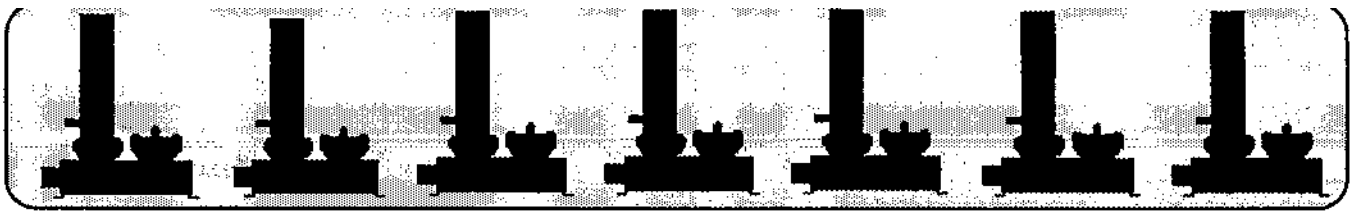


DTU

Ram Pump Programme

DTU S1 PUMP





DTU S1

hydraulic ram pump

The name "S1" stands for a Steel pump with a drive pipe up to 1" in diameter.

A ram pump is powered by falling water. Water from a stream or spring is diverted and dropped through a drive pipe into the pump. The power of the falling water is used to pump some of the water where it is wanted. The amount of power in the falling water limits how high you can pump, and how much water you can pump. Generally, the more water you drop and the further you let it fall, the more power there will be.

The DTU S1 hydraulic ram pump is a steel machine, using a 3/4" or 1" diameter galvanised drive pipe, that can lift water up to a height of 80 meters. It was designed for water supply to small groups of houses from minor sources of water such as springs and small streams. It is being used successfully in many African countries.

The pump has been designed to be made in small workshops with welding equipment and a pillar drill. A lathe can be useful but is not essential.

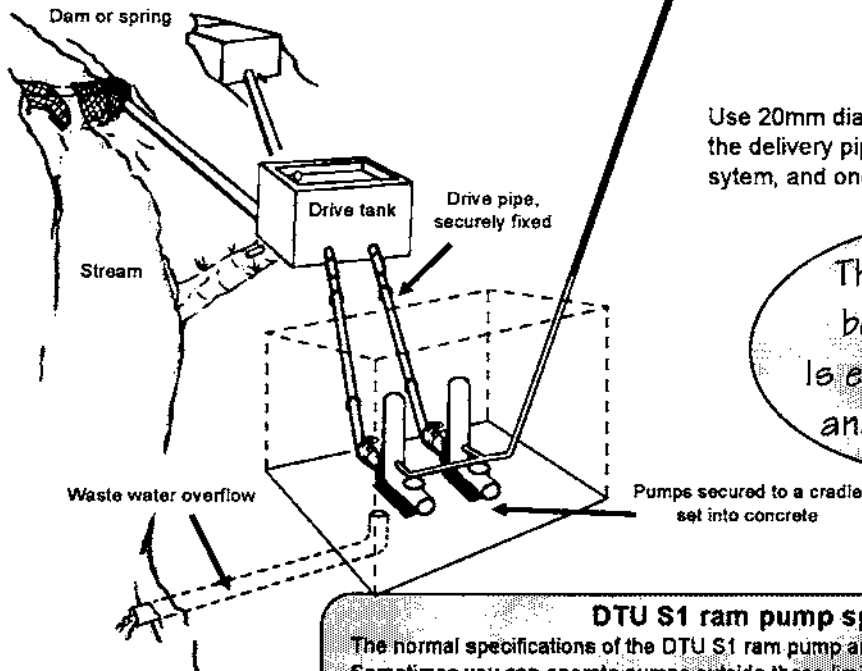
In areas where the water source flow varies greatly during the year, more than one pump can be installed, all sharing the same delivery pipe as shown in the drawing below.



Distribution system, for domestic use. A tank is always recommended.

Delivery pipe, rising all the way along its length (no ups and downs). The pipe should be buried where possible and protected if it has to be above ground.

Use 20mm diameter plastic pressure pipe for the delivery pipe if there is one pump in the system, and one size larger if there are two.



The DTU S1 can be locally made
is easy to maintain
and cheap to run!

DTU S1 ram pump specifications

The normal specifications of the DTU S1 ram pump are given here. Sometimes you can operate pumps outside these limits, but they may not work well.

drive head range	—	2 to 15 meters
drive flow range	—	20 to 60 liters a minute
drive pipe material	—	Galvanised iron
drive pipe diameter	—	3/4" for flows from 20 to 35 liters a minute
drive pipe diameter	—	1" for flows from 30 to 60 liters a minute
delivery head range	—	up to 80 meters
typical delivery range	—	0.5 to 10 liters a minute
delivery pipe diameter	—	20mm

