PMI Unicode String Specification
Examples and Mapping Strategies

for Dimensioning and Tolerancing, GD&T, Surface Texture Symbol,
and Welding Symbol PMI Annotation Entities

Revision J

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Table of Contents

Comments for Discussion

General:

There are some outstanding issues that we need to discuss about the UCS material.

Description:

Page	**Comment:**
28	In my opinion, I do not think we should have mapped the All Around symbol as a UC string. It should be polylines, as it is on the leader, not part of the note or feature control framec. This would also apply to the All Over symbol. If accepted, changes would be required in the mapping section and Annex A.
Annex B	We need to address the concerns outlined in “STEP PMI Symbol Unicode Mapping ejp brf.xls”

I added sequential figure numbers to all figures in Sections 1-5.

1 Scope, Introduction and Definitions

1.1 Scope

This document contains examples of and Unicode string mapping strategies for Product and Manufacturing Information (PMI) annotation entities that may be encountered on annotated models. These entities are formatted in accordance with the applicable ASME and ISO standards as described herein. This document includes examples of and mapping strategies for standard Dimensioning and Tolerancing and GD&T annotation entities, and mapping strategies for Surface Texture and Welding Symbols. This document was prepared at the request of LOTAR International. It is not intended as a standardization document; it is intended to capture and convey recommended practices information to LOTAR member companies, the CAx Implementor Forum, and participating CAD software vendors.

1.2 Introduction

This report was developed at the request of LOTAR International in July 2009, with work continuing into September 2009. The goal was to build upon previous efforts by LOTAR member companies and suppliers, with the primary intent of developing an extensive list of GD&T and Dimensioning and Tolerancing PMI entities that may be encountered in annotated models and within data sets, and subsequently translated into STEP.

This report includes examples of the Dimensioning and Tolerancing and GD&T symbols and techniques defined in ASME and ISO standards. No preference was given to either standardization body. Again, the initial goal was to create an exhaustive list or superset of Dimensioning and Tolerancing annotation entity types, symbols, configurations, and representative examples of PMI that may be encountered in an annotated model data set.

The report also includes examples and mapping strategies for Surface Texture and Welding Symbols. The Surface Texture and Welding Symbol examples are included without the extensive example set provided for Dimensioning and Tolerancing and GD&T, as these were developed primarily in the Seattle workshop, and not as part of the original effort by Advanced Dimensional Management LLC.

The report is structured as follows:

Sections

1. Scope, Introductions, and Definitions
2. Dimensioning and Tolerancing Examples
3. GD&T Examples
4. Mapping Examples: Dimensioning and Tolerancing and GD&T
5. Mapping Examples: Surface Texture and Welding Symbols

Annexes

A. Legend for LOTAR Unicode String Standard
B. Annex B Text Encoding

This report classifies annotation entities by type, using keywords such as DIM, TGT, DTM, TXT, SRF, WLD, etc. See Annex A for a more detailed explanation.

This revision of the report includes the comments and directives from the UCS Workshop help in Seattle from July 29-31, 2009, feedback from several LOTAR WebEx meetings, and the continued work of the LOTAR UCS Working Group

For annotation entities consisting of multiple data elements (compartmentalized data), the Workshop chose to use variable compartment mapping. Each data compartment is numbered sequentially, even if one or more compartments may intentionally be empty or missing. For example, in ASME Y14.5M-1994, reading from left-to-right, a Feature Control Frame may have up to six compartments:

1. Tolerance Type
2. Tolerance Zone
3. Maximum Tolerance Value
4. Primary Datum Feature
5. Secondary Datum Feature
6. Tertiary Datum Feature

Even though Feature Control Frames may have up to six compartments, all do not, so a string for a Feature Control Frame may also contain less than six compartments. Rather than include an empty field for a compartment that is empty or missing, that compartment would not be mapped, and the data in the next compartment would be the next field in the string. For entities that have empty or missing fields at the end there will be no trailing empty compartments. Thus each string of a particular type may have a different number of compartments.

1.3 Definitions

Compartment: A distinct and/or segregated area within an annotation entity that contains annotation with a discrete purpose or meaning. Certain symbolic GD&T entities are sub-divided into distinct areas or compartments. The data entered into each area of these symbolic entities has a particular meaning. Examples are Datum Target Symbols, Datum Feature Symbols, Feature Control Frames (ASME) or Tolerance Frames (ISO). Each of these annotation entity types are defined symbolically, with their alphanumeric and Unicode data inside a circular or rectangular frame or outline. Thus the data elements in these symbols are subdivided and mapped into fields that correspond to the separate compartments. The same approach was used in mapping welding symbols and surface texture symbols. Although these symbols are not contained within a circular or rectangular frame, they do have a defined set of potential components or compartments, and thus are conducive to compartmentalization.

Concatenation: (From Wikipedia) “In computer programming, string concatenation is the operation of joining two character strings end to end. For example, the strings ‘snow’ and ‘ball’ may be concatenated to give ‘snowball’.”

In this document, each separate annotation entity that contains text or Unicode characters is defined as a separate string. However, as many of these strings are specified in a set and are related to one another, the strings may be concatenated into a larger superstring. Each string that makes up the superstring is readily identifiable as a separate string by its leading keyword, which will aid software queries intending to extract or understand a particular string, and also represents a level of the semantic relationship between the constituent strings.

Mapping: Isolating and writing individual characters or groups of characters in an annotation entity into distinct compartments or fields within a Unicode string. Some strings only contain a single field, such as Dimension and Text strings, and some contain multiple fields or compartments, such as Feature Control Frame and Datum Target strings. Each field within a string may be composed of multiple characters, including codes that explain formatting and placement (e.g. stacked upper and lower limits, stacked + and - tolerances, fractional values, etc.)

2 Dimensioning and Tolerancing Examples

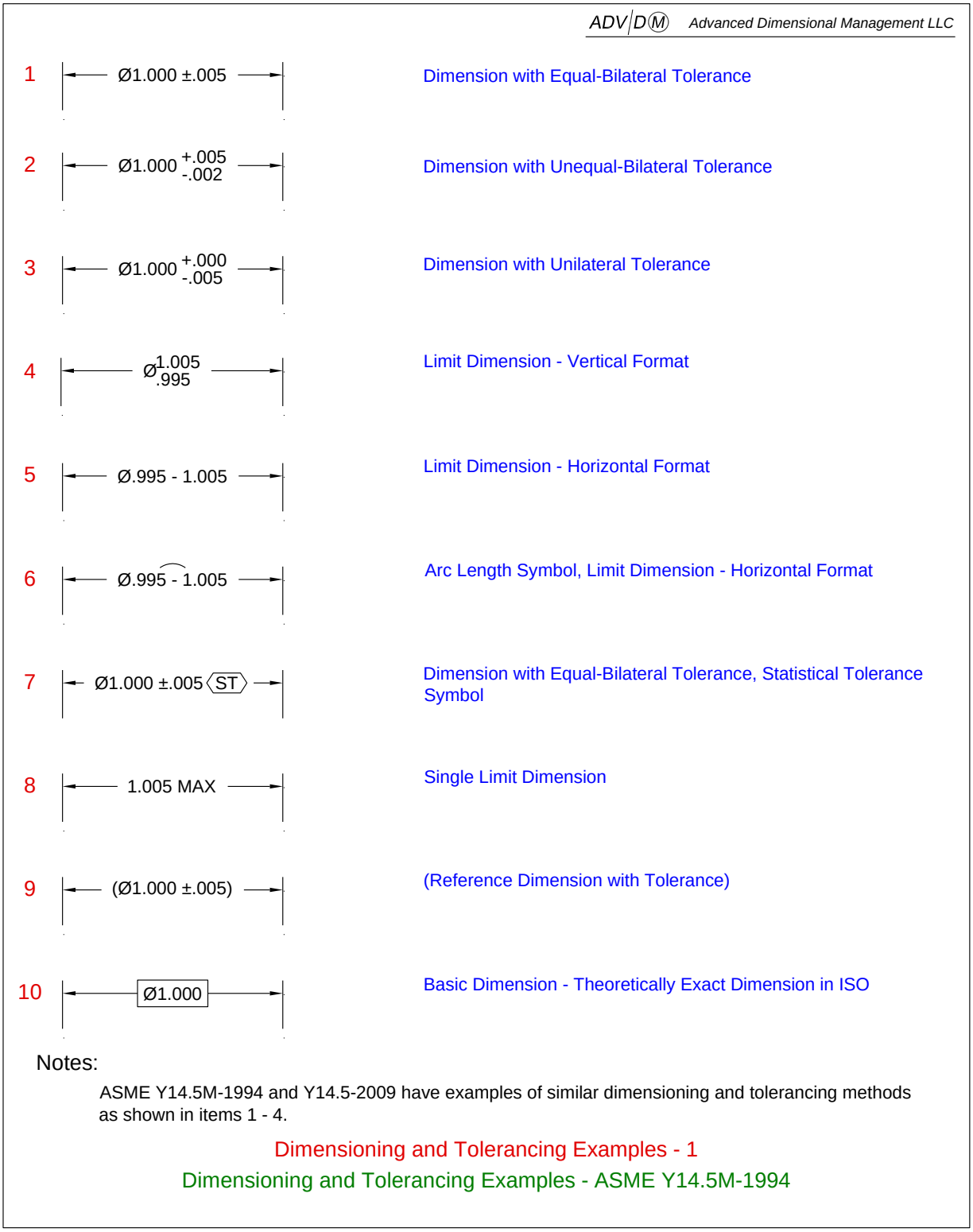
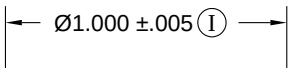
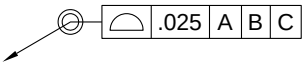


Figure 1

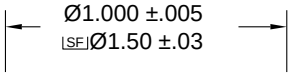
ADV/DM Advanced Dimensional Management LLC

1 

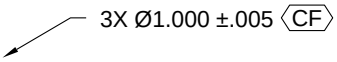
Dimension and Tolerance with Independency Symbol

2 

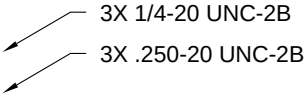
All-Over Symbol (with Profile Tolerance)

3 

Spotface Symbol (with Dimensions and Tolerances)

4 

Continuous Feature Symbol (with Dimension and Tolerance)

5 

Screw Thread - Inch - Unified National Series: Fractional
Screw Thread - Inch - Unified National Series: Decimal

6 

AFTER COATING:
MAX MAJOR DIAMETER .2500
MAX PITCH DIAMETER .2268

BEFORE COATING:
MAJOR DIAMETER .2494 - .2431 SPL
PITCH DIAMETER .2256 - .2235 SPL

Screw Thread - Inch - Unified National Series
Decimal Designation
Coated Thread
Before and After Thread Size Designations

7 

Screw Thread - Metric - M Profile - Internal

8 

Screw Thread - Metric - M Profile - External
with Gaging System

Notes:

ASME Y14.5M-1994 and Y14.5-2009 have examples of similar dimensioning and tolerancing methods as shown in items 1 - 4.

Inch screw thread specifications from ASME B1.1 - 2003.

Metric screw thread designations from ASME B1.13M - 2005.

