LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

LLNL-TR-415545

Volume 9

Jack Rabbit Pretest Shadowplate Drawings For TATB IHE Model Development

Mark M. Hart, Dennis W. McDaniel

July 10, 2009

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

The Jack Rabbit Pretest (PT) series consisted of 5 focused hydrodynamic experiments 2021E PT3, PT4, PT5, PT6, and PT7. They were fired in March and April of 2008 at the Contained Firing Facility, Site 300, Lawrence Livermore National Laboratory, Livermore, California. These experiments measured dead-zone formation and impulse gradients created during the detonation of TATB based insensitive high explosive.

When setting up computer simulations of the Jack Rabbit Pretest series, the modeler or code developer can execute simulations with increasing degrees of refinement using detail found in the shadowplate design. The easiest way to get started is by treating the shadowplate in each experiment as a monolithic homogeneous piece of stainless steel. The simulation of detonation would begin as a point initiation below the center, bottom surface of the shadowplate. The detonation running through the ultrafine TATB booster can be simulated using program burn and then switched over to a reactive flow detonation model as the detonation front crosses the boundary into the main charge LX-17 IHE.

A modeler wanting to further refine the simulation and progression of shock through the shadowplate can use the more detailed shadowplate design information presented in this document. The source drawings are included in Appendix A of this document. Their titles and drawing numbers are listed below.

JACK RABBIT SHADOWPLATE, PT3 & PT4 SIMPLE ASSY, AAA09-502710

JACK RABBIT SHADOWPLATE, PT3 & PT4 FULL ASSY, AAA09-502711

JACK RABBIT SHADOWPLATE, PT5 & PT6 SIMPLE ASSY, AAA09-502712

JACK RABBIT SHADOWPLATE, PT5 & PT6 FULL ASSY, AAA09-502713

JACK RABBIT SHADOWPLATE, PT7 SIMPLE ASSY, AAA09-502714

JACK RABBIT SHADOWPLATE, PT7 FULL ASSY, AAA09-502715

Each experiment's shadowplate consists of two major components. A 303 stainless steel shape that defines the outer dimensions of shadowplate and a cylindrical 303 stainless steel detonator housing that is located in a closely machined pocket in the shape. The SIMPLE ASSY drawing accurately represents the dimensions of the outer shape, it's machined cylindrical pocket, and detonator body which is treated as a monolithic, homogeneous piece of stainless steel. The detonator body cross section shows an accurately dimensioned void where the slapper flyer barrel, LX-16 (pressed PETN) pellet, and pellet can flyer barrel are located.

The FULL ASSY drawing accurately represents the dimensions of the outer shadowplate shape and it's machined pocket. The detonator dimensions and materials are detailed in cross section and exploded view. All diameters, thicknesses, and materials are called out in the drawing. You will notice that the detonator includes a multilayer slapper assembly with two layers of electrically insulating Kapton sandwiching the copper foil bridge circuit. The Kapton insulated circuit is sandwiched between two thin stainless steel sheets. This slapper assembly is secured to the detonator body with two screws. There is a 0.25 mm gap between the slapper assembly and the outer shadowplate shape.

The stainless steel detonator body contains an off-center titanium wheel. This titanium wheel is secured to the detonator body with one screw and two pins to maintain position and orientation of the pellet can assembly in the center of the detonator body. The titanium wheel contains a tantalum/tungsten washer and pellet can assembly. The pellet can assembly consists of a pressed LX-16 initiator pellet contained in an extruded aluminum foil can.

It may be useful for the modeler to include some of the details of the shadowplate and detonator design to further refine simulations of the Jack Rabbit Pretest experiments. These details may be relevant to the progression of shock originating from the PETN initiation pellet and ultrafine TATB booster that propagates through the shadowplate.

JACK RABBIT PRETEST SERIES: 2021E PT3 & PT4 DRAWINGS

Figure 1. SHADOWPLATE DESIGN – Simplified, Exploded Diagram

NOTE:

1) The shadowplate assembly is made up of a cylindrical outer shape and an inset detonator body
2) The shadowplate assembly designs for PT3 and PT4 are identical
3) The PT3 shadowplate is positioned 10 millimeters from the diagnostic plate (refer to posters in Appendix B)
4) The PT4 shadowplate is positioned 20 millimeters from the diagnostic plate (refer to posters in Appendix B)
5) The shadowplate assembly design is not axi-symmetric
6) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
7) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
8) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)

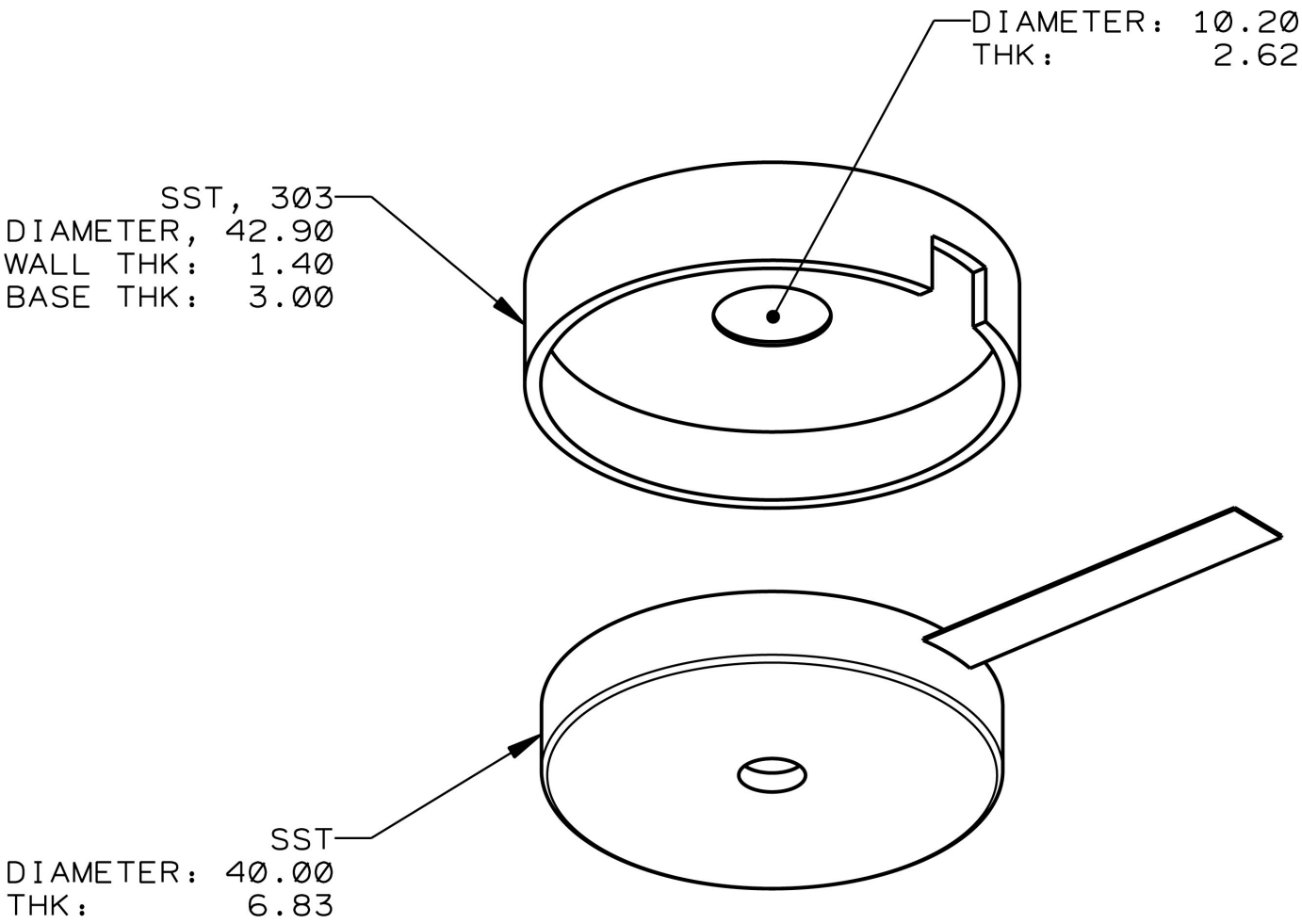


Figure 1. 2021E PT3 & PT4 Shadowplate: Simplified Exploded Diagram

JACK RABBIT PRETEST SERIES: 2021E PT3 & PT4

Figure 2. SHADOWPLATE DESIGN – Simplified, Top View & Cross Section

NOTE:

1) The shadowplate assembly is made up of a cylindrical outer shape and an inset detonator body
2) The shadowplate assembly design is not axi-symmetric
3) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
4) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
5) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
6) The void shown in detonator body cross section represents (top to bottom) slapper flyer barrel, LX-16 (pressed PETN) pellet in a can (extruded aluminum foil), and the pellet can flyer barrel

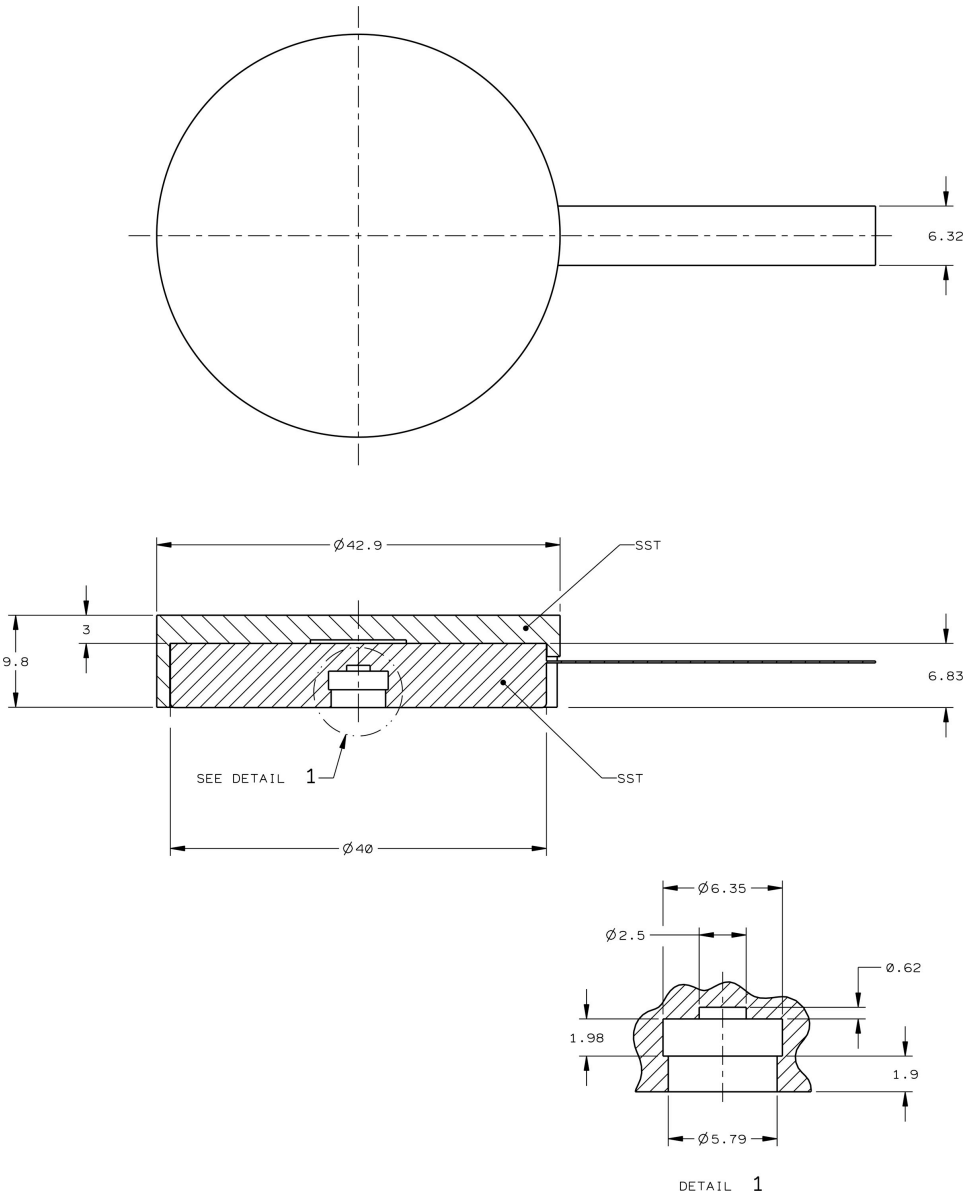


Figure 2. 2021E PT3 & PT4 Shadowplate: Simplified Top View and Cross Section

JACK RABBIT PRETEST SERIES: 2021E PT3 & PT4

Figure 3. SHADOWPLATE DESIGN – Full Assembly, Top View & Cross Section

NOTE:

1) The shadowplate assembly is made up of an outer shape and an inset detonator body
2) The shadowplate assembly design is not axi-symmetric
3) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
4) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
5) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
6) The detonator body assembly design is not axi-symmetric
7) A gap of approximately 0.25 mm exists between the slapper assembly and the pocket machined into the outer shape

