

CH53K Design Models; Can They Support System Sustainment?

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LMI

CH53K King Stallion*



* Picture courtesy of Sikorsky Aircraft

- USMC heavy lift replacement for CH53E
- Triple-turbine engine, 22,500hp
- Lift capacity ~14 tons
- Mission radius at max lift capacity ~110 nm

Bottom Line Up Front

- Technical data provided in proprietary CAD formats doesn't work for DLA or other sustainment activities (e.g., NAVSUP)
- DLA R&D Project got Navy's attention and Navy is working the fix (i.e., 3D PDF + STEP file)
- Native CAD files must be comprehensive and fully annotated to produce useful 3D PDF files

Background


- Problem: CH53K program planned to deliver technical data to DLA and NAVSUP as native CATIA files. Neither DLA nor NAVSUP has capability to read/use such files.
- DLA Reaction: Initiate R&D task to characterize issue and identify solution
- R&D Task Objective: Ensure DLA's capability to procure parts using 3D technical data by developing solution acceptable to DLA and CH53K

CH53K is just the first of many programs that will provide only 3D technical data to DLA and other downstream users

Task Approach

- Engage CH53K PMO to understand state of program's 3D technical data and inform them of DLA data requirements (content and format) for provisioning/cataloging and sustainment
- Engage NAVSUP to understand their data requirements for provisioning and sustainment
- Engage Logistics Information Services (LIS) to understand their data requirements for cataloging
- Develop a recommended solution for providing requisite data in format(s) useable by NAVSUP, LIS, and DLA

Major Findings

- DON* Policy on Digital Product/Technical Data (23 Oct 2004) specifies requirements for procurement of technical data
 - Does not address provisioning and procurement “because neither suitable standards nor DON consensus exist on the treatment of these forms of digital data.”
 - Doesn’t support DLA or NAVSUP needs
- CH53K EDFP** contract complies with current DON 3D Technical Data policy
 - Contract written circa 2006
 - PMO planned to deliver CATIA CAD files and STEP files to NAVSUP and DLA; neither activity can read/use CATIA files
- Initial delivery of CH53K EDFP models did not meet DLA data requirements for part procurement
 - Missing requisite metadata etc. 
 - Not ‘annotated’

