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**SEISMIC ISOLATION SYSTEM (SEI)  
ASSEMBLY FIXTURE & SEQUENCE  
PRELIMINARY DESIGN REVIEW (PDR)**

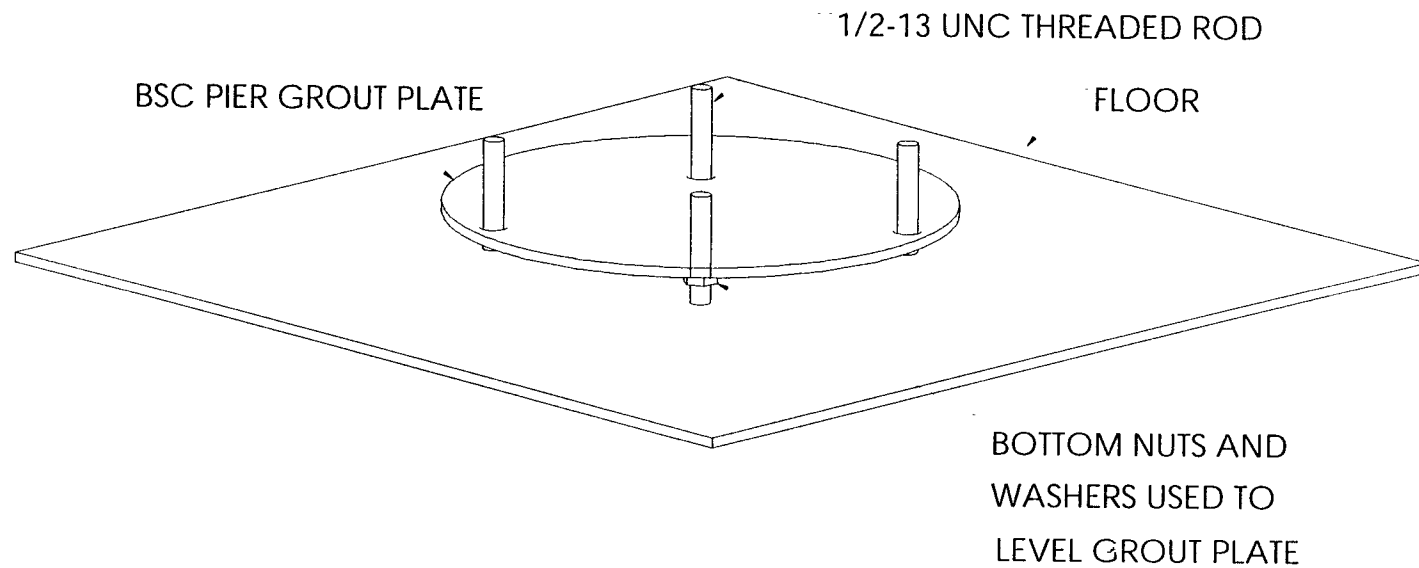
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Bill K. Miller  
HYTEC Inc.

September 23, 1997

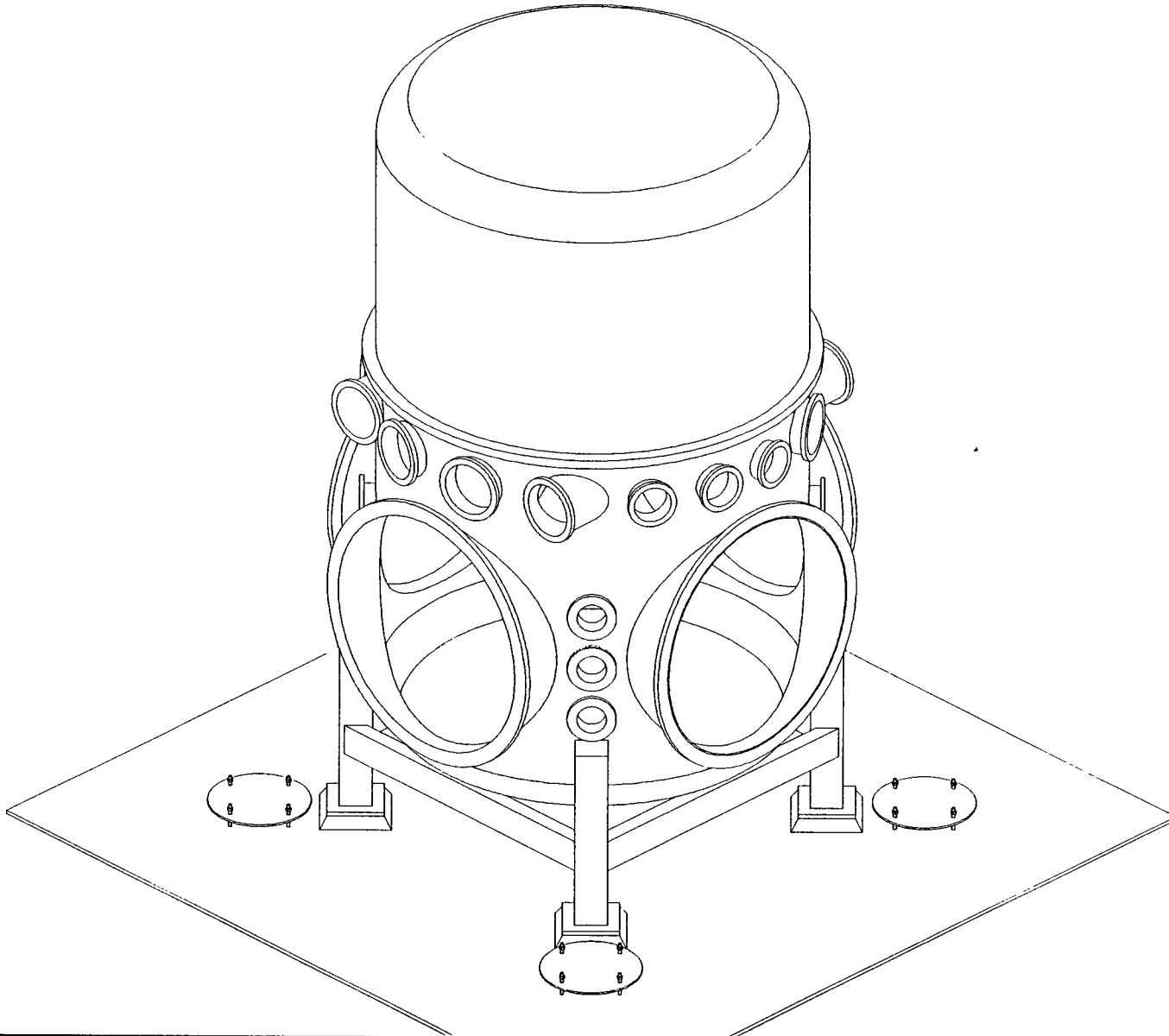
# LIGO BSC Assembly PDR

## Pier Grout Plate Assembly



# LIGO BSC Assembly PDR

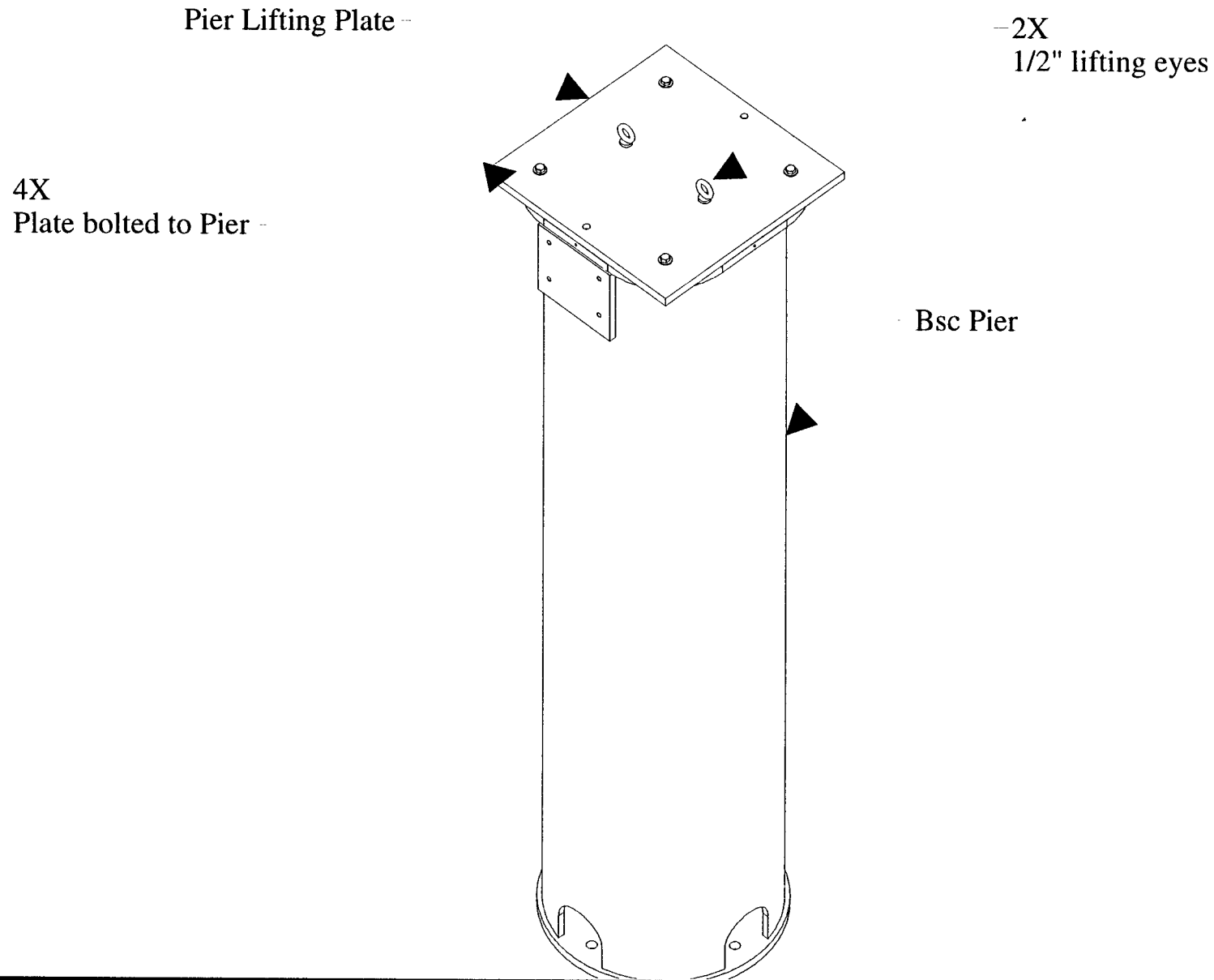
All Four Grout Plates Installed and Leveled



# LIGO BSC Assembly PDR

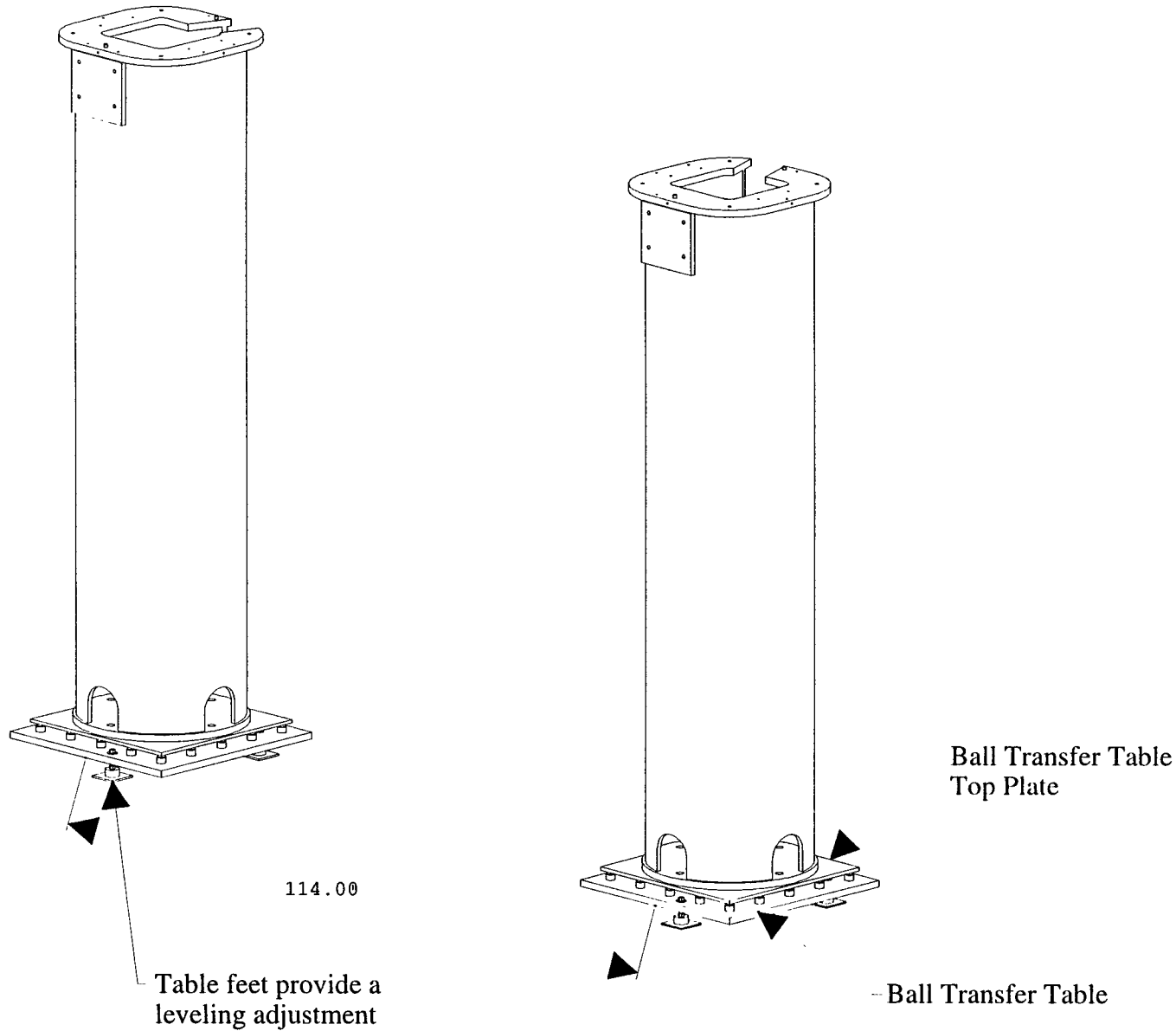
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## Lifting a BSC Pier



# LIGO BSC Assembly PDR

## BSC Piers on Ball Transfer Tables

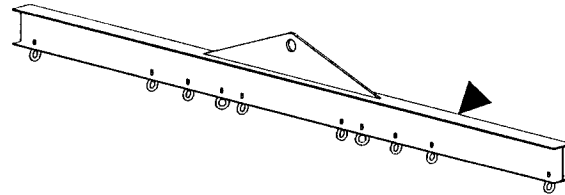


# LIGO BSC Assembly PDR

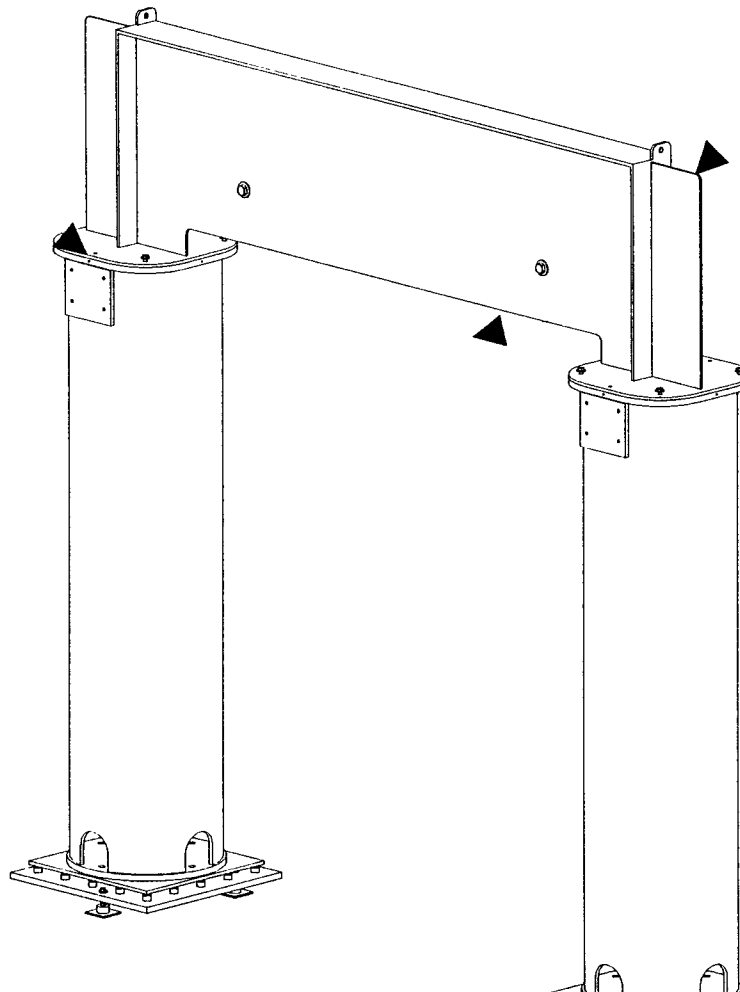
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## Piers Lifting Jig

Spreader Bar



Pin in Pier registers  
in hole in Lifting Jig



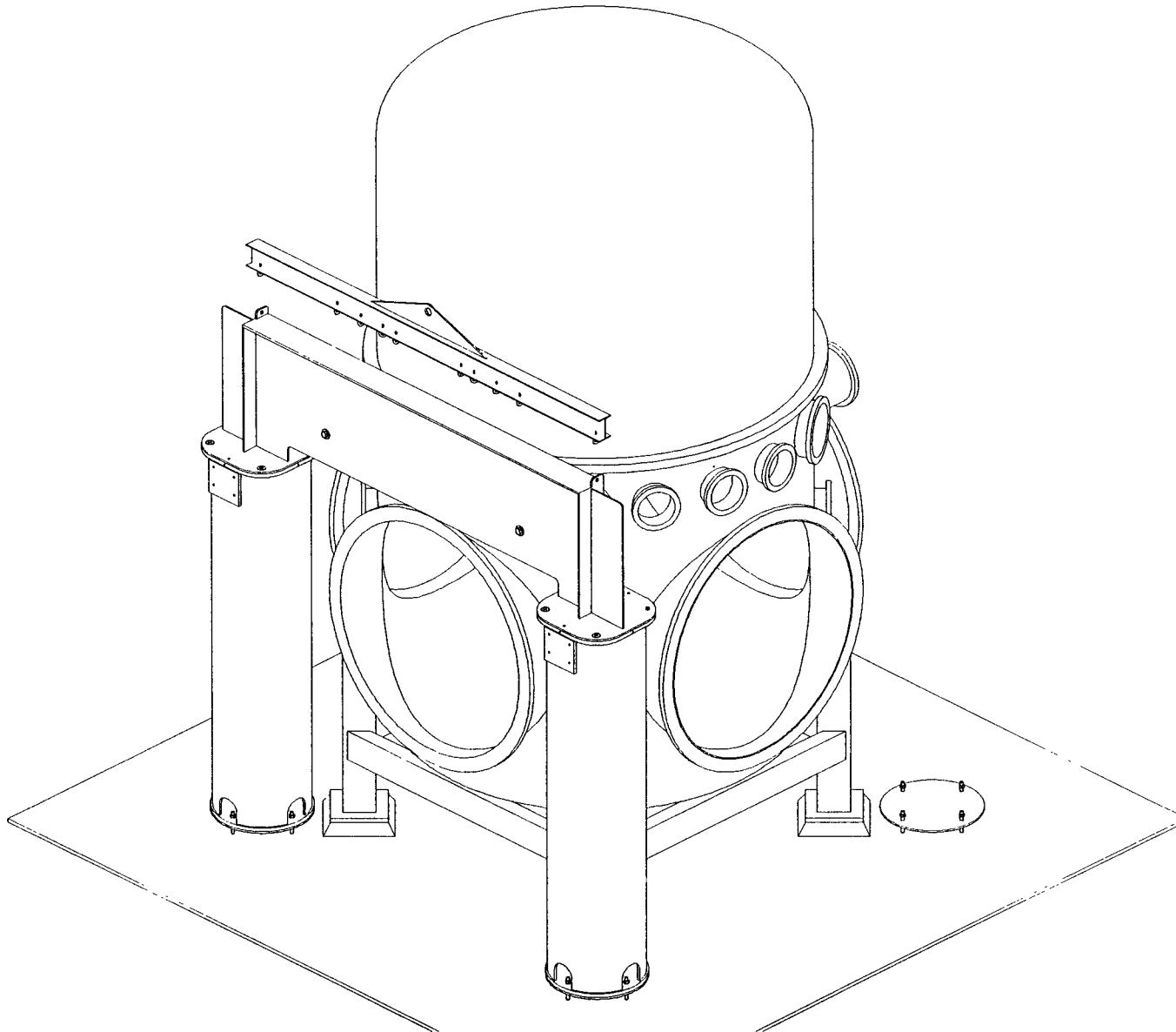
Pier Lifting Jig Assembly

Jig bolted to Pier

# LIGO BSC Assembly PDR

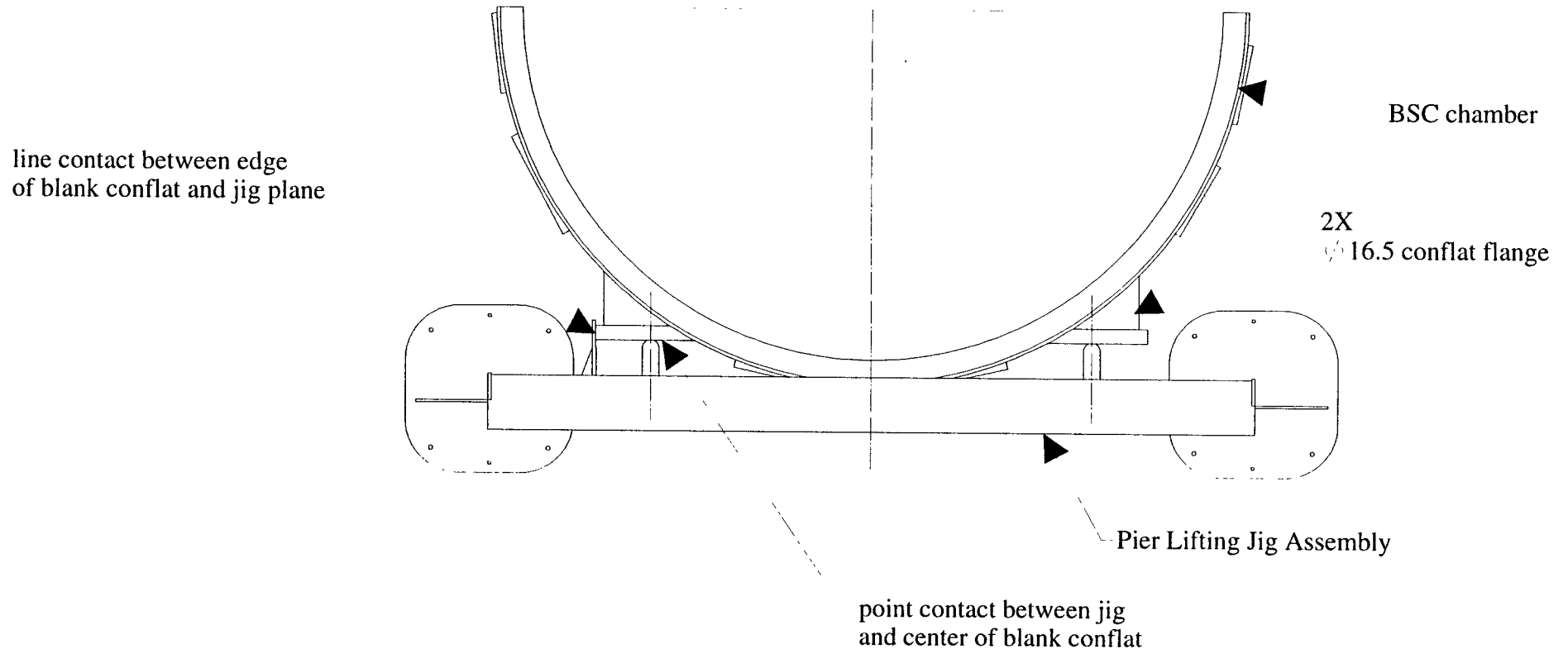
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## Piers are Lowered Into Position