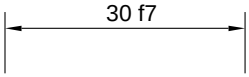
These screw thread specifications are very simple examples, and do not represent an exhaustive set of screw thread specifications.

New Dimensioning and Tolerancing Symbols: Screw Threads - 2

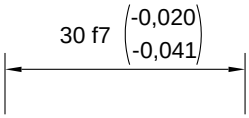
Dimensioning and Tolerancing and Screw Threads Examples - ASME Y14.5-2009

Figure 2

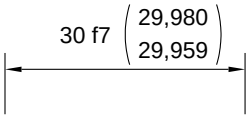
ADV/DM Advanced Dimensional Management LLC

1 

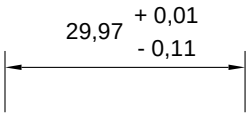
Basic Size Dimension, Tolerance Symbol

2 

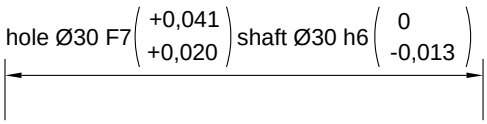
Basic Size Dimension, Tolerance Symbol, Deviations (Tolerances)
(in parentheses)

3 

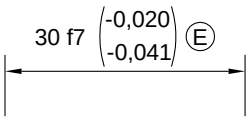
Basic Size Dimension, Tolerance Symbol, Limits of Size (in parentheses)

4 

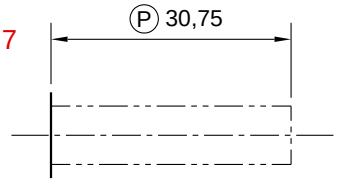
Basic Size Dimension, Deviations (Tolerances)

5 

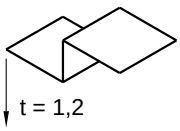
Basic Size Dimension, Deviations (Tolerances)
Example of Dimensioning of Mating Features on an Assembly

6 

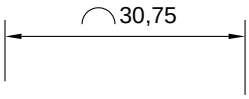
Basic Size Dimension, Tolerance Symbol, Deviations (Tolerances), Envelope Requirement

7 

Projected Tolerance Zone Symbol, Projection Distance

8 

Thickness dimension of thin part, where thickness of part was not modeled (from ISO 16792:2006)

9 

Arc Length Symbol, Dimension Value

Notes:

ASME Y14.5M-1994 and Y14.5-2009 include examples of similar dimensioning and tolerancing methods as shown in items 1 - 4.

Dimensioning and Tolerancing Examples - 3

Dimensioning and Tolerancing Examples - ISO 129-1:2006 & ISO 406:1987

Figure 3

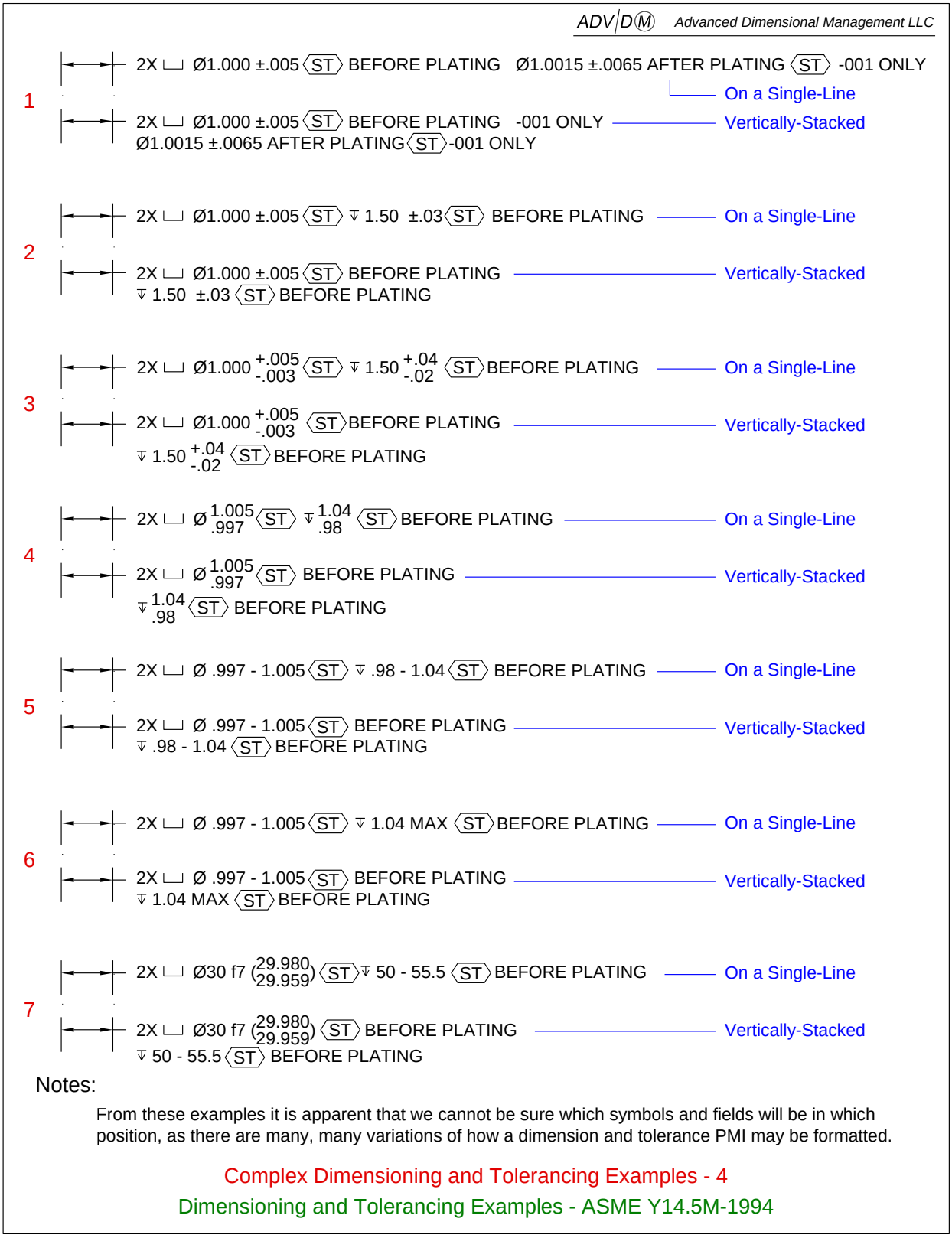
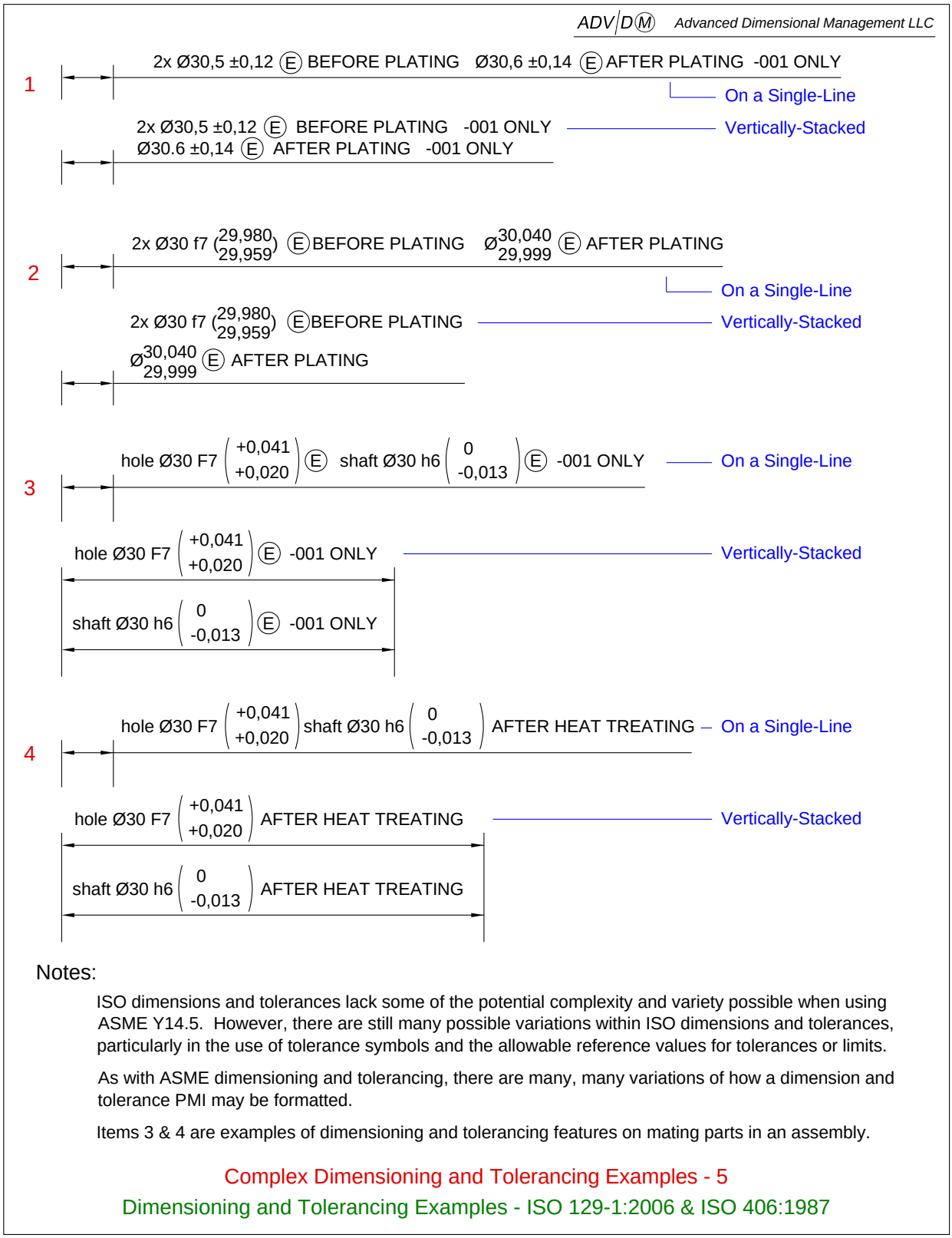

