPA's rule does not address wind speed, but when the wind is strong enough to move dust and debris, precautions need to be taken to keep the work area contained. That may mean creating a wind screen of plastic at the edge of the ground-cover plastic to keep dust and debris from migrating. Ultimately, you are responsible for preventing dust and debris from leaving the work area, so take appropriate precautions when wind is a factor or consider rescheduling the renovation for a less windy day.

Workers should protect themselves. Without the right personal protective equipment, workers may ingest or inhale lead from the job and may risk bringing lead from the worksite home to their families. Disposable Tyvek suits cover your clothing to limit contamination. They can be stored in a plastic bag and reused if they are fairly clean and are not torn. Small tears can be repaired with duct tape. „ Disposable shoe covers to prevent the tracking of dust from the work area and to protect your shoes from exposure to dust. Proper HEPA respiratory protection to prevent from breathing in lead dust. No smoking, drinking or eating in the work area. Wash up. Workers should wash their hands and faces each time they stop working. It is especially important to wash up before eating and at the end of the day. Wash your work clothes separately from family laundry.

As you work, your goal is to keep down the dust. Remember that as you scrape, drill, cut, open walls, etc., you are creating dust. You can keep dust down by using the right tools and following some simple practices that minimize and control the spread of dust. Low-temperature heat gun (under 1,100 degrees Fahrenheit) Chemical strippers without methylene chloride. Power tools with HEPA filter equipped vacuum attachments. Do Not Use Prohibited Practices. The Renovation, Repair and Painting Rule prohibits the following dangerous work practices by contractors: Open-flame burning or torching of painted surfaces. The use of machines designed to remove paint or other surface coatings through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, on painted surfaces unless such machines have shrouds or containment systems and are equipped with a HEPA vacuum attachment to collect dust and debris at the point of generation. Machines must be operated so that no visible dust or release of air occurs outside the shroud or containment system. Operating a heat gun on painted surfaces at temperatures greater than 1,100 degrees Fahrenheit. Control the spread of dust. You must keep the work area closed off from the rest of the structure. The work area must be sufficiently isolated and maintained to prevent the escape of dust or debris. You must ensure that all personnel, tools, and all other items exiting the work area are free of dust and debris. Don't track dust out of the work area: Vacuum all personnel leaving the work area, pay particular attention to the soles of shoes. Consider disposable protective clothing and shoe covers to minimize the contamination of work clothes and shoes. Also, a large disposable tack pad on the floor can help to clean the soles of your shoes. You should launder non-disposable protective clothing separately from family laundry. You should use wet sanders and misters to keep down the dust created during sanding, drilling

and cutting. You must keep components that are being disposed of in the work area until they are wrapped securely in heavy plastic sheeting or bagged in heavy duty plastic bags. Once wrapped or bagged, remove them from the work area and store them in a safe area and label them as hazardous lead waste.

The work area should be left clean at the end of every day and must be cleaned thoroughly at the end of the job. The area must be completely free of dust and debris. On a daily basis, you should: Pick up as you go. Put trash in heavy-duty plastic bags. Vacuum the work area with a HEPA vacuum cleaner frequently. Clean tools at the end of the day. Wash up each time you take a break and before you go home. Dispose of or clean off your personal protective equipment. Remind occupants to stay out of the work area. When the job is complete, you must clean the work area until no dust, debris or residue remains: Collect all paint chips and debris and seal in a heavy-duty bag. Remove the protective sheeting. Mist the sheeting before folding it dirty side inward, and either tape shut or seal in heavy-duty bags. Sheeting used to isolate contaminated rooms from non-contaminated rooms must remain in place until after the cleaning and removal of other sheeting. Dispose of the sheeting as waste. Additional cleaning for interior renovations. The firm must clean all objects and surfaces in the work area and within 2 feet of the work area, cleaning from higher to lower: Walls. Clean walls with a HEPA vacuum or wiping with a damp cloth.

Label all waste appropriately and follow hazardous waste disposal guidelines for the area.

When all the work is complete, and before interior space is reoccupied, you must determine whether it is a safe environment. To ensure work areas are safe for reoccupancy, cleaning verification is required EPA Certified Renovator must perform the cleaning verification procedure. If clearance is required, a Certified Lead Inspector, Certified Lead Risk Assessor, or Certified Lead Sampling Technician must conduct clearance testing. Renovator must visually inspect the work area to confirm that it is free of dust, debris, or residue. For exterior projects, when work areas have passed the visual inspection, the project is complete and the area may be turned over to the occupants. For interior projects, when work areas have passed the visual inspection, the cleaning verification procedure is performed by wiping all dust collection surfaces in the work area with a wet, disposable cleaning cloth and comparing that cloth visually to a cleaning verification card. Dust collection surfaces include window sills, countertops and floors.

EFFECTS OF LEAD

CHILDREN

Lead is particularly dangerous to children because their growing bodies absorb more lead than adults do and their brains and nervous systems are more sensitive to the damaging effects of lead. Babies and young children can also be more highly exposed to lead because they often put their hands and other objects that can have lead from dust or soil on them into their mouths.

