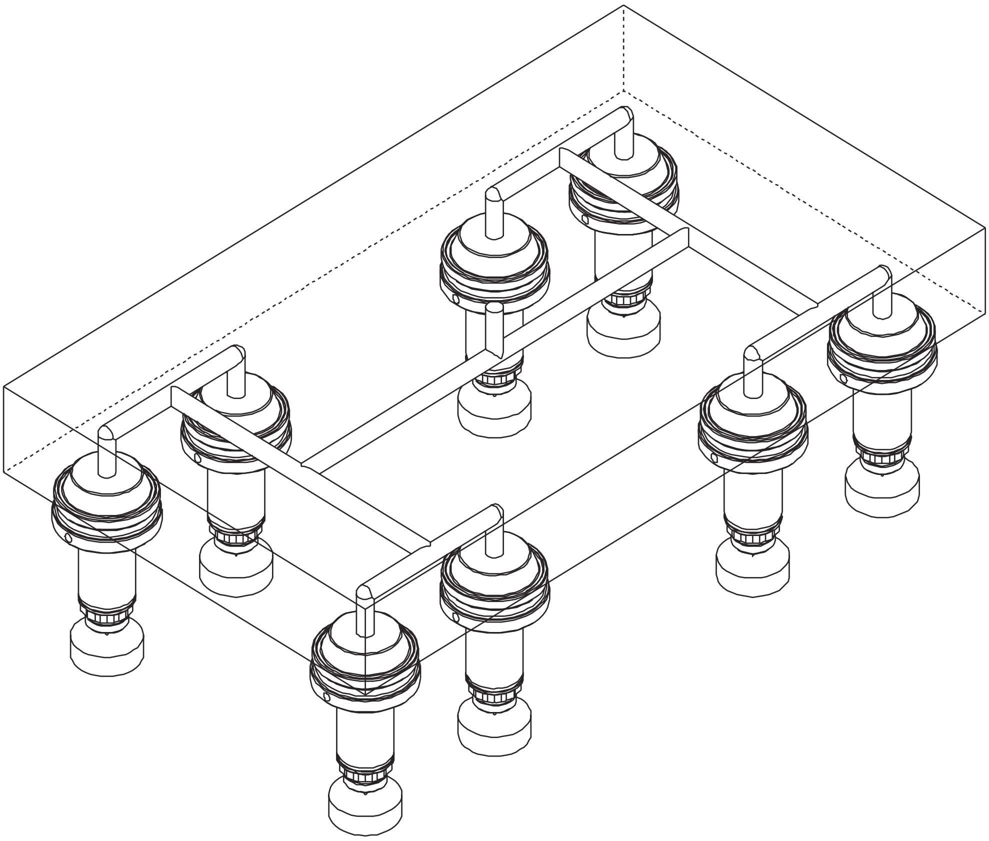
TECHNICAL MANUAL



CONTENTS

OVERVIEW

A Hot Runner System is used to maintain a molten flow of plastic from the molding machine nozzle to the gate in a plastic injection mold.

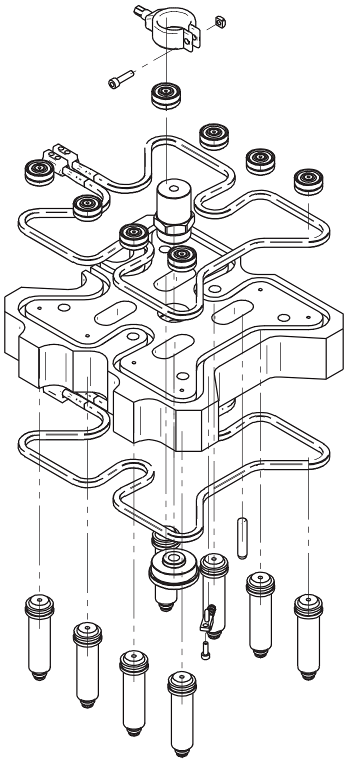
Main benefits of a Hot Runner System

- Reduce cycle times
- Remove cold runner that would be either scrap or require regrind
- Improve part consistency and quality
- Reduced gate mark.
- Reduce injection pressure.
- With valve gates, makes sequential filling and family of parts molds possible
- Offers more process control for fine tuning.

The system is generally composed of three parts, the sprue bush, the manifold block and one or more hot nozzles. The system can also include valve gates which are a method of physically shutting the gate off, giving a better cosmetic appearance and allowing larger gates to be used.

The critical areas of performance for a hot runner system are:

- Precise temperature control of the molten plastic to avoid degradation
- Balanced flow to all cavities giving even filling of parts
- Nozzle sizing for maintaining sufficient molten material flow
- Gate detail to correctly fill the part but also shut the gate off after filling ensuring minimal drool and short cycle time
- No traps or areas of flow hesitation to ensure quick colour change and prevent material degradation
- Minimum pressure drop across the hot runner system
- Reasonable melt residence time



NOZZLES

GATE SELECTION

When designing an injection mold the size and location of the gate is one of the most important considerations for correct molding of the part. With Hot Runner molds the most common gate type is direct gating. Direct gating offers the simplest construction and high reliability.

Mastip also makes a range of nozzles with other gate options such as Side, Edge and Valve gates, refer nozzle catalogue.

Direct Gating

Considerations when designing the gate

- Flow rate
- Pressure drop
- Cycle time
- "Shut off" after filling to prevent drooling
- Visual impact of the gate on the component part

As well as the size of the gate the actual shape of the gate and gate cavity is of vital importance to its performance. In particular the size of the land is important as too long a land increases the pressure drop, and too small a land weakens the gate.

When considering nozzle selection and gate sizing it is important to look at the two in combination.

Factors to consider:

- The shot size of the part.
- Material to be molded
  - Material Flow Index (M.F.I.)
  - Additives
  - Glass fiber
  - Flame retardant
- Cosmetic appearance of the gate
- Part wall thickness
- Longest flow length of the part
- Required cycle time

Material Category

There are three broad categories of materials, easy, medium and difficult to mold materials.

When selecting nozzles for plastics with large percentages of filler (>15%) or a very low M.F.I. the material effectively moves up a grade i.e. Easy to Medium or Medium to Difficult.

Parts with very thin wall sections or very long flow lengths will need a larger than normal nozzle and gate to achieve proper filling, this may be one to two sizes.

As a general rule the gate should be a of 75% of the wall section at the injection point for a medium flow materials. This is can be adjusted up or down for easy or difficult materials.

GATE DETAILS

Design Stage

- Best results are produce by machining the nozzle seat directly into mold. i.e. MTT
- Provide maximum and **uniform** cooling around the gate area
- Allow for the thermal expansion of the nozzle when calculating the cavity overall length (L in figure 5.1)
- The pocket for the nozzle head should be stepped and the dimension H maintained to ensure minimal heat loss and ease of removal. Refer figure 5.1
- Wire channel must be straight for the given length of 40mm, to allow for the heater ferrule, other dimensions are listed on the relevant page in the nozzle catalogue.

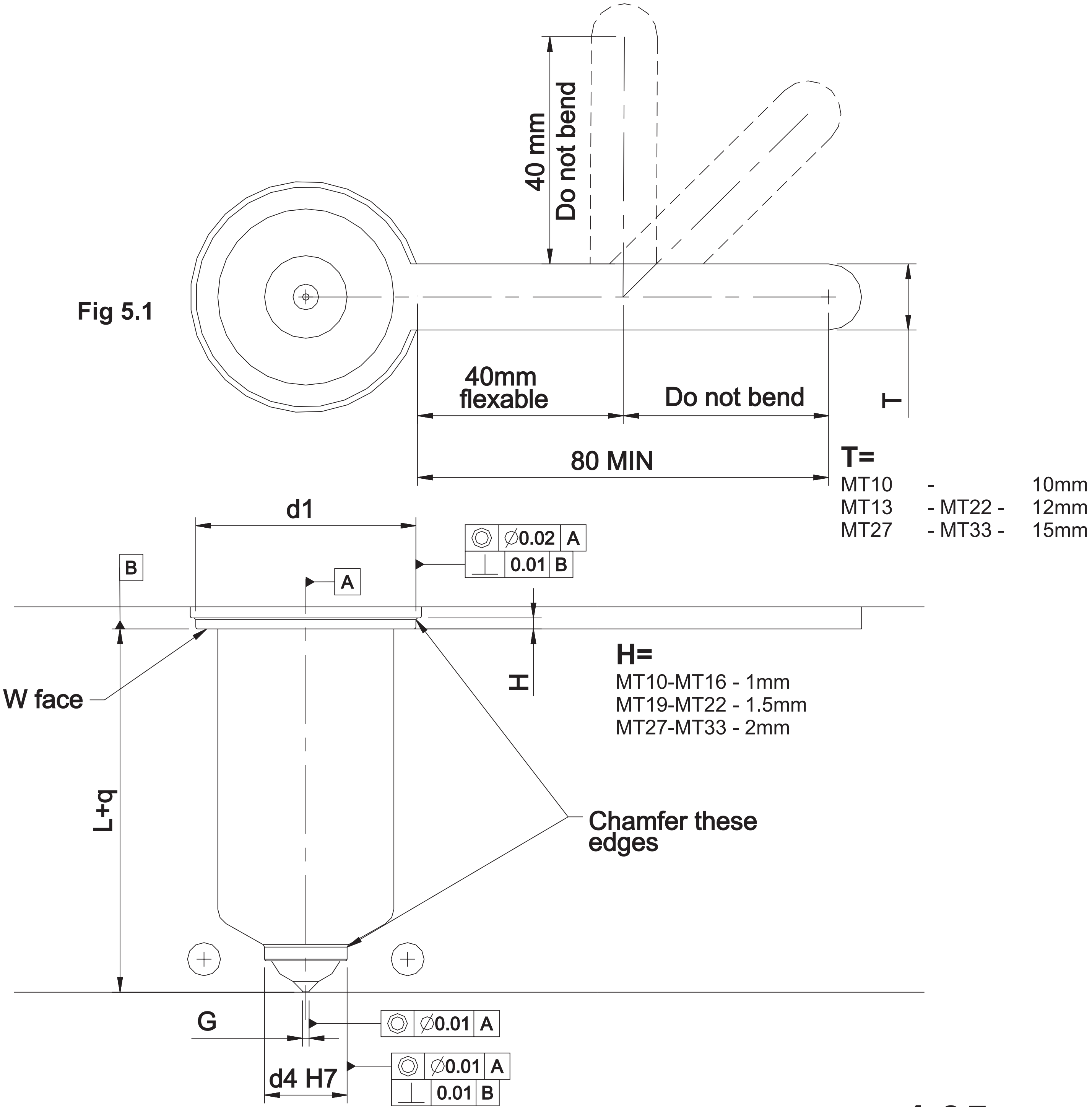


Fig 5.1

GATE DETAILS

Manufacturing Stage

- Concentricity between G and d4 is vital
- Perpendicularity between d4 and W is also vital
- Concentricity between d1 and d4 is important
- Sizing of d4 is important to prevent leaks
- Chamfer points indicated to aid fitting of the nozzle
- Machining the gate area produces better results than sparking (EDM).

Retro fitting Nozzle

- It is possible to retro fit the new MT series nozzle into the older SB series cavities with some minor modifications (figure 5.2) See pages 1.2.5-1.2.6 in nozzle catalogue for details.
- Requires special retro nut
- May require a spacer in the seat area

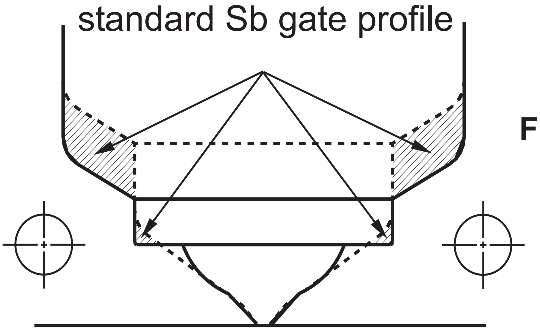


Fig 6.1

Conversion machining
detail for Sb to MTT

GATE MODIFICATIONS

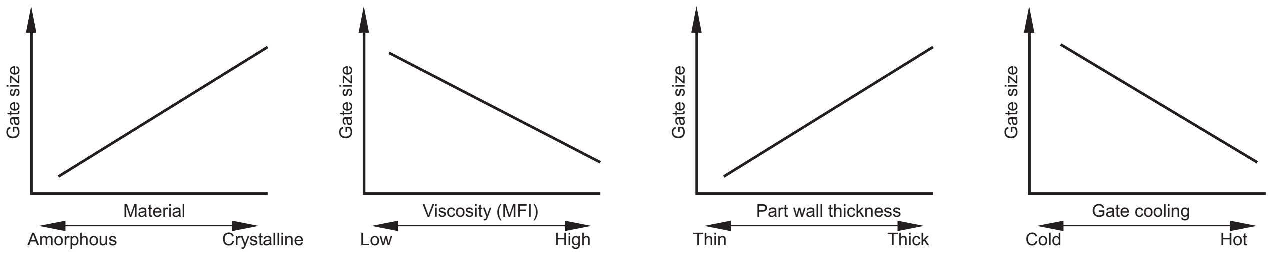
Sometimes it is desirable to enlarge the recommended gate (dimension. G) on a nozzle to increase the flow of plastic melt for a given nozzle size.

It should be noted that flow increases exponentially with the increase in gate diameter. Hence gate size should be adjusted in small increments.

MASTIP does not recommend increasing the G dimension more that 50% above the size shown in the nozzle catalogue.
If larger gate is required, a larger nozzle should be considered.

The maximum possible size for the gate is dependent on a number of variables:

- The type of plastic to be molded
- The viscosity (MFI) of the melt.
- The thickness of the wall section to be injected into.
- The amount of cooling around the gate. (Note: gate cooling is a complex variable and cycle time, gate profile and land length are also involved)



It is VITAL to maintain q at a maximum of 0.2mm for proper nozzle function.(see figure 7.1)
When the gate dimension G is enlarged the gate profile must be changed to maintain the correct land (q)
If the taper angle in the gate is not lowered (shown with dotted line) the q dimension or land length increases to q+.

This increase in land length will:

- Increase the heating effect around the gate (possibly burning the materiel)
- Restrict flow
- Cause the gate to freeze off prematurely especially when running chilled water around the gate
- Leave an enlarged gate vestige (mark)

Contact MASTIP if you require specific details for your application.

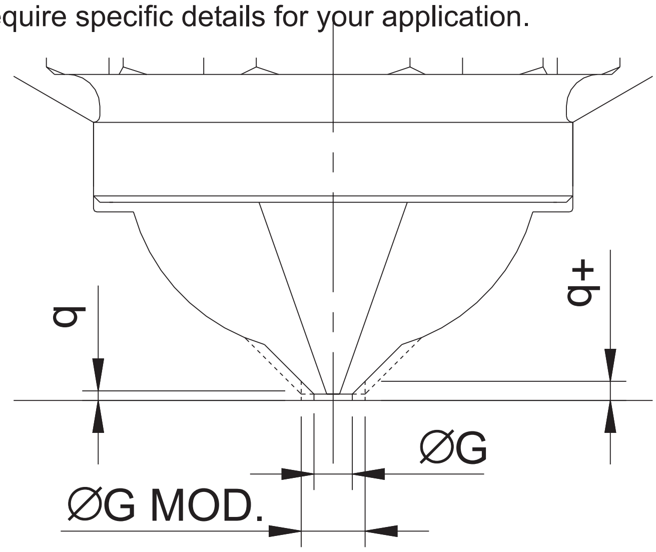


Fig 7.1

GATE MODIFICATIONS BUSH NUT

Figure 8.1 shows the best way to correct the land length (q) after an increase in gate size (G) in a bush nut. The modification is best done with a cutter and not EDM, as EDM can cause the gate to crack. Check the land length with plastercine. Contact ***MASTIP*** if you require specific details for your application.

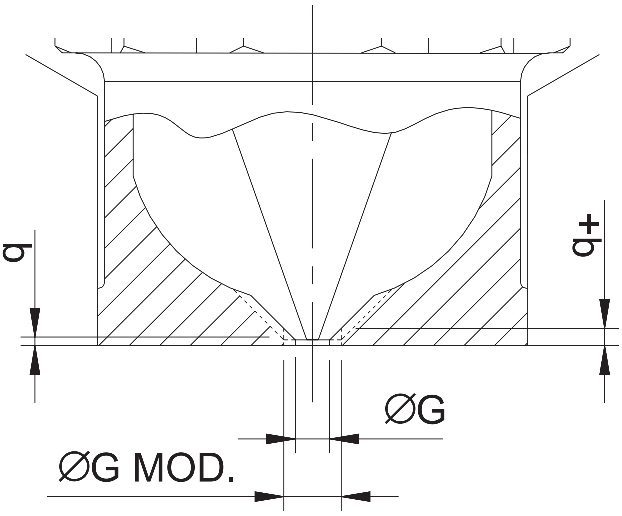


Fig 8.1

Figure 8.2 shows another method to correct the land length when G is changed. It is not the recommended method. but machining of the nut may be easier. This method will leave a raised dome on the part.
It is also possible to machine the MOD dimension off the face of the nut, but this will require re-machineing the nozzle cavity, manifold spacers heights etc.

