26
7/13/81
22 NTIS

TS
B 5557

MASTER

BDX-613-2607

The Simplified Definition System- Magnetic Products Fabrication

By R. S. Morris

Published June 1981

Topical Report

Prepared for the United States Department of Energy
Under Contract Number DE-AC04-76-DP00613.

**Kansas City
Division**

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Printed in the United States of America

Available From the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

Price:	Microfiche	\$3.00
	Paper Copy	\$4.00

BDX-613-2607
Distribution Category UC-38

THE SIMPLIFIED DEFINITION SYSTEM--
MAGNETIC PRODUCTS FABRICATION

By R. S. Morris

Published June 1981

Topical Report

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Technical Communications

**Kansas City
Division**

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

THE SIMPLIFIED DEFINITION SYSTEM--MAGNETIC PRODUCTS FABRICATION

BDX-613-2607, Topical Report, Published June 1981

Prepared by R. S. Morris

The Simplified Definition System, a product definition approach that differentiates between design and production agency manufacturing requirements, has been used in producing 50 types of magnetic products. This system was formed as a result of cooperative work and proposed modifications by engineers from Bendix Kansas City and Sandia National Laboratories Albuquerque (SNLA) to reduce product costs. The system places responsibility for production-related requirements with a production agency, a procedure that has realized both direct and indirect cost savings. This report is a documentation of the system's description and projected savings on magnetic products.

DDK/TR18/b

This report was prepared as an account of work sponsored by the United States Government. Neither the United States, nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, expressed or implied or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

The Bendix Corporation
Kansas City Division
P. O. Box 1159
Kansas City, Missouri 64141

A prime contractor with the United States
Department of Energy under Contract Number
DE-AC04-76-DP00613

CONTENTS

Section	Page
SUMMARY.	4
DISCUSSION	5
SCOPE AND PURPOSE.	5
SIMPLIFIED DEFINITION SYSTEM (SDS)	6

TABLES

Number		Page
1	Projected SDS Implementation Costs	11
2	Total Projected Annual Cost Savings.	12
3	Projected Manufacturing Marking Operator Savings.	13
4	Tool-Made Sample (TMS) Cost.	14
5	Process Qualification Cost	15
6	Projected TMS/Process Qualification Savings.	16
7	Projected Failure Analysis Savings	17
8	Projected Specification Exception Release (SXR) Savings.	18
9	Projected Advance Change Order (ACO) Savings.	19

SUMMARY

The United States Department of Energy (DOE) design agencies furnish design definition for products manufactured by The Bendix Corporation, Kansas City Division. This definition typically contains design and production information for product acceptance according to the combined requirements of both agencies. Bendix and Sandia National Laboratories Albuquerque (SNLA) have initiated cooperative efforts to simplify the design definition that will result in more efficient manufacturing and design.

This simplification, called the Simplified Definition System, (SDS) identifies production information not requiring Sandia control and approval and places control of this information with Bendix. Sandia is responsible for specifying final design acceptance criteria based on parameters critical to product fit and function. Bendix is responsible for specifying all in-process manufacturing and inspection requirements.

SDS has been incorporated initially on 50 active magnetic products controlled by Bendix and Sandia. Initial application on these products is complete.

The projected annual cost savings resulting from use of SDS on magnetic devices is \$170,861. The actual results have met predictions and additional indirect advantages are expected as the engineering staff gains experience with the system.

DISCUSSION

SCOPE AND PURPOSE

As design and production agencies, Sandia and Bendix have the responsibility of producing highly technical products at minimum cost while maintaining the highest quality standards. To help maintain an effective cost/product ratio, both agencies jointly have proposed modifications to the ways product is defined. This new product definition system, called the Simplified Definition System, (SDS) effectively differentiates between the design and manufacturing information included in a typical product drawing set. Placing the responsibility for manufacturing related requirements with the production agency achieves greater design and production efficiencies. This ultimately results in maintaining a high-quality product at minimum cost.

I. SIMPLIFIED DEFINITION SYSTEM (SDS)

A. Activity

Tighter budgetary demands within the DOE weapons complex have necessitated a reexamination of the factors contributing to production cost. One area that contributes to product cost is the definition used to produce and accept the product. Bendix and Sandia maintain that drawing set simplifications can be made that will result in worthwhile cost reductions in manufacturing.

