

Guideline (not under Configuration Control)

CAD Manual 09 - Drawing Best Practices

This document describes the ITER DO Drawing Best Practices and Methodologies.

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9 ITER Drawing Practices


This section describes the general procedures to be followed in producing drawings for ITER. The detailed procedures refer to general rules which shall be applied whatever the CAD tool used, and the same principles and practices should be applied at any site contributing ITER drawings. ITER drawing practices are also in conformity with ISO Standards Handbook 12 “Technical Drawings”.


If any mismatch between this document and any ISO standard would occur, the definition of the ISO standard have to be applied.

9.1 Quick Reference Guide to rules

The following table provides an overview of the rules contained in this section of the CAD Manual.

For Categories (Cat.): M = Mandatory (Shall comply)
R = Recommended (Should comply)
FB = Filebased....

Rule N°	Rule Description	Cat.	Q-Checker Rule	FB/ EV5	hyperlink 
RED02	The first sheet (Sheet.1) or MODIFICATION_SHEET) shall always be the ‘Modification sheet’.	M		F/E	9.2
RED03	The second sheet (Sheet.2) is the first of the drawing sheets.	M		F/E	9.2
RED06	For each revision of a drawing sheet the information about the modification shall be entered on the modification sheet.	M		F/E	9.2.1
RED07	If the modification sheet becomes full, then the current entries are removed and an entry is made stating that the earlier history is shown on the previous revision of the Drawing. There shall be only 1 modification sheet per Drawing.	M		F/E	9.2.1
RED12	For supplier manufacturing drawings first angle projection can be used. Clear normalized indication in the supplier title block is required.	M		F/E	9.3.2
RED14	The drawing number is unique across the whole ITER project and is also independent of the PBS levels	M		E	9.4
RED15	The drawing “DESCRIPTION” field must start with the main assembly name e.g., “BL” for Blanket, “CS” for Central solenoid, “DIV” for Divertor, etc ...	M		E	9.4
RED18	For each kind of these listed drawings (from a to d) be sure to choose the right location depending on technical needs (Enovia V5, SMDD, etc...)	M		F/E	9.7
RED22	Drawings produced by the Suppliers/Manufacturers may be bi-lingual. The primary language is English and the secondary language is that of the supplier/manufacturer.	M		F/E	9.8.1

Rule N°	Rule Description	Cat.	Q-Checker Rule	FB/EV5	hyperlink 
RED30	All dimensioning shall conform to ISO 129: “Engineering Drawing – Dimensioning”. See also ISO Standards Handbook 12.	M		F/E	Error! Reference source not found.
RED31	All models shall have dimensions that are true. Text editing of dimension values is not allowed.	M		F/E	Error! Reference source not found.
RED34	The drawing notes should be as clear and concise, to convey the relevant information. The notes must be sequentially numbered.	M		F/E	9.12
RED36	All drawings classified as ‘ITER RESTRICTED’ shall be clearly marked as such on each drawing sheet.	M		F/E	9.15

9.2 Standard Drawing Sheets

Non-standard sizes or formats shall not be used. The smallest suitable sized drawing sheet shall always be used.

The first sheet (Sheet.1) in the Drawing shall always be the ‘Modification sheet’ (RED02- Figure 9.2-1 shows a typical modification sheet).

The second sheet (Sheet.2) is the first of the drawing sheets (RED03-[Error! Reference source not found.](#) shows a typical A3 sheet).

9.2.1 Modification Sheet

Each CATDrawing file shall have a modification sheet. This shall always be the first sheet (Sheet.1) in the series of sheets. (Figure 9.2-1 shows a typical modification sheet).

For each revision of a drawing sheet the information about the modification shall be entered on the modification sheet (RED06).

If the modification sheet becomes full, then the current entries are removed and an entry is made stating that the earlier history is shown on the previous revision of the CATDrawing. There shall be only 1 modification sheet per CATDrawing(RED07).