TECHNICAL

11

RELEASE

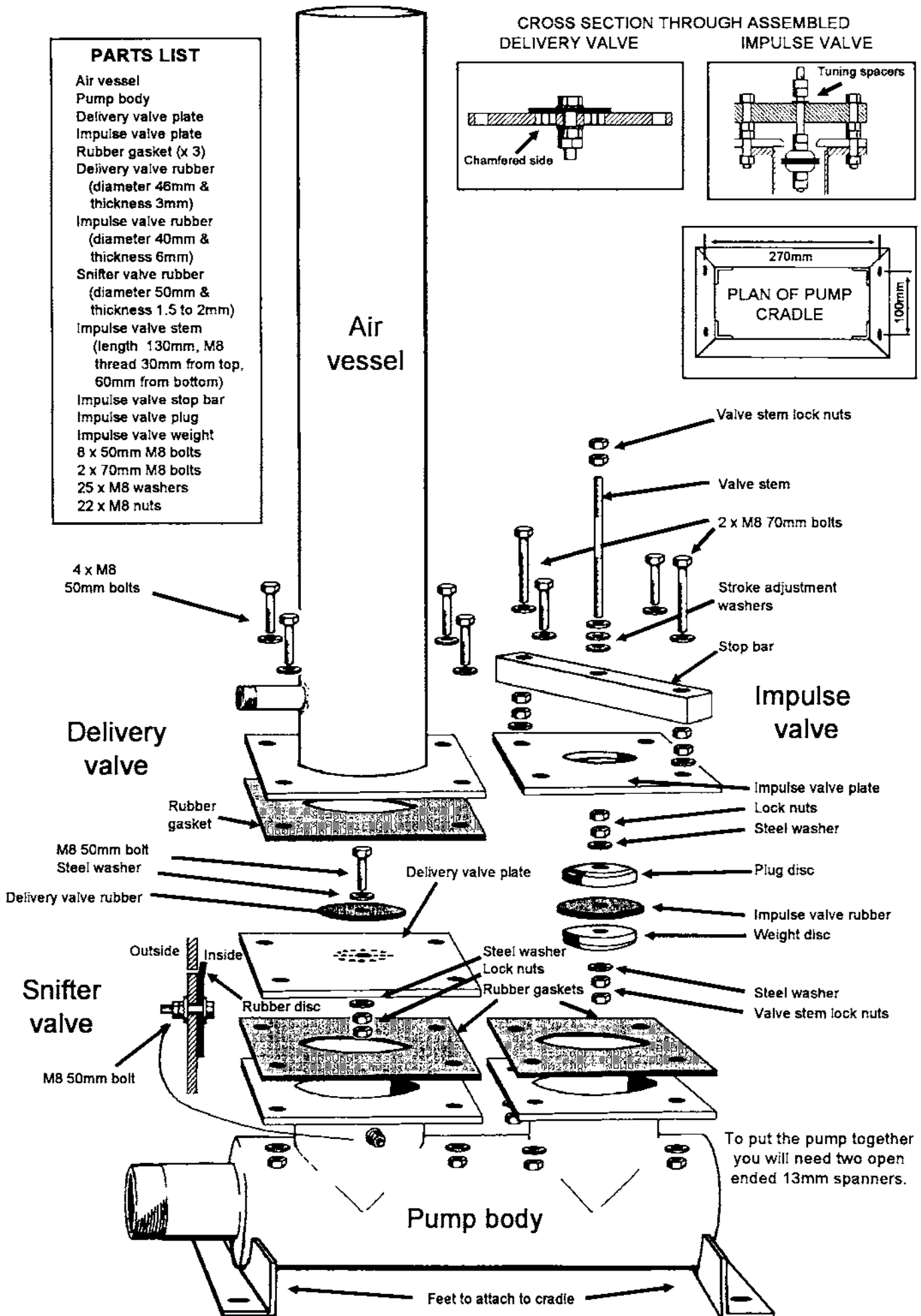
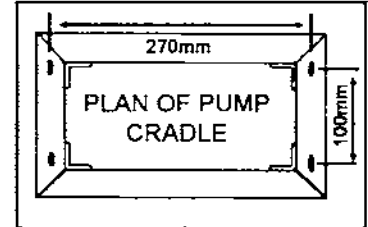
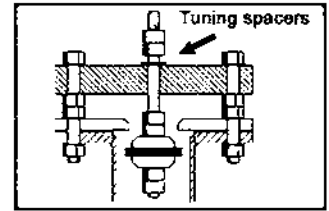
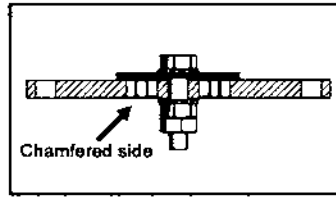
DTU S1 PUMP: USER INSTRUCTIONS

AN EXPLODED VIEW OF THE DTU S1 PUMP

PARTS LIST

- Air vessel
- Pump body
- Delivery valve plate
- Impulse valve plate
- Rubber gasket (x 3)
- Delivery valve rubber (diameter 46mm & thickness 3mm)
- Impulse valve rubber (diameter 40mm & thickness 6mm)
- Snifter valve rubber (diameter 50mm & thickness 1.5 to 2mm)
- Impulse valve stem (length 130mm, M8 thread 30mm from top, 60mm from bottom)
- Impulse valve stop bar
- Impulse valve plug
- Impulse valve weight
- 8 x 50mm M8 bolts
- 2 x 70mm M8 bolts
- 25 x M8 washers
- 22 x M8 nuts

CROSS SECTION THROUGH ASSEMBLED DELIVERY VALVE IMPULSE VALVE



Pump repair

If the pump stops or starts delivering less water than usual, it may require adjustment or repair.

Look at the pump and if there is no obvious fault start it again if you can. Watch the pump and listen for irregular pumping or unusual noises. A worn impulse valve, for example, is usually obvious because water squirts through when the valve is closed. Some parts of your ram pump may need occasional replacement, the frequency of this will depend on how hard the pump is working and on the cleanliness of the drive water.

Tools you will need:

- 2 x 13mm ring/open end spanners to disassemble and assemble the pump
- 2 x Adjustable wrenches - to loosen a union joint on the delivery pipe (if fitted)

Taking the pump apart

Depending on the fault it may be necessary to disassemble the impulse valve and/or the air vessel. Before attempting to take apart the pump:

- 1 Make sure that the drive pipe valve is closed and the impulse valve is open. This will allow you to work on the impulse valve ONLY.
- 2 Depressurise the air vessel.

WARNING - Before attempting to remove the air vessel, always release the pressure in it slowly. An ideal system will have a gate valve or one-way valve and a union fitted between the air vessel and the bottom of the delivery pipe and the optional bleed screw fitted to the air vessel. With the pump stopped, close the gate valve in the delivery pipe to stop it draining back. If a one-way valve is fitted it will close automatically. Then loosen the bleed screw to release the pressure in the air vessel. If none of the above are fitted, the only other way to release the pressure in the air vessel is to loosen each of the air vessel flange bolts one turn at a time until the water and air escapes through the join at the flange. You will certainly get wet this way.

Checks

- 1 Check the delivery valve rubber for wear and blockage of the valve holes.
- 2 Check that the snifter valve is in good condition.
- 3 Remove the impulse valve and check the impulse valve rubber. Check the nuts on the valve stem and check for excessive wear of the stem. Replace things if necessary.
- 4 Check the pump body is firmly bolted down, then reassemble the pump, ensuring that all bolts are greased.

Putting the pump back together

Assembly of the pump is shown in the exploded view drawing, but the following important points need to be kept in mind:

- 1 **Assembling the delivery valve**
Put together the delivery valve plate, the rubber and the bolt. Make sure the side of the plate with the chamfered holes is on the opposite side to the rubber, and that the rubber is on top.
Screw on the first nut until it is finger tight and then undo it by one turn. Care must be taken not to overtighten the bolt and nuts as this will affect the performance of the valve. Next, screw on the other nut and tighten it up against the first. Use the spanners to tighten them firmly together. This will lock them together, and also allow a small up-and-down movement of the bolt and rubber.
- 2 **Assembling the snifter valve**
Put the 'shaped' bolt and washer together, feed the bolt through the valve rubber, then push this through the pump body. Make sure that the shaped curve of the bolt head and washer align with the curvature of the body.
Screw on the first nut until it is only finger tight. If the nut is on too tight the rubber will curl away from the pump body and will need to be slackened off slightly. Then screw on the second nut and tighten the two nuts firmly together using the spanners. Then check that the rubber has not distorted. If it has, slacken the nuts half a turn and tighten the outer one again.
- 3 **Assembling the air vessel and delivery valve**
Align the delivery valve, air vessel, pump body and rubber gasket mounting holes and feed through the bolts. Make sure the delivery valve is the correct way up (the valve rubber facing upwards) and then tighten the nuts by hand. Use the spanners to tighten each nut and bolt a little at a time, working around the flange. This will draw the assembly together evenly.
- 4 **Assembling the impulse valve**
The first parts to assemble are the valve stem, discs and rubber. Screw two nuts onto the longer threaded end of the stem up to the end of the thread. Push a steel washer on up to the nuts. Follow this with the valve plug disc, with the chamfered side towards the nut. Slide the valve rubber up against this, then the weight disk with the chamfered side facing away from the rubber. Follow this with another steel washer. Screw a nut up to them until it is finger tight. Thread on another nut and use the spanners to tighten the nuts together. This part of the assembly is sometimes known as the valve plug.
Hold the impulse valve plate and the valve plug together, with the chamfered side of the plate opposite to the side against which the valve rubber presses. Slide the stop bar onto the top of the stem and thread a nut loosely on the stem.
Push the two longer bolts through the ends of the stop bar and thread two nuts onto each. Use spanners to lock the nuts tightly. Align the valve assembly, pump body and rubber gasket and feed through the flange bolts.
Thread on the four washers and nuts by hand, then use the spanners to tighten the two shorter bolts that hold down the valve plate. Again care must be taken to ensure that these nuts are tightened evenly. The next step is to make sure the closed valve plug is centred in the valve plate hole before tightening down the two remaining nuts that secure the stop bar. To check the alignment, open and close the valve manually turning the valve plug to make sure it does not catch on the hole in the valve plate.

