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Clothing — Digital fittings — Vocabulary and terminology used for the virtual garment

Habillement — Essayage virtuel — Vocabulaire et terminologie utilisés pour les vêtements virtuels

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Contents

Page

Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 133, *Clothing sizing systems — Size designation, size measurement methods and digital fittings*.

Introduction

This International Standard deals with virtual garments for digital fitting.

Various types of virtual garment-based IT/fashion convergence technology are being attempted today, in response to the rapid development of the vast online fashion market, including the internet, smart phones, smart TVs, and virtual fittings at bricks-and-mortar stores. Meanwhile, the increased demand for ubiquitous fashion business services is encouraging efforts to innovate with regard to the traditional processes of planning, production and sales. The use of digital technology in the modern international apparel industry is leading to the use of three-dimensional information for fashion products. These products reflect appearance, design and texture characteristics of garments. It is envisaged that consumers will be able to go online anytime, anywhere, to try on clothes, evaluate the style and fit and place orders. Despite such advances, there is no International Standard related to virtual garments.

The purpose of this International Standard is to specify the data attributes and formats required for the creation of virtual garments, facilitating clear and synchronized communication of terminology.

This International Standard provides a platform that unifies specified vocabulary and terminology for the development of virtual garment systems. In addition, online consumers, fashion designers, manufacturers and retailers will be able to become familiar with and make use of this vocabulary.

NOTE Measurements of the body and garments are in millimetres (mm). Upward direction corresponds to the +y-axis (height), a leftward direction to the +x-axis (width), and a forward direction to the +z-axis (depth). The origin of body and garment is X = 0, Y = 0, Z = 0 in local coordinates; the common import/export formats for body and garment is dxf format.

Clothing — Digital fittings — Vocabulary and terminology used for the virtual garment

1 Scope

This International Standard defines the terms that are commonly used for the digital fitting system. The digital fitting system includes virtual fabric, virtual fabric properties, virtual garment pattern, virtual garment pattern properties, virtual sewing line, virtual garment, and virtual garment simulation of a virtual garment on a virtual human body model for fit assessment.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1 General terms

2.1.1 Virtual fabric

2.1.1.1
virtual fabric attribute
virtual fabric attribute characteristic of virtual fabric

EXAMPLE Tensile modulus, bending rigidity, shear resistance, thickness, weight.

Note 1 to entry: Refer to ISO 5084, ISO 13934-2, ISO 14087, and ISO 14273.

Note 2 to entry: It can be retrieved from library or imported.

2.1.2
virtual garment pattern
shapes consisting of closed curves that mark the area of a digitized pattern to be used on the *virtual garment* (2.1.3)

Note 1 to entry: The example of a virtual garment pattern is shown in Figure 1.

2.1.2.1
virtual garment pattern properties
pattern consisting of contours and multiple *internal lines* (2.2.1.3), which are used to express seams, internal openings, fold lines and other garment characteristics

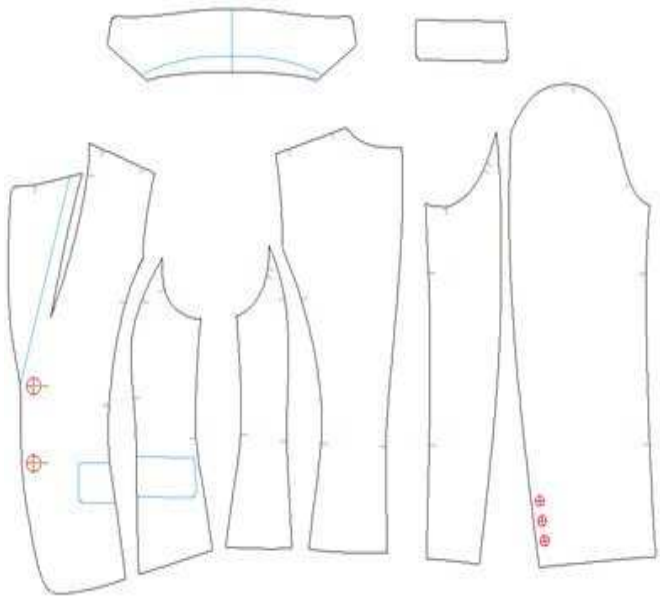


Figure 1 — Example of virtual garment pattern (jacket)

2.1.2.2
virtual sewing line
virtual line segment used to assemble patterns

Note 1 to entry: An example of virtual sewing is shown in Figure 2.

