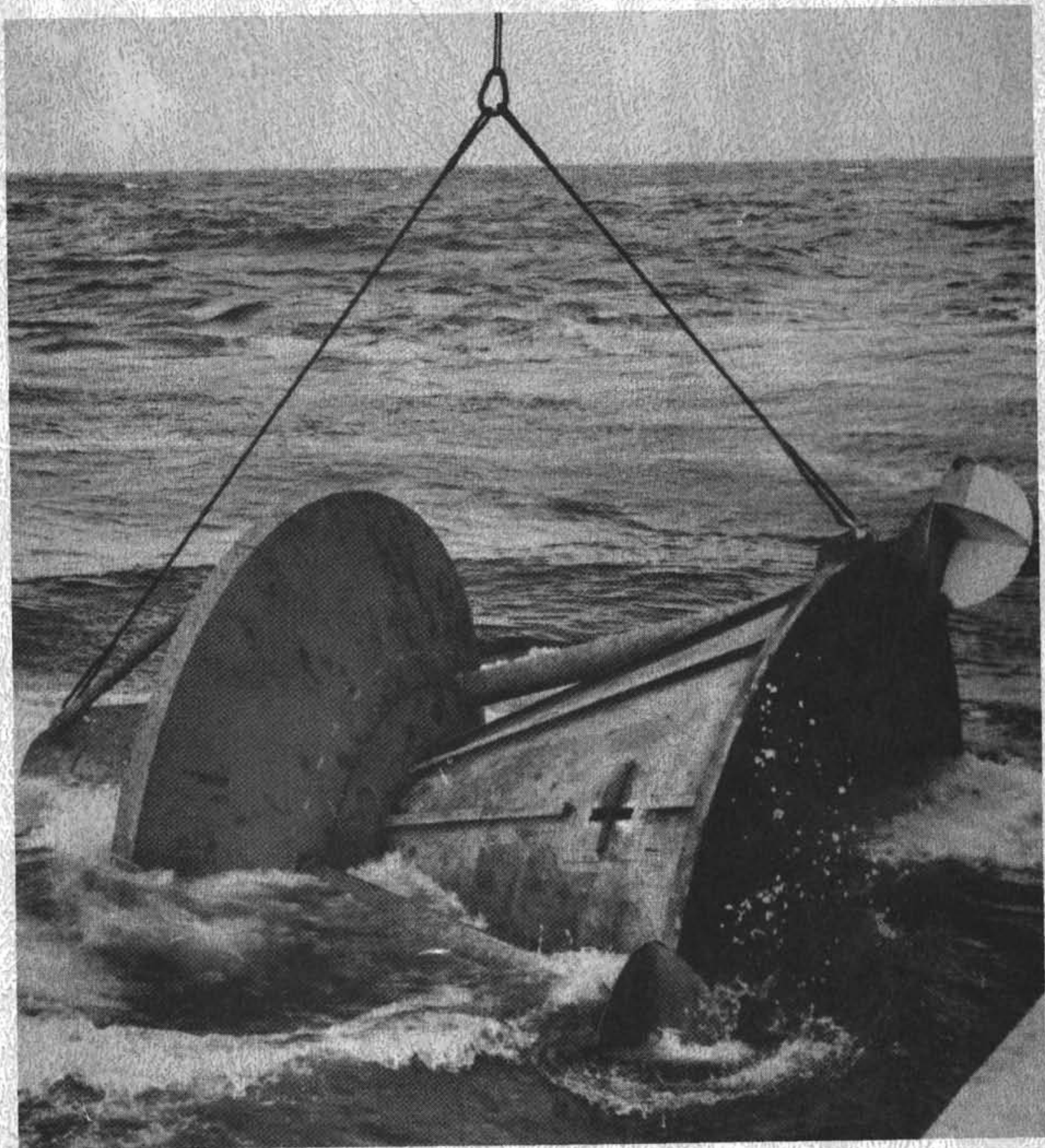
INTERNATIONAL PHASE OF OCEAN DRILLING (IPOD)
DEEP SEA DRILLING PROJECT
DEVELOPMENT ENGINEERING
TECHNICAL REPORT NO. 13

REENTRY CONE MULTIPLE CASING HANGER SYSTEMS



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UNIVERSITY OF CALIFORNIA AT SAN DIEGO
CONTRACT NSF C-482
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DISCLAIMER

THE COVER PICTURE

New style "Dual Casing Hanger" Re-entry Cone is being deployed from the *GLOMAR CHALLENGER* in preparation for the keelhauling operation. The cone is designed to accept both 16" and 11-3/4" casing strings. Note the advanced design has a steel "mudskirt" for increased bearing resistance and diverter pipes for enhanced cuttings removal. The cones are routinely deployed in the sideways configuration to prevent rapid filling with seawater followed by ship's heave snapping the lifting slings. Photo taken on Leg 45 (December 1975)

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LA JOLLA, CALIFORNIA 92093

January 9, 1984

Please note the following changes to

Table I - Re-entry Cone Deployment History

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(1) Map No. 1, Leg 15, Site 146. -
Water depth should be 3957 meters.

(2) Map No. 14, Leg 53, Site 418A -
Sonic/Caliper/Gamma Ray Logging tool with 300 m of cable may be left in hole. Cable parted during drill string trip. Tool may or may not be in hole. Caution should be encouraged in future operations.

Revised: January 1984

M. A. Storms

TABLE I
REENTRY CONE DEPLOYMENT HISTORY

P ①	LEG NO.	SITE NO.	CONE LOCATION		WATER DEPTH (m)	PENET. DEPTH (m)	CASING LENGTH (m)		NO. OF RE.	REMARKS
			LATITUDE	LONGITUDE			16"	11 3/4"		
1	15	146	15° 06.99'N	69° 22.67'W	3957*	762	50②	②	2	Hole open
2	30	288A	5° 58.35'S	161° 49.53'E	3030	999	56②	②	2	Hole bridged
3	34	319A	13° 01.04'S	101° 31.46'W	4296	157	65②	②	1	Hole open
4	34	320B	9° 00.40'S	83° 31.80'W	4487	183	65②	②	1	Hole open
5	37	332B	36° 52.76'N	33° 38.57'W	1841	721	68②	②	9	Sidetracked hole
6	37	333A	36° 50.45'N	33° 40.05'W	1682	529	70②	②	1	D.P. left in hole
7	45	395A	22° 45.35'N	46° 04.90'W	4485	664	62	109	13	Sinker bar in hole
8	46	396B	22° 59.14'N	43° 30.90'W	4465	406	120	163	7	Hole open
9	47	398D	40° 57.60'N	10° 43.10'W	3900	1740	③	80	2	Hole open
0	48	400A	47° 22.90'N	9° 11.90'W	4399	778	75	——	1	D.P. left in hole
1	50	415A	31° 01.65'N	11° 39.97'W	2817	1080	68	331	3	Reflector obscured
2	50	416A	32° 50.18'N	10° 48.06'W	4203	1605	40	——	9	Hole open
3	51B	417D	25° 06.69'N	68° 02.82'W	5489	709	113	——	3	BHA left in hole
"	52	"	"	"	"	"	"	——	7	"
4	52	418A	25° 02.08'N	68° 03.45'W	5519	868	71	——	4	Hole open
	53		"	"	"	"	"	——	9	Sonic/CAL/GR Tool in Hole?*
5	55	433C	44° 46.63'N	170° 01.23'E	1874	551	45	——	3	Hole open
6	57	438B	40° 37.80'N	143° 14.80'E	1575	1039	41	——	1	D.P. left in hole
7	58	442B	28° 59.04'N	136° 03.43'W	4645	455	65	——	2	Hole open
8	61	462A	7° 14.50'N	165° 01.90'E	5186	1206	75	——	15	Hole open
"	89	"	"	"	"	"	"	——	4	"
9	65	482D	22° 47.31'N	107° 59.51'W	3012	187	60	——	1	D.P. left in hole
0	65	483B	22° 52.99'N	108° 14.84'W	3084	267	66	123	7	Blocked at cone
1	69	504A	1° 13.61'N	83° 43.95'W	3468	278	90	——	2	Bit cones in hole
2	69	504B	1° 13.61'N	83° 43.81'W	3474	1350	90	——	6	Hole open
"	70	"	"	"	"	"	"	——	4	"
"	83	"	"	"	"	"	"	——	16	"
"	92	"	"	"	"	"	"	——	1	"
3	76	534A	28° 20.63'N	75° 22.89'W	4976	1647	86	533	8	Hole open
4	79	547B	33° 46.84'N	9° 20.98'W	3952	1030	28	——	3	Hole open
5	81	553A	56° 05.32'N	23° 20.61'W	2339	683	60	——	2	Bit released in hole
6	88	581B	43° 55.66'N	159° 47.77'E	5478	372	72	364	2	D.P. left in hole
7	91	595B	23° 49.30'S	165° 31.60'W	5630	124	34	74	3	Hole open
8	92	597C	18° 48.39'S	129° 46.23'W	4157	110	40	——	2	Hole open
9	93	603B	35° 27.70'N	70° 01.90'W	4644	1585	72	500	4	D.P. left in hole

① Refer to Reentry Cone Deployment Map (Figure 13)
② Only 13 3/8 single casing string was available prior to Leg 45
③ Only 11 3/4 casing was run with special adapter to cone

TECHNICAL REPORT NO. 13

Prepared for the
National Science Foundation
National Ocean Sediment Coring Program
Under Contract C-482
by the
University of California
Scripps Institution of Oceanography
Prime Contractor for the Project

October 1983

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INTRODUCTION

This Deep Sea Drilling Project Technical Report No. 13 includes a paper on the analysis, design and operation of the Re-entry Cone/Dual Casing Hanger System authored by M. A. Storms and J. H. Gerken. Operational details, a design review and an evaluation of soil support for the re-entry structure are included in an appendix.

The Re-entry Cone/Dual Casing Hanger System was developed to permit deeper penetrations into the ocean margins as well as significant penetrations into the volcanic basement underlying the ocean floor.

Scientific objectives required the drilling and coring of 500 to 1000 meters of unconsolidated sediments, clays, and chert stringers, before reaching basement rock. This deep water re-entry system, therefore, had to be capable of being set in water depths exceeding 6,000 meters, allow drilling through sedimentary layers 1000 meters thick, permit casing to be run and cemented, and provide for an unlimited number of re-entries. In association with Deep Oil Technology of Long Beach (now Fluor Subsea Systems), DSDP initiated a program to define and develop the required deep water re-entry hardware.

Modifications to the original re-entry system provided for an increased conductor casing diameter of 16" and an improved means for diverting the cuttings to the seafloor. In addition, the casing hanger assembly provided for the landing of an 11-3/4" protective string with provisions for cementing and conductor casing settling. All modifications were done so as to maintain compatibility with existing project running tools and consistent with past *GLOMAR CHALLENGER* operational procedures.

In anticipation of the substantial casing loads for the modified Re-entry Cone/Hanger System, a soils investigation was initiated by Dames & Moore. The purpose of this analysis was to evaluate the ability of the seafloor sediments to support the re-entry cone and subsequent additional loads imposed by the casing string. The Dames & Moore analysis concluded that the calcareous oozes typical of the deep ocean sediments were insufficient to support a cone/casing system through bearing. As a result, a concept of supporting the jetted in 16" conductor casing through skin friction was recommended.

Having successfully passed sea trials during Leg 44A (November 1975), the Dual Casing Re-entry System was deployed for its first scientific mission on Leg 45 (December 1975). Since that time, re-entry cones have been set at 23 different sites and a total of 144 successful re-entries have been accomplished.

In the spring of 1978, a Triple Casing Hanger System was designed and tested. This system has the conductor string expanded to 20 inches in diameter and a surface protective string 16" in diameter. A third casing string 11-3/4" in diameter is available should additional protection be required downhole. This system has yet to be deployed from the *CHALLENGER* during a scientific mission.

ACKNOWLEDGEMENTS

The DSDP multiple casing hangar/re-entry cone systems may be used to case-off unstable hole at deep penetration sites. This development is an extension of the original single casing re-entry design which proved operational on Christmas Day 1970.

The dual casing design was developed by Mr. M. A. Storms of DSDP in collaboration with Mr. J. H. Gerken of Deep Oil Technology. The triple casing design was developed by Mr. Valdemar F. Larson, DSDP, and Mr. William Fischer, Consultant. Machine drawings for both systems were made by Deep Oil Technology (presently Fluor Sub Sea Systems). Mr. M. A. Storms also edited and compiled Technical Report No. 13 and is the principal author of the paper entitled "GLOMAR CHALLENGER'S DEEP WATER RE-ENTRY CONE/DUAL CASING HANGER SYSTEM" which is a part of this report.

Mr. Valdemar F. Larson's notable technical and operational contributions to re-entry systems since their inception is gratefully acknowledged.

The use of multiple casing hanger re-entry cone systems has led to a maximum penetration, to date, of 1740 meters in 3900 meters water depth off the west coast of Spain, during Leg 47. The longest casing string used with the new system was 533 meters of 29.85 cm O.D. (11-3/4 inch) casing used on Leg 76. The penetration at this site off the U. S. east coast is 1647 meters in a water depth of 4976 meters.

M. N. A. Peterson
Principal Investigator
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IPOD/DSDP/SIO

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A. GLOMAR CHALLENGER'S DEEP WATER RE-ENTRY CONE DUAL CASING HANGER SYSTEM

GLOMAR CHALLENGER'S DEEP WATER RE-ENTRY CONE/DUAL CASING HANGER SYSTEM

by

M. A. Storms
J. H. Gerken

ABSTRACT

Since 1968, when the Deep Sea Drilling Project (DSDP) began its worldwide scientific drilling and coring operations aboard the D/V GLOMAR CHALLENGER, the Project has been at the forefront of deep ocean technology exploring the geologic history of the earth.

In August, 1975, DSDP accepted a new challenge, the International Phase of Ocean Drilling (IPOD). Crucial to this new deep ocean challenge was the refinement of the Project's deep water re-entry hardware to permit penetration of the volcanic basement underlying the ocean floor. This paper covers the analysis, design, and operation of DSDP's deep water re-entry cone/dual casing hanger system developed in 1975.

DEEP SEA DRILLING PROJECT

The Deep Sea Drilling Project (DSDP) began coring in August, 1968, under the auspices of the National Science Foundation's (NSF) Ocean Sediment Coring Program to increase man's knowledge of the earth's development through the exploration of the ocean floor. The prime contract for the Project was executed in 1966 between NSF and the Board of Regents of the University of California (UC). Scripps Institution of Oceanography in La Jolla, California, which is part of the UC system, is responsible for the management and operation of the Project. Global Marine, Inc. (GMI) of Los Angeles, owner, designer, and builder of the *GLOMAR CHALLENGER,* subcontracts with Scripps to provide the drilling vessel for the drilling and coring program.

To plan the scientific objectives of the program, major oceanographic institutions in the United States (including Woods Hole Oceanographic Institution, Lamont-Doherty Geological Observatory of Columbia University, Rosenstiel School of Marine Sciences of the University of Miami, the University of Washington and Scripps), joined in an agreement to mutually support such a program of deep ocean drilling. This association is called the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) and provides scientific guidance for the Deep Sea Drilling Project. Recently the group has been enlarged and now includes nine American and five foreign institutions.

Scientific Achievements

During the Project's first seven years, DSDP and JOIDES have developed a priceless legacy of scientific achievements including:

1. Confirmation of the significant theories of seafloor spreading and continental drift through actual core samples of the continental margins.

2. Determination of the youth of the ocean basins--approximately 180 years young compared to the oldest known continental rock, 3.6 billion years old.

3. Performance of paleoceanography through the world's oceans and determination of the geologic history of such areas as the Mediterranean Sea, the Arctic and the Anarctic.

4. Confirmation of the existence of valuable heavy mineral deposits in the Red Sea.

5. Development and refinement of the methods of fossil dating.

6. Discovery of the existence of oil in salt domes in deep subsea knolls in the Gulf of Mexico.

Technical Achievements

At the outset of the Project, DSDP realized it needed a unique platform to accomplish the scientific objectives of deep ocean drilling. As a result of competitive bidding, Global Marine designed and built the *D/V GLOMAR CHALLENGER* (Fig. 1) to perform the scientific drilling and coring program for the Project. The drillship, modified version of GMI's "Grand Isle" class, bears the respected name of the world's first full time oceanographic vessel, the *H.M.S. CHALLENGER*. The latter was a converted British warship, which was outfitted as a research vessel in 1872 and explored the oceans of the world in the first comprehensive attempt to survey the world underwater.

The *GLOMAR CHALLENGER* with its drilling systems and procedures has been recognized as a major technical achievement since drilling began in the Gulf of Mexico in 1968. The 10,500 metric ton drillship features an advanced on-board computer, dual bow and stern dual thrusters to dynamically position itself and maintain station in up to 30 knot winds and heavy seas, a 43 meter derrick amidships with a hook-load capacity of 450 metric tons and a capacity to drill in water depths in excess of 6,000 meters. The *CHALLENGER* uses an automatic pipe racker capable of handling 7,300 meters of 5-inch drill pipe, and an advanced drill pipe heave compenstor. Well equipped shipboard scientific laboratories are utilized to conduct comprehensive core analyses.

The technical achievements of DSDP and the *GLOMAR CHALLENGER* over nine years, 53 cruises, are truly remarkable:

625 holes drilled in 418 sites

190,333 total meters (624,454 feet) drilled below seafloor

91,027 meters 298,644 feet) of sediment cored

48,022 meters (157,551 feet) of sediment recovered and stored in repositories at Columbia University's Lamont-Doherty Geological Observatory and Scripps Institution of Oceanography

9,901 cores recovered

1,740 meters (5,709 feet) is the deepest *CHALLENGER* penetration beneath the ocean floor--this was at Site 398 in Leg 47 in the Atlantic Ocean. Water depth was 3,900 meters (12,796 feet)

582 meters (1,910 feet) is the maximum penetration into basaltic crustal layers in any single hole. This was at Site 332B on Leg 37 in the Atlantic Ocean.

6,243 meters (20,483 feet) of water is the deepest water worked in thus far in DSDP--this was at Site 212 on Leg 22 in the Indian Ocean.

6,764 meters (22,192 feet) is the longest drillstring ever suspended beneath *D/V GLOMAR CHALLENGER*--this also was at Site 212 on Leg 22.

Re-entry achieved first operational re-entry on December 25, 1970 in 3,960 meters (13,000 feet) of water at the Venezuelan Basin in the Caribbean Sea at Site 146 on Leg 15--re-entry can now be accomplished at any site.

451,122 kilometers (243,586 nautical miles) traveled by *D/V GLOMAR CHALLENGER* since August 11, 1968, the beginning of Leg 1 until the end of Leg 53 at Cristobal, Canal Zone, April 25, 1977.

International Phase of Ocean Drilling

Scientific and technical successes of the Project's first decade of deep ocean drilling paved the way for a new challenge in August of 1975. Usually the coring program and scientific investigation focused on the unconstituted sedimentary surface of the ocean floor. In 1975 scientists felt it was necessary to drill even deeper into the ocean margins as well as penetrate the volcanic basement underlying the ocean sediments. This expanded program would require multiple bit runs and longer casing strings.

This, then, is the challenge of IPOD, the International Phase of Ocean Drilling; an initial three-year deep crustal drilling program supported financially and scientifically by the governments of France, Germany, Japan, England and Russia in addition to the American National Science Foundation. The first phase of IPOD involved exploration of the Atlantic Ocean. It began with Leg 45 in November of 1975 and ended with Leg 53 in April of 1977. The second, or Pacific phase of IPOD began with Leg 54 in May of this year at the Canal Zone; at least eight deep water re-entries are scheduled for the next year.

DEEP WATER RE-ENTRY SYSTEM

Critical to the success of the IPOD challenge is the refinement of the Project's deep water re-entry hardware, originally developed in the early 1970's. Based on earlier concepts for NSF's Project Mohole, DSDP developed and successfully tested the first operational re-entry system on Christmas Day, 1970 in 3,900 meters of water in the Caribbean's Venezuelan Basin (Fig. 2).

This early system consisted of a 4.5 meter diameter steel guide cone with three passive reflectors and an automatic, segment-type, spring-loaded casing hanger for suspending 13-3/8 inch conductor pipe, and a scanning sonar tool that was lowered through the 5-inch drill pipe on standard seven-conductor logging cable. Although this system proved effective, re-entry was performed infrequently during the next four years. The development of improved core bits allowed the relatively shallow coring objectives to be reached without re-entry.

Ipod Re-entry

The IPOD scientific objectives often require the drilling and coring of 500 to 1000 meters of unconsolidated sediments, clays, and chert stringers, before reaching basement rock. The DSDP deep water re-entry system, therefore, must be capable of being set in water depths exceeding 6,000 meters, allow drilling through sedimentary layers 1000 meters thick, permit casing to be run and cemented, and provide for re-entry an unlimited number of times. In association with Deep Oil Technology (DOT) of Long Beach, California, DSDP initiated a program to define and develop deep water re-entry hardware to meet the IPOD challenger.

Design Criteria

In the initial design analysis, the Project engineers believed several factors would effect the hardware design. These factors were:

1. Soil bearing capacity of the sediments
2. Mechanical strength required in the re-entry cone and casing hangers
3. Borehole casing required at various depths through unconsolidated sediments
4. Providing redundant passive reflectors in case of breakage during successive re-entries
5. Requirements for a cuttings removal system to dispose of drilled solids to keep the cone and wellbore clean of debris for re-entry.

The original re-entry system resulted in the development of a through drill pipe scanning sonar system and a suite of running tools and procedures. Since this auxiliary hardware was readily available, and the *CHALLENGER's* crew was familiar with its operation, it was desirable to incorporate this equipment into the IPOD re-entry system.

System Bearing Load

DSDP's experience in coring the shallow sediments in the deep ocean basins revealed the first design problem. That was, what type of footing was needed to support the anticipated cone and casing loads?

DSDP Scientists investigated core samples from the anticipated deep re-entry sites and observed that the ocean floors consisted predominatly of calcareous oozes, or muds, for 100 meters or more below the seafloor. The possibility of the re-entry cone settling into this subsea "quicksand" and preventing re-entry was a real concern. The services of a consulting firm specializing in solid analysis and oilfield platform piles was enlisted to assist in determining the bearing capacity of the ocean floors. The anticipated loads of the re-entry cone and dual casing system were reviewed and "typical" core samples from the proposed deep re-entry sites were analyzed to ascertain soil bearing and shear strengths.

Initially, a conventionally designed re-entry cone was considered with a flat bearing plate for support on the ocean floor. The soil analysts concluded that this was not feasible due to the poor bearing strength of the colloidal sediments. Instead, the soils study suggested that the sediments' reconstituted shear strength would be required to support the vertical casing load through skin friction.

After "jetting-in" the re-entry cone and 16-inch conductor, to a depth predetermined by a pilot core hole, the sediments, with the exception of clay, tend to reconsolidate around the casing. The skin friction between the pipe and the soil particles create an adhesion that effectively holds the re-entry system in place. A curve (Fig. 3), plotting vertical load of the 11-3/4 inch casing string, versus the depth of a 16-inch conductor supported by "skin friction" was developed for Operations to design their casing string at each unique re-entry site. This conclusion has a significant impact on the cone design.

Modified Re-entry Cone

Although the original cone design proved effective in the re-entries of the early 1970's, the IPOD objectives required several improvements.

Mechanical and structural features of the larger upper cone were considered sufficient for the new design. The *CHALLENGER's* design required any structure to be keelhauled. However. no significant increases in weight could be allowed due to the limited crane capacity. The demands of IPOD required a substantial modification of the lower cone in which the casing was landed. The principal design objectives were to increase the size of the lower cone to accept the anticipated dual casing hangers, strengthen the lower cone to support the heavier casing loads, and strengthen the transition zone to provide a greater resistance to bending. A failure in a re-entry cone structure occurred in 1974, apparently during re-entry operations.

Additional improvements in the re-entry cone design included provisions for redundant passive reflectors to assure successful re-entries throughout the long-term crustal drilling, and a cuttings removal system to dispose of the drilled solids. Both of these systems were subsequently integrated into the modified re-entry cone design.

Dual Casing Hangers

Because of the deep penetrations required to reach the IPOD objectives, a second casing string would be required to protect the borehole during drilling operations. This required not only a unique design to land two casing hangers in the lower cone but also required a full complement of running tools that could effectively set and release the casing in 6,000 meters of water and also allow use of the scanning sonar to direct the casing into the hole.

SYSTEM DESIGN

The re-entry cone dual casing hanger system designed for the IPOD phase of the Deep Sea Drilling Project (Fig. 4) is comprised of the following major components.

1. Upper Re-entry Cone
2. Lower Re-entry Cone
3. 16 Inch Casing Hanger and Running Tool
4. 11-3/4 Inch Casing Hanger and Running Tool
5. 11-3/4 Inch Casing Expansion Joint
6. Cuttings Disposal System

As discussed earlier, the IPOD re-entry system designed for deep penetrations maintains certain similarities to the original re-entry cone but incorporates several design improvements.

Re-entry Cone

The upper cone section (Fig. 5) is rolled mild steel with a 4.4 meter diameter, tapered at 30 degrees to a 1.2 meter mating flange. Angle and channel iron are used to structurally reinforce the outer perimeter of the cone; the interior remaining smooth to guide the core bit into the lower cone section. The upper section is split in half to facilitate shipping. Six semi-circular passive reflectors, one meter in diameter, are mounted on the upper rim of the cone to provide backup reflectors in case some are damaged during re-entry.

The lower cone section (Fig. 5) consists of a heavy wall transition section which provides greater resistance to bending moments and a landing collar for the 16-inch casing hanger. Integral to the lower cone is a 2.4 meter diameter mud skirt and three vertical transition fins; these provide bearing and permit the drilling to "feel" the ocean floor. Bearing can be increased by adding an optional 4.2 meter diameter mud skirt extension. In addition, three 8-inch discharge lines are incorporated into the lower cone as a part of the cuttings removal system to transport drilled solids away from the cone and borehole.

The cone sections are assembled in an inverted position with the inside greased to facilitate latching of the 16-inch casing hanger. The entire assembly is keelhauled (Fig. 6) over the port, or leeward, side of the *CHALLENGER* and secured into position below the drillship's centerwell.

16-Inch Casing Hanger and Running Tools

The original re-entry system used a single conductor string of 13-3/8 inch casing. For deeper penetration depths, the Project designed the IPOD re-entry system to include a dual casing string; a 16-inch, 75 pounds per foot buttress thread conductor and an 11-3/4 inch, 54 pounds per foot buttress thread surface string.

The 16-inch casing hanger assembly (Fig. 7) includes a 26-inch casing hanger welded to a heavy wall transition sub, and provided with a 16-inch buttress box down. A latch ring to capture the 11-3/4 inch casing hanger and a shoulder retaining ring nest in the 16-inch hanger. A special 16-inch landing tool was designed to handle the 16-inch casing hanger assembly, 16-inch conductor and re-entry cone. The 16-inch landing tool consists of a latch sleeve with three paddles mounted on paddle shafts and actuated by torsion springs recessed in the latch sleeve.

With the re-entry cone suspended below the centerwell, a length of 16-inch conductor predetermined by a pilot corehole is lowered through the cone. The 16-inch hanger assembly is threaded onto the top of the casing and the landing tool is lowered into the hanger. Engagement is achieved by manually rotating the paddles 90 degrees under the latch groove ring and running the DSDP release sub behind the paddles to lock them out. The entire assembly is then lowered into the cone where a conventional split latch ring engages the cone's landing collar. The slings are then removed from the re-entry cone and the cone with the casing attached is run in on the drill string.

Once on bottom, the 16-inch casing is "washed in" to the prescribed depth until the cone rests on the ocean floor. A release tool is lowered through the drill pipe on a sandline and engages in a sleeve in the running tool. Retrieving the sandline moves the sleeve up and releases the paddles. Drilling operations can then be resumed without tripping the drill pipe.

11-3/4 Inch Casing Hanger and Running Tools

The 11-3/4 inch casing hanger assembly (Fig. 8) consists of a flow-through hanger designed to permit circulation through the 16-inch x 11 3/4 inch annulus during cementing operations. Like the 16-inch hanger, a three meter long, heavy wall transition sub is welded to the hanger with an 11-3/4 inch buttress box down. A left hand modified buttress thread is provided in the hanger bore to run and land the assembly using an 11-3/4 inch hex-kelly running tool with a three meter stroke. The tapered flank of the buttress thread locks the hanger to the running tool as long as the casing is in tension.

After re-entering the cone, the 11-3/4 inch hanger is latched into the groove ring of the 16-inch hanger using a conventional split ring. Once an upward pull demonstrates that the casing is latched, the hex-kelly is placed in "neutral" and the left hand thread is disengaged from the flow through hanger. The casing is then cemented in place. A latch down plug is used to follow the cement.

11-3/4 Inch Casing Expansion Joint

As indicated earlier, possible settling of the re-entry system in unconsolidated sediments was a significant concern. Therefore, an 11-3/4 inch casing expansion joint (Fig. 9) was incorporated into the system to eliminate compressional loads on the 11-3/4 inch casing due to any differential settling of the re-entry cone and the 16-inch casing. The simple slip joint includes a mandrel with a three-meter stroke, a mandrel head, a honed outer barrel assembly and a packing retained. Braided asbestos packing is used in the expansion joint.

Cuttings Disposal System

Because the deep crustal sites would require several re-entries and the drilling would generate considerable drilled solids, it was essential to design a cuttings disposal system.

For IPOD, this system consisted of the 11-3/4 inch circulating casing hanger, three re-entry cone discharge lines and a diverter packoff assembly (Fig. 10). The diverter packoff serves to seal the annular area and divert the circulating fluids through the discharge lines and around the outside of the re-entry cone.

Primary sealing is provided by a drill pipe packer with a secondary cone packer to prevent cuttings from filling the lower cone and disrupting re-entry. Designed to pass 7-1/4 inch tool joints, but shoulder on 8-1/4 inch drill collars, the diverter packoff is run after the last drill collar. After re-entry, the assembly nests in the lower cone transition section while the drill pipe is lowered to bottom. The packoff rides back on top of the drill collars when a bit change is made. The diverter packoff is held down by gravity with no attempt at latching.

Re-entry

Re-entry is accomplished by lowering the drill pipe until the core bit is 4 to 9 meters above the guide cone with a full stand of drill pipe up in the derrick. A wireline swivel is attached to the top of the drill pipe and the 3-3/4 inch EDO Western high resolution scanning sonar tool (Fig. 11) is run on an electric logging cable. The instrument is circulated to bottom through the tubing and seats in the core barrel with the sonar transducer extending below the core bit.

When the sonar tool is seated and scanning the ocean floor, the Plan Position Indicator (PPI) oscilloscope on the *CHALLENGER's* bridge receives an acoustic response from the passive reflectors (Fig. 12). The drillship is maneuvered until the bit is directly above the cone and the drill string is lowered. Re-entry is verified if resistance is not encountered.

RESULTS: IPOD ATLANTIC PHASE

Prior to starting the first phase of IPOD, Engineering Leg 44A was scheduled off the east coast of Florida to conduct operational tests of the re-entry system. Although no re-entry was accomplished on this shakedown cruise, Operations personnel aboard the *CHALLENGER* gained valuable experience with the re-entry hardware.

The primary operational problem occurred with the 16-inch split latch ring. Because of its design, it was possible for the latch ring to move off center. This made it extremely difficult to stab the 16-inch hanger in the lower cone and engage the latch ring in the landing collar. Both the 16-inch and 11-3/4 inch latch rings were redesigned and provided with a retaining ring to capture and centralize them. The fine-threaded shoulder ring on the 16-inch casing hanger assembly was replaced with a coarse thread and moved externally to prevent damage during make-up. Additional lifting eyes were provided and the keelhaul slings were revised for improved handling. The passive reflectors were strengthened and excessive protective coating was eliminated from the bore of the cone's transition section. These modifications were accomplished prior to the *CHALLENGER's* departure from San Juan, Puerto Rico, on the first IPOD leg.

The first phase of IPOD commenced on Thanksgiving Day, 1975, with Leg 45 and involved a north-easterly excursion from San Juan through the North Atlantic eventually returning to the Caribbean. The Atlantic phase of IPOD ended 17 months later with the completion of Leg 53 on April 25, 1977 at Cristobal in the Canal Zone.

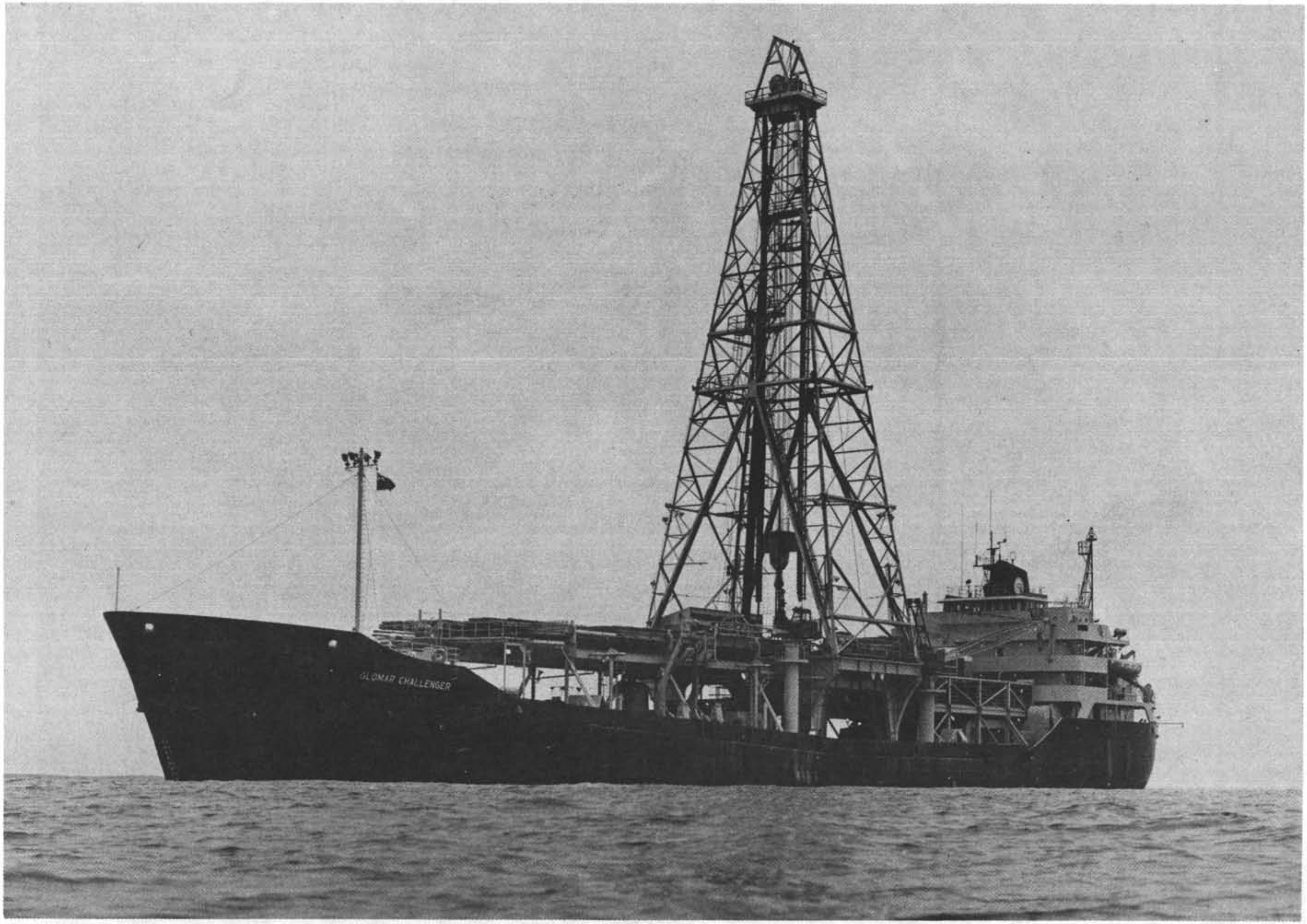
During the IPOD Atlantic phase, re-entry proved an unqualified success (Fig. 13), thereby extending the horizons for the scientific community. On seven of the Project's nine legs, seven re-entry cones were successfully landed on the ocean floor and a total of 52 re-entries were achieved. Only once, on Leg 51, was a re-entry cone lost. This was due to a failure of a pin on the lower bumper sub when subjected to excessive bending. Total penetration of the ocean sediments and basalts was 6127 meters ranging from 406 meters on Leg 46 to 1624 meters on Leg 50B. Average water depth was 4600 meters with the deepest water of 5519 meters encountered at the Bermuda rise on Legs 52B and 53. During Leg 53, a fatigue failure caused the drill pipe to part and fall in the borehole. A standard oilfield overshot was guided into the re-entry hole and a 365 meter section of drill pipe was successfully recovered.

FUTURE: IPOD PACIFIC PHASE

During the first 15 months of IPOD, the improved re-entry system (Fig. 14) permitted the DSDP scientists to reach the volcanic basement and investigate deep geology in such areas as the mid-Atlantic Ridge, the Bay of Biscay and the Rockall Plateau, the continental margins off the North Atlantic Coast and the Bermuda Rise.

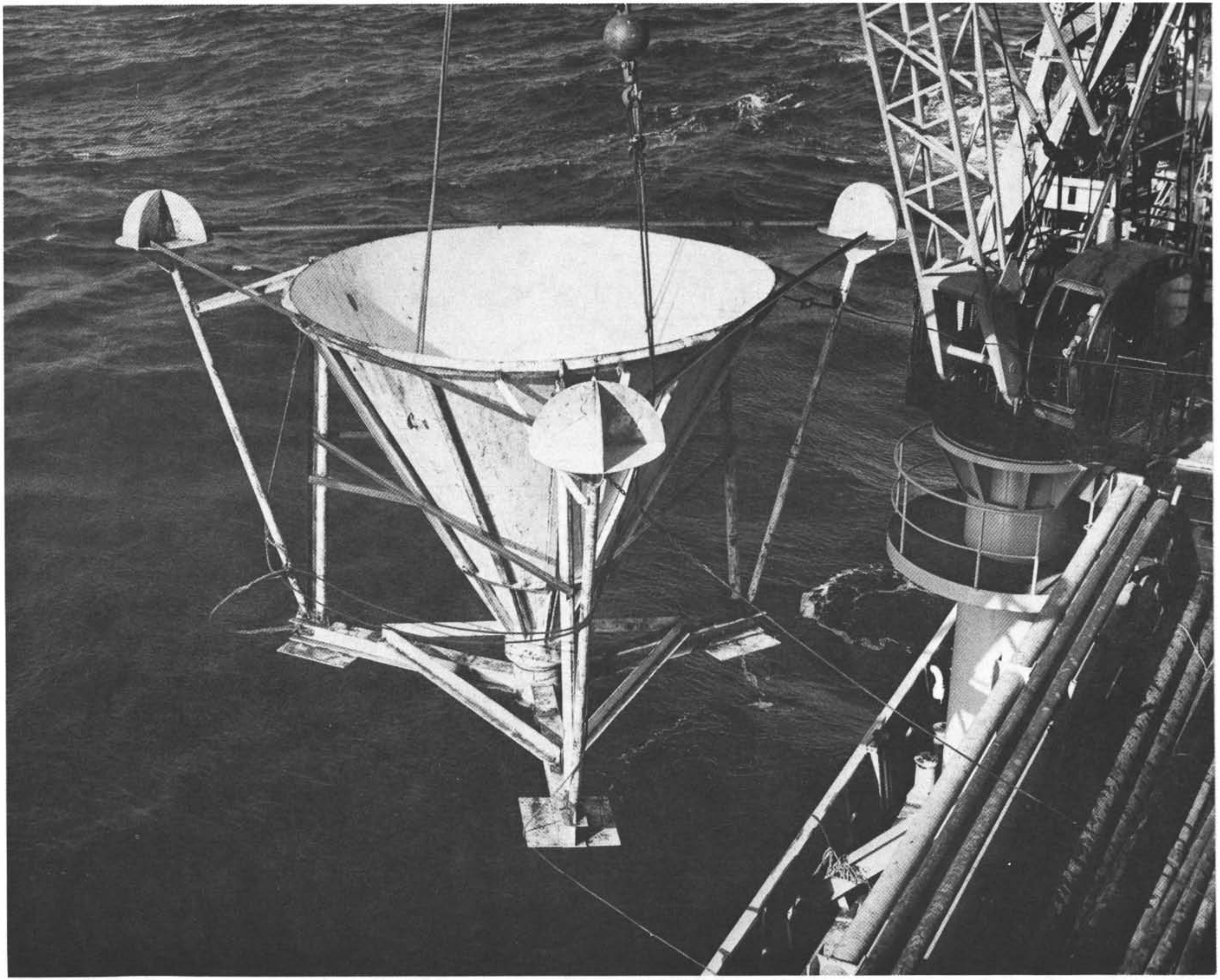
No significant mechanical design problem has developed since the redesign of the latch rings. Only the particular hole conditions at each deep crustal re-entry site seem to limit the drilling and coring operations. DSDP is, in fact, considering a third generation re-entry system that would include a third casing string to permit even deeper penetration attempts.

Because of the success of the Atlantic phase, the IPOD participants have extended the original three year project an additional 14 months. During the next phase of IPOD, the *GLOMAR CHALLENGER* will crisscross the Pacific twice setting re-entry cones at at least eight deep crustal sites. Through a combination of improved drilling systems and the efforts of the Project's scientists and engineers, the Deep Sea Drilling Project is continuing its remarkable development of man's understanding of his planet.



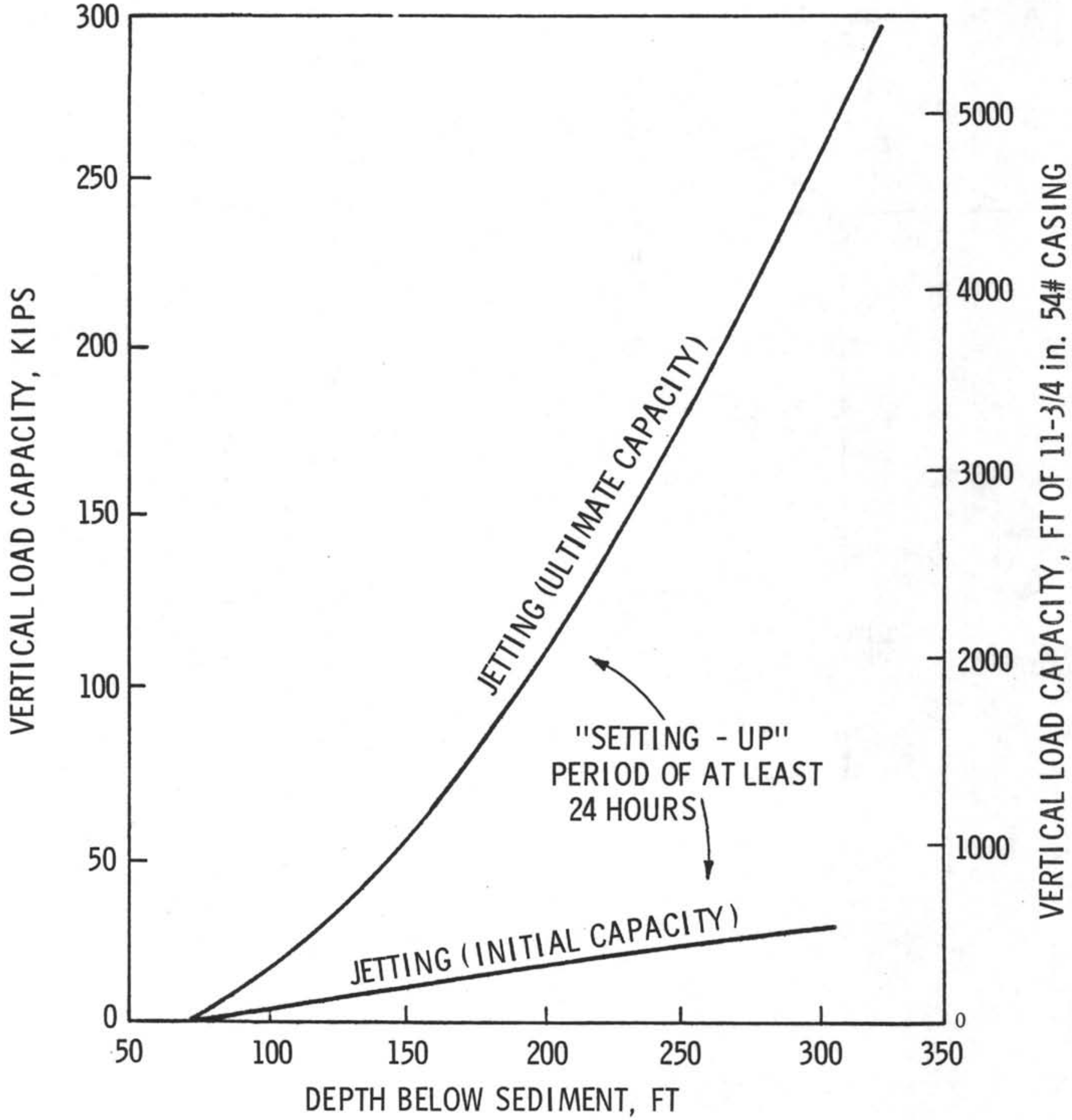
D/V GLOMAR CHALLENGER

Fig. 1



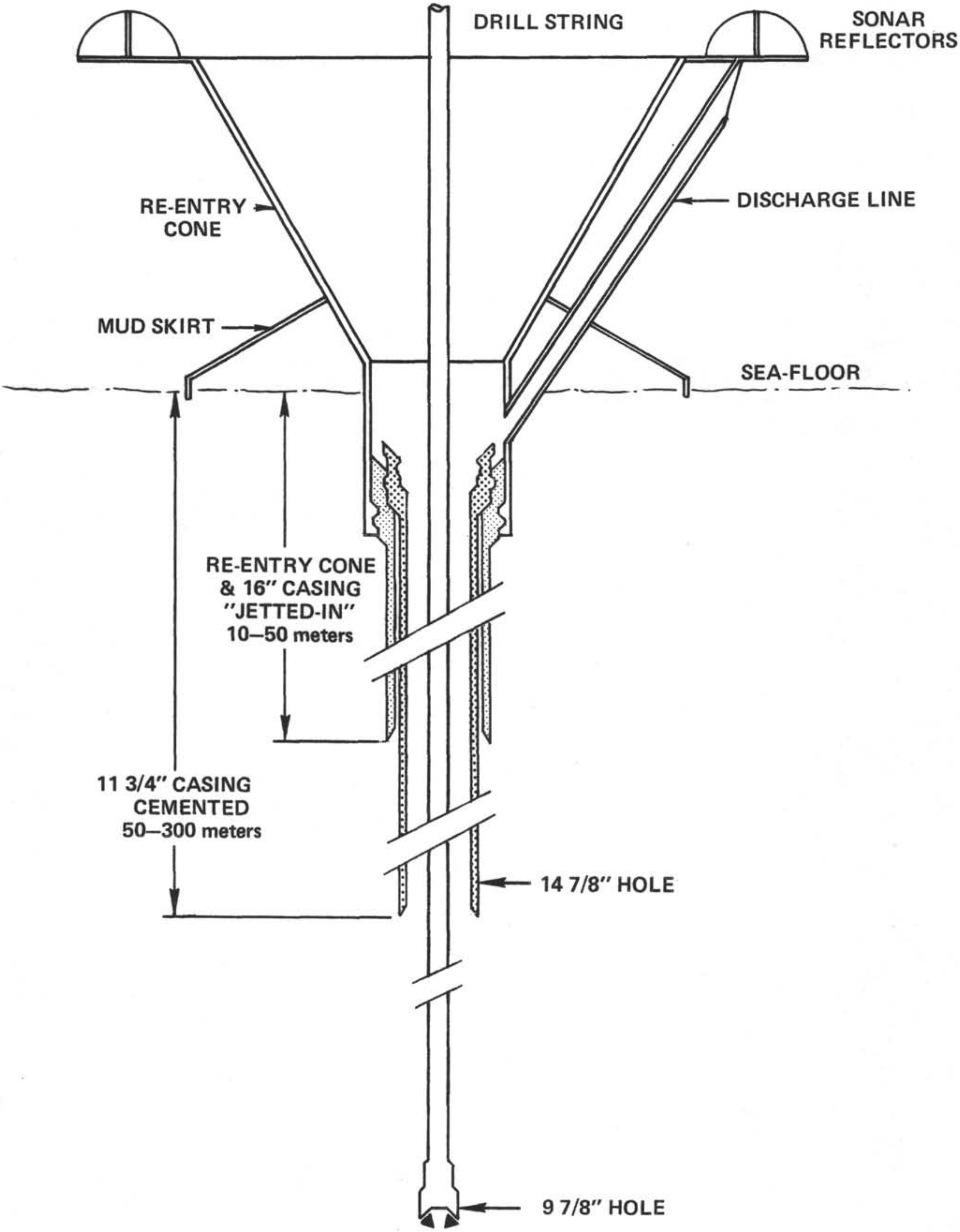
KEELHAULING ORIGINAL RE-ENTRY CONE

Fig. 2

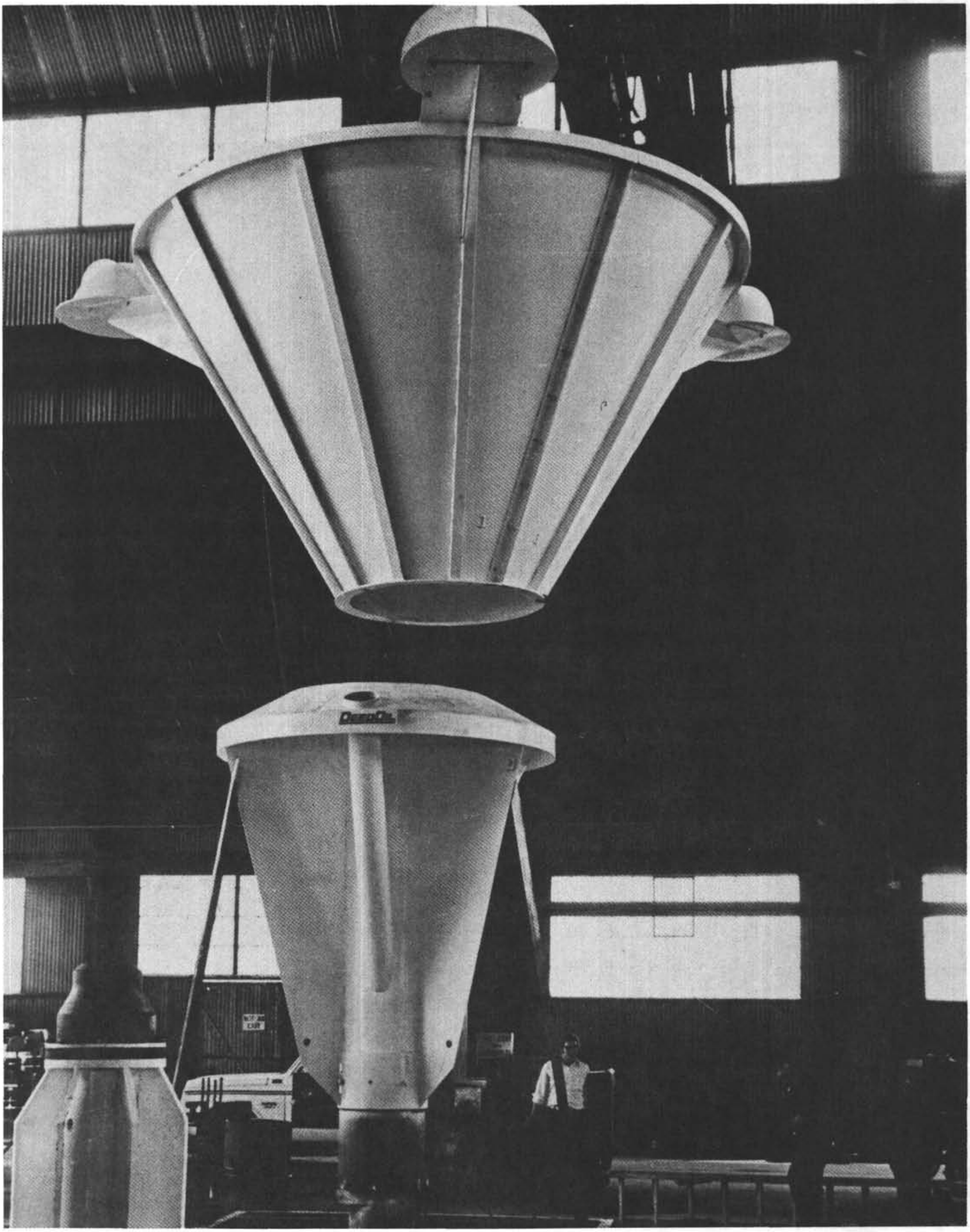


VERTICAL LOAD CAPACITY, KIPS
300
250
200
150
100
50
0
VERTICAL LOAD CAPACITY, FT OF 11-3/4 in. 54# CASING
5000
4000
3000
2000
1000
0
JETTING (ULTIMATE CAPACITY)
JETTING (INITIAL CAPACITY)
"SETTING - UP" PERIOD OF AT LEAST 24 HOURS
50
100
150
200
250
300
350
DEPTH BELOW SEDIMENT, FT

Fig. 3

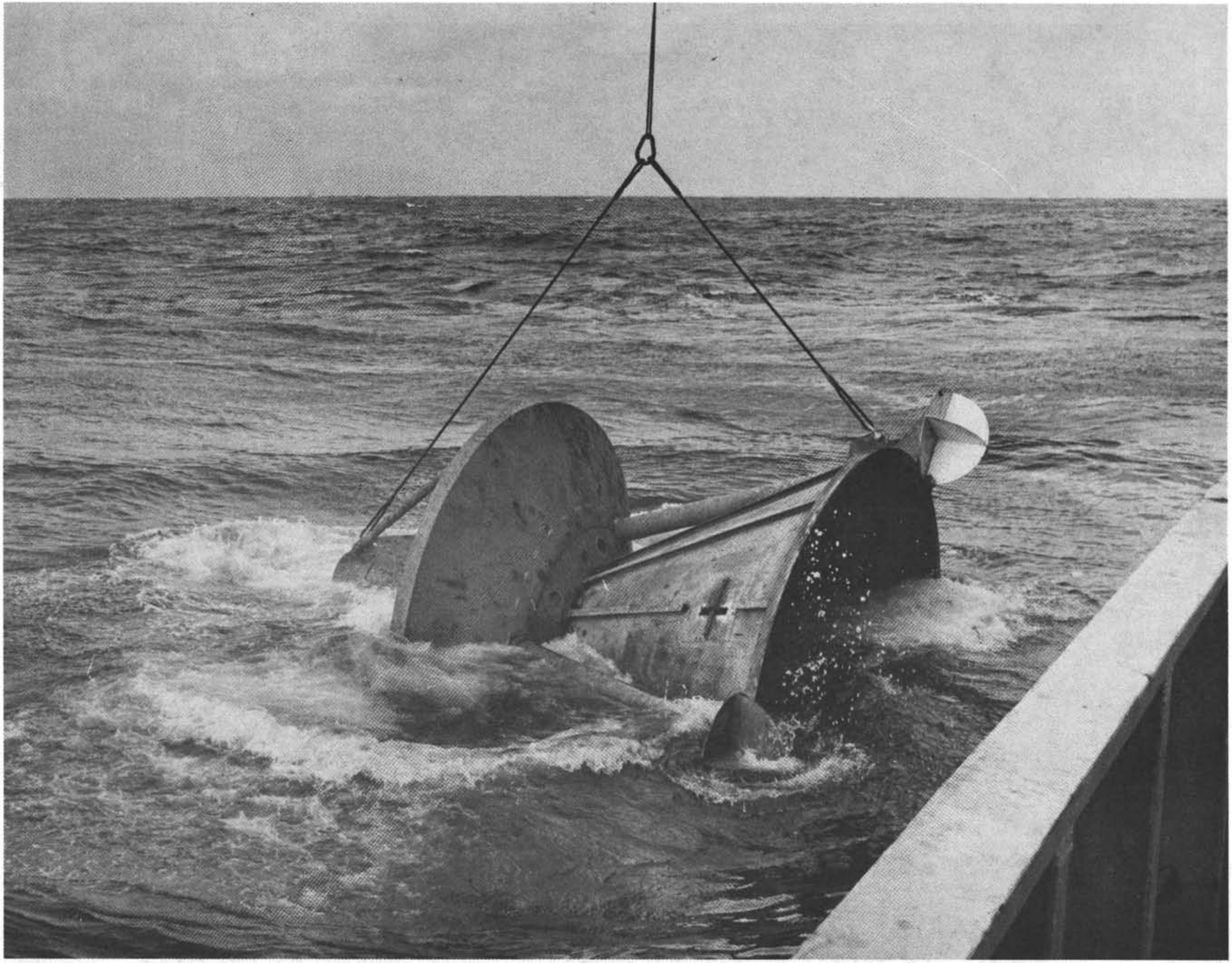


REENTRY CONE/DUAL CASING HANGER ASSEMBLY
FIG. 4



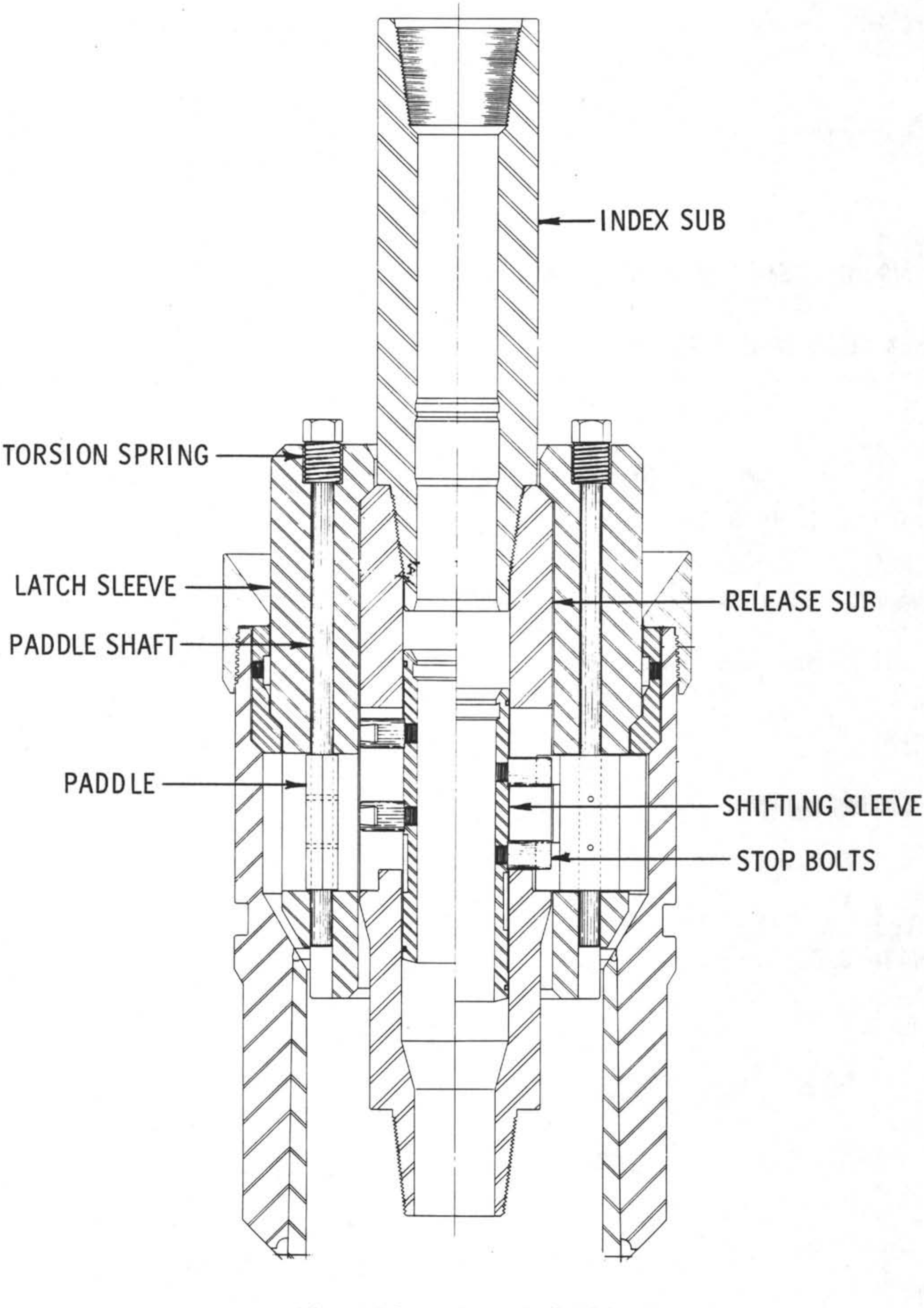
ASSEMBLING IPOD REENTRY CONE

Fig. 5

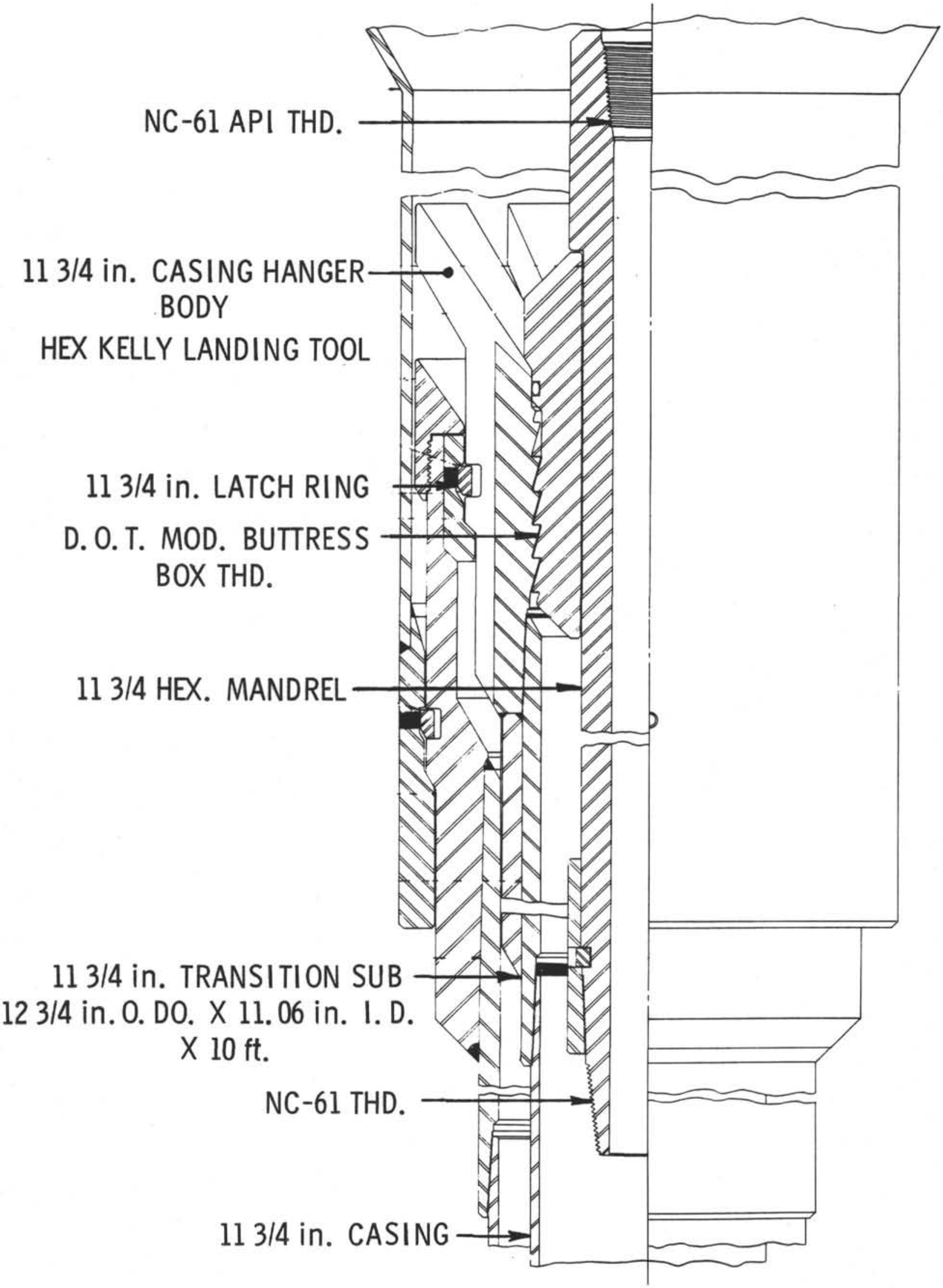


KEELHAULING IPOD REENTRY CONE

Fig. 6

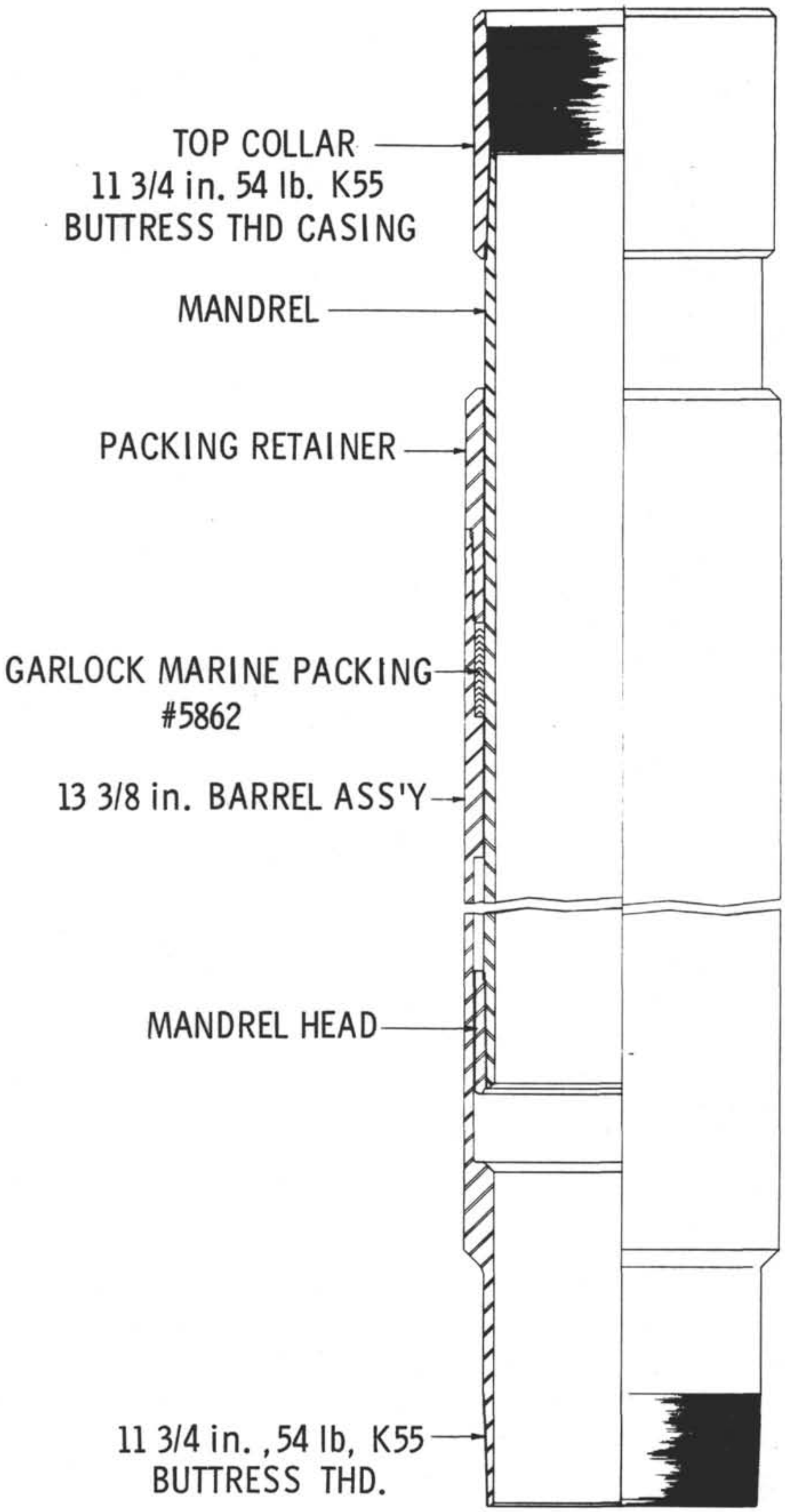


16 in. CASING RUNNING TOOL
Fig. 7



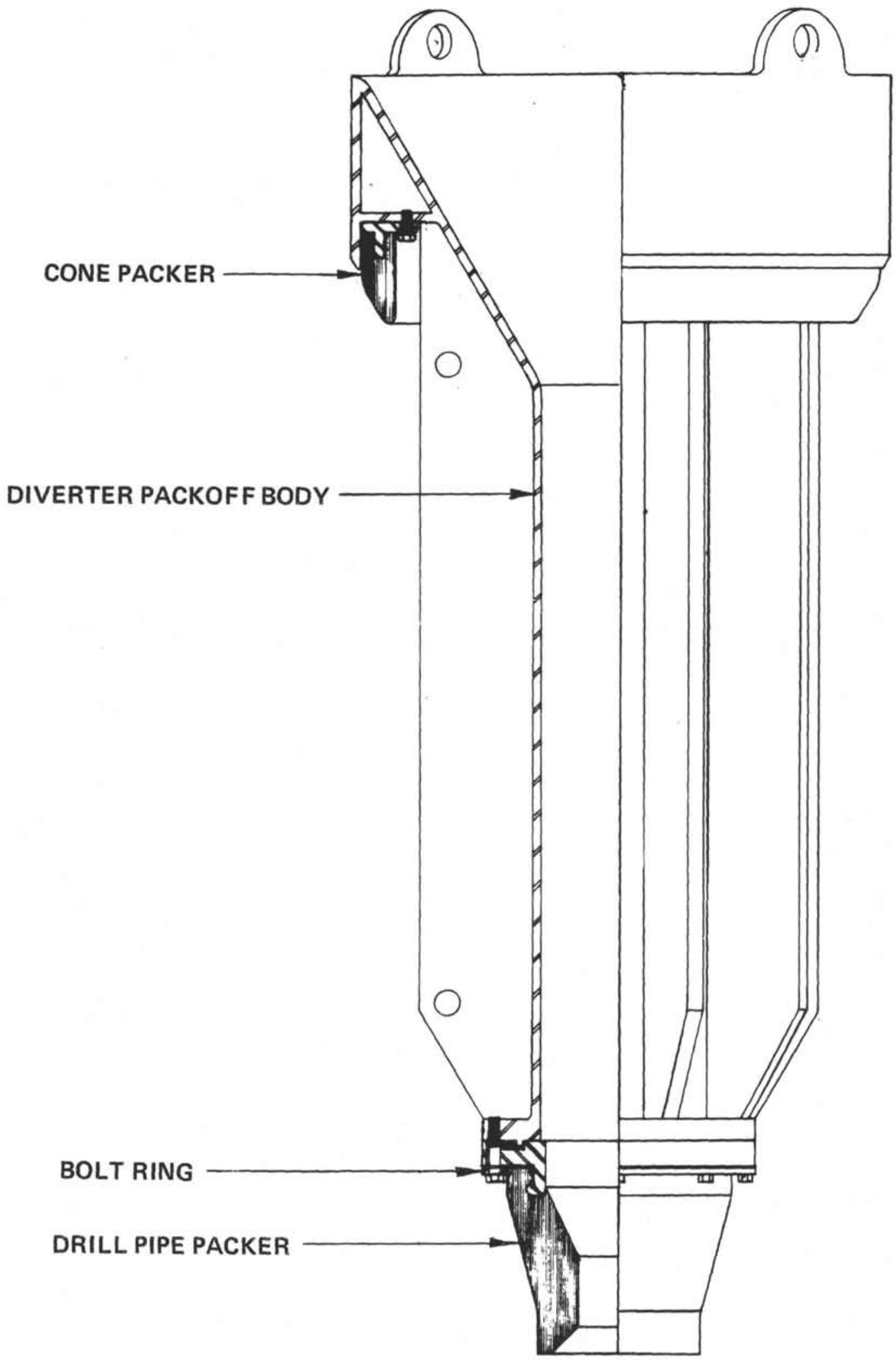
11 3/4 in. CASING HANGER / RUNNING TOOL

Fig. 8



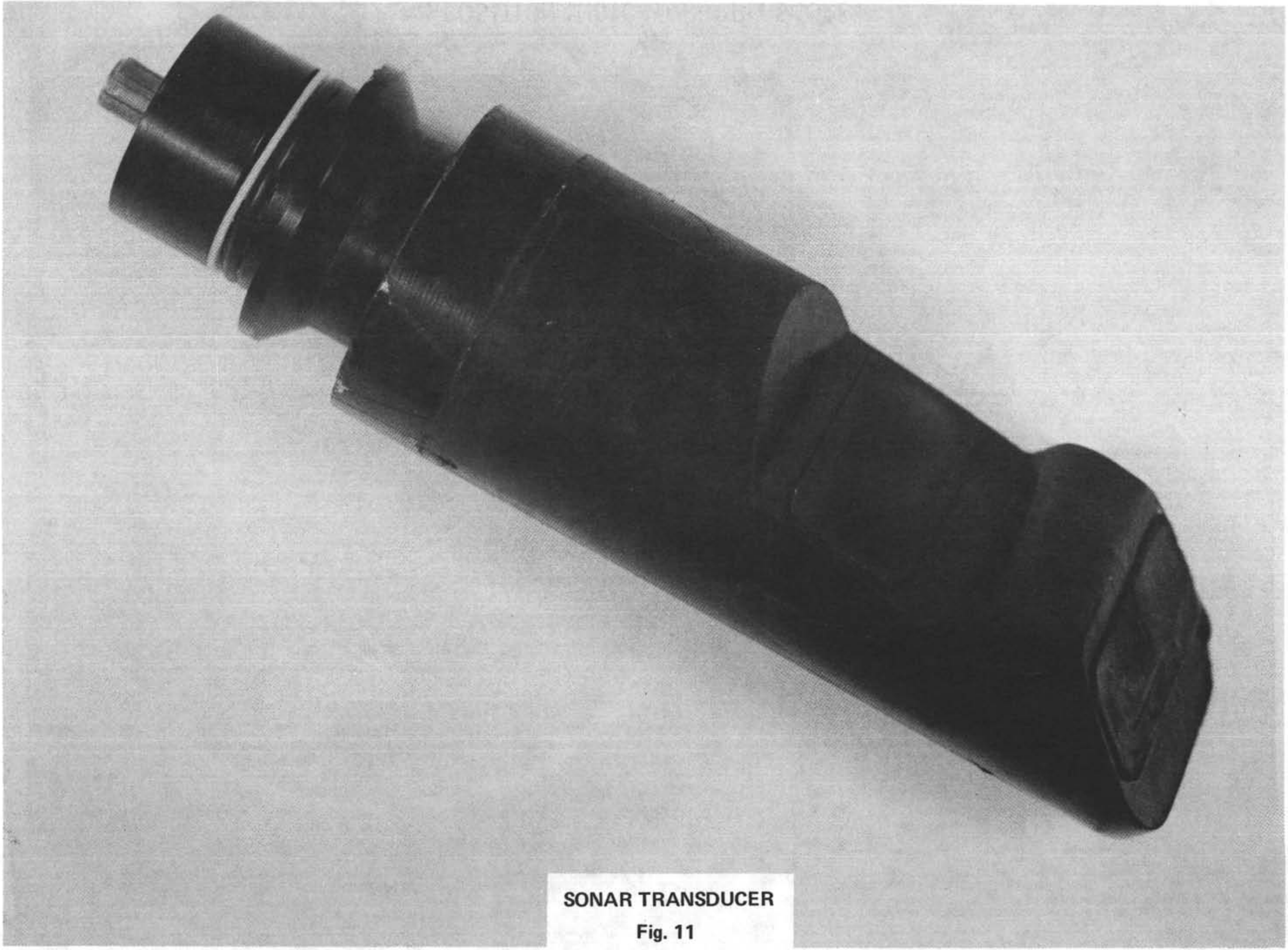
11 3/4 in. CASING EXPANSION JOINT

Fig. 9



DIVERTER PACKOFF

Fig. 10



SONAR TRANSDUCER

Fig. 11

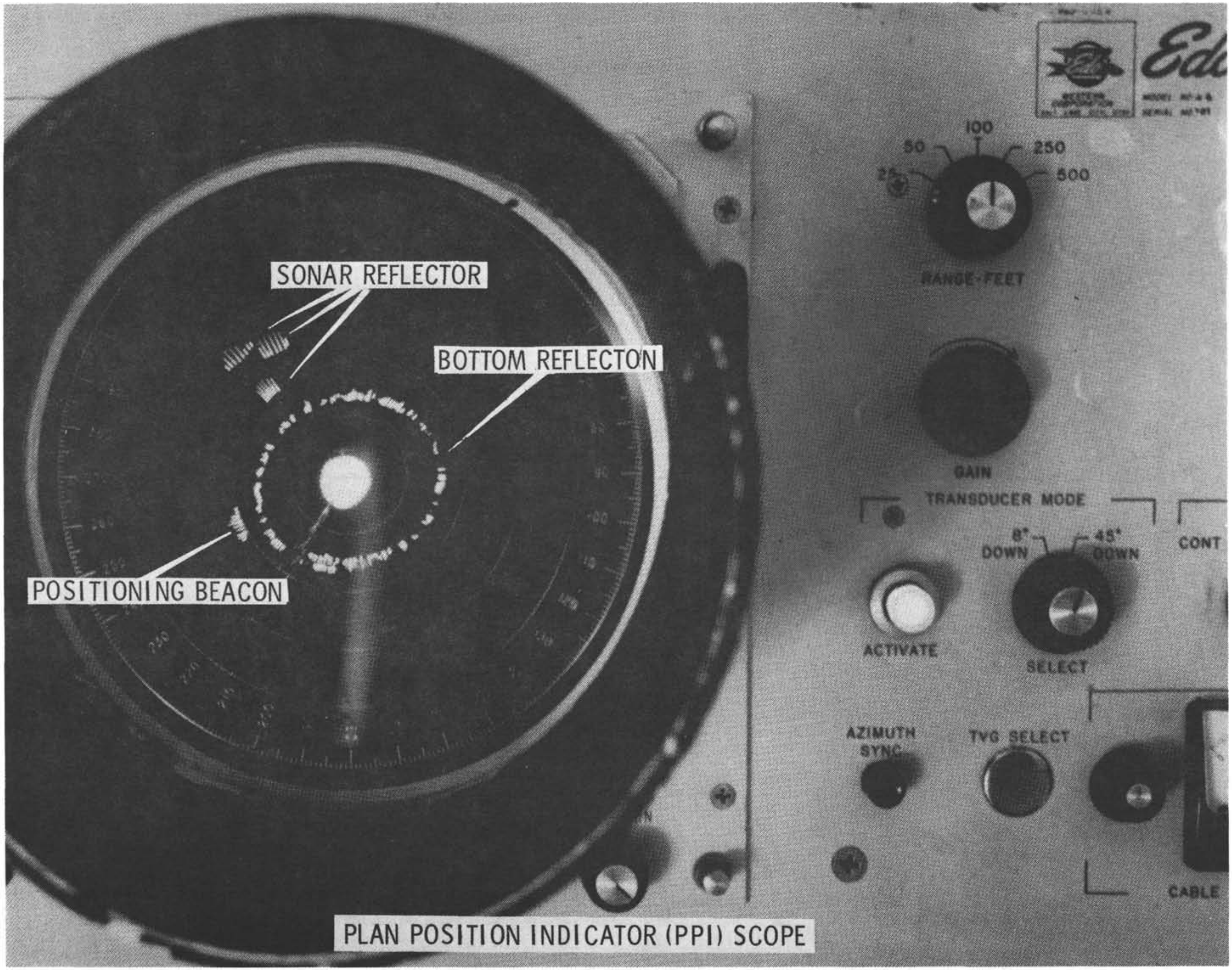
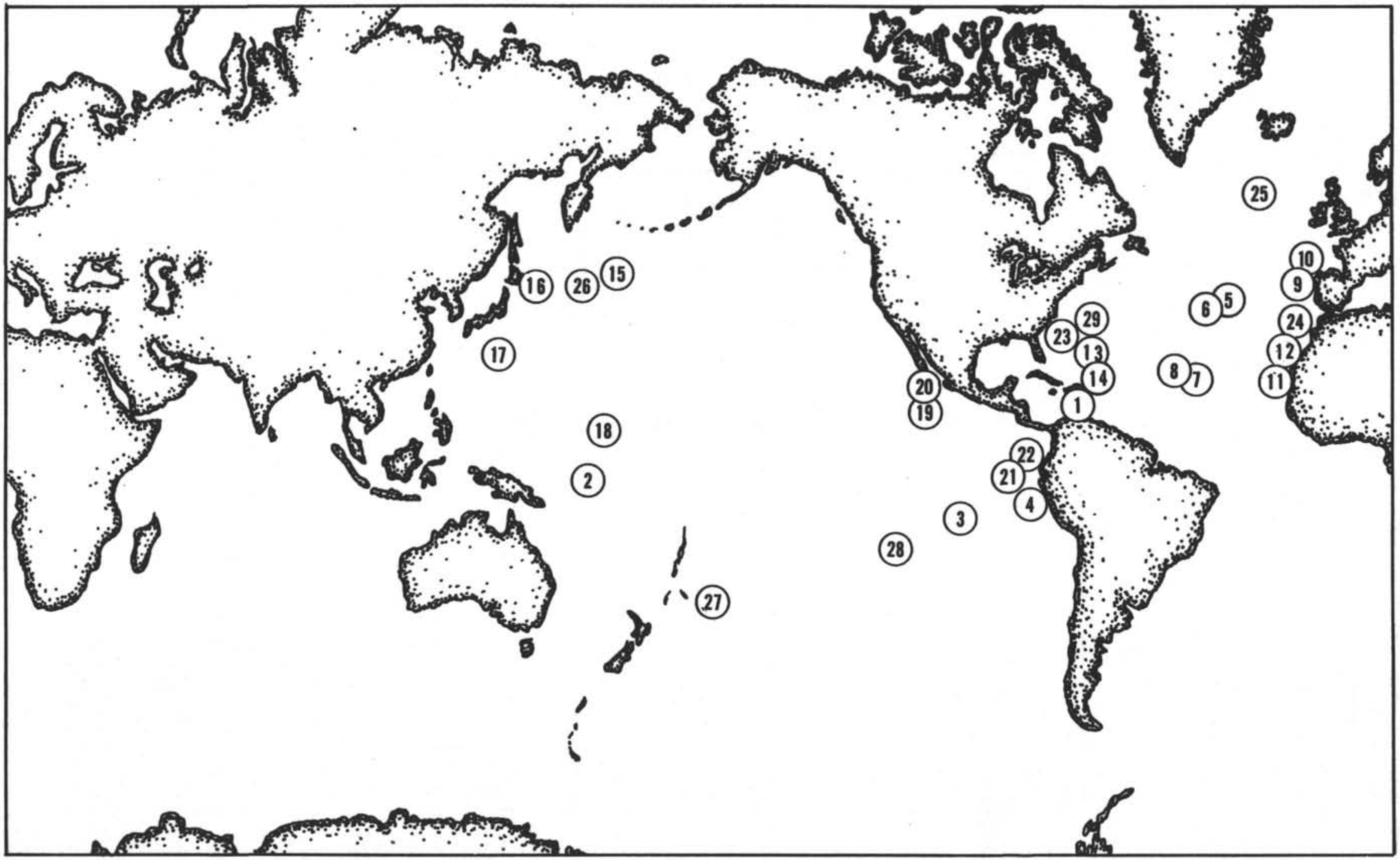

SONAR REFLECTOR
BOTTOM REFLECTON
POSITIONING BEACON
PLAN POSITION INDICATOR (PPI) SCOPE
100
50
250
25
500
RANGE-FEET
GAIN
TRANSDUCER MODE
8° DOWN
45° DOWN
CONT
ACTIVATE
SELECT
AZIMUTH SYNC
TVG SELECT
CABLE

Fig. 12

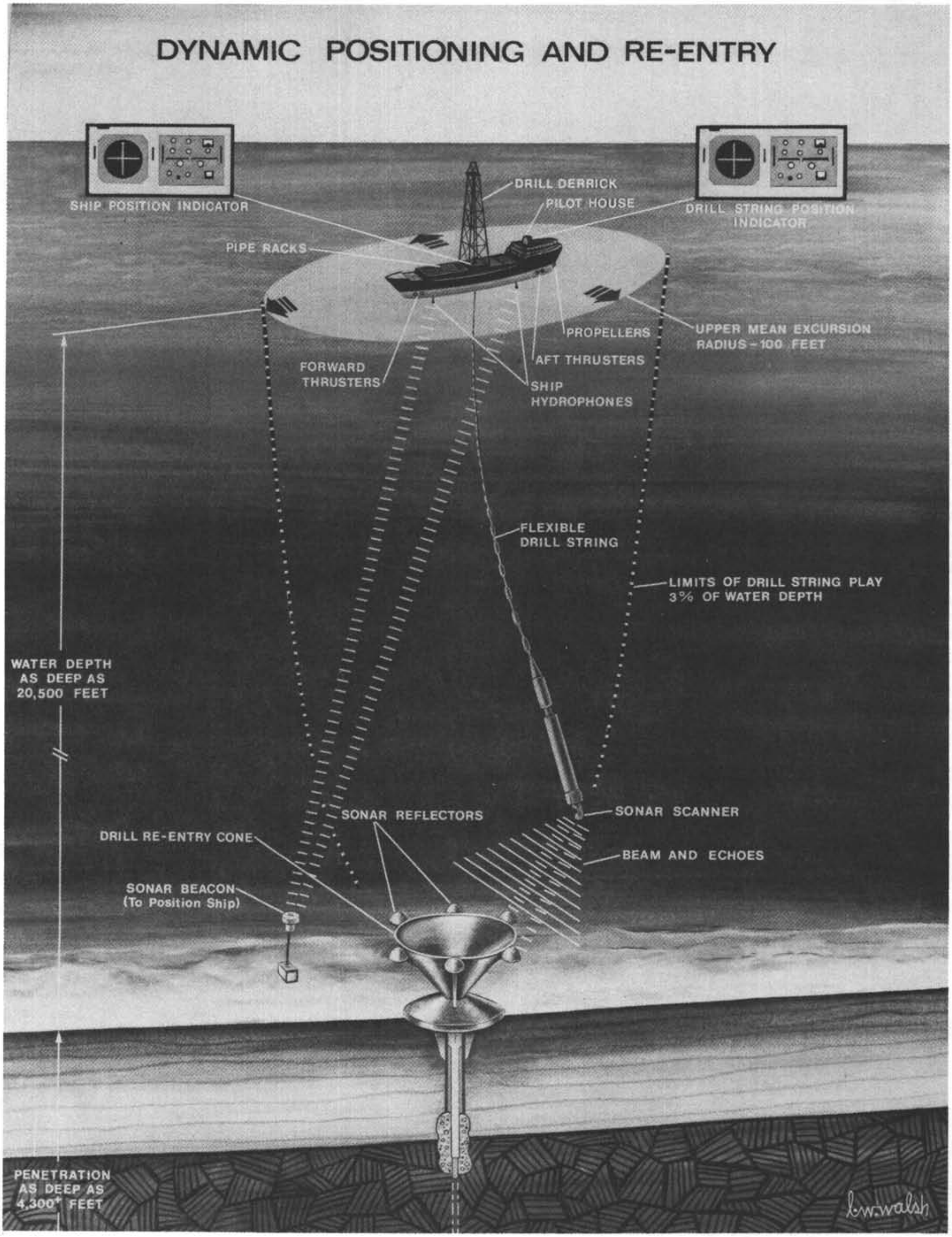


RE-ENTRY CONE DEPLOYMENT MAP
FIG. 13
SEE DEPLOYMENT HISTORY, TABLE I

TABLE I
REENTRY CONE DEPLOYMENT HISTORY

MAP NO.①	LEG NO.	SITE NO.	CONE LOCATION		WATER DEPTH (m)	PENET. DEPTH (m)	CASING LENGTH (m)		NO. OF RE.	REMARKS
			LATITUDE	LONGITUDE			16"	11 3/4"		
1	15	146	15° 06.99'N	69° 22.67'W	3939	762	50②	②	2	Hole open
2	30	288A	5° 58.35'S	161° 49.53'E	3030	999	56②	②	2	Hole bridged
3	34	319A	13° 01.04'S	101° 31.46'W	4296	157	65②	②	1	Hole open
4	34	320B	9° 00.40'S	83° 31.80'W	4487	183	65②	②	1	Hole open
5	37	332B	36° 52.76'N	33° 38.57'W	1841	721	68②	②	9	Sidetracked hole
6	37	333A	36° 50.45'N	33° 40.05'W	1682	529	70②	②	1	D.P. left in hole
7	45	395A	22° 45.35'N	46° 04.90'W	4485	664	62	109	13	Sinker bar in hole
8	46	396B	22° 59.14'N	43° 30.90'W	4465	406	120	163	7	Hole open
9	47	398D	40° 57.60'N	10° 43.10'W	3900	1740	③	80	2	Hole open
10	48	400A	47° 22.90'N	9° 11.90'W	4399	778	75	—	1	D.P. left in hole
11	50	415A	31° 01.65'N	11° 39.97'W	2817	1080	68	331	3	Reflector obscured
12	50	416A	32° 50.18'N	10° 48.06'W	4203	1605	40	—	9	Hole open
13	51B	417D	25° 06.69'N	68° 02.82'W	5489	709	113	—	3	BHA left in hole
"	52	"	"	"	"	"	"	—	7	"
14	52	418A	25° 02.08'N	68° 03.45'W	5519	868	71	—	4	Hole open
	53		"	"	"	"	"	—	9	"
15	55	433C	44° 46.63'N	170° 01.23'E	1874	551	45	—	3	Hole open
16	57	438B	40° 37.80'N	143° 14.80'E	1575	1039	41	—	1	D.P. left in hole
17	58	442B	28° 59.04'N	136° 03.43'W	4645	455	65	—	2	Hole open
18	61	462A	7° 14.50'N	165° 01.90'E	5186	1206	75	—	15	Hole open
"	89	"	"	"	"	"	"	—	4	"
19	65	482D	22° 47.31'N	107° 59.51'W	3012	187	60	—	1	D.P. left in hole
20	65	483B	22° 52.99'N	108° 14.84'W	3084	267	66	123	7	Blocked at cone
21	69	504A	1° 13.61'N	83° 43.95'W	3468	278	90	—	2	Bit cones in hole
22	69	504B	1° 13.61'N	83° 43.81'W	3474	1350	90	—	6	Hole open
"	70	"	"	"	"	"	"	—	4	"
"	83	"	"	"	"	"	"	—	16	"
"	92	"	"	"	"	"	"	—	1	"
23	76	534A	28° 20.63'N	75° 22.89'W	4976	1647	86	533	8	Hole open
24	79	547B	33° 46.84'N	9° 20.98'W	3952	1030	28	—	3	Hole open
25	81	553A	56° 05.32'N	23° 20.61'W	2339	683	60	—	2	Bit released in hole
26	88	581B	43° 55.66'N	159° 47.77'E	5478	372	72	364	2	D.P. left in hole
27	91	595B	23° 49.30'S	165° 31.60'W	5630	124	34	74	3	Hole open
28	92	597C	18° 48.39'S	129° 46.23'W	4157	110	40	—	2	Hole open
29	93	603B	35° 27.70'N	70° 01.90'W	4644	1585	72	500	4	D.P. left in hole

① Refer to Reentry Cone Deployment Map (Figure 13)
② Only 13 3/8 single casing string was available prior to Leg 45
③ Only 11 3/4 casing was run with special adapter to cone



IPOD REENTRY CONCEPT

Fig. 14

B. RE-ENTRY CONE/DUAL CASING HANGER SYSTEM DESCRIPTION

REENTRY CONE/DUAL CASING HANGER
SYSTEM DESCRIPTION

The Reentry Cone/Dual Casing Hanger System designed for future reentries and deep crustal penetrations maintains certain similarities to the original reentry cone and incorporates several new features.

