I.M. BOHANNON
MECHANICAL DESIGN

Engineering Design and Drafting Company Standards

Standards for Development Engineers and Managers

Foreword

This document provides a comprehensive, ready-to-tailor template for establishing drafting and design standards at a new or growing engineering organization. Its purpose is to accelerate the creation of clear, consistent product definition practices that reduce ambiguity, improve manufacturability, and enable quality and compliance from day one. Each section is structured for rapid adoption: a concise foreword (in italics and brackets) explains why the topic matters and how it fits into the broader governance system, followed by a technical example that illustrates what a robust standard can look like. A "commonly adjusted by company" list highlights where policy decisions and process nuances vary by industry, customer requirements, tools, and supplier capabilities. Together, these elements provide a practical blueprint you can implement immediately and evolve as your business scales.

The content is CAD-agnostic and aligned to widely recognized standards (e.g., ASME Y14 series, ISO 9001/AS9100, and ASME Y14.41 for MBD). It spans foundational items (title block, numbering, revision control), core definition practices (view layout, orthographic/section/detail usage, standard notes), release governance (document control, change control linkage, effectivity), and digital definition (Model-Based Definition and PMI). The result is a coherent system: drawings and models read the same way across programs and suppliers; PLM rules, permissions, and audit trails backstop the policy; and downstream teams—manufacturing, quality, supply chain—consume a single, authoritative definition.

Implementing standards can be daunting—especially when balancing customer contracts, regulatory expectations, multi-CAD environments, PLM integration, and supplier readiness. I.M. Bohannon Mechanical Design helps companies in any industry adopt and sustain these standards with a proven, hands-on approach that meets you where you are and scales as you grow.

How I.M. Bohannon Mechanical Design helps

- Standards and policy authoring: Translate business goals into clear, enforceable drafting and MBD policies; harmonize with ASME and industry norms without over-constraining innovation.
- Template and style guide creation: Deliver CAD-agnostic templates, view layouts, title blocks, standard notes, and MBD/PMI style guides that are easy to maintain and audit.

- PLM enablement: Configure states, permissions, e-signatures, metadata, and release packages so written policy is enforced by the system (and traceable for audits).
- MBD deployment: Establish view taxonomies, semantic PMI conventions, inspection-ready datasets (e.g., STEP AP242, QIF), and supplier-consumable release artifacts.
- Supplier and team training: Provide concise training for authors, checkers, approvers, and suppliers; build quick-reference job aids aligned to your templates.
- Pilot and rollout support: Run pilots on representative parts/assemblies, measure cycle time and first-pass yield, then scale with corrective actions and KPIs.
- Compliance and customer alignment: Map your standards to contract clauses and regulatory frameworks; prepare artifacts that withstand audits and customer reviews.
- Continuous improvement: Instrument metrics (review defects, rework, cycle time), analyze failure modes, and implement targeted improvements to sustain gains.

Whether you design aerospace hardware, medical devices, automotive components, industrial machinery, energy systems, or consumer products, the framework in this document serves as a practical starting point. Use the forewords to understand intent, the examples to bootstrap content, and the “commonly adjusted” lists to localize decisions for your programs, sites, and suppliers. I.M. Bohannon Mechanical Design partners with your team to implement, train, and institutionalize these standards—turning policy into day-to-day practice that improves quality, accelerates releases, and drives predictable outcomes across your product lifecycle.

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CONTENTS

1. INTRODUCTION

The Introduction defines the purpose and scope of the company's drafting and design standards, establishing the foundation for consistent product definition across all engineering activities. This document clarifies how standards will be applied within the organization, outlines their relationship to industry-recognized practices such as the ASME Y14 series, and identifies the role of these standards in ensuring clarity, manufacturability, and compliance. It provides the governing framework that connects drawing and model practices, document control, and product lifecycle management (PLM), ensuring that every released artifact conveys a single, authoritative definition. By formalizing these standards, the company enables efficient collaboration across engineering, manufacturing, quality, and supply chain functions, reduces ambiguity in internal and external communication, and ensures that product information remains accurate and traceable throughout its lifecycle.

1.1. REFERENCE DOCUMENTS

- ASME Y14.1/Y14.1M: Drawing Sheet Size and Format
- ASME Y14.2: Line Conventions and Lettering
- ASME Y14.3: Multiview and Sectional View Drawings
- ASME Y14.5: Dimensioning and Tolerancing
- ASME Y14.6: Screw Thread Representation
- ASME Y14.8: Castings, Forgings, and Molded Parts
- ASME Y14.24: Types and Applications of Engineering Drawings
- ASME Y14.34: Associated Lists
- ASME Y14.35: Revision of Engineering Drawings and Associated Documents
- ASME Y14.38: Abbreviations and Acronyms
- ASME Y14.41: Digital Product Definition Data Practices (MBD)
- ASME Y14.44: Reference Designations for Electrical and Electronics Parts and Equipment
- ASME Y14.47/Y14.46: Additive Manufacturing Practices
- ASME Y14.100: Engineering Product Definition and Related Documentation Practices
- IEEE Std 315: Graphic Symbols for Electrical and Electronics Diagrams
- IPC/WHMA-A-620: Requirements and Acceptance for Cable and Wire Harness Assemblies
- IPC J-STD-001: Requirements for Soldered Electrical and Electronic Assemblies
- IPC-A-610: Acceptability of Electronic Assemblies

- ISA 5.1: Instrumentation Symbols and Identification
- IPC-2221: Generic Standard on Printed Board Design
- AWS A2.4: Welding Symbols

2. DRAWING AND SPECIFICATION SYSTEM

2.1. PART/DRAWING NUMBERING

[This section establishes the company's part and drawing identification scheme, defining how project code, installation number, subassembly number, and configuration number combine into a unique drawing/part number. It also clarifies how unique numbers are assigned for top-level assemblies, installation assemblies, and inseparable assemblies. The objectives are uniqueness, scalability, and clear traceability across design, manufacturing, quality, and supply chain. The practices align with ASME Y14.100 for configuration identification and ASME Y14.24 for drawing applications, with explicit conventions for mirrored (odd/even) configurations and three-digit configuration numbers for inseparable assemblies.

Numbering strategy trade-offs: sequential vs smart part numbers

- *Sequential numbers*
  - *Pros: Stable over time; resilient to organizational changes; minimal chance of forced renumbering; easiest to automate in PLM/ERP; shortest identifiers; lowest human error when assigning; excellent for reuse across projects.*
  - *Cons: Provide no immediate human context; require metadata to interpret; harder for quick triage without system access; may slow paper-based workflows or supplier discussions without full BOM context.*
- *Smart numbers embedding context (e.g., project, installation, subassembly)*
  - *Pros: Immediate human readability; faster triage and grouping; helpful in offline settings; can reflect physical breakdown (form/fit hierarchy) at a glance.*
  - *Cons: Brittle to change (reparenting, reuse across programs, project renames); greater risk of renumbering and broken references; longer strings; higher assignment errors; encourages overloading with semantics that age poorly; can leak program/customer info outside the company.*
- *Practical guidance*
  - *If you expect heavy reuse and long product lifecycles, prefer serialized numbers with rich metadata. If rapid, small-team triage is paramount, a constrained meaningful prefix may help.*

- *Maintain clear cross-references in PLM, reserve ranges for prototypes/fixtures, and enforce a single authority for number assignment.*

Commonly adjusted by company

- *Structure and delimiters: Segment order, segment lengths, use of hyphens/underscores, and zero-padding to meet PLM/ERP field limits and barcode/QR usage.*
- *Sequential vs smart numbers: How much meaning is embedded (project, installation, subassembly) vs using sequential IDs with metadata carrying meaning.*
- *Reserved ranges: Blocks for prototypes/IRAD, tooling/fixtures, test equipment, and training or legacy conversions.*
- *Overflow policy: Rules when installation levels exceed initial ranges (e.g., moving from "19" to "20") and when subassemblies exceed "99".*
- *Configuration numbering: Starting value, odd/even mirroring policy, and whether near-mirror parts are treated as unique configurations.*
- *COTS and supplier items: Whether COTS receive internal part numbers, and when to use source control or selected item drawings referencing vendor PNs.*
- *Reuse across programs: Whether identical parts used in multiple projects share a single number or are re-identified per program code.*
- *Character set and casing: Allowed characters, uppercase policy, and prohibition of spaces/special characters for system compatibility.*
- *Inseparable assemblies: Whether components carry individual configuration numbers and the assembly uses a three-digit configuration, and any exceptions for weldments or bonded sets.*
- *Change control impact: When changes require re-identification vs revision only, and how numbering choices support interchangeability rules.*
- *Migration and legacy: How existing numbers are onboarded, preserved, or mapped to the new structure without disrupting operations.]*

