OPERATING & MAINTENANCE INSTRUCTIONS

FOR HYDRATIGHT SEA SERPENT

UNDERWATER HYDRAULIC BOLT

TENSIONING TOOLS.

DOUG STAPP.

LAMAR / SHAWN SMITH

FLEXITALIC

INTRODUCTION

The Sea Serpent' is a form of hydraulic bolt tensioning tool which has been designed primarily for the tightening of bolts on underwater pipelines. It is easily and safely handled by the diver with the minimum of instruction, even in the poorest of visibility and the most restrictive of situations. Sea Serpent bolt tensioners are unequalled in any subsea tensioning application from riser, pipeline and flowline flanges, anchor and guide clamps, to strengthening and repair clamps. In fact, anywhere uniform and accurate bolt loading is required, with the benefit of enormous time saving, and complete confidence that the desired bolt preload has been achieved. Before proceeding with the operating and maintenance instructions there follows a brief description of the Sea Serpent and the principle of operation.

Description of operation.

To accommodate the Sea Serpent tool an extended portion of studbolt is required through the hexagon nut. The Sea Serpent tool is placed over the bolt to be tightened and a reaction nut is screwed onto the portion of stud protruding through the tool. When brought into contact with the Sea Serpent ram the reaction nut retains the tool on the bolt. The tool is connected to a hydraulic pump unit and oil is pumped at high pressure into the chamber beneath the ram. The hydraulic pressure acts upon the annular area of the ram attempting to push it out of the Sea Serpent body. The ram pushes against the reaction nut and, since the reaction nut is screwed onto the bolt, all the resultant load is transferred to the bolt stretching it axially. As the bolt is stretched the hexagon nut lifts from the flange manually, with zero torque, by applying a tommy bar through the slot in the bridge of the tool. The pressure is released and the load is retained in the bolt. The Sea Serpent tool is then removed.

Studbolt and Hexagon Nut Preparation

To accommodate the tools to facilitate operation an extended portion of stud is required above the hexagon nut and tommy bar holes are required to be drilled in the flats of the hexagon nuts. Details are as follows:-

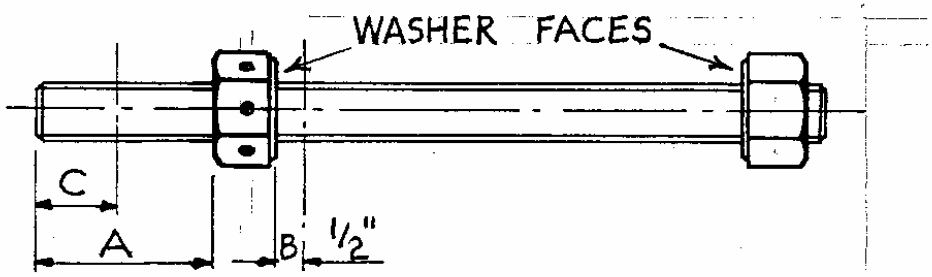


Figure 1

Sea Serpent Tool Ref.	Z	A	B	C	D	E	F	G	H	I
Length A (mm)	115	122	130	134	140	153	160	163	186	195

Notes

(1) Drilling details of the hexagon nuts are shown on Data Sheet HT5.

(2) Studbolts are assembled with one plain hexagon nut and one drilled hexagon nut. The stud protrudes through the drilled nut.

(3) It is recommended that length A is pre-set before the bolts are lowered to the diver. It is most important that the drilled hexagon nut is free running on the bolts particularly over length A and 1/2" length B.

(4) A reaction nut of the hydraulic tools should be assembled to random bolts along length C (equal to approx. one diameter D) to check free running.

(5) It is important that the nuts are assembled the correct way round i.e. washer faces pointing inwards.

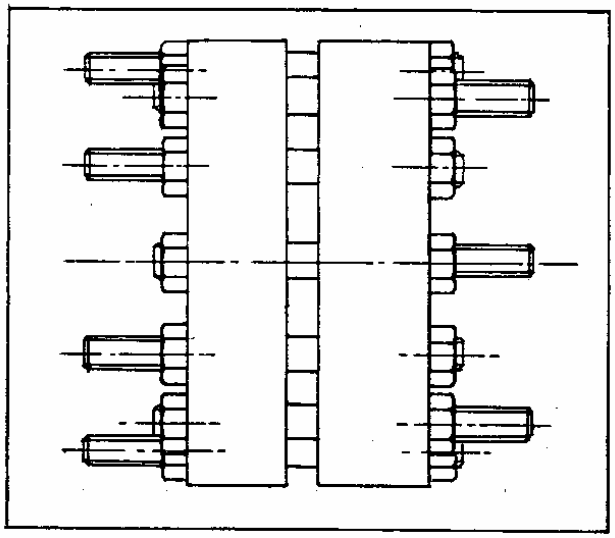
(6) The nuts should be visibly checked to make sure the tommy bar holes are in the correct position i.e. nearer the washer face of the nuts.

(7) It is recommended that the protruding portion of thread is protected by P.V.C. adhesive tape which can by removed by the divers once the bolts are assembled the flange.

ASSEMBLY OF BOLTS TO FLANGE

100 % TENSIONING

Assemble the bolts to the flange with the extra thread length protruding above the hexagon nuts on alternate sides of the flange as illustrated.



It is important to assemble the bolts correctly, i.e. with the washer faces of the hexagon nuts in contact with the flange; this is particularly important because the nuts have holes drilled in their flats.

ALL NUTS MUST BE FREE RUNNING ON THE BOLTS

A Hydraulic Tool will be fitted to every alternate bolt on each side of the flange connection, i.e. where the extra thread length is protruding .

ASSEMBLY OF TOOLS TO THE BOLTS

Assemble tools to the bolts by sliding them onto the protruding portions of the bolts and locking them in place with the hexagon or ring type reaction nuts. When nipping up the reaction nuts make sure:-

(a) The slot in the bridge of the tool is pointing outwards allowing free access to the drilled hexagon nut.

(b) Where a spigoted reaction nut is used to centralise the tool make sure that the spigot is correctly located in the tool.

(c) When assembling the reaction nuts ensure they do not bind on the threads and cause the whole bolt to turn through the hexagon nut on the opposite side of the flange. If this occurs then there will be insufficient thread engagement between the reaction nut and the bolt and this could lead lead to thread stripping on application of load.

FOR LESS THAN 100 % TENSIONING

The number of tools available should be divided into the number of bolts in the flange in order to determine which bolts are to be tightened simultaneously e.g. if 12 tools are available for a 36 bolt flange, then every 3rd bolt will be tightened simultaneously and tools will be placed on the corresponding bolts. It is advisable to initially number the bolts around the flange to help the initial assembly of the tools and subsequent operation of the system. See fig.2

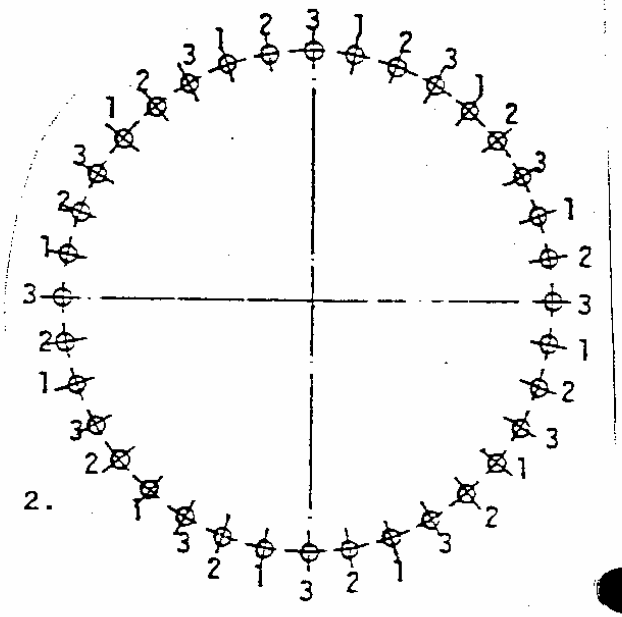


Fig. 2.

Assembly of Hydraulic Manifold. (Fig 3)

100 % tensioning

1 Assemble the interconnecting pipes (Part No.HTAE158) to all tools on the flange by snapping coupling X of the pipe onto the tools.

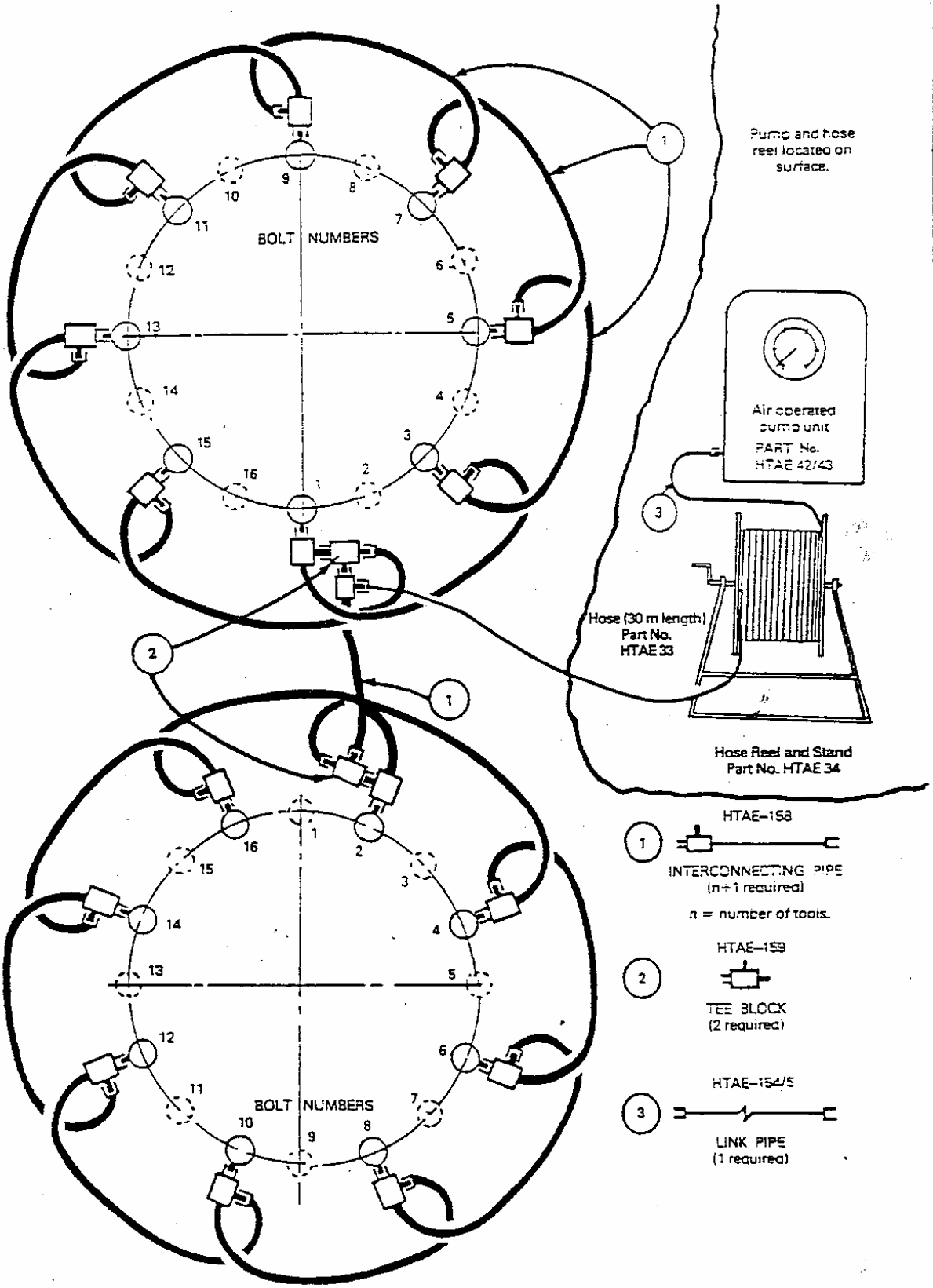
2 Working either clockwise or anti-clockwise around the flange link together all the interconnecting pipes by connecting coupling Y to nipples Z on the neighbouring pipes. Having completed this operation a close hydraulic circuit should result on this side of the flange.

