

## Fire Investigation in Malaysia JAPAN – MALAYSIA INTERNATIONAL FORUM FIRE AND DISASTER MANAGEMENT

29 NOVEMBER 2016 KUALA LUMPUR

BPK

## Fire in Malaysia

*Source: Operation Div. JBPM* 2

	2010	2011	2012	2013	2014	2015
Structure	7,249	7,249	7,375	7,974	7,914	7,958
Motor	2,759	2,759	3,169	3,450	3,576	3,777

## What is Fire Investigation?



 Fire Investigation is the process of determining the origin, cause and development of fire (NFPA 921)

 Fire Investigation is the process of determining the cause, origin and circumstance of fire (Fire Services Act 1988)

- Fire Investigation in FRDM
  - was form in 2003 with 144 officers.
  - In 2008, the role of fire Investigation become important, it form one division called Fire Investigation Div. with 460 Officers.
- Train Fire Investigator Officer
  - trained by the expert from IAAI (International Arson Association Investigation)
  - attended course in Japan, USA, UK & Australia.



- Member of IAAI.
- Member of MQA (Malaysia Quality Assurance) in Forensic Science.



## **9 Fire Investigation Laboratary**

#### **Equipments at each Fire Investigation Lab**

- Polimer
  - Thermal Gravimetry Analyzer (TGA),
  - Thermomechanical Analyzer (TMA)
  - Differential Scanning Calorimetry (DSC),
- Organic Compound
  - High Performance liquid chromatography
  - Automatic Thermal Desorption Gas chromatography and Mass Spectometer (A GCMS)
- Inorganic Compound
  - Fourier Transform Infra-Red Spectroscop
  - Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES),
  - Ultra Violet Spectrophotometry (UV-VIS).







# The Purpose of Fire Investigatio

- 1. To determine the cause, origin and circumstance of fire systematically and scientifically.
- 2. To prepare the investigation paper for Incendiary Fire.
- 3. To evaluate the effectiveness of operation tactic, fire prevention and enforcement of fire safety.
- 4. To determine the effectiveness of Fire Safety Installation at premises.
- 5. To purpose any standard of fire safety installation to Malaysia Standard.
- 6. To purpose effectiveness of fire safety campaign to public.
- 7. To advice the manufacture of electrical equipment or others manufacture about fire safety.

# **Provision from Act**



- Section 5(1)(b) making of investigation into cause, origin and circumstances of fire.
- Section 45 The Minister appoint any persons to hold an enquiry into the cause and circumstances of any fire and action taken.
- Section 46 taking possession of premises and other property damaged or destroyed by fire.
- Section 47 Unauthorized presence in premises possession whereof has taken under Section 46 shall be guilty of an offence.

# **Provision from Act**

- Section 38 –Power of entry.
- Section 39 Restriction on disclosure of information.
- Section 40 Power to arrest without warrant person found committing an offence under section 47.
- Section 41 power of investigation.
- Section 42 power to require attendance of witnesses
- Section 43 Examination of witnesses.

# Provision from Penal Code (Act 57

- Section 435 Mischief by fire or explosive with intent to cause damage to amount RMI50.00. Whoever commits mischief by fire or any explosive substance, intending to cause, damage to any property to the amount of RM50.00 or upwards. shall be punished with imprisonment for a term which may extend to 7 years and shall also be liable to fine.
- Section 436 Mischief by fire or explosive with intent to destroy a house etc.
  Whoever commits mischief by fire or any explosive substance, intending to cause, or knowing it to be likely that he will thereby cause, the destruction of any building which is ordinary used as; a place of worship, or for the administration of justice, or for the transaction of public affairs, or for education, or art, or for public use, or Ornament, or as a human dwelling, or as a place for the custody of property. shall be punished with imprisonment for a term which may extend to 20 years and shall also be liable to fine.

# Provision from Penal Code (Act 57

Section 438 – Punishment for the mischief described in the last section when committed by fire or any explosive substance

Whoever commits mischief by fire or any explosive substance, intending to cause, or knowing it to be likely that he will thereby cause, the destruction of any building which is ordinary used as:-

shall be punished with imprisonment for a term which may extend to 20 years and shall also be liable to fine.

## **Procedure Protocol**

- Using international
  - Guide Fire and Explosion Investigation NFPA 921.
  - Fire and Arson Scene Evidence: A Guide for Public Safety Personnel by U.S. Department of Justice.
  - Professional guide
  - Standard Standard
- Fire Investigation guide/ direction.







