Canadian Conservation Institute
Institut canadien de conservation

CCI Notes 18/4

# A Small Backlit Suction Device for Treating Textiles

## Introduction

The Canadian Conservation Institute (CCI) created a small backlit suction device specifically for localized stain removal on textiles (Figure 1). The prototype was designed and fabricated in the mid-1990s by Stefan Michalski (CCI Senior Conservation Scientist) and further refined by Paul Heinrichs (CCI Conservator). CCI has carried out a variety of treatments using this apparatus in conjunction with a 560-W (3/4 -horsepower) rotary vane pump, housed in a custom-made sound abatement box equipped with wheels and foot-activated switch (Daly Hartin et al. 1999; Vuori et al. 2000; Vuori et al. 2009).

The detailed plans provided here will enable a skilled machinist to fabricate a similar suction device. The additional components that are required for operation, such as a pump, lamp with fibre optic cable, liquid trap, and vacuum gauge, are all commercially available.

*Figure 1. Small backlit suction device fabricated at CCI.*

**Caution!**

- This suction device is designed for use with water or aqueous solutions. **It is not intended for use with organic solvents.**
- When using aqueous solutions that release noxious fumes (e.g. bleach or reducing agents), the exhaust from the pump should be vented into a fume hood or source capture device (elephant trunk).
- Professional judgment must be exercised to determine if a textile can tolerate suction treatment.

## Features of the Suction Device

### Light

The interior light passes up through the suction device and the textile, and greatly facilitates positioning the apparatus directly beneath the area of staining. Once the device is in place, the light should be turned off so that the user can better see the effect of the reagents on the textile.

### Level of suction

Textiles are subject to strong capillary forces that cause liquid to wick along the yarn. These forces increase as the twist of the yarn increases and as the diameter of the fibres in the yarn decreases. Therefore, to move solvent and stain through the fabric without allowing lateral movement of the liquid and the subsequent formation of tide lines, high levels of suction are required. Generally speaking, the minimum suction pressure to overcome capillarity is at least 8 in.Hg (27 kPa) (Michalski 1984). Much higher levels are required to afford good control of capillarity, and

a suction pressure of approximately 15 in.Hg (50.8 kPa) is recommended. The higher level of suction is especially important when it is essential to prevent wicking of the liquid reagent, for example when using a bleach or reducing agent that adversely affects the appearance of areas adjacent to stains on a relatively thin textile (Vuori et al. 2000). Suction devices designed for treating paper or for washing textiles do not usually generate this high a level of suction.

Achieving a high level of suction through a textile is difficult because the openings between textile yarns provide little resistance to airflow. Textiles therefore need more airflow per unit area than paper to achieve the same level of suction. This means that a moderately sized suction pump can achieve the required level of suction on only a very small working area, typically a few square centimetres. Small working areas can be created by using a large table and masking an area of a textile, or by building a very small suction device such as the one described in this Note.

Placing a blotter underneath the textile will block the airflow and subsequently increase the level of suction as indicated by a suction gauge. However, this suction will be almost entirely through the blotter, not through the textile. With certain combinations of textile, blotter, and very slow application of liquid, this may prove successful (if the blotter is in good capillary contact with the yarns and is continuously stripped of liquid by the suction, it may prevent the lateral spread of liquid in the textile). However, the use of a blotter is not recommended.

### Liquid traps

When this suction device is in operation, the liquid (and any material that it dissolves) is drawn directly through the apparatus and collected in a liquid trap. Because much of the liquid simply passes through the interstices of the weave, a lot of liquid is used — much more than for a similar paper suction treatment. The liquid trap must be large enough to accommodate the volume of liquid, and it must be checked and emptied regularly.

### Table support

The suction device can be inserted into a table top and fastened in place using the collar (Figure 2). Alternatively, it can be used on its own to extract water or aqueous solutions from the top surface of textile-covered objects, such as upholstered furniture.