* Department of the Navy

** Engineering Data for Provisioning

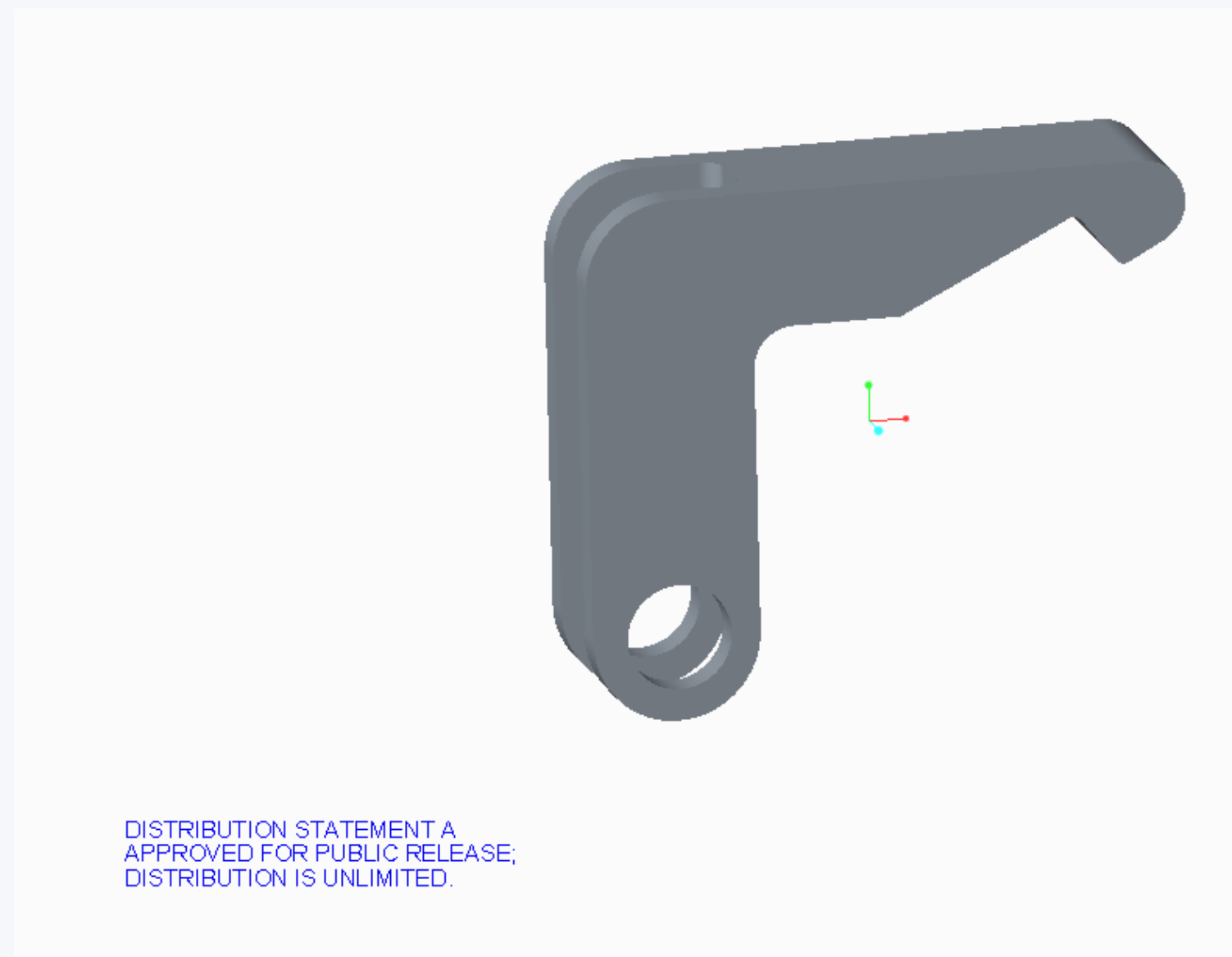
Disconnect between Tech Data Policy and DLA data requirements