Note 2 to entry: For each pair of patterns to be sewn together, a pair of virtual sewing line segments is defined. The pattern pieces are then arranged in a space and the *points* (2.2.1.1) on each pair of line segments are pulled together through physical simulation. This process is repeated to join the pieces and create a *virtual garment* (2.1.3).

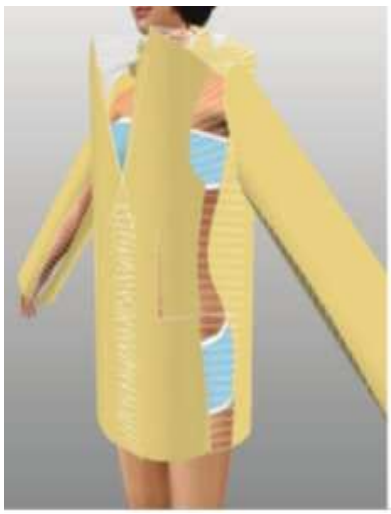


Figure 2 — Virtual sewing

2.1.3
virtual garment
three-dimensional clothing in digital form that exists in virtual space

Note 1 to entry: An example of a virtual garment is shown in Figure 3. An example of notation of virtual garment information is shown in Annex A. An example of data structure of virtual garment model is shown in Annex B.

Figure 3 — Example of virtual garments

2.1.4
virtual garment simulation
creation and drape simulation of a *virtual garment* (2.1.3) for a virtual human body using a *virtual garment pattern* (2.1.2), virtual sewing and bounding volume

Note 1 to entry: An example of clothing simulation is shown in Figure 4.

Figure 4 — Garment simulation

2.1.5
digital fitting
qualitative and/or quantitative evaluation of overall and/or specific simulation of garment fit through the analysis of the garment balance, gap between body and garment (which includes cross sections), heat map, surface wrinkles, etc.

Note 1 to entry: Digital fitting may be used for many different areas of application of *virtual garments* (2.1.3), such as product development, marketing, etc.

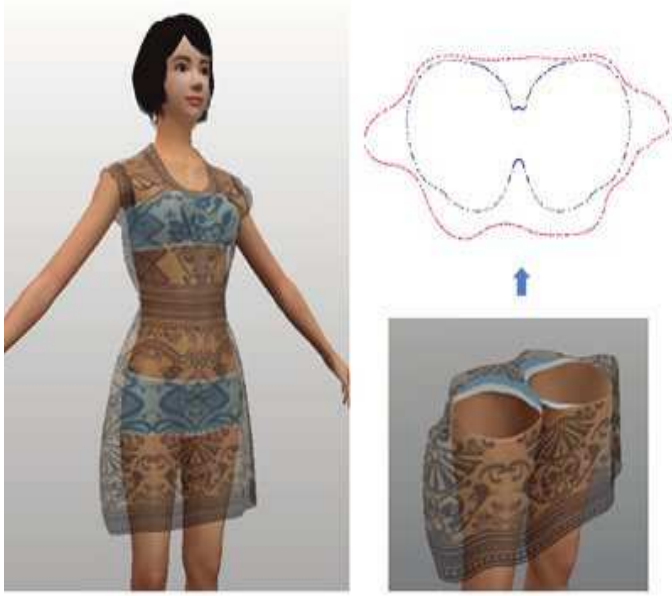


Figure 5 — Digital fitting

Figure 6 — Example of visualization of gap using pattern strain using colour scale

2.1.5.1
garment balance
status of garment that hangs in the correct relationship with the virtual human body's size, contour and posture

