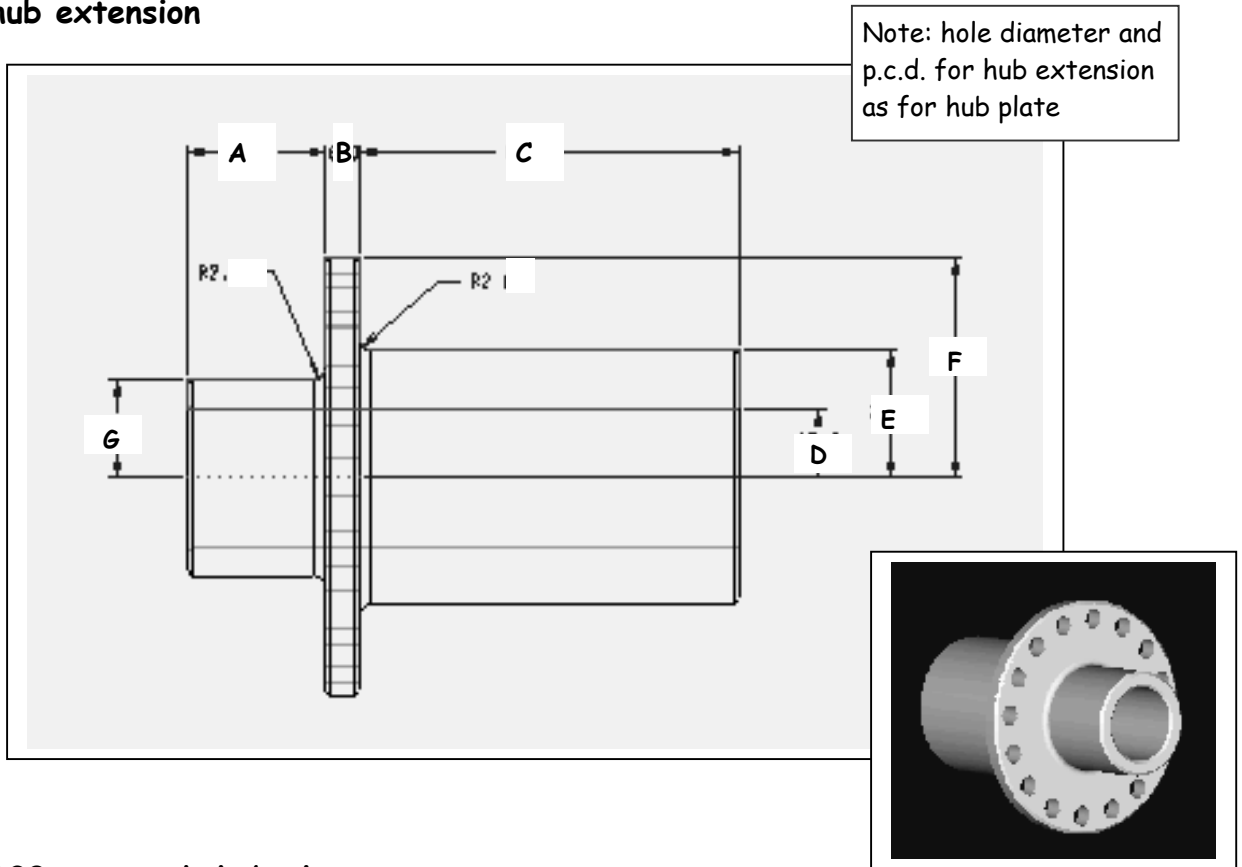
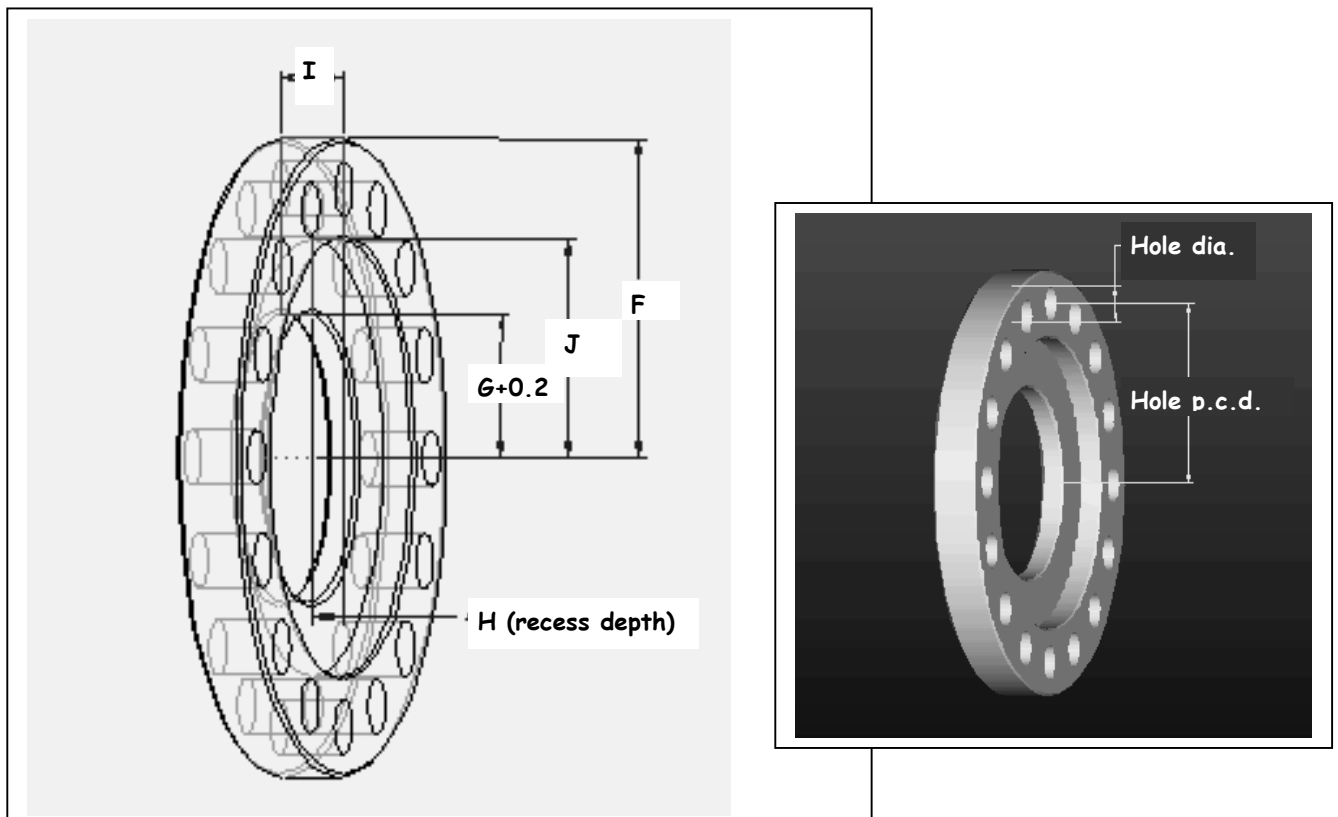