# LIGO BSC Assembly PDR

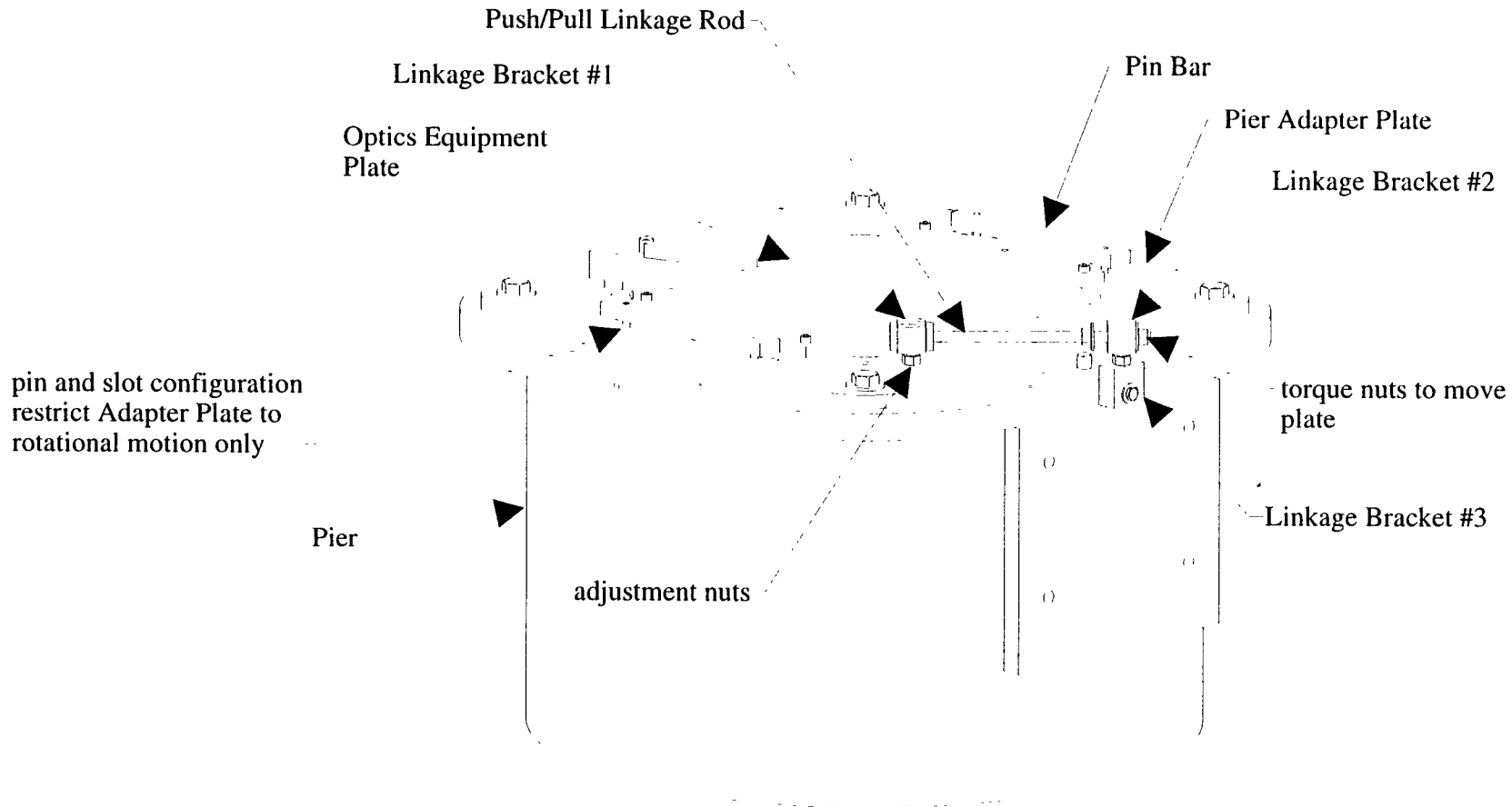
## Jig Referencing the Nozzle Port Surfaces





# LIGO BSC Assembly PDR

## Leveling and Clocking the Pier Adapter Plate

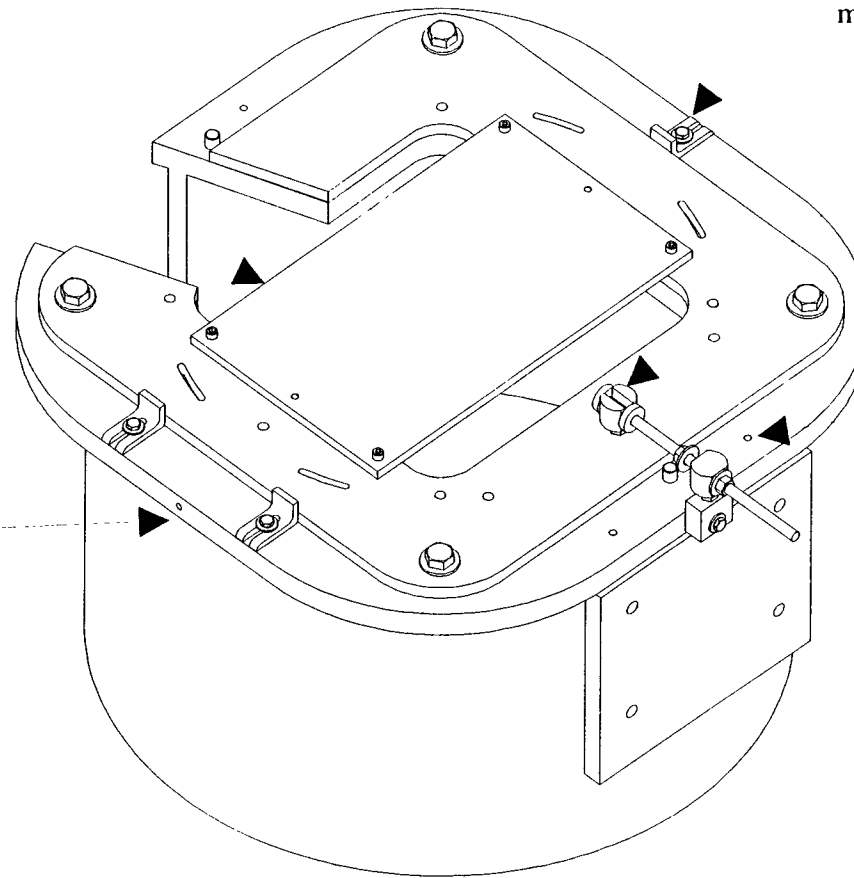


# LIGO BSC Assembly PDR

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## Translating the Pier Adapter Plate

Optics Equipment Plate  
remains bolted in position -



Guide Brackets restrict  
Adapter Plate to linear  
motion only

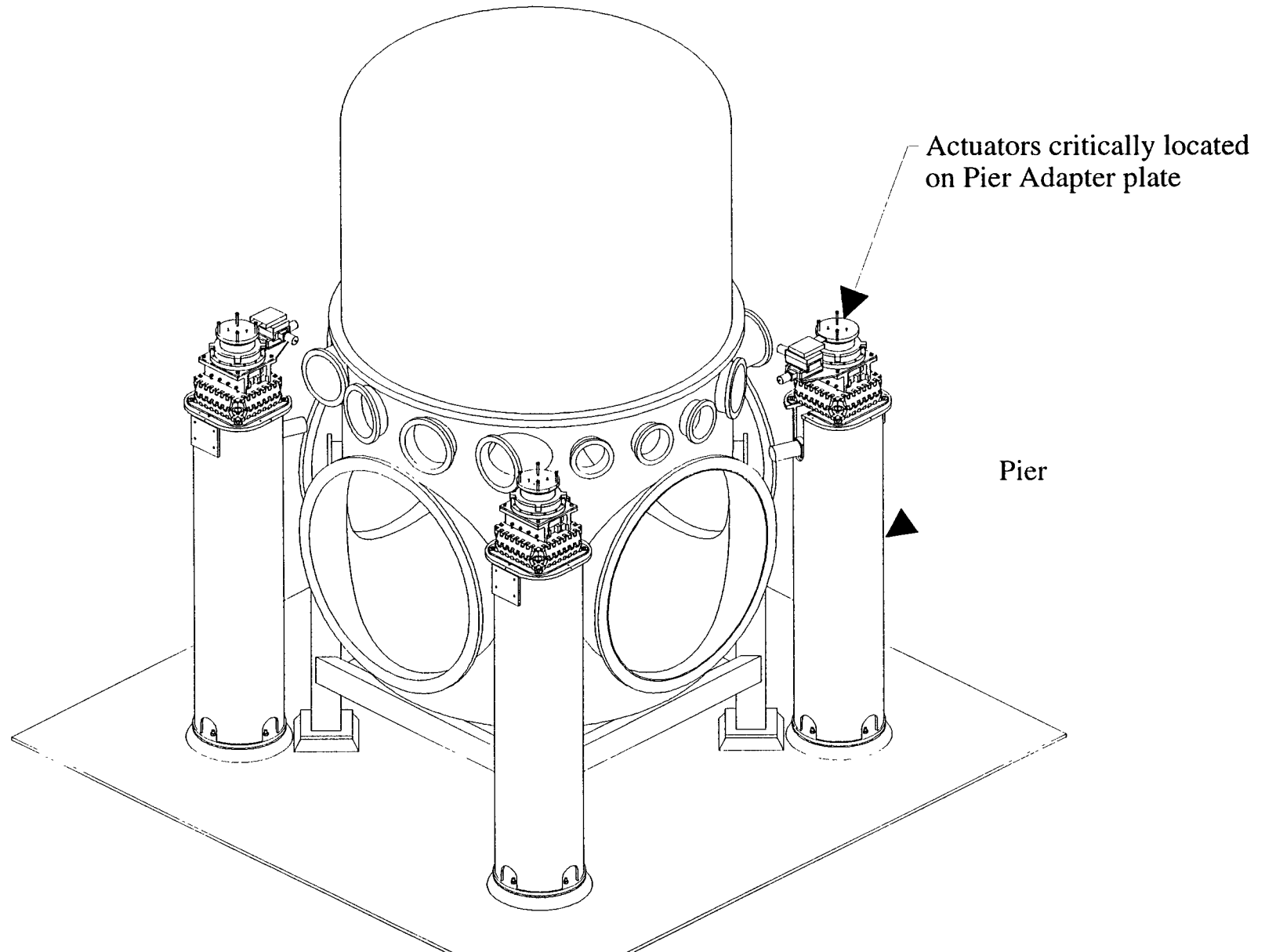
Linkage Bracket #1  
moved to this position  
for linear motion

Guide Brackets are moved  
to new positions to provide  
transverse motion

same linkage setup  
assembled here for  
transverse motion

# LIGO BSC Assembly PDR

## Actuator Columns Installed

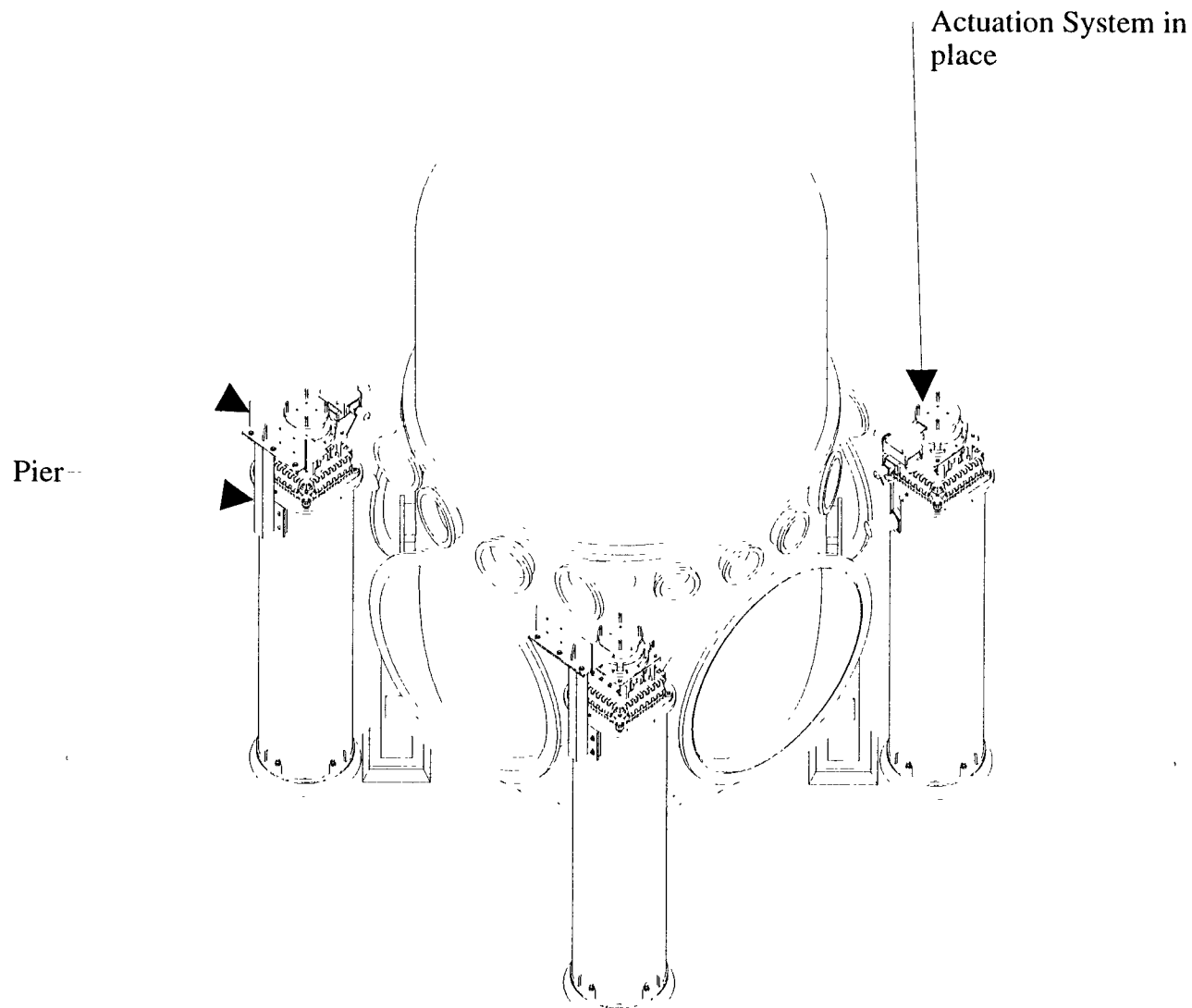


# LIGO BSC Assembly PDR

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## Crossbeam Support Brackets in Place

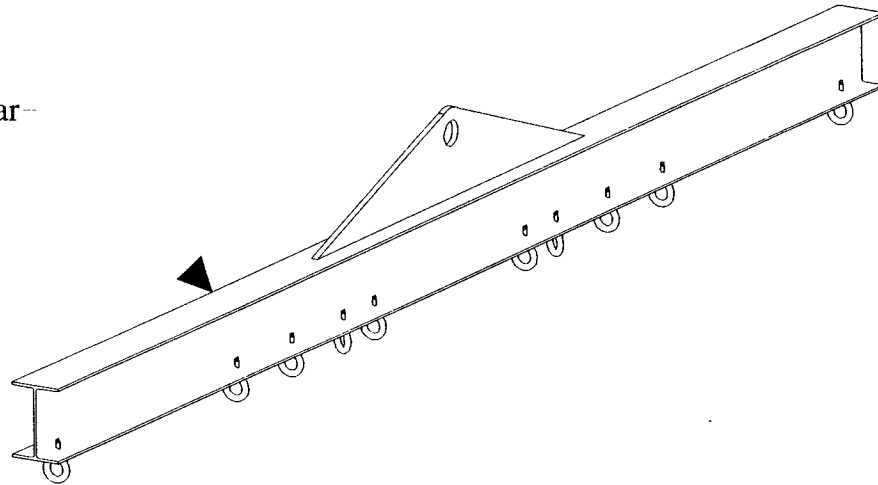
2X  
Crossbeam Support  
Bracket bolted loosely  
in place



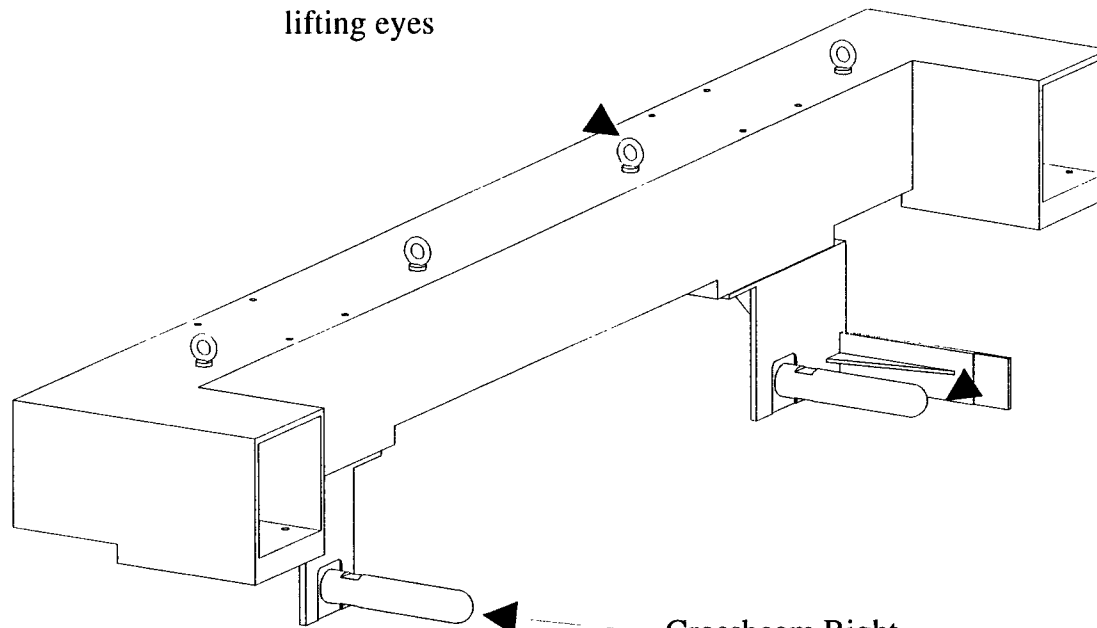
# LIGO BSC Assembly PDR

## Crossbeam Being Hoisted

Spreader Bar



4X  
lifting eyes



-- Crossbeam Left  
Centering Jig (point  
and plane contact  
to nozzle port)

