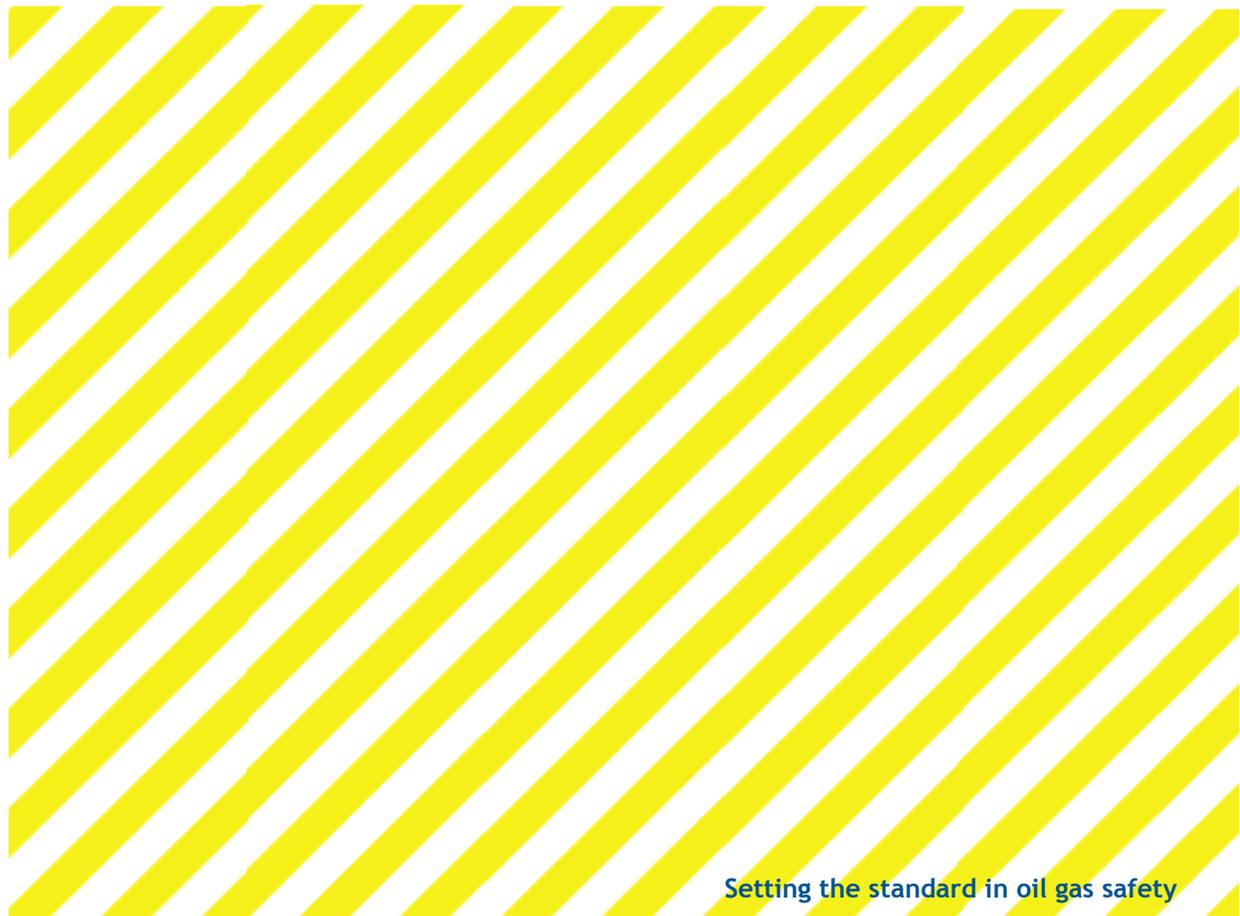




FLAME RESISTANT WORKWEAR (FRW)

A Program Development Guideline

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- Canadian Association of Petroleum Producers (CAPP)
- Canadian Energy Pipeline Association (CEPA)
- Explorers and Producers Association of Canada (EPAC)
- Petroleum Services Association of Canada (PSAC)

ABOUT ENERGY SAFETY CANADA

Energy Safety Canada is the upstream oil and gas industry's advocate and leading resource for the continuous improvement of safety performance. Our mission is to help companies achieve their safety goals by providing practices, assessment, training, support, metrics and communication.

AVAILABILITY

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TABLE OF CONTENTS

1.0	Introduction	2
1.1	Provincial Injury and Illness Statistics Related to Burns	2
2.0	Roles and Responsibilities	3
2.1	Prime Contractor	3
2.2	Employer	3
2.3	Worker	4
3.0	Selection, Use, Care and Maintenance	5
3.1	Selection	5
3.1.1	Task Specific Hazard Assessment	6
3.1.2	Specific Hazards and Applicable Standards	6
3.1.3	Evaluation	9
3.2	Use	10
3.3	Care and Maintenance	10
3.3.1	Cleaning	10
3.3.2	Inspection	11
3.3.3	Decontamination	11
3.3.4	Repair of Damage	11
3.3.5	Storage	11
3.3.6	Dispose of Damaged or Deteriorated Garments	11
4.0	Glossary	12
4.1	Acronyms	12
4.2	Definitions	13
APPENDIX A	Alberta Burn Injuries	15
APPENDIX B	British Columbia Burn Injuries	18
APPENDIX C	Saskatchewan Burn Injuries	21
APPENDIX D	Standards and Resources	24
APPENDIX E	WorkSafeBC Stand Out Safely	27
APPENDIX F	Labeling	29

PURPOSE

The purpose of this guideline is to serve as an aid to employers in the selection, use and care of flame resistant workwear (FRW) for protection against exposure of individuals to a hydrocarbon flash fire, arc flash or related thermal hazards.

Organizations must make their own decisions about the degree of protection they require and type of FRW that meets their needs. The guidance provided in this document will help companies and other users to make these decisions. The actual period for which protective workwear can offer protection against the hazard varies with the intensity of the heat, the fit of the garment, other properties of the garment (e.g. insulation, water resistance), and the capabilities of the wearer.

PROJECT SCOPE

This guide is divided into four main sections: Section 1: Introduction and Background, Information of Burn Injury History. Section 2: Roles and Responsibilities for Prime Contractors, Employers and Workers. Section 3: Selection Use Care & Maintenance and Section 4: Glossary of terms.

Section 3: Selection Use Care & Maintenance, is based on NFPA 2113, Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire - 2015 Edition. This standard provides information for selecting, using and caring for FRW. It was developed originally based on work done in both Canada and the United States to develop FRW standards. The guidance provided in this standard has been modified to suit the purposes of Canadian users of FRW. It is intended to be a practical guide for selecting and using FRW on a day-to-day basis. Limitations Energy Safety Canada offers this guideline with no specific guarantee or warranty stated or implied. Fire and conditions cannot be predicted with absolute certainty. As such, Energy Safety Canada cannot declare that workers who follow this guideline will not sustain injuries or other negative outcomes.

CONTRIBUTORS

This document incorporates information from the Canadian Association of Petroleum Producers (CAPP)'s Selection, Use and Care of Flame Resistant Workwear Guideline.

1.0 Introduction

In the oil and gas industry, incidents involving flash fires have resulted in serious incidents, including fatalities. This guideline is intended to provide background information around burn injuries, and provide information on the selection, use, care and maintenance flame resistant workwear (FRW) to protect workers from burn injuries. This information is based extensively on NFPA 2113, Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire. The additional hazards of Arc Flash, Steam and Hot liquids are considerations which should also be evaluated, as these hazards contribute to significant injuries to workers.

1.1 Provincial Injury and Illness Statistics Related to Burns

Data is provided by WCB Alberta, WorkSafeBC and WCB Saskatchewan, as of Q3 2017. This introduction includes all of Energy Safety Canada's funding industry codes and classification units. The information below only accounts for injury claims involving lost time due to disability. For a discussion on overall injury claim rate, and claim costs, see the appendix for each province.

