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Fire Risk Assessment Guide



**SINGAPORE
CIVIL DEFENCE FORCE**
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Fire Risk Assessment Guide

The Fire Risk Assessment Guide is developed based on the Ministry of Manpower's Risk Assessment Guidelines, and is aimed at helping employers, fire safety managers, safety officers/supervisors and other safety personnel, in the assessment of fire risks in the workplace. The overall objective is to help management and employers to arrive at suitable risk control measures to minimize or eliminate fire risks. The Guide is most relevant and useful to all companies, in particular Small and Medium Sized Enterprises (SMEs) in the commercial, service and light industrial sectors.

The Guide highlights the five steps involved in carrying out an activity-based Fire Risk Assessment. They are:

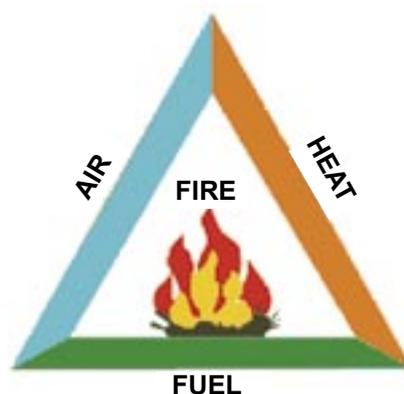
Step 1: Information Gathering

Prior to conducting an activity-based fire risk assessment, all of the following information should be gathered from observation on-site and past fire safety records, as far as practicable:

- ✓ Work activities and locations where flammable materials or combustibles are present near heat, open flame, or sparks
- ✓ List of equipment where a component failure may result in a fire because flammables/ combustibles are present or nearby
- ✓ Layout plan of building, plant, work site or factory
- ✓ Process flowcharts where release of flammable materials may result in a fire
- ✓ Past records on fire related incidents and accidents
- ✓ Fire safety inspection records, such as annual fire certification records
- ✓ Past records of fire risk assessment carried out on the same premises
- ✓ Other relevant information, such as material safety data sheets (MSDS) or manufacturers' technical data sheets for flammable materials

Step 2: Fire Hazard Identification

The fire triangle is a simple model for understanding the ingredients necessary for most fires to occur. In order to ignite and sustain a fire, all of the 3 elements must be present - heat, fuel, and oxygen. Fire hazards can be present under any one of the 3 elements, but are most commonly detected as sources of heat or fuel. As ambient air usually contains oxygen, it is not usually considered to be a fire hazard.



Step 2 focuses on fire hazard identification, probably the most crucial step in fire risk assessment, because fire hazards can only be controlled if they are identified. This step involves identifying and listing all fire hazards associated with a specific work activity being carried out in a specific location. During this process, the overall aim is to spot fire hazards, listing all the possible ways that a fire may be caused by these hazards, and to identify the possible groups of people that may become victims of fire due to each fire hazard. A comprehensive listing of fire elements, associated fire hazard classifications and examples of fire hazards are provided below, but which is by no means exhaustive. Therefore anyone using the Guide is advised to identify all possible fire hazards that may exist in specific work activities at a particular workplace.

Fire Element	Fire Hazard Classification	Examples of Fire Hazard
Heat	Incendiary: Fire deliberately set under circumstances in which the individual knows that the fire should not be set.	Burning of shoe rack along the corridor.
	Naked Light: Open flame or fires, exposed incandescent materials, any other confined source of ignition.	Flame from burning candle, blow torches, Bunsen burners, and campfire
	Electrical Origin: Fire as a result of electrical faults in the wirings, fixtures or electrical equipment	Short circuit, overloading, and arcing
	Dropped Light: Ember / smoldering materials dropped or indiscriminately disposed of.	Lighted cigarette butt and lighted match stick.
	Spontaneous Ignition: Initiation of combustion of a material by an internal chemical or biological reaction that can produce sufficient heat to ignite the material.	Linseed oiled rags and ignition of nitrocellulose.
	Overheating: Fire due to excessive heat being applied or generated.	Unattended cooking, overheating of deep fryer and electrical iron placed on ironing board.
	Sunlight: Fire due to exposure to rays from the sun.	Glass refraction from rays from the sun.
	Embers: Hot or smoldering ashes.	Ashes from burning incense and charcoal.
	Hot Works: Welding and cutting operations.	Oxy-acetylene cutting and arc welding.
	Sparks: Sparks generated as a result of friction.	Grinding operations and motor vehicle impact.
	Lightning: Electrical discharge of natural origin.	Lightning strike on a tree.
Fuel	Explosion: The sudden conversion of potential energy (chemical or mechanical) into kinetic energy with the production and release of gas(es) under pressure.	Explosives, dust explosion and ammunition.
	Chemical Reaction: Mixture of any substances causing exothermic reaction.	Magnesium fire and phosphorus exposed to air
	Exposure to heat source: Exposure to or contact with hot surfaces causing ignition.	Combustibles placed near to heated surface causing ignition.