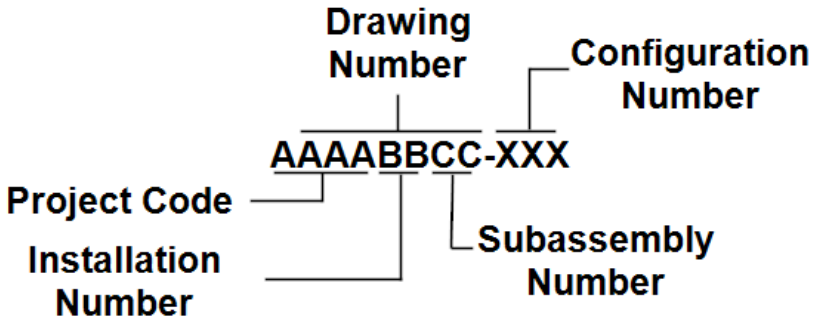

Figure 1: Part Number Layout

Project Code – The project code is assigned to each development project at the beginning of the project. The structure of the project code is two alphabetic letters followed by two numerical digits. Internal research and development (IRAD) projects are given the alphabetic letters RD followed by a sequential number beginning with “01”.

Installation Number – The installation number is a two-digit number assigned to each installation level of the system and assigned sequentially beginning with “11”. The number “10” is reserved for the top-assembly item. An installation level is defined as the highest-level subassembly that is installed into the top-level assembly, which is the end system. When the number of installations exceeds nine, the next installation level shall be assigned the “20” installation number.

Subassembly Number – The subassembly number is a two-digit number assigned to each subassembly within the installation assembly and sub-levels within that installation assembly. Each subassembly is numbered sequentially beginning with “01”. No provision is made for when a given installation level exceeds 99 subassemblies.

Drawing Number – The drawing number is the number resulting in combining the project code, installation number, and subassembly number.

Configuration Number – A sequential number shall be assigned as the configuration number beginning with the number “-1”. Unique configurations shall always be given an odd number configuration number and mirrored opposites shall have an even number configuration number directly following the source configuration as defined in ASME Y14.100. For example, a unique configuration will be given the “-1” and the mirrored opposite of that configuration shall be given the “-2” configuration number. Where configurations are nearly opposite but not exactly opposite, an odd configuration number shall be used.

Part Number – The part number is the number resulting in combining the drawing number and configuration number.

2.1.1. UNIQUE PART NUMBERS

Top-level Assembly – The installation number assigned to the top-level assembly shall be “10” with the subassembly number reserved for the sequential numbering of the top-level assembly of project. For example, the first configuration of the first top-level assembly of the first IRAD project will be given the part number “RD011001-1”. When a program contains a second unique top-level assembly, that top-level assembly will be given the number “RD011002-1”. An alternate configuration of that same top-level assembly will be “RD011002-3”

Installation Assembly – An installation assembly is the upper most subassembly that is assembled into the top-level assembly. The subassembly number assigned to the installation assembly shall be “01”. For example, the first installation assembly in the first IRAD project will have the part number “RD011101-1”. A unique configuration of that same installation assembly will have the part number “RD011101-3”

Inseparable Assembly – An inseparable assembly as defined by ASME Y14.100 is a single item or group of items joined together that cannot be disassembled without destruction or impairment of the intended use. Examples of inseparable assemblies include welded, riveted or bonded assemblies, or assemblies with inseparable fasteners such as clinch nuts, threaded inserts, or studs. Individual components of an inseparable assembly shall be given a unique configuration number with the appropriate drawing number. The inseparable assembly containing those components will be given the same drawing number, followed by a three-digit configuration number beginning with the number “1”. For example, an individual component within an inseparable assembly may have the part number “RD011202-1” and the inseparable assembly will have the part number “RD011202-101”.

2.2. SPECIFICATION NUMBERING

[This section defines the company’s numbering scheme for controlled specification documents that are not engineering drawings. Its goals are uniqueness, clarity, and lifecycle traceability across Document Control and PDM/PLM, while keeping identity (the document number) separate from state (the revision). The scheme uses short, human-scannable category prefixes (TRS, MPS, WMS, TQS, CCS, EHS), a sequential four-digit serial, and an optional program code suffix when a document is limited to a single program. Numbers are immutable across revisions; scope changes that alter category or audience require re-identification with cross-references.

This policy is highly dependent on the company. The chosen categories, prefix labels, serial length, and program code convention should reflect existing governance, supplier expectations, and system constraints. Where customers impose their own identifiers, map those in metadata rather than changing the controlled number.

Standards alignment

- *Identification and re-identification practices align with ASME Y14.100.*
- *Revision control aligns with ASME Y14.35.*
- *This section complements (but does not replace) the drawing numbering and revision sections.]*

Document Category Prefix – Each controlled specification shall be assigned one of the following prefixes to identify its category:

- Technical Requirement Specification – Defines product, subsystem, software, and interface requirements used to drive design and verification. Typical documents include system/hardware/software requirements, interface requirements/control, and hardware design specifications. Prefix — TRS.
- Materials and Process Spec – Establishes approved materials, finishes/coatings, treatments, and controlled manufacturing/handling processes (e.g., SOPs, work instructions, cleaning/passivation, heat treat, welding/brazing procedures, packaging/labeling/shipping, storage/handling). Prefix — MPS.
- Workmanship Standards – Specifies workmanship criteria and visual acceptance requirements for mechanical, electrical, and documentation practices (e.g., harness and solder acceptability, weld visual standards, Engineering Design Guidelines). Prefix — WMS.
- Technical Quality Standards – Governs inspection and quality planning artifacts (inspection/control plans, sampling plans, MSA, calibration procedures), first article plans/reports, supplier quality requirements, source inspection, configuration management, and document control procedures. Prefix — TQS.
- Certification and Compliance Spec – Controls regulatory and compliance deliverables and test artifacts, including certification plans/procedures, CoC/CoA templates, declarations of conformity, test plans, acceptance/qualification/environmental test procedures, FAT/SAT, and associated test reports. Prefix — CCS.
- Environmental Health and Safety – Defines safety, environmental, and facility controls such as hazardous material handling/chemical hygiene, ESD and FOD control, lockout/tagout, PPE requirements, environmental/waste management, special storage/handling (e.g., batteries, compressed gas), and spill response. Prefix — EHS.

Serial Number – A four-digit, zero-padded serial number (####) shall be assigned sequentially by Document Control within each prefix. Serial numbers are unique within their prefix and shall not be reused.

Program Code – When a document is specific to a single program, the Program Code shall be appended to the document number as “-AAAA”. The Program Code shall follow the project code convention defined in section 2.1 (two letters followed by two digits, e.g., “RD01”). When omitted, the document is company-wide.

Document Number – The document number shall be formed by combining the category prefix and the serial number, with the optional Program Code when applicable:

- Company-wide format: PREFIX-####

- Program-specific format: PREFIX-####-AAAA Only uppercase letters, digits, and hyphens are permitted; no spaces or other symbols.
- Uniqueness – Company-wide documents must be unique within their prefix (e.g., only one TRS-0042). Program-specific documents must be unique within each PREFIX+Program combination (e.g., TRS-0042 and TRS-0042-RD01 may both exist if their scopes differ).

Assignment and Ownership – Document Control assigns and records serial numbers at time of creation. The owning organization (and program, if applicable) shall be identified in the document metadata.

Revisions – Revisions are tracked using the company revision system (see revision section). Do not append revision identifiers to the document number. The current revision shall appear in the document's title page/metadata, and changes shall be recorded in the revision history.

Re-identification – A change to document scope that alters category or audience requires a new number (e.g., moving from program-specific to company-wide, or from MPS to TQS). The superseding document shall reference the superseded number and vice versa in the revision history.

Examples – TRS-0005; MPS-0120; WMS-0007; TQS-0042; CCS-0133-RD01; EHS-0009; TRS-0078-RD01

2.3. REVISION SYSTEM

[This section defines the revision system used to communicate controlled changes on drawings and associated models. The intent is to provide a clear, auditable sequence that is easy to read on the shop floor and unambiguous in PDM/PLM. This standard adopts an alphabetical revision scheme per ASME Y14.35, with "-" for the initial release, followed by uppercase letters that skip I, O, Q, S, X, and Z. The revision shown in the title block, revision history block, and governing model is identical so that the drawing and model remain a single source of truth at release.