CH53K 3D Data Problem in a Nutshell

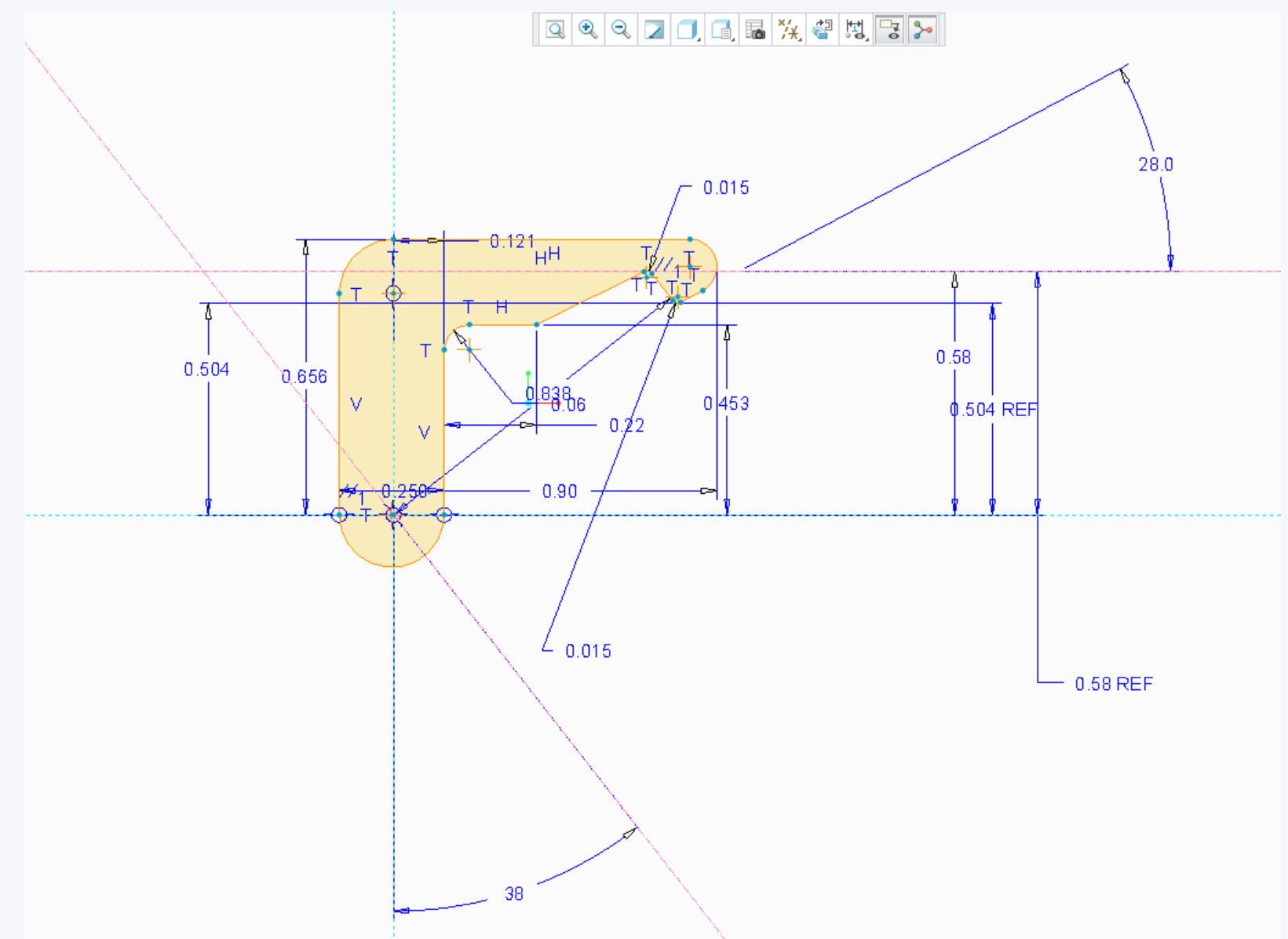
- CATIA model format is unusable by DLA for procurement
 - DLA lacks appropriate software and training to read/use any CAD files (CATIA, NX, CREO, SOLIDWORKS, AutoCAD, etc.)
 - Technical data package files must be readily useable by potential suppliers/manufacturers
 - Format must be human-readable and intuitive
 - Format cannot require purchase of software to view/use the data (government fairness paradigm - avoid protests)
- Initial EDFP models don't include minimum required data elements for procurement (or provisioning)

