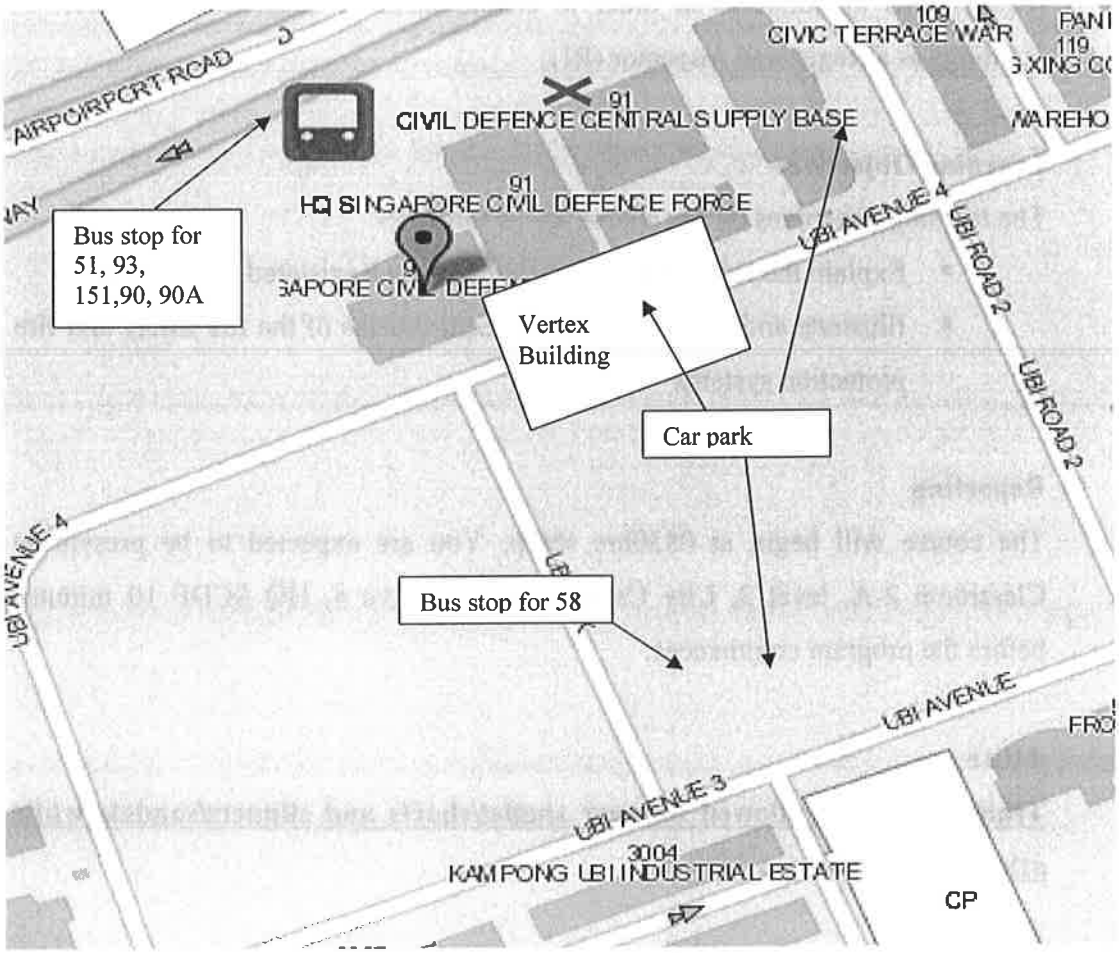
CIVIL DEFENCE ACADEMY
101 Jalan Bahar, Singapore 649734
Tel: 67945674 Fax: 67945522

COURSE INFORMATION

REGISTERED INSPECTOR COURSE

The Training Academy of
The Singapore Civil Defence Force



1	**Course Location**	:	Classroom 2-A and 2-B, level 3, City Campus, 91 Ubi Ave 4, HQ SCDF (marked X in below map within HQ SCDF)
2	**Duration**	:	14 March 2017 to 15 March 2017
3	**Time**	:	0900hrs to 1800hrs

4 Aim

This course is designed to train participants in fire safety and fire protection requirements in buildings in order to enable them to undertake inspection of buildings as a Registered Inspector (RI).

5 Learning Objectives

The learning objectives of this course are as follows:-

- Explain the roles and responsibilities of a Registered Inspector (RI)
- Illustrate and apply the various requirements of the fire safety and fire protection systems

6 Reporting

The course will begin at 0830hrs sharp. You are expected to be present in Classroom 2-A, level 3, City Campus, 91 Ubi Ave 4, HQ SCDF 10 minutes before the program commences.

7 Attire

Trainees are not allowed to wear singlet/shorts and slippers/sandals while attending training sessions.

8 Attendance and Punctuality

You are to confirm your particulars as indicated in the Attendance Register and to sign the attendance daily.

9 Certificate

You will need to attain a minimum of 80% attendance in order to receive a Certificate of Attendance.

10 Cleanliness

During the course, please maintain the cleanliness of the various training areas and amenities for your own comfort as well as those of other users/participants.

11 Time Off/Leave

Due to the short duration of the course, you will not be allowed time off during the course. You will also not be allowed to apply leave during the course.

13 Use of Hand Phones

You are requested to put your hand phones and other electronic devices to silent mode and respond to calls only during breaks or outside the classroom, so as not to disrupt the class.

15 No Smoking

Smoking is strictly prohibited within the compound of the Academy. Offenders can be fined up to a maximum of $500.00.

16 Transportation

If you are taking public transport, there are a few buses that can reach HQ SCDF. Please refer to the location map above for busses and bus stops around HQ SCDF.

17 Parking

You are encouraged to car-pool or take public transport due to limited parking space in the HQ SCDF. Alternatively, you may park at the nearby car park. There are 2 open car parks and a sheltered car park just across HQ SCDF. Please refer to the map above.

18 Loss/ Damage

Please note that SCDF will not be responsible for any loss or damage to personal belongings during your course. We recommend that you bring little cash or valuables.

19 Clarification

Any query is to be directed to the Course Coordinator.

MAJ Cheong Yew Dong at DID 67945660
Course Coordinator WO Zahini at DID 67945674.

LTC Ow Yong Tuck Wah

Head Specialist Fire Training Centre

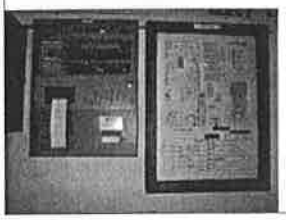
Civil Defence Academy

TIME	Period 1	Period 2	Period 3	Period 4	1235	Period 5	Period 6	Period 7	Period 8	Period 9
	0900 - 0950	0955 - 1045	1050 - 1140	1145 - 1235	to	1340 - 1430	1435 - 1525	1530 - 1620	1625 - 1715	1720 - 1800
DAY/DATE					1335					
TUES	Roles & Resp of RI & RI Regulation	Sharing of RI non-compliance cases	TFP/FSC Inspection Procedures			Means of Escape		Structural Fire Precautions	PSB Product Listing Scheme	
14/03/2017										
	Maj Ang Oon Chye					Mr Randy Tan		Maj Lim Lam Kwang	Miss Emily Mok	
	Lect Rm 2A/B - SCDF HQ					Lect Rm 2A/B - SCDF HQ				
WED	Plan audit check findings and waiver issues	Sharing of Performance Based Projects	Fire safety requirements for FM and general warehouses for storing FM materials and general goods/items			Inspecting Mechanical & Electrical Fire Safety Works : RI Experience		Inspecting Building Fire Safety Works: RI Experience		Course Evaluation & Certificate Presentation
15/03/2017										
	LTC Choh Choon Jin	Mr Nicholas Lee	LTC Han Fook Kuang			Mr Matthew Kwek Yoong Yoong		Mr Chan Kok Way		MAJ Cheong Yew Dong / Maj Ang Oon Chye
	Lect Rm 2A/B - SCDF HQ					Lect Rm 2A/B - SCDF HQ				



SCDF

Roles & Responsibilities of RI & RI Regulation





Learning Objectives

SCDF

To Recognise the Concept of RI Scheme

- Role & duties of RI
- Scope of fire safety works to be inspected by RI

To be familiar with FSA & Regulations related to RI Scheme

- Disciplinary actions
- Continuing Education



Scope

SCDF



- Introduction
- RI Scheme
- Relationship between RI & TFP/ FSC
- Duties of RI
- FSA & Regulations
- Conclusion



Introduction



SCDF

- Launched on 8th April 1994
- To achieve faster response & clearance of TFP /FSC applications for projects
- To achieve higher standard of fire safety in buildings

Registered Inspector

SCDF





Scheme

Who is a Registered Inspector ?

SCDF

- A person registered with SCDF
- Qualified & competent to inspect & certify fire safety works in projects
- Issuance of TFP/FSC



Registered Inspector(RI) Scheme

SCDF

Two disciplines of Registered Inspectors

- **Architectural**
- **M & E**





Criteria for a RI

SCDF

- **Registered Architect with Board of Architects or Professional Engineer with the Professional Engineers Board**
- **Min 10 years experience as a Registered Architect or Professional Engineer**
- **Experience in design , installation & inspection of fire safety works in a wide variety of projects**



Procedures for RI Registration

SCDF





Submission of application form

⬇

Shortlisting by CED

⬇

Interview by RI Selection Panel

⬇

Approval by Comr SCDF

⬇

Attendance of RI Familiarisation Course

⬇

Registration as RI



SCDF

Relationship between





RI & TFP/ FSC

Relationship between RI & TFP/ FSC

SCDF

What is the purpose of TFP/ FSC ?

- **To ensure that building/ premises meets the fire safety standards before it is allowed to be occupied**
- **To provide a fire safe environment for building occupants**



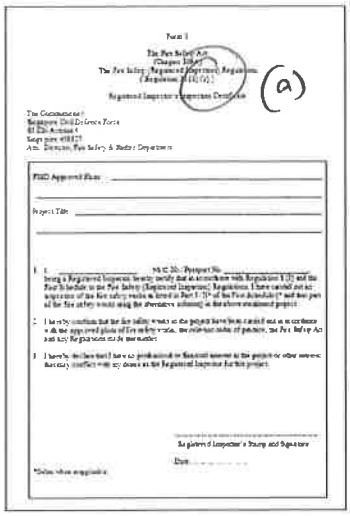
RI Inspection Certificate

SCDF

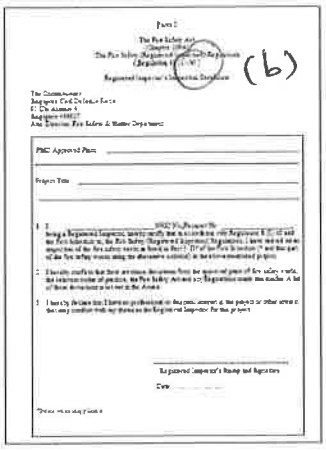
- **2 types of inspection certificates**
  - **Form 1**
  - **Form 2**
- **Final decision to issue partial TFP, TFP or FSC rests with SCDF**

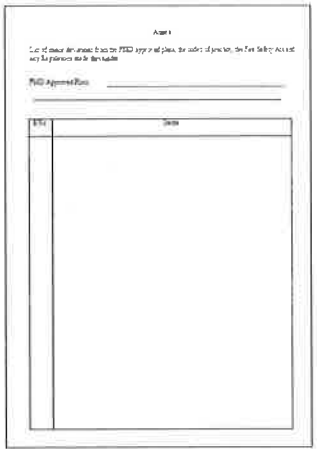


RI Inspection Certificate Form 1


(a)

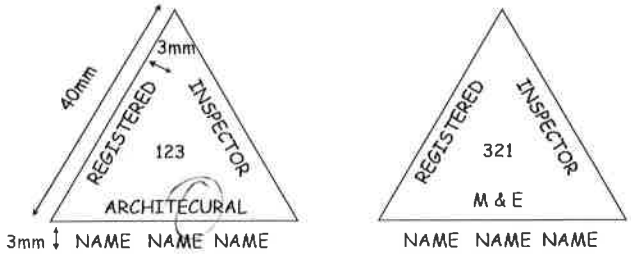
RI Inspection Certificate Form 2


(b)



⇒ Valid for 2 months only from date of form.

Sample of RI stamp



RI Inspection Report

- **Who are present at the site**
- **Number of inspections carried out**
- **Documents to prove when there is RI Inquiry**

Annex A

REGISTERED INSPECTOR'S INSPECTION / RE-INSPECTION REPORT

REPORT NO. _____

PROJECT	
APPROVED PLANS & NUMBERS USE FOR INSPECTION	
DATE & TIME OF INSPECTION	
NAMES OF INSPECTORS/ QP/ OWNER & REPRESENTATIVES WHO ARE PRESENT DURING INSPECTION	
FINDINGS (ATTACHED PHOTOS IF ANY) RI (M&E) TO INCLUDE RELEVANT READINGS FOR HYDRANT, WET & DRY RISING MAINS, etc	

NAME & SIGNATURE OF RI _____ DATE _____

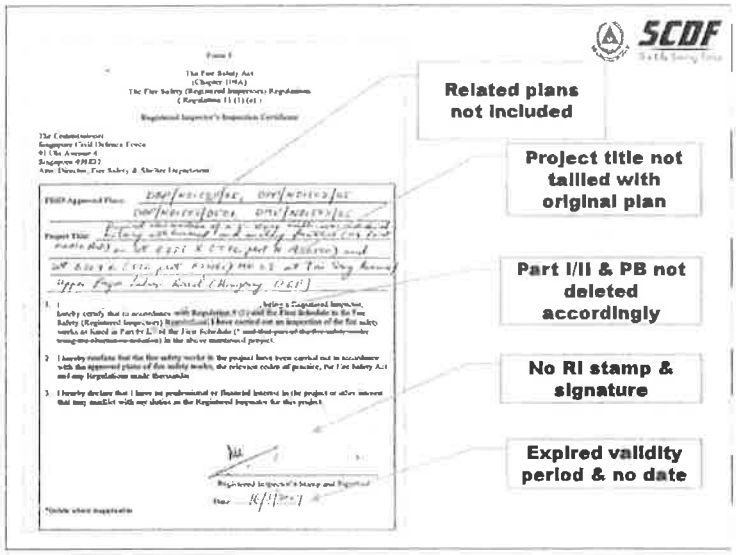
*Note :

1. This RI inspection report is to be attached as part of the TFP/FSC application.
2. To attach photos if any.
3. To attach separate inspection findings or additional Annexes where applicable, if space provided in this 1 page report is insufficient.

Useful Resources for RI



Common mistakes made on RI Form 1 & 2



Related plans not included

Project title not tallied with original plan

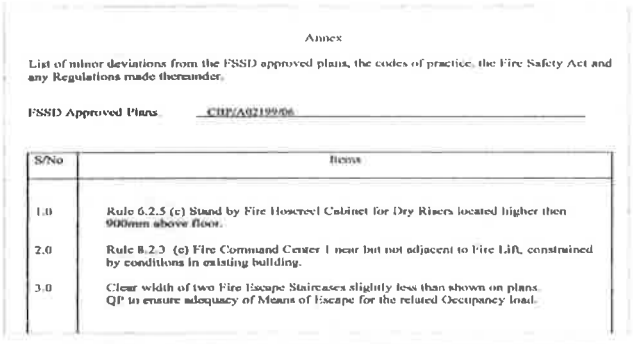
Part I/II & PB not deleted accordingly

No RI stamp & signature

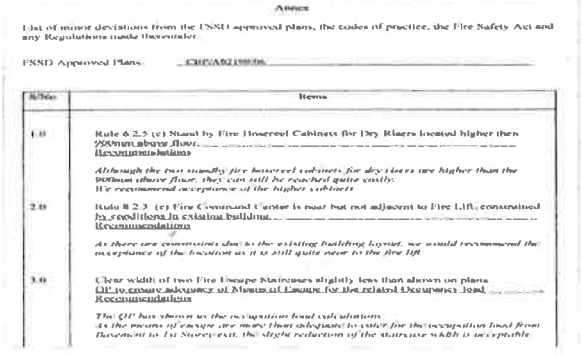
Expired validity period & no date



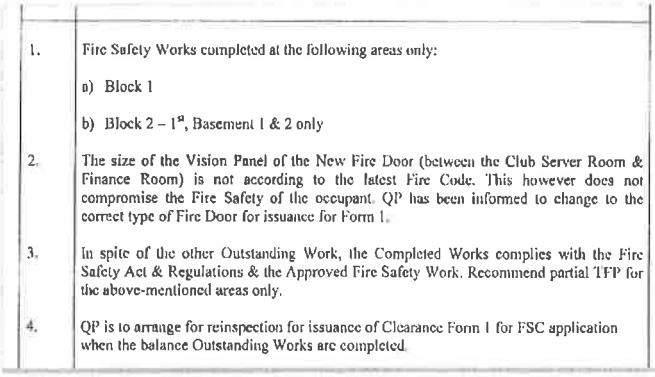
RI Appointment form no need to include related plan numbers for RI(Arch)



RI form 2 no recommendations made by RI - NOT ACCEPTABLE



RI form 2 with RI recommendations



RI form 2 with RI recommendations

RI Inspection Certificate Form 2

- RI indicates the minor outstanding matters that have yet to be completed or that part of the project that is ready for occupation on Annex
- Issued when the project or part of it has generally complied with fire safety requirements & is safe for occupation
- Recommends that FSSD can issue a Temporary Fire Permit for a limited period





Duties of RI



Duties of RI

- Inspect & test fire safety works
- Request for & check all relevant documents needed to ascertain fire safety of project
- Certify only when there is generally full compliance of fire safety standards
- Keep proper records
- Submit to owner Certificate of Inspection
- Notify CED of any non-compliance if QP or owner refuses to make good defects



Project Qualified Person

QP to provide RIs with

- All approved plans & documents needed for inspection of project for issuance of the TFP/FSC
- Schedule of date/time of inspection of fire safety works



List of Fire Safety Works to be inspected by RI

First schedule

- Part I- Architectural
- Part II- M & E









Part I of First Schedule (Arch)

Means of Escape



- Determination of exit requirements
- Means of escape requirements
- Exit signs and directional signs
- Provision of exit lightings, emergency lightings (self-contained light fittings only), & low level photo luminescent signs



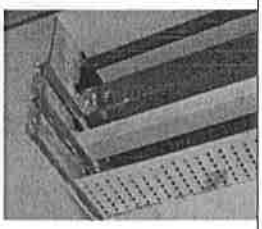


Part I of First Schedule (Arch)

SCDF

Structural Fire Precautions

- Compartment walls and floors
- Elements of structure
- External walls
- Separating walls
- Protected shafts and lift shafts
- Protection of openings
- Exit staircases
- Concealed spaces
- Fire stopping
- Restriction of flame spread
- Roofs
- Materials for construction





Part I of First Schedule (Arch)

SCDF

Site planning and external fire fighting provisions

- Provision for external access to building for fire fighting and accessibility of site to fire fighting appliances
- Access to buildings with rising mains
- Hydrants









Part I of First Schedule (Arch)

SCDF

Fire Fighting Systems (Provisions Only)

- Automatic and manual fire alarm systems
- Dry and wet rising main systems
- Emergency power supply
- Fire lifts
- Fixed automatic fire extinguishing systems
- Hosereels (include testing for direct Public Utilities Board supply)
- Mechanical ventilation
- Natural ventilation openings
- Sprinkler installations
- Smoke control systems





Part I of First Schedule (Arch)

SCDF

Other Provisions

- Emergency voice communication systems
- Fire Command Centre
- Portable Fire Extinguishers
- PWD











Part I of First Schedule (Arch)

SCDF

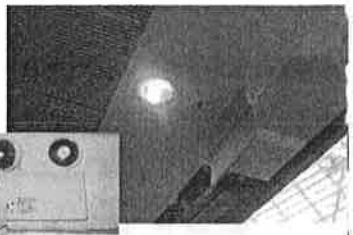
- Pressurized or non-pressurised storage cylinders, tanks &cylinders with manifold system (testing not required)
- Any other requirement specified by the Fire Code
- Any other requirement specified by other accepted Codes of Practice that have been adopted for the project
- Any other endorsements made on the approved building plans



Part II of First Schedule (M & E)

SCDF

Means of Escape – Exit lightings, emergency lightings and low level photo luminescent signs





Site planning & external fire fighting provision - Private hydrants (testing only)

Part II of First Schedule (M & E)

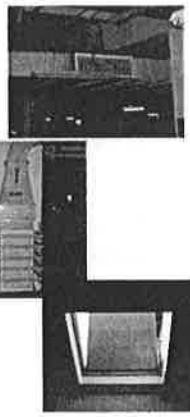
Fire Fighting Systems (Verification & Testing)



- Automatic & manual fire alarm systems
- Dry & wet rising main systems
- Emergency power supply
- Emergency voice communication systems
- Fire lifts
- Fixed automatic fire extinguishing systems
- Hosereels (pump feed)
- Integrated fire fighting & protection systems testing under both fire alarm activation and power failure condition
- Sprinkler installations

Part II of First Schedule (M & E)

Mechanical ventilation & smoke control systems



- Mechanical ventilation/air-conditioning systems, including dampers & fire resisting construction of ductworks
- Pressurisation systems
- Smoke control systems (both mechanical &venting systems)

Part II of First Schedule(M& E)



- Other Provisions:
  - Emergency voice communication systems (testing only)
  - PWD (testing only)
- Pressurized or non-pressurised storage cylinders, tanks & cylinders with manifold systems (testing only)
- Any other requirement specified by the Fire Code
- Any other requirement specified by other accepted Codes of Practice that have been adopted for the project
- Any other endorsements made on approved building plans

Fire Safety Act & Regulations



FIRE SAFETY ACT

(CHAPTER 109A)

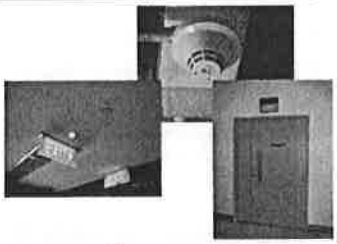
An Act to make provision for fire safety and for matters connected therewith.

PART I

PRELIMINARY

FSA & Regulations

Conflict of Interest



- Professional Interest
- Financial Interest
- Any other interest which may be in conflict with the RI's performance of inspection duties
- Example
  - Is/ has been responsible for or acting as consultant to design/ construction of project/ fire safety works ..... OR
  - RI or the member/ officer/ employee having a professional/ financial interest

Disciplinary Action

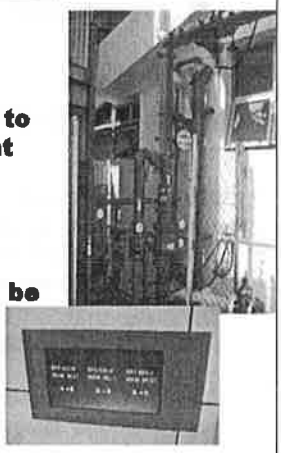
- Can be charged in court for an offence under the FSA
- Can be fined or imprisoned or subject to both
- For poor performance of inspection duties or breach of the code of conduct
- FSA empowers SCDF to impose separate penalties for contravention of the FSA
- RIs & project QP / PEs responsible /answerable to owners



Fire Safety Act

Under Section 6A to 6D

- Powers for Inquiry Committee to investigate complaints brought up against RIs
- Other forms of penalties to be meted out to the RI if found to be at fault



Fire Safety Act

Inquiry Panel

- Made up of 2 external & 2 SCDF members
- A chairman who can either be external/ internal member
- To provide neutrality in investigating complaints and hearing cases against RIs
- Being selected from a panel of members who are invited directly by SCDF
- 2 year term



Inquiry Committee

Concept

- A system of graduated penalties
- Based on severity of the offence
- Based on past records of RI
- Introduced other forms of penalties besides just de-registration



Penalties

- A written reprimand
- A composition fine not exceeding $5,000
- Suspension for a fixed period not exceeding 12 months
- Cancellation of Registration



Fire Safety Act

Code of Conduct

- Section 61 of the FSA prescribe a code of professional conduct & ethics for RI
- RI are to abide by this code of conduct
  - Duties & Responsibilities
  - Publicity of Services
  - Contribution/ Participation in Fire Safety
  - Prohibiting on Touting & Soliciting
  - Prohibition on Supplanting
  - Conflict of Interest



Fire Safety Act

Performance-based plans & Fire Safety Engineers



- An engineering solution for the fire safety works to satisfy the fire performance requirements in the Fire Code

- **Fire Safety Engineer (FSE)**
  - A person who is registered as a fire safety engineer under this Act
  - Prepare or supervise the preparation of plans containing alternative solution, & another FSE as peer reviewer to review & assess those plans

- **Peer Reviewer**
  - A fire safety engineer who is appointed to review & assess whether the alternative solution proposed, satisfies the fire performance requirements

Fire Safety Act



Section 5A(1)(f)

- No RI can practise as a RI if he is suspended or deregistered as a QP
- If he is suspended or deregistered as a FSE, he cannot inspect projects incorporating an alternative solution

Section 5A(4)

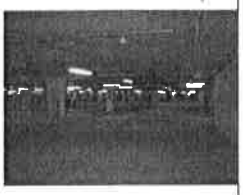
- Reinstatement of RI upon expiry of suspension is within 7 days

RI Regulation

- No RI shall inspect any fire safety work which uses any alternative solution unless he is a FSE
- Owners are likely to engage only 1 RI(A) and 1 RI(M & E) as per current practice
- RIs who are not FSEs are not allowed to inspect projects incorporating an alternative solution



RI Regulation



- Duty of RI to find out whether the project incorporates an alternative solution before taking on the job
- QPs to ensure that appropriate RIs are engaged before application of the TFP/ FSC if the plans incorporate an alternative solution
- RIs who are registered as FSEs will be identified as such in FSSD's computerised TFP/FSC processing system



RI Regulation

- RI cannot be Peer Reviewer for project (conflict of professional interest)
- RIs are required to know the fire performance requirements of alternative solution before taking on the job



Continuing Education



- Based on a 2-year cycle
- 3 similar courses conducted within 2-yr cycle
- To attend only 1 course per cycle
- Certificate of Attendance
- One day session



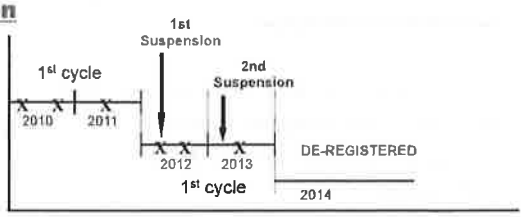
Continuing Education

Implication of not attending the course

- Failure to attend any of the 3 courses within 2-yr cycle
  - Suspension from practice for 1 year
- Powers provided under FSA to suspend or de-register
- Continuing failure to attend courses in 1st year of the 2nd cycle
  - Result in 2nd suspension for another 1 year
  - Names of RI who have been suspended will be automatically blocked in the TFP/ FSC processing system
  - This acts as a Final Warning before de-registration

Continuing Education

- **Failure to attend 1st cycle – 1st suspension on 3rd yr**
- **Failure to attend 3rd year in 2nd cycle – continue 2nd suspension on 4th yr**
- **Failure to attend 2 cycles (4 yrs period) – De-registration**



Conclusion

- **Speed up processing of TFP/FSC applications for projects**
- **Makes use of vast pool of expertise in private sector in helping ensure high standards of fire safety in buildings**
- **QPs who are RIs provide better quality work when it comes to fire safety**
- **Fees chargeable is matter to be agreed between owner & RI**



Sharing of RI Non-Compliant Cases





Scope

- Actions taken against RIs for non-compliant projects
- Case studies





Learning Objective

Understanding the common non-compliances found during RI inspection



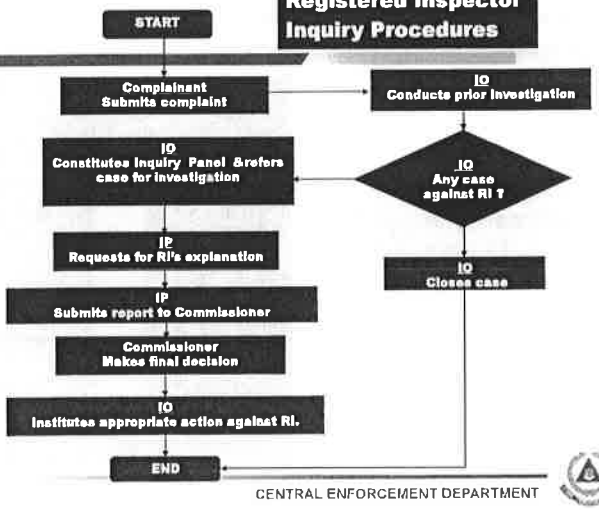
Under what circumstances non-compliances were found?

- Complaints
- Enforcement
- Spot checks
- Plan Audit
- Processing TFP/FSC application





Registered Inspector Inquiry Procedures



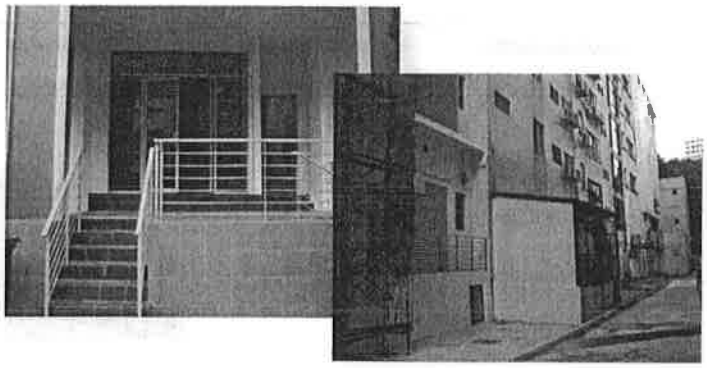
Actions taken against RIs for non-compliant projects

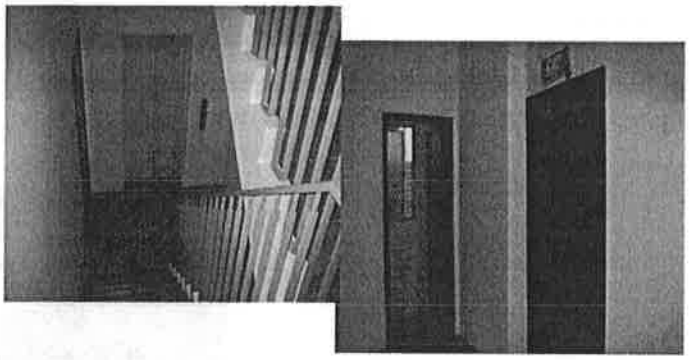
Action	No of Cases
De-registered	1
Suspended	2
Fine $5000	2
Fine $4000	1
Fine $3000	6
Fine $1500	1
Fine $1200	1
Fine $1000	7
Fine $600	1
Fine $500	15
Fine $300	6
Fine $200	4
Warning Letter	17
Advice Letter	2
Total no of RIs taken to task : 37	

Case 1

6-storey Commercial Building used as Office

- **Staircase sharing same shaft as lift**
- **Dry riser not provided**
- **Automatic alarm system not provided**
- **Smoke-stop lobby not provided**
- **Ventilation to staircase not provided**
- **2 Independent exit staircases**





Case 2

Proposed additions and alterations and extension of existing karaoke lounge

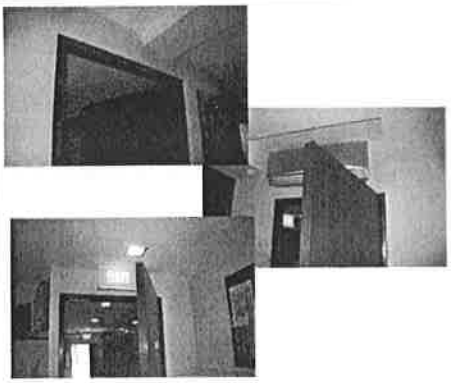
Missing manual call point except bell - Clause 6.3.3



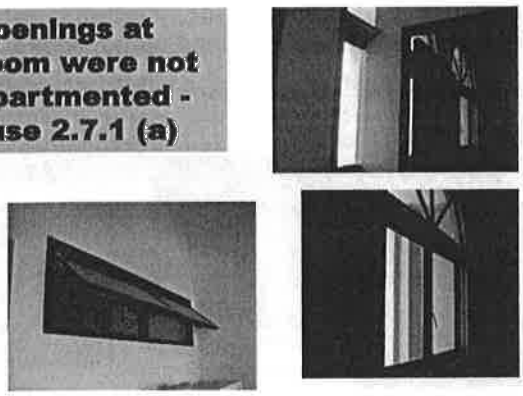
Case 3

Proposed additions & alterations to 1 unit of existing 2-storey shophouse, change of use of 1st storey from shop to boarding house and 2nd storey from office to boarding house with an additional attic used as boarding house

Door closers were not installed for fire-rated doors -Clause 3.9.2 (b)



Openings at bedroom were not compartmented - Clause 2.7.1 (a)



Case 4

Proposed additions and alterations to childcare centre (change of use from shop) at 2nd storey & minor alteration to 1st storey's entrance lobbies



No separation between childcare centre and carpark with fire-rated wall and door - Clause 2.5.1 (c) (i)



No manual call-point provided - Clause 6.3.3

Case 5

Proposed additions and alterations to a existing 5 storey backpackers' hostel

Width of staircase less than 1000mm - Clause 2.2.7



Case 6

Proposed change of use from the existing 2nd storey living quarters to commercial school

Enclosure walls of protected staircase with more than 2 doors provided -Clause 2.3.2 (a) (II)



Protected staircase was not separated and protected at 1st storey discharge point - Clause 2.3.3 (a) (I)



Door closer to fire-rated door for staircase at 2nd storey not installed - Clause 3.9.2 (f)



2 independent exit staircases were not provided - Clause 2.2.1



Exit door at 1st storey discharge was not opened in the direction of exit travel - Clause 2.3.9 (c)



Case 7

Proposed erection of a 14-storey detached multi-user light-industrial factory (Business 1) building with a staff canteen and basement carpark (total '18 factory units')

Emergency Voice Communication Systems was not provided – Clause 8.2.1 (a)







Case 8

Proposed new erection of a 8-storey multiple-user clean and light industrial development with mezzanine floor at 8th storey comprising 220 flatted factory units with a staff canteen

Two-way Emergency Voice Communication System was not provided in FFL – Clause 8.2.1(b)

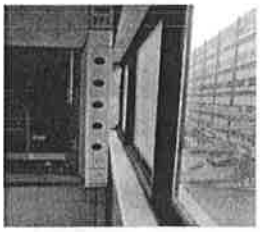






Case 9

Proposed erection of new gas yard on 1st storey and additions and alterations to #03-01





Compartmented wall for Solvent Room at 2nd storey was not fully enclosed - Clause 3.2.5(o)

Case 10

Proposed additions & alterations of internal partition works to unit

Sprinkler point with PVC piping (dummy sprinkler) installed and not connected to water supply - CP52





Case 11

Proposed condominium housing development

Location of dry rising main breeching inlets not conspicious & obstructed



Protected staircase discharged into cover area and facing the ventilation opening of the basement carpark area



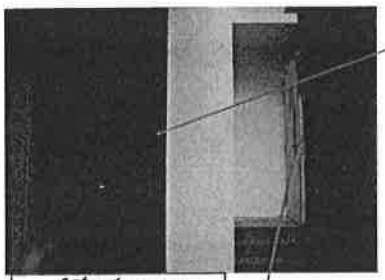
Staircase discharged on 1st storey



Basement carpark opening

Basement carpark not separated from discharge staircase

Basement carpark





1st storey staircase discharge

Case 12

Proposed erection of a 10-storey hotel building

Location of fire engine accessway not suitable

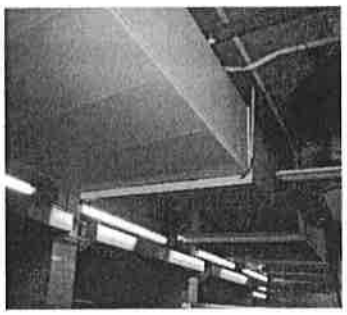
Fire engine accessway



Water gauge, water tank capacity, access ladder and pump number were not provided in the sprinkler pump room



Under duct sprinkler not provided for fresh air supply duct more than 800mm in width installed in the kitchen



Case 13

Proposed erection of a 15-storey hotel building

Exit discharged into carpark & not directly to the safe exterior open space



CENTRAL ENFORCEMENT DEPARTMENT

Thank You



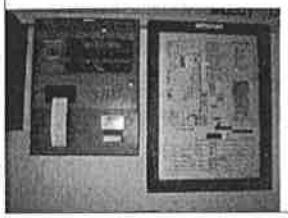


CENTRAL ENFORCEMENT DEPARTMENT

Hotel staircases cannot be HV because of noise must be high the consider



Roles & Responsibilities of RI & RI Regulation





Learning Objectives

To Recognise the Concept of RI Scheme

- Role & duties of RI
- Scope of fire safety works to be inspected by RI

To be familiar with FSA & Regulations related to RI Scheme

- Disciplinary actions
- Continuing Education



Scope



- Introduction
- RI Scheme
- Relationship between RI & TFP/ FSC
- Duties of RI
- FSA & Regulations
- Conclusion



Introduction



- Launched on 8th April 1994
- To achieve faster response & clearance of TFP /FSC applications for projects
- To achieve higher standard of fire safety in buildings

Registered Inspector





Scheme

Who is a Registered Inspector ?

- A person registered with SCDF
- Qualified & competent to inspect & certify fire safety works in projects
- Issuance of TFP/FSC



Registered Inspector(RI) Scheme

SCDF

Two disciplines of Registered Inspectors

- Architectural
- M & E





Criteria for a RI

SCDF

- Registered Architect with Board of Architects or Professional Engineer with the Professional Engineers Board
- Min 10 years experience as a Registered Architect or Professional Engineer
- Experience in design , installation & inspection of fire safety works in a wide variety of projects



Procedures for RI Registration

SCDF





Submission of application form

⬇

Shortlisting by CED

⬇

Interview by RI Selection Panel

⬇

Approval by Comr SCDF

⬇

Attendance of RI Familiarisation Course

⬇

Registration as RI



SCDF

Relationship between





RI &

TFP/ FSC

Relationship between RI & TFP/ FSC

SCDF

What is the purpose of TFP/ FSC ?

- To ensure that building/ premises meets the fire safety standards before it is allowed to be occupied
- To provide a fire safe environment for building occupants



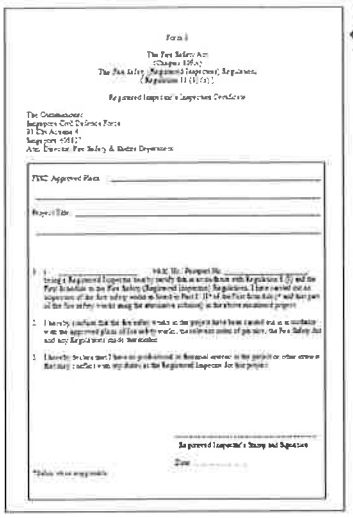
RI Inspection Certificate

SCDF

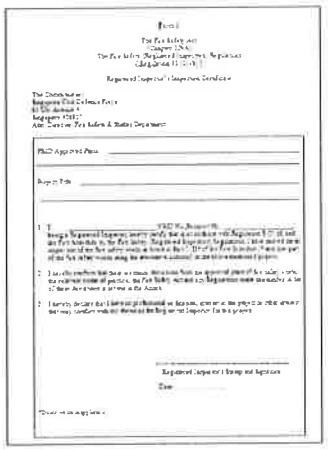
- 2 types of inspection certificates
  - Form 1
  - Form 2
- Final decision to issue partial TFP, TFP or FSC rests with SCDF

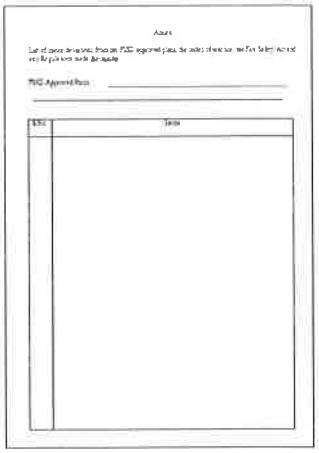


RI Inspection Certificate Form 1

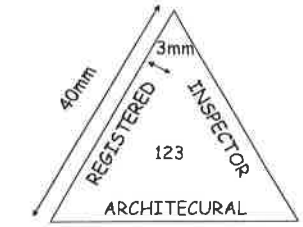


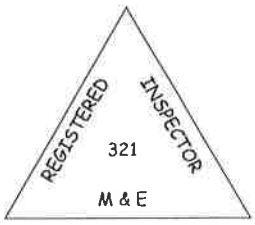
RI Inspection Certificate Form 2





Sample of RI stamp





RI Inspection Report

- **Who are present at the site**
- **Number of inspections carried out**
- **Documents to prove when there is RI Inquiry**

Annex A

REGISTERED INSPECTOR'S INSPECTION / RE-INSPECTION REPORT

REPORT NO. _____

PROJECT	
APPROVED PLANS & NUMBERS/S USE FOR INSPECTION	
DATE & TIME OF INSPECTION	
NAMES OF INSPECTORS/ QP/ OWNER & REPRESENTATIVES WHO ARE PRESENT DURING INSPECTION	
FINDINGS (ATTACHED PHOTOS IF ANY) RI (M&E) TO INCLUDE RELEVANT READINGS FOR HYDRANT, WET & DRY RISING MAINS, etc	

NAME & SIGNATURE OF RI _____ DATE _____

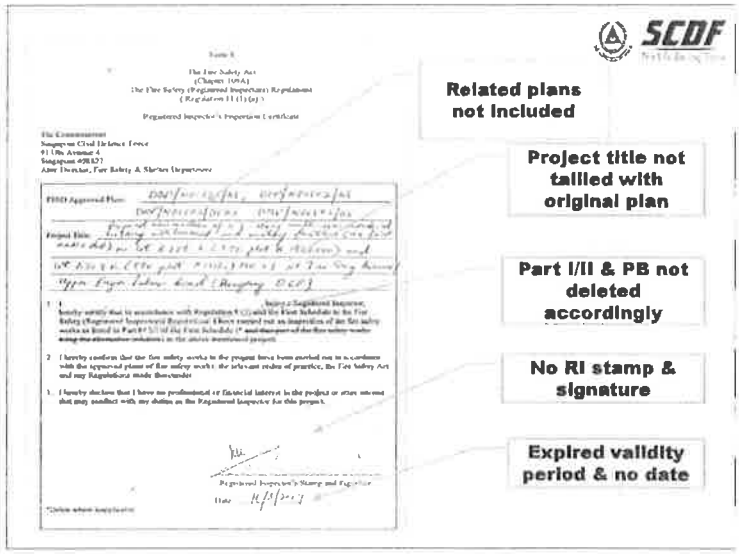
*Note:

1. This RI inspection report is to be attached as part of the TFP/FSC application.
2. To attach photos if any.
3. To attach separate inspection findings or additional Annexes where applicable, if space provided in this 1-page report is insufficient.

