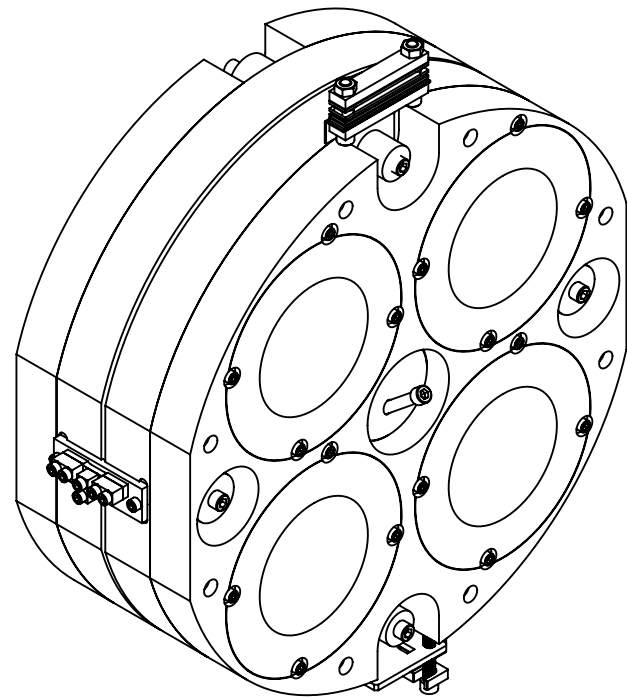


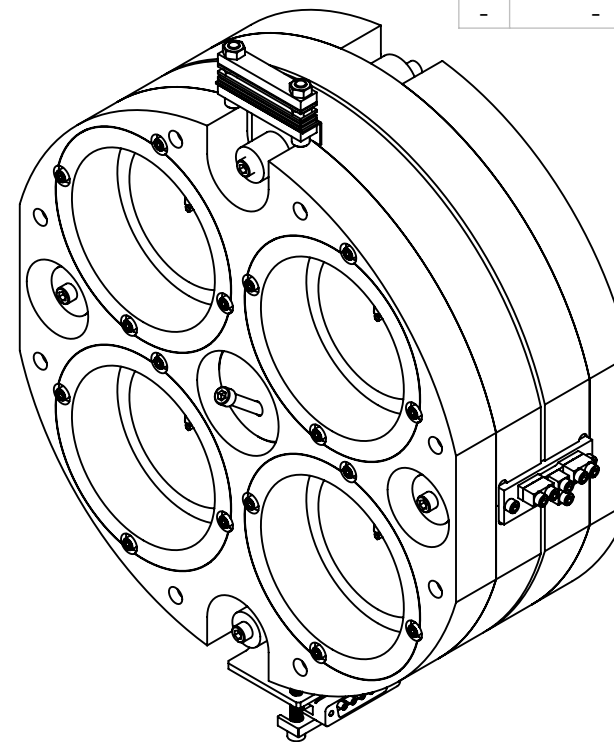
ASSEMBLY PROCESS

(DRAWING UPDATED TO CURRENT CAD FORMAT BY E.SANCHEZ 08/07/2014)

REV.	DATE	DCN #	DRAWING TREE #
v8	16 FEB 2010	-	-
v11	06 APR 2016	E1600105-x0	-
-	-	-	-



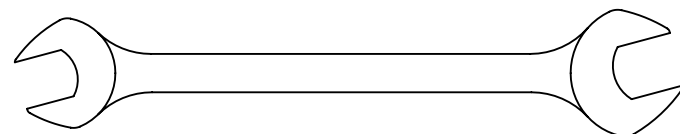
QUAD PEN RE MASS, ETM



QUAD PEN RE MASS, ITM

RECOMMENDED TOOLING

(IMAGE SHOWN MAY NOT REFLECT ACTUAL TOOL)



1/2" OPEN END WRENCH



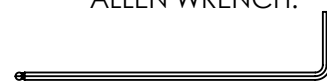
1/4 HELICOIL INSERTION TOOL
&
#8 HELICOIL INSERTION TOOL



3/16" HEX L ALLEN WRENCH



9/64" HEX L ALLEN WRENCH.



5/64" HEX L ALLEN WRENCH

ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	ETM Mass/REQ	ITM Mass/QTY.
16	D080166-ETM	OSEM CAN ETM VERSION	N/A	4	-
15	C-810-A UC COMPONENTS OR EQ.	SCREW, SHC, 8-32 X .63 LG., Ag PLATED (VENTED)	18-8 SSSL	4	4
14	MS16995-841	WASHER, FLAT #8	300 SSSL	4	4
13	1185-2EN246 EMHART OR EQ.	8-32 X .246 LG.	Material <not specified>	8	8
12	C-2016-NA UC COMPONENTS OR EQ.	SCREW, SHC, 1/4-20 X 1" Lg., Ag PLATED	Ag-PLATED 300 SSSL	20	20
11	D1101305	ALIGO, SUS, UHV CONNECTOR CLAMP ASSY.	N/A	1	1
10	D080240	PEN RE MASS BUMP STOP ASSEMBLY	N/A	4	4
9	D080166-ITM	OSEM CAN ITM VERSION	N/A	-	4
8	D070222	PEN RE MASS CABLE CLAMP	N/A	1	1
7	D060359-100	MASS, aLIGO SUS	316 SSSL	6	6
6	D060359-050_0	aLIGO, SUS, QUAD N-PTYPE, ADDITIONAL MASS, 50 G	304 SSSL	2	2
5	D060352	PITCH MASS	N/A	1	1
4	D060344	aLIGO, SUS, PENRE ETM QUAD, BACK PLATE	304, 316 OR 302 SSSL	1	1
3	D060343	aLIGO, SUS, PENRE ETM QUAD, FRONT PLATE	304, 316 OR 302 SSSL	1	1
2	D060342	aLIGO, SUS, PENRE ETM QUAD, CENTRAL MASS	304, 316 OR 302 SSSL	1	1
1	D060337	PENULTIMATE MASS WIRE CLAMP	N/A	2	2

PARTS LIST

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES

MATERIAL N/A FINISH N/A μinch

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SYSTEM: **ADVANCED LIGO** SUB-SYSTEM: **SUS**

NEXT ASSY: **D0901346**

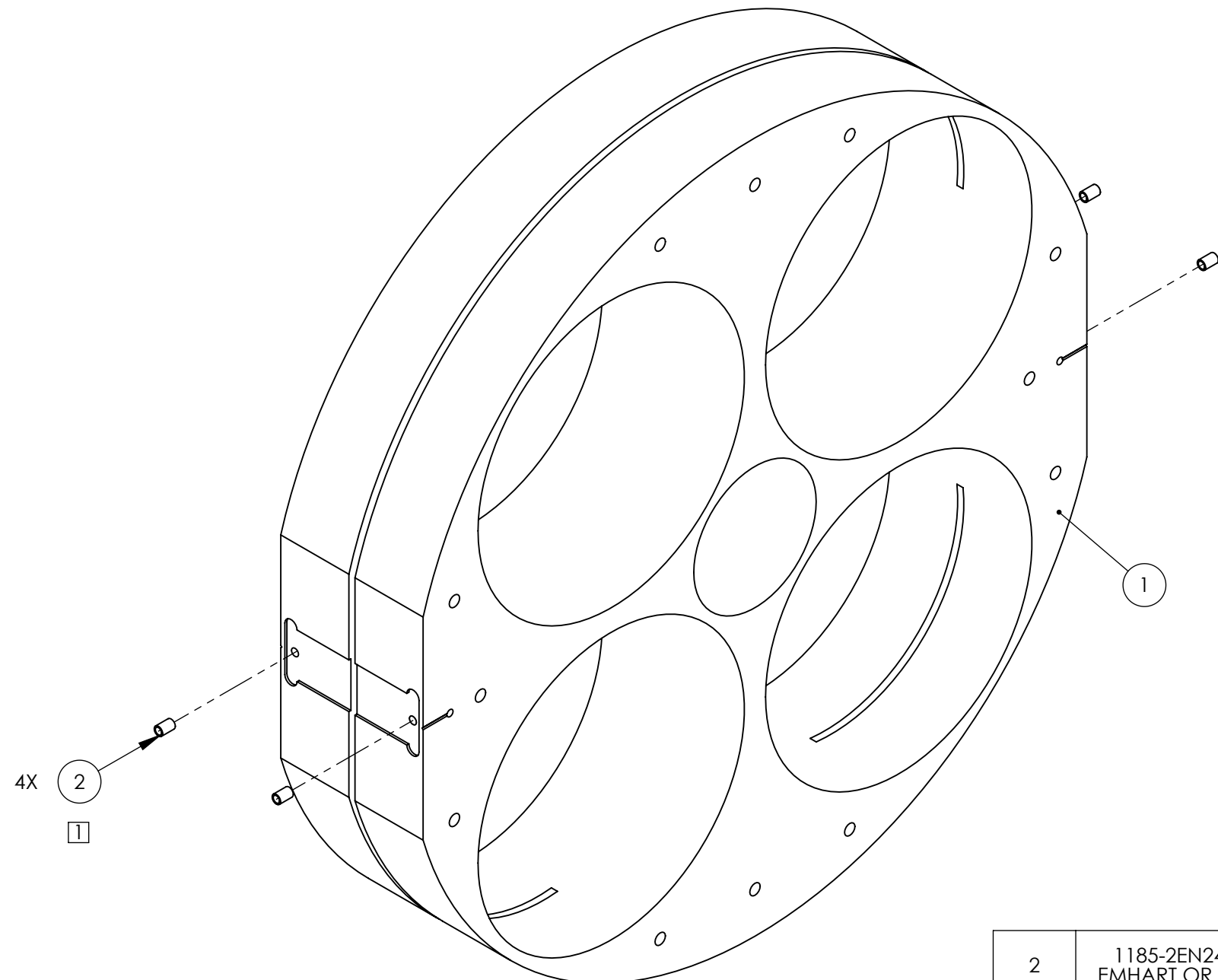
PART NAME: **aLIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM/ITM CONFIG.**

DESIGNER	C.MAK	10 AUG 2009	SIZE	DWG. NO.	REV.
DRAFTER	J O'DELL	12 FEB 2010	B	D060341	v11
CHECKER	JOD	16 FEB 2010	SCALE:	1:2	PROJECTION:
APPROVAL	JOD	16 FEB 2010	SHEET 1 OF 15		

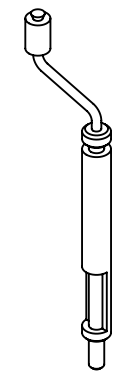
D060341 aLIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-077, DRAWING PDM REV: X-007

D060341 αLIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-077, DRAWING PDM REV: X-007

