Octopus™
Stock Approach System

Another innovative solution for multi-ply board production from

FCFORMTEK
a Division of AES Engineered Systems

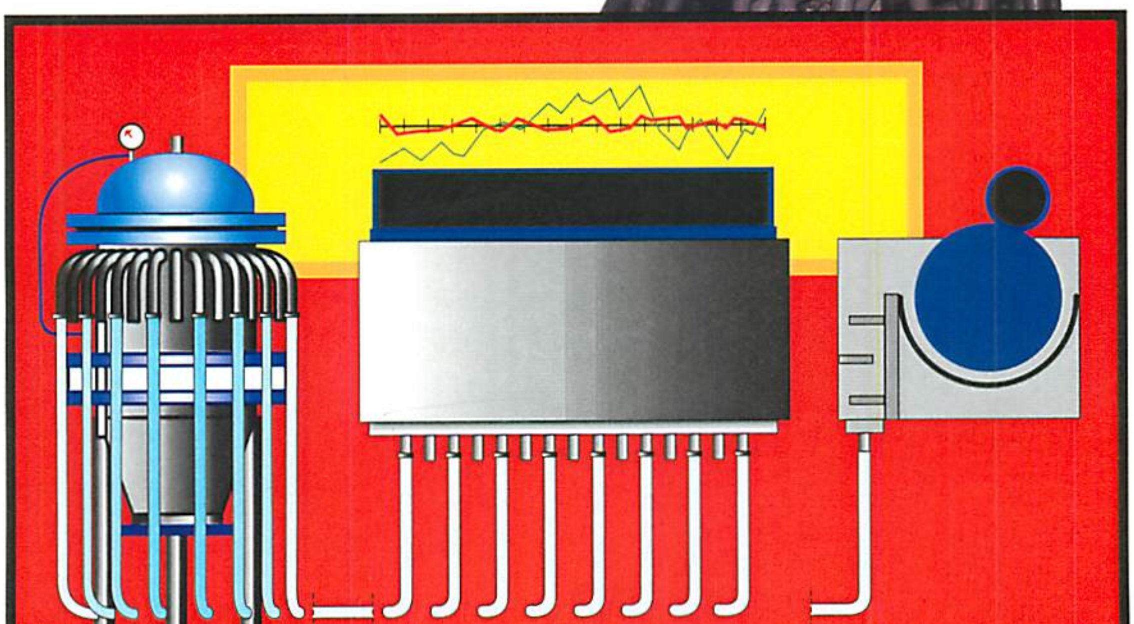
- ***Improved CD Profile***
- ***Quicker Grade Changes***
- ***Proven Technology***

Octopus™ *System includes:*

- Distributor/Attenuator
- Hoses and Clamps

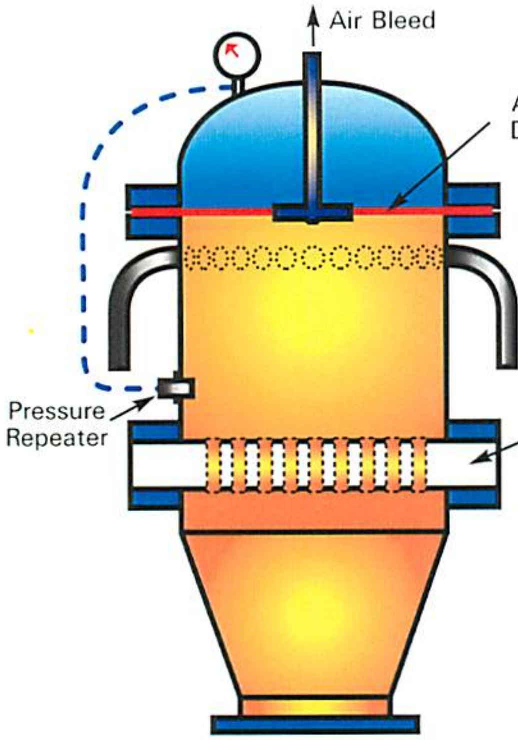
Optional:

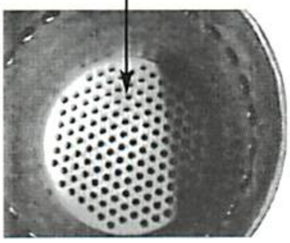
- CD Profile Control
- Custom Designed Vat or Headbox Inlet Flange



Octopus™

Distributor/Attenuator





Benefits:

- Provides uniform CD flow per basis weight to former or vat, independent of total flow rate
- Reduces basis weight grade change time
- Dampens pressure pulsation
- Reduces entrained air
- Reduces floc size

Features:

- All wetted metal parts are 316L Stainless Steel
- Automatic air pad pressure compensation control included
- Optional CD consistency profiling
- Applicable to Vats, Hydrolic Formers *(Horne, Bristol, etc.)* and Headboxes *(Kobayashi, Sandy Hill, Beloit, etc.)*

FCFORMTEK
a Division of AES Engineered Systems

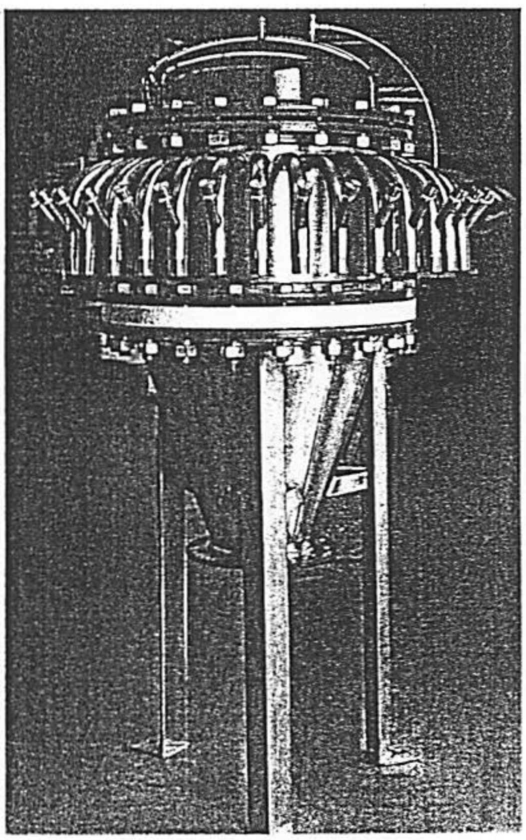
436 Quaker Road, P.O. Box 7010, Queensbury, NY 12804
Tel: (518)793-8801 Fax: (518)793-9392

Printed in U.S.A. OCT1198N.5M

INSTALLATION AND OPERATION MANUAL

FOR

FCFORMTEK PRODUCTS OCTOPUS™ STOCK APPROACH SYSTEMS



Crocker Technical Papers
Fitchburg, Massechusetts
Kadant AES Job No. 2403309

Revised August 25, 2004

TABLE OF CONTENTS

1. THEORY OF OPERATION AND DESIGN

The [illegible]™ Stock Approach System from FC[illegible]TEK is redefining "acceptable" CD basis weight variation for Multiply Board manufactured using cylinder vats. The [illegible]™ System applies the latest Fourdrinier headbox approach system technology to cylinder vats.

APPROACH SYSTEMS

The goal of a stock approach system, whether for a headbox or for an open vat, is to provide the forming section with deflocculated flow, distributed uniformly in the cross machine direction. This is illustrated symbolically in Figure 1.

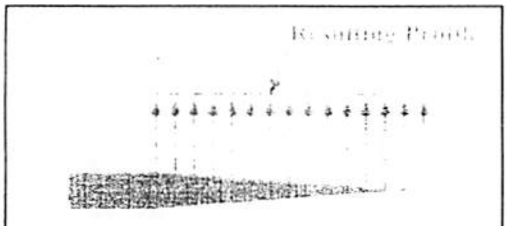


Figure 1. *Level CD Profile*

CD profile and its precise control have long been studied for headboxes. However, while headboxes have slice profile adjustment, profile quality for open vats still often depends upon the papermaker's skill at placing bricks on the vat's making board and adjusting the vat's wings. While some vats are equipped with flow adjustment mechanisms, these devices require continual readjustment as flow conditions vary with grade and speed changes.

Typical approach systems for forming devices include tapered inlet headers, branched headers and V shaped hoppers. Each type of approach system gives its own typical profile. These profiles are illustrated in Figure 2. Of the types illustrated, the tapered manifold offers the best control if the recirculation line is accurately adjusted to compensate for changes in stock flow at each grade change.

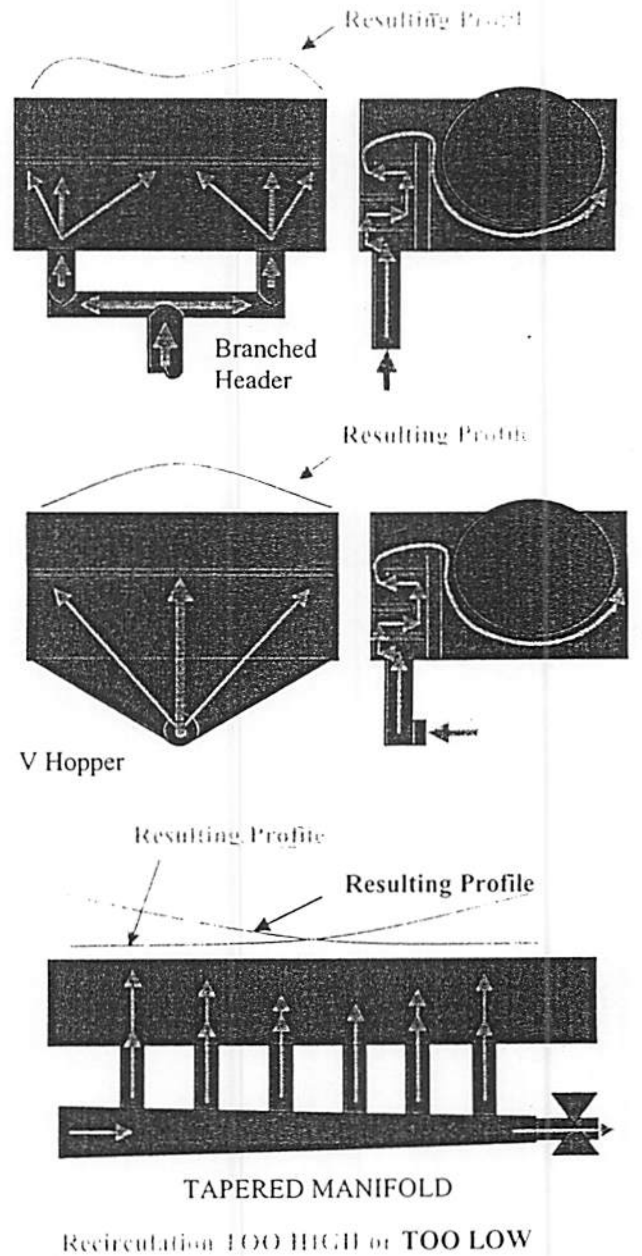


Figure 2. *Typical Inlet Designs*

Costs of Poor CD Profile

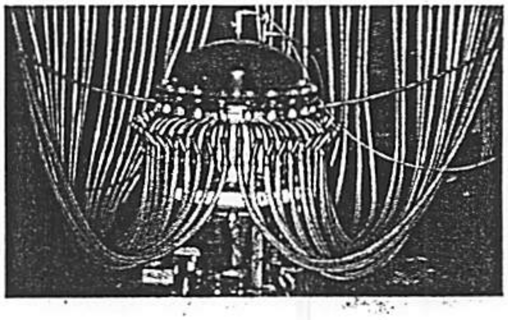
The waste involved with poor CD Basis weight profile is high. The larger the variation from an average basis weight (or caliper) the higher the board maker must target his process in order to achieve minimum allowable quality numbers. "Aiming high" to compensate for a poor profile wastes fiber. It also wastes energy or curtails production, since the heavy basis weight areas must be dried even if the low basis weight areas are over-dried. While any approach system may be tuned to provide a good profile, "fine-tuning" several vats takes time, time spent "off-grade".

