

Legislative Requirements on the Safe Use of Combustible Dust



MINISTRY OF
MANPOWER

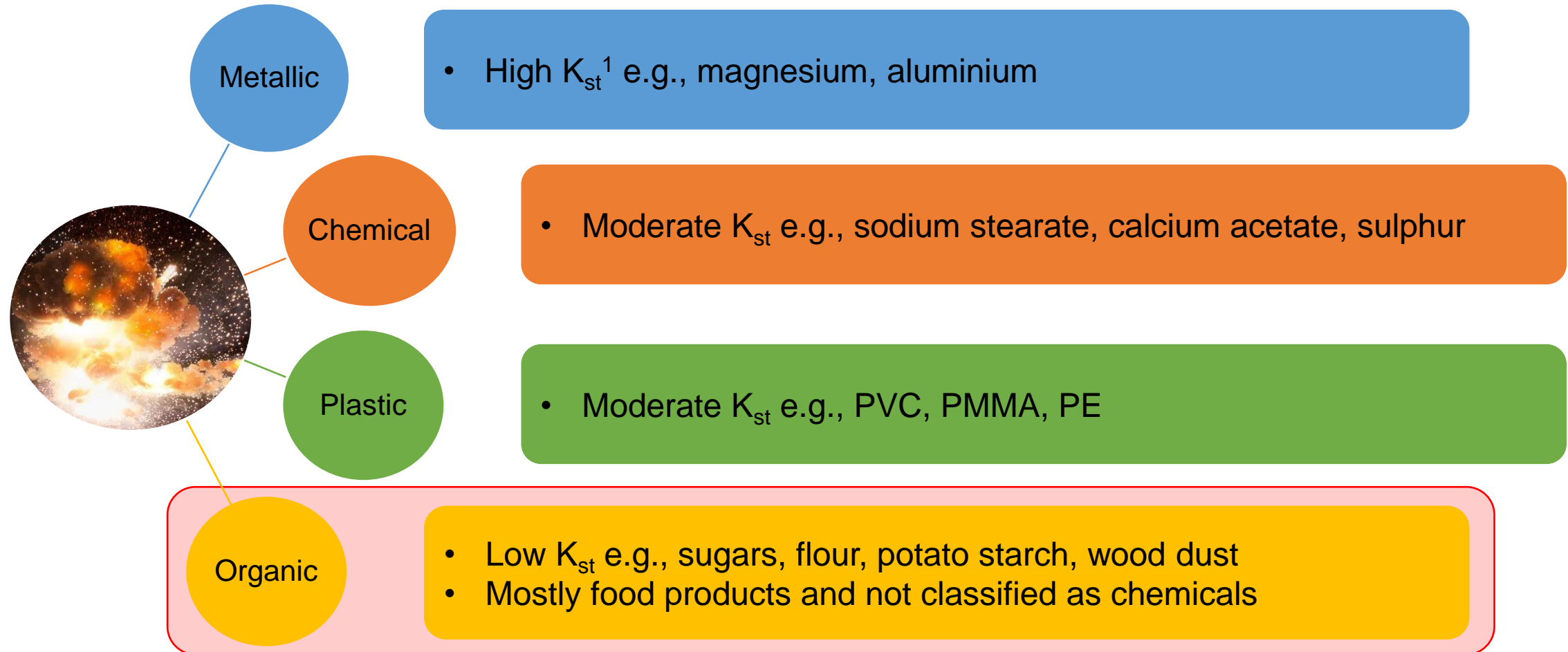
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20/11/2024



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Types of combustible dusts & typical K_{st} values