The figure shows a template for a modification sheet, which is a drawing sheet with a grid. The grid is 8 columns wide and 4 rows high. The columns are numbered 1 to 8, and the rows are lettered A to D. The title block is located in the bottom right corner, spanning columns 5 to 8 and rows C to D. It contains the following information:

REV. NO.				DETAILS OF MODIFICATION				SHEET GRID				DATE				DCH. NO.			
R5C63B				G7ZJET				ITER Organization				Ch-0000				GUYANA			
608 Test PBS				Training Zone 00				VOLLMAT				ITER DRAWING				MAIN VIEWS			
22 Apr 15				CD				BELOGLS				ISO-VIEW				---			
K3				T-1				W				01				04 76 AA.00			
037337				---				W											

Figure 9.2-1 A Typical Modification Sheet

9.3 Drawing Projection

9.3.1 Third Angle projection

All IO drawing projections shall be in **THIRD ANGLE** (see ISO 5456-2).

In those cases where it would be advantageous to position the views not according to the strict pattern of the third angle projection method, the use of the reference arrows method permits the various views to be freely positioned. With the exception of the principal view, each view shall be identified by a capital letter placed immediately below the view in accordance with Figure 9.3-1. A lower-case letter indicates in the principal view the direction of observation of the other views.

Whatever the direction of observation, the capital letters identifying the views shall always be positioned to be read from the normal direction of viewing of the drawing.

This is in accordance with ISO 5456-2.