ADULTS, INCLUDING PREGNANT WOMEN

Adults may breathe lead dust by spending time in areas where lead-based paint is deteriorating, and during renovation or repair work that disturbs painted surfaces in older homes and buildings. A pregnant woman's exposure to lead from these sources is of particular concern because it can result in exposure to her developing baby. Lead can accumulate in our bodies over time, where it is stored in bones along with calcium. During pregnancy, lead is released from bones as maternal calcium and is used to help form the bones of the fetus. This is particularly true if a woman does not have enough dietary calcium. Lead can also cross the placental barrier exposing the fetus to lead. This can result in serious effects to the mother and her developing fetus, including:

- Reduced growth of the fetus
- Premature birth

PREGNANT WOMEN AND OTHER ADULTS EXPOSED TO LEAD CAN SUFFER FROM:

- Cardiovascular effects, increased blood pressure and incidence of hypertension
- Decreased kidney function
- Reproductive problems (in both men and women)

WHAT ARE THE HEALTH AFFECTS OF LEAD IN CHILDREN?

Lead can affect almost every organ and system in your body. Children six years old and younger are most susceptible to the effects of lead. Even low levels of lead in the blood of children can result in:

- Behavior and learning problems
- Lower IQ and Hyperactivity
- Slowed growth
- Hearing Problems
- Anemia

In rare cases, ingestion of lead can cause seizures, coma and even death.

BASIC SURFACE PREPARATION TECHNIQUES AND PAINT FAILURES

Moisture is the number one cause of most paint failures. Know the moisture content of your substrate, the humidity of the air, also pay close attention to precipitation and dew points.

MASONRY

Masonry substrates are hard, contain lime and other soluble salts and are mostly porous.

The surface condition of masonry varies from rough and very porous to very smooth and glossy. Rough and porous masonry surfaces need little preparation (simply wash) and if adequately aged, provides good surface conditions for coatings. Applying coatings to smooth masonry can result in adhesion problems. To prevent this failure, the surface must be properly etched. Means of etching may include wire brushing, scraping, grinding, acid washing or sand blasting.

Fresh masonry surfaces are highly alkaline. Alkalinity can cause failure to an applied coating unless the coating is alkali resistant. Alkali resistant coatings include latex and rubber based paints. Its best to allow three months of weathering prior to coating new masonry.

Masonry surfaces contain water soluble salts which dissolve in moisture. The moisture is either carried through the substrate causing a chalky deposit to crystalize on the surface called efflorescence. Efflorescence can be removed and corrected by wire brushing followed by washing with muriatic acid, TSP or hydrochloric acid. Always rinse with water as the final step.

METAL

Metal substrates may need to be cleaned with solvents to remove any grease or oil. A deeper preparation may be required if corrosion has occurred on the substrate. Steel substrates may have rust, rust scale or mil scale that requires stabilizing or removal. Adhesion is best if there is a mechanical bond between the finish and the substrate. Create a profile or teeth in the metal by sanding, grinding, wire brushing, etching or sandblasting. These teeth will essential bite the coating applied.

Apply an anti-corrosive primer to metal substrates before applying the topcoat. Like any system, trapped elements between the metal substrate and the coating will result in failure.

WOOD

New wood should be clean, smooth, dry, free of oil, grease, and dirt. Removal of contaminants can be done with solvents or sanding. Seal knots and pitch pockets with shellac primer. Another great use for shellac is to prime wood that has slight fire damage. Use stain blocking primers to seal against tannins which are activated by moisture.

PREVIOUSLY PAINTED SUBSTRATES

All previously painted substrates usually require cleaning and sanding. Glossy surfaces should be dulled by cleaning with a strong detergent solution or sponged with a de-glossing chemical. Another simple method to dull a surface is to scuff sand. This will create a tooth in the finish, something for the new finish to grab.

All exterior substrates are susceptible to chalking, checking, cracking flaking and peeling paint. Chalking is due to weathering of the coating. Checking or "alligatoring" paint are tiny cracks forming in the top layers of the finish. The paint has become hard and brittle. Cracking finishes will usually open a finish up down to the substrate. Flaking happens when moisture is able to seep into cracks and get underneath the coating. Peeling paint is an extreme form of flaking where water continues to loosen the paint far larger areas of the substrate.

Preparing chalking paint is simple. Scrub the surface with a brush and detergent or pressure wash. Allow the surface to dry and apply the appropriate primer before finish paint. Alligatoring paint can be prepared similarly as chalking however sanding may be necessary. Cracking, flaking and peeling paint need to be removed by scraping, sanding or chemical stripping depending upon the degree of failure.

Always beware of the EPA lead laws. Use preferred methods of preparation in case lead is present. Occasionally it is safer and more effective to chemically remove cracking, flaking or peeling paint. Encapsulating chalking or checking paint can be a beneficial preparatory step. There are many encapsulating primers available on the market. They are used to bridge failures in paint tying them to sound areas of the same coating.

COMMON FILLERS

WOOD PUTTY

Wood putty is a substance used to fill imperfections in wood such as nail holes and joints. It is often composed of wood dust combined with a binder that dries and a diluent (thinner), and, sometimes, pigment.

The main problem in using putty is matching the color of the putty to that of the wood. If the substrate is specified to be painted, putty and sand prior to paint. If the substrate is to be stained and clear coated you can use a neutral colored, sandable, stainable putty. If you are using a non sandable colored putty to fill the voids wait until you see the dried finish colors of the stain and clear coat system. Then find or create a colored putty to fill the voids. Any residue left behind after applying the putty can be easily wiped off a clear coat. If you apply a colored putty to a bare wood surface the residue left behind interferes with the finishing process.

There are many different brands, types, and colors that are commercially available. New colors can be created by blending colors together.

