



# **TANK JACKING EQUIPMENT**

## **OPERATION MANUAL**

Bell Fluidtechnics Pvt Ltd, A-238,MIDC – MAHAPE

*Note: The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein*

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## 1.0 SAFETY REQUIREMENTS

### **WARNING ARC WELDING MAY BE DANGEROUS**

*PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH, KEEP CHILDREN*

*AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.*

Read and understand the following safety highlights, *BE SURE THAT ALL INSTALLATION, OPERATION,*

*MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.*

#### *1. ELECTRIC SHOCK can kill.*

- The electrode and work (or ground) circuits are electrically “hot” when the welder is on, do not touch these “hot” parts with your bare skin or wet clothing.
- Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.
- In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are electrically “hot”.
- Always be sure the work cable makes a good electrical connection with the metal being welded, the connection should be as close possible to the area being welded.
- Ground the work or metal to be welded to a good electrical (earth) ground.
- Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
- Never dip the electrode in water for cooling.
- Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
- When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

## ***2. ARC RAYS can burn***

- Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Head shield and filter lens should conform to nation standard.
- Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.
- Protect other nearby personnel with suitable, non-flame able screening and warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

## ***3. FUMES AND GASES can be dangerous.***

- Welding may produce fumes and gases hazardous to health, Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and exhaust at the arc to keep fumes and gases away from the breathing zone.
- Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
- Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.
- Read understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet and follow your employer's safety practices.

## ***4. WELDING SPARKS can cause fire or explosion.***

- Remove fire hazards from the welding area, if this is not possible; cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines.
- Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations.
- When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
- Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside.
- Vent hollow castings or containers before heating, cutting or welding. They may explode.

- Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuff less trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.
- Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail

#### ***5. FOR ELECTRICALLY powered equipment (apply in to welding and cutting equipment)***

- Turn off input power using the disconnect switch at the fuse box before working on the equipment.
- Install equipment in accordance with BELL HYDROMATIC recommendations (as: manual).
- Ground the equipment in accordance with our recommendations

#### ***6. Other***

- Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belt, gears, fans and all other moving parts when starting, operating or repairing or repairing equipment.
- In some cases it may be necessary to remove safety guards to perform required maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.
- Do not put hands near the running fan, do not operate with panel open or guards off.

#### ***7. ELECTRIC AND MAGNETIC FIELDS may be dangerous.***

- Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF).Welding current creates EMF fields around welding cables and welding machines.
- EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding
- All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit: a) Rout the electrode and work cables together –Secure them with tape when possible. Never coil the electrode lead around your body. b) Do not place your body between the electrode and work cables.if the electrode cable is on your right side,the work cable should also be on your right side, c) Connect the work cable to the workpiece as close as possible to the area being welded, d) Do not work next to welding power source.

## 2.0 TECHNICAL DATA

### WARNING

"Overload or misuse of a Tank Erection Equipment can cause **PROPERTY DAMAGE, BODY INJURE OR DEATH**. Before operating read carefully and understand the information contained on the sheet below. If you have any questions or concerns, please contact us at [bellhyd@vsnl.com](mailto:bellhyd@vsnl.com)

#### Specifications:

##### Model

##### Description

**BH 12 BH 18/ 25**

Working capacity (metric tons) 12 18 25

Jack's testing load (tons) 18 27 37.5

Standard arc spacing between jacks (m) 1.80 to 3.50

Trestles lift plates height up to (m) 2.50 or 3.00

Climb/stroke 100mm (mm/stroke)

Time per stroke (minutes) Approx 5

Retracting system Spring double action

- Hydraulic Jacks **MUST NOT EXCEED** working capacity at any time (see table above)
- Arc spacing between trestles **MUST NOT EXCEED** 3.50 m
- If tank height is larger than tank diameter contact technical support
- Overload a Tank Jacking Equip can cause **PROPERTY DAMAGE, BODY INJURE OR DEAD**

## **3.0 INSTRUCTIONS FOR INSTALLATION AND OPERATION**

### **1.1 FIXING OF TRESTLE BASE PLATE**

The trestle base plate of size 350 mm x 300 mm is to be fixed such that the edges of the base plate are at a distance of 125 mm from the shell plate. All the base plates shall be placed at equal distance from each other around the periphery of the tank. The trestle base plate shall be fixed parallel to the tank shell plate such that the distance between the shell plate and trestle base plate is the same at both the edges of the base plate. The side measuring 350 mm shall be parallel to the tank shell plate. The base plate shall be welded to the tank bottom plate.

### **1.2 FIXING OF TRESTLE BOX AND STAY PIPES**

The trestle box is laid horizontally on the tank foundation with the bottom bolt (6" long) in place and fixed to the trestle base plate. Two stay pipes are fixed to the trestle box with the stud bolt. The stay pipes are also laid on the ground horizontally. The loading point, sliding chair and lifting arm are fixed to the jack rod on the trestle box and slid to the end near the base plate. The complete assembly comprising of trestle box with 2 stay pipes are lifted up to vertical position. The jack rod should face the tank shell plate. For positioning of the lower lugs (base plate for the stay pipes), mark a point "X" on the tank bottom plate at about 2000 mm from the inner shell perpendicular to the trestle base plate. From this point mark two points perpendicular to the line joining the shell plate to the point "X", at about 1200 mm distance on either side of point "X". These two points are where the two lower lugs should be fixed and tack welded to the tank bottom plate. These distances are only indicative and may change depending upon the distance between the trestles. The angle forming between the two stays pipes should be between 60 degrees and 90 degrees. The trestle box should be proper plumb. This can be adjusted by rotating the stay pipes, which act like turn buckles.