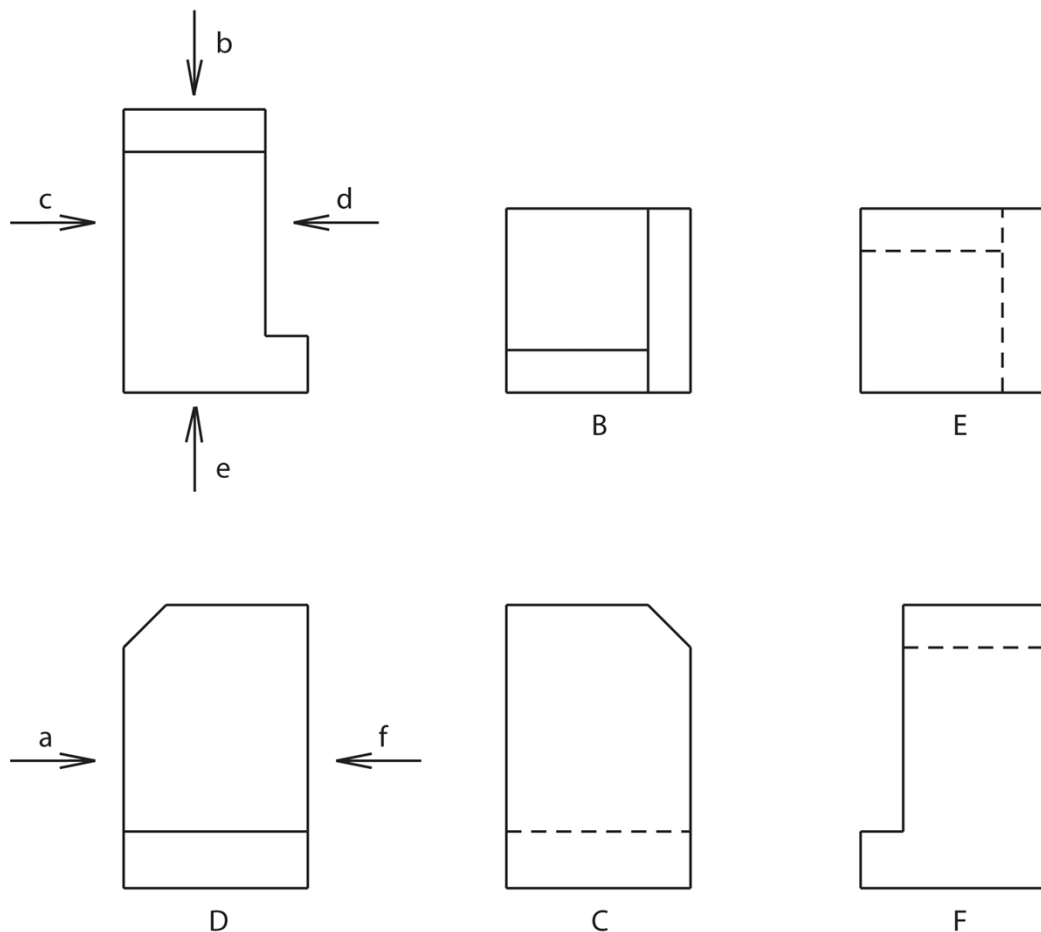


Figure 9.3-1 Identifying Views

For third angle projection, and following the ISO 5456-2 norm, the name of the view should be positioned below the views.

9.3.2 First angle projection

For supplier manufacturing drawings first angle projection can be used in countries where the national preference goes to this mode of projection,
Clear normalized indication in the supplier title block is required (**RED12**).

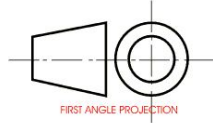


Figure 9.3-2 2 First angle projection

For first angle projection, and following the ISO norm, the name of the view should be positioned above the views.

9.4 ITER Title Block

The ITER title block and drawing frames shall appear on the drawing.

This chapter applies to all drawings generated under the IO responsibility. For drawings generated by DAs and suppliers, please refer to the chapter 9.5

The following sub-sections describe the contents of each of the boxes in the ITER title block.



DRW DOC ID R5C63B		RELEASED BY CHIOCCS		ITER Organization			
LINKED EV5 PT ID G7ZZJET		APPROVED BY CHYUANV		DRAWING TITLE ITER DRAWING MAIN VIEWS ISO-VIEW			
PBS TITLE EDB Test PBS Training Training Zone 00		CHECKED BY VOLLMAT					
REV DATE 19 Aug 15	PT MATURITY CD	PT VERSION - - -	CONTROLLED BY BELOGLS				
SHEET FORMAT A0	SCALE 1:100	PT STATUS W	DRAWN BY HEIDLH				
THIRD ANGLE PROJECTION 		SHEET 02	N° OF SHEETS 05	PBS 3 LEVELS 76 AA 00	DRAWING NUMBER 037337	REVISION - - -	DR STATUS W

Figure 9.4-1 The ITER Title Block

9.5 ITER Title Block for Isometric drawings


DRW DOC ID URU83Z			REFRASRD BY -		ITER Organization		 china EU India Japan Korea Russia USA
LINKED EV5 PT ID QRACKL			APPROVED BY -		DRAWING TITLE 2nd TITLE LINE - CATIA PARAMETER 3rd TITLE LINE - CATIA PARAMETER		
PBS TITLE EDB Test PBS Testing			CHECKED BY -				
REV DATE 14 Apr 17			PT MATURITY CD				
SHEET FORMAT A0		SCALE N/A		PT STATUS W		DRAWN BY -	
THIRD ANGLE PROJECTION N/A		SHEET 01		N° OF SHEETS 01		PBS 3 LEVELS 76,TE,--	
				DRAWING NUMBER 043906		REVISION ---	
						DR STATUS W	
21		22		23		24	

Figure 9.5-1 Example of piping ITER Isometric Title Block

9.5.1 DRAWING NUMBER

This is a unique sequential number defined when the drawing is created. . This drawing number is unique across the whole ITER project and is also independent of the PBS levels (**RED14**). The drawing number when used in conjunction with the sheet No., Revision and status will identify exactly the drawing for the purpose of quoting in documentation. For example shown thus 000665_02_--B_W describes the drawing in section **Error! Reference source not found.**

9.5.2 SHEET

This is the sheet number in the series of sheets with the same drawing number.