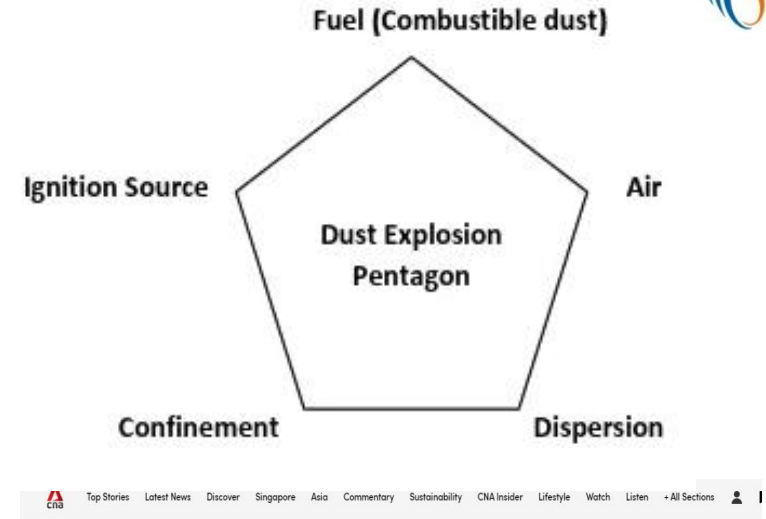


¹ K_{st} is defined as the deflagration index of a dust cloud. It is a generalized number used to estimate the anticipated behaviour of dust deflagration or explosion, allowing an approximation of a dust's explosive power compared to other dusts.



Combustible dust explosion

- The **24 Feb 2021** accident resulted in three deaths, five major injuries, two minor injuries, and severe property damage
- The explosion of the mixer machine ignited combustible potato starch powders in the workshop, leading to secondary flash fires



Singapore

10 people suffer burns after 'loud explosion' at Tuas industrial building



SCDF paramedics attending to the injured after a Tuas industrial building fire on Feb 24, 2021. (Photo: Facebook/SCDF)

SINGAPORE: Ten people were taken to hospital with burns on Wednesday (Feb 24), following what witnesses say was a "loud explosion" at an industrial building in Tuas.

Ang Hwee Min
Low Zoey
24 Feb 2021 03:39PM
(Updated: 25 Feb 2021 09:50PM)

Related Topics
Singapore Civil Defence Force

Source: CNA



Source: CNA



Source: The Straits Times



Legislation relevant to combustible dust hazard at the workplace

Workplace Safety and Health Act (WSH Act)

WSH (Risk Management) Regulations

WSH (General Provisions) Regulations

WSH (Incident Reporting) Regulations

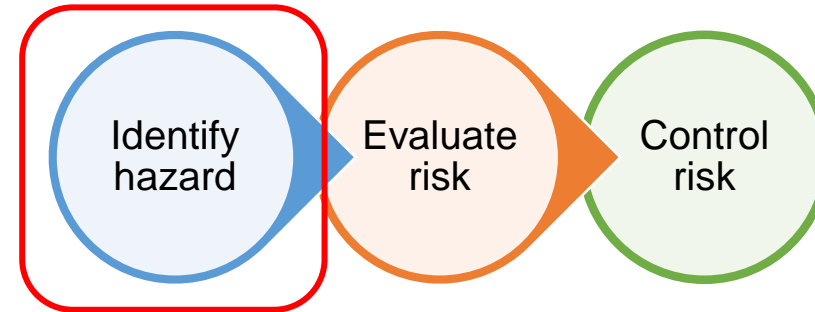


WSH Act - dutyholders at workplaces



WSH (Risk Management) Regulations

Conduct Risk Assessment:



SS 586: Specification for hazard communication for hazardous chemicals and dangerous goods - Part 3: Preparation of safety data sheets (SDS)

- *Clause 7.2.4 - Combustible dust hazard to be stated in Section 2 of SDS under other hazards which do not result in classification*

7.2.4 Other hazards which do not result in classification

The statement “May form explosible dust-air mixture if dispersed.” is appropriate in the case of a dust explosion hazard and shall be indicated in this section of the SDS.

Example of warning to be included for hazardous substance with combustible dust hazard

Storage

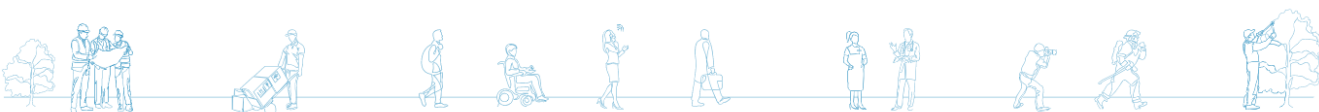
Store in a well-ventilated place. Keep container tightly closed.
Store locked up.

Disposal

Dispose of contents/container in accordance with Singapore regulations.

Other hazards which do not result in classification:

May form explosible dust-air mixture if dispersed.



