

INSTRUCTION MANUAL for MAIN ENGINE TOP BRACING



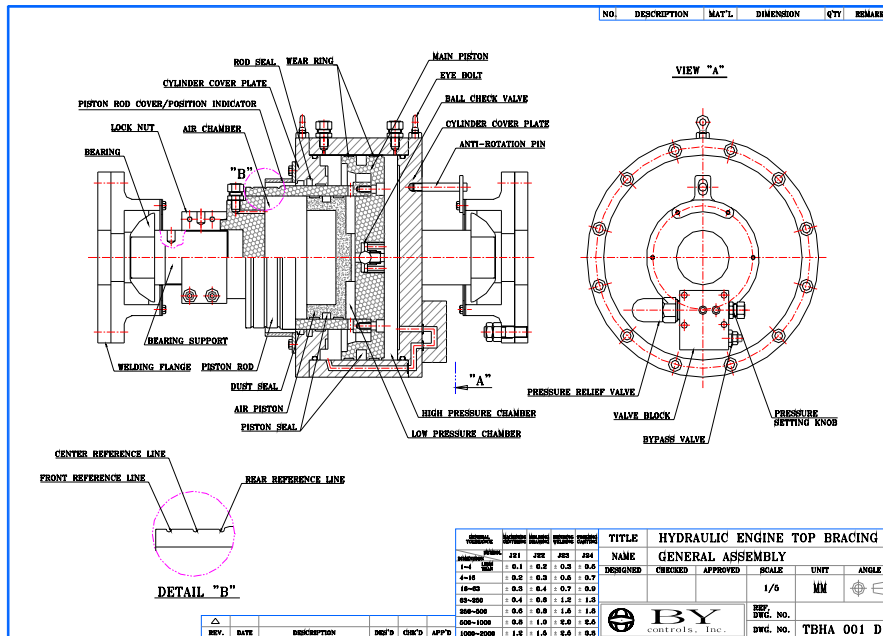
Hydraulically Operated Main Engine Top Bracing with Manifold Block

Main Engine Top Bracing

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1. GENERAL



As the output power of the ship engine becomes larger the height of the engine becomes higher accompanied by greater rocking movement of the engine body. This movement causes heavy vibration and necessitates the use of engine top bracing to reduce or prevent the vibration from being transmitted to the hull side.

BY's engine top bracing (hereinafter ETB) is consisted of several parts such as cylinder (ID 300mm), main piston, air piston, piston rod (OD 210mm), relief valve, by-pass valve, bearing support, spherical bearing and etc.. Small-sized air piston is designed to be placed in the main piston rod which is utilized as the air piston cylinder. This kind of differential type piston assembly enables a small and compact structure with cheaper product cost. The spherical bearing on both sides protect the piston assembly from being exposed to the vertical force caused by the external power source. This will prevent the unbalanced wear of the cylinder and reduces the necessity for frequent maintenance.

The BY's ETB is to be installed on the upper starboard side of engine in single or in pairs. It is operated both hydraulically and pneumatically with self-return mechanism. During the operation, basically two types of function – spring function and damper function – are to be exercised to reduce or dampen the vibration depending on the magnitude of frequency and vibration.

Spring function is displayed when the compressive force from the engine is not so large enough for the relief valve to be opened. Under this condition the ETB reduces the engine vibration in the same way as a spring does against an external compressive force. In contrast to spring function, damper function is displayed when the compressive force from the engine is large enough to make the relief valve open. Under this condition a portion of

the oil in the high pressure oil chamber is forced to be squeezed into the low pressure oil chamber through the open port in the relief valve, thus creating damping effect as a result of reactive force.

By-pass valve is to be used to select the function of the ETB: in case it is closed, both the spring function and damper function can be attained, but in case it is kept open only the damper function is possible.