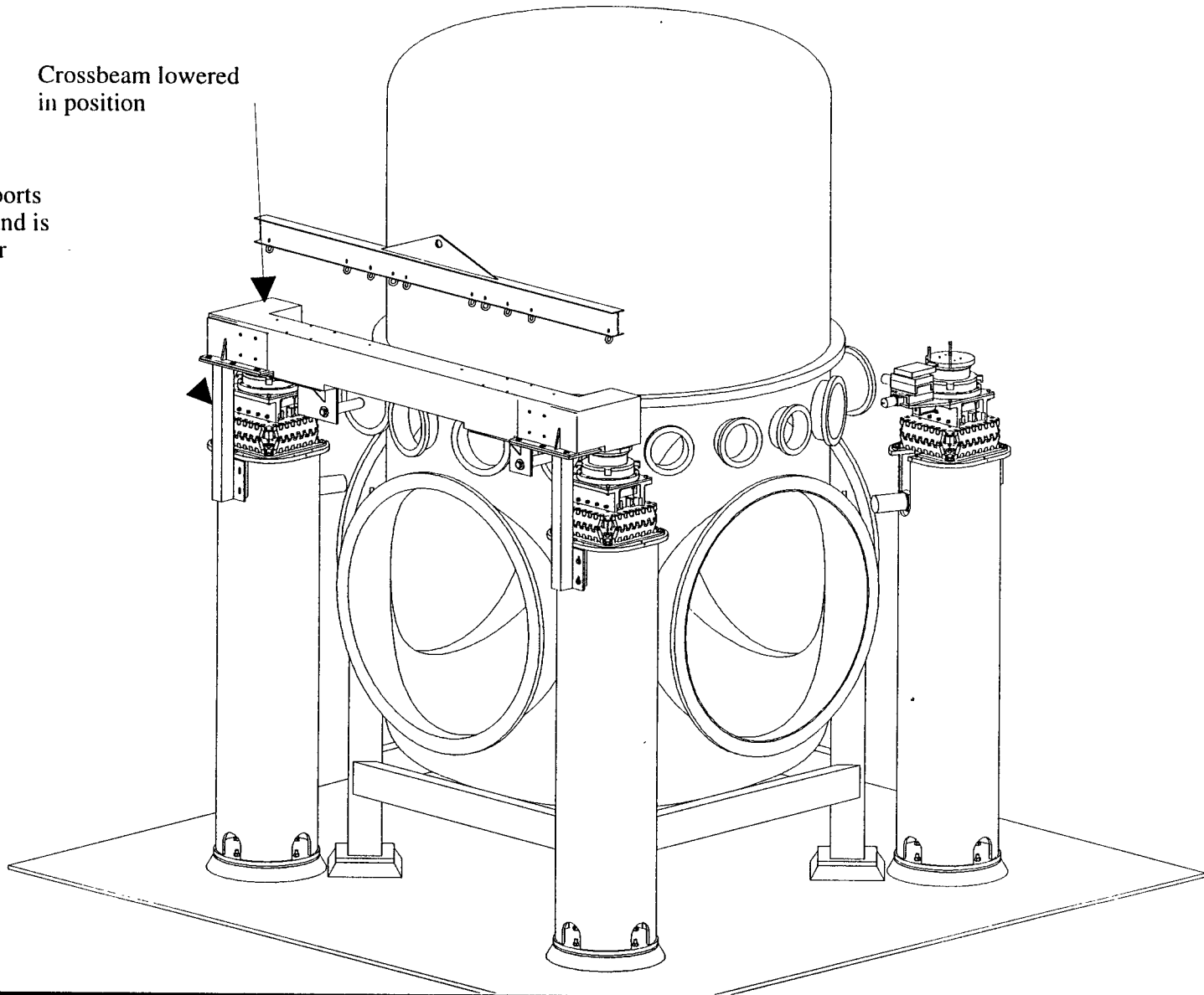
Crossbeam Right  
Centering Jig

# LIGO BSC Assembly PDR

## Crossbeam Lowered Into Position

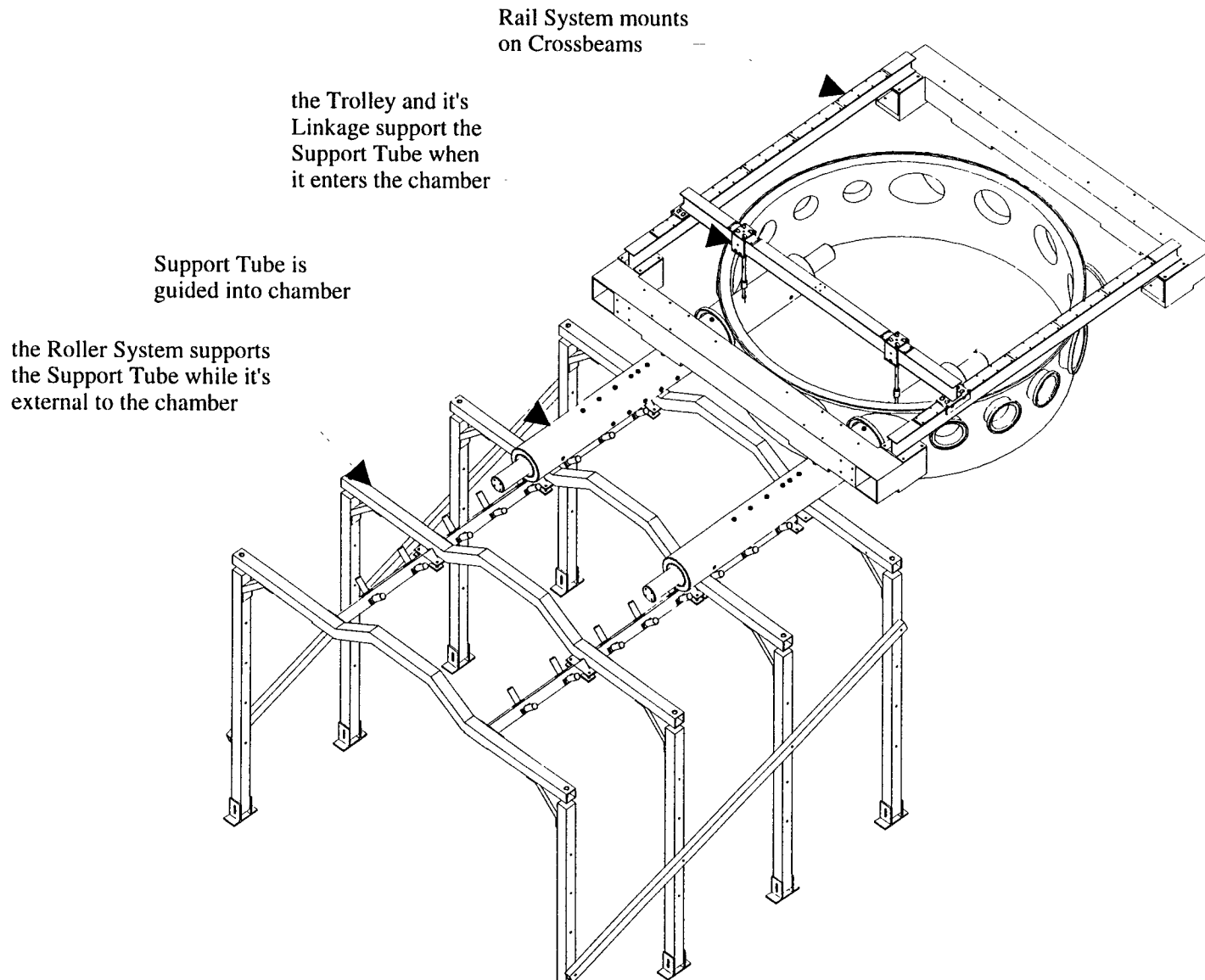
Crossbeam lowered  
in position

Bracket supports  
Crossbeam and is  
bolted to Pier



# LIGO BSC Assembly PDR

## Transverse Rail #1 Connected to the Support Tubes



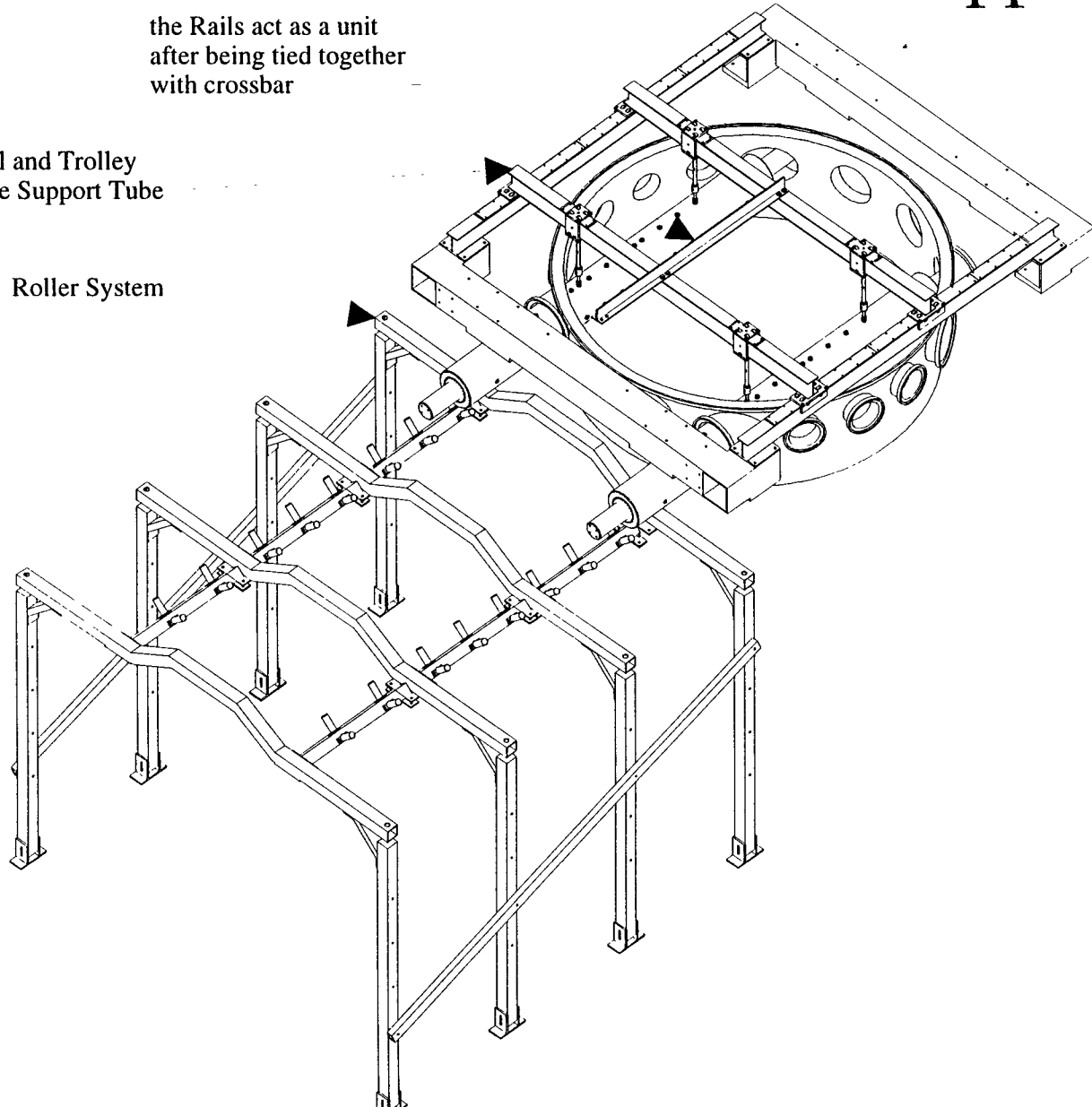
# LIGO BSC Assembly PDR

## Transverse Rail #2 Connected to the Support Tubes

the Rails act as a unit  
after being tied together  
with crossbar

second Rail and Trolley  
supports the Support Tube

Roller System





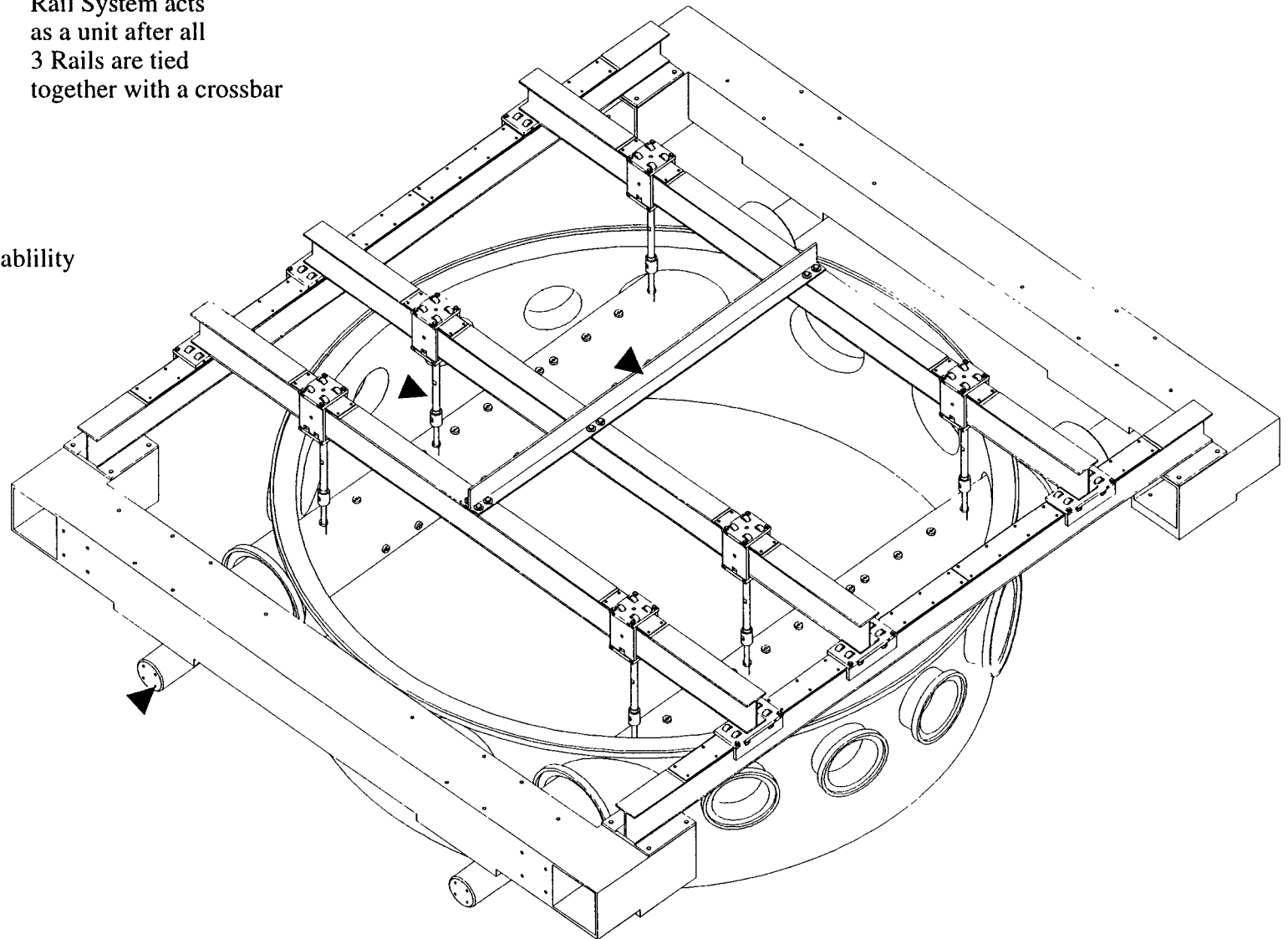
# LIGO BSC Assembly PDR

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## Support Tubes in Position

Rail System acts  
as a unit after all  
3 Rails are tied  
together with a crossbar

Trolley Linkage  
has vertical adjustability



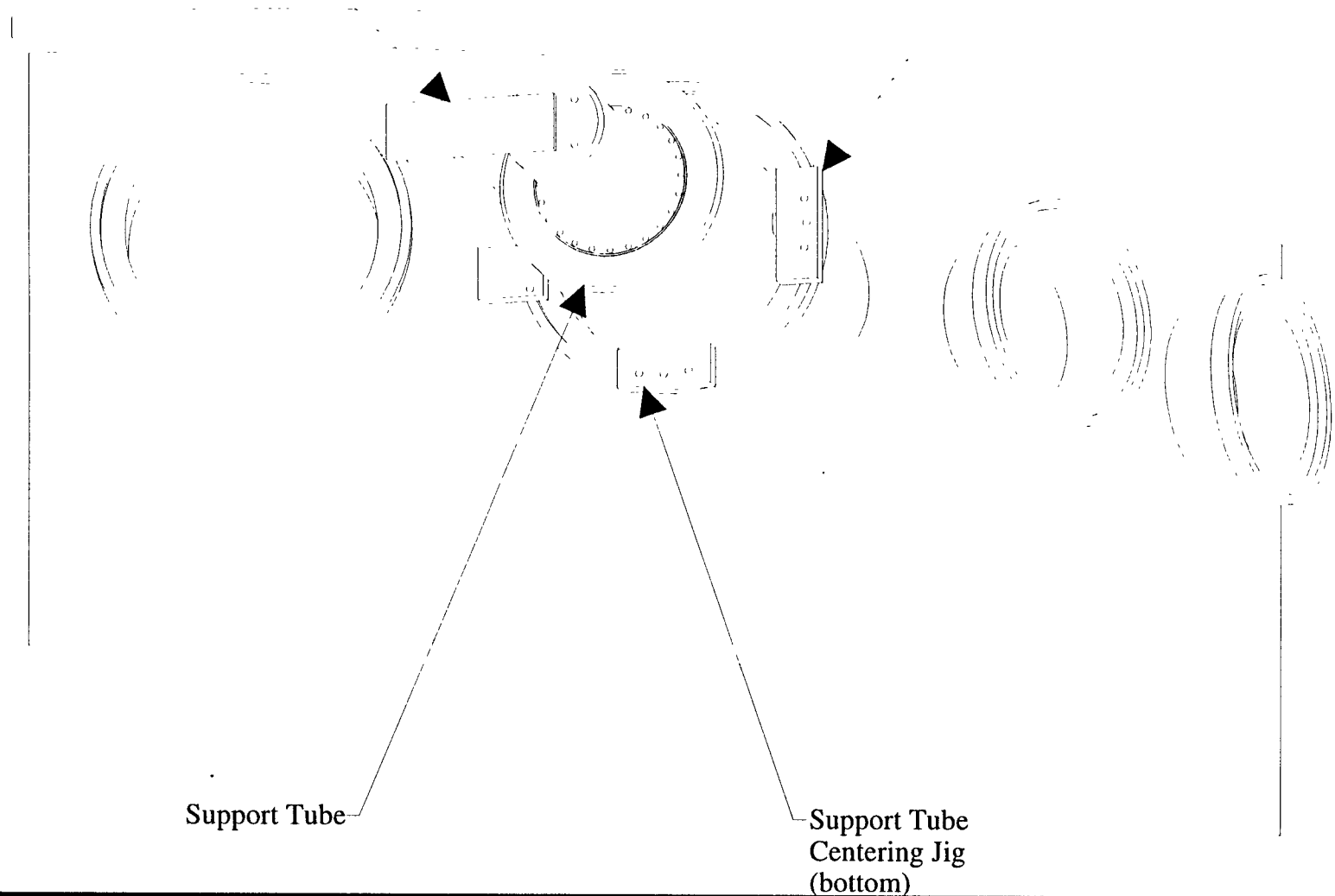
Support Tubes  
in position

# LIGO BSC Assembly PDR

## Support Tube Centering Jigs in Place

Support Tube  
Centering Jig  
(end)

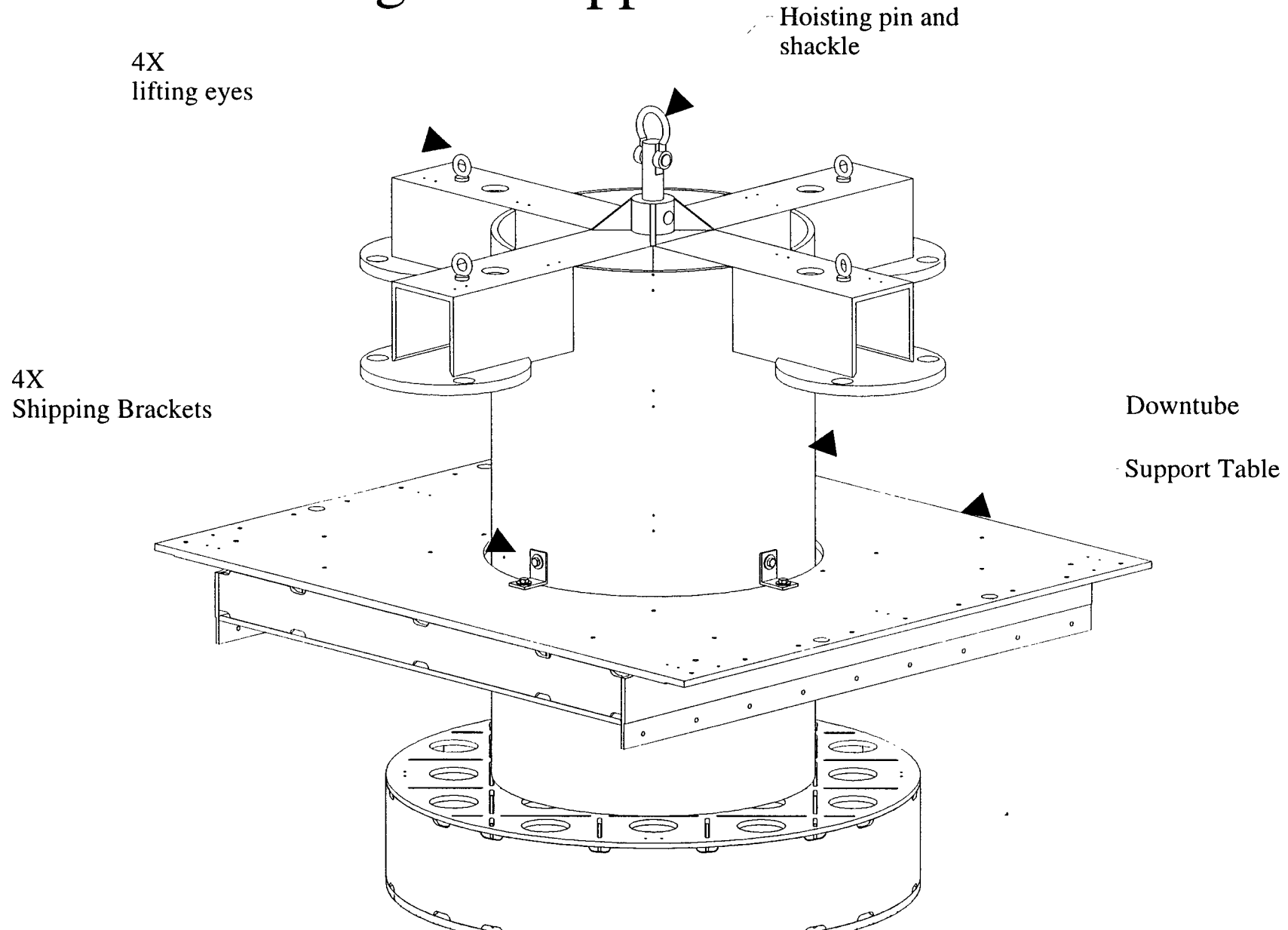
Support Tube  
Centering Jig  
(side)



# LIGO BSC Assembly PDR

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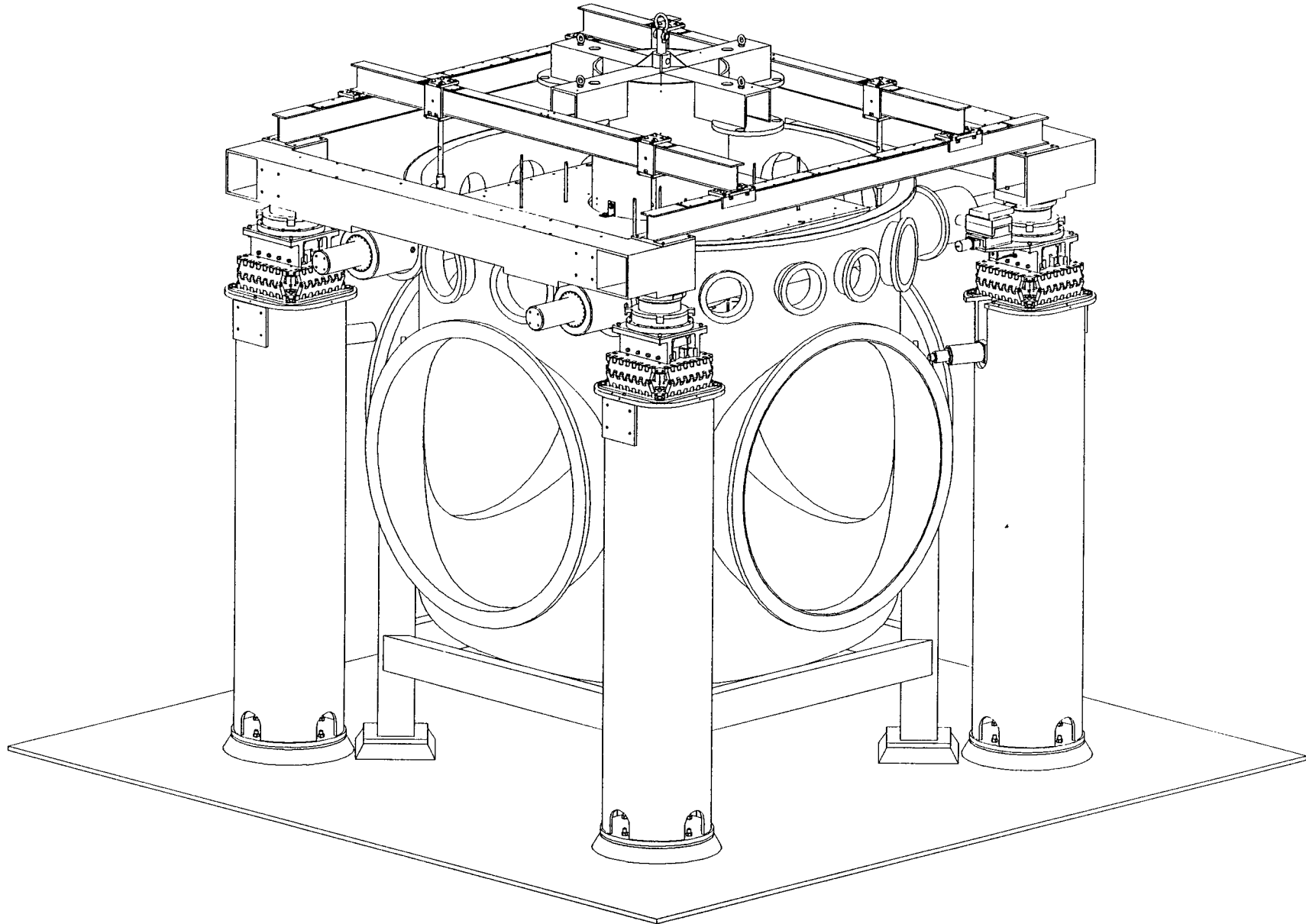
## Hoisting the Support Table/Downtube



