

# Wet on Dry Coating System Contents

*Selective Resin Vessels per Coating Channel*

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## **Introduction**

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The system is designed to achieve stable concentric and low defect coating of optical fibre in routine production at low draw speeds whilst applying a single coating or a dual coating by a wet-on-dry process. It offers a number of major benefits over previous technology, the major areas being as follows.

- Short wetted length helps minimise draw-induced tension and hence risk of yield-reducing fibre breaks above the capstan. Torsion blocking for fibre spinning is also minimised.
- Wet start capability.
- Low operating pressure.
- Fully hands-off operation -no periodic pressure or die adjustment required.
- More tolerant of high bare fibre temperatures than other designs.
- Coating defect risk minimised by low internal volume of die assembly and zero dead spaces, 2 micron particle filtration and use of high quality stainless steel diaphragm valves.
- System already proven with a wide range of industry standard coating materials.
- A proven very wide performance range of the die assembly design concept in terms of fibre diameter and coating thickness.

(Drawing numbers 380115A, 284466A, 284876A, 286599A, 289112A, 289112S, 380114A, 380134A, 380144A, 380169A, 380299A, 380302A, 380305A, 284876A, 380418A refer).

# **Equipment Description**

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## **System Overview**

The Wet on Dry Coating System, mounted on a frame on the face of the tower, comprises for each coating channel:

- A coating applicator comprising a thermostatic resin delivery block, a coating cartridge assembly and a bubble stripper cap.
- A coating pressure control system
- Water circulation unit.
- Heated resin delivery pipes, pneumatic valves and resin filters.

The coating system can be divided into four main functional areas:

- Pressure control – Coating Pressure Control Boxes and Resin Control Box.
- Temperature control - Water circulator, Heating tape, Heating Jacket
- Resin vessels and delivery line
- Coating applicator

## **Pressure Control**

Pressure control is distributed over two operator interface panels, a Coating Pressure Control Box for each primary and secondary channel and a common Resin Control Box, both mounted on the draw tower adjacent to the coating applicator. The Resin Control Box also houses rota flow meters for the UV liner purge (50 lpm N2) and the bubble stripper (4.4 lpm CO2).

The Coating Pressure Control Box houses the amplifier circuits and power supply for the remotely situated pressure controller and transducer.

The optimum pressure for achieving good coating geometry and freedom from air bubbles is dependent on fibre line speed. Line speed data from the capstan control module is used to adjust the pressure level to both coating applicators. The data is fed into the draw tower control system Programmable Logic Controller

(PLC) where an appropriate analogue voltage is generated and sent to each pressure control system.

The control signal passes into the Coating Pressure Control Box where a trim potentiometer allows the operator to modify the pressure, if required, and then to the electronic closed loop pressure controller. This regulates the air supply pressure to the resin pressure vessel. This pressure, applied to the surface of the resin, forces it up a dip tube, through a delivery line, into the coating applicator and onto the fibre.

Each coating applicator is supplied with acrylate resin from its own pressure vessel which has its own dedicated amplifier channel and pressure controller.

#### **Coating Pressure Control Box (*drawing 380134A*)**

Pressure-Bar : shows actual and set point pressure in 'bar'

Set Point button and a Trim potentiometer : Pressure is adjustable using Trim potentiometer with Set Point button pressed.

Valve On/Off button (Red) : opens and closes pneumatic resin supply valves to the coating applicator

Coating Enable button : Enables QB3 coating controller

Auto Shut Off button : enables/disables auto shut off on the fibre break

On start-up the system, Valve On/Off button is off as the pneumatically operated resin valves are normally closed. Coating Enable button is Off and Auto Shutoff is On. A set point of 0 bar (0 volt) is applied directly to the pressure controllers, bypassing the Pressure Control Box.

Pressing the Coating Enable on illuminates the button and applies power to the QB3 pressure controller in the Resin Control Box. Pressing the Coating Enable button off extinguishes the illumination and disables QB3 pressure controller.

The Valve On/Off button actuates the pneumatically operated valve that opens and closes the resin supply to the coating applicator.

#### **Auto Shutoff**

An Optical sensor, mounted on the capstan, detects if the fibre has broken during the draw process. If a fibre break occurs the sensor sends a signal via the PLC and activates the AUTO SHUTOFF function resulting in the following automatic actions:

- Power is removed from the COATING Enable button, setting pressure to zero on both coating channels.
- The resin supply valves are closed.

To enable thread up of the tower with the AUTO SHUTOFF switch active, the tower PLC control system inhibits the fibre break condition until a minimum fibre speed has been achieved only above this speed will absence of fibre in the detector cause the coating system to shut down.

This facility avoids the need to manually disable the AUTO SHUTOFF before each start-up and the necessity to reactivate it after thread up. The auto shutoff disable function is primarily for use with the coating control system in a 'stand-alone' mode. In normal tower operation this AUTO SHUTOFF function is left permanently active.

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*Note 1: Auto-shutoff ON: Green light illuminated. Coating system shuts down in event of fibre break.*

*Note 2: Auto-shutoff Off: Green light off. Coating system does not shut down if fibre breaks.*

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#### Display & Set Point button

The LED display indicates the resin vessel pressure in Bars for that channel. The set point button allows the pressure set point to be displayed in place of the measured pressure. When the coating is ON the demanded pressure, as set on the PLC, should always be the same as the measured pressure.

#### Trim Potentiometer

The trim potentiometer is designed to allow adjustments to the coating pressure when initially establishing optimum coating conditions or during a fibre draw where rapid intervention is required to correct a coating variation. Once set manual interaction is normally not required on production runs.

The potentiometer is a ten-turn unit with a Vernier scale turn counter.

When the potentiometer is set to 5.0 turns the pressure signal from the PLC is unaffected. For each turn away from this position, a bias of 2 volts (positive if the potentiometer is turned clockwise, negative if it is turned anti-clockwise) is applied to the

command signal to the pressure controller. This is equivalent to a 1 Bar pressure offset.

#### **Resin Control Box (*drawing 289112S, 289112A*)**

The Resin Coating Control box houses the following major components:

- Electronic Pressure Controllers QB3.
- Pressure Gauges
- Pressure Relief Valves
- 2 micron particle filter and manual valves to open/close instrumental grade air supply to the pressure controllers QB3
- N2 gas supply for UV lamp purge and CO2 for coating bubble stripping.

Air pipe admitting into the resin control box passes through a 2 micron high flow stainless steel mesh filter to the manual isolation valve. Opening the isolation valve admits the air to the pressure controller QB3. The controlled air pressure passes by an analogue pressure gauge (0-6 bar) and a pressure relief valve to reach the manual switching valve.

The solenoid valve in the QB3 pressure controller is normally closed and when electrical power is removed from the controller, the system remains at the pressure existing at the time of electric power interruption.

Accidental overpressure of the system is prevented by a spring loaded pressure relief valve set to 5 Bar.



***Caution: The relief valves are factory set. Under no circumstances are they to be adjusted.***

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Each relief valve is equipped with a manual override button to allow the vessel to be depressurised as required, e.g. when disconnecting for refilling. An extract spigot at the top of the control box allows resin vapours, vented during depressurisation of the system, to be extracted from the area.

On the lower side of the control box, two N2 flowmeters are provided to regulate the fibre purge flow connected to the bottom of UV quartz liner tubes with a range of 4 to 50 litres/min and two

CO<sub>2</sub> flowmeters are to regulate the flow of bubble stripper gas with a range of 0.6 to 4.4 litres/min connected to the bubble stripper capsule located on the top of the coating cartridge. Solenoid valves switches the gases on automatically when the first UV Curing Lamp is switched on and switches it off when the last UV Curing Lamp is switched off. This ensures that it is always on when fibre coating is taking place. The CO<sub>2</sub> line contains a stainless steel, high efficiency particle filter for removal of particles of 2 microns and larger.

### Temperature Control

Resin temperature control can be divided into three areas :

- The resin vessels.
- The resin delivery pipework.
- The coating applicator.

Resin temperatures in the applicator are precisely controlled by two independent thermostatic water circulators. These maintain the viscosity of the resin being applied to the fibre at levels pre-determined to be optimum for control of coating quality and geometry at the prevailing line speed.

The resin vessels are heated separately by an electric heater jacket. Similarly, the resin delivery pipework is heated separately by an insulated, electric trace heating system.

### Resin Delivery

The resin storage and delivery system on this installation is designed to allow two pressure vessels to be connected to each coating applicator.

#### Resin Vessels

Stainless steel resin pressure vessels per coating channel, each having a volumetric capacity of 5.5 litres, are installed on the tower frame adjacent to the coating system and connected to the Coating Control Panel. The maximum safe working pressure for the vessels is 10 Bar and the pressure relief valves on the Resin Control Panel are factory set to 5 Bar.

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*Note: To allow sufficient head-space for pressurisation the vessels should not contain more than 5 Litres of resin.*

*Note: Optionally 1L and 2L Polypropylene bottles are supplied to place in the stainless steel vessels for small amount of consumption and easier replacement and cleaning. (drawing 282266A)*

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### **Resin Delivery**

Pressurised resin is delivered through the dip tubes in the vessel, heated black nylon pipe , 2 micron resin filter and pneumatically operated valve to the coating applicator. The valve is actuated by the red button on the Coating Pressure Control box.

### **Coating Applicator**

The die assembly is surface-mounted on a water-heated resin delivery block. Resin is delivered to a port in its top surface and so enters the die assembly through a corresponding port in its bottom surface. An O ring between block and die assembly makes the joint leak-tight.

A feature of the coating system is the use of a “hanging meniscus” for wetting the fibre. This has a number of process advantages over “raised meniscus” systems. However this design concept normally suffers from lack of operator visibility as, by its nature, the meniscus is recessed deep inside the applicator. This inability to monitor and, if required, to adjust the meniscus to maintain optimum process conditions is overcome on this design by provision of a viewing path from above the applicator. A microscope is supplied for this, mounted on a fixed bracket that allows the operator to check the meniscus at any stage through a transparent window in the top of the bubble stripper cap.

Resin input to the applicator is via a high flow stainless steel filter with a nominal mesh size of 2 microns. It is placed at the input of the assembly to facilitate changeover in the event of blockage. Filter fitting and removal is facilitated by the use of VCR connections which also minimise dead space in the joints.

The filter output is directly connected to a high quality pneumatic diaphragm valve which switches on and off resin supply to the applicator. The valve design ensures minimum dead space,

involves no wearing seals that can generate particulates and has a high flow capacity. VCR connections are used here also.

### **Applicator Cartridge Design (drawing 284876A)**

The single coating applicator comprises two main assemblies, each containing a die. These are, from top to bottom, the Entry Die Holder and the Coating Die Holder. Both are made of stainless steel and as their names suggest, each houses one of the two dies: the flat-bottomed Entry Die through which the fibre passes into the coating chamber and the taper-profiled Coating Die.

The entry die holder has a central threaded hole into which screws the entry die via a coarse thread, allowing its quick detachment for cleaning. As a result the applicator can remain in place between draws if "wet starting" is being employed (only applicable for single coating and the secondary coating of a wet-on-dry dual coating system).

Wet starts are advantageous not only due to the saving of time, wear & tear and materials involved in stripping down, cleaning and reassembling the applicator, but has other benefits. It lubricates the coating die, thus avoiding abrasion wear that otherwise occurs in the interval between thread-up and turning on the coating resin. By pre-filling the resin gallery, and partly filling the coating chamber itself it reduces the quantity of air trapped in the applicator that then has to be vented through the dies before defect-free coating can be obtained. It also allows the meniscus to be established much sooner and more reliably than if the applicator were to start completely dry.

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*Note : wet starting is only appropriate for single layer coating and for the secondary applicator of a dual layer coating system where the primary applicator has to be started "dry".*

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Carbon dioxide bubble-stripping gas enters through a pipe in the holder's side, emerging into a circular gallery around the die.

The stainless steel entry die possesses an internal taper zone leading down to a central aperture through which the fibre enters the primary coating chamber. It is threaded on the outside for screwing into the entry die holder, sealing against it by a taper zone at the base. Tightening and loosening of the die is facilitated by a hexagonal exterior profile.

Over the outside of the entry die is fitted the aluminium bubble stripper cap. This enclosure rests on the entry die holder and its

bore locates concentrically on the corners of the die's hexagonal external profile. The bubble stripper has a glass top window to allow microscope viewing of the entry die's opening into the primary coating chamber during fibre drawing. The fibre enters the bubble stripper chamber through a push-in plastic insert that can be removed for cleaning, as can the glass top should either become contaminated with resin. Carbon Dioxide gas passes up the gaps between die and cap, filling the space above the die before exiting via the plastic insert.

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*Note: at low line speeds, the use of bubble stripping gas may be found unnecessary, in which case the applicator can be used without the cap in place. It does however also form a barrier against objects falling into the die and potentially damaging the fibre or disrupting the coating process.*

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The die holder locates the Stainless Steel coating die with Polycrystalline diameter insert and in combination with the underside of the entry die holder, forms the coating chamber with its associated resin feed gallery.

The complete die assembly fits into a shallow recess in the top of the adaptor block.

There are "O" rings that seal between each of the two interfaces in this three-layer "sandwich" (delivery block, coating die holder and entry die holder), so preventing resin leaks to the outside.

A microscope with 20 \* magnification is provided for viewing the meniscus inside the entry die at any time during the coating process.

# **Operation of Coating System**

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## **Preparations**

**Switching Active Pressure Vessel** (only systems having more than one pressure vessel simultaneously connected to the coating applicator)

**Refer to drawings 380299A, 289112S & 289112A**

### **Cleaning Applicator**

Rotate the coating cartridge by 90 degrees to align with the port on the required resin delivery block.

Turn the upper pair of manual valves on panel 289112A to direct the pressurising gas to the correct pressure vessel and the pneumatic gas controlling the shut off valve to the same vent line e.g if pressure vessel B is to deliver resin to the resin delivery block then the manual valve switches should both point towards vessel B. Drawing 289112A shows a system with two primary (inner) resin vessels (A & B) and two secondary (outer) resin vessels (C & D) with primary resin vessel B and secondary resin vessel D selected.

## **Coating Applicator**

### **Cleaning Applicator**

For single coating and for the secondary of a wet-on-dry dual coating, the applicator is designed for “wet starts” and so need not be removed from the draw tower or cleaning unless there is some problem which requires it, such as die blockage or unusual coating behaviour which cannot otherwise be rectified. The entry die will however have been at least partially flooded with resin at the end of the previous draw and must be cleaned as detailed below. If this not immediately replaced with a clean spare, the top of the applicator in the meantime must be covered with clean, light-proof material.



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***Warning: The applicator is a very high precision piece of equipment which is capable of excellent coating geometry control whilst also minimising draw breaks and eliminating die abrasion of the fibre. However it can only guarantee to deliver these benefits if it is treated with the care and respect it deserves***

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Items which must be kept by the tower's coating station at all times:

- Filtered compressed air gun
- 2.5 mm Allen key
- Magnifier lenses (\*3 and \*10)
- Entry die removal tool (provided)
- Squeeze bottle with thin spout, containing alcohol (IPA or Ethanol)
- Lint free wipes
- Lint free gloves

#### **Removal from tower coating station**

1. Put on gloves
2. Undo bubble stripper gas connection
3. Undo the 4 outer screws and lift applicator off the base complete with bubble stripper cap.
4. Check the delivery block O ring is not stuck to underneath of applicator.
5. Cover top of delivery block with clean, light-proof material.
6. Place applicator upright on a lint-free wipes.
7. Carry applicator (still upright) to die cleaning area and place on table in die "dismantling zone" (keep this area separate from the die "assembly zone")

The following items must be kept in the cleaning area at all times:

- Heated ultrasonic cleaner, thermostatically controlled to 40 degrees C (a vapour cleaner may also be used with certain precautions).
- Engineering microscope with XYZ encoders and range of lens magnifications up to \*50.
- Filtered compressed air gun

- Squeeze bottle with fine tip containing alcohol (IPA or Ethanol)
- 2 / 2.5 / 3 mm Allen keys
- Forceps
- Laboratory tongs
- Hand magnifier lenses (\*3.5 and \*10)
- Range of micro-drills
- Entry die removal tool (supplied)
- Lint-free wipes
- Lint-free gloves
- Die removal tools (supplied)
- Supply of inhibited trichloroethylene (e.g. ICI "Trikhone N")
- Supply of alcohol

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**Warning:** *ALWAYS work on the work surface or directly over it. If any part is accidentally dropped it will then fall only a short distance and small items like screws will be easy to find. However extreme care must always be taken to avoid dropping or knocking any main part of the applicator. Once is enough possibly to damage it irreparably. Always work carefully and methodically, thinking through the next action before carrying it out. Every instruction in this SOP is there for a reason. Do not deviate from it.*



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*Note: handle all cleaned items with fresh disposable gloves and avoid contamination from tools or work surfaces contaminated with dirt or resin. The best way of achieving this is to keep the dismantling and assembly areas and their associated materials and tools completely segregated. If gloves become contaminated, change them for new ones immediately.*

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### Stripping down

1. Lay out lint-free wipes on the "dismantling zone" work surface for placing items on once removed.
2. Remove bubble stripper.
3. Remove entry die and place upside down to drain
4. Dismantle entry die holder, adjuster and coating die holder.

5. Remove O ring. Coating die is not to be removed unless it has to replaced. (ref. Coating Die Replacement section)
6. Wipe out components to remove as much resin as possible

### **Ultrasonic or vapour cleaning**

1. Carefully place dismantled components (plus the Allen key and any other tools contaminated with resin) in a plastic or plastic-lined basket so each item is lying flat and not touching the others. As a precaution place the die holders upside down to protect their most vulnerable surfaces from scratching on the floor of the basket.
2. Check the liquid level in ultrasonic cleaner is sufficient to avoid the cut-out operating and that it is clean.
3. Lower tray/basket gently into the cleaning bath and replace the cover. Run the ultrasonic cleaner for 30 mins at 40 deg C.
4. Wipe down work surface with a lint-free wipes and alcohol. And discard used gloves and any used wipes.
5. After the necessary cleaning time remove the basket and place it on the “assembly zone”.
6. Place cleaned components on fresh lint free wipes.

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*Note: the bubble stripper cap's plastic insert will soften and swell in trichloroethylene. However manual cleaning alone is insufficient to guarantee an adequate standard.*

*Therefore it should still be immersion cleaned but only for 1 - 2 minutes.*

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### **O rings**

*Note: Correct geometry of all the O rings is critical to proper functioning of the applicator. Any swell induced by exposure to resins or solvents may impact on ease and accuracy of assembly as well as leak integrity. It is therefore recommended that the applicator O ring is replaced every time it is reassembled. Failing that, they should be changed very regularly and in between only be immersed in solvent (especially Trichloroethylene) for the briefest period necessary to clean them effectively, e.g. using the procedure given below.*

Clean O rings by threading onto laboratory tongs or forceps, allowing free movement whilst still retaining them securely, and agitate in the ultrasonic cleaner for 10-15 seconds. Immediately on removal and whilst still retained in the tongs, squirt them with alcohol and blow dry. Place on the lint-free wipe.

### Final rinse and blow dry

Put on fresh gloves.



***Warning: if the fresh gloves become contaminated at any time during the following procedures by contact with items that are dirty or contaminated with resin, discard them immediately and put on fresh ones.***

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If the vapour cleaner is used rather than the ultrasonic cleaner place items in a bath of fresh alcohol to cool.

Rinse each item with alcohol, squirting through each die (see it coming out as a continuous jet) and then blowing dry. As each item is finished, place on a clean lint-free wipe.

### Inspecting parts

Use a 3 to 5 x magnifier under strong light to inspect each part on all surfaces, looking for any damage or contamination.

Look through each die hole on the microscope with top and bottom illumination using at least a 20\* objective lens. On coating dies in particular, check for signs of wear due to fibre abrasion (seen as "bite" marks in its circumference). Such damage will not stop the die functioning but eventually coating concentricity will become worse. As well as an indication that the die will soon need to be replaced at some point, the appearance of such damage is a sign that start-up procedures need to be reviewed to avoid or at least minimise dry running of coating dies.

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If any particles are seen or other signs of contamination in the die, squirt through with alcohol, blow dry and re-inspect. If this fails, return the parts to the cleaner for a further 10 minutes and repeat above procedures.

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*Note: the safest and most effective way of removing stubborn die contamination is with a specialist blast cleaner. It can likewise be used on other coating components, guide pulleys, etc. Should*

*this be of interest SG Controls will be happy to supply further information.*

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Stubborn particles adhering to the bore of dies can sometimes be “scraped off” by passing through the die a section of coated fibre previously wiped clean in a lint-free wipes moistened with alcohol. Lubricating the die with alcohol, the fibre should be sawed gently to and from whilst moving the point of contact around the die’s circumference. Get someone else to hold the die whilst doing this. Avoid excessive lateral force or the coating will be stripped off. Remove the fibre, squirt through with alcohol, blow dry and return to the ultrasonic cleaner for 10 minutes and re-inspect it.