Now you only need to set the stroke length of the valve for the pump to be ready for use.

Spare parts to keep on the site

- impulse, delivery and snifter valve rubbers
- an impulse valve stem
- a few spare M8 nuts, bolts and washers

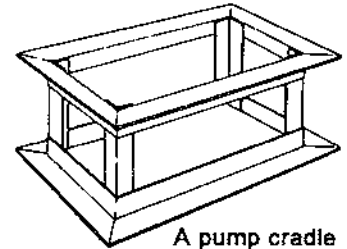


The Development Technology Unit (DTU)

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Installation notes

The DTU S1 pump should be installed in a properly designed system. To prevent vibration causing breakages, it should be firmly bolted to a steel frame (called a pump cradle) that is half buried in a concrete base. The cradle is usually made from 40 x 40mm angle iron and will vary in size depending on the number of pumps installed. Hole locations for just one pump are shown on the previous page. All pipes in the system should be supported firmly, and buried where possible. The drive and delivery tanks should be constructed on good foundations by experienced tradesmen. Pipe joints to the drive tank should allow the pipes to move slightly without damaging the tank walls or leaking badly.



A pump cradle

Starting and stopping the ram pump

Although ram pumps often start very easily, they can be awkward the first time they are run.

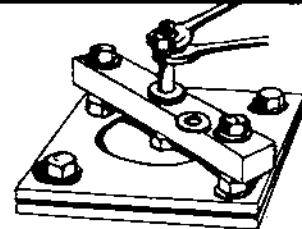
To start the pump:

- 1 Make sure that any valve fitted on the delivery pipe is open and then open the drive pipe valve. Water will flow out of the open impulse valve until it suddenly shuts. If it reopens automatically, the pump should continue to run on its own. If it does not, you must prime the delivery system as described in Step 2 alongside.
- 2 Push down on the top of the impulse valve stem with your foot to reopen it (wear strong boots). Again, water will flow out of the open impulse valve until it suddenly shuts, then push down immediately to re-open the valve. Keep helping the valve to re-open until it will do so by itself.

To stop the pump, hold the impulse valve stem up to close it or shut the valve at the bottom of the drive pipe.

Tuning for best performance

The DTU S1 can be tuned to adjust performance. This is done by changing the up and down movement of the impulse valve, which is normally set to about 12mm. Tuning is usually done to achieve either the maximum delivery flow or the most efficient use of the drive water available.



Maximum delivery

When there is plenty of drive water available, the pump can be tuned to deliver as much water as possible. To do this, remove all washers from the impulse valve stem so that the valve has as much up and down movement as possible.

WARNING: - this also puts the pump parts under greater stress and makes them wear more quickly.

Low drive flow

If the pump uses more drive flow than is available it will soon stop. If this happens it must be tuned to use less. The impulse valve should be tuned down to use 90-95% of the water available from the source. To tune the pump down, add washers onto the impulse valve stem so that the valve has less up and down movement. The shorter the stroke, the smaller the amount of drive flow needed, and the less water is delivered. The minimum stroke length is about 7mm.

Routine maintenance

While the pump is running normally, a visit should be made once a week to check that bolts are tight and that there are no leaks. Once a month an inspection of the whole system should be carried out. It is also recommended that a log book is kept to record the checks and repairs that have been made.