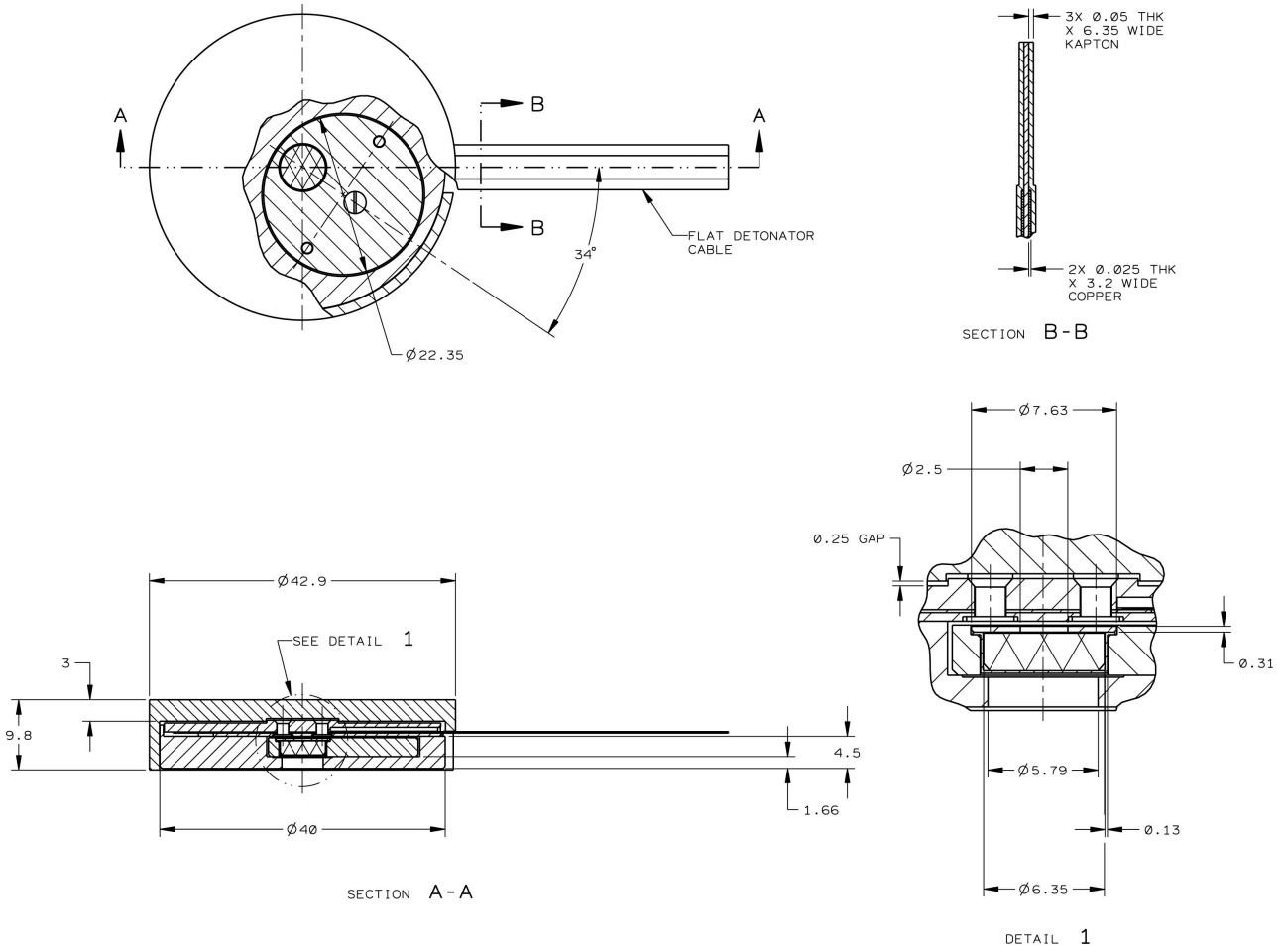


Figure 3. 2021E PT3 & PT4 Shadowplate: Full Assembly Top View and Cross Section

JACK RABBIT PRETEST SERIES: 2021E PT3 & PT4

Figure 4. SHADOWPLATE DESIGN – Full Assembly, Exploded Diagram

NOTE:

1) The shadowplate assembly is made up of a cylindrical outer shape and an inset detonator body
2) The shadowplate assembly design is not axi-symmetric
3) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
4) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
5) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
6) The detonator body design is not axi-symmetric
7) The detonator body consists of slapper assembly attached to a 303 stainless steel body, with a titanium alloy wheel insert holding the tantalum/tungsten washer and the LX-16 (pressed PETN) pellet can assembly

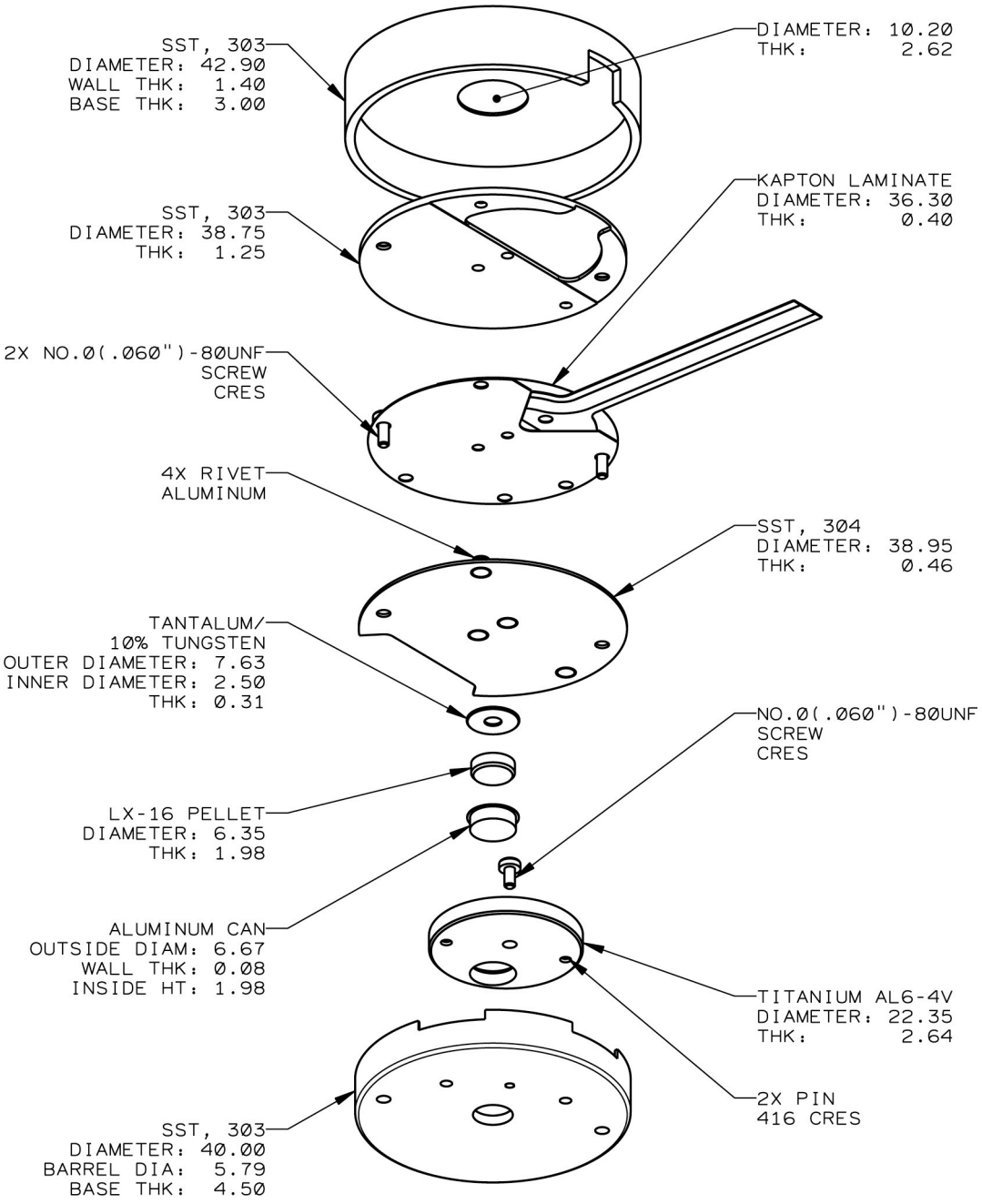


Figure 4. 2021E PT3 & PT4 Shadowplate: Full Assembly Exploded Diagram

JACK RABBIT PRETEST SERIES: 2021E PT5 & PT6 DRAWINGS

Figure 5. SHADOWPLATE DESIGN – Simplified, Exploded Diagram

NOTE:

1) The shadowplate assembly is made up of a cylindrical outer shape and an inset detonator body
2) The shadowplate assembly designs for PT5 and PT6 are identical
3) The PT5 shadowplate is positioned 10 millimeters from the diagnostic plate (refer to posters in Appendix B)
4) The PT6 shadowplate is positioned 20 millimeters from the diagnostic plate (refer to posters in Appendix B)
5) The shadowplate assembly design is not axi-symmetric
6) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
7) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
8) A stainless steel wedge fills the void in the shadowplate cable run
9) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)

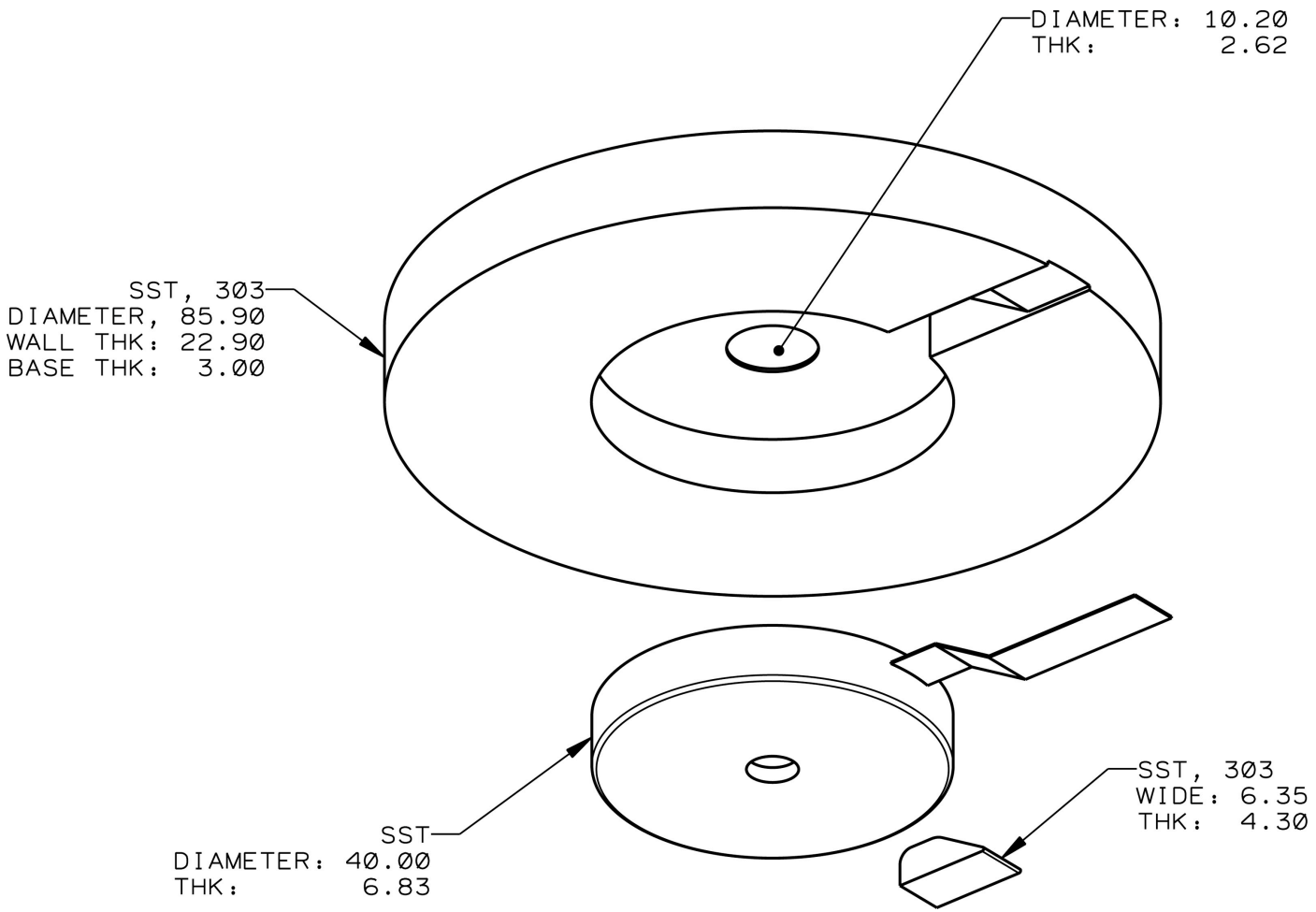


Figure 5. 2021E PT5 & PT6 Shadowplate: Simplified Exploded Diagram

JACK RABBIT PRETEST SERIES: 2021E PT5 & PT6

Figure 6. SHADOWPLATE DESIGN – Simplified, Top View & Cross Section

NOTE:

1) The shadowplate assembly is made up of a cylindrical outer shape and an inset detonator body
2) The shadowplate assembly design is not axi-symmetric
3) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
4) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
5) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
6) A stainless steel wedge fills the void in the shadowplate cable run
7) The void shown in detonator body cross section represents (top to bottom) slapper flyer barrel, LX-16 (pressed PETN) pellet in a can (extruded aluminum foil), and the pellet can flyer barrel