3 At a suitable point remove coupling X of one interconnecting pipe and insert a harness tee block (Part No. HTAE159) between the nipple of the tool and the pipe.

4 Connect the completed manifold to the air operated pump unit via the hydraulic downline on the hose reel and stand and by inserting the link pipe HTAE154/5 between inlet nipple on the stand and the nipple on the pump unit.

5 With the harness assembled and connected to the pump unit the system is now ready for pressurisation but before pressurising the system it is important to **READ BOTH ATTACHED SAFETY NOTES AND THE INSTRUCTION FOR THE OPERATING THE PUMP.**

TYPICAL HARNESS SHOWING ARRANGEMENT OF TOOLS AND HOSES EITHER SIDE OF FLANGE



Flexitallic
TURNER & NEWALL PLC

HYDRA-TIGHT LTD.
Argyle House, Bentley Mill Way,
Walsall, West Midlands WS2 0LB
Telephone: Walsall (0922) 645945 Telex: 339994

Notes on Harness Assembly

All hoses are fitted with self sealing quick disconnect couplings and oil will not flow unless the coupling is correctly assembled. It is imperative, therefore, that when the manifold has been assembled, all connections are checked to make sure they are fully coupled.

Should any of the quick disconnect couplings not assemble to the tools then it may be due to :-

a) slight internal pressure within the tool caused by locking the reaction nut of the tool too tightly. In such an event, release the reaction nut, make the connection and re-tighten the reaction nut making sure that the slots in the bridge of the Sea Serpent tools allow free access to the hexagon nut.

b) internal pressure within the hose resulting from the hose being used previously at a greater depth. In such an event the hoses must be returned to the surface and the internal pressure released as described in the section "Maintenance of Equipment".

PRESSURISATION OF TOOLS

SIMULTANEOUSLY TENSIONING ALL OF THE STUDS.

Each individual flange will have its own pre-calculated value of oil pressure which must be applied to the tools. When tightening all bolts simultaneously only one pressure needs to be applied "Pressure B" See section Determination / Explanation of Pressure A or B.

Proceed as follows:-

1 Apply pressure "B" to the tools.

(a) The diver must check that the gaps are appearing between the rams and bodies of all tools. If not check all hose connections are properly made.

(b) That no one tool has an excessive gap significantly more than any other. If so check that the hexagon nut on the back of the flange is tight up against the flange.

(c) At a pressure of 1,000 p.s.i. stop the pump and take measurements between flanges at [illegible] deg increments. If there is an even gap at all points then pressurisation can continue.

2 Tighten down the hexagon nuts by inserting a tommy bar into the drilled hole in the nut, through the slot in the bridge of the tool.

3 Release the hydraulic pressure. To minimise the effects of embedment, settlement, and thread deflection repeat steps 1, 2, and two additional times before removing the tools.

IMPORTANT NOTE

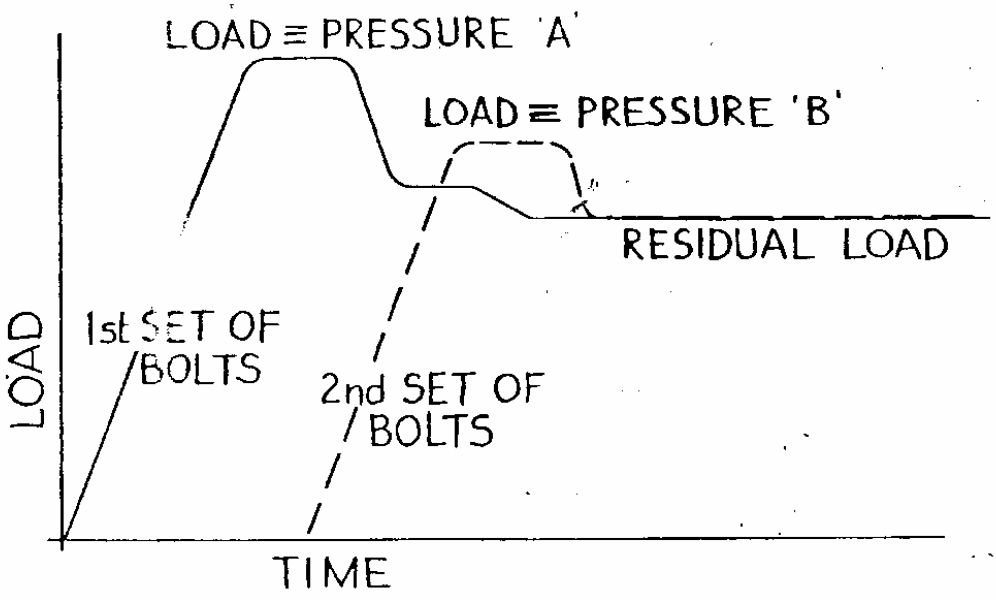
If during pressurisation the stroke of the ram approaches the max. limit before pressure is reached, then the pump must be stopped the nuts tightened and the pressure released. The rams pushed back into the tools by manually screwing down the ring nuts using the tommy bar. The tools must remain connected to the pump and the return-to-tank valve on the pump must be in the fully open position to allow the oil to drain from the tool while retracting the rams. Pressure can then be re-applied to the system.

NOTES

(1) **Because of the long distance that the oil has to travel to the system there is a short time lag resulting in a** difference between the oil pressure reading in the gauge and the actual pressure at the tools. This means that as the pressure is increased the gauge always reads a higher pressure than that which is present at the tools. To obtain a true reading of the value of pressure, the pump must be stopped intermittently and the gauge needle allowed to settle back. When nearing the final operating pressure for the flange being tightened the gauge reading can be taken up to 2,000 p.s.i. over this final operating pressure to allow for setting effect provided the initial pressure does not exceed 15,000 p.s.i., which is the MAXIMUM allowable pressure for the system is reached when the pump is stopped and the gauge needle settles back to a static position corresponding to this pressure.

EXPLANATION OF 50 % TENSIONING

When using 50 % tensioning (a tool on every other bolt), it is necessary to apply a higher pressure to the first set of bolts than to the second set. This is to allow for a reduction of the initial applied load when the second set are tensioned . The following graph illustrates how the load varies during the tensioning process.



INTRODUCTION

The operating pressure of the Sea Serpent tools depends on the load which is required in the bolts and this in turn depends upon a number of factors i.e. operating and test pressure of pipeline, pipeline and flange material and wall thickness of pipe, and the type of gasket which is employed.

Hydra-Tight Limited offer a complete service in calculating the operating pressure for any specific flange but to do so the following information must be submitted:

1) Flange size and rating.

2) Pipe outside diameter and wall thickness.

3) Flange and pipe material specification and/or minimum yield strength.

4) Bolt material if other than ASTM A193 grade B7.

5) Design or operating pressure of pipeline.

6) Hydrostatic test pressure of pipeline.

7) Gasket material.

8) Gasket type.

9) Whether or not swivel flanges are employed and if so what is the thickness of the swivel flange.

10) Whether or not there is access to both sides of the flange of 450mm from the flange face.

Alternatively if the residual bolt stress in the bolts is know then tool operating pressures relating to various grip lengths can be read directly from graphs.

PRESSURISATION OF TOOLS

SIMULTANEOUSLY TENSIONING 50% OF THE STUDS.

Each individual flange will have its own pre-calculated valve of oil pressure which must be applied to the tools (Refer to Section "Determination explanation of pressure A and B"). Two valves of pressure will be given.
Call the higher : Pressure "A"
Call the lower : Pressure "B"
Every other bolt in the flange will have a tool fitted on to it and connected via the manifold to the pump as previously explained.

Proceed as follows:-

1 Apply pressure "A" to the tools.

(a) The diver must check that the gaps are appearing between the rams and bodies of all tools. If not check all hose connections are properly made.

(b) That no one tool has an excessive gap significantly more than any other. If so check that the hexagon nut on the back of the flange is tight up against the flange.

(c) At a pressure of 1,000 p.s.i. stop the pump and take measurements between flanges at 90 deg increments. If there is an even gap at all points then pressurisation can continue.

2 Tighten down the hexagon nuts by inserting a tommy bar into the drilled hole in the nut, through the slot in the bridge of the tool.

3 Release the hydraulic pressure. <u>To minimise the effects of embedment, settlement, and thread deflection repeat steps 1, 2, and 3 two additional times before transferring the tools to the next set of studs.</u>

IMPORTANT NOTE

If during pressurisation the stroke of the ram approaches the max. limit before pressure is reached, then the pump must be stopped the nuts tightened and the pressure released. The rams pushed back into the tools by manually screwing down the ring nuts using the tommy bar. The tools must remain connected to the pump and the return-to-tank valve on the pump must be in the fully open position to allow the oil to drain from the tool while retracting the rams. Pressure can then be re-applied to the system.

4 **Transfer the tools to the second set of bolts.**

5 **Repeat operations 6.1 to 6.3 using pressure "B".**

6 **Transfer one of the tools back to a bolt of the first set of tensioned. Connect this tool directly to the pump using the downline connection.**

7 Insert a tommy bar into a hole in a nut. While exerting only very slight force on the tommy bar in the loosening direction, **SLOWLY** increase pump pressure until pressure "B" is reached or until the nut starts to turn, whichever occurs first.

If the nut remains tight at Pressure "B" the tensioning procedure is complete.

If the nut breaks loose before pressure "B" is reached, stop the pump and tighten the nut, noting the break loose pressure.

Continue with step 8.

8 With the tools still on the second set of bolts re-tighten using pressure "A" and repeat operations 2 to 7.

9 If the nut breaks loose before pressure "B" again checks of the flange, gasket etc. are necessary to ensure that "flange rotation" or gasket damage has occurred.

IN THIS CASE HYDRA-TIGHT LIMITED WILL BE PLEASED TO ADVISE.

DETERMINATION OF PRESSURE "A" AND PRESSURE "B"

In order to determine pressure "A" and pressure "B" the following information is required :-

1 The grip length of the bolts being tensioned (see fig 4)

2 The required minimum residual stress to be developed in the bolts.

3 The bolt diameter and pitch.

4 The tool ref number of the HYDRATIGHT tool being used.

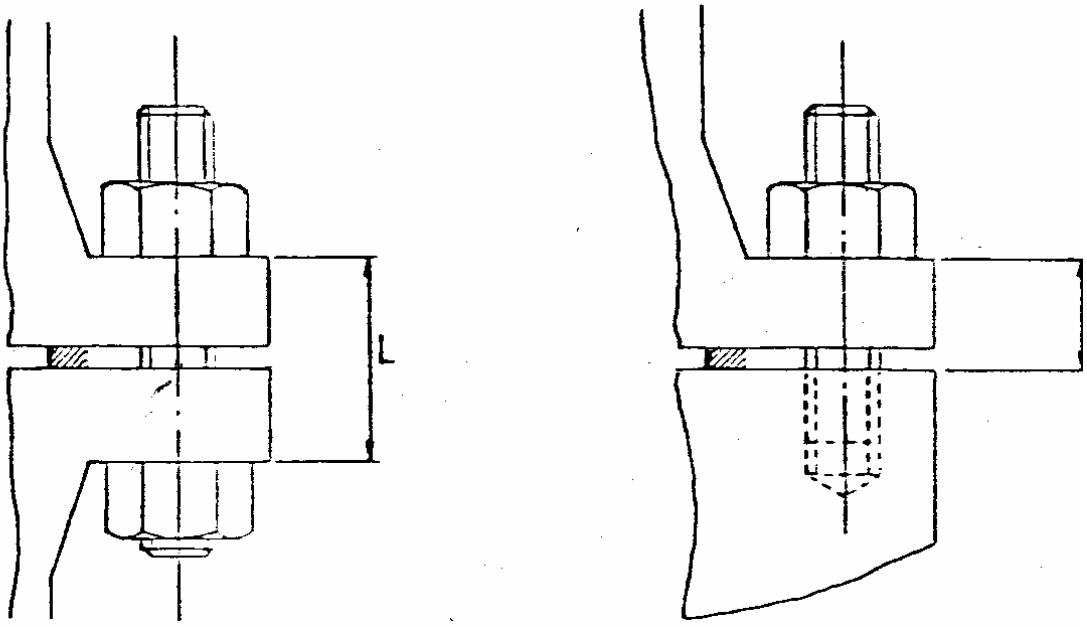


Fig. 4. Grip length

5 Select the graph corresponding to the bolt diameter and Tool number being used.

6 Determine the grip length of the bolts to be tensioned.

7 For the grip length selected, read off the graph the oil pressure "B" corresponding to the minimum residual bolt stress required.

