THERMO BLACK CLAWSON INC.

A Thermo Fibertek company

DNT WASHER™ MANUAL

Installation, Operation, Maintenance, and Service Parts
Model 100 and 200

Deliver manuals to:

Attention:

Prepared for:

Mill:

Customer order number: Number of manuals:

Shop order number Serial number

Read this manual carefully to learn how to operate and service your equipment correctly; failure to do so could result in personal injury or equipment damage. Keep this manual readily accessible and legible to anyone doing maintenance on or operating this equipment.

Thank you for purchasing a Thermo Black Clawson product.

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Manual Overview

This manual is for general information and guidance. For specific information concerning parts or items, refer to the certified drawings of the equipment.

Your Thermo Black Clawson unit will provide many years of dependable service when installed, operated, and maintained according to our recommended procedures. The instructions in this manual are recommended procedures for installing, operating, and maintaining your unit. Correct installation of the unit is critical. Reasonable operation and maintenance will not compensate for poor installation.

All information, illustrations, and specifications in this manual are based on the latest information available at the time of publication.

Drawings in this manual are only sketches that exist for no other purpose other than to provide a visual reference for the text within this manual. The drawings in this manual are not to be used for construction purposes.

It is the responsibility of the purchaser of this equipment to make sure that operators, maintenance personnel, and anyone else involved with this equipment is aware of this manual, has easy access to this manual, and has read and understands the contents of this manual. It is also the purchaser's responsibility to keep this manual in legible condition.

WE RESERVE THE RIGHT TO MAKE CHANGES AT ANY TIME WITHOUT NOTICE.

Thermo Black Clawson Inc.

605 Clark Street, Middletown, OH 45042-0160

Phone 1-513-424-7400

North America emergency 24-hour service: 1-800-448-5422

Global emergency 24-hour service: 1-513-391-0881

1.0 SAFETY

1.1 SAFETY INTRODUCTION

This manual is a guide for safe and trouble-free installation and operation of your Thermo Black Clawson equipment. Follow the recommendations in this manual to ensure the safety of your personnel along with the dependable operation of your Thermo Black Clawson equipment. Your particular situation may require additional procedures and safety measures.

You--the purchaser of this equipment--are responsible for ensuring that your personnel are trained in the safe operation and maintenance of this equipment. We recommend that your personnel obtain refresher sessions covering safety, operation, and maintenance procedures periodically throughout the life of your Thermo Black Clawson equipment. **Note**: Thermo Black Clawson offers qualified field service instructors to help train your operators and maintenance personnel.

FOLLOW THE SAFETY INFORMATION IN THIS MANUAL

RECOGNIZE SAFETY INFORMATION. The triangle to the left with the exclamation mark within it is the international safety alert symbol. When you see this symbol on your equipment or in this manual, be alert to the potential for personal injury. Follow recommended precautions and safe operating practices.

UNDERSTAND SIGNAL WORDS

DANGER

Danger indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. *Danger* is to be limited to the most extreme situations.

WARNING

Warning indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Caution indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTE: Notes place special emphasis on information.

Safety Steps

- Carefully read all safety messages in this manual and on your machine safety signs.
- Do not operate equipment until it has been fully integrated into the system.
- Do not perform service or maintenance work on this equipment until unit is at zero mechanical state (ZMS).
- Keep safety signs in good condition, clean, and legible.
- Replace missing or damaged safety signs.
- Learn how to operate the machine and how to use controls properly.
- Do not let anyone operate the machine without instructions.
- Keep your machine in proper working condition.
- Do not modify the equipment without written authorization from Thermo Black Clawson. Unauthorized modifications may impair the function, shorten the machine life, and render built-in safety features useless.
- Inspect the unit before starting and make sure that the following conditions are met:

    - All guards and covers are in good condition and fastened in place.

    - No parts are loose, worn, damaged, or missing.

    - All personnel are clear of equipment.

- When any repair work or examination is done, the DNT Washer should have all motor breakers disengaged, locked out and tagged. The unit should be at zero mechanical state. Feed flow must be discontinued before the motors are disengaged.
- The DNT Washer should not be operated unless all guards are in place. There are certain areas designated as high temperature surfaces. Wear gloves and protective clothing in these areas and also when handling doctor blades.
- When removing the hood, examine the lifting device to make sure it is attached properly. Examine area for objects that would obstruct the hood's travel. Do not leave hood suspended. Lower the hood onto the floor surface before performing maintenance.

- Be sure that all electrical breakers are disengaged before the hood is removed. Do not walk or stand on the hood. When the hood is reinstalled, be careful that all tools and foreign objects are removed from the machine. Also, be careful of the pinch points between the pan and the hood when hood is being lowered. Examine the hood for correct placement before engaging the machine. The hood should be the innermost splash containment surface of all panels.

- When the hood is removed for fabric or roll changes, examine the cantilevering devices for wear and damage. Examine the screw threading of the jack screws and the screw threading on the cantilevering plate for damage. When the rolls are cantilevered, do not walk or work underneath the rolls. If work must be done on the pan beneath the rolls, remove the rolls and place them on the floor. Do not use cantilevering jack screws if they are damaged or stripped.

- Guard thick stock and white water discharge areas, including the thick stock screw conveyor, in accordance with all state, local, and federal OSHA ordinances.

- Do not conduct any repair or maintenance work while the DNT Washer is in operation. These locks must be removed by personnel attending to the machine before any automatic start up.

- Do not remove any guard when the machine is in operation. All guards must be properly installed and fastened before start up of the DNT Washer.

- Do not introduce any foreign object, including hand, hose, or other items in a machine which in operation or which could automatically start.

- Do not operate the DNT Washer unless valves are in proper position.

- Do not operate the shower at pressures above 350 PSI, and all hoses should be rated for these pressures.

- Use the appropriate electrical connections for motors.

- When the DNT Washer is in operation, use caution when obtaining samples.

When taking samples:

- Keep hands away from all moving parts.

- Wear gloves, face shield, and other protective clothing necessary.

- Do not reach up the chute or place any object into the discharge chute.

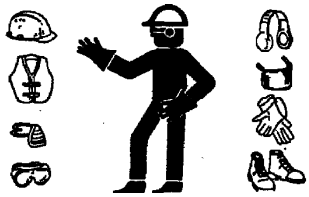
- Examine all sample ports and repair when machine is not in operation.

- Observe all mill safety procedures and precautions.

- Do not remove protective grating from hood door openings.

Safe Maintenance Overview

- Keep equipment area clean and dry.
- Keep all equipment parts in good condition and properly installed.
- Understand service procedures before you do the work.
- Replace worn, broken, or missing parts.
- Do not operate damaged equipment--fix damage immediately.



- Wear close fitting clothing and safety equipment appropriate to the job.

- Consult applicable federal, state, and local codes for proper installation and guarding.

1.2 SAFETY GUIDELINES

Do not use or service this equipment until you read and understand the guidelines and instructions below and throughout this manual. If you have any questions, contact your supervisor.

Safety Guidelines

HAZARD	WHAT COULD HAPPEN	PREVENTION
Stock leaks from pipe connections, blind flanges, body joints, open access doors, etc. Water leaks from shower water, inlet dilution water, or other water sources.	**WARNING** Skin contact with stock might result in chemical or thermal skin reaction, such as skin irritation or scalding.	Follow shut down guidelines. Bring unit to ZMS. Tighten or replace loose, leaking connections.
Valves - air and electrically operated.	**WARNING** Amputation or severe injury to fingers, hands, or arms, could result.	Lockout valves and their energy sources and ensure that equipment is at zero mechanical state (ZMS). **NOTE: Controls may not be independent.** Extreme care must be used when isolating power sources. Be sure of what will shut down when energy sources are locked out. Make sure that other automatic equipment connected to source will also shut down. Do not insert fingers, hands, arms, head, or and other body parts into such devices.

HAZARD	WHAT COULD HAPPEN	PREVENTION
Motor-drive units	**WARNING** Amputation or severe injury to fingers, arms, or hands could result.	Do not expose electrical units to water. Shut down and lockout unit before cleaning or servicing. Do not operate the unit with covers, hoods, or guards removed. Note: Manual rotation of rotating elements may be required with enclosures removed. Be sure all personnel are clear of unit before manually rotating rotor.
Poly chains, sprockets, drive shafts	**WARNING** Amputation or severe injury could occur.	Do not operate unit with guards removed. Be sure unit is shut down and lock-outs are in place before installing guards that have been removed.

1.3 SAFETY PRACTICES

Post the laminated safety sign (provided by Thermo Black Clawson and pictured below) in plain view on or near the equipment at installation and keep it clean.

SAFETY INSTRUCTIONS

STOCK PREPARATION AND PULP MILL EQUIPMENT

Failure to follow these safety instructions may result in serious personal injury or death.

DO NOT PROCEED until you READ and UNDERSTAND these instructions.

1. READ and UNDERSTAND the machine's instruction/operation manual and ALL applicable OSHA regulations (29CFR1010.261).

2. FOLLOW the SHUT DOWN PROCEDURE in the manual.

3. The machine must be brought to a ZERO MECHANICAL STATE and LOCKED OUT with YOUR PADLOCK BEFORE any maintenance, inspection, cleaning, adjusting, or servicing is performed.

a) The MOTOR MAIN POWER DISCONNECT switch must be LOCKED OUT.

b) CHECK DISCONNECT. Try to start motor BEFORE proceeding further.

c) ALL SOURCES OF POWER AND FLOW OF MATERIAL must be SHUT OFF including BLEED OFF of pressure and LOCKING OUT ALL **pneumatic, hydraulic, electrical circuits, steam systems, chemical systems, gas systems, and flows of material stock.**

NOTE: See the glossary in the equipment manual to obtain the definition of zero mechanical state.

NEVER REMOVE another person's lockout (padlock) or tag.

DO NOT assume the machine is locked out. ALWAYS check yourself.

NOTE: If services are not independent of the main supply, DO NOT PROCEED--contact your supervisor.

d) Place or attach a "DANGER - PERSONNEL WORKING" sign near lockout.

e) BLOCK any rotating elements to prevent accidental rotation.

4. DO NOT ENTER vessel or unit unless you have at least ONE OTHER PERSON OUTSIDE the unit at all times. Certain vessels require use or harness, gas masks, and other specialized safety equipment.

