ISO 19107:2019-12 (E)

Geographic informa tion - Spatial schema

Contents

Page

Foreword viii

Introduction ix

1 Scope 1

2 Normative references 1

3 Termsanddefinitions 1

4 Symbols, notation and abbreviated terms 17
4.1 Presentation and notation 17
4.1.1 Unified Modeling Language (UML) 17
4.1.2 Naming conventions 17
4.2 Organization 18
4.3 Abbreviated terms and symbols 18

5 Conformance 19
5.1 Requirements class conformance targets 19
5.1.1 Conformance targets 19
5.1.2 Geometry metrics (geodesy) 22
5.1.3 Topological dimensionality 22
5.1.4 Interpolation schemes 22
5.1.5 Structural complexity 23
5.1.6 Functional complexity 24
5.2 Conformance classes 24
5.3 Requirements classes 25

6 Coordinates and core geometry 26
6.1 Semantics 26
6.2 Requirements Class Coordinate 27
6.2.1 Codelists to specify capabilities 27
6.2.2 Coordinate systems for Geometry -- Semantics 27
6.2.3 GeometricReferenceSurface 31
6.2.4 Interface ReferenceSystem 35
6.2.5 Codelist ReferenceSystemTypes 36
6.2.6 Interface CompoundReferenceSystem 36
6.2.7 Interface HomogeneousCoordinateSystem 37
6.2.8 Interface GeometricCoordinateSystem 37
6.2.9 Datatype DirectPosition 42
6.2.10 Union Datatype RSID 44
6.2.11 Codelist Axis 45
6.2.12 Role metadata: AxisDescription 45
6.2.13 Datatype Axis Description 45
6.2.14 Codelist SpatialAxis 45
6.2.15 Codelist SphericalAxis 45
6.2.16 Codelist TemporalAxis 45
6.2.17 Codelist ParametricAxis 46
6.2.18 Codelist Datum 46
6.2.19 Datatype Parameter 47
6.2.20 Datatype Permutation, Projection 47
6.2.21 Interface ReferenceDirection 48

6.2.22 Datatype Bearing 48
6.2.23 Codelist Rotation 50
6.2.24 Codelist RelativeDirection 50
6.2.25 Codelist FixedDirection 50
6.2.26 Codelist CurveRelativeDirection 50
6.2.27 Datatype Vector 51
6.2.28 Interface Envelope 52

6.2.29 Engineering coordinate systems, Tangent spaces and local interpolations 53
6.3 Requirements Class Coordinate Data 53
6.4 Requirements Class Geometry 54
6.4.1 Semantics 54
6.4.2 Interface TransfiniteSetOfDirectPositions 55
6.4.3 CodeList: BoundaryType 55
6.4.4 Interface Geometry 56
6.4.5 Datatype GeometryData 70
6.4.6 CodeList: GeometryType 70
6.4.7 Interface Encoding 70
6.4.8 Interface Query2D 71
6.4.9 Interface Query3D 74
6.4.10 Interface Empty 75
6.4.11 Interface Primitive 76
6.4.12 Datatype PrimitiveData 77
6.4.13 Interface Point 78
6.4.14 Datatype PointData 80
6.4.15 Interface Orientable 80
6.4.16 Datatype OrientableData 81
6.4.17 Datatype Knot 82
6.4.18 Interface Curve 83
6.4.19 DataType CurveData 93
6.4.20 Interface OffsetCurve 93
6.4.21 Datatype OffsetCurveData 94
6.4.22 Interface ProductCurve 94
6.4.23 ProductCurveData 96
6.4.24 CodeList: CurveInterpolation 96
6.4.25 Interface Surface 97
6.4.26 Datatype SurfaceData 101
6.4.27 CodeList: SurfaceInterpolation 101
6.4.28 Interface Solid 101
6.4.29 Datatype SolidData 104
6.4.30 CodeList: SolidInterpolation 104
6.4.31 Interface Collection 105
6.4.32 Role element: Geometry 106
6.4.33 DataType CollectionData 107
6.4.34 Interface Complex 107
6.4.35 Role Complex: generator: Primitive 110
6.4.36 Role Complex: superComplex and subComplex 110
6.5 Requirements Class Geometry Data 111

7 Interpolations for Curves 111
7.1 Requirements Class Line Curve 111
7.1.1 Semantics 111
7.1.2 Interface Line 111
7.1.3 DataType LineData 113
7.2 Requirements Class Line Data 114
7.3 Requirements Class Geodesic Curve 114
7.3.1 Semantics 114
7.3.2 Interface Geodesic 115
7.3.3 DataType GeodesicData 115
7.4 Requirements Class Geodesic Curve Data 115
7.5 Requirements Class Rhumb 116
7.5.1 Interface Rhumb 116

