

## Paper Outline

<b>Syllabus</b>	New – 2015
<b>Unit</b>	Fire Science
<b>Level</b>	SFF

## Prescriptor

An in-depth study of the principles of fire engineering science in regards to firefighting operations. This paper draws on a wide range of knowledge and on specific activities to demonstrate ability to draw relevant strands together in reviewing evaluating live situations.

## Content

The paper consists of three modules:

1. Scientific principles which underpin diverse aspects of fire activities;
2. Knowledge of fire dynamics and fire modeling; and
3. Understanding operational fire science.

## Learning Outcomes

Studying for this unit provides the opportunity to develop knowledge in applied fire science. Candidates who achieve this unit should be able to:

- Interpret data and carry out calculations accurately in firefighting contexts;
- Understand scientific principles in relation to the management of fires;
- Interpret fire behaviour and apply relevant methods of extinguishing fire;
- Demonstrate good professional practice relevant to firefighting operations; and
- Demonstrate critical technical knowledge, understanding and skills required for individuals to be competent in fire science jobs/roles/activities.

## Learning Strategies

1. Learning methods will emphasise student-centered learning and self-directed study.
2. Learning strategies will include access to online material, reading lists, links to videos, and case studies.

**Assessment Methods**

The assessment takes the form of one written two-hour examination. The examination contains ten multiple choice questions and three long answer questions.

**Learning Resources**

- Prescribed Resources
- Industry Magazines
- Academic Journals
- Websites

## Paper Content: Unit Paper Plan Guide

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The content of the unit has been designed to reflect the critical technical knowledge that fire professionals need in order to understand the behaviour of fire, the behaviour of materials and its application to fire operations. This knowledge and skill will contribute to good professional practice.

### 1. Scientific principles which underpin diverse aspects of fire activities

#### 1.1. Mechanics/Physics

- 1.1.1 Basic definitions and terms
- 1.1.2 Speed, acceleration
- 1.1.3 Force and physical mechanics
- 1.1.4 Friction between surfaces
- 1.1.5 Work and energy
- 1.1.6 Centre of gravity
- 1.1.7 Simple machines, levers and pulleys

#### 1.2 Chemistry

- 1.2.1 Basic definitions and terms
- 1.2.2 State of matter
- 1.2.3 The chemistry of combustion
- 1.2.4 Acid and bases
- 1.2.5 Gases and vapours
- 1.2.6 Principles of liquefaction of gases
- 1.2.7 Noxious fumes and gases
- 1.2.8 Hydrocarbons
- 1.2.9 Oxidising and reducing agents
- 1.2.10 Specific gravity, vapour density and miscibility IV

#### 1.3 Electricity

- 1.3.1 Basic facts about electricity
- 1.3.2 Conductors and insulators
- 1.3.3 Electrical resistance
- 1.3.4 Simple electrical circuits
- 1.3.5 Injuries caused by electric shocks

## **1.4 Heat**

- 1.4.1 Basic definitions and terms
- 1.4.2 The nature of combustion
- 1.4.3 Heat and temperature
- 1.4.4 Processes of heat transmission
- 1.4.5 Melting point, boiling point and evaporation
- 1.4.6 Principles of thermal expansion, thermostats
- 1.4.7 Changes in state, heat units
- 1.4.8 The effect of heat on matter

## **2. Knowledge of Fire Dynamics and Fire Modeling**

### **2.1 Fire behavior**

- 2.1.1 Principles of fire dynamics
- 2.1.2 Compartment fire
- 2.1.3 Ventilated fire

### **2.2 Fire development**

- 2.2.1 Fire initiation and growth
- 2.2.2 Flashover and back draft (recognising signs and symptoms, preventing occurrence)
- 2.2.3 Flame spread, steady burning and plume
- 2.2.4 Smoke control management

### **2.3 Data analysis and interpretation**

- 2.3.1 Calculations of area, volume and capacity of various shapes
- 2.3.2 Chemical equations
- 2.3.3 Electrical energy calculations
- 2.3.4 Electrical circuit calculations
- 2.3.5 Specific and latent heat calculations
- 2.3.6 Rate of development of fire calculations
- 2.3.7 Burning rate in compartment fires calculations

## **3. Understanding Operational Fire Science**

### **3.1 Extinguishing media**

- 3.1.1 Properties, reactions of water and principles of pressure
- 3.1.2 Operational use of water supplies for firefighting
- 3.1.3 Ventilation
- 3.1.4 Fire extinguishing agents
- 3.1.5 Action of fire extinguishing agents
- 3.1.6 Fire technologies
  - Flame retardant chemistry
  - Drone technology