ASSY. STEP 1: ADD THREADED INSERTS TO D060342



ISO VIEW, REAR LEFT



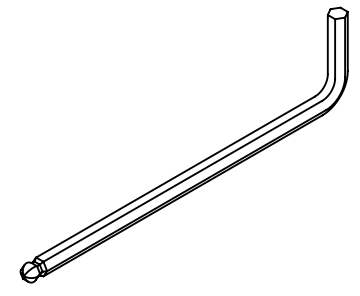
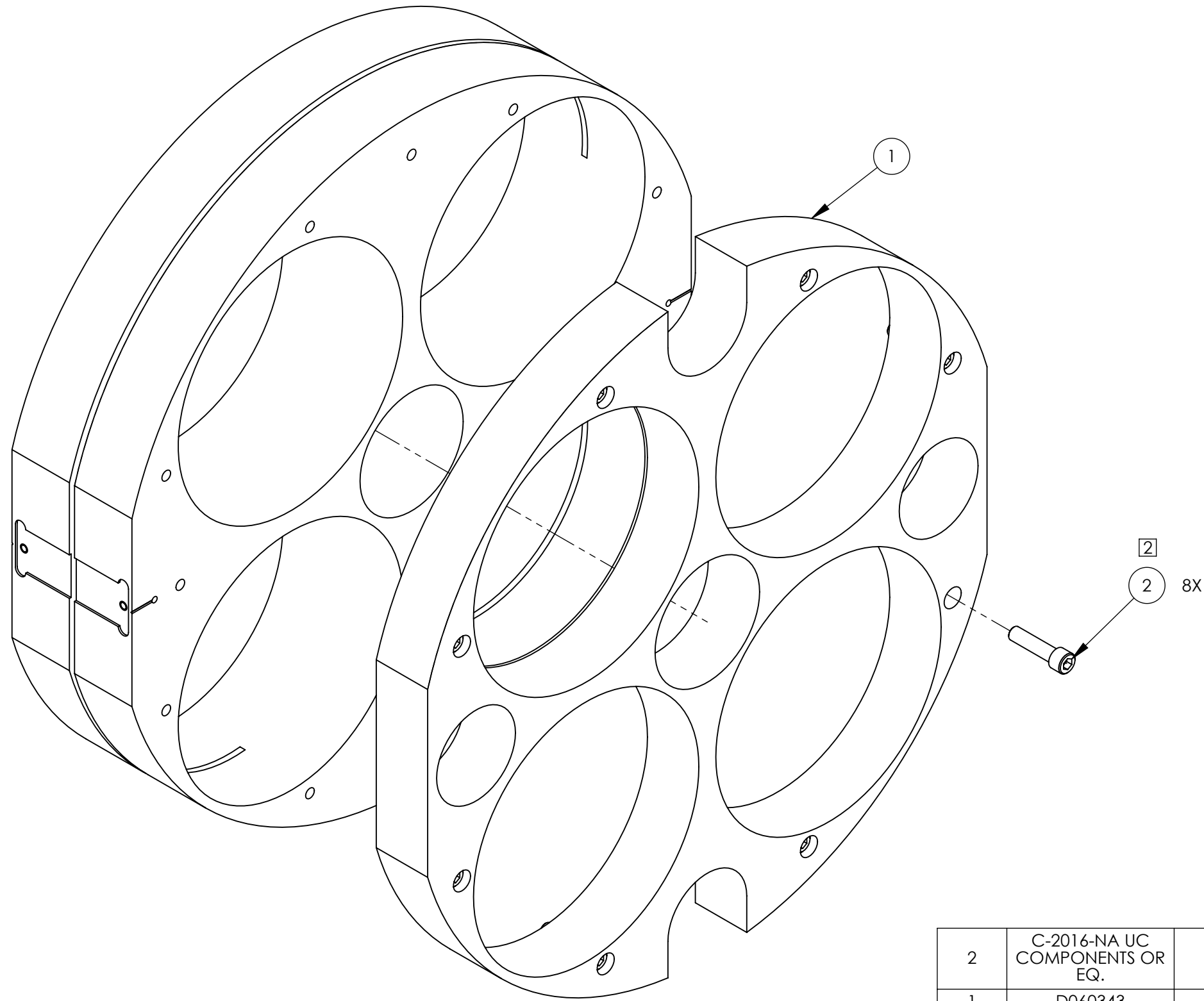
USE NO. 8 HELICOIL INSERTION TOOL

2	1185-2EN246 EMHART OR EQ.	8-32 X .246 LG.	Material <not specified>	4
1	D060342	αLIGO, SUS, PENRE ETM QUAD, CENTRAL MASS	304, 316 OR 302 SSTL	1
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
PARTS LIST				

CALIFORNIA INSTITUTE OF TECHNOLOGY
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SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: 1:2 PROJECTION: SHEET 2 OF 15

ASSY. STEP 2: ADD FRONT PLATE, AND BOLT IN PLACE



2 USE STANDARD 3/16 HEX L ALLEN WRENCH. TORQUE TO 10 FT /LB

2.1 USE STANDARD 3/16 HEX L ALLEN WRENCH. LEAVE LOOSE

2
2 8X

ISO VIEW, FRONT LEFT

ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
2	C-2016-NA UC COMPONENTS OR EQ.	SCREW, SHC, 1/4-20 X 1" Lg., Ag PLATED	Ag-PLATED 300 SSSL	8
1	D060343	αLIGO, SUS, PENRE ETM QUAD, FRONT PLATE	304, 316 OR 302 SSSL	1

PARTS LIST

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SIZE DWG. NO. **B** **D060341** REV. **v11**

SCALE: 1:2 PROJECTION: SHEET 3 OF 15

D060341 αLIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-002, DRAWING PDM REV: X-007

ASSY. STEP 3: HELICOIL BACK PLATE, AND BOLT IN PLACE

D060341 QUGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-002, DRAWING PDM REV: X-007

D

C

B

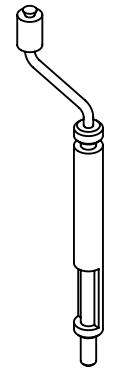
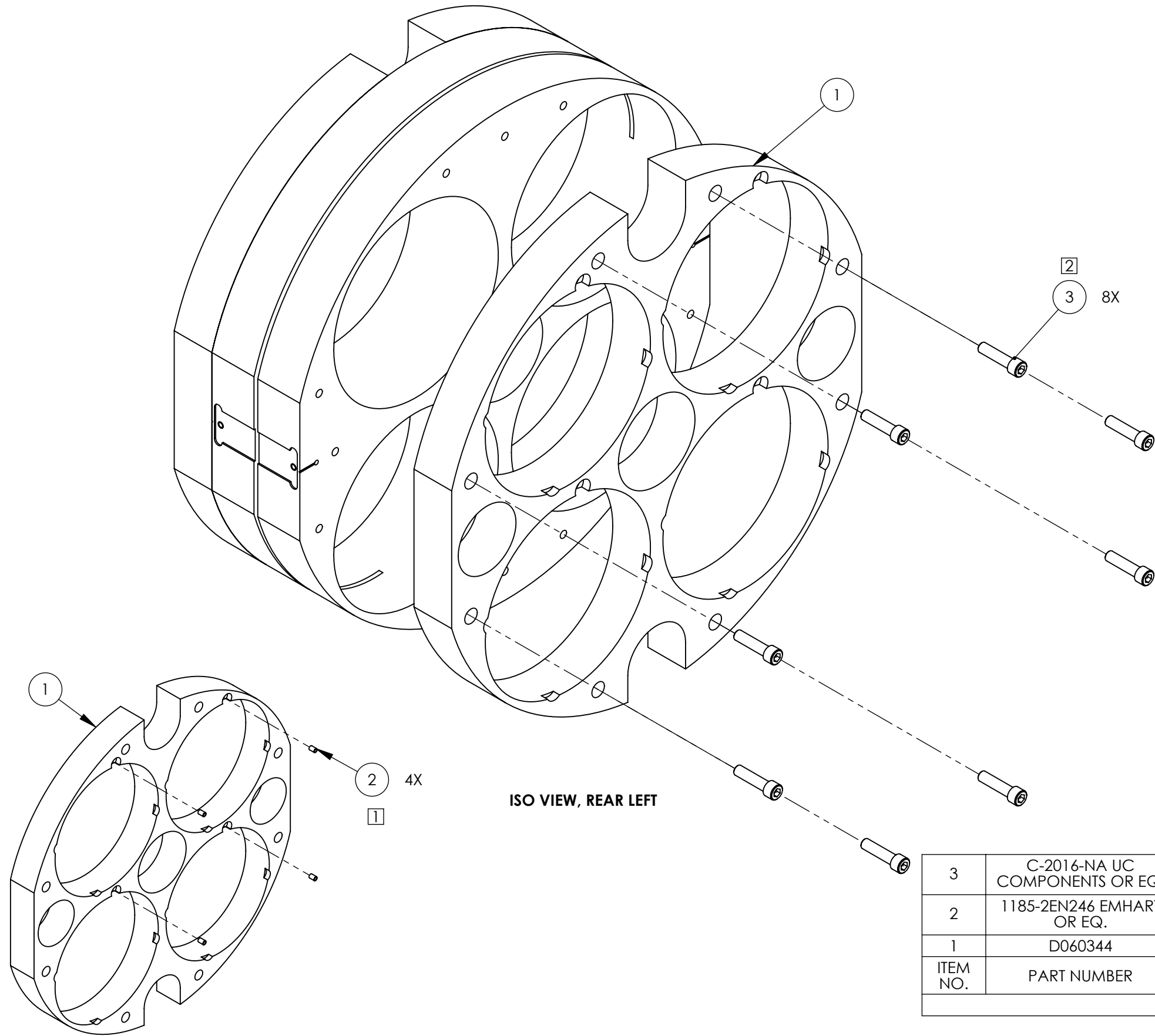
A

D

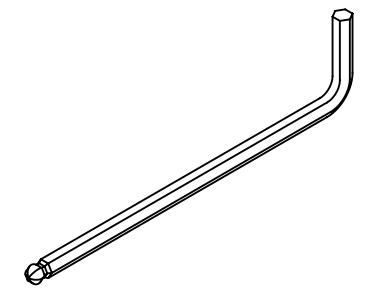
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B

A

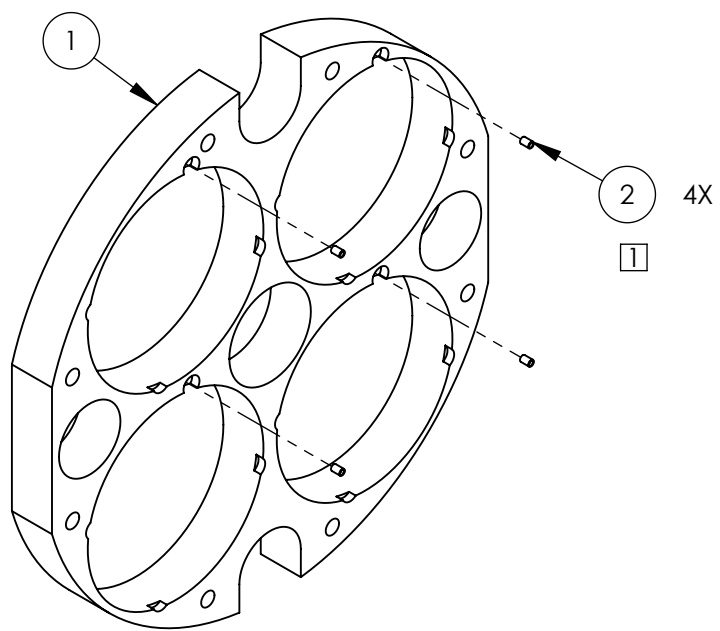


1 USE NO. 8 HELICOIL INSERTION TOOL



2 USE STANDARD 3/16 HEX L ALLEN WRENCH. TORQUE TO 10 FT /LB.

3	C-2016-NA UC COMPONENTS OR EQ.	SCREW, SHC, 1/4-20 X 1" Lg., Ag PLATED	Ag-PLATED 300 SSSL	8
2	1185-2EN246 EMHART OR EQ.	8-32 X .246 LG.	Material <not specified>	8
1	D060344	αLIGO, SUS, PENRE ETM QUAD, BACK PLATE	304, 316 OR 302 SSSL	1
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
PARTS LIST				



ISO VIEW, REAR LEFT

ISO VIEW, REAR LEFT

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SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: NTS PROJECTION: SHEET 4 OF 15

8 7 6 5 4 3 2 1

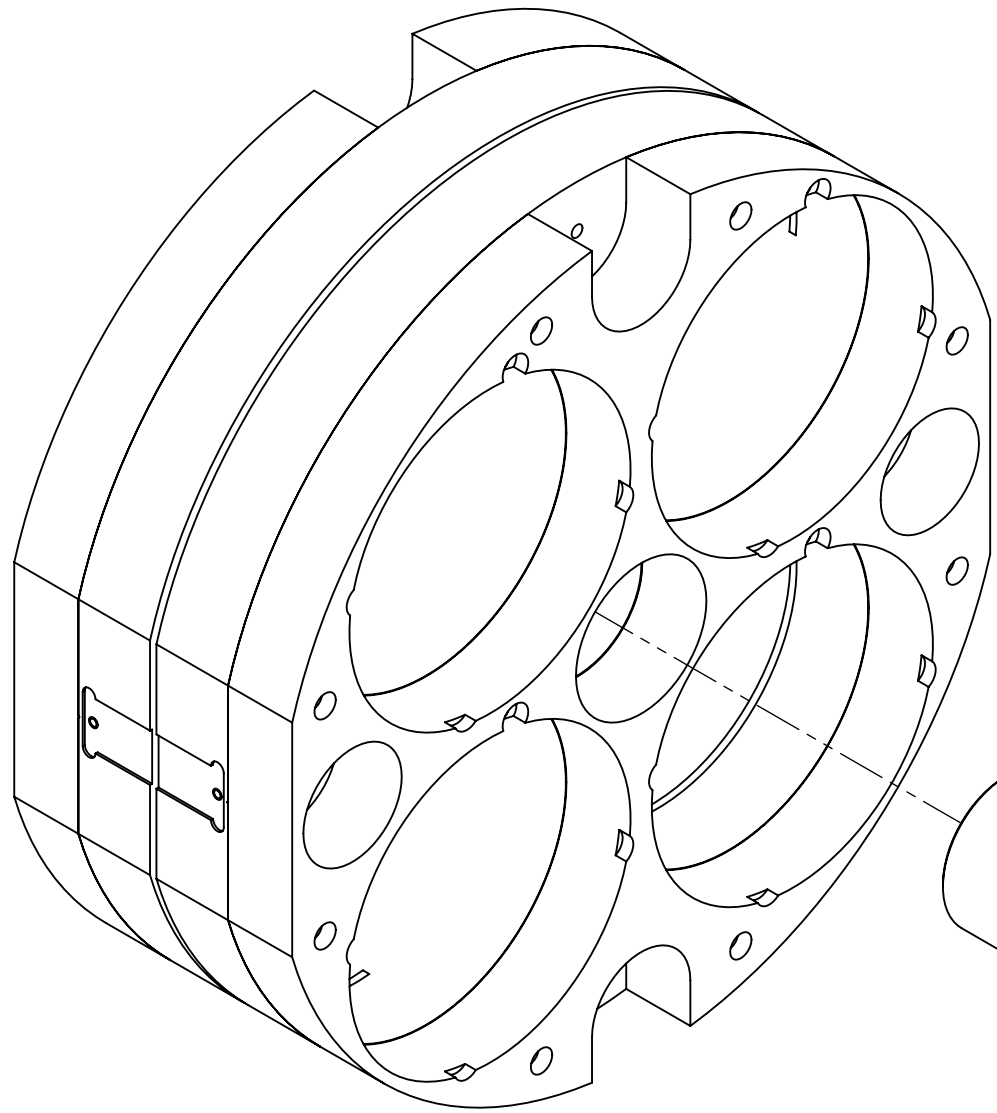
ASSY. STEP 4: ASSEMBLE AND INSTALL PITCH MASS