9.5.3 REVISION

This is the document revision given by the CAD/PLM system. The value contains up to 3 alphabetical characters.

9.5.4 STATUS

This is the document status/maturity given by Enovia. The values are:

‘W’ for ‘In Work’

‘D’ for ‘Draft’

‘C’ for ‘In Check’

‘A’ for ‘Approved’

‘O’ for ‘Obsolete’

“EP” for External Partner Draft (EP_Draft)

“DD” for Domestic Agency Draft (DA_Draft)

9.5.5 DRAWING TITLE

The drawing name field must start with the main assembly name e.g., “BL” for Blanket, “CS” for Central solenoid, “DIV” for Divertor (**RED15**), “PF1” for Poloidal Field coil number 1,

“TF” for Toroidal Field coil, “VV” for Vacuum Vessel etc. This will help people who have only the drawing to identify the Assembly more easily. The first line is identical on all drawing sheets of the CATDrawing.

The title shall be as concise as possible whilst retaining clarity.

Generally the drawing title is expanded from the 3D model title with additional information to identify each drawing sheet. Any code, type or reference number relating to the equipment shall be included. This inclusive title will generally be given to the design specification, and it should appear on all general arrangements and assembly drawings together with their associated parts lists and diagrams. Only abbreviations and acronyms included in the ITER [‘DO Abbreviations \(24844F\)’](#) list are to be used in the title.

9.5.6 DRAWN BY

This field concerns the creator/designer of the drawing

9.5.7 CONTROLLED BY

This is the name of responsible engineer.

9.5.8 CHECKED BY

The design office checker is designated by the DOM.

9.5.9 APPROVED BY

This is the person within the component owner organisation assigned to approve drawings.

9.5.10 RELEASED BY

This is the person in Design Integration assigned to release drawings.

9.5.11 ORGANISATION NAME

This is the site location of the CAD office. The figure example shows ‘ITER ORGANIZATION’ this is the ITER IO DO in Cadarache.

9.5.12 ENOVIA ITER ID

This is the six character alpha-numeric unique ITER id number generated by the ENOVIA number generator for the drawing.

9.5.13 USED ON

This is the ITER id number for the assembly or part the drawing is used on.

9.5.14 PBS TITLE

The PBS title is shown on 3 separate lines. REV DATE

9.5.15 REV DATE

This date is supplied by ENOVIA when the drawing is registered. PT MATURITY

This is the part maturity for the part that contains the drawing document.

The part maturity varies from CD ‘Concept Design’ to AI ‘As Installed’ and describes the lifecycle of the whole project. Maturity values will be defined in detail by the project.

9.5.16 PT VERSION

This is the part version given by ENOVIA. The value contains up to 3 numerical characters. The current standard implementation of ENOVIA shows alpha characters – this will be customised to numbers.

9.5.17 SHEET SIZE

Information depending upon the frame selected in drawing for each sheet.

9.5.18 SCALE

This is the general scale generally defined for the principal view.

9.5.19 THIRD ANGLE PROJECTION

This is the drawing projection used for all ITER drawings. (See 9.3 Drawing Projection)

9.5.20 NO. OF SHTS

This is the number of drawing sheets in the series with the same drawing number.

9.6 Title-Block and Banners management for suppliers, DAs and IO

1. Requirements for DA and External contributors drawings identification:

- The manufacturing supplier (owner) of the drawing must have his title-block in the bottom right hand corner complying with his drawing management plan.
- The full supply chain validation/ lifecycle must be identifiable on the drawing: This implies for the DA and for IO to show their recording of the drawing registration and checking of the drawing onto the drawing itself.