CH53K EDFP Model Content

- Below is a surrogate sample* similar to initial EDFP model content



Native file as seen using CAD software



Native file – Sketch Mode – as seen using CAD software

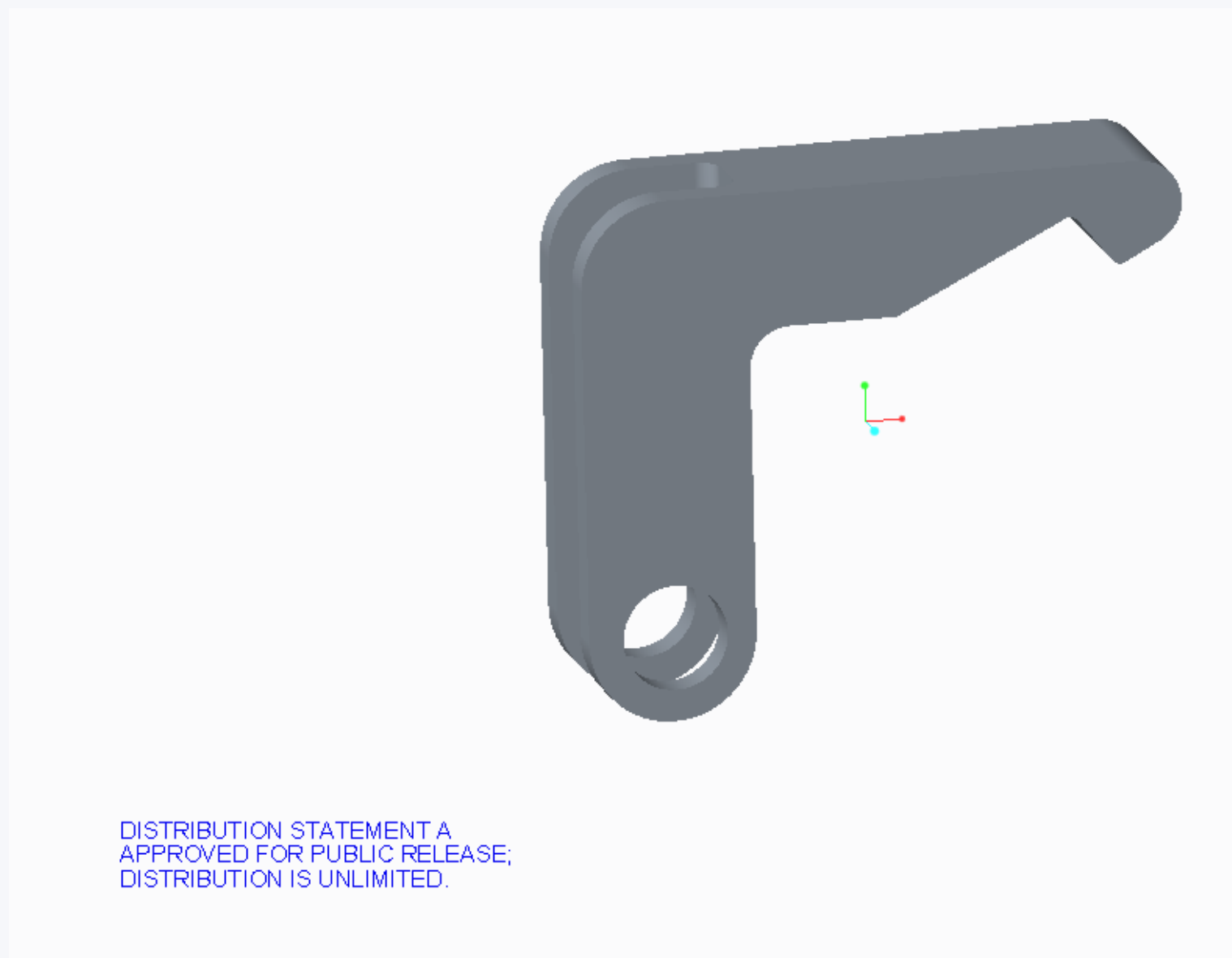
Current EDFP models don't meet DLA technical data requirements

How Do We Solve the CH53K Technical Data Problem?

