Interior Firefighting

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Interior Firefighting

Contents

1. Incidents
2. Rapid fire developments
3. Fire Behaviour Training
4. Techniques & Tactics
5. Protective Clothing
6. When it goes wrong…
7. A typical fire…
INCIDENTS AT
FIRE SCENES

Flashover, 2 hurt, Raesfeld 5/2004
The number of fires drops

But...

The number of injured or killed firefighters does not ↓

German Data…

<table>
<thead>
<tr>
<th>Year</th>
<th>Injured</th>
<th>Year</th>
<th>Injured</th>
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<td>1995</td>
<td>3† - 20</td>
<td>2000</td>
<td>0† - 4</td>
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<td>1† - 4</td>
<td>2001</td>
<td>1† - 6</td>
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<td>0† - 3</td>
<td>2002</td>
<td>0† - 23</td>
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<tr>
<td>1999</td>
<td>0† - 5</td>
<td>06/2004</td>
<td>0† - 4</td>
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</tbody>
</table>

Even in Belgium…

– 2003, House fire, 2 injured, Zottegem
– 2002, Spanish Embassy, 1† Brussel
– 2002, Gyproc factory, 1†, Wijnegem

Flashover, 2 †, London, 7/2004
Analysis of the data

Causes...

Type of incidents
- Burns 67%
- Breathing difficulties 7%
- Heart failure 4%
- Other ‘Cuts and Bruises’ 21%

Causes
- Rapid Fire Development
- Technical (Clothing,…)
- Lost orientation
- Ran out of air
- Collapse / Falls

Collapse, 3 †, Haarlem, 05/2003

Tactical Fire Fighting
Analysis of the data

Rapid fire develop.

Less Fires…
  => Less experienced
Newer Buildings (insulation)
  => Flashover & Backdraft ↑
Faster intervention (mob. phone)
  ⇒ Pre-flashover

Old techniques & principles
⇔ Venting a fire
⇔ Controlling a fire before rescue
⇔ 3D-fog, PPV, CAFS

Backdraft, 5†, Paris, 9/2002
RAPID FIRE DEVELOPMENTS
Rapid Fire Developments

Types

1. Flashover
   Heat-induced transition to fully developed compartment fire
   Started by ignition of smoke gases in the overhead (= Lean flashover, dancing angels)

2. Backdraft
   Deflagration due to sudden air admission into a zone containing to rich smoke gases and an ignition source

3. Fire gas ignitions
   Ignition of accumulated smoke gases, present as an ideal explosive mix, mostly due to introduction of an ignition source
Rapid Fire Progress

Flashover

T 1.30

T 3.00

T 4.30

T 5.30
Rapid Fire Progress

Flashover

T 7.00

T 7.23

T 7.30

FLASHOVER
THERMAL TRANSITION TO FULLY DEVELOPED FIRE

Tactical Fire Fighting
FIRE BEHAVIOUR TRAINING
Fire Behaviour Training

What?

CFBT = Compartment Fire Behaviour Training

• Started in Zweden in 1980
• Followed by Finland, UK, Germany, France, Spain, Australia, USA,…

• Goal:
  – Reduce incidents ↓
  – Insight ↑
  ⇒ Efficiency ↑, Safety ↑, Motivation ↑
1. Theory
   Fire development, firefighting techniques, ventilation, recognising signals, cases…

2. Small Scale Demos
   Fire fighters aquarium, Dolls house, …

3. Large Scale Demos (Container)
   Reading the fire, extinguishing the ‘gasses’

4. Multicompartiment Training
   Scenario-training = ventilation, firefighting, rescue, communication,…

5. Analysis of interventions and incidents
   Own experiences and cases

+ Refresher courses…
### Fire Behaviour Training

#### ‘Container’

<table>
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<tr>
<th></th>
<th>Gas fired</th>
<th>Wood fired</th>
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<td>+</td>
<td>Controle</td>
<td>Signals</td>
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<tr>
<td></td>
<td>Health/environment</td>
<td>Smoke gasses</td>
</tr>
<tr>
<td></td>
<td>No time loss</td>
<td>Reality</td>
</tr>
<tr>
<td></td>
<td>(More divers drills)</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>Signals</td>
<td>Time</td>
</tr>
<tr>
<td></td>
<td>Smoke gasses</td>
<td>Health/environment</td>
</tr>
<tr>
<td></td>
<td>(Cost)</td>
<td>Controle</td>
</tr>
</tbody>
</table>