SPACKLE

Spackling paste is a putty used to fill holes, small cracks, and other minor surface defects in wood, drywall, and plaster. Though spackle products differ in composition there intended use is consistent with one another. User friendly spackles spread easily and sand with little effort. Shrinkage usually happens when spackle has been applied to deeper defects and may require a second application to create a flush repair. A spackle bag is a convenient way to carry and to keep spackle from drying out. A spackle bag also insures that spackle crumbs won't form and ruin the smooth consistency of the spackle that is necessary for easy application with a putty knife. Preparing spackle for finish coats requires a prime coat.

CAULKING

Silicone caulking forms a durable, water-tight seal, but are not typically paintable. Some silicone sealants are made to be paintable with certain types of paint such as water or oil-based paints. When using silicone caulk that can't be painted, choose a color that most closely matches the surrounding area, or select clear for an unobtrusive look.

There are several paintable types of caulking for a variety of uses. Some are used to bridge large gaps and have excellent adhesion and extreme elasticity. Some are designed to dry quickly and fill small gaps and don't possess any other useful purpose other than keeping a schedule.

BACKER ROD

Backer rods are used to reduce consumption of the caulking by filling part of the joints. If joints are to large caulking may not be a possibility. Backer rod may have to be used in this situation. Backer rod helps to keep caulking from falling into a void. It creates a surface that caulking can stick to while bridging or seaming the substrates together.

BONDO OR 2 PART FILLERS

2-part fillers allow you to fill and shape dents, holes, missing pieces in metals, wood and other substrates. The chemical reaction that takes place with 2 component fillers forms a sandable surface quickly. These quickly solidified fillers can be extremely hard to sand both mechanically and by hand. It is more efficient to apply two or three consecutive coats of tightly pulled filler that require very little if any sanding.

BONDO GLAZING AND SPOT PUTTY

This is a 1-part putty that fills very small imperfections, pinholes. scratches, paint chips and minor dings. This does not dry as fast as a 2-part filler, however it is easily sanded.

QUICK SETTING "HOT" MUD

Quick setting drywall mud comes in a powdered form. Mixing water with the powder creates a chemical reaction that feels "hot". The mixture begins to set rather quickly. As it hardens it becomes more difficult to pull/spread "working time". It is suggested to use small amounts so it won't set in your pan. There are different set times and they are clearly labeled on the package. Once hardened it still requires time to dry. Hot mud does not sand easily. Apply it to avoid sanding.

COMMON PAINT SPRAYERS / GUNS

CONVENTIONAL AIR GUN SPRAYING – TRANSFER EFFICIENCY IS 30%-40%

This process occurs when paint is applied to an object through the use of an air-pressurized spray gun. The air gun has a nozzle, paint basin, and air compressor. When the trigger is pressed the paint mixes with the compressed air stream and is released in a fine spray.

Due to a wide range of nozzle shapes and sizes, the consistency of the paint can be varied. The shape of the workpiece and the desired paint consistency and pattern are important factors when choosing a nozzle. The three most common nozzles are the full cone, hollow cone, and flat stream. There are two types of air-gun spraying processes. In a manual operation method, the air-gun sprayer is held by a skilled operator, about 6 to 10 inches (15–25 cm) from the object, and moved back and forth over the surface, each stroke overlapping the previous to ensure a continuous coat. Disadvantages include high material waste with the lowest transfer efficiency rating, very slow and can only spray low viscosity paints. Advantages include a high end finish, good control and you can use small amounts of material.

AIRLESS SPRAY GUNS – TRANSFER EFFICIENCY IS 35% - 50%

These operate connected to a high pressure pump commonly found using 300 to 7,500 pounds per square inch (2,100–51,700 kPa) pressure to atomize the coating, using different tip sizes to achieve desired atomization and spray pattern size. This type of system is used by contract painters to paint heavy duty industrial, chemical and marine coatings and linings.

Most coatings can be sprayed with very little thinner added, thereby reducing drying time and decreasing the release of solvent into the environment.

Airless sprayers operate at extremely high pressure. If your finger (or any part of your body) gets too close to the tip, paint can be injected under the skin. If this happens, seek emergency treatment immediately, and be sure to inform the care provider you have an injection wound. The injury may not look all that serious, but most coating materials contain dangerous toxins that must be removed.

Airless pumps can be powered by different types of motor: electric, compressed air (pneumatic) or hydraulic. Most have a paint pump (also called a lower) that is a double acting piston, in which the piston pumps the paint in both the down and the upstroke. Some airless pumps have a diaphragm instead of a piston, but both types have inlet and outlet valves.

Most electric powered airless pumps have an electric motor connected through a gear train to the paint piston pump. Pressure is achieved by stopping and starting the motor via a pressure sensor (also called a transducer); in more advanced units, this is done by digital control in which the speed of the motor varies with the demand and the difference from the pressure set-point, resulting in a very good pressure control. Some direct drive piston pumps are driven by a gasoline engine with pressure control via an electric clutch. In electric diaphragm pumps, the

motor drives a hydraulic piston pump that transmits the oil displaced by the piston, to move the diaphragm.

Hydraulic and air-powered airless pumps have linear motors that require a hydraulic pump or an air compressor, which can be electric or gasoline powered, although an air compressor is usually diesel powered for mobile use or electric for fixed installations. Some airless units have the hydraulic pump and its motor, built onto the same chassis as the paint pump.

