



Designation: F2783 – 14

Standard Practice for Design, Manufacture, Operation, Maintenance, and Inspection of Amusement Rides and Devices, in Canada¹

This standard is issued under the fixed designation F2783; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

Note—This ASTM Standard has been developed to replace CAN/CSA Z267-00 (R2011), which is being withdrawn as an active CSA Standard.

INTRODUCTION

The Canadian Standards Association (CSA) and the American Society for Testing Materials (ASTM) have paved the way for the development of new ASTM amusement device standards, introducing uniform safety criteria for both Canada and the United States of America.

Seeking to gain a level of consistency and eliminate much duplication, CSA and ASTM struck a subcommittee to develop a new ASTM F24 standard, a comprehensive, one-volume document, that provides a mechanism to:

- adapt F24 standards to Canadian needs;
- provide greater two way communication between CSA and ASTM; and
- facilitate adoption by Canadian provinces and territories.

This one-source standard replaces the current CSA Z267 Safety Code for Amusement Rides and Devices. As CSA Z267 was primarily based on the ASTM F24 Family of Standards, Practice F2783 is a realignment of those core essentials with new sections tailor-made for Canada. Categorized in four distinct sections, the standard includes:

- **Core Standards** (for example, Terminology, Design, Manufacture, Operation, Maintenance, and Inspection);
- **Supporting Standards** (for example, Measuring Ride Dynamics and Hardness of Composite Foam);
- **Specific Classification of Amusement Rides and Devices Standards** (for example, Go-Karts, Water Slides, Inflatables and Trains); and
- **Unclassified Amusement Rides and Devices Standard** (for example, Zip Lines, Bungee Type Devices, Gravity or Patron Controlled Non-mechanical Spherical Devices and Extreme Thrill Devices).

This standard is structured such that Section 2.1 listings of Core Standards capture the essential and broad safety requirements for all amusement rides and devices. Section 2.2 listings of Supporting Standards are intended to complement in design of all amusement rides and devices where applicable. Section 2.3 listings of Specific Classification of Amusement rides and Devices Standards capture supplemental requirements in addition to Core Standards for anomalous amusement rides and devices. Section 2.4 listing of Unclassified Amusement Rides and Devices Standards captures general essential safety requirements for new amusement rides or devices that have yet to be regulated but have recently appeared within the public domain for use in conjunction with Core Standards and Supporting Standards.

To provide greater application within Canada, Practice F2783 also incorporates specific sections that include: Standards Cross Referencing Table; Substitutions; Exceptions; and Additional Requirements.

This unique initiative would not have been possible were it not for the active collaboration of the CSA Z267 and the ASTM F24.80 Harmonization Committees, representative of a diverse stakeholder base, including delegates from government (regulators), manufacturers, engineers, park owners/operators as well as general and consumer interests.

Practice F2783 is supported by Canadian provincial and territorial regulators and amusement device stakeholders, the International Association of Amusement Parks and Attractions (IAAPA), CSA and ASTM.

This standard has been printed in Canada's two official languages.

1. Scope

1.1 This practice applies to the terminology, design, manufacture, operation, maintenance, and inspection of amusement rides and devices in Canada.

1.2 This practice adopts ASTM Committee F24 Standards listed under Sections 2.2, 2.3 and 2.4.

1.3 This practice includes an annex (mandatory), which provides additional information (for example, rationale, background, interpretations, drawings, commentary, etc.) related to the application of the criteria presented in this practice.

1.4 This practice includes an appendix (non-mandatory), which provides additional information (for example, rationale, background, interpretations, drawings, commentary, and so forth) to improve the user's understanding and application of the criteria presented in this practice.

1.5 It is the responsibility of the users of this practice and other ASTM Standards to judge their suitability for a particular purpose.