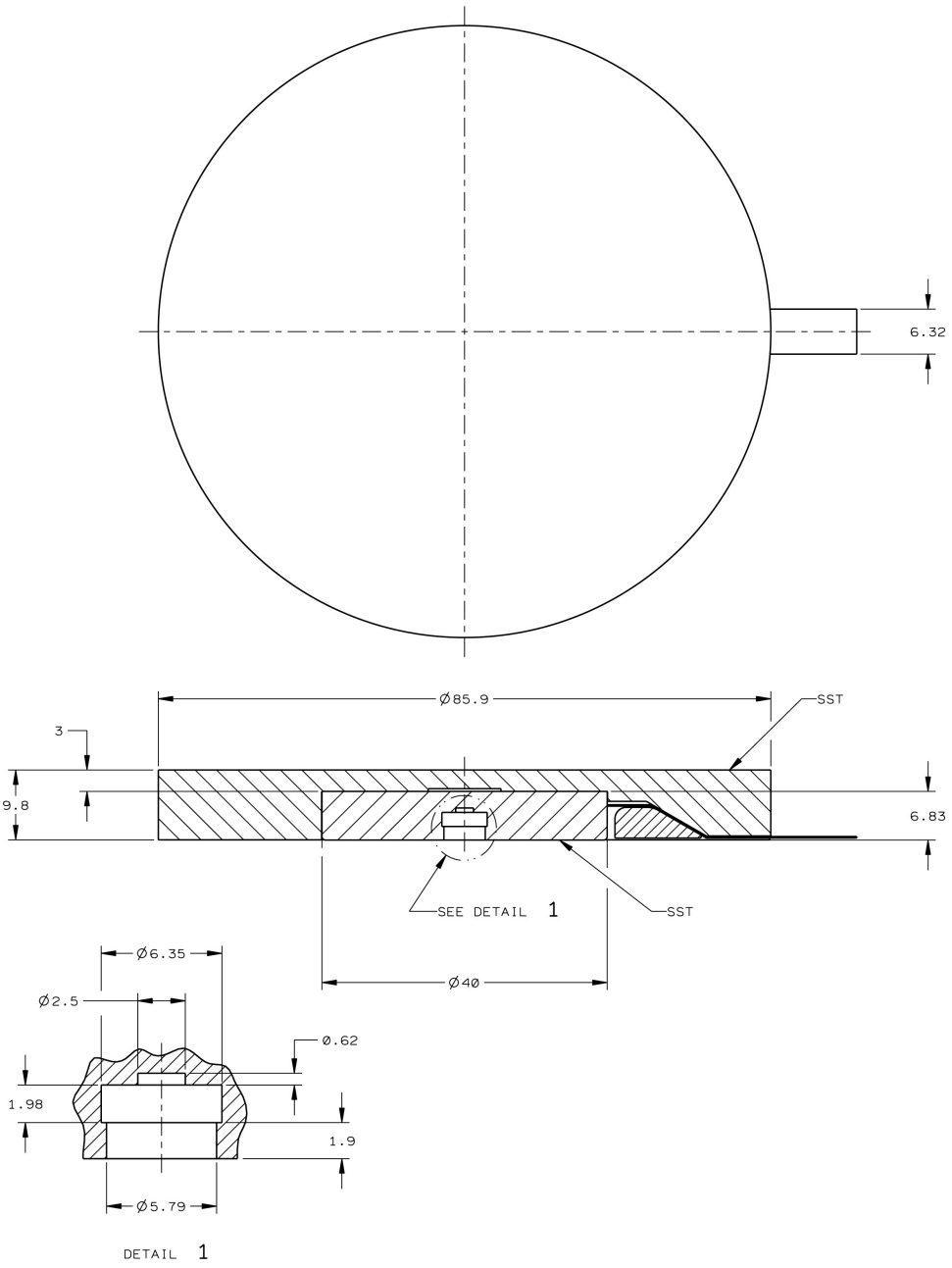


Figure 6. 2021E PT5 & PT6 Shadowplate: Simplified Top View and Cross Section

JACK RABBIT PRETEST SERIES: 2021E PT5 & PT6

Figure 7. SHADOWPLATE DESIGN – Full Assembly, Top View & Cross Section

NOTE:

1) The shadowplate assembly is made up of a cylindrical outer shape and an inset detonator body
2) The shadowplate assembly design is not axi-symmetric
3) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
4) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
5) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
6) The detonator body assembly design is not axi-symmetric
7) A gap of approximately 0.25 mm exists between the slapper assembly and the pocket machined into the outer shape

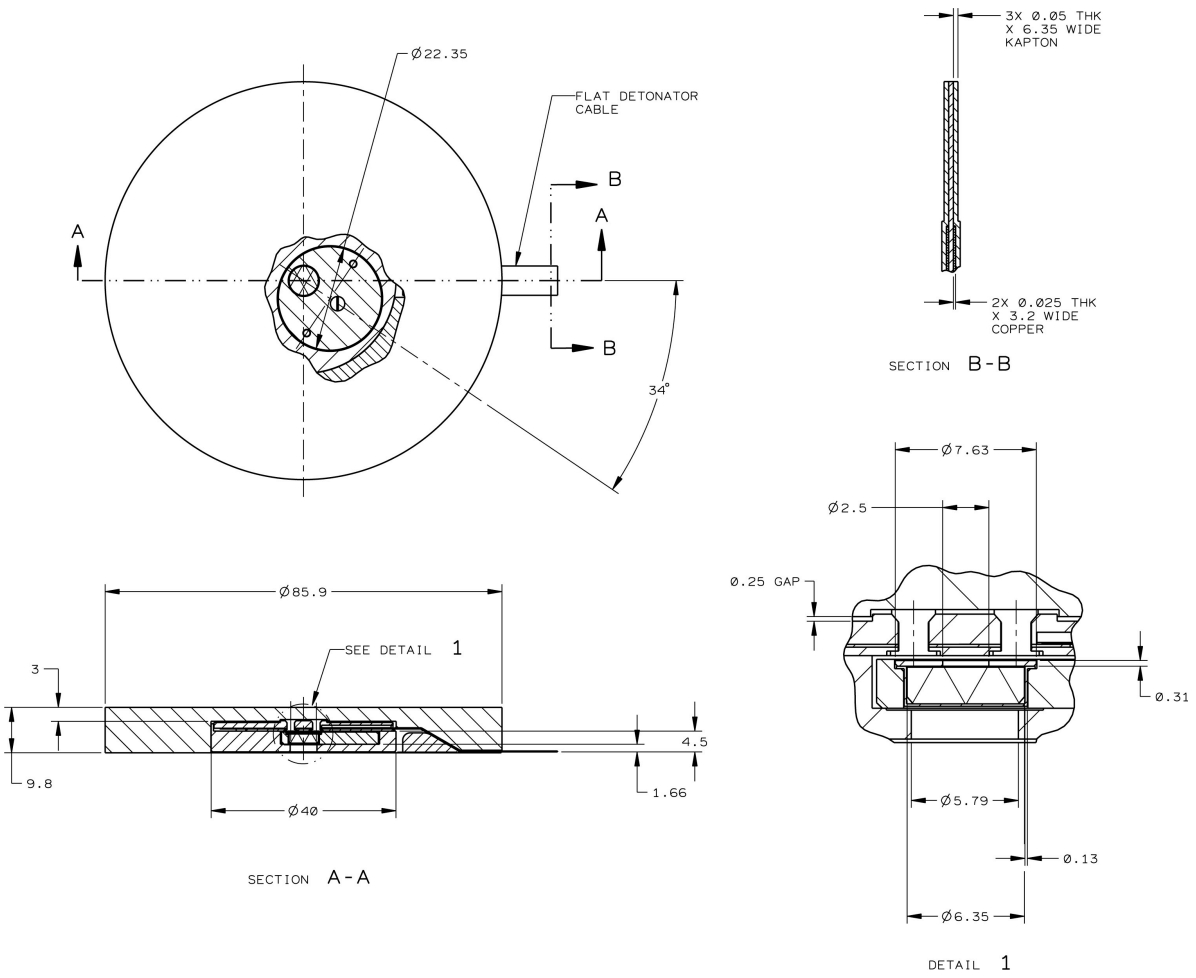


Figure 7. 2021E PT5 & PT6 Shadowplate: Full Assembly Top View and Cross Section

JACK RABBIT PRETEST SERIES: 2021E PT5 & PT6

Figure 8. SHADOWPLATE DESIGN – Full Assembly, Exploded Diagram

NOTE:

1) The shadowplate assembly is made up of a cylindrical outer shape and an inset detonator body
2) The shadowplate assembly design is not axi-symmetric
3) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
4) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
5) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
6) The detonator body design is not axi-symmetric
7) The detonator body consists of slapper assembly attached to a 303 stainless steel body, with a titanium alloy wheel insert holding the tantalum/tungsten washer and the LX-16 (pressed PETN) pellet can assembly

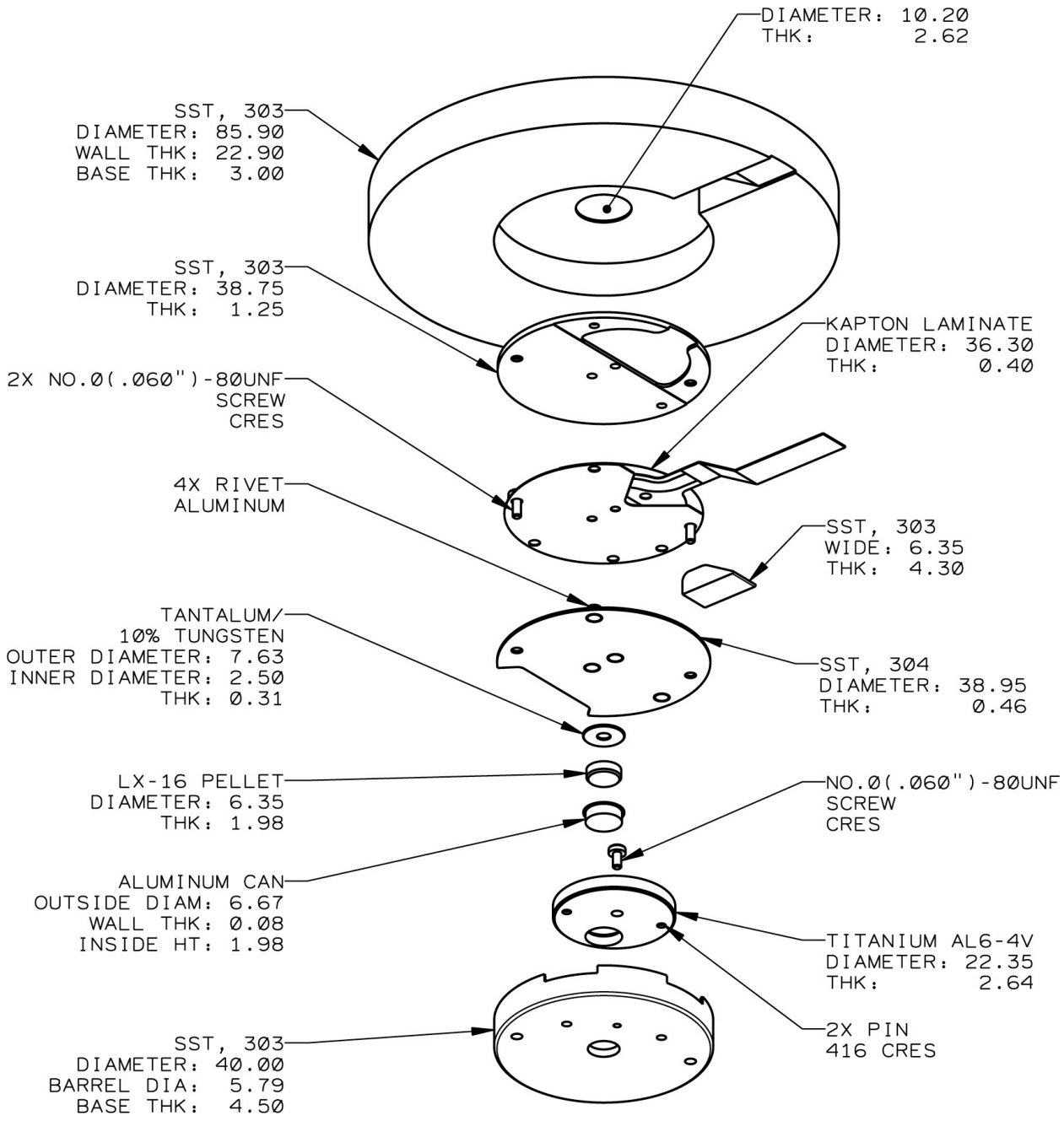


Figure 8. 2021E PT5 & PT6 Shadowplate: Full Assembly Exploded Diagram

JACK RABBIT PRETEST SERIES: 2021E PT7 DRAWINGS

Figure 9. SHADOWPLATE DESIGN – Simplified, Exploded Diagram

NOTE:

1) The shadowplate assembly is made up of an outer shape and an inset detonator body
2) The outer shape contour is defined by two intersecting spherical surfaces, Figure 10
3) The shadowplate assembly design is not axi-symmetric
4) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
5) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
6) A stainless steel wedge fills the void in the shadowplate cable run
7) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)