9 Appendix A: Pelton hub

9.1 hub extension



9.2 120mm p.c.d. hub plate



9.3 Hub extension dimension key

Motor frame	Runner p.c.d.	Hub extension							Hub plate					Bucket K
		A	B	C	D*	E*	F*	G*	H	I	J*	Hole dia.	Hole p.c.d	
D90	120mm	24	6	66	12	22	38	17	4	8	26	6.5	64	49
	160mm	30	8	60	12	22	44	17	4	8	32	6.5	76	70
	200mm	36	10	56	12	22	51	17	5	10	34	8.5	84	92

9.4 Modifications to dimensions for alternative motor frame sizes:

Motor Frame	Motor Shaft	D*	E*	G*
D80	19mm	9.5	20	15
D90	24mm	12	22	17
D100	28mm	14	24	19
D112	28mm	14	24	19
D132	38mm	19	30	24

NOTES: * indicates a radius dimension, all dimensions in millimetres, all edges chamfered 45°x1mm

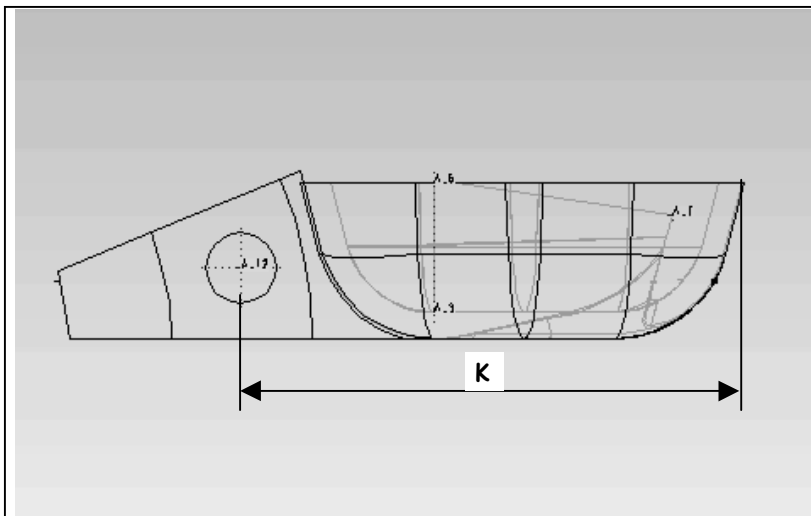


Figure 8 Use the end of the bucket as a reference for drilling the fixing hole. Dimensions for K are given in the key above and are applicable for buckets cast from patterns supplied by NTU. Ensure that this hole is drilled in an identical place on each bucket.

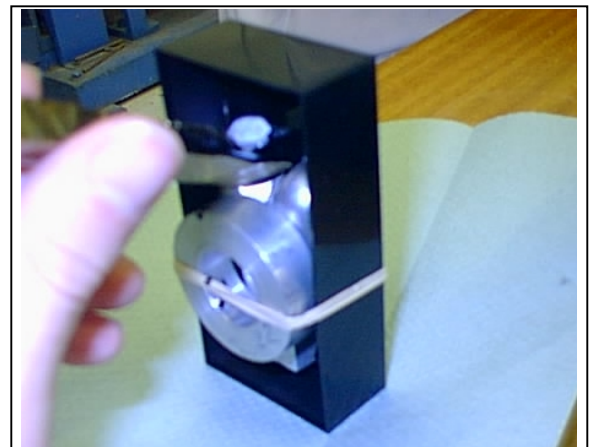
10 Appendix B: Pelton bucket fixture

A jig or fixture of some kind is required to hold each bucket in the same way while the root is machined. A reference surface is required on the side of each bucket root. This reference is a surface parallel to the splitter ridge in the centre of the bucket and equal distance away from it. The fixture should allow each cast bucket to be held in exactly the same way on the bed of the milling machine.

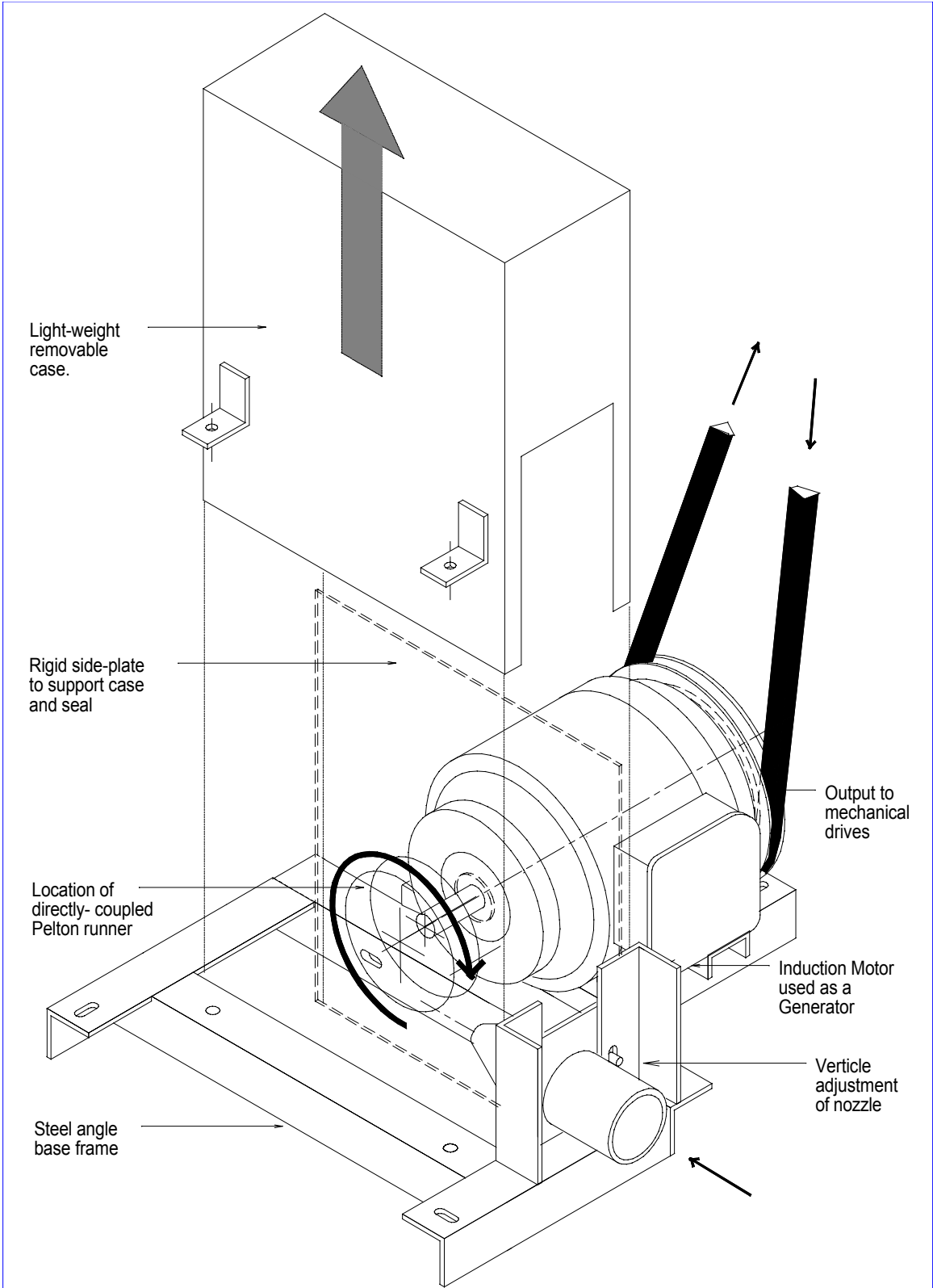
One easy method of producing a suitable fixture is to use epoxy resin. Pour some resin into a small tray and allow this to set. Alternatively machine a metal plate (4mm - 6mm thick) so that it is just bigger than the face of the bucket and has perfectly square sides. Lightly grease the inside of a bucket. This will help when trying to remove it from the epoxy. Clamp a bucket face down onto the layer of solid epoxy or the metal plate. Use a height gauge or some other suitable method to check that the bucket splitter is parallel with the sides of the base to which it is clamped as shown opposite.