## Tips for Using the Suction Device

### Support screen

When the suction device is used beneath the textile, a support made of silkscreen fabric attached to a frame cut from plastic sheet (e.g. Coroplast) can facilitate sliding the textile around over the suction device (moving the frame takes the textile along with it). A silkscreen support also reduces the risk that the suction device's metal screen will create an imprint on the textile without significantly reducing the level of suction, except on very open weave textiles. Note: The device should generally be switched off when positioning the textile over the suction area. When the suction device is used over the top surface of a textile, the same screen can be placed between the device and weak or fragmented areas of textile.

### Testing

It is important to determine if the suction pressure required for the treatment will leave an imprint on the textile (the suction pressure is related to the airflow, which varies depending on the textiles' weave structure, weight, finishing, etc.). This is usually a concern with very lightweight textiles only. The fine metal screen that forms the top surface of the suction device is less likely to create imprints than a perforated metal sheet.

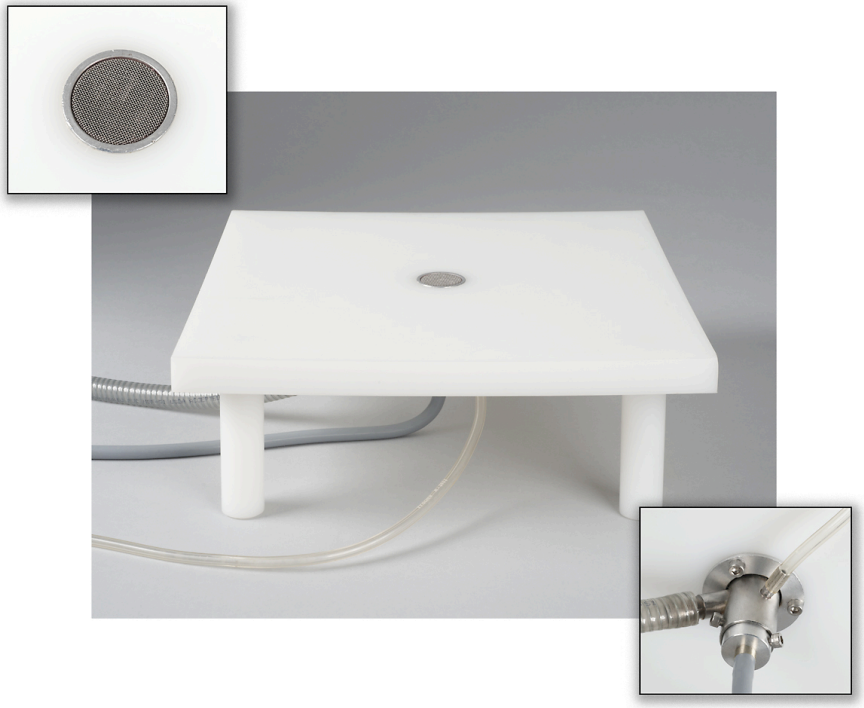

*Figure 2. Suction disk mounted into table with details showing top and bottom.*

### Masking

The suction area of this device is 27 mm in diameter. To ensure that the required level of suction can be achieved, an area of this size is usually masked down using two sets of circular masks made from plastic sheet. One mask is placed directly over the suction area of the device and beneath the silkscreen supporting the textile. This mask should be made of black plastic sheet, which prevents light from passing through. A second mask can be used on the top of the textile to further adjust the level of suction pressure. This mask should be made from clear plastic sheet (e.g. polyethylene or polyester), which makes it possible to see the portion of the textile covered by the mask. Both sets of masks can be made easily using cork borers to cut out circular openings of various sizes. Masks can also be made with openings that mimic the shape of the stain. Testing with water will indicate the effect of the masks.

### Delivering reagent

Water or aqueous solutions can be applied in a variety of ways, e.g. squeegee bottles, pipettes, or brushes. Ultrasonic misters and air brushes can also be used. The best delivery method for any particular treatment will depend on the characteristics of the textile and the requirements of the treatment. If a continuous flow of the liquid is required, plastic tubing can be used to siphon the liquid directly from a beaker. This method can deliver a large volume of liquid in a relatively short time, so the liquid trap must be checked and emptied regularly.