Slightly undersize micro-drills may be used for diamond dies, but should be avoided on stainless steel ones as this may damage them. Always use alcohol as a lubricant.

Inspect bubble stripper for cured resin inside aluminium body and in/around plastic insert. If necessary, disassemble it, clean out manually, removing every trace and reassemble. Return to ultrasonic cleaner for another 10 minutes. This item must be as clean as the applicator itself.

### **Cartridge Assembly Procedure**



***Warning: The coating die holder and entry die holder combinations are made as matched pairs and are uniquely identified by an engraved letter (“1A”, “1B”, “1C” etc). These parts must not be mixed between cartridges !***

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1. Refer to drawing 284876A
  2. Assemble Entry Die Holder (3) and Adjuster (4) using M2.5x5 screws (28). Do not tighten screws.
  3. Fit coating die to to coating die holder (1) if it is removed. See coating die replacement section below.
  4. Fit the O ring to coating die holder (1)  
*Note: if the O ring does not easily fit into its groove, it must be replaced with a cleaned new one.*
  5. Assemble entry die holder/adjuster to coating die holder aligning cartridge ID marks using M3x10 screws (22) Do not tighten screws.
  6. Fit entry die using entry die tool.

7. Fit M3 brass tipped grub screws (27) but do not tighten. Grub screws are to adjust entry die position above the coating die.
8. Align entry die and coating die on the microscope.
9. Fix all the screws once entry die / coating dies are aligned.
10. Fit bubble stripper and place the cartridge in a clean sealable plastic bag or container.
11. Take screws to fit cartridge on the resin delivery block.

## Coating Die Replacement



***Warning: coating die removal and replacement must only be done by properly trained personnel or severe damage to the applicator may result! Only the aluminium die insertion/removal tool and aluminium block provided should come into contact with the applicator parts and extreme care must be taken at all stages.***

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Coating dies fit by a taper into their holders and are pressed in from the top and knocked out from the bottom.

All parts must be completely clean before new dies are fitted.

Always place the die holders concentrically on the cylindrical aluminium block, itself resting on a solid bench-top, preferably directly over one of its legs.

When inserting dies, carefully controlled force must be used to ensure they are securely seated to their proper depth and will not drop out during immersion in the vapour cleaner. Excessive force may however cause permanent deformation of the die holder.

When removing dies the insertion/removal tool must be accurately centred on the die and held perpendicular before tapping it out with a light-weight hammer. The tool must also be gripped firmly to avoid its over-travel when the die is knocked out as this could result in damage to the rim of the die aperture.

## Tower Preparations for Fibre Drawing

### In-situ preparation of a pre-wetted applicator (single and secondary coating only)

#### **Microscope**

The microscope is mounted off a bracket attached to the coating applicator mount. It is normally dismounted from the bracket for thread-up to allow full access to the applicator. It is attached to the bracket by a location pin which is secured by a thumbscrew. When removed from the bracket place it in a safe location.

#### **Bubble stripper cap**

Lift off cap, check if inside is wet with resin or the glass plate is dirty. If so, clean in ultrasonic bath (preferred method). If there is no time for this and no spare exists, pivot the spring clips away and remove plate. Clean all internal surfaces, plate and hole of plastic insert with alcohol and lint-free wipes. Blow dry before reassembly. Check the glass plate is properly located and secured with the clips, the plastic insert hole is perfectly clear, it is not tilted and is pushed in fully.

#### **Entry die**

If the applicator is already fitted to the tower and has previously been used for drawing fibre, inevitably at the end of the last draw the entry die will have been flooded when the fibre broke or was cut. Therefore the entry die must be removed and cleaned as detailed above. If not immediately replaced with a spare, the top of the applicator must be covered with clean, light-proof material.

In an emergency it may be cleaned in situ as follows. Remove resin in the cone of die with a lint-free wipe screwed up into a point, also wipe bottom of die. Squirt alcohol through die hole (see a strong jet coming out), then blow through hole with filtered air gun. Repeat this procedure at least once more. Inspect both sides with magnifier. If not totally clean, repeat as required.

### Fitting a fresh cleaned applicator (single, primary or secondary coating)

If the applicator has been removed and cleaned after the previous draw, the following procedures should be carried out.

Check levelness of the adaptor block in X and Y axes with good quality spirit level and adjust if required using the tilt screws.

Wipe the top surface of the resin delivery block with an alcohol-moistened lint-free wipe, paying attention to remove resin and particles right up to the rim.

Check the 2 small O rings in their grooves for signs of damage or swelling. These should be replaced very regularly, if not every time the cartridge is removed.

Place a resin catch bowl under the block to catch resin drips.

Purge the resin channel briefly to generate a puddle of resin around its exit port. This is to ensure the delivery gallery is full and any particles at its exit have been purged away.

Fit the cartridge on the resin block aligning index marks. Tighten down each screw in sequence until firm resistance is felt (do NOT over-tighten).

### **Purging fresh applicator for wet starting (single and secondary coat only)**

Remove entry die, if fitted.

Thoroughly clean the tip of the syringe needle with an alcohol-moistened clean lint-free wipe. Blow it off with a filtered air gun.

Ensure a resin catch bowl is under the applicator to catch drips from the coating die.

Set a pressure of around 0.3 bar and open resin valve.

Purge until resin begins to fill up hole in bottom of entry die holder.

Suck out the resin from the entry die holder and coating chamber with the syringe until all free liquid has been removed.

Screw in entry die (see note below), fit bubble stripper cap and cover with a lint free wipe.

*Note: if there is to be any delay before passing the fibre, do not screw the entry die in more than 1 turn at this stage. If fully screwed in now, resin level in the coating chamber may slowly rise causing the die's neck to become wetted, so risking flooding during start-up. Therefore, when finally ready for start-up, suck out the coating chamber again, check the underside of the entry die is still dry and screw it fully home.*

*Note: the entry die removal tool may be used to tighten the entry die, but this should not be necessary to obtain a reliable seal. If resin is leaking past with the die properly finger-tight, then there will be another explanation, such as damage to the taper sealing faces.*

## **Draw Start Up**

### **Passing fibre through applicator**

The following instructions may seem over-elaborate but a clean and successful first-time thread-up of the tower is an excellent way of guaranteeing a problem-free draw. One things start going wrong with this phase, there can easily be knock-on effects that will seriously degrade fibre quality or abort the draw.

Ensure both resin valves are closed and switch “Coating Enable” button “on” and the correct pressures for start-up are displayed (trim pots are in the correct positions for zero pressure offset i.e, 5.0, correct pressure ramps are programmed into the computer).

Check fibre drop-weights are clean and ready.

Check all UV lamp liner tubes are clear and top/bottom doors are open. Turn on the top UV lamp on each stack and confirm power is at minimum. This may not be necessary for coating cure if the applicator is threaded up dry but it disperses static electricity on the liner tube that can otherwise cause the fibre to stick to it.

Plug the entry of the UV lamp with a piece of tissue to catch any resin drips from the coating applicator.

Remove resin catch bowl away from under the applicator.

Just before passing the fibre, put on fresh lint free gloves. Then do not touch anything else with the hand used to pass the fibre. If the glove does become contaminated, change it or spray-rinse the hand with alcohol and blow dry with air gun.

There is a range of techniques for passing the fibre and users will soon evolve their own. However, at all times it pays to:

- have the pre-run checklist completed in every detail
- ensure a good supply of drop weights is on hand in case one falls off
- all drop weights are clean of old fibre and resin
- wait until fibre diameter has stabilised over whole length from furnace to applicator
- not to thin down the fibre too far or it becomes unnecessarily fragile
- not to try and pass the fibre when mini-capstan is at too high a speed
- know exactly what you are going to and then do it only once!

A suggested method for die passing is given below which is designed for pre-wetted applicators, but works equally well for dry ones.

Pick up the drop weight in the hand not to be used for holding the fibre. As the fibre comes off the mini-capstan (or in the case of a secondary applicator as it emerges from the primary UV lamp), break off the fibre with the chosen hand and hold between forefinger and thumb around 80 mm from its end keeping it straight and vertical. Pass it smoothly through the hole in the bubble stripper cap as far it will go. Quickly release the grip, transfer it to around 80 mm above the coating applicator and again push the fibre through as far as it will go. The fibre end will now be projecting below the applicator mounting plate. With the other hand attach the drop weight and, whilst still holding the weight with that hand, release grip on the fibre with the other. Then quickly but smoothly lower the drop weight until the fibre becomes straight again, then releasing grip on the weight. If this is done without delay and the mini-capstan is at an appropriate speed the drop weight should still be well above the UV lamp entry and can be guided into it.

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*Note: If the applicator is pre-wetted, the fibre will have picked up some coating material. However if the above procedure is followed correctly, at no point should it be necessary to handle wet fibre with either hand. Once this happens, resin is easily transferred to many other surfaces, controls, tools, etc., spreading contamination around the coating area. If the coated fibre touches the UV lamp quartz liner tube before it's fully cured, then it can stick to it, aborting the thread-up. However with the drop weight correctly applied (fibre placed centrally in the gripping zone), this will not happen.*

*Note: when threading up pre-wetted applicators, the fibre must never be raised, even slightly, once it has passed into the coating chamber, as resin can then be transferred from the coating chamber onto the entry die which may then flood when the resin valve is turned on.*

---

On the wet-on-dry dual coating system, when passing the fibre through the primary applicator, do NOT turn on the resin valve. For the secondary applicator (or the sole applicator if single coating) turn the resin valve on immediately after fibre is passed and drop weight has been attached. A few seconds delay should not risk fibre abrasion of the coating die but if possible turn on the resin valve before the fibre passes through the UV lamp.

Remove the UV lamp cover and guide the weighted fibre into the UV lamps.

Ensure the fibre stays straight above the applicator as it passes through the UV lamps. If it forms a loop and touches surfaces above the applicator it can transport particles into the entry die. Therefore if the fibre touches or snags on anything, cut the fibre and clean entry die.

During thread the fibre through the lower part of the tower, should the fibre stop moving through an applicator whose resin supply has already been switched on, coating should immediately be turned off and the attempt aborted. Pressure in the coating chamber will have pushed resin back through the entry die. Therefore for applicators suitable for wet starting, the entry die should be removed, re-cleaned and the coating chamber sucked out again before attempting to pass the fibre again. Primary coating applicators will need to be removed, cleaned and reinstalled.

Should fibre become wedged in a coating die, the applicator should be removed, cleaned and the coating die removed (see Maintenance section for details) Unblocking can then be attempted on the bench by a skilled engineer using approved methods and tools.

### Start of run

For dual coating systems, immediately after the fibre is on the main capstan, open the resin valve on the primary coating channel.



***Warning: any delay in starting the flow of coating resin will cause unnecessary wear to the coating die and hence every effort should be made to minimise it.***

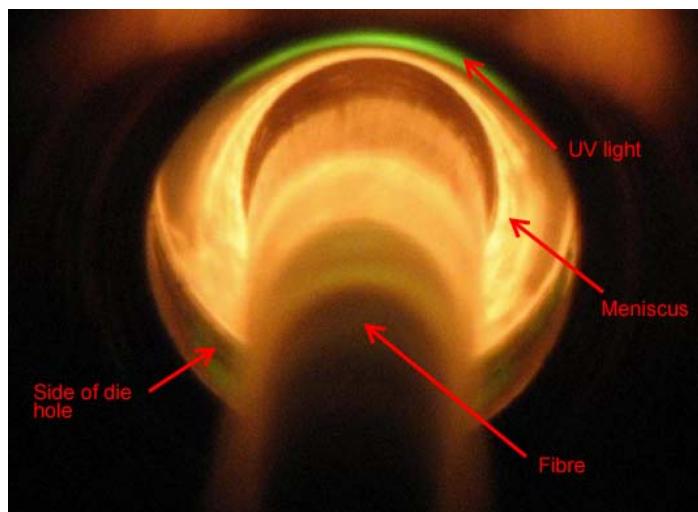
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On each channel in turn, fit the microscope and “find” the meniscus at the base of the entry die taper. Left/right adjustment of targeting is done by loosening the bracket mounting screws and pivoting the bracket before re-tightening the screws but once set, this should not require further adjustment. The meniscus will however need to be located in the up-down direction by pivoting the microscope body via the location pin location sleeve. This is locked in place by a thumbscrew.



**Warning: Care must be taken not to pivot the microscope too far towards the horizontal or the fibre will be touched by the objective lens. Therefore start with the microscope near vertical and then pivot it inwards whilst viewing through the lens.**

The meniscus should come into view as an orange patch of light. Note: the microscope image is inverted and so the fibre enters the die from the “bottom”.



Coarse focussing is done by sliding the microscope body in and out of its location sleeve, first slackening the thumbscrew that secures it. However if this is not disturbed on removal, then only fine focussing should be required and this may be done by moving the eyepiece in and out. Focus on the meniscus itself, not the hole in the die above it. If the image remains blurred there may be resin on the bubble stripper window in which case rotating the bubble stripper one way or the other may allow a cleaner zone to move into the line of sight. Alternatively there may be resin on the eyepiece or objective lens. These may be cleaned with a lint-free wipe moistened with alcohol.

The meniscus should be properly formed, approximately central in the entry die, the neck of the die should be dry and free of particulates, textile fibres etc. If any of these problems are found, it is best to abort the run, then remove and clean the entry die before starting again. On a wet-on-dry system, if this is the primary channel, the whole applicator will need to be cleaned.

Check bubble stripper CO<sub>2</sub> is connected properly and flow is normal.

Where concentricity monitors are fitted check both concentricity patterns for normal behaviour.



The patterns at this stage may not be perfectly symmetrical or steady, but should not be jammed over completely on one side. This would be a sign of a particle jammed in the coating die for which the only solution is to abort the run immediately as the situation is most likely unrecoverable and may damage the die. The coating cartridge should be removed, cleaned and the coating die carefully inspected under the microscope and its concentricity to the secondary also checked.

Check coating pressures and diameters are as expected for the current line speed.

### Ramp up

During ramp up, check at intervals that coating pressure, meniscus and concentricity pattern is normal on each channel (see Process Optimisation section for details).

Avoid overshoot of line speed or fibre diameter. If fibre diameter continues to increase rapidly beyond the target value, this could indicate a runaway situation that will end in die blockage so be ready to cut the fibre before this can happen. Fibre cooling may also be reduced to a level where entry die flooding may occur.

As final line speed is approached, confirm meniscus appearance, concentricity patterns, coating pressures, CO<sub>2</sub> flow and coating diameters are all normal.

### During run

Periodically check all pressures, meniscus, CO<sub>2</sub> flow, coating diameters and concentricity patterns if appropriate.

## **End of Drawing**

Ensure coating has switched off after the end of drawing (along with UV lamps, furnace, preform feed and capstan). Check fibre break detector if this does not happen. The coating must not overflow from entry die into the bubble stripper cap.

Remove spilt resin and fibre debris from coating area.

Cover coating applicator with a lint-free wipe.

Clean mini-capstan rollers.#

## **Maintenance Procedures**

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### **Resin Purging**

There are four versions of resin purge that can be done, the one selected depending on the circumstances.

#### **Delivery block purge**

This is a usually brief and low pressure purge performed with the coating cartridge removed where resin wells up out of the port on the top of the delivery block and drains away via the central fibre exit hole into the resin bowl placed underneath. Purge pressure has to be carefully limited (usually < 1 bar) or resin will overflow the rim of the block. This is done briefly before fitting a cleaned applicator to ensure the delivery gallery is full and any particles at its exit have been flushed away. It can also be done for a longer period as a check for bubbles in the delivery line using a torch light and magnifier focussed onto the exit port.

1. Remove coating cartridge, if fitted.
2. Ensure a resin catch bowl is under the delivery block to catch drips from the coating die.
3. Set a pressure of <1 bar and open resin valve (exact pressure will depend on resin viscosity, line resistance etc.)
4. Purge for as long as required. If prolonged keep a careful watch on resin level and reduce pressure if required to stop an overflow.
5. Ensure delivery block is then immediately covered with a clean light-proof cover.

#### **Line purge to waste container**

“Line purging” is a higher flow version of a delivery block purge where a Purge Cap is fitted to it. This pipes resin away directly to a waste container, so removing any limit on the line pressure that can be used. This should be done routinely, e.g. every week, after any prolonged period of inactivity and also at any time that die purge flows do not stop immediately the valve is closed or when the coating chamber fails to stay dry after emptying with syringe. Either of these last two conditions suggest the presence

of air pockets somewhere in the delivery line, a potential source of coating defects.

Another use for line purging is following any disturbance or replacement of parts in the resin delivery line, e.g. line filter, where air has been introduced into the system and needs to be removed thoroughly. Likewise, if a resin vessel liner has been replaced, necessitating lifting of the dip tube above resin level, an air pocket will be introduced as resin drains out of it and a line purge will be needed to remove. Similarly if the resin type has been changed but the delivery line has not been cleaned or replaced (which would be the recommended course of action), then a prolonged line purge will be required to displace the old material.

1. Remove the coating cartridge.
2. Fit the purge cap (part 284884) with its port lining up with that on the delivery block.
3. Fit a length of PVC tube to its spigot and direct into a waste resin container.
4. Check channel pressure is set to 3 bar minimum.
5. Turn resin valve on.
6. Wait for several minutes, watching resin passing through the tube immediately downstream of the cap for any signs of bubbles passing. Use a torch light and magnifier. If any bubbles are seen, continue until none have been seen for at least one further minute.
7. Turn resin valves off.
8. Remove purge cap, discard PVC pipe and clean cap for next use.

### **Coating Applicator / Cartridge Purge**

On single coat systems and on the secondary channel on a wet-on-dry coating system where wet starting is adopted, before any draw start, resin is purged into the applicator with the entry die removed until it fills the chamber above the coating die. This displaces air in the delivery galleries and minimises the residual air in the coating chamber although the chamber has then to be partially re-emptied with a syringe to prevent wetting of the entry die when it is refitted.

1. Remove entry die, if fitted.

2. Thoroughly clean the tip of the syringe needle with an alcohol-moistened clean lint-free wipes. Blow it off with a filtered air gun.
3. Ensure a resin catch bowl is under the applicator to catch drips from the coating die.
4. Set a pressure of around 0.3 bar and open resin valve.
5. Purge until resin begins to fill up hole in bottom of entry die holder.
6. Suck out the resin from the entry die holder and coating chamber with the syringe until all free liquid has been removed.
7. Screw in entry die (see note below), fit bubble stripper cap and cover with a lint free wipes.

### **Applicator / Cartridge Purge to waste container**

On single coat systems and on the secondary channel of the wet-on-dry coating system where wet starts can be adopted, it is possible to perform an enhanced form of the applicator purge normally carried out before passing the fibre. For this purpose a purge adaptor is provided that screws into the entry die holder in place of the entry die. Like the purge cap, this has a spigot to which a PVC tube can be attached.

This can be used as a line purge with the applicator in-situ but its primary purpose is to guarantee that any remaining air bubbles in the resin pathway inside the applicator have been flushed out. This is not normally required as trapped volume in the resin pathway is anyway kept to a minimum and the normal applicator purge is sufficient to achieve this. Clearly, nothing can be done about the air pocket in the coating chamber itself but this is a vigorous circulation zone and so bubbles in this zone are normally dispersed and vented quickly after thread-up. However should coating defects prove a problem, and blow-outs are suspected as the source (see above section on minimising coating defects), then this enhanced applicator purging is an option.

1. Remove the entry die
2. Fit the entry purge adaptor (part 285029)
3. Fit a length of PVC tube to its spigot and direct into a waste resin container
4. Check channel pressure is set to 1 bar minimum.

5. Place a resin catch bowl under the applicator to catch drips from the coating die.
6. Turn resin valve on
7. Wait 2-3 minutes, watching resin passing through the tube and dropping into the container for any signs of bubbles passing. If bubbles seen, continue until they have stopped for at least 1 minute.
8. Turn resin valve off
9. Remove entry purge adaptor, discard PVC pipe and clean adaptor for next use.

## Applicator Alignment

### Preliminary notes

The nature of a “hanging meniscus” coating applicator is that the meniscus applies no controlling force on the position of the fibre in the primary die, so centring forces generated by flow patterns in the die are unopposed and the fibre is maintained in the middle of the die, so giving good coating concentricity to the fibre. However if there are any external lateral forces acting on the fibre along the tower axis, these will be transferred directly to the fibre in the applicator pushing the fibre off centre in the primary die.

One potential source of such external forces is horizontal displacement of the applicator away from the tower axis (i.e. a straight line between the preform tip in the draw furnace and the input guide pulley to capstan at the bottom). Significant misalignment between the applicator and the tower axis could therefore result in coating concentricity error.

Lateral forces on the fibre are also generated by clean air flow across the cooling zone between furnace and applicator and could also result in coating concentricity error. Therefore clean air velocity should be kept to the minimum consistent with the maintenance of particle-free conditions on the fibre line.

### Alignment procedure

Before attempting alignment of the coating system, a good quality spirit level should be used to ensure the top face of the delivery block is precisely level on both axes. As necessary adjust the XY tilt screws until this is achieved. Subsequently,

levelness of the applicator should be rechecked daily or before refitting a cleaned die assembly, whichever is sooner.