ADV/DM Advanced Dimensional Management LLC
1
2X ⌴ Ø1.000 ±.005 (ST) BEFORE PLATING Ø1.0015 ±.0065 AFTER PLATING (ST) -001 ONLY
On a Single-Line
2X ⌴ Ø1.000 ±.005 (ST) BEFORE PLATING -001 ONLY
Ø1.0015 ±.0065 AFTER PLATING (ST) -001 ONLY
Vertically-Stacked
2
2X ⌴ Ø1.000 ±.005 (ST) ↧ 1.50 ±.03 (ST) BEFORE PLATING
On a Single-Line
2X ⌴ Ø1.000 ±.005 (ST) BEFORE PLATING
↧ 1.50 ±.03 (ST) BEFORE PLATING
Vertically-Stacked
3
2X ⌴ Ø1.000 +.005 -.003 (ST) ↧ 1.50 +.04 -.02 (ST) BEFORE PLATING
On a Single-Line
2X ⌴ Ø1.000 +.005 -.003 (ST) BEFORE PLATING
↧ 1.50 +.04 -.02 (ST) BEFORE PLATING
Vertically-Stacked
4
2X ⌴ Ø 1.005 .997 (ST) ↧ 1.04 .98 (ST) BEFORE PLATING
On a Single-Line
2X ⌴ Ø 1.005 .997 (ST) BEFORE PLATING
↧ 1.04 .98 (ST) BEFORE PLATING
Vertically-Stacked
5
2X ⌴ Ø .997 - 1.005 (ST) ↧ .98 - 1.04 (ST) BEFORE PLATING
On a Single-Line
2X ⌴ Ø .997 - 1.005 (ST) BEFORE PLATING
↧ .98 - 1.04 (ST) BEFORE PLATING
Vertically-Stacked
6
2X ⌴ Ø .997 - 1.005 (ST) ↧ 1.04 MAX (ST) BEFORE PLATING
On a Single-Line
2X ⌴ Ø .997 - 1.005 (ST) BEFORE PLATING
↧ 1.04 MAX (ST) BEFORE PLATING
Vertically-Stacked
7
2X ⌴ Ø30 f7 (29.980 29.959) (ST) ↧ 50 - 55.5 (ST) BEFORE PLATING
On a Single-Line
2X ⌴ Ø30 f7 (29.980 29.959) (ST) BEFORE PLATING
↧ 50 - 55.5 (ST) BEFORE PLATING
Vertically-Stacked
Notes:
From these examples it is apparent that we cannot be sure which symbols and fields will be in which position, as there are many, many variations of how a dimension and tolerance PMI may be formatted.
Complex Dimensioning and Tolerancing Examples - 4
Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 4



Notes:

ISO dimensions and tolerances lack some of the potential complexity and variety possible when using ASME Y14.5. However, there are still many possible variations within ISO dimensions and tolerances, particularly in the use of tolerance symbols and the allowable reference values for tolerances or limits.

As with ASME dimensioning and tolerancing, there are many, many variations of how a dimension and tolerance PMI may be formatted.

Items 3 & 4 are examples of dimensioning and tolerancing features on mating parts in an assembly.

Complex Dimensioning and Tolerancing Examples - 5

Dimensioning and Tolerancing Examples - ISO 129-1:2006 & ISO 406:1987

Figure 5

3 GD&T Examples

Figure 6

ADV/DⓂ *Advanced Dimensional Management LLC*

DF = Datum Feature

1 ⌖ | Ø2.75 Ⓜ Ⓟ | A | B Ⓜ | C Ⓜ

Positional Tolerance MMC, Projected Tol Zone,
Primary DF RFS, Secondary DF MMC, Tertiary DF MMC

2 ⌖ | Ø2.75 Ⓜ Ⓟ 60.5 | A | B Ⓜ | C Ⓜ

Positional Tolerance MMC, Projected Tol Zone with Value,
Primary DF RFS, Secondary DF MMC, Tertiary DF MMC

3 ⌖ | Ø2.75 Ⓜ Ⓟ 60.5 Ⓕ | A | B Ⓜ | C Ⓜ

Positional Tolerance MMC, Projected Tol Zone with Value,
Free State,
Primary DF RFS, Secondary DF MMC, Tertiary DF MMC

4 ⌖ | Ø2.75 Ⓜ Ⓟ 60.5 Ⓕ 〈ST〉 | A | B Ⓜ | C Ⓜ

Positional Tolerance MMC, Projected Tol Zone with Value,
Free State, Statistical Tolerance,
Primary DF RFS, Secondary DF MMC, Tertiary DF MMC

5 ⌖ | Ø2.75 Ⓜ Ⓟ 60.5 Ⓕ 〈ST〉 | Ø2.85 MAX | A | B Ⓜ | C Ⓜ

Positional Tolerance MMC, Projected Tol Zone with Value,
Free State, Statistical Tolerance, Max Geo Tol Value,
Primary DF RFS, Secondary DF MMC, Tertiary DF MMC

6 ⌖ | Ø2.75 Ⓜ Ⓟ 60.5 Ⓕ 〈ST〉 | Ø2.85 MAX | A-B-C | D Ⓜ-E Ⓜ-F Ⓜ | G Ⓜ-H Ⓜ-J Ⓜ

Positional Tolerance MMC, Projected Tol Zone with Value,
Free State, Statistical Tolerance, Max Geo Tol Value,
Primary Multiple DF RFS, Secondary Multiple DF MMC,
Tertiary Multiple DF MMC

7 ⌖ | Ø2.75 Ⓜ Ⓟ 60.5 〈ST〉 | Ø2.85 MAX | A-B-C | D Ⓜ-E Ⓜ Ⓕ-F Ⓜ Ⓕ | G Ⓜ Ⓕ-H Ⓜ-J Ⓜ

Positional Tolerance MMC, Projected Tol Zone with Value,
Statistical Tolerance, Max Geo Tol Value,
Primary Multiple DF RFS, Secondary Multiple DF MMC,
Tertiary Multiple DF MMC:
Some DFs Referenced Free State

Notes:

Items 6 & 7 show some of the complexities of Datum Feature Referencing in Feature Control Frames. When more than one Datum Feature is referenced in a single compartment separated by dashes, it is called a Multiple Datum Feature. Each Datum Feature within the reference may include its own modifiers, separate from the other Datum Features. E.g. all of the Datum Features referenced in each compartment don't have the same modifiers.

Positional Tolerance - 2: Single Segment

Sample Feature Control Frames - ASME Y14.5M-1994

Figure 7

ADV/DM Advanced Dimensional Management LLC

DF = Datum Feature

Positional Tolerance - 3: Composite

Sample Feature Control Frames - ASME Y14.5M-1994

Figure 8

ADV/DM Advanced Dimensional Management LLC

DF = Datum Feature

1 | ⌖ | Ø2.75 Ⓜ | A |
| | Ø0.85 Ⓜ | |

Two Segments
Single DF Reference in Upper Segment,
No DF References in Lower Segment

2 | ⌖ | Ø2.75 Ⓜ | A | B | C |
| | Ø0.85 Ⓜ | A | B | |
| | Ø0.25 Ⓜ | A | | |

Three Segments
Three DF References in First Segment,
Two DF References in Second Segment,
One DF Reference in Third Segment

3 | ⌖ | Ø2.75 Ⓜ | A | B | C |
| | Ø0.85 Ⓜ | A | B | |
| | Ø0.25 Ⓜ | | | |

Three Segments
Three DF References in First Segment,
Two DF References in Second Segment,
No DF References in Third Segment

4 | ⌖ | Ø2.75 Ⓜ | A | B | C |
| | Ø0.85 Ⓜ | A | | |
| | Ø0.25 Ⓜ | | | |

Three Segments
Three DF References in First Segment,
One DF Reference in Second Segment,
No DF References in Third Segment

5 | ⌖ | Ø2.75 Ⓜ | A | B |
| | Ø0.85 Ⓜ | A | |
| | Ø0.25 Ⓜ | | |

Three Segments
Two DF References in First Segment,
One DF Reference in Second Segment,
No DF References in Third Segment

6 | ⌖ | Ø2.75 Ⓜ | A | B Ⓜ | C Ⓜ |
| | Ø0.85 Ⓜ | A | B Ⓜ | C Ⓜ |
| | Ø0.25 Ⓜ | A | | |

Three Segments
Three DF References in First Segment,
Three DF References in Second Segment,
One DF Reference in Third Segment

7 | ⌖ | Ø2.75 Ⓜ | A | B Ⓜ | C Ⓜ |
	Ø0.8 Ⓜ	A	B Ⓜ	C Ⓜ
	Ø0.25 Ⓜ	A		
	Ø0.1 Ⓜ			

Four Segments
Three DF References in First Segment,
Three DF References in Second Segment,
One DF Reference in Third Segment
No DF References in Fourth Segment

8 | ⌖ | Ø2.75 Ⓜ Ⓟ 60.5 | A | B | C Ⓜ |
	Ø0.8 Ⓛ	Ø1.2 MAX	A	B
	Ø0.25 Ⓕ ⟨ST⟩	A		
	Ø0.1			

Four Segments (Run and Hide)
First Segment: MMC, Projected, Three DF References,
Second Segment: LMC, Maximum Tol, Two DF References,
Third Segment: Free State, Statistical Tol, One DF Reference,
Fourth Segment: No DF References

Positional Tolerance - 4: Composite

Sample Feature Control Frames - ASME Y14.5M-1994

Figure 9

ADV/DM Advanced Dimensional Management LLC

Profile Tolerance - 1: Single-Segment and Composite

Sample Feature Control Frames - ASME Y14.5M-1994

Figure 10

ADV/DM Advanced Dimensional Management LLC

DF = Datum Feature

1 | ⌓ | 4.5 Ⓤ 1.5 | A | B Ⓜ | C Ⓜ |
Single Segment
Unequally-Disposed,
Primary, Secondary, Tertiary DF References RMB, MMB, MMB

2 | ⌓ | 4.5 Ⓤ 1.5 | A | B Ⓛ | C Ⓛ |
Single Segment
Unequally-Disposed,
Primary, Secondary, Tertiary DF References RMB, LMB, LMB

3 | ⌓ | 4.5 Ⓤ 1.5 Ⓕ | A | B Ⓜ | C |
Single Segment
Unequally-Disposed, Free State,
Primary, Secondary, Tertiary DF References RMB, MMB, RMB

4 | ⌓ | 4.5 Ⓤ 1.5 Ⓕ | A | B [BASIC]* | C |
Single Segment
Unequally-Disposed, Free State,
Primary, Secondary, Tertiary DF References RMB, @ BASIC, RMB

5 | ⌓ | 4.5 Ⓤ 1.5 Ⓕ | A | B [BSC]* | C |
Single Segment
Unequally-Disposed, Free State,
Primary, Secondary, Tertiary DF References RMB, @ BSC, RMB

6 | ⌓ | 4.5 Ⓤ 1.5 Ⓕ | A | B [Ø10.505]* | C |
Single Segment
Unequally-Disposed, Free State,
Primary, Secondary, Tertiary DF References RMB, @ Ø10.505, RMB

7 | ⌓ | NON-UNIFORM | D | E Ⓜ | F Ⓜ |
Single Segment
NON-UNIFORM Tol Zone,
Primary, Secondary, Tertiary DF References RMB, MMB, MMB

8 | ⌓ | 3.75 | D | E Ⓜ ▷** | F Ⓜ |
Single Segment
Primary DF Reference RMB, Secondary DF Reference MMB with Translation Modifier, Tertiary DF Reference MMB

9 | ⌓ | 3.75 | D [z, u, v]*** | E Ⓜ [x]*** | F [y, w]*** |
Single Segment
Primary DF Reference RMB, Secondary DF Reference MMB, Tertiary DF Reference RMB: All three DF References with Degree of Freedom Constraint Modifiers

10 | ⌓ | 2.75 Ⓤ 0.75 / 25 x 25 Ⓕ ⟨ST⟩ | A-B-C [BASIC]* ▷** [z,u,v]*** | D-E-F [Ø12.1]* [x]*** | G-H-J Ⓜ [y,w]*** |
Single Segment [Run and Hide]
Unequally-Disposed, Unit Basis with Extents, Free State, Statistical Tol Zone,
Primary Multiple DF Reference A-B RMB & C BASIC with Translation Modifier, Secondary Multiple DF Reference D-E RMB & F @ Ø12.1 , Tertiary Multiple DF Reference G-H RMB & J MMB: All three DF References with Degree of Freedom Constraint Modifiers

Notes:

This page includes all of the new Feature Control Frame content defined in ASME Y14.5-2009.