It is important to keep the liquid confined to the area of suction and to maintain a dry space, a few millimetres wide, between the liquid and the edge of the mask or suction area. If the liquid reaches the edge of the masks, or the edge of the suction area, it will be unimpeded by suction and will be able to wick along the textile, carrying stain. Given the small working area, extra care is needed to avoid liquid application near the edge of the masks. The following procedures will help to prevent accidental wicking:

- Move the working area as needed to keep the liquid application near the centre of the working area.
- Avoid applying liquid too fast for its removal.
- Do not let the wet spot creep to the edge of the working area.
- Use the illumination feature frequently to confirm the location of the working surface, as well as to observe the edge of the wet spot.

## Bibliography


Daly Hartin, D., S. Tse, and J. Vuori. "A Collaborative Treatment: Reducing Water Stains on a Silkscreen on Linen." pp. 293–298 in *ICOM Committee for Conservation 12th Triennial Meeting Lyon 29 August – 3 September 1999: Preprints Volume 1*. Lyon: ICOM Committee for Conservation, 1999.

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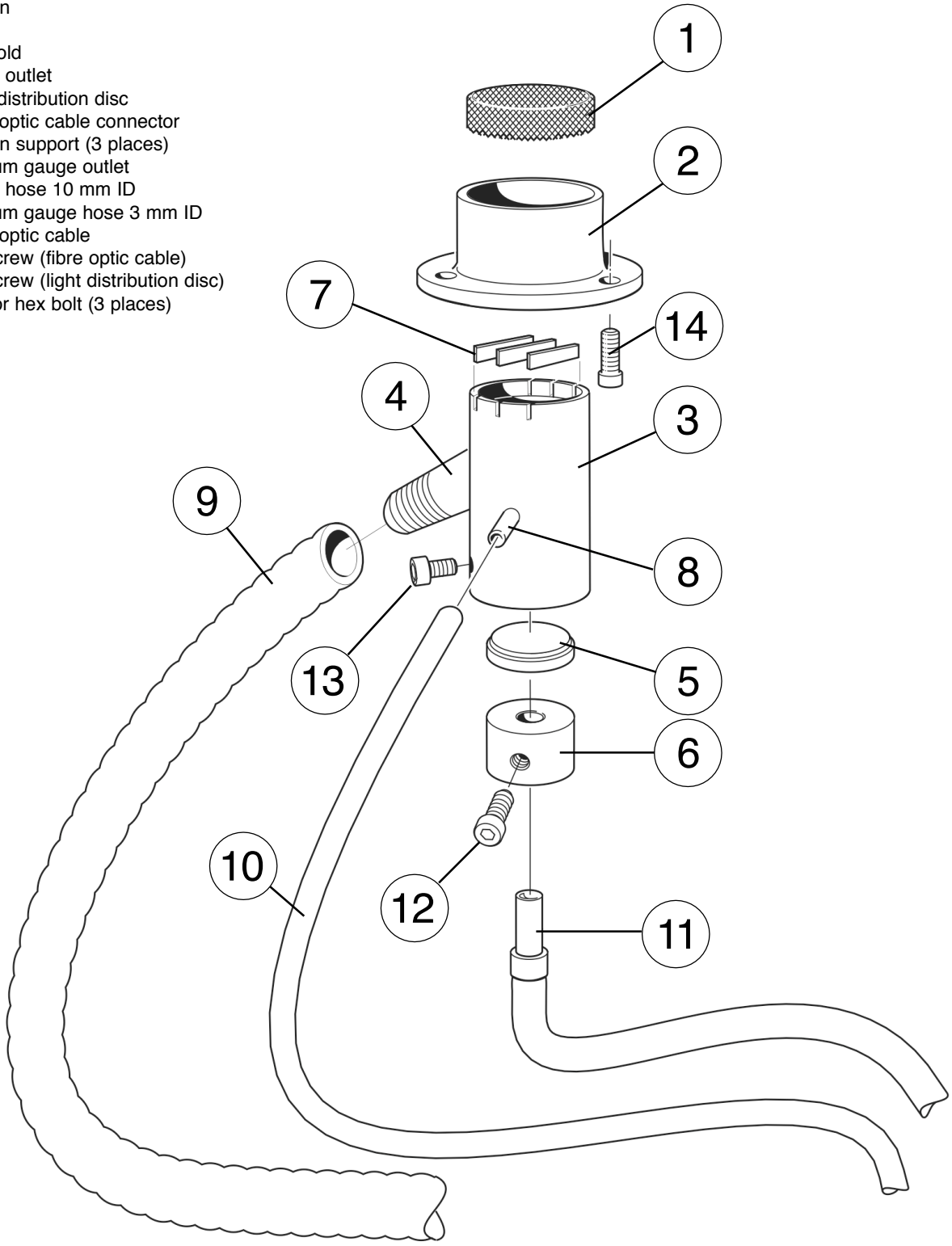
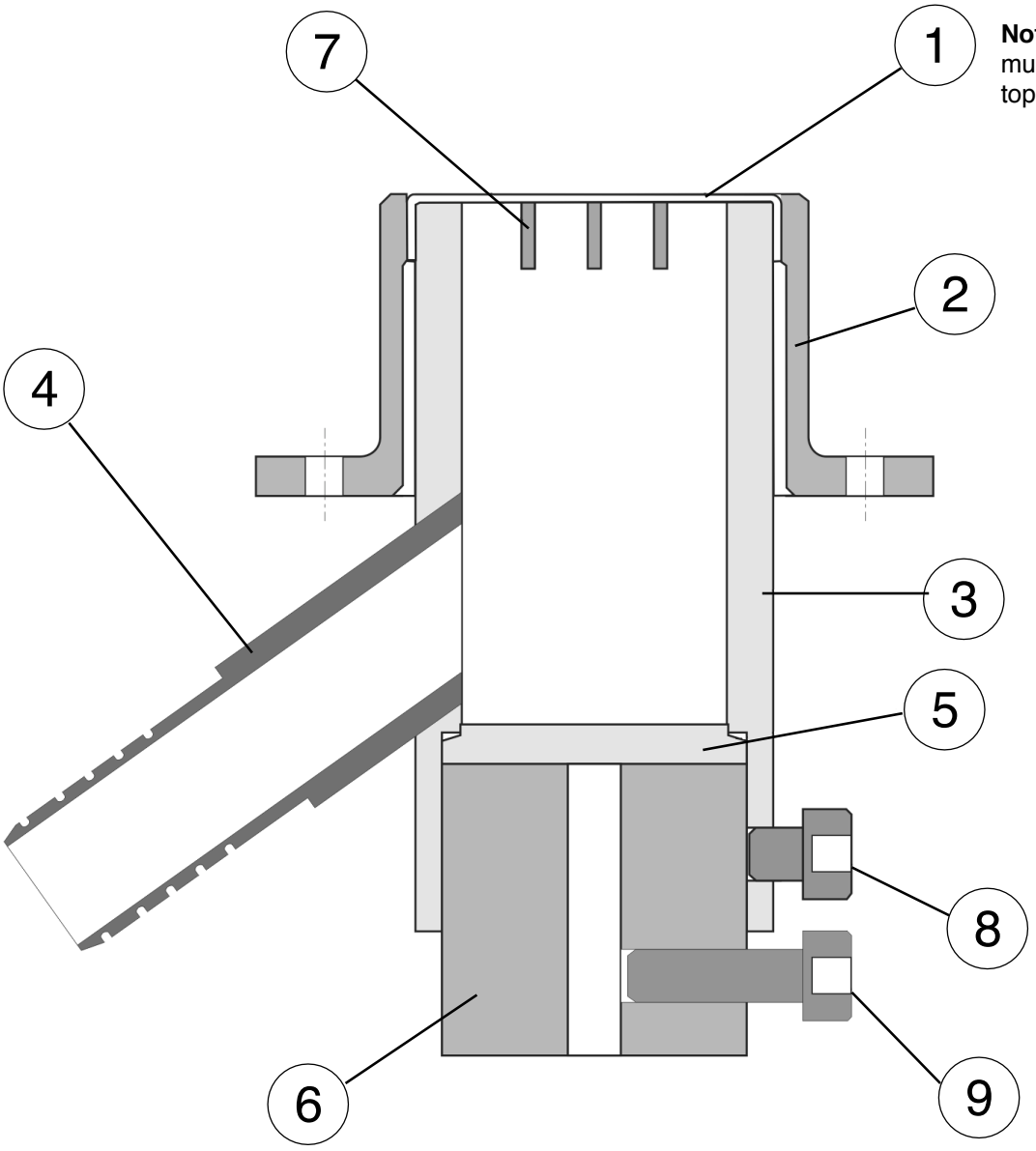
## Suction Device General Assembly