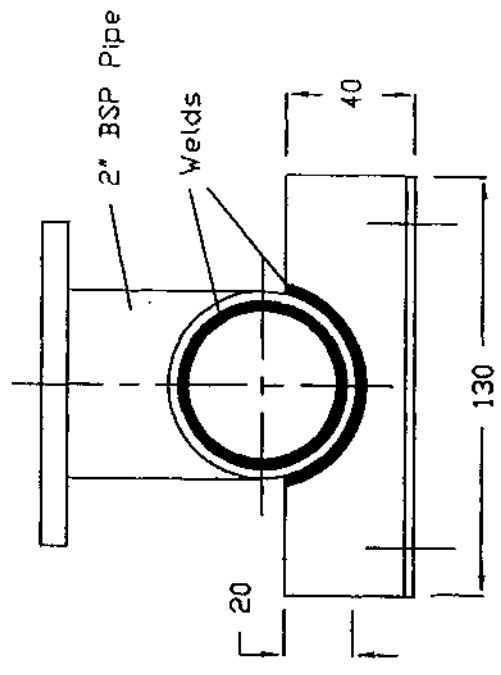
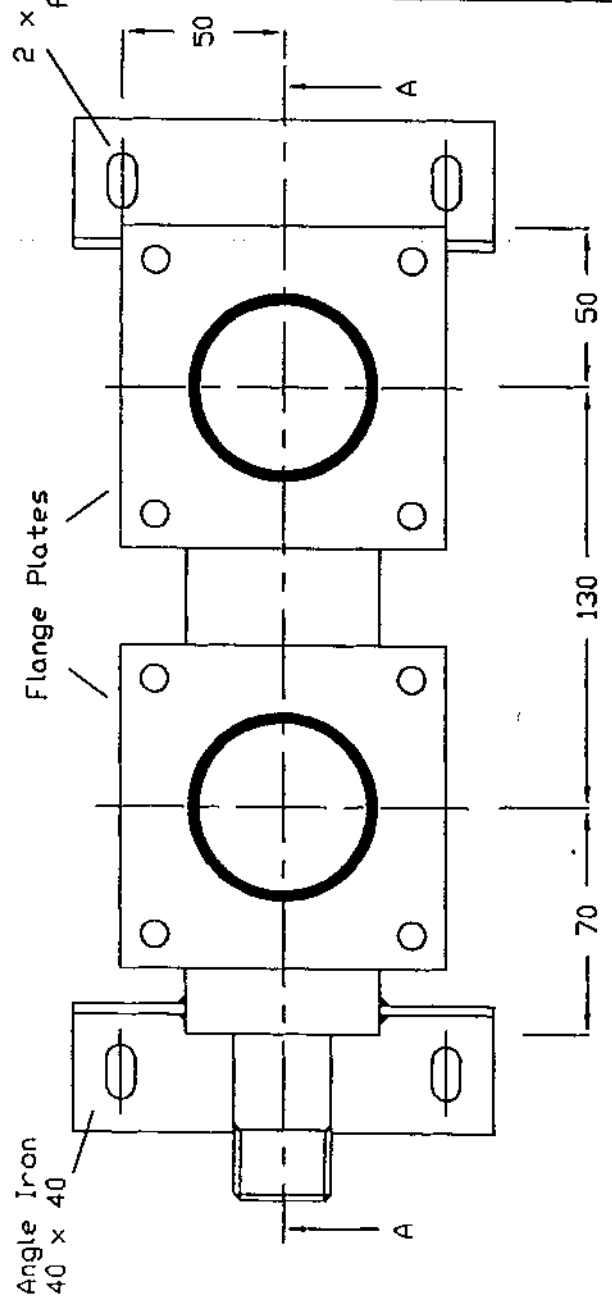
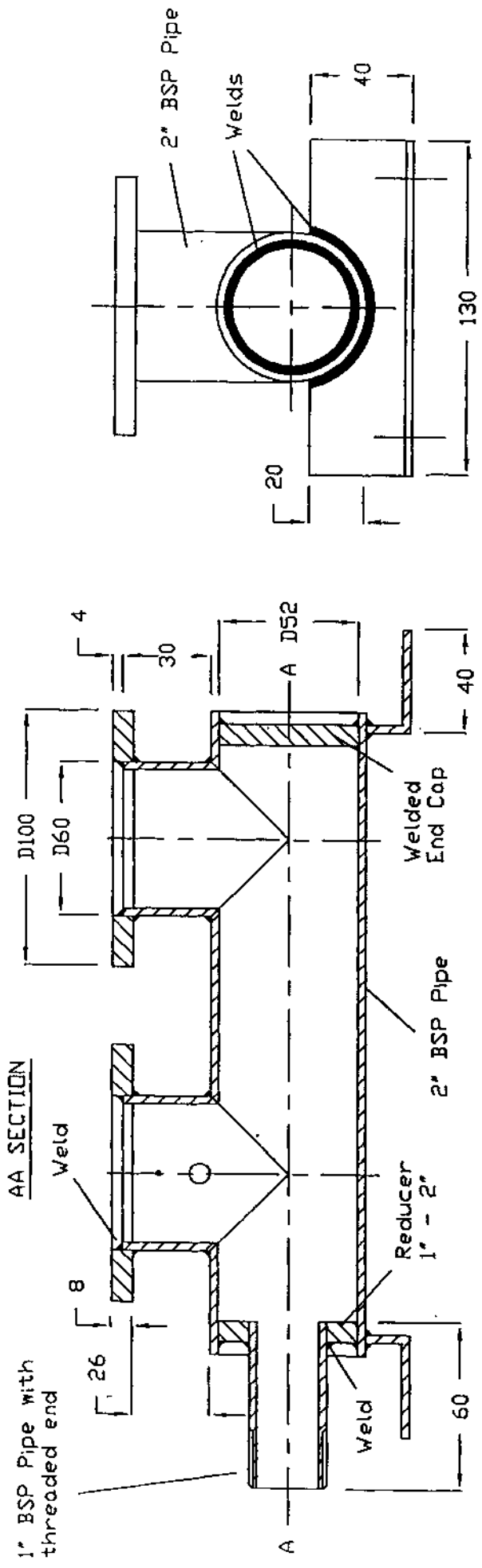
Monthly maintenance check list (without stopping the pump):

- 1 Inspect all the joints to check for leaks.
- 2 Check if there is sufficient air in the air vessel. This can be done by listening carefully to the pump. If there is insufficient air in the air vessel, the pump will be much louder than usual. This means that the sniffer valve is probably blocked and will need to be cleared.
- 3 Clean any filters installed in the system.
- 4 Remove excess silt or debris from tanks or from behind the intake dam or weir if necessary.
- 5 Walk along all pipes looking for damage. Also, inspect the tanks for leaks, particularly at pipe joints.

The following Technical release contains more information about making the DTU S1 pump

TR 11b DTU S1 pump drawings

Similar information is available for the other DTU pumps



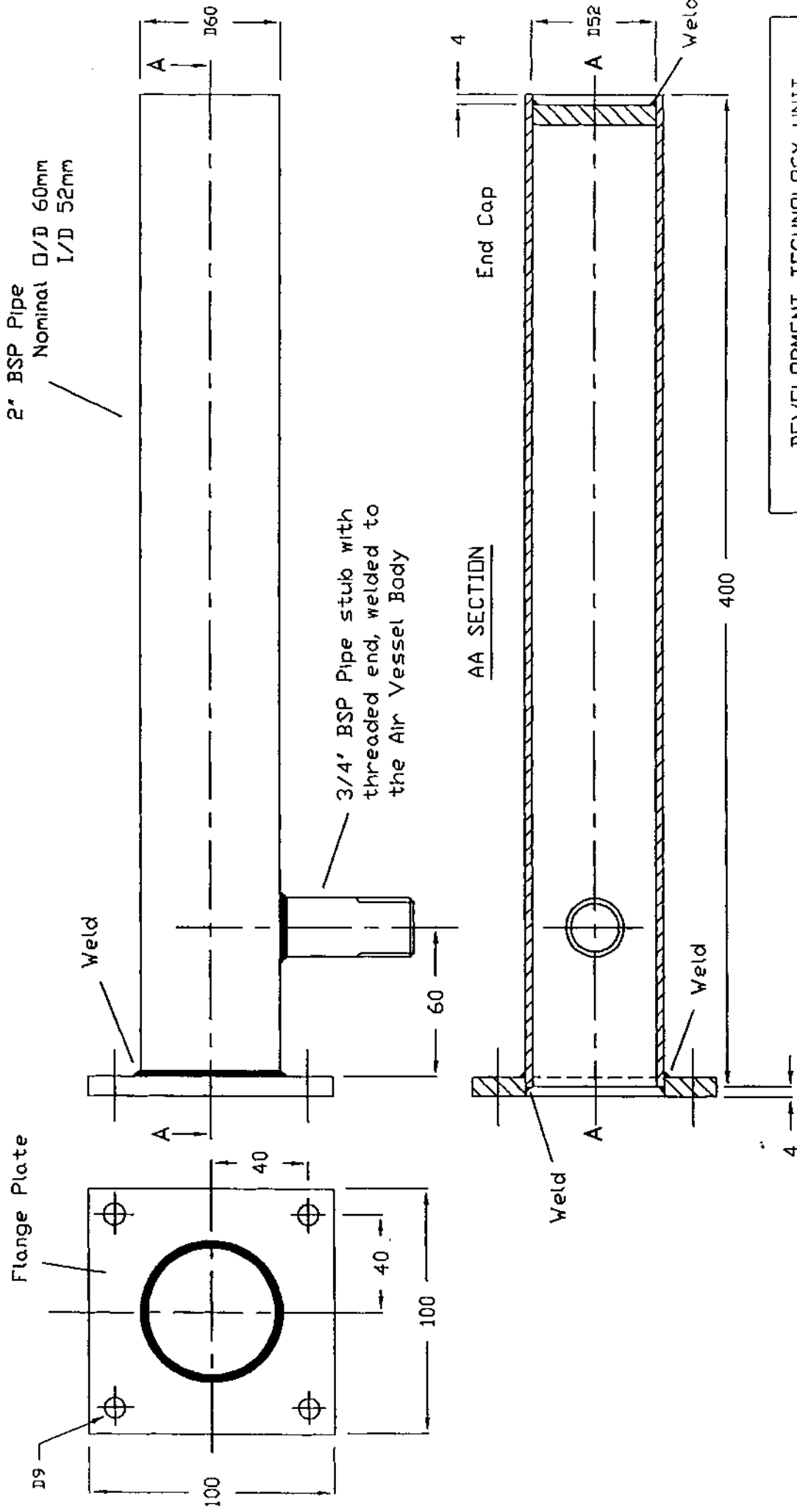
PIPE: Mild Steel Nominal 2"
 O/D 58mm, I/D 52mm