D

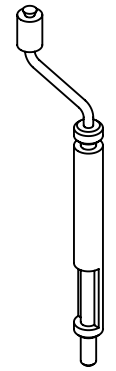
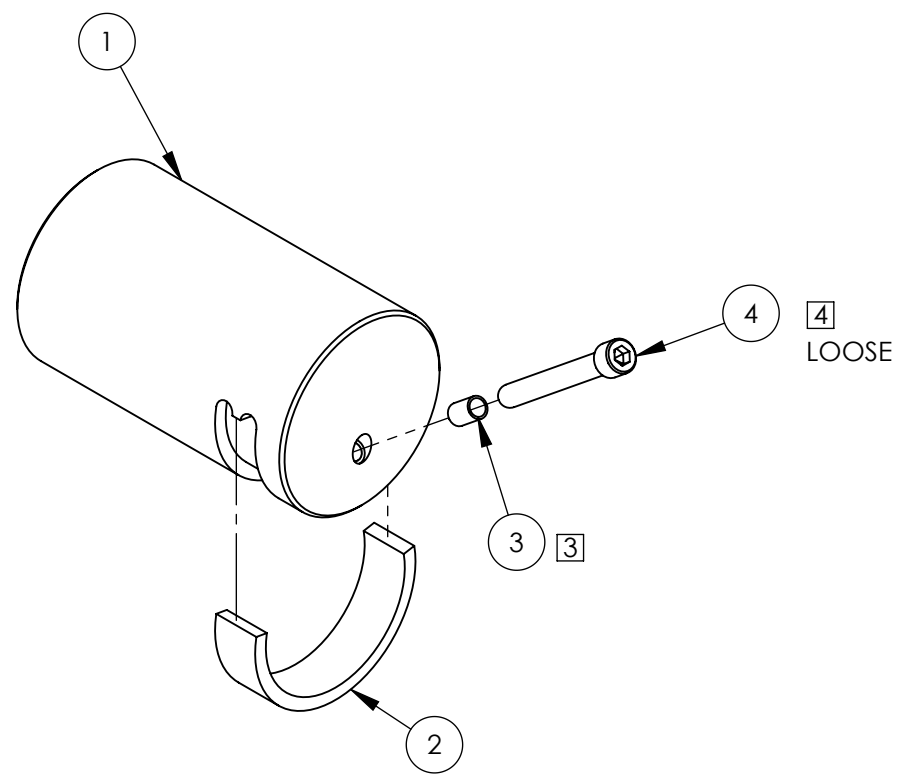
C

B

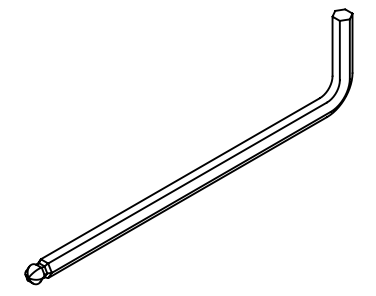
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ISO VIEW, REAR LEFT





3 USE 1/4 HELICOIL INSERTION TOOL



4 USE STANDARD 3/16 HEX L ALLEN WRENCH. NIP TIGHT AFTER INSTALLATION

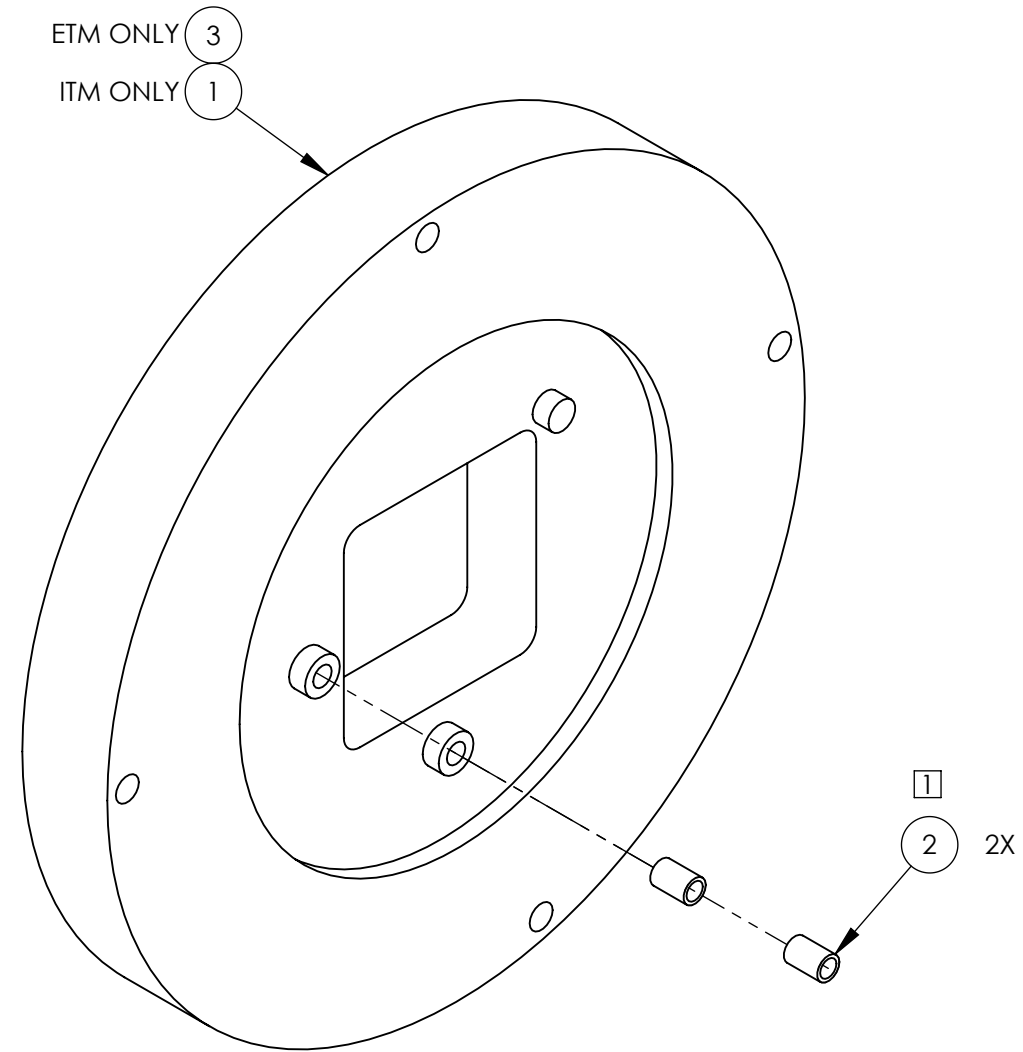
4		SCREW, SHC, 1/4-20 X 2.00 , ROUNDED END	300 SSSL	1
3	1185-4EN375 EMHART OR EQ.	HELICOIL 1/4-20 X 1.5 DIA NITRONIC 60	NITRONIC 60	1
2	D060354	CLAMPING COLLAR (PITCH MASS)	PH BRONZE	1
1	D060353	PEN RE PITCH MASS	304, 316 OR 302 SSSL	1
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
PARTS LIST				

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 SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: NTS PROJECTION:  SHEET 5 OF 15

D060341 QIG0 SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-002, DRAWING PDM REV: X-007

8 7 6 5 4 3 2 1

ASSY. STEP 5: HELICOIL CAN FRONT PLATE (4 OFF)



USE NO. 8 HELICOIL INSERTION TOOL

ISO VIEW

3	D1600142	αLIGO, SUS, PENRE ETM QUAD, CAN FRONT PLATE	304 SSTL	1
2	1185-2EN246 EMHART OR EQ.	8-32 X .246 LG.	NITRONIC 60	2
1	D080167	CAN FRONT PLATE PEN RE MASS CAN	304, 316 OR 302 SSTL	1
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
PARTS LIST				

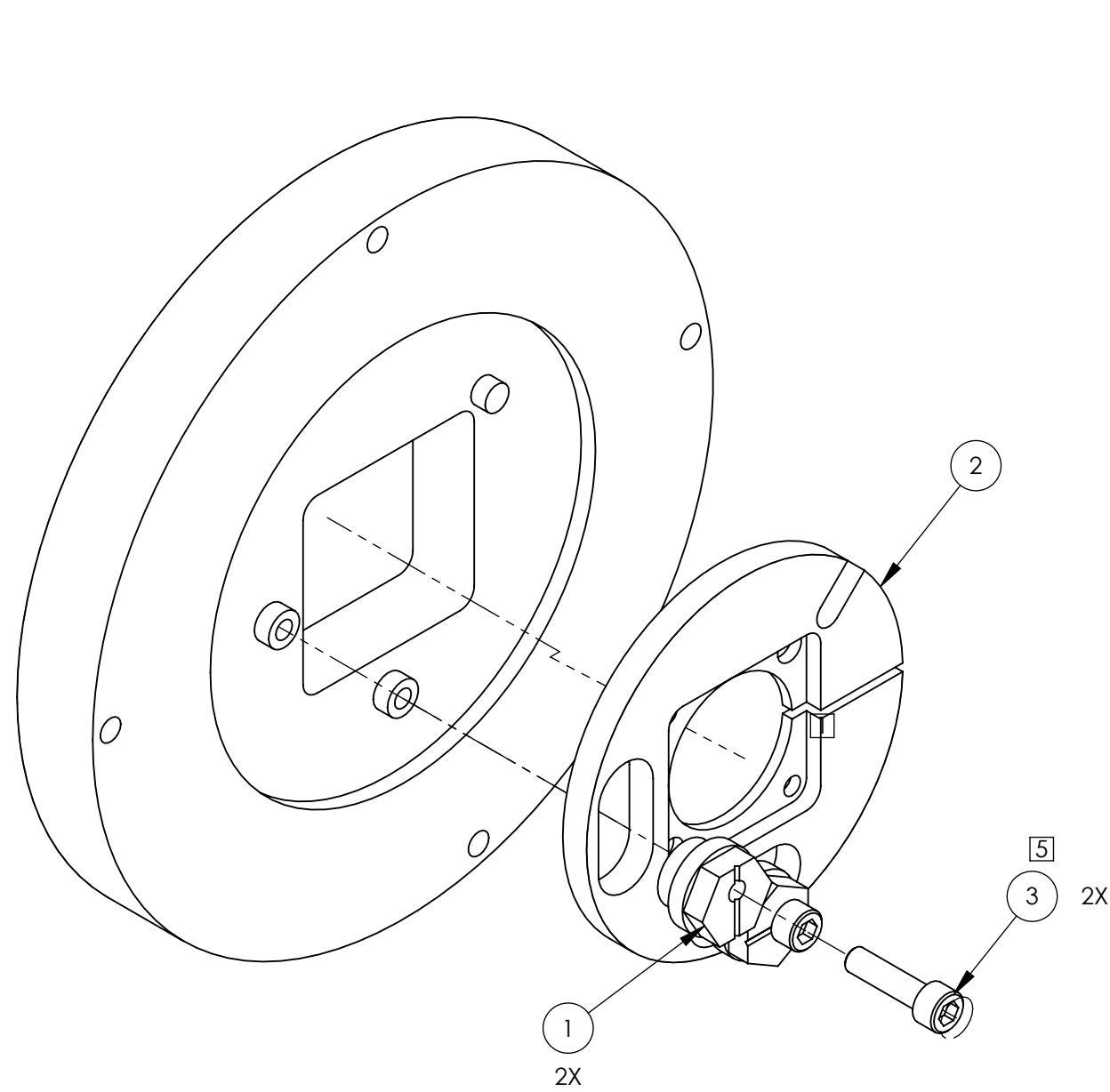
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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SIZE DWG. NO. **D060341** REV. **v11**
B