A hydraulic or air powered airless provides a more uniform pressure control since the paint piston moves at a constant speed except when it changes direction. In most direct drive piston pumps, the piston is crankshaft driven in which the piston will be constantly changing speed. The linear motors of hydraulic or compressed air drive pumps, are more efficient in converting engine power to material power, than crankshaft driven units. All types of paint can be painted by using airless method.

Advantages of the airless are the coating penetrates better into pits and crevices. A uniform thick coating is produced, reducing the number of coats required. A very "wet" coating is applied, ensuring good adhesion and flow-out. Fast application and better transfer efficiency than the conventional sprayer. Some disadvantages include poor control and reduced quality in the finish (fine finish tips will produce better quality finishes than standard tips). Incapable of partial triggering, Susceptible to “tails” or “fingers” and risk of fluid injections. Tips wear quickly.

Airless spray tips have a tendency to wear quickly. Straining paint prior to using decreases the chance of premature tip wear. Spraying with too much pressure also wears a tip prematurely. If atomization is poor and “tails” or “fingering” are occurring reduce the tip size and or turn up the pump pressure. Always inspect pump and gun filters as well as the suction tube’s filter for blockage. A clogged filter overworks the pump as well as decreases the pressure at the tip.

AIR ASSISTED AIRLESS SPRAY GUNS – TRANSFER EFFICIENCY IS 45% -68%

These use air pressure and fluid pressure 300 to 3,000 pounds per square inch (2,100–20,700 kPa) to achieve atomization of the coating. This equipment provides high transfer and increased application speed and is most often used with flat-line applications in factory finish shops.

The fluid pressure is provided by an airless pump, which allows much heavier materials to be sprayed than is possible with an airspray gun. Compressed air is introduced into the spray from an airless tip (nozzle) to improve the fineness of atomization. Some electric airless sprayers are fitted with a compressor to allow the use of an air assisted airless gun in situations where portability is important. Advantages of these units are better control than the airless with high production rates. The transfer efficiency is better than an airless. Reduced wear on the pump and nozzles is another benefit. Its disadvantages are no partial triggering. A second hose (air) needs to be hooked to the gun. The possibility of fluid injection is still there. Transfer efficiency can be greatly decreased if the fluid pressure and air pressure are not properly set.

HVLP (HIGH VOLUME LOW PRESSURE) – TRANSFER EFFICIENCY IS 65% - 80%

This is similar to a conventional spray gun using a compressor to supply the air, but the spray gun itself requires a lower pressure (LP). A higher volume (HV) of air is used to aerosolize and propel the paint at lower air pressure. The result is a higher proportion of paint reaching the target surface with reduced overspray, materials consumption, and air pollution. A regulator is often required so that the air pressure from a conventional compressor can be lowered for the HVLP spray gun. Alternatively, a turbine unit can be used to propel the air.

A rule of thumb puts two thirds of the coating on the substrate and one third in the air. Advantages are a high transfer efficiency with a great finish. Requires less maintenance and cleaner. Its disadvantages are slow application rates and can only spray low viscosity materials.

LVLP (LOW VOLUME LOW PRESSURE) – TRANSFER EFFICIENCY IS 65% - 83%

Like HVLP, these spray guns also operate at a lower pressure (LP), but they use a low volume (LV) of air when compared to conventional and HVLP equipment. This is a further effort at increasing the transfer efficiency (amount of coating that ends up on the target surface) of spray guns, while decreasing the amount of compressed air consumption. Its advantages are slightly better transfer efficiency than the HVLP. Its application rate is slightly slower than the HVLP is its disadvantage.

ELECTROSTATIC SPRAY PAINTING – TRANSFER EFFICIENCY IS 75% - 90%

Electrostatic painting was first patented in the U.S. by Harold Ransburg in the late 1940s. Harold Ransburg founded Ransburg Electrostatic Equipment and discovered that electrostatic spray painting was an immediate success as manufacturers quickly perceived the substantial materials savings that could be achieved. In electrostatic spray painting the atomized particles are made to be electrically charged, thereby repelling each other and spreading themselves evenly as they exit the spray nozzle. The object being painted is charged oppositely or grounded. The paint is then attracted to the object giving a more even coat and also greatly increasing the percentage of paint that sticks to the object. This method also means that paint covers hard to reach areas. Advantages are the savings from minimal material waste. It has the highest transfer efficiency rating amongst sprayers and it doesn't require a lot of training. The disadvantages are its upfront costs, can produce minor shocks and the need to be grounded can be difficult to maintain sometimes.

PRESSURE POWER ROLLER – TRANSFER EFFICIENCY IS 98% -100%

A power roller attaches to your airless spray gun or in-line valve and rolls continuously when spraying isn't possible. The roller doesn't require dipping, simply trigger the gun for more paint and keep rolling. The advantage of the power roller is a clean alternative to spraying with very little need to mask adjacent surfaces. It's much more productive than rolling from a tray. Its disadvantage is its inability to achieve a fast, consistently even finish without lap marks. It must

be followed by someone back rolling to even out the finish. Pressure power roller assemblies are connected and powered by airless pumps. The assembly replaces the spray gun.

AIRLESS TIPS

Airless spray painting gets its name from the fact that no compressed air is used with the paint to form the spray. Airless spray units develop extremely high pressures. Airless spray equipment operates by forcing liquids at very high pressure through a very small, precise opening. This can force liquids you are spraying into your body tissue at rifling speeds. Never put your hand or fingers in front of the gun. Never aim a spray gun at someone or yourself. Paint injection injuries can lead to amputation and even death. Always keep the spray gun in the locked position when not in use. Before removing any part of equipment including the tip be sure to turn off the pump, release the pressure and lock the gun.

