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Final Development Report H1632 Adjustable Caster Assembly

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FINAL DEVELOPMENT REPORT H1632 ADJUSTABLE CASTER ASSEMBLY

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Abstract

The H1632 Adjustable Caster Assembly was developed for use on the H1501B Transportation Accident Resistant Container (TARC). The caster can be raised and lowered via its attached leveling jack or, by removing a locking pin, can be aligned horizontally or removed for transportational purposes. The H1632 is packaged as a single kit that contains two left and two right adjustable caster assemblies along with the required support plates and hardware.

* E. F. Kibalo is an Allied-Signal employee on contract to Sandia National Laboratories

FINAL DEVELOPMENT REPORT

H1632 ADJUSTABLE CASTER ASSEMBLY

Introduction

The H1632 Adjustable Caster Assembly was designed specifically for the H1501B Transportation Accident Resistant Container (TARC) but it is also compatible with the H1501 TARC and H1501A TARC. The unique features of the H1632, P/N 214250, include its ability to raise and lower the caster via its attached leveling jack and that by removing a locking pin, the casterjack can be aligned horizontally during transportation or removed while the bracket remains attached to the bolster.

The most important goal of the H1632 was to have a caster that can be raised and lowered and is not a threat to puncturing the outer skin of the H1501B if an accident should occur during transportation. This is important because if a fire occurred after the accident the exposed redwood would burn and char more quickly which could reduce the amount of protection the H1501B provides to the transported warhead.

This goal is achieved by turning the casterjack 90 degrees when the H1501B is shipped. This puts the jack part of the assembly horizontal to the container where it is less likely to puncture the container in an accident as opposed to the current design of casters on the H1501 or H1501A containers.

Design

A search of caster vendors was conducted but none of these vendors wanted to build or had built an adjustable caster assembly. Next, a search of jack companies discovered Regent Manufacturing of Downey, CA. Regent had built adjustable caster assemblies in the past but did not have exactly what was needed for the application. (Regent was willing to work on a design and was the only company found that had any experience).

Sandia's requirements for the H1632 were as follows:

- the bracket needed to be angled slightly away from the container, as the mounting bolster is 36 inches wide while the container is 38 inches in diameter
- the bracket hole pattern compatible with the bolster
- a right and left bracket to avoid interfering with fork lift slots
- two thousand pound load capacity
- that the caster be eight inches in diameter with a 90 Shore A hardness polyurethane on an aluminum or polyurethane core with a four position wheel lock
- that the caster be raised and lowered
- that the casterjack be able to be rotated 90 degrees

Regent received a purchase order and delivered the casterjack and brackets as shown in Figure 1. The parts were tested at Sandia/CA and a failure occurred. The assembly failed during the towing test when one weld finally gave away. Analysis of the other three assemblies showed that all the quick release pins that held the bracket to the casterjack assembly were bent. The results indicated that the assembly, while working fine in buildings, needed more strength when being towed on a rough road at 5 mph.

Sandia redefined the requirements as follows:

- change from rotating 90 degrees to locking 90 degree positions (from a round interface that could rotate to a square interface where the casterjack is removed, turned 90 degrees, and reinserted)
- the locking pin diameter was increased from .375 to .500 inches
- shock absorbing (spring loaded) casters for better weight balance replaced the regular casters (with the same requirements on the caster wheel)
- the minimum welding requirements were specified

These improvements were made and the four caster assemblies were shipped to Sandia/CA for testing. As before, the caster assemblies were mounted to a H1501A that weighed about 3,650 to simulate the weight of a loaded H1501B (since the H1501B was not yet available). This container was towed about two miles on non-uniform streets and gravel roads to represent worst cast actual use. The caster assemblies were analyzed after the test and they sustained no damage. The four caster assemblies then took part in the H1501B-Drop 7 (B61) test at Sandia/NM where the container received an impact that exceeded 225 ft/sec. The orientation of this drop was an inverted 20 degree slapdown. While three of the caster assemblies left marks on the container, the H1632 met the goal of not puncturing the container and exposing the redwood.

Sandia Design Improvements

Sandia noticed a number of potential improvements during these tests. Saginaw Products, the casterjack vendor, agreed to weld the mounting stud directly to the casterjack. This eliminated two plates and the required hardware. The locking pin diameter was increased to .625 inches for added strength. A less weight, same strength, die cast aluminum, shock absorbing caster from a different supplier was found. Sandia designed an improved bracket assembly that uses a different material, weighs less, contains fewer components and will be less costly to manufacture. All together, these changes reduced the weight of the casterjack assembly to 70 pounds, a reduction of over 40 pounds.