SCALE: 1:1 PROJECTION: SHEET 6 OF 15

D060341 αLIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-002, DRAWING PDM REV: X-007

ASSY. STEP 6: ASSEMBLE X-Y STAGE TO OSEM CAN FRONT PLATE (4 OFF)



5 USE STANDARD 9/64 HEX L ALLEN WRENCH. FINGER TIGHT

ISO VIEW

3	92185A196 McMASTER-CARR OR EQ.	SHCS 8-32 X 5/8" LG	316 SSTL	2
2	D060348	OSEM TRANSLATION PLATE PEN RE MASS CAN	6061-T6 Al	1
1	D060336	ALIGO, SUS, Penre MASS Quad N-Ptype, 2MM CAM, OSEM ADJUSTER	PHOSPHOR BRONZE P<or=0.35%, PB<or= 1%, Zn<or= 1%	2
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
PARTS LIST				

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
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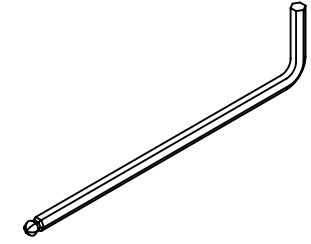
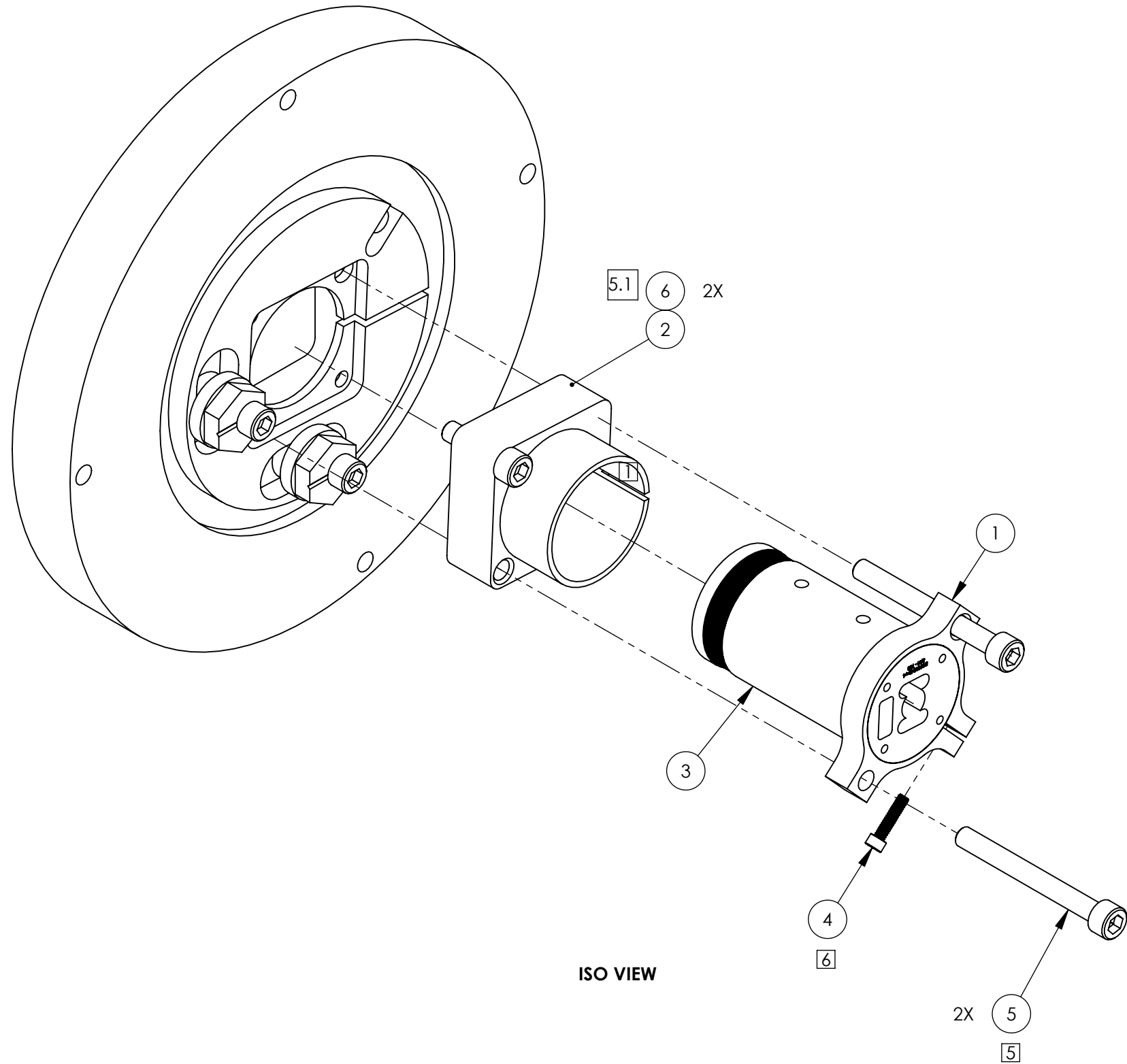
SIZE DWG. NO. **D060341** REV. **v11**

SCALE: 1:1 PROJECTION: SHEET 7 OF 15

D060341 ALIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-074, DRAWING PDM REV: X-007

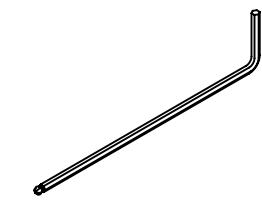
ASSY. STEP 7: ASSEMBLE AND OSEM Z ADJUSTER TO OSEM CAN ASSEMBLY (4 OFF)

D060341 QJAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-074, DRAWING PDM REV: X-007



5 USE STANDARD 9/64 HEX L ALLEN WRENCH. FINGER TIGHT

5.1 USE STANDARD 9/64 HEX L ALLEN WRENCH. TORQUE TO 5 FT/LB



6 USE STANDARD 5/64 HEX L ALLEN WRENCH. TORQUE TO 2 FT/LB

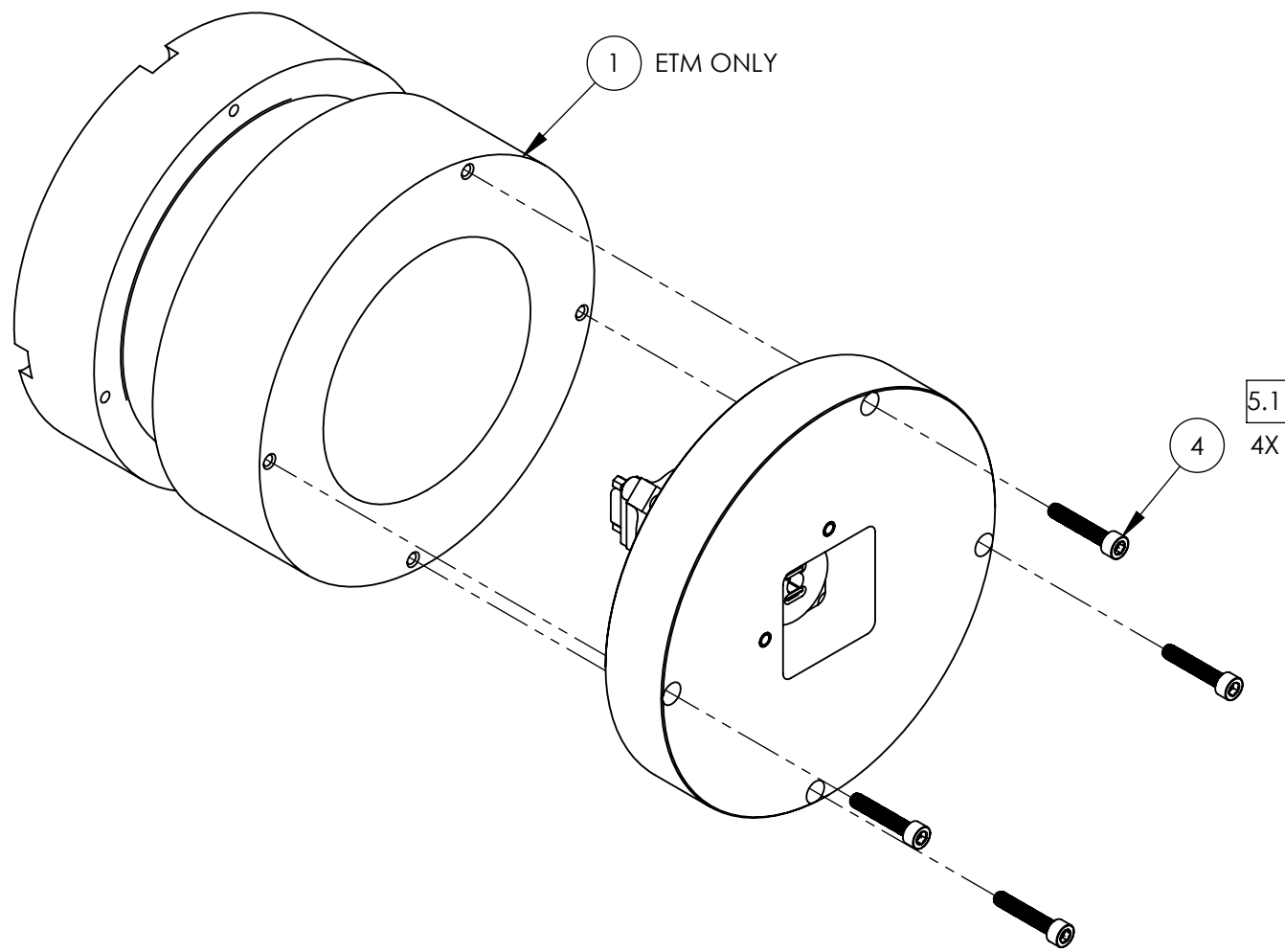
6	92185A196 McMASTER-CARR OR EQ.	SHCS 8-32 X 5/8" LG	2
5	C-824-N UC COMPONENTS OR EQ.	SCREW, 8-32 X 1.5 LG.	2
4	D1201461	CONTROL RING, SCREW, SHC, 2-56 X .38 LG.	1
3	D0901065	OSEM ASSY.	1
2	D060351	BASE PLATE, OSEM MT.	1
1	D060350	CONTROL RING, OSEM MT.	1
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
PARTS LIST			