When using an airless spraying system, the airless spray is atomized (broken up) at the tip into tiny droplets without the use of compressed air. The specific functions of a tip are:

- Determine the fluid or amount of the coating applied.
- Create back pressure in the line for an evenly atomized pattern.
- Create the spray pattern and fan width.

Spray tips come in various styles but the most common tip is the RAC tip (reverse-a-clean). Reverse the tip to unclog it.

Spray tips are usually identified by a numerical system. The 3-digit number on a tip represents 2 things. The first digit is the fan width. A 310 tip means the fan width is 6". A 513 tip means the fan width is 10". Essentially you are multiplying the first digit by 2 to get the fan width. The last two numbers represent the orifice size in thousandths of inch. The smaller the number means the smaller the hole. The smaller the hole means a smaller amount of paint that can travel through the tip and the more back pressure that is created. The more back pressure that is created the more atomization will occur as the paint finally makes its way through the hole of the tip.

A 310 tip has a 6-inch fan and atomizes paint extremely well producing a very high end finish (putting your thumb over the opening of a garden hose as the water is comes out). A 619 tip has a 12" fan and allows a lot of paint to pass through the tip quite easily (running a garden hose without putting your thumb over the opening).

Sometimes it requires a larger tip to allow high viscosity materials to pass through it. Usually that means needing a larger pump to create more pressure to push heavier materials through the tip just to create atomization.

Recommended width tip sizes for a particular material:

Material	Tip Size
Lacquer and stain	.011 to .013

Oil based paint	.013 to .015
Average latex paint	.015 to .019
Heavy water base	.021 to .025
Block filler	.025 to .035

Tip wear occurs with normal use. The greatest wear occurs within the first 30 gallons of material sprayed. Most tips are worn out after 100-150 gallons.

Premature tip wearing (blown out tip) is caused by excessive material, abrasive material, paint not strained, filters not used wrong size filters and using old or dirty lines.

COMMON BRUSH TYPES

WATER BASE PAINT

When applying water based paints, only use brushes constructed with synthetic bristles (filaments). Synthetic bristles are much more water resistant than natural bristles making them the only choice for latex and acrylic paints. Because synthetics do not easily absorb water they are able to maintain their shape and perform well.

NYLON filaments are very durable and resist wear on rough surfaces. Nylon is also a relatively soft bristle. It does not offer the stiffness and flex to that of polyester. Even though nylon has a superior durability, its lack of stiffness does not make nylon brushes the best choice for rough surfaces. Nylon filaments also tend to soften and lose their shape with prolonged use and hot and humid conditions. Nylon is very easy to clean. Paint brushes constructed with nylon filaments are best suited for use with water base paints on interior smooth and semi-smooth surfaces. *Nylon* works best for interior and limited exterior painting on smooth and semi-smooth surfaces. Use nylon only with water base paints. Try not to leave nylon submerged in paint for a prolonged period of time because it will lose its shape.

POLYESTER filaments perform especially well to resist water absorption. This enables polyester paint brushes to maintain their stiffness and maximize flex during use. Because 100% polyester brushes do not have good resistance to abrasion, they do not stand up to heavy use on rough surfaces. Polyester also tends to leave brush marks. These filaments are very difficult to clean, but may be used with all paints. Polyester brushes may be a good choice for exterior painting applications on smooth, semi-smooth, and semi-rough surfaces.

NYLON/POLYESTER blends bring together the positive characteristics of nylon and polyester. Paint brushes made with these filaments offer the softness and durability of nylon along with polyester's stiffness and ability to maintain its shape. They work well for interior and exterior painting applications, with all types of paint. The nylon/polyester blend can be used for rough and semi-rough surfaces because of the durability of nylon combined with the stiffness of polyester. It also works well for smooth surfaces because of the softness and tipped ends of nylon. Some effort is required for cleaning, because of the polyester content.

ENGINEERED NYLON is a term that some brush manufacturers use to describe advanced nylon filaments. Engineered nylon is a type of filament that retains all the positive characteristics of nylon with added stiffness for better control.

OIL BASE PAINT

When working with oil base paints or alkyd paints, the natural bristle brushes are a good choice. Although they are not nearly as durable as the synthetics, they do give you the ability to achieve a smooth, level finish. Certain characteristics of these animal hairs cannot be reproduced by synthetics, making the natural bristle brushes the best for oil base paints. Never use a natural bristle brush with water base coatings! The natural fibers will absorb water making them sticky and causing them to lose their shape.

BLACK CHINA BRISTLE is a natural bristle made from hog hairs. Black china bristle paint brushes are fine to use for the application of all oil, alcohol, and solvent base paints, including alkyd enamels, oil base primers, and oil base stains. The bristles are slightly coarser than the ox hair or the white china bristle making them preferable for semi rough and rough surfaces.

WHITE CHINA BRISTLE is also a natural bristle made from hog hairs. White china bristle paint brushes have softer bristles than that of the black china bristle brushes. They work well with all oil base and solvent base paints. They perform especially well with fine oil base paints such as alkyd enamels, clear wood finishes, and oil base stains. A white china bristle brush is a good choice where a smooth finish is desired.