Alphabetical vs numeric revision systems

- *Alphabetical (used here): Common in mechanical drafting and widely recognized by suppliers. Easy to distinguish from numeric fields on a drawing and avoids confusion with version or lot numbers. Skipping visually ambiguous letters improves legibility. Double-letter continuation (AA, AB, …) preserves ordering at higher counts.*
- *Numeric: Familiar to software or document controls and provides a long runway (0–9, 10–99, …). However, numeric revisions can be mistaken for dimensions or*

quantities, may collide with part numbering schemes, and are less aligned with common mechanical drawing practice and ASME Y14.35 conventions.

Prototype vs production releases

- *Prototypes are typically managed under lifecycle states (e.g., Preliminary/Prototype) and typically do not require a separate revision system. If a prototype is formally released, a company might choose to create a separate revision system for that prototype release such as X01, X02 etc..*
- *Transition to production is typically captured by advancing the revision (e.g., to "A") with a description such as "INITIAL PRODUCTION RELEASE." Revisions should not reset or reused between prototype and production; the history should remain continuous for traceability.*
- *The use of a separate revision system for prototype and production releases require that new revisions are created for all models and drawings during the transition to production, which may be overly burdensome.]*

Revisions identify changes to released product definition on drawings and associated models. The revision shown in the title block, revision history block, and governing model shall be identical. Model revision shall match the drawing revision at release.

Initial release — The initial released revision is "-". The first subsequent revision shall be "A".

Sequence and skipped letters — Revisions progress alphabetically, skipping the following letters: I, O, Q, S, X, and Z. Revisions shall continue with double letters, applying the same skips to each position (e.g., AA, AB, AC, …; omit AI, AO, AQ, AS, AX, AZ, etc.).

Format — Revision identifiers shall be uppercase alphabetic characters or "-" only. Numbers, special characters, prefixes/suffixes, and embedded spaces must not be used.

Applicability — A revision increment is required for any change to the released drawing or governing model, including notes, dimensions, tolerances, materials/finishes, parts list, views, and PMI. Administrative edits (e.g., spelling, formatting) shall also increment the revision. Clerical fixes without revisions are not permitted.

Multi-sheet drawings — All sheets of a multi-sheet drawing set shall carry the same revision. Individual sheets are not revised independently.

Display — The current revision shall be shown in the title block "REV" field and in the most recent row of the revision history block in accordance with section 2.4.2. Prior

revisions shall remain visible in the revision history block and must not be altered or removed.

2.4. DRAFTING STANDARDS

2.4.1. DRAWING TYPES

[This section defines the standard drawing types used by the company and the intended scope of each, so that requirements are communicated consistently and unambiguously throughout the product lifecycle. It clarifies what each drawing type must contain, what it should avoid, and how adjacent types relate, reducing overlap and duplication (e.g., manufacturing detail belongs on detailed mechanical drawings, not layouts or general arrangements). Uniform use of drawing types improves readability for internal teams and suppliers, streamlines reviews, and enables predictable downstream processing in PDM/PLM and ERP systems.

Standards alignment

- *Drawing type intent aligns with ASME Y14.24.*
- *Where dimensions are used, GD&T shall conform to ASME Y14.5.*
- *Electrical/electronic symbology and reference designations should follow IEEE/ANSI conventions (e.g., IEEE 315 and ASME Y14.44) where applicable.*
- *Sheet format, title block, and revision practices follow the company standards and ASME Y14.1/Y14.35 as referenced elsewhere.*

Avoid mixing purposes; instead, cross-reference related drawings to maintain a single source of truth for each requirement set.
If customer-imposed formats or symbols are required, they may be used provided the technical intent of the selected drawing type is preserved and deviations are documented per company procedure.

Commonly adjusted by company

- *Naming variants and additions (e.g., Interface Control Drawing, Outline/Envelope, Tabulated/Family).*
- *Whether certain drawings may include optional parts lists or indices.*
- *Symbol libraries and workmanship standards (e.g., IPC/WHMA-A-620 for harnesses).*
- *The level of reference vs mandatory requirements permitted on layout and GA drawings.*
- *Use of exploded vs installed views and the extent of assembly sequencing notes.]*

All drawing types shall comply with the company sheet format, title block, and revision practices. Where dimensions are used, Geometric Dimensioning and Tolerancing shall conform to ASME Y14.5. Drawing type intent aligns with ASME Y14.24.

Layout Drawing — Establishes overall configuration, packaging, interfaces, envelopes, and key reference dimensions for concept and interface coordination. Manufacturing detail is not required and should be avoided.

Detailed Mechanical Drawing — Fully defines a single part for manufacture and inspection; shall include complete dimensions and tolerances (GD&T), material/specifications, finishes/coatings, heat treatment, edge conditions, and surface texture as required.

Assembly Drawing — Defines how components are assembled and constrained; shall depict relationships, sequences or critical notes (e.g., torque, adhesive, sealant), interface dimensions as needed, and identify subcomponents by part number without repeating their detail dimensions.

Kit Drawing — Defines items to be kitted, packaged, and issued as a single deliverable; shall specify contents, quantities, packaging/labeling/marking requirements, and any substitution rules. Geometry is not required.

Installation Drawing — Defines installation of an assembly or equipment into a next-higher assembly or end item; shall show mounting details, keep-outs, required hardware and consumables, torque and sealing notes, routing references, and post-installation checks.

General Arrangement Drawing — Presents the physical arrangement of major components for packaging, access, maintenance, and spatial coordination; shall provide overall views with outlines, reference dimensions, clearances, and cross-references to subordinate drawings. Manufacturing detail should be avoided.

Source Control Drawing — Controls a purchased item by performance and interface requirements and lists approved sources; shall define acceptance criteria and envelope/interface details as needed while excluding internal design details.

Mechanical Schematic Drawing — Depicts functional flow for mechanical fluid/power systems (e.g., hydraulics, pneumatics, lubrication); shall use standard symbols, show flow paths/directions, setpoints, instrumentation callouts, reference designations, and operating notes. Physical layout is not implied.

Matched Set Drawing — Defines items selected and maintained as a matched group; shall state matching criteria/tolerances, pairing/grouping rules, marking/serialization, traceability, replacement policy, and handling requirements.

Harness Drawing — Defines a wiring harness for fabrication and inspection; shall include wire list (IDs, gauge, color, length), connector/pin tables, splices, shielding/grounding, labels/markers, branch lengths, tie points, and workmanship standards.

Circuit Drawing — Electrical/electronic schematic defining circuit function and connectivity; shall use standard symbols, nets, and reference designations with necessary notes and cross-references.

System Schematic Drawing — Depicts multi-subsystem interconnections (power, control, data, and/or fluid) at system level; shall show blocks and detailed interconnects, identifiers, I/O tables, addressing/network IDs, interface definitions, and cross-references to related drawings.

Software Installation Drawing — Defines software load and configuration for controlled, repeatable installation on target hardware; shall list software items/versions, checksums, target mapping, required tools, load sequence and configuration parameters, verification/rollback steps, and compliance notes. Geometry is not required.

2.4.2. SHEET FORMAT

[This section defines the standard sheet format used across all drawings so that readers can reliably locate notes, title and revision areas, parts lists, and zone references regardless of sheet size or drawing type. Consistent sheet formats improve navigation (via zones), reduce misinterpretation on the shop floor and at suppliers, and enable automation in publishing/plotting workflows. Practices align with ASME Y14.1 for sizes, borders, margins, and zoning, while constraining company choices for orientation and placement to maintain uniformity across multi-sheet packages.

Commonly adjusted by company

- *Permitted sizes and use of Size A: Whether more drawing types may use Size A; allowance for roll plots or special sizes; policy on discouraging Size E.*
- *Orientation rules: Portrait use on Size A; exceptions for customer formats or legacy drawings.*
- *Border and margin width: Adjustments for printers/plotters, binding holes, or digital distribution needs.*

- *Placement of core areas: Exact locations and extents for notes, title block, revision history block, and parts list; whether notes are allowed to flow to additional columns.*
- *Zone scheme: Number/letter counts per edge, letters to skip (I/O), read direction (left-to-right vs right-to-left), and zone size uniformity; whether enlarged partial-zone grids are allowed on detail sheets.*
- *Projection symbol and symbology: Inclusion and location of third-/first-angle symbols; regional requirements for export packages.*
- *Plotting/publishing policy: Approved output formats (PDF at 1:1), font embedding, line weights/colors, and prohibitions on "fit to page" or auto-rotation for manufacturing copies.*
- *Consistency and templates: Whether multiple sheet formats exist (e.g., schematic vs mechanical) and how they are auto-applied via CAD templates/PDM.*
- *Dual-dimension/units callouts: Whether units are indicated on the sheet format and any restrictions on dual-dimensioning.*
- *Customer-specific formats: Handling of mandated customer title blocks or borders, and the approval required to deviate from the company standard.]*

Drawing Sizes - Drawing sizes must be in accordance with ASME Y14.1 and are limited to sizes A thru E. Only schematic drawings and source control drawings may use size A. All other drawing types must be size B or larger. Size E drawings are acceptable when needed, but should be avoided. All sizes larger than size A must be in landscape orientation. Size A drawings may be in portrait or landscape orientation. Drawing sheet sizes must be consistent across all sheets of a drawing. Drawing sheets must not be scaled.