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
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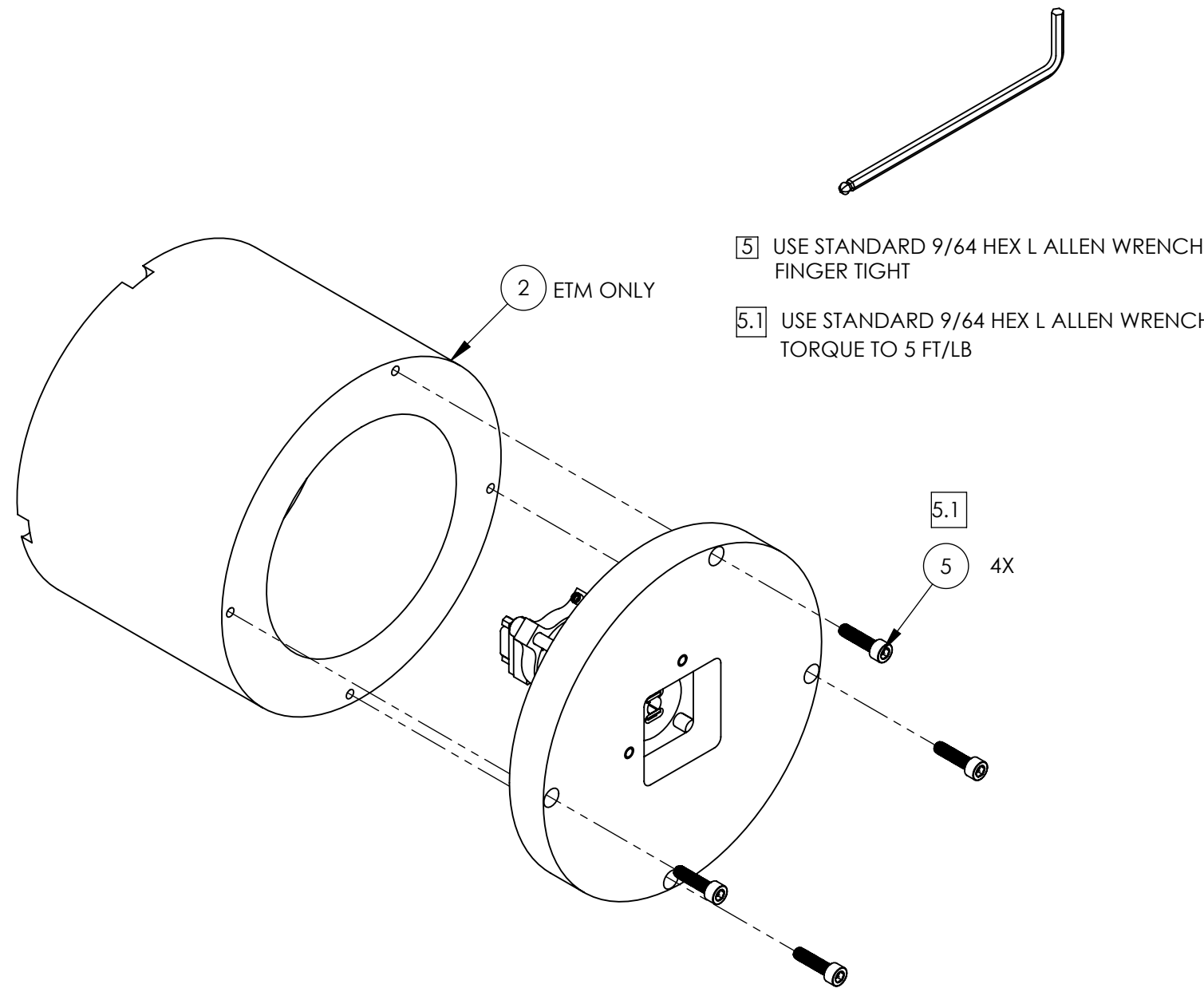
SIZE DWG. NO. **D060341** REV. **v11**
B

SCALE: 1:1 PROJECTION: SHEET 8 OF 15

ASSY. STEP 8: ASSEMBLE CAN BODY TO CAN (4 OFF)



ISO VIEW (ETM CONFIG.)



5 USE STANDARD 9/64 HEX L ALLEN WRENCH. FINGER TIGHT

5.1 USE STANDARD 9/64 HEX L ALLEN WRENCH. TORQUE TO 5 FT/LB

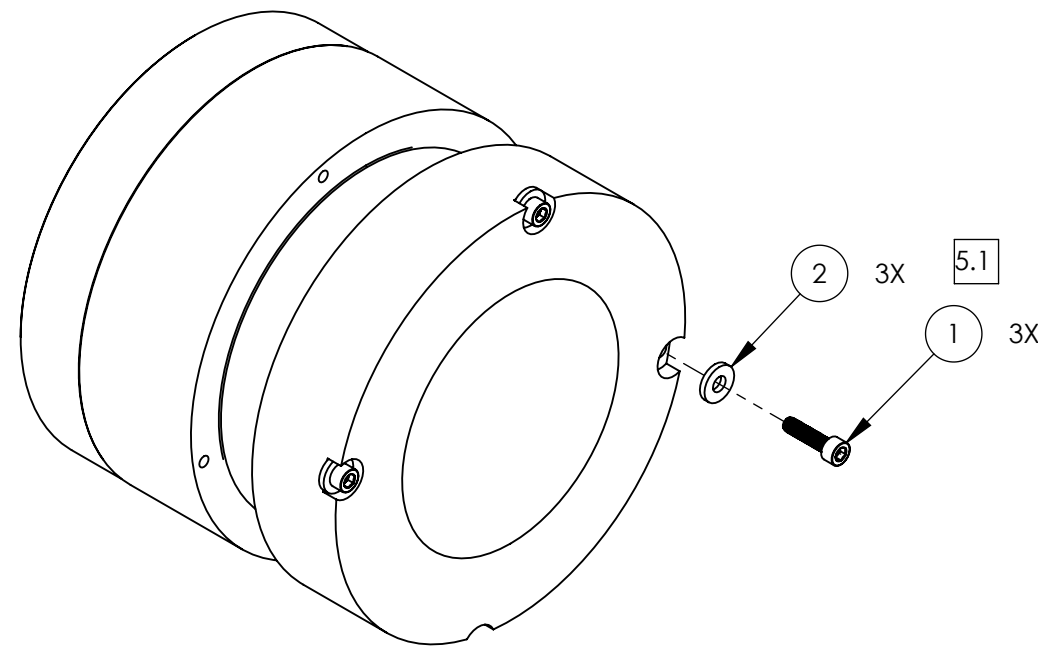
ISO VIEW (ITM CONFIG.)

4	C-814-A UC COMPONENTS OR EQ.	SCREW, SHC, 8-32 X .88 LG., Ag PLATED (VENTED)	18-8 SSSL	-	4
3	C-810-A UC COMPONENTS OR EQ.	SCREW, SHC, 8-32 X .63 LG., Ag PLATED (VENTED)	18-8 SSSL	4	-
2	D1002200	HEAVY ITM CAN BODY, PEN RE ITM MASS CAN	304 SSSL	1	-
1	D1500428	αLIGO, SUS, PENRE ETM QUAD, HEAVY OSEM CAN BODY	304 SSSL	-	1
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	ITM QTY.	ETM QTY.
PARTS LIST					

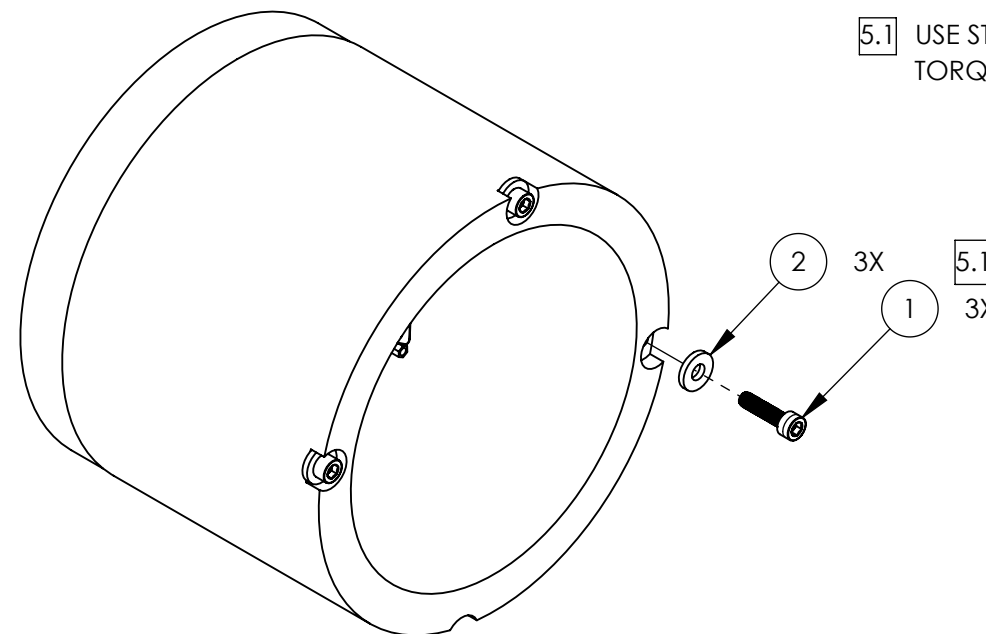
 CALIFORNIA INSTITUTE OF TECHNOLOGY
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY
 SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: 1:1 PROJECTION:  SHEET 9 OF 15

D060341 αLIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-074, DRAWING PDM REV: X-007

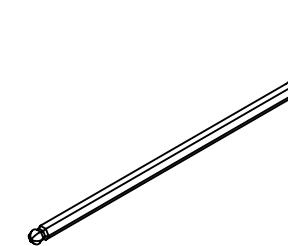
ASSY. STEP 9: ADD STOP SCREWS AND WASHERS TO BACK OF OSEM CANS (4 OFFS)



ISO VIEW (ETM CONFIG.)



ISO VIEW (ITM CONFIG.)



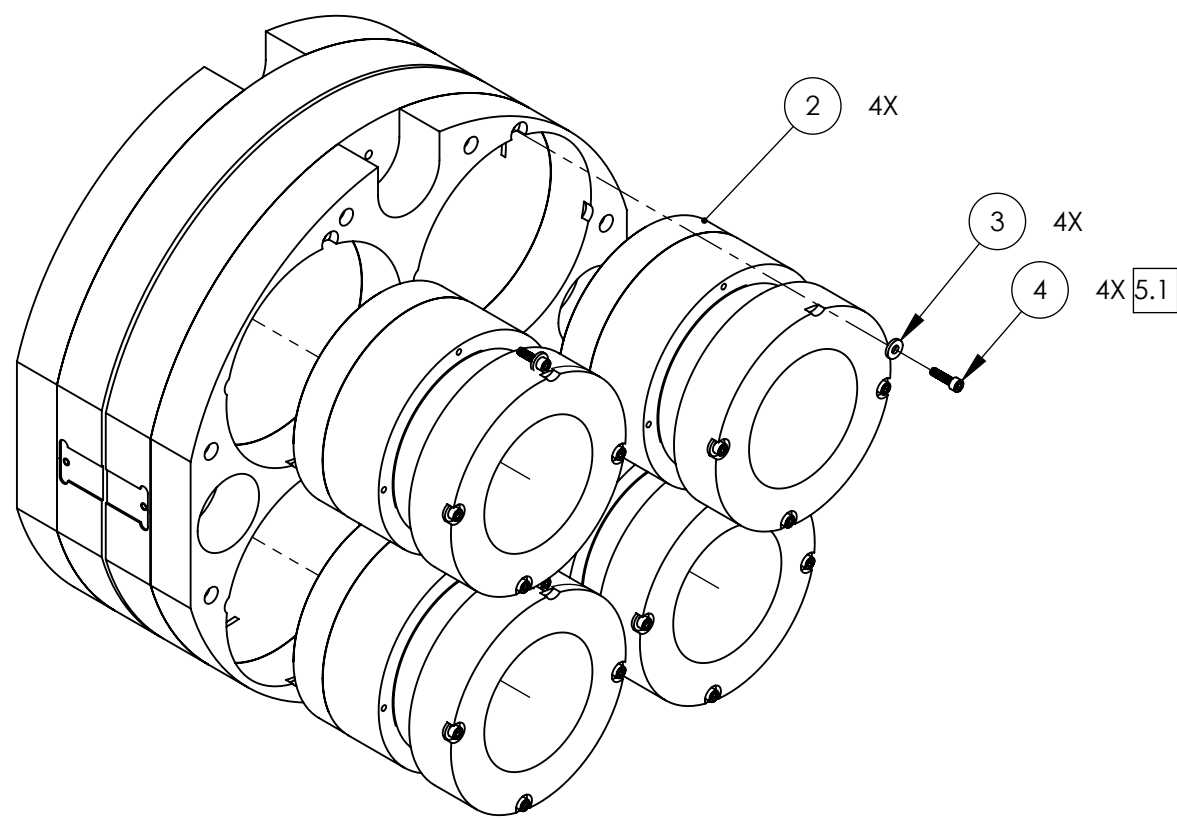
- 5 USE STANDARD 9/64 HEX L ALLEN WRENCH. FINGER TIGHT
- 5.1 USE STANDARD 9/64 HEX L ALLEN WRENCH. TORQUE TO 5 FT/LB

2	MS16995-841	WASHER, FLAT #8	300 SSSL	3	3
1	C-810-A UC COMPONENTS OR EQ.	SCREW, SHC, 8-32 X .63 LG., Ag PLATED (VENTED)	18-8 SSSL	7	3
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	ITM QTY.	ETM QTY.
PARTS LIST					