OCTOPUS™ System

The Octopus™ System uses a distributor/attenuator vessel custom designed for the range of flows of a particular application. A photo of an OCTOPUS™ installation is at the right while Figure 3 illustrates the OCTOPUS™ System schematically.

The Distributor/Attenuator is constructed of three flanged sections. The top section houses the pulse attenuator and air purge system. The center section has the distributor feed connections and the bottom section has the stock inlet. Captured between the inlet section and the distributor section is a diffuser plate.

Materials of Construction:
Body: 304L Stainless (all welds polished)
Dome: Epoxy painted carbon steel
Flanges: Epoxy painted carbon steel
Diaphragm: Fabric Reinforced Rubber
Diffuser: HDPE



The beauty of the OCTOPUS™ System is that when properly designed, it is totally insensitive to the range of flow rates over an entire grade structure. There is nothing to adjust at grade change. While simple in concept, the overall success of an OCTOPUS™ System depends upon two critical factors, a) proper selection of flow velocities and b) keeping all feed hoses equal in length and properly arranged to maintain uniform pressure drops regardless of stock flow rate. The OCTOPUS™ stock approach system supplies the forming device (vat or former) with a level CD profile that does not change as flow rates change.

Other Applications

The OCTOPUS™ System may also be applied to headboxes found on Bristol Formers, Horne Formers, and Kobayashi Formers and even to replace tapered inlets on conventional Fourdrinier machines with widths less than 300".

II. Components of OCTOPUS™ stock approach system

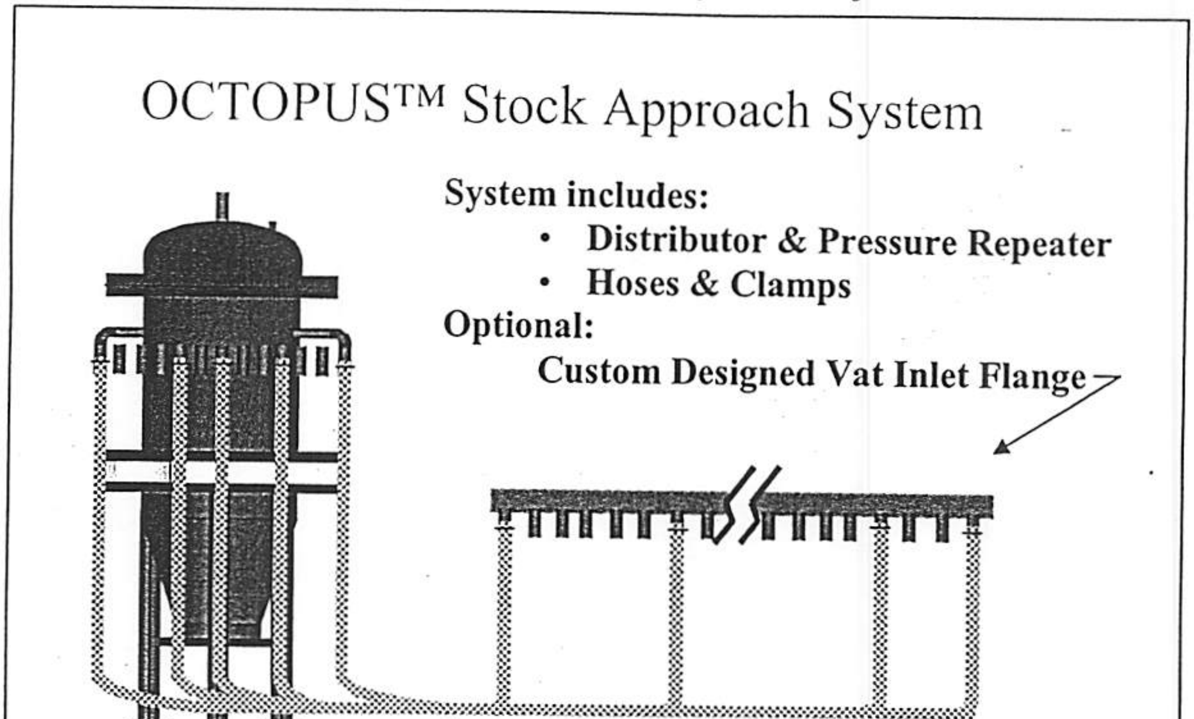


Figure 3 *OCTOPUS™ System*

III. Installation

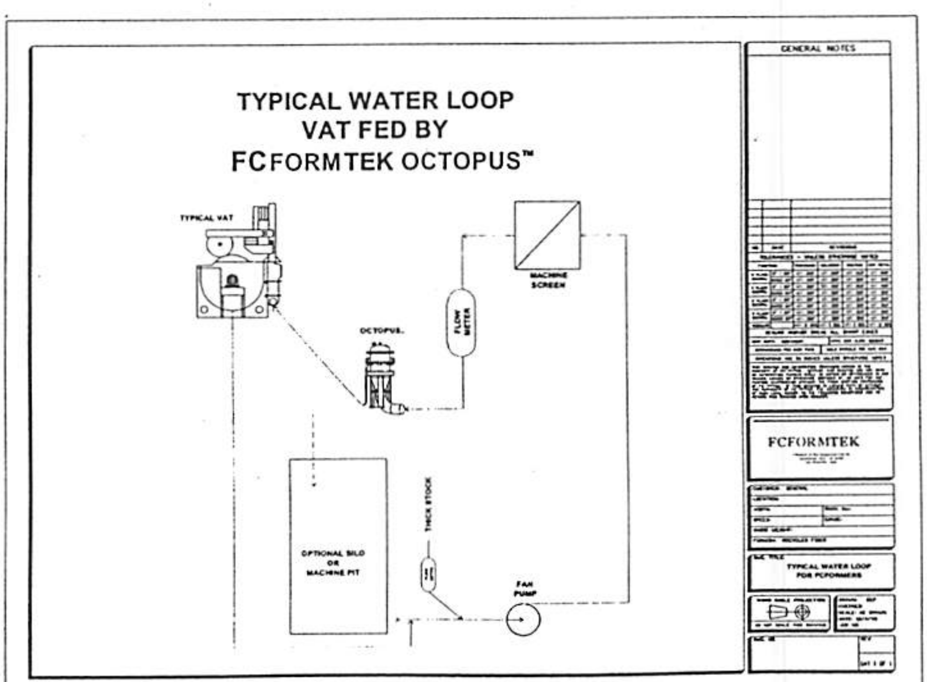
The Octopus™ approach systems are shipped assembled and ready for installation. Typically the unit(s) will be located either under the paper machine or on the operating floor level on the drive side of the paper machine. While the installation is straight forward, there are a few steps that will assure the best operation of the units.

Installation guidelines

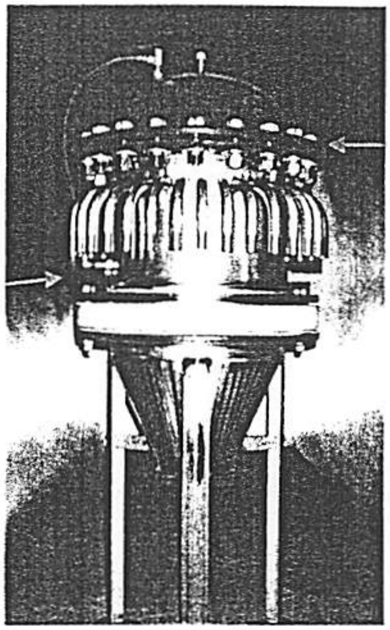
1. Before starting installation, locate all the components that will be installed and have been supplied by FCFORMTEK. These usually include:
   - the Octopus™ units
   - The pre-cut hoses from the Octopus™ units to the forming device
   - The hose clamps (two per hose)
   - Forming device inlet adapter (if supplied by FCFORMTEK)

2. Locate the components that are to be supplied by the mill. These include:
   - Pressure gauge for the attenuator portion of the Octopus™
   - Air supply tubing (1/4" poly typ.) and pressure regulator for pressure transmitter
   - ½" Ball valve for top air bleed
   - 3/8" poly line for top air bleed
   - Anchor bolts for Octopus™ legs (3 per unit)
   - Forming device inlet adapter, gasket and attachment bolts
   - Hoses, pressure header and valves (if consistency profiling option has been purchased)

3. The Octopus™ is inserted between the pressure screen and forming device on machines that use individual machine screens or between the fan pump and forming device on machines employing pressure loops and beater room screens. The piping to the Octopus™ should be prefabricated to reduce the installation time required. The inlet size to the Octopus™ is shown on the drawings supplied to the customer prior to shipment of the units. Typical sizes are 6 - 14 inch *pipe size*. The inlet is a stainless steel angle face ring with a steel backing flange. The approach to the Octopus™ should be reduced to the correct pipe size using eccentric reducers to avoid air pockets and fed into the bottom of the Octopus™. A manual 2 or 3 inch drain valve should be installed at the low point in the piping to allow the Octopus™ to be emptied when the machine is down.



