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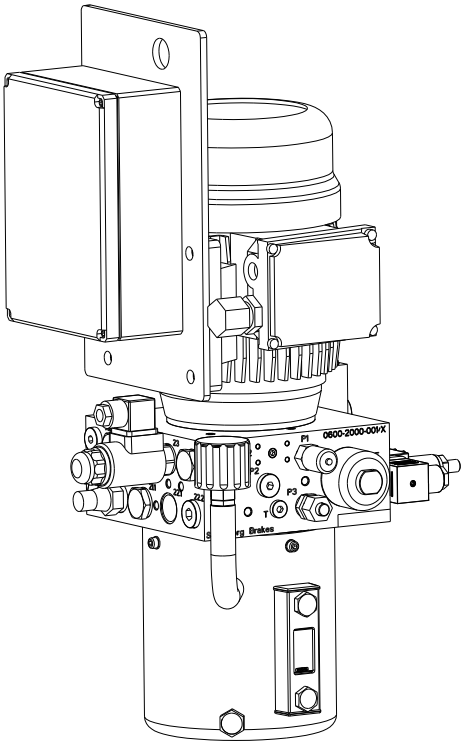
Installation and Maintenance Manual

“LCS” HYDRAULIC POWER UNIT
Part Number: T7600561
M1662



Twiflex® Limited

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1. General

Thank you for buying a Twiflex Ltd product. Before using the product please read this manual carefully.

1.1 Who to contact

In case you have any questions regarding this manual please contact your local representative or nearest Twiflex Ltd office:

FU IBÉRICA:

www.fuiberica.com
Phone: +34 932 681 833
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1.2 Safety

The Twiflex Ltd range of brake products is designed to be applied to a rotating brake disc for use in conjunction with parking brake applications, service brake applications or emergency brake applications only.

❖ **NOTE**

- Always make sure that you consult Twiflex Ltd before using tools or any other equipment not recommended or specified in this manual.
- In order to maintain the warranty always use original spare parts from Twiflex Ltd.
- Customer is responsible for always keeping the brake and hydraulic aggregate clean, and free from dirt, grease or oil.
- Customer is responsible for ensuring the air gap between brake pads and brake disc never exceeds the recommended setting.
- Always use a torque wrench when refitting mounting bolts or valves in order to ensure the correct torque is obtained.
- There should be a copy of the manual available for the service and maintenance crew as a minimum.

Hydraulic power unit:

- Do not operate the hydraulic power unit before correctly filling the oil reservoir.
- Do not adjust valves or pressure switches to higher operating pressures than specified in the manual.
- Do not change the size or type of components.
- Do not use hydraulic fluid types other than those recommended in this manual.

Brakes:

- Do not operate the brake before removing the air from the hydraulic system by bleeding and re-filling with oil.
- Do not use higher operating pressures than specified on the nameplate of the brake or in the manual.
- Do not change the size or type of spring pack.
- Do not use the brake pads when they are worn to the minimum thickness as shown in the manual.
- Do not operate the brake if there is dirt, contamination or residual corrosion protection on the disc face or brake pads.

Personal safety:

Do not work on the brake/ system before:

- The manual has been read and understood.
- The brake disc is locked and not able to rotate before adjusting the brake and/or air gap.
- Securing the brake/spring-pack by using the ‘parked-off’ setting or retraction bolt when working on a spring applied brake.
- Being sure there is no pressure on the hydraulic power unit or brake circuit.
- Being sure the oil pressure in the accumulator(s) has been relieved.
- The control signals have been shut off and blocked before working on the system.
- The electrical power has been shut off.

1.3 Symbols used in this manual

To make sure you perform certain tasks properly, please take note of the following symbols used throughout this manual.

WARNING
Information to prevent personal injury when trying to complete a task.

CAUTION
Information to prevent damage to the components when trying to complete a task.

WARNING
Electrical shock hazard.

❖ **IMPORTANT**
Information you MUST follow to complete a task.

❖ **NOTE**
Tips and additional information to aid in completing a task.

Figures within brackets ( ) relate to position and Appendix number i.e. (15-B) refers to position number 15 in Appendix B

1.4 Disclaimer

Twiflex Ltd reserves the right to revise this document without prior notification. These documents have been checked for accuracy. Despite this, technical and typographical deviations can sometimes occur.

This document is updated on a regular basis; changes will be published in future printings. Improvements and/or changes to the described products or manual can be implemented at any time without preceding notice.

In no event should Twiflex Ltd be liable for any special, incidental, consequential or punitive damages. This includes, but is not limited to: damage to other property or person, inconvenience, loss of goodwill, lost profits or revenue, loss of use of this product or any associated equipment, cost of substitutive equipment, downtime costs or claims of any party such damages, resulting from any misspellings or inaccurate information in this users guide.

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1.5 Transportation

When leaving the factory the hydraulic power unit is always packed to ensure maximum security for the product during transport.

CAUTION
If the hydraulic power unit has been sent by air freight note that the gas (N2) pressure may have been released from the accumulator(s).

A label (see figure 1.1) is then attached to the accumulator.

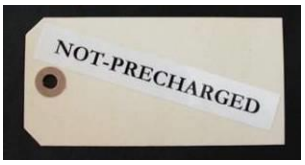


FIGURE 1.1

In such a case it must be recharged before usage. See section 4.11 – “Recharging the accumulator” for details

Normally there is no hydraulic oil in the unit. A warning label is attached to it.

WARNING

WARNING
FOR TRANSPORT REASONS
THE PUMP IS SHIPPED
WITHOUT OIL
FILL WITH RECOMMENDED OIL
BEFORE STARTING
REFER TO MANUAL

FIGURE 1.2

The hydraulic power unit must be filled with oil according to Appendix F of this manual before use. If run dry the pump may be permanently damaged.

1.6 Lifting

The hydraulic power unit weighs approximately 30 kg. If it is necessary to use a lifting harness, under no circumstance place it around valves, gauges or accumulators (see correct lifting process, below).