* [BASIC], [BSC], and [value] are new methods to override the default size/boundary for Datum Feature Simulators. [BSC] is an abbreviation for [BASIC], which means the basic size / shape.

** ▷ is the Datum Feature Simulator Translation Modifier. This is used to indicate that a Datum Feature Simulator moves (translates) until it contacts the as-produced part.

*** [x,y,z,u,v,w] are Degree of Freedom Constraint Modifiers. These are used to indicate which Degrees of Freedom are eliminated by the Datum Feature Simulator, potentially overriding the default conditions.

Profile Tolerance - 2: Single-Segment

Sample Feature Control Frames - ASME Y14.5-2009

Figure 11

ADV/DⓂ Advanced Dimensional Management LLC

DF = Datum Feature

1	⌖ 2,75	Position Tolerance RFS, No DF References
2	⌖ 2,75 A	Position Tolerance RFS, Primary DF RFS
3	⌖ 2,75 A B C	Position Tolerance RFS, Primary DF RFS, Secondary DF RFS, Tertiary DF RFS
4	⌖ 2,75Ⓜ A B C	Position Tolerance MMC, Primary DF RFS, Secondary DF RFS, Tertiary DF RFS
5	⌖ 2,75Ⓜ A BⓂ CⓂ	Position Tolerance MMC, Primary DF RFS, Secondary DF MMR, Tertiary DF MMR
6	⌖ ∅2,75	Position Tolerance Ø, RFS, No DF References
7	⌖ ∅2,75 A	Position Tolerance Ø, RFS, Primary DF RFS
8	⌖ ∅2,75 A B C	Position Tolerance Ø, RFS, Primary DF RFS, Secondary DF RFS, Tertiary DF RFS
9	⌖ ∅2,75Ⓜ A B C	Position Tolerance Ø, MMC, Primary DF RFS, Secondary DF RFS, Tertiary DF RFS
10	⌖ ∅2,75Ⓜ A BⓂ CⓂ	Position Tolerance Ø, MMC, Primary DF RFS, Secondary DF MMR, Tertiary DF MMR
11	⌖ SØ2,75	Position Tolerance SØ, RFS, No DF References
12	⌖ SØ2,75 A	Position Tolerance SØ, RFS, Primary DF RFS
13	⌖ SØ2,75 A B C	Position Tolerance SØ, RFS, Primary DF RFS, Secondary DF RFS, Tertiary DF RFS
14	⌖ SØ2,75Ⓜ A B C	Position Tolerance SØ, MMC, Primary DF RFS, Secondary DF RFS, Tertiary DF RFS
15	⌖ SØ2,75Ⓜ A BⓂ CⓂ	Position Tolerance SØ, MMC, Primary DF RFS, Secondary DF MMR, Tertiary DF MMR
16	⌖ ∅2,75Ⓛ A BⓁ CⓁ	Position Tolerance Ø, LMC, Primary DF RFS, Secondary DF LMR, Tertiary DF LMR
17	⌖ ∅2,75Ⓛ A BⓂ CⓂ	Position Tolerance Ø, LMC, Primary DF RFS, Secondary DF MMR, Tertiary DF MMR
18	⌖ ∅2,75Ⓛ A B C	Position Tolerance Ø, LMC, Primary DF RFS, Secondary DF RFS, Tertiary DF RFS
19	⌖ ∅2,75 A BⓁ CⓂ	Position Tolerance Ø, RFS, Primary DF RFS, Secondary DF LMR, Tertiary DF MMR

Position Tolerance Examples - 1

Sample Tolerance Frames - ISO 1101:2004

Figure 12

ADV/DM Advanced Dimensional Management LLC

DF = Datum Feature

1 ⌖ Ø2,75 Ⓜ Ⓟ | A | B Ⓜ | C Ⓜ

Position Tolerance MMC, Projected Tol Zone,
Primary DF RFS, Secondary DF MMR, Tertiary DF MMR

2 ⌖ Ø2,75 Ⓜ Ⓟ 60,5 | A | B Ⓜ | C Ⓜ

Position Tolerance MMC, Projected Tol Zone with Value,
Primary DF RFS, Secondary DF MMR, Tertiary DF MMR

3 ⌖ Ø2,75 Ⓜ Ⓟ 60,5 Ⓕ | A | B Ⓜ | C Ⓜ

Position Tolerance MMC, Projected Tol Zone with Value,
Free State,
Primary DF RFS, Secondary DF MMR, Tertiary DF MMR

4 ⌖ Ø2,75 Ⓜ CZ Ⓕ | A | B Ⓜ | C Ⓜ

Position Tolerance MMC,
Common Zone, Free State
Primary DF RFS, Secondary DF MMR, Tertiary DF MMR

5 ⌖ Ø2,75 Ⓜ Ⓕ | A | B Ⓜ | C Ⓜ
common zone *

Position Tolerance MMC,
Free State
Primary DF RFS, Secondary DF MMR, Tertiary DF MMR
Common Zone Keyword

6 ⌖ Ø2,75 Ⓜ Ⓡ | A | B Ⓜ | C Ⓜ **

Position Tolerance MMC,
Reciprocity Requirement,
Primary DF RFS, Secondary DF MMR, Tertiary DF MMR

7 ◎ Ø2,75 | A-B | C

Coaxiality Tolerance RFS,
Multiple Primary DF RFS, Secondary DF RFS

8 ◎ Ø2,75 | A-B | C ***ACS

ACS Symbol
Concentricity Tolerance RFS,
Multiple Primary DF RFS, Secondary DF RFS

9 ◎ Ø2,75 Ⓜ | A Ⓜ -B Ⓜ | C

Coaxiality Tolerance MMC,
Multiple Primary DF MMR, Secondary DF RFS

10 ⌖ Ø2,75 Ⓜ | A | B Ⓜ | C Ⓜ
Ø0,05 | A

Lower Compartment(s) Aligned with Top
Upper Segment MMC, Lower Segment RFS,
Primary DF Reference in Lower Segment

Notes:

* Example 5 uses the Common Zone method from ISO 1101:1983.

** The Reciprocity Requirement and the reciprocity symbol are defined in ISO 2692:2006.

*** ISO 1101:2004 doesn't include rules for determining whether the ◎ symbol is Concentricity or Coaxiality; the concept and application are only defined by example. Apparently placing ACS adjacent to the Tolerance Frame determines what the tolerance controls.

Position, Concentricity, and Coaxiality Tolerance Examples - 2

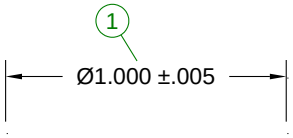
Sample Tolerance Frames - ISO 1101:2004

Figure 13

4 Mapping Examples: Dimensions and Tolerancing and GD&T

ADV/D(M) Advanced Dimensional Management LLC

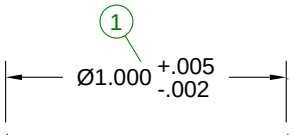
1



Unicode String:
DIM\wØ1.000 ±.005

Dimension with Equal-Bilateral Tolerance

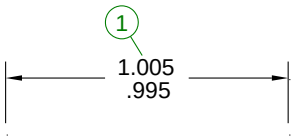
2



Unicode String:
DIM\wØ1.000 \u+.005\n-.002\u

Dimension with Unequal-Bilateral Tolerance

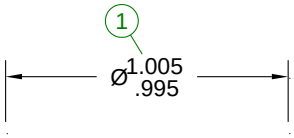
3



Unicode String:
DIM\w\u1.005\n.995\u

Limit Dimension

4



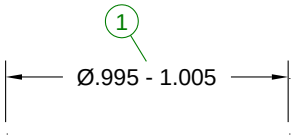
Unicode String:
DIM\wØ\u1.005\n.995\u

Limit Dimension with Ø Symbol

5

N/A

6



Unicode String:
DIM\wØ.995 - 1.005

Limit Dimension Horizontal Format

Note:
I recommend that we treat the entire dimension string as a single entity. Thus, Ø.505 ±.010 would be a single entity, rather than 3 entities. For example:

Preferred Ø.505 ±.010
Unicode String: DIM\wØ.505±.010

Not-Preferred Ø.505 ±.010
Unicode String: DIM\wØ\w.505\w±.010

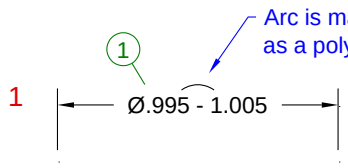
Items 5 & 6 illustrated optional approaches of how to map a horizontal limit dimension. Item 6 was the preferable method, and is the method shown here. Item 5 is not needed.

Mapping - 3: Treating Content as a Single String
Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 14

ADV/DM Advanced Dimensional Management LLC

1



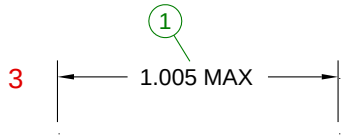
Unicode String:
DIM\wØ.995 - 1.005

Dimension with Arc Length Symbol: Option 1

2

N/A

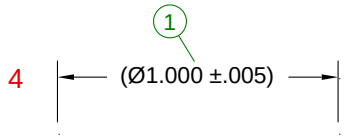
3



Unicode String:
DIM\w1.005 MAX

Single Limit Dimension

4



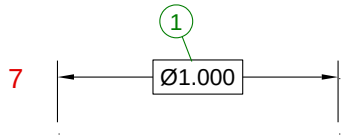
Unicode String:
DIM\w(Ø1.000±.005)

Reference Dimension with Tolerance

5, 6

N/A

7



Selected Method:
Unicode String:
DIM\wØ1.000

Basic Dimension

Note:
I recommend that we treat the entire dimension string as a single entity. Thus, Ø.505 ±.010 would be a single entity, rather than 3 entities. For example:

Preferred Ø.505 ±.010
Unicode String: DIM\wØ.505±.010

Not-Preferred Ø.505 ±.010
Unicode String: DIM\wØ\w.505\w±.010

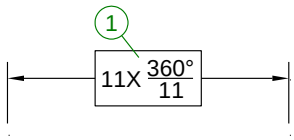
Items 5 & 6 are not needed.

Mapping - 4: Treating Content as a Single String
Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 15

ADV/D(M) Advanced Dimensional Management LLC

1



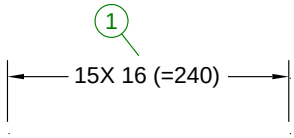
Selected Method:

Unicode String:

DIM\w11X \v360°\n11\v

Basic Dimension with Fractional Content

2

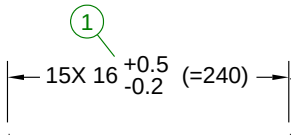


Unicode String:

DIM\w15X 16 (=240)

Repetitive Feature Dimension: Example 1

3

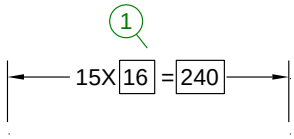


Unicode String:

DIM\w15X 16 \u +0.5\n-0.2\u (=240)

Repetitive Feature Dimension: Example 2

4



Unicode String:

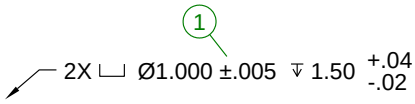
DIM\w15X 16 = 240

Repetitive Feature Dimension: Example 3 - Selected Method

5

Repetitive Feature Dimension: Example 3 - Alternate Method

6



Unicode String:

DIM\w2X ⌴ Ø1.000 ±.005 ↧ 1.50 \u.+04\n-.02\u

Counterbores with Depth Dimension and Tolerance

Note:
There are no examples in the mapping pages for symbols that are not currently supported in Unicode.

