FIBERPREP

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#23194

FIBERPREP/ELP SpirELPak 136

DESCRIPTION, INSTALLATION,

MAINTENANCE & OPERATING MANUAL

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Custom Papers Grouping
1 Old Princeton Road
Fitchburg, MA 01420-4823

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ELP 136
ELP 118-126

PO #29923

Fiberprep/ELP SpirELPak 136

Table of Contents

1. CANISTER DESCRIPTION AND INSTALLATION

The SpirELPak 136 canister is a disc shaped unit containing a single layer of cleaners. The canister is divided into feed, accept, and reject chambers by horizontal flat plates. Cleaners are installed vertically with upturned rejects which are exposed when the canister lid is removed. Sealing between the chambers is accomplished by modified cup seals which are incorporated into the cleaner. The entire assembly is stiffened by means of rods running through the canister. The lid is secured by bolts which screw into the tops of these rods and into a flange at the outside diameter of the canister.

The canister lid has an operating port over each cleaner, which contains a sight glass and unplugging grommet. The lid also has a float type air vent to release any air which may accumulate at the top of the reject chamber of the canister, as well as lifting hooks (when needed) and handles to facilitate the removal and replacement of the lid.

Each canister chamber has one or more small nipples which can be used to flush out the canister during shutdown.

*Bolted to the outside of each canister is a pressure panel containing three gauges which indicate feed, accept and reject pressures.

*Note: Pressure Gauge Panels not included on this order.

There are two basic styles of canister, those where the feed, accept and reject pipes come in through the side of the canister and those where they come in through the bottom of the canister.

Side connector canisters are 32 inches in diameter or smaller. The feed is from one side, while the accept and reject are taken off

1. CANISTER DESCRIPTION AND INSTALLATION (continued)
from the opposite side. This results in a "side to side" flow pattern for the pulp stock.

Canisters larger than 32 inches in diameter use bottom connections. Both the feed and accept flow within the canister proceeds primarily from the outside wall to the center, while the rejects flow primarily from the center to the outside wall.

Although it is rarely necessary, both styles of canister have allowance for the introduction of dilution water into the reject chamber of the canister.

Please refer to the attached Figures 1 and 2 for a cross section of typical canister of each style. The Appendix contains general notes on the canister construction and installation.

1. <u>CANISTER DESCRIPTION AND INSTALLATION</u> (continued)

Fiberprep/ELP SpirELPak - 136

SIDE DISCHARGE CANISTER

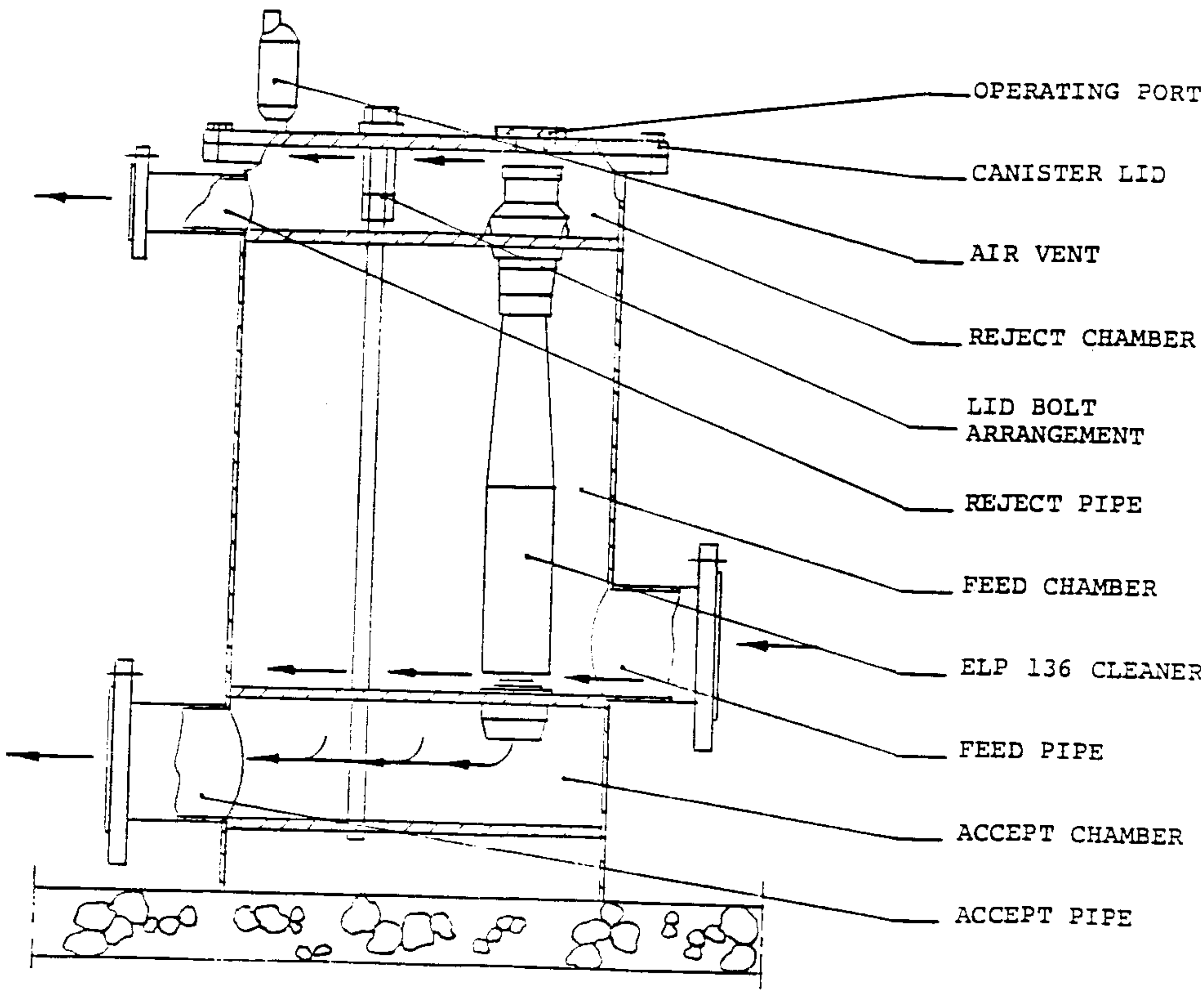


FIGURE 1.

1. CANISTER DESCRIPTION AND INSTALLATION (continued

Fiberprep/ELP SpirELPak - 136

BOTTOM DISCHARGE CANISTER

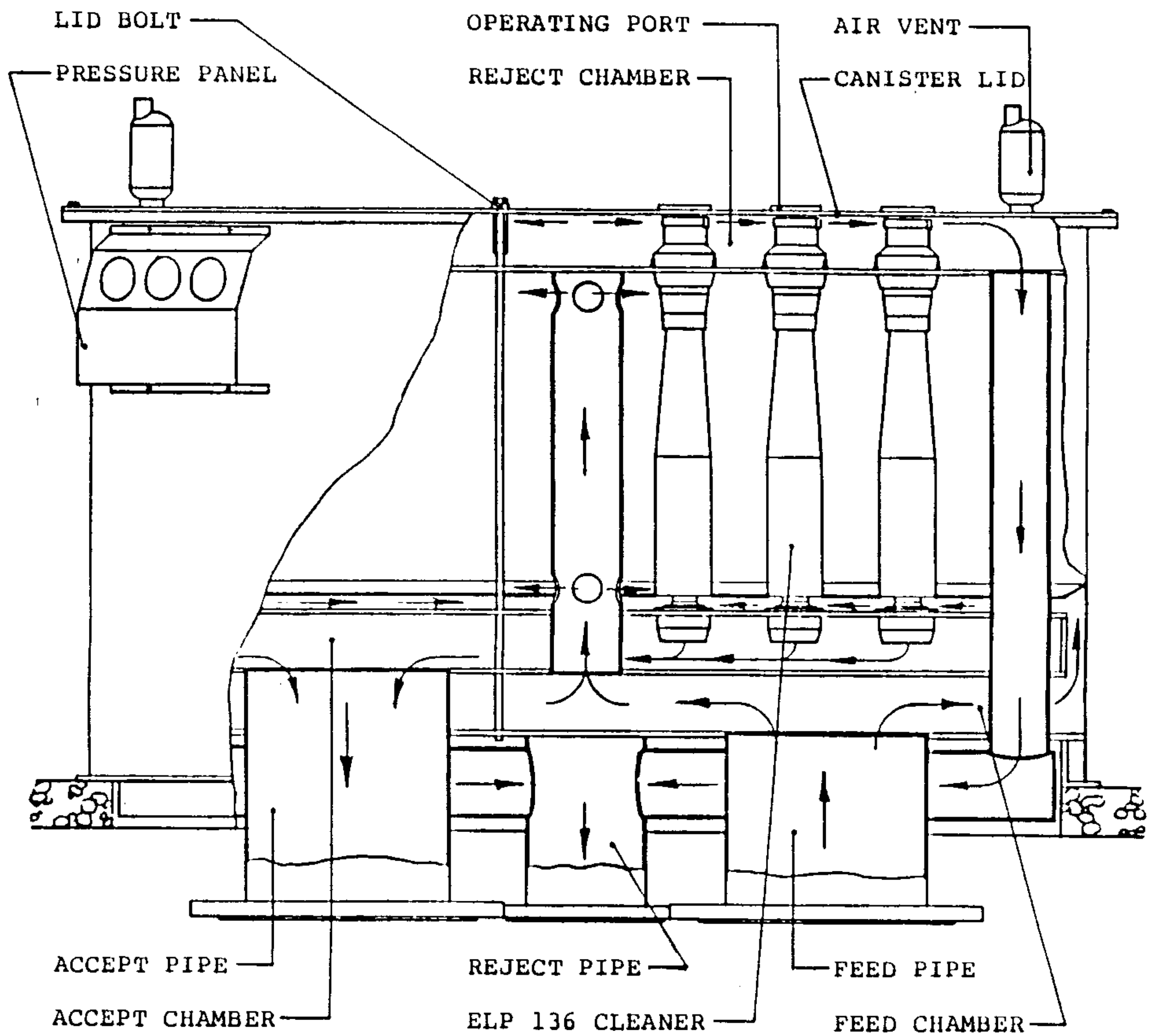


FIGURE 2.

2. FIBERPREP/ELP 136 CLEANER DESCRIPTION

The ELP 136 is a 3" diameter cleaner with an overall length of about 30 inches. The cleaner is an assembly of 6 major parts, namely the body, the spiral, the reject and accept seals, and the reject and accept seal covers. The reject and accept seals are snap connected to the body and spiral. The spiral is connected to the body by 6 stainless steel pins. The resulting ELP 136 cleaner cannot be disassembled into its constituent parts.

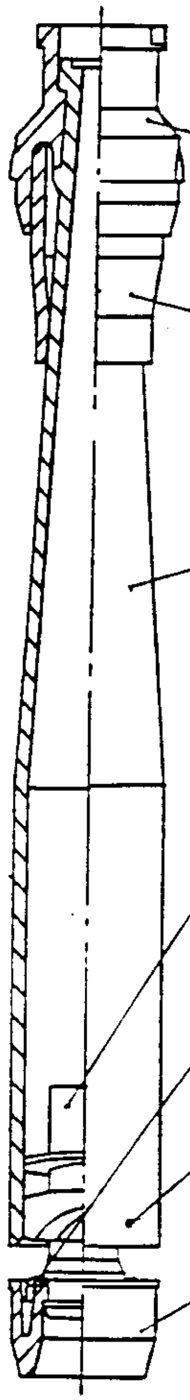
With the exception of the pins, the cleaner is made from Elast-O-Life polyurethane. A flexible grade is used for the seals and seal covers, while a stiff grade is used for the body and spiral. Elast-O-Life's unique combination of abrasion resistance, toughness, and resistance to chemical and temperature degradation results in many years of service under normal operating conditions.

After several weeks of operation, a slight growth in the cleaner may be noticed. This is perfectly normal, and the cleaner and canister were designed to accommodate it. Typically, the cleaner's dimensions will increase by about 2% from their original values within 2 weeks, and then stabilize at that point.

The Fiberprep/ELP 136 incorporates spiral channels in the reject part of the cleaner, and a spiral feed entry. The reject spiral greatly reduces the plugging frequency and stock thickening by controlling the reject flow, while the spiral feed allows for lower feed pressure requirements.

Please refer to Figure 3 (PT:079) for an assembly drawing of the ELP 136 Cleaner, and the Appendix for its capacity and flow ratio curves (F:1167 and F:1180). Please note that the Appendix also contains a list of definitions of terms (such as flow ratio) commonly used in this manual.