5. Upon completion, follow the START UP PROCEDURES in this manual.

6. NEVER START the machine UNLESS

a) All personnel are clear of the machine. b) All doors and hatches are closed.

c) All guards and covers are in place.

If you have any questions, contact your supervisor.

Middletown, Ohio 45042-2117 USA

THERMO BLACK CLAWSON INC.

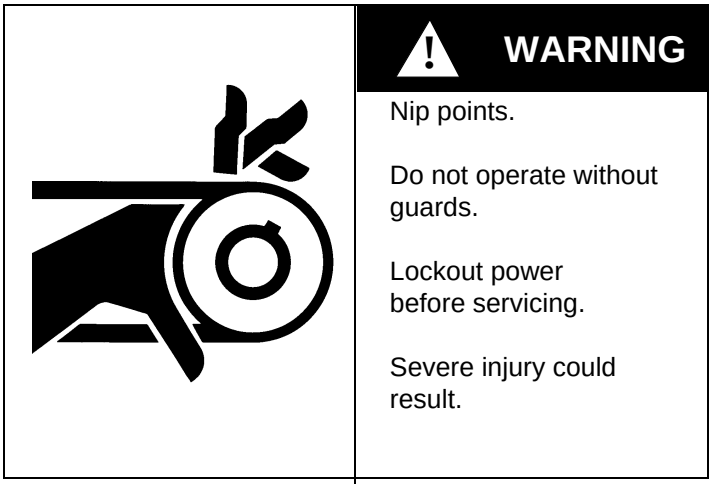
A Thermo Fibertek company

Toll Free 24 Emergency Service: 800-448-5422

Laminated Safety Sign

1.4 SAFETY SIGNS

These following signs are factory installed and should remain on the unit for the life of the machine and should be kept clean and legible. Do not remove the signs unless replacement signs are in hand and installed immediately after the old signs are removed.



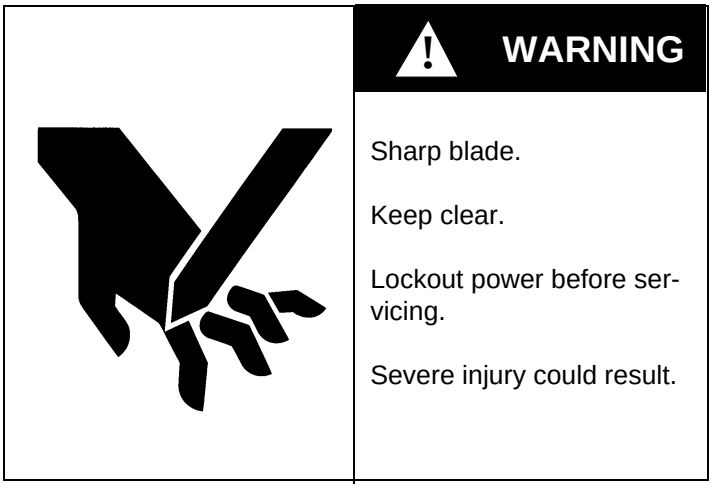
WARNING

Nip points.

Do not operate without guards.

Lockout power before servicing.

Severe injury could result.



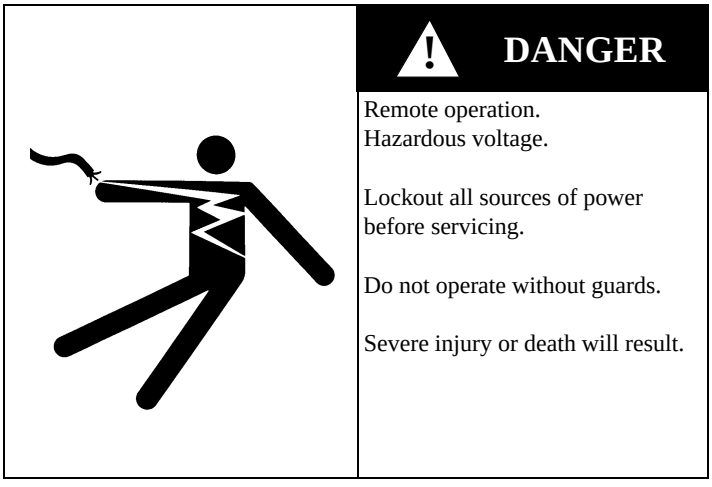
WARNING

Sharp blade.

Keep clear.

Lockout power before servicing.

Severe injury could result.



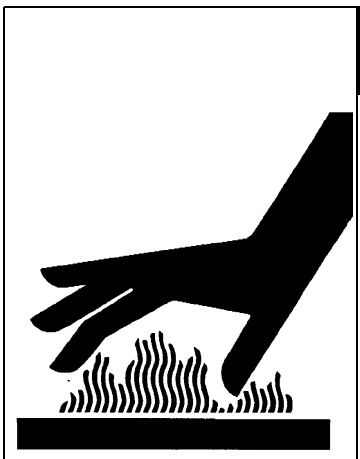
DANGER

Remote operation.
Hazardous voltage.

Lockout all sources of power before servicing.

Do not operate without guards.

Severe injury or death will result.

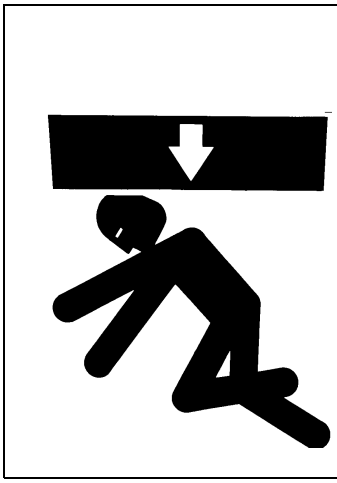


WARNING

Hot surfaces.

Do not touch.

Severe injury could result.

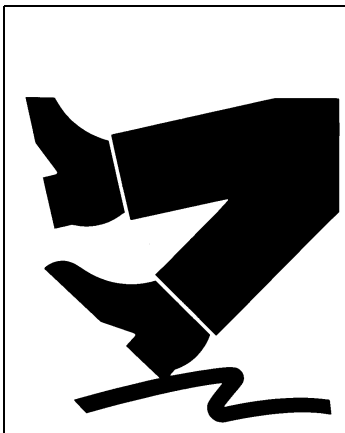


WARNING

Cantilevered rolls or beams.

Keep clear of area.

Severe injury could result.



DANGER

Hood will not support weight.

Do not stand or walk on hood.

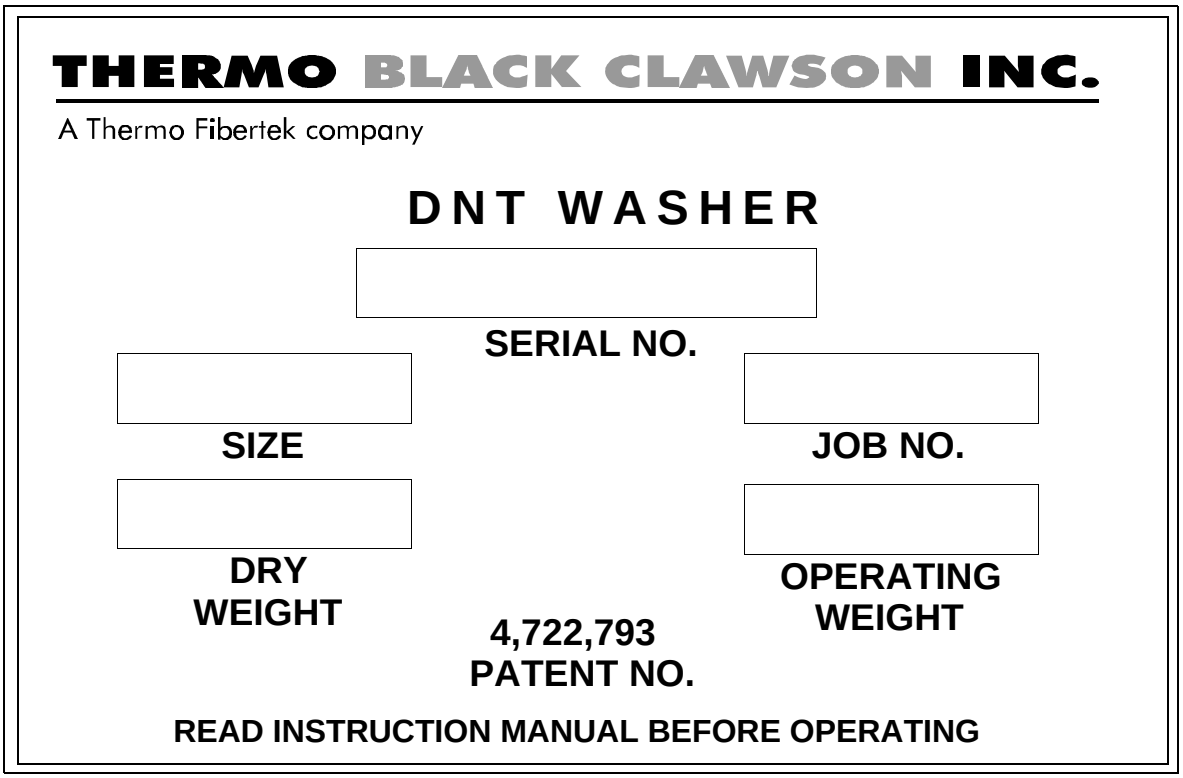
Severe injury or machine damage will result.

2.0 EQUIPMENT IDENTIFICATION

2.1 NAMEPLATE

Product identification numbers include the serial number, job or shop order number, and model number. They are provided to help identify this unit if it needs service.

Thermo Black Clawson needs these numbers when you order parts.



3.0 GENERAL INFORMATION

3.1 EQUIPMENT DETAIL

Your Thermo Black Clawson unit is designed to give trouble-free operation with minimum maintenance. However, certain precautions and procedures must be observed in handling, installing, and servicing the unit to obtain optimum performance.

The information in this manual should cover most situations. Should questions arise that are not covered in this manual, contact us for additional information:

Customer Service

Thermo Black Clawson Inc.