PLATE: Mild Steel
 8 or 10mm

ALL JOINTS WELDED

DEVELOPMENT TECHNOLOGY UNIT University of Warwick, Coventry, UK
S1 PUMP BODY
Drawing number 1 of 7
NOT TO SCALE

ALL DIMENSIONS IN mm



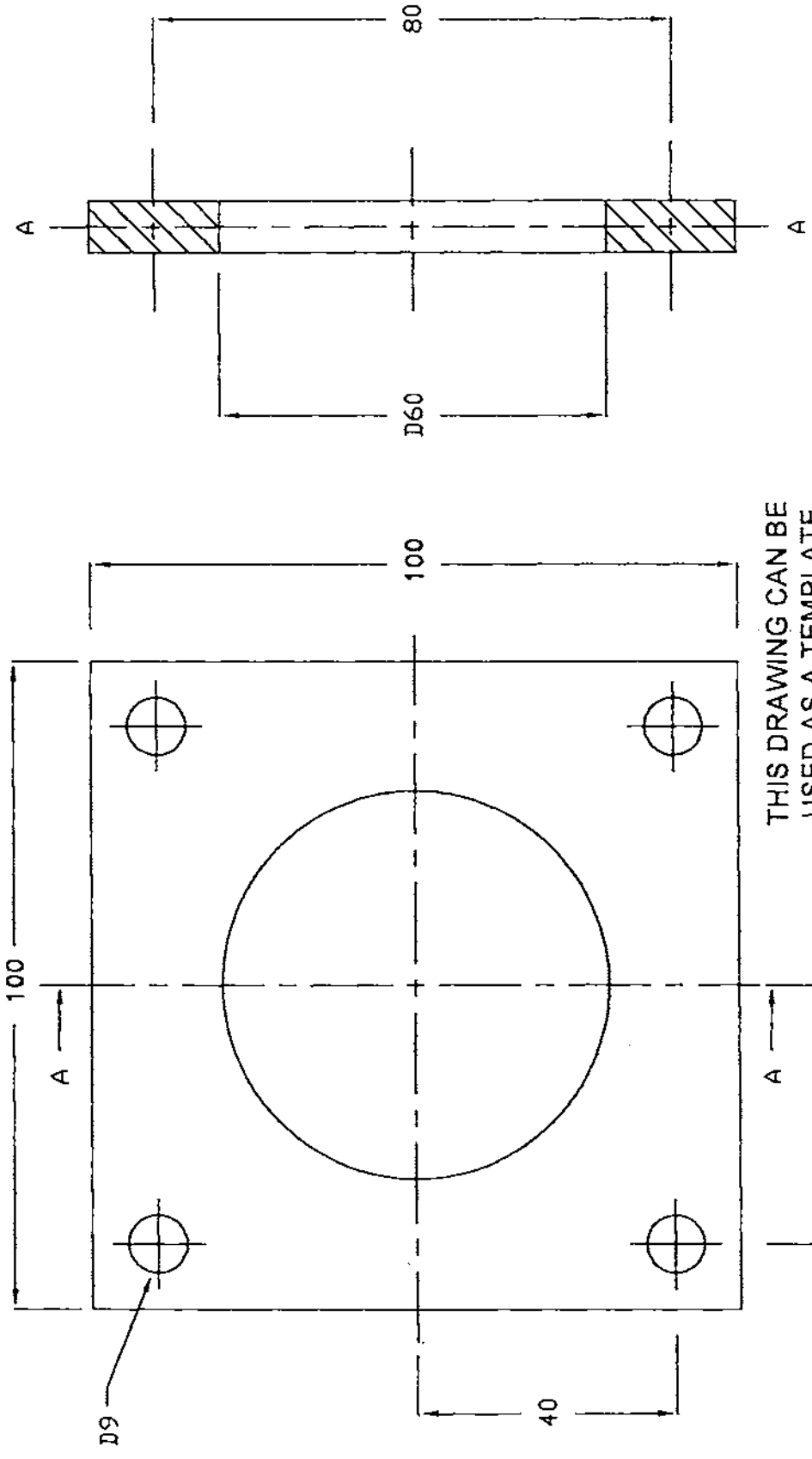
NOTE

The Flange Plate & End Cap are 8 to 10mm in thickness
To make the Flange Plate See the separate Drawing/Template

DEVELOPMENT TECHNOLOGY UNIT University of Warwick, Coventry, UK
S1 AIR VESSEL
Drawing number 2 of 7
NOT TO SCALE

ALL DIMENSIONS IN mm

AA SECTION

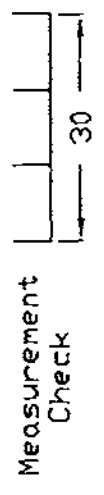


THIS DRAWING CAN BE USED AS A TEMPLATE

NOTE

Flange Plate thickness is 8 to 10mm

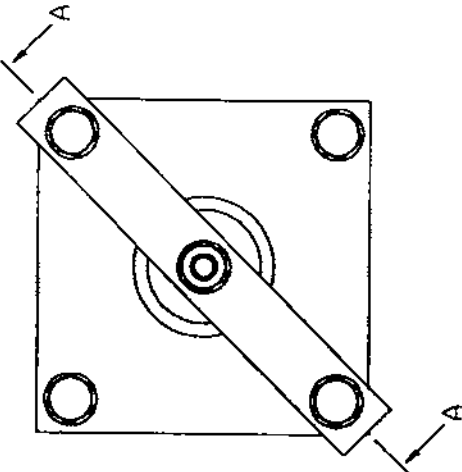
The internal diameter of the Flange Plate (60mm) may need to be different depending on the outside diameter of the steel pipe used for the pump body.