Bolt Load and Flange Stress Analysis.

It is not only important to correctly tighten all flanges and to apply the load in a controlled manner but essential that the correct load is applied to the bolts. The bolt stresses applied are calculated to the **ASME VIII Division 2 Pressure Vessel Design Code** and are minimum to seal the vessel under both operating and Hydrotest conditions. As well as not underloading it is important that a high load is not applied which could distort the flanges. Therefore if required HYDRA -TIGHT LIMITED CONDUCT EXTENSIVE FLANGE STRESS CALCULATIONS ON VESSEL OR PIPELINE FLANGES ON OUR IN HOUSE COMPUTER IF REQUIRED. This gives bolt and flange stresses during and after tensioning with zero internal pressure, during pressure testing and during operating conditions.

LOOSENING STUDS AROUND A FLANGE

For loosening studs on a flange sub sea it is more practical to fit the tools to all the studs.

1. Assemble the tools to all the studs on the flange. Make sure that the ram is fully retracted.

2. Connect the hydraulic harness (See assembly of hydraulic harness).

3. Turn back the ring nut so that approximately 3mm gap appears between the ring nut and the hydraulic head.

4. Slowly apply sufficient pressure to the tool to release the hexagon nut under the bridge.

5. Loosen the hexagon nut one complete turn using a tommy bar inserted into a hole in the nut.

6. Release the pressure to zero, check that the nuts are still loose.

7. Remove the tools and harness.

NOTE: PUMP IS TO BE SHIPPED FROM FACTORY WITHOUT HYDRAULIC OIL

ADD HYDRAULIC OIL BEFORE OPERATING PUMP

ISO VISCOSITY GRADE 68
SUCH AS

AMOCO AW 68	MOBIL DTE 26
ARCO DURO AW 68	PHILLIPS MAGNUS A OIL 68
BP ENERGOL HLP 68	SHELL TELLUS 68
CHEVRON EP HYD OIL 68	SOHIO INDUSTRON 53 CITGO
A/W HYD OIL 68	SUN SUNVIS 754
EXXON NUTO 68	TEXACO RANDO HD 68
GETTY VEEDOL AW 61	UNION UNAX AW 68
GULF HARMONY 68 AW	VALVOLINE AW OIL 30

Air Driven Hydraulic Pump Unit.

(See Data Sheet HT10)

A compact robust unit designed for simplicity and speed of operation. Measuring 38 x 36 x 44 cms high, the unit weighs approximately 35 kgs and comprises of a reciprocating piston pump mounted in a tubercular frame containing an oil reservoir and all air/oil valves and fittings.

It consists of the following :

a. **Air Filter** - Ensures a clean dry air supply is maintained. Any water is collected in the bowl and can be drained off by turning the "filter"drain screw clockwise.

b. **Air regulator** - Complete with its own pressure gauge, regulates the air pressure to the pump. To increase air pressure screw the air pressure regulator into its body.

c. **Air Lubricator** - Lubricates air supply and should be set to give one drop for every 40 stokes of the pump, by adjusting the red knob A. Top up when required using a good grade lubricating oil.

d. **Air flow valve** - Controls air supply to pump and gives variable pump speed control.

e. **Reservoir** - Capacity 9 litres, has coarse filter at filler neck and fine filter at outlet pipe. Level indication tube should show minimum half full. Top up when required using a hydraulic oil with a viscosity of 22.

f. **Oil Return to Tank Valve** - When open allows oil to flow back to reservoir.. To open turn handle anti-clockwise.

g. **Pump** - Piston type unit - Full breakdown details and spares kits available on request.

h. **Oil Pressure Gauge** - 0/1700 Bar (0/25,000 p.s.i.). Accuracy should be checked periodically.

i. **Oil Outlet Nipple** - Quick discount type sealing to prevent dirt penetration and oil drips.

OPERATION OF HYDRAULIC PUMP UNIT.

It is recommended that the pump is regulated to stall at the oil pressure required to operate the hydraulic tools.

1 To regulate the pump in Reservoir proceed as follows :

2 Check oil levels in Reservoir and lubricator and top up as necessary. Adjust lubricator to provide one drop for every 40 strokes of the pump.

3 Check air filter bowl drain if necessary.

4 Fit a blanked off coupling or a self connected interconnecting pipe to the oil outlet nipple.

5 Close the flow valve.

6 Open oil return to tank valve

7 Connect dry air supply to point B'

8 Turn air pressure regulator screw to give zero pressure reading on the air pressure gauge.

9 Open air flow valve (Pump should not operate because the regulator as been set to zero step 9.7)

10 Close oil return to tank valve.

11 Screw in air pressure regulator until the desired operating pressure is indicated on the oil pressure gauge.

12 Close air flow valve.

13 Open **slowly** oil return to tank valve thus releasing pressure. The pump is now set to stall at the desired operating pressure and is ready to be coupled to the hydraulic harness.

9.14 Pressurise the system by closing the oil return to tank valve and opening the air flow valve.

9.15 De-pressurise the system by closing air flow valve and **slowly** opening the oil return to tank valve.

Safety Notes.

1 **Never pressurise the pump unit while the oil outlet nipple is disconnected - it is dangerous to pressurise the back of an uncoupled quick disconnect nipple or coupling.**

2 Before connecting the air supply ensure that the air flow valve is closed and the oil return to tank valve is open. Connecting the air supply with the air valve open and oil return to tank valve closed will immediately start the pump and lead to excessive system pressures, especially if the pump has not been regulated as Section 9.

3 Always ensure that the quick disconnect couplings are properly coupled before pressurisation.

4 Never operate the pump when the lubricator has run dry as this will quickly damage the pump.

5 Keep pressurised times to a minimum, work quickly and efficiently while the system is pressurised. Always depressurise when leaving the system unattended.

6 Never position yourselves in line with the axis of a hydraulic bolt tensioning tool.

7 Ensure proper thread engagement of ring nut on the stud.

8 Never exceed maximum ram stroke.

9 Never exceed Hydratight recommended pressures.

MAXIMUM RAM STROKE/RAM RETRACTION

When pressurising the tools it is important to observe the movement of the ram to prevent the ram from being over extended.

Maximum Ram stroke is 15mm
Except for Tool No. 02 -6mm Tool No. 01 - 8mm
Certain Hire Tools - coloured black - 8mm stroke.
Sea Serpent tools - 20mm

A change of section in the section in the ram indicates when the maximum stroke has been achieved. If a red or white mark is seen the maximum ram stroke has been exceeded and you must proceed as follows:

Stop the pump but do not release the pressure.

Tighten down the hexagon nuts using a tommy bar Ensure that the nut washer face comes fully into contact with the surface of the flange.

When all the nuts are tight release the oil pressure opening fully the return to tank valve.

Retract all of the tool rams by turning the ring nut/puller in the tightening direction using a tommy bar.

The tools must remain connected to the pump and the return to tank valve on the pump must be in the fully open position to allow the oil to drain from the tools while retracting the rams.

After the rams are retracted the tightening procedure can be continued by closing the return to valve and restarting the pump.

NOTE: Rams can also be retracted by connecting each individual tool to the pump via the link pipe, opening the oil return to tank valve, and turning the ring nuts with a tommy bar. An alternative method, which allows easier retraction of the ram on larger tools, is to disconnect the hose from each tool and install an open ended coupling (Part No.HTAE1) through which the oil can be drained into a clean cup by turning the ring nut in the tightening direction. After the oil is drained from each tool reconnect the hoses and pour oil back in reservoir.

Ram retract jigs are also available but generally are not necessary.

STORAGE

Hydraulic bolt tensioning (SEA SERPENT) tools.

1 **Store tools with the ram retracted.**

2 The epoxy coating will protect the tools from rust etc. but for added protection a light coating of oil or rust inhibitor should be applied to all exposed surfaces.

3 Cover the internal threads of the reaction nuts with Rocol Rustshield or similar rust inhibitor.

4 Store tools upright (ram upmost).

5 Keep dust cap on the oil inlet nipple when not in use.

Harness hoses, hose reel and stand.

1 Wipe all hoses clean and apply light coating of oil or suitable rust inhibitor to all nipples, couplings, tee blocks.

2 Always keep dust caps fitted to nipples and coupling when hoses are not in use.

3 Do not coil hoses too tightly. The minimum bend radius of the hose is approximately 5 inches.

Air Driven Pump.

1 **Always store the pump upright.**

2 Apply light oil coating or suitable rust inhibitor to all exposed unpainted metal items.

3 Leave the oil return to tank valve in the open position.

4 Leave the air control valve in the open position.

5 Always keep dust covers on inlet/outlet oil fittings.

TESTING

It is recommended at approximately six monthly intervals if the tools/equipment has not been used they should be tested/operated as detailed.

Hydraulic bolt tensioning (SEA SERPENT) tools.

1 Fit a SEA SERPENT tool over the correct test bolt (not provided with original equipment) and screw on the ring nut until it is in contact with the rams.

2 Connect tools to air driven pump unit and slowly apply oil pressure up to 15,000 p.s.i. (1034 bar) Refer to standard operating instructions for pump operating procedure and safety precautions.

3 Release pressure. Turn the reaction nut back until a gap of approx. 15 mm exists between the ram and the underside of the reaction nut.

4 Reapply the oil pressure. Ensure that the ram does not extend beyond the full stroke mark machined around the ram.

5 If no leak occurs release the oil pressure. Apply grease to the exposed surfaces of the ram.

6 Retract the ram by screwing down the reaction nut.

7 Refit dust cap to nipple and store.

Air Driven Pump Unit.

1 Check oil level in reservoir.

2 Fit blanked off coupling to nipple outlet or self connected interconnecting pipe.

3 Connect pump to suitable air supply.

4 Drain of any water from the air filter.

5 Open oil return to tank valve fully and slowly open air control valve. This will start the pump cycling and circulate oil around the system.

6 With the pump running check the "drip rate" from the air lubricator. If necessary re-set to give one drop every 40 strokes of the pump.

7 Look for air bubbles in the oil return to tank plastic hose. If any bubbles appear keep the pump running until return pipe is full, i.e. no bubbles appear. Run pump for approximately one minute after return pipe is full.

8 Close air control valve to stop pump cycling.

9 Close oil return to tank valve to operate the pump very slowly.

10 Allow the oil pressure to build up to 15,000 p.s.i. Close control valve. Slowly open oil return to tank valve.

Harness, hose, hose reel and stand.

1 Connect a snap coupling of the hose to the outlet coupling of the pump unit. Blank off all other nipples/couplings using blank couplings or nipples

NEVER PRESSURISE ANY HOSE WITH ANY CONNECTION OPEN.

2 Slowly apply the oil pressure to the hose and check for leakage. THE MAXIMUM PRESSURE FOR THE HIGH PRESSURE (BLUE HOSE) SHOULD BE 1034 bar (15000 p.s.i.)

3 Release oil pressure. If no leaks occur remove from pump and remove blanked fittings.

4 Apply a light coat of oil or suitable rust inhibitor to all exposed surfaces of nipples and couplings. Pull back the retaining ring of the couplings and ensure surfaces under the ring are also protected.

5 Fit dust caps and store.

WARNING

WITH ONLY A BLANKED OFF COUPLING FITTED TO THE PUMP OUTLET THE OIL PRESSURE WILL BUILD UP VERY QUICKLY. ENSURE THAT AIR PRESSURE IS REGULATED TO A LEVEL WHICH WILL NOT ALLOW OVER PRESSURISATION OF THE SYSTEM .

