DATA TABLES

TSSA PUBLIC SAFETY REPORT 2020

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Appendix A – Cross-Program Data

Incidents, Injuries and Risk Prediction

TSSA reports on two main measures of public safety and risk:

1. Observed Injury Burden, which summarizes what has happened in the past and quantifies fatalities and injuries, expressed in terms of fatality equivalents per million people per year (FE/mpy).

2. Risk of Injury or Fatality (RIF), which uses a predictive approach [1] developed by TSSA; it is a composite score across all TSSA-regulated sectors that uses past data to predict what might happen in the future.[1]

Table A1: Cross-Program State of Safety Measures (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	4,290	4,586	4,917	5,456	5,329	5,574	5,027	5,611	6,258	5,732	52,780	5,278	2.5%
Non-Permanent Injuries	653	913	950	1,246	1,167	1,594	1,069	1,354	1,820	1,895	12,661	1,266	5.1%
Permanent Injuries	19	32	35	51	56	80	68	41	59	44	485	49	None
Fatalities	6	4	5	10	5	1	4	2	2	3	42	4	None
Observed Injury Burden (FE/mpy)	0.20	0.32	0.59	0.65	0.40	0.28	0.40	0.33	0.36	0.33	N/A	0.39	N/A

Table A2: Cross-Program Risk of Injury or Fatality (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.72

TSSA's acceptance criterion is 1.00 FE/mpy.

[1] Readers are cautioned that composite Risk of Injury or Fatality has been established for reporting and benchmarking purposes only. Sections provided for the individual safety programs help gain an understanding of the significant causes and, more importantly, strategies for monitoring and managing risk to Ontarians.

Figure A1: Occurrences and Observed Injury Burden for Regulated Program Areas (2011 – 2020)

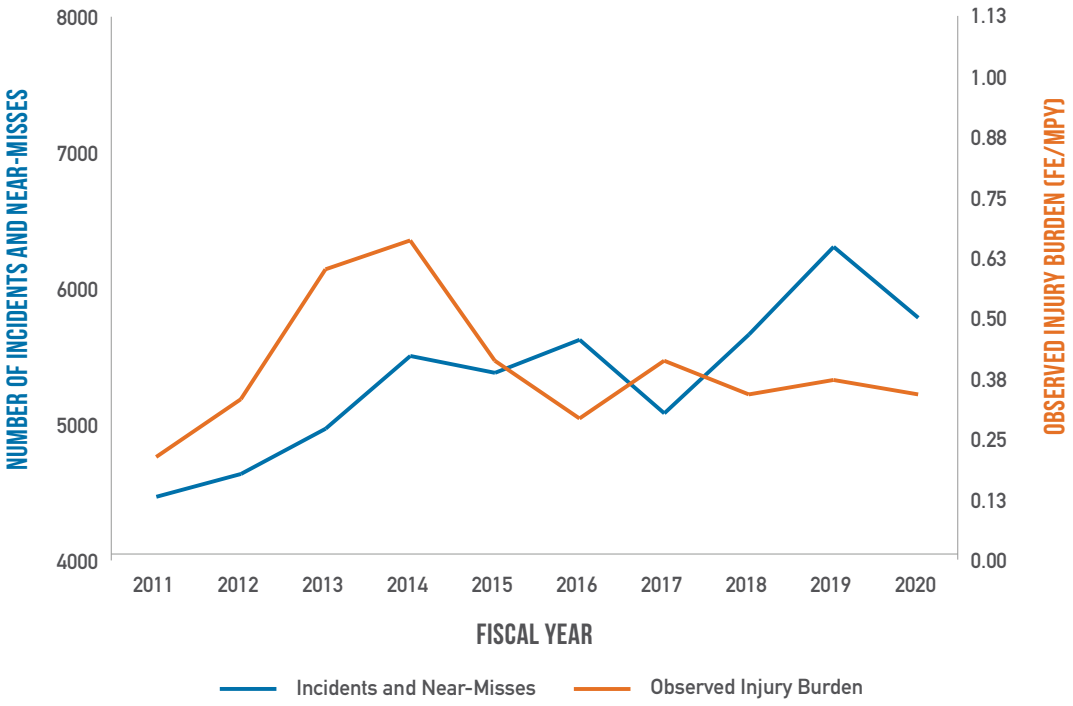
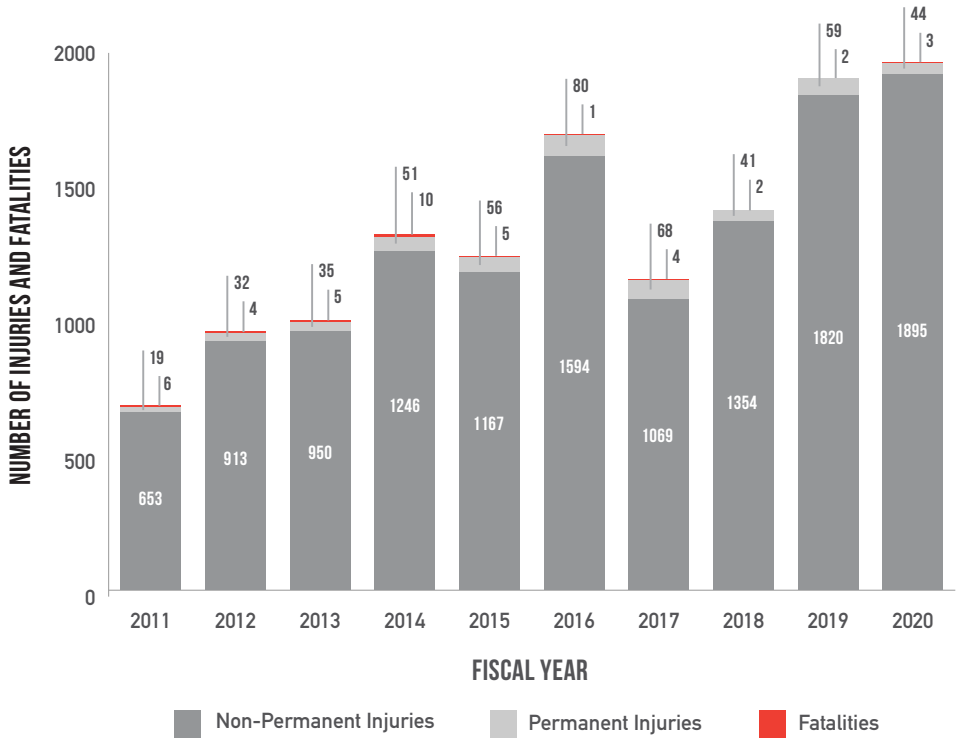


Figure A2: Injuries and Fatalities for Regulated Program Areas (2011 – 2020)



Areas of Concern

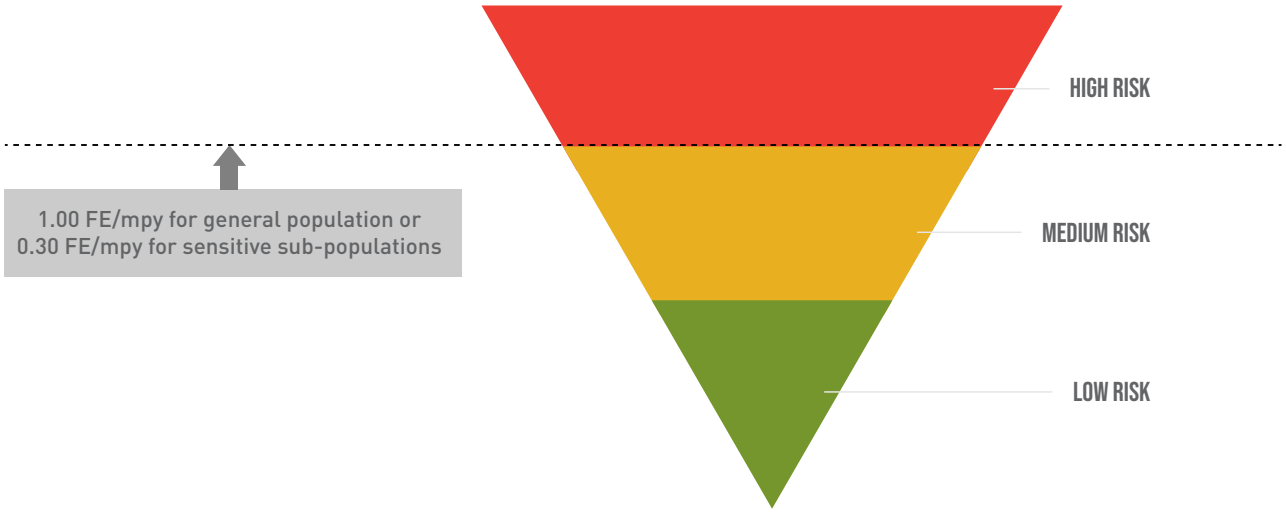
TSSA uses a risk-informed approach to understand the state of safety across its regulated sectors, to identify areas of concern. The state of safety is described using a risk metric, known as the RIF, that is measured in terms of FE/mpy. This measure helps compare against international risk acceptability criteria benchmarks, and to set internal thresholds for decision-making. TSSA has adopted risk acceptability criteria from various international[2] and national[3] best-practice methods. These best-practice methods have been leveraged to provide guidance to decision-makers on:

- Situations that warrant mandatory action versus discretionary action; and
- Enhancing responses to areas of concern.

Specifically, TSSA uses a criterion of 1.00 FE/mpy for evaluating risk to the general population of Ontario and a criterion of 0.30 FE/mpy for evaluating risks to sensitive sub-populations [2, 3, 4, 5].

Additionally, for the purposes of better understanding the sources of risk, TSSA has adopted the use of "As Low As Reasonably Practicable" (ALARP) principles [5], to assist in classifying risks and identifying areas of concern. As shown in Figure A3, risks can be classified into one of three regions of the triangle: high risk; medium risk; and low risk.

Figure A3: TSSA Adaptation of ALARP Principles for Classifying Risk Sources



Identifying Risks – Risk of Injury or Fatality Approach

As detailed in Appendix M[4], the RIF relies on historical data (i.e., reported occurrences and injuries over the last ten fiscal years) to determine the potential risks that could be observed by certain populations of interest (typically the Ontario population as a whole) when exposed to TSSA-regulated technologies and devices. The approach relies on the use of predictive analytics and multiple simulations. For reporting and decision-making purposes, the 50th percentile value of the simulations is used to avoid over- or under-estimating risks.

[2] Health and Safety Executive [5], US Centers for Disease Control, The National Institute for Occupational Safety and Health [6].
[3] Major Industrial Accidents Council of Canada [2].
[4] Appendix is found in Technical Appendices report.

High Risk

Risk sources that require mitigating actions (shown in the red zone of Figure A3) exceed the risk acceptability criteria for either the general population (1.00 FE/mpy) or for sensitive sub-populations (0.30 FE/mpy). TSSA identifies these risk sources as safety issues that require risk management strategies. These strategies can include regulatory actions (such as director's orders), as well as advisories and bulletins, collaborative partnerships with stakeholders and public education.

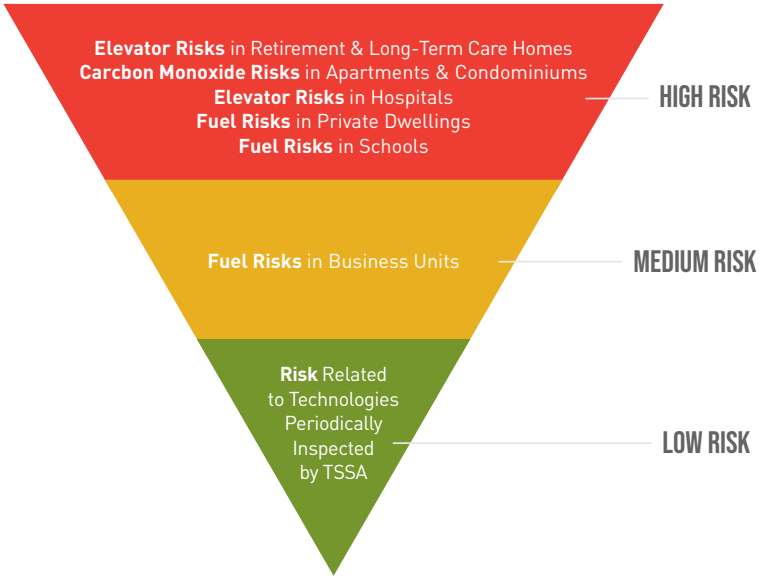
Medium Risk

When risk sources approach the risk acceptability criteria, TSSA utilizes enhanced monitoring (shown in the yellow zone of Figure A3). TSSA considers these risk sources to be potentially emerging areas of risk to be monitored (including investigating specific incidents in the affected program area) and/or addressed through mitigation strategies.

Low Risk

Risk sources that are well below the risk acceptability criteria are shown in the green zone of Figure A3. These risk sources are within broadly acceptable levels due to TSSA's preventive/predictive inspection programs. While TSSA considers these risk sources as not being of immediate concern, it continues to monitor and oversee these sources using the various regulatory tools available, such as engineering reviews and periodic inspections.

Figure A4: TSSA's Risk Sources (2020)



GREEN
LOW RISK

Green indicates safety issues that are low risk and require periodic inspection.

YELLOW
MEDIUM RISK

Yellow indicates minor safety issues that are medium risk and require enhanced monitoring.

RED
HIGH RISK

Red indicates major safety issues that are high risk and require an actionable response.

Table A3: TSSA's Areas of Concern (2020)

RISK SOURCE	RISK OF INJURY OR FATALITY (FE/MPY)	ACCEPTABILITY CRITERION (FE/MPY)
Elevator Risks in Retirement and Long-Term Care Homes	1.32	0.30
CO Risks in Apartments and Condominiums	3.54	1.00
Elevator Risks in Hospitals	3.53	1.00
Fuel Risks[4] in Private Dwellings	2.65	1.00
Fuel Risks[5] in Schools (K-12)	0.38	0.30
Fuel Risks[6] in Business Units	0.61	1.00

TSSA remains committed to reducing the risk of injury or fatality in areas identified here. The outcome-based regulator initiative will transform TSSA's regulatory delivery, allowing TSSA to more precisely identify and reduce harms in these areas.

Throughout this report, all references to specific years refer to TSSA's fiscal year, which runs from May 1 to April 30.

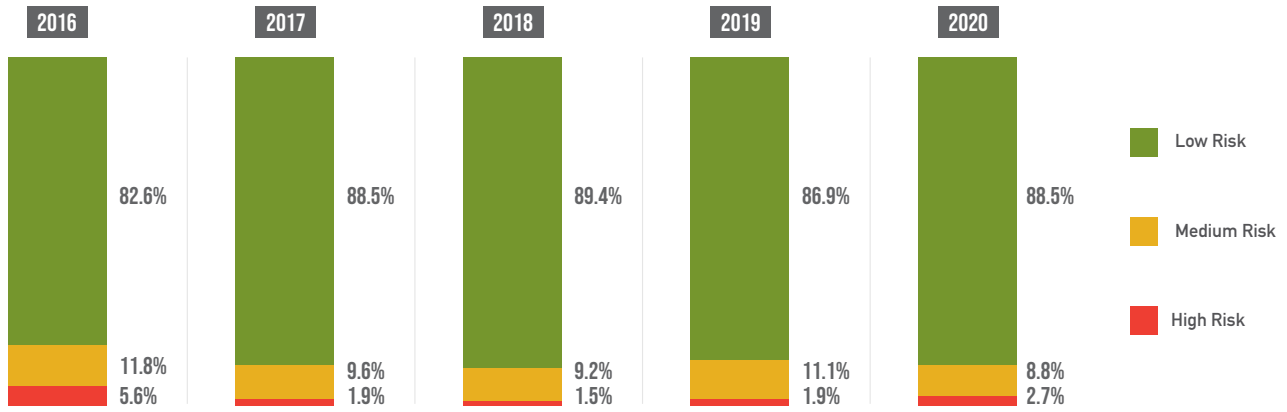
Table A4: TSSA's Fiscal Year (2020)

2020 FISCAL YEAR
May 1, 2019 through April 30, 2020

Risk of Facilities or Devices

Using a harmonized approach described in Appendix N[7], an inventory risk profile has been generated to reflect the level of compliance across TSSA's entire regulated inventory. The calculation only includes devices for which there is sufficient inspection history (i.e., three or more periodic inspections) to estimate the risk. Certain sectors (i.e., Elevating Devices) have a large fraction of new devices for which an assessment cannot yet be made.

Figure A5: Inventory Risk Profiles from Outcomes of Periodic Inspections Across All Programs (2016 – 2020)



[4] Fuel risks include CO release, fire, explosion, and/or vapour release.
[5] Fuel risks include CO release, fire, explosion, and/or vapour release.
[6] Fuel risks include CO release, fire, explosion, and/or vapour release.
[7] Appendix is found in Technical Appendices report.

Compliance

TSSA uses a rolling five-year period for measurement and reporting of compliance information for this report. For more details on statistical methods, please refer to Appendix M[1].

Table A5: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Across All Programs (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	29.0%	-2.7%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspections (e.g., pass or fail), the inspection risk spectrum (shown as a pie chart) portrays the potential safety risks associated with non-compliance found during the inspections. The dark red segments of the spectrums show unacceptable levels of risk.

Figure A6: Inspection Risk Spectrums from Outcomes of Periodic Inspections Conducted in All Regulated Sectors (2016 – 2020)

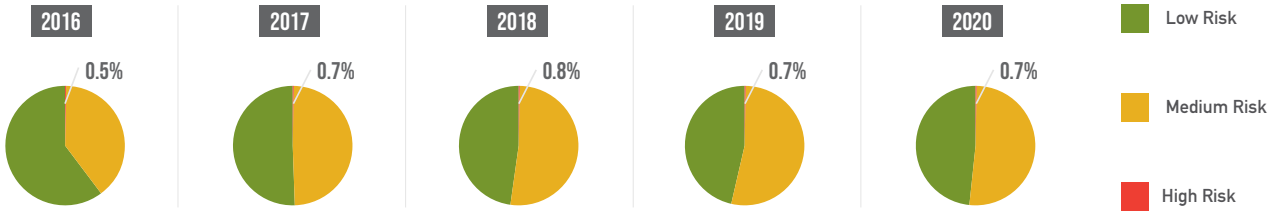


Table A6: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted in All Regulated Sectors (2020)

RISK SOURCE	FISCAL YEAR 2020
Major Issues	0.7%
Minor Issues	74.6%
Fully Compliant	24.7%

[1] Appendix is found in Technical Appendices report.

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" nor "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate, which can result in small differences between the two numbers.

Table A7: Cross-Program Inspection and Re-Inspection Results (2020)

DESCRIPTION	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Ad Hoc/Unscheduled Inspections	1,496	1,862	98	3,456	44.6%
Alteration Inspections	146	4	0	150	97.3%
Complaint Inspections	468	68	0	536	87.3%
Initial Inspections	8,090	3,147	20	11,257	72.0%
Inspections for Certification	2,552	93	0	2,645	96.5%
Minor Alteration Inspections	1,790	1,459	0	3,249	55.1%
Non-Mandated/Non-Regulated Inspections	1,788	472	609	2,869	79.1%
Occurrence Inspections	33	110	3,667	3,810	23.1%
Operational Inspections	244	19	0	263	92.8%
Other Inspections	12,040	4,204	225	16,469	74.1%
Periodic Inspections	8,783	20,637	377	29,797	29.9%
Re-Inspections	10,759	21,524	472	32,755	33.3%
Repair Inspections	674	9	0	683	98.7%
All Programs Total	48,863	53,608	5,468	107,939	47.7%

TSSA Collaboration with Other Organizations

See Appendix Q[1] for a list of organizations and groups that TSSA has worked with to help keep Ontarians safe.

[1] Appendix is found in Technical Appendices report.

Appendix B – Boilers and Pressure Vessels

TSSA's Boilers and Pressure Vessels Safety Program ensures the safe design, construction, maintenance, use, operation and repair of pressure-retaining components in Ontario. This includes all pressure-retaining components that produce and distribute hot water, steam, compressed air and other compressed liquids and gases for industrial, commercial or institutional purposes.

Note that numbers may not add up fully or may exceed the 100th percentile due to rounding off.

Incidents, Injuries and Risk Prediction

Table B1: State of Safety Measures for *Uninsured* Boilers and Pressure Vessels (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	1	2	2	0	1	5	4	22	117	143	297	30	8.9%
Non-Permanent Injuries	0	0	0	0	0	1	0	0	2	0	3	0	None
Permanent Injuries	0	2	0	0	0	1	2	1	0	0	6	1	None
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	None
Observed Injury Burden (FE/mpy)	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	N/A	0.00	N/A

Note that the large increase in incidents in the past couple of years was due to an increase in reporting, not to an actual increase in the number of physical incidents. The increased reporting was due to better coordination with the Spills Action Centre in the reporting of incidents.

Table B2: Risk of Injury or Fatality for *Uninsured* Boilers and Pressure Vessels (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.04

TSSA's acceptance criterion is 1.00 FE/mpy.

Incidents involving these types of equipment could include cracked and corroded vessels or piping, leaks or rupture, resulting in poisonings, suffocations, fires and/or explosions. Failures can be catastrophic and may immediately threaten life and property. The safe design, installation, operation, and maintenance of boilers and pressure vessels, in accordance with appropriate codes and standards, are essential to public safety. TSSA's activities help ensure that safeguards are in place for the lifecycle of this type of equipment.

Figure B1: Occurrences and Observed Injury Burden for *Uninsured* Boilers and Pressure Vessels (2011 – 2020)

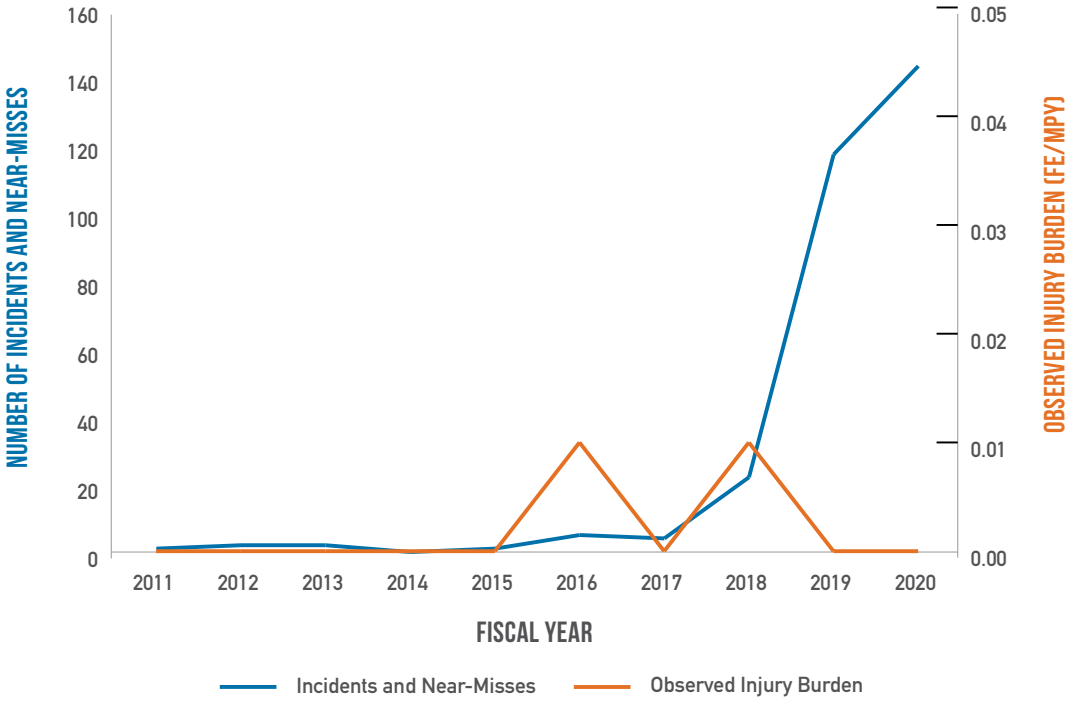


Figure B2: Injuries and Fatalities for Uninsured Boilers and Pressure Vessels (2011 – 2020)

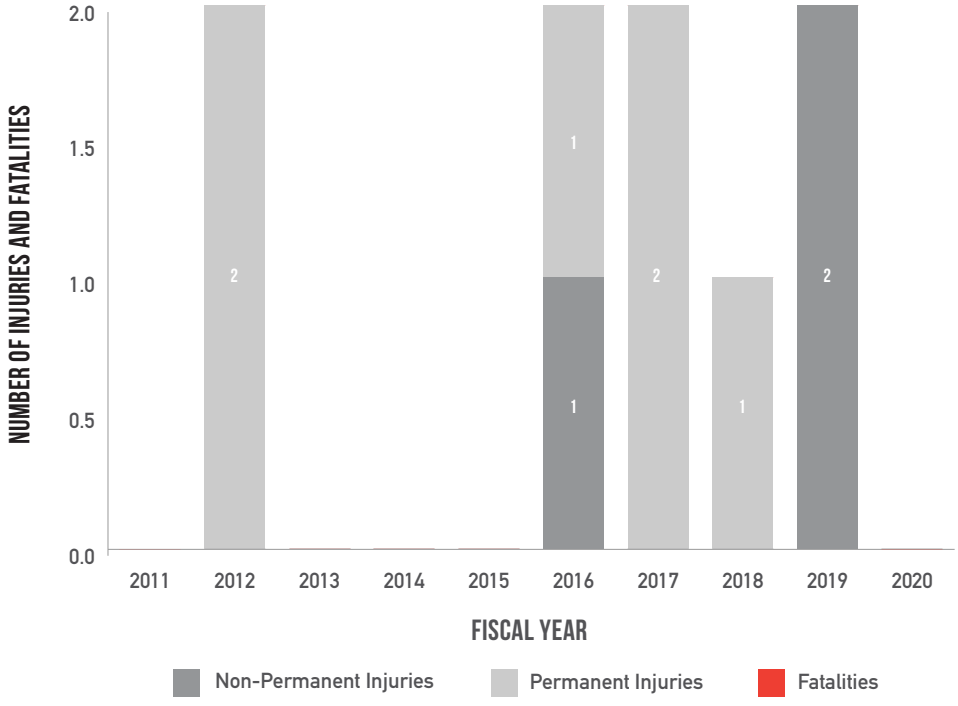
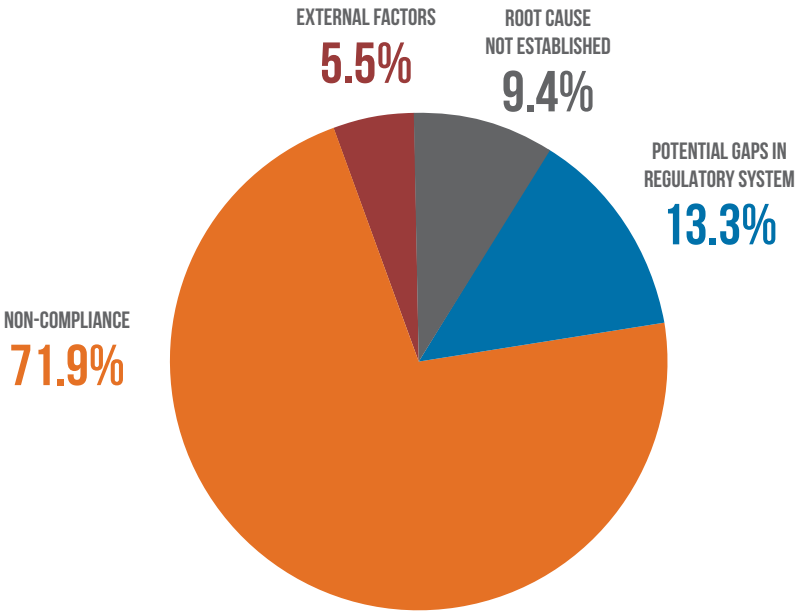


Figure B3: Risk of Injury or Fatality for Boilers and Pressure Vessels by Casual Analysis Category (2011 - 2020)



Compliance

Ontario Regulation 220/01, Boilers and Pressure Vessels assigns periodic inspection responsibility to both TSSA and insurers who underwrite boiler and machinery insurance. Insurers conduct periodic inspections for the majority of Ontario's fleet of boilers and pressure vessels (98 to 99%), while TSSA inspects the remaining 1 to 2%.