1. Upper cone section - retains the same physical dimensions of the original cone incorporating additional passive reflectors and a modified cuttings disposal system.

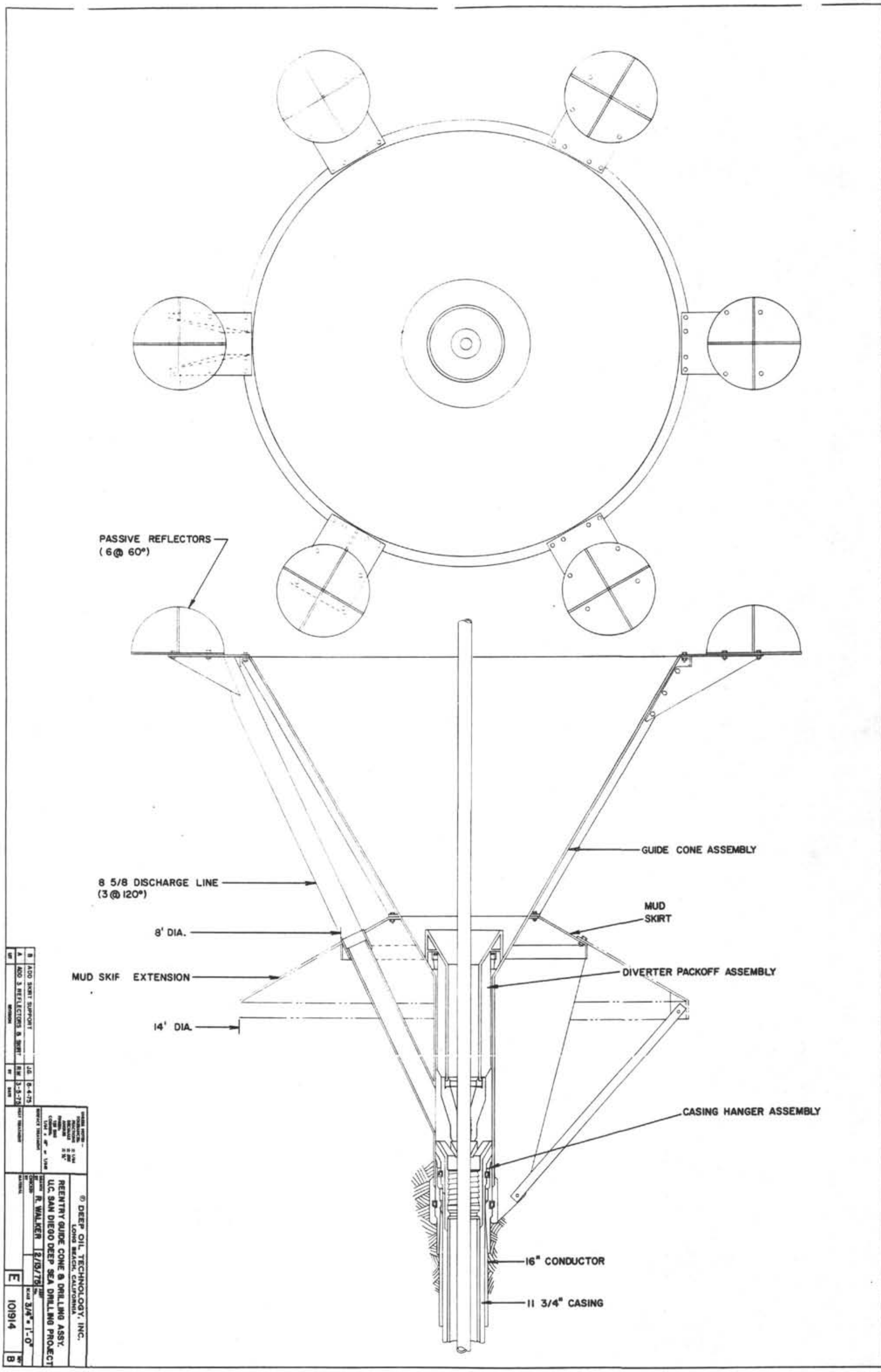
2. Lower cone section - modified to include additional structural support and provide the means to land an increase conductor casing diameter (16").

3. Dual casing hangers - provisions to run and land 300' of 16", 75# conductor and 3000' of 11 3/4", 54# protective casing.

4. Cuttings disposal system - integral to the reentry cone with an internal diverter packoff assembly to disburse cuttings away from the cone.

5. Casing expansion joint - incorporated to minimize compressional loads on the 11 3/4" casing due to differential settling of the reentry cone in the deep ocean sediments.

6. Casing landing tools - modified to run the 16" and 11 3/4" dual casing hangars.


PASSIVE REFLECTORS
(6@ 60°)
GUIDE CONE ASSEMBLY
8 5/8 DISCHARGE LINE
(3@120°)
MUD
SKIRT
8' DIA.
MUD SKIF EXTENSION
DIVERTER PACKOFF ASSEMBLY
14' DIA.
CASING HANGER ASSEMBLY
16" CONDUCTOR
11 3/4" CASING
ADD SKIRT SUPPORT
ADD 3 REFLECTORS & SKIRT
© DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
REENTRY GUIDE CONE & DRILLING ASSY.
U.C. SAN DIEGO DEEP SEA DRILLING PROJECT
R. WALKER
3/4" = 1'-0"
E
101914
B

A. Reentry Cone (Dwg. 101914)

The reentry cone consists of an upper cone section (P/N 102027) fabricated in two halves and a lower cone assembly (P/N 102028). Prior to keelhauling, assemble the reentry cone in an inverted position as follows:

1. Flange the upper cone halves together per the attached bolting specification in Appendix I. Cone halves are match-marked (e.g. 1-1, 1A-LA, 2-2, 2A-2A) and should be so assembled to assure flange alignment.

2. Flange the lower cone to the assembled upper cone, making sure that the bolted side flanges on the upper cone are in line with the lifting eyes on the lower cone. This is required for keelhauling operations.

3. Pickup an upper discharge line (P/N 102037) and stab into the connecting collar on the lower cone. Bolt the top flange of the discharge line to the 3 1/2" angle on the upper cone. Continue until all three discharge lines are in place.

4. Install the desired number of reflector support brackets (P/N 102039-3 max.), bolting to the top and side angles of the upper cone.

5. Install the desired number of passive reflectors (P/N 102038-6 max.) by bolting to the upper discharge lines (3 req'd) and support brackets (3 max.).

6. If seafloor conditions warrant, install the mud skirt extension (P/N 102040) a half section at a time, bolting to the lower cone assembly. After both sections are in place, flange the half-sections together and install the three 3" OD mud skirt stiffeners.

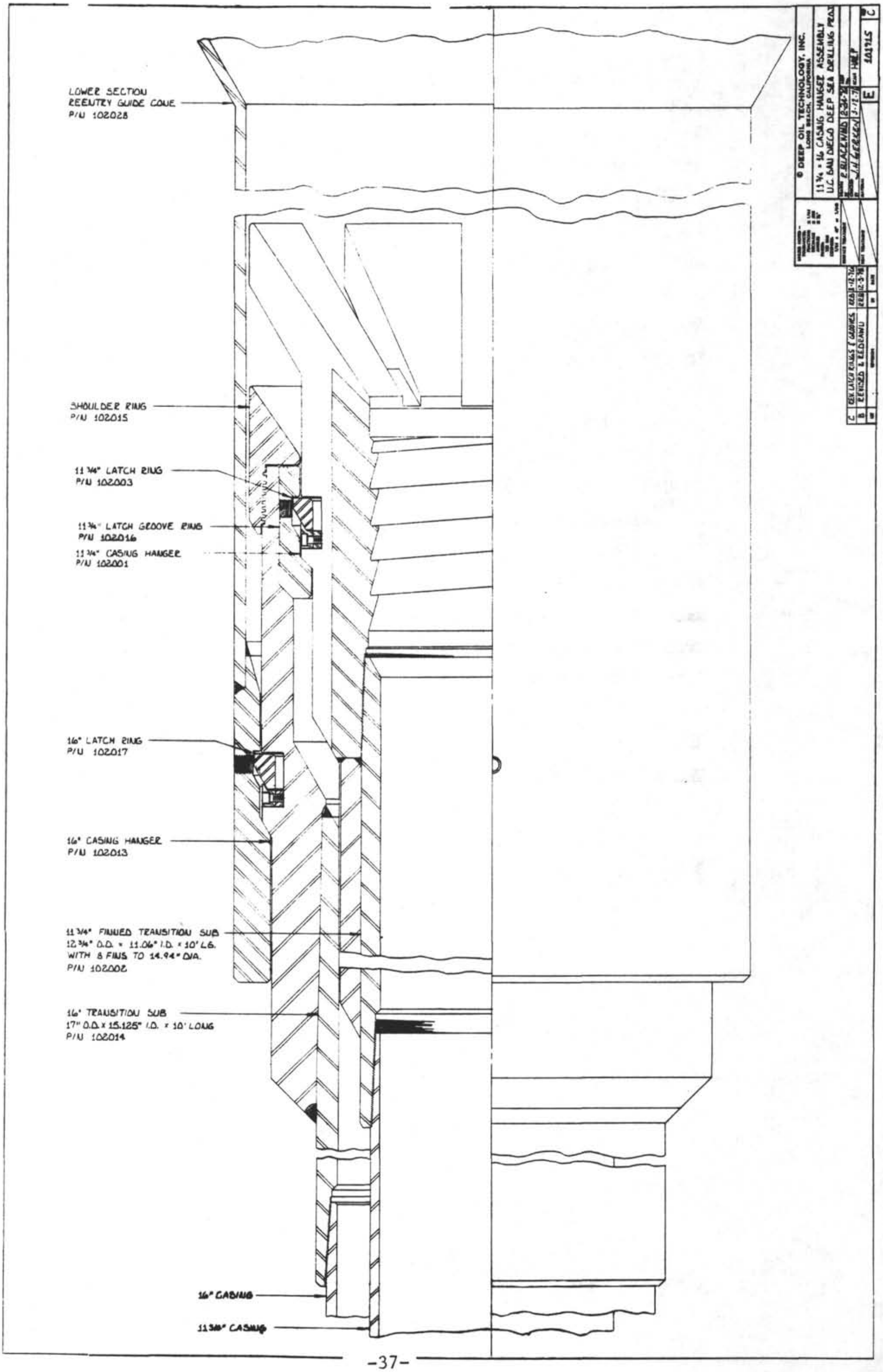
7. Before keelhauling the cone assembly, thoroughly coat the inside of the lower cone with grease to facilitate landing of the 16" hanger.
   NOTE: Lifting eyes with shackles are provided on the upper cone at the side flange, and on the lower cone at the base of the landing collar.

B. Dual Casing Hanger (Dwg. 101915)

The casing hangers include provisions to run and land multiple strings of casing, 16" and 11 3/4". The 16" running tool assembly (P/N 102196) used to run the 16" conductor and reentry cone allows the use of existing DSDP lowering and index subs and is released by either the Baker or Rotary shifting tools. A 11 3/4" hex-kelly running tool (P/N 102026) was developed to run and land the 11 3/4" casing hanger in the 16" hanger. This tool utilizes a modified buttress left hand thread to land the 11 3/4" hanger and incorporates a 10' stroke hex-kelly to facilitate disengagement.

The 16" casing hanger assembly (P/N 102012) includes the 16" hanger (P/N 102013) welded to a 16" heavy wall transition sub (P/N 102014) provided with a 16" buttress box down. A shoulder ring (P/N 102015), latch groove ring (P/N 102016) to land the 11 3/4" hanger, a 16" latch ring (P/N 102017), and a set of retaining rings (P/N 102636 & 102637) complete the assembly. The 16" casing hanger is landed on a heavy-wall landing collar in the base of the reentry cone and engaged with the 16" latch ring.

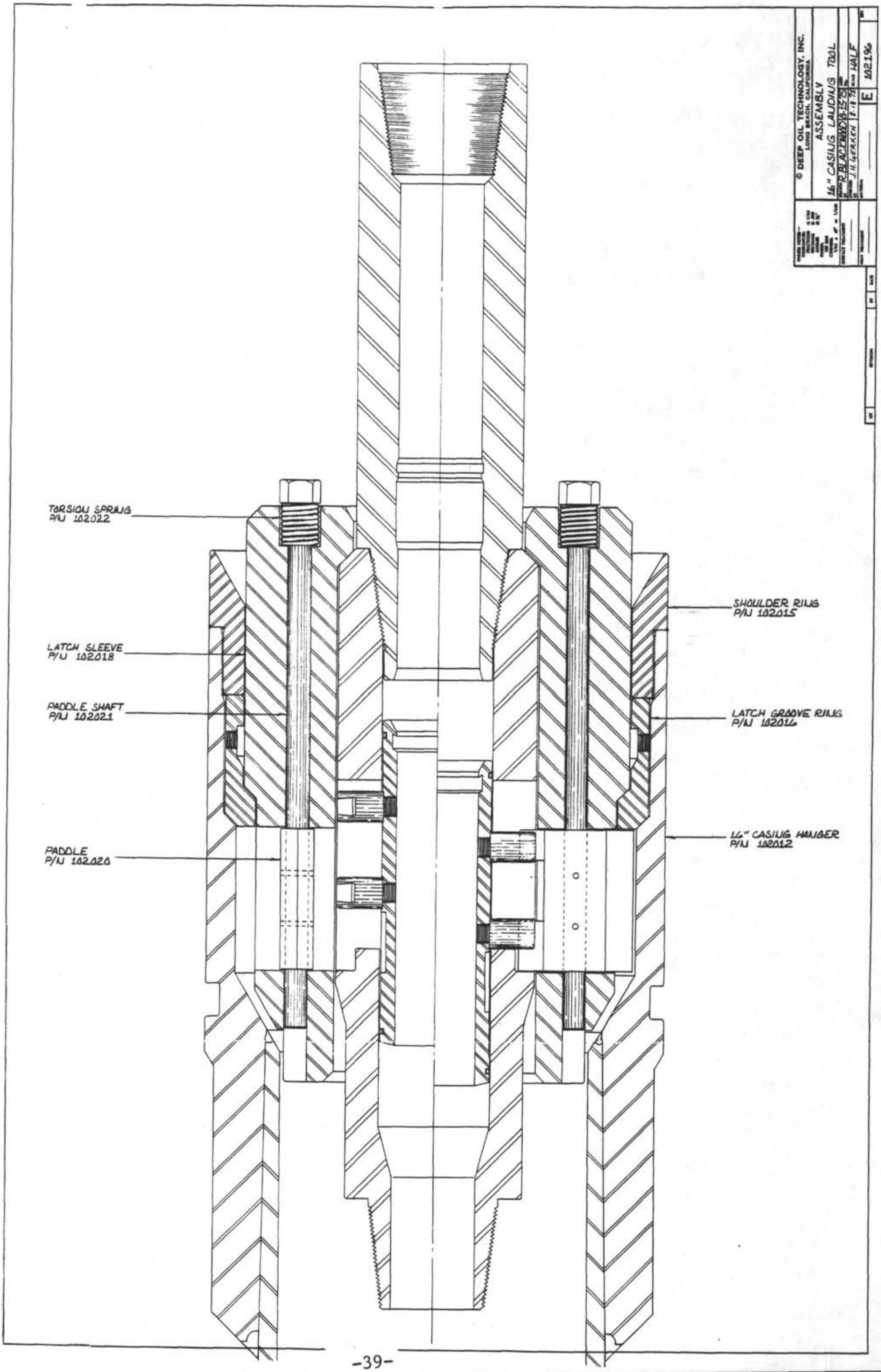
The 11 3/4" casing hanger assembly (P/N 102000) includes the 11 3/4" hanger (P/N 102001) welded to a 11 3/4" heavy wall transition sub (P/N 102002) provided with an 11 3/4" buttress box down. A left hand modified buttress thread is provided to run and land the 11 3/4" hanger using an 11 3/4" hex-kelly landing tool (P/N102026). The 11 3/4" flow through hanger is designed to permit circulation through the 16" by 11 3/4" annulus during cementing operations. The 11 3/4" latch ring (P/N 102003) and a set of retaining rings (P/N 102638 & 102639) complete the assembly.


LOWER SECTION
REENTRY GUIDE CONE
P/N 102028
SHOULDER RING
P/N 102015
11 3/4" LATCH RING
P/N 102003
11 3/4" LATCH GROOVE RING
P/N 102016
11 3/4" CASING HANGER
P/N 102001
16" LATCH RING
P/N 102017
16" CASING HANGER
P/N 102013
11 3/4" FINNED TRANSITION SUB
12 3/4" O.D. × 11.06" I.D. × 10' LG.
WITH 8 FINS TO 14.94" DIA.
P/N 102002
16" TRANSITION SUB
17" O.D. x 15.125" I.D. × 10' LONG
P/N 102014
16" CASING
11 3/4" CASING
© DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
11 3/4 × 16 CASING HANGER ASSEMBLY
U.C. SAN DIEGO DEEP SEA DRILLING PROJ
R BLACKWING 8-30-72
J.H. GERKEN 3-12-73
HALF
E
101915
C
C REV. LATCH RINGS & GROOVES
B REVISED & REDRAWN 12-5-78

C. <u>16" Casing Landing Tool Assembly (P/N 102196)</u>

A casing landing tool is provided to handle the 16" hanger, conductor and reentry cone using existing casing lowering tools. The 16" landing tool includes the 16" latch sleeve (P/N 102018) run on the lowering sub, three paddles (P/N 102020), paddle shafts (P/N 102021) and torsion springs (P/N 102022).

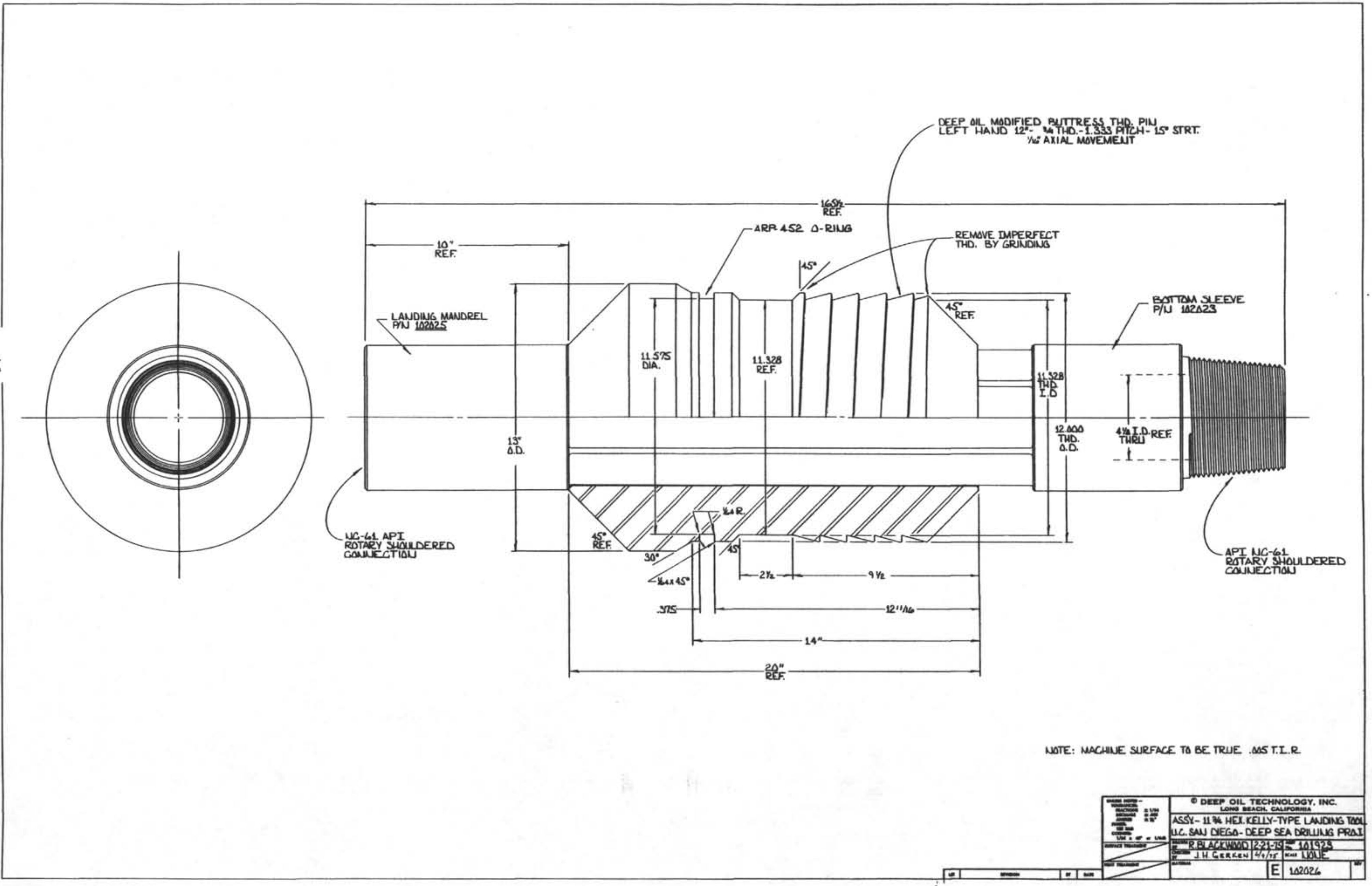
Assembly of the tool is accomplished by engaging the torsion springs in their pockets and placing the paddles in the lower windows. Make certain the square paddle corner is at the top. The paddle shafts are now inserted through the springs and paddles and the shaft head engaged with the torsion spring. Paddles and shafts are match-marked and should be so assembled. Using a pipe wrench, rotate the shaft head clockwise approximately 90°, thereby aligning the holes in the paddles and shafts. Secure with 5/16" x 1 5/8" stainless steel roll pins and release the shaft head. The torsion springs will act to keep the paddles in a closed position when released. Remove the three lifting eyes (3/4") provided in each latch sleeve for handling purposes before landing in the 16" hanger.

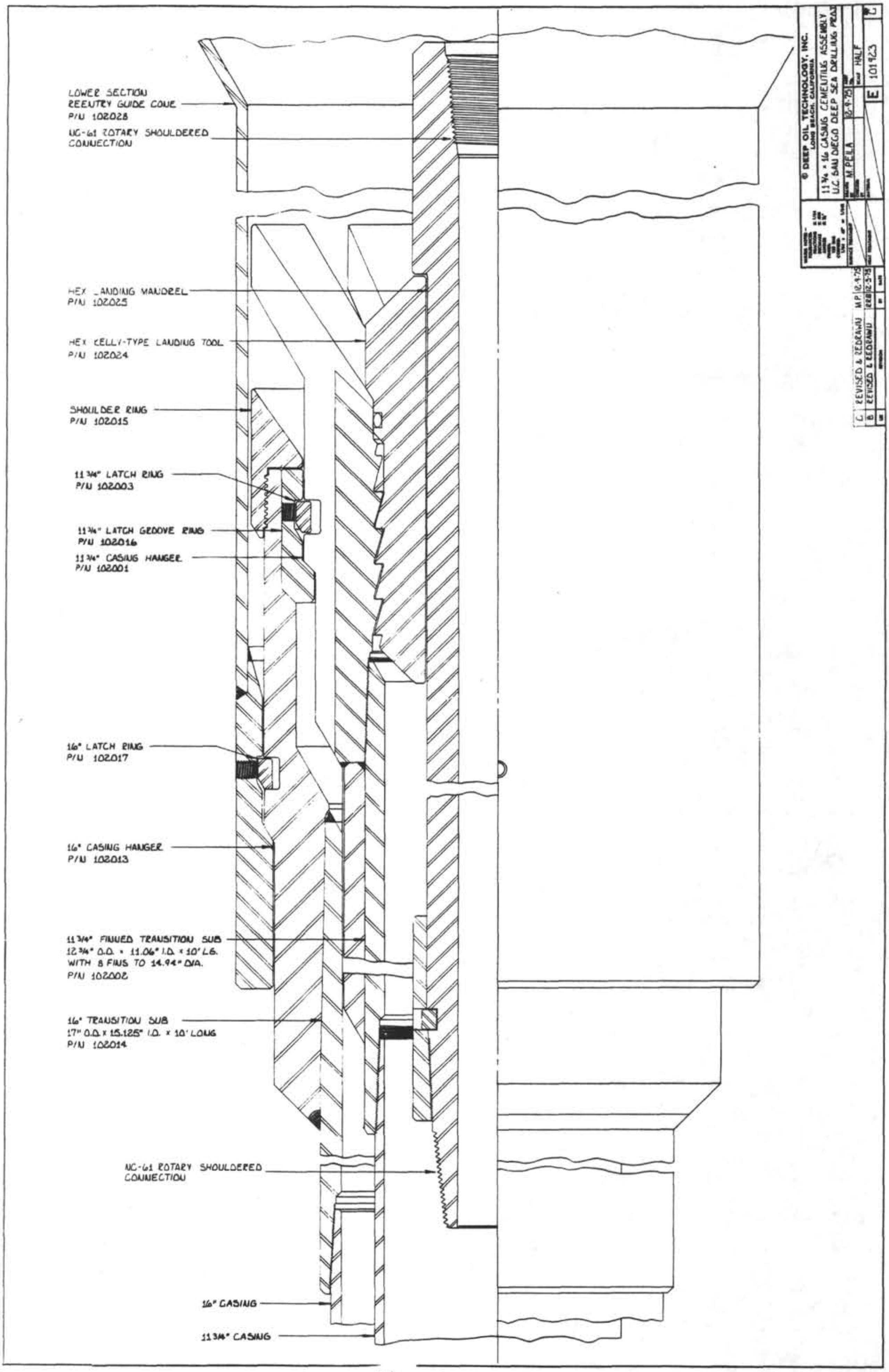

TORSION SPRING
P/N 102022
LATCH SLEEVE
P/N 102018
PADDLE SHAFT
P/N 102021
PADDLE
P/N 102020
SHOULDER RING
P/N 102015
LATCH GROOVE RING
P/N 102016
16" CASING HANGER
P/N 102012
© DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
ASSEMBLY
16" CASING LANDING TOOL
R. BLACKWOOD 8-15-75
J.H. GERKEN 8-18-75
HALF
E
102196

D. 11 3/4" Casing Landing Tool (P/N 102026)

An 11 3/4" hex-kelly landing tool is provided to run and land the 11 3/4" casing hanger in the 16" latch groove ring. This landing tool consists of a 10 foot stroke hex-kelly landing mandrel (P/N 102025) provided with API NC-61 rotary shouldered connections, a landing tool with a modified buttress left-hand thread (P/N 102024) to land and release the 11-3/4" hanger, and a bottom sleeve (P/N 102023) that permits kelly repairs. Dress the landing tool by installing an ARP-452 O-Ring trash seal as provided. Holding the mandrel in neutral, the buttress landing tool is threaded into the 11 3/4" hanger and made up hand tight. The assembly is then picked up on a drill collar and run in to bottom on the drill-pipe. After the casing is landed in the 16" hanger, the hex-kelly mandrel is put in neutral and the landing tool released from the hanger. by turning to the right.

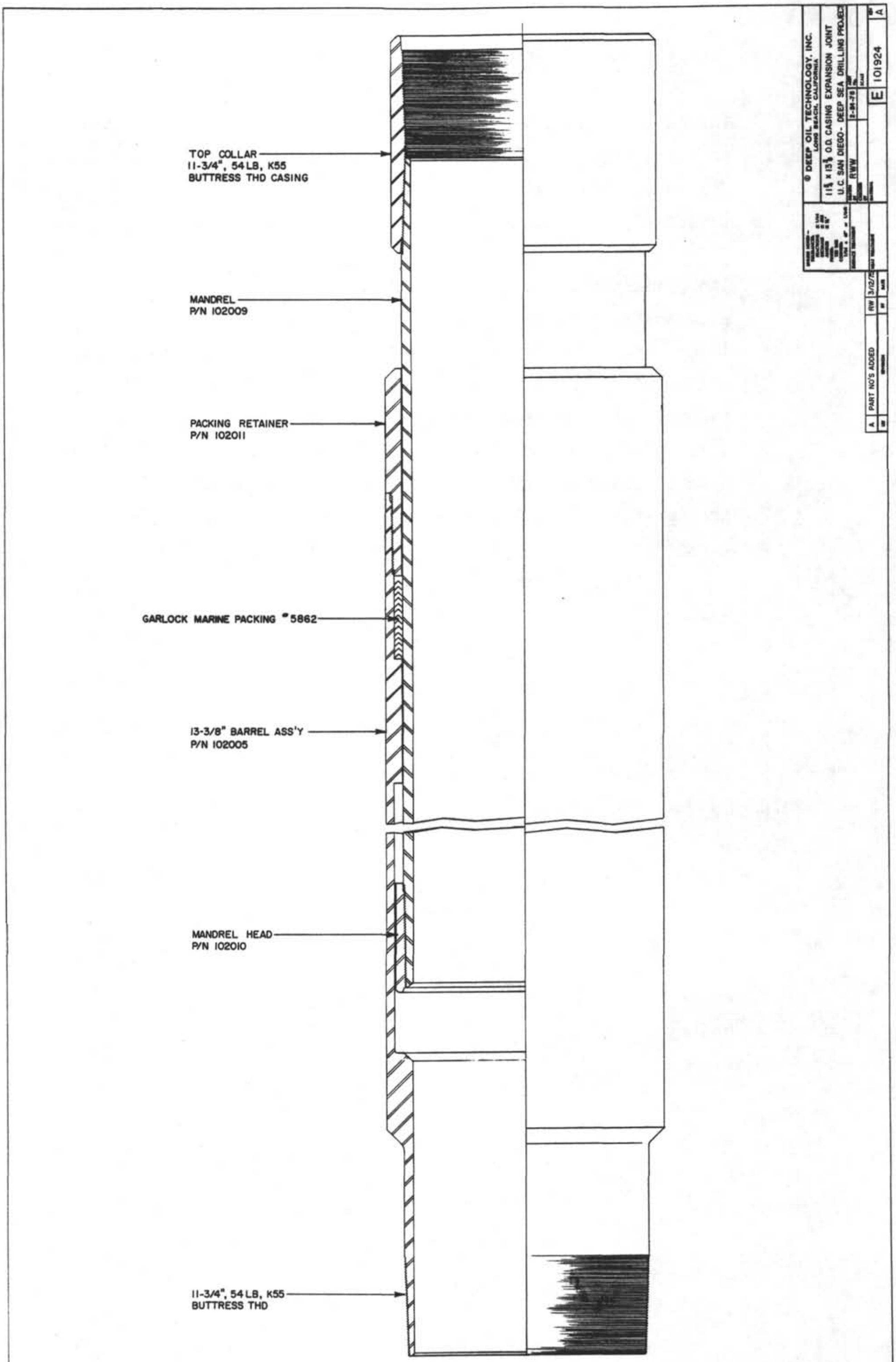
Disassembly of the landing tool is accomplished by drilling out the three one inch plug welds in the bottom sleeve (center punched for locating) and the alloy steel retaining plugs removed. The bottom sleeve can be backed off and the landing tool slid off the kelly mandrel for repairs. To reassemble, reverse the procedure making certain alloy steel (AISI 4130) retaining plugs are inserted before plug welding.


DEEP OIL MODIFIED BUTTRESS THD. PIN
LEFT HAND 12"- ¾ THD.-1.333 PITCH-15° STRT.
1/16" AXIAL MOVEMENT
165¾ REF.
ARP 452 O-RING
REMOVE IMPERFECT THD. BY GRINDING
10" REF.
45°
45° REF.
LANDING MANDREL P/N 102025
BOTTOM SLEEVE P/N 102023
11.575 DIA.
11.328 REF.
11.328 THD. I.D.
13" O.D.
12.000 THD. O.D.
4¼ I.D. THRU REF.
1/64 R.
NC-61 API ROTARY SHOULDERED CONNECTION
45° REF.
30°
45°
1/64 x 45°
2½
9½
.375
12 11/16
14"
20" REF.
API NC-61 ROTARY SHOULDERED CONNECTION
NOTE: MACHINE SURFACE TO BE TRUE .005 T.I.R.
© DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
ASSY- 11¾ HEX. KELLY-TYPE LANDING TOOL
U.C. SAN DIEGO- DEEP SEA DRILLING PROJ.
R. BLACKWOOD 2-21-75 101923
J.H. GERKEN 4/4/75 NONE
E 102026


LOWER SECTION
REENTRY GUIDE CONE
P/N 102028
NC-61 ROTARY SHOULDERED
CONNECTION
HEX LANDING MANDREL
P/N 102025
HEX KELLY-TYPE LANDING TOOL
P/N 102024
SHOULDER RING
P/N 102015
11 3/4" LATCH RING
P/N 102003
11 3/4" LATCH GROOVE RING
P/N 102016
11 3/4" CASING HANGER
P/N 102001
16" LATCH RING
P/N 102017
16" CASING HANGER
P/N 102013
11 3/4" FINNED TRANSITION SUB
12 3/4" O.D. × 11.06" I.D. × 10' LG.
WITH 8 FINS TO 14.94" DIA.
P/N 102002
16" TRANSITION SUB
17" O.D. × 15.125" I.D. × 10' LONG
P/N 102014
NC-61 ROTARY SHOULDERED
CONNECTION
16" CASING
11 3/4" CASING
© DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
11 3/4 × 16 CASING CEMENTING ASSEMBLY
U.C. SAN DIEGO DEEP SEA DRILLING PROJ
M. PENA
12-9-75
HALF
E
101923
C
C REVISED & REDRAWN M.P. 12-9-75
B REVISED & REDRAWN RRB 12-5-75

E. 11 3/4" Casing Expansion Joint (P/N 101924)

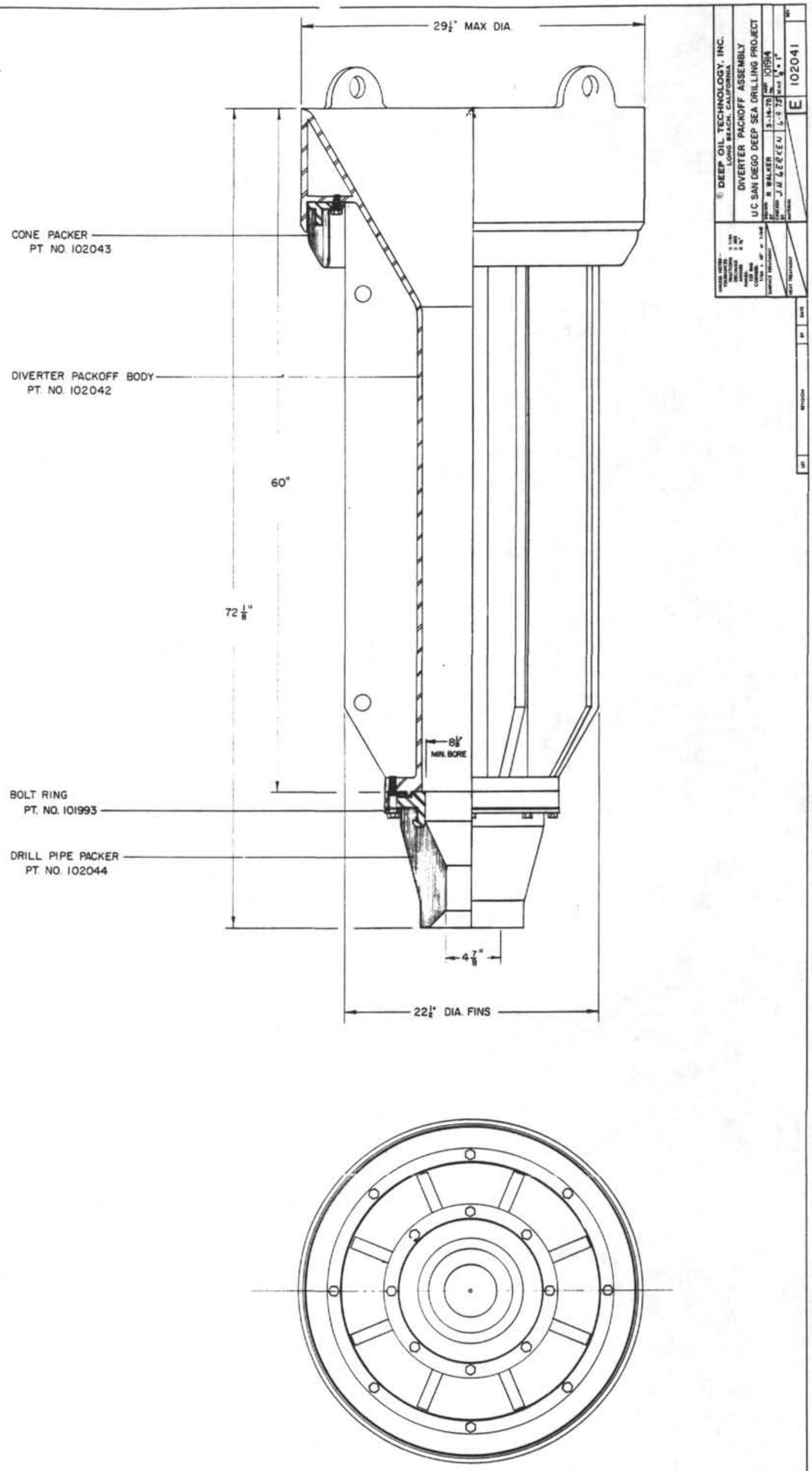
An 11 3/4" casing expansion joint is incorporated into the system to minimize the compressional loads on the 11 3/4" due to differential settling of the reentry cone and 16" casing. The expansion joint is provided with 11 3/4" buttress thread and includes a ten foot stroke inner mandrel (P/N 102009), a mandrel head (P/N 102010), an outer barrel assembly (P/N 102005) and a packing retainer (P/N 102011) Conventional asbestos rope packing (Garlock Marine Packing #5862 or equivalent) is used in the slip joint.


TOP COLLAR
11-3/4", 54 LB, K55
BUTTRESS THD CASING
MANDREL
P/N 102009
PACKING RETAINER
P/N 102011
GARLOCK MARINE PACKING #5862
13-3/8" BARREL ASS'Y
P/N 102005
MANDREL HEAD
P/N 102010
11-3/4", 54 LB, K55
BUTTRESS THD
© DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
11¾ x 13⅜ O.D. CASING EXPANSION JOINT
U.C. SAN DIEGO - DEEP SEA DRILLING PROJECT
RWW
2-24-78
E 101924
A
A PART NO'S ADDED RW 3/12/78

F. Diverter Packoff Assembly (P/N 102041)

The cuttings disposal system consists of the 11 3/4" circulating casing hanger, the reentry cone discharge lines and the diverter packoff assembly. The diverter packoff serves to seal the annular area and divert the circulating fluids through the cone discharge line.

The primary seal is provided by the drillpipe packer (P/N 102044) with the cone packer (P/N 102043) preventing cuttings from filling the lower cone and disrupting reentry. The diverter packoff will pass 7 1/4" tool joints but will shoulder on 8 1/4" drill collars. The assembly is, therefore, to be run after the last drill collar. A 5 1/2" API FH starting mandrel is provided to assist in stripping the assembly over the first tool joint. Depending upon the drillpipe packer wear during drilling or cementing operations, the diverter packoff should ride out on the first stand of drill collars.


29½" MAX DIA.
CONE PACKER
PT NO. 102043
DIVERTER PACKOFF BODY
PT. NO. 102042
60"
72⅛"
8⅝" MIN. BORE
BOLT RING
PT. NO. 101993
DRILL PIPE PACKER
PT. NO. 102044
4⅞"
22½" DIA. FINS
© DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
DIVERTER PACKOFF ASSEMBLY
U C SAN DIEGO DEEP SEA DRILLING PROJECT
R WALKER
3-14-75
101914
J.H. GERKEN
6-4-75
E
102041

INSTALLATION OF 16" and 11-3/4"LATCH RINGS

A special tool to be used for installation of the 16" and 11-3/4" latch rings is currently being developed. In the interim period, the latch rings can be installed utilizing the following procedure:

1) Slip ring over transition sub and onto casing hanger body. Ring will have to be slightly spread and jarred onto body. The ring can then be driven with brass mallets until it comes in contact with shoulder directly beneath latch ring groove.

2) Using No. 3 Armstrong C-clamps, place lower clamp surface beneath ring and upper clamp surface on bottom of latch ring groove. First clamp should be placed near 3" gap in ring.

3) Slowly ease latch ring up onto O.D. of shoulder beneath latch ring groove using C-clamps approximately 6" apart on circumference. Begin at one end and work around circumference.

4) After ring is fully expanded around maximum O.D. hanger, all C-clamps should be removed. Now ring can be "popped" into groove by using brass mallets.

5) Latch ring retainer can now be installed to centralize the ring in the groove.

6) Installation procedure should require approximately one half hour to complete.

NOTE: Should it be necessary to test the 11-3/4" casing hanger aboard ship with the latch ring installed, it is recommended that the "shoulder ring" be left off of the 16" casing hanger. This will allow the latch ring to be released after testing. If the "shoulder ring" is installed prior to the test, then removal of the 11-3/4" latch ring from the latch groove will be necessary in order to separate the "shoulder ring" from the 11-3/4" casing hanger body. This is not advised as it subjects the ring to possible damage during removal.

C. RE-ENTRY CONE/DUAL CASING HANGER SYSTEM OPERATION

II. OPERATIONAL PROCEDURES FOR DEEP CRUSTAL PENETRATIONS

A. Keelhaul Reentry Cone

1. Assemble reentry cone in an inverted position. Turn cone on its side and install reflectors. Rig reentry cone for keelhauling by placing 1" doubled slings (each 66' or 33' doubled) around the lifting bars on the upper cone and store inside cone. Make-up short bridle (13'6" and 10' slings) on upper and lower cone padeyes to doubled 3/4" line and shackle into crane whipline (Figure 15). In addition, shackle into crane block using a short 1" sling.

2. Pickup cone with crane block and swing cone onto port side of main deck with open end facing towards the starboard bow. Use air tuggers to restrain cone (use tuggers both from rig floor and main deck).

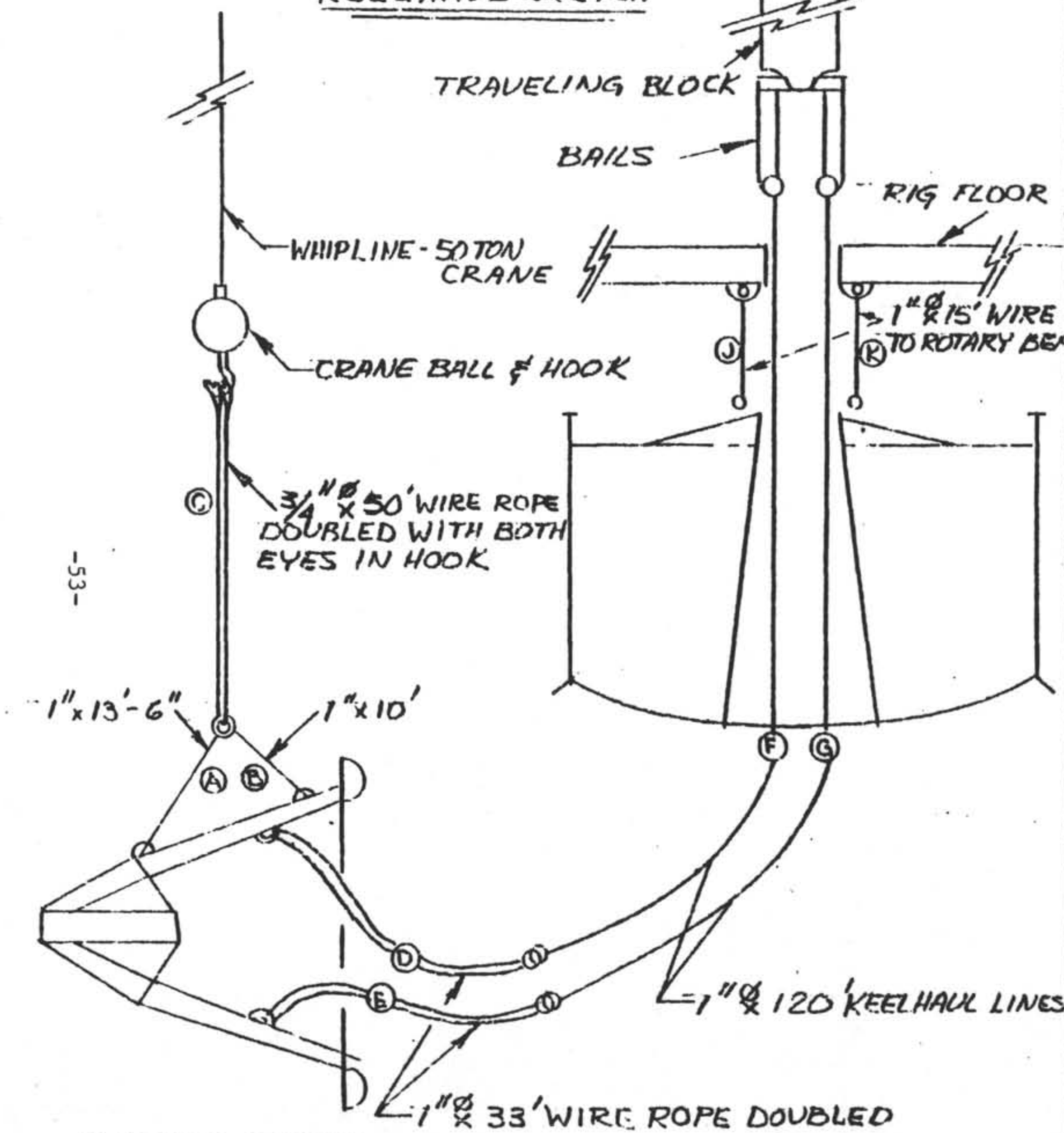
3. Hook up keelhaul lines to main doubled keelhaul slings. Use at least one inch keelhaul lines (120' long each) rigged up to derrick travelling blocks (Figure 15).

   NOTE: Keelhaul lines should be run prior to these operations. Small diameter manila pull lines have been installed without the aid of divers by positioning the Glomar Challenger so that the ocean current is running thwart ship from the starboard. The manila line is lowered along with a small diameter rubber air hot hose attached through the proper openings in the moon pool. A fabric bag (pillow case) secured to the end is then inflated and floats alongside on the port side where it is retrieved.

4. Remove crane block and short sling from short bridle and transfer load to crane whipline.

5. Using crane whipline swing cone over the side with open end facing the moon pool. Take up slack on keelhaul lines with derrick travelling blocks. These lines will act to keep the cone in proper orientation (Figure 6).

KEEL HAUL SKETCH



MODIFIED AFTER
TRAVIS
12-16-70

FIGURE #15

KEEL HAUL PROCEDURE

1. ASSEMBLE CONE IN A VERTICAL POSITION
2. RIG SHORT BRIDLE A & B TO CONE PADEYES & TEMPORARILY CONNECT TO BLOCK WITH SHORT 1" SLING.
3. SECURE LINES (D) & (E) INSIDE CONE & MOVE CONE TO PORT SIDE & LAND ON PIPE RACK, DECK, & PORT RAIL.
4. SHACKLE LINES (F) & (G) CONNECTED TO BAILS OF TRAVELLING BLOCKS, TO LINES (D) & (E)
5. RERIG SHORT BRIDLE (A) & (B) WITH LINE (C) AND CONNECT TO WHIPLINE. SWING CONE TO MID-SHIP & LOWER INTO WATER TO WHERE "WHIPLINE" HOOK IS AT RAIL ON MAIN DECK. KEEP CONE BELOW WAVE ACTION.
6. PICK-UP ON LINES (F) & (G) WITH TRAVELLING BLOCK UNTIL ALL SLACK IS OUT OF LINES.
7. WITH CUTTING TORCH, CUT ONE EYE OFF LINE (C) AT "WHIP LINE" HOOK TO LET LINE (C) STRIP THRU RING ON LINES (A) (B)
8. PICK-UP ON LINES (F) & (G) UNTIL LINES (D) & (E) MAKE UP WITH LINES (J) & (K).
9. REMOVE LINES (F) & (G).

6. Assure lines are not fouled on reflectors. Lower cone quickly while hauling in on keelhaul lines. When ball on whip line is even with bulwark, cut one 3/4" line below eye with cutting torch and retrieve entire line.

7. Pick up on keelhaul line carefully and shackle doubled lifting slings from cone onto sling prepared to receive same in moon pool.

8. Secure reentry cone in moon pool (Fig. 16).

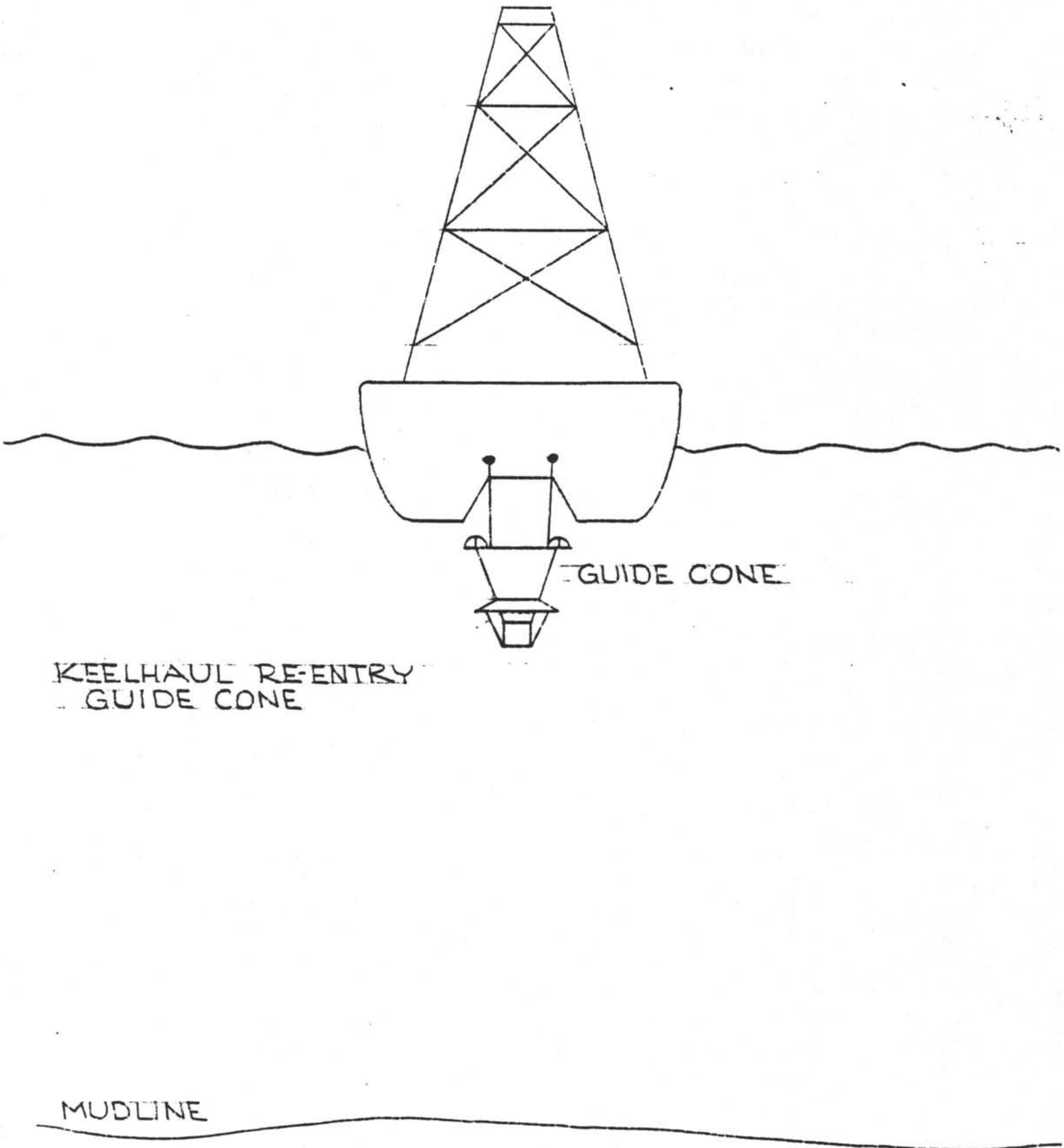


FIGURE 16

B. Running 16" Casing

The length of the 16" casing string is affected by two factors: 1) the condition of the ocean floor as determined by an exploratory core hole (i.e. the depth of penetration possible without rotation), and 2) the anticipated length of the 11 3/4" surface casing. The amount of 16" conductor recommended to effectively support (through skin-friction) the 11 3/4" casing will be based on the corehole depth and Figure #4.

NOTE: Casing aboard the Challenger is usually rusted due to exposure in storage. The casing should be thoroughly cleaned in the elevator area prior to running.

1. After the casing length is determined, the lower joint is cut to fit keeping in mind that the bit should be spaced out to be at the casing shoe.

2. The casing shoe is welded on the lower joint.

3. All threaded casing connections will be glued and/or tack-welded.

   a. Mill made up collars are to be tack welded before beginning to run casing (2" passes in three places). Any casing tack welded should not be run into the water until it is cool (200 F.±).

   b. Baker-Lok must be applied on a completely clean and dry thread.

4. Remove the collar from the last casing joint and weld a false collar (stop ring) 12" below the threads to prevent the casing string from passing through the slips set in the rotary table.

5. Prior to installing the 16" casing hanger, grease the 16" latch ring and the entire hanger to facilitate landing in the reentry cone. With the 30^{o} taper down, slip the latch ring over the 16" transition sub and engage in the hanger groove. Install the 16" outer and inner retaining rings, P/N 102636 & 102637, per the match-marks and fasten together with the 3/8" X 5/8" long UNF cap screws.
   NOTE: Refer to the special operating procedure for installing the latch rings.

6. Makeup the 16" casing hanger on the last joint of 16" casing using the casing clamp and doubled one inch slings provided (10' minimum) and land the hanger on top of the support plate situated in the lower horn section (Figure 17).

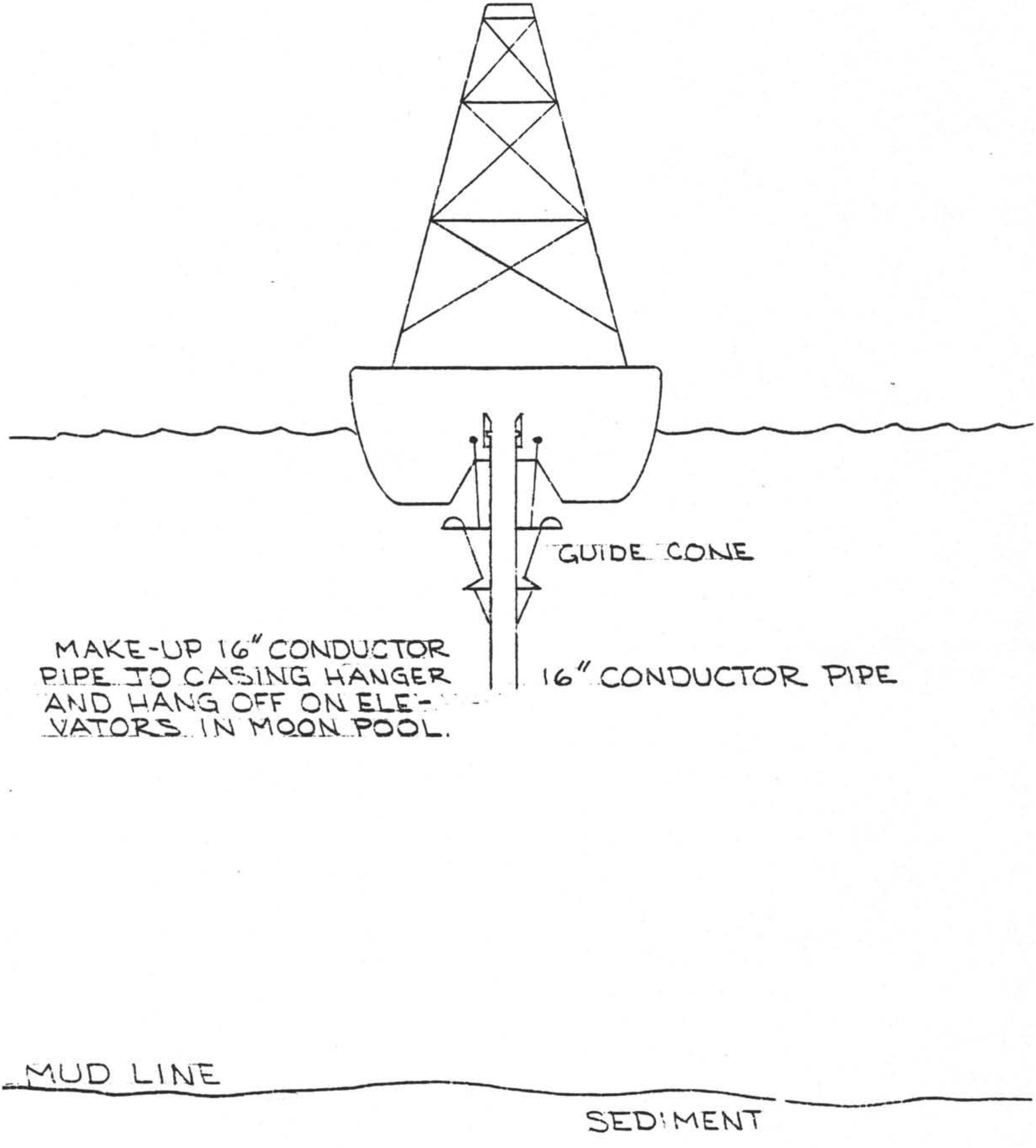

GUIDE CONE
MAKE-UP 16" CONDUCTOR PIPE TO CASING HANGER AND HANG OFF ON ELE-VATORS IN MOON POOL.
16" CONDUCTOR PIPE
MUD LINE
SEDIMENT

FIGURE 17

C. <u>Bottomhole Assembly</u>

1. The bottomhole assembly is made up including a 15" bit and the 16" casing running tool (Figure 18). The casing running tool is made up in the bottomhole assembly so that when engaged in the 16" casing hanger, the core bit will be at the casing shoe (Figure 19). This usually requires that the casing length be fitted to the bottomhole assembly and the shoe joint cut to proper length prior to running the casing.

2. Makeup the lowering and index subs on the assembly plate provided (consisting of an NC-61 thread protector welded to a 24" square plate). Lower the latch groove ring over the subs and rest on the plate. Place the latch sleeve over the assembled running tool and shoulder on the index sub. Lift the latch groove ring up to shoulder on the latch sleeve and hold in place with 7/8" NC bolts provided. The latch sleeve is rotated until the windows in the latch sleeve and the slots in the lowering sub line up.

3. The sliding sleeve is raised until the three spring clips lock and hold it in the up position. After the rollers are aligned correctly, release two of the spring clips simultaneously. Turn the paddles to the in or latched position verifying that the rollers remain correctly aligned. The third spring clip holding the sliding sleeve is released allowing sleeve to slide down locking the paddles in place (Drawing DOT 102196). At times, the sleeve may have to be forced down.

4. Releasing is checked by lowering the shifting tool into place with the sandline and shifting the sleeve to release the paddles.

5. The paddles are reengaged and checked for latching by attempting to rotate the lowering sub in the latch sleeve. Disengage and remove all the 7/8" bolts holding the latch groove ring.

6. Lift the shoulder ring over the assembly and lower onto the top of the latch sleeve.

NOTE: Steps #2 through #6 are to be accomplished before picking up drill collars.

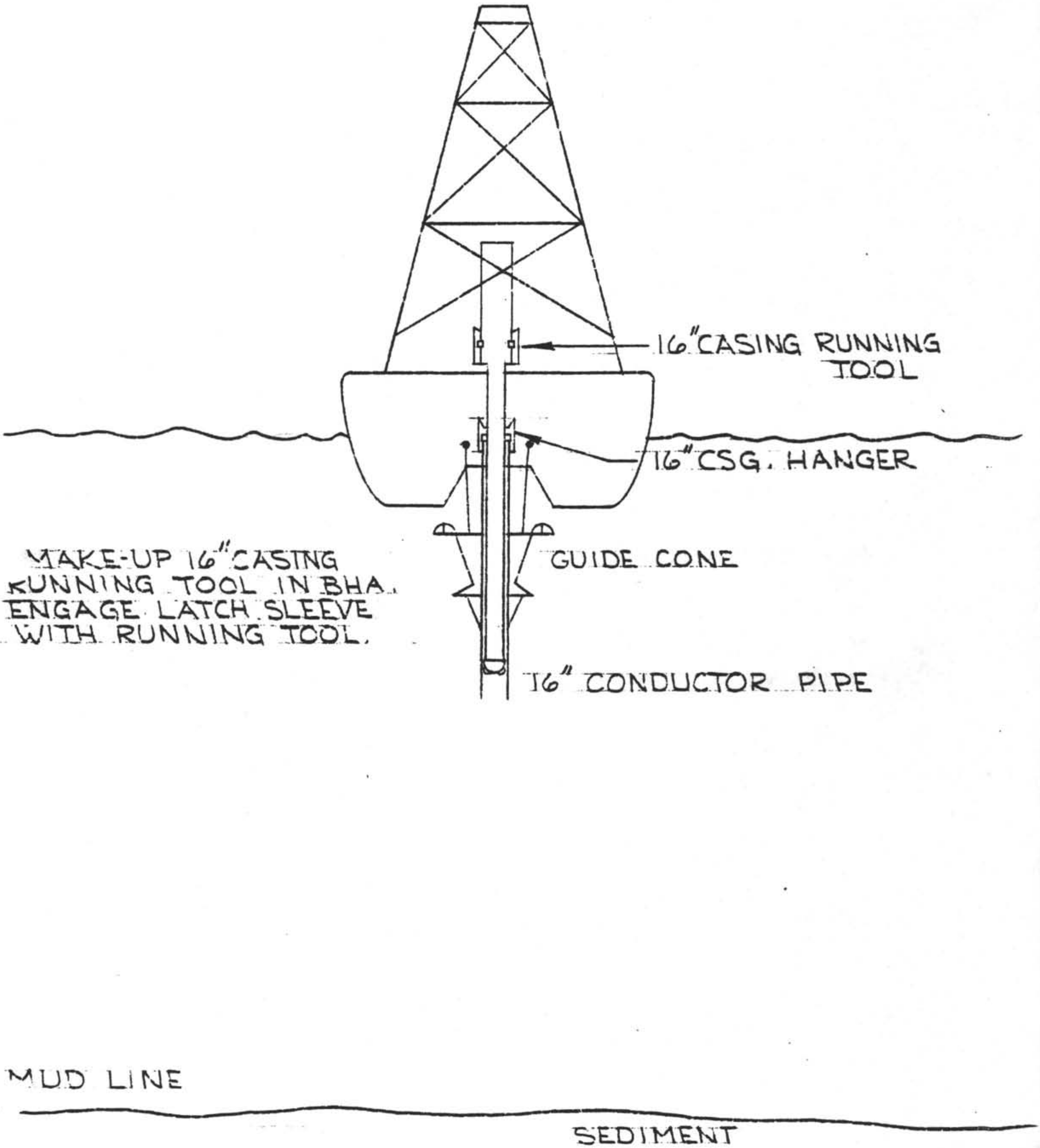

16" CASING RUNNING TOOL
16" CSG. HANGER
MAKE-UP 16" CASING RUNNING TOOL IN BHA. ENGAGE LATCH SLEEVE WITH RUNNING TOOL.
GUIDE CONE
16" CONDUCTOR PIPE
MUD LINE
SEDIMENT

FIGURE 18

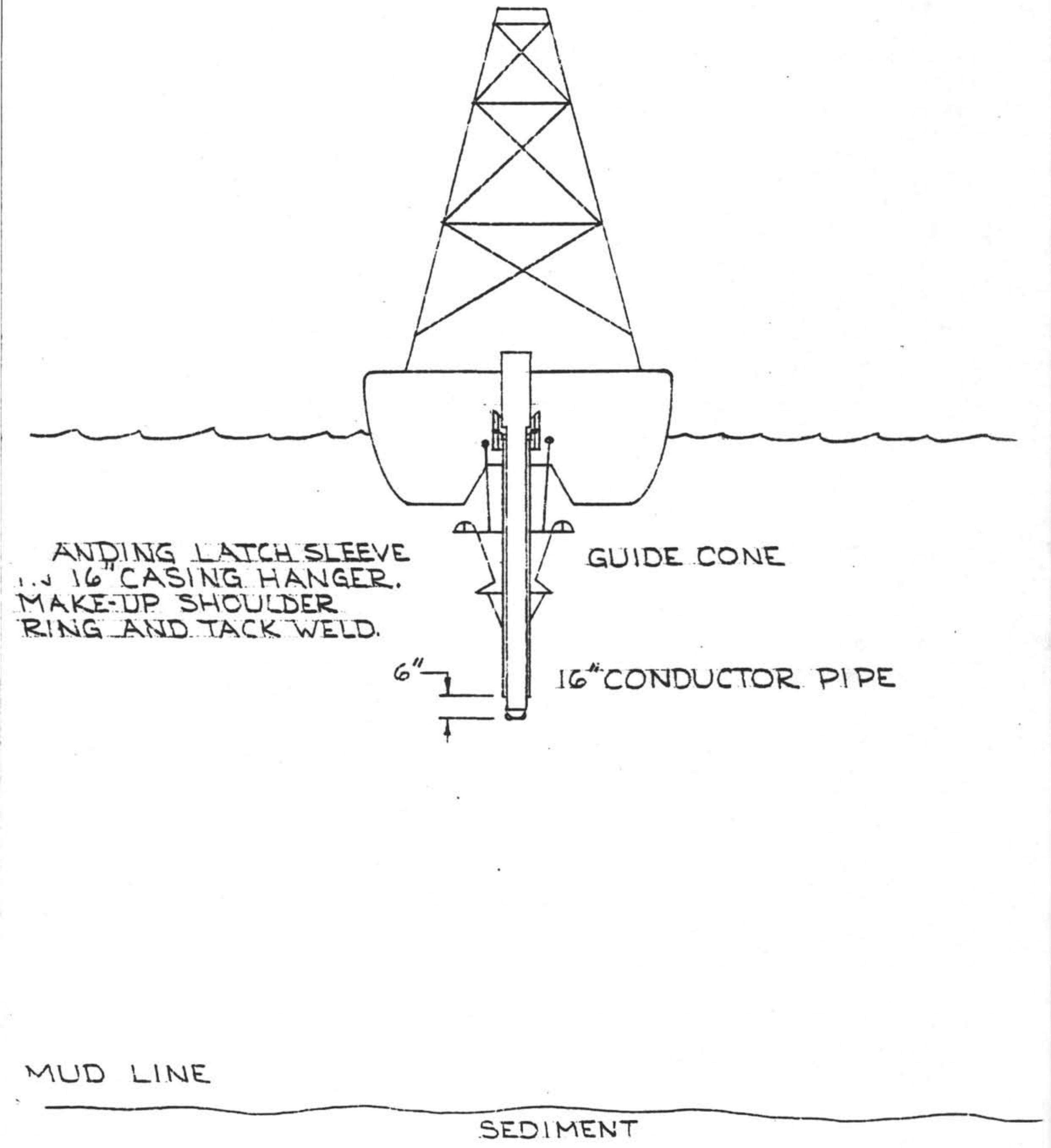
7. A drill collar is added to the bottomhole assembly and the lowering and index subs are made up to a bumper sub. The assembly is lowered through the table until the latch sleeve is just above the 16" casing hanger.

8. The latch sleeve is now eased into the 16" casing hanger until it is seated. The shoulder ring is made up using the two 3/4" holes and tack welded (Dwg. DOT 102196, Figure 19).

9. The 16" casing assembly is then lowered slowly into the reentry cone and latched (Figure 20). On the earlier (1975) cone design, a significant frictional drag occurs as the latch ring is lowered through the lower cone section. This condition has been basically eliminated in the new (1976) cones in that the cone bore and the latch ring OD will come into contact only in the last three inches of travel. Verify the engagement by lifting the entire assembly. Before proceeding shake the assembly several times.

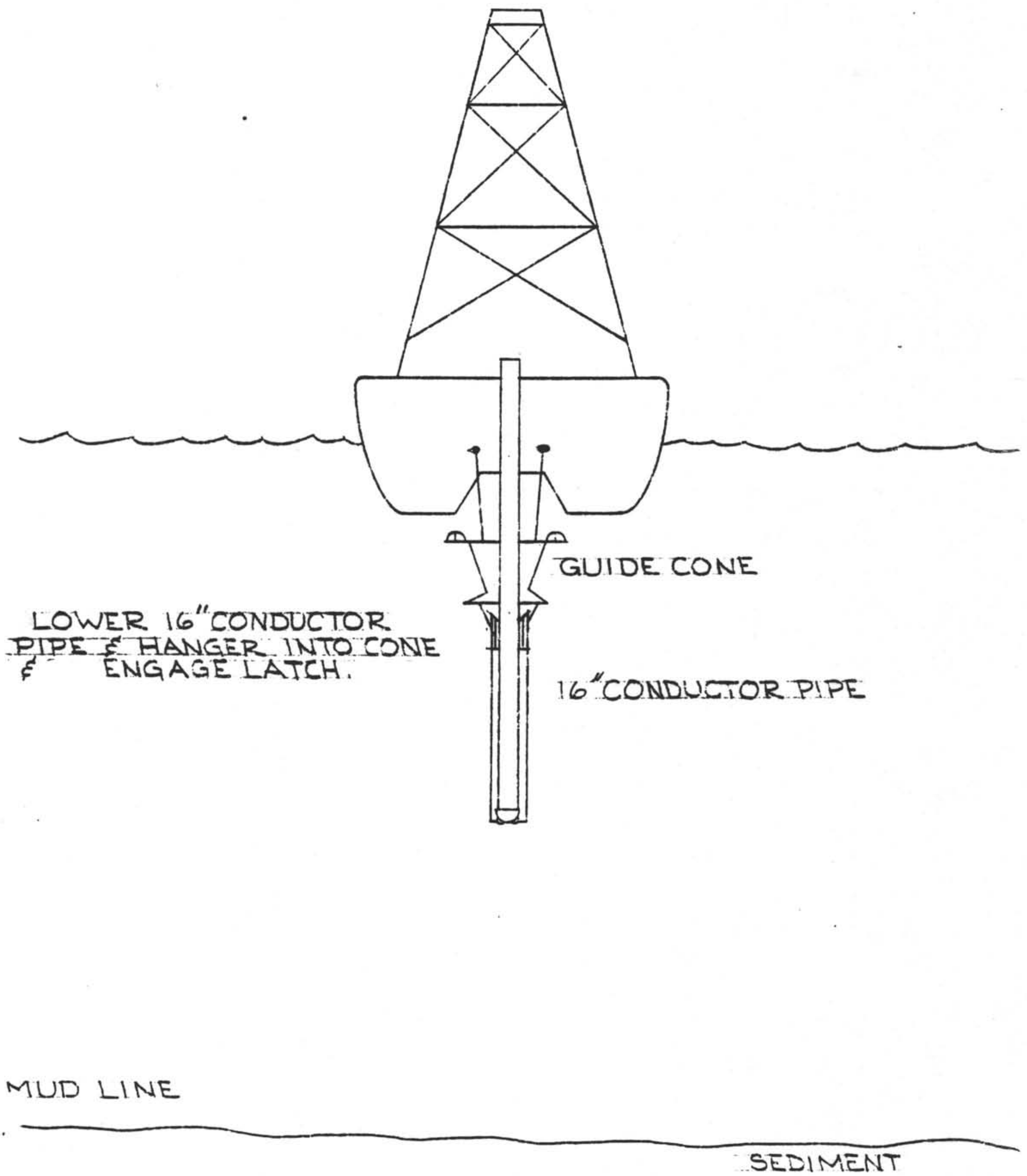
   NOTE: In case of current, allow ship to drift off station to assure proper alignment.

10. When ready to lower cone, one side of each doubled keelhaul sling is cut below the eye and the wire retrieved.



ANDING LATCH SLEEVE
ON 16" CASING HANGER.
MAKE-UP SHOULDER
RING AND TACK WELD.
GUIDE CONE
6"
16" CONDUCTOR PIPE
MUD LINE
SEDIMENT

FIGURE 19



GUIDE CONE
LOWER 16" CONDUCTOR PIPE & HANGER INTO CONE & ENGAGE LATCH.
16" CONDUCTOR PIPE
MUD LINE
SEDIMENT

FIGURE 20

D. Running to Bottom

The remainder of the bottomhole assembly is picked up and the reentry cone run to bottom in normal manner, care being exercised not to lower the cone too rapidly. The lowering can be watched on the PDR to 6000 feet plus.

NOTE: After running to last 8 1/4" drill collar, pick up the diverter packoff assembly on the first 7 1/4"drill collar and run in on the drillstring, using the 5 1/2" starter mandrel to install the diverter on the drill collar.

E. Washing in Casing

When the casing shoe is a few meters off bottom, the swivel and Bowen sub is picked up. Circulation is started and the casing string is washed in until the base of the reentry cone is resting on the ocean floor (Figure 21).

F. Release Reentry Cone and Casing

The shifting tool is run in on the 1/2" coring line with the normal retrieving hook up (refer to Appendix II for complete description of shifting tools).It is lowered until the drag blocks engage the index sub and the dogs are below the sliding sleeve. The coring line is pulled:

(1) The line pulls tight and released indicating the sliding sleeve moved to the released position.

(2) The line pulls tight and holds, indicating the sliding sleeve is in a bind. Normally, rotating the pipe left and right and raising and lowering the drillstring will free the sleeve. As soon as the sleeve has been moved up, rotating the drillstring to the right will force the paddles to rotate, releasing the drill string from the cone and the base.

G. Coring

Normal coring operations continue until dull bit forces first "tripping" operation or the desired casing depth has been reached. (Fig. 22). Fill hole with gel mud.

NOTE: With roller bits due regard to bearing life is required to avoid loss of hole gauge.

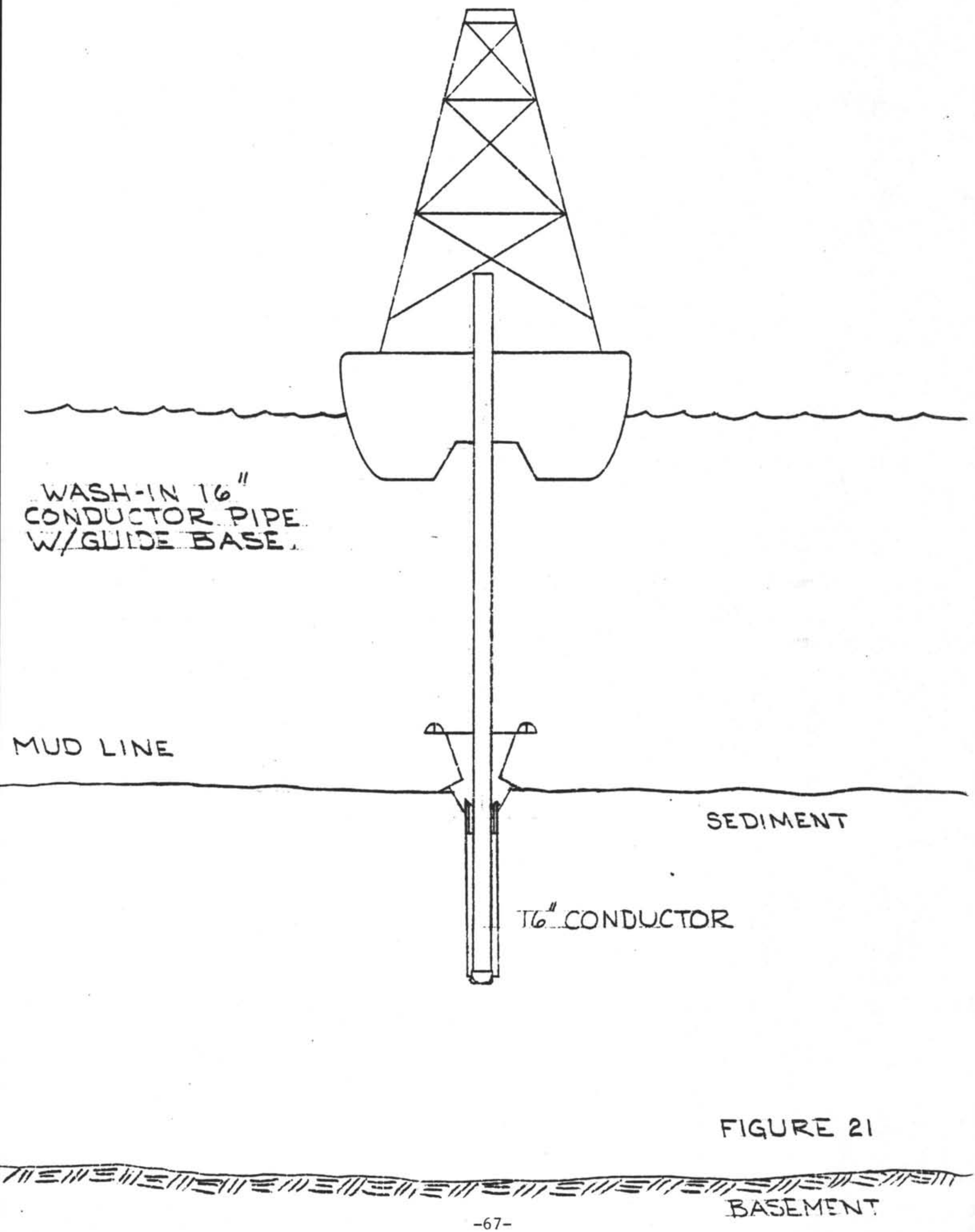

WASH-IN 16"
CONDUCTOR PIPE
W/GUIDE BASE
MUD LINE
SEDIMENT
16" CONDUCTOR
BASEMENT

FIGURE 21

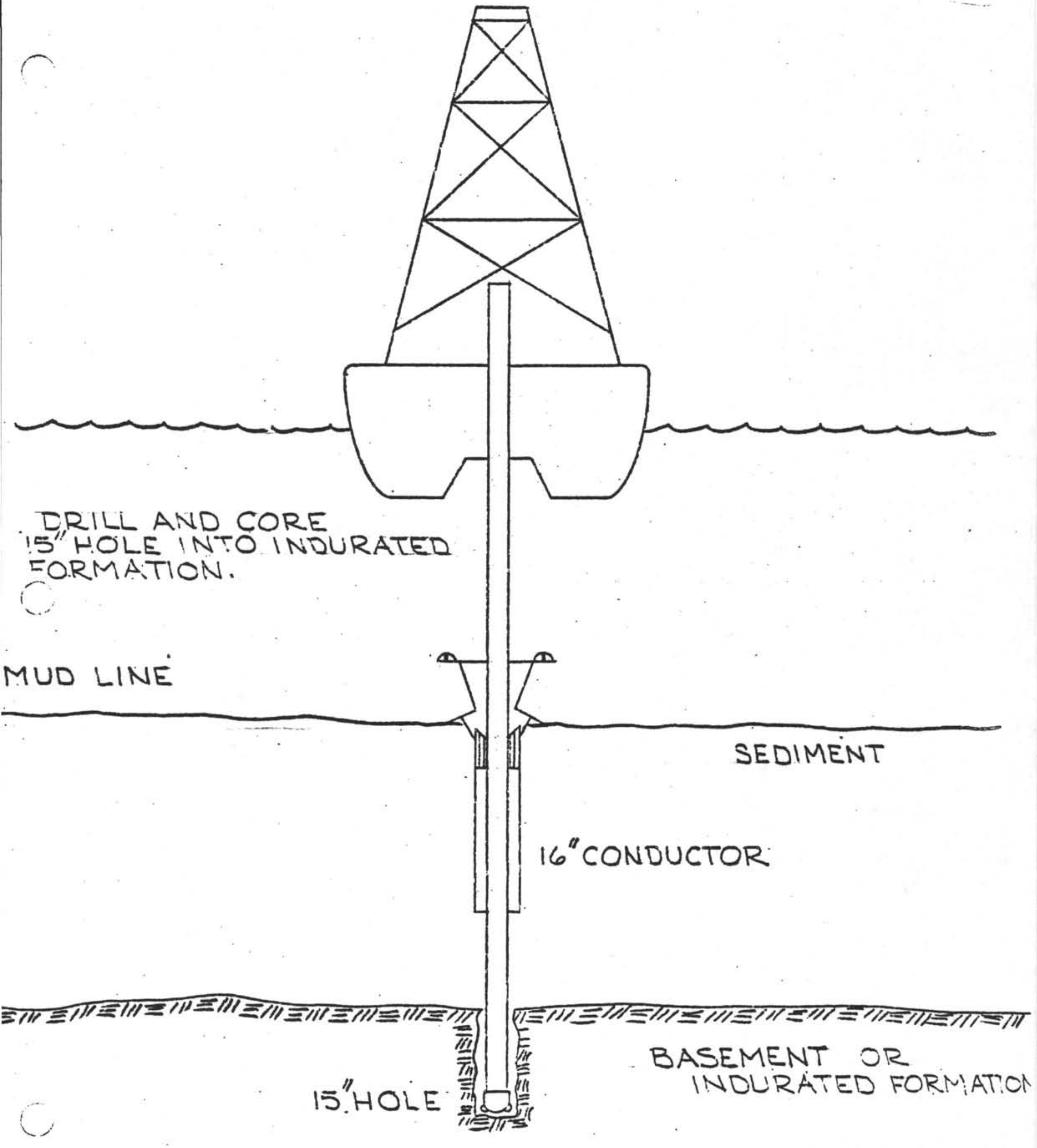

DRILL AND CORE
15" HOLE INTO INDURATED
FORMATION.
MUD LINE
SEDIMENT
16" CONDUCTOR
BASEMENT OR
INDURATED FORMATION
15" HOLE

FIGURE 22

H. Tripping

Conduct normal "tripping" operations. Diverter packoff assembly is designed to be carried out on the first stand of drill collars. The latch sleeve should be allowed to ride to the rig floor on top of the lowering sub. The casing running tools are broken out of the bottomhole assembly at this time.