11 Disconnect air supply. Open oil return to tank valve, then air control valve.

12 Drain off any water from the air filter (see section 9.3 of operating instructions).

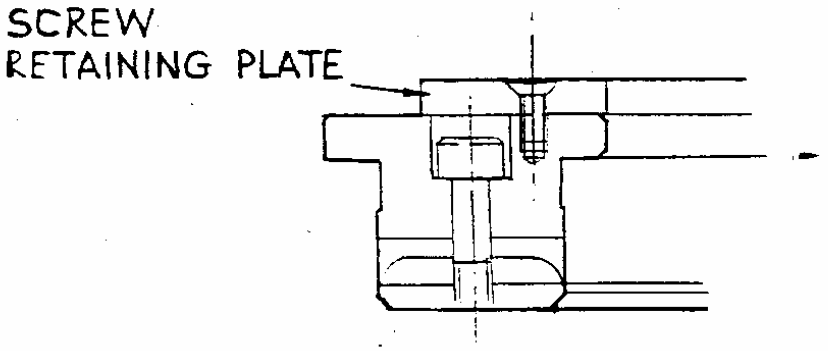
13 Return to store.

OBSERVE SAFETY AND PUMP OPERATING INSTRUCTIONS BEFORE TESTING.

SAFETY NOTE

SEA SERPENT Ref E, F, G, H, & I.

The above listed tool use Hexagon reaction nuts and unlikethe ring type, they do not cover the pre-load screw heads.
A screw retaining plate is fitted to prevent any screws from becoming detatched from the seal support ring under pressure.



TORQUE SETTING FOR PRELOAD SCREWS

TOOL REF	SCREW SIZE	TORQUE
Y	M3	15 lb in
Z	M4	20 lb in
A	M6	4 lb ft
B	M6	4 lb ft
C	M6	4 lb ft
D	M6	4 lb ft
E	M8	9 lb ft
F	M8	9 lb ft
G	M8	9 lb ft
H	M10	10 lb ft
I	M10	10 lb ft

WARNING

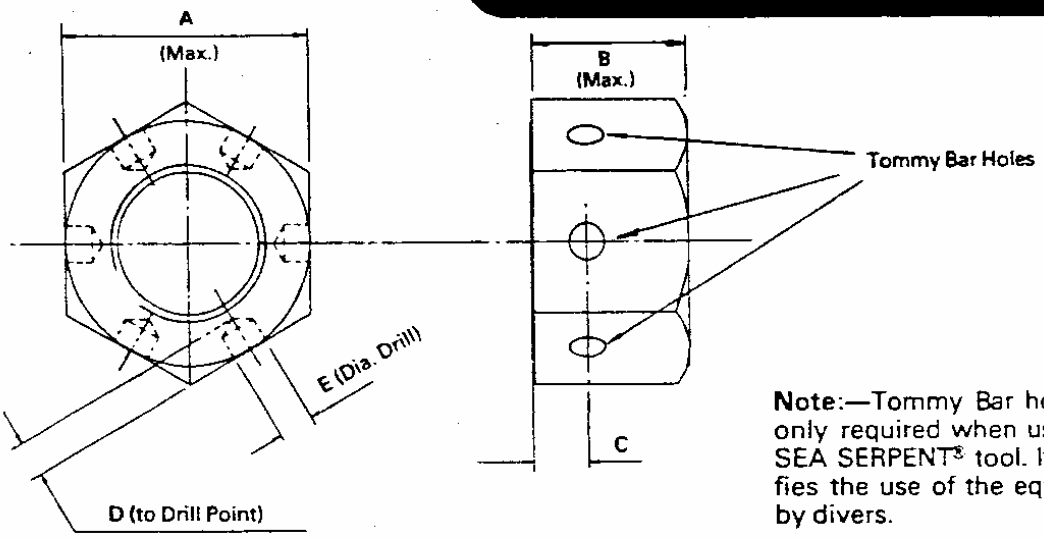
Never exceed the torque figure specified as this could result in the bending of the seal support ring, early failure of the seal and leaking of the hydraulic head.

N.B.—The Standard HYDRATIGHT® Tensioner for use above sea level does NOT require drilled nuts—see Data Sheet HT1.

HYDRATIGHT®

Drilled hexagon nuts for use with SEA SERPENT® bolt tensioning equipment.

DATA SHEET HT5



Note:—Tommy Bar holes are only required when using the SEA SERPENT® tool. It simplifies the use of the equipment by divers.

Nominal Thread Diameter	A (inches)	B (inches)	C (mm)	D (mm)	E (mm)	Tommy Bar Size (mm)
3/4"	1.250	0.758	9	5	6.2	6
7/8"	1.437	0.885	9	5	6.2	6
1"	1.625	1.012	9	6	6.2	6
1 1/8"	1.812	1.139	9	6	6.2	6
1 1/4"	2.000	1.251	12	8	8.2	8
1 3/8"	2.187	1.378	12	8	8.2	8
1 1/2"	2.375	1.505	15	9	10.2	10
1 5/8"	2.562	1.632	15	9	10.2	10
1 3/4"	2.750	1.759	15	10	10.2	10
1 7/8"	2.937	1.886	15	10	10.2	10
2"	3.125	2.013	18	12	12.4	12
2 1/4"	3.500	2.251	18	12	12.4	12
2 1/2"	3.875	2.505	21	14	14.4	14
2 3/4"	4.250	2.759	21	14	14.4	14
3"	4.625	3.013	24	16	16.4	16
3 1/4"	5.000	3.251	24	17	16.4	16
3 1/2"	5.375	3.506	24	18	16.4	16
3 3/4"	5.750	3.759	24	18	16.4	16
4"	6.125	4.013	24	18	16.4	16

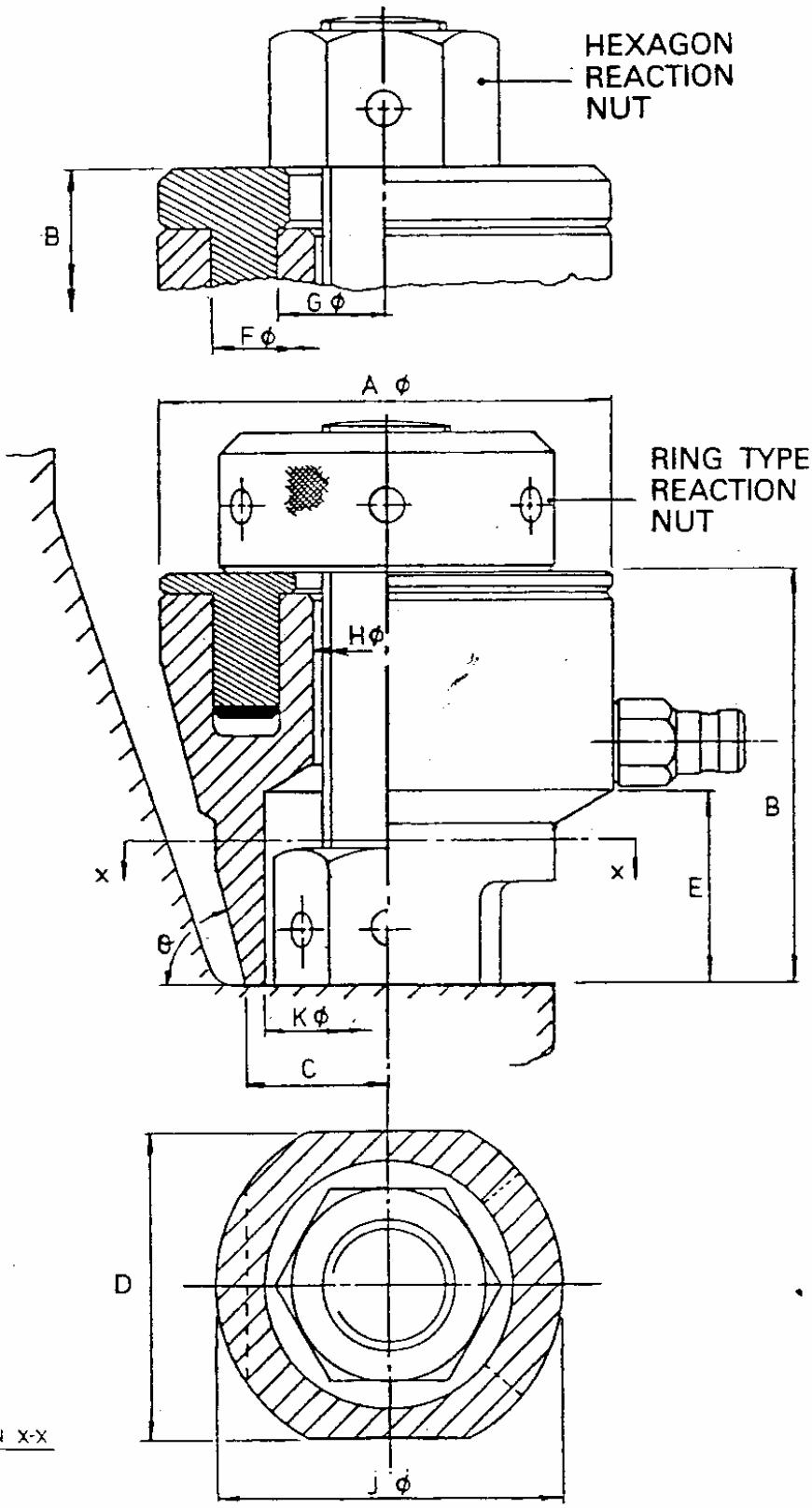
Basic significant dimensions conform to BS4882 and ANSI B18.2.2. Heavy Series (UNC threads up to 1" dia, UN-8TPI on 1 1/8" dia. and above). They are normally supplied in Grade 2H material, other grades are available. Metric nuts and nuts with special dimensions can be supplied to meet customer's specific requirements.

Size/Range Specification

HYDRATIGHT®

SEA SERPENT® Tensioners

DATA SHEET HT2



	SEA SERPENT Tool Ref.	Bolt Diameter (inches)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	J (mm)	K (mm)	ϑ°	Pressure Area (in^2)	Maximum Load (tons)	Approx. Weight (kg)	Extra Length Studbolt Required (mm)
Reaction Nut – Ring Nut Type	Z	1″ / 1 1/8″	94	113	30	—	50	70,5	45,5	31	74	57	73°	3,53	23,6	4	135
	A	1 1/4″ / 1 3/8″	113	122	35	—	52	86	55	36	86	68	71°	5,32	35,6	5.5	142
	B	1 1/2″ / 1 5/8″	129	130	41	—	60	102	66	42,5	98	80	72°	7,36	49,3	7.5	150
	C	1 3/4″	150	134	45	106	64	114	70	45,5	110	86	70°	9,86	66	10	154
	D	1 7/8″ / 2″	160	140	50	110	70	124	82	52	126	97	70°	10,53	70,5	11.5	160
Reaction Nut – Hexagon Type	E	2 1/4″	174	153	58	—	75	144	89	59	134	108	76°	15,6	104	13.5	173
	F	2 1/2″	197	160	64	—	80	157	95	65	144	118	72°	19,0	127	17.5	180
	G	2 3/4″	211	163	68	—	83	171	101	71	158	128	71°	23,2	155	21.5	183
	H	3″	220	186	78	176	93	186	108	78	186	141	72°	28,0	187	26	206
	I	3 1/4″ / 3 1/2″	257	195	89	—	107	213	122	91	200	162	70°	37,1	248	35	215

ALL RAM STROKE CAPACITIES 20mm — LARGER STROKES AVAILABLE ON REQUEST

All dimensions subject to alteration without notice

Flexitallic

TURNER & NEWALL PLC

HYDRA-TIGHT LTD.
Argyle House, Bentley Mill Way,
Walsall, West Midlands WS2 0LB
Telephone: Walsall (0922) 645945 Telex: 339994

