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H1640 Caster Tool Development Report

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L. A. Brown

Prepared by

Sandia National Laboratories

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H1640 Caster Tool Development Report

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Handling Equipment Engineering Department
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Livermore, California 94551

ABSTRACT

This report describes the development and certification of the H1640 caster tool. The H1640 is available to the DoD (Air Force) through the Special Equipment List (SEL) for the B83 as a replacement for the H631 and H1216 caster tools.

ACKNOWLEDGMENTS

Cook Story, Dennis Beyer, and Robert Monson, SNL/CA Managers who supported the development of the H1640. Darryl Brunswick and Allan Rahe, AlliedSignal/FM&T Product Engineers on the H1640 for their efforts on the product definition. Marv Loll, 2265, for his critique of this report. Steve Buck, formerly, 2265, for the testing on the H1640 and Judy Tejada, formerly 2264, for quality support on the H1640.

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H1640 Caster Tool Development Report

Introduction

The H631 (Figure 1) and the H1216 (Figure 2) caster tools, used to rotate swivel caster wheels 90 degrees, have been the primary caster tools since the introduction of the B28 bomb. They were both called out for rotating castering wheels on bomb hand trucks or shipping containers for the B28, B43, W56, B57, B61, B83, and W87 programs, while the B53 and W71 only called out the H1216. These tools are easy to use, low cost, and lightweight. They work well on lightweight systems equipped with flat-sided casters (Figure 3). Figures 4 and 5 show their usage on a flat-sided caster for the B83.

The B83 is a heavy bomb system and weighs close to 5600 pounds for a two-high stack configuration (Figure 6). The H1347 bomb hand truck for the B83 was designed to use on the cradle and caster assemblies from the H695A bomb hand truck for the B43 (now retired). This cradle was originally equipped with flat-sided casters, but later in the B43 program a barrel caster was introduced as an alternate. The H1347 casters are now predominately barrel casters with only approximately 10% of the population being flat-sided casters.

The H1216 and H631 caster tools with parallel forks do not engage the barrel caster frame (Figures 7, 8, and 9). High castering moments (handle length times the force exerted on handle) are required to caster a wheel for a two-high stack of B83s, which weighs approximately 600 pounds more than did a two-high stack of B43s. This castering action results in sharp gouges on the barrel caster frame (Figure 10) and also inflicts some damage on the flat-sided caster (Figure 11). Also, the handle on the H631 is too short to easily turn the wheel. Air Force personnel have noted scraped knuckles when the tool has slipped and also have cut fingers from burrs left on the caster frame by the action of the caster tool.

To resolve these problems, the B83 program committed to an effort to design and qualify a better caster tool and to make this tool available to the Air Force through the Special Equipment List. This tool is the H1640.

Design of the H1640 Caster Tool

The H1640 caster tool (Figure 12) rotates the caster assembly on the B83 bomb hand truck by engaging the wheel across the hub (Figure 13) rather than on the caster frame. This caster tool works equally well with either the barrel or flat-sided caster. Castering of one wheel (rotating a wheel perpendicular to the other three) is required when units are being transported in an unshored condition such as on a truck/trailer or aircraft or when they are in storage. Wheels also need to be locked into their proper position when towing the bomb hand truck.

Figure 1. H631 Caster Handling Tool.

Figure 2. H1216 Caster Tool.

Figure 3. Flat-Sided Caster.

Figure 4. Using H631 to Turn Flat-Sided Caster.

Figure 5. Using the H1216 to Turn Flat-Sided Caster.

Figure 6. B83/H1347, Two-High Stack.

Figure 7. Barrel Caster/H631 Caster Tool.
Note: Lack of Full Engagement

Back Side

Figure 8. H631/Barrel-Type Caster.

Note: Lack of full engagement with the H631 while engaging the back or front side on the barrel-type of caster.

Figure 9. H631/Barrel-Type Caster.

Front Side

Note: Sharp edge/burr.

Figure 10. Typical Damage to Barrel-Type Caster from the H631 Caster Tool.

Figure 11. Typical Damage to Yoke on Flat-Sided Caster from the H631 Caster Tool.

Figure 13. Determining the Force to Caster a Wheel.

Figure 12. H1640 Caster Tool.

Design requirements for the H1640 include: a) easy to use, b) lightweight, c) can be used in tight places, and d) does not damage the caster. A safety factor of three based on yield is required per DG10220, Design and Manufacturing Guide.

Design features on the H1640 include the following:

- 1) Lightweight aluminum construction.
- 2) Fork: 6.0 inches wide $\times$ 7.0 inches long $\times$ 2.5 inches high, made from 6061-T6 aluminum.
- 3) Handle: adjustable to 18.0, 24.0, or 30.0 inches long, made from 2024-T3 aluminum. The short length can be used in tight quarters, whereas the long length provides easy castering of the wheel.
- 4) Knurl feature on slider to prevent slippage from the operator's hand.
- 5) The handle attaches to the fork by means of a spring (roll) pin.
- 6) Weighs less than 7.0 pounds.
- 7) The fork engages on the wheel hub rather than on the caster frame. The fork fits closely to and is parallel to the wheel hub providing ample surface area for contact.
- 8) Appendix A shows the drawing set for the H1640 caster tool.

Force to Caster a Wheel

We tested a two-high stack of B83s loaded into H1347s to determine the force required to caster or turn one wheel perpendicular to the other three. The stack was positioned on a rough concrete surface. The caster tool handle was set at the 30-inch length. A scale was attached to the handle of the caster tool, and by pulling on the opposite end of the scale (Figure 13), we measured the force required to turn one wheel 90 degrees. After several tests, the maximum force was determined to be 70 pounds.

Testing and Qualification

Appendix B describes the development and qualification tests performed on the H1640. In all these tests, the handle was set at the 30-inch length. An early test on a prototype (Appendix B-3) with a 1-inch O. D. handle and 1.25-inch O. D. slider resulted in the handle bending at a 250-pound load. This met the yield requirement three times the design load, but the decision was made to design a more robust handle. The handle was increased to 1.25-inch O. D., and the slider increased to 1.50-inch O. D.