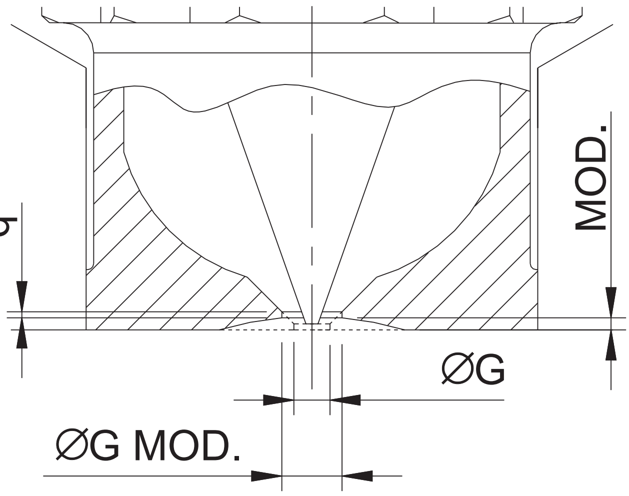


Fig 8.2

In some MTB and MTS applications sticking of plastic may occur to the front of the nut during operation. This is due to excessive heat build up in the nut perhaps because of inadequate gate cooling or a rapid cycle time.
This problem can be corrected by using the BNE or SNE nuts.
These nuts have full contact with the wall of the nozzle cavity and by machining on a rebate (H dimension) the customer can adjust the heat loss from the nut to suit. (Figure 8.3)

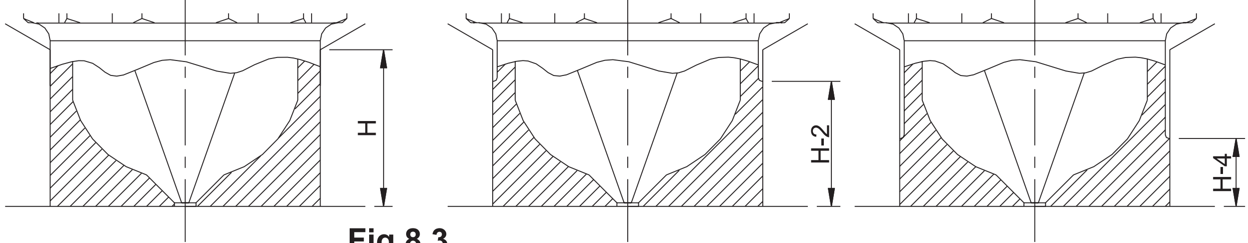
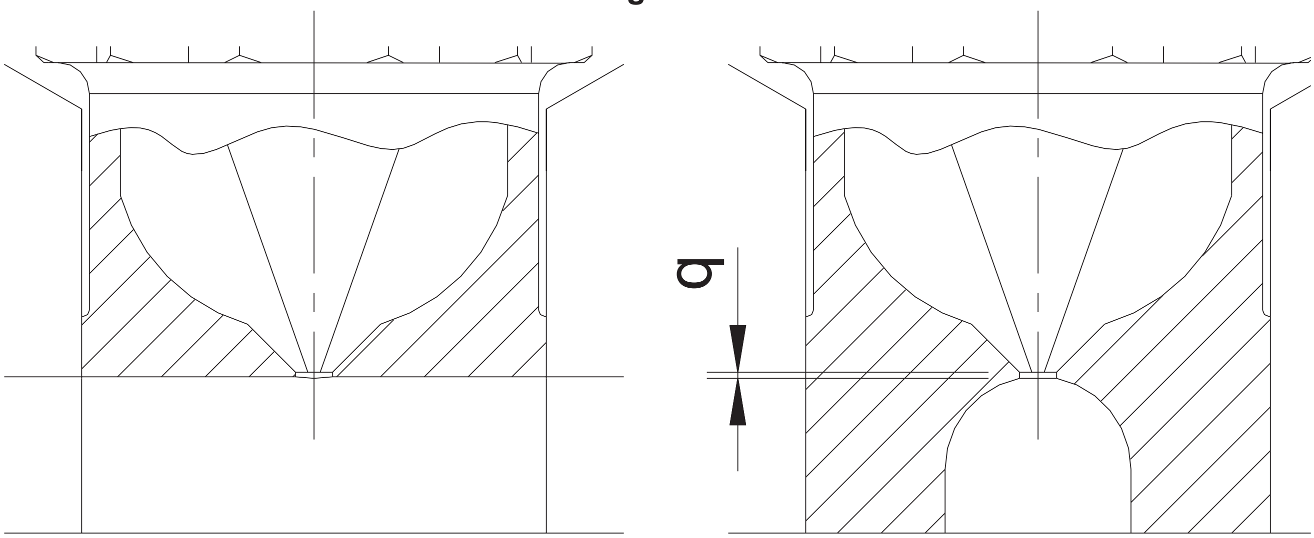


Fig 8.3

GATE MODIFICATIONS SPRUE NUT

Figure 9.1 shows an example of a modification of a MTS sprue nut gating into a cold runner. For all such modifications it is important to maintain q at 0.2mm maximum.

Fig 9.1

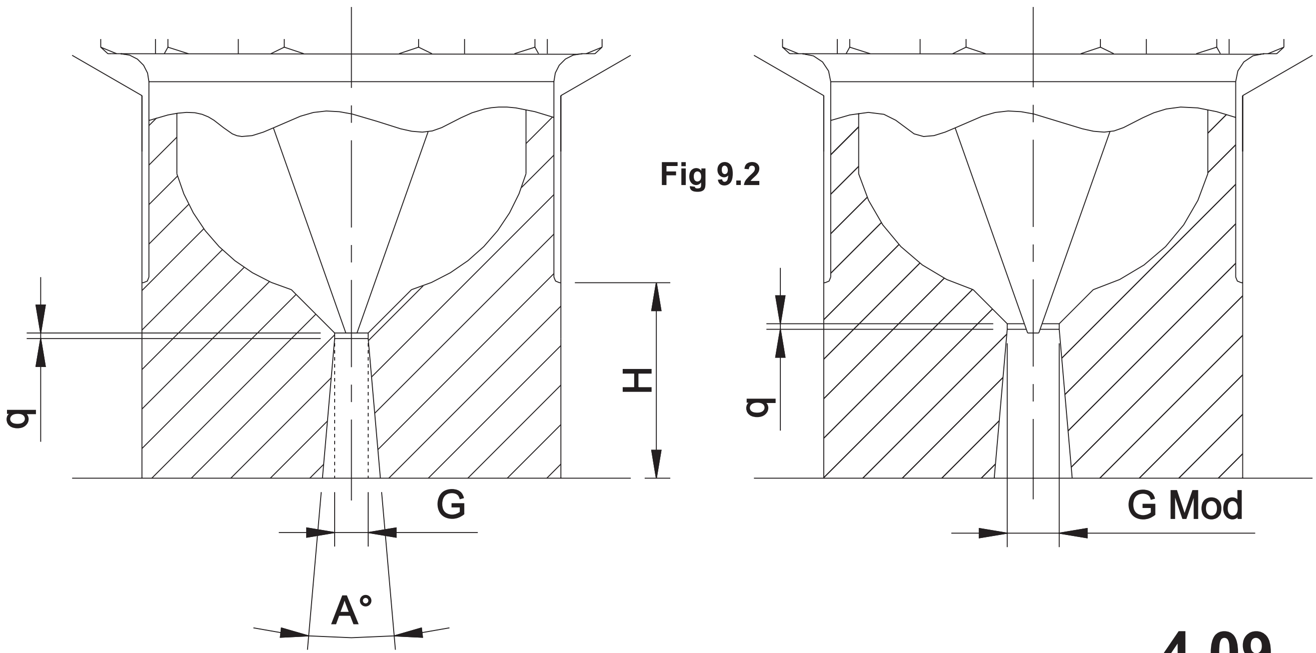


FRONT VIEW

SIDE VIEW

Figure 9.2 shows an example of an MTS sprue nut being used to extend a standard nozzle.
The MTS nut is supplied with a parallel hole in the end (shown with dotted lines), a taper **MUST** be machined in end of the sprue nut to suit the plastic to be used.
The q dimension must also be maintained at 0.2mm minimum to prevent a sharp edge forming.
When the G dimension is enlarged on a sprue nut, and a sprue is to left on the part, extra modifications are not needed. (Fig 9.2)
The MTS sprue nuts are also available in 15mm and 30mm extra long lengths
When using these lengths it is advisable to adjust the H dimension to prevent excessive heat loss from the nut and premature freeze off.

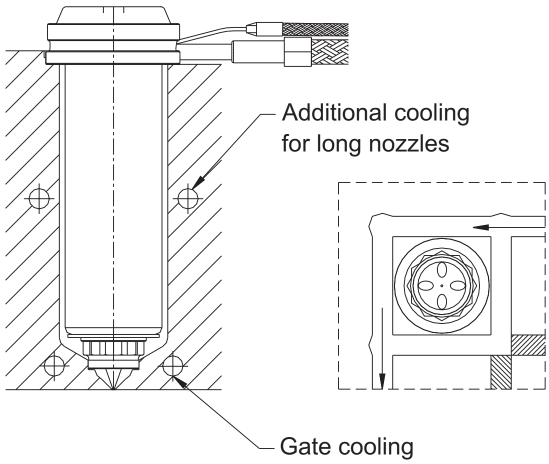
Fig 9.2



MOLD CONSTRUCTION- NOZZLE COOLING

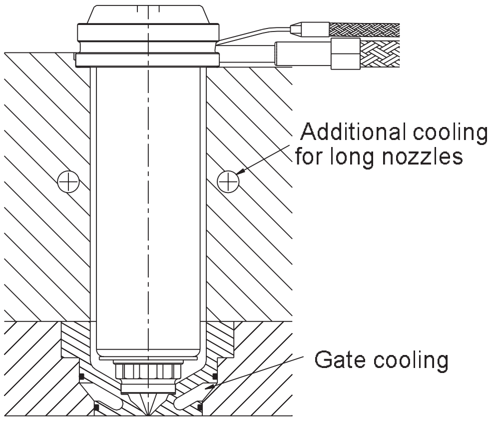
Gate cooling is vital to obtain best performance over the widest molding window. If there is insufficient cooling the gate may “drool” and longer cycle times may be needed.
Below are three approaches to gate cooling, they are shown from the easiest but least efficient, to the most complex and highest performance.
Note that for high cavity tooling or where long nozzles are used it is advisable to additional cooling as shown below.
Care should be taken when using materials such as beryllium copper around the gate cavity, as this can cause too much heat transfer and premature gate “freezing”. Use a titanium insulating ring around the d4 diameter on the nozzle, or adjust the d4 contact area to be the minimum possible to avoid problems (contact *MASTIP* for details).

ACCEPTABLE



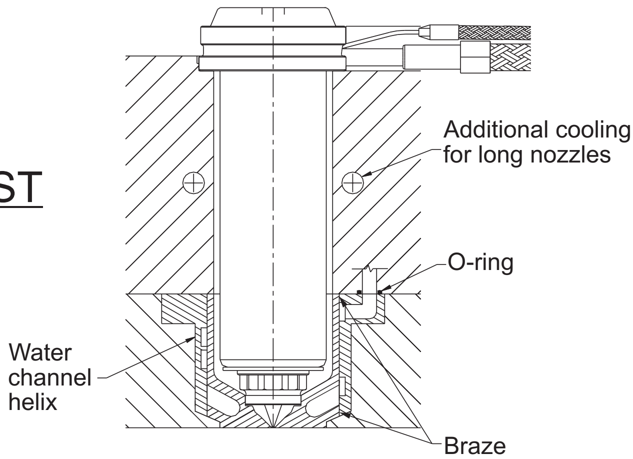
Two sets of parallel water ways drilled around the nozzle. (Can leave hot spots)

BETTER



Nozzle insert with cooling channel cut around circumference sealing of insert with O-rings. Extra nozzle retaining plate added to tool, to aid maintenance and to make inserts easier to make.

BEST



Integral cavity insert with machined water channel and no O-rings. Water feed in from split line on nozzle retaining plate

INSTALLATION

When installing a *MASTIP* Nozzle please note the following

- Nozzles should be handled carefully
- Avoid scratching or denting the ground faces
- Clean of anti rust oil with solvent
- Fit nozzles one at a time and check for correct and even clearance around the tip using "flexible putty" and for correct gate land length.
- Carefully enter the nozzle into the nozzle cavity and gently press in
- Align the wire with the wire slot before fully installing. DO NOT try and turn the nozzle by the wires. Make sure heater and thermocouple wires are not sharply bent or crushed when fitted
- For multi nozzle molds, check that the W face on all the nozzles are the same plane (+/-0.02)
- Keep nozzle contact to a minimum in areas indicated in Fig 11.1
- Do not fit the o-rings until all the nozzles have been checked for fitting height and the manifold is ready to be assembled in the mold.
- When up to heat check clearance around the tip between the tip and the gate with a piece of **soft wire** i.e. fuse wire. Their must be clearance and it must be uniform, if their is no or very little clearance (less than 0.2mm) check calculations for E value and gate size.

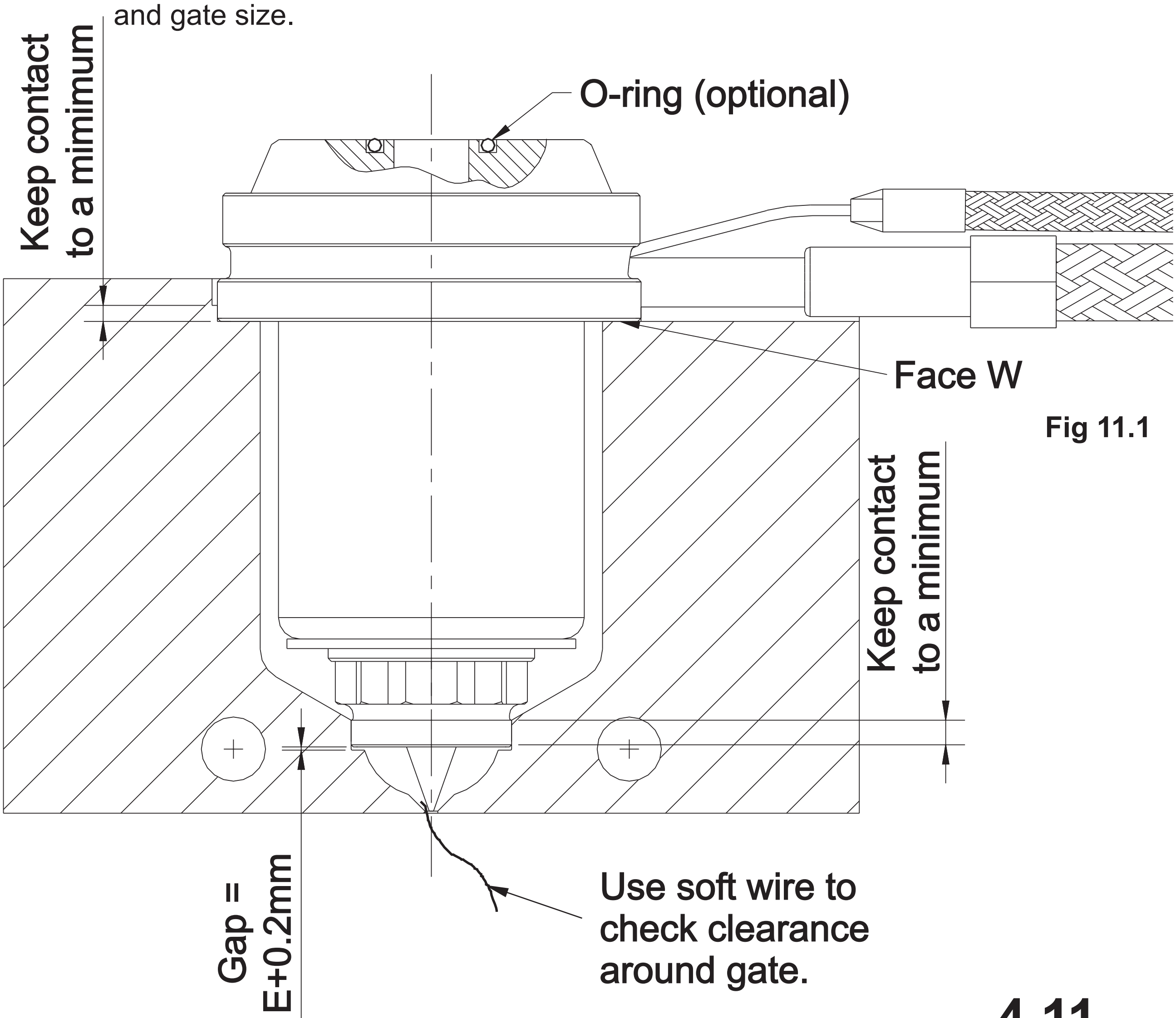


Fig 11.1

START UP AND RESTART

Starting and restarting a Hot Nozzle

1. Ensure "Soft Start" is selected on the temperature controller
2. Allow 10 minutes for the nozzle to heat up
3. Purge machine barrel before connecting to nozzle
4. Slowly bring machine nozzle up to hot nozzle to avoid damage
5. When nozzle is up to temperature you are ready to inject the mold
6. Check material comes out the gate and correct if required
7. Adjust nozzle temperature to get suitable molding (Note: nozzle will often need to run hotter than barrel temperature to achieve a good result)
8. If the machine is left idle and only a single nozzle is used, (ie no manifold) it is strongly recommended to gently purge the first shot through the MASTIP nozzle. This will clear any cool slug that may have formed near the head.