Testing

The Sandia designed caster assembly, Figure 2, was extensively tested at Sandia/CA per the H1632 Adjustable Caster Assembly Test Plan, dated January 4, 1993. Tri-axial accelerometers were attached to the left front and right rear caster brackets, corresponding side gussets on the bolster, and one on top of the fully loaded H1501B container as shown in Figures 3 and 4. The container was towed about three miles around the complex at 5 MPH over gravel roads, a one inch thick board, and pot holes to simulate worse case actual military uses. The container then was allowed to roll

down an incline of 11.5 degrees for 12 feet to a level surface, a ramp made from one inch thick plywood, to simulate a military aircraft unloading error.

The caster and casterjack performed well but there was some permanent deformation to the bracket (from 1/8 to 1/4 inch bend towards the container for all four assemblies). The bracket has gussets to support the square tube that holds the casterjack. These gussets did not extend past the bend area on the belief that it was not necessary with the shock absorbing casters. The deformation was noticed in the first half of the test but no further deformation occurred in the last half of the test. All welded areas held and there was no damage to the quick release pin. The design change of the bracket now has the gussets extend past the bend for additional strength.

The shock absorbing caster tested was from R. T. Laird. This caster is unique as it is made from die cast aluminum, has a polyurethane wheel (Shore A hardness of 90) and weighs only 20 lbs. This was the only aluminum caster that could be found that met the requirements. Also, it was less than half of the weight of the previously tested steel housing caster. The caster performed superbly. There was no damage to the polyurethane and throughout all the towing tests all four casters kept in contact with road surface. In earlier tests with non-shock absorbing casters the uneven road surfaces often caused one of the casters to lose contact with the ground and it was evident that the container was experiencing a rough ride.

The casterjack was built by Saginaw Products and has been the casterjack for all previous designs. However, this time the square stud that holds the casterjack to the bracket was welded directly to the casterjack. Previously, a plate was welded to the casterjack, the stud was welded to a plate, and the two plates were bolted together. This design made the assembly stronger while deleting the two plates and the required hardware. This modified configuration held up well as no damage occurred to the welds and, as always, the casterjack worked properly.

The accelerometer data gathered during the towing test was unique as it was transmitted by radio frequency to Building 910, where a computer immediately analyzed data. A technician, viewing a terminal screen, communicated by cellular phone to the test personnel the received accelerometer information so feedback on how the test was proceeding was almost instantaneous. Figures 5-13 show the acceleration filtered with a 200 Hz low pass filter that the container, bolster, and caster bracket experienced during the towing test.

Accelerometers were mounted in the forward (X), sideways (Y), and vertical (Z) directions in five locations as shown in Figure 14.

Figures 5, 6 and 7 show the results of the container being towed over a gravel road. Figures 8 and 9 show the response to a caster hitting a pothole. Figures 10-11 and 12-13 show the caster hitting a pothole and less than one second later running over a 1x4 board. As shown in these figures the top graph, which corresponds to the top of the container, did not receive much acceleration as the shock absorbing casters were very effective.

Summary

The H1632 Adjustable Caster Assembly is designed and packaged as a single kit. The H1632 has a specially designed shipping box that contains two left and two right adjustable caster assemblies along with the required support plates and hardware. The reason for the left and right brackets is to prevent the caster wheels, when lowered, from interfering with the fork lift slots. The caster wheels can swivel or be locked in place at 90 degree intervals. When the container is towed, the rear caster wheels should be locked in the direction of travel while letting the forward wheels swivel freely. This will keep the container from swaying all over the place yet make turning easier. The casterjack has a six inch stroke, with a .75 inch hex drive that has 12 revolutions per one inch of travel. The mounting stud is welded directly to the casterjack. The stud has two through holes to allow a .625 locking pin to hold the casterjack in place, either horizontally for shipping or vertically for normal use.

Figure 1. *Original Design With Round Interface.*

Figure 2. *Sandia Design With Square Interface.*

Figure 3. *H1632 With Accelerometers.*

Figure 5. *Towing Over Gravel (X).*

Figure 6. *Towing Over Gravel (Y).*

Figure 7. *Towing Over Gravel (Z).*

Figure 8. *Towing on Road - Hit Pot Hole (X).*

Figure 9. *Towing on Road - Hit Pot Hole (Z).*

Figure 10. *Towing on Road - Hit Pot Hole (X).*

Figure 11. Towing on Road - Run Over 1 x 4 Board (X).

Figure 12. Towing on Road - Hit Pot Hole Then (Z).