Step 3: Fire Risk Evaluation

Fire risk evaluation consists of the following 4 sequential actions:

- (a) Identify existing risk control measures;
- (b) Assess potential severity of consequence of fire;
- (c) Determine the likelihood of occurrence and;
- (d) Assess the overall risk level based on severity and likelihood of a fire occurring.

Fire risk evaluation is a process of estimating the risk levels for the identified fire hazards, and is used as a basis for prioritizing actions to control these fire hazards and minimising fire risks. In accessing a fire risk, two aspects are looked at – the **Severity** and the **Likelihood** of fire occurrence.

(1) **Severity** is the extent of damage or injury that can be caused by fire hazards, such as the presence of flammable/combustible materials. Severity can be classified into 3 categories - Minor, Moderate and Major, as shown in the following table.

Severity	Description
Minor	Any fire would be contained and prevented from spreading; Fire is small with limited flammables/combustibles; Person(s) are present for early response to fire.
Moderate	Fire can escalate and spread because of flammables/combustibles; Person(s) may not be present for early response.
Major	Fire would spread widely and incur significant damage.

(2) **Likelihood** is the probability that a fire hazard will cause a fire of a specific severity, based on factors such as existing risk controls, past records of fire occurrences, as well as handling experience with flammable/combustible materials in a particular industry. Likelihood can be classified into 3 categories – Remote, Occasional and Frequent, as shown in the following table.

Likelihood	Description
Remote	No fires has ever occurred; No flammables/combustibles, or flammables/combustibles are present but fire risk controls are in place.
Occasional	A fire has occurred before; Flammables/combustibles are present; Fire risk controls could be inadequate.
Frequent	More than one fire associated with this work activity has occurred at this site; Fire risk controls are inadequate.

The risk level of a fire, occurring due to a specific work activity at a particular location, can be determined once its severity and likelihood have been established. A recommended approach is to use a 3 by 3 fire risk matrix as shown below. In this matrix, the fire risk level is described in the cell at the intersection of the severity row and the likelihood column, and is classified as low, medium or high risk, for a particular work activity at a certain location.

Likelihood \ Severity	Remote	Occasional	Frequent
Major	Medium	High	High
Moderate	Low	Medium	High
Minor	Low	Low	Medium

Step 4: Fire Risk Control

Based on the fire risk level determined in Step 3, suitable fire risk control measures should be selected to reduce the fire risk level to an acceptable level. This can be done by reducing the Severity and/or the Likelihood associated with the specific work activity. As indicated in the risk matrix in Step 3, when the risk level is “High”, economically effective and practicable risk controls must be implemented to bring down the High Risk level to at least “Medium Risk” or even “Low Risk”. The following table shows the acceptability of fire risk and recommended actions for different fire risk levels, which can be used to guide the selection of risk controls.

Fire Risk Level	Acceptability of Fire Risk	Recommended Actions on Fire Risk Control
Low Risk	Acceptable	<u>Take discretionary remedial action</u> ; Additional fire risk control measures may not be necessary; Frequent reviews to maintain or reduce fire risk level.
Medium Risk	Moderately Acceptable	<u>Take remedial action at appropriate time</u> ; Evaluation of fire hazards to ensure low fire risk level using interim fire risk control measures; Management attention is required.
High Risk	Not Acceptable	<u>Operation not permissible</u> ; High Risk level must be reduced to at least Medium Risk before work commences. Eliminate fire hazard if practicable, before work commences. No interim fire risk control measures; Immediate management intervention is required.

It is essential for fire hazards to be removed or reduced “at source”. If a risk cannot be controlled completely by engineering measures, it is necessary to protect the workers by administrative control or personal protection. This can be accomplished according to the Hierarchy of Control Measures that is divided into 5 categories:

- (a) Elimination
- (b) Substitution
- (c) Engineering Controls
- (d) Administrative Controls
- (e) Personal Protective Equipment (PPE)

According to this hierarchy, fire risk control measures range from “Elimination” as a permanent solution which should be attempted in the first instance, to “PPE” which should be used only as a last resort, or as a short-term or additional protective measure. Risk control measures are usually not mutually exclusive, e.g. engineering controls like sprinkler systems can be implemented together with administrative controls like fire extinguisher training and fire evacuation exercises.