605 Clark Street, Middletown, OH 45042-0160

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Global emergency 24-hour service: 1-513-391-0881

FAX: 1-513-424-1168

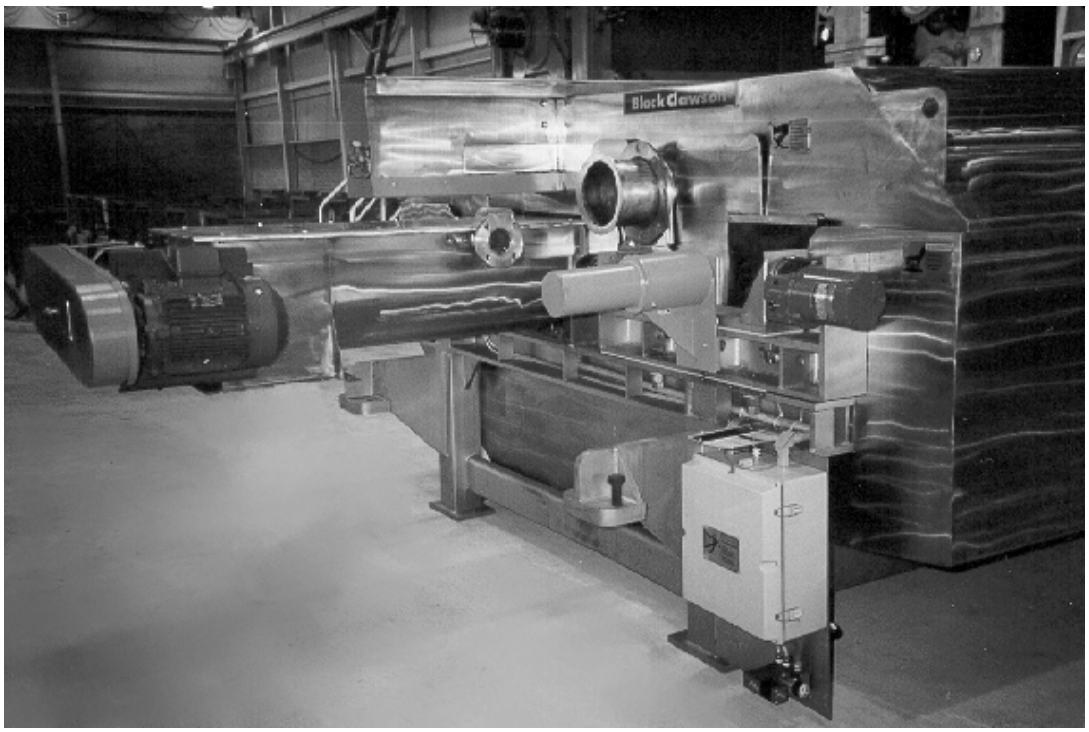
Serial Numbers

The serial number is on the nameplate and the certified drawings. When inquiring about service or maintenance problems, always provide the serial number, size, and type of unit.

Renewal Parts

Orders for renewal parts should state the serial number(s) and include the item number, description, and part number shown on the parts list of the certified drawings. **Part numbers are not specified in this manual.** Refer to your certified drawings for part numbers.

3.2 DESCRIPTION



DNT: Drive Side

The DNT Washer is a high speed washing/thickening device which is capable of high flow rates in a compact space. The DNT Washer consists of one 31.50 inch diameter roll, one 31.75 inch diameter roll, a synthetic woven fabric, a headbox, doctor blade, and a screw conveyor. These items are completely enclosed by a stainless steel hood and pan.

The DNT Washer is able to remove ink and clay at or very close to the hydraulic reject rate (the hydraulic reject rate volume of the feed flow). The turbulent dewatering allows excellent capacity and deinking efficiency.

The DNT Washer operates by feeding stock into the headbox at 0.5 to 3.0% consistency and distributing stock into the nip formed between the breast roll and the fabric. The breast roll is covered with polyurethane and is grooved, which allows greater nip volume and dewatering distribution between the two nips. The breast roll nip created by the grooved breast roll and the synthetic fabric does not press the stock, so most of the dewatering of the stock is by centrifugal force, which is a factor of fabric speed, roll diameter, and fluid velocity.

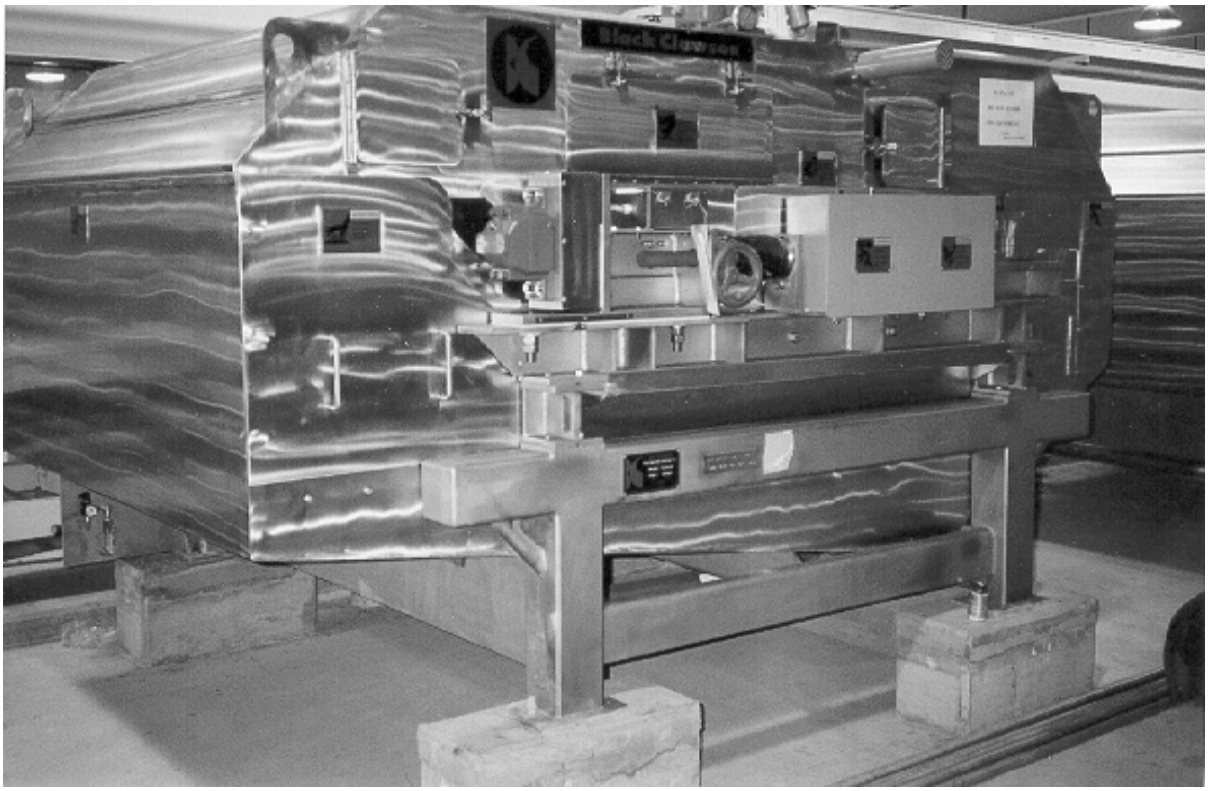
Because the stock is thrown against the fabric as it travels around the breast roll, the stock is *self-doctored* from the grooves. The stock is laid onto the fabric in stripes matching the groove pattern and carried into the nip of the couch roll.

The couch roll is a smooth, hard rubber covered roll. Stock is dewatered in the second nip by force of the fabric pressing against the smooth couch roll. The thick stock is then removed from the couch roll by a doctor blade at consistencies ranging from 8 to 14%. The thick stock is doc-

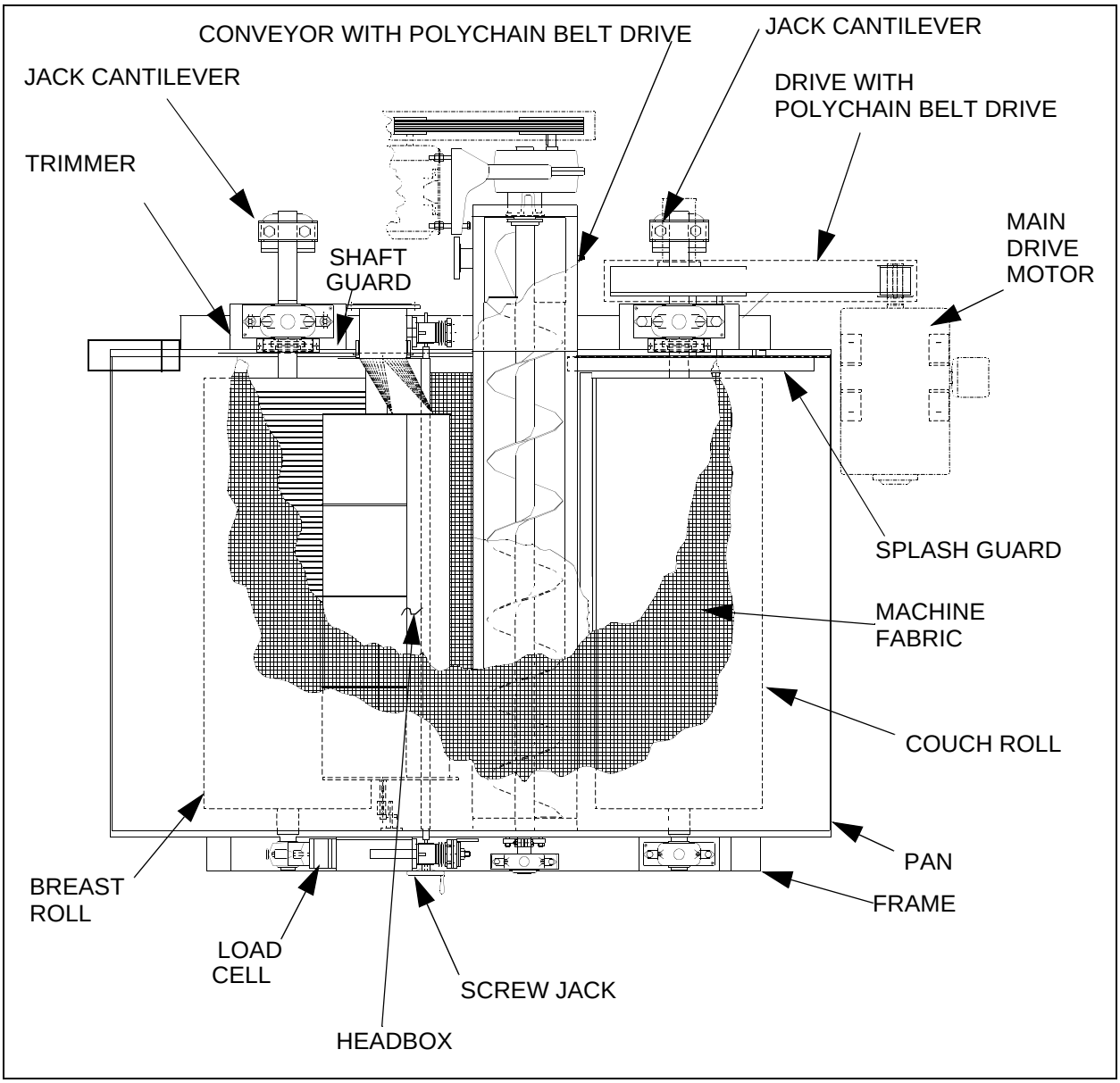
tored into the screw conveyor where it is carried laterally out of the machine.