Pour more liquid epoxy using a small channel, made of folded tin for example, into the opening around the notch. Holding the bucket in an upright position (with the root pointing downwards) fill with liquid epoxy. Allow to set, then unclamp and free the bucket casting. An epoxy copy of the inside of the bucket should be left behind. This fixture will allow each bucket to be precisely located on the machine bed.



11 Appendix C: Drawings of turbine assembly and components

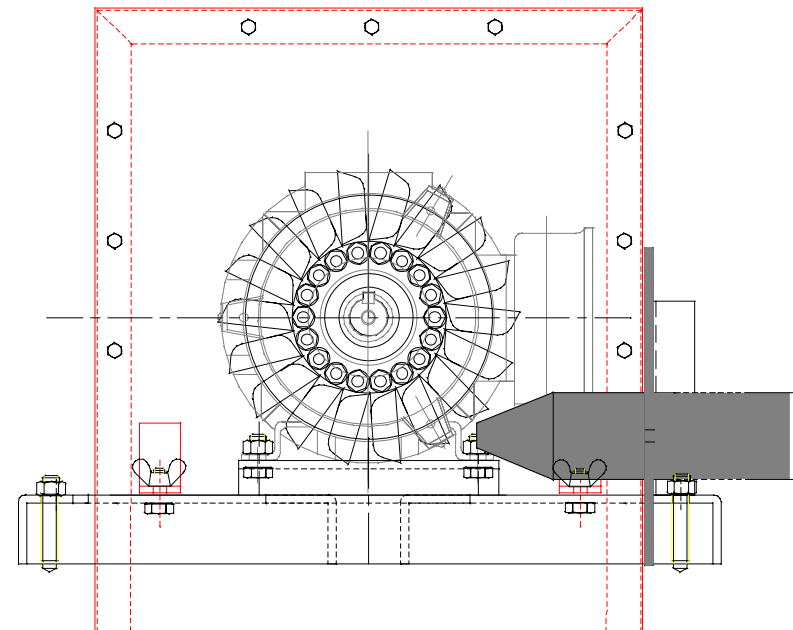
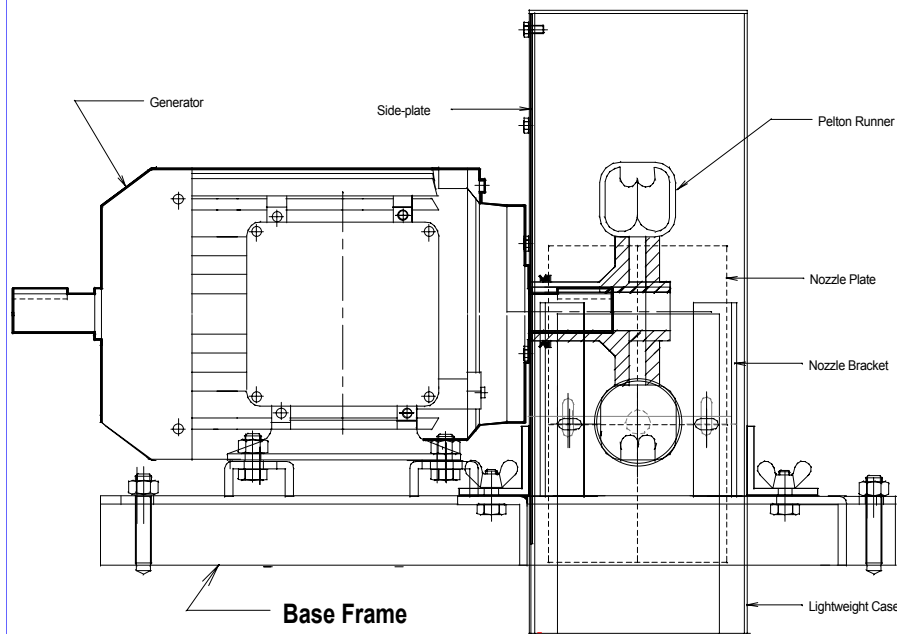
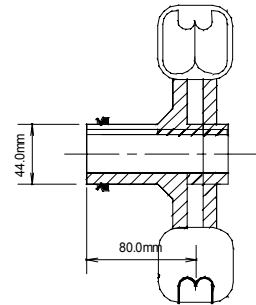


The 'Pico Power Pack'	02.06.99	1 of 12	P.Maher
	1mm = 5mm	Drawing No. 1	Nottingham MHRG