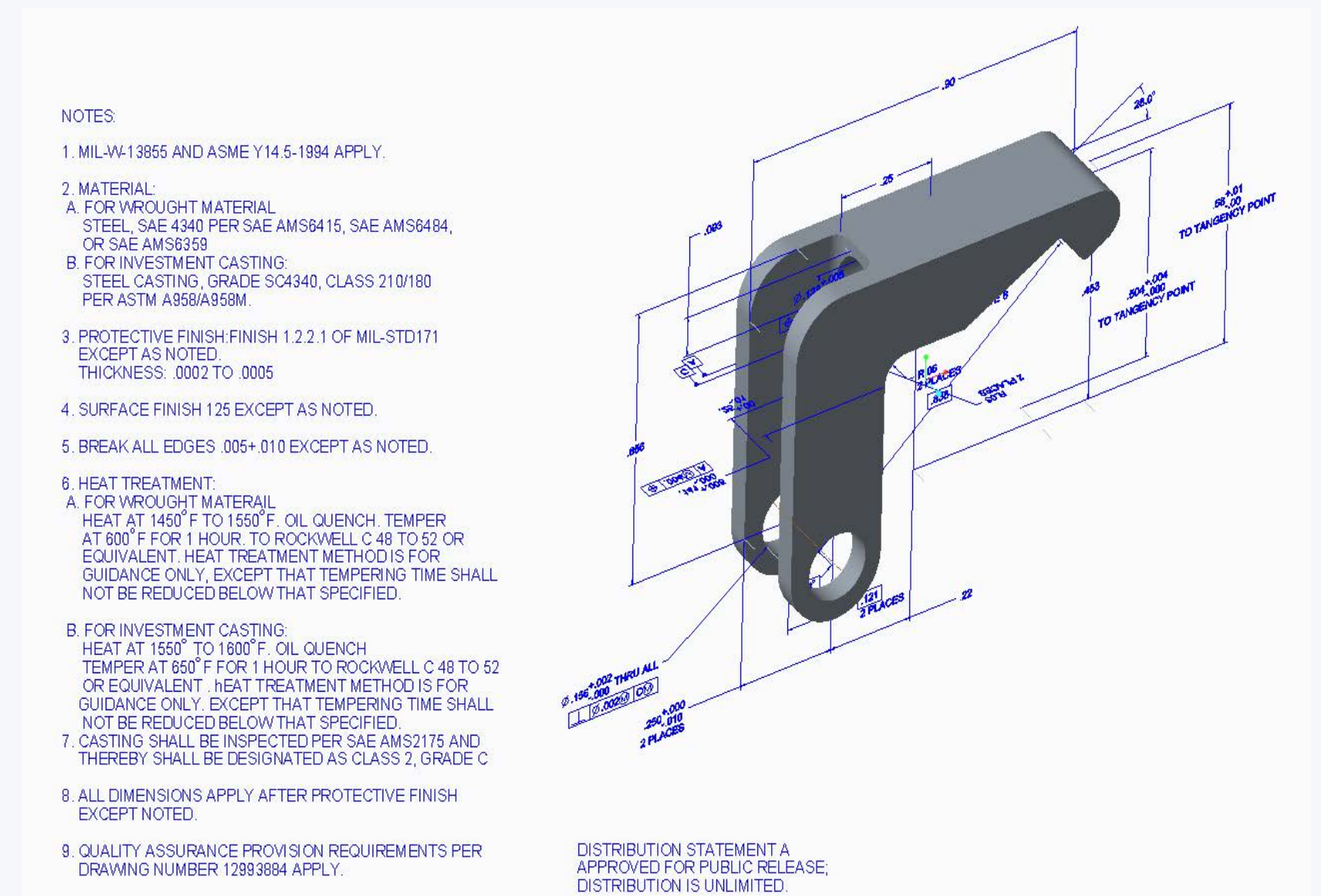
- Implement a 3D PDF solution
 - PMO ensures native CATIA files contain requisite metadata and part attributes to support sustainment
 - PMO ensures native CATIA files are fully annotated
 - PMO converts native CATIA files to 3D PDF format and validates
 - PMO converts native CATIA model to STEP (AP203) file and validates
 - PMO provides technical data to DLA and NAVSUP in a 3D PDF file plus STEP file format

Unannotated and Annotated CAD Models

- Comparison of unannotated and annotated models



Unannotated surrogate* EDFP model



Annotated surrogate* EDFP model

How Do We Solve the CH53K Technical Data Problem?