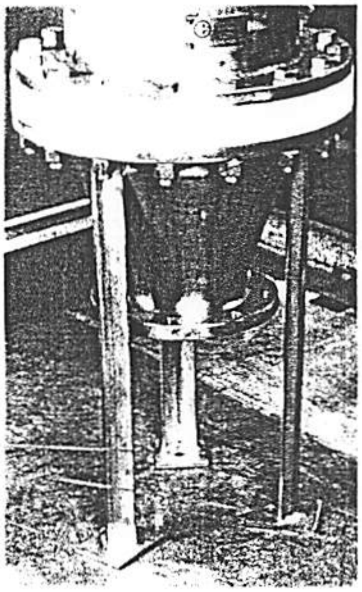
4. The air supply to the pressure transmitter (located on the side of the distributor section) should also be run to the general area where the TM will be located to reduce installation time. This supply is mill instrument air at 40 psig pressure.



5. Determine the location of the TM units with respect to the paper machine. If the units are to be located on the operating floor level and used to feed conventional vats (counterflow, uniflow or dry), the elevation of the attenuator diaphragm (see above photo) should be at least two inches lower than the making board of the vat. This will assure the unit is completely full of stock when operation.

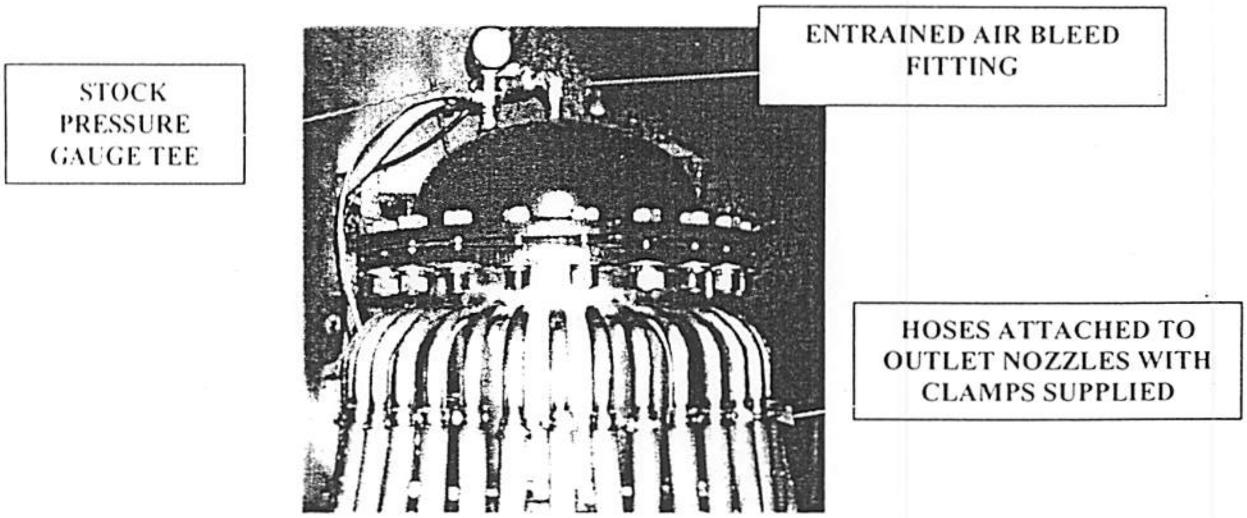
6. Verify that the hose length supplied will reach from the TM to the furthest attachment point away without kinking following the path that they will ultimately follow.

7. Once the TM is in location, attach the three legs to the floor using Hilti anchors or similar devices. This will prevent the unit from tipping during hose attachment.



8. Attach the forming device inlet flange. This may require removal of the existing inlet system (v hopper or tapered inlet). Make sure the inlet flange is gasketed to prevent leaks at the connection.

9. Connect the hoses from the ™ outlet nozzles to the forming device inlet flange by sliding the ends over the hose barbs and securing with the hose clamps provided. It is advisable to number the ends of each hose and work from one side of the forming device to the other so that hoses may be correlated with cross machine feed position.



CAUTION: The hoses must all be of equal length to provide equal pressure drops between the ™ and the forming device. Hoses may be shortened if the longest run is shorter than the hoses supplied; however if one hose is shortened, all hoses must be shortened the same amount.

10. Connect the air supply to the pressure filter/regulator and the output of the pressure regulator to the air supply port on the distributor section pressure transmitter. Set the output pressure of the regulator feeding the pressure transmitter to 35psig.

11. Install an air pressure gauge in the "tee" fitting on top of the ™. The gauge range should be 0 - 30 psi. The "tee" fitting is ¼" npt (see photo above).

12. Install the ½" valve on the center nipple of the attenuator dome. This is the air bleed from the stock portion of the ™. Run a 3/8" polyethylene (or like) tube from this valve to a point in the forming device water return to the fan pump. This will allow the air to leave the system before entering the forming device while recapturing the fiber and returning it to the fan pump (see photo above).

Manual Consistency Profiling (if applicable)

13. Install the manual control valves on the consistency profiling taps (see photo). The taps are NPT thread.

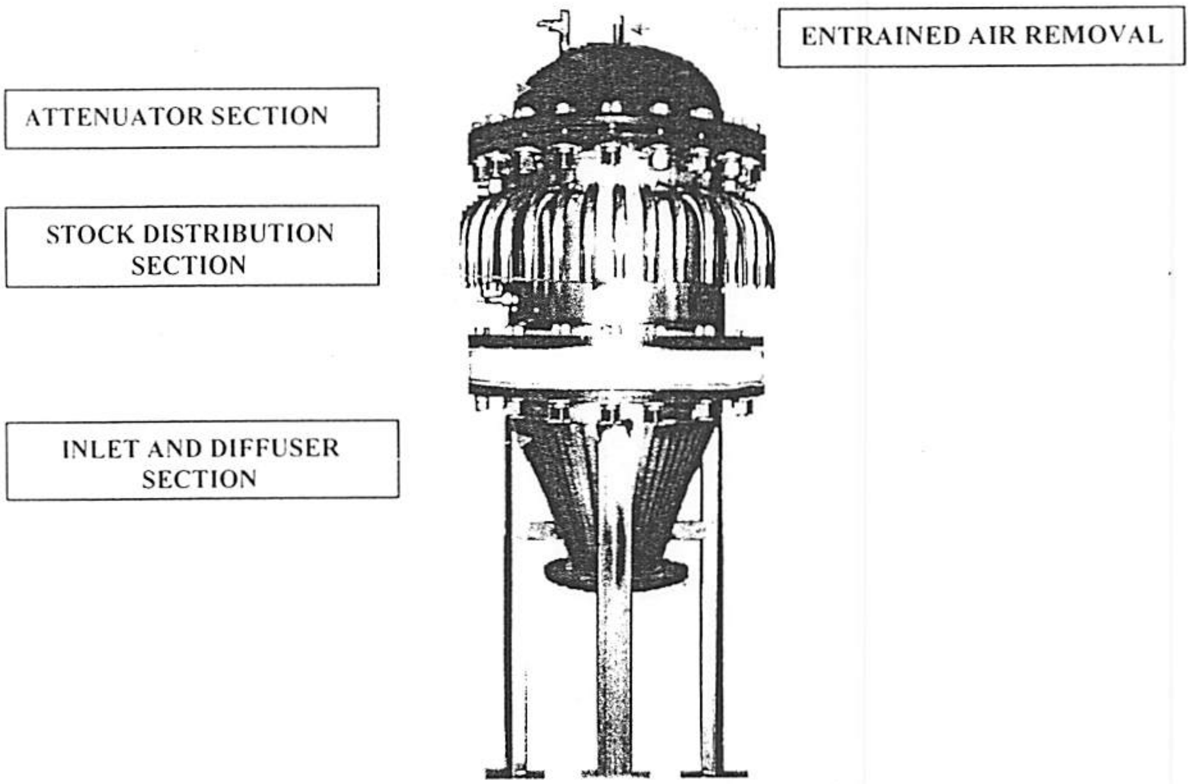
14. Connect the hoses from the white water dilution header (either supplied by mill or FC TEK) to the manual valves.

15. Open the valves approximately 50% for startup.

The ™ installation is now complete.

IV. ™ Operation

The operation of the basic ™ is straightforward and does not require the paper maker to make adjustments to the unit. Stock is fed to the ™ from the fan pump loop the same way stock was fed to the forming device prior to the rebuild.



Inlet Section

The stock enters the ™ through the conical inlet section located at the bottom of the unit and passes up through a diffuser plate that accelerates the fiber and breaks up fiber flocs.

Distributor Section

From here the fiber enters the uniform pressure (distributor) section. The stock passes up through the body of the distributor and enters the individual outlet nozzles where the pressure at every nozzle is the same. The stock continues through the feed hoses and because each hose is identical in length and has equal pressure drops the flow supplied to the forming device is the same across the entire machine width. When the operator changes the flow to the ™ by opening the discharge valve of the machine pressure screen or fan pump the absolute pressure in the distributor section will change, but the pressure at each hose inlet will still be uniform. With equal feed pressure at each hose inlet and equal pressure drops across the hoses the cross machine profile will remain constant. The distribution section may also be equipped with consistency profiling. A discussion of this option follows this section.

Attenuator Section

Above the distributor section is the attenuator portion of the Octopus™. Pulsations from fan pump impellers and pressure screen foils are not desirable. When these pressure pulses are carried through to the paper machine they may affect the formation of the sheet. The Octopus™ reduces these pulsations by a compressible air pad over the stock distributor portion of the unit. The air pad is isolated from the stock via a flexible membrane located between two flanges. In order to maintain maximum membrane flexibility for maximum pulsation attenuation, the air pad and stock pressure should be equal.

To achieve this, the Octopus™ employs a pressure transmitter in the distribution section that senses the internal stock pressure and generates an air supply that is equal in pressure. This air supply is then fed to the top of the attenuator so the pressure above and below the membrane is the same. If the stock pressure changes, the transmitter senses the change and alters the air pad pressure accordingly.

Entrained Air Removal

As stock is fed to the Octopus™, a certain amount of entrained air or foam will be carried into the unit. If this air were allowed to build up in the top of the unit below the attenuator membrane, is would eventually find its' way out through a feed hose. This "burp" of air is not desirable and could cause a foam streak or lump in the sheet. In order to avoid this, air that accumulates in the distribution section of the Octopus™ is removed via a center bleed that passes through the attenuator membrane and out the top of the unit. This air/fiber mixture is taken back to the water returning to the fan pump via the 3/8' top bleed to recapture the fiber. The end of the tube is typically fed into the inner forming device circle via the head control weir boxes on the end of the vat. Sending this bleed back to stock chests or other locations is also permissible.