2. <u>FIBERPREP/ELP 136 CLEANER DESCRIPTION</u> (continued)



DESCRIPTION	PART NUMBER
REJECT SEAL	ELP03504
REJECT SEAL COVER	ELP03707
CLEANER BODY	ELP03701
FEED SPIRAL	ELP03702
ACCEPT SEAL COVER	ELP03706
PIN	ELP03505
ACCEPT SEAL	ELP03503

FIGURE 3. PT:079

Note: Fiberprep/ELP 136 Supplied as complete assembly.

3. MAINTENANCE OPERATIONS

NOTE: Please refer to the Appendix for a list of replaceable spare parts for SpirELPak 136 Cleaning System.

3.1 Lid Removal and Replacement

General Discussion

The lid is held down to the canister by means of bolts which are threaded into special hex couplings which are in turn threaded onto the ends of the stiffening rods. Please refer to Figure 4 for details of this connection.

It is **ESSENTIAL** that a power tool is **NEVER** used to install or remove the lid bolts. Because of corrosion requirements, both the bolt and the hex coupling are stainless steel, and high turning speeds will result in a high probability of galling the bolt and coupling together.

Lids for canisters 32 inches in diameter and smaller are light enough to be carried by hand. Larger lids require the use of an overhead hoist or crane for safe removal.

While the lid will easily support someone's weight, it is quite likely that damage to the sight glasses could result. If for some reason it is necessary to stand on the lid, it is recommended that first a piece of plywood be placed on the lid in order to protect the sight glasses. Naturally caution should be used to insure that sight glasses are not damaged by falling tools, etc., and that appropriate safety procedures are followed.

Lid Removal

1. Remove the lid bolts, using a hand wrench only. Because of the tight tolerances involved, the seal housing and seal will normally come off together with the bolts.

3. MAINTENANCE OPERATIONS (continued)

Lid Removal (continued)

2. For small diameter canisters without lifting hooks, remove the lid by hand and put it in a safe place out of the way, being sure not to damage the air vent. Lids which have lifting hooks will require the use of a hoist or crane.

3. Move the lid to a safe location being careful not to let the lid tip, or the air vent be damaged. One convenient location for the lid may be on top of a nearby SpirELPak canister, however care must be taken not to damage the sight glasses or vent of the other canister.

4. Remove the lid O'ring from its groove in the lower flange and store it in a safe location.

3. MAINTENANCE OPERATIONS (continued)

CANISTER LID BOLT ARRANGEMENT

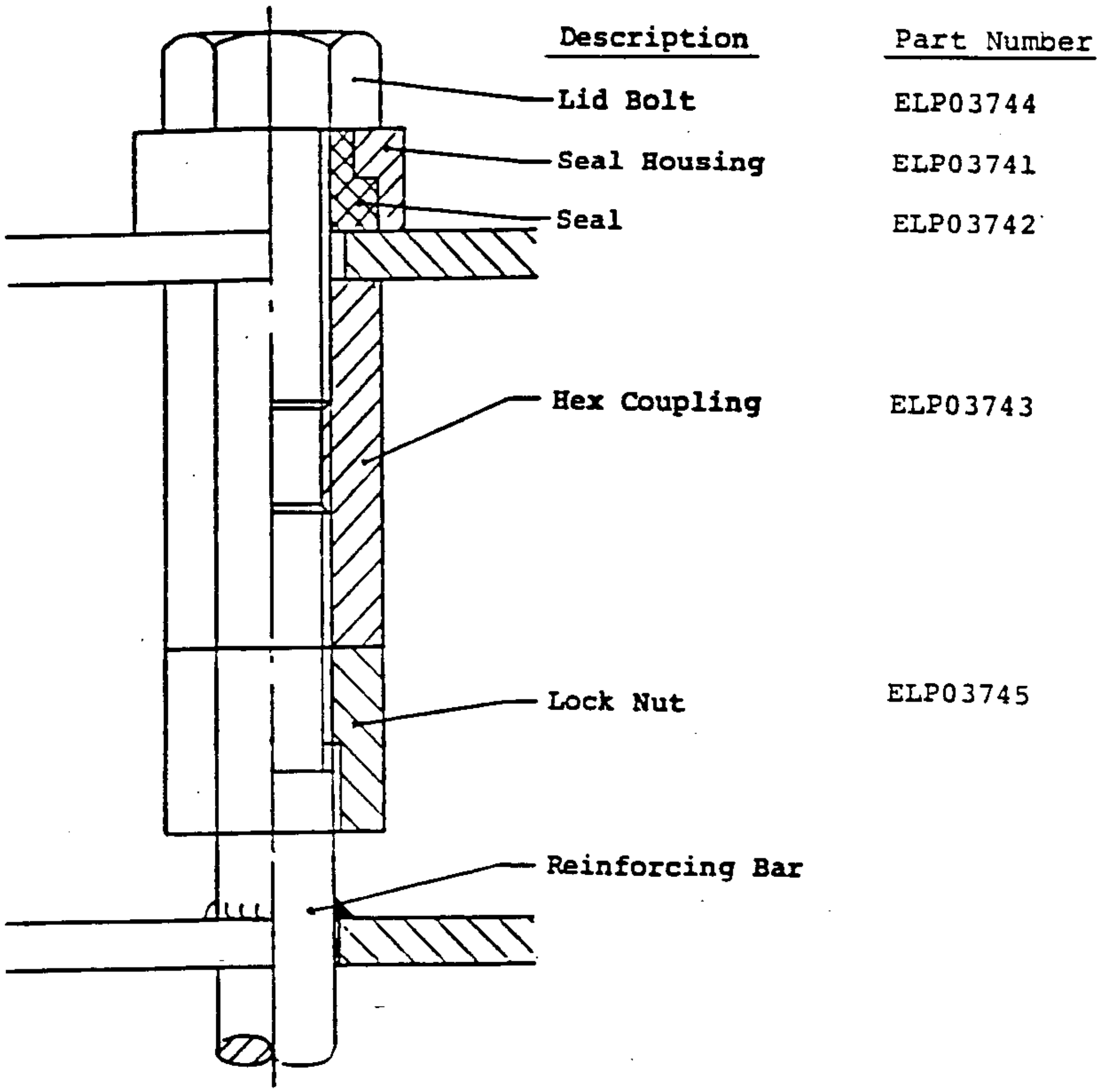


FIGURE 4. PT:091

NOTE: All Threads 5/8 UNC

3. <u>MAINTENANCE OPERATIONS</u> (continued)

<u>Lid Replacement</u>

1. Inspect the lid O'ring and replace if damaged. Place it in the O'ring groove in the lower flange.
2. Either by hand or with the hoist or crane, place the lid back on top of the canister. Insure the lid is properly oriented with respect to the canister, or the lid bolts will not line up with the hex couplings. The proper orientation is obtained when the alignment notches in the lid and flange line up.
3. If the lid must be moved slightly, lift the lid clear of the canister before moving or else the lid O'ring may be dislodged and subsequently pinched. Carefully lower the lid, ensuring that the lid bolt holes are directly over the hex couplings.
4. Reinstall the lid bolts and seals using a hand wrench. The bolts only need to be tightened until snug. Do not over tighten.

3.2 Galling

If galling does occur, the following details the steps required to repair the connection.

1. Cut the head off the bolt.
2. Remove the remaining lid bolts, and take off the lid.
3. Back off the lock nut.
4. Remove the hex coupling along with the frozen stub from the bolt.
5. Replace the hex coupling with a new one, screwing it onto the reinforcing rod until the top of the nut is flush with the canister lid flange.
6. Retighten the lock nut.

3. <u>MAINTENANCE OPERATIONS</u> (continued)

7. Replace the bolt seal housing and seal if they were damaged when the head was cut off the galled bolt.

3.3 Fiberprep/ELP 136 Insertion and Removal

The Fiberprep/ELP 136 cleaner is installed by lowering it into the canister so that the accept and reject seals are in the appropriate holes, and then the cleaner is tapped down until the stops on the reject seal contact the reject plate. The cleaner may be tapped using a rubber mallet, or even another cleaner.

The Fiberprep/ELP 136 is removed using the supplied puller, illustrated in Figure 5. The puller is put in place with its feet on the reject plate, the cup located around the reject seal under the pulling lip, and the puller handles in the up position. Pushing down on the handles will raise the cup, pulling the cleaner free.

During operation, the cleaner may "pump out" slightly, so that the stops on the reject seal no longer contact the reject plate. This is perfectly normal. The rectangular openings on the side of the reject seal are designed to provide a flow path for the cleaner rejects when the reject seal contacts the lid.

3.4 Operating Port Use and Replacement

The operating port assembly consists of a number of parts as shown in Figure 6. This assembly is held down by three bolts, and sealed by an O'ring between the flange and lid. When replacing an

3. MAINTENANCE OPERATIONS (continued)

3.4 Operating Port Use and Replacement (continued)

operating port, a gasket sealant should be placed on each bolt to prevent any leakage along the bolt.

The sight glass grommet actually contains two sealing sections. The bottom opening is a slot which is forced shut by the pressure inside the canister. Directly above the slot is a circular section measuring just under 1/4 inch in diameter. If an appropriate sized rod is pushed through the grommet, it will seal in this circular section when the slot is opened. This design allows a 1/4 inch or 6mm rod to be inserted into the reject of a cleaner during canister operation with minimal leakage or spray. It is **VERY IMPORTANT** that the proper sized rod with a tapered or rounded end is used, or the grommet may be damaged or fail to work properly.

Looking straight down through the sight glass will show if the cleaner is discharging properly. In the event that the cleaner is plugged, the reject can be cleaned out by pushing a 1/4 inch (6mm) rod through the grommet, into the cleaner. Working the rod up and down should clear the plug. The unplugging operation will be easier if a high pressure nozzle of the proper outside diameter is used rather than just a simple rod. We provide such a special pressure wand for just this purpose; please see Figure 7. In either case, some caution should be exercised not to put excessive side loads on the grommet. This does not help unplugging, and may damage the grommet.

3. <u>MAINTENANCE OPERATIONS</u> (continued)