Figure 13. *Towing on Road - Run Over 1 x 4 Board (Z).*

1. GENERAL REQUIREMENTS AND DRAWING INTI
DEFINED IN 9900000.
- 2.
3. ALL ACCELEROMETERS ARE BONDED WITH *
4. TEST UNIT WEIGHT IS APPROXIMATELY 36

Figure 14. H1632 Caster Test Unit

50 POUNDS WITH CG AS INDICATED.

REVISION						
ISS	DATE	PREPARED BY	DESCRIPTION	DATE	CHKD	APVD
A		C.A.ERSKINE.827/P.L.A.1.3363		12-14-92

-	-	-	-	-	-	17
-	-	-	-	-	-	16
-	-	-	-	-	-	15
-	-	-	-	-	-	14
15	M32044H6	NUT, SELF-LOCKING, HEX .375-24 UNF	-	-	-	13
16	AN980-C616	WASHER, FLAT .390 I.D., .625 O.D. X .063 THK	-	-	-	12
16	M36998-78	SCREW, CAP, SOC MD .50X .375-24 UNF-SA R 2.00LMB	-	-	-	8
8	2490A-00	PLATE, SUPPORT	-	-	-	10
3	-	ACCELEROMETER ASSEMBLY	-	-	-	9
2	A7457280	ADJUSTABLE CASTER ASSY, RIGHT	-	-	-	8
2	A7457287	ADJUSTABLE CASTER ASSY, LEFT	-	-	-	7
1	249460	LIFTING ADAPTER	-	-	-	6
1	249461-00	DUMMY CBS (B&I)	-	-	-	5
1	249456-00	AFT SUPPORT ASSY	-	-	-	4
2	249457-00	RND SUPPORT	-	-	-	3
1	249458-00	FORWARD SUPPORT	-	-	-	2
1	24241-00	H308B SPECIAL TRANSPORTATION CONTAINER	-	-	-	1
SHEET PAGE NO.	PART NUMBER, HQ	DESCRIPTION/HANDLING	NOTE	SHEET TOTAL	ITEM	

CLASSIFY BY: [REDACTED] AT: [REDACTED]

NO. OF CLASSIFY BY: [REDACTED]
 NO. OF REVIEWERS: [REDACTED]
 NO. OF APPROVERS: [REDACTED]
 ALTY. # [REDACTED]

SHEET	1	2	-	-	TITLE	(U) TITLE CLASSIFICATION
REVIEW	A	A	-	-	H1632 CASTER TEST UNIT(U)	
PART CLASSIFICATION						
UNCLASSIFIED						
CLASSIFICATION REASON/REMARKS					STUD CLASSIFICATION NUMBER	
UNCLASSIFIED					E	A50292
STATUS SL-REL-JAN-08-93					CAGE# 1424 SCALE 1/4 SHEET 1 OF 2	WHEN SL-CVCS-REV6.2

VIEW A-A

SCALE: 1/4

ACI		
CH I.D.	REQ RANGE	LC
V1X	±15G	STAIN DRU
V2Y	±15G	STAIN DRU
V3Z	±15G	STAIN DRU
V4X	±15G	LE CAST
V5Y	±15G	LE CAST
V6Z	±15G	LE CAST
V7X	±15G	LE BOLS
V8Y	±15G	LE BOLS

Figure 14

V7X, V8Y, V9Z
CENTER OF GUSSET

ACCELEROMETER DATA

LOCATION	CH I.D.	REQ RANGE	LOCATION
LESS STEEL AT 0°	V9Z	±15G	LEFT REAR BOLSTER GUSSET
LESS STEEL AT 0°	V10X	±15G	RIGHT FRONT CASTER BRACKET
LESS STEEL AT 0°	V11Y	±15G	RIGHT FRONT CASTER BRACKET
FT REAR R BRACKET	V12Z	±15G	RIGHT FRONT CASTER BRACKET
FT REAR R BRACKET	V13D	±15G	SPARE
FT REAR R BRACKET	V14X	±15G	RIGHT FRONT BOLSTER GUSSET
FT REAR R GUSSET	V15Y	±15G	RIGHT FRONT BOLSTER GUSSET
FT REAR R GUSSET	V18Z	±15G	RIGHT FRONT BOLSTER GUSSET

DRAWING NUMBER			
A80692			
DRAWING CLASSIFICATION			
UNCLASSIFIED			
SIZE	CASE 14214	SCALE	1/4
E	DATE A	SHEET	2 OF 2
STATUS SL-REL-JAN-08-93			

1. H1632 Caster Test Unit (Continued).

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