1. Screen
2. Collar
3. Manifold
4. Pump outlet
5. Light distribution disc
6. Fibre optic cable connector
7. Screen support (3 places)
8. Vacuum gauge outlet
9. Pump hose 10 mm ID
10. Vacuum gauge hose 3 mm ID
11. Fibre optic cable
12. Set screw (fibre optic cable)
13. Set screw (light distribution disc)
14. Interior hex bolt (3 places)



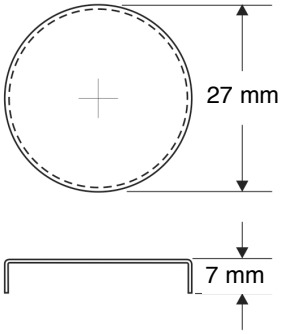
**Suction Device Cross Section**



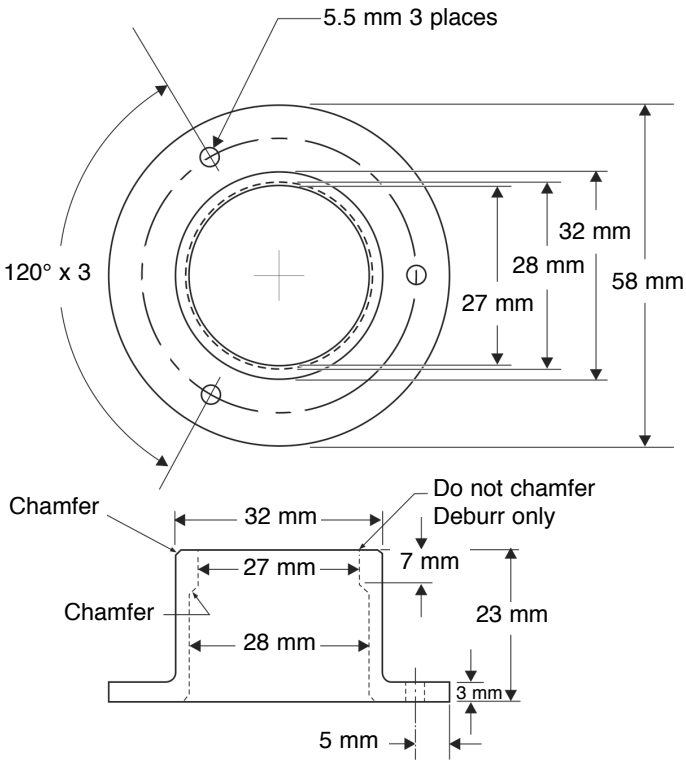

**Note:** Top of collar must be flush with top of screen

1. Screen
2. Collar
3. Manifold
4. Pump outlet
5. Light distribution disc
6. Fibre optic cable connector
7. Screen support (3 places)
8. Set screw (light distribution disc) 6 mm x 1 x 10 mm
9. Set screw (fibre optic cable) 6 mm x 1 x 20 mm