The existing Unicode character set is based on *STEP_Drawing_Text_Symbol_UNICODE_Mapping_RevG.xls* and Unicode Character Charts.

Mapping - 5: Complex Examples 1

Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 16

ADV/DM Advanced Dimensional Management LLC

1 2X ⌴ Ø1.000 ±.005 BEFORE PLATING (1) Ø1.0015 ±.0065 AFTER PLATING -001 ONLY

Unicode String:

DIM\w2X ⌴ Ø1.000 ±.005 BEFORE PLATING Ø1.0015 ±.0065 AFTER PLATING -001 ONLY

Complex Dimension and Tolerance Specification: One Line

2 2X ⌴ Ø1.000 ±.005 BEFORE PLATING -001 ONLY (1)
Ø1.0015 ±.0065 AFTER PLATING -001 ONLY

Unicode String:

DIM\w2X ⌴ Ø1.000 ±.005 BEFORE PLATING -001 ONLY\nØ1.0015 ±.0065 AFTER PLATING -001 ONLY

Complex Dimension and Tolerance Specification: Two Lines

3 3X 1/4-20 UNC-2B (1)

Unicode String:

DIM\w3X 1/4-20 UNC-2B

Screw Thread: Inch: Fractional Designation

4 3X .250-20 UNC-2B (1)

Unicode String:

DIM\w3X .250-20 UNC-2B

Screw Thread: Inch: Decimal Designation

5 3X M6 X 1 - 5H6H (1)

Unicode String:

DIM\w3X M6 X 1 - 5H6H

Screw Thread: Metric

6 3X .250-28 UNF-3A (1)

AFTER COATING:
MAX MAJOR DIAMETER .2500
MAX PITCH DIAMETER .2268

BEFORE COATING:
MAJOR DIAMETER .2494 - .2431 SPL
MAJOR DIAMETER .2494 - .2431 SPL

Unicode String:

DIM\w3X .250-28 UNF-3A\n\nAFTER COATING:\nMAX MAJOR DIAMETER .2500\nMAX PITCH DIAMETER .2268\n\nBEFORE COATING:\nMAJOR DIAMETER .2494 - .2431 SPL\nMAJOR DIAMETER .2494 - .2431 SPL

Screw Thread: Inch: With Coating Data

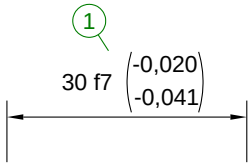
Mapping - 6: Complex Examples and Screw Threads

Dimensioning and Tolerancing Examples - ASME Y14.5-1994, B1.1, B1.13

Figure 17

ADV/DM Advanced Dimensional Management LLC

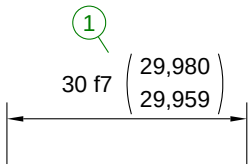
1



Unicode String:
DIM\w30 f7 (\u-0,020\n-0,041\u)

Basic Size with Deviations

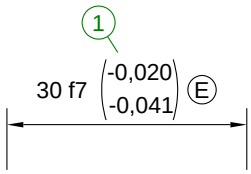
2



Unicode String:
DIM\w30 f7 (\u29,980\n29,959\u)

Basic Size with Limits of Size

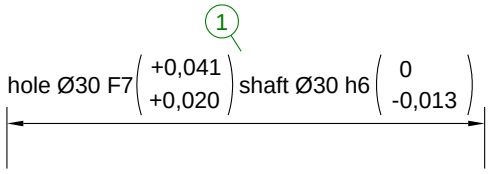
3



Unicode String:
DIM\w30 f7 (\u-0,020\n-0,041\u)Ⓔ

Basic Size with Deviations and Envelope Requirement

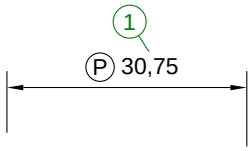
4



Unicode String:
DIM\w30 F7 (\u+0,041\n+0,020\u) shaft Ø30 h6 (\u0\n-0,013\u)

Basic Size with Deviations for Hole and Shaft in Assembly

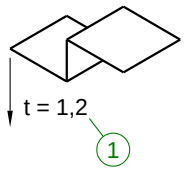
5



Unicode String:
DIM\wⓅ 30,75

Projected Tolerance Zone Dimension

5



Unicode String:
DIM\wt = 1,2

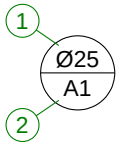
Thickness Dimension (where thickness of part was not modeled)

Mapping - 7: Complex Examples
Dimensioning and Tolerancing Examples - ISO 129-1:2006 & ISO 406:1987

Figure 18

ADV|D(M) *Advanced Dimensional Management LLC*

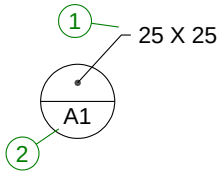
1



Unicode String:
TGT\wØ25\nA1

Datum Target Symbol: Target Area Inside

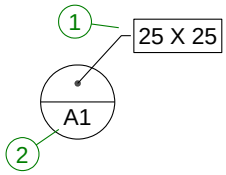
2



Unicode String:
TGTw25 X 25\nA1

Datum Target Symbol: Target Area Outside

3

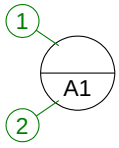


Unicode String:
TGT\w25 X 25\nA1

Note
Workshop preference. There is no means to indicate that item 1 is a basic dimension. Basic outline will be mapped as polylines.

Datum Target Symbol: Target Area Outside - Basic

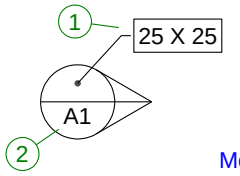
4



Unicode String:
TGT\w\nA1

Datum Target Symbol: No Target Area

5

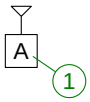


Unicode String:
TGT\w25 X 25\nA1

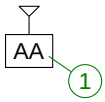
Note
Workshop preference. There is no means to indicate that item 1 is a basic dimension. Basic outline will be mapped as polylines.

Movable Datum Target Symbol: Target Area Outside - Basic

6



Unicode String:
DTM\wA



Unicode String:
DTM\wAA

Datum Feature Symbol: Examples 1 & 2

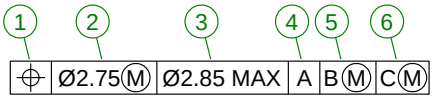
Note:
Mapping Annotation Entities on a By-Compartment Basis:
The Annotation Entities Datum Target Symbol, Datum Feature Symbol, and Feature Control Frame (Tolerance Frame in ISO) should be mapped on a By-Compartment basis. This means that the annotation in each compartment shall be treated as single field rather than breaking the annotation in each compartment into multiple fields. So, "Ø.005 Ⓜ" within the tolerance compartment of a Feature Control Frame shall be treated as a single field rather than 3 fields.
By definition and by rule, each of these Annotation Entities has a finite number of compartments.
Thus, a Feature Control Frame may have at most 6 compartments per ASME Y14.5M-1994, 5 compartments per ASME Y14.5-2009, and 5 compartments per ISO 1101:2004. It may be possible for a Feature Control Frame per ASME Y14.5-2009 to have 8 compartments, but this application is not illustrated or defined in the standard.

Mapping - 8: By Compartment - Datum Target and Datum Feature Symbols
Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 19

ADV/D(M) *Advanced Dimensional Management LLC*

1

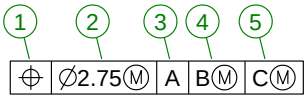


Unicode String:

FCF\w⌖\wØ2.75Ⓜ\wØ2.85 MAX\wA\wBⓂ\wCⓂ

Feature Control Frame: Single Segment: With Maximum Number of Compartments

2



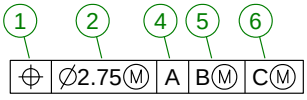
Unicode String:

FCF\w⌖\wØ2.75Ⓜ\wA\wBⓂ\wCⓂ

Note
Compartments numbered consecutively, even though one possible compartment was not used.

Feature Control Frame: Single Segment: Option 1 - Variable Compartment Numbering

3



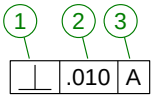
Unicode String:

FCF\w⌖\wØ2.75Ⓜ\w\wA\wBⓂ\wCⓂ

Note
Compartments numbered to correspond to the 6 possible compartments.
(Compartment 3 is missing.)

Feature Control Frame: Single Segment: Option 2 - Fixed Compartment Numbering

4

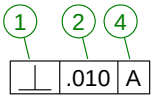


Unicode String:

FCF\w⊥\w.010\wA

Feature Control Frame: Single Segment: Option 1 - Variable Compartment Numbering

5

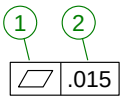


Unicode String:

FCF\w⊥\w.010\w\wA\w\w

Feature Control Frame: Single Segment: Option 2 - Fixed Compartment Numbering

6

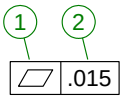


Unicode String:

FCF\w▱\w.015

Feature Control Frame: Single Segment: Option 1 - Variable Compartment Numbering

7



Unicode String:

FCF\w▱\w.015\w\w\w\w

Feature Control Frame: Single Segment: Option 2 - Fixed Compartment Numbering

Note:

We need to decide if we want to number the compartment fields for Feature Control Frames using Fixed or Variable Numbering as shown above.

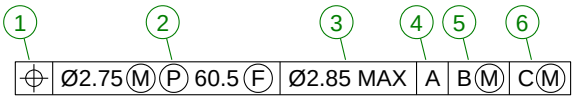
Mapping - 9: Feature Control Frames

Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 20

ADV/DM Advanced Dimensional Management LLC

1

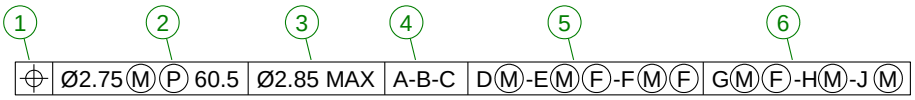


Unicode String:

FCF\w⌖\wØ2.75Ⓜ℗60.5Ⓕ\w2.85 MAX\wA\wBⓂ\wCⓂ

Feature Control Frame: Single Segment: Complex Content

2

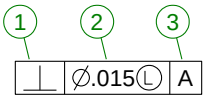


Unicode String:

FCF\w⌖\wØ2.75Ⓜ℗60.5\w2.85 MAX\wA-B-C\wDⓂ-EⓂ Ⓕ-FⓂⒻ\wGⓂ Ⓕ-HⓂ-JⓂ

Feature Control Frame: Single Segment: Complex Content

3

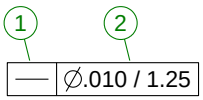


Unicode String:

FCF\w⊥\wØ.015Ⓛ\wA

Feature Control Frame: Single Segment: Perpendicularity

4

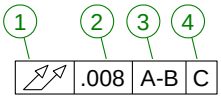


Unicode String:

FCF\w—\wØ.010 / 1.25

Feature Control Frame: Single Segment: Straightness - Unit-Basis

5

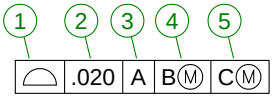


Unicode String:

FCF\w⌰\w.008\wA-B\wC

Feature Control Frame: Single Segment: Total Runout

6



Unicode String:

FCF\w⌓\w.020\wA\wBⓂ\wCⓂ

Feature Control Frame: Single Segment: Profile of a Surface

Note:

The examples on this page use variable compartment Numbering for Feature Control Frames.