NOTE: Casing running tool and latch sleeve must be completely disassembled, washed with fresh water, oiled and wrapped in polyehtylene.

I. Reentry

1. The drillpipe is run until the 15" bit is approximately 4-9 meters above the cone with a full stand up. A poor boy swivel is attached to the top of the drillpipe and fitted with a wireline stripper. It is necessary to circulate while running the scanning sonar tool. The large diameter (3 3/4") of the scanning sonar tool causes the tool to drop very slowly in the drillpipe without circulation and the wireline can easily be overrun.

2. The EDO high resolution scanning sonar instrument is attached to a Schlumberger cable head. The instrument and surface electronic gear are checked per the EDO Instruction Manual. The instrument is run to bottom and seated in the core barrel. Care must be exercised while running in so that the conductor cable does not overrun the instrument.

3. When the instrument is seated and scanning, the bit is guided over the cone by manuevering the vessel. The bit height above the cone should be three to four meters. When the bit is directly over the cone, the drill string is slacked off allowing the bit to slide down the cone and be guided into the casing. Hold tension on Schlumberger line.

   NOTE: If the drillpipe stops and verification of reentry is required, run collar locator or sidewall sampler.

4. Continue with normal coring operations until a 15" diameter hole has penetrated at least 50' into the basalt (or indurated sediment) or a dull bit forces second tripping operation.

J. Surface Casing String (11 3/4")

1. After making required penetration into basalt or indurated sediment, trip out of hole.

2. Make up and run on drillpipe sufficient 11 3/4" casing to place Halliburton cementing shoe within 50" of total depth. This will require approximately 1200" of casing (3000" maximum). Run casing centralizers 10" above the shoe and on the first collar.
   NOTE: Make up and run the 11 3/4" casing expansion joint two joints below the last casing joint (Figures 23 and 24).

3. Remove the collar from the last casing joint and weld a false collar (stop ring) 12" below the threads.

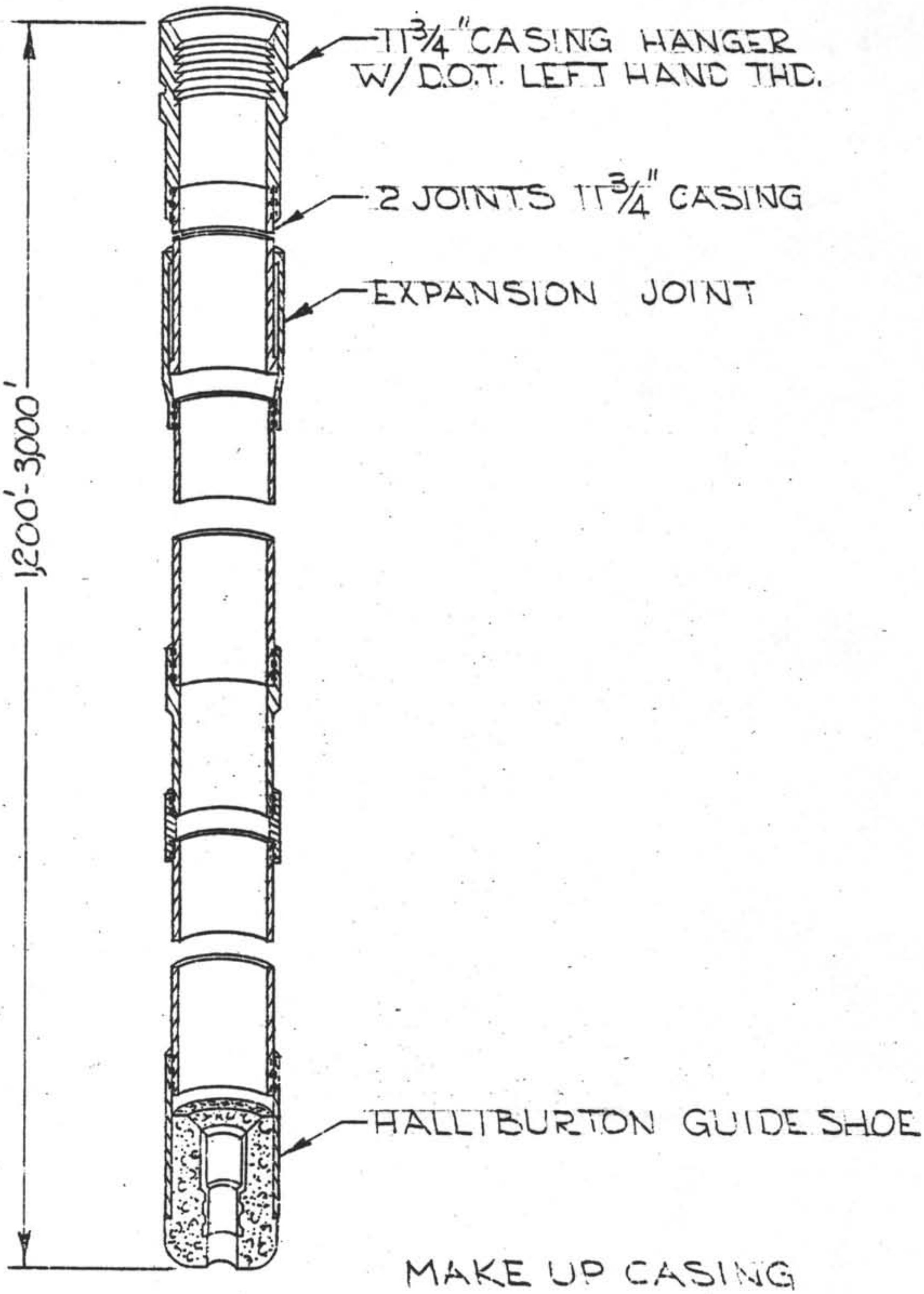
4. Prior to installing the 11 3/4" casing hanger, grease the 11 3/4" latch ring to facilitate engagement with the latch groove ring. With the 30^0 taper down, slip the latch ring over the 11 3/4" transition sub and engage in the hanger groove. Install the 11 3/4" outer and inner retaining rings, P/N 102638 & 102639 per the match-marks and fasten together with the 3/8" X 5/8" long UNF cap screws.

5. Make up the 11 3/4" casing hanger on the last joint of 113/4" casing (transition sub is provided with a 11 3/4" buttress box down).

6. Make up the 11 3/4" hex-kelly casing running tool in the 11 3/4" hanger by turning to the left until fully engaged (shouldered hand tight). Run 11 3/4" casing hanger to bottom and reenter cone by scanning sonar. Latch into the latch groove ring (Figure 25, DWG. DOT 101915). Pull up and verify that casing is latched.

7. Clean out to bottom of hole and check that hanger is all the way down (Figure 26).

8. Release from the 11 3/4" casing hanger by turning to the right with the hex-kelly in neutral (Figure 27).



MAKE UP CASING

FIGURE 23

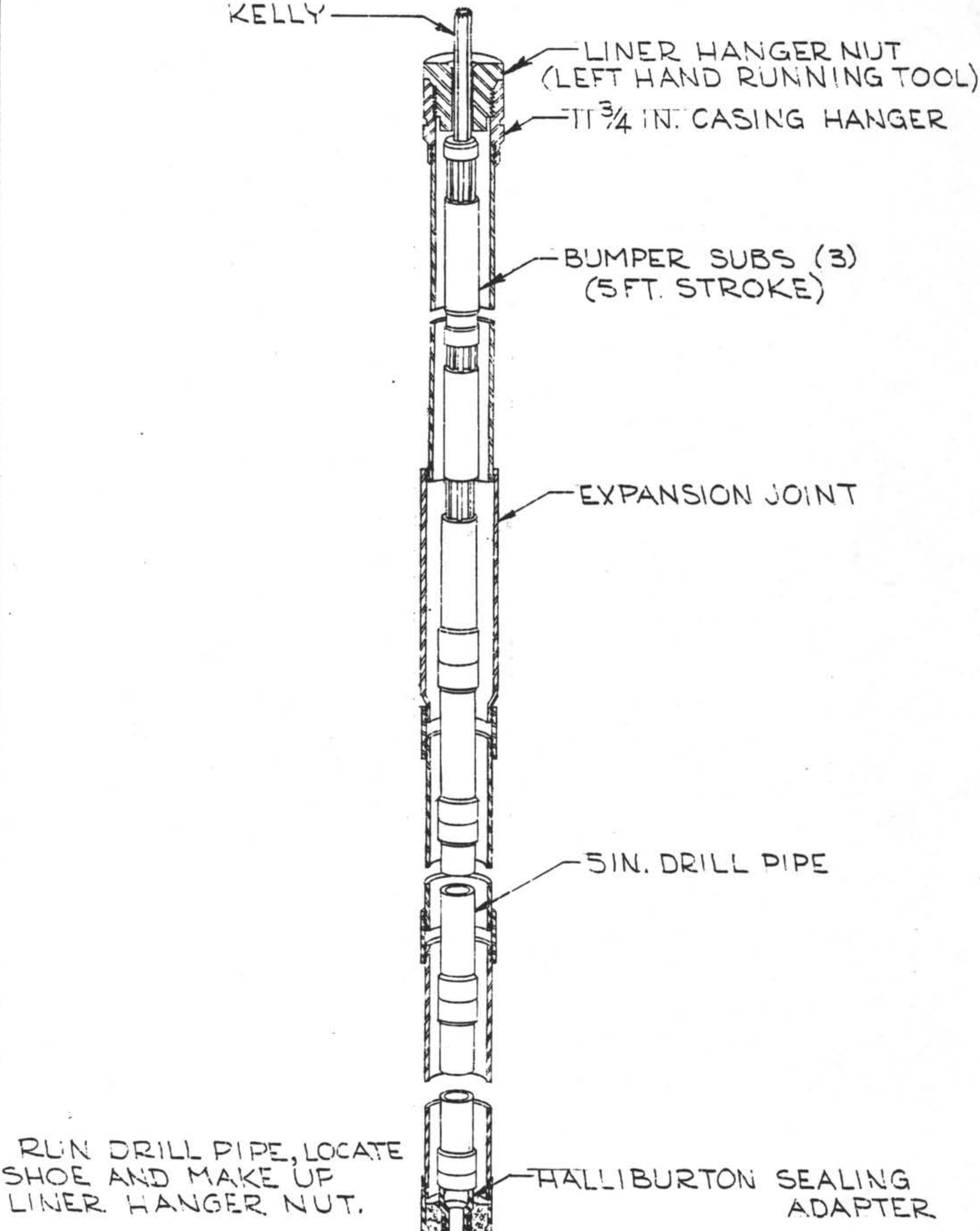

KELLY
LINER HANGER NUT
(LEFT HAND RUNNING TOOL)
11 3/4 IN. CASING HANGER
BUMPER SUBS (3)
(5 FT. STROKE)
EXPANSION JOINT
5 IN. DRILL PIPE
RUN DRILL PIPE, LOCATE
SHOE AND MAKE UP
LINER HANGER NUT.
HALLIBURTON SEALING
ADAPTER
HALLIBURTON GUIDE SHOE

FIGURE 24

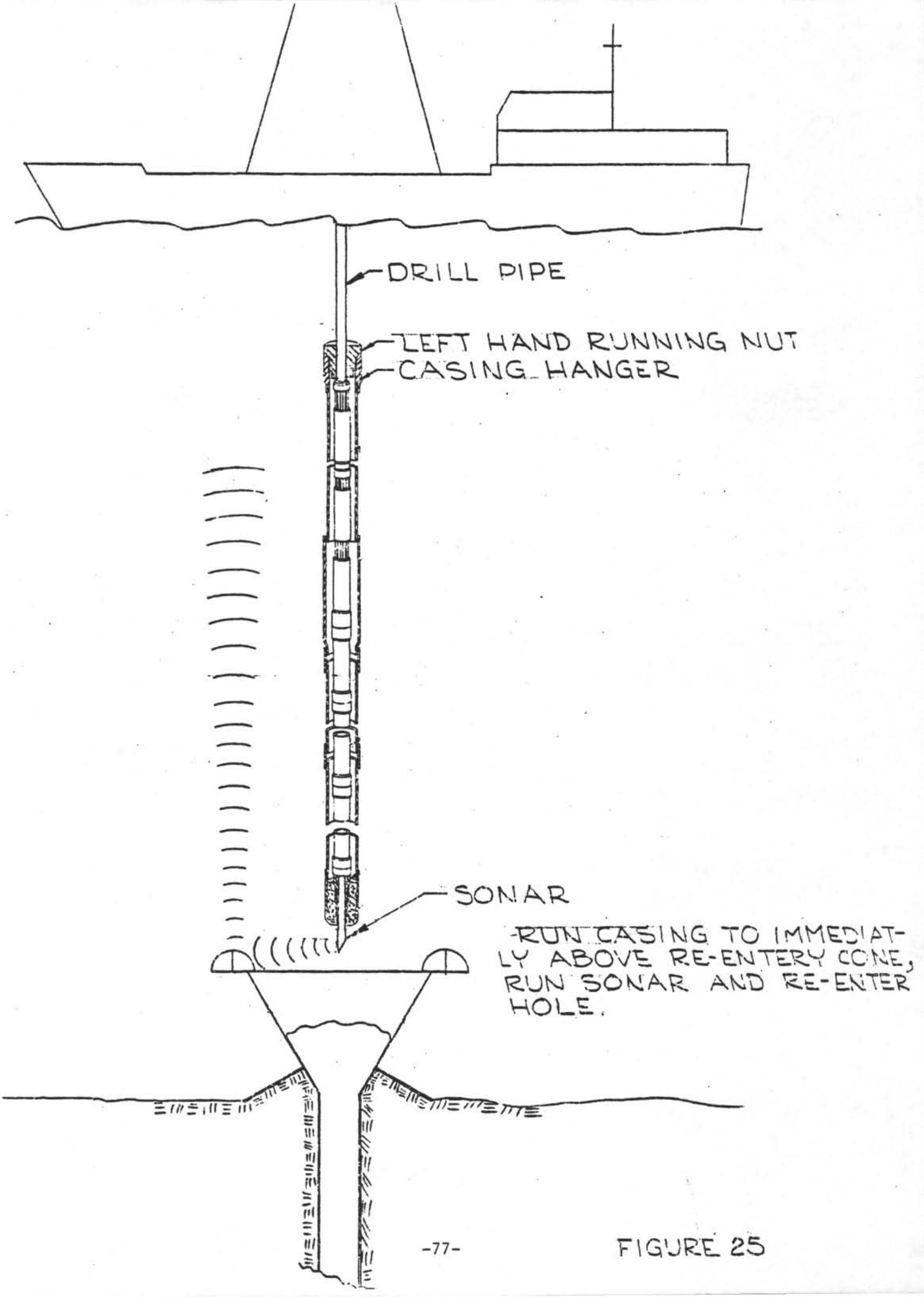

DRILL PIPE
LEFT HAND RUNNING NUT
CASING HANGER
SONAR
RUN CASING TO IMMEDIATLY ABOVE RE-ENTERY CONE, RUN SONAR AND RE-ENTER HOLE.

FIGURE 25

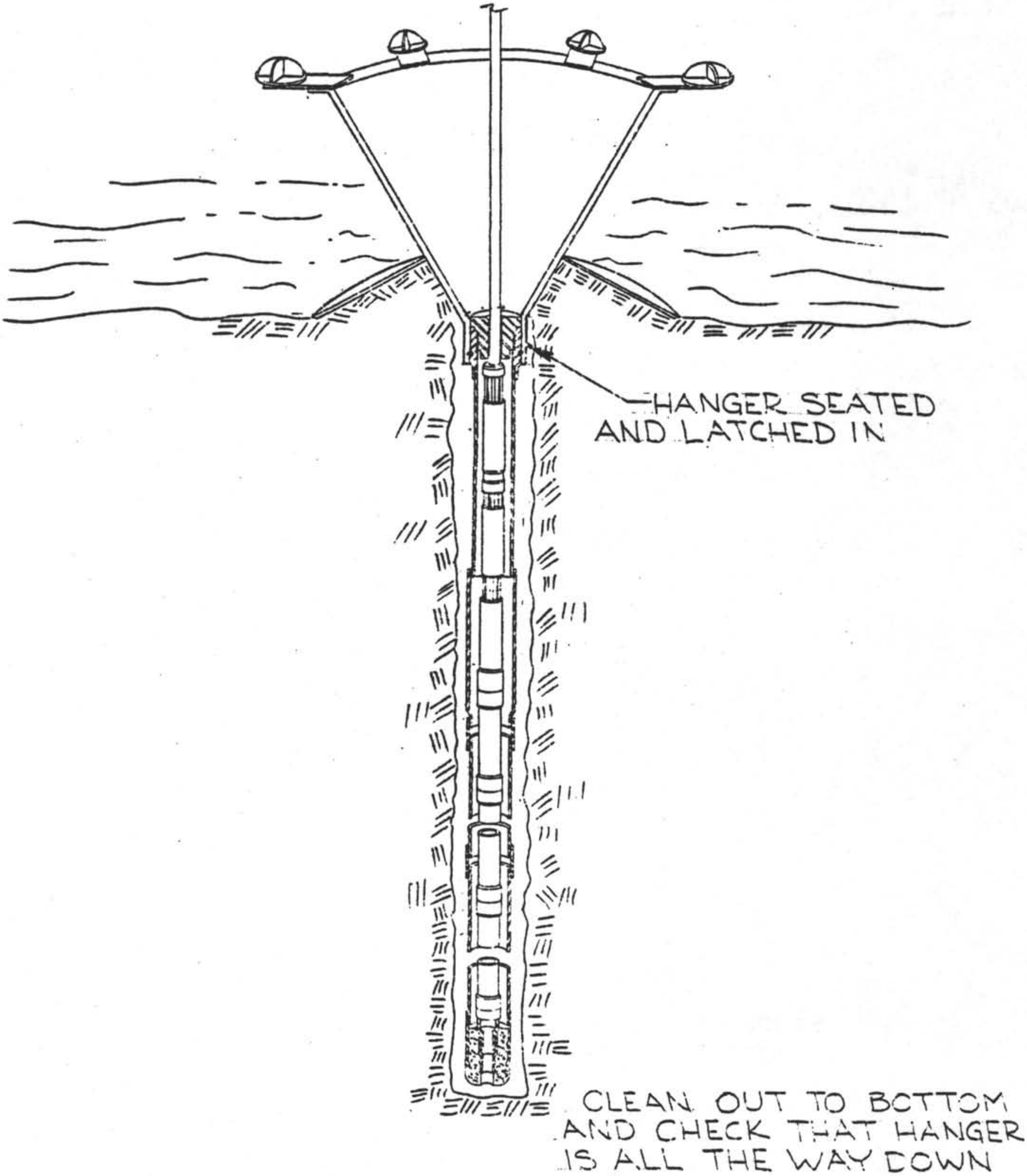

HANGER SEATED
AND LATCHED IN
CLEAN OUT TO BOTTOM
AND CHECK THAT HANGER
IS ALL THE WAY DOWN

FIGURE 26

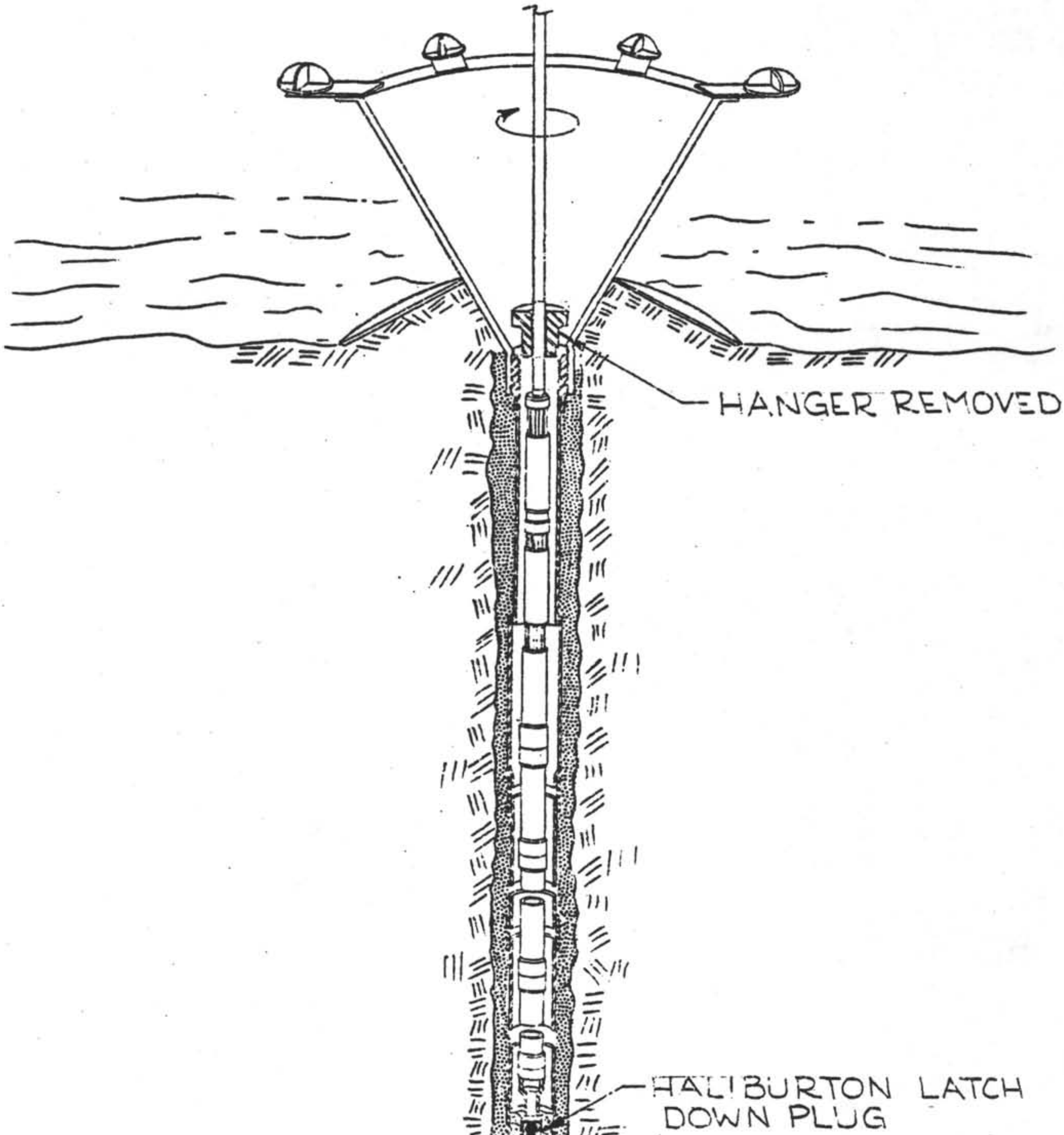

HANGER REMOVED
HALIBURTON LATCH DOWN PLUG
RELEASE FROM CASING, CEMENT CASING, BUMP PLUG.

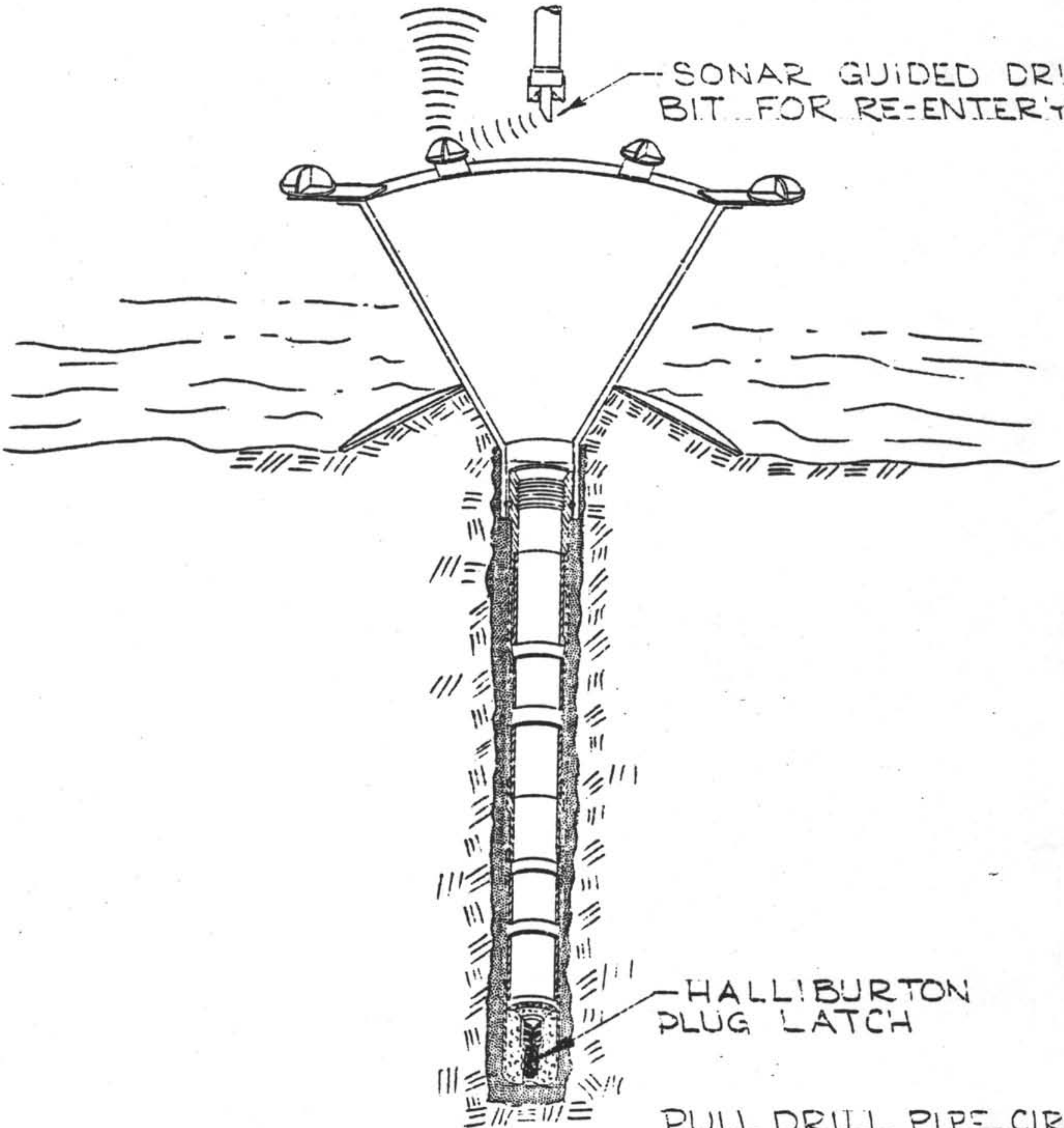
FIGURE 27

9. Cement the casing in place through drillpipe with sufficient gel cement to fill annulus to the ocean floor. Last 100 sacks to be neat cement (refer to Appendix III-D).

   NOTE: Wiper lock-down plug to be inserted in drillpipe 25 sacks prior to completing mixing.

10. Pull drillpipe, circulate residual cement out of drillpipe. Run 10" bit and reenter hole. Drill out cement and 11 3/4" casing shoe with standard core bit (Figure 28).

11. Core 10" diameter hole to depth as determined by shipboard scientists (Figure 29).



PULL DRILL PIPE, CIRCULATE RESIDUAL CEMENT OUT OF PIPE AND RUN BIT.

FIGURE 28

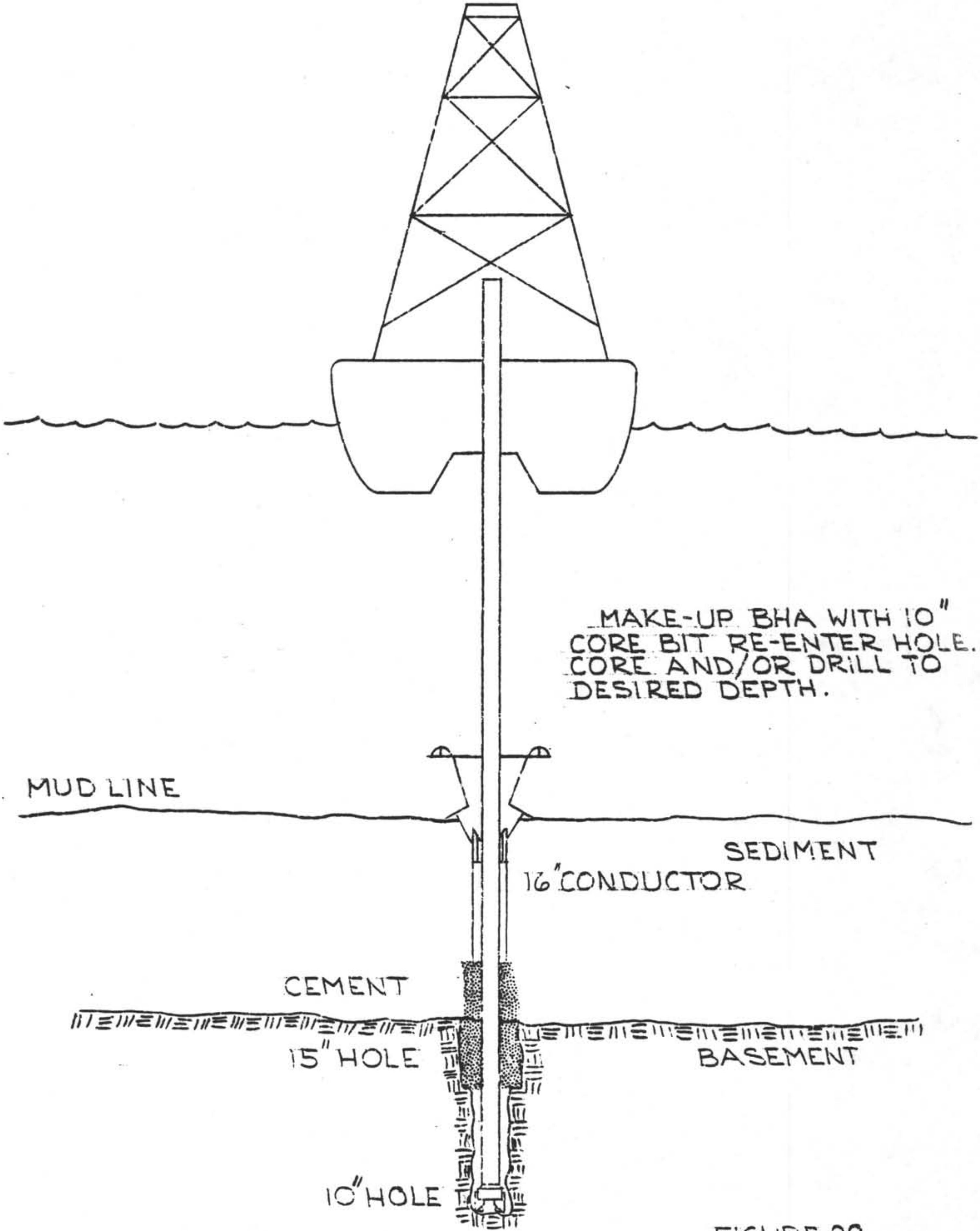
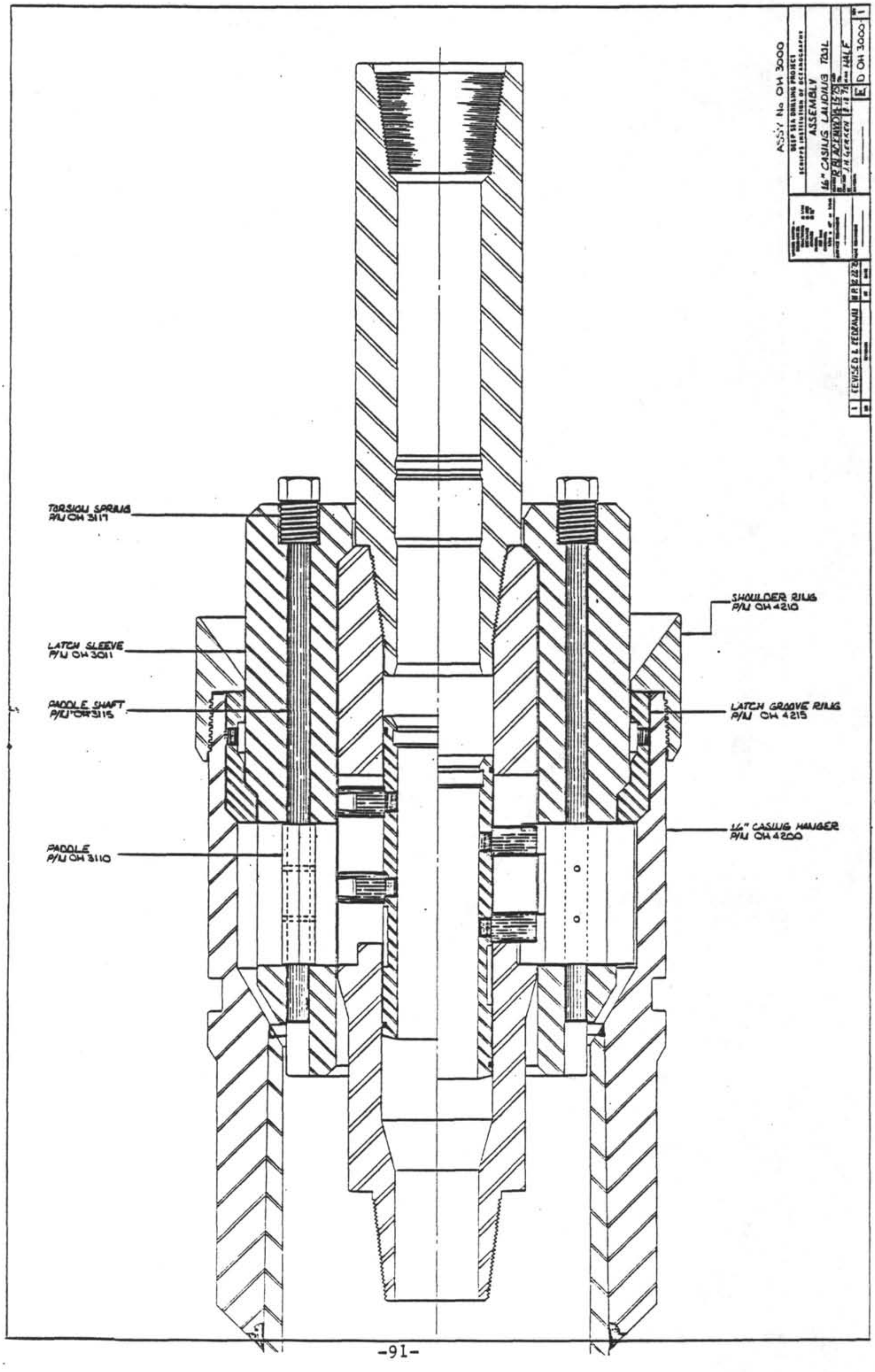

MAKE-UP BHA WITH 10"
CORE BIT RE-ENTER HOLE.
CORE AND/OR DRILL TO
DESIRED DEPTH.
MUD LINE
SEDIMENT
16" CONDUCTOR
CEMENT
15" HOLE
BASEMENT
10" HOLE

FIGURE 29

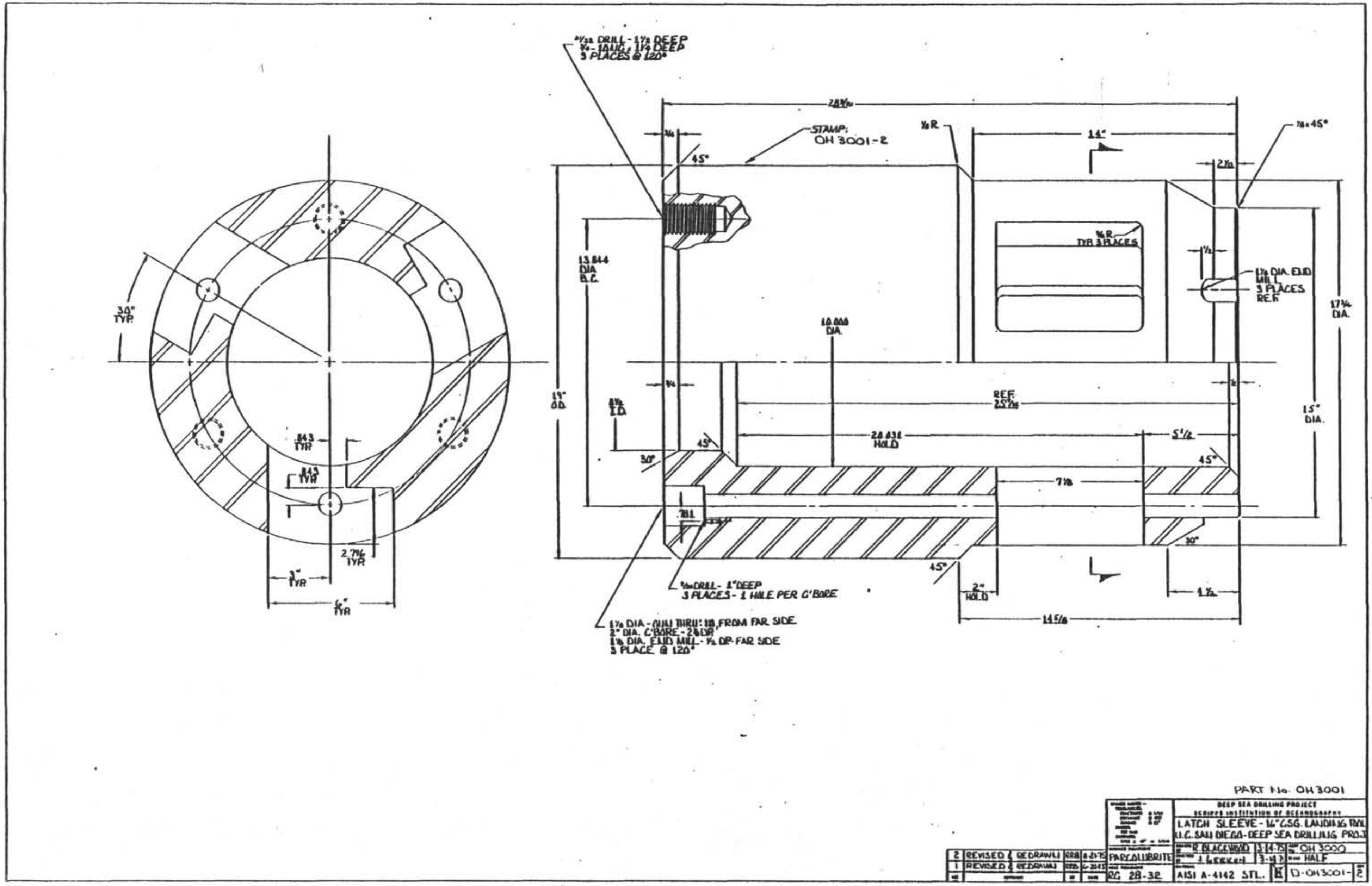
D. RE-ENTRY CONE/DUAL CASING HANGER
PARTS LIST, DRAWINGS, SPECIFICATIONS

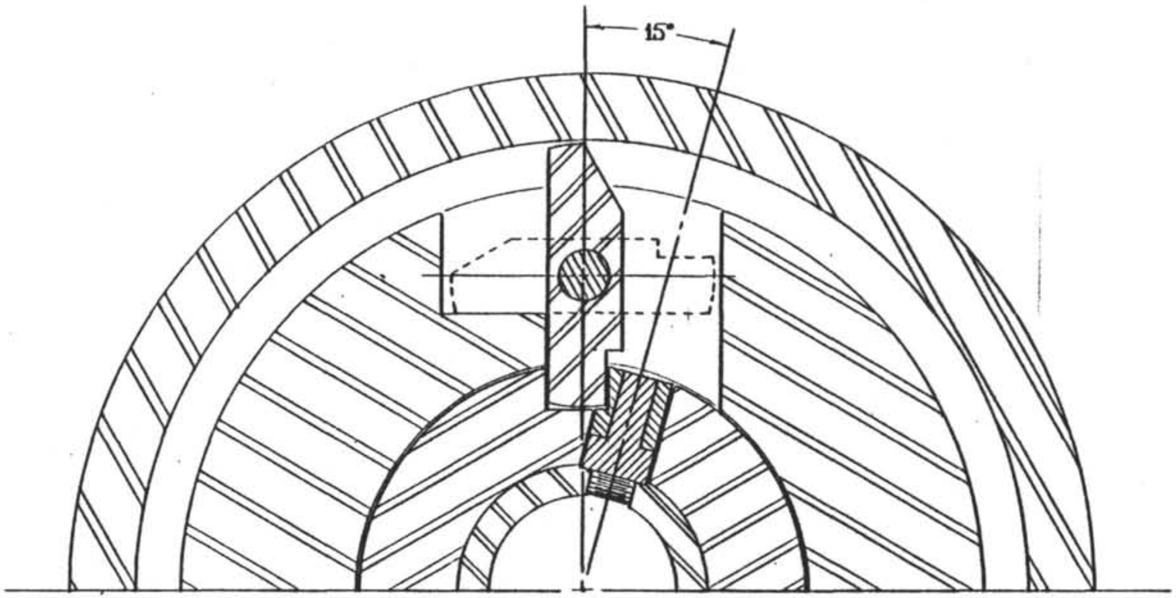
RE-ENTRY CONE DUAL CASING HANGER
PARTS, DRAWINGS AND SPECIFICATIONS

DSDP	DOT	DESCRIPTION
OH 3000(D)	102196	16" Casing Landing Tool Assembly
OH 3001(D)	102018B	Latch Sleeve - 16" Casing Landing Tool
OH 3002(C)	102019	Paddle Actuation
OH 3110(C)	102020B	Paddle
OH 3111(A)	102047	Roll Pin - 16" & 20" Landing Tool
OH 3115(B)	102021B	Paddle Shaft
OH 3117(A)	102022A	Torsion Springs
OH 3300(D)	102026A	11-3/4" Hex-Kelly Landing Tool Assembly
OH 3301(D)	101923C	11-3/4" Hex-Kelly Landing Tool - Conceptual
OH 3305(C)	102024A	11-3/4" Hex-Kelly Type Landing Tool
OH 3306(D)	102025A	11-3/4" Landing Mandrel
OH 3307(B)	102023A	Bottom Sleeve
OH 4000(D)	101914B	Re-entry Guide Cone Assembly
OH 4005(D)	102027A	Re-entry Guide Cone - Upper Section
OH 4010(D)	102028A	Re-entry Guide Cone - Lower Section Assembly
OH 4011(C)	102029A	Re-entry Guide Cone - Lower Section
OH 4012(C)	102030	Cone Mud Skirt
OH 4013(B)	102031A	Lower Cone Reinforcing Web
OH 4014(B)	102032	Discharge Line Reinforcing Web
OH 4015(B)	102033A	24" Cone Transition Section
OH 4016(C)	102034B	Cone Landing Collar
OH 4017(B)	102035A	Discharge Line - Lower Section
OH 4018(B)	102036A	Discharge Line - Connecting Collar
OH 4020(C)	102040A	Mud Skirt Extension
OH 4021(B)	102049	Mud Skirt Extension Stiffeners
OH 4030(C)	102037	Discharge Line - Upper Section
OH 4040(C)	102038	Passive Reflector, 3'
OH 4042(C)	102039	Reflector Support Bracket
OH 4043(A)	101914S	Bolting Specification - DSDP Re-entry Cone
OH 4190(D)	101915(C)	11-3/4" x 16" Casing Hanger Assembly - Conceptual
OH 4200(D)	102012B	16" Casing Hanger Assembly
OH 4201(D)	102013F	16" Casing Hanger Body
OH 4202(C)	102014	16" Casing Transition Sub
OH 4210(C)	102015C	Shoulder Ring, 16" & 20" Casing Hangers
OH 4215(C)	102016C	Latch Groove Ring
OH 4220(C)	102017C	Latch Ring, 16" & 20" Casing Hangers
OH 4221(C)	102636	Outer Retaining Ring, 16" & 20" Casing Hangers
OH 4222(D)	102227	Casing Elevators, 16" & 20" Casing Hangers
OH 4300(D)	102000C	11-3/4" Casing Hanger Assembly - 11-3/4" X 16" Casing Hanger
OH 4301(D)	102001D	11-3/4" Casing Hanger Body
OH 4302(C)	102002	11-3/4" Casing Hanger Transition Sub
OH 4303(A)	102004A	Transition Sub Fins
OH 4320(C)	102003C	11-3/4" Latch Ring
OH 4321(C)	102638	11-3/4" Outer Retaining Ring
OH 4400(D)	101924A	11-3/4" Casing Expansion Joint
OH 4401(C)	102005A	13-3/8" Barrel Assembly
OH 4402(C)	102006B	13-3/8" Barrel
OH 4403(B)	102007	Barrel Insert
OH 4404(C)	102008	Bottom Sub
OH 4405(C)	102009A	11-3/4" Mandrel
OH 4406(C)	102010A	11-3/4" Mandrel Head
OH 4407(C)	102011B	Packing Retainer
OH 4408(A)	101924S	Packing Specification - 11 3/4" Casing Expansion Joint
OH 4500(D)	102041	Diverter Packoff Assembly
OH 4501(D)	102042B	Diverter Packoff Body
OH 4505(D)	102044	Drill Pipe Packer
OH 4506(B)	101993	Bolt Ring
OH 4507(D)	102043A	Packer Molding Ring
OH 4508(A)	102041S	Packer Specification - Diverter Packoff Assembly
OH 4509(B)	102226	Starting Mandrel - Diverter Packoff Assembly
OH 4600(C)	102046	Ring/Plug Gauge #159 (DOT Safety Thread)
OH 4601(C)	102266	Ring/Plug Gauge #168 (Shoulder Ring)



TORSION SPRING P/N OH 3117
LATCH SLEEVE P/N OH 3011
PADDLE SHAFT P/N OH 3115
PADDLE P/N OH 3110
SHOULDER RING P/N OH 4210
LATCH GROOVE RING P/N OH 4215
16" CASING HANGER P/N OH 4200
ASSY No OH 3000
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
ASSEMBLY
16" CASING LANDING TOOL
HALF
E D OH 3000
REVISED & REDRAWN


STAMP: OH 3001-2
1 7/8 DIA. END MILL 3 PLACES REF.
5/16 DRILL - 1" DEEP 3 PLACES - 1 HOLE PER C'BORE
PART No. OH3001
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LATCH SLEEVE - 16" CSG. LANDING TOOL
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.
R. BLACKWOOD 3-14-75
OH 3000
HALF
2 REVISED & REDRAWN
1 REVISED & REDRAWN
PARCOLUBRITE
RC 28-32
AISI A-4142 STL.
D-OH3001-2



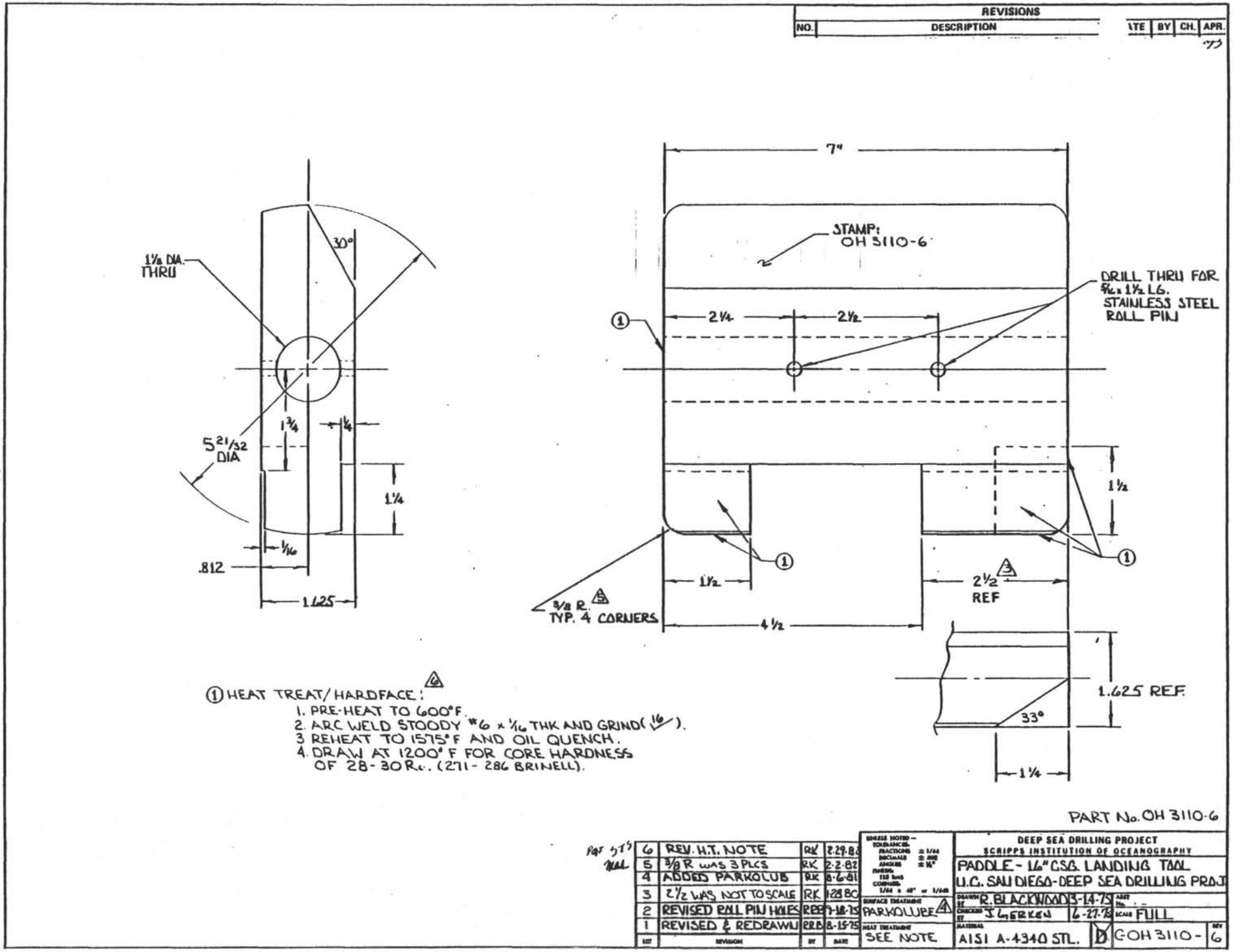
RECOVERABLE LATCH
CASING HANGER ASSEMBLY

FOR USE WITH 9⅞" CASING RUNNING TOOL
AND 16" O.D. 75 LBS/FT. 7/16 WALL CASING

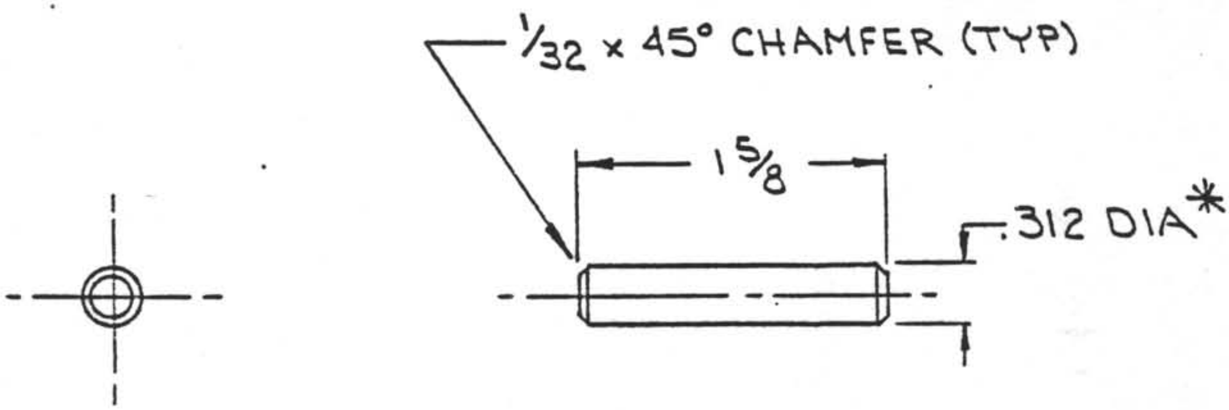
PART No OH3002

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY
	PADDLE ACTUATION - 16" CSG. LANDING TOOL U.C. SAN DIEGO - DEEP SEA DRILLING PROJ
SURFACE TREATMENT	DRAWN BY R. BLACKWOOD 3-14-75 ASSY No.
	CHECKED BY J. GERKEN 3-14-75 SCALE HALF
HEAT TREATMENT	MATERIAL D C-OH3002- REV 0

LET	REVISION	BY	DATE


REVISIONS
NO.
DESCRIPTION
DATE BY CH. APR.
7"
STAMP: OH 3110-6
DRILL THRU FOR 5/16 x 1½ LG. STAINLESS STEEL ROLL PIN
1⅛ DIA. THRU
30°
2¼
2½
①
5 21/32 DIA
1¾
¼
1¼
1½
1/16
.812
1.625
1½
2½ REF
⅜ R. TYP. 4 CORNERS
4½
1.625 REF.
33°
1¼
① HEAT TREAT/HARDFACE:
1. PRE-HEAT TO 600°F.
2. ARC WELD STOODY #6 x 1/16 THK AND GRIND(16).
3 REHEAT TO 1575°F AND OIL QUENCH.
4. DRAW AT 1200° F FOR CORE HARDNESS OF 28-30Rc. (271-286 BRINELL).
PART No. OH 3110-6
6 REV. H.T. NOTE RK 2.29.88
5 ⅜R WAS 3 PLCS RK 2-2-82
4 ADDED PARKOLUB RK 8-6-81
3 2½ WAS NOT TO SCALE RK 1-28 80
2 REVISED ROLL PIN HOLES RBB 9-18-75
1 REVISED & REDRAWN RBB 8-15-75
LTR REVISION BY DATE
SURFACE TREATMENT PARKOLUBE
HEAT TREATMENT SEE NOTE
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
PADDLE - 16" CSG. LANDING TOOL
U.C. SAN DIEGO-DEEP SEA DRILLING PROJ
DRAWN BY R. BLACKWOOD 3-14-75
CHECKED BY J. GERKEN 6-27-75
SCALE FULL
MATERIAL AISI A-4340 STL.
D GOH 3110- 6

NO.	REVISIONS DESCRIPTION	DATE	BY	CH.	APR.

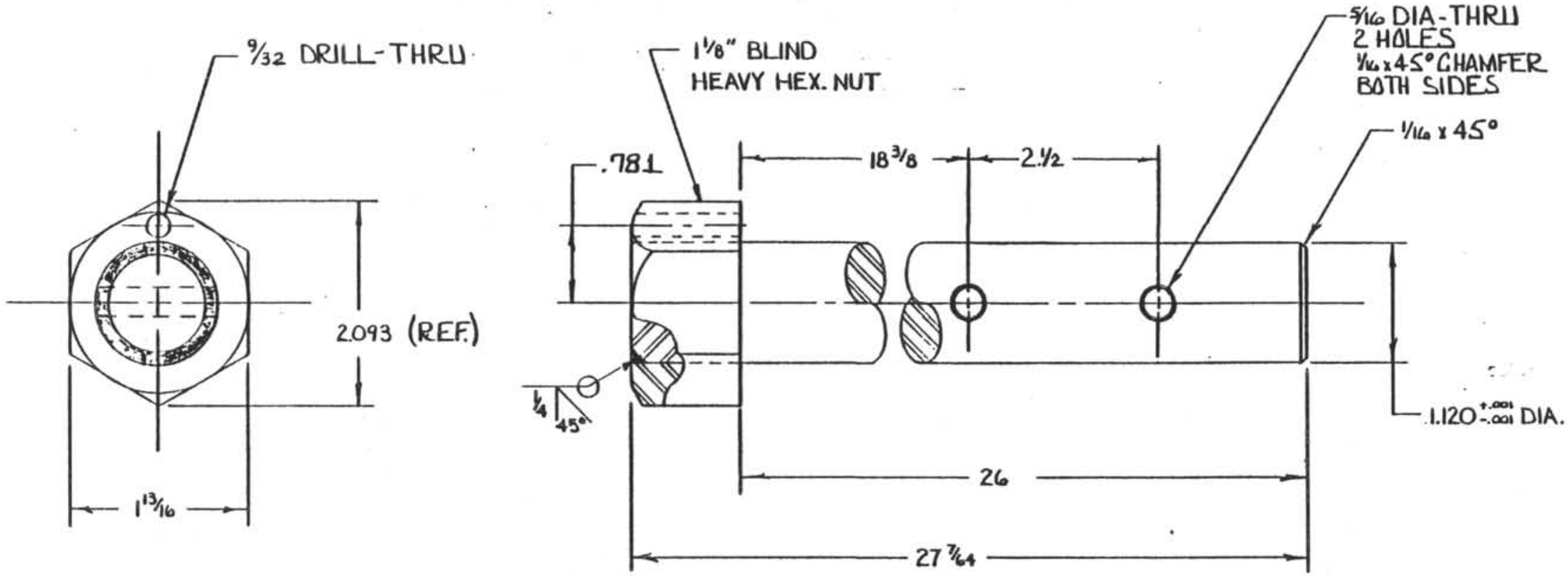


*FOR PRESS FIT W/P/N OH 3110

DO NOT SCALE

CONCENTRICITY ALL DIAMETERS: TIR .003

TOLERANCES UNLESS NOTED FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2° CORNERS 1/64 x 45° or 1/64 R FINISH 125	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY UNIVERSITY OF CALIFORNIA, SAN DIEGO LA JOLLA, CALIFORNIA 92093 TITLE: ROLL PIN 16" + 20" LANDING TOOL					
SURFACE TREATMENT	MATERIAL: S.STEEL		DATE: 9.23.83	BY: RK	CHECKED	APPROVED
HEAT TREATMENT	SCALE: 1:1	REQ'D/ASS'Y	PART NO.: OH3111		DWG. NO.: A-OH3111	(REV.)



PART NO. OH3115

LET	REVISION	BY	DATE
2	REV. ROLL PIN HOLES	RRB	9-18-75
1	REVISED & REDRAWN	RRB	8-21-75

UNLESS NOTED —
TOLERANCES:
FRACTIONS ± 1/64
DECIMALS ± .005
ANGLES ± 1/2°
FINISH:
125 RMS
CORNERS:
1/64 x 45° or 1/64R

SURFACE TREATMENT: PARCOLUBRITE

HEAT TREATMENT: RC: 28-32.

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

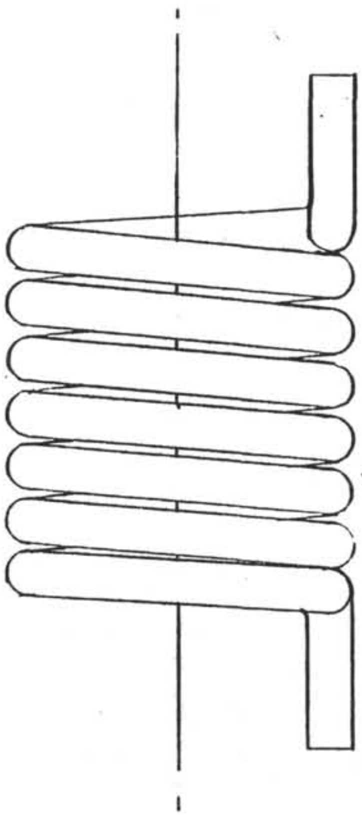
SHAFT - 16" CSG. LANDING TOOL
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ

DRAWN BY R. BLACKWOOD 3-14-75 | ASSY No. -

CHECKED BY J. GERKEN 3-14-75 | SCALE NONE

MATERIAL: AISI 1 1/8" 4130 BAR STK. | B | B-OH3115- | REV 2

SPECIFICATION - HELICAL TORSION SPRING



Wire Diameter:	1/4" Ø
Spring O.D. (Free):	1.900"
Active Coils:	7
Free Height:	2.000
Torque @ 180^0:	408 in/#

To work in 2.000" dia. hole

To work over 1.125" dia. shaft

All Tolerances: Commercial

Straight offset ends, 3/4" Long, squared and ground smooth.

Left-Hand Wind

DO NOT SCALE DWG

PART NO. OH 3117

UNLESS NOTED —
TOLERANCES:
FRACTIONS ± 1/64
DECIMALS ± .005
ANGLES ± ½°
FINISH:
125 RMS
CORNERS:
1/64 x 45° or 1/64R

SURFACE TREATMENT
Cad. Plate

HEAT TREATMENT

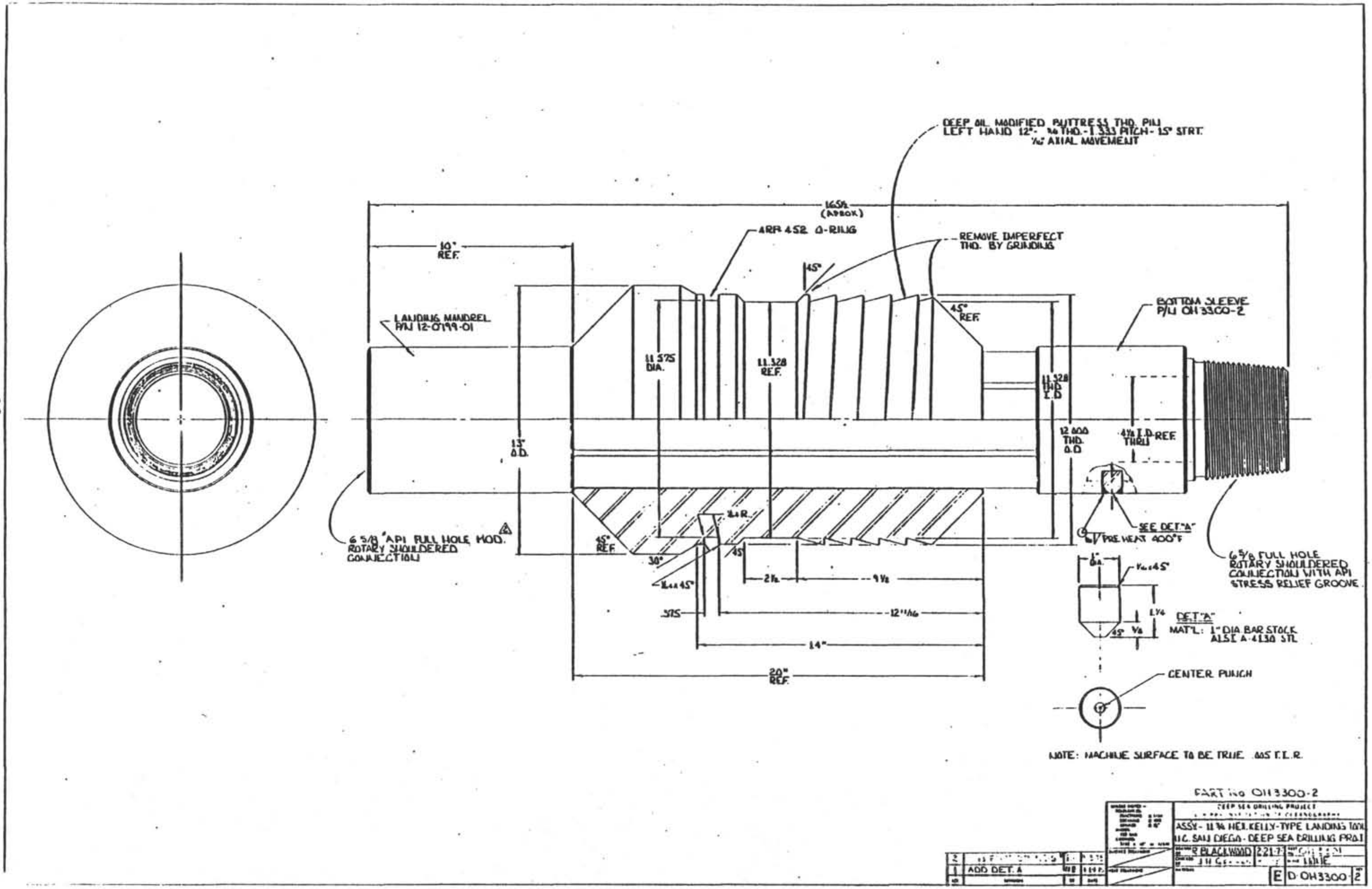
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

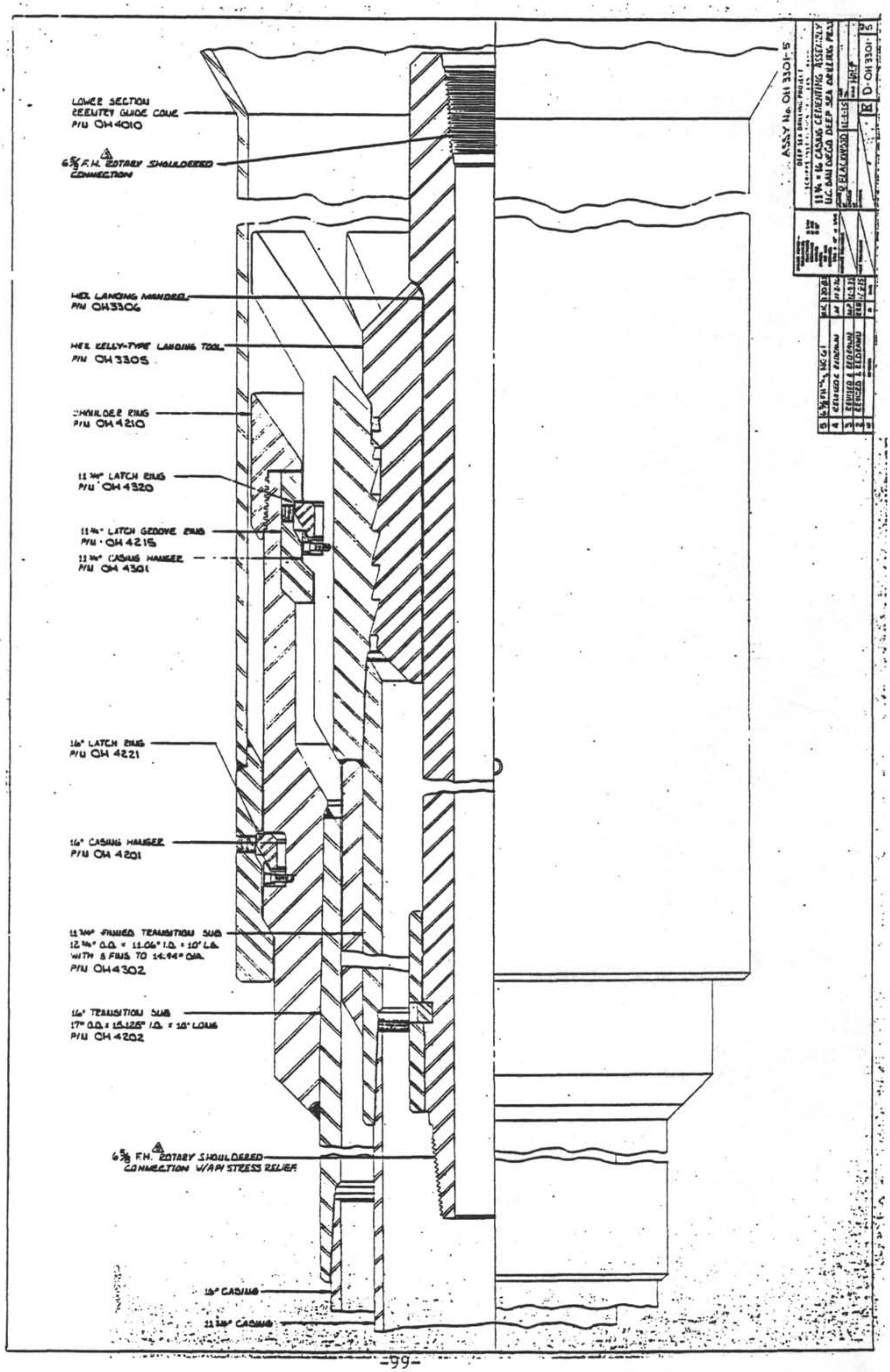
TORSION SPRING
16" Casing Hanger Landing Tool Ass'y.

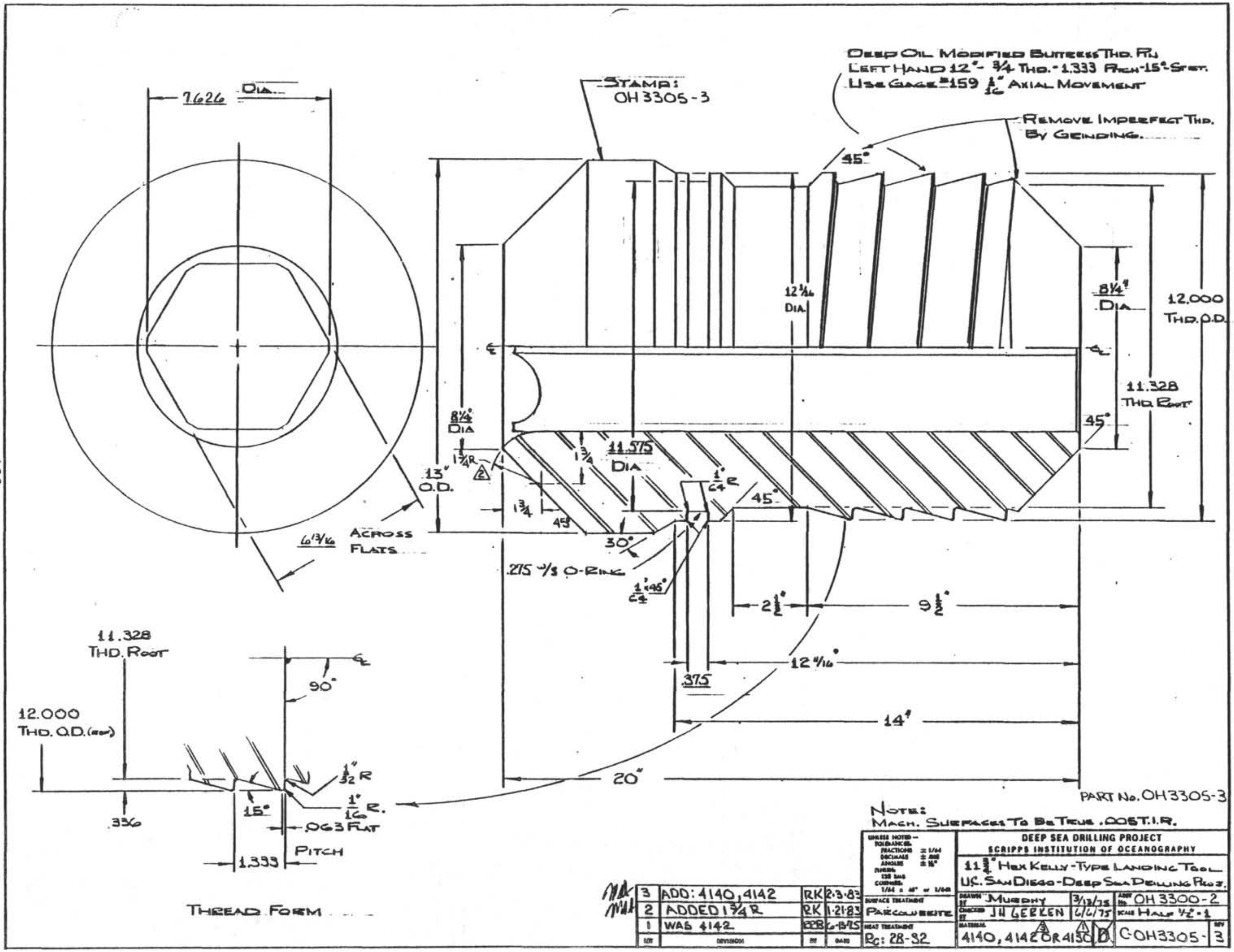
DRAWN BY J.H. GERKEN 8/22/75
CHECKED BY J.H. Gerken 8/22/75
ASSY No. 102196
SCALE ———
MATERIAL ASTM A-228

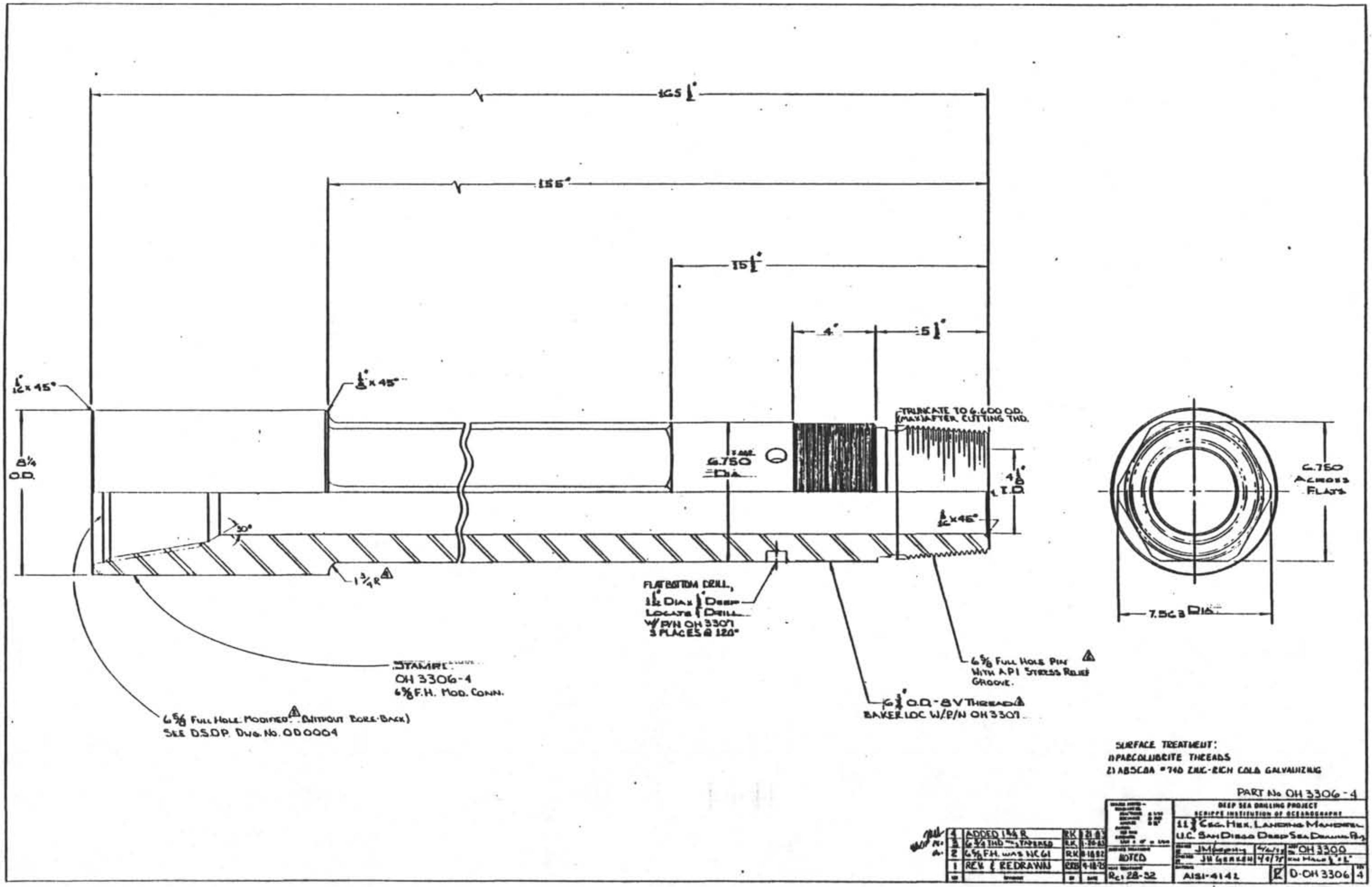
A | A-OH3117- | REV 2

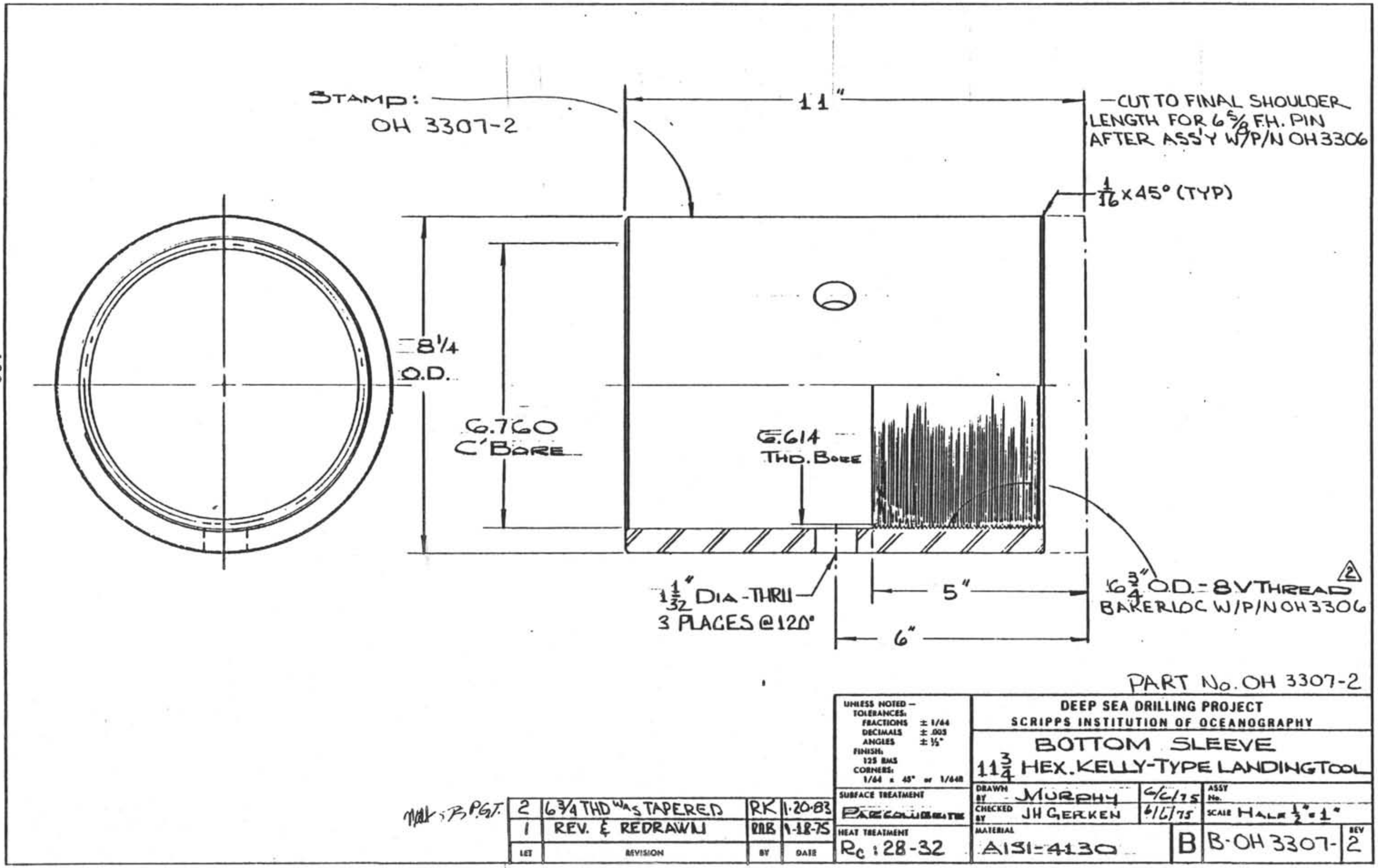
	REVISION	BY	DATE
2	DETAIL ADDED	RK	7·11·79