Useful Resources for RI



Common mistakes made on RI Form 1 & 2



Related plans not included

Project title not tallied with original plan

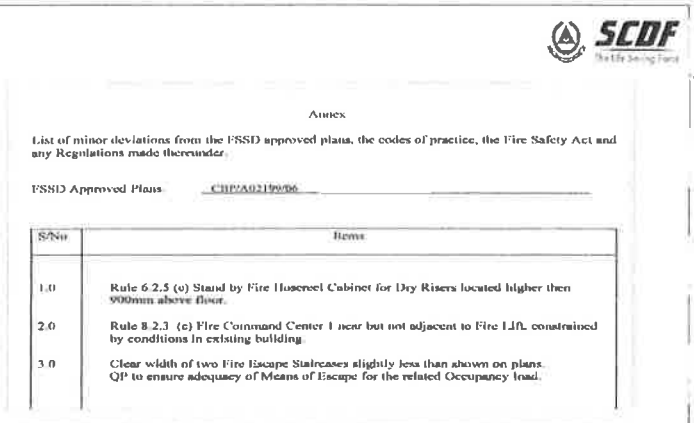
Part I/II & PB not deleted accordingly

No RI stamp & signature

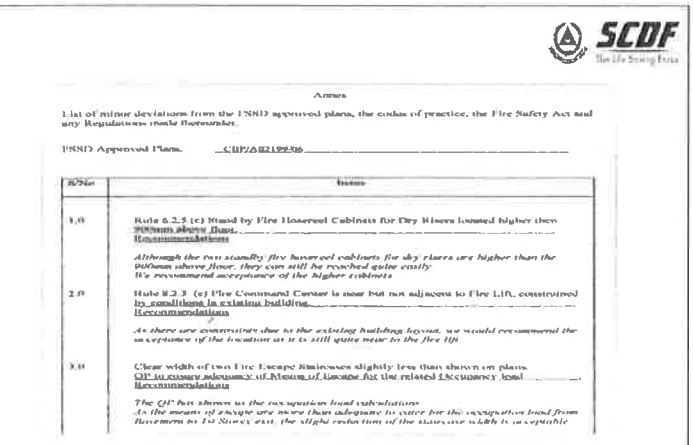
Expired validity period & no date



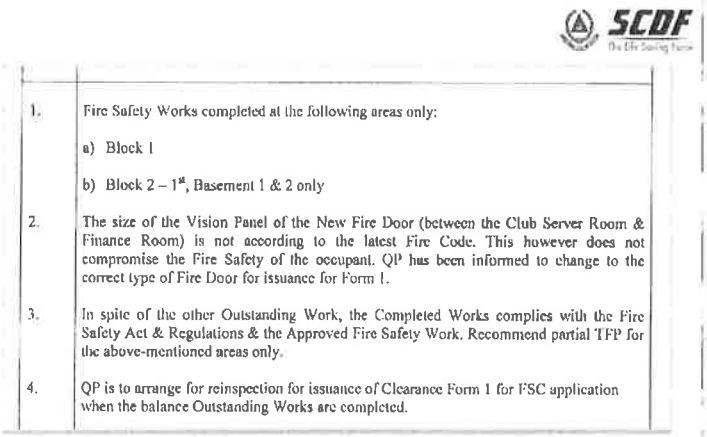
RI Appointment form no need to include related plan numbers for RI(Arch)



RI form 2 no recommendations made by RI - NOT ACCEPTABLE



RI form 2 with RI recommendations

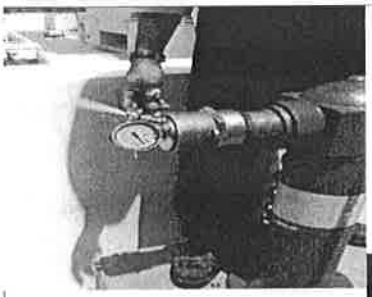


RI form 2 with RI recommendations

RI Inspection Certificate Form 2

- RI indicates the minor outstanding matters that have yet to be completed or that part of the project that is ready for occupation on Annex
- Issued when the project or part of it has generally complied with fire safety requirements & is safe for occupation
- Recommends that FSSD can issue a Temporary Fire Permit for a limited period





Duties of RI



Duties of RI

- Inspect & test fire safety works
- Request for & check all relevant documents needed to ascertain fire safety of project
- Certify only when there is generally full compliance of fire safety standards
- Keep proper records
- Submit to owner Certificate of Inspection
- Notify CED of any non-compliance if QP or owner refuses to make good defects



Project Qualified Person

QP to provide RIs with

- All approved plans & documents needed for inspection of project for issuance of the TFP/FSC
- Schedule of date/time of inspection of fire safety works



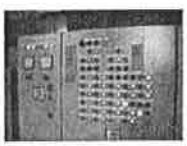
List of Fire Safety Works to be inspected by RI

First schedule

- Part I- Architectural
- Part II- M & E









Part I of First Schedule (Arch)

Means of Escape



- Determination of exit requirements
- Means of escape requirements
- Exit signs and directional signs
- Provision of exit lightings, emergency lightings (self-contained light fittings only), & low level photo luminescent signs



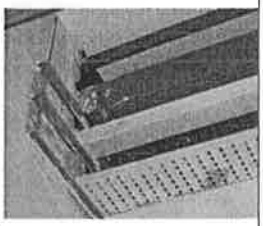


Part I of First Schedule (Arch)

SCDF

Structural Fire Precautions

- Compartment walls and floors
- Elements of structure
- External walls
- Separating walls
- Protected shafts and lift shafts
- Protection of openings
- Exit staircases
- Concealed spaces
- Fire stopping
- Restriction of flame spread
- Roofs
- Materials for construction





Part I of First Schedule (Arch)

SCDF

Site planning and external fire fighting provisions

- Provision for external access to building for fire fighting and accessibility of site to fire fighting appliances
- Access to buildings with rising mains
- Hydrants









Part I of First Schedule (Arch)

SCDF

Fire Fighting Systems (Provisions Only)

- Automatic and manual fire alarm systems
- Dry and wet rising main systems
- Emergency power supply
- Fire lifts
- Fixed automatic fire extinguishing systems
- Hosereels (include testing for direct Public Utilities Board supply)
- Mechanical ventilation
- Natural ventilation openings
- Sprinkler installations
- Smoke control systems





Part I of First Schedule (Arch)

SCDF

Other Provisions

- Emergency voice communication systems
- Fire Command Centre
- Portable Fire Extinguishers
- PWD











Part I of First Schedule (Arch)

SCDF

- Pressurized or non-pressurised storage cylinders, tanks &cylinders with manifold system (testing not required)
- Any other requirement specified by the Fire Code
- Any other requirement specified by other accepted Codes of Practice that have been adopted for the project
- Any other endorsements made on the approved building plans



Part II of First Schedule (M & E)

SCDF

Means of Escape – Exit lightings, emergency lightings and low level photo luminescent signs





Site planning & external fire fighting provision - Private hydrants (testing only)

Part II of First Schedule (M & E)

SCDF

Fire Fighting Systems (Verification & Testing)



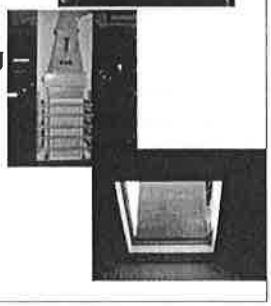
- Automatic & manual fire alarm systems
- Dry & wet rising main systems
- Emergency power supply
- Emergency voice communication systems
- Fire lifts
- Fixed automatic fire extinguishing systems
- Hosereels (pump feed)
- Integrated fire fighting & protection systems testing under both fire alarm activation and power failure condition
- Sprinkler installations

Part II of First Schedule (M & E)

SCDF

Mechanical ventilation & smoke control systems





- Mechanical ventilation/air-conditioning systems, including dampers & fire resisting construction of ductworks
- Pressurisation systems
- Smoke control systems (both mechanical &venting systems)

Part II of First Schedule(M& E)

SCDF

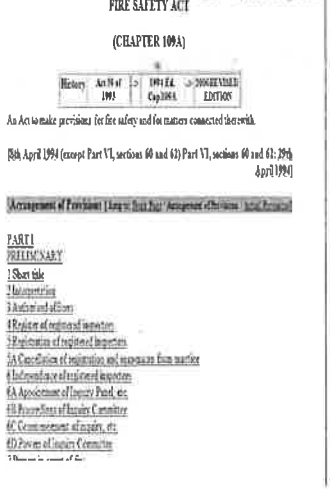


- Other Provisions:
  - Emergency voice communication systems (testing only)
  - PWD (testing only)
- Pressurized or non-pressurised storage cylinders, tanks & cylinders with manifold systems (testing only)
- Any other requirement specified by the Fire Code
- Any other requirement specified by other accepted Codes of Practice that have been adopted for the project
- Any other endorsements made on approved building plans

Fire Safety Act & Regulations

SCDF





FIRE SAFETY ACT

(CHAPTER 109A)

An Act to make provision for fire safety and for matters connected therewith.

PART I
PRELIMINARY
1 Short title
2 Interpretation
3 Application and effect
4 Register of registered inspectors
5 Registration of registered inspectors
5A Cancellation of registration and suspension from practice
6 Independence of registered inspectors
6A Appointment of Inquiry Panel, etc.
6B Proceedings of Inquiry Committee
6C Commencement of inquiry, etc.
6D Powers of Inquiry Committee

FSA & Regulations

SCDF

Conflict of Interest



- Professional Interest
- Financial Interest
- Any other interest which may be in conflict with the RI's performance of inspection duties
- Example
  - Is/ has been responsible for or acting as consultant to design/ construction of project/ fire safety works ..... OR
  - RI or the member/ officer/ employee having a professional/ financial interest

Disciplinary Action

SCDF

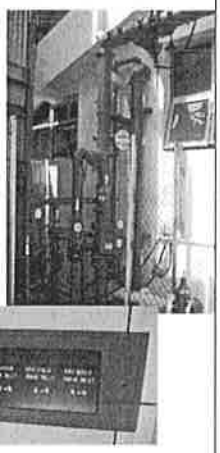
- Can be charged in court for an offence under the FSA
- Can be fined or imprisoned or subject to both
- For poor performance of inspection duties or breach of the code of conduct
- FSA empowers SCDF to impose separate penalties for contravention of the FSA
- RIs & project QP / PEs responsible /answerable to owners



Fire Safety Act

Under Section 6A to 6D

- Powers for Inquiry Committee to investigate complaints brought up against RIs
- Other forms of penalties to be meted out to the RI if found to be at fault



Fire Safety Act

Inquiry Panel

- Made up of 2 external & 2 SCDF members
- A chairman who can either be external/ internal member
- To provide neutrality in investigating complaints and hearing cases against RIs
- Being selected from a panel of members who are invited directly by SCDF
- 2 year term



Inquiry Committee

Concept

- A system of graduated penalties
- Based on severity of the offence
- Based on past records of RI
- Introduced other forms of penalties besides just de-registration



Penalties

- A written reprimand
- A composition fine not exceeding $5,000
- Suspension for a fixed period not exceeding 12 months
- Cancellation of Registration



Fire Safety Act

Code of Conduct

- Section 61 of the FSA prescribe a code of professional conduct & ethics for RI
- RI are to abide by this code of conduct
  - Duties & Responsibilities
  - Publicity of Services
  - Contribution/ Participation in Fire Safety
  - Prohibiting on Touting & Soliciting
  - Prohibition on Supplanting
  - Conflict of Interest



Fire Safety Act

Performance-based plans & Fire Safety Engineers



- An engineering solution for the fire safety works to satisfy the fire performance requirements in the Fire Code
- **Fire Safety Engineer (FSE)**
  - A person who is registered as a fire safety engineer under this Act
  - Prepare or supervise the preparation of plans containing alternative solution, & another FSE as peer reviewer to review & assess those plans
- **Peer Reviewer**
  - A fire safety engineer who is appointed to review & assess whether the alternative solution proposed, satisfies the fire performance requirements

Fire Safety Act



Section 5A(1)(f)

- No RI can practise as a RI if he is suspended or deregistered as a QP
- If he is suspended or deregistered as a FSE, he cannot inspect projects incorporating an alternative solution

Section 5A(4)

- Reinstatement of RI upon expiry of suspension is within 7 days

RI Regulation

- No RI shall inspect any fire safety work which uses any alternative solution unless he is a FSE
- Owners are likely to engage only 1 RI(A) and 1 RI(M & E) as per current practice
- RIs who are not FSEs are not allowed to inspect projects incorporating an alternative solution



RI Regulation



- Duty of RI to find out whether the project incorporates an alternative solution before taking on the job
- QPs to ensure that appropriate RIs are engaged before application of the TFP/ FSC if the plans incorporate an alternative solution
- RIs who are registered as FSEs will be identified as such in FSSD's computerised TFP/FSC processing system



RI Regulation

- RI cannot be Peer Reviewer for project (conflict of professional interest)
- RIs are required to know the fire performance requirements of alternative solution before taking on the job





Continuing Education



- Based on a 2-year cycle
- 3 similar courses conducted within 2-yr cycle
- To attend only 1 course per cycle
- Certificate of Attendance
- One day session



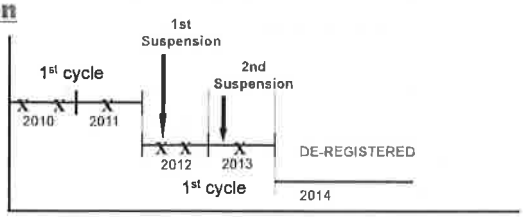
Continuing Education

Implication of not attending the course

- Failure to attend any of the 3 courses within 2-yr cycle
  - Suspension from practice for 1 year
- Powers provided under FSA to suspend or de-register
- Continuing failure to attend courses in 1st year of the 2nd cycle
  - Result in 2nd suspension for another 1 year
  - Names of RI who have been suspended will be automatically blocked in the TFP/ FSC processing system
  - This acts as a Final Warning before de-registration

Continuing Education

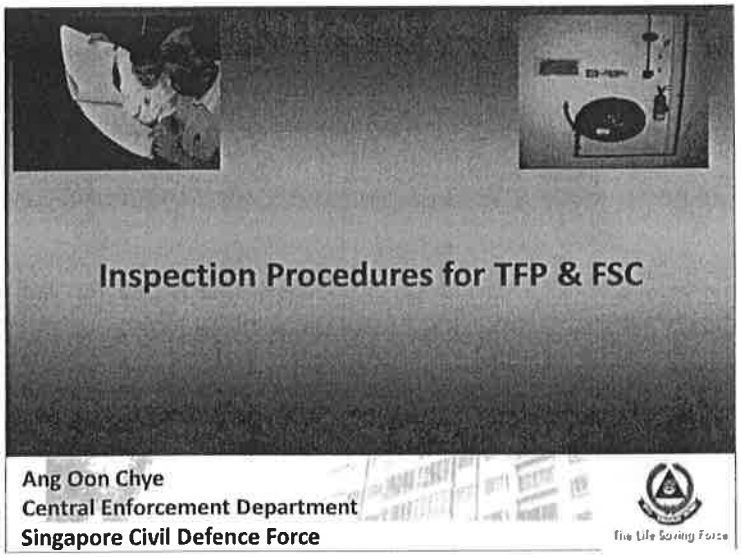
- **Failure to attend 1st cycle – 1st suspension on 3rd yr**
- **Failure to attend 3rd year in 2nd cycle – continue 2nd suspension on 4th yr**
- **Failure to attend 2 cycles (4 yrs period) – De-registration**

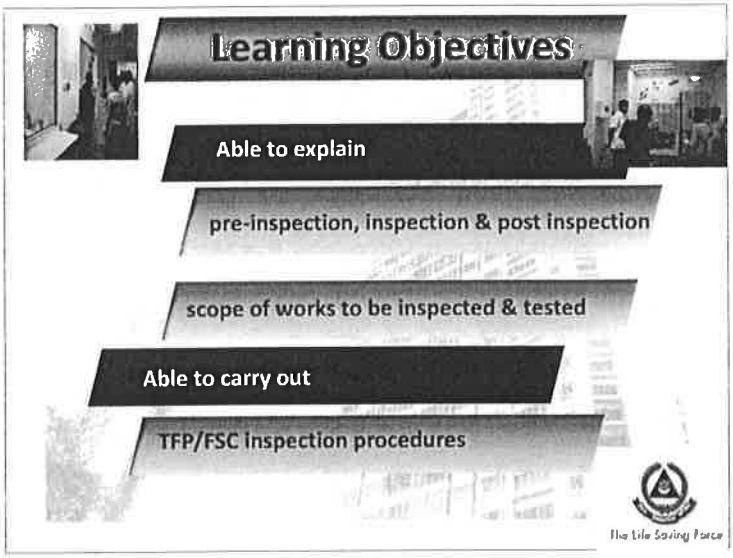


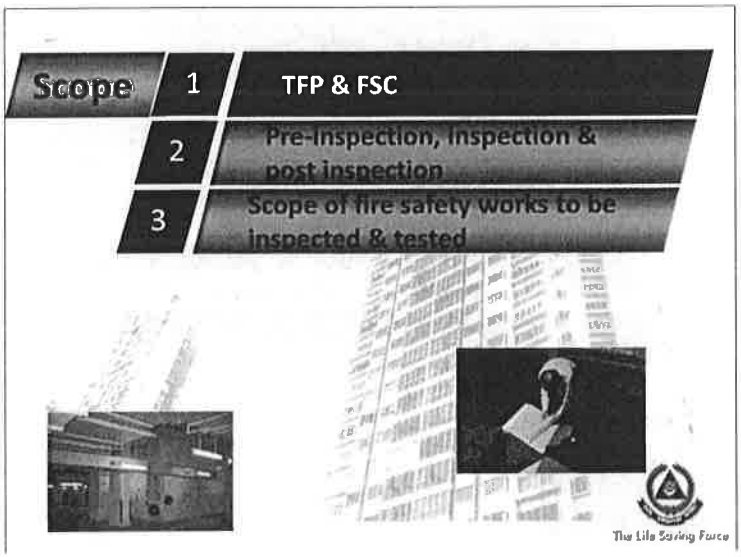
Conclusion

- **Speed up processing of TFP/FSC applications for projects**
- **Makes use of vast pool of expertise in private sector in helping ensure high standards of fire safety in buildings**
- **QPs who are RIs provide better quality work when it comes to fire safety**
- **Fees chargeable is matter to be agreed between owner & RI**



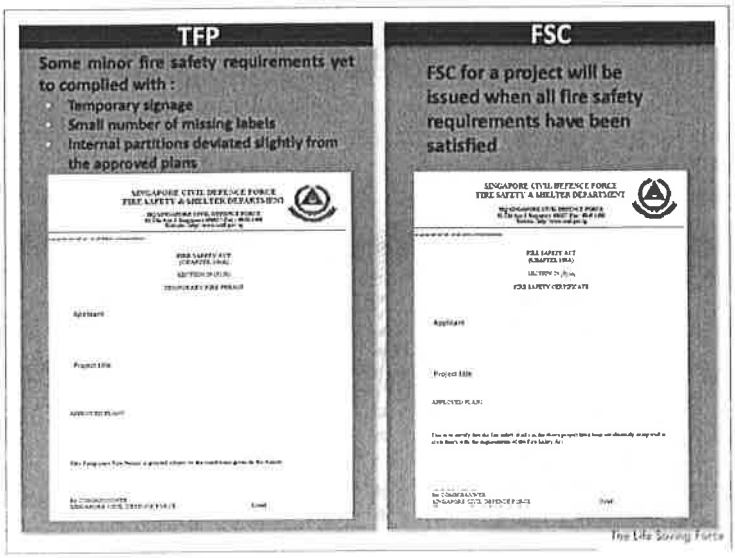

Inspection Procedures for TFP & FSC
Ang Oon Chye
Central Enforcement Department
Singapore Civil Defence Force
The Life Saving Force


Learning Objectives
Able to explain
pre-inspection, inspection & post inspection
scope of works to be inspected & tested
Able to carry out
TFP/FSC inspection procedures
The Life Saving Force


Scope
1 TFP & FSC
2 Pre-inspection, inspection & post inspection
3 Scope of fire safety works to be inspected & tested
The Life Saving Force


Temporary Fire Permit (TFP)
&
Fire Safety Certificate (FSC)
The Life Saving Force


Temporary Fire Permit & Fire Safety Certificate
FSC/ TFP must be obtained for the fire safety works of a project & completed in accordance to the various codes of practices & statutory requirements before the premises is allowed to be occupied
Inspection of fire safety works by Registered Inspectors (RI) on behalf the authorities
SCDF conducts spot checks
The Life Saving Force


TFP
Some minor fire safety requirements yet to complied with :
Temporary signage
Small number of missing labels
Internal partitions deviated slightly from the approved plans
FSC
FSC for a project will be issued when all fire safety requirements have been satisfied
The Life Saving Force

TFP/FSC Application Procedures

Approval of BP, FP & MV plans by SCDF



Inspections by Registered Inspectors

RI to certify when project complies with fire safety standards

QP/owner to apply for TFP /FSC

Processing of applications & spot checks by SCDF



Issuance of TFP/FSC by SCDF

The Life Saving Force

Scope

1. TFP & FSC
2. Pre-inspection, inspection & post inspection
3. Scope of fire safety works to be inspected & tested



The Life Saving Force

Scope of Works

1. Size of project
2. Type of project e.g. residential, commercial, industrial, institutional, etc
3. Complexity of project
4. Types of fire safety systems eg sprinkler, engineering smoke control system, etc





The Life Saving Force

Pre-Inspection

1. Study the approved plans eg. building plan(BP), fire protection(FP) & mechanical ventilation(MV) first & decide on scope of works to inspect & test
2. Any special conditions imposed or consultations or waiver granted
3. Staffing of inspection teams, their duties & deployment



The Life Saving Force

Inspection

1. QP of the project will be informed of the fire safety works that are to be inspected & tested
2. Allow QP to organise his personnel & plan the deployment strategy accordingly to meet the inspection stages
3. Major projects normally have a wide range of fire safety works & they will undergo the full inspection



The Life Saving Force

Inspection



Inspection is carried out in 3 phases

1. Phase 1 – Fire alarm activation
2. Phase 2 – Power failure simulation test
3. Phase 3 – Inspection & testing of individual systems

The Life Saving Force

Post-Inspection

1. List of irregularities consolidated & make known to QP at site
2. QP to clarify on the list of irregularities
3. An official written direction sent to QP for compliance
4. QP required to make rectifications & report compliance





The Life Saving Force

Post-Inspection

1. Depending on severity of cases, another inspection may be needed, before FSC/TFP can be issued
2. To request for plans to be audited if suspected that the approved plans are not in order



The Life Saving Force

Scope

1. TFP & FSC
2. Pre-inspection, inspection & post inspection
3. Scope of fire safety works to be inspected & tested





The Life Saving Force

Scope of fire safety works to be inspected & tested

1. Architectural



2. M&E
   - Building services
   - Fire protection systems
   - MV/AC systems

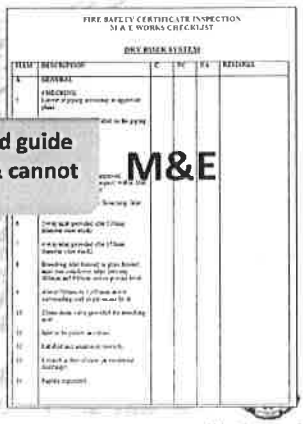




The Life Saving Force

Inspection Checklist



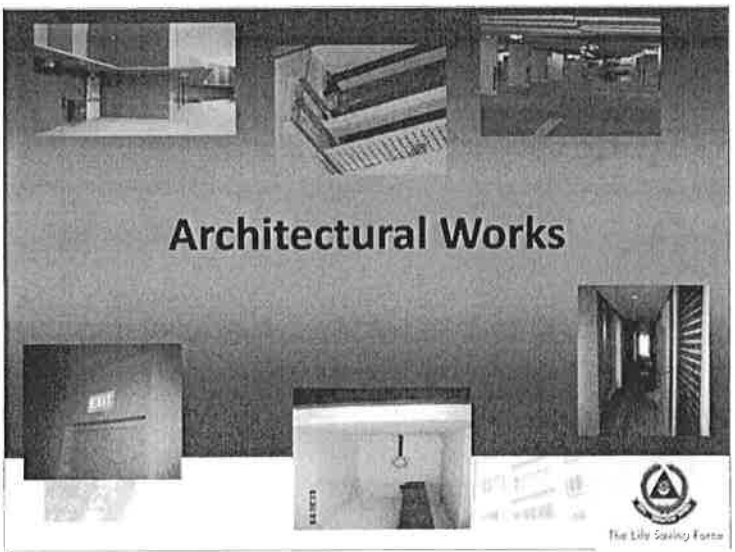


Served as a good guide for inspection & cannot be exhaustive

Arch

M&E

The Life Saving Force



The Life Saving Force

Architectural Works



1. Corridors/lobbies/staircases
2. Escape routes
3. Fire doors
4. Exit doors
5. Duct risers
6. Accessway & fire engine access road
7. Compartmentation
8. Miscellaneous



The Life Saving Force

Corridor/Lobby/Staircase

1. Staircase numbering & storey





2. Service pipes not permitted
3. Escape floor plan





4. Finishes to walls, floors & ceilings are non-combustible
5. Clear of Obstruction



The Life Saving Force

Escape Route



1. Clear of obstruction



2. Exit & directional signs



3. Electro-magnetic device for door

The Life Saving Force

Fire Door/Exit Door

1. Certification body's label





2. Door closer



3. No locking devices



4. Clear of obstruction

The Life Saving Force

Certification Bodies



1. TUV SUD PSB Pte Ltd
2. Exova (Singapore) Pte Ltd
3. Setsco Service Pte Ltd
4. Singapore Test Services



The Life Saving Force

Duct Riser



1. Fire-Stopping



2. No storage

The Life Saving Force

Accessway & Fire Engine Access Road

1. Clear of obstruction





2. Signage display "Fire Engine Access – Keep Clear"

3. Marking of corners



The Life Saving Force

Access Openings

1. Facing accessway





2. Panels to access opening posted with red or orange triangle sign on external

3. Internal side with wordings "Fire Fighting Access – Do not obstruct"



The Life Saving Force

Compartmentation

1. Walls & floors no opening







2. Wall full height



The Life Saving Force

Miscellaneous

1. Unauthorised works/change of use





2. Obstruction to fire protection systems

3. Fire safety signages provided e.g. "FIRE HOSEREEL", "DRY RISER OUTLET", etc



The Life Saving Force

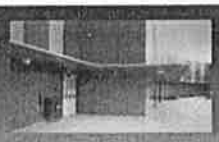
Building Services





The Life Saving Force

Integrated Testing of Fire Safety Systems







The Life Saving Force

Phase 1 - Fire Alarm Activation



Inform fire alarm monitoring company (DECAM)

Ensure all lightings, mechanical ventilation systems & building services to be operating under normal condition



Activate fire alarm

Check
- Check sounding of alarm bells, alarm signal transmission to SAP, MAP & DECAM company
- Homing of lifts
- Opening & stay opened of auto exit sliding door
- Releasing of door held by magnetic device
- Closing of fire shutters and/or lowering of smoke curtains
- Starting of pressurisation fans
- Auto running of smoke extract system including opening of smoke vents, if applicable
- Activation of smoke purging system eg. basement carpark, warehouse, etc
- Activation of recording device for emergency voice communication system
- Observe running status of remote fan control panel at FCC or MAP

Phase 2 - Power Failure Simulation Test

Reset fire alarm, lift system, sliding doors, magnetic doors & fire shutters

By-pass alarm signal to lift



Activate all fire pumps (wet riser, ring main, sprinkler systems)

Activate fire alarm

Trip Power Grid power supply & observe running of standby generator & transfer to emergency power supply

Check
- Homing of lifts, fire's lift shall home first
- Opening & stay opening of auto exit sliding doors
- Releasing of door held by magnetic device
- Closing of fire shutters
- Emergency light powered by generator
- Continued running of fire related fans & fire pumps
- Generator shall not trip during the above tests

Phase 3 – Check & Testing of Individual System



Restore normal power

Reset all systems

By-pass lifts



Check
- Main alarm panel (MAP) & sub alarm panel (SAP)
- Fire extinguishers
- Exit & directional signs



Test
- Detectors
- Manual call points
- Fire hosereel
- Smoke cut-off switch in AHU
- Fire pump
- Sprinkler control valves
- Pressurisation staircase
- Private fire hydrant

The Life Saving Force

Testing Equipment



Anemometer for measuring air velocity in pressurisation staircase



Hydrant testing kit for measuring water flowrate & pressure

Digital force gauge for measuring pull force for door in pressurisation staircase



The Life Saving Force

Testing Equipment



Lux meter for measuring illumination level



Sound meter kit for measuring sound level for alarm

Distance meter for measuring width of accessway, corridors, exits



The Life Saving Force

Building Services

1 Lifts



2 Emergency exit sign & lighting



3 Emergency Voice Communication Systems



The Life Saving Force

Lifts

1. Enclosed shaft protected with smoke detector at the top



2. Lift labelling & storey numbering at lift lobbies





3. Warning notice "In Case of Fire Do Not Use Lifts" displayed at every lift lobby

4. Lift door shall be of fire-rated type with certification body's label



The Life Saving Force

Lifts

1. Passenger & Fire Lifts homing under alarm & power failure modes & lift car door remained open & lift rendered inoperative. Fire lift to home first



2. EBOPS provided with certification body's label & functional upon power failure



The Life Saving Force

Fire Lift

Under fire switch

- Fire switch enclosed in glass fronted cover & label



- Travel from ground to top level within one minute
- Lift not respond to external landing call



- Shall be able to change & select other floor even after a floor is selected
- When desire floor is reached, door remained close until door open button is pressed & continuously pressed till door fully opened. Otherwise, the door will re-closed when button released

The Life Saving Force

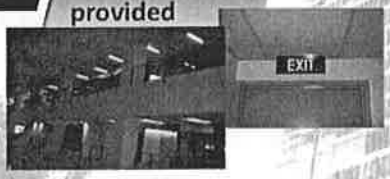
Emergency Lighting/Exit Sign



2. Illumination level sufficient



1. Adequately provided



The Life Saving Force

Emergency Voice Communication System

One-Way EVC System

Message broadcast is correct & audible





Zoning tally with the selection button



Secondary power supply provided

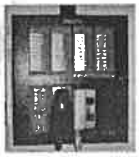
The Life Saving Force

Emergency Voice Communication System

Two-Way EVC System

1. Testing of fireman's intercom on private-line & party-line



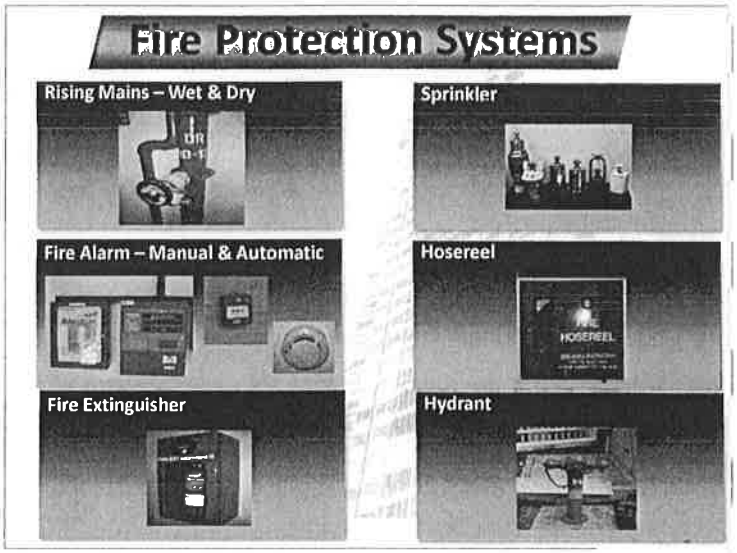


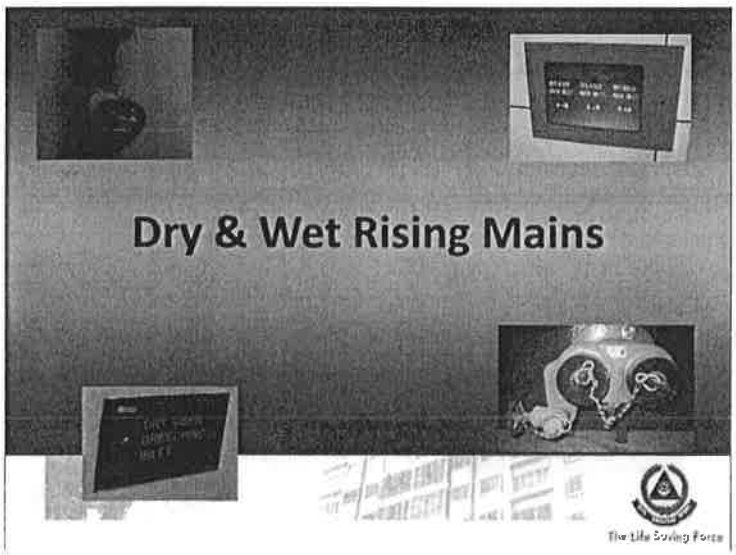
2. Intercommunication provided between FCC & various strategic locations such as fire lifts lobbies, fire pump rooms, AHU rooms, lifts motor rooms, etc

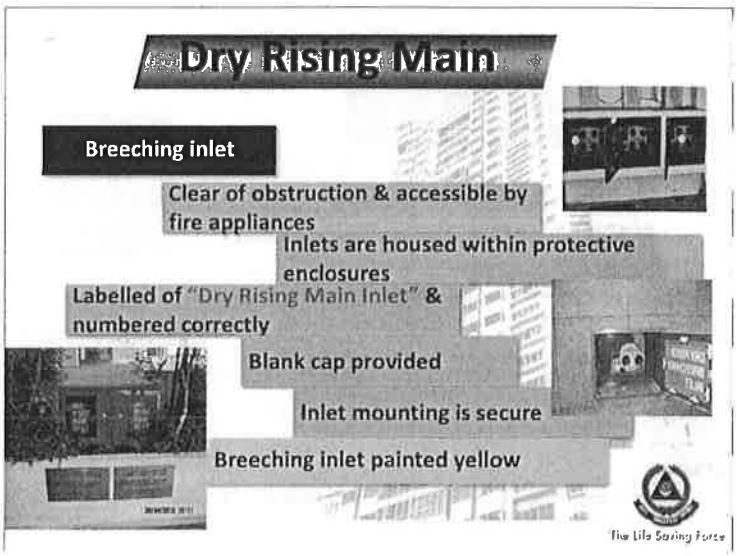


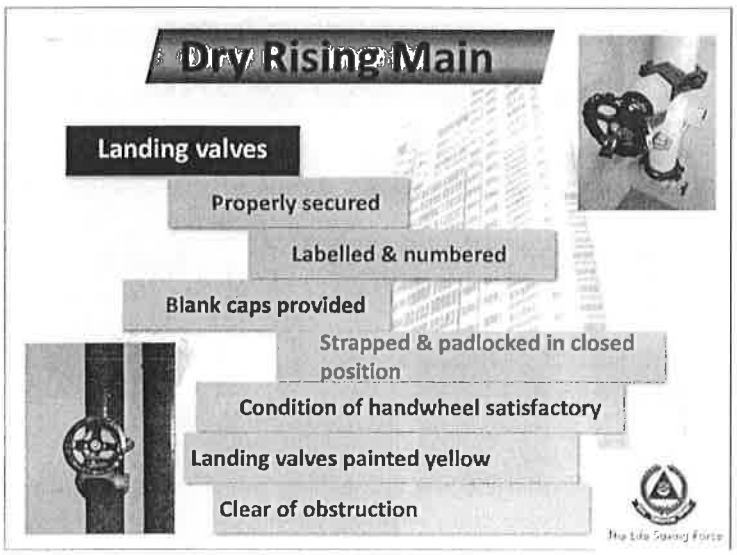
The Life Saving Force

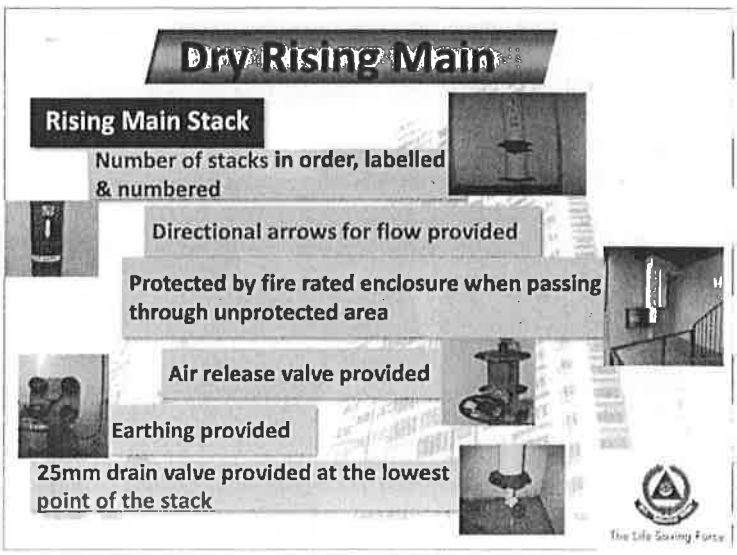

Fire Protection Systems
The Life Saving Force


Fire Protection Systems
Rising Mains – Wet & Dry
Sprinkler
Fire Alarm – Manual & Automatic
Hosereel
Fire Extinguisher
Hydrant


Dry & Wet Rising Mains
The Life Saving Force


Dry Rising Main
Breeching inlet
Clear of obstruction & accessible by fire appliances
Inlets are housed within protective enclosures
Labelled of "Dry Rising Main Inlet" & numbered correctly
Blank cap provided
Inlet mounting is secure
Breeching inlet painted yellow
The Life Saving Force


Dry Rising Main
Landing valves
Properly secured
Labelled & numbered
Blank caps provided
Strapped & padlocked in closed position
Condition of handwheel satisfactory
Landing valves painted yellow
Clear of obstruction
The Life Saving Force


Dry Rising Main
Rising Main Stack
Number of stacks in order, labelled & numbered
Directional arrows for flow provided
Protected by fire rated enclosure when passing through unprotected area
Air release valve provided
Earthing provided
25mm drain valve provided at the lowest point of the stack
The Life Saving Force

Dry Rising Main

Air release valve functioning







Hydrostatic pressure test

13.8 bars (200psi) for 2 hrs

The Life Saving Force

Wet Rising Main



Breeching inlet

Clear of obstruction & accessible by fire appliances

Inlets are housed within protective enclosures

Labelled of "Wet Rising Main Inlet" & numbered correctly



Inlet mounting is secure

Blank cap provided

Breeching inlet painted red

The Life Saving Force

Wet Rising Main

Landing valves



Properly secured

Labelled & numbered

Blank caps provided

Pressure reducing valve attached to landing valve



Strapped & padlocked in closed position

Condition of handwheel satisfactory

Landing valves painted red

The Life Saving Force

Wet Rising Main

Rising Main Stack

Number of stacks in order, labelled & numbered

Directional arrows for flow provided

Protected by fire rated enclosure when passing through unprotected area



Air release valve provided

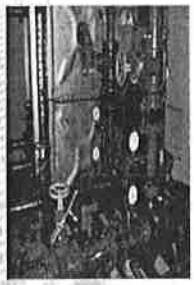
Earthing provided

25mm drain valve provided at the lowest point of the stack

The Life Saving Force

Wet Rising Main

Wet Rising Main Storage Tank



Water level gauge provided for tank

Access panel & ladder provided

Effective capacity indicated

The Life Saving Force

Wet Rising Main

Wet Rising Main Pumps

All valves to pumps kept strapped & padlocked in appropriate positions

Labelling & numbering of pumps

Pressure gauge & pressure switch provided

Discharge for the test drain pipe provided

Pumps painted in red



Permanent pressure setting chart provided & securely mounted

Ventilation fan & emergency lighting provided for pump room & connected to emergency power supply