Procedure for colour change

1. Increase mold temperature by 15°C
2. Increase manifold and nozzle temperature by 50°C
3. Retract molding machine nozzle
4. Auto purge molding machine as per you standard practice
5. Hand purge using standard material
6. Re-start normal cycle - 6 shots
7. Lower manifold and nozzle temperature 20°C - 1 shot
8. Lower manifold and nozzle temperature 20°C - 1 shot
9. Lower manifold and nozzle temperature 10°C - 1 shot
10. Lower mold temperature 15°C
11. New colour is now ready

MAINTAINENCE

Heater and Thermocouple Replacement

1. Remove hot half from mold
2. Remove Locating ring that clamps hot nozzle in place
3. Remove back plate of mold, if required, to give access to nozzle head
4. Using a small jimmy bar carefully remove the nozzle, ensure thermocouple and heater wires are not trapped
5. Remove circlip and heater cover
6. Grip body by the head and remove heater by turning the heater such that the heater coils loosen and at the same time pull the heater off the body
7. Remove thermocouple
8. Check the resistance of the thermocouple with a multi meter, the resistance should be 0.0 ohms (or less).
9. When replacing the thermocouple you need to bend the end as per figure 13.1.
   To fit heater push heater as far as it will go onto the body, with bottom heater connection inline with slot on body.
11. Then turn ("Unwind") the heater as you continue to push the heater towards the head of the nozzle. **Make sure heater is fully forward on body Fig 13.1**
12. Refit the heater cover, if the cover is tight check that the heater is not partially unwound
13. Refit the circlip
14. Recheck the thermocouple resistence as per 8 above
15. Refit nozzle into the nozzle cavity in the mold, taking care not to crush the heater or thermocouple wires

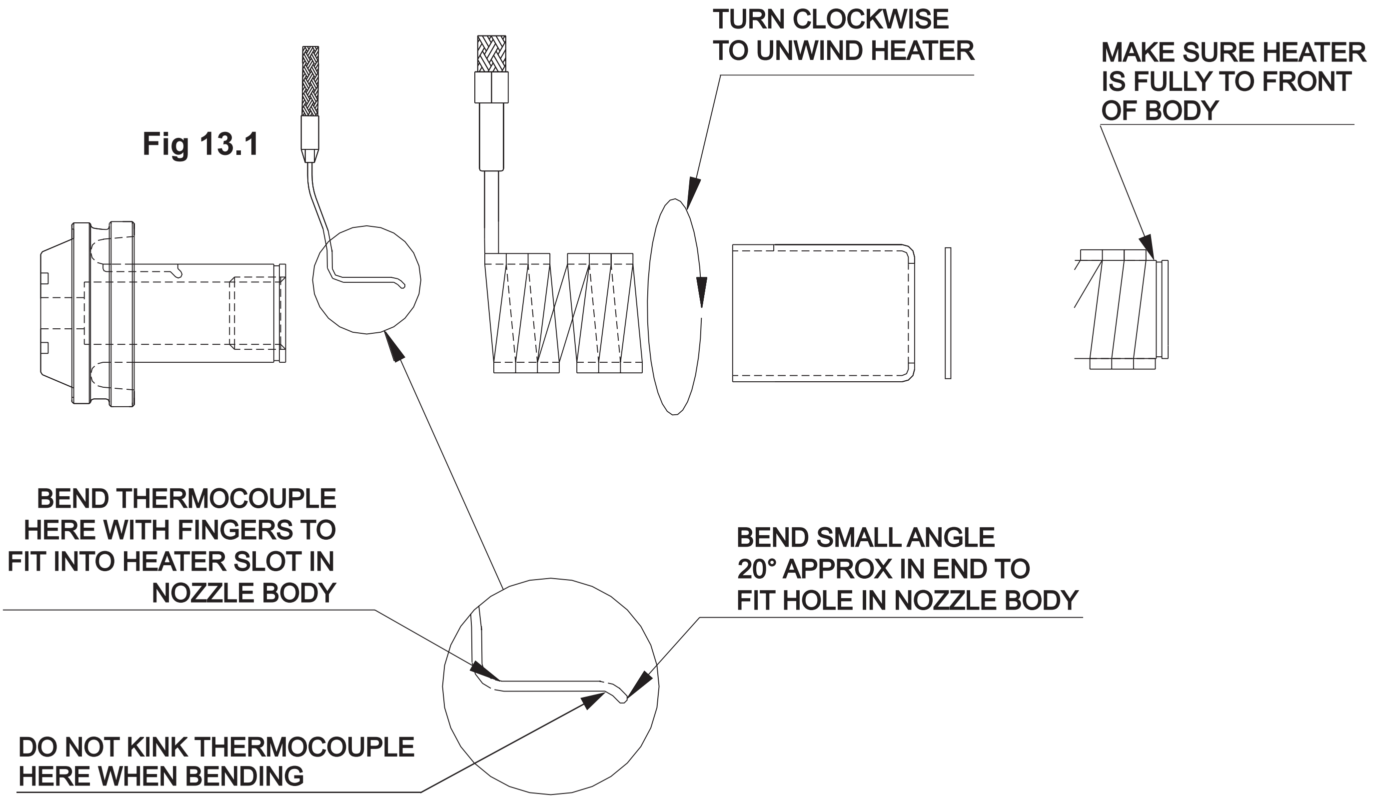


Fig 13.1

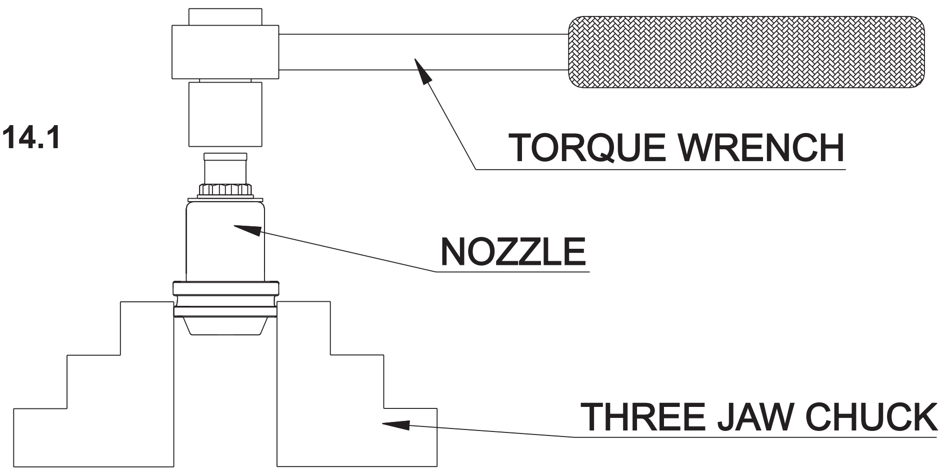
MAINTENANCE

Tip Blockage

1. Very carefully try and remove the blockage with a small piece of wire, taking care not to damage either the tip or the gate
2. If unsuccessful remove nozzle from tool.
3. Remove circlip and heater cover
4. Place body in three jaw chuck
5. Heat the nozzle up to the plastic's processing temperature.
6. Unscrew nut
7. Remove plastic from bush and tip taking care not to scratch or damage either one
8. If the blockage is a foreign body, find cause and fix the problem. DO NOT reassemble nozzle and tool until the problem is identified, as more contamination coming through the hot runner system will only cause more blockages
9. Reassemble nozzle making sure to use the correct torque setting when tightening the bush nut
10. Reassemble mold

MT NOZZLES	ASSEMBLY TORQUE REQUIREMENT	
	LB.FT	N.m
10 SERIES	10 – 12	14 - 16
13 SERIES	10 – 15	14 - 20
16 SERIES	15 – 20	20 - 27
19 SERIES	20 – 25	27 - 34
22 SERIES	20 – 30	27 - 41
27 SERIES	30 – 35	41 - 48
33 SERIES	30 – 40	41 - 54

Fig 14.1



TROUBLE SHOOTING

The following is a list of common problems and answers for hot runner systems.

Problem: **The part is not filling.**
Cause: Melt temperature too low, injection pressure to low, gate too small, nozzle too small, mold too cold, exit from machine nozzle too small, nozzle blocked
Remedy: raise nozzle and manifold temperature, raise injection pressure, enlarge gate, raise mold temperature, fit larger nozzle, enlarge hole in machine nozzle, clear blockage.

Problem: **Nozzle drooling**
Cause: Insufficient suck back, Melt temperature too high, gate too big, insufficient gate cooling, incorrect Nozzle type selected
Remedy: Increase suck back, lower nozzle and/or mold temperature, re-machine gate to fit new bush or sprue nut, contact MASTIP for correct nozzle selection.

Problem: **Nozzle not working**
Cause: Heater failure, Thermocouple failure, Nozzle blockage, Incorrect allowance for expansion of nozzle
Remedy: Check/replace heater, check/replace thermocouple, remove clean nozzle, re-machine nozzle cavity.

Problem: **Poor colour change.**
Cause: Incorrect colour change procedure, wrong type of nozzle.
Remedy: See guide for correct colour change, Contact MASTIP for correct nozzle selection.

Problem: **Excessive flash on part**.
Cause: Too high an injection pressure, temperature too high, poor shut off face flatness Insufficient clamp pressure on molding machine, tool plates flexing.
Remedy: reduce injection/pack, lower nozzle/manifold/mold temp, increase machine clamp force, change tool.

Problem: **Burn marks/streaks on part or near gate.**
Cause: Not enough venting in tool, injection speed too high, gate profile incorrect, material not dry
Remedy: Add more venting, lower injection speed, increase “J” dimension on gate profile, dry material.

Problem: **Excessive tip wear in nozzles when using plastics with high glass fill content.**
Cause: Tip material too soft for application
Remedy: Change to MASTIP Carbide tips

Problem: **Gate vestige too large.**
Cause: Gate too large, incorrect nozzle selection, gate profile machined incorrectly
Remedy: Fit bush/sprue nut to reduce gate, Contact MASTIP for correct nozzle selection, check gate machining profile

Problem: **Gate freezing off too soon, or during cycle.**
Cause: Melt too cold, gate too small for material being used, excessive cooling around gate, too much contact between nozzle and mold, gate profile incorrect or incorrect type.
Remedy: Raise nozzle temperature, raise mold temperature around gate, check machining of nozzle cavity and make sure contact is at a minimum, check machining of gate profile and change if needed.

Problem: **Flow lines on large flat part**
Cause: Incorrect nozzle type
Remedy: Use MIT or MOT nozzles.

Problem: **Bloom on part opposite gate**
Cause: Mold too cold, melt too cold, cold slug in part
Remedy: Raise mold temperature, raise melt temperature, use MOT nozzle.

Problem: **Cold slug in part**
Cause: Wrong nozzle selection, head of nozzle too cold.
Remedy: Contact MASTIP for correct nozzle selection, machine cold slug trap opposite gate, insure contact area on nozzle head is minimum.

Problem: **Intermittent blockage caused by cold slug, tip fails by trying to extrude through nut**
Cause: Too much head loss through nozzle head.
Remedy: Reduce head contact to a minimum.

Problem: **Plastic sticking to front of bush nut or sprue nut.**
Cause: Not enough contact between nut and mold to dissipate heat.
Remedy: Use BNE/SNE type nut with increased contact area to dissipate heat.

MANIFOLDS

MANIFOLD DESIGN GUIDELINES

BASIC DESIGN STEPS / MANIFOLD SELECTION

- Estimate weight of part and material to be used based on design specification.
- Identify location of gate and suitable gate type.
  This is dependent on:
  - cosmetic appearance
  - wall sections,
  - dimensional stability.
- Identify suitable nozzle series noting above factors
  - Colour change importance
  - Thin walled part or long flow lengths (Increase nozzle size one or two sizes)
  - Abrasive material (special tips, gate inserts etc)
  - Fast cycle times needed (more gate cooling)
  - No flow marks acceptable (MIT or MOT tip)
  - Visible part surface must be perfect (valve gate)
- Calculate number of parts moldable in tool based on:
  - machine shot size
  - clamp tonnage
  - machine plattern size
  - minimum distance between nozzles.
- Lay out the drops so that the manifold is as symmetrical as possible (fig 17.1), as per the manifold catalogue.
  Non-symmetrical manifolds are harder to balance and more expensive to design.
  Consider all variables of manifold such as:
  - Overall height.
  - Heater exit, thermocouple connections, and associated wiring
  - Gate cooling and back plate cooling
  - Provision for extra split line for maintenance
  - Extra height in tool if valve gating is used
  - Allow minimum 10mm air gap all round manifold.
- Select standard manifolds with relevant dimensions and option details from catalogue, or contact ***MASTIP*** for custom design.

If you have any questions do not hesitate to contact ***MASTIP.***

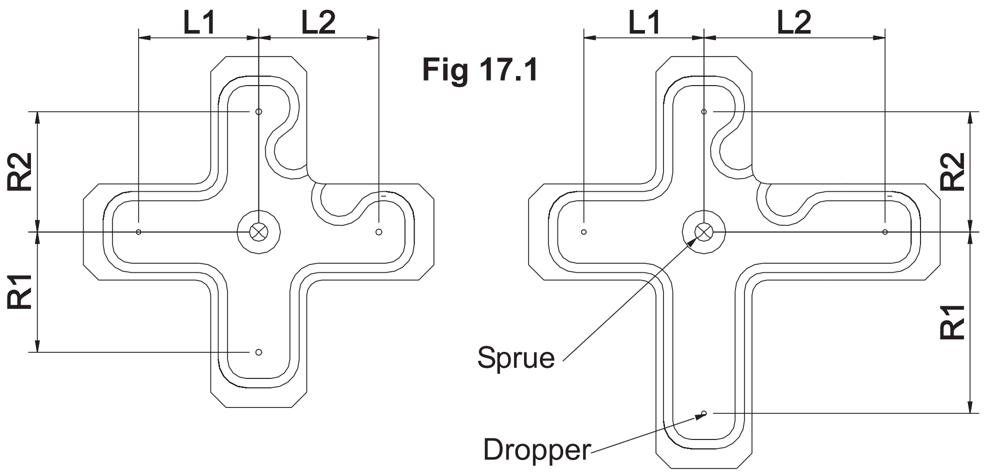


Fig 17.1

Good manifold layout
All runners equal length giving balanced design

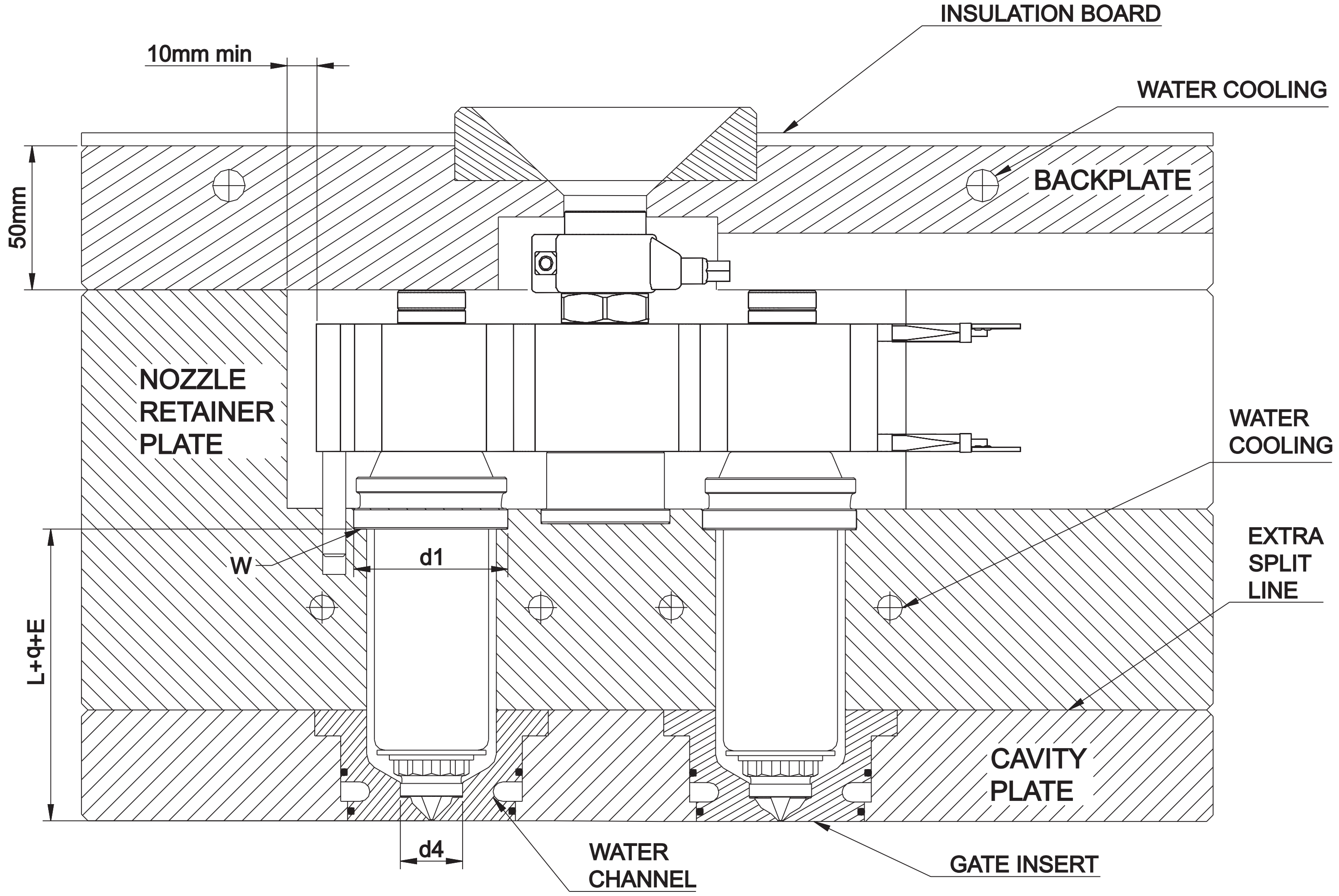
Poor manifold layout
Runners un-equal length giving unbalanced design. Extra work is required to balance

TOOL/MANIFOLD DESIGN FEATURES

Design guidelines for High Production /Long Life Tooling

- Use thick nozzle cavity plate with longer nozzles for better rigidity and longevity. Make provisions for extra water cooling in middle of plate around nozzles.
- Machine manifold pocket from one piece of solid tool steel, add provision for water-cooling.
- Use thick back plates (Minimum 50mm thick).
- Provide adequate manifold clamping between backplate and nozzle cavity plates to ensure sealing between manifold and nozzles, ***MASTIP*** recommends three bolts per drop with a minimum of two bolts per drop as close to manifold as possible. (see page 4.20).
- Accurately machine and assemble the nozzle seating (W face and d1 area), nozzle nut seating (d4 area) and maintain correct L and E values (see page 1.5.1)
- Use insulation board between platen and back plate.
- Use water cooled gate inserts with cooling right around the insert. (page 4.10)
- Use extra split line to allow clearing of nozzle blockages at gate without having to strip down hot half.
- Make sure wiring is not exposed to the direct heat of the manifold, use aluminum shields over the wiring troughs if needed.

Fig 18.1



MOLD CONSTRUCTION

TYPICAL LAYOUT: This is the most common and basic layout for the fixed cavity side of a Hot Runner tool, the back plate and bolsters are separate, and there is no extra split line for maintenance.