On July 1, 2018, TSSA began issuing certificates of inspection (COI) for boilers and pressure vessels which had undergone periodic inspections.

The frequency of inspections is specified in the Code Adoption Document (CAD) associated with *Ontario Regulation 220/01.* Periodic inspections contribute to the preventative management of risk associated with boilers and pressure vessels. Through the inspection process, any non-conformances are directed to the owner for action within an appropriate time frame.

Uninsured Equipment

Table B3: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Uninsured Boilers and Pressure Vessels (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Equipment not maintained in safe working condition	23.7%
Pressure relief device is inadequate	15.8%
Failure to supply water required for testing	5.3%

Note that the Boilers and Pressure Vessels Safety Program does not currently use a risk-based inspection system.

Insured Equipment

This year it was found that the data for insured equipment was not considered to be reliable. Therefore, no results will be discussed in this year's Public Safety Report. When the insured equipment data becomes more reliable, the results will be presented in a future Public Safety Report.

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" nor "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate used in the main body of the report, which can result in small differences between the two numbers.

Table B4: *Uninsured* Boilers and Pressure Vessels Inspection and Re-Inspection Results (2020)

INSPECTION TYPE	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Alteration Inspections	133	1	0	134	99.3%
Initial Inspections	3,616	118	0	3,734	96.8%
Inspections for Certification	2,552	93	0	2,645	96.5%
Non-Mandated/Non-Regulated Inspections	1,612	0	6	1,618	100.0%
Occurrence Inspections	0	0	19	19	N/A
Other Inspections	11,040	491	0	11,531	95.7%
Periodic Inspections	380	13	0	393	96.7%
Re-Inspections	161	43	0	204	78.9%
Repair Inspections	674	9	0	683	98.7%
Boilers and Pressure Vessels Total	20,168	768	25	20,961	96.3%

Legislation and Regulatory Information

Table B5: TSSA Boilers and Pressure Vessels Legislation and Regulatory Information

LEGISLATION AND REGULATORY INFORMATION AS OF 2020	LATEST REVISION
Ontario Regulation 220/01: Boilers and Pressure Vessels Regulation	2018
Summary of Key Changes for the Regulation of Pressure Equipment	2001
Minister's Exemption for Agriculture	2001
Boilers and Pressure Vessels CAD Amendment BPV-18-01	2018

During this fiscal year, there were no Boilers and Pressure Vessels director's orders, advisories, bulletins, or guidelines issued. Visit www.tssa.org for a comprehensive listing of legislation and regulatory information.

Appendix C – Operating Engineers

TSSA's Operating Engineers Safety Program registers, inspects and regulates plants that power Ontario with electricity, refrigeration, heating and cooling and is also responsible for the examination and certification of operating engineers (also known as power engineers). In addition, TSSA provides oversight of the management, operation and maintenance of plants to ensure compliance to the regulation and established safety standards.

Note that numbers may not add up fully or may exceed the 100th percentile due to rounding off.

Incidents, Injuries and Risk Prediction

Table C1: State of Safety Measures for Operating Plants (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	1	2	0	2	2	2	5	5	25	7	51	5	10.1%
Non-Permanent Injuries	0	0	0	0	1	0	0	0	0	0	1	0	None
Permanent Injuries	0	0	0	1	1	1	0	0	0	0	3	0	None
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	None
Observed Injury Burden (FE/mpy)	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	N/A	0.00	N/A

Table C2: Risk of Injury or Fatality for Operating Plants (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.01

TSSA's acceptance criterion is 1.00 FE/mpy.

Figure C1: Occurrences and Observed Injury Burden for Operating Plants (2011 – 2020)

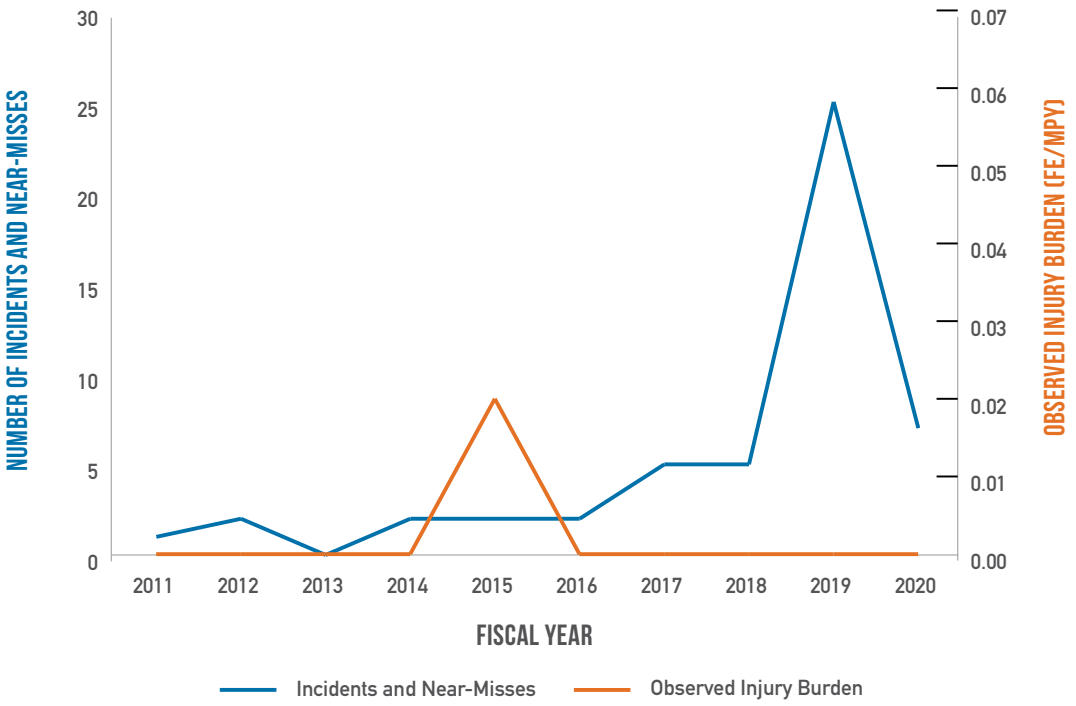


Figure C2: Injuries and Fatalities for Operating Plants (2011 – 2020)

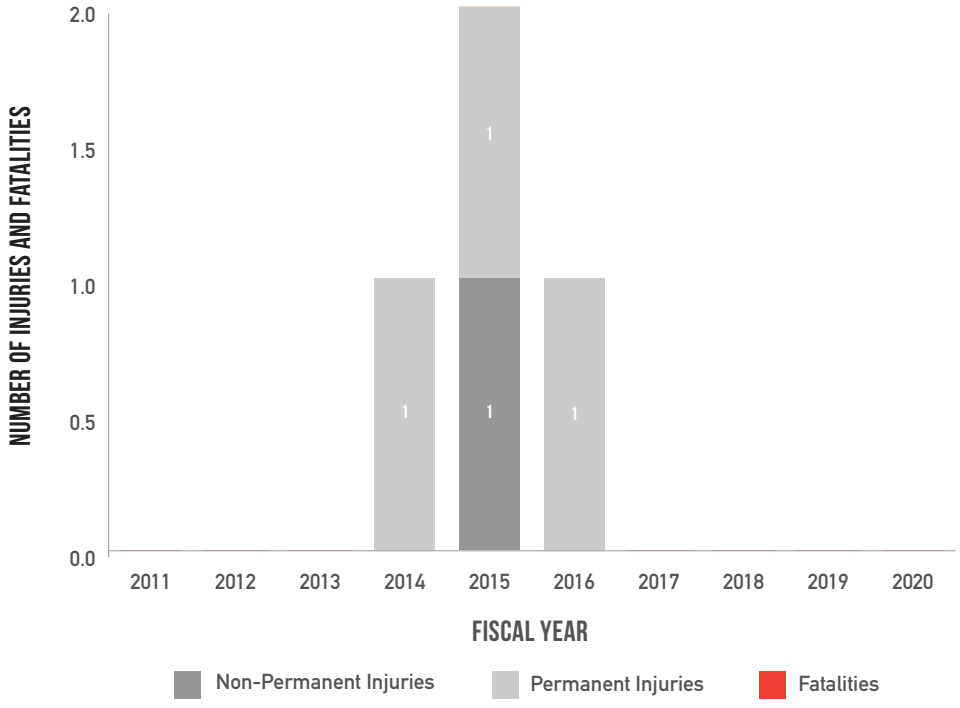
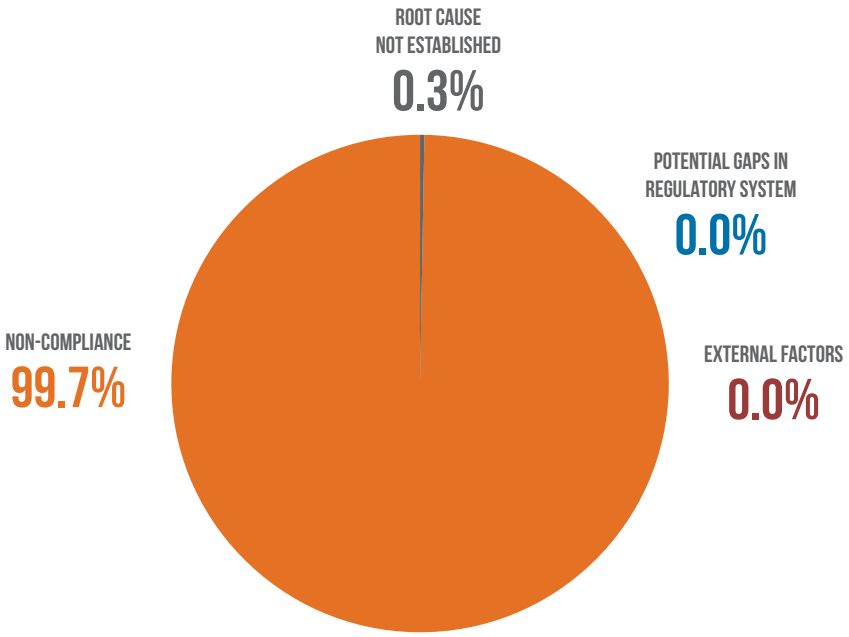


Figure C3: Risk of Injury or Fatality for Operating Plants by Casual Analysis Category (2011 - 2020)



Risk of Facilities

TSSA conducts periodic inspections of registered operating plants in Ontario. These inspections assist in maintaining a low to negligible risk of injury or fatality to Ontarians that may result from non-compliance with the regulatory requirements. TSSA uses a risk-based inspection scheduling process (RBS) [7] to determine the frequency of inspections of all registered plants. Data collected through these inspections helps prioritize frequency of inspections and proactively manage risk of injury or fatality.

Table C3: Number of Operating Engineers (2020)

DESCRIPTION	NUMBER
Operating engineers	12,500

Table C4: Number of Operating Plants (2020)

DESCRIPTION	NUMBER
Operating plants inventory	3,366
Operating plants that had sufficient inspection history to calculate a risk score	2,832

Figure C4: Inventory Risk Profiles from Outcomes of Periodic Inspections Conducted on Operating Plants (2016 – 2020)

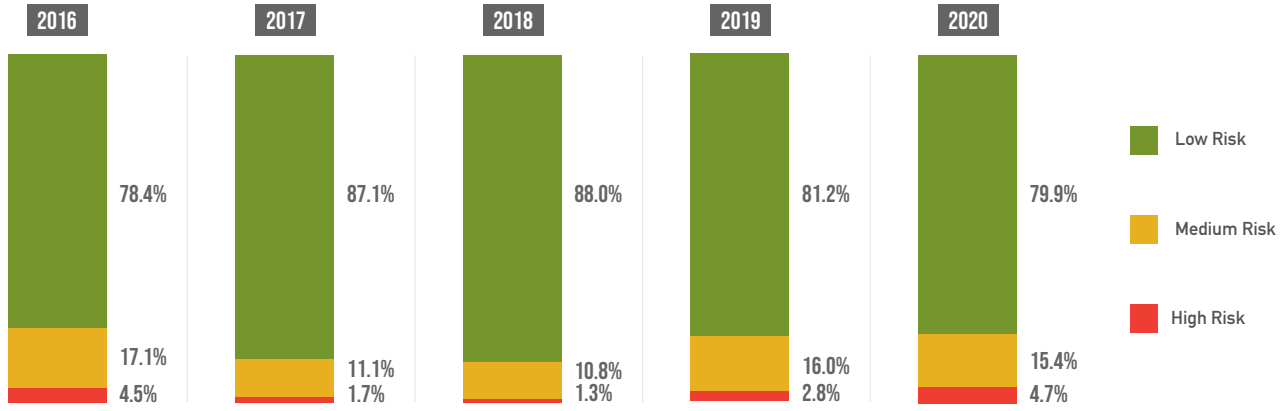


Table C5: Number of High-Risk Operating Plants (2020)

DESCRIPTION	NUMBER	PERCENT OF QUALIFIED PROVINCIAL INVENTORY
High-Risk Operating Plants	132	4.7%

Table C6: Top High-Risk Plant Types (2020)

PLANT TYPE	PERCENTAGE OF TOTAL HIGH-RISK PLANTS
Refrigeration Plant	26.5%
Low-Pressure Steam Plant	19.7%
High-Pressure Watertube Low-Water-Volume Power Plant	15.9%

Table C7: Top High-Risk Plant Function Types (2020)

PLANT FUNCTION TYPE	PERCENTAGE OF TOTAL HIGH-RISK PLANTS
Public Services	22.7%
Manufacturing Industries	17.4%
Food Process	15.9%

Compliance

The compliance rate is defined as the percentage of periodic inspections with no orders issued compared to the total number of periodic inspections.

Using a risk-based approach (i.e., RBS), the entire inventory is inspected at least once over a two-year period. The RBS model, described in Appendix N[1] in detail, is based on a historical profile of the nature and significance of non-compliance found at the plants.

Figure C5: Yearly Compliance Rates from Outcomes of Periodic Inspections Conducted on Operating Plants (2016 – 2020)

Table C8: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Conducted on Operating Plants (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	41.2%	None

TSSA deals with observed non-compliance by issuing inspection orders to the owner to address the non-compliance within an appropriate time frame. This process contributes to the preventative management of risk of injury or fatality associated with operating plants.

[1] Appendix is found in Technical Appendices report.

Table C9: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Operating Plants (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Equipment not inspected and posted by an Insurance Company or TSSA	10.9%
Testing of safety devices not recorded	5.4%
Safety limiting devices not tested, logged and tagged at least once per year	4.4%

Table C10: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Inspections Conducted on Operating Plants (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Registered TSSA seals missing	78.2%
Boiler safety valves over 5 years old not recertified or replaced	4.5%
Refrigeration plant safety valves over 5 years old not maintained or replaced	2.6%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspection (e.g., pass nor fail), the inspection risk spectrum (shown as a pie chart) portrays the potential safety risks associated with non-compliance found during the inspection. The dark red segments of the spectrums show unacceptable levels of risk.

Figure C6: Inspection Risk Spectrums from Outcomes of Periodic Inspections Conducted on Operating Plants (2016 – 2020)

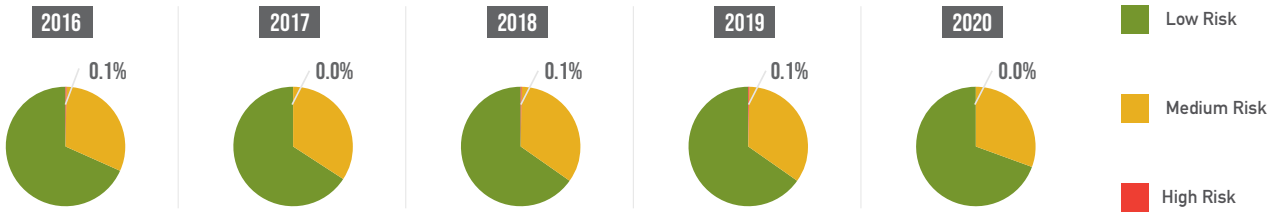


Table C11: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted on Operating Plants (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	0.0%
Minor Issues	58.4%
Fully Compliant	41.6%

Some examples of minor issues include: the plant not being re-registered after changing its name or ownership; missing signage; the registration certificate not being posted in a conspicuous location; missing information from the logbook; and general housekeeping concerns.

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" nor "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate used in the main body of the report, which can result in small differences between the two numbers.

Table C12: Operating Plants Inspection and Re-Inspection Results (2020)

INSPECTION TYPE	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Initial Inspections	21	106	0	127	16.5%
Occurrence Inspections	0	0	29	29	N/A
Other Inspections	59	42	102	203	58.4%
Periodic Inspections	913	1,194	0	2,107	43.3%
Re-Inspections	596	384	33	1,013	60.8%
Operating Engineers Total	1,589	1,726	164	3,479	47.9%

Legislation and Regulatory Information

Table C13: TSSA Operating Engineers Legislation and Regulatory Information (2020)

LEGISLATION AND REGULATORY INFORMATION AS OF 2020	LATEST REVISION
Ontario Regulation 219/01: Operating Engineers Regulation	2001
Ontario Regulation 219/01: Director's Order	2003

During this fiscal year, there were no Operating Engineers director's orders, advisories bulletins or guidelines issued. Visit www.tssa.org for a comprehensive listing of legislation and regulatory information.

Appendix D – Amusement Devices

TSSA's Amusement Devices Safety Program regulates amusement rides in Ontario to ensure all devices conform to the Act and its associated regulations, codes and standards. The various types of regulated amusement devices include roller coasters, Ferris wheels, merry-go-rounds (and other circular motion rides), water slides, flume rides, dry slides, go-karts, bumper cars, inflatables (inflatable bouncers), bungee devices, bungee-assisted bouncers, zip lines (track and cable rides), and other generic spinning and whirling rides. As part of the Amusement Devices Safety Program, TSSA: licenses operators; reviews and registers rides; conducts inspections and incident investigations; and, issues permits for each ride in the current operating season.

Note that numbers may not add up fully or may exceed the 100th percentile due to rounding off.

Incidents, Injuries and Risk Prediction

Table D1: State of Safety Measures for Amusement Devices (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	104	222	331	521	647	921	430	709	1,195	1,377	6,457	646	5.4%
Non-Permanent Injuries	89	216	313	454	585	847	368	661	1,095	1,232	5,860	586	5.9%
Permanent Injuries	3	5	11	25	24	42	33	23	29	26	221	22	6.0%
Fatalities	0	0	0	0	0	0	0	0	1	0	1	0	None
Observed Injury Burden (FE/mpy)	0.00	0.05	0.06	0.02	0.08	0.11	0.08	0.11	0.16	0.15	N/A	0.08	N/A

Table D2: Risk of Injury or Fatality for Amusement Devices (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.23

TSSA's acceptance criterion is 1.00 FE/mpy.

Figure D1: Occurrences and Observed Injury Burden for Amusement Devices (2011 – 2020)

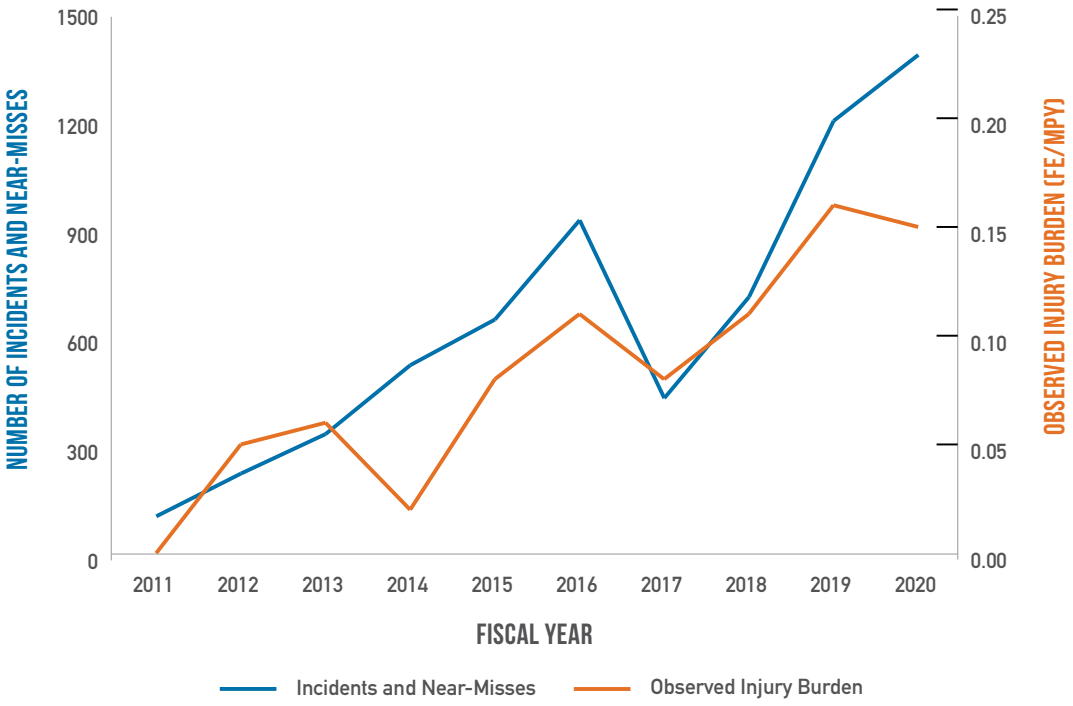


Figure D2: Injuries and Fatalities for Amusement Devices (2011 – 2020)

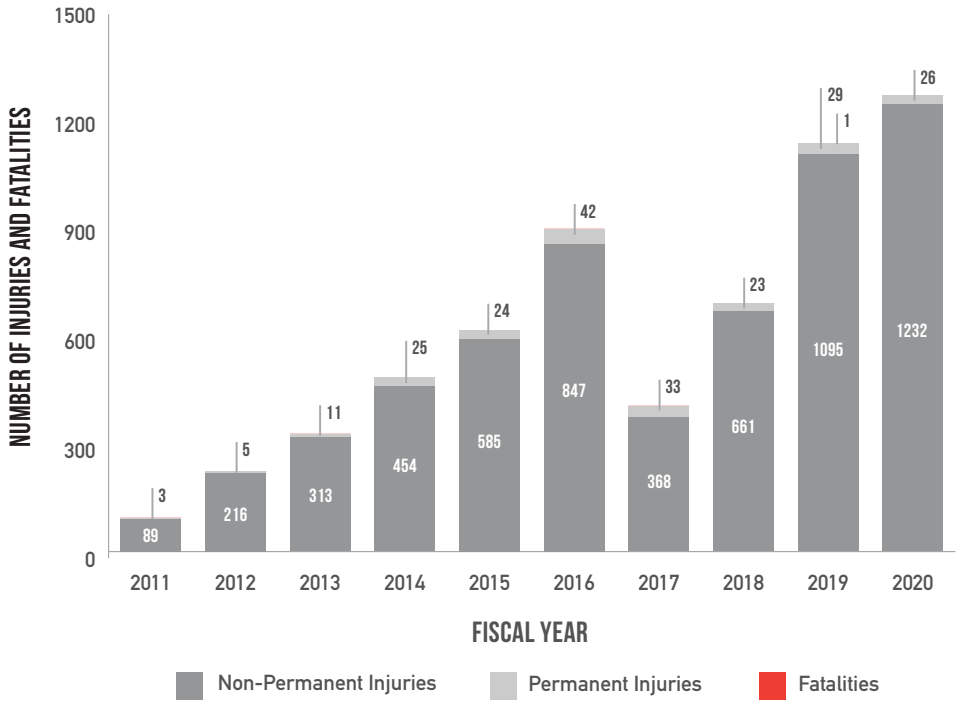
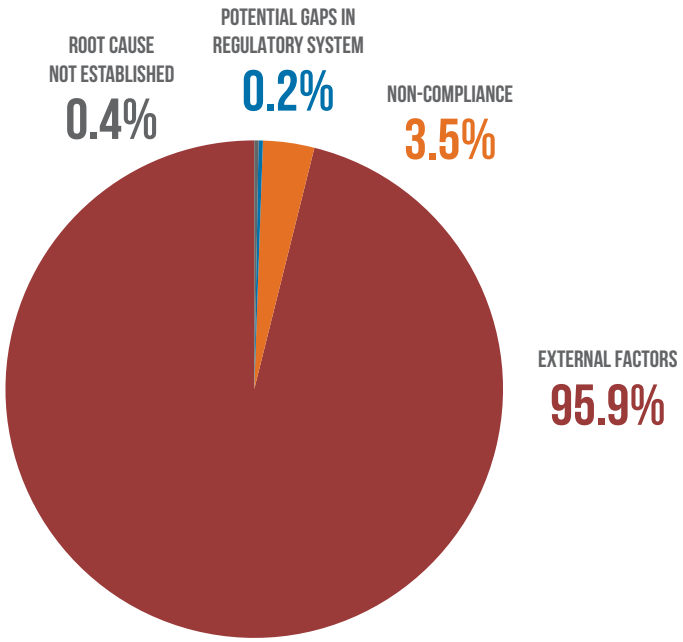


Figure D3: Risk of Injury or Fatality for Amusement Devices by Casual Analysis Category (2011 - 2020)



Risk of Potential Gaps in the Regulatory System

Some typical examples of potential gaps in the regulatory system include: head injuries that might have been avoided through the use of helmets and/or device padding; enhanced railings to prevent egress of riders from the device (e.g., railings along the sides of slides); and additional guarding of moving parts to prevent entrapment (e.g., finger under train wheel).