ALL DIMENSIONS IN mm

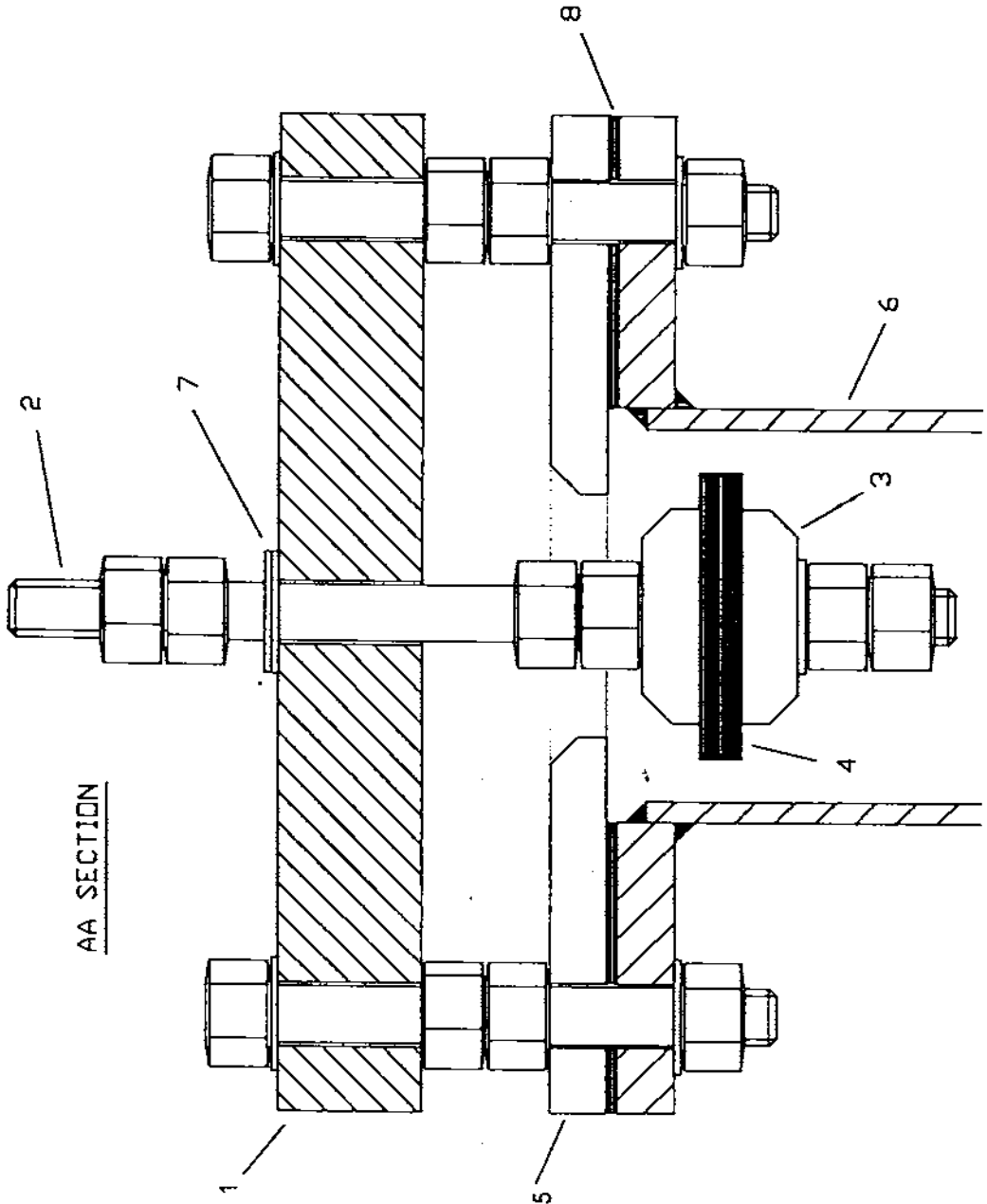
DEVELOPMENT TECHNOLOGY UNIT University of Warwick, Coventry, UK	S1 FLANGE PLATE Drawing number 3 of 7 SCALE 1:1
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IMPULSE VALVE TOP VIEW



PARTS LIST

- 1 - Cross-bar
- 2 - Valve Stem
- 3 - Valve Disc (x2)
- 4 - Rubber Disc
- 5 - Valve Plate
- 6 - Pump Body
- 7 - Stroke Adjustment Washers
- 8 - Rubber Gasket
- 9 - M8 Bolts, Nuts and Washers
 Bolts: M8 x 70mm (2 of)
 M8 x 50mm (2 of)

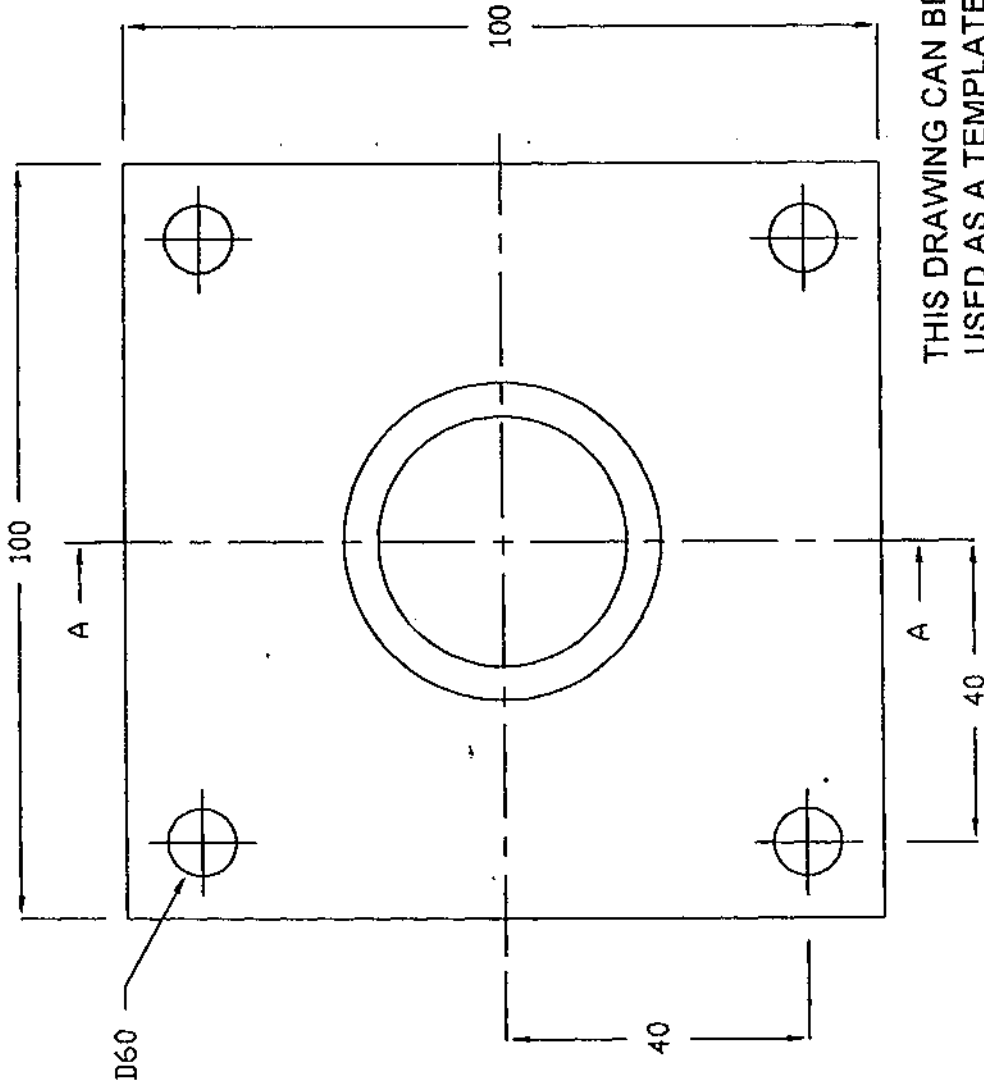
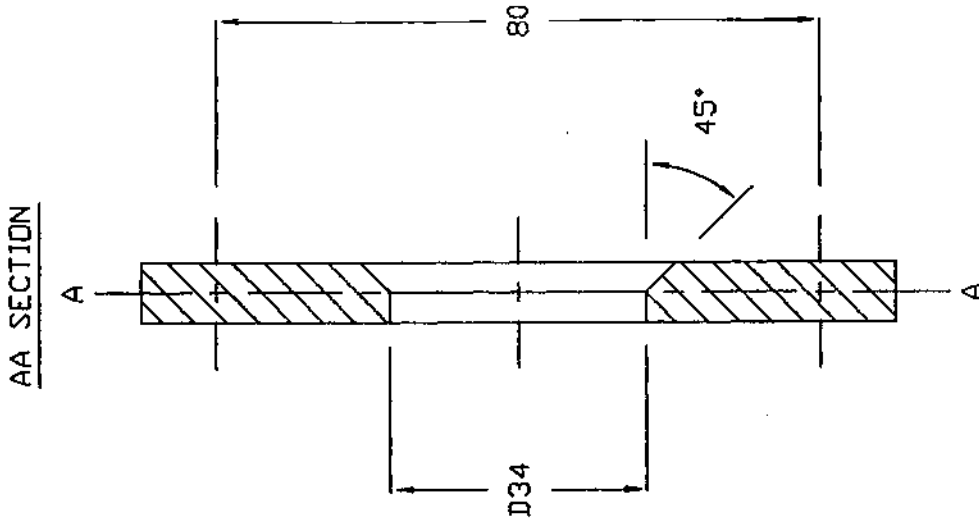