Orientation — All sizes larger than size A must be in landscape orientation. Size A drawings may be in portrait or landscape orientation. Drawing sheet sizes must be consistent across all sheets of a drawing.

Borders and margins — Borders, filing/binding margins, and title block placement shall comply with ASME Y14.1. Required margins shall be maintained on all sheets. No views, dimensions, or notes shall extend into the border area.

Notes, title and revision areas — The upper-left area shall be reserved for the drawing notes. The lower-right area shall be reserved for the title block. The upper-right area shall be reserved for the revision history block. The parts list shall be placed above the title block on Sheet 1 per the parts list section. When space conflicts occur, continuation practices shall follow the respective sections.

Zones — All drawing sizes must include zones for reference purposes. Zones shall be indicated by alphabetical and numerical entries in the drawing margins. Alphabetical letters shall be used on the vertical margins with “A” beginning at the bottom and increasing upward. Numbers shall be used on the horizontal margins with “1” beginning on the right and increasing to the left. Letters “I” and “O” should not be used to avoid confusion with numerals. Zone divisions shall be of equal size, and zone identifiers shall appear on both opposing margins (left/right and top/bottom). Zone identification on multiple drawing sheets must follow the repetitive method as defined in ASME Y14.1 and must match on all sheets beginning with the letter “A” and the number “1”.

Plotting and scaling — Drawings must be created at full-size for the selected sheet size. Drawing sheets must not be scaled. Printed or exported copies shall preserve the specified sheet size; “fit to page” or proportional scaling must not be used for manufacturing or inspection.

Consistency across sheets — Border style, margins, zone layout, title block placement, and projection symbol placement must be consistent across all sheets within the same drawing. When additional sheets are added, the same format shall be used without alteration.

2.4.3. TITLE BLOCK

[This section defines the required content and placement of the title block so that essential document identity, governance, and usage information is consistently presented and quickly found. The title block serves as the drawing’s data contract: it identifies the company, the document number and revision, the applicable default tolerances and notes, and key attributes such as size, scale, weight, and sheet count. Clear, uniform title blocks improve readability on the shop floor and at suppliers, enable automation in PDM/PLM/ERP systems, and protect intellectual property through standardized proprietary notices. The practices here align with ASME Y14.1 (sheet size and format), ASME Y14.2 (lettering and conventions), ASME Y14.5 (geometric tolerancing note), and ASME Y14.100 (product definition and document identification).

Commonly adjusted by company

- *Branding and layout: Logo size/aspect, exact positioning, and whether the company name spans the full width or shares space with other fields.*
- *Proprietary/Legal text: Exact wording, inclusion of address/CAGE code, export control statements (e.g., ITAR/EAR), and customer-specific confidentiality clauses.*

- *Block tolerances: Inch vs metric defaults, value magnitudes based on capability, inclusion of angular and radii/chamfer defaults, and separate defaults for sheet metal/weldments.*
- *Units and dual-dimensioning: Whether a UNITS field is shown, capitalization style, and if dual dimensions are permitted or prohibited.*
- *Scale conventions: Use of "AS NOTED" vs per-view scales, and whether NTS is allowed on part drawings.*
- *Identification fields: Placement and labels for DWG. NO., REV, SIZE, and SHEET X OF Y; addition of barcodes/QR codes for drawing number and revision.*
- *Weight policy: When weight is required, rounding rules, unit (LB vs KG), and whether assembly weights are shown.*
- *Sign-off and dates: Inclusion of DRAWN/CHECKED/APPROVED fields and date formats, or reliance on PDM metadata instead of on-sheet signatures.*
- *Projection and symbology: Display of projection method symbol (third-angle/first-angle) adjacent to the title block and any regional requirements.*
- *Client/Project usage: Whether the Project/Client field is mandatory, optional, or replaced by internal program identifiers.*
- *Automation: Which fields are auto-filled from PDM/PLM properties, field names that must match system attributes, and restrictions on manual edits.*
- *Language and localization: Capitalization conventions, abbreviations, and translation requirements for international releases.]*

The title block shall be located in the lower right corner of the drawing format and must contain the following information:

Company logo and name – The company logo must be placed in the top left block and the company name must be placed to the right of the company logo and span the remaining width of the title block.

Block Tolerances – Block tolerances must be placed below the company logo proceeding with the phrase "UNLESS OTHERWISE SPECIFIED:" The block tolerances are to be based on decimal spaces and are +/-0.010 inches for two decimal place dimensions and +/-0.005 inches for three decimal place dimensions. All angular dimensions will have a tolerance of +/-1.0 degrees.

Specification and format scaling notes – The following notes must be placed below the block tolerances "GEOMETRIC TOLERANCES PER ASME Y14.5" and "DO NOT SCALE DRAWING"

Project/Client – The title of the project or name of the client with the drawing is created for must to be the right of the company logo.

Proprietary Note – The proprietary note must be placed below the Project/Client block and must contain the following:
"PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF I.M. BOHANNON MECHANICAL DESIGN. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF I.M. BOHANNON MECHANICAL DESIGN IS PROHIBITED."

Title – The title must be placed to the right of the Project/Client block. The drawing title must match the title of the component or schematic described on the drawing. The drawing title must be in accordance with ASME Y14.100.

Drawing size — The drawing size must be identified in a field labeled "SIZE" within the title block and must match the physical sheet size used. Permitted values are A, B, C, D, or E in accordance with ASME Y14.1.

Drawing number — The drawing number must be placed in the field labeled "DWG. NO." and must be the primary identifier for the document. The drawing number must conform to section 2.1. The same drawing number must appear on all sheets of the drawing set.

Revision — The current revision must be shown in the title block in the field labeled "REV". The revision must match the most recent entry in the revision history block. The initial released revision is "-" unless otherwise specified.

Scale — The scale must be shown as "SCALE: X:1", "SCALE: 1:X". When no scale applies, "SCALE: NTS" must be used.

Weight — The weight must be shown for single-part drawings as the mass of the finished part in LB (or KG when metric), rounded to two decimal places unless otherwise specified. For assembly drawings, the field should be "N/A" unless a total assembly weight is required. When the part or assembly weight is not required, this field is optional.

Sheet number — The sheet identification must be shown as "SHEET X OF Y" in the title block on every sheet. The sheet count must be updated whenever sheets are added or removed.

MBD — When MBD is used in accordance with ASME Y14.46, a title block shall be added as an annotation. The information in the title block shall be linked to PMI in the model definition.

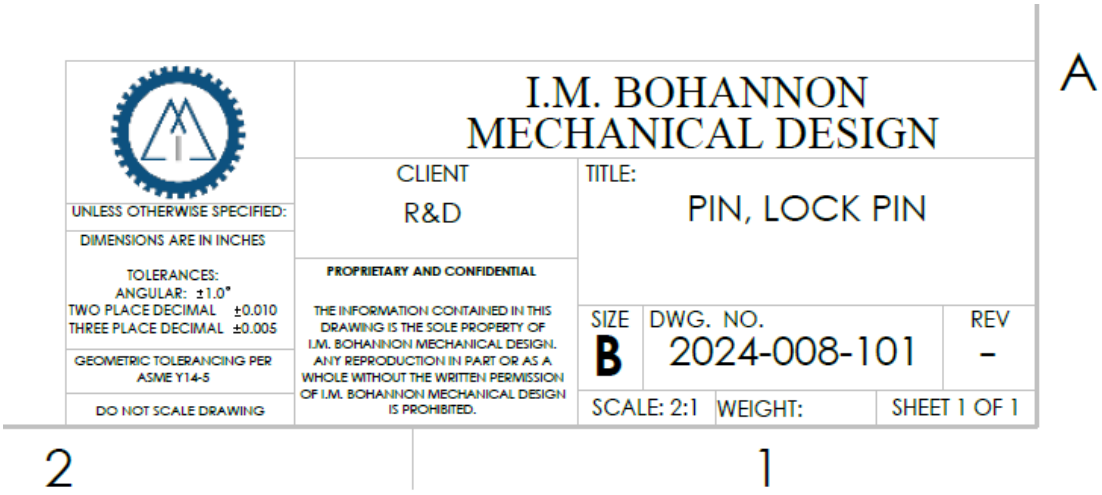

Figure 2: Title Block Reference

2.4.1.PARTS LIST

[This section defines how the parts list appears on the face of the drawing to ensure clear, unambiguous linkage between the bill of materials and the graphic views. It describes where the table is placed, how item numbers (find numbers/balloons) relate to parts list entries, how opposite/handed items are represented, how quantities and units are interpreted, and how continuations and post-release changes are handled. The intent is to make assembly definition immediately readable on Sheet 1, reduce misinterpretation on the shop floor and at suppliers, and maintain consistency across drawings. This guidance aligns with ASME Y14.24 for drawing types and Y14.34 for associated lists, while specifying company choices that drive day-to-day usability.