Above the screw conveyor housing is an oscillating high pressure shower which removes stickies, ash, dirt, etc., which can plug the fabric The fabric can also be cleaned with special fabric cleaning chemicals occasionally, as desired. A low pressure fan shower is fixed to the hood after the couch roll doctor blade. A conveyor shower is fixed to the conveyor which prevents stock from building up.

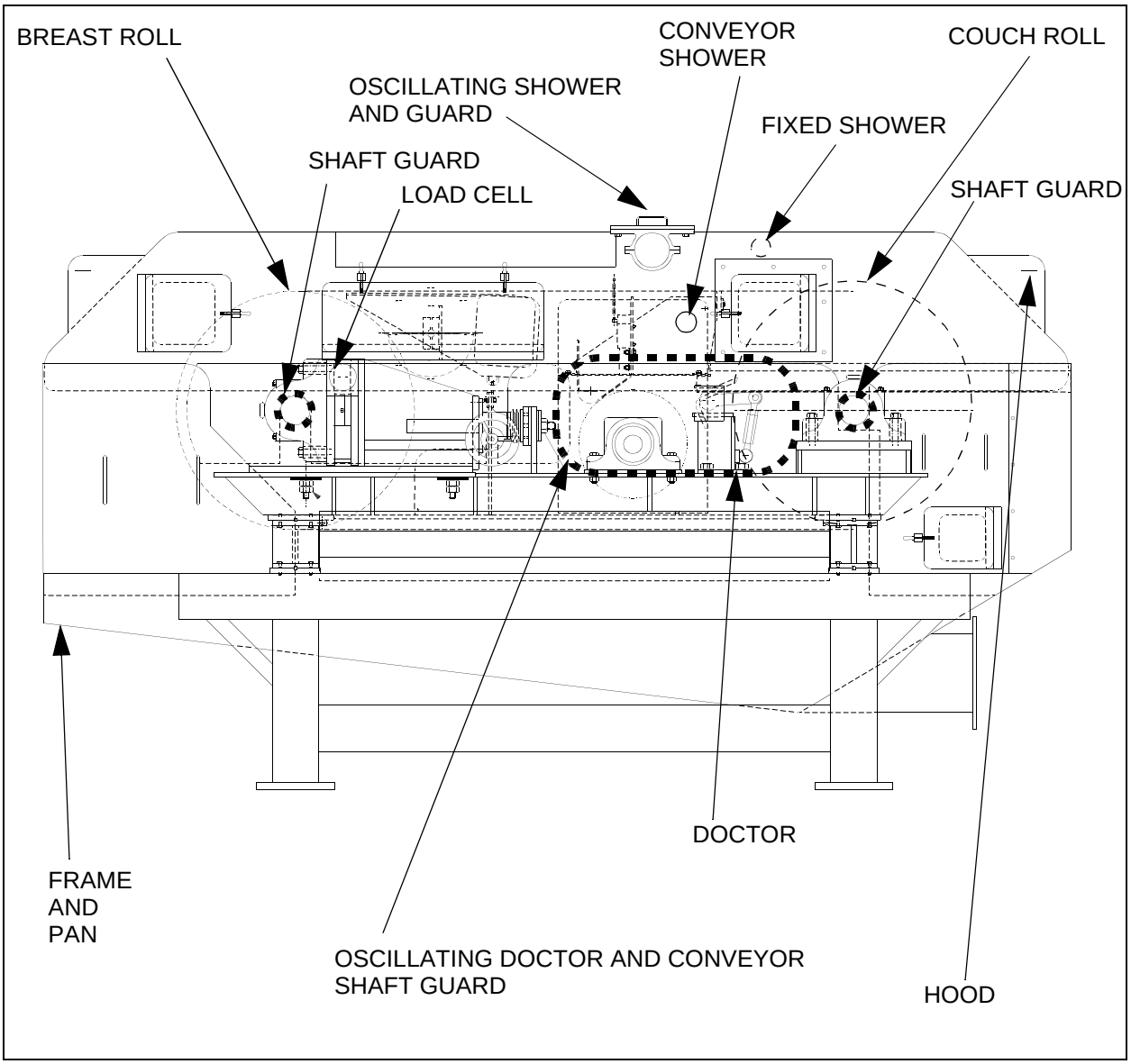
The white water is collected by the hood and the pan, and drains out of the DNT Washer at a central white water discharge point. Baffles near the couch roll prevent white water from splashing outward. The white water consistency generally ranges from 0.10 to 0.60%. Several inspection ports are located on the hood to allow fabric, roll, and shower inspection and to check for stock buildup without removing the hood.



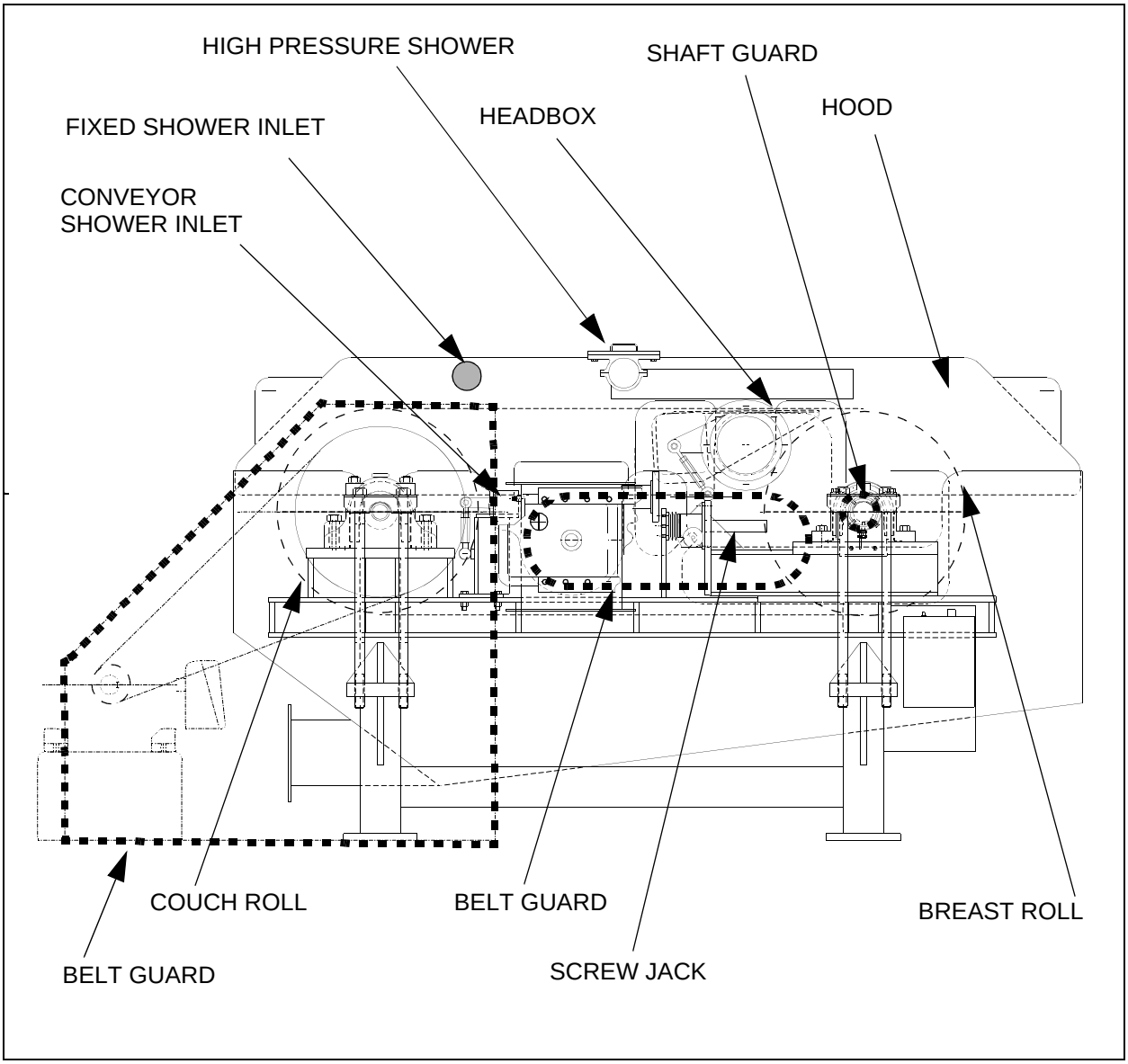
DNT: Tending Side



DNT: Top View



DNT: Tending Side



DNT: Drive Side

3.3 SPECIFICATIONS

The specifications below are standard. Refer to your certified drawings to verify the specifications of your unit.