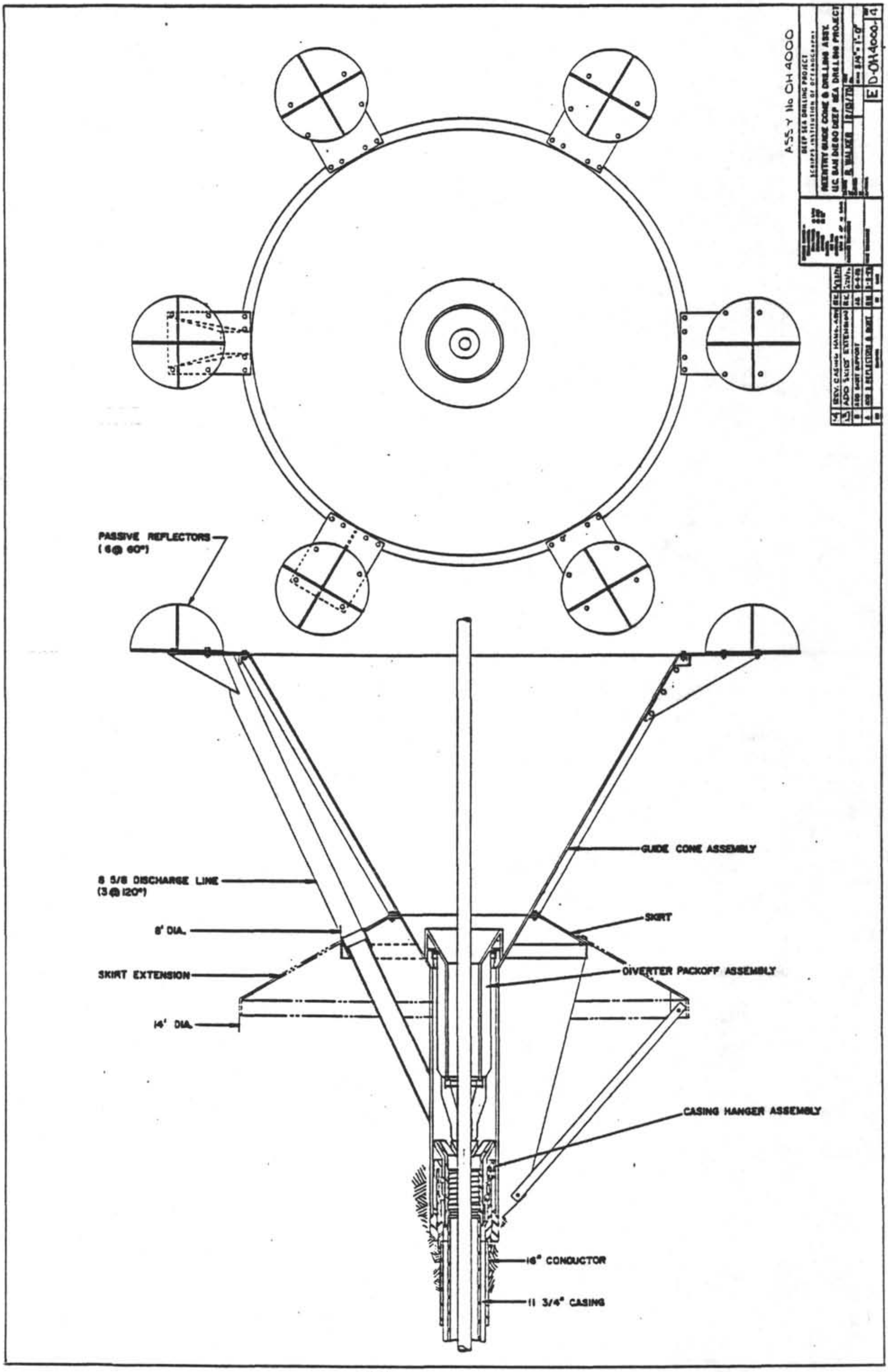

DEEP OIL MODIFIED BUTTRESS THD. PIN
LEFT HAND 12" - 3/4 THD. - 1.333 PITCH - 1.5° STRT.
1/4" AXIAL MOVEMENT
165/8 (APROX)
ARP 452 O-RING
REMOVE IMPERFECT THD. BY GRINDING
10" REF.
45°
45° REF.
LANDING MANDREL P/N 12-0199-01
BOTTOM SLEEVE P/N OH 3300-2
11.375 DIA.
11.328 REF.
11.328 THD. I.D.
12.600 THD. O.D.
4¾ I.D. THRU REF
13" O.D.
6 5/8" API FULL HOLE MOD. ROTARY SHOULDERED CONNECTION
45° REF.
30°
45°
SEE DET "A"
PRE HEAT 400°F
6⅝ FULL HOLE ROTARY SHOULDERED CONNECTION WITH API STRESS RELIEF GROOVE
2½
9½
.375
12 11/16
14"
20" REF.
1" DIA.
1/16 x 45°
1¼
45°
⅛
DET "A"
MAT'L: 1" DIA BAR STOCK AISI A-4130 STL
CENTER PUNCH
NOTE: MACHINE SURFACE TO BE TRUE .005 T.I.R.
PART NO OH3300-2
DEEP SEA DRILLING PROJECT
ASSY - 11¾ HEX.KELLY-TYPE LANDING TOOL
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ
R BLACKWOOD
ADD DET. A
E
D OH3300
2

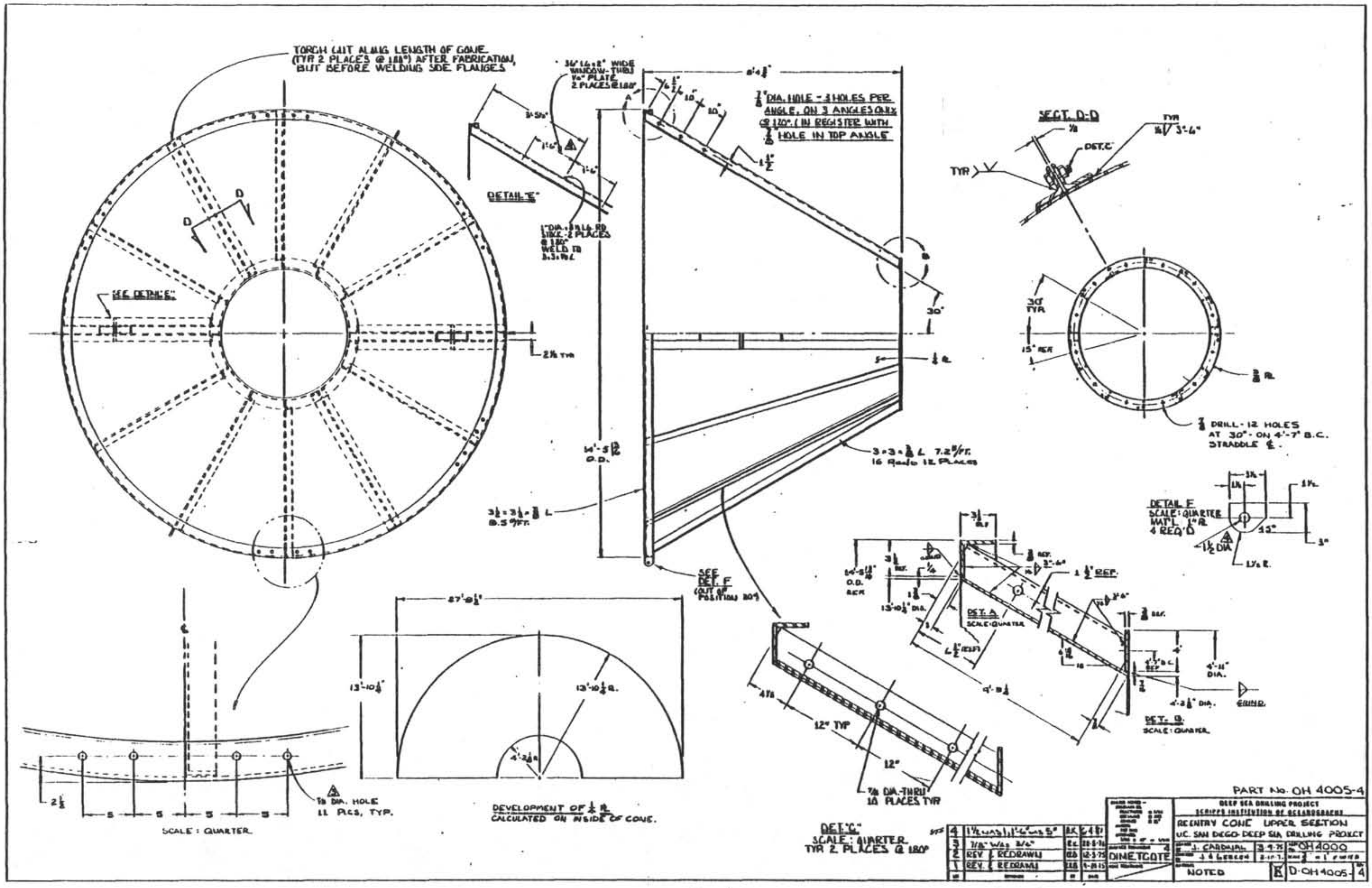

LOWER SECTION
REEUTRY GUIDE COUE
P/N OH4010
6⅝ F.H. ROTARY SHOULDERED
CONNECTION
HEX LANDING MANDREL
P/N OH3306
HEX KELLY-TYPE LANDING TOOL
P/N OH3305
SHOULDER RING
P/N OH4210
11¾" LATCH RING
P/N OH4320
11¾" LATCH GEDOVE RING
P/N OH4215
11¾" CASING HANGER
P/N OH 4301
16" LATCH RING
P/N OH 4221
16" CASING HANGER
P/N OH 4201
11¾" FINNED TRANSITION SUB
12¾" O.D. × 11.06" I.D. × 10' LG.
WITH 8 FINS TO 14.44" DIA.
P/N OH4302
16" TRANSITION SUB
17" O.D. × 15.125" I.D. × 10' LONG
P/N OH 4202
6⅝ F.H. ROTARY SHOULDERED
CONNECTION W/API STRESS RELIEF
16" CASING
11¾" CASING
ASSY No. OH 3301-5
DEEP SEA DRILLING PROJECT
11¾ × 16 CASING CEMENTING ASSEMBLY
U.C. SAN DIEGO DEEP SEA DRILLING PROJ.
R. BLACKWOOD
D-OH 3301-5


7.626 DIA.
STAMP: OH 3305-3
DEEP OIL MODIFIED BUTTRESS THD. PIN
LEFT HAND 12" - 3/4 THD. - 1.333 PITCH - 15° - STBT.
USE GAGE #159 1/16" AXIAL MOVEMENT
REMOVE IMPERFECT THD. BY GRINDING.
45°
12 3/16 DIA.
8 1/4" DIA
12.000 THD. O.D.
11.328 THD. ROOT
45°
8 1/4" DIA
13" O.D.
1 3/4 R
1 3/4
11.575 DIA
1/64 R
45°
1 3/4
45°
30°
6 13/16 ACROSS FLATS
.275 W/S O-RING
1/64 x 45°
2 1/2"
9 1/2"
12 11/16"
.375
14"
20"
11.328 THD. ROOT
90°
12.000 THD. O.D. (REF)
1/32 R
1/16 R.
15°
.336
.063 FLAT
1.333
PITCH
THREAD FORM
PART No. OH3305-3
NOTE: MACH. SURFACES TO BE TRUE .005T.I.R.
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
11 3/4" HEX KELLY-TYPE LANDING TOOL
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.
DRAWN BY MURPHY 3/13/75
CHECKED BY JH GERKEN 6/6/75
OH 3300-2
HALF 1/2 = 1
SURFACE TREATMENT: PARCOLUBRITE
HEAT TREATMENT: Rc: 28-32
MATERIAL: 4140, 4142 OR 4130
C OH3305- 3
3 ADD: 4140, 4142 RK 2-3-83
2 ADDED 1 3/4 R RK 1-21-83
1 WAS 4142

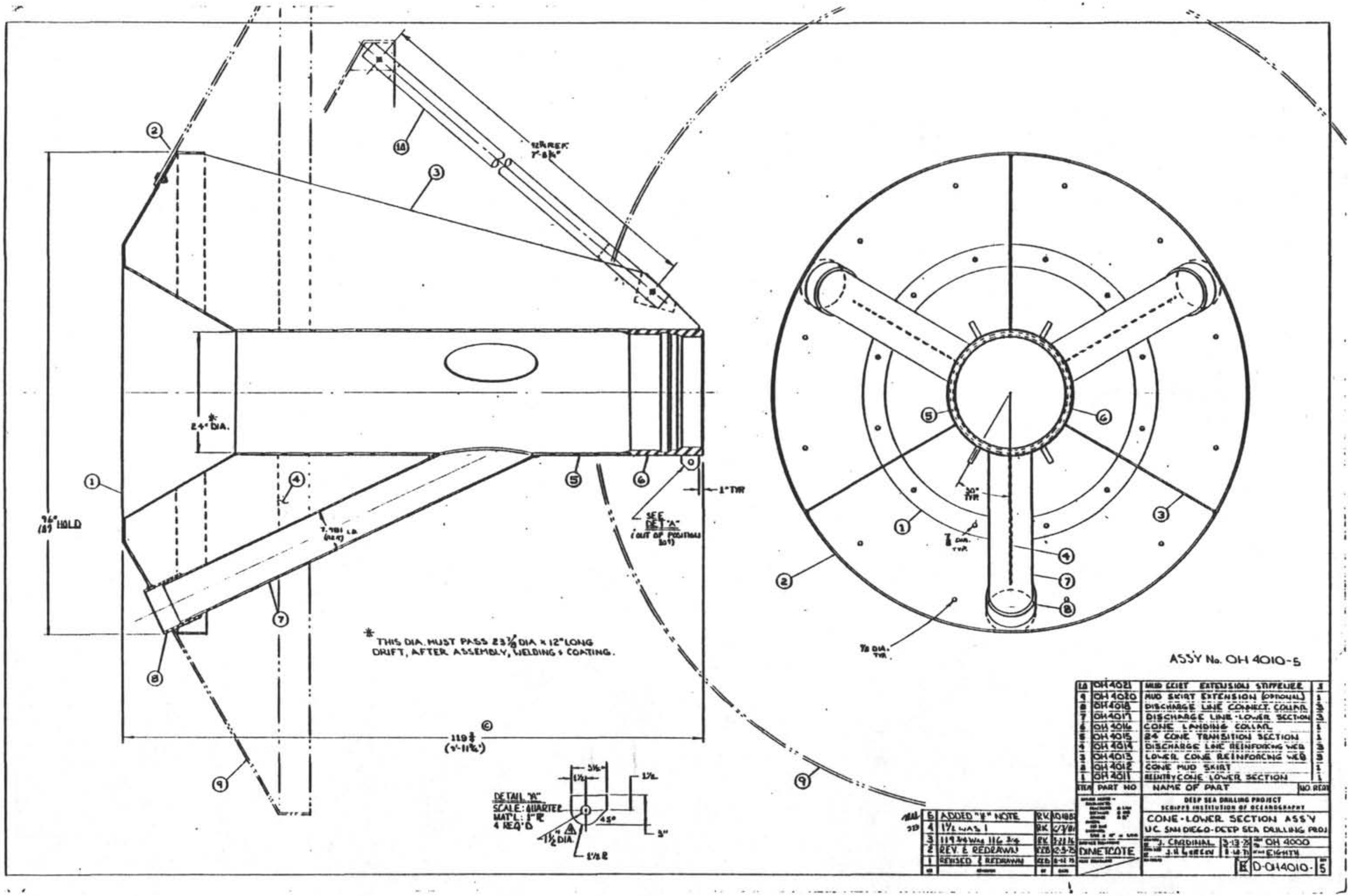

165 1/2"
155"
15 1/2"
4"
5 1/2"
1/16 x 45°
1/8 x 45°
TRUNCATE TO 6.600 O.D. (MAX) AFTER CUTTING THD.
8 1/4 O.D.
6.750 DIA
4 1/8 I.D.
1/16 x 45°
30°
1 3/4 R
FLAT BOTTOM DRILL, 1 1/2 DIA x 1/2 DEEP LOCATE & DRILL W/ P/N OH 3307 3 PLACES @ 120°
STAMP: OH 3306-4 6 5/8 F.H. MOD. CONN.
6 5/8 FULL HOLE PIN WITH API STRESS RELIEF GROOVE.
6 3/4 O.D. - 8V THREAD BAKER LOC W/P/N OH 3307
6 5/8 FULL HOLE MODIFIED (WITHOUT BORE-BACK) SEE D.S.D.P. DWG. No. OD 0004
6.750 ACROSS FLATS
7.563 DIA
SURFACE TREATMENT:
1) PARCOLUBRITE THREADS
2) ABSCOA #740 ZINC-RICH COLD GALVANIZING
PART No OH 3306-4
4 ADDED 1 3/4 R RK 1-21-83
3 6 3/4 THD ... RK 1-20-83
2 6 5/8 F.H. WAS NC 61 RK 8-18-82
1 REV & REDRAWN RRB 4-18-79
NOTED
Rc 28-32
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
11 3/4 CSG. HEX. LANDING MANDREL
U.C. SAN DIEGO DEEP SEA DRILLING PROJ.
J M ... 4/4/75
J H GERKEN 4/4/75
OH 3300
AISI-4142
D-OH 3306 4


STAMP: OH 3307-2
11"
—CUT TO FINAL SHOULDER LENGTH FOR 6 5/8 F.H. PIN AFTER ASS'Y W/P/N OH3306
1/16 x 45° (TYP)
8 1/4 O.D.
6.760 C'BORE
6.614 THD. BORE
1 1/32" DIA-THRU 3 PLACES @120°
5"
6"
6 3/4" O.D.-8V THREAD BAKERLOC W/P/N OH3306
PART No. OH 3307-2
UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2° FINISH: 125 RMS CORNERS: 1/64 x 45° or 1/64R
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
BOTTOM SLEEVE
11 3/4 HEX. KELLY-TYPE LANDING TOOL
DRAWN BY MURPHY 6/6/75
CHECKED BY JH GERKEN 6/6/75
ASSY No.
SCALE HALF 1/2"=1"
SURFACE TREATMENT PARCOLUBRITE
HEAT TREATMENT Rc : 28-32
MATERIAL AISI-4130
B B-OH 3307- 2
REV
2 6 3/4 THD WAS TAPERED RK 1-20-83
1 REV. & REDRAWN RAB 1-18-75
LET REVISION BY DATE

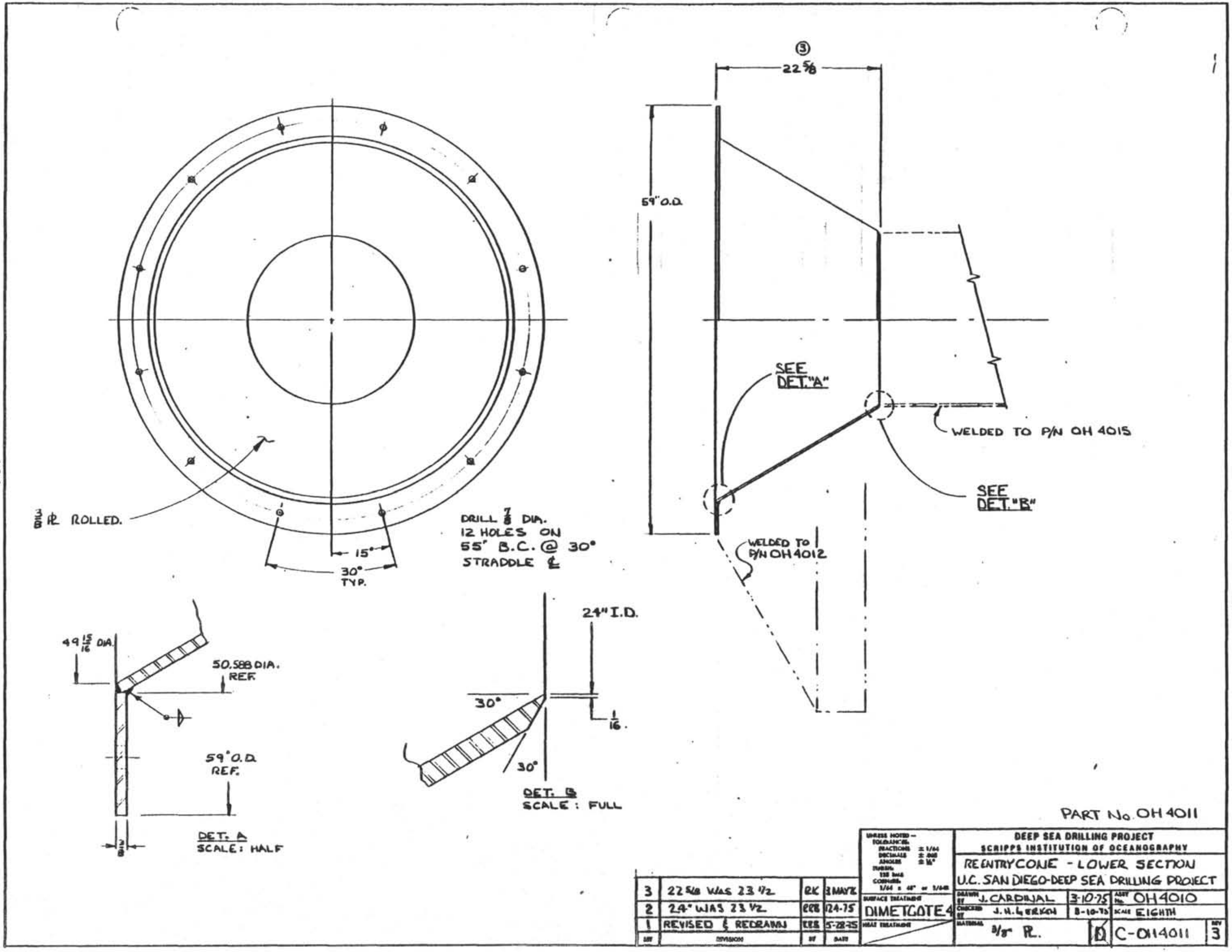

PASSIVE REFLECTORS (6@ 60°)
GUIDE CONE ASSEMBLY
8 5/8 DISCHARGE LINE (3@120°)
SKIRT
8' DIA.
SKIRT EXTENSION
DIVERTER PACKOFF ASSEMBLY
14' DIA.
CASING HANGER ASSEMBLY
16" CONDUCTOR
11 3/4" CASING

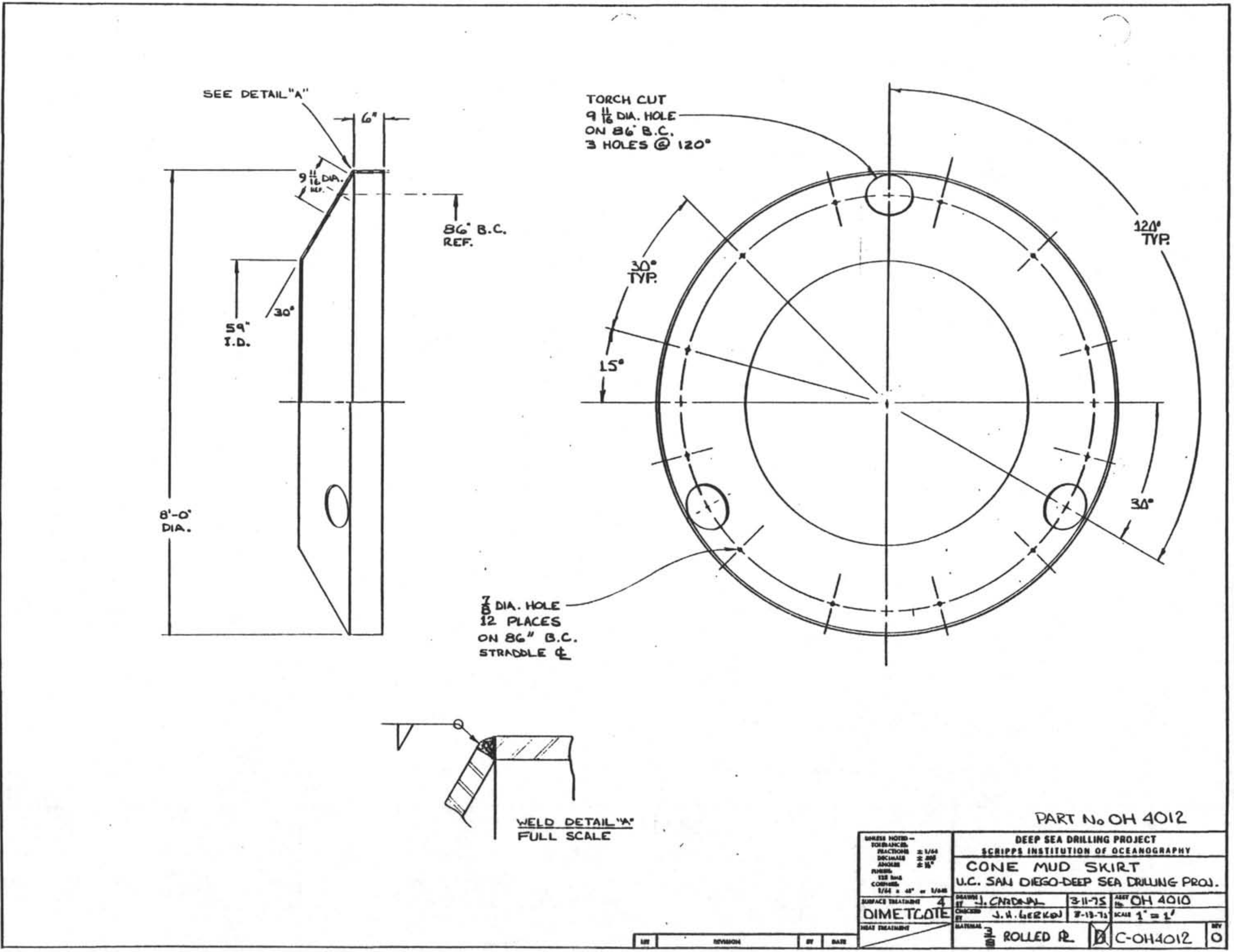


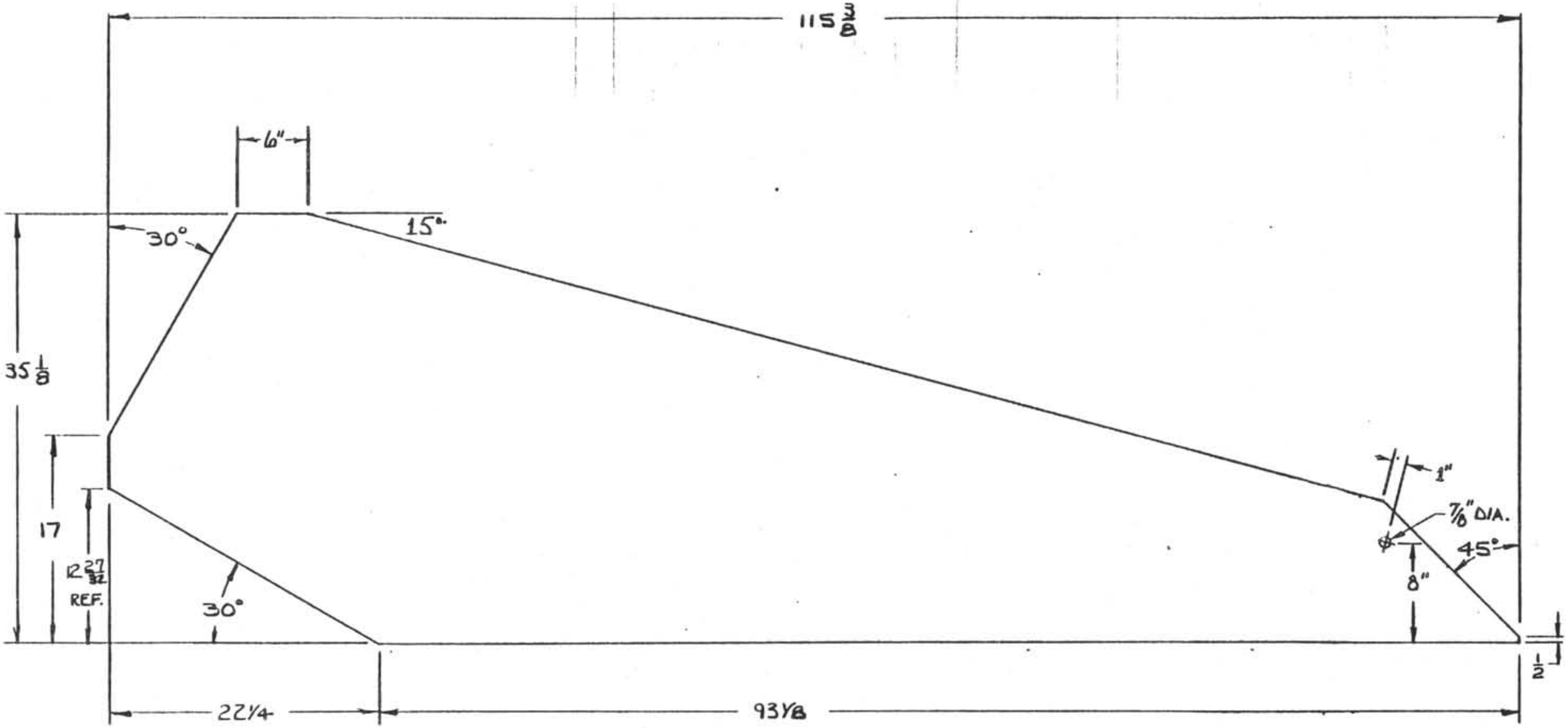
TORCH CUT ALONG LENGTH OF CONE (TYP 2 PLACES @ 180°) AFTER FABRICATION, BUT BEFORE WELDING SIDE FLANGES
SEE DETAIL "E"
DETAIL "E"
SECT. D-D
DET. C
TYP
8'-4 1/8"
7/8" DIA. HOLE - 3 HOLES PER ANGLE, ON 3 ANGLES ONLY @ 120°. (IN REGISTER WITH 7/8" HOLE IN TOP ANGLE
30°
15° REF
30° TYP
7/8 DRILL - 12 HOLES AT 30° - ON 4'-7" B.C. STRADDLE ℄.
14'-5 1/2" O.D.
3 1/2 x 3 1/2 x 3/8 L 8.5 #/FT.
3 x 3 x 3/8 L 7.2 #/FT. 16 Req'd 12 PLACES
SEE DET. F (OUT OF POSITION 80°)
DETAIL F SCALE: QUARTER MAT'L 1" PL 4 REQ'D
1 1/2 DIA
35°
DET. A SCALE: QUARTER
DET. B SCALE: QUARTER
13'-10 1/2" DIA.
4'-11" DIA.
4'-3 1/2" DIA.
GRIND
9'-9 1/4
27'-8 1/2"
13'-10 1/2"
13'-10 1/2 R.
4'-2 1/8
DEVELOPMENT OF 1/2 PL CALCULATED ON INSIDE OF CONE.
12" TYP
12"
7/8 DIA.-THRU 10 PLACES TYP
DET. "C" SCALE: QUARTER TYP 2 PLACES @ 180°
7/8 DIA. HOLE 11 PLCS, TYP.
SCALE: QUARTER
PART No. OH 4005-4
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
REENTRY CONE UPPER SECTION
U.C. SAN DIEGO DEEP SEA DRILLING PROJECT
J. CARDINAL
OH 4000
NOTED
D-OH 4005-4
DIMETCOTE
4 | 1 1/2 WAS 1 | 1'-6" WAS 5"
3 | 7/8" WAS 3/4"
2 | REV. & REDRAWN
1 | REV. & REDRAWN



24" DIA.
96" (8') HOLD
7.981 I.D. (REF)
1" TYP
SEE DET "A" (OUT OF POSITION 30°)
30° TYP
7/8 DIA. TYP
7/8 DIA. TYP.
119 3/4 (9'-11 3/4")
* THIS DIA. MUST PASS 23 7/8 DIA x 12" LONG DRIFT, AFTER ASSEMBLY, WELDING & COATING.
DETAIL "A"
SCALE: QUARTER
MAT'L: 1" PL
4 REQ'D
1 1/2 DIA.
45°
ASSY No. OH 4010-5
1A | OH 4021 | MUD SKIRT EXTENSION STIFFENER | 3
9 | OH 4020 | MUD SKIRT EXTENSION (OPTIONAL) | 1
8 | OH 4018 | DISCHARGE LINE CONNECT. COLLAR | 3
7 | OH 4017 | DISCHARGE LINE - LOWER SECTION | 3
6 | OH 4016 | CONE LANDING COLLAR | 1
5 | OH 4015 | 24 CONE TRANSITION SECTION | 1
4 | OH 4014 | DISCHARGE LINE REINFORCING WEB | 3
3 | OH 4013 | LOWER CONE REINFORCING WEB | 3
2 | OH 4012 | CONE MUD SKIRT | 1
1 | OH 4011 | REENTRY CONE LOWER SECTION | 1
ITEM | PART NO | NAME OF PART | NO REQ'D
5 | ADDED "*" NOTE | RK
4 | 1 1/2 WAS 1 | RK
3 | 119 3/4 WAS 116 3/4 | RK
2 | REV. & REDRAWN
1 | REVISED & REDRAWN
DIMETCOTE
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
CONE - LOWER SECTION ASS'Y
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ
J. CARDINAL
J. H. GREEN
OH 4000
EIGHTH
D-OH4010-
5


③
22 5/8
59" O.D.
SEE DET. "A"
WELDED TO P/N OH 4015
SEE DET. "B"
WELDED TO P/N OH 4012
3/8 PL ROLLED.
DRILL 7/8 DIA.
12 HOLES ON
55" B.C. @ 30°
STRADDLE ℄
15°
30° TYP.
49 15/16 DIA.
50.588 DIA. REF.
59" O.D. REF.
DET. A
SCALE: HALF
24" I.D.
30°
30°
1/16
DET. B
SCALE: FULL
PART No. OH 4011
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
REENTRY CONE - LOWER SECTION
U.C. SAN DIEGO-DEEP SEA DRILLING PROJECT
3 22 5/8 WAS 23 1/2 RK 3 MAY 75
2 24" WAS 23 1/2 RRB 12-4-75
1 REVISED & REDRAWN RRB 5-28-75
SURFACE TREATMENT DIMETCOTE 4
DRAWN BY J. CARDINAL 3-10-75
CHECKED BY J. H. GERKEN 3-10-75
ASSY No. OH 4010
SCALE EIGHTH
MATERIAL 3/8" PL.
D C-OH4011
REV 3


SEE DETAIL "A"
6"
9 11/16 DIA. REF.
86" B.C. REF.
59" I.D.
30°
8'-0" DIA.
TORCH CUT
9 11/16 DIA. HOLE
ON 86" B.C.
3 HOLES @ 120°
120° TYP.
30° TYP.
15°
30°
7/8 DIA. HOLE
12 PLACES
ON 86" B.C.
STRADDLE ℄
WELD DETAIL "A"
FULL SCALE
PART No. OH 4012
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
CONE MUD SKIRT
U.C. SAN DIEGO-DEEP SEA DRILLING PROJ.
SURFACE TREATMENT 4
DIMETCOTE
HEAT TREATMENT
DRAWN BY J. CARDINAL 3-11-75
CHECKED BY J.H. GERKEN 3-13-75
ASSY No. OH 4010
SCALE 1" = 1'
MATERIAL 3/8 ROLLED PL
C-OH4012
REV 0



PART No OH 4013-2

3-REQ'D PER CONE

LET	REVISION	BY	DATE
2	REV. & REDRAWN	RRB	12-3-75
1	ADD PADEYE AND 7/8" HOLE	M.P.	9-25-75

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R

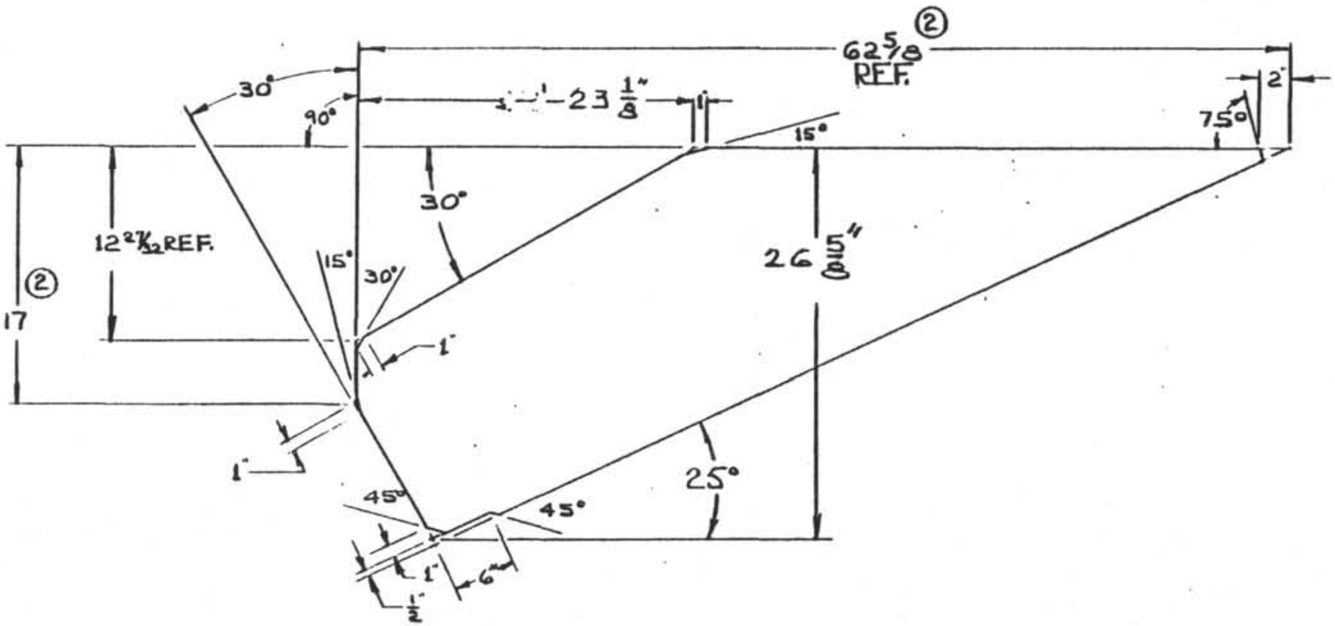
SURFACE TREATMENT: DIMETCOTE

HEAT TREATMENT:

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

LOWER CONE REINFORCING WEB
U.C. SAN DIEGO-DEEP SEA DRILLING PROJ.

DRAWN BY	J. CARDNAL	3-11-75	ASSY No. OH 4010
CHECKED BY	J. W. GERKEN	3-14-75	SCALE EIGHTH
MATERIAL	1/2 PL	B	B-OH4013- / REV 2



3 REQ'D. PER CONE

PART No. OH 4014-2

LET	REVISION	BY	DATE
2	17 WAS 17 1/2, 62 5/8 WAS 63 11/16	RK	3 MAY 76
1	REV. & REDRAWN	RRB	12-4-75

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64; DECIMALS ± .005; ANGLES ± 1/2°. FINISH: 125 RMS. CORNERS: 1/64 x 45° or 1/64R

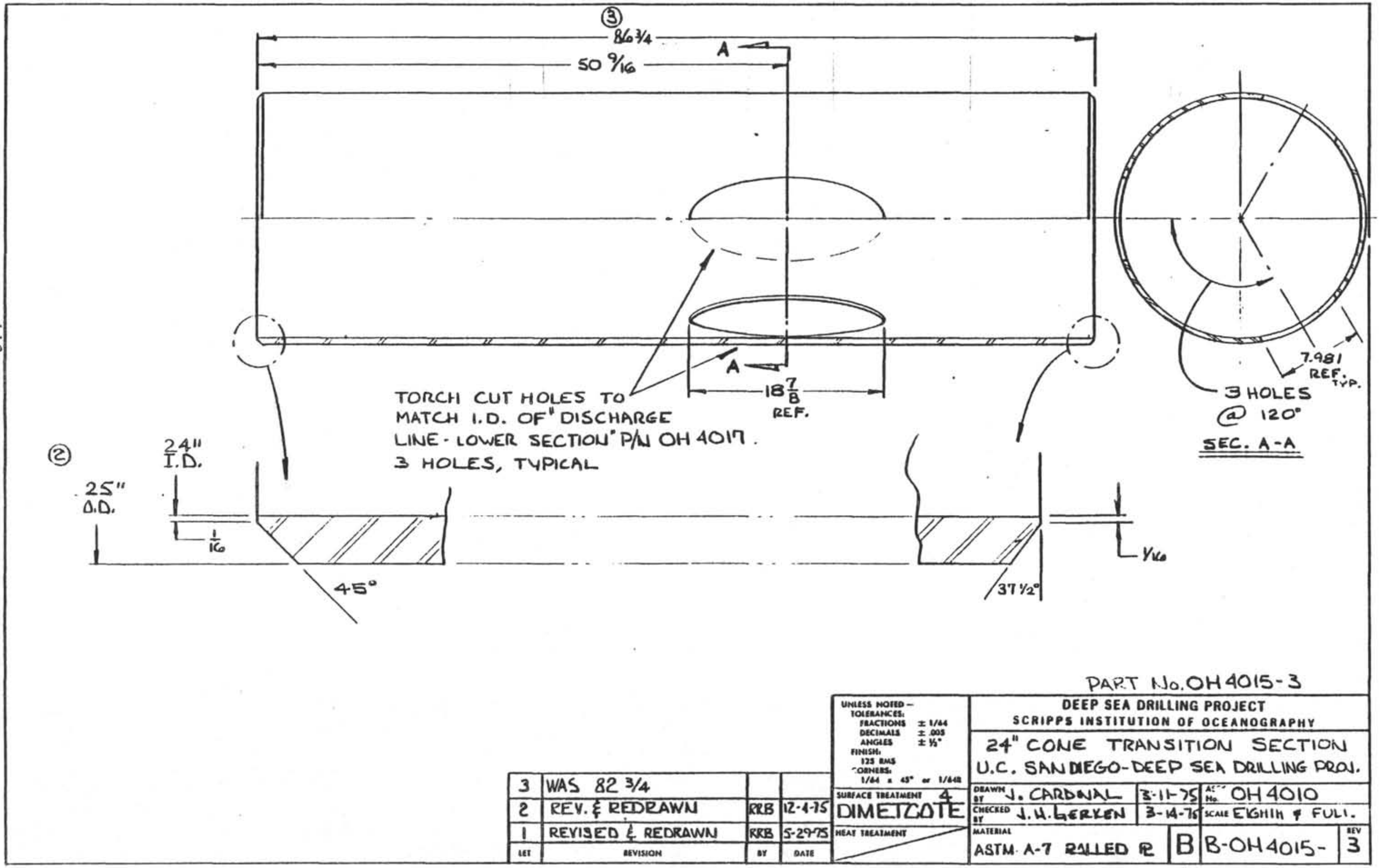
SURFACE TREATMENT: DIMETCOTE 4

HEAT TREATMENT:

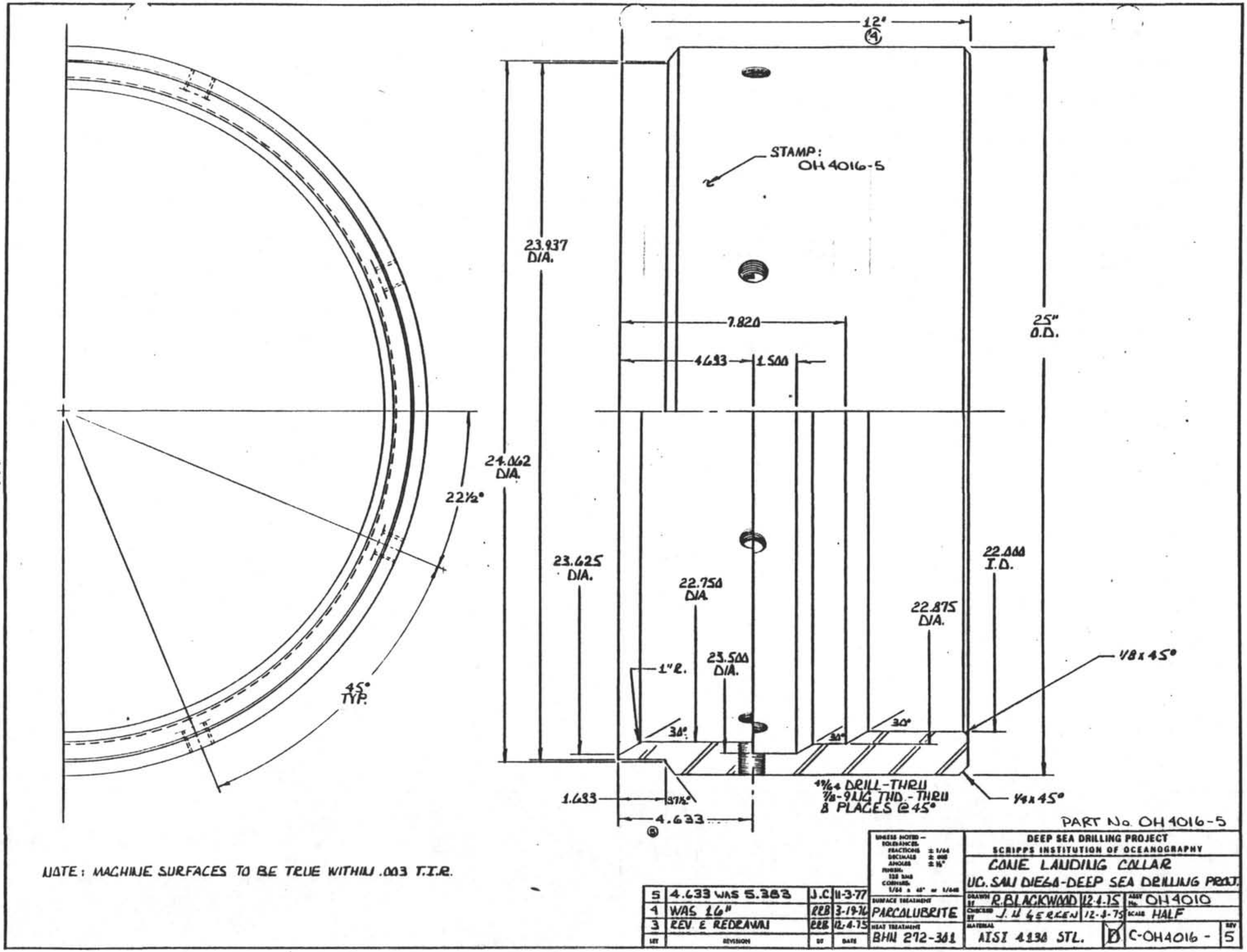
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

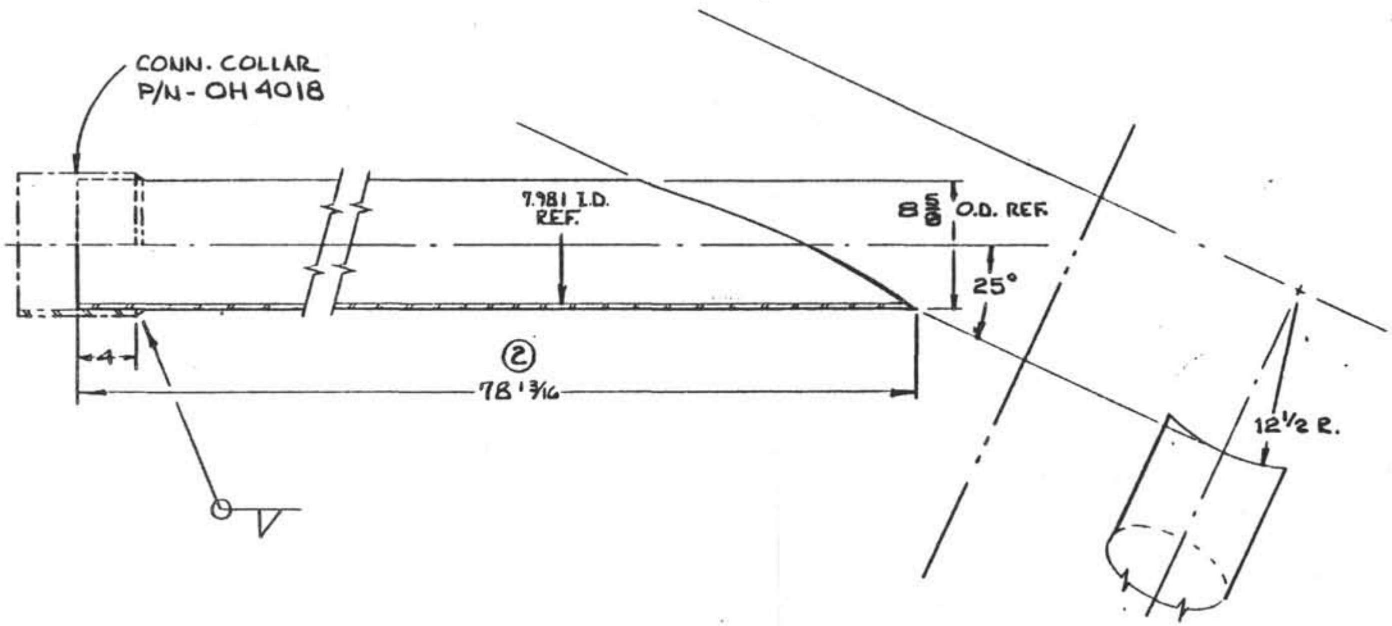
DISCHARGE LINE REINFORCING WEB
U.C. SAN DIEGO DEEP SEA DRILLING PROJ.

DRAWN BY J. CARDINAL	3-14-75	ASSY No OH4010
CHECKED BY J.H. GERKEN	3-14-75	SCALE EIGHTH
MATERIAL 1/4 PL	B	B-OH4014- REV 2



③
86 3/4
50 9/16
A
A
18 7/8 REF.
TORCH CUT HOLES TO MATCH I.D. OF "DISCHARGE LINE - LOWER SECTION" P/N OH 4017. 3 HOLES, TYPICAL
7.981 REF. TYP.
3 HOLES @ 120°
SEC. A-A
②
24" I.D.
25" O.D.
1/16
45°
1/16
37 1/2°
PART No. OH 4015-3
UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2° FINISH: 125 RMS CORNERS: 1/64 x 45° or 1/64R
SURFACE TREATMENT 4
DIMETCOTE
HEAT TREATMENT
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
24" CONE TRANSITION SECTION
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.
DRAWN BY J. CARDNAL 3-11-75
CHECKED BY J. H. GERKEN 3-14-75
ASSY No. OH 4010
SCALE EIGHTH & FULL
MATERIAL ASTM A-7 ROLLED PL
B
B-OH4015-
REV 3
3 WAS 82 3/4
2 REV. & REDRAWN RRB 12-4-75
1 REVISED & REDRAWN RRB 5-29-75
LET REVISION BY DATE


12"
STAMP: OH 4016-5
23.937 DIA.
24.062 DIA.
25" O.D.
7.820
4.633
1.500
22½°
45° TYP.
23.625 DIA.
22.750 DIA.
23.500 DIA.
22.875 DIA.
22.000 I.D.
1" R.
30°
1/8 x 45°
1/4 x 45°
49/64 DRILL-THRU
7/8-9UNC THD.-THRU
8 PLACES @ 45°
1.633
37½°
4.633
PART No. OH 4016-5
NOTE: MACHINE SURFACES TO BE TRUE WITHIN .003 T.I.R.
5 4.633 WAS 5.383 J.C. 11-3-77
4 WAS 16" RRB 3-19-76
3 REV. & REDRAWN RRB 12-4-75
LET REVISION BY DATE
UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± ½° FINISH: 125 RMS CORNERS: 1/64 x 45° or 1/64R
SURFACE TREATMENT PARCOLUBRITE
HEAT TREATMENT BHN 272-301
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
CONE LANDING COLLAR
UC. SAN DIEGO-DEEP SEA DRILLING PROJ.
DRAWN BY R. BLACKWOOD 12-4-75
CHECKED BY J. H. GERKEN 12-4-75
ASSY No. OH 4010
SCALE HALF
MATERIAL AISI 4130 STL.
D C-OH4016-
REV 5

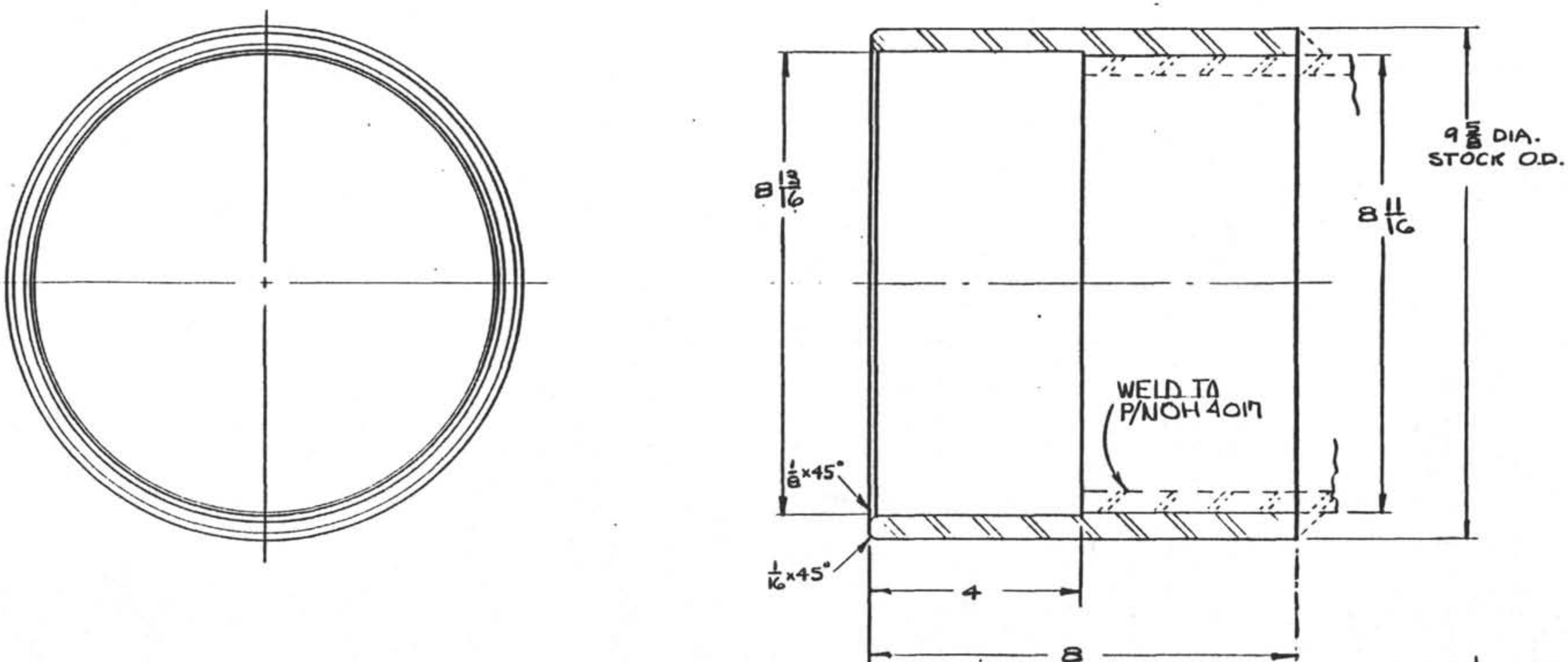


3 REQ'D PER CONE

PART No. OH 4017-2

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY				
	DISCHARGE LINE - LOWER SECTION U.C. SAN DIEGO - DEEP SEA DRILLING PROJECT				
SURFACE TREATMENT 4	DRAWN BY J. CARDINAL	3-14-75	ASSY No. OH 4010		
DIMETCOTE	CHECKED BY J.W. GERKEN	3-14-75	SCALE EIGHTH		
HEAT TREATMENT	MATERIAL .322 THK WALL 8" SCHED. 40 PIPE	B	B-OH4017-	REV 2	

LET	REVISION	BY	DATE
2	WAS 80"	RRB	12-4-75
1	REVISED & REDRAWN	RRB	5-28-75



3 REQ'D PER CONE

PART No. OH 4018-1

UNLESS NOTED —
TOLERANCES:
FRACTIONS ± 1/64
DECIMALS ± .005
ANGLES ± ½°
FINISH:
125 RMS
CORNERS:
1/64 x 45° or 1/64R

SURFACE TREATMENT 4
DIMETCOTE

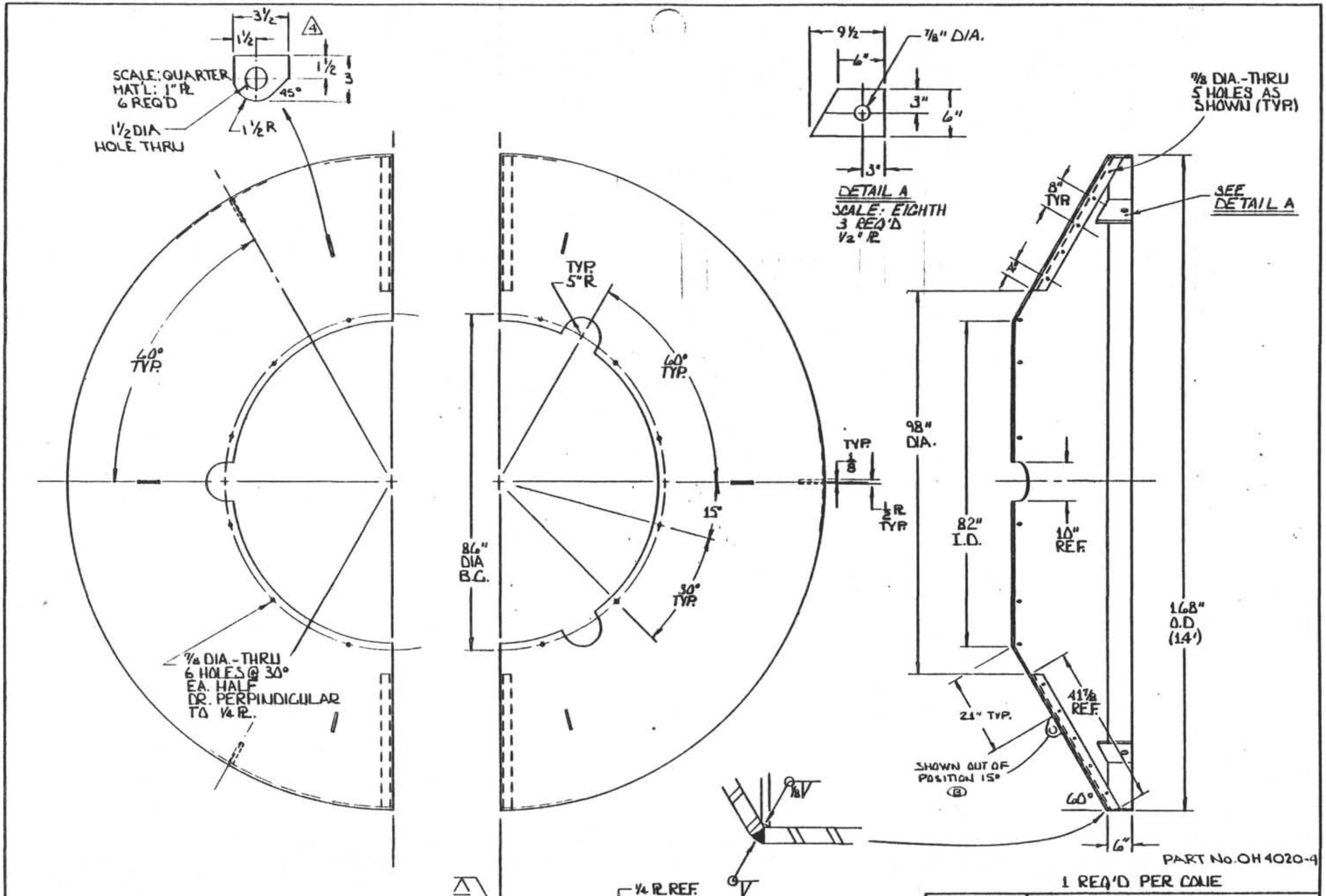
HEAT TREATMENT

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

CONNECTING COLLAR - DISCHARGE LINE
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ

DRAWN BY J. CARDINAL	3-14-75	ASSY. No. OH 4010	
CHECKED BY J.H. GERKEN	3-14-75	SCALE HALF	
MATERIAL 9" X-STRONG PIPE (9.5/8 O.D. x .500 WALL)	B	B-OH4018-	REV 1

LET	REVISION	BY	DATE
1	REVISED & REDRAWN	RRB	5-28-75



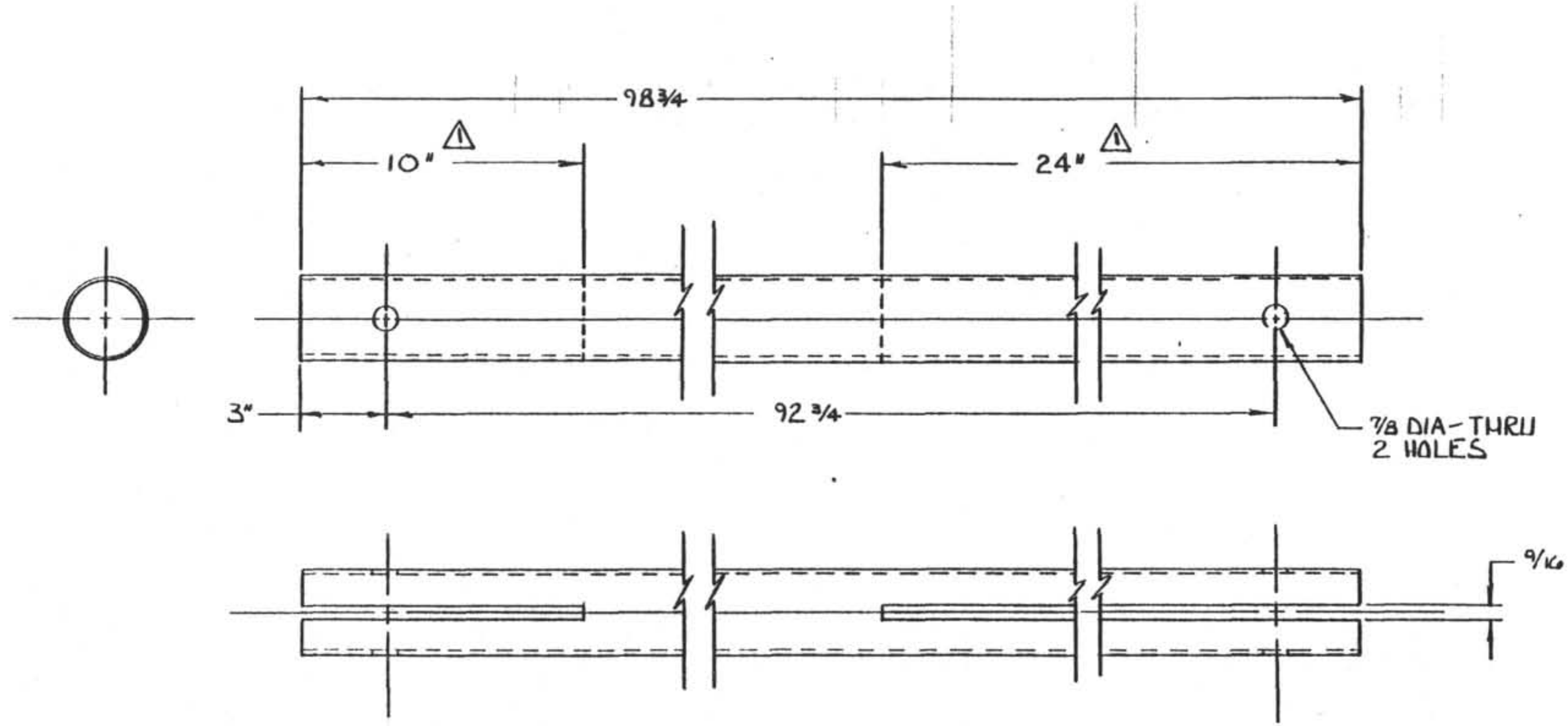
LET	REVISION	BY	DATE
4	REVISED PICKUP RING	RK	6-2-81
3	MODIF. PICKUP RINGS	RK	10-11-79
2	ADD PICKUP RINGS	RRB	12-3-75
1	ADD DET. A	RRB	6-12-75

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°
SURFACE TREATMENT: DIMETCOTE
HEAT TREATMENT

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

MUD SKIRT EXTENSION
U.C. SAN DIEGO-DEEP SEA DRILLING PROJ.

DRAWN BY	R. BLACKWOOD	5-30-75	ASSY No. OH 4010
CHECKED BY	J.H GERKEN	5-31-75	SCALE ¾" = 1'-0"
MATERIAL	¼ ROLLED PL & NOTED	D	C-OH 4020-	REV 4



PART No. OH 4021-1

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R

SURFACE TREATMENT: DIMETCOTE 4

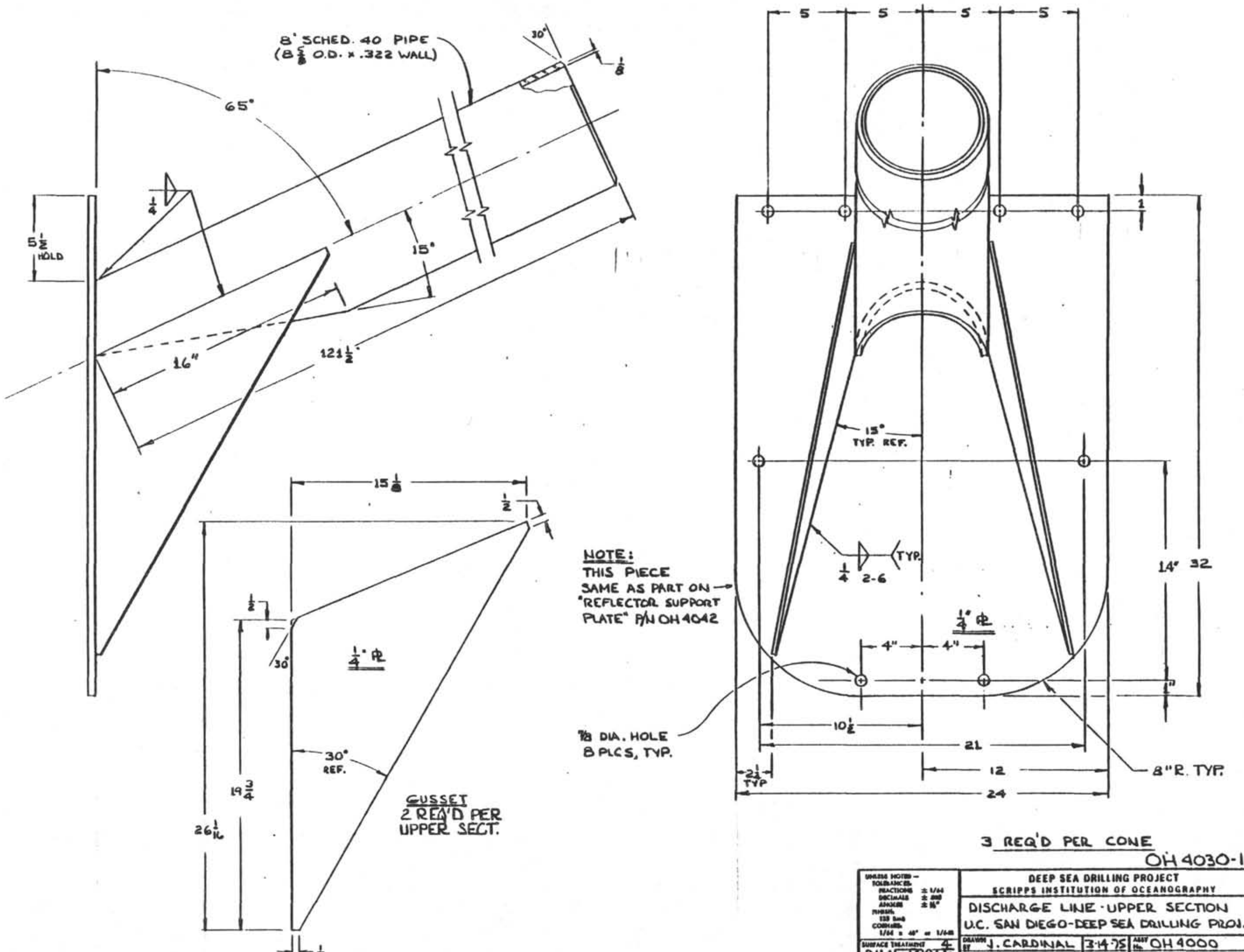
HEAT TREATMENT

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

MUD SKIRT EXTENSION STIFFNER
U.C. SAN DIEGO-DEEP SEA DRILLING PROJ

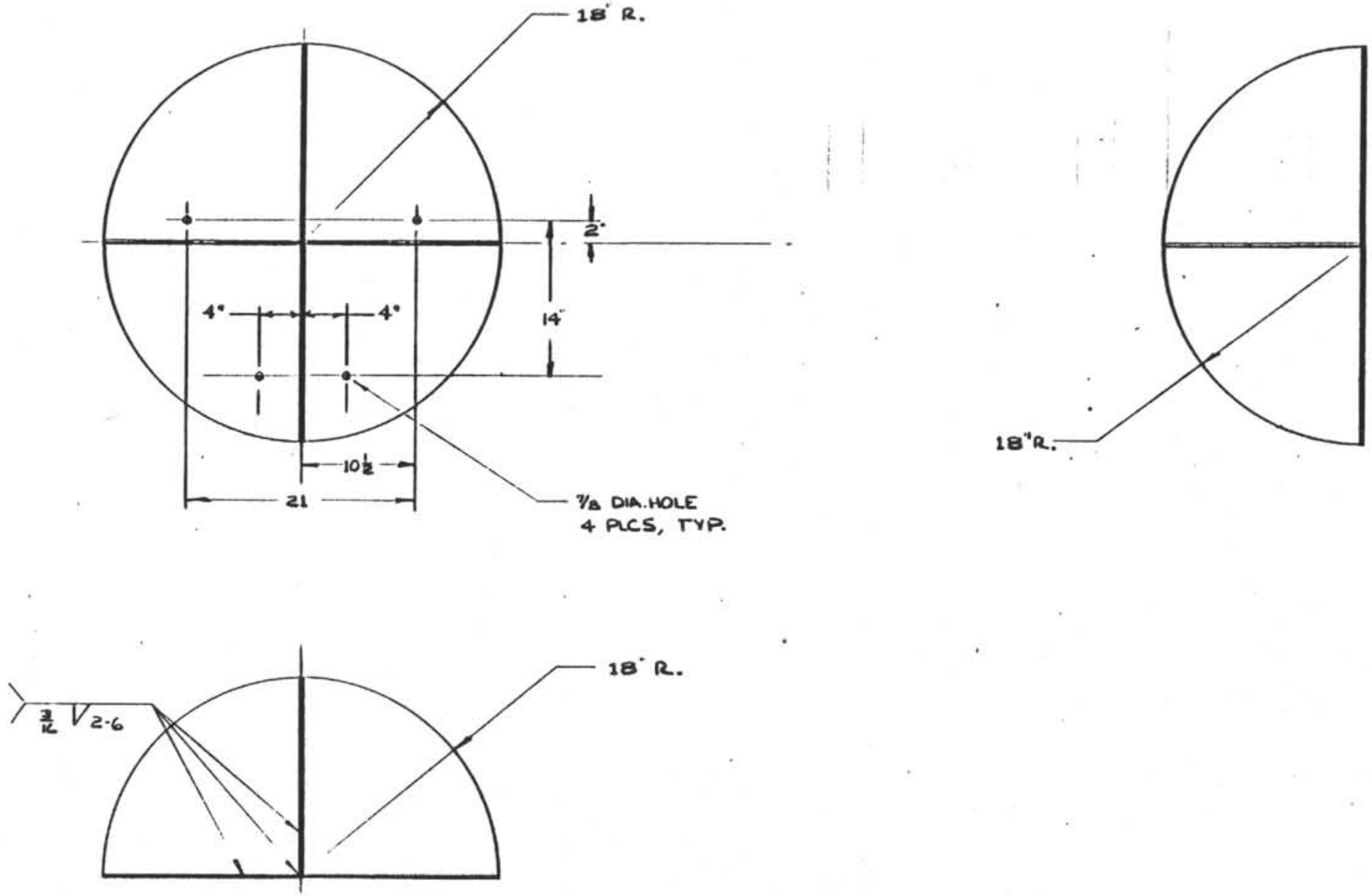
DRAWN BY R. BLACKWOOD 12-4-75 | ASSY No. OH4010
CHECKED BY J.H. GERKEN 12-4-75 | SCALE QUARTER
MATERIAL 3" STD. WT. PIPE | B | B-OH4021- | REV 1

LET	REVISION	BY	DATE
1	10" WAS 7", 24" WAS 16"	RK	6-2-81



UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°; FINISH: 125 bmd; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY		
	DISCHARGE LINE - UPPER SECTION U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.		
SURFACE TREATMENT: DIMETCOTE 4	DRAWN BY J. CARDINAL	3-14-75	ASSY No. OH 4000
	CHECKED BY J. H. GERKEN	3-14-75	SCALE QUARTER
HEAT TREATMENT	MATERIAL NOTED	D	C-OH 4030 REV 1

LTR	REVISION	BY	DATE
1	REV. & REDRAWN	RRB	12-5-75



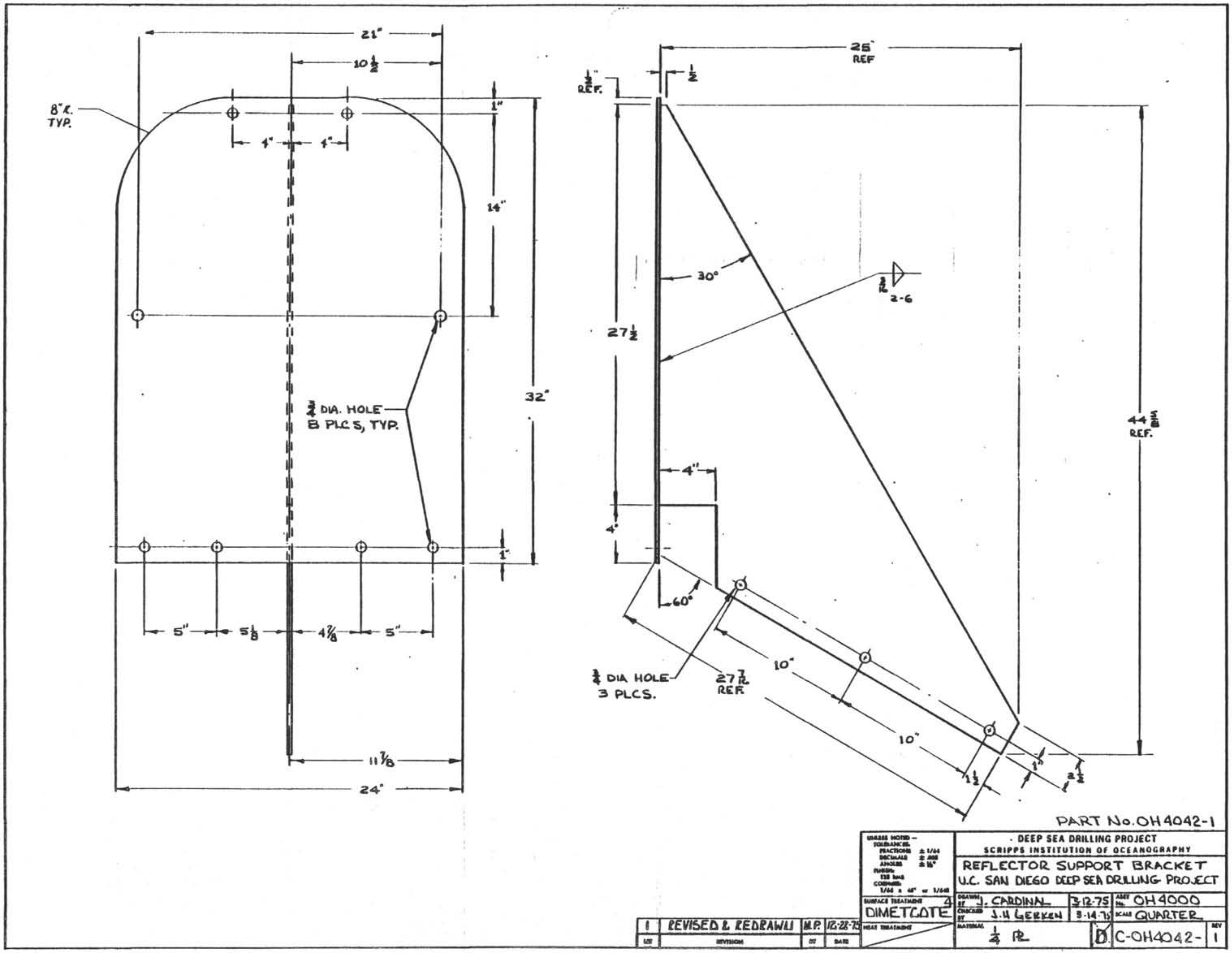
PART No. OH 4040-3

3	7/8" HOLES WERE 3/4"	J.M.	2-9-77		
2	DELETE "3 REQ'D." NOTE	J.C.	11-3-77	SURFACE TREATMENT: DIMETCOTE	
1	REV. E REDRAWN	RRB	12-3-75	HEAT TREATMENT	
LTR	REVISION	BY	DATE		

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

3' PASSIVE REFLECTOR
U.C. SAN DIEGO DEEP SEA DRILLING PROJECT

DRAWN BY J. CARDINAL	3-12-75	ASSY No.
CHECKED BY J.H. LERKEN	3-14-75	SCALE EIGHTH
MATERIAL 1/4" PL	D	C-OH4040- REV 3



21"
10 1/2
8" R. TYP.
1"
4"
4"
14"
32"
3/4 DIA. HOLE 8 PLCS, TYP.
1"
5"
5 1/8
4 7/8
5"
11 7/8
24"
25" REF
1/2" REF.
1/2
30°
27 1/2
3/8 2-6
44 3/8 REF.
4"
4"
60°
3/4 DIA HOLE 3 PLCS.
27 7/8 REF.
10"
10"
1 1/2
1"
2 1/2
PART No. OH4042-1
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
REFLECTOR SUPPORT BRACKET
U.C. SAN DIEGO DEEP SEA DRILLING PROJECT
SURFACE TREATMENT DIMETCOTE 4
DRAWN BY J. CARDINAL 3-12-75
CHECKED BY J.H. GERKEN 3-14-75
ASSY NO. OH4000
SCALE QUARTER
MATERIAL 1/4 PL
D C-OH4042- 1
1 REVISED & REDRAWN M.P. 12-22-75
LTR REVISION BY DATE
HEAT TREATMENT

BOLTING SPECIFICATION

DSDP Reentry Cone System (1976)

A. 3/4"-10NC x 2" Long Hex-Head Cap Screws, SAE Grade 5 (4140 Quenched and tempered steel) with heavy hex nuts and lockwashers; T.S.=120,000#, P.L.=85,000#.

#	Fastener Use
20	Upper Cone Flange Fastener
12	Upper-Lower Cone Fastener
12	Mud Skirt Extension
10	Mud Skirt Flange Fastener
24	(6) Passive Reflector Fasteners
24	(6) Reflector Brackets to Upper Cone Flange
9	(3) Reflector Brackets to Side Flange

B. 5/8"-11 NC x 5" Long Alloy Stud Bolts, (ASTM 193-B7 Steel) with heavy hex nuts and lockwashers: T.S.=125,000#, Y.S.=105,000#.

#	Fastener Use
8	Drillpipe Packer to Diverter Body

C. 5/8"-11 NC x 1 1/2"Long Hex-Head Cap Screws, SAE Grade 2 (ASTM 307-B steel) with finished hex nuts and lockwashers; T.S.=64,000#, P.L.=52,000#.

#	Fastener Use
8	Cone Packer to Diverter Body

D. 3/4"-10 NC x 5" Long Hex-Head Cap Screws, SAE Grade 5 with heavy hex nuts and lockwashers; T.S.=120,000#, P.L. = 85,000#

#	Fastener Use
6	(3) Mud Skirt Extension Stiffeners

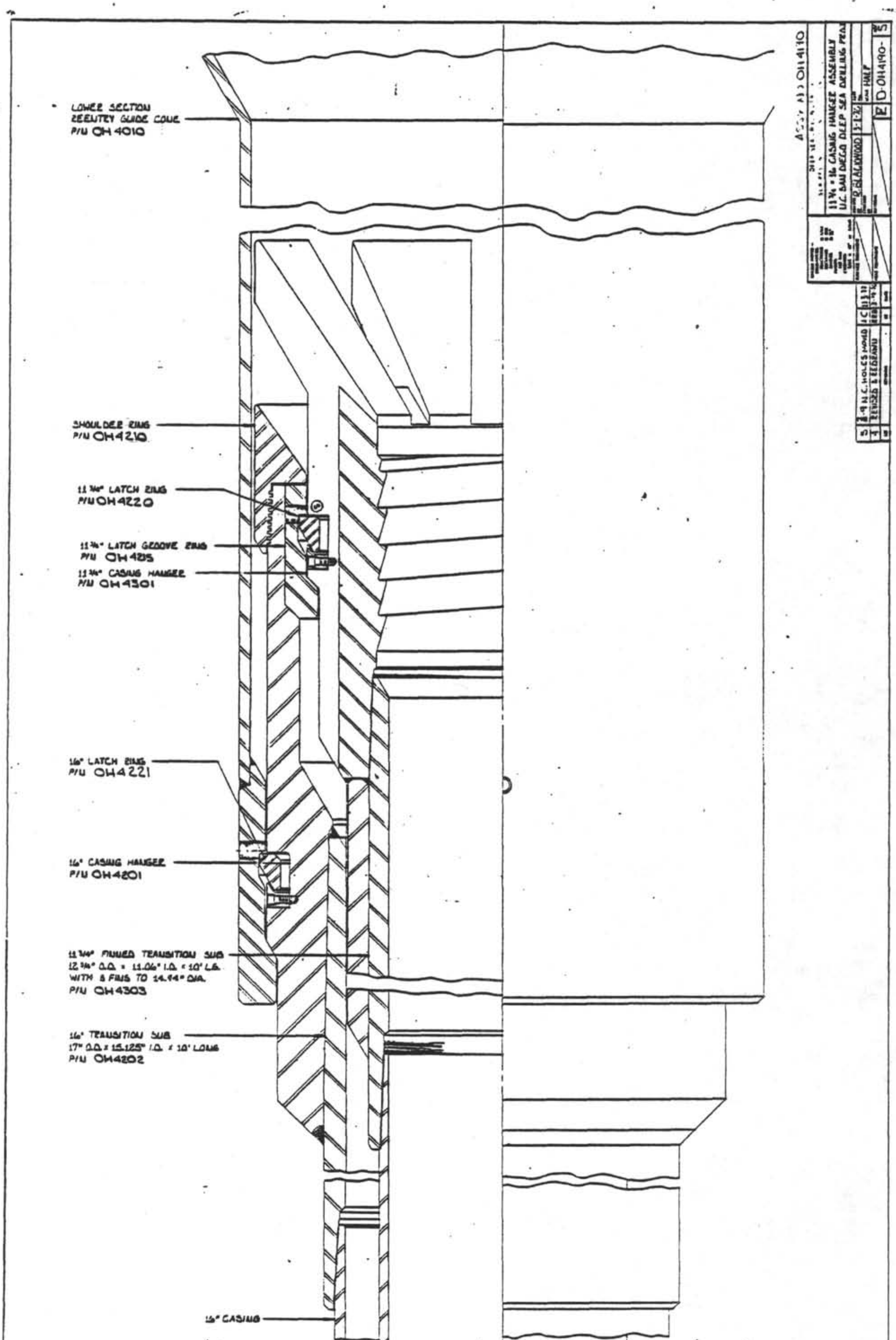
E. 7/8"-9 NC x 1 3/16" Long Hex-Head Cap Screws, SAE Grade 5; T.S.=115,000#, P.L.=78,000#.

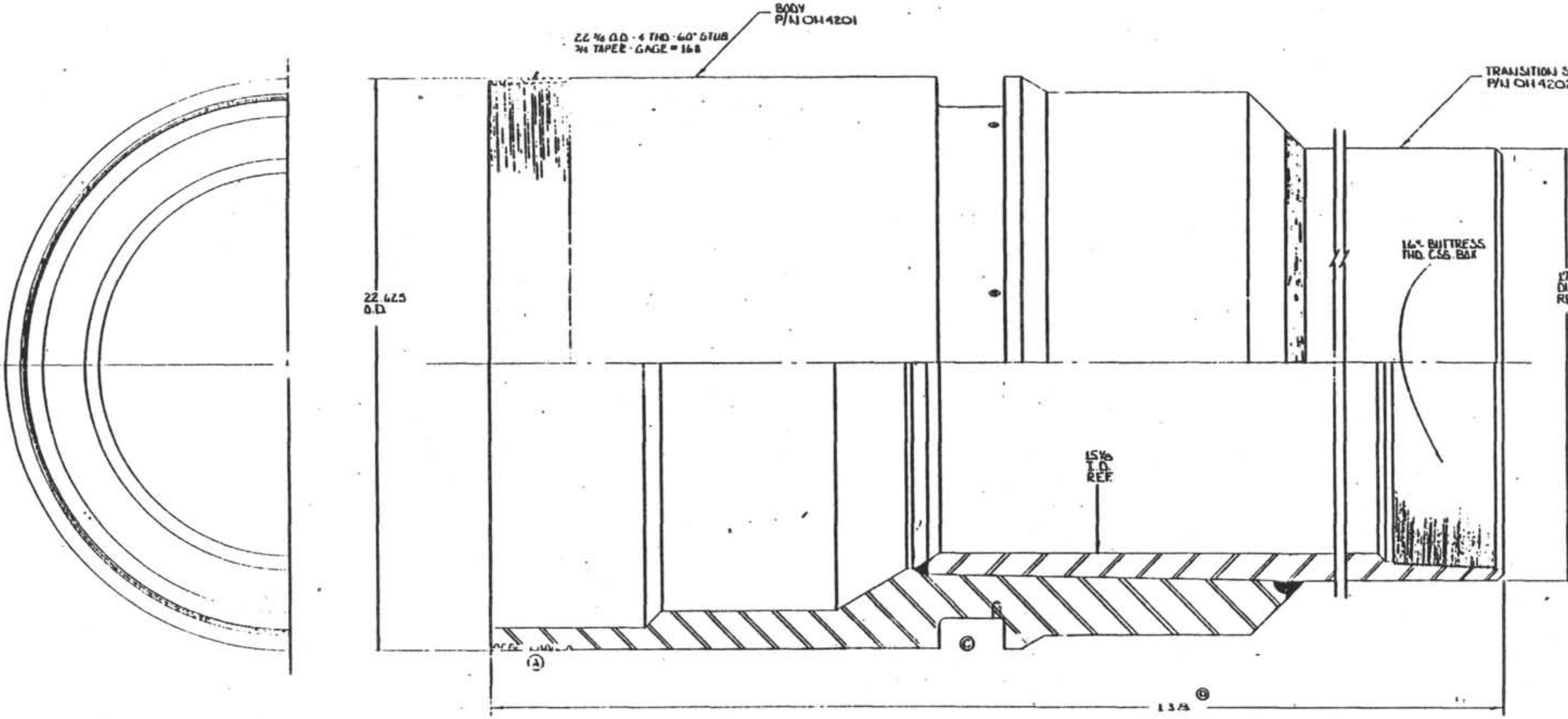
#	Fastener Use
8	a. Retains latch groove ring on latch sleeve while engaging paddles beneath ring. b. Disengages 16" casing hanger from cone landing collar during testing. c. Disengages 11 3/4" casing hanger from latch groove ring during testing.