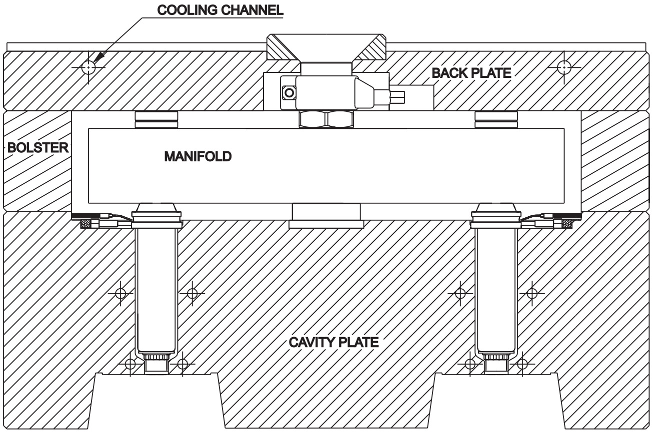


Fig 19.1

MANIFOLD POCKET LAYOUT: In this layout a pocket is machined for the hot runner manifold in the cavity plate. This makes the tool stronger and assembly and dis-assembly of the tool easier.

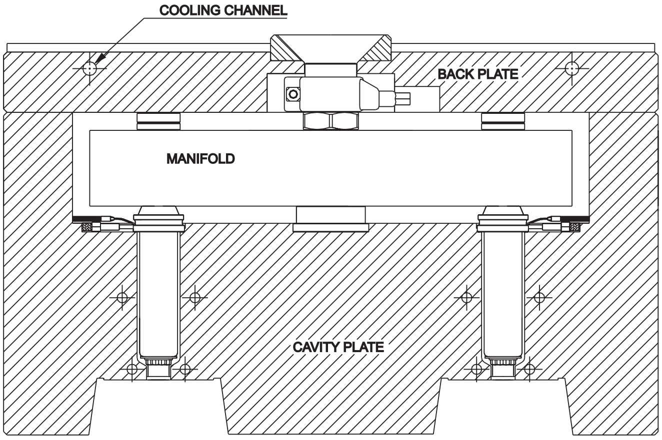


Fig 19.2

HOT HALF LAYOUT This layout has an extra split line which makes nozzle servicing easier. The entire hot runner system including wiring etc is now removable as a unit. ***MASTIP*** can manufacture hot halves to order.

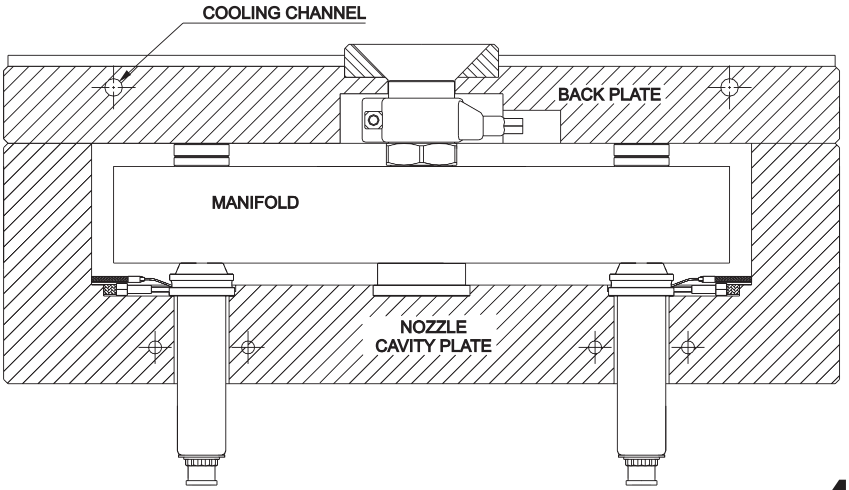


Fig 19.3

MOLD CONSTRUCTION - CLAMPING

- The nozzle cavity plate of the mold must have a cavity cut in it to allow for the hot runner system. It must have at least 10mm clearance all around.
- Keep clamping bolts as close as possible to manifold to ensure good sealing. ***MASTIP*** recommends three bolts per drop on a PCD (PCD size should be determined from details in manifold catalogue on the relevant manifold page) two bolts per drop is the minimum.
- Keep bolts as close as possible to manifold but do not expose to direct heat form manifold.

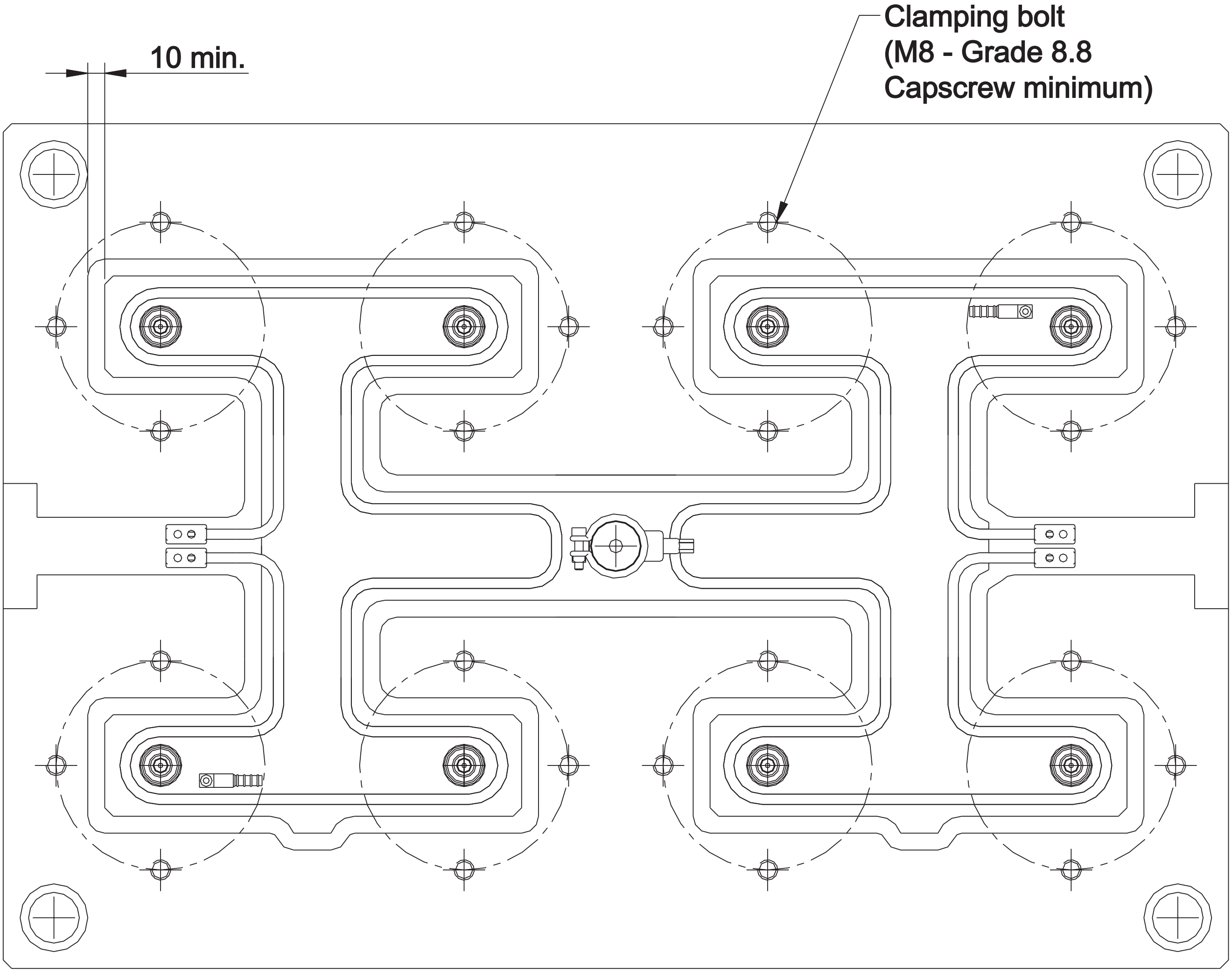


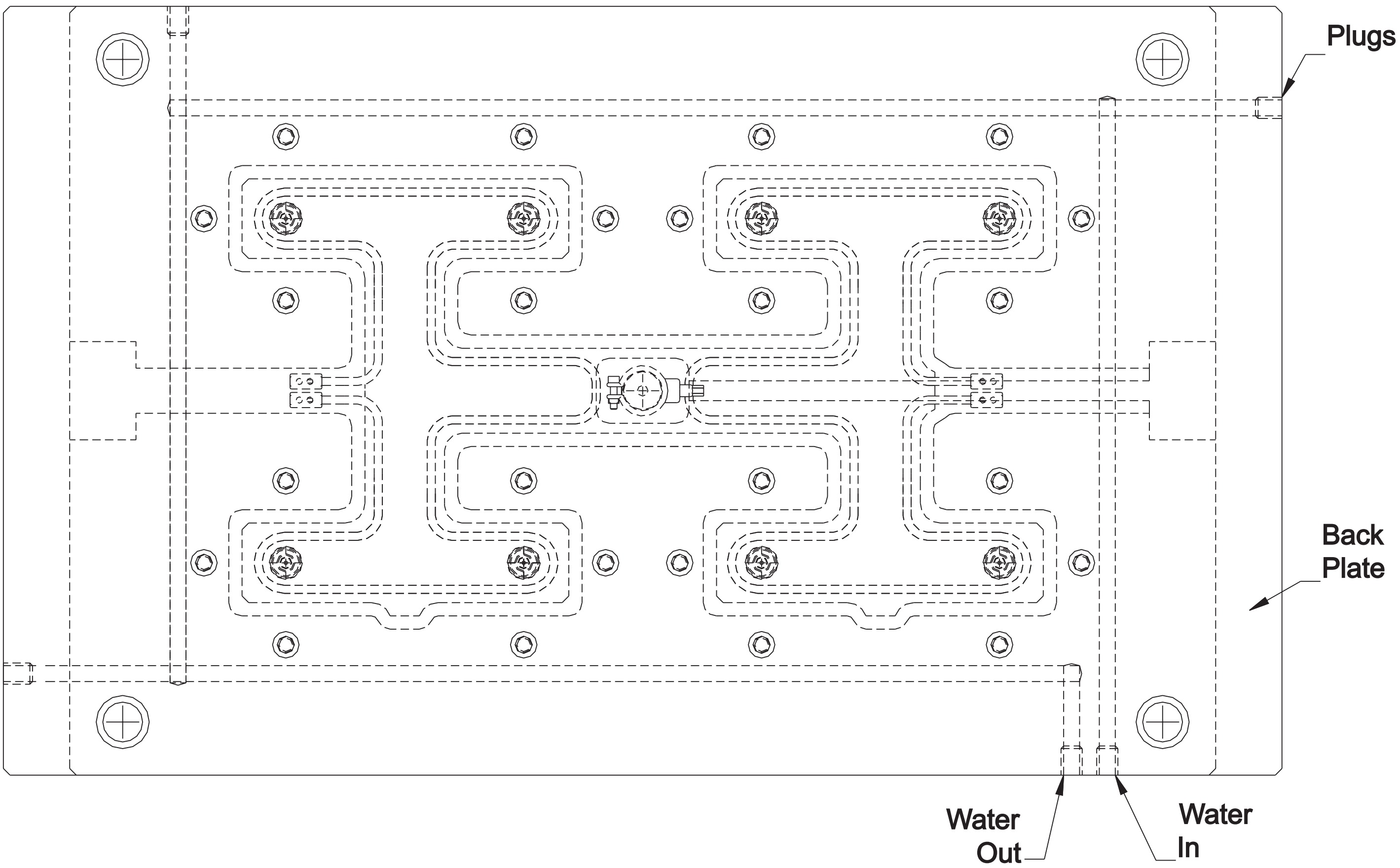
Fig 20.1

MOLD CONSTRUCTION - BACK PLATE COOLING

Mold cooling for the back plate is important due to the large amount of heat that can build up in the back of the tool.
This heat can transfer into the molding machine and cause accuracy and mechanical problems.
Fig 21.1 shows typical cooling channels in the back plate of the tool.

- One circuit in the back of the tool should be sufficient.
- Make sure the cooling channels are not to close to the manifold spacers, as this can affect the manifold performance.
- When using valve gates supply cooling around the cylinders to improve seal life.
- Use a thermal insulation board between back of mold and machine platen to reduce heat transfer.

Fig 21.1



MOLD CONSTRUCTION - WIRING

Figure 22.1 shows a cutaway view of a 8 drop manifold cavity plate, to illustrate how the wiring grooves for the nozzles are best set up

Key points:

1. The wiring slots for the nozzles must be of sufficient size, see nozzle catalogue. Especially note the length required to accommodate the nozzle heater ferules. If there is insufficient room the heaters may be bent. See Fig 22.1
2. Where the wiring troughs meet, allow for a larger slot to accommodate the bundled mass of wires.
3. Provision should be made to clamp the wires in place, as loose wiring can come in contact with the hot manifold and be damaged by the manifold heat. See Fig 22.2
4. For maximum life and reliability, or where running temperatures for the manifold are above 260°C an aluminum shield should be used that covers the wiring trough to protect the wires from the heat. See Fig 22.1
5. Make sure their are no sharp edges to damage the nozzle wires, and that the wires are not crushed.
6. Allow a cutout for mounting box
7 Never rotate the nozzle by the heater or thermocouple wires

Fig 22.1

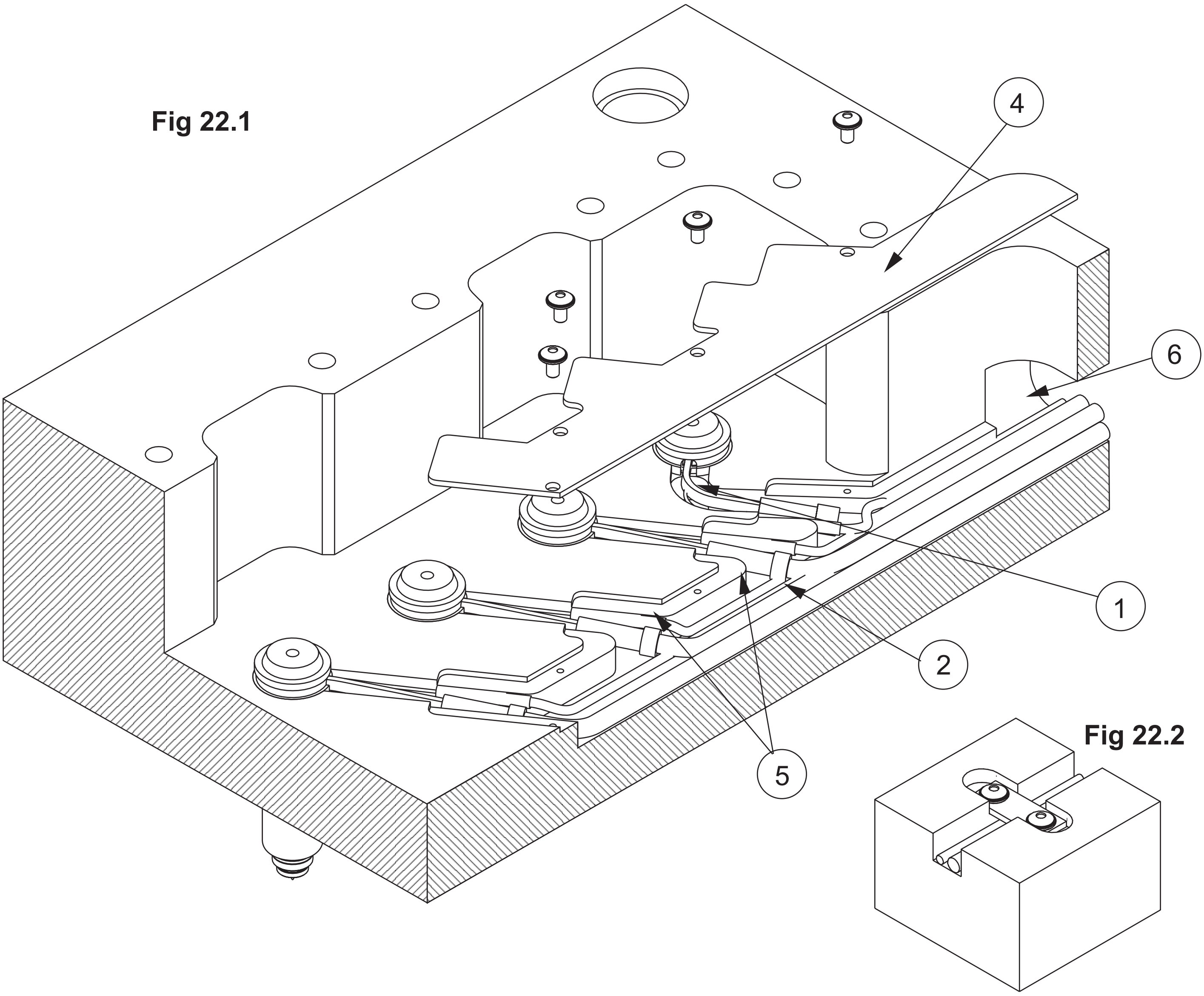
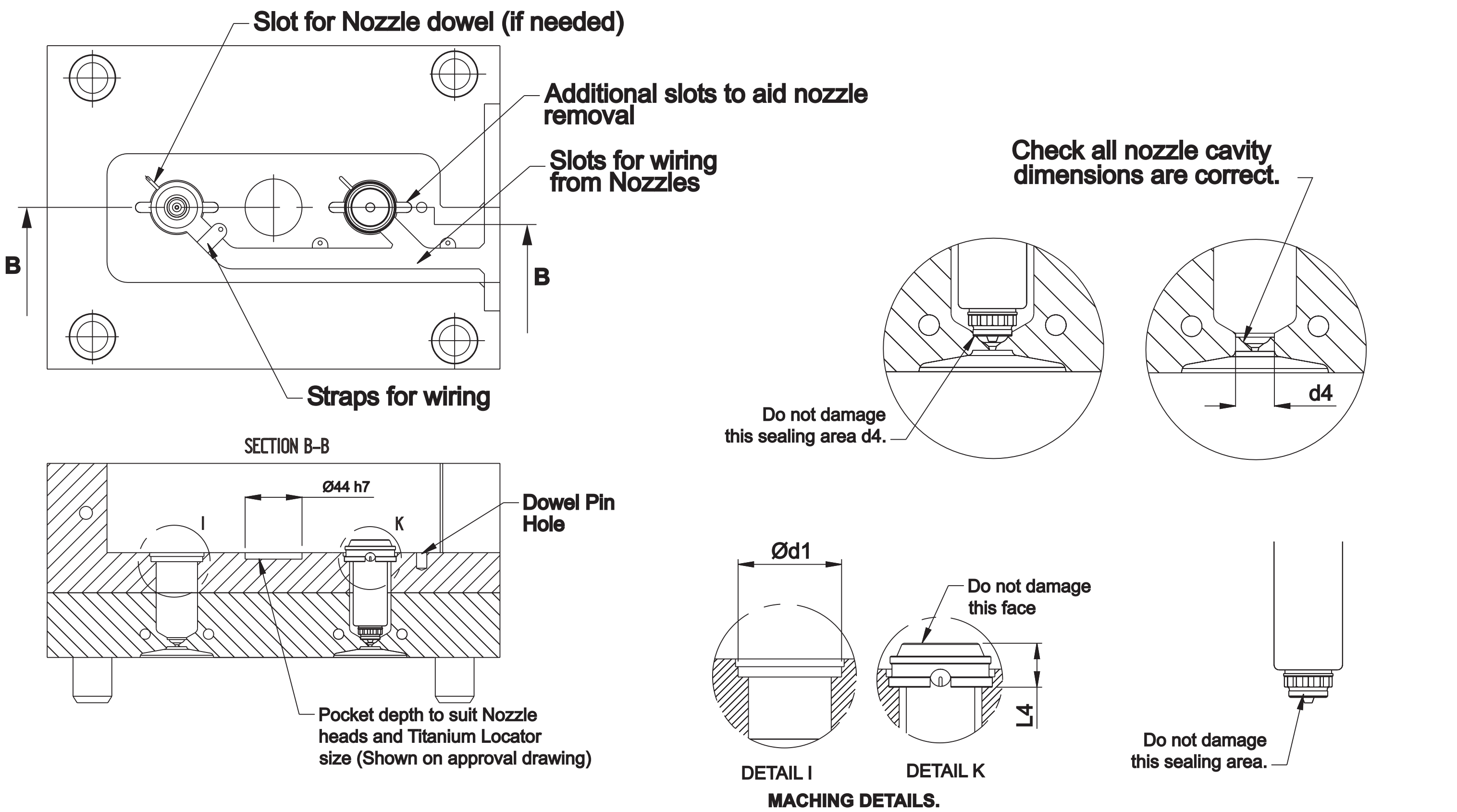