2. SPECIFICATION

Hydraulic Cylinder	1. Type	HY 300
	2. Dimension, mm	Head end diameter: 300 Rod end diameter: 210 Piston travel length: ± 20 Volume of gas accumulator: 2.5 liter
	3. Repulsive force per cylinder under air supply pressure of 6~8 bar	2100 kgf for 6 bar 2400 kgf for 7 bar 2800 kgf for 8 bar
	4. Max. expected dynamic load	5,000 kgf
	5. Installation	2×8 Stud bolts, Nut M16×65L
	6. Valve Block Components	One(1) Relief Valve One(1) Bypass Valve
Accessories	1. Manifold Block	One(1) per two(2) or four(4) ETB
	2. Manifold Block Components	Air regulator with press gage Check valve (on the air supply line) Manifold header with press gage (for oil supply and air bleeding) Block valves
	3. Oil type	Standard hydraulic oil (ISO VG 32)
	4. Oil volume/ 1 Cylinder	3.3 liters
	5. Weight	Approx. 100 kg
	6. Max. allowable ambient temp.	Approx. 75°C
	7. Allowable installation offsets	± 10 mm (normal)

3. SCOPE of SUPPLY

- ♦ Hydraulic cylinder with built-in valve block assembly
- ♦ Manifold block with fittings and rubber hoses.
- ♦ Spare parts (O-rings, wear rings, piston seals)
- ♦ Special tools (hand pump and a pair of hook wrench)

☞ Piping material except flexible hoses is to be supplied by shipyard.

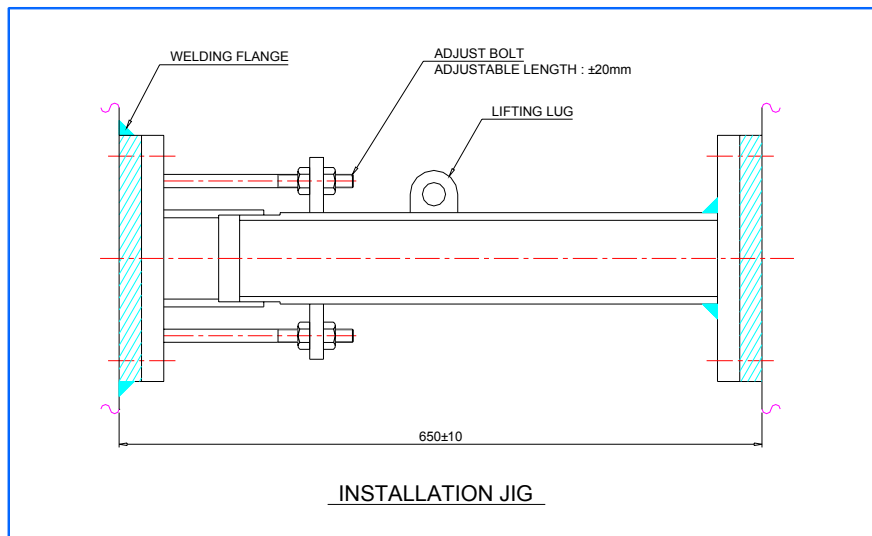
☞ Fitting & valves to be connected to hydraulic cylinder & manifold block are included in the scope of supply.

4. INSTALLATION

4.1 Before starting the installation work

It is recommended to read this manual before starting to install the ETB. Review the relevant drawings and check the parts if they comply with the specification. Also check if there is any missing part.

4.2 Preparation (Flange Welding)



- 1) Disconnect both of the welding-flanges from the ETB and fit them in the installation jig.
- 2) Measure the distance between the hull-side beam and gallery (engine-side) beam.
The distance should be within 650 ± 5 mm. In case the distance is too short it is recommended to cut the gallery beam to meet the required distance. But, on the contrary, if the distance is too long it is recommended to apply an adjustable plate to the gallery beam.
- 4) After having set the required distance, lift and fix the installation jig temporarily inbetween the hull-side and gallery beams using the adjust bolts.
- 5) Check the alignment of the horizontal axis line if it is within the tolerance range. If acceptable, weld the welding flange.
- 6) Remove the installation jig
- 7) Weld inside corner of the flange
- 8) Remove welding slugs and do the painting.

4.3 Install the hydraulic cylinder

Lift the hydraulic cylinder and tighten the mounting bolts.

4.4 Install piping btwn the hydraulic cylinder and the manifold block

- It is of utmost importance to ensure these piping line be free of any leakage for the safe and reliable performance of the whole system.
- See piping diagram (TBHA 007 or TBHA 045) for correct piping.

- ☞ Be sure to use flexible piping or rubber hoses to avoid premature rupture caused by heavy vibration.

4.5 Oil Filling & Air Bleeding

(Refer to the piping diagram TBHA 007 or TBHA 045)

4.5.1 PREPARATION

1) Hand pump:

Fill the hand pump with oil (*) and connect the hand pump hose to the oil supply nozzle on the manifold block.