If not mounted in cabinet the hydraulic power unit may be lifted in the motor – see figure 1.3

FIGURE 1.3 – Correct Lifting Procedure

CAUTION

Do not lift the hydraulic power unit in the valves etc. – see figure 1.4

FIGURE 1.4 – Incorrect Lifting Procedure

If the hydraulic power unit is mounted in a cabinet the entire assembly may be lifted by using the lifting point in the supporting frame.

FIGURE 1.5 – Correct Lifting Procedure

1.7 Storage

Hydraulic power units must be stored indoors in a clean, dry area. They must be stored in such a way that they cannot be damaged by passing or falling objects.
For indoor storage for up to 3 months the hydraulic power units do not need any surface treatment. For longer periods they should be covered with a plastic or canvas cover to protect against dirt.

1.8 How to order spare parts

When ordering spare parts please refer to the specific item number in the parts list – see appendices.

For full identification of the hydraulic power unit please provide the assembly part number or the details recorded on the label attached to the manifold or tank.

FIGURE 1.6

2. Installation and commissioning

2.1 Mounting

In the back of the manifold there are 2 threaded M10 x 15mm holes for wall mounting. See (Appendix A).

Optionally, a foot-mounting bracket is available.

2.2 Connections

Hydraulic pressure ports out of the manifold are G1/4" or G1/2". All connection points are plugged with VSTI-plugs.

All pipes, hoses, fittings etc. mounted to the total system, should be flushed to meet the demands of NAS 1638 Class 8 or ISO 4406 Class 19/17/14.

2.3 Before starting the pump unit

The power unit may have been sent without nitrogen gas (N2) in the accumulator, depending on global or local regulations for transport of pressurised equipment. If the unit has been sent without pressure, a label (see figure 2.1) is attached to the accumulator.

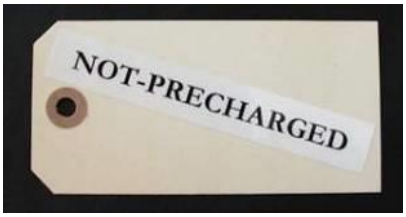


FIGURE 2.1

If the accumulator is not pre-charged it must be charged before usage. See section 4.11 – "Recharging the accumulator".
After recharging you should remove the label.

If the accumulator is pre-charged – proceed to section 2.3.1

Mount the connection fitting to the brakes in one of the points shown on the hydraulic diagram

2.3.1 Fill the tank with oil of the recommended quality (see Appendix E).

The oil fill volume is approximately 3 litres.
Remove the air breather (5b), and add filtered oil.

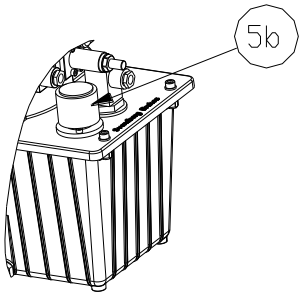


FIGURE 2.2

2.3.2 Fill the oil reservoir to the top level mark in the sight glass located on the reservoir sidewall.

CAUTION

Use only filtered oil of the right viscosity for refilling (see Appendix E).

FIGURE 2.3

❖ **NOTE:**

- Stated oil volumes are approximate and must be checked for correct fill level according to the sight glass in the tank.
- Additional oil volume may be required for bleeding.
- Oil must be filtered through a 10-micron nominal filter.
- For more details see Appendix E.

2.3.3 Connect the electrical power. Check that the rotation of the electric motor is correct as indicated on the motor – i.e. Counter clockwise viewed from the fan end.

WARNING

External electrical cables must be connected to the junction box according to the electrical wiring, diagrams see Appendix D, or separate documentation supplied along with the equipment.

The unit must only be connected by a skilled electrician.

The customer is responsible for ensuring all electrical connections are made according to national and international regulations for the installation of electrical equipment.

The device must be supplied from an isolated source and protected by an over current device to ensure the limited voltage circuit requirements according to national and international standards.

No warranty will be considered if this is not completed accordingly.

2.3.4 Start the electric motor and let the unit run 10 cycles (pressurising/de-pressurising):

- With system pressurised bleed the brakes.
- With system de-pressurised refill oil if necessary.

2.3.5 **Bleeding and flushing the hydraulic power unit**

To meet the demands of NAS 1638 Class 8 or ISO 4406 Class 19/17/14 the hydraulic power units supplied from Twiflex Ltd have been flushed before leaving the factory.

Despite the above, the hydraulic system must always be flushed and bled again before commissioning.

Flushing of the system will remove minor particles and potential dirt in the system and prevent damage to the unit.

After flushing, the hydraulic power unit must be bled in order to remove any air in the system.

If the hydraulic power unit is not properly bled potential damage to the seals may occur.

The hydraulic power unit must always be bled in conjunction with assembly, repair or when making changes in the system.

Failure to bleed the hydraulic system will allow air to remain in the brake lines which could prevent the brake system from reacting fast enough. This might, for example, cause the linings to remain in contact with the brake disc and excess heating of the brake pads and brake disc could occur.

Air in the system could also destroy the seals (diesel effect) within the hydraulic system.

Make a functional check of the system by checking the pressure, and the hydraulic settings.

3. Description of the hydraulic system

3.1 General

The LCS hydraulic units have been developed to be used together with active (pressure applied) and passive (spring applied) brake calipers from Twiflex Ltd. The pump can be connected to one or more brakes.

The hydraulic power unit typically consists of 2 main items:

- Base unit (including tank, manifold, motor and pump)
- Optional junction box (including terminal rail, mounting plate and lifting eye)

Except for the dimensional drawing and mounting/handling instructions this manual contains no further information about the cabinet.

The power unit is described in detail including functionality, assembly/mounting, pressure settings, spare parts, description of main parts, maintenance, trouble shooting, and hydraulic fluids, etc.

The junction box is illustrated in the electrical diagram (see Appendix D) and is installed in order to simplify the electrical connection.

3.2 Function

(See the hydraulic diagram section 3.3)

3.2.1 **System energy**
In the hydraulic system an electric motor (4) and a pump (2) convert electrical power into oil pressure and oil flow.

Pressure is limited by:

- The pressure switch (40) that turns off the motor when the preset pressure is reached.
- A system relief valve (16).