The premise of this Simplified Definition System is that the drawing definition contains two types of information: the design information critical to product fit and function, and the manufacturing information critical to processing and process control. Identifying manufacturing information that does not require design laboratory control attains significant cost reductions.

Within SDS, the design laboratories are responsible for specifying only criteria pertinent to product fit and function. The production agency is responsible for specifying all manufacturing and inspection requirements needed to maintain adequate process control.

Sandia and Bendix acknowledge the effectiveness and applicability of SDS because

- Bendix has a mature, quality, production capability;
- Quality is primarily production agency and DOE responsibility;
- The production agency decides on scrap;
- Reliability is intrinsic and can be established by testing during development;
- Process qualification is valid; and
- Fewer design agency requirements will mean lower product cost.

B. Definition

The SDS concept is a modified type of drawing system that differentiates clearly between the

drawing information pertinent to product fit and function (design information) and product manufacturing information (production information).

Responsibilities for information included in a typical drawing set are handled as indicated:

Automated Materials List (AML)

- The design agency controls specifications on critical piece parts and materials.
- The production agency controls use of process materials of a general nature, such as solder, flux, and cleaning solvents.
- The production agency also controls process standard callouts and process materials used to build the product.

Graphic Drawing (AY)

- Dimensions affecting fit and function on magnetic items whose next assemblies are at another production agency are controlled by the design agency. Other dimensions are production agency responsibility.
- Notes and other information critical to part performance are specified by the design agency.
- Notes and other information critical to processing are specified by the production agency.

Product Acceptance Specification (PS)

- Tests critical to part performance are design agency responsibility.
- Tests critical to process control are production agency responsibility.
- The production agency quality organization is authorized to determine sample size and acceptance quantity for production agency-controlled tests.

- A section containing design performance characteristics is included in the general section of the product specification for parts not requiring qualification.
- The test summary table generally has two columns. One is labeled Process Verification Tests and the other is labeled Acceptance Tests. A third column labeled "Qualification Tests" is included for parts having qualification requirements.
- Failure analysis is required initially, but the value of this system is being reviewed.
- Design agency engineering staff is notified when more than 10 percent of a product fails a design agency test.
- Production agency engineering staff is notified when more than 10 percent of a product fails a Bendix-specified test.
- Many of the parameter tests, previously considered acceptance tests, are called process verification tests and are the responsibility of the production agency. Each product is reviewed individually by the responsible Bendix and Sandia engineers to determine tests critical to product function.
- Qualification is minimized. The decision to qualify is based upon the following criteria.

Reasons for not requiring qualification include

- Product similarity to others recently fabricated;
- Product does not require new processes or techniques;
- Product is extremely simple part;
- Noncritical product application;
- Product lends itself well to grouping into submittals or lots;

- Development has been adequate to prove processes or design or both;

Reasons for requiring qualification are

- Product includes a unique design;
- Nonstandard processes are involved;
- Very critical product application;
- Development time or funds is not sufficient to adequately establish product quality before production.

Generally one or more of the preceeding reasons is sufficient to decide, but qualification may be required in situations such as these:

- Fabrication involves use of some minor new or different processes;
- Product design different than usually used, but not necessarily unique;
- Extended period of time has elapsed since process or design was employed in production;
- Decisions to qualify or not are about equally balanced. In those cases, an arbitrary engineering decision will have to be made.

C. Benefits

Implementation of the Simplified Definition System on 50 active magnetic devices at Bendix is expected to produce these effects:

- Reduced product fabrication time;
- Reduced product inspection time;
- Fewer drawing changes and product deviation requests submitted to the design agency; and
- Decreased effort by the design agency to review manufacturing problems.

A combination of these effects will produce important annual cost savings.

II. IMPLEMENTATION

Simplified Definition System implementation on magnetics was handled as follows:

- Two Bendix engineers reviewed the active magnetic products to determine which ones would benefit most from Simplified Definition System conversion. They generated a tentative product list.
- The Manufacturing and Quality divisions reviewed the list and prepared a semifinal list.
- Sandia reviewed and approved the semifinal list.
- Bendix and Sandia engineers reviewed the drawing sets for each part to assign design agency and production agency responsibilities.
- Drawing changes were issued, and the Simplified Definition System was incorporated into the final parts list.