(*) Depending on the situation, it may be necessary to fill several times during the air purge operation since the oil chamber in the hand pump is not large.

2) Line-up:

Check if the bypass valve in the valve block is open, and all of the block valves on the manifold headers are closed.

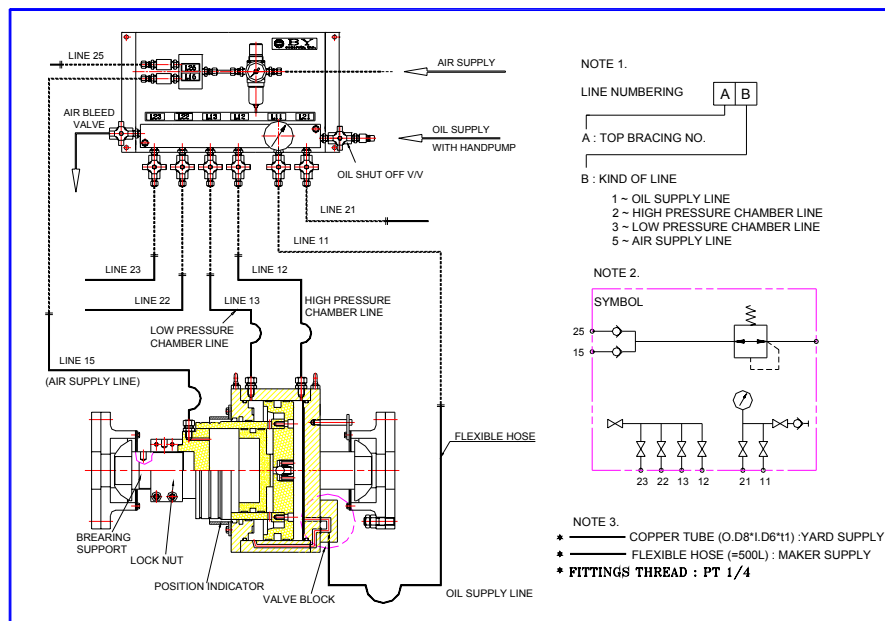
3) Position of the main piston:

Check if the position indicator (the edge of piston rod cover) meet the center line (if not, adjust accurately by turning the bearing support with hook wrench supplied by BY and fix it with lock nut after completion of adjustment.)

4) Drainage panel:

Put a oil drainage panel below the ETB to prevent oil spillage over the floor.

4.5.2 AIR BLEEDING



1) Air filling to the air chamber:

- Turn the knob at the air regulator clockwise (line #15,) and fill the air to
- 4.0 bar in case the normal operating pressure (*1) in the air chamber is 6 bar
 - 4.5 bar in case the normal operating pressure (*1) in the air chamber is 7 bar
 - 5.0 bar in case the normal operating pressure (*1) in the air chamber is 8 bar

After air has been filled up to proper pressure among the three cases above, block the air supply line by turning the knob at the air regulator counterclockwise (*2) or simply closing the main stop valve on the air supply line.

(*1) This pressure is the same as the air supply pressure since the pressure in the air chamber is normally maintained at the same air supply pressure level available in the ship.

(*2): The reason for air filling is to keep the volume of low pressure oil chamber to the minimum during this stage, thus to facilitate air purging operation.)

2) Line-up:

Open the air bleed valve on the air bleed manifold header, block valve on the line to and from the high-pressure chamber (line #11, 12) and main oil block valve at the oil supply manifold header.

Confirm if the bypass valve in the valve block assembly is opened.

3) Air purging in the high pressure oil chamber:

Start air purging supplying oil with hand pump. Oil will now fill the cylinder and the air trapped both in the piping and oil chamber will be purged through the bleed valve. When oil overflows with no sign of entrainment of air bubbles, the high-pressure chamber is regarded as fully bled.

When air purging is finished, stop hand pump and close block valve on the line from the high-pressure chamber (line #12).

4) Air purging in the low pressure oil chamber

Open the block valve on the line out of the low-pressure chamber (line #13), and start air purging supplying oil to the low pressure chamber with hand pump. Oil will now fill the cylinder and the air trapped inside the low pressure oil chamber will be purged out of the system through the bleed valve. When oil runs out with no sign of entrainment of air bubbles, the air in the low -pressure chamber is regarded as fully bled.