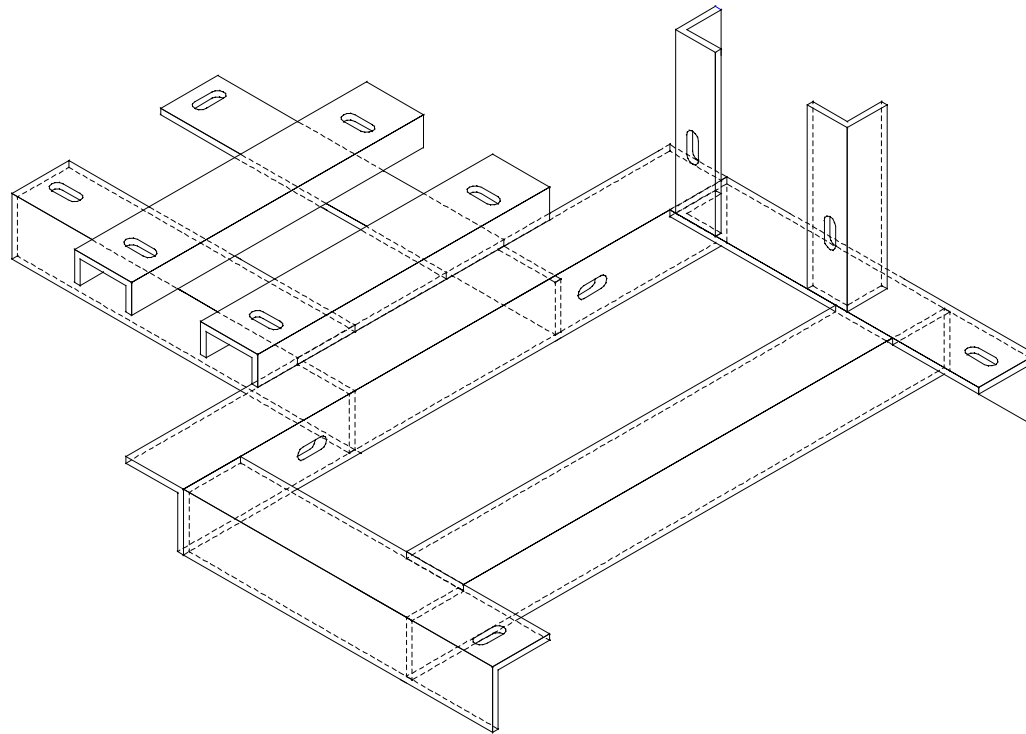
The pelton runner hub extension is 80mm from the bucket centre line. When positioned correctly, the hub should be pushed up to the shoulder at the end of the protruding shaft. This locates the runner centrally in the case which is 160mm wide. Small adjustments can be made to align the nozzle by sliding the complete generator and runner assembly left or right as required.

The sealing arrangement is shown separately (Drawing Number 11)

Pelton Runner with Hub Extension



TITLE ASSEMBLED PICO POWER PACK	DATE 02.06.99	SHEET 2 of 12	DRAWN BY P.Maher
	SCALE 1mm = 5mm	DRAWING NO 2	COMPANY Nottingham MHRG



TITLE

VIEW OF BASE FRAME

DATE

02.06.99

SHEET

3 of 12

DRAWN BY

P.Maher

SCALE

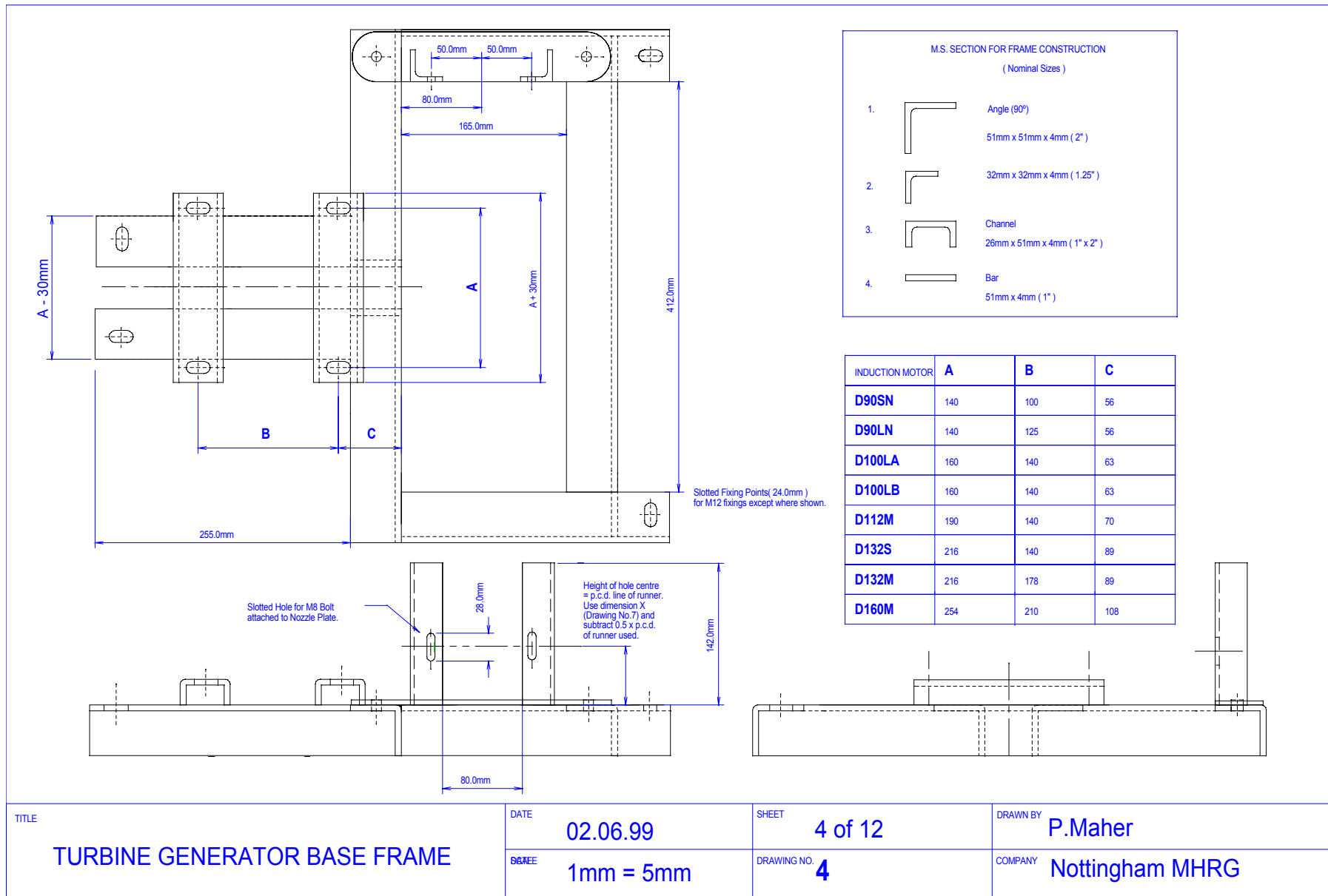
1mm = 5mm

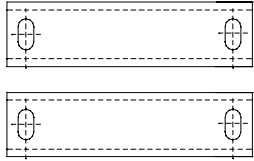
DRAWING NO.