Risk of Non-Compliance

Some typical examples of non-compliance include: the operator not obeying the ride height restrictions; a lap bar spring becoming detached, a slip-ring wire coming loose and electrifying the fence; the drive wheel of a Ferris wheel coming loose; and the passenger-carrying unit coming loose due to a broken weld.

Risk of External Factors

Table D3: Human Factors in Amusement Device Occurrences (2011 – 2020)

DESCRIPTION	PERCENTAGE OF EXTERNAL FACTOR OCCURRENCES
Human Factors	99.6%[1]

[1] Human factors make up 99.6% of external factors. External factors make up 95.9% of the total.

Table D4: Top Amusement Device Types by Number of External-Factor Occurrences (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Water Slides	31.9%
Coaster Rides	22.8%
Zip Lines	12.7%

Table D5: Top Amusement Device Types by External-Factor Observed Injury Burden (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Water Slides	43.0%
Coaster Rides	26.9%
Circular Rides	8.4%

Table D6: Top Occurrence Types by Number of External-Factor Occurrences for Amusement Devices (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Physical Impacts	55.5%
Sudden Movements	15.1%
Trips/Falls	11.9%

Table D7: Top Occurrence Types by External-Factor Observed Injury Burden for Amusement Devices (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Physical Impacts	45.6%
Falls from Height	23.1%
Sudden Movements	18.6%

The top occurrence types are expanded below in greater detail.

Physical Impacts

Table D8: Top Amusement Device Types by Number of External-Factor Occurrences for Physical Impacts (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Water Slides	32.3%
Zip Lines	20.9%
Coaster Rides	18.4%

Table D9: Top Amusement Device Types by External-Factor Observed Injury Burden for Physical Impacts (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Coaster Rides	31.5%
Water Slides	28.3%
Circular Rides	16.8%

Sudden Movements

Table D10: Top Amusement Device Types by Number of External-Factor Occurrences for Sudden Movements (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Coaster Rides	54.5%
Water Slides	13.2%
Circular Rides	11.2%

Table D11: Top Amusement Device Types by External-Factor Observed Injury Burden for Sudden Movements (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Coaster Rides	54.3%
Water Slides	35.4%
Inflated Rides	2.7%

Trips/Falls

Table D12: Top Amusement Device Types by Number of External-Factor Occurrences for Trips/Falls (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Water Slides	22.2%
Coaster Rides	21.2%
Circular Rides	18.4%

Table D13: Top Amusement Device Types by External-Factor Observed Injury Burden for Trips/Falls (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Water Slides	27.7%
Coaster Rides	26.1%
Circular Rides	12.8%

Falls from Height

Table D14: Top Amusement Device Types by Number of External-Factor Occurrences for Falls from Height (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Water Slides	70.6%
Circular Rides	7.9%
Coaster Rides	4.3%

Table D15: Top Amusement Device Types by External-Factor Observed Injury Burden for Falls from Height (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Water Slides	96.3%
Inflated Rides	1.6%
Dry Slides	1.0%

Risk of Devices

TSSA conducts periodic inspections of all amusement devices at the start of the season to oversee and manage the state of compliance across permitted amusement devices in the province of Ontario. Amusement device operations are generally seasonal in nature with a few devices operating all year round. TSSA deals with non-compliance by requiring the owner to address observed failures within an appropriate time frame through the issuance of inspection orders. This process contributes to the preventative risk management of the inventory.

Table D16: Number of Amusement Devices (2020)

DESCRIPTION	NUMBER
Amusement devices inventory	2,401
Amusement devices that had sufficient inspection history to calculate a risk score	2,989

Note that the number of amusement devices that had sufficient inspection history to calculate a risk score is larger than the amusement devices inventory because the larger figure includes devices that can become inactive at any time due to various reasons (e.g., a portable device moved out of the province).

Figure D4: Inventory Risk Profiles from Outcomes of Periodic Inspections Conducted on Amusement Devices (2016 – 2020)

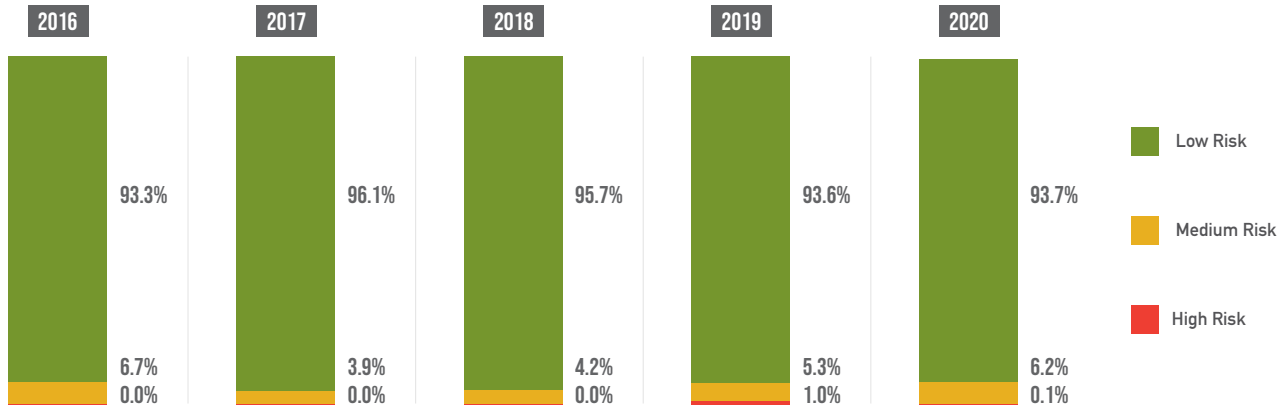


Table D17: Number of High-Risk Amusement Devices (2020)

DESCRIPTION	NUMBER	PERCENT OF QUALIFIED PROVINCIAL INVENTORY
High-Risk Devices	2	0.1%

Table D18: Top High-Risk Amusement Device Types (2020)

DEVICE TYPE	PERCENTAGE OF TOTAL HIGH-RISK DEVICES
Circular Rides	50.0%
Water Slides	50.0%

Compliance

For amusement devices, the ride operators perform an important role in ensuring that the users are adhering to the rules for safe riding. Part of TSSA's inspection is to witness the operation of the ride and verify that operating procedures are being followed, thus managing the risk of non-compliance.

The compliance rate is defined as the percentage of periodic inspections with no orders issued compared to the total number of periodic inspections.

Some operational inspections were also performed and their numbers are given below for comparison purposes.

Figure D5: Yearly Compliance Rates from Outcomes of Periodic Inspections Conducted on Amusement Devices (2016 – 2020)

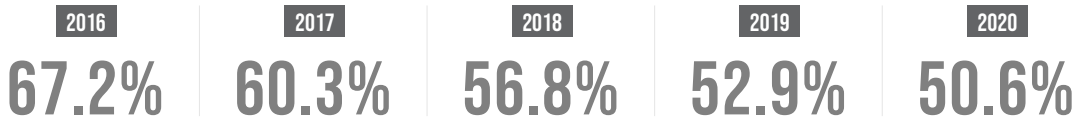


Figure D6: Yearly Compliance Rates from Outcomes of Operational Inspections Conducted on Amusement Devices (2016 – 2020)

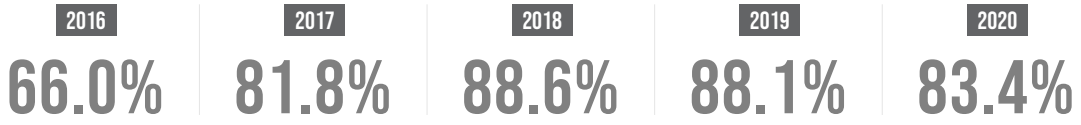


Table D19: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Conducted on Amusement Devices (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	57.5%	-4.5%

Table D20: Five-Year Mean Compliance Rate from Outcomes of Operational Inspections Conducted on Amusement Devices (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	81.7%	None

Table D21: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Amusement Devices (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
No record of training	3.0%
Hole/tear in inflatable structure	2.7%
Amusement device plate not permanently affixed	2.4%

Table D22: Top Compliance Issues by Number of Orders Issued from Outcomes of Operational Inspections Conducted on Amusement Devices (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF NUMBER OF ORDERS ISSUED
Insufficient number of ride operators	4.7%
No record of training	4.4%
Daily pre-opening inspection not carried out	3.5%

Table D23: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Inspections Conducted on Amusement Devices (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Tie downs and anchors are not in place	16.3%
Tie downs and anchors are used in an unapproved manner	12.9%
Fencing is missing around ride	11.9%

Table D24: Top Compliance Issues by Risk of Orders Issued from Outcomes of Operational Inspections Conducted on Amusement Devices (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Tie downs and anchors are not in place	40.7%
Tie downs and anchors are used in an unapproved manner	18.8%
Lap bar restraint is not fully operational	9.9%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspection (e.g., pass/fail), the inspection risk spectrum (shown as a pie chart) portrays the potential safety risks associated with non-compliance found during the inspection. The dark red segments of the spectrums show unacceptable levels of risk.

Figure D7: Inspection Risk Spectrums from Outcomes of Periodic Inspections Conducted on Amusement Devices (2016 – 2020)

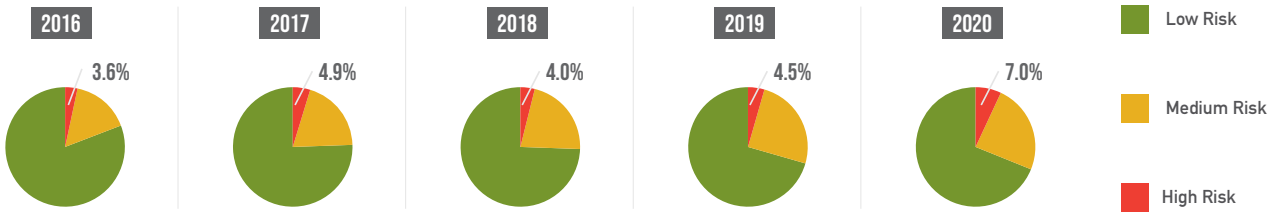


Figure D8: Inspection Risk Spectrums from Outcomes of Operational Inspections Conducted on Amusement Devices (2016 – 2020)

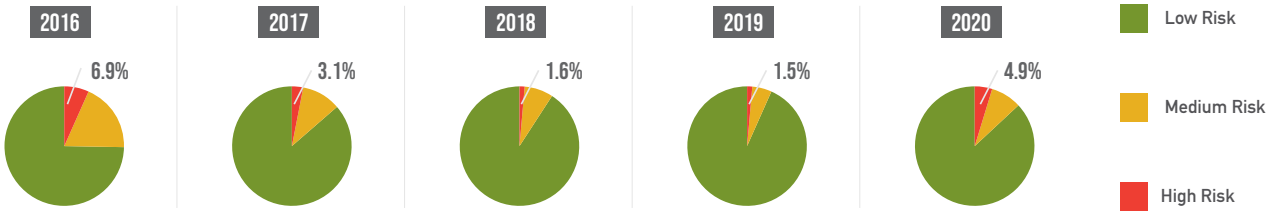


Table D25: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted on Amusement Devices (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	7.0%
Minor Issues	42.3%
Fully Compliant	50.6%

Table D26: Inspection Risk Spectrum from Outcomes of Operational Inspections Conducted on Amusement Devices (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	4.9%
Minor Issues	11.7%
Fully Compliant	83.4%

Some typical examples of minor issues include: missing device information plates; missing signage; records of training not in the logbook; missing information from the technical dossier; and passenger-carrying units not identified with markers, letters or colours.

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" nor "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate used in the main body of the report, which can result in small differences between the two numbers.

Table D27: Amusement Devices Inspection and Re-Inspection Results (2020)

INSPECTION TYPE	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Ad Hoc/Unscheduled Inspections	5	10	5	20	33.3%
Initial Inspections	53	119	0	172	30.8%
Minor Alteration Inspections	1	1	0	2	50.0%
Occurrence Inspections	2	17	0	19	10.5%
Operational Inspections	203	9	0	212	95.8%
Other Inspections	76	4	0	80	95.0%
Periodic Inspections	906	855	2	1,763	51.4%
Re-Inspections	151	158	1	310	48.9%
Amusement Devices Total	1,397	1,173	8	2,578	54.4%

Legislation and Regulatory Information

Table D28: TSSA Amusement Devices Legislation and Regulatory Information (2020)

LEGISLATION AND REGULATORY INFORMATION AS OF 2020	LATEST REVISION
Ontario Regulation 221/01: Amusement Devices Regulation	2009
Ontario Regulation 187/03: Certification and Training of Amusement Device Mechanics	2013
Amusement Devices CAD Amendment 535-18	2018
Canadian Bungee Safe Code of Practice	2000

During this fiscal year, there were no Amusement Devices director's orders, advisories bulletins or guidelines issued. Visit www.tssa.org for a comprehensive listing of legislation and regulatory information.

Appendix E – Elevators

The Elevating Devices Safety Program regulates elevating devices in Ontario to ensure all devices conform to the Act and applicable regulations, codes and standards. TSSA reviews and registers elevating devices, issues licences, conducts inspections, performs incident investigations, registers contractors and certifies mechanics. The Elevating Devices Safety Program consists of three areas: 1) elevators; 2) escalators and moving walks; and 3) passenger ropeways (ski lifts). The various types of regulated elevators include passenger elevators, freight elevators, observation elevators, temporary elevators, limited use/limited application elevators, dumbwaiters, freight platform lifts, material lifts, lifts for persons with disabilities (including stair chair lifts, enclosed stair platform lifts, unenclosed stair platform lifts, enclosed vertical platform lifts, and unenclosed vertical platform lifts), manlifts, construction hoists, incline lifts (including funicular railways), stage lifts, parking garage lifts, and special elevating devices.

Note that numbers may not add up fully or may exceed the 100th percentile due to rounding off.

Incidents, Injuries and Risk Prediction

Table E1: State of Safety Measures for Elevators (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	205	340	382	499	463	569	533	683	701	641	5,016	502	9.5%
Non-Permanent Injuries	104	167	146	186	119	169	145	131	114	126	1,407	141	None
Permanent Injuries	4	12	11	7	7	11	11	4	5	8	80	8	None
Fatalities	1	2	1	0	1	0	2	1	0	1	9	1	None
Observed Injury Burden (FE/mpy)	0.01	0.13	0.09	0.03	0.03	0.02	0.18	0.03	0.02	0.11	N/A	0.07	N/A

Table E2: Risk of Injury or Fatality for Elevators (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.67

TSSA's acceptance criterion is 1.00 FE/mpy.

Figure E1: Occurrences and Observed Injury Burden for Elevators (2011 – 2020)

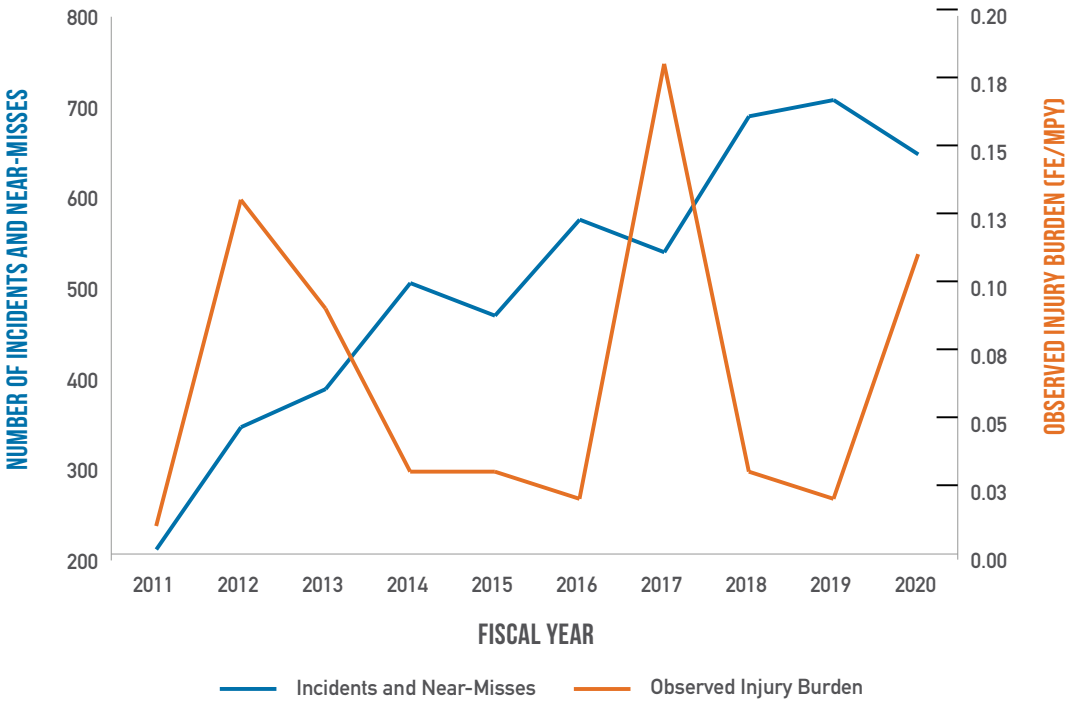


Figure E2: Injuries and Fatalities for Elevators (2011 – 2020)

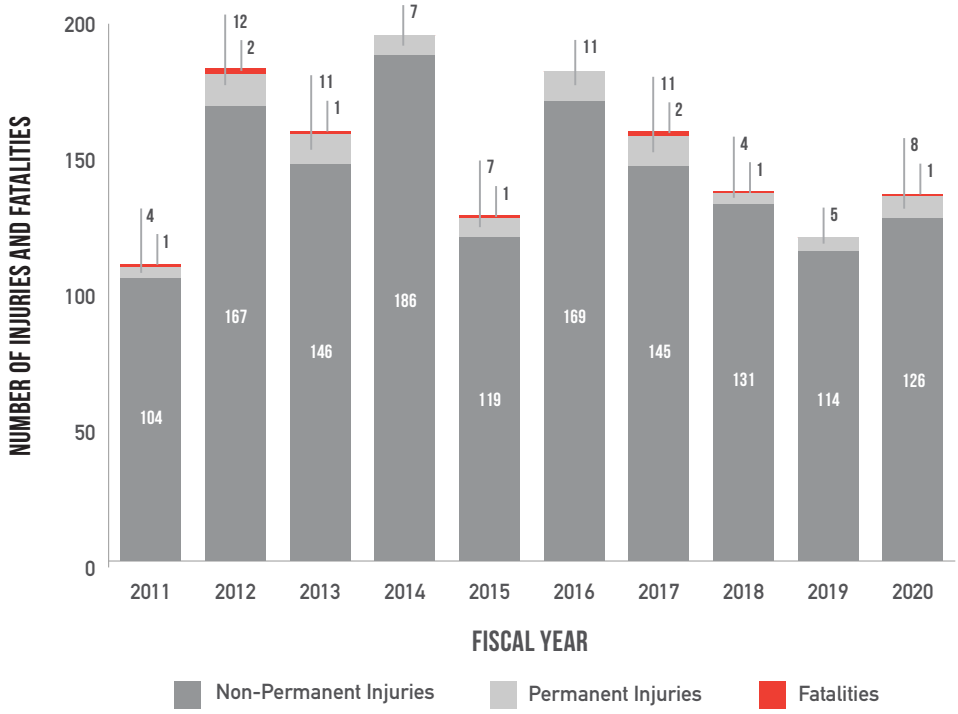
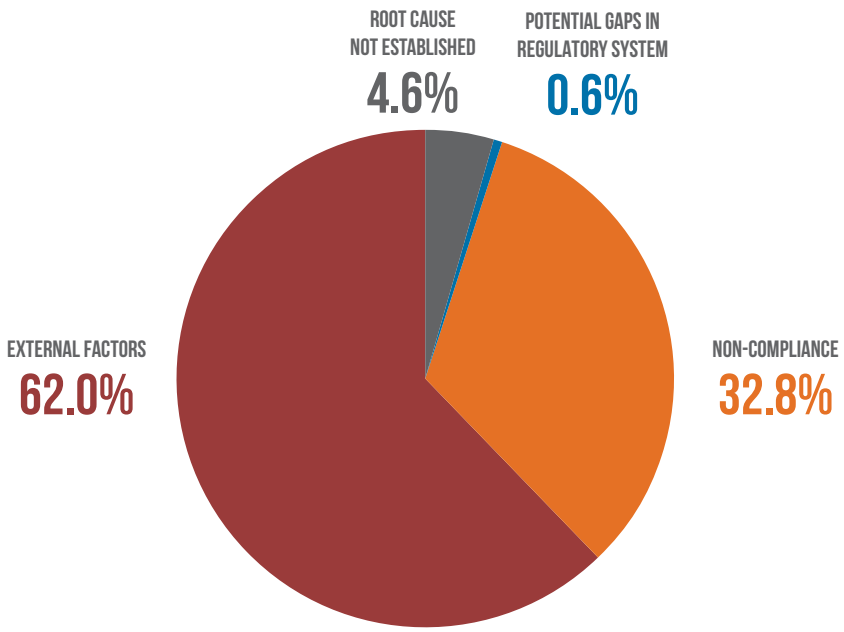


Figure E3: Risk of Injury or Fatality for Elevators by Casual Analysis Category (2011 - 2020)



Risks due to Potential Gaps in the Regulatory System (2011 – 2020)

Some typical examples of potential gaps in the regulatory system include: improved door closing safety features to prevent injuries to passengers; improved fire protection requirements in the machine room; improved emergency braking requirements; improved out-of-level requirements to help reduce trips and falls; improved fastener locking requirements to prevent parts from coming loose and injuring passengers; improved prevention methods of passengers manually escaping the elevator during an entrapment; and improved procedures to prevent prolonged entrapment of passengers.

Risks due to Non-Compliance (2011 – 2020)

Some typical examples of non-compliance include: a worm shaft sheared at the brake drum coupling; an emergency brake seized in the open position; a hole in the hydraulic cylinder from corrosion; no employee training records; and, a brake replaced by an unauthorized person.

Risks due to External Factors (2011 – 2020)

Table E3: Human Factors in Elevator Occurrences (2011 – 2020)

DESCRIPTION	PERCENTAGE OF EXTERNAL FACTOR OCCURRENCES
Human Factors	33.4%[1]

[1] Human factors make up 33.4% of external factors. External factors make up 62.0% of the total.

Table E4: Top Elevator Location Types by Number of External-Factor Occurrences (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Rental Apartment Buildings	22.5%
Offices	20.9%
Condominiums	17.6%

Table E5: Top Elevator Location Types by External-Factor Observed Injury Burden (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Student Residences	44.0%
Offices	28.9%
Rental Apartment Buildings	14.2%

Table E6: Top Occurrence Types for Elevators by Number of External-Factor Occurrences (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Flooding	48.5%
Door Closings	19.6%
Trips/Falls	12.6%

Table E7: Top Occurrence Types for Elevators by External-Factor Observed Injury Burden (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Entrapments	44.2%
Door Closings	8.1%
Unintentional Movements	7.9%

The top occurrence types are expanded below in greater detail.

Flooding

Table E8: Top Elevator Location Types by Number of External-Factor Occurrences for Flooding (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Rental Apartment Buildings	23.8%
Condominiums	22.7%
Offices	17.4%

Observed injury burden due to flooding is negligible.

Door Closings

Table E9: Top Elevator Location Types by Number of External-Factor Occurrences for Door Closings (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Offices	27.5%
Rental Apartment Buildings	16.2%
Commercial	12.7%

Table E10: Top Elevator Location Types by External-Factor Observed Injury Burden for Door Closings (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Rental Apartment Buildings	71.9%
Offices	13.3%
Commercial	4.9%

Trips/Falls

Table E11: Top Elevator Location Types by Number of External-Factor Occurrences for Trips/Falls (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Rental Apartment Buildings	25.9%
Offices	22.7%
Condominiums	15.2%

Table E12: Top Elevator Location Types by External-Factor Observed Injury Burden for Trips/Falls (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Rental Apartment Buildings	39.8%
Condominiums	33.0%
Offices	14.9%

Entrapments

The term "entrapment" when used with elevators refers to the situation where passengers cannot get out of the elevator because the doors do not open.

Table E13: Top Elevator Location Types by Number of External-Factor Occurrences for Entrapments (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Rental Apartment Buildings	24.2%
Offices	20.0%
Condominiums	20.0%

Table E14: Top Elevator Location Types by External-Factor Observed Injury Burden for Entrapments (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Student Residences	99.7%
Learning Institutions	0.2%
Rental Apartment Buildings	0.1%

Some examples of learning institutions include schools, colleges and universities.

Entrapment occurrences are typically safe, so long as the passengers remain inside the elevator. Injuries typically occur when passengers try to self-extract themselves from the elevator, e.g., obtaining abrasions or crushing injuries or even falling down the elevator shaft. It is always recommended that entrapped passengers signal for help and wait for properly trained rescue personnel to free them from the elevator.