Fiberprep/ELP CLEANER PULLER

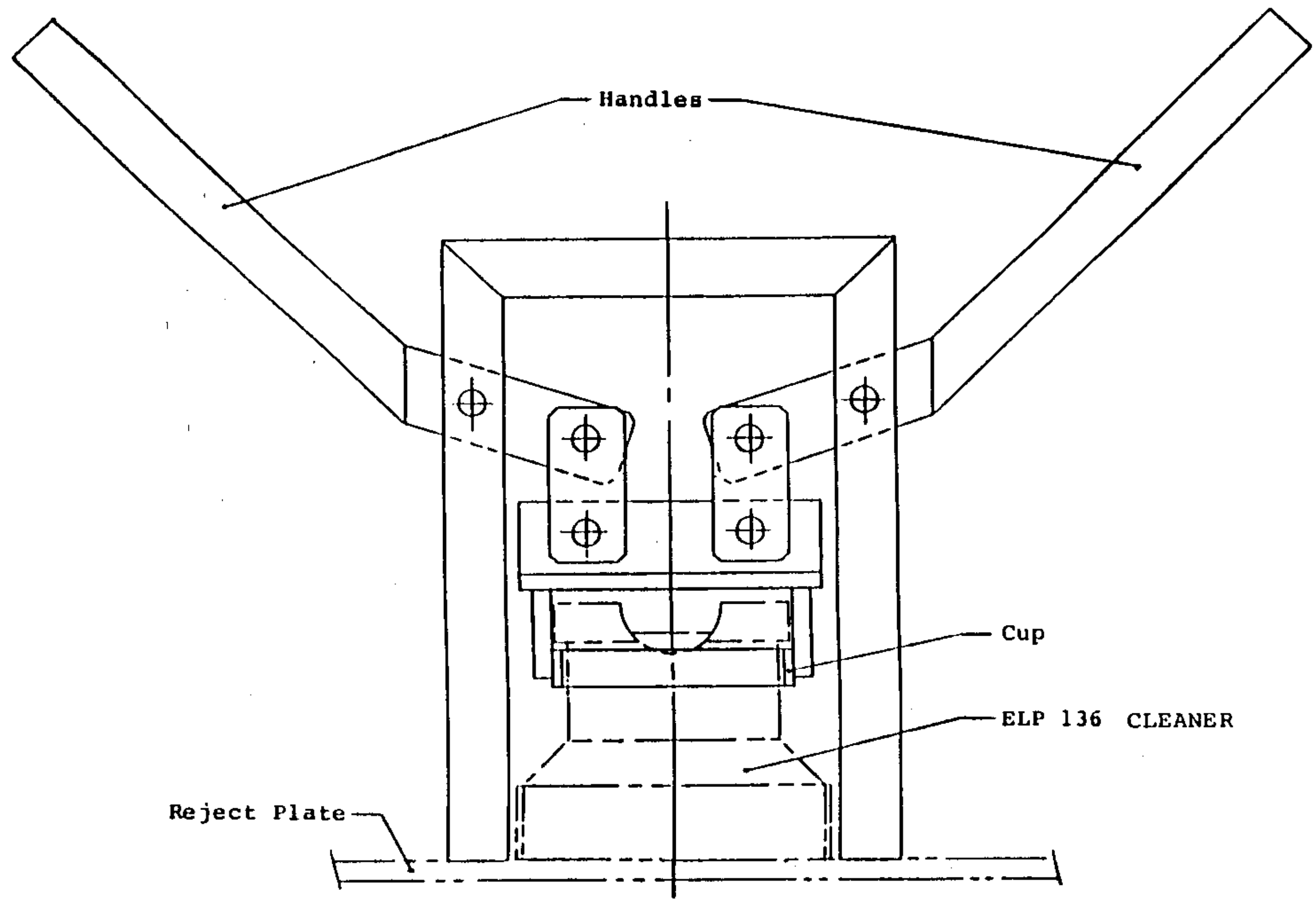


FIGURE 5. PT:092

3. <u>MAINTENANCE OPERATIONS</u> (continued

CANISTER OPERATING PORT

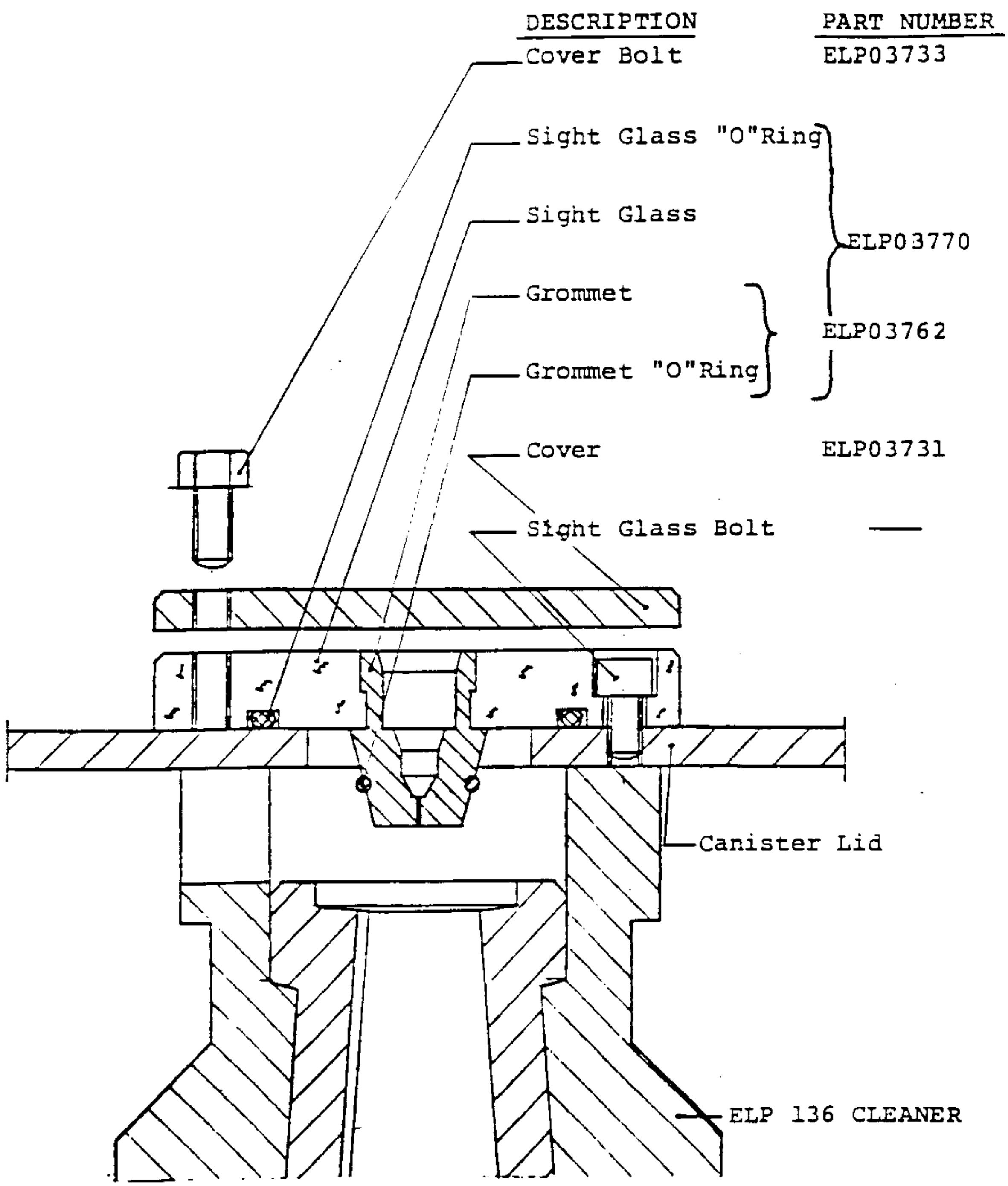


FIGURE 6. PT:093

3. MAINTENANCE OPERATIONS (continued)

3.4 Operating Port Use and Replacement (continued)

If the cleaner immediately replugs after being cleared, this indicates that either the canister is being operated improperly (too low a reject rate), that worn cleaners are mixed with new cleaners (the new cleaners have too low a reject rate in order to try and compensate for the high reject rate of worn cleaners), or else the cleaner contains a very large piece of debris which cannot be easily passed through the reject opening. In any event, the canister will have to be shut down and the cleaner removed before it can be permanently unplugged under these circumstances.

If a cleaner has been left plugged for a long period of time before an attempt is made to clear it, it is possible for the plug to pack hard enough that it can only be unplugged after the cleaner has been removed from the canister during a shut down.

In the event that a leak should develop in the operating port, the cover plate shown in Figure 6 should be bolted over it. Either the grommet itself or the complete operating port can then be replaced at the next shut down.

When replacing the operating port or installing a cover plate, care must be taken to ensure that the bolts are not over tightened. Over tightening will break the sight glass.

3.5 Canister Inspection

The canister should be inspected periodically during operation as follows:

1. Note the pressure gauge readings and compare them to the target settings.

3. MAINTENANCE OPERATIONS (continued)

3.5 Canister Inspection (continued)

2. Inspect the cleaner reject flow via the sight glass to check for plugging. Initially just check the cleaners around the outside of the canister. If plugged cleaners are found, they should be unplugged following the procedure outlined in 3.4 and the balance of the cleaners checked.
3. If an unplugging grommet is leaking, a cover plate should be bolted to the sight glass flange. The grommet or sight glass assembly can then be replaced during the next shut down.

During a shut down, the lid should be removed and the following points checked:

1. The pressure gauges should be zeroed and calibrated at least once a year.
2. Inspect the cleaner rejects for plugging and wear. Once every six months a random sampling of cleaners should be pulled from the canister and thoroughly inspected as outlined in section 3.6. Once a year all the cleaners should be removed and inspected.
3. Inspect the reject chamber for any debris build up, and clean out if necessary.

3.6 Cleaner Inspection

The Fiberprep/ELP 136 cleaner should be thoroughly inspected on a regular basis as outlined in section 3.5. This inspection consists of three main steps.

1. Thoroughly clean the Fiberprep/ELP 136, insuring that both the feed spiral and reject are clear of pulp.

3. MAINTENANCE OPERATIONS (continued)

3.6 Cleaner Inspection (continued)

2. Measure the reject opening of the cleaner across the major diameter (i.e., the root of the thread). If the opening exceeds .77 inches (19.5mm) the cleaner should be discarded, as its reject rate is very difficult to control. If the opening diameter is between .73 inches (18.5mm) and ..77 inches it should only be used in a canister filled with cleaners worn to a similar degree. If not, various cleaners in the canister will have different reject rates. In such a case, whereas the overall canister reject rate may be satisfactory, individual cleaners with smaller reject openings may be rejecting at a low enough rate to either risk plugging or else not provide any cleaning. For example, a canister that has a 20% reject rate may contain 2 groups of cleaners, one rejecting at 35%, and the other at 5%. The poor efficiency of the 5% group will overwhelm the cleaning of the 35% group, while plugging and excessive wear are a constant danger. Ironically, in such a situation it is the newest, least worn cleaners which experience the difficulty.

3. MAINTENANCE OPERATIONS (continued)

CLEANER UNPLUGGING TOOL

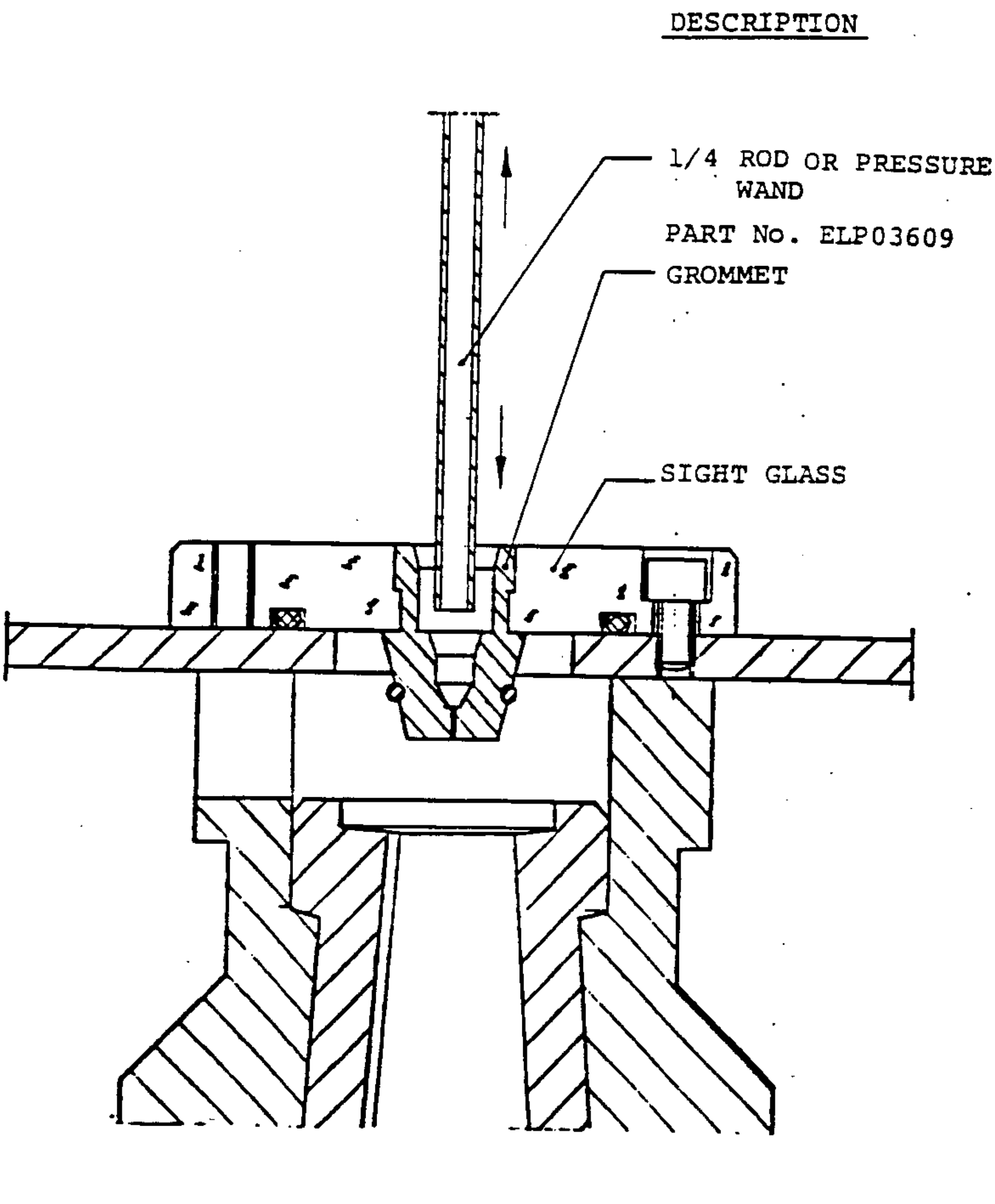


FIGURE 7. PT:094

3. MAINTENANCE OPERATIONS (continued)

3.6 Cleaner Inspection (continued)

3. Shine a flash light down the spiral vortex finer and looking through the reject, check for wear in the tapered section of the cleaner. This wear can occur in two distinct patterns.

   If localized wear has occurred a short distance down from the start of the taper, the cleaner has been operated while plugged. If wear in the cone wall is about 1/8 inch (3mm) or more, the cleaner should be discarded.

   If localized wear occurs in or just above the thread area, the cleaner has been operated with too low a reject rate. This can result from either improper canister operations, or by mixing new cleaners in a canister with worn (.77 inches reject opening or larger) cleaners. If the thread has been worn away at any point, or if the wear in the cleaner wall exceeds 1/8 inch, the cleaner should be discarded.