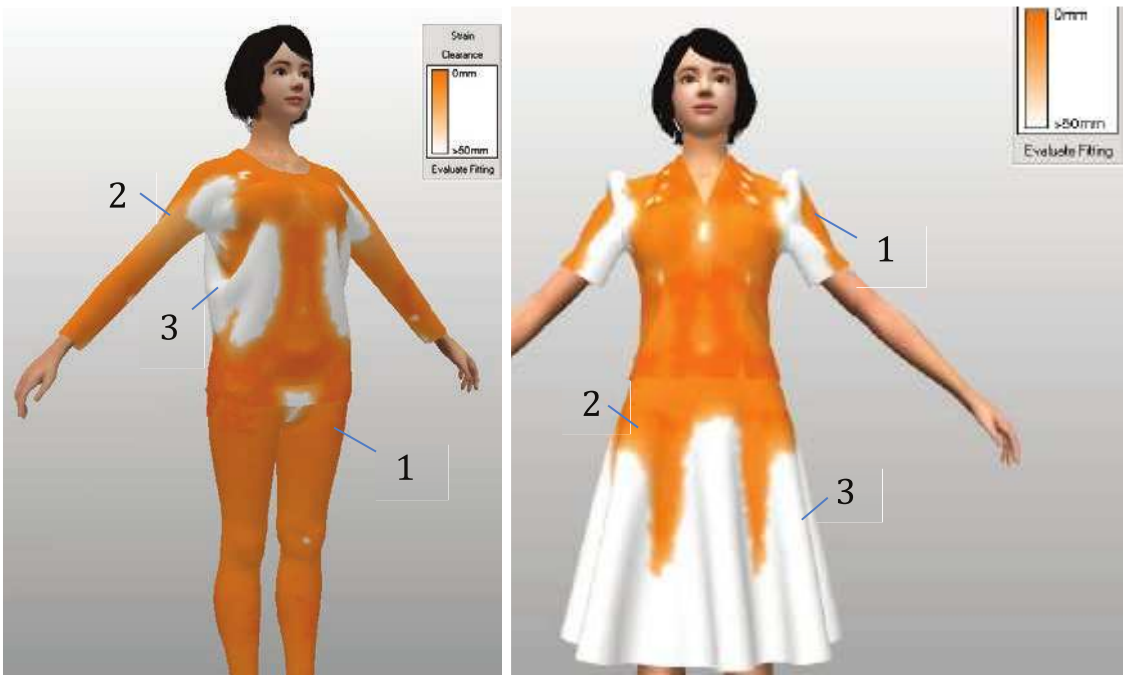
Note 1 to entry: The balance of a garment is usually determined by the hemline being parallel to the ground unless the hemline is asymmetrical. The balance is correct when the centre back, centre front lines and side seams are perpendicular to the ground.

2.1.5.2
pattern strain
amount of deformation caused on a garment pattern in the drape simulation process

Note 1 to entry: Pattern strain can be visualized in different ways. For example, pattern strain can be visualized through a surface colour map where the colour is darker as the strain increases and vice versa. White indicates zero strain.

2.1.5.3
gap
distance between a *point* (2.2.1.1) on a *virtual garment* (2.1.3) and the virtual human body

Note 1 to entry: Gap can be expressed through horizontal or vertical slices indicating the relationship between body and garment, or through the distance between a point on a virtual garment and the virtual human body, etc. Gap can be visualized as colour (heat) map. Colour becomes darker as the gap increases and vice versa. The colour scale can vary according to the type of software.



Key
1 tight
2 appropriate
3 loose

Figure 7 — Example of visualization of gap using colour scale

2.2 Terms relating to basic composition and attributes

2.2.1 Composition of virtual garment pattern (refer to Annex A and Annex B)

2.2.1.1
point
point on a *virtual garment pattern* (2.1.2) indicating the notch point, sewing point, button, button position and grade point

2.2.1.2
outline
closed loop of lines necessary to form the contour of a pattern piece

2.2.1.3
internal line
lines that are not part of the *outline* (2.2.1.2)

2.2.2 Attributes of virtual garment patterns

2.2.2.1
layer order
sequence of layers of a *virtual garment pattern* (2.1.2) from the body in a multi-layered *virtual garment* (2.1.3)

Note 1 to entry: Lower layer numbers are simulated closer to the body, and it is impossible to wear identical layer numbers simultaneously.