Fig 22.2

INSTALLATION

Fitting *MASTIP* nozzles

- ***Mastip*** nozzle's should be handled carefully without damaging the nozzle tip or seal off area (d4). Any scratches in the seal off area could result in leaking during the injection cycle.
- Clean the protective oil off nozzles with solvent before fitting.
- Check nozzle cavity dimensions to ensure all sizes and tolerances are correct.
- Make sure that contact between nozzles and mold cavity is minimal in order to reduce heat loss.
- Introduce the nozzle into cavity until it is in contact with bottom seal off area (d4) and then gently press the nozzle to the pocket. Never use excessive force.
- Fit the nozzles one at a time, then check the heights to the tops of the back faces, they should all be equal to within 0.02mm (L4)
- Check clearance around the tip by using "flexible Putty" on top of the nozzle tip. Fit the nozzle into the nozzle cavity, remove the nozzle, and measure the clearance between the end of the tip and the gate, it should be equal all around. Remove the Putty.
- For MT22 to MT33 series nozzles where dowels are to be used, additional slots may be added opposite each other around the nozzle head to facilitate easy nozzle removal from the cavity with the assistance of two die levers
- Be careful with the wire slots, they must be in line with the nozzle wires and the slot in the nozzle head otherwise damage to the wires or thermocouple could occur. In addition take care not to excessively bend the heater or thermocouple wires as they exit the nozzle as this would damage them. Do not twist the nozzles by the wires (see **MASTIP** catalogue for details)



INSTALLATION

FITTING THE MANIFOLD.

- To ensure there is proper expansion allowance between the manifold and the mold, so the nozzles will seal correctly follow this procedure
  - Measure the overall heights of manifold, the steel and titanium spacers plus L4 on the nozzle
  - Then measure the height of the space the manifold and nozzles will sit in. I.e. the height from face W to the backplate.
  - NOTE: The height of the steel and titanium spacer will measure more than is shown on the ***MASTIP*** approval drawing because the steel spacer has a 0.3mm grinding allowance.
  - At operating temperature there should be 0.05mm interference between the manifold titanium spacer and the mold back plate. This is adjusted by grinding the steel spacer.

To calculate the correct amount to grind of the spacers follow this example:

Nozzle = MTT16036 (L4=15.00mm)
Manifold height = 44.00mm
Titanium spacer = 6.5mm
Steel spacer = 5.3mm
Depth from face W to backplate = 70.50 (11.5mm +44.00mm +15.00mm)
Nozzle and manifold temperature = 230°C
Mold temperature = 40°C

E=(15.00mm+44.00mm+11.5mm) x 0.0000132 x (230°C-40°C) = 0.2mm
70.5mm + 0.05mm (interference) = 70.55mm
70.55mm-0.2mm = 70.35mm

Cold height of L4+manifold block height + spacers = 70.35mm
Supplied height = 15.00mm+44.00mm+5.3mm+6.5mm= 70.80mm

70.80mm - 70.35mm =0.45mm
So grind 0.45mm off the **STEEL SPACER** to achieve correct height.

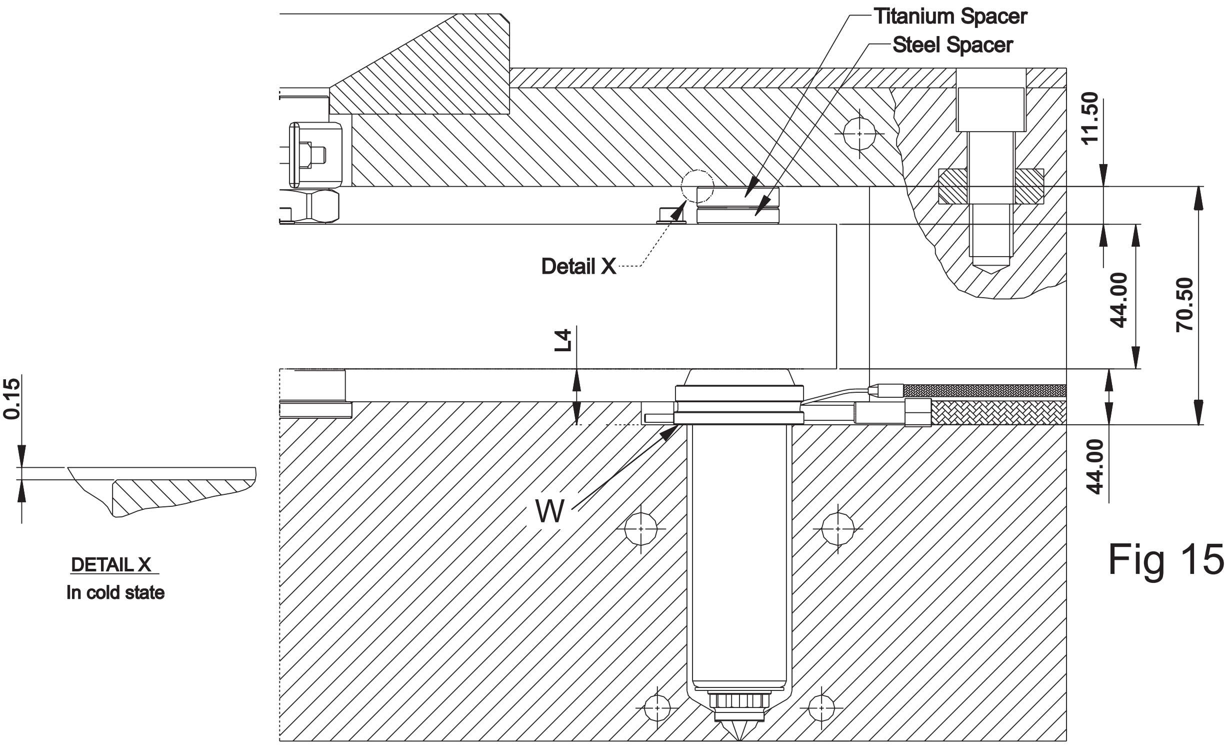
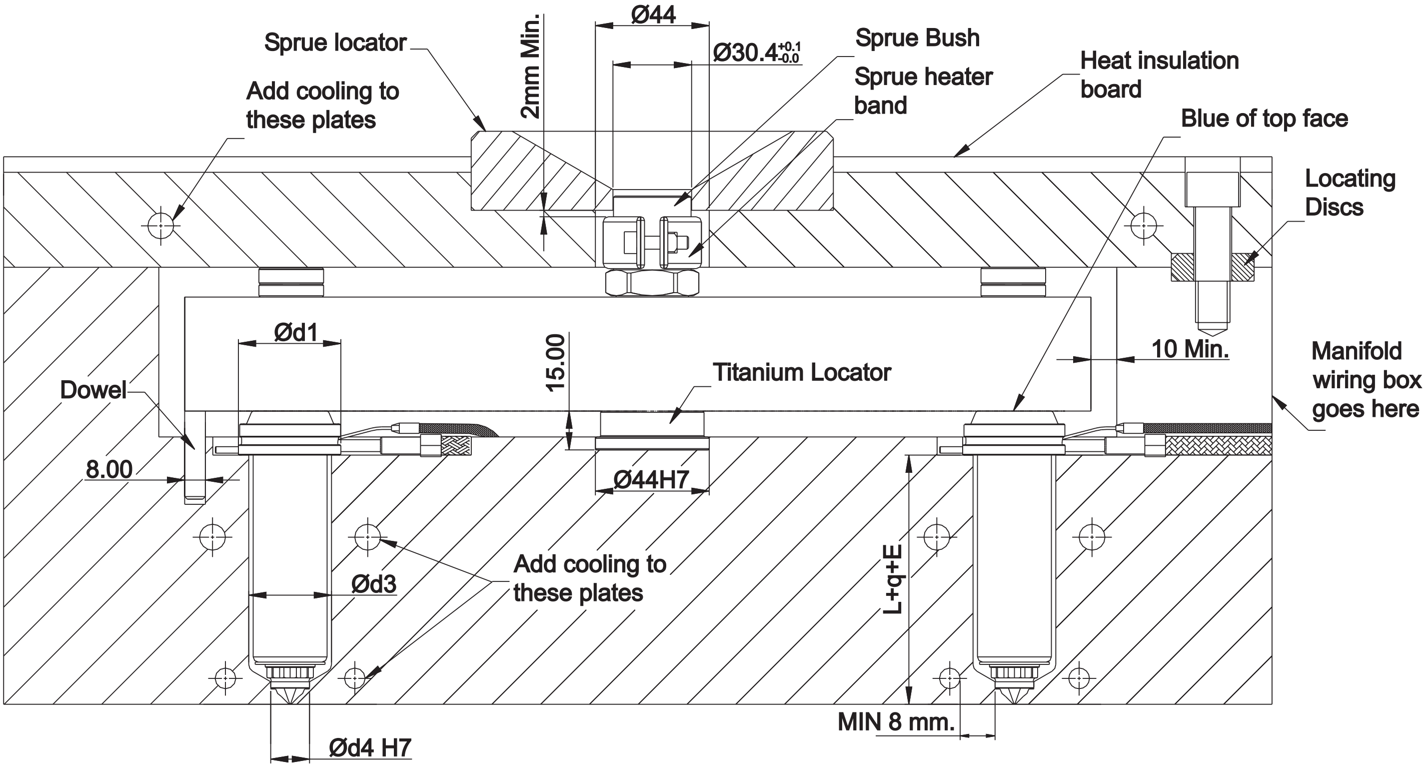


Fig 15.1

INSTALLATION

FITTING THE MANIFOLD.

- Fit the titanium locator and dowel pin and line up manifold. Mark out and drill and tap fixing holes for ears if needed. Note if hole in ear is 12mm, use M8 - Grade 8.8 bolt with hardened washer.
- Always make sure all threads have a smear of anti-seize grease to aid in disassembly. Note that the ears are an assembly aid only, they are not intended to hold the manifold against the nozzle and so replace the spacers, so do not over tighten as this could cause bolt failure when the manifold is heated.
- Use locators to maintain alignment between back plate and the nozzle cavity plate. See figure below.
- Make sure suitable wiring channels are provided for the nozzles, thermocouples and manifold heaters. Wiring should be directed to a terminal box usually on the non-operator side, on the top of the mold, and no wires should be crushed or excessively bent. Make sure all wiring is secure with clips or an aluminum cover.
- Clean down the manifold with solvent before assembly to remove protective oils.
- Bearing blue the top of the nozzle faces, fit the manifold and check all the nozzles are in full contact with the manifold surface.
- Assemble the ‘o’ ring to the nozzles.(if used)
- Tighten ear hold down bolts (if used). To allow for heat expansion always use a belleview type washer.
- Check clearance between clamp plate and sprue bush heater. Make sure their is no contact. Check that the locator ring for the mold does not have too much clearance around top of sprue, 0.4mm is enough.
- Wire up the manifold and heaters and thermocouples and perform the final check.(Care should be taken to prevent any fatal shock caused while wiring. This procedure should only be carried out by someone with correct training in electrical equipment).
- Note: Moldmakers should carefully inspect all stack heights, nozzle and manifold dimensions against ***MASTIP*** hot runner production drawings. Contact ***MASTIP*** about any questions BEFORE assembly.



START UP & RESTART

Starting and restarting a Hot Nozzle and manifold

1. Ensure "Soft Start" is selected on the temperature controller for both.
2. Allow 20-30 minutes for the system to heat up (depending on size)
3. Purge machine barrel before connecting to manifold sprue
4. Slowly bring machine nozzle up to sprue to avoid damage
5. When system is up to temperature you are ready to inject the mold
6. Check material comes out the gate and correct if required
7. Adjust nozzle temperature to get suitable molding (Note: nozzle will often need to run hotter than barrel temperature to achieve a good result) Manifold temperature should remain constant.
8. If mold is left idle and needs to be restarted, raise nozzle temperatures to make gates “live” again, **do not** increase manifold temperature by a large amounts as large increases of temperature above the design figures can damage the sealing faces of the manifold and nozzle due to excessive expansion.

MAINTAINENCE

MANIFOLDS:

When properly installed ***MASTIP*** manifolds will operate trouble free. If a problem occurs it is usually due to heater or thermocouple failure or melt contamination.

HEATER/THERMOCOUPLE FAILURE

- Let the tool cool down
- Disassemble the hot half taking care when un-torqueing, not to bow or distort manifold.
- Undo screws holding in the heater and remove heater.
- Replacement heaters come with manifold, for extra spares contact ***MASTIP*** and have the manifold's approval drawing or A---- number ready.
- New heater should be installed in groove with the use of a soft hammer. **Do not use excessive force**. Take care when installing new heater not to bend or distort the element as this will damage the heater.
- Test heater insulation then reassemble hot half.

CLEANING OUT RUNNERS

- To clean out the runners, let tool cool and disassemble.
- Remove end plug grub screws, (Note it may be necessary to heat manifold to loosen screws if they are stuck).
- Before you can extract the end plugs you must remove the M4 grub screws which lock the end plugs in place. This is normally located on the top of the manifold, but may be at the bottom of the heater groove, in which case you will need to remove the heater as well. You will need to use a puller to extract the end plugs.
- Then heat the manifold to the BOTTOM range of its processing temperature and using a hot wire with a hook on the end, try to hook out the melt just as the outer layer of plastic melts in the runner. **Take extreme care not to scratch bores.**
- If this is not successful, heat the manifold to full operating temperature and allow to soak for 20-30 minutes and use a tight fitting rod of soft material e.g. Aluminum to push out the plastic from the runners.
- If the manifold has deviation plugs, contact ***MASTIP*** before attempting disassembly.
- Do not under any circumstances attempt to blow out hot plastic with an air gun.
- Carefully refit end plugs, making sure alignment of end radii is correct, apply anti seize to threads on set screws.
- Torque to figures in manifold catalogue.
- Refit manifold.

TROUBLE SHOOTING

The following is a list of common problems and answers for hot runner systems.

Problem:	**Manifold will not come up to temperature.**
Cause:	Thermocouple is loose, thermocouple is faulty, heater is shorted, heater wiring is loose or shorted.
Remedy:	Check thermocouple is tight and functions correctly, check heater circuit.
Problem:	**Manifold slow to heat up**
Cause:	One heater shorted or wiring is loose, insufficient manifold air gap, too much cooling above spacers, thermocouple is loose
Remedy:	Check both heaters, increase air gap to 10mm min or use insulation board, Add insulation board to back plate or reduce coolant flow to backplate, check thermocouple.
Problem:	**Manifold temperature not stable**
Cause:	Thermocouple is loose
Remedy:	Check thermocouple
Problem:	**Metal contamination in melt**
Cause:	Debris for machine screw, debris from plastic material
Remedy:	Check purge for metal particle and repair machine screw, Check plastic for contamination
Problem:	**Manifold leaks from nozzle faces**
Cause:	Incorrect allowance for temperature expansion, machining of W face heights inconsistent, backplate material too soft, manifold run at very high temperature for short time, O-ring installation faulty
Remedy:	Recheck calculations and correct, check and correct W face heights, change backplate, check for damage and replace damaged or crushed parts, replace O-rings.
Problem:	**Manifold leaks from deviation plug**
Cause:	No spacer fitted
Remedy:	Fit spacer

VALVE GATES

GATE DETAILS

Why use a valve gate?