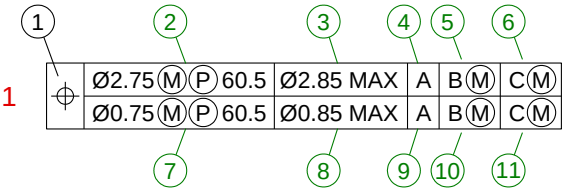
Mapping - 10: Complex and Other Feature Control Frames

Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 21

ADV/DM Advanced Dimensional Management LLC

1

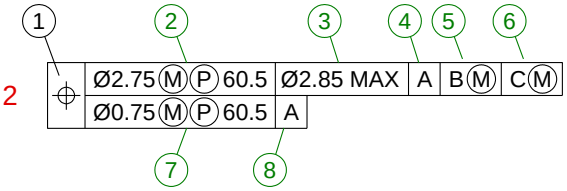


Unicode String:

FCF\w⌖\wØ2.75Ⓜ℗60.5\w2.85 MAX\wA\wBⓂ\wCⓂ\nØ0.75Ⓜ℗60.5\w0.85 MAX\wA\wBⓂ\wCⓂ

Composite Feature Control Frame: Complex - All Compartments Populated

2

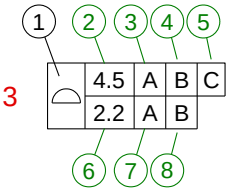


Unicode String:

FCF\w⌖\wØ2.75Ⓜ℗60.5\w2.85 MAX\wA\wBⓂ\wCⓂ\nØ0.75Ⓜ℗60.5\wA

Composite Feature Control Frame: Complex - All Compartments Not Populated

3

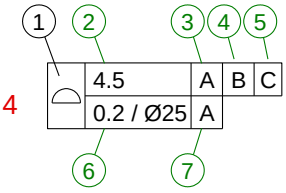


Unicode String:

FCF\w⌓\w4.5\wA\wB\wC\n2.2\wA\wB

Composite Feature Control Frame: Profile of a Surface

4

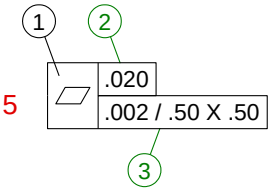


Unicode String:

FCF\w⌓\w4.5\wA\wB\wC\n0.2 / Ø25\wA

Composite Feature Control Frame: Profile of a Surface with Unit-Basis

5



Unicode String:

FCF\w▱\w.020\n.002 / .50 X .50

Composite Feature Control Frame: Flatness with Unit Basis

Note:

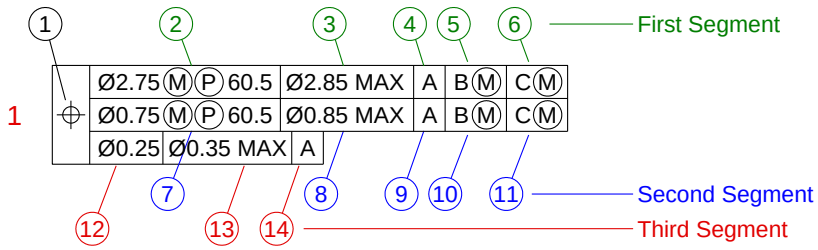
I propose to use the Mapping Scheme for Composite Feature Control Frames as shown above. The examples on this page use Fixed compartment Numbering for Feature Control Frames.

Mapping - 11: Composite Feature Control Frames

Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 22

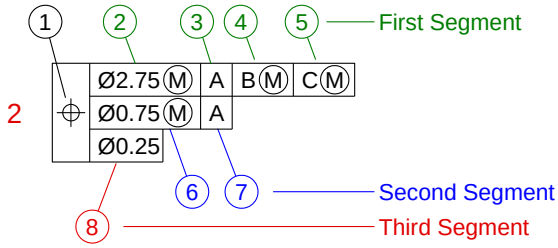
ADV/DM Advanced Dimensional Management LLC



Unicode String:

FCF\w⌖\wØ2.75Ⓜ℗60.5\w2.85 MAX\wA\wBⓂ\wCⓂ\nØ0.75Ⓜ℗60.5\w0.85 MAX\wA\wBⓂ\wCⓂ
\nØ0.25\w0.35 MAX\wA

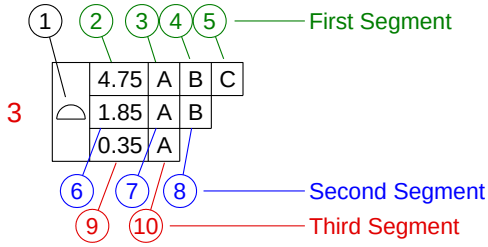
Composite Feature Control Frame: Complex: Position - Three Segments



Unicode String:

FCF\w⌖\wØ2.75Ⓜ\wA\wBⓂ\wCⓂ\nØ0.75Ⓜ\wA\nØ0.25

Composite Feature Control Frame: Complex: Position - Three Segments



Unicode String:

FCF\w⌓\w4.75\wA\wB\wC\n1.85\wA\wB\n0.35\wA

Composite Feature Control Frame: Complex: Position - Three Segments

Note:

The examples on this page use variable compartment numbering for Feature Control Frames.

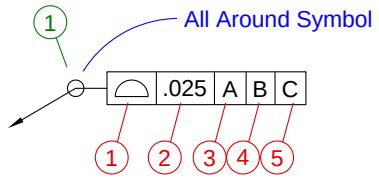
Mapping - 12: Composite Feature Control Frames: Complex

Dimensioning and Tolerancing Examples - ASME Y14.5M-1994

Figure 23

ADV|D(M) *Advanced Dimensional Management LLC*

1



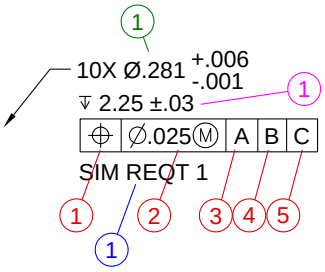
Unicode Strings:

AAS\w

FCF\w⌓\w.025\wA\wB\wC

Feature Control Frame: Profile of a Surface - All Around — ASME

2



Unicode Strings:

DIM\w10X Ø.281 \u+.006\n-.001\u

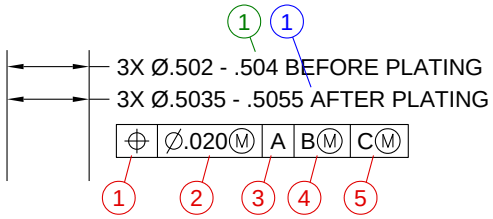
DIM\w↧ 2.25 ±.03

FCF\w⌖\wØ.025Ⓜ\wA\wB\wC

TXT\wSIM REQT 1

Size Dimension, Feature Control Frame and SIM REQT Keyword — ASME

3



Unicode Strings:

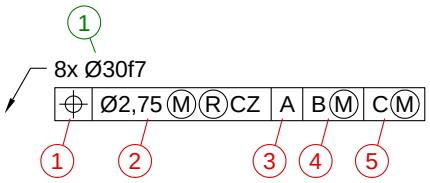
DIM\w3X Ø.502 - .504 BEFORE PLATING

DIM\w3X Ø.5035 - .5055 AFTER PLATING

FCF\w⌖\wØ.020Ⓜ\wA\wBⓂ\wCⓂ

Pre- and Post-Finishing Size Dimensions and Feature Control Frame — ASME

4



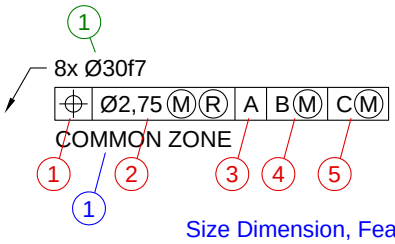
Unicode Strings:

DIM\w8x Ø30f7

FCF\w⌖\wØ2,75ⓂⓇCZ\wA\wBⓂ\wCⓂ

Size Dimension and Feature Control Frame — ISO 1101: 2004

5



Unicode Strings:

DIM\w8x Ø30f7

FCF\w⌖\wØ2,75ⓂⓇ\wA\wBⓂ\wCⓂ

TXT\wCOMMON ZONE

Size Dimension, Feature Control Frame and COMMON ZONE Keyword — ISO 1101:1983

Note:

I propose that each separate line in a related set of Annotation Entities be mapped as a separate Unicode String as shown above. The examples on this page use Variable compartment Numbering for Feature Control Frames.

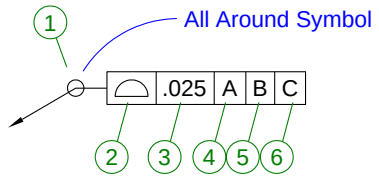
Mapping - 13: Annotation Sets: Related Entities as Individual Strings

Dimensioning and Tolerancing Examples - ASME Y14.5M-1994 & ISO 1101

Figure 24

ADV|DM Advanced Dimensional Management LLC

1

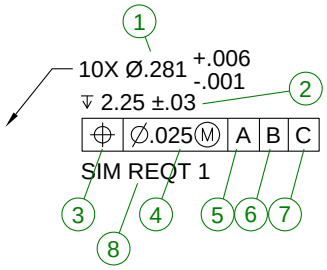


Concatenated Unicode String:

AAS\w\x\n
FCF\w⌓\w.025\wA\wB\wC

Feature Control Frame: Profile of a Surface - All Around — ASME

2

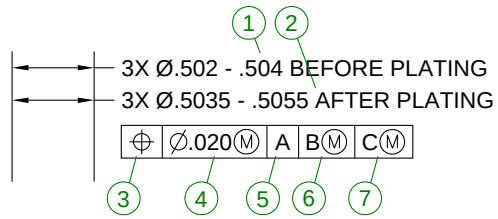


Concatenated Unicode String:

DIM\w10X Ø.281 \u+.006\n-.001\u\x\n
DIM\w↧ 2.25 ±.03\x\n
FCF\w⌖\wØ.025Ⓜ\wA\wB\wC\x\n
TXT\wSIM REQT 1

Size Dimension, Feature Control Frame and SIM REQT Keyword — ASME

3

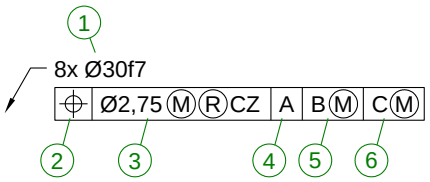


Concatenated Unicode String:

DIM\w3X Ø.502 - .504 BEFORE PLATING\x\n
DIM\w3X Ø.5035 - .5055 AFTER PLATING\x\n
FCF\w⌖\wØ.020Ⓜ\wA\wBⓂ\wCⓂ

Pre- and Post-Finishing Size Dimensions and Feature Control Frame — ASME

4

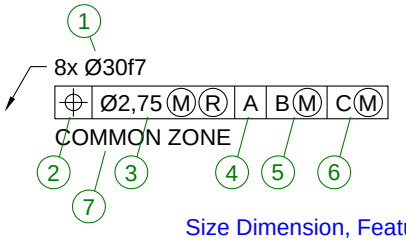


Concatenated Unicode String:

DIM\w8x Ø30f7\x\n
FCF\w⌖\wØ2,75Ⓜ ⓇCZ\wA\wBⓂ\wCⓂ

Size Dimension and Feature Control Frame — ISO 1101: 2004

5



Concatenated Unicode String:

DIM\w8x Ø30f7\x\n
FCF\w⌖\wØ2,75Ⓜ Ⓡ\wA\wBⓂ\wCⓂ\x\n
TXT\wCOMMON ZONE

Size Dimension, Feature Control Frame and COMMON ZONE Keyword — ISO 1101:1983

Note:

In these examples, each separate line in a related set of Annotation Entities is mapped as a distinct Unicode String, and each of these strings is concatenated into a larger Unicode String.