### **1.3 PLACING OF JACKS AND FIXING OF LUGS**

The jack is to be mounted onto the jack rod of the trestle box below the loading point (by manually lifting the loading point, sliding chair and lifting arm) such that the loading point sits on the jack. All the four jaw lock levers should be on "locked" or "closed" position.

Weld the lifting lugs at a level slightly above the point where the lifting arm touches the tank shell plate. All the lifting lugs should be at the same level. (This can be checked using water level tube). Normally 6 to 8 mm fillet weld on both sides along the full length of the lug is done and this weld quality is checked using suitable methods, such as DPT / MPI. The fend-off lugs are welded to the tank shell plate in such

as manner that there is a gap of minimum 5 mm between the bottom edge of the fend off lug and the upper edge of the sliding chair, so as to ensure that no vertical load is transferred from the tank shell plate to the sliding chair.

After the hose and power pack connection, lift all the jacks slightly so that the top of the lifting arm touches the bottom edge of the lifting lug. Now the jacking equipment is ready for lifting the tank.

### **1.4 HOSE CONNECTIONS**

The Powerpack can be placed inside the tank or outside the tank. From the main outlet of the powerpack, one hose pipe is connected to the manifold block (5-way, 8-way or 10-way connector, depending upon the number of jacks used in the tank). From this manifold block, 4, 8 or 10 main distribution lines are fixed in radial direction. One hose of 2.5 metres is fixed to each jack through a stop cock valve. The other end of the hose is fixed to a Tee-connector, which in turn is fixed to other hoses forming a circumferential ring near the periphery of the tank.

The main distribution hoses are connected to this circumferential ring using Tee connections.

Teflon tape should be used at each hose joint.

## **2. ERECTION OF JACKING EQUIPMENT**

### **2.1 OPERATING THE JAW LOCKS**

There are four jaws in each jack, an upper pair and a lower pair. Each jaw can be locked or unlocked using jaw lock levers. By turning the levers on the left side in clockwise direction and the levers on the right side in the anti-clockwise direction, the levers can engage or lock the jaws. Always, both levers of either upper pair or lower pair should be operated simultaneously for locking and for unlocking. In the locked position, the jack can only move upwards and not downwards. Therefore, during lifting, both the pairs of jaws should be in locked position.

Only when the jack is to be lowered down, the levers are to be unlocked, but at any point of time, any one pair of jaws should be in locked position, otherwise the jack will fall down possibly causing injury.

### **2.2 OPERATING THE HYDRAULIC POWERPACK**

After connecting the motor to the power source through the starter, the direction of rotation of the motor fan should be checked and ensured that it is in clockwise direction.

Hose connection should be tight so that there is no leakage of oil. The oil tank should be filled with hydraulic SHELL-Tellus 32 OR IOC SERVO SYSTEM 46/68 depending of working temperature. See section of oil selection

The Relief valve pressure on the power pack is first to be set to 80 bar.

Follow the steps below to set up pressure.

- Power Pack should be On.
- Ball valve should be Close.
- All valves on jacks should be Close.
- Pull the lever and adjust relief valve to get desire pressure.

Start with a lifting pressure of 80 bars; gradually increase the pressure as needed. Max working pressure should be 110 bars.

At this point the system is ready for lifting. Open all the valves on the jacks and ensure the ball valve is close. Slowly push the lever until a full stroke is archived by the jacks. By pushing the lever, oil will start flowing from the hose pipes into the jacks. Once the full stroke is archive, release the lever (this will go back to its neutral position).

Open the ball valve to allow the oil to return to the Power Pack oil tank. This will allow the jack pistons to retract, thereby completing one lifting cycle. This sequence of operations is repeated for each consecutive lift of 100 mm until the lifting height is archived.

### **2.3 LOWERING THE JACKS**

After the second ring is put in place, the jacks should be lower to sit the ring that was lifted into the second ring. Lowering gap should be around 25 mm, which is the gap between the two rings.

There are two simple rules that need to be follow at all times while lowering the jacks, failure to do so can cause the lifted ring to fall.

1. When piston is out, bottoms locks must not be open.
2. When piston is in, top locks must not be open.

To lower the jacks follow the steps below, this must be follow really carefully.

- a. Makes sure all the jacks are with the pistons all the way IN.
- b. Close the valves on all the jacks.
  
- c. Open valve on 1<sup>st</sup> jack.
- d. Open bottom locks on 1<sup>st</sup> jack.
- e. Press lever on Power Pack until 1<sup>st</sup> jack pistons are release by 70 mm.
- f. Lock the bottom locks on 1<sup>st</sup> jack.
- g. Repeat steps c to f for the rest of the jacks.
- h. Open all valves on jacks.
- i. Press lever all the way up, this will cause an additional lift of 30 mm. (100mm – 70mm = 30mm).
- j. Open all the top locks in all jacks.
- k. Open the ball valve, this will allow the jacks to be lowered by 70 mm.

Note: Piston lowering should be more than gap plate; otherwise more than one iteration will be needed to lower the plate.