- Over the last five years (2013 - Q3 2017), burn related injuries account for 3.8% of all time-loss injuries in Western Canada's oil and gas industry, and 3.6% of all days lost
- Burns are the sixth largest nature of injury in Western Canada's oil and gas industry, in terms of both number of time-loss claims and the number of days lost to disability
- Burn injuries that affected multiple body parts caused the most disability, resulting in 5,350 disability days over the last five years (66% of all burn injuries). Facial burns caused the most lost days out of single-body-part burns (8% of days lost, in total), and were the most common place for workers to be severely burned (29% of all time-loss burn injuries).

For the full reports and breakdown for each Province:

Appendix A: Alberta Burn Injuries

Appendix B: British Columbia Burn Injuries

Appendix C: Saskatchewan Burn Injuries

2.0 Roles and Responsibilities

This document is not designed to interpret Canadian federal and provincial legislation. For more detail, please refer to applicable legislation for the jurisdiction where the work is being carried out. This section discusses the general responsibilities of the prime contractor, employer and worker.

2.1 Prime Contractor

The Prime Contractor is responsible for:

- Establishing a policy for flame resistant workwear on applicable worksites
- Identifying and informing employers and self-employed persons about site specific flammable, explosive or thermal hazards for which the Prime Contractor is responsible
- Ensuring, where reasonably practicable, that the employers or self-employed persons at a worksite eliminate and reduce fire hazards identified by the Prime Contractor before work begins on the worksite

2.2 Employer

The Employer is responsible for:

- Ensuring compliance with the applicable Occupational Health and Safety Legislation
- Identifying and assessing the risks associated with hydrocarbon flash fire, arc flash or thermal related hazards
- Developing and implementing an FRW program
- Implementing a hierarchy of controls for elimination or control of hazards
- Providing adequate training and guidance on use and care of FRW
- Communicating potential fire and explosion hazards to workers

2.3 Worker

The worker is responsible for:

- Complying with employers' FRW policy or program including, but not limited to:
 - Pre-use inspections, use and maintenance protocols
 - Clothing worn beneath FRW and against the skin is made of flame resistant fabrics or natural fiber that will not melt when exposed to heat
 - Clothing worn as outer wear should not burn or melt
- Following established industry practices and safe work procedures
- Assisting in identifying hazards and implementing hazard controls
- Reporting unsafe situations and conditions to supervisors
- Complying with the applicable regulations

3.0 Selection, Use, Care and Maintenance

When developing an FRW program, Employers should include four components: selection, use, care and maintenance. For more information, refer to Appendix D: Standards and Resources.

3.1 Selection

Selection of appropriate FRW should be determined by specific criteria related to individual job requirements and worksite hazards. The choice of protective workwear is a compromise between protection or safety factors (flame resistance, thermal protection) and other important criteria such as durability (abrasion resistance, tearing and breaking strength), comfort (thermal comfort, functional fit), hot water and steam resistance, appearance, and cost. Employers must determine the relative importance of each of these criteria before the optimum combination of fabric/garment properties can be validated for a specific job. Wear trials are suggested to determine optimal levels of comfort, durability and design or garment improvements.

Selection of appropriate FRW is based on the following principles:

- The level of risk tolerance and injury to workers to be considered as acceptable. Note: Standards specify different pass criteria for single layer worker protection in a three second flash fire. NFPA 2112 specifies less than 50%, while CSGB 155.20 and ASTM 2733 both cite 40% maximum body burn as acceptable.
- The use of hazard assessments to identify the need for FRW, as well as additional hazards such as hot fluids, steam, electrical fire and arc flash; considerations must be made for scope of work and duties of worker groups
- An evaluation of FRW designs and characteristics to determine the type of FRW suitable for protecting workers from the identified hazards; for specifications on garment labelling, refer to Appendix F: Labelling
- The development of specifications for purchasing FRW

Garments to be considered include, but are not limited to:

- Coveralls
- Winter Jackets/Parkas/Bibs
- Gloves
- Rainwear (slickers/pants)
- Headwear and accessories
- Base layers and mid-weight insulation layers

Note: A significant number of burns are suffered to both the face and hands as they are often omitted as a protected area. New options and technologies are available which are effective and more comfortable than historical products. It is recommended these protective garments be included in the FRW program.

3.1.1 Task Specific Hazard Assessment

Conducting a Task Specific Hazard Assessment is required to determine all the hazards control measures required to protect workers. Consider the following factors in deciding the requirement for FRW:

- Proximity of work to flash fire hazards and ignition sources
- The potential for the work being done to increase the risk of a flash fire
- Means and duration of escape within the danger zone (Geronimo line, escape hatches, emergency egress routes)
- Determine if there is a need for garment decontamination
- Determine if there are any ergonomic (e.g. restricted movement) or environmental constraints (e.g., temperature extremes) to using FRW on worksites

Certain tasks may require specialized FR workwear. Specifically, where hazards of material contamination (e.g. NORM, asbestos) or highly absorbable substances (e.g. Toluene, hydrochloric acid) are in use. Consider specialized workwear such as disposable coveralls or limited use apparel and impervious outerwear. CAN/CGSB 155.20 Workwear for Protection Against Hydrocarbon Flash Fire and Optionally Steam and Hot Fluids details the performance criteria for disposable coveralls or limited use apparel.

3.1.2 Specific Hazards and Applicable Standards

Refer to Appendix D: Standards and Resources for more information.

Note: Reference the most current edition of each standard in publication.

Subject	Number and Title	Description
Flash Fire	CAN/CGSB 155.20 Workwear for Protection Against Hydrocarbon Flash Fire and Optionally Steam and Hot Fluids	Provides minimum requirements for performance of workwear worn for protection against unplanned exposure to hydrocarbon flash fire
	NFPA 2112 Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire	Specifies the minimum design, performance, certification, and testing requirements for flame-resistant fabric and garments for use in areas at risk from flash fires
	NFPA 2113 Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire	Provides minimum requirements for the correct selection, care, use, and maintenance of flame resistant clothing (FRC) compliant with the NFPA 2112

Subject	Number and Title	Description
Electrical	CSA Z462 Workplace Electrical Safety	Offers direction on integrating electrical safety programs into OHS management systems helping to comply with due diligence requirements
	NFPA 70E Standard for Electrical Safety in the Workplace	Information about the effects of arc flash, arc blast, and direct current (dc) hazards, and recent developments in electrical design and (PPE)
	ULC S/801 Standard on Electric Utility Workplace Electrical Safety for Generation, Transmission and Distribution	Applies to the construction, operation, maintenance and replacement of electric utility systems that are used to generate, transform, transmit, distribute or deliver electrical power or energy to consumer services or their equivalent.
Welding	ANSI Z49.1: Safety in Welding and Cutting	The protection of persons from injury and illness and the protection of property from damage by fire and explosions arising from welding, cutting, and allied processes
	OSHA 29C.F.R.1910.252(b)(3) Welding, cutting, and brazing. Protective clothing - General requirements.	Basic precautions for welding, cutting, and brazing
High Visibility	Z96 High-Visibility Safety Apparel	Incorporates advice on selection, use, and care of high-visibility safety material and includes recommendations for hazard assessments
	ANSI 107 American National Standard for High-Visibility Safety Apparel and Accessories	Reviews three performance classes of garments based on the amount of visible materials and design attributes incorporated into the final configuration
Rainwear	ASTM F2733 Standard Specification for Flame Resistant Rainwear for Protection Against Flame Hazards	Minimum performance criteria for flame resistance and other requirements for rainwear used by workers with the potential to be simultaneously exposed to wet weather conditions and either hydrocarbon or petrochemical industrial fires