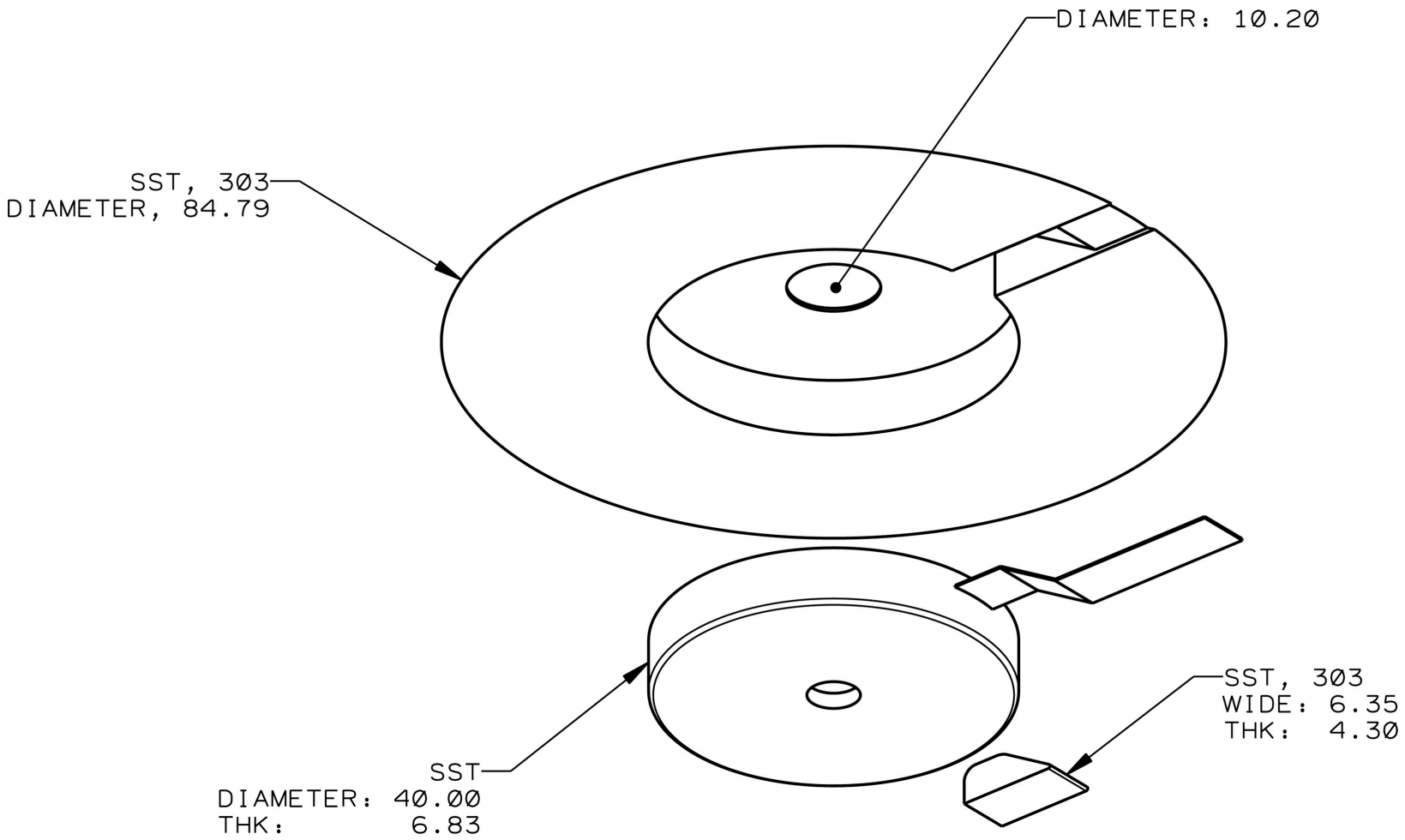


Figure 9. 2021E PT7 Shadowplate: Simplified Exploded Diagram

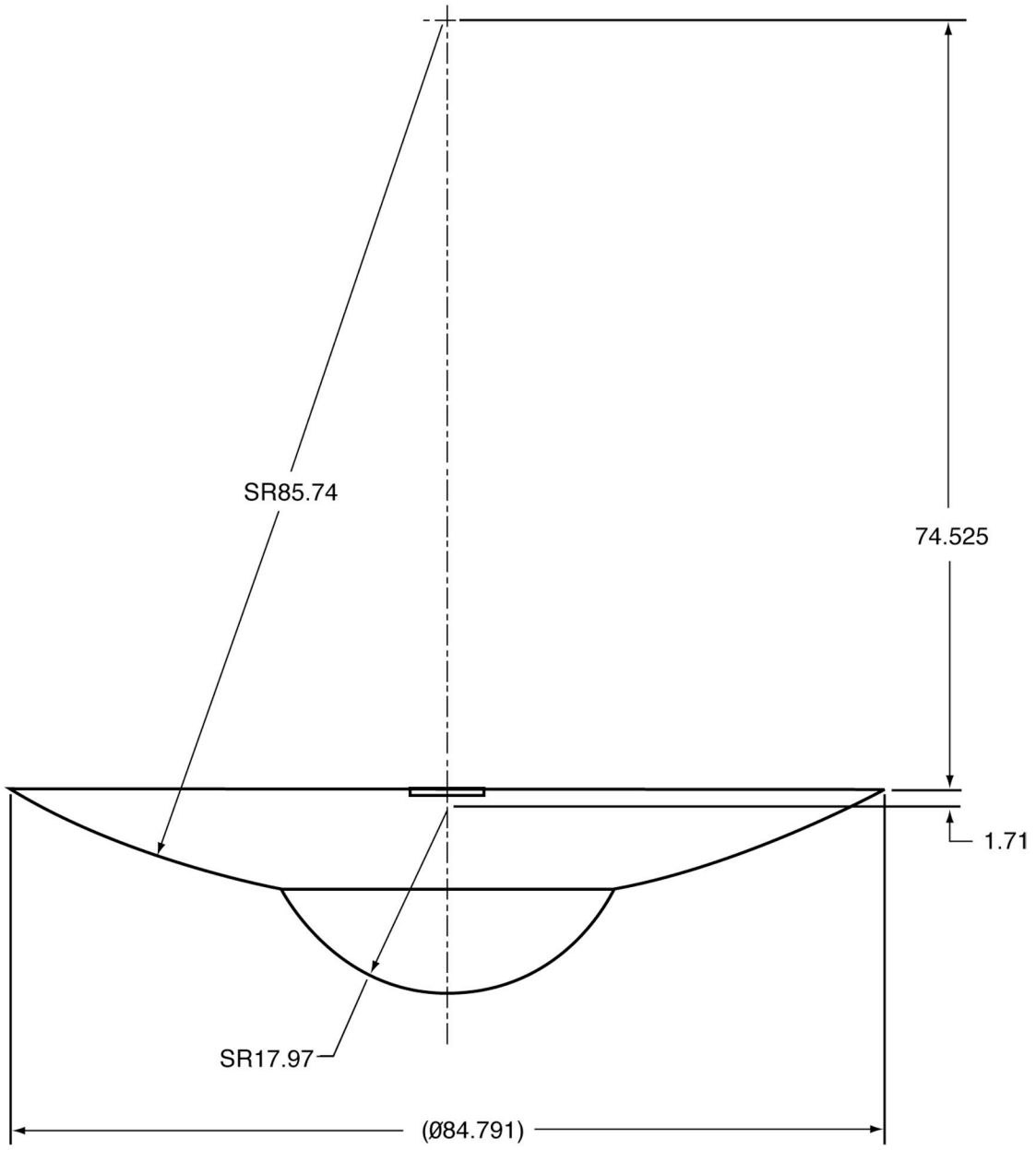


Figure 10. 2021E PT7 Shadowplate: Contour dimensions

JACK RABBIT PRETEST SERIES: 2021E PT7

Figure 11. SHADOWPLATE DESIGN – Simplified, Top View & Cross Section

NOTE:

1) The shadowplate assembly is made up of an outer shape and an inset detonator body
2) The outer shape contour is defined by two intersecting spherical surfaces, Figure 10
3) The shadowplate assembly design is not axi-symmetric
4) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
5) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
6) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
7) The void shown in detonator body cross section represents (top to bottom) slapper flyer barrel, LX-16 (pressed PETN) pellet in a can (extruded aluminum foil), and the pellet can flyer barrel

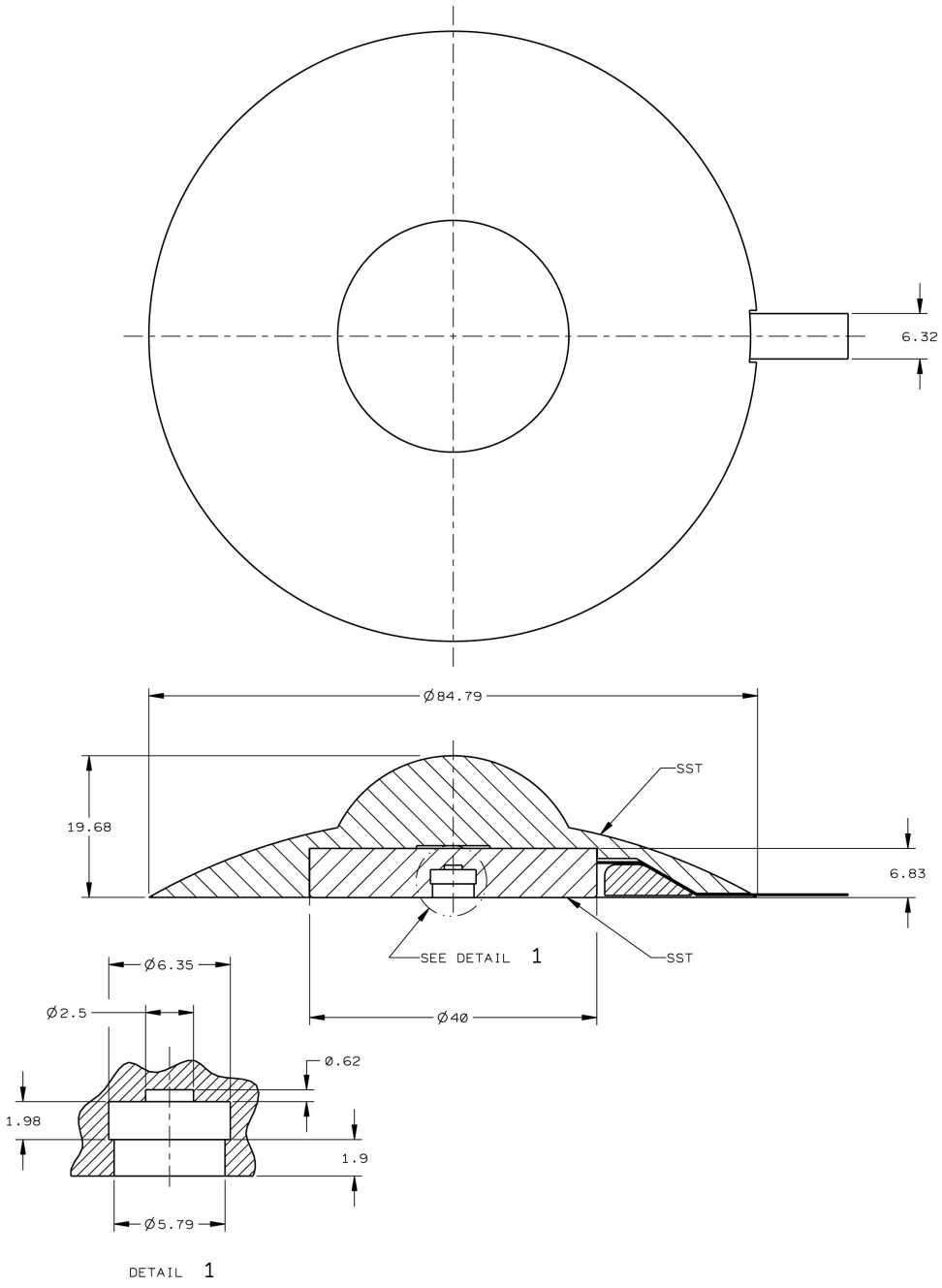


Figure 11. 2021E PT7 Shadowplate: Simplified Top View and Cross Section

JACK RABBIT PRETEST SERIES: 2021E PT7

Figure 12. SHADOWPLATE DESIGN – Full Assembly, Top View & Cross Section

NOTE:

1) The shadowplate assembly is made up of an outer shape and an inset detonator body
2) The outer shape contour is defined by two intersecting spherical surfaces, Figure 10
3) The shadowplate assembly design is not axi-symmetric
4) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
5) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
6) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
7) The detonator body assembly design is not axi-symmetric
8) A gap of approximately 0.25 mm exists between the slapper assembly and the pocket machined into the outer shape

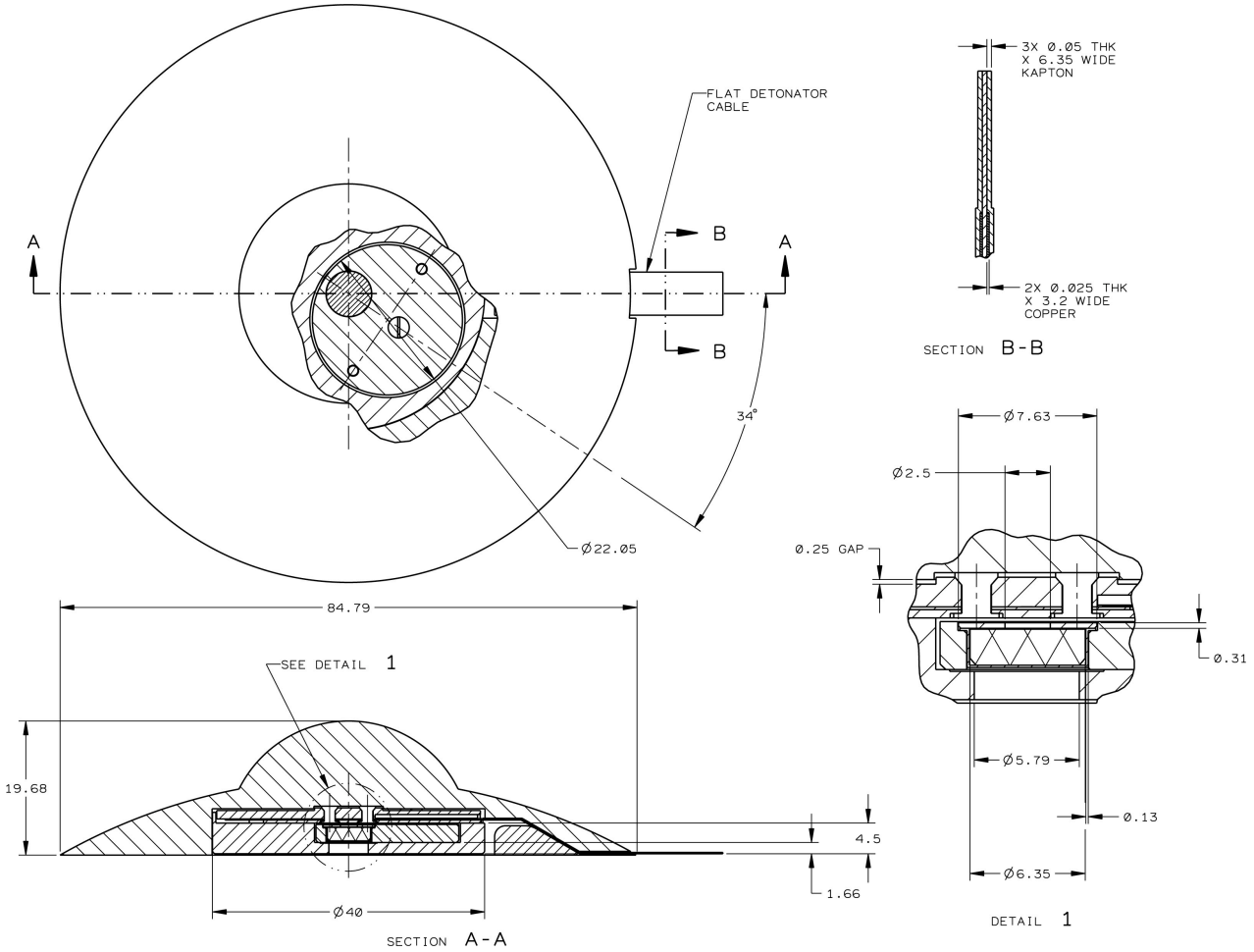


Figure 12. 2021E PT7 Shadowplate: Full Assembly Top View and Cross Section

JACK RABBIT PRETEST SERIES: 2021E PT7

Figure 13. SHADOWPLATE DESIGN – Full Assembly, Exploded Diagram

NOTE:

1) The shadowplate assembly is made up of an outer shape and an inset detonator body
2) The outer shape contour is defined by two intersecting spherical surfaces, Figure 10
3) The shadowplate assembly design is not axi-symmetric
4) The detonator body design is the same in all experiments PT3, PT4, PT5, PT6, PT7
5) The detonator body fits in a closely machined cylindrical pocket, forming the complete shadowplate assembly
6) The Kapton flat detonator cable runs out the parting line between upper and lower main charge LX-17 (refer to posters in Appendix B)
7) The detonator body design is not axi-symmetric
8) The detonator body consists of slapper assembly attached to a 303 stainless steel body, with a titanium alloy wheel insert holding the tantalum/tungsten washer and the LX-16 (pressed PETN) pellet can assembly

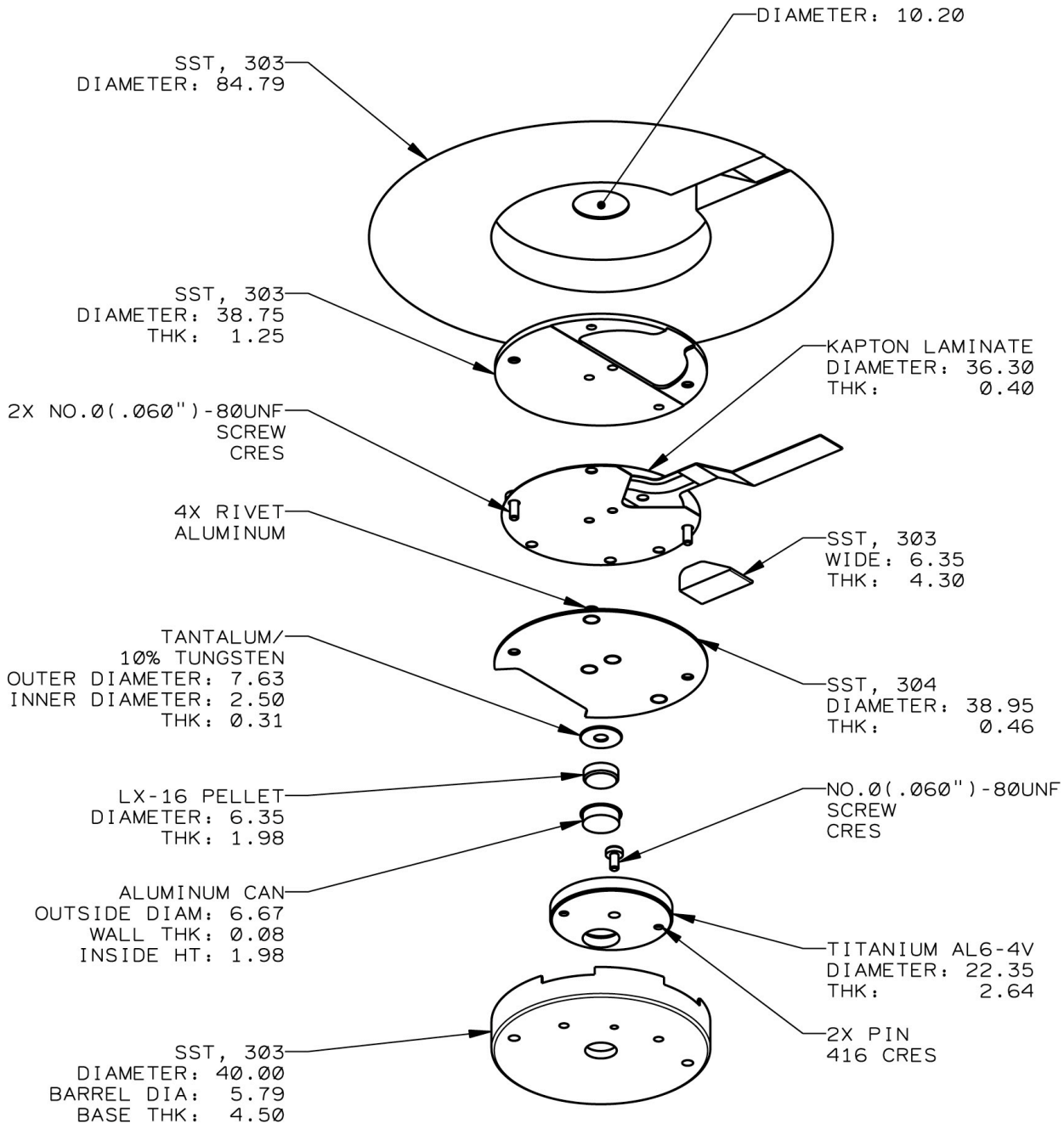


Figure 13. 2021E PT7 Shadowplate: Full Assembly Exploded Diagram

APPENDIX A – SHADOWPLATE SOURCE DRAWINGS

The following serve as source drawings for this document and are included in this appendix.

JACK RABBIT SHADOWPLATE, PT3 & PT4 SIMPLE ASSY, AAA09-502710

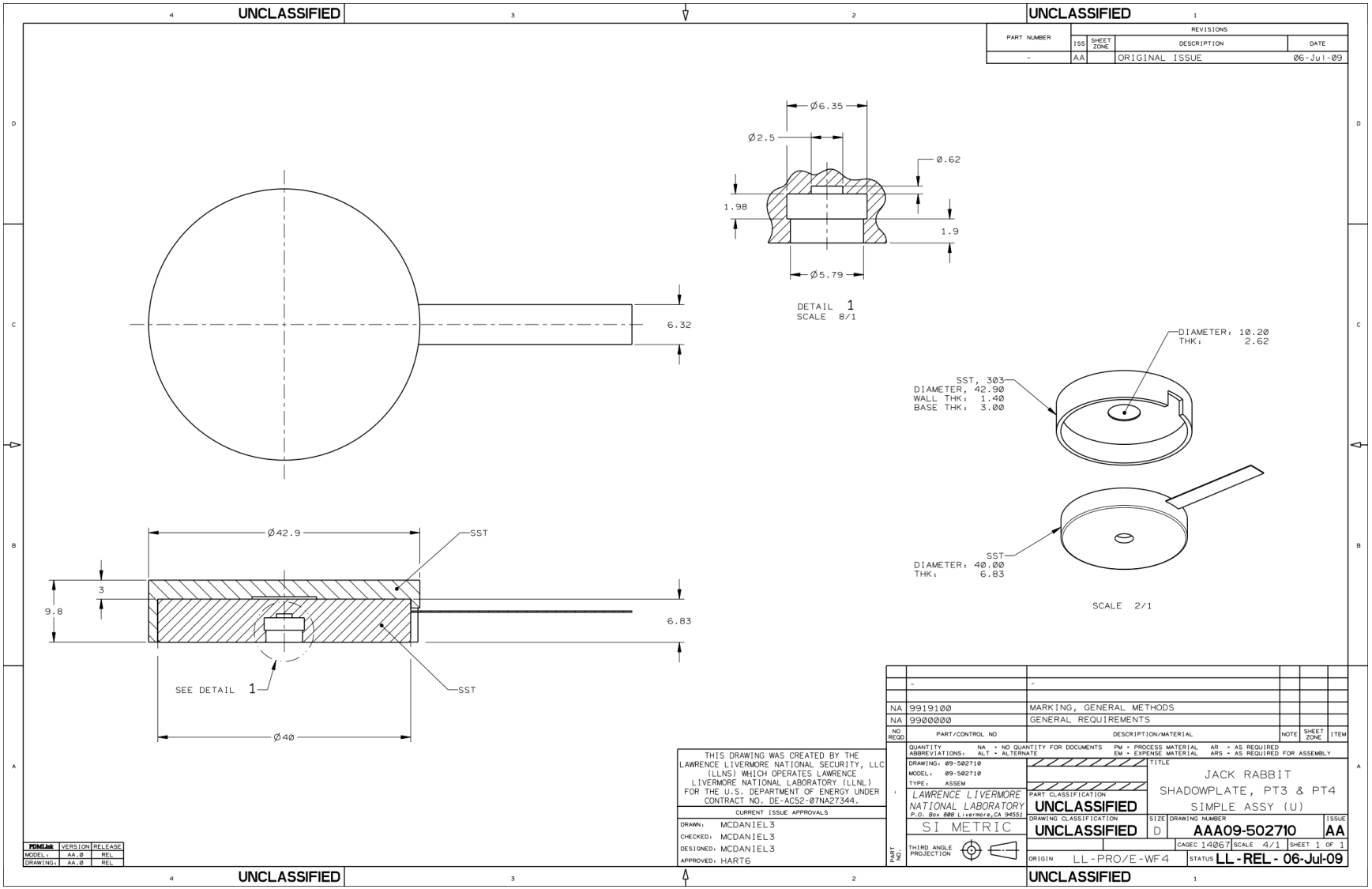
JACK RABBIT SHADOWPLATE, PT3 & PT4 FULL ASSY, AAA09-502711

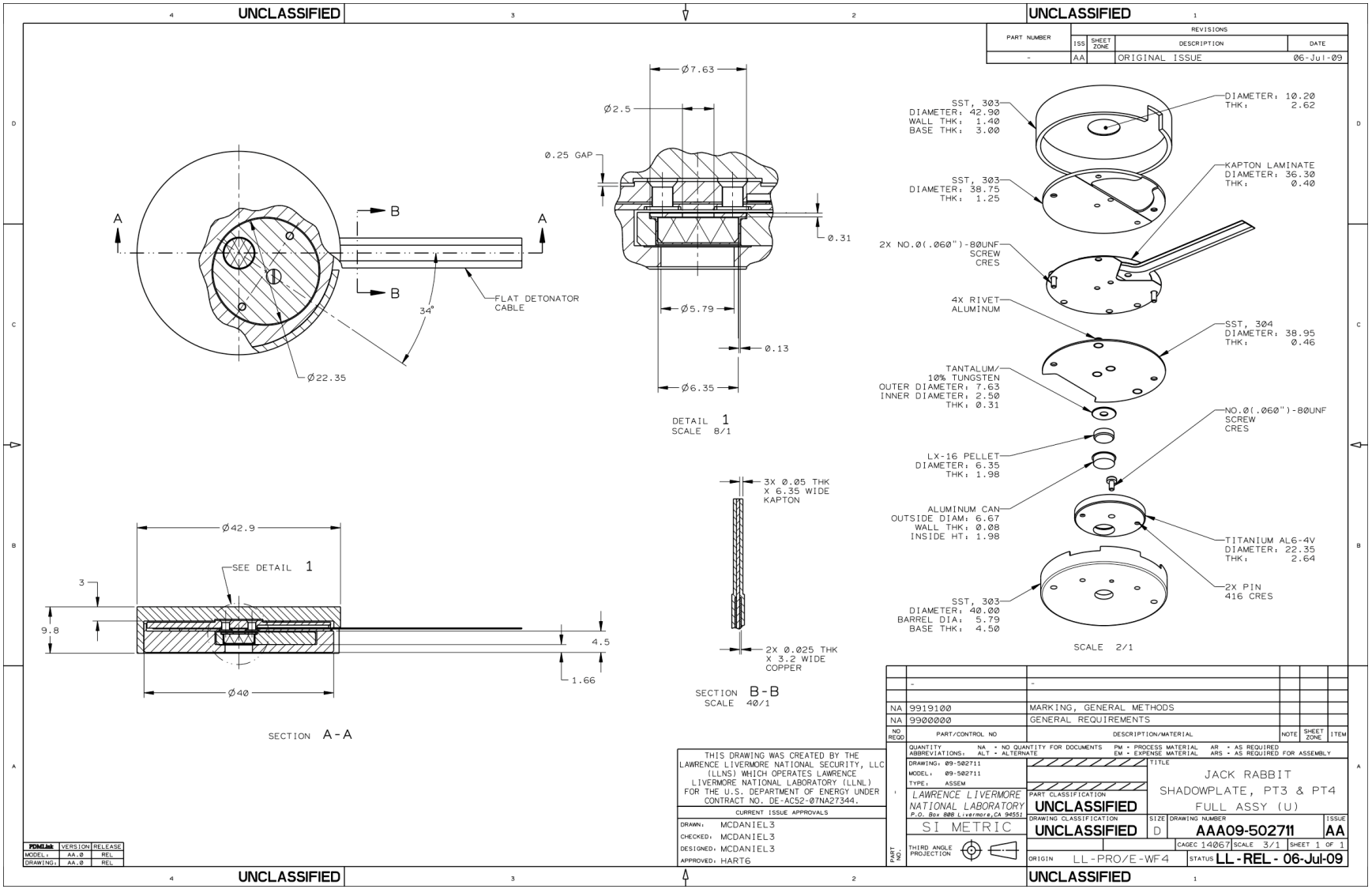
JACK RABBIT SHADOWPLATE, PT5 & PT6 SIMPLE ASSY, AAA09-502712