Mapping - 14: Annotation Sets: Related Entities Concatenated into a Single String

Dimensioning and Tolerancing Examples - ASME Y14.5M-1994 & ISO 1101

Figure 25

5 Mapping Examples: Surface Texture and Welding Symbols

Unicode String Workshop 07/29 – 07/31 2009: Unicode String (UCS) Mapping Solutions for Surface Texture Symbols and Welding Symbols

Unicode String mapping solutions for Surface Texture Symbols and Welding Symbols were developed at the UCS Workshop in Seattle July 29–31, 2009. ISO and ASME standards were consulted and solutions developed that work for both systems. These solutions follow.

Surface Texture Symbol Mapping:

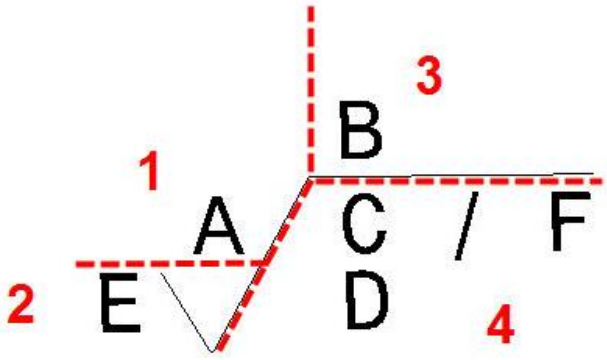


Figure 26: Surface Texture Symbol Mapping Regions

Locations for Data entered into a Surface Texture Symbol are separated into distinct regions as shown above in Figure 26 Solutions are intended to work when mapping Surface Texture Symbols per ISO1302-2002 and ASME 14.36M – 1996 (R2008).

Keyword Names for Surface Texture Symbols:

Refer to Figure 27 for a graphical representation of UCS Surface Texture Symbol mapping.

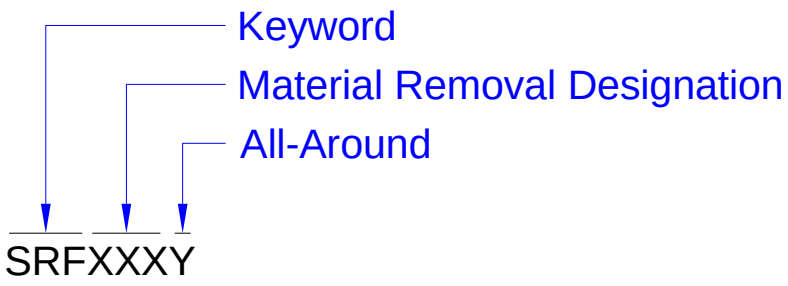


Figure 27: UCS Mapping for Surface Texture Symbols

General Mapping: Symbol Name + Suffix_1 (Optional) + Suffix_2 (Optional)

Symbol Name: SRF

Suffix_1: Material Removal Designation

APA	Any Process Allowed
MRR	Material Removal Required
NMR	No Material Removed

Suffix_2: All-Around or Not All-Around

A	All-Around
N	Not All-Around

Keyword Examples Including Suffixes:

SRFAPAA	Any Process Allowed, All-Around
SRFAPAN	Any Process Allowed, Not All-Around
SRFMRRA	Material Removal Required, All-Around
SRFMRRN	Material Removal Required, Not All-Around
SRFNMRA	No Material Removed, All-Around
SRFNMRN	No Material Removed, Not All-Around

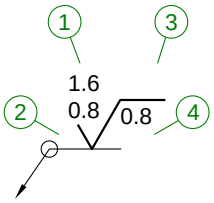
Refer to Figure 5 on page 6 of ASME 14.36M – 1996 (R2008) Surface Texture Symbols for the specifications that correspond to the following Unicode Strings.

Mapped Examples:

SRFAPA\w\w1.6\w\w\w0.8
SRFAPA\w\w1.6\r0.8\w\w\w0.8
SRFNMR\w\w1.6\w\w\w0.8
SRFAPA\w\w0.8\w\w\w2.5
SRFAPA\w\w0.2\w\w\w0.8\r2.5/R\u\rz\u0.8\r=
SRFAPA\w\w\w\w2.5/R\u\rz\u0.4
SRFAPA\w\w\w\w2.5/R\u\rz\u0.8
SRFAPA\w_\w0.8\w\w\w0.8\r_
SRFAPA\w\w0.8\w\w0.8/S\u\rM\u0.5\r_
SRFMRR\w\w1.6\w6\wNOTE X\w0.8
SRF\w1.6\r6\w0.8\wNOTE X

ADV/DM Advanced Dimensional Management LLC

1

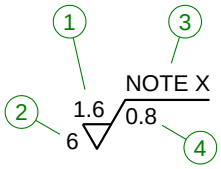


Unicode String:

SRFAPA\w1.6\n0.8\w\w\w0.8

Surface Texture - All Around

2

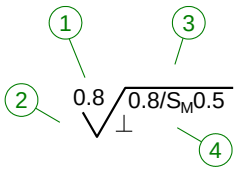


Unicode String:

SRFMRR\w1.6\w6\wNOTE X\w0.8

Surface Texture - Material Removal Prohibited

3



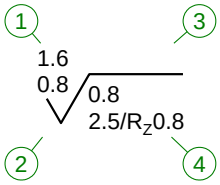
Unicode String:

SRFAPA\w0.8\w\w\w0.8/S\u\nM\u0.5\n ⊥

Surface Texture - Roughness Spacing & Perpendicular Lay

4a

Standard Orientation

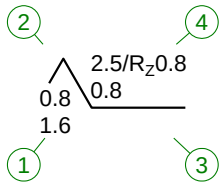


Unicode String:

SRFAPA\w\u1.6\n0.8\u\w\w\w\u0.8\n2.5/R_Z0.8\u

4b

Inverted Symbol, Text Inverted

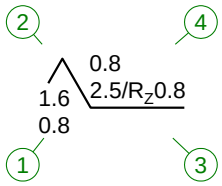


Unicode String:

SRFAPA\w\u0.8\n1.6\u\w\w\w\u2.5/R_Z0.8\n0.8\u

4c

Inverted Symbol, Text Not Inverted



Unicode String:

SRFAPA\w\u1.6\n0.8\u\w\w\w\u0.8\n2.5/R_Z0.8\u

Surface Texture - Standard Orientation and Inverted

Surface Texture Symbol and Mapping Examples

Figure 28

Welding Symbol Mapping:

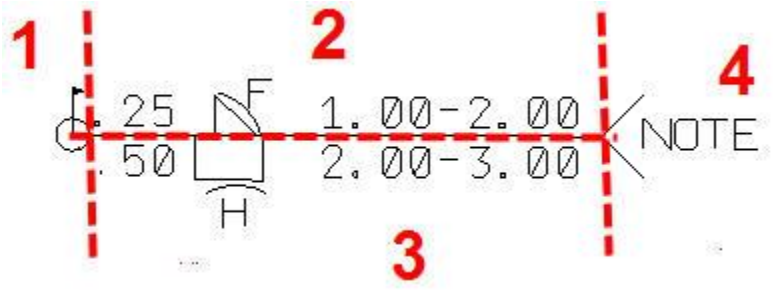


Figure 29: Welding Symbol Mapping Regions

Locations for data entered into a Welding Symbol are separated into distinct regions as shown above in Figure 29 Solutions are intended to work when mapping Welding Symbols per ISO 2553 and AWS A2.4 standards for Welding Symbols.

Keyword Names for Surface Texture Symbols:

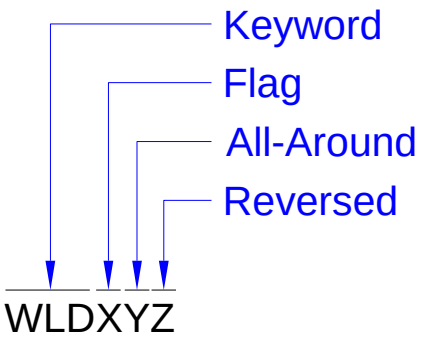


Figure 30: UCS Mapping for Welding Symbols

General Mapping:

Symbol Name + Suffix_1 + Suffix_2 + Suffix_3

Symbol Name: WLD

Suffix_1: Flag, No Flag

F	Flag
N	No Flag

Suffix_2: All Around, Not All Around

A	All Around
N	Not All Around

Suffix 3: Reversed:

R	Reversed

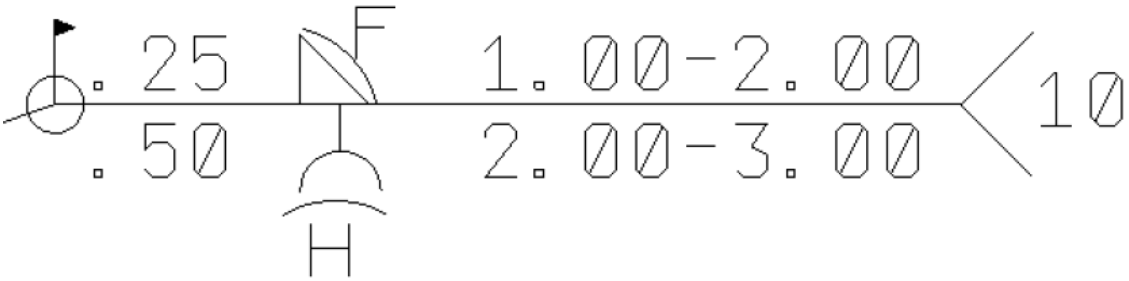


Figure 31: Welding Symbol Example

Keyword Examples Including Suffixes:

WLDFAR	Flag, All-Around, Reversed
WLDNAR	No Flag, All-Around, Reversed
WLDFNR	Flag, Not All-Around, Reversed
WLDNNR	No Flag, Not All-Around, Reversed
WLDFAN	Flag, All-Around, (Not Reversed)
WLDNAN	No Flag, All-Around, (Not Reversed)
WLDFNN	Flag, Not All-Around, (Not Reversed)
WLDNNN	No Flag, Not All-Around, (Not Reversed)

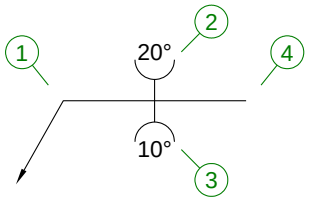
Mapped Examples:

UCS Mapping for welding specification in Figure 31.