4. MEASURING HYDROCYCLONE CLEANING SYSTEM OPERATION

The system flow balance for proper operation is shown in the Appendix. Please note that the flow sheet provided with this manual is based on the original production rate and consistency specified. If this has since changed, it is likely that the proper system balance has also changed. Always ensure that an up-to-date flow sheet is included with this manual, as it becomes the operating target. If there are any doubts in this regard, please contact Fiberprep Inc..

In order to ensure the optimum operation of the SpirELPak 136 system, it is necessary to first measure its current operation and prepare a flow sheet from the resulting data. The system's performance can then be assessed, and any necessary changes made to bring the actual operation in line with the target operation.

A detailed description of how to measure the operation and prepare a flow sheet is given in the Appendix.

5. SPIRELPAK 136 CLEANING SYSTEM OPERATION

The methods and procedures used to ensure the proper operation of the SpirELPak 136 system are basically the same as that used for all types of canister style cleaning systems. Detailed operating instructions are given in the Appendix and cover such topics as start up and system adjustment.

6. TROUBLE SHOOTING

The Appendix contains guidelines on how to determine the source of various problems, and the necessary corrective steps.

FIBERPREP/ELP SPIRELPAK 136

SPIRELPAK 136

OPERATING MANUAL

APPENDICES

1. Notes on Canister Construction and Installation
2. Replaceable Parts and Accessories
3. Flow Sheet (s)
4. Definitions - Pulp & Paper Cleaning
5. ELP 136 Capacity Curve - F:1167
6. ELP 136 Flow Ratio Curve - F:1180
7. Measuring Cleaning System Performance
8. Cleaning System Operation
9. Trouble Shooting

APPENDIX 1.

NOTES ON CANISTER CONSTRUCTION AND INSTALLATION

1. All piping is standard 150 psi, 316 stainless steel with galvanized backing flanges for all Van Stone ends. Stainless steel fasteners (supplied by customer) are recommended for all flanged connections.
2. All wetted parts are either 316 stainless steel or "Elast-O-Life" polyurethane.
3. 3/4" or 1" nipples with full port ball valves for sampling points are to be supplied by customer on straight sections of feed, accept, and reject lines at least 5 diameters downstream from the last obstruction.
4. A pressure panel containing feed, accept and reject pressure gauges is supplied for each canister. When shipping, the panels are packaged separately from the canisters. The panels must be installed and the pressure line seals connected to the canister after the canister is put into position and the piping connected.
5. Customer to supply gauges and transmitters for remote pressure panels, and to install all required transmitter nipples.
6. Various patents apply.
7. All welding conforms to AWS standards.
8. Canister is pressure tested before shipping.
9. Maximum rated feed pressure is 45 psi, maximum accept or reject pressure is 25 psi, maximum feed to accept differential pressure is 30 psi, and minimum reject pressure is 5 psi.
10. Flushing nipples are provided for each canister chamber. These should not be used as sampling points.
11. Floor opening dimension tolerances should be +/- 1/2 inch.
12. One or more float type air vents are located on the top lid for air removal during operation, and vacuum breaking during drainage.

APPENDIX 1. (continued)

NOTES ON CANISTER CONSTRUCTION AND INSTALLATION (continued)

13. Grouting is not necessary. The canister must be secured to the floor by two 1" anchor bolts.
14. Minimum of 24" clearance around the canister is necessary for access.
15. Walking on the lid, or after raising the lid, walking on the exposed cleaners and reject plate is permitted from a structural view point. All necessary precautions should be taken to prevent falling or equipment damage.

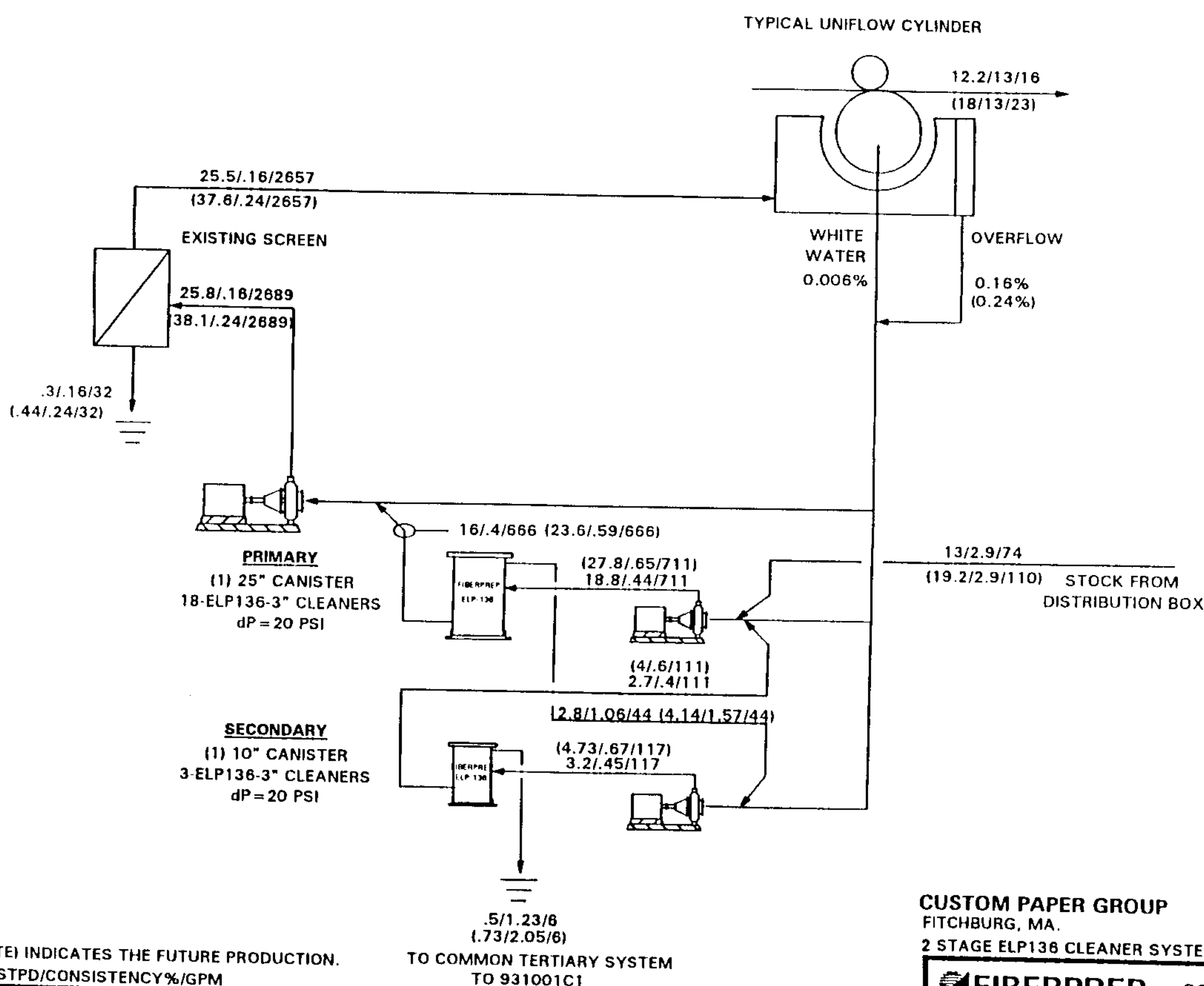
FIBERPREP/ELP SPIRELPAK 136

APPENDIX 2.
REPLACEABLE PARTS AND ACCESSORIES

DESCRIPTION	PART #
ELP 136 Cleaner	ELP03765
ELP 136 Dummy	ELP03751
ELP 136 Puller	ELP03767
Pressure Wand	ELP03609
Grommet Cover	ELP03731
Lid Bolt Seal Housing	ELP03741
Canister Bolt Seal	ELP03742
Hex Nut	ELP03743
Grommet & O'ring Assembly	ELP03762
Sight Glass Assembly - E	ELP03770

LID O'RINGS

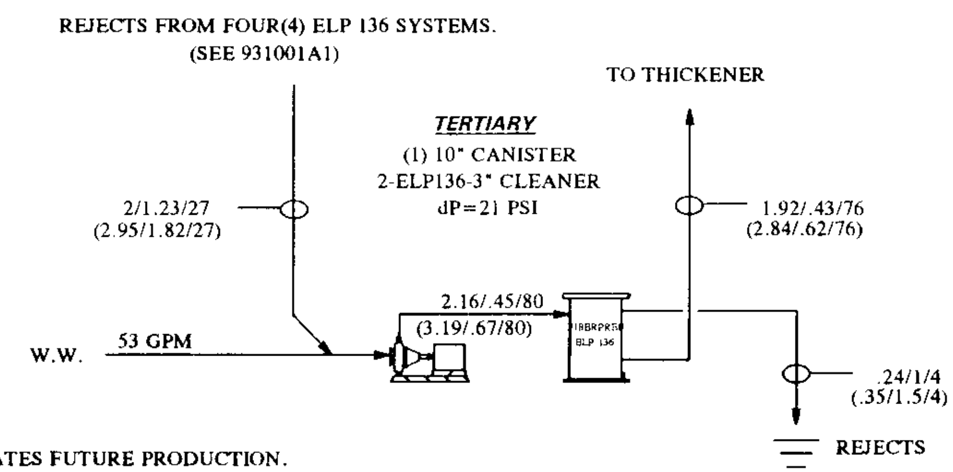
Canister Size		
10	CM O'RING .210 X 35.75 LG....................	ELP03851
15	CN O'RING .210 X 51.50 LG....................	ELP03852
22	CO O'RING .210 X 73.50 LG....................	ELP03853
25	CP O'RING .210 X 83.00 LG....................	ELP03854
32	CR O'RING .210 X 105.00 LG..................	ELP03855
39	ECA O'RING .375 X 126.75 LG..................	ELP03861
46	ECB O'RING .375 X 148.75 LG..................	ELP03862
55	ECC O'RING .375 X 177.00 LG..................	ELP03863
66	ECD O'RING .375 X 212.00 LG..................	ELP03864
79	ECE O'RING .375 X 254.25 LG..................	ELP03865
97	ECF O'RING .375 X 309.75 LG..................	ELP03866
115	ECG O'RING .375 X 366.25 LG..................	ELP03867



(FLOWRATE) INDICATES THE FUTURE PRODUCTION.
CODE:BDSTPD/CONSISTENCY%/GPM

CUSTOM PAPER GROUP
FITCHBURG, MA.
2 STAGE ELP136 CLEANER SYSTEM

FIBERPREP 931001A1



(FLOWRATE) INDICATES FUTURE PRODUCTION.
CODE:BDSTPD/CONSISTENCY%/GPM

FUTURE
COMMON TERTIARY
FOR FOUR(4) VAT SYSTEMS

CUSTOM PAPER GROUP
FITCHBURG, MA.
COMMON TERTIARY SYSTEM

FIBERPREP 931001C2

APPENDIX 4.

DEFINITIONS AND SYMBOLS - HYDROCYCLONE CLEANING

Symbol	Definition
F	Feed to the hydrocyclone
A	Accept from the hydrocyclone
R	Reject from the hydrocyclone
W	White water, dilution water or makeup water
Q	Liquid flow rate - e.g. liters per minute
C	Consistency, % Oven Dried: ratio of the weight of oven dried pulp to the sample weight, expressed as a percentage
T	Solids flow rate: expressed in units of weight per unit time - e.g. short tons per day
k	Conversion factor for determining solids flow rate when liquid flow rate and consistency are known: T = kQC. The value of k is dependent on the units used for Q and T as follows:

k FACTORS

Solids Flow Rate (per day except) (as noted)		Liquid Flow Rate		
		USGPM	L/min.	cu. m/hr
SHORT TONS	oven dried air dried	.0601 .0667	.0159 .0176	.2650 .2944
LONG TONS	oven dried air dried	.0536 .0596	.0142 .0157	.2367 .2630
METRIC TONS	oven dried air dried	.0545 .0606	.0144 .0160	.2400 .2667
KG per HOUR	oven dried air dried	2.2708 2.5208	.6000 .6667	10.00 11.11

APPENDIX 4. (continued)

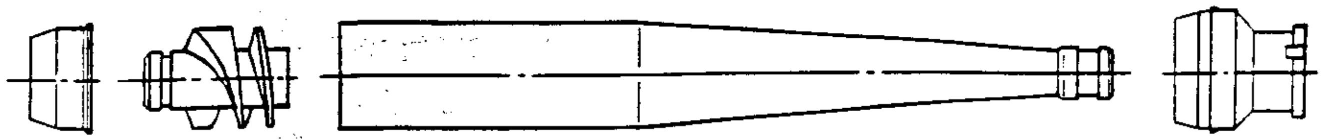
Definitions and Symbols - Hydrocyclone Cleaning (continued)