# LIGO BSC Assembly PDR

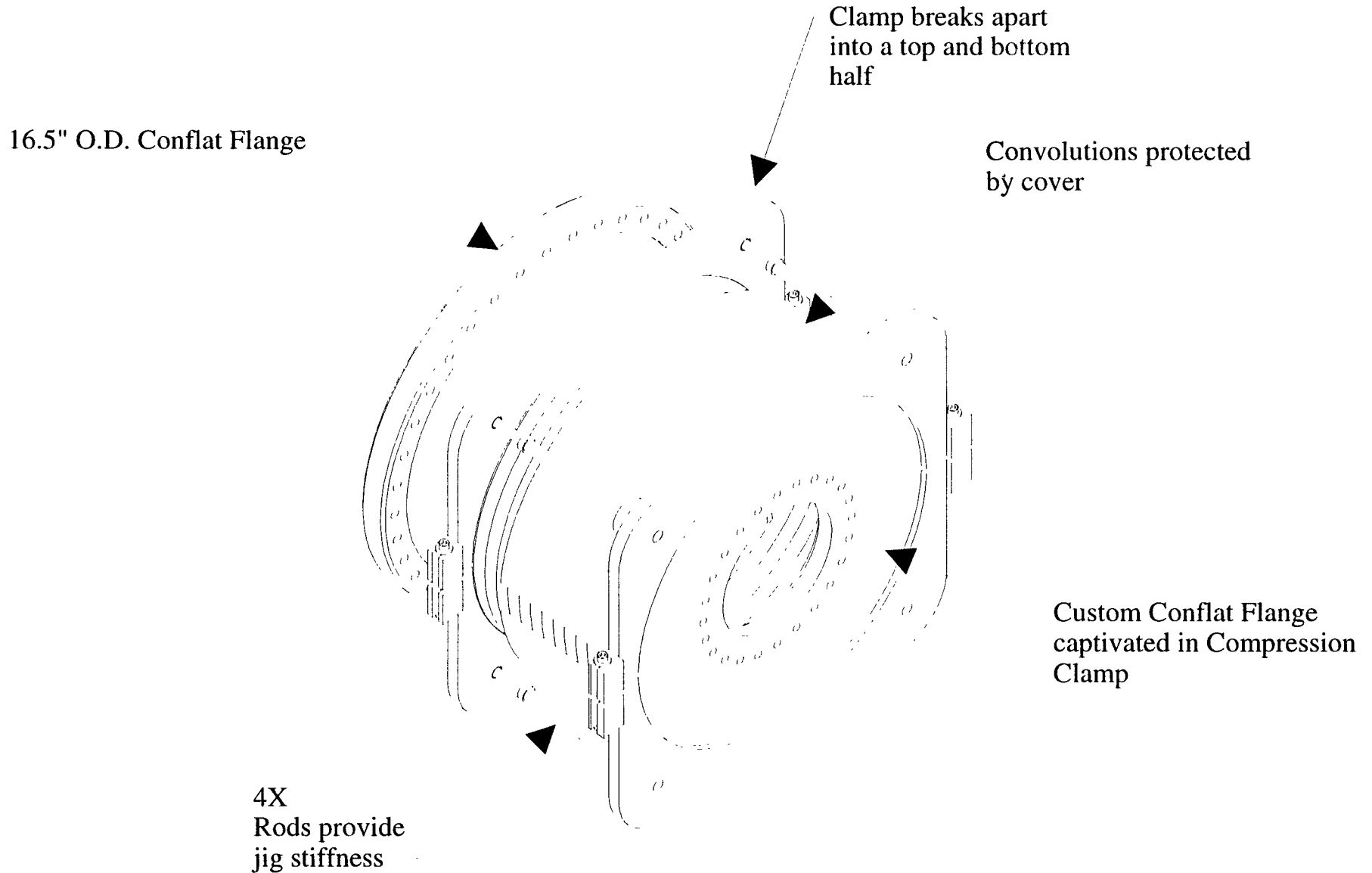
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## Support Table Bolted to the Support Tubes



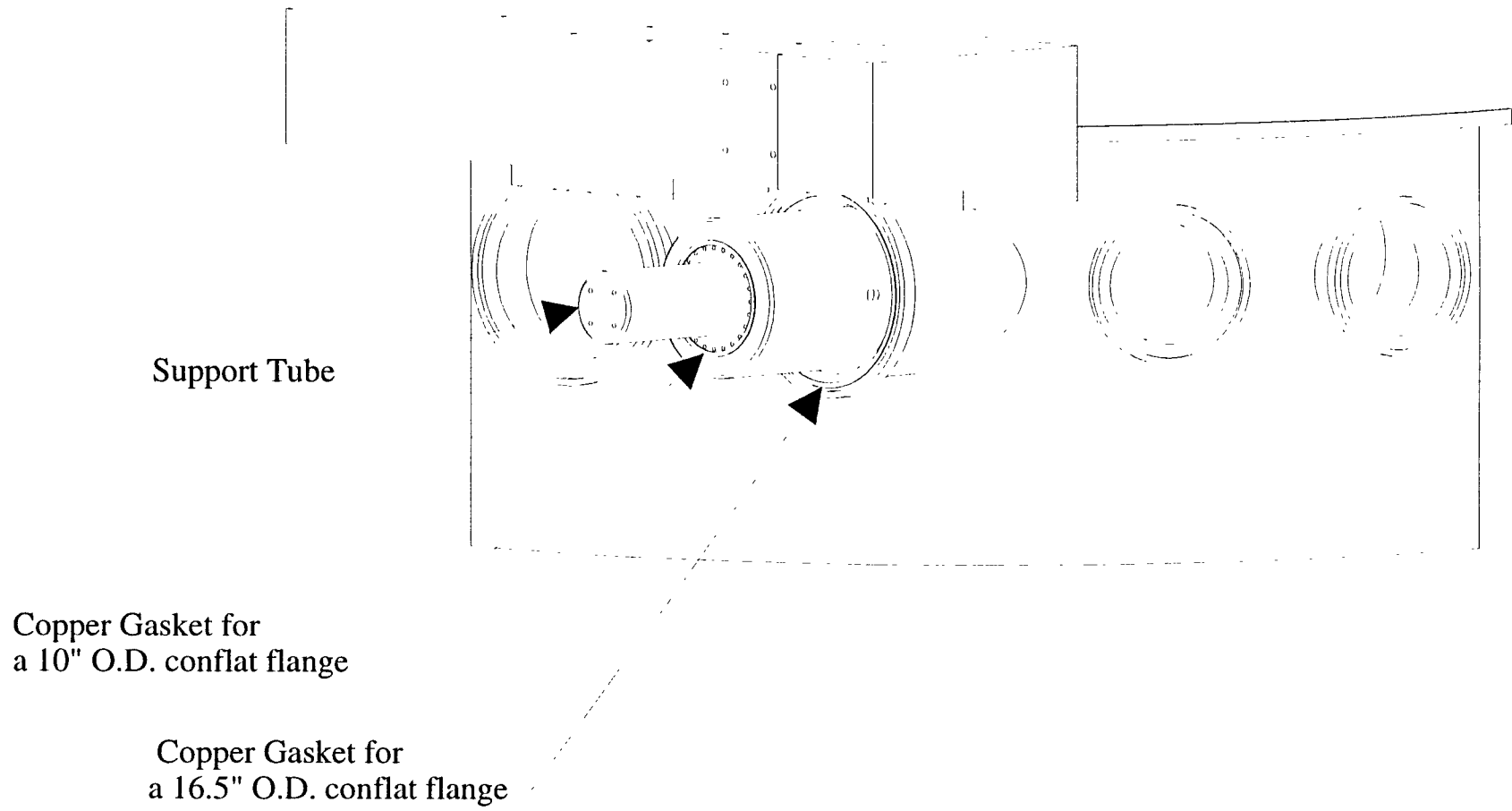
# LIGO BSC Assembly PDR

## Bellows Compression Clamp



# LIGO BSC Assembly PDR

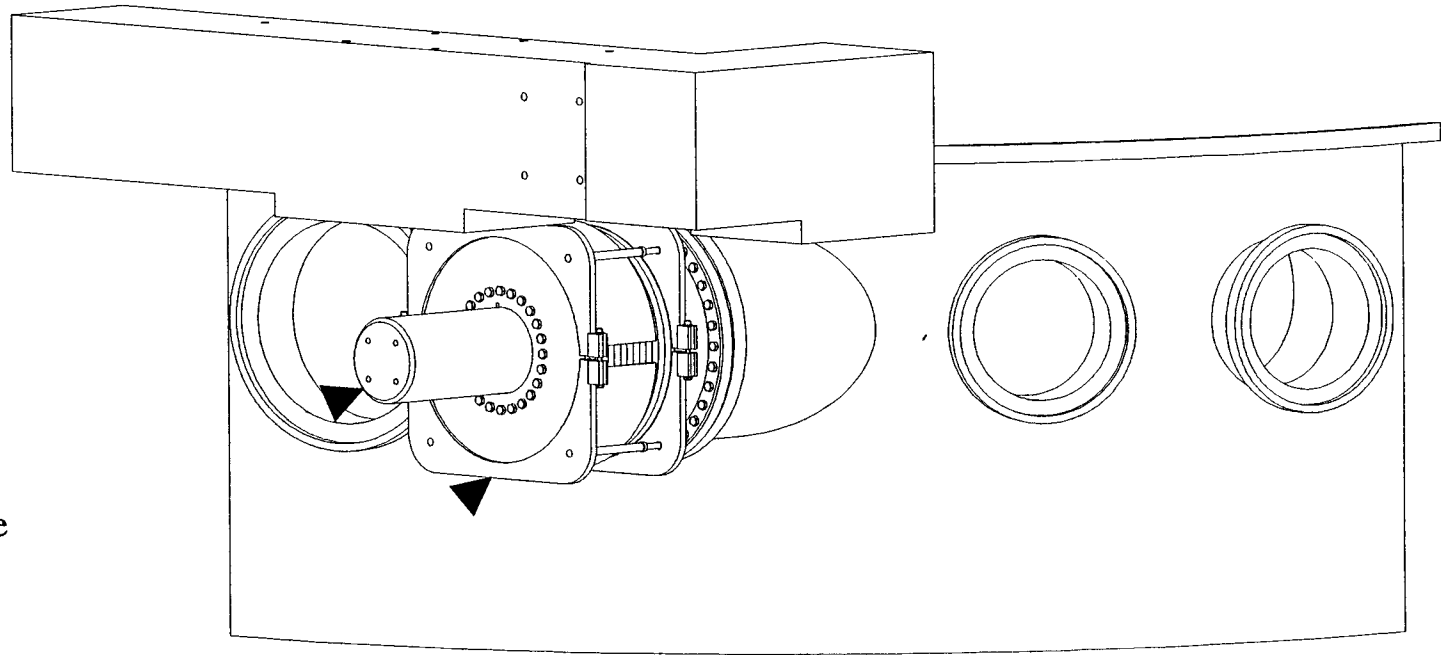
## Copper Gaskets Placed in Position



# LIGO BSC Assembly PDR

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## Bellows Being Installed



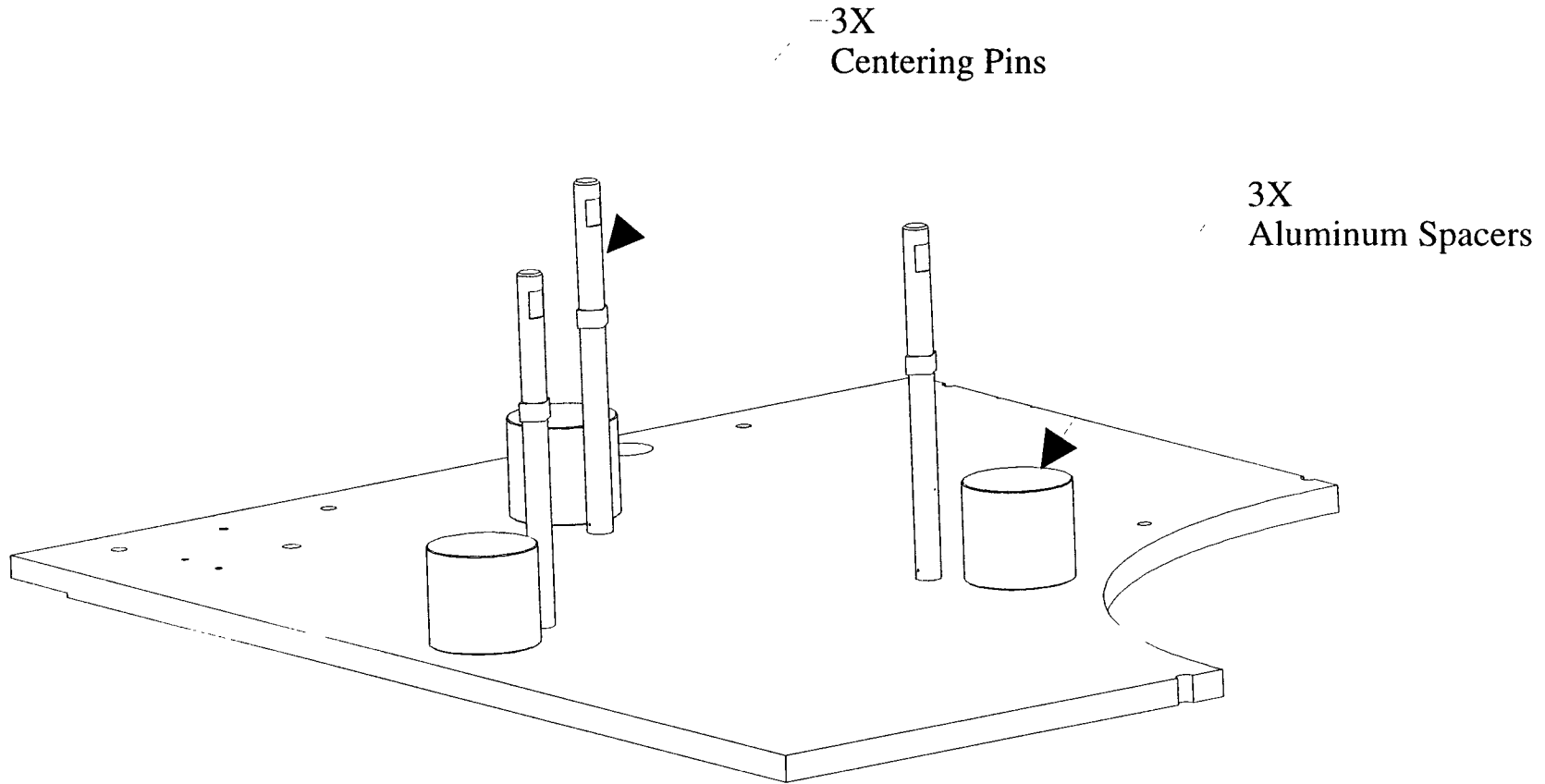
Support Tube

Bellows Compression Clamp

# LIGO BSC Assembly PDR

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## Preparation for Leg Element #1





# LIGO BSC Assembly PDR

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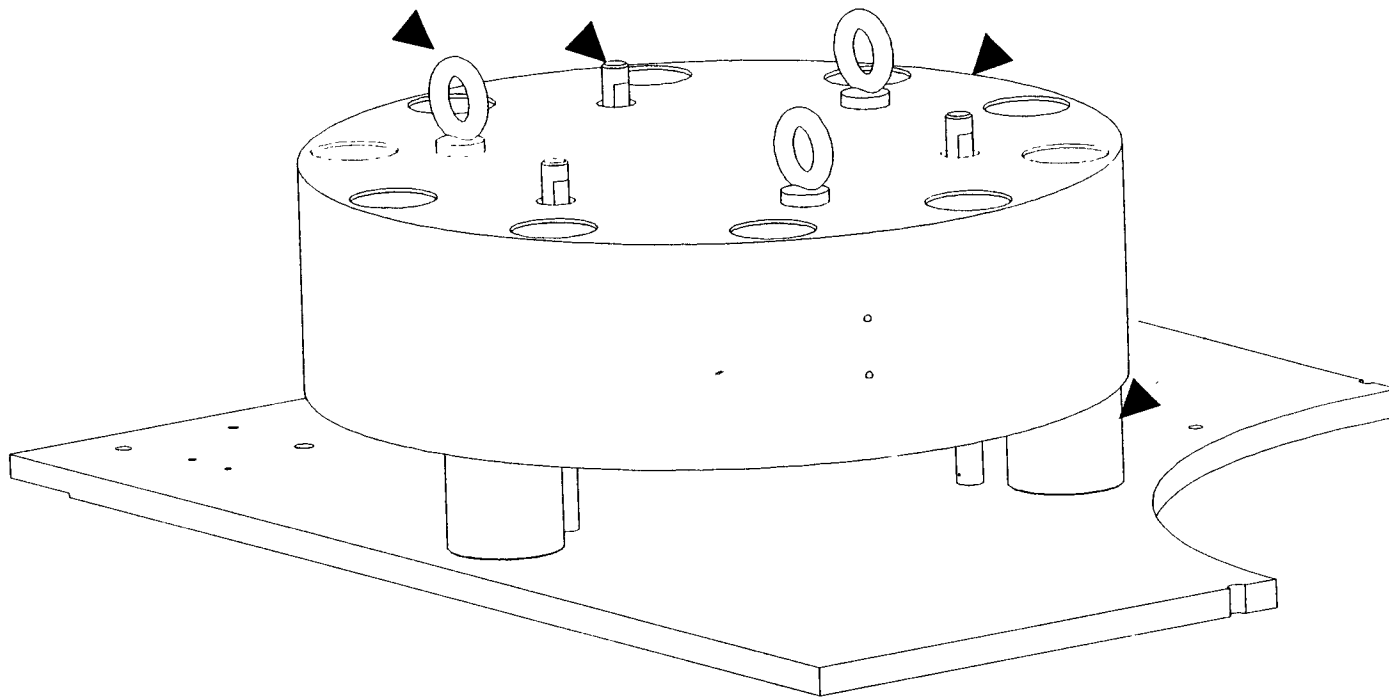
## Leg Element #1 Lowered in Position

3X  
Centering Pins

3X  
Lifting Eye

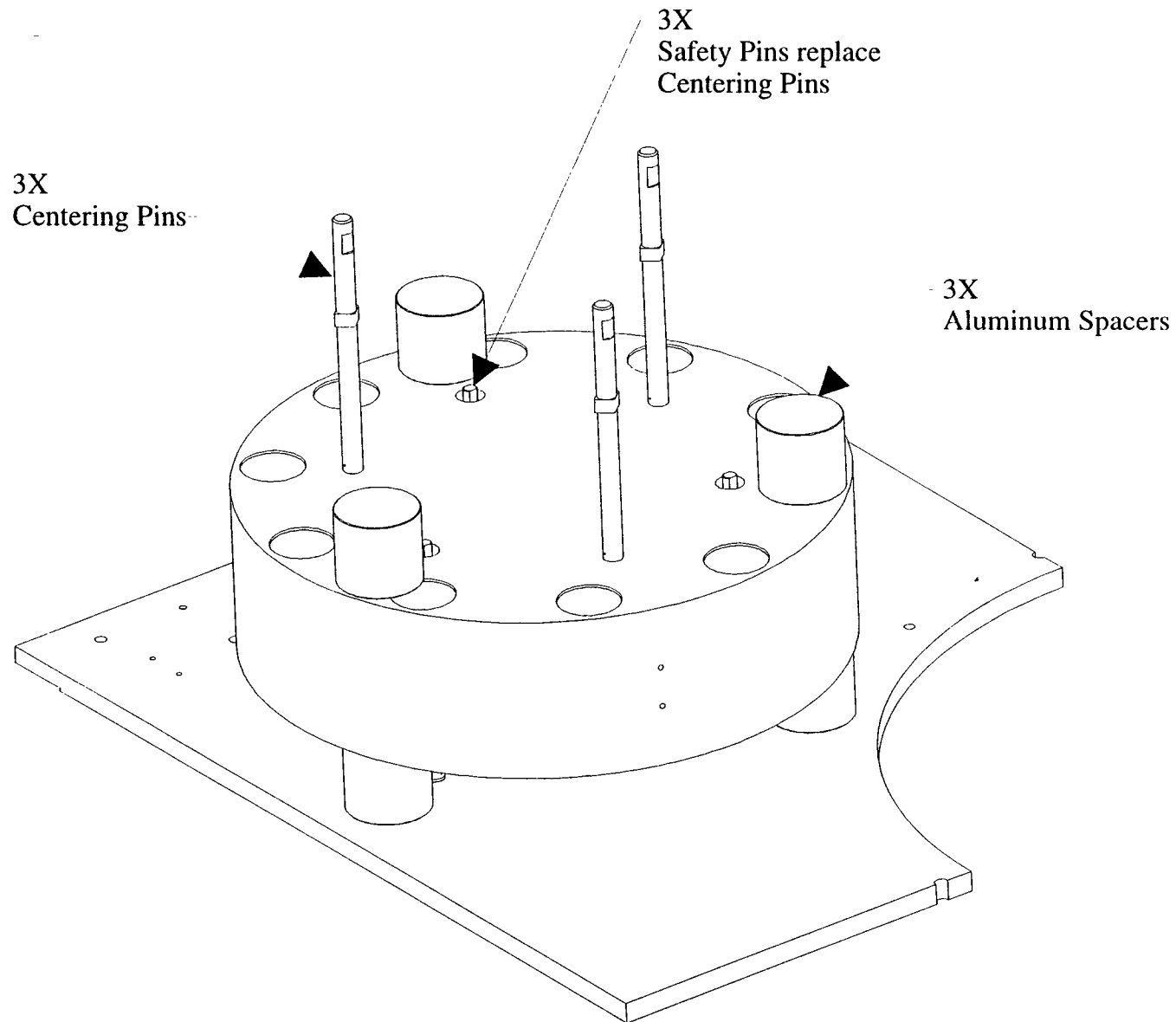
Leg Element #1

3X  
Aluminum Spacers



# LIGO BSC Assembly PDR

## Preparation for Leg Element #2



# LIGO BSC Assembly PDR

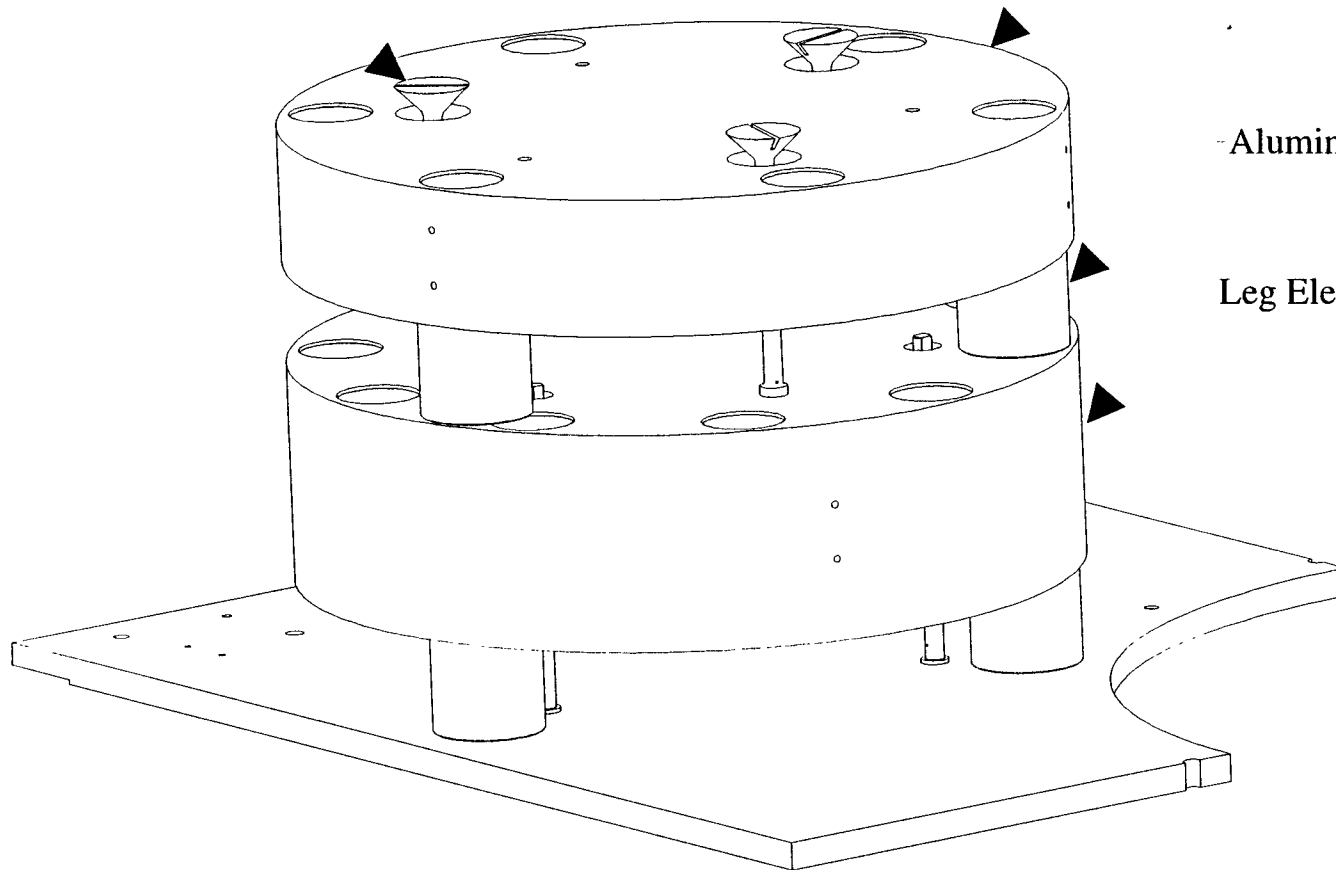
## Leg Element #2 in Position with Safety Pins