\*\*\*\*\*

## 2.4 SKETCHES

### Base Plate for Trestle Box

Lower Lug

Upper Lug

Stay Pipe

### Trestle Box

Hydraulic Jack Model HLJ 12  
(View from tank Shell side)

## HOSE CONNECTION

### DETAIL – A

## 4.0 GENERAL INSTRUCTIONS

### 1.0 Data

1.1 The lifting equipment is composed of a number of trestle assemblies (lifting trestles with hydraulic climbing jacks) and one common high-pressure oil pump/ power pack.

1.2 Lifting / lowering capacity: 1) Model BH 12, 12 metric tons per trestle, 2) Model BH 18, 18 metric tons per trestle, 3) Model BH 25, 25 metric tons per trestle

1.3 Effective lifting height = Maximum shell ring height): 1) Standard trestle: 2500 mm, 2) Available for 3000 mm

1.4 Effective lift: 95 mm per stroke.

1.5 Jacks Model BH 12 can be connected to the following pump type:

7.5 HP at maximum 20 jacks.

10 HP at maximum 34 jacks.

15 HP at maximum 55 jacks.

20 HP at maximum 65 jacks.

40 HP at maximum 115 jacks.

## **2.0 Range of application of the lifting equipment**

Erection of tank of steel or other materials.

Repair of tank of tank foundations.

Enlargement of storage capacity in existing tanks.

## **3.0 Principle of the erection system**

Working principle for the erection of a tank is outline below. This is only an outline, which can be modified depending on the field conditions. Refer to Drawing CC-1 for diagram.

3.1 The tank bottom – plates are placed on the prepared foundation and welded together.

3.2 Spacers cum guide beams of maximum 400 mm height are tack welded to the tank bottom along the periphery. The plates of the first shell ring (in fact the top ring of the tank) are positioned and welded together.

3.3 The beams or lattice work of the roof are assembled and finally joined to the upper rim of the shell ring. Possibly the inner sheets of the roof are placed and welded together.

3.4 The lifting equipment is assembled according to Chapter 10 and 13. The plates of the second shell ring (next to top ring) are positioned outside the first one.

3.5 The completed part of the tank (the roof and top shell ring) is lifted hydraulically to a height, at which the plates of the second shell ring can be moved into place and the roof sheeting can be completed, except for about 2 or 3 roof plates which shall not be fixed until completion of the tank for air to pass through.

3.6 The plates of the second shell ring are located exactly and welded together to the lower edge of the first shell ring.

3.7 The plates of the third shell ring are placed outside the second shell ring.

3.8 The completed part of the tank (the roof and the two uppermost shell rings) is lifted.

3.9 The above cycle of operations is repeated until the last (bottom) shell ring is finished.

3.10 The entire tank is lowered down to the bottom plate and welded to this. The lifting equipment is dismantled.

#### **4.0 Main components of the tank trestle**

4.1 The jacking equipment is composed of the following components

(Drawing CC-3 and CC-4)

4.2 1 pc Trestle box with base plate Items 1 & 2

The trestle box is 4000 mm long

4.3 2 pcs Stay pipes with upper and lower lugs Items 11, 12 & 13

Stays with adjustable length. Average length is about 4180 mm. Trimming allowance is +/- 100 mm.

4.4 1 pc Loading point Item 3

Loading point is the point of transfer of load onto the jack from the trestle arm

4.5 1 pc hydraulic jack type 2510-50D Item 4

4.6 High pressure oil hose Item 5

4.7 2 pcs Stop cock valve with elbow Item 6

4.8 1 pc Sliding chair Item 7

Sliding chair with a seat for lifting arm and bracket for a fend-off lug

4.9 Lifting arm Item 9

## 5.0 Oil Pump / Power pack

5.1 The jacks are connected to an electrical driving pump unit, also known as, Power Pack. See instructions for power pack in Chapters 10 and 14. Connection diagram is shown in Drawing CC-2.

### 5.2 Pump data for a BH 12

10 HP Power Pack

Flow, liters/min 31

Max working pressure, bars/psi - 110 /1595

Tank volume, liters 200

Number of lifting jacks per pump, max 34

20 HP Power Pack

Flow, liters/min 59

Max working pressure, bars/psi - 110 /1595

Tank volume, liters 300

Number of lifting jacks per pump, max 65

40 HP Power Pack

Flow, liters/min 118

Max working pressure, bars/psi 110 / 1595

Tank volume, liters 500

Number of lifting jacks per pump, max 115

### 5.3 Pump data for a HLJ 25

40 HP Power Pack

Capacity, liters/min 120

Max working pressure, bars/psi 110 / 1595

Motor, kW/HP 30/40

Tank volume, liters 1200

Number of lifting jacks per pump, max 60

## 6.0 Auxiliary devices

Drawing CC-3 to CC-7

6.1 Fend-off lug (8) and lifting lug (10) are not included in the lifting equipment. These details are made at site according to drawing CC-6 and CC-7 respectively.

6.2 Minimum height plate that the trestle will take is 2 meters. If plate of less than 2 meters will be used, beams spacers must be used to raise the height of the first shell.

## 7.0 Number of tank trestles/jacks

7.1 The number of trestle/jacks required for a tank determine by the following:

a. Weight of the tank, this should include weight of the roof, rings, and all components that will be lifted with the tank. Also wind speed should be taking into account to determine the extra dead load on the tank. Considering wind speed zero, number of trestles/jacks = Total lifting weight / jack capacity

b. Arc distance between two consecutive trestles/jacks should be between 1.8 m to 3.5 m. Arc distance must be chosen depending of diameter of the tank to be lifted.