## The scientific Method



**Scientific Method** is systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of a hypothesis (NFPA 921).

**Systematic Approach** is that of the scientific method, which is used in the physical science.

#### **Step 1 – Recognize the need**

- A fire has occurred
- The origin is unknown

#### **Step 2 – Define the Problem**

• Determine the origin

#### Step 3 – Collect Data

- Basic site data
- Determine pre-fire conditions
- Documentation of post-fire conditions
- Excavation, examination, and reconstruction of the scene -Photograph, sketch and collect evidence
- Witness statements and observations
- FDRM information
- Alarm, detector ,and security.

# **Scientific Method**

#### **Step 4– Analyze the Data**

- Pattern analysis.
- Heat and flame vector analysis
- Depth of char and calcination surveys
- Arc mapping
- Event sequencing.
- Fire Dynamics consideration
- Building construction and occupancy consideration.

#### **Step 5 – Develop a working Hypothesis**

- Initial origin hypothesis
- Working origin hypothesis
- Alternate hypothesis

#### **Step 6– Test the Working Hypothesis**

- Is there a competent ignition source at the origin?
- Does the origin explain the data?
- Are contradictions resolved?
- Does an alternate origin explain the data equally well?

#### **Step 7 – Select the Final Hypothesis**

- Area of origin
- Point of origin

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• Origin insufficient to the determine cause









## **Point of Origin**

• the exact physical location where a heat source and a fuel come in contact with each other and a fire begins.

## **Source of Ignition**

## **Cause of Fire**

- The circumstance, conditions, or agencies that brings together a fuel, ignition source, and oxidizer (such as air and oxygen) resulting in a fire.
- Fire cause be classified as
  - Accidental,
  - Incendiary, or
  - Natural.

**Determination of the origin** of the fire involves the coordination of information derived from one or more of the following:-

- **1.** Witness Information. The analysis of observation reported by persons who witnessed the fire or were aware of conditions present at the time of the fire.
- 2. Fire Patterns. The analysis of effects and patterns left by the fire.
- **3.** Arc Mapping. The analysis of the location where electrical arcing has caused damage and the documentation of the involved electrical circuits
- **4. Fire Dynamics**. The analysis of the fire dynamics, that is the physical and chemistry of fire initiation and growth and the interaction between the fire and the building's system.
- **5.** Fire Alarm Detection. The examination of all involved fire protection system (fire detection, fire alarm, and fire suppression system) is important in determining if each system functioned properly, and can assist in tracking the growth and spread of a fire.
- 6. Security Cameras-CCTV: Security cameras that monitor buildings may be very useful, particularly for providing "hard " times.

# **Source of Ignition**

#### **Primary Ignitors**

- 1 Matches/Lighter
- 2 Torches/Candles

#### **Secondary Sources**

- 3 Hot Object/Hot Surfaces/Welding
- 4 Friction/Impact
- 5 Chemical Reaction

#### The Role of Service & Appliances in Starting Fires

- 6 Gas Appliances
- 7 a) Arcs
  - b) Short Circuit/Spark
  - c) Overload/Overcurrent
  - d) Resistance Heating
- 8 Glowing fire (smoking, mosquito coil etc)



# Others9Firecrackers10Lightning11Spontaneous Combustion/ Self<br/>Heating12Explosions13Others

An unplanned event that interrupts an activity and sometimes causes injury or damage or a chance occurrence arising from unknown causes; an <u>unexpected</u> happening due to <u>careless, ignorance, and the like</u>

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Incendiary

Arson

Accidental

An <u>Incendiary fire</u> is a fire that deliberately set with the intent to cause the fire to occur in an area where the fire should not be.

The crime of <u>maliciously</u> and <u>intentionally</u>, or <u>recklessly</u>, starting a fire.

NFPA 921, 2011 Edition

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## **Fire Pattern**



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The major objective of any fire scene examination is to collect data as required by the scientific method.

**Fire Pattern** – the visible or measurable physical changes or identifiable shapes formed by a fire effect or group of fire effects. (NFPA 921, 2011).