2.2.2.2
layer structure
different structural layers in one item of clothing, such as lining or interfacing inside a jacket

2.2.2.3
sewing order
sequence in which virtual sewing takes place

2.2.2.4
mechanical property
property of a virtual fabric in drape simulation that differs from properties of a real fabric

Note 1 to entry: A virtual fabric uses a cloth physics model to simulate the physical properties of a material which may include tensile modulus, bending rigidity, shear resistance, etc. in warp and weft (refer to ISO 5084, ISO 13934-2, ISO 14087 and ISO 14273).

Note 2 to entry: There are several methods for representing mechanical properties of virtual fabric, such as orderly structure of particles with concentrated mass, rod-based model for knitted fabrics, etc.

2.2.2.5
surface appearance
texture maps and texture functions of light scattering from image-based models or procedural models for rendering the appearance of different materials in different lighting conditions

Note 1 to entry: For the texture mapping, texture image used for the visualization of textile design or additional surface characteristics, such as trimmings, buttons, zippers, etc. An example of a texture mapping is shown in Figure 8.

Note 2 to entry: More sophisticated surface features such as fine wrinkles, woven structures and fur can be expressed by combining other types of texture maps.

Figure 8 — Examples of virtual garment texture mapping

2.2.3
mesh structure of virtual garment patterns
areas of the *virtual garment pattern* (2.1.2) divided into polygonal elements as the basic element for physical calculation during clothing simulation

2.2.4
spatial arrangement of virtual garment patterns
information on location of pattern on a bounding volume surface that surrounds certain body segments

Note 1 to entry: An example of a spatial arrangement of a *virtual garment pattern* (2.1.2) is shown in Figure 9.

Note 2 to entry: For example, a sleeve pattern is wrapped around the bounding volume of the arm, and a slacks pattern is wrapped around the bounding volume of the legs.

Figure 9 — Example of arrangement of virtual garment patterns

2.3 Terms relating to optional composition and attributes

2.3.1
grading rule
method to increase or decrease the *virtual garment pattern* (2.1.2) size from the control points with size intervals based on changes of the human body dimensions

Note 1 to entry: Refer to ISO 8559.

Annex A
(informative)

Example of notation of virtual garment information

Virtual garment information is divided into meta information, apparel product data, simulation data and fitting information. See Table A.1 for an example of an information table.

Table A.1 — Example of virtual garment information

Class	Contents	
Meta information	Name	
	Type (shirt, blouse, skirt, pants, jacket, vest, designer, colour)	
Apparel product data	2D Pattern	
	3D trim	
	Physical properties (e.g. cloth mechanical properties)	
	Surface appearance (e.g. texture maps, displacement maps, yarn level modes)	
Simulation data	Spatial arrangement — Name of bounding volume — Relative position on bounding volume	
	Sewing	List of segment pairs to be sewn together
		Sewing order
	Layers	
Fitting information	Distribution of surface strain	
	Balance	
	Colour map	
	Air gap	

Annex B
(informative)

Example of data structure of virtual garment models

B.1 Definition of data object

Data object refers to a computer programming algorithm that manages many different types of data related to each other as one unit. Basic object of garment refers to a sub-data object that structures the digital garment, and the upper object can include many different standard objects. Table B.1 defines the types and definitions of basic digital garment objects.

The basic objects are divided into garment model, garment pattern (including pattern points, pattern lines and pattern notches), sewing conditions, garment options, texture map and 3D model.

Table B.1 — Example of basic objects definition

No.	Basic object	Definition
1	Garment model	An object that is the basis of the garment model, including data, such as garment pattern information and sewing conditions and texture map
2	Garment pattern	An object that includes garment pattern outline information, a 3D model and space arrangement information
2a	Pattern point	An object that includes garment pattern vertex coordinates and amount of grading for each vertex
2b	Pattern lines	An object that includes pattern outline information, sewing notch information
2c	Pattern notches	An object that includes information necessary to mark notches on the pattern outline
3	Sewing conditions	An object that includes sewing information, such as point to point or line to line, and information necessary to fix certain points to the surface of the body
4	Garment options	An object that has information necessary to create garments of different shapes through pattern combinations
5	Texture map	An object that has texture map information for expression of garment appearance
6	3D model	An object that has information necessary for 3D expression of garments

B.2 Data structure according to object

B.2.1 Garment model

The garment model is an object that is the foundation of digital garments. It not only includes general information, such as garment name and type, but also includes sewing information objects that set sewing conditions between patterns, information related to garment grading, basic garment data based on pattern combinations and various garment options (e.g. details) to comprehensively include all information needed to create garment models of many different designs. Table B.2 defines the categorization of object data (e.g. main categories, sub-categories), data name, data type and explanations.