Subject	Number and Title	Description
Rainwear	ASTM F1891 Standard Specification for Arc and Flame Resistant Rainwear	Establishes minimum physical and thermal performance criteria, for rainwear for use by workers who may be exposed to thermal hazards of momentary electric arcs and open flames
Steam & Hot Liquids	CAN/CGSB 155.20 Workwear for Protection Against Hydrocarbon Flash Fire and Optionally Steam and Hot Fluids	Minimum requirements for performance of workwear worn for protection against exposure to hydrocarbon flash fire
Fire and Dust Explosions	NFPA 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids	Safety measures to prevent and mitigate fires and dust explosions in facilities that handle combustible particulate solids, which include combustible dusts, fibers, flocks, flakes, chips, and chunks
Wildland Fire Fighting	NFPA 1977 Standard on Protective Clothing and Equipment for Wildland Fire Fighting CAN/CGSB 155.22 Fireline workwear for wildland firefighters	Minimum product labeling and design criteria; performance and certification requirements for protective clothing, helmets, gloves, and footwear designed to protect fire fighters against adverse environmental effects during wildland fire fighting operations Minimum requirements for performance of fireline workwear used for the protection against the adverse effects to the firefighter's body during wildland firefighting, or prescribed fire operations
Chemical Splash	NFPA 1992 Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies	Requirements for protection of emergency responders from hazardous materials incidents where liquid or liquid splash threats are present or expected
Turnout Gear	NFPA 1851 Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting	Requirements for the selection, care, and maintenance of firefighting protective ensembles to reduce health and safety risks associated with improper maintenance, contamination or damage
	NFPA 1971 Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting	Minimum levels of protection from thermal, physical, environmental, and bloodborne pathogen hazards encountered during structural and proximity firefighting operations

3.1.3 Evaluation

In addition to the hazard assessment, attention must be given to additional functional aspects of FRW. Daily use, wear, comfort, and ease of maintenance should all be evaluated in conjunction with the primary protective factors.

Further garment specific evaluations to be considered:

- Garment construction and components (pockets, types of closures, etc.)
- Avoidance of static charge build-up
- Conditions under which workwear will be worn
- Comfort of fabric and garment
- Cleaning and maintenance
- Ensure selected workwear will cover both the upper and lower body and any non-FR under layers
- Workwear should not be tight-fitting; a layer of air between the fabric and the skin will provide additional insulation against heat
- Non-flame resistant logos and other decorative symbols are kept to a minimum and small in size
- Specify garment materials that are in the lightest weight possible without compromising protection for ease of movement and less stress on workers

Vendor specific considerations:

- Choose garment/fabric manufacturers that can provide details of their in-house total quality management (TQM) qualifications from start to finish
- Ensure vendor will support wear trials of new products and technology to confirm garment fit/functionality/design
- Customer support and care to support delivery issues, quality concerns and timely supply

Provincial regulatory considerations:

- With respect to high visibility class and selection, employers should specify CSA Class 1 Level FR apparel requirements, as this meets or exceeds all provincial regulatory requirements
- WorkSafeBC has had the most stringent requirements around high visibility usage, see Appendix E: WorkSafeBC Stand Out Safely

3.2 Use

Employers should consider the following principles when identifying FRW usage:

- Refer to the completed task specific hazard assessment
- Ensure the label of the garment is aligned with the controls of the hazard assessment
- Workers should be notified if additional neck, head, hand or foot protection is required (see Section 3.1 Note on hand and facial burns)
- Provide users of FRW with information on care, use, and maintenance of the garments as well as any written instructions, limits or warnings provided by the manufacturer
- FRW shall be worn as described from the manufacturer instructions
- Provide employees guidance on the use of undergarments that may be worn with the FRW (under-garments cannot be subject to melting or shrinking or contribute to additional burn injury)
- Provide guidance on the use of over garments that may be worn with the FRW (over-garments cannot be flammable or contribute to additional burn injury)
- Provide guidance on the use of auxiliary FRW clothing that may be worn for insulating / layering purposes (base layers / mid insulating layers)

3.3 Care and Maintenance

To ensure performance and protective function, care and maintenance procedures must be established, the following principles should be considered: cleaning, inspection, repair of damage, decontamination, disposal and storage.

3.3.1 Cleaning

- Clean FRW according to manufacturer's instructions
- It is important to note that FR Rainwear has specific cleaning considerations and should be cleaned separately (never to be dry cleaned or bleached)
- Ensure FRW is laundered when it becomes soiled with hydrocarbon or other flammable products to prevent a build-up of contamination
- Employers should ensure each employee has sufficient quantity of FRW to complete each shift (taking in to consideration timeliness and availability of laundry facilities)

3.3.2 Inspection

Develop an inspection program for FRW that includes the following:

- Inspection after each cleaning and prior to each use; check for fabric damage, of the outer shell, lining, wind/moisture barrier, hardware, wristlets, and reinforcements
- Do not use damaged or contaminated FRW; remove from service immediately
- Decide whether the damaged FRW should be repaired or retired (employer should establish criteria for removal from service to be repaired or disposed of)

3.3.3 Decontamination

Some tasks may result in extremely heavy contamination (beyond soiling and staining) that will require special cleaning.

- Dispose of contaminated FRW if no instructions for decontamination are provided (eg. NORM, chlorinated hydrocarbons, beryllium)
- Prevent cross contamination of clean workwear
- Do not launder or dry-clean contaminated FRW at home or in public facilities; only use approved industrial facilities for wet wash and dry-clean

3.3.4 Repair of Damage

- All repairs and alterations to FRW must be performed by a qualified vendor using approved materials by the manufacturer
- Clean FRW before doing repairs

3.3.5 Storage

- Store FRW in accordance with manufacturer's instructions
- Ensure FRW is clean and dry before long-term storage
- Ensure storage areas are clean, dry and well-ventilated

3.3.6 Dispose of Damaged or Deteriorated Garments

- Retire damaged or deteriorated FRW when it can no longer be repaired or cleaned
- Dispose of retired FRW in a way that ensures it cannot continue to be used
- Dispose of any workwear which has been exposed to a flash fire

4.0 Glossary

4.1 Acronyms

AR	Arc Resistant
ASTM	American Society for Testing and Materials
ATPV	Arc Thermal Performance Value
CGSB	Canadian General Standards Board
CSA	Canadian Standards Association
EBT	Energy Breakopen Threshold
ESD	Electro Static Discharge
FR	Flame Resistant, Fire Resistant
FR/AR	Flame Resistant and Arc Resistant
FRC	Flame Resistant Clothing
FRW	Flame Resistant Workwear
HRC	Hazard Risk Category
HTP	Heat Transfer Performance
ISO	International Organization for Standardization
MVTR	Moisture Vapour Transmission Rate
NFPA	National Fire Protection Association
NORM	Naturally Occurring Radioactive Material
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
TPP	Thermal Protective Performance
TQM	Total Quality Management
ULC	Underwriters Laboratories of Canada

4.2 Definitions

Aramid

A manufactured fibre; aramid fibres exhibit low flammability, high strength. Fabrics made from aramid fibres maintain their integrity at high temperatures, but may shrink.

Arc Flash

An arc flash (or arc blast) event is a type of electrical explosion that results from a low impedance connection to ground or another voltage phase, also called a “short”, in an electrical system. The massive energy released in the fault instantly vapourizes the metal conductors, blasting molten metal and expanding plasma outward with extreme force.

Arc Thermal Performance Value

The incident energy on a material that results in sufficient heat transfer through the material for a 50% probability of the onset of a second-degree burn on human tissue.

Breakopen Threshold

See Energy Breakopen Threshold

Energy Breakopen Threshold

The energy needed to cause the material to breakopen. Breakopen Threshold Energy Above Stoll See Energy Breakopen Threshold

Contamination

The presence of an unwanted constituent, contaminant or impurity in a material. Examples include: NORM, Asbestos, Lead, Beryllium, chlorinated hydrocarbons, fibrous glass, and infectious agents.

Fabric Blend

A fabric consisting of a combination of two or more textile fibres. The fabric blend has special performance qualities.

Flash Fire

A rapidly moving flame front through diffuse fuel such as gas, vapours from liquids or dust. Hydrocarbon flash fire is relatively short in duration at three seconds or less.