3X  
Safety Pins

Leg Element #2

Aluminum Spacers

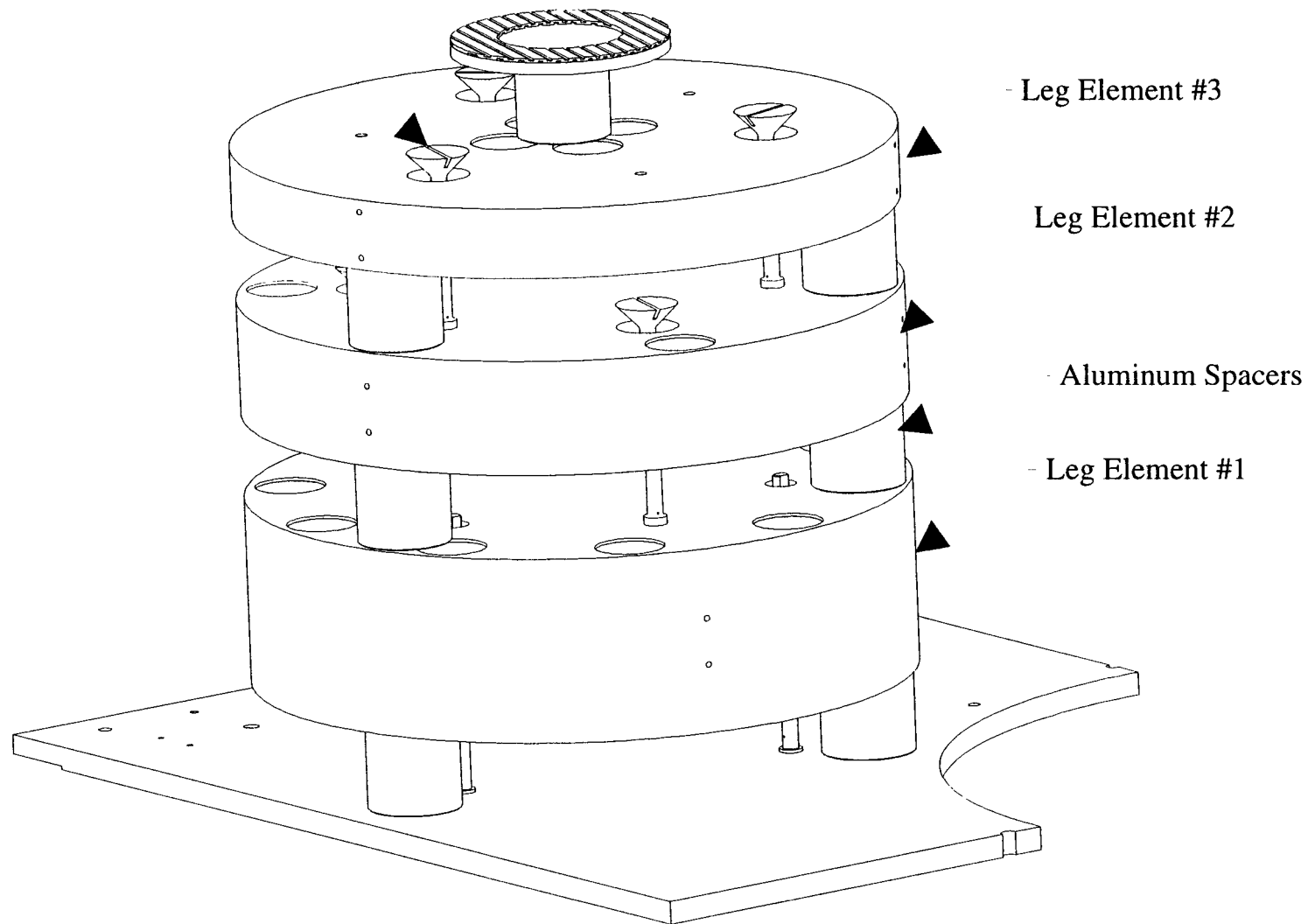
Leg Element #1



# LIGO BSC Assembly PDR

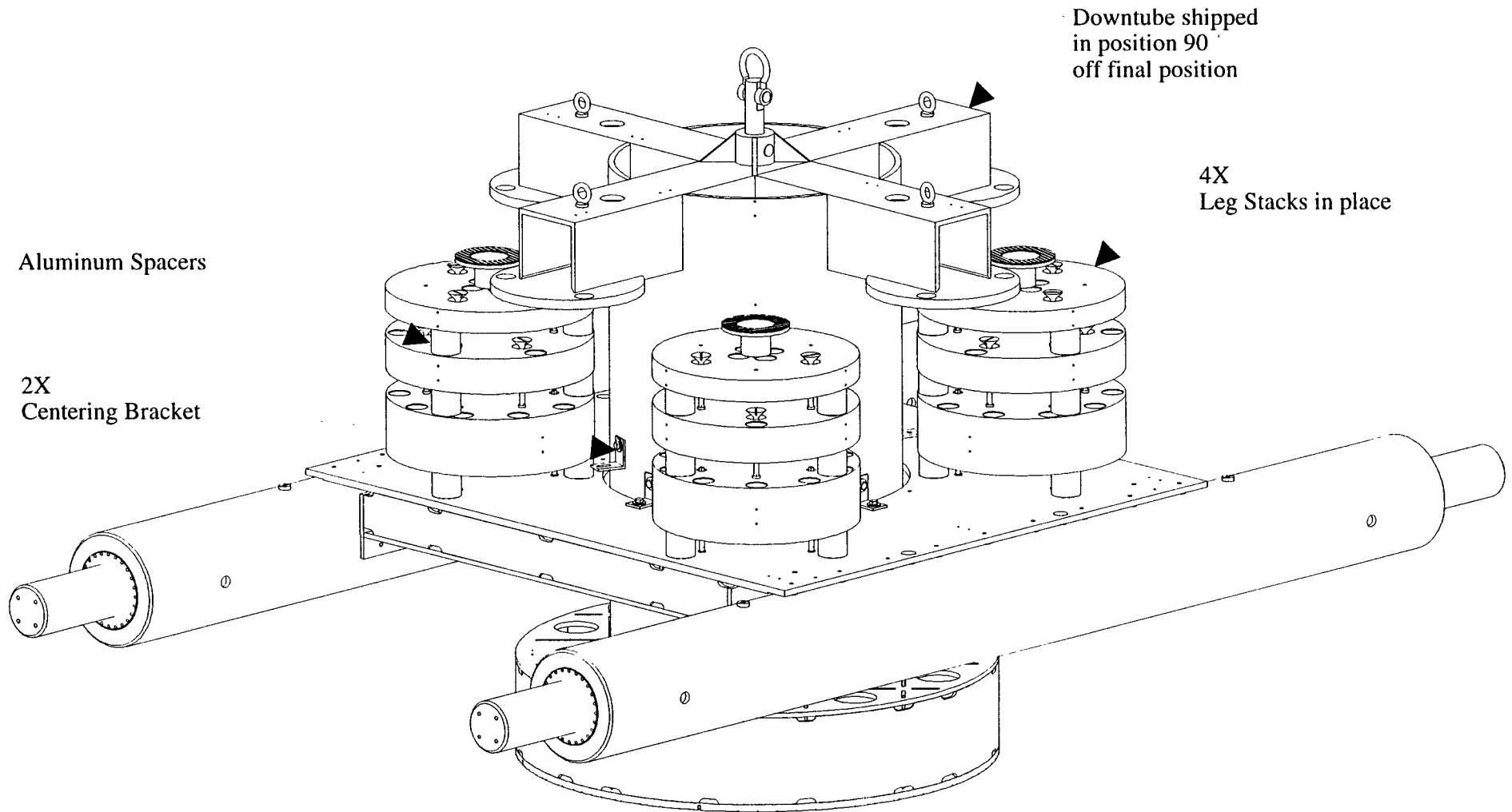
## Isolation Stack Leg Assembled

Safety Pins



# LIGO BSC Assembly PDR

## BSC Isolation Stack Assembled



Downtube shipped  
in position 90  
off final position

4X  
Leg Stacks in place

Aluminum Spacers

2X  
Centering Bracket

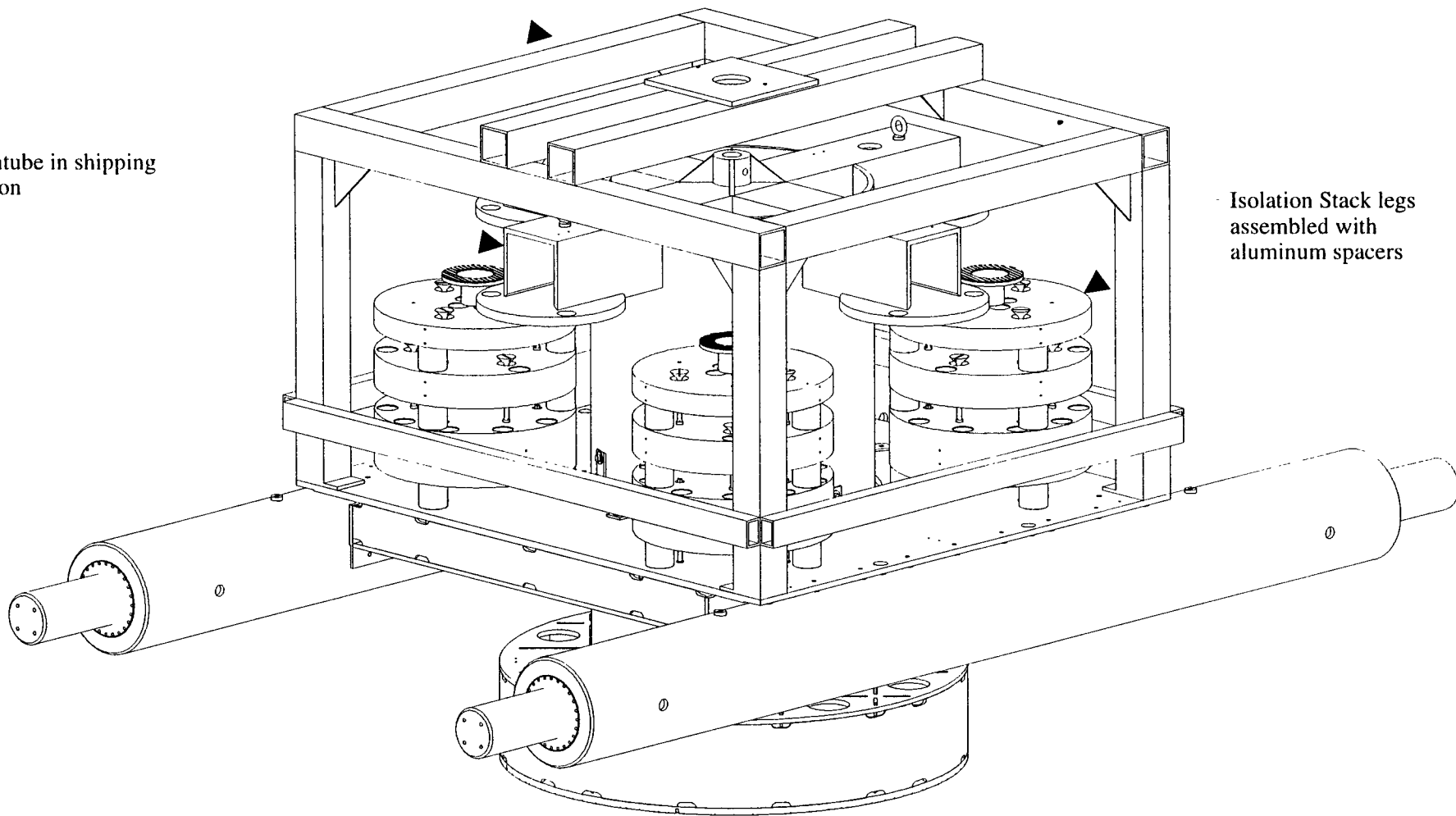
# LIGO BSC Assembly PDR

## Downtube Centering Structure Lowered in Place

Downtube Centering Structure legs register on temporary pins put into Support Table

Downtube in shipping position

Isolation Stack legs assembled with aluminum spacers



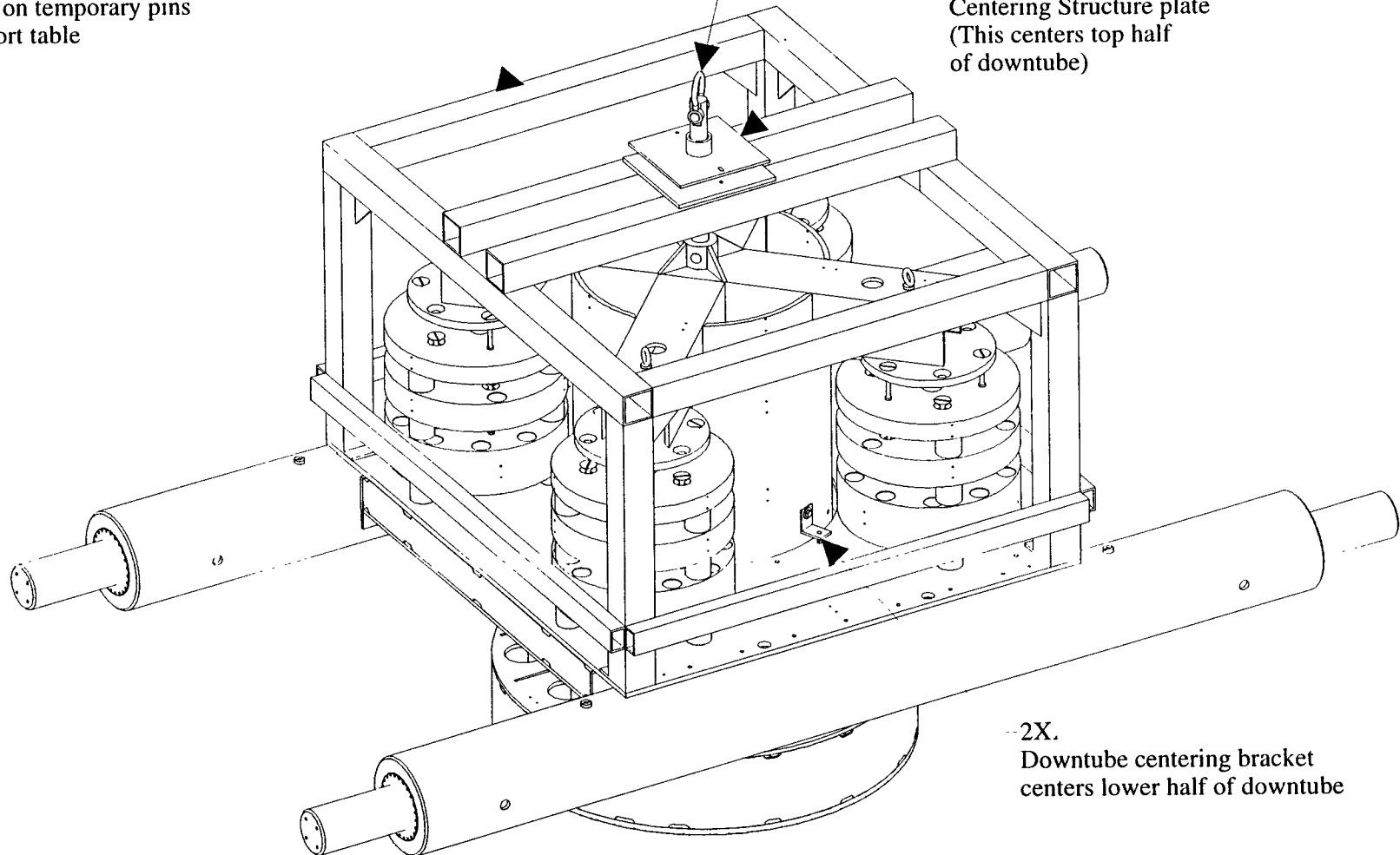
# LIGO BSC Assembly PDR

## Downtube Rotated 45 Degrees for Spring Assembly

Downtube Centering Structure legs register on temporary pins in support table

Downtube Lifting Pin Assembly

Plate mates with pins in Centering Structure plate (This centers top half of downtube)

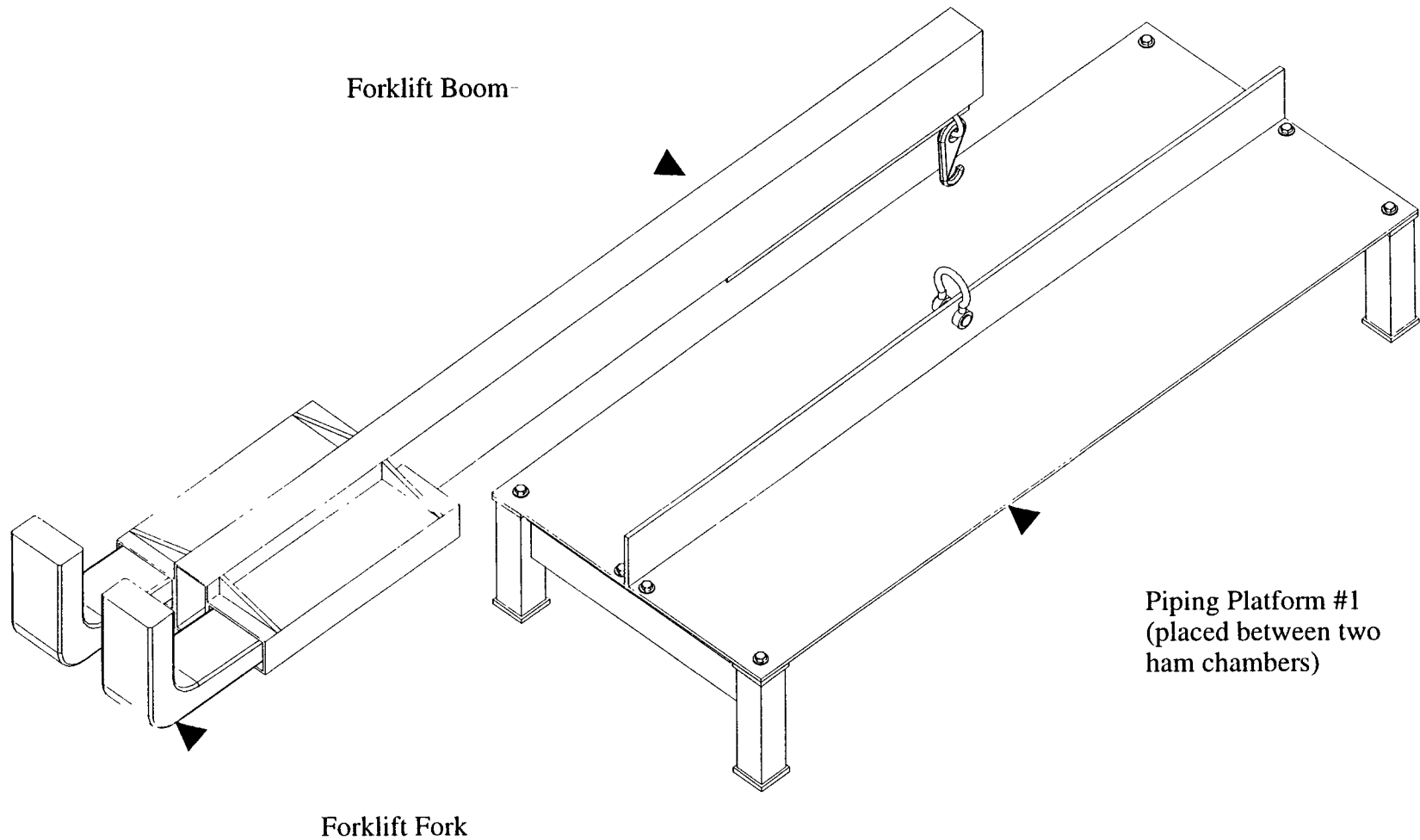


-2X.  
Downtube centering bracket centers lower half of downtube

# LIGO HAM Assembly PDR

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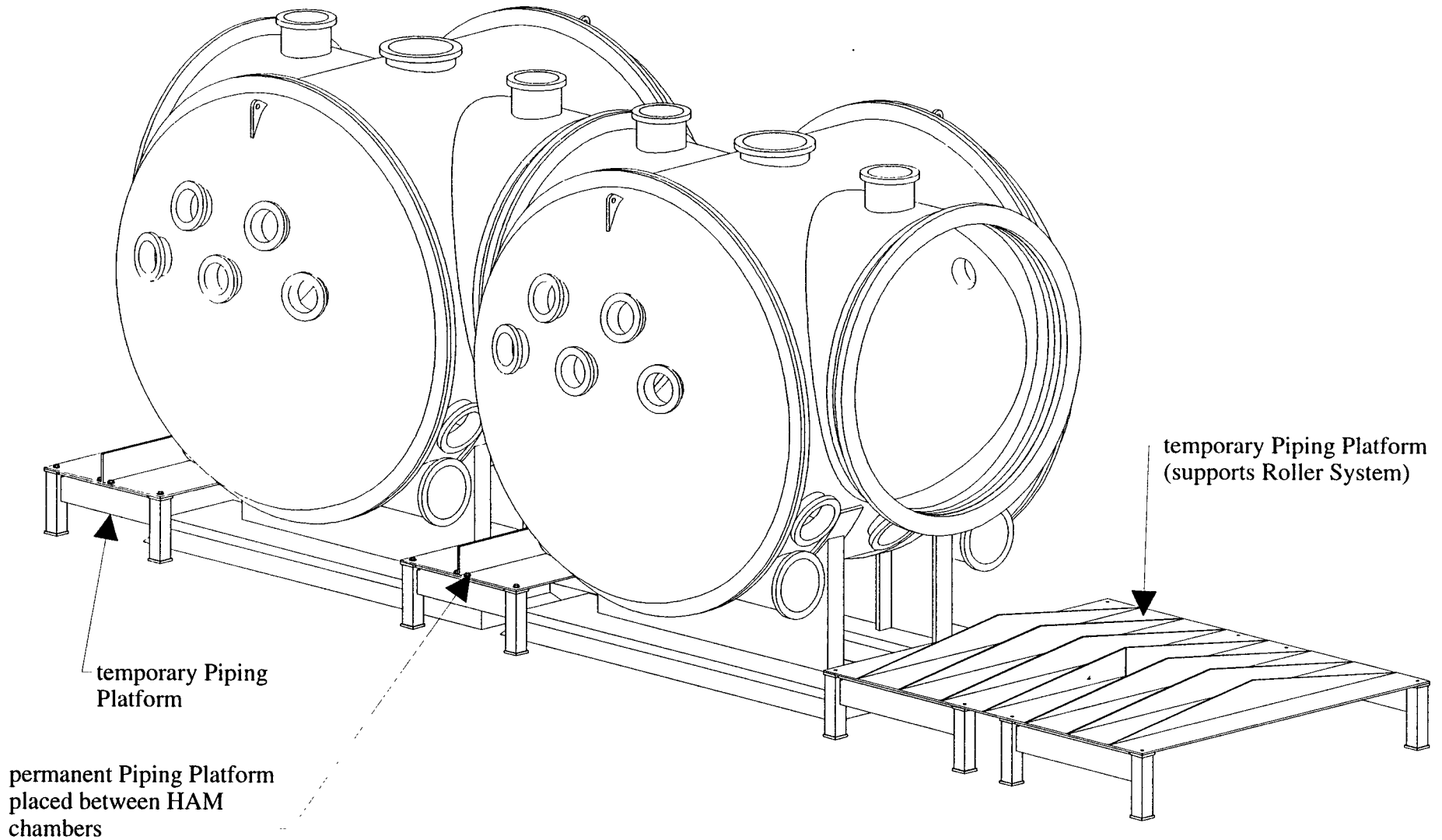
## Piping Platform Being Hoisted