F. 3/8"-24 NF X 5/8" Long Unbrako Socket-Head Cap Screws, Series 1960; Tensile Strength = 190,000#.

#	Fastener Use
16	(2) Latch Retaining Rings

A-OH 4043


LOWER SECTION
REENTRY GUIDE CONE
P/N OH 4010
SHOULDER RING
P/N OH4210
11 3/4" LATCH RING
P/N OH4220
11 3/4" LATCH GROOVE RING
P/N OH 4215
11 3/4" CASING HANGER
P/N OH4301
16" LATCH RING
P/N OH4221
16" CASING HANGER
P/N OH4201
11 3/4" FINNED TRANSITION SUB
12 3/4" O.D. x 11.06" I.D. x 10' LG.
WITH 8 FINS TO 14.94" DIA.
P/N OH4303
16" TRANSITION SUB
17" O.D. x 15.125" I.D. x 10' LONG
P/N OH4202
16" CASING
11 3/4" CASING
11 3/4 x 16 CASING HANGER ASSEMBLY
U.C. SAN DIEGO DEEP SEA DRILLING PROJ
R. BLACKWOOD
D-OH4190-
REVISED & REDRAWN



WELDING PROCEDURE:

PREVIOUS TO WELDING, A MINIMUM DISTANCE OF 2" EACH SIDE OF THE WELD SHALL BE PREHEATED TO A TEMPERATURE OF 400° F - 500° F. THE PREHEAT TEMPERATURE SHALL BE MAINTAINED UNTIL WELDING IS COMPLETE. AFTER COMPLETING THE WELD, THE WELD AND ADJACENT AREA, 4" EACH SIDE OF THE WELD, SHALL BE STRESS RELIEVED IMMEDIATELY BY HEATING TO A TEMPERATURE OF 1100°F - 1250°F. THE STRESS RELIEVING TEMPERATURE SHALL BE MAINTAINED FOR A MINIMUM OF ONE-HALF HOUR. TEMPERATURE TO BE INDICATED BY "TEMPILSTIKS".

IN ALL CASES, ALLOW TO COOL SLOWLY IN AIR UNTIL HEAVIEST PART HAS REACHED A TEMPERATURE LESS THAN 500° F BEFORE PERMITTING ANY LOAD TO BE APPLIED AND BELOW 300° F BEFORE PERMITTING ANY LOAD TO BE APPLIED AND BELOW 300°F BEFORE PERMITTING ANY QUENCHING.

WELDING ELECTRODE: E-7018

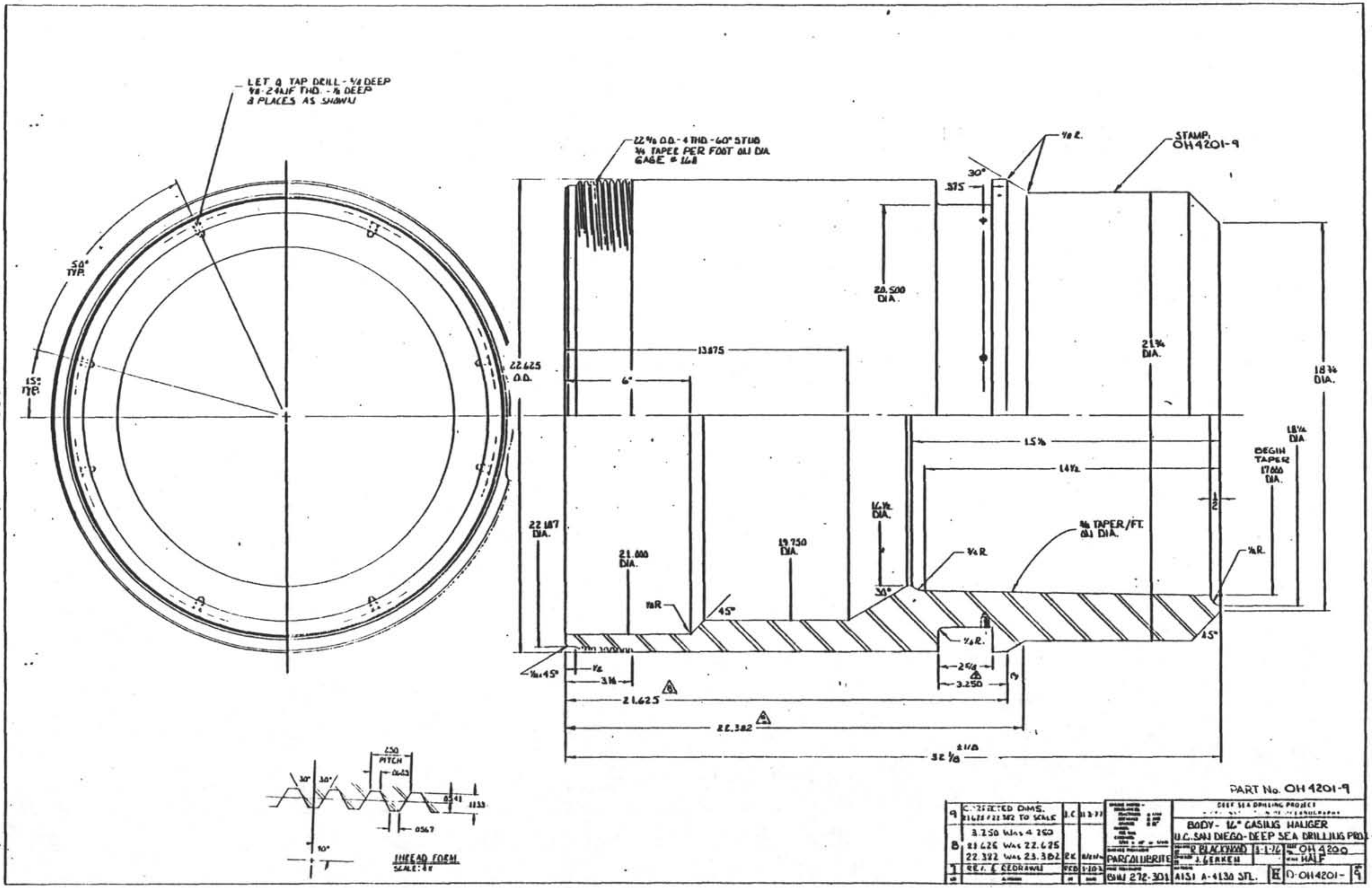
NOTE: WELD AS SHOWN

PART No OH4200

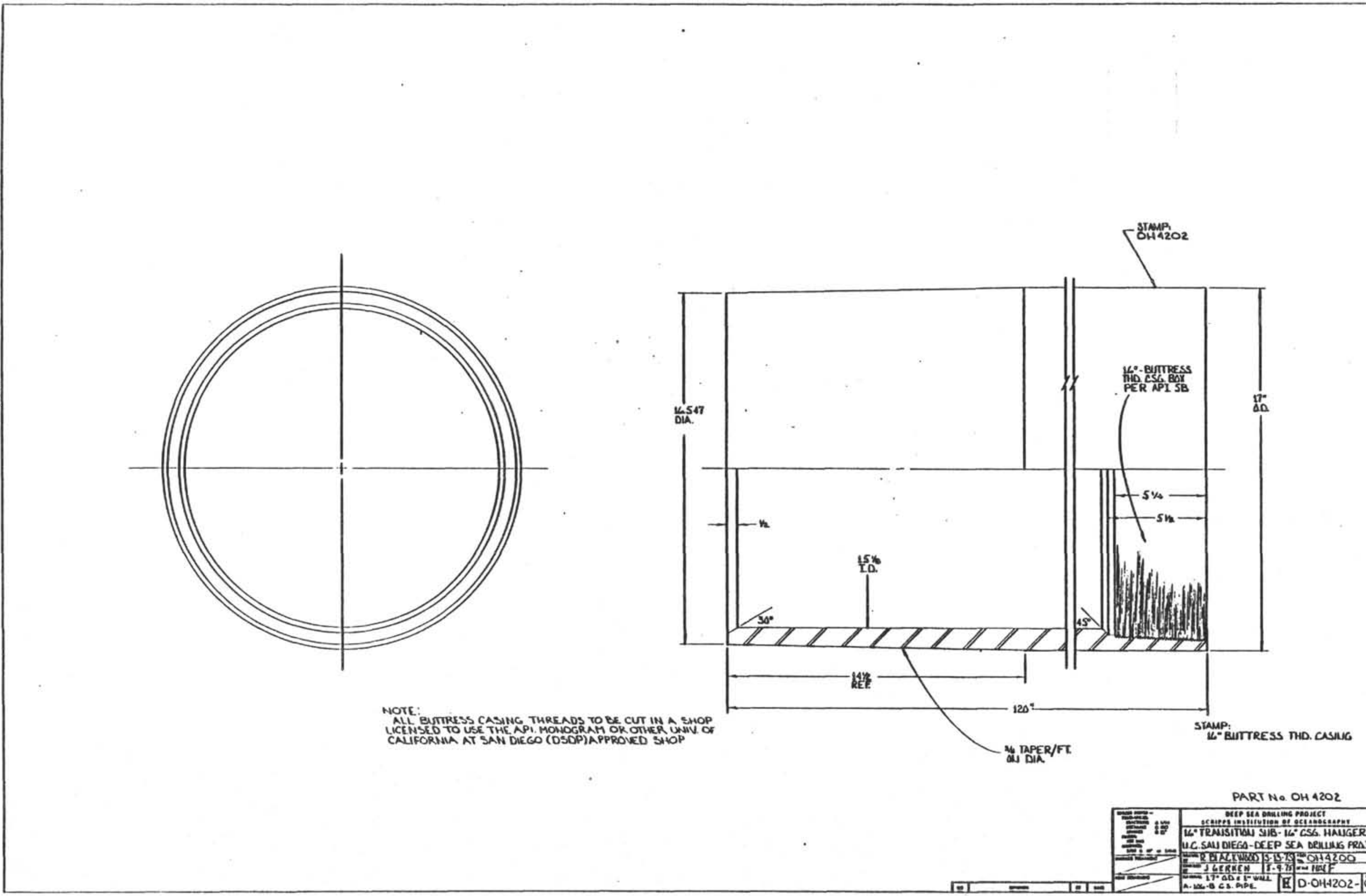
E	WELD SPEC. ADDED	J.C.	11-3-77
D	13.8 WAS 137.625	JM	[illegible]
C	REV GROOVE LOCATION	RRB	3-31-[illegible]
B	REV GROOVE	RRB	1-12-76
A	REV THD.	GB	11-3-75

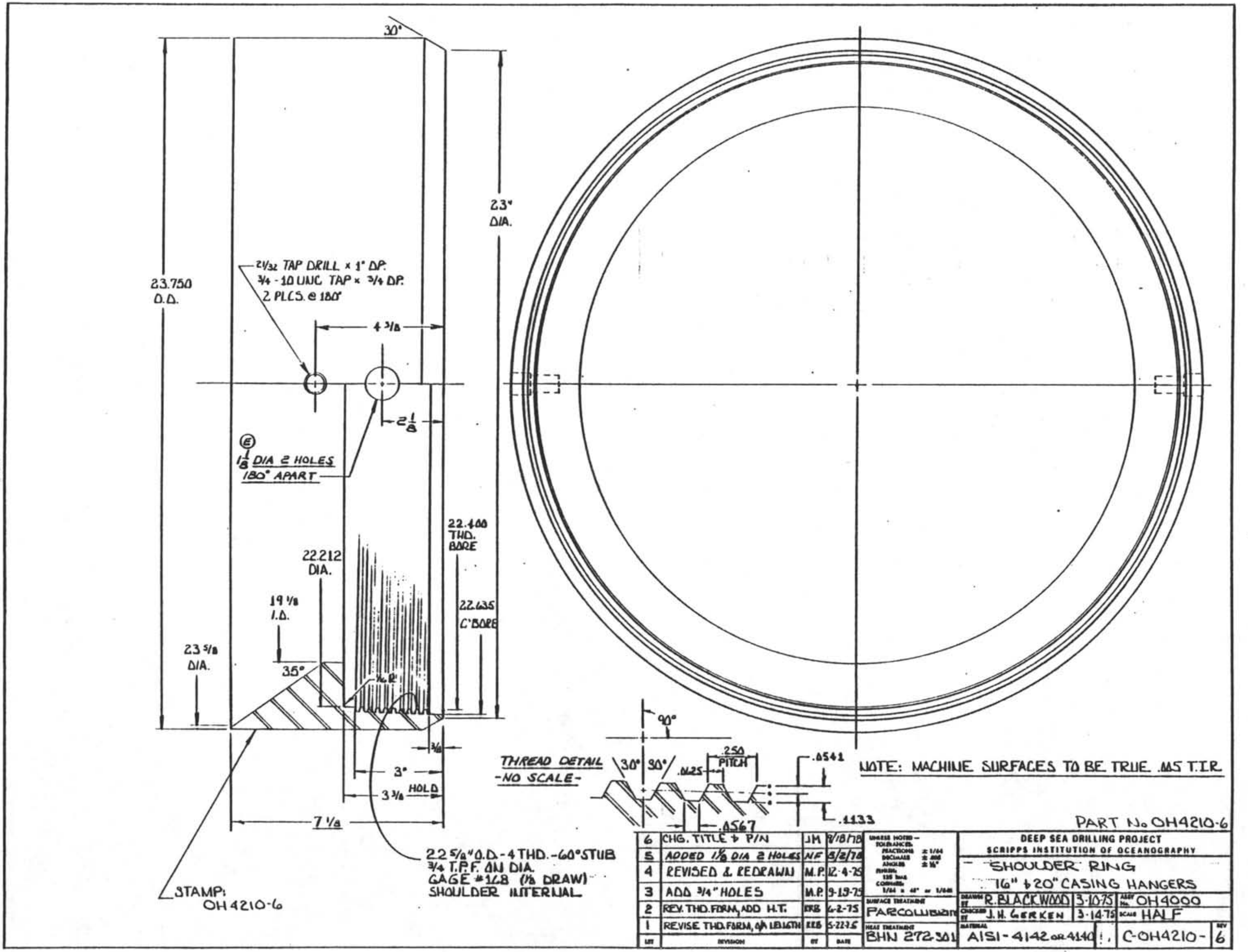
16" CSG. HANGER ASSY - 11¾ x 16" CSG HANGER
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.

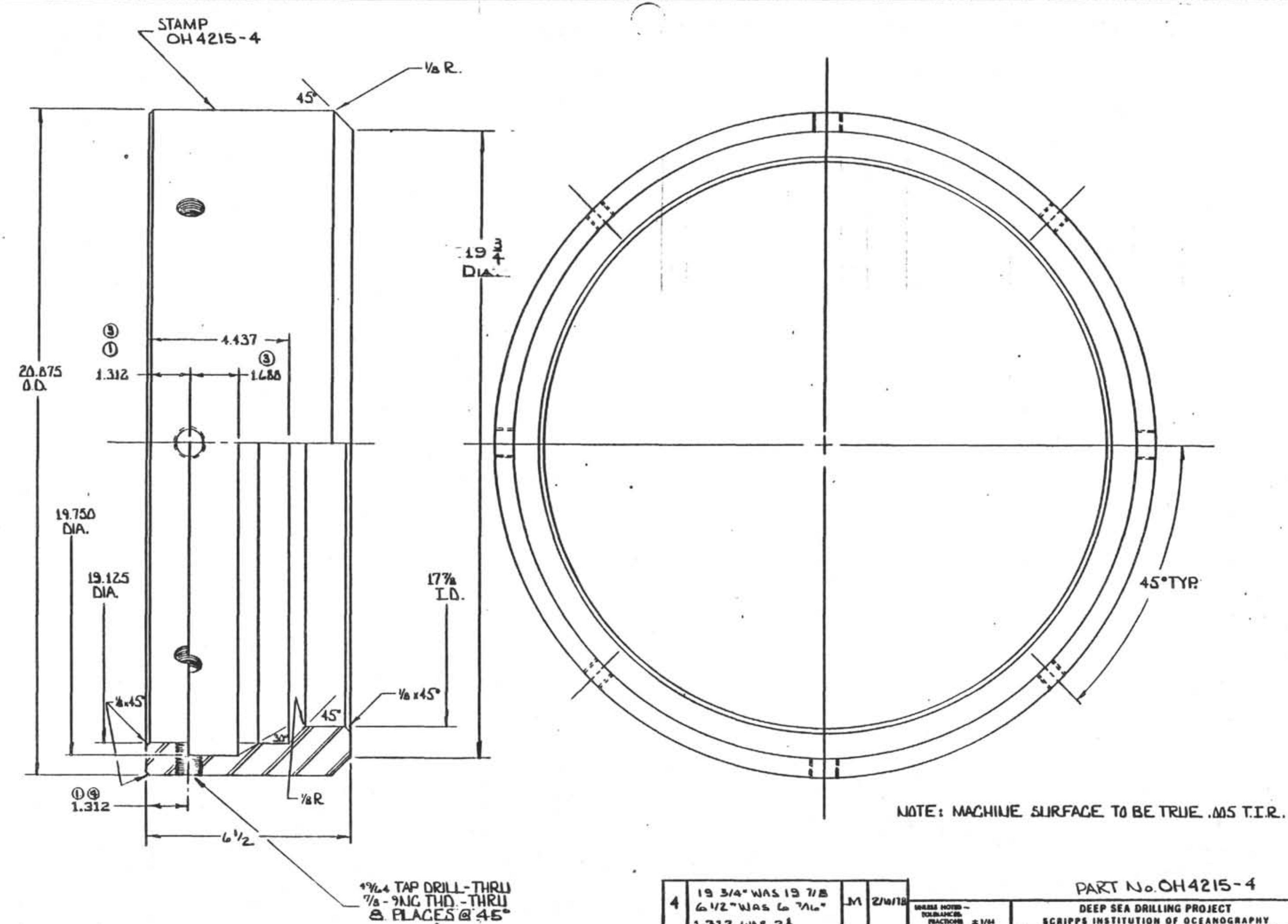
R BLACKWOOD 3-14-75 — OH 4190
J GERKEY 5-9-75 — HALF
NOTED — E — D-OH4200-5



LET Q TAP DRILL - 5/8 DEEP
5/8-24NF THD. - 1/2 DEEP
8 PLACES AS SHOWN
50° TYP.
15° TYP.
22.625 O.D.
22 5/8 O.D. - 4 THD. - 60° STUB
3/4 TAPER PER FOOT ON DIA.
GAGE = 1.68
STAMP: OH4201-9
20.500 DIA.
13.875
6"
21 3/4 DIA.
18 3/4 DIA.
15 5/8
14 1/2
BEGIN TAPER 17.000 DIA.
22.187 DIA.
21.000 DIA.
19.750 DIA.
3/4 TAPER/FT. ON DIA.
21.625
22.382
32 1/8
3.250
THREAD FORM
SCALE: 4X
PITCH
PART No. OH 4201-9
C. RRECTED DIMS. 21.625 / 22.382 TO SCALE
3.250 WAS 4.250
21.625 WAS 22.625
22.382 WAS 23.382
REV. & REDRAWN
PARCALUBRITE
BODY - 16" CASING HANGER
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.
DEEP SEA DRILLING PROJECT
R BLACKWOOD
J. GERKEN
OH 4200
HALF
AISI A-4130 STL.
D-OH4201-9


STAMP: OH4202
16"-BUTTRESS THD. CSG. BOX PER API 5B
16.547 DIA.
17" O.D.
5 1/4
5 1/2
1/2
15 3/16 I.D.
30°
45°
14 1/2 REF.
120"
3/4 TAPER/FT. ON DIA.
STAMP: 16" BUTTRESS THD. CASING
NOTE:
ALL BUTTRESS CASING THREADS TO BE CUT IN A SHOP LICENSED TO USE THE API. MONOGRAM OR OTHER UNIV. OF CALIFORNIA AT SAN DIEGO (DSDP) APPROVED SHOP
PART No. OH 4202
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
16" TRANSITION SUB - 16" CSG. HANGER
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.
R. BLACKWOOD 5-15-75 OH4200
J GERKEN 8-9-75
17" O.D. x 1" WALL A-106-B C.S. PIPE
D-OH4202-0


30°
23.750
O.D.
2.3"
DIA.
21/32 TAP DRILL × 1" DP.
3/4 - 10 UNC TAP × 3/4 DP.
2 PLCS. @ 180°
4 3/8
2 1/8
(E)
1 1/8 DIA 2 HOLES
180° APART
22.400
THD.
BORE
22.212
DIA.
19 1/8
I.D.
22.635
C'BORE
23 5/8
DIA.
35°
1/16 R
3/8
3"
3 3/8 HOLD
7 1/8
STAMP:
OH 4210-6
22 5/8" O.D. - 4 THD. - 60° STUB
3/4 T.P.F. ON DIA.
GAGE #148 (1/8 DRAW)
SHOULDER INTERNAL
THREAD DETAIL
-NO SCALE-
90°
30° 30°
.0125
.250
PITCH
.0541
.1133
.0567
NOTE: MACHINE SURFACES TO BE TRUE .005 T.I.R.
PART No. OH4210-6
6 CHG. TITLE & P/N JM 8/18/78
5 ADDED 1 1/8 DIA 2 HOLES NF 5/2/76
4 REVISED & REDRAWN M.P. 12-4-75
3 ADD 3/4" HOLES M.P. 9-19-75
2 REV. THD. FORM, ADD H.T. KRB 6-2-75
1 REVISE THD. FORM, O/A LENGTH KRB 5-22-75
LTR REVISION BY DATE
SURFACE TREATMENT
PARCOLUBRIZING
HEAT TREATMENT
BHN 272-301
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
SHOULDER RING
16" & 20" CASING HANGERS
DRAWN BY R. BLACKWOOD 3-10-75
CHECKED BY J.H. GERKEN 3-14-75
ASSY No. OH4000
SCALE HALF
MATERIAL
AISI - 4142 OR 4140
C-OH4210- 6



NOTE: MACHINE SURFACE TO BE TRUE .005 T.I.R.

PART No. OH4215-4

LTR	REVISION	BY	DATE
4	19 3/4" WAS 19 7/8 6 1/2" WAS 6 7/16" 1.312 WAS 2 1/8	JM	2/10/78
3	WAS 1 1/2 - NOW 1.312 WAS 1 1/2 - NOW 1.688	M.P.	11-26-76
2	ADD HEAT TREAT	RRB	6-2-75
1	WAS 2 5/16 - NOW 2 1/4 WAS 1 9/16 - NOW 1 1/2	RRB	5-21-75

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°; FINISH: 125 RMS; CORNERS: 1/64 × 45° or 1/64 R

SURFACE TREATMENT: PARCOLUBRIZE

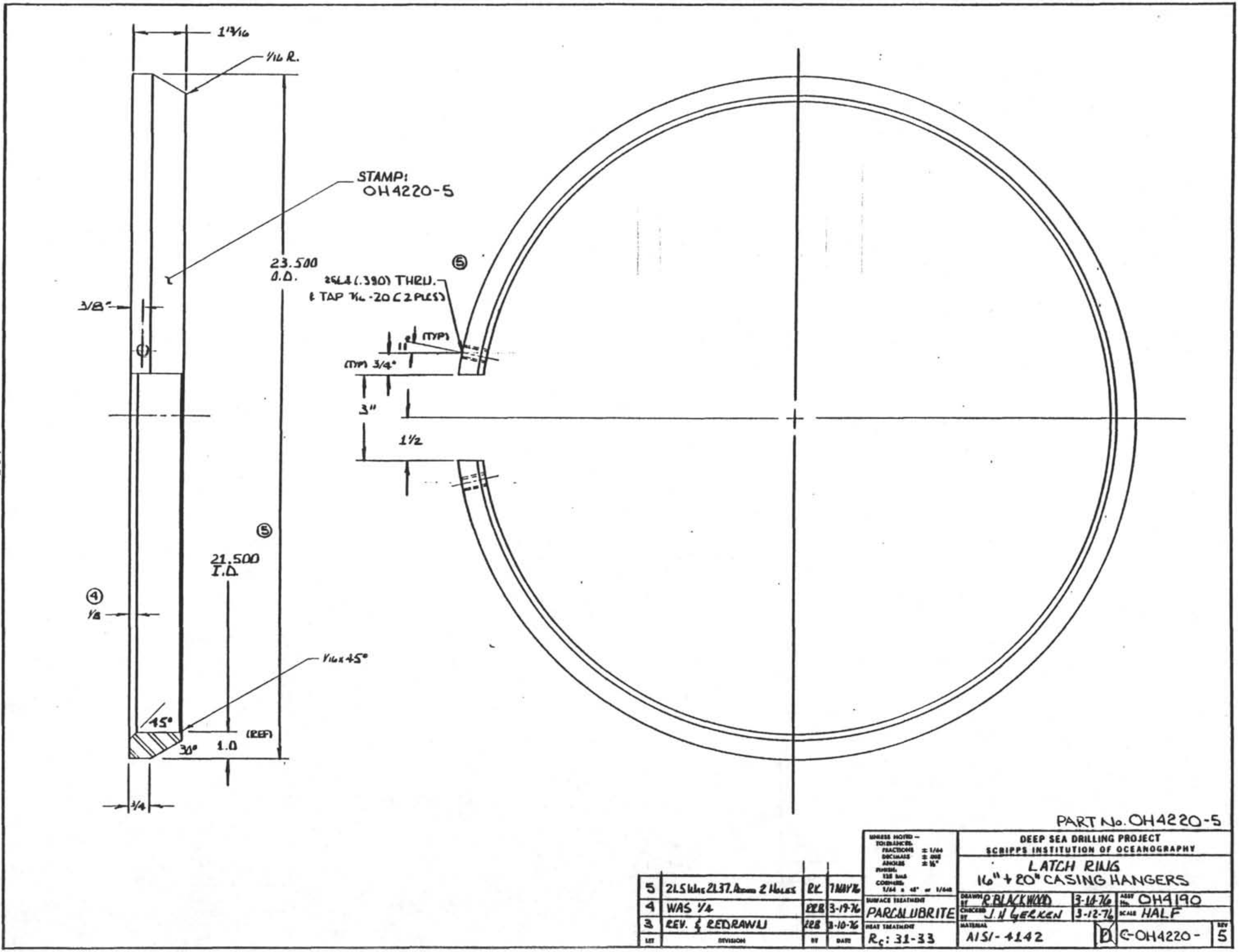
HEAT TREATMENT: BHN 272-301

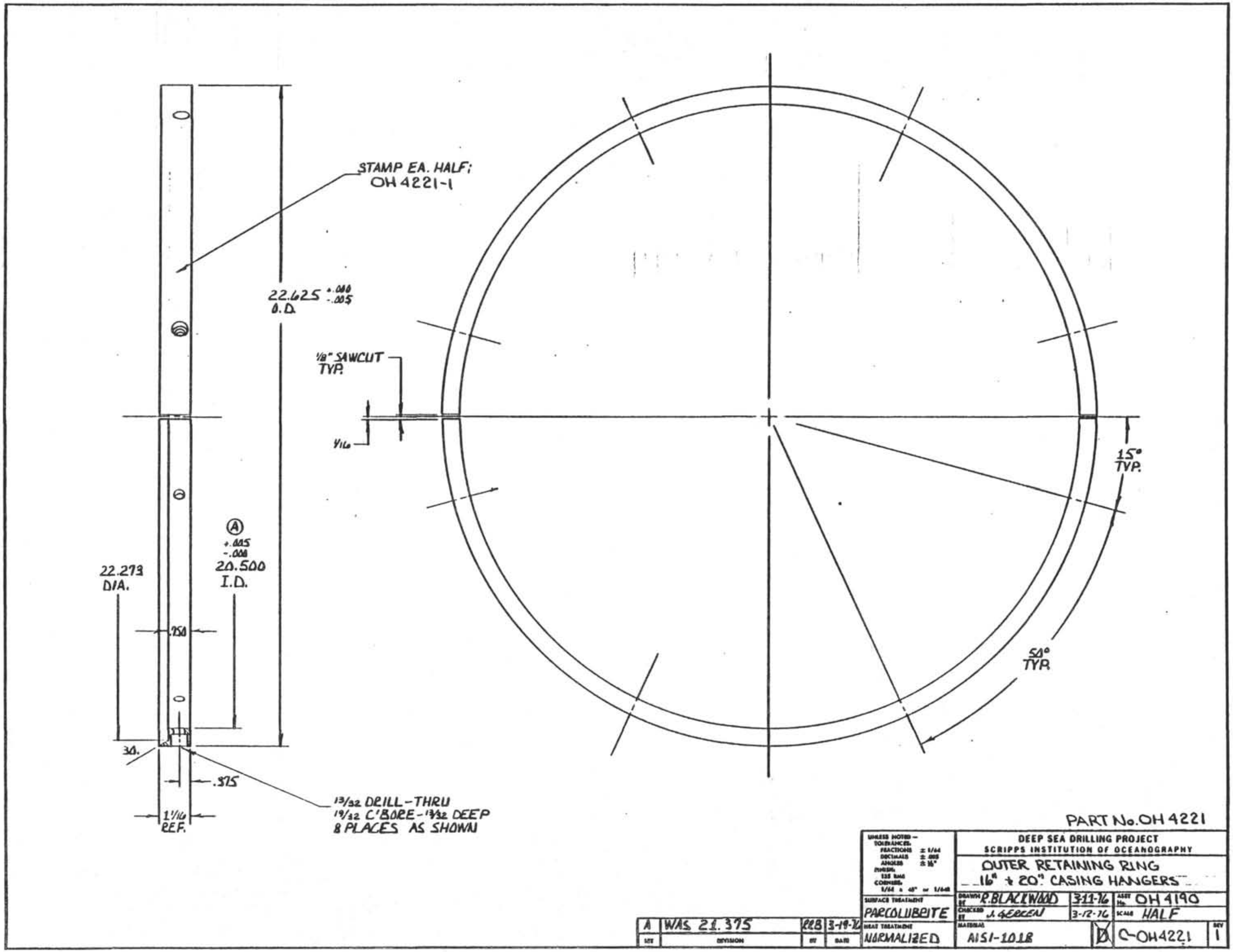
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

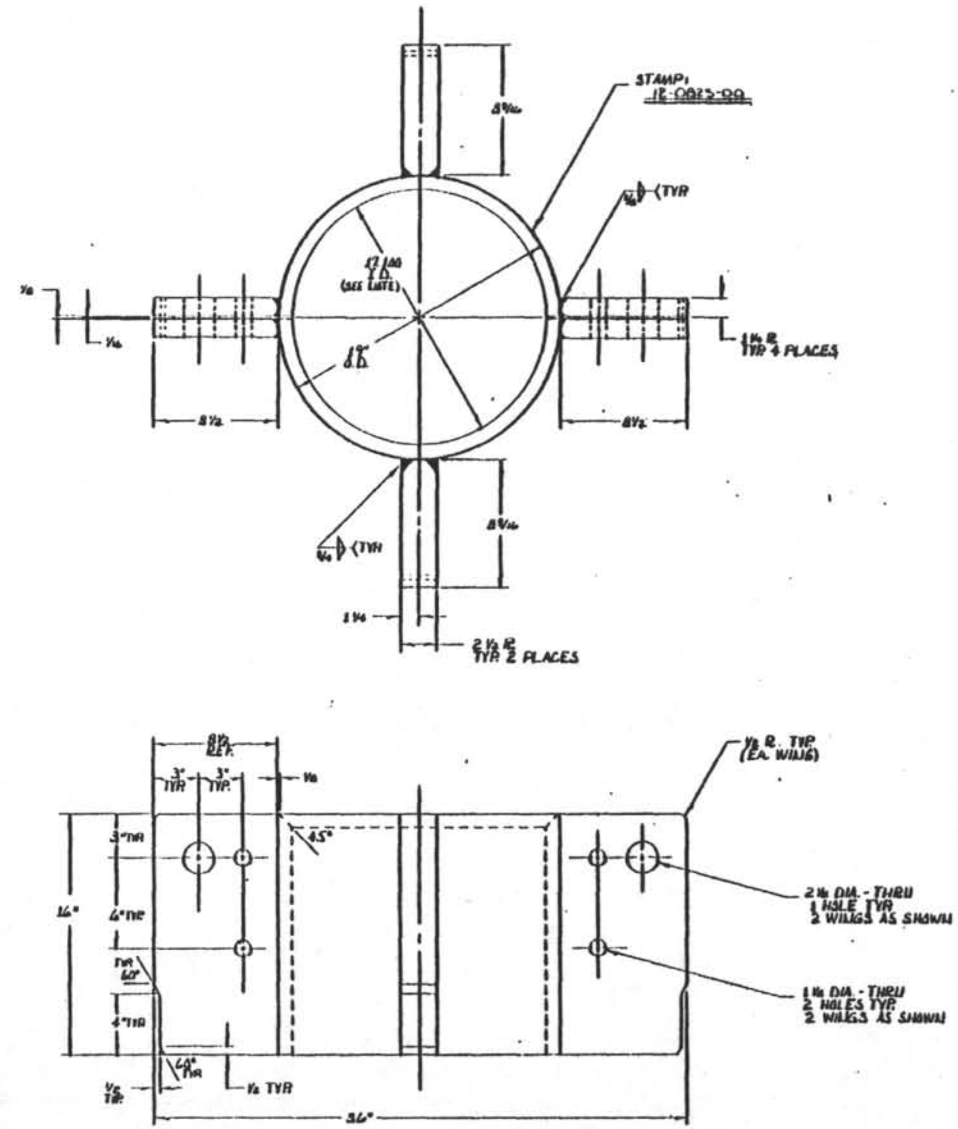
11 3/4 LATCH GROOVE RING

U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.

DRAWN BY: R. BLACKWOOD	3-10-75	ASSY No.: OH4190	
CHECKED BY: J. GERKEN	5-9-75	SCALE: HALF	
MATERIAL: AISI 4142 or 4140	D	C-OH4215-	REV 4


1 3/16
1/16 R.
STAMP: OH4220-5
23.500 O.D.
3/8"
⑤
(TYP) 3/4"
3"
1 1/2
⑤
21.500 I.D.
④
1/8
1/16 x 45°
45°
30°
1.0
(REF)
1/4
PART No. OH4220-5
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LATCH RING
16" + 20" CASING HANGERS
5 | 21.5 Was 21.37. Added 2 Holes | RK | 7 MAY 76
4 | WAS 1/4 | RRB | 3-19-76
3 | REV. & REDRAWN | RRB | 3-10-76
LTR | REVISION | BY | DATE
SURFACE TREATMENT PARCALUBRITE
HEAT TREATMENT R_c: 31-33
DRAWN BY R. BLACKWOOD 3-16-76
CHECKED BY J. H. GERKEN 3-12-76
ASSY No. OH4190
SCALE HALF
MATERIAL AISI-4142
C-OH4220-
REV 5


STAMP EA. HALF; OH 4221-1
22.625 +.000 -.005 O.D.
1/8" SAWCUT TYP.
1/16
15° TYP.
50° TYP.
Ⓐ +.005 -.000 20.500 I.D.
22.273 DIA.
.250
30.
.375
1 1/16 REF.
13/32 DRILL-THRU
19/32 C'BORE-13/32 DEEP
8 PLACES AS SHOWN
PART No. OH 4221
UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2° FINISH: 125 RMS CORNERS: 1/64 x 45° or 1/64R
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
OUTER RETAINING RING
16" + 20" CASING HANGERS
SURFACE TREATMENT PARCOLUBRITE
HEAT TREATMENT NORMALIZED
DRAWN BY R.BLACKWOOD 3-11-76
CHECKED BY J. GERKEN 3-12-76
MATERIAL AISI-1018
ASSY No. OH 4190
SCALE HALF
C-OH4221
REV 1
A WAS 21.375 RRB 3-19-76
LTR REVISION BY DATE

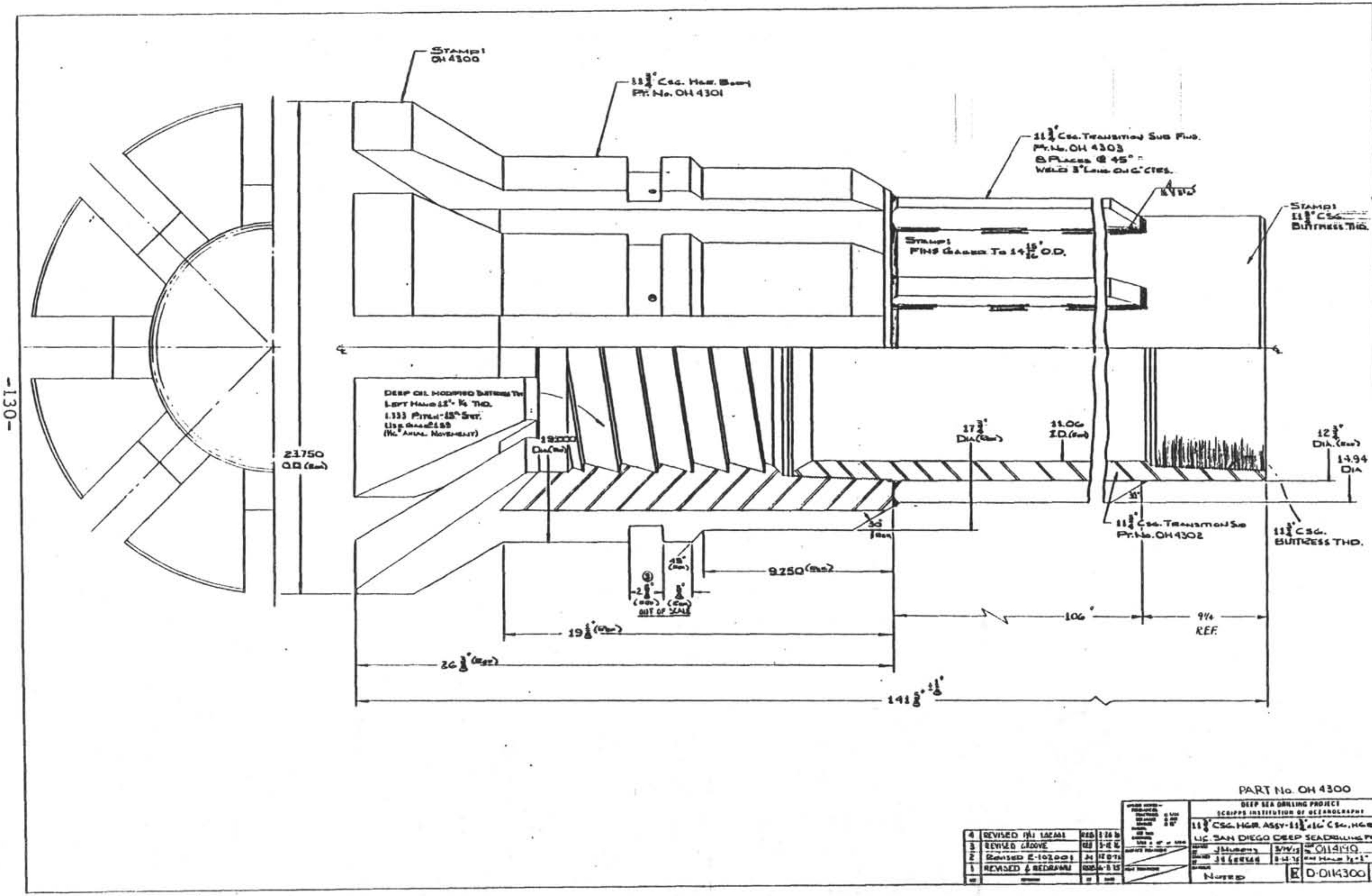


FABRICATION NOTES

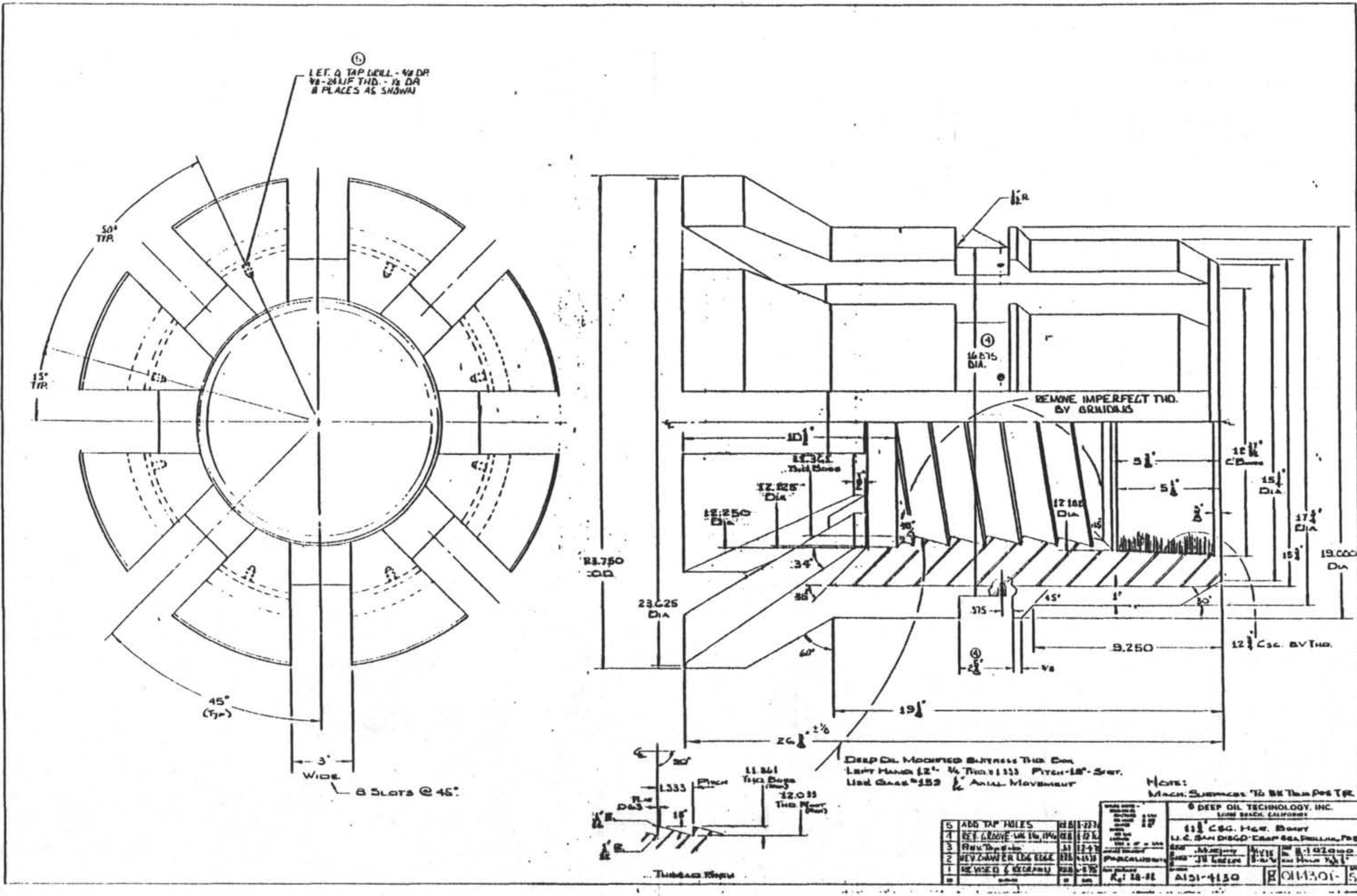
1. ROLL 1" MILD STEEL R TO 17" I.D ± 1/16".
2. FLAME CUT ELEVATOR WINGS, DRILL & CHAMFER AS SHOWN.
3. BOLT ELEVATOR WINGS TOGETHER, USE 1/16" THK WASHERS FOR STANDOFF.
4. WELD WINGS TO CYLINDER - EXTERNAL WELDS ONLY.
5. TORCH CUT CYLINDER IN HALF AS SHOWN, MAKE INTERNAL WELDS & GRIND SMOOTH.
6. ASSEMBLE TOOL (WITHOUT 1/16" WASHERS) & MACHINE I.D TO 17.130"

PART No OH4222

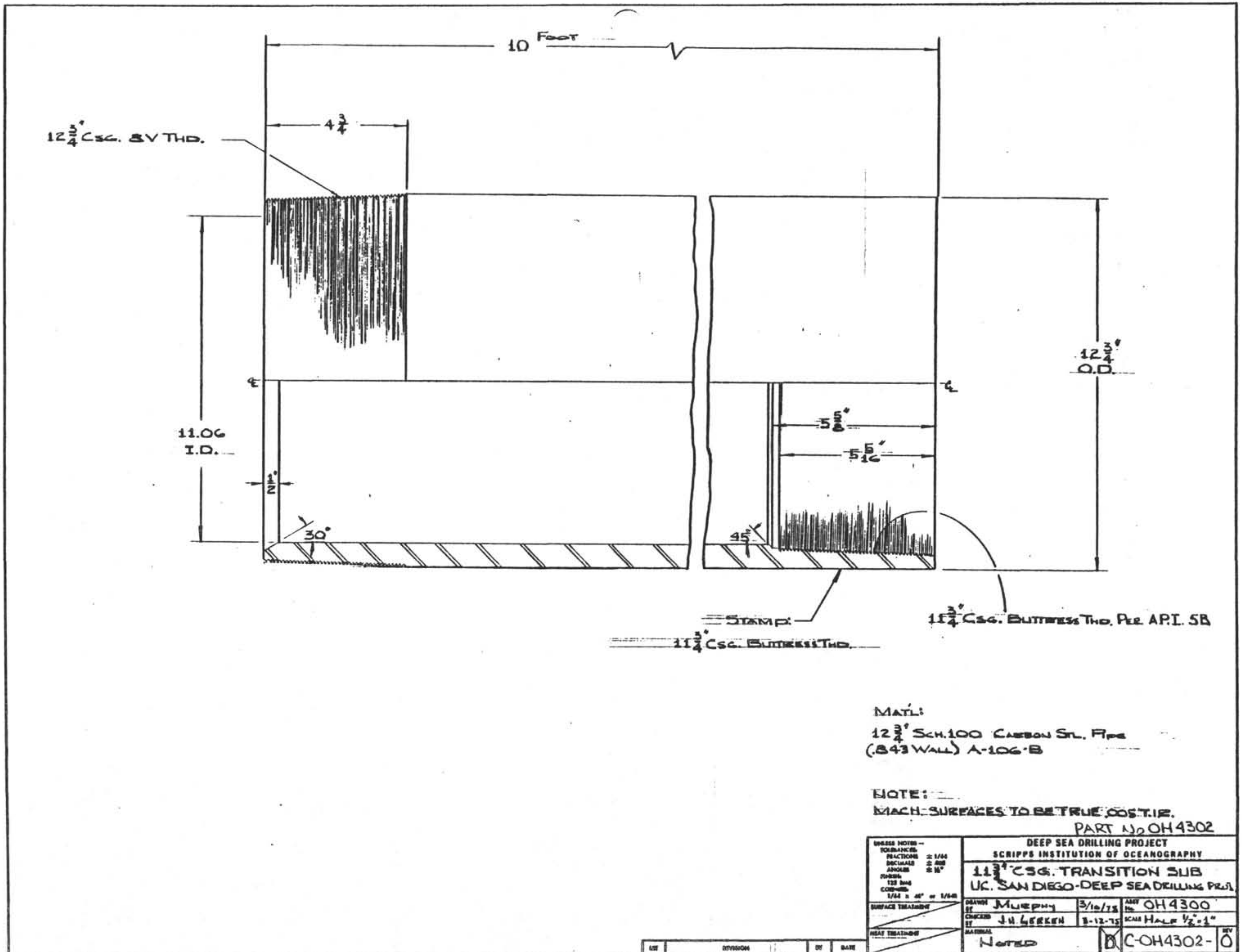
DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY	
CASING ELEVATORS 16" & 20" CASING HANGERS	
DIMETCOTE	MILD STEEL
D-OH4222	

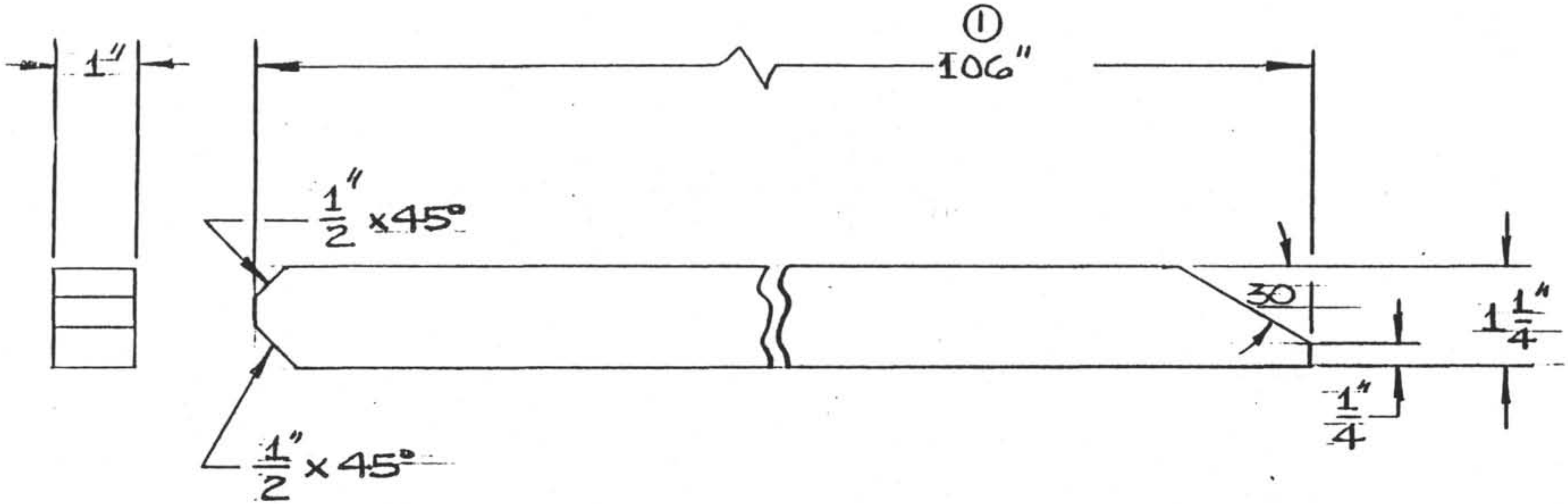


STAMP: OH 4300
11 3/4" CSG. HGR. BODY PT. No. OH 4301
11 3/4" CSG. TRANSITION SUB FINS. PT. No. OH 4303 8 PLACES @ 45° WELD 3" LONG ON 6" CTRS.
STAMP: FINS GAGED TO 14 15/16" O.D.
STAMP: 11 3/4" CSG. BUTTRESS THD.
DEEP OIL MODIFIED BUTTRESS THD. LEFT HAND 15"- 1/4 THD. 1.333 PITCH-15° SET. USE GAGE 159 (1/16" AXIAL MOVEMENT)
23.750 O.D.
19.000 DIA.
17 3/4" DIA.
11.06 I.D.
12 3/4" DIA.
14.94 DIA
30°
11 3/4" CSG. TRANSITION SUB PT. No. OH 4302
11 3/4" CSG. BUTTRESS THD.
45°
2 1/8"
1/8"
OUT OF SCALE
9.750
19 3/8"
26 3/8"
106"
9 1/4 REF.
141 3/8" ± 1/8"
PART No. OH 4300
4 REVISED
3 REVISED GROOVE
2 REVISED E-102001
1 REVISED & REDRAWN
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
11 3/4" CSG. HGR. ASSY-11 3/4" x 16" CSG. HGR.
U.C. SAN DIEGO DEEP SEA DRILLING PROJ.
0114190
NOTED
E
D-0114300
4



LET. Q TAP DRILL - 3/8 DP. 5/8-24 UNF THD. - 1/2 DP. 8 PLACES AS SHOWN
50° TYP.
15° TYP.
45° (Typ)
3" WIDE
8 SLOTS @ 45°
1/32 R
16.875 DIA.
REMOVE IMPERFECT THD. BY GRINDING
10 1/4"
12.250 DIA
12.825 DIA
23.750 O.D.
23.625 DIA
34°
60°
12.180 DIA
45°
30°
5 1/4"
15 1/4 DIA
17 3/4 DIA
19.000 DIA
12 3/4 CSG. BY THD.
9.250
19 1/4"
26 1/4"
DEEP OIL MODIFIED BUTTRESS THD. BOX
THREAD FORM
NOTES:
MACH. SURFACES TO BE THIN PHOSPHATE
DEEP OIL TECHNOLOGY, INC.
LONG BEACH, CALIFORNIA
11 3/4" CSG. HGR. BODY
5 ADD TAP HOLES
4 REV. GROOVE
3 ADD TAPER
2 REV. CHAMFER LDG EDGE
1 REVISED & REDRAWN
AISI-4130


10 FOOT
12 3/4" CSG. 8V THD.
4 3/4
11.06 I.D.
12 3/4" O.D.
1/2"
30°
45°
5 5/8"
5 5/16"
STAMP:
11 3/4" CSG. BUTTRESS THD.
11 3/4" CSG. BUTTRESS THD. PER. A.P.I. 5B
MAT'L:
12 3/4" SCH.100 CARBON STL. PIPE
(.843 WALL) A-106-B
NOTE:
MACH. SURFACES TO BE TRUE CONC. T.I.R.
PART No OH4302
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
11 3/4" CSG. TRANSITION SUB
UC. SAN DIEGO-DEEP SEA DRILLING PROJ.
DRAWN BY MURPHY 3/10/75
CHECKED BY J.H. GERKEN 3-12-75
ASSY No. OH4300
SCALE HALF 1/2"=1"
MATERIAL NOTED
C-OH4302-0
SURFACE TREATMENT
HEAT TREATMENT
DIVISION



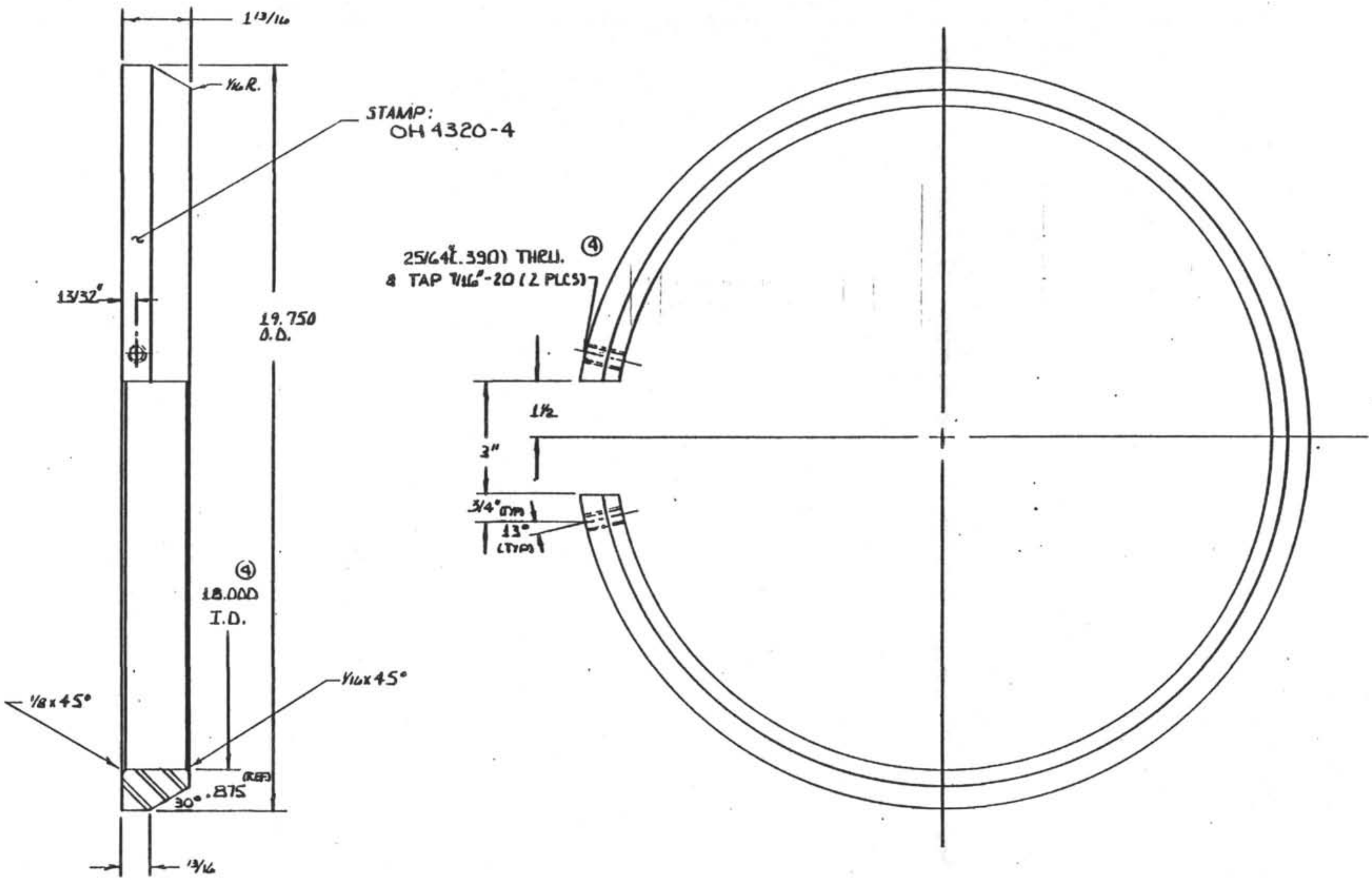
(8 REQ'D PER SET)

NOTE:
WELD TO 12 3/4" O.D. & TURN 14.94 O.D.

PART No. OH 4303-1

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64; DECIMALS ± .005; ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY
	11 3/4" CSG. TRANSITION SUB FIN. U.C. SAN DIEGO DEEP SEA DRILLING PROJ.
SURFACE TREATMENT	DRAWN BY J MURPHY 3/10/75 — ASSY No. 4300
	CHECKED BY J. GERKEN 3-12-75 — SCALE HALF ½"–1"
HEAT TREATMENT	MATERIAL MILD STL — A — A-OH4303- — REV 1

LET	REVISION	BY	DATE
1	WAS 114 3/4	RPB	5-22-75



PART No. OH4320-4

4	18. WAS 17.625, HOLES ADDED	R.K.	7 MAY 76	
3	REV. & REDRAWN	RRB	3-11-76	
LET	REVISION	BY	DATE	

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R

SURFACE TREATMENT: PARCOLUBRITE

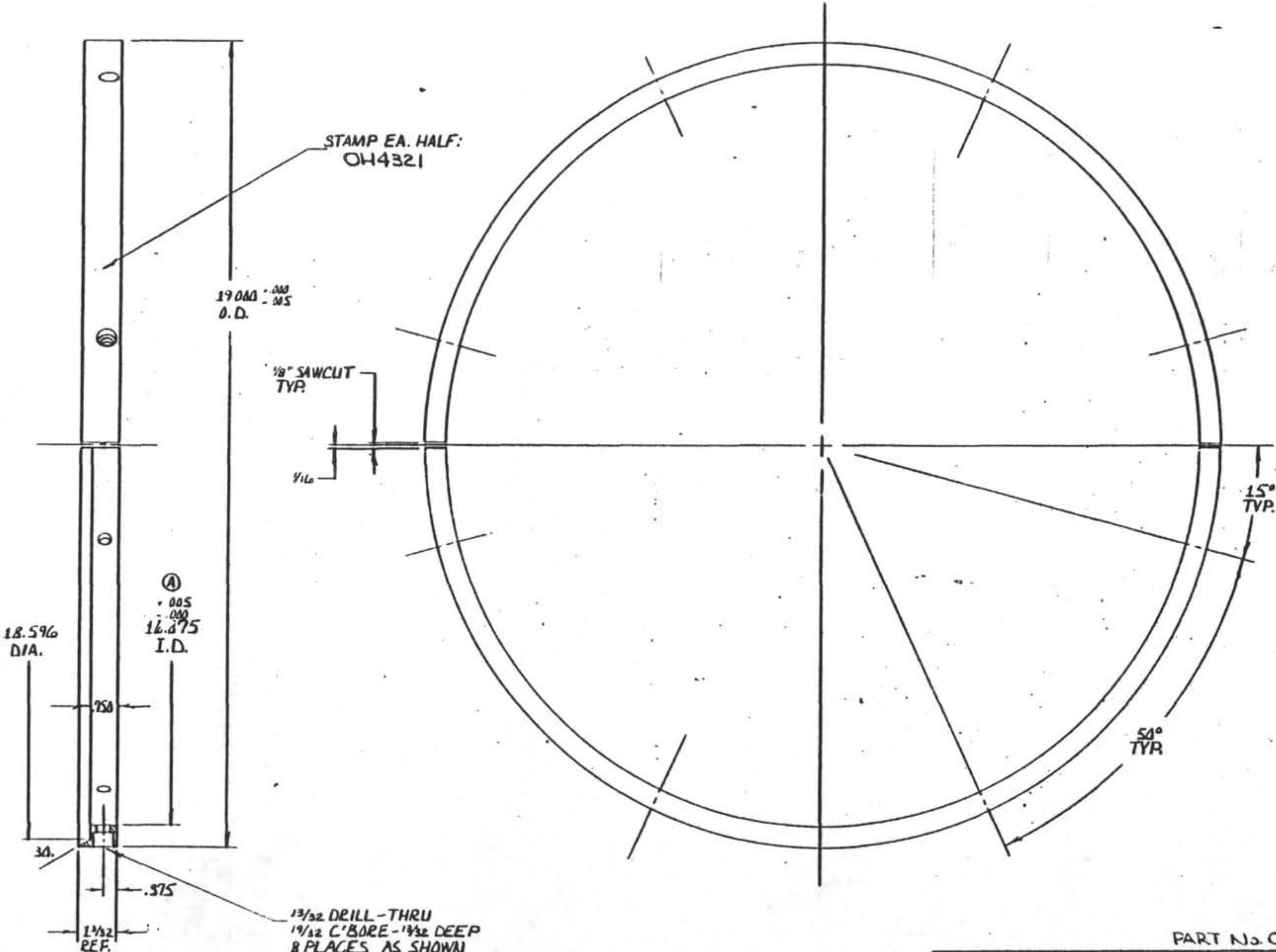
HEAT TREATMENT: R_c: 31-33

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

11¾" LATCH RING

UC. SAN DIEGO - DEEP SEA DRILLING PROJECT

DRAWN BY R. BLACKWOOD	3-11-76	ASSY No. OH4190	
CHECKED BY J H GERKEN	3-12-76	SCALE HALF	
MATERIAL AISI 4142	D	C-OH4320-	REV 4



PART No. OH 4321

LET	REVISION	BY	DATE
1	WAS 17.625	RRB	3-19-76

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R

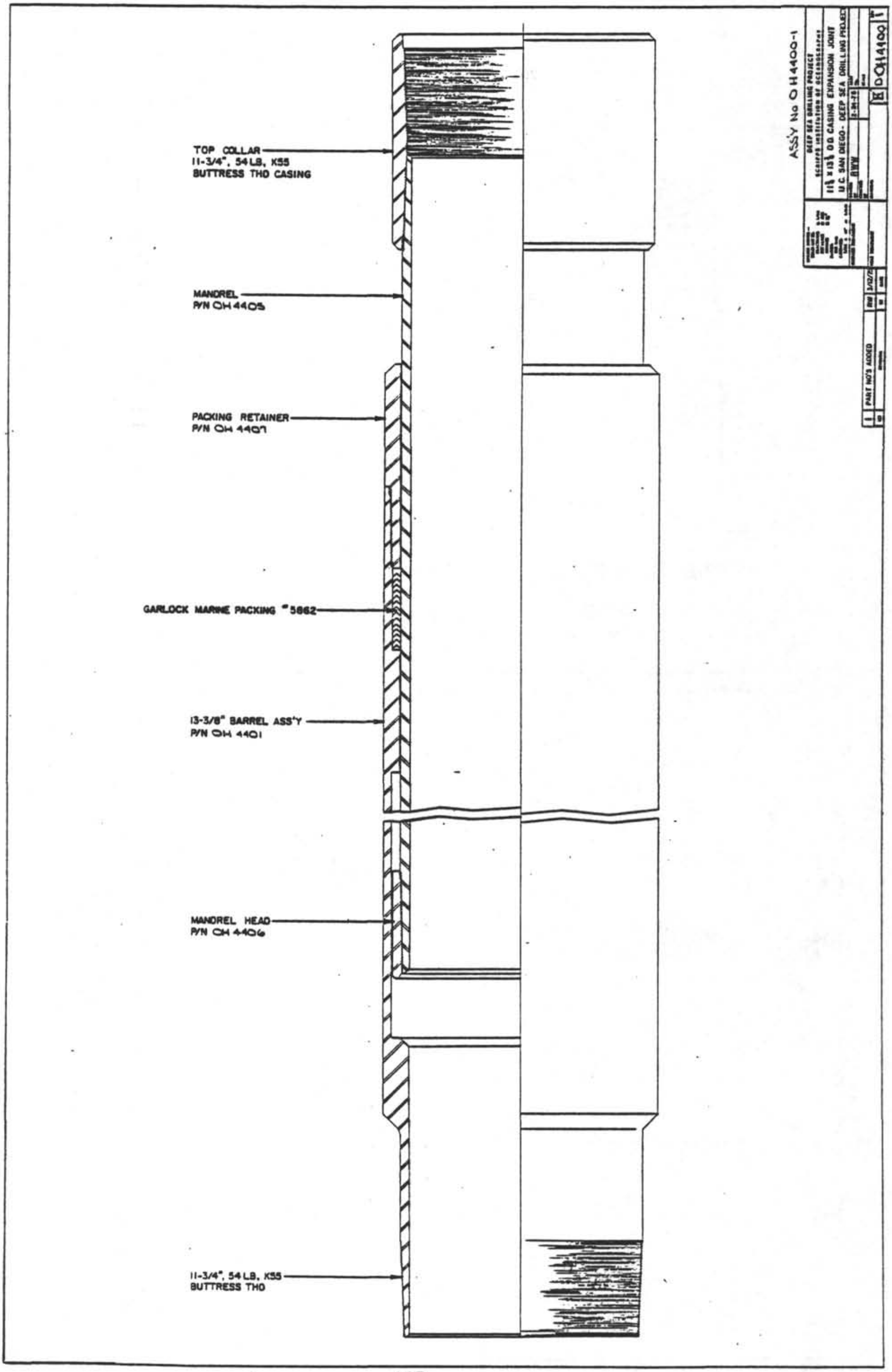
SURFACE TREATMENT: PARCOLUBRITE

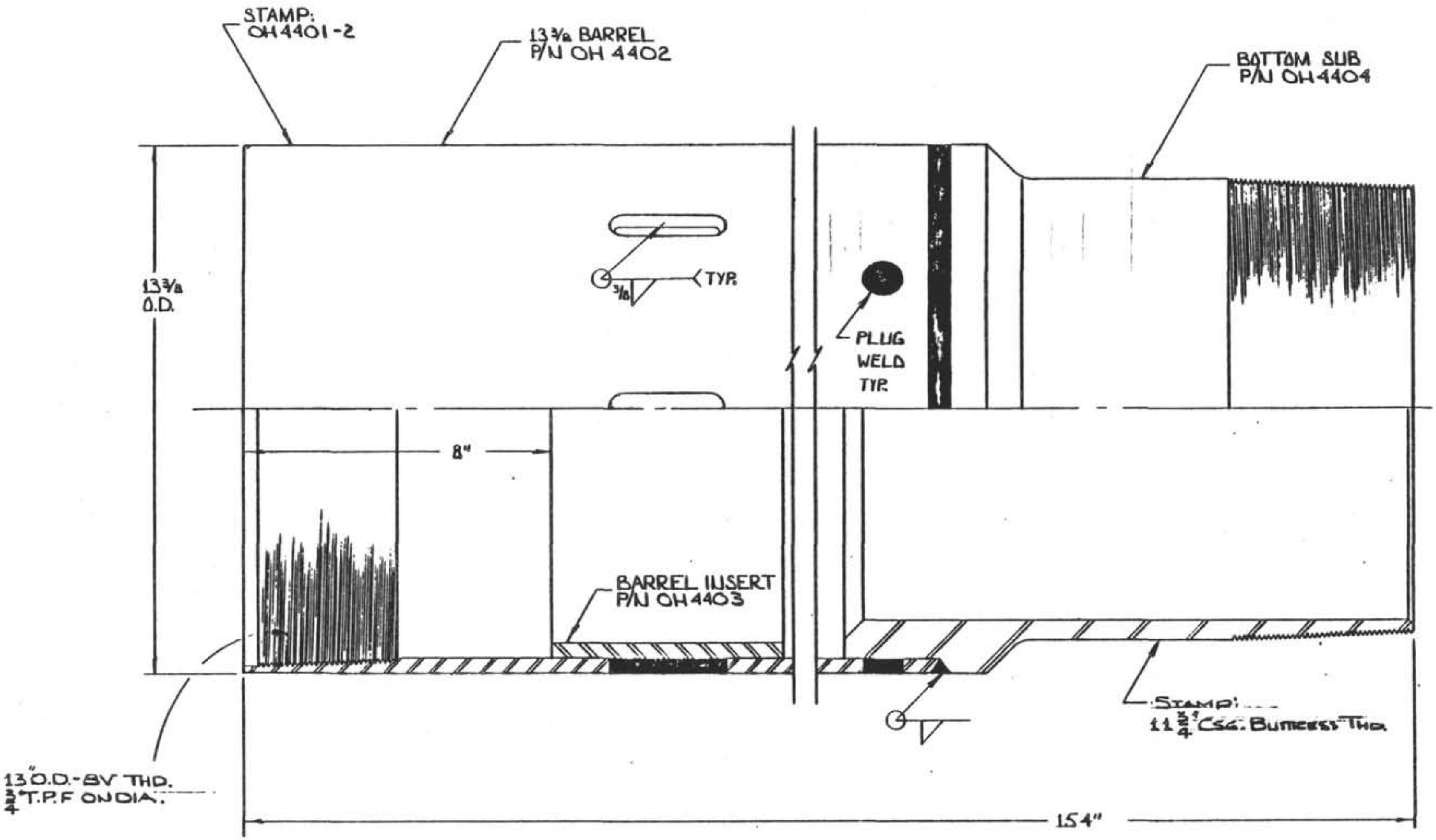
HEAT TREATMENT: NORMALIZED

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

11 3/4" LATCH RETAINING RING (OUTER)
U.C. SAN DIEGO - DEEP SEA DRILLING PROJECT

DRAWN BY: R. BLACKWOOD	3-11-76	ASSY No.: OH 4190	
CHECKED BY: [illegible]	3-[illegible]-76	SCALE: NONE	
MATERIAL: 1151 1018	D	C-OH4321-	REV: 1


TOP COLLAR
11-3/4", 54 LB, K55
BUTTRESS THD CASING
MANDREL
P/N OH 4405
PACKING RETAINER
P/N OH 4407
GARLOCK MARINE PACKING #5862
13-3/8" BARREL ASS'Y
P/N OH 4401
MANDREL HEAD
P/N OH 4406
11-3/4", 54 LB, K55
BUTTRESS THD
ASS'Y No OH4400-1
DEEP SEA DRILLING PROJECT
11¾ x 13⅜ OD CASING EXPANSION JOINT
U.C. SAN DIEGO - DEEP SEA DRILLING PROJECT
RWW
D OH4400
PART NO'S ADDED



2 WELDING PROCEDURE

PREVIOUS TO WELDING, A MINIMUM DISTANCE OF 2" EACH SIDE OF THE WELD SHALL BE PREHEATED TO A TEMPERATURE OF 400°F - 500°F. THE PREHEAT TEMPERATURE SHALL BE MAINTAINED UNTIL WELDING IS COMPLETE. AFTER COMPLETING THE WELD, THE WELD AND ADJACENT AREA, 4" EACH SIDE OF THE WELD, SHALL BE STRESS RELIEVED IMMEDIATELY BY HEATING TO A TEMPERATURE OF 1100°F - 1250°F. THE STRESS RELIEVING TEMPERATURE SHALL BE MAINTAINED FOR A MINIMUM OF ONE-HALF HOUR. TEMPERATURE TO BE INDICATED BY "TEMPILSTIKS". IF UNUSUAL CONDITIONS MAKE IT IMPOSSIBLE TO ATTAIN THE MINIMUM TEMPERATURE LISTED, THE HIGHEST TEMPERATURE ATTAINABLE SHOULD BE HELD FOR ONE-HALF HOUR. IN ALL CASES, ALLOW TO COOL SLOWLY IN AIR UNTIL HEAVIEST PART HAS REACHED A TEMPERATURE LESS THAN 500°F BEFORE PERMITTING ANY LOAD TO BE APPLIED AND BELOW 300°F BEFORE PERMITTING ANY QUENCHING.

WELDING ELECTRODE E-7018

NOTE:

BOTTOM SUB (P/N OH4404) TO BE WELDED ON AFTER INSERTION OF MANDREL (P/N OH4405) AND MANDREL HEAD (P/N OH4406) ASSY. INTO BARREL ASSY: (P/N OH4401) SEE DWG. OH4400.

OH4401-2

LTR	REVISION	BY	DATE
2	WELD NOTE ADDED	R.K.	10-12-76
1	DELETE GAGE, REVISE WELD	M.R.	5-23-75

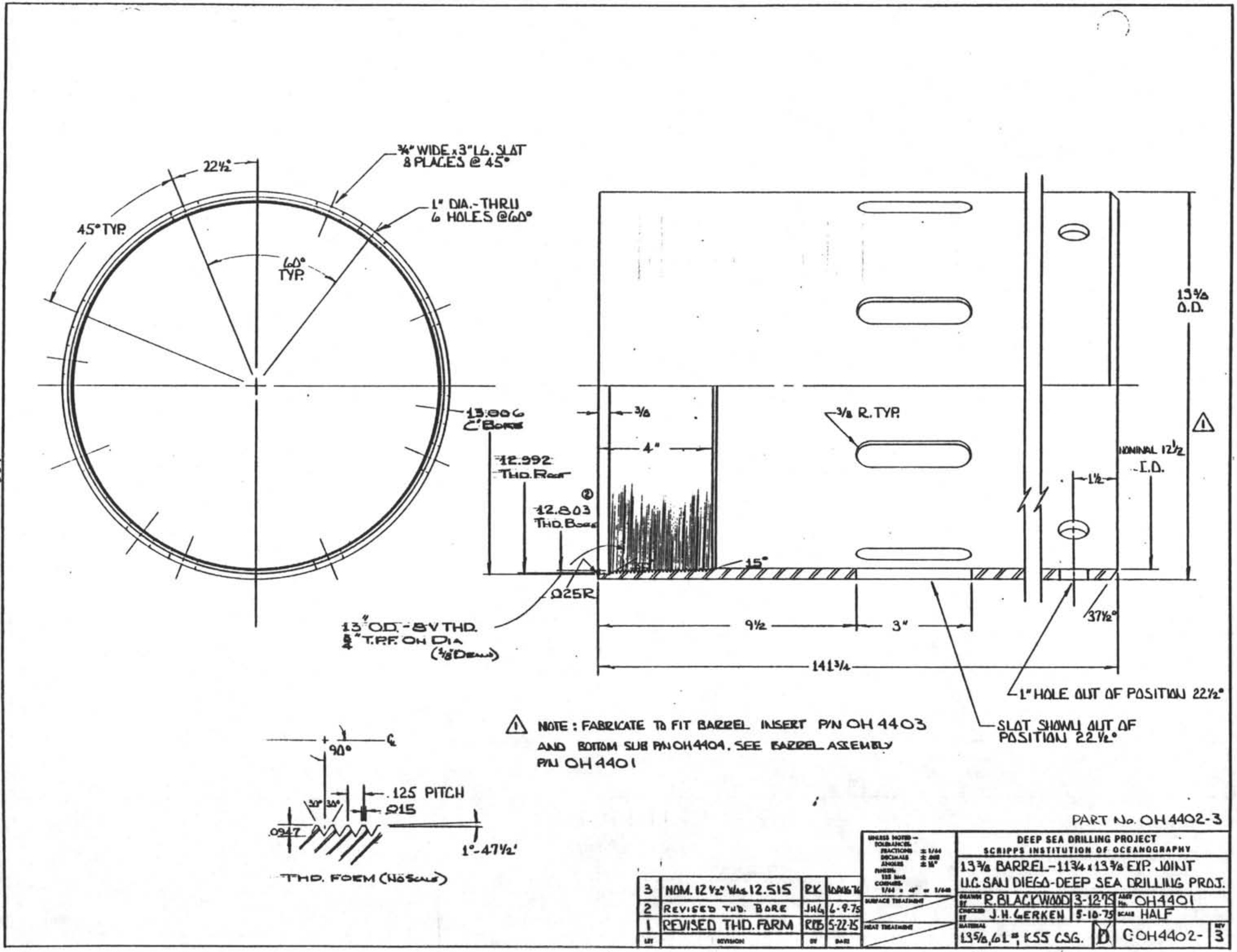
UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R

SURFACE TREATMENT —
HEAT TREATMENT —

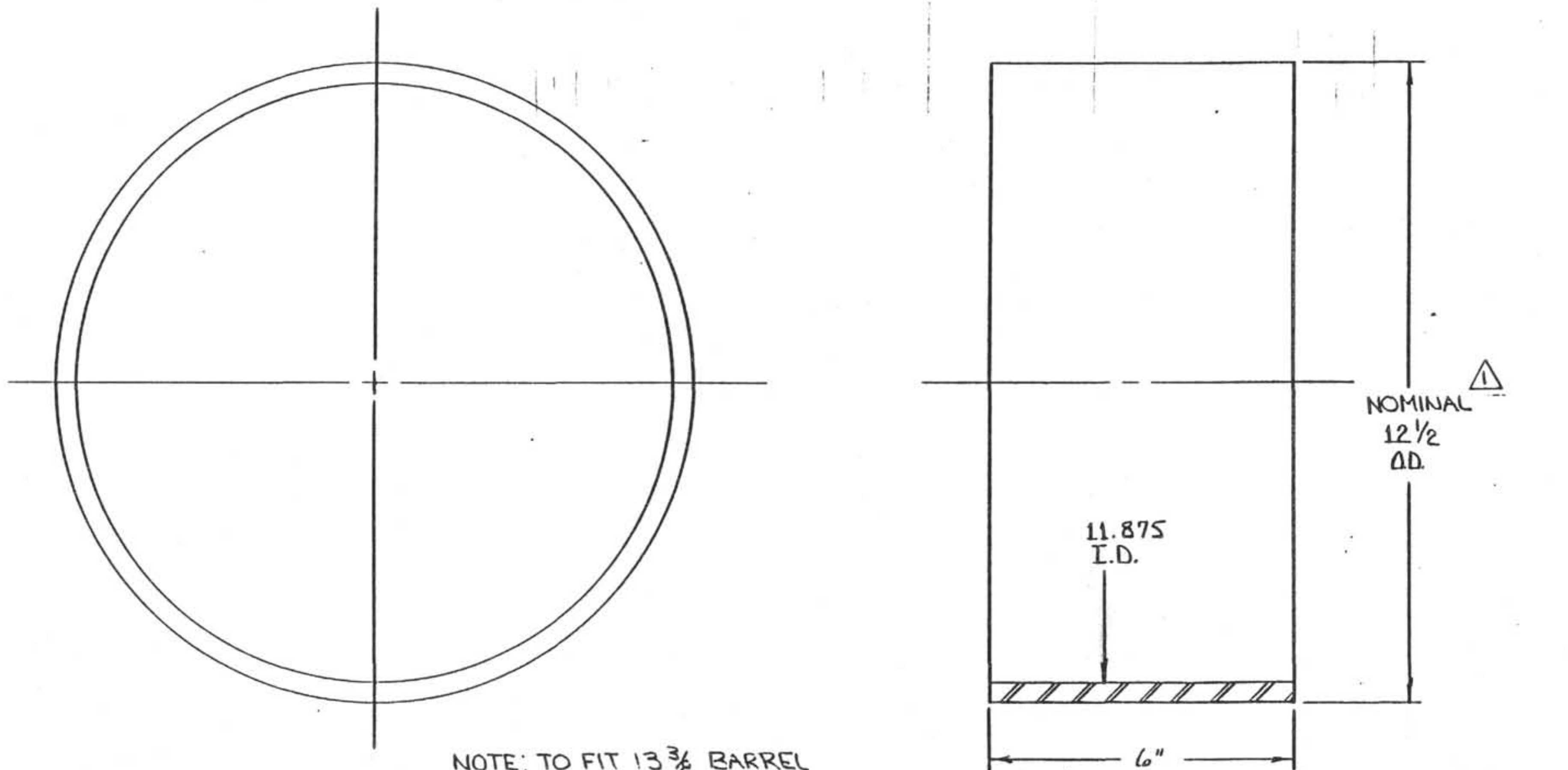
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

13 3/8 BARREL ASSEMBLY
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.

DRAWN BY	R. BLACKWOOD	3-12-75	ASSY No. OH4400
CHECKED BY	J. H. GERKEN	3-14-75	SCALE HALF
MATERIAL		D	C-OH4401- REV 2



3/4" WIDE x 3" LG. SLOT 8 PLACES @ 45°
22½°
45° TYP.
1" DIA.-THRU 6 HOLES @60°
60° TYP.
13.006 C'BORE
12.992 THD. ROOT
12.803 THD. BORE
.025R
13" O.D. - 8V THD. ¾" T.P.F. ON DIA (⅛" DEAD)
3/8
4"
3/8 R. TYP.
15°
9½
3"
141¾
1½
37½°
13⅜ O.D.
NOMINAL 12½ I.D.
1" HOLE OUT OF POSITION 22½°
SLOT SHOWN OUT OF POSITION 22½°
NOTE: FABRICATE TO FIT BARREL INSERT P/N OH 4403 AND BOTTOM SUB P/N OH4404. SEE BARREL ASSEMBLY P/N OH 4401
90°
.125 PITCH
.015
30° 30°
.0947
1°-47½'
THD. FORM (NO SCALE)
PART No. OH 4402-3
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
13⅜ BARREL-11¾ x 13⅜ EXP. JOINT
U.C. SAN DIEGO-DEEP SEA DRILLING PROJ.
DRAWN BY R. BLACKWOOD 3-12-75 ASSY No. OH4401
CHECKED BY J.H. GERKEN 5-10-75 SCALE HALF
MATERIAL 13⅝, 61#, K55 CSG. D C OH4402- REV 3
3 NOM. 12½" WAS 12.515 RK
2 REVISED THD. BORE JHG 6-9-75
1 REVISED THD. FORM RCB 5-22-75
LTR REVISION BY DATE
SURFACE TREATMENT
HEAT TREATMENT

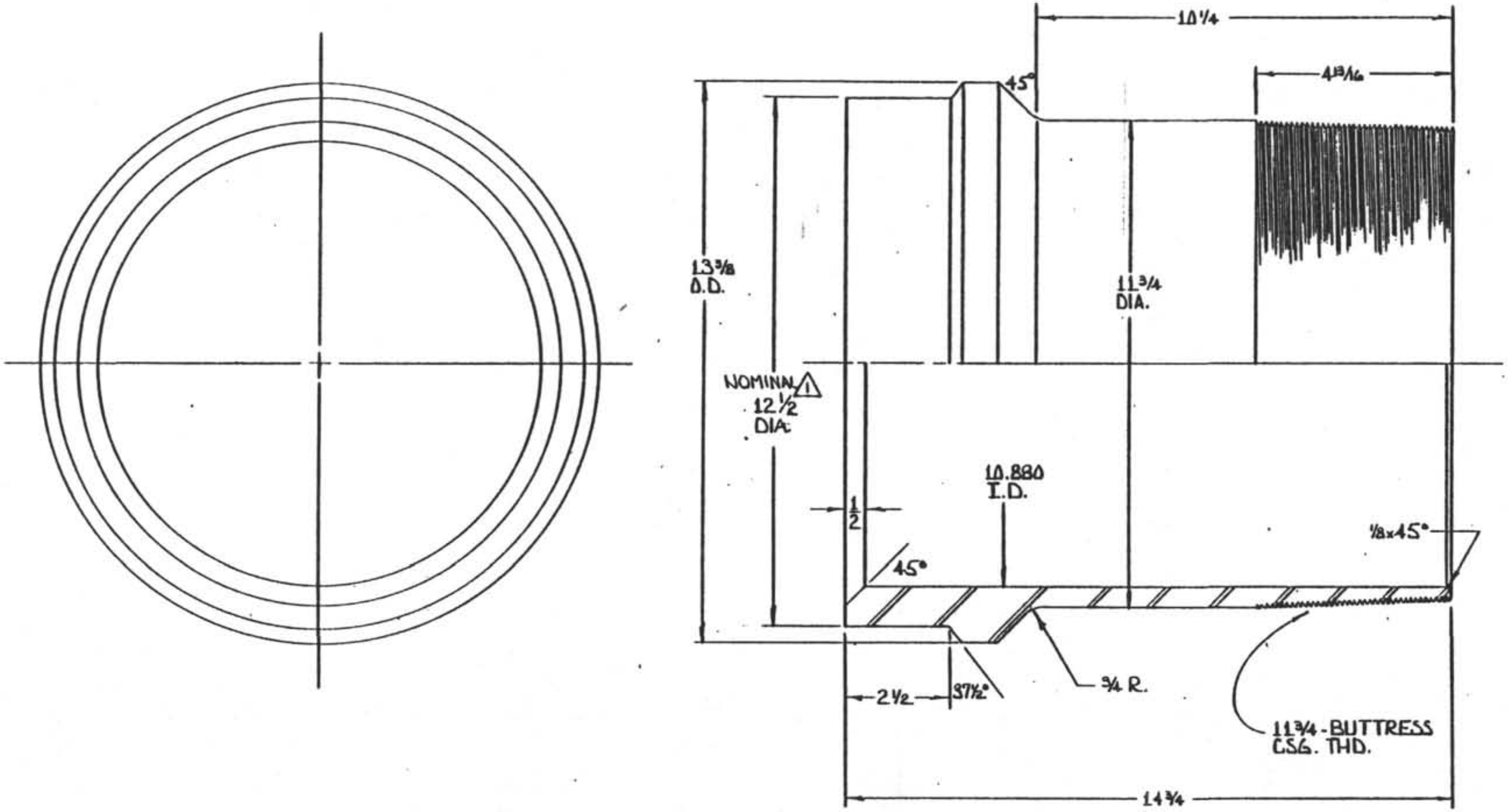


NOTE: TO FIT 13 ⅜ BARREL
(PART No. OH 4402)

PART No. OH 4403-1

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY	
	BARREL INSERT - 11 ¾ x 13 ⅜ EXP. JOINT U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.	
SURFACE TREATMENT	DRAWN BY R. BLACKWOOD 3-12-75	ASSY No. OH 4401
	CHECKED BY J.H. GERKEN 3-14-75	SCALE HALF
HEAT TREATMENT	MATERIAL MILD STL. B	B-OH 4403 REV 1

LET	REVISION	BY	DATE
1	NOMINAL 12½ was 12.510	RK	8-10-76



1 NOTE: TO FIT 13 3/8 BARREL (PART No. OH 4402)

NOTE: MACHINE SURFACES TO BE TRUE .003 T.I.R.