Pressure is monitored by a pressure switch (40). If pressure drops below the pre-set value the motor will restart to increase pressure.

The check valve (17) prevents pressure from returning to tank when the motor stops.

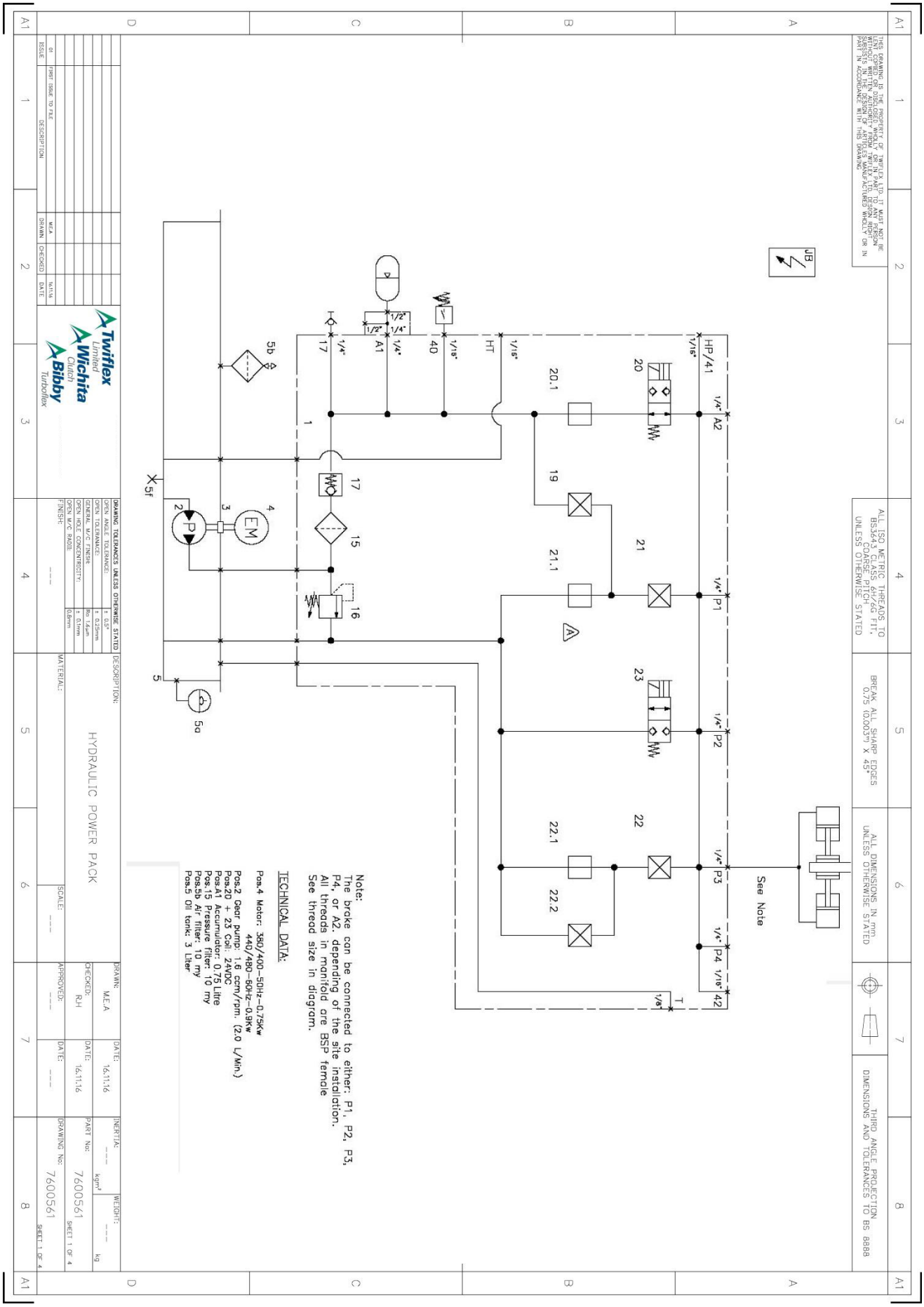
The accumulator (A1) provides an additional volume of pressurised oil to minimise the number of motor starts.

3.2.2 **Applying the brakes.**
Operating the motor (4) (on) and closing of valve (23) (off), transfers the oil from the pump to the brakes.

3.2.3 **Releasing the brakes**
When opening valve (23) (on) and stopping the motor (4) (off) this will dump the oil to tank, which immediately releases the brakes.

3.2.4 **Monitoring**
Pressure switch (40) monitors the system pressure (see 3.2.1).
When there is a need to re-pressurise the system it will restart the motor (providing a signal for a maximum of 5 seconds)

3.3 Hydraulic diagram



4. Maintenance

Maintenance is important for the ability of the hydraulic power unit to control the brakes at any time.

Maintenance consists of inspection and service.

All pressure control valves, flow control valves, pump regulators and signalling devices such as pressure switches are adjusted during the initial manufacture and subsequent commissioning.

The settings must be monitored continuously during the initial stages of operation and then subsequently at reasonable intervals.

4.1 Inspection

Initial commissioning inspection is done to check if adjustment of the pump unit is necessary.

Later inspection is done on a regular basis.

CAUTION

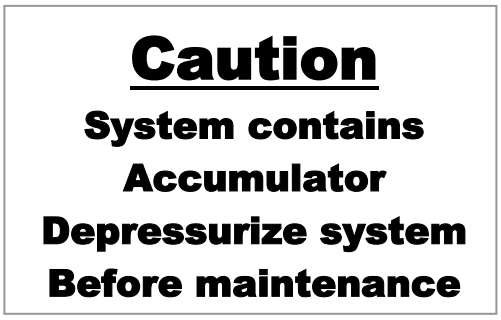


FIGURE 4.1

- **IMPORTANT** (safety information)
  Be aware that the system is equipped with a hydraulic accumulator, and before any maintenance work it should be ensured that the system is completely without hydraulic pressure by opening the valve (23).

4.2 Adjustment

A number of components demand the correct setting or charging in order to make the braking system work properly.

The correct setting and adjustment procedures can be found in Appendix C.