The Life Saving Force

Wet Rising Main

Wet Rising Main Pumps



Cut-in pressure of duty & standby pumps tested in order

Cut-out pressure jockey pump tested in order

Auto change over from PUB to emergency power supply in order

Auto change over from duty to standby pump operation in order

The Life Saving Force

Wet Rising Main

Wet Rising Main Pump Control Panel

Pumps numbering tallied with actual operation

Panel to be painted red



Pumps are differentiated

The Life Saving Force

Wet Rising Main

Pressure & flow rate test



Static pressure less than 8 bars

Running pressure 3.5 to 5.5 bars

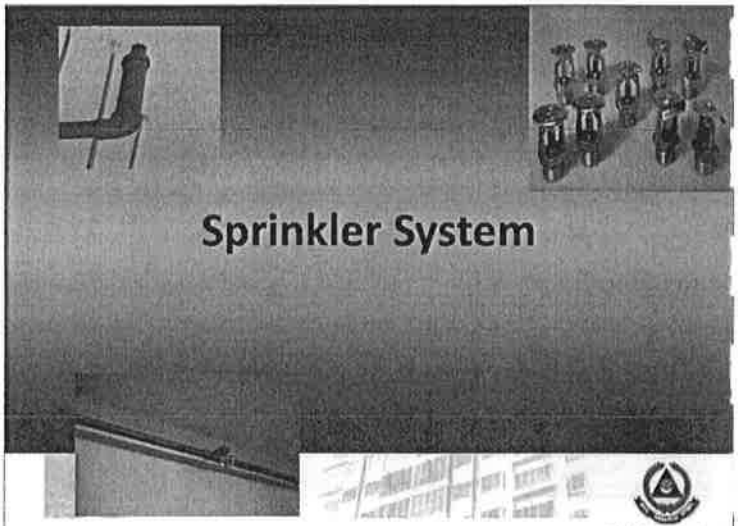


For 1 stack, 1 or 2 landing valves, normally the topmost ones will be opened



Flow rate
- 27 l/s (residential)
- 38 l/s (non-residential)

The Life Saving Force



The Life Saving Force

Sprinkler System

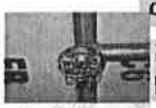


Layout according to approved plans

Sufficient coverage



Sprinkler head not obstructed or painted over



Protective metal guard provided for low level sprinkler head





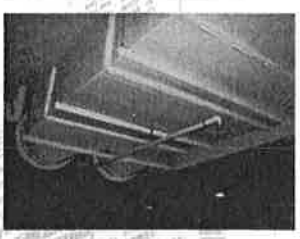
Directional arrows provided

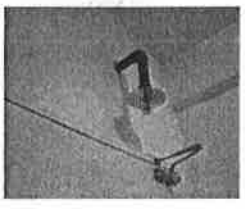
Flow switch provided

The Life Saving Force

Sprinkler System

Under-duct sprinkler provided for MV ducting with width more than 800mm





Cut off sprinkler head provided above door to staircase

The Life Saving Force

Sprinkler System

Breeching inlet

- Clear of obstruction & accessible by fire appliances
- Inlets are housed within protective enclosures
- Labelled of "Sprinkler Breeching Inlet".
- Blank caps provided
- Inlet mounting is secure
- Breeching inlet painted red





The Life Saving Force

Sprinkler System

Sprinkler Control Valves



- Labelled to indicate storey served
- Clear of obstruction



- Strapped & padlocked in open position
- Location plate of 'Sprinkler Control Valve Inside' provided on access door(if enclosed)



- Water proving flowmeter provided

The Life Saving Force

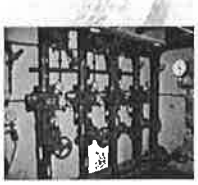
Sprinkler System

Sprinkler Tank

- Water level gauge provided



- Access panel & ladder provided



- Effective capacity indicated

The Life Saving Force

Sprinkler System

Sprinkler Pump

- All valves to pumps kept strapped & padlocked in appropriate positions
- Pumps painted in red
- Discharge for the test drain pipe provided
- Labelling & numbering of pumps





- Pressure gauge provided
- Permanent pressure setting chart provided & securely mounted

The Life Saving Force

Sprinkler System

Sprinkler Pump

- Cut-in pressure of duty & standby pumps



- Cut-out pressure jockey pump
- Auto change over from PUB to emergency power supply



- Auto change over from duty to standby pump operation

The Life Saving Force

Sprinkler System

Sprinkler Pump Control Panel

- Pumps numbering tally with actual operation
- Panel painted red



- Pumps are differentiated

The Life Saving Force

Sprinkler System

Water Proving Test



Flow rate & running pressure satisfactory

Readings of running pressure at the design flow rates would be taken & these should not be less than the design pressures



Designed flow rate, hazard group, area served tested & design pressured shown permanent water proving chart displayed next to control valve/s

The Life Saving Force

Sprinkler System



Flow switch test



Signal received at MAP

Gong activated

General sounding

The Life Saving Force

Sprinkler System

Sprinkler Bursting Test



2 or more sprinkler heads at most remote or next most convenient point is burst

Sprinkler head is operational

Water spray pattern acceptable & overlapping of sprinkler discharge

Sprinkler water gong & general sounding of alarm system activated



Alarm signal correctly received at MAP/SAP

The Life Saving Force

Manual Fire Alarm



The Life Saving Force

Manual Fire Alarm

1 Call point is not obstructed





2 Call-point provided with tampered glass

The Life Saving Force

Manual Fire Alarm



Test on call-point



1 Alarm bells in operational condition

2 General sounding throughout the building

3 Call-point tested correctly indicated on MAP/SAP

4 Audible alarm and alarm indication lights indicated at MAP/SAP during testing

The Life Saving Force

Manual Fire Alarm

Fault Test

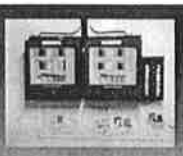
1. Call-point tested correctly registered on MAP/SAP
2. Audible fault alarm & fault indication light on MAP/SAP





The Life Saving Force





Automatic Fire Alarm System





The Life Saving Force

Automatic Fire Alarm System

Heat/Smoke Detector



1. Layout according to approved plans & Sufficient coverage
2. Detector points are not obstructed & not painted over
3. Zoning diagrams provided & securely mounted on wall adjacent to MAP/SAP





The Life Saving Force

Automatic Fire Alarm System

Test on detector point



1. Fire zone tested correctly indicated on MAP/SAP
2. Signal received by fire alarm monitoring company
3. General sounding throughout the building
4. Audible alarm and alarm indication lights for smoke/heat detector indicated at MAP/SAP during testing

The Life Saving Force

Automatic Fire Alarm System

Fault Test



1. Detector tested correctly registered on MAP/SAP
2. Audible fault alarm and fault indication lights for smoke/heat detector indicated at MAP/SAP during testing



The Life Saving Force



Fire Hosereel



The Life Saving Force

Fire Hosereel



General

1. Nozzle
2. Inlet valve
3. Clear of obstruction
4. Labelling provided for cabinet
5. Length of hose - 30m

The Life Saving Force

Fire Hosereel



Test on hosereel

1. 6m horizontal throw
2. No leakage

Test on hosereel booster pump

1. Auto cut-in/cut-off of pumps
2. Auto changeover from duty to standby pump





The Life Saving Force





Portable Fire Extinguisher



The Life Saving Force

Portable Fire Extinguisher



1. Properly hung on bracket
2. Date of service
3. Clear of obstruction
4. Certification body's label
5. No corrosion



The Life Saving Force





Fire Hydrant



The Life Saving Force

Fire Hydrant



1. Clear of obstruction
2. Cover for spindle chamber visible
3. Blank caps provided to outlets
4. Test for sufficient water supply
5. 100mm thick yellow band around private fire hydrant
6. Hydrant numbering eg. 1-2, 2-2





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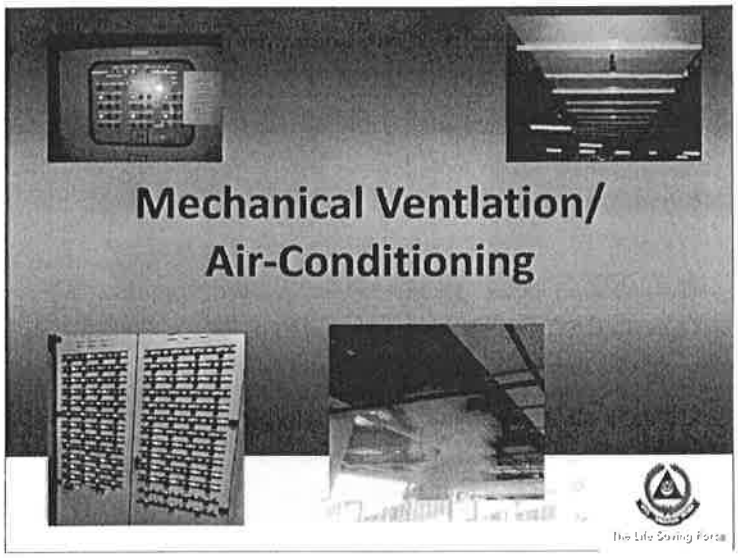


Fire Dampers

1. Duct passes through compartment wall or floor installed with fire dampers
2. Certification body's label & approved fire rating are provided
3. Access panel provided for fire damper
4. Fire damper properly mounted



The Life Saving Force

Basement Smoke Extract System

1. Automatically operated upon fire alarm activation, signal lamp to indicate true status
2. Linked to secondary power supply
3. Failure of exhaust will cut off the corresponding supply fan (interlocking)
4. Fan can only be reset after MAP reset. After reset, fan back to normal mode



The Life Saving Force

Atrium Smoke Control System

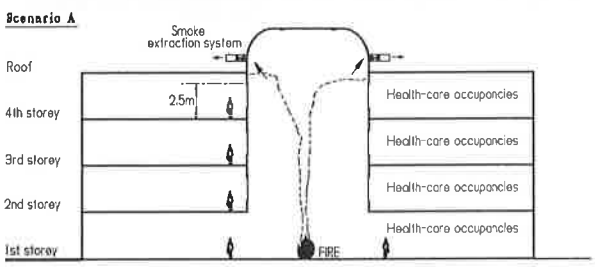
1. Activation under fire alarm by detector
2. System functions under secondary power supply
3. Supply mode is automatically activated by the fire alarm under secondary power supply (where applicable)
4. System should continue operating until the exhaust fans are individually & manually reset
5. Smoke curtain activated



The Life Saving Force

Atrium Smoke Control System

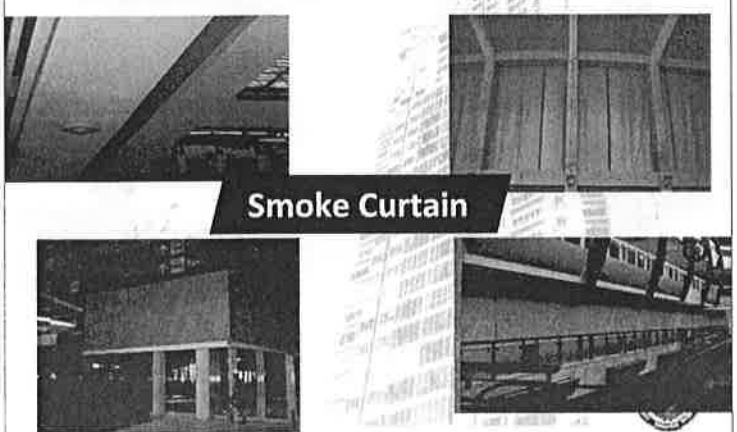
Scenario A





The Life Saving Force

Atrium Smoke Control System



Smoke Curtain

The Life Saving Force

Atrium Smoke Control System



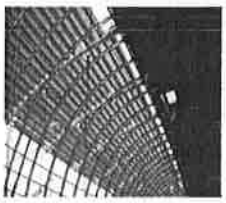
Sliding doors open

Fire shutter activated



The Life Saving Force

Atrium Smoke Control System





Smoke Vents activated



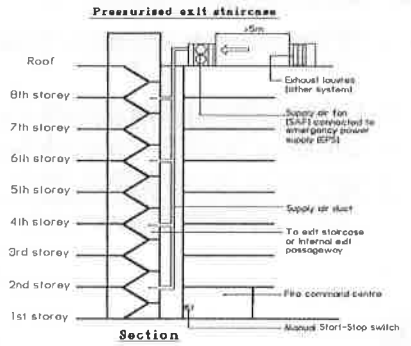
The Life Saving Force

Atrium Smoke Control System



The Life Saving Force

Pressurisation Exit Staircase System



The Life Saving Force

Pressurisation Exit Staircase System

1. Fans operate at high speed



2. Operating under both normal & secondary power supply



3. Airflow velocity exceeding 1 m/s



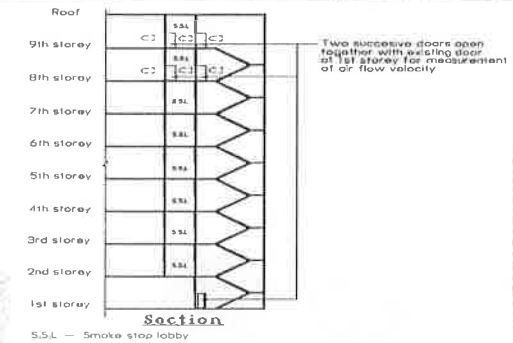
4. Pull force for door not exceeding 110N



5. Pressure differential greater than 50Pa
6. Manually reset

The Life Saving Force

Pressurisation Exit Staircase System



The Life Saving Force

Air-Conditioning System

1. Smoke detector provided within return air stream of AHU
2. Upon activation of smoke cut-off switch will shut down the AHU
3. Manual reset control panel for AHU



The Life Saving Force

Thank you for your attention



The Life Saving Force

Means of Escape



We Set the Standards

Introduction

- How do we escape?
- Corridor/passageway/staircase
- Distance to travel
- Explain the requirements of means of escape

We Set the Standards

Objectives

- To know
  - types of travel distances
  - the calculation of OL Vs EC
  - types of exit facilities

We Set the Standards

DETERMINATION OF EXIT REQUIREMENTS

Factors affecting the exit requirements are as follows:

- Types of occupancy (purpose group)
- Floor area
- Occupant Load (OL)
- Capacity of an exit (EC)
- Travel distance to an exit

We Set the Standards

Purpose groups

- PG I Small Residential (eg. bungalow, semi-d, terrace)
- PG II Other Residential (residential other than PG I)
- PG III Institution
- PG IV Office
- PG V Shop
- PG VI Factory
- PG VII Places of public resort
- PG VIII Storage

We Set the Standards

OL Vs EC

- Occupant load is referring to the pre-determined max. no of people expected to be accommodated by a room/space in a building.
- Exit capacity is referring to the pre-determined max. no of people that are allowed to use the exit staircases or exit doors.

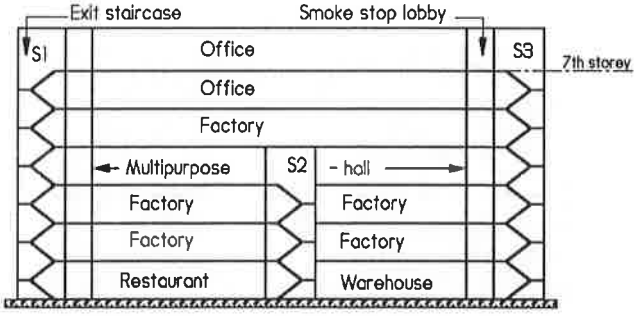
We Set the Standards

What is multiple occupancy?

•It is where different types of occupancy (eg office, shops, places of public resorts etc), are co-located in a premises (i.e. floor/building)

Mixed Occupancy in a Building

Clause 2.2.2



Travel Distance

- What is one way travel & two way travel?
- What is Dead end?
- Differences if building is with sprinkler protection?
- How to measure travel distance?
- Maximum exit stair width
- Remoteness of exit door/stair

What is travel distance?

It is an actual distance that is required to travel from the most remote point in any room or space to the edge of a door opening directly to:

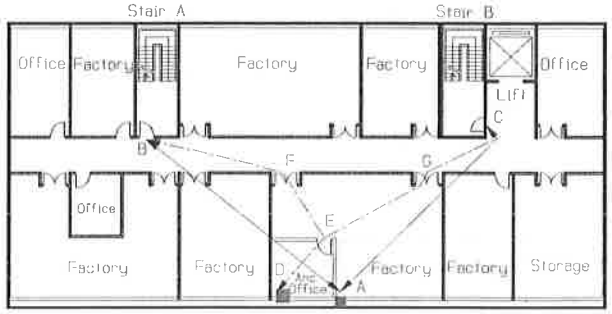
A. an exit staircase or
B. an exit passageway or
C. an open exterior space.

One Way Travel

- It is a "common path" in a floor space that is arranged such that occupants within that space are able to travel in only one direction to reach any of the exits or to reach the splitting point where they have the choice of two or more routes of travel to remote exits.

Travel Distance

Example of a mixed development with factory, office and storage



AB and AC are Direct Distance measurements annotated by ◄---►
DEFB and DEGC are Travel Distance measurement paths annotated by ◄---►

What is non-simultaneous occupancy?

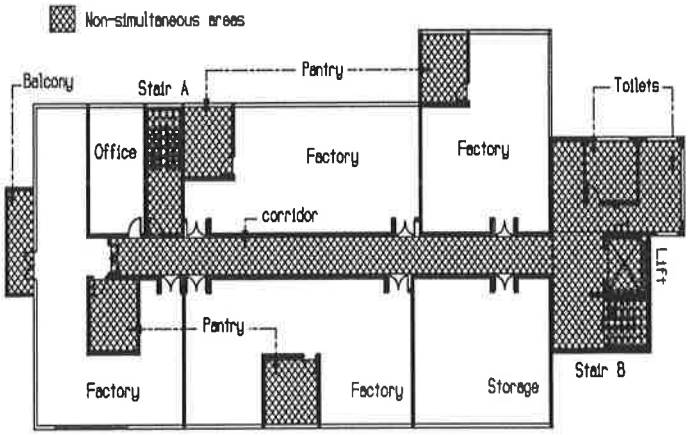
- It is an area which serves other rooms and spaces on the same storey but are not occupied at the same time. These areas are not included in OL calculations.

- Examples are toilets, locker rooms, storage rooms, staff canteens, lobbies, corridors and similar rooms and spaces.

We Set the Standards

Non-simultaneous occupancy

Clause 2.2.4



Calculation

Given

- 4 factories of gross area 120m² each. Each factory has a pantry of size 20m²
- Office has an area of 50m²
- Storeroom has an area of 120m²
- (OL density of factory is 10m²/pax, storeroom is 30m²/pax)

- Staircase A and Staircase B are identical in size. Staircase width is 1500mm and door is 1000mm wide.

Calculate OL and EC for this floor.

We Set the Standards

Calculation

Given

- OL of 4 factories = [(120-20) / 10m²] x 4 = 40 persons
- OL of office = 50/ 10m2 = 5 persons
- OL of storeroom = 120 / 30m2 = 4 persons
- Overall OL = 40 + 5 + 4 = 49 persons

- EC of staircase width = 1500/500 x 60 = 180 persons
- EC of door = 1000/500 x 80 = 160 persons
- Overall EC of 2 staircase = 160 x 2 = 320 persons

We Set the Standards

OL And EC

Criteria

- EC > OL (determine the number of exit staircase, width of the exit door and staircase)
- Travel Distance (determine the required number and location of the exit staircase)

We Set the Standards

Occupancy Load (OL) Calculation

Effective floor area = Floor Area – non-simultaneous usage

OL= Effective Floor Area / OL Density

eg. **Office**
OL = 900(m²) / 10(m²/person)= 90 persons

eg. Meeting **room**
OL = 900(m²) / 1.5(m²/person)= 600 persons

We Set the Standards

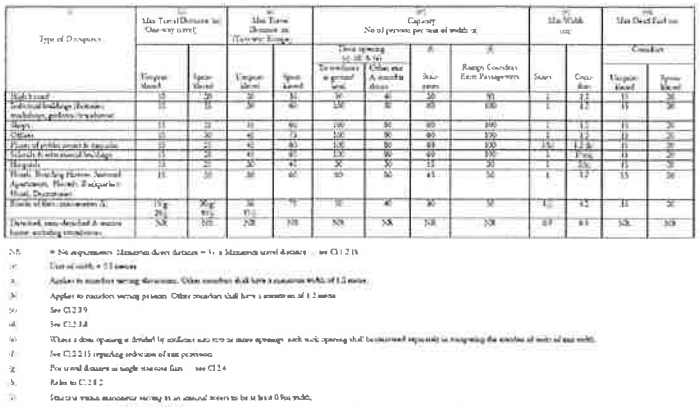
BUILDING TYPES ~~Schedule 1~~	OFFICES, BANKS, PUBLISHERS, STOCK BROKERS	
FUNCTIONAL SPACES	REMARKS	OCCUPANCY LOAD (m²/person)
Reception Area		3.0
Lobby/Corridors	non-simultaneous	—
Waiting Area/Visitors Lounge		3.0
Admin Office		10.0
Business Centre		10.0
Meeting/Seminar Room		1.5
Archive/Library	Stack Area	10.0
	Reading Area	5.0
Filing Room/Store		10.0
Computer Room		5.0
Design Studio		5.0
Drafting Office		5.0
Trading Floor		2.0
Trading Gallery		1.5
Banking Hall		3.0
Deposit/Strong Room		30.0
Machine/Printing Room*(2)		10.0
Restaurant		1.5
Canteen		1.5
Staff Canteen		1.5
Shop		5.0
Toilets	non-simultaneous	—

Where to find this?
Fire Code, Chap 1

Fig A

Available from Fire Code, Chap2 Table 2.2

TABLE 2.2A DETERMINATION OF EXIT REQUIREMENT

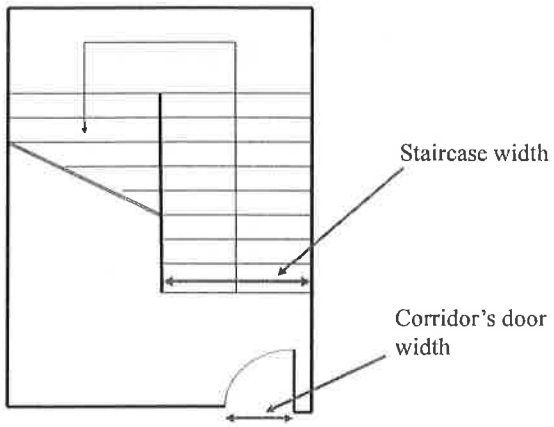


Refer to your course notes if letter is too small

TABLE 2.2A DETERMINATION OF EXIT REQUIREMENT

(i) Type of Occupancy	(v) Capacity No of persons per unit of width (x)			
	Door opening (c), (d) & (e)		(f)	(g)
	To outdoors at ground level	Other exit & corridor doors	Stair-cases	Ramps Corridors Exits Passageways
High hazard	50	40	30	50
Industrial buildings (factories, workshops, godown/warehouse)	100	80	60	100
Dormitories, hostels	50	40	30	50
Shops	100	80	60	100
Offices	100	80	60	100
Places of public resort & carparks	100	80	60	100
Schools & educational buildings	100	80	60	100
Hospitals	30	30	15	30
Hotels, boarding houses (k)	50	40	30	50
Blocks of flats/maisonettes (k)	50	40	30	50
Detached, semi-detached & terrace house, including townhouses	NR	NR	NR	NR

We Set the Standards



We Set the Standards

Exit Capacity (EC) Calculation

- Determined by the width of door/corridor **and** exit staircase.
- 1 unit of (x) = 500mm
- 0.5 unit of (x) = 250mm

Determine EC of Exit door

- EC = Actual door width / (x)

= 850mm/500mm = 1.7 units of x ≈ 1.5 units of (x) (always round down)

EC = 1.5 units of (x) x 80

= 120 persons

We Set the Standards

Exit Capacity (EC) Calculation

Determine EC of Staircase width

- EC of staircase = Staircase width/(x) =1250mm/500mm = 2.5 units of (x)

EC = 2.5 units of (x) x 60 = 150 persons

Take the smaller EC (limiting factor)

EC of door = 120 persons

EC of staircase width = 150 persons

Therefore overall EC of this staircase is 120 persons.

We Set the Standards

Table 2.2A: Determination of travel distance and exit capacity

Clause 2.2.6

TABLE 2.2A DETERMINATION OF EXIT REQUIREMENT

(i) Type of Occupancy	(ii) Max Travel Distance (m) (One-way Escape)		(iii) Max Travel Distance (m) (Two-way Escape)		(iv) Capacity No of persons per unit of width (t) Door openings (c) To outdoors at ground level	(e) Other exit & corridor doors	(f) Stair-cases	(d) Ramps Corridors Exits Passageways	(v) Min Widths (m) Stairs	Corri-dors	(vi) Max Dead End (m) Corridors
	Unsprin-klered	Sprin-klered	Unsprin-klered	Sprin-klered							
High hazard	10	20	20	35	50	40	30	50	1	1	13
Industrial buildings (factories, workshops, godowns/warehouse)	15	25	30	60	100	80	60	100	1	1	13
Dormitories, hostels	15	30	30	60	50	40	30	50	1	1	13
Shops	15	25	45	60	100	80	60	100	1	1	13
Offices	15	30	45	75	100	80	60	100	1	1	13
Places of public resort & carparks	15	25	45	60	100	80	60	160	1(h)	1(h)	13
Schools & educational buildings	15	25	45	60	100	80	60	100	1	1½(a)	13
Hospitals	15	25	30	45	30	30	15	30	1	2(h)	13
Hotels, boarding houses (k)	15	20	30	45	50	40	30	50	1	1	13
Blocks of flats/maisonettes (k)	(15(g)	30(g)	30	60	50	40	30	50	1	1(i)	13
	(20(j)	40(g)	45(j)								
Detached, semi-detached & terrace houses, including townhouses	NR	NR	NR	NR	NR	NR	NR	NR	0.9	1	NR

PROPOSAL: PROPOSED CHANGE OF USE (FROM EXT'G OFFICE TO COMMERCIAL SCHOOL) AND INTERNAL PARTITION TO EXT'G UNITS #03-05A/06/07/08/09/10/11 STARHUB CENTRE AT NO. 51 CUPPAGE ROAD SINGAPORE 229469

OCCUPANT LOAD CALCULATION FOR 3RD

Item No.	Usages	Floor Area (m^2)	Area of occupied floor space per person (m^2)	No of persons	Remarks
#03-05A/06/07/ 08/09/10/11	CLASSROOM 1	162.42	1.5	109	
	CLASSROOM 2	113.46	1.5	76	
	CLASSROOM 3	113.46	1.5	76	
	CLASSROOM 4	113.46	1.5	76	
	CLASSROOM 5	113.46	1.5	76	TOTAL OCCUPANT LOAD FOR COMMERCIAL SCHOOL OF THESE UNITS = 812 PERSONS
	CLASSROOM 6	91.75	1.5	62	
	CLASSROOM 7	47.52	1.5	32	
	CLASSROOM 8	78.94	1.5	53	
	CLASSROOM 9	67.62	1.5	46	
	BREAKOUT AREA	53.39	10	53	
#03-01/02/03/ 04/05	OFFICE	660	10	66	
#03-12	OFFICE	93.84	10	10	
			Total:	666	

CIVIL [redacted] 2270 SINGAPORE

Qualified Person's name & signature

26/1/06

Date

e-version form Updated on 1 Jul 03

DETERMINATION OF NO OF PERSONS PROVIDED WITH MEANS OF ESCAPE AT EACH NON-RESIDENTIAL STOREY

PROPOSAL: PROPOSED CHANGE OF USE (FROM EXT'G OFFICE TO COMMERCIAL SCHOOL) AND INTERNAL PARTITION TO EXT'G UNITS #03-05A/06/07/08/09/10/11 STARHUB CENTRE AT NO. 51 CUPPAGE ROAD SINGAPORE 229469

Note: For 1st storey with direct exit to external without passing on the protected staircase, columns no. 2a, 2b & 4a shall be left blank.

(1) Storey occupancy (eg 5th storey office)	(2) Exit located or identification (2a) Stairs (eg stair A)	(2b) Exit doors (eg door no appr A)	(3) Clear width (m) (3a) Stairs (eg 1.5)	(3b) Exit doors (eg 1.4)	(4) Units of Width (No of persons per unit of width) (4a) Stairs Unit of Width	(4a) Stairs Persons per Unit Width (eg 60)	(4b) Exit doors Unit of Width	(4b) Exit doors Persons/Unit Width (eg 60)	(5) Exit capacity (No of persons) (5a) Stairs	(5b) Exit doors	(6) No of persons provided with means of escape (the smallest of 5a & 5b)
3RD STOREY	STAIRS 1	DOOR 1	1.20	1.20	2.5	60	2.5	60	150	150	150
	STAIRS 2	DOOR 2	1.20	1	2.5	60	2	60	150	150	150
	STAIRS 3	DOOR 3	1.20	1.2	2.5	60	2	60	150	150	150
	STAIRS 4	DOOR 4	1.20	1.2	2.5	60	2	60	150	150	150
	STAIRS 5	DOOR 5	1.20	1.2	2.5	60	2	60	150	150	150
									Total:		750

CIVIL [redacted] 2270 SINGAPORE

Qualified Person's name and signature

26/1/06

Date

e-version form Updated on 1 Jul 2003

DETERMINATION OF NO OF PERSONS PROVIDED WITH MEANS OF ESCAPE AT EACH NON-RESIDENTIAL STOREY

Proposal: PROPOSED CHANGE OF USE (FROM EXT'G OFFICE TO COMMERCIAL SCHOOL) AND INTERNAL PARTITION TO EXT'G UNITS #03-05A/06/07/08/09/10/11 STARHUB CENTRE AT NO. 51 CUPPAGE ROAD SINGAPORE 229469

Storey: 3RD

Instructions: One copy of this form is to be submitted for each "non-residential storey/typical storey for every new building & for amendments or alterations & additions where there is an increase in occupant load. (Separate calculations are needed for cinemas, auditoriums and the like)

1 The occupant load of this storey based on the floor area of: 2373.01 sq m

The applicable rates of Table 1.2A of the Code of Practice for Fire Precautions in Buildings 2002 is. 667 persons

(Detail calculations shall be attached Please use Form FSB-BP3)

2 No of persons provided with means of escape for this storey is 750 persons

I confirm that the means of escape provided for this storey comply with the provisions of the Code of Practice for Fire Precautions in Buildings 2002

Name of Qualified Person's Firm: KC FONG CONSULTANTS

CIVIL FONG KIT CHENG 2270 SINGAPORE

Qualified Person's name & signature

26/1/06

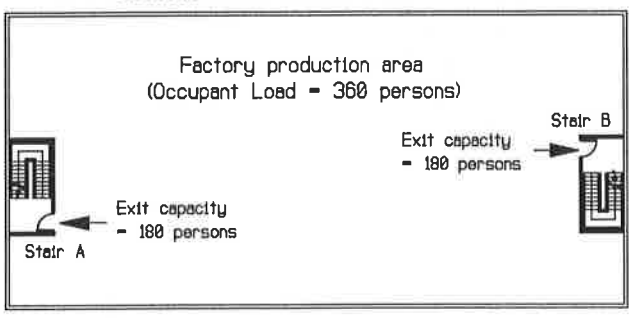
Date

e-version form Updated on 1 Jul 2003

Q & A

Capacity of exits and exit facilities

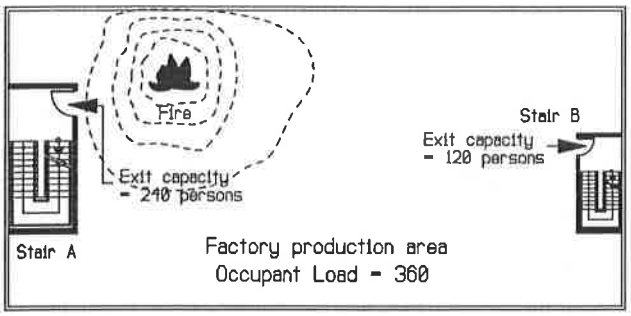
Acceptable distribution of Exit capacity



Clause 2.2.5

Reasons: Fire at one of the Staircase or obstructed

Not Acceptable distribution of exit capacity

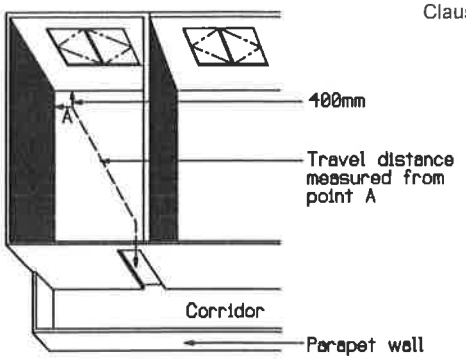


Clause 2.2.5

We Set the Standards

Measurement of Remote Point

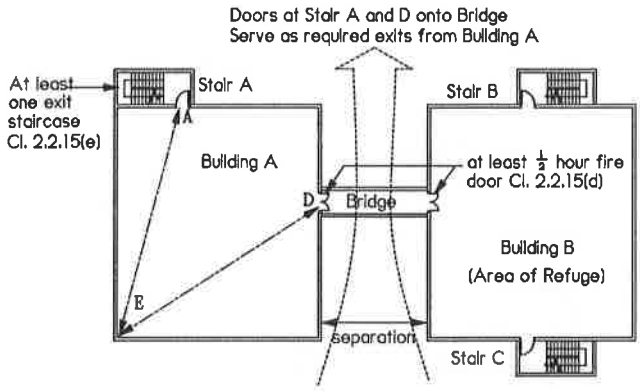
Clause 2.2.6 (c)



We Set the Standards

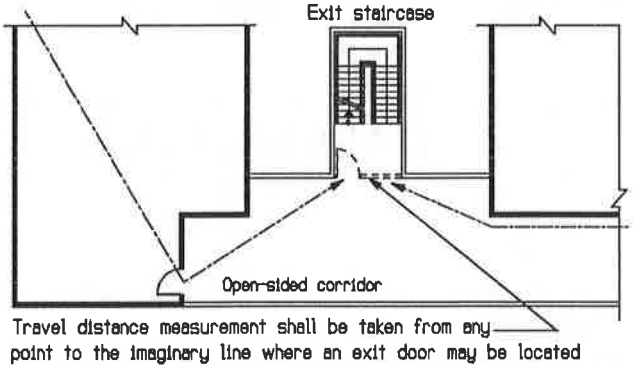
Area of refuge

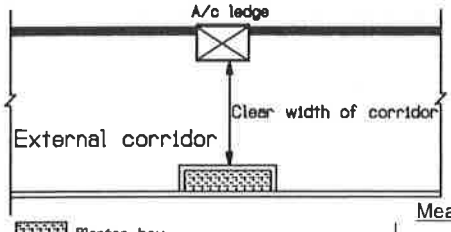
Clause 2.2.6 (f)



Measurement of Travel Distance

Clause 2.2.6(g)





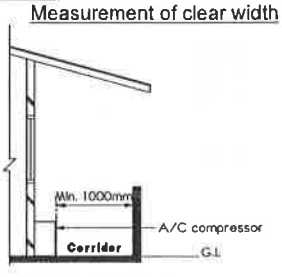
Clause 2.2.7

See Table 2.2A

Minimum width
(corridor) is 1.2m

Special cases
Class room min 1.5m
Hospital min 2m

Measurement of clear width

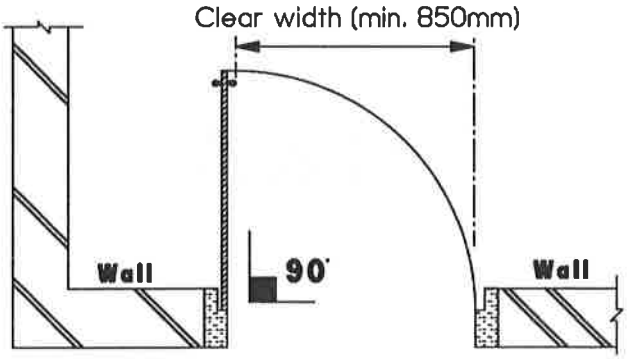


Sectional Elevation

We Set the Standards

Minimum width(door)

Clause 2.2.7

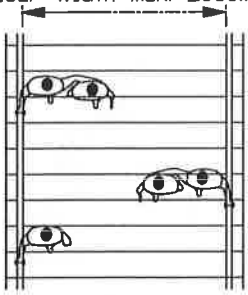


Plan

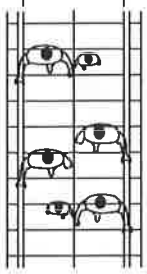
Maximum Width

Clause 2.2.8

Projection of handrail (clear width max. 2000mm)



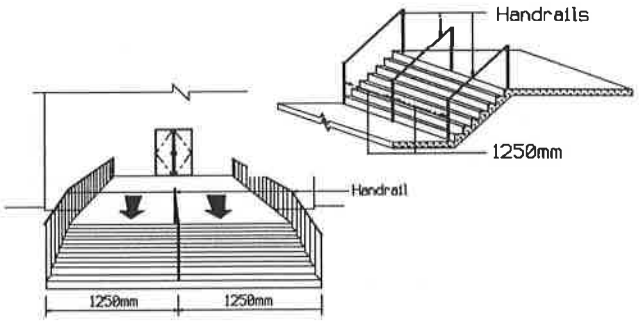
Projection of handrail (clear width min. 1000mm)



We Set the Standards

Provision of Handrails

Clause 2.2.8



We Set the Standards

EXIT

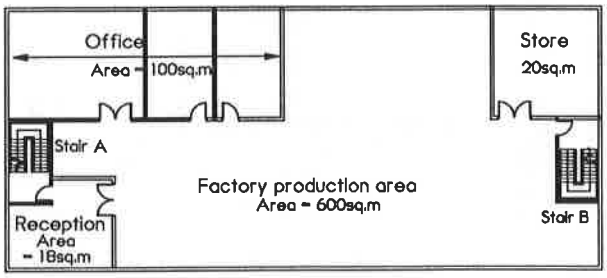
Maximum width of exit staircases

- shall be not more than 2000mman
- any part of excess width of > 2000mm shall not be taken into account for EC calculation

We Set the Standards

Minimum two exits facilities

Clause 2.2.10



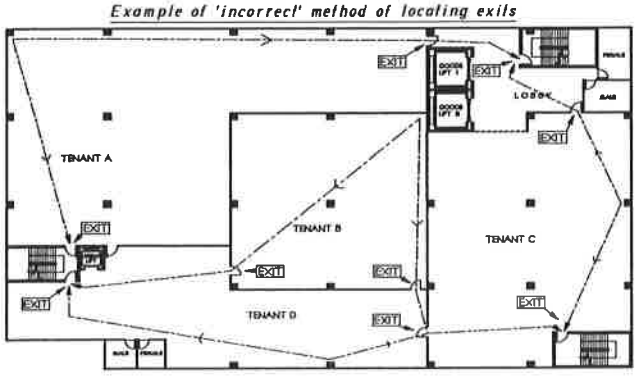
We Set the Standards

In-correct arrangement of exits

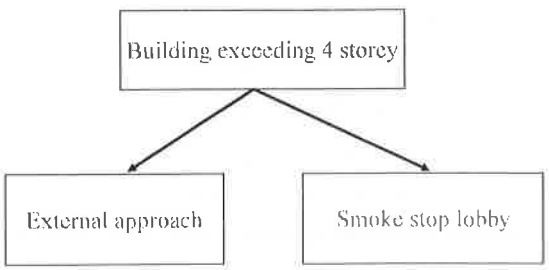
Example 1

Clause 2.2.10

Example of 'incorrect' method of locating exits



SMOKE FREE APPROACH

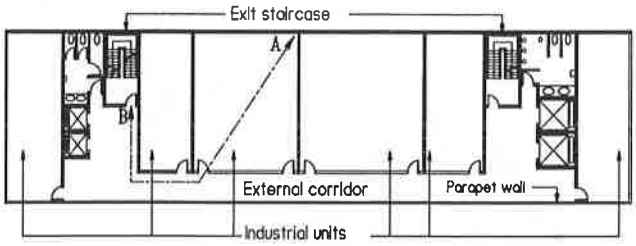


We Set the Standards

External approach (external corridor)

Clause 2.2.13

APPROACH TO EXIT STAIRCASE THROUGH EXTERNAL CORRIDOR

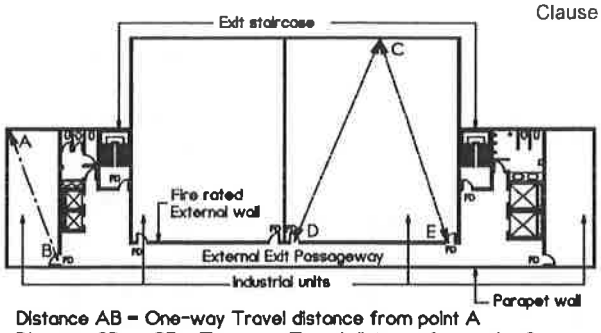


Distance AB is taken as the Travel Distance from point A

We Set the Standards

External approach (external exit passageway)

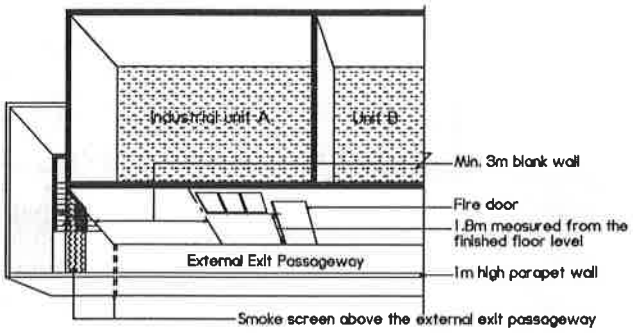
Clause 2.2.13



Distance AB = One-way Travel distance from point A
Distance CD or CE = Two-way Travel distance from point C
All doors opening to external exit passageway shall be fire rated
FD - Fire rated exit door

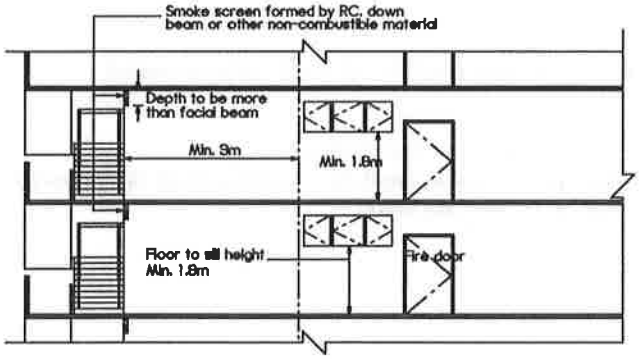
External exit passageway

Clause 2.2.13



We Set the Standards

External exit passageway



Section

Smoke free approach

Ext corridor | Smoke stop lobby | Cross ventilated lobby / corridor

When do we allow single staircase?