1.6 This practice includes the following sections:

Title	Section
Scope	1
Referenced Documents	2
ASTM Committee F24 Core Standards for Amusement Rides and Devices	2.2
ASTM Committee F24 Supporting Standards for Amusement Rides and Devices	2.3
ASTM Committee F24 Standards for Specific Classification of Amusement Rides and Devices	2.4
Reference Codes, Standards, Specifications, and Handbooks	2.6
Terminology	3
Significance and Use	4
Design	5
General	5.1
Substitution of Referenced Documents in Practice F2291 with Alternate Documents	5.3
General	5.3.1
Canadian Standards	5.3.2
Exceptions from Practice F2291	5.4
Additional Requirements	5.5
Manufacture	6
Ownership, Operation, Maintenance, and Inspection	7
Exceptions from Practice F770	7.3
Additional Requirements	7.4
Auditing of Amusement Rides and Devices	8
Recognized Certification Marks	Annex A1
Significance and Use	Appendix X1
Hardness Measurement of Patron Seat and Restraint Padding	Appendix X2

1.7 For a glossary of terms that includes the meaning and intent of words such as shall, should, may, will, standard, practice, guide, classification, specification, etc. used in ASTM standards, please refer to “Form and Style for ASTM Standards,” which is available at www.astm.org.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate*

appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 The documents listed in 2.2, 2.3 and 2.4 contain provisions, which through reference in this standard, constitute provisions of this practice.

NOTE 1—For undated references, the latest edition of the referenced document applies. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, users of this practice are encouraged to investigate the possibility of applying the most recent editions of documents referenced below.

- 2.2 *Core Standards for Amusement Rides and Devices:*²
- F747 Terminology Relating to Amusement Rides and Devices
 - F770 Practice for Ownership, Operation, Maintenance, and Inspection of Amusement Rides and Devices
 - F1193 Practice for Quality, Manufacture, and Construction of Amusement Rides and Devices
 - F2291 Practice for Design of Amusement Rides and Devices
 - F2974 Guide for Auditing Amusement Rides and Devices

2.3 *Supporting Standards for Amusement Rides and Devices:*²

- F1957 Test Method for Composite Foam Hardness—Durometer Hardness
- F2137 Practice for Measuring the Dynamic Characteristics of Amusement Rides and Devices
- F2375 Practice for Design, Manufacture, Installation and Testing of Climbing Nets and Netting/Mesh used in Amusement Rides, Devices, Play Areas and Attractions

2.4 *Standards for Specific Classification of Amusement Rides and Devices:*²

- F2007 Practice for Design, Manufacture, and Operation of Concession Go-Karts and Facilities
- F2374 Practice for Design, Manufacture, Operation, and Maintenance of Inflatable Amusement Devices
- F2376 Practice for Classification, Design, Manufacture, Construction, and Operation of Water Slide Systems

2.5 *Other Standards:*

- D785 Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
- D2240 Test Method for Rubber Property—Durometer Hardness

2.6 *Reference Codes, Standards, Specifications, and Handbooks:*

NOTE 2—Table 1 provides cross-references of document(s) acceptable in lieu of specific editions of codes, standards, specifications, and handbooks referenced in standards from ASTM Committee F24 on Amusement Rides and Devices. Only that portion of the codes, standards, specifications and handbooks as specified by the requirements of this standard is applicable.

¹ This practice is under the jurisdiction of ASTM Committee F24 on Amusement Rides and Devices and is the direct responsibility of Subcommittee F24.80 on Harmonization.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Cross-References of Documents

Reference Documents in ASTM F24 Committee Standards		Alternate Acceptable Documents in Canada	
ASTM Standards Reference Source	Designation (Publisher)	Title	Title
F1193	ANSI/AWS D1.1/D1.1M	Structural Welding Code - Steel	Certification of Companies for Fusion Welding of Steel Welded Steel Construction (Metal Arc Welding)
F1193	E543 (ASTM) or ASNT SNT-TC-1A	Standard Specification for Agencies Performing Nondestructive Testing Topical Outlines for Qualification of Nondestructive Testing Personnel	Nondestructive Testing: Qualification and Certification of Personnel
F2291	STP-1330 (ASTM)	Composite Materials: Fatigue and Fracture, 7th Volume	None
F2291	301 (ACI)	Specifications for Structural Concrete	NBCC (NFRC)
F2291	318 (ACI)	Building Code Requirements for Structural Concrete (318) and Commentary (318R)	NBCC (NFRC)
F2291	NDS 2005 (AF&PA - American Wood Council); or USDA-72 (US Department of Agriculture); or 16 (ASCE)	National Design Specification for Wood Construction; or The Wood Handbook – Wood As An Engineering Material, Forest Service, Forest Products Laboratory; or Standard for Load and Resistance Factor Design (LRFD) for Engineered Wood Construction	O86 (CSA)
F2291	316 (AISC)	Manual of Steel Construction, Allowable Stress Design (ASD)	(CISC) & S16 (CSA)
F2291	M015 (AISC)	Manual on Steel Construction, Load & Resistance Factor Design (LRFD)	(CISC) & S16 (CSA)