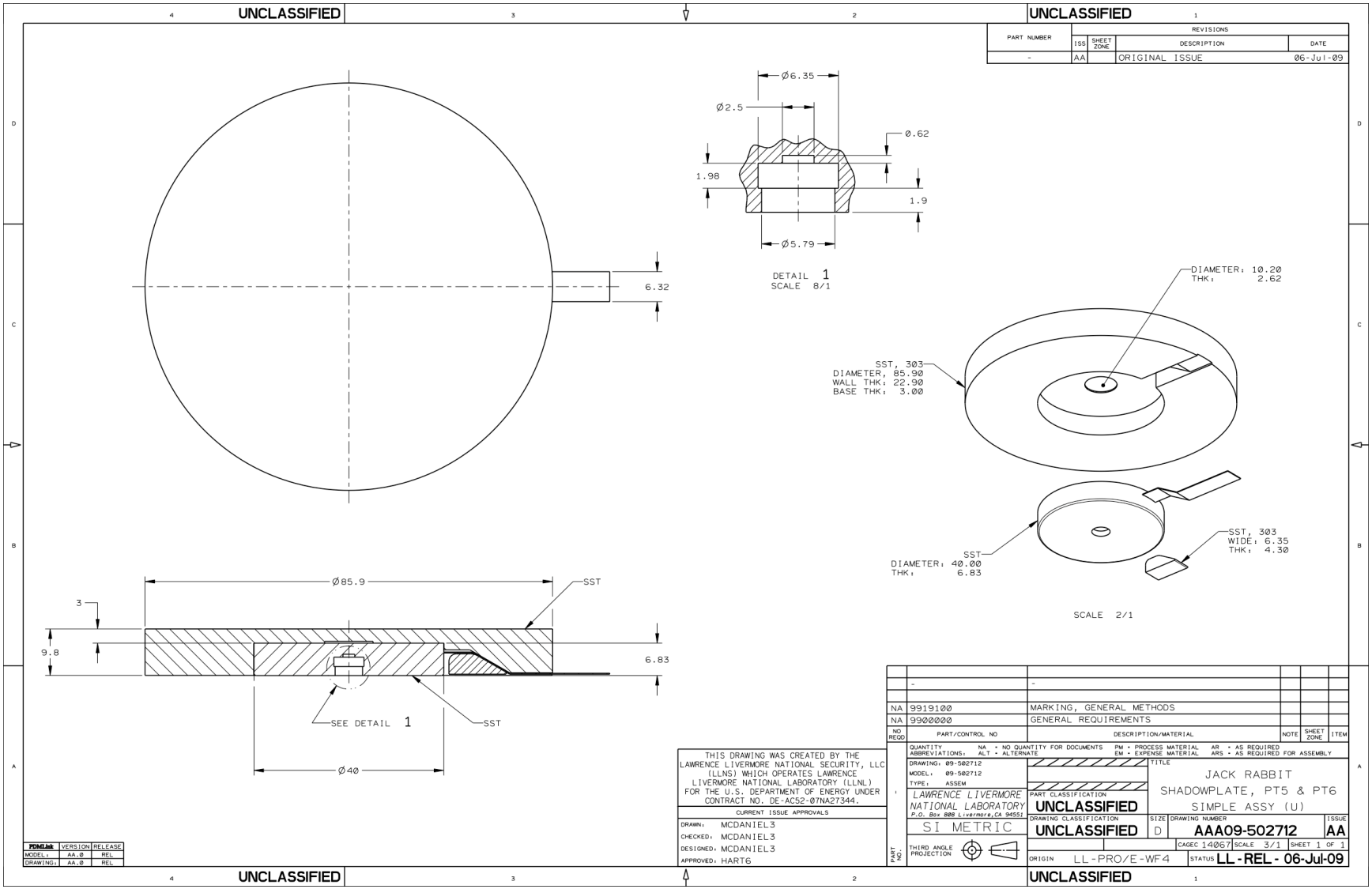
JACK RABBIT SHADOWPLATE, PT5 & PT6 FULL ASSY, AAA09-502713

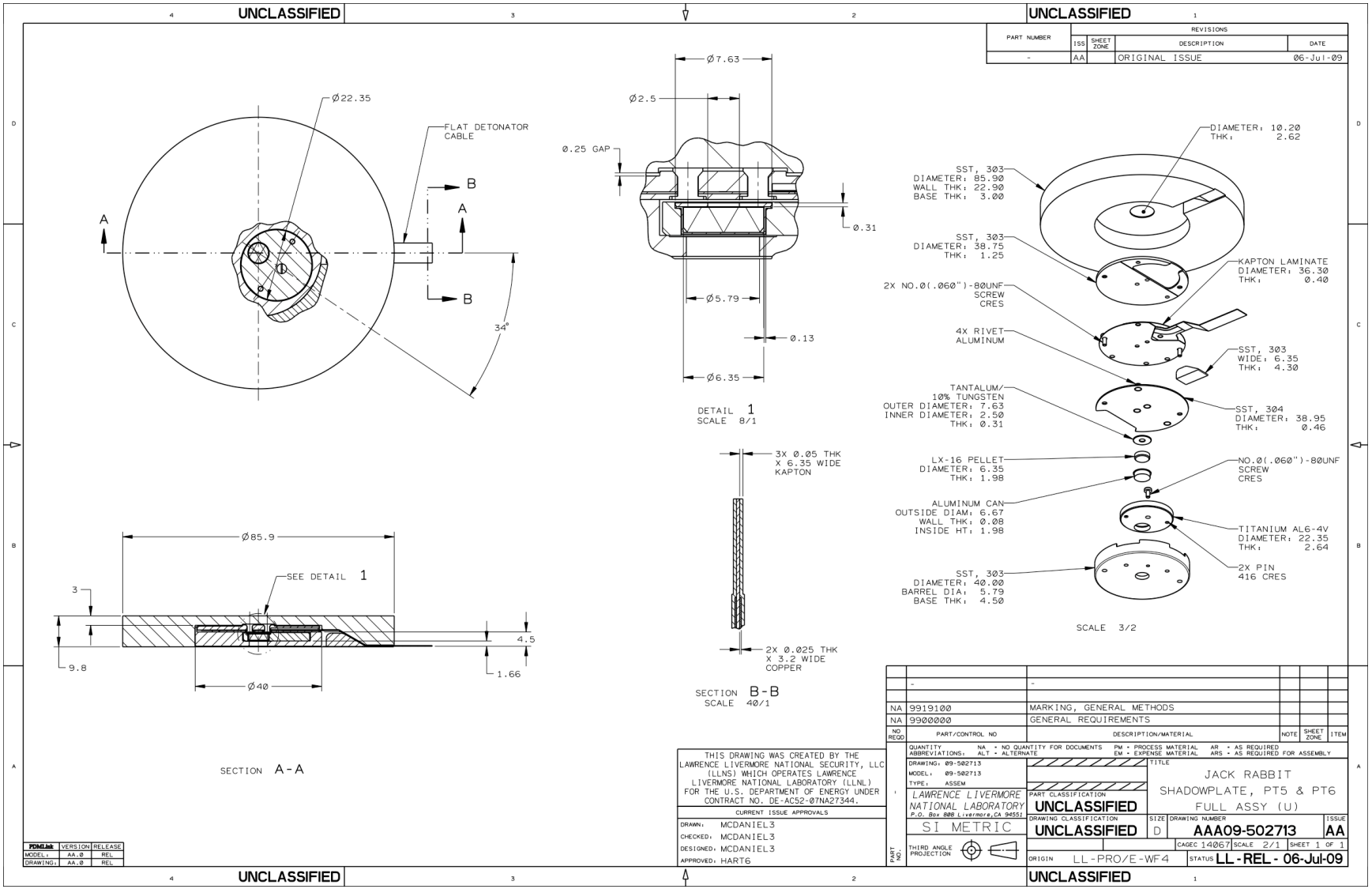
JACK RABBIT SHADOWPLATE, PT7 SIMPLE ASSY, AAA09-502714

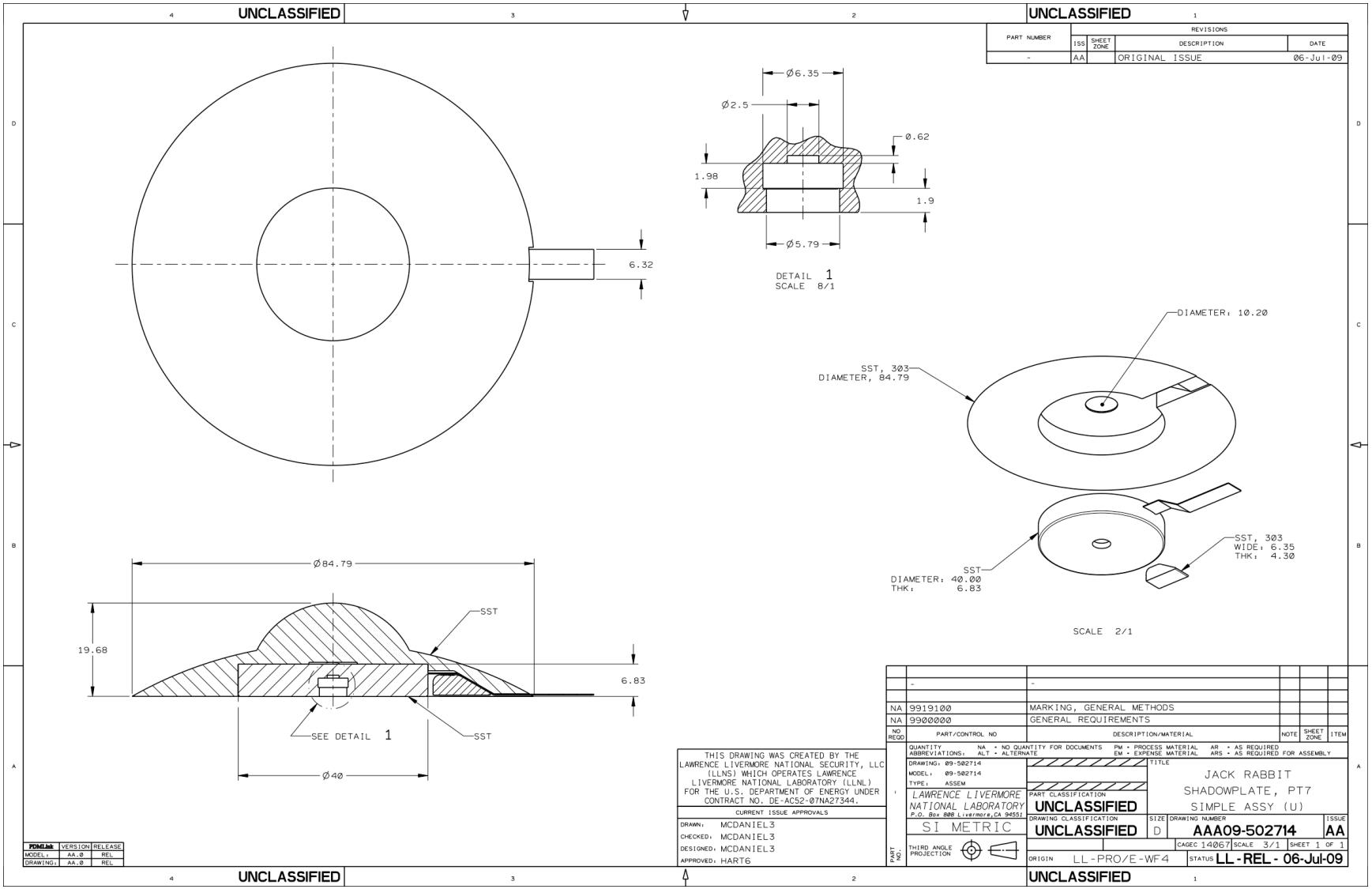
JACK RABBIT SHADOWPLATE, PT7 FULL ASSY, AAA09-502715