Commonly adjusted by company:

- *Placement and reading order: Some organizations place the parts list at the top-right or run it left-to-right; others keep the bottom-to-top order used here.*
- *Column set and order: Teams often add or reorder columns (e.g., MAKE/BUY, CAGE/VENDOR, MFR P/N, MATERIAL, EFFECTIVITY, CONFIG columns) based on product type and procurement workflow.*
- *Item numbering style: Choices include leading zeros, numeric vs alphanumeric item numbers, reserved ranges for hardware or subassemblies, and whether item numbers track across sheets.*
- *Find number/balloon conventions: Balloon shape, size, leader style, whether a single balloon serves multiple instances, and when balloons are omitted for non-modeled items vary by practice and CAD tool capability.*

- *Opposite/handed items: Some companies assign a single item number to both hands (as in this example); others assign distinct item numbers or use suffixes. The chosen approach typically follows configuration management policy and inspection practice.*
- *Ordering rules: Non-COTS before COTS is common; alternatives group by subassembly, by function (e.g., fasteners together), or by install sequence.*
- *Quantity policy: Unit conventions (capitalization and abbreviations), whether "each" is shown or implied, treatment of variable-length items (wire, hose, sealants), and use of "A/R" (as required) differ by industry and ERP integration.*
- *Continuations and pagination: Some prefer multi-column continuations on Sheet 1; others continue on subsequent sheets with repeated headers and references.*
- *Change handling: Policies vary on renumbering after release, removal of rows vs "VOID/RESERVED" placeholders, and whether to freeze item numbers across revisions for traceability.*
- *Automation and data sources: Organizations using PDM/PLM often auto-generate the parts list and synchronize balloons from model properties; manual tables remain common in small teams and may require tighter drafting checks.*
- *Non-modeled content: Inclusion of adhesives, lubricants, and consumables as items vs notes, and where those appear in the table (or in separate materials lists), is typically tailored to manufacturing and quality needs.]*

Location and orientation — Parts lists are shown on Sheet 1 directly above the title block. The table is oriented to read from the bottom upward. Item 1 shall appear on the bottom row; item numbers shall increase on successive rows above.

Table content — The parts list shall include the following columns ordered from left to right: -001, ITEM NO, PART NUMBER, DESCRIPTION, and REMARKS.

Ordering — Non-COTS items shall be listed first, followed by COTS items. A single ascending item number sequence shall be maintained across the entire table (bottom to top). Newly added COTS items shall be appended after the last non-COTS item at the next available item number; existing items shall not be renumbered solely to preserve grouping.

Item numbers and find numbers — The ITEM column is the find number used to identify items on the sheet of the drawing. Single character item balloons shall be used to identify the item number. Item numbers shall be unique within the assembly. A given item number must not be reassigned to a different component within the same assembly.

Opposite/handed items — Opposite items (e.g., left-hand and right-hand) are listed on separate rows and shall use the same item number in the parts list. Each row shall have

its distinct PART NUMBER and a DESCRIPTION indicating hand (e.g., LH/RH). The combined QTY across rows shall equal the total installed quantity for that item number.

Item Balloons (find numbers) — Item balloon numbers shall match the item number exactly. A balloon should be placed for each distinct item number visible in the view. For multiple instances of the same item, a single balloon with multiple leaders or repeated balloons with the same number may be used.
Opposite items shall carry the same balloon number as their shared item number. Letters or suffixes must not be appended inside the balloon. Balloons should be circular with a single leader arrow to the part surface or silhouette, placed to minimize leader crossings and outside the part envelope when practical.

Quantities — The item quantity is shown in the column containing the configuration number. The item quantity reflects the count installed in the assembly described. Items used in multiple locations within the same assembly shall retain a single item number with an aggregated quantity. The quantity units shall be excluded when the unit is “each”. When the quantity units are not “each”, the following abbreviated values shall be used following the quantity number.

Unit	Abbreviation
millimeter	mm
centimeter	CM
meter	M
inch	IN
foot	FT
cubic millimeter	CU mm
cubic centimeter	CC
milliliter	mL
liter	L
cubic inch	CU IN
cubic foot	CU FT
fluid ounce	FL OZ

Unit	Abbreviation
gram	g
kilogram	KG
ounce	OZ
pound	LB

A specified quantity should be used whenever possible. When a specified quantity is not needed, an as-required quantity may be defined as “A/R”. When an as-required quantity is specified, a quantity of zero is acceptable. When multiple configurations are included, additional columns shall be added to the left with the column labeled using that configuration number.

Non-modeled items — Non-modeled items (e.g., adhesive, threadlocker) are included in the parts list with an item number and QTY per assembly. When there is no clear pointing surface, balloons should be omitted and the item should be referenced in assembly notes.

Continuations — When the parts list exceeds available space on Sheet 1, a continuation parts list shall be added to a new sheet 2 above the sheet 2 title block with the header “PARTS LIST (CONTINUED)”. If additional space is still required, continuation shall proceed on subsequent sheets. The ascending item order from bottom to top shall be maintained across all continuations.

Changes — When items are added after release, they shall be appended at the next available item number at the end of the parts list. Items removed from the parts list shall have the entire row removed from the parts list. Existing item numbers shall not be changed to re-sequence or regroup the table.

MBD — When MBD is used in accordance with ASME Y14.46, a parts list table shall be added as an annotation. The information in the parts list shall be linked to PMI in the model definition.

2.4.2. REVISION HISTORY BLOCK

[This section defines how the revision history block communicates the what, where, and when of drawing changes directly on the face of the document. Its purpose is to provide a concise, auditable trail that links each revision to a clear description, prior condition, and release date so that engineers, manufacturers, suppliers, and auditors can

understand change intent without consulting external systems. The practices here align with ASME Y14.35 for revision practices and ASME Y14.100 for configuration management, and note considerations for model-based definition (MBD) per ASME Y14.41/46 when applicable.

Commonly adjusted by company

- *Placement and pagination policy: Whether the primary block stays on Sheet 1 only or is continued on additional sheets; whether continuation notes are required on Sheet 1.*
- *Column set and content: Some organizations add ECN/ECO number, By/Check/Approval initials, effectivity/serial range, or change reason; this example intentionally fixes the block to three columns for simplicity.*
- *Revision identification rules: Skipped letters, use of "-" for pre-release vs first production release, and when administrative edits require a revision.*
- *Date policy: Source of truth for dates (PDM server time vs local), time zone, and whether the recorded date reflects approval completion or release posting.*
- *Description conventions: Required WAS/IS phrasing, sheet/zone citation style, character limits, permitted abbreviations, and how to reference external change documents.*
- *Linkage to change control: How the block references ECN/ECOs, deviations, and waivers, and whether those records must be released before or concurrent with the drawing revision.*
- *MBD handling: Where and how the revision history is embedded or annotated in the model, and how entries are linked to PMI updates.*
- *Obsolescence language: Standardized phrasing for supersession vs cancellation and whether lifecycle state changes must be mirrored in PLM.]*

Location — The revision history block is located in the upper-right corner of the drawing format on Sheet 1.

Columns — The revision history block must contain, in order from left to right: Revision, Description, and Date. Additional columns may not be added.

Entries — The first entry of the revision history block must be revision "-" with the Description "INITIAL RELEASE". For legacy drawings being migrated, a note should be added in the first revision describing the migration context and any normalization performed such as formatting and standards changes.