NOTE: ALL BUTTRESS CASING THREADS TO BE CUT IN A SHOP LICENSED TO USE THE API MONOGRAM OR OTHER UNIV. OF CALIF. AT SAN DIEGO (DSDP) APPROVED SHOP

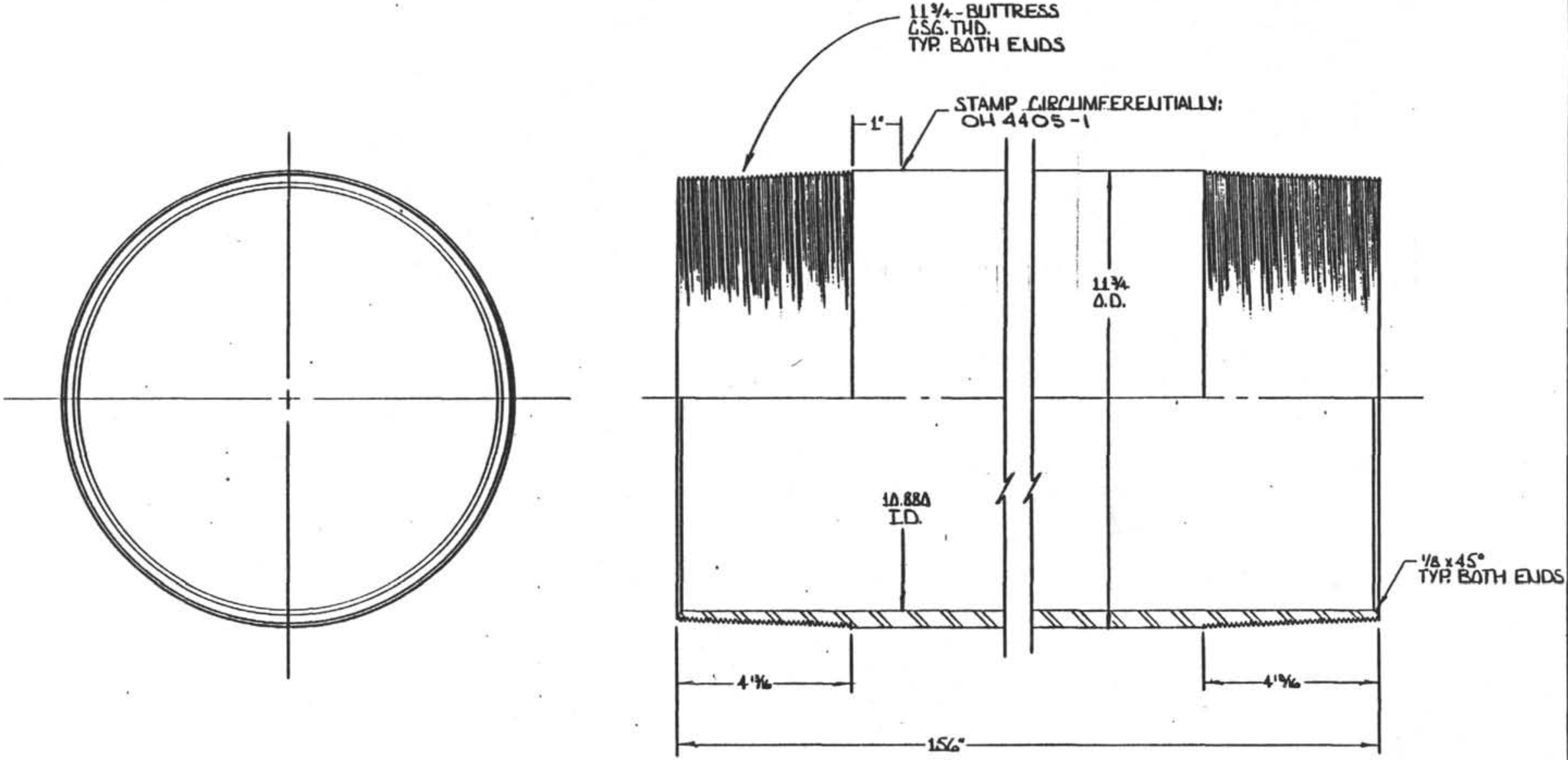
PART No. OH 4404-1

DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

BOTTOM SUB - 11 3/4 x 13 3/8 EXP. JOINT
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°, FINISH: 125 RMS, CORNERS: 1/64 x 45° or 1/64R	
SURFACE TREATMENT: PARCOLUBRITE	DRAWN BY: R. BLACKWOOD 3-11-75 · ASSY No. OH 4401
	CHECKED BY: J.H. GERKEN 3-14-75 · SCALE HALF
HEAT TREATMENT	MATERIAL: A.I.S.I. A-4130 STL. · B · C-OH4404- · REV 1

LET	REVISION	BY	DATE
1	NOM 2 1/2 was 12.510	RK	8-10-78



NOTE:
ALL BUTTRESS CASING THDS TO BE CUT IN A SHOP LICENSED TO USE THE API MONOGRAM OR OTHER UNIV. OF CALIF. AT SAN DIEGO (DSDP) APPROVED SHOP.

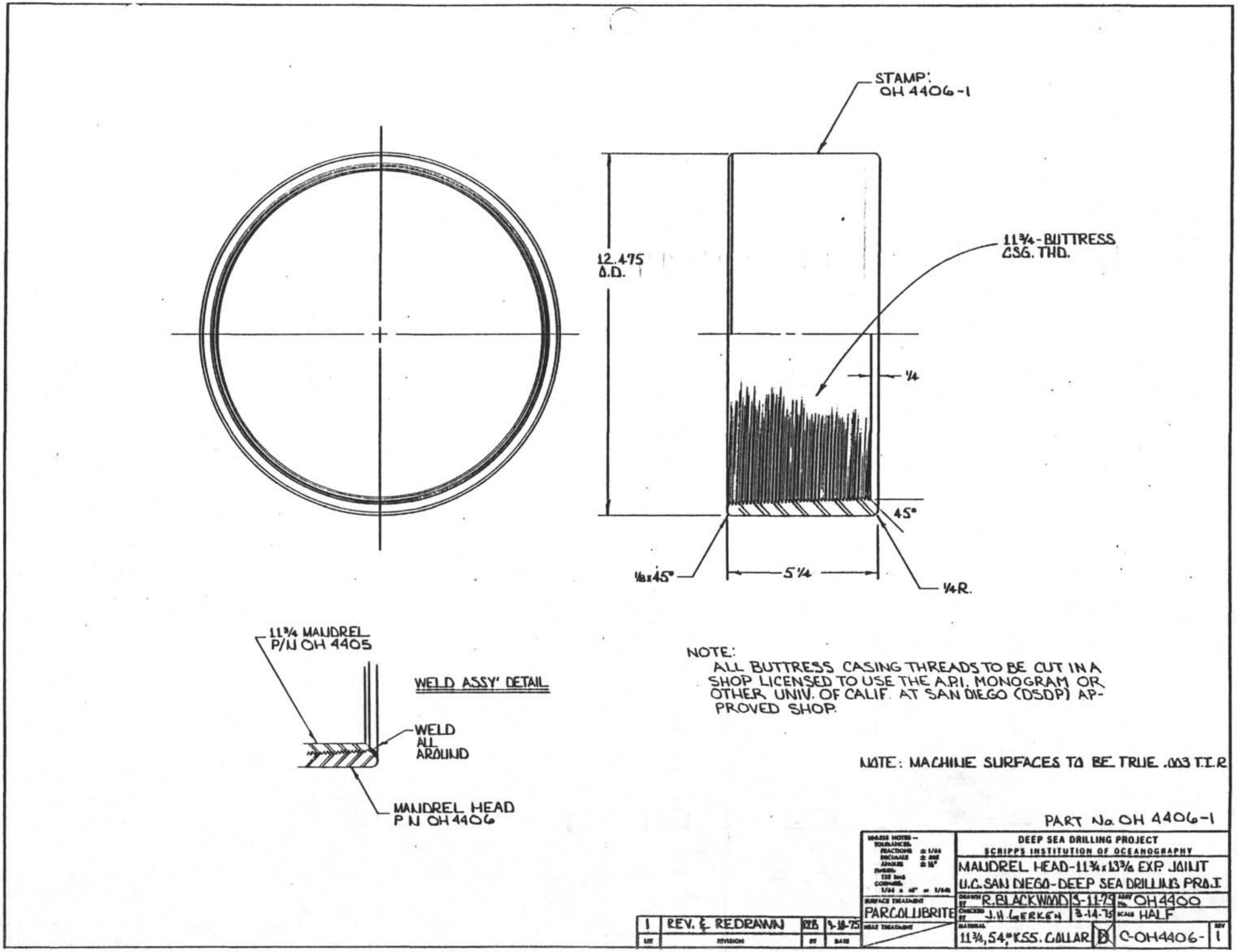
1) POLISH O.D. OF CASING AFTER MACHINING THREADS

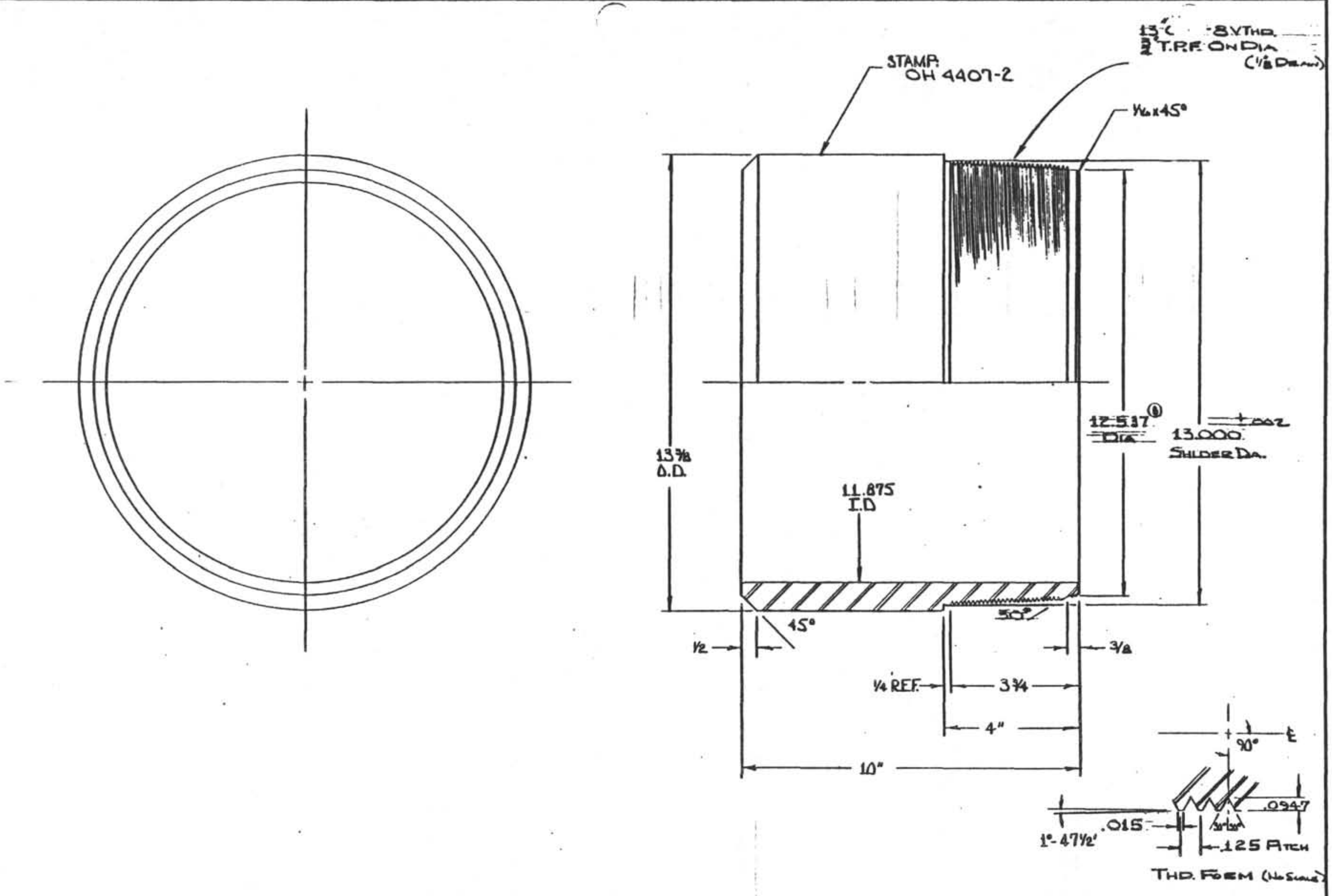
NOTES:

PART No. OH4405-1

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY
	11¾ MANDREL - 11¾ x 13⅜ EXPANSION JOINT U.C. SAN DIEGO - DEEP SEA DRILLING PROJ
SURFACE TREATMENT	DRAWN BY R. BLACKWOOD 3-12-75 · ASSY No. OH 4400
	CHECKED BY J.H. GERKEN 3-14-75 · SCALE HALF
HEAT TREATMENT	MATERIAL 11¾", 54# K55 CASING · C-OH4405- · REV 1

LTR	REVISION	BY	DATE
1	ADD POLISHING NOTE	MP	9-19-75


STAMP:
OH 4406-1
12.475
O.D.
11¾-BUTTRESS
CSG. THD.
¼
45°
⅛x45°
5¼
¼R.
11¾ MANDREL
P/N OH 4405
WELD ASSY' DETAIL
WELD
ALL
AROUND
MANDREL HEAD
P N OH 4406
NOTE:
ALL BUTTRESS CASING THREADS TO BE CUT IN A SHOP LICENSED TO USE THE A.P.I. MONOGRAM OR OTHER UNIV. OF CALIF. AT SAN DIEGO (DSDP) APPROVED SHOP.
NOTE: MACHINE SURFACES TO BE TRUE .003 T.I.R
PART No. OH 4406-1
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
MANDREL HEAD-11¾x13⅜ EXP. JOINT
U.C. SAN DIEGO-DEEP SEA DRILLING PROJ.
R.BLACKWOOD 3-11-75
OH 4400
J.H. GERKEN 3-14-75
HALF
PARCOLUBRITE
11¾, 54# K55. COLLAR
B
C-OH4406-
1
1 REV. & REDRAWN RRB 9-18-75



NOTE: MACHINE SURFACES TO BE TRUE .003 T.I.R.

PART No. OH 4407-2

				UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± 1/2°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY PACKING RETAINER - 11 3/4 x 13 7/8 EXP. JOINT U.C. SAN DIEGO - DEEP SEA DRILLING PROJ.		
				SURFACE TREATMENT	DRAWN BY R. BLACKWOOD	3-12-75	ASSY No.
2	REVISED THD. C'BORE	JHG	6-9-75	PARCOLUBRITE	CHECKED BY J. GERKEN	5-10-75	SCALE HALF
1	REVISED THD. FORM	RBS	5-21-75	HEAT TREATMENT	MATERIAL MILD STL.	D	C-OH4407- REV 2
LTR	REVISION	BY	DATE				

PACKING SPECIFICATION

11-3/4" Casing Expansion Joint

Manufacturer: Garlock

Packing Type: 3/8" Rope

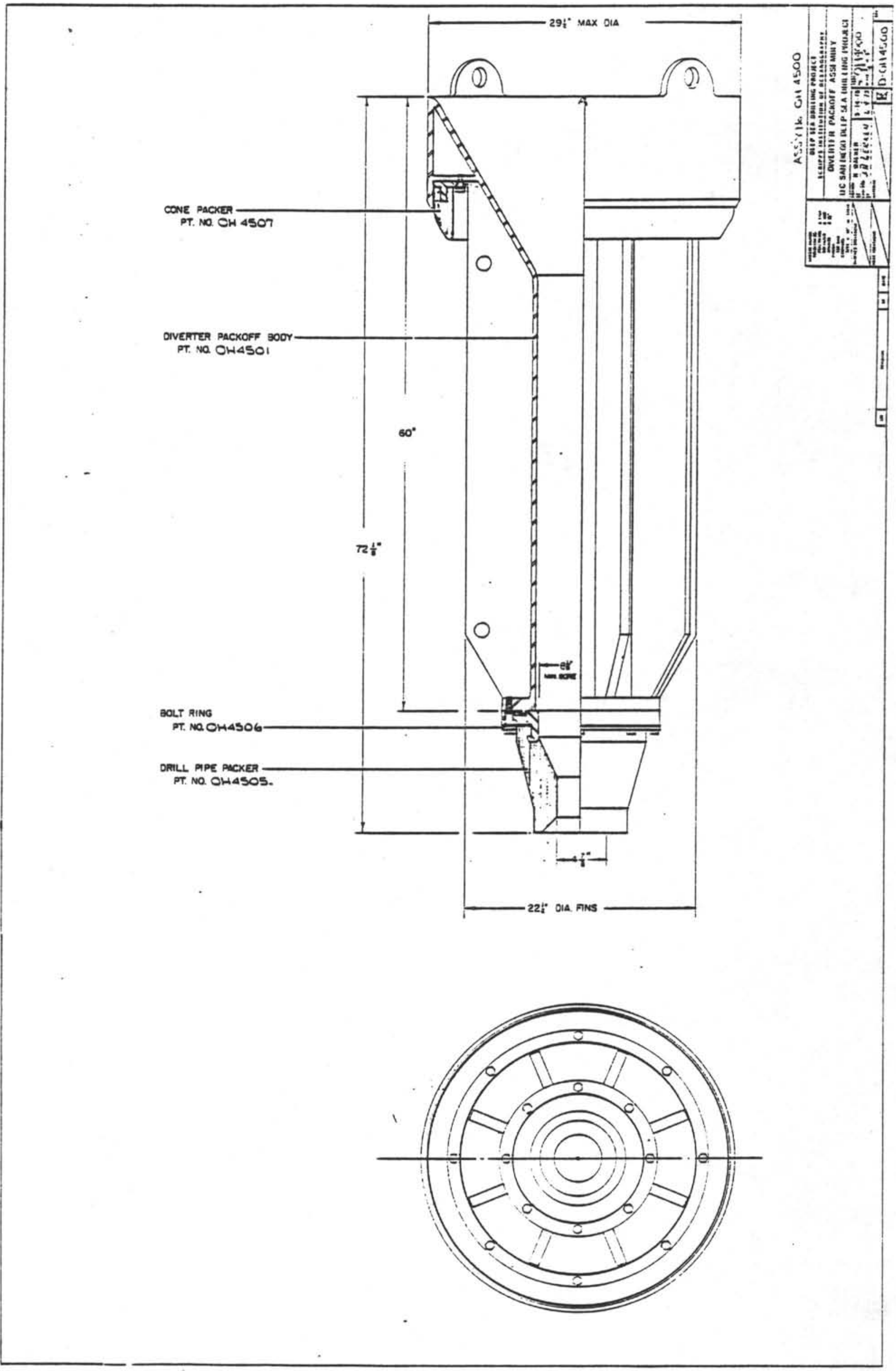
Packing Style: #5862

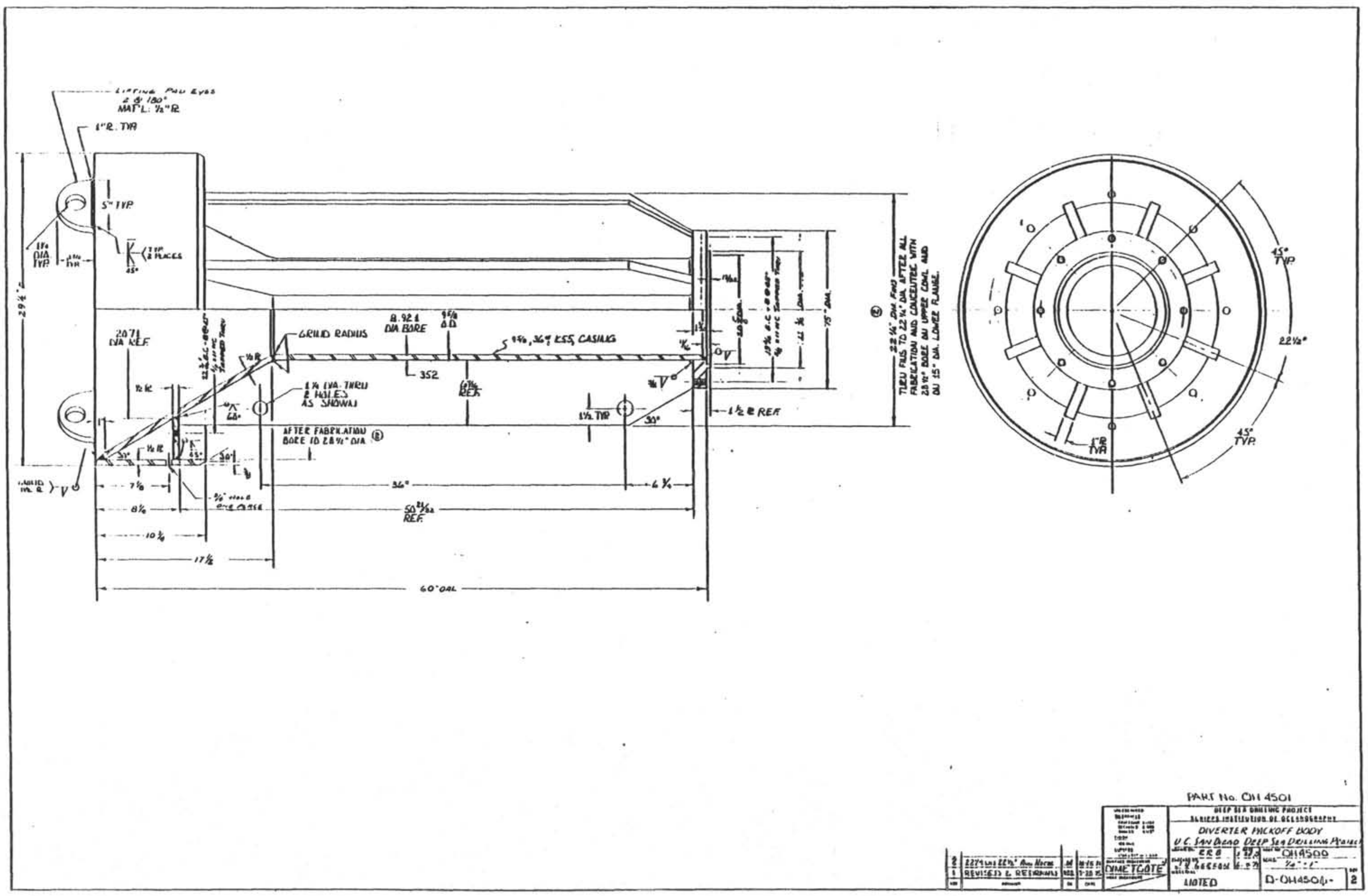
Composition: Long-fiber asbestos yarn with TFE impregnation and white lubricant.

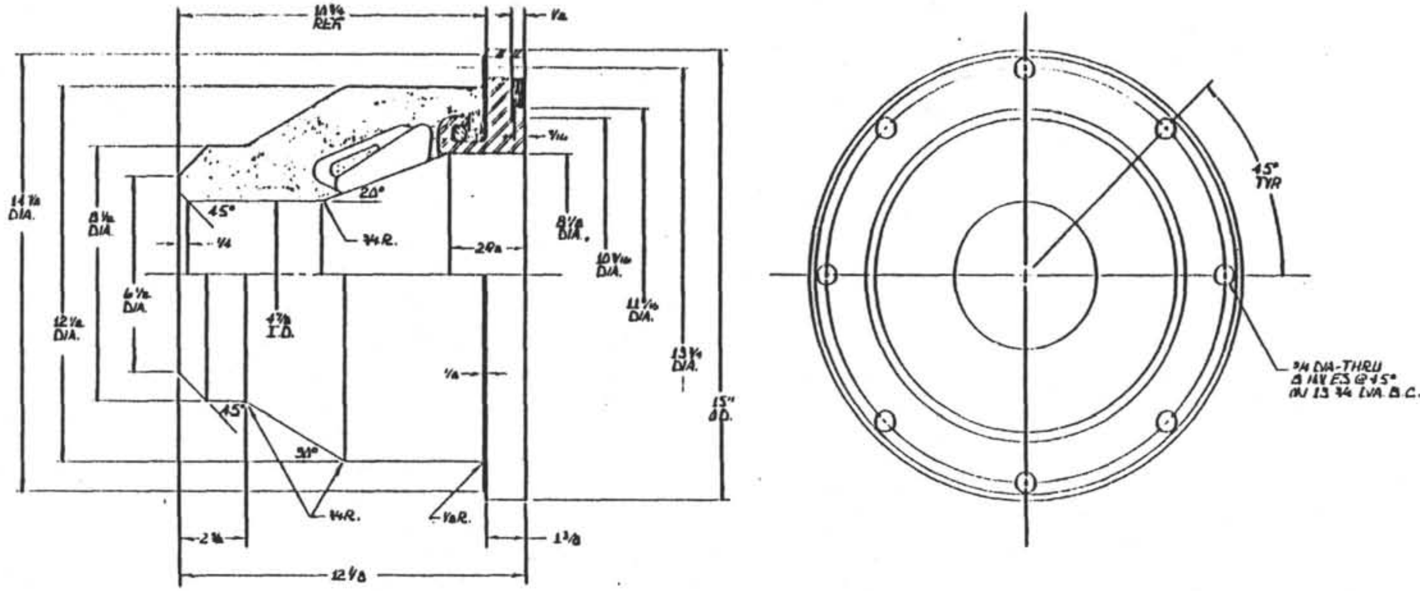
Max. Temp: 500^{0} F

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	© DEEP OIL TECHNOLOGY, INC. LONG BEACH, CALIFORNIA		
	Packing 11-3/4" Casing Expansion Joint		
SURFACE TREATMENT	DRAWN BY J.H. Gerken	8/22/75	ASSY No.
	CHECKED BY J.H. Gerken	9/3/75	SCALE ———
HEAT TREATMENT	MATERIAL Abestos w/TFE	A	A-OH4408 REV

LET	REVISION	BY	DATE


29½" MAX DIA
CONE PACKER
PT. NO. OH 4507
DIVERTER PACKOFF BODY
PT. NO. OH4501
60"
72⅛"
BOLT RING
PT. NO. OH4506
DRILL PIPE PACKER
PT. NO. OH4505.
22½" DIA. FINS
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
DIVERTER PACKOFF ASSEMBLY
UC SAN DIEGO DEEP SEA DRILLING PROJECT
D-OH4500


LIFTING PAD EYES
2 @ 180°
MAT'L: ½" PL
1"R. TYP
5" TYP
29¼"
2071
DIA REF
GRIND RADIUS
8.921
DIA BORE
9⅝
OD
9⅝, 36# K55 CASING
352
1¾ DIA. THRU
2 HOLES
AS SHOWN
AFTER FABRICATION
BORE ID 28¼" DIA
1½ TYP
30°
1½ REF
36"
6¾
50 21/32
REF
7⅞
8⅞
10⅞
17½
60" OAL
75" DIA
THRU FAB TO 22¼" DIA AFTER ALL FABRICATION AND CONCENTRIC WITH 28½" BORE ON UPPER COWL AND ON 15" DIA LOWER FLANGE
45° TYP
22½°
1"R TYP
PART No. OH 4501
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
DIVERTER PACKOFF BODY
U.C. SAN DIEGO DEEP SEA DRILLING PROJECT
REVISED & REDRAWN
DIMETCOTE
NOTED
OH4500
D-OH4504-
2



SHAFFER TYPE RS 53-66 STRIPPER RUBBER, OR EQUIV.

PART No. OH 4505

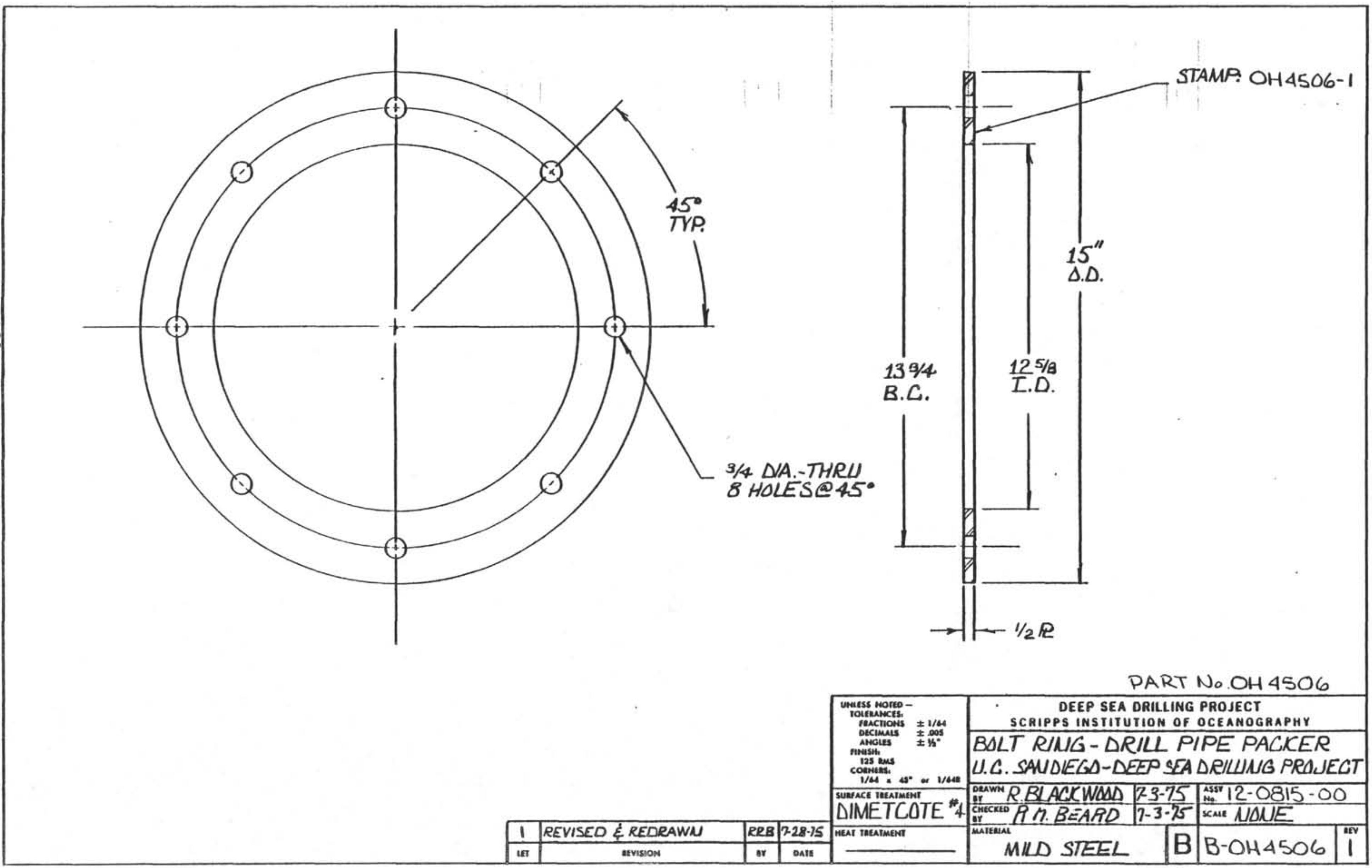
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

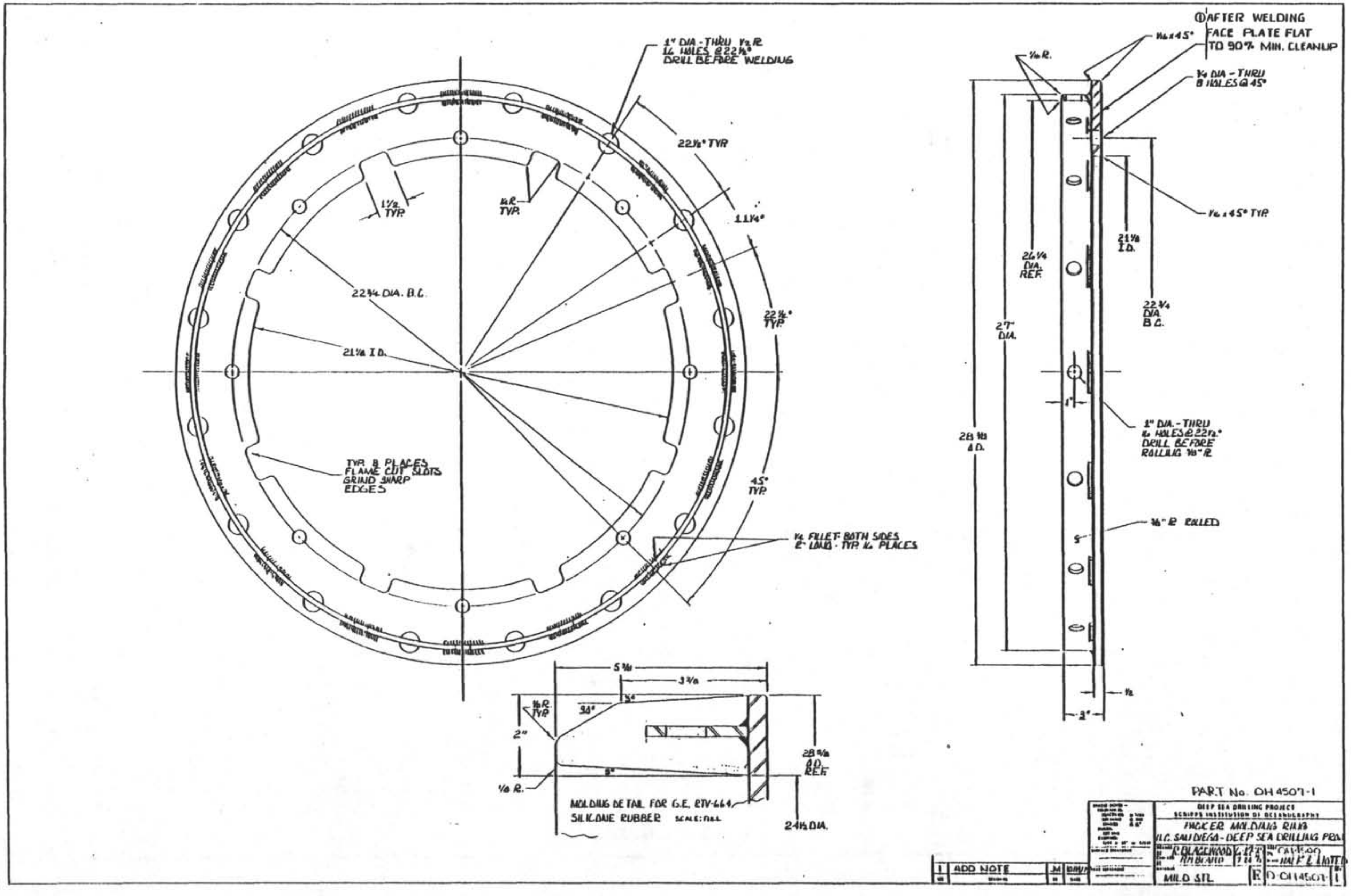
DRILL PIPE PACKER

U.C. SAN DIEGO - DEEP SEA DRILLING PROJECT

HALF

NATURAL RUBBER | R | D-OH4505


STAMP: OH4506-1
45° TYP.
15" O.D.
13 3/4 B.C.
12 5/8 I.D.
3/4 DIA.-THRU
8 HOLES @ 45°
1/2 R
PART No. OH 4506
UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± ½° FINISH: 125 RMS CORNERS: 1/64 x 45° or 1/64R
SURFACE TREATMENT DIMETCOTE #4
HEAT TREATMENT
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
BOLT RING - DRILL PIPE PACKER
U.C. SAN DIEGO - DEEP SEA DRILLING PROJECT
DRAWN BY R. BLACKWOOD 7-3-75
CHECKED BY R.M. BEARD 7-3-75
ASSY No. 12-0815-00
SCALE NONE
MATERIAL MILD STEEL
B
B-OH4506
REV 1
1 REVISED & REDRAWN RRB 7-28-75
LET REVISION BY DATE



1" DIA - THRU 1/2 R
16 HOLES @ 22 1/2°
DRILL BEFORE WELDING
22 1/2° TYP
11 1/4°
22 1/2° TYP
45° TYP
1 1/2 TYP
1/4 R. TYP
22 3/4 DIA. B.C.
21 1/8 I.D.
TYP 8 PLACES
FLAME CUT SLOTS
GRIND SHARP
EDGES
1/4 FILLET BOTH SIDES
2" LONG - TYP 16 PLACES
① AFTER WELDING
FACE PLATE FLAT
TO 90% MIN. CLEANUP
1/16 x 45°
1/4 DIA - THRU
8 HOLES @ 45°
1/16 x 45° TYP
21 1/8 I.D.
22 3/4 DIA. B.C.
24 1/4 DIA. REF.
27" DIA.
28 1/8 O.D.
1" DIA. - THRU
16 HOLES @ 22 1/2°
DRILL BEFORE
ROLLING 1/2" R
3/8" R ROLLED
5 3/8
3 3/8
1/8 R TYP
30°
2"
28 3/8 O.D. REF.
1/8 R.
24 1/2 DIA.
MOLDING DETAIL FOR G.E. RTV-664
SILICONE RUBBER SCALE: FULL
PART No. DH 4507-1
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
PACKER MOLDING RING
U.C. SAN DIEGO - DEEP SEA DRILLING PROJ
ADD NOTE
MILD STL
D-DH4507-1

DIVERTER PACKOFF ASSEMBLY

Packer Specifications

A. Cone Packer (P/N 102043)

General Electric RTV-664 (or RTV 630) Silicone Liquid Rubber Molding Compound with mild steel molding ring. SS-4155 Primer required.

Typical cured properties:

Physical Strength, 48 hours at room temperature:

Tensile, psi	750
Elongation, %	280
Durometer, Shore A	60
Tear , Die B, #/in.	100

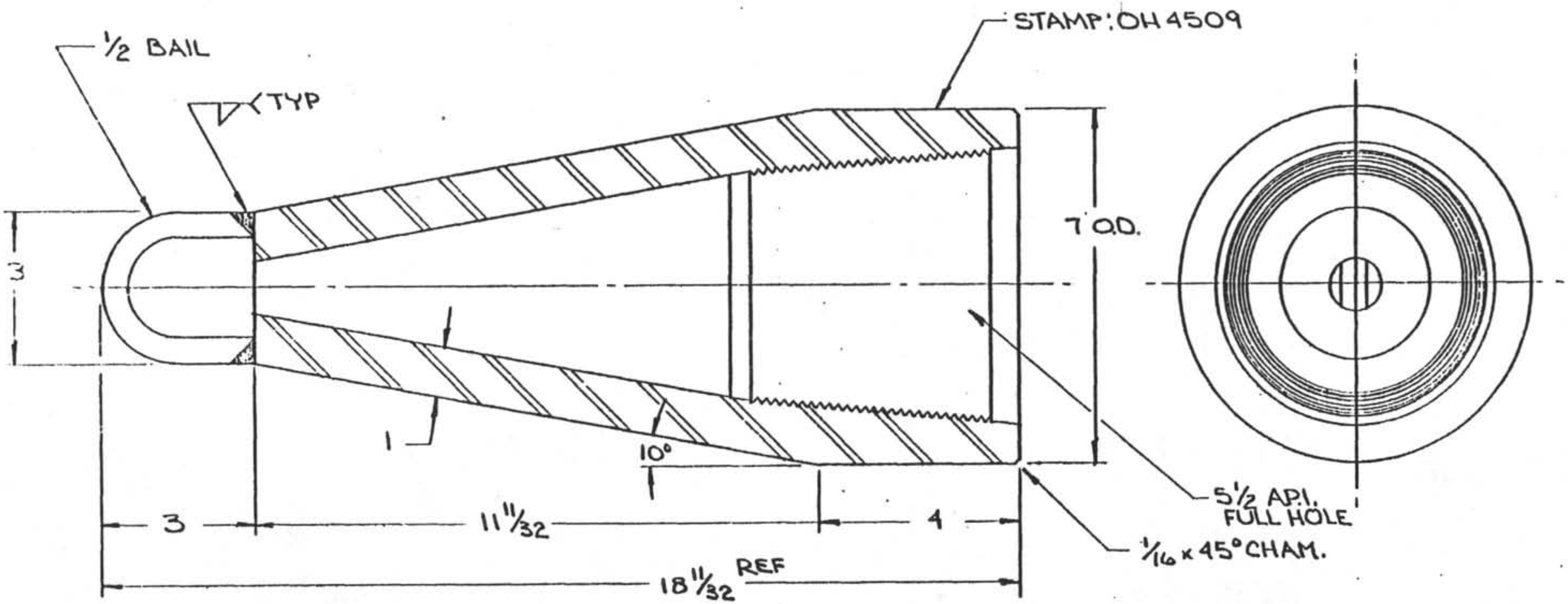
B. Drillpipe Packer (P/N 102044)

Shaffer Type RS 55-66 Stripper Rubber, or equal. Natural rubber composition (Shaffer P/N 143232).

Size of drillpipe: 5 1/2" thru 6 5/8"
Stripper rubber expands to 8" OD.

A-OH 4508

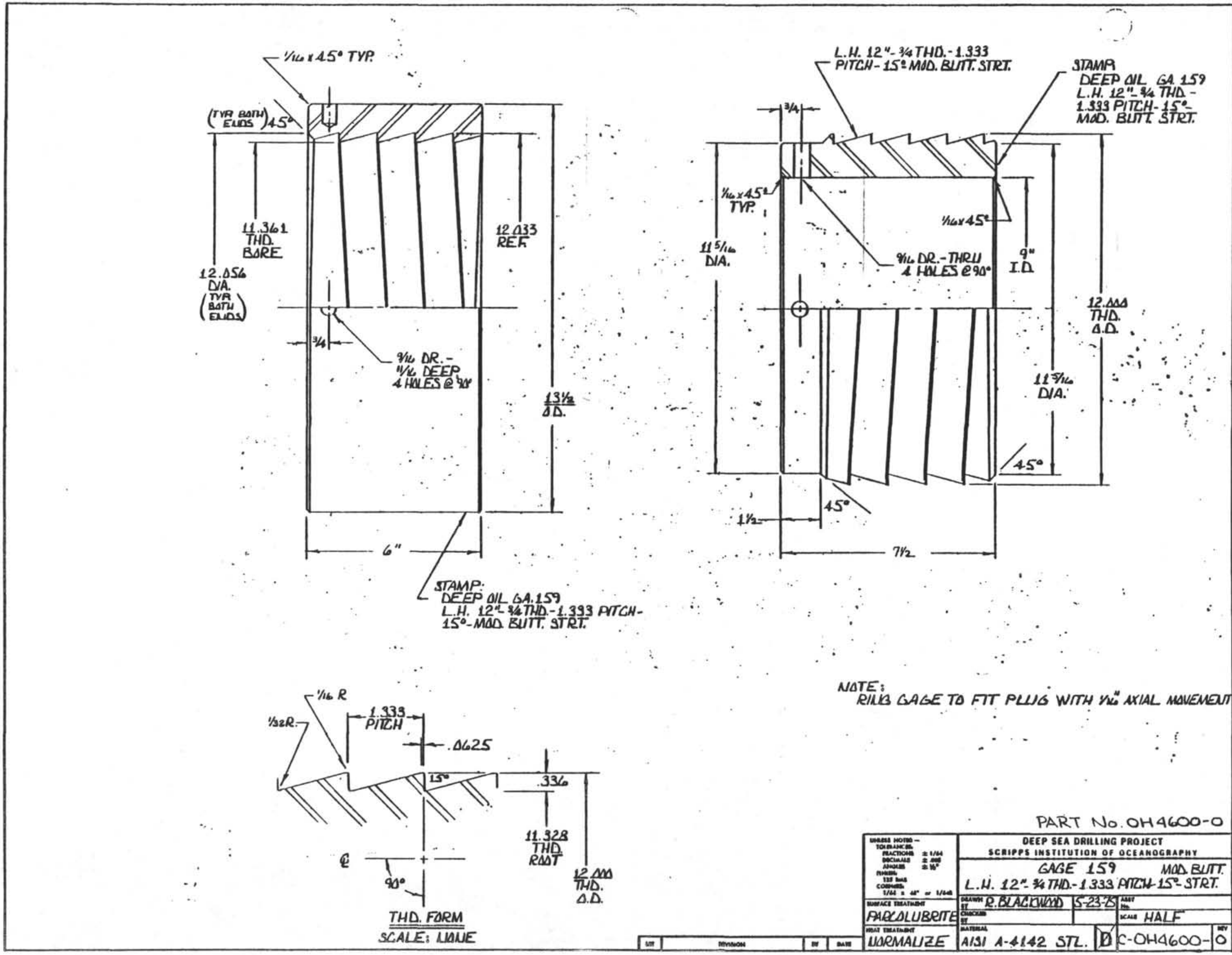
REVISIONS					
NO.	DESCRIPTION	DATE	BY	CH.	APR.

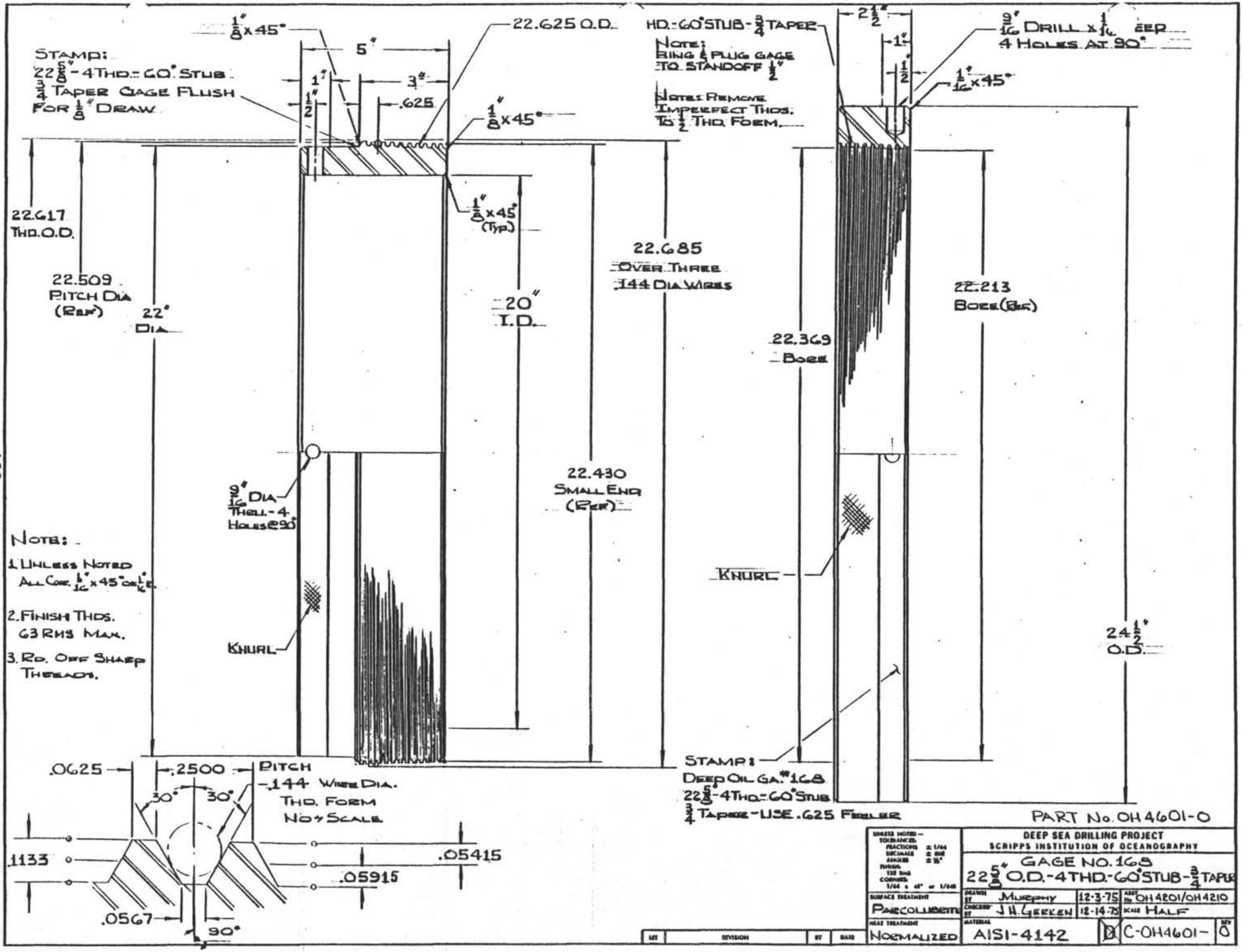


DO NOT SCALE

CONCENTRICITY ALL DIAMETERS: TIR .003

TOLERANCES UNLESS NOTED FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2° CORNERS 1/64 × 45° or 1/64 R FINISH 125	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY UNIVERSITY OF CALIFORNIA, SAN DIEGO LA JOLLA, CALIFORNIA 92093 TITLE STARTING MANDREL DIVERTER PACKOFF ASSEMBLY				
SURFACE TREATMENT DIMECOTE	MATERIAL MILD STEEL	DATE 9.27.83	BY RK	CHECKED	APPROVED
HEAT TREATMENT —	SCALE ½	REQ'D/ASS'Y 1	PART NO. OH 4509	DWG. NO. B-OH 4509	(REV.)


1/16 x 45° TYP.
(TYP. BOTH ENDS) 45°
11.361 THD. BORE
12.056 DIA. (TYP. BOTH ENDS)
12.033 REF.
3/4
9/16 DR. - 11/16 DEEP 4 HOLES @ 90°
13 1/2 O.D.
6"
STAMP: DEEP OIL GA.159 L.H. 12"- 3/4 THD.-1.393 PITCH-15°-MOD. BUTT. STRT.
L.H. 12"- 3/4 THD.-1.333 PITCH-15° MOD. BUTT. STRT.
STAMP DEEP OIL GA. 159 L.H. 12"- 3/4 THD.-1.333 PITCH-15°-MOD. BUTT. STRT.
3/4
1/16 x 45° TYP.
1/16 x 45°
11 5/16 DIA.
9/16 DR.-THRU 4 HOLES @ 90°
9" I.D.
12.000 THD. O.D.
11 5/16 DIA.
45°
45°
1 1/2
7 1/2
NOTE: RING GAGE TO FIT PLUG WITH 1/16" AXIAL MOVEMENT
1/16 R
1/32 R.
1.333 PITCH
.0625
15°
.336
11.328 THD. ROOT
12.000 THD. O.D.
90°
THD. FORM
SCALE: NONE
PART No. OH4600-0
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
GAGE 159 MOD. BUTT.
L.H. 12"- 3/4 THD.-1.333 PITCH-15°-STRT.
R. BLACKWOOD 5-23-75
SCALE HALF
PARCOLUBRITE
NORMALIZE
AISI A-4142 STL.
D C-OH4600-0



STAMP:
22 5/8"-4 THD.-60° STUB
3/4 TAPER GAGE FLUSH
FOR 1/8" DRAW
1/8" x 45°
5"
1"
3"
1/2"
.625
22.625 O.D.
1/8" x 45°
1/8" x 45° (TYP.)
22.617 THD. O.D.
22.509 PITCH DIA (REF)
22" DIA
20" I.D.
22.685 OVER THREE .144 DIA WIRES
22.430 SMALL END (REF)
9/16" DIA THRU.-4 HOLES @ 90°
KNURL
NOTE:
1. UNLESS NOTED ALL COR. 1/16" x 45° OR 1/16" R.
2. FINISH THDS. 63 RMS MAX.
3. RD. OFF SHARP THREADS.
HD.-60° STUB-3/4 TAPER
NOTE: RING & PLUG GAGE TO STANDOFF 1/2"
NOTE: REMOVE IMPERFECT THDS. TO 1/2 THD. FORM.
2 1/2"
1"
1/2"
9/16 DRILL x 1/16 DEEP 4 HOLES AT 90°
1/16" x 45°
22.369 BORE
22.213 BORE (REF)
KNURL
24 1/2" O.D.
STAMP: DEEP OIL GA. #168
22 5/8-4 THD.-60° STUB
3/4 TAPER-USE .625 FEELER
.0625
.2500
PITCH
.144 WIRE DIA.
THD. FORM
NOT SCALE
30°
30°
.1133
.05415
.05915
.0567
90°
PART No. OH 4601-0
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
GAGE NO. 168
22 5/8" O.D.-4 THD.-60° STUB-3/4 TAPER
DRAWN BY MURPHY 12-3-75
CHECKED BY J.H. GERKEN 12-14-75
ASSY No. OH 4201/OH 4210
SCALE HALF
SURFACE TREATMENT PARCOLUBERITE
HEAT TREATMENT NORMALIZED
MATERIAL AISI-4142
C-OH4601-
REV 0
REVISION
BY
DATE

TABLE II

CASING SPECIFICATIONS OG - 0320

September 29, 1983

11 3/4" 54 lb/ft   16" 75 lb/ft   20" 94 lb/ft

K-55 or J-55, Range 2 Casing w/Buttress Threads

Manufactured in accordance with API Specification 5A.

Couplings to be locked w/Baker-Lok epoxy.

Maximum permissible length for each joint 32' OAL.

Vendor to supply thread protectors.

II. TRIPLE CASING HANGER SYSTEM

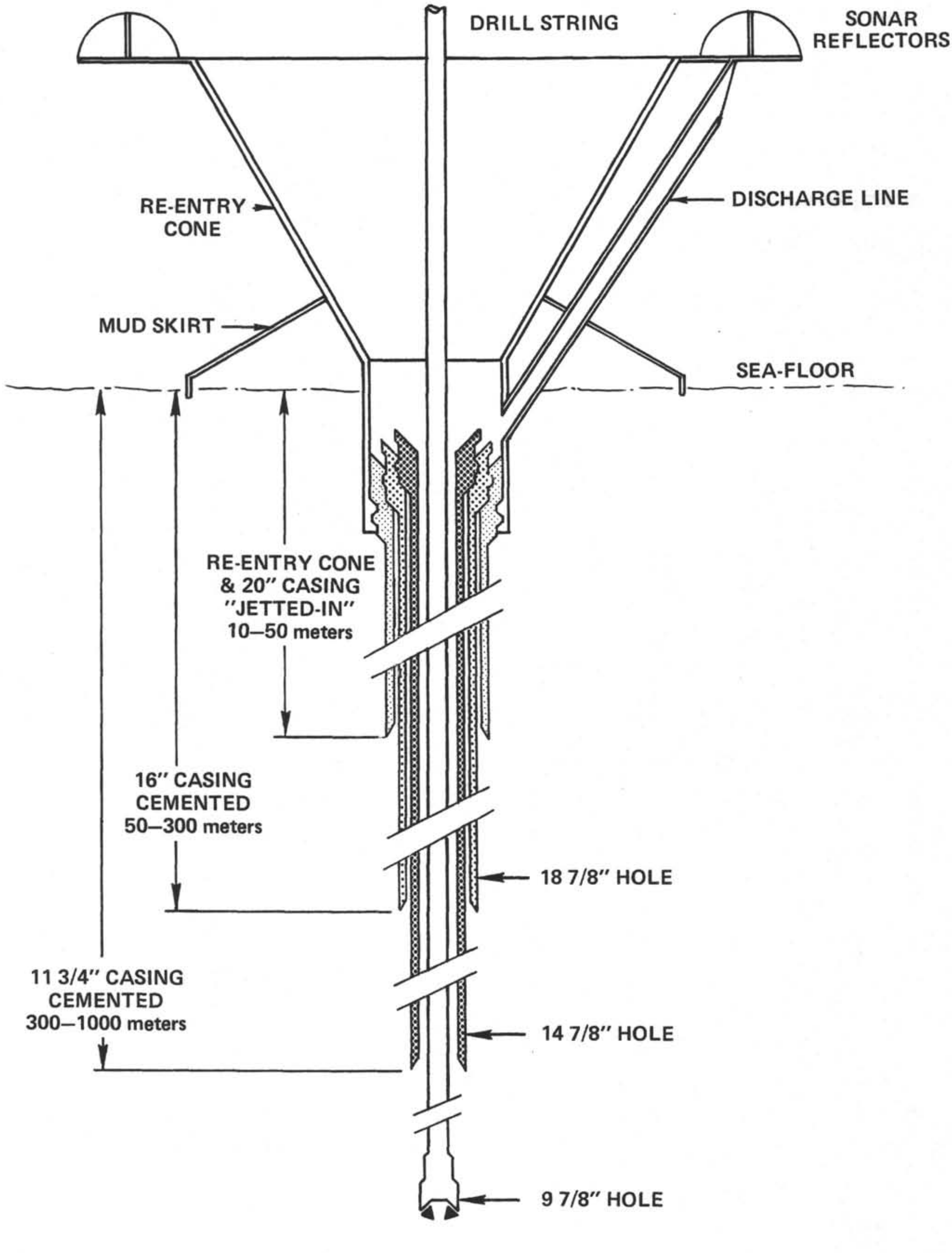
A. RE-ENTRY CONE/TRIPLE CASING HANGER SYSTEM DESCRIPTION

RE-ENTRY CONE/TRIPLE CASING STRING DESCRIPTION

The Triple Casing Re-entry System builds on the highly successful Dual Casing System in operation since December 1975 (Leg 45). Where as the Dual Casing System is limited to a 16" Conductor string and a single 11-3/4" string of surface casing, the Triple Casing System utilizes a 20" conductor allowing the use of two protective strings of casing; 11-3/4" and 16" (Figure 30). The need for this second protective string became apparent on earlier sites where intervals of unstable hole were encountered deeper in the sediment column, below the already cemented 11-3/4" casing string. The Triple Casing String System now allows an additional string of protective casing to be emplaced when more than one unstable area exists in the formation.

The Deep Sea Drilling Project, aided by Mr. William Fischer (Independent Consultant), developed concepts for the Triple Casing Hanger Re-entry System late in 1976. In 1977, the concept was finalized and Deep Oil Technology (now Fluor Subsea Systems) was commissioned to prepare machine drawings suitable for use in the fabrication of the prototype assembly.

Upon completion of the drawings and specifications, a prototype assembly was fabricated and Latch-In clearance tests were conducted at the DSDP facility. Having successfully completed these shore based tests, the system was approved for sea trials aboard the *GLOMAR CHALLENGER*. Since no re-entry location appropriate for the sea trials testing of the system was forthcoming, the testing was not completed. Therefore, the operational readiness of the Triple Casing String System awaits further shipboard deployment and testing.



REENTRY CONE/TRIPLE CASING HANGER ASSEMBLY
FIG. 30

B. RE-ENTRY CONE/TRIPLE CASING HANGER
PARTS LIST, DRAWINGS, SPECIFICATIONS

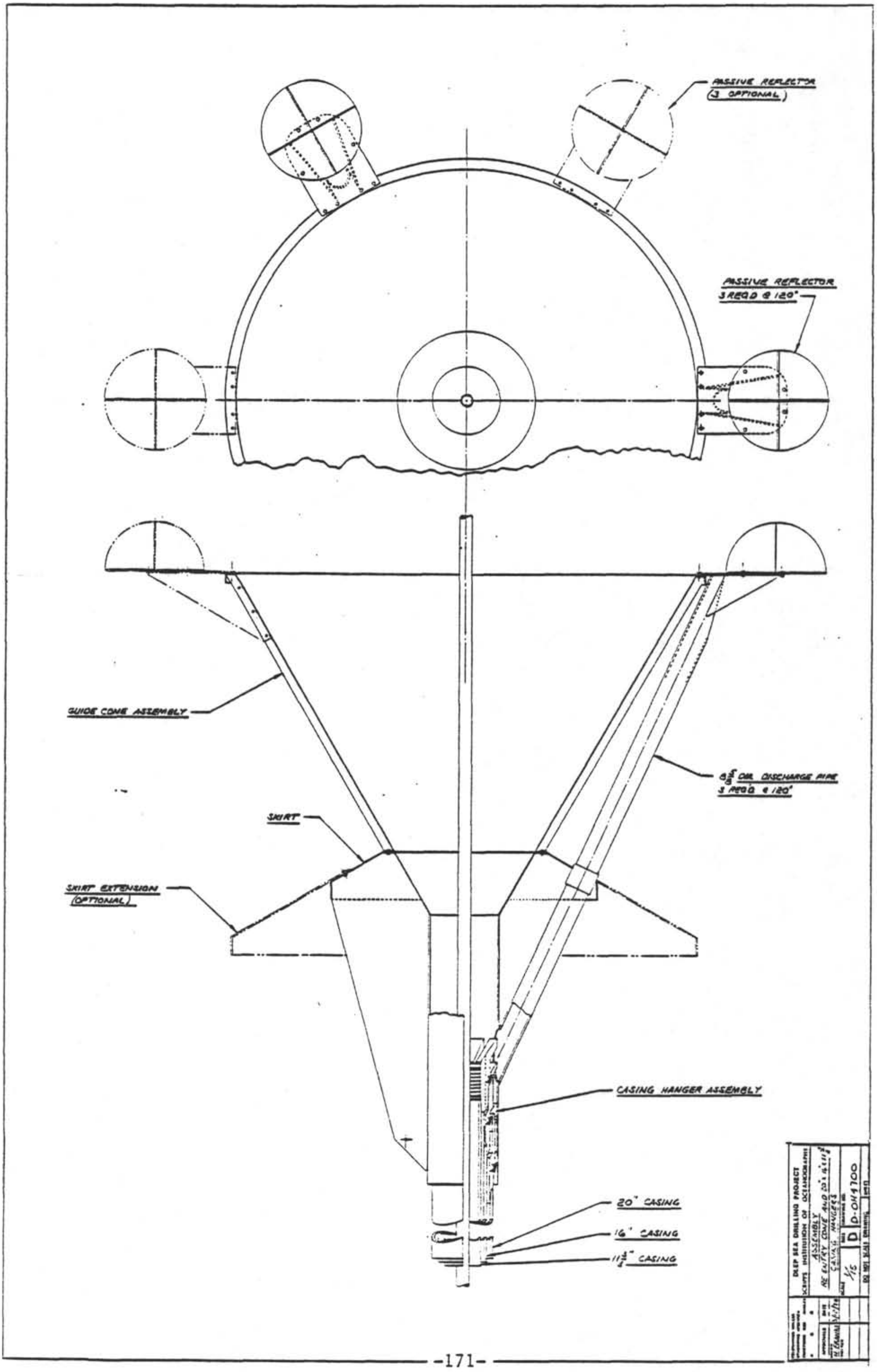
RE-ENTRY CONE/TRIPLE CASING HANGER SYSTEM
PARTS, DRAWINGS AND SPECIFICATIONS

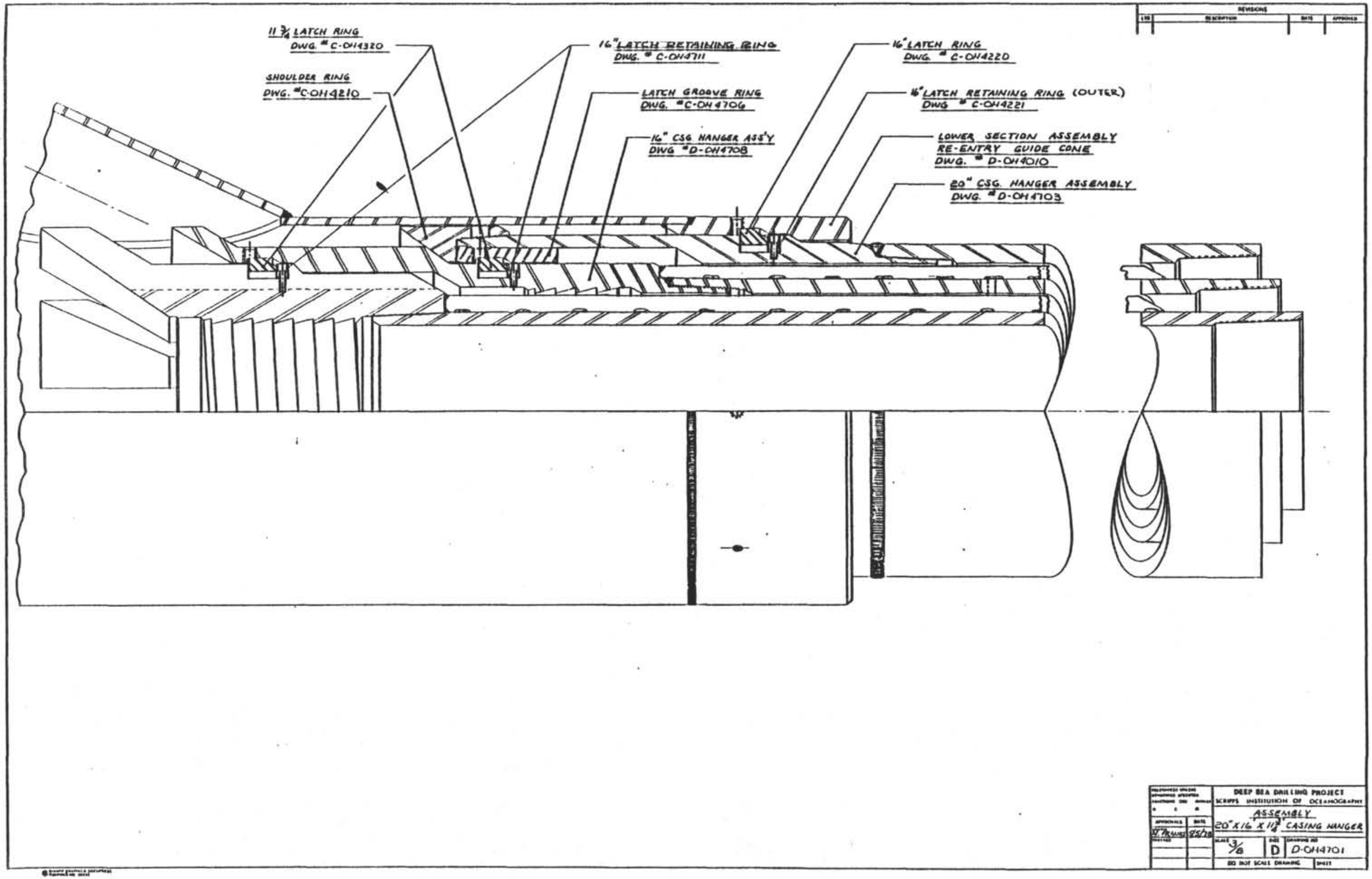
I. TRIPLE CASING HANGER SYSTEM

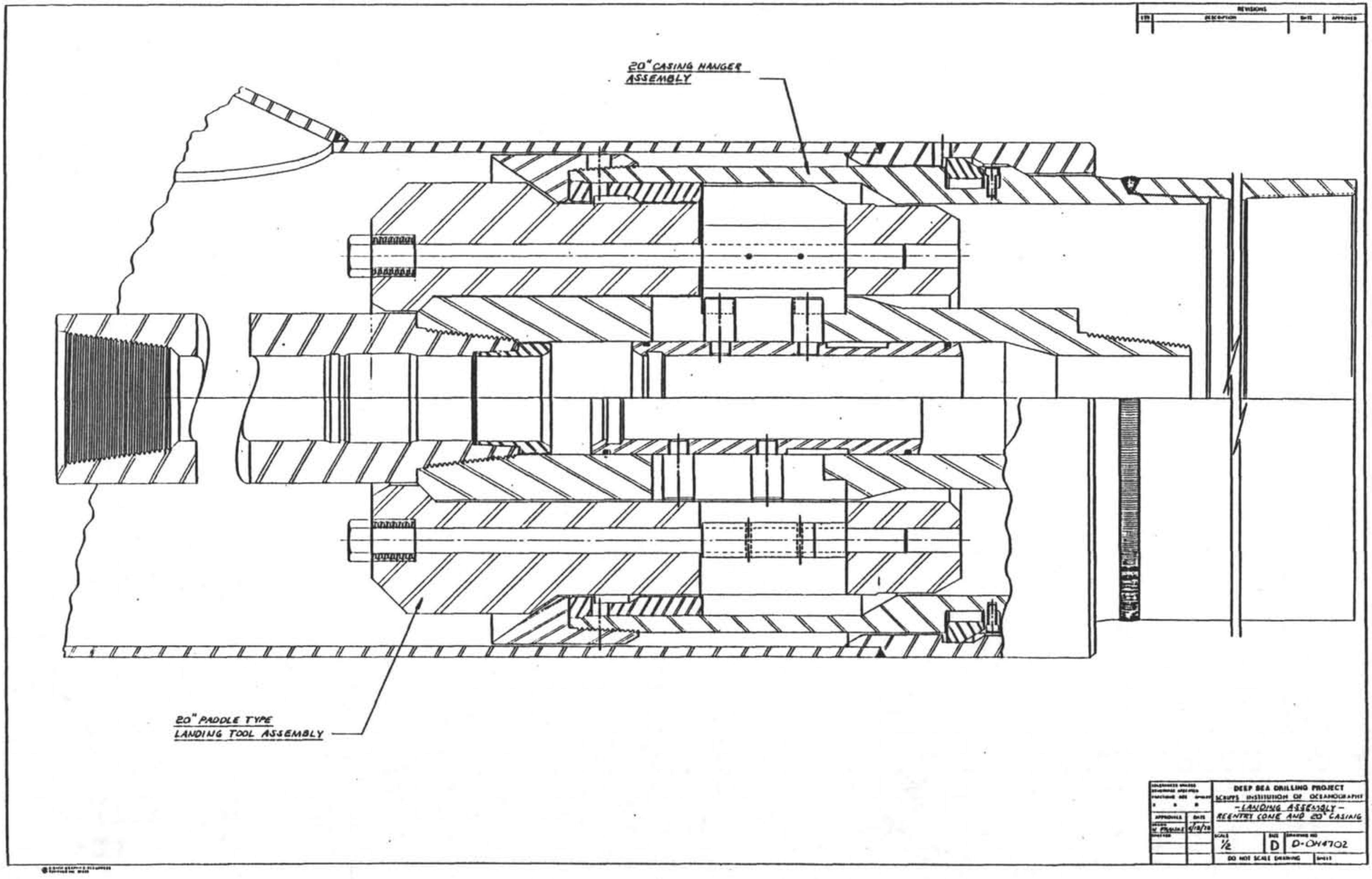
OH	D4700	Assembly - Re-entry Cone & 20" x 16" x 11-3/4" Casing Hanger
OH	D4701	Assembly - 20" x 16" x 11-3/4" Casing Hanger
OH	D4702	Landing Assembly - Re-entry Cone & 20" Casing
OH	D4703	Assembly - 20" Casing Hanger
OH	D4704	Body -20" Casing Hanger
OH	C4705	Transition Sub - 20" Casing Hanger
OH	C4706	Latch Groove Ring - 20" Casing Hanger
OH	D4707	Landing Assembly - 16" Casing
OH	D4708	Assembly - 16" Casing Hanger
OH	D4709	Body - 16" Casing Hanger
OH	C4710	Transition Sub - 16" Casing Hanger
OH	C4711	16" Latch Retaining Ring (20" x 16" Assembly)
OH	D4712	Landing Assembly - 11-3/4" Casing
OH	D4713	16" Hex - Kelly Landing Tool Assembly
OH	D4714	16" Bushing for 11-3/4" Hex-Kelly
OH	D4715	Assembly - 20" Paddle Type Landing Tool
OH	D4716	Latch Sleeve - 20" Paddle Type Landing Tool
OH	D4717	20" Paddle Actuation
OH	C4718	Paddle - 20" Paddle Type Landing Tool Assembly
OH	D4719	15-7/8" O.D. Modified Buttress Thread Gauge
OH	B4720	Ribs - 16" Casing Hanger Assembly
OH	D4721	Re-entry/Triple Casing String System

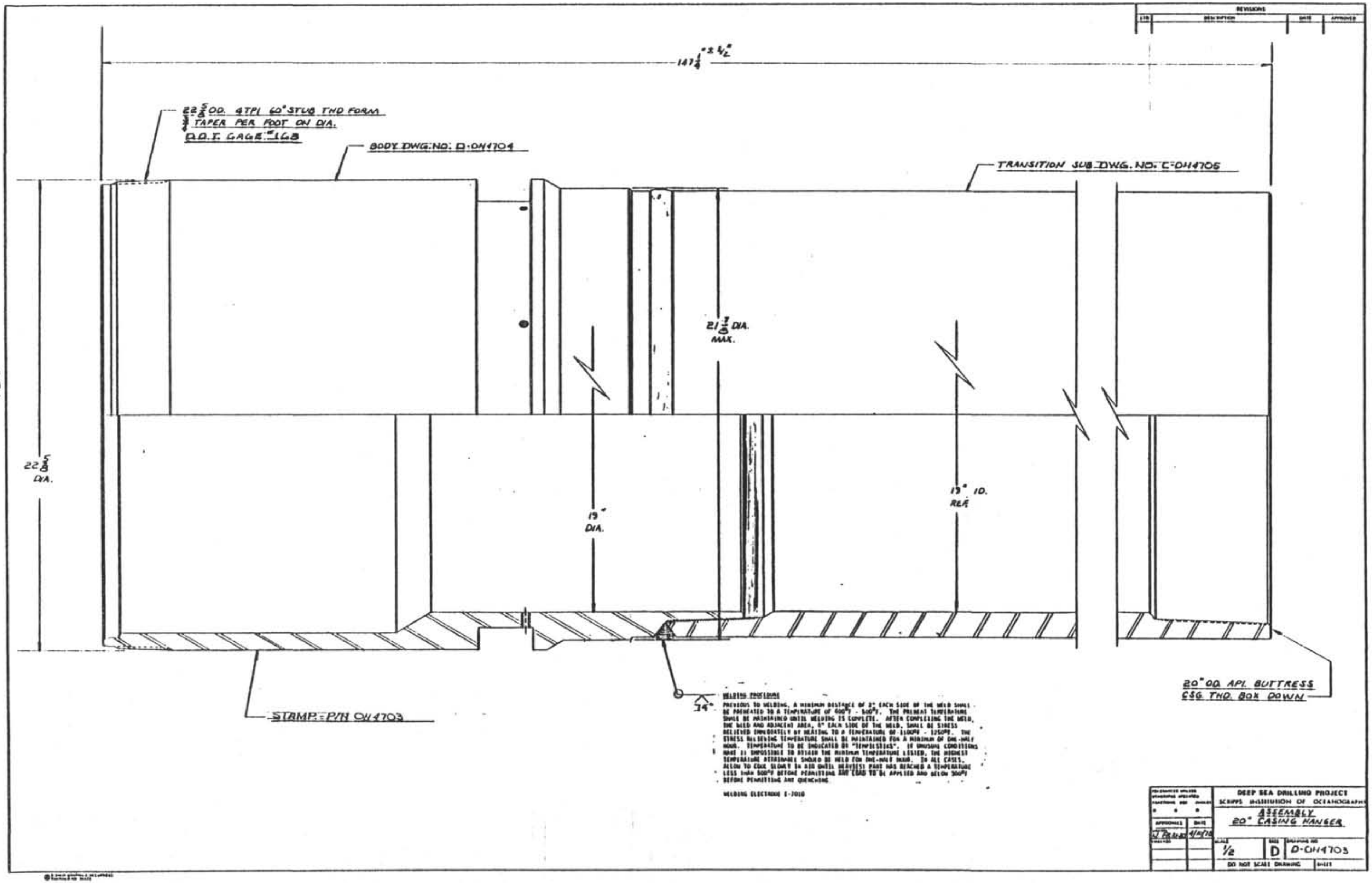
II. TRIPLE/DUAL CASING HANGER SYSTEMS (Common)

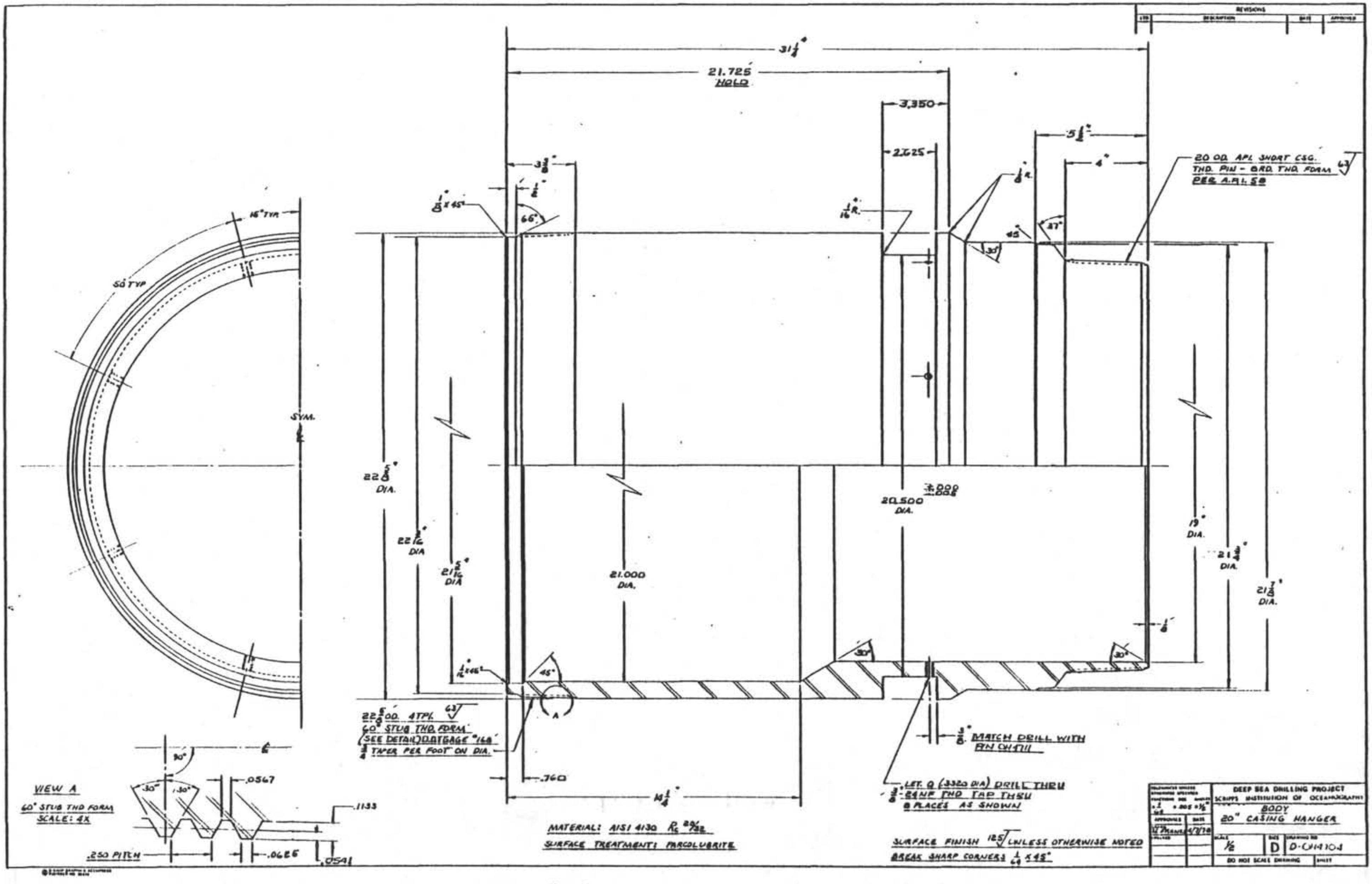
OH	A3111	Roll Pin - 20" & 16" Landing Tools
OH	B3115	Paddle Shaft
OH	A3117	Torsion Springs
OH	D3300	11-3/4" Hex-Kelly Landing Tool Assembly
OH	C3305	11-3/4" Hex-Kelly Type Landing Tool
OH	D3306	11-3/4" Landing Mandrel
OH	B3307	Bottom Sleeve
OH	D4005	Re-entry Guide Cone - Upper Section
OH	D4010	Re-entry Guide Cone - Lower Section Assembly
OH	C4011	Re-entry Guide Cone - Lower Section
OH	C4012	Cone Mud Skirt
OH	B4013	Lower Cone Reinforcing Web
OH	B4014	Discharge Line Reinforcing Web
OH	B4015	24" Cone Transition Section
OH	C4016	Cone Landing Collar
OH	B4017	Discharge Line - Lower Section
OH	B4018	Discharge Line - Connecting Collar
OH	C4020	Mud Skirt Extension
OH	B4021	Mud Skirt Extension - Stiffeners
OH	C4030	Discharge Line - Upper Section
OH	C4040	Passive Reflector, 3'
OH	C4042	Reflector Support Bracket
OH	A4043	Bolting Specification - DSDP Re-entry Cone
OH	C4210	Shoulder Ring, 16" & 20" Casing Hangers
OH	C4220	Latch Ring, 16" & 20" Casing Hangers
OH	C4221	Outer Retaining Ring, 16" & 20" Casing Hangers
OH	D4222	Casing Elevators, 16" & 20" Casing Hangers
OH	D4301	11-3/4" Casing Hanger Body
OH	C4302	11-3/4" Casing Hanger Transition Sub
OH	A4303	Transition Sub Fins
OH	C4320	11-3/4" Latch Ring
OH	D4400	11-3/4" Casing Expansion Joint
OH	C4401	13-3/8" Barrel Assembly
OH	C4402	13-3/8" Barrel
OH	B4403	Barrel Insert
OH	C4404	Bottom Sub
OH	C4405	11-3/4" Mandrel
OH	C4406	11-3/4" Mandrel Head
OH	C4407	Packing Retainer
OH	A4408	Packing Specification - 11-3/4" Casing Expansion Joint
OH	C4600	Ring/Plug Guage #159 (DOT Safety Thread)
OH	C4601	Ring/Plug Guage #168 (Shoulder Ring)


PASSIVE REFLECTOR
(3 OPTIONAL)
PASSIVE REFLECTOR
3 REQD @ 120°
GUIDE CONE ASSEMBLY
SKIRT
SKIRT EXTENSION
(OPTIONAL)
CASING HANGER ASSEMBLY
20" CASING
16" CASING
11¾" CASING
DEEP SEA DRILLING PROJECT