The schedule for implementing the Simplified Definition System on 50 active magnetic devices called for converting 10 devices a month starting in September, 1979.

Table 1 shows the projected implementation cost for the 50 active magnetic devices.

New magnetic devices will be released initially into the Simplified Definition System. Sandia designates design requirements on its initial drawing releases to Bendix. The Bendix engineer adds manufacturing requirements as soon as those needs become apparent.

III. COST SAVINGS

The projected annual cost savings resulting from converting magnetic products to the Simplified Definition System is \$170,861 (Table 2). This amount would be reduced \$28,584 (implementation cost) during the first year. In addition, the savings would have to be factored to account for the percentage of time that product was actually converted during the first year.

Table 1. Projected SDS Implementation Costs

Direct Labor and Support Activity	Time (Hours)	Cost (Dollars)
Drafting	800	15,784
Quality Process Engineering	100	2,188
Products Engineering	400	10,612
Total	1,300	28,584

Table 2. Total Projected Annual Cost Savings

Activity	Current	Proposed	Annual Savings
Manufacturing Marking Operators (Ref. Table 3)	1.55	0.55	\$ 24,170
Visual Inspectors	3	2	24,710
Electrical Inspectors	9	7	49,420
TMS/Process Qualification (Ref. Tables 4, 5 and 6)	\$48,000	\$3,519	44,481
Failure Analysis (Ref. Table 7)	\$14,400	\$3,600	10,800
Specification Exception Release (Ref. Table 8)	240/year	240/year	5,760
Local	24	216	
Design Agency	216	24	
Engineering Changes (Ref. Table 9)	480/year	480/year	11,520
Local	48	432	
Design Agency	432	48	
TOTAL	NA	NA	\$170,861

Table 3. Projected Manufacturing Marking Operator Savings

Estimated quantity of parts to be marked in a year	50,000
Estimated time to mark one part (in hours)	0.01667
Estimated time to mark all parts (in hours)	833.5
Estimated time to mark all parts adjusted for 80 percent efficiency (in hours)	1,000
Total available hours/year/operator	1,824
Estimated number of operators required for marking operation = $\frac{1,000}{1,824}$	0.55
Estimated number of operators required for temperature cycling operation = $\frac{824}{1,824}$	0.45
Total number of operators currently performing marking and temperature cycling	2
Estimated number of operators required using Simplified Definition System marking requirements	1
Estimated manufacturing savings (in operators)	1
Total dollar savings	\$24,170

Table 4. Tool-Made Sample (TMS) Cost

Bendix Cost	Hours	Dollars
Product/Process Engineer	68	2,040
Quality Engineer	16	480
Process Engineer	16	480
Total Bendix Cost	100	3,000
Sandia Cost		
Product/Quality Initiate TMS Planning Sheet	24	720
Travel Expenses (\$300 x 2)		600
Salary Expenses (28 hr x 2)	56	1,680
Product/Quality Review Packet and Release TMS	8	240
Total Sandia Cost	NA	3,240
Total Cost per TMS = Bendix Cost + Sandia Cost		6,240

Table 5. Process Qualification Cost

Bendix Cost	Hours	Dollars
Product/Process Engineer	76	2,280
Quality Engineer	16	480
Quality Process Engineer	16	480
Manufacturing Operator	24	279
Total Bendix Cost	132	3,519
Sandia Cost		
Product/Quality Initiate Qualification Planning Sheet	24	720
Travel Expenses (\$300 x 2)	NA	600
Salary Expenses (36 hrs x 2)	72	2,160
Product/Quality Review Packet and Release Qualification	8	240
Total Sandia Cost	104	3,720
Total Cost per Process Qualification =		
Bendix Cost + Sandia Cost		7,239