All components in the pump unit are pre-set to the stated pressure from the factory, but may need adjustment during initial commissioning.

4.3 Checks

By remaining alert and paying close attention to detail it is possible to detect faults in their early stages and so prevent them from developing into more serious malfunctions. This is particular important during the early stages, but also remains important throughout the service life of the pump unit.

A constant attention should be kept for:

- External leaks
- Dirt
- Damage, especially to hoses and pipes
- Unusual noises from pump, electric motor, valves etc.
- Proper functioning of instruments and gauges

A maintenance log should be established to ensure the equipment is kept in operating condition.

4.3.1 Typical Check and Inspection plan

Inspection plan	See chapter	Initial commissioning and installation	Service interval/period after commissioning. Whichever comes first:
Function			
Test of each valve		Before first real operation	6 months/1000 h
Hydraulic oil			
Level of oil		Continuous	Monthly/160 h
If not using the level and termo switch (3 litre tank)		Continuous	Weekly/40 h
Temperature		Continuous	Monthly/160 h
Oil condition (sample)			6 months/1000 h
Oil change			2 years/4000 h
Filters			
Oil filter cleaning (change if necessary)		After one week	6 months/1000 h
Air filter change			6 months/1000 h
Accumulators			
Gas pressure		Daily	6 months/1000 h
Other checks			According to legal requirements
Adjustments			
Valves etc.		Continuous	6 months/1000 h
Checks			
External leaks		Daily	Monthly/160 h or if decresing oil level
Dirt			Monthly/160 h
Damage		Continuous	Monthly/160 h
Noises		Continuous	Monthly/160 h
Instruments / electrical connections		Continuous	6 months/1000 h

❖ **NOTE**

During initial commissioning all items above should be continuously monitored with the exception of changing the oil and/or taking oil samples.

4.4 Function test

Redacted

Testing component position (see hydraulic diagram)	Component		Explantion
	Before action	Action	
2, 3, 4, 16, 17, 23, 40 Testpoint: P1	4: off 23: on	4: on	Motor (4) shall start and stop at the preset pressure signal from (40). For a period of 10 minutes motor shall not re-start proving all connections and the valve (23) are tight. CAUTION: This test will apply the brakes.
23 Testpoint: P1	4, 23: on	4: off 21: off	Dis-connect the motor(4) and opening valve (23) will transfer the pressure from (A1) and the brakes to tank, releasing the brakes. CAUTION: This test will release the brakes.

Function matrix		
Valve	Brakes Off	Brakes ON
23	-	x
Motor	-	x
x	valve ON	
-	valve OFF	

4.5 Dismantling the power unit

This should only be carried out in an authorised hydraulic workshop.

4.6 Changing the oil

WARNING

Disconnect all power to the unit and relieve all internal oil pressure in the system.

4.6.1 Remove the drain plug.
The location of the drain is on the side of the reservoir.

4.6.2 Make sure that all the oil drains into a secondary container for proper disposal.

4.6.3 Replace the drain plug and tighten the plug (12-15 Nm).

4.6.4 Refill the oil reservoir to the top level mark in the sight glass located on the reservoir sidewall. See fig 4.2.

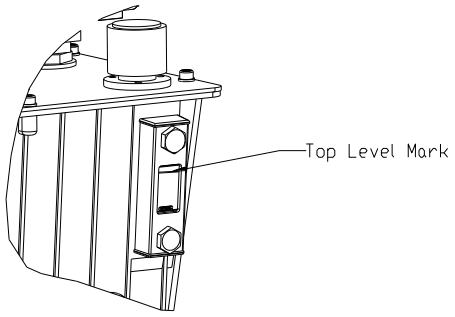


FIGURE 4.2

CAUTION

Use only filtered oil of the right viscosity for refilling (see Appendix E).
It is important that the oil added to the system is filtered through a 10-micron purity off-line filter unit according to the following classes: NAS 1638, Class 8, or ISO 4406, Class 19/17/14.

4.6.5 Reconnect the electrical power and start the pump. Let the unit run 10 cycles (pressurising/de-pressurising):

- With system pressurised bleed the brakes.
- With system de-pressurised refill oil if necessary.

4.7 Changing the oil and cleaning the reservoir

It is recommended that this procedure always carried out in a hydraulic workshop to ensure a clean environment.

WARNING

Disconnect all power to the hydraulic power unit and relieve all internal oil pressure in the system.

4.7.1 Remove the drain plug.
The location of the drain is on the side of the reservoir.

4.7.2 Make sure all the oil drains into a secondary container for proper disposal.

4.7.3 Replace the drain plug and tighten the plug (12-15 Nm).

4.7.4 Unscrew the 4 screws with a metric T-socket wrench.

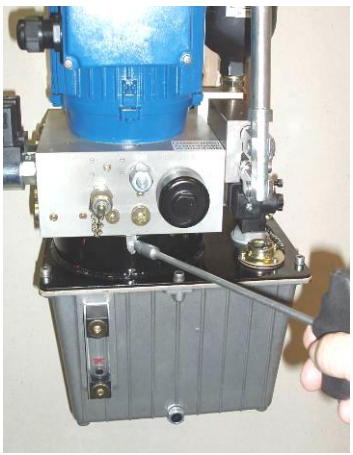


FIGURE 4.3

4.7.5 Remove the motor and manifold assembly (25 – 35 kg).

❖ **IMPORTANT**

Lift straight up to protect the o-ring and all parts.

FIGURE 4.4

4.7.6 Clean the reservoir with a lint-free rag.

4.7.7 Refit the motor and manifold assembly onto the reservoir. Be sure not to damage the o-ring during this step.

FIGURE 4.5

4.7.8 Refit the 4 screws and torque tighten to 5 - 10 Nm.

FIGURE 4.6

4.7.9 Refill the oil reservoir to the top level mark in the sight glass located on the reservoir sidewall. See fig 4.7.

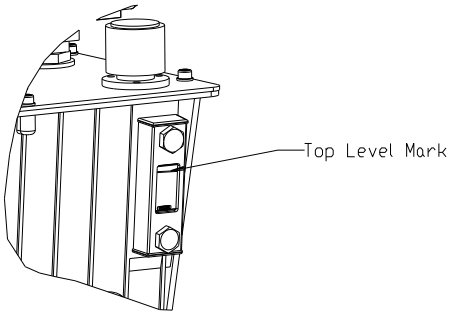


FIGURE 4.7

CAUTION

Use only filtered oil of the right viscosity for refilling (see Appendix E).