Comments

Refer to **5.4.4** for additional information. CSA W47.1 and CSA W59 together are acceptable to ANSI D1.1

For all NDT Personnel:
Natural Resources Canada (NRCan), through the CANMET Materials Technology Laboratory (MTL), is the Certifying Agency for the Canadian Non-Destructive Testing (NDT) Personnel Certification Program. NRCan certifies individuals according to the Canadian General Standards Board Standard CAN/CGSB-48.9712 (Qualification and Certification of Non-Destructive Testing Personnel).
For NDT of Welding to CSA W47.1:
In Canada, the CWB (Canadian Welding Bureau) is the Certification Body for the administration of CSA Standard W178:
1) NDT shall be conducted by organization certified to W178.1-08 – Certification of Welding Inspection Organizations.
2) NDT shall be conducted by individual certified to W178.2-08 – Certification of Welding Inspectors.

Publication STP-1330 contains papers presented at the Seventh Symposium on Composite Materials, and Fatigue and Fracture. See also **5.3.2.6**.

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TABLE 1 Continued

Reference Documents in ASTM F24 Committee Standards		Alternate Acceptable Documents in Canada			
ASTM Standards Reference Source	Designation (Publisher)	Title	Designation (Publisher)	Title	Comments
F2291	360-05 (ANSI/AISC)	Specifications for Structural Steel Buildings	(CISC) & S16 (CSA)	Limit States Design in Structural Steel Eighth Edition, and Design of steel structures	AISC 360, the CISC LSD publication, and CSA S16 are to be used in conjunction with the section on loads and strengths in Practice F2291 . None
F2291	Y32.10 (ANSI)	Graphic Symbols for Fluid Power Diagrams	None	None	None
F2291	T2.24.1 (NFPA)	Hydraulic fluid power—Systems standard for stationary industrial machinery—Supplement to ISO 4413:1998—Hydraulic fluid power	None	None	None
F2291	B11.TFR3 (ANSI)	—General rules relating to systems Risk Assessment and Risk Reduction—A Guide to Estimate, Evaluate, and Reduce Risks Associated with Machine Tools	None	None	This technical report is intended to complement the topic about Ride Analysis covered in Practice F2291 .
F2291	B77.1 (ANSI)	Passenger Ropeways—Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors—Safety Requirements	Z98 (CSA)	Passenger ropeways and passenger conveyors	See also 5.4.3 .
F2291	7 (ASCE/SEI)	Minimum Design Loads for Buildings and Other Structures	NBCC (NPRCC)	National Building Code of Canada	ASCE 7 and the NBCC are to be used in conjunction with the section on loads and strengths in Practice F2291 .
F2291	(ASM)	ASM Atlas of Fatigue Curves and ASM Handbook Volume 19: Fatigue and Fracture	None	None	The ASM Atlas and the ASM Handbook are intended to complement the topic about fatigue strength of mechanical and structural components.
F2291	BPVC (ASME)	ASME Boiler and Pressure Vessel Code	B51 (CSA)	Boiler, pressure vessel, and pressure piping code.	Accumulators shall be constructed in accordance with Section 8, Division 1 of the ASME Boiler and Pressure Vessel Code for unfired pressure vessels, or equivalent. None
F2291	B15.1 (ASME)	Safety Standards for Mechanical Power Transmission Apparatus	None	None	This standard may be applicable where elevator and escalator technology is used in the design of amusement rides or devices.
F2291	ASME A17.1-2010/CSA B44-10 (ASME/CSA)	Safety Code for Elevators and Escalators	ASME A17.1-2010/CSA B44-10 (ASME/CSA)	Safety code for elevators and escalators	See also 5.4.4 . Note: CSA W47.1 and CSA W59 together are acceptable as an equivalent to AWS D1.1.
F2291	D1.1/D1.1M (ANSI/AWS)	Structural Welding Code—Steel	W47.1 (CSA) W59 (CSA)	Certification of companies for fusion welding of steel Welded steel construction (metal arc welding)	See also 5.4.4 .
F2291	D14.4 (ANSI/AWS)	Specification for Welded Joints in Machinery and Equipment	W59 (CSA)	Welded steel construction (metal arc welding)	See also 5.4.4 .
F2291	D1.1/D1.1M (ANSI/AWS)	Structural Welding Code – Steel	W178.1 (CSA) W178.2 (CSA)	Certification of welding inspection organizations Certification of welding inspectors	None
F2291	BS 5400-10 (BSI) and BS 7608 (BSI)	Steel, Concrete and Composite Bridges—Code of Practice for Fatigue Design and Assessment of Steel Structures	None	None	BS 5400 and BS 7608 are intended to complement the topic about fatigue strength of mechanical and structural components.
F2291	International Building Code (ICC)	International Building Code Chapter 16, “Structural Design”	NBCC (NPRCC)	National Building Code of Canada	The International Building Code and the NBCC are to be used in conjunction with the section on loads and strengths in Practice F2291 .