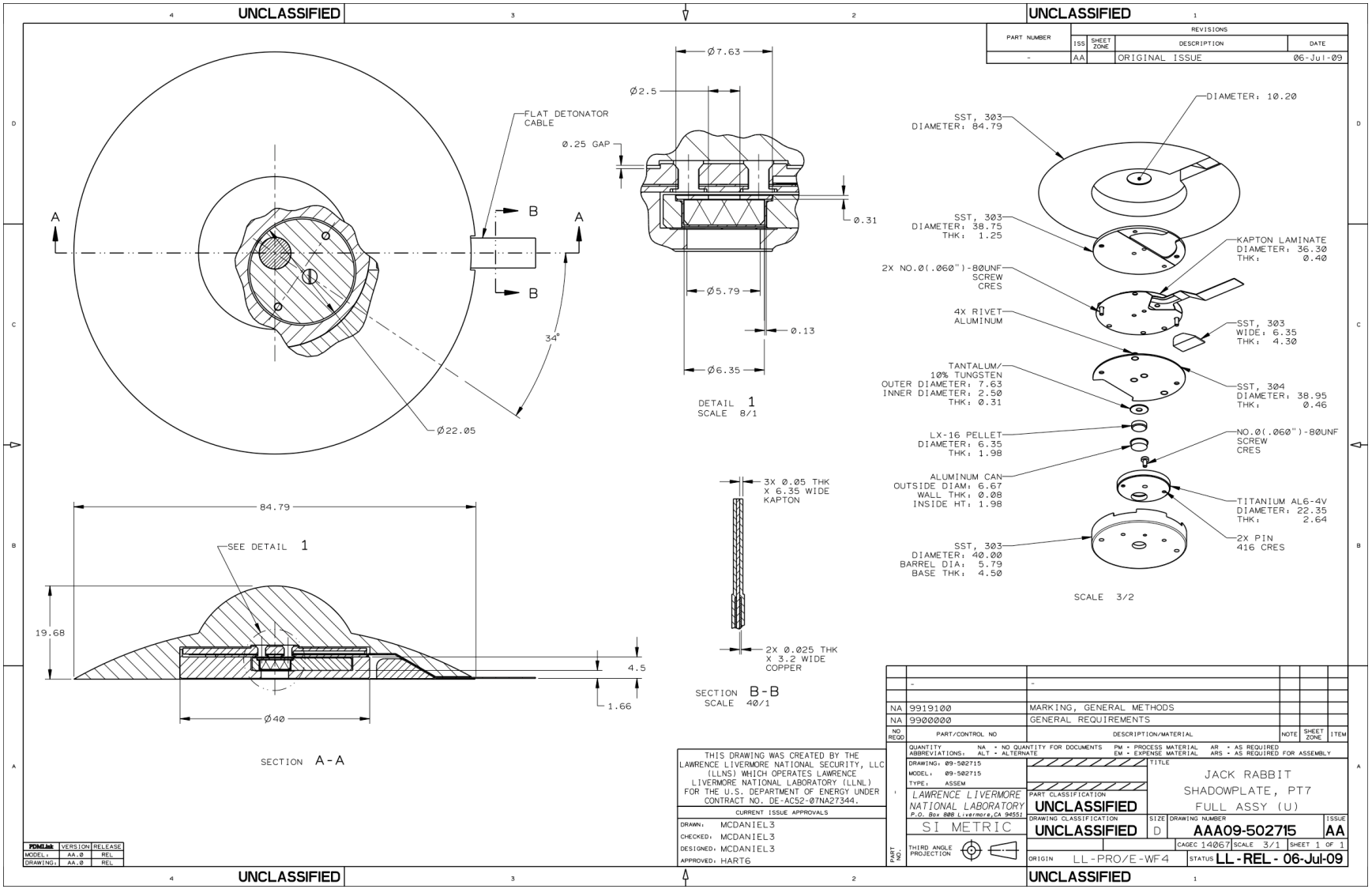

UNCLASSIFIED
UNCLASSIFIED
PART NUMBER
REVISIONS
ISS
SHEET ZONE
DESCRIPTION
DATE
-
AA
ORIGINAL ISSUE
06-Jul-09
Ø6.35
Ø2.5
Ø.62
1.98
1.9
Ø5.79
DETAIL 1
SCALE 8/1
6.32
DIAMETER: 10.20
THK: 2.62
SST, 303
DIAMETER, 42.90
WALL THK: 1.40
BASE THK: 3.00
SST
DIAMETER: 40.00
THK: 6.83
SCALE 2/1
Ø42.9
SST
3
9.8
6.83
SEE DETAIL 1
SST
Ø40
NA 9919100 MARKING, GENERAL METHODS
NA 9900000 GENERAL REQUIREMENTS
NO REQD
PART/CONTROL NO
DESCRIPTION/MATERIAL
NOTE
SHEET ZONE
ITEM
QUANTITY NA - NO QUANTITY FOR DOCUMENTS PM - PROCESS MATERIAL AR - AS REQUIRED
ABBREVIATIONS: ALT - ALTERNATE EM - EXPENSE MATERIAL ARS - AS REQUIRED FOR ASSEMBLY
THIS DRAWING WAS CREATED BY THE LAWRENCE LIVERMORE NATIONAL SECURITY, LLC (LLNS) WHICH OPERATES LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC52-07NA27344.
CURRENT ISSUE APPROVALS
DRAWN: MCDANIEL3
CHECKED: MCDANIEL3
DESIGNED: MCDANIEL3
APPROVED: HART6
DRAWING: 09-502710
MODEL: 09-502710
TYPE: ASSEM
LAWRENCE LIVERMORE NATIONAL LABORATORY
P.O. Box 808 Livermore,CA 94551
SI METRIC
THIRD ANGLE PROJECTION
PART NO.
TITLE
JACK RABBIT
SHADOWPLATE, PT3 & PT4
SIMPLE ASSY (U)
PART CLASSIFICATION
UNCLASSIFIED
DRAWING CLASSIFICATION
UNCLASSIFIED
SIZE
D
DRAWING NUMBER
AAA09-502710
ISSUE
AA
CAGEC 14067
SCALE 4/1
SHEET 1 OF 1
ORIGIN LL-PRO/E-WF4
STATUS LL-REL- 06-Jul-09
PDMLink VERSION RELEASE
MODEL: AA.0 REL
DRAWING: AA.0 REL
UNCLASSIFIED
UNCLASSIFIED


UNCLASSIFIED
UNCLASSIFIED
PART NUMBER
REVISIONS
ISS
SHEET ZONE
DESCRIPTION
DATE
-
AA
ORIGINAL ISSUE
06-Jul-09
Ø7.63
Ø2.5
0.25 GAP
0.31
Ø5.79
0.13
Ø6.35
DETAIL 1
SCALE 8/1
A
B
B
A
34°
FLAT DETONATOR CABLE
Ø22.35
SST, 303
DIAMETER: 42.90
WALL THK: 1.40
BASE THK: 3.00
DIAMETER: 10.20
THK: 2.62
SST, 303
DIAMETER: 38.75
THK: 1.25
KAPTON LAMINATE
DIAMETER: 36.30
THK: 0.40
2X NO.0(.060")-80UNF
SCREW
CRES
4X RIVET
ALUMINUM
SST, 304
DIAMETER: 38.95
THK: 0.46
TANTALUM/
10% TUNGSTEN
OUTER DIAMETER: 7.63
INNER DIAMETER: 2.50
THK: 0.31
NO.0(.060")-80UNF
SCREW
CRES
LX-16 PELLET
DIAMETER: 6.35
THK: 1.98
ALUMINUM CAN
OUTSIDE DIAM: 6.67
WALL THK: 0.08
INSIDE HT: 1.98
TITANIUM AL6-4V
DIAMETER: 22.35
THK: 2.64
2X PIN
416 CRES
SST, 303
DIAMETER: 40.00
BARREL DIA: 5.79
BASE THK: 4.50
SCALE 2/1
3X 0.05 THK
X 6.35 WIDE
KAPTON
2X 0.025 THK
X 3.2 WIDE
COPPER
SECTION B-B
SCALE 40/1
Ø42.9
SEE DETAIL 1
3
9.8
4.5
1.66
Ø40
SECTION A-A
NA 9919100 MARKING, GENERAL METHODS
NA 9900000 GENERAL REQUIREMENTS
NO REQD
PART/CONTROL NO
DESCRIPTION/MATERIAL
NOTE
SHEET ZONE
ITEM
QUANTITY ABBREVIATIONS: NA - NO QUANTITY FOR DOCUMENTS ALT - ALTERNATE
PM - PROCESS MATERIAL EM - EXPENSE MATERIAL
AR - AS REQUIRED ARS - AS REQUIRED FOR ASSEMBLY
THIS DRAWING WAS CREATED BY THE LAWRENCE LIVERMORE NATIONAL SECURITY, LLC (LLNS) WHICH OPERATES LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC52-07NA27344.
CURRENT ISSUE APPROVALS
DRAWN: MCDANIEL3
CHECKED: MCDANIEL3
DESIGNED: MCDANIEL3
APPROVED: HART6
DRAWING: 09-502711
MODEL: 09-502711
TYPE: ASSEM
LAWRENCE LIVERMORE NATIONAL LABORATORY
P.O. Box 808 Livermore,CA 94551
SI METRIC
THIRD ANGLE PROJECTION
PART NO.
TITLE
JACK RABBIT
SHADOWPLATE, PT3 & PT4
FULL ASSY (U)
PART CLASSIFICATION
UNCLASSIFIED
DRAWING CLASSIFICATION
UNCLASSIFIED
SIZE D
DRAWING NUMBER AAA09-502711
ISSUE AA
CAGEC 1406Z
SCALE 3/1
SHEET 1 OF 1
ORIGIN LL-PRO/E-WF4
STATUS LL-REL- 06-Jul-09
PDMLink
VERSION
RELEASE
MODEL: AA.0 REL
DRAWING: AA.0 REL
UNCLASSIFIED
UNCLASSIFIED


UNCLASSIFIED
UNCLASSIFIED
PART NUMBER
REVISIONS
ISS
SHEET ZONE
DESCRIPTION
DATE
-
AA
ORIGINAL ISSUE
06-Jul-09
Ø6.35
Ø2.5
0.62
1.98
1.9
Ø5.79
DETAIL 1
SCALE 8/1
6.32
DIAMETER: 10.20
THK: 2.62
SST, 303
DIAMETER, 85.90
WALL THK: 22.90
BASE THK: 3.00
SST
DIAMETER: 40.00
THK: 6.83
SST, 303
WIDE: 6.35
THK: 4.30
SCALE 2/1
Ø85.9
SST
3
9.8
6.83
SEE DETAIL 1
SST
Ø40
THIS DRAWING WAS CREATED BY THE LAWRENCE LIVERMORE NATIONAL SECURITY, LLC (LLNS) WHICH OPERATES LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC52-07NA27344.
CURRENT ISSUE APPROVALS
DRAWN: MCDANIEL3
CHECKED: MCDANIEL3
DESIGNED: MCDANIEL3
APPROVED: HART6
NA 9919100 MARKING, GENERAL METHODS
NA 9900000 GENERAL REQUIREMENTS
NO REQD
PART/CONTROL NO
DESCRIPTION/MATERIAL
NOTE
SHEET ZONE
ITEM
QUANTITY NA = NO QUANTITY FOR DOCUMENTS PM = PROCESS MATERIAL AR = AS REQUIRED
ABBREVIATIONS: ALT = ALTERNATE EM = EXPENSE MATERIAL ARS = AS REQUIRED FOR ASSEMBLY
DRAWING: 09-502712
MODEL: 09-502712
TYPE: ASSEM
LAWRENCE LIVERMORE NATIONAL LABORATORY
P.O. Box 808 Livermore,CA 94551
SI METRIC
THIRD ANGLE PROJECTION
PART NO.
TITLE
JACK RABBIT
SHADOWPLATE, PT5 & PT6
SIMPLE ASSY (U)
PART CLASSIFICATION
UNCLASSIFIED
DRAWING CLASSIFICATION
UNCLASSIFIED
SIZE
D
DRAWING NUMBER
AAA09-502712
ISSUE
AA
CAGEC 14067
SCALE 3/1
SHEET 1 OF 1
ORIGIN LL-PRO/E-WF4
STATUS LL-REL- 06-Jul-09
PDMLink VERSION RELEASE
MODEL: AA.0 REL
DRAWING: AA.0 REL
UNCLASSIFIED
UNCLASSIFIED


UNCLASSIFIED
UNCLASSIFIED
PART NUMBER
REVISIONS
ISS
SHEET ZONE
DESCRIPTION
DATE
-
AA
ORIGINAL ISSUE
06-Jul-09
Ø22.35
FLAT DETONATOR CABLE
A
B
A
B
34°
Ø7.63
Ø2.5
0.25 GAP
0.31
Ø5.79
0.13
Ø6.35
DETAIL 1
SCALE 8/1
DIAMETER: 10.20
THK: 2.62
SST, 303
DIAMETER: 85.90
WALL THK: 22.90
BASE THK: 3.00
SST, 303
DIAMETER: 38.75
THK: 1.25
KAPTON LAMINATE
DIAMETER: 36.30
THK: 0.40
2X NO.0(.060")-80UNF
SCREW
CRES
4X RIVET
ALUMINUM
SST, 303
WIDE: 6.35
THK: 4.30
TANTALUM/
10% TUNGSTEN
OUTER DIAMETER: 7.63
INNER DIAMETER: 2.50
THK: 0.31
SST, 304
DIAMETER: 38.95
THK: 0.46
LX-16 PELLET
DIAMETER: 6.35
THK: 1.98
NO.0(.060")-80UNF
SCREW
CRES
ALUMINUM CAN
OUTSIDE DIAM: 6.67
WALL THK: 0.08
INSIDE HT: 1.98
TITANIUM AL6-4V
DIAMETER: 22.35
THK: 2.64
2X PIN
416 CRES
SST, 303
DIAMETER: 40.00
BARREL DIA: 5.79
BASE THK: 4.50
SCALE 3/2
3X 0.05 THK
X 6.35 WIDE
KAPTON
2X 0.025 THK
X 3.2 WIDE
COPPER
SECTION B-B
SCALE 40/1
Ø85.9
SEE DETAIL 1
3
4.5
9.8
1.66
Ø40
SECTION A-A
NA 9919100 MARKING, GENERAL METHODS
NA 9900000 GENERAL REQUIREMENTS
NO REQD
PART/CONTROL NO
DESCRIPTION/MATERIAL
NOTE
SHEET ZONE
ITEM
QUANTITY ABBREVIATIONS: NA = NO QUANTITY FOR DOCUMENTS ALT = ALTERNATE
PM = PROCESS MATERIAL EM = EXPENSE MATERIAL
AR = AS REQUIRED ARS = AS REQUIRED FOR ASSEMBLY
THIS DRAWING WAS CREATED BY THE LAWRENCE LIVERMORE NATIONAL SECURITY, LLC (LLNS) WHICH OPERATES LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC52-07NA27344.
CURRENT ISSUE APPROVALS
DRAWN: MCDANIEL3
CHECKED: MCDANIEL3
DESIGNED: MCDANIEL3
APPROVED: HART6
DRAWING: 09-502713
MODEL: 09-502713
TYPE: ASSEM
LAWRENCE LIVERMORE NATIONAL LABORATORY
P.O. Box 808 Livermore,CA 94551
SI METRIC
THIRD ANGLE PROJECTION
PART NO.
TITLE
JACK RABBIT
SHADOWPLATE, PT5 & PT6
FULL ASSY (U)
PART CLASSIFICATION
UNCLASSIFIED
DRAWING CLASSIFICATION
UNCLASSIFIED
SIZE
D
DRAWING NUMBER
AAA09-502713
ISSUE
AA
CAGEC 14067
SCALE 2/1
SHEET 1 OF 1
ORIGIN LL-PRO/E-WF4
STATUS LL-REL- 06-Jul-09
PDMLink
VERSION
RELEASE
MODEL: AA.0 REL
DRAWING: AA.0 REL
UNCLASSIFIED
UNCLASSIFIED


UNCLASSIFIED
UNCLASSIFIED
PART NUMBER
REVISIONS
ISS
SHEET ZONE
DESCRIPTION
DATE
-
AA
ORIGINAL ISSUE
06-Jul-09
Ø6.35
Ø2.5
Ø.62
1.98
1.9
Ø5.79
6.32
DETAIL 1
SCALE 8/1
DIAMETER: 10.20
SST, 303
DIAMETER, 84.79
SST, 303
WIDE: 6.35
THK: 4.30
SST
DIAMETER: 40.00
THK: 6.83
SCALE 2/1
Ø84.79
SST
19.68
6.83
SEE DETAIL 1
SST
Ø40
NA 9919100 MARKING, GENERAL METHODS
NA 9900000 GENERAL REQUIREMENTS
NO REQD
PART/CONTROL NO
DESCRIPTION/MATERIAL
NOTE
SHEET ZONE
ITEM
QUANTITY NA = NO QUANTITY FOR DOCUMENTS PM = PROCESS MATERIAL AR = AS REQUIRED
ABBREVIATIONS: ALT = ALTERNATE EM = EXPENSE MATERIAL ARS = AS REQUIRED FOR ASSEMBLY
THIS DRAWING WAS CREATED BY THE LAWRENCE LIVERMORE NATIONAL SECURITY, LLC (LLNS) WHICH OPERATES LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC52-07NA27344.
CURRENT ISSUE APPROVALS
DRAWN: MCDANIEL3
CHECKED: MCDANIEL3
DESIGNED: MCDANIEL3
APPROVED: HART6
DRAWING: 09-502714
MODEL: 09-502714
TYPE: ASSEM
LAWRENCE LIVERMORE NATIONAL LABORATORY
P.O. Box 808 Livermore,CA 94551
SI METRIC
THIRD ANGLE PROJECTION
PART NO.
TITLE
JACK RABBIT
SHADOWPLATE, PT7
SIMPLE ASSY (U)
PART CLASSIFICATION
UNCLASSIFIED
DRAWING CLASSIFICATION
UNCLASSIFIED
SIZE
D
DRAWING NUMBER
AAA09-502714
ISSUE
AA
CAGEC 14067
SCALE 3/1
SHEET 1 OF 1
ORIGIN LL-PRO/E-WF4
STATUS LL-REL- 06-Jul-09
PDMLink VERSION RELEASE
MODEL: AA.0 REL
DRAWING: AA.0 REL
UNCLASSIFIED
UNCLASSIFIED