Heat Transfer Performance

The amount of heat it takes to pass through a fabric to cause second-degree burns based on the skin burn Stoll Curve.

Hazard Risk Category

The classification of a task according to the type of hazard present when performing the task. Zero represents minimal risk, four represents the greatest risk. The five Hazard/Risk categories are specified in NFPA 70E. Ranges are from HRC 0 (which is low risk and allows for 100% untreated cotton), up to HRC 4 (which is high risk and requires FR clothing with a minimum arc rating of 40). The HRC is used to determine the necessary arc rating of a garment worn during a given job task.

Thermal Protective Performance (TPP)

Measures how well a fabric protects the wearer against second-degree burns in a flash fire. The higher the TPP value, the more thermal protection the fabric provides relative to other fabrics. The NFPA minimum requirement of a TPP rating of 35 equates to 17 1/2 seconds until second-degree burn occurs in a flashover situation.

APPENDIX A Alberta Burn Injuries

Oil and Gas Industry Occupational Injuries: 2013 to 2017

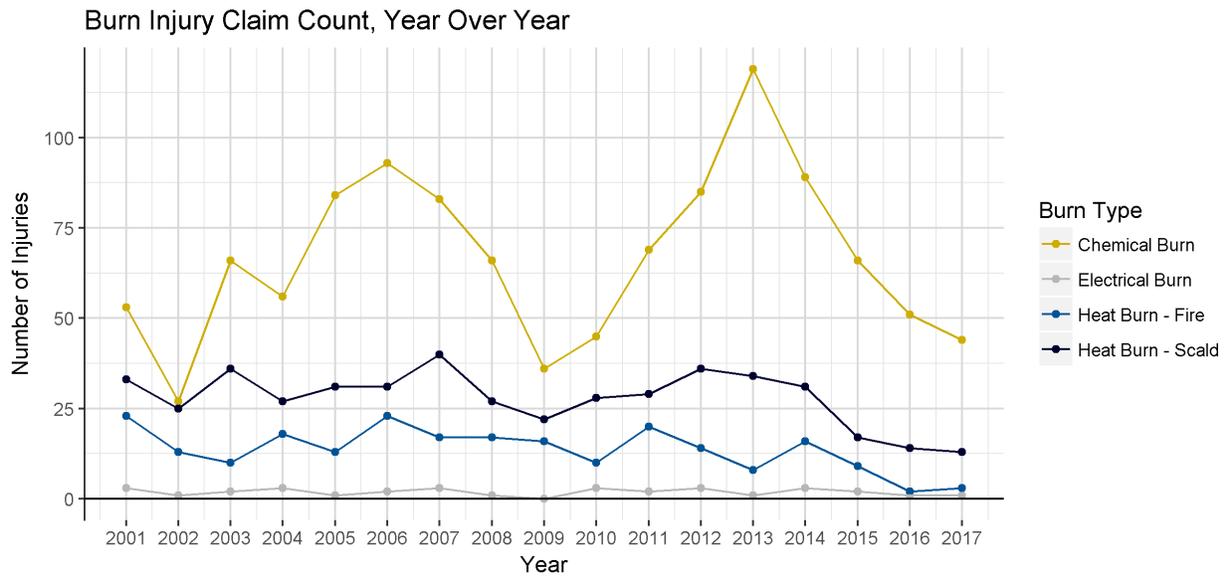
Data provided by Workers' Compensation Board-Alberta as of Q3 2017. The included industries are Energy Safety Canada's 21 historical funding industry codes from Alberta (this report has been updated to include 6600 - Oilsands Operations).

Key Facts

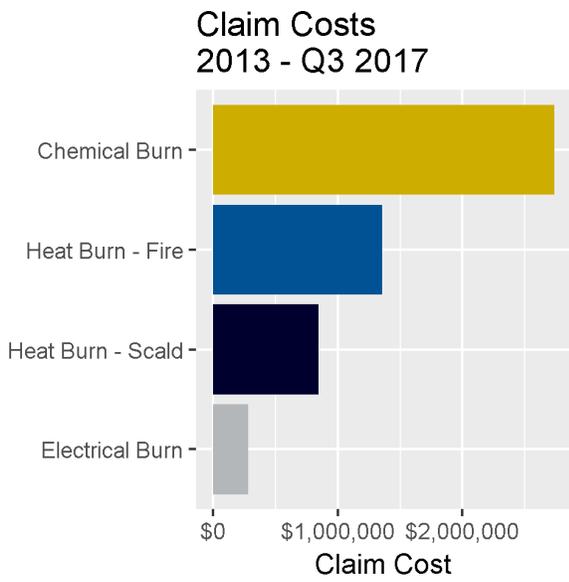
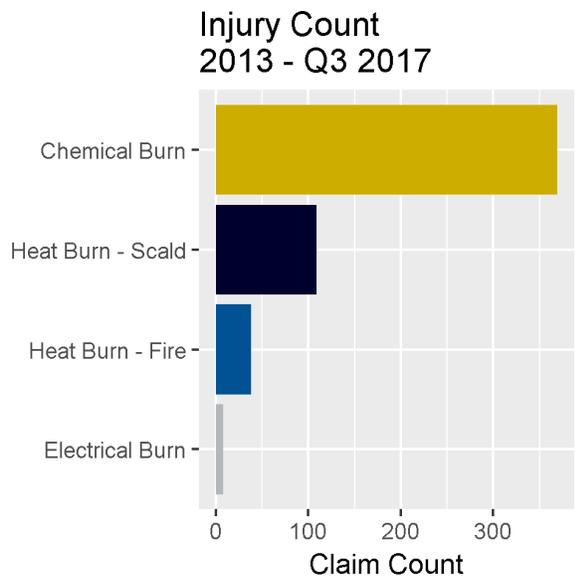
- Over the last five years (2013 - Q3 2017), burn related injuries account for 4% of all injuries in Alberta's oil and gas industry, and 5% of all claim costs
- Burns are the sixth largest nature of injury in Alberta's oil and gas industry, in terms of both claim cost and claim count
- WCB-Alberta classifies burns into four categories. The following statistics cover the last five years:
 - Chemical burns - 53% of burn injuries were chemical burns, and they account for 47% of claim costs
 - Heat burns, scalds - 32% of burn injuries were heat burns of various types, and they account for 46% of claim costs. This report will split heat burns into three more categories (Fire, Scald, and Other) based on the source of the injury.
 - Scalds were three times as numerous as burns from fire, but burns from fire were more severe and more costly.
 - Electrical burns - 1% of burn injuries were electrical burns, but they account for 5% of claim costs
 - Unclassified and Unspecified - 14% of burn injuries don't have a specified type in the WCB's data
- Burn injuries that affected multiple body parts were the most costly at \$4.3M over the last five years (73% of all burn injury claim costs). Facial burns were most costly out of single-body-part burns (7% of all burn injury claim costs), and were the most common place for workers to be burned (42% of all burn injuries).

Trending

This graph shows the number of claims of each known burn type, year over year. Chemical burns are consistently most numerous, but have been dropping in number since their peak in 2013.



Of the four classifications of burns with known source, chemical burns are the most numerous and costly (in sum total), followed by heat burns and, finally, electrical burns. Electrical burns and fire burns have the highest average cost per claim, meaning that those types of injuries tend to be more severe when they do occur.



Supporting Tables

The tables below include data from Workers' Compensation Board-Alberta, between 2013 and Q3 2017.