# LIGO HAM Assembly PDR

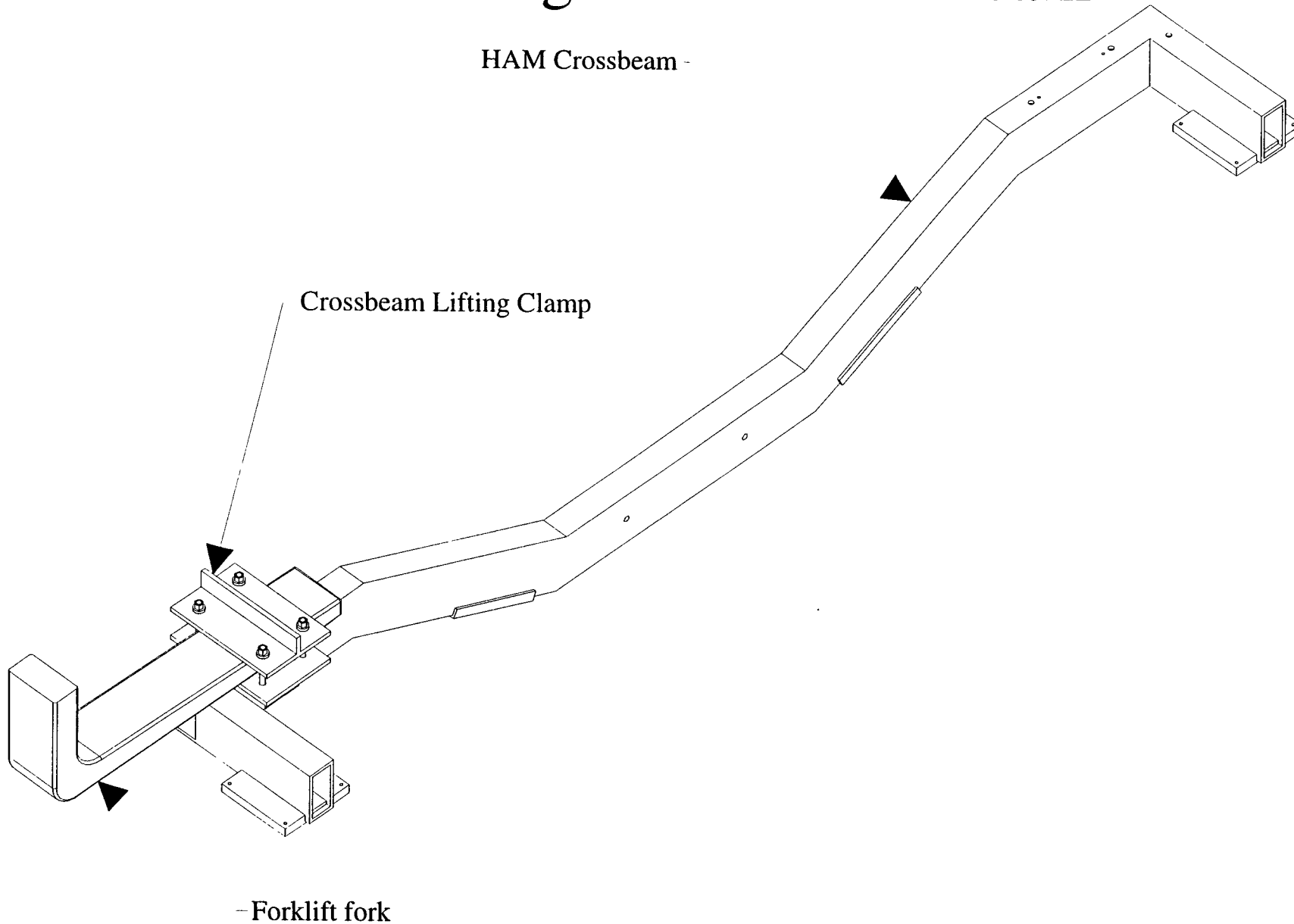
## Piping Platforms Located in Position for Two Chambers



# LIGO HAM Assembly PDR

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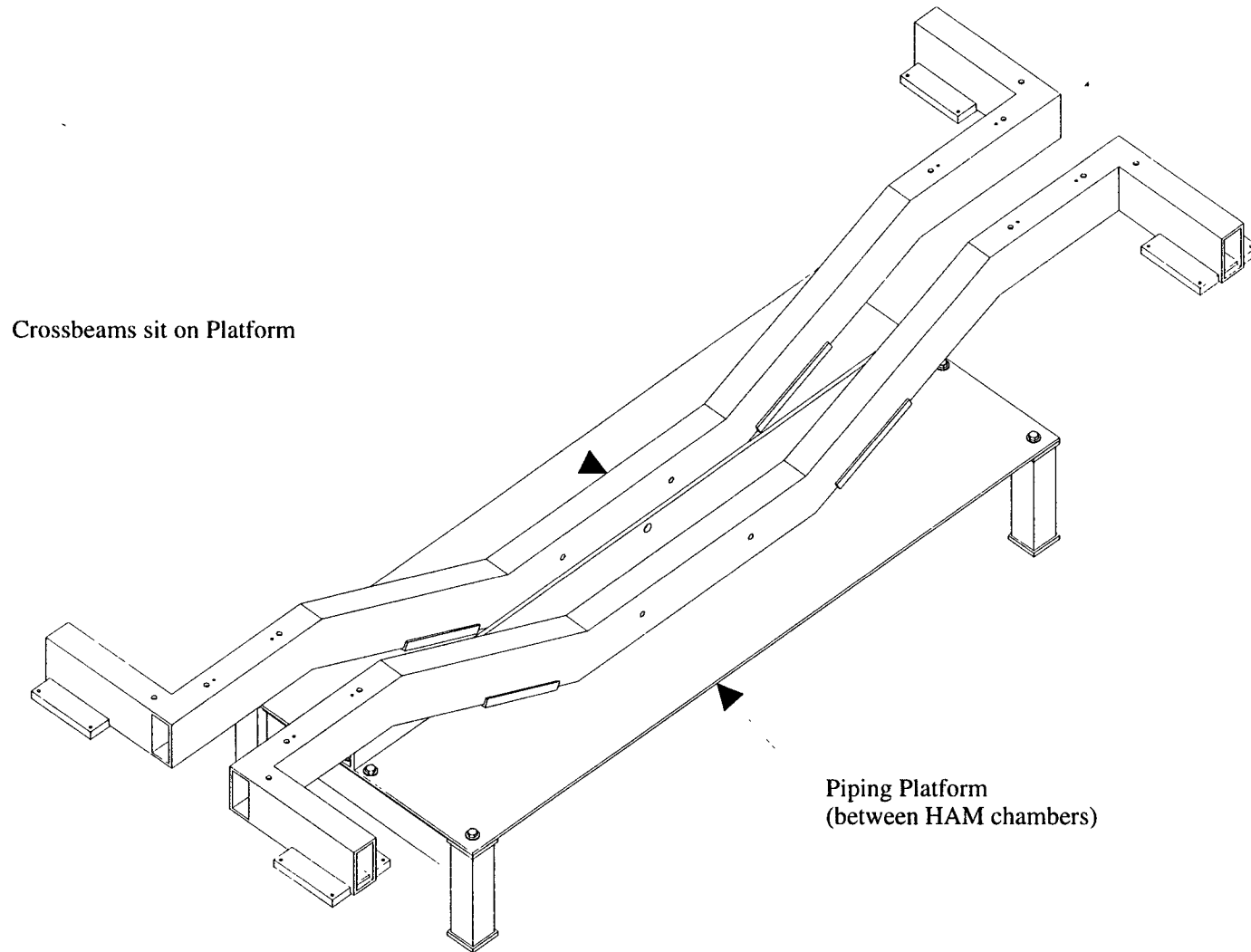
## Hoisting a HAM Crossbeam



# LIGO HAM Assembly PDR

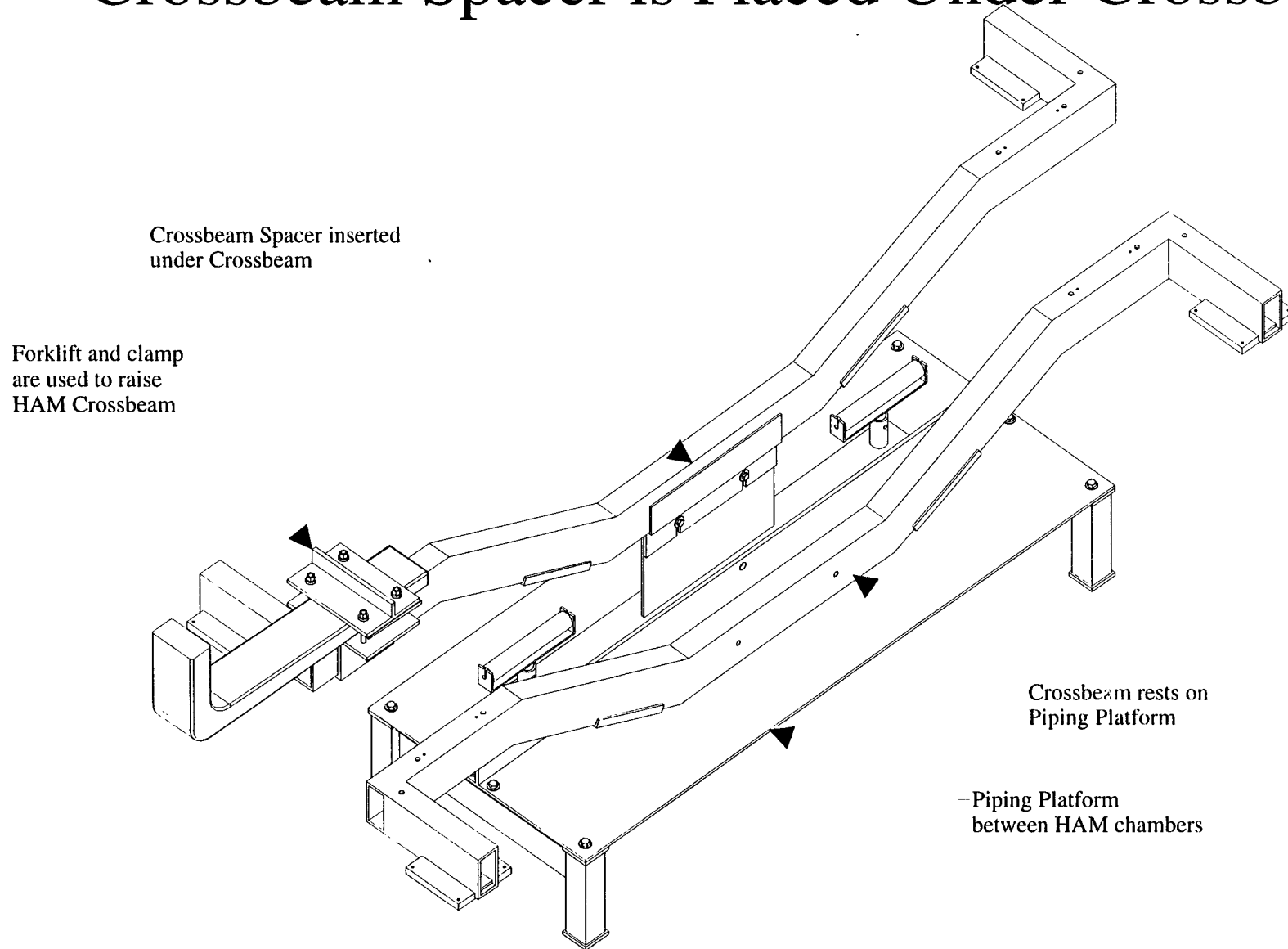
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## Two HAM Crossbeams on a Piping Platform



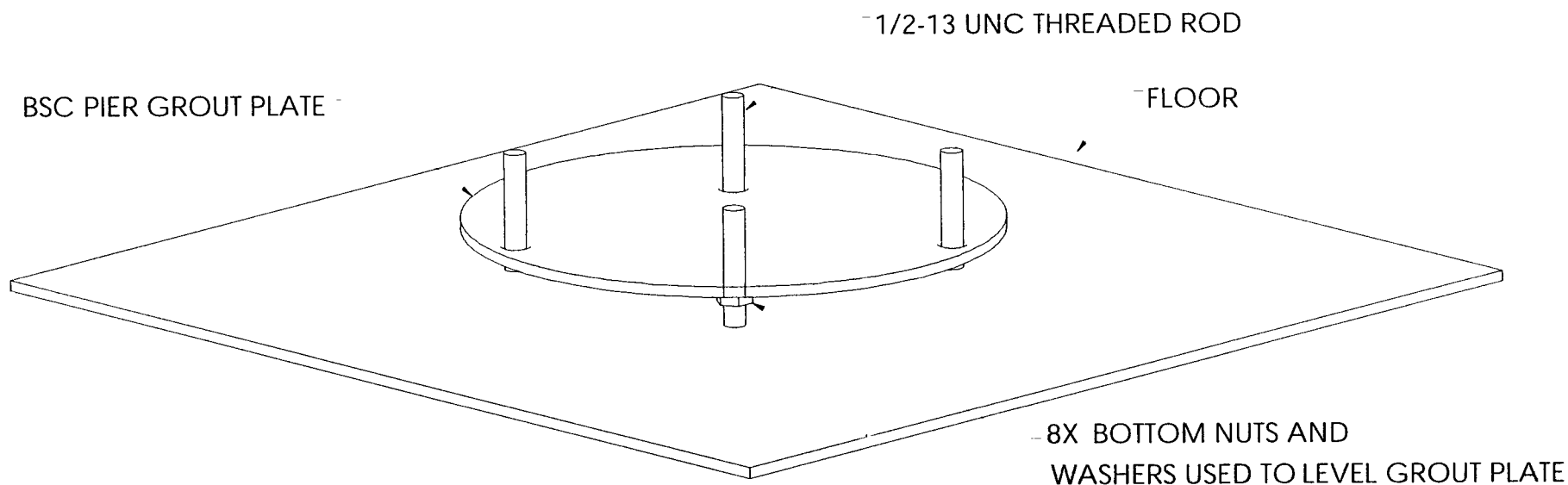
# LIGO HAM Assembly PDR

## Crossbeam Spacer is Placed Under Crossbeam



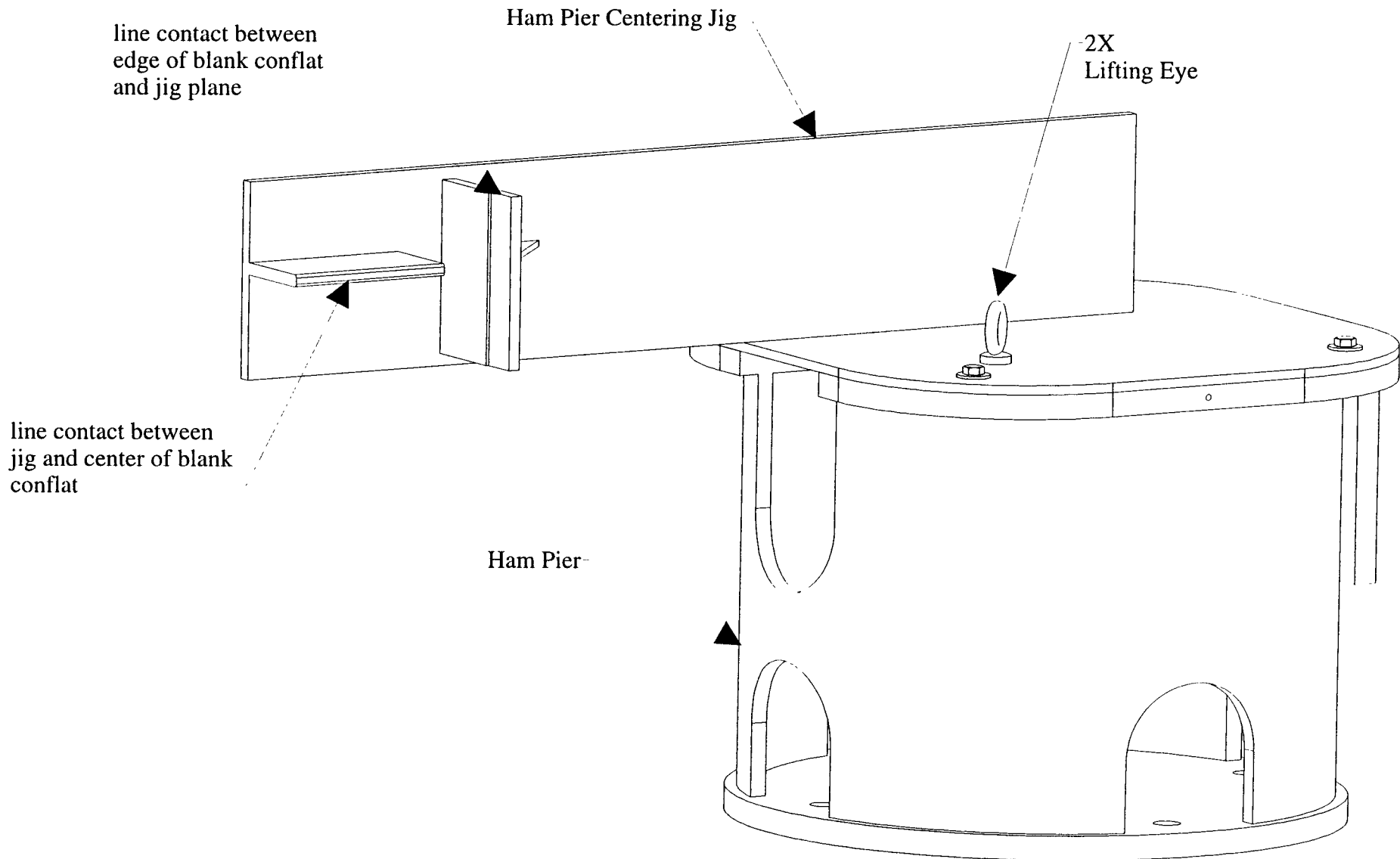
# LIGO HAM Assembly PDR

## Pier Grout Plate Installation



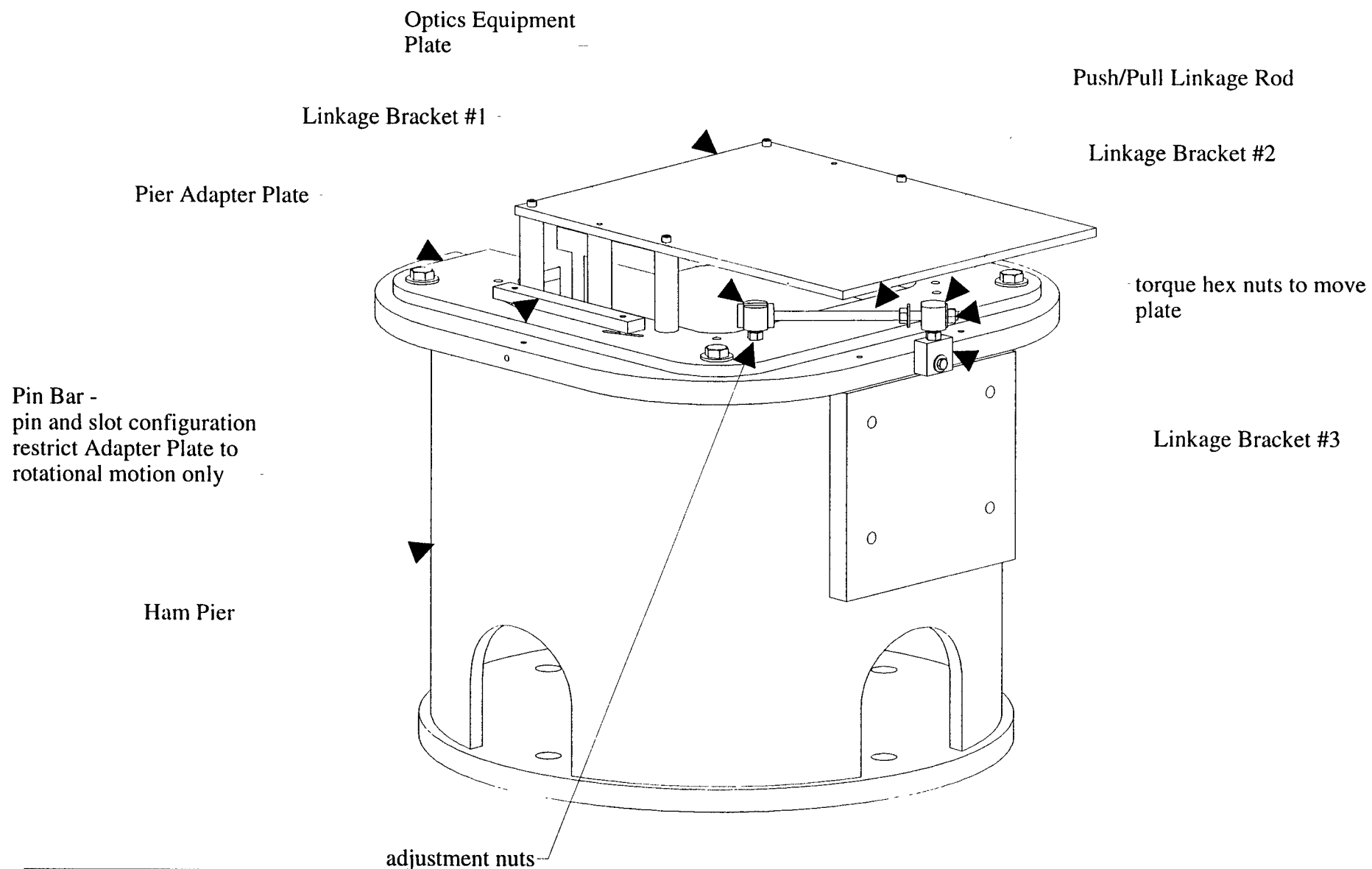
# LIGO HAM Assembly PDR

## HAM Pier with Centering Jig



# LIGO HAM Assembly PDR

## Leveling and Clocking Pier Adapter Plate



# LIGO HAM Assembly PDR

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## Translating Pier Adapter Plate