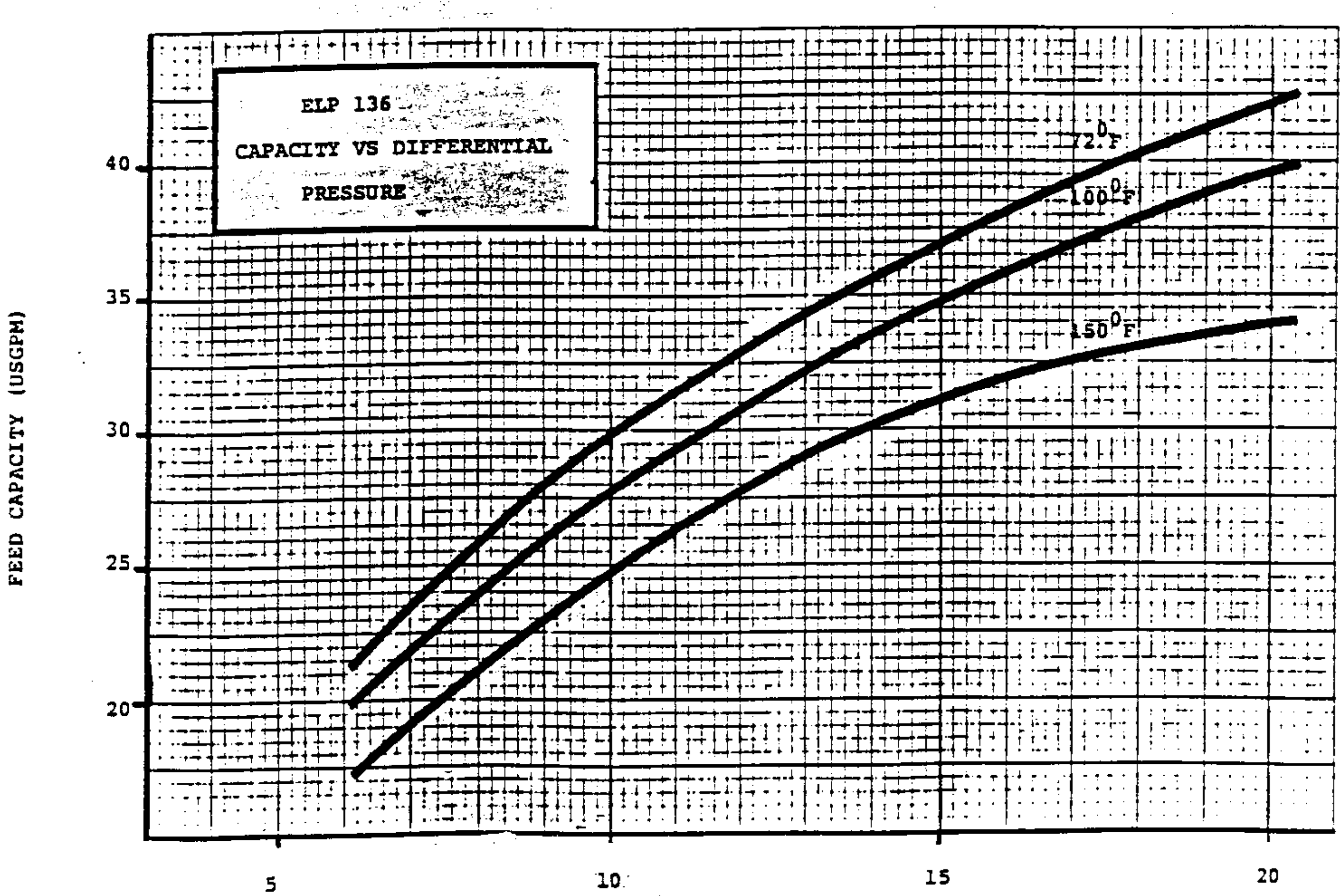
Symbol	Definition
FR	Flow Ratio: Percentage of liquid feed flow going out of the reject. FR = QR/QF X 100. Also known as rejects by volume.
TH	Thickening Factor: Ratio of reject consistency to feed consistency. TH = CR/CF
RR	Reject Rate: Percent of the solids feed flow going out of the reject. RR = TR/TF = FR X TH. Also known as rejects by weight.
D	Dirt Count: Expressed as number of dirt specs per unit time
	Cleaning Efficiency: Percent of the dirt in the feed flow which goes out the reject during a given time. = DR/DF x 100.
S	Dirt Concentration: Expressed as either specks/gram or ppm (parts per million). Can be used to calculate cleaning efficiency as follows: = SR/SF X RR
	Dirt Concentration can also be used to calculate reject rate. While this formula is theoretically exact, the accuracy of the result is very dependent on the accuracy of the dirt concentration, especially if the cleaning efficiency is low.
	RR - (SF-SA) / (SR-SA) X 100
	For the above reason, when calculating cleaning efficiency, determine the reject rate by using the formula RR = FR X TH.

ELP 136

Part Number

(ELP 03765)





FEED TO ACCEPT DIFFERENTIAL PRESSURE (psi)

APPENDIX 6.


$P_A - P_R$
psi
ELP 136
FR = f(P_A - P_R)
ΔP22
ΔP17
ΔP15
ΔP14
0
1
2
3
4
0
2
6
8
10
12
14
16
18
22
24
F:1180
FR %

APPENDIX 7.

MEASURING HYDROCYCLONE CLEANING SYSTEM OPERATION

In order to ensure the optimum operation of a cleaning system, it is necessary to first measure its operation and prepare a flow sheet from the resulting data. The system's operation can then be assessed.

Accuracy

Naturally, the resulting flow sheet will only be as accurate as the data obtained. Therefore, please take careful note of the following.

CONSISTENCIES

It is critical that consistency measurements be accurate, preferably with 5% of the "actual" value. The recommended sampling method is as follows:

a. Flush the sample line, then draw at least (preferably three to four) gallon of stock into a large container.
b. Take all of the required samples around the system in as short a time as possible to ensure that the overall system performance is consistent for all samples.
c. Mix well while taking the sample from the container. If time permits, take three samples and average the results.
d. Determine the consistency from the sample(s), using standard mill procedures.

CLEANER CAPACITY VERSUS STOCK TEMPERATURE

The most common way of determining the capacity of a stage is by using the capacity curve of the cleaner along with the number of

APPENDIX 7. (continued)

MEASURING HYDROCYCLONE CLEANING SYSTEM OPERATION (continued)

cleaners in the given stage and the feed to accept differential pressure. However, it must be kept in mind that the capacity of a cleaner drops as the stock temperature rises. In general, the capacity will drop about 1% for every 4 degrees F the stock temperature goes up. If the temperature at which the cleaner capacity curve was determined is not available, assume that this was done at 75 F, and adjust accordingly for your stock.

FORMULA ACCURACY

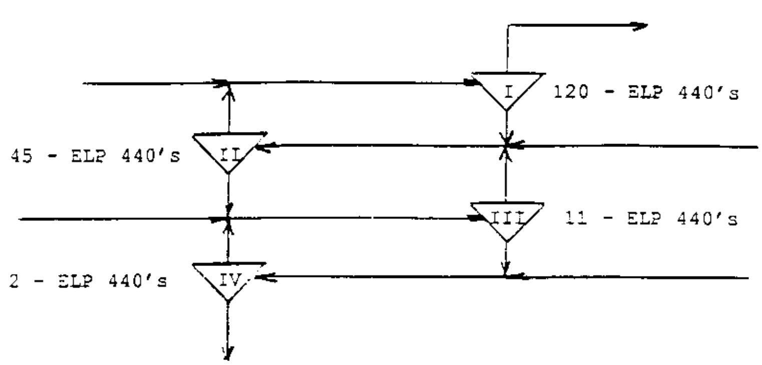
The formulas given are approximate, giving values slightly low. However, this is accurate enough for system balance purposes, especially if care is taken in determining flow rates and consistencies as described above. The exact formulas and the assumptions made to simplify them are shown on page 38.

A. DATA ACQUISITION

1. **Obtain a flow layout of the system.**

This should include the number and type of cleaners in each stage and the piping arrangement between stages. In most cases, a copy should already be available and on file. If not, a new one will have to be prepared from scratch by physically inspecting the system, searching files and possible contacting the equipment supplier. If a new flow layout has to be prepared, be sure to keep a copy on file for future use. Please refer to the following example.

Figure 8. Sample System Flow Layout



2. **Obtain capacity curves for the cleaners in the system.**

This data provides the capacity of the cleaner as a function of the pressure drop between the feed and accept. They are normally supplied in graph form, and occasionally as a mathematical formula. This should be available on file. If not, it can be obtained from the cleaner supplier, in which case be sure to keep a copy in file for future use.

3. **Take the following measurements from the system.**
   a. feed, accept and reject (if available) pressures for each stage, including each bank or canister within each stage if more than once.
   b. feed consistency to each stage, including each bank or canister within each stage if more than one.
   c. final stage reject flow rate and consistency.
   d. makeup (white water) consistency for each stage.

B. CALCULATIONS

NOTE: The following procedure is based on the assumption that each stage consists of only 1 bank or canister. If not, the flow balance for each bank or canister should be calculated and displayed separately.

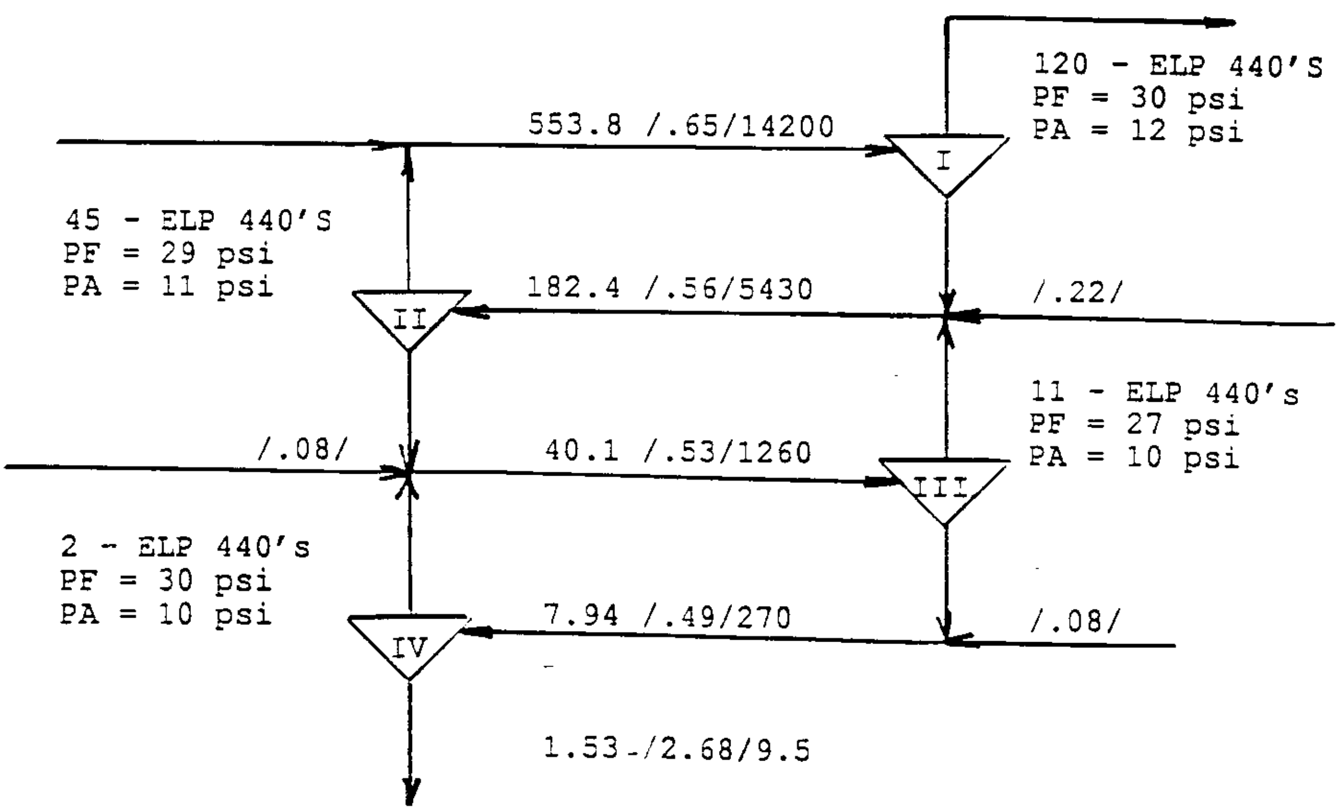
1. Calculate the pressure drop for each stage by subtracting the accept pressure from the feed pressure.
2. Calculate the feed flow to each stage by first determining the capacity for each cleaner from the capacity curve, then multiplying by the number of cleaners.

APPENDIX 7. (continued)

B. CALCULATIONS (continued)

3. Calculate the solids flow rate at the feed to each stage and for the last stage rejects by multiplying together the capacity, consistency and the appropriate conversion factor; i.e. T = Q X C X k
   Please refer to Appendix 4, attached, for a detailed explanation of this formula.
4. Note the data and calculation results obtained to this point on the flow sheet. Please refer to the following sample flow sheet for an example of the minimum amount of information which should now be on the flow sheet.