When air purging is finished, stop hand pump and close both the air bleed valve and the block valve on the line out of the low pressure oil chamber (line #13).

4.5.3 OIL CHAMBER PRESSURE and BYPASS V/V SETTING

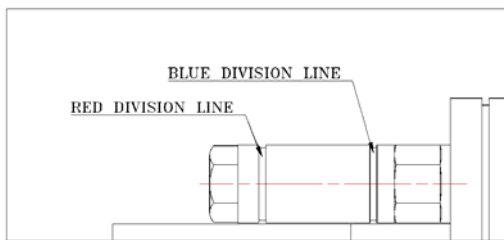
1) Oil chamber pressure setting

With the outlet block valves of both the high and low pressure oil chambers closed and the bypass valve in the valve block assembly open, continue pumping until the pressure in the oil chambers reach the final set pressure (6 or 7 or 8 bar) which matches the air chamber pressure described in 4.5.2 1) above (*1).

(*1): The reason for oil chamber pressure setting is to put the air piston in proper (neutral)

position (*2) for safe and stable performance of the ETB.

- (*2): This can be easily checked with the New Type ETB which has an indicating cap with inner indicating bar nailed into the body of the air piston. If the bar is positioned in the blue division line $\pm 20\%$ range, it is regarded as normal. If the bar is positioned out of this range, adjustment can be made by simply supplying (in case the bar is in the negative side) or releasing (in case the bar is in the positive side) the oil as required.



2) Line-up:

After the oil pressurization has been finished, close the block valves on the line to the low-pressure chamber (line #11) and oil supply line to the manifold header.

3) Setting of bypass valve opening

Fully close the bypass valve (*).

(*) The degree of opening is based on the cumulated experiences. Depending on the specific conditions of the engine, this can be adjusted by the user to the optimum.

5. ROUTINE CHECK AFTER INSTALLATION

5.1 Air supply pressure (air chamber pressure)

Check the pressure in the pressure gage of the air regulator on the air supply line. This should be the same as the pressure in the air chamber.

5.2 Pressure in the high-pressure oil chamber

Open the block valve on the line out of the high-pressure chamber (line #12) and check the pressure using the pressure gauge on the manifold block. Close the block valve after check has been finished (*).

(*): If wanted, one block valve may be kept open for convenience.

5.3 Position of the main piston

Check if the position indicator (the edge of the piston rod cover) meets the center reference line marked on the outside surface of the piston rod.

If the piston rod is found to have moved inside (the edge of the piston rod cover

approaching the front reference line marked on the piston rod), it is suspected that the oil in the oil chambers is leaking.

5.4 Position of the air piston

a. ETB without The Indicating Bar :

It is difficult to directly confirm the right position of the air piston with the existing type of ETB. In case the procedure 4.5.2.1) & 4.5.3 1) are followed strictly the air piston is believed to be kept in neutral position.

b. ETB with The Indicating Bar :

Check if the indicating bar is positioned within the normal position range (blue division line) $\pm 20\%$. If the bar is positioned out of this range, adjustment can be made by simply supplying (in case the bar is in the negative side) or releasing (in case the bar is in the positive side) the oil as required.

6. MAINTENANCE

6.1 Dismantling

- 1) Secure a strong hoist wire to the lifting lugs on the ETB body.
Put the oil spillage panel ready under the ETB body
- 2) Stop air supply by turning the knob on the air regulator counterclockwise and disconnect the air line from the cylinder (air chamber).
- 3) Close the block valve on the line to the oil chambers (line # 11) and disconnect the oil lines from top of the cylinder (line # 12,13).
- 4) Loosen the adjustment nut to give slack, and remove the ETB to safe place.

(ETB weigh approximately 100kg and may be slippery because of oil on the surface. Special care must be taken to prevent E.T.B. from being dropped on the floor by mistake.

6.2 Disassembling

1) Oil draining out of the low pressure oil chamber:

Connect air supply tube to the air inlet port and set the pressure at approx. 2 bar.
This will make the air chamber expand, squeezing the oil in the low pressure oil chamber out of the cylinder.
Vent the air pressure completely after oil has been drained.