Hazard identification – other references for combustible dust

2015 MOM Circular

- Examples of
combustible
dust materials

NFPA 652¹ List of Combustible Dusts

- An international
standard widely
adopted by
industry

German database (GESTIS- DUST-EX)

- Database for
combustion and
explosion
characteristics

Laboratory testing of sample

- Dust Hazard
Analysis
(DHA) –
taking
reference from
SS667

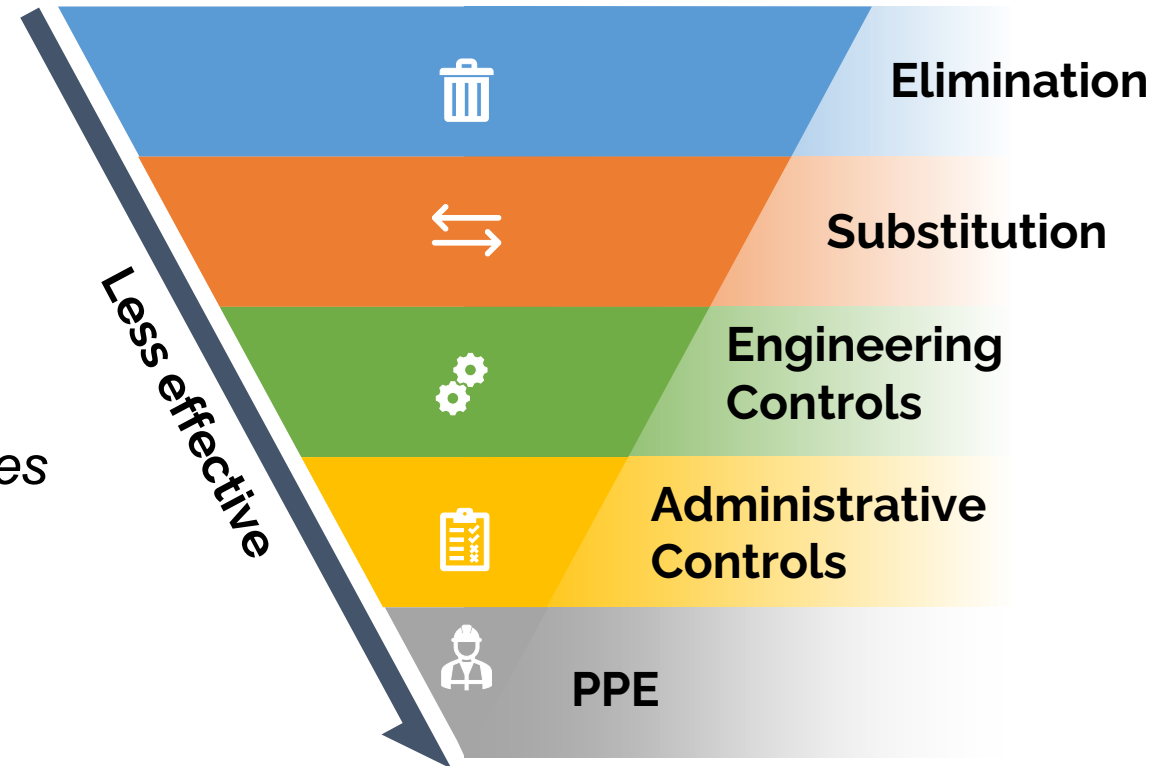
¹ This Standard is no longer under revision as part of a consolidation plan and will be combined into a new consolidated draft, NFPA 660.



WSH (General Provisions) Regulations

Provisions relating to combustible dust hazard:

- *r26: Precautions with regard to explosive or flammable dust, gas, vapour or substance*
- *r38: Safety provisions in case of fire*
- *r39: Toxic dust, fumes or other contaminants*
- *r40: Permissible exposure levels of toxic substances*
- *r41: Hazardous substances*
- *r42: Warning labels*
- *r43: Safety data sheet*



WSH (General Provisions) Regulations



**Explosive or flammable dust,
gas, vapour or substance
and fire safety**

r26

r38



**Measures to ensure
exposures are within
Permissible Exposure Levels
+ workplace monitoring**

r39

r40



**Management of hazardous
substances and hazard
communication**

r41

r42

r43



WSH (General Provisions) Regulations

r26 - Precautions with regard to explosive or flammable dust, gas, vapour or substance

- Enclosure of the plant used in the process
- Removal or prevention of accumulation of the dust, gas, vapour or substance
- Exclusion or effective enclosure of possible sources of ignition
- Use of suitable flame-proof equipment
- Restrict the spread and effects of explosion by the provision of chokes, baffles and vents, or other equally effective appliances in the plant