Unintentional Movements

Table E15: Top Elevator Location Types by Number of External-Factor Occurrences for Unintentional Movements (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Offices	26.3%
Rental Apartment Buildings	22.8%
Condominiums	17.8%

Table E16: Top Elevator Location Types by External-Factor Observed Injury Burden for Unintentional Movements (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Rental Apartment Buildings	77.5%
Industrial	16.7%
Condominiums	4.3%

Areas of High Risk

Areas of high risk are those with RIF values greater than 1.00 FE/mpy for the general population or greater than 0.30 FE/mpy for sensitive sub-populations.

There were two areas of high risk identified in the Elevators Safety Program Area this fiscal year:

1. Elevator risks in retirement and long-term care homes; and
2. Elevator risks in hospitals.

They have been detailed below based on their relative ranking. This ranking is based on the RIF value and/or the deviation of the risk value from the risk acceptability criteria.

1. Elevator Risks in Retirement and Long-Term Care Homes

Table E17: State of Safety Measures for Elevator Risks in Retirement and Long-Term Care Homes (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	5	12	13	12	10	16	14	29	18	20	149	15	11.5%
Non-Permanent Injuries	3	6	5	6	2	7	5	11	10	2	57	6	N/A
Permanent Injuries	0	2	0	0	0	0	0	0	1	0	3	0	N/A
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Observed Injury Burden (FE/mpy)	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	N/A	0.00	N/A

Table E18: Risk of Injury or Fatality for Elevator Risks in Retirement and Long-Term Care Homes (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	1.32

The risk criterion is 0.30 FE/mpy for this Ontario sensitive sub-population.

Figure E4: Occurrences and Observed Injury Burden for Elevator Risks in Retirement and Long-Term Care Homes (2011 – 2020)

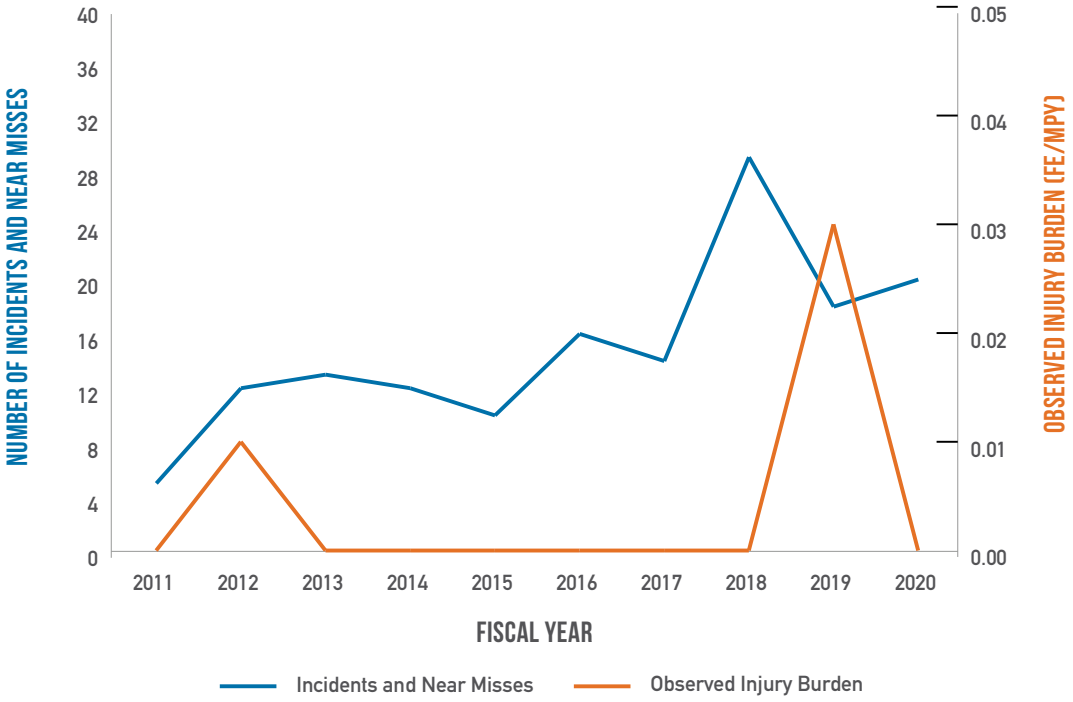


Figure E5: Injuries and Fatalities for Elevator Risks in Retirement and Long-Term Care Homes (2011 – 2020)

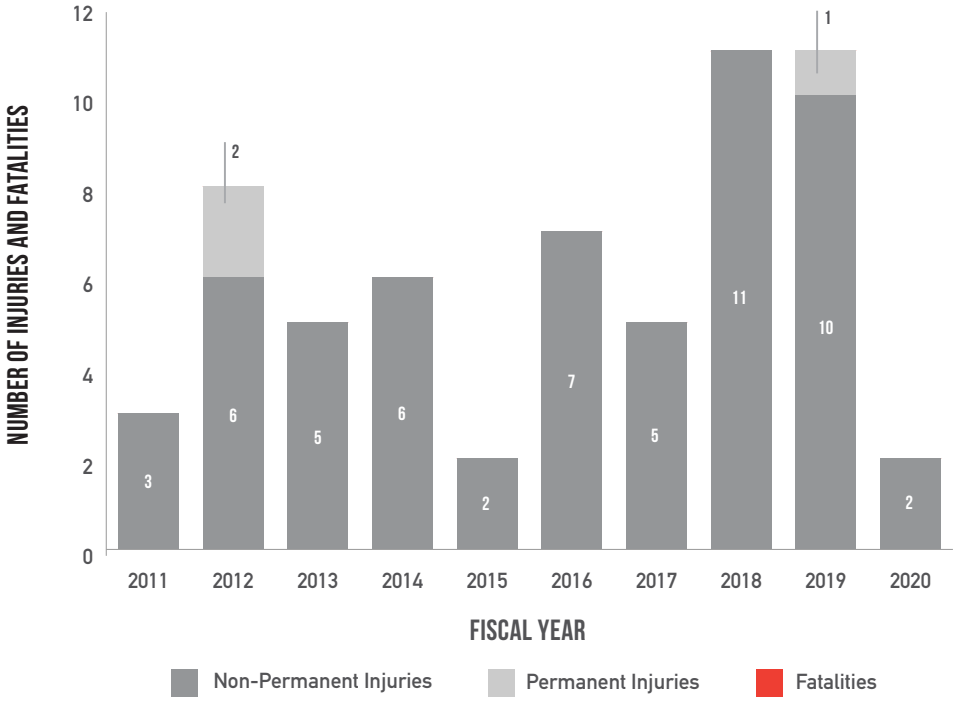


Table E19: Top Occurrence Types by Number of External-Factor Occurrences for Elevators in Retirement and Long-Term Care Homes (2011 – 2020)

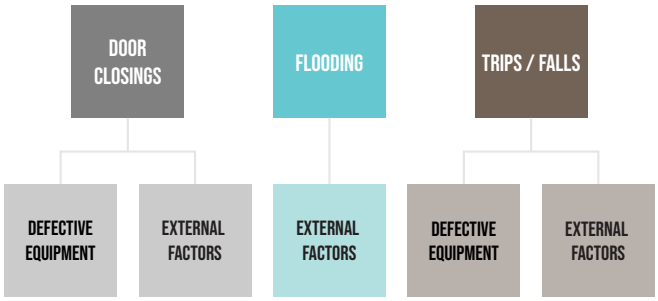
OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Flooding	42.2%
Door Closings	31.0%
Unintentional Movements	6.9%

Table E20: Top Occurrence Types by External-Factor Observed Injury Burden for Elevators in Retirement and Long-Term Care Homes (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Door Closings	94.6%
Trips/Falls	3.5%
Unintentional Movements	1.6%

These occurrences were primarily due to elevator car doors closing on passengers. Door closing occurrences were driven mainly by elevator door speeds that did not provide adequate time for the resident to enter or exit the elevator in a safe manner. This risk was further exacerbated when the resident was reliant on a mobility aid. The figure below illustrates the contributing causes for elevator safety issues identified in retirement and long-term care homes.

Figure E6: Top Contributing Causes of Elevator Safety Issues in Retirement and Long-Term Care Homes (2011 – 2020)



2. Elevator Risks in Hospitals

Table E21: State of Safety Measures for Elevator Risks in Hospitals (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	18	33	30	42	36	46	43	39	32	52	371	37	4.8%
Non-Permanent Injuries	6	21	11	19	12	19	14	13	5	17	137	14	N/A
Permanent Injuries	0	1	2	2	0	2	1	1	2	0	11	1	N/A
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Observed Injury Burden (FE/mpy)	0.01	0.08	0.01	0.44	0.00	0.09	0.03	0.00	0.00	0.00	N/A	0.07	N/A

Table E22: Risk of Injury or Fatality for Elevator Risks in Hospitals (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	3.53

Since most of the occurrences involved doors closing on hospital workers wheeling carts or gurneys, the acceptability criterion used was 1.00 FE/mpy.

Figure E7: Occurrences and Observed Injury Burden for Elevator Risks in Hospitals (2011 – 2020)

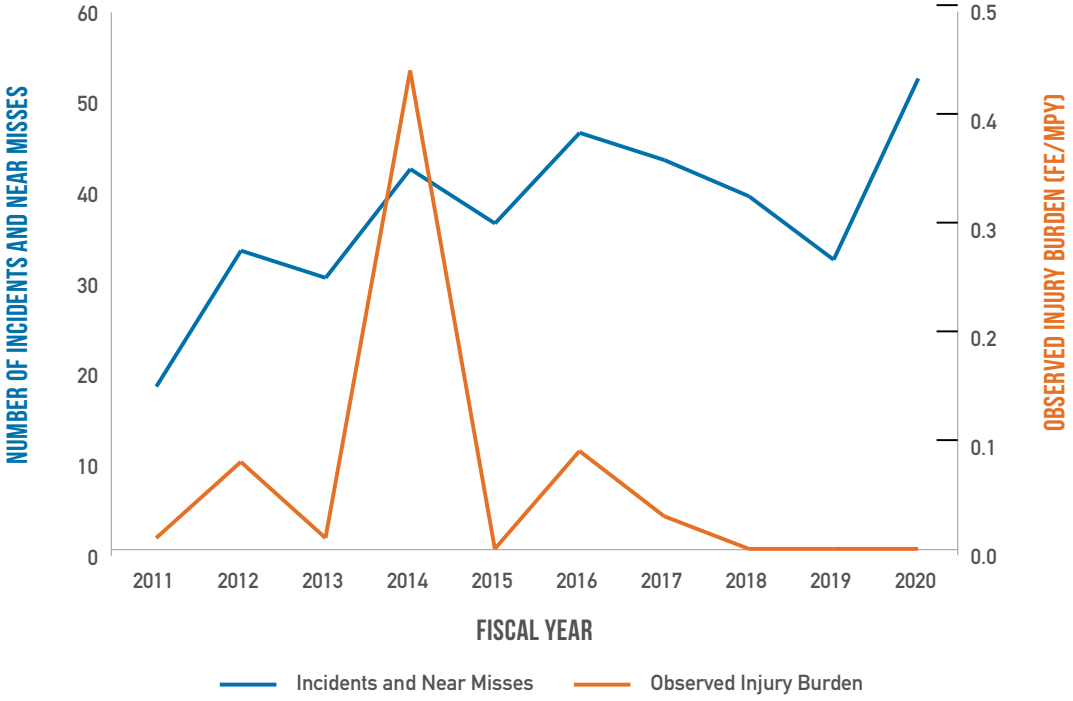


Figure E8: Injuries and Fatalities for Elevator Risks in Hospitals (2011 – 2020)

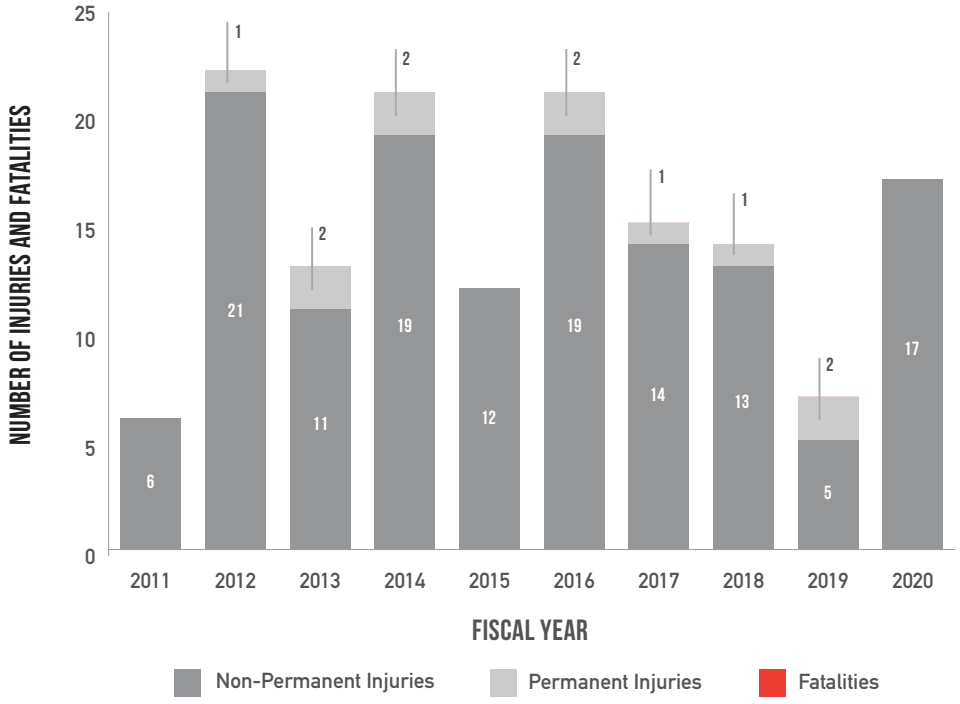


Table E23: Top Occurrence Types by Number of External-Factor Occurrences for Elevators in Hospitals (2011 – 2020)

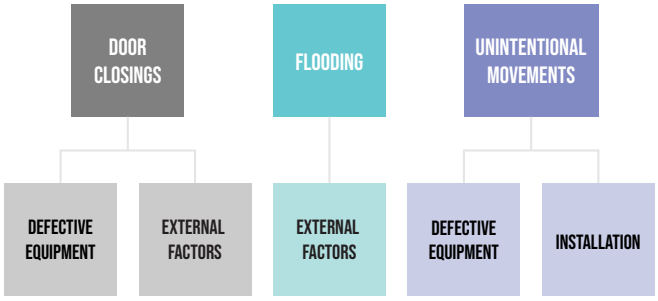
OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Flooding	33.0%
Door Closings	29.0%
Trips/Falls	16.1%

Table E24: Top Occurrence Types by External-Factor Observed Injury Burden for Elevators in Hospitals (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Trips/Falls	50.7%
Unintentional Movements	5.7%
Door Closings	5.7%

The figure below illustrates the contributing causes for elevator safety issues identified in hospitals. The primary issue was door closing occurrences which were driven mainly by elevator door speeds that did not provide adequate time for an individual to enter or exit the elevator in a safe manner, particularly when a worker was wheeling a cart or gurney.

Figure E9: Top Contributing Causes of Elevator Safety Issues in Hospitals (2011 – 2020)



Risk of Devices

TSSA conducts periodic inspections of all elevators using a risk-based approach to oversee and manage the state of compliance across all elevators in the province of Ontario. TSSA deals with non-compliance by requiring the owner to address observed failures within an appropriate time frame through the issuance of inspection orders. This process contributes to the preventative risk management of the inventory.

Table E25: Number of Elevators (2020)

DESCRIPTION	NUMBER
Elevators inventory	59,887
Elevators that had sufficient inspection history to calculate a risk score	47,185

Figure E10: Inventory Risk Profiles from Outcomes of Periodic Inspections Conducted on Elevators (2016 – 2020)

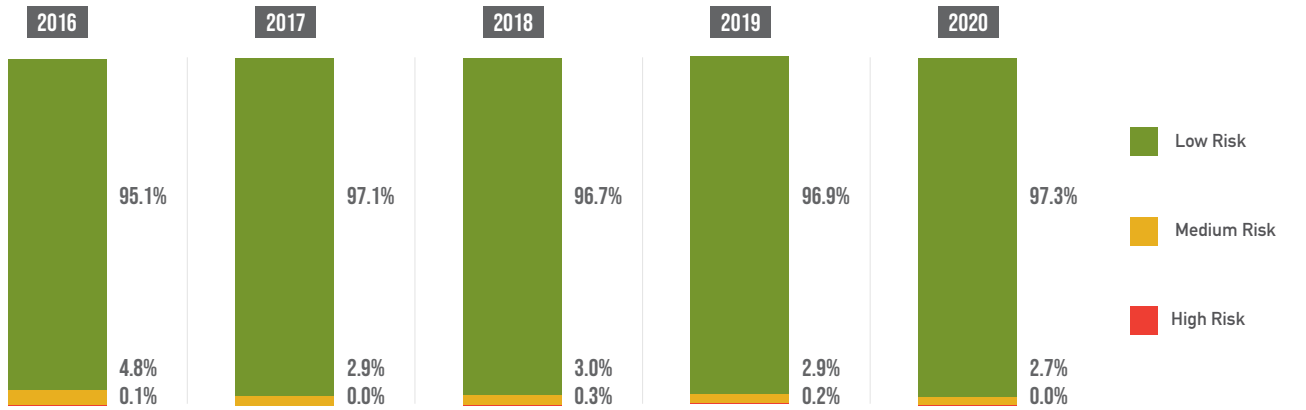


Table E26: Number of High-Risk Elevators (2020)

DESCRIPTION	NUMBER	PERCENT OF QUALIFIED PROVINCIAL INVENTORY
High-Risk Devices	23	0.0%

Table E27: Top High-Risk Elevator Location Types (2020)

LOCATION TYPE	PERCENTAGE OF TOTAL HIGH-RISK ELEVATORS
Condominiums	21.7%
Learning Institutions	17.4%
Offices	17.4%

Compliance

The compliance rate is defined as the percentage of periodic inspections with no orders issued compared to the total number of periodic inspections.

Figure E11: Yearly Compliance Rates from Outcomes of Periodic Inspections Conducted on Elevators (2016 – 2020)

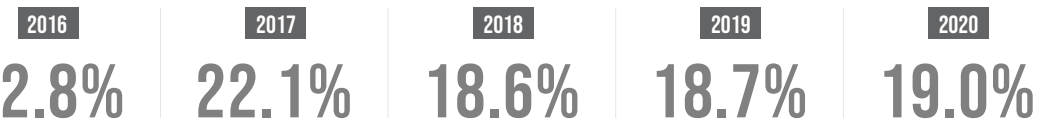


Table E28: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Conducted on Elevators (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	19.8%	-1.2%

Table E29: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Elevators (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Late annual periodic task for emergency power and lowering operation	2.8%
Late annual periodic task for firefighter emergency operation	2.1%
Late annual periodic task for normal and final terminal stopping devices	1.8%

Table E30: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Inspections Conducted on Elevators (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Drive machine brakes inadequate stopping and holding capacity	12.1%
Oily brake liners	8.5%
No reference point for oil level	5.5%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspection (e.g., pass nor fail), the inspection risk spectrum (shown as pie charts) portrays the potential safety risks associated with non-compliance. The dark red segments of the spectrums show unacceptable levels of risk.

Figure E12: Inspection Risk Spectrums from Outcomes of Periodic Inspections Conducted on Elevators (2016 – 2020)

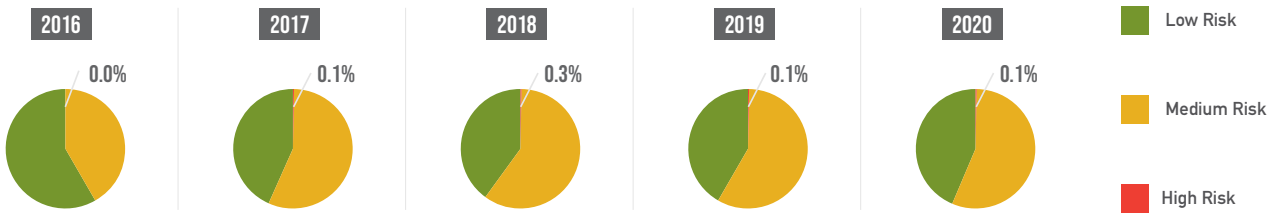


Table E31: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted on Elevators (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	0.1%
Minor Issues	81.0%
Fully Compliant	19.0%

Some typical examples of minor issues include: overdue periodic testing; the car top not being cleaned; missing data plate for counterweight; current licence not posted in a conspicuous location; and, pit lighting being inoperative.

Elevator Availability

Ontario Regulation 209/01, Elevating Devices, which governs TSSA's scope of elevator activities, does not include elevator availability. TSSA's focus is elevator safety. Hence, TSSA does not have historical data on elevator availability.

However, there is a secondary effect of elevators being unavailable. If an elevator is out of service, there are accessibility issues for users, particularly for sensitive sub-population individuals, who may not be able to climb the stairs. In addition, first responders would not have the use of an elevator in an emergency.

TSSA has now started recording basic availability information when inspectors are sent out on inspections.

For further details, refer to the "TSSA Elevator Availability Study Final Report" [8].

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" or "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate used in the main body of the report, which can result in small differences between the two numbers.

Table E32: Elevators Inspection and Re-Inspection Results (2020)

DESCRIPTION	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Ad Hoc/Unscheduled Inspections	449	1,105	83	1,637	28.9%
Initial Inspections	723	2,276	0	2,999	24.1%
Minor Alteration Inspections	1,750	1,444	0	3,194	54.8%
Non-Mandated/Non-Regulated Inspections	162	441	6	609	26.9%
Occurrence Inspections	25	83	2	110	23.1%
Other Inspections	40	139	79	258	22.3%
Periodic Inspections	4,059	16,767	333	21,159	19.5%
Re-Inspections	7,662	18,285	373	26,320	29.5%
Elevators Total	14,870	40,540	876	56,286	26.8%

Legislation and Regulatory Information

Table E33: TSSA Elevators Legislation and Regulatory Information (2020)

LEGISLATION AND REGULATORY INFORMATION AS OF 2020	LATEST REVISION
Ontario Regulation 209/01: Elevating Devices	2009
Ontario Regulation 222/01: Certification and Training of Elevating Devices Mechanics	2009
Elevating Devices CAD Amendment 277-19	2019

During this fiscal year, there were no Elevators director's orders, bulletins or guidelines issued. The following advisories were issued:

- 252/12-r2 – Simplified Revision Form to Correct / Revise a Registered Design Submission;
- 278-19 – Otis Brake Lever for 130, 131, 139 and 156 series Gearless Machines;
- 279-19 – Construction Hoist & Transport Platform Brake Testing Frequency;
- 280-19 – Fatal Incident involving a Worker on a Freight Elevator;
- 281/19 – Turnbull Spring Hitch;
- 282/19 – R&O Mufflers;
- 283/19 – Installation Code Edition – Maintenance and the Code at time of Installation;
- 284/20 – Examination of a Construction Hoist (Elevating Device) Form; and
- 285-20 – Elevating Device Owner Responsibilities Removing Devices from Service during COVID-19 Pandemic.

Visit www.tssa.org for a comprehensive listing of legislation and regulatory information.

Appendix F – Escalators and Moving Walks

The Elevating Devices Safety Program regulates elevating devices in Ontario to ensure all devices conform to the Act and applicable regulations, codes and standards. TSSA reviews and registers elevating devices, issues licences, conducts inspections, performs incident investigations, registers contractors and certifies mechanics. The Elevating Devices Safety Program consists of three areas: 1) elevators; 2) escalators and moving walks; and 3) passenger ropeways (ski lifts). The various types of regulated devices include escalators, and moving walks (including shopping cart conveyors).

Note that numbers may not add up fully or may exceed the 100th percentile due to rounding off.

Incidents, Injuries and Risk Prediction

Table F1: State of Safety Measures for Escalators and Moving Walks (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	512	522	519	642	592	742	702	726	785	670	6,412	641	4.7%
Non-Permanent Injuries	360	362	384	438	383	470	441	458	519	456	4,271	427	3.4%
Permanent Injuries	2	4	3	3	7	5	4	0	4	1	33	3	None
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	None
Observed Injury Burden (FE/mpy)	0.00	0.02	0.01	0.00	0.01	0.02	0.00	0.00	0.00	0.00	N/A	0.01	N/A

Table F2: Risk of Injury or Fatality for Escalators and Moving Walks (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.03

TSSA's acceptance criterion is 1.00 FE/mpy.