1. For office/shop/factory/warehouse usage only
2. Not more than 4 storey
3. Gross floor area (GFA) not more than 200m2
4. Habitable Height < 15m
5. Non-combustible construction
6. Comply with travel distance
7. Access from fire engine access to building are complied with.

We Set the Standards

When is smoke stop lobby needed?

Building more than 4 storeys

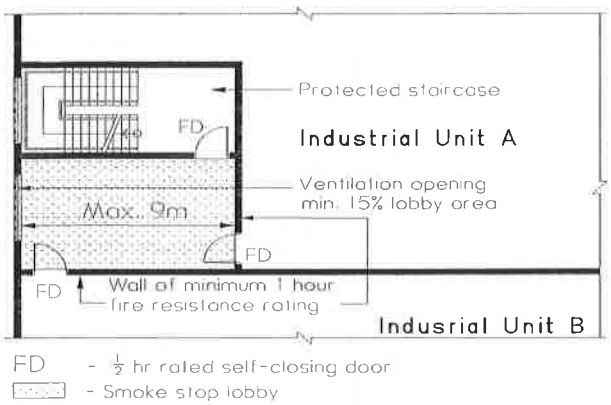
We Set the Standards

Features of smoke-stop lobby

1. Wall have at least 1 hour.
2. Exit door shall have least half an hour fitted with automatic self-closing device
3. The floor area of a smoke-stop lobby shall be not less than 3m².
4. permanent fixed ventilation openings to external > 15% of floor area of the lobby
5. Opening < 9m from any part of the lobby
6. Emergency to provide 10 air change, normal is 4 air change.

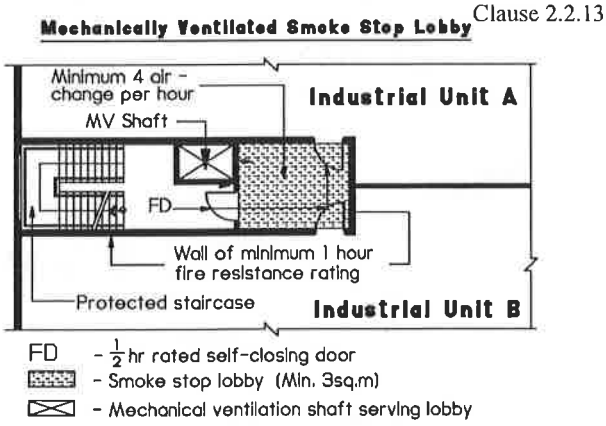
Features of Fire fighting lobby

1. Wall shall at least be 1 hour fire resistance
2. Door shall have at least have half an hour fitted with automatic self-closing device.
3. Area shall at least be 6 m2, no dimension shall be smaller than 2m
4. Floor gradient shall slope from lift towards lobby door 1:200.
5. Emergency to provide 10 air change, normal is 4 air change.



Smoke stop lobby (Mechanical Ventilation)

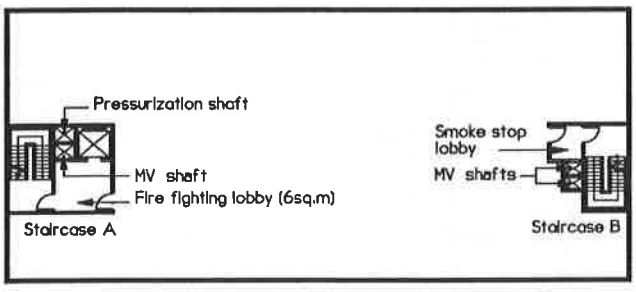
Clause 2.2.13



Smoke Stop lobby

Basement Situation (> 4 levels)

Clause 2.2.14



Typical Plan of Basement storey

Conditions where smoke stop lobby is not required

Building exceeding 4 storeys and designed with:

- Internal exit staircase pressurized up to a habitable height of 24m; or
- an external exit staircase is provided; or
- Open-sided car park floor where cross-ventilation is provided.

Not applicable to:

- PG III and VII; or
- Pressurization to exit staircase exceeding 24m in habitable height; or
- Fire fighting staircase adjacent to a fire lift.

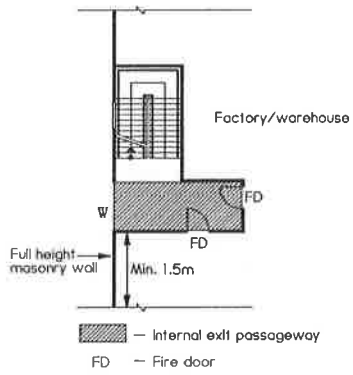
EXIT FACILITIES

Clause 2.3

- Internal exit passageway
- External exit passageway
- Internal exit staircase
- External exit staircase

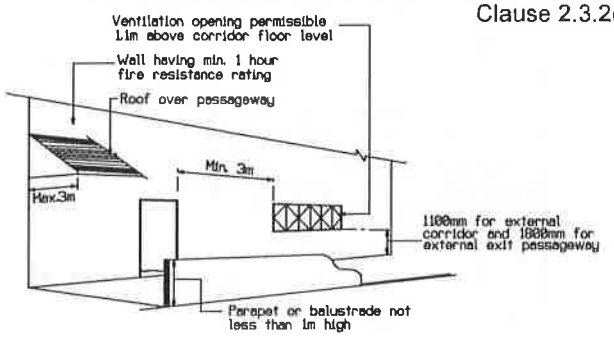
Internal Exit Passageway

Clause 2.3.2 (b)



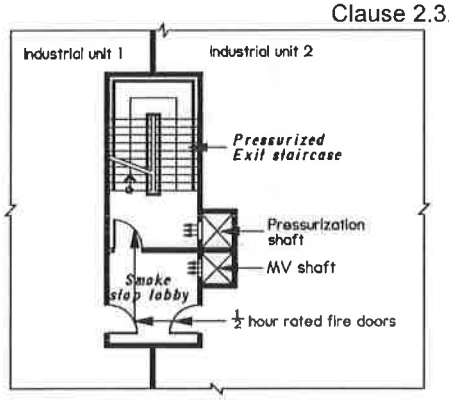
External Exit Corridor/Passageway

Clause 2.3.2(c)



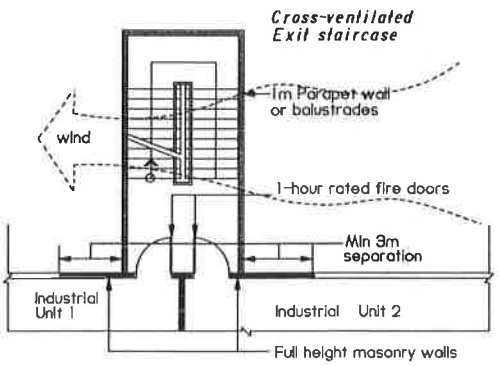
Internal Staircase & SSL

Clause 2.3.3(a)

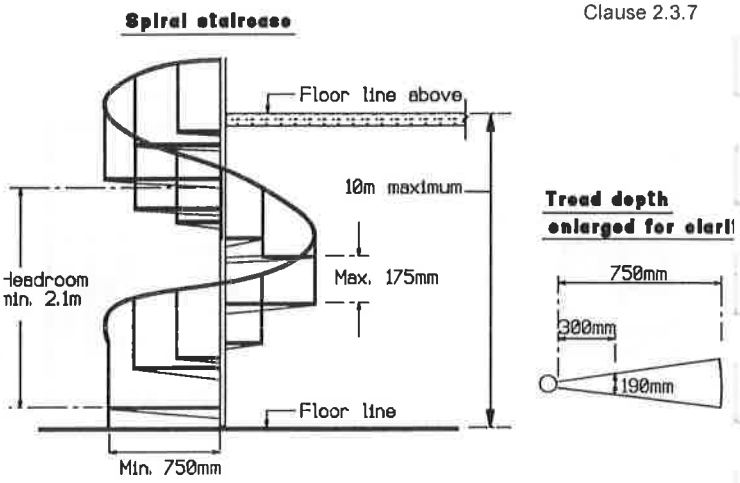


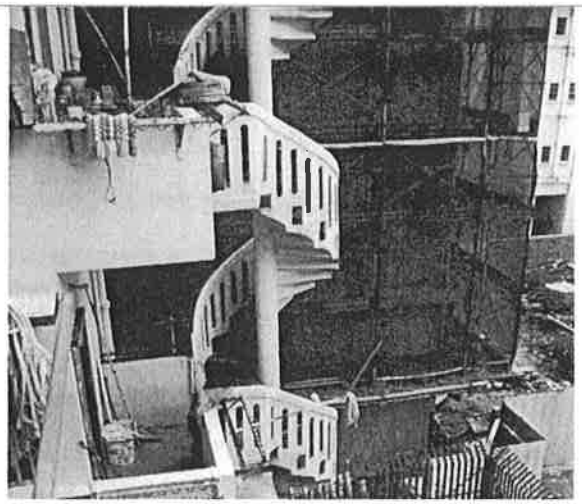
External Staircase

Clause 2.3.3 (b)



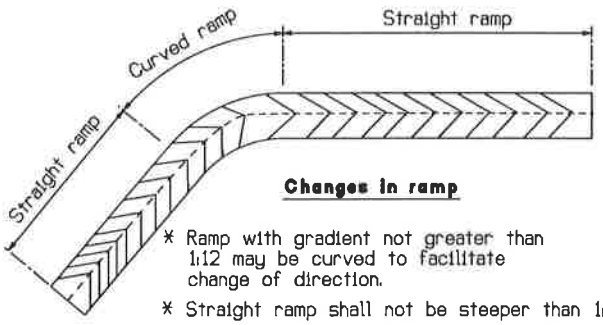
Clause 2.3.7





Exit Ramp

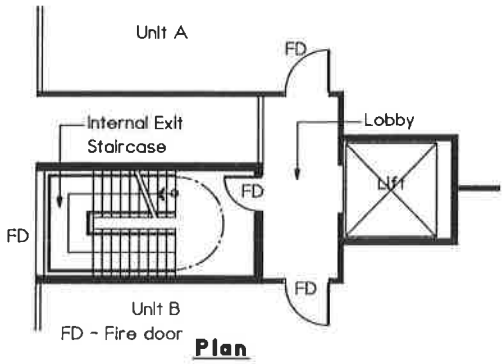
Clause 2.3.8



Changes in ramp

* Ramp with gradient not greater than 1:12 may be curved to facilitate change of direction.
* Straight ramp shall not be steeper than 1:10

Door swing not impede the egress



Plan

Thank You



Structural Fire Precautions

FIRE TESTS

- Methods adopted to determine the performance of building materials under specific heating condition, including:
  - Combustibility
  - Fire resistance performance
  - Smoke density
  - Toxicity

FIRE TESTS FOR COMBUSIBILITY

- Non-combustible materials
- Surface spread of flame rating of materials
- Flame retarding and self-extinguishing materials

NON-COMBUSTIBLE MATERIALS

- **Materials that do not contribute to fire-load**
- **Fire test, as stipulated in Fire Code 2013**
  - **BS 476 Pt 4: Non-combustibility testfor materials**
    - **Furnace temp - 750°C**
    - **Duration of test - 10 minutes**
    - **Criteria**
      - **no flaming within burning chamber, or if flaming occurred,not more than 10 seconds**
      - **Temperature increased not more than 50°C**

NON-COMBUSTIBLE MATERIALS

- Material would also be deemed as non-combustible:
  - when tested to BS 476 Pt 11: Method of assessing the heat emissionfrom materials-
    - (For materials having density 300 kg/m³ or more) does not flame and the rise in temperature on the furnacethermocouple is not more than 20°C, or
    - (For materials having density less than 300 kg/m³) does not flame for more than 10 seconds, and the rise in temperature on the centre (specimen) thermocouple is not more than 35 °C and on the furnacethermocouple is not more than 25°C

RAISED FLOOR

- Raised floor shall be constructed of non-combustible material
- Raised floor can be constructed of combustible materials for sprinkler protected building, subject to the following conditions:
  a. It shall not contain plastics;and
  b. The top, bottom and all sides are covered with materials with surface spread of flame rating not lower than class '0'

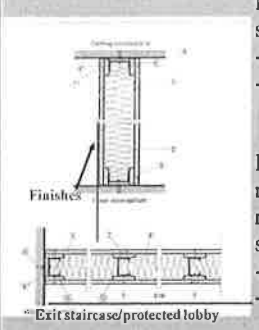
* No specific requirement for retractable seats, except the decking requireto be of non-combustible

PROVISION OF SURFACE SPREAD OF FLAME RATING

- Applicable to
  - Finishes (exceeding 1.0mm thick) to wall/ceiling. This includes wall paper, panelling, laminates, acoustic panels, etc
  - Internal wall, ceilings and roof coverings (homogenous construction)
  - Other materials such as smoke curtain, finishes to raised floor, etc

* Any finish having a surface spread of flame rating with a suffix should not be acceptable

FINISHES TO PARTITION/CEILING



Need not comply with surface spread of flame rating
- contain no plastic
- sprinkler protected buildings

Finishing materials of thickness not more than 1.0mm would not require to comply with surface spread of flame rating provided:
- Contain no plastic; and
- Not used in exit staircase, exit passageway and protected lobby

FLAME RETARDING & SELF-EXTINGUISHING MATERIALS

- Materials that would cease from burning when the heat source is removed
- Fire tests adopted
  - BS 5852 : Source 0, 1 & 5
  - ASTM D 635
  - UBC 26-9

PROVISIONS OF FIRE CODE



Upholstered or plastic seats used in auditorium, cinema, theatre, etc
- BS 5852 : Source 0, 1 & 5

Composite panels for external wall cladding
- The core shall have a surface spread of flame rating not lower than class '0' when the core material is subjected to the test of BS 476 Pt 6 & 7, or
- Test in accordance with UBC 26-9, and
- External/backing wall shall have fire resistance not less than 1-hr fire rating

UPVC WINDOW FRAME

ASTM D - 635



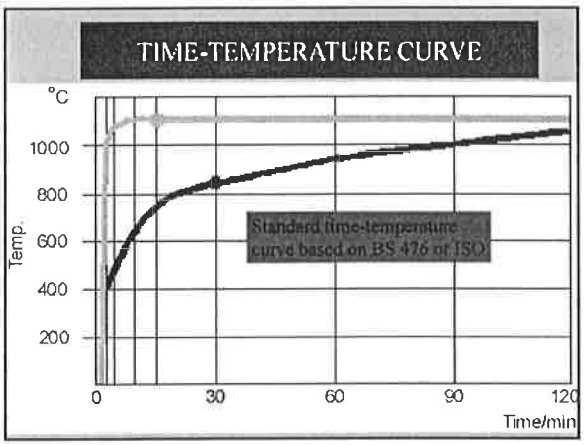
GUIDELINES ON INSTALLATION OF UPVC WINDOWS

Conditions of Installation of UPVC Window Frame

Building Type	Limitation of Installation (maximum building height (m)) Non sprinklered building	Limitation of Installation (maximum building height (m)) Sprinklered building	Maximum Length of window (m)	Brickwall Break Between window
Group I - Conventional housing	No restriction on installation			
Group II - Residential	Up to 60m	Not applicable	Window length shall not exceed 3m	For each window, a brickwall break of 1m horizontally and 1.5m vertically shall be provided.
Institutional buildings & places of public resort	Up to 15m	Up to 24m	Window length shall not exceed 3m	For each window, a brickwall break of 1m horizontally and 1.5m vertically shall be provided
Offices, Shops & Industrial buildings	Up to 15m	Up to 24m	Window length shall not exceed 3m	For each window, a brickwall break of 1m horizontally and 1.5m vertically shall be provided

FIRE RESISTANCE RATING OF MATERIALS

- Material that have the ability to resist fire from spreading through it for a specified period of time
- Fire tests adopted
  - BS 476 Pt 20 to 24, or equivalent standards acceptable to FSSD
    - Criteria
      - Integrity
      - Insulation
      - Loading capacity
      - Radiation heat flux (optional)



FIRE TESTS FOR FIRE RESISTANCE RATING

- **BS 476 Pt 20 - Method for determination of the fire resistance of elements of construction (General Principles)**
  - **Scope: Applies to elements not detailed under Pt 21 to Pt 24, ie fire damper, fire stopping materials, fire-rated collar, etc**
  - **Criteria**
    - **Integrity and/or**
    - **Insulation**

TABLE 3.4A

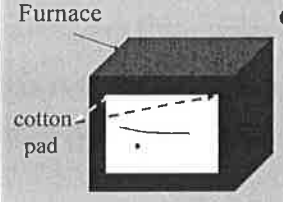
Element	Stab.	Inte.	Insu
Structural beam, column	*		
Floor	*	*	*
External wall	*1	*	#
Compartment wall	*1	*	*
Fire door		*2	

Legend

* Period of fire resistance as specified # Min 15 minutes

*1 Applicable for loadbearing wall *2 Min 30 minutes

INTEGRITY RATING



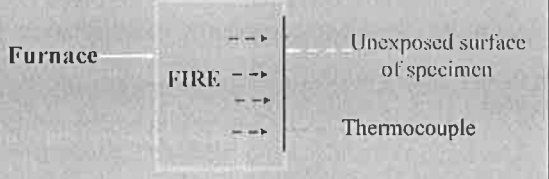
Criteria

No Collapse

Size of gap/hole developed should not exceed permissible limits

Flaming of cotton pad not more than 10 secs

INSULATION RATING

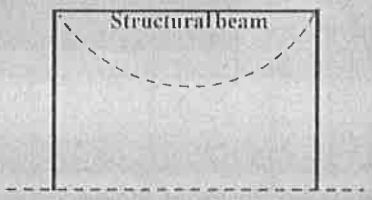


Sectional view

LOAD-BEARING CAPACITY RATING

Criteria

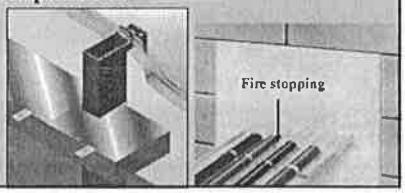
Extent of bulkering should not exceed permissible limits



FIRE-STOPPING MATERIALS

- **Fire stopping material for openings in compartment wall/floor shall have integrity and insulation rating**

* **it is acceptable for the fire stopping material to contain plastic. Separate approval from FSSD is not required. However, it shall only be used for sealing up gaps in compartment wall/floor**



PROTECTION TO STEEL STRUCTURE

Performance -

Non-combustibility : BS 476 Pt 4/11

Fire resistance : BS 476 Pt 21

Impact: BS 5234 Pt 2 : 1992

Water absorption : BS 1230 Pt 1 : 1985 (for gypsum board)

Water absorption : ISO 1896 (for calcium silicate orcement board)

Applicable to dry board and spraying materials use



INTUMESCENT PAINT

Fire resistance - BS 8202 Pt 2/BS 476 Pt 21

Durability (weather) - BS 8202 Pt 2

PROTECTION TO TIMBER OR STEEL FLOORING

Performance

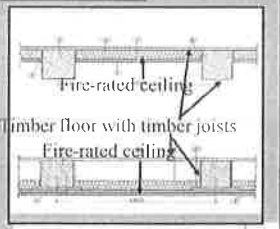
Non-combustibility - BS 476 Pt 4/11

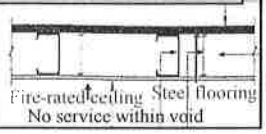
Fire resistance - BS 476 Pt 21

Installation

Fire Code 2013

- No services within void
- No perforation to ceiling





PROTECTED SHAFT - LIFT

Performance -

- Non Combustibility : BS 476 Part 4/11
- Fire resistance : BS 476 Part 22 : 1987
- Impact : BS 5588 Pt 5 Appendix A : 1991 and BS 5234 Pt 2 : 1992
- Water absorption: ISO 1896 (for calcium silicate or cement board)
- Water absorption: BS 1230 Pt 1 : 1985 (for gypsum board)
- Cyclic loading & dynamic : Cl 3.3 of building code of Australia

Installation - Fire Code 2013

PROTECTED SHAFT - STAIRCASE

Performance -

- Non Combustibility : BS 476 Part 4/11
- Fire resistance : BS 476 Part 22 : 1987
- Impact : BS 5588 Pt 5 Appendix A : 1991 and BS 5234 Pt 2 : 1992
- Water absorption: ISO 1896 (for calcium silicate or cement board)
- Water absorption: BS 1230 Pt 1 : 1985 (for gypsum board)

Installation – Fire Code 2013

FIRE-RATED GLASS WALL/PANEL

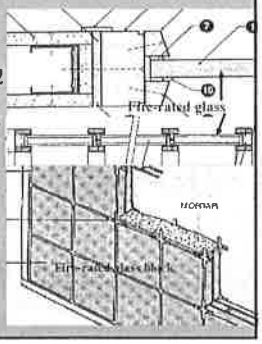
Performance

Fire resistance - BS 476 Pt 22

Impact - BS 6206 or AS 2208

Installation

Fire Code 2013



FIRE-RATED LIFT LANDING DOOR



Performance

Fire resistance - BS 476 Pt 22 or EN 81-58

Installation

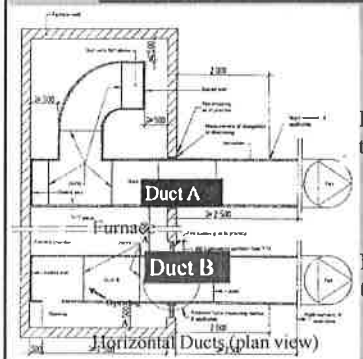
Fire Code 2013

SS 550(previously CP 2)

FIRE TESTS FOR FIRE RESISTANCE RATING

- BS 476 Pt 24 - Methods for determination of the fire resistance of ventilation ducts
  - Scope: Applies to ducting systems for ventilation, smoke extraction or kitchen exhaust
    - Duct A: Fire attacks from external to duct
    - Duct B: Fire attacks from both internal and external to duct
  - Criteria
    - Integrity
    - Stability
    - Insulation

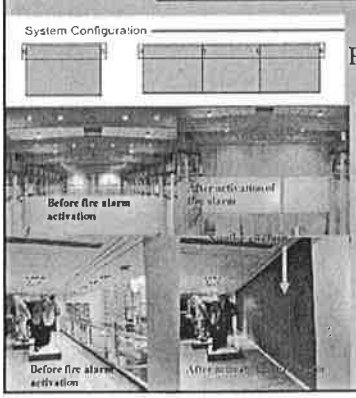
ARRANGEMENT OF DUCT



Duct A - No opening to duct within furnace

Duct B - With opening to duct within furnace

SMOKE CURTAIN



Performance

Class '0' - BS 476 Pt 6 & 7

Deflection - BS 7346 Pt

Rolling - BS 7346 Pt 3

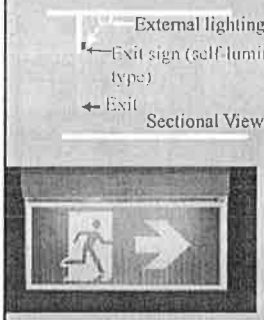
Heating - BS 7346 Pt 3

Installation

Fire Code 2013

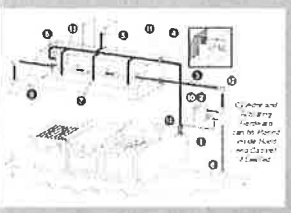
BS 7346 Pt 3

SELF-LUMINOUS SIGN



- Position/Height of installation of signage
- External vertical lighting for self-luminous sign

FIRE EXTINGUISHING SYSTEM FOR KITCHEN HOOD

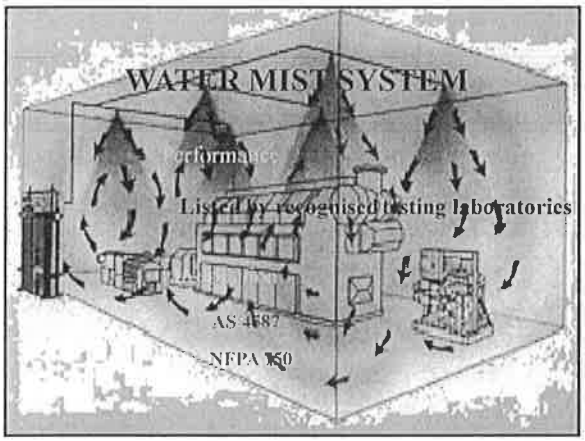


Performance

Performance - UL 300

Installation

As detailed in the test report and manufacturer's specification



INSTALLATION

- **Should be installed by a trained installer**
- **Shall be supervised by the project QP, or QP/PE engaged by supplier**
- **Shall be constructed in accordance with the prototype as detailed in the test report**
- **Any variation/modification to the prototype shall be supported by assessment report issued by recognised testing lab. In addition, the modified construction shall be listed under PLS**

RI INSPECTION OF FIRE SAFETY MATERIALS/PRODUCTS

To check

- **The details stated in the Certificate of Conformity (COC) issued for the listed products**
  - **QP's/PE's certificate of supervision for the fire safety products, if applicable**

  Inspect the installation to verify the construction with the prototype, as detailed in the test report(s) referred in the COC

- **QP to note that building material listed in PSB directory does not imply that the material can be used in building. RI to ensure that the material complied with fire code requirements.**

CONCLUSION

- Fire safety materials/systems shall be type tested in accordance with specific standard
- Shall be listed under PLS for assurance of performance and quality of installation
- Performance achieved shall conform to FSSD's requirements



TÜV SÜD PSB Singapore

Choose certainty. Add value.

TÜV SÜD PSB Pte Ltd

TÜV SÜD PSB Product Listing Scheme (PLS)

Emily Mok
Certification Department

Content



1 Introduction
2 Conformity Assessment
3 Product Testing
4 TÜV SÜD PSB Product Listing Scheme

Content



1 Introduction
2 Conformity Assessment
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4 TÜV SÜD PSB Product Listing Scheme

Technical Infrastructures facilitate markets access and increase confidence level

Policy, regulation, contracts	Measurement (metrology and physical standards)	Documentary standards, methods of test	Claims of conformity, verification, certification	Accreditation, peer assessment
Public, trade and corporate policy Better regulatory practice	Legal measurement Scientific and technical measurement	Performance standards Prescriptive standards Test methods	Auditing, Calibration, Evaluation, Examination, Inspection, Testing 3rd party conformity and marking	Assessment of technical competence

Technical outcomes for higher confidence and better informed in decision making

Standards and Conformance Framework

Building Trust through Quality and Standards

1) Assure Quality of Products and Services
2) Enhance Safety, Health and Environment Protection
3) Facilitate Trade and Market Access

NATIONAL QUALITY AND STANDARDS INFRASTRUCTURE

STANDARDS	CONFORMANCE	REGULATIONS	MEASUREMENT
• Singapore Standards	• Accreditation • Good Laboratory Practice • Business Excellence Certification • Quality Assurance* • Certification* • Testing & Inspection*	• Consumer Protection • Consumer Goods Safety Requirements • Weights and Measures	• Primary Standards @ A*STAR • Calibration*

* Private Sector

SPRING : National Standards Body, National Accreditation Body, National Business Excellence Body, Safety Authority for Controlled and General Consumer Goods, Weights and Measures Authority & GLP Compliance Monitoring Authority

- SPRING as accreditation body
- Private organisations as CABs

Content



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Material Reaction-to-Fire Performance

British Standard
- BS 476 Part 4 (Non-combustible test)
- BS 476 Part 11 (Limited combustibility test)
- BS 476 Part 7 (Spread of flame test)
- BS 476 Part 6 (Fire Propagation test)

Test method	Classification
BS 476 Part 4	Non-combustible
BS 476 Part 11	Limited Combustibility
BS 476 Part 6 & 7	Class 0
BS 476 Part 7	Class 1, 2, 3 & 4

Material Reaction-to-Fire Performance

European Standard
- EN ISO 1182 (Non-combustibility test)
- EN ISO 1716 (Calorific value test)
- EN 13823 (Single burning item test)
- EN ISO 11925-2 (Small flame test)

Performance	Test method
Non-combustible	EN ISO 1182 & 1716
Limited combustibility	EN ISO 1182 or EN ISO 1716 & EN 13823
Highest level of combustible performance	EN 13823 & EN ISO 11925-2
Grades of combustible Performance	EN 13823 & EN ISO 11925-2
Lowest level of Performance	EN ISO 11925-2



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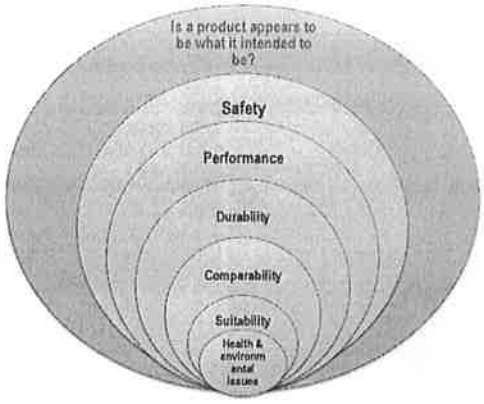
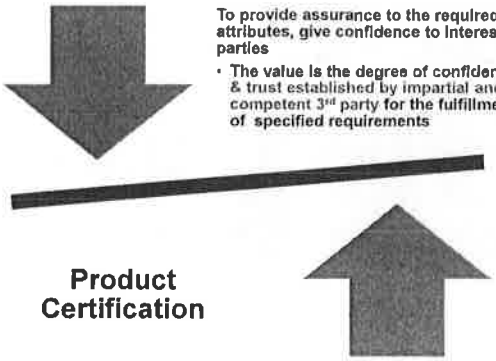
INTRODUCTION



INTRODUCTION



To provide assurance to the required attributes, give confidence to interested parties
- The value is the degree of confidence & trust established by impartial and competent 3rd party for the fulfillment of specified requirements

Product Certification

INTRODUCTION

What is Product Certification?

- Product Certification is a means by which a third party provides assurance that a product conforms to specified standards (published international /national standards)
- Voluntary or regulatory

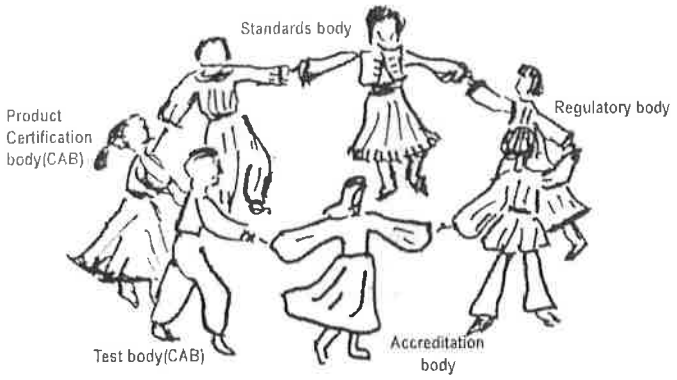
TEST & CERTIFICATION



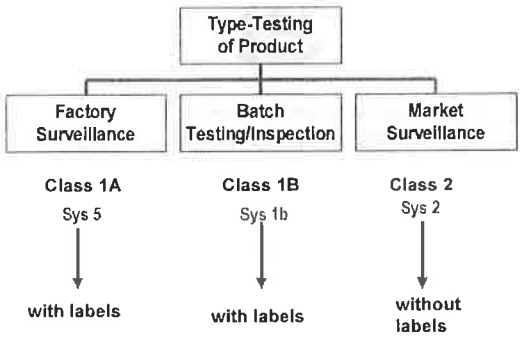
Type Test:
An examination of the design of a product. No surveillance.

Product Certification:
- "To confirm formally or verify that a product comply with requirements to varying level of assurance"
- Monitoring to ensure continuing of conformity

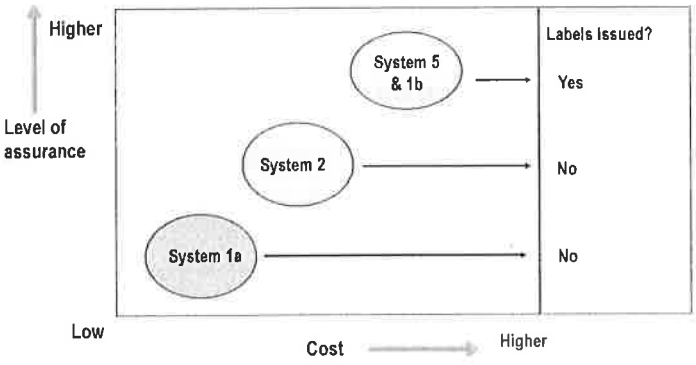
Stakeholders



PLS – ISO Certification Scheme



Level of QA of Product Performance



What is PLS?

The Product Listing Scheme (PLS) is a third party broad-based product certification scheme where the safety and performance of a product is assessed by type testing and surveillance / testing.

A structured way having follow-up surveillance programme for certified products has been established either by means of regular factory inspections and selective product testing or batch testing to ensure products will continually complied with requirements.

Quality In Building Projects

Depends on

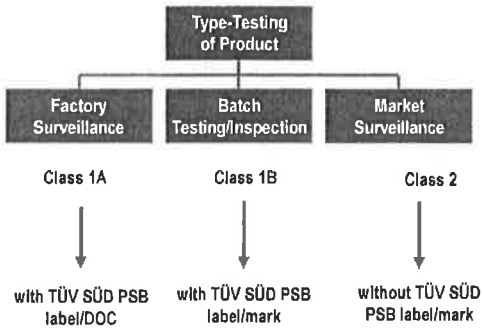
- Quality of **DESIGN**
- Quality of **WORKMANSHIP** (INSTALLATION/CONSTRUCTION)
- Quality of **PRODUCTS** USED

Regulations on Fire Protection Products

- 2 considerations:
  (i) Approved standards
  The use of these products must be in accordance to the Fire Code. These products are required to conform to specific standards specified by SCDF in the Fire Code

  (ii) Evidence of compliance
  The quality and continual compliance of these products is based on TÜV SÜD PSB Product certification scheme (PLS) and not on type test alone.

TÜV SÜD PSB Product Listing Scheme



What are SCDF regulated products and their requirements?

A list of these products and corresponding standards may be obtained from website:

http://www.tuv-sud-psb.sg/ProductRequirement.aspx

http://www.scdf.gov.sg/content/scdf_internet/en/building-professionals/fire-safety-plan-approval/building-materials.html

Fire Safety Guidelines FSG1 : 2017

FIRE SAFETY AND SHELTER DEPARTMENT
SINGAPORE CIVIL DEFENCE FORCE

FIRE SAFETY GUIDELINES

CERTIFICATION OF REGULATED FIRE SAFETY PRODUCTS & MATERIALS

Fire Safety Guidelines FSG1 : 2017

a **ISO/IEC Type 1b Certification Scheme[1]**

ISO/IEC Type 1b Certification Scheme consists of type testing of a sample of a production and subsequent batch inspection. Regulated fire safety products certified under ISO/IEC Type 1b Certification Scheme are issued with product labels which are also displayed on the products.

b **ISO/IEC Type 2 Certification Scheme[2]**

ISO/IEC Type 2 Certification Scheme consists of type testing of a sample and market surveillance. Market surveillance is conducted and samples of the product from the market are assessed for ongoing conformity.

c **ISO/IEC Type 5 Certification Scheme[3]**

ISO/IEC Type 5 Certification Scheme consists of testing and assessment of the quality system involved. Surveillance of the quality system is conducted and samples of the product from either the market or at the point of production, or both, are assessed for ongoing conformity. Regulated fire safety products certified under ISO/IEC Type 5 Certification Scheme (Discrete System) are issued with product labels which are also displayed on the products.

ASSESSMENT OF MODIFICATION TO CERTIFIED FIRE SAFETY PRODUCTS/MATERIALS

6 The fire safety products/materials shall be installed in the manner as the tested prototype described in the test report. Any modifications or deviations to the tested prototype shall be supported by a report prepared by a local or an overseas test laboratory accredited or recognised by SAC.

Fire Safety Guidelines FSG1 : 2017

APPLICANTS OF FIRE SAFETY PRODUCTS SEEKING MULTIPLE CERTIFICATIONS FROM CBS

8 An applicant who seeks certification of their fire safety products with a CB shall declare the status of certification he had with the previous CB.

9 If the applicant had previously sought certification with a CB but failed in its certification attempt, he is required to submit the latest audit report and surveillance test results prepared by the previous CB to the new CB for their reference and highlight any improvement made to the product to be certified by the new CB.

10 However, if the applicant declares that he has yet to seek certification with any CB, it shall be mandatory for the CB that is approached by the applicant to confirm the status from the directory of certified and failure products maintained by the other CBs.

11 If the CB subsequently finds out that the applicant had earlier approached a CB but failed in its certification attempt, the CB shall require the applicant to (i) submit the latest audit report and surveillance test results prepared by the previous CB and (ii) highlight any improvement made to the product. If the applicant fails to do so, the CB shall reject the applicant's application for certification of his product.

12 Compliance of the procedures by the CBs shall be part of the audit requirements of SAC.

VALIDITY OF TEST REPORTS FOR REGULATED FIRE SAFETY PRODUCTS

13 Test report(s) shall be valid for 5 years for products listed under ISO/IEC Type 5 Certification Scheme (Discrete system) and ISO/IEC Type 1b Certification Scheme which are issued with product labels.

14 Test report(s) shall be valid for 10 years for products listed under ISO/IEC Type 5 Certification Scheme (Non-discrete systems) which are issued with Declaration of Compliance (DOC).

Fire Safety Guidelines FSG1 : 2017

VALIDITY OF CERTIFICATE OF CONFORMITY (COC) FOR REGULATED FIRE SAFETY PRODUCT

15 COC for regulated fire safety product shall be valid for 5 years. Under the PLS, a fire safety product supplier shall obtain a COC for their product before it is used for building construction in Singapore. The issuance of COC for regulated fire safety products listed under the PLS is solely based on compliance of stipulated test performance standard of the product certified in the test report issued by a local or an overseas test laboratory accredited or recognised by SAC.

MANAGEMENT OF FIRE SAFETY PRODUCT LABELS

16 CBs who issue the fire safety product labels shall maintain a record for periodic audit. Fire safety product labels are controlled and serialized items. Such records shall form part of the audit requirements of SAC to ensure its transparency and accountability.

17 The supplier of a regulated fire safety product shall make a police report on the missing product labels before they are replaced with new labels by the CBs.

TRACEABILITY OF CERTIFIED PLS LISTED PRODUCTS

18 Regulated fire safety products listed under the PLS and certified under ISO/IEC Type 5 Certification Scheme (Discrete System) and ISO/IEC Type 1b Certification Scheme are issued with product labels which are displayed on the products. To enhance accountability, quality, process and traceability of regulated fire safety product, the supplier who is the certificate holder of COCs of these categories of regulated products shall also display labels which include their company's name on the certified fire safety products with effect from 6 Feb 2018.

19 Both the product labels and company labels displayed on the certified fire safety products shall be water-proof, tampered-proof and capable of preventing forgery of labels.

ANNEX A
LIST OF REGULATED FIRE SAFETY PRODUCTS & MATERIALS

List of Regulated Fire Safety Products /Materials under PLS

View the list of regulated fire safety products /materials under the Product Listing Scheme.

https://www.scdf.gov.sg/sites/www.scdf.gov.sg/files/RevisedProceduresForCertificationOfRegulatedFireSafetyProducts-FSG-3-AnxA-Updated%202015%200702.pdf

Fire Shutter_SS489:2015

SCDF
SINGAPORE CIVIL DEFENCE FORCE

Your Ref : Our Ref: CDF/SSD/12/02/03/01

Date : 15 Nov 2016

Registrar, Board of Architects
Registrar, Professional Engineers Board
President, Singapore Institute of Architects
President, Institution of Engineers, Singapore
President, Association of Consulting Engineers, Singapore

Dear Sir/Mdm,

IMPLEMENTATION OF SS 489:2015 – SINGAPORE STANDARD FOR SPECIFICATION FOR FIRE SHUTTERS

The SS 489:2015 – Singapore Standard for specification for fire shutters was officially launched by SPRING on 4 May 2015. This standard specifies requirements and testing methods to assess the fire resistance of the shutter required to protect openings in walls to resist passage of fire. This standard applies to fire resistant vertical roller shutters, lateral shutters, horizontal roller shutters and folding sliding shutters.

2 Please be informed that the standard shall be applicable to all building plans that are submitted to SCDF for approval from 15 Nov 2017 onwards. The grace period given is for roller shutter suppliers to test and test their products with the approved certification bodies.