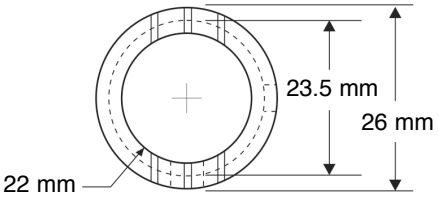
## Suction Device Detailed Parts

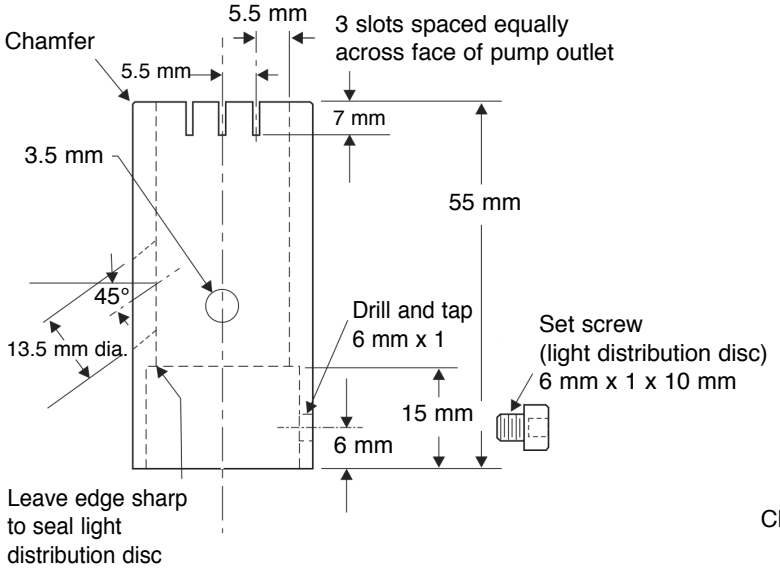



**Detail 1**
Plain Weave Screen
Stainless Steel 17/cm x 17/cm
(see page 9 for screen construction and assembly)

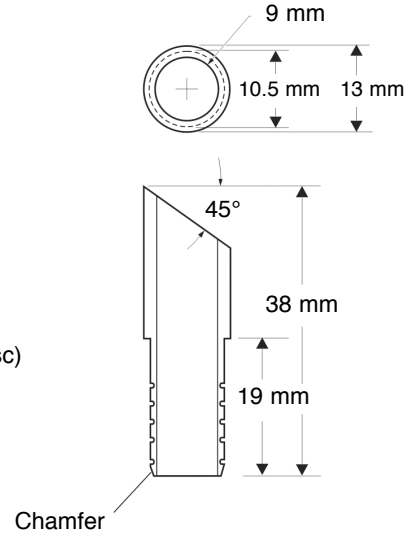



**Detail 2**
Collar
Aluminum



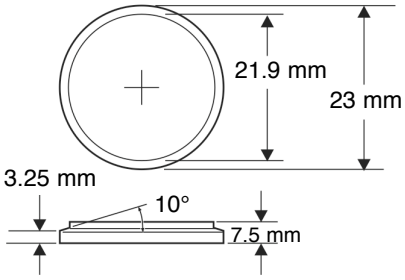




**Detail 3**
Manifold
Stainless Steel

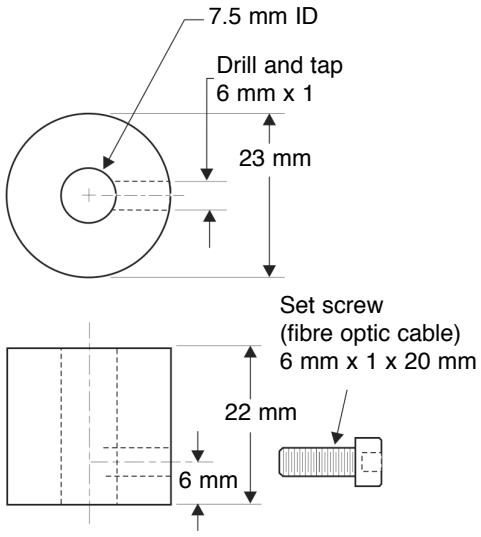



**Detail 4**
Pump Outlet
Stainless Steel

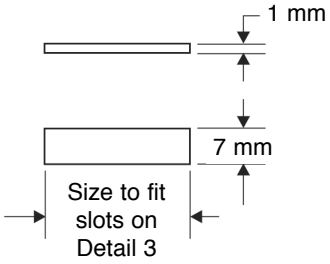
## Suction Device Detailed Parts (cont.)