Figure F1: Occurrences and Observed Injury Burden for Escalators and Moving Walks (2011 – 2020)

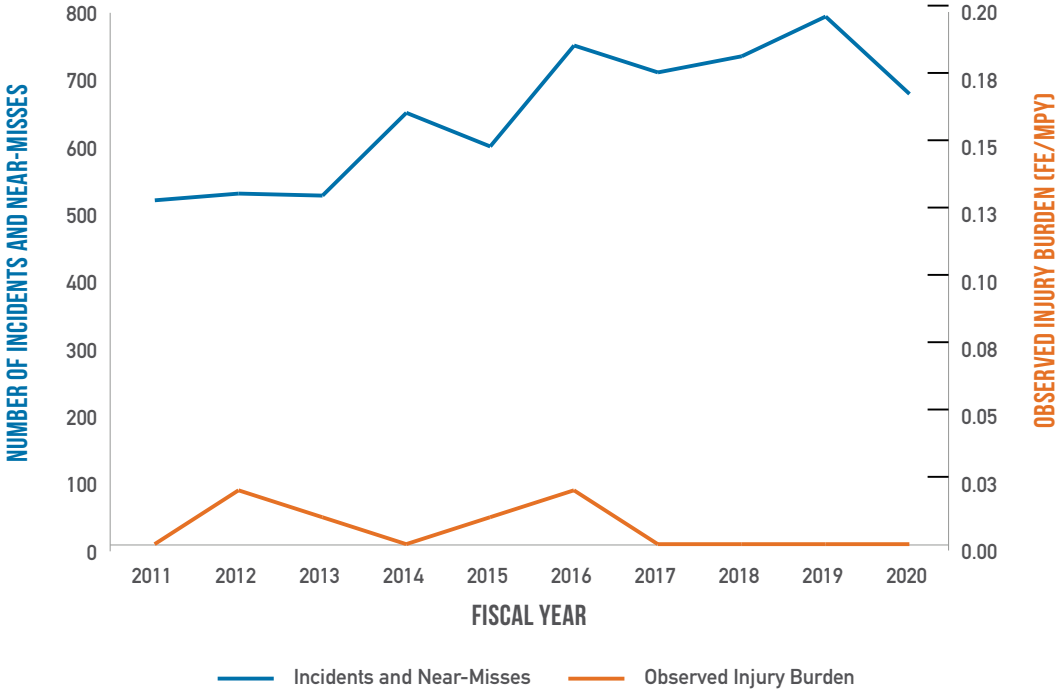


Figure F2: Injuries and Fatalities for Escalators and Moving Walks (2011 – 2020)

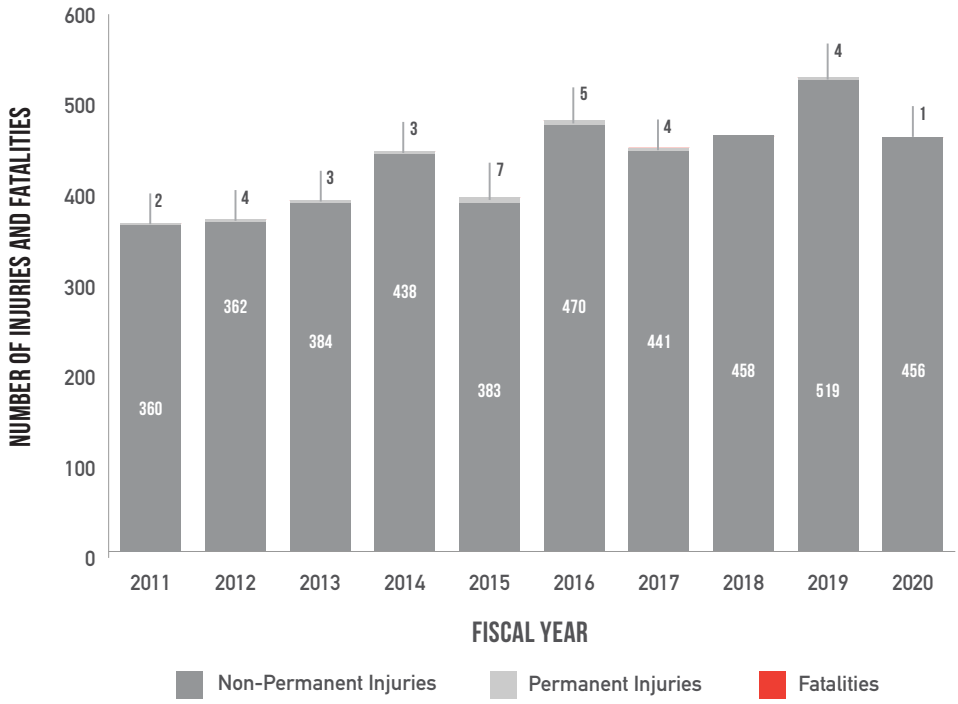
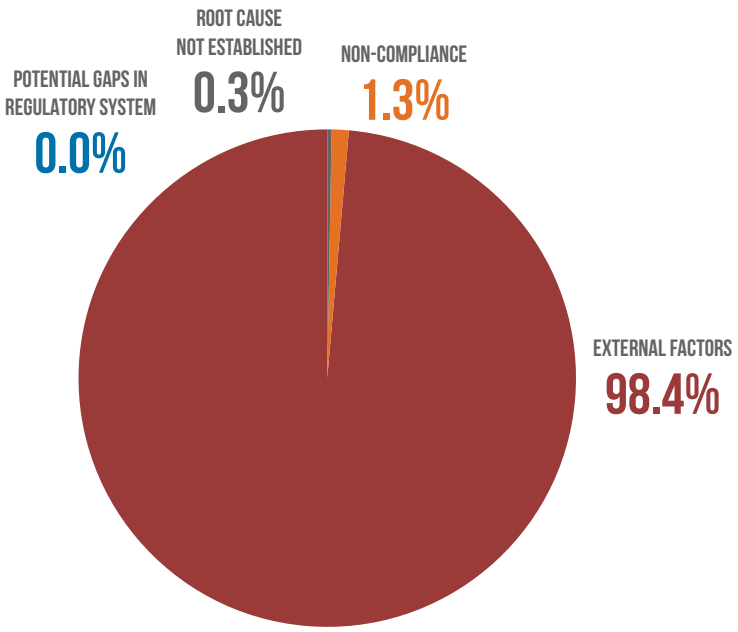


Figure F3: Risk of Injury or Fatality for Escalators and Moving Walks by Casual Analysis Category (2011 - 2020)



Risks due to Potential Gaps in the Regulatory System (2011 – 2020)

Some typical examples of potential gaps in the regulatory system include: improving warning signage or preventing access to stationary escalators to prevent injury to passengers (escalators are more dangerous than stairs because of varying step heights near the ends); improving design of comb teeth or improving warning signage to prevent entrapments; and improving fastener locking requirements to prevent parts coming loose and injuring passengers.

Risks due to Non-Compliance (2011 – 2020)

Some typical examples of non-compliance include: a relay coil failure in a controller; steps piled up on broken comb plates causing the handrail to stop; bull gear bolts loosened and sheared; and, a step chain that jumped out of the drive sprocket.

Risks due to External Factors (2011 – 2020)

Table F3: Human Factors in Escalators and Moving Walks Occurrences (2011 – 2020)

DESCRIPTION	PERCENTAGE OF EXTERNAL FACTOR OCCURRENCES
Human Factors	93.4%[1]

[1] Human factors make up 93.4% of external factors. External factors make up 98.4% of the total.

Table F4: Top Escalator and Moving Walk Location Types by Number of External-Factor Occurrences (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Mass Transportation	60.0%
Commercial	31.6%
Offices	4.0%

Table F5: Top Escalator and Moving Walk Location Types by External-Factor Observed Injury Burden (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Mass Transportation	47.4%
Commercial	39.0%
Assemblies	8.8%

Some examples of commercial locations include retail stores and shopping malls. Assemblies are locations where the public can congregate; some examples include libraries, churches, museums, convention centres, community centres, casinos, theatres, concert halls, tourist attractions and sporting events/facilities.

Table F6: Top Occurrence Types for Escalators and Moving Walks by Number of External-Factor Occurrences (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Trips/Falls	83.2%
Entrapments	10.2%
Flooding	1.8%

Table F7: Top Occurrence Types for Escalators and Moving Walks by External-Factor Observed Injury Burden (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Trips/Falls	91.2%
Entrapments	2.8%
Unintentional Movements	1.6%

The top occurrence types are expanded below in greater detail.

Trips/Falls

Table F8: Top Escalator and Moving Walk Location Types by Number of External-Factor Occurrences for Trips/Falls (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Mass Transportation	62.2%
Commercial	30.2%
Offices	3.5%

Table F9: Top Escalator and Moving Walk Location Types by External-Factor Observed Injury Burden for Trips/Falls (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Mass Transportation	47.0%
Commercial	39.6%
Assemblies	8.2%

Entrapments

Note that the term "entrapment" when used with escalators has a different meaning than when used with elevators. In this case, it refers to the consequence that could result when a user's body parts, clothing, footwear or accessories becomes physically caught in the moving parts of an escalator or moving walk.

Table F10: Top Escalator and Moving Walk Location Types by Number of External-Factor Occurrences for Entrapments (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Mass Transportation	57.9%
Commercial	34.1%
Offices	3.9%

Table F11: Top Escalator and Moving Walk Location Types by External-Factor Observed Injury Burden for Entrapments (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Mass Transportation	53.7%
Commercial	44.7%
Offices	1.2%

Flooding

Table F12: Top Escalator and Moving Walk Location Types by Number of External-Factor Occurrences for Flooding (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Mass Transportation	46.0%
Commercial	26.5%
Offices	19.5%

There was no observed injury burden due to flooding.

Unintentional Movements

Table F13: Top Escalator and Moving Walk Location Types by Number of External-Factor Occurrences for Unintentional Movements (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OCCURRENCES
Commercial	45.8%
Mass Transportation	33.3%
Offices	18.1%

Table F14: Top Escalator snd Moving Walk Location Types by External-Factor Observed Injury Burden for Unintentional Movements (2011 – 2020)

LOCATION TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Commercial	98.3%
Offices	1.0%
Mass Transportation	0.7%

Risk of Devices

TSSA conducts periodic inspections of all escalators and moving walks to oversee and manage the state of compliance in the province of Ontario. TSSA deals with non-compliance by requiring the owner to address observed failures within an appropriate time frame through the issuance of inspection orders. This process contributes to the preventative risk management of the inventory.

Table F15: Number of Escalators and Moving Walks (2020)

DESCRIPTION	NUMBER
Escalators and moving walks inventory	2,306
Escalators and moving walks that had sufficient inspection history to calculate a risk score	1,586

Figure F4: Inventory Risk Profiles from Outcomes of Periodic Inspections Conducted on Escalators and Moving Walks (2016 – 2020)

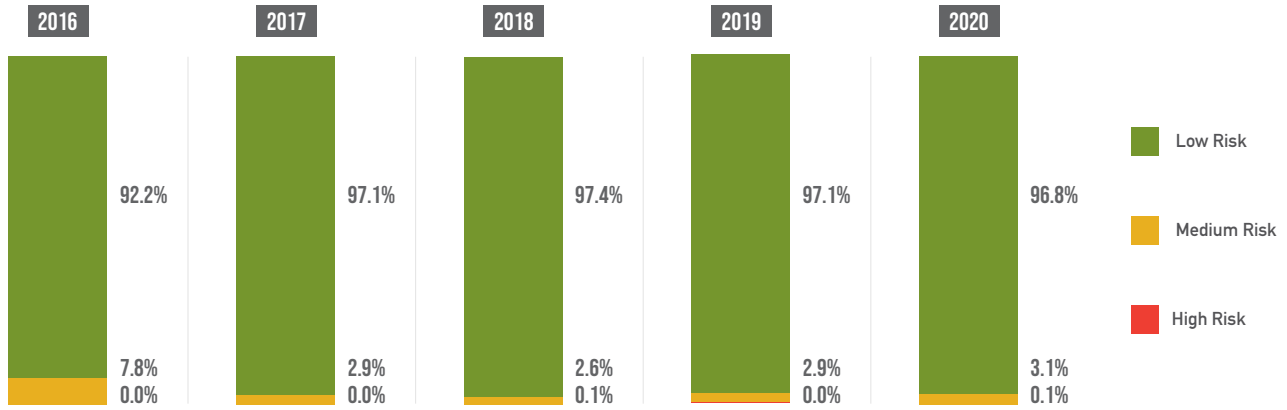


Table F16: Number of High-Risk Escalators and Moving Walks (2020)

DESCRIPTION	NUMBER	PERCENT OF QUALIFIED PROVINCIAL INVENTORY
High-Risk Devices	1	0.1%

Table F17: Top High-Risk Escalator and Moving Walk Location Types (2020)

LOCATION TYPE	PERCENTAGE OF TOTAL HIGH-RISK ESCALATORS AND MOVING WALKS.
Hospital	100.0%

Compliance

The compliance rate is defined as the percentage of periodic inspections with no orders issued compared to the total number of periodic inspections.

Figure F5: Yearly Compliance Rates from Outcomes of Periodic Inspections Conducted on Escalators and Moving Walks (2016 – 2020)

2016	2017	2018	2019	2020
11.2%	11.0%	11.1%	11.3%	13.4%

Table F18: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Conducted on Escalators and Moving Walks (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	11.6%	None

Table F19: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Escalators and Moving Walks (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Late annual periodic task for skirt/step performance index	5.5%
Late maintenance for escalator cleaning	2.7%
Late maintenance for skirt/step performance index	2.2%

Table F20: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Inspections Conducted on Escalators and Moving Walks (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Inadequate brake torque	29.3%
Incorrect no-loading stopping distance	13.5%
Worn brake liners	2.2%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspection (e.g., pass/fail), the inspection risk spectrum (shown as a pie chart) portrays the potential safety risks associated with non-compliance found during the inspection. The dark red segments of the spectrums show unacceptable levels of risk.

Figure F6: Inspection Risk Spectrums from Outcomes of Periodic Inspections Conducted on Escalators and Moving Walks (2016 – 2020)

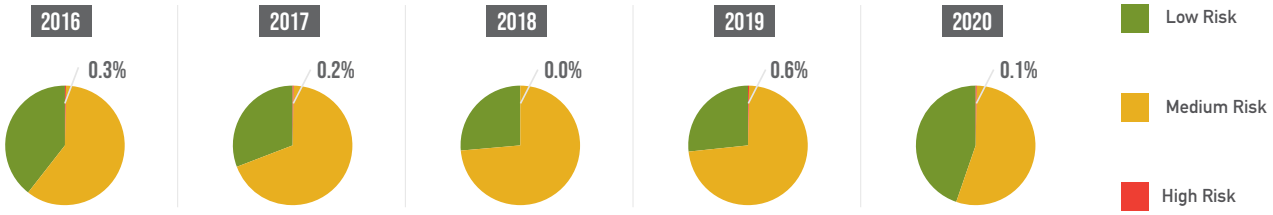


Table F21: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted on Escalators and Moving Walks (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	0.1%
Minor Issues	86.5%
Fully Compliant	13.4%

Some typical examples of minor issues include: overdue periodic testing; missing signage; inoperative lighting in the machine space; the brake adjustment procedure not being posted; and, records of authorized trained personnel not available.

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" nor "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate used in the main body of the report, which can result in small differences between the two numbers.

Table F22: Escalators and Moving Walks Inspection and Re-Inspection Results (2020)

INSPECTION TYPE	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Ad Hoc/Unscheduled Inspections	5	32	8	45	13.5%
Initial Inspections	15	42	0	57	26.3%
Minor Alteration Inspections	39	12	0	51	76.5%
Non-Mandated/Non-Regulated Inspections	12	29	0	41	29.3%
Occurrence Inspections	4	8	1	13	33.3%
Other Inspections	0	2	3	5	0.0%
Periodic Inspections	114	640	20	774	15.1%
Re-Inspections	390	827	25	1,242	32.0%
Escalators and Moving Walks Total	579	1,592	57	2,228	26.7%

Legislation and Regulatory Information

Table F23: TSSA Escalators and Moving Walks Legislation and Regulatory Information (2020)

LEGISLATION AND REGULATORY INFORMATION AS OF 2020	LATEST REVISION
Ontario Regulation 209/01: Elevating Devices	2009
Ontario Regulation 222/01: Certification and Training of Elevating Devices Mechanics	2009
Elevating Devices CAD Amendment 277-19	2019

During this fiscal year, there were no Escalators and Moving Walks director's orders, bulletins or guidelines issued.
The following advisory was issued:

- 252/12-r2 - Simplified Revision Form to Correct / Revise a Registered Design Submission.

Visit www.tssa.org for a comprehensive listing of legislation and regulatory information.

Appendix G – Passenger Ropeways (Ski Lifts)

The Elevating Devices Safety Program regulates elevating devices in Ontario to ensure all devices conform to the Act and applicable regulations, codes and standards. TSSA reviews and registers elevating devices, issues licences, conducts inspections, performs incident investigations, registers contractors and certifies mechanics. The Elevating Devices Safety Program consists of three areas: 1) elevators; 2) escalators and moving walks; and 3) passenger ropeways (ski lifts). The various types of regulated ski lifts include chair lifts, bar lifts, recreational conveyors, gondola lifts, reversible ropeways, passenger ropeways, rope tows, tube tows, belt tows and aerial tramways.

Note that numbers may not add up fully or may exceed the 100th percentile due to rounding off.

Incidents, Injuries and Risk Prediction

Table G1: State of Safety Measures for Ski Lifts (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	83	132	83	88	66	72	71	87	83	89	854	85	None
Non-Permanent Injuries	66	117	70	66	52	54	60	64	66	61	676	68	None
Permanent Injuries	1	0	0	3	2	2	3	2	1	1	15	2	None
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	None
Observed Injury Burden (FE/mpy)	0.01	0.00	0.00	0.03	0.02	0.03	0.01	0.01	0.00	0.00	N/A	0.01	N/A

Table G2: Risk of Injury or Fatality for Ski Lifts (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.01

TSSA's acceptance criterion is 1.00 FE/mpy.

Figure G1: Occurrences and Observed Injury Burden for Ski Lifts (2011 – 2020)

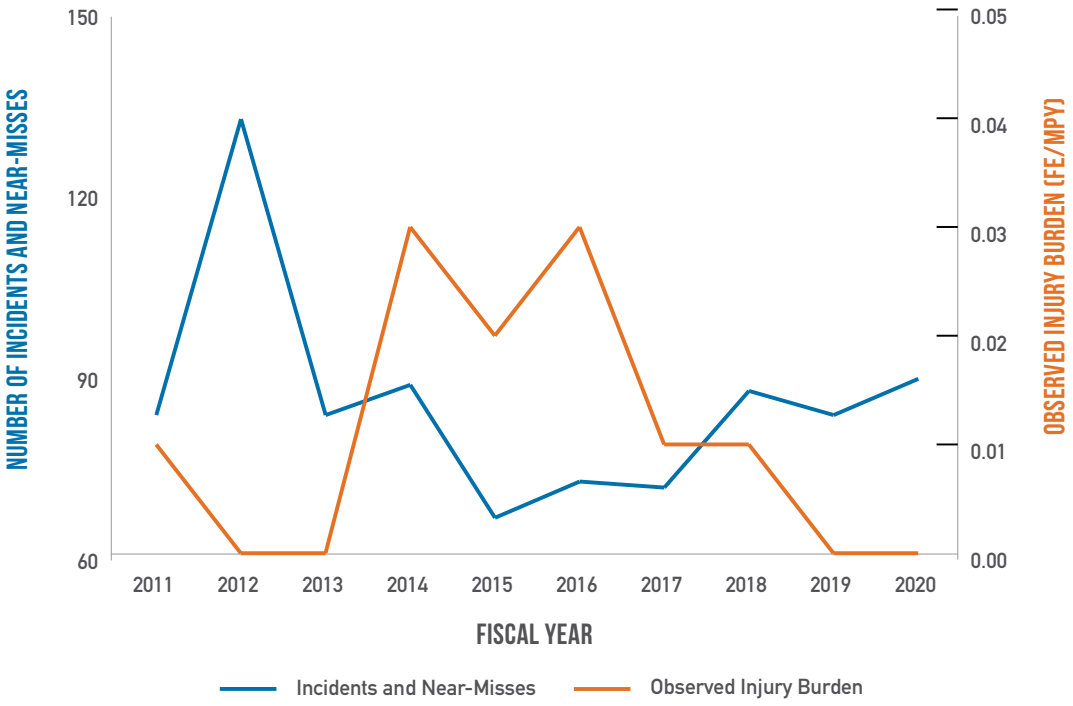


Figure G2: Injuries and Fatalities for Ski Lifts (2011 – 2020)

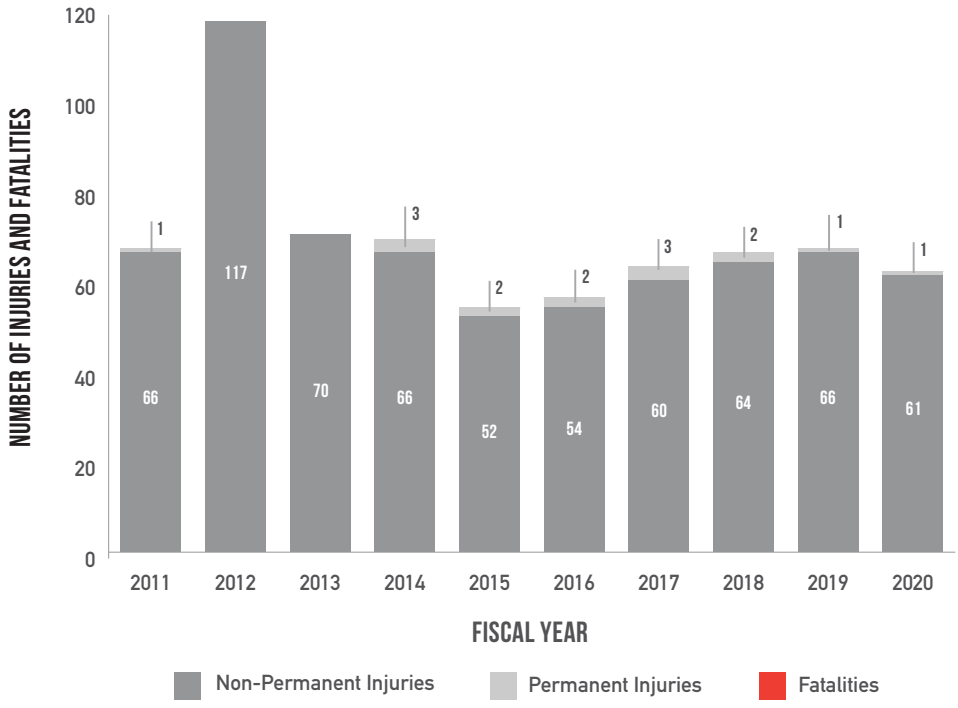
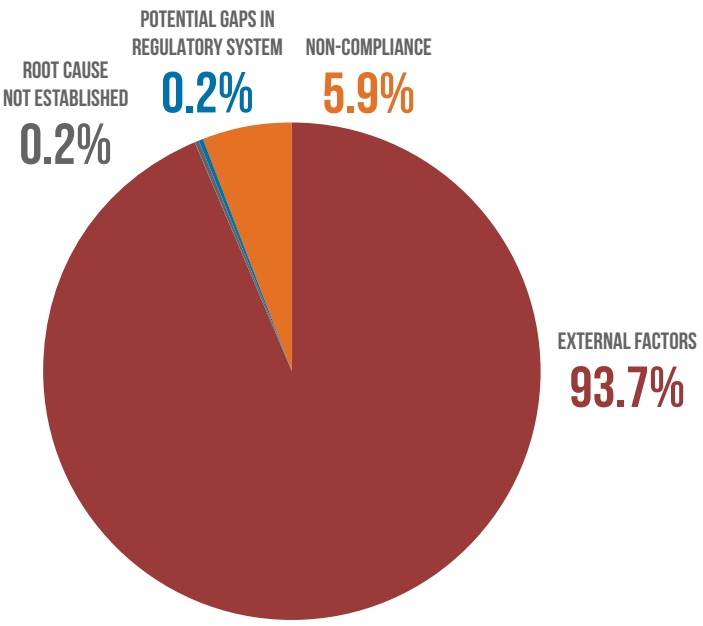


Figure G3: Risk of Injury or Fatality for Ski Lifts by Causal Analysis Category (2011 - 2020)



Risks due to Potential Gaps in the Regulatory System (2011 – 2020)

There was only one example of a potential gap in the regulatory system: improving the design requirements of ski lifts to remove parts that could potentially entrap the passenger.

Risks due to Non-Compliance (2011 – 2020)

Some typical examples of non-compliance include: a cracked seat pivot pin keeper tab; a bull wheel cracked shaft; a broken gearbox pinion shaft; stitching broken at a tow ring; and, a broken heat pad in an electrical panel.

Risks due to External Factors (2011 – 2020)

Table G3: Human Factors in Ski Lifts Occurrences (2011 – 2020)

DESCRIPTION	PERCENTAGE OF EXTERNAL FACTOR OCCURRENCES
Human Factors	99.5%[1]

Table G4: Top Ski Lift Types by Number of External-Factor Occurrences (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Chair Lifts	82.5%
Bar Lifts	8.4%
Passenger Conveyors	5.7%

Table G5: Top Ski Lift Types by External-Factor Observed Injury Burden (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Chair Lifts	60.6%
Passenger Conveyors	38.4%
Rope Tows	0.6%

[1] Human factors make up 99.5% of external factors. External factors make up 93.7% of the total.

Table G6: Top Occurrence Types for Ski Lifts by Number of External-Factor Occurrences (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Trips/Falls	49.1%
Physical Impacts	32.9%
Falls from Height	15.0%

Table G7: Top Occurrence Types for Ski Lifts by External-Factor Observed Injury Burden (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Entanglements	38.3%
Physical Impacts	29.7%
Trips/Falls	21.9%

The top occurrence types are expanded below in greater detail.

Trips/Falls

Table G8: Top Ski Lift Types by Number of External-Factor Occurrences for Trips/Falls (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Chair Lifts	85.4%
Passenger Conveyors	7.3%
Rope Tows	4.5%

Table G9: Top Ski Lift Types by External-Factor Observed Injury Burdenfor Trips/Falls (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Chair Lifts	96.4%
Rope Tows	2.3%
Passenger Conveyors	0.9%

Physical Impacts

Table G10: Top Ski Lift Types by Number of External-Factor Occurrences for Physical Impacts (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Chair Lifts	72.9%
Bar Lifts	21.1%
Passenger Conveyors	3.4%

Table G11: Top Ski Lift Types by External-Factor Observed Injury Burden for Physical Impacts (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Chair Lifts	98.7%
Bar Lifts	1.1%
Rope Tows	0.2%

Falls from Height

Table G12: Top Ski Lift Types by Number of External-Factor Occurrences for Falls from Height (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Chair Lifts	97.5%
Bar Lifts	0.8%
Rope Tows	0.8%

Table G13: Top Ski Lift Types by External-Factor Observed Injury Burden for Falls from Height (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Chair Lifts	99.8%
Rope Tows	0.1%
Bar Lifts	0.0%

Entanglement

Table G14: Top Ski Lift Types by Number of External-Factor Occurrences for Entanglements (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OCCURRENCES
Chair Lifts	60.0%
Passenger Conveyors	35.0%
Rope Tows	5.0%

Table G15: Top Ski Lift Types by External-Factor Observed Injury Burden for Entanglements (2011 – 2020)

DEVICE TYPE	PERCENTAGE OF OBSERVED INJURY BURDEN
Passenger Conveyors	99.8%
Chair Lifts	0.2%
Rope Tows	0.0%

Risk of Devices

TSSA conducts periodic inspections of all ski lifts using a risk-based approach to oversee and manage the state of compliance across all regulated ski lifts in the province of Ontario with the inspection frequency ranging from as often as twice a season to once every two years. TSSA deals with non-compliance by requiring the owner to address observed failures within an appropriate time frame through the issuance of inspection orders. This process contributes to the preventative management of risk associated with ski lifts.