OX HAIR BLEND is a natural bristle obtained from the ears of oxen. They are the softest bristles amongst all the natural bristles, which are commonly used for paint brushes. Unlike hog hair, they do not have flagged ends, but rather come to a fine point. Ox hair bristles are always blended with hog hair in order to capture the positive attributes of both types of bristles. China bristle, having naturally flagged ends, has the ability to hold more paint than ox hair. The hog hair also offers added durability to the blend.

Brushes blended with ox hair bristles are the best to use on smooth surfaces where a very fine finish is required. Their ability to bring a superior finish, make them a great choice for fine alkyd enamels, polyurethanes, varnishes, and brushing lacquers. They are more expensive than the china bristle paint brushes.

PAINT

Paint is any liquid, liquefiable, or mastic composition that, after application to a substrate in a thin layer, converts to a solid film. It is most commonly used to protect, color, or provide texture to objects. Paint can be made or purchased in many colors—and in many different types, such as watercolor, synthetic, etc. Paint is typically stored, sold, and applied as a liquid, but most types dry into a solid.

Paint has four major components: pigments, binders, solvents, and additives. Pigments serve to give paint its color, texture, toughness, as well as determining if a paint is opaque or not. Common white pigments include titanium dioxide and zinc oxide. Binders are the film forming component of a paint as it dries and affects the durability, gloss, and flexibility of the coating. Polyurethanes, polyesters, and acrylics are all examples of common binders. The solvent is the medium in which all other components of the paint are dissolved and evaporates away as the paint dries and cures. The solvent also modifies the curing rate and viscosity of the paint in its liquid state. There are two types of paint: solvent-borne and water-borne paints. Solvent-borne paints use organic solvents as the primary vehicle carrying the solid components in a paint formulation, whereas water-borne paints use water as the continuous medium. The additives that are incorporated into paints are a wide range of things which impart important effects on the properties of the paint and the final coating. Common paint additives are catalysts, thickeners, stabilizers, emulsifiers, texturizers, biocides to fight bacterial growth, etc.

PIGMENT AND FILLER

Pigments are granular solids incorporated in the paint to contribute color. Fillers are granular solids incorporate to impart toughness, texture, give the paint special properties, or to reduce the cost of the paint. Alternatively, some paints contain dyes instead of or in combination with pigments.

Pigments can be classified as either natural or synthetic. Natural pigments include various clays, calcium carbonate, mica, silicas, and talcs. Synthetics would include engineered molecules, calcined clays, blanc fixe, precipitated calcium carbonate, and synthetic pyrogenic silicas.

Hiding pigments, in making paint opaque, also protect the substrate from the harmful effects of ultraviolet light. Hiding pigments include titanium dioxide, phthalo blue, red iron oxide, and many others.

Fillers are a special type of pigment that serve to thicken the film, support its structure and increase the volume of the paint. Fillers are usually cheap and inert materials, such as diatomaceous earth, talc, lime, barytes, clay, etc. Floor paints that must resist abrasion may

contain fine quartz sand as a filler. Not all paints include fillers. On the other hand, some paints contain large proportions of pigment/filler and binder.

Some pigments are toxic, such as the lead pigments that are used in lead paint. Paint manufacturers began replacing white lead pigments with titanium white (titanium dioxide), before lead was banned in paint for residential use in 1978 by the US Consumer Product Safety Commission. The titanium dioxide used in most paints today is often coated with silica/alumina/zirconium for various reasons, such as better exterior durability, or better hiding performance (opacity) promoted by more optimal spacing within the paint film.

BINDER OR FILM FORMER

The binder is the film-forming component of paint. It is the only component that is always present among all the various types of formulations. Many binders are too thick to be applied and must be thinned. The type of thinner, if present, varies with the binder.

The binder imparts properties such as gloss, durability, flexibility, and toughness.

Binders include synthetic or natural resins such as alkyds, acrylics, vinyl-acrylics, vinyl acetate/ethylene (VAE), polyurethanes, polyesters, melamine resins, epoxy, silanes or siloxanes or oils.

Binders can be categorized according to the mechanisms for film formation. Thermoplastic mechanisms include drying and coalescence. Drying refers to simple evaporation of the solvent or thinner to leave a coherent film behind. Coalescence refers to a mechanism that involves drying followed by actual interpenetration and fusion of formerly discrete particles. Thermoplastic film-forming mechanisms are sometimes described as "thermoplastic cure" but that is a misnomer because no chemical curing reactions are required to knit the film. Thermosetting mechanisms, on the other hand, are true curing mechanism that involve chemical reaction(s) among the polymers that make up the binder.

DILUENT OR SOLVENT

The main purposes of the diluent are to dissolve the polymer and adjust the viscosity of the paint. It is volatile and does not become part of the paint film. It also controls flow and application properties, and in some cases can affect the stability of the paint while in liquid state. Its main function is as the carrier for the non volatile components. To spread heavier oils (for example, linseed) as in oil-based interior house paint, a thinner oil is required. These volatile substances impart their properties temporarily—once the solvent has evaporated, the remaining paint is fixed to the surface.

This component is optional: some paints have no diluent.

Water is the main diluent for water-borne paints, even the co-solvent types.

Solvent-borne, also called oil-based, paints can have various combinations of organic solvents as the diluent, including aliphatics, aromatics, alcohols, ketones and white spirit. Specific examples are organic solvents such as petroleum distillate, esters, glycol ethers, and the like. Sometimes volatile low-molecular weight synthetic resins also serve as diluents.