3 Please convey the contents of this circular to members of your Board/ Institution/ Association. This circular is also available on CORENET-e-Info http://www.corenet.gov.sg/einfo. For any clarification, please contact LTC Choh Choon Jin at DID: 6848 1454 or Email: Choh_Choon_Jin@scdf.gov.sg.

Services within Drywall

Our Ref: CDF/SSD/12/02/03/01 — HQ Singapore Civil Defence Force
Your Ref: — 91 Ubi Avenue 4
Date: 15 Nov 2016 — Singapore 408827
Tel: 6848 1400
Fax: 6848 1488

Registrar, Board of Architects
Registrar, Professional Engineers Board
President, Singapore Institute of Architects
President, Institution of Engineers, Singapore
President, Association of Consulting Engineers, Singapore

Dear Sir/Mdm,

PERMITTING SERVICES WITHIN FIRE RATED DRY CONSTRUCTION IN BUILDINGS

1) Clause 3.1 of the prevailing fire code stipulates that fire rated dry construction for walls, floors, ceilings, columns or beams in a building shall be tested to achieve the required fire resistance rating. The test is carried out without services within it such as electrical cables, gas pipes and chilled water pipes, as these services are considered to not well undermine the fire integrity and insulation of the dry construction under fire conditions.

2) To facilitate industry needs, SCDF has reviewed this requirement and permits the incorporation of services within dry wall construction, subject to the conditions specified in Annex A of this circular. This circular shall take immediate effect.

3) The installation of services within dry wall construction for existing building projects is permitted provided such installations comply with the requirements in Annex A within 9 months from the date of issuance of this circular. This is to facilitate testing and listing of the product.

4) Please convey the contents of this circular to members of your Board / Institution / Association. This circular is also available on CORENET-e-Info http://www.corenet.gov.sg/einfo.

5) For any inquiry or clarification on the subject please contact Mr Peng Teng Teck at DID: 6848 1401 or E-mail: Peng_Teng_Teck@scdf.gov.sg.

Recognition of type test reports

TÜV SÜD PSB accepts non-TÜV SÜD PSB type test reports for listing, subject to following criteria and verification:

- SAC-Singlas accredited laboratories
- SAC-Singlas MRA partners (effective from date of MRA signed)
- TÜV SÜD PSB-MOU partners
- IECEE-CB Scheme

Award of Certificate of Conformity

- Certificate is renewed every 3 years
- Certificate is to be returned to TÜV SÜD PSB upon termination or expiry of the certification

Surveillance

- Periodical evaluation of certified product
- CB established surveillance regime on certified products
- Procedures include testing, inspection or audit as appropriate
- Sampling on specimen typical of production, can be from factory, warehouse or open market
- Certificate holder inform CB of any changes, CB evaluate change and advise acceptance before product can be marked and place in market

Listing

- Products under PLS will be listed in a Directory, and the Internet (website: www.tuv-sud-psb.sg)
- Includes information on applicant, country of origin, range of products, model number and scope of listing
- Directory will be updated yearly & Internet weekly

Labeling

- "TÜV SÜD PSB" labels or marks are to be affixed only on products under PLS. They shall not be used on any other product.
- For discrete products regulated by SCDFunder Class 1A or 1B, serialised and non-transferable labels are issued by TÜV SÜD PSB Under Class 1A, records of labels issued and received shall be kept.
- The exceptions are FR cables and door closers where the manufacturers are allowed to print/emboss "TÜV SÜD PSB" mark on their certified products.
- For non-discrete products regulated by SCDFunder Class 1A or 1B eg. FR systems, instead of labels/ marking, a serialised Declaration of Compliance (DOC) are issued by TÜV SÜD PSB to applicant. RI should ask for a copy of the DOC for every project.

Termination of CoC

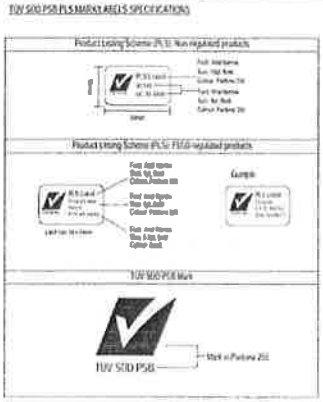
- Company to return Certificate of Conformity and any unused labels
- Terminated CoC will be updated on the Internet PLS webpage.
- Company can re-list their products, subject to conditions and approval.

What you can find on www.tuv-sud-psb.sg

- Terminated CoCs
- Updates of standards
- Changes in certification requirements
- Updates of applicants and products
- Updates on Regulators' requirements
- Certification process
- Application forms

1. Look for:

TÜV SÜD PSB mark on the product



2. Ask for TÜV SÜD PSB

Certificate

Of

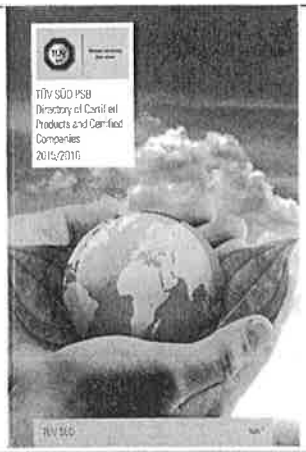
Conformity


CERTIFICATE OF CONFORMITY

OR/AND

3. *Verify the validity of the CoC from website*

www.tuv-sud-psb.sg

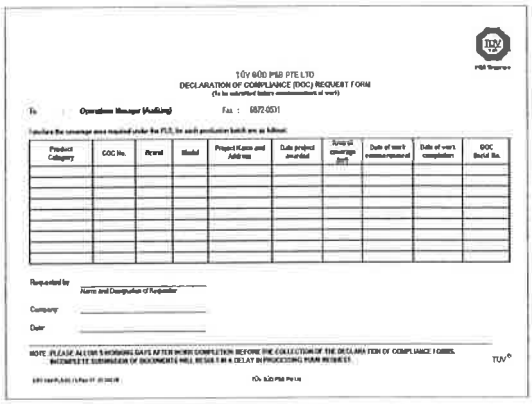


Labeling/Declaration of Conformity

Certification for FR systems

- FR systems - Wall/glass partition system, ducting, floor/ceiling system, protection to steel structures are to be certified under PLS class 1A.
- Listed applicants will issue Certificates known as Declaration of Compliance(DOC) obtained from TÜV SÜD PSB
- TÜV SÜD PSB will audit applicant based on extent of area of installation stated in the DOC issued.

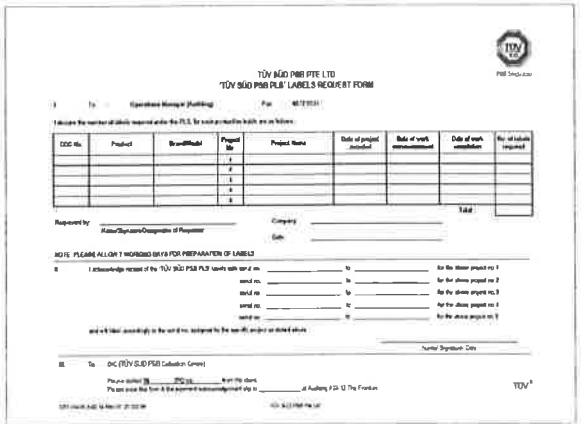
PLS - DOC Request Form


TÜV SÜD PSB PTE LTD
DECLARATION OF COMPLIANCE (DOC) REQUEST FORM

PLS – Declaration of Compliance


Declaration of Compliance

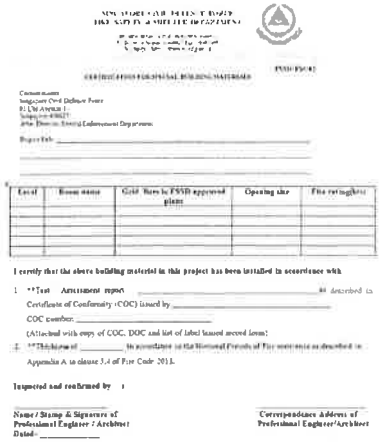
PLS - Labels Request Form


TÜV SÜD PSB PTE LTD
'TÜV SÜD PSB PLS' LABELS REQUEST FORM

Labeling for FR Doors



FSC 02 Form _Certification for Special Building Material



Level	Room name	Grid lines in FSSD approved plans	Opening size	Fire rating(hrs)

I certify that the above building material in this project has been installed in accordance with

1. **Test Assessment report _____ as described in Certificate of Conformity (COC) issued by _____ COC number: _____ (Attached with copy of COC, DOC and list of label issued record form)
2. **The below of _____ in accordance to the Structural Periods of Fire resistance as described in Appendix A in clause 3.4 of Fire Code 2013.

Inspected and confirmed by :

_____ Name / Stamp & Signature of Professional Engineer / Architect
Dated: _____

_____ Correspondence Address of Professional Engineer/Architect

How can users like architects and engineers use it to make the right choice in selection of materials and products?

By selecting and using certified products under PLS.

Note: Usage of the listed product under SCDF needs to comply with SCDF's Code of Practice for Fire Precautions in Buildings.

End of Presentation



Emily Mok
TÜV SÜD PSB Pte Ltd
Emily.mok@tuv-sud-psb.sg

www.tuv-sud-psb.sg

Sharing on plan audit check findings and waiver issues

Audit Check Finding
Common Audit Issues

Provision of Hosereel

- New submission
- Addition/Alteration Plans
- Minor Addition/Alteration Plans

Scope

- Introduction
  - Audit Process
  - Waiver Process
- Common Audit issues
- Common waiver issues
- Conclusion

- Setback for unprotected openings
- Total area and volume
- Existing fire engine accessway/access road/Fire Access Panel
- Existing hydrant
- Discharge of existing exit staircases

Introduction

- Audit Process
  - Audit Check Committee (ACC) & Audit Disciplinary Committee (ADC)
  - Reply to Notification Letter on Non-compliance items
  - Attending the Audit Hearing meeting
- Waiver Process
  - How to write the waiver issue
    - To permit/To allow/To waiver
  - Clear & Precise
  - Attach relevant plans
  - Discussion with processing officer
  - Appeal for waiver decision

Audit Check Finding

- Calculation of occupancy load for change of use
- HDB project submit under MAA.
  - MAA not allowed without TFP/FSC (except those issued with approval and certificate of Inspection)

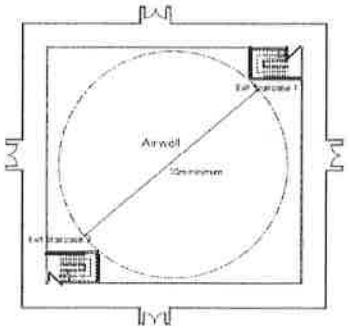
Common Waiver Issues

Note : Ventilation opening for exit staircase shall face the external of building

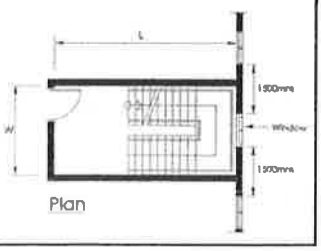
What is external of building?

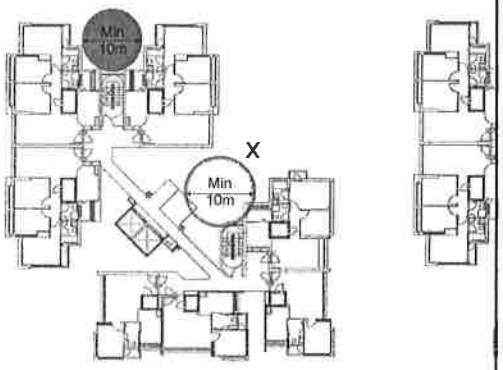
Minimum Air-well Size	
Max habitable height of building	**Min clear width of air-well**
18m	10 m
24 m	11 m
36 m	12 m
48 m	13 m
60m and above	14 m

Ventilation for Exit Staircase and Smoke Stop Lobby



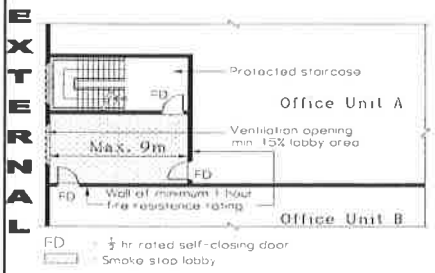
All exit staircases shall be ventilated by fixed openings in the external walls, such openings being of area not less than 10 per cent of the floor area per floor of the staircase, or mechanically ventilated.





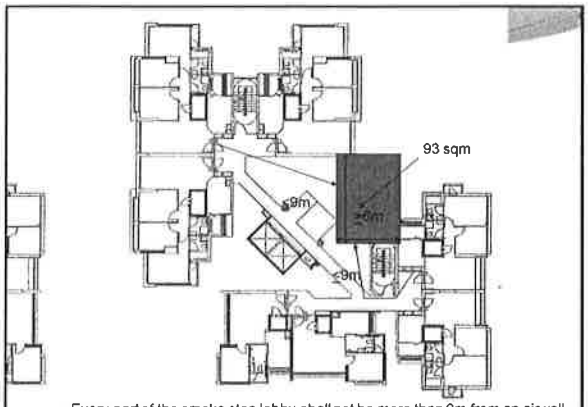
Ventilation for Smoke Stop Lobby

Permanent fixed ventilation openings in the external wall of the lobby; such ventilation openings shall have an area of not less than 15 per cent of the floor area of the lobby and located not more than 9m from any part of the lobby



Common Waiver Issues

- Setback for residential buildings (Purpose Group I)
- Insulation rating for fire rated roller shutter and fire rated glass
- Provision of breeching inlet for residential buildings (Purpose Group II)
- Non provision of lift lobby at basement



Every part of the smoke stop lobby shall not be more than 9m from an airwell (at least 6m in width and 93 sqm in area)

Conclusion

- QP to ensure plans comply with requirements before submitting to FSSD
  - Waiver to submit prior to submission of plans
  - Consultations with FSSD
    - Record of consultation

Summary

Exit Staircase (natural ventilation)

- Ventilation opening to face external
  - based on airwell size (min : 10m)
  - at least 10%

Smoke stop lobby (natural ventilation)

- Ventilation opening shall not be more than 9m from external
  - min 6m (width)
  - 93 sqm

FSSD

Sharing on *Performance Based* Projects

Nicholas Lee
Senior Consultant
Performance Based Plans
FSSD

FSSD

What comes to mind when you think of *"Performance Based Projects ?"*

FSSD

What are *Performance Based* Projects ?

FSSD

Have you worked on *Performance Based* Projects ?

What were the issues ?

- **Technical**
- **Administrative**

FSSD

What are ***PB*** Projects ?

Design solution based on fire engineering principles.

What do you understand by that ?

FSSD

What are the common *deviations* ?

FSSD

FSEs are not magicians



FSSD

The *PB* Approach.
And what it entails.

FSSD

Common *Deviations*

- Enlarged smoke reservoir area/length
- Extended TD/excessive OL
- Internal discharge of exit staircases
- Set back from boundary
- Fire resistance rating
- Ductless jet fans

FSSD

PB approach to fire safety design

Conceptual Design Stage
Fire Safety Engineering Design Brief (FEDB)

Detailed Design Stage
Fire Safety Engineering Report (FER)
Operations & Maintenance Manual (O&M Manual)
Peer Reviewer Report (PRP)

Fire Safety Certificate
R.I. (FSE)

FSSD

Appointment of FSEs

- When do FSEs come on board ?
- When should FSEs come on board ?

FSSD

PB approach to fire safety design

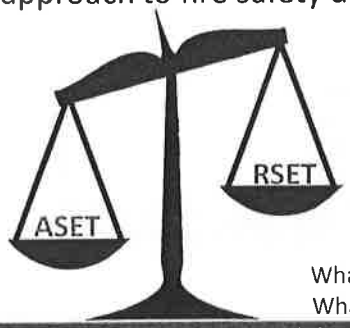
- What is :
  - FEDB?
  - FER?
  - Peer Reviewer Report?
  - Operations & Maintenance Manual?

PB approach to fire safety design

- Singapore Fire Safety Engineering guidelines 2015
  - Part 1 : Fundamentals, input parameters
  - Part 2 : Methods of assessing common deviations
    - FEDB
    - FER
    - Peer Reviewer Report
    - Operations & Maintenance Manual
    - RI (FSE)

Public Protection: Pragmatic in Approach. Professional in Service.

PB approach to fire safety design



What is **ASET** ?
What is **RSET** ?

Public Protection: Pragmatic in Approach. Professional in Service.

CHAPTER 3

3.0 REGISTERED INSPECTOR (FSE) — RI PSE

3.1.1 When are Registered Inspectors (PSE) required?

For projects containing alternative solutions, the aspect under the performance-based assessment has to be supported by a SCDF registered RI, who must also be a PSE. His scope of work involves the checking of on-site installation of fire safety engineering works for compliance with the approved PB plans, FER and Operations & Maintenance Manual and to endorse irregularities to SCDF.

(a) Performance based projects would require RI (PSE): RI (Arch) and RI(M&E). If the RI(Arch) is also a PSE, he/she can be responsible for both the fire safety works listed in Part II of the Fire Safety (Registered Inspector) Regulations and the performance-based works of the project. See Annex H. — RI (Arch)

(b) If the RI(M&E) is also a PSE, he/she can be responsible for both the fire safety works listed in Part II of the Fire Safety (Registered Inspector) Regulations and the performance-based works of the project. See Annex H. — RI (M&E)

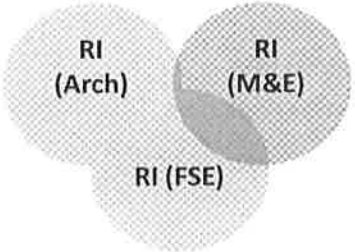
Public Protection: Pragmatic in Approach. Professional in Service.

ASET = Time to untenability

When does a space become untenable ?

Public Protection: Pragmatic in Approach. Professional in Service.

RI (FSE) Scope



Public Protection: Pragmatic in Approach. Professional in Service.

ASET = Time to untenability

Smoke Layer	Tenability Criteria
Smoke layer 2.5m above relevant Finished Floor Level (FFL)	Visibility > 10m Temperature < 200oC
Smoke layer drops below 2.5m above relevant FFL	Temperature < 60oC

Why 2.5m ?

Public Protection: Pragmatic in Approach. Professional in Service.

ASET = Time to untenability

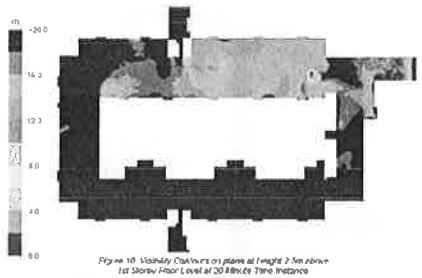


Figure 10: Visibility Contours on plane at Height 2.5m above 1st Storey Floor Level at 20 Minute Time Instance

Evacuation Analysis

Press to start movie

Determines travel and flow times

ASET = Time to untenability

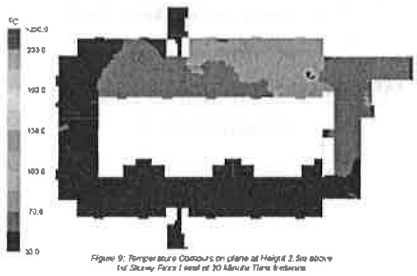


Figure 9: Temperature Contours on plane at Height 2.5m above 1st Storey Floor Level at 20 Minute Time Instance

PB approach to fire safety design

- ASET/RSET – Indefinite
- ASET/RSET ≥ 2
- ASET/RSET ≥ 1.2 *Sensitivity analysis*

RSET = Evacuation Time

$t_d + t_n + t_{pre} + t_{trav}$ and/or t_{flow}

Where :

t_d = detection time
t_n = detection to notification
t_{pre} = notification until evac begins
t_{trav} = time spent moving towards place of safety
t_{flow} = time spent in congestion

PB approach to fire safety design

- Structural Steel
- Radiation/Set back
- DJF

FSSD

PB projects in Singapore

- Which are these ?
- What were their issues ?



Public Protection: Pragmatic in Approach. Professional in Service.

FSSD

PB in Singapore

- Project list in website
- FSE list in website
- Statistics
- More waivers with engineering justification

Public Protection: Pragmatic in Approach. Professional in Service.

FSSD

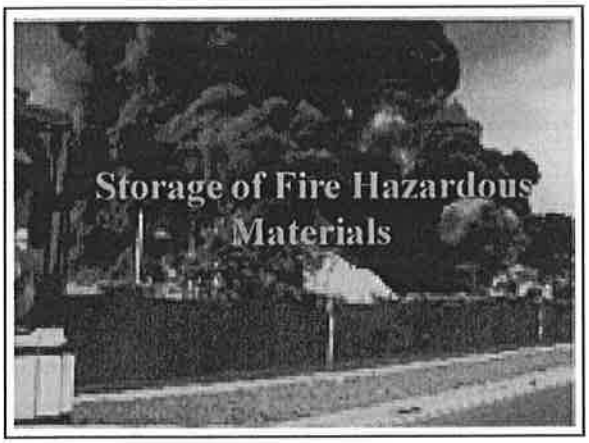
Thank you.

Public Protection: Pragmatic in Approach. Professional in Service.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Design Principles

1. Separation of potential hazards
2. Avoidance of flammable concentration
3. Avoidance of ignition source



Principal Considerations

- **Size Limitation & storage height limit**
- **Site Planning & External Fire Fighting Provision**



1) HAZMAT Dept ← QRA

2) Fire Safety & Shelter Dept (FSSD)

3) Central Enforcement Dept (CED)

↑ Licencing. — storage
Transport
Import
Pipeline.

General Requirements

Hazardous Materials

- **Fire Safety Requirements For Chemical/Hazmat warehouse**
  - ➢**Appendix B of the Fire Code 2007**
  - ➢**Code Of Practice For Fire Precautions In Building 2007**
- **Fire Safety requirements for General Warehouse**
  - ➢**Appendix D of the Fire Code 2007**
    - ➢**Smoke Control System**
      - ➢**Smoke vent, purging system or engineered smoke control system**

SCIC – Guidebook on Warehouse & Storage of Hazardous Materials & Dangerous Goods

1. Guidebook on transport and handling of dangerous goods,
2. Guidebook on the globally harmonised system of classification and labels of chemicals and
3. Guidebook on warehousing and storage of hazardous materials and dangerous goods

International Maritime Organization

IMO

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Appendix B
FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

1 SCOPE

Chemicals or hazardous materials (hazmat) have a wide range of properties and hazards which must be identified and understood in order to fulfill the requirements of safe warehousing. A complete understanding of the hazards requires an assessment of the container and packaging systems and storage arrangements. In addition, the requirements of shall be complied with.

Note: The fire safety requirements for laboratory storing and using chemicals/hazmat shall be in accordance with NFPA 45 [except for the Maximum Allowable Quantity (MAQ) which shall be as stipulated in Table 2 & 3 of this Guideline]. Refer to SCDF's Web-site for more comprehensive details.

Classification of Hazards

Class	Description
1	**Explosives**
2	Flammable Gases [LPG, Hydrogen]
3	**Flammable Liquids** [Acetone, Benzene]
4	**Flammable Solids** [Phosphorus, Magnesium]
5	**Oxidizing Substances** [Benzoyl peroxide, Ether peroxide]
6	**Poisonous Material**
7	**Radioactive Material**
8	**Corrosive Material**
9	**Miscellaneous**

Class 2 Flammable Gases
Class 2.1 – Flammable gases
Class 2.2 – Non-flammable gases
Class 2.3 – Poisonous (toxic) gases

Class 3 Flammable Liquids

Class 4 Flammable Solids
Class 4.1 – Flammable solids
Class 4.2 – Substances liable to spontaneous combustion
Class 4.3 – Substances which, on contact with water, emit flammable gases

Class 5 Organic Peroxides
Class 5.1 – Oxidizing agents
Class 5.2 – Organic peroxides

Class 6 Poisonous Material
Class 6.1 – Poisonous substances
Class 6.2 – Infectious substances

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

2 IDENTIFICATION OF HAZARDOUS MATERIALS (HAZMAT)

2.1 Substances listed as hazardous materials are classified as follows:



FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Class	Type of Hazmat
1	Explosives (1.1 to 1.6)
2.1	Flammable gas
2.2	Non-flammable compressed gas
2.3	Poisonous gas
3	Flammable and combustible liquid
4.1	Flammable solid
4.2	Substance liable to spontaneous combustion
4.3	Substance which, dangerous when contact with water
5.1	Oxidizer
5.2	Organic peroxide
6.1	Poisonous substance
6.2	Infectious substance (etiologic agent)
7	Radioactive material Category I
	Radioactive material Category II
	Radioactive material Category III
8	Corrosive material
9	Miscellaneous hazardous material (dangerous when wet)

Dangerous Goods

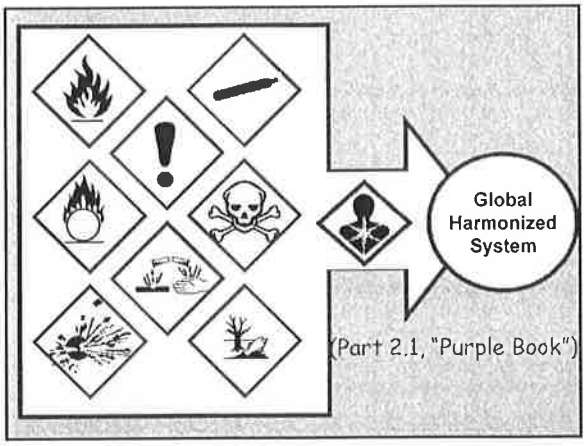


- The "Orange book"
- 16th edition from http://www.unece.org/trans/danger/danger.htm
- Revised biennially
- 16th edition is also available in paper & CD-ROM

6 Nov 2006 SCIC Conference - Logistic & Distribution 12

'Mother Code'

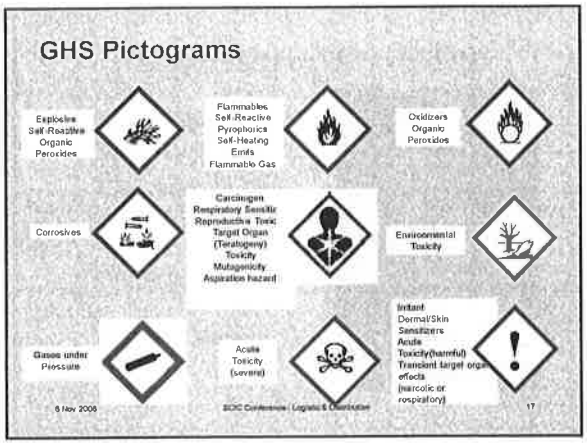
- UN Orange Book – Recommendations on the Transport of Dangerous Goods (UNTDG)
  - – transport them safely by air, rail, road, sea and inland waterways (is the internationally recognized recommendations for classification, package testing and marking requirements)
- IATA, Dangerous Goods Regulations 2008, 49th Edition (International Air Transport Association) – ship dangerous good by air – use by more than 200 airlines
- ICAO, Technical Instructions for the Safe Transport of Dangerous Goods by Air (International Civil Aviation Organization)
- IMO, IMDG Code – Regulations for the safe transportation of Dangerous Goods by Ocean (International Maritime Organization)
- ADR, European Agreement Concerning the International Carriage of Dangerous Goods by Road



SS 586: 2008 (SS286 & CP98)

Specification For Hazard Communication For Hazardous Substances And Dangerous Goods

- **Part 1: Recommendations on the Transport of Dangerous Goods (based on "Orange Book")**
- **Part 2: Globally Harmonised System of Classification and Labelling of Chemicals – Classification And Labelling of Chemicals (based on "Purple Book")**
- **Part 3: Preparation of Safety Data Sheets (SDS) (based on "Purple Book")**



GHS HAZARD CATEGORIES

- Explosive
- Oxidizing
- Flammable
- Corrosive
- Irritant
- Toxic
- Mutagenic
- Carcinogenic
- Teratogenic
- Reproductive Effects
- Harmful to Environment

Globally Harmonized System

UN Dangerous Goods Class	GHS HAZARD CATEGORIES
1 Explosive	• Explosive
2 Compressed gas	• Flammable
3 Flammable liquid	• Oxidizing
4 Flammable solid	• Irritant
5 Oxidizing substances	• Toxic
6 Poison substances	• Mutagenic
7 Radioactive materials	• Carcinogenic
8 Corrosive substances	• Teratogenic
9 Other	• Reproductive Effects
"Orange Book"	• Corrosive
	• Harmful to Environment
	"Purple Book"

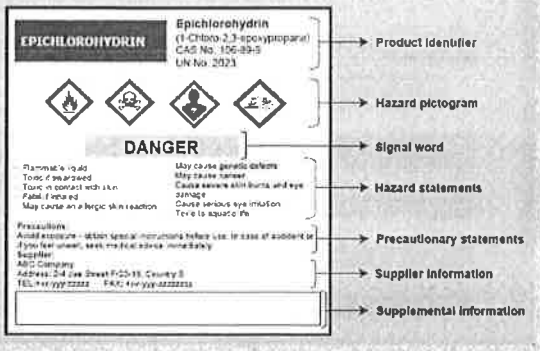
GHS

The "Globally Harmonized System of Classification and Labelling of Chemicals" is the work spanned a wide range of expertises and co-ordinated and published by the United Nations Economic Commission.

GHS provides

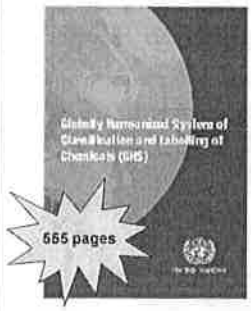
- harmonized criteria for classifying chemicals according to their health, environmental and physical hazards; and
- harmonized hazard communication elements, including requirements for
  - Labelling
  - Safety Data Sheets (SDS)

Hazard Communication - GHS Labels



Work Place Safety

Globally Harmonized System



"The purple book"

- 1st revison : 2005
- 2nd revision: 2007
- 3rd revison : Summer 2009
- Hard copy and CD-ROM
- Internet (FOC)

Hazard Communication - GHS Labels

Labels ...

Old



New

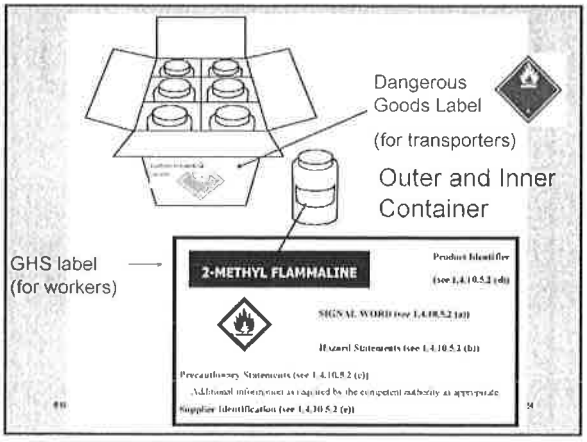


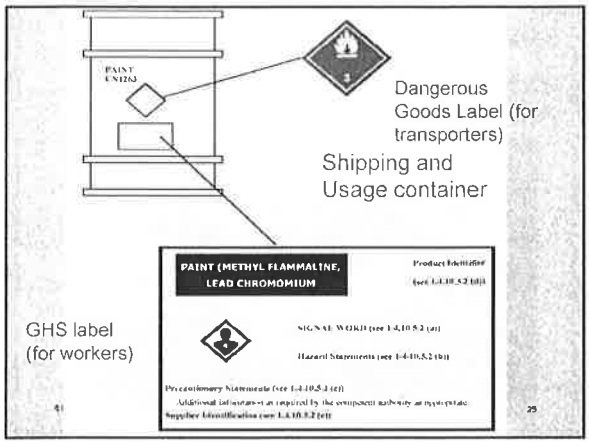
What is a GHS compliant LABEL?

FORMAT and CONTENT

SS586 Part 2 2008

1. Product Identifier
2. Product Pictogram
3. Signal Words
4. Hazard Statements
5. Precautionary statements
   - ✓ General
   - ✓ Prevention
   - ✓ Response
   - ✓ Storage
   - ✓ Disposal
6. Supplier Identification
7. Supplemental Information

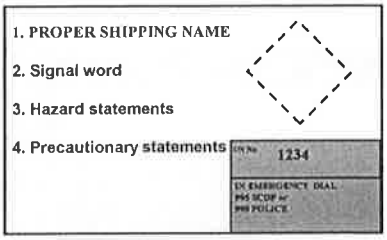




SS 586 : Part 1:2008

Warning Panel for Dangerous Goods

Storage in public areas (Eg. eating places / coffee shops) {NEW}





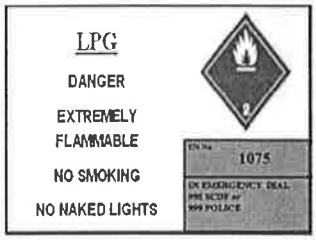
SS 586 : Part 1:2008

Warning Panel for Dangerous Goods

Storage in public areas {NEW}

Sample

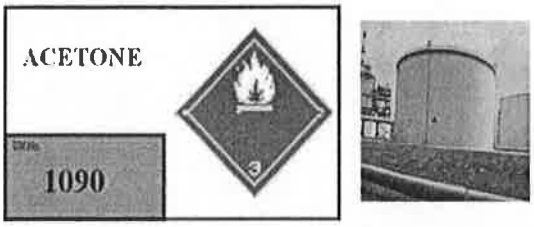


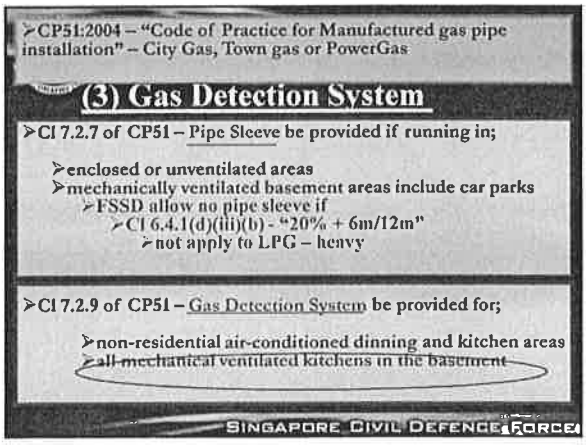


SS 586 : Part 1:2008

Storage Emergency Information Panel (SEIP) {NEW}

Tanks and bulk package stores





Fire Code
(3) Gas Detection System

- FSSD Seminar on Oct 2007
- Metal Pipe Sleeve and Gas Leak Detection System to be provided regardless N/V or M/V for LPG piping system installation within building

Town Gas and LPG

SINGAPORE CIVIL DEFENCE FORCE

SS 586 : Part 1:2008

Transport Emergency Information Panel

--- under SS 286



Hazardous Materials

LPG Cylinder Installation for Commercial & Industrial

To provide steel pipe sleeve for gas pipes that are

(1) in enclosed, unventilated area
(2) basement with mechanically ventilated car park area

[one end of the sleeve shall be exposed to the exterior open safe space]

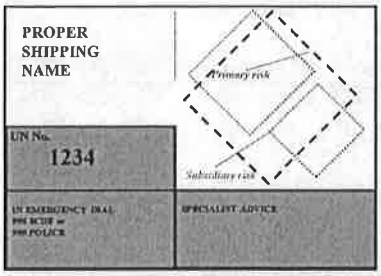
To provide gas leak detection system for the following;

(1) air-conditional dinning & kitchen area
(2) basement kitchen area

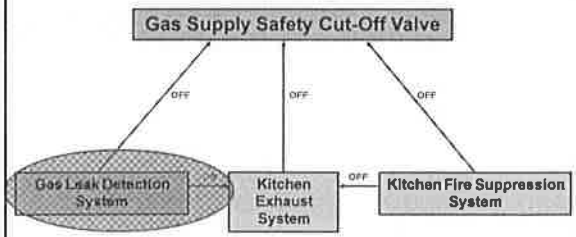
[piping system in basement floor should be provided with the gas leak detection system to activate the gas supply safety cut-off valve]

SS 586 : Part 1:2008

Transport Emergency Information Panel



Interlocking System



FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Note: Consultation with FSSD shall be sought at the initial stage (Quantitative Risk Assessment study may be required by the Hazmat Dept of SCDF) and, at the stage of finalising for further comment and concurrence before the formal plan submission under the Self Regulation Scheme. QP shall obtain the technical requirements from other relevant agencies first before consulting FSSD especially for the followings classes of hazardous materials:

- SPF for Class 1
- NEA for Class 2.3, 3, 6.1, 6.2, & 8
- MOH for Class 6.2 (Health Sciences Authority, HSA)

UN Hazard Substances Classification System

Class 1 Explosives

Trinitrotoluene (TNT), fireworks



Class 1 - Singapore Police Force (SPF)
[Special Unit – NFPA 495 & QRA]

UN Hazard Substances Classification System

Class 4 Flammable substances

Class 4.1 Flammable solids
eg. sulphur, matches

Class 4.2 Substances liable to spontaneous combustion
eg. yellow phosphorus, charcoal

Class 4.3 Substances emit flammable gases on contact with water
eg. Calcium carbide, sodium metal

UN Hazard Substances Classification System

Class 2 Gases

Class 2.1 Flammable gases
eg. acetylene, LPG, hydrogen

Class 2.2 Non-flammable gases
eg. oxygen,nitrogen,



Class 2.3 Poisonous (toxic) gases.
eg. carbon monoxide, chlorine

Class 2 – NFPA 55 (Compressed Gases & Cryogenic Fluids) & NFPA 5000

UN Hazard Substances Classification System

Class 5 Oxidizing substances

Class 5.1 Oxidizing agents
eg nitric acid (HNO_3);
ammonium nitrate

Class 5.2 Organic peroxides
eg benzoly peroxide

- NFPA ~~430~~ 400 or AS 4326 for Class 5.1 (MEA/SPF -ISEP since 2007)
- NFPA ~~432~~ 400 or AS 2714 for Class 5.2

UN Hazard Substances Classification System

Class 3 Flammable liquids

Naphtha
Kerosene

SS 532: 2007 16



UN Hazard Substances Classification System

Class 6.1 Poisonous Substances
eg. ammonia, cyanide

Class 6.2 Infectious Substances
eg. anthrax, ebola



National Environment Agency (NEA) – Class 6.1
Health Sciences Authority (HSA) – Class 6.2

UN Hazard Substances Classification System

Class 7 Radioactive Substances
eg. cesium-137, cobalt-60

Class 8 Corrosive Substances
eg. acid - sulphuric acid
alkalis - potassium hydroxide



National Environment Agency (NEA) RPNSD

~~CRPNS (Centre for Radiation Protection and Nuclear Science)~~ which is under NEA regulates radiological materials.