Number of trestles/jacks = Perimeter of tank / distance between trestles

The appropriate number of trestles / jacks must be the grater of a & b.

If the tank has a permanent roof column support, two or more additional trestles/ jacks must be required. The column should consist of sections of the same size as the shell plates and install each time a new ring is placed.



## 8.0 Example of tank under erection

8.1 The drawing CC-2 shows an example of a tank with arrangements necessary for the erection. The figures symbolize the following:

1. Foundation of the tank
2. Bottom plate
3. High pressure oil pump / Power pack
4. Oil line of high pressure hoses
5. Lower lug
6. Stay pipe
7. Base plate for trestle box
8. Hydraulic climbing jack
9. Fend-off lug
10. Lifting arm
11. Lifting lug
12. Jack rod of the lifting trestle
13. Next uppermost shell ring
14. Uppermost shell ring
15. Vertical column of lifting trestle / trestle box
16. Sliding chair
17. Spacer cum guide beam
18. Roof beam
19. Roof sheet
20. Splitter for oil lines.

## 9.0 Working procedure

9.1 The tank periphery is marked out on the bottom plates

9.2 The first (uppermost) shell ring is positioned on the base of the tank. The shell ring is checked to be exactly level. The shell plates are placed with correct radius and in plumb.

9.3 Roof beams are assembled and finally fastened to the uppermost shell ring. Possibly some of the roof sheets are placed and welded. Roof clearance is needed for trestles.

9.4 The location of the lifting trestles is marked out inside the erected shell ring. The division should be symmetrical with equal spacing between all tank trestles.

9.5 The lifting equipment is installed according to Chapters 10 and 13.

9.6 The first shell ring is lifted to a height at which the top edges of the tank trestles are below the roof sheets. If the height of the two uppermost shell rings added together is less than the height of the trestle, these two shell rings should be welded together before this height is reached.

9.7 The roof sheets are placed and finally welded. If floating roof is required on the tank, the roof is constructed first except of the plates that are close to the wall of the tank, where the trestles will be placed. Once the full tank is erected, the final plates are welded.

9.8 Raise the completed part of the tank so that the next shell ring can be inserted below the first one.

Do not lift unnecessarily high! The lifting can be stopped at any moment by putting the operating lever into the neutral position. The lift may not be exactly the same at all points. As soon as the required height is reached at one point, the lifting is stopped and the stop valve of that lifting point (jack) is closed. Then the lifting starts again until another point has reached the same height. This procedure is repeated until the correct height is reached at all the lifting points. All valves are thus now closed and the elevated part of the tank is now loading the lower grip-jaws of the climbing jacks. Usually a gap in between shell of 25 mm will be sufficient.

9.9 Leveling the lifted portion of the tank can be done by lifting or lowering certain sections of the tank at different time. Close all the valves on the jacks and only open the ones that need to be adjusted. Repeat with different sections until the lifted portion is level.

9.10 The next shell ring is fitted and horizontally welded. Last sheet can be left out to allow personal to go in and out of the tank. Bracing can be used instead of last shell. If there is wind, it is recommended anchoring the lifted portion using 4 steel cables. These cables will grab the tank from the top and will be anchored in any structure close by.

9.11 The lifted shell is lowered into the new shell ring. Guiders can be used to make the operation easier.

9.12 The climbing jacks and sliding chairs are lowered one at a time using a rope with chain (drwg CC-8). During this operation, both of the grip-jaw sets of the jacks must be in disengaged (open) position.

9.13 The lifting and fend-off lugs (10 and 8 on drwg CC-3) are now removed from the first shell, and welded to the next uppermost shell ring.

9.14 The same procedure as above is now repeated for following shell rings. As the load on the lifting trestles has now increased, the oil pressure must be increased, but not more than necessary, and in no case more than 110 bar.

9.15 Before the assembly of the last (bottom) shell ring. If necessary the powerpack can be placed outside the tank. After the last shell ring is welded to the tank wall, the lower edge of the last shell ring is welded to the bottom plates.

9.16 The assembly and lifting equipment is dismantled.

9.17 Never make a lift in strong winds or when the wind velocity exceeds or is expected to exceed the "maximum safe wind speed for lifting" which can be calculated by the manufacturer and provided on request.

### **10.0 Assembly of the jacking equipment and lifting (Drawing CC-3)**

10.1 The trestle column (2) with climbing jack (4) and loading point (3), sliding chair (7), stay pipes (11) and base plate (1) are placed radially along the tank periphery. The base plate is tack-welded to the tank bottom have a space measure of 50 mm between the inside of the shell sheet and the outside of the base-plate.

10.2 The vertical column of the lifting trestle is raised into vertical position. The two lower lugs are welded to the tank bottom plate. The screws for vertical adjustment of the lifting trestle shall be screwed out about 100 mm in order to have adjustment. The vertical position is checked and adjusted in both directions, if required by rearranging the two stays.

10.3 All tank trestles are set up as described above.

10.4 The lifting and fend-off lugs (10, 8) are welded to the inside of the shell sheet. Note, that there must be a space of about 5 to 10 mm between the upper edge of the spacing clamp of the sliding chair and the fend-off lug.

10.5 The elbows and stop cocks (6) are fitted to all jacks.

10.6 The powerpack is placed inside the tank or outside. Connect the powerpack with hoses to the jacks. When using a large number of tank trestles make extra branch hose lines. See that the hoses are not twisted and hang them up for prevention of damage.