Figure 9. <u>Sample Flow Sheet - Partially Completed</u>



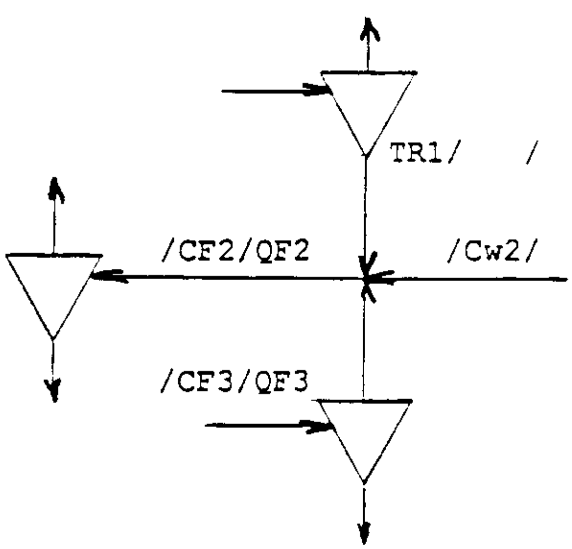
Legend: ODT/D, % Const., USGPM

APPENDIX 7. (continued)

B. CALCULATIONS (continued)

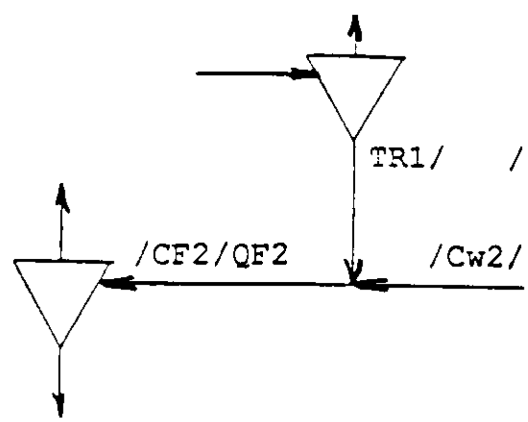
5. Using the appropriate formula as follows, calculate the reject solids flow rate and the resulting reject rate from each stage. Note that the last stage reject solids should have already been calculated (Ref. Step 3, Page 34). Refer to Figure 10 (Page 36) for sample reject solids and reject rate calculations, attached for a detailed explanation of the reject rate calculation.

CASE I
Recirculated Accepts



TR1=QF2(CF2-Cw2)k-QF3(CF3-Cw2)k

CASE II
No Recirculated Accepts



TR1=QF2(CF2-Cw2)k

LEGEND: tonnage/consistency/flow rate

B. CALCULATIONS (continued)

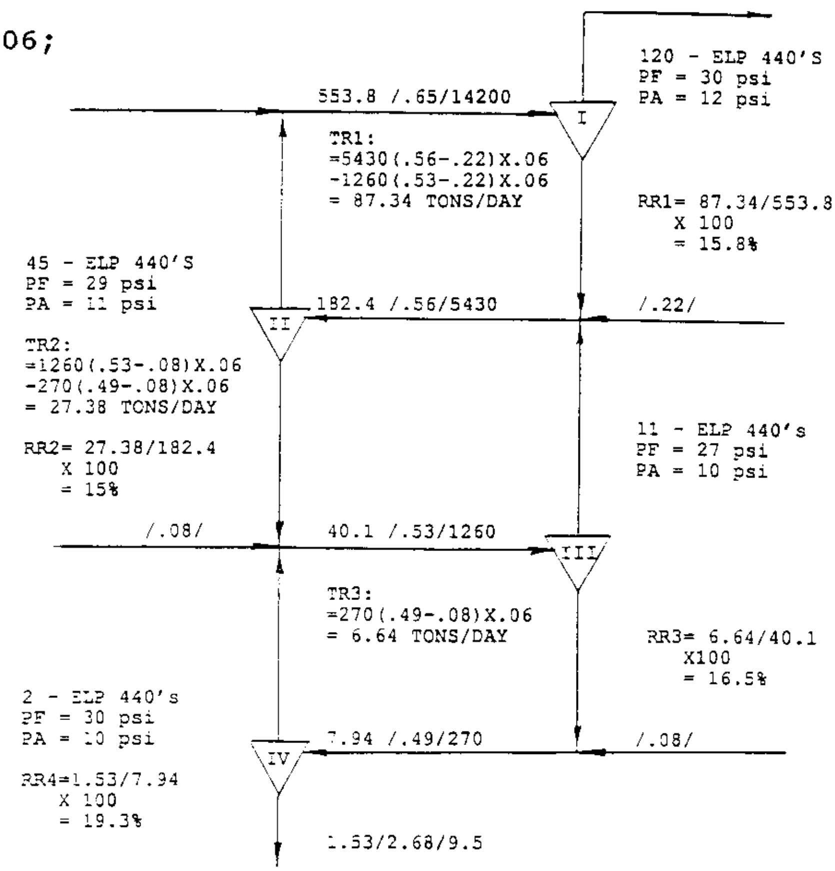
6. Note the reject solids flow and the reject rates on the flow sheet. Refer to Figure 11 (Page 37) for an example of a completed flow sheet.

   The completed flow sheet should now be compared to the optimum flow sheet to assess performance and to determine if adjustments in operation should be made.

   A copy of the completed flow sheet should be kept on file for future reference.

Figure 10. __Reject Rate Calculation__

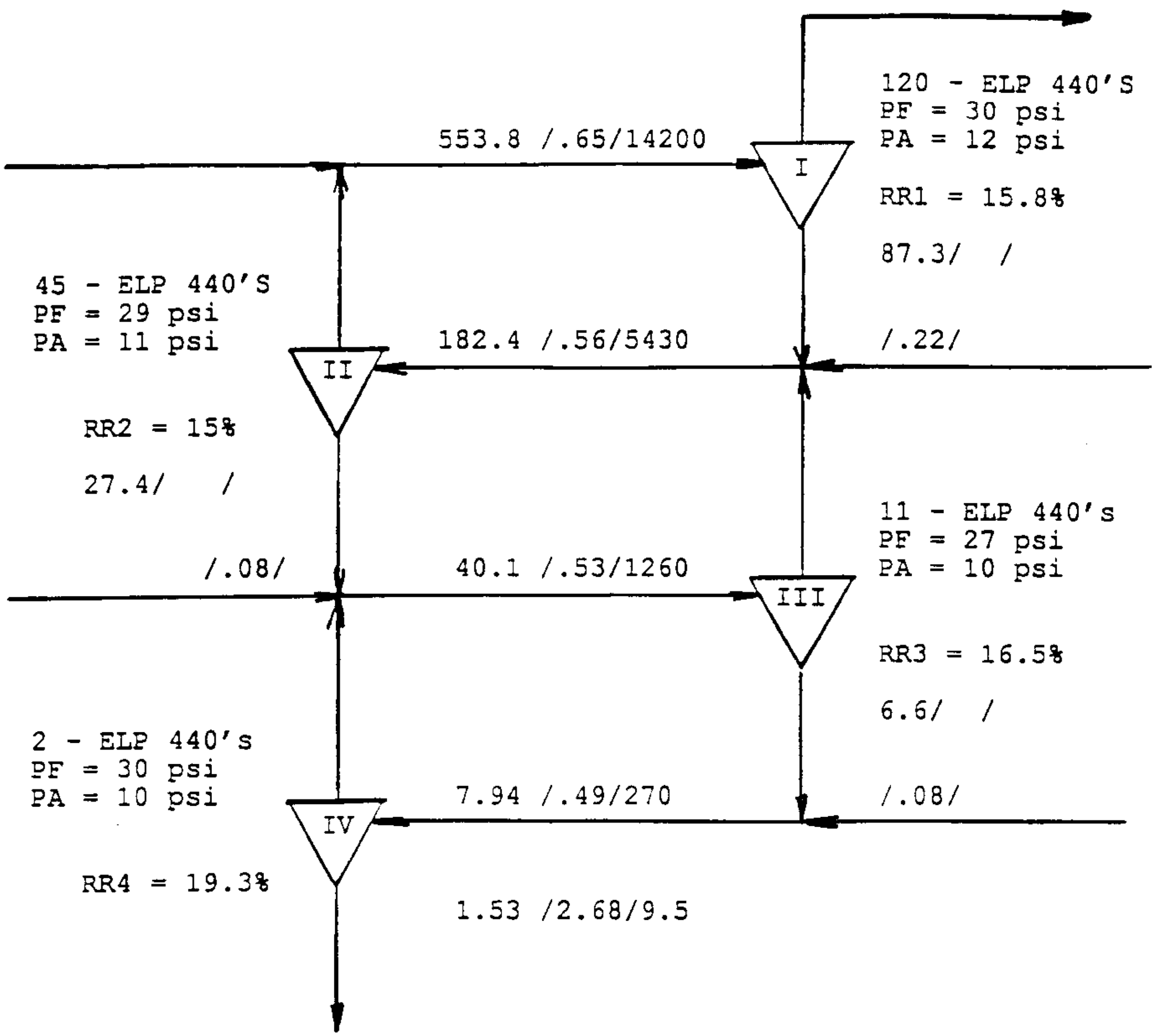
NOTE: k = .06;



Legend: ODT/D, % Const., USGPM

APPENDIX 7. (continued)

Figure 11. **Completed Sample Flow Sheet**



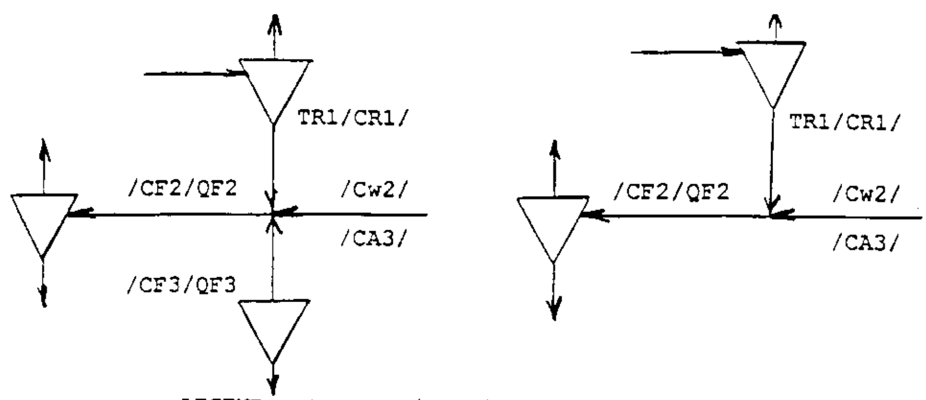
Legend: ODT/D, % Const., USGPM

FORMULAS FOR EXACT REJECT RATE CALCULATIONS

As discussed earlier, the formulas given on Page 35 are approximations which should provide sufficient accuracy in most cases. The approximate formulas have the advantage of only requiring feed and white water consistency measurement. The exact formulas as shown below require accept and reject consistency measurements as well as feed and white water consistencies.

CASE I — Recirculated Accepts

CASE II — No Recirculated Accepts



LEGEND: tonnage/consistency/flow rate

CASE I, Recirculated Accepts

$$TR1 = QF2(CF2-Cw2) \times K \times \frac{CR1}{(CR1-Cw2)} - QA3(CA3-Cw2) \times K \times \frac{CR1}{(CR1-Cw2)}$$

CASE II, No Recirculated Accepts

$$TR1 = QF2(CF2-Cw2) \times K \times \frac{CR1}{(CR1-Cw2)}$$

LEGEND: tonnage/consistency/flow rate

NOTE: The formulas given on page 31 were derived from the above formulas by assuming that CR1/(CR1-CW2) = 1 and CA3 = CA2. For most cleaning systems, these assumptions are close enough. However, significant errors can arise in systems where the white water consistency is very high, or where cleaners are run with very high flow ratios, resulting in accept consistencies significantly lower than the corresponding feed consistencies.

APPENDIX 8.

CLEANING SYSTEM OPERATION
FOR CANISTER SYSTEMS

General Discussion

The objective of a cleaning system is to provide the cleanest possible pulp at the required production rate with minimal fiber loss.

In order to reach this objective, the first requirement is to have specific goals for the capacities, feed consistencies, and target reject rates for each stage, and to project feed, accept and reject pressures. This information is typically displayed on a flow sheet such as the sample flow sheet attached. The flow sheet will normally carry additional information such as the number of canisters in each stage, number of cleaners, flow data and reject rates for optimum cleaning given the system's capacity for cleaning. If an "optimized" flow sheet for the system is not available, contact Fiberprep Inc.