Hazard Grade Classification

Hazard Classification		Hazard Grade 4	3	2	1	0
Liquids (L)	Class 3	Class I Flash point < 23 °C	Class II Flash point 23 – 61 °C	Class III Flash point 61 – 150 °C	Flash point > 150 °C	Only burns with supporting fire
Solid Materials (S)	Class 4	Ignites very easily and burns rapidly	Ignites and burns rapidly	Readily combustible	Moderately combustible	Combustible only with supporting fire
Oxidizing Agent (O.A)*	Class 5.1	Very strong oxidizing agent	Strong Oxidizing agent	Weak Oxidizing Agent	-	-
Organic Peroxide (OP)*	Class 5.2	Class I (may classified Under Explosive)	Class II	Class III	Class IV	Class V

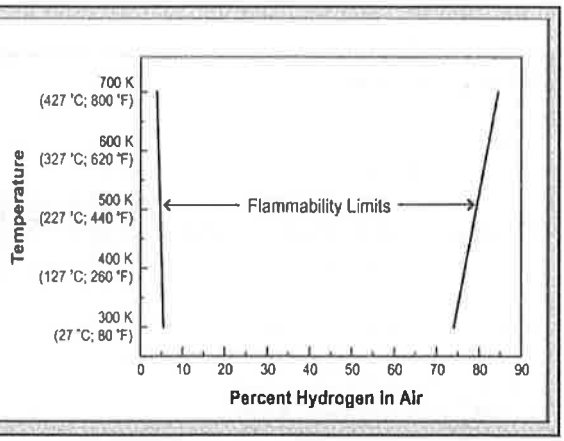
* Base on NFPA

For flammablegases (Class 2.1)classification, theLFL less than 13% or flammability range isgreaterthan 12

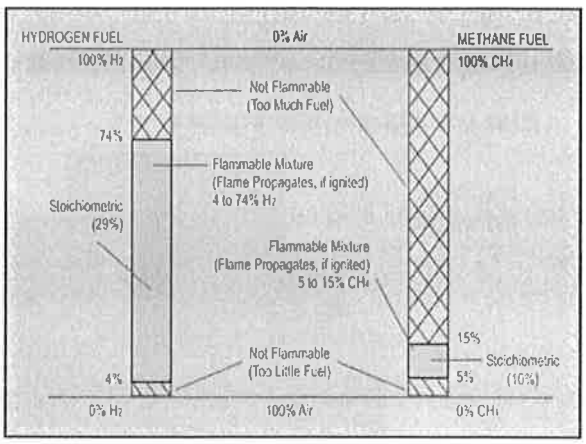
UN Hazard Substances Classification System

Class 9 Miscellaneous dangerous substances
eg aerosols, bitumen









Classification of Flammable Liquids: Singapore

SS 286: 1984	CP 98: 2003	Petroleum & FM Regulations 2005
FP < -18°C or possessing low FP with other dangerous property	PG I: FP < 23°C Initial BP ≤ 35°C	Class O: LPG
FP > -18°C and < 23°C	PG II: FP < 23°C Initial BP > 35°C	Class I: FP < 23°C
FP ≥ 23°C and ≤ 60°C	PG III: FP ≥ 23°C but ≤ 61°C Initial BP > 35°C	Class II: FP ≥ 23°C but < 61°C
		Class III: FP ≥ 61°C but ≤ 93°C

Remarks: FP - Flash Point, BP- Boiling Point, PG – Packaging Group

General Requirements

Hazardous Materials

- **Compressed Gas (Class 2), Flammable liquids (Class 3), flammable solids (Class 4), oxidizing agent (Class 5.1) and organic peroxide (Class 5.2)**
  - ➢ be located at ground floor only
  - ➢ Storage height limit to 18m (single-storey warehouse)
  - ➢ Storage height limit to 15m (1st storey within multiple-storey warehouse) [for non-sprinkler building the height limit is shall baseon NFPA and should not be higherthan 3.6m]
- **Solid materials (Class 4.1)**
  - Allow at upper floor but less than 24m
  - storage quantity limit to 1,200kg/m²
- **No compartment to comprise more than one storey**

GHS Cl 3.12.1 (SS532) Categories of flammable liquid

Categories	Range of Flash point SS 532 : 2007 (Revision of CP 40)	FPC 2004
Cat 1	Flash point less than 23°C (initial boiling point ≤ 35°C)	Class I
Cat 2	Flash point less than 23°C (initial boiling point > 35°C)	
Cat 3	Flash point between 23°C (inclusive) to 60°C (inclusive)	Class II
Cat 4	Flash point ranging between 60°C to 93°C (inclusive)	Class III
Not classified by GHS	Flash point more than 93°C to 150°C (inclusive) (follow Cat 4 classification requirements)	

General Requirements

Hazardous Materials

- **Different Classes and incompatible materials to be stored in separate compartment**
- **Hazmat that react with water (class 4.3) to be stored in separate compartment**
- **The travel distance shall comply with high hazard occupancy, the 10/20m (for NS) or 20/35m (for S) for hazard grade 2 to 4.**
  - **➢ 15/30m (for NS) or 25/60 (for S) for normal warehouse**
- **For those use & storage of Hazmat that allow at upper floor shall not be at level higher than 24m habitable floor height**
- **To comply with the General Warehouse requirements**
  - **the storage height limit sign "No Storage Beyond This Line"**
  - **smoke control ventilation**

Note: NS: Non-Sprinkler
S: Sprinkler

Size Limitation & Fire Protection Syste

Hazardous Materials

Hazard Grade	Maximum Fire Compartment Size (m²) K1	K2	K3	K4
4 & 3	≤50	≤200	≤600	≤900
2	≤100	≤ 400	≤ 2400	≤ 3600
1	≤400	≤ 1600	Comply with the General Warehouse	Comply with the General warehouse

[take hazard grade4 & 3 as example]

K1 Small Structure [allow fire compartment up to 50 m²]
Manual fire alarm with DECAM

K2 Automatic surveillance [allow fire compartment up to 200 m²]
Automatic fire detection with DECAM

K3 Extinguishing systems [allow fire compartment up to 600 m²]
Automatic sprinkler with DECAM

K4 Extinguishing system with foam [allow fire compartment up to 900 m²]
Automatic foam sprinkler with DECAM

Site Planning & External Fire Fighting Provisio

Hazardous Materials

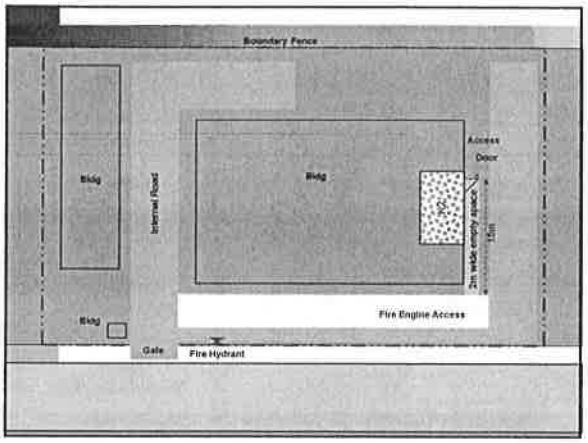
- **The provision of accessway (minimum 6m wide) shall be calculated base on the gross cubical extent of the building (fire compartment?):**
  - < 14,200m³ (7,100m³) - 1/6 perimeter (min 15m)
  - < 28,400m³ (14,200m³) - ¼ perimeter
  - < 42,400m³ (28,400m³) - ½ perimeter
  - < 56,800m³ (42,400m³) - ¾ perimeter
  - > 56,800m³ (42,400m³) - Island wide site access

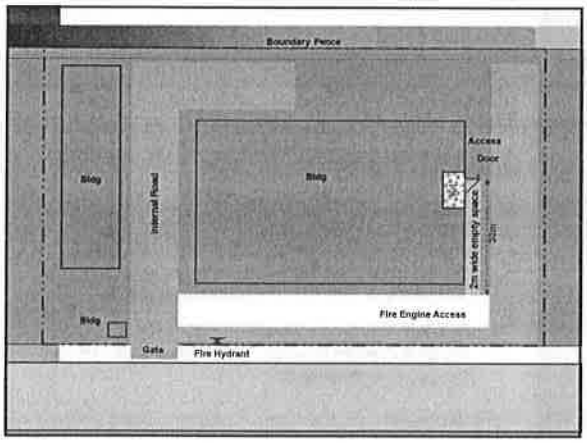
Site Planning & External Fire Fighting Provisio

Hazardous Materials

➢For K1 compartment size, at least one wall of such compartment shall be directly on the external facade of the building fronting at least a 2m wide empty space such as turf area leading to the fire engine access road or accessway.

➢At least one access door shall be provided and placed not more than 30m from the fire engine access road or accessway for ease of fire-fighting.





Site Planning & External Fire Fighting Provisio

Hazardous Materials

➢For K3 and K4 compartment size, at least one wall of such compartment shall be directly on the external facade of the building fronting the 4m wide fire engine access road or 6m wide accessway.

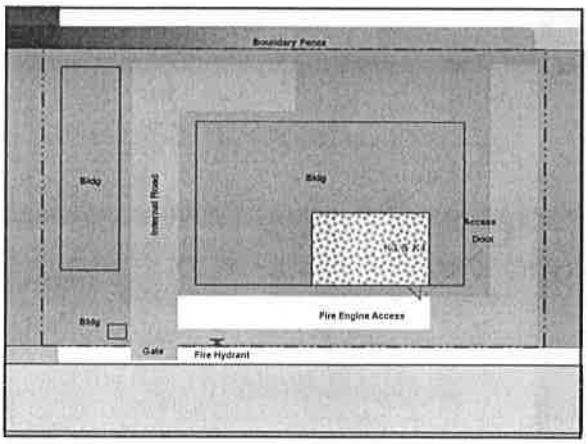
➢At least one access door shall be provided along this external wall for ease of fire-fighting.

Site Planning & External Fire Fighting Provisio

Hazardous Materials

➢For K2 compartment size, at least one wall of such compartment shall be directly on the external facade of the building fronting at least 2m wide empty space such turf area leading to the fire engine access road or accessway.

➢At least one access door shall be provided and placed not more than 15m from the fire engine access road or accessway for ease of fire-fighting.



Site Planning & External Fire Fighting Provision

Hazardous Materials

➢The loading and unloading shall be carried out directly from the external wall for K2, K3 and K4 compartment size

➢ For K1, the access distance from the external to these compartment shall be less than 10m for NS and 15m for S.

➢If Fireman Access Panels (FAP - door or window) are provided they shall be placed not more than 20m apart.

➢For storage located at upper floor such as Class 4.1, fire engine accessway and FAP shall be provided for the full stretch of the external wall.

Note: NS: Non-Sprinkler
S: Sprinkler



Site Planning & External Fire Fighting Provision

Hazardous Materials

- **Fire water supply for private hydrant**
  - PUB fed hydrants – K1 & K2
  - Pump fed hydrants – K3 & K4
- **Spillage Control and Retention Basin for the Hazmat and Fire-Fighting Water run-off**
  - SS532 & NEA requirements (NFPA 30)
    (drain pipe with gate valve to open drain line)
- **Caution labels (data/info & warning sign) for all exit and access door**
  - ➢SS586

Fire Extinguisher

Hazardous Materials

➢The provision of fire extinguishers shall comply with CP55 and CP532

➢50kg ABC (foam or chemical power) fire extinguishers (the safe operating range shall be minimum of 6m with discharge hose length of minimum 6m) shall be provided to cover the loading and unloading area for K2, K3 and K4 compartment.

Ventilation System

Hazardous Materials

➢The daily ventilation shall comply with SS532 (CP40) and the smoke control system shall comply with the general warehouse requirements.

➢The daily operated mechanical ventilation systems for vapour removal shall be interlocked with the smoke control system to ensure that both system will not be affecting one another.

➢The ventilation design shall allow air-movement across all portions of the floor/room to prevent the accumulation of vapour and to avoid short-circuiting the M/V system.

Hazardous Materials



Fire Extinguisher

Hazardous Materials

➢The provision of fire extinguishers shall comply with CP55 and CP532

➢50kg ABC (foam or chemical power) fire extinguishers (the safe operating range shall be minimum of 6m with discharge hose length of minimum 6m) shall be provided to cover the loading and unloading area for K2, K3 and K4 compartment.

➢The access from any remote point of the loading/unloading area (including the parking lots area) to such 50kg fire extinguishers shall not be more than 15m.

➢For K1 compartment size, such 50kg fire extinguisher is needed only when the overall Hazmat storage area is more than > 100 m²

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Note:

(i) Refer to Table 1 for hazard grade classification;

(ii) The required fire protection system is only restricted to the chemical/hazmat warehouse fire compartment. However, automatic fire detectors (linked to DECAMS) shall also be provided along the perimeter of the fire compartment wall if the building housing the hazmat warehouse is not protected with the automatic or the sprinkler system (it is only applicable where the warehouse is directly connected to other occupied area within the building through access opening);

(iii) The fire rating of the fire compartment wall shall be minimum 2 hours regardless of the type of fire protection system. For Class 3 hazmat storage, it shall be masonry construction except the ceiling (all floor element above such hazmat storage shall be masonry construction with minimum of 2 hours rating) may use fire rated board but to comply fully with the M&E riser shaft requirements.

(iv) Different classes and incompatible hazmat shall be stored in separate fire compartment with minimum 2 hours fire rating;

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

3 SIZE LIMITATION

3.1 For chemical/hazmat warehouses storing Class 3, 4 & 5 hazardous materials, the maximum floor area per compartment and type of fire protection system shall as follows:

Hazard Grade	Maximum Fire Compartment Size (m²)			
	K1	K2	K3	K4
3 & 4	≤ 50 m²	≤ 200 m²	≤ 600 m²	≤ 900 m²
2	≤100 m²	≤ 400 m²	≤2,400 m²	≤3,600 m²
1	≤400 m²	≤2,000 m²	**	**

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Note:

(v) No basement floor is allow to store Hazardous materials;

(vi) The compartment size limit and type of fire protection system for Class 2 Hazmat shall follow Hazard Grade 1 requirements;

(vii) Fire rated roller shutter is not allowed for the purpose to limit the compartment size control; any fire rated roller shutter at the access opening shall be activated by either local automatic smoke detection system or/and the general building automatic fire alarm system;

** No specific limit but to comply with the fire safety requirements for general warehouse.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

3 SIZE LIMITATION

Type	Provision of Fire Protection System	
K1	Relatively small structure & low fire risk	Manual fire alarm with DECAMS system
K2	Automatic surveillance	Automatic fire detection with DECAMS system
K3	Automatic fire suppression system	Automatic sprinkler (CP52) with DECAMS system
K4	Automatic extinguishing system (foam system)	Automatic foam sprinkler with DECAMS system

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

3.2 Storage of compressed gases (Class 2), flammable liquid (Class 3), flammable solid (Class 4.2 & 4.3), oxidizing agent (Class 5.1) and organic peroxide (Class 5.2) shall be located only at the ground floor with at least one external wall facing directly to a exterior open safe space unless otherwise stipulated;

3.3 Solid materials (Class 4.1) is allowed to be stored at aboveground floors of habitable height not more than 24m and the storage quantity shall be limited to 1,200kg/m² of floor area.

3.4 Compressed gas cylinders (Class 2) are allowed to be stored at aboveground floors of habitable height not more than 24m provided that a vehicular ramp (with turning facility) suitable for 24 ton fire engine is erected for direct access to the storage area.

3.5 For Class 2 hazardous materials, no stacking is allowed. The hazardous materials shall be laid directly on the floor.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

3.6 Storage, use and handling of compressed gases (Class 2) shall be in compliance with NFPA 55 and it may allow be located at aboveground floor.

3.7 For sprinkler protected warehouse, the storage height shall be limited to 18m for single storey warehouse and 15m for Warehouse that is located at 1st storey of a multiple-storey building. For non-sprinkler protected warehouse storing Class 3 hazardous materials, the storage height shall be in compliance with NFPA 30 (basing on the flashpoints of the hazardous materials), subject to a maximum height of 3.6m.

3.8 Storage of oxidizers (Class 5.1, solid or liquid) shall be in compliance with NFPA 430 or AS 4326.

3.9 Storage of organic peroxide (Class 5.2) shall be in compliance with NFPA 432 or AS 2714.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

4.2 At least one external wall of the warehouse shall be directly fronting an empty space (such as turf area) of minimum width 2m. One of the access doors provided along this external wall shall be placed not more than 30m (for type K1) or 15m (for type K2) from the fire engine access road or accessway for ease of fire-fighting.

4.3 For K3 and K4 compartment, at least one external wall shall be directly fronting an engine access road or accessway. At least two exit access doors (minimum 15m apart) shall be provided along this external wall for ease of fire-fighting.

4.4 The loading and unloading (the area may be roofed over) shall be carried out directly from the exterior open space for type K2, K3 and K4 compartments.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

3.10 No compartment in the chemical/hazmat warehouse shall comprise more than one storey.

3.11 Recommendations made within the individual Material Safety Data Sheet (MSDS) shall be complied with.

3.12 An approved layout plan (with the relevant TFP/FSC) with such hazmat warehouse/storage clearly highlighted shall be kept within the premises to facilitate the inspection and emergency operation procedures.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

4.5 For type K1 compartment, the distance from the external loading/unloading area (may be roofed over) to the access door of the compartment shall not be more than 10m for non-sprinkler protection building and 15m for sprinkler protection building. For Class 3 hazardous materials, the maximum volume of hazardous liquid shall be limited to 3,000L or 5,000L for non-sprinkler and sprinkler protected compartment respectively.

4.6 For storage of Class 4.1 hazardous materials aboveground level, fire engine accessway and the associated FAPs shall be provided for the full stretch of the external wall of the storage area.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

4 PROVISION OF ACCESSWAY

Fire engine accessway shall be provided for fire fighting appliances. The length of the accessway, based on the gross cubical extent of the entire warehouse space, shall be as follows:

Non-Sprinkler Protected Cubicle Extent	Length of Acessway
<7,100m³	1/6 perimeter (min 15m)
<14,200m³	⅓ perimeter
<28,400m³	½ perimeter
<42,400m³	⅔ perimeter
>42,400m³	island site access

Sprinkler Protected Cubicle Extent	Length of Acessway
<14,200 m³	1/6 perimeter (min 15m)
<28,400m³	¼ perimeter
<42,400m³	⅓ perimeter
<56,800m³	¾ perimeter
>56,800m³	island site access

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

5 WATER SUPPLY FOR PRIVATE HYDRANT

5.1 Water supply for hydrant system shall comply with the following requirements:

(a) Hydrant fed by PUB mains is allowed for type K1 and K2 compartments. The water supply requirement shall comply with the clause 4.4.2(a) of the Fire Code.

(b) Hydrant with dedicated pumping & storage facilities shall be provided for type K3 and K4 compartment. The water supply requirement shall comply with the Table 4.4.2(a) of the Fire Code with minimum running pressure of 3.5 bars (it shall be designed accordingly to individual emergency respond plan and respective SOP).

5.2 The spillage control and retention basin for fire fighting water for warehouse storage hazardous substances shall be in accordance with SS 532 , NEA requirements and NFPA30. Gate valve(s) shall be provided from the second containment (such as bund wall) at a safe location to allow the fire-fighters to operate during emergency and, the outlet shall be directly drained to a safe area or storm drain.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

6 MECHANICAL VENTILATIONSYSTEMS

6.1 The ventilation systems for warehousestoring Class3 hazardous materialsshall comply with SS 532 and the smoke control system shallcomply with the requirements for general warehouse.

6.2 The ventilation system for Class 2 shall comply with NFPA55;

6.3 Mechanical ventilation system for removal of vapour shall be interlockedwith the smoke control system to ensure that both systemswill not be affectingone another.

6.4 The ventilation system shall be designed toprovide air-movement across all portions of the room to prevent the accumulation of vapours. Short-circuiting of the mechanical ventilation system shall be avoided.

6.5 Fresh air inlets and exhaust outlets shall be properly located according to the type of gases or vapours to be exhausted.

Note: The air-conditioningsystem and M/V system for the storage area of hazmat shall not be sharedwith other occupied area.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

9 OTHER FIRE SAFTY REQUIREMENTS

9.1 The following standards and codes of practices (may not be exhaustively listed) shall be complied with for the proposed chemical/hazmat warehouse:

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

7 FIRE EXTINGUISHER

7.1 Fire extinguisher shall be provided complying with CP 55, SS532 and other related standards. Please also refer to the relevant MSDS and consult the manufacturer or supplier for the details.

7.2 Additional mobile type 50kg ABC (foam or chemical powder) fire extinguishers having minimum 6m throw and the discharge hose length of minimum 6m shall be provided to cover the loading and unloading area for K2, K3 and K4 compartment under hazard grade 2, 3 & 4. The access from any remote point of the loading / unloading area (including the parking lots area) to the 50kg fire extinguishers shall not be more than 15m.

7.3 For K1 compartment size, mobile type 50kg fire extinguisher shall only be required when the overall Hazmat storage area is more than 100m².

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

a) CP 10 : Code of Practice for theInstallation and Servicing ofElectrical Fire Alarm System

b) CP 29 : Code of Practice for FireHydrant Systems and HoseReels

c) CP 52 : Code of Practice for AutomaticFire Sprinkler System

d) CP 55 : Code of Practice for Use and Maintenanceof Portable Fire Extinguishers

e) SS 98 : Preparation and use of Material Safety DataSheets (MSDS)

f) SS 254: Electrical Apparatusfor explosive Gas Atmosphere

g) SS 286 :Classification and class labels for hazardous substances

h) SS 532 : Storage of Flammable and CombustibleLiquids

i) NFPA 16A : Foam-Water Sprinkler and Spray Systems

j) NFPA 45 : Fire Protection for Laboratories Using Chemicals (refer to Table 2& 3 for the MAQ)

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

8 DETERMINATION OF EXIT REQUIREMENT

8.1 The determination oftravel distance in chemical/hazmatwarehouse shall be in compliance withTable 2.2 A of the Fire Code for high hazard occupancy, 10m/20m for non-sprinkler building and 20m/35m for sprinkler protected building.

8.2 All exit and access doors shall be provided with the proper hazard and warning sign on both sides of these doors.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

k) NFPA 55 : Compressed Gases & Cryogenic Fluids

l) NFPA 70 : National Electrical Code

m) NFPA 430 : Liquid and Solid Oxidizers

n) NFPA 432 : Storage of Organic Peroxide

o) NFPA 495 : Explosive Materials Code

p) NFPA 704 : Identification of the Hazards of Materials

q) AS 2714 : The storage and handling of hazardous chemical materials – Class 5.2 substances (organic peroxides)

r) AS 4326 : The storage and handling of oxidizing agents

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Table1: Hazard Grade Classification

Hazard Classification		Hazard Grade				
		4	3	2	1	0
Liquids	Class 3	category 1 & 2 Flash point 23° C	category 3 Flash point 23 - 60° C	category 4 Flash point between 60 - 150° C	Flash point > 150° C	Only burns with supporting fire
Solid Materials	Class 1	Ignites very easily and burns rapidly	Ignites and burns rapidly	Readily combustible	Moderately combustible	Combustible only with supporting fire
Oxidizing Agent	Class 5.1	class 1 Very strong oxidizing agent (may classified under explosive substance)	class 3 Strong oxidizing agent	class 2 Weak oxidizing agent		
Oxidizing Peroxide	Class 5.2	class I	class II	class III	class IV	class V

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Table 3: Maximum Allowable Quantities (MAQ) in Laboratory for Gases

Item	Types of Gases	MAQ (L, litres per Lab Work Floor Area with sprinkler protection)
1	Flammable gasses	(i) 170 L or (ii) 3.4 L/m² per cluster
2	Oxidizing gasses	(i) 170 L or (ii) 3.4 L/m² per cluster
3	Liquefied flammable gasses*	(i) 30 L or (ii) 0.6 L/m² per cluster
4	Toxic gasses	(i) 8L or (ii) 0.16 L/m² per cluster

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Table 2: Maximum Allowable Quantities (MAQ) in Laboratory for Liquid

Lab Unit	Including Qty in Cabinet	Including Qty in Cabinet
	Max Qty (L, litres per Lab Unit floor area)	Max Qty (L, litres per Lab Unit floor area)
Laboratory	(i) 70L or (ii) 1.6L/m² and not more than 350L (500L); should portion of liquid stored used in cat 1 & 2, it shall be limited to (i) 2.4L or (ii) 0.8L/m² and not more than 250L (350L)	(i) - (ii) 3.2L/m² and not more than 750L (1000L); should portion of liquid stored used in cat 1 & 2, it shall be limited to (i) - (ii) 1.6L/m² and not more than 500L (750L);
Laboratory with hospital and healthcare occupancy	(i) 30L or (ii) 0.4L/m² and not more than 150L (250L); should portion of liquid stored used in cat 1 & 2, it shall be limited to (i) 5L or (ii) 0.4L/m² and not more than 150L (250L)	(i) - (ii) 0.8L/m² and not more than 250L (500L); should portion of liquid stored used in cat 1 & 2, it shall be limited to (i) - (ii) 0.8L/m² and not more than 250L (500L);

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Note:

i) The capacity in litres (L) is referred to the internal volume (water capacity) of the gas cylinder;

ii) Lab Work Area is not necessary be individual fire compartment but shall be housed within a lab unit;

iii) For item 1 to 3, the MAQ shall be halved for those building which is not protected with sprinkler system;

iv) Item 1 to 4 may be accommodated in a single cluster and be spaced at least 3 m apart from each cluster (6 m for building without sprinkler protection);

v) To comply with NFPA 45 for others requirements such as the ventilation (4 & 8 A/C), hazard identification and "No Smoking" signs etc;

vi) The provision of sprinkler system shall be designed under the Ordinary Hazard Group 3 Special (CP52);

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Note:

i) Individual lab unit shall be a fire compartment;

ii) Each safety cabinet is still restricted to max of 250L (to comply with SS 532);

iii) { } is referring to the maximum allowable quantities for sprinkler protected building;

iv) Laboratory operators are strongly advised and encouraged to minimize their amount of flammable liquids on benches by returning them to chemical store or safety cabinets (UL, FM or PSB listed product) when the liquid are not needed for the day. The quantity of these liquid placed on benches and fume cupboards shall not exceed 10% of the total allowable storage capacity within the lab unit. Liquids used for running and operating laboratory instruments or other work-in-progress which may require some quantities of solvents to operate are exempted from the 10% limit.

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES

Note:

vii) No combustible materials shall be placed within 3m buffer range of the gas cylinder;

viii) No flammable or combustible liquid shall be placed within 6m buffer range of the gas cylinder;

ix) For storage and handling of Class 2 hazmat in enclosed space (including the concealed space of raised floor and ceiling), metal pipe sleeve and gas leak detection system shall be provided to reduce the accumulation of gases and vapours that may cause danger to occupant, building and emergency response team. Oxygen-level monitoring system shall be provided to prevent the possibility of oxygen-deletion (Asphyxiation) within the room;

x) The air-conditioning system and M/V system for laboratory unit shall not be shared with other occupied area.

* For LPG cylinders, only 2 x 4.5kg cylinders are allow for each lab unit.

Appendix B

FIRE SAFETY REQUIREMENTS FOR CHEMICAL/HAZMAT WAREHOUSES & LABORATORIES USING CHEMICALS

1 SCOPE

1.1 Chemicals or hazardous materials (hazmat) have a wide range of properties and hazards which must be identified and understood in order to fulfill the requirements of safe warehousing. A complete understanding of the hazards requires an assessment of the container and packaging systems and storage arrangements. In addition, the requirements of general warehouse shall be complied with.

1.2 For laboratory where there is handling of chemicals/hazmat, it shall comply with this Fire Code, NFPA 45:2011 and NFPA 55:2010. In addition, it is to be noted that for NFPA 45:2011, Class A and B of the Maximum Allowable Quantity (MAQ) as specified in this standard is not permitted in the laboratory. However, for Class C and D MAQ, these are permitted in the laboratory but with modifications (see Table 2 of this Appendix). Also, the MAQ shall be further reduced based on floor level as stipulated in NFPA 45 and 55.

1.3 Laboratory with Class C MAQ will be considered as industrial occupancy and shall be designed based on purpose group VI as defined in the Fire Code. For such laboratory, the door swing shall be in the direction of escape if it serves more than 25 persons. For buildings provided with fireman lift, the minimum lift car size shall be 1.7m (depth) x 1.5m (width).

stored 10% of the total allowable storage capacity within the lab unit. Liquids used for research and operating laboratory instruments or other work-in-progress which may require some quantities of solvents to operate are exempted from the 10% limit.

f) The above-mentioned MAQ shall include waste. The quantity of each package container shall be limited to 5L.

g) To comply with SS586 on "Specification for Hazard Communication for Chemicals and Dangerous Goods".

h) To comply with NFPA 45 including air changes and all relevant requirements stipulated by MOM.

i) Please refer to Table 5.11.1 of NFPA 55 for the limitation on MAQ per Control Area for Laboratory Use.

j) No more than 6 cylinders shall be placed within the limits of any gas cabinet unless the gas cabinets are kept within gas enclosure or the building is protected with sprinkler system.

k) No flammable or combustible liquid shall be placed within the limits of these gas cabinets.

l) The provision of sprinkler system shall be designed under the Ordinary Hazard Group 2 Special (OH2) for Class C and Ordinary 1.

m) For storage and handling of Class 2 hazmat in enclosed areas (including the associated types of manual flow and racking), manual pipe sleeve and gas leak detection system shall be provided to reduce the accumulation of gases and vapours that can cause danger to occupant, building and emergency response team. Oxygen-level monitoring system shall be provided to prevent the possibility of oxygen-deficient (asphyxiation) within the room.

n) The air-conditioning system and M/V system for laboratory unit shall not be shared with other occupied area.

o) For the provision of fire extinguisher under CP5, Class C and D are considered as High and Medium Hazard respectively.

p) Laboratory without hazmat does not attract it. However, if it need be located at the basement, it shall be considered to apply the four treatment tiers.

q) For LPG cylinders, only 2 x 45kg cylinders are allow for each lab unit.

Table 1: Hazard Grade Classification

Hazard Classification		Hazard Grade				
		4	3	2	1	0
Liquids	Class 3	Category 1 & 2 Flash point < 23° C	Category 3 Flash point 23 - 60° C	Category 4 Flash point between 60 - 150° C	Flash point > 150° C	Only burns with supporting fire
Solid Materials	Class 4	Ignites very easily and burns rapidly	Ignites and burns rapidly	Readily combustible	Moderately combustible	Combustible only with supporting fire
Oxidizing Agent	Class 5.1	Class 4 Very strong oxidizing agent (may classified under explosive substance)	Class 3 Strong oxidizing agent	Class 2 Weak oxidizing agent	-	-
Oxidizing Peroxide	Class 5.2	Class I	Class II	Class III	Class IV	Class V

Note:
a For flammable gases (Class 2), the LFL (or LEL) is less than 13% or the flammability range is greater than 12
b Classification and this respective hazard grades may subject to change in accordance with the international standards such as ISO, EN, or GHS (Globally Harmonized System of Classification & Labelling of chemicals) etc.

Fire Safety Requirements

Singapore Standards

Code of Practice SS 532: 2007

"Code of Practice for Storage of Flammable Liquids"



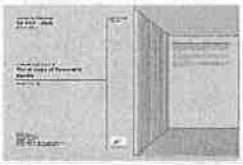


Table 2: Maximum Allowable Quantities (MAQ) in Laboratory for Liquid

Lab Unit	Excluding Qty in Cabinet	Including Qty in Cabinet
	Max Qty (L, litres per Lab Unit floor area)	Max Qty (L, litres per Lab Unit floor area)
Laboratory (Class C and classified as industrial building)	i) 50L or ii) 1.0L/m² and not more than 350L (500L) should portion of liquid stored/used in cat 1, 2 and 3, it shall be limited to i) 20L or ii) 0.8L/m² and not more than 250L (350L)	i) - ii) 3.2L/m² and not more than 750L (1000L) should portion of liquid stored/used in cat 1, 2 and 3, it shall be limited to i) - ii) 1.6L/m² and not more than 500L (750L)
Laboratory (Class D and classified as non-industrial building)	i) 10L or ii) 0.4 L/m² and not more than 150L (250L) should portion of liquid stored/used in cat 1, 2 and 3, it shall be limited to i) 5L or ii) 0.4 L/m² and not more than 150L (250L)	i) - ii) 0.8L/m² not more than 250L (500L) should portion of liquid stored/used in cat 1, 2 and 3, it shall be limited to i) - ii) 0.8L/m² and not more than 250L (500L)

Note:
i Each lab unit shall be a fire compartment with fire rated construction (REI/60). The minimum fire rating including fire resisting doors shall be 2 hours (excluding the roof) during the construction (BWP and Structural Steel).
ii Each store cabinet shall not exceed its max of 250L, to comply with BS 545.
iii [ ] is referring to the maximum allowable quantities for operation personnel working. However, it is now prohibited to bring the lab unit that be provided with automatic fire sprinkler system.
iv Laboratory operators are strongly advised and encouraged to minimize their inventory of flammable liquids on benches by returning them to chemical store or safety cabinets ASAP. Put in FSB board products when the liquid are not needed for the day. The quantity of these liquid placed on benches and fume cupboards shall not

CP532 (2007)

Hazardous Materials

•CP 40 – 1987

•Introduce minor storage concept base on AS 1940-2004

•To allow more fire safety cabinets as a group and kept in a fire compartment base on NFPA 30-2003

•Incorporate part of the guidelines stipulated in the "Oil & Petrochemical Industry Technical & Safety Committee" (OPITSC - 1991)

•Public comment in Jun 06

•SS532(CP40) Seminar by SPRING in 7th July 06

•Launching of new SS 532 by SPRING in 29th July 07

Fire Fighting Facilities

- **Fire extinguishment**
- **Fire Exposure Protection**
- **Mobile & Portable Fire Equipment**

Contents

CP40 :1987	SS 532 : 2007 (Revision of CP40)	
1. Scope	1. Scope	
---	2. Normative references ←	NEW
2. Definitions	3. Definitions	
---	4. Minor Storage ←	NEW
3. General requirements	5. General requirements for package and tank storage	
4. Package storage areas	6. Package storage and Handling	
5. Storage in tanks	7. Storage in tanks	
6. Piping and tank auxiliaries	8. Piping and tank auxiliaries	
7. Operations	9. Operations	
8. Fire-fighting facilities	10. Fire fighting facilities	

Fire Fighting Facilities

1. **Fire Mains**
2. **Fire Pumps**
3. **Hydrant System**
4. **Foam System (Fixed/Semi-fixed)**
5. **Exposure Protection**
6. **Mobile & Portable Fire Equipment**

Minor Storage

- The underlying concept of this clause is that quantities below a certain level are so small, or are so scattered and separated, that they **present no real hazard**, add little to a building's fire load, and are **generally unlikely to play a significant part in spreading a fire from place to place**.
- The fire safety and fire-fighting facilities required under normal building regulations are expected to cope **adequately**.
- Any storage of flammable liquids in quantities not exceeding those listed in **Table 1** shall be classified as being minor storage and are exempted from other clauses of this Standard unless otherwise specified.

Retension Basin for Fire-Fighting Water for Warehouse Storing Hazardous Substances

CHEMICAL WAREHOUSE

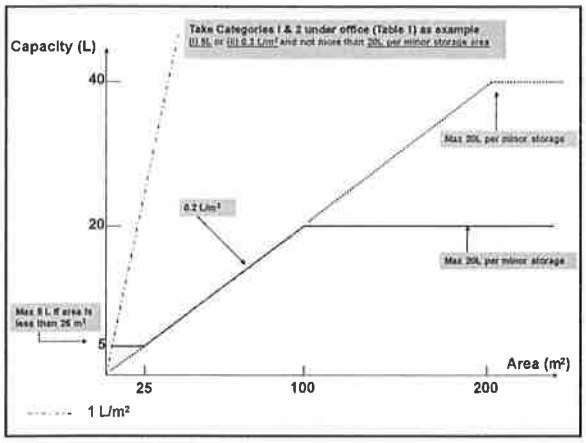
Fire Compartment (m^2)		Average Fire-Fighting Water Used (l/m^2 min)	Retention Of Fire-Fighting Water (m^3/m^2)	Total Volume of Retention Required (m^3)
50	WO WS	3.3	0.1	5
	With WS	3.3	0.1	5
100	WO WS	6.6	0.2	20
	With WS	6.6	0.2	20
150	WO WS	8.8	0.4	60
	With WS	8.8	0.4	60
200	WO WS	10.0	0.6	120
	With WS	10.0	0.6	120
300	WO WS	7.7	0.7	210
	With WS	6.6	0.4	120
400	WO WS	6.6	0.8	320
	With WS	5.0	0.3	120
800	WO WS	6.0	0.9	480
	With WS	4.0	0.15	120
600	WO WS	3.8	1.0	600
	With WS	3.1	0.2	120
800	WO WS	5.6	1.2	960
	With WS	2.6	0.15	120
1000	WO WS	5.4	1.4	1400
	With WS	2.0	0.12	120
1200	WO WS	5.3	1.5	1800
	With WS	1.7	0.1	120
1600	WO WS	5.0	1.5	2400
	With WS	1.3	0.075	120
>1600	WO WS	5.0	1.5	To Be Calculated
	With WS	1.3	0.075	120

WO WS = Without Water Sprinklers.
With WS = With Water Sprinklers.

NOTE: The retention volume does not include materials leaked out from containers and rainwater.

Table 1 – Minor storage

Location	Maximum capacity of liquid storage, in litres (L)			
	Category of liquids stored			
	Categories 1 & 2	Category 3	Category 4	Mixed Category
Residential buildings of any type (i) Indoor (ii) Outdoors in a shed or garage, away from the boundary by 1 m in separation	5L 10L	10L 20L	20L 40L	20L 40L
Institutions Examples: Educational establishments, clinics, hospitals, day care centre, kindergartens, homes for aged and orphanages.	(i) 5L or (ii) 0.1L/m^2 and not more than 10L per minor storage area	(i) 10L or (ii) 0.25L/m^2 and not more than 25L per minor storage area	(i) 20L or (ii) 0.5L/m^2 and not more than 50L per minor storage area	(i) 20L or (ii) 0.5L/m^2 and not more than 50L per minor storage area
Offices Examples: Commercial buildings Shops Examples: Shopping centres, showrooms, supermarkets, departmental stores, beauty salons, pawnshops, etc Place of Public Resort Examples: Hotels, cinemas, private clubs, eating houses, restaurants, hawker centres, public swimming complex, etc Storage Examples: Godowns, warehouses, stores, etc Laboratories	(i) 5L or (ii) 0.2L/m^2 and not more than 20L per minor storage area	(i) 10L or (ii) 0.5L/m^2 and not more than 50L per minor storage area	(i) 20L or (ii) 1.0L/m^2 and not more than 100L per minor storage area	(i) 20L or (ii) 1.0L/m^2 and not more than 100L per minor storage area
Factories	(i) 10L or	(i) 20L or	(i) 50L or	(i) 50L or



Notes for Table 1(.....continued):

Category	Criteria	Maximum container capacity (litres)
1	Flash point < 23° C Initial boiling point ≤ 35° C	5
2	Flash point < 23° C Initial boiling point > 35° C	5
3	23° C ≤ flash point ≤ 60° C	10
4	60° C < flash point ≤ 93° C	25

- **If product 93°C < flashpoint < 150°C, requirements similar to that of Category 4 liquid**

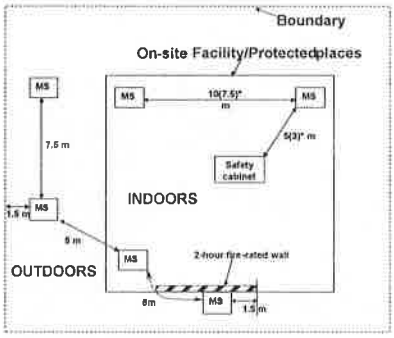
Table 1 – Minor storage

Location	Maximum capacity of liquid storage, in litres (L)			
	Category of liquids stored			
	Categories 1 & 2	Category 3	Category 4	Mixed Category
Offices Examples: Commercial buildings Shops Examples: Shopping centres, showrooms, supermarkets, departmental stores, beauty salons, pawnshops, etc Place of Public Resort Examples: Hotels, cinemas, private clubs, eating houses, restaurants, hawker centres, public swimming complex, etc Storage Examples: Godowns, warehouses, stores, etc Liquor stores	(i) 8L or (ii) 0.2L/m² and not more than 20L per minor storage area	(i) 10L or (ii) 0.5L/m² and not more than 50L per minor storage area	(i) 20L or (ii) 1.0L/m² and not more than 100L per minor storage area	(i) 20L or (ii) 1.0L/m² and not more than 100L per minor storage area

Precautions for minor storage

- No storage in the vicinity of potential sources of ignition
- Person who handle such liquids shall be trained and aware of the hazards involved
- Containers to be kept closed when not in use
- Transportation of flammable liquids carried in safe manner so to minimize spillage
- Do not store flammable liquids such that it hinder escape in event of a fire
- Segregate any materials that might interact dangerously if mixed with flammable liquids
- Containers used shall not be pressurized as a means of transferring contents
- Avoid concentrated storage of flammable liquids at one particular area
- Exercise caution during decanting and pouring of small quantities of flammable liquids

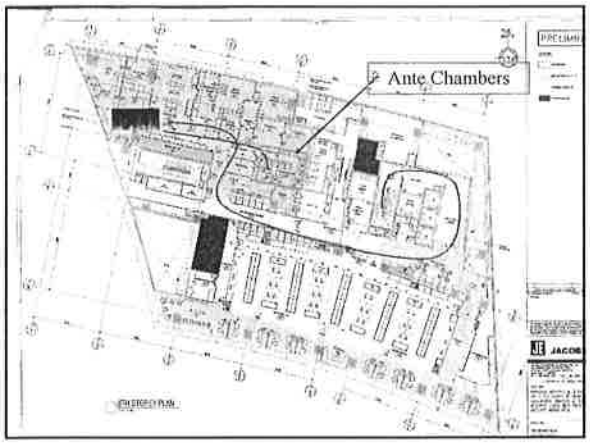
Separation distances for minor storage



Guidelines on Fire Safety Requirements for Bio-Containment Facilities

Purpose of the guidelines

To stipulate the fire safety requirements for biomedical facilities (Bio-Safety Level 3 and above) handling biological agents or toxins.



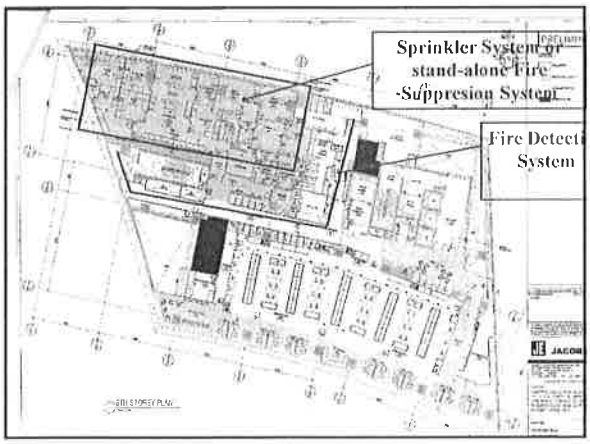
Caution Label

- Caution labels shall be provided at all the laboratory entrances and exits complying to SS 286

Fire Suppression and Detection System

- **All BLS-3 or BSL-4 shall be protected with sprinkler system or active fire suppression system**
  (regardless whether the building is protected with such active fire suppression system)
- **In a non-sprinkler protected building smoke detectors shall be installed along the outer perimeter of the fire compartmented enclosure**





Caution Label

- In addition, a label indicating the information as stated in Annex A shall be provided.


BIOHAZARD
ADMITTANCE TO AUTHORIZED PERSONNEL ONLY
Biosafety Level: _____
Responsible Investigator: _____
In case of emergency call: _____
Daytime phone: _____ Home phone: _____
Authorization for entrance must be obtained from the Responsible Investigator named above.