A tensioned fishing line is now installed on the tower's fibre line between top and bottom datums, these being respectively the centre of the bare fibre diameter gauge window just below furnace level and the input guide pulley to the capstan.

First, coarse alignment is done using coating system XY table adjustment to centre the line by eye in the central 6 mm hole in the adaptor block itself.

For fine alignment, a split alignment plate (283838) is provided which locates onto the top surface of the adaptor block. One half of the alignment plate is then fitted into position against the rim on the block top surface and fine adjustment made until the line is sitting in but not touching the 1 mm semi circular aperture. The other plate half is then fitted and final adjustment made until the line is in the exact centre of the 1 mm aperture. Use of a magnifier lens and torch are recommended for this. Note and record the XY table micrometer settings.

It is recommended that any Helium cooling tube's alignment is then checked, especially that of the bottom doors and adjustments made as necessary before the fishing line is removed.

Alignment of the applicator should be checked at regular intervals, e.g. monthly.

## Resin Delivery System

Before every run, check resin level in all vessels and ensure there is sufficient material remaining for the intended draw. Even if resin vessel heaters are used, coatings should still be fully conditioned according to the manufacturer's instructions before filling the vessels.

If refilling is performed, ensure sufficient time is then allowed for bubbles to disperse before starting the run. Remove any dust from the lids and tops of the vessels and the resin containers before opening them to prevent potential contamination. When opening vessels, always check cleanliness and condition of gaskets/O rings on the lid. Clean or replace as required. When filling place lids so that where they cannot become contaminated.

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*Note : As the dip tube passes through the lid, this is also withdrawn when the lid is removed. Resin will run off it and therefore will have to be contained. There is also the risk of contamination that will then be transferred into the vessel. Resin draining from the dip tube inevitably allows air into the resin line. Therefore the line must be purged after each fill to remove this air (see resin purging above). If a liner bottle is being used, and the depleted bottle can be lifted out as the lid is removed, holding it above the dip tube. This can then quickly be swapped with a full one so minimising the issues described above.*

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Excessive ambient light levels can result in pre-curing of resin in the vessels and in the dip tube. Therefore it is strongly recommended that light levels in this area are limited or low UV emission strip lights installed. However opening times for the vessels should anyway be kept to a minimum.

During every run note and record the coating pressures used on both channels during steady state drawing. If this is seen to be rising progressively with run sequence it may indicate that the filter needs to be changed. It may be possible to reuse filters after cleaning and back-flushing with solvent, but this is not recommended as contamination can be transferred to the downstream side. In any case full flow capacity is normally not restored. If pressure rise is more sudden check water temperature/flow, resin line heating and pneumatic pressure to the valves.

Weekly check all exposed system joints for signs of resin leakage. Perform a line purge on each channel of sufficient duration to expel any air bubbles which may have collected along the resin pathway inside the coating assembly. Wipe clean all exposed surfaces of fibre debris, resin spillages and other contamination.

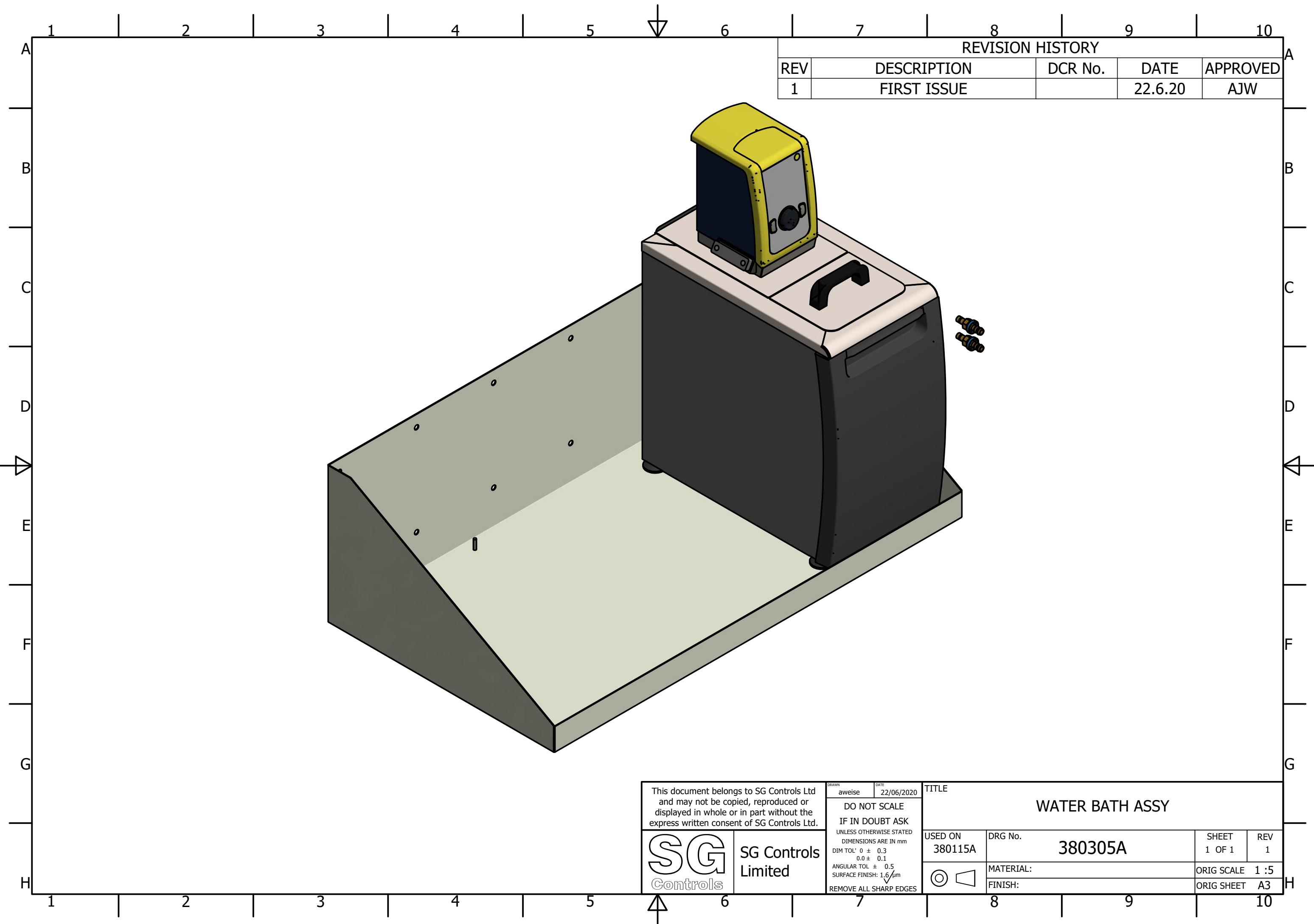
Whenever a VCO or VCR joint is undone for any reason, the O ring or gasket as appropriate must be replaced with a new one before the joint is remade. Whatever the type of joint that has been disturbed, the resin line must then be purged thoroughly to vent any trapped air this has introduced.

## Water Circuit

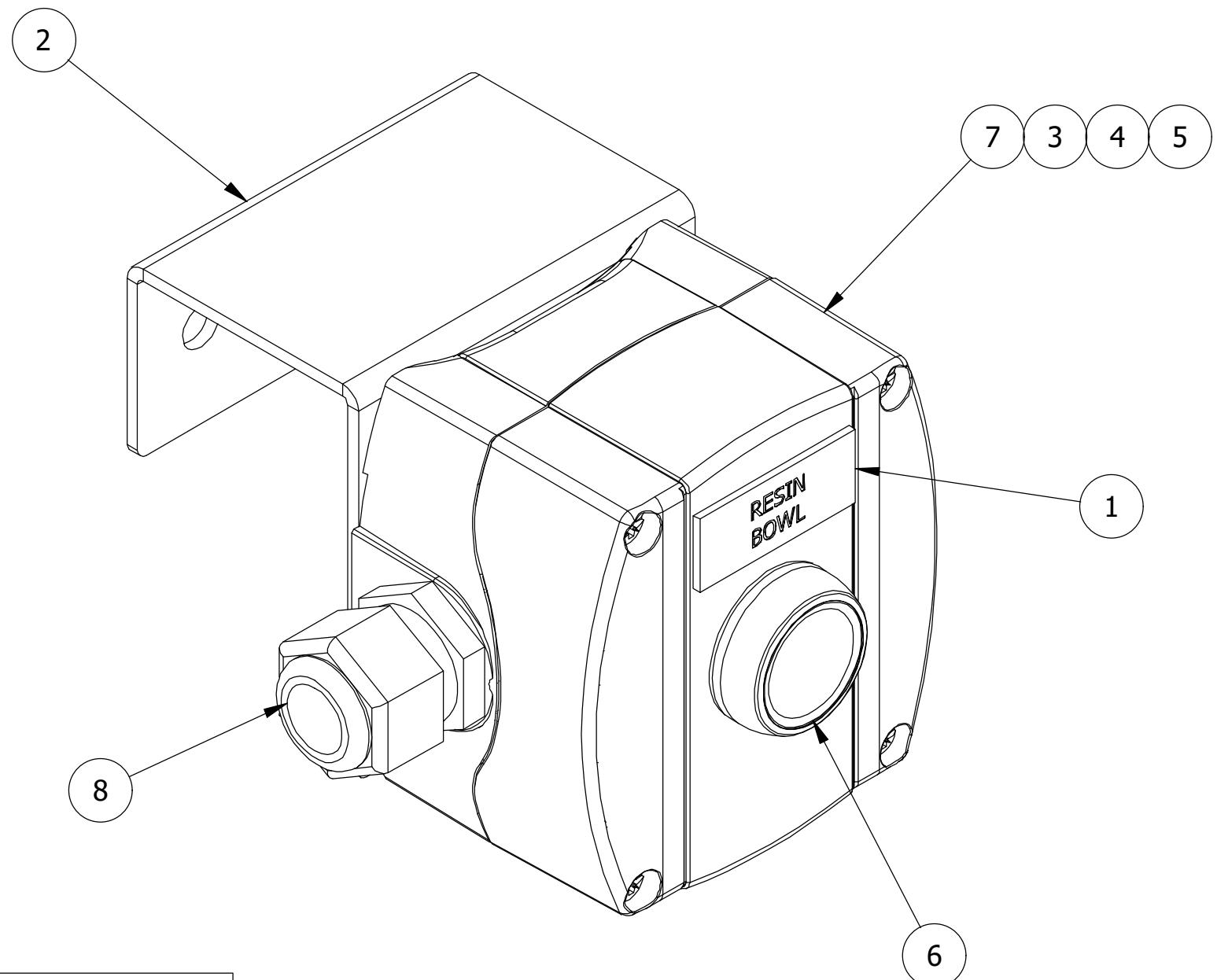
Before every run check resin block temperature; if abnormal, check water circulator setting and condition.

At least weekly check water level and condition in the circulator and top up as required with ready-mixed corrosion inhibitor solution. Check water flow is normal Check for any leaks in the system.

On an annual basis, or sooner if required, drain the system completely, fill with clean water, circulate for several minutes, drain again and refill with ready-mixed corrosion inhibitor solution.



1	2	3	4	5	6	7	8	9	10	
A						REVISION HISTORY			A	
B						REV	DESCRIPTION	DCR No.	DATE	APPROVED
C						1	FIRST ISSUE		11/02/19	LAR



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	283830-165	LABEL - RESIN BOWL
2	1	284978	MOUNTING BRACKET
3	1	EE048400	PLASTIC LATCH, AB 800F-ALP
4	1	EE048402	CONTACT BLOCK 1N/0, AB800F-X10
5	1	EE048407	LED MODULE 24V AC/DC, WHITE AB 800F-N3W
6	1	EE048412	ACTUATOR ILLUMINTED MOMENTARY CLEAR, AB 800FP-LF7
7	1	EE049036	PLASTIC ENCLOSURE 1-GANG GREY, 800F-1PM
8	1	EE067092	GLAND M20 7-13mm BLACK - NO NUT

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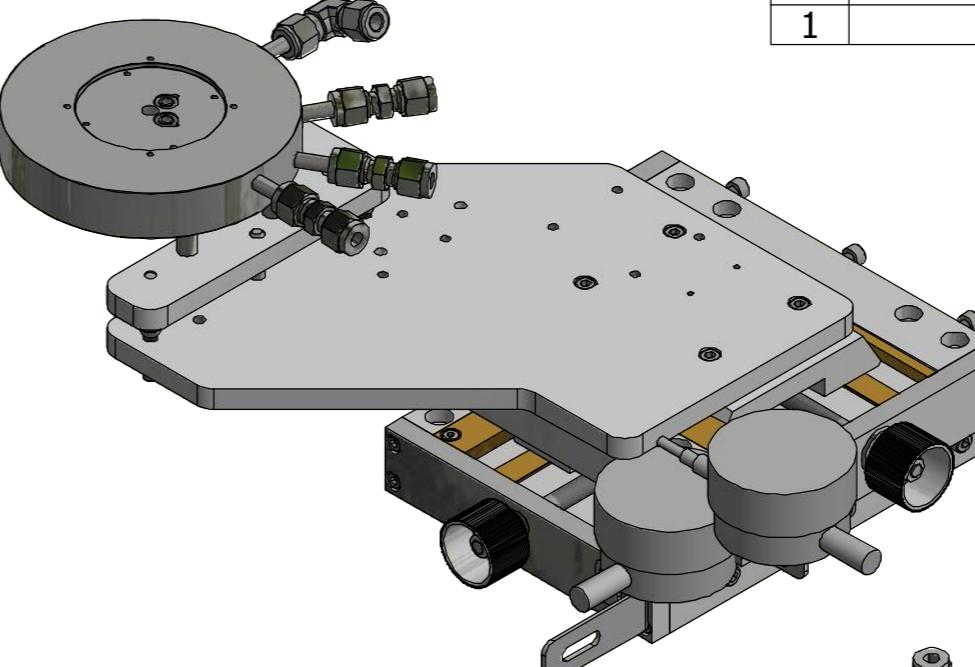
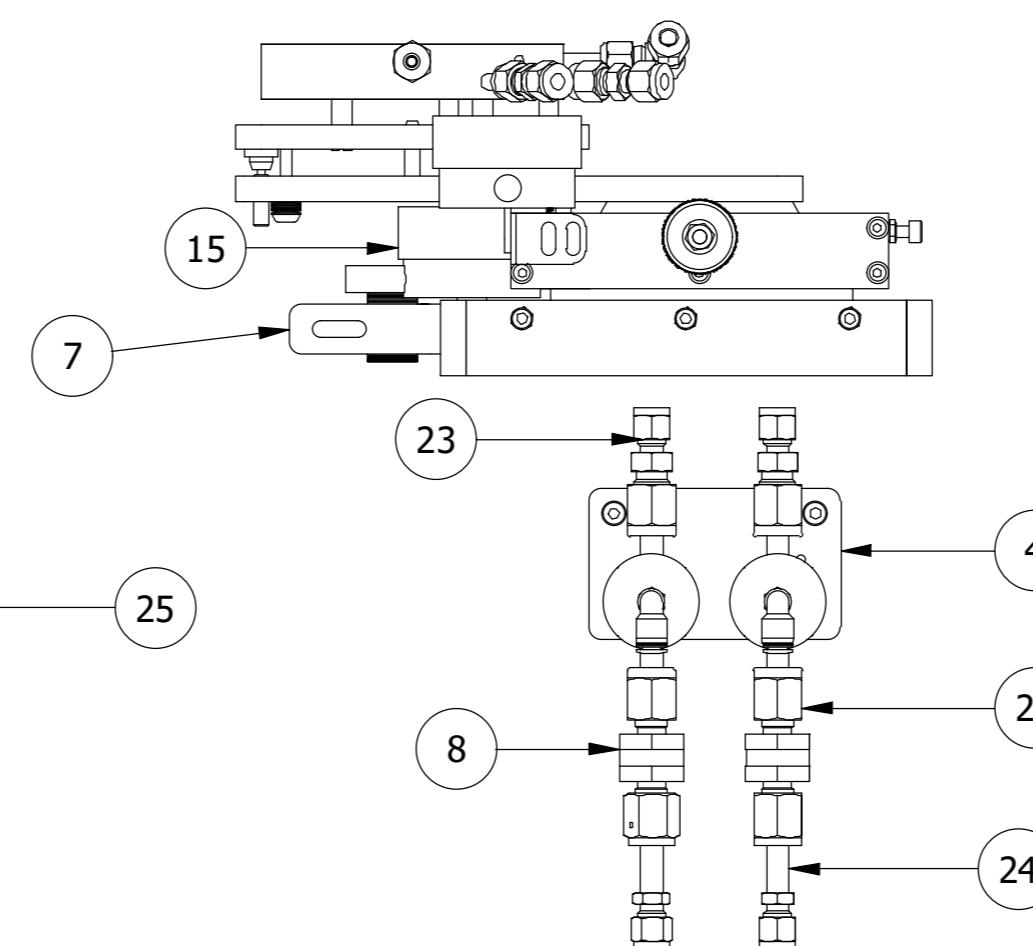
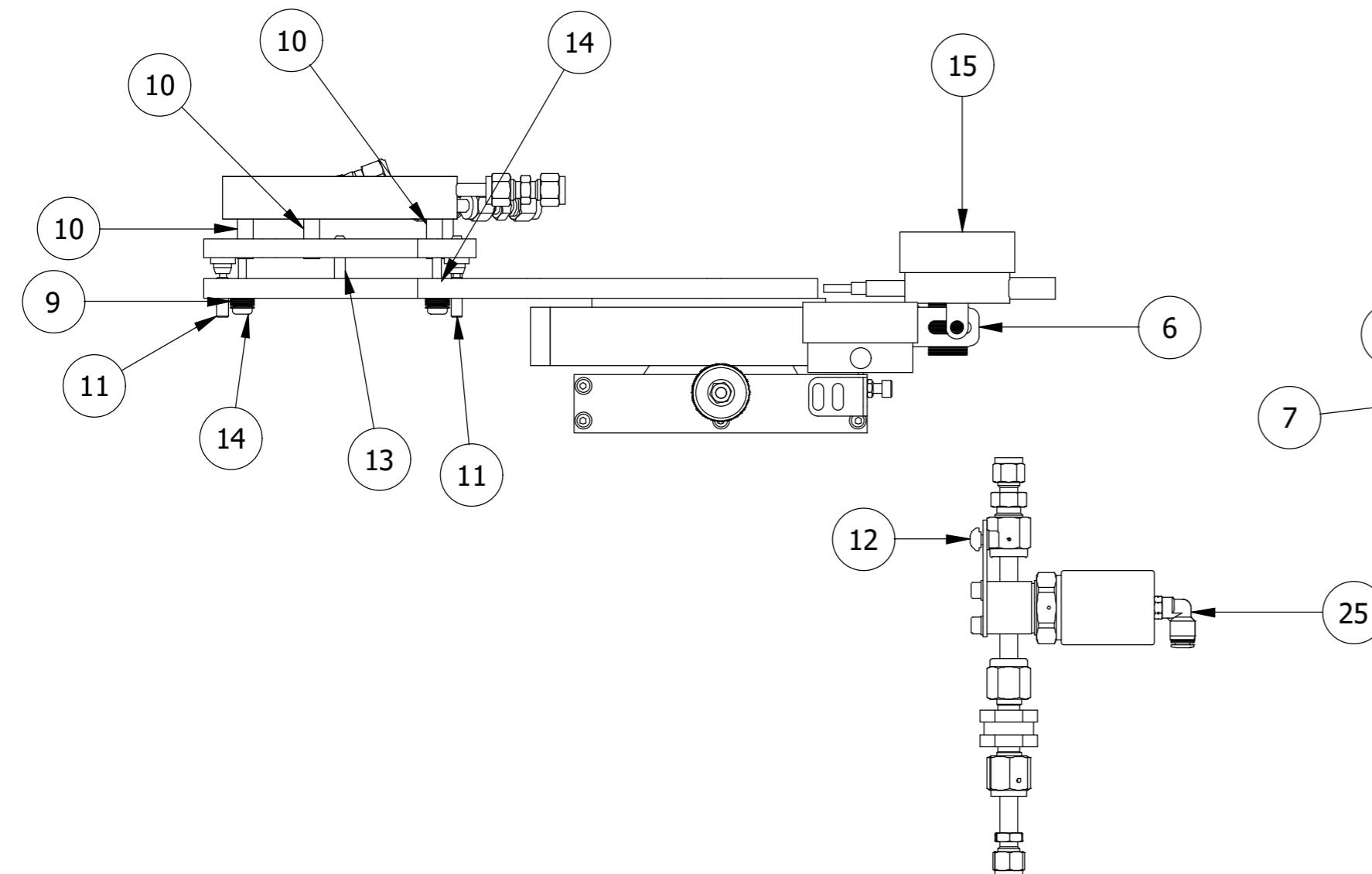
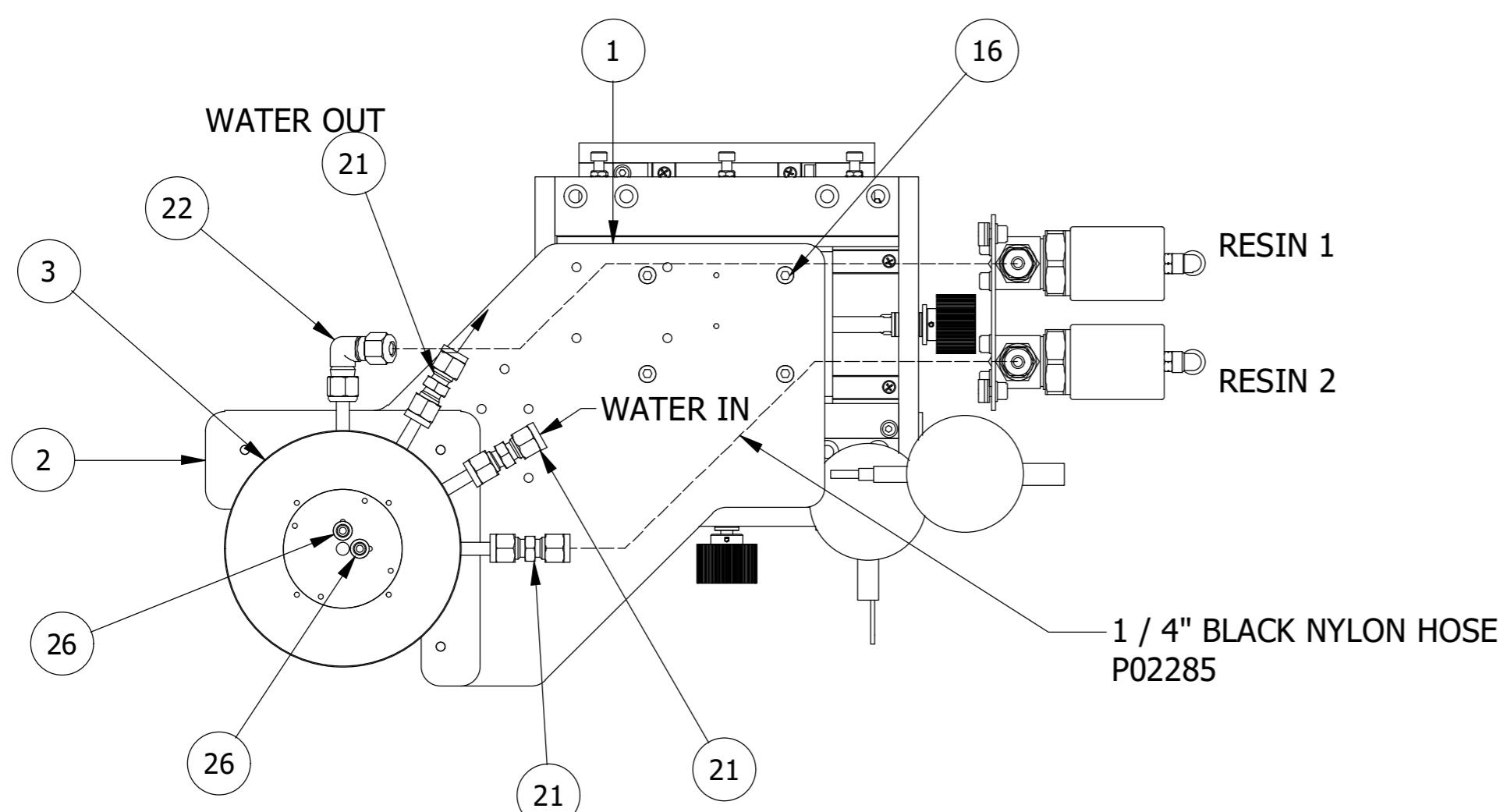
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LAR 08/02/2019  
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UNLESS OTHERWISE STATED  
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0.0 ± 0.1  
ANGULAR TOL: 0.5  
SURFACE FINISH: 1.6 µm  
REMOVE ALL SHARP EDGES