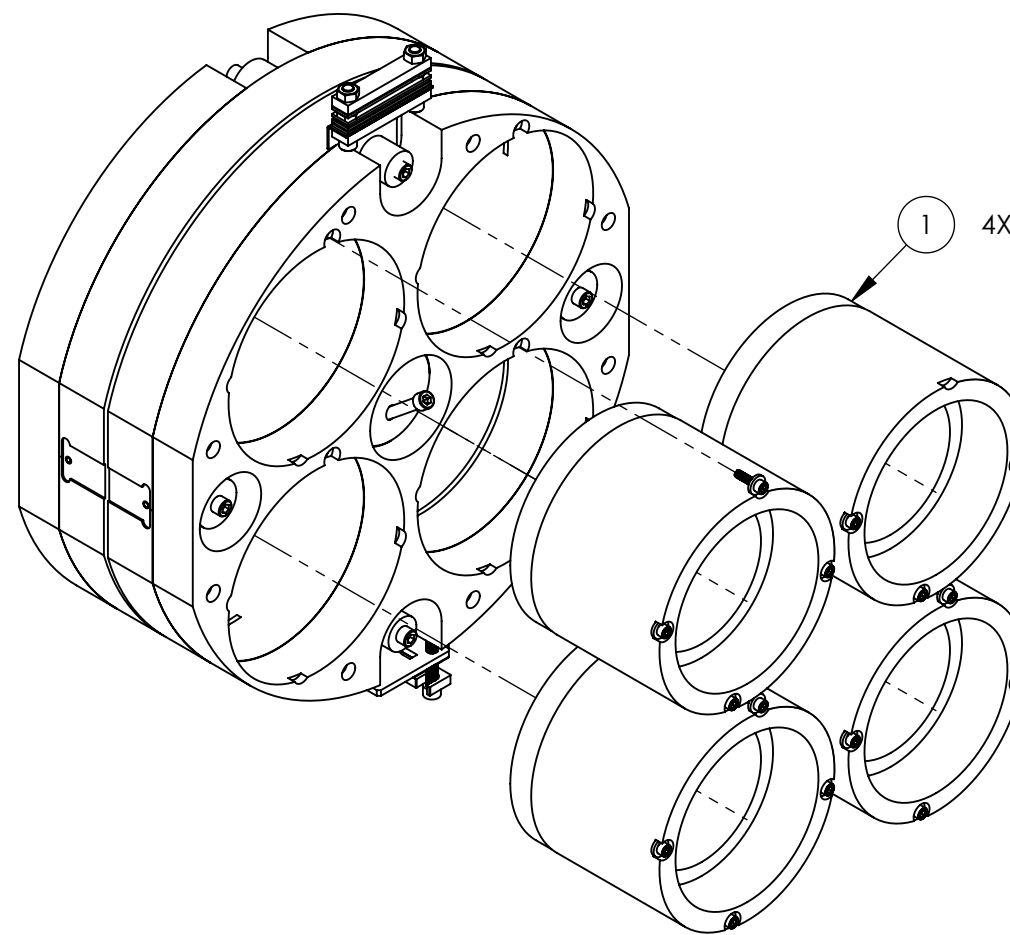
 CALIFORNIA INSTITUTE OF TECHNOLOGY
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY
 SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: 1:1 PROJECTION:  SHEET 10 OF 15

D060341 QIUGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-074, DRAWING PDM REV: X-007

ASSY. STEP 10: ASSEMBLE 4 OSEM CANS TO MASS AND BOLT IN PLACE



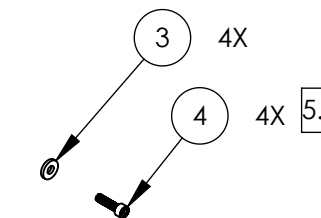
ISO VIEW (ETM CONFIG.), REAR LEFT



ISO VIEW (ITM CONFIG.), REAR LEFT

5 USE STANDARD 9/64 HEX L ALLEN WRENCH. FINGER TIGHT

5.1 USE STANDARD 9/64 HEX L ALLEN WRENCH. TORQUE TO 5 FT/LB

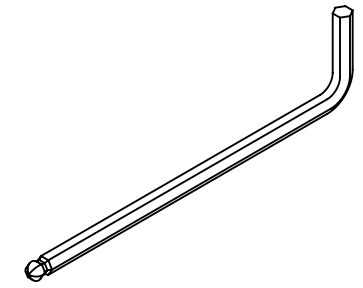
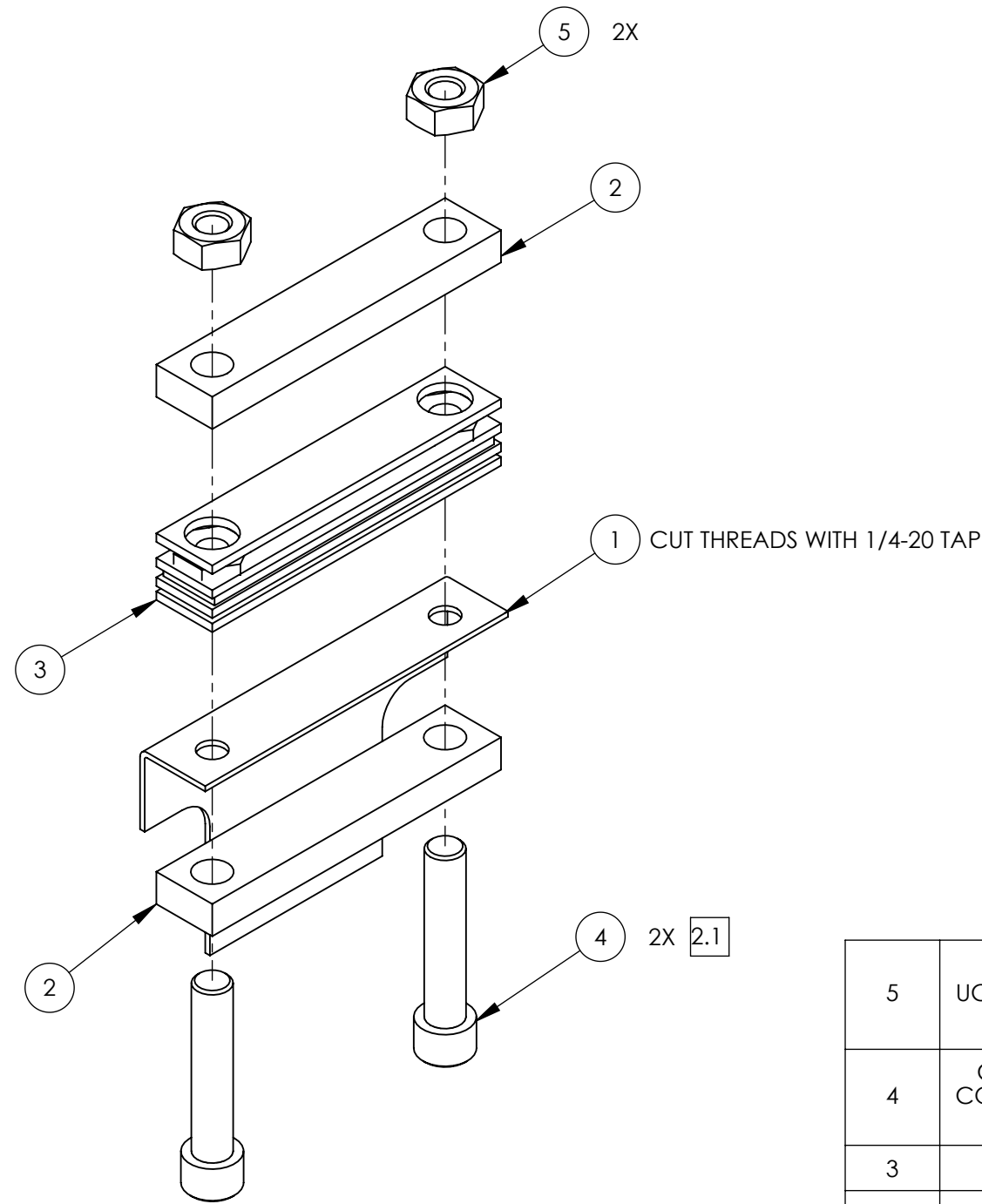


ITEM NO.	PART NUMBER	DESCRIPTION	ETM QTY.	ITM /QTY.
4	C-810-A UC COMPONENTS OR EQ.	SCREW, SHC, 8-32 X .63 LG., Ag PLATED (VENTED)	4	4
3	MS16995-841	WASHER, FLAT #8	4	4
2	D080166-ETM	OSEM CAN ETM VERSION	4	-
1	D080166-ITM	OSEM CAN ITM VERSION	-	4
PARTS LIST				

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 SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: 1:2 PROJECTION:  SHEET 11 OF 15

D060341 QUGAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-077, DRAWING PDM REV: X-007

ASSY. STEP 11: ASSEMBLE UPPER CABLE CLAMP



- 2 USE STANDARD 3/16 HEX L ALLEN WRENCH. TORQUE TO 10 FT /LB
- 2.1 USE STANDARD 3/16 HEX L ALLEN WRENCH. LEAVE LOOSE

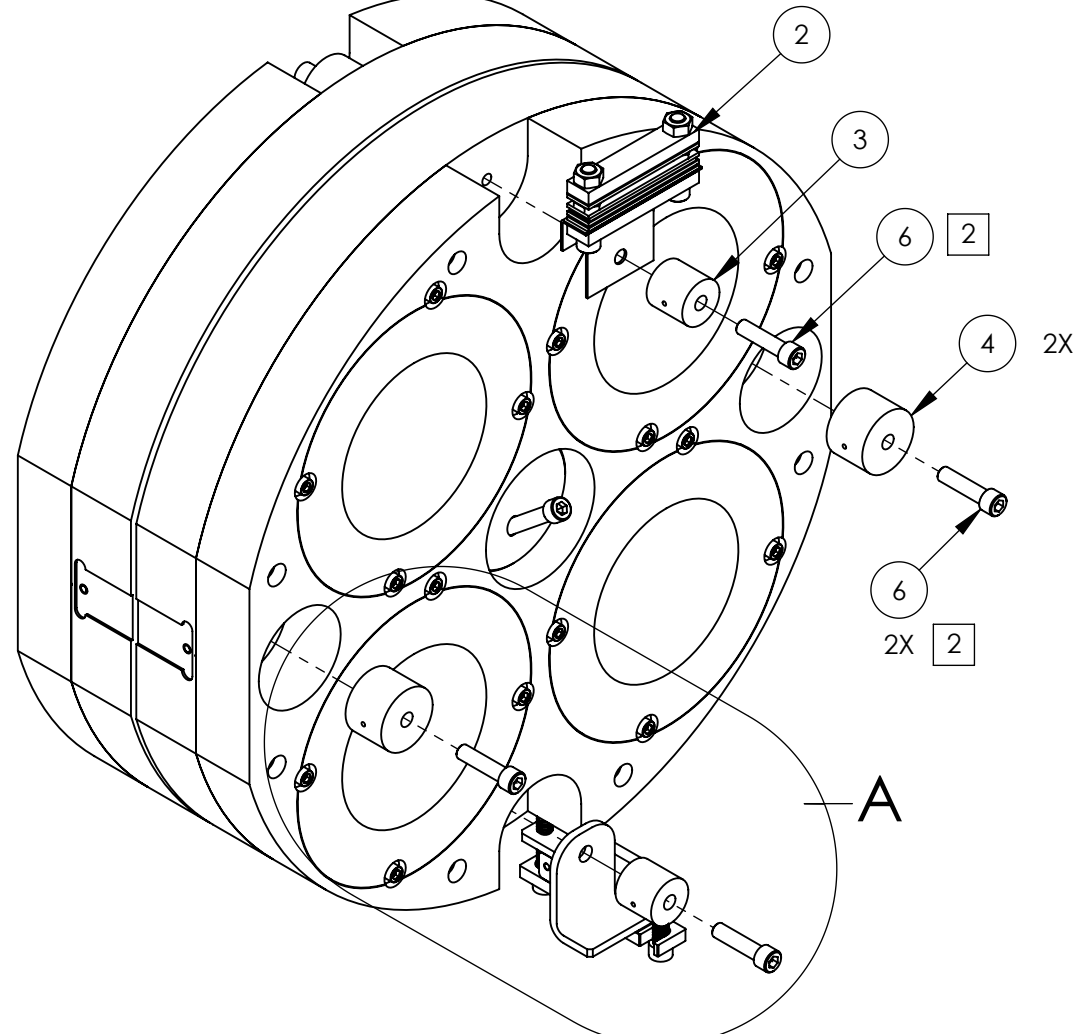
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
5	N-2520-A UC COMPONENTS OR EQ.	HEX NUT, 1/4-20 UNC, Ag PLATED	304, 316 OR 302 SSTL	2
4	C-2020-NA UC COMPONENTS OR EQ.	SCREW, SHC, 1/4-20 X 1.25 Lg., Ag PLATED	Ag-PLATED 300 SSTL	2
3	D1001512	QUAD CABLE CLAMP, FLOUREL PAD ASSY	--	1
2	D070226	WIRING HARNESS, CABLE CLAMP JAW	6061-T6 Al	2
1	D070223	PEN RE MASS WIRE CLAMP	6061-T6 Al	1
PARTS LIST				