“UNS” stands for “Unspecified”

Top 10 Nature of Injury Classifications - 2013 to Q3 2017

Nature of Injury	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count
Traumatic injuries to muscles, tendons, ligaments, joints, etc.	\$35,240,717	6858	34.9%	39.8%
Traumatic injuries to bones, nerves, spinal cord	\$19,829,889	1845	19.6%	10.7%
Other traumatic injuries and disorders	\$12,718,163	1549	12.6%	9.0%
Multiple traumatic injuries and disorders	\$6,440,844	293	6.4%	1.7%
Open wounds	\$6,025,724	1985	6.0%	11.5%
Burns	\$5,870,740	693	5.8%	4.0%
Surface wounds and bruises	\$4,466,693	2400	4.4%	13.9%
Traumatic injuries and disorders, UNS	\$2,542,717	223	2.5%	1.3%
Intracranial injuries	\$2,428,461	242	2.4%	1.4%
Mental disorder or syndrome	\$1,371,851	114	1.4%	0.7%
All other injuries	\$4,170,643	1041	4.1%	6.0%
Total	\$101,106,442	17243	100%	100%

Breakdown of “Burn” Injuries - 2013 to Q3 2017

Burn Type	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count	Cost per Claim
Chemical burn	\$2,734,610	369	46.6%	53.2%	\$7,411
Heat burn - Fire	\$1,358,489	38	23.1%	5.5%	\$35,750
Heat burn - Scald	\$844,333	109	14.4%	15.7%	\$7,746
Heat burn - Other	\$544,440	75	9.3%	10.8%	\$7,259
Electrical burn	\$281,277	8	4.8%	1.2%	\$35,160
Unclassified	\$107,591	94	1.8%	13.6%	\$1,145
Total	\$5,870,740	693	100%	100%	\$8,471

Part of Body Burned - 2013 to Q3 2017

Part of Body Burned	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count	Cost per Claim
Multiple body parts, UNS	\$4,270,541	82	72.7%	11.8%	\$52,080
Face	\$412,048	290	7.0%	41.8%	\$1,421
Hand(s), except finger(s)	\$299,097	72	5.1%	10.4%	\$4,154
Leg(s)	\$228,820	48	3.9%	6.9%	\$4,767
Foot (feet), except toe(s)	\$191,635	37	3.3%	5.3%	\$5,179
Arm(s)	\$92,093	43	1.6%	6.2%	\$2,142
All other locations	\$376,505	121	6.4%	17.5%	\$3,112
Total	\$5,870,740	693	100%	100%	\$8,471

APPENDIX B British Columbia Burn Injuries

Oil and Gas Industry Occupational Injuries: 2013 to 2017

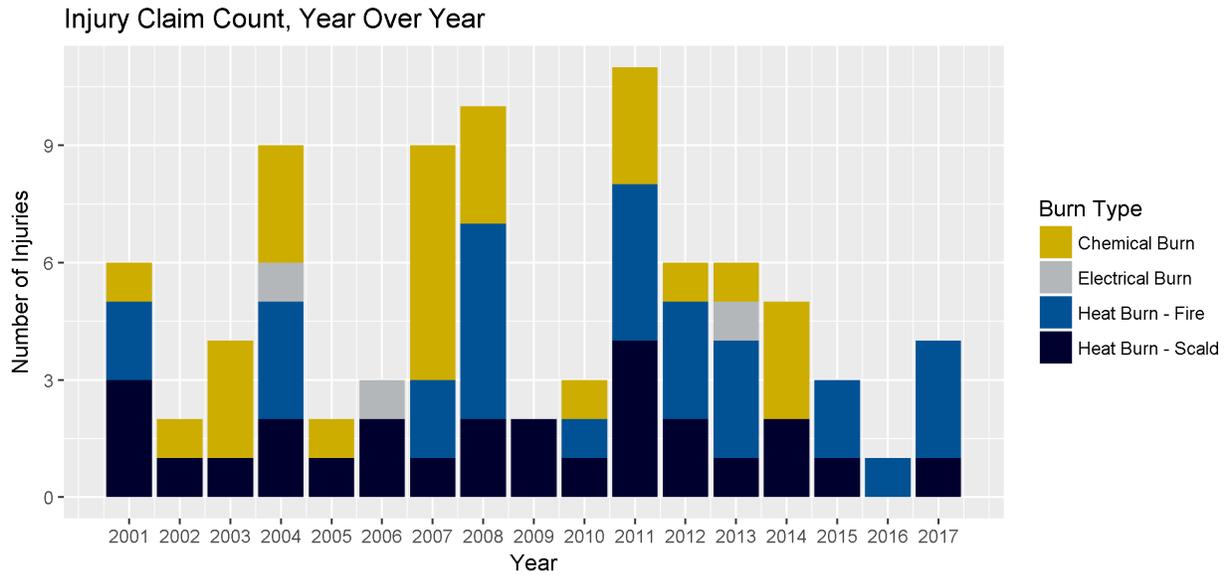
Data provided by WorkSafeBC as of Q3 2017. The included industries are Energy Safety Canada's seven funding classification units from B.C.

Key Facts

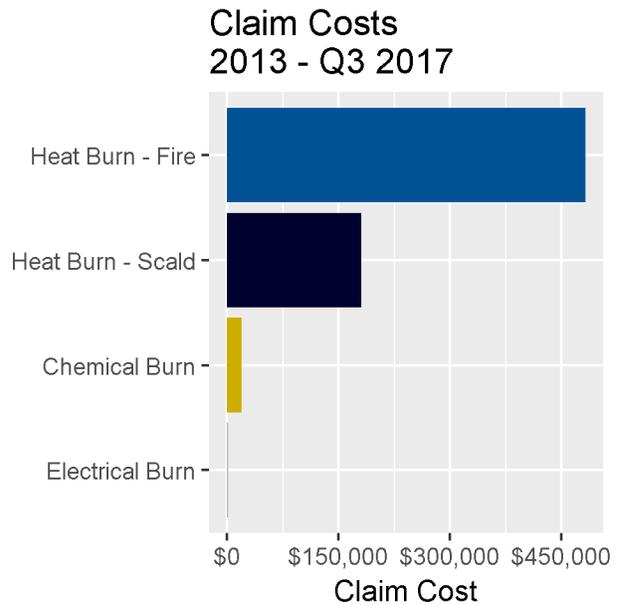
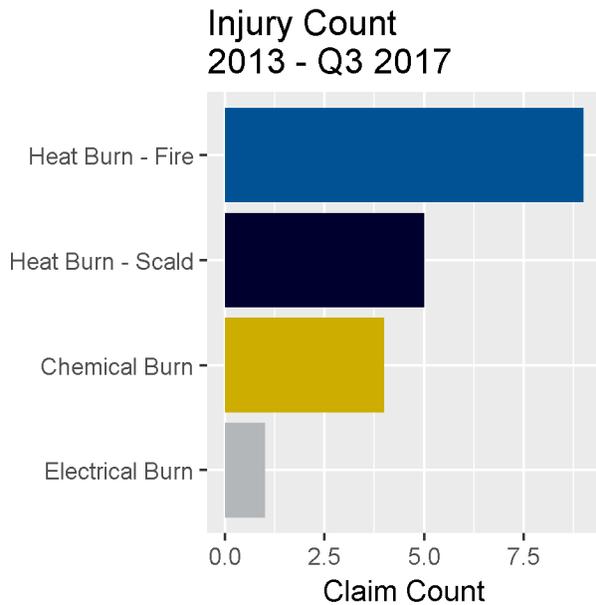
- Over the last five years (2013 - Q3 2017), burn related injuries accounted for 7.4% of all injuries in B.C.'s oil and gas industry, and 1.6% of all claim costs
- Burns are the fifth largest nature of injury in B.C.'s oil and gas industry in terms of claim cost, and sixth in terms of number of injuries
- There are a large number of unclassified claims in the B.C. data (mostly low-cost claims), so there may be burn injuries that are not represented in this report
- WorkSafeBC classifies burns into four categories. These statistics cover the last five years:
 - Heat burns, scalds - 70% of known burn injuries were heat burns, and they account for 94% of claim costs. This report will split heat burns into three more categories (Fire, Scald, and Other) based on the source of the injury.
 - Fire burns were about twice as numerous as scalds
 - Heat burns were the most severe types of burns, on average
 - Chemical burns - 20% of burn injuries were chemical burns, but account for 2.8% of burn claim costs
 - Electrical burns - 5% of burn injuries were electrical burns, and they account for 0.2% of burn claim costs
- Burn injuries that affected multiple body parts were the most costly, costing \$627,984 over the last five years (91% of all burn injury claim costs). Facial burns were most costly out of single-body-part burns (3.8% of all burn injury claim costs), and were the most common place for workers to be burned (25% of all burn injuries).