Thanks You

Registered Inspector Experience Sharing

M & E

Presented by

MATTHEW KWEK YOONG YOONG
P.E.(Mech), RI (M&E), FSE, FSM
20th March 2012

PLANS REQUIRED

1. Architectural Plans.
2. ACMV Plans.
3. Fire Protection Plans.
4. Smoke Control System Plans.
5. Performance Based Plans. (M&E)

PB DOC REQUIRED

1. Correspondence with SCDF (consultations or waivers)
2. FEDB
3. FSER
4. Peer Reviewer Report
5. O&M

ARCHITECTURAL APPROVED PLAN

- How many of you provide Architecture approved plans to M&E RI?
- If so, are they the latest and tally with what is built?
- Is the M&E plan layout tally with the Architecture approved plan?

INFORMATION FROM BP

1. Where are the Fire Rated Compartment Wall and its Fire Rating.
2. Usage of every room. Especially named as Flammable/Hazardous Storage.
3. Mode of Ventilation to each room.
4. Consultation & Waiver approval.

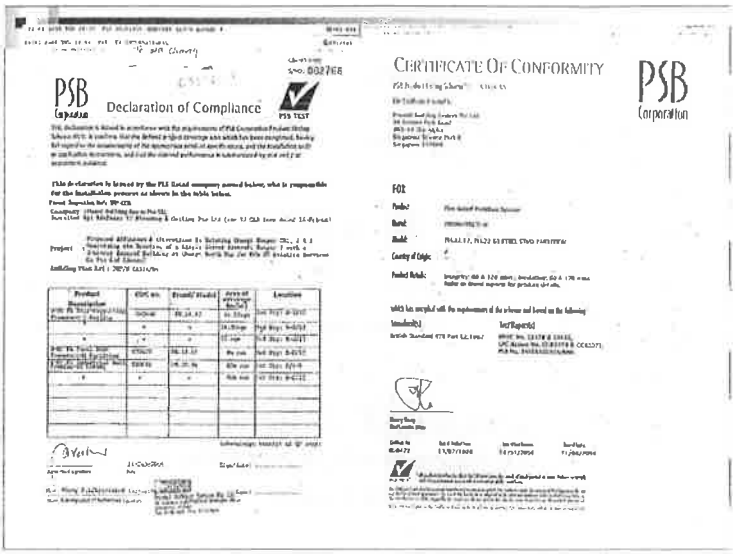
INFORMATION FROM BP

5. Confirmation of EVC requirement etc?
6. Information on location of Landing Valve, Exit Sign, Emergency Lights, Hose Reel, Breeching Inlet, Hydrant, Fire Lift, MFIB, Gas Cylinder Storage Area & FCC.

FIRE RATED BOXED UP

Verify following documentation are in order:

1. PSB Certificate of Conformity
2. PSB Declaration of Compliance
3. Installation Location tally with approved plan?
4. Installation details/ method tally with suppliers' instructions?
   - Joints/Penetrations are properly sealed
   - unauthorized penetrations
   - violation to Code of Practice
5. Declaration of Compliance cover all locations?
6. Certificate of Special Building Materials



PSB Corporation

Declaration of Compliance

PSB TEST

CERTIFICATE OF CONFORMITY

PSB Corporation

SINGAPORE CIVIL DEFENCE FORCE
FIRE SAFETY & SHELTER DEPARTMENT

FSSD-FSC02

CERTIFICATION FOR SPECIAL BUILDING MATERIALS

Commissioner
Singapore Civil Defence Force
91 Ubi Avenue 4
Singapore 408827
Attn: Director, Central Enforcement Department

BP Title

Project Title: *Proposed Condominium Housing Development Comprising 1 Block of 36-Storey Residential Building (Total: 152 Units) with a Basement Carparks, Swimming Pool and Ancillary Facilities on Lots 578, 969, 970, 99723 and 99724 TS 21 at Devonshire Road/Riding Road/St. Thomas Walk Singapore*

FSSD Approved Plan No *FMV/N00744/07* Approved date: *10 Oct 2008*

Type of building material: *Promatect-H 2-hours Fire Rated Duct System*

Location (To attached floor plans endorsed by Professional Engineer~~/Architect~~ by indicating the location of material installed).

Level	Room name	Grid lines in FSSD approved plans	Opening size	Fire rating(hrs)
B1	~~Carpark (serving Spk Pp Room)~~	(a) A1-3/A,B-E (b) 2-3/C-D	N.A.(Drawing No: KAC-B1-01 part plan)	2-hours
B1	~~Carpark (serving FFL)~~	11-15/E-N	N.A.(Drawing No: KAC-B1-02 part plan)	2-hours
1st Sty	~~Carpark (serving FFL)~~	11-15/E-S	N.A.(Drawing No: KAC-1st-01 part plan)	2-hours
1st Sty	~~Carpark (serving Spk Pp Rm at B1)~~	2-3/D	N.A.(Drawing No: KAC-1st-02 part plan)	2-hours

I certify that the above building material in this project has been installed in accordance with

1. **Test /Assessment report *CSIRO no. FSH 1124, FSH 1109* as described in Certificate of Conformity issued by *PSB* (COC No *020465* dated *13/07/1998* is attached)
2. **Thickness of *15mm* in accordance to the National Periods of Fire resistance as described in Appendix A to clause 3.4 of Fire Code 2007.

Inspected and confirmed by :

Name / Stamp & Signature of Professional Engineer ~~/ Architect~~
Dated: _____

Correspondence Address of Professional Engineer ~~/Architect~~

Not by RI

Updated 1 June 2011

**Delete where not applicable

Building and Construction Authority

GUIDELINES

ON

SUBMISSION OF APPLICATIONS

TO

COMMISSIONER OF BUILDING CONTROL

SECTION 2 - PREPARATION & SUBMISSION OF BUILDING PLANS

2.1.3 The floor plan shall show –

(a) **The purpose of every room or space in the building**

(b) the types of material to be used for the main elements of the building;

(c) the grid lines or dimensions between columns, corridors, staircase landing and the thickness of walls and columns;

(d) the type of plant, equipment or water tank to be installed and the location of the equipment, every plant room or water tank room;

SECTION 2 - PREPARATION & SUBMISSION OF BUILDING PLANS

(e) **the space to be air conditioned or mechanically ventilated;**

(f) the existing and proposed platform levels of the site and adjoining lots (first storey plan only); and

(g) the distance between new building and lot boundary (first storey plan only).

Examples of Common Non-Compliance with Code

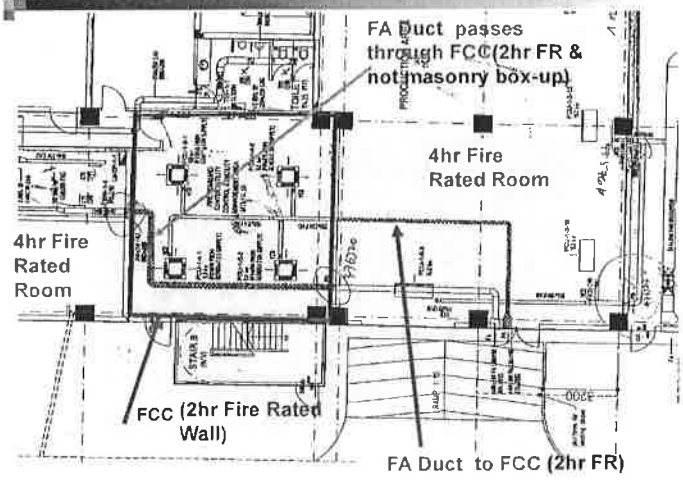
- Fire Command Centre (FCC)

  @ Fire Code 2007, Section 7.1.6 (b)

  - corresponding ducts run outside FCC
    - > enclosed in a structure same fire rating as FCC
    - > constructed to the same fire rating as the room they pass through (higher than FCC?)

  @ Fire Code 2007, Section 7.1.6 (d)

  - duct serving areas other than the FCC shall not pass through the FCC room.



Examples of Common Non-Compliance with Code

- Ductwork through Smoke Stop or Fire Fighting Lobby :

  @Fire Code 2007, Section 7.1.1 (e)

  - Ventilation ducts should not pass through smoke-stop or fire fighting lobby.
  - When unavoidable, duct within the lobby shall be enclosed in masonry with same fire resistance rating.
  - If other form of FR box-up, to fit Fire Dampers at penetration.

Examples of Common Non-Compliance with Code

- Exit Staircase and Internal Exit Passageway :

  @ Fire Code 2007, Section 7.1.3 (b)

  - shall be independent system.

  @ Fire Code 2007, Section 7.1.3 (b)(iii)

  - staircase duct passes through outside staircase to be enclosed in masonry or drywall of same rating without fire damper.

CASE STUDY EXAMPLE

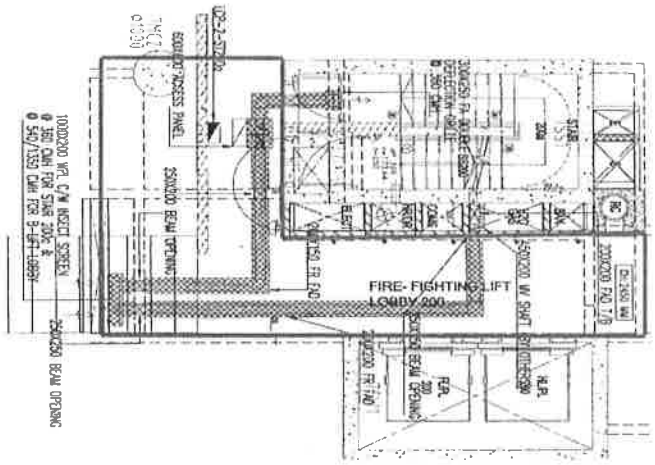
What happen if the ventilation duct for the exit staircase

Passes through

The Fire Fighting Lobby or Smoke Stop Lobby

and box-up with Fire Rate Board

(are you going to fix the Fire Damper?)



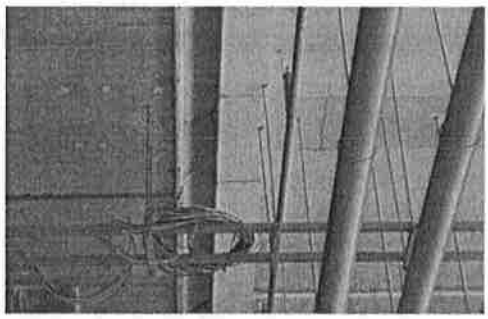
Examples of Common Non-Compliance with Code

- Running other non-fire rated services above fire rated duct

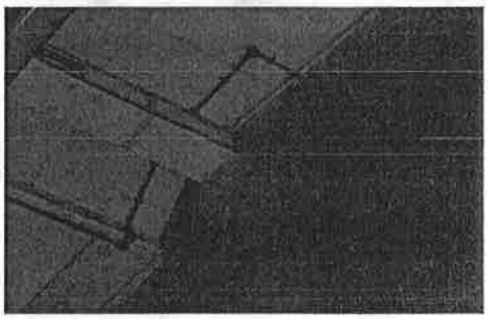
  @ Fire Code 2007, Section 7.1.1 (j)(iii)

  - Other services above fire rated duct should be avoided
  - When unavoidable, other services above duct shall have support strengthened not exceeding 10N/mm^2 tensile stress.

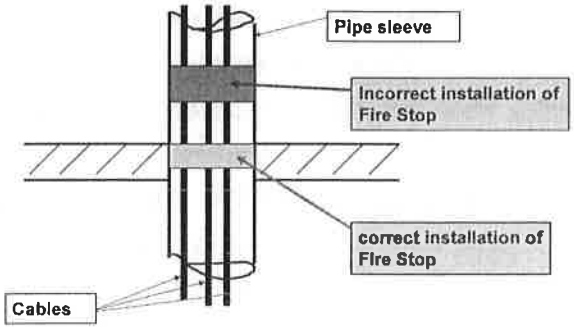
Examples of Common Non-Compliance Installation



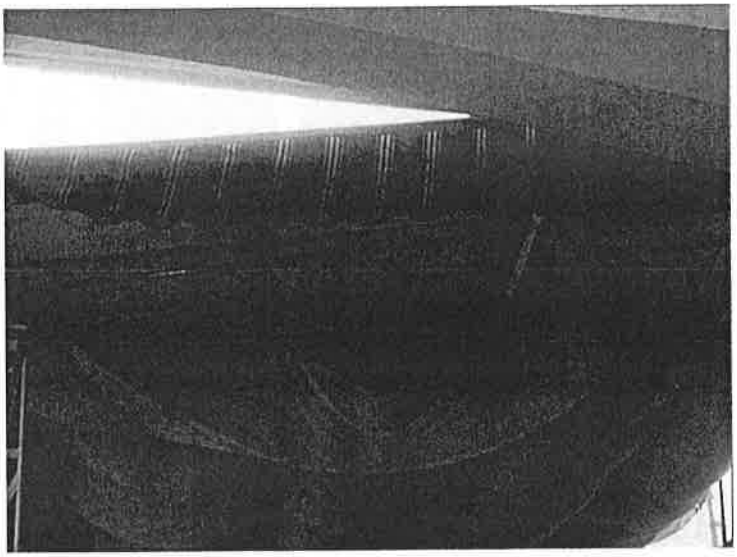
Examples of Common Non-Compliance Installation

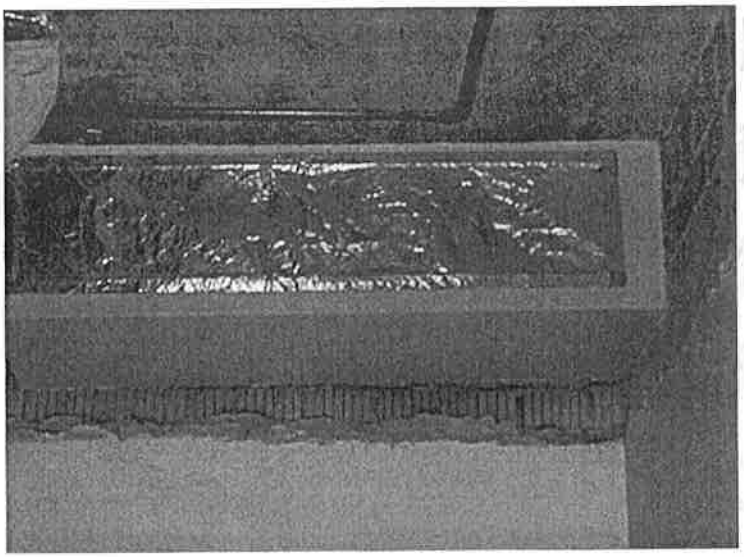


Examples of Common Non-Compliance Fire Stop Installation

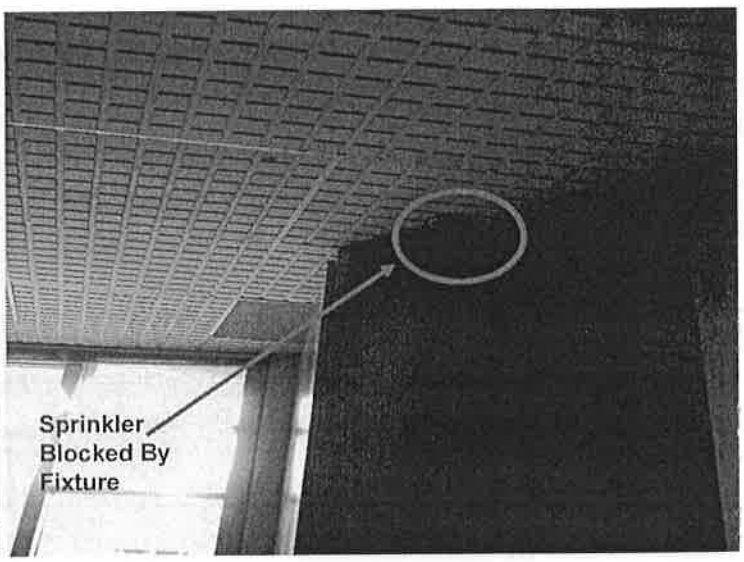




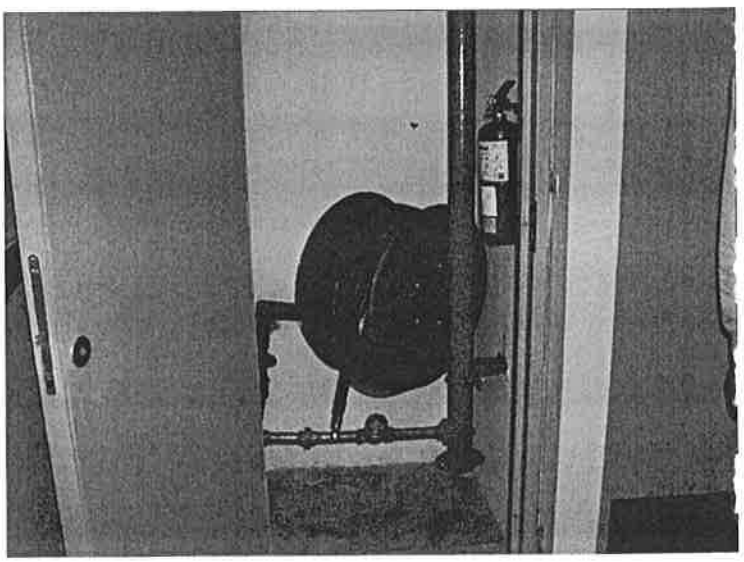






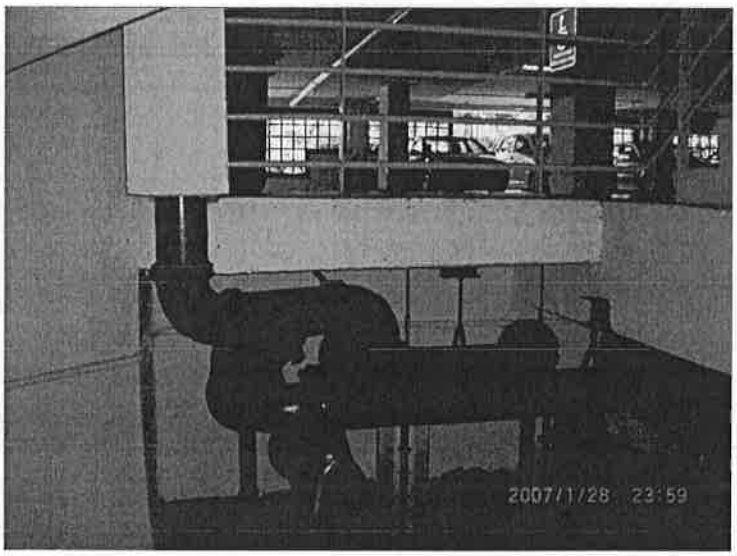

Sprinkler
Blocked By
Fixture


2






Breeching
Inlet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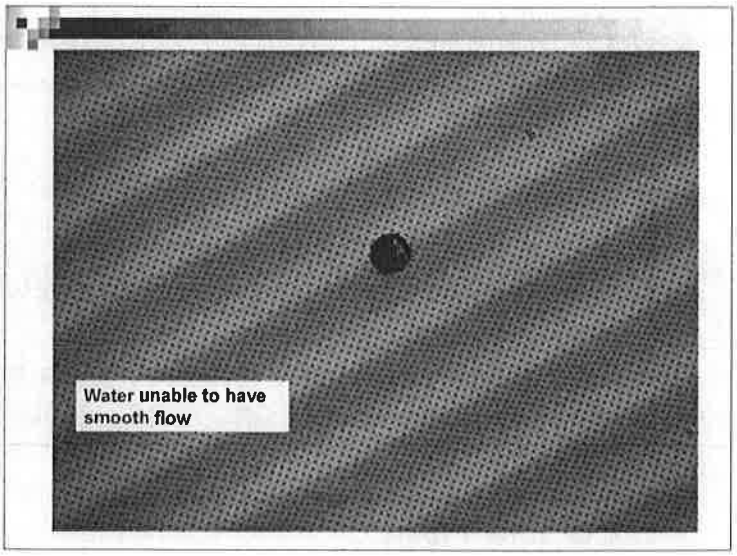
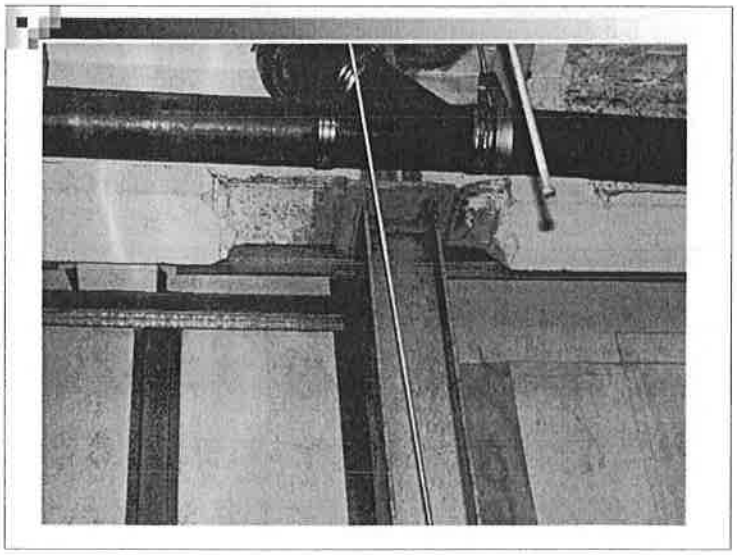
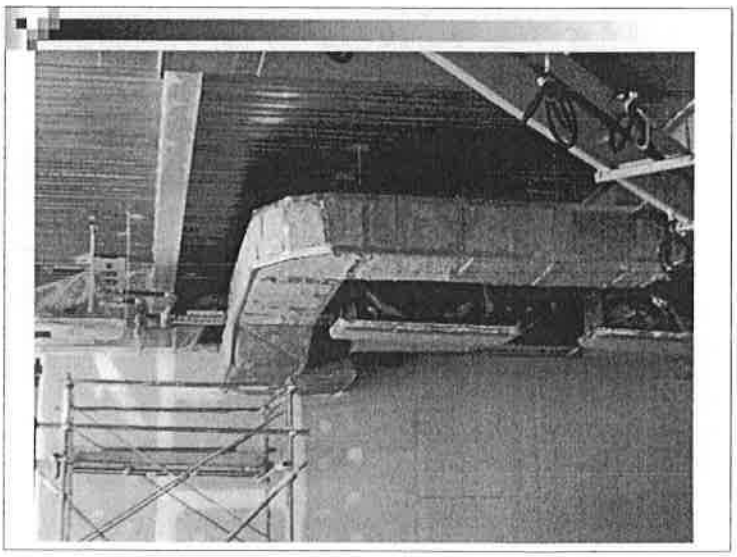
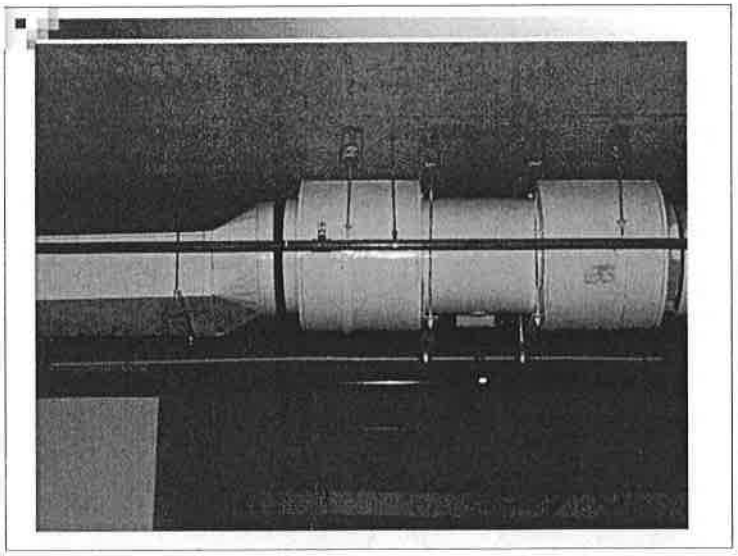
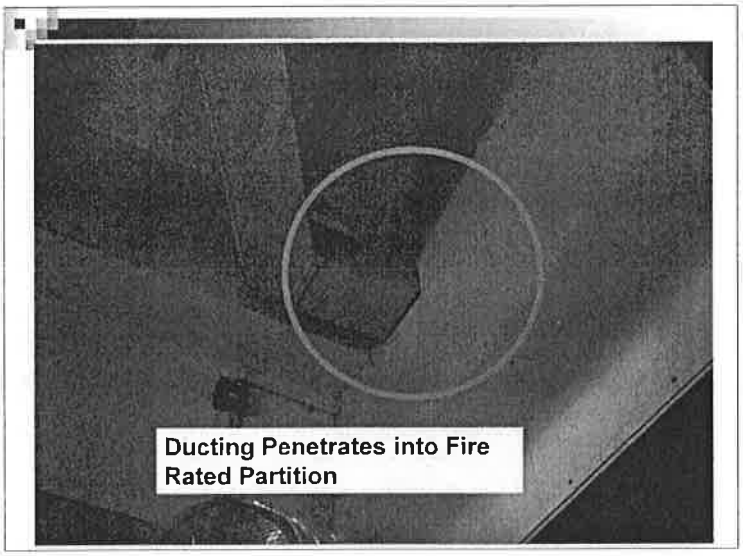
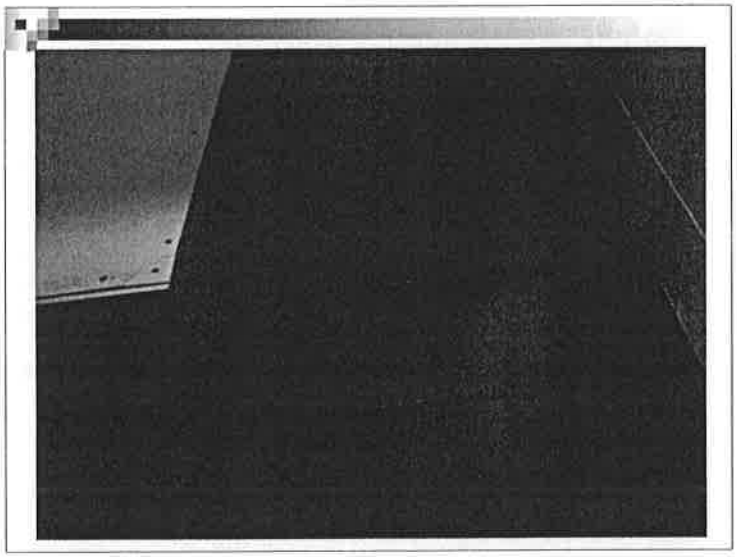

Water unable to have
smooth flow



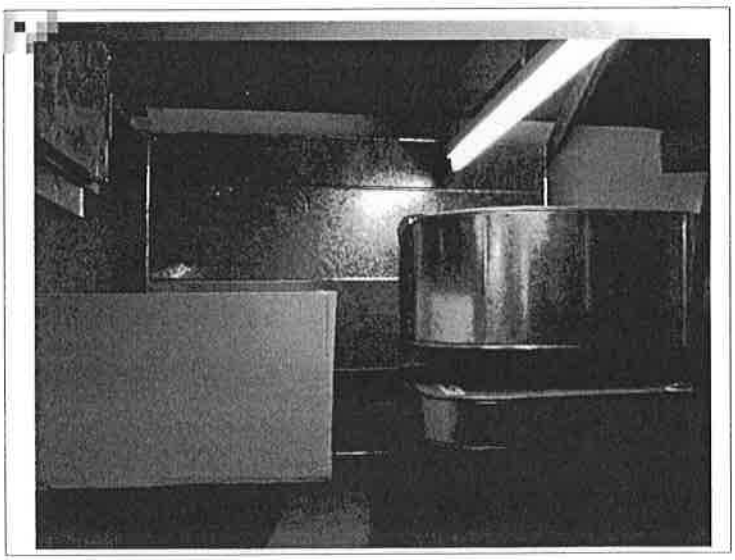


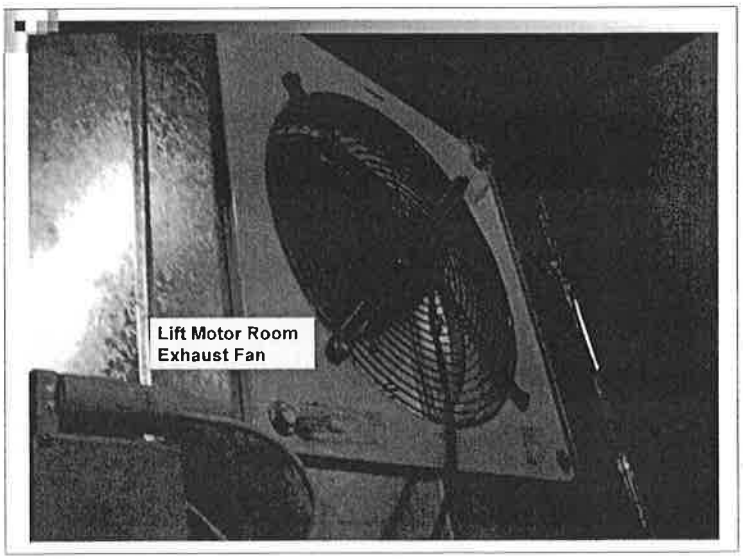


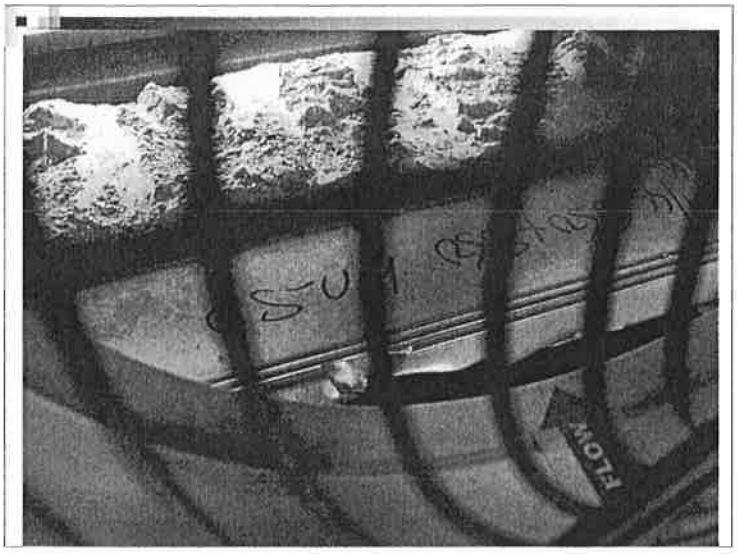

Ducting Penetrates into Fire
Rated Partition

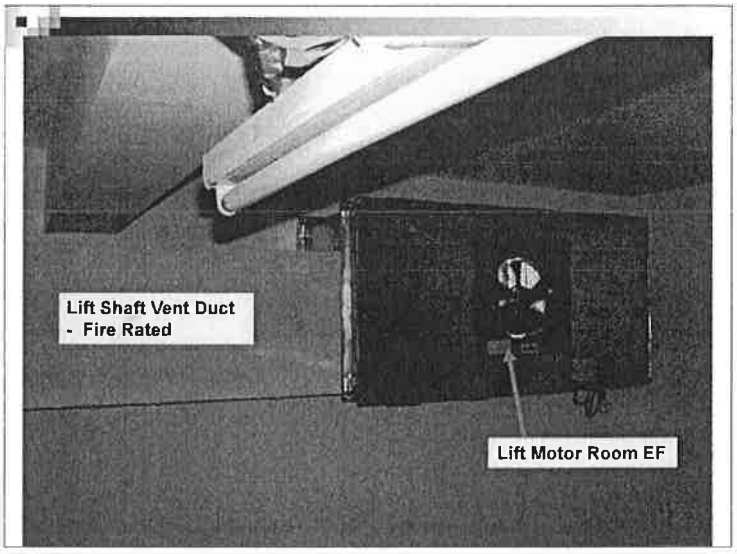


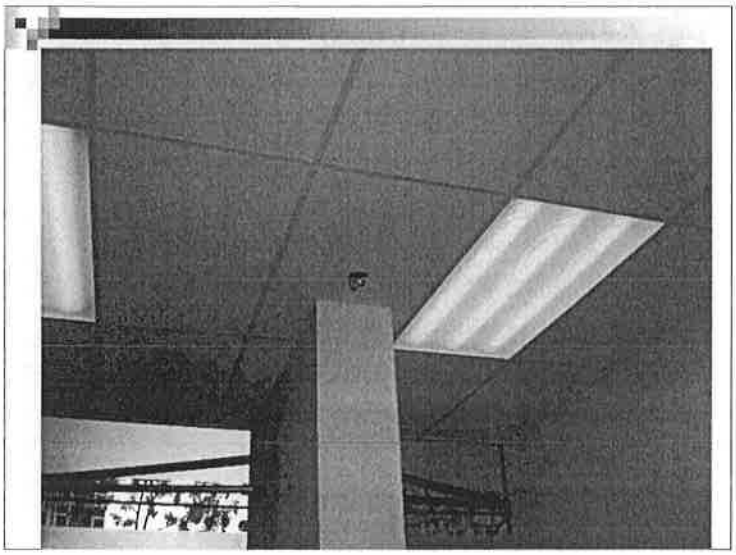


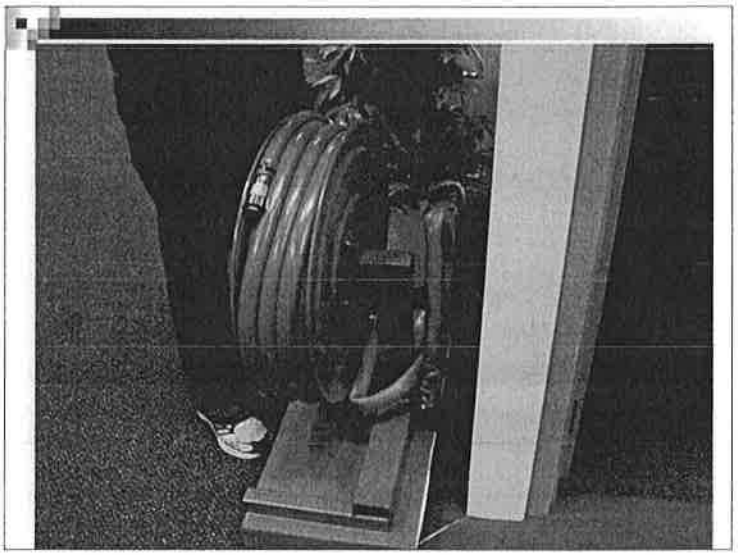


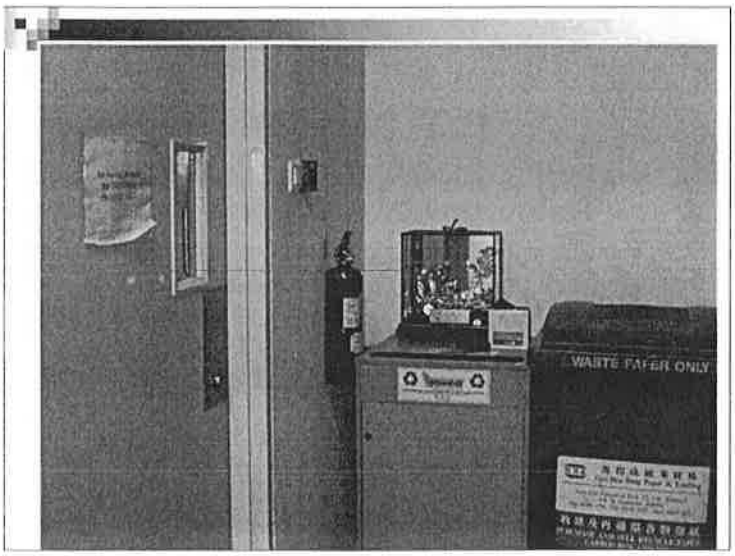

Lift Motor Room
Exhaust Fan

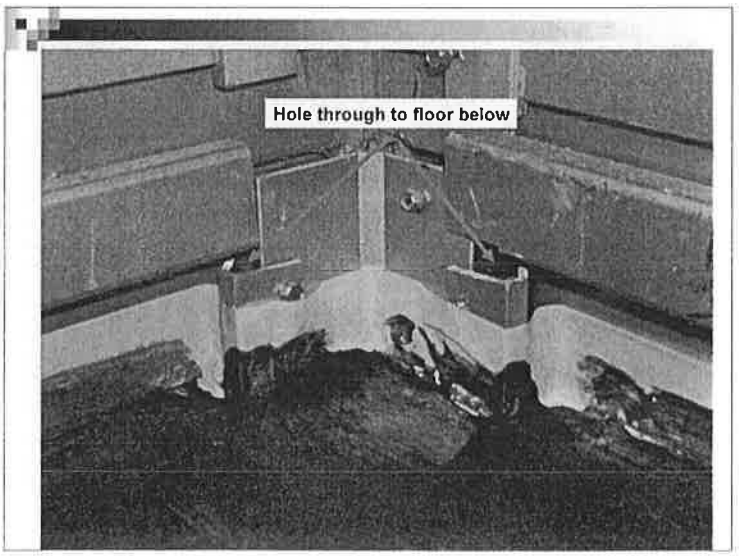

FLOW

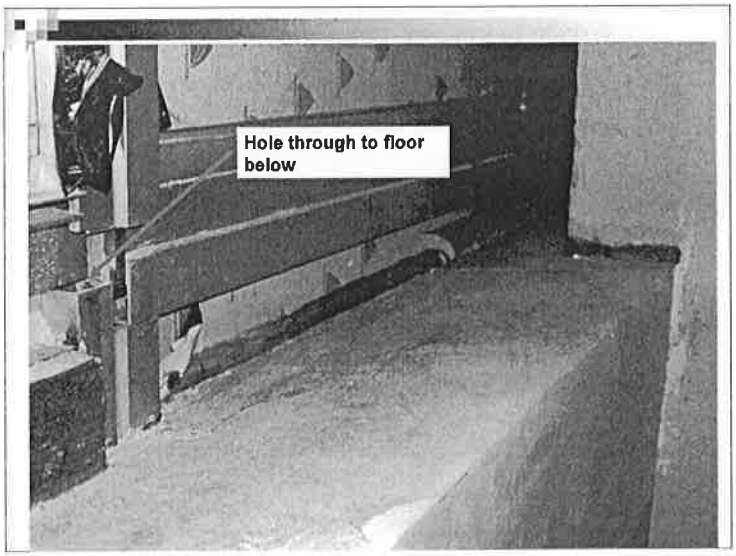

Lift Shaft Vent Duct
- Fire Rated
Lift Motor Room EF

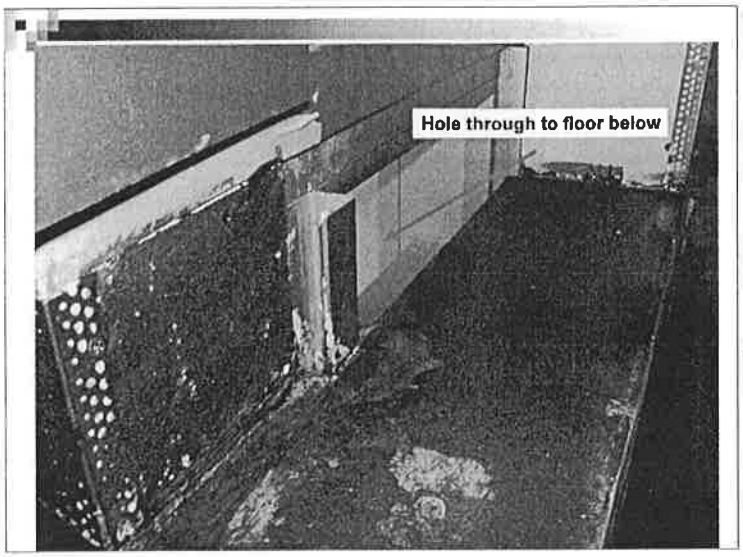


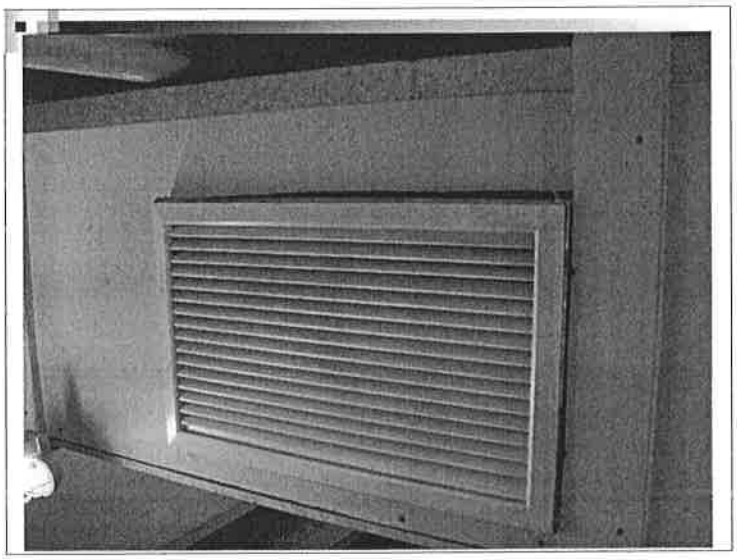


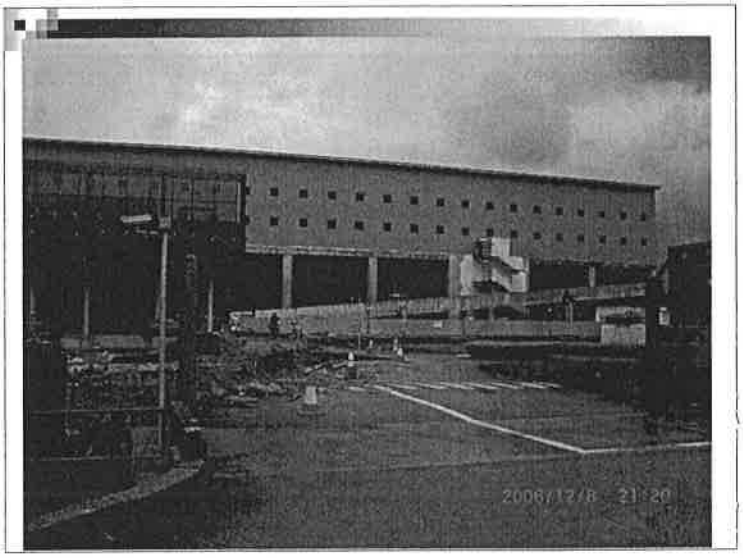

WASTE PAPER ONLY


Hole through to floor below


Hole through to floor below


Hole through to floor below

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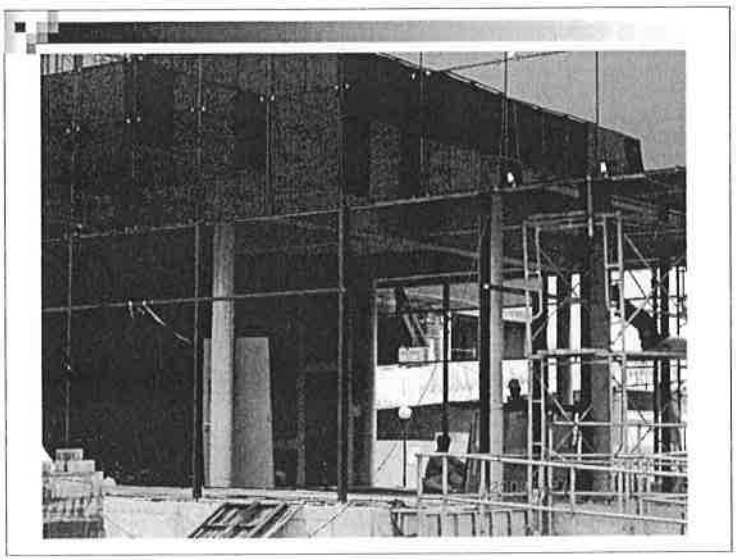