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1	FIRST ISSUE		12.2.18	CK
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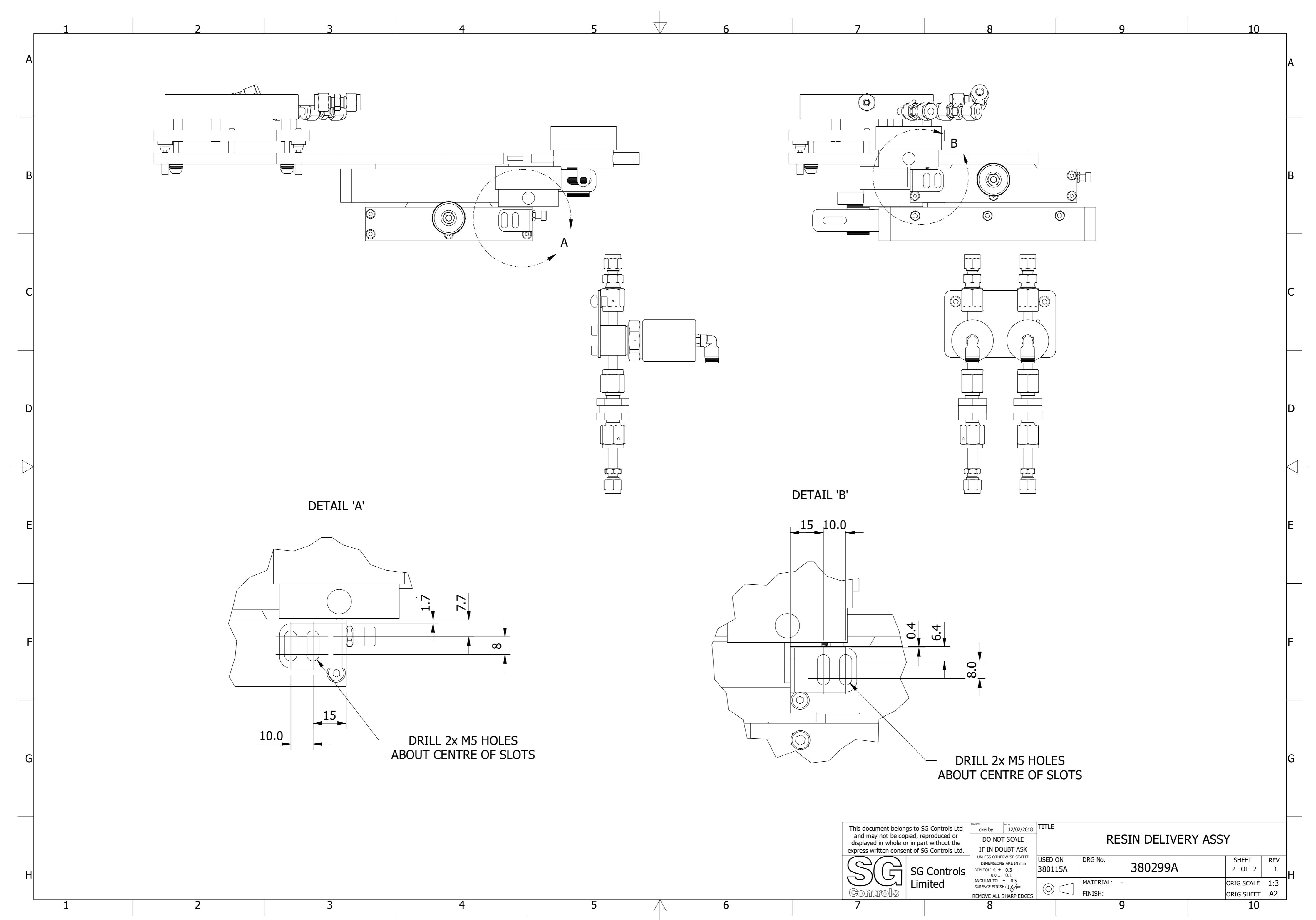


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2	1	284857	ADJUSTING PLATE
3	1	284870	RESIN DELIVERY BLOCK
4	1	284871	VALVE BRACKET
5	2	289815A	SLIDE ASSEMBLY
6	1	380300	SLIDE GAUGE BRACKET SMALL
7	1	380301	SLIDE GAUGE BRACKET LARGE
8	2	F00149	FILTER FW SERIES
9	18	H04426	DISC SPRING SS
10	4	H04513	METAL COLLAR SS
11	3	H04515	SWIVEL SCREW
12	2	H04609	T NUT M5 8 SLOT
13	2	H04947	LOCATING PIN
14	3	H04948	COVER BOLT
15	2	H05349	LINEAR GAUGE
16	4	K00053	HxCpHd M5x16 S/S
17	6	K00061	Washer 5mm Std S/S
18	6	K00162	HxCpHd M5x8 S/S
19	4	K03193	CskSlt M4x25 S/S
20	6	P00627	1/4" VCR GASKET
21	3	P01961	UNION 1/4"
22	1	P02309	ELBOW UNION 1/4" S/S
23	2	P03304	REDUCING CONNECTOR
24	2	P03763	1/4" TO 1/4" COMPRESSION
25	2	P03804	PUSH FIT ELBOW 1/8" 6MM
26	2	S00518	O-RING 6.1 ID
27	2	V01560	1/4" DIAPHRAM VALVE N/C

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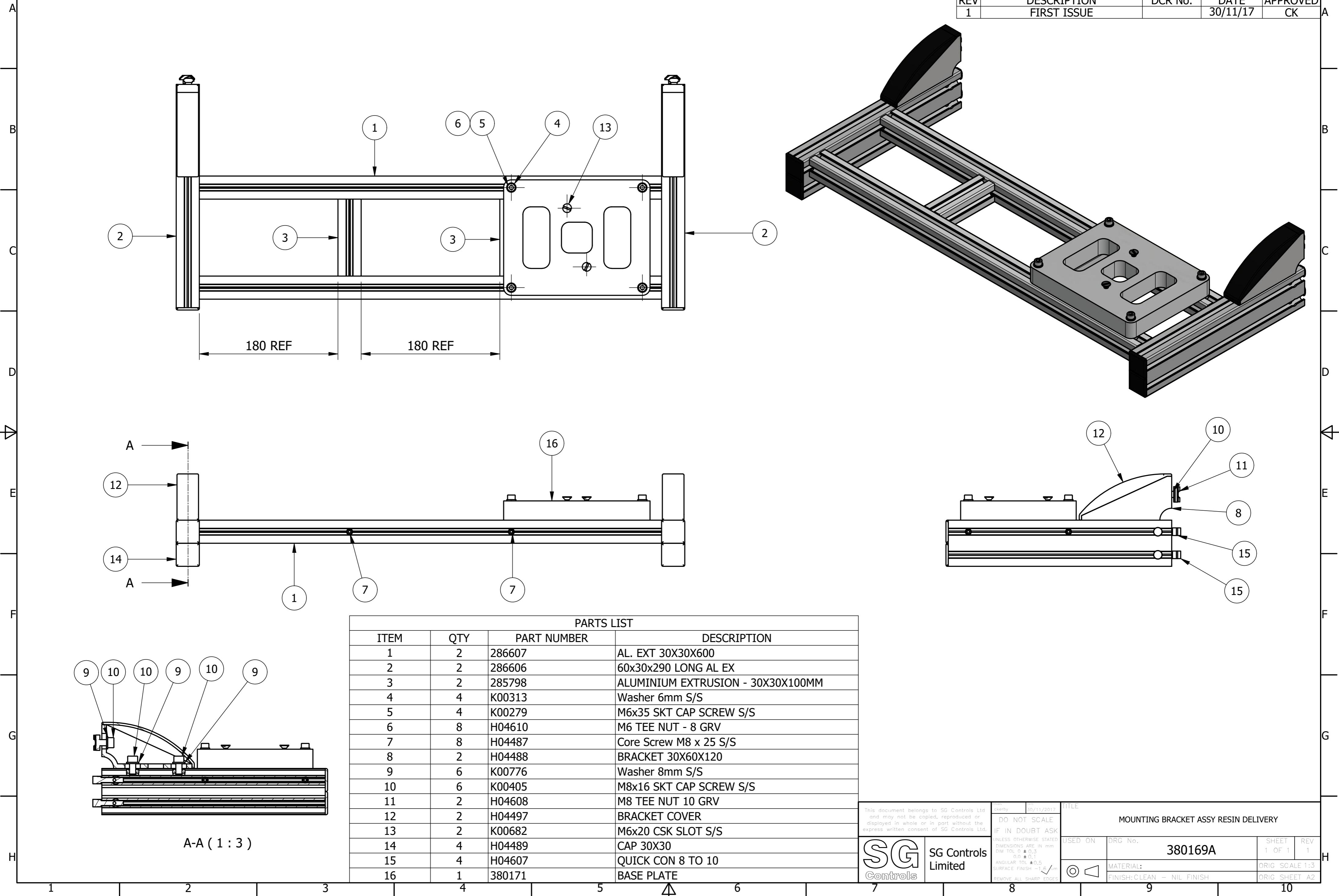
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ANGULAR TOL: ± 0.5		
SURFACE FINISH: 1.6 µm		
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FINISH: A2	ORIG SHEET	A2



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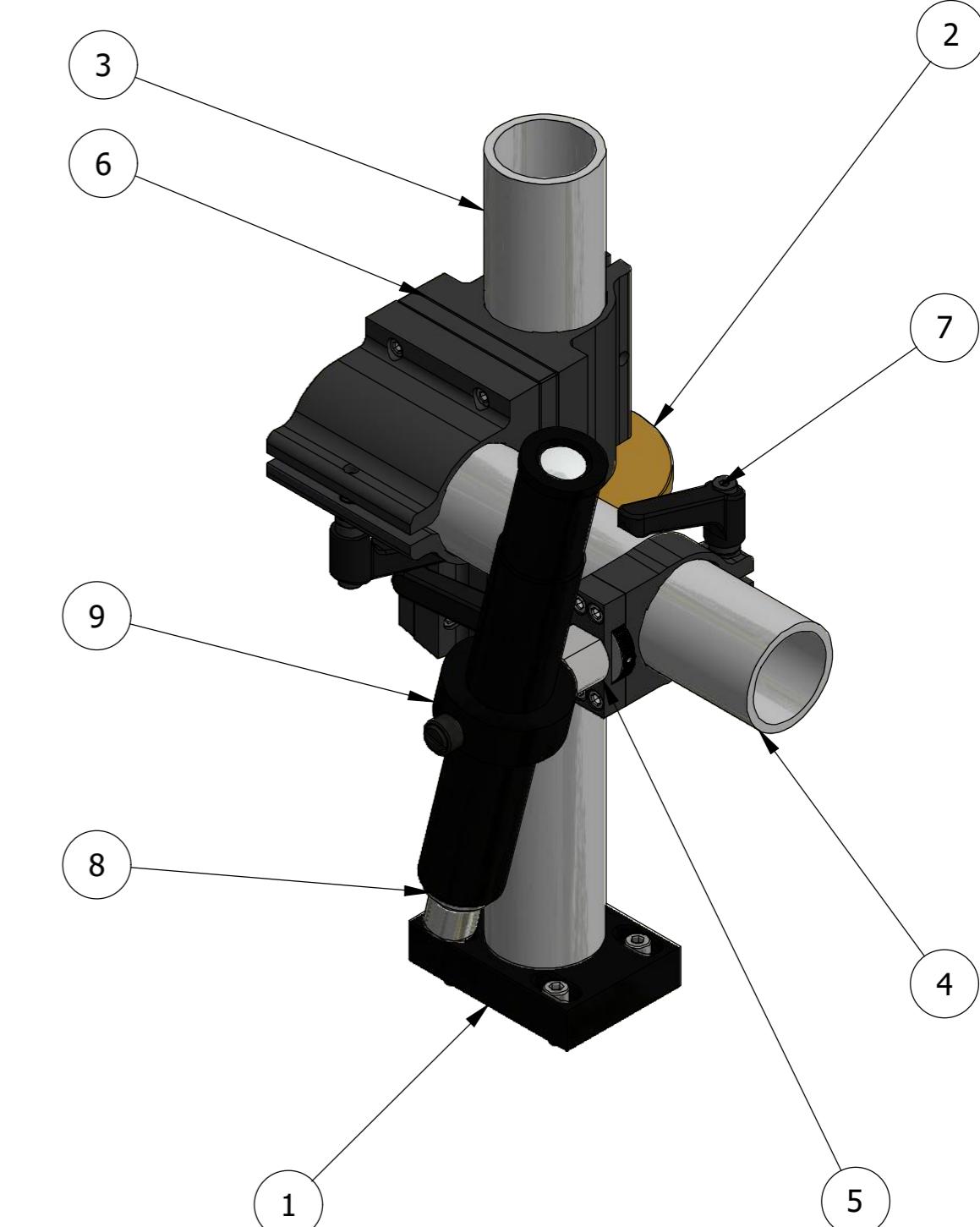
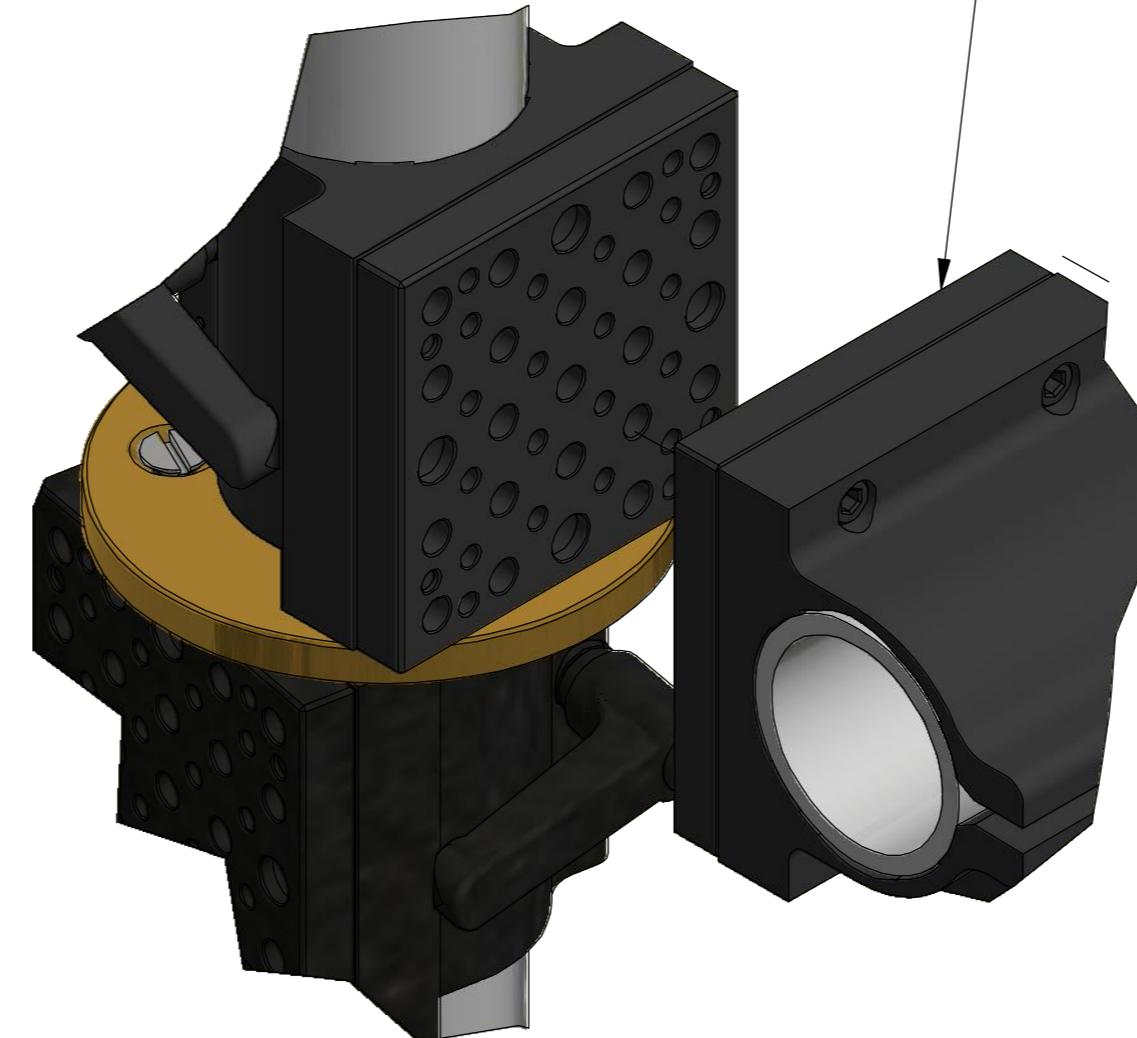
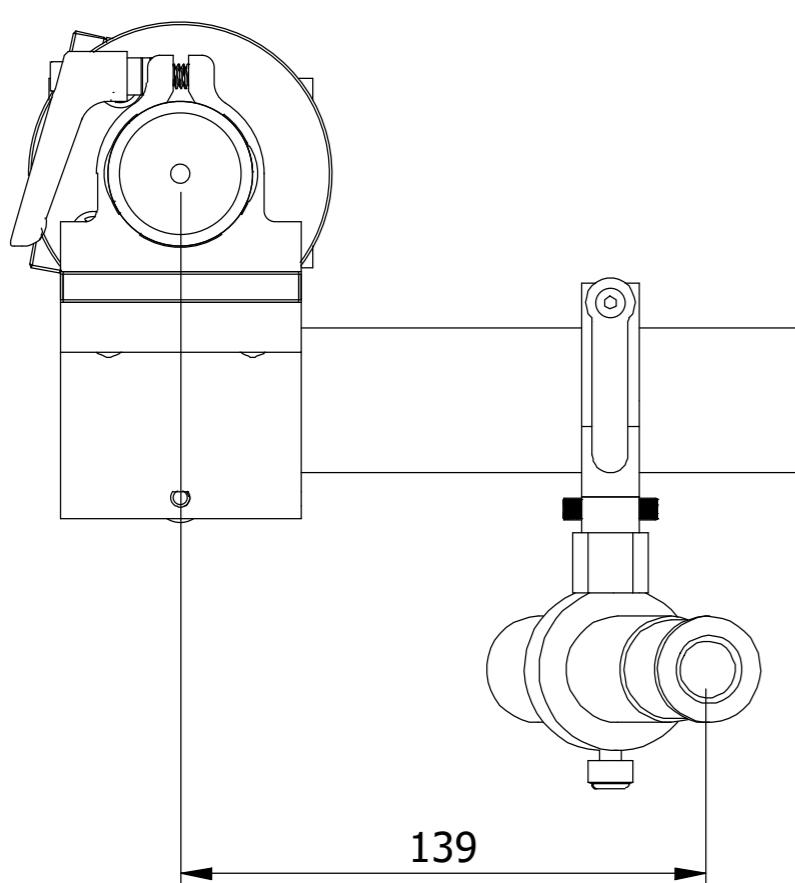
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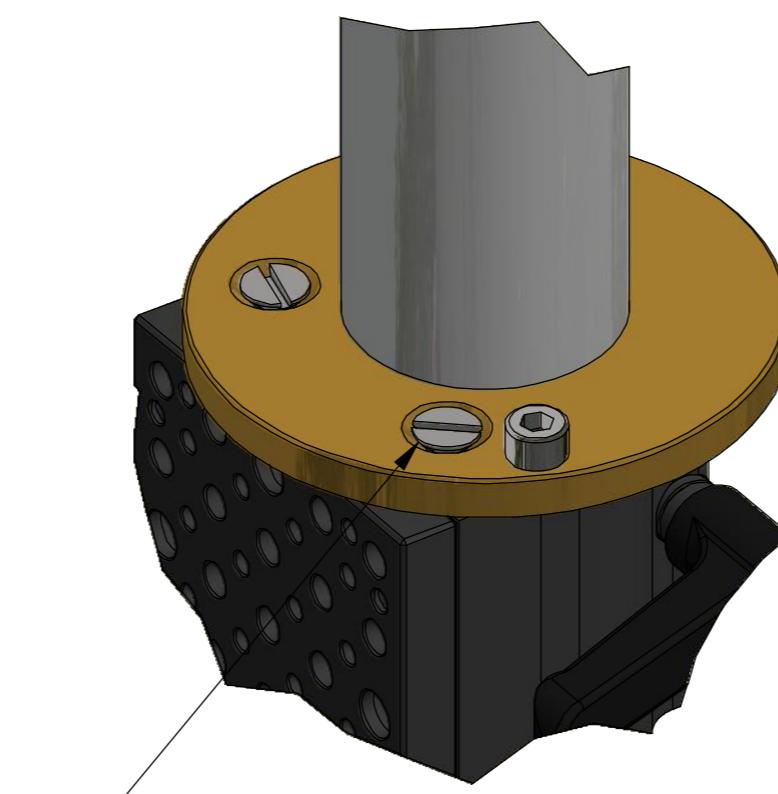
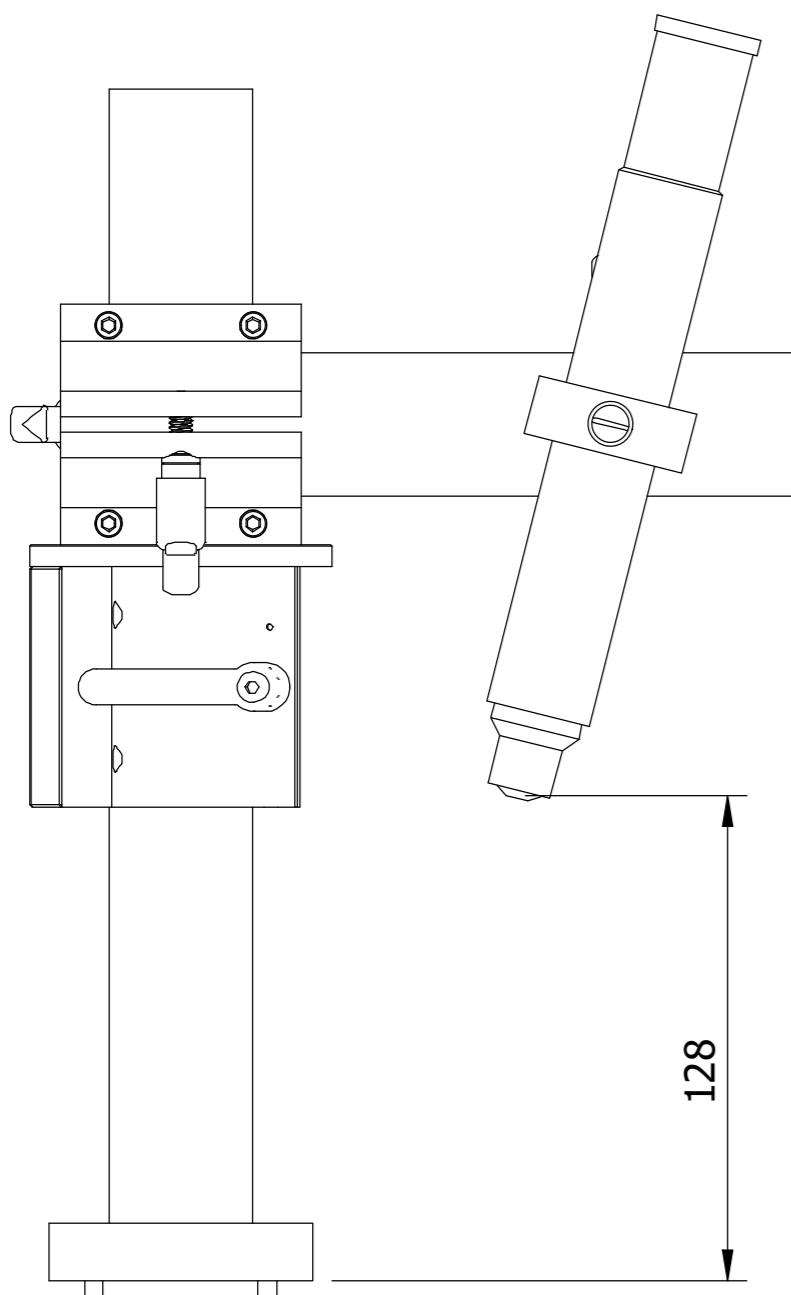