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**Complementarity …**

Initiation on wood ! & Further training on gas

**Rigid Safety measures !**
TACTICS WITHOUT TECHNOLOGY IS HELPLESS

- TECHNOLOGY WITHOUT TACTICS IS USELESS!
1. Direct attack (Drowning a fire)
   1/3 effect, 2/3 run-off
   Enormous water damage

2. Indirect attack (Suffocating a fire)
   Fog spray on hot surfaces
   Enormous amounts of steam
   Flames & heat pushed to other rooms
   Getting engulfed, burns…

3. 3D-Fog (Controlling a fire)
   Pulsating fog spray in hot gaslayers
   Chances on Flashover & Backdraft
**Technology & Tactics**

**Goal?**
- Control = rendering less dangerous
- Not meant to extinguish => (extra line)

**How?**
- Fine **water mist** in hot gaslayers
  => **Cooling & inertisation**

**Factors**
- No water on surfaces !!! ↔ indirect
- Don’t drown the smoke!
- Pulsations = 0.1-0.5 s
- Right cone angle and application angle
- Right droplet size

**Ideally 4scloud**

**3D Fog?**
Technology & Tactics

3D Fog?

Practical?
- Modern fog nozzle
- Drills (even blind)
- No sweeping = disturbing gaslayers
- High pressure hose & Back-up

Aim at the farthest corner where the walls reach the ceiling

115 L/min at 8 bar
We never ventilate! ↔ Don’t open doors?

Opening & Entry Procedure
Spray water above your heads, right before entry

Anti-ventilation
Close the door partially after entry...

- Inflow of air ↓,
  - Combustion ↓,
  - Smoke layer ↑,
  - Heat Radiation ↓,
  - Chances on Flashover ↓
  - Seat of fire (victims) visible!
Why?
Removing Hot Flammable gases
⇒ Heat ↓
⇒ Chances of Backdraft & Flashover ↓
⇒ Visibility ↑

Basics
• As high as possible
• Take note of wind (direction, speed)
• Provide cover hoseline (Don’t attack via exit !)
• Full Gear + BA
• Provide means of ‘rapid’ regress

Coordinated Ventilation
= on demand of attack crew inside
Positive Pressure Ventilation

Fire fighting by blowing in some extra air?

How?
• Overpressure pushes heat and flames out
• A ‘pocket’ of clean air to work in + rescue

What?
1. Locate the fire & note interior lay-out
2. Create exit opening
3. Provide cover at inlet & exit
4. Position ventilator (D = H door)
5. Attack…
DON’T USE PPV WHEN …
- No outlet opening present
- Location of fire unknown
- Fire outside its compartment
- Chances of Backdraft
- Powders/ dust

• 1 †, Basement fire, High rise, Koln, Ger.
  - PPV into basement from ground floor
  - Fire intensified…
  - Flowback of smoke gasses rookgassen = PPV engine fails oxygen, stops
  - Attack crew out of air, visibility ↓
  - 1 entangles in guide line…

Against natural ventilation ! To limited outlets !
Basic principle
Surface tension ↓ penetration ↑

Class A foam
Water + foam agent

Compressed Air Foam System (CAFS)
• Water + foam agent + air

Best ? ↔ What do you want to tackle?
• Flashover & Backdraft ?
• Post-Flashover fire ?
• How ? Fog or direct attack ?
• How can you access the fire ?
## Technology & Tactics