2) Pulling out the main piston & piston rod assembly

- Open the front cover-plate (piston rod side) of the cylinder by unscrewing the bolts.
- Pull out the main piston (or let it slide out by turning the cylinder upside-down)
Be careful the sliding surfaces don't get scratched.
- Open the rear cover-plate, if needed.

3) Pulling out the air piston

- Separate the main piston and the piston rod by unscrewing the bolts installed through the main piston wall.
- Pull the air piston out of the piston rod by slightly pressurizing (*) the air chamber with air.

(*): Care must be taken not to increase abruptly to avoid air piston being puffed out of the piston rod like a blind bullet.

4) Replace the seals

Replace all of the seals and O-rings with spare parts.

5) Check all of the super-finish surfaces

Check for any damage or severe wear. If the surfaces look damaged, the damaged part should be either repaired (lapped) or replaced.

6.3 Re-assembling

- 1) Insert the **air piston** into the rod.
- 2) Check if the **check valve** is clean and the **ball** is in place.
- 3) Re-assemble the piston **rod** and **main piston**.
- 4) Fit the **main piston & piston rod assembly** into the front cover plate
- 5) Fit the **main piston & piston rod assembly** into the cylinder.
- 6) Tighten the **cover plates**.

 Lubricate well before inserting the piston into the cylinder. Care should be taken no seals be cut or damaged during this step.

6.4 Re-installation

Reinstall carefully according to 4. INSTALLATION procedure in this manual.

7. TROUBLE SHOOTING

7.1 Rattling Noise around the bearing support

- 1) Possible cause: ① Insufficient oil charge before service
② Excessive oil loss from the oil chambers or
③ Abnormally low pressure in the air chamber.
- 2) Diagnosis: Check if air pressure in the air chamber is normal.
Check if the position of the main piston is normal.
- 3) Remedy: In case of heavy oil loss, overhaul the ETB assembly for replacement of the seals including O-rings.
In case of insufficient oil charge, make up to normal level.
In case of air pressure loss, locate the leaky point and fix it.

7.2 External oil leakage along the surface of piston rod

- 1) Possible cause: ① Worn out piston seal or

② Scratches on the piston rod surface.

- 2) Remedy: Overhaul the ETB assembly for replacement of the seals or repair of the scratches on the surface of piston rod.

7.3 Internal oil leakage into the air chamber

1) Possible cause: ① Worn out piston seal.

- 2) Diagnosis: If oil in the low pressure oil chamber can leak into the air chamber the reverse can be possible. In this case the repulsive force by the air chamber will be deteriorated or paralyzed. Open the block valve on the line #13, and crack-open the air bleed valve on the manifold header to confirm if any sign of air bubble is found.

2) Remedy: Overhaul the ETB assembly for replacement of air piston seal.

7.4 Front reference line marked on the piston rod is near the position indicator

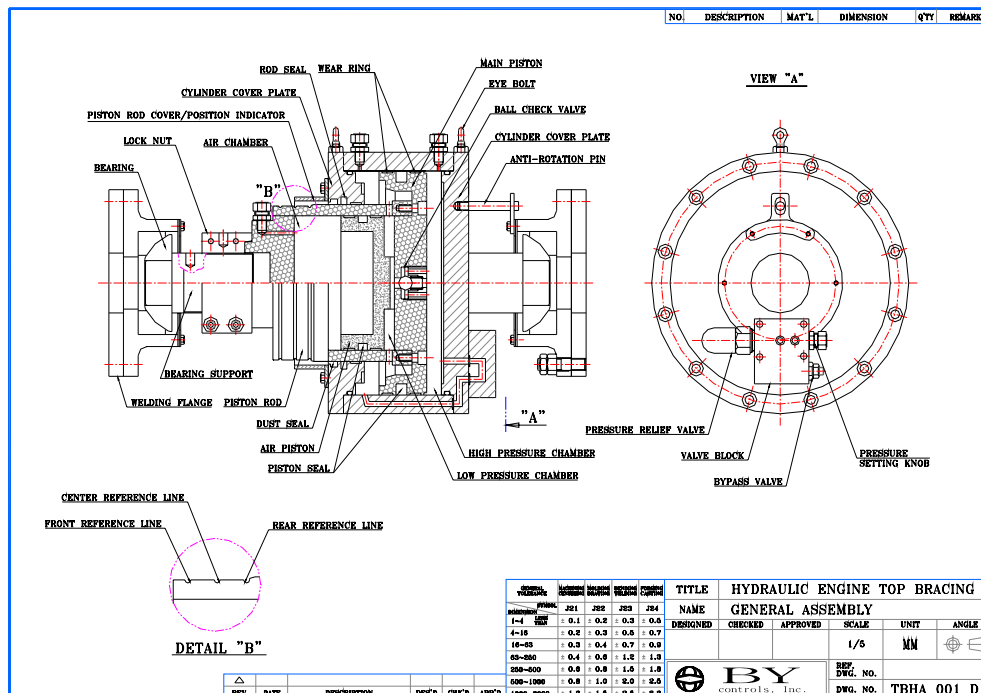
1) Possible cause: ① Worn out piston seal or