Advantages of using a valve gate

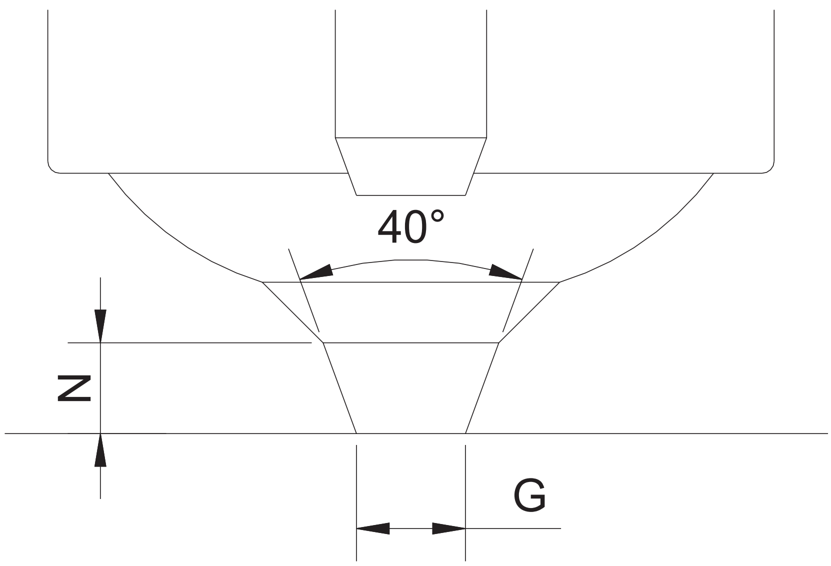
- Less pressure to fill part due to larger gate size.
- Part will fill faster, and so cycle time may be reduced
- No protruding gate mark or vestige
- No possibility of gate drool
- No cold slug from thermal gate
- Control of gate shut off determined by molder, not by gate design or cooling etc
- Sequential or independent control of multiple gates is possible
- Insensitivity to changes in materials

Dis-advantages

- Cost
- Extra height and size in tooling
- Extra complexity due to actuators and control systems
- Pin will leave small ring in part
- Plastic can stick to larger pins, marking part

Gate details for MASTIP valve gate systems.

- Gate profiles incorporate a 40° included taper in the front of the gate to seal and align the pin.
- The end user must machine this taper on the supplied pins.
- The gate profile in tool should be a hardened insert, to allow for action of the pin on gate taper.
- MASTIP standard gates and valve gate profiles are not interchangeable (ie you can not machine 40° taper into an existing MTT gate and fit a valve gate system).
- The G diameter of the gate should only be changed in if absolutely necessary. If G is changed make sure there will still be enough contact on the N dimension to support the taper.

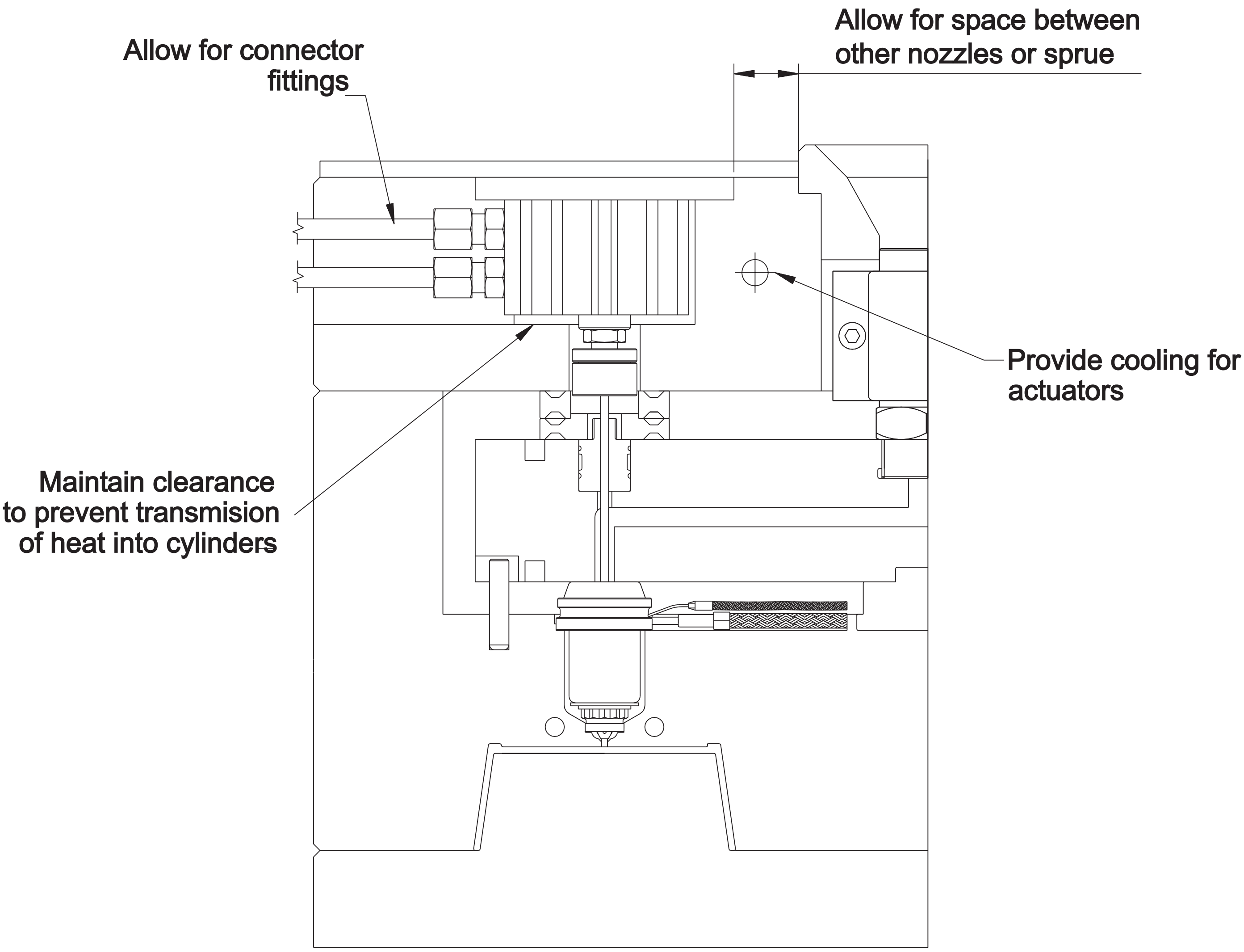


MOLD CONSTRUCTION

Where valve gateing is required there are several extra variables to consider.

- Extra thickness must be allowed in the back plate for mounting the actuators.
- Allowance must be made for pneumatic / hydraulic feeds to actuators.(fittings, piping, etc)
- Distance between nozzles must be sufficient to allow mounting of cylinders and back plates
- Cooling should be provided in backplate to reduce cylinder temperatures and prolong the life of the seals.
- For very large manifolds it may be necessary to mount the cylinder(s) on columns direct onto the manifold, due to large thermal expansions (Contact ***MASTIP*** for details)

For specific details see pages in Nozzle catalogue.



INSTALLATION

1. Assemble the ***MASTIP*** nozzle as per normal previous information.
2. Assemble the ***MASTIP*** manifold (see Fig. 32.1), pin guide bush, steel spacer and titanium spacer. Pin guide bush should be a snug fit in hole in manifold (Dia. D), maximum clearance is 0.01mm, the top face of the bush should be slightly proud (0.01-0.05mm) of manifold top surface to aid sealing. See Fig 32.2. The shut-off pin should be an extremely snug fit in pin guide bush
The bush should have a slight frictional resistance to movement on the pin.

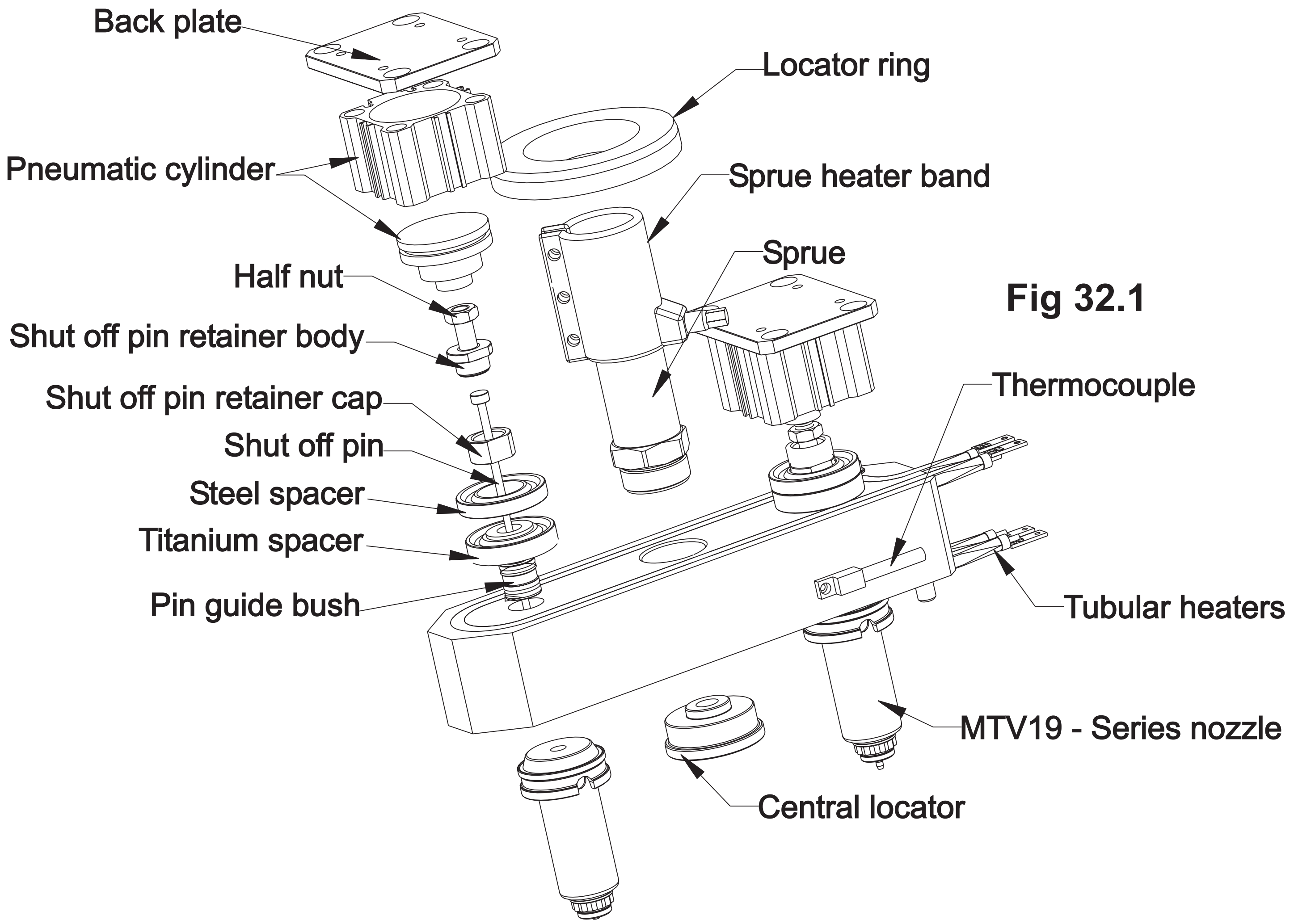
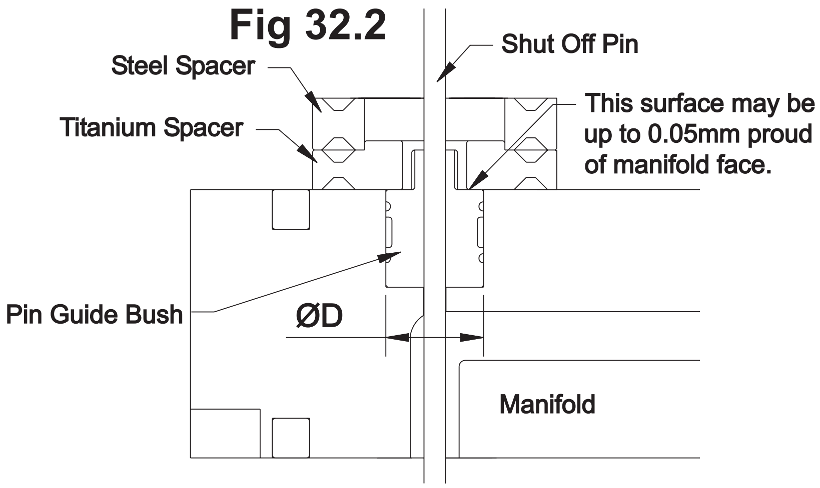


Fig 32.1

Fig 32.2



INSTALLATION

3. A cold clearance is necessary to protect the manifold components from collapsing due to thermal expansion when the system is at operating temperature.
   A procedure very similar to that used on page 4.23-4.25 is used to calculate this.
   Measure the distance from face W to the underside of the back plate.
   Measure and compare this to the stack height of the manifold and spacers and L4 dimension of the nozzle.
   There should be 0.05mm of interference between the titanium spacer and the backplate at full working temperature.

   Example

   Spacer stack = 15.00mm (titanium spacer = 6.5mm, steel spacer = 8.5mm)
   Manifold = 44.00mm
   L4 of nozzle = 15.00 mm
   Gap from face W to back plate = 74.00mm
   Nozzle manifold operating temp = 260°C
   Mold temperature = 60°C

   E for Spacers, manifold and L4 = (15.00+44.00+15.00)x0.0000132x(260°C-60°C)= 0.2mm

   Manifold, spacers etc will expand to 74.2mm in hot state
   So to achieve 0.05mm interference cold height of manifold etc will need to be 73.85mm
   (73.85+0.20 =74.05mm)

   74.05mm-74.00mm (gap from face W to backplate) = 0.05 interference.
   Grind 0.15mm off the **STEEL** spacer

   Moldmakers should carefully inspect all stack height and pocket dimensions against the hot runner *Mastip* drawings. Any questions should be discussed immediately with the nearest *Mastip* hot runner systems representative.

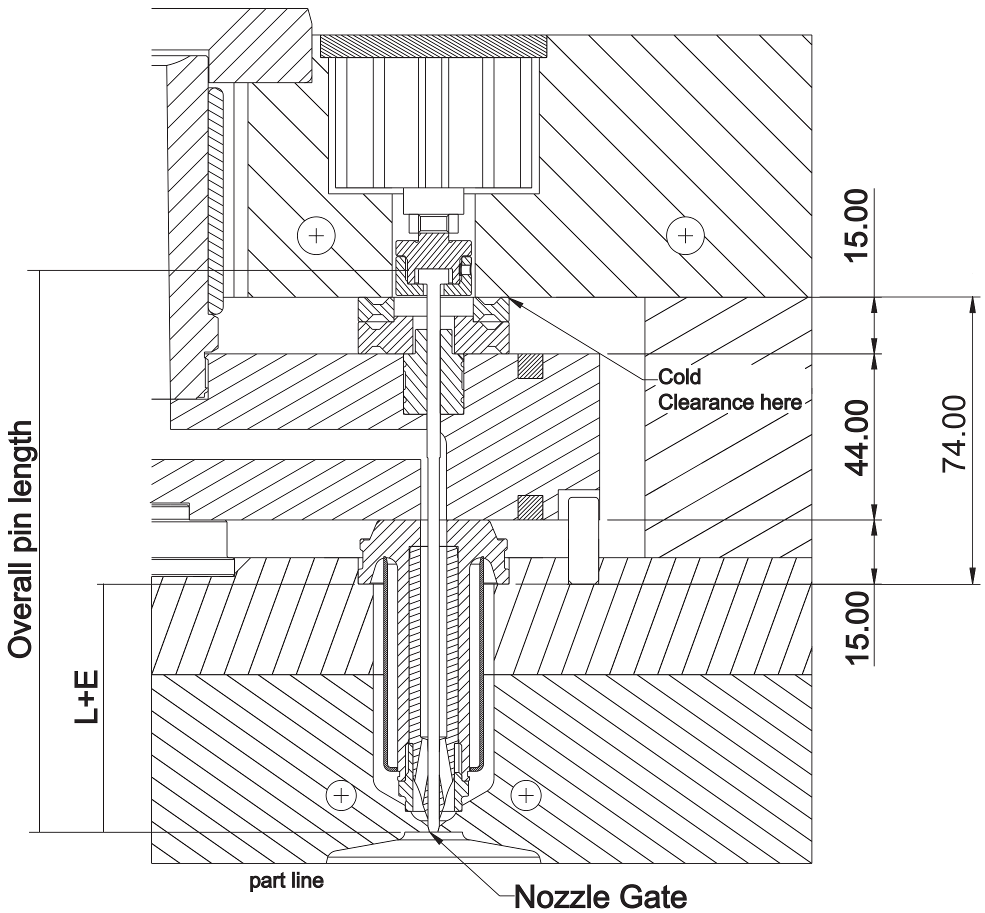


Fig 33.1

INSTALLATION

4. Approximate pin lengths can be determined from the formulas shown on pages 1.3.11-1.3.17 of the nozzle catalogue.
   Note: the E values for these lengths uses the length of the ***shut off pin.***
5. Cut pin to length and grind 40° taper on end of pin, make sure taper is a good fit in gate taper with bearing blue.
6. The cut outs in the mold back plate for the cylinder should be aligned with nozzle gate hole. The backplate should be aligned with the nozzle cavity plate with spacer discs or pillars. The titanium locator and dowel pin ensure the alignment between the manifold block and nozzle cavity plate. Misalignments can cause excessive wear on the shut off pin(s).
7. It may be necessary, in some cases, to machine the slot for feed lines right through the clamping plate to allow for ease of fitting from the back of the tool. Fig 34.1
8. Assemble the manifold and nozzles as per instructions for the standard manifold.
   DO NOT fit the O-rings yet
9. Assemble the Valve gate cylinder assembly, which consists of:
   shut off pin, half nut, pin retainer assembly, cylinder (hydraulic or air) and backing plate.
   Make sure the half nut has a 2mm adjustment gap as indicated in Fig 34.2