2. Implementation:

- The owner of the drawing shall apply its own title-block in the bottom right hand corner of each sheet of the drawing. The FTB Manager application allows the supplier to include on it its own title blocks
For the supplier, the easiest solution –not mandatory- is to use the ITER titleblock as template, and then to change the logo and names as appropriate for the supplier [ITER_D_HQV46Z - How to prepare a Titleblock to implement in FTB Manager](#)
- The minimum required information is title, unique identification or drawing number, status and version. All information within the title block does not come necessarily from Enovia (ex: second & third lines of title).
- The supplier shall keep the bottom border and the left hand border clear of any grid line, graphical sign or text, these areas being reserved for DA and IO banners according to the dimensions given hereafter. The DA will display the information of the drawing registration and status as following the DA checking and promotion process using a reserved space area in the left hand border of the drawing, so-called “DA Banner”

- The IO will display the information of the drawing registration and status as following the IO checking and promotion process using a reserved space area in the bottom left corner of the drawing border, so-called “IO Banner”.

The supplier drawing sheets shall comply with the standards: ISO 5457-1999 and ISO5457/A1-2010

9.6.1 Banners Definition

Location: DA Banner: Left hand side border as shown below in “Example of a typical drawing” picture.

IO Banner: Bottom border as shown below in “Example of a typical drawing” picture.

Content: DA banner: content requested by DA QA

IO banner: content requested by IO QA

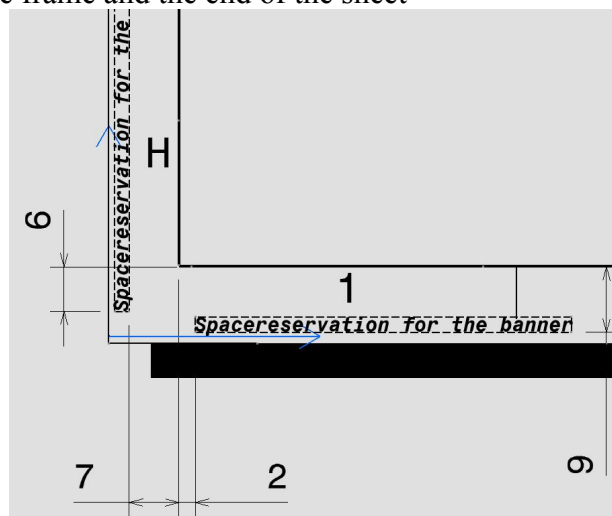
The precise content will be define on a later stage.

Method: Drawing file: Depending of functionalities for each CAD tool.

PDF file: Applied through the use of SMDD

[ITER_D_LYEH46 - Working Instruction for Usage of SMDD](#)

Size: Between the frame and the end of the sheet



Position: The position of DA banner shall take place vertically at the bottom left corner of the CV5 drawing, between the frame and the external border of the paper sheet. The DA banner shall be centred between the frame of the drawing and the text “Space reservation for the banner”

The position of IO banner shall take place at the bottom left corner of the CV5 drawing, between the frame and the external border of the paper sheet. The IO banner shall be centred between the frame of the drawing and the text “Space reservation for the banner”

DA banner and IO banner shall appear in superposition and “bring to front” of already existing text (ex: grid for position 1-2-3, A-B-C, etc ...)

Graphical Summary:

Example of typical drawing with SMDD banners

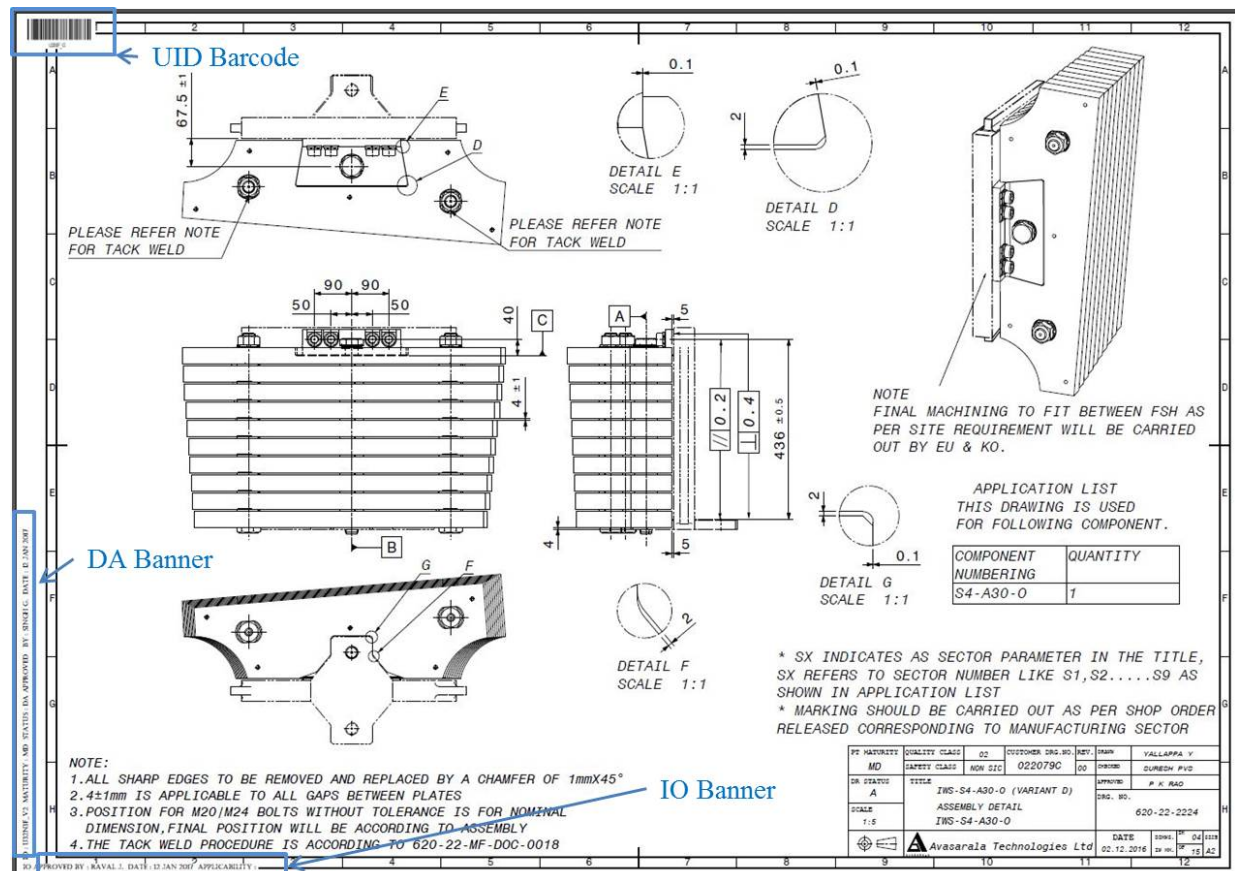
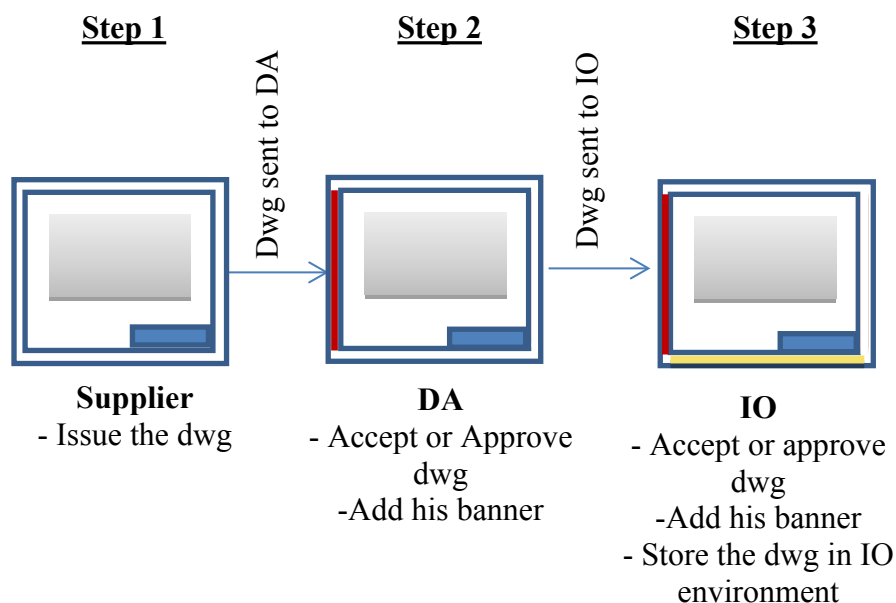