Standard Specifications

Description	MODEL 100	MODEL 200
Length	132.5 inches	
Width	140.5 inches	see certified drawings
Height	137 inches	172 inches
Inlet flange	Standard 8 inch U.S. flange	
Flow distribution nozzle	Circular feed section with a nozzle extending into the feed nip. 316L stainless steel	
Rolls	Two mild steel rolls with 316L stainless steel ends, each 30 inches in diameter. The drive roll is covered with hard rubber with P&J hardness of 0-1. The rubber covering is 3/4 inch thick so that the overall diameter of the roll is 31.50 inches. The breast roll is covered with polyurethane of 15-17 P&J and is 7/8 of an inch thick so that overa1l diameter of the roll is 31.75 inches. It is also grooved to increase capacity and eliminate breast roll doctor blade. The couch roll is smooth. The rolls are dynamically balanced for 4000 feet per minute. Rolls are designed for normal operating speed of 3000 feet per minute.	
Doctor blade	One non-contacting oscillating doctor blade located on the couch roll. The blade is stainless steel, .50 inch thick with 500 bevel. Oscillation stroke is 3/4 inch and requires 30 PSI maximum air pressure.	
Fabric	One endless triple layer Triotech 114 polyester fabric, mesh count 114 x 110. Two fabric guides attached.	
Shower	One oscillating needle jet high pressure shower, designed to operated at 350 PSI maximum water pressure. One fixed fan jet medium pressure shower, designed to operate at 80-100 PSI water pressure.	
Drive	The DNT Washer has two separate drives; one for the drive roll (couch roll) and one for the screw conveyor. The couch roll is driven by a belt/sheave arrangement. The couch roll is belted to run nominally at 3000 feet per minute. A variable speed drive is recommended to control fabric speed from 1600 to 3000 feet per minute range. The screw conveyor is driven by a 10 horsepower, 1800 rpm motor equipped with a gear reducer (typically a Falk drive). The drive motor for the drive roll is supplied by the purchaser. A soft start drive can be used as an alternative drive method.	
Main drive motor horsepower	40	60, 75, or 100 (flow rate dependent)
Main drive motor RPM	1200	
Main drive Drive belt type	Polychain	
Main drive drive belt width	68 mm	
Main drive roll sprocket size	see certified drawings	
Main drive motor sprocket size	see certified drawings	

Description	MODEL 100	MODEL 200
Conveyor drive Falk gearbox model	4207JSC14	
Conveyor drive motor horsepower	7.5	10
Conveyor drive motor RPM	1800	
Conveyor drive screw RPM	100	
Interlock system	Zero speed switches are provided to shut the unit down if the breast (driven) roll or screw conveyor stops for any reason. Two limit guides detect fabric mistracking. Complete instrumentation interlock system can be provided.	
Screw conveyor	A 14-inch diameter, 316L stainless steel screw conveyor is provided to remove the thick stock on the drive side of the DNT washer, complete with 10 horsepower, 1800 rpm motor and drive.	
Cantilevered design	The DNT Washer is cantilevered to use an endless fabric. The design consists of two sets of jacking screws on the drive side. When these jack screws are tightened, two blocks and three panels can be removed on the tending side for a fabric change.	
Fabric tensioning device	Two heavy-duty worm gear screw jacks with adjusting hand wheel on the tending side are used to adjust the fabric tension. Attached to the tending side worm screw jack is a mechanism for fine squaring adjustment by allowing movement of tending side only. Tensioning should be set at 10-20 pounds per linear inch. A loadcell is supplied for tensioning readout. Four Special-Duty Dodge grease lubricated pillow block bearings for the couch roll and breast roll. Tending side bearings are 2.5 inch. Drive side bearings are 3.5 inch.	
Frame	Mild steel frame is standard. 316L stainless steel is available as an option.	
Hood	316L stainless steel, having inspection doors on tending side. Hood has four lifting points to be picked up by hoist for fabric change, etc.	
Pan	316L stainless steel, having rectangular discharge at couch roll end of machine. Discharge is horizontal. Other arrangements of discharge are available.	
Orientation	Machine is right-handed--the drive is on right-hand side looking at the DNT Washer from the couch roll end.	
Weight empty (roughly)	6800 lb	8,600 lb
Weight full (roughly)	9000 lb	13,000 lb

3.4 ACCESSORY EQUIPMENT

Thermo Black Clawson offers complete system design or individual units to integrate into an existing system. Your local Thermo Black Clawson Sales Manager or our Systems Engineering Group is available to assist you with your specific application requirements.

4.0 SHIPMENT CHECK

4.1 SHIPPING AND RECEIVING

Carrier

Thermo Black Clawson units and accessory equipment are shipped by truck.

Shipping Papers

One set of shipping papers is attached to the shipment in plain view to those unloading the unit. Another copy of the shipping papers was mailed to your receiving department.

WARNING

Verify weights shown on shipping papers with certified drawings and determine if your crane or hoist can lift the heaviest item safely.

Check-Off

During unloading, check-off parts from shipping papers. Report shortages to Thermo Black Clawson within 24 hours. File damage claim against transportation company within 24 hours.

Unloading Patterns

Trucks are generally unloaded from back to front. The crane operator must be sure of a clear lift or the piece being lifted may swing against other parts and cause damage.

Wooden Boxes (Crates)

Clamps, bolts, nuts, cap screws, eyebolts, and other small parts are shipped in one or more wooden boxes. **Do not store these boxes outdoors.**

Bracing Material

Leave wood blocks, steel strapping, and other bracing material in place until hoisting sling is in place and the piece is ready to be lifted.

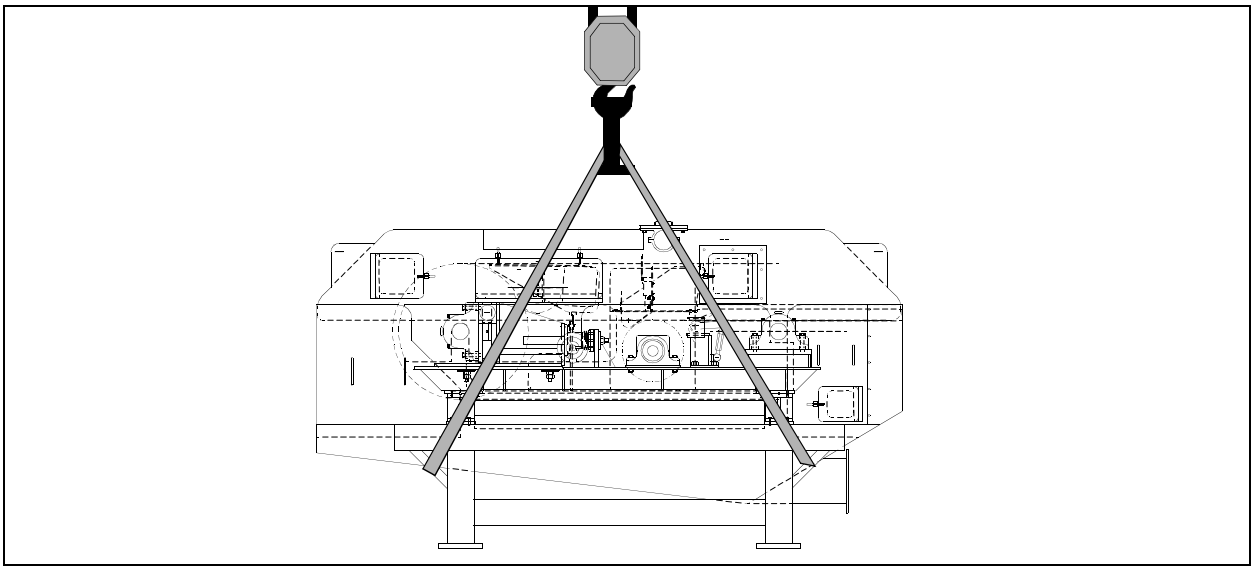
4.2 UNLOADING AND HANDLING

Lifting, Unloading, and Moving Unit

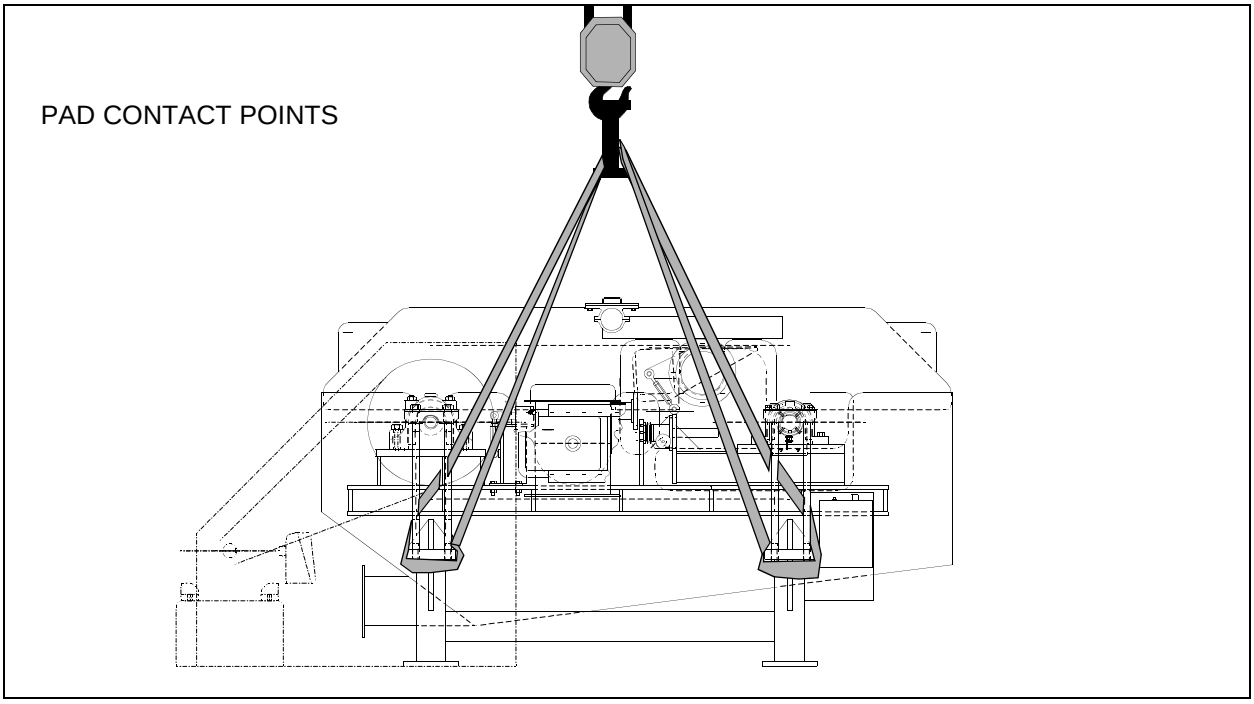
- Check to be sure that eyebolts and hooks are attached securely and have appropriate lifting rating.
- Straighten the sling as the slack is removed. Test by allowing the weight of the piece to be supported by the crane while the piece is not more than one or two inches (25-51 mm) above the truck bed.
- Lift pieces carefully and smoothly. With cast parts, the flanges will break next to the cored holes if pieces are jerked suddenly by the crane.
- Use properly sized rigging.
- All lifting and rigging must comply with federal, state, and local safety codes.