TABLE 1 Continued
 Alternate Acceptable Documents in Canada

ASTM Standards Reference Source	Designation (Publisher)	Title	Designation (Publisher)	Title	Comments
F2291	Growth Charts (CDC) J833 (SAE) The MIT Press, Cambridge, MA, USA The MIT Press, Cambridge, MA, USA (CISC)	Basic Body Measurements Human Physical Dimensions Human Scale 4/5/6, Bardagly, J., Diffrient, N., and Tilley, A., 1981 Human Scale 7/8/9, Bardagly, J., Diffrient, N., and Tilley, A., 1982	None 3411 (ISO) Tilley, A. R., Henry Dreyfuss & Associates.	None Earth-moving machinery – Physical dimensions of operators and minimum operator space envelope. The measure of man and woman: Human factors in design None	SAE J833 has been superseded by ISO 3411. Human Scale 4/5/6 and 7/8/9 books are no longer published.
F2291	(CISC)	Hollow Structural Section Connection and Trusses—A Design Guide	None	Human factors in design	This document is referenced for the purpose of its application for design of structure using hollow structural section.
F2291	1055 (DIN) 1055-100 (DIN)	Actions on structures, Parts 1–7 Load combinations	NBCC (NRC)	National Building Code of Canada	DIN 1055 and DIN 1055-100 are to be used in conjunction with the section on loads and strengths in Practice F2291 .
F2291	15018-1 (DIN)	Cranes; Steel Structures; Verification and Analyses Data	None	None	DIN 15018-1 is not specifically referenced in Practice F2291 . It is up to designer/engineer to determine its relevance in Practice F2291 . None
F2291	EN 280 (CEN)	Mobile Elevating Work Platforms –Design Calculations, Stability Criteria, Construction, Safety, Examinations, and Tests	B29-100 (ANSI/ASME)	Precision Power Transmission, Double-Pitch Power Transmission, and Double-Pitch Conveyor Roller Chains, Attachments and Sprockets	
F2291	EN 954-1 (CEN)	Safety of Machinery—Safety Related Parts of Control Systems –General Principles for Design	ISO 13849-1 (ISO)	Safety of machinery—Safety-related parts of control systems –Part 1: General principles for design	ISO 13849 is intended to complement the topic of electrical, electronic, and programmable electronic systems covered in Practice F2291 .
F2291	EN 1050 (CEN)	Safety of Machinery—Principles for Risk Assessment	12100 (ISO)	Safety of machinery – General principles for design – Risk assessment and risk reduction	EN 1050 and ISO 12100 are intended to complement the topic of ride analysis covered in Practice F2291 .
F2291	EN 1991 (CEN) EN 1992 (CEN) EN 1993 (CEN) EN 1994 (CEN) EN 1995 (CEN)	Eurocode 1: Actions on structures Eurocode 2: Design of concrete structures Eurocode 3: Design of steel structures Eurocode 4: Design of composite steel and concrete structures Eurocode 5: Design of timber structures	NBCC (NRC) National Building Code of Canada	National Building Code of Canada	The Eurocodes 1 to 5 and the NBCC are to be used in conjunction with the section on loads and strengths in Practice F2291 .
F2291	EN 60947-1 (CEN)	Low-Voltage Switchgear and Control gear	60947-1 (IEC)	Low-voltage switchgear and control gear—Part 1: General rules	None
F2291	6930 (FM Global)	Flammability Classification of Industrial Fluids	None	None	None
F2291	60204-1 (IEC)	Safety of Machinery—Electrical Equipment of Machines—Part 1: General Requirements	None	None	NFPA 79 is also used for these devices.
F2291	61496-1 (IEC)	Safety of Machinery—Electrosensitive Protective Equipment –General Requirements and Tests	E61496-1 (CSA)	Safety of machinery - electro-sensitive protective equipment – Part 1: General requirements and tests	CAN/CSA-E61496-1 adopted IEC-61496-1 with Canadian deviations.
F2291	61508-1 (IEC)	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems –General Requirements	None	None	IEC 61508-1 is Part 1 of a series of standards on safety related control systems. It is used commonly for testing and certification of electrical, electronic, and programmable electronic systems.