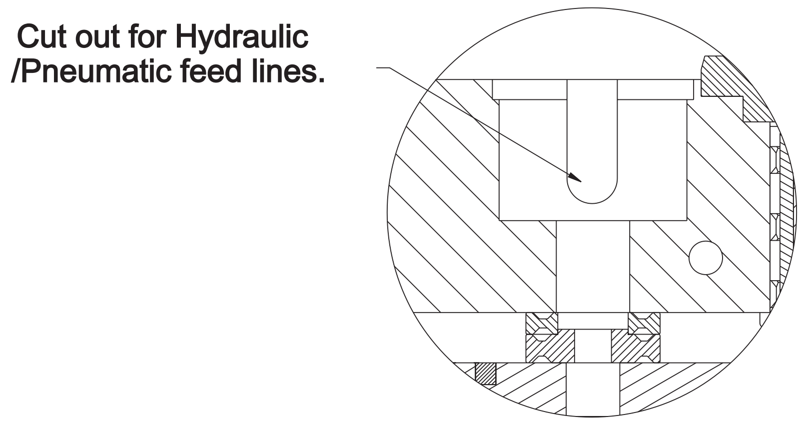


Fig 34.1

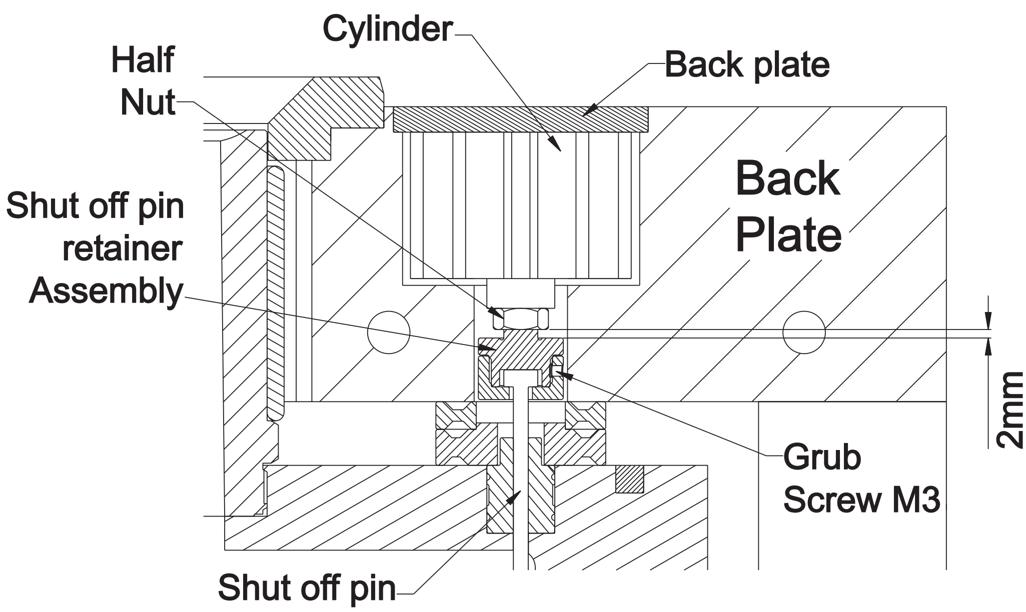


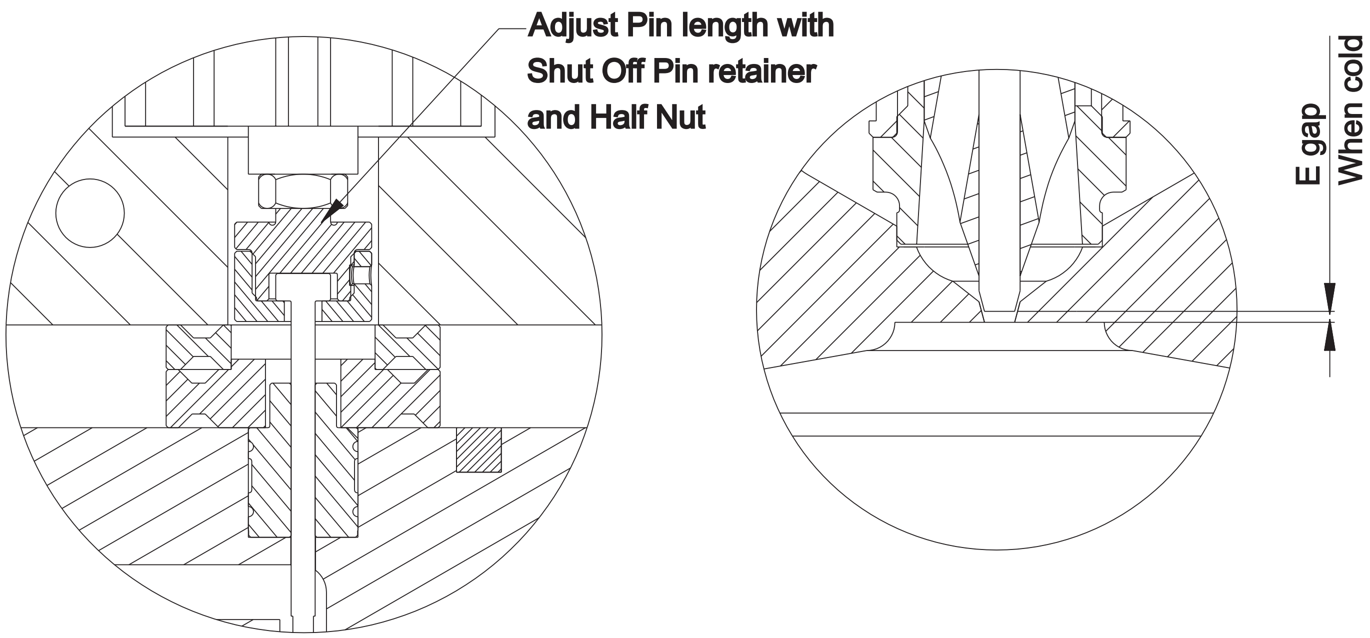
Fig 34.2

Valve gate cylinder assembly

INSTALLATION

10. Assemble the back plate on the tool.
11. Place tool in position so the valve gate cylinder assembly (see 8.) can be fitted into the back of the tool, and the front face of the gate is visible as well.
12. Insert valve gate assembly into back of tool so the valve gate assembly back plate is properly located, screw down valve cylinder back plate.
13. Apply LOW pressure air to cylinder to bring cylinders forward and the measure the gap at front of gate to the front face of pin (fig 35.1) with a depth micrometer (you may need a special anvil for the small pins). The gap should be equal to the shut off pins E value, if not remove valve cylinder assembly and adjust pin retainer and half nut until correct
14. **The gap between the gate and the pin in cold state is critical. If there is to much gap there will be a poor gate vestige and perhaps drooling from the nozzle. If the gap is to small the pin can strike the gate and will damage it.**

Fig 35.1



15. Now dis-assemble valve gate cylinder assembly from tool and remove backplate. Fit O rings and re-assemble
16. Before you install the valve gate cylinder assembly within the tool, fit the hydraulic piping or air lines to the cylinder.
17. For hydraulic's, we recommend the use of quick connect fittings with shut-off's to prevent hydraulic fluid losses when the mold is disconnected from the hydraulic power source.
    Always use solid piping whenever possible, but if in doubt seek expert advice.
    Care should be taken to check the maximum operating pressures and temperatures in the tool prior to trial to ensure unit will not be damaged.
    The hydraulic cylinders should not be used with more than 50 bar of pressure to avoid possible damage to gate if the tool is over heated

MAINTENANCE

The MASTIP valve gate system should give trouble free operation provided a few simple maintenance is procedures are followed

- Make sure pneumatic air is clean and free from water or oil.
- Make sure hydraulic fluid properly filtered and change regularly
- Minimum air pressure **at cylinder** should be 6 bar.
- Maximum hydraulic pressure should be 50 bar
- Break down tool and inspect for the following, every six to twelve months depending of use:
  - Service cylinders (contact ***MASTIP*** for seal kits)
  - Inspect shut off pins and shut off pin bush for wear and possible leakage

TROUBLE SHOOTING

The following is a list of common problems and answers for hot runner systems.

Problem: **Cylinders do not work**
Cause: No air / oil flow to cylinder, Cylinder seized, Not enough pressure in system
Remedy: Check lines, fitting pipes, and pump for leaks and blockages etc, Inspect cylinders, Too many bends in feed pipes, restrictive fittings or valves

Problem: **Cylinders seized**
Cause: Alignment of cylinder, manifold and nozzle incorrect, Too much heat in backplate.
Remedy: Check alignments, supply more cooling around cylinder

Problem: **Cylinders jam when hot**
Cause: Alignment of cylinder, manifold and nozzle incorrect, Too much heat in backplate, Spacers rubbing on shut of pin retainer
Remedy: Check alignments, supply more cooling around cylinder, re-align spacers

Problem: **Melt leaks from around shut off pin bush**
Cause: Bush to loose in manifold
Remedy: Check diameters of bush and manifold hole, check height of bush and manifold hole.

Problem: **Melt leaks from between bush and pin**
Cause: Wear, MFI of melt to high, pressure to high
Remedy: Check alignments of system, replace pin and bush **as a unit,** check melt MFI, reduce fill pressure.

Problem: **Melt sticks to front of pin**
Cause: To much heat in pin
Remedy: Reduce nozzle and gate temperature, increase cooling time

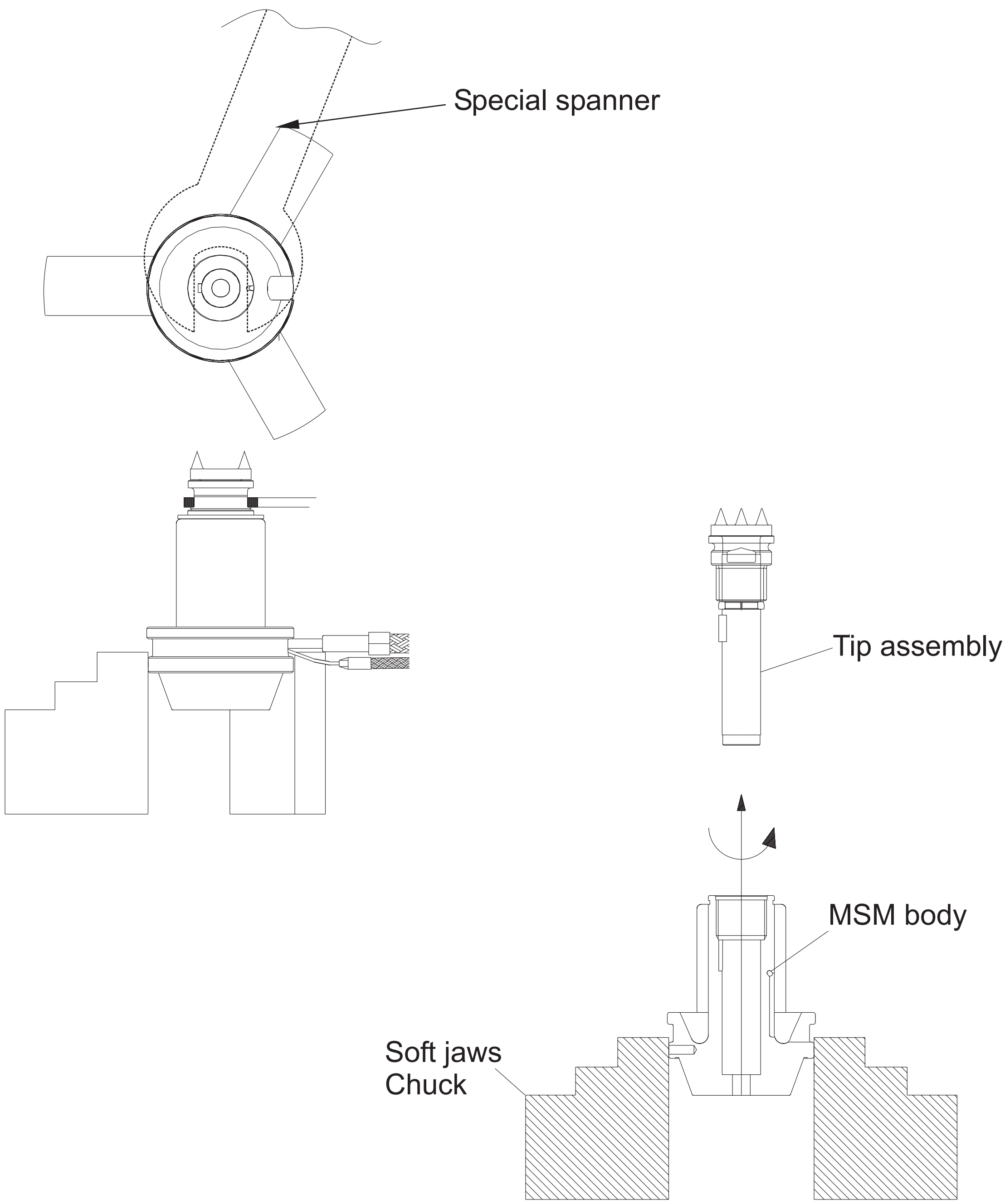
Problem: **Pin does not shut off or bush nut is damaged using MTVB or MOVB**
Cause: Nozzle operating at temperature different to one used to calculate E expansion
Remedy: Adjust pin position with pin retainer and half nut

MULTI-TIP NOZZLES

MSM TIP ASSEMBLY INSTRUCTIONS

STEP 1

Hold the nozzle assembly firmly in a three jaw chuck with soft jaws.



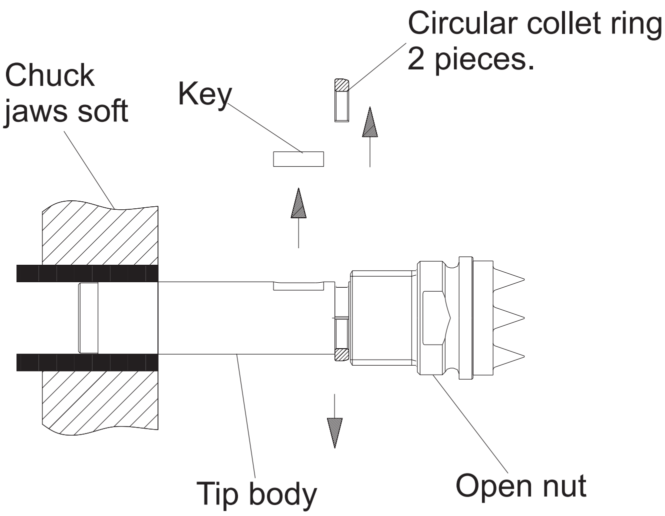
STEP 2

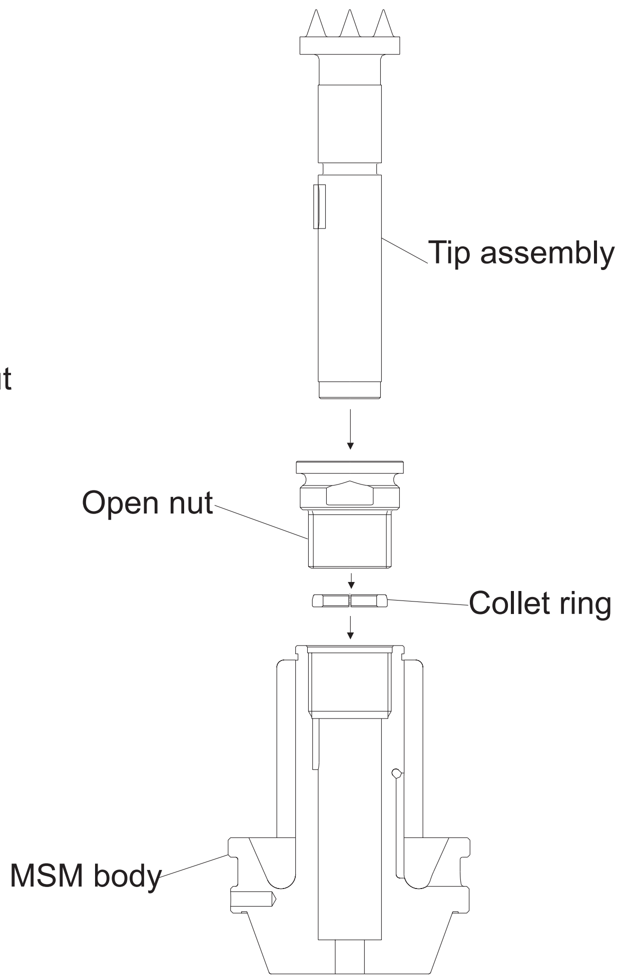
Unscrew the nut and remove the tip from the nozzle body using a special ring spanner.