Sequence of Equipment Startup

1. FILL FORMING DEVICE WITH WATER
2. TURN ON PRESSURE SCREEN (IF APPLICABLE)
3. TURN ON WHITE WATER TO CONSISTENCY PROFILING HEADER (IF APPLICABLE)
4. TURN ON FAN PUMP
5. START THICK STOCK INTO FAN PUMP LOOP

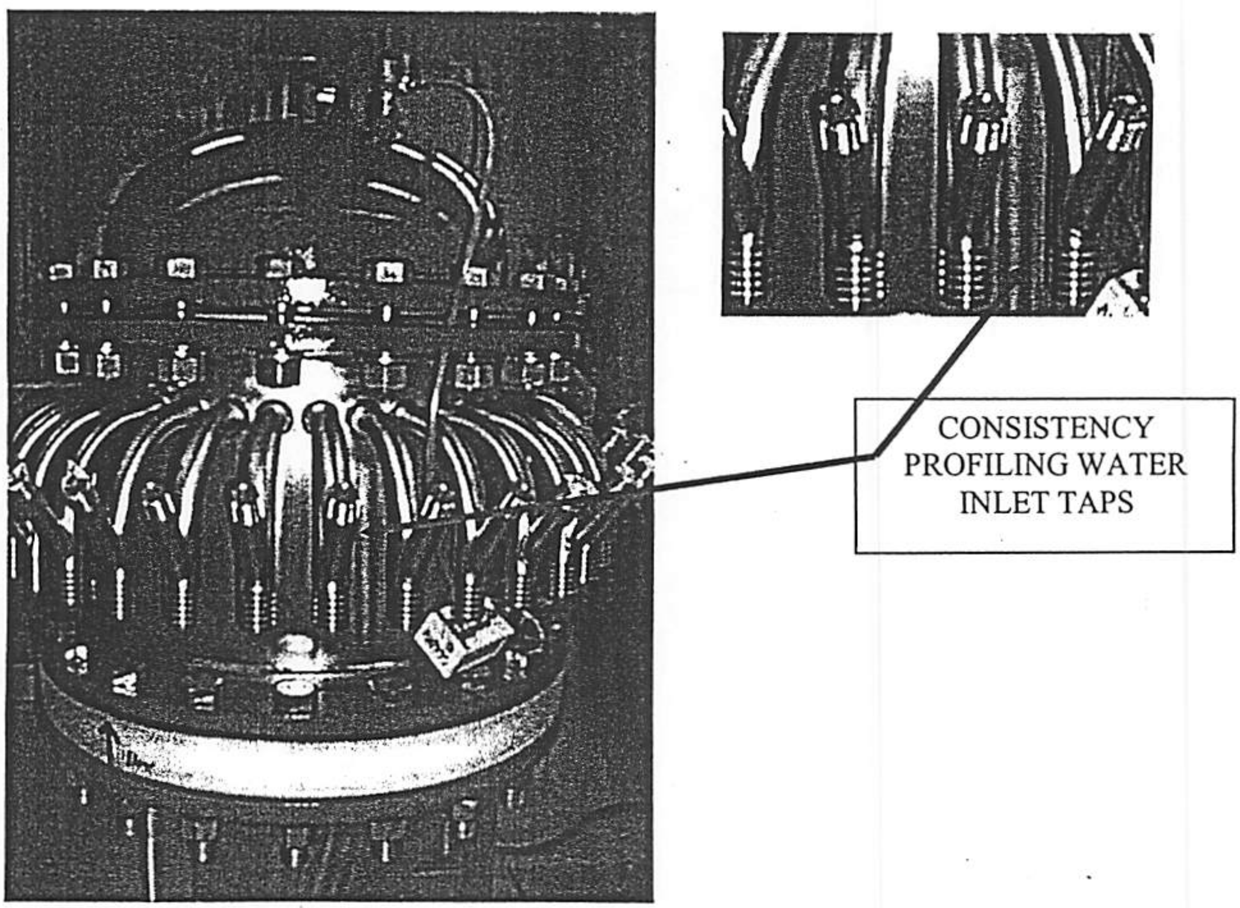
Consistency Profiling Option

Concept

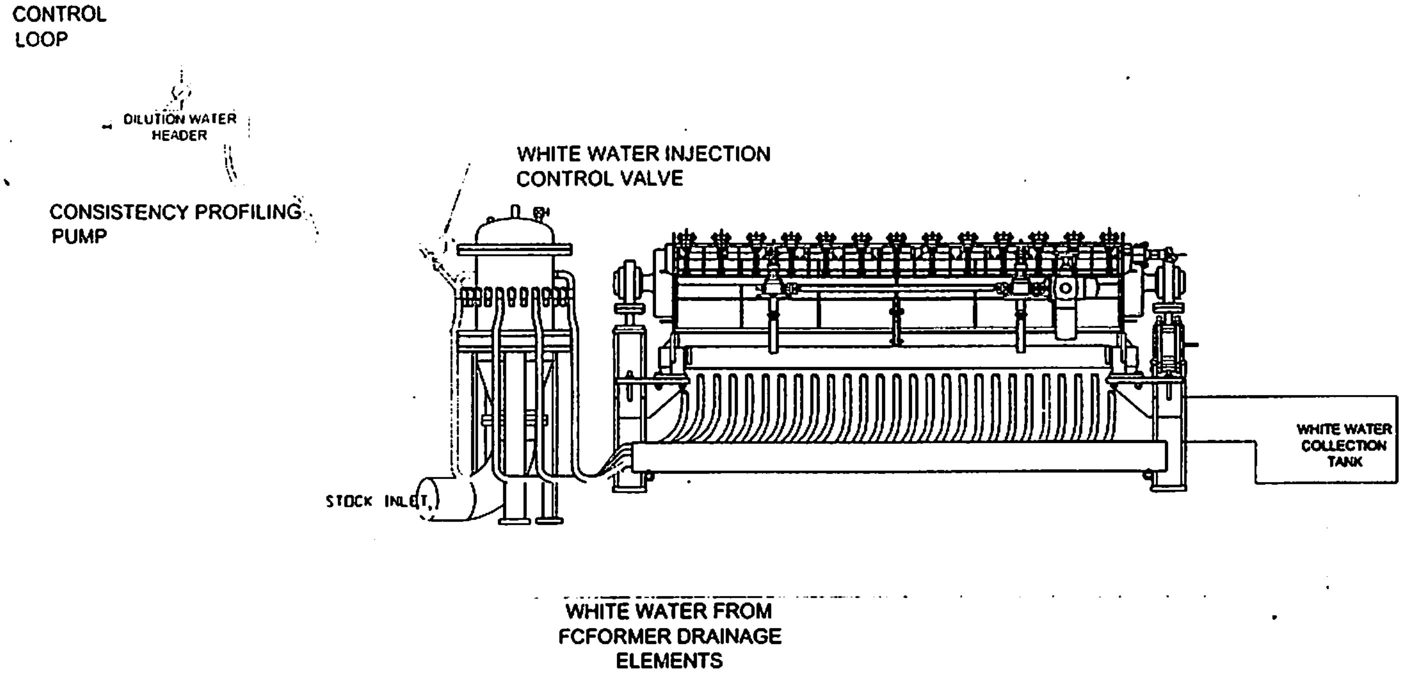
The Octopus™ approach system supplies stock to the forming device via hoses that create discreet forming zones. The basis weight of the sheet and cross machine profile is a function of the stock flow *and* consistency in each hose that supplies these zones.

The stock flow, typically measured in gallons per minute, is the same in each hose by concept design in the Octopus™ system. This results in a flat cross machine profile. It is possible however to change this flat profile by varying the consistency in each hose independently. This may be done to compensate for basis weight variations caused by the forming device after the stock exits the Octopus™ hoses or to level the final sheet when the forming device is used in conjunction with other forming devices.

When the Octopus™ is equipped with dilution control inlet taps (photo and schematic) white water is injected into each hose to control the consistency in that individual hose and the corresponding forming zone of the paper machine.



FCFORMER OCTOPUS™
WITH
CONSISTENCY PROFILING


CONTROL LOOP
DILUTION WATER HEADER
CONSISTENCY PROFILING PUMP
WHITE WATER INJECTION CONTROL VALVE
STOCK INLET
WHITE WATER COLLECTION TANK
WHITE WATER FROM FCFORMER DRAINAGE ELEMENTS

Consistency Profiling System Startup and Testing

There are two areas to consider when equipping an Octopus™ Stock Approach System with consistency profiling systems:

- design and installation of the profiling and supporting systems
- Initial startup and normal operation of the systems

During the design phase, it is important to take into consideration factors affecting the consistency profiling system. These include:

- white water temperature
- white water pressure control
- profiling tap design
- profiling valve design
- profiling valve control

<u>White Water Temperature</u>

The forming device system usually pumps white water in a short circulation loop with thick stock injected into that loop. The Octopus™ system is incorporated into this loop (see "Typical Water Loop, Vat Fed by FCFORMTEK Octopus™" drawing), without altering the system temperature. When the Octopus™ is equipped with consistency profiling, the white water used may come from a source that is at a different temperature than the forming device loop. Because the Octopus™ creates discreet forming zones, white water temperatures different than the loop temperature may create a temperature "streak" in the sheet. Because water viscosity varies with temperature, this streak may affect the pressing process.