3

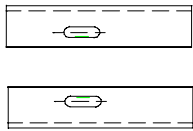
COMPANY

Nottingham MHRG

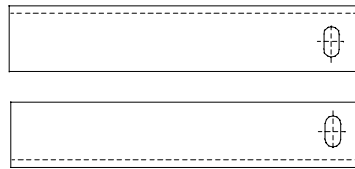




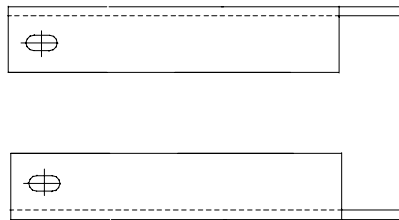
Channel Section Generator Supports
Length depends on dimension A
(170mm min, 250mm max.) x 2



Angle Nozzle Brackets (1.25")
Length : 140mm x 2



Angle Section (2")
Length 270mm x 2



Angle Section (2")
Length 300mm x 2



Angle Section (2")
Length 512mm x 1

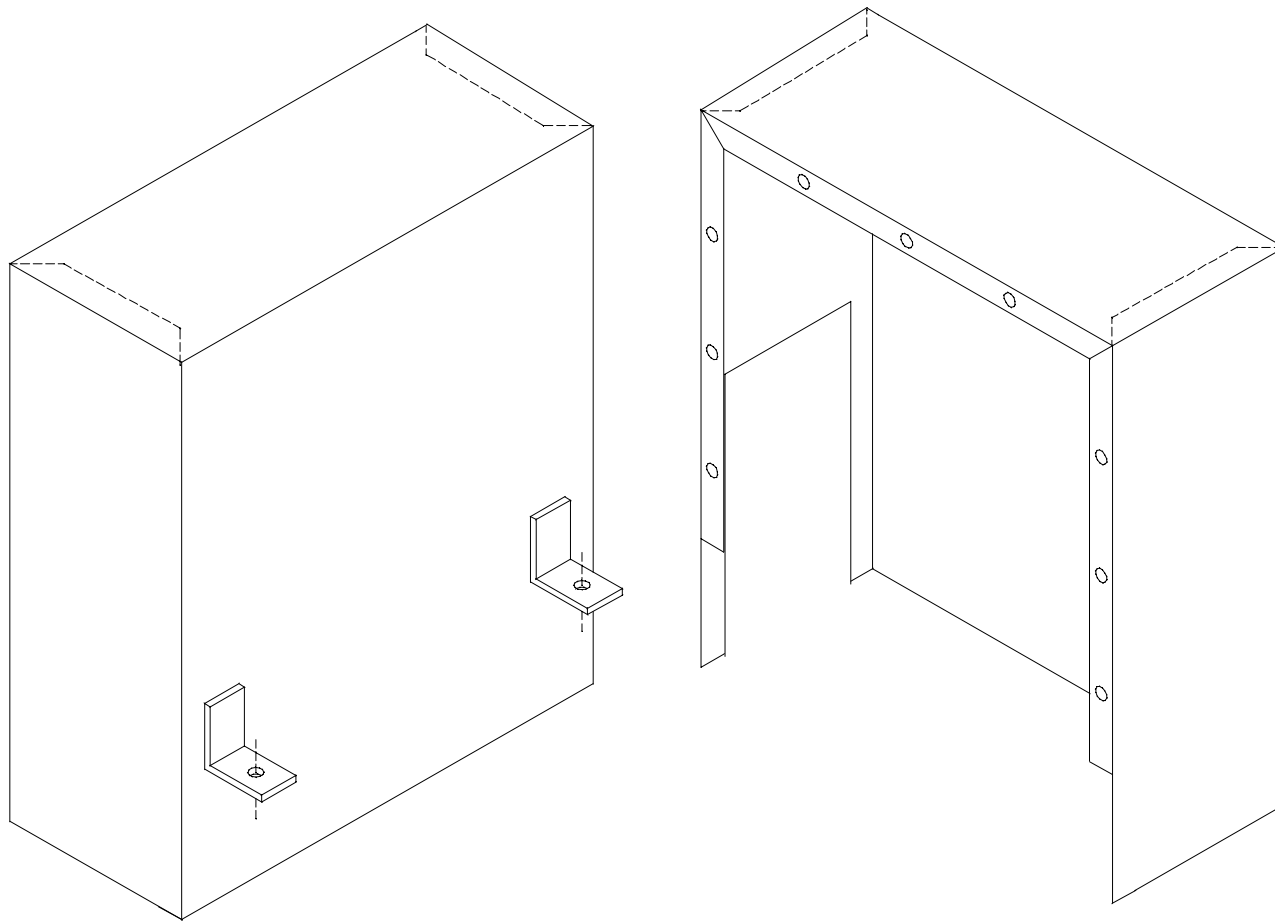


Angle Section (2")
Length 508mm x 1

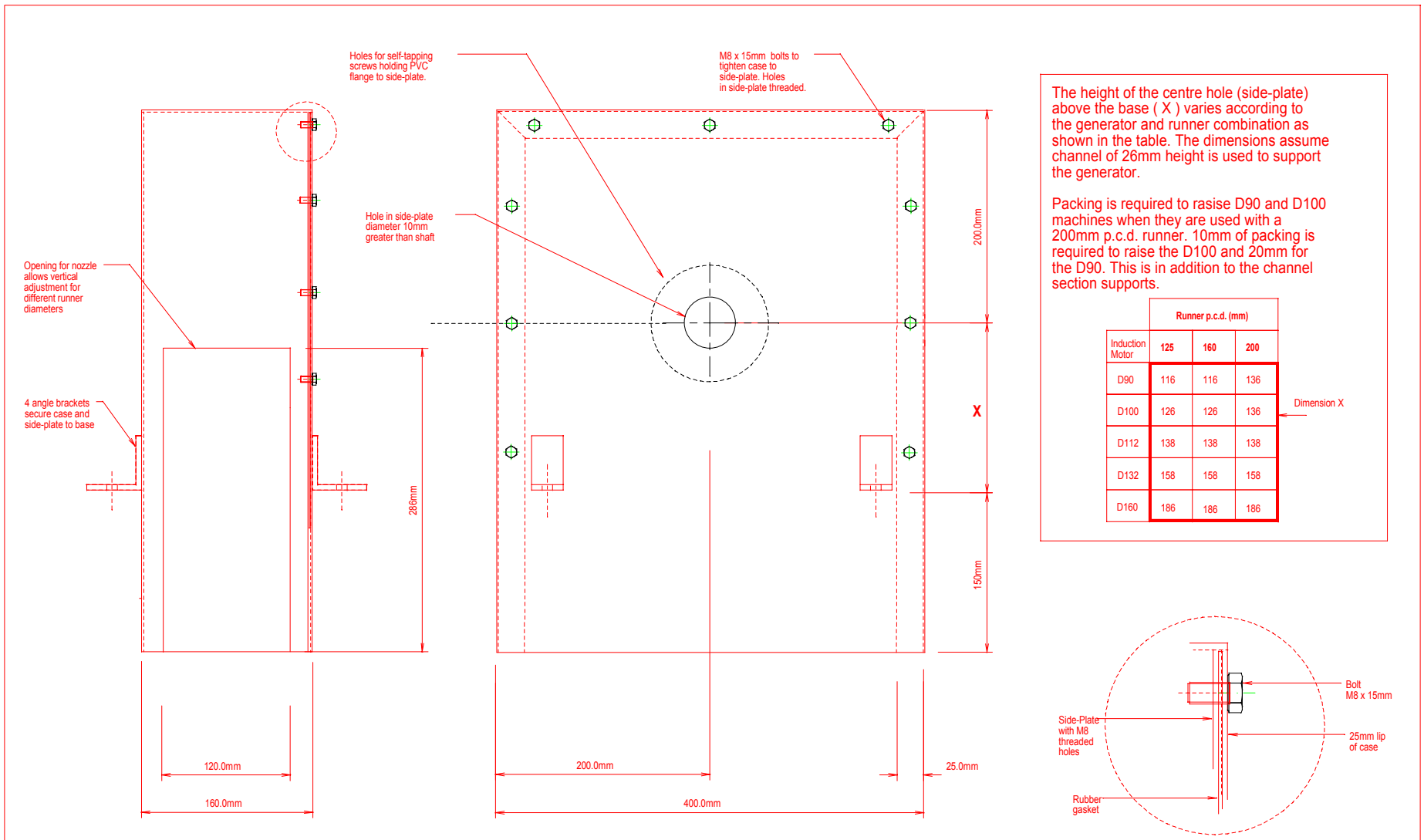
M.S. SECTION FOR FRAME CONSTRUCTION
(Nominal Sizes)