> **WARNING**
>
> Never stand underneath equipment that is being lifted. To do so is to risk severe personal injury or death.

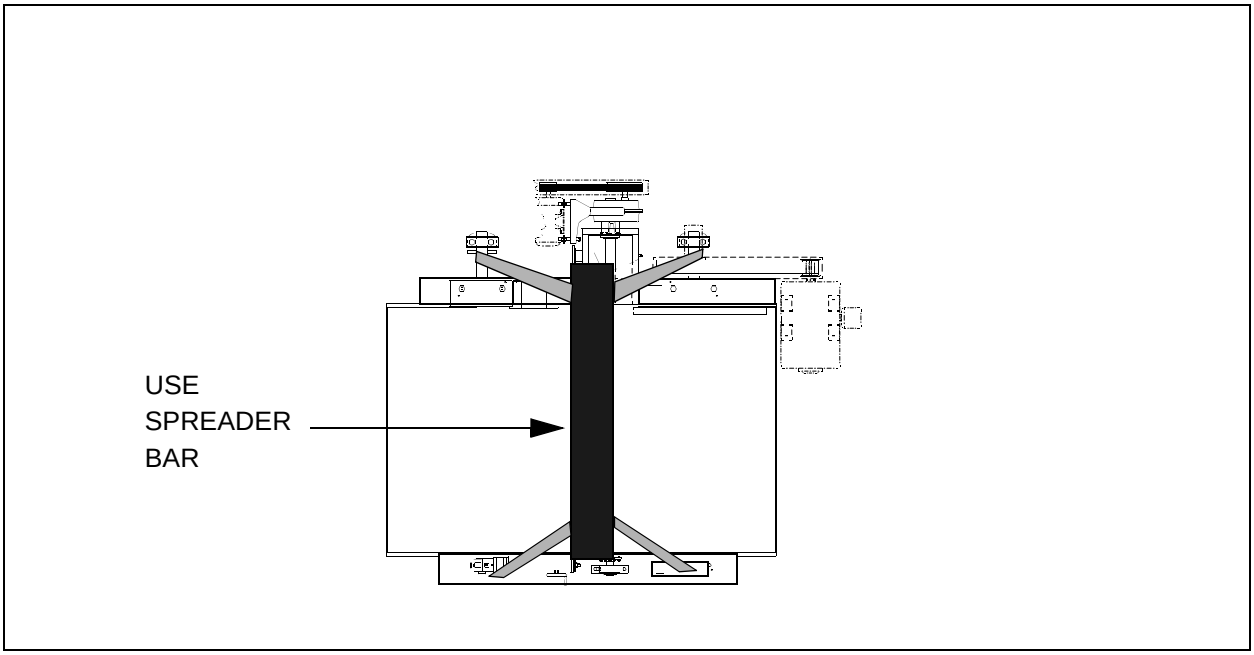
- Use shipping weight as a guide to determine lifting requirements. Verify that lifting equipment has sufficient capacity.
- Do not lift unit by chaining or slinging around pipe connections or motor stand.
- Use a spreader bar to prevent damage to the unit when lifting.
- Take extreme caution when moving units into location for permanent installation. In using overhead hoist, keep all personnel away from area underneath machine.



Tending Side Lifting Points



Drive Side Lifting Points



Top View of Lifting Points

5.0 STORAGE

5.1 UNIT STORAGE

Take the following precautions to minimize potential damage to the unit if outside storage is planned:

- Cover equipment with waterproof covering.

- Do not allow water to accumulate in or on the unit, especially if the weather conditions approach freezing (32 degrees Fahrenheit [0 degrees Centigrade]) or below.

- Do not store items such as valves, cylinders, switches, etc. outside.

- Consult the drive unit manual for any special storage requirements for the drive.

NOTE:

At the time of installation, all protective coatings must be removed carefully to prevent damage to the seals, etc. Bearings must be flushed and lubricated with lubricants that are clean and meet the specifications for the bearing application.

THERMO BLACK CLAWSON ASSUMES NO LIABILITY AS TO THE SPECIFIC STORAGE REQUIREMENTS FOR EQUIPMENT OR COMPONENTS.

6.0 INSTALLATION

6.1 SAFETY PRECAUTIONS

ATTENTION OPERATORS AND MAINTENANCE PERSONNEL! Read and make sure that you understand all of the safety information and correct procedures before using or servicing this equipment. This manual should be available to you at all times.

Do not modify the machine without authorization. Modifications could affect the function of the machine, shorten machine life, or render built-in safety features useless.

Never start the machine unless the following conditions are met:

- All personnel are clear of the machine.
- All doors and hatches are closed.
- All guards and covers are in place.

See "Operation" section for complete start up procedure.

Do not exceed the maximum design pressure. Maximum design pressure of this unit is stated on the certified drawings.

Bring machine to ZMS before servicing. Unit must be at zero mechanical state (ZMS) before any service work is done. All energy sources and stock supply must be shut-off and locked out with your padlock before and during installation, maintenance, inspection, cleaning, or adjusting this unit.

WARNING

Never remove another person's lockout (padlock) or tag.

Check disconnect. Try to start motor before servicing unit.

Bleed off pressure and lockout all pneumatic, hydraulic and steam systems, electrical circuits, chemical and gas systems, water, and stock flow.

Do not proceed if services are not independent of the main supply. Contact your supervisor.

Follow installation and maintenance procedures in this manual along with your company's safety guidelines.

Use valves designed for lockout and tagging. All valves used on this equipment should be designed to be locked out and tagged. Never operate unit without guards in place.

Tighten sheave bushings to manufacturer's specification.

Check torque prior to start up. Tack welding of bolt heads is an accepted industry practice.

CAUTION

Over tightening fasteners can result in failure of bolts and other attachments.

6.2 PRE-INSTALLATION

Complete pre-installation before you receive the unit. Use this section as a checklist.

Documents

- **Certified Drawings** - prepared by Thermo Black Clawson upon receipt of your purchase order and your returned approval drawings.
- **Owner's Manual** - sent with certified drawings.
- **Shipping List** - we send one copy with the shipment and one to the mill the day of shipment.

Foundation

Refer to the certified drawings for foundation information.

Equipment Placement

Certified drawings show space requirements for equipment operation and the anchor bolt plan. Consider equipment clearances in your layouts and maintenance and installation requirements.

When equipment has to be lowered through an opening in the floor above, be sure that it is in correct foundation position before the unit is erected.

NOTE: Check the certified drawings to determine if any unusual clearance problems will arise while moving the unit through the mill.

Lifting Equipment

We have attempted to ensure that the unit weights (not including crating weight) are on the certified drawings for each piece of equipment. If the weight is not on the certified drawings, contact Thermo Black Clawson. Verify that the hoist or crane at the mill has adequate load capacity to lift the unit safely. If not, lease lifting equipment or contract for the services of a rigger.

Electrical Requirements

Be sure that power cables and controls are properly sized, and can be routed to the unit with a minimum of bends and turns. Verify that the available electricity is correct for the equipment.

Piping

Check certified drawings for pipe sizes. Be sure that correct sizes of pipe, fittings, and adapters will be available when the piping is installed. All piping must be well supported. Expansion loops or joints should be installed in the connecting pipes to allow for linear expansion. Piping must not be connected to the unit until the grout has hardened and the foundation bolts have been tightened.

Leveling Instruments

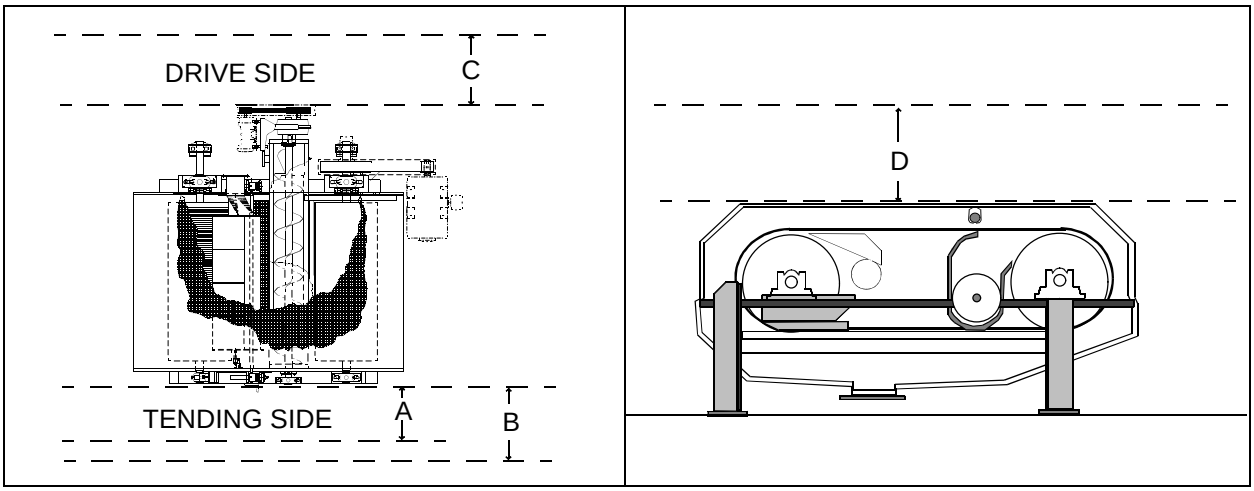
The Starrett 12 inch Model 98 is the industrial standard for leveling heavy machinery. Level to within 0.005 of an inch (.13 mm) per foot (30 cm).

6.3 INSTALLATION

Install the DNT Washer on a level surface with access for required piping, and sufficient clearance for hood and roll removal and fabric changes. The DNT Washer can be installed on the ground floor of a mill; however, provision must be taken to pump or convey white water and thick stock from the unit. It may be convenient to locate the DNT Washer above thick stock and white water collection tanks. Motor and motor base are generally supplied by the customer. We recommend a variable speed drive. Provide a method to accelerate or decelerate the drive roll over a period of 30 to 60 seconds from 0 to 370 rpm. Use an overhead hoist for hood and roll removal.