### Tests

<table>
<thead>
<tr>
<th>Tests</th>
<th>Type</th>
<th>Water</th>
<th>Class A</th>
<th>CAFS</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK Home Office</td>
<td>wooden palet</td>
<td>Fog/ direct</td>
<td>Nevel/ Vol</td>
<td>NT</td>
<td>No significant difference</td>
</tr>
<tr>
<td>University of Canterbury</td>
<td>Post-flashover</td>
<td>Fog</td>
<td>Fog</td>
<td>Direct jet</td>
<td>Equal in extinguishing potential</td>
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</tr>
<tr>
<td>US, Salem, Connecticut</td>
<td>Roomfire Post-flashover T drop at 1,2m</td>
<td>Direct jet</td>
<td>Direct jet</td>
<td>Direct jet</td>
<td>CAFS</td>
</tr>
</tbody>
</table>
Technology & Tactics

CAFS

• No comparative test for smoke cooling

• Advantages CAFS
  – Post-flashover
  – Attack from greater distances (from outside)
  – Knocks down fires faster compared to direct H₂O
  ⇒ Fighting capacity watertank ↑
  – Turnover ↓
  – Manouvrbility↑ (weight↓)
  – Usable in dry riser

• Disadvantages foams
  – Environment and health
  – Increased risk on falls (slippery, …)
  – Arson investigation ↓
PROTECTIVE CLOTHING ?
Protective Clothing

Basic equipment
- ‘Nomex’- jacket & -trousers
- Helmet with ‘Nomex’ attached or ‘Nomex’ hood
- Gloves, Safety boots
- Breathing apparatus

Burns and skin temperature
- 48°C = 1 th degree
- 55°C = 2 th degree
- >55°C = 3th degree
- 62°C = Numb
- 72°C = Immediate destruction skin

Burns are function of time and temperature

Without Nomex, Hessen (D), ‘95, 4 injured

Tactical Fire Fighting
Protective Clothing

Burns

Turnout gear = 4 layers + 1

1. **Outer shell** = Nomex, -Kevlar, PBI, PBO,…
2. **Moisture barrier** = Breathing water barrier
3. **Isolation** = Luchtlagen bv. in Nomex weefsel
4. **Smooth inner layer** = Comfort, sweat,…
5. **Station wear** = No synthetics eg nylons…

Burns

- **Compression** = isolation ↓
  - Crawling, BA,… (extra thick padding)
- **Water** = isolation ↓
  - Crawling through water, sweat, …
- **Steam** = gas
  - passes permeable liner + burns alle exposed skin
- **Hot liquids**
  - Droplets of tar, plastics,…
**Protective Clothing**

**Burns**

1. 1st pain = signals, react = Shake off, move!
2. Exit hot zone
3. Remove clothing !!!
4. Apply water…

Cooling somebody with water in a hot zone…? = Burn risk↑

Quick-out system

Turnout gear = max 10s protection in Flashover conditions!!!

**Tactical Fire Fighting**
Tactical Fire Fighting

Helmet

Burns

1. Not without ‘hood
2. Raise collar
3. BA !!

Still want to feel the heat?
Even in a sudden Backdraft?

Flashover, ‘95
Hessen (D), 4 injured

Flashover, ‘98, Bayern (D), 1†, 2 injured

Tactical Fire Fighting
Gloves

Test

- No House and garden equipment!
- Use sleeve restrainers!
- Bunsen test ‘Feuerwehr Dusseldorf’
  - Leather shrinks (-)
  - Nomex chars (+)
  - Elk leather with liner & Nomex insulation (++)
Well protected?

Heatstress

Hot and humid environments
⇒ Body can’t lose heat

Turnout gear
⇒ Slows body temperature rise

1. Heat exhaustion
- Circulatory distress
- Lack of minerals ⇒ muscle cramps
- Concentration ↓, strength ↓, headache, …

Rehydration = Isotone fluids & Handcooling

2. Heatstroke, hyperthermia
- BT > 41°C
- Possibly lifethreatening
- Delirium, loss of consciousness, sweating stops

Cool the body & Medical treatment

3 injured Herrstein (D) 03/2004

Tactical Fire Fighting
WHAT IF IT STILL GOES WRONG ... ?