Prototype II caster tool with the stronger handle was tested (Appendix B-2) with no yielding of the handle at 350 pounds and a 0.50-inch permanent set at 400 pounds.

The production hardware was tested (Appendix B) with the handle beginning to yield at a force of approximately 300 pounds. Another test showed the maximum force that could be exerted on the handle by various operators ranged between 188 and 318 pounds. Therefore, the design of the handle makes it improbable that an operator can bend it in normal operations. There was no visual damage to the caster tool fork or to the caster assembly in any of the above tests.

A destructive test on the H1640 resulted in the tool slipping off the caster wheel hub at 468 pounds force. In this test, the handle showed some bending where it connects to the fork, and the width of the fork opened up .

The Engineering Evaluation Release is shown in Appendix C, and the Qualification Evaluation Release is found in Appendix D.

Summary

We designed the H1640 casting tool to rotate the caster assembly on the B83 bomb hand truck. The H1640 replaces the H631 and H1216 tools, which could damage the frames on the barrel casters. The forks on the H1640 engage the wheel across the hub rather than on the caster frame (Figures 14 and 15).

A series of structural tests to evaluate and verify design characteristics of the H1640 caster tool were conducted. These tests demonstrated the H1640 adequately meets the design requirement for a safety factor of three based on yield strength. Permanent set to the handle at the fork interface occurred at 300 pounds force, well above the 210-pound requirement.

The H1640 caster tool was demonstrated to the Air Force at KUMSC. The Air Force has approved the use of this tool and has procured approximately 14 to replace the H631 and H1216 for use on the B83 program.

Figure 14. H1640 Engaging Barrel-Type Caster.

Figure 15. H1640 Engaging Flat-Sided Caster.

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APPENDIX A

Drawings

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457660 Fork	22
AY457660 Fork	23
457662 Handle	24
AY457662 Handle	25
457663 Slider	26
AY457663 Slider	27

KC-----PRINTED 05/26/94-----U-N-C-L-A-S-S-I-F-I-E-D-----DRAWING NUMBER---214257 ISSUE--- B
TITLE---H1640,CASTER TOOL (U) TIE ---SL/KC/ DRG---2 DESIGN AGENCY CAGE CODE---14214
DRAWING LOCATION---KC DATE---05-26-94

RELEASED BY PS RELEASED DATE---5-31-94

FOR EXPLANATION OF CODES SEE END OF CALLOUTS SECTION.

*** OTHER REQUIREMENTS ARE ***
0000000 GENERAL REQUIREMENTS
9919100 MARKING, GENERAL METHODS

HARTLEY, G S 894/BROWN, L 5365/BRUNSWICK 862 00100
940980KC C 00101

DOE P/N CHANGE HISTORY DATE
AER/DTER 940073SL ISSUE A -00/-00 00200
00201
00202
00203
*** STANDARD NOTES ***
STD NOTE V. OE REQUIRED. 01500
01549

ML CODE	UNIT OF MEASURE	PRODUCTION AGENCY	CAGE	DESIGN AGENCY	PART CLASS	T	LINE
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				PART OR CONTROL NO			
	NA		14214	AY214257-000			02500
	1		14214	457660-00			1 30100
	1		14214	457662-00			2 30200
	1		14214	457663-00			4 30400
	1		96906	MS171722			6 30500
	1		96906	MS17984-C416			7 30700
	1		14213	881347-00			8 30800

EXPLANATION OF CODES.

QUANTITY CODE/S--- AR-AS RORD ARS-AS RORD PER ASSY NA-DOCUMENTS PM-PROCESS MATERIEL EM-EXPENSE MATERIEL ALT-ALTERNATE
UNIT OF MEASURE CODE/S---IN-INCHES LB-POUNDS OZ-OUNCES AVOIRDUPOIS TZ-OUNCES TROY G-GRAMS FT-FEET PC-PER CENT

N-METRE MM-MILLIMETRE KG-KILOGRAM

PART CLASSIFICATION CODES: UNCLASSIFIED---N UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION---R

KC-----PRINTED 05/28/94-----U-N-C-L-A-S-S-I-F-I-E-D-----DRAWING NUMBER---214257 ISSUE--- B

▶ INSTALL CABLE RING, FROM CABLE ASSEMBLY, INTO GROOVE ON SLIDER.
RE-ATTACH CABLE ASSEMBLY TO CABLE RING AND DOUBLE CRIMP FERRULE.
ATTACH CABLE ASSEMBLY TO S-HOOK ON QUICK RELEASE PIN AND CRIMP
S-HOOK.

CONTROL NUMBER	REVISON			
	ISSUE	SHEET	DESCRIPTION	DATE
AY214257-000	B	PREPARED BY		
		G. HARTLEY B94KC		
		1. BROWN 3365		
		D. BRUNSWICK 062KC		
		5409B00KC C		
		Released E-51-94 PS

SHEET 1 TABLE 1 PART CLASSIFICATION UNCLASSIFIED DRAWING CLASSIFICATION UNCLASSIFIED	TITLE H1640, CASTER TOOL (U) DRAWING NUMBER AY214257
TIE SL/HC STATUS KC-	DFC 2 CASE# 14214 SCALE 1/2 ORIGIN SL-CVCS-REVS.2

22

-----END OF CALLOUT SECTION-----

EXPLANATION OF CODES.