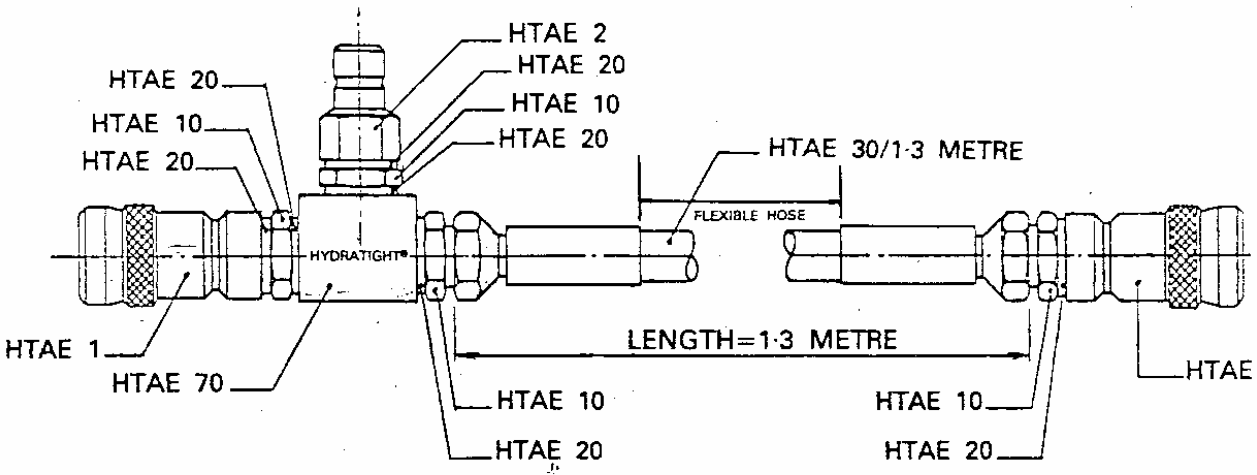
An associate company of Flexitallic Ltd., Heckmondwike, West Yorks., Glasgow, Aberdeen and Houston

HYDRATIGHT®

DATA SHEET HT 7/9

HARNESS COMPONENT PARTS
WITH FLEXIBLE HOSES AND QUICK
DISCONNECT COUPLINGS

INTERCONNECTING PIPE. PART No. HTAE 158



VARIOUS LENGTHS AVAILABLE

Part No.	Description	No. Off
HTAE 1	Quick Disconnect Coupling	2
HTAE 2	Quick Disconnect Nipple	1
HTAE 10	¼" BSP×¼" BSP Adaptor	4
HTAE 20	¼" BSP Dowty Seal	6
HTAE 30/1·3	High Pressure Flexible Hose with swivel end connections	1
HTAE 70	¼" BSP Tee Block	1

NOTE: All quick disconnect fittings are self sealing when disconnected.
All components are oil filled, air bled and pressure tested.

Flexitallic.
TURNER & NEWALL PLC

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Walsall, West Midlands WS2 0LB
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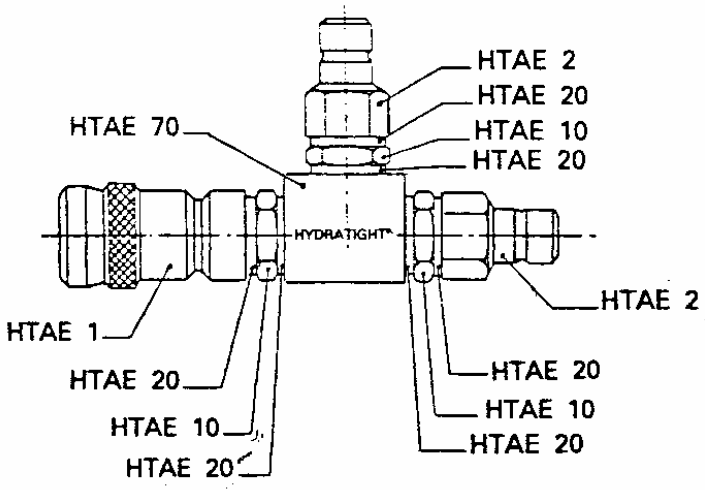
HYDRATIGHT®

DATA SHEET HT 7/10

HARNESS COMPONENT PARTS
WITH FLEXIBLE HOSES AND QUICK
DISCONNECT COUPLINGS

TEE BLOCK. PART No. HTAE 159



Part No.	Description	No. Off
HTAE 1	Quick Disconnect Coupling	1
HTAE 2	Quick Disconnect Nipple	2
HTAE 10	¼" BSP×¼" BSP Adaptor	3
HTAE 20	¼" BSP Dowty Seal	6
HTAE 70	¼" BSP Tee Block	1

NOTE: All quick disconnect fittings are self sealing when disconnected.
All components are oil filled, air bled and pressure tested.

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Walsall, West Midlands WS2 0LB
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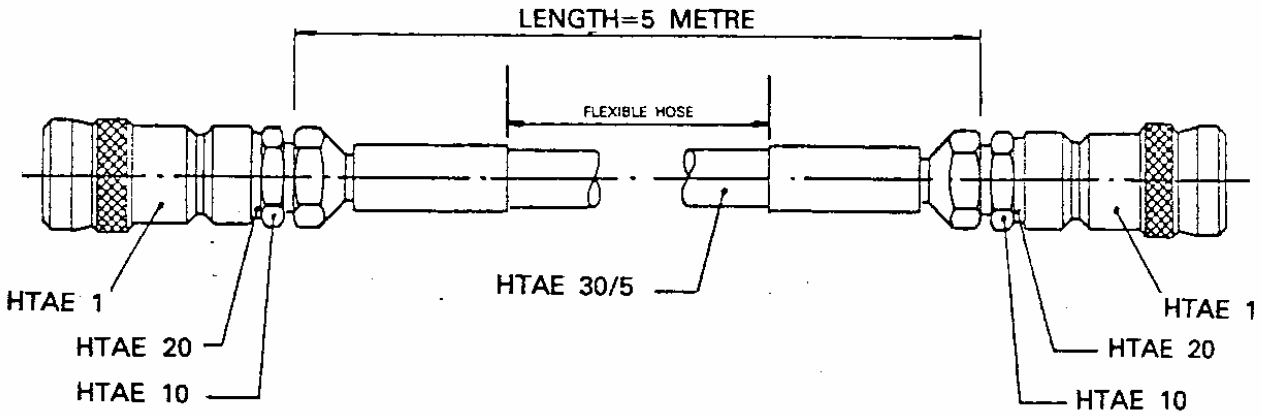
HYDRATIGHT®

DATA SHEET HT 7/6

HARNESS COMPONENT PARTS
WITH FLEXIBLE HOSES AND QUICK
DISCONNECT COUPLINGS

LINK PIPE. PART No. HTAE 154/5



Part No.	Description	No. Off
HTAE 1	Quick Disconnect Coupling	2
HTAE 30/5	High Pressure Flexible Hose with swivel end connections	1
HTAE 10	¼" BSP×¼" BSP Adaptor	2
HTAE 20	¼" BSP Dowty Seal	2

NOTE: All quick disconnect fittings are self sealing when disconnected.
All components are oil filled, air bled and pressure tested.

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OIL PRESSURE / BOLT STRESS GRAPH

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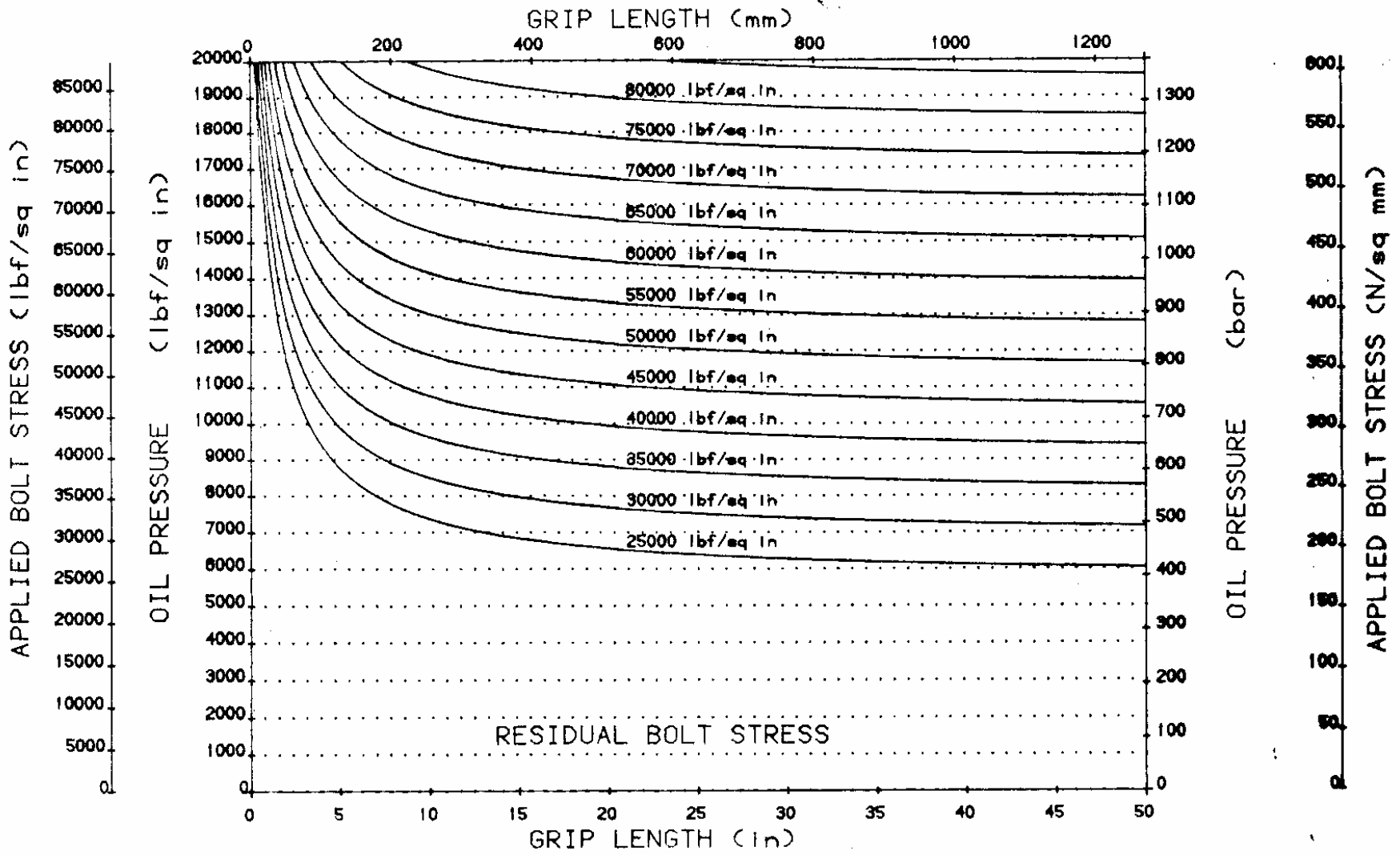