WLDFAN\w\w.25\uF\n□\n□\u1.00-2.00\w.50\u□\n□\nH\u2.00-3.00\w10

ADV/DM Advanced Dimensional Management LLC

1

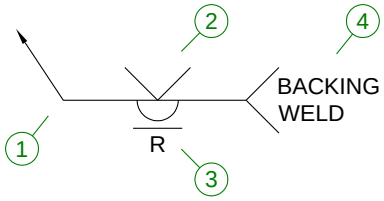


Unicode String:

WLDNNN\w\w\u20°\n□\u\w\u□\n10°\u

Welding Symbol - 6.3.3

2

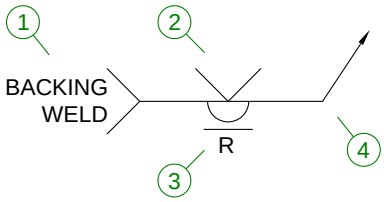


Unicode String:

WLDNNN\w\w□\w\u□\n□\nR\u\w\uBACKING\nWELD\u

Welding Symbol - 6.7.4.2

3

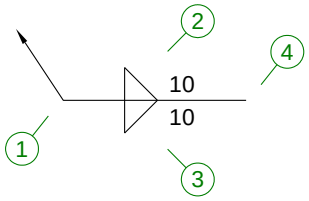


Unicode String:

WLDNNR\w\uBACKING\nWELD\u\w□\w\u□\n□\nR\u\w

Welding Symbol - 6.7.4.2 - Reversed

4



Unicode String:

WLDNNN\w\w□10\w□10

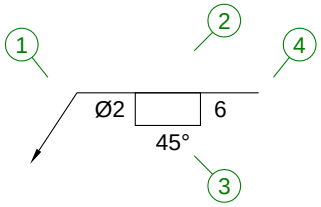
Welding Symbol - 7.3.1

Welding Symbol and Mapping Examples

Figure 32

ADV/DM Advanced Dimensional Management LLC

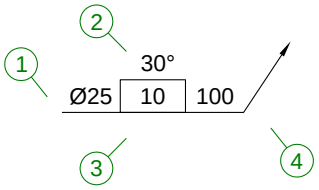
5a



Unicode String:

WLDNNN\w\w\wØ2\u□\n45°\u6

5b

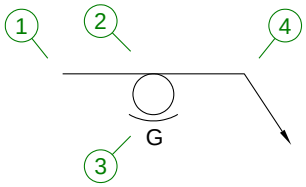


Unicode String:

WLDNNR\w\wØ25\u30°\n□\n10\u100

Welding Symbols - 8.1.3

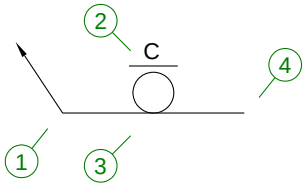
6a



Unicode String:

WLDNNR\w\w\w\u□\n□\nG\u

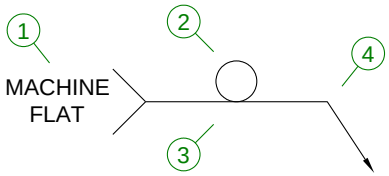
6b



Unicode String:

WLDNNN\w\w\uC\n□\n□\u

6c



Unicode String:

WLDNNR\w\uMACHINE\nFLAT\u\w□

Welding Symbols - 10.6.2

Welding Symbol and Mapping Examples

Figure 33

Annex A Legend for Unicode String Specification

Keyword Definitions:

Sample:

All-Around Symbol	**AAS**	
All Over Symbol	**AOS**	
Datum Feature Symbol	**DTM**	
Datum Target Symbol	**TGT**	
Dimension	**DIM**	
Feature Control Frame (ASME)	**FCF**	(Same as Tolerance Frame in ISO)
Flag Note	**FLG**	
Surface Texture Symbol	**SRF**	
Tolerance Frame (ISO)	**FCF**	(Same as Feature Control Frame in ASME)
Text	**TXT**	
Welding Symbol	**WLD**	

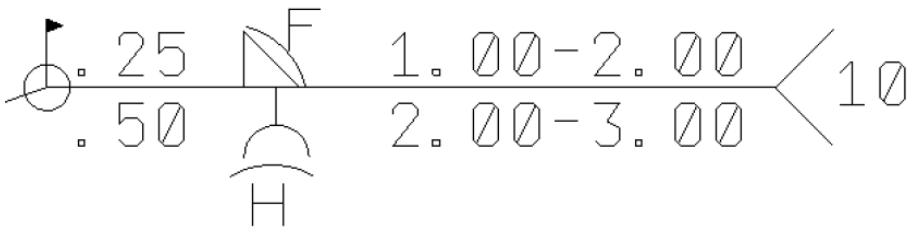
Surface Texture Symbols:

Standard Surface Finish:	**SRF**	e.g. SRF\w1.6\n6\w0.8\wNOTE X
Any Process Allowed:	**SRFAPA**	e.g. SRFAPA\w\w1.6\w\w\w0.8
Material Removal Required:	**SRFMRR**	e.g. SRFMRR\w\w1.6\w6\wNOTE X\w0.8
No Material Removed:	**SRFNMR**	e.g. SRFNMR\w\w1.6\w\w\w0.8

A = All around
N = Not all around

SRFAPAA
SRFAPAN
SRFMRRA
SRFMRRN
SRFNMRA
SRFNMRN

Welding:



Standard: **WLD** e.g. WLD\w⌈ ○ \w.25\uF\n⌒ \n✓ \u1.00-2.00\w.50\uY\n⌒ \nH\u2.00-3.00\w10

Reversed: **WLDR**

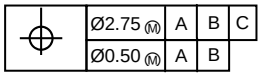
Unicode String Operator Definitions

\n New Line, Hard Return, Wrapping, or Soft Return

Use a hard carriage return to denote the following text occurs on a separate line. This is a literal carriage return because a new line of characters begins below the previous line, within the same string.

\n is also used as a separator between strings in a concatenated superstring. See page Mapping - 14: Annotation Sets: Related Entities Concatenated into a Single String in the Mapping Section of the report.

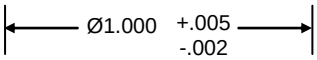
Use a soft return prior to text to denote a semantic separation. This would include texts and symbols that belong to a single string of text, and are on the same line, but are symbolically distinct. For example, the datum identifiers in a feature control frame. This supports the top down left right rule that we have designated for this specification.

Example: 

FCF\w⌖ \w⌀ 2.75Ⓜ\wA\wBwC\n⌀ 0.50Ⓜ\wA\wB

\u Stack or upper/lower limits

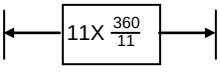
This character set denotes a bilateral tolerance condition. Place the \u prior to the text appearing on the top to denote the end of the upper level text and at the end of the bottom end of the tolerance string to close.

Example: 

DIM\wØ1.000\u+.005\n-.002\u

\v Fraction

This character set is similar to the stack or upper and lower limits (\u) except it has a horizontal line between the limits. The example shown is on a Theoretically Exact Dimensional string.

Example: 

DIM\w11X \v360°\n11\v

\w Field or compartment separator

Unicode text strings are structured in several fields that are separated by \w character set. For annotation entities with compartmentalized data, the fields are mapped to correspond to the appropriate compartment in the annotation entity.

Annex B Text Encoding

B.1 Placeholder for unspecified symbols

It may happen that when calculating the Unicode string for a given annotation, that annotation contains symbols which are not handled in this document. This may be the case e.g. when company-specific guidelines are used to create the original PMI in the 3D model, or when product definition standards are used in this process which are out of scope for this document.

In this case, the unspecified symbols shall be replaced by a Unicode placeholder character, namely:

Unicode (X2 encoding, see 0): `FFFD` Shown as: 

B.2 \S\ characters

Within STEP Part 21, only printable characters are allowed as a part of a string. Within a string, \S\ denotes that the immediately following character represents a character with the binary value 128 higher. For example, `\S\1` represents the plus-minus symbol. The character 1 in ASCII has the binary representation equal to 49. The plus-minus symbol has the binary representation equal to 177.

The following are common characters which might be used by GD&T data.

Name	Symbol	Unicode
Copyright	©	`\S\)`
Degree	°	`\S\0`
Diameter	⌀	`\S\X`
Plus-Minus	±	`\S\1`
Pound Sterling	£	`\S\#`
	¬	`\S\,`

B.3 Unicode Symbols

Within STEP Part 21, Unicode characters can be defined within a string by an X2 encoding. If the characters '\X2\' are found, they should be followed by one or more sets of 4 hexadecimal characters (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F). Each set of 4 hexadecimal characters represents a character or symbol defined by the Unicode tables (see www.unicode.org).

The following symbols might be used by GD&T data.

Name	Symbol	Unicode
Angularity	∠	2220
Arc length	⌒	2330
Between	↔	2194
Cap Omega	Ω	03A9
Center Line	℄	2104
Circular Runout	↗	2197
Circularity	○	25CB
Concentricity	◎	25CE
Conical Taper	⌲	2332
Continuous Feature	⟨CF⟩	Not yet in Unicode
Controlled Radius	CR	No Unicode (plain text)
Counterbore	⌴	2334
Countersink	⌵	2335
Cylindricity	⌭	232D
Degree	°	00B0
Diameter	⌀	2300
Depth	↧	21A7
Envelope Requirement	Ⓔ	24BA
Flatness	▱	23E5
Free State	Ⓕ	24BB
Independency	Ⓘ	24BE
Least Material Condition	Ⓛ	24C1
Max Material Condition	Ⓜ	24C2
Parallelism	//	2AFD
Perpendicularity	⊥	23CA
Plus/Minus	±	00B1
Position	⌖	2316
Profile of a Line	⌒	2312
Profile of a Surface	⌓	2313

Name	Symbol	Unicode
Projected Tolerance Zone	Ⓟ	24C5
Radius	R	No Unicode (plain text)
Reciprocity	Ⓡ	24C7
Regardless of Feature Size	Ⓢ	24C8
Slope	⌓	2333
Small Omega	ω	2375
Spherical Diameter	S⌀	Plain S + 2300
Spherical Radius	SR	No Unicode (plain text)
Spotface	⌴	Not yet in Unicode
Square	□	25A1
Statistical Tolerance	⌔	Not yet in Unicode
Straightness	—	23E4
Symmetry	⌯	232F
Tangent Plane	Ⓣ	24C9
Total Runout	⌰	2330
Translation Modifier	▷	25B7
Unilaterally / Unequally Disposed	Ⓤ	24CA