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REMOVE THIS CLAMP BASE FROM H05322 TO  
ENABLE TWO CAMPS TO BE ATTACHED TO EACH OTHER.



VIEW WITH UPPER CLAMPS REMOVED ( 1 : 1 )

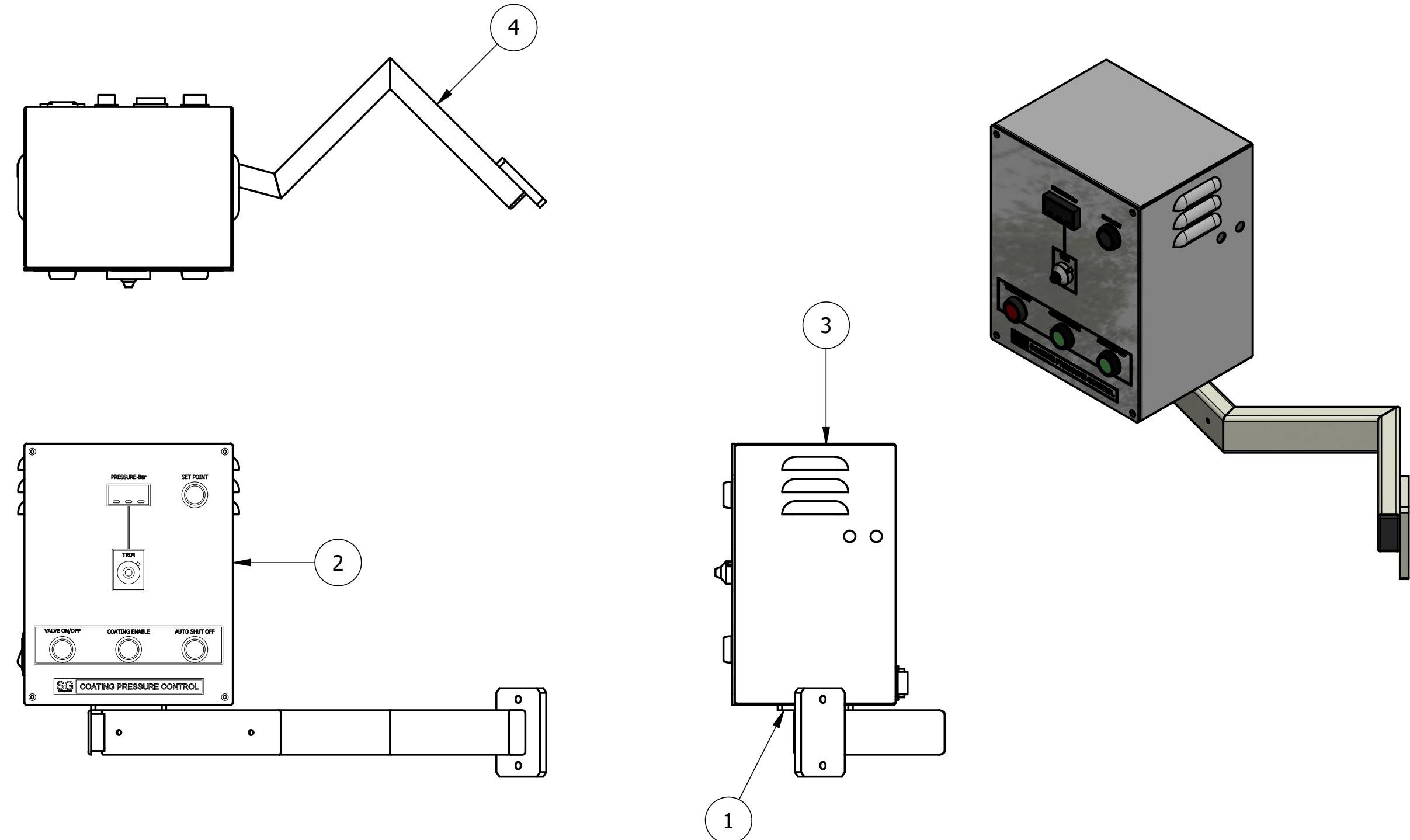


DRILL AND TAP 2-OFF M5x0.5  
x 12 DEEP IN TO MICROSCOPE CLAMP

PARTS LIST			
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2	1	283806	PIVOT/STOP PLATE
3	1	380142	LONG MICROSCOPE TUBE
4	1	380143	SHORT MICROSCOPE TUBE
5	1	380145	MICROSCOPE BOSS
6	3	H05322	MICROSCOPE CLAMP (LARGE)
7	1	H05323	MICROSCOPE CLAMP (SMALL)
8	1	N00035	MICROSCOPE X20
9	1	N00043	DIRECT MOUNT HOLDER

gregory	10/11/2017	TITLE	MICROSCOPE ASSEMBLY		
DO NOT SCALE IF IN DOUBT ASK					
UNLESS OTHERWISE STATED DIMENSIONS ARE IN mm DIM TOL 0 ± 0.3 0.0 ± 0.1 ANGULAR TOL ± 0.5 SURFACE FINISH - um/1.6 REMOVE ALL SHARP EDGES		USED ON	DRG No.	380115A	SHEET 1 OF 1 REV 1
		SG Controls Limited			
		(CIRCLE)	MATERIAL:		ORIG SCALE 1:2
		(TRIANGLE)	FINISH:		ORIG SHEET A2

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REV	DESCRIPTION			DCR No.		DATE	APPROVED		
1	FIRST ISSUE					29/11/17	CK		



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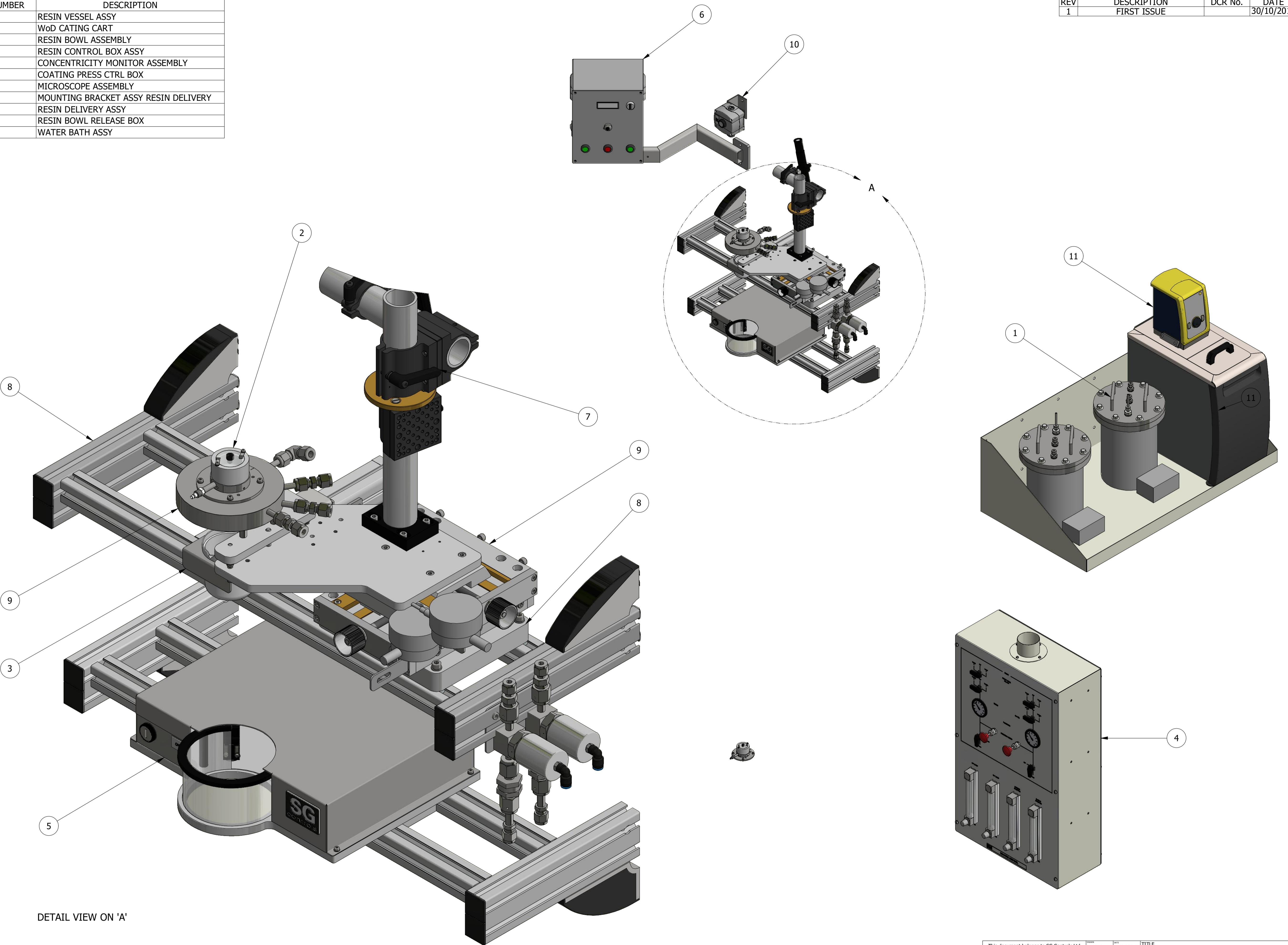
DRAWN BY: J. Cokerby DATE: 29/11/2017  
DO NOT SCALE  
IF IN DOUBT ASK  
UNLESS OTHERWISE STATED  
DIMENSIONS ARE IN mm  
DIM TOL 0.0 ± 0.3  
0.0 ± 0.1  
ANGULAR TOL ± 0.5  
SURFACE FINISH -1.6 µm  
REMOVE ALL SHARP EDGES

SG Controls Limited

USED ON	DRG No.	SHEET	REV
380134A		1 OF 1	1
MATERIAL:		ORIG. SCALE 1:5	
FINISH:		ORIG. SHEET A3	

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	284466A	RESIN VESSEL ASSY
2	2	284876A	WOD CATING CART
3	2	286599A	RESIN BOWL ASSEMBLY
4	1	289112A	RESIN CONTROL BOX ASSY
5	2	380114A	CONCENTRICITY MONITOR ASSEMBLY
6	2	380134A	COATING PRESS CTRL BOX
7	2	380144A	MICROSCOPE ASSEMBLY
8	2	380169A	MOUNTING BRACKET ASSY RESIN DELIVERY
9	2	380299A	RESIN DELIVERY ASSY
10	2	380302A	RESIN BOWL RELEASE BOX
11	2	380305A	WATER BATH ASSY

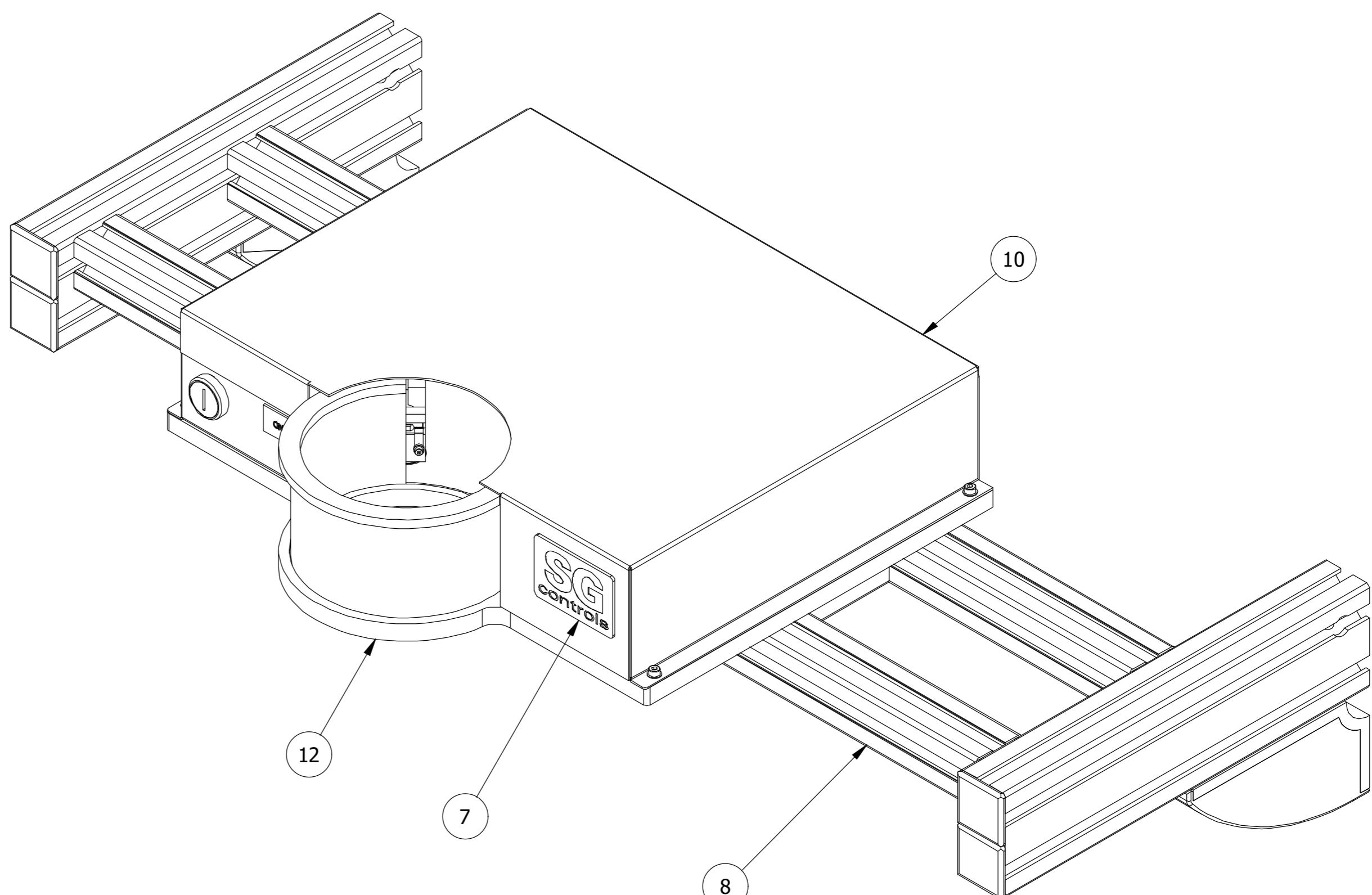
REVISION HISTORY			
REV	DESCRIPTION	DCR No.	DATE APPROVED
1	FIRST ISSUE		30/10/2017 CK