Flashover in room, Baltimore (US)
Extra gear

Some ideas

1 scissors
2 Wallhydrant tools
3 Band
4 PASS
5 Markers
6 Door blocks

Feuerwehr Düsseldor (D)

Tactical Fire Fighting
Extra Gear

- Crashrescue
- Opening doors
- Broadening search
- Emergency escape
Furniture factory, Lustenau, Austria, jan. 02
• Firefighters gets blocked in
• >15 min before rescue
• 2th & 3th degree burns

Do you have a team stand-by to rescue your colleagues?

Registration is step 1,
Rescue is step 2

RIT = Rapid Intervention Team
Rapid Intervention Team

What? When?

What?
2 firefighters armed to the teeth
  • Extra BA
  • Axe, ropes, escape hoods,…
  • ‘Stretcher’
  • Attack hose line
  • Radio, lights

When?
ASAP !!!

When?
Persons trapped / No occupants

Where?
Close to the ‘entrance’ at ‘hearing’ range of chief
Close to the actual fire location eg High rise fires
Rapid Intervention Team

Tactical Fire Fighting
Rapid Intervention Team

Evacuation?

Rapid Intervention Team

Evacuation?

Rapid Intervention Team

Evacuation?

Rapid Intervention Team

Evacuation?

Rapid Intervention Team

Evacuation?
Rapid Intervention Team Training

1. Search techniques
2. Air supply
3. Rescue from position
4. Evacuation

E.g. Out of air?
• Feel if breathing? ↔ Hear?
• Remount BA (Blind)
• Purge

Tactical Fire Fighting
A TYPICAL FIRE

BERLIN 2 APRIL 2004
Berlin, April 2004

Appartement fire 1st floor, Buesselstraße 72

• Started in couch
• Occupant attempts fail
• Rans out to the street (Door remains open)
• Calls 112 (911)

• 17h55 : First call
• 17h57 : Alarm Fire crew
• 17h59 : On site
• 2 pumpers, 1arial ladder, 1 ambulance

Arrival
• Heavy smoke from 1st floor
• Persons hanging from 3th floor

A typical fire
Rapid overview?
- All clear until first floor landing
- Possible several persons on upper floors
- No persons visible from rear

Intervention?
1. 2 teams persons rescue
2. Ventilate stairs = position PPV
3. Position attackline
4. Request Assistance (18h02)
5. Rescue attempt via ladder: changing wind + smoke, failed, repositioned
6. ‘Rescue mattress’ at front
A typical fire

Berlin, April 2004

- Water crew, Did hydrant > put on BA for attack
- Water crew start attack on 1st floor
- Flashover… + fire in whole stairwell
- Watercrew retreats for protection

- Rescue team 1 on 4th sends ‘mayday’ and breaks window

- Firefighters at rear report persons hanging from window
- ‘Rescue mattress’ to rear
- 2 firefighters jump = 17,10m
A typical fire

Berlin, April 2004

View down... 4th floor

Height = 17.10 m

3.4.2004

Tactical Fire Fighting
A typical fire

Berlin, April 2004
A typical fire

Berlin, April 2004
A typical fire

Berlin, April 2004
A typical fire

Berlin, April 2004

• 2 firefighters land in safety mattress
  1: Hip fracture + 10% burns
  2: 30% burns

• Fire spread to penthouse and 4th floor
• Rescue team 2 got blocked in flat on 3th floor

• Scale-up of firefighting and rescue
  – 20 BA firefighters
  – Attack with 4 LP hoses
  – 5 persons + rescue team 2 evacuated via laddertruck

Evacuation of victims

Tactical Fire Fighting
A typical fire

Conclusion

• To little insights in fire development & risks
• To little insight in smoke gas spread
• Rescue teams go up passed opened door to fire!

What is the correct priority…

Rescue or Fire fighting?

SAFE INTERVENTION REQUIRES FAST CONTROL OF THE FIRE
THE LESSONS FROM OTHERS ARE THERE TO BE LEARNED…”

P. GRIMWOOD
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