QUANTITY CODE/S--- AR-AS RORD ARS-AS RORD PER ASSY NA-DOCUMENTS PM-PROCESS MATERIEL EM-EXPENSE MATERIEL ALT-ALTERNATE

UNIT OF MEASURE CODE/S---IN-INCHES LB-POUNDS OZ-OUNCES AVOIRDOUPOIS TZ-OUNCES TROY G-GRAMS FT-FEET PC-PER CENT

M-METRE MM-MILLIMETRE KG-KILOGRAM

PART CLASSIFICATION CODES: UNCLASSIFIED---N UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION---R

KC-----PRINTED 05/26/94-----U-N-C-L-A-S-S-I-F-I-E-D-----DRAWING NUMBER---457660

KC-----PRINTED 06/22/94-----U-N-C-L-A-S-S-I-F-I-E-D-----DRAWING NUMBER---457662 ISSUE--- C
TITLE---HANDLE (U) DESIGN AGENCY CASE CODE---14214
TIE ---SL/KC/ DRC---2 DRAWING LOCATION---KC DATE---06-22-94
RELEASED BY *f* RELEASED DATE--- 7-6-94

-----SHEET---001 OF 001
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*** OTHER REQUIREMENTS ARE ***
9900000 GENERAL REQUIREMENTS
9919100 MARKING, GENERAL METHODS

REMPE, *dk* 894/BROWN, L A 5365/RAHE, A H 862 00100
941195KC C *gkr* 00101
00198
00199

DOE P/N CHANGE HISTORY DATE

AER/DTER 9400735L ISSUE A -00/-00
00200
00201
00202
00203

ML CODE	UNIT OF MEASURE	PRODUCTION AGENCY	CAGE	DESIGN AGENCY	PART CLASS	I	LINE
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-QTY-	-QTY-	-QTY-	-QTY-	-QTY-	-QTY-	-QTY-	
			-00	457662-00	457662-00		02000
					PART OR CONTROL NO		
			NA	14214	AY457662-000		02500
			NA	14061	9919104-01		02600
							RT081
			ARS	14213	7420261-02		1 30100
							RT081
			EM	14213	5000247-01		2 30200

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EXPLANATION OF CODES.
QUANTITY CODE/S--- AR-AS RQRD ARS-AS RQRD PER ASSY NA-DOCUMENTS PM-PROCESS MATERIEL EM-EXPENSE MATERIEL ALT-ALTERNATE
UNIT OF MEASURE CODE/S---IN-INCHES LB-POUNDS OZ-OUNCES AVOIRDUPOIS TZ-OUNCES TROY G-GRAMS FT-FEET PC-PER CENT
M-METRE MM-MILLIMETRE KG-KILOGRAM
PART CLASSIFICATION CODES: UNCLASSIFIED---N UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION---R

KC-----PRINTED 06/22/94-----U-N-C-L-A-S-S-I-F-I-E-D-----DRAWING NUMBER---457662 ISSUE--- C

1. GENERAL REQUIREMENTS AND DRAWING INTERPRETATIONS ARE DEFINED IN 9900000.
2. IF PROCURED INDIVIDUALLY, MARK PART NUMBER AND SUFFIX PER 9919100, CLASS H-1.
3. ENGRAVE A LINE ALL AROUND .020 MAX WIDE X .020 MAX DEEP. FILL ENGRAVINGS PER 9919104, USING ITEM 2, RED FILLFR.
4. FOR CONVENIENCE IN MANUFACTURING, THE .75 I.D. MAY BE CHAMFERED.

CONTROL NUMBER		REVISION						
ISSUE	SHEET TO	PREPARED BY	DESCRIPTION	DATE	CHKD	APVD		
AY457662-000	D	J. NICHOLS B94KC L. BROWN 5365 A. RAHE B62KC 941550KC C						
	RELEASED 10-28-94							
E		J. KEEHLER B94KC L. BROWN 5364 A. RAHE B62KC 941924KC C					12-94	JAK <i>gfk</i>
Released 1-2-95 <i>f</i>

SHEET		TITLE	
1		HANDLE (U)	
ISSUE	E		
PART CLASSIFICATION		UNCLASSIFIED	
DRAWING CLASSIFICATION		UNCLASSIFIED	
TIE SL/XC		DRC 2	
STATUS		KC-	
		AY457662	
		CARR 14214 SCALE 1/1 SHEET 1 OF 1	
		ORIGIN SL-CVCS-REV6.2	

KC-----PRINTED 06/21/94-----U-N-C-L-A-S-S-I-F-I-E-D-----DRAWING NUMBER---457663 ISSUE--- C
 TITLE---SLIDER (U) DESIGN AGENCY CAGE CODE---14214
 TIE ---SL/KC/ DRC---2 DRAWING LOCATION---KC DATE---06-21-94
 RELEASED BY *df* RELEASED DATE--- 7-6-94

-----SHEET---001 OF 001
 FOR EXPLANATION OF CODES SEE END OF CALLOUTS SECTION.

*** OTHER REQUIREMENTS ARE ***
 9900000 GENERAL REQUIREMENTS
 9919100 MARKING, GENERAL METHODS

REMPE, R J 894/BROWN, L 5365/RAHE, A H 862 00100
 941195KC C *QHR* 00101

DOE P/N CHANGE HISTORY DATE
 AER/DTER 940073SL ISSUE A -00/-00 00198
 00199
 00200
 00201
 00202
 00203

ML CODE	UNIT OF MEASURE	PRODUCTION AGENCY	CAGE CODE	DESIGN AGENCY PART NUMBER	PART CLASS	LINE
I	I	NUMBER /PENTAGON M/	I		I E	NO
-QTY- -QTY- -QTY- -QTY- -QTY- -QTY-	-00	457663-00		457663-00	N	02000
	NA		14214	AY457663-000		02500
	ARS		14213	7420261-02		1 30100
				ALUMINUM ALLOY, 2024-T3, DRAWN SEAMLESS TUBE, ROUND		RT081
	ARS		14213	881396-00		2 30200
				RIVET, BLIND		

-----END OF CALLOUT SECTION-----
 EXPLANATION OF CODES.
 QUANTITY CODE/S--- AR-AS RORD ARS-AS RORD PER ASSY NA-DOCUMENTS PM-PROCESS MATERIEL EM-EXPENSE MATERIEL ALT-ALTERNATE
 UNIT OF MEASURE CODE/S--- IN-INCHES LB-POUNDS OZ-OUNCES AVOIRDUPOIS T2-OUNCES TROY G-GRAMS FT-FEET PC-PER CENT
 M-METRE MM-MILLIMETRE KG-KILOGRAM
 PART CLASSIFICATION CODES: UNCLASSIFIED---N UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION---R