UNCLASSIFIED
UNCLASSIFIED
PART NUMBER
REVISIONS
ISS
SHEET ZONE
DESCRIPTION
DATE
- AA ORIGINAL ISSUE 06-Jul-09
FLAT DETONATOR CABLE
0.25 GAP
Ø7.63
Ø2.5
Ø0.31
Ø5.79
0.13
Ø6.35
34°
Ø22.05
A
B
DETAIL 1
SCALE 8/1
DIAMETER: 10.20
SST, 303
DIAMETER: 84.79
SST, 303
DIAMETER: 38.75
THK: 1.25
KAPTON LAMINATE
DIAMETER: 36.30
THK: 0.40
2X NO.0(.060")-80UNF
SCREW
CRES
4X RIVET
ALUMINUM
SST, 303
WIDE: 6.35
THK: 4.30
TANTALUM/
10% TUNGSTEN
OUTER DIAMETER: 7.63
INNER DIAMETER: 2.50
THK: 0.31
SST, 304
DIAMETER: 38.95
THK: 0.46
LX-16 PELLET
DIAMETER: 6.35
THK: 1.98
NO.0(.060")-80UNF
SCREW
CRES
ALUMINUM CAN
OUTSIDE DIAM: 6.67
WALL THK: 0.08
INSIDE HT: 1.98
TITANIUM AL6-4V
DIAMETER: 22.35
THK: 2.64
2X PIN
416 CRES
SST, 303
DIAMETER: 40.00
BARREL DIA: 5.79
BASE THK: 4.50
SCALE 3/2
84.79
SEE DETAIL 1
19.68
4.5
1.66
Ø40
SECTION A-A
3X 0.05 THK
X 6.35 WIDE
KAPTON
2X 0.025 THK
X 3.2 WIDE
COPPER
SECTION B-B
SCALE 40/1
NA 9919100 MARKING, GENERAL METHODS
NA 9900000 GENERAL REQUIREMENTS
NO REQD
PART/CONTROL NO
DESCRIPTION/MATERIAL
NOTE
SHEET ZONE
ITEM
QUANTITY ABBREVIATIONS: NA - NO QUANTITY FOR DOCUMENTS ALT - ALTERNATE
PM - PROCESS MATERIAL EM - EXPENSE MATERIAL
AR - AS REQUIRED ARS - AS REQUIRED FOR ASSEMBLY
THIS DRAWING WAS CREATED BY THE LAWRENCE LIVERMORE NATIONAL SECURITY, LLC (LLNS) WHICH OPERATES LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC52-07NA27344.
CURRENT ISSUE APPROVALS
DRAWN: MCDANIEL3
CHECKED: MCDANIEL3
DESIGNED: MCDANIEL3
APPROVED: HART6
DRAWING: 09-502715
MODEL: 09-502715
TYPE: ASSEM
LAWRENCE LIVERMORE NATIONAL LABORATORY
P.O. Box 808 Livermore,CA 94551
SI METRIC
THIRD ANGLE PROJECTION
PART NO.
TITLE
JACK RABBIT
SHADOWPLATE, PT7
FULL ASSY (U)
PART CLASSIFICATION
UNCLASSIFIED
DRAWING CLASSIFICATION
UNCLASSIFIED
SIZE D
DRAWING NUMBER AAA09-502715
ISSUE AA
CAGEC 14067 SCALE 3/1 SHEET 1 OF 1
ORIGIN LL-PRO/E-WF4
STATUS LL-REL- 06-Jul-09
PDMLink VERSION RELEASE
MODEL: AA.0 REL
DRAWING: AA.0 REL
UNCLASSIFIED
UNCLASSIFIED

APPENDIX B – JACK RABBIT PRETEST POSTERS

This series of three posters lays out the general design of experiments and presents a selection of basic data.

The poster numbers and titles are as follows:

Poster number: LLNL-POST-403089

Title: Contained Firing Facility – Laboratory Research at Site 300

Poster number: LLNL-POST-403014r1

Title: Jack Rabbit: Exploring the limitations of our high explosive safety models

Poster number: LLNL-POSTER-403303

Title: All in a day's work… Contained Firing Facility, Site 300

- Contained Firing Facility -

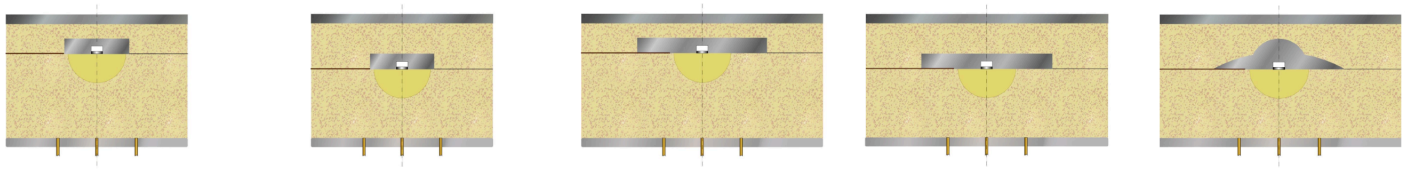
Laboratory Research at Site 300

Contained Firing Facility

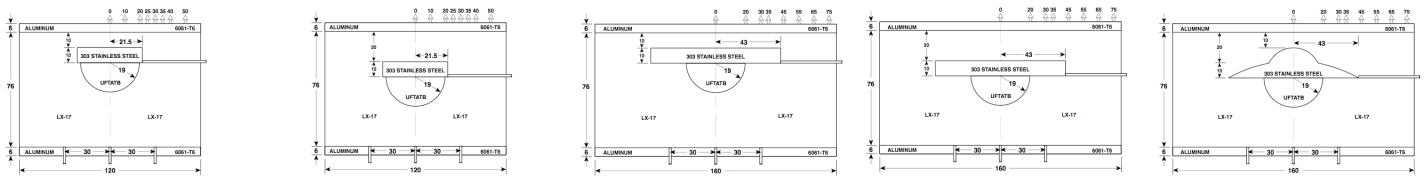
Jack Rabbit Pretest Series — a study of the safety and performance characteristics of LX-17 insensitive high explosive at ambient room temperature

2021E PT3 March 12, 2008	2021E PT4 March 19, 2008	2021E PT5 March 17, 2008	2021E PT6 April 1, 2008	2021E PT7 April 3, 2008

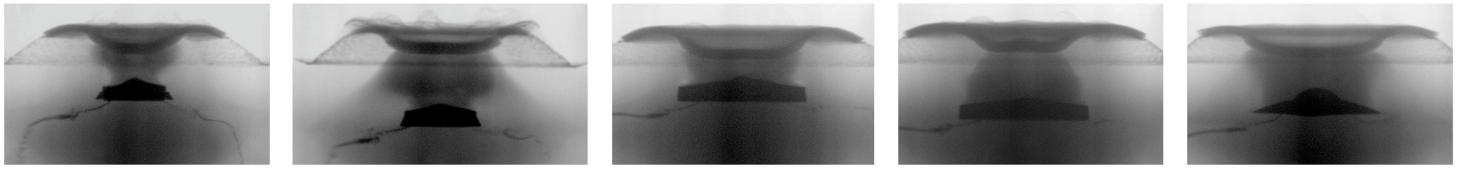
Cross Section Graphic



Cross Section Schematic



X-ray image at 30 microseconds following initiation, showing shadowplate induced LX-17 dead-zone formation under gull-winged diagnostic plate



Lawrence Livermore National Laboratory

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

LLNL-POST-403089

Jack Rabbit: Exploring the limitations of our high explosive safety models

Contained Firing Facility

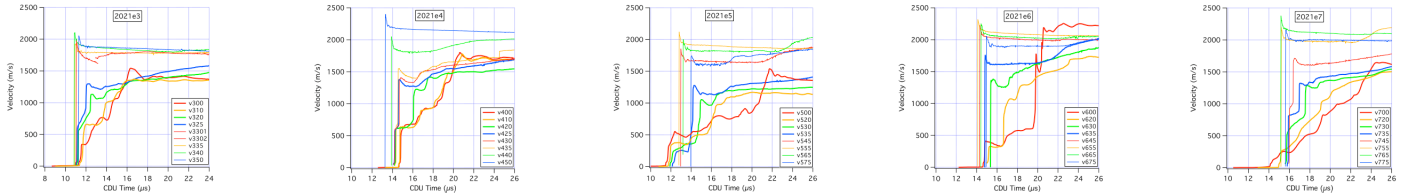
Producing data to improve predictive capability of our high explosive models

– Focusing on regimes where physical mechanisms are poorly understood

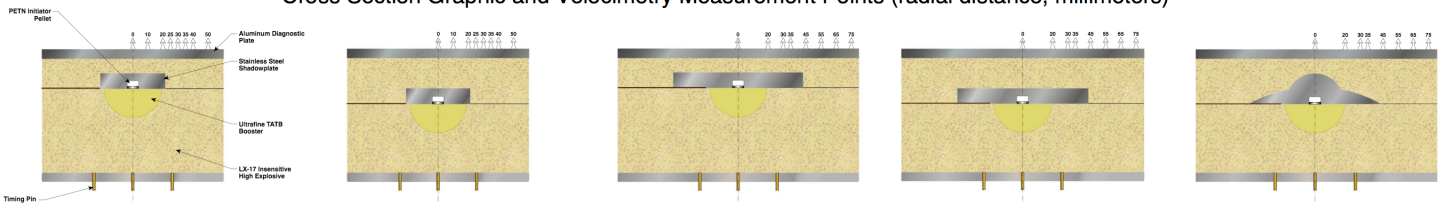
– High fidelity data enables enhancement and validation of models

2021E PT3 | 2021E PT4 | 2021E PT5 | 2021E PT6 | 2021E PT7

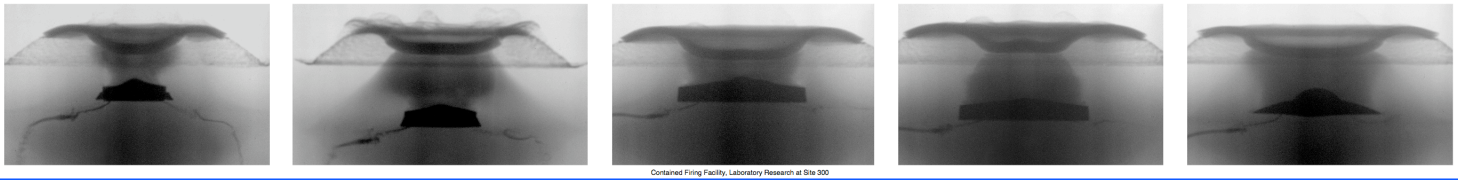
Heterodyne Photonic Doppler Velocimetry (HPDV) Plots



Cross Section Graphic and Velocimetry Measurement Points (radial distance, millimeters)



X-ray image at 30 microseconds following initiation, showing shadowplate induced LX-17 dead-zone formation under gull-winged diagnostic plate



Contained Firing Facility, Laboratory Research at Site 300

Lawrence Livermore National Laboratory

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

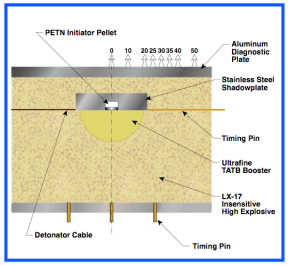
LLNL-POST-403014r1

All in a day's work...

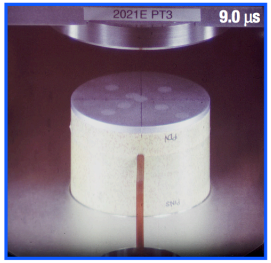
Contained Firing Facility, Site 300

Contained Firing Facility

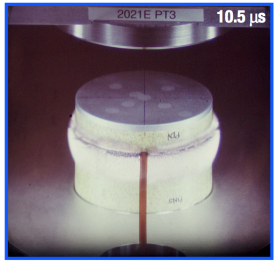
Photographing events lasting millionths of seconds with an accuracy measured in billionths of seconds



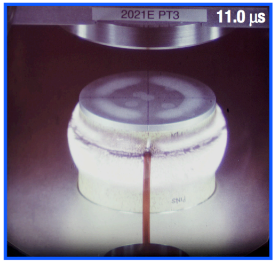
Cross section of the Jack Rabbit Pretest experiment using LX-17 insensitive high explosive



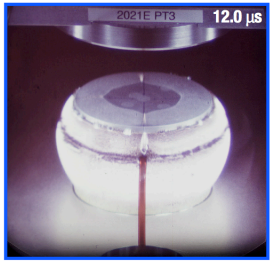
The detonation was started within the LX-17 insensitive high explosive 9 microseconds ago



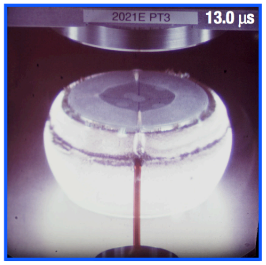
The detonation wave is breaking out from the cylindrical surface of the LX-17 insensitive high explosive



The aluminum plate is shocked by the detonation wave, forming a "frosted" surface



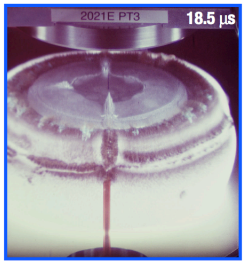
The center region is protected by the undetonated LX-17 dead-zone and remains unshocked



The detonation front becomes incandescent with the heat of chemical reaction

Fine aluminum particles scoured by the explosion form a dark ring around the aluminum plate

The flat detonator cable (foreground) has influenced the detonation



Three fine lines of aluminum particles at 6, 9 and 12 o'clock form over heavily shocked regions

An impulse gradient dishes the aluminum plate, indicating a persistent LX-17 dead-zone

Jack Rabbit Pretest: Studying corner-turning failure and dead-zone formation in LX-17
— focusing on regimes where physical mechanisms are poorly understood

Lawrence Livermore National Laboratory

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

LLNL-POST-403303