Figure 9.6-1 Banners location

Note: IO Banner is only added when IO Approves/Accepts/Rejects

PROCESS:



9.7 Type of drawings

Respecting the different CAD tools and collaboration schemes used in the project we can classify drawings according to source and storage area.

a) Native drawing stored in ENOVIA – IO, DA, supplier

Native drawings which are also normally based on 3D data stored in ENOVIA shall be saved in ENOVIA following all rules of the CAD-Manual. Native drawings from ENOVIA will automatically be stored in addition as PDF in SMDD.

b) Native drawing without 3D submitted to IO stored as PDF in SMDD – supplier, IO, DA
Supplier working with CAD tools file based can store the drawings exclusively in SMDD.

c) Drawing – dress up with other CAD system, ex AutoCAD – SMDD

Specific drawings like General Arrangement drawings can be produced with the following methodology:

1. Generate a native drawing based on original 3D data. This drawing shall be saved in ENOVIA as master.

2. Clean and dress up can be made with other CAD software like AutoCAD. The result shall be stored as PDF in SMDD with the native (AutoCAD...) file as attachment.

The native drawing remains the official document (Master).

Autocad files or other file format shall contain ID/drawing number as reference.

For each kind of these listed drawings (from a to c) be sure to choose the right location depending on technical needs (Enovia V5, SMDD, etc...) (**RED18**).

9.8 Drawing Presentation

9.8.1 Text Language used on Drawings

Drawings produced by the Suppliers/Manufacturers may be bi-lingual. The primary language is English and the secondary language is that of the supplier/manufacturer. The English text shall have exactly the same technical meaning as the supplier/manufacture text, and the English version is the contractual reference for IO review.

When bi-lingual text is used it shall apply to all texts on the drawing (**RED22**).

9.8.2 Dimensioning of Drawings

All dimensioning shall conform to ISO 129: “Engineering Drawing – Dimensioning”. See also ISO Standards Handbook 12 (**RED30**).

9.8.3 True Dimensioning

All models shall have dimensions that are true. Text editing of dimension values is not allowed (**RED31**).

9.8.4 Necessary Dimensions

Dimensions other than necessary to describe the end product should not be given. No feature should be located by more than one dimension in any one direction. Exceptions to this rule are as follows:

- A) Special cases where it is necessary to give the dimensions that are applicable to intermediate stages of manufacture. i.e. the size of a feature before carburizing and finishing to size.
- B) Where it is desirable to add auxiliary dimensions, as an aid for manufacturing and assembly procedures, it is permissible as they do not control the definition or acceptability of the part or affect the tolerances. They are shown to be auxiliary dimensions if they are enclosed by brackets.

9.9 Manufacturing Details

Where manufacturing details of 'not drawn' parts are used, the description shall be shown in the parts list, and not adjacent to the item identification circle on the drawing.

- A) Where parts are individually detailed e.g. stock sizes of sheet material, wire, etc. information shall normally be given in the body of the drawing.
- B) Where applicable on dimensioned assembly drawings, stock sizes may be shown on the parts list to assist planners. The word 'STOCK' shall be shown adjacent to the dimensions of material that can be used in the 'as supplied' condition.