Table 6. Projected TMS/Process Qualification Savings

Tool-Made Sample (TMS) Cost Avoidance/Year

$$= \text{TMSs Eliminated/Year} \times \text{Bendix Cost/TMS}$$

$$= 16 \times \$3,000$$

$$= \$48,000$$

Process Qualification Cost Increase/Year

$$= \text{Process Qualifications Added/Year} \times \text{Bendix Cost/Process Qualification}$$

$$= 1 \times \$3,519$$

$$= \$3,519$$

Projected TMS/Process Qualification Savings/Year

$$= \text{TMS Cost Avoidance} - \text{Process Qualification Cost Increase}$$

$$= \$48,000 - \$3,519$$

$$= \$44,481$$

Table 7. Projected Failure Analysis Savings

Failure Analysis Activity	Minutes	Dollars
Round trip to factory	5	2.50
Review failure analysis finding with inspection/manufacturing personnel	15	7.50
Conduct investigation to determine cause of problem and the needed corrective actions	20	10.00
Review data with SNLA and make recommendations	15	7.50
Complete failure analysis and release in system	5	2.50
Total Cost/Failure Analysis	60	30.00
Projected Failure Analysis Savings/Year = Failure Analysis/Year (Std. TIE System - SDS System) x Cost/Failure Analysis = $480 - 120 \times \$30 = \$10,800.$		

Table 8. Projected Specification Exception
Release (SXR) Savings

SXR Activity	Time (Hours)	Cost (Dollars)
Preparation by Engineer	2	60.00
Engineering Records	0.25	2.22
Comcenter	1.5	13.32
Duplicating	0.25	2.22
Distribution	0.08	.75
Production Control	1	11.41
Inspection Control Center	0.5	5.71
Total Cost/SXR	5.58	\$95.63

Projected Savings/SXR = 1 Hour (Engineering Time) x \$30/Hour = \$30.00

Projected Annual SXR Savings = Savings/SXR
x Sandia-controlled SXRs (Old System - SDS) =
\$30 x (216 - 24) = \$5,760

Table 9. Projected Advance Change Order (ACO) Savings

Activity	Time (Hours)	Cost (Dollars)
Preparation by Engineer	2	60.00
Engineering Records Processing	0.25	2.22
Comcenter	1.5	13.32
Duplicating	0.25	2.22
Distribution	0.08	.75
Drafting	6	143.04
Engineering Records	0.17	1.48
Production Control	3	34.24
Inspection Control Center	1	11.41
Total ACO Cost	NA	\$268.68
Projected savings for each ACO = 1 Hour (Engineering Time) x \$30/Hour = \$30		
Projected Annual ACO Savings = Savings/ACO x Sandia-Controlled ACOs (Old System - SDS) = \$30 x (432 - 48) = \$11,520		

BDX-613-2607

THE SIMPLIFIED DEFINITION SYSTEM--MAGNETIC
PRODUCTS FABRICATION, R. S. Morris, Topical,
June 1981

The Simplified Definition System, a product definition approach that differentiates between design and production agency manufacturing requirements, has been used in producing 50 types of magnetic products. This system was formed as a result of cooperative work and proposed modifications by engineers from Bendix Kansas City and Sandia National Laboratories Albuquerque (SNLA) to reduce product costs. The system places responsibility for production-related requirements with a production agency, a procedure

SPECIAL PROJECTS: SDS-Magnetic Products

THE SIMPLIFIED DEFINITION SYSTEM--MAGNETIC
PRODUCTS FABRICATION, R. S. Morris, Topical,
BDX-613-2607, June 1981

The Simplified Definition System, a product definition approach that differentiates between design and production agency manufacturing requirements, has been used in producing 50 types of magnetic products. This system was formed as a result of cooperative work and proposed modifications by engineers from Bendix Kansas City and Sandia National Laboratories Albuquerque (SNLA) to reduce product costs. The system places responsibility for production-related requirements with a production agency, a procedure

THE SIMPLIFIED DEFINITION SYSTEM--MAGNETIC
PRODUCTS FABRICATION, R. S. Morris, Topical,
BDX-613-2607, June 1981

The Simplified Definition System, a product definition approach that differentiates between design and production agency manufacturing requirements, has been used in producing 50 types of magnetic products. This system was formed as a result of cooperative work and proposed modifications by engineers from Bendix Kansas City and Sandia National Laboratories Albuquerque (SNLA) to reduce product costs. The system places responsibility for production-related requirements with a production agency, a procedure

that has realized both direct and indirect cost savings. This report is a documentation of the system's description and projected savings on magnetic products.

that has realized both direct and indirect cost savings. This report is a documentation of the system's description and projected savings on magnetic products.

that has realized both direct and indirect cost savings. This report is a documentation of the system's description and projected savings on magnetic products.