KC-----PRINTED 06/21/94-----U-N-C-L-A-S-S-I-F-I-E-D-----DRAWING NUMBER---457663 ISSUE--- C

CONTROL NUMBER		REVISION				
ISSUE	SHEET COUNT	PREPARED BY	DESCRIPTION	DATE	CHKD	APPRO
AY457663-000	B	G. HARTLEY 894KC L. BROWN 5365 D. BRUNSWICK 862XC 940980KC C REV 1			<i>GH</i>	<i>DLB</i> 3-74
<i>Released 5-13-95</i>

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APPENDIX B

Testing

Test Result	Page
Post-Test Report—Qualification Testing of the H1640 Caster Tool (214257) Steve Buck (5365) to Larry Brown (5364) and Distribution, November 11, 1994 (also published in Sandia Report, SAND97-8264, Appendix C).	30
Post-Test Report—Load Testing of the H1640 Caster Tool (214257), Prototype II, Steve Buck (5365) to Larry Brown (5364) and Distribution, February 1, 1994 (also published in Sandia Report, SAND97-8264, Appendix B).	42
Load Testing of a Prototype H1640 Caster Tool (214257), Steve Buck (5365) to Larry Brown (5364) January 6, 1994 (also published in Sandia Report, SAND97-8264, Appendix A).	48

SANDIA NATIONAL LABORATORIES

Livermore, California 94551-0969

date: November 11, 1994

to: Larry Brown, MS9035 (5364)
Distribution,

Steve Buck

from: Steve Buck, MS9035 (5365)

subject: Post-Test Report - Qualification testing of the H1640 Caster Tool (214257)

Reference: Load Testing of a Prototype H1640 Caster Tool (214257) dated January 6, 1994.
Reference: Load Testing of the H1640 Caster Tool, Prototype II, dated February 1, 1994.
Both documents are in File S-5.47.2 H1347 and H-Gear (5365).

The purpose of the testing was to evaluate and verify design characteristics of the H1640 caster tool. The H1640 caster tool will be used on the H1347 bomb hand truck to rotate caster wheels 90 degrees when in transportation and storage of the B83.

REQUIREMENTS:

The static load qualification testing requirements are given in DESIGN AND MANUFACTURING GUIDE, DG10220 / A - Handling Equipment, paragraph 4.2.2 which states: " H-Gear equipment shall be designed to withstand the forces imposed by the rated load with a minimum safety factor of 3.0, based on the minimum value of the yield strength of the structural material ".

RESULTS:

A meeting was held on November 4th with the design engineer, quality personnel, solid mechanics personnel, and team members to review the test results. We concurred that the design of the H1640 caster tool passed the static load qualification testing. We also agreed to add a CAUTION note to the TP manual. The CAUTION note will read: "Failure to unlock caster can result in damage to the caster or caster tool".

BACKGROUND:

From previous testing of the development H1640 caster tool the load perceived to rotate a unlocked caster on a double stacked bomb hand truck was 70 pounds of force. Three times that load would be 210 pounds.

Static load testing was completed on the H1640 caster tool. Date of testing was November 2nd and 3rd. The H1640 caster tool was sent to Sandia for evaluation from AlliedSignal, KCD. The voucher number was 310120. The weight of the H1640 caster tool assembly was 6.8 pounds.

TEST PARAMETERS:

In order to verify design parameters two performance tests and one destructive test were performed on the H1640 Caster Tool using the Static Load Frame in building 914. Facility personnel that supported testing was: Ken Lee, John Korellis, and John Totten, all in Dept. 8746. The first two tests were configured to transmit loads 90 degrees to the axis of the caster tool. The third test had a different configuration.

Test number one configuration had the tool mounted to a fixed block which represented the caster wheel. A series of loads were applied to the caster tool handle (200, 250, 300, 350, and 400 pounds). After each load, measurements of the width of the fork and straightness of the handle were taken. After the 300 pound load, it was observed that the handle had a small bend. The bend occurred where the handle is attached to the fork. The bend grew in size with loads of 350 and 400 pounds. Reference page 3, 4, and 5 for test setup and data.

Test number two configuration had a development H1640 tool mounted to a caster wheel on a bomb hand truck cradle which was toe clamped to the static frame. Various personnel (four) were used to apply the loads. The measurements of the loads were recorded by what force a person could pull on the handle. The size of the personnel varied from 5'6" to 6' and the weight varied from 140 to 215 pounds. The loads pulled varied from 188 pounds to 318 pounds. Reference page 6 for test setup.

The third and last test was a destructive test again using the development H1640 mounted to the same cradle setup as in test number two. The load configuration was different. Four consecutive pull test were completed. The caster on the bomb hand truck was locked in position. At 468 pounds the tool slipped out of the caster wheel. The handle showed some bending where it connects to the fork and the width of the fork showed that it had opened up in size. The caster on the bomb hand truck showed no damage. There was a small indentation in the slot where the locking pin engages in the caster. Reference page 7, 8, 9, 10 and 11 for test setup configurations and data.

The following pages is to document pre-test and post-test setups of hardware, test fixturing and test data for the three tests mentioned above.

TEST NUMBER ONE CONFIGURATION

Pre-Test Setup

Photo's of Loads being applied

Qualification Testing of the H1640

H1640 Caster Tool Test;

TEST NUMBER TWO CONFIGURATION

**Bomb Hand Truck Cradle
toe clamped to static frame**

Pre-Test Setup

Personnel pulling handle

TEST NUMBER THREE CONFIGURATION

Comments: There was four pull tests completed. In this test configuration there was changing of the test setup as we went along.

- I. In the first test the ram on the actuator bottomed out at a load of 464 pounds.
- II. In the second test we shorten the linkage to the actuator and again the ram bottomed out at a load of 490 pounds.
- III. In the third test we moved the pivot point of the actuator and again the ram bottomed out at a load of 547 pounds.
- IV. In the fourth test we changed the setup using a strap, roller, and crane. In this configuration the H1640 caster tool slipped out of the caster at a load of 468 pounds.

Pre-Test Setup
Test I, II, and III

Test I and II
17.5 inches

Test III
23.5 inches

Photo's of Loads being applied
Test Configuration I, II, and III

(Hole grid on static load frame
is on 6 inch centers.)