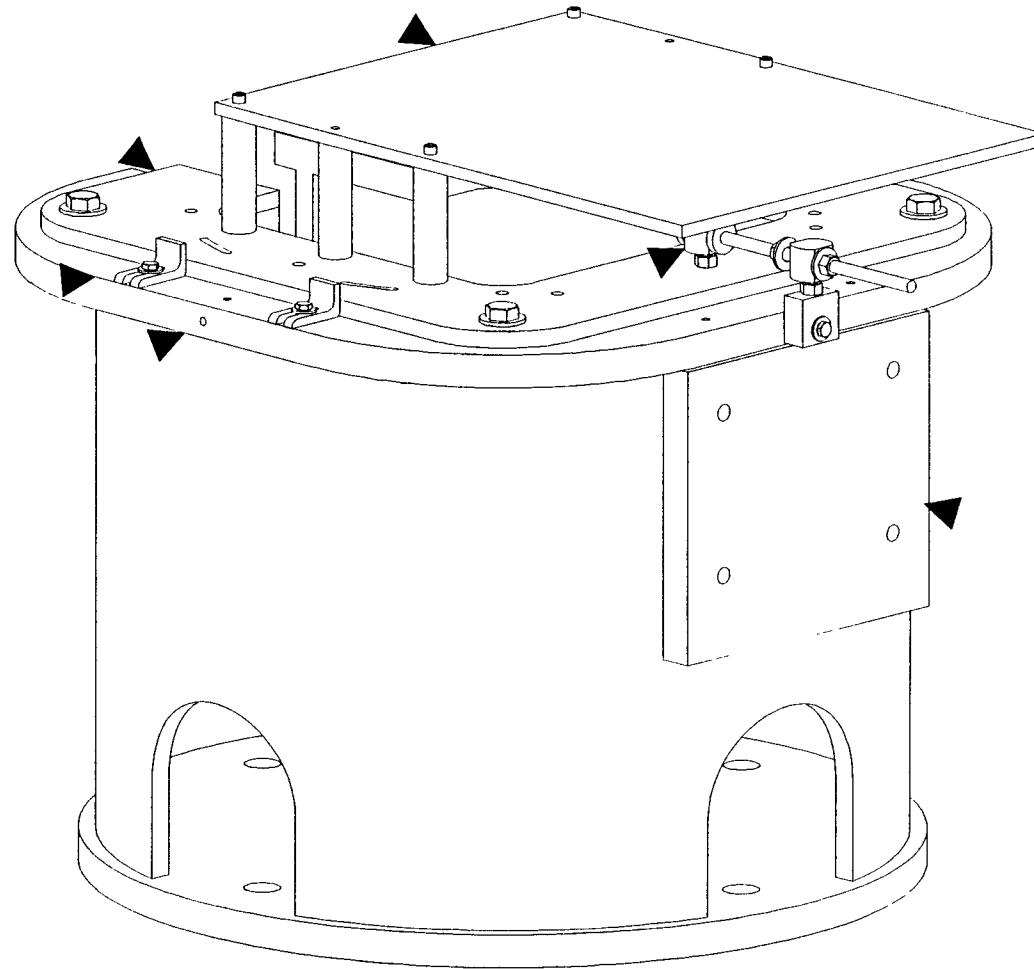
Optics Equipment Plate  
remains bolted in position -

Pier Adapter Plate -

Guide Brackets restrict  
Adapter Plate to linear  
motion only

same linkage setup  
assembled here for  
transverse motion -

Linkage Bracket #1  
moved to this position  
for linear motion



Ham Pier

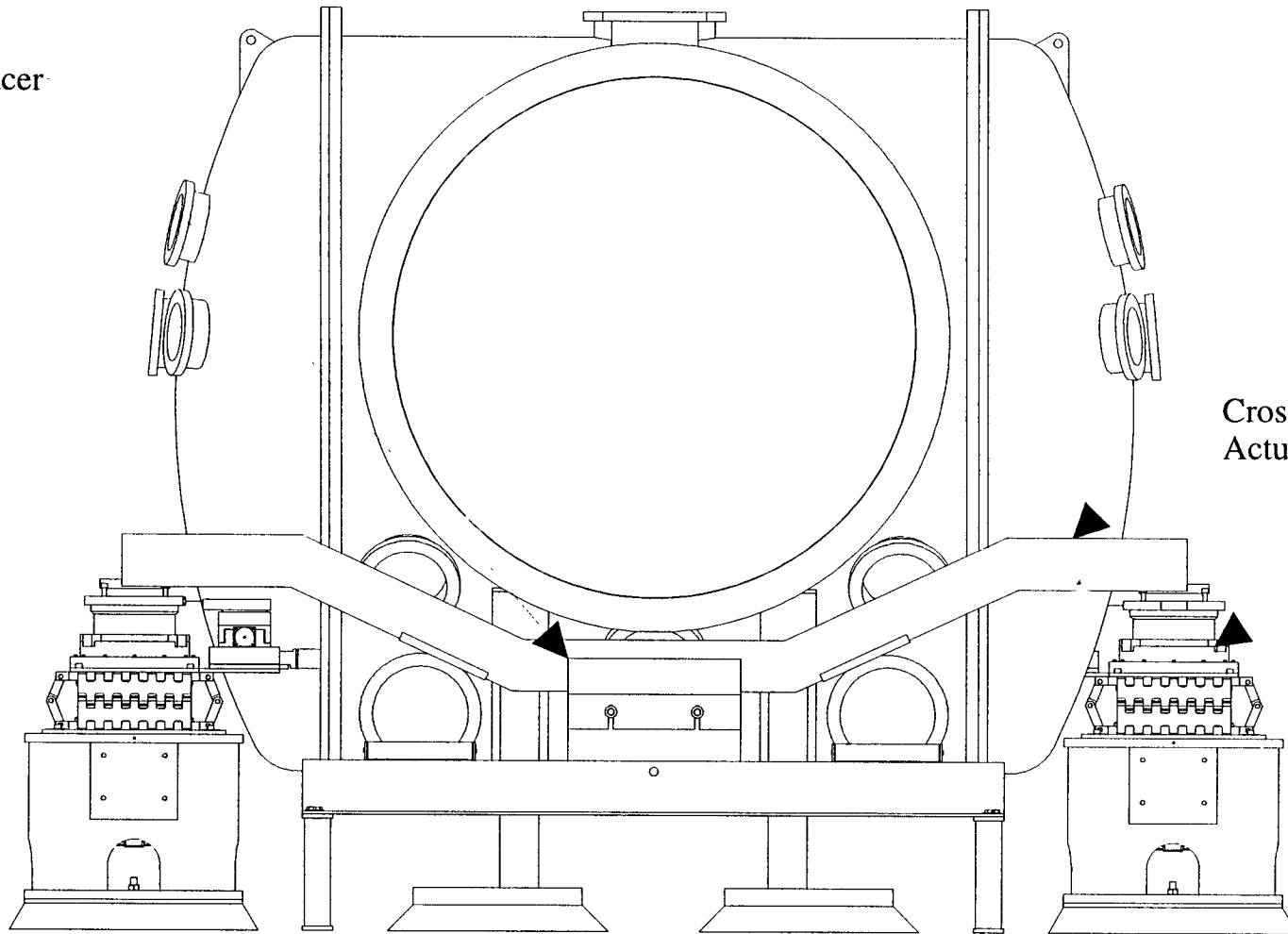


# LIGO HAM Assembly PDR

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## Actuator Columns Installed