Revision sequence — Revision identification shall continue in accordance with section 2.3. New revision entries must be added in sequence in a new row below the last revision row. Rows must not be left blank between revisions. Changes to previous revision entries must be included in the current revision description.

Description content — The Description must contain a clear, specific description of the change made and must include the previous condition ("was condition"). Sheet and zone references should be included whenever possible (e.g., "SHT 1 ZONE B3: WAS Ø6.5, NOW Ø6.8; SHT 2 ZONE D2: ADDED NOTE 7"). When additional documentation is used to describe a change (e.g., ECN/ECO), the document number shall be added to the entry description with the note "REFER TO DOCUMENT xxx FOR CHANGE DETAILS". Those additional documents shall be released prior to or with the latest revision in accordance with section 2.5.

Date format — The Date field must be the date the revision was released in accordance with section 2.5 and must use the date format MM/DD/YYYY. Dates shall include leading zeros and must reflect the approval completion date; backdating is prohibited.

Space management — Drawing views may be relocated as needed to provide space for revision entries. When the revision history block conflicts with the title block or parts list, a second revision history block must be added to a new Sheet 2 immediately following Sheet 1. All following sheets must be renumbered accordingly, and the sheet changes must be described in the revision Description. When a second sheet is used for additional notes or parts list items, the additional revision history block may be added to that second sheet.

Permanence — All previous revision entries must not be deleted or removed. Existing rows must not be overwritten or repurposed.

Obsolescence — When an item is made obsolete, the final revision Description shall state "OBSOLETE — SUPERSEDED BY [PN/DRW] REV [X]" or "CANCELLED WITHOUT REPLACEMENT".

1

REVISIONS		
REV.	DESCRIPTION	DATE
-	INITIAL RELEASE	11/14/2024

Figure 3: Revision Block Reference

Revision Symbols – Revision symbols as described in ASME Y14.35 shall not be used.

MBD — When MBD is used in accordance with ASME Y14.46, a revision history block shall be added as an annotation. The information in the revision history block shall be linked to PMI in the model definition.

2.4.3. VIEW LAYOUT

[This section defines the required layout and sheet sequencing of drawing views so that readers can quickly find the orientation view, authoritative dimensioned views, and any specialized content without ambiguity. It establishes a consistent pattern across commonly used view types. Clear separation of view types prevents conflicting requirements, reduces clutter, and improves downstream usability by suppliers and manufacturing. Practices align with ASME Y14.3 (multiview and sections), ASME Y14.2 (line conventions), ASME Y14.1 (sheet format), ASME Y14.24 (drawing types), and ASME Y14.5 (dimensioning authority in true views).

Commonly adjusted by company

- *Projection and symbology: Third-angle vs first-angle and symbol placement; regional/customer requirements.*
- *Sheet 1 policy: Whether orthographic views may share Sheet 1 with the isometric or if Sheet 1 is reserved for isometric and title/revision blocks only.*
- *Isometric conventions: Allowed count on Sheet 1, orientation standard, and whether reference balloons are ever permitted (typically prohibited).*
- *Exploded view content: Allowable annotations (balloons, sequence tables), prohibition of dimensions, and whether multiple configurations share a sheet.*
- *Flat pattern rules: Requirement for 1:1 scale, bend table format, DXF reference notes, and CAM datum/origin callouts.*
- *Composite layout: Naming of the laminate/ply schedule, required co-location with composite views, use of color/legends, and permitted section/detail density per sheet.*
- *Schematic pagination: Grid/zone requirements, off-sheet connector style, sheet naming, and dedicated title block variants.*
- *View scales and captions: Use of “AS NOTED” at sheet level vs per-view scales; minimum text height and leader density.*
- *Detail/section conventions: Lettering sequences (omitting I, O, Q), placement on parent sheet vs cross-sheet with mandatory references.*
- *Hidden line policy: Limits on hidden lines in orthographic views and preference for sections/auxiliaries to resolve ambiguity.*
- *Sheet sequencing: Default order and permitted alternates by product family.*
- *MBD exceptions: When 3D annotated models reduce 2D content and how the view layout adapts (e.g., retained isometric only with limited 2D details).*

- *Cross-reference style: Required "SEE SHEET X, ZONE Y" format and zone grid usage.]*

Isometric View – Isometric views shall be placed on Sheet 1 and, where space allows, located directly beneath the revision history block. Show the complete item described on the drawing (or the primary configuration when multiple configurations exist). When multiple configurations are defined, each configuration shall have its own isometric view; place the primary configuration on Sheet 1 and, if additional isometric views do not fit on Sheet 1, add a subsequent sheet dedicated to isometric views only. Do not apply dimensions, tolerances, balloons, or notes to isometric views. Use consistent orientation across sheets for readability.

Orthographic Views – Primary orthographic views (Front, Top, Right) shall be placed in the main field of Sheet 1 below the isometric if space permits; otherwise, place them on the next sheet containing assembled definition. Maintain standard alignment and spacing. Use orthographic views as the dimensioning authority; do not duplicate dimensions in multiple views. Add auxiliary and section views on the same sheet as their parent view to clarify true shape and interior features. Keep orthographic/section/detail views off any sheets that are dedicated to exploded, schematic, flat pattern, or composite content.

Detailed Views – Place detailed views on the same sheet and in proximity to their parent orthographic or section view whenever possible. If clarity requires moving a detail to another sheet, include cross-references on both the callout and the detail (e.g., "DETAIL A (SHEET 3)" and "FROM SHEET 2"). Detail view scales shall be stated beneath each detail. Do not place detailed views on sheets dedicated to exploded, schematic, flat pattern, or composite content.

Exploded Views – Exploded views shall be placed on their own dedicated sheets, separate from assembled orthographic content. Each exploded view sheet may include balloons, leader lines, and assembly sequence callouts, but shall not include dimensions or tolerances. Maintain orientation consistent with the assembled isometric when feasible. For multiple configurations, provide separate exploded sheets for each and label them clearly (e.g., "EXPLODED VIEW — 001"). Include a cross-reference on the assembled sheets directing the reader to the exploded sheet(s).

Schematic Views – Schematic content (electrical, system, mechanical schematics) shall be placed only on dedicated schematic sheets. Do not mix schematic views with orthographic, exploded, flat pattern, or composite content on the same sheet. Schematics are not to scale and shall not carry geometric dimensions; use symbols, nets/tags, and cross-references. Provide off-sheet connectors and sheet/zone references for multi-sheet schematics.

Flat Pattern / Unfolded View – Flat patterns for sheet metal parts shall be placed on their own dedicated sheet(s), separate from formed orthographic content. The flat sheet shall contain the flat geometry, grain/roll direction, bend table/notes, and any required CAM datum/origin information. Do not show formed feature dimensions on the flat sheet; formed definition remains on assembled/orthographic sheets. If multiple configurations exist, provide a distinct flat sheet per configuration or a clearly tabulated mapping.

Composite Part Views – Composite definition (ply/laminate/core) shall be placed on dedicated composite sheets. The laminate/ply schedule (composite table) and the composite views that it governs (plan, sections, details, zone maps) shall be located on the same sheet to maintain immediate traceability. Use additional composite-only sheets as needed for large or complex parts. Do not mix composite content with orthographic, exploded, schematic, or flat pattern content on the same sheet. Cross-reference from assembled/installation sheets to the composite sheet(s) for material systems, orientations, and local build-ups.

Sheet Sequencing and Cross-References – A typical sequence is: Sheet 1 (Isometric beneath revision history block; primary orthographic/sections/details if space allows), followed by assembled definition sheets (orthographic/sections/details), then dedicated sheets in this order as applicable: Exploded, Flat Pattern, Composite, and Schematic. Place explicit “SEE SHEET X” callouts near relevant views/tables to guide the reader across dedicated sheets.

2.5. GENERAL DRAWING NOTES

[This section defines the purpose and governance of general drawing notes that can appear by default on engineering drawing templates. General notes define the most common notes used across the company so that drawings read consistently and unambiguously across programs and suppliers. Standardizing these notes reduces repetitive callouts, prevents interpretation errors, and supports quality, compliance, and PLM automation. The accompanying technical example is illustrative only; companies should tailor the exact wording and values in controlled templates and specifications.