MSM TIP ASSEMBLY INSTRUCTIONS

STEP 3

1. Firmly hold the tip assembly with a three jaw chuck with soft jaws.
2. Remove the key from the tip assembly.
3. Carefully remove the collet halves from the tip assembly





STEP 4

1. Replace tip with new MSM tip.
2. Assemble unit in reverse order, take care to align the key in the nozzle body.

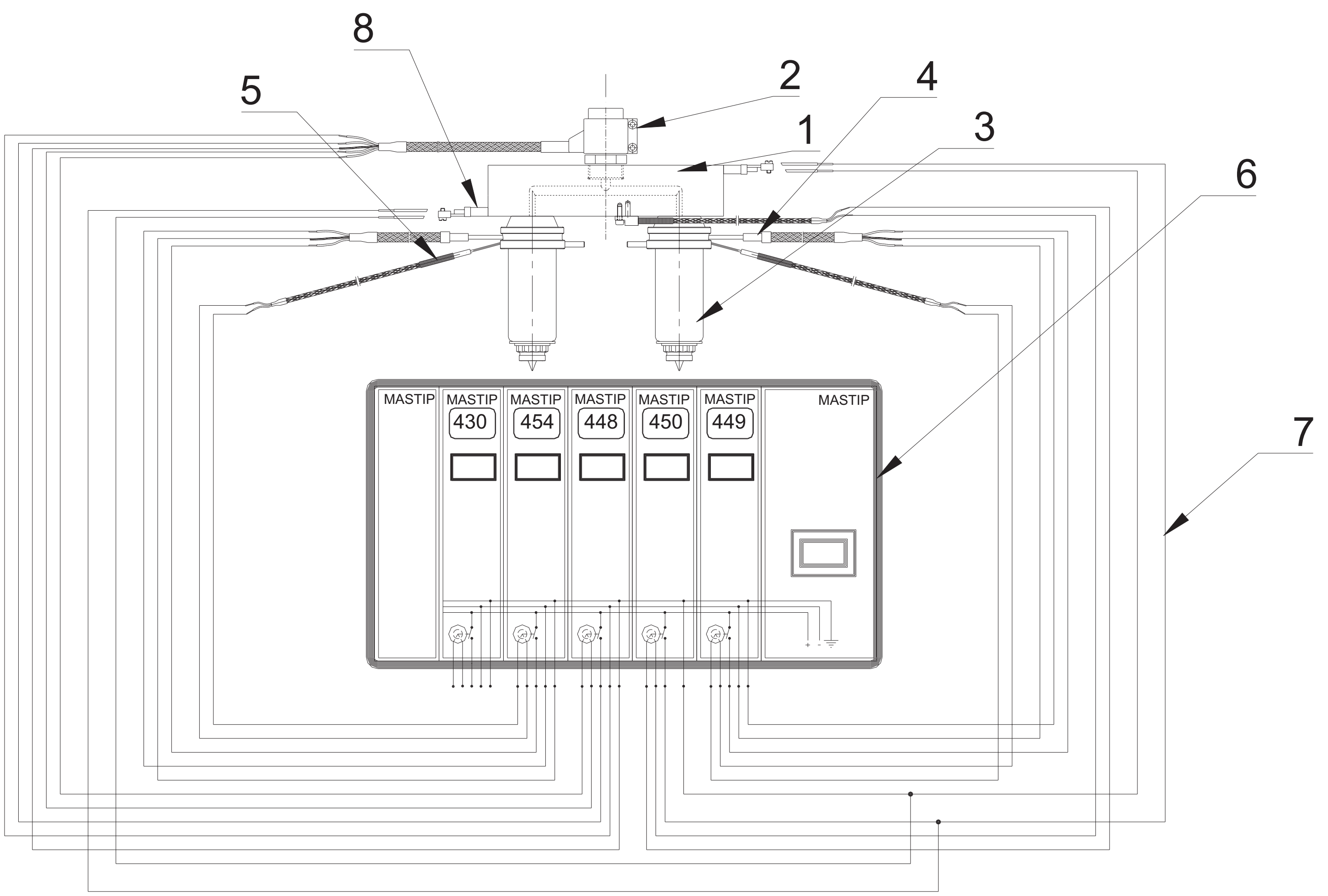
TEMPERATURE CONTROLLERS

WIRING DIAGRAM

CONNECTION OF NOZZLES, THERMOCOUPLES AND SPRUE BUSH HEATERS TO THE CONTROLLER.

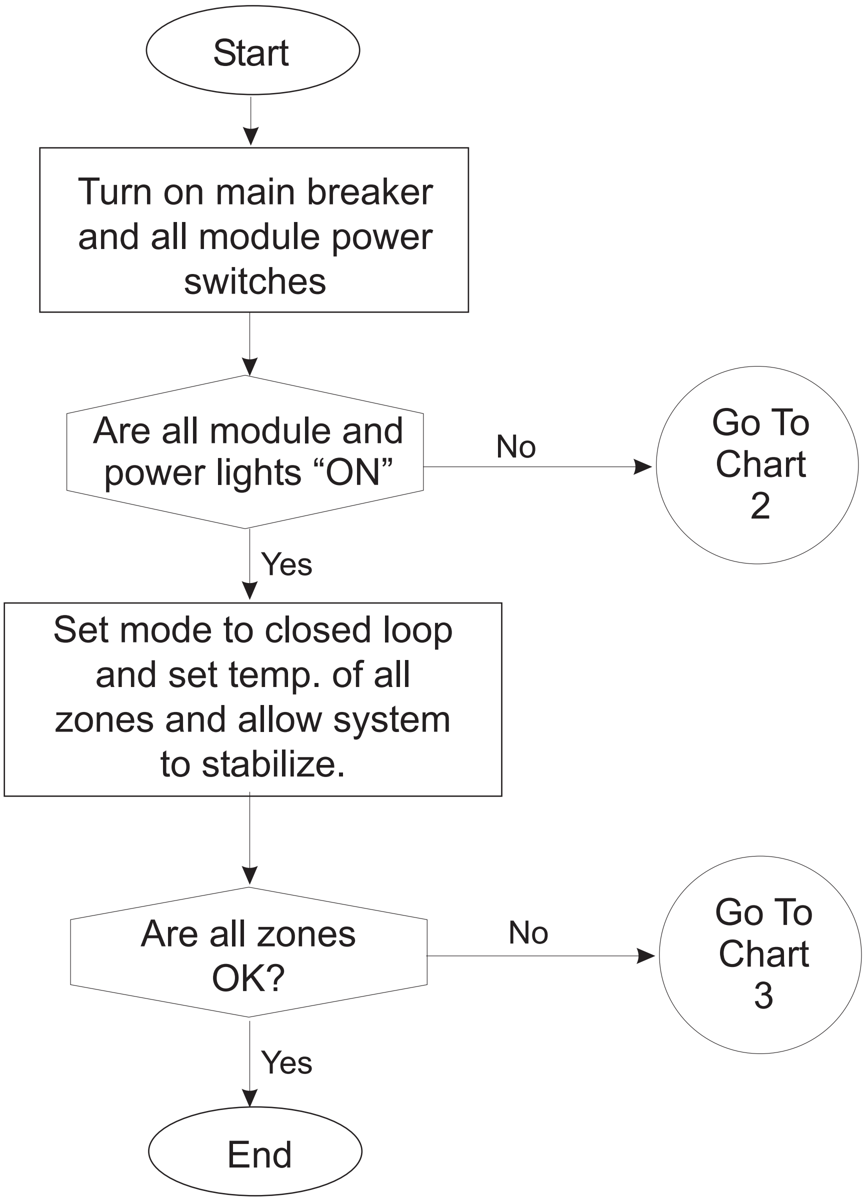
The diagram below shows the wiring diagram of a 2 drop manifold with sprue bush heater and thermocouple.
The layout of the heaters and thermocouples is shown for clarity only and is not technically correct.

1. Manifold block
2. Sprue bush heater with thermocouple
3. MTT series nozzle
4. Nozzle heater
5. Nozzle thermocouple
6. Controller
7. Wiring
8. Manifold heater



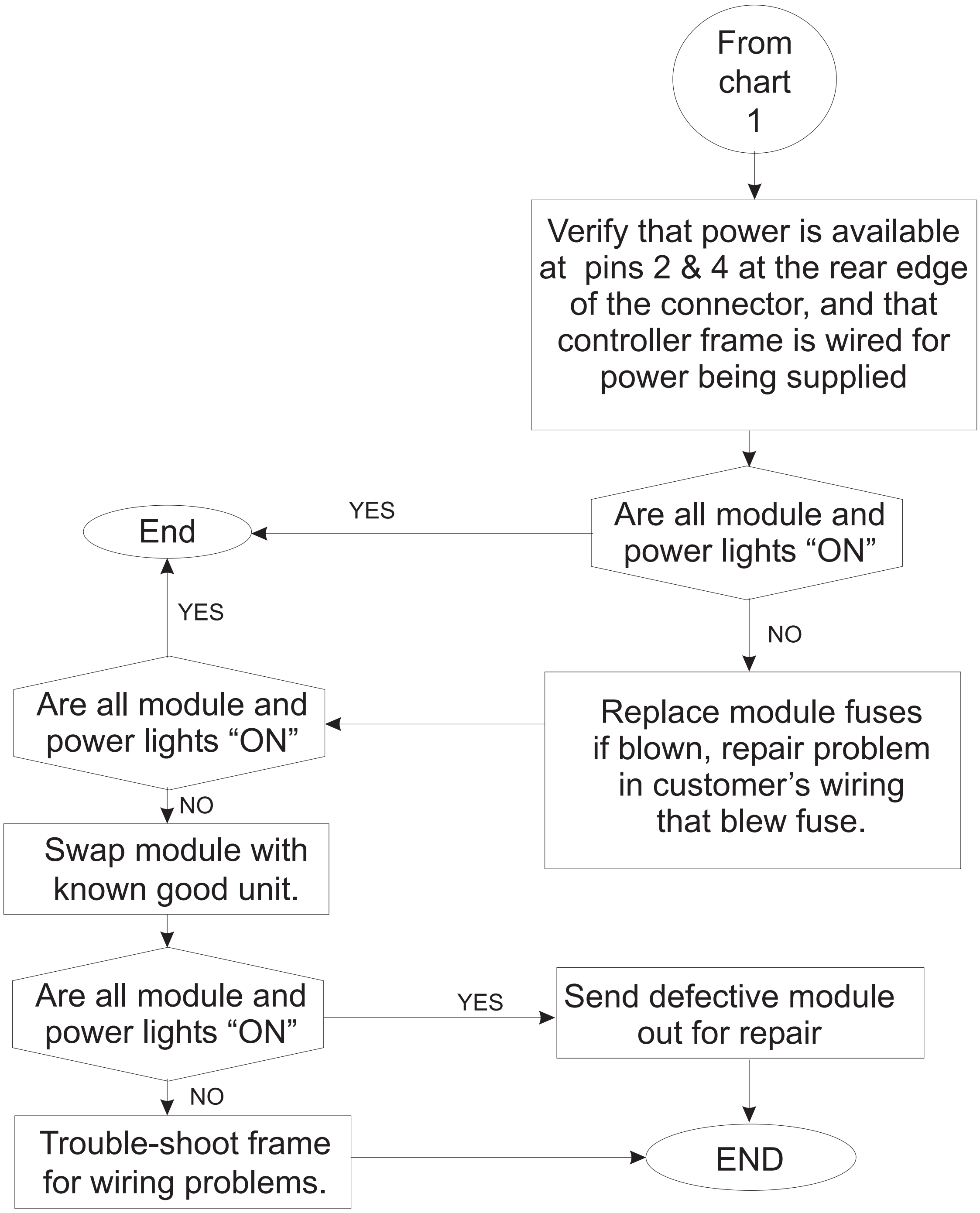
CONTROLLER TROUBLESHOOTING

Controller Trouble Shooting - Chart 1
Fault Classification



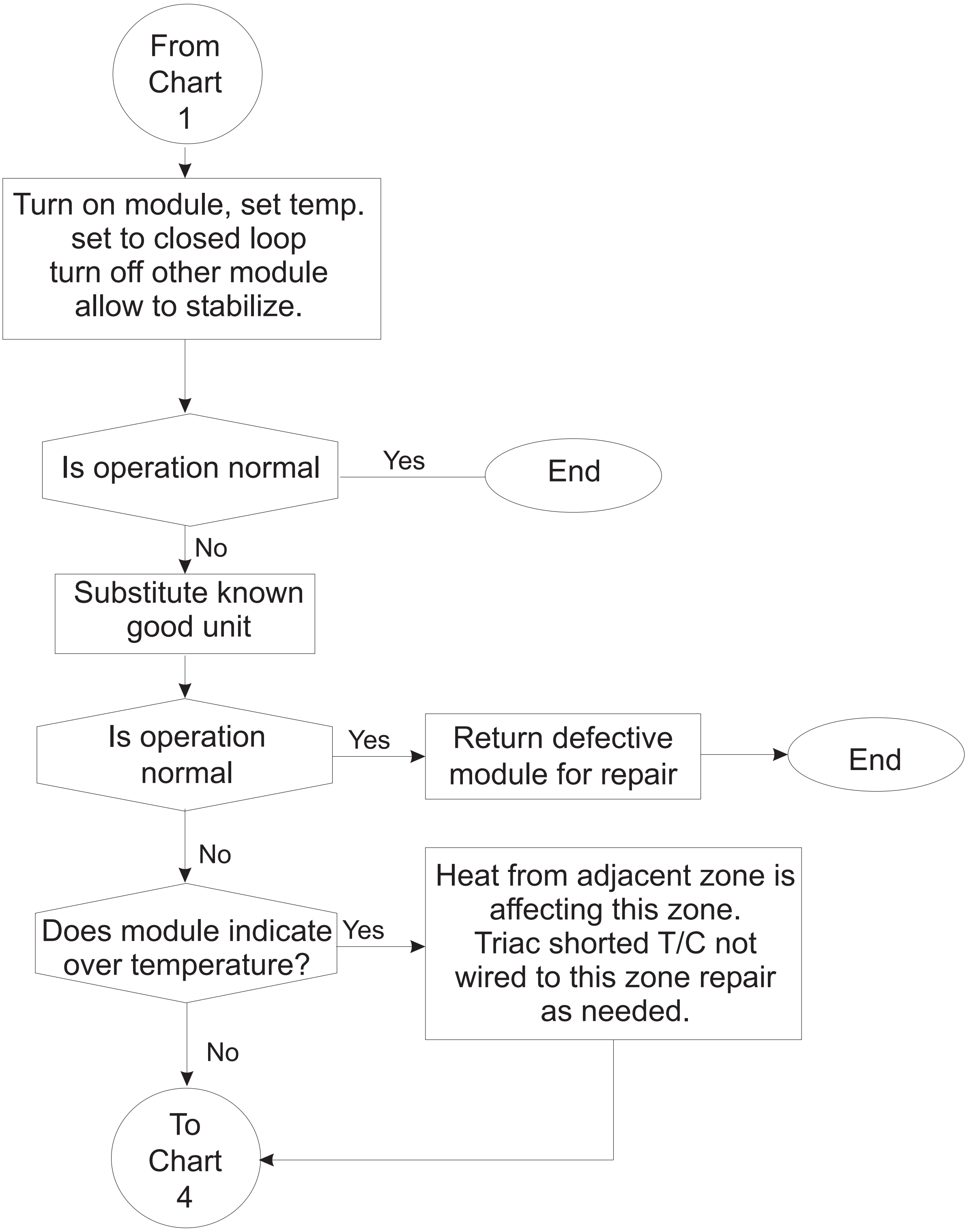
CONTROLLER TROUBLESHOOTING

Controller Trouble Shooting - Chart 2
Power



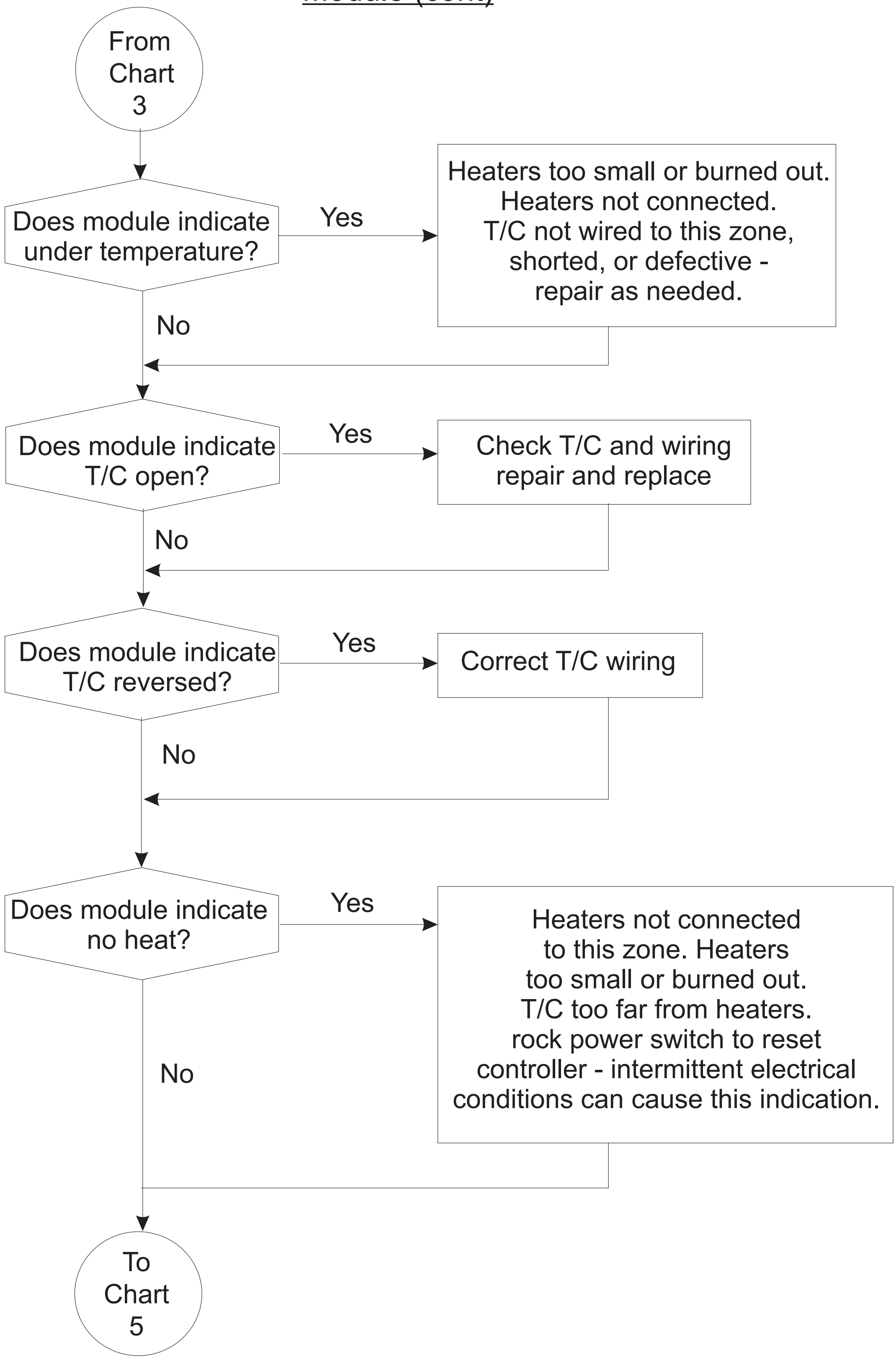
CONTROLLER TROUBLESHOOTING

Controller Trouble Shooting - Chart 3
Module



CONTROLLER TROUBLESHOOTING

Controller Trouble Shooting - Chart 4
Module (cont)



CONTROLLER TROUBLESHOOTING

Controller Trouble Shooting - Chart 5
Module