Trending

This graph shows the number of claims of each known burn type, year over year. There have been five burn injuries each year, on average, but with high variance.



Of the four classifications of burns with known source, burns from fire were the most common and the most costly. It should be noted, though, that a large proportion of low-cost claims in British Columbia are reported without information about the nature of the injury. So chemical burns (for example) might be more common than what’s shown here.



Supporting Tables

The tables below include data from WorkSafeBC, between 2013 and Q3 2017.

“UNS” stands for “Unspecified”

Top 10 Nature of Injury Classifications - 2013 to Q3 2017

Nature of Injury	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count
Traumatic injuries to bones, nerves, spinal cord	\$2,191,685	86	23.6%	6.8%
Traumatic injuries to muscles, tendons, ligaments, joints, etc.	\$2,148,883	143	23.1%	11.3%
Intracranial injuries	\$1,502,935	18	16.2%	1.4%
Unknown	\$1,078,269	892	11.6%	70.7%
Burns	\$690,194	20	7.4%	1.6%
Open wounds	\$528,268	28	5.7%	2.2%
Other traumatic injuries and disorders	\$339,750	21	3.7%	1.7%
Multiple traumatic injuries and disorders	\$204,863	2	2.2%	0.2%
Malignant neoplasms and tumors	\$187,095	2	2.0%	0.2%
Musculoskeletal system and connective tissue diseases and disorders	\$134,520	8	1.4%	0.6%
All other injuries	\$277,786	41	3.0%	3.3%
Total	\$9,284,249	1261	100%	100%

Breakdown of Burn Injuries - 2013 to Q3 2017

Burn Type	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count	Cost per Claim
Heat burn - Fire	\$481,920	9	69.8%	45.0%	\$53,547
Heat burn - Scald	\$180,686	5	26.2%	25.0%	\$36,137
Chemical burn	\$19,533	4	2.8%	20.0%	\$4,883
Heat burn - Other	\$6,349	1	0.9%	5.0%	\$6,349
Electrical burn	\$1,705	1	0.2%	5.0%	\$1,705
Total	\$690,194	20	100%	100%	\$34,510

Part of Body Burned - 2013 to Q3 2017

Part of Body Burned	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count	Cost per Claim
Multiple body parts, UNS	\$525,004	9	76.1%	45.0%	\$58,334
Multiple lower extremities	\$102,980	2	14.9%	10.0%	\$51,490
Face	\$26,289	5	3.8%	25.0%	\$5,258
Leg(s)	\$26,280	1	3.8%	5.0%	\$26,280
Unknown	\$4,200	1	0.6%	5.0%	\$4,200
Arm(s)	\$3,736	1	0.5%	5.0%	\$3,736
Hand(s), except finger(s)	\$1,705	1	0.2%	5.0%	\$1,705
Total	\$690,194	20	100%	100%	\$34,510

APPENDIX C Saskatchewan Burn Injuries

Oil and Gas Industry Occupational Injuries: 2013 to 2017

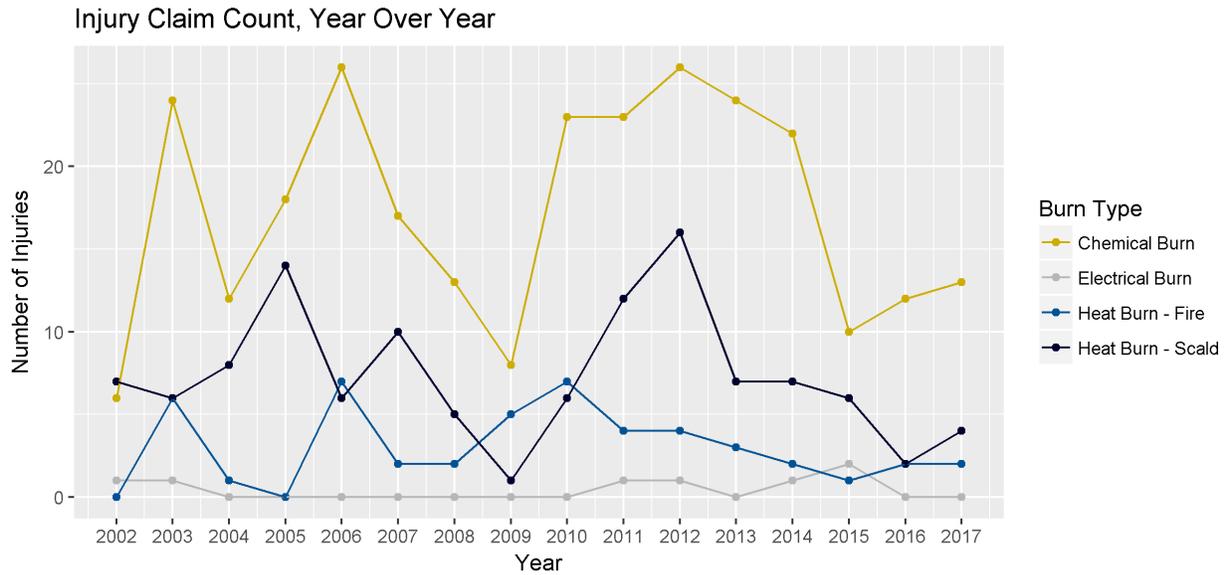
Data provided by Saskatchewan WCB as of Q3 2017. The included industries are Energy Safety Canada's seven funding classification units from Saskatchewan.

Key Facts

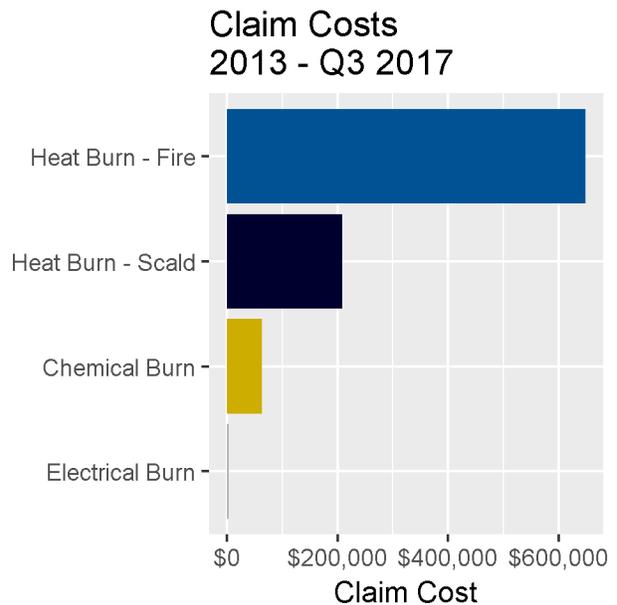
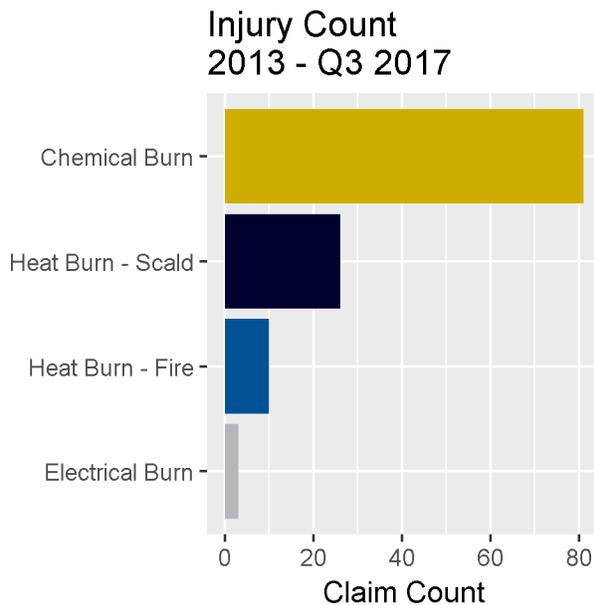
- Over the last five years (2013 - Q3 2017), burn related injuries accounted for 4.5% of all injuries in Saskatchewan's oil and gas industry, and 5% of all claim costs
- Burns are the sixth largest nature of injury in Saskatchewan's oil and gas industry, in terms of both claim cost and claim count
- Saskatchewan WCB classifies burns into four categories. The following statistics cover the last five years:
 - Chemical burns - 57% of burn injuries were chemical burns, but account for 6.4% of claim costs
 - Heat burns, scalds - 38% of burn injuries were heat burns, and they account for 93% of claim costs. This report will split heat burns into three more categories (Fire, Scald, and Other) based on the source of the injury.
 - Scalds were two and a half times as numerous as burns from fire
 - On average, fire burns were the most severe by far, costing the most per injury
 - Electrical burns - 2% of burn injuries were electrical burns, and they account for 0.3% of claim costs
 - Unclassified and Unspecified - 2.8% of burn injuries do not have a specified type in the WCB's data
- Burn injuries that affected multiple body parts were the most costly, costing \$828,923 over the last five years (83% of all burn injury claim costs). Facial burns were most costly out of single-body-part burns (4.6% of all burn injury claim costs), and were the most common place for workers to be burned (47% of all burn injuries).