Qualification Testing of the H1640

Pre-Test Setup
Test IV

Qualification Testing of the H1640

Photo's of Loads being applied Test Configuration IV

(Hole grid on static load frame
is on 6 inch centers.)

The H1640 Caster Tool
slipped out of the caster wheel
at a 468 pound load

Qualification Testing of the H1640

Data Plots for Test Three (four pull tests)

Qualification Testing of the H1640

Distribution:

MS9035, 5365 G.C. Story.....File: S - 5.47.2
MS9034, 5363 D.J. Beyer
MS9035, 5364 R.D. Monson
MS9042, 8741 Y R Kan
MS9035, 5365 M.B. Loll
MS9035, 5364 J.A. Tejada
(0320A) A.H. Rahe, AS/KCD, D/862

SANDIA NATIONAL LABORATORIES

Albuquerque, New Mexico 87185-5800
Livermore, California 94551-0969

date: February 1, 1994

to: Larry Brown, 5365
Distribution,

from: Steve Buck, 5365

subject: Post-test Report : Load Testing of the H1640 Caster Tool (214257), Prototype II.

The purpose of the test was to verify the yield strength of the H1640 caster tool assembly. The test was configured to transmit a load perpendicular to the axis of the fork on the caster tool. See photos on following page for configuration of test set-up.

This report documents the testing completed on the prototype II.
(Previous testing was completed on prototype I with the handle O.D. 1.00 inch X .625 inch I.D. and the slider O.D. 1.25 inch X 1.00 inch I.D. Post-test results showed the handle bent approximately 3.00 inches after a load of 250 pounds. At what load the yield occurred was not determined. Reference post-test results in File S-5.47.2 dated January 6, 1994.)

Prototype II hardware has a handle O.D. of 1.25 inch X .75 inch I.D. and a slider O.D. of 1.50 inch X 1.25 inch I.D.. The material of both prototypes is 2024-T3 aluminum. The same fork was used on both tests with no visual damage or yield.

SUMMARY AND CONCLUSIONS

In a test with a double stack configuration of B83's mounted in the bomb hand trucks, the H1640 caster tool was used to rotate a caster 90 degrees. In that load test, it took approximately 70 pounds of force to rotate the caster 90 degrees.

The prototype II model took a permanent set of .50 inch post-test at a load of approximately 400 pounds of force. There wasn't any permanent yield up to 350 pounds of force. The 350 pounds of force is approximately 5 times the working load it would take to rotate a caster 90 degrees. See post-test photos and test description on following pages.

Design passed qualification testing per DESIGN AND MANUFACTURING GUIDE, DG10220 / A - Handling Equipment, ref. 4.2.2 " H-Gear equipment shall be designed to withstand the forces imposed by the rated load with a minimum safety factor of 3.0, based on the minimum value of the yield strength of the structural material".

TEST DESCRIPTION

The following pages will document pre-test and post-test set-ups of hardware, test fixturing and test data.

Test was completed January 14, 1994 at Sandia, Ca. on the static load frame in building 914.

Test Setup

H-1640 caster tool at different loads

H-1640 caster tool at different loads

H-1640 caster tool at different loads

Post Test after 400 pound load

DATA PLOTS : LOAD VERSUS TIME

Distribution;

File: S - 5.47.2..... Attention: Cook Story, 5365

MS 9035 / 5365 Marv Loll

MS 9035 / 5365 Steve Buck

MS 9034 / 5363 Walter Ghio

MS 9042 / 8741 Mike Chiesa

(0320A) D.R. Brunswick, KCD/005

SANDIA NATIONAL LABORATORIES

Albuquerque, New Mexico 87185-5800
Livermore, California 94551-0969

date: January 6, 1994

to: Larry Brown, 5365

from: Steve Buck, 5365

subject: Load Testing of a Prototype H1640 Caster Tool (214257)

The purpose of the test was to evaluate and verify design characteristics of the H1640 caster tool. The test was configured to transmit a load perpendicular to the axis of the fork on the caster tool. See photos below for configuration of test set-up.

This report is for documentation of testing completed on this prototype. More testing is being planned for other prototypes being designed.

Test Setup

The following photos show the caster tool :
pre-test and post test
at a load of 150 pounds, 200 pounds, and 250 pounds
post-test with a set displacement of approximately 3 inches

MS 9042 / 8741 Mike Chiesa
 Copy: File: S - 5.47.2
 Attention: Cook Story, 5365
 Mary Loll, 5365

17-Dec-93

APPENDIX C

Engineering Evaluation Release

PRIORITY

* U N C L A S S I F I E D *

Fri Dec 16 19:07:25 1994

SLL0110

ER NO: 940170SL

SUBJECT: ENGINEERING EVALUATION RELEASE

ICO NO:

REV NO: 1

FROM: SL/L A BROWN 5364 X2784 MS9035
SL/J A TEJADA 5364 X1275 MS9035

TO: KC/A RAHE X3843 AS/KCD

REFERENCE LEVELS RELEATED RELEASES DISTRIBUTION DWG

PROGRAM:
B83/H1640
H1347

SL 4 KC
KC/415 J LEE
SL/12336 G E DAHMS
SL/MS9035 M B LOLL
SL/MC9035 S A BUCK
SL/MS9032 B O BOLDEN
SL/MS9034 W J GHIO
DOE-AL/F P JARAMILLO
J M OPUSZENSKI

REASON FOR RELEASE

TO RELEASE THE QS PLAN FOR THE H1640 CASTER TOOL, P/N 214257 AND ASSOCIATED PIECE PARTS.

REASON FOR REVISION

REV 1 - THE REASON FOR REVISION IS TO CHANGE EVALUATION DATE TO 10/27/94 AND TO RELEASE THE RESULTS OF THE QS PERFORMED AT ALLIEDSIGNAL, KANSAS CITY DIVISION.