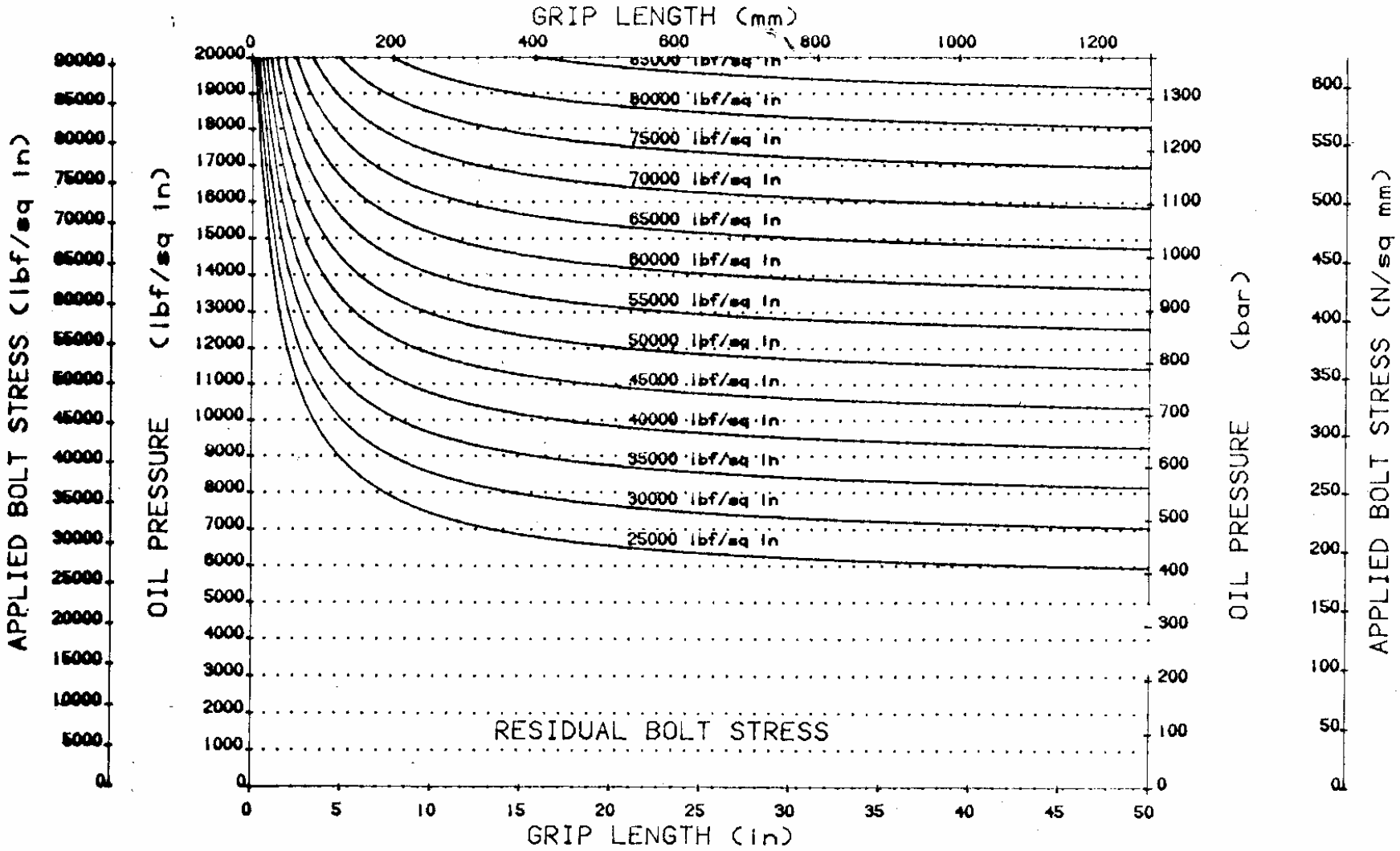
REF Z SEA SERPENT

1-1/8" UN8

45000/SQR(D) = 42426 lbf/sq in

OIL PRESSURE / BOLT STRESS GRAPH

© HYDRA-TIGHT LTD.



REF A SEA SERPENT

1-3/8" UN8

10-SEP-04 - GRAPH P02 V3.0 - RA3.3

45000/SQR(D) = 38376 lbf/sq in

OIL PRESSURE / BOLT STRESS GRAPH

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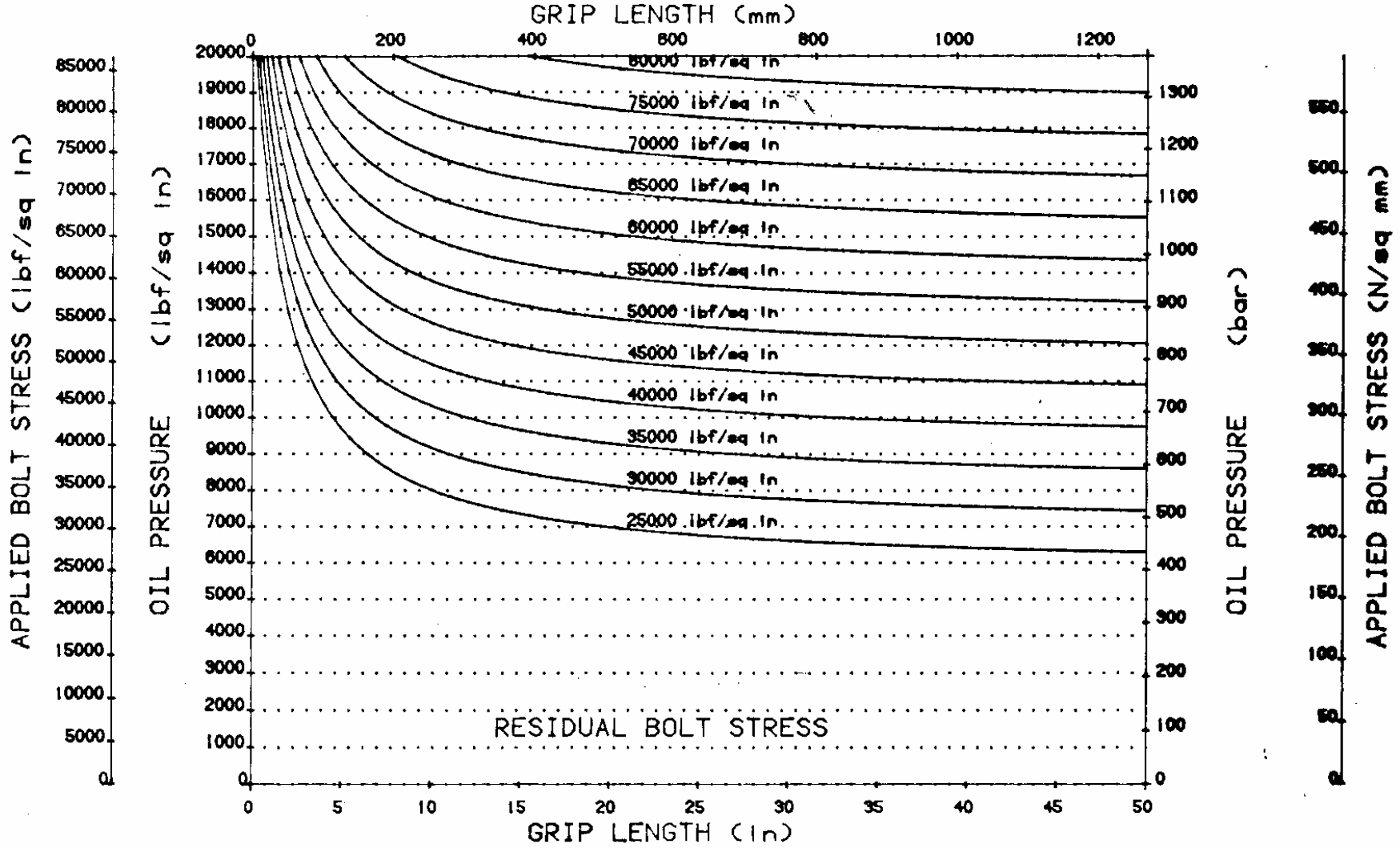
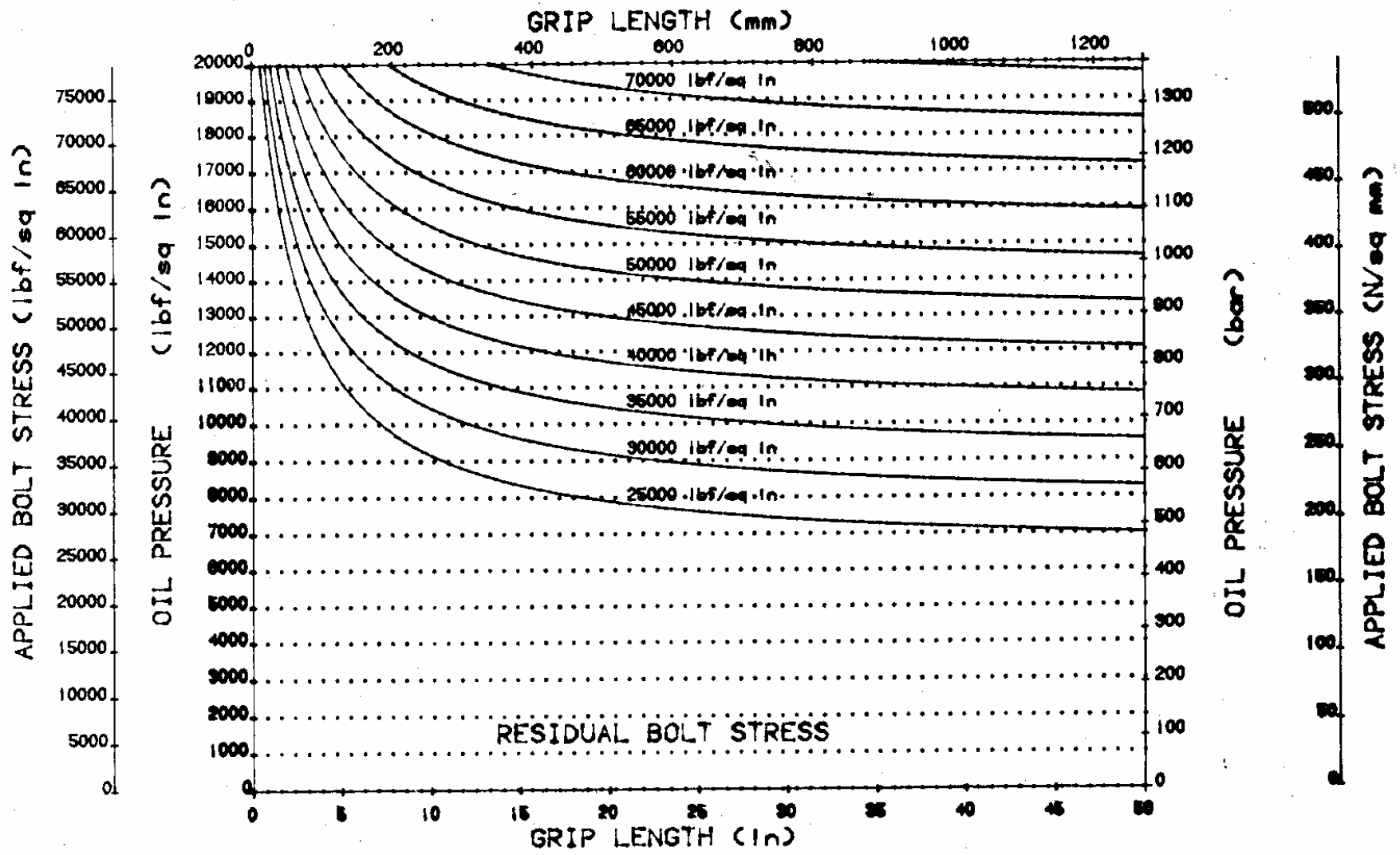


REF B SEA SERPENT 1-5/8" UN8

45000/SQR(2) = [illegible] lbf/sq in

OIL PRESSURE / BOLT STRESS GRAPH

© HYDRA-TIGHT LTD.