10.7 Test the oil pump. Check before starting that the motor is set for the existing voltage. Check the direction of rotation, this should be clockwise. Check the oil level. See separate pump instruction in Chapter 14.

10.8 Close all stop cocks of the climbing jacks and run the pump with 110 bar oil pressure to check the tightness of the hose joints.

10.9 Regulate the pump pressure to 50 – 60 kg/cm<sup>2</sup> and stop the motor. Open all stop cocks. The equipment is now ready for lifting.

## 10.10 Lifting.

Start the pump. Put the operating lever into lifting position and watch the pressure gauge and the jacks. If no lifting place at the set oil pressure, increase the pressure until lifting starts, but in no case should the pressure be increased to more than 110 bar. This operation must always be made with the lowermost pump pressure required as in that way even and uniform lifting occurs. When all the jacks have made their full stroke, the operating lever is slowly brought into return position. Keep in this position until all jacks have made their return stroke, that is the piston rods are completely retracted in the cylinders.

The operations are repeated until the required lifting height is reached.

## 11.0 Lifting speed

11.1 Pressure should be set to 80 bar for the first lift. It must be increased gradually as the system requires. The oil must be fluid at the existing temperature conditions. In cold weather a circulation run with preheated oil before starting the lifting operations can considerably shorten the return speed. The stroke volume is about 1.90 liters per climbing jack. The pumping time is calculated from the time the lever is pushed to start the lifting until the time the lever is brought back to neutral position. The pumping time is directly dependent on the pump capacity and the number of jacks connected, provided that the oil system is completely filled with oil and free of air.

## 12.0 Oil Selection

### 12.1 Oil Type vs Working Temperature

Temperature Oil Specs

Below 0°C (32°F) Mobil Oil 10W

0°C to +25°C (32°F to 80°F) Mobil Oil 20W-20

Above +25°C (80°F) Mobil Oil 30 or any oil with

Viscosity of 68

### 13.0 Factory Synchronized Power Packs.

Description of the 2 types of powerpacks supplied are as follows :

1. The Main Powerpack has a Direction Control Valve. For the purpose of clarity, we shall call this PP – A.
2. The secondary powerpack does not have the Direction control valve fitted to it, and instead has a carry-over plate. This shall be called as PP – B. When the carry-over plate of this Powerpack is removed and replaced by a Direction Control valve, then this Powerpack becomes same as “PP-A”.

The system essentially consists of a 125 lpm pump coupled to 40 HP motor, manifold block with pressure relief valve suitable for 400 lpm, a lever valve (or Direction control valve) suitable for up to 500 lpm, one low pressure ball valve and one high-pressure ball valve.

**CAUTION:** The ball valve in the flow line, (low pressure ball valve) should always be “OPEN” before the motor is started, otherwise the pump will get damaged

Open the low pressure ball valve before starting the motor. An electrical interlock is provided, which ensures that the pump does not start unless low-pressure valve is open. The direction of rotation of fan should be clockwise (unless otherwise marked on the motor) when viewed from motor fan cover end. In case the direction of rotation is counterclockwise, change any two phases.

Setting of pressure relief valve:

Fix plugs on Port “A” and Port “B” and keep high-pressure ball valve closed. Start motor, wait until the motor switches from Star to Delta, then operate Direction control valve by pushing and holding back, adjust the pressure and set to 135 kg/cm<sup>2</sup>. Switch off the motor.

Remove plugs from “A” and “B” and connect to each port one 17-way manifold using high pressure hoses 1½” BSP x 3 mtr. supplied with the system. Hose of 1½” BSP x 3 mtr long are to be used only when the powerpacks are being used as standalone units and not being used simultaneously with another powerpack. In this case, use other hoses / steel tubes as mentioned below under the heading “Special instructions for using 2 nos. 40 HP powerpacks simultaneously”.

Hose connection should be tight so that there is no leakage of oil. The oil tank should be filled with hydraulic oil of 68 grade (viscosity). The oil tank capacity is 1200 liters.

The motor is switched on. Then the lever of the high-pressure ball valve should remain in closed position. Then the lever on the Direction control valve is pushed and held back in this position till the jacks achieve the full stroke length. The oil starts flowing out into the hose pipes and into the jacks. The jacks will lift the tank construction. After all the jacks have achieved the full stroke length of 100 mm (effectively 95 mm), the lever on the Direction Control valve is released and it comes back to neutral position by spring action. Then the lever is pulled in the opposite direction and kept in this position. This causes the protruded jack pistons to retract, thereby completing one lift cycle. This sequence of operations is repeated for each consecutive lift of 100 mm.

## **15.0 Maintenance and control instructions**

15.1 All exposed parts should be cleaned regularly.

15.2 Before each mounting of the climber the following must be checked:

- a. The back of grip jaws are lubricated with grease between grip jaw back and grip jaw head
- b. The teeth of the grip jaws are clean and the grip jaw backs are bright.

15.3 After 20 m of climbing, check the following :

- a. That no grip jaws have become blunt
- b. That there is sufficient grease behind the grip jaws

15.4 The grip-jaw springs have not lost their tension

15.5 Power pack should be covered properly to avoid entry of any foreign particles into the powerpack components, especially the oil tank.

15.6 Filter of the powerpack should be changed periodically (after about every 4 month during continuous operation)

15.7 Hose pipe connections and couplings / tees / stop cock valves should be cleaned with diesel oil before use.

15.8 Never leave the climbers with the pistons in protruded position.

15.9 Never leave the tank loaded onto the jacks for long periods of time.

## **16.0 Preventive maintenance for powerpack**

16.1 A hydraulic system properly installed will serve for many years, provided that routine maintenance is carried out and correct spare components are held to allow continuous operation during component overhaul.