DRAWING NUMBERS	DWG LOC	SUFFIX DA PA	ISSUE	DRAWING INFORMATION
214257	KC		B	H1640 CASTER TOOL
AY214257	KC		B	H1640 CASTER TOOL
457660	KC		B	FORK
AY457660	KC		B	FORK
457662	KC		B	HANDLE
AY457662	KC		B	HANDLE
457663	KC		B	SLIDER
AY457663	KC		B	SLIDER

REFERENCES AND REMARKS

PEER REVIEWED BY G.E. DAHMS, DEPT.12336 08/08/94

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DOC CODE	REVISION	APPROVED BY	AGENCY	ORG	DATE
EER	0	L A BROWN	SL	5364	06/16/94
EER	1	L A BROWN	SL	5364	12/01/94

DESCRIPTION OF RELEASE ACTION

THIS PLAN CONTAINS THE MINIMUM REQUIREMENTS OF THE QUALIFICATION SAMPLE (QS) EVALUATION. IT SPECIFIES THE ACTIONS REQUIRED TO MEET THE OBJECTIVES OF THE EVALUATION STATED IN EP401011 AND EP401401. THESE REQUIREMENTS MAY BE CHANGED AT THE DISCRETION OF THE QUALIFICATION EVALUATION TEAM (QET). THE LATEST DRAWINGS AND SPECIFICATIONS BY WHICH THE PRODUCT WAS FABRICATED ARE TO APPLY AT THE TIME THE EVALUATION IS PERFORMED.

1.0 GENERAL INFORMATION FOR ALLIEDSIGNAL AEROSPACE CO.

OBJECTIVES OF EP401011 AND EP401401:

- A. PRODUCT DESIGN DEFINITION.
- B. PRODUCT CONFORMS TO DESIGN DEFINITION.
- C. MANUFACTURING PROCESSES AND EQUIPMENT WILL RELIABLY PRODUCE PRODUCT THAT CONFORMS TO DESIGN AND MANUFACTURING DEFINITION THROUGHOUT THE SCHEDULED MANUFACTURING PERIOD.
- D. A QUALITY PROGRAM HAS BEEN IMPLEMENTED TO ASSURE THAT MATERIAL ARE PRODUCED IN A CONTROLLED MANNER AND IN ACCORDANCE WITH ANY SPECIFIC QUALITY REQUIREMENTS.

PRODUCTION AGENCY:

ALLIEDSIGNAL SEROSPACE CO.
KANSAS CITY DIVISION
2000 E. 95TH ST.
KANSAS CITY, MO 64131-3095

LOCATION OF EVALUATION:

ALLIEDSIGNAL AEROSPACE CO.

REV. 1 ESTIMATED EVALUATION DATE: 10/27/1994

SPECIFICATIONS:

214257-00 AND ALL SUBORDINATE DWGS

MINIMUM SIZE OF QS LOT:

2 EA.

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NUMBER TO BE EVALUATED: 2 EA.

NUMBER TO BE D-TESTED: 1 PIECE PART

QUALIFICATION EVALUATION TEAM (QET):

KC QUALITY ENGINEER:	J. LEE	(816) 997-5806
KC PRODUCT ENGINEER:	A. RAHE	(816) 997-3843
SL QUALITY ENGINEER:	J.A. TEJADA	(510) 294-1275
SL DESIGN ENGINEER:	L.A. BROWN	(510) 294-2784

2.0 PREPARATORY ACTIVITIES

2.1 SCHEDULING

THE SANDIA DESIGN ENGINEER AND THE ALLIEDSIGNAL PRODUCT ENGINEER SHALL SCHEDULE THE QS EVALUATION SUCH THAT IT CAN BE ACCOMPLISHED AS EXPEDITIOUSLY AS POSSIBLE. SCHEDULING SHALL BE FLEXIBLE ENOUGH TO ALLOW OBSERVATION OF PIECE PART PROCESSING AS WELL AS INSPECTION OPERATIONS.

2.2 PERSONNEL AVAILABILITY

THE REGULAR PRODUCTION PERSONNEL, SUCH AS THE RESPONSIBLE PRODUCT AND QUALITY ENGINEERS, SHALL BE AVAILABLE AT THE TIME OF THE EVALUATION.

2.3 DRAWINGS AND PROCEDURES

A COPY OF ALL RELEASED PRODUCT DRAWINGS, SPECIFICATIONS, AND MANUFACTURING AND INSPECTION INSTRUCTIONS SHALL BE AVAILABLE AT THE TIME OF THE EVALUATION.

2.4 SUPPLIER EVALUATIONS

SUPPLIER AUDITS OR REPORTS SHALL BE PROVIDED BY THE ALLIEDSIGNAL QUALITY ENGINEER, FOR ALL PROCURED MATERIAL OR PIECE PARTS AND MADE AVAILABLE UPON REQUEST.

2.5 MATERIAL CERTIFICATIONS

MATERIAL CERTIFICATIONS SHALL BE AVAILABLE.

3.0 ON-SITE EVALUATION ACTIVITIES

3.1 DRAWING RELEASE STATUS

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THE RELEASE STATUS OF ALL APPLICABLE DRAWINGS,
SPECIFICATIONS, AND INSTRUCTIONS WILL BE REVIEWED.

REV. 1 - RESULTS: ALL DRAWINGS WERE REVIEWED AND
CURRENT RELEASE AND ISSUE WERE UPDATED AS NECESSARY.
CURRENT STATUS ON ALL DRAWINGS AT THIS TIME.

3.2 INSPECTIONS AND TESTS

THE INSPECTION AND TEST REPORTS FOR ALL H1640 PARTS
AND ASSEMBLIES IN THE QS LOT MANUFACTURED AT AND/OR
PROCURED BY ALLIEDSIGNAL WILL BE REVIEWED.

REV. 1 - RESULTS: II (INSPECTION INSTRUCTIONS) AND
RESULTS WERE REVIEWED FINAL INSPECTION REPORTS FOR
SUPPLIER SURVEYS WILL BE FORWARDED TO LARRY BROWN,
SNL/CA.