ADDITIVES

Besides the three main categories of ingredients, paint can have a wide variety of miscellaneous additives, which are usually added in small amounts, yet provide a significant effect on the product. Some examples include additives to modify surface tension, improve flow properties, improve the finished appearance, increase wet edge, improve pigment stability, impart antifreeze properties, control foaming, control skinning, etc. Other types of additives include catalysts, thickeners, stabilizers, emulsifiers, texturizers, adhesion promoters, UV stabilizers, flatteners (de-glossing agents), biocides to fight bacterial growth, and the like.

Additives normally do not significantly alter the percentages of individual components in a formulation.

WOOD STAIN

A wood stain consists of a colorant suspended or dissolved in an agent or solvent. The suspension agent can be water, alcohol, petroleum distillate, or the actual finishing agent (shellac, lacquer, varnish, polyurethane, etc.). Colored or 'stained' finishes, like polyurethane, do not penetrate the pores of the wood to any significant degree and will disappear when the finish itself deteriorates or is removed intentionally.

Pigments and dyes are largely used as colorants. The difference between the two is in the size of the particles. Dyes are microscopic crystals that dissolve in the vehicle and pigments are suspended in the vehicle and are much larger. Dyes will color very fine grained wood, like cherry or maple, which pigments will not. Those fine-grained woods have pores too small for pigments to attach themselves to. Pigments contain a binder to help attach themselves to the wood.

The type of stain will either accentuate or obscure the wood grain. Most commercial stains contain both dye and pigment and the degree to which they stain the appropriate wood is mostly dependent on the length of time they are left on the wood. Pigments, regardless of the suspension agent, will not give much color to very dense woods but will deeply color woods with large pores (e.g. pine). Dyes are translucent and pigments are opaque.

Gel stains are more akin to paint and have little penetrating ability.

WOOD STAIN COMPOSITION

Stain is composed of three of the four primary ingredients used to make paint (pigment, solvent, and binder) but is predominantly pigment (or dye) and solvent with little binder. Much like the dyeing or staining of fabric, wood stain is designed to add color to the substrate of wood and other materials while leaving the substrate mostly visible. Transparent varnishes or surface films are applied afterwards. In principle, stains do not provide a surface coating or film. However, because the binders are from the same class of film-forming binders that are used in paints and varnishes, some build-up of film occurs.

BASIC STEPS TO WOOD STAINING (ALL STEPS MAY NOT BE NECESSARY AND MAY REQUIRE MORE STEPS)

MOCKUPS / HANDLING

On difficult projects it's always wise to create a mockup. Whatever methods used to achieve the accepted mockup should become a consistent process throughout the main project. Wood finishing involves thinking about the production process. Careful handling of the wood is needed to avoid dents, scratches and soiling with dirt. Any excess glue should be carefully removed to avoid further damage to the wood. Glue's will not allow stains to be absorbed into the wood. Wood's moisture content affects staining of wood. Changes in wood moisture content can result in swelling and shrinkage of wood which can stress and crack coatings. Both problems can be avoided by storing wood indoors in an environment where it can equilibrate to a recommended moisture content of 6% to 8%.

SANDING

The key to preparing a defect free surface is to develop a sanding schedule that will quickly eliminate defects and leave the surface smooth enough so that tiny scratches produced by sanding cannot be seen when the wood is finished. A sanding schedule usually begins with sandpaper that is coarse enough to remove larger defects (typically 80 or 100 grit, but sometimes higher if the surface is already quite smooth), and progresses through a series of sandpaper grades that gradually remove the sanding scratches created by the previous sanding steps. A typical sanding schedule prior to wood finishing might involve sanding wood along the grain with the following grades of sandpaper, 80, 100, 120, 150 and finishing with 180 and sometimes 220 grit. The precise sanding schedule is a matter of trial and error because the appearance of a sanded surface depends on the wood you are sanding and the finish that will subsequently be applied to the wood.

WOOD BRIGHTENING OR BLEACHING

Peroxide Bleaches:

These bleaches are sold as a two-part system. The two components are usually sodium hydroxide and strong hydrogen peroxide. Used by themselves they are ineffective but when mixed together, a strong oxidizing reaction is formed which is quite effective in removing the natural color in wood.

Oxalic Acid:

Oxalic acid is unique in that it will remove a certain type of stain formed when iron and moisture come into contact with tannic acid in the wood. Oxalic acid will remove this discoloration without affecting the natural color of the wood.

Oxalic acid is also used to lighten the graying effects of outdoor exposure. It will lighten the color and re-establish an even tone to the wood.

WOOD CONDITIONING (ALWAYS CHECK COMPATIBILITY OF PRODUCTS, SOLVENT BORNE AND WATERBORNE DON'T ALWAYS MIX)

Applying a conditioner to your sanded substrate is an excellent way to pre-condition the wood before applying a stain. Conditioners penetrate deeply and do not leave a surface film. Once thoroughly dried some conditioners become an integral part of the wood's cell structure. The use of conditioners greatly reduces the possibility of grain raising. They also decrease the chances of a "mottled", "blotchy" or "spotty" appearance in the stained finish.

APPLYING STAIN (COMMON PRACTICE)

Various techniques can be used to apply stains be it by brush, roller, cloth, or sprayer. Never allow stains to dry on the woods surface. Always work with a wet edge. When wiping use a lint free cloth and have several cloths on hand as they become nonabsorbent quickly.

RAG DISPOSAL

All solvent waste, oily rags, and flammable liquids shall be kept in fire resistant covered containers until removed from worksite. These types of rags do self-ignite.