16.2 Following are suggested measures for routine inspection:

a. Daily inspection:

- check oil level
- check for leakages
- check for unusual noise and vibrations
- correct operating sequence

b. Monthly inspection

- clean strainer
- check oil condition and check for contamination of oil

- check oil tank
- replace return line filter element every six months

16.3 Cleanliness is of utmost importance. The hydraulic oil must never come in contact with diluted soluble oils, chips, dust, etc. The filter cap must be closed immediately after filling oil into the tank.

16.4 The oil temperature must never exceed 65 to 70 degrees C, else there will be faster oxidation of oil and oil change has to be made in shorter periods. Also, the oil seals will get damaged due to high temperature.

16.5 If foaming of oil is observed, the pump must be shut down and cause of oil foaming should be determined and rectified.

16.6 The electric motor must never be started without having sufficient oil.

## **17.0 Drawings CC-1 to CC-8**

### **Drawing CC-1**

### **Drawing CC-2**

### **Drawing CC-3**

### **Drawing CC-4**

## TANK ERECTION LIFTING TRESTLE

Position No. Nos. Name

- 1 1 Trestle Base Plate
- 2 1 Trestle Box
- 3 1 Loading Point
- 4 1 Jack
- 5 Oil hose
- 6 2 Elbow and stop cock valve
- 7 1 Sliding chair
- 8 1 Fend-off lug
- 9 1 Lifting arm
- 10 1 Lifting lug
- 11 2 Stay Pipe
- 12 2 Upper lug
- 13 2 Lower lug



### **Drawing CC-5**

Note: The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein

#### **NOTES :-**

### **Drawing CC-6, 12 ton trestle**

#### **NOTES :-**

Notes: 1) Fend off Lug is not provided by us. Buyer usually make of scratch material one number per trestle, maybe another one for spare part.

The above drawing is for a **Fend off Lug of 12 tons trestle**, 2) The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein

### **Drawing CC-6, 18 ton trestle**

Notes: 1) Fend off Lug is not provided by us. Buyer usually make of scratch material one number per trestle, maybe another one for spare part.

The above drawing is for a **Fend off Lug of 18 tons trestle**, 2) The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein

### **Drawing CC-6, 25 ton trestle**

Notes: 1) Fend off Lug is not provided by us. Buyer usually make of scratch material one number per trestle, maybe another one for spare part.

The above drawing is for a **Fend off Lug of 25 tons trestle**, 2) The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein

#### **NOTES :-**

### **Drawing CC-7, 12 ton trestle**

#### **NOTES :-**

Notes: 1) Lifting Lug is not provided by us. Buyer usually make of scratch material one number per trestle, maybe another one for spare part.

The above drawing is for a **Lifting Lug of 12 tons trestle**, 2) The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein

### **Drawing CC-7, 18 ton trestle**

Notes: 1) Lifting Lug is not provided by us. Buyer usually make of scratch material one number per trestle, maybe another one for spare part.

The above drawing is for a **Lifting Lug of 18 tons trestle**, 2) The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein

**:-**

### **Drawing CC-7, 25 ton trestle**

Notes: 1) Lifting Lug is not provided by us. Buyer usually make of scratch material one number per trestle, maybe another one for spare part.

The above drawing is for a **Lifting Lug of 25 tons trestle**, 2) The information contained in this manual is intended to be accurate. However the manufacturer retain the rights to make changes in design which may not be include herein

### **Drawing CC-8**

## 5.0 METHODOLOGY FOR CONSTRUCTION

### OF FIXED ROOF STORAGE TANKS

1. The tank bottom plates are placed on the prepared foundation and welded together.
2. The tank periphery is marked out on the bottom plates.
3. Spacers for guiding the shell plates are placed at approx. 2 m centre and are tack welded to the bottom plates. These spacers could be made of Beam of 400 mm depth and 300 mm width. These spacer beams provide passage for the manpower and tools inside the tank. This is optional, we could replace the spacer beams by removing a plate from the first shell.
4. The topmost shell ring is erected in place and vertical welds are completed.
5. The location of the lifting trestles is marked out inside the erected shell ring. The division should be symmetrical with equal spacing between all tank trestles. The trestle verticals and diagonal struts with the jack mounted on it and with all accessories such as the lifting arm with sliding chair and loading point duly assembled to the trestle vertical, are positioned and erected. The trestle base plate and the lower lugs for struts are welded to the tank bottom plate. If there is a permanent column on the inside of the tank, 2 extra jacks will be used at each side of the column.
6. Appropriate access platforms are fixed to the trestles at a height of 2500 mm above tank floor level.
7. The beams or lattice work of the roof are assembled and finally joined to the upper rim of the shell ring. Possibly the inner sheets of the roof are placed and welded except those plates where the trestles are positioned, since the trestle height is can be up to 3500 mm.
8. The lifting equipment is assembled and all hydraulic connections are completed. The hydraulic power pack is placed outside the tank. Hydraulic hose pass through the gap of 400 mm height created by the spacer beams.
9. A special precaution to be taken only for 6 mm thick shell plates:

Before welding the lifting lugs to the shell plates, patch plates of size 150 mm x 300 mm x 12 mm thick are welded to the 6 mm thick shell plates and the lifting lugs are welded to these 12 mm thick plates. (Fillet weld of 6 mm thick x 200 mm long on each vertical side of the patch plate and on each vertical side of the Lifting-lug) For the Fend-off lugs, patch plates of size 150 mm x 200 mm x 12 mm thick are welded to the 6 mm thick shell plates and the Fend-off lugs are welded to these 12 mm thick plates. In addition, a curved ring (with the same radius as the tank shell) fabricated of Mild steel angle or plate is to be placed on top of the lifting lug and stitch welded to the tank shell plate in case buckling is observed.