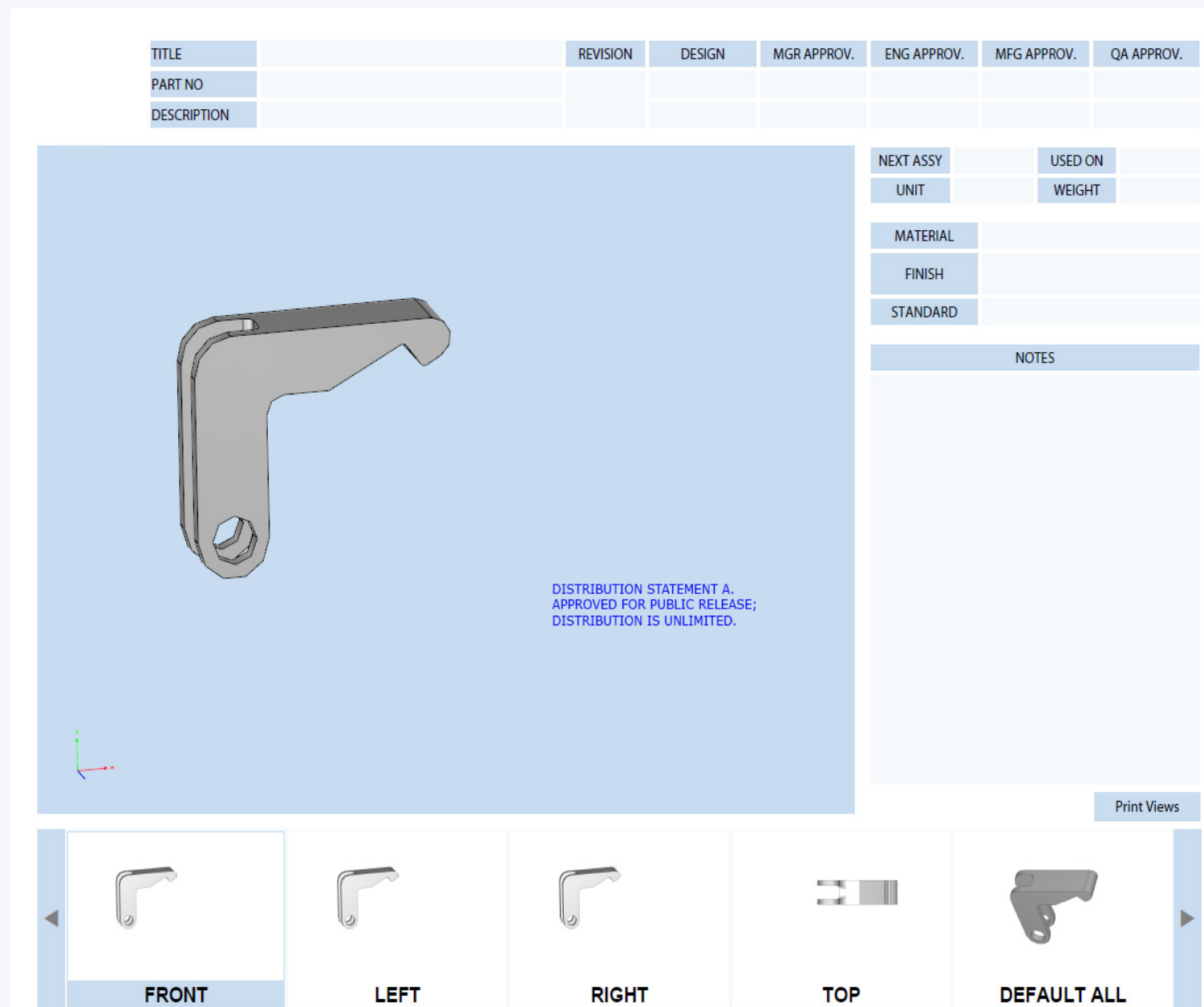
(2)