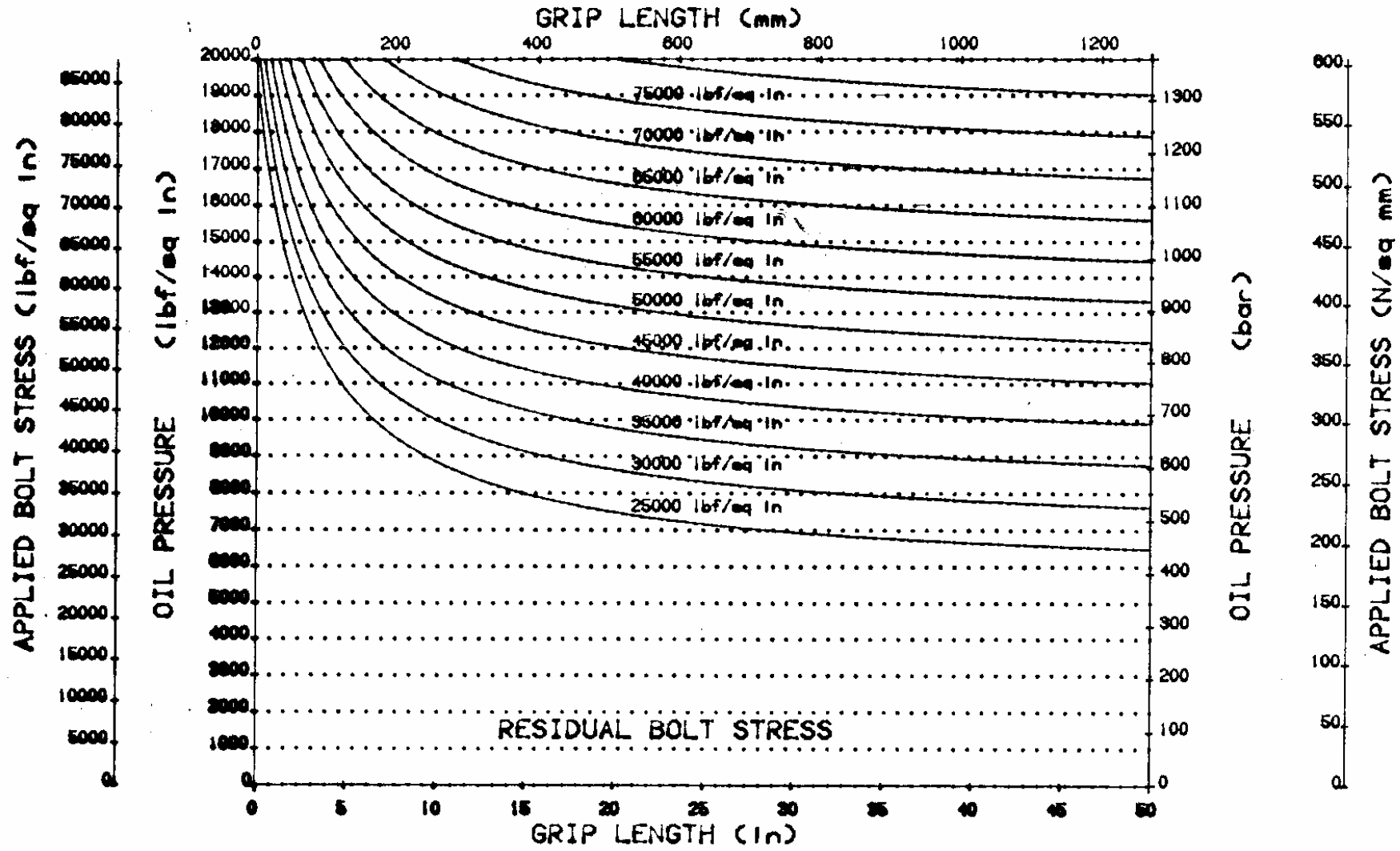
REF D SEA SERPENT 2" UN8

18-SEP-84 - GRAPH P02 V3.0 - RA4.4

45000/SQRCD) = 31818 lbf/sq in

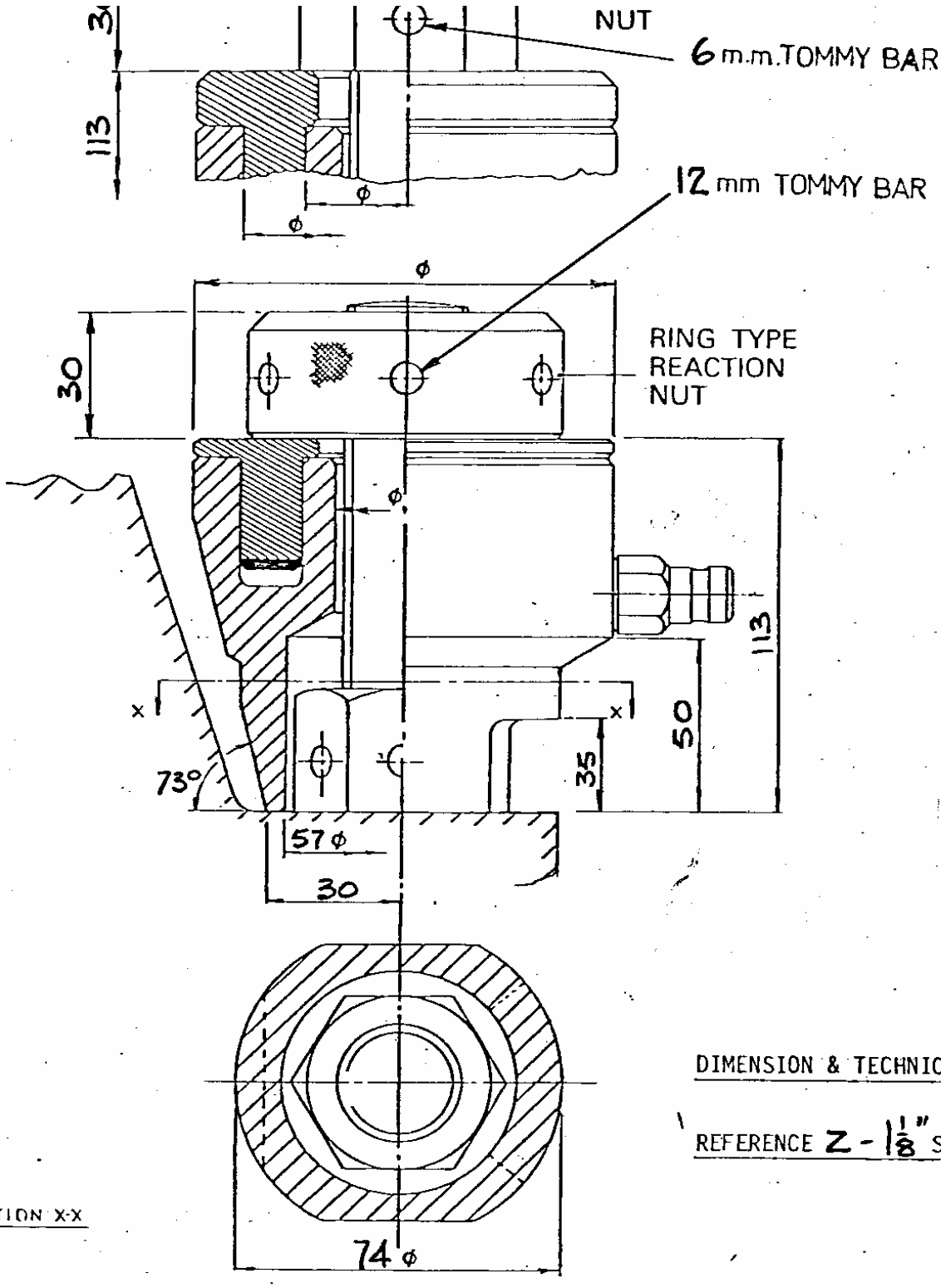
OIL PRESSURE / BOLT STRESS GRAPH

© HYDRA-TIGHT LTD.



REF H SEA SERPENT 3" UN8

45000/SQRT(D) = 25980 lbf/sq in



SECTION X-X

DIMENSION & TECHNICAL DATA SHEET

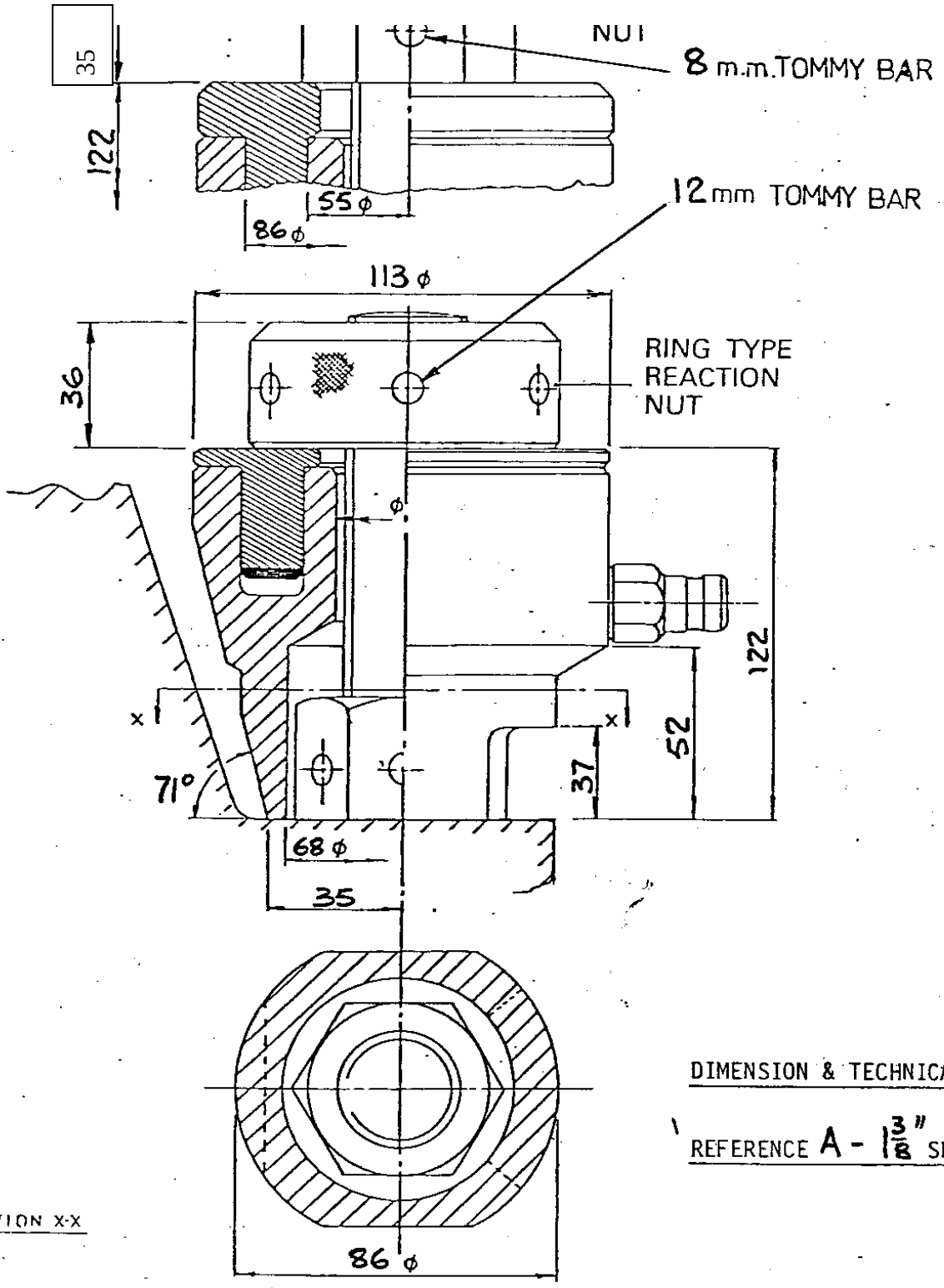
REFERENCE Z - 1⅛" SEA SERPENT

MAX LOAD CAPACITY @ 15000 psi = 23.6 Tons

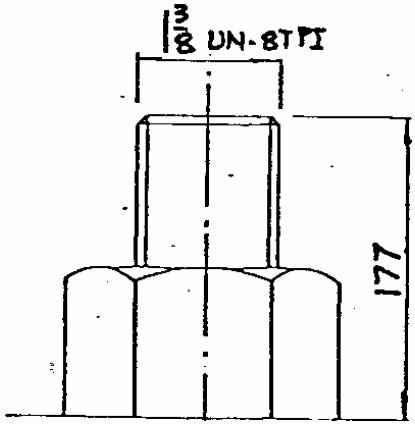
MAX. ALLOWABLE RAM STROKE = 20 mm

HYDRAULIC PRESSURE AREA = 3.53 in^2.