7.5.2 DataType RhumbData 116
7.6 Requirements Class Rhumb Curve Data 117
7.7 Requirements Class Polynomial Curves 117
7.7.1 Semantics 117
7.7.2 Interface RealFunction 118
7.7.3 Interface FunctionArc 118
7.7.4 Association Role function 118
7.7.5 Interface FunctionCurve 119
7.7.6 Interface RealPolynomial 119
7.7.7 Interface PolynomialArc 120
7.7.8 Datatype PolynomialArcData 121
7.7.9 Interface PolynomialCurve 121
7.7.10 DataType PolynomialCurveData 121
7.8 Requirements Class Polynomial Curve Data 121
7.9 Requirements Class Conic Curves 122
7.9.1 Semantics 122
7.9.2 Interface Arc 123
7.9.3 Datatype ArcData 124
7.9.4 Interface Circle 125
7.9.5 Interface Conic 125
7.9.6 Interface EllipticArc, Datatype EllipticArcData 128
7.10 Requirements Class Conic Curve Data 128
7.11 Requirements Class Spiral Curve 128
7.11.1 Semantics, Mathematical background: curves and curvature 128
7.11.2 Interface Spiral Curves 134
7.11.3 Interface Clothoid Curve 136
7.11.4 Datatype SpiralData 136
7.12 Requirements Class Spiral Curve Data 136
7.13 Requirements Class Spline Curve 136
7.13.1 Semantics 136
7.13.2 CodeList: KnotType 137
7.13.3 CodeList: SplineCurveForm 138
7.13.4 Interface SplineCurve 138
7.13.5 Interface PolynomialSpline 141
7.13.6 Interface CubicSpline 142
7.13.7 Interface Bezier 143
7.13.8 Interface BSplineCurve (and NURBS) 144
7.13.9 DataType BsplineData 145
7.14 Requirements Class Spline Curve Data 145

8 Interpolations for Surfaces 145
8.1 Requirements Class Polygon Surface 145
8.1.1 Semantics 145
8.1.2 Interface Polygon 145
8.1.3 Datatype PolygonData 147
8.1.4 Interface PolyhedralSurface 147
8.1.5 Datatype PolyhedralSurfaceData 147
8.1.6 Interface Triangle 147
8.1.7 Datatype TriangleData 148
8.1.8 Interface TriangulatedSurface 148
8.1.9 Datatype TriangulatedSurfaceData 148
8.2 Requirements Class Polygon Surface Data 148
8.3 Requirements Class Parametric Curve Surface 148
8.3.1 Semantics 148
8.3.2 Interface ParametricCurveSurface 149
8.3.3 Datatype ParametricCurveSurfaceData 152
8.3.4 Interface BilinearGrid 152
8.3.5 Extensions of ParametricCurveSurface 153
8.4 Requirements Class Parametric Curve Surface Data 153
8.5 Requirements Class Conic Surface 154
8.5.1 Semantics 154
8.5.2 Interface Sphere 154

8.5.3 Interface Cone 155
8.5.4 Interface Cylinder 155
8.6 Requirements Class Conic Surface Data 155
8.7 Requirements Class Spline Surface 156
8.7.1 Semantics 156
8.7.2 Interface BSplineSurface (and NURBS) 156
8.7.3 Codelist BSplineSurfaceForm 158
8.8 Requirements Class Spline Surface Data 158

9 Interpolations for Solids 158
9.1 Requirements Class Boundary Representation Solid 158
9.2 Requirements Class Boundary Representation Solid Data 159
9.3 Requirements Class Parametric Curve Solid 159
9.3.1 Interface ParametricCurveSolid 159
9.3.2 Interface BSolidSpline 160
9.3.3 Other interpolations 161
9.4 Requirements Class Parametric Curve Solid Data 161

10 Topology 161
10.1 Requirements Class Topology root 161
10.1.1 Semantics 161
10.1.2 Interface Topology 162
10.1.3 Interface Primitive 166
10.1.4 Interface DirectedTopo 168
10.1.5 Datatype TopologyData 170
10.1.6 DataType PrimitiveData 171
10.1.7 DataType ComplexData 171
10.1.8 Datatype Expression 171
10.1.9 Datatype ExpressionTerm 174
10.2 Requirements Class Topology Root Data 174
10.3 Requirements Class Node 174
10.3.1 Semantics 174
10.3.2 Interface Node 174
10.3.3 Interface DirectedNode 175
10.4 Requirements Class Edge 175
10.4.1 Interface Edge 175
10.4.2 Interface DirectedEdge 176
10.5 Requirements Class Face 177
10.5.1 Semantics 177
10.5.2 Interface Face 177
10.5.3 Interface DirectedFace 178
10.6 Requirements Class Topology Solid 178
10.6.1 Interface Solid 178
10.6.2 Interface DirectedSolid 179
10.7 Requirements Class Topological Complex 179
10.7.1 Semantics 179
10.7.2 Interface Complex 179
10.8 Requirements Class Derived Topological Relations 182
10.8.1 Introduction 182
10.8.2 Canonical form for Geometry 183
10.8.3 Boundary operators for aggregate objects 183
10.8.4 Boolean or set operators 185
10.8.5 Egenhofer operators 186
10.8.6 Full topological operators 187
10.8.7 Combinations 190

11 Special Requirements Classes 190
11.1 Requirements Class Simplicial geometry 190
11.1.1 Semantics 190
11.1.2 Datatype Simplex 191
11.1.3 DataType SimplicialTerm 193
11.1.4 DataType::SimplicialPolynomial 193

11.1.5 DataType::SimplicialComplex 193
11.2 Requirements Class Point Clouds 193
11.2.1 Semantics 193
11.2.2 Interface PointCloud 194

Annex A (normative) Abstract test suite 196

Annex B (informative) Examples for application schemas 211

Annex C (informative) MiniTopo 215

Annex D (informative) Crosswalk 19107:2003 to current version 220

Bibliography 223