Trending

This graph shows the number of claims of each burn type, year over year. Chemical burns are consistently most numerous, with peaks corresponding with industry growth.



Of the four classifications of burns with known source, chemical burns were the most common, but burns from fire were significantly more costly. This is due to the high average claim cost of fire burns.



Supporting Tables

The tables below include data from Saskatchewan WCB, between 2013 and Q3 2017.

“UNS” stands for “Unspecified”

Top 10 Nature of Injury Classifications - 2013 to Q3 2017

Nature of Injury	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count
Traumatic injuries to muscles, tendons, ligaments, joints, etc.	\$4,412,359	760	22.1%	23.9%
Other traumatic injuries and disorders	\$4,187,164	576	20.9%	18.1%
Traumatic injuries to bones, nerves, spinal cord	\$3,650,762	320	18.3%	10.1%
Open wounds	\$1,294,689	441	6.5%	13.9%
Multiple traumatic injuries and disorders	\$1,002,546	72	5.0%	2.3%
Burns	\$994,274	143	5.0%	4.5%
Surface wounds and bruises	\$678,663	338	3.4%	10.6%
Traumatic injuries and disorders, UNS	\$465,422	59	2.3%	1.9%
Intracranial injuries	\$222,541	23	1.1%	0.7%
Effects of environmental conditions	\$99,894	34	0.5%	1.1%
All other injuries	\$2,992,185	415	15.0%	13.0%
Total	\$20,000,500	3181	100%	100%

Breakdown of Burn Injuries - 2013 to Q3 2017

Burn Type	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count	Cost per Claim
Heat burn - Fire	\$648,060	10	65.2%	7.0%	\$64,806
Heat burn - Scald	\$208,362	26	21.0%	18.2%	\$8,014
Heat burn - Other	\$64,471	19	6.5%	13.3%	\$3,393
Chemical burn	\$63,181	81	6.4%	56.6%	\$780
Unclassified	\$7,001	4	0.7%	2.8%	\$1,750
Electrical burn	\$3,198	3	0.3%	2.1%	\$1,066
Total	\$994,274	143	100%	100%	\$6,953

Part of Body Burned - 2013 to Q3 2017

Part of Body Burned	Claim Cost	Injury Count	% of Claim Cost	% of Claim Count	Cost per Claim
Multiple Body Parts, UNS	\$828,923	21	83.4%	14.7%	\$39,473
Face	\$45,401	67	4.6%	46.9%	\$678
Finger(s), fingernail(s)	\$35,782	4	3.6%	2.8%	\$8,946
Leg(s)	\$22,330	7	2.2%	4.9%	\$3,190
Foot (feet), except toe(s)	\$22,262	9	2.2%	6.3%	\$2,474
Arm(s)	\$14,667	11	1.5%	7.7%	\$1,333
All other locations	\$24,908	24	2.5%	16.8%	\$1,038
Total	\$994,274	143	100%	100%	\$6,953

APPENDIX D Standards and Resources

Standards and resources should be consulted in the selection of FRW. These standards and resources may include, but are not limited to, the latest editions of the following:

Canadian General Standard Board (CGSB)

CGSB is a government organization that provides standards development and conformity assessment services in, including programs for certification of products and services.

- CAN/CGSB 155.20 Workwear for Protection Against Hydrocarbon Flash Fire and Optionally Steam and Hot Fluids
- CAN/CGSB 155.22 Fireline workwear for wildland firefighters

Canadian Standards Association (CSA)

CSA represents the interests of its members by creating a better, safer, more sustainable world - primarily through standards development, technical research, and training in relevant fields.

- Z96 High-visibility safety apparel
- Z462 Workplace electrical safety

National Fire Protection Association (NFPA)

NFPA is a global non-profit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards.

- 70E Standard for Electrical Safety in the Workplace
- 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids
- 1851 Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
- 1971 Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
- 1977 Standard on Protective Clothing and Equipment for Wildland Fire Fighting.
- 1992 Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies
- 2112 Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire
- 2113 Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire

American Society for Testing and Materials (ASTM) - International

ASTM is a not-for-profit, voluntary standards-developing organization. It provides a forum for the development and publication of international voluntary consensus standards for materials, products, systems and services.

- D3393 - 91 Standard Specification for Coated Fabrics—Waterproofness
- D6413M Standard Test Method for Flame Resistance of Textiles (Vertical Test)
- E96/E96M Standard Test Methods for Water Vapor Transmission of Materials
- F903 Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Liquids
- F955 Standard Test Method for Evaluating Heat Transfer through Materials for Protective Clothing Upon Contact with Molten Substances
- F1506 Standard Performance Specification for Flame Resistant and Arc Rated Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards
- F1891 Standard Specification for Arc and Flame Resistant Rainwear
- F1930 Standard Test Method for Evaluation of Flame Resistant Clothing for Protection Against Fire Simulations Using an Instrumented Manikin
- F1959 Standard Test Method for Determining the Arc Rating of Materials for Clothing
- F2733 Standard Specification for Flame Resistant Rainwear for Protection Against Flame Hazards

American National Standards Institute (ANSI)

- 107 American National Standard for High-Visibility Safety Apparel and Accessories
- Z49.1: Safety in Welding and Cutting

International Organization for Standardization (ISO)

ISO is an independent, non-governmental international organization with a membership of 162 national standards bodies.

- 11612 Protective clothing - Clothing to protect against heat and flame - Minimum performance requirements

Occupational Safety and Health Administration (OSHA)

OSHA is an agency of the United States Department of Labor with a mission to assure safe and healthful working conditions for working men and women by setting and enforcing standards and providing training, outreach, education and assistance.

- 29C.F.R.1910.252(b)(3) Welding, cutting, and brazing. Protective clothing - General requirements

Underwriters Laboratories of Canada (ULC)

ULC is an independent product safety testing, certification and inspection organization.

- S/801 Standard on Electric Utility Workplace Electrical Safety for Generation, Transmission and Distribution



APPENDIX E WorkSafeBC Stand Out Safely

Stand out safely

If you work around mobile equipment, your high-visibility gear must meet strict safety standards. Here are five variations that fit that description.



New!



Flame-resistant (FR) coverall style:

- Retro-reflective band 19-mm wide minimum
- Level 2 (330 cd/lx-m²) minimum

As of September 19, 2014, CSA Class 1 high-visibility safety apparel is an acceptable alternative to a Type 3 garment referenced in WCB PPE2-1997. See OHS Guideline 8.24-1: "Alternative standard for high-visibility apparel."