**Fire effects** are the observable or measurable changes in or on material as a result of exposure to the fire.

The collection of fire scene data requires the recognition and identification of fire effects and fire patterns







- V Pattern on Vertical Surfaces
- Inverted Cone (Triangular) Patterns
- 3. Hourglass Patterns
- 4. U- shaped Patterns
- 5. Truncated Cone Patterns
- 6. Pointers and Arrow Patterns
- Circular-Shaped Patterns

Fire Effects (Patterns Geometry) 8. Irregular Patterns

- Doughnut-Shaped Patterns
- 10. Linear Patterns
  - a) Trailers
  - b) Protected Floor Areas
  - c) Fuel Gas Jets
- 11. Area Patterns
- 12. Saddle Burns

## Fire Intensity versus Duration

- Intensity/Duration—The total fire damage to an object observed after a fire is the result of both the intensity of the heat applied to that object and the duration of that exposure.
- <u>Time-Varying Conditions</u> Both the intensity and exposure of that heat may vary considerably during the fire.



# Example

### FIRE PATTERN ANALYSIS DEMARCATIONS

- 1. "V" patterns
- 2. Calcination

#### SURFACE EFFECTS

- 3. Charring
- 4. Cracked glass
- 5. Flammable liquid burn pattern **PENETRATIONS**
- 6. Damage to ceiling *LOSS OF MATERIAL*
- 7. Combustible surface



# Incendiary Fire !

- **INCENDIARY FIRE**: An **Incendiary fire** is a fire that deliberately set with the intent to cause the fire to occur in an area where the fire should not be.
- **INCENDIARY FIRE INDICATORS**: There are a number of conditions related to fire origin and spread that may provide physical evidence of an incendiary fire cause.



# **Electrical Fire !**

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**ELECTRICAL FIRE**: A fire directly caused by the <u>flow of electric</u> <u>current or by static electricity</u>, if it is not due to normal, purposive heating produced by an electrical device.

Latter types of fires should be categorized as 'accidental contact of combustibles with a <u>heat source</u>.'

## Beads are characterized by the distinct and identifiable line of demarcation between the melted bead and the adjacent unmelted portion of the conductor. Fig. (c), (a), Fig. (b), Fig. 2(c),

## (a) Arc Damage to 18 AWG Cord by Arcing Through the Charred Insulation.



#### Fig. (a) : Copper Conductors Severed by Arcing Through the Charred Insulation

Fig. (b) : Copper Conductors Severed by **Arcing** Through the Charred Insulation with a Large Bead Welding the two Conductors together



## Short Circuit and Ground Fault Parting Arcs ..

Fig : Stranded Copper Conductors Severed by Arcing Through the Charred Insulation with the Strands Terminated in Beads.



## 1) Short Circuit and Ground Fault Parting Arcs ..

Fig (a) : Spot Arc Damage to 14 AWG Conductor Caused by Arcing Through the Charred Insulator



Fig (b) : Arc Damage to 18 AWG Cord by Arcing Through the Charred Insulation.



# 3) Overheating Connection



Fig. (a): Overheated Connection on 208 V 3-Phase Fuse Terminal.



Fig. (b): Overheated Connections Two-Pole Circuit Breakers

# 3) Overheating Connection



Fig. (c): Overheated Connection on 240 V dryer Outlet.

Fig. (d): Overheated Connection on 120 V Duplex Outlet

Fig. (b) :Aluminum Conductor Severed by Overcurrent showing Offsets



## 5) Effects Not Caused by Electricity

Fig. (a) :Copper Conductors Fire-Heated to the Melting Temperature, Showing Regions of Flow of Copper, Blistering and surface Distortion



Figure (b) : Fire Melting of Stranded Copper Wire





Figure (c) : Another Example Fire Melting of Stranded Copper Wire

## **Fire Deaths and Injuries**

- These physiological effects are generally categorized into the following areas (Purser 2002):-
  - **Toxic gases**. Toxic gas inhalation causes confusion, respiratory tract injuries, loss of consciousness or asphyxiation
  - **Heat transfer**. Heat irritates exposed skin and respiratory tracts, causing pain and varying degrees of burn injuries or hyperthermia.
  - **Visibility.** Optical opacity of the smoke and irritants produce impaired vision as the distribution of thick smoke descends toward the floor through rooms, staircases and hallways.