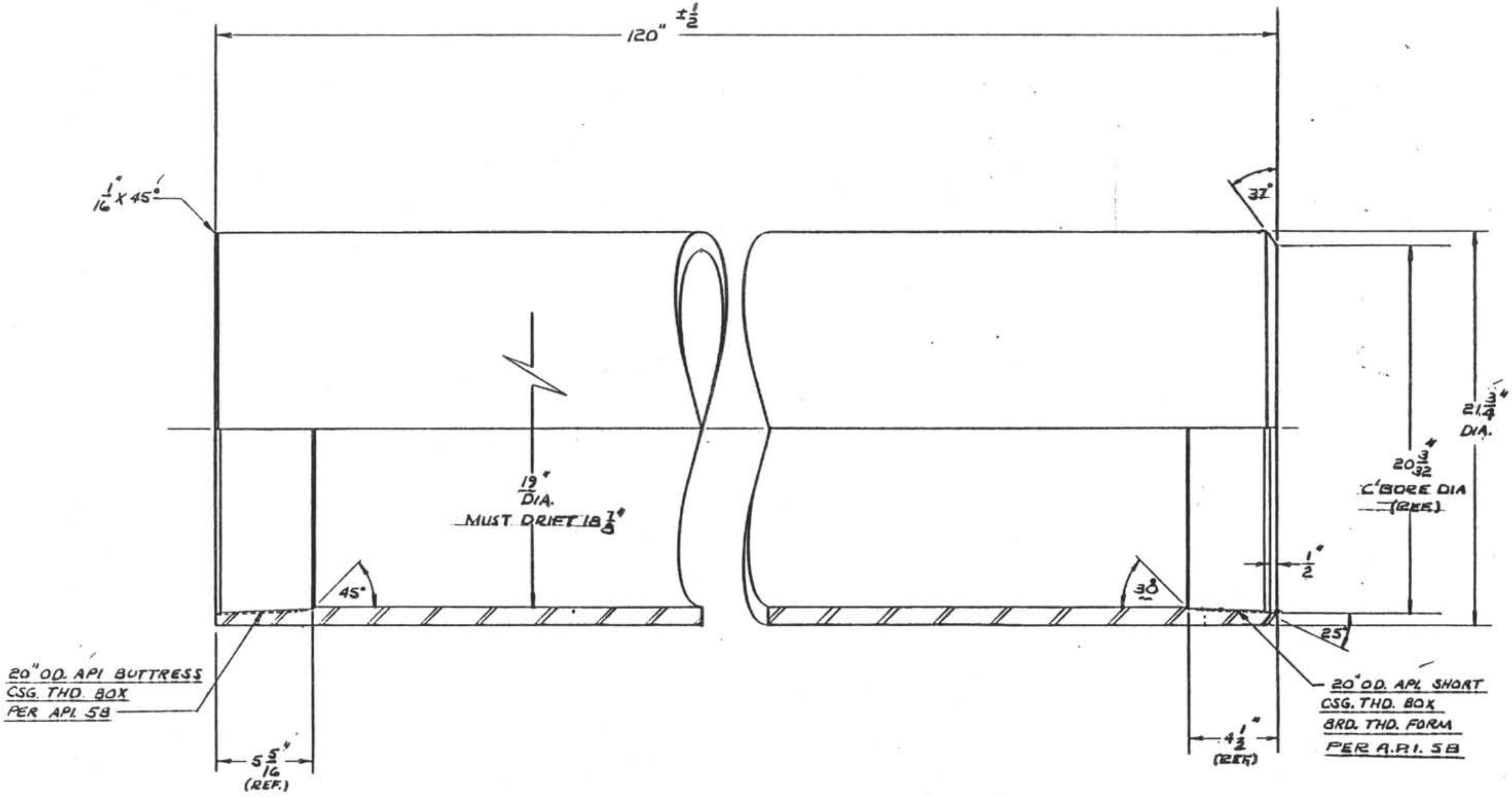

11¾ LATCH RING
DWG. # C-OH4320
16" LATCH RETAINING RING
DWG. # C-OH4711
16" LATCH RING
DWG. # C-OH4220
SHOULDER RING
DWG. # C-OH4210
LATCH GROOVE RING
DWG. # C-OH4706
16" LATCH RETAINING RING (OUTER)
DWG # C-OH4221
16" CSG. HANGER ASS'Y
DWG # D-OH4708
LOWER SECTION ASSEMBLY
RE-ENTRY GUIDE CONE
DWG. # D-OH4010
20" CSG. HANGER ASSEMBLY
DWG. # D-OH4703
REVISIONS
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
ASSEMBLY
20" X 16" X 11¾" CASING HANGER
3/8
D
D-OH4701
DO NOT SCALE DRAWING


20" CASING HANGER ASSEMBLY
20" PADDLE TYPE LANDING TOOL ASSEMBLY
REVISIONS
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
-LANDING ASSEMBLY-
REENTRY CONE AND 20" CASING
APPROVALS
DATE
SCALE
½
D
D-OH4702
DO NOT SCALE DRAWING
SHEET


REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
147 1/4" ± 1/2"
22 5/8 OD. 4TPI 60° STUB THD FORM
TAPER PER FOOT ON DIA.
D.O.T. GAGE #168
BODY DWG. NO. D-014704
TRANSITION SUB DWG. NO. C-014705
21 7/8 DIA. MAX.
22 5/8 DIA.
19" DIA.
19" ID. REF.
STAMP - P/N 014703
34°
WELDING PROCEDURE
PREVIOUS TO WELDING, A MINIMUM DISTANCE OF 3" EACH SIDE OF THE WELD SHALL BE PREHEATED TO A TEMPERATURE OF 400°F - 500°F. THE PREHEAT TEMPERATURE SHALL BE MAINTAINED UNTIL WELDING IS COMPLETE. AFTER COMPLETING THE WELD, THE WELD AND ADJACENT AREA, 6" EACH SIDE OF THE WELD, SHALL BE STRESS RELIEVED IMMEDIATELY BY HEATING TO A TEMPERATURE OF 1100°F - 1250°F. THE STRESS RELIEVING TEMPERATURE SHALL BE MAINTAINED FOR A MINIMUM OF ONE-HALF HOUR. TEMPERATURE TO BE INDICATED BY "TEMPILSTIKS". IF UNUSUAL CONDITIONS MAKE IT IMPOSSIBLE TO ATTAIN THE MINIMUM TEMPERATURE LISTED, THE HIGHEST TEMPERATURE ATTAINABLE SHOULD BE HELD FOR ONE-HALF HOUR. IN ALL CASES, ALLOW TO COOL SLOWLY IN AIR UNTIL HEAVIEST PART HAS REACHED A TEMPERATURE LESS THAN 500°F BEFORE PERMITTING ANY LOAD TO BE APPLIED AND BELOW 300°F BEFORE PERMITTING ANY QUENCHING.
WELDING ELECTRODE E-7018
20" OD. API. BUTTRESS CSG. THD. BOX DOWN
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
ASSEMBLY
20" CASING HANGER
APPROVALS
DATE
SCALE
1/2
SIZE
D
DRAWING NO.
D-014703
DO NOT SCALE DRAWING
SHEET



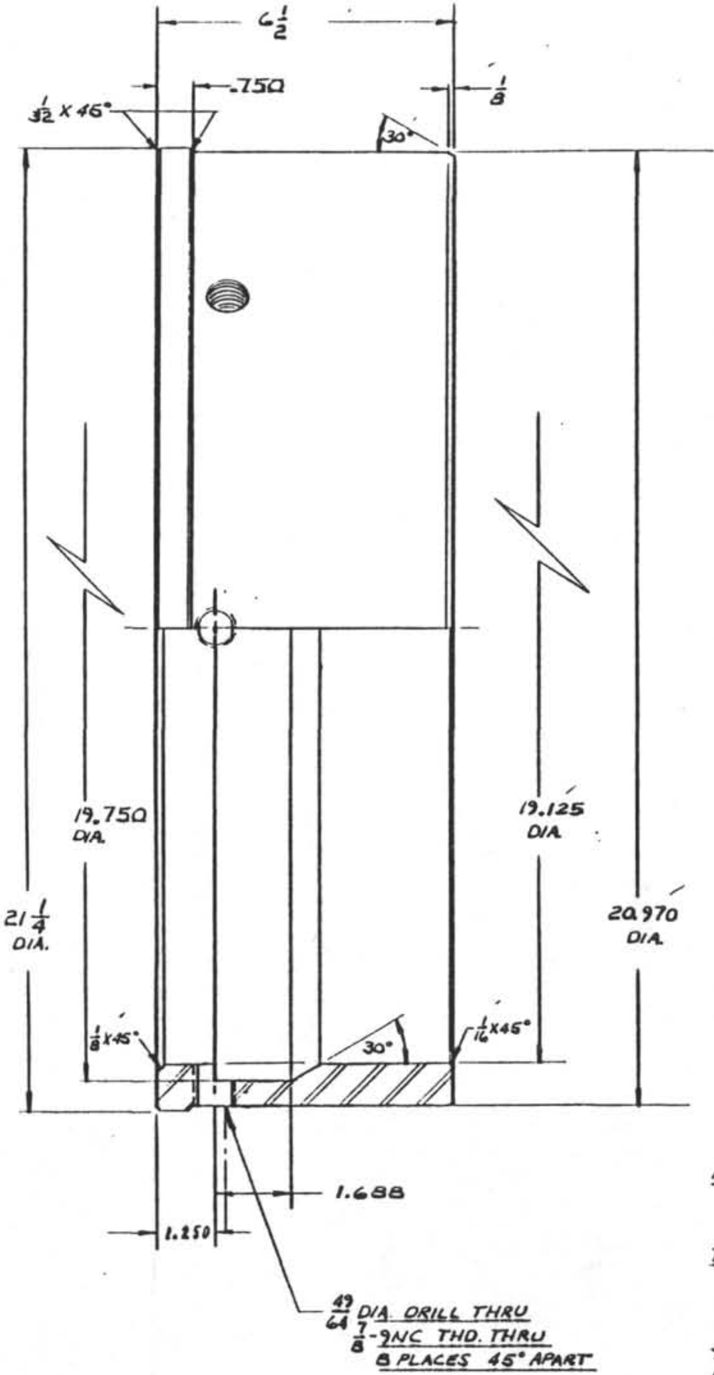
31 1/4"
21.725 HOLD
3.350
2.625
5 1/2"
4"
20.00 OD. API SHORT CSG. THD. PIN - 8RD. THD. FORM PER A.P.I. 5B
22 5/8" DIA.
22 3/16" DIA
21 5/16" DIA
21.000 DIA.
20.500 DIA.
19" DIA.
21 3/4" DIA.
21 7/8" DIA.
SYM.
VIEW A
60° STUB THD FORM
SCALE: 4X
.250 PITCH
.0547
.1133
.0626
.0541
22 5/8 OD. 4TPI.
60° STUB THD FORM
(SEE DETAIL) DATGAGE
3/4 TAPER PER FOOT ON DIA.
.760
14 1/4"
MATCH DRILL WITH P/N CH111
LET. Q (.3320 DIA) DRILL THRU
3/8-24NF THD TAP THRU
8 PLACES AS SHOWN
MATERIAL: AISI 4130
SURFACE TREATMENT: PARCOLUBRITE
SURFACE FINISH 125 UNLESS OTHERWISE NOTED
BREAK SHARP CORNERS 1/64 X 45°
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
BODY
20" CASING HANGER
1/2
D
D-CH104
DO NOT SCALE DRAWING

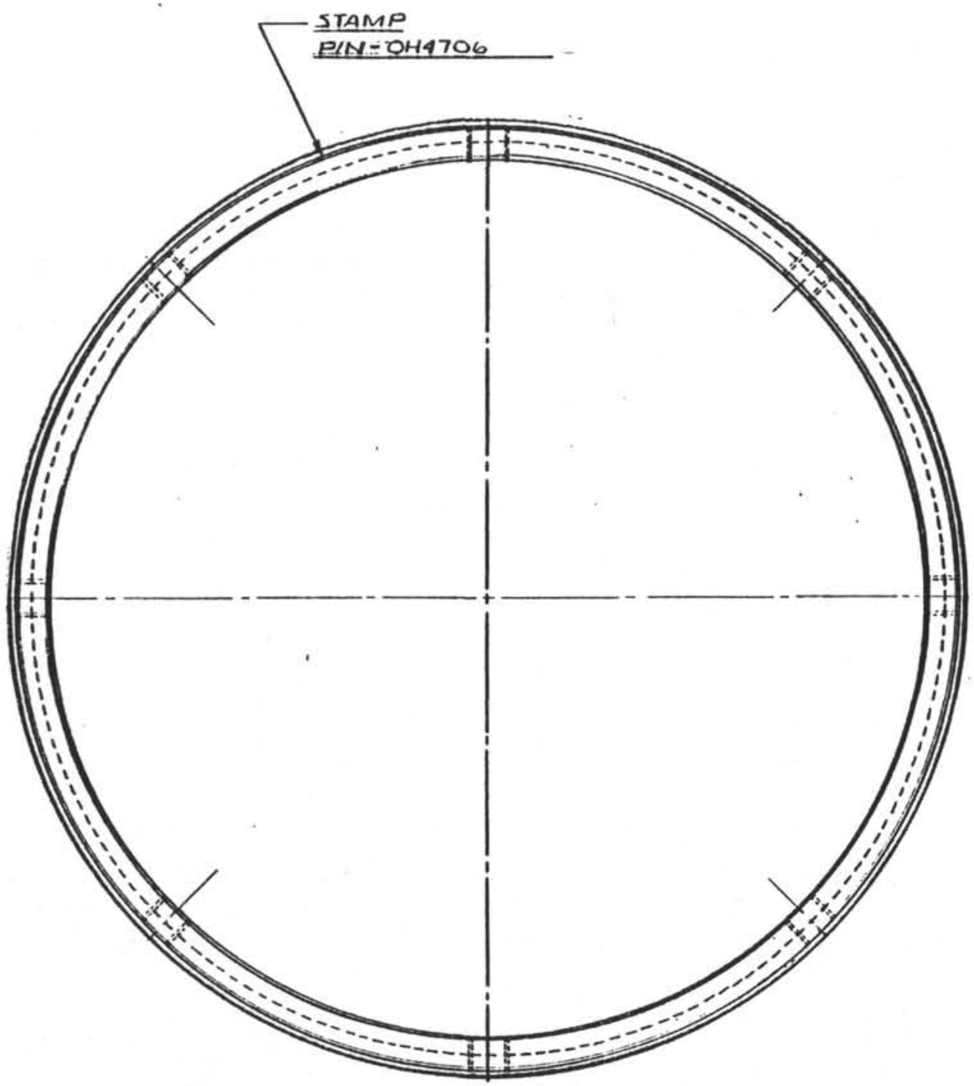


MATERIAL
22" OD. X 1 1/2" WALL PIPE
GRADE A-106B
MUST DRIFT 18 7/8"
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONS ± 1/64 DECIMALS ±.005
ANGLES ± 1/2° CONCENTRICITY .005 TIR

O.D. SURFACE FINISH 125 I.D. PER SPEC A-106B
BREAK SHARP CORNERS 1/64 X 45°

DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY		
SCALE: 1/4 DATE: 4/10/78	APPROVED BY:	DRAWN BY N. FRAWKS REVISED
TRANSITION SUB 20" CASING HANGER		
		DRAWING NUMBER C-OH4705





MATERIAL

AISI 4142 R_c 28/32 PARCOLUBRITE AFTER FINISH MACHINE

TOLERANCES UNLESS OTHERWISE NOTED

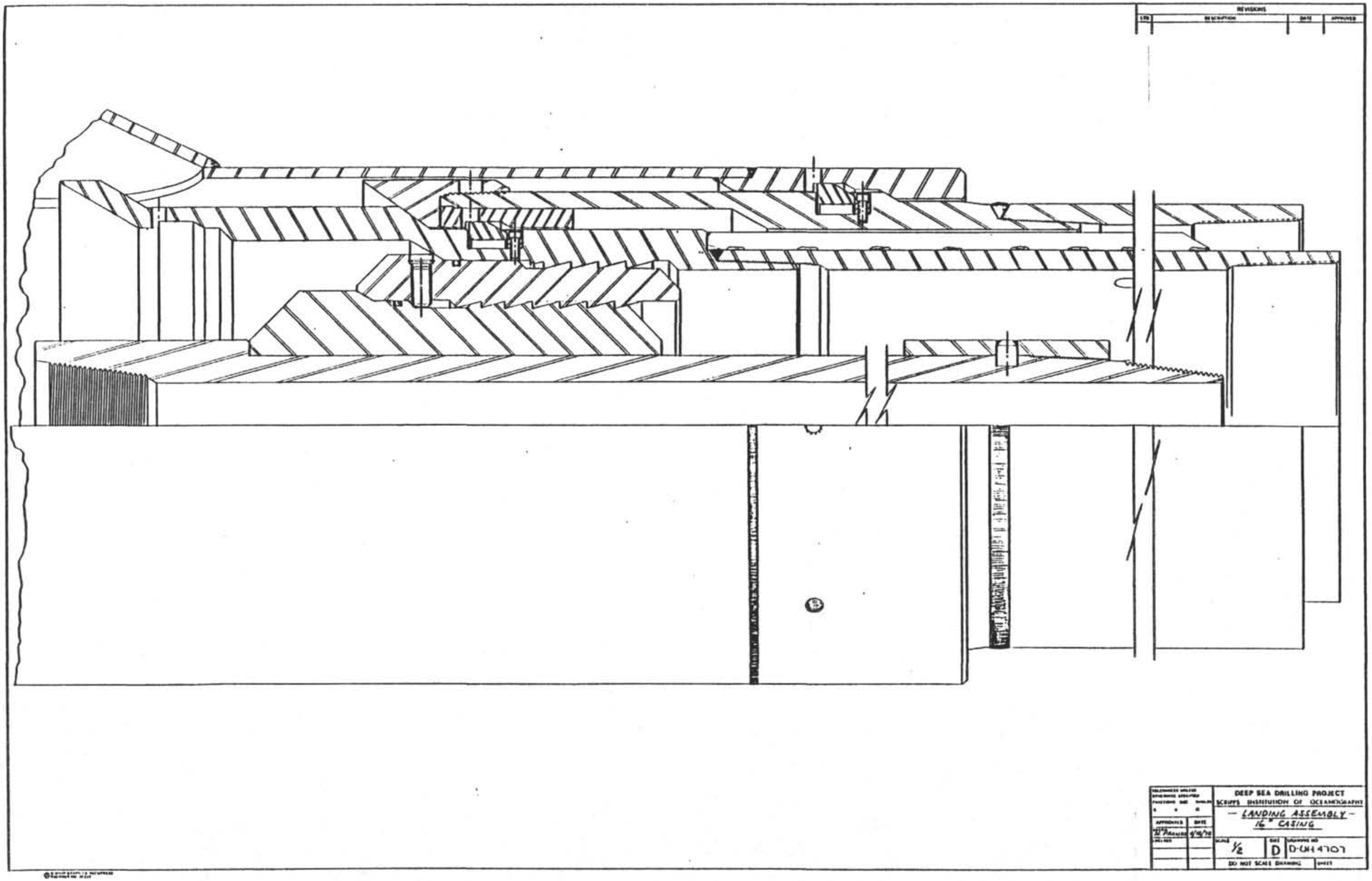
FRACTIONS ± 1/64 DECIMALS ±.005

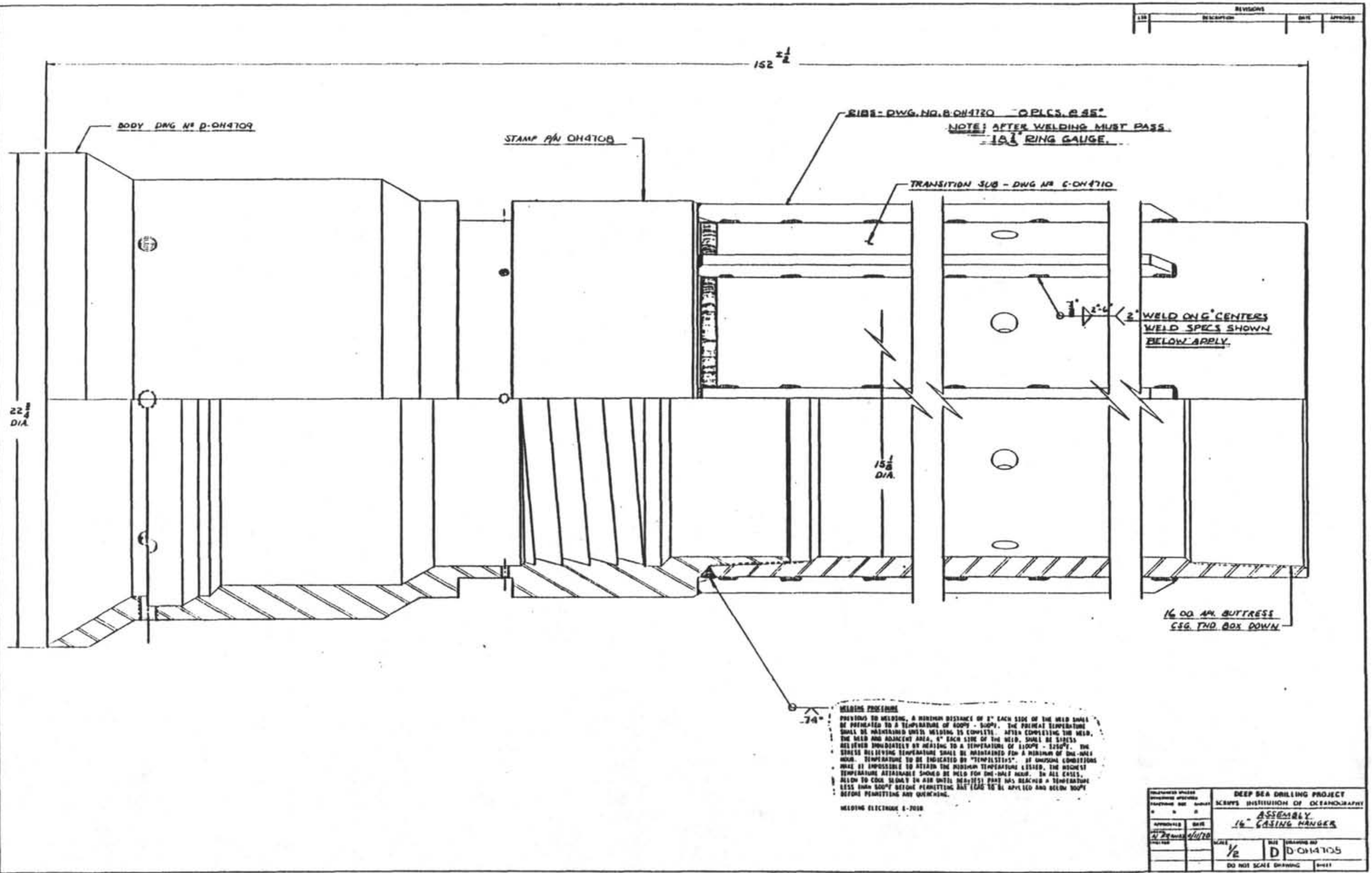
ANGLES ± 1/2° CONCENTRICITY .005TIR.

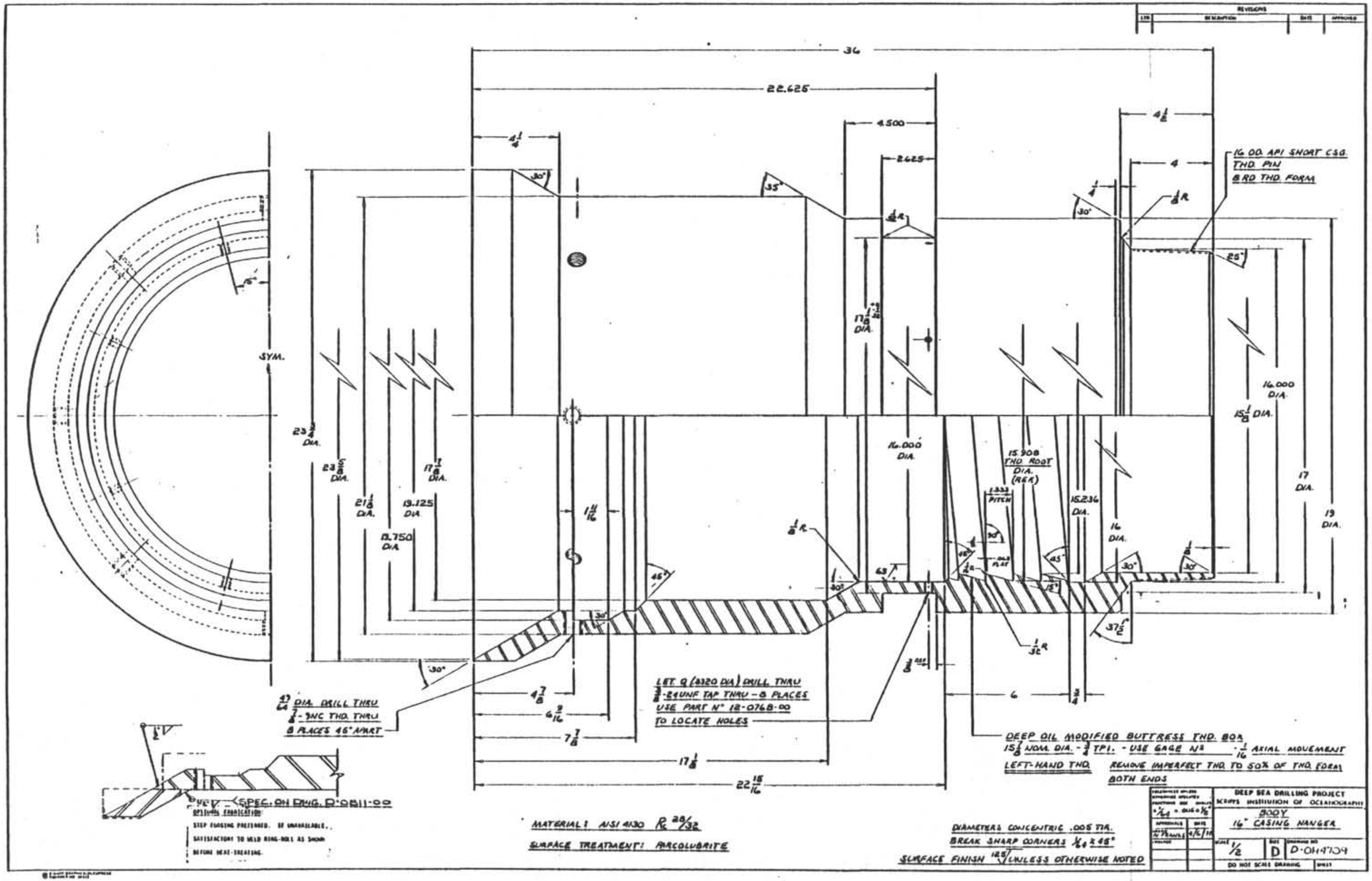
SURFACE FINISH 125 UNLESS OTHERWISE NOTED

BREAK SHARP CORNERS 1/64 X 45°

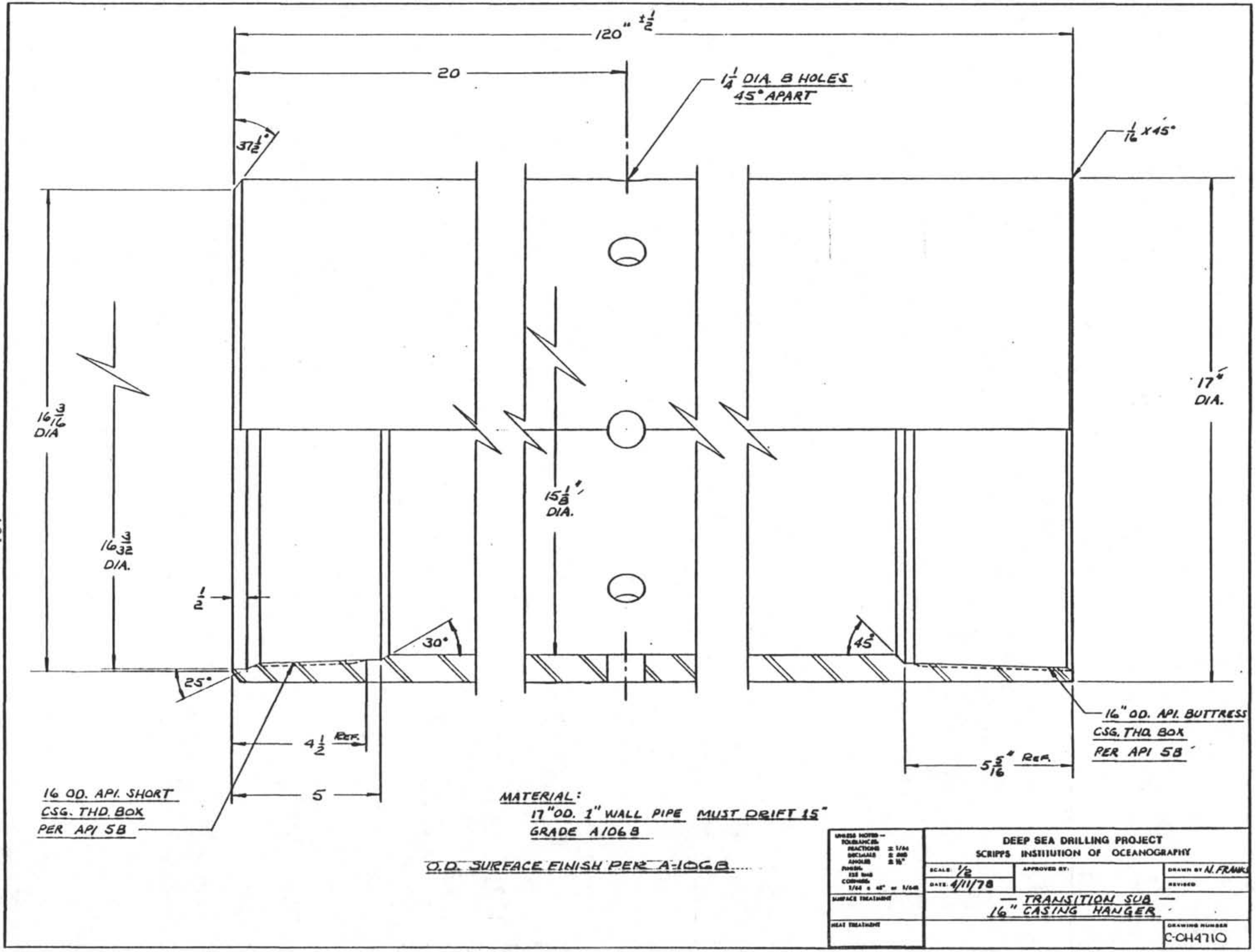
DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY		
SCALE 1/2	APPROVED BY:	DRAWN BY AL FRANKS
DATE 4/13/78		REVISED
— LATCH GROOVE RING — 20" CASING HANGER		
P/N - 0H4706		DRAWING NUMBER G0H4706

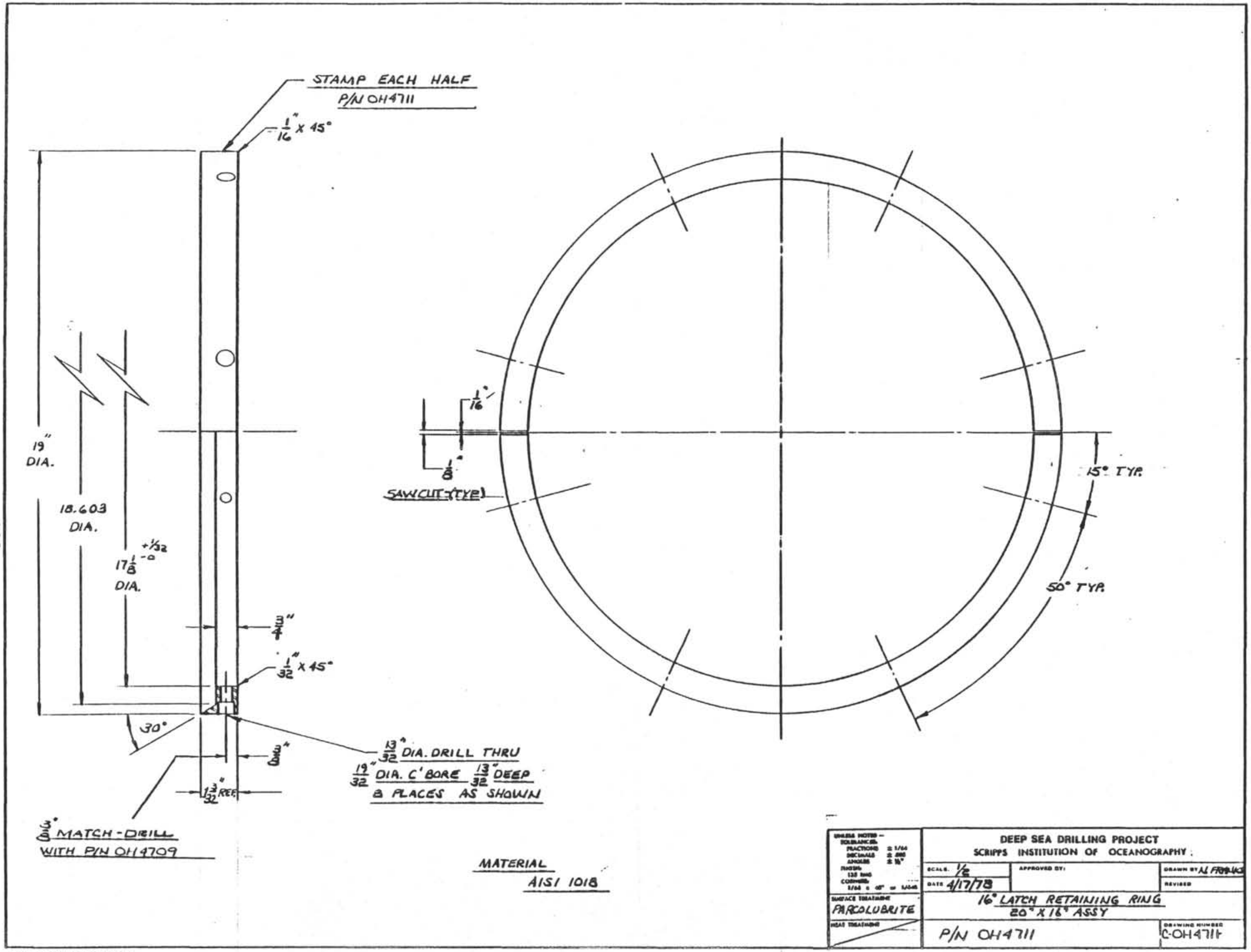

REVISIONS
DESCRIPTION
DATE
APPROVED
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
— LANDING ASSEMBLY —
16" CASING
APPROVALS
DATE
SCALE
1/2
D
D-UH 4707
DO NOT SCALE DRAWING
SHEET

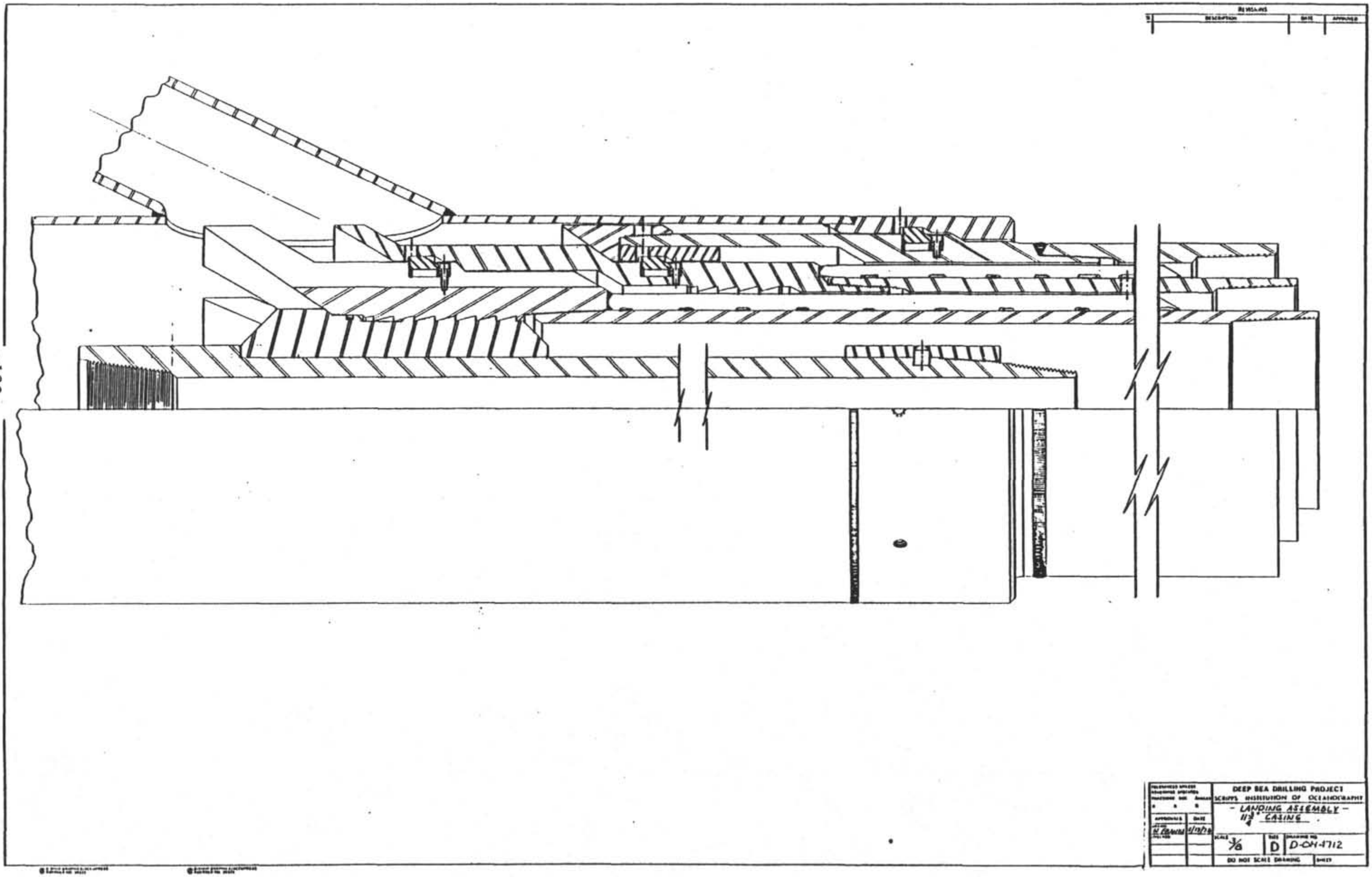

REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
152 2 1/2
BODY DWG Nº D-OH4709
STAMP P/N OH4708
RIBS - DWG. NO. B-OH4720 8 PLCS. @ 45°
NOTE: AFTER WELDING MUST PASS
18 3/4" RING GAUGE.
TRANSITION SUB - DWG Nº C-OH4710
2" WELD ON 6" CENTERS
WELD SPECS SHOWN
BELOW APPLY.
22 3/4 DIA.
15 1/8 DIA.
16 OD API BUTTRESS
CSG. THD. BOX DOWN
.74"
WELDING PROCEDURE
PREVIOUS TO WELDING, A MINIMUM DISTANCE OF 3" EACH SIDE OF THE WELD SHALL BE PREHEATED TO A TEMPERATURE OF 400°F - 500°F. THE PREHEAT TEMPERATURE SHALL BE MAINTAINED UNTIL WELDING IS COMPLETE. AFTER COMPLETING THE WELD, THE WELD AND ADJACENT AREA, 6" EACH SIDE OF THE WELD, SHALL BE STRESS RELIEVED IMMEDIATELY BY HEATING TO A TEMPERATURE OF 1100°F - 1250°F. THE STRESS RELIEVING TEMPERATURE SHALL BE MAINTAINED FOR A MINIMUM OF ONE-HALF HOUR. TEMPERATURE TO BE INDICATED BY "TEMPILSTIKS". IF UNUSUAL CONDITIONS MAKE IT IMPOSSIBLE TO ATTAIN THE MINIMUM TEMPERATURE LISTED, THE HIGHEST TEMPERATURE ATTAINABLE SHOULD BE HELD FOR ONE-HALF HOUR. IN ALL CASES, ALLOW TO COOL SLOWLY IN AIR UNTIL HEAVIEST PART HAS REACHED A TEMPERATURE LESS THAN 500°F BEFORE PERMITTING ANY LOAD TO BE APPLIED AND BELOW 300°F BEFORE PERMITTING ANY QUENCHING.
WELDING ELECTRODE E-7018
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
ASSEMBLY
16" CASING HANGER
APPROVALS
DATE
6/11/70
SCALE 1/2
SIZE D
DRAWING NO D-OH4705
DO NOT SCALE DRAWING
SHEET

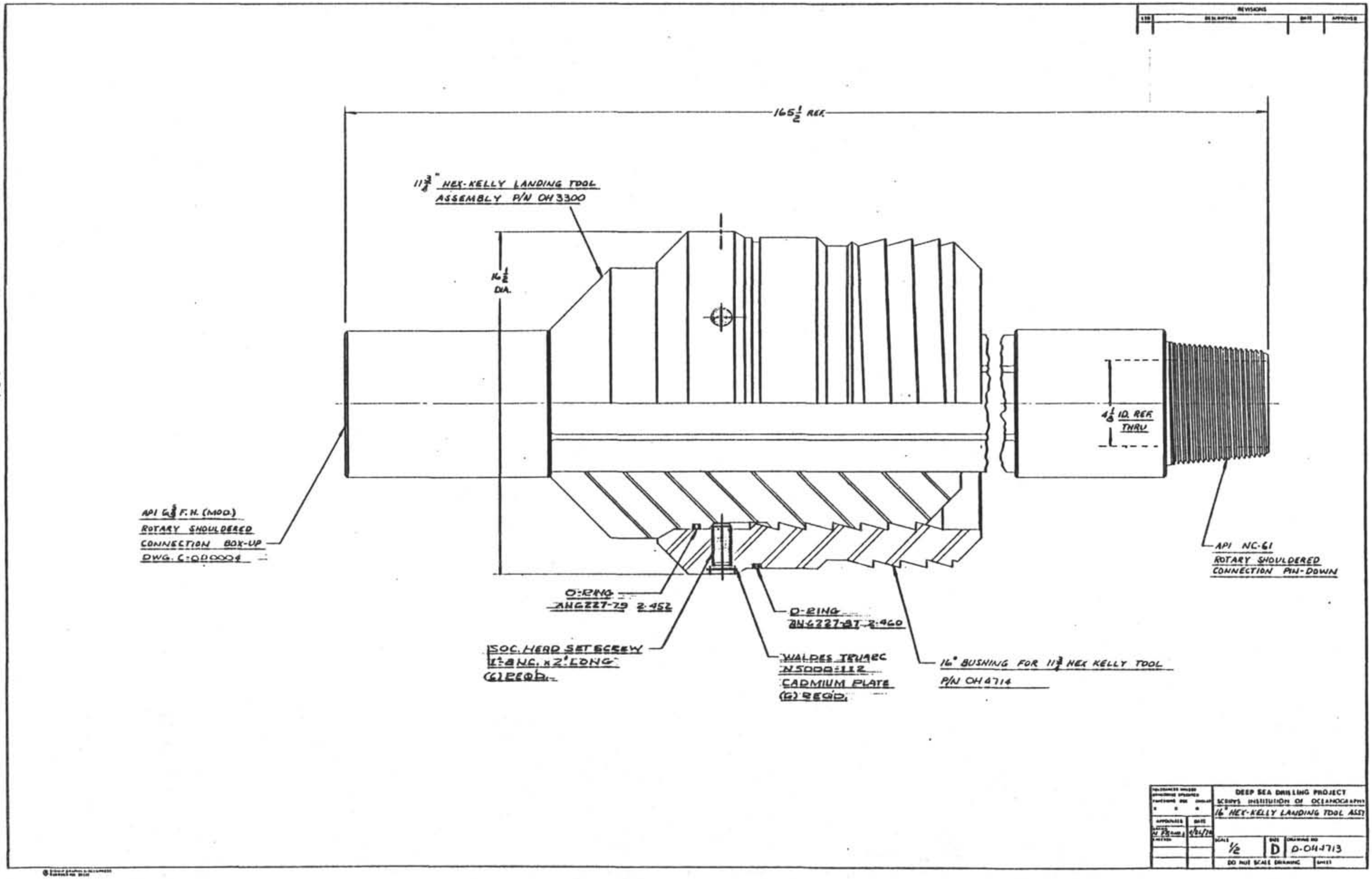


16 OD. API SHORT CSG. THD. PIN 8 RD THD. FORM
SYM.
43/64 DIA. DRILL THRU 7/8 - 9NC THD. THRU 8 PLACES 45° APART
LET. Q (.3320 DIA) DRILL THRU 3/8-24UNF TAP THRU - 8 PLACES USE PART N° 12-0768-00 TO LOCATE HOLES
DEEP OIL MODIFIED BUTTRESS THD. BOX 15 7/8 NOM. DIA. - 3/4 TPI. - USE GAGE N° - 1/16 AXIAL MOVEMENT
LEFT-HAND THD.
REMOVE IMPERFECT THD. TO 50% OF THD. FORM BOTH ENDS
SPEC. ON DWG. D-0811-00
OPTIONAL FABRICATION:
STEP FLOGING PREFERRED. IF UNAVAILABLE, SATISFACTORY TO WELD RING-ROLL AS SHOWN BEFORE HEAT-TREATING.
MATERIAL: AISI 4130 Rc 28/32
SURFACE TREATMENT: PARCOLUBRITE
DIAMETERS CONCENTRIC .005 TIR.
BREAK SHARP CORNERS 1/64 x 45°
SURFACE FINISH 125 UNLESS OTHERWISE NOTED
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
BODY
16" CASING HANGER
1/2
D
D-014709
DO NOT SCALE DRAWING

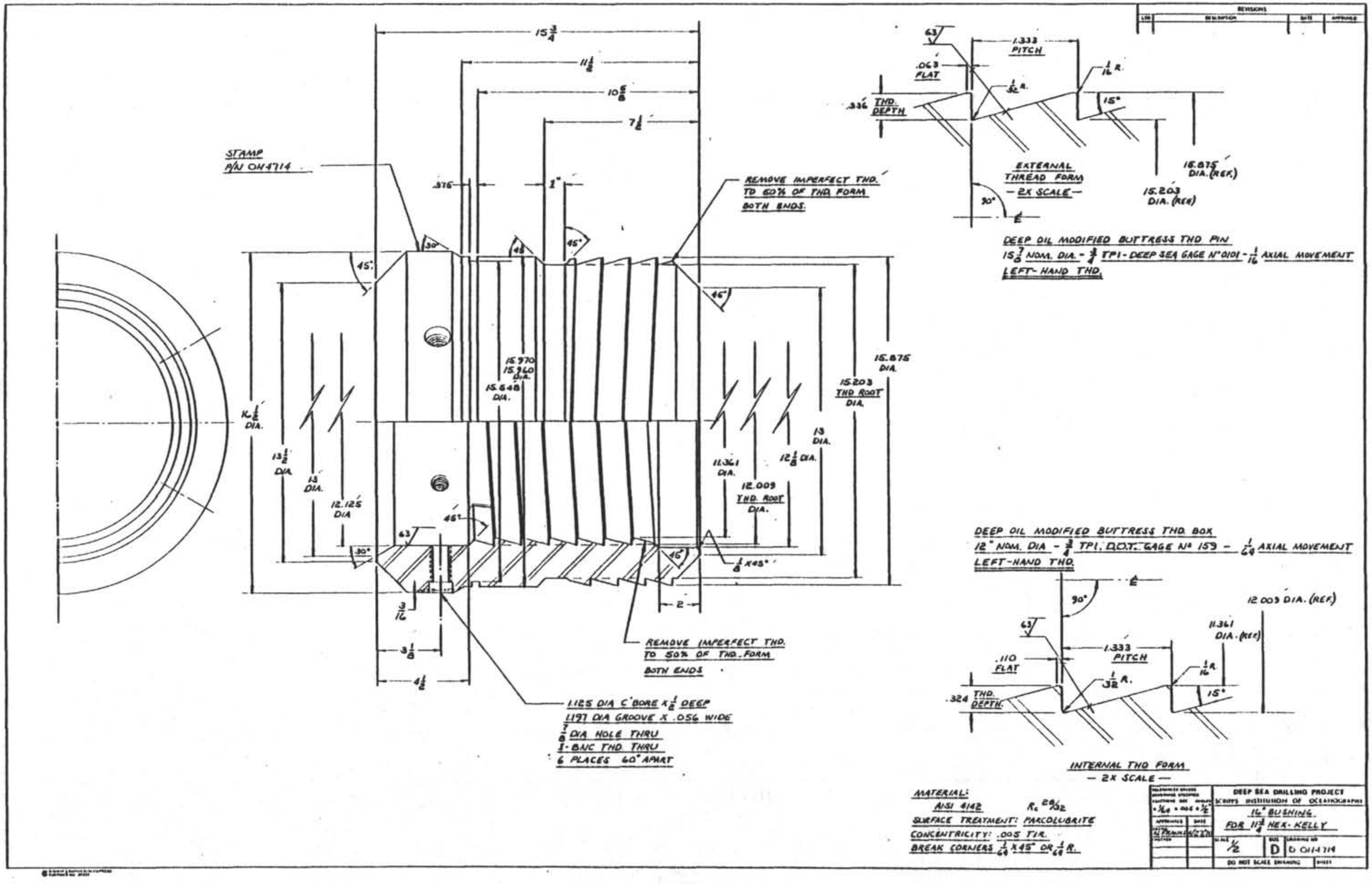

120" ± 1/2
20
1 1/4 DIA. 8 HOLES
45° APART
37 1/2°
1/16 X 45°
16 3/16 DIA
17" DIA.
15 1/8" DIA.
16 3/32 DIA.
1/2
30°
45°
25°
4 1/2 REF.
5
5 5/16" REF.
16" OD. API. BUTTRESS
CSG. THD. BOX
PER API 5B
16 OD. API. SHORT
CSG. THD. BOX
PER API 5B
MATERIAL:
17" OD. 1" WALL PIPE MUST DRIFT 15"
GRADE A106B
O.D. SURFACE FINISH PER A-106B
UNLESS NOTED — TOLERANCES
SURFACE TREATMENT
HEAT TREATMENT
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
SCALE 1/2
DATE 4/11/78
APPROVED BY:
DRAWN BY N. FRANKS
REVISED
— TRANSITION SUB —
16" CASING HANGER
DRAWING NUMBER
C-CH4710

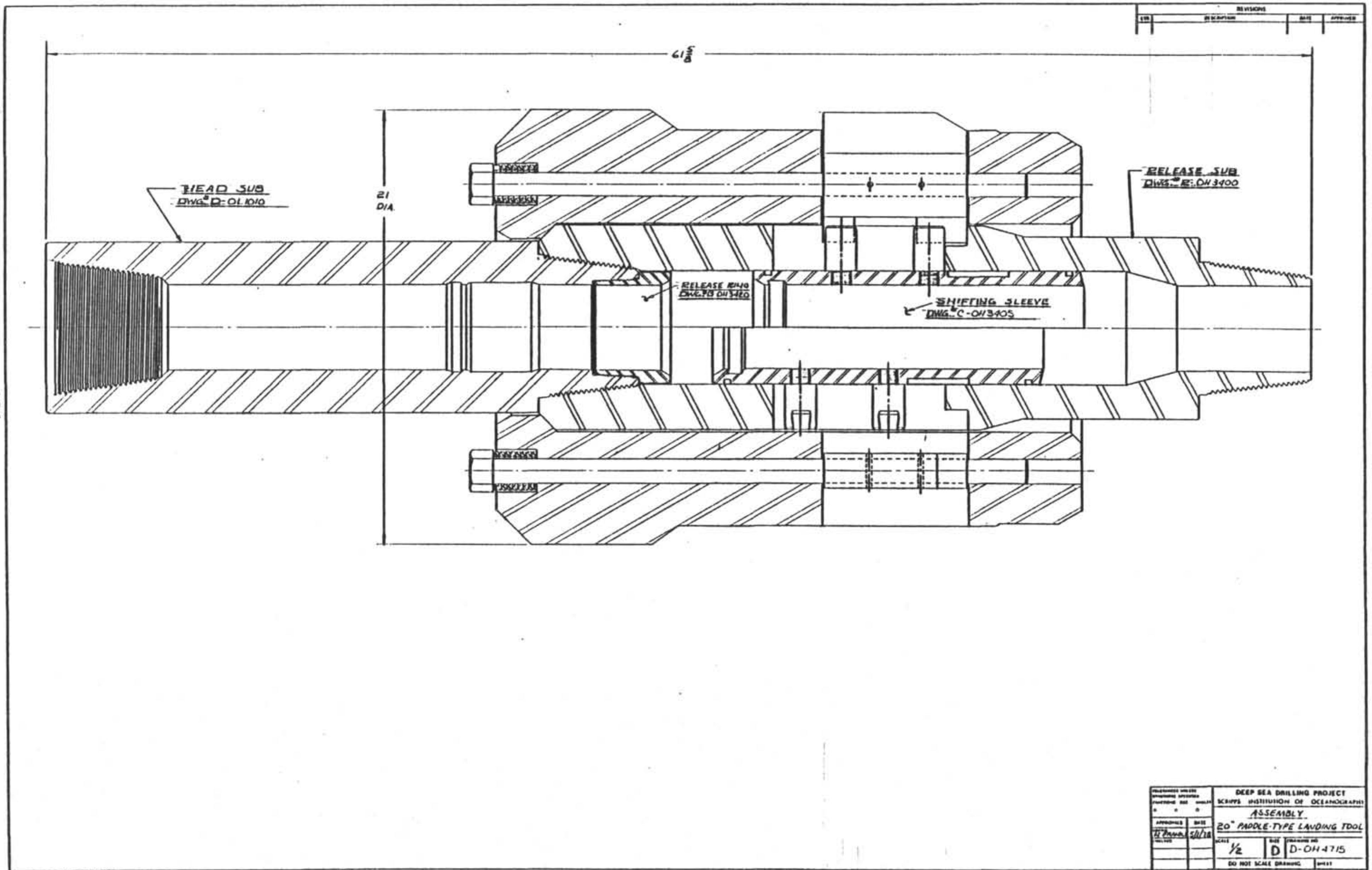

STAMP EACH HALF
P/N OH4711
1/16" X 45°
19" DIA.
18.603 DIA.
17 1/8 +1/32 -0 DIA.
3/4"
1/32" X 45°
30°
3/8"
1 3/32" REF.
13/32" DIA. DRILL THRU
19/32" DIA. C' BORE 13/32" DEEP
8 PLACES AS SHOWN
3/8" MATCH-DRILL
WITH P/N OH4709
1/16"
1/8"
SAW CUT (TYP)
15° TYP.
50° TYP.
MATERIAL
AISI 1018
SURFACE TREATMENT
PARCOLUBRITE
HEAT TREATMENT
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
SCALE 1/2
DATE 4/17/78
APPROVED BY:
DRAWN BY N. FRANKS
REVISED
16" LATCH RETAINING RING
20" X 16" ASSY
P/N OH4711
DRAWING NUMBER
C-OH4711

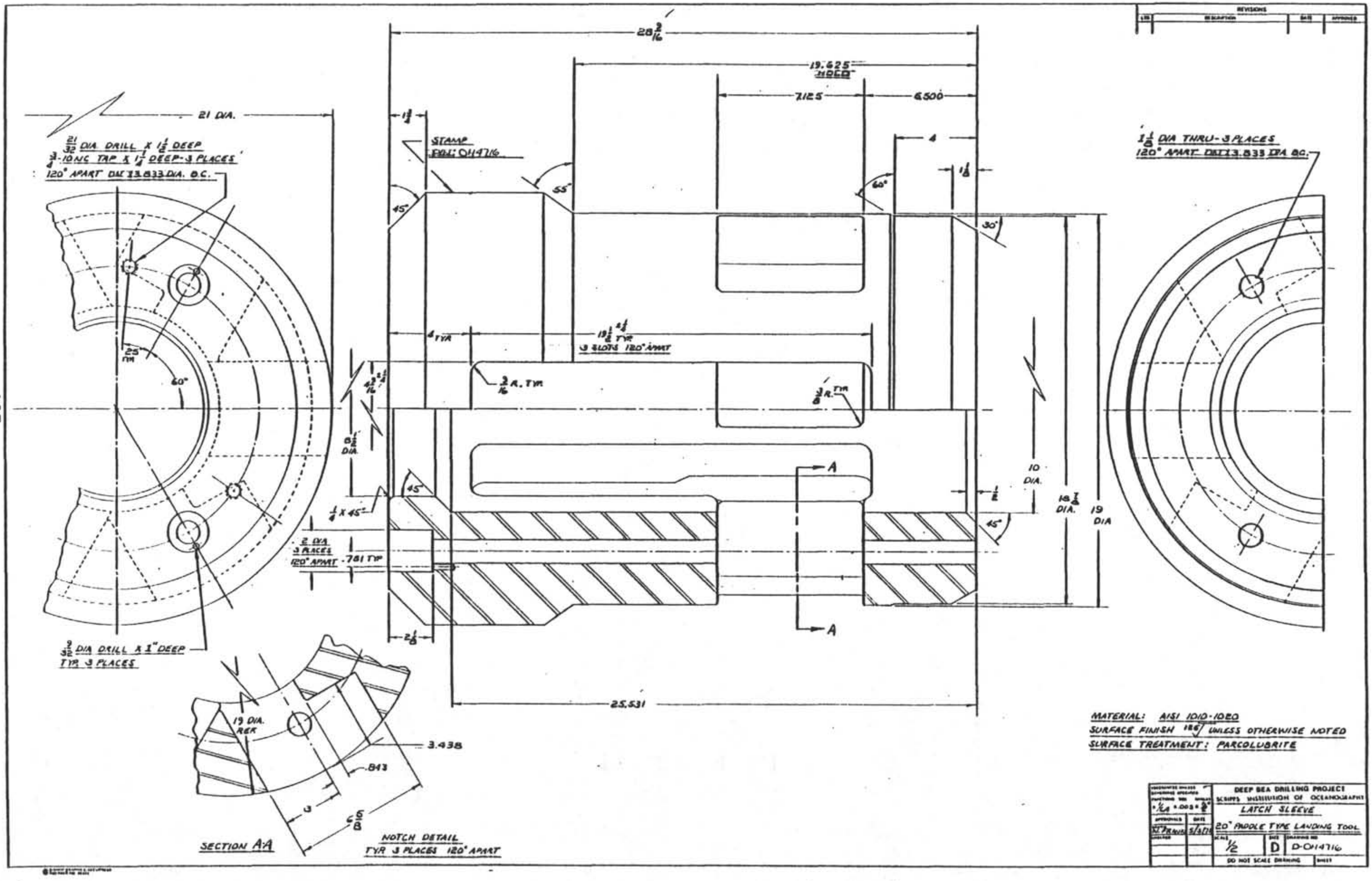

REVISIONS
DESCRIPTION
DATE
APPROVED
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
- LANDING ASSEMBLY -
11 3/4" CASING
SCALE 3/8
SIZE D
DRAWING NO D-OH-1712
DO NOT SCALE DRAWING
SHEET

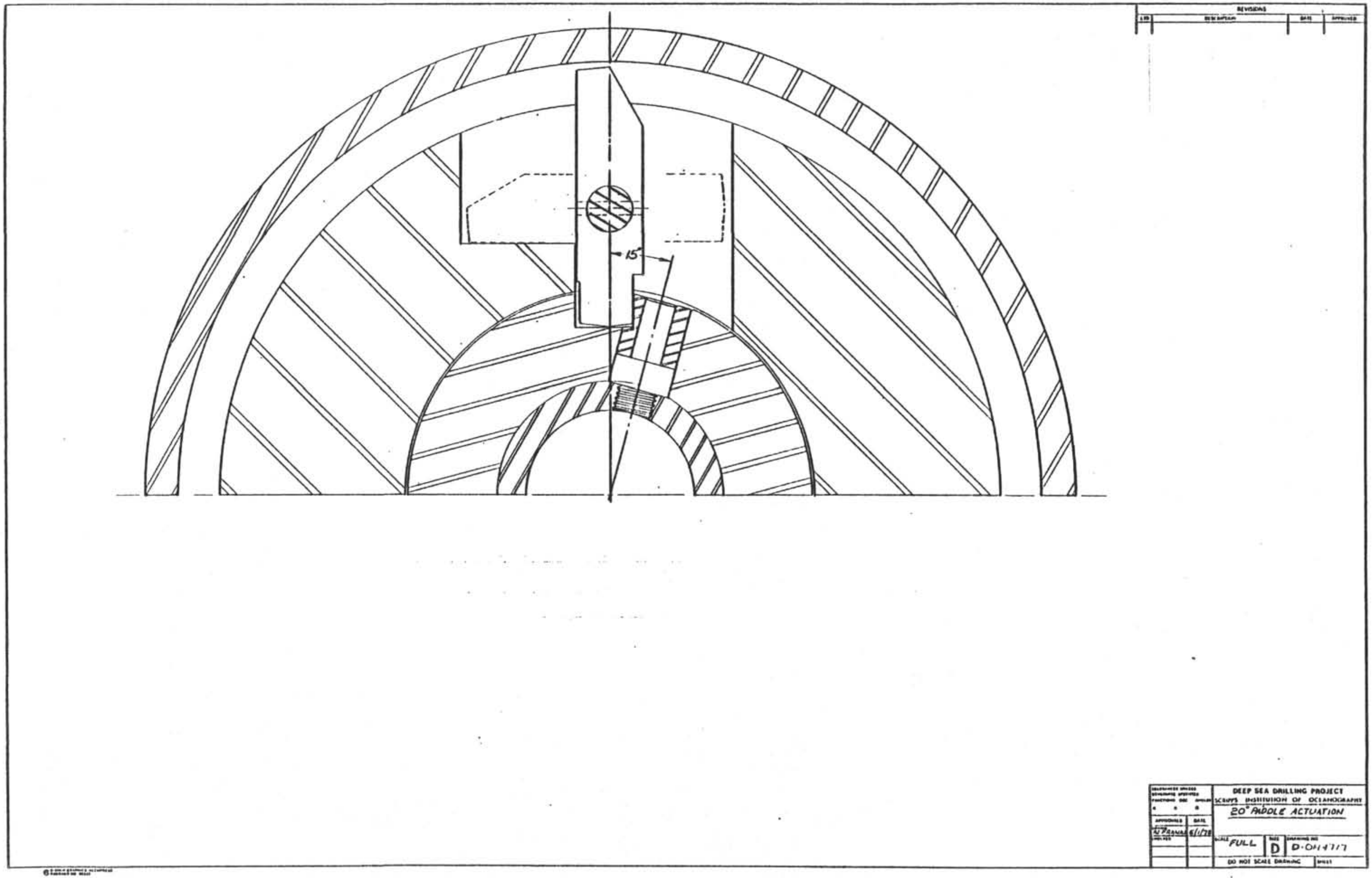


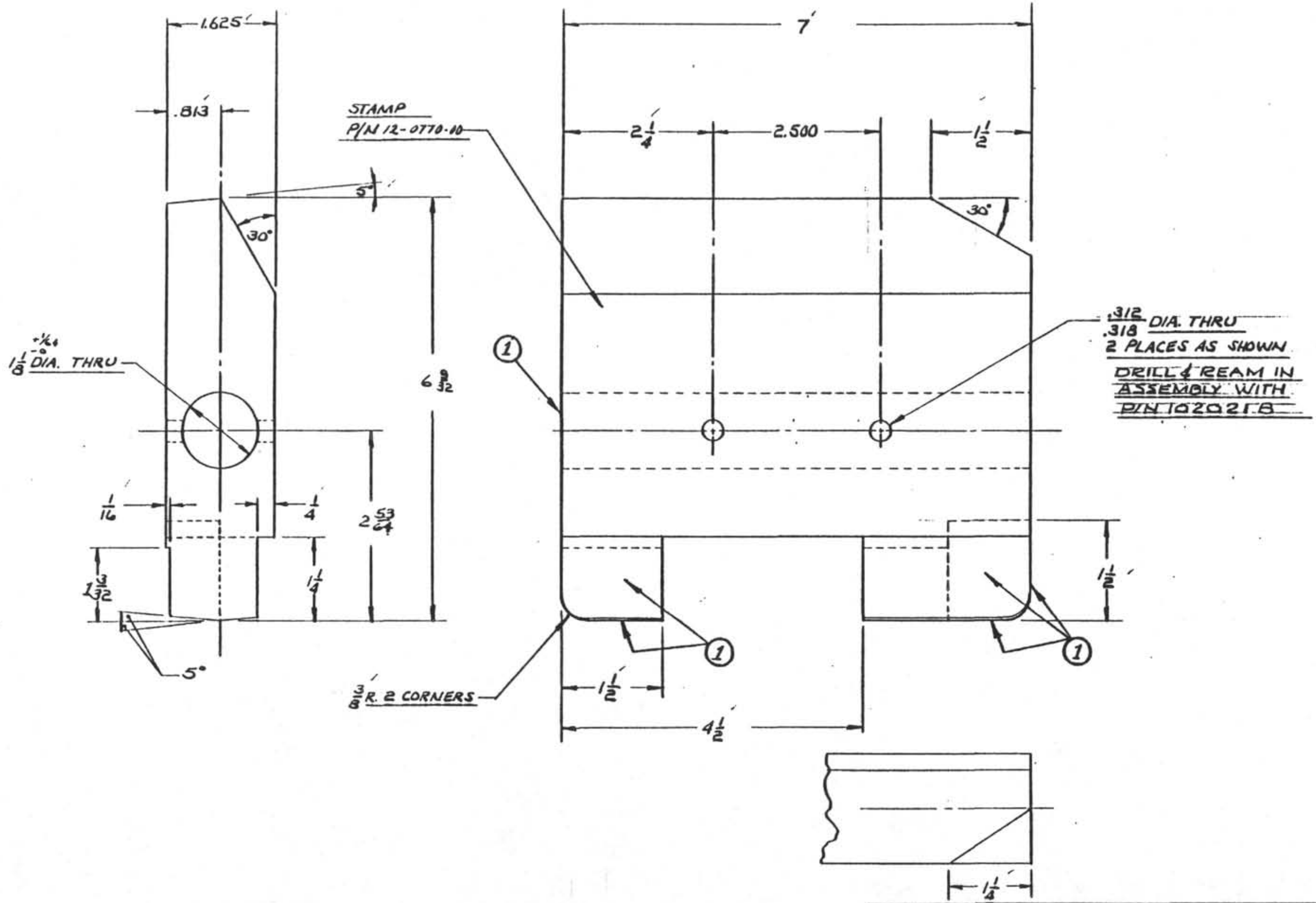
REVISIONS
165½ REF.
11¾" HEX-KELLY LANDING TOOL ASSEMBLY P/N OH3300
16½ DIA.
4⅛ I.D. REF. THRU
API 6⅝ F.H. (MOD.) ROTARY SHOULDERED CONNECTION BOX-UP DWG. C-OD0004
API NC-61 ROTARY SHOULDERED CONNECTION PIN-DOWN
O-RING ANG227-79 2-452
O-RING AN6227-87 2-460
SOC. HEAD SET SCREW 1"-8NC. x 2" LONG (6) REQD.
WALDES TRUARC N5000-112 CADMIUM PLATE (6) REQD.
16" BUSHING FOR 11¾ HEX KELLY TOOL P/N OH4714
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
16" HEX-KELLY LANDING TOOL ASSY
SCALE ½
SIZE D
DRAWING NO. D-OH-1713
DO NOT SCALE DRAWING
SHEET


STAMP P/N OH4714
REMOVE IMPERFECT THD. TO 60% OF THD. FORM BOTH ENDS.
REMOVE IMPERFECT THD. TO 50% OF THD. FORM BOTH ENDS
1.125 DIA C'BORE x 1/2 DEEP
1.197 DIA GROOVE X .056 WIDE
7/8 DIA HOLE THRU
1-8NC THD THRU
6 PLACES 60° APART
EXTERNAL THREAD FORM
- 2X SCALE -
1.333 PITCH
.063 FLAT
.336 THD. DEPTH
16.875 DIA. (REF.)
15.203 DIA. (REF.)
DEEP OIL MODIFIED BUTTRESS THD PIN
15 7/8 NOM. DIA. - 3/4 TPI - DEEP SEA GAGE N° 0101 - 1/16 AXIAL MOVEMENT
LEFT-HAND THD.
DEEP OIL MODIFIED BUTTRESS THD. BOX
12" NOM. DIA - 3/4 TPI, D.O.T. GAGE N° 159 - 1/64 AXIAL MOVEMENT
LEFT-HAND THD.
INTERNAL THD FORM
- 2X SCALE -
.110 FLAT
.324 THD. DEPTH
12.003 DIA. (REF.)
11.361 DIA. (REF.)
15.875 DIA.
15.203 THD ROOT DIA.
15.970
15.960 DIA.
15.648 DIA.
16 1/2 DIA.
13 1/2 DIA.
13 DIA.
12.125 DIA
11.361 DIA.
12.009 THD. ROOT DIA.
12 1/8 DIA.
MATERIAL:
AISI 4142 Rc 28/32
SURFACE TREATMENT: PARCOLUBRITE
CONCENTRICITY: .005 TIR.
BREAK CORNERS 1/64 X 45° OR 1/64 R.
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
16" BUSHING
FOR 11 1/4 HEX. KELLY
1/2
D
D 014714
DO NOT SCALE DRAWING


REVISIONS
61 5/8
21 DIA.
HEAD SUB
DWG.# D-01.1010
RELEASE SUB
DWG.# E-OH3400
RELEASE RING
DWG.# B-OH3410
SHIFTING SLEEVE
DWG.# C-OH3405
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
ASSEMBLY
20" PADDLE-TYPE LANDING TOOL
SCALE 1/2
SIZE D
DRAWING NO. D-OH4715
DO NOT SCALE DRAWING
SHEET

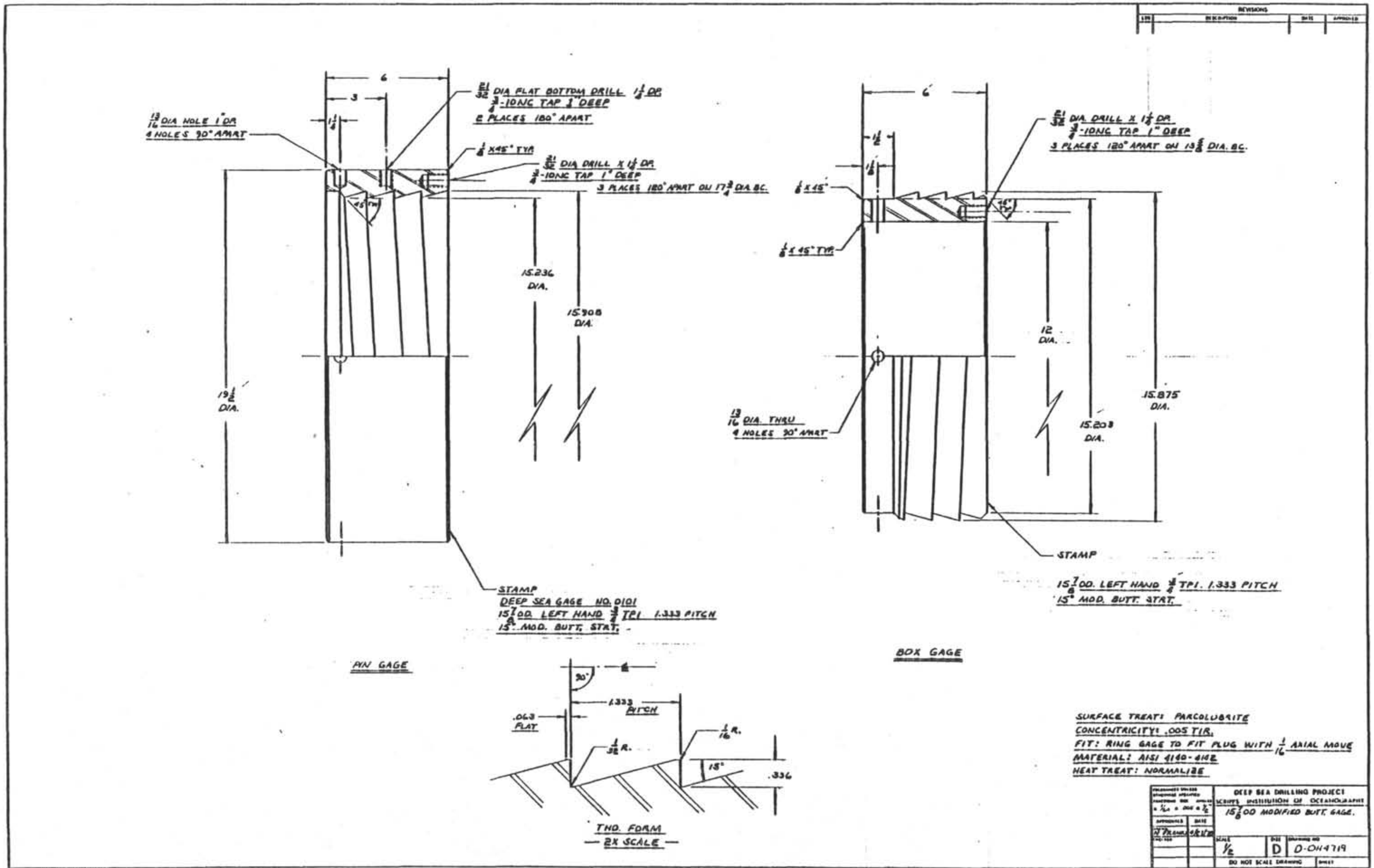

REVISIONS
21 DIA.
STAMP
28 9/16
19.625
7.125
6.500
4
55°
60°
45°
30°
3 SLOTS 120° APART
10 DIA.
19 DIA
25.531
MATERIAL: AISI 1010-1020
SURFACE FINISH 125 UNLESS OTHERWISE NOTED
SURFACE TREATMENT: PARCOLUBRITE
SECTION A-A
NOTCH DETAIL
TYP 3 PLACES 120° APART
3.438
.843
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LATCH SLEEVE
20" PADDLE TYPE LANDING TOOL
1/2
D
D-014716
DO NOT SCALE DRAWING

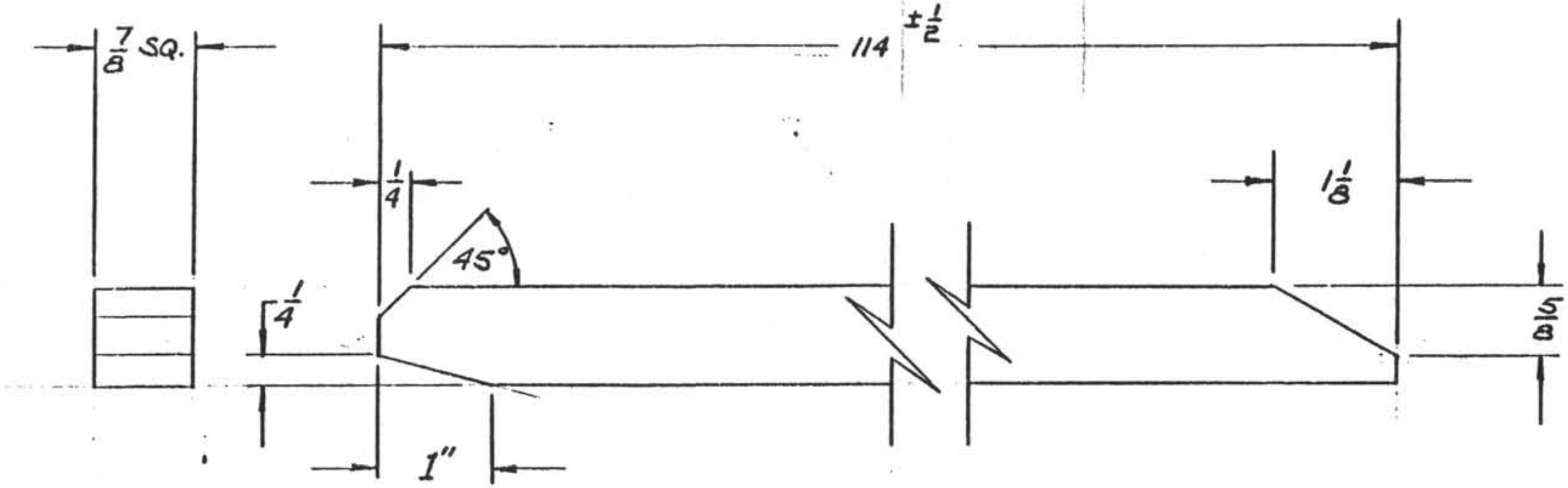

REVISIONS
15°
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
20° PADDLE ACTUATION
6/1/78
FULL
D
D-014717
DO NOT SCALE DRAWING



(1) HARDFACE WITH STOODY #6 OR EQUIVALENT 1/16 THICK
GRIND TO FINISHED DIMENSIONS 16√ SURFACE FINISH

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY		
	SCALE: FULL	APPROVED BY:	DRAWN BY: N. FRANKS
	DATE: 5/2/78		REVISED
SURFACE TREATMENT	PADDLE 20" PADDLE TYPE LANDING TOOL ASSEMBLY		
HEAT TREATMENT: 4340 ~ 30-32Rc	P/N - 014718		DRAWING NUMBER: C014718

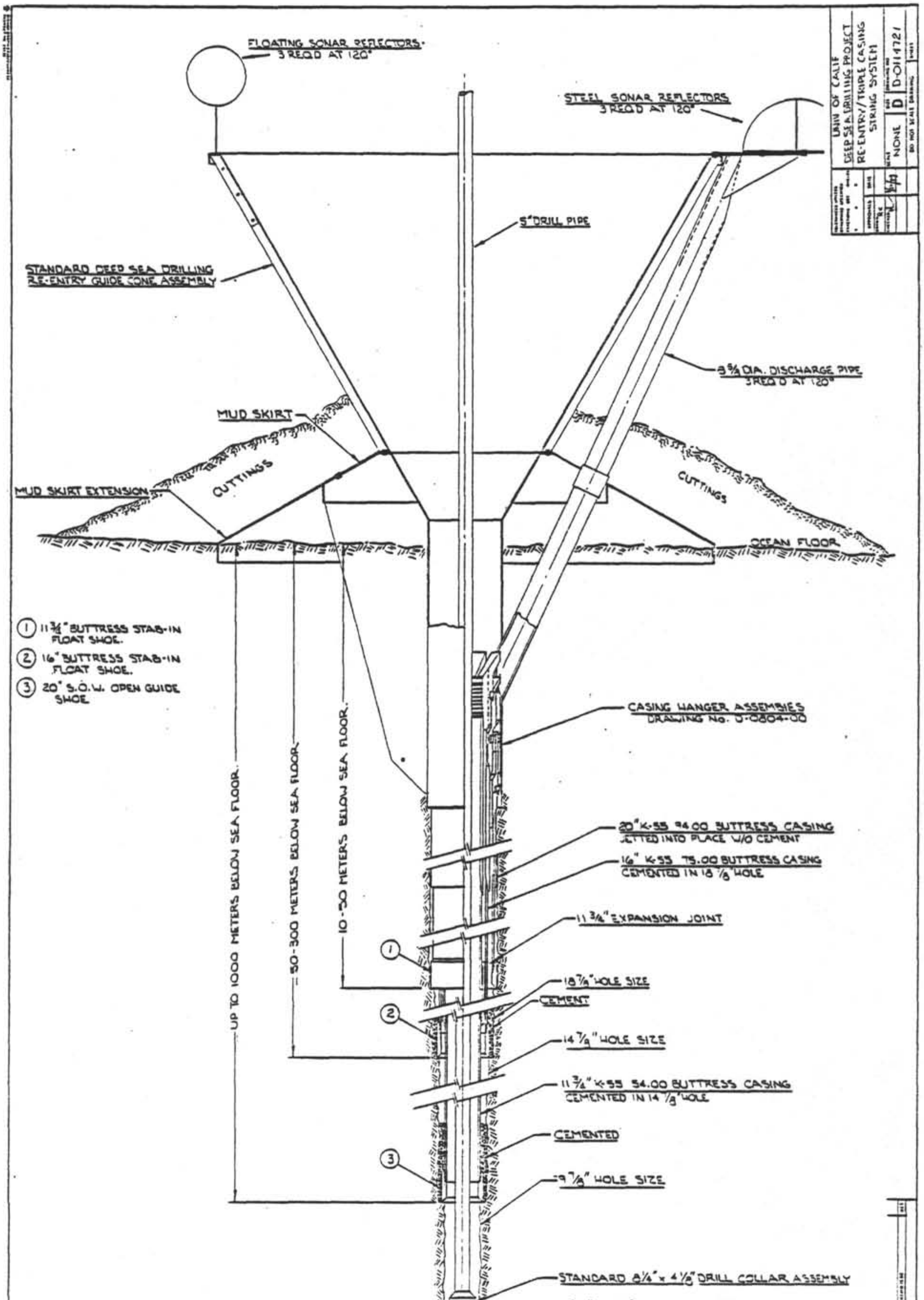

21/32 DIA FLAT BOTTOM DRILL 1 1/4 DP.
3/4-10NC TAP 1" DEEP
2 PLACES 180° APART
13/16 DIA HOLE 1" DP.
4 HOLES 90° APART
1/8 X45° TYP.
21/32 DIA DRILL X 1 1/4 DP.
3/4-10NC TAP 1" DEEP
3 PLACES 120° APART ON 17 3/4 DIA BC.
15.236 DIA.
15.308 DIA.
19 1/2 DIA.
STAMP
DEEP SEA GAGE NO. 0101
15 7/8 OD. LEFT HAND 3/4 TPI 1.333 PITCH
15° MOD. BUTT. STAT.
PIN GAGE
21/32 DIA. DRILL X 1 1/4 DP.
3/4-10NC TAP 1" DEEP
3 PLACES 120° APART ON 13 5/8 DIA. BC.
1/8 X 45°
1/8 X 45° TYP.
12 DIA.
15.875 DIA.
15.203 DIA.
13/16 DIA. THRU
4 HOLES 90° APART
STAMP
15 7/8 OD. LEFT HAND 3/4 TPI. 1.333 PITCH
15° MOD. BUTT. STAT.
BOX GAGE
.063 FLAT
1.333 PITCH
1/32 R.
1/16 R.
.336
THD. FORM
— 2X SCALE —
SURFACE TREAT: PARCOLUBRITE
CONCENTRICITY: .005 TIR.
FIT: RING GAGE TO FIT PLUG WITH 1/16 AXIAL MOVE
MATERIAL: AISI 4140-4142
HEAT TREAT: NORMALIZE
DEEP SEA DRILLING PROJECT
SCRIPPS INSTITUTION OF OCEANOGRAPHY
15 7/8 OD MODIFIED BUTT. GAGE.
1/2
D
D-OH4719
DO NOT SCALE DRAWING



MATERIAL

AISI 1010-1020

UNLESS NOTED — TOLERANCES: FRACTIONS ± 1/64, DECIMALS ± .005, ANGLES ± ½°; FINISH: 125 RMS; CORNERS: 1/64 x 45° or 1/64R	DEEP SEA DRILLING PROJECT SCRIPPS INSTITUTION OF OCEANOGRAPHY		
	SCALE: FULL	APPROVED BY:	DRAWN BY N SF
	DATE: 8/2/78		REVISED
SURFACE TREATMENT	RIBS - 16" CASING HANGER ASSEMBLY RE-ENTRY CONE / TRIPLE CASING SYSTEM		
HEAT TREATMENT			DRAWING NUMBER B-011720



RE-ENTRY/TRIPLE CASING STRING SYSTEM~ DRAWING NO. D-OH4721

III. APPENDICES

APPENDIX A

AUXILIARY EQUIPMENT

A. Release Sub

The release sub, DSDP Dwg. RE-010, is placed (spaced out) in the bottom hole assembly so that the core bit will be at the casing shoe, preferably immediately below a bumper sub. This sub has three pockets on the outside into which the paddles of the casing hanger are rotated into. The paddles are locked in place by moving stop bolts alongside the paddles. These stop bolts are screwed into a sleeve in the bore of sub. The sleeve is shifted (moved up) by a special tool run onthe 1/2 inch wire coring line. When the sleeve is up the paddles are free to rotate out of the pockets and when the sleeve is down, the paddles are locked in the pockets. Catches on the sleeve hold it in the up position after shifting.

B. Shifting Tools

A shifting tool, similar to those used to open and close sleeves in oil field production tubing, is used to release the downhole assembly from the base. The shifting sleeve (with stop bolts) is machined so that either the Rotary Oil Tool or the Baker Oil Tool shifting tool, will engage, shift, and release.

The tool is run in and retrieved with the same wireline used to retrieve cores. The Baker shifting tool has had a history of broken profile keys, and should only be considered as a backup to the Rotary tool.

1. Baker Oil Tool Company Equipment

The Baker Shifting Tool, Ref. Baker Oil Tool Dwgs. 204/865, DSDP Dwg. RE-12, is designed to move the shifting sleeve in the release sub to release the bottom hole assembly from the reentry cone.

A positioning groove is machined in the crossover sub on top of the release sub. Spring loaded profile keys in the Baker shifting tool expand into this groove when the tool is run in on the sand line. This stops downward motion of the tool and positions the shifting fingers slightly below the shifting sleeve in the release sub to engage the sleeve. An upward pull on the sand line moves the sleeve to the release position and then collapses the fingers so the tool can be retrieved.