Crossbeam Spacer

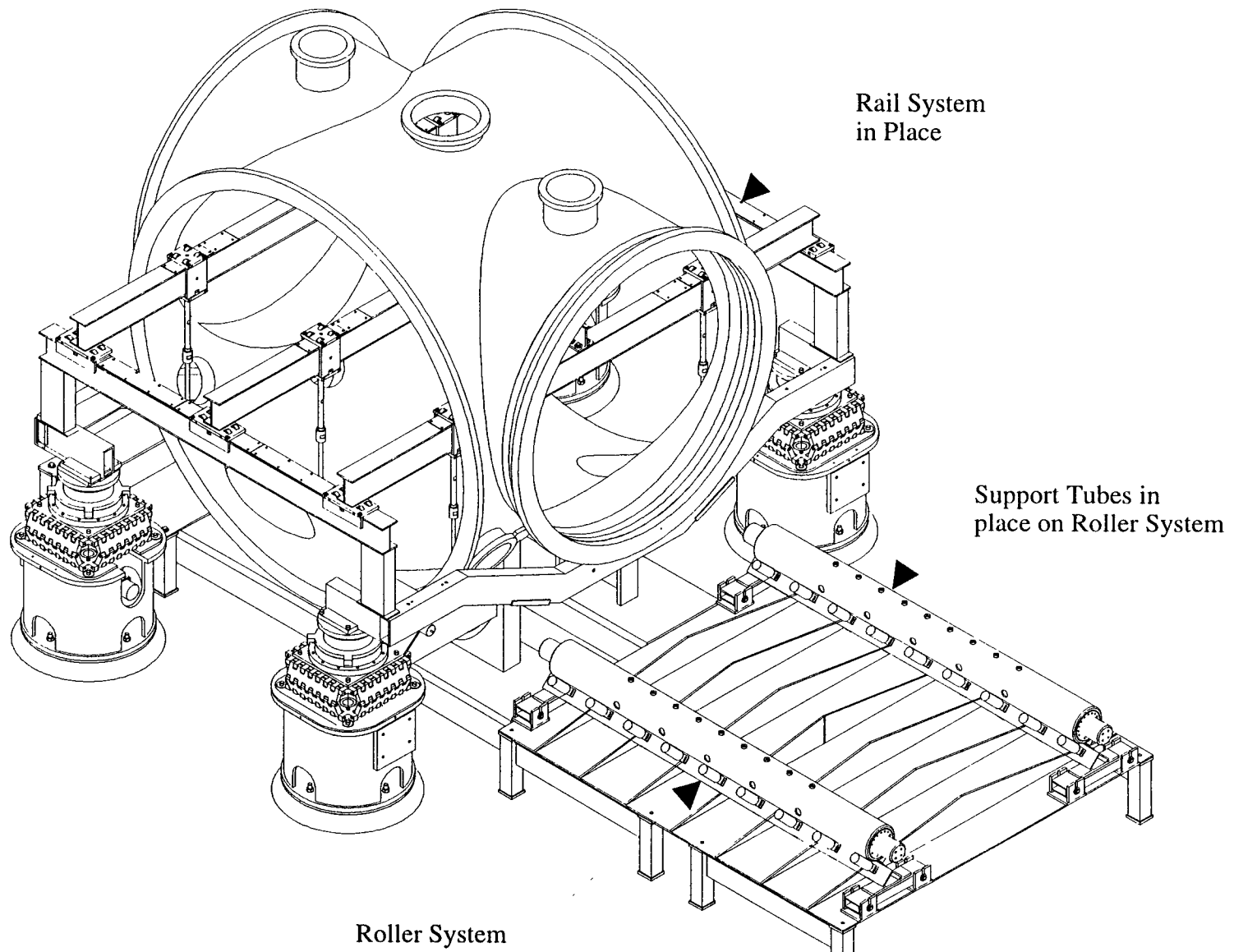


Crossbeam height allows  
Actuation System placement

Actuation System  
hoisted in place

# LIGO HAM Assembly PDR

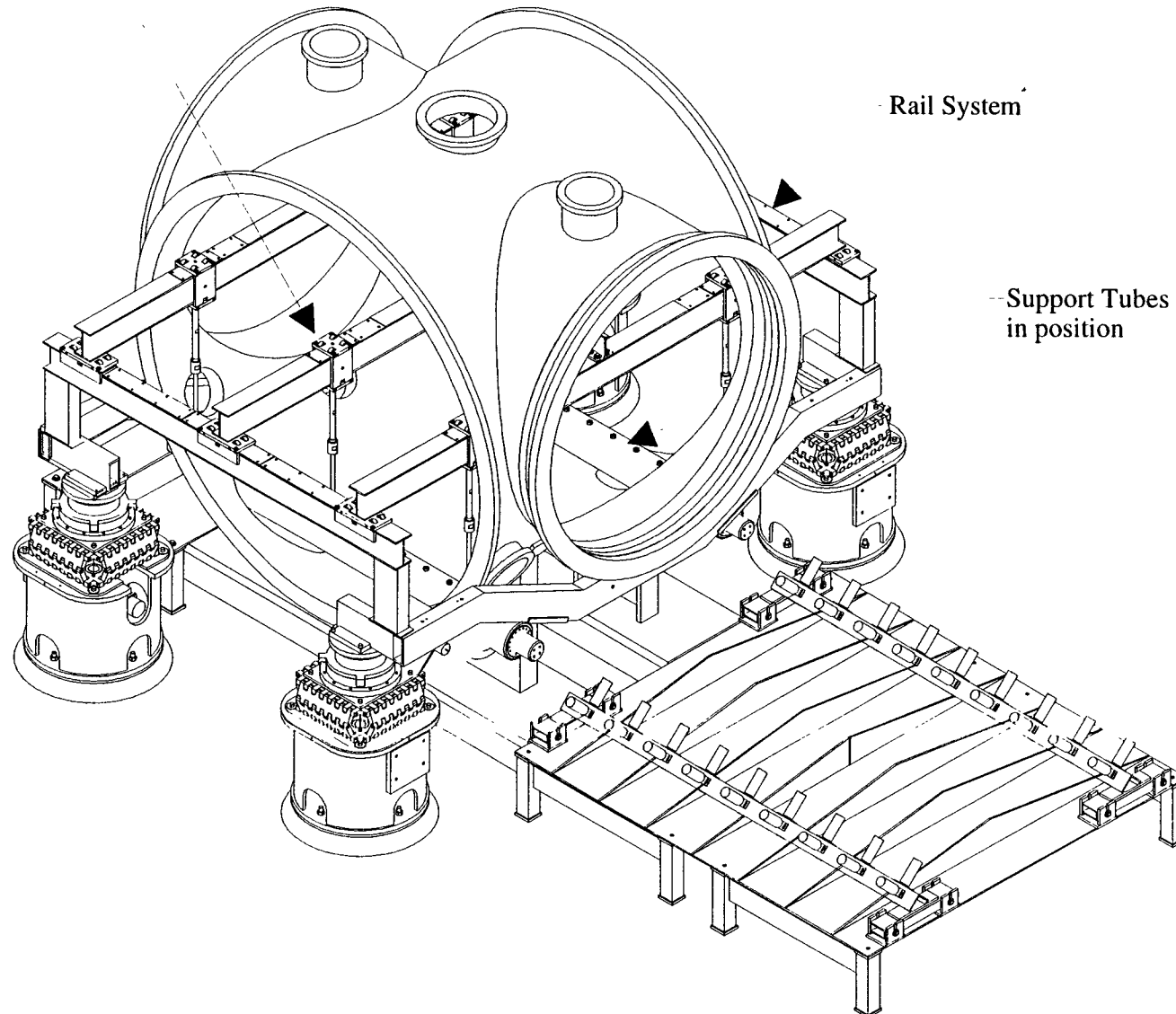
## Support Tubes in Roller System



# LIGO HAM Assembly PDR

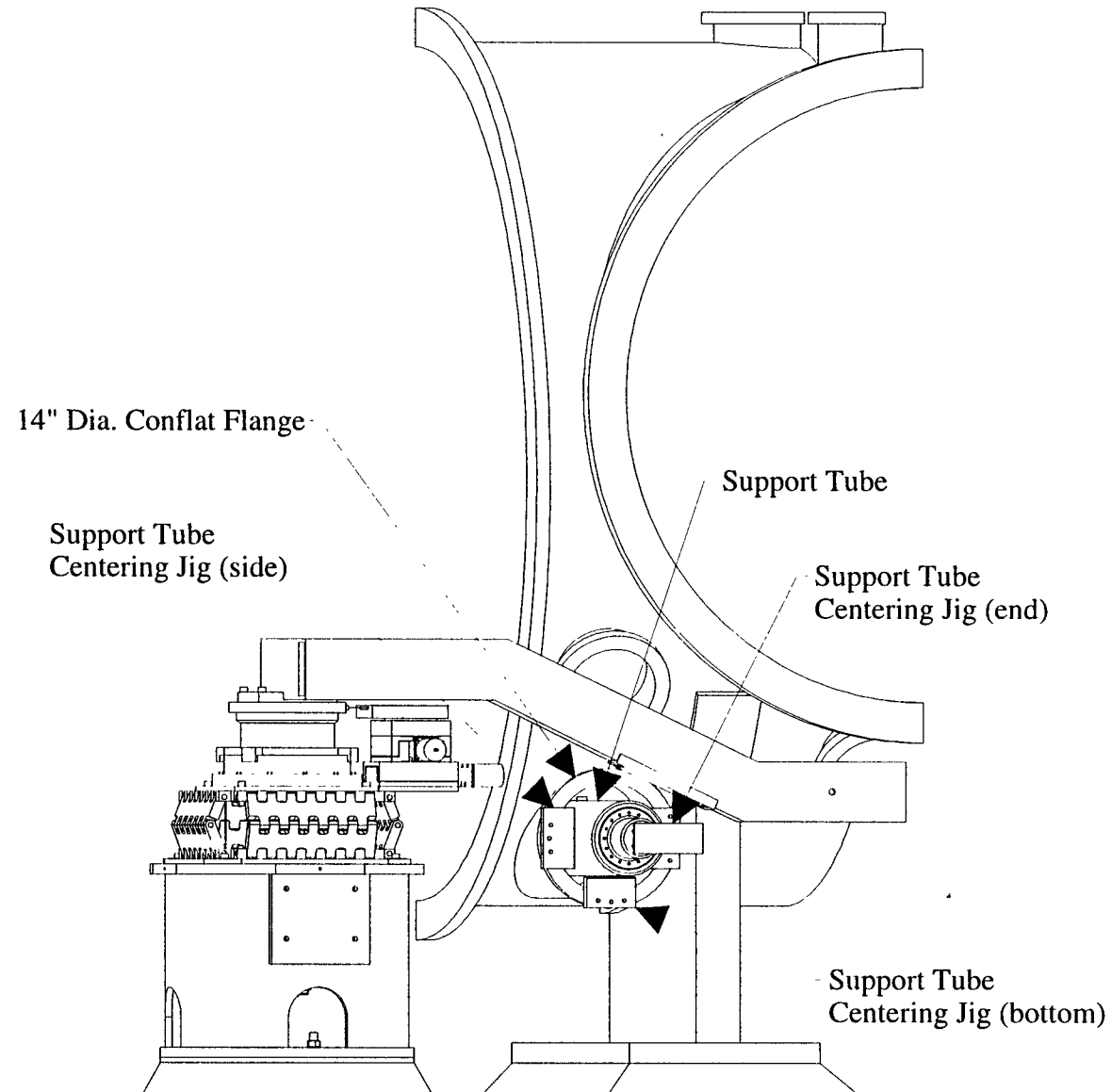
## Support Tubes in Position

Trolleys and Linkages  
support the Support Tubes



# LIGO HAM Assembly PDR

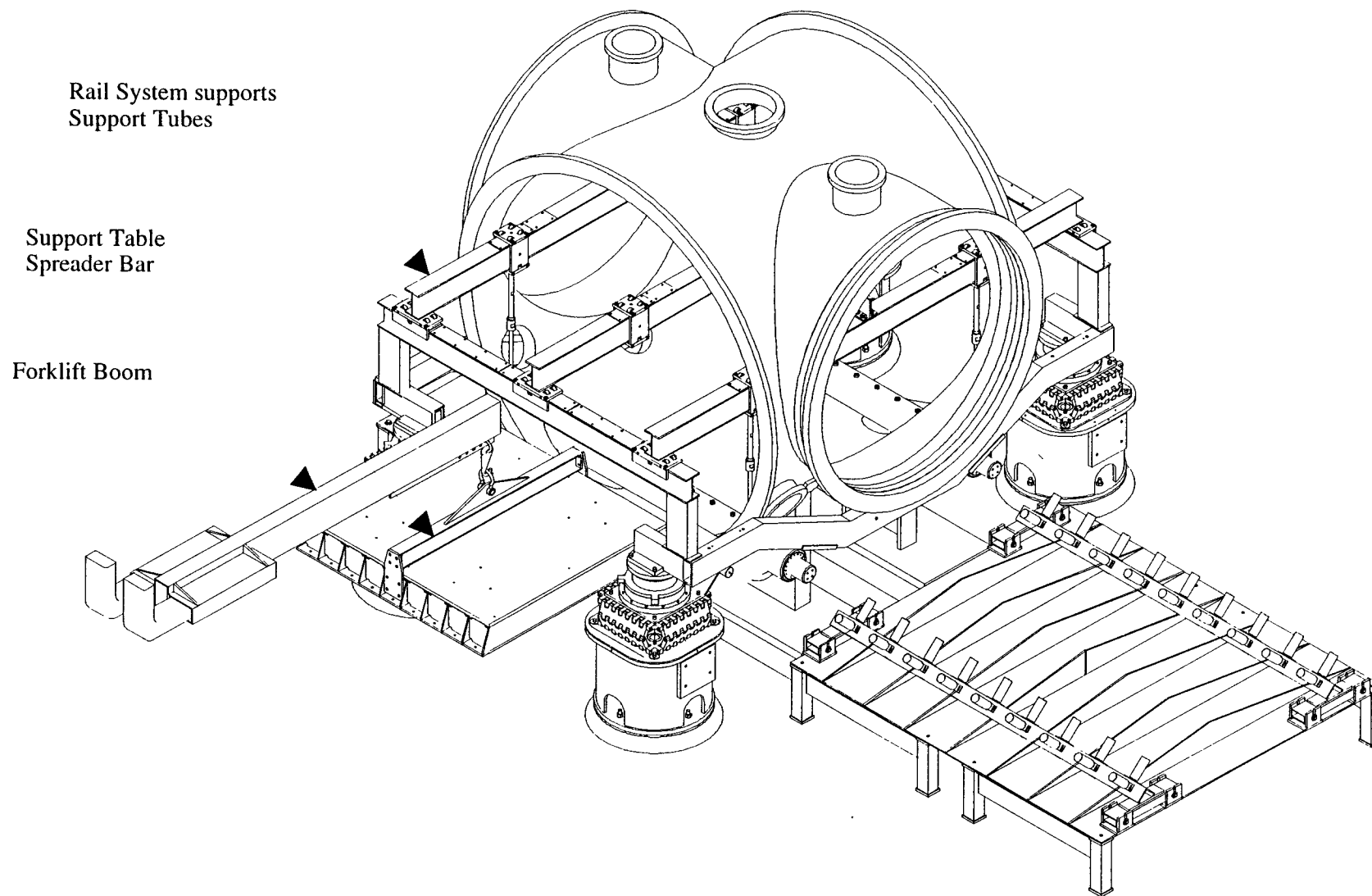
## Support Tube Centering Jigs



# LIGO HAM Assembly PDR

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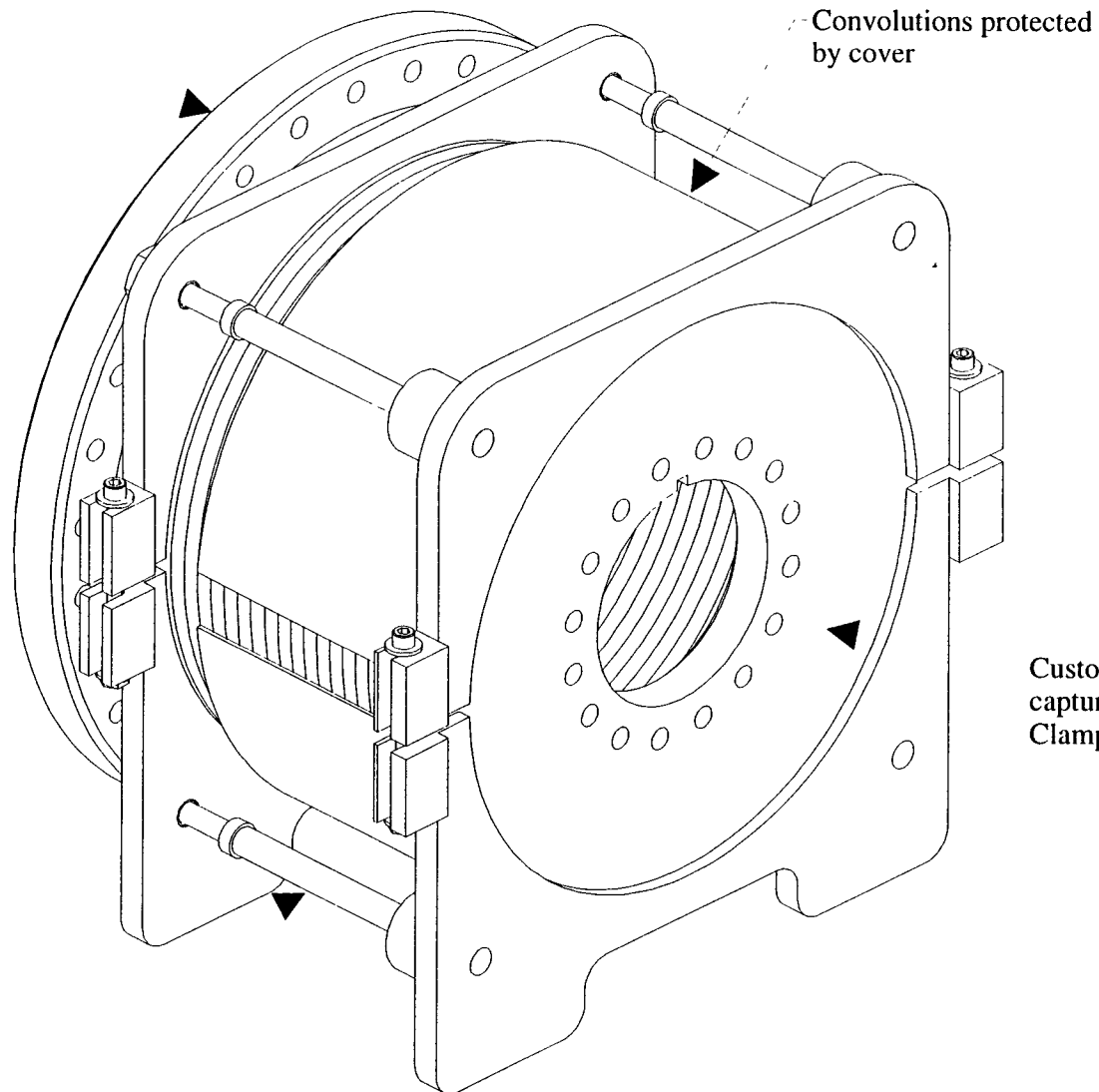
## Hoisting the Support Table



# LIGO HAM Assembly PDR

## Bellows Compression Clamp

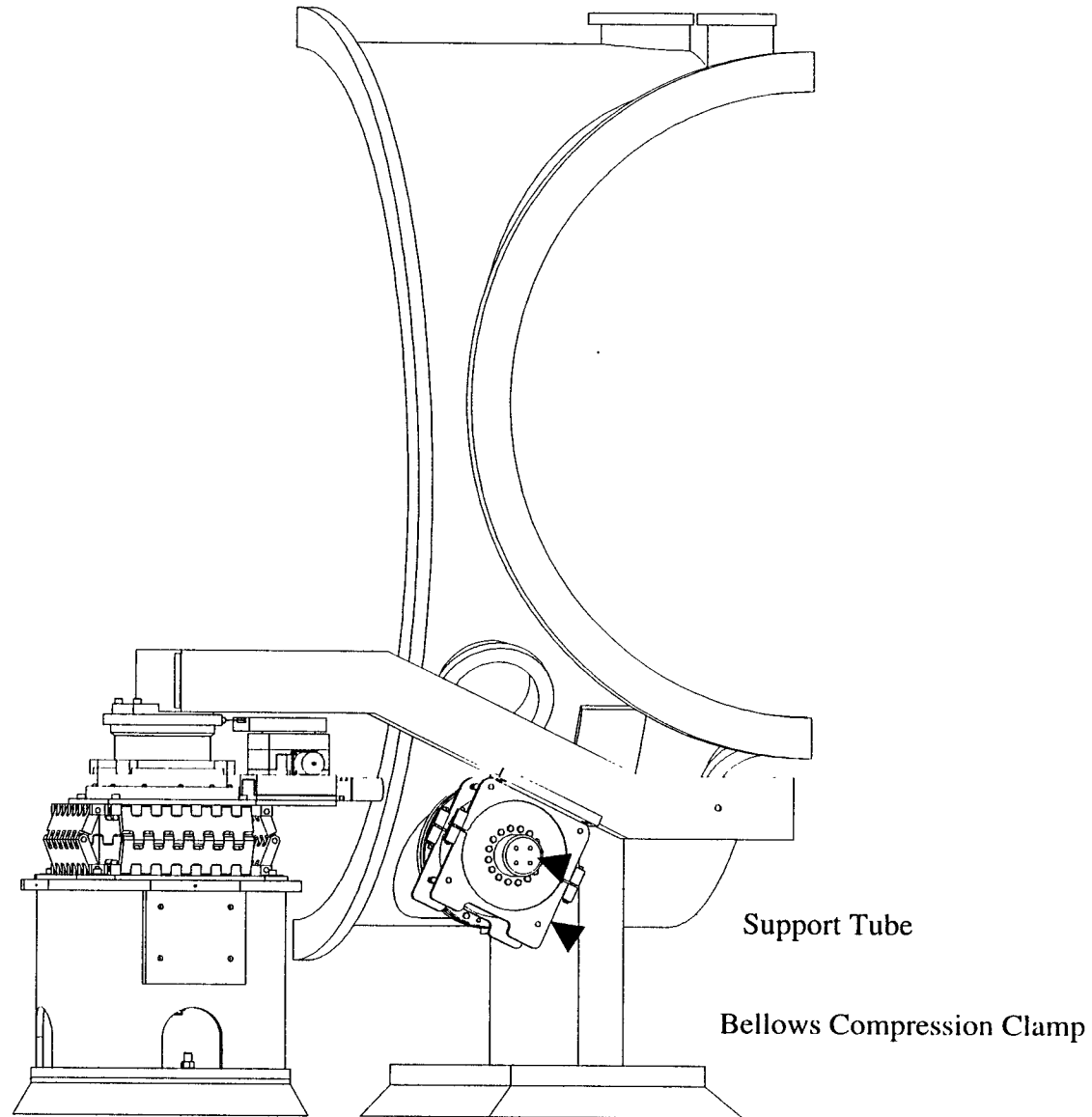
14.0" O.D. Conflat Flange



# LIGO HAM Assembly PDR

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## Bellows Being Installed



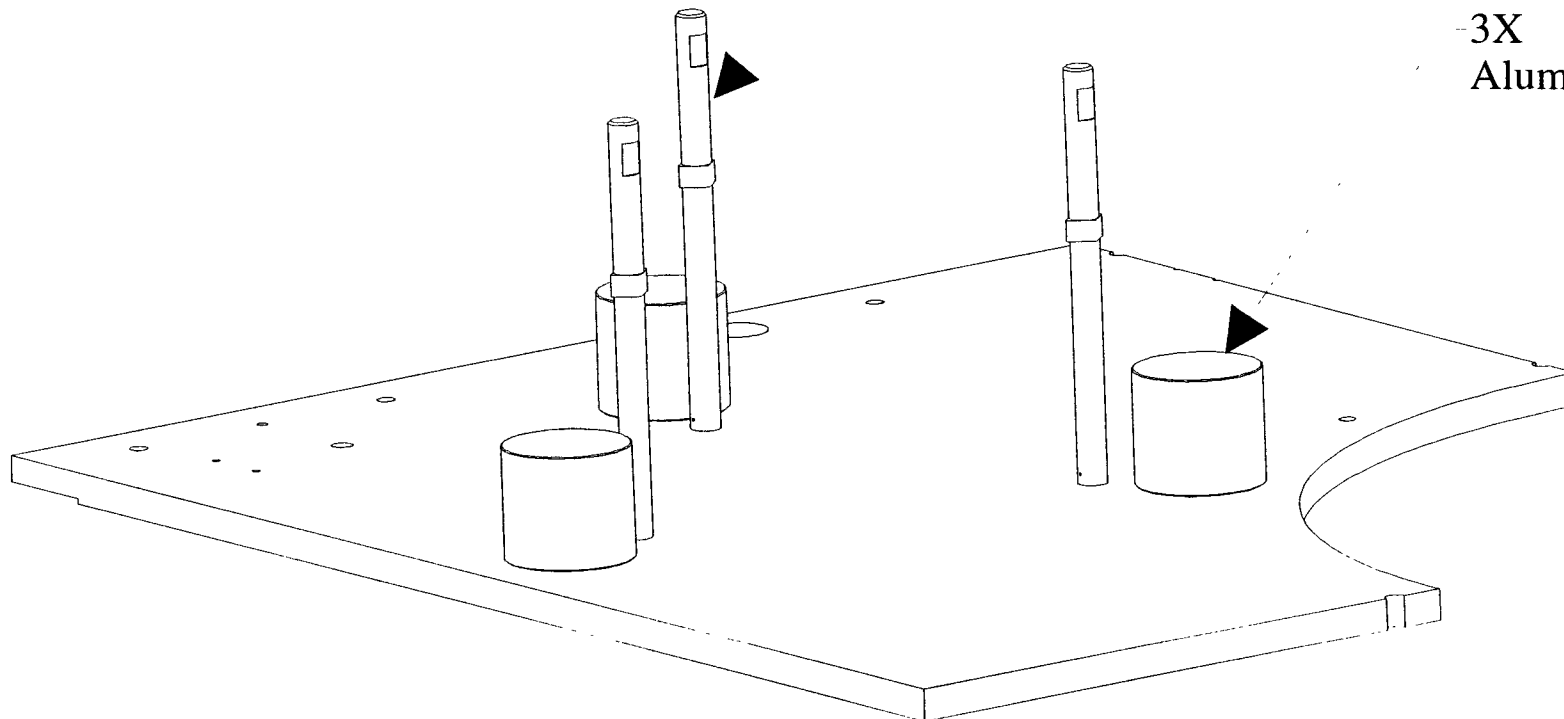
# LIGO HAM Assembly PDR

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## Preparation for Leg Element #1

-3X  
Centering Pins

-3X  
Aluminum Spacers





# LIGO HAM Assembly PDR

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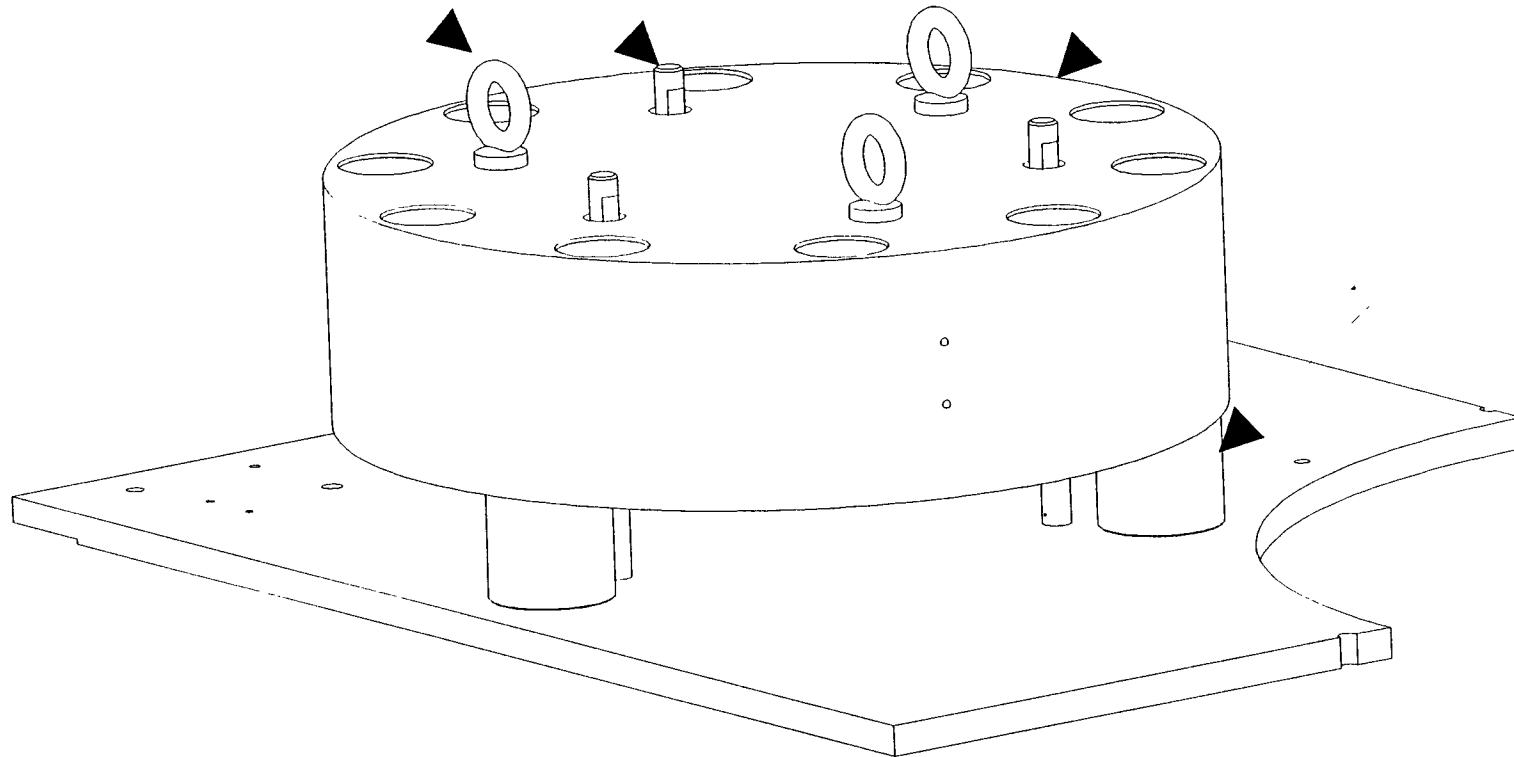
## Leg Element #1 Lowered Into Position

3X  
Centering Pins

3X  
Lifting Eye

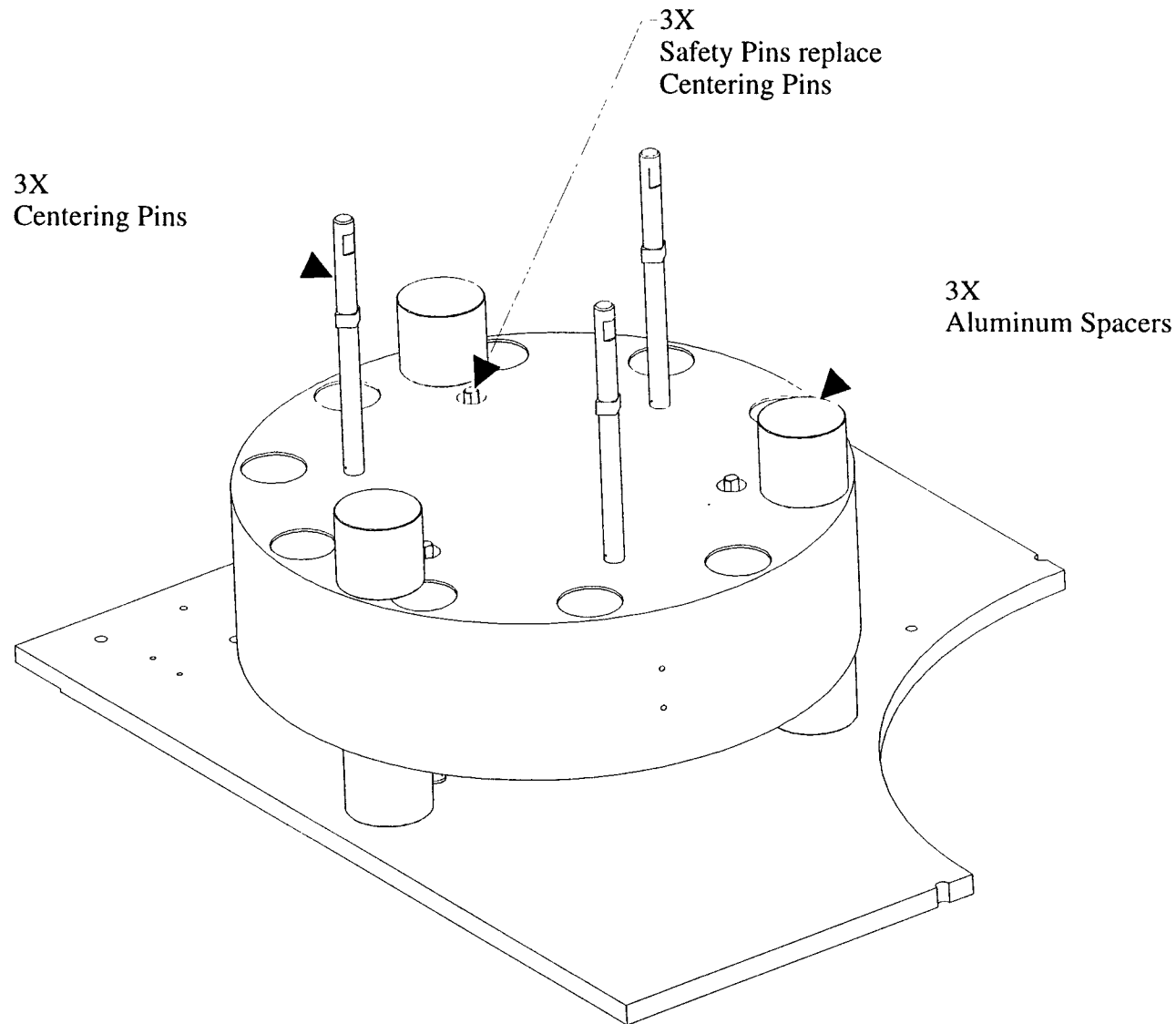
Leg Element #1

3X  
Aluminum Spacers



# LIGO HAM Assembly PDR

## Preparation for Leg Element #2

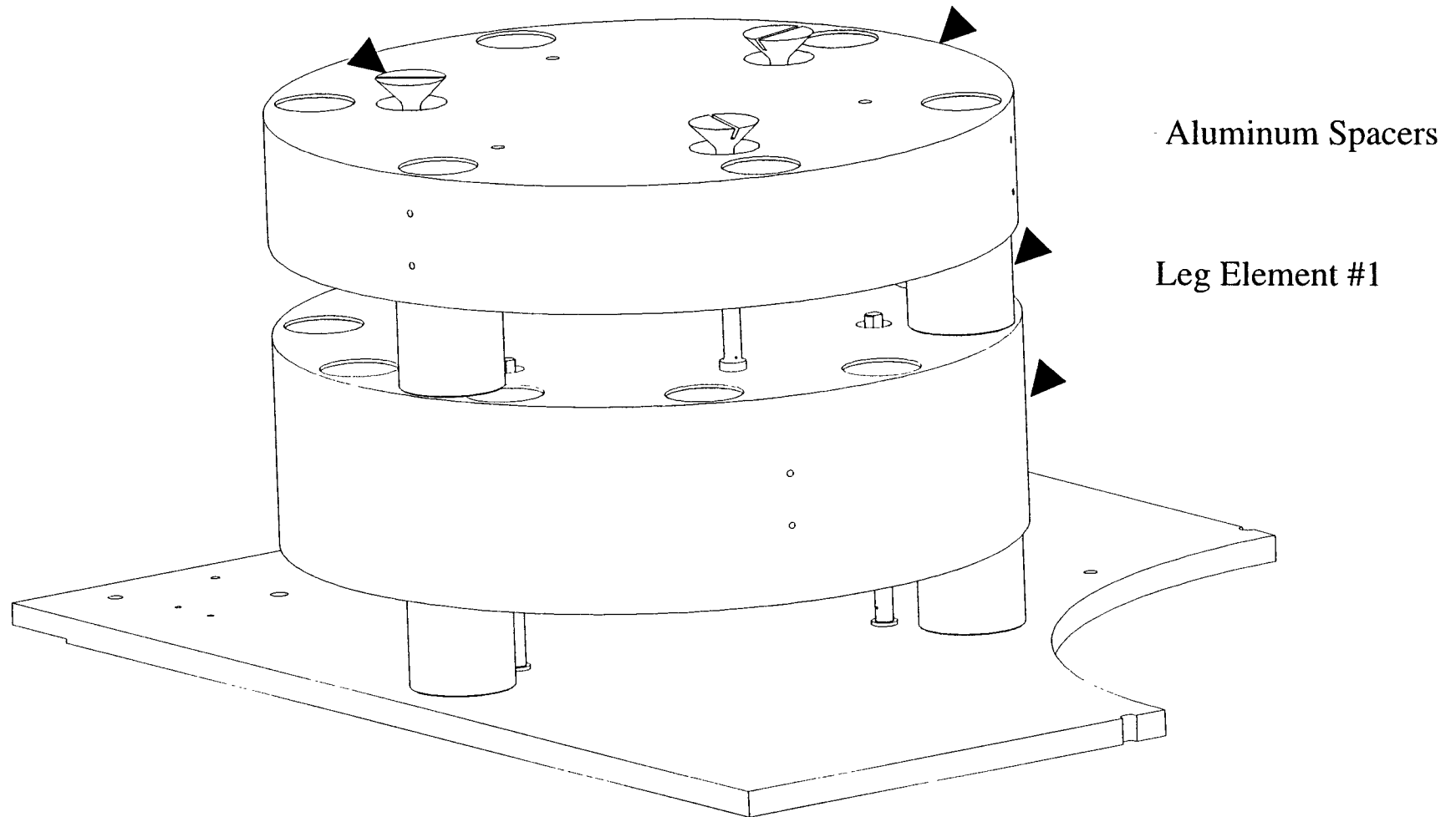


# LIGO HAM Assembly PDR

## Leg Element #2 in Position with Safety Pins

3X  
Safety Pins

Leg Element #2



# LIGO HAM Assembly PDR

## Stack Assembly Complete

Safety Pins