The total accepted tonnage from a system is called the production rate. In cascade systems, the production rate is determined by the capacity and feed consistency of the first stage cleaners. Peak cleaning efficiency is determined to a large extent by the reject rate of the primary stage although the operation of subsequent stages can reduce the overall cleaning efficiency. Subsequent stages are used to recover fiber.

The optimum reject rates for a specific system are primarily a function of the design of the system. Fiberprep designed systems are normally run with up to 25% reject rate in the first stage for maximum efficiency, with lower reject rates in subsequent stages to

APPENDIX 8. (continued)

reduce fiber loss. The minimum reject rate is 10 to 15% depending on the stock type.

Each subsequent stage in a cleaning system has a higher dirt load (i.e. amount of dirt per kg of fiber), and a higher thickening factor. To compensate for this, it is preferable to decrease the feed consistency for each following stage, as lower consistencies allow better cleaner performance. Typically systems are designed to have a 0.05 reduction in feed consistency for each subsequent stage, to a minimum of 0.35%.

Operational Considerations

The operation of a cleaning system is accomplished by setting the system flows so that the required feed flow to each stage is correct and that the reject rate of each stage is correct. These control the performance of the system. The flows are controlled by setting the required feed, accept and reject pressures for each stage.

Capacity, i.e. feed flow is set with the feed and accept pressures. The pressure differential required to deliver a given feed flow through a cleaner (P_F - P_A) is predictable for any cleaner and requires only an adjustment for temperature to be accurate within a few percent.

Reject rate is set using the accept and reject pressures. These control the flow ratio i.e. the reject flow as a percent of feed flow. The flow ratio is the first of two factors which makes up the reject rate.

APPENDIX 8. (continued)

The second is the thickening factor. Thickening factor is the ratio of the reject consistency to the feed consistency. Its value is unique to each situation and is difficult to predict other than to establish a probable range. Thickening factor does remain constant in a given application however and cannot be varied through operational changes.

It follows that the final pressures required to obtain the specified reject rates may not be exactly as predicted. This is not unusual. The pressures are simply the means used to obtain the flows for the required reject rates.

Because the thickening factor cannot be varied, changes to the reject rate must be accomplished through adjustments to the flow ratio.

In canister systems, the reject flow rate is usually changed by adjusting only the rejects pressure. This is not correct, however, if this change results in a line pressure of less than 30 kPa (5 psi) or if it results in a valve being closed more than 80%. In this case, the accept pressure should be changed to effect the desired result.

Whenever an accept pressure is changed, care must be taken so as not to change the feed to accept differential pressure (Dp). This will occasionally mean that both the feed and accept pressures require adjustment.

Start-Up

Projections of the required feed, accept and reject pressures are needed as starting points; however, it is normal for the final

APPENDIX 8. (continued)

ACCEPT TO REJECT differential pressure to be somewhat different than originally projected.

When starting up a system, approximate pressures are set with water. After stock is introduced, the feed, accept and reject pressures are reset to yield the target differential pressures as noted on the flow sheet. The system is allowed to operate for approximately one hour to stabilize consistencies and flows and then evaluated for conformance to "idealized" operation. Adjustments are then made if required.

Before starting, always make sure that all pressure gauges are accurate.

Setting Operating Pressures

1. Based either on past experience of cleaner performance data, select starting pressures intended to approximate the reject rates and capacities shown on the flow sheet. NOTE: operating pressures should always be a minimum of 30 kPa (5 psi) in any pressurized line and no control valve should be fully open or more than 80% closed.
2. If the last stage includes a Fiberprep/ELP Fiber Saver, the Fiber Saver should be started using clear water as per the Fiber Saver operating instructions BEFORE starting the various system feed pumps.
3. Starting with the last stage first, start the feed pumps. Conversely all pumps can be started simultaneously.
4. For each individual canister, set the feed, accept and reject pressures, in that order, to within 15 kPa (2 psi) then again to within 3 kPa (1/2 psi) after all banks in all stages have the rough settings.

APPENDIX 8. (continued)

5. Once all pressures are within the target range, introduce stock into the system via the system feed. This will normally cause a small change in the pressures. Reset pressures to within 3 kPa (0.4 psi).

At this point, the capacities for each stage should be correct, and the reject rates should be in the general target area. The next major objective is to fine tune the reject rates.

Setting Reject Rates

1. Once the stock has been introduced into the system and the pressures reset, let the system run for about one hour, then take consistency samples from al feed streams, the final rejects stream and the makeup water. Determine by measurement the final stage rejects flow rate. Prepare a system balance using the method described in Appendix 7 attached.
2. If it has been determined that one or more reject rates need to be adjusted, this is normally done by changing the reject pressure. This action changes the reject rate by changing the flow rate through the reject.

   Experience with a given system will soon result in some "rules of thumb" with regard to reject rate adjustment. For example, "an X psi change in the accept pressure gives a Y% change in reject rate".

   Alternative to changing the reject pressure, the accept pressure can be changed to influence the rejects flow. Note that if the accept pressure is changed, the feed pressure may require adjustment to maintain the feed to accept pressure differential.

APPENDIX 8. (continued)

3. After adjusting the system pressures, let the system run for about 1 hour to allow all changes to stabilize. Draw consistencies as in 1. above and check the system balance. Repeat steps 1. through 3. until the desired system operation is obtained.

NOTE: Multiple Canisters In a Single Stage

If a STAGE has more than one canister in it, it is necessary to be certain that each is rejecting at the same rate. This is most easily done if the reject flow rate from each canister can be measured. If not, the objective is to ensure the same feed flow and reject rate by maintaining the same feed to accept differential pressure and the same accept consistency for each canister. Naturally, it is preferable if this can be obtained by using the same pressures, however, this is not essential. For example, if the cleaners in a different canister of a given stage are worn to differing degrees, it will be necessary to use different pressure on each canister.

Troubleshooting

Refer to TSB #30 for a general troubleshooting procedure and hints for specific problems.

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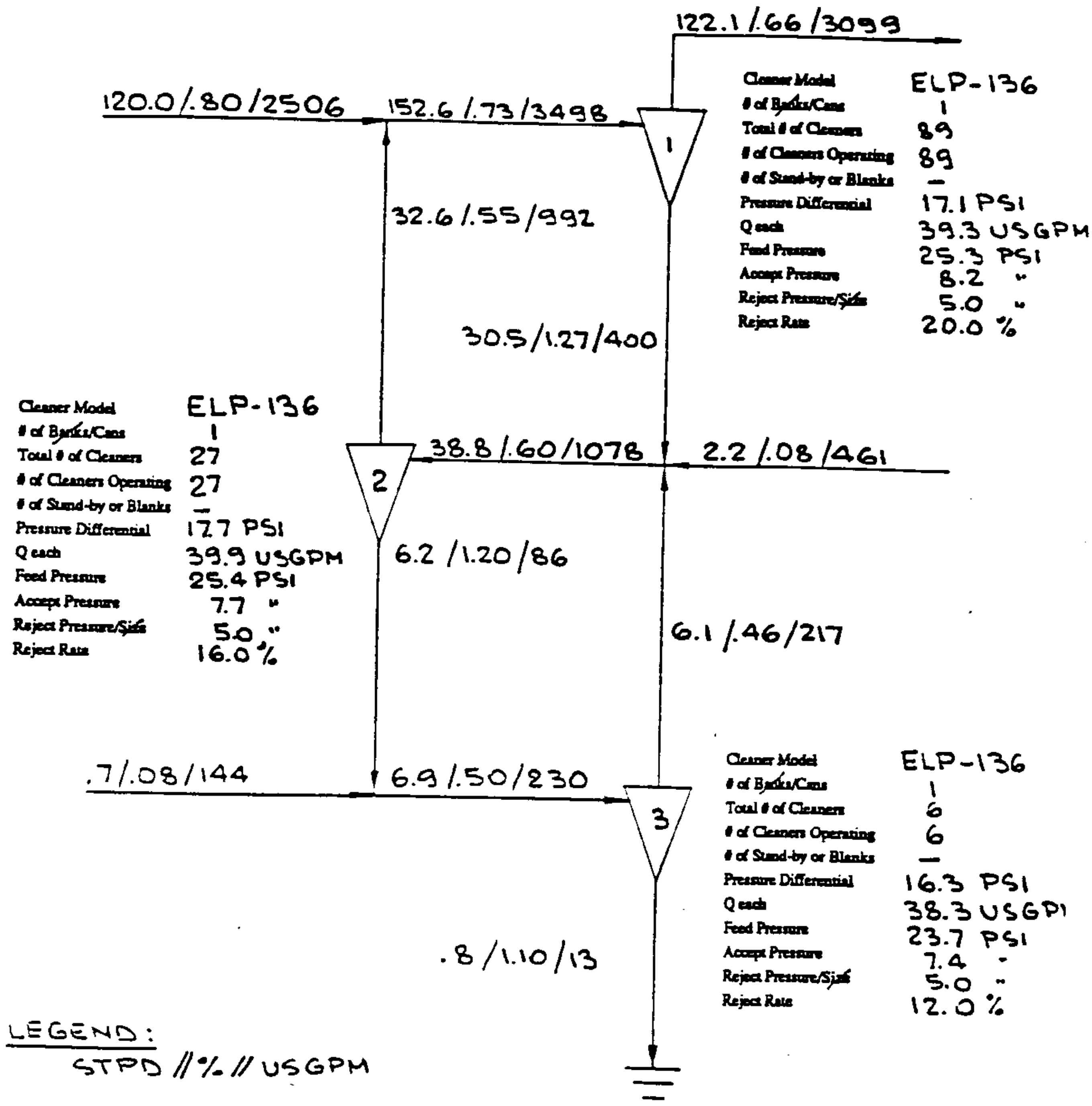
APPENDIX 8. (continued)

SAMPLE FLOW SHEET Figure 12.



TSB: 23 5 of 5

TROUBLESHOOTING
FORWARD CLEANING SYSTEMS

Introduction

Although this guide provides a general approach to troubleshooting, every cleaning system is unique. In case of doubt or difficulty do not hesitate to contact Fiberprep for assistance.

The five basic steps for troubleshooting cleaning systems are:

I. *Document the current system operation.*
II. *Assess the physical condition and capability of the system.*
III. *Assess the operation of individual cleaners and stages.*
IV. *Assess the overall system operation and balance.*
V. *Prepare and act on a prioritized list of corrective measures.*

The balance of this document discusses each of the five steps. Included with the discussion of step V. is a generalized list of troubleshooting hints.

I. Document the Current System Operation

The documentation of the system operation must include both the physical details of the system as well as its current operating conditions. Specific information which must be obtained includes:

1. The number of cleaners used on each stage.
2. Any extra cleaners or cleaner positions either shut down or blanked off.
3. All the operating pressures.
4. All valve positions.
5. The flow balance (i.e. flows, tonnages, consistencies and reject rates).

Refer to Appendix 7 for instructions on how to determine the flow balance as required in 5. above.

II. Assess the Physical Condition and Capability of the System

Physical problems include any physical defect which prevents the cleaning system from performing its function. The most typical problems are plugging and wear. In addition, over and undersized systems, stages, valves, pumps, etc. may contribute to the problem. Once identified, the severity of the physical problems must be assessed since their consequences normally cannot be corrected by changes made to the operation of the system.

Plugging and wear can often cause changes in the operating pressures. It is extremely important that the pressure gauges be functioning properly and correctly located to give an accurate reading of the true pressure. The location for any gauge should be such that there is minimal influence from any control device, pipe elbow, tee, pump, etc.

1. Physical Problems Associated with Hydrocyclones

1.1 <u>Plugging</u>

Plugging can occur in any system including new ones, normally at locations where there are restrictions to flow such as the cleaner feed or accept valves, the feed entry or the reject area. The principle indication of plugging is disrupted flow patterns, however, this is not always easy to detect.
In cleaners, normally it is the reject opening that is plugged. Visual inspection of the rejects stream can be made, in which case the pattern and flow velocity are good indicators of possible plugging.

Whenever possible, once the plug is removed, the cleaner should be flushed and inspected for internal wear. The cone interior can be inspected by shining a light through one end while looking through the other.

Occasionally, the feed entry will be plugged. The feed entry can easily be checked since the cleaner must normally be removed from the canister for inspection anyway.

1.2 <u>Wear</u>

Reject Outlet Wear

Wear in the reject opening will cause two problems: excessive reject rates causing reduced cleaning efficiency due to operational imbalance; uneven wear of the reject opening causes cleaners to discharge at different rates.

Wear in the reject opening is measured by calipers or a wear gauge at the major diameter of the reject tip. This measurement is compared with the reject tip diameter of a new cleaner to determine the amount of wear present. The normal maximum allowable wear is around 20% or less. Wear in excess of this is such that the cleaner flows can no longer be adequately controlled by pressures.

If a cleaner in this condition is to be discarded, it must be replaced with a part with a reject tip size comparable (within 2%) to the reject opening size of the remaining cleaners in that canister.