<u>White Water Pressure</u>

A typical Octopus™ will have between 25 and 80 injection taps. When operating, the water pressure in the supply header is a few pounds higher (10 - 15) than the Octopus™ pressure. When any one control valve opens or closes it is important that the header pressure remains constant. If the header pressure were to rise when one valve closes, the remaining valves would all see an increased flow that would change the consistency in those hoses (ref. formula below). It is therefore important that the white water header pressure feeding the control valves remains constant. This may be accomplished via header control valves, variable frequency supply pump motors or use of a water source that is not affected by the amount of dilution water used.

$$Q = Cv\sqrt{\frac{\Delta P}{Sp.Gr.}}$$

Where Q = flow in US GPM
Cv = valve constant
Δ P= pressure drop across valve
SpGr = Specific Gravity at flowing temperature

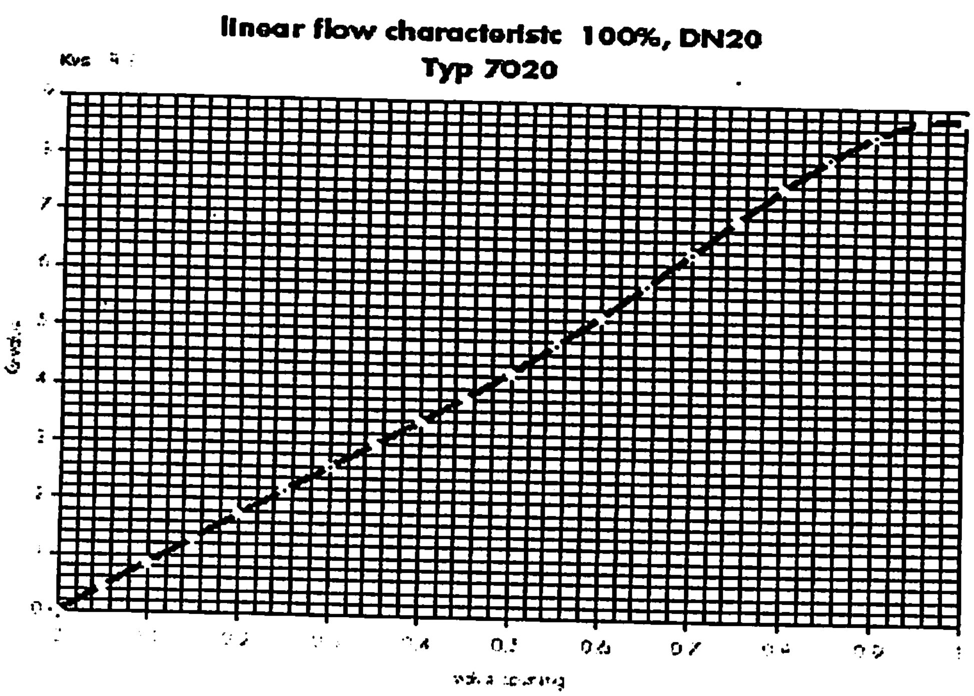
Profiling Tap Design

The white water is injected at an angle to promote maximum mixing of the two flows and dilutes the stock from the main distributor section to the normal machine operating consistency. This is typically 0.5 to 0.75% consistency entering the forming device for good formation. In addition, the angle at which the water is injected must be such as to displace the stock entering that hose from the Octopus™ Stock Approach System distributor section. For example, if the flow in the hoses is 50 gpm at the discharge end with the consistency profiling valves closed, and then 5 gpm (10%) of dilution water is injected into one hose, the flow at the discharge of the that hose must remain at 50 gpm. The five gallons per minute injected must stop five gallons per minute of stock from entering the hose from the distributor section. If the discharge volume from any hose differs from the adjacent hose, the control zone widths will vary with flow variation.

Valve Design

Valve flow rate characteristics vary widely by valve type. For example, an O ported knife gate valve (used for on / off applications) delivers the majority of it's' flow capacity with only a small percentage of the valve actually being open, while a globe valve (used for control applications) has a more linear relationship. Consistency control valves should be sized so that they will operate approximately one half open and deliver enough water to vary the total hose flow by +/- 15%. These valves should have a linear flow response to give good resolution over the operating range.

The valves supplied by Kadant AES FCFORMTEK Products (both manual and automatic) have a linear response to give 50% flow at 50% valve opening and are generally be operated in this range. The graph below shows the valve flow versus opening.



Valve Control

Valves may be either manual, which requires the machine tender to determine which valve should be changed to effect the location and direction of the basis weight correction desired, or automated so the machine process control computer can make the changes. Computer control is the more desirable method in that the computer will constantly adjust the process where the machine tender will make fewer corrections. A hybrid between the two types of control may consist of manually controlling the valves with the DCS. This involves having the machine tender look at the sheet profile from the machine scanner, and then manually adjust the output of the DCS to the automatic valves.

Consideration between the methods includes the cost of automated systems valves when weighed against the profile variation reduction and ease of operation and maintenance.

Regardless of which type of control method is chosen, the valves should be located is such a way as to make operator and maintenance access easy. If the valves are hard to reach, the tendency is for the operators not to make control changes, and if a valve fails to have to wait long periods of time before it is fixed. Both of these problems limit the systems efficacy.

The manual system is the least expensive option, followed by the hybrid and fully automated systems respectively.

System Testing Prior to Start Up

After addressing the above considerations it is advisable to check/test the systems prior to turning them on with the machine making paper to allow:

1. Verification that the valves and hoses have been properly installed and attached to the correct dilution tap (or taps) on the Octopus™ Stock Approach System.
   - Visually check to be sure the flow is in the correct direction through the valve.
   - each hose should be physically checked to see that it goes to the correct Octopus™ Stock Approach System hose, i.e. Control valve #1 should go to Octopus™ discharge hose #1 etc.
2. Checking of automatic valves for proper operation without affecting the paper machine
   - each valve should be dry run prior to connecting it to the Octopus™ consistency profiling tap. This involves attaching an air supply to the valve and sending it an electrical signal (4 - 20 ma) to visually see the valve move. If this is done prior to attaching the hoses, the valve plug is visible and should move.
3. Checking of the water supply system pumps and header pressure control system
   - the pumps and pressure control system should be activated and verified that as the flow varies, the pressure remains constant. This can be done by cycling a number of control valves and watching the header pressure.

Initial System Start Up

After the system has been physically checked, the paper machine may be started. It is suggested that the consistency profiling system valves be closed during this initial start up period and the paper machine allowed to get on grade and settle down. This may take a few hours.

After the machine is stable, with the consistency profiling valves closed, the dilution water supply pump should be started and the system checked for leaks.

If the supply system is tight, a base line cross machine profile from the machine process control computer should then be recorded.

Next the valves should be gradually opened.

Systems with <u>manual valves</u>

each valve should be opened approximately one-half turn. The flow in the hose should be visible, but may vary slightly depending on how tightly the valve was initially closed. After waiting a few minutes, the profile should be checked again and recorded and the header pressure checked to be sure it has stayed constant. If the profile has not changed shape (it shouldn't) open each valve another one-half turn. Continue checking the profile and opening the valves until they are 50% open (app. 5 turns). At this point the valves individually may be further opened or closed to "flatten" the basis weight profile.

Systems with <u>automatic valves</u>

This system should be started in a similar manner to the manual valves above except that with the DCS in manual, the operator will increase an electric signal to the valves. Starting at 4 milliamps (valve closed) increase the signal to the valves in one milliamp increments until 12 milliamps (50% open) is reached. At this point the DCS may be put in automatic and the valves individually may be further opened or closed to "flatten" the basis weight profile.

NOTE:

1. The flow to the forming device is the sum of the fan pump flow and dilution water flow. Depending on location of the flow meters, the flow to the forming device may not appear to change when in actuality it has increased. Physically observe the forming device as the dilution water flow is increased to be sure the forming device is operating correctly. Checking the consistency at the forming device is advised.
2. If the profile moves too much (appears oversensitive) to a valve position change it is possible the header feed pressure is too high. Typically the pressure difference between the dilution header and the Octopus™ Stock Approach System pressure will be 10 - 15 psig. Adjusting the differential pressure either higher or lower will change the flow through the valve (see equation above).

Normal Operations

During normal operation the paper machine is <u>started</u> with each control valve feeding a consistency profiling tap open to provide 50% of its' maximum flow (one-half open). See component start up sequence above.

Once the machine has reached normal operating conditions the cross machine basis weight may be either increased or decreased from the average weight by closing or opening the control valve that corresponds to the forming zone that is to be altered. If the machine is started with the control valves closed, then lowering the basis weight is the only control action possible.

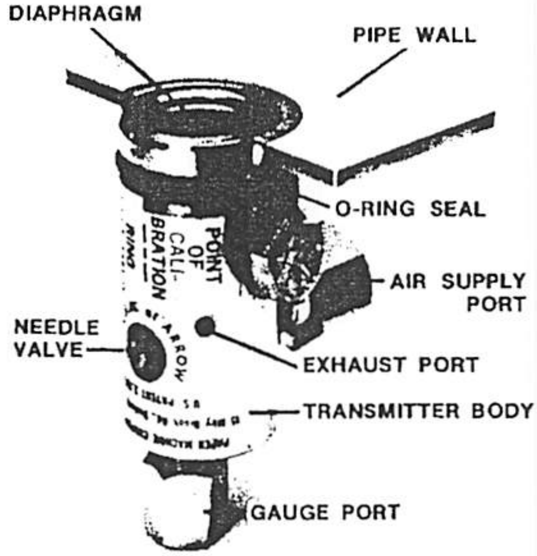
V. VENDOR LITERATURE

1. PAPER MACHINE COMPONENTS
   Octopus™ Stock Approach System Pressure Transmitter
2. SCHUBERT & SALZER CONTROL SYSTEMS
   Consistency Profiling Valves
   ¾" manual part no. A29246, angled body Model 7011 valve
   ½" manual part no. A29379, angled body Model 7011 valve
   ½" manual part no. A29670, right angle body Model 7051 valve
   ¾" automatic part no. A28122

PAPER MACHINE COMPONENTS, INC.

MINIATURE PRESSURE TRANSMITTER INSTALLATION & OPERATING DATA

MIRY BROOK ROAD, DANBURY, CONNECTICUT, U.S.A. 06810 Telephone: (203) 792 8686



(1) CUT HOLE FOR NIPPLE

Drill or cut a hole slightly smaller than the nipple outside diameter (1.316"), in the top or side of the pipe where the transmitter is to be located. The hole should be close to a flange or opening so that the inside wall of the pipe can be cleaned up after the nipple is welded in place. File the hole so that the steel nipple fits tightly into the hole. The fit must be snug, otherwise the nipple will cock when it is welded in place. Some customers have made up a collapsing internal mandrel to insert into the nipple before the weld operation. This helps prevent distortion of the nipple.

NOTE: Marvel* or similar nipple hole saws (1.316")O.D. (33mm) may be used with a slow speed drill (**150 RPM**) to cut out the proper size hole. The saw teeth should be continuously cooled and lubricated while cutting the hole, with a water soluble cutting oil such as Rustlick WS-500. (*Armstrong-Blum Mfg. Company, 5700 W. Bloomingdale Ave., Chicago 39, Illinois, manufacture Marvel hole saws.)