CSA Class 1

Background:

- 0.14 m² / 217 in.²
- Fluorescent — yellow-green, orange-red, red**
- Bright — yellow-green, orange-red**

Non-FR coloured stripes or bands:

- Distinctive pattern
- Retro-reflective or combined performance
- 0.10 m² / 155 in.² (minimum front or back)
- Level 1 (250 cd/lx-m²) or Level 2 (330 cd/lx-m²)
- 50-mm wide (minimum)

WCB Standard Type 3 — harness-style

Vertical length of garment: 0.51 m/20 in. (minimum)

Background:

- 0.06 m² / 100 in.² (minimum front or back)
- Fluorescent — lime-yellow, yellow, orange*



WCB Standard Type 3 — affixed

- Type 3 harness-style garment that is permanently affixed to another garment (i.e., vest, shirt, or jacket)
- Harness portion meets the Type 3 requirements



*High-visibility background colours must meet chromaticity and luminance requirements of the WCB Standard.
**Colours must meet CSA requirements for chromaticity and luminance.

For a detailed look at the requirements, you'll need to familiarize yourself with CSA Z96-09: "High visibility safety apparel," available at ohs.csa.ca.



Stand out safely

If you work around vehicles moving faster than 30 km per hour, your high-visibility gear must meet strict safety standards. Here are four variations that fit that description.



WCB Standard Type 1 — vest, shirt, or similar garment

Vertical length of garment: 0.61 m/24 in. (minimum)

Background:

- 0.13 m²/200 in.² (minimum front or back)
- Fluorescent — lime-yellow, yellow, orange*

Visibility-enhancing (VE) trim (fluorescent portion):

- 0.05 m²/80 in.² (minimum front or back)
- Contrasting colour to background



WCB Standard Type 2 — jacket, coat, coveralls, or similar garment

Vertical length of garment: 0.61 m/24 in. (minimum)

Background:

- 0.26 m²/400 in.² (minimum front or back)
- Fluorescent — lime-yellow, yellow, orange*
- Bright — yellow, orange, red*

VE trim (fluorescent portion):

- 0.05 m²/80 in.² (minimum front or back)
- Contrasting colour to background



Types 1, 2, and 3

VE-trim requirements:

- A smooth, flat exterior finish, securely attached to the garment, and at least 50-mm (2 in.) wide
- Visible on the side of the garment
- One vertical stripe on either side of the front of the garment with an "X" pattern on the back
- Made either from combined performance or separate performance materials***
- The retro-reflective portion of the VE trim continues along the length of the trim, with a minimum coefficient of retro-reflection equal to 240 cd/lx·m²

*High-visibility background colours must meet chromaticity and luminance requirements of the WCB Standard.

***Combined performance consists of a single strip that is both fluorescent and retro-reflective; separate performance consists of two strips (one fluorescent and one retro-reflective).

For a detailed look at the requirements, you'll need to familiarize yourself with the WCB Standard: "PPE 2 High Visibility Garment — Personal Protective Equipment Standard 2," available under WCB Standards on worksafebc.com.



APPENDIX F Labeling

To identify and validate that properly rated FRW and rainwear is being used, check garment labels for the following:

- Name, trademark, or identification of manufacturer
- Design of the product type, commercial name or code
- Size
- Description of the FR Textile comprising the primary fabric
- CGSG 155.20 and/or NFPA 2112 Compliant (NFPA 2112 certification requires the entire garment must be compliant to this standard)
- ASTM 1506 Compliant (for electrical rating)
- ASTM 2733 Compliant (only for Rainwear)
- FR/AR Performance Rating (either ATPV or EBT)
- Visibility Standard Compliance (Suggested to be CSA Z96)
- Both English and French language

Label layout will vary from each manufacturer - the samples below are provided as reference for content only.

FRW Label Sample (French tags not shown):

<p style="text-align: center;">Manufacturer Logo Contact Information And Identifiers</p> <p style="text-align: center;">THIS GARMENT IS FLAME RESISTANT</p> <p>This garment, constructed from flame resistant fabrics and components, resists ignition and will not continue to burn when removed from the ignition source.</p> <p>Designed for continuous wear, this garment meets the performance requirements of</p> <p style="text-align: center;">Minimum Performance Standard from Risk Assessment</p> <p style="text-align: center;">!WARNING!</p> <p>This garment is not intended for fire entry or structural fire fighting activities and provides no personal from chemical exposures.</p> <p>Keep this garment clean: soiling may reduce protective qualities.</p>	<p style="text-align: center;">Shell - Extérieur</p> <p style="text-align: center;">Style and identifier Weight and Material Material Composition</p> <p style="text-align: center;">FLAME RESISTANT RESISTANT A LA FLAMME</p> <p style="text-align: center;">Manufacturer Number</p> <p style="text-align: center;">Cut # and Date</p> <p style="text-align: center;">Style Number</p> <p>STYLE MODELE SIZE TAILLE MADE IN CANADA FABRIQUE AU CANADA</p> <p style="text-align: center;">  </p>
	<p style="text-align: center;">CSA Z462 / NFPA 70E HRC 2</p> <p>AFPV = Identified minimum value from risk assessment</p> <p>Machine Wash Very Hot (60° C / 140° F), Non-Chlorine Bleach, Only Use Detergent, No AntiOStats, Tumble Dry Low, Iron Medium (If Necessary), Dry-Clean Normal</p> <p style="text-align: center;">Vendor Name</p> <p>Style Unlined Deluxe Coverall Manufacturer Material Reflective Material ¾ inch Silver FR Trim on Yellow Fluorescent Manufacturer 2 inch CAN/CSA Class 1 Level FR Manufacturer Background Material</p>

FR Rainwear Label Sample (French tags not shown):

<p>Manufacturer Name and Logo Here</p> <p>Machine Wash Warm, Rinse Thoroughly </p> <p>Do Not Use Bleach or Fabric Softener </p> <p>Tumble Dry Warm </p> <p>Do Not Iron </p> <p>Do Not Dry Clean </p> <p>Do Not Puncture Rainwear Fabric </p> <p>Special Care Instructions: (Go to website)</p>	<p>English</p> <p>Product Commercial Name Here</p> <p>Fabric Technology</p> <p>Manufacturer: Manufacturer name and address</p> <p>Flash Fire Resistant: This rainwear meets or exceeds requirements or exceeds requirements for ASTM F2733-09 Standard Specification for Flame Resistant Rainwear for Fire Hazards.</p> <p>Electric Arc Resistant: This rainwear meets or exceeds requirements for ASTM F1891-12 Specification for Arc and Flame Resistant Rainwear. Arc Rating (ARC or E_{BT} ≥ 15CAL/CM²) Meets background color and retro reflectivity requirements defined by: ANSI/ISEA 107-15 CSA Z96-15 Multi-hazard garment Breathable laminate Oeko-Tex compliant laminate Resistant flex cracking to -40C</p> <p>DO NOT REMOVE THIS LABEL</p> <p>Warning: This garment is consider foul weather protective outerwear that must be worn over underclothing made of flame resistant or non-melting fibers. The garment is not intended for fire entry, structural or wildland fire fighting activities. In order to provide intended burn protection for the wearer, the garment must be worn properly and care instructions must be followed. All closures must be completed fastened to eliminate openings and drawcords should be tightly cinched to create the proper fit. Failure to follow the care instructions could adversely affect the protection offered by the garment. Manufacturer Name Here make no guarantee of how the garment will perform in actual use.</p>
<p>(Brand of Garment here) CSA Z96-2015</p> <p>Model: Hi-Vis Jacket</p> <p>Class 3, Level 2 Fluorescent FR: ASTM F2733-09 ASTM 1891 Size:</p> <p>Garment Storage: Store in cool dry environment, away from direct sunlight. Maintenance: Check stored items after 2 years for any visual or functional defects.</p>	

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