SOME COMMON PAINT SOLVENTS

MINERAL SPIRITS

Used for most oil-based and alkyd paints, primers and varnishes. Add to paint for reduction or thinning or to extend the paints open time. Use it to clean brushes, etc. It is not effective in cleaning up dried paint.

ODORLESS MINERAL SPIRITS

A reduced odor version of mineral spirits.

VM&P NAPHTHA (Varnish Maker's and Painters Naphtha):

Naphtha is similar to mineral spirits, though it is somewhat faster drying.

LACQUER THINNER

Used with pigmented and clear lacquers. It is extremely flammable and can soften plastics and dried paints.

DENATURED ALCOHOL

Used with Shellac and Shellac-Based Primers. Do not substitute with Isopropyl Alcohol.

XYLENE (Xylol):

Strong solvent used in some fast dry enamels and in some lacquers.

TOLULENE (Toluol):

Toluene is somewhat faster drying than Xylene.

SCHEDULES

A schedule is a basic time management tool. Making and following a schedule is an important tool in construction. A person responsible for making a particular schedule may be called a scheduler.

It consists of a list of times at which possible tasks, events, or actions are intended to take place, or a sequence of events put in chronological order in which such things are intended to take place.

The process of creating a schedule is deciding how to put in order these tasks and how to commit resources between the variety of possible tasks (sharing ladders or lifts).

Schedules are necessary in situations where individuals need to know what time they must be at a specific location and what task they'll be performing. A scheduled task will have a start date and a finish date. Some schedules do not include times rather note what task needs to happen before another task can start (the door frames need to be painted before the carpet goes in).

Schedules can span both short periods, such as a daily or a weekly schedule, and long-term planning with respect to periods of several months or years. In some situations, schedules can be uncertain, such as where work relies on environmental factors outside of human control (weather).

In creating a schedule, a certain amount of time is usually set aside as a contingency against unforeseen delays. This time is called scheduling variance, or float. Take advantage of these float times. Anytime an area is empty of other trades use it to your advantage. Paint production times increase when you are not dancing around other trades. Do not to deviate from the current working schedule rather find opportunities where tasks scheduled for a later time can be completed early.

DEFINITIONS

AIR:

Air consists of 78% Nitrogen, 21 % Oxygen and 1% of other gases.

COMPETENT PERSON:

A competent person must have authority to take prompt measures to eliminate hazards at the work site and have the experience to be capable of identifying these hazards.

FLASHPOINT:

The temperature at which a particular organic compound gives off sufficient vapor to ignite in air.

HOUSEKEEPING:

The act of keeping you shop area clean. All items not being used should be cleaned, folded, coiled and stored neatly. Job boxes should be free of trash and used for the sole purpose of storing equipment and supplies. Task areas should be kept clean as well. Do not consider the task complete until all items used and trash created to perform the work are properly stored and disposed of.

MIL:

All Coatings are normally measured and calculated in "Mil Thickness", (*thousands of an inch*)

MOCKUP:

Mockups are commonly required by designers, architects, and end users for custom finishes. The intention is often to produce a replica of reduced scale, using exact materials and methods in order to verify a finish. Mockups are used to test colors, sheens, durability, compatibility adhesion and design details which cannot be visualized or determined from the initial drawings and specifications. The cost of making mockups is often more than repaid by the savings made by avoiding going into production with a finish which fails or needs improvement.

NAP:

The length of the fibers on a roller cover. Short nap covers (1/4"- 3/8") are used for painting smooth surfaces. Medium length naps (3/8" – 1/2") are used for painting lightly textured surfaces. Long nap covers (3/4" - 1 1/2") make it possible to paint heavily textured areas, pits other irregularities of rough surfaces.

OVERSPRAY:

When paint, varnish, stain or other non-water-soluble airborne particulate material drifts to an unintended location. Wind can carry overspray material hundreds of yards "down wind" from the spraying operation.

QUALIFIED PERSON:

A qualified person must have a recognized degree, certificate, etc., or extensive experience and ability to solve the subject problems, at the worksite. Supporting systems design shall be by a qualified person.

SPECIFICATIONS:

Specifications describe the materials and workmanship required for a development. They do not include cost, quantity or drawn information. Of the 50 divisions in construction, painting specifications are found in 09 Finishes.

SUBSTRATE:

In painting it's the primary or underlying material on which other materials, such as primers epoxies, paints, etc. are applied to. Examples: A bare metal door that requires painting needs to be primed with a primer suitable for a metal substrate. A bare wood door needs to be stained. You wouldn't use a concrete stain for this task rather you'd use a wood stain.

TRANSFER EFFECIENCY:

The transfer efficiency of a spray finishing process means the amount of material that adheres to the target compared to the amount of material that was sprayed through the applicator toward the target. Transfer efficiency is expressed as a percentage. Transfer efficiency is usually expressed as the percentage of the weight of solids sprayed versus the weight of solids gained by the target. As an example, 60 percent transfer efficiency means that 60 percent of the weight of the solids in the material that was sprayed actually reached the target. The balance of 40 percent was lost to other areas during the spray finishing process. The material that is lost as over spray is both a regulatory problem and a cost overrun for the job.

VENTILATION: The process of "changing" or replacing air in any space to provide high air quality.

VISCOSITY:

The state of being thick, sticky, and semifluid in consistency, due to internal friction. For example, water has a lower *viscosity* than molasses and flows more easily.