SG Controls	SG Controls Limited	COATING SYS - 2X WOD		
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DO NOT SCALE IF IN DOUBT ASK UNLESS OTHERWISE STATED DIM TOL: 0 ± 0.3 0.2 ± 0.1 HIGH: 0.25 mm SURFACE FINISH: 1.6 μm REMOVE ALL SHARP EDGES		DRAWN BY: [Signature] DATE: 30/10/2017		
USED ON	DRG No.	SHEET	REV	
380000A	380115A	1 OF 1	1	
MATERIAL: -	ORIG SCALE: 1:6	FINISH: A1		

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REVISION HISTORY									
REV	DESCRIPTION	DCR No.	DATE	APPROVED					

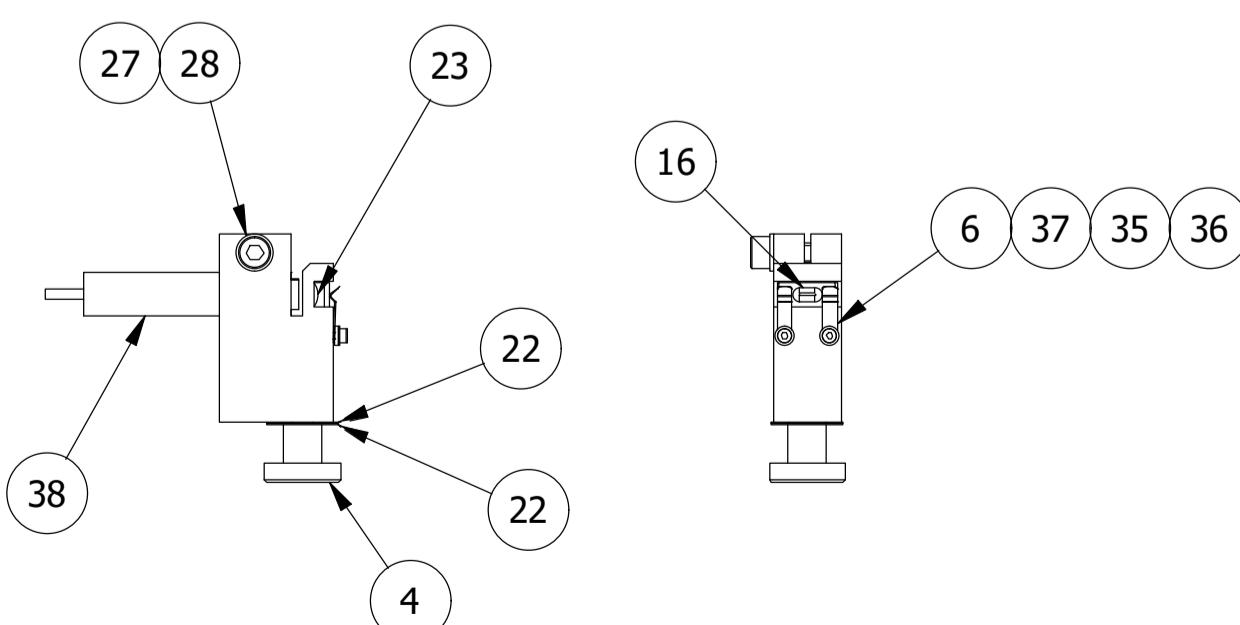
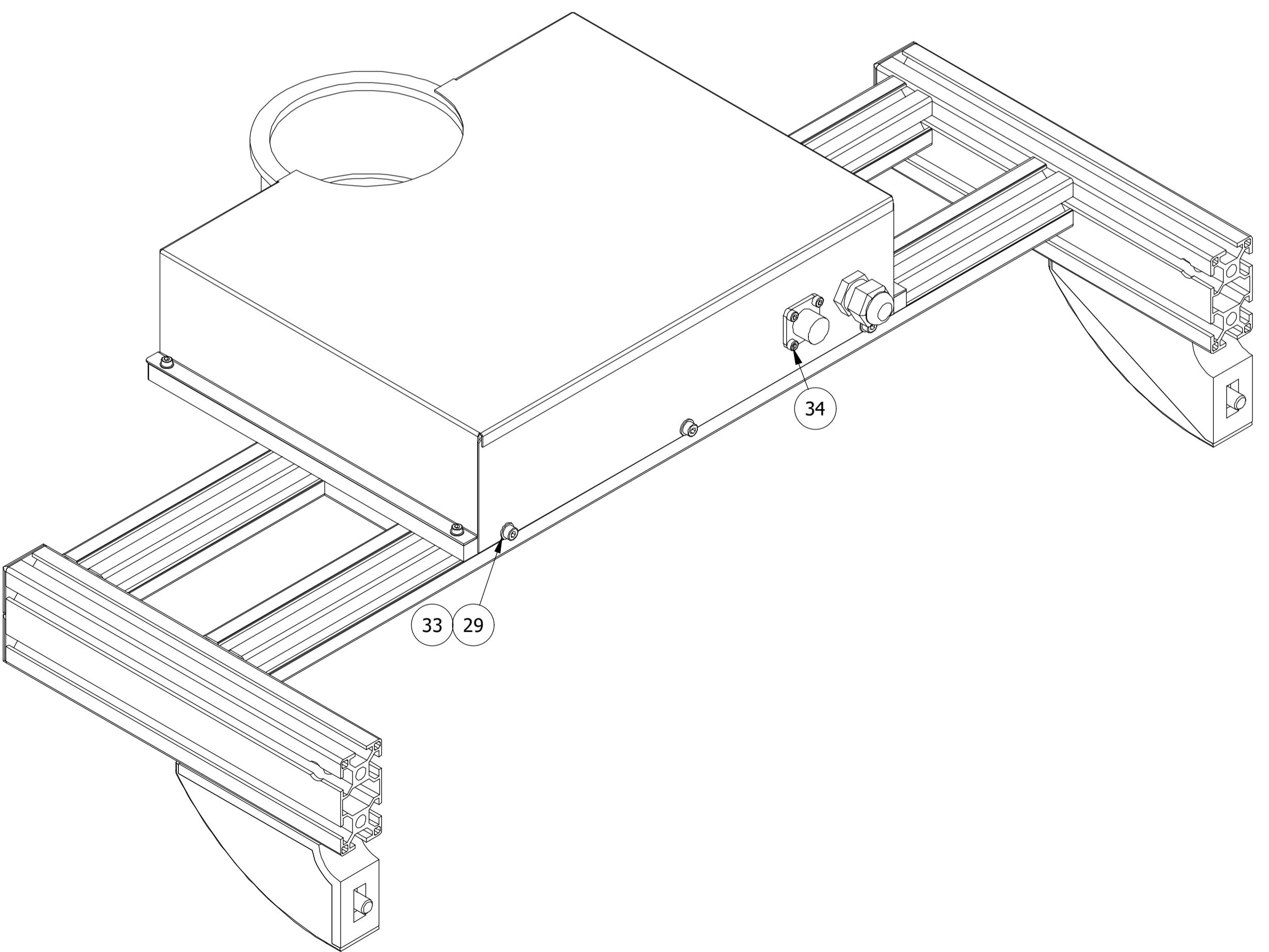
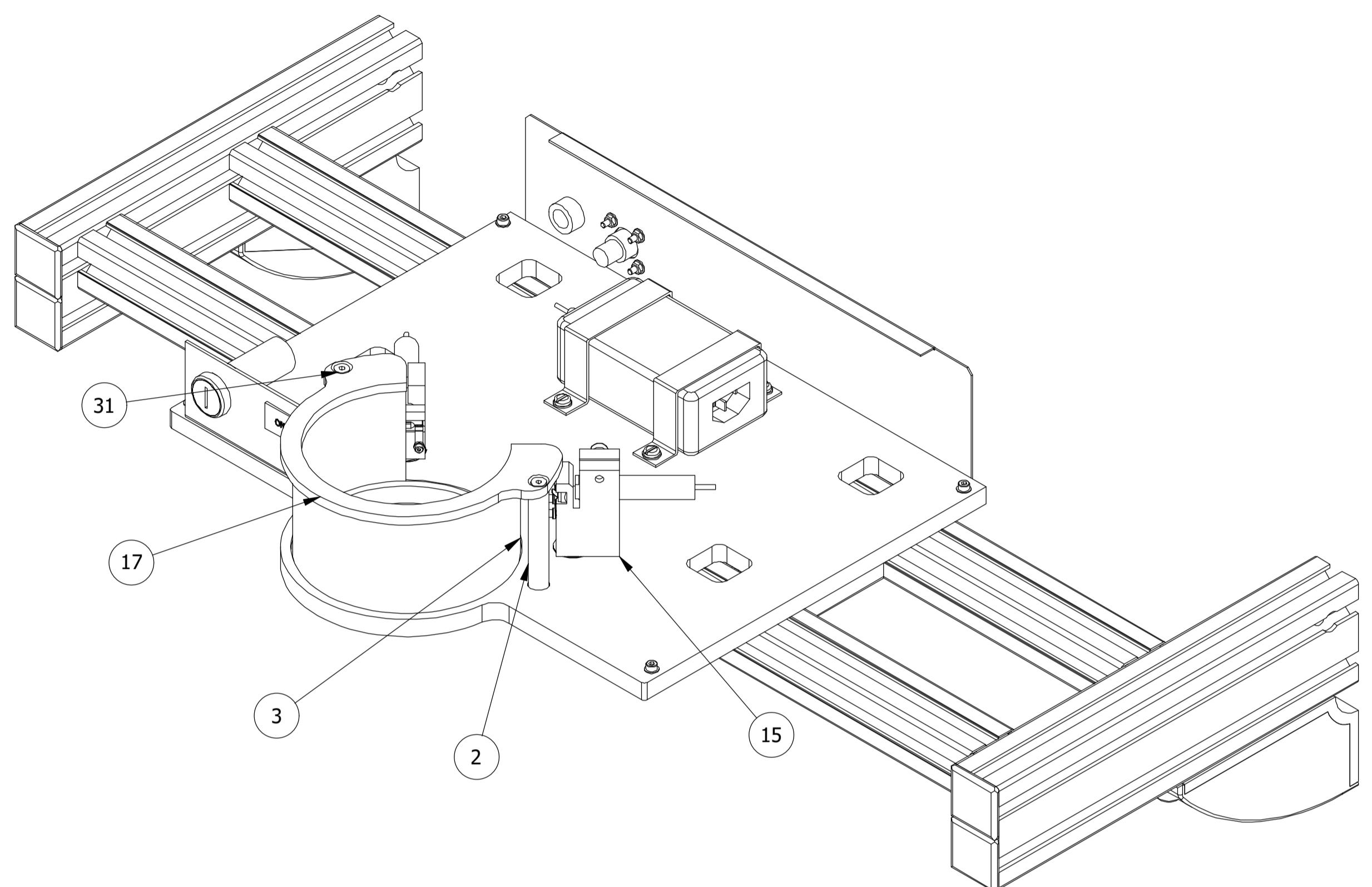
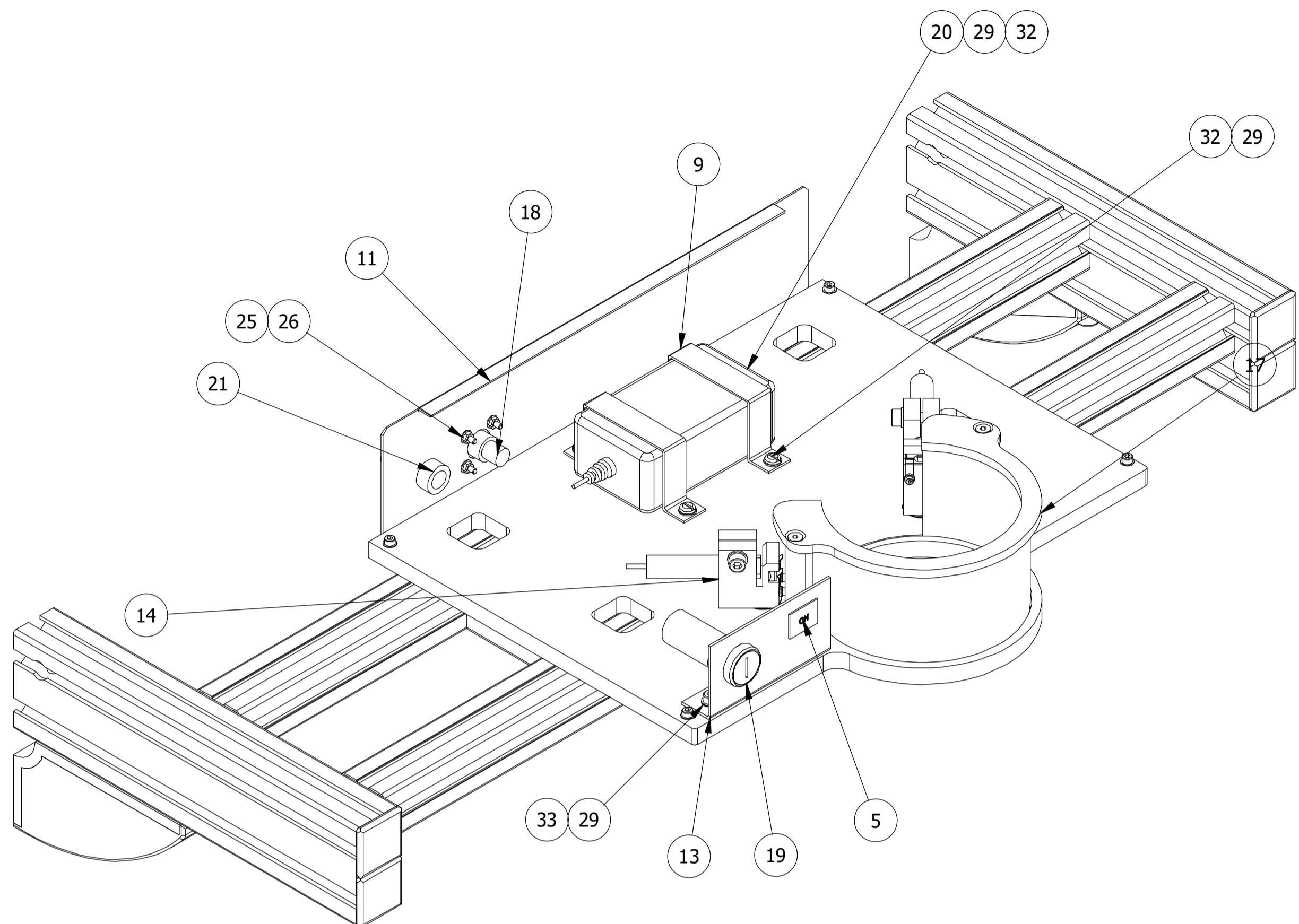
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	186495	CLAMP DISC
2	2	188120	PILLAR
3	1	188129	SCREEN
4	2	189184	PIVOT
5	1	283830-10	LABEL - ON
6	4	283867	SPRING CLIP - WINDOW
7	1	285114	MTG PLATE - SG LOGO
8	1	285397A	SUPPORT BRACKET ASSY
9	2	288620	POWER SUPPLY FIXING BRACKET
10	1	289450	COVER
11	1	289451	BACK PANEL
12	1	289452	CONC. MONITOR BASE PLATE
13	1	289453	CONC. MONITOR KEY BRKT
14	1	289509	LASER MOUNT - LOW
15	1	289510	LASER MOUNT - HIGH
16	2	289521	PRECISION SLIT
17	1	289823	SCREEN RETAINER (TOP)
18	1	EE040086	PLUG QM 4 WAY CHASSIS MNT PINS
19	1	EE047004	KEYSWITCH 2NO 2NC MAINTAINED
20	1	EE061190	PSU DESKTOP, 5V DC 3A
21	1	EE067091	CABLE GLAND M16
22	4	H00260	DISC SPRING
23	2	H05251	CONCAVE CYLN LENS
24	4	K00030	HxCpHd M6x25 S/S
25	8	K00033	Washer 3mm Std S/S
26	4	K00034	HxNut M3 S/S
27	2	K00053	HxCpHd M5x16 S/S
28	2	K00061	Washer 5mm Std S/S
29	11	K00087	Washer 4mm Std S/S
30	4	K00313	Washer 6mm Std S/S
31	2	K00326	HxCsk M4 x 12 S/S
32	4	K00422	PnHd M4 x 12 S/S
33	5	K00621	HxCpHd M4x8 S/S
34	8	K00635	HxCpHd M3x10 S/S
35	4	K03166	HxCpHd M2x4 S/S
36	4	K03167	Washer 2mm Std Nylon 6
37	4	K03192	Washer 2mm Std S/S
38	2	N00049	RED FLEXPONI DOT LASER