PMC offers a Hole saw kit (PT - HSK) which includes a ground Marvel hole saw, mandrel, drill, guide dowel, SRC speed control, cutting oil concentrate, applicator and case. Needs ½" electric drill........Kit cost:

(2) WELD NIPPLE IN PLACE

Position the nipple and transmitter with set screw installed into the hole ,so that the diaphragm on the transmitter is flush with the inside wall of the pipe. Mark the nipple both inside and out. On small diameter pipes (4" or less) the nipple and transmitter will protrude into the pipe due to crown of the pipe. **(The Transmitter must be removed from the nipple before welding.)** Weld the nipple in place with either Heliarc (inert gas arc process) or with arc and stabilized 316 stainless steel rods. This will prevent carbide precipitation and subsequent corrosion at the weld.

(3) GRIND NIPPLE FLUSH

Finish grind the nipple flush with the inside of the pipe. Clean up the inside edge of the nipple at the pipe end with a fine half round file. Remove all burrs but do not make any ridges or grooves on the inside nipple wall, otherwise material inside the tank will leak past the O-ring seal.

(4) INSTALL TRANSMITTER

Capsules of Dow Silicone grease (Valve Seal) are furnished with each order. Apply a thin wipe to the O-ring, diaphragm ring, edge of the nipple, and the remainder to the inside wall of the nipple at the bottom end where it connects to the pipe wall. Silicone grease is stable from –40°F to 500° and does not readily dissolve. Install the transmitter and locate with set screw. The transmitter diaphragm will be flush with the inside wall of the pipe if the nipple was properly positioned before welding. NOTE: Avoid contact with the eyes when using silicone grease.

(5) CONNECT SUPPLY AIR

Connect dry filtered air to the **SUPPLY** port. The standard transmitter has been calibrated with 100 PSIG supply air and consumes approximately 3 standard cubic feet of air per hour. It will also operate at any specified range providing supply air 5 PSIG greater than the maximum reading desired is available. The air must be clean and dry otherwise the flow control needle will become plugged and fail to operate. **A 2" supply pressure gauge should be connected to the supply line** to ensure that the flow control valve and transmitter are being supplied with adequate air pressure.

(6) MAKE GAUGE CONNECTION

Connect a pressure gauge, manometer, or recorder to the **GAUGE** port. If remote operation is desired, readings up to 100 ft. away may be obtained if continuous 50 ft. lengths of ¼"O.D. copper tubing are used. (We say continuous because this avoids connections which invariably are not tightened and therefore leak, and the transmitter does not yield proper readings.) **Special care must be taken to tighten all connectors and use thread seal on all pipe connections between transmitter and remote indicator or recorder, in order to avoid air leaks.** Leaks can be detected with children's soap bubble solution.

(7) TURN ON SUPPLY AIR

Turn on the air supply. Air should escape at a slight rate from the exhaust port.

(8) ADJUSTMENTS TO FLOW CONTROL VALVE

Normally there is no need to make any adjustment. The flow control valve has been set approximately ½ turn open to deliver 3 SCFH (standard cubic per hour). A rota-meter-taper flowmeter, part PT-FM @ may be used for checking proper flow rate. If better response is required, be sure to check for air leaks in the connecting tubing with a soap bubble solution before making any adjustments to the needle valve. **Excess use of air and unsatisfactory operation will occur if the needle valve is opened beyond ONE FULL TURN.** The factory setting is marked in line with the needle valve slot.

(9) LOW READINGS

If gauge readings appear low, close the needle valve then reopen approximately ½ turn to point where the slot lines up with the calibration vee mark. This action clears residual carbon and oil gum and restores proper air flow through the transmitter.

ADDITIONAL INFORMATION

- Do not use a pipe wrench on the body of the transmitter during installation. The fit between nipple and transmitter should be free enough to permit installation and removal by hand. Avoid excess clearance.
- Avoid excess use of thread seal, otherwise the gauge connection and supply connection filter discs may become plugged and prevent the transmitter from operating properly.
- DUMMY TRANSMITTERS: Are available in 303 stainless steel @ each. Order code PT-11-S/S. Also available in PVC with stainless steel insert @ each. Order code PT-11-PVCI. The plastic PVC dummy has a service temperature limit of 120°F (50°C).
- The transmitter body O-ring may be removed with a scriber or a small screw driver.

ADDITIONAL INFORMATION (continued)

- **EXHAUST SILENCER:** A silicone sleeve has been pressed into the ⅛" exhaust port. The silencer is equipped with a .052"D hole to limit transmitter exhaust rate, thereby eliminating undesirable exhaust whistle.

- **SERIAL NUMBER:** Each transmitter is marked on the end opposite the diaphragm. Please refer to this number when ordering parts.

- **EXTREMELY IMPORTANT:** A white cap has been installed over the diaphragm to protect it during shipment and installation. **Keep this cap in place until the final tubing connections have been made.**

- **DIAPHRAGM REPLACEMENT:** *Replacement diaphragms are available only as* BONDED ASSEMBLIES, *and consist of retainer ring, diaphragm bonded in place, and inner O-ring. These assemblies provide long term dependable readings, eliminate the possibility of blow out and errors due to accumulation between the diaphragm and lip of the retainer ring.*

- **BONDED ASSEMBLY INSTALLATION:** Remove the outer O-ring. Unscrew the diaphragm retainer ring by hand or by fitting a hose clamp over the ring and loosen by hand or with pump pliers. Clean face and threads of body. Remove inner O-ring from new assembly and run ring up by hand until diaphragm contacts face (**avoid force**). Magic mark ring opposite arrow on body. Remove ring, install inner O-ring, then thread assembly until ring mark lines up with existing calibration V or dot mark on body. Transmitter is ready to use. Use PMC Field Test Panel for precise calibration.

- **FILTER DISC INFORMATION:** All transmitters are equipped with a filter adapter in the air supply port and gauge port. The air supply filter traps out final traces of dirt and oil that may clog the flow control needle valve. **This filter adapter is not intended as the main line instrument air filter.*** The gauge port filter traps out dirt and metal particles that may originate from the remote gauge connection. The filter discs are sintered from 316 stainless steel particles and have an average pore size of 20 microns (.001"). The standard adapter is chrome plated brass. Stainless adapters are available—see PT-10-SS & PT-12-SS on parts list page 4.

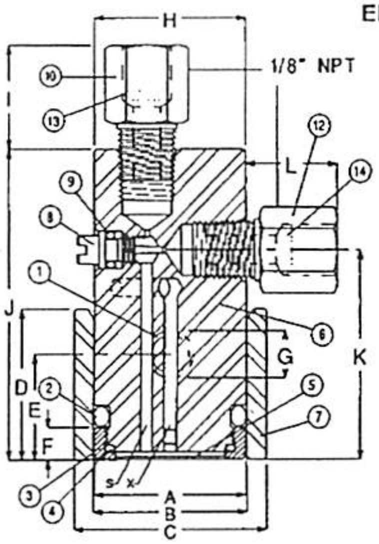
- **REPLACEMENT INFORMATION: Air Supply Port Filter**
  In the unplugged state the filter disc will pass 30 x more air than is required to operate the transmitter. If it becomes necessary to open the needle valve beyond 1 turn, the filter disc should be replaced in the following manner:
  (a) Shut off supply air and disconnect line at air supply port.
  (b) Remove adapter fitting and push out plugged filter disc with a punch.
  (c) Insert new disc and drive into place with a clean punch approximately 5/16"(8mm) in diameter.
  (d) Re-assemble adapter fitting and air supply line. Avoid getting dirt in supply port.

  NOTE: Transmitter can be worked on while under pressure without fear of damaging diaphragm.

- **RECOMMENDED AIR FILTER:** Where clean instrument air is not available we recommend the following filter:
  Adjustable Filter Regulator: (1) Norgren B11-221-M2E-W-5203-01 —our part LT-NMFR. This regulator handles four transmitters—two ranges 3-50 psi and 5-125 psi—*please specify range desired.*

MINIATURE PRESSURE TRANSMITTER

ENGINEERING DATA



	INCHES	M.M.
A	1.035	26.28
B	1.049	26.64
C	1.315	33.40
D	1.000	25.40
E	.700	17.80
F	.215	5.46
G	.316	8.02
H	1.035	26.28
I	.670	17.02
J	2.050	52.07
K	1.440	36.57
L	.750	19.05

CERTIFIED PRINT

PARTS DESCRIPTION

1. S/S Set Screw & Lock Washer
2. Outer O-Ring
3. Diaphragm Retainer Ring - 316 S/S
4. Inner O-Ring
5. Diaphragm - 3.5 mil thick
6. Transmitter Body - 304 S/S
7. Weld-on Nipple - 316L S/S
8. Needle Flow Control Valve
9. Needle Valve O-Ring
10. Filter Adapter - Gauge Port
11. Dummy Transmitter Plug - not shown
12. Filter Adapter - Air Supply Port
13. Filter Disc - sintered S/S
14. Filter Disc - sintered S/S

PRINCIPLE OF OPERATION

Regulated supply air flows steadily past needle flow control valve 8, lifts diaphragm and exhausts through central port X. An increase of pressure against diaphragm outer face blocks exhaust port X, until back pressure at S reaches a point of balance. The connected gauge or recorder reads this back pressure. A slight rate of exhaust occurs when balance is reached. The system acts in reverse with decreasing pressure.

PARTS LIST AND PRICES

Number	Description	Price
PT-01	S/S Set Screw & Lock Washer	
*PT-02-N	Outer O-Ring - Buna N #210 *(35301864 ISO)*	
PT-02-Si	Outer O-Ring - Silicone #210 *(35301864 ISO)*	
PT-02-V	Outer O-Ring - Viton #210 *(35301864 ISO)*	
*PT-03-Ha	Diaphragm Retainer Ring Assembly (Parts, 3,4, & 5) Havar diaphragm bonded in place	
PT-03-Hc	As above - but with Hastelloy-C diaphragm	
PT-03-Ta	As above - but with Tantalum diaphragm and Hastelloy-C Retainer Ring	
PT-04-Si	Inner O-Ring - Silicone #018 *(17801877 ISO)*	
PT-04-V	Inner O-Ring - Viton #018 *(17801877 ISO)*	
PT-05	Diaphragm - *Available only in bonded assemblies* See part PT-03-Ha above	
PT-06	Transmitter Body - 303 Stainless Steel	
*PT-07	Weld-on nipple - 316 ELC Stainless Steel	
*PT-08	Needle Valve in 303 S/S, complete with Buna N O-Ring (Add .80 for Silicone or Viton)	

Number	Description	Price
PT-09-N	Needle Valve O-Ring - Buna N #006 *(17800290 ISO)*	
PT-09-Si	Needle Valve O-Ring - Silicone #006 *(17800290 ISO)*	
PT-09-V	Needle Valve O-Ring - Viton #006 *(17800290 ISO)* . .	
*PT-10-B	Adapter - Gauge Port, with filter disc - 1/8" NPT female x 1/8" NPT male. Adapter in plated brass	
PT-10-SS	Adapter - as above in 303 stainless steel	
PT-11-SS	Stainless Steel Dummy Transmitter complete with O-Ring (not shown)	
*PT-12-B	Adapter - Air Supply Port, (same as PT-10-B)	
PT-12-SS	Adapter - Air Supply Port, (same as PT-10-SS)	
PT-13	Filter Disc - Order assembly PT-10-B	
PT-14	Filter Disc - Order assembly PT-12-B	
PT-16	Silicone Grease Capsule	
PT-20	Needle Valve Plastic Cap	
PT-21	Exhaust Silencer - Silicone rubber	

Recommended spare parts for every five (5) transmitters

MINIMUM ORDER -

Parts orders should include Transmitter Serial Number

MANUFACTURED AND SOLD BY:

PAPER MACHINE COMPONENTS, INC.
Miry Brook Road
Danbury, Connecticut U.S.A. 06810
Telephone: (203) 792-8686

TROUBLE SHOOTING & CALIBRATION INSTRUCTIONS

FOR MINIATURE PRESSURE TRANSMITTERS

FIELD FUNCTION TESTS: The purpose of these tests is to determine whether installed and operating transmitters are yielding correct pressure readings.