 CALIFORNIA INSTITUTE OF TECHNOLOGY
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY

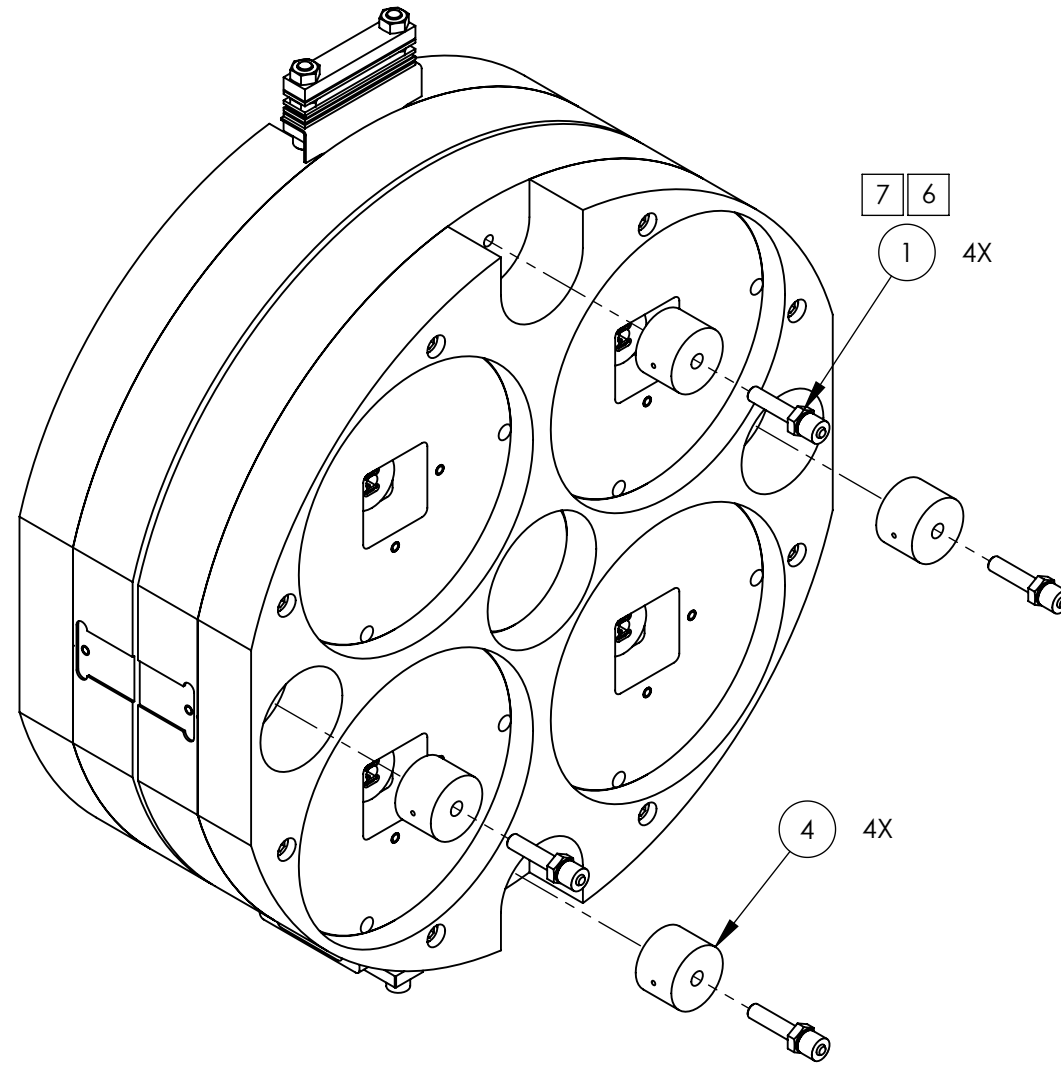
SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: 1:1 PROJECTION:  SHEET 12 OF 15

D060341 QIUGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-040, DRAWING PDM REV: X-007

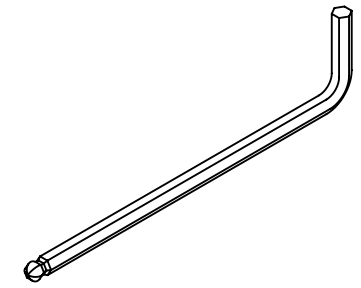
ASSY. STEP 12: ADD CABLE CLAMPS + ADDABLE / REMOVABLE MASS



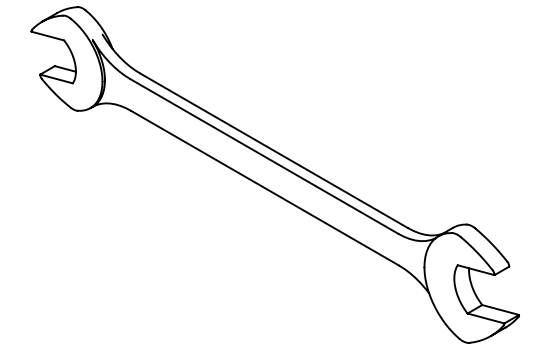
ISO VIEW, REAR LEFT



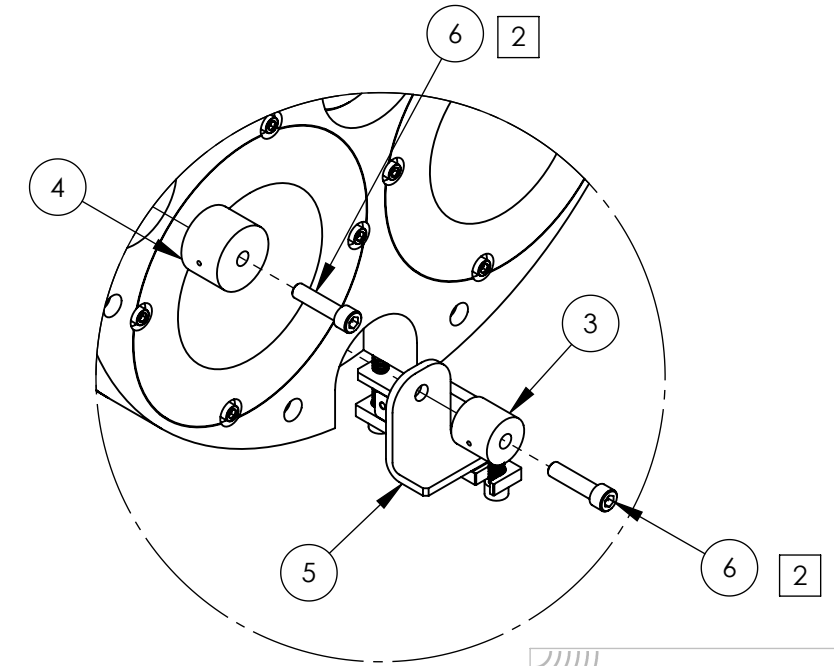
ISO VIEW, FRONT LEFT



- 2 USE STANDARD 3/16 HEX L ALLEN WRENCH. TORQUE TO 10 FT /LB
- 2.1 USE STANDARD 3/16 HEX L ALLEN WRENCH. LEAVE LOOSE
- 6 BUILD AND INSTALL INDICATED ITEM BEFORE CHAINS ARE JOINED.



- 7 USE STANDARD 1/2" OPEN END WRENCH TORQUE TO 10 FT /LB



DETAIL 'A'

7	C-810-A UC COMPONENTS OR EQ.	SCREW, SHC, 8-32 X .63 LG., Ag PLATED (VENTED)	18-8 SSTL	4
6	C-2016-NA UC COMPONENTS OR EQ.	SCREW, SHC, 1/4-20 X 1" Lg., Ag PLATED	Ag-PLATED 300 SSTL	4
5	D1101305	ALIGO, SUS, UHV CONNECTOR CLAMP ASSY.	N/A	1
4	D060359-100	MASS, αLIGO SUS	316 SSTL	6
3	D060359-050_0	αLIGO, SUS, QUAD N-PTYPE, ADDITIONAL MASS, 50 G	304 SSTL	2
2	D070222	PEN RE MASS CABLE CLAMP	N/A	1
1	D080240	PEN RE MASS BUMP STOP ASSEMBLY	N/A	4
ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.

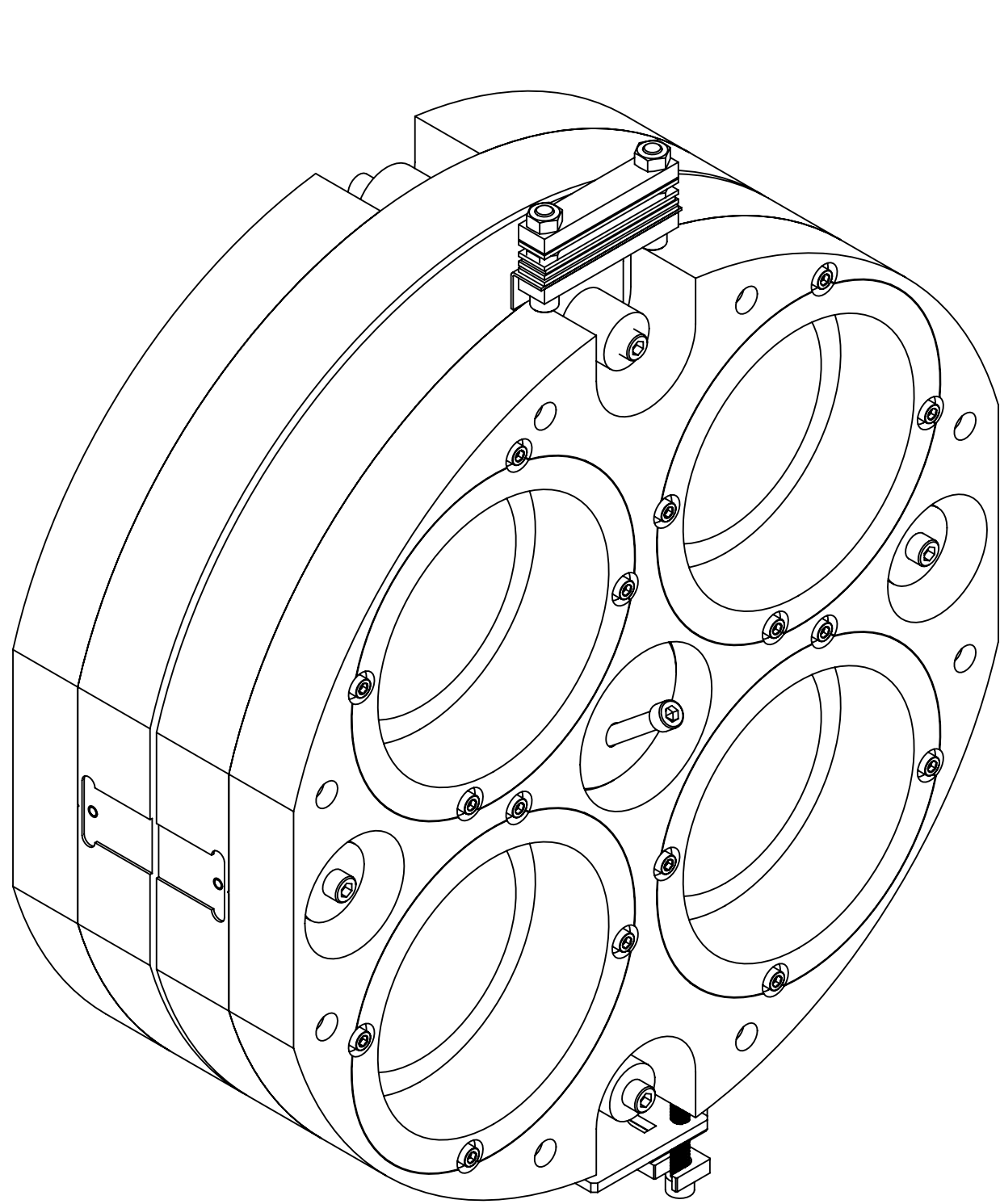
PARTS LIST

CALIFORNIA INSTITUTE OF TECHNOLOGY
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY
 SIZE DWG. NO. **D060341** REV. **v11**
 SCALE: NTS PROJECTION: SHEET 13 OF 15