Table G16: Number of Ski Lifts (2020)

DESCRIPTION	NUMBER
Ski lifts inventory	246
Ski lifts that had sufficient inspection history to calculate a risk score	235

Figure G4: Inventory Risk Profiles from Outcomes of Periodic Inspections Conducted on Ski Lifts (2011 – 2020)

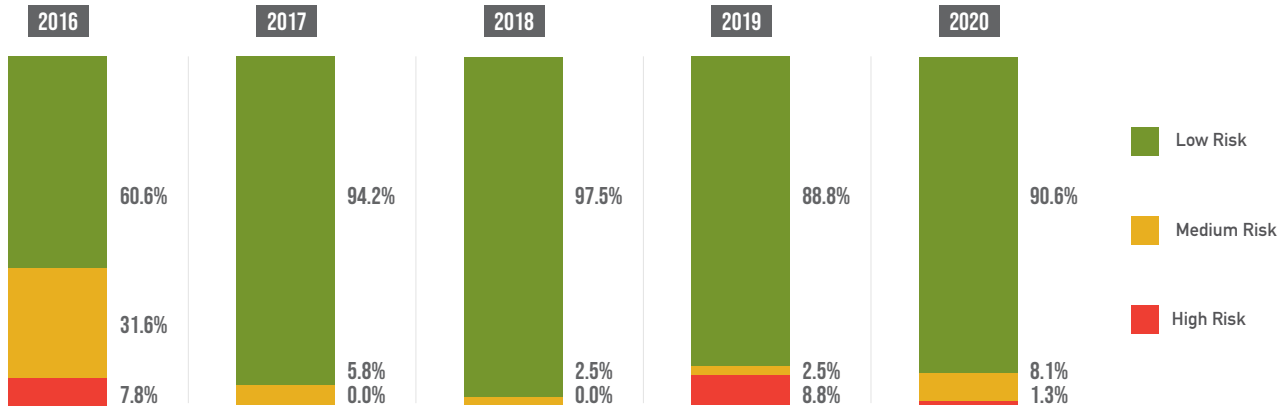


Table G17: Number of High-Risk Ski Lifts (2020)

DESCRIPTION	NUMBER	PERCENT OF QUALIFIED PROVINCIAL INVENTORY
High-Risk Devices	3	1.3%

Table G18: Top High-Risk Ski Lift Types (2020)

DEVICE TYPE	PERCENTAGE OF TOTAL HIGH-RISK SKI LIFTS
Bar Lifts	100.0%

Compliance

The compliance rate is defined as the percentage of periodic inspections with no orders issued compared to the total number of periodic inspections.

Some operational inspections were also performed and their numbers are given below for comparison purposes.

Figure G5: Yearly Compliance Rates from Outcomes of Periodic Inspections Conducted on Ski Lifts (2016 – 2020)

2016	2017	2018	2019	2020
52.9%	54.2%	45.6%	40.6%	44.5%

Figure G6: Yearly Compliance Rates from Outcomes of Operational Inspections Conducted on Ski Lifts (2016 – 2020)

2016	2017	2018	2019	2020
80.0%	85.7%	60.8%	61.1%	79.6%

Table G19: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Conducted on Ski Lifts (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	47.6%	None

Table G20: Five-Year Mean Compliance Rate from Outcomes of Operational Inspections Conducted on Ski Lifts (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	70.7%	None

Table G21: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Ski Lifts (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Sheave assembly misalignment	2.4%
Overhanging tree limbs	2.3%
Missing signs	2.3%

Table G22: Top Compliance Issues by Number of Orders Issued from Outcomes of Operational Inspections Conducted on Ski Lifts (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Personnel not adequately trained	26.6%
Operator not trained for specific device	13.0%
Device operated by untrained personnel	9.5%

Table G23: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Inspections Conducted on Ski Lifts (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Inadequate clearance to carrier	17.8%
Anti-rollback device inoperative	9.6%
Conveyor rigid skirting required	9.4%

Table G24: Top Compliance Issues by Risk of Orders Issued from Outcomes of Operational Inspections Conducted on Ski Lifts (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Safety gate too far from unload point	34.9%
Inadequate clearance to carrier	30.6%
Conveyor rigid skirting required	16.2%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspection (e.g., pass/fail), the inspection risk spectrum (shown as a pie chart) portrays the potential safety risks associated with non-compliance found during the inspection. The dark red segments of the spectrums show unacceptable levels of risk.

Figure G7: Inspection Risk Spectrums from Outcomes of Periodic Inspections Conducted on Ski Lifts (2016 – 2020)

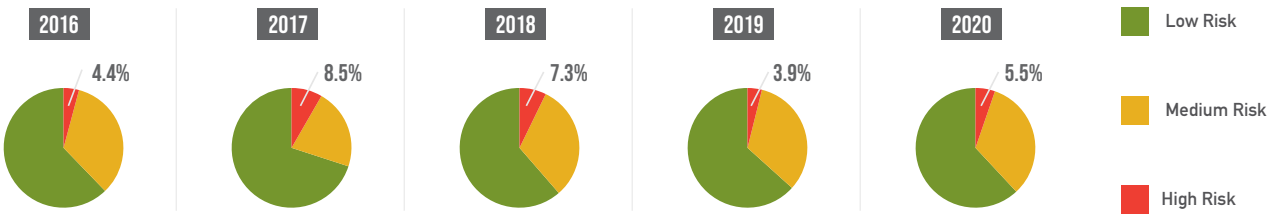


Figure G8: Inspection Risk Spectrums from Outcomes of Operational Inspections Conducted on Ski Lifts (2016 – 2020)

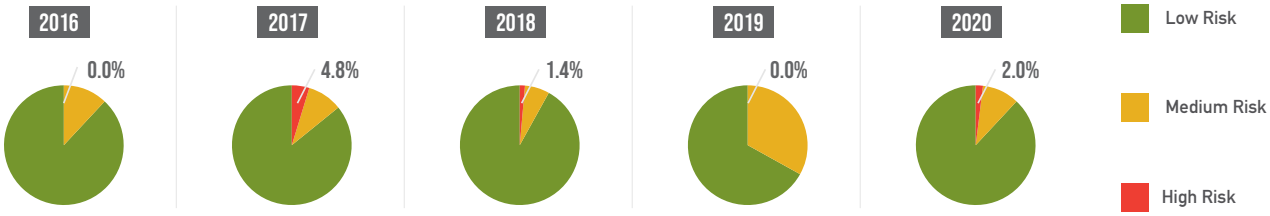


Table G25: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted on Ski Lifts (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	5.5%
Minor Issues	50.0%
Fully Compliant	44.5%

Table G26: Inspection Risk Spectrum from Outcomes of Operational Inspections Conducted on Ski Lifts (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	2.0%
Minor Issues	18.4%
Fully Compliant	79.6%

Some typical examples of minor issues include: the machine room lighting not being guarded; missing signage; general housekeeping requirements not being met; towers not being identified with successive numbers; and, start, run, stop and speed control switches not being permanently marked.

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" nor "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate used in the main body of the report, which can result in small differences between the two numbers.

Table G27: Passenger Ropeways (Ski Lifts) Inspection and Re-Inspection Results (2020)

INSPECTION TYPE	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Ad Hoc/Unscheduled Inspections	3	4	2	9	42.9%
Alteration Inspections	3	2	0	5	60.0%
Initial Inspections	3	11	0	14	21.4%
Minor Alteration Inspections	0	2	0	2	0.0%
Non-Mandated/Non-Regulated Inspections	2	2	1	5	50.0%
Occurrence Inspections	2	2	0	4	50.0%
Operational Inspections	41	10	0	51	80.4%
Periodic Inspections	50	60	4	114	45.5%
Re-Inspections	48	22	1	71	68.6%
Ski Lifts Total	152	115	8	275	56.9%

Legislation and Regulatory Information

Table G28: TSSA Passenger Ropeways (Ski Lifts) Legislation and Regulatory Information (2020)

LEGISLATION AND REGULATORY INFORMATION AS OF 2020	LATEST REVISION
Ontario Regulation 209/01: Elevating Devices	2009
Ontario Regulation 222/01: Certification and Training of Elevating Devices Mechanics	2009
Elevating Devices CAD Amendment 277-19	2019

During this fiscal year, there were no Ski Lifts director's orders, advisories, bulletins or guidelines issued.

Visit www.tssa.org for a comprehensive listing of legislation and regulatory information.

Appendix H – Fuels

TSSA's Fuels Safety Program regulates the transportation, storage, handling and use of fuels in Ontario. Fuels under this program include: natural gas; propane; butane; hydrogen; digester gas; landfill gas; fuel oil; gasoline; and, diesel. TSSA licenses fuel facilities, registers contractors and certifies tradespeople who install and service equipment. TSSA also reviews and approves facility plans for sites licensed by TSSA and perform custom equipment approvals and inspection services to ensure safe handling and usage of fuel.

Note that numbers may not add up fully or may exceed the 100th percentile due to rounding off.

Incidents, Injuries and Risk Prediction

Table H1: State of Safety Measures for Fuels (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences[7]	1,180	946	1,258	1,333	1,091	899	994	1,004	1,056	785	10,546	1,055	-2.1%
Non-Permanent Injuries	34	51	37	102	27	53	55	40	24	20	443	44	None
Permanent Injuries	9	9	10	12	15	18	15	11	20	8	127	13	None
Fatalities	5	2	4	10	4	1	2	1	1	2	32	3	None
Observed Injury Burden (FE/mpy)	0.17	0.11	0.42	0.57	0.24	0.09	0.12	0.16	0.18	0.07	N/A	0.21	N/A
Pipeline Strike Occurrences[8]	2,204	2,420	2,342	2,371	2,467	2,364	2,288	2,375	2,296	2,020	23,147	2,315	None

Table H2: Risk of Injury or Fatality for Fuels (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	1.34

TSSA's acceptance criterion is 1.00 FE/mpy.

[7] The numbers in this row exclude pipeline strikes.
[8] The numbers in this row include pipeline strikes only. Data not included in Incidents & Near-Miss Occurrences row above.

Figure H1: Occurrences and Observed Injury Burden for Fuels (2011 – 2020)

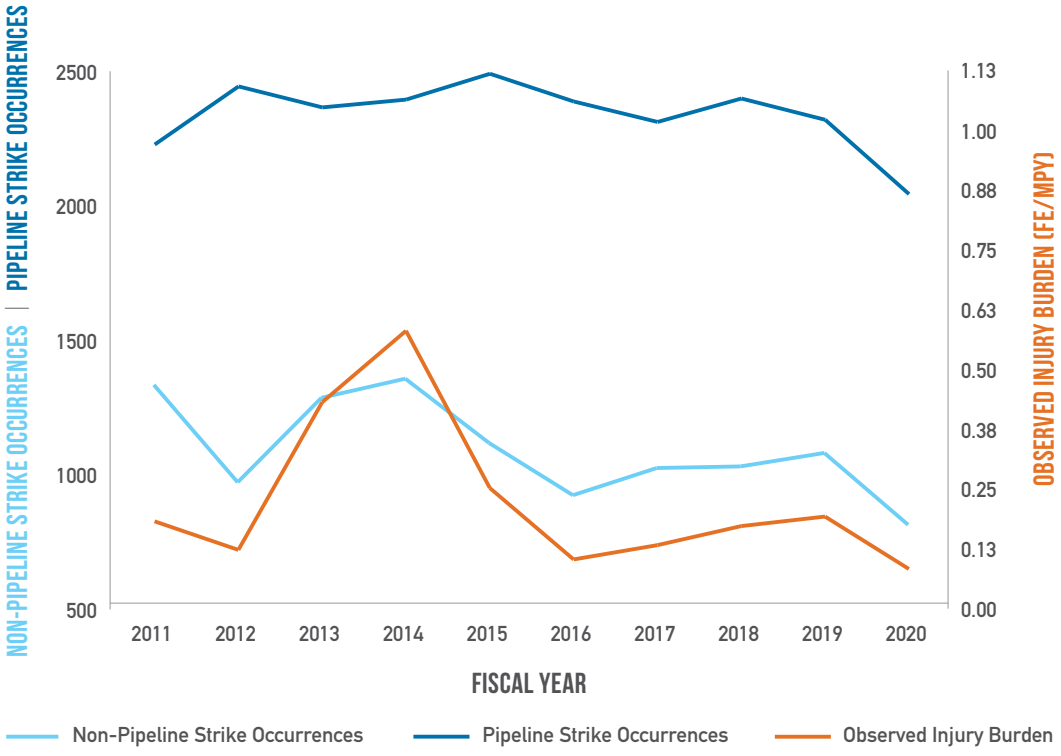


Figure H2: Injuries and Fatalities for Fuels (2011 – 2020)

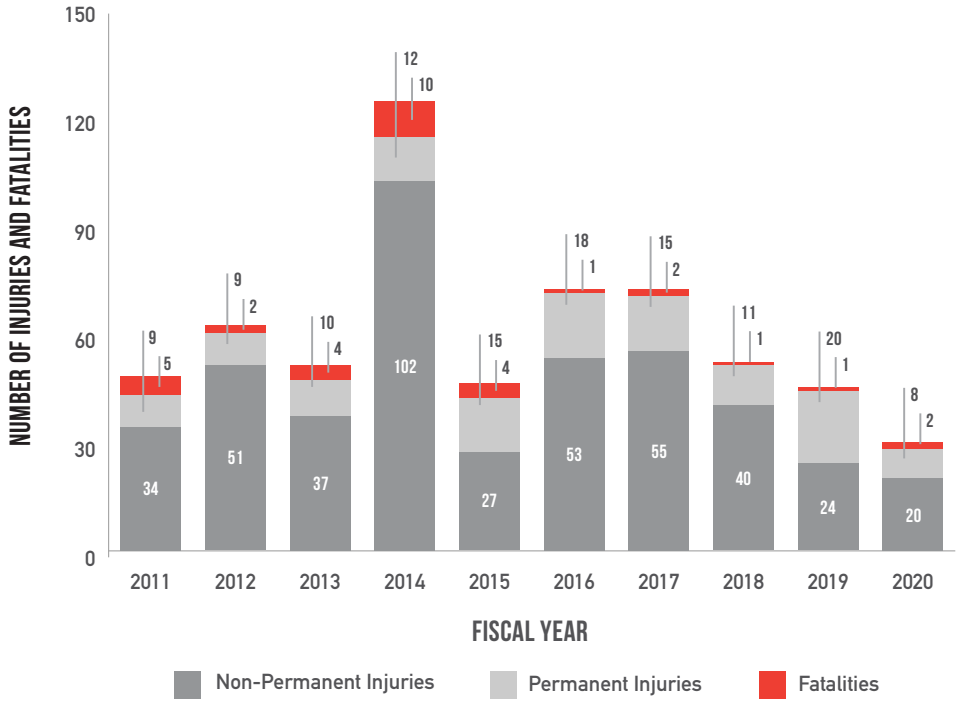
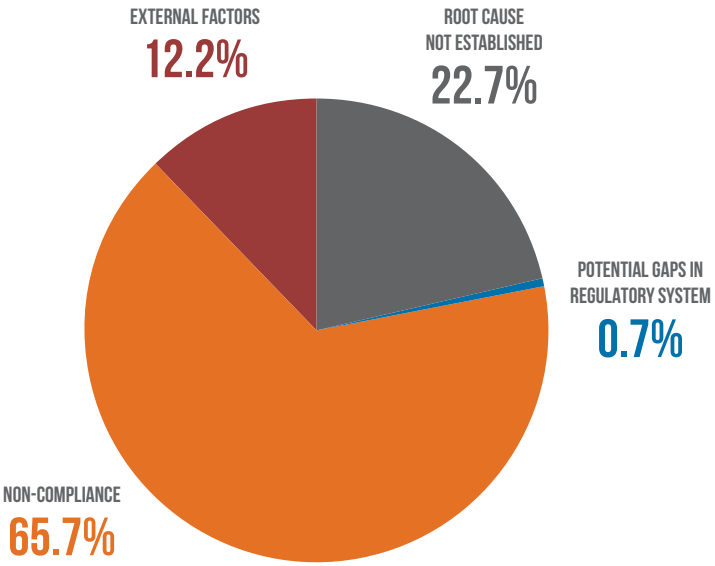


Figure H3: Risk of Injury or Fatality for Fuels by Casual Analysis Category (2011 - 2020)



Risks due to Potential Gaps in the Regulatory System (2011 – 2020)

Some typical examples of potential gaps in the regulatory system include: an improperly sized kitchen exhaust fan that caused negative pressure, resulting in a downdraft in the stove; uncertified equipment installed; a natural gas meter set damaged by a vehicle due to inadequate crash protection; and a faulty relief valve that resulted in a vapour release.

Risks due to Non-Compliance (2011 – 2020)

Some typical examples of non-compliance include: no maintenance performed on a water heater since installation resulting in failed component parts; logs not installed properly in a natural gas fireplace resulting in a carbon monoxide (CO) release; a chimney liner was installed too short, resulting in soot being released inside the residence; an appliance not installed to manufacturer's certified instructions; a worn out gasket; vent ducting not securely fastened; and a commercial kitchen fire as a result of a grease-laden exhaust hood.

Risks due to External Factors (2011 – 2020)

Some typical examples of external factors include: a chimney damaged in a wind storm blocking the exhaust; high winds causing a downdraft; freezing rain causing the combustion air outlet to be partially blocked, resulting in a CO release; a rooftop HVAC unit buried under heavy snow; and vandalism of a meter set.

Pipeline Strikes

A pipeline strike is a reportable pipeline incident (or near-miss) involving damage to a pipeline, or its protective coating, including gouges, scrapes, dents or creases, resulting in, or having the potential to, damage a pipeline, even if there is no release/spillage of products or substances from the pipeline. Even small disturbances to a pipeline's integrity may cause a future leak due to subsequent corrosion. A pipeline strike can also involve the rupture of an underground natural gas pipeline during an excavation that results in the release of natural gas.

Areas of High Risk

Areas of high risk are those with RIF values greater than 1.00 FE/mpy for the general population or greater than 0.30 FE/mpy for sensitive sub-populations.

There were three areas of high risk identified in the Fuels Safety Program this fiscal year:

1. carbon monoxide (CO) risks in apartments and condominiums;
2. fuel risks in private dwellings; and
3. fuel risks in schools.

The three areas of high risk have been detailed below based on their relative ranking. This ranking is based on the RIF value and/or the deviation of the risk value from the risk acceptability criteria.

1. CO Risks in Apartments and Condominiums

This is inclusive of high rises, both rental apartment buildings and condominiums.

Table H3: State of Safety Measures for CO Risks in Apartments and Condominiums (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	20	17	13	33	18	16	21	15	11	0	164	16	None
Non-Permanent Injuries	2	0	0	7	4	0	0	0	0	0	13	1	N/A
Permanent Injuries	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Fatalities	0	0	0	0	1	0	0	0	0	0	1	0	N/A
Observed Injury Burden (FE/mpy)	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	N/A	0.01	N/A

Table H4: Risk of Injury or Fatality for CO Risks in Apartments and Condominiums (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	3.54

TSSA's acceptance criterion is 1.00 FE/mpy.

Figure H4: Occurrences and Observed Injury Burden for CO Risks in Apartments and Condominiums (2011 – 2020)

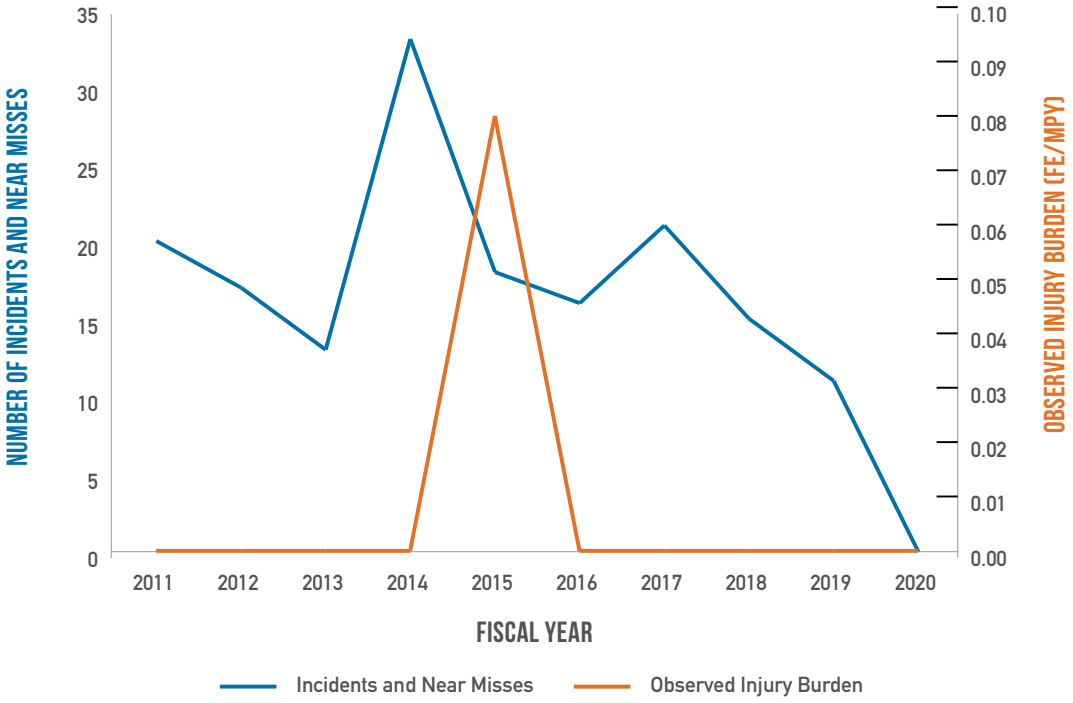


Figure H5: Injuries and Fatalities for CO Risks in Apartments and Condominiums (2011 – 2020)

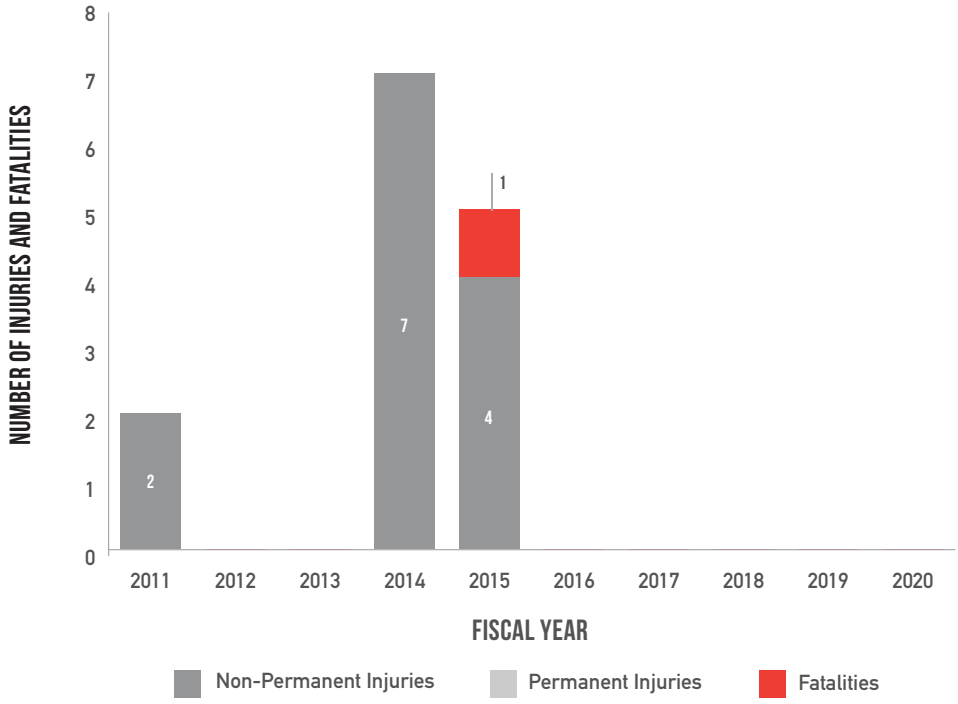
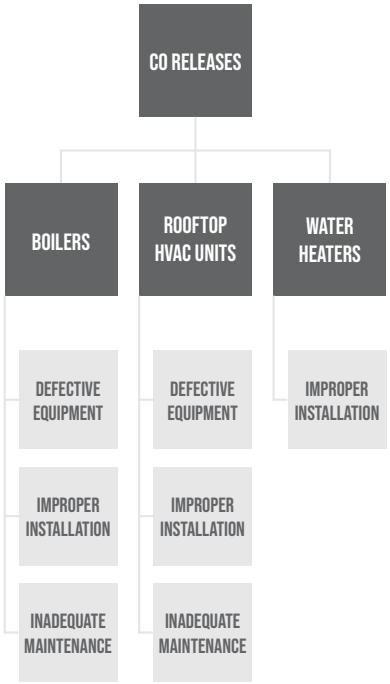


Table H5: Top Equipment Types for CO Risks in Apartments and Condominiums (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Boilers	38.1%
Rooftop Heating Ventilation and Air Conditioning (HVAC) Units	30.2%
Water Heaters	11.1%

Figure H6: Top Contributing Causes of CO Release Safety Issues in Apartments and Condominiums (2011 – 2020)



2. Fuel Risks in Private Dwellings

Private dwellings are residential locations which, for the purposes of this report, include detached and semi-detached houses, duplexes and townhouses. In addition, TSSA is monitoring other configurations of residences to better understand their fuel-related risks.