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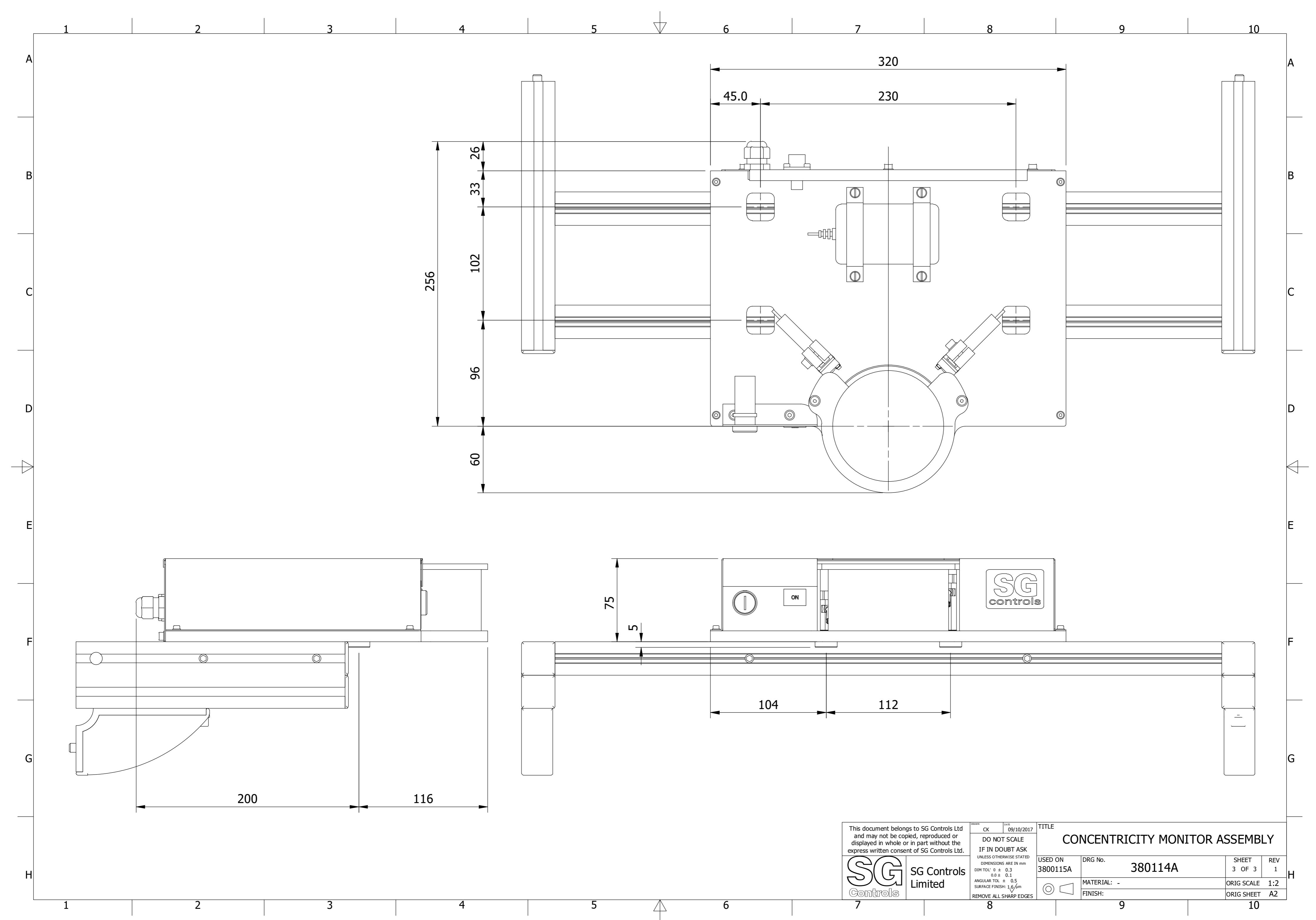
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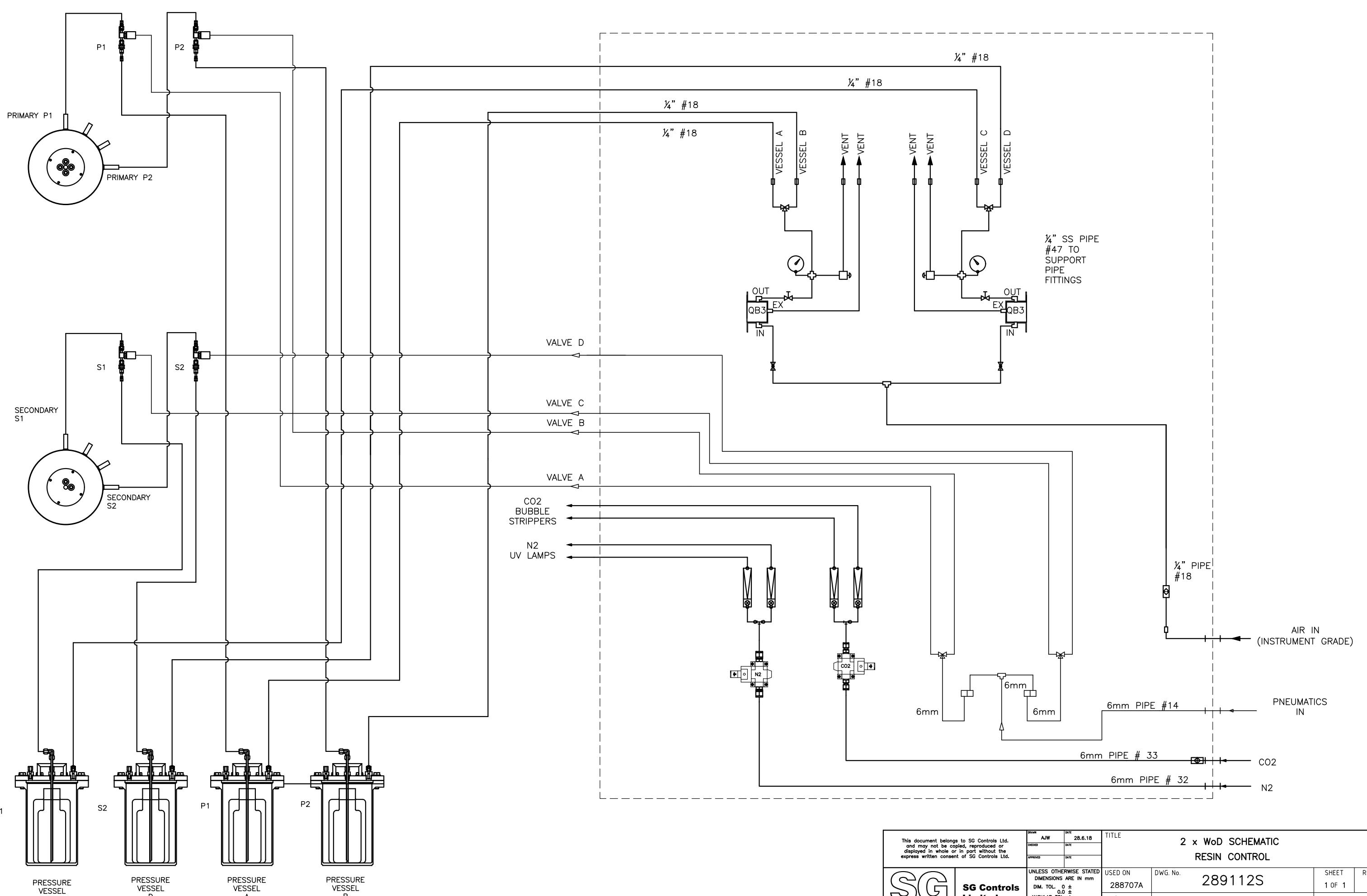
DRAWN BY	DATE	TITLE
CK	09/10/2017	CONCENTRICITY MONITOR ASSEMBLY
DO NOT SCALE IF IN DOUBT ASK UNLESS OTHERWISE STATED		
DIM TOL: 0 ± 0.3 0.0 ± 0.1 ANGULAR TOL: ± 0.5 SURFACE FINISH: 1.6 µm REMOVE ALL SHARP EDGES		
USED ON 3800115A	DRG No. 380114A	SHEET 1 OF 3 REV 1
(CIRCLE) (TRIANGLE)	MATERIAL: -	ORIG SCALE 1:2
	FINISH:	ORIG SHEET A2



TYP. LASER MOUNT SETUP ( 1 : 2 )

DRAWN BY		DATE	TITLE	
CK		09/10/2017	CONCENTRICITY MONITOR ASSEMBLY	
			DO NOT SCALE IF IN DOUBT ASK UNLESS OTHERWISE STATED DIM TOL: 0 ± 0.3 0.2 ± 0.1 ANGLE TOL: 0.5° SURFACE FINISH: 1.6 μm REMOVE ALL SHARP EDGES	
USED ON	DRG No.			
3800115A	380114A	SHEET	2 OF 3	REV 1
MATERIAL:	-	ORIG SCALE	1:2	
FINISH:		ORIG SHEET	A1	





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DRAWN BY AJW DATE 28.6.18  
CHECKED BY DATE  
APPROVED BY DATE

TITLE 2 x WoD SCHEMATIC  
RESIN CONTROL

SG Controls Limited

USED ON 288707A	DWG. No. 289112S	SHEET 1 OF 1	REV 1
(Material icon)	MATERIAL	ORIG. SCALE	
(Finish icon)	FINISH	ORIG. SHEET AO	

UNLESS OTHERWISE STATED  
DIMENSIONS ARE IN mm  
DIM. TOL. ± 0.0  
ANGULAR TOL. ± 0.0  
SURFACE FIN. ✓  
REMOVE ALL SHARP EDGES

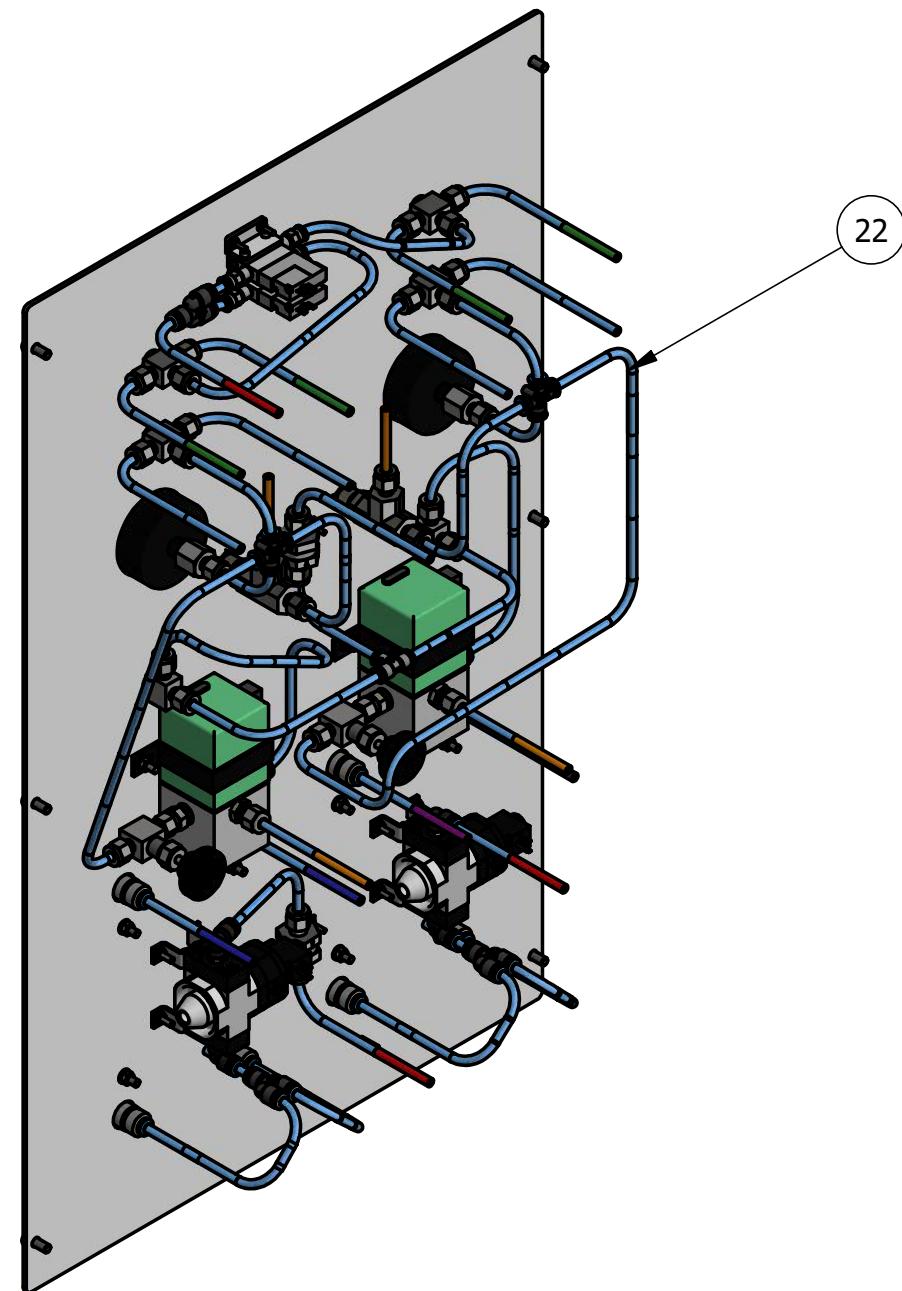
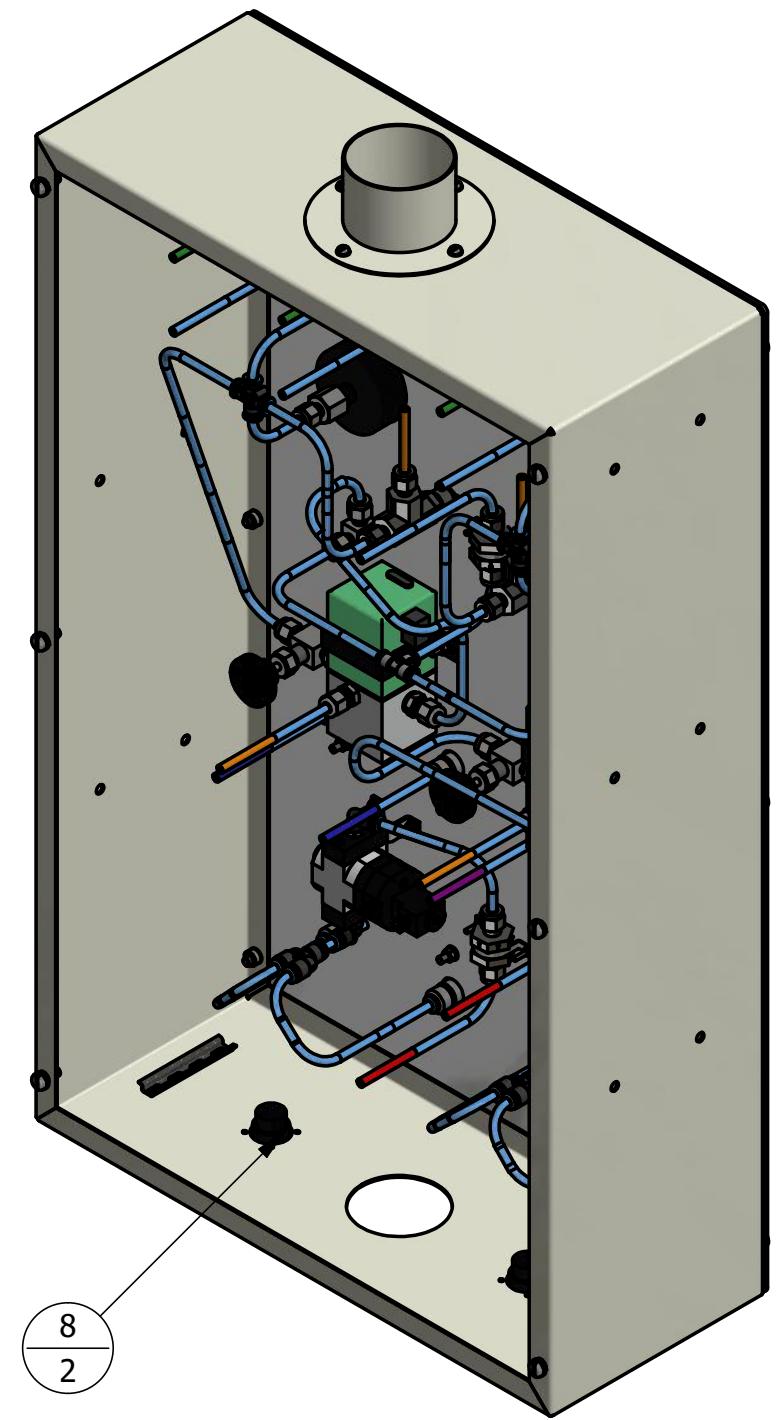
THIRD ANGLE PROJECTION

1	2	3	4	5	6	7	8	9	10
A									A
REVISION HISTORY									
	REV	DESCRIPTION	DCR No.	DATE	APPROVED				
	1	FIRST ISSUE		01/08/16	MT				
PARTS LIST									
ITEM	QTY	PART NUMBER	DESCRIPTION						
1	1	186151-18	BLANK U PANEL						
2	2	188557	FILTER CLAMP						
3	1	280966	EXTRACTOR CONNECTOR						
4	1	OLD-284874	BRACKET SOL VALVE						
5	1	285006	VALVE SPACER						
6	1	289110	GAS CONTROL PANEL						
7	1	289111	19" X 18U X CONTROL BOX						
8	2	EE040254	PLG QM/EMC 19W CHAS						
10	2	H04494	QBT-01 MOUNT BRKT						
12	8	K00033	Washer 3mm Std S/S						
13	8	K00034	M3 PLAIN NUT - FULL S/S						
14	8	K00058	HxNut M4 S/S						
15	12	K00060	M5 PLAIN NUT - FULL S/S						
16	12	K00061	Washer 5mm Std S/S						
17	12	K00087	Washer 4mm Std S/S						
18	4	K00263	PnHd M4 x 10 S/S						
19	12	K00313	Washer 6mm Std S/S						
20	2	K00391	HxCpHd M3x35 S/S						
21	12	K00723	PnHd M6 x 16 S/S						
22	5m	P01572	6mm OD x 1mm WT TUBE - BLUE						
27	32	P02213	6MM FERRULE SET						
28	4	P02302	CONNECTOR MALE 1/4" x 1/4" NPT						
29	2	P02307	CONNECTOR 1/4" FEMALE						
30	2	P02393	FILTER FW SERIES 2 MICRON						
31	4	P03711	3 WAY BALL VALVE						
32	1	P03732	QSMT(2)-T connector						
33	4	P03752	PUSH IN FITTING 6mm TUBE TO M5						
34	2	P03757	MALE TUBE ADAPTOR 1/4"						
35	2	P03765	PUSH-IN CROSS 6MM						
37	8	P03841	1/4" 6MM UNION PUSH FIT						
38	3	P04085	6MM PUSH IN 'Y' CONN						
39	2	V00064	SHUT-OFF REGULATOR						
40	2	V00865	PRESSURE RELEASE VALVE						
41	2	V01173	FLOWMETER 50LPM						
42	2	V01174	FLOWMETER 4.4LPM						
43	2	V01523	ON/OFF SOLONOID VALVE						
44	2	V01533	3/2 SOLENOID VALVE NC M5, CPE10						
45	2	V01567	PRESSURE GAUGE 0-6BAR						
46	2	V01568	PID CONTROLLER						
47	2	V01816	2-WAY VALVE						
48	2	V01628	MOUNTING BRACKETS						
49	4	P03804	PUSH FIT ELBOW 1/8" 6MM						

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DRAWN mtofts	DATE 01/08/2016	TITLE RESIN CONTROL BOX ASSY		
DO NOT SCALE IF IN DOUBT ASK				
UNLESS OTHERWISE STATED DIMENSIONS ARE IN mm DIM TOL 0 ± 0.3 0.0 ± 0.1 ANGULAR TOL ± 0.5 SURFACE FINISH – 1.6 µm REMOVE ALL SHARP EDGES		USED ON 380115A	DRG No. 289112A	SHEET 1 OF 4
		MATERIAL: FINISH:		REV 1
			ORIG SCALE 1:5	ORIG SHEET A3

**SG Controls Limited**



SIMILAR TO 287796S

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DRAWN BY mtofts DATE 01/08/2016

DO NOT SCALE  
IF IN DOUBT ASK

UNLESS OTHERWISE STATED

DIMENSIONS ARE IN mm

DIM TOL  $0.0 \pm 0.3$

$0.0 \pm 0.1$

ANGULAR TOL  $\pm 0.5$

SURFACE FINISH  $-1.6 \mu\text{m}$

REMOVE ALL SHARP EDGES

TITLE

RESIN CONTROL BOX ASSY

USED ON

380115A

DRG No.

289112A

SHEET

2 OF 4

REV

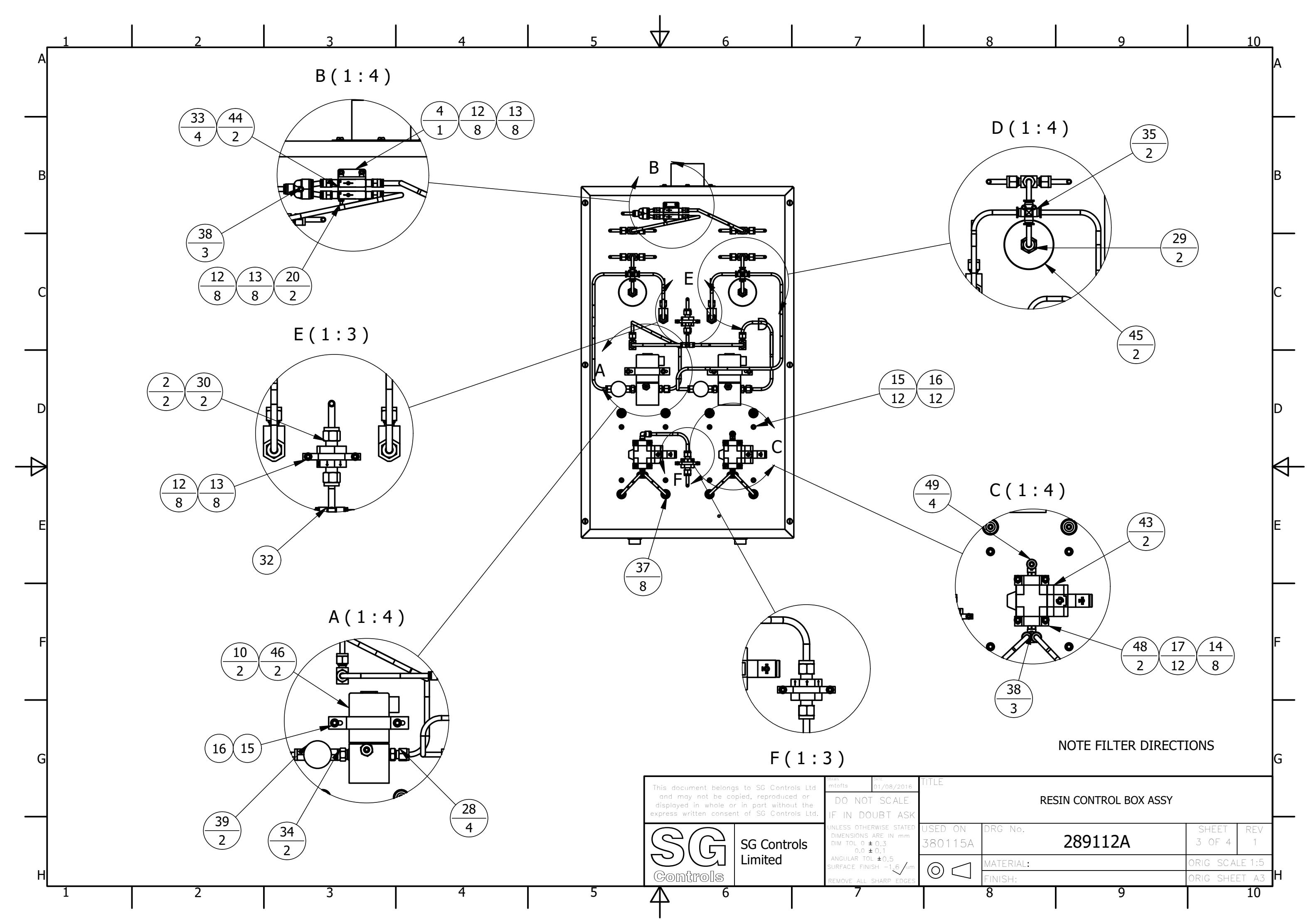
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MATERIAL:  
FINISH:

ORIG. SCALE 1:5

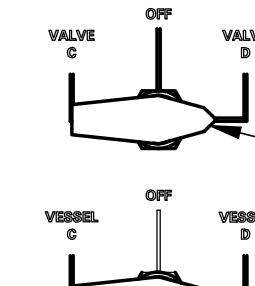
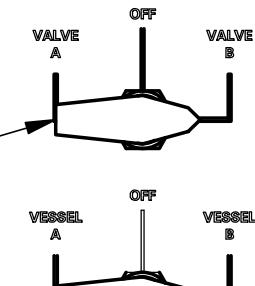
ORIG. SHEET A3



MANUAL VALVE TO SWITCH  
PNEUMATIC SUPPLY  
TO INNER (PRIMARY)  
RESIN VALVES

MANUAL VALVE TO SWITCH  
PRESSURISING IG AIR  
TO INNER (PRIMARY)  
RESIN VESSELS

RESIN  
SELECT

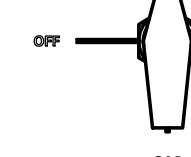
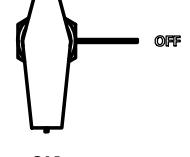
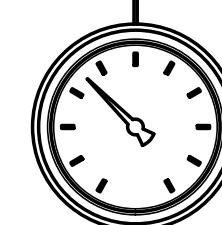
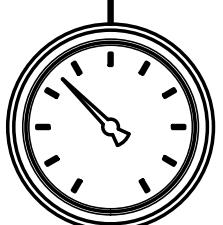


INNER

OUTER

PRESSURE

PRESSURE RELIEF



UV LAMP

BUBBLE  
STRIPPER

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DRAWN  
mtofts DATE  
01/08/2016

DO NOT SCALE  
IF IN DOUBT ASK

UNLESS OTHERWISE STATED  
DIMENSIONS ARE IN mm  
DIM TOL  $0.0 \pm 0.3$   
 $0.0 \pm 0.1$   
ANGULAR TOL  $\pm 0.5$   
SURFACE FINISH  $1.6 \mu\text{m}$   
REMOVE ALL SHARP EDGES

TITLE

RESIN CONTROL BOX ASSY

USED ON

380115A

DRG No.