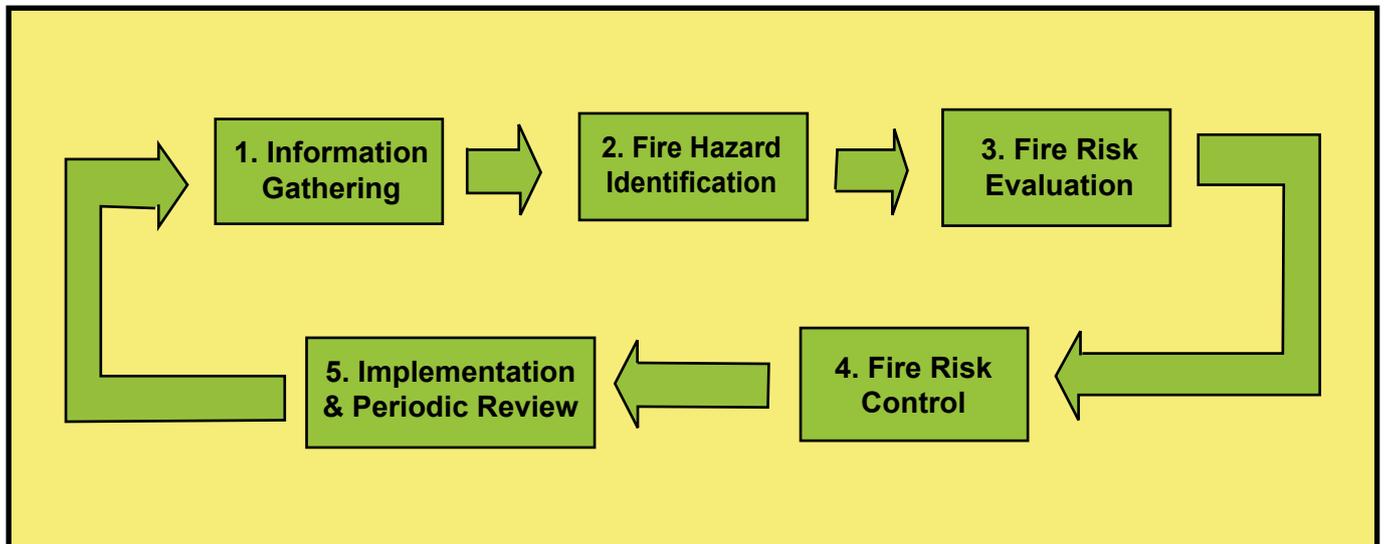
Examples of Fire Risk Control Measures (with category of Control Measure indicated):

- ✓ Removal of flammable and combustible materials (Elimination)
- ✓ Use of intrinsically safe equipment to prevent fire/explosion (Engineering)
- ✓ Installation of sprinkle system, smoke detector system, fire extinguishers (Engineering)
- ✓ Proper storage of flammable/ combustible materials (Administrative)
- ✓ Signage to alert workers of fire hazard (Administrative)
- ✓ Safe work procedures developed and workers trained (Administrative)

Step 5: Implementation and Periodic Review

Once all the fire risk controls have been identified, the risk assessment team should designate suitable action officers to implement the fire risk controls and state the follow-up dates to ensure timeliness in implementation of risk controls. Management or employers must endorse and approve the fire risk assessment results. These results must be communicated to all employees. After implementation, management or employers must monitor the follow-up actions, and keep the fire risk assessment records for at least 3 years. Another round of fire risk assessment should be conducted after the fire risk control measures have been implemented, so that any reduction in fire risk levels can be documented.

A review of fire risk assessment records should be carried out every 3 years or whenever there are changes in work processes or work activities, whichever is earlier. Periodic reviews will ensure that the risk control measure(s) implemented for every fire hazard remain adequate to address the associated fire risk level. When new equipment or substances are brought into a workplace, or changes are made to any work site, or after any fire or accident, a fresh fire risk assessment should be conducted, to ensure that effective fire risk controls are in place to maintain acceptable levels of fire risk for all work activities. Regular fire safety audits are recommended, to ensure that fire risk control measures have been implemented and are functioning effectively. This 5-step fire risk assessment procedure can be illustrated by the following flowchart.



Activity-Based Fire Risk Assessment Form

The Activity-Based Fire Risk Assessment Form shown overleaf helps to facilitate the risk assessment process and record the findings of fire risk assessment. One risk assessment form should be used for each work process or work activity. The entire 5-step fire risk assessment procedure can be documented using the assessment form, according to the following sequence:

- ✓ List the work activities in sequence for a work process
- ✓ Identify the fire hazard(s) applicable to each work activity
- ✓ Recognise person(s) that may be at risk due to the fire hazard(s)
- ✓ State existing risk control measure(s) to protect against fire hazard(s) identified
- ✓ Determine the severity and likelihood of fire hazard occurrence
- ✓ Evaluate fire risk by considering existing risk control(s) and rank the fire risk level
- ✓ List possible additional fire risk control measure(s) to reduce fire risk level
- ✓ Indicate action officer(s) assigned and the follow-up date(s)
- ✓ Repeat assessment procedure for all work activities in that work process

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A Project by the
Industrial & Commercial
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Disclaimer: This publication serves as a guide for personnel involved in fire safety at the workplace, and should not be used to substitute official or approved fire safety documents. The National Fire Prevention Council (NFPC) or the Singapore Civil Defence Force (SCDF) will not be responsible for any errors or omissions.

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