All Dimensions in mm



SECTION X-X



DIMENSION & TECHNICAL DATA SHEET

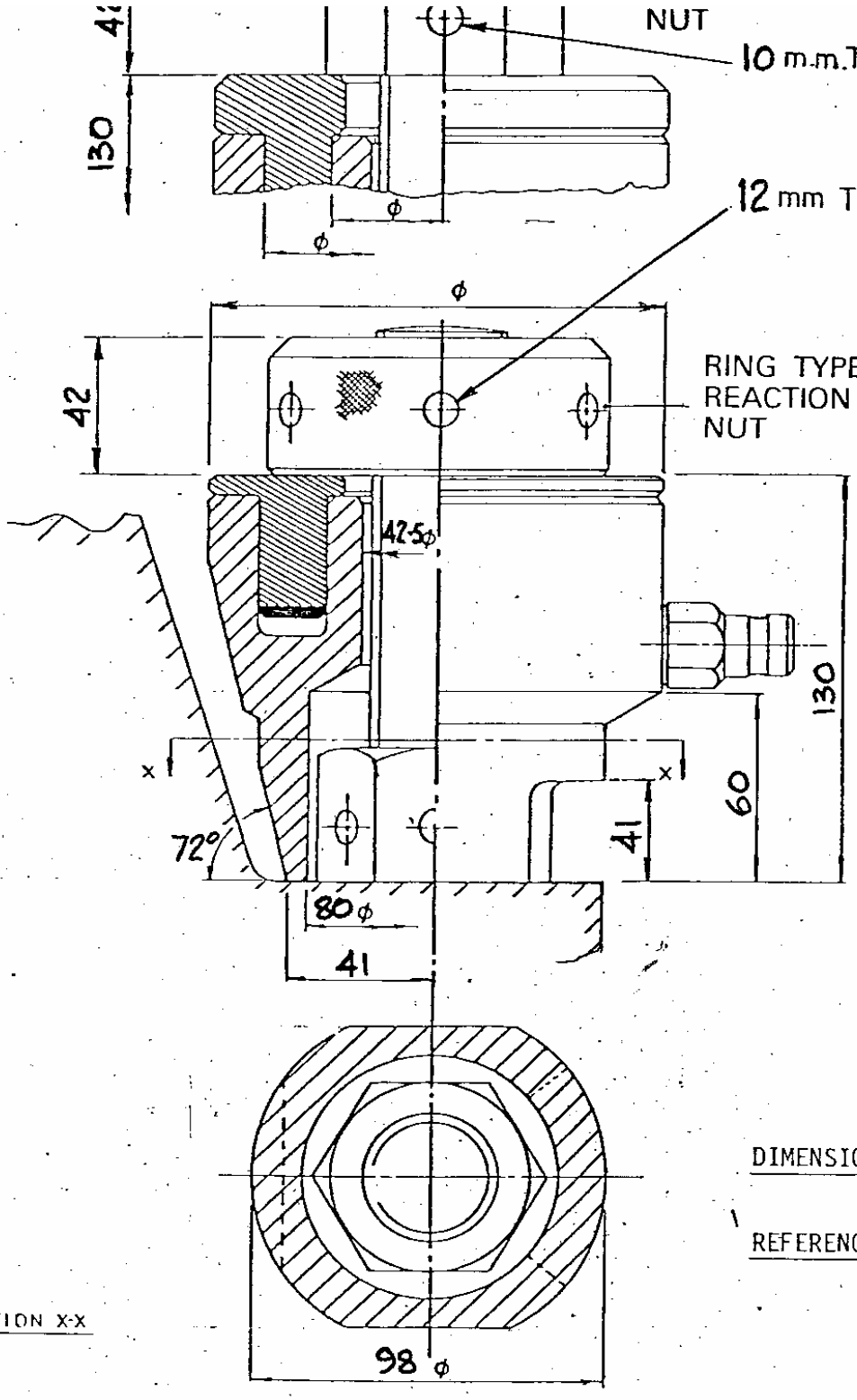
REFERENCE A - $1\frac{3}{8}$" SEA SERPENT

MAX LOAD CAPACITY @15000 psi = 35.6 Ton

MAX. ALLOWABLE RAM STROKE = 20mm

HYDRAULIC PRESSURE AREA = 5.32 in^2.

All Dimensions in mm.



DIMENSION & TECHNICAL DATA SHEET

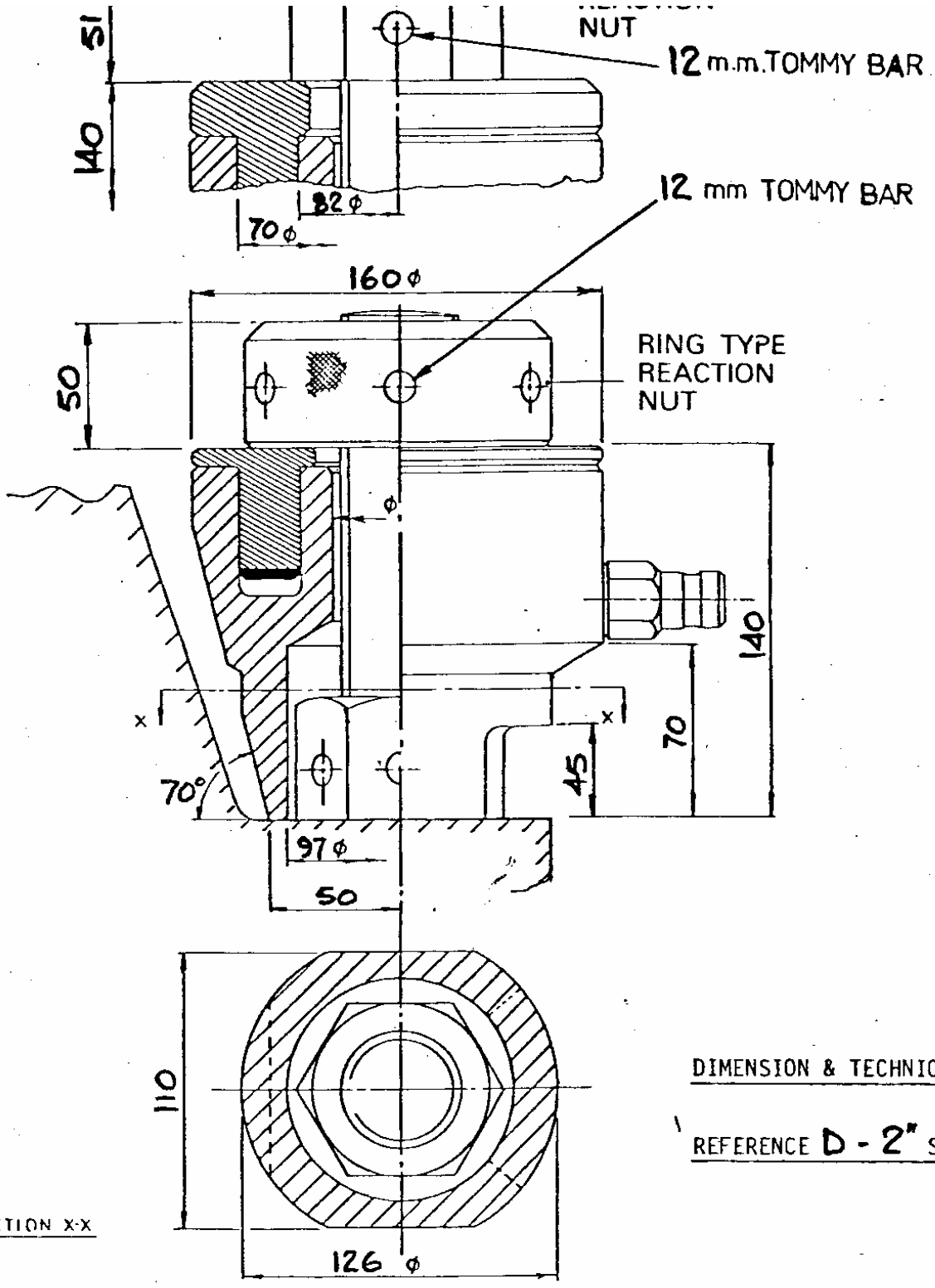
REFERENCE B - 1⅝" SEA SERPENT

MAX LOAD CAPACITY @ 15000 psi = 49·3 Tons

MAX. ALLOWABLE RAM STROKE = 20mm

HYDRAULIC PRESSURE AREA = 7·36 in^2.

All Dimensions in mm.



SECTION X-X

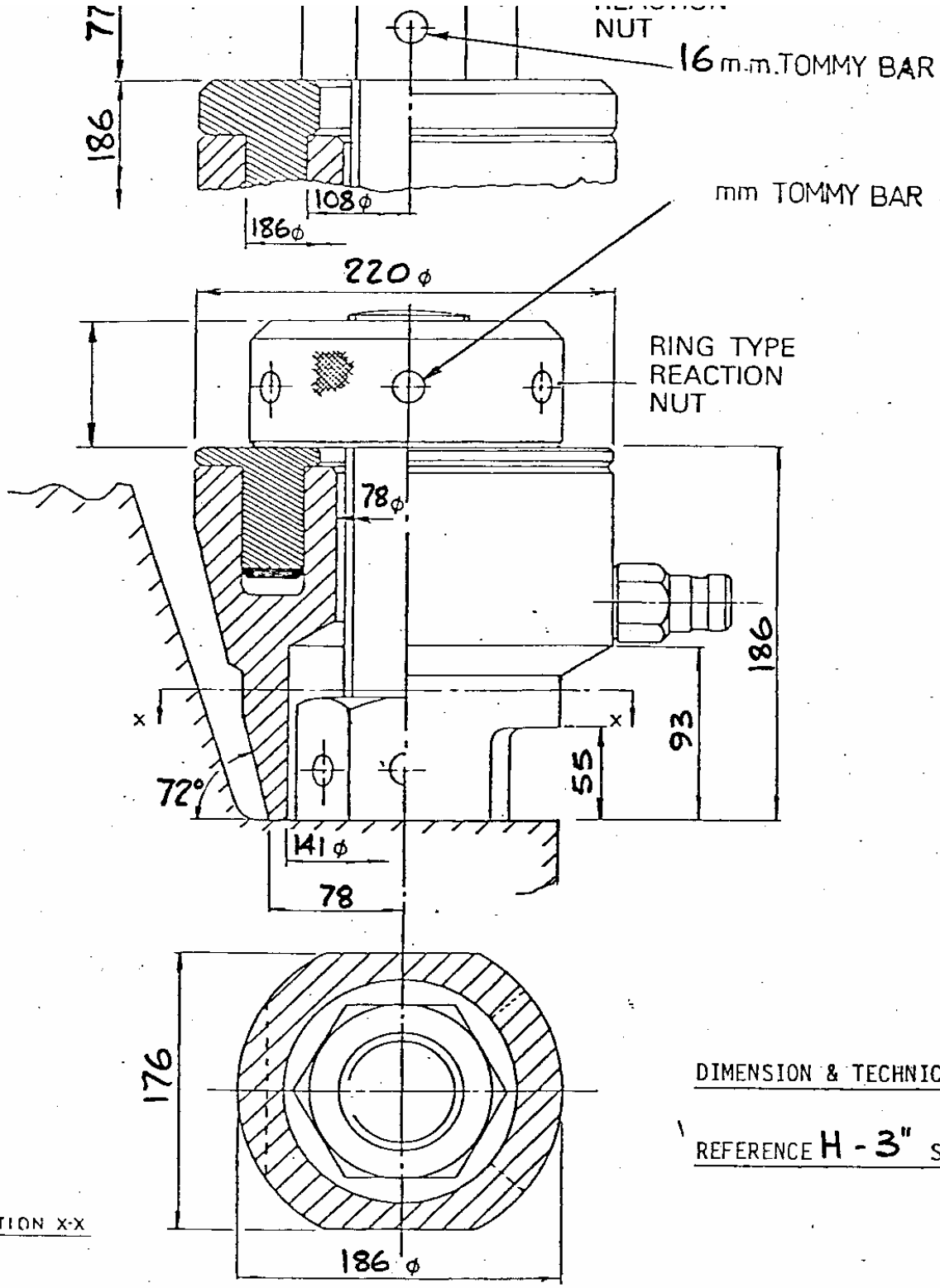
DIMENSION & TECHNICAL DATA SHEET

REFERENCE D - 2" SEA SERPENT

MAX LOAD CAPACITY @ 15000 psi = 70·5 Ton

MAX. ALLOWABLE RAM STROKE = 20mm

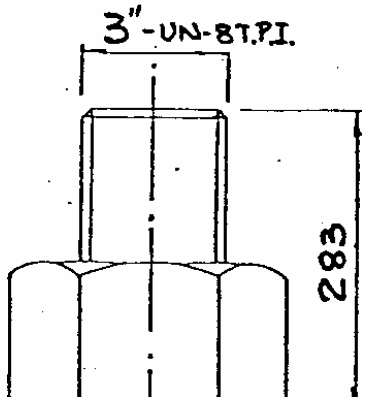
HYDRAULIC PRESSURE AREA = 10·53 in^2.



SECTION X-X

DIMENSION & TECHNICAL DATA SHEET

REFERENCE H - 3" SEA SERPENT



MAX LOAD CAPACITY @ 15000 psi = 187 To

MAX. ALLOWABLE RAM STROKE = 20mm

HYDRAULIC PRESSURE AREA = 28·0 in^2.

All Dimensions in mm