NOTE

The Rubber Disc (4) is 40mm in diameter and 6mm thick
 DO NOT use a diameter larger than this as the flow
 through the valve will be restricted

The Rubber Gasket (8) can be 1.5 to 3mm thick and is
 cut to match the Pump Body Flange

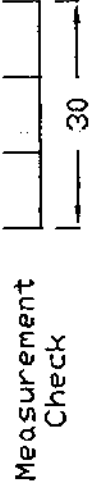
DEVELOPMENT TECHNOLOGY UNIT University of Warwick, Coventry, UK
S1 IMPULSE VALVE ASSEMBLY Drawing number 4 of 7 AA SECTION - SCALE 1:1



THIS DRAWING CAN BE
USED AS A TEMPLATE

NOTE

The impulse valve plate thickness is 8 to 10mm.
It is important to ensure that the Impulse Valve Plate and
the Impulse Valve Discs are of the same thickness.



ALL DIMENSIONS IN mm

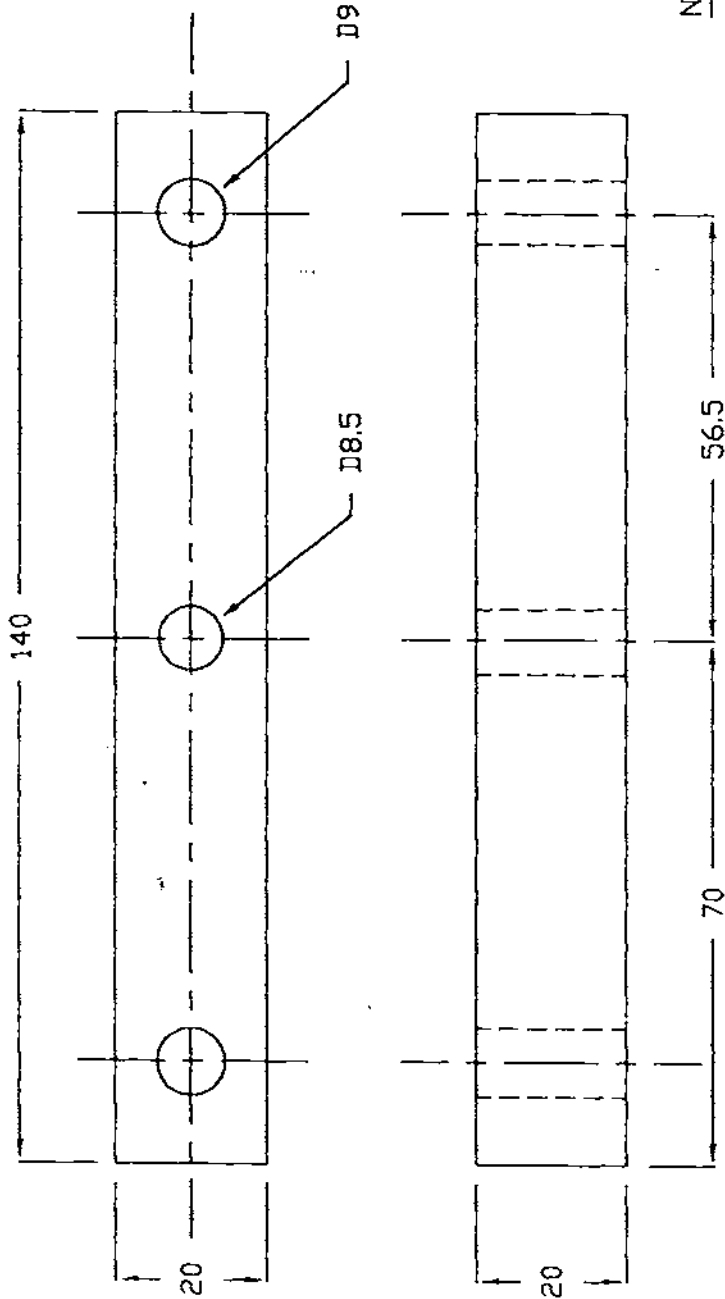
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S1 IMPULSE VALVE PLATE

Drawing number 5 of 7

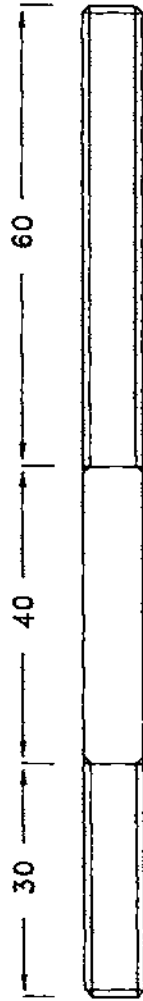
SCALE 1:1

IMPULSE VALVE CROSS-BAR



NOTE
Cross-bar is mild steel

IMPULSE VALVE STEM

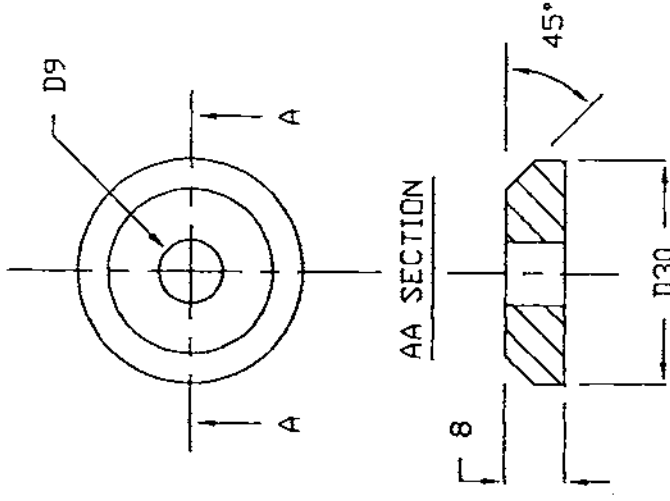


NOTE
The Valve Stem is made from 8mm steel bar or reinforcing bar. Use Stainless steel if possible