## **Fire Deaths and Injuries**

- **First-degree burns** involve only reddening of skin.
- Second-degree burns involve damage to the epidermis with blistering and sloughing. These are sometimes referred to as partial-thickness burns. Since the germinative layer of the dermis remains, such burn will usually heal from their entire surface, usually without grafts.
- Third-degree burns are called full thickness burns because the dermis is damaged and the wound will heal from the edges only and will require grafting.
- Fourth-degree burns Full-thickness burns can also include those in which the skin is destroyed, exposing muscle and even bones beneath

*DeHaan, 2007* 

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## **Fire Investigator**

#### (Fire Investigation Officer) NFPA 1033

- 1) Scene Examination :inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment and containment of the fire.
- 2) Documenting the scene :diagramming the scene, photographing and taking field notes to be used to compile a final report.
- **3)** Evidence Collection /Preservation :using proper physical and legal procedures to retain evidence required within the investigation.
- 4) Interview :obtaining information regarding the overall fire investigation from others through verbal communication.
- **5) Post-Incident Investigation** : investigation of all factors beyond the fire scene at the time of the origin and cause determination.
- 6) Presentation: the presentation of findings to those individuals not involved in the actual investigations.

# Investigation of Structure Fire Source: Fire Investigation Div. FRDM

		2013		2014		2015	
1	Residential	4,448	61.9%	4,552	63.8%	4,642	67.4%
2	Hotel	38	0.5%	44	0.6%	41	0.6%
3	Hostel/Boarding	79	1.1%	59	0.8%	75	1.1%
4	School	152	2.1%	122	1.7%	119	1.7%
5	Higher Learning Inst.	26	0.4%	25	0.4%	19	0.3%
6	Hospital / Clinic	36	0.5%	44	0.6%	34	0.5%
7	Office	302	4.2%	297	4.2%	224	3.3%
8	Shop	830	11.5%	735	10.3%	699	10.1%
9	Shopping Complex	53	0.7%	35	0.5%	41	0.6%
10	Place of Assembly	62	0.9%	39	0.5%	60	0.9%
11	Storage	228	3.2%	268	3.8%	268	3.9%
12	Factory	439	6.1%	398	5.6%	392	5.7%
13	Petrol Station	9	0.1%	15	0.2%	6	0.1%
14	Special structure	37	0.5%	29	0.4%	34	0.5%
15	Others	448	6.2%	472	6.0%	236	3.4%
	TOTAL	7,187		7,134	BPK	6,890	39

# Source: Fire Investigation Div. FRDM

NO	SOURCE OF IGNITION	2013		2014		2015	
			%		%		%
1	Lightning	74	1.0%	42	0.6%	46	0.7%
2	Matches/Lighter	1,058	14.7%	641	9.0%	558	8.1%
3	Gas Equipment	1,026	14.3%	1,461	20.5%	1,622	23.5%
4	Fireworks/Firecrackers	37	0.5%	21	0.3%	12	0.2%
5	Spontaneous Combustion – self heating	19	0.3%	12	0.2%	15	0.2%
6	Electrical - Arcs		9.8%	1,281	18.0%	988	14.3%
7	Electrical-Sparks/Short Circuit		34.6%	1,876	26.3%	2,123	30.8%
8	Electrical-Overcurrent/Overload		6.9%	419	5.9%	405	5.9%
9	Electrical-Resistance Heating	217	3.0%	361	5.1%	281	4.1%
	Electrical	3,900	54.3%	3,937	55.2%	3,797	55.1%
10	Friction	72	1.0%	60	0.8%	33	0.5%
11	Open Flame (Pelita/Lilin/Obor)	158	2.2%	254	3.6%	245	3.6%
12	Glowing fire	396	5.5%	386	5.4%	340	4.9%
13	Explosion	31	0.4%	11	0.2%	4	0.1%
14	Chemical Reaction	24	0.3%	14	0.2%	12	0.2%
15	Hot Surface	263	3.7%	186	2.6%	148	2.1%
16	Others	117	1.6%	80	1.1%	34	0.5%
17	Undetermined	12	0.2%	29	0.4%	17	0.2%
	TOTAL	7,187		₱ <b>,</b> ¶34	40	6,890	



# **Cause of Fire for Structure Fire**

Source: Fire Investigation Div. FRDM

No	Cause of Fire	2012		2013		2014		2015	
			%		%		%		%
1	Natural	148	2.4	93	1.30	54	0.8	61	0.9
2	Accidental	5,652	91.3	6,655	92.6	6,666	93.4	6,471	93.9
3	Incendiary	355	5.7	427	5.9	385	11.7	341	5.0
4	Undetermined	37	0.6	12	0.2	29	0.4	17	0.2
	TOTAL	6,192		7,187		7,134		6,890	



## STATISTIK

SISTEM PELAPORAN PENYIASATAN KEBAKARAN (eSPPK)