The data structure is divided into meta information, geometric shapes and appearance. Meta information includes general elements, such as garment name and size information, geometric shapes include garment 2D pattern information and information necessary for 3D simulation of garment shape

and grading, and appearance includes a texture map for expression of texture surface and pattern combination information for different designs.

Table B.2 — Example of garment model data structure

Category	Sub-category	Name	Description	Data type
Meta information	Information	Information	Meta information for garment model	Text
Geometry	Pattern	PatternNum	Number of patterns	Integer
	Pattern	Pattern	List of patterns	Garment pattern (see B.2.2)
	Sewing condition	SewingNum	Number of sewing conditions	Integer
	Sewing condition	Sewing	List of sewing conditions	Sewing condition (see B.2.3)
	Grading	GradingType	Type of grading rule	Integer
	Grading	GradeName	Name of grade	String
	Grading	GradeLevel	Level of grading	Float
Appearance	Texture	TextureNum	Number of texture maps	Integer
	Texture	Texture	List of texture maps	Texture map (see B.2.5)
	Option	OptionNum	Number of options	Integer
	Option	Option	List of options	Garment options (see B.2.4)

B.2.2 Garment pattern

The garment pattern object includes geometric information on each of the patterns that make up the garment and data, such as garment properties. Geometric information includes 2D outline information, shape information in a 3D space, and comparative definitions of locations on the pattern space when the pattern is on the bounding surface of the body.

Garment pattern object data structure is divided into meta information, physics and geometric shape. Meta information includes general information, such as pattern name and size information. Physics includes the physical properties of materials and geometric shape includes flat pattern, 3D pattern shape in space and comparative location information on the body.

Table B.3 — Example of garment pattern data structure

Category	Sub-category	Name	Description	Data type
Meta information	Information	Name	Pattern name	String
Physics	Property	Property	Fabric physical properties for simulation	Float array
Geometry	Original pattern	OriginalPointNum	Number of original points	Integer
		OriginalPoint	List of original points	Vector (xy) array
		OriginalLineNum	Number of original lines	Integer
		OriginalLine	List of original lines	Pattern line
	Optimized pattern	PointNum	Number of points	Integer
		Point	List of points	Pattern point
		LineNum	Number of lines	Integer
		Line	List of lines	Pattern line
		OutlineNum	Number of lines consisting the outline	Integer
		Outline	List of lines consisting the outline	Integer list
		FoldingLineNum	Number of folding lines	Integer
		FoldingLine	List of the indices of folding lines	integer list
		FlatModel	2D flat representation of model (z coordinate = 0)	3D model
		Model	3D representation of model	3D model
	Arrangement	Bounding surface	Target bounding surface	Integer
		Position	Relative position of pattern on the bounding surface	Vector (xy)
NOTE Optimized pattern is adjusted pattern for virtual garment sewing and virtual garment simulation.				

B.2.2.1 Pattern points

The pattern points object includes data on each point that structures the pattern outline. Structural elements include 2D coordinates and how much the grading starting point needs to move.

Table B.4 — Example of pattern points data structure

Category	Sub-category	Name	Description	Data type
Geometry	Position	Point	2D position	Vector (xy)
	Grading	Grading	Grading amount	Vector (xy)

B.2.2.2 Pattern lines

The pattern lines object has information necessary to express the pattern outline. Data includes definition of straight lines and curves, number of control points that decide the shape and location of notches that are a standard for sewing.