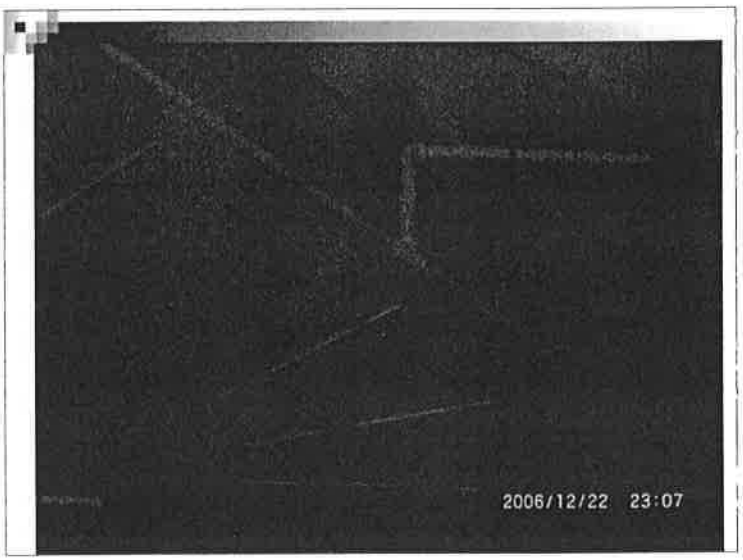
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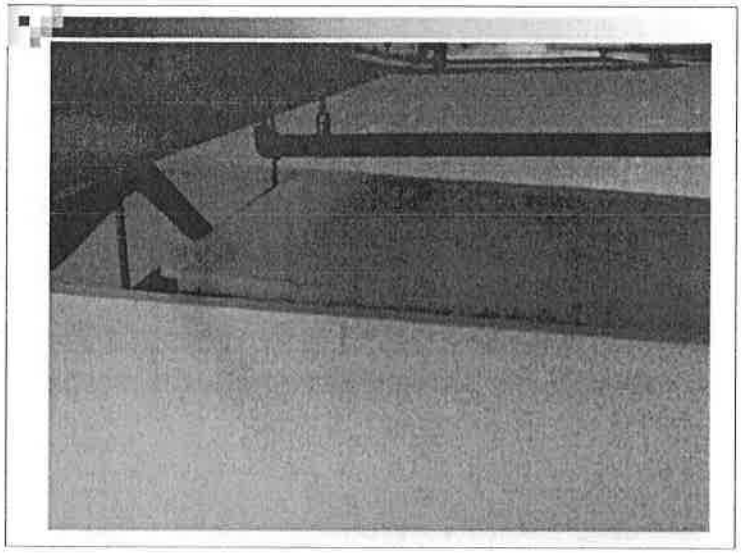
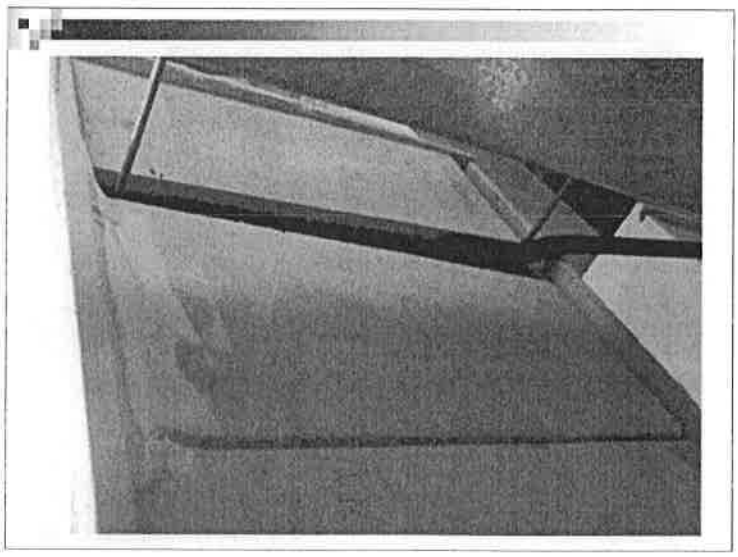
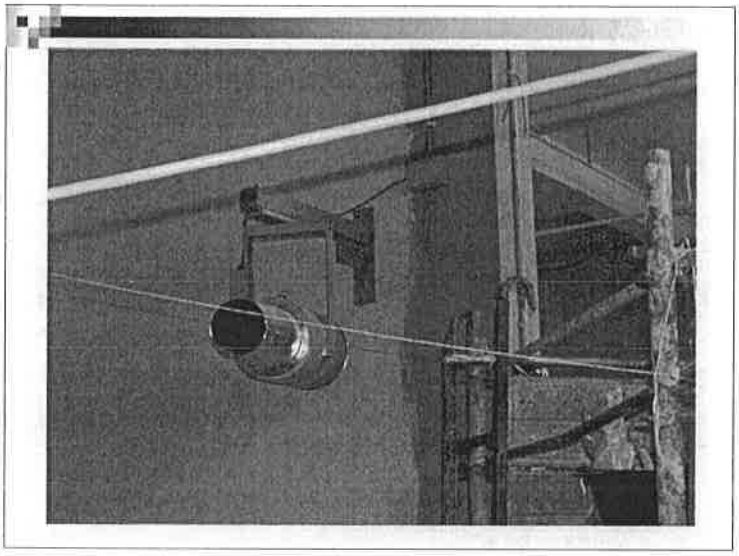
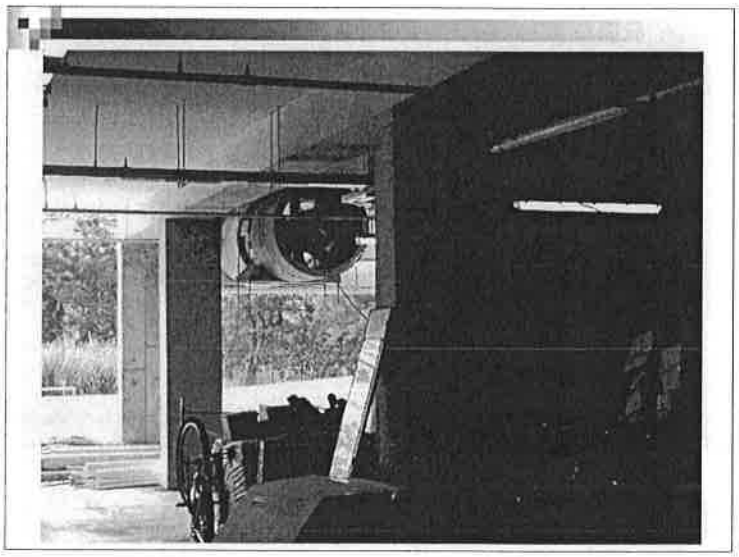
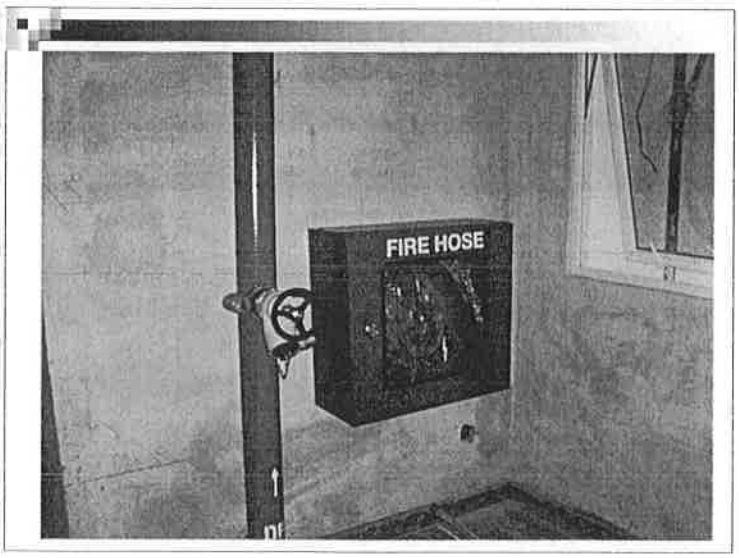
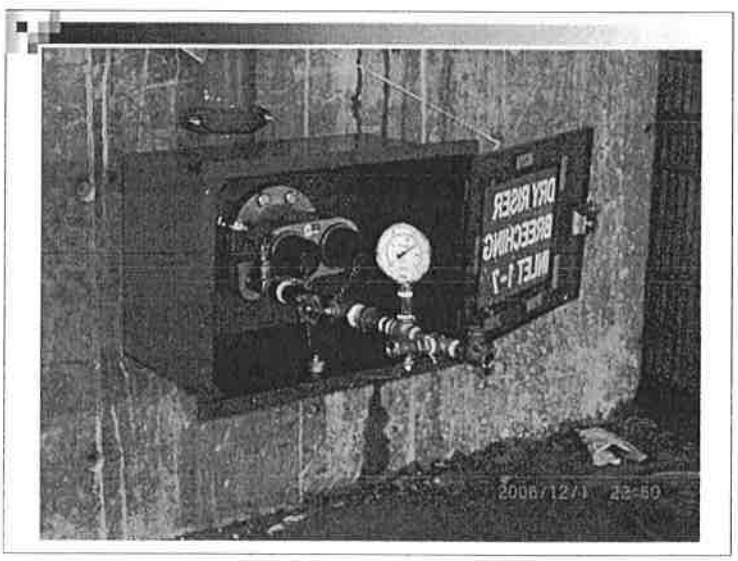


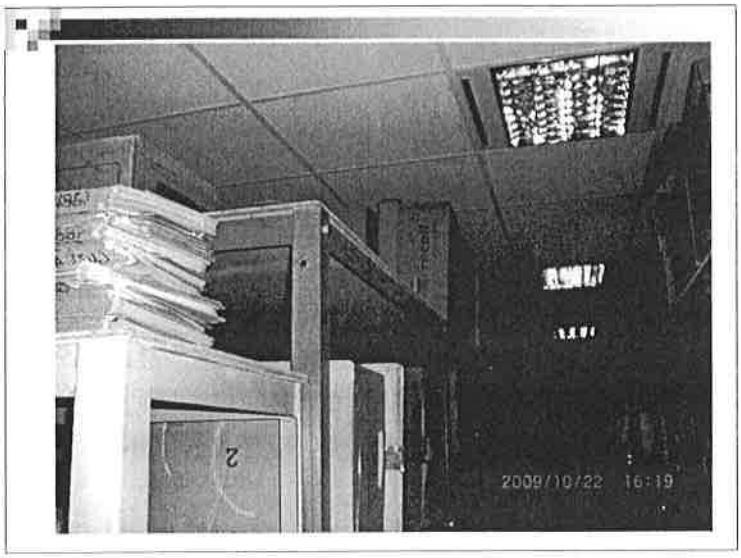







FIRE HOSE

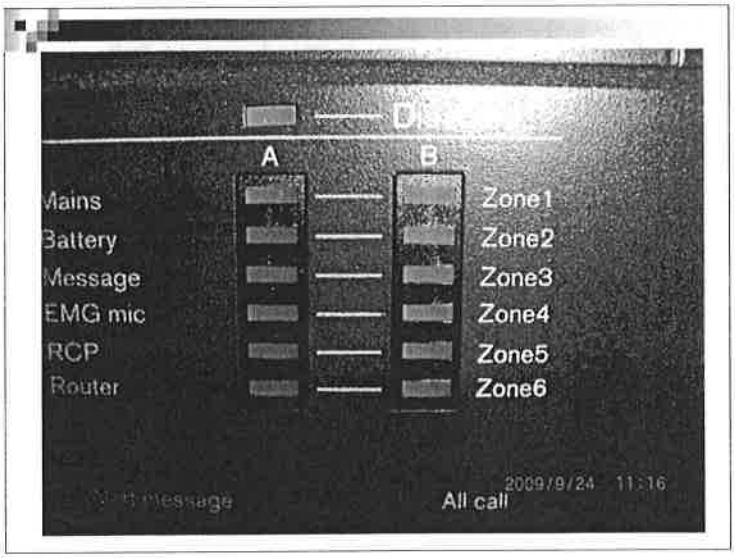

DRY RISER
BREECHING
INLET 1-7
2006/12/1 22:50



E V C SYSTEM

- How many of you as M&E QP do check the EVC System installed are complied to SS 546 with effect from 1.1.2010.
- If yes, what function of the system do you check?





Examples of Common Non-Compliance with Code

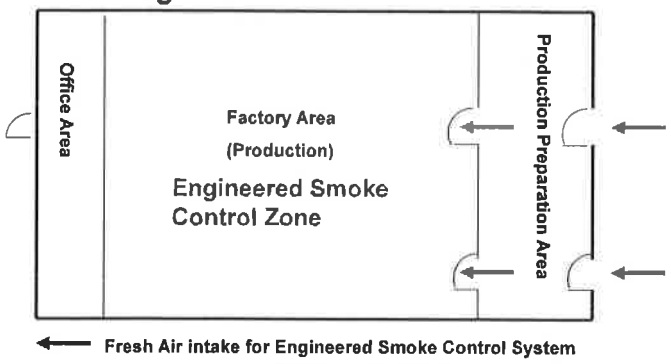
- 15 storey Residential Building has two Fire Engine access on 2 main road at level 1 & level 7. All lift homing at L1. Guard House at L7.
- Main Fire Alarm Panel is at L1 lobby, Lift supervisory panel at MA office.
- Basement Carpark smoke purging control panel at L7 Guard House.
- Can RI Form 1 or 2 issued?

POINTS TO NOTE

- RI, becomes the T&C for PE; as PE has no time to conduct testing when RI called.
- RI becomes PM for owner/main con.; contract require you to provide list of item not completed for each visit.
- RI becomes PM; Coordinate all QP/PE design for D&B project.
- RI becomes trouble shooter and provide solution instead of QP/PE.

CAN FOLLOWING SITUATION BE ISSUED WITH RI FORM 1/2 ?

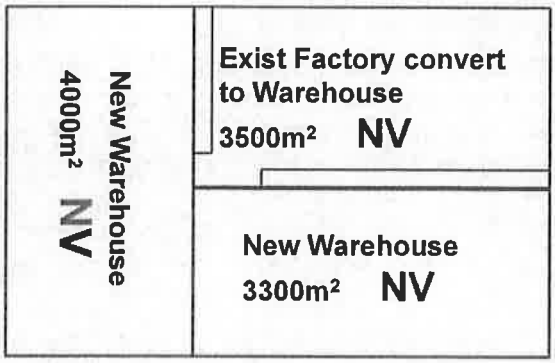
Can production prep. area used for Storage with racking in BP submission?



CAN FOLLOWING SITUATION BE ISSUED WITH RI FORM 1/2 ?

- The site permanent water (from PUB water) has not been connected.
- The site permanent Power Supply has not been connected.
- Fire Rated Duct not complete.
- PA system no battery backup.
- PA system without recording device.
- Lifts not complete and unable to check Homing.

CAN FOLLOWING SITUATION BE ISSUED WITH RI FORM 1/2 ?



HDB Residential Projects New Flats, MUP or LUP

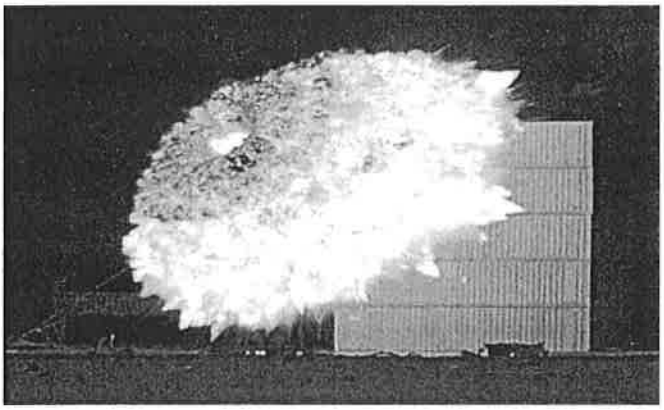
- New, & HIP requires full compliance.
- LUP flats to have Fire Lift function, except the size of Fire Lift Lobby and no generator required.
- Escape Staircases can not have non-combustible material (pvc conduit/trunking)
- Hose Reel shall comply for plans registered after 1st Sep 2008

POINTS FOR DISCUSSION

- Is the provision of Emergency Light be the Architect or M&E RI?
- Is the Location of Sprinkler Control Valves placed be the Architect or M&E RI?
- Is the Exhaust & Fresh Air intake shall be 5m apart be the Architect or M&E RI?
- Is the provision of Sub-Fire Alarm Panel, DR/WR landing valve & HR be the Architect or M&E RI?



FIRE SAFETY COME FIRST



FIRE SAFETY REGISTERED INSPECTOR

- To be a Registered Inspector is very easy.
- To be a 有责任感，熟悉消防规范，认识火患的危险 和 认真 Register Inspector is not easy.

知之为知之，不知为不知也。

知之为不知，不知为不知也。

知之为知之，不知为知之也。



RI Course
Sharing of RI Experience

Chan kok way
Architect, FSE & RI (Arch)
SD Architects & Associates Pte. Ltd.

15 March 2017

Contents

- 1050 – 1140, 50 mins
  - Introduction
  - Process of fire safety inspection
- 1145 – 1235, 50 mins
  - Special attention
  - Case study

Introduction

- My RI Journey
  - Registered as RI (Arch) in 1994 and as Fire Safety Engineer in 2004
  - Inspected more than 3,000 cases of new and existing building projects
  - Recent works:
    - National Art Gallery
    - South Beach
    - Sport Hub
    - West Gate
    - d'Leedon
    - Leedon Residence & .....others

Introduction

- s 8(2) Fire Safety (Registered Inspectors) Regulations

  In performing RI's duties, RI may require QP to:
  - supply a complete set of plans and all consultation notes and wavier approvals;
  - facilitate time and date of inspection;
  - cause to be carried out any rectifications as required by RI;
  - assist RI in performing his duties.



Process of Fire Safety Inspection

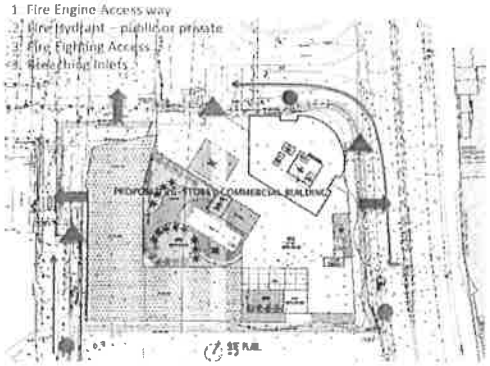
1 Desktop plans check
2 Site Inspection
3 Documentation
4 RI Form 2/1

1 Desktop Plans Check

- From external to internal
  - External fire engine access
  - Compartmentation & Special Purpose Rooms (table 6.4A)
  - SSL & FFL
  - Staircases & its dicharges at 1st storey
  - Special features, e.g. fire rated shutters & fire rated smoke curtains
  - 1-way & 2-way travel distances
  - DR/FHR/MCP coverages
  - Exit & E-lighting

1 Desktop Plans Check

1. Fire Engine Access way
2. Fire hydrant – public or private
3. Fire Fighting Access
4. Sprinkler Inlets



1 Desktop Plans Check

1. Discharge at 1st storey
2. Exit Doors – Fire Break
3. FCC
4. Staircases & SSL/FFL
5. DR/FHR/MCP
6. Services Shafts
7. Fire Rated Door Ratings
8. Exit & Emergency Lightings
9. 1-way/2-way Travel Distances
10. Fire Rated Shutters/Smoke Curtains



1 Desktop Plans Check

1. Staircases & SSL/FFL
2. DR/FHR/MCP
3. Services Shafts
4. Fire Rated Door Ratings
5. Exit & Emergency Lightings
6. 1-way/2-way Travel Distances
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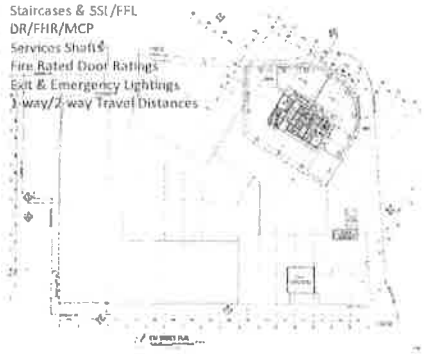
1 Desktop Plans Check

1. Staircases & SSL/FFL
2. DR/FHR/MCP
3. Services Shafts
4. Fire Rated Door Ratings
5. Exit & Emergency Lightings
6. 1-way/2-way Travel Distances



1 Desktop Plans Check

1. Staircases & SSL/FFL
2. DR/FHR/MCP
3. Services Shafts
4. Fire Rated Door Ratings
5. Exit & Emergency Lightings
6. 1-way/2-way Travel Distances



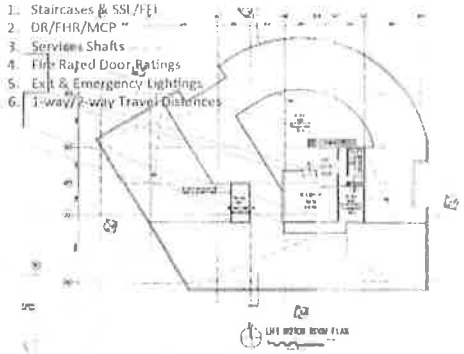
1 Desktop Plans Check

1. Staircases & SSL/FFL
2. DR/FHR/MCP
3. Services Shafts
4. Fire Rated Door Ratings
5. Exit & Emergency Lightings
6. 1-way/2-way Travel Distances



1 Desktop Plans Check

1. Staircases & SSL/FEL
2. DR/FHR/MCP
3. Services Shafts
4. Fire Rated Door Ratings
5. Exit & Emergency Lightings
6. 1-way/2-way Travel Distances



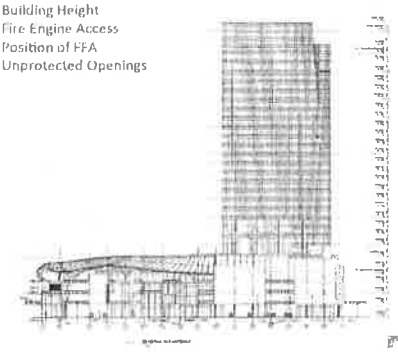
1 Desktop Plans Check

1. Building Height
2. Fire Engine Access
3. Position of FFA
4. Compartment Floors
5. Staircases & SSL/FEL
6. Lift Shafts
7. Services Shafts



1 Desktop Plans Check

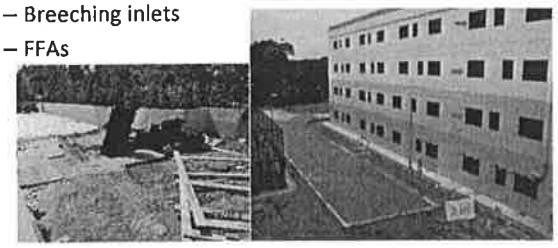
1. Building Height
2. Fire Engine Access
3. Position of FFA
4. Unprotected Openings



2 Site Inspection

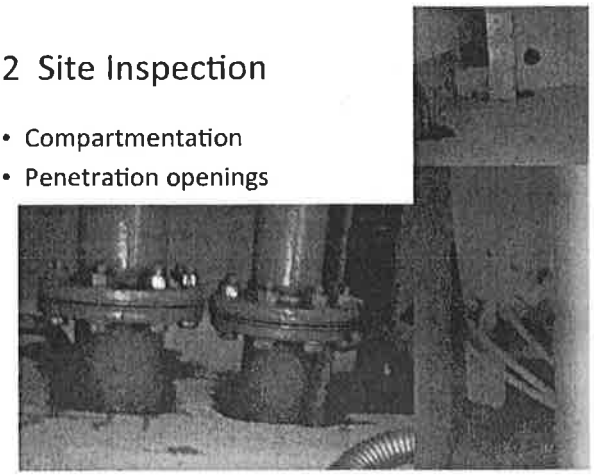


- External Access
  - Fire engine access: "way or road"
  - Fire hydrant: "private or public"
  - Breeching inlets
  - FFAs



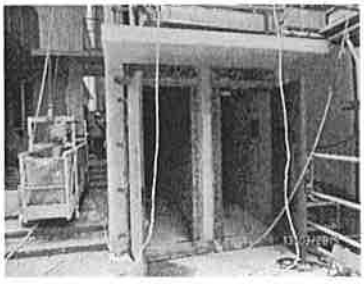
2 Site Inspection

- Compartmentation
- Penetration openings



2 Site Inspection

- Discharges from 1st storey
- Fire break on both sides

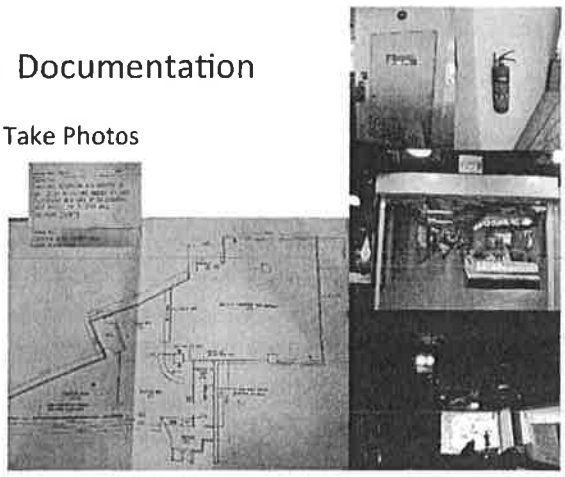


Documentation

- Take Photos
- RI Checklists
- RI Comments' list

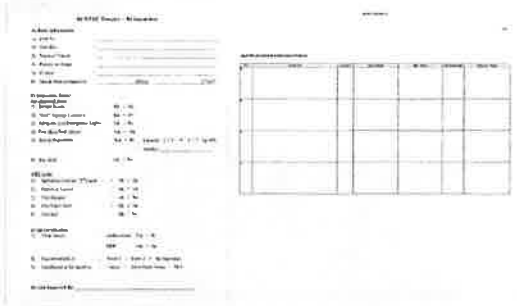
3 Documentation

- Take Photos



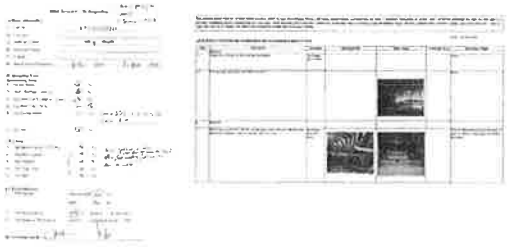
Documentation

- RI Comments' lists

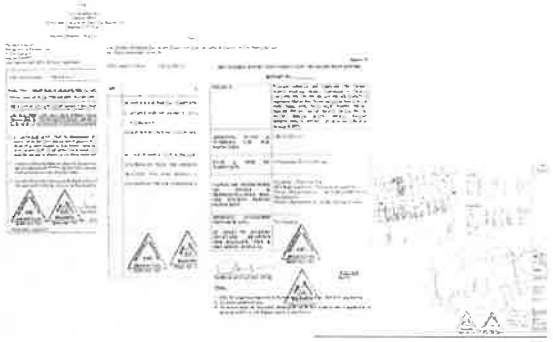


Documentation

- Reply to RI Comment's lists



4 Form 2



4 Form 2

- In Annex to Form 2

  "QP applies for completion of Works.

  As the subject site complies with fire safety provisions in accordance with the approved plans, the relevant codes of practice, the fire safety act and regulations except the following: "



4 Form 2

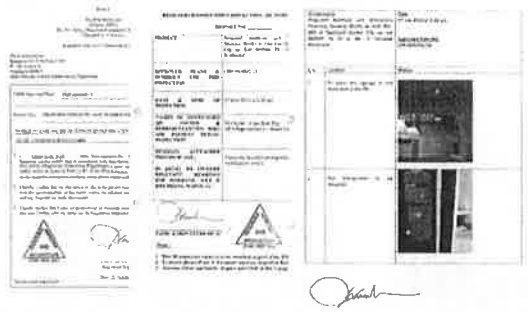
- List of outstanding items:
  - To complete fire stops to vertical and horizontal penetration openings at compartment walls and floors;
  - To complete installation of fire rated door's door closers, door selectors and its PSB labeling;
  - To complete installation of permanent signages to all fire escape staircases, exit doors and services duct and rooms;
  - To complete installation of fire engine accessway finishes and its surrounding areas;
  - Submission of amendment to Approved Plans to reflect "as-build" site condition;
  - To complete installation of exit signages and emergency lightings to various areas;
  - Other special situations, e.g. covered linkway or make-up air door not installed.

4 Form 2

"In view of the above, I hereby recommend TFP for this project."



4 Form 1



Special Attention

- Lift – Ledge Opening & Head room
- Escalator Pit– sprinkler
- Location of Dry Riser & fire hose reel adjacent to exit

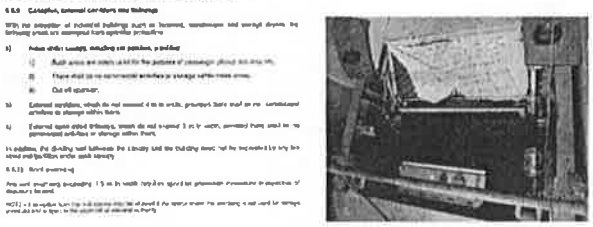
Special Attention

- Lift – Ledge Opening
  (350 mm x 500 mm)
  - Head room (2000 mm)



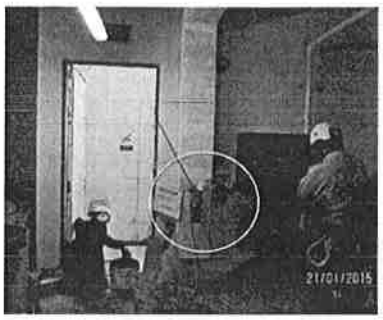
Special Attention

- Escalator Pit – sprinkler 6.6.7 of CP 52: 2004



Special Attention

- Location of DR & FHR adjacent to exit
  (max 3000 mm)



Special Attention

- Fire Extinguisher SS 578:2012
  (mininum rating – 13A)





3.2 Fire extinguisher size and placement for Class A hazards

3.2.1 Extinguishers shall be located so that no person needs to travel more than 15 m to reach an extinguisher

3.2.2 Minimum size of fire extinguishers for the various Class A occupancy hazards shall be provided in accordance with the following:

(a) For the low hazard occupancy the minimum rating shall be 13A

(b) For the medium hazard occupancy the minimum rating shall be 21A

(c) For the high hazard occupancy the minimum rating shall be 34A

(d) There shall be at least one extinguisher of the minimum size on each storey/level of buildings

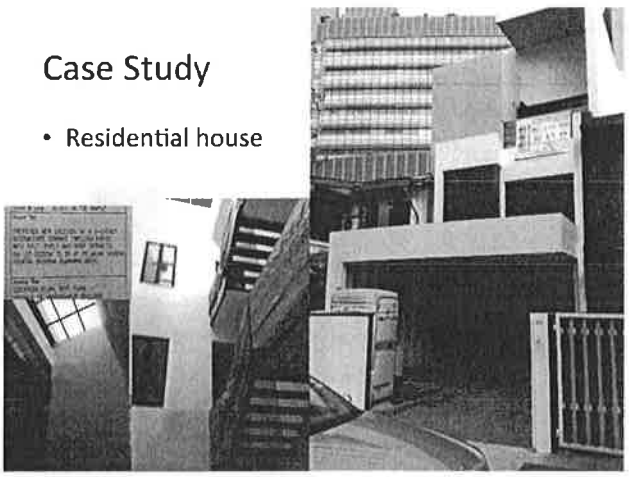
NOTE – For each unit of 'A' rating, the maximum floor area is as covered in 10 m² regardless of the classification of the occupancy hazard.

Case Study

Residential House
Tenancy Work
A/A Work
Mixed Development

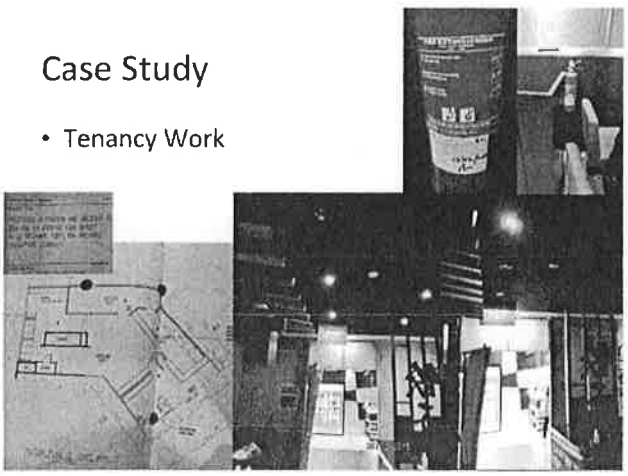
Case Study

- Residential house



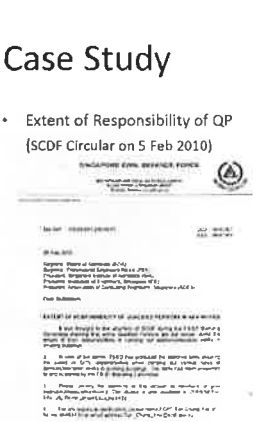
Case Study

- Tenancy Work

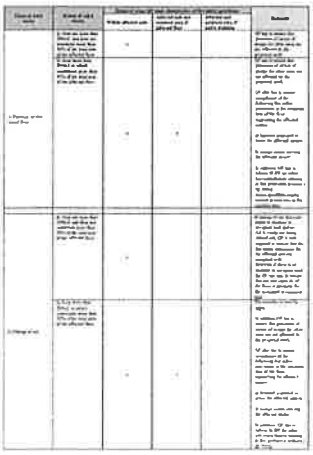


Case Study

- Extent of Responsibility of QP
  (SCDF Circular on 5 Feb 2010)



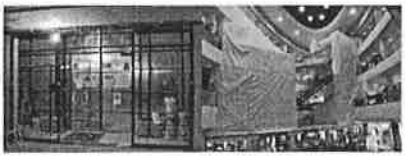
SINGAPORE CIVIL DEFENCE FORCE



Case Study

- Fire Safety for Use of Hoarding & Safety Net (SCDF Circular on 1 Mar 2016)
- Fire Code 2013 cl 3.15.15
  For A/A to existing buildings, non-combustible partitions shall be used for separation of areas undergoing A/A works

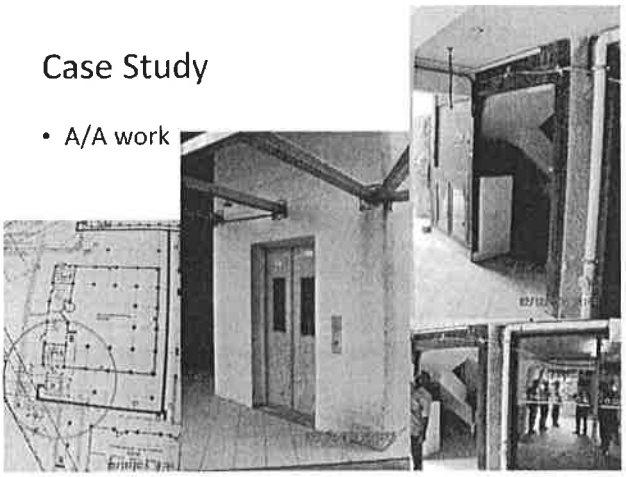






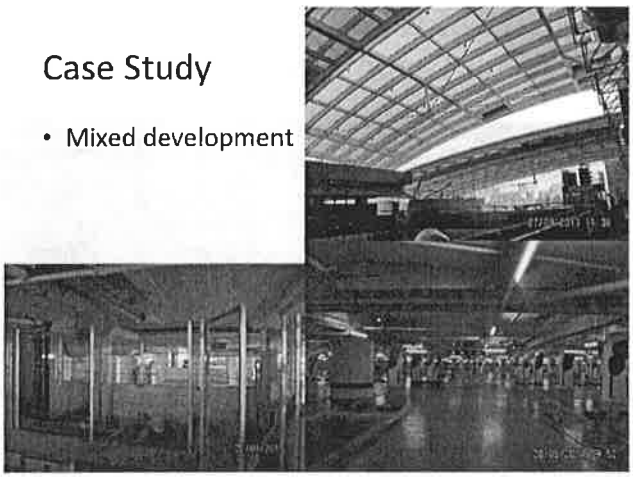
Case Study

- A/A work



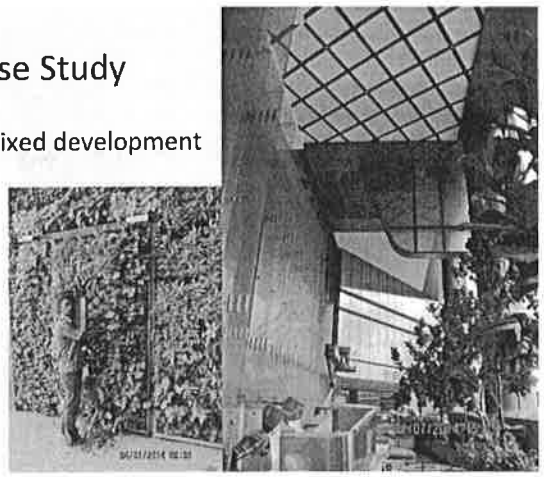
Case Study

- Mixed development



Case Study

- Mixed development



Case Study

- Mixed development



Case Study

- Mixed development
  PV Installation on Roof
  (SCDF Circular on 31 Dec 2015)

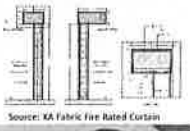




Component Testing

Insulated fire rated curtain
Water canon test
Sprinkler test

Insulated Fire Rated Curtain



Source: KA Fabric Fire Rated Curtain

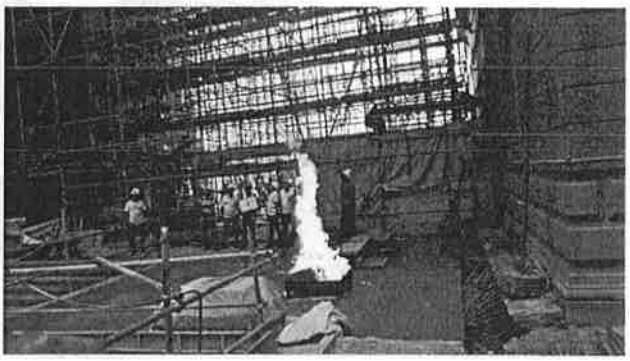




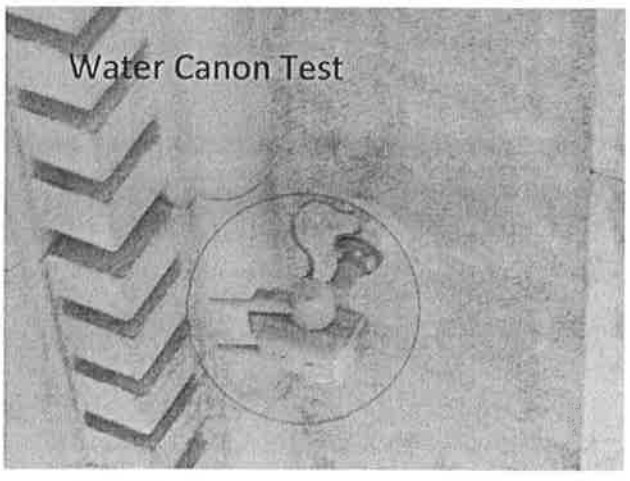
Insulated Fire Rated Curtain Test



Water Canon Test



Water Canon Test



Sprinkler Test



Thank You

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ckw@sdarchitects.com.sg