(1) CHECK FOR CORRECT SUPPLY PRESSURE TO THE TRANSMITTER

The operating range of the transmitter is code marked above the serial number on the exposed end of the transmitter body. Domestic transmitters are marked PMC-PT-100-N-HA-S. The 100 signifies 0-100 psi and other ranges are marked 0-60, 0-30, 0-20, 0-15 and 0-10. Foreign transmitters are marked in bars, thus 7,6,5,4,3,2,1.The word STD signifies standard and is often used in place of PMC-PT-100# (7 bars)-N-HA-S.

The standard range transmitter works quite well with clean mill air supply pressure ranging from 65 psi to 105 psi or 4 to 7 bars.

If ranges other than STD/standard are installed then transmitters should be supplied with regulated supply 5 psi (0.3 bars) greater than the code marked range.

False readings result from incorrect supply pressure.

Ranges other than STD/standard are furnished to customers who wish to limit the maximum transmitter output pressure in order to prevent over ranging quality pressure gauges (such as installed on pulp cleaner systems) and receiver elements mounted in expensive recorders and controllers.

(2) CHECK FOR CORRECT FLOW OF AIR THROUGH TRANSMITTER

A PMC exhaust Flowmeter (PT-FM @ may be used to check for correct flow. At low process pressure 0-15 psi (0-1 bar) the flowmeter ball should indicate 3 SCFH. At higher pressure 40-60 psi (3-4 bars) the ball will drop to 2.5 SCFH reading. If the flow is low, adjust the needle valve to achieve correct flow.

NOTE: Low readings often result from partially plugged needle valves and are caused by dirty supply air. Needle valves since 1972 (Serial No. 14000) have been equipped with a groove to pass most of the supply air. This design change helped overcome the dirty air problem, however, all users should equip their service people with PMC exhaust flowmeters if only as field test aids.

(3) CHECK FOR AIR LINE LEAKS BETWEEN TRANSMITTER AND REMOTE GAUGE OR PANEL SYSTEM

If test (1) and (2) have been made and low readings are still suspected then all tubing connections between transmitter and remote gauge should be soap bubble tested for leaks. An alternate test is to mount a good gauge directly to the transmitter gauge port as an alternate to searching for and leak testing all fittings. Higher readings at the transmitter will confirm a fitting or line leak.

Comment: If test (1), (2) and (3) fail to give satisfactory readings the following steps can be taken:

(4) INSPECTION FOR DIAPHRAGM DAMAGE

Blown or ruptured diaphragms or foreign material trapped under the diaphragm may cause low readings. The suspected transmitter can be removed to inspect for diaphragm rupture or trapped particles during process shut-down.

P.M.C. offers a Field Extractor which permits transmitter inspection and exchange during operation at pressure of up to 100 psi (7 bars) Part No. (PT-FX @

NOTE: Replacement diaphragms are now available only as BONDED ASSEMBLIES and consist of retainer rings, diaphragm bonded in place and inner o-ring. These assemblies provide long term dependable readings, eliminate the possibility of blow-out and errors due to accumulation between the diaphragm and lip of the retainer ring.

Bonded Assembly Installation:

Remove the outer o-ring. Unscrew the diaphragm retainer ring by hand or by fitting a hose clamp over the ring and loosen by hand or with pump pliers. Clean face and threads of body. Remove inner o-ring from new assembly and run ring up by hand until diaphragm contacts face, (avoid force). Mark ring opposite arrow on body with permanent marker. Remove ring, install inner o-ring, then thread assembly until ring mark lines up with existing calibration V or mark on body. Transmitter is ready for use. Use PMC field test panel for precise calibration.

Printed in USA

(5) FIELD TEST

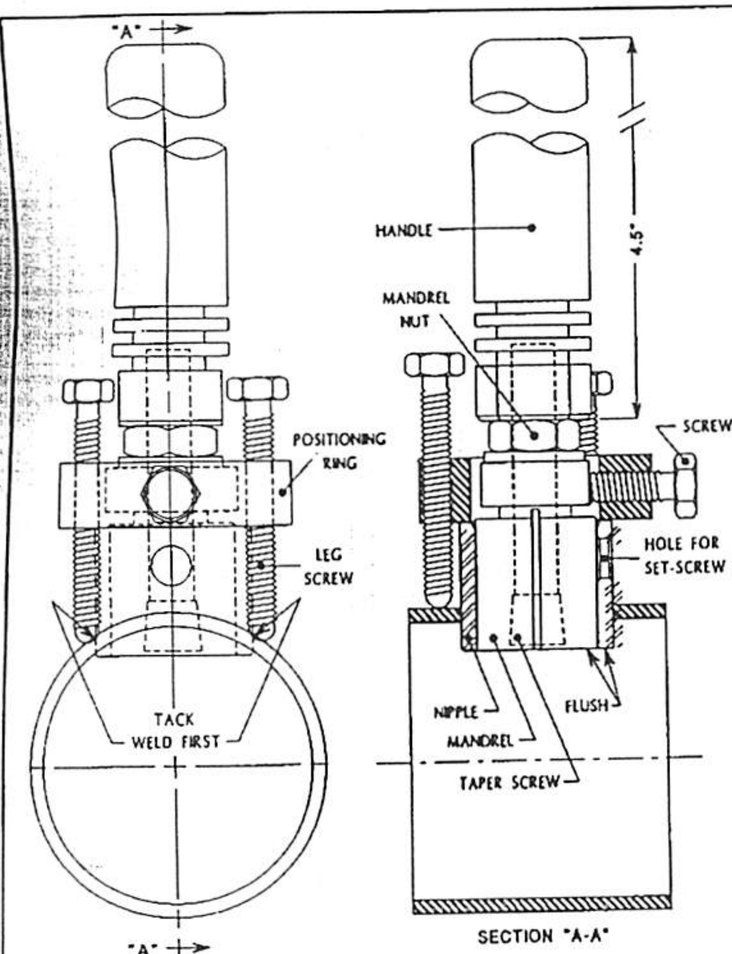
Transmitters that appear to yield low or false reading can be removed for field test during shut-down or extracted while under pressure and range tested. Part number for the Field Test Panel is (PT-FTP @ The test panel uses a 3-way air switch and single gauge to compare process pressure against transmitter output. This arrangement helps eliminate the normal error that exists between a pair of test gauges. (If customers elect to use a pair of test gauges or manometers a preliminary test should be made by connecting a common adjustable supply and a check made over the test range to determine variations between gauges. P.M.C. transmitters cannot be made to track test gauges with gross errors or leaking manometers. Be sure to check first before assuming P.M.C. transmitters are in error.)

(6) FACTORY REBUILDS

All units no matter how old can be returned for rebuild, up-date and recalibration at approximately half the cost of a new unit and carry a new year guarantee.

(7) FACTORY CALIBRATION INFORMATION

All miniature pressure transmitters are factory calibrated, rechecked a week later and then code marked. There is no basic difference between a standard transmitter 100 psi(7 bars) range and one with a range of 0-15 psi(1 bar). During calibration the retainer ring and diaphragm are screwed down further, placing the diaphragm closer to the transmitter face for lower ranges. The needle valve is also opened to achieve correct flow (3 SCFH) for lower ranges. Supply pressure must be 5 psi(0.3 bar) greater than the range.



PT-07 Nipple Installation Instructions

1. Bore a 1-5/16" ID hole in top or side of pipe.
2. Mount MANDREL in NIPPLE, making sure that NIPPLE and MANDREL bottoms are flush.
3. Expand MANDREL by tightening MANDREL NUT. Thread HANDLE onto exposed TAPER SCREW.
4. Mount POSITIONING RING onto MANDREL and tighten SCREW.
5. Adjust three LEG SCREWS to position nipple on pipe wall. On small diameter pipes the nipple protrudes into the flow line.
6. Tack weld the nipple at three points then remove POSITIONING RING.
7. Proceed to weld nipple at sides as noted then complete weld all around.
8. Remove MANDREL by loosening MANDREL NUT and tapping TAPER SCREW free. Using a welding clamp, grip the outboard part MANDREL and work free.

CAUTION: Do not pull TAPER SCREW.

PAPER MACHINE COMPONENTS DANBURY, CONNECTICUT U.S.A.			
PART NAME PT-07 NIPPLE WELDING MANDREL ASSEMBLY			
MATERIAL #303 STAINLESS STEEL		DATE Jan. 21, 1993	SCALE FULL
QUANTITY	DRAWN BY L.W.	ORIG. DWG.	ASSY. DWG.
BREAK ALL SHARP EDGES AND CORNERS FRACT. DIMS. +/- 1/64", DECIMAL DIMS. +/- .005" ANGLES +/- 1/4° UNLESS OTHERWISE SPECIFIED		DWG. NO. 1925-A	

SCHUBERT & SALZER
CONSISTENCY PROFILING VALVES
Automatic Valve

1. Position

The adjustment of the i/p-positioner was carried through for a horizontal position of the valve in the pipeline (positioner upside). When changing the position, zero point and end value have to be readjusted.

2. Supply pressure

Supply air has to be connected to "P" (G1/8"). It has to be free from oil, water and dust (instrument air). The admissible supply pressure range is stated on the type label (max. 6 bar). The adjustment in the factory is carried out for 4 bar. When changing the supply pressure, zero point and end value have to be readjusted.