4.7.10 Reconnect the electrical power and start the pump. Let the unit run 10 cycles (pressurising/de-pressurising):

- With system pressurised bleed the brakes.
- With system de-pressurised refill oil if necessary.

4.8 Changing the oil filter

4.8.1 Disconnect all power to the hydraulic power unit and relieve all internal oil pressure in the system.

The oil filter is located in the filter housing.

4.8.2 Using a C-spanner, turn the filter housing counter clockwise until it is disconnected from the filter manifold.

4.8.3 Remove the oil filter and clean the inside of the filter housing and cavity. Insert a new oil filter taking care to preserve the correct the orientation.

4.8.4 Clean the o-ring and Teflon-ring outside the filter housing.
Renew o-ring and Teflon-ring if necessary.

4.8.5 Refit the filter housing.

4.9 Changing the air breather

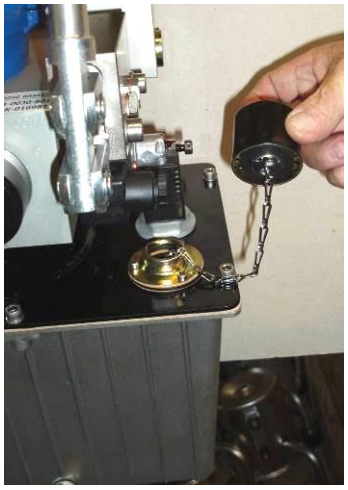
4.9.1 Disconnect all power to the hydraulic power unit and relieve all internal oil pressure in the system.

The air breather consists of two parts:

- A strainer inside the reservoir.
- A filter in the cap.

❖ **NOTE**

Only the 3-litre tank has the filter in the cap.



4.9.2 The air breather is connected to the reservoir with three small screws. Remove these screws with a screwdriver.
Remove the air breather along with the seals.

FIGURE 4.9

4.9.3 Mount a new complete air breather and torque tighten the three small screws to 1-2 Nm.

FIGURE 4.10

4.10 Measuring the gas pressure

CAUTION

Disconnect all power to the hydraulic power unit and relieve all internal oil pressure in the system.

4.10.1 Oil pressure must be zero to measure the gas pressure (accumulator 'pre-charge') correctly. When working with a hydraulic power unit it is recommended to install two pressure gauges for measuring accumulator pressure and brake pressure.
Unscrew the threaded cap on top of the accumulator.

FIGURE 4.11

4.10.2 Using a 6mm Allen key undo the plug by turning it anti-clockwise (¼ turn). The screw is now loose without losing gas.

FIGURE 4.12

4.10.3 Mount the gas pressure gauge and close the side valve.

FIGURE 4.13

4.10.4 Open the top valve, measure the gas pressure and close the valve again.

FIGURE 4.14

4.10.5 If the gas pressure does not meet the required value the accumulator must be recharged.

4.11 Recharging the accumulator

WARNING

Recharging must be done according to local safety regulations for working with pressure vessels.

FIGURE 4.15

4.11.1 Establish a filling line between the gas pressure valve and a gas tank.
The accumulator charging kit contains a pressure gauge and a filling line.
Remember that the adaptor from the line and to the gas tank is country specific and may need to be sourced separately.

FIGURE 4.16

4.11.2 Open the gas tank valve and the top valve to fill the accumulator.
Close gas tank valve and wait several minutes for the new gas to equalize to the accumulator temperature.

Measure the gas pressure.

If the pressure is too low apply more gas.

FIGURE 4.17

4.11.3 If the gas pressure is too high open the side valve to relieve gas.
Close the top valve when the gas pressure is correct.

FIGURE 4.18

4.11.4 Open the side valve, relieve the pressure completely and remove the gas pressure gauge.

4.11.5 Tighten the plug (18 - 22Nm) using the 6mm Allen key (hexagonal) and mount the threaded end cap by hand.

FIGURE 4.19

5. Trouble Shooting

5.1 'Passive'/spring applied, hydraulically released brakes			
Brakes will not close	Brakes are free of pressure	YES	PU is working OK Failure is caused by the brakes
		NO	See section 5.2 – Power unit does not release pressure
Brakes will not open	Brakes have sufficient pressure (see hydraulic settings)	YES	PU is working OK Failure is caused by the brakes
		NO	See section 5.3 – Power Unit does not reach release pressure
Brakes and PU work, but behave unexpectedly			See section 5.4 - Other causes of failure