SS 667 - Code of Practice for handling, storage and processing of combustible dust

r38 - Safety provisions in case of fire

- Ensure good house-keeping
- Escape paths are free from obstruction



WSH (General Provisions) Regulations

r39 - Toxic dust, fumes or other contaminants

- Take measures to control (e.g., upstream risk controls) and protect persons against inhalation of toxic airborne contaminants
- Clean dust, fibre or waste accumulated on surfaces using suitable means which will not make the dust airborne
- Regular workplace monitoring of toxic dust and fumes generated/present in the atmosphere

r40 - Permissible exposure levels of toxic substances

- Ensure persons at work are not exposed to toxic substances exceeding respective Permissible Exposure Level (PEL)

Toxic substances monitoring report

Companies that use or generate toxic substances at their workplace should regularly monitor and report these hazards.

At a glance

Who can submit	<ul style="list-style-type: none"> • Company representatives • Toxic substances monitoring officers
When to submit	Within 2 weeks after monitoring is completed
Related eService	Submit and manage toxic substances monitoring reports
Related documents	<ul style="list-style-type: none"> • Guidelines on sampling strategy and submission of toxic substances monitoring report • Toxic substances monitoring report template

FIRST SCHEDULE

Regulations 2 and 40

PERMISSIBLE EXPOSURE LEVELS OF TOXIC SUBSTANCES

Toxic Substance	Permissible Exposure Level (PEL)			
	PEL (Long Term)		PEL (Short Term)	
	ppm ^a	mg/m ³ ^b	ppm ^a	mg/m ³ ^b
Acetaldehyde	—	—	25	45
Acetic acid	10	25	15	37
Acetic anhydride	5	21	—	—
Acetone	750	1780	1000	2380
Acetone cyanohydrin	—	—	4.7	5
Acetonitrile	40	67	60	101
Acetophenone	10	49	—	—
Acetylene tetrabromide	1	14	—	—
Acrolein	0.1	0.23	0.3	0.69
Acrylamide	—	0.03	—	—
Acrylic acid	2	5.9	—	—
Acrylonitrile (Vinyl cyanide)	2	4.3	—	—
Adipic acid	—	5	—	—
Adiponitrile	2	8.8	—	—



WSH (General Provisions) Regulations

Sample GHS Label

- r41 –
Hazardous
substances

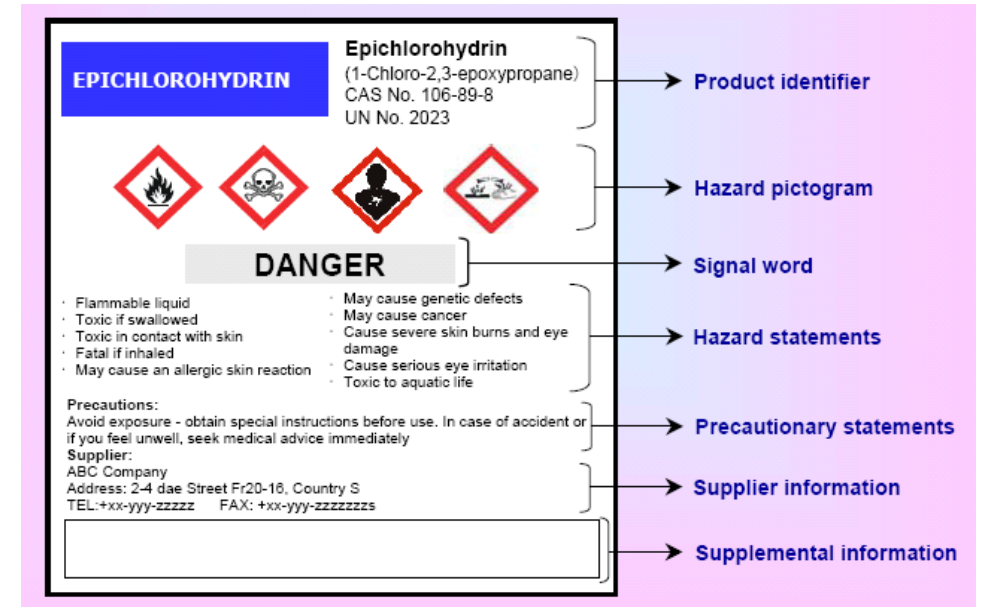
 - Hazardous substances shall be under the charge of a competent person
 - Hazardous substances shall be properly kept, stored, used and disposed