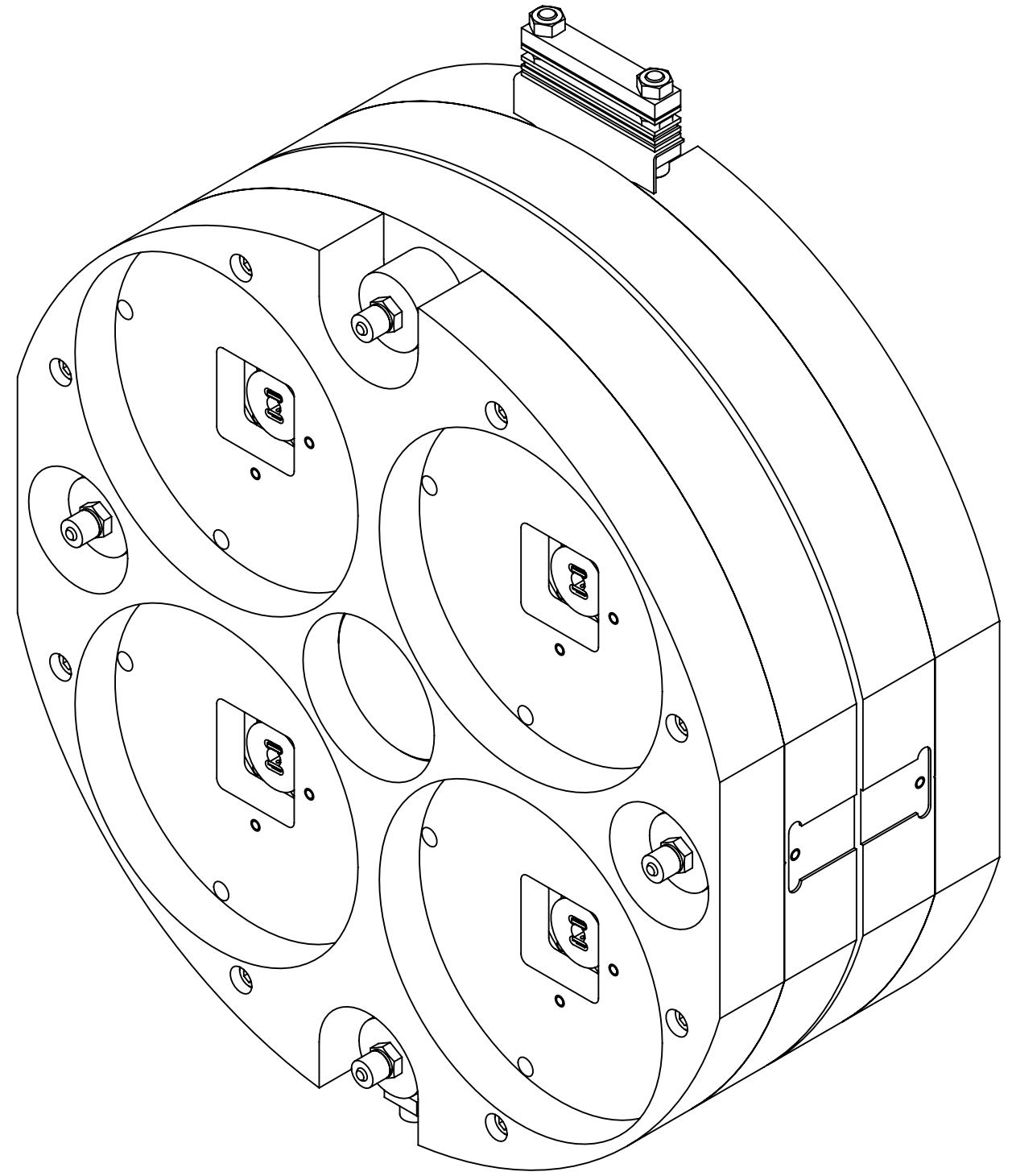
D060341 αLIGO SUS, QUAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-077, DRAWING PDM REV: X-007

ITM

D060341 QJAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-077, DRAWING PDM REV: X-007





ISO VIEW, REAR LEFT



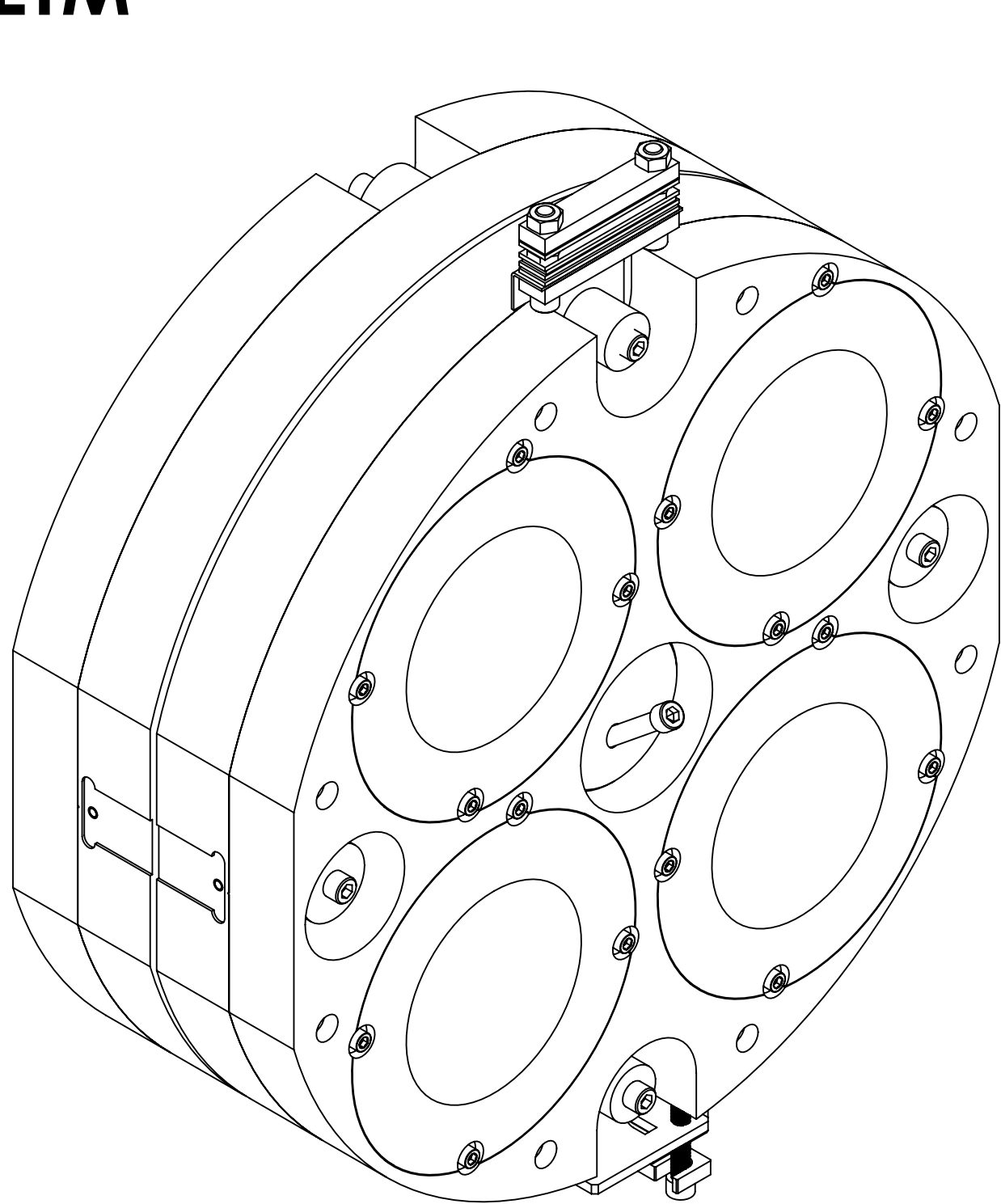
ISO VIEW, FRONT RIGHT

FINISHED PEN RE MASS

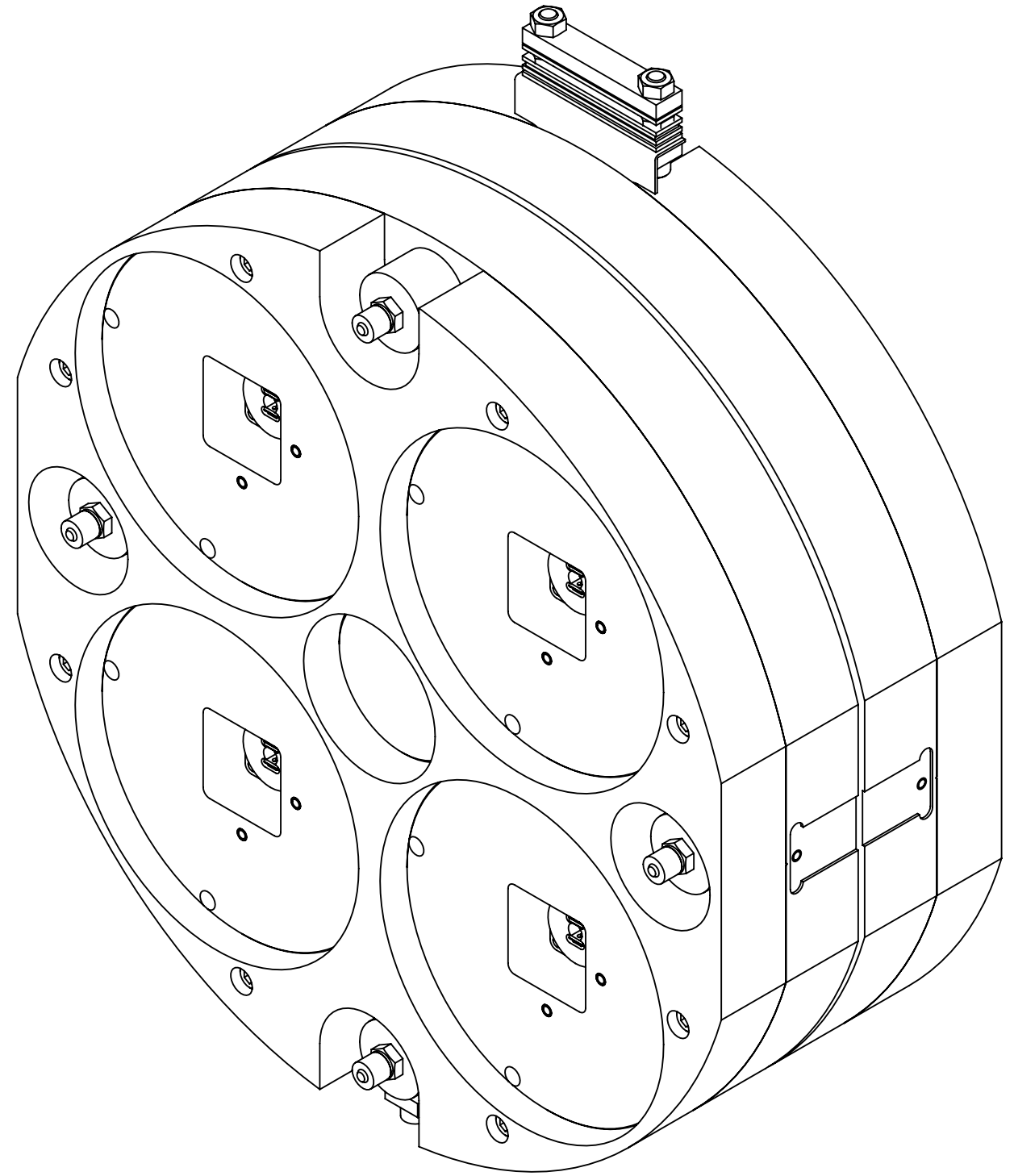
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SIZE B	DWG. NO. D060341	REV. v11
SCALE: 1:2	PROJECTION: 	SHEET 14 OF 15

ETM

D060341 QJAD, PENULTIMATE REACTION MASS, ETM_ITM CONFIG., PART PDM REV: X-077, DRAWING PDM REV: X-007




ISO VIEW, REAR LEFT



ISO VIEW, FRONT RIGHT

FINISHED PEN RE MASS

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SIZE DWG. NO.	D060341
B	REV. v11
SCALE: 1:2	PROJECTION:  SHEET 15 OF 15