Commonly adjusted by company

- *Units and dual-dimension policy (inches vs metric; whether duals are permitted or reference-only).*
- *Edge-break range and deburr wording, including where it applies.*
- *Default surface roughness limits and which surfaces they govern.*
- *Dimensional basis before/after finish and any exceptions for critical interfaces.*
- *CAD model authority scope and default tolerance for unshown dimensions.*

- *Material and finish source specifications and approved lists.*
- *Marking standard (e.g., MIL-STD-130 vs internal), required content, and placement.*
- *Inclusion of additional baseline notes (threads, weld/process specs, cleanliness/packaging, environmental compliance).]*

The following drawings notes are applied by default to the engineering drawing templates. These notes have been standardized to reduce repetitive callouts and ambiguity. These notes provide a baseline for the notes on the drawing and should be modified and added to as needed.

- MATERIAL: MAKE FROM [XXX]
- FINISH: [XXX]
- UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. DUAL DIMENSIONS ARE FOR REFERENCE ONLY.
- REMOVE ALL BURRS AND SHARP EDGES. BREAK EDGES 0.005–0.015 IN [0.13–0.38 MM].
- SURFACE TEXTURE: UNLESS OTHERWISE SPECIFIED, RA 125 µIN [3.2 µM] MAX ON UNSPECIFIED SURFACES; RA 63 µIN [1.6 µM] MAX ON MACHINED SURFACES.
- DIMENSIONS APPLY AFTER FINISH/COATING UNLESS OTHERWISE SPECIFIED.
- UNLESS OTHERWISE SPECIFIED, CAD DATASET IS DIMENSIONAL AUTHORITY. REFER TO CAD DATASET FOR DIMENSIONS NOT SHOWN WITH AN APPLIED TOLERANCE OF +/-.030.
- BAG OR TAG PER MIL-STD-130. MARK PART NO. AND REV IN LOCATION SHOWN.

2.6. MODEL BASED DEFINITION (MBD)

[This section defines how Model-Based Definition (MBD) shall be applied so the 3D model and its Product and Manufacturing Information (PMI) serve as the dimensional and specification authority per ASME Y14.41 and ASME Y14.5. It establishes company-specific rules for model authority and governance, organization and configuration control, saved/named views, PMI placement and semantics, assembly usage, and required release artifacts, validation, and change control. Defining MBD at this level reduces ambiguity found in 2D derivatives, preserves associativity for downstream automation (CAM, CMM, QIF), and provides a consistent, auditable definition across programs and suppliers.

Implementing MBD can be daunting—organizations must align standards, view/PMI conventions, semantic quality, PLM integrations, and supplier readiness. I.M. Bohannon Mechanical Design supports company-wide MBD adoption with policy and style guides, CAD-agnostic templates, semantic PMI validation, pilot deployments, and targeted training to deliver consistent, auditable results across programs and sites.

Commonly adjusted by company

- *Scope of adoption: parts only vs parts and assemblies, drawingless release vs hybrid 2D snapshots, exception criteria requiring 2D drawings.*
- *Semantic coverage: minimum percent of semantic PMI, permitted cases for graphical PMI, and validation checks for associativity.*
- *View taxonomy and naming: required view sets, ordering, and conventions for datums, sections, feature groups, and inspection views.*
- *Datum strategy and GD&T style: preferred DRF patterns, use of profile vs position, baseline vs basic schemes, and CTQ identification.*
- *PMI presentation: text heights, symbol sizes, colors, layer/filter categories, annotation plane rules, and density limits per view.*
- *Units and precision: model units, default decimal precision, and rounding/display rules for PMI.*
- *Release derivatives: required neutral formats (e.g., STEP AP242 with PMI, 3D PDF, JT) and optional inspection exchanges (e.g., QIF).*
- *Assembly practices: when item balloons or sequence notes appear in PMI, interface/installation view requirements, and relationship to the PLM BOM.*
- *Sheet metal and composites: flat-pattern state and bend table PMI conventions; laminate/ply schedule placement and zone/closeout views.*
- *PLM integration: mandatory model properties (number, title, revision, material), e-signature/audit expectations, and change control for saved view names.*
- *Supplier readiness: approved tool/viewer list, minimum viewer instructions, and fallback rules when a supplier cannot consume semantic PMI.]*

This section defines how Model-Based Definition (MBD) is applied within a 3D model so the model, together with its Product and Manufacturing Information (PMI), serves as the dimensional and specification authority per ASME Y14.41 and ASME Y14.5. The use of MBD is defined on a program level prior to the initial program kickoff.

Definitions

- Model authority: The released 3D model and associated PMI that govern geometry, size, and requirements.
- PMI (Product and Manufacturing Information): 3D annotations including dimensions, GD&T, datum features/targets, surface texture, notes, weld symbols, process symbols, tables, and references.

- Semantic PMI: Machine-readable PMI that maintains associativity to model topology and supports downstream automation (CMM, CAM, inspection planning).
- Graphical PMI: Human-readable PMI without guaranteed machine readability or robust associativity.
- Annotation plane: A defined plane (or view plane) to which PMI is oriented to ensure legibility.
- Saved/Named view (combination state): A stored orientation, visibility, section/cut state, and annotation display set.
- Datum Reference Frame (DRF): The ordered set of datums establishing the coordinate system for design and inspection.
- Presentation set: A curated group of saved views that communicate a coherent definition (overview, datums, feature groups, sections).

Model authority and governance

- The released model and PMI shall be the dimensional authority. Any 2D derivatives or 3D PDFs are for reference and shall not override the model.
- Model units, material, material condition, and revision metadata shall be present and consistent with PLM.
- Geometry and PMI shall remain associative; broken or dangling PMI must be resolved before release.
- Semantic PMI should be used wherever practicable; graphical PMI may be used only when semantic representation is not feasible.

Model organization and configuration control

- Each configuration or option shall have its own controlled model configuration or separate model as defined by company configuration policy.
- Layers/categories/filters should separate PMI by type (e.g., GD&T, dimensions, notes, surface texture) and audience (manufacturing, inspection, assembly) to aid visibility management.
- Suppressed/hidden features that affect definition shall not be used to mask active requirements; use configurations or variant models instead.

Saved/Named views (how views are applied in the model)

- A standard view set shall be created and saved with stable names and ordering. A typical minimum set includes:
    - 01-Overview: Overall orientation; no dimensions; reference callouts only as needed.
    - 02-Primary Datums: Establishment of datum features/targets and DRF.
    - 10–19 Feature Groups: Views per logical feature set (e.g., Hole Patterns, Bosses, Cutouts).

    - 20–29 Sections: Full/half/offset sections revealing interior features; hatch conventions applied.
    - 30–39 Interfaces: Mounting patterns, mating faces, keep-outs, envelopes.
    - 40–49 Surface and Process: Surface texture, edge breaks/chamfers, coatings masks if applicable.
    - 50–59 Inspection: PMI filtered for inspection planning (CTQ features, gage datums).
- Each saved view shall capture: camera orientation, active bodies/components, section/cut state, shown/hidden PMI categories, and annotation plane assignment.
- Views should avoid overlapping PMI; multiple views shall be created rather than crowding a single view.
- Section and auxiliary views shall be created as additional saved views; persistent model geometry shall not be altered to create a view.

PMI application — general rules

- PMI shall be placed on annotation planes parallel to the reader; text and symbols shall face the viewer and remain legible at default zoom.
- PMI shall be associated to the controlling feature(s) (faces, edges, axes) and maintain semantic links; free-floating PMI is not permitted.
- Only one source of authority shall define size and location: either GD&T with basic dimensions or directly toleranced dimensions per ASME Y14.5. Over-dimensioning and conflicting tolerances are not permitted.
- Global notes shall reside in a dedicated “Notes” view; feature-specific notes shall be attached to the affected features within their feature-group views.
- Units and precision shall match model units; avoid mixing unit systems within a single model.

PMI categories and specifics

- Datums and DRF
    - Primary/secondary/tertiary datum features shall be clearly identified; apply material boundary modifiers (M, L, S) where applicable.
    - Datum targets (if used) shall define size/location/shape and be fully constrained.
    - A dedicated “Primary Datums” view shall display the DRF clearly with minimal other PMI.
- GD&T
    - Feature Control Frames (FCFs) shall follow ASME Y14.5; geometric characteristic symbols, tolerance values, modifiers, and datum references shall be complete.
    - Basic dimensions shall establish true profiles and locations; basic dims shall not carry plus/minus tolerances.