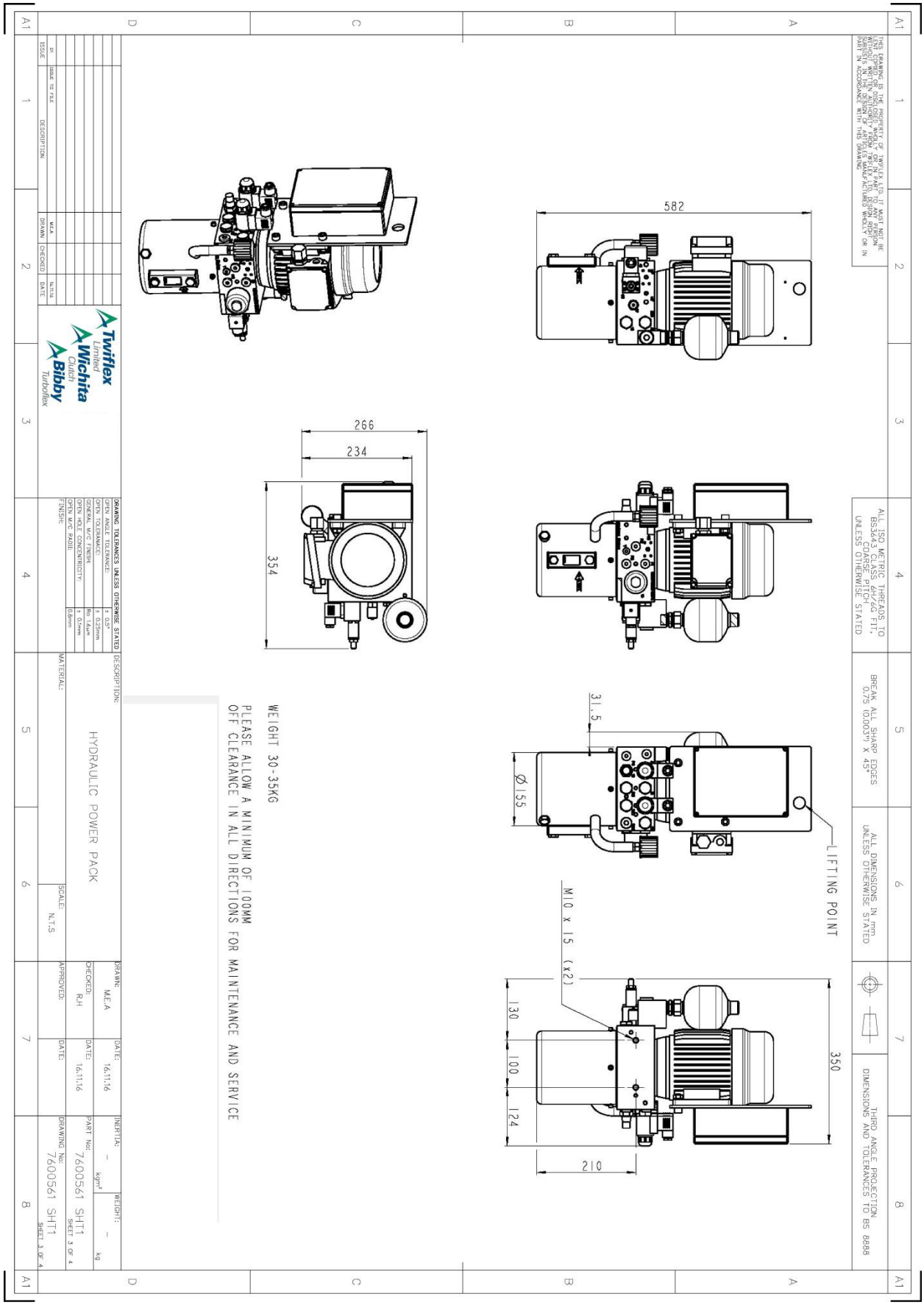
5.2 Power Unit does not release pressure	
Valve between brakes and tank does not open. Make sure that the valves from the pump to the brakes are closed or the pump is off (not running).	Failure in solenoid or power supply for solenoid. Try manual override - if this releases the pressure, the problem is in the coil or its power supply. Try disconnecting the electrical plug from the coil - if this releases pressure failure is in the power supply.
	Defective or dirty (choked) valve or nozzle. Before unscrewing a valve or other component you must ensure that the pressure behind the valve is released. If only one dump valve is present, you can release the pressure through a test hose/Minimess hose.

5.3 Power Unit does not set/build up pressure	
Oil level in tank is too low and/or oil contamination outside the braking system	If it is not immediately obvious where the leak is coming from, you must refill the tank and start the pump, watching for leaking oil or bubbles.
Motor is not running	Power supply failure or motor wrongly connected Defective motor Oil level too low or oil too hot (cut off by level or thermal switch) if fitted Defective pressure switch Check motor protection setting and fuses.
Motor is running the wrong direction	Check rotation according to direction on motor, phases in the motor junction box may be wrongly connected (swapped)
Motor is running but its speed decreases before the system has reached the correct pressure	Power supply has too low voltage Defective motor Motor power is too low for the pressure/volume needed to operate the brake