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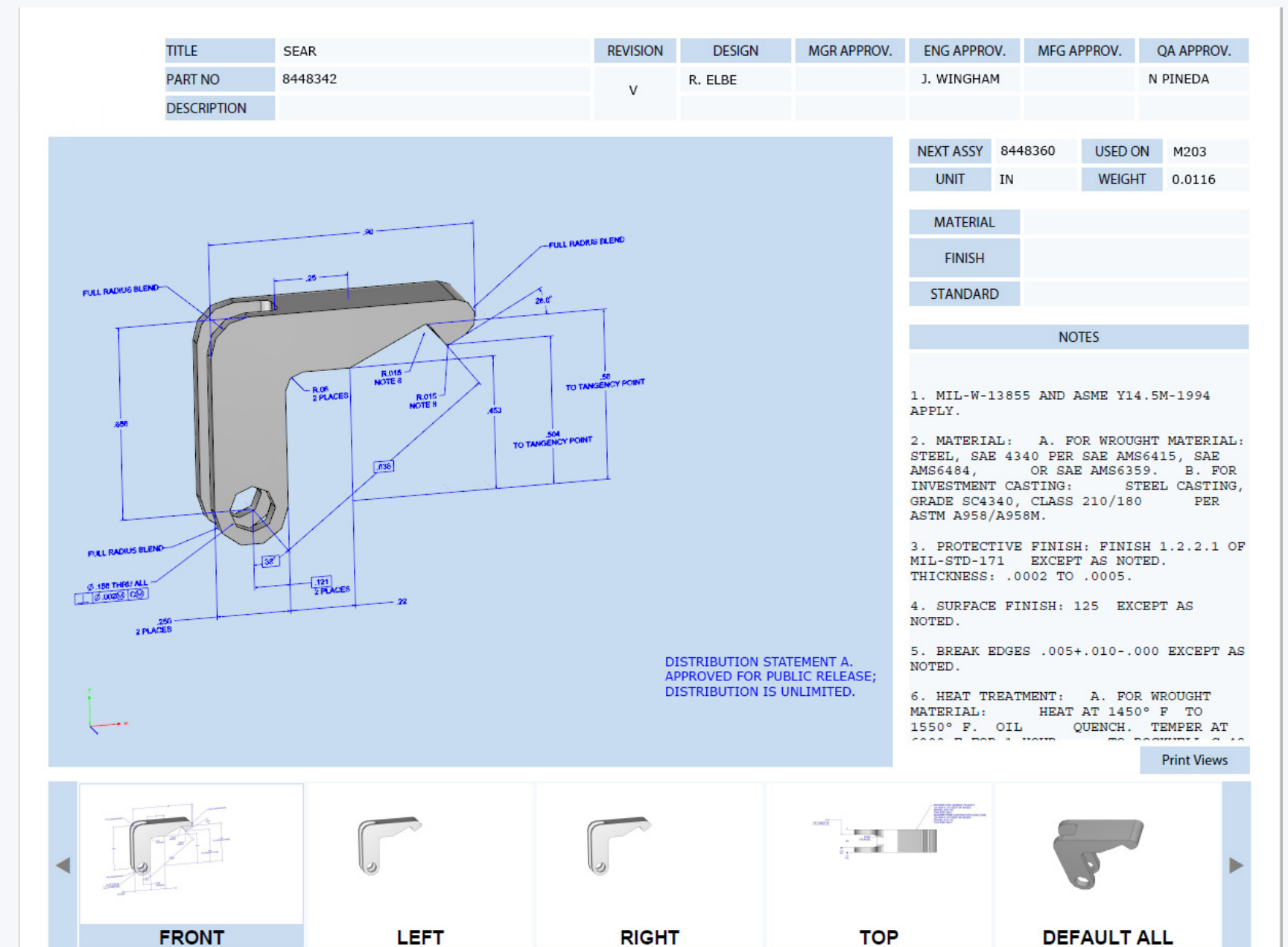
CH53K PMO doing 3D PDF conversions in-house vice OEM conversions

Comparison of 3D PDF File Conversions

- 3D PDF files created from surrogate* EDFP models



3D PDF file created from non-annotated model



3D PDF file created from annotated model

Requirements to Implement 3D PDF solution

- Include requisite metadata and part attributes in native CATIA models
- Annotate native CATIA models (prerequisite for producing a useful 3D PDF document for provisioning, cataloging, and sustainment)
- Acquire and maintain 3D PDF conversion software
- Create 3D PDF template
- Convert CATIA model to 3D PDF (PRC*) format and validate file
- Convert CATIA model to STEP (AP203) file and validate

3D PDF Conversion Software Sources

- Software embedded in the basic CAD platform
- Add-on software produced by the CAD platform developer (such as CATIA Composer or SOLIDWORKS MBD)
- Third-party software (such as Anark Core, Tetra4D, or Lattice Technology)

Cost of Implementing A 3D PDF Solution

- DLA R&D Team created a cost estimating tool (Excel spreadsheet) to assist CH53K PMO
 - Includes cost elements covering each of the implementation requirements (see slide 13)
 - Includes labor hour estimates (constants)
 - Tailorable for individual programs/situations
 - Requires knowledge of the number and complexity of models to be converted to 3D PDF