### **3.2 Behaviour of materials in fire**

- 3.2.1 Identifying types of burning materials
- 3.2.2 Behaviour of building materials in fire
- 3.2.3 Fire resistance relative to material behaviour
- 3.2.4 Electrical hazards and safeguard
- 3.2.5 Firefighting and hazardous substances
- 3.2.6 Firefighting and electricity
- 3.2.7 Firefighting and plastics
- 3.2.8 Firefighting and flammable liquids
- 3.2.9 Firefighting and gas ignition

### **3.3 Fire predictive tool**

- 3.3.1 Hose and pipeline capacity calculations
- 3.3.2 Calculations relating to flow of water, discharge of water through nozzles, jet reaction forces
- 3.3.3 Basic calculations for operation of pumps
- 3.3.4 Sign of collapse

## Resource List

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## Recommended resources

<b>Resources</b>	<b>Reference details</b>
<p>Many of the reading materials are available on Firenet (Manuals and Policies) and are therefore of current national standard. TAPS study guides also make good reading for some units.</p>	
NZFS TAPS- Programmes	<p>Firefighter Training Notes Volume 1</p> <p style="padding-left: 40px;">Section 2</p> <p style="padding-left: 40px;">Section 10</p> <p style="padding-left: 40px;">Section 20</p> <p>Firefighter Training Notes Volume 2</p> <p style="padding-left: 40px;">Section 33</p> <p>Phase III Training Notes</p> <p style="padding-left: 40px;">Section 11</p> <p style="padding-left: 40px;">Section 15</p> <p>Phase IV Training Notes</p> <p style="padding-left: 40px;">Section 4</p> <p style="padding-left: 40px;">Section 17</p>
NZFBI Units	<p><a href="http://www.ufba.org.nz/nzfbf/exams/downloads.php">http://www.ufba.org.nz/nzfbf/exams/downloads.php</a></p> <p>Acid and bases</p> <p>Basic facts about electricity</p> <p>Calculation of electrical energy</p> <p>Centre of gravity</p> <p>Combustion</p> <p>Electrical circuit calculations</p> <p>Electrical resistance</p> <p>Electricity</p> <p>Energy and power</p> <p>Firefighting and chemistry</p> <p>Firefighting and electricity</p>

	<p>Flammable liquids</p> <p>Flashover backdraft</p> <p>Friction between surfaces</p> <p>Gases and vapours</p> <p>Hazards and safeguard</p> <p>Heat and temperature</p> <p>How to deal with fallen wires</p> <p>Hydrocarbons</p> <p>Injuries caused by electric shocks</p> <p>Noxious fumes and gases</p> <p>Oxidising agents</p> <p>Plastics</p> <p>Principles of fire extinguishment</p> <p>Simple electrical circuits</p> <p>Simple machines, levers and pulleys</p> <p>Specific and latent heat calculations</p> <p>Speed, acceleration</p> <p>State of matter</p> <p>The effect of heat on matter</p> <p>The nature of combustion</p> <p>Work and energy</p>
Hydraulics, mathematics, water supplies	<p><a href="http://firenet.fire.org.nz/TAPS-Programmes/NZFS%20Document/Specialist%20Training%20Tab/Pump%20Operator/Hydraulics%20Handout%20(POP1-D%20HydHO)%20270907jc.pdf">http://firenet.fire.org.nz/TAPS-Programmes/NZFS%20Document/Specialist%20Training%20Tab/Pump%20Operator/Hydraulics%20Handout%20(POP1-D%20HydHO)%20270907jc.pdf</a></p>
Ventilation	<p>NZFS Operational Instructions (G6)</p> <p><a href="http://firenet.fire.org.nz/General-Operational-Tasks/NZFS%20Document%20Exception/G6%20Ventilation%20December%202008.pdf">http://firenet.fire.org.nz/General-Operational-Tasks/NZFS%20Document%20Exception/G6%20Ventilation%20December%202008.pdf</a></p> <p>QFV-3 Volunteer Qualified-Firefighter Pre-course Study Guides Section 03 Ventilation</p> <p><a href="http://firenet.fire.org.nz/Qualified-Firefighter/Pages/default.aspx">http://firenet.fire.org.nz/Qualified-Firefighter/Pages/default.aspx</a></p>
Fire science and ventilation	<p>QFC-4 Qualified-Firefighter Career Stage 1 Study Guides, Section 07 Fire Science and Ventilation</p> <p><a href="http://firenet.fire.org.nz/Qualified-Firefighter/Pages/default.aspx">http://firenet.fire.org.nz/Qualified-Firefighter/Pages/default.aspx</a></p> <p>QFV-3 Volunteer Qualified-Firefighter Pre-course Study Guides, Section 05 Fire Science</p> <p><a href="http://firenet.fire.org.nz/Qualified-Firefighter/Pages/default.aspx">http://firenet.fire.org.nz/Qualified-Firefighter/Pages/default.aspx</a></p>