1.		Angle (90°) 51mm x 51mm x 4mm (2")
2.		32mm x 32mm x 4mm (1.25")
3.		Channel 26mm x 51mm x 4mm (1" x 2")

TITLE BASE FRAME SECTION DETAIL	DATE	03.06.99	SHEET	5 of 12	DRAWN BY	P.Maher
	SCALE	1mm = 5mm	DRAWING NO.	5	COMPANY	Nottingham MHRG



TITLE LIGHTWEIGHT TURBINE CASE	DATE 02.06.99	SHEET 6 of 12	DRAWN BY P.Maher
	SCALE 1mm = 5mm	DRAWING NO. 6	COMPANY Nottingham MHRG

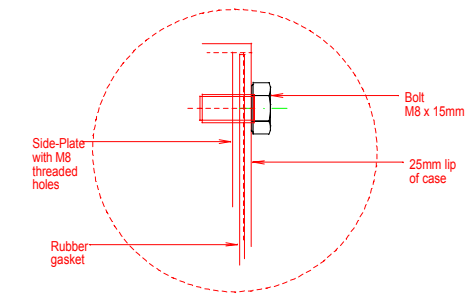


The height of the centre hole (side-plate) above the base (X) varies according to the generator and runner combination as shown in the table. The dimensions assume channel of 26mm height is used to support the generator.

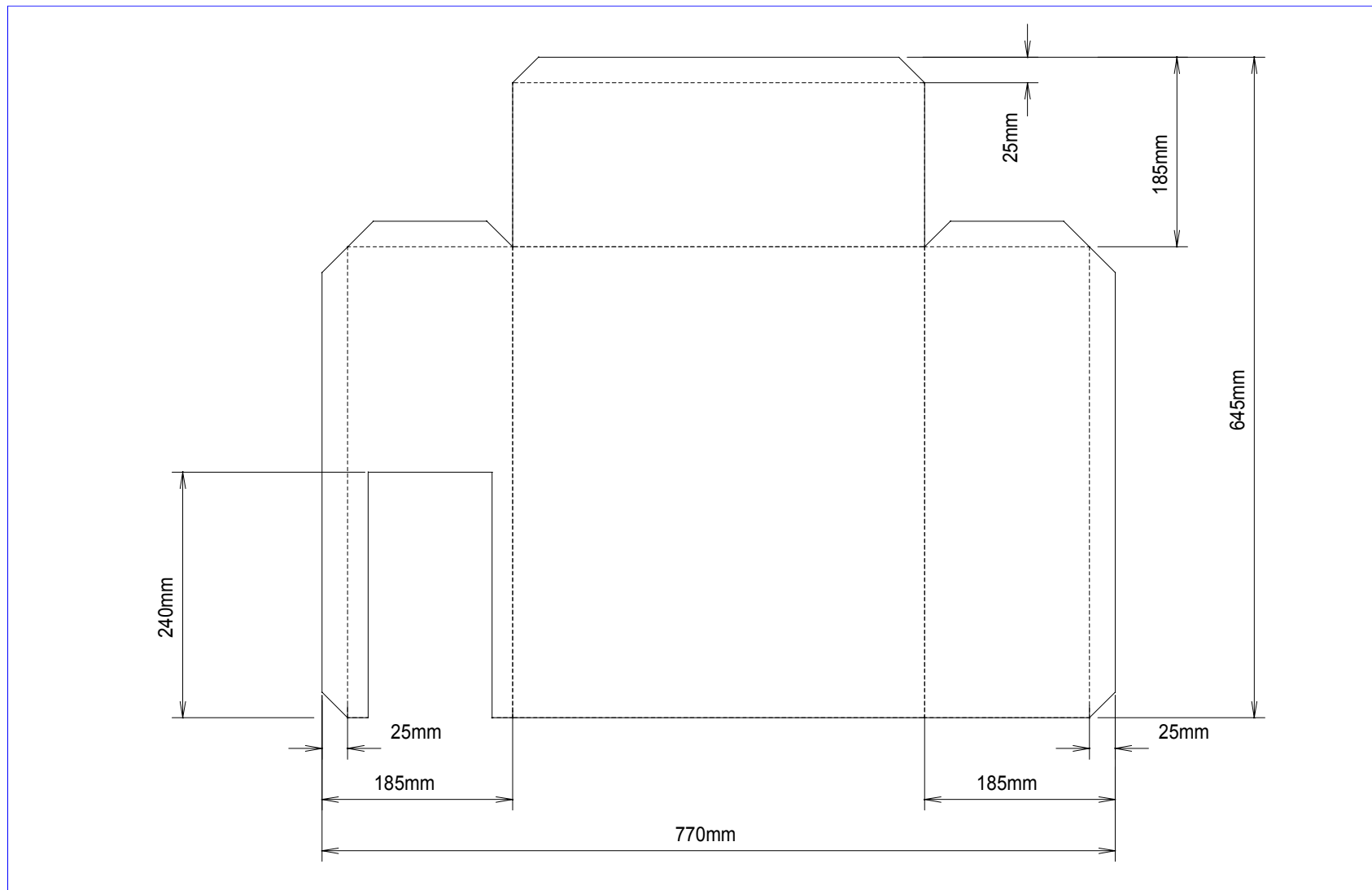
Packing is required to raise D90 and D100 machines when they are used with a 200mm p.c.d. runner. 10mm of packing is required to raise the D100 and 20mm for the D90. This is in addition to the channel section supports.