10. The plates of the second shell ring (next to top ring) are positioned outside tank around the periphery.

11. The completed part of the tank (the roof and top shell ring) is lifted hydraulically to a height, at which the plates of the second shell ring can be moved into place and the roof sheeting can be completed. Manhole on roof should be left open until the bottom most shell ring is erected.

12. The plates of the second shell ring are placed and vertical welding is done.

13. The top shell ring with the roof (being held in position by the jacking units) is lowered slightly (about 20 to 30 mm) to sit on the new shell ring (suitable gap for weld to be maintained). Horizontal welding between the top ring and the second ring is completed.

14. The jacks with sliding chairs and lifting arm are lowered one at a time using a rope and pulley arrangement. During this operation both the grip jaws of the jack must be in disengaged position.

15. The lifting lugs, fend-off lugs, patch plates, and curved ring are removed from the top shell ring and fixed to the second (new shell ring) which is now erected.

16. Repeat the same steps until the last shell ring is erected. If spacer beams are used; the spacer beams are to be removed and the plates of the last shell ring shall be placed on the tank bottom plate.

17. The jacking equipment is dismantled.

## **6.0 METHODOLOGY FOR REPAIRS/ REPLACEMENTS OF TANK BOTTOM PLATES INCLUDING FOUNDATION (FOR FLOATING ROOF TANKS)**

1. The tank under maintenance is first gas freed, piping connections dismantled checked & certified by the engineer in charge.
2. If required fire screen, safety barrier is also erected around the tank.
3. For floating roof tanks, the seal is dismantled and removed.
4. The rolling ladder to the roof is dismantled.
5. Considering safe load bearing capacity of the soil around the tank periphery, structural members of heavy plates are placed around the tank periphery for erecting the vertical trestles. This is required for transferring the vertical load uniformly to the ground.
6. For supporting the stay pipes of the trestles, scaffolding arrangement is made from the ground level to the tank foundation level around the tank foundation.
7. After erecting and aligning the vertical trestles & stay pipes the jacks are mounted on the trestles.
8. The Roof drain is disconnected.
9. After erecting and aligning the vertical trestles & stay pipes the jacks are mounted on the trestles.
10. The Hydraulic circuit is completed.
11. The lifting lug and fend off lugs are welded to the tank shell.
12. The load of the tank is transferred to the jacking units by initial operation of the hydraulic pump.
13. The tank shell is separated from the bottom plates by gauging/ cutting the shell to bottom plate weld.
14. On completion of the cutting operation the entire load of the tank is transferred to the jacking units.
15. After checking, the hydraulic pump is operated and the tank shell roof is gradually lifted to the required height (Max. 2500 mm from the bottom plates).
16. The annular plates are cut and removed.
17. Before cutting the bottom plates, the pipe supports for the roof are removed after providing temporary supports at various locations.
18. To avoid continuous loading on the jacking units, the entire tank can be lowered to temporal structural / supports placed uniformly along the tank periphery.

19. The bottom plates are cut and removed in sequence.
20. After inspection, tank foundation is made ready in all respects (including installation of cathodic protection system if required).
21. Newly fabricated annular plates are laid and welded and testing completed as per requirement.
22. The centerline of the tank periphery is marked.
23. The tank is lowered to the newly laid annular plates and aligned.
24. The bottom sketch plates are laid and the welding and testing completed as per code.
25. The shell to bottom welding is completed and testing as per code is completed.
26. The jacking units are dismantled.
27. The pipe supports for floating roof is placed at the required positions.
28. The rolling ladder, foam seal assembly, roof drain assembly is completed.
29. Fire screen / safety barrier removed.
30. Piping connections completed.

**Ref: Tank diameter (D) VS Tank height (H) shall be  $D \geq H$ .**

If the relation is  $D < H$  is the case; four steel cables shall be needed. Cables are fixed at the top of the tank and the other end is fixed to the ground and tensioned with a tirfor only as a precautionary measure. When lifting take place, the wires are loosened, and once the desire height is archived wires are tightened again while the new shell is assemble.

**Ref: Fend of Lugs & Lifting Lugs**

Fend off Lugs and Lifting Lugs are not provided by us. Buyer usually make of scratch material one each per trestle, maybe another one for spare part.