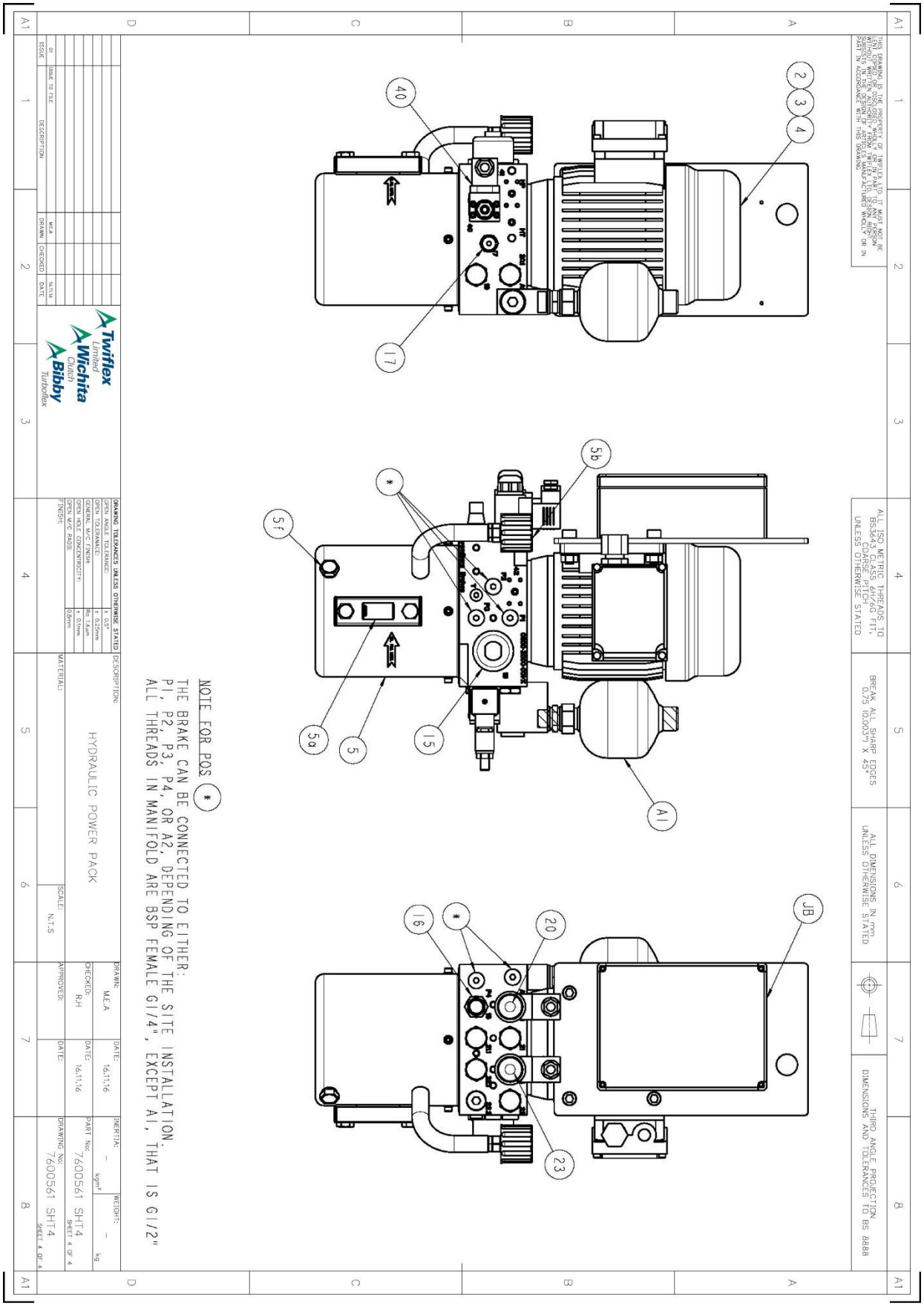
5.3 Power Unit does not set/build up pressure (continued) (FS)	
Motor is running but no pressure is generated	Coupling between the motor and the pump is broken. Defective safety relief valve or not adjusted correctly Defective pump or pump not torque tightened sufficiently
Motor is running but runs backwards after it stops	Defective check valve
Pressure is generated but not sufficient	Safety relief valve not adjusted properly or defective Pressure switch setting too low Defective pump or tightening torque Leaking valves or plugs If present, a throttle valve for emptying the accumulator for service is not completely closed.
Pressure is generated but is not transferred to brakes on command	Valve between pump and brakes does not open when it should Try manual override - if this solves the problem, the coil or its power supply will fail. If not, the valve is defective. Check also that the dump valves operate correctly (close). If present, a throttle valve to tank is not closed.
Pressure is generated but is transferred to tank instead of to the brakes.	Valve(s) between brakes and tank does not close when it should. Failure in solenoid or power supply for solenoid. Try manual override - if this releases the pressure, then the failure is in the coil or its power supply.

5.4 Other failures	
Instrumentation failure	Check signals from: • Level/thermal (temperature) switch if fitted • Pressure switches or transmitters in the pump line • Pressure switches or transmitters in the brake line • Pressure switches or transmitters for accumulator monitoring • Gauges, if mounted in the pump and/or in the brake line, maybe with a gauge valve, ensure this is open for visual check on the gauge. Close the valve after use.
Insufficient braking torque	Failure in brake pad or brake pad not bedded-in? Brake pad or brakes disc contaminated (oiled or greased)? Air gap too large? Residual pressure in spring-applied brake? Valves not operational due to excessive viscosity (low oil temperature)? Also check the brake manual for more possible causes of brake failure.
Brake activation too slow	Air in the braking system? Bleed brakes/system Valves not working correctly due to oil contamination Pipe/hose dimensions are too small/length too long Orifice too small for actual viscosity (low oil temperature)?
Braking too fast	Viscosity too low due to too high oil temperature? Pre-charge pressure in the accumulator(s) is incorrect?
Excessive operating temperature	Ambient temperature too high? Pump running continuously (due to leaky valves, external leaks or incorrect component adjustment?)