If the reject opening sizes are different they will have different reject flow rates. Cleaners with larger reject openings will reject more. While the average may be correct, individual cleaners can be outside the range for optimum cleaning. For this reason, it is important that reject opening sizes must be the same for every cleaner in a given canister to ensure that the <u>individual cleaner reject rates</u> are the same as the <u>average reject rate</u>.

Internal Wear

If a cleaner has had a particle orbiting within it for a long period of time, the particle will wear a groove inside the cleaner. A second type of internal wear is that of a general roughening of the interior surface. This too can be caused by orbiting particles or simply by long service life. Grooves or surface roughening become a problem if the groove depth or peak height exceeds 1/8 inch. Cleaners exceeding these limits should be replaced, being careful that the reject opening size is the same as other cleaners in the canister of bank.

Visual inspection is the best means of detecting internal wear.

2. Physical Problems Associated with Auxiliary Equipment

The following section is only a brief overview, and any action regarding this equipment adjustment should be at the direction of the equipment manufacturer.

2.1 Plugging
Plugging can occur at any location, most often at a location of restriction to flow. Valves are often affected particularly if they are operated more than 80% closed. Piping can become affected if the flow is too slow. Pumps can plug for a number of reasons, from high density stock to becoming air bound.

Plugging upstream from the cleaners shows as a reduced feed pressure. Plugging downstream from the cleaners shows as increased reject rates if in the accepts or reduced reject rates if in the rejects.

Apart from removing the plug, the source of the plugging should be addressed if possible. For example, a valve that is too large may be replaced with a smaller one if it becomes more than an occasional nuisance.

2.2 Wear
Wear in auxiliary equipment is generally confined to the pump impeller and casing, the result of which is reduced pressure and flow. Pump maintenance as recommended by the manufacturer is required.

2.3 Other Equipment Considerations
Chronic cleaning system problems can result from improperly

sized valves, undersized pumps, incorrect piping etc. In such cases the system operation cannot improve until the source cause is corrected.

3. *System Capability*

Before considering any operational changes to an existing system, a brief assessment of the systems capability should be made to ensure that the desired performance targets are feasible. If the system is already providing optimum performance any adjustment would be futile and could decrease performance.

136 Canister Cleaners are capable of removing from 60 to 98% of the "heavy" debris entering the system, depending on the debris type. Heavy debris such as sand will be removed easily at high efficiency while debris such as shives or sclereids will typically have a lower efficiency.

Beyond physical and operational problems which can be addressed through proper maintenance and troubleshooting, other factors an reduce an overall systems capability below the potential of the cleaners. While these problems can normally be addressed only through capital expenditures, it is worth while to recognize the effect they may have on a given installation.

a. Size of the System

If the system is undersized for the tonnage it is expected to handle, feed consistencies will be too high and efficiency will be low as a result. See Section III.3 for a discussion of the acceptable range of consistencies.

3. *System Capability* *(continued)*

b. Stage Proportions

If a given stage is significantly undersized, its feed consistency will be high and/or the preceding stage reject rates will be low. Both of these factors will reduce the cleaning system performance as discussed in Section IV. Also see Section IV. for steps which may be taken to minimize the impact on efficiency.

c. Inappropriate Cleaner Selection

In general, large diameter cleaners which have longer residence times are more effective on large wood derived debris such as shive and chop from mechanical pulps, while small diameter cleaners which induce higher overall centrifugal forces are more effective on small speck debris.

III. Assess the Operation of Individual Cleaners and Stages

The factors which govern the cleaning efficiency of individual cleaners are: pressure differentials, reject rate and feed consistency.

1. Pressures Differentials

Hydrocyclone cleaners operate because the flows within the cleaner are such that the stock undergoes the high centrifugal force caused by rotation. The flows have a characteristic pattern which cannot be disrupted without loss of cleaning efficiency.

The driving and controlling force for the flows are the pressure differences between the feed, accept and reject openings. The difference between the feed and accept pressure determines the total flow through the hydrocyclone. The pressure difference between the accept and reject opening determines, in large part, the flow split within the cleaner. The difference between the feed and reject pressures plays a minor role in both of the above and can be largely ignored in forward cleaners.

1.1 Feed to Accept Differential Pressure (P_F - P_A)

The feed to accept differential pressure is used to set the total throughput of a hydrocyclone. The throughput is proportional to the square root of the differential pressure with provision for temperature corrections. Performance data is typically provided in the form of a graph or as an equation.

Hydrocyclone cleaners are effective only within a limited pressure differential range. This range is the operating range and is a function of the feed entry geometry. The operating range is usually only a portion of the graphical representation of flow vs. P_F - P_A and should be indicated. For mathematical representations the correct range should be stated.

The minimum pressure differential included in the operating range is an absolute. At any pressure differential under the range, the flow pattern inside the cleaner is disrupted simply because there is insufficient energy to sustain the proper flow pattern.

The maximum operating pressure differential is usually a function of practical limitations. Pumping costs and the cleaner's ability to withstand high pressures are the principle limitations.

1.2 <u>Accept to Reject Differential Pressure (P_A - P_R)</u>
The accept to reject differential pressure controls the reject rate of a hydrocyclone by controlling its reject flow. The second factor involved in reject rate is the thickening factor, a value which is a constant but is unique to each stock and situation.

The required accept to reject pressure differential is a function of the cleaner design and of the size of the reject opening.

2. Reject Rates
The reject rate of a cleaner is the percent by weight of the feed solids that exits the cleaner through the rejects opening. It is the product of two factors, the thickening factor and the flow ratio.

The reject rate is set by controlling the reject flow. This is accomplished by setting the accept pressure or by setting the accept to reject differential pressure.

The cleaning efficiency of a hydrocyclone is directly related to its reject rate. As the reject rate increases within its range, so too does the cleaning efficiency.

The lower limit for a reject rate is a function of flow. At

2. Reject Rates (continued)
flow ratios of less than 3.5%, the propensity of a cleaner to plug increases to the point where plugging is likely, rather than just a possibility. Thus, the absolute lower limit for reject rate is normally between 7 to 15%, depending on the thickening factor.

The upper limit has two considerationse which define it. One of these is the fact that over a certain level the rejects flow, itself, disrupts the flow pattern within the cleaner. This varies from cleaner to cleaner and is dependent on a number of design factors. The range of reject rates for most hydrocyclones rarely exceeds 25 to 30% because of this.

The second consideration is a practical one. Since the rejects stream carries a significant amount of fiber, recovery stages are necessary. Higher reject rates would require more and larger recovery stages.

3. Feed Consistencies
The typical range of consistencies for "low consistency" cleaners is 0.3 to 1.0% solids. At consistencies lower than this, the drag force of the water tends to carry more of the debris out the accept and thus negatively affects cleaning. At consistencies over 1%, the resistance to debris migration by the high consistency stock becomes more dominant.

Cleaning efficiency tends to peak with feed consistencies in the range of 0.35 to 0.60%. Efficiency drops off quite noticeably between 0.6 and 1.0% consistency.

IV. Assess the Overall System Operation and Balance

The system balance refers to the relative flow of stock between the individual stages. It is set by controlling the reject rates of each stage so that each individual stage performs its function to the optimum and does not prevent subsequent stages from performing their functions. The optimum reject rates are a function of the system architecture i.e. the number and type of cleaners in each stage, the piping arrangement and the operational requirements of the individual stages.

1. Effect of Reject Rate on Feed Consistencies

The reject rate of any given stage directly controls the feed consistency of the following stage. This occurs because the previous stage rejects is the primary source of fiber and the only source of high density stock for the following stage. Therefore, increasing reject rates increases feed consistencies.

The negative effect on cleaning efficiency of increasing feed consistencies above .8% normally exceeds the benefits of increased reject rates.

2. Selecting Reject Rates for Reasonable Feed Consistencies

Reject rates are preferably highest in the first two stages (to a limit of about 25-30%) for maximum cleaning efficiency and decreasing thereafter to minimize the loss of good fiber from the system. The effect of reject rate on overall system efficiency is minimal for all stages whose accepts are recleaned at least twice before becoming part of the system accepts. However, even for these stages, the reject flow must be high enough to contain the system debris and to ensure that the plugging frequency is manageable.

The first stage feed consistency is set by the system accept requirements. Subsequent stage consistencies should reduce with each stage, the rate of which is determined by the relative sizes of the stages. Reducing feed consistencies in later stages helps reduce fiber losses, helps reduce plugging frequency and improves cleaning efficiency.

The effect of consistency on efficiency is more severe than that of reject rate. Therefore, if a compromise is required because of undersized stages, it is preferable to reduce previous stage reject rates rather than increase feed consistency above about .8% until the limit caused by plugging frequency is reached.

3. Off Size Stages

Stages which are significantly off size make it difficult to operate a system well. They are relatively easy to find as they exist where the reject rate of one stage is at one extreme (either low or high) and the following stage feed consistency is at the other extreme. Analysis of the flow balance will show which stage (s) are off size.

If a stage is oversized, an attempt to decrease the throughput can be made either by reducing the number of operating cleaners or reducing the feed to accept differential pressure. In this later case, it is essential that the differential pressure is kept above the minimum required for the particular cleaner.

If a stage is undersized, an attempt can be made to increase the throughput by increasing the number of operating cleaners or the feed to accept differential pressure.

APPENDIX 9. (continued)

Increasing or decreasing the number of cleaners can be accomplished by changing out blanks with cleaners or cleaners with blanks.

4. Prepare a New Flow Sheet

Before any proposed changes in the system operation are made, first prepare a flow sheet incorporating the proposed changes. This flow sheet should then be checked to ensure that no problems are caused to other stages as a result of the proposed change.

5. Contact Fiberprep

The above provides a general approach for determining a reasonable operating target for a cleaning system. However, every system and its performance demands are unique, and it takes time and experience to determine the optimum performance targets for a specific system. In case of doubt, or even just for the sake of your convenience, please do not hesitate to contact Fiberprep for help in setting operating targets as well as general troubleshooting assistance.

V. Prepare and Act on a Prioritized List of Corrective Measures

Address the physical problems first to the extent possible. Until they are resolved, the system is prevented from performing effectively.

Once physical problems are corrected to the extent possible, changes to the operation of individual cleaner canisters are to be addressed to ensure that the cleaners are operating within their normal range, especially with regard to pressure differentials.

APPENDIX 9. (continued)

Finally, make any adjustments in overall system operation such as reject rates.

After changes are made, the system should be allowed to run for a period of time to establish a new balance (about one hour). The system can then be re-evaluated to determine the effect of the changes and to determine further action.

At all times, notes should be kept as to the work done, cleaners replaced, etc., so that trends can be anticipated and planned for.

Troubleshooting Hints

IT IS IMPORTANT TO ALWAYS KEEP IN MIND THAT ALMOST EVERY ACTION TAKEN ON A CLEANING SYSTEM AFFECTS SOMETHING ELSE. BEFORE MAKING ANY CHANGES TO AN EXISTING OPERATION, ALWAYS CONSIDER ALL THE CONSEQUENCES.

1. Before making any adjustments to the system operation, address all obvious physical problems such as worn or plugged cleaners, malfunctioning pumps, valves or pressure gauges, etc.
2. Compare valve positions to previous settings, and operating pressures to recommended and previous pressures. Changes to pressures without accompanying changes in valve settings can indicate either worn or plugged cleaners, or pressure gauge malfunction.
3. Measure the system operation using the method outlined in Appendix 7 and prepare a flow diagram of the current system operation. Compare this to an optimized flow diagram to determine corrective actin.

APPENDIX 9. (continued)

4. Make sure that all reject rates are within their target areas. A preliminary assessment of this can be obtained by looking at the feed consistencies. Keep in mind that reject rates that are too high or too low will upset overall system cleaning.
5. Keep in mind that <u>EVERY</u> stage must operate at least adequately for the overall system to perform properly.
6. Hydrocyclone cleaners have limitations in concentrating debris. If the concentration of debris in the rejects is in the range of 30 to 50% of the total solids by weight, the cleaner has reached its maximum potential for concentrating debris.
7. Make sure that all the cleaners in a given canister have the same size reject openings, to within a maximum variation of plus or minus two percent.

   Different openings (usually resulting from different amounts of wear) will give different reject rates for the individual cleaners. These differences could lead to poor cleaning or plugging for INDIVIDUAL CLEANERS even though the measured AVERAGE reject rate for that canister is well within the acceptable operating range. The expected overall cleaning efficiency is lost because cleaners with below average reject rates will have much lower efficiency, while cleaners with above average reject rates will only have a marginal if any increase in efficiency.
8. Check the cleanliness of the incoming stock. Because cleaners remove a percentage of the debris, an increase in incoming debris will result in a corresponding increase in accepted debris, even though the system is operating properly.
9. Sometimes there is no single major source for the difficulty and so the solution is found in correcting a number of marginal situations.

# # #