Induction Motor	Runner p.c.d. (mm)		
	125	160	200
D90	116	116	136
D100	126	126	136
D112	138	138	138
D132	158	158	158
D160	186	186	186

Dimension X

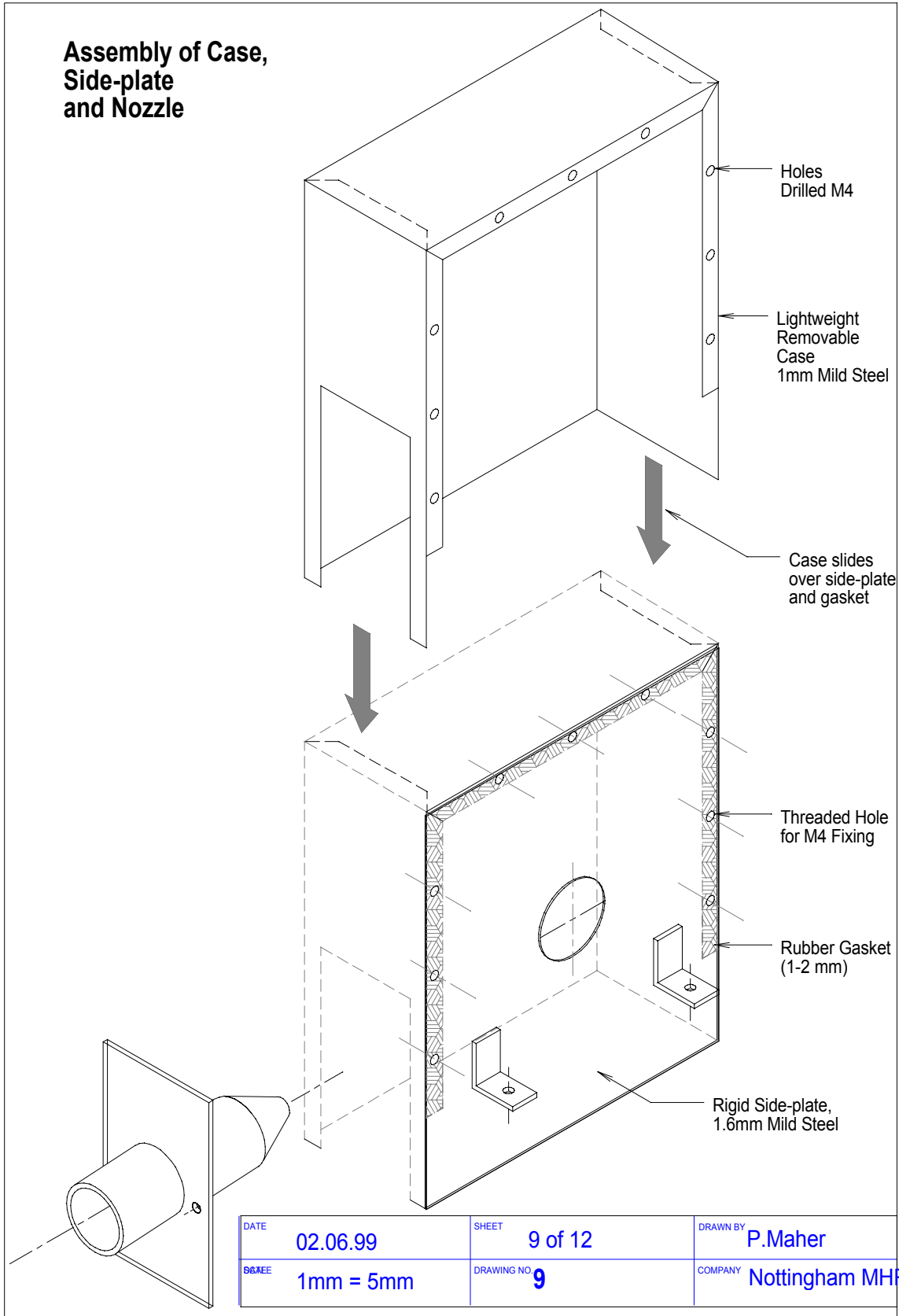


TITLE TURBINE CASE AND SIDE-PLATE	DATE 02.06.99	SHEET 7 of 12	DRAWN BY P.Maher
	SCALE 1mm = 5mm	DRAWING NO. 7	COMPANY Nottingham MHRG

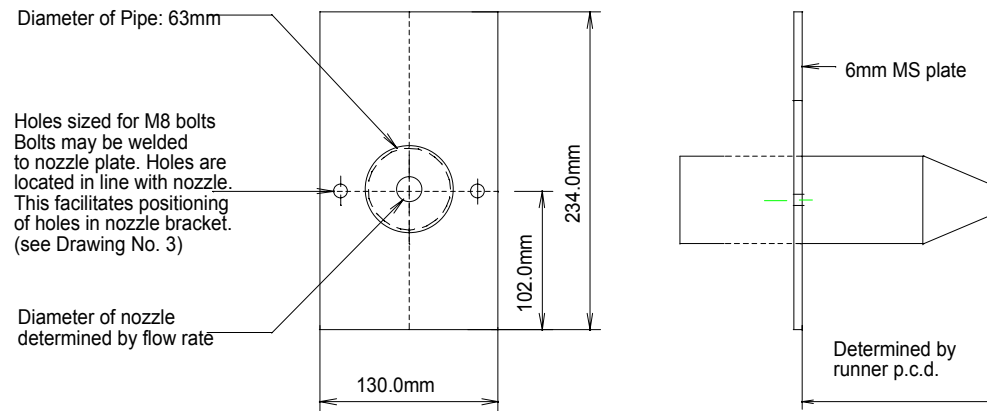


TITLE TURBINE CASE DEVELOPMENT	DATE 03.06.99	SHEET 8 of 12	DRAWN BY P.Maher
	SCALE 1mm = 5mm	DRAWING NO. 8	COMPANY Nottingham MHRG