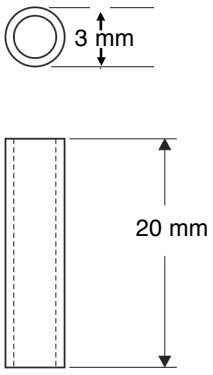

**Detail 5**
Light Distribution Disc
High Density Polyethylene




**Detail 6**
Fibre Optic Cable Connector
Aluminum

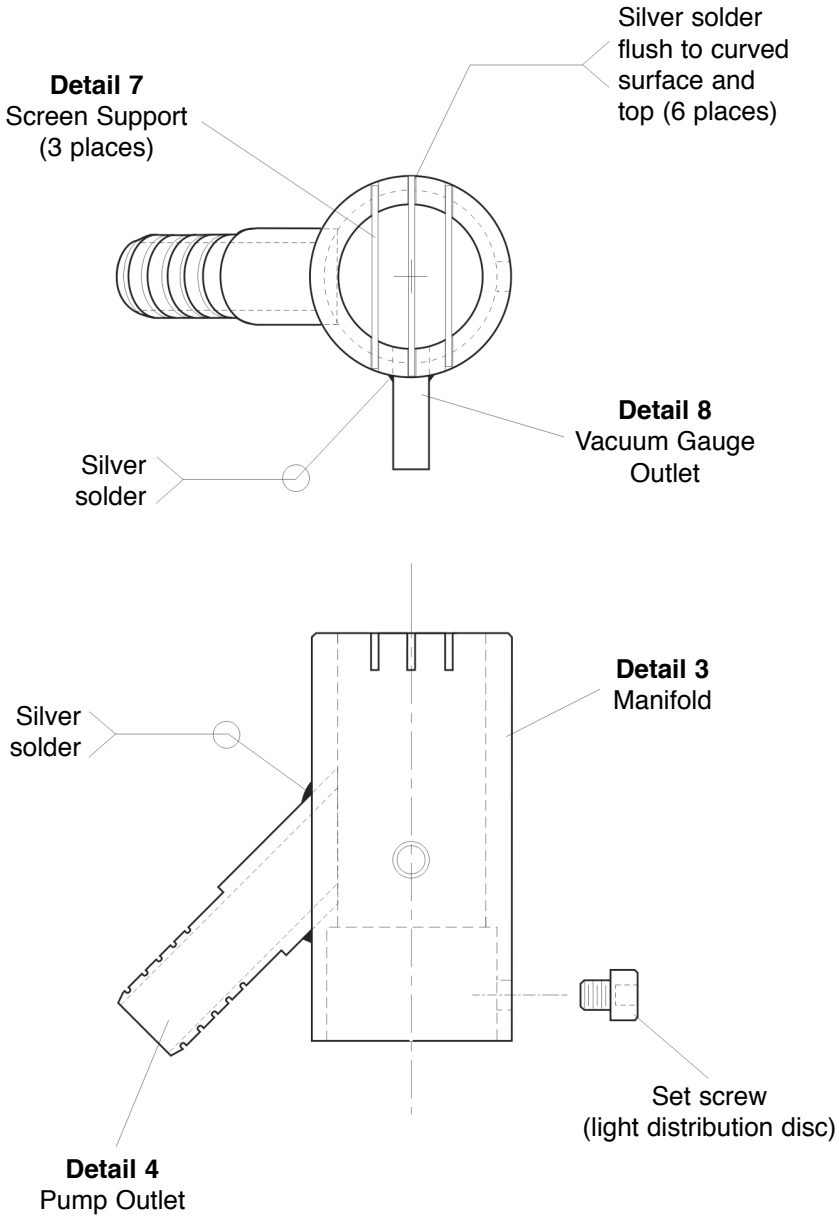



**Detail 7**
Screen Support
Stainless Steel
(make three)

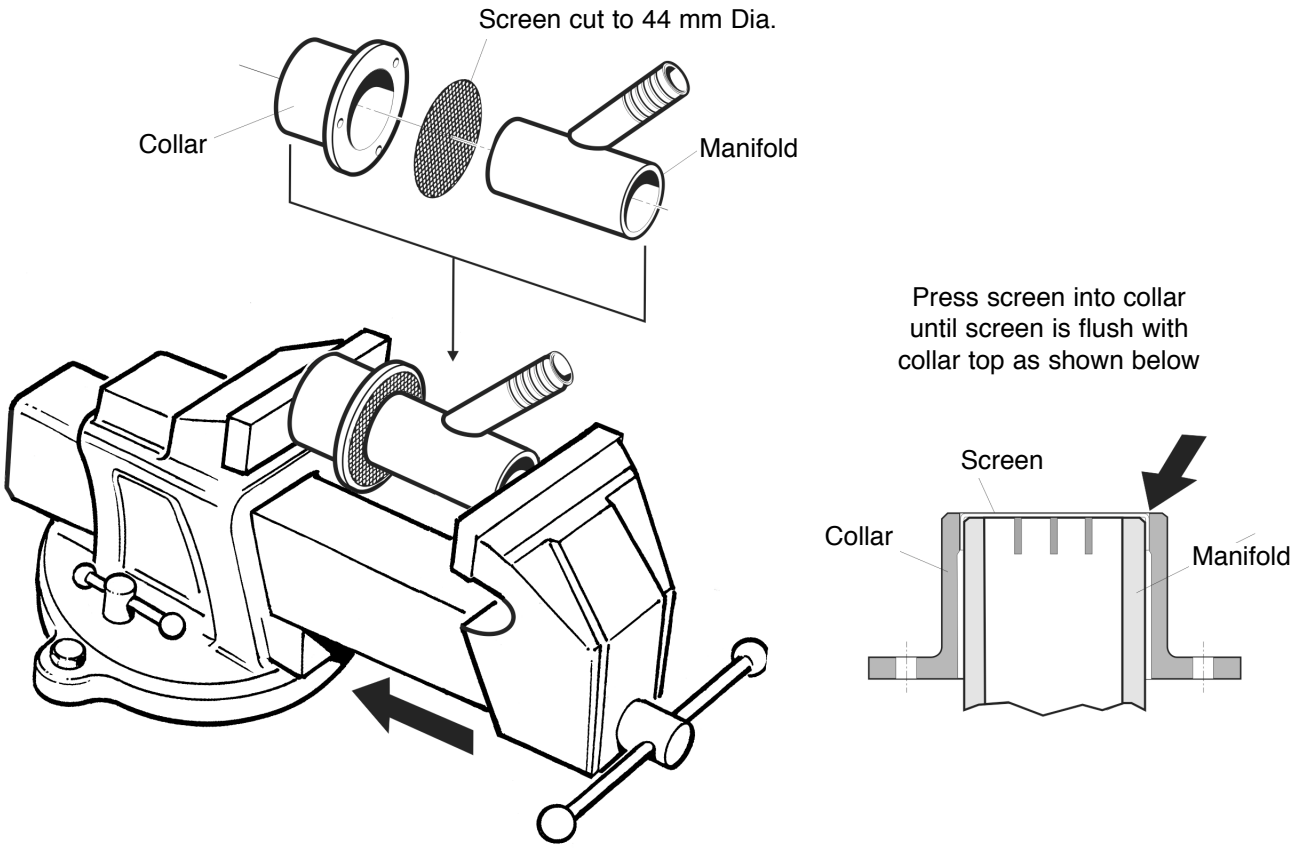



**Detail 8**
Vacuum Gauge
Outlet
Stainless Steel

**Pump Outlet**
**Soldered Assembly**



**Screen Assembly**




## Additional Notes

**Collar (Detail 2)**

- The interior dimensions of 27 mm and 28 mm can be changed if a different type of screen is used.
- When a different type of screen is used, the collar dimensions must be checked to ensure that a good press fit is obtained.
- The 20 mm height dimension can be changed to suit the thickness of the table top.
- The top of the collar must be flush with the top of the table.
- The interior hex bolts fastening the suction device to the underside of the table can be altered to suit the application.

**Pump Outlet (Detail 4)**

- If a 3/8 in. ID pump hose is used (instead of the 10 mm ID diameter pump hose), the pump outlet dimensions must be changed to allow the hose to fit.

**Fibre Optic Cable Connector (Detail 6)**

- The 7.5 mm ID dimension can be changed to suit the type of fibre optic cable to be used.

**Vacuum Gauge Outlet (Detail 8)**

- If a 1/8 in. ID vacuum gauge hose is used (instead of the 3 mm ID diameter vacuum gauge hose), the dimensions of the vacuum gauge outlet must be changed to allow the hose to fit.