    - Profile should be preferred for complex contours; position used for features of size; orientation and form applied as needed.
- Dimensions (size, location, angle)
    - Direct dimensions with tolerances may be used where GD&T is not required; dimension only where needed to fully define design intent.
    - Chain vs baseline dimensioning shall follow company policy; redundant dimensions are not permitted.
- Surface texture and edges
    - Surface texture symbols shall indicate Ra (or other parameters) and process requirements where needed; unspecified surfaces default per standard notes/specs.
    - Edge breaks/chamfers/fillets shall be called out where critical; global deburr notes may apply elsewhere.
- Notes and process symbols
    - General notes shall be in the “Notes” view; flag notes shall reference a numbered list or table.
    - Weld, adhesive, and process symbols shall follow applicable standards and be placed on relevant views.
- Tables
    - Hole, thread, or pattern tables may be attached as PMI objects; tables shall be filtered by view to avoid clutter.
- Identification and marking
    - Marking requirements (e.g., part number, revision) shall be included as PMI notes with references to governing standards.

Assembly MBD

- Assembly models shall include a BOM in PLM; item numbers may be referenced in PMI only for clarity. Assembly PMI shall not replace the controlled BOM.
- Assembly saved views should include:
    - Overview assembled view (no dimensions).
    - Interface/installation views with critical mount patterns and envelopes.
    - Fastener/joint definition views (torque, adhesive, weld) where required.
- Exploded saved views may be included for visualization; they shall not carry dimensions or tolerances.

Flat patterns, sheet metal, and composites in MBD

- Sheet metal models should include a flat pattern configuration/state with bend table data captured as PMI; formed-state PMI remains in formed views.
- Composite parts should include laminate/ply schedule as PMI (table) and views showing ply directions, zone maps, and closeouts; associativity to surfaces and edges shall be maintained.

Readability and formatting

- Text height, line weights, and symbol sizes shall be legible at default view zoom; company defaults should be applied.
- Color usage should follow a controlled scheme (e.g., datums, basic dims, FCFs) and shall not be the sole means of conveying meaning.
- PMI density shall be limited; create additional views rather than overlapping leaders or stacking FCFs.

Release artifacts

- The release package shall include:
  - Native model with semantic PMI.
  - Neutral derivative with PMI (e.g., STEP AP242 with PMI) and a human-consumable 3D PDF if required.
  - Any required inspection extract (e.g., QIF) when supported.
- Model metadata (number, title, revision, units, material) shall be complete and consistent with PLM. Any viewer instructions should be included in a “Read Me” PMI note.

Validation and quality checks

- Prior to release, PMI associativity shall be verified (no dangling annotations; correct feature links).
- A standards check shall confirm ASME Y14.41/Y14.5 compliance, datum scheme correctness, tolerance completeness, and absence of contradictions.
- A readability check shall confirm that each saved view is self-contained, legible, and filtered to its purpose.

Change control and traceability

- Changes to model geometry or PMI shall follow the same revision and workflow controls as drawings. Saved view names shall remain stable across revisions; new or retired views shall be recorded in the revision history note set.
- Where 2D snapshots or prints are distributed, they shall be clearly identified as for reference only and shall include a link to the governing model record.

Notes

- Where a requirement cannot be represented semantically, a graphical PMI with an explicit reference to a governing specification shall be used.
- Company-specific conventions (naming of saved views, layers, colors, and PMI categories) should be documented in a companion MBD style guide and enforced via templates.

3. DOCUMENT CONTROL

[This section defines the company's document control practices for engineering drawings, governing models, and controlled specifications. It establishes a single, auditable release process across file types with clearly defined states (WIP, Engineering Check, Quality Review, Manufacturing Review, Final Engineering Approval, Released), mandatory metadata and attachments, and alignment to numbering and revision policies. The objective is to deliver consistent release packages, maintain end-to-end traceability (including ECN/ECO linkage), and ensure a reliable "single source of truth" for downstream use. Practices align with ASME Y14.100 (product definition and documentation) and ASME Y14.35 (revisions), and support QMS expectations (e.g., ISO 9001/AS9100). Because organizational structures, customer contracts, and PLM capabilities vary, this policy is highly dependent on the company; tailoring should be explicitly documented here and enforced via PLM configuration.

Commonly adjusted by company

- *Workflow states and routing: State names, serial vs parallel reviews, conditional gates (e.g., Regulatory, Safety/EHS, Supply Chain), and N/A paths with justification.*
- *Roles and approvals: Checker qualifications, proxy approvers, additional approvals for high-risk/safety-critical items, and CCB thresholds.*
- *Metadata requirements: Effectivity (date/lot/serial/config), export control (ITAR/EAR), security classification, customer/contract tags, site/plant, commodity, and program codes.*
- *Attachments and artifacts: Required derivatives (e.g., STEP AP242, DXF, 3D PDF), controlled templates/annexes for specs, BOM/eBOM or MBOM extracts, and routed work instructions.*
- *Numbering and program codes: Prefix sets, serial lengths, permitted use of program-specific suffixes, and any reserved ranges (enforced by PLM).*
- *Revision policy nuances: Administrative vs technical change handling, lockstep model–drawing revisions for MBD, and derivative file refresh rules.*
- *Change control integration: ECN/ECO requirement scope, impact analysis checklists (cost, tooling, inventory, validation), and CCB decision records.*
- *Effectivity management: Default immediate effectivity vs date/lot/serial/software build; configuration parameters for software/firmware deployments.*
- *Obsolescence and archival: Use of Obsolete/Superseded/Cancelled states, "Superseded by" references, retention periods, and archive retrieval.*
- *Access control and e-signatures: Permissions by lifecycle state, export-controlled access, supplier/external sharing rules, and compliant e-signature settings.*

- *External/customer and supplier documents: Handling reference-only vs controlled copies, mapping external IDs to internal records, and supplier portal access.*
- *Templates and formatting: Corporate templates for specs, title pages and revision tables, drafting/MBD standards, and periodic template updates.*
- *Distribution and notification: Auto-notifications to stakeholders, subscription rules by site/product line/category, and release notes for impacted teams.*
- *System integration: PLM↔ERP/MES/CAD synchronization, part master creation, BOM handoffs, and effectivity propagation.*
- *Audits and metrics: Workflow audits for QMS compliance, KPIs (cycle time, first-pass yield, rework rates), and continuous improvement actions.*
- *Multi-site and localization: Site-specific reviewers/holidays, numbering uniqueness across sites, and translation/localization for customer-facing releases.]*

This subsection defines a single PLM-controlled release workflow used for both engineering drawings and controlled specifications. The company PLM governs states, permissions, routing, approvals, and the audit trail. Numbers and revisions follow their respective numbering sections; the workflow is identical for all file types.

Applicability — Engineering drawings and associated models; specification documents, including program-specific items using the Program Code suffix.

Workflow states and gates

- WIP (Drafting)
  - Entry: New or revised item created; number assigned (drawing/part number or Specification Number).
  - Actions: Authoring and self-check; complete required metadata; generate preliminary PDF.
  - Pass: Draft content complete; required metadata populated; attachments ready for review.
- Engineering Check
  - Actions: Independent technical check for accuracy and standards compliance; confirm model–drawing or content–template alignment.
  - Pass: Issues resolved; checker approval recorded.
- Quality Review
  - Actions: QMS and compliance review; verify controlled references, revision history entries, and applicability statements.
  - Pass: Quality approval recorded.
- Manufacturing Review

    - Actions: Manufacturability and process readiness; verify special processes, tooling, and operational impacts; may be marked Not Applicable with justification if no manufacturing impact.
    - Pass: Manufacturing approval recorded.
- Final Engineering Approval
    - Actions: Design authority confirms completeness, risk items, prior approvals, and ECN/ECO linkage if applicable.
    - Pass: Approval recorded; PLM transitions to Released and publishes the release package.
- Released
    - Status: Item becomes the controlled record consumed by downstream teams. Subsequent changes re-enter the workflow and increment revision per the revision system.

Return/rework rules

- Any reviewer may return the item to a prior state (typically WIP) with mandatory comments. Authors must address all comments before resubmission. Pre-release iterations do not change the number; revisions advance only upon release per policy.

Required metadata

- Number; title; owner; category (drawing or spec with prefix); revision; lifecycle state; Program Code (if used); related items and references; ECN/ECO link (if applicable).

Required attachments by file type

- Drawings: Native CAD model/drawing files
- Specifications: Editable source (e.g., DOCX), controlled annexes/templates as needed.
- All: Any supplemental unreleased files cited within the document (e.g., spreadsheets, data packs, ECO/ECN) must be included at release.

Revision and numbering alignment

- Revisions follow the company alphabetical system (initial “-” at first release, then A, B, … with ASME Y14.35 skips). Do not append revisions to numbers.
- Drawings and models carry matching revisions at release.
- Specifications retain immutable document numbers. Revisions are tracked separately.

Traceability and cross-links

- The revision history shall reference the controlling change record (ECN/ECO) when applicable.