② Scratches on the piston rod surface.

- 2) Remedy: Overhaul the ETB assembly for replacement of the seals or repair of the scratches on the surface of piston rod.

8. APPENDIX (DRAWINGS)

8.1 General Assembly

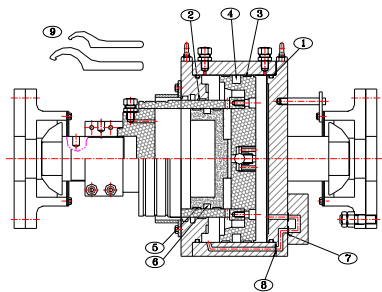


Main Engine Top Bracing

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8.2 Spare Parts & Tool List

NO. DESCRIPTION MAT'L DIMENSION QTY REMARK



SPARE PARTS LIST

ITEM	PART NAME	MODEL NO. for HY 300	SPARE for SHIP	REMARK
1	O-RING	G200	1	NOK
2	WEAR RING	B850705-2100C-TLSE	1	BUSAK
3	WEAR RING	B850705-3000A-TLSE(900)	1	
4	PISTON SEAL	USH280	1	
5	WEAR RING	B850705-1800A-47	1	
6	PISTON SEAL	PQ0301800	1	
7	O-RING	P12	2	NOK
8	O-RING	P9	1	NOK

TOOL LIST

ITEM	NAME	MODEL NO.	QTY	REMARK
9	HOOK WRENCH	ø60/ø40	2	
10	HANDPUMP	1000cc	1	*

NOTE : * Mark is not shown in this drawing.

TITLE HYDRAULIC ENGINE TOP BRACING
NAME SPARE PARTS & TOOL LIST

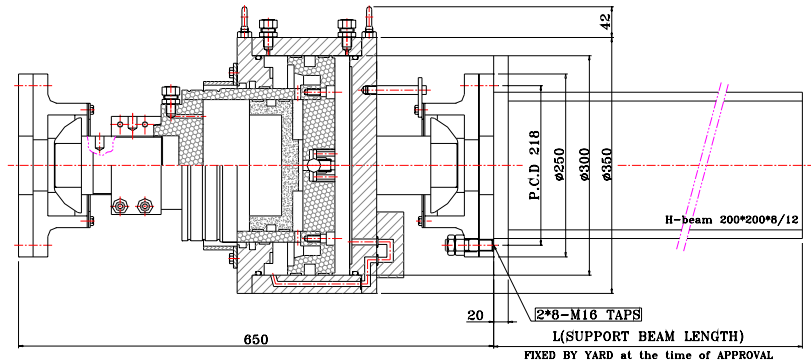
DESIGNED	CHECKED	APPROVED	SCALE	UNIT	ANGLE
			1/5	MM	

BY controls, Inc. **REV.** NO. **ENG. NO.** TBHA 002 I

REV.	DATE	DESCRIPTION	DES'D	CHE'K	APP'D
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8.3 ETB Dimension