3.3 ENVIRONMENTAL SAFETY AND HEALTH (ES&H)

THE ALLIEDSIGNAL PRODUCT ENGINEER SHALL REVIEW THE
EVALUATION ACTIVITIES IN THIS ENGINEERING RELEASE
AGAINST THE PRODUCTION FACILITY ES&H PLAN, ASSURE
THAT THE EVALUATION ACTIVITIES DO NOT CONFLICT
WITH AND REMAIN IN COMPLIANCE WITH THE ES&H PROGRAM
OF THE FACILITY. THE FACILITY SHALL BE AWARE OF ANY
HAZARDS ASSOCIATED WITH THE EVALUATION ACTIVITIES
AND BE PREPARED TO DISPOSE OF ANY WASTE GENERATED
FROM THESE ACTIVITIES.

THE INTENT OF THE QET IS NOT TO EVALUATE THE ES&H
PROGRAM OF THE FACILITY, BUT TO VERIFY THAT THE
EVALUATION ACTIVITIES ARE CONSISTENT WITH THE
FACILITY ES&H PROGRAM.

REV. 1 - RESULTS: SATISFACTORY

3.4 QUALITY CONTROL PROGRAM

THE QET WILL REVIEW THE ALLIEDSIGNAL QUALITY SYSTEM,
QUALITY HISTORY, AND ACTIONS TAKEN OR PLANNED TO
CORRECT ANY PROBLEM AREAS.

REV. 1 - RESULTS: SATISFACTORY

3.5 PROCESS AND MANUFACTURING OBSERVATIONS

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THE FOLLOWING MANUFACTURING PROCESSES OR PROCEDURES
WILL BE REVIEWED BY THE QET DURING THE ON-SITE VISIT,
QS LOT SAMPLE SHALL BE AVAILABLE FOR REVIEW OF MARKINGS
AND PACKAGING.

H1640 CASTER TOOL (214257)
-INSPECT COMPLETED ASSEMBLY
-HANDLING AND PACKAGING
-MARKING

FORK (457660)
-MATERIAL CERTIFICATION (INCLUDE TEST RESULTS AND
ALLOY COMPOSITION)
-INSPECTION INSTRUCTIONS AND INSPECTION DATA

HANDLE (457662)
-INSPECTION INSTRUCTIONS AND INSPECTION DATA
-MATERIAL CERTIFICATION

SLIDER (457663)
-MATERIAL CERTIFICATION (INCLUDE TEST RESULTS AND
ALLOY COMPOSITION)
-INSPECTION INSTRUCTIONS AND INSPECTION DATA

SPRING PIN
-PRODUCT CERTIFICATION & VERIFICATION
-INSPECTION INSTRUCTIONS AND INSPECTION DATA

PIN, QUICK RELEASE (C416)
-PRODUCT CERTIFICATION & VERIFICATION
-INSPECTION INSTRUCTIONS AND INSPECTION DATA

STRANDED WIRE (881347)
-PRODUCT CERTIFICATION & VERIFICATION

ALL COMPONENTS AND PIECE PARTS WERE INSPECTED AND ALL
MATERIAL CERTIFICATIONS AND TEST RESULTS WERE EXAMINED
AND FOUND TO BE IN ORDER.

4.0 OFF-SITE EVALUATION

4.1 PRODUCT TESTING

ONE H1640 CASTER TOOL SHALL BE RANDOMLY SELECTED
FROM THE QS LOT AND SHIPPED TO:
SANDIA NATIONAL LABORATORIES/CA
RECEIVING, BLDG. 928

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7011 EAST AVE.
LIVERMORE, CA 94551

ATTN: LARRY BROWN, MS9035

THIS ASSEMBLY, WILL NOT BE RETURNED AFTER TESTING

4.2 TEST OBJECTIVES

THERE ARE TWO TEST OBJECTIVES.

1) FUNCTIONALLY CASTER A WHEEL WITH THE H1640
ON A TWO HIGH STACK OF B83'S OR APPROVED WEIGHT
MOCKUP

2) PROOF TEST THE HANDLE AND FORK OF THE H1640
BY PULLING THE HANDLE WITH 280 POUNDS OF FORCE,
WHICH IS FOUR TIMES THE MEASURED FORCE TO CASTER
ONE WHEEL ON A DOUBLE HIGH STACK OF B83'S.

4.3 TEST PLAN

1) SELECT A CONCRETE FLOOR THAT DOES NOT HAVE A
SMOOTH OR PAINTED FINISH AND USING A TWO HIGH
STACK OF B83'S OR APPROVED WEIGHT SIMULATION,
CASTER EACH WHEEL, A MINIMUM OF 90 DEGREES, ON
THE LOWER BOMB HAND TRUCK. MEASURE THE WIDTH OF
THE FORK AND THE STRAIGHTNESS OF THE HANDLE
AFTER ALL CASTERS HAVE BEEN ROTATED.

2) SECURE THE FORK OF THE H1640 TO PREVENT ANY
ROTATION. ATTACH THE HANDLE TO A HYDRAULIC
ACTUATOR AND PULL THE HANDLE IN INCREMENTAL STEPS
UP TO 400 POUNDS OF FORCE.

MEASURE THE WIDTH OF THE FORK AND STRAIGHTNESS
OF THE HANDLE AT EACH STEP, AFTER APPLYING
250, 275, 300, 350, AND 400 POUNDS OF FORCE.

RESULTS: ALL TEST RESULTS CAN BE FOUND IN THE
ATTACHED COPY OF THE TEST REPORT WRITTEN BY
STEVE BUCK.

5.0 CORRECTIVE ACTIONS

5.1 SANDIA - THE ONLY CORRECTIVE ACTION WAS WITH REGARD TO THE
ALIGNMENT OF THE HOLE FOR THE PIN PLACEMENT AND LOCATION ON THE
HANDLE AND THE REQUIRED CHANGES HAVE BEEN MADE ON THE DRAWINGS
PN'S

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457662	KC	B	HANDLE
AY457662	KC	B	HANDLE
457663	KC	B	SLIDER
AY457663	KC	B	SLIDER

5.2 ALLIED SIGNAL - NONE

6.0 OBSERVATIONS, RESULTS, AND PRELIMINARY CONCLUSIONS - THE CLASSIFICATION OF THIS QER IS SATISFACTORY. PRODUCT MAY BE USED AT A HIGHER LEVEL WITHOUT RESTRICTIONS. THE QE HAS SHOWN THAT THE MANUFACTURING FACILITY, TOOLING, PRODUCTION PROCESS AND CONTROLS, AND CERTIFICATION METHODS AND EQUIPMENT WERE ADEQUATE TO PRODUCE AND ACCEPT PRODUCT THAT CONFORMS TO PRODUCT REQUIREMENTS AND DESIGN INTENT.