Note: Although the use of the term 'STOCK' on drawings means that the face thus marked should not be machined, there will be cases where a light machining operation leaving a 'witness mark' is required. This is to provide a datum surface for subsequent operations. For instance, if a diameter is critical, it can be limited to a stated minimum size, e.g. 15 Dia. STOCK or 14 Dia. MIN.

- C) If machining of a face or diameter is to be avoided this should be stated.

9.10 Preferred Sizes

Whole numbers shall be used for all metric dimensions unless precise requirements demand the use of decimal fractions. Where a 'bought out' component which is dimensioned in imperial units (inches) is used, the important imperial sizes i.e. hole centres, etc., may be referred to, but the actual dimension, if used for manufacturing other items, must be metric.

9.11 Character Height

Upper case lettering shall normally be used in drawings. The required height for numerals and upper case lettering is 5 mm for A0; A1; A2 and 3.5 mm for A3; A4. Titles and items numbers shall be 7 mm.

The character height conforms to ISO 6428: "Technical Drawings – Requirements for Micro-copying". See also ISO Standards Handbook 12.

9.12 Drawing Notes

The drawing notes should be as clear and concise, to convey the relevant information. The notes must be sequentially numbered (**RED34**).

9.13 Modifications to Drawings

The modifications sheet must be used to record all modifications to the drawing. (See figure 9.1-1)

Modifications to registered models can be carried out only through ENOVIA and this will automatically re-number all documents as required.

9.14 CAD-Related Standards

The ISO standards associated with drawing practices, and referred to in the text of this document, are listed in [CAD Manual 10 - ISO Drawing Standards \(24MZWV\)](#). In all cases the latest issue of each standard, together with the latest amendments, if any, shall be used. A copy of these standards is held in the CAD Office.

Reference to associated standards quoted shall be regarded as an integral part of those standards.

9.15 Restricted drawing

All drawings classified as “ITER RESTRICTED” shall be clearly marked as such on each drawing sheet (**RED36**).



9.16 Construction Drawings

This chapter is related to IDM document [ITER_D_PTYGS4 - Rules and Guidelines for Drawings & Models for Works Execution](#). For any consideration on references, roles, responsibilities, acronyms and specific terminology please refer to this document.

9.16.1 Rules for Construction Drawings & Models

All entities involved in tasks that generate drawings and models that will be used in the Site Construction phase shall comply with the following requirements:

R1. All components and parts modelled in 3D or displayed on drawings shall be identified. The identification system utilised for components and parts (refer to Table 3.0.2) shall be as specified in the procedure [3] ITER Numbering System for Components & Parts (28QDBS), supported by [4] ITER Function Category Designators : TTT Codes (43WDW9).

R2. All mandatory attributes and formats specified in [5] ITER Site Construction Documentation and Data Management Plan (JQGTVR) shall be populated.

R3. The Bill of Materials (BoM) must be clearly associated to the relevant drawings and stored electronically as structured data for retrieval with the drawings.

R4. Identification of components and parts shall be consistent between drawings.

R5. Identification of components and parts in drawings shall be consistent with the 3D models.

R6. 3D models shall be structured for assembly purposes at minimum of sub-assembly or component level of detail as appropriate and in consultation with construction engineers.

R7. Sub-assemblies shall be uniquely identified on drawings and modelled in 3D.

R8. Parts within a Sub-assembly are not typically required to be individually modelled. However the Sub-assembly shall be fully documented in assembly drawings, parts shall be tagged in drawings and listed in the Bill of Materials.

R9. 3D models, drawings and schedules/lists (e.g. for pipes, cables, components and in-line equipment) shall be developed using data derived from specifications in the central catalogue database in order to minimise duplicate entry (i.e. single source).

R10. 3D models, when extracted from the CAD system, shall retain associated engineering data (including at least part/component identification).

9.16.2 Modification table

The usual management of modification sheet is not relevant for construction drawings.

The modification sheet shall not appear on construction drawings.