M8 Thread

ALL DIMENSIONS IN mm

IMPULSE VALVE DISCS



NOTE
2 Impulse Valve Discs are required.
Discs are of mild steel

Measurement
Check
30

THIS DRAWING CAN
BE USED AS A TEMPLATE

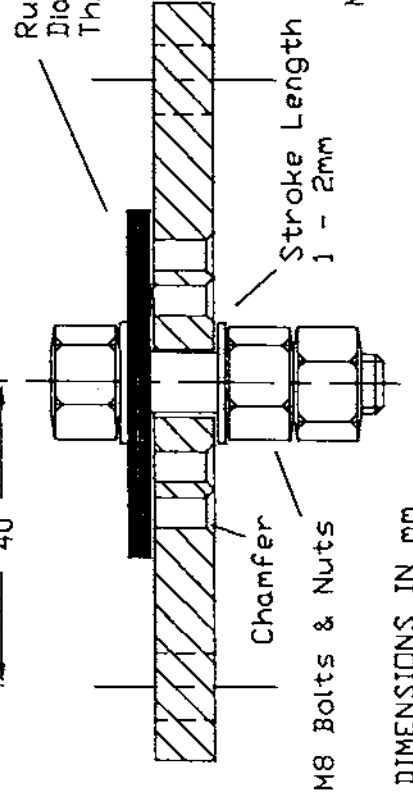
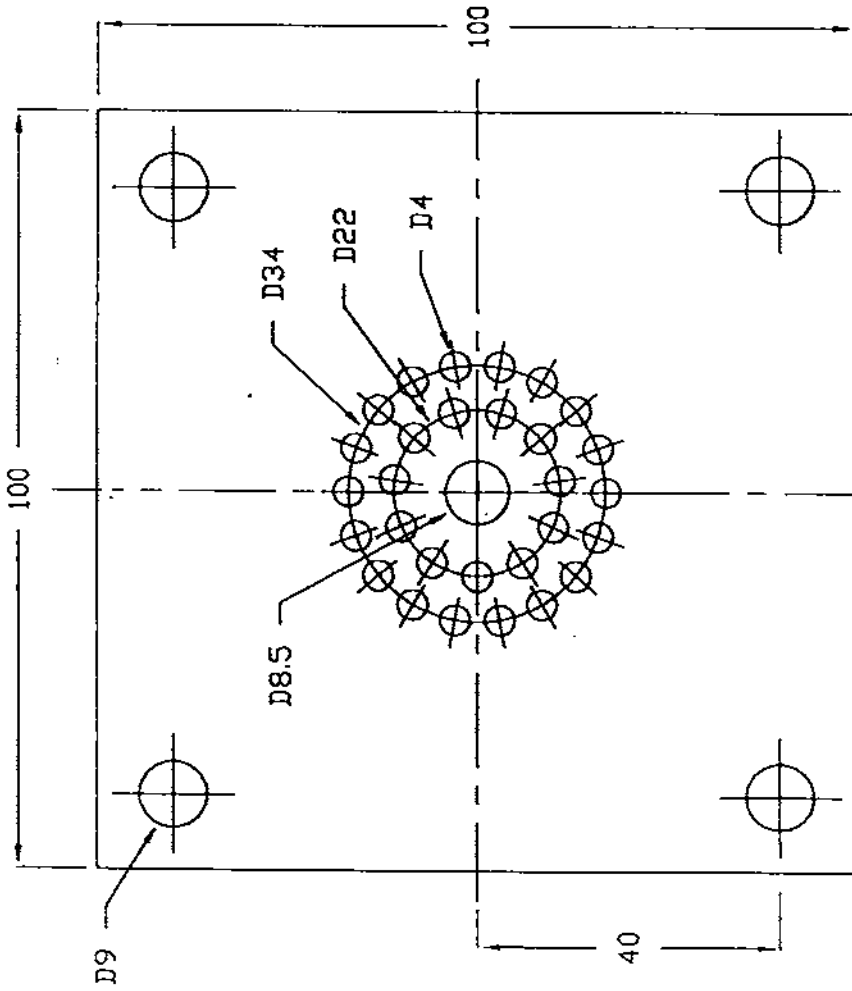
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S1 IMPULSE VALVE COMPONENTS

Drawing number 6 of 7

SCALE 1:1

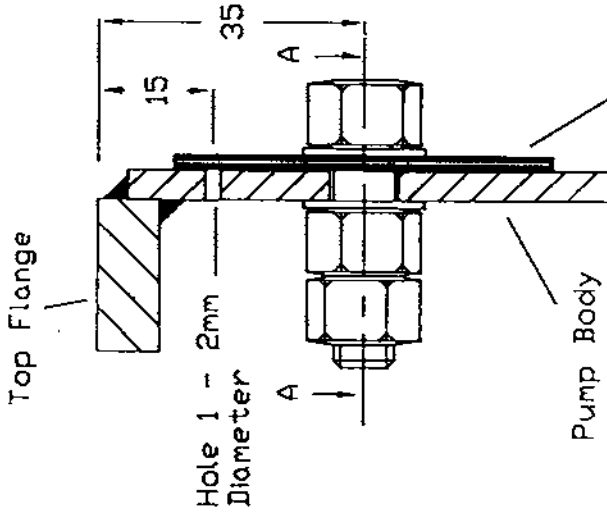
DELIVERY VALVE PLATE & ASSEMBLY



ALL DIMENSIONS IN mm

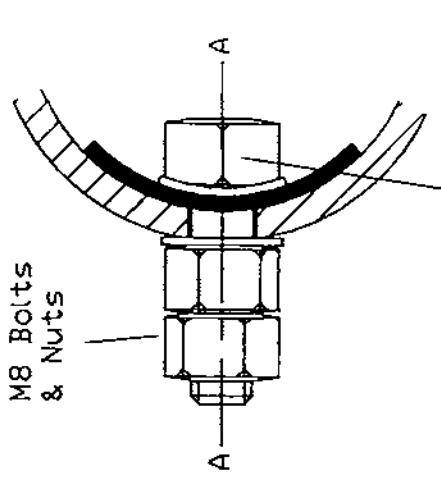
SNIFTER VALVE ASSEMBLY

SIDE VIEW



TOP VIEW

AA SECTION



M8 Bolts & Nuts

Rubber Disc
Diameter 50mm
Thickness 1.5 - 2mm

Bolt & Washer
shaped to the
curvature of
the Pump Body

**THIS DRAWING CAN
BE USED AS A TEMPLATE**

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DELIVERY & SNIFTER VALVE
ASSEMBLIES

Drawing number 7 of 7

SCALE 1:1