- r42 – Warning
labels

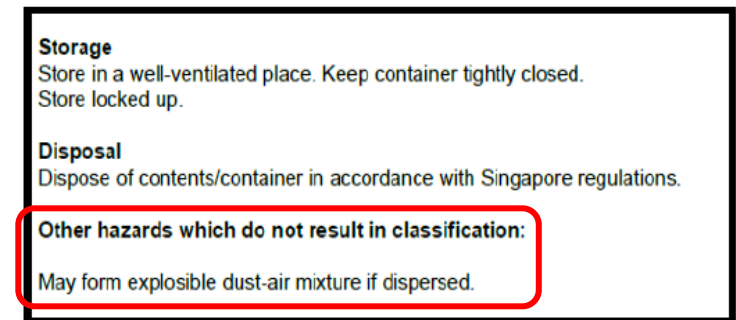
 - Containers of hazardous substances shall be labelled in accordance with SS 586 Part 2

- r43 – Safety
data sheet

 - Supplier shall provide SDS with accurate and adequate information
 - Occupier shall obtain the SDS, assess it and make it available to persons at work



The image shows a sample GHS label for Epichlorohydrin. The label includes the product name, chemical name, CAS No., and UN No. It features four hazard pictograms: Flammable liquid, Acute toxicity (oral), Health hazard, and Environment. The signal word is 'DANGER'. Hazard statements include: 'May cause genetic defects', 'May cause cancer', 'Cause severe skin burns and eye damage', 'Cause serious eye irritation', and 'Toxic to aquatic life'. Precautionary statements include: 'Avoid exposure - obtain special instructions before use. In case of accident or if you feel unwell, seek medical advice immediately'. Supplier information includes: 'ABC Company, Address: 2-4 dae Street Fr20-16, Country S, TEL: +xx-yyy-zzzzzz, FAX: +xx-yyy-zzzzzzzz'. A supplemental information box is also present.



Storage
Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal
Dispose of contents/container in accordance with Singapore regulations.

Other hazards which do not result in classification:
May form explosible dust-air mixture if dispersed.

Inclusion of warning statement on combustibile dust explosion hazard in label – SS586 Part 2: 2022



WSH (Incident Reporting) Regulations

- Deaths
- Dangerous Occurrence, WSHA Fifth Schedule Part 2
 - *Reporting of incidents such as flash fire/explosion involving combustible dust*
- Work-related accident
 - *Outpatient / hospitalisation leave*
 - *Light duty*
- Occupational disease, WSHA Second Schedule
 - *e.g., occupational asthma*

DANGEROUS OCCURRENCES

1. Bursting of a revolving vessel, wheel, grindstone or grinding wheel moved by mechanical power.
2. Collapse or failure of a crane, derrick, winch, hoist, piling frame or other appliance used in raising or lowering persons or goods, or any load bearing part thereof (except breakage of chain or rope slings), or the overturning of a crane.
3. Explosion or fire damage to the structure of any room or place in which persons are at work, or to any machinery or plant contained therein, and resulting in the complete suspension of ordinary work in the room or place or stoppage of machinery or plant for 5 hours or more, where the explosion or fire is due to the ignition of dust, gas or vapour, or the ignition of celluloid or substance composed wholly or in part of celluloid.
4. Electrical short circuit or failure of electrical machinery, plant or apparatus, attended by explosion or fire or causing structural damage thereto, and involving its stoppage or disuse for 5 hours or more.
5. Explosion or fire affecting any room in which persons are at work and causing complete suspension of ordinary work therein for 24 hours or more.
6. Explosion or failure of structure of a steam boiler or of a receiver or container used for the storage at a pressure greater than atmospheric pressure of any gas or gases (including air) or any liquid or solid resulting from the compression of gas.
7. Failure or collapse of formwork or its supports.
8. Collapse, in part or in whole, of a scaffold exceeding 15 metres in height or of a suspended scaffold or a hanging scaffold from which any person may fall more than 2 metres.
9. Accidental seepage or entry of seawater into a dry dock or floating dock causing flooding of the dry dock or floating dock.