NO. DESCRIPTION MAT'L DIMENSION QTY REMARK



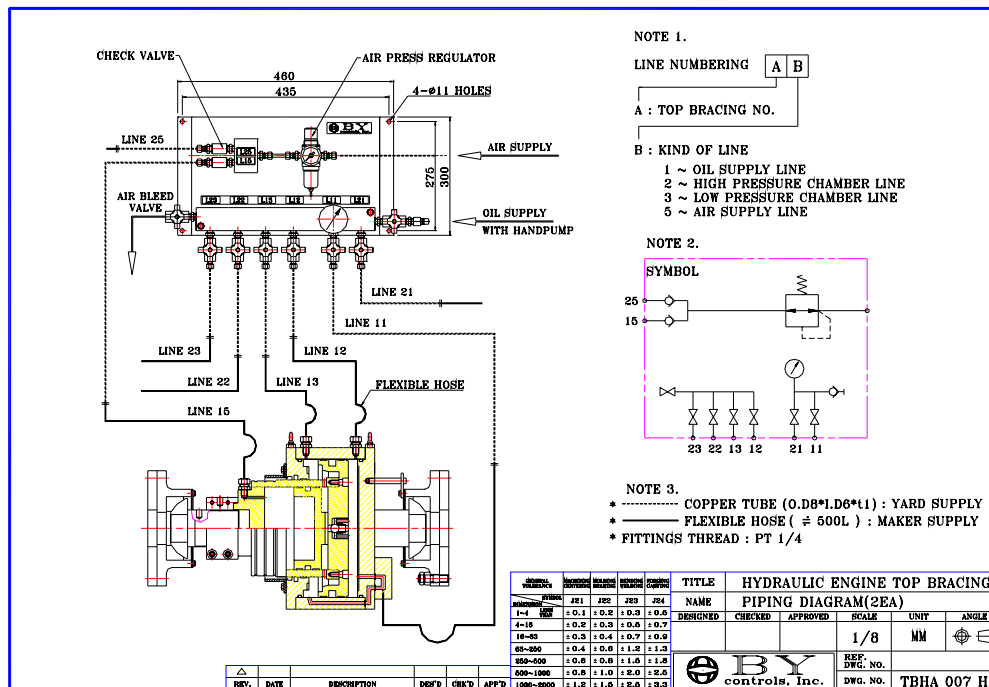
TITLE HYDRAULIC ENGINE TOP BRACING
NAME E.T.B DIMENSION

DESIGNED	CHECKED	APPROVED	SCALE	UNIT	ANGLE
			1/5	MM	

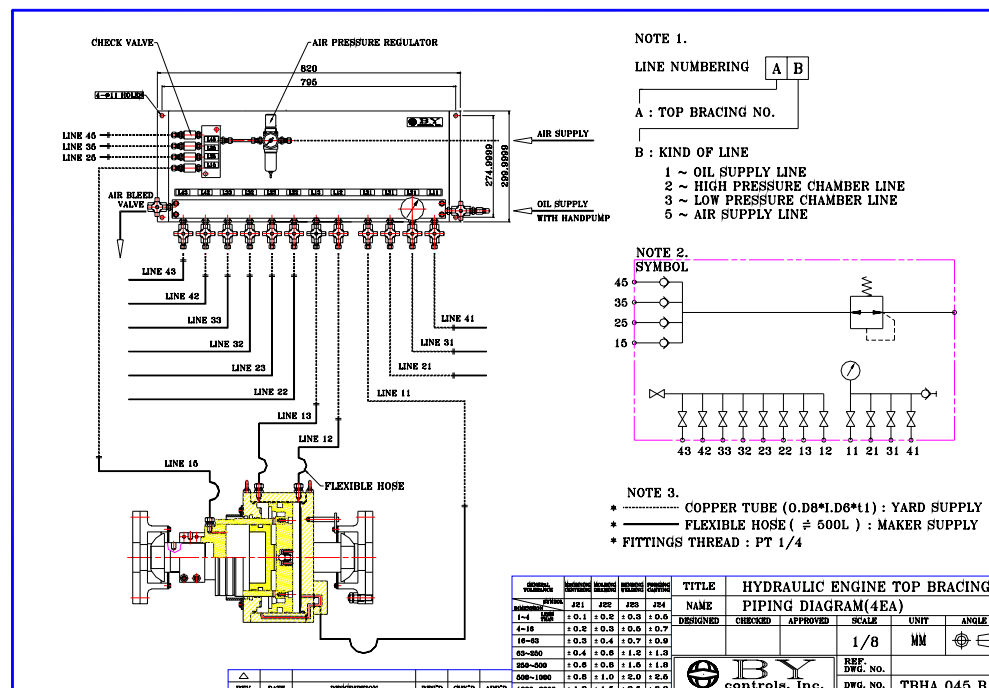
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8.6 Piping Diagram (for two ETB)



8.7 Piping Diagram (for four ETB)



-The End