TABLE 1 Continued

Reference Documents in ASTM F24 Committee Standards			Alternate Acceptable Documents in Canada		
ASTM Standards Reference Source	Designation (Publisher)	Title	Designation (Publisher)	Title	Comments
F2291	61511 (IEC)	Functional Safety: Safety Instrumented Systems for the Process Industry Sector	None	None	IEC 61511 relates primarily to instrumentation used in the process industry sector.
F2291	62061 (IEC)	Safety of Machinery-Functional Safety—Electrical, Electronic, and Programmable Electronic Control Systems	None	None	IEC 62061 plays an increasing role in the achievement of overall machine safety as a result of automation, demand for increased production and reduced operator physical effort. See 8.2.2.7 of ISO 4113.
F2291	4113 (ISO)	Road Vehicles – Calibration Fluid for Diesel Injection Equipment	None	None	See 8.2.2.7 of ISO 4113.
F2291	4413 (ISO)	Hydraulic fluid power – General rules relating to systems	None	None	None
F2291	4414 (ISO)	Pneumatic Fluid Power General Rules Relating to Systems	None	None	None
F2291	4406 (ISO)	Particle Count Chart	None	None	None
F2291	6149-1 (ISO)	Connections for hydraulic fluid power and general use – Ports and stud ends with ISO 261 metric threads and O-ring sealing – Part 1: Ports with truncated housing for O-ring seal	None	None	None
F2291	17 (MIL)	The Composite Materials Handbook	None	None	None
F2291	882C (MIL)	System Safety Program Requirements	None	None	MIL 882C is intended to complement the topic of ride analysis covered in Practice F2291.
F2291	250 (NEMA)	Enclosures for Electrical Equipment	C22.2 NO. 94 (CSA)	Special purpose enclosures	None
F2291	79 (NFPA)	Electrical Standard for Industrial Machinery	C22.2 NO. 14 (CSA)	Industrial control equipment	None
F2291	70 (NFPA)	National Electric Code (NEC)	C22.1 (CSA)	Canadian electrical code, part I, safety standard for electrical installations	See also 5.3.2 and 5.3.3.
F2291	101 (NFPA)	Life Safety Code	None	None	None
F2291	B93.114M (ANSI)	Pneumatic Fluid Power—Systems Standard for Industrial Machinery (was NFPA/JIC T2.25.1M)	4414:2010 (ISO)	Pneumatic fluid power – General rules and safety requirements for systems and their components	None
F2291	T2.25.1M (NFPA/JIC)	Pneumatic Fluid Power—Systems Standard for Industrial Machinery	T2.25.1(NFPA/JIC) 4414:2010 (ISO)	Pneumatic fluid power - Systems Standard for industrial machinery - Supplement to ISO 4414:1998 - Pneumatic fluid power - General rules relating to systems	ANSI/(NFPA) T2.25.1 is based upon the provisions of ISO 4414:1998, with certain exceptions as described in ANSI/(NFPA)T2.25.1. The user of ANSI/(NFPA) T2.25.1 will require both of these standards for use on a pneumatic systems application.
F2291	SAE J517	Hydraulic Hose	None	None	None
F2291	SAE J-211	Instrumentation for Impact Test –Electronic Instrumentation	None	None	SAE J211 provides guidelines and recommendations for the techniques of measurement used in impact tests. The aim is to achieve uniformity in instrumentation practice and in reporting test results. Use of this recommended practice will provide a basis for meaningful comparisons of test results from different sources.