Assembly of Case, Side-plate and Nozzle

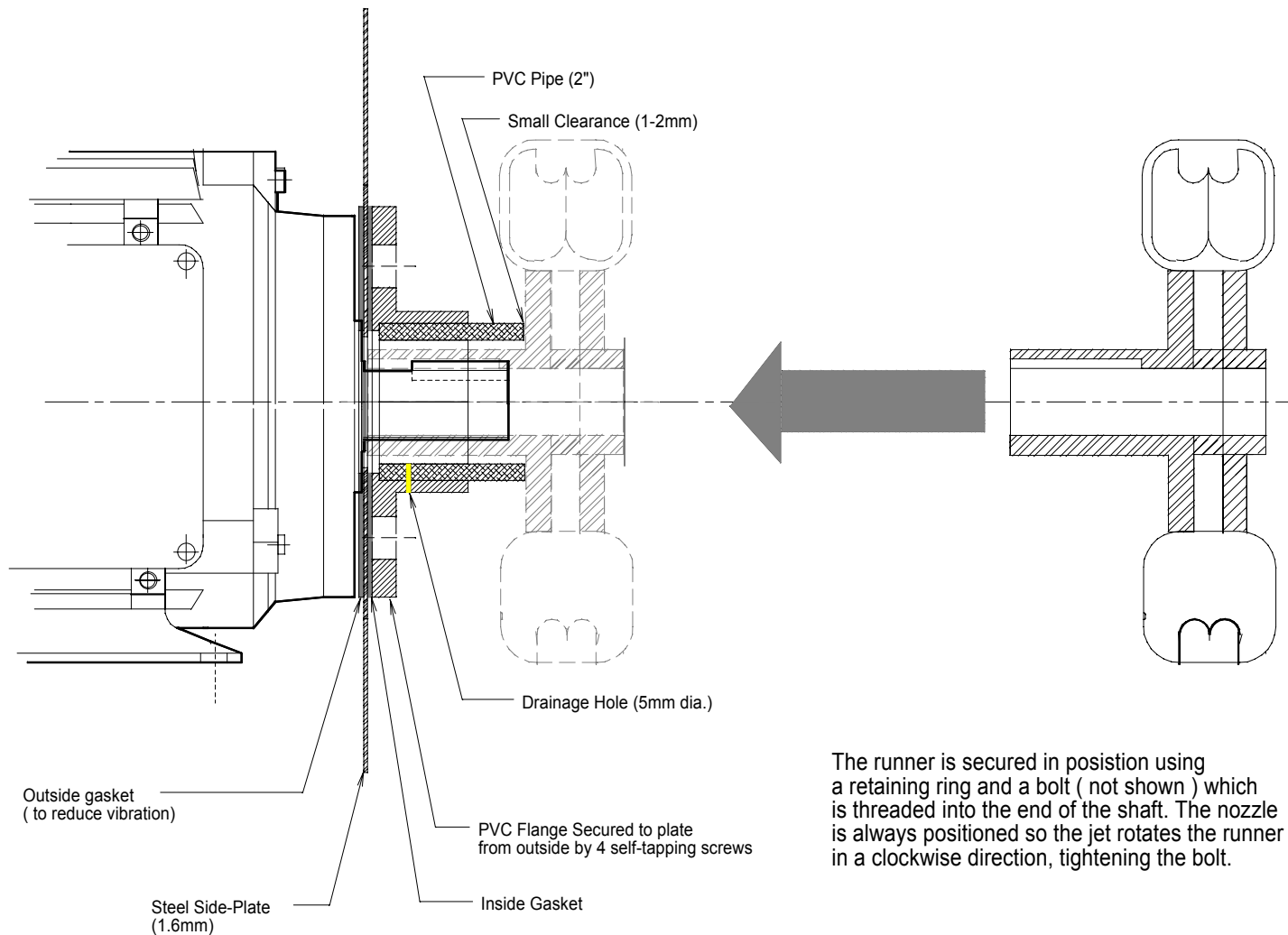


DATE	02.06.99	SHEET	9 of 12	DRAWN BY	P.Maher
SCALE	1mm = 5mm	DRAWING NO.	9	COMPANY	Nottingham MHR



Nozzle / Runner clearance should be as small as possible for max. efficiency

TITLE NOZZLE AND FIXING PLATE	DATE 02.06.99	SHEET 10 of 12	DRAWN BY P.Maher
	SCALE 1mm = 5mm	DRAWING NO. 10	COMPANY Nottingham MHRG



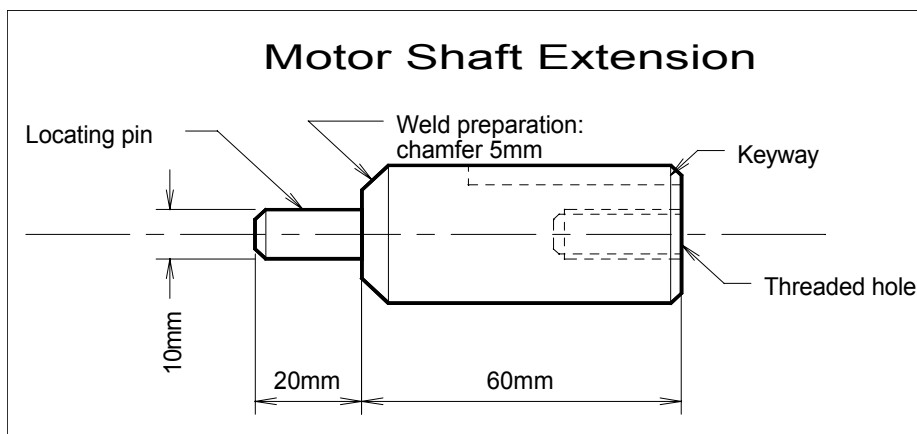
TITLE SHAFT SEALING ARRANGEMENT	DATE 02.06.99	SHEET 11 of 12	DRAWN BY P.Maher
	SCALE 1mm = 2.5mm	DRAWING NO. 11	COMPANY Nottingham MHRG

Generator shaft extensions

Since the induction motor / generator shaft is coupled to a Pelton turbine a generator shaft extension is required at the opposite end in order to provide a mechanical drive. The principal workshop requirements are for lathe, welding and drilling facilities. A puller and screwdrivers will also be required for motor disassembly.

1. Disassemble motor, removing the fan cover, roll clip retaining the fan (using a correctly sized roll clip punch) and the fan itself. Loosen the bearing cap screws and remove the end-shield. Slide out the shaft complete with the rotor and both sets of bearings. A puller may be required to remove the end-shield. The end-shield at the drive end can also be removed in the same way if required.

2. Machine the shaft extension from high-grade (shaft quality) carbon steel bar. The diameter of this should be slightly greater than the diameter of the motor shaft. Additional features of the extension such as a keyway or threaded hole are determined by the requirements of the pulley being attached. These features should be added to the shaft extension before further assembly. Leave the outside diameter 2-5mm larger than the motor shaft. The total length of the extension should be the same as the protruding drive shaft plus an additional section for a locating pin. The locating pin should be approximately 10mm in diameter and 20mm in length. A chamfer of approximately 5mm depth is added to the extension piece. This will allow the two shafts to be machined flush whilst maintaining sufficient depth of welded metal.



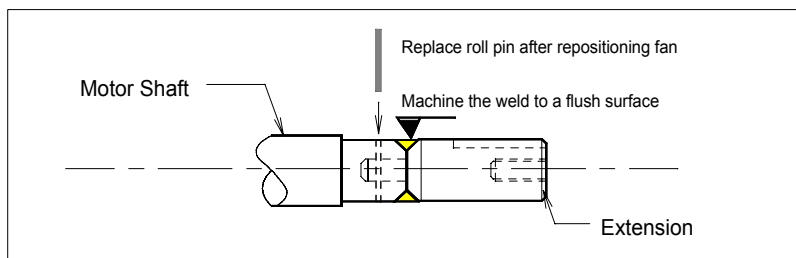
3. The fan end of the rotor shaft is prepared in the lathe with a chamfer of 5mm to accept the weld. A hole is reamed to a depth of 22mm and a diameter of 10mm.

4. The locating pin is inserted into the reamed hole by pressing the shaft and extension piece together between the chuck and tailstock in the lathe. The two

shafts checked for concentricity by running briefly in the lathe with the tailstock in position.

5. The two shafts are welded together along the 5mm chamfer by supporting the shaft in a rotating bench clamp (or in the lathe). The welded metal should stand proud of the shaft diameter around the entire circumference. It is then machined flush between the two shafts. The extension diameter is then turned

down to match the diameter of the original shaft.



6. The hole for the fan-retaining roll clip is drilled through the central locating pin using the hole in the rotor shaft as a guide. The generator is ready for re-assembly.