3. Input signal connection: 0(4) - 20mA resp. 20 - (4)0mA

The connection of the input signal is provided by a 2m two-wire cable or by a two-terminal clamp located in a side-mounted housing (clamp adapter). This housing with the cable bushing is closed by a screwed cap.
The ex-proof version of the positioner is delivered only with clamp adapter.

The polarity depends on the operating mode of the valve as follows:

standard:

rising input signal opens the valve:	brown +
	white or black -
rising input signal closes the valve:	brown -
	white or black +

ex-proof:

rising input signal opens the valve:	1 or brown "+"
	2 or black "-"
rising input signal closes the valve:	1 or brown "+" (works adjustment)
	2 or black "-" (works adjustment)

The factory adjustment of the i/p-positioner is stated on the type label. The electrical signal is converted to a signal pressure by an I/p-converter. This pressure can be controlled by a gauge fitted to the G1/8"-thread closed by a threaded cap. This eases adjustment and trouble-shooting.

4. Adjustment of the i/p-positioner:

Both zero point (ZERO) and end value (SPAN) of the converter have to be adjusted:

ZERO: remove cap 105, turn spur wheel with a screw driver
("+" converter pressure rises, "-" converter pressure falls)

SPAN: remove bleeder screw (142), turn trimmer with a small screw driver
("counter-clockwise" converter pressure rises,
"clockwise" converter pressure falls)

The adjustments of ZERO and SPAN are to be repeated alternatively for several times, as they are influencing each other. The further procedures are described below.

4.1. Rising signal opens, spring closes, signal range 0-20 mA

- connect current source for the input signal (input resistance < 220 Ω, ex-proof version: < 420 Ω)
- polartity: brown "+", white or black "-"
(ex-proof version: 1 or brown "+", 2 or black "-")
- *input signal 0 mA:* valve is completely closed
- *input signal 2 mA:* valve starts to open
pressure at control gauge approx. 0,3 ±0,03 bar
(adjusted with "ZERO")
- *input signal 20 mA:* valve is completely opened
pressure at control gauge approx. 1 ±0,03 bar
(adjusted with "SPAN")

4.2. Rising signal opens, spring closes, signal range 4-20 mA

- connect current source for the input signal (input resistance < 285 Ω, ex-proof version: < 460 Ω)
- polartity: brown "+", white or black "-"
(ex-proof version: 1 or brown "+", 2 or black "-")
- *input signal 4 mA:* valve is completely closed
- *input signal 6 mA:* valve starts to open
pressure at control gauge approx. 0,3 ±0,03 bar
(adjusted with "ZERO")
- *input signal 20 mA:* valve is completely opened
pressure at control gauge approx. 1 ±0,03 bar
(adjusted with "SPAN")

4.3. Rising signal closes, spring closes, signal range 0-20 mA

- connect current source for the input signal (input resistance < 220 Ω, ex-proof version: < 420 Ω)
- polarity: brown "-", white or black "+" (ex-proof version: factory adjustment required)
- *input signal 0 mA:* valve is completely opened
pressure at control gauge approx. 1 ±0,03 bar
(adjusted with "ZERO")
- *input signal 18 mA:* valve starts to close
pressure at control gauge approx. 0,3 ±0,03 bar
(adjusted with "SPAN")
- *input signal 20 mA:* valve is completely closed

4.4. Rising signal closes, spring closes, signal range 4-20 mA

- connect current source for the input signal (input resistance < 285 Ω, ex-proof version: < 460 Ω)
- polarity: brown "-", white or black "+" (ex-proof version: factory adjustment required)
- *input signal 4 mA:* valve is completely opened
  - pressure at control gauge approx. 1 ±0,03 bar (adjusted with "ZERO")
- *input signal 18 mA:* valve starts to close
  - pressure at control gauge approx. 0,3 ±0,03 bar (adjusted with "SPAN")
- *input signal 20 mA:* valve is completely closed

After the adjustment has been finished the control gauge is removed and the threaded cap (with sealing) is mounted again. The bleeder screw and the protection cap are inserted.

Adjustment of the supply air flow:

Using the adjustment nozzle (99) the air consumption and at the same time the actuator velocity are controlled.
Turning the nozzle screw clockwise makes the air consumption decrease. Furthermore the opening of the valve is slowed down. Throttling too far has to be avoided as the valve then will not be able to open completely.
Turning the nozzle screw counter-clockwise makes the air consumption increase. The opening of the valve is speeded up and the closing is slowed down. Opening the nozzle too far has to be avoided as the valve then will not be able to close completely.

Changing the I/p-positioner

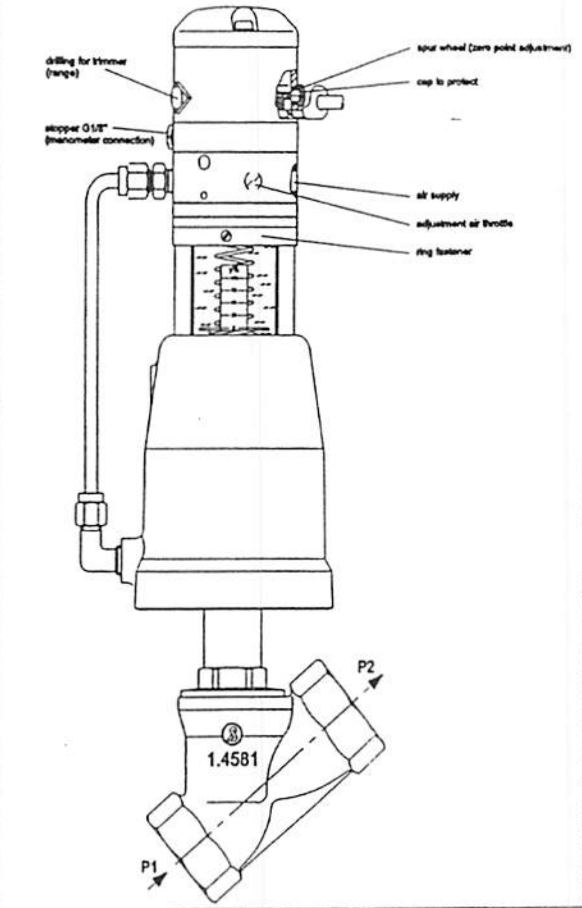
- disconnect cable from signal source
- disconnect air supply "P" (G1/8")
- loose 3 screws (131) at ring fastener (130) using a 2,5 mm hexagon screwdriver
- loose coupling piece (128) at pipe (78)
- remove positioner

Attn.: Do not open the I/p-positioner. If required send it to the factory for repair.

The positioner should be continously connected to supply air of min. 4 bar when being in contact with water or other fluids (e.g. when cleaning the installation).

DANGER: The actuator is spring-loaded. Injuries are risked when not dismantled in a suitable manner. Use exclusively our special tools for this purpose.

SCHUBERT & SALZER CONTROL SYSTEMS | ANGLE BODIED CONTROL VALVE WITH I/P-POSITIONER | 7020 0005 E

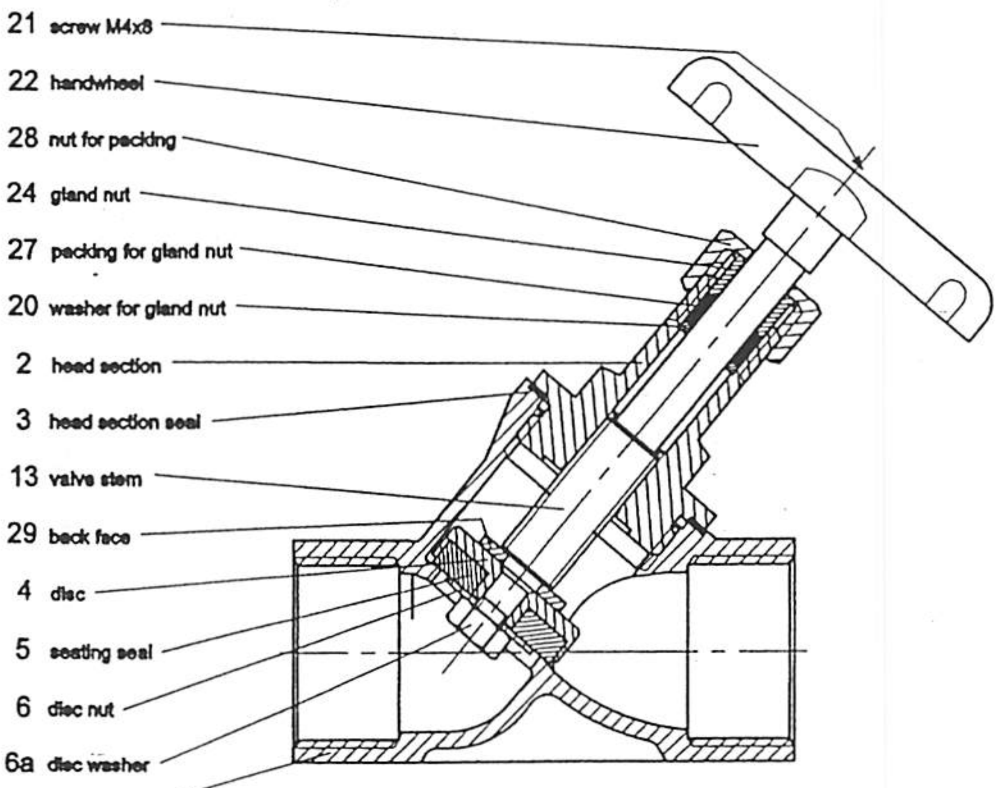


04.07.95 | 27.09.93 | HAERTL | 7020 0005 E

SCHUBERT & SALZER
CONSISTENCY PROFILING VALVES
Manual Angled Body Valve Model 7011

MOUNTING AND OPERATING INSTRUCTIONS FOR HAND-OPERATED 2/2-WAY-VALVES TYPE 7011

The valves have to be mounted in the pipeline according to the direction of flow. The direction of flow is marked by an arrow on the valve body.
The valves are closed by turning the handwheel clockwise, openend by turning it counterclockwise.
The admissible pressure range is 40 bar,max., depending on valve size and operating conditions.
If there is any leakage at the valve stem, the packing has to be adjusted (nut 28).



SCHUBERT & SALZER
CONSISTENCY PROFILING VALVES
Manual Right Angle Body Valve Model 7051

The Model 7051 right angle manual dilution valve uses the same stem part numbers as the 7011 angled body valve above.