289112A

SHEET

4 OF 4

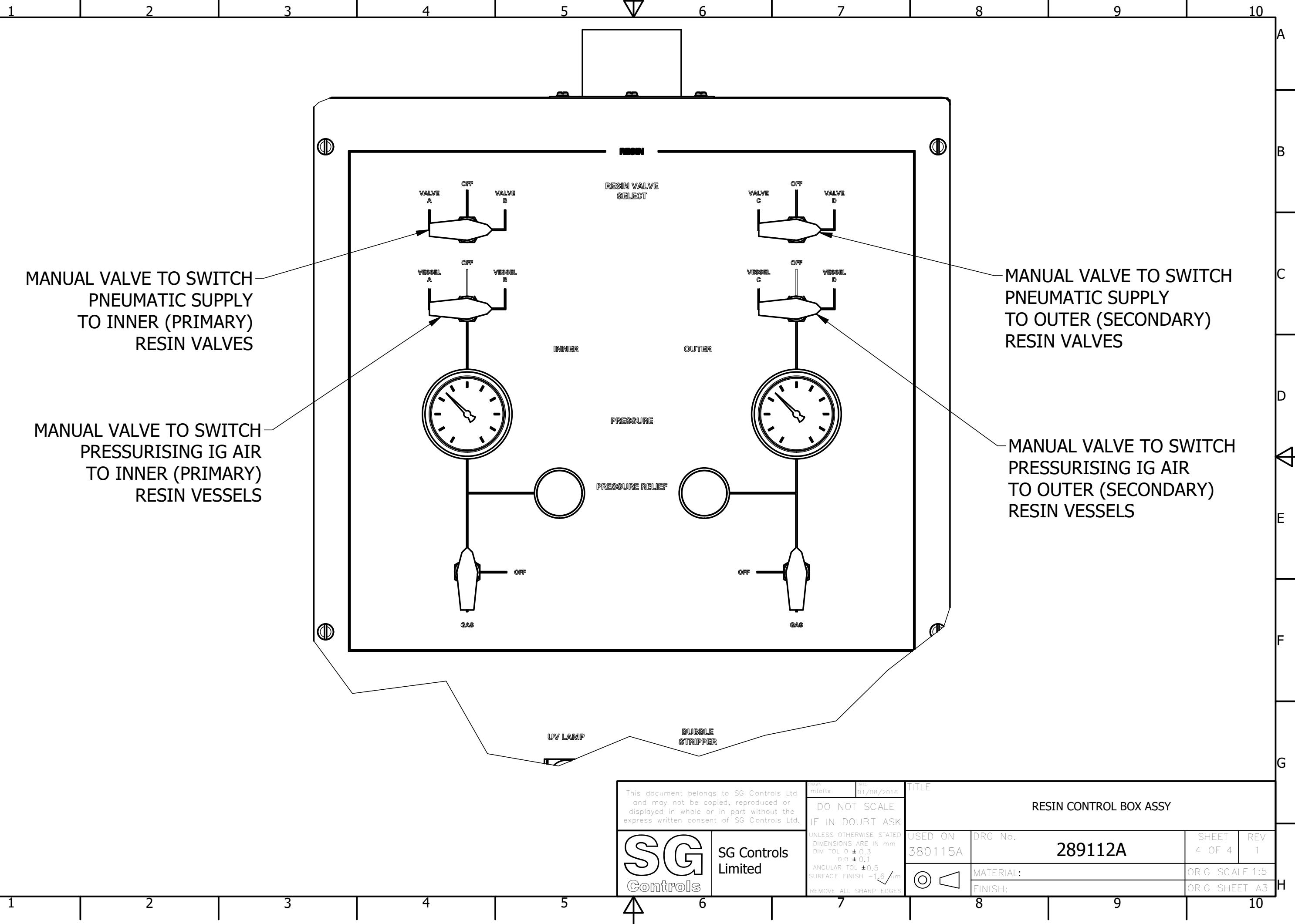
REV

1



MATERIAL:  
FINISH:

ORIG SCALE 1:5  
ORIG SHEET A3



DWG. No.  
286599A

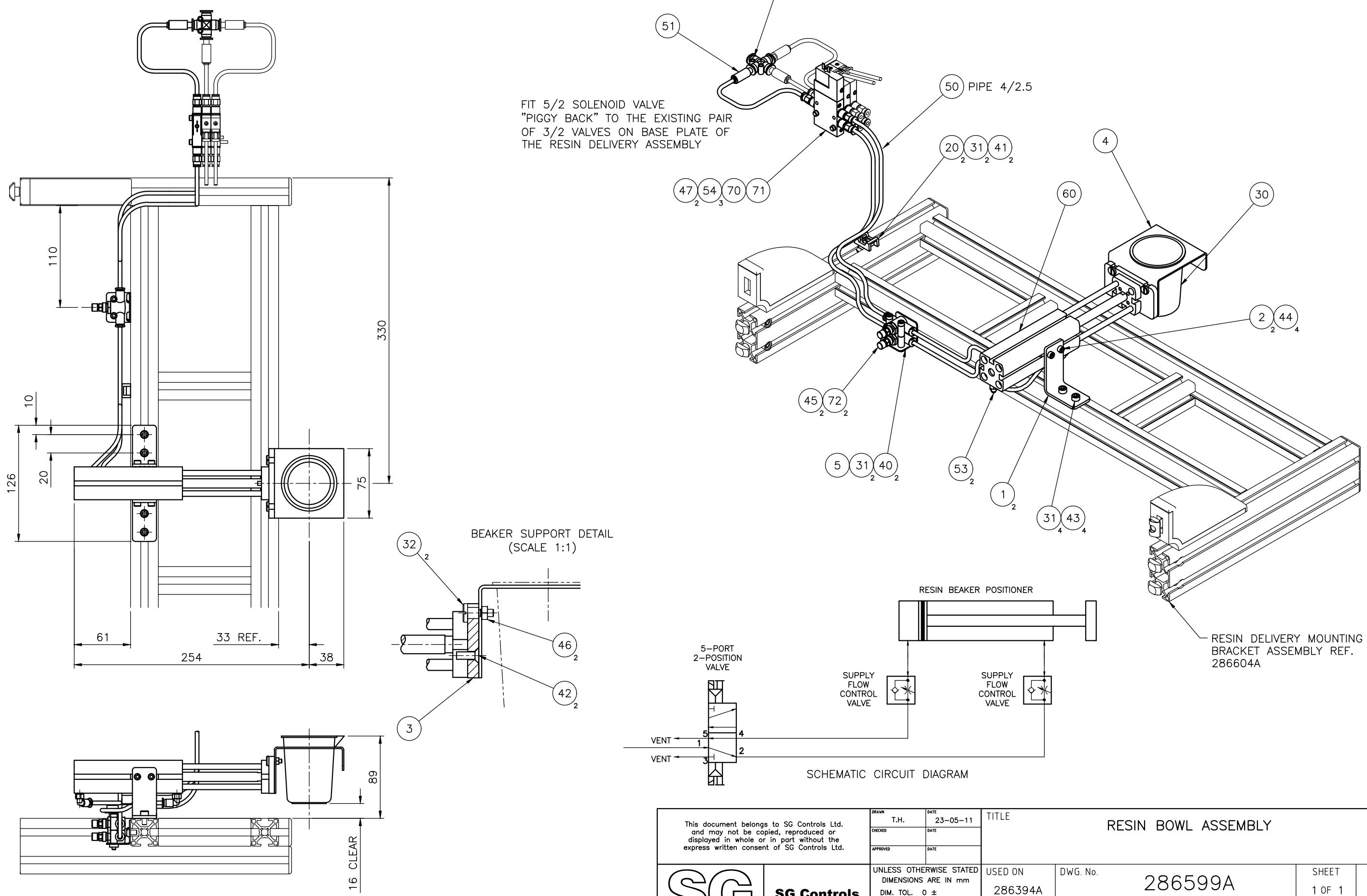
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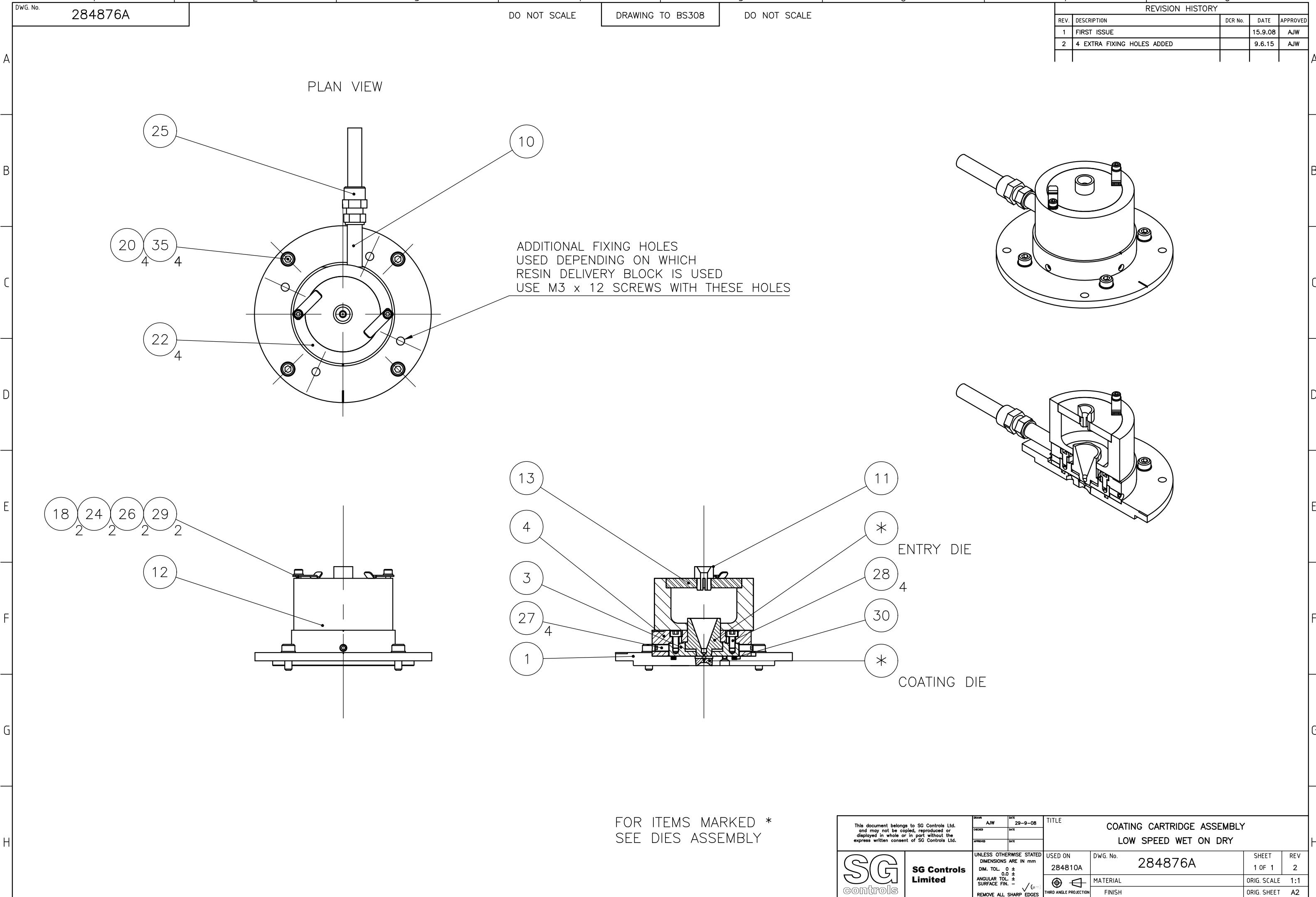
DRAWING TO BS308

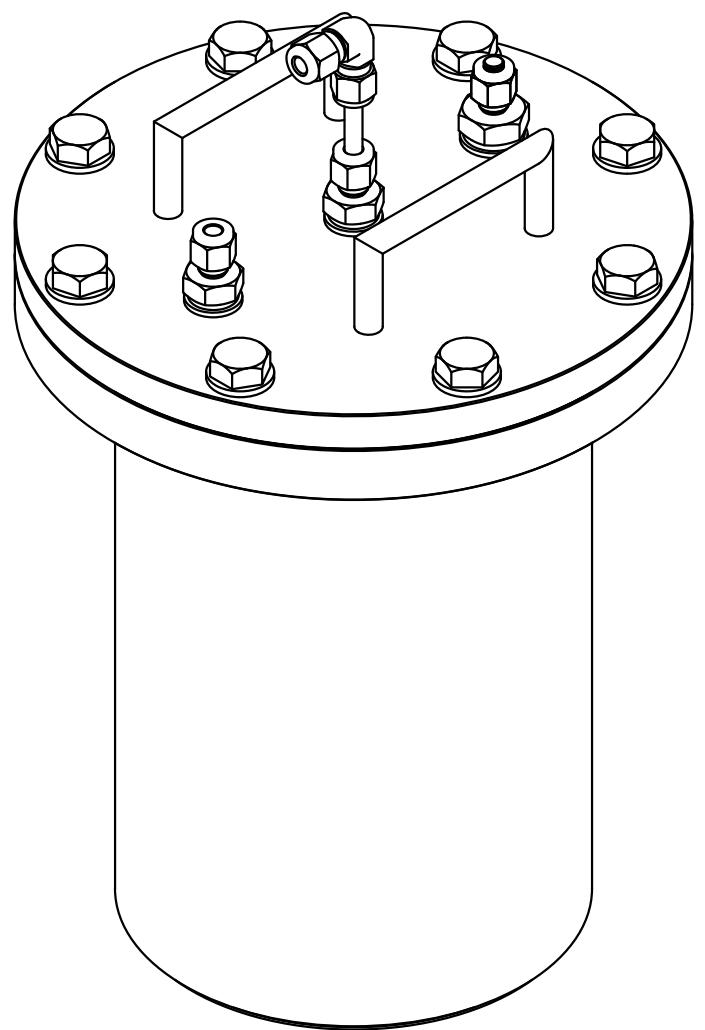
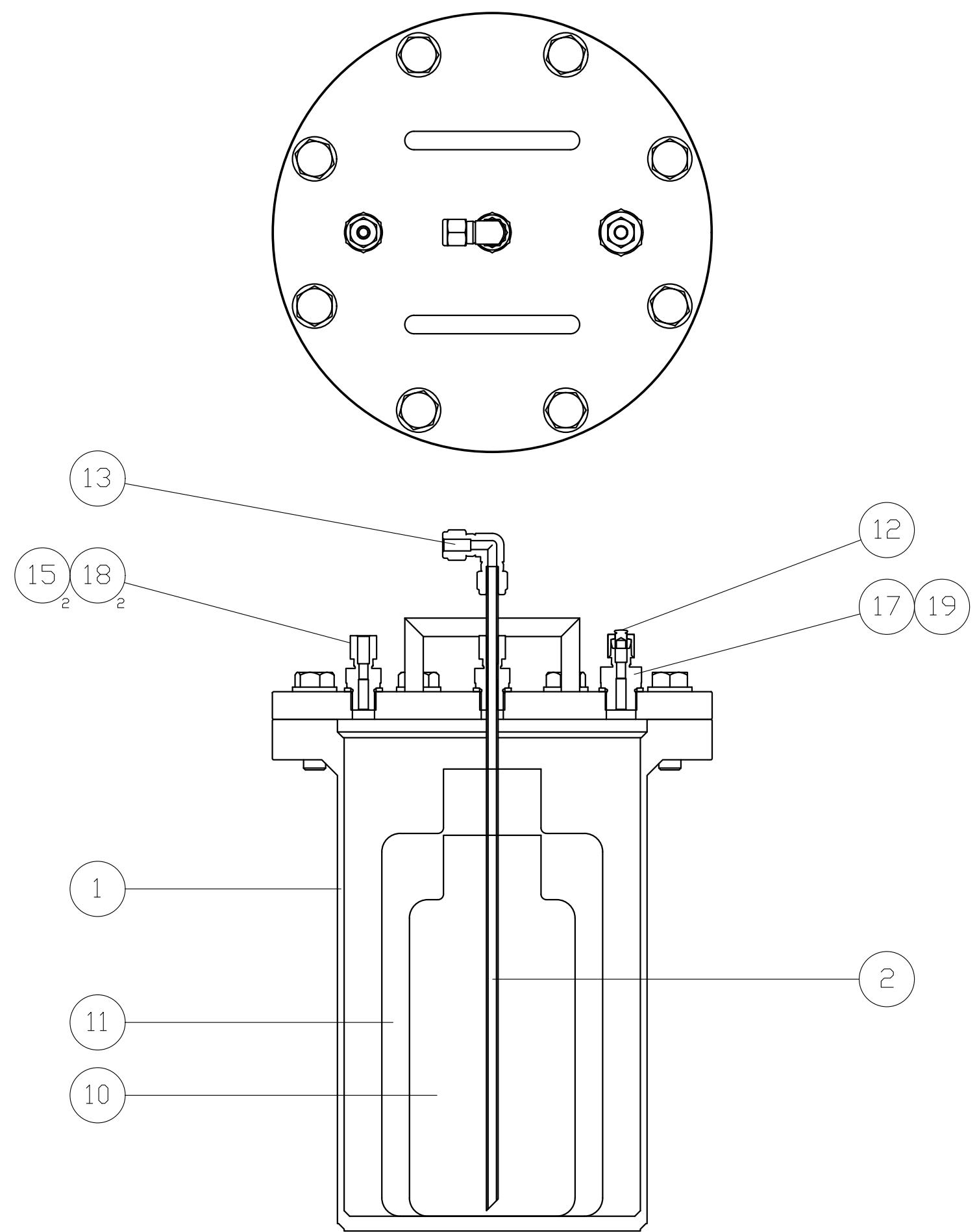
IF IN DOUBT ASK

## REVISION HISTORY

REV.	DESCRIPTION	DCR No.	DATE	APPROVED
1	FIRST ISSUE		23.05.11	T.H.







BLACK NYLON HOSE (ITEM 14) & FERRULE SETS  
(ITEM 16) NOT SHOWN  
USED AS REQUIRED FOR RESIN DELIVERY LINE

This document belongs to SG Controls Ltd. It may not be copied or reproduced in whole or in part without the express written consent of SG Controls Ltd.		DRAWN AJW DATE 2-7-08	TITLE RESIN VESSEL ASSEMBLY		
		CHECKED  APPROVED  DATE			
		UNLESS OTHERWISE STATED DIM. TOL. 0 ± ANGULAR TOL. ± SURFACE FIN. - ✓ (µm) REMOVE ALL SHARP EDGES			
SG controls	SG Controls Limited	USED ON 284315A	DWG. No. 284466A	SHEET 1 OF 1	REV 1
		THIRD ANGLE PROJECTION	MATERIAL	ORIG. SCALE 1:12	
			FINISH	ORIG. SHEET A2	