Control and management of combustible dust

Enclosure

- Do not store materials in the open
- Enclose equipment with sufficient safety features to prevent combustible dust explosion

Dust control

- Local exhaust ventilation system (flame-proof)
- Proper housekeeping (no dry sweeping)

Ignition source control

- Effective grounding and bonding
- Use suitable flame-proof equipment e.g., flame-proof forklift, flame-proof dust collectors

Explosion prevention and protection

- Provide explosion vent
- Install spark detectors

Training

- Provide training on combustible dust hazard
- Communicate the precautionary measures to be taken

PPE

- Workers working with combustible dust to be equipped with necessary PPE e.g., fire retardant clothing, static dissipative safety shoes



Silo storage bins



ATEX rated vacuum cleaner



Grounding points



Bonding points



Flame-proof forklift



Common lapses

- Risk assessment did not include combustible dust hazard
- Open storage of combustible dust
- Poor dust control measures
- Poor housekeeping
- Poor control of ignition sources
 - *Hot works/processes*
 - *Non flame-proof equipment used*
 - *Insufficient grounding/bonding*
- No explosion protection system in place
 - *Explosion vents*



Tuas Inquiry Committee recommendations

Government Accepts Recommendations by the Tuas Explosion Inquiry Committee

25 March 2022 | [Workplace safety and health](#)

1. The Inquiry Committee (IC) appointed to look into the fatal explosion and fire at 32E Tuas Avenue 11 on 24 February 2021 has submitted its report to the Minister for Manpower. After carefully reviewing the IC's recommendations, the Government has accepted all of them.

Background

2. On 24 February 2021, eight workers at manufacturing company Stars Engrg Pte Ltd ("Stars Engrg") were preparing a mixer machine to mix potato starch powder with heated water, in order to produce a compound to manufacture fire retardant sheets. An explosion occurred in the process, killing three workers, injuring seven others, and causing severe damage to the building structure.

Recommendations by the IC

- a) Encourage buyers of industrial equipment to certify their equipment to the machinery safety standard SS 537-1¹;
- b) Review and expand the Fifth Schedule of the Workplace Safety and Health Act² to include higher-risk machineries, such as those powered by mechanical, electrical, hydraulic or pneumatic energy;
- c) Require suppliers of materials that pose a defined level of combustible dust hazard to include a label explicitly informing others of the hazard before selling or redistributing those materials;
- d) Require companies that handle prescribed amounts of specified combustible powders to register or notify the authorities;
- e) Require occupiers to inform building owners or landlords about the use of combustible powders; and
- f) Put in place more outreach and guidance efforts for Small and Medium Enterprises, as well as workers who may be at risk.

Legislation will be revised to effect these recommendations

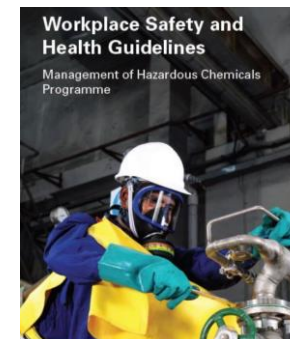


Resources

- Approved Code of Practice
 - *SS 667 - Code of Practice for handling, storage and processing of combustible dust*
 - *SS 658 - Code of Practice for design, operation, testing, and maintenance of local exhaust ventilation systems*
 - *SS 537 - Code of Practice for safe use of machinery*
 - *SS 586 – Specification for Hazard Communication for hazardous chemicals and dangerous goods*
 - *Code of practice on Workplace Safety and Health (WSH) Risk Management*
- WSH Guidelines on Management of Hazardous Chemicals Programme
- MOM Circular on Hazards and Controls of Combustible Dusts
- WSH Council Publication on 6 Basic WSH Rules for Handling Combustible Dust

THE SCHEDULE — *continued*

<i>Approved Codes of Practice</i>		<i>Year Published</i>
74.	SS 650: Code of practice for temporary electrical installations (Formerly CP 88) Part 2: Festive lighting, trade-fairs, mini-fairs and exhibition sites	2019
75.	SS 651: Safety and health management system for the chemical industry – Requirements with guidance for use	2019
76.	SS 657: Code of practice for workplace noise control	2020
77.	SS 658: Code of practice for design, operation, testing and maintenance of local exhaust ventilation systems	2020
78.	SS 659: Code of practice for scaffolds	2020
79.	SS 663: Code of practice for safe loading on vehicles (Formerly CP 30)	2020
80.	SS 667: Code of practice for handling, storage and processing of combustible dust	2020
81.	SS 679: Code of practice for workplace safety and health	2021



Thank you

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