Table H6: State of Safety Measures for Fuel Risks[9] in Private Dwellings (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	597	547	717	746	642	456	522	542	620	417	5,806	581	None
Non-Permanent Injuries	18	20	23	24	10	21	30	34	18	12	210	21	N/A
Permanent Injuries	3	7	7	7	6	12	5	4	10	6	67	7	N/A
Fatalities	3	2	4	9	3	1	2	1	1	2	28	3	N/A
Observed Injury Burden (FE/mpy)	0.15	0.12	0.53	0.57	0.26	0.10	0.13	0.20	0.13	0.07	N/A	0.22	N/A

Table H7: Risk of Injury or Fatality for Fuel Risks in Private Dwellings (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	2.65

TSSA's acceptance criterion is 1.00 FE/mpy.

These occurrences resulted in CO releases, fires, explosions, and/or vapour releases.

[9] Includes occurrences and injuries resulting from CO release, fire, explosion, and/or vapour release.

Figure H7: Occurrences and Observed Injury Burden for Fuel Risks in Private Dwellings (2011 – 2020)

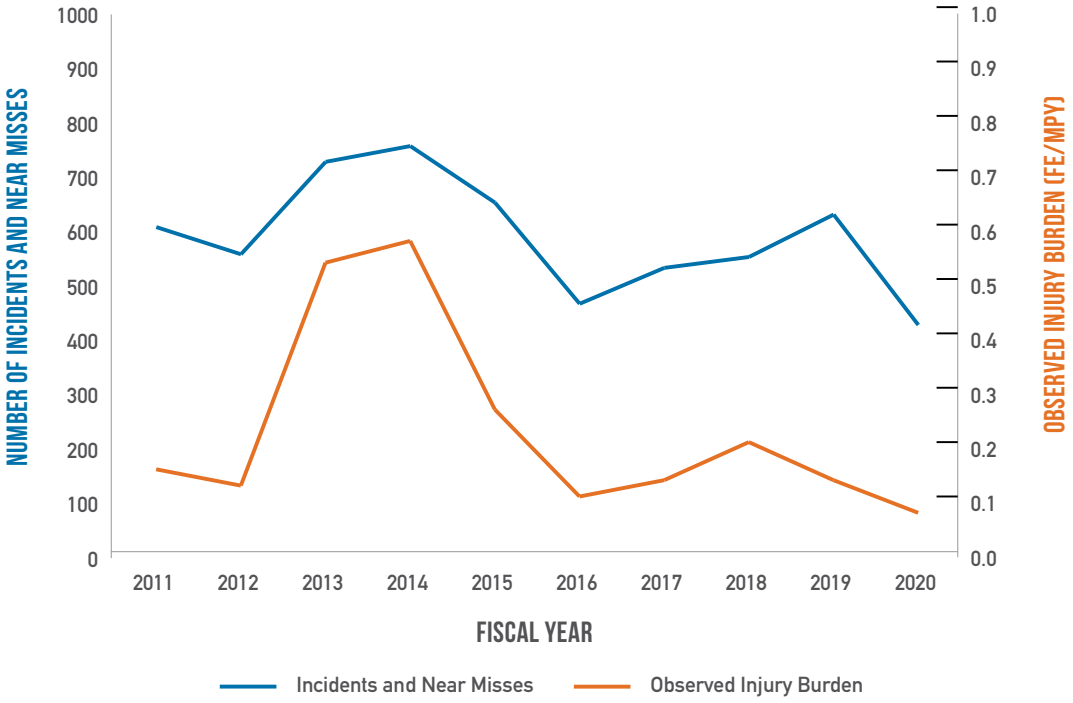


Figure H8: Injuries and Fatalities for Fuel Risks in Private Dwellings (2011 – 2020)

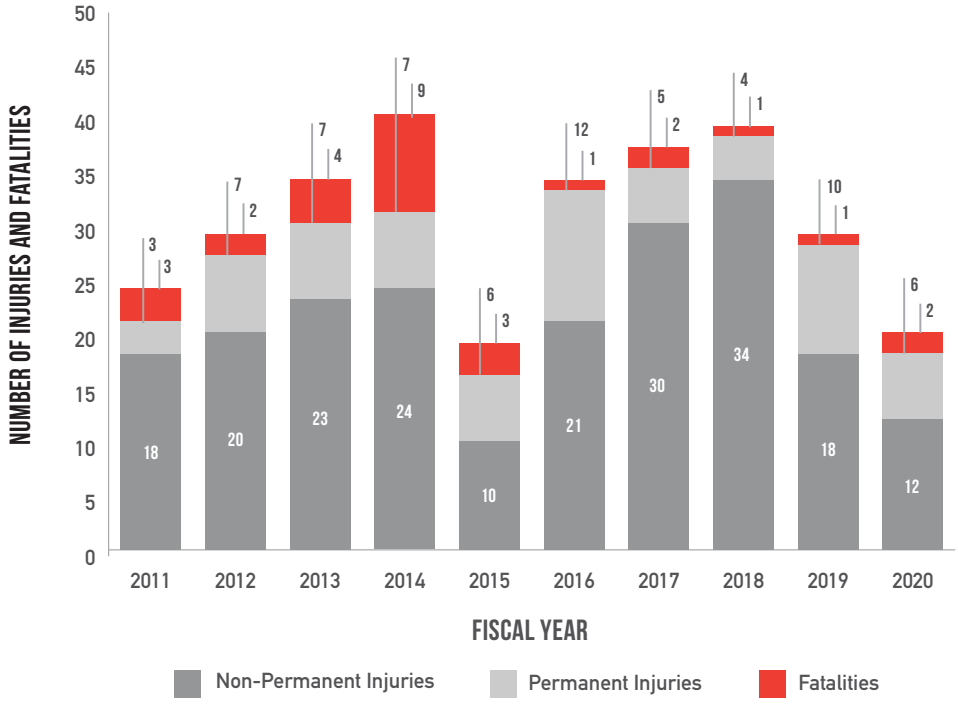


Table H8: Occurrence Types for Fuel Risks in Private Dwellings (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
CO Releases	38.5%
Vapour Releases	30.7%
Fires	24.9%
Explosions	5.2%

Comprehensive drilldowns have been provided for CO releases, fires, explosions and vapour releases. TSSA's RIF acceptance criterion for this area is 1.00 FE/mpy.

CO Releases

Table H9: Injuries and Fatalities for CO Releases in Private Dwellings (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	114
Permanent Injuries	0
Fatalities	12

Table H10: Risk of Injury or Fatality for CO Releases in Private Dwellings (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	7.06

Table H11: Top Equipment Types for CO Releases in Private Dwellings (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Furnaces	49.2%
Water Heaters	18.0%
Boilers	4.9%

Table H12: Percentage of Fatalities due to CO Release that Occur in Private Dwellings Compared to Overall CO Fatalities (2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Private Dwellings	80.0%

Explosions

Table H13: Injuries and Fatalities for Explosions in Private Dwellings (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	10
Permanent Injuries	24
Fatalities	3

Table H14: Risk of Injury or Fatality for Explosions in Private Dwellings (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.46

Table H15: Top Equipment Types for Explosions in Private Dwellings (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Fireplaces	23.0%
Water Heaters	9.5%
Furnaces	8.1%

Fires

Table H16: Injuries and Fatalities for Fires in Private Dwellings (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	4
Permanent Injuries	27
Fatalities	7

Table H17: Risk of Injury or Fatality for Fires in Private Dwellings (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	2.00

Table H18: Top Equipment Types for Fires in Private Dwellings (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Furnaces	21.7%
Fireplaces	8.3%
Barbecues	7.7%

Vapour Releases

Table H19: Injuries and Fatalities for Vapour Releases in Private Dwellings (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	0
Permanent Injuries	2
Fatalities	3

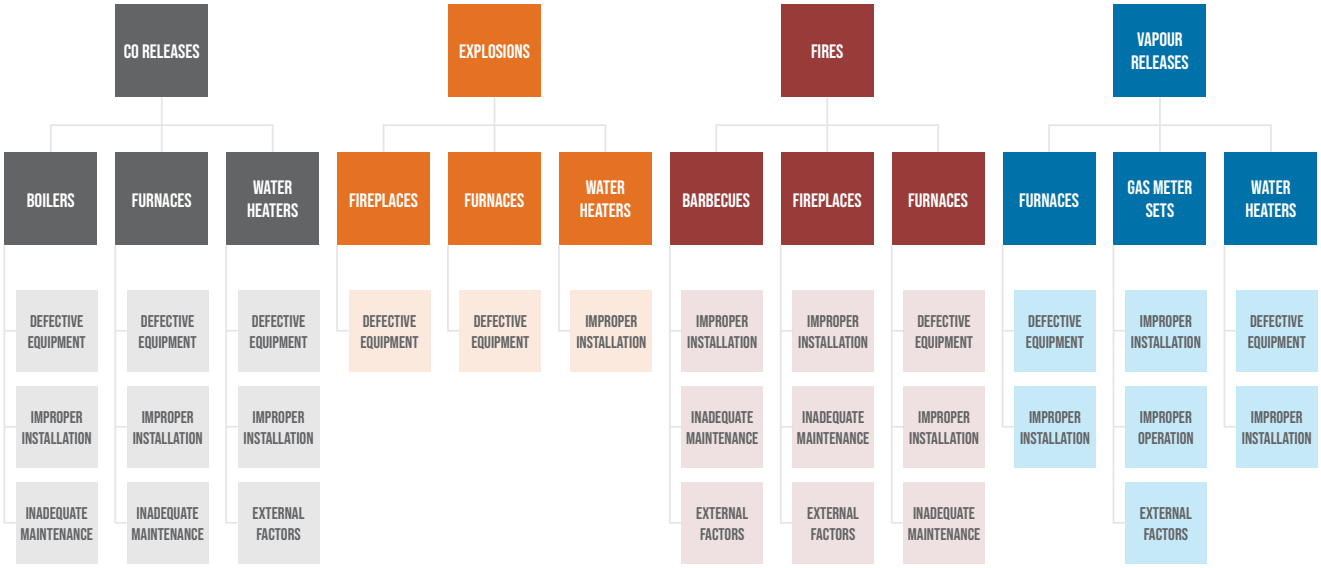
Table H20: Risk of Injury or Fatality for Vapour Releases in Private Dwellings (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.91

Table H21: Top Equipment Types for Vapour Releases in Private Dwellings (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Gas Meter Sets	49.0%
Water Heaters	11.2%
Furnaces	5.3%

Figure H9: Top Contributing Causes of Fuel-Related Safety Issues in Private Dwellings (2011 - 2020)



3. Fuel Risks in Schools

Schools in this section include kindergarten through grade 12, both public and private. They exclude nursery schools, universities and colleges.

Table H22: State of Safety Measures for Fuel Risks[10] in Schools (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	15	13	26	30	9	18	21	22	18	15	187	19	None
Non-Permanent Injuries	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Permanent Injuries	0	0	0	1	0	0	0	0	0	0	1	0	N/A
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Observed Injury Burden (FE/mpy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00	N/A

Table H23: Risk of Injury or Fatality for Fuel Risks in Schools (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.38

TSSA's acceptance criterion is 0.30 FE/mpy. This is understandably much lower than other exposed populations due to the type of population and the ability of their occupants to escape in the event of an emergency.

[10] Includes occurrences and injuries resulting from CO release, fire, explosion, and/or vapour release.

Figure H10: Occurrences and Observed Injury Burden for Fuel Risks in Schools (2011 – 2020)

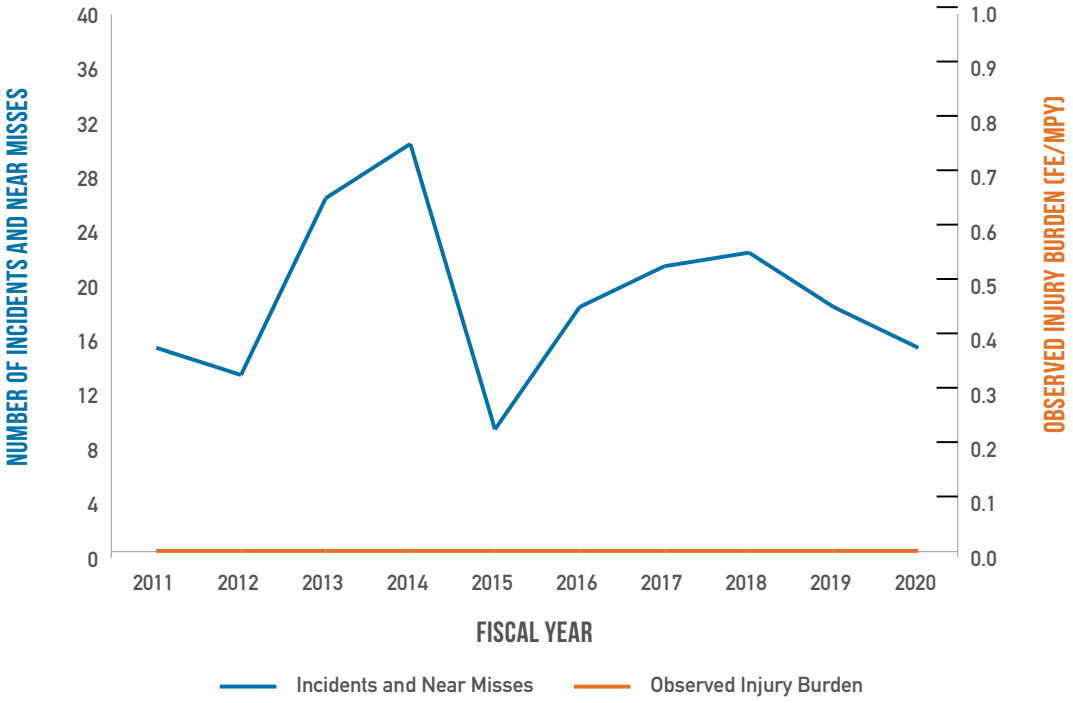


Figure H11: Injuries and Fatalities for Fuel Risks in Schools (2011 – 2020)

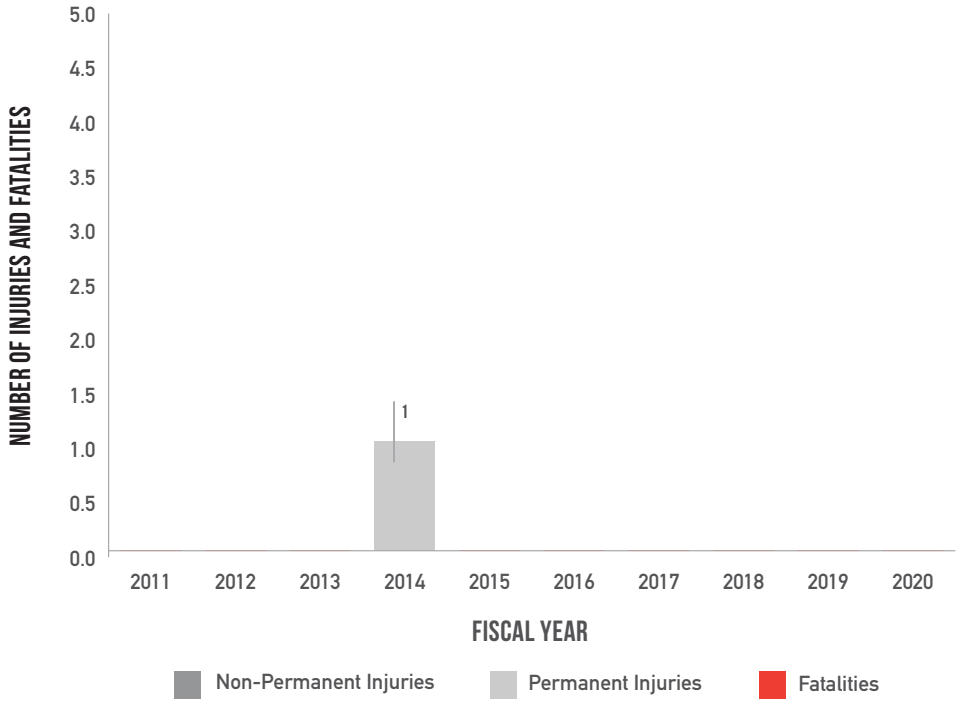


Table H24: Occurrence Types for Fuel Risks in Schools (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Vapour Releases	53.5%
CO Releases	25.1%
Explosions	6.4%
Fires	5.3%

Comprehensive drilldowns have been provided for CO release, fires, explosions and vapour releases. TSSA's RIF acceptance criterion in this area is 0.30 FE/mpy.

CO Releases

Table H25: Injuries and Fatalities for CO Releases in Schools (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	0
Permanent Injuries	0
Fatalities	0

Table H26: Risk of Injury or Ratality for CO Releases in Schools (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.85

Table H27: Top Equipment Types for CO Releases in Schools (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Boilers	58.7%
Rooftop Heating Ventilation and Air Conditioning (HVAC) Units	21.7%
Furnaces	6.5%

Explosions

Table H28: Injuries and Fatalities for Explosions in Schools (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	0
Permanent Injuries	1
Fatalities	0

Table H29: Risk of Injury or Fatality for Explosions in Schools (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.15

Table H30: Top Equipment Types for Explosion in Schools (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Boilers	83.3%

Fires

Table H31: Injuries and Fatalities for Fires in Schools (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	0
Permanent Injuries	0
Fatalities	0

Table H32: Risk of Injury or Fatality for Fires in Schools (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.12

There was insufficient data to determine equipment types for fires in schools.

Vapour Releases

Table H33: Injuries and Fatalities for Vapour Releases in Schools (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Non-Permanent Injuries	0
Permanent Injuries	0
Fatalities	0

Table H34: Risk of Injury or Fatality for Vapour Releases in Schools (2020)

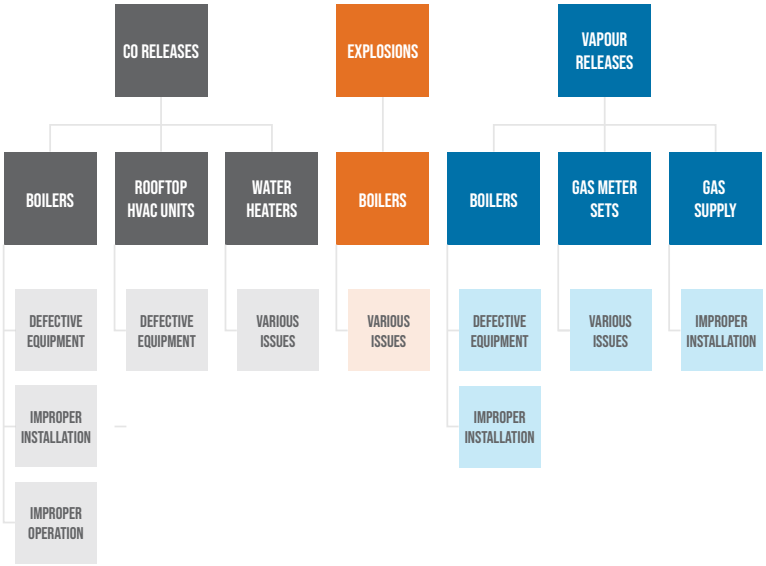
DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.41

Table H35: Top Equipment Types for Vapour Releases in Schools (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Gas Supply	34.4%
Boilers	29.0%
Gas Meter Sets	4.3%

There have been two factors that have contributed to an increase in the risk at schools. There has been an increase in the annual occurrence rate (i.e., the number of occurrences per year). In particular, there has been increased reporting from schools over the last few years, particularly with CO release occurrences. Moreover, a CO release occurrence in a school could lead to many impacted people, thereby resulting in more exposed students per occurrence. These factors in conjunction contributed to the increase in risk.

Figure H12: Top Contributing Causes of Fuel-Related Safety Issues in Schools (2011 – 2020)



Area of Medium Risk

There was only one area of medium risk identified in the Fuels Safety Program this fiscal year:

- fuel risks in business units.

Fuel Risks in Business Units

Business units include commercial plazas and various retail, service, supply and office locations. They exclude food service locations, manufacturing facilities and warehouses.

Table H36: State of Safety Measures for Fuel Risks[11] in Business Units (2011 – 2020)

DESCRIPTION	FISCAL YEAR										TOTAL	AVERAGE	TREND (ANNUAL)
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Incidents and Near-Miss Occurrences	51	48	88	90	57	66	69	77	86	63	695	70	None
Non-Permanent Injuries	0	4	4	2	1	7	0	2	3	2	25	3	N/A
Permanent Injuries	0	0	0	1	0	1	0	1	5	0	8	1	N/A
Fatalities	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Observed Injury Burden (FE/mpy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	N/A	0.02	N/A

Table H37: Risk of Injury or Fatality for Fuel Risks in Business Units (2020)

DESCRIPTION	FISCAL YEAR 2020
RIF (FE/mpy)	0.61

TSSA's acceptance criterion is 1.00 FE/mpy.

[11] Includes occurrences and injuries resulting from CO release, fire, explosion, and/or vapour release.

Figure H13: Occurrences and Observed Injury Burden for Fuel Risks in Business Units (2011 – 2020)

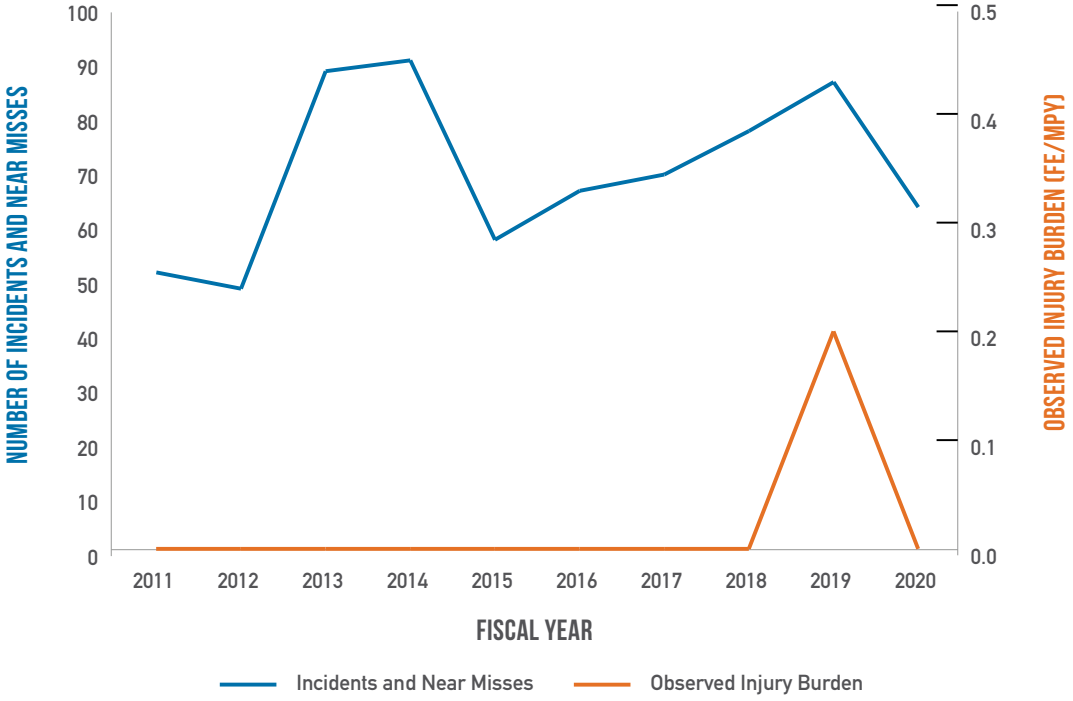


Figure H14: Injuries and Fatalities for Fuel Risks in Business Units (2011 – 2020)

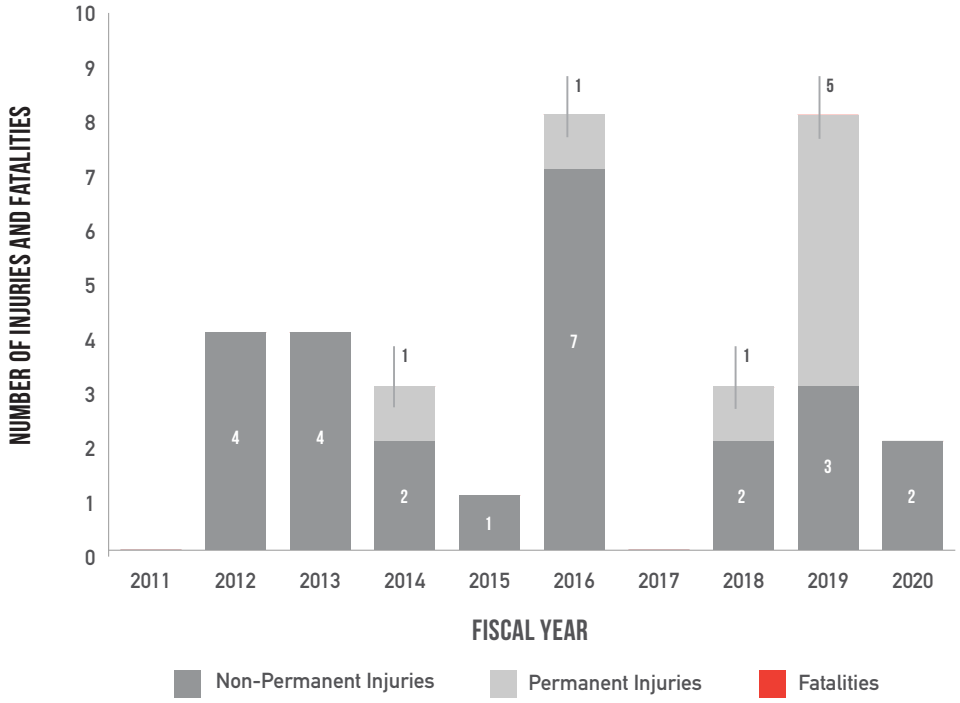


Table H38: Upstream and Downstream Occurrences for Fuel Risks in Business Units (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Upstream	30.1%
Downstream	69.9%

Upstream occurrences (i.e., outside of the commercial establishment on fuel distributor meters and service lines) involved gas supply equipment, such as piping, pipelines and regulators, and resulted in vapour release.

Table H39: Upstream Occurrence Types for Fuel Risks in Business Units (2011 – 2020)

DESCRIPTION	FISCAL YEARS 2011 – 2020
Vehicle Collisions	73.6%
Non-Vehicle Occurrences	26.4%

Vehicles colliding with gas supply equipment typically included passenger motor vehicles, snow removal equipment, construction equipment, and forklifts.