CAUTION: The spacing of the positioning groove, shifting sleeve, and profile keys and fingers on the tool are very critical. If the shifting tool jams the keys, ride up the taper in the positioning groove. Jarring action releases the fingers by shearing pivot pins.

2. Rotary Oil Tool Company Equipment
The Rotary Oil Tool sleeve shifting tool, DSDP Dwg. RE-019, is assembled as follows:

a. Place dog spring (3) in spring cavity in shifting dog (2). Insert dog and spring in slot in shifting tool body (1). Push forward until end of dog is under retainer lip of slot. The pin holes in the body and dog should now line up.

b. The dog pivot pins are next driven through the body and dog. If it is desired to have the pivot pins shear and release the dogs before parting the coring line, pins with reduced shear areas can be selected. The pin is retained by a 1/4" NC socket head cap screw. Drift holes are continued through one boss, so sheared section of the pivot pin can be removed with a drift.

C. Edo Western Model 516 High Resolution Scanning Sonar consists of the following units:

1. Surface Control Unit

2. Power Supply

3. Remote Display

4. Downhole Scanner-Transceiver

This equipment will locate and range underwater targets at ranges from two feet to 500 feet. The scanner-transducer must see the target and will operate through a 2 7/16 inch core bit. The signal is transmitted to the surface through a standard 7-conductor logging cable.

Edo Western's instruction manual No.13096, complete with blue line prints, covers the operation and maintenance of this equipment. A copy is onboard the Glomar Challenger.

D. Logging Cable and Logging Unit

The logging cable is standard 7-conductor double armour 15/32 inch diameter. The logging unit is the special unit designed by Schlumberger for Project Mohole. Instruction manuals for this unit are onboard the Glomar Challenger.

ACOUSTIC REENTRY

A. Method for Reentry Using Vessel's Positioning Equipment Only

1. Leave vessel in automatic mode of operation during all operations and leave vessel on same heading.

2. During all observations, make frequent notation of blip heading on sonar oscilloscope to assure that Edo Tool has not slipped in azimuth. Also, be certain that all observations or range and bearings are taken with the vessel centered over beacon display of computer oscilloscope. Observations on range and bearing should be made only after the drillpipe motion due to vessel excursion is minimal. (Normally this requires a minimum of 15 minutes without a major change in position).

3. All movements of vessel, range and bearing of target should be plotte on U.S. Navy maneuvering board HO 2665-20 with original positioning beacon plotted as center and the vessel's position in relation to this beacon plotted using any offsets previously put into computer. This must be done so that the final movements of the vessel by use of depth changes will be along a path angle in direct relation to the true position of the positioning beacon.

4. While using 500 foot scan on sonar oscilloscope locate target. With vessel directly centered over positioning beacon display on computer take initial range and bearing of reentry cone target. Plot the circle of observed range from the vessel's plotted position.

5. Make an arbitrary move of vessel by using offsets in one direction only, preferably as near as possible to the vessel's heading. (Vessel's heading will of necessity be determined by existing elements and has no significant effect upon the operation).

6. Observe whether offset move has increased or decreased the range of reentry cone target. If vessel's move has increased range, the arbitrary move was in the wrong direction. In this case, the offsets should be removed and opposite direction offsets should be put into

computer. Offsets of 200 to 400 feet should be used depending upon the distance of the original observed range of the target. If there has been a substantial decrease in range of target, allow sufficient time for vessel and drill pipe to settle (minimum of 15 minutes) and then, by an average of new ranges on target, draw another circle of range from the vessel's newly plotted position. This circle will intersect the original plotted range circle at two locations either of which could be the potentially true position of reentry cone.

7. The approximate true position of the reentry cone target may now be ascertained by observing the apparent relative motion of the reentry target either to the right or left. The correct position is now selected.

8. After ascertaining the true position of the reentry cone, draw a line from the center of the plotting sheet (i.e., true position of the beacon) through the true position of the reentry cone.

9. Before any further movement of the vessel, plot three or more alternate coordinates of 100 foot offsets adjacent to the position of the reentry cone. Draw dotted lines from the center of the plotting sheet to the outer edge of the plotting sheet which passes through these coordinates. (It is along these lines that the vessel may be moved by altering depth settings).

10. If desired, at this point the drillpipe may be rotated to display azimuth as follows:

    a. Plot the true position of the reentry cone target.

    b. Calculate the relative bearing.

    c. Rotate the drillpipe with chain tongs until the relative azimuth of the reentry cone is displayed in its proper position on the sonar oscilloscope.

NOTE: The above procedure may be desirable, however, in our present stage of evaluation of reentry capabilities, it is not a requisite.

11. By visual inspection of the plotted alternate coordinates, select that set of coordinates whose azimuth through the center of the plotting board most closely approaches the target. The vessel can be made to move in and out along these lines of azimuth by adjustment of water depth selections (approximately).

12. Now, move the vessel in 100 foot increments by "offsets" to your selected coordinates.

NOTE: A study is in process to modify the positioning system so that offsets as small as 10 feet can be used.

13. A brief exploration of the movements of the vessel by depth adjustments follows:

NOTE: This formula is approximate, but sufficiently accurate when used with small offsets in deep water.

a. To decrease range along plotted azimuth to beacon "increase" water depth.

b. To increase range from beacon "decrease" water depth.

c. The following formula may be used to pre-compute "closest point of approach" of reentry cone target.

$$\text{Depth Setting Required} = \text{True Depth} \times \frac{\text{Range from Beacon}}{\text{New Range Desired}}$$

or

$$\text{Depth Setting Required} = \text{True Water Depth} \times \frac{\text{Coordinate Selected-Range from Beacon}}{\text{Desired Range (Over Cone) from Beacon}}$$

EXAMPLE

In attached "example plot" the water depth is 13,000 feet. The coordinate selected range from beacon is 590 feet, the position of reentry cone target from beacon is 450 feet.

$$X = 13{,}000 \text{ feet} \times \frac{590}{450} = 16{,}900 \text{ feet}$$

16,900 feet = required depth setting to place vessel over sonar reentry cone within 10 feet in example.

14. Now, after the vessel and bottom hole assembly has settled over new offset coordinates, increase or decrease depth settings as required to approach "CPA" of reentry cone target.

15. A third alternate should always be borne in mind and that is our capability of moving "forward" or "aft" along a line of azimuth with our heading a distance of approximately 54 feet by making alternate hydrophone selections.

16. The above explained method of reentry using vessel positioning only, does not preclude the future possibilities of movement in semi-automatic or manual modes of operation as our evaluation of ideas and techniques develop. However, at our present stage of development the automatic mode of operation appear by fare the most expeditious.

17. Please refer to attached plotting sheets for a graphic display of vessel and target movements.

APPENDIX C

COMPONENT WEIGHTS

DEEP SEA DRILLING PROJECT
REENTRY CONE/DUAL CASING HANGER SYSTEM

Part #	Description	Weights in Lbs.	
101924	11 3/4" Casing Expansion Joint		1655
102000	11 3/4" Circulating Casing Hanger	2125	2145
102003	11 3/4" Latch Ring	20	
102012	16" Casing Hanger Assembly	2700	3000
102015	Shoulder Ring	150	
102016	Latch Groove Ring	125	
102017	16" Latch Ring	25	
102026	11 3/4" Hex-Kelly Landing Tool Assembly		1625
102027	Reentry Guide Cone-Upper Section	3900	12,700*
102028	Reentry Guide Cone-Lower Assembly	4000	
102037	Discharge Line-Upper Section, 3 @ 350# ea.	1050	
102038	Passive Reflector, 6 @ 175# ea.	1050	
102039	Reflector Brackets, 3 @ 75# ea.	225	
102040	Mud Skirt - Extension & Stiffeners	2475	
102041	Diverter Packoff Assembly		1500
102196	16" Casing Landing Tool Assembly		1450

*Fully-Equipped Keel-Haul Weight

APPENDIX D

CEMENTING PROGRAM

GLOMAR CHALLENGER

4% PRE-HYDRATED GEL-CEMENT

(Equivalent to 12% Dry Blend)

MIXING FLUID - GEL/WATER

Requires 31.46# of bentonite/100 gal fresh water or 13.21# bentonite/barrel of fresh water.

Weight of gel/water mix 8.5 PPG or 63.5 PCF

*To test fluid property take gel/water and add cement 7.85#/gal) and weigh the resultant slurry. It should be approximately 90-94 PCF or 12.0-12.4 PPG and a pumpable consistency. If this weight is low add water. If high, add bentonite.

TO MIX ONE CU. FT. OF SLURRY

5.7 gal gel/water
44.8 lbs cement

On the GLOMAR CHALLENGER, it is necessary to measure the mixing water as it is impractical to measure the amount of dry cement mixed.

EXAMPLE CALCULATION

Cement 700 ft of 11 3/4" of 54# casing in 15" hole through 15.095' of 5" 19.50# drill pipe with sufficient 4% pre-hydrated gel cement followed with 100 sx. API Class "H" cement to fill to the ocean floor and leave 80' of cement inside the casing.

HOLE-CASING ANNULUS VOLUME

11 3/4" x 15" = 0.4742 cu ft/lin ft

Theorectical Volume = 700 x 0.4742	=	332 cu ft
Excess 20% for wash outs	=	66
Total	=	398 cu ft

CASING VOLUME

11 3/4" 54# = 0.6456 w. ft/lin ft

Volume = 0.6456 x 80 = 52 cu ft

REQUIRED VOLUME OF SLURRY

398 + 52 = 450 cu ft

NEAT CEMENT VOLUME

1.2 cu ft/sack = 120 cu ft

GEL CEMENT SLURRY

450-120 = 330 cu ft

GEL-WATER REQUIRED FOR MIXING

5.7 gal x 330 = 1881 gal

= 45 bbls

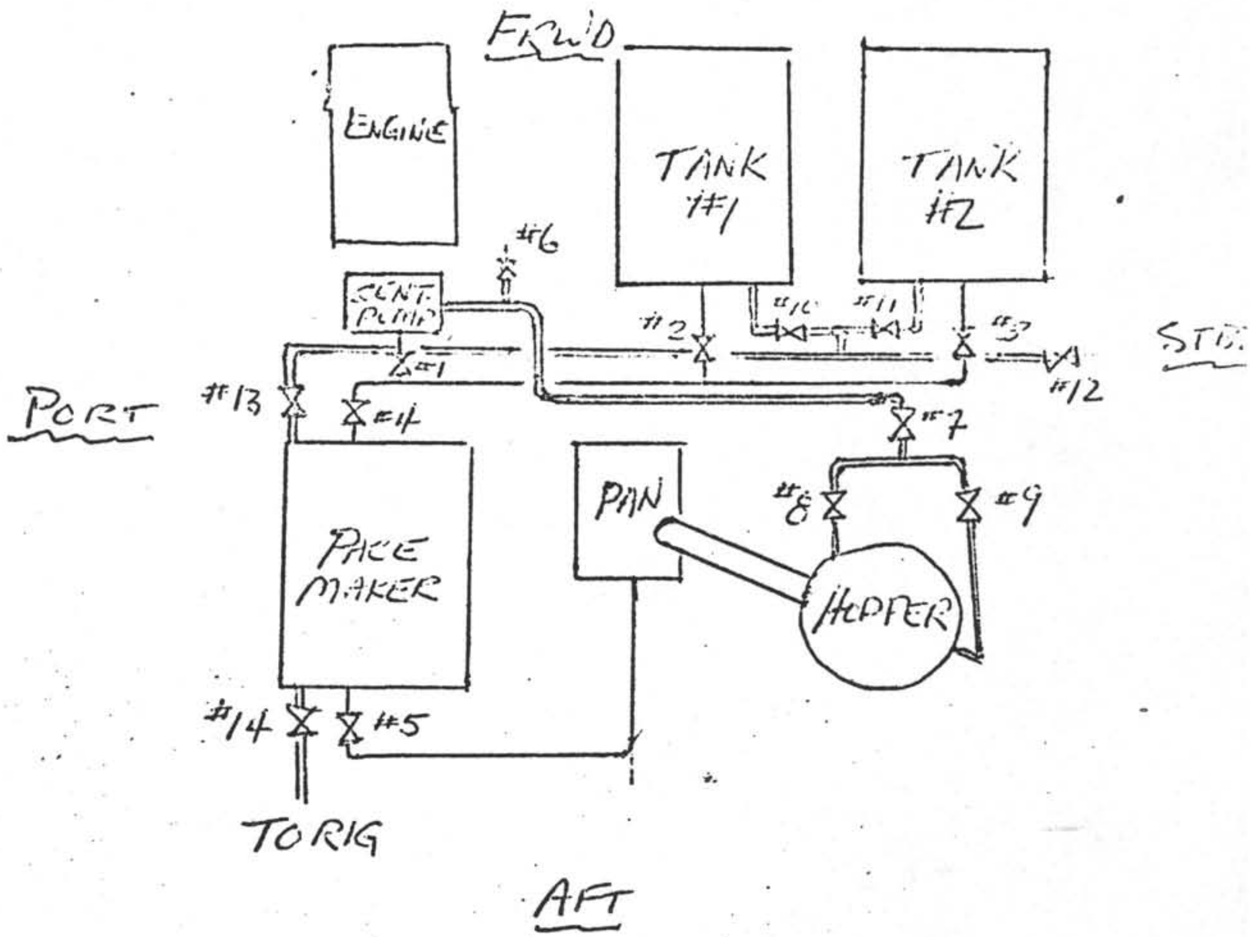
FRESH WATER REQUIRED FOR MIXING

5.4 gal x 100 sx = 540 gal

= 13 bbls

DISPLACEMENT VOLUME OF DRILL PIPE

0.01776 bbls/lin ft x 15.095' = 268 bbls



SCHEMATIC - CEMENTING EQUIPMENT
GLOMAR CHALLENGER

OPERATIONAL PROCEDURES

STEP #1

Mix 200 barrels + of a gel - fresh water mix weighing 63.5 PCF (8.5 PPG) in 500 barrel storage tank. Test mixture with cement as shown on Page 1 of instructions.

STEP #2

Hook-up transfer line to valve #12 and fill measuring tanks with gel-water.

STEP #3

Check operation of unit by circulating measuring tanks set valves as follows:

Valve #1 - Open	Valve #8 - Closed
Valve #2 - Open	Valve #9 - Open
Valve #3 - Closed	Valve #10 - Open
Valve #4 - Closed	Valve #11 - Closed
Valve #5 - Open	Valve #12 - Closed
Valve #6 - Closed	Valve #13 - Open
Valve #7 - Open	Valve #14 - Closed

STEP #4

Close jet line valve #9 to hopper and adjust throttle on Detroit diesel so that centrifugal pump discharge reads 100 psi.

STEP #5

Shut master Valve #7 to hopper control stand. Open hopper jet line Valve #9 and open hopper density control Valve #8 to one half.

STEP #6

Open master control Valve #7 and circulate tanks. Leave throttle setting fixed and change gears as required to keep mixing pan one-half full.

STEP #7

Hook-up pneumatic cement shipping line to surge hopper. Fill hopper.

STEP #8

Close master control Valve #7. Open Valve #14 and close Valve #13. Open Valve #7 and fill hopper with cement.

STEP #9

Weigh slurry and adjust density with density control Valve #8. Open to lower density and close to increase density.

STEP #10

When fluid level in first tank has gone down 5 barrels (15 barrels remaining) switch to #2 tank. Open Valve #3 and close #2.

STEP #11

Refill #1 measuring tank. Continue mixing gel-cement. After using fluid in #2 tank switch to #1 tank. Refill #2 tank with fresh water.

STEP #12

After completion of mixing gel-cement slurry, switch to fresh water tank and adjust density to 116-118 PCF (15.5 - 15.7 PPG). After mixing with 6.0 barrels close master control Valve #7 and put pacemaker in neutral. Fill #1 tank with sea water.

STEP #13

Remove cementing head from drill pipe and insert wiper/latch down plug. Reinstall cement head.

STEP #14

Open Valve #7 and complete mixing of neat cement (7 barrels) and follow cement with remaining fresh water (7 barrels).

STEP #15

Switch valves to displace directly with pacemaker pump. Open Valve #4 and close #5. Open #2 and close #3.

STEP #16

Displace cement with theorectical volume (254 barrels) of sea water and slow pump down and watch for pressure increase. An excess of 1-3% is normal to allow for air in displacing fluid. Bump plug with 1000 psi and check for back-flow by opening Valve #13.

STEP #17

Fill tank #1 with fresh water and circulate system. Use hose on Valve #6 to thoroughly wash down equipment.

STEP #18

Break all lines exposed to cement. Wash lines, hopper and pan. Remove cement shipping line. Remove suction line adjacent to Valve #5 and clean and replace.

APPENDIX E

PHASE I - ENGINEERING REVIEW & DESIGN

STATEMENT OF WORK

I SUMMARY

The scope of Phase I work as proposed below is to design and prepare final machine drawings for fabrication of a complete prototype Re-entry Cone/Casing Hanger System as per conceptual drawings No.'s D-0212-03, C-0208-01 and C-0213-02. This sytem is to be used in lowering conical re-entry base (guide cone) and conductor casing to seafloor, jetting in this assembly and then releasing from drill pipe using existing Project running tools. The system is to be capable of suspending 500' of 16" O.D. 65 lbs./ft. casing (conductor pipe) and provide casing head for 3,000' of 11-3/4" O.D. 54 lbs./ft. casing (surface string).

A provision for removal of cuttings from the re-entry cone area will be included in Phase I. A previous concept will be reviewed as well as other designs based on proven drilling techniques currently being used in other areas.

To insure that the re-entry cone assembly will have the ability to support the 11-3/4" surface string weight (162,000 lbs. in air - 139,320 lbs. in water), Phase I will include a review of soil data, furnished by the Project from previous drilling operations.

Work to be accomplished in Phase I is described in detail below. The resultant system is to be consistent with and accompanied by appropriate operational procedures.

Upon acceptance of Phase I, a prototype system will be fabricated and tested (Phase II). The Project is to retain all rights to completed machine drawings and has the right to review all drawings prior to fabrication of the prototype. Additional units will be fabricated as the result of competitive bidding (Phase III).

II DESIGN CONCEPT

The proposed design will utilize a present design which will be modified through this Statement of Work to provide for an increased conductor casing diameter and a means of landing a second (surface) casing string with provisions for cementing. The proposed design will be based on the following concepts.

To accommodate varying seafloor conditions, a modification to the supporting structure of the re-entry cone will be required. This modification will be based upon the analysis of soil data previously developed by the Project. A consulting firm specializing in soil studies will be used as a subcontractor to aid in this analysis. Criteria will be developed to determine those seafloor conditions requiring special preparations for distributing the weight of the re-entry cone and casing over a greater area.

Phase I will include recommendations for a method of determining seafloor integrity, either by penetrating with the drill string or by more formal penetrometer techniques. These recommendations will be intended for use in determining the need for the soft bottom adapter assembly.

A casing running tool will be made up as part of the drill string from which a re-entry cone, 16" casing hanger and conductor casing are to be lowered to the seafloor, washed-in and released. A second 11-3/4" surface casing string will then be lowered on a duplex cementing shoe, landed and automatically latched into the 16" casing hanger assembly.

During lowering operations, the 16" casing hanger assembly (including re-entry cone) will be suspended on three spring loaded paddles in the latch sleeve. These paddles are to be locked in the open or running position with a sleeve and stop bolt assembly contained within the casing running tool and made-up in the drill string. To release the 16" casing hanger assembly (including re-entry cone) from the drill string, a shifting tool will be run inside the drill pipe on a sandline and positioned in by an indexing sub. By pulling up on the shifting tool, the sleeve and stop bolt assembly are to be moved upwards allowing the spring loaded paddles to swing out and free the 16" casing hanger from the drill string.

> NOTE: The design is to allow the paddles to be released by drill string rotation if necessary after sleeve has been shifted up.

The 11-3/4" surface casing and hanger will be run on a duplex cementing shoe, latched into the 16" casing hanger assembly and cemented in place with swab cups.

The design should incorporate an adequate safety factor allowing for dynamic loads commonly experienced during operations from a floating vessel. Heaves of up to 10' roll and pitch of 8^{o} (1/2 amplitude) may be experienced.

The maximum water depth to which the assembly will be used is approximately 25,000 feet.

III DESCRIPTION OF PHASE I REVIEW AND DESIGN TASKS

A. 16" O.D. Casing Hanger Assembly - The proposed work will result in final machine drawings for use in fabrication of the 16" casing hanger assembly as per conceptual drawing No.'s. D-0212-03 and C-0208-01 and to be compatible with present 9 7/8" casing running tools drawing No.'s RE-010 (release sub), R-068-01 (index sub, D-0079-02 (shifting sleeve), A-0081-02 (stop bolt assembly), A-0080-03 (stop bolt sleeve) and RE-28 (stop bolt). These drawings are to include the following:

1. 16" casing hanger body
2. shoulder ring
3. latch groove ring
4. latch sleeve
5. shaft (3 required assemblies)
6. paddle (3 required assemblies)
7. torsion spring (3 required assemblies)
8. roll pin (6 required assemblies)
9. transition sub (16" casing hanger to 16" O.D. 65 lbs./ft. casing pup).

B. 11 3/4" O.D. Casing Hanger Assembly - The proposed work will result in final machine drawings for use in fabrication of the 11-3/4" O.D. casing hanger and latch assembly as per conceptual drawing No. C-0213-02 and to be compatible with 16" casing hanger assembly as described in A. above. These drawings are to include the following:

1. 11-3/4" O.D. casing hanger
2. latch ring
3. stabilizing lugs for first joint of 11-3/4" O.D. casing.

NOTE: Stabilizing lugs may be welded to slightly oversized tubing that can be slipped over 11-3/4" casing joint tack welded in place and clamped at the base (Drawing No. C-0213-01).

C. 16" Diameter Conical Re-entry Base (Guide Cone) - The proposed work will include modifying existing machine drawings No. RE-020, 10285 sheet No. 1, 1028t sheet No. 2, 10285 sheet No. 3 (conical re-entry base), B-0084-00 (cone, guide base, re-entry), A-RE-030 (guide base latch installation), A-RE-31 (guide base latch), A-RE-32 (latch rod), A-RE-35 (stop washer), A-RE-33 (latch spring) and A-RE-34 (latch spring retainer), to be compatible with the 16" O.D_ casing hanger assembly and the 11 3/4" O.D. casing hanger assembly described in A. and B. above and consistent with conceptual drawing No.C-0213-01.

The proposed work will also include modifying of the existing re-entry base to accept the required soft-bottom adapter assembly. This equipment would be used only if required, as indicated by seafloor integrity.

D. Cuttings Removal System - The proposed work will include developing of an acceptable design for a cuttings removal system to insure that cuttings returning to the top of the hole will not build up in the re-entry cone but will be discharged to the seafloor.

PHASE II PROTOTYPE FABRICATION AND TEST

Although Phase II is outside the scope of this proposal, the following statement of work is included for clarification. If awarded Phase I, Deep Oil is prepared to undertake Phase II subject to estimates which will be prepared based on Phase I designs.

The designs and construction drawings developed in Phase I will be used in the fabrication of a complete prototype unit. Upon completion of the prototype components a test program will be conducted to demonstrate proper clearances, mechanical actuation, and reliability of latching and locking devices. Phase II will also include modification of production drawings and preparation of bid specifications for use by the Project for the fabrication of production units (Phase III).

The various components will be tested as follows:

16" Casing Hanger Test

1. Rotate paddles to support position under latch groove ring and cock by sliding shifting sleeve to down position. This will check paddles clearance and compatibility with running tool.

2. Lower casing running tool and latch sleeve into 16" casing hanger with shoulder and latch groove rings riding on upper paddle surface. Make up shoulder ring to casing hanger.

3. Pick-up assembly. Rotate and/or shake 16" casing hanger assembly through horizontal and vertical angle to test for premature release.

4. Pull shifting sleeve up allowing paddles to rotate and release latch assembly from 16" casing hanger assembly.

5. Repeat cycle five times.

6. Latch 16" casing hanger assembly into conical re-entry base and lift to verify latching action. Set down and release latch segments.

7. Repeat cycle five times.

8. Latch 16" casing hanger assembly into conical re-entry base. Pick up off bottom and repeat steps one through five.

9. A 50,000 lb. static load pull test should be performed on latch sleeve assembly.

<u>11 3/4" Casing Hanger Test</u>

1. Latch in 16" casing hanger assembly with transition sub to conical re-entry base- Retrieve latch sleeve assembly.

2. Land and latch-in 11 3/4" casing hanger and one joint of heavy wall casing with stabilizing lugs in 16" casing hanger. Pick up to test latching ring.

   NOTE: Latch groove ring to be equipped with threaded holes around circumference for release screws.

3. Rotate and/or shake assembly through horizontal and vertical angles to test for failure of latch ring.

4. Repeat three times.

5. A 200,000 lbs. static load pull test should be performed on the 11 3/4" casing hanger assembly.

Cuttings Disposal System Test

Test of this unit will be limited to assembly for the purposes of verifying clearances and mechanical actuation only. It is not within the scope of this test to verify actual cuttings disposal capability.

Foundation Support Equipment

Test of the Foundation Support Equipment will be limited to the assembling of the "soft bottom adapter" with the re-entry base to verify the alignment of the connections.

Dynamic Testing

All dynamic testing will be limited to the safe handling capacity of the existing 10 Ton bridge crane in Deep Oil's test facility. This program, as presently written, does not include any special handling or dynamic test equipment for developing operational type accelerations that may be considered as representative of at-sea conditions.

Production Drawings and Specifications

At the completion of Phase II prototype test and acceptance, a production bid package will be compiled including production drawings, assembly drawings, bills of materials, and specifications for use by the Project in procuring subsequent units.

PHASE III FABRICATION OF PRODUCTION UNITS

Although outside the scope of this proposal, it is understood that following the fabrication of the prototype unit, additional units required by the Project will be procured by competitive bids from qualified manufacturers. Deep Oil Technology requests to be regarded as a qualified source for these units.

APPENDIX F

REPORT
EVALUATION OF SOIL SUPPORT
DRILLING REENTRY SYSTEM
DEEP OCEAN SITES
FOR DEEP SEA DRILLING PROJECT

DAMES & MOORE JOB NO. 8607-001-02
LOS ANGELES, CALIFORNIA
February 26, 1975

February 27, 1975

Deep Oil Technology
1280 Windham Avenue (Pier G)
Long Beach, California 90802

Attention: Mr. Ed Horton, President

Gentlemen:

We are transmitting herewith five copies of our report, "Evaluation of Soil Support, Drilling Reentry System, Deep Ocean Sites, for Deep Sea Drilling Project."

This work was commenced following our December 2 and 18, 1974 meetings in your offices. Our initial steps are discussed in our December 18, 1974 letter to you, and subsequent steps toward solution were identified and planned during further technical meetings.

We have recommended that the reentry system be supported by jetting-in at least 300 feet of 16-inch casing, and have described conditions representing exceptions to our assumptions. We believe recommended single system configuration and utilization of a familiar and simple installation method represents the most economical solution to the problem.

This has been an exceptionally interesting and challenging problem for which there was no soils engineering precedent. Hence, we drew upon the combined offshore experience of a number of Dames & Moore staff members in addition to the technical team members represented in our meetings.

We wish to express our appreciation for the excellent assistance and cooperation we received from your project team and from the Deep Sea Drilling Project staff. This was especially helpful to us in identifying and defining the practical soil mechanics problems to be addressed.

It has been a pleasure to assist you in this unique project. Please contact us if you have any questions regarding this report.

Very truly yours,

DAMES & MOORE

Vernon A. Smoots
Partner

Jerry C. Wilson
Associate

VAS:JCW:do

APPENDIX F

REPORT
EVALUATION OF SOIL SUPPORT
DRILLING REENTRY SYSTEM
DEEP OCEAN SITES
FOR DEEP SEA DRILLING PROJECT

INTRODUCTION

Deep Oil Technology has been contracted by the Deep Sea Drilling Project (DSDP) to design a complete prototype drilling reentry cone/casing hanger system. This system is to be installed in the sea floor in both the Atlantic and Pacific Ocean basins and must be supported by the deep ocean sediments. The system must be operational for a period of several months and provide for multiple reentries at deep crustal drilling sites. Provisions for sonar tracking and cuttings removal must be compatible with the concept for support of the system.

Deep Oil Technology (DOT) has authorized Dames & Moore to assess the supporting concept for this new system and the capacity of the deep ocean sediments to carry the imposed loading. Total load of the system may be up to 180,000 pounds. This will consist of the reentry cone/casing hanger system, 16-inch surface conductor and 11-3/4 inch casing. The lower end of the casing must be cemented into oceanic basalt. Dames & Moore also reviewed the methods of installation of the system as this is a critical influence on the strength of the supporting sediments. There is no basis of engineering experience regarding the potential behavior of these soils.

SCOPE OF WORK

The work tasks performed by Dames & Moore included the following:

1. Assess the supporting concept to be designed into the system, including surface bearing, skin friction, end bearing, or combinations of these.

2. Review available physical property information and other published data provided by DSDP and DOT to extract geotechnical engineering data.

3. Use these to make general assumptions and choose soil parameters for use in computations on the basis of our past experience and judgment.

4. Perform computations to analyze load carrying capacities.

5. Provide recommendations for comparison of various methods of placement.

6. Define work needed before and during drilling at reentry sites to confirm applicability of our assumptions and computational approach.

SUPPORT CONCEPT

Dames & Moore reviewed general unreduced sedimentary data and discussed results of previous reentry operations using a lighter system. On the basis of this initial information we provided the recommendation that the system support should be evaluated in terms of skin friction. DOT acknowledged that this was feasible in terms of their design considerations.

The problem was then defined as support capacity of a single pipe pile. Following this, our work was directed toward collecting sedimentary data appropriate to this type of soil mechanics analysis.

SOIL DATA

Previous borings made by DSDP have revealed that unconsolidated surface sediments of ooze and clay are characteristic of both the Atlantic and the Pacific Ocean sites, typically to depths on the order of 300 meters (1,000 feet) below ocean bottom. This generalization was concluded in conjunction with DSDP staff on the basis of boring data in the vicinity of the five reentry sites specified for this project. Eighty to ninety percent of all these surface sediments were found to be calcareous or siliceous ooze, which is primarily fine grained sediment. One sample selected as typical by DSDP was provided to us for visual inspection and appeared to have the characteristics of a silt soil. Differences in engineering characteristics between samples, especially strength properties, may be overshadowed by the large amount of disturbance during this type of sampling. However, certain baseline engineering information can be assumed from the scattered data.

Shear strength data are available for a limited number of ocean sites. These data do not show a significant variation from site to site. A laboratory vane or a torvane was used to perform these tests. This is not the best testing method for silty materials. Therefore, the shear strength information must be utilized only with caution. A review of density, porosity, and water content data from DSDP samples indicates that these materials are fairly uniform. Limited data are available on the plasticity and grain specific gravity of the ooze. These latter properties are not affected by soil disturbance.

These data are directly related to soil behavior and indirectly related to strength characteristics. To make a selection of soil parameters for use in computations, considerable judgment was needed in utilizing the limited available data. This was augmented somewhat by a visual inspection of one typical sample of ooze selected by DSDP. Our judgments were based on comparing our past experience with similar structures and various offshore installation procedures.

In view of this discussion it is apparent that a relatively low degree of confidence can be placed on the input data. However, our calculations do serve to demonstrate orders of magnitude and allow comparison of various installation techniques.

CALCULATIONS

Three methods of installation for the casing pipe were considered: jetting, drilling-and-grouting, and driving. Computations were made for load-carrying capacities of the casing if it were installed by each of these three methods. The results of the computations are shown on Plate 1, Recommended Vertical Load Capacity of 16-Inch Casing in Deep

Ocean Ooze Assumed Typical of Reentry Sites. It was assumed that the casing is embedded entirely in ooze. A discussion of the assumptions and choice of soil parameters is presented in the appendix.

The computations were performed using two approaches. In the first approach all soil parameters used in the computation were chosen as conservative numbers that would yield low vertical load capacities with no factor of safety applied. In the second method, numbers that in our judgment were realistically applicable were used to develop vertical load capacities, and a factor of safety of 3 was applied. The use of the safety factor of 3 for vertical pile capacities after having chosen realistic soil parameters is not uncommon in the practice of geotechnical engineering. A comparison of the capacities calculated by these methods showed that the first method generally yielded lower capacities.

We also took into account the effect of liquefaction which may occur in the ooze material due to cyclic lateral loading on the casing pipe during drilling. We calculated the hypothetical maximum depth of liquefaction to be on the order of 70 feet. This reduction of strength was included in both methods of analysis.

CONCLUSIONS

Our computations indicate that although jetting would yield lower ultimate vertical capacities, it would still be the most desirable method of implacement. This is in view of simplicity and previous experience in field installation and the relatively short length (300 feet) of casing needed for generating the design capacity. We understand from DOT that jetting-in to penetration of 300 feet is feasible and practical with the GLOMAR CHALLENGER.

We believe that upon initial installation with jetting, the casing will have only a small fraction of the capacity that it will ultimately reach after "setting-up." It is difficult to estimate the time required for the setting-up process to reach equilibrium. However, we understand that the casing will not be loaded to its full capacity immediately after installation. A time lapse of at least 24 hours should be allowed for the casing to set up.

VERIFICATION

In order to assure that the material in which the casing is being installed is of the same type as assumed, we recommend that plasticity tests (Atterberg Limits test) be performed aboard the drilling ship on cores recovered from sediments at the site. These are relatively simple tests. They may be performed by a technician in a reasonably short period of time. The test methods are described in the American Society for Testing and Materials, Test Procedure Designations D-423 and D-424. These tests are used to classify fine grained soils. If the results of these tests on the drilling ship indicate an ML or MH type soil (using the Unified System of Soil Classification) having a plasticity index of less than 20 the curves and data provided by us may be used. We anticipate that all ooze material will be found to be of the above type. If large proportions of the cored material are not of these types (say more than 25 percent) a revision of our recommendations may be needed.

The following items should be observed in the field. These are indicators of possible problem areas.

1. If it is found that the material of the surface sediment plots soil type as CL or CH and in addition to that, the second method of jetting

described below under "Recommendations," is essential for lowering the casing to the required depths, there is a serious problem.

2. We understand that experience indicates that if jetting is stopped for about 2 hours or more, then the casing "sets up" and further jetting is not possible. If at any time it is found that this is not true and that jetting may be continued even after allowing several hours of setting up time, then the minimum set-up time recommended should be increased. Further, this indicates that the material is not behaving in accordance with our assumptions.

3. If the casing is jetted through zones of hard material (hard material includes anything of the consistency of soft rock) then friction cannot be relied on in this zone. This reduces the vertical capacity of the pipe. Such a condition is not common in the ooze, but if hard layers of significant thickness are encountered, the length of the casing should be increased by the thickness of such layers.

4. The density of the ooze material has been assumed at 94 pounds per cubic foot (1.51 gm/cc), yielding a submerged unit weight of 30 pounds per cubic foot (0.51 gm/cc). If it is found at any time that the in situ density of the ooze material is less than this number, a correction should be made in the required length of the 16-inch casing. For example, if the density of the ooze is found to be as low as 84 pounds per cubic foot (1.35 gm/cc), which yields a submerged density of 20 pounds per cubic foot (0.35 gm/cc) then the required length of the

casing should be increased in proportion to the submerged densities. In this example the length of the casing required would be 1-1/2 times our initial recommendation (that is, 450 feet).

RECOMMENDATIONS

We recommend that for all sites where the surface material is composed primarily of calcareous ooze the 16-inch casing be placed to a depth of 300 feet or more. We understand that this is not an unrealistic depth by current field procedures, and such a length will be sufficient to provide lateral support for the drill string. If the casing is installed by jetting, at least 24 hours should be allowed to elapse before the casing is loaded to its full capacity. A longer length of time to allow setting up is preferable.

To better define the coefficient of friction between ooze material and casing pipe, we recommend that laboratory tests be performed on already obtained samples of ooze. This is an inexpensive process which will lend further confidence to our analysis.

We are informed that the jetting process may be performed by two methods. In the first method, a pipe is lowered inside the 16-inch casing and material is cleaned by jetting from inside the casing only. In the second method, this pipe is extended about 1 foot below the bottom of the 16-inch casing and a seal provided in the annulus between this pipe and the 16-inch casing so that the drilling fluid is forced to return upward along the outside of the 16-inch casing. The second method results in considerably greater disturbance to the in situ soils. This reduces vertical capacity in general. Therefore, we recommend that if the casing can possibly be lowered to the recommended depth of 300 feet using the first method of jetting, then this method should be used. If this method has to be supplemented with the second method the use of the second method should be minimized and jetting pressures should be kept as low as feasible.

We recommend consideration of including a procedure to "rattle" or vibrate the system after the design depth is reached. This might be done by an eccentric attachment that could be rotated by the drill string. This would tend to augment the setup of the pipe. In addition, it would provide the advantage of causing any soil strength reductions related to liquefaction by cyclic loadings to occur prior to actual drilling and reentry operations. Some of this loss will be recovered during the set up period.

o0o

The following plate and appendix are attached and complete this report:

Plate 1 - Recommended Vertical Load Capacity of 16-Inch Casing in Deep Ocean Ooze Assumed Typical of Reentry Sites

Appendix: Assumptions and Choice of Soil Parameters

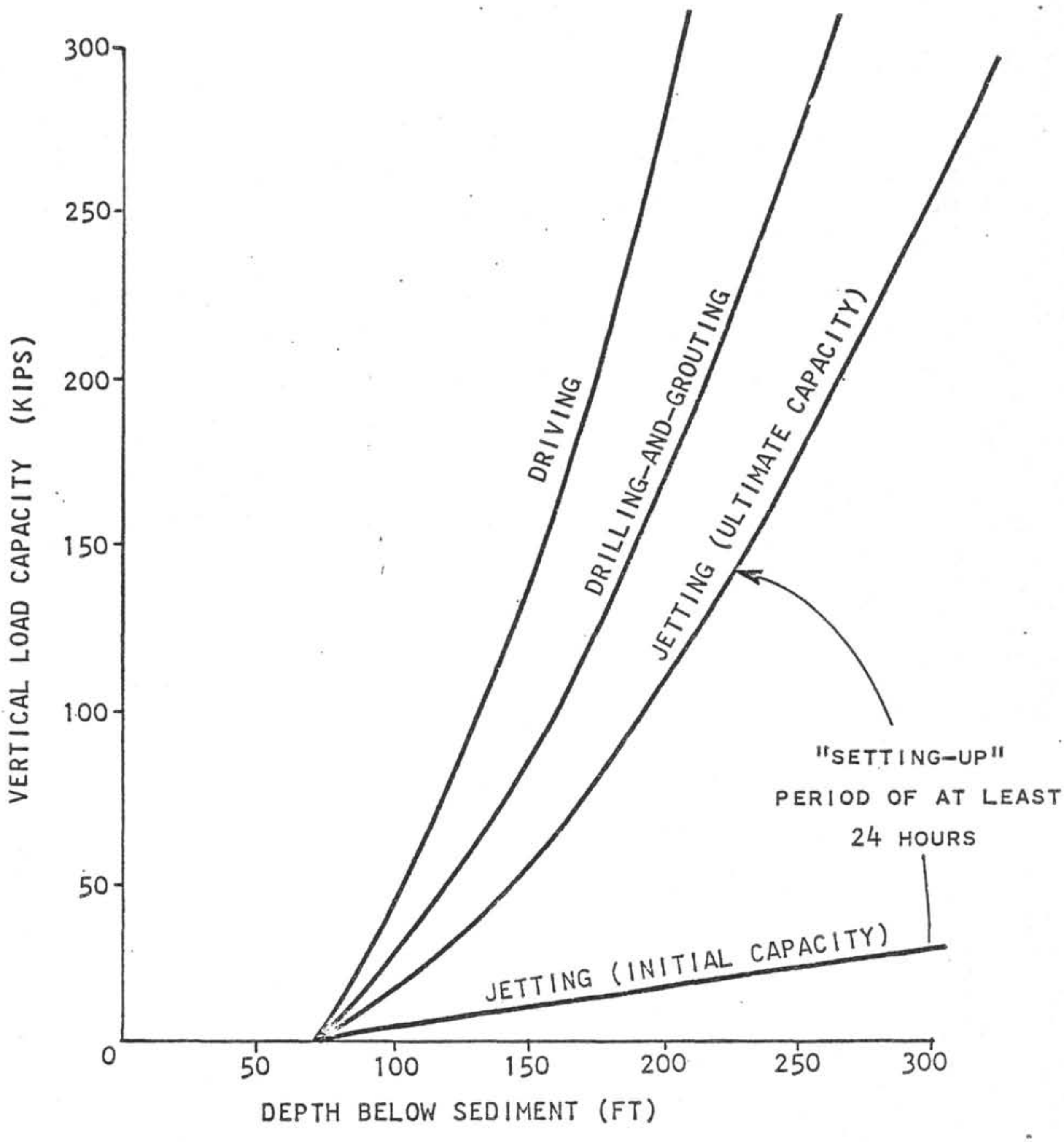
DAMES & MOORE

Vernon A. Smoots
Partner

Jerry C. Wilson
Marine Geologist

Iskandar Khan
Soils Engineer

February 27, 1975
Los Angeles, California



RECOMMENDED VERTICAL LOAD CAPACITY OF 16 INCH CASING IN DEEP OCEAN OOZE ASSUMED TYPICAL OF REENTRY SITES

PLATE 1

APPENDIX
ASSUMPTIONS AND CHOICE OF SOIL PARAMETERS

GENERAL ASSUMPTIONS

1. The casing is embedded throughout its length in ooze. This assumption is reasonable in the sense that the depths (of sediments) we are considering are less than 600 feet (approximately 200 meters). The ooze and clay at Site 146/149 were found to exist to twice that depth. Also, the clay has a higher strength than the ooze, based on available data, in its undisturbed condition.

2. The three methods of placement have the following essential features:

   a. Jetting: A jet of drilling fluid scours material at the bottom of and ahead of the casing. The drilling fluid returns inside the casing. Some water may be lost in the sediment while jetting ahead. The casing is advanced by some method to the required depth.

   b. Drilling-and-Grouting: The casing is provided with drilling teeth. It is rotated into the ocean bottom with slight over-coring. A jet cleans the inside of the casing but stays well above the bottom during drilling. At the required depth grout is injected under pressure at the bottom and joints of the casing.

   c. Driving: The casing is driven ahead. The soil inside is removed by jetting making sure that the jet stays well within the casing. This procedure is repeated until the required casing depth is reached.

3. The choice of soil parameters used in these computations has been based on information available from tests on highly disturbed samples. No strength data were available for Site 146/149. Information from other sites was reviewed to estimate strength parameters. There is considerable scatter in shear strength data generated at any particular location. However, the overall trend is the same for all ooze material studied.

CHOICE OF SOIL PARAMETERS

The following parameters were chosen after a review of available soil information.

Description of Parameter	Symbol	Chosen Value: Most Conservative	Chosen Value: Realistic	Remarks
Average total unit weight	γ_t	94 pcf	104 pcf	
Average submerged unit weight	γ_b	30 pcf	40 pcf	
Effective cohesion	C'	0	0	
Effective angle of internal friction	ϕ'	35°	25°	Used to compute lateral pressures only.
		15°	20°	Used Elsewhere
Remolded undrained strength	C_{ur}	30	100	
Angle of friction between ooze and casing	δ	10°	20°	
Ratio of horizontal effective stress to vertical effective stress	K			
a. Jetting	K_j	$\frac{1-\sin\phi'}{1+\sin\phi'}$	0.35	
b. Drilling and Grouting	K_g	$1-\sin\phi'$	0.6	
c. Driving	K_d	0.7	1.0	

W. NUGENT
REG. PROFESSIONAL ENGINEER
ASSOCIATE FELLOW AIAA

Date November 9, 1976.

To: Mr. S. T. Serocki
Chief Engineer.
Deep Sea Drilling Project
Scripps Institution of Oceanography
University of California at San Diego.

Subject: Progress Report- Re entry Guide Cone Drilling Assembly

Reference: P.O. No 7B-02172-0

STAFF STUDY REPORT

1.0 Introdution and Problem Statement.

The subject assembly is exposed to a variation of environmental and physical conditions which interact and contribute to possible malfunction.
This thirty hour study will review and outline the mechanics of some of the probable failure causes.

2.0 Assumptions
The results of "Beari ng Capacity Study of Seafloor Soils Mid-Atlantic Ridge Atlantic Ocean" by Mc Clelland Engineers, Inc. Houston Texas, Dated April 1976, is used as the baseline.

2.1 Particular reference is made to the following:
Maximum load onthe cone withot skirt extension 125,000 lbs. at a penetration depth of 12 feet below the ocean floor based on a friction angle of 20°

Maximum load on the cone with the skirt extension 200,000 lbs. at a penetration depth of 4 feet below the ocean floor based on a friction angle of 20°.

Density of the calcareous ooze 35 lb/ft^3.

3.0 Facts Bearing upon the Problem.
An increase in the base area of the cone skirt produces a significant increase in the supporting capacity of the re entry guide cone for a given penetration. Reference is made to Plates 5and 6. The change in slope of the load versus penetration relationship cunve Plate 6 at 4 feet indicates a sudden change in the stress - strain relationship of the foundation material.

4.0 Discussion
The primary objective of this study is to analyze the structural integrity of the subject assembly particularly the skirt extension.
An intuitive approach is taken to analyze the mechanism.
Consider a thin membrane structure with a light weight rim, Reference Figure 1.

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Mr. S. T. Serocki
Progess Report
Re entry Guide Cone Assembly
P.O. No 7B-02172-0

Date November 9, 1976

4.0 Discussion (continued)
The Guide Cone Assembly Skirt is considered to be loaded at P and supported uniformly at its base. Reference Figure 1.
A static condition will be analyzed with the load P =-200,000 lb.
The contribution of the struts will be neglected.
Results of a preliminary analysis will be presented in Appedix A to this report.

5.0 Observations
The foundation material on the ocean floor is reported to be subject to liquification due in part to vibratory motion during the drilling process. This "pumping action" tends to reduce the foundation bearing pressure, and coupled with the predicted sudden change in the load versus penetration relationship Plate 6., the assembly may experience relatively high acceleration and high rates of change in acceleration(snatch loads).

6.0 Recommendations
1) The assembly be analyzed for factual operating weights and predicted vibration and acceleration spectra.

2) Investigate the application of buoyancy material to reduce the submerged weight of the installation.

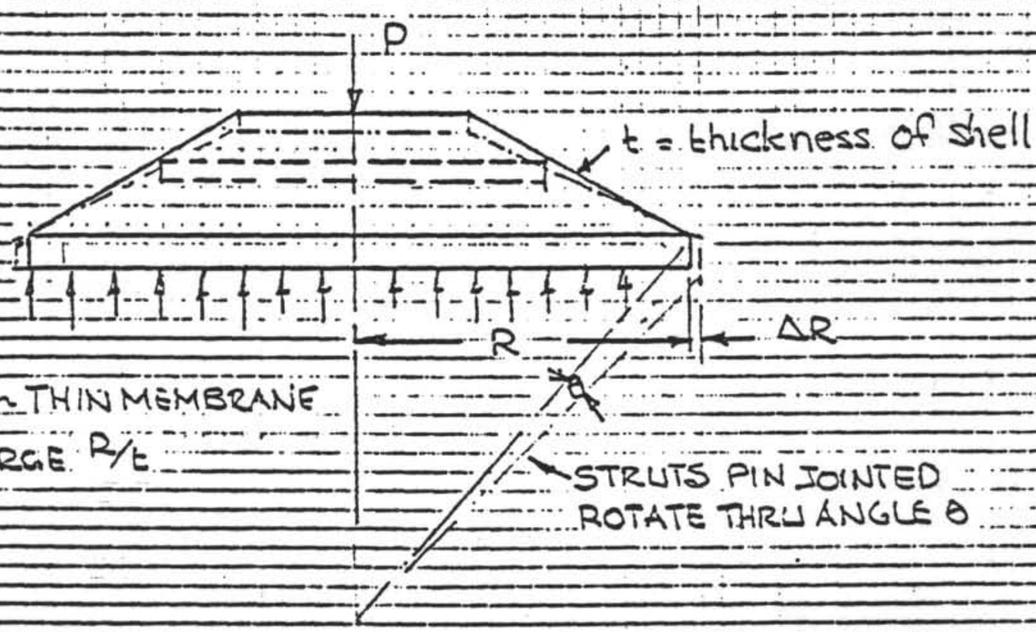
7.0 Proposed Study Items for the next Phase.
1) Methods for reinforcing the skirt and skirt extension for exposure to 25,0001b. casing hanger systems in 10, 20, 50g acceleration environments.

2) methods for load alleviation viz. buoyancy material application.

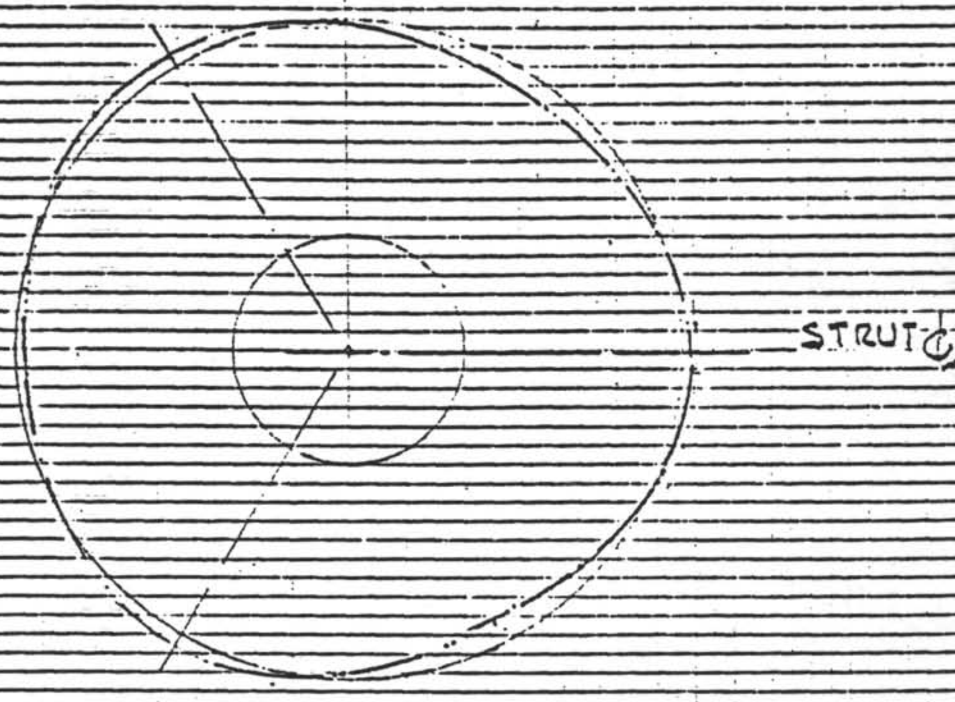
8.0 Time Used for this Phase.

1) Conference and Familiarization	3 hours
2) Report Reading and Digest	2.5 hours
3) Data Search (references)	2.5 hours
4) Analysis	8.0 hours
5) Report Preparation	2.0 hours
6) Travel	40 miles.

F.GURE 1



THE BASE RIM DEFLECTS INTO AN OGIVAL SHAPE UNDER THE INFLUENCE OF THE STRUTS



IF THE RIM IS STIFF "NON-YIELDING", THE BASE MORE NEARLY RETAINS ITS CIRCULAR FORM & THE CONICAL SHELL DEFLECTS.

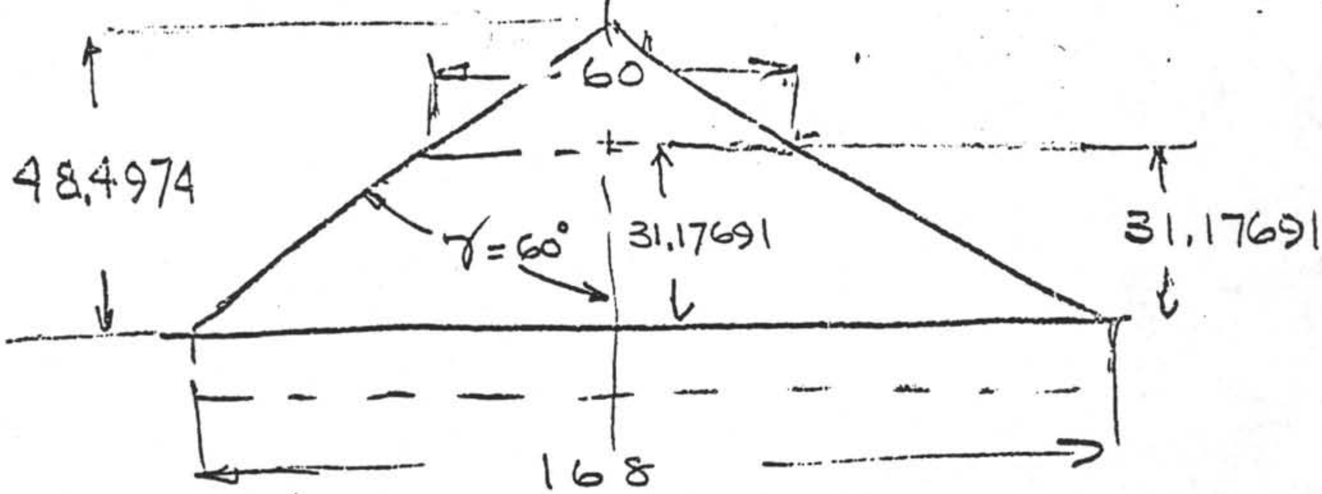
INCREASING THE MOMENT OF INERTIA OF THE CONICAL SHELL BY STIFFENERS RADIAL TO THE CONICAL SURFACE REDUCES THE DEFLECTION & INCREASES THE LOAD SUPPORTING CAPACITY.

THEN THE STRUTS, WHILE PROVIDING A DEGREE OF STABILITY, ARE REDUNDA

Date November 9,1976

Progress Report on
Re entry Guide Cone Study
P.O No 7B-02172-0

W. Nugent



CONDITIONS

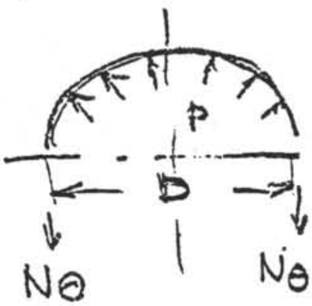
A TRUNCATED THIN WALL CONE SUPPORTED AT ITS BASE

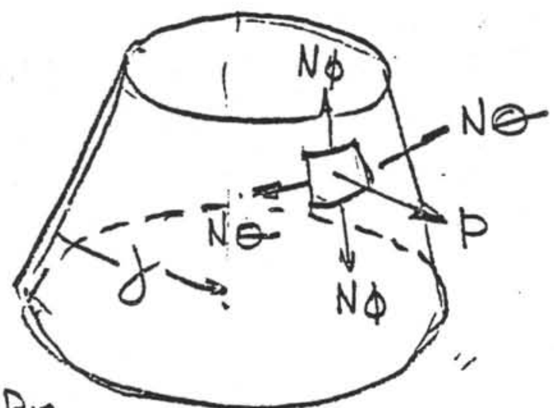
WALL THICKNESS 0.25

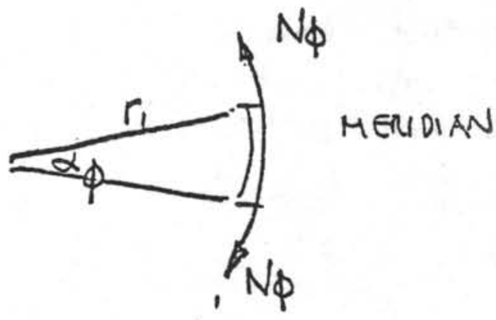
MODULUS OF ELASTICITY 29.5×10^6 lb/in^2

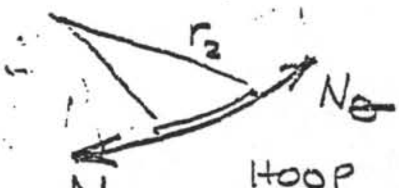
USE POISONS RATIO = 0.25

PROCEDURE: – A MEMBRANE ANALYSIS WILL BE USED TO OBTAIN REASONABLE RESULTS, IN A FIRST-ORDER-OF-MAGNITUDE ANALYSIS TO DETERMINE THE SPECIFIC STRESS LEVEL ON THE MUD CONE AND SKIRT EXTENSION.









$2N_\theta = P \cdot D$

$N_\theta = P\frac{D}{2} = Pr$

$N_\phi = P(\pi r^2)/2\pi r = \frac{Pr}{2}$

FROM THE CLASSICAL STUDY THE MERIDIAN FORCE IS HALF THE HOOP FORCE.

FOR A CONE r_1 IS INFINITY AND

$N_\theta = p r_2 = \frac{pr}{\cos\gamma}$

$N_\phi = \frac{p r_2}{2} = \frac{pr}{2\cos\gamma}$

$$\frac{N\phi}{r_1} + \frac{N\theta}{r_2} = p$$

FOR THE CONDITION OF LOADING $p = 0$

$$\therefore \frac{N\phi}{r_1} + \frac{N\theta}{r_2} = 0$$

AND $\frac{P}{\sin\gamma} = N\phi \, 2\pi R$

OR $N\phi = \frac{P}{2\pi R \sin\gamma}$

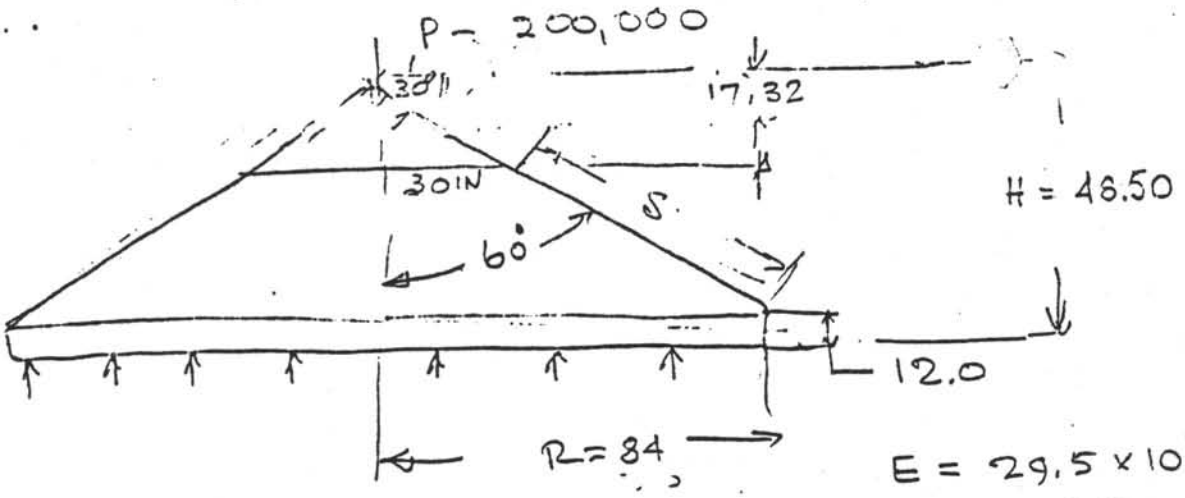
$$= \frac{200{,}000}{2\pi (84)(\sin 60°)} = 437 \text{ lb/in}$$

$$\boxed{= 1748 \text{ psi}}$$ LIMIT LOAD

THIS IS THE INTENSITY OF STRESS IN THE MERIDIANAL DIRECTION ACTING ON THE CONICAL SKIRT, NO SAFETY FACTORS HAVE BEEN APPLIED.

IF A 10g ACCELERATION IS APPLICABLE, AND THE SKIRT IS MANUFACTURED IN 'AISI 12XX MATERIALS CARE MUST BE TAKEN IN FINISHING & PROCESSING, TO ACHIEVE THE DESIRED WORKING STRESS.

TOT 1311 #/in.



$E = 29.5 \times 10^6$

$\mu = 0.25$

$$S = \sqrt{(R-r)^2 + h^2}$$

$= 62.35$ INCHES

SURFACE AREA OF TRUNCATED CONE

$$A = 1.5708(62.35)(114) = 11,165.775 \text{ INS}^2$$

EQUIVALATE THE REACTION AT THE BASE TO A HYPOTHETICAL DENSITY OF THE CONE REF ROAK

THEN $\delta = 200,000/A = 17.91 \text{ LB/IN}^3$

$$\sigma = \frac{-17.91(84)}{2 \sin 60^\circ \cos 60^\circ} = 1737 \text{ psi}$$

$$\Delta R = \frac{-17.91(84)^2}{29.5 \times 10^6 \cos 60^\circ}\left(\sin 60^\circ - \frac{0.25}{2 \sin 60^\circ}\right) = .00629 \text{ INCHES}$$

$$\Delta y = \frac{-17.91(84)^2}{29.5 \times 10^6 \cos 60^\circ}\left(\frac{1}{4 \sin^2 60^\circ} - \sin^2 60^\circ\right) = -.00357 \text{ INCHES}$$

VERTICAL DEFLECTION OF THE TRUNCATED CONE

$$\Delta_{y\,tc.} = -.00357\left(\frac{30}{84}\right)^2 = -.0004553 \text{ INCHES}$$

THE VOLUME OF SURFACE MATERIAL REMOVED BY 17.32 IN

$$\frac{30}{\sin 60^\circ}\left[30\pi\right] \times .25 = 816 \text{ IN}^3$$

WEIGHT OF VERTEX SECTION = 816 × 17.91 = 14618.31 LB.

EQUIVALATING THE UNIFORM LOAD REACTED AT THE BASE OF THE CONE TO THE EFFECTIVE WEIGHT THE RELATIVE DENSITY $\delta = 19.22 \text{ lb/IN}^3$

STRESS IN CONICAL SKIRT

$$\sigma = \frac{-19.22\,(84)}{2 \sin 60^\circ \cos 60^\circ} = -1864.155 \text{ psi}$$

CHANGE IN BASE RADIUS

$$\Delta R = -\frac{19.22(84)^2}{29.5\times10^6 \cos 60^\circ}\left(\sin 60^\circ - \frac{0.25}{2\sin 60^\circ}\right) = .00636 \text{ INCHES}$$

$$\Delta y = \frac{19.22(84)^2}{29.5\times10^6 \cos 60^\circ}\left(\frac{1}{4\sin^2 60^\circ} - \sin^2 60^\circ\right) = -.0038131 \text{ INCHES}$$

VERTICAL DEFLECTION OF THE TRUNCATED CONE

$$\Delta y_{tc} = -.0038131\left(\frac{30}{84}\right)^2 = -.00048$$

THE VOLUME OF SURFACE MATERIAL REMOVED

$$\frac{30}{\sin 60^\circ}\left[30\pi\right]0.25 = 816 \text{ INS}^3$$

WEIGHT OF VERTEX REMOVED $816 \times 19.22 = 15683.52$ LBS

$$\sigma_{tc} = \frac{15683.52}{2\pi(84)(.25)(\cos 60^\circ} = 237.724 \text{ psi}$$

$$\Delta R_{tc} = \frac{-0.25(15683.52)}{2\pi(84)(.25)\cos 60^\circ\,(29.5\times10^6)} = -2.0176\times10^{-6} \text{ INCHES}$$

$$\Delta h_{tc} = \qquad = 4.02\times10^{-4}$$

THEREFORE THE TRUNCATED SECTION OF THE CONE

$$\sigma = -1864 + 237 = 1627 \text{ psi}$$

$$\Delta R = .00636 - 2.0\times10^{-6} = .006358 \text{ INCHES}$$

$$\Delta h = -.00331 + .00048 + (4.02\times10^{4}) = -.00293 \text{ INCHES}$$

SUMMARY OF DISCUSSION NOV 18 1976

MR J.T. SEROCKI CHIEF ENGINEER

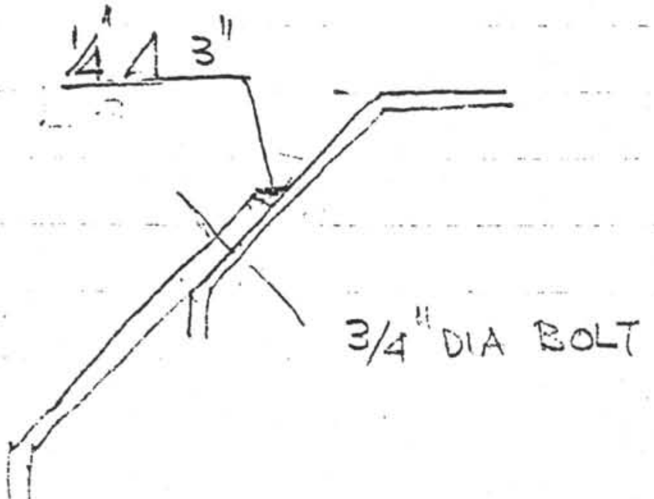
W. NUGENT CONSULTANT

SUBJECT MUD SKIRT ATTACHMENT FOR THE RE ENTRY CONE.

EXAMINATION OF THE DESIGN FOR THE SUBJECT EQUIPMENT POINTED OUT AREAS OF IMPROVEMENT FOR THE ATTACHMENT OF THE MUD SKIRT & MUD SKIRT EXTENSION AS FOLLOWS!

PROVIDE WELDS AT THE INTERSECTION OF THE MUD SKIRT AND MUD SKIRT EXTENSION

INTERMITTENT WELDS 3 INS LONG 1/4 INCH AROUND THE CONICAL INTERSECTI[illegible]



THIS ACTION IS RECOMMEND ON THE BASIS OF THE SHEAR LOAD DEVELOPED IN THE CONICAL SURFACE OF THE PLATE

MERIDINAL SHEAR = 437 LB/IN

HOOP SHEAR = 874 LB/IN

THE COMBINED EFFECT YIELDS A SHEAR STRESS OF 24,758 psi. SAY f_s = 25,000 psi.

THE ALLOWABLE f_s OF MATERIAL = 75,000 psi

SAFETY FACTORS

ALLOW 1.5 FOR LOAD FACTOR

1.5 FOR ALIGNMENT & FITTING FACTOR

3.0 FACTOR TOTAL

APPLYING A FACTOR OF 3 TO 25,000 psi SHOWS THAT THE BOLT IN THE SKIRT ARE LOADED TO THE MAXIMUM CAPACITY. FURTHERMORE THE 7/8 INCH DIAMETER HOLES IN THE SKIRT AND THE 3/4 INCH DIAMETER BOLTS DO NOT INSURE THAT THE BOLTS ARE UNIFORMLY LOADED.

AS A CONSEQUENCE THE CHAIN WELD 3INCH WELD 3INCH GAP IS RECOMMENDED TO PROVIDE UNIFORM SHEAR DISTRIBUTION AROUND THE ATTACHMENT.

W. Nugowbn

W. NUGENT
3736 GAYLE ST.
SAN DIEGO.

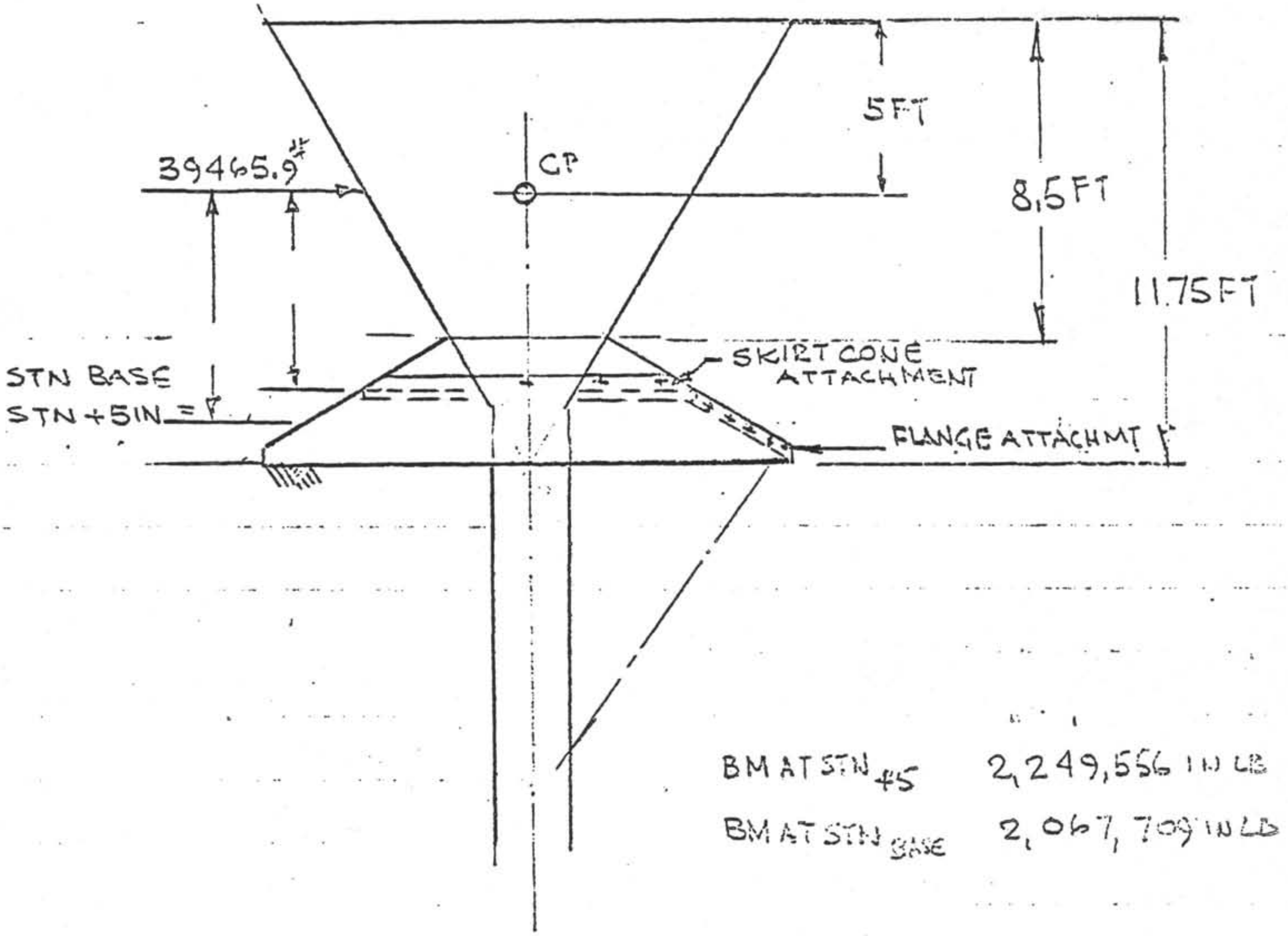
SUBJECT: DEEP SEA DRILLING PROJECT
MUD SKIRT FOR REENTRY CONE

ATTENTION:
MR STAN SEROCKI
CHIEF ENGINEER

THE STRUCTURAL DESIGN OF THE MUD SKIRT WILL BE SIGNIFICANTLY IMPROVED IF; THE BOLTING ARRANGEMENT OF THE TWO HALVES OF THE SKIRT EXTENSION, AND THE BOLT ATTACHMENT AT THE 8FT DIAMETER SKIRT & THE SKIRT EXTENSION ARE INCREASE IN NUMBER.

THE 7/8 INCH DIAMETER HOLES WITH 3/4 INCH DIAMETER BOLTS DO NOT INSURE THAT EACH BOLT IN THE ATTACHMENT CARRIES ITS SHARE OF THE LOAD, PROGRESSIVE FAILURE OF THE BOLTS IN THE ATTACHMENT COULD LEAD TO A STRUCTURAL FAILURE.

W. Nugent



CONDITIONS:

FLOW VELOCITY ~ 15 ft/SEC

DRAG COEFFICIENT ~ 2

ρ ~ (64)/32.2

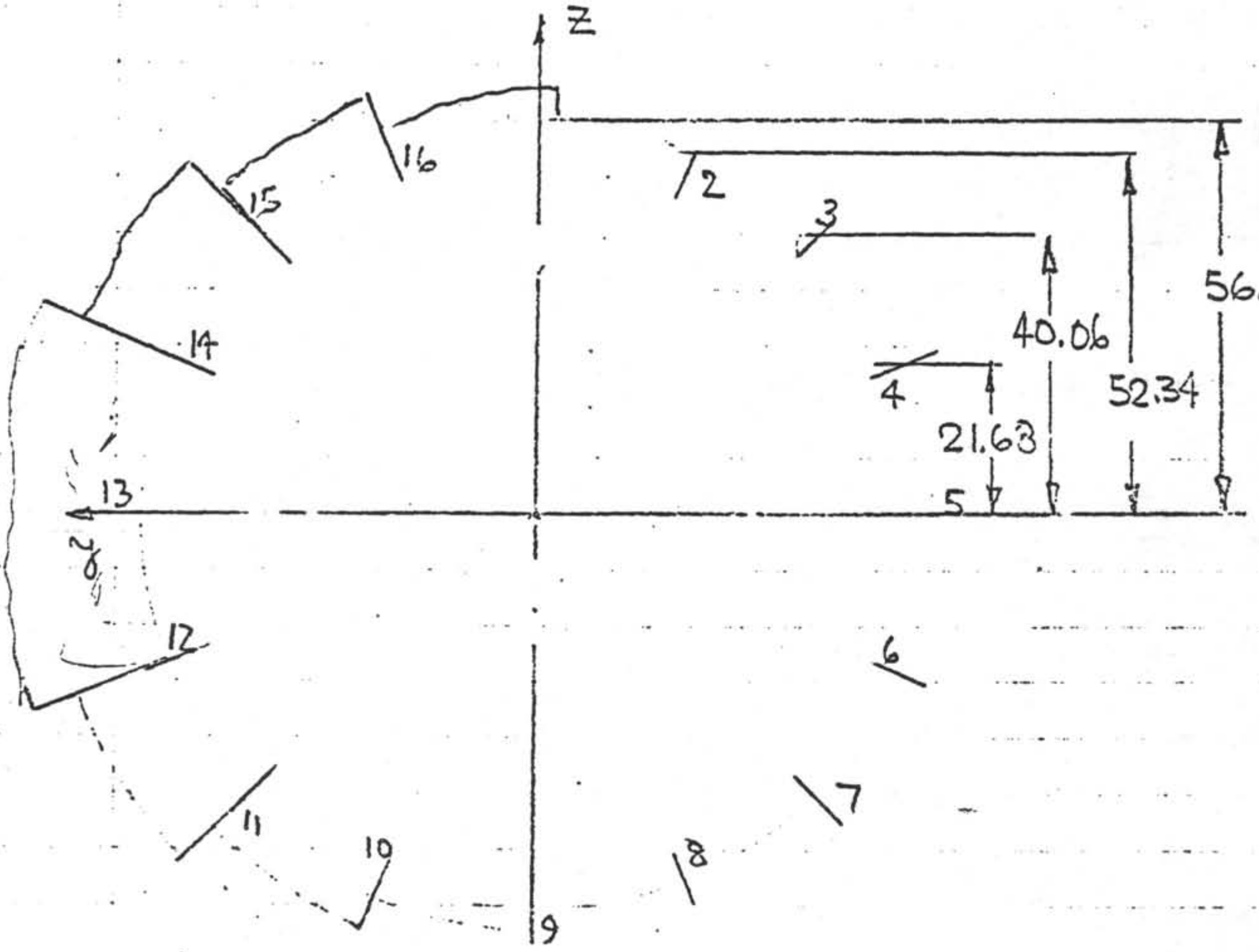
THEN DRAG FORCE $= \frac{1}{2} \rho V^2 C_D$

$= (225)(2)(.99375) = 447.2$

CONICAL SURFACE AREA $= [8.5(7.5)] + [3.5(7.)] = 88.25 FT^2$

ESTIMATED C.P. $= \dfrac{[63.75 \times 5] + [24.5 \times 6]}{88.25}$

$\cong$ 5 FT


Z
2
3
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12
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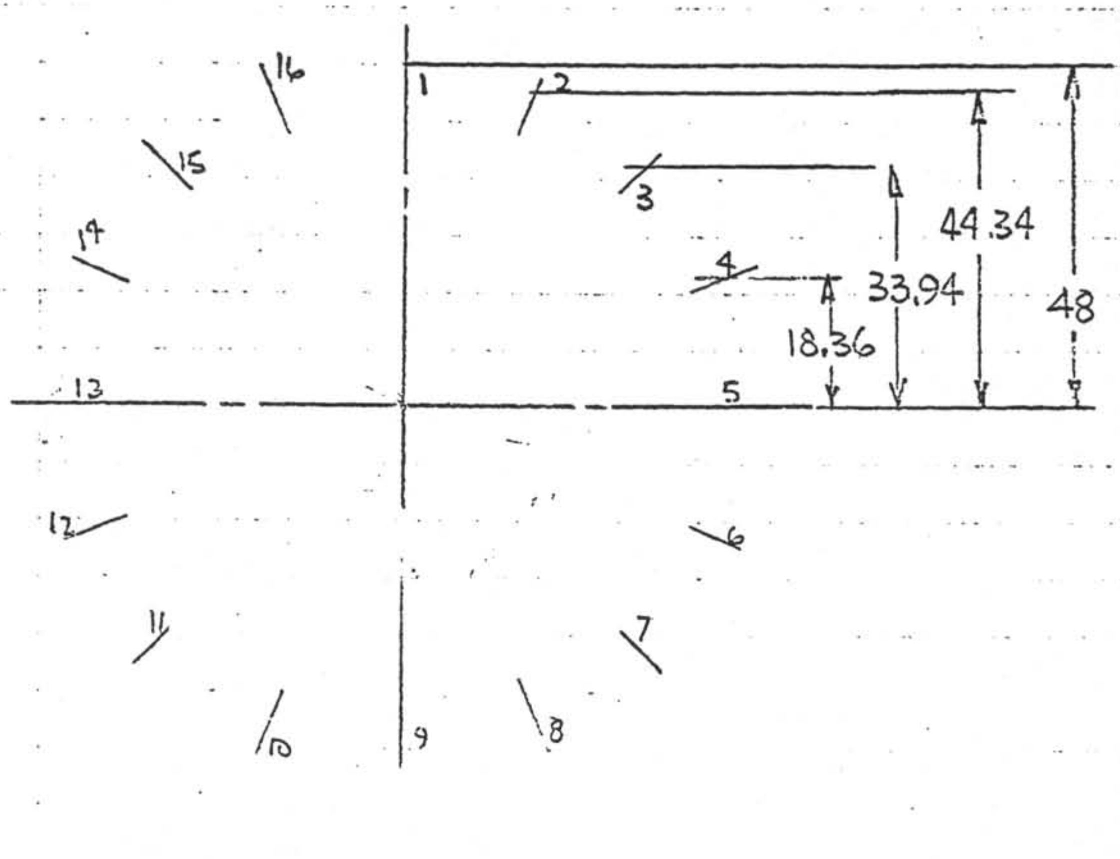
14
15
16
56.66
52.34
40.06
21.63


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
48
44.34
33.94
18.36

1	2	3	4	5	6	7	8	9		PANEL TAPER NEGLECTED
NO	STA +5" Z ARM	STA BASE Z ARM	AREA a	STA +5 $f_b = 1.99Z$	STA BASE $f_b = .255Z$ PSI	STIFFENER LOAD LBS STA +5	STA BASE	$\frac{\Delta F}{5}$ LB/IN		SHEAR LB/IN
1	56.66	48	.22	-11,281	-12238	-2481	2692	42.03		42.03
2	52.34	44.346	.44	-10,421	-11306	-4585	4974	77.75		119.78
3	40.06	33.94	↑	-7976	-8653	-3509	3807	59.5		179.28
4	21.683	18.369		-4317	-4683	-1809	2060	32.09		211.37 ✓
5	0	0		0	0	0	0	0		211.37 ✓
6	-21.683	-18.369		4317	4683	1809	-2060	-32.09		179.28
7	-40.06	-33.94	↓	7976	8653	3509	-3807	-59.5		11.9.78
8	-52.34	-44.346	.44	10,421	11,306	4585	-4474	-77.75		42.03
9	56.66	-48	.22	11,281	12,238	2481	-2692	-42.03		

$$I_{y\,+5} = (56.66^2(0.44)\times 2) + [4\{0.44(52.34^2 + 40.06^2 + 21.683^2)\}] = 1,298.5 \text{ IN}^4$$

$$I_{y\,BASE} = \{48^2(0.44)(2)\} + [4\{0.44(44.346^2 + 33.94^2 + 18.369^2)\}] = 8109.9 \text{ IN}^4$$

$$f_{b\,+5} = \frac{M_{+5}\, Z_{+5}}{I_{y\,+5}} = 1.99\, Z_{+5} \qquad f_{b\,BASE} = \frac{M_{BASE}}{I_{y\,BASE}} Z_{BASE} = 225\, Z$$

MUD SKIRT EXTENSION BOLT ATTACHMENTS (FLANGE)

5 - 3/4 IN DIA BOLTS -

LENGTH = 41.88 IN

SHEAR = 211 LB/IN

$$\text{LOAD/BOLT} = \frac{41.88 \times 211}{5} = 1767 \text{ LB}$$

f_s BOLTS = 4001 p.s.i.

CONSIDER HYDRODYNAMIC FORCES ON THE GUIDE CONE ACTING SIMULTANEOUSLY WITH A VERTICAL FORCE

REF APPENDIX (A2) 437 LB/IN MERIDIANAL FORCE

874 LB/IN HOOP FORCE

$$\text{LOAD/BOLT} = \frac{41.88 \times 437}{5} = 3660 \text{ LB.}$$

f_s/BOLT = 3660/.4417 = 8286 p.s.i

$$f_t/\text{BOLT} = \frac{41.88 \times 874}{5(.4417)} = \boxed{16,573 \text{ psi.}}$$

$$\text{SHEAR/BOLT} = f_s = \boxed{12,285 \text{ psi}}$$

MUD SKIRT EXTENSION BOLT ATTACHMENT (SKIRT CONE)

MERIDIAN = 437 + 211 = 648 LB/IN

HOOP 874 + 211 = 1085 LB/IN

RESULTANT = 1263 LB/IN

f_s = 64,378 P.S.I. RECOMMEND MORE FASTENERS IN THE SKIRT ATTACHMENT

SUMMARY OF DISCUSSION NOV 18 1976

MR S.T. SEROCKI CHIEF ENGINEER

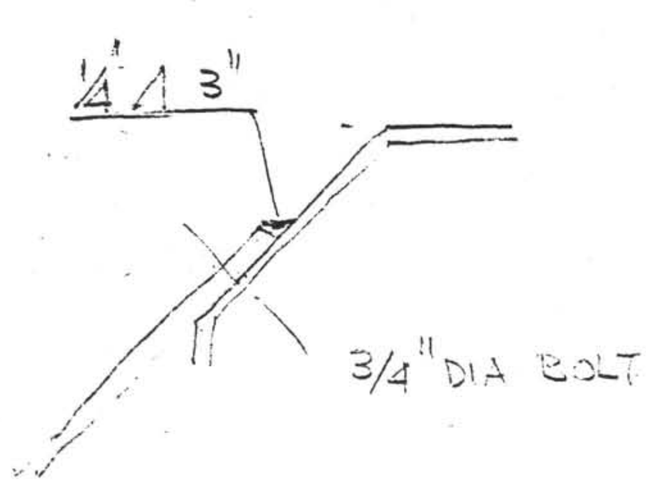
W. NUGENT CONSULTANT

SUBJECT MUD SKIRT ATTACHMENT FOR THE RE ENTRY CONE.

EXAMINATION OF THE DESIGN FOR THE SUBJECT EQUIPMENT POINTED OUT AREAS OF IMPROVEMENT FOR THE ATTACHMENT OF THE MUD SKIRT & MUD SKIRT EXTENSION AS FOLLOWS:

PROVIDE WELDS AT THE INTERSECTION OF THE MUD SKIRT AND MUD SKIRT EXTENSION

INTERMITTENT WELDS 3 INS LONG 1/4 INCH AROUND THE CONICAL INTERSECT.



THIS ACTION IS RECOMMENDED ON THE BASIS OF THE SHEAR LOAD DEVELOPED IN THE CONICAL SURFACE OF THE PLATE

MERIDINAL SHEAR = 437 LB/IN
HOOP SHEAR = 874 LB/IN

THE COMBINED EFFECT YIELDS A SHEAR STRESS OF 24,758 psi. SAY f_s = 25,000 PSI.

THE ALLOWABLE f_s OF MATERIAL = 75,000 psi

SAFETY FACTORS

ALLOW 1.5 FOR LOAD FACTOR
1.5 FOR ALIGNMENT & FITTING FACTOR
3.0 FACTOR TOTAL

APPLYING A FACTOR OF 3 TO 25,000 psi SHOWS THAT THE BOLT IN THE SKIRT ARE LOADED TO THE MAXIMUM CAPACITY. FURTHERMORE THE 7/8 INCH DIAMETER HOLES IN THE SKIRT AND THE 3/4 INCH DIAMETER BOLTS DO NOT INSURE THAT THE BOLTS ARE UNIFORMLY LOADED.

AS A CONSEQUENCE THE CHAIN WELD 3 INCH WELD 3 INCH GAP IS RECOMMENDED TO PROVIDE UNIFORM SHEAR DISTRIBUTION AROUND THE ATTACHMENT.

W. Nugent