Space Requirements

Illustration Reference	Description	Model 100	Model 200
A	Minimum fabric change space requirement	four feet	six feet
B	Recommended fabric change space requirement	six feet	eight feet
C	Minimum drive side maintenance space requirement	five feet	five feet
D	Lift distance requirement	three feet	three feet



Space Requirements

Thermo Black Clawson assumes no responsibility for the site preparation and construction required for the installation of this equipment. An adequate foundation, determined from the machine weight and floor loading conditions, must be provided.

The general guidelines suggested in this manual are for those individuals involved in installing the unit. It is the responsibility of the customer's erection crew or agents to maintain *as built* specifications during the installation of the unit. If you have any problems or questions concerning the installation of this equipment, please contact the Thermo Black Clawson Field Service Depart-

ment. If you want more information on grouting, ask for our ***Typical Grouting Practices*** manual.

Customer Supply

The customer is to furnish all foundations, anchor bolts, steel shims, packing, piping, grating, etc. The motor and motor base are generally supplied by the customer. Refer to quotations and certified drawings for a complete listing of parts and hardware furnished by Thermo Black Clawson.

Foundation Surfaces

See “Grout” on page 33.

Anchor Bolt Pockets

Remove all debris and dust from anchor bolt pockets before installing sleeves.

Shim Packs

Steel shims will be required to level the unit before it is grouted in place. Mill supply must include 3 inch x 3 inch (76 mm x 76 mm) shims.

Anchor Bolts

Bolts must project at least ¼ inch (6.35 mm) through the nut when the unit is bolted down. Allow for grout and thickness of soleplate/footpads and nut when determining bolt length. See “Recommended Anchor Bolt Method” on page 34. The certified drawings call out the anchor bolt sizes, typical spacing, and layout. We recommend that anchor bolts be encased in sleeves to make allowance for minor deviations in mounting hole location.

Grout

All grout design and placement of grout is the responsibility of the customer. Deviations from standard grouting practice could result in structural failure. Piping must not be connected to the unit until the grout has thoroughly hardened and the foundation bolts have been tightened. All couplings should be final aligned after the piping is completed. Grout selection will be effected by such areas as curing time, tight clearances, creep resistance at elevated temperatures, high load conditions, high impact and vibration conditions. Consult the grout manufactures engineering technical group for specific requirements.

Surface Preparation

The surface shall be free of oil, grease, and dust. When a concrete type grout is being used, the existing concrete surface should be soaked with clean water, leaving the surface saturated but free of standing water. When using epoxy grout, the surface must be clean, dry ,sound and roughened to assure a good bond.

Gap Size

For most grouts the minimum gap is one inch with the maximum being four inches. If the gap size is beyond this range, consult the technical department of the grout manufacturer.

Curing Time

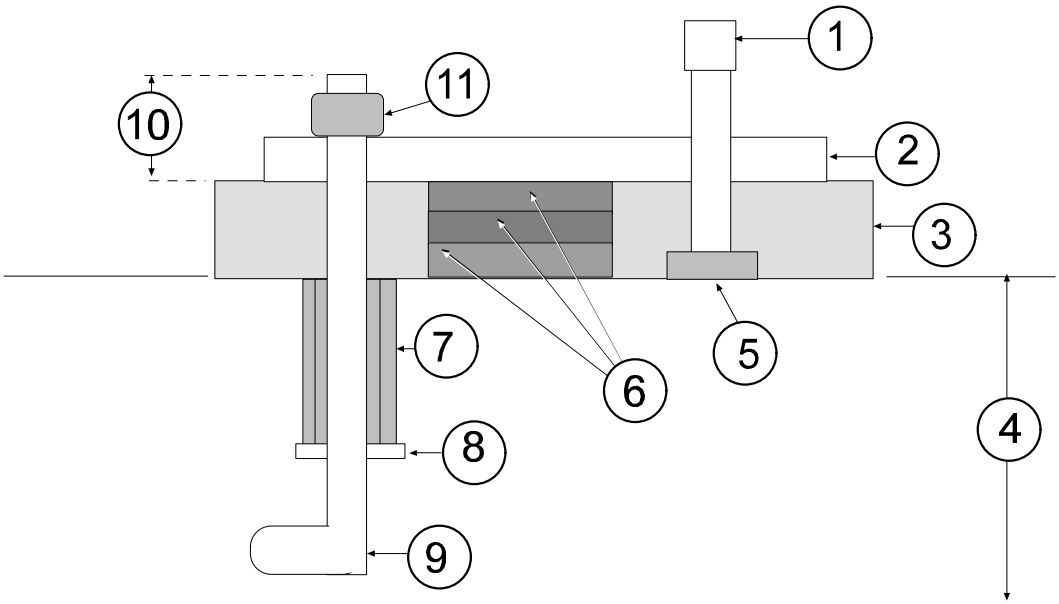
Curing time will be effected by thickness and temperature. Consult the technical bulletins which

came with the grout being used.

Temperature

Refer to the grout manufacturer's technical bulletins for temperature requirements at the time of installation for the type of grout being used. When epoxy grout is being used, flowability and strength grain are adversely affected by lower temperatures. When the temperature is below 70 degrees Fahrenheit or above 90 degrees Fahrenheit refer to the grout suppliers technical data.

Concrete type grouts may be used with temperatures as low as 35 degrees Fahrenheit, however if lower temperatures are encountered, consult the technical department of the grout manufacturer.



1. LEVELING SCREW; 2. BASE PLATE; 3. GROUT; 4. FOUNDATION; 5. STEEL BLOCK; 6. SHIM PACK; 7. SLEEVE; 8. WASHER; 9. ANCHOR BOLT; 10. DISTANCE PROVIDED IN CERTIFIED DRAWINGS; 11. NUT

Recommended Anchor Bolt Method

Leveling the Unit

Install the unit on the foundation by lowering it over the anchor bolts. Level the unit and place steel shims next to each anchor bolt and underneath unsupported lengths of the unit base. Use care not to distort the alignment of the unit when shimming. The leveling screws are intended only for leveling and should carry no weight of the unit when the anchor bolts are tight. It is a good practice to remove the leveling screws at the completion of the installation.

The unit is shipped to the mill completely assembled (i.e., rotor, cylinder, and mechanical seal installed). Position the unit over the anchor bolts. Refer to your certified drawings for correct placement and orientation of the unit on the foundation. Unit needs to be leveled before grouting into place.

- Place 3 inch x 3 inch x 1/2 inch (76 mm x 76 mm x 13 mm) thick steel plate on the foundation under each leveling screw to provide a solid surface for the leveling screw to bear against during the leveling procedure.
- Remove the top cover to gain access to a machined reference surface to properly level the unit.
- Check for level in two directions, in line with the corners of the base.
- Adjust the leveling screws on the base mounting pads to obtain a level condition within 1/16 inch in both directions.
- Use steel shim under the mounting pads to support the unit in level position. Shims are permanent and remain in place after the unit is grouted.
- Tighten the anchor bolts.
- Recheck the unit for level and be sure that unit is securely supported on the shims, not by the leveling screws.
- Remove the leveling screws.

Discharge

- Guard thick stock and white water discharge areas, including the thick stock screw conveyor, in accordance with all state, local, and federal Occupational Safety and Hazard Act ordinances.

Screw Conveyor

In certain cases, the DNT Washer may be supplied without screw conveyor assembled to the unit because of space limitations (from mill or transport). In this case, use the following procedure.

Removing the Screw Conveyor

Changing or removing the screw conveyor on the DNT Washer takes approximately six hours to complete. Before performing screw conveyor changes, read and observe all of the safety precautions described in this manual. The process for removing the screw conveyor trough, flight, and assembly, is as follows:

- Be sure that unit is at zero mechanical state.
- Follow fabric removal steps then proceed.
- Disconnect the conveyor discharge end.
- Remove the two 3/8 inch bolts on the drive side that connect the screw conveyor trough to the framing.
- Place straps around screw conveyor trough. Put tension on the straps with a hoist to take the weight off the fasteners.
- Remove the two 3/4 inch bolts and two 3/8 inch bolts from the tending side of the conveyor.
- Lift the conveyor vertically about one-half inch and then move it to the drive side approximately five inches. Next, lift the assembly straight out of the machine vertically.

Replacing the Screw Conveyor

- Check to ensure that the screw conveyor trough is seated on the drive side so that two bolts line up correctly.
- Replace these two bolts.

Main Drive

The main drive to turn the couch roll is belt driven by a Polychain type or equivalent belt and pulley arrangement. The motor size depends upon roll speed and feed flow rate, and generally ranges from 60 to 100 horsepower. Belts and pulleys should be properly aligned. Follow installation procedures as specified by drive supplier. We recommend a variable speed drive to vary fabric speed. Required fabric speed depends greatly on flow rate, feed consistency, etc. Normal operating limits are 1600 to 3000 feet per minute. A soft start arrangement should be included to accelerate/decelerate the DNT Washer from 0 to 3000 feet per minute within 30 to 60 seconds.

Flow Distribution Nozzle Connection

On machines supplied for the U.S. market, an 8 inch diameter U.S. standard flange is supplied for feed stock supply. For DNT Washers supplied outside of the U.S., an equivalent size flange or adaptor is normally supplied. Due to the movement of the breast roll for fabric tensioning, a flexible connection is required to attach to the flow distribution nozzle. Rigid piping cannot be used. The flexible connection should be designed for 8-inch horizontal movement, and should be 6 feet in length.

A proper size pump must be selected to give adequate feed pressure to the flow distribution box.

Oscillating High Pressure Shower

The high pressure shower is important to maximize fabric life and capacity of the DNT Washer. The shower should oscillate on a *45 second/per complete* cycle to ensure entire fabric surface is cleaned once per shower cycle. Shower should be connected with reinforced hosing designed for a minimum of 400 PSI. You must use flexible hosing to allow the shower to oscillate. These connections will require disconnection for hood removal. The high pressure shower requires the following utilities.

Utilities for Oscillating Shower

UTILITY	FLOW (USGPM)	MAXIMUM PRESSURE (PSI)	FITTING (INCH NPT)	QUALITY
Water	20	350	1 1/2	Less than 1 pound TSS/1000 gallons (120 PPM)
High pressure water pump by customer.				

Non-Oscillating Low Pressure Shower

The low pressure fan shower is a fixed non-oscillating shower designed to clean the fabric in the cross machine direction. This shower can be equipped with either flexible or rigid piping. This connection will require disconnection for hood removal.