Table H40: Upstream Occurrence Types for Fuel Risks in Business Units (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Vapour Releases	93.1%
Fires	3.4%
CO Releases	3.4%

Table H41: Downstream Occurrence Types for Fuel Risks in Business Units (2011 – 2020)

OCCURRENCE TYPE	PERCENTAGE OF OCCURRENCES
Vapour Releases	43.1%
CO Releases	37.6%
Fires	15.8%

Table H42: Top Downstream Equipment Types for CO Releases in Business Units (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Rooftop HVAC Units	30.3%
Boilers	19.7%
Furnaces	15.8%

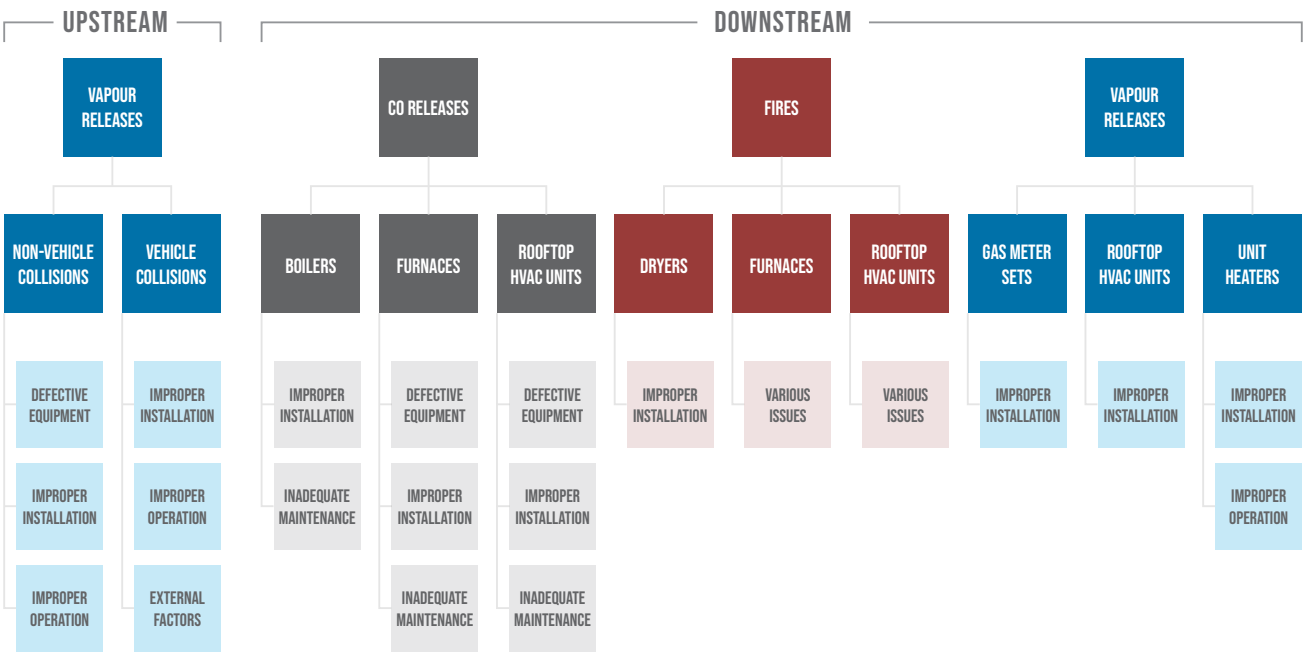
Table H43: Top Downstream Equipment Types for Fires in Business Units (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Dryers	21.9%
Rooftop HVAC Units	12.5%
Furnaces	12.5%

Table H44: Top Downstream Equipment Types for Vapour Releases in Business Units (2011 – 2020)

EQUIPMENT TYPE	PERCENTAGE OF OCCURRENCES
Unit Heaters	32.2%
Rooftop HVAC Units	10.3%
Gas Meter Sets	6.9%

Figure H15: Top Contributing Causes of Fuel-Related Safety Issues in Business Units (2011 – 2020)



Licensed Liquid Fuels Sites

Risk of Sites

TSSA conducts periodic inspections of liquid fuels storage and dispensing facilities at least once every three years to oversee and manage the state of compliance across all licensed sites in Ontario.

Table H45: Number of Licensed Liquid Fuels Sites (2020)

DESCRIPTION	NUMBER
Licensed liquid fuels sites inventory	4,221
Licensed liquid fuels sites that had sufficient inspection history to calculate a risk score	3,474

Figure H16: Inventory Risk Profiles from Outcomes of Periodic Inspections Conducted on Licensed Liquid Fuels Sites (2016 – 2020)

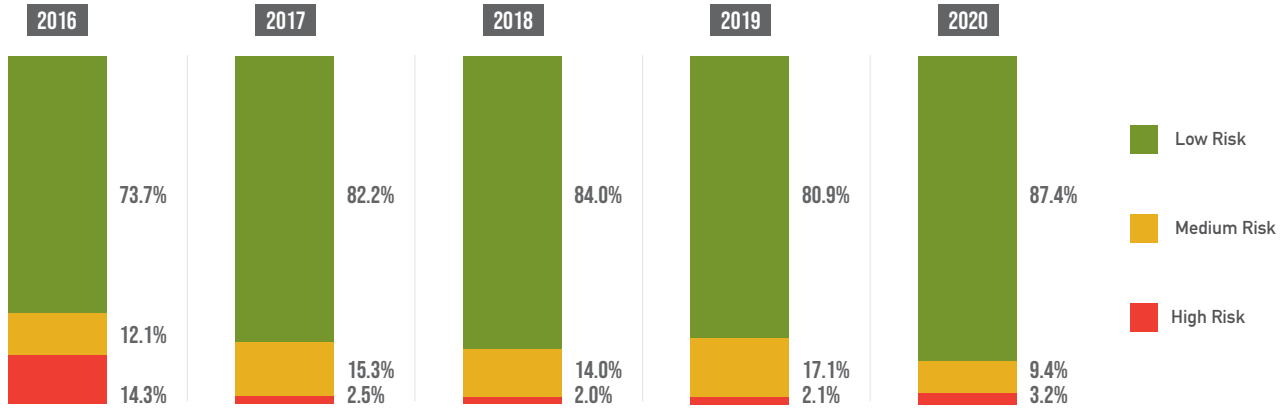


Table H46: Number of High-Risk Licensed Liquid Fuels Sites (2020)

DESCRIPTION	NUMBER	PERCENT OF QUALIFIED PROVINCIAL INVENTORY
High-Risk Sites	111	3.2%

Table H47: Top High-Risk Licensed Liquid Fuels Site Types (2020)

SITE TYPE	PERCENTAGE OF TOTAL HIGH-RISK SITES
Gas Stations	82.9%
Marinas	13.5%
Bulk Plants	3.6%

Compliance

The compliance rate is defined as the percentage of periodic inspections with no orders issued compared to the total number of periodic inspections.

Figure H17: Yearly Compliance Rates from Outcomes of Periodic Inspections Conducted at Licensed Liquid Fuels Sites (2016 – 2020)

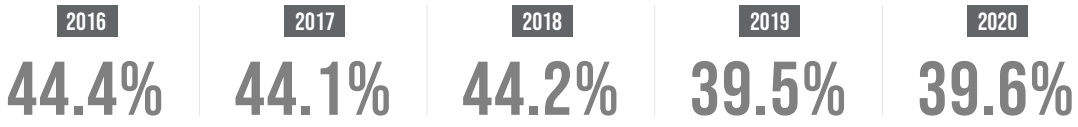


Table H48: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Conducted at Licensed Liquid Fuels Sites (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	42.3%	-1.3%

Table H49: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Liquid Fuels Licensed Sites (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Defective equipment needs to be repaired or replaced	17.1%
Shear valve and leak detection system maintenance documentation missing	9.5%
Leak testing not being performed	5.8%

Table H50: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Inspections Conducted on Liquid Fuels Licensed Sites (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Operating facility without licence	8.3%
Unpermitted/unregistered modification	3.0%
Employers not ensuring employees comply with TSS Act and regulations	3.0%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspection (e.g., pass/fail), the inspection risk spectrum (shown as a pie chart) portrays the potential safety risks associated with non-compliance found during the inspection. The dark red segments of the spectrums show unacceptable levels of risk.

Figure H18: Inspection Risk Spectrums from Outcomes of Periodic Inspections Conducted on Liquid Fuels Licensed Sites (2016 – 2020)

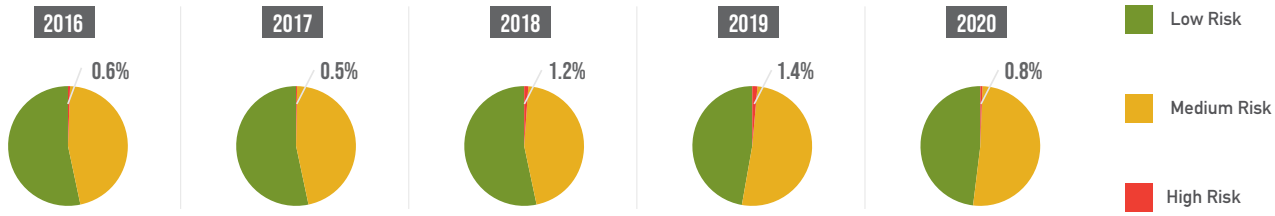


Table H51: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted at Licensed Liquid Fuels Sites (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	0.8%
Minor Issues	59.7%
Fully Compliant	39.6%

Some typical examples of minor issues include: above ground storage tanks not being permanently marked; missing signage; testing not being performed; licence not being displayed; and, underground storage tanks not being removed after being out of service for two years.

Licensed Propane Sites

Risk of Sites

TSSA conducts periodic inspections of propane facilities to oversee and manage the state of compliance across all licensed sites in the province of Ontario.

Table H52: Number of Licensed Propane Sites (2020)

DESCRIPTION	NUMBER
Licensed propane sites inventory	1,328
Licensed propane sites that had sufficient inspection history to calculate a risk score	1,048

Figure H19: Inventory Risk Profiles from Outcomes of Periodic Inspections Conducted on Licensed Propane Sites (2016 – 2020)

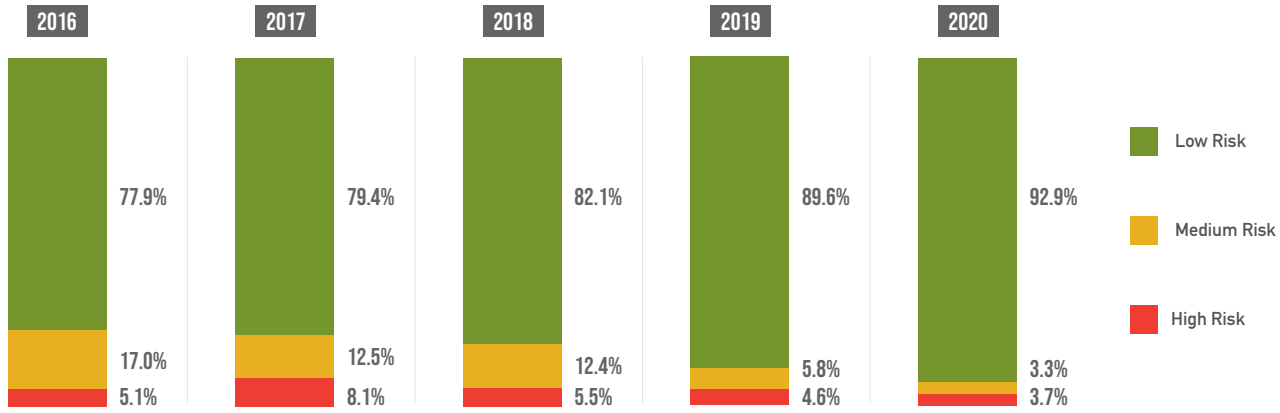


Table H53: Number of High-Risk Licensed Propane Sites (2020)

DESCRIPTION	NUMBER	PERCENT OF QUALIFIED PROVINCIAL INVENTORY
High-Risk Sites	39	3.7%

Table H54: Top High-Risk Licensed Propane Site Types (2020)

SITE TYPE	PERCENTAGE OF TOTAL HIGH-RISK SITES
Cylinder Refill Centres	84.6%
Propane Filling Plants > 5000 USWG	15.4%

Compliance

The compliance rate is defined as the percentage of periodic inspections with no orders issued compared to the total number of periodic inspections.

Figure H20: Yearly Compliance Rates from Outcomes of Periodic Inspections Conducted at Licensed Propane Sites (2016 – 2020)

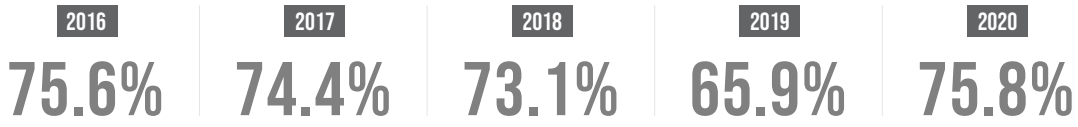


Table H55: Five-Year Mean Compliance Rate from Outcomes of Periodic Inspections Conducted at Licensed Propane Sites (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	73.2%	None

Table H56: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Inspections Conducted on Licensed Propane Sites (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Readily ignitable materials around container	9.2%
Portable fire extinguisher not installed	5.2%
Piping and tubing not protected with paint or coating	5.0%

Table H57: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Inspections Conducted on Licensed Propane Sites (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Match, candle or flame used to check for propane leak	31.1%
No notification to inspector after occurrence	30.3%
Employee handling propane without certificate	30.3%

Risk of Orders

While the compliance rate provides an outcome of the periodic inspection (e.g., pass nor fail), the inspection risk spectrum (shown as pie charts) portrays the potential safety risks associated with non-compliance. The dark red segments of the spectrums show unacceptable levels of risk.

Figure H21: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted on Licensed Propane Sites (2016 – 2020)

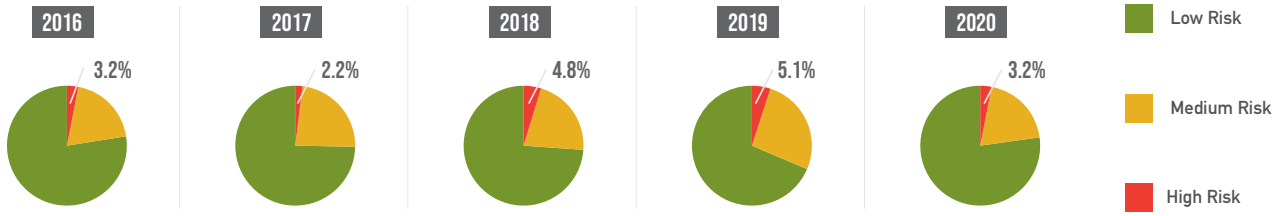


Table H58: Inspection Risk Spectrum from Outcomes of Periodic Inspections Conducted at Licensed Propane Sites (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	3.2%
Minor Issues	21.6%
Fully Compliant	75.2%

Some typical examples of minor issues include: missing signage; unpainted steel tanks; readily ignitable materials including vegetation being too close to containers, inadequate fencing, and licences not being displayed.

In the spirit of continuous improvement of TSSA's risk-based inspection scheduling, TSSA is heeding the advice of the Auditor General of Ontario, which noted that information used in Risk and Safety Management Plans (RSMPs) could also be used to inform inspection frequencies. For example, RSMPs list the land usage surrounding propane facilities. As such, the risk threshold for facilities in high density residential zones is 10% of that in remote/industrial locations and the threshold near sensitive receptors is 3% of the industrial threshold. In this way, TSSA can target inspection resources to facilities with the greatest potential for harm.

Fuels Contractors

Heating Contractors

Compliance

TSSA conducts periodic audits on heating contractors in the province of Ontario to oversee and manage their state of compliance. The compliance rate is defined as the percentage of heating contractor audits with no orders issued compared to the total number of heating contractor audits.

Figure H22: Yearly Compliance Rates from Outcomes of Periodic Audits Conducted on Heating Contractors (2016 – 2020)

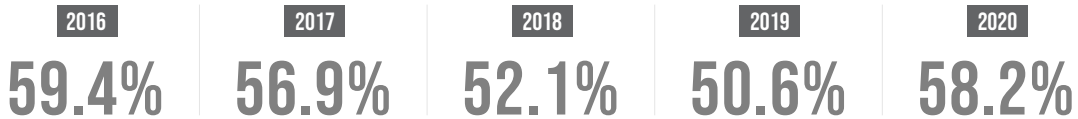


Table H59: Five-Year Mean Compliance Rate from Outcomes of Periodic Audits Conducted on Heating Contractors (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	55.3%	-2.2%

Table H60: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Audits Conducted on Heating Contractors (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Unacceptable condition - no immediate hazard	25.5%
Equipment not installed per manufacturer's certified instructions	9.2%
Equipment not installed per Code requirements	3.8%

Table H61: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Audits Conducted on Heating Contractors (2016 – 2020)

EQUIPMENT NOT INSTALLED PER CODE REQUIREMENTS	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Equipment not installed per Code requirements	21.6%
Tag is missing after pressure test	9.8%
Equipment not installed per manufacturer's certified instructions	3.4%

Risk of Orders

While the compliance rate provides an outcome of the periodic audit (e.g., pass nor fail), the audit risk spectrum (shown as pie charts) portrays the potential safety risks associated with non-compliance. The dark red segments of the spectrums show unacceptable levels of risk.

Figure H23: Audit Risk Spectrum from Outcomes of Periodic Audits Conducted on Heating Contractors (2016 – 2020)

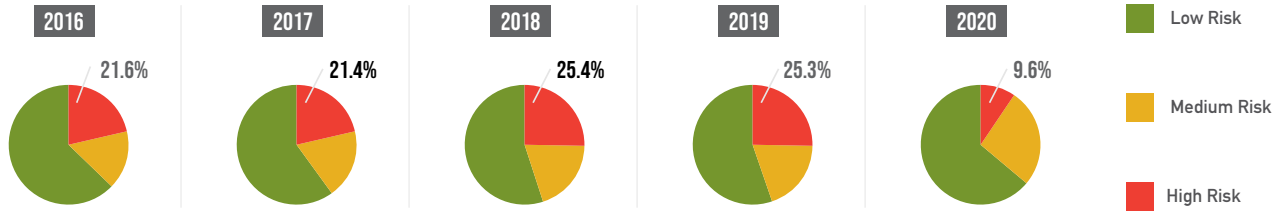


Table H62: Inspection Risk Spectrum from Outcomes of Periodic Audits Conducted on Heating Contractors (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	9.6%
Minor Issues	32.1%
Fully Compliant	58.3%

Some typical examples of minor issues include: the registration not being displayed in a conspicuous location; equipment not being installed per manufacturer's instructions; use of unapproved equipment; drip or dirt pockets not readily accessible for cleaning; and the installer not leaving the manufacturer's instructions with the user.

Petroleum Contractors

Compliance

TSSA conducts periodic audits on petroleum contractors in the province of Ontario to oversee and manage their state of compliance. The compliance rate is defined as the percentage of petroleum contractor audits with no orders issued compared to the total number of petroleum contractor audits.

Figure H24: Yearly Compliance Rates from Outcomes of Periodic Audits Conducted on Petroleum Contractors (2016 – 2020)

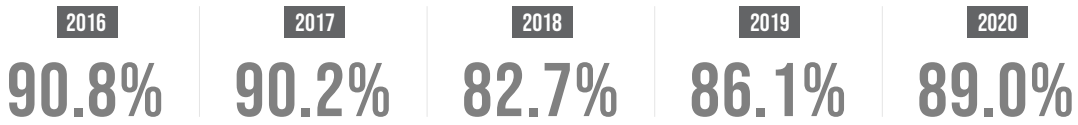


Table H63: Five-Year Mean Compliance Rate from Outcomes of Periodic Audits Conducted on Petroleum Contractors (2016 – 2020)

DESCRIPTION	FISCAL YEAR 2016 – 2020	TREND (PER YEAR)
Compliance Rate (Mean)	87.2%	None

Table H64: Top Compliance Issues by Number of Orders Issued from Outcomes of Periodic Audits Conducted on Petroleum Contractors (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL NUMBER OF ORDERS ISSUED
Above ground storage tank not protected from vehicular impact	5.9%
Combustible materials around dispenser	5.9%
Vehicle not clearly marked	5.3%

Table H65: Top Compliance Issues by Risk of Orders Issued from Outcomes of Periodic Audits Conducted on Petroleum Contractors (2016 – 2020)

COMPLIANCE ISSUE	PERCENTAGE OF TOTAL RISK OF ORDERS ISSUED
Contractor not registered	28.7%
No notification of unacceptable condition	20.7%
Employees not being instructed to comply with Act and Regulation	16.6%

Risk of Orders

While the compliance rate provides an outcome of the periodic audit (e.g., pass nor fail), the audit risk spectrum (shown as pie charts) portrays the potential safety risks associated with non-compliance. The dark red segments of the spectrums show unacceptable levels of risk.

Figure H25: Audit risk spectrum from outcomes of periodic audits conducted on petroleum contractors (2016 – 2020)

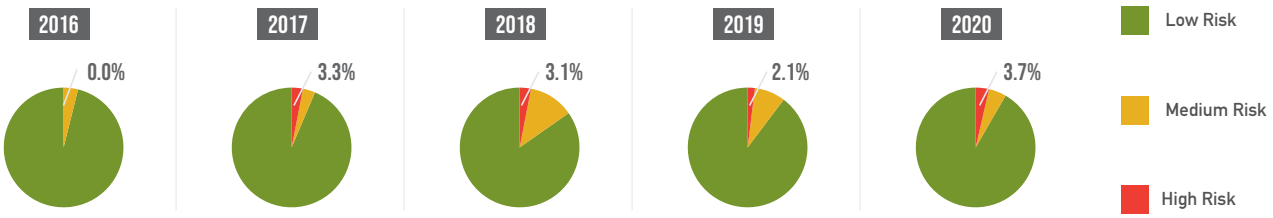


Table H66: Inspection Risk Spectrum from Outcomes of Periodic Audits Conducted on Petroleum Contractors (2020)

INSPECTION RISK SPECTRUM	FISCAL YEAR 2020
Major Issues	3.7%
Minor Issues	7.3%
Fully Compliant	89.0%

Some examples of minor issues included: aboveground storage tanks not being permanently marked; aboveground storage tanks not being protected against vehicular impact; contractor vehicles not being marked with the name and registration number; missing signage; and, the application for licence renewal being made after it had already expired.

Inspection and Re-Inspection Results

The table below contains numbers and types of inspections, as well as re-inspection results. "Pass" nor "Fail" was based on the outcome status of an inspection. "Other" was a group of inspection outcomes that included either non-mandated outcomes, outcomes that were neither pass nor fail (such as validating installed base statuses or occurrence inspections), and various other miscellaneous statuses. "Other" outcomes were not included in the pass rate. There are subtle differences between the pass rate used in this appendix and the compliance rate used in the main body of the report, which can result in small differences between the two numbers.

Table H67: Fuels Inspection and Re-Inspection Results (2020)

INSPECTION TYPE	PASS	FAIL	OTHER	GRAND TOTAL	PASS RATE (%)
Ad Hoc/Unscheduled Inspections	1,034	711	0	1,745	59.3%
Alteration Inspections	10	1	0	11	90.9%
Complaint Inspections	468	68	0	536	87.3%
Initial Inspections	3,659	475	20	4,154	88.5%
Non-Mandated/Non-Regulated Inspections	0	0	596	596	N/A
Occurrence Inspections	0	0	3,616	3,616	N/A
Other Inspections	825	3,526	41	4,392	19.0%
Periodic Inspections	2,361	1,108	18	3,487	68.1%
Re-Inspections	1,751	1,805	39	3,595	49.2%
Fuels Total	10,108	7,694	4,330	22,132	56.8%

Legislation and Regulatory Information

Table H68: TSSA Fuels Legislation and Regulatory Information (2020)

LEGISLATION AND REGULATORY INFORMATION AS OF 2020	LATEST REVISION
Oil and Gas Pipeline Systems	
Ontario Regulation 210/01: Oil and Gas Pipeline Systems	2001
Ontario Regulation 210/01: Director's Order	2001
Oil and Gas Pipeline Systems CAD Amendment FS-238-18	2018
Propane Storage and Handling	
Ontario Regulation 211/01: Propane Storage and Handling	2015
Ontario Regulation 197/14: Liability Insurance Requirements for Propane Operators	2016
Propane CAD Amendment FS-224-17	2017
Gaseous Fuels	
Ontario Regulation 212/01: Gaseous Fuels	2015
Ontario Regulation 212/01: Director's Order	2001
Gaseous Fuels CAD Amendment FS-225-17	2017
Mobile Food Service Equipment Code TSSA-MFSE-2014	2014
Field Approval Code TSSA-FA-2016	2016
Digester, Landfill and Bio-Gas Code TSSA-DLB-2016	2016
Fuel Oil	
Ontario Regulation 213/01: Fuel Oil	2001
Ontario Regulation 213/01: Director's Order	2001
Fuel Oil CAD Amendment FS-219-16	2016
Compressed Gas	
Ontario Regulation 214/01: Compressed Gas	2007
Compressed Gas CAD Amendment FS-143-09	2009
Liquid Fuels	
Ontario Regulation 217/01: Liquid Fuels	2001
Ontario Regulation 217/01: Director's Order	2001
Liquid Fuels CAD Amendment FS-235-18	2019
Minister's Exemption Liquid Fuels Regulation 217/01	2020
Requirements for Contractors	
Ontario Regulation 216/01: Certification of Petroleum Equipment Mechanics	2008
Ontario Regulation 215/01: Fuel Industry Certificates	2015
Amendment to Ontario Regulation 215/01 - CDT Activation (Ontario Regulation 184/03)	2003

During this fiscal year, there were no Fuels director's orders, bulletins or guidelines issued. The following advisories were issued:

- FS-245-19 – Mobile Fueling Operations;
- FS-247-19 – Introduction of TSSA's Fuel Oil Distributor Audit Program;
- FS-248-20 – Revision of TSSA's Fuels Heating Contractor Audit Program; and
- FS-249-20 – Single-Wall Underground Equipment.

Visit www.tssa.org for a comprehensive listing of legislation and regulatory information.