**Ref: Installation Time, Example**

**Tank Specs: 10.0 m diameter @ 8 m height @ 5 rings**

Day 1, Install the first ring

Day 2 and 3, Two days for install the jacks

Day 4, One hour for lifting the first ring and install the second ring

Day 5, One day to install the jacks on second ring

Day 6, One hour for lifting the second ring and install the third ring

Day 7, One day to install the jacks on third ring

Day 8, One hour for lifting the third ring and install the forth ring

Day 9, One day to install the jacks on fourth ring

Day 10, One hour for lifting the forth ring and install the fifth ring

Total number of days: Around 10 to 12 days

**Tank Specs: 24.0 m diameter @ 14 m height @ 9 rings**

Day 1 2, 3. Install the first ring

Day 4 and 5, Two days for install the jacks

Day 6 and 7, One hour for lifting the first ring and install the second ring

Day 8 and 9, Two day to install the jacks on second ring

## cp8.0 Quick Reference Guide of Operation (ANNEX “B”)

### 1. To determine number of Jacks

a. Weight of the tank, this should include weight of the roof, rings, and all components that will be lifted with the tank. Also wind speed should be taking into account to determine the extra dead load on the tank. Considering wind speed zero, number of trestles/jacks = Total lifting weight / jack capacity

b. Arc distance between two consecutive trestles/jacks should be between 1.8 m to 3.5 m. Arc distance must be chosen depending of diameter of the tank to be lifted. Number of trestles/jacks = Perimeter of tank / distance between trestles

The appropriate number of trestles / jacks must be the greater of a & b.

Note: If the wind speed is more than 80 km/hour **DO NOT** lift the tank.



### 2. Prepared work at Site

Before getting started there is a few things that need to be ready at the site.

- Lifting lugs, and fend-off lugs should be ready.
- Hydraulic Oil for Power Pack.
- Electricity outlet for Power Pack.

### 3. Assemble of the trestles & erection. (From inside of the tank)

- Assembling of the trestle can be found in the manual
- Base plate should be tack welded at a distance of 125 mm from the edge to the shell.
- Mark Points A and B of the diagram below.
- Open the screws of the stay pipe half way.
- Lift the trestle.
- Make sure the trestle is in plump (90 degrees).
- Weld plates A and B to the base of tank.
- Use screws on stay pipes to adjust the trestle.



#### **4. Hydraulics**

- Plug the power pack to the electrical power. Motor fan should be spinning on a clockwise direction.
- Fill up the tank with Hydraulic Oil
- Each jack should have the following connected to the F valve = an elbow, a valve, and a T connector. (see page 12 on Manual, Detail – A).
- Hoses should be connected as shown in diagram on page 12 of manual. (Enough hose should be use in between jacks).
- Max jacks per line should be 12.
- Ideal number of jacks per line 7-8.
- How to set the pressure on the relief valve.
- Make "0" pressure on relief valve, by turning anticlockwise direction.
- Shut the valve in between port and 5 ways.
- Switch ON the power on power pack.
- Press lever, pressure should increase.
- For the first lift use 70 to 80 bars.
- Increase pressure gradually if the power pack is not lifting (110 bar is the max pressure that the system will handle).

#### **5. Set up of Lugs**

- Weld the Lifting Lug 1 inch from the resting arm on 1<sup>st</sup> jack.
- Weld the rest of the lifting lugs. All Lifting lugs should be place at the same level.
- Close all the valves on the jacks.
- Open Valve on Jack #1, and raise the jack until the resting arm is touching the lifting lug.
- Close valve on Jack #1.
- Repeat the same for all the jacks.
- Weld all the fend-off lugs in place. They should be 10mm from sliding chair.

#### **6. Lifting the tank**

- Make sure all the valves are open.
- All locks should be close.
- Pull the lever: this will raise the jacks by one stroke (100mm).
- Open release valve to bring the jack back to its normal position.
- Repeat the same steps, until the ring is 25mm to its desire position.

## 7. Lowering the Jacks

When piston is out; bottom locks should NOT be open.

When piston is in; top locks should NOT be open

To lower the jack follow the following steps, this steps should be follow carefully.

- a. Close all valves on jacks.
- b. Open valves on 1<sup>st</sup> jack.
- c. Open bottom locks on jack 1.
- d. Press lever on power jack until jack 1 comes out by 70 mm.
- e. Lock bottom locks and close valve.
- f. Repeat B to E for all jacks in the system.
- g. Open all the valves.
- h. Press lever all the way up, tank will be lifted by some amount  $x = 100 - 70$
- i. Open the top locks in the all the jacks.
- j. Release the jacks, by opening release valve. Tank should be lower by 70mm

Note: Piston lowering should be more than plate gap.

## 8. Trouble Shooting:

- a. If the jack is not releasing: Use metal rod on bolts from jack, nut might be stuck on frame.
- b. If no pressure on power pack: check the motor is running in a clockwise direction, check oil level on tank, and check for any leakages in the system.
- c. Filter on power Packs: 2 types of filters, suction filter (inside power pack) and return line filter (on the return line, outside of power pack). These filters must be change every 4 months on a heavy use situation.
- d. If a jack seal is broken during lifting what to do;
  - i. Close the valve on the jack that is licking
  - ii. Lift the rest of jacks a few mm until the damage jack is not lifting any more.
  - iii. Replace seal on jack.
  - iv. Open valve on new repaired jack.
  - v. Close valve on all the rest of jacks.
  - vi. Lift repaired jack, until is at the same level as the rest.
  - vii. Open all valves.
- e. What happens if a hose is broken: If a hose is broken during lifting, the system will no fail. Jacks will remain pressurize due to a safety valve inside of them that will not allow the oil to empty the jack cylinder. So; it a hose is broken its necessary to replace for a new one and the equipment is ready for lifting again.
- f. What happens if electricity fails: If the electricity fails during lifting, nothing will happen to the system. Get the electricity fix and resume lifting.

FEW OF THE SNAPS TAKEN AT THE SITE DURING CONSTRUCTION OF SITE