Notional Cost for Implementing 3D PDF Solution

Cost Tool Input Data	
No. models to annotate and convert to 3D PDF	10000
Average number of annotations per model	49
No. labor hours required for each annotation	0.05
Labor rate for modeling/conversion efforts (\$/Hr)	\$ 115
Number of Labor hours to create 3D PDF template	320
No. labor hours required to select/designate a model for conversion	0.08
No. of Simple Models/Files that require validation	3000
No. of Medium Complexity Models/Files that require validation	4500
No. of Complex Models/Files that require validation	2500
Time to validate a simple model/file using CAD/IQ (Hrs)	0.28
Time to validate a medium complexity model/file using CAD/IQ (Hrs)	0.4
Time to validate a complex model/file using CAD/IQ (Hrs)	0.58

Implementation Requirement	Cost	Annual Maintenance Cost
1. Develop Native CAD Files with Minimum Data Requirements for Sustainment	\$0	NA
2. Annotate dimensions, tolerances, datum, and procurement metadata in native CAD models	\$2,817,500	NA
3. Acquire 3D PDF conversion software	\$115,000	NA
3a. Support 3D PDF conversion software	NA	\$29,000
4. Create 3D PDF template	\$36,800	NA
5. Convert native CAD files to 3D PDF (PRC) document using 3D PDF template	\$95,883	NA
5.b Validate each 3D PDF document using automated software	\$561,375	\$17,400
6. Produce STEP (AP203) file corresponding to each 3D PDF file	\$95,883	NA
7. Validate each STEP file using automated software	\$472,458	NA
Total Notional Cost to Implement a 3D PDF Solution	\$4,194,800	\$46,400

Annotating native CAD files is cost driver for implementing 3D PDF solution

Conclusions

- CH53 PMO, NAVSUP, LIS, and DLA agree that 3D PDF + STEP file is best solution for transferring 3D technical data for sustainment and provisioning
- Largest cost component to implement 3D PDF solution for new weapon system is cost of annotating dimensions, tolerances, datums, and procurement metadata in native CAD models
 - Normally done by the OEM, dependent on contract requirements
 - Cost is 50% less when performed during original design creation process vs after model creation
 - Annotating during original design creation can reduce 3D PDF implementation cost by 25 – 33%
- CH53K provisioning and sustainment issues are not unique
 - Downstream use of digital data through the life cycle is not typically considered during concept exploration and system design
 - Lack of detail in DoD policy/Mil-STDs re: 3D data and format requirements
 - Tip of the iceberg (SSBN 826, CVN-78, CVN-80, etc.)

Take-Aways for Model Designers and PMOs

- OEM contract must specify appropriate data and output format requirements to support provisioning, cataloging, and sustainment
- Design models (native files) must be comprehensive – include requisite data to support sustainment (slide 22)
- Native files must be fully annotated
- PMO should review program's technical data deliverables and determine whether they meet provisioning, cataloging, and sustainment requirements
- If Program intends to receive and use 3D technical data (vice 2D technical data), consider implementing a 3D PDF solution as the delivery format to support provisioning, cataloging, and sustainment processes
- PMO should contact its provisioning activity (e.g., NAVSUP) and DLA (J344), ASAP, to discuss approach for delivering technical data including, format, when PMO will seek provisioning, cataloging, and sustainment support, and estimated number of parts that require support

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BACKUP

Data Elements and Attributes Required by DLA as part of 3D Technical Data Package (TDP)* for Procurement

- Specifications
- Dimensions
- Tolerances
- Welding requirements
- Materials (ballistics)
- Temper
- Heat treatments
- Finishes
- Rights in Data
- License Agreement
- Distribution Statement
- Document Type–Parts List, Detailed Drawing, Assembly List, Quality
- Assurance Provision, etc.
- Security code
- Tech data availability code
- Foreign secure
- Nuclear
- Subsafe
- Control code
- Legibility
- Completeness
- Restrictions
- Document approval
- Document title
- Document number
- Revision and date
- Revision type
- Expiration date
- Document data code
- Size of drawing, number of sheets, frames
- Call outs
- Sources
- First Article Test requirements
- Inspection requirements
- Higher level contract quality requirements
- Part number
- NSN
- Export control
- Commercial and government entity (CAGE) code