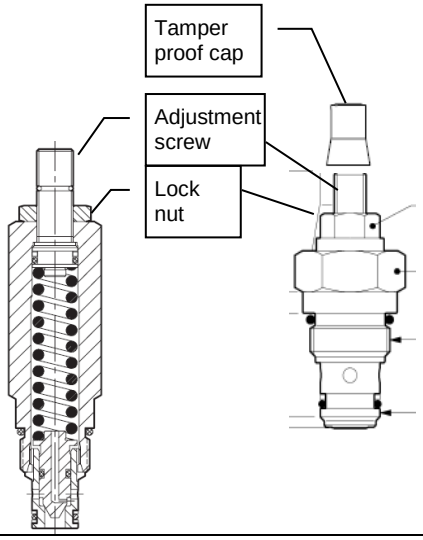
Appendix A - Dimension drawing



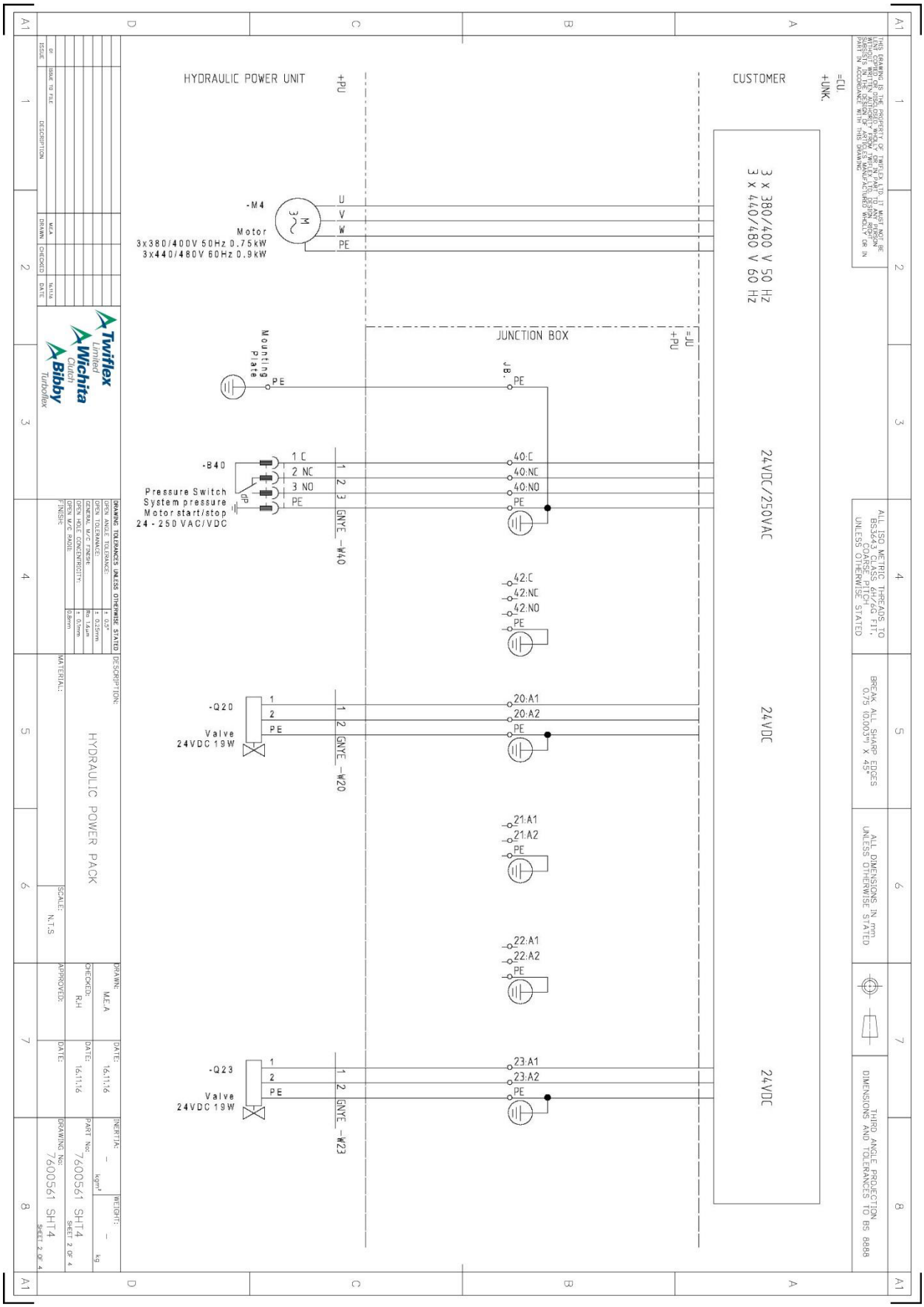
Appendix B - Spare part drawing



Appendix C - Adjustments

Adjustment method	Item type	Item drawing/Photo	Description
1	Pressure switch		The pressure switches have fixed hysteresis. **Precise adjustment of set point to actuate on increasing pressure** 1. Lower system pressure to 0 Bar. 2. Increase pressure slowly and check if micro switch is actuated at desired switch pressure. 3. If necessary, readjust by turning the adjustment screw 4. Repeat step 1 - 3 until micro switch operates at desired switch pressure. **Precise adjustment of set point to actuate on decreasing pressure** 1. Increase pressure up to a point clearly above the desired switch pressure (At least, switch pressure plus max. hysteresis; not above max. operating pressure). 2. Lower pressure slowly and check if micro switch is actuated at desired switch pressure. 3. If necessary, readjust by turning the adjustment screw. 4. Repeat step 1 - 3 until micro switch operates at desired switch pressure.
2	Relief valve or Counter pressure valve (same item)		The system safety valve (Pos. 16 – relief valve) is preset at the factory to the correct pressure / setting. Do not adjust this valve. If the tamper proof cap is broken or missing the power unit is no longer covered by Twiflex Ltd warranty. For other relief valves if adjustment is needed, remove the tamper proof cap, loosen the lock nut and screw out (counter-clockwise) to decrease maximum pressure setting. Screw in (clockwise) to increase maximum pressure. Remember to re-tighten the lock nut.
4	Accumulator		See section 4.10 - Measuring the accumulator gas pressure & 4.11 Charging / recharging the accumulator

Appendix D - Electrical diagram



Appendix E - Recommended Fluids for Disc Brakes and "LCS" Hydraulic Power Units

Pressure Fluids/Oil Types
The following oil types are recommended by Twiflex Ltd – other types corresponding to these can be used.

The general temperature range for standard products using hydraulic oil is -20°C to +60°C (-4°F to +140°F). For operating temperatures outside this range please contact Twiflex Ltd.

Standard		
Mineral Oil	-20°C - +40°C	+10°C - +60°C
	-4°F - +104°F	+50°F - +140°F
Shell	Tellus S2 V32	Tellus S2 V46
Mobil/EXXON	DTE 10 Excel 32	DTE 10 Exel 46
Texaco	Rando HDZ32	Rando HDZ46
Valvoline	Ultramax HVLP32	Ultramax HVLP46
Q8 Oils	Q8 Haydn 32	Q8 Haydn 46

Viscosity
Recommended viscosity range: 20-200 cSt at working temperature. Generally, Twiflex hydraulic systems are designed to allow higher viscosity for short periods.

Filtration
The oil in a hydraulic system and any oil added to the hydraulic system must always be filtered. The level of cleanliness in a hydraulic system is an important factor in the lifetime of the system.

When refilling the hydraulic tank, it is stipulated that the oil added to the system is filtered through a 10-micron purity offline filter unit to the classes listed below.

The hydraulic system, supplied by Twiflex Ltd, has a built-in oil filter with a standard 10-micron purity filter. To maintain a reliable system it is recommend that only hydraulic oil of the following classes of purity is used: NAS 1638, Class 8, or ISO 4406, Class 19/17/14.

It is recommended that the filter is changed at a minimum, once every six months or more often depending on the level of exposure to contamination.

Service Life of Pressure Fluids
Mineral oil: 8000 Hours or at least once a year.
Other fluids: 2000 Hours or at least once a year.

Change of Pressure Fluid
Note: The mixing or blending of different brands or types of pressure fluid can cause unintended chemical reactions, such as sludging, gumming etc. The complete hydraulic system should be thoroughly flushed prior to changing from one oil type to another.

The respective manufacturers should be contacted prior to changing from one pressure fluid to another.