TEPHAD		
TERMIN		
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	antobio15543 bersama den	gar.
	an Jali berrombor K/P as we	
Profit Mohd Jaslizad a	eryiasatari ke atas kecura	
Dengan ini saya penyasatan saya telah menunuk		
pairwart	7027/15	
(a) BL Kejadian	18.11.2015/19:40.50	
on Tarikh / jam Kebakaran	RUMAH KEDIAMAN,	
(iii) Nama dan Alamat Premis /	NO 21 JALANTING.	
Kenderaan	SELANGOR, Selangor	
	42700, BASK 111	
to 34.00 dicapati bat	TUNET ATAN GAS ( GAS APPLIANCES .	
pada 18.11.2015 jam and ignition)	KEMALANGAN	
Sumber Nyataan (Source of Fire)	50.00	
Punca Kebakugian (RM)	50.04	
Anggaran Harta diselamata		
100		
Pasukan Penylasatan Kabakaran		
Ketua -		
the Jali		
PPgB Mohd Jasland Barba		
Penolong Penguasa and	Tarikh: 27/11/2	019
Zon RUM Industan Bomba dan Penyelamat asaray		
Jacobian Contraction of the Cont	TERH	AD
Cop Rases Jacobs		

LPK 1



#### LAPORAN MENGENAI PUNCA KEBAKARAN

[ Seksyen 5(1)(b) ] Akta Perkhidmatan Bomba 1988

Bil. Siasatan : SL:BTN/0102/2015

Dengan ini saya PPgB Mohd Jaslizad Bin Jalil bernombor K/P 831001015843 bersama dengan pasukan penyiasatan saya telah membuat penyiasatan ke atas kebakaran:

	TERHAD
Cop Rasmi Jabatan	Tarikh : 27/11/2015
Jabatan Bomba dan Penyelamat Malays	ia.
Zon KLIA	
Penolong Penguasa Bomba	
PPgB Mohd Jaslizad Bin Jalii	
()	
Ketua Pasukan Penyiasatan Kebakaran:	
Anggaran Harta diselamatkan (RM)	: 50.00
Anggaran kerugian (RM)	: 50.00
Sumber Nyalaan (Source of Ignition) Punca Kebakaran (Cause of Fire)	: PERALATAN GAS ( GAS APPLIANCES ) KEMALANGAN
pada 10.11.2010 jam 20.34.00 Gidapad	URINITYS."
nada 18 11 2015 jam 20-34-00 didacati	habour
	EHSAN,BANTING, SELANGOR, 42700, BANTING, Selangor
(c) Nama dan Alamat Premis / Kenderaan	RUMAH KEDIAMAN, NO 21, JALAN BSE 4/19, BANDAR SERI
(b) Tarikh / jam Kebakaran	: 18.11.2015/19:40:00
(a) Bil. Kejadian	: 7027/15
(a) Di Kaindian	7027/48

TERHAD

	LFK J
LER Z LAPORAN PENYIASATAN KEBAKARAN BAGI KES	LAPORAN TINDAKAN PENYIASATAN KEBAKARAN
SENGAJA DIBAKAR	Akta Perkhidmatan Bomba 1988
(Incendiary Fire)	Akta reinina
[ Seksyen 5(1)(b) ] Akta Perkhidmatan Bomba 1988	1. Bil. Siasatan    3. Bil. Kejadian      2. Tarikh Kebakaran    4. Tarikh Siasatan
KETERANGAN AM:1.1.Bil. Siasatan1.2.Bil. Kejadian:	5. Nama dan Alamat Premis/kenderaan Kejadian
1.3. Tarikh Kebakaran: 1.4.Tarikh Siasatan :	
1.5. Nama dan Alamat Premis/kenderaan Kejadian :	Jenis/Kegunaan Premis/kenderaan :
	Tempat bermula kebakaran ( <i>Origin of Fire</i> ) : Sumber Nyalaan ( <i>Source of Ignition</i> ) :
TUJUAN PENYIASATAN KEBAKARAN KETERANGAN PREMIS/KENDERAAN: KRONOLOGI KEJADIAN DAN KEADAAN KEBAKARAN	Punca Kebakaran <i>(Cause of Fire)</i> : Anggaran Kerugian (RM) : Anggaran Harta diselamatkan (RM) :
KETERANGAN SAKSI DOKUMENTASI PENDAPAT/KESIMPULAN	Cadangan langkah-langkah Pembaikpulih adalah seperti Lampiran A.
	Ketua Pegawai Penyiasatan Kebakaran (CFIO)
	Nama
	Pangkat :
	Tarikh :



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