Table B.5 — Example of pattern lines data structure

Category	Sub-category	Name	Description	Data type
Meta information	Information	Type	Line type	Integer
Geometry	Shape	PointNum	Number of control points	Integer
		Point	List of the indices of points	Integer array
Sewing	Notch	NotchNum	Number of notches	Integer
		Notch	List of notches	Pattern notch

B.2.2.3 Pattern notches

The pattern notches object includes data related to the setting of notches that are a standard for sewing. A notch is located at a certain distance from the starting or end point of a line, so the necessary data is defined as follows.

Table B.6 — Example of pattern notches data structure

Category	Sub-category	Name	Description	Data type
Geometry	Definition	Type	Notch type	Integer
		Length	Position of notch by length	Float
		Position	2D position of notch	Vector (xy)

B.2.3 Sewing conditions

The sewing conditions object includes information necessary for sewing. Data includes whether or not a point or line is sewn, the index and sewing distance of two points when points are sewn, the index of the two lines when lines are sewn, and index of the point on the surface of the body when a certain point is fixed on the surface of the body.

Table B.7 — Example of sewing conditions data structure

Category	Sub-category	Name	Description	Data type
Geometry	Definition	Type	Type of sewing condition (point or line)	Integer
		Point	indices of two points to be sewn together	Integer array
		Distance	Distance between two points to be sewn together	Float
		Line	Indices of two lines to be sewn together	Integer array
		FixedPointNum	Number of fixed points	Integer
		FixedPoint	List of points to be fixed on the body surface	Integer array

B.2.4 Garment options

The garment options object includes information to make garments of different designs by adding various garment options (e.g. details) to basic garment data. It includes a list of options that can be set, a list of possible details for each option and a list of patterns necessary to create each detail.

Table B.8 — Example of garment options data structure

Category	Sub-category	Name	Description	Data type
Meta information	Information	Name	OptionName	String
Definition	Detail	DetailNum	Number of available details	Int
		DetailName	Name list of available details	String array
		DetailPattern	List of patterns used in specific detail combinations	Int array

B.2.5 Texture map

The texture map object includes texture image data for realistic expression of the texture surface design. Data includes image size, actual size on material, the colour value of each point on the texture map and transparency value. It also includes information necessary for the bump mapping method that expresses surface bumps without complex geometry.

Table B.9 — Example of texture map data structure

Category	Sub-category	Name	Description	Data type
Meta information	Information	Name	Texture name	String
Geometry	Size	RealSize	Actual size of texture map	Vector (xy)
		Size	Size of texture map in pixels	Vector (xy)
Data information	Image	Bitmap	Bitmap representation of texture map	Bitmap image
	Colour value	Colour	Colour data for each pixel in the texture image	Byte array (RGB)
	Alpha value	Alpha	Alpha value for each pixel	Byte array
	Bump map	Bump	Bump mapping value for each pixel	Byte array (xyz)

B.2.6 3D model

The 3D model object includes data necessary to define the 3D model. Data includes the structural method of coordinates of points to use when expressing geometry of 3D model space and triangular elements, colour and shine of the surface, texture map, coefficients needed to adjust the size of the texture map and the sub-models list included in the model.

Table B.10 — Example of 3D model data structure

Category	Sub-category	Name	Description	Data type
Meta information	Information	Name	Model name	String
3D geometry	Node	NodeNum	Number of nodes	Integer
	Node	Node	List of nodes	Vector (xyz)
	Element	ElemNum	Number of elements	Integer
	Element	ElemNum	List of elements	Element (three node indices)
	Normal	Normal	List of normal vector for each node	Vector (xyz)
	Sub model	SubModelNum	Number of sub models	Integer
	Sub model	SubModel	List of sub models	3D model

Table B.10 *(continued)*

Category	Sub-category	Name	Description	Data type
Appearance	Colour	DefaultColor	Surface colour	Colour (RGB)
	Opacity	Opacity	Surface opacity	Float
	Shininess	Shininess	Surface shininess	Float
	Texture	TextureNum	Number of texture maps	Integer
	Texture	Texture	List of texture maps	Texture map
	Texture	TexturePoint	List of texture point for each node	Vector (xy)
	Texture	TextureScale	Scale adjustment for texture	Float
	Texture	TextureAngle	Angle adjustment for texture	Float

Bibliography

[1] ISO 5084, *Textiles — Determination of thickness of textiles and textile products*

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