KC PRODUCT ENGINEER:	A. RAHE	(816) 997-3843
SL QUALITY ENGINEER:	J.A. TEJADA	(510) 294-1275
SL DESIGN ENGINEER:	L.A. BROWN	(510) 294-2784

END SLL0110

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APPENDIX D

Qualification Evaluation Release

PRIORITY

* U N C L A S S I F I E D *

Fri Dec 16 17:22:37 1994

SLL0109

QER NO: 940408SL

REV NO: 0

SUBJECT: QUALIFICATION EVALUATION RELEASE

STATUS: ACCEPTABLE

FROM: SL/L A BROWN 5364/MS9035 X2784

SL/J A TEJADA 5364/MS9035 X1275

TO: KC/A RAHE AS/KCD 816-997-3843

REFERENCE LEVELS RELATED RELEASES DISTRIBUTION DWG

PROGRAM:
B83/H1640
H1347

EER 940170SL

SL 4 KC
KC/415 J LEE
SL/12336 G E DAHMS
SL/MS9035 M B LOLL
SL/MS9035 S A BUCK
SL/MS9032 B O BOLDEN
SL/MS9034 W J GHIO
DOE-AL/F P JARAMILLO
J M OPUSZENSKI

REASON FOR RELEASE

TO RELEASE THE QS STATUS FOR THE CASTER TOOL P/N 214257 MANUFACTURED
BY FURNO COMPANY, FOR ALLIEDSIGNAL, KANSAS CITY DIVISION, AS ACCEPTABLE.

REASON FOR REVISION

DWG NUMBERS	DWG LOC	SUFFIX DA PA	ISSUE	DRAWING INFORMATION
214257	KC		B	H1640 CASTER TOOL
AY214257	KC		B	H1640 CASTER TOOL

REFERENCES AND REMARKS

QS EVALUATION WAS CONDUCTED PER EER 940170SL.
DESIGN DEFINITION WAS RELEASED PER AER/DTER 940073SL AND CER 940199SL.
PEER REVIEWED BY G.E. DAHMS, DEPT. 12336 08/08/94

DOC CODE	REVISION	APPROVED BY	AGENCY	ORG	DATE
CER	0	J A TEJADA	SL	5364	12/12/94
		R D MONSON	SL	5364	12/12/94

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35094:SLL0109

DESCRIPTION OF RELEASE ACTION

- 1.0 THE QUALIFICATION SAMPLE (QS) EVALUATION WAS PERFORMED AT ALLIED SIGNAL, KANSAS CITY DIVISION ON OCTOBER 27, 1994. ALL SPECIFICATIONS REQUIRED TO MEET THE OBJECTIVES OF THE EVALUATION STATED IN EER 940170SL WERE MET AND FOUND TO BE ACCEPTABLE.
- 2.0 THE PROCESSES ASSOCIATED WITH THE H1640 CASTER TOOL WERE REVIEWED AT ALLIEDSIGNAL, KANSAS CITY DIVISION AND FOUND TO BE IN COMPLIANCE WITH ALL NECESSARY REQUIREMENTS. THE REQUIREMENT OF A "S" RING ASSEMBLY ON THE SPRING PIN WAS MODIFIED TO ACCOMODATE EITHER A SNAP RING OR "S" RING. THE STRANDED WIRE ASSEMBLY LENGTH HAS BEEN INCREASED BY 1.00 INCH IN OVERALL LENGTH TO FACILLITATE EASE OF USE. DWG. NO. AY457662 SHALL INCLUDE DWG. NO. 941924KC REV.0. THE STRANDED WIRE 881347 SHALL ALSO INCLUDE 941924KC REV .0..
- 3.0 JIM LEE, ALLIEDSIGNAL QUALITY ENGINEER, REPORTED THAT ALL QS EVALUATION ACTIVITIES WERE PERFORMED IN ACCORANCE WITH ALLIEDSIGNAL ES&H POLICIES AND PROCEDURES, VERIFIED BY INCLUSION OF VENDOR SURVEY REPORT.
- 4.0 QUALIFICATION TEAM AND PARTICIPANTS:

KC QUALITY ENGINEER:	J. LEE	(816)997-5806
KC PRODUCT ENGINEER:	A. RAHE	(816)997-3843
SL QUALIFTY ENGINEER:	J.A. TEJADA	(510)294-1275
SL DESIGN ENGINEER:	L.A. BROWN	(510)294-2784

END SLL0109

PRIORITY

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35094:SLL0109

Distribution:

1	U. S. Department of Energy Albuquerque Operations Office Attn: J. M. Eckert, WQD P. O. Box 5400 Albuquerque, NM. 87115-5400	
1	U. S. Department of Energy Albuquerque Operations Office Attn: Jay Pape, WPD P. O. Box 5400 Albuquerque, NM. 87115-5400	
1	AlliedSignal/FM&T/KCD Attn: Allan Rahe P. O. Box 419159 Kansas City, MO. 64141-6159	
1	MS 0457	H. W. Schmitt, 2000
1	MS 0645	K. C. Kvam, 14713
1	MS 9005	J. B. Wright, 2200
1	MS 9006	D. J. Bohrer, 2203
1	MS 9013	R. G. Miller, 2266
1	MS 9034	D. J. Beyer, 2263
1	MS 9035	R. D. Monson, 2265
4	MS 9035	L. A. Brown, 2265
1	MS 9035	M. B. Loll, 2265
1	MS 9036	D. R. Henson, 2254
1	MS 9036	S. A. Buck, 2254
3	MS 9018	Central Technical Files, 8940-2
4	MS 0899	Technical Library, 4916
2	MS 9021	Technical Communications Department, 8815 for DOE/OSTI
1	MS 9021	Technical Communications Department, 8815/Technical Library

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UC Category (19) UC-706, DOE/ER

DOE