Utilities for Non-Oscillating and Conveyor Shower

Shower	FLOW (USGPM)	MAXIMUM PRESSURE (PSI)	FITTING (INCH NPT)	QUALITY
Non-Oscillating	6 - 8	100	1 1/4	Less than 1 pound TSS/ 1000 gallons (120 PPM)
Conveyor	10	100	1 1/4	Less than 1 pound TSS/ 1000 gallons (120 PPM)

Doctor Blade

The oscillating doctor blade removes thick stock from the couch roll. The oscillator prevents grit from lodging between the blade and roll to prevent the roll from scoring.

Air for Oscillator

FLOW (CFM)	MAXIMUM PRESSURE (PSI)	FITTING INCH NPT
.05	30	1/4 at filter / regulator

Drain Pan Opening for White Water

A standard drain pan discharge opening for white water is located on the couch roll end and is a rectangular flanged opening (see certified drawings for dimensions). Because the white water drains from the DNT Washer by gravity, piping cannot restrict the flow of white water from the DNT Washer. Restriction of white water flow will cause white water level to rise in the DNT Washer pan, causing operational problems and possible drive motor overload.

Thick Stock Discharge

The thick stock discharge is a square opening 15 inches by 15 inches from which thick stock

drops directly down into appropriate thick stock collection tank.

Shower Water Collection Pan

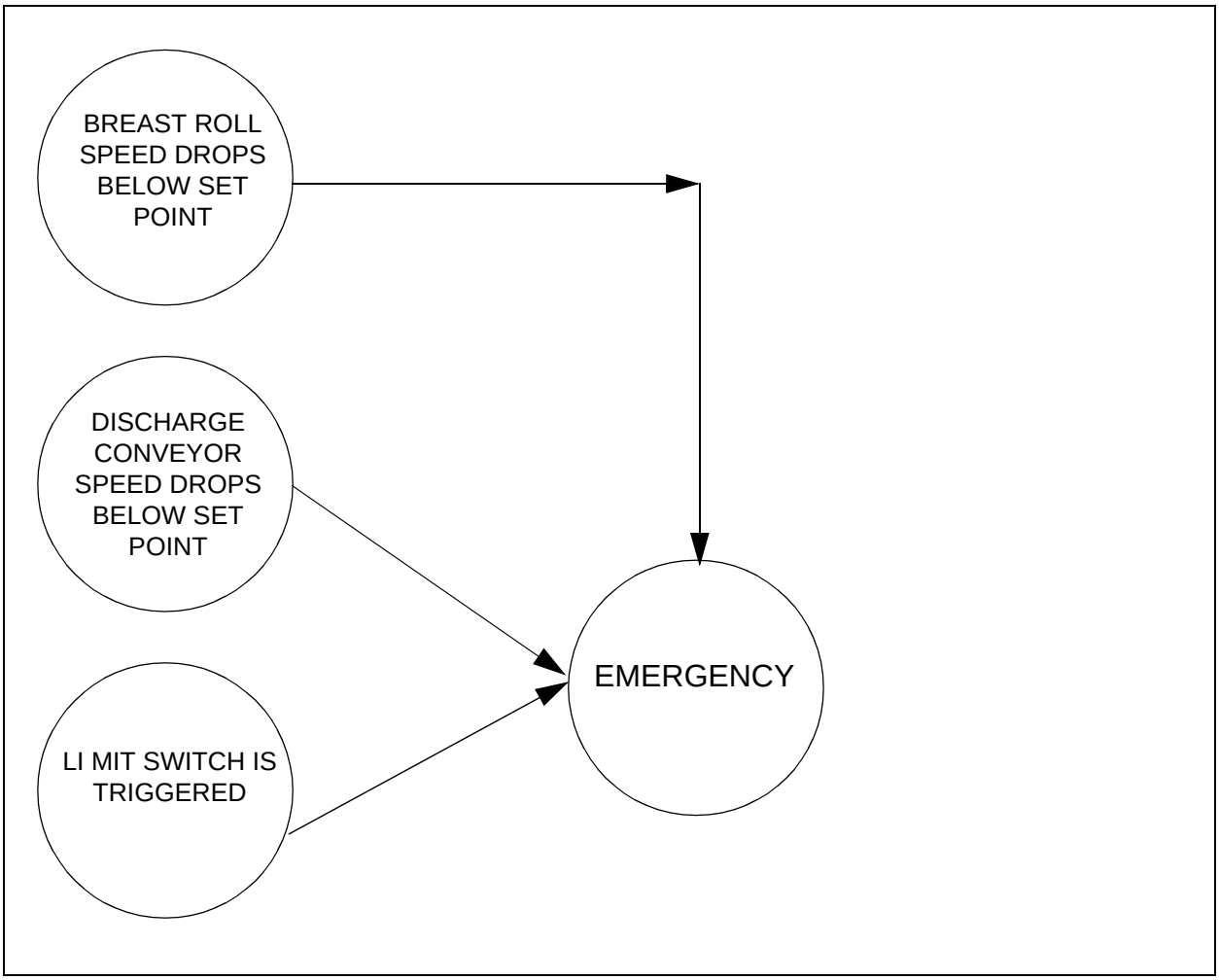
A shower water collection pan is provided to collect water from both the high pressure oscillating shower and low pressure non-oscillating shower. A common 3 inch U.S. flange is provided to allow water to be drained from pan. This water may be treated separately due to possible contamination from stickies removed from fabric.

Roll Alignment and Installation

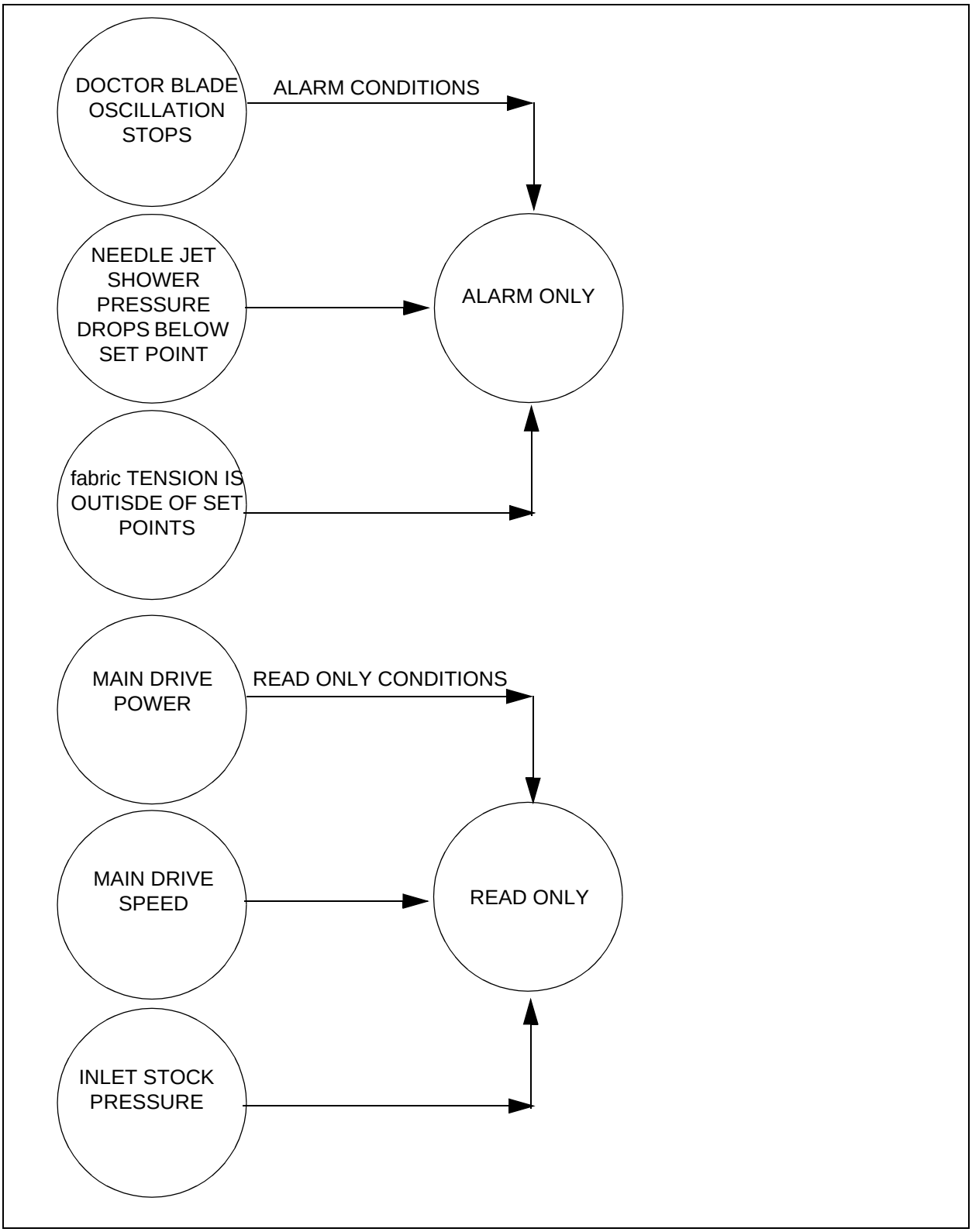
Before starting, loosen all pillow blocks and bearing taper locks and retract the carriages completely. Check both carriages for complete retraction.

1. Level couch roll to within .01 of an inch
2. Center couch roll drive side journal to within plus or minus 1/16 of an inch in pan opening and lock down pillow block.
3. Position couch roll face in pan. Distance between roll face end and inside pan on drive side should be 4.75 inches plus or minus 1/16 of an inch. After face is positioned, lock taper lock bearing to shaft on drive side.
4. Square couch roll with frame by adjusting tending side pillow block. Next, lock down tending side pillow block. Center the bearing unit inside pillow block and lock taper lock bearing to shaft. Refer to bearing manufacturing mounting sheet for proper mounting.
5. Squaring can be done by aligning the drive sheave parallel to the frame to within .03 of an inch on the outer diameter of the sheave. Rotating the roll can ensure the perpendicularity of the sheave to the roll.
6. Level the breast roll to within .01 of an inch and lock down the tending side pillow block to the carriage.
7. Center the breast roll drive side journal to within plus or minus 1/16 of an inch with the shaft guard. Center and lock down the pillow block.
8. Position the breast roll face in the pan in the same manner as in step 3. When positioned 4.75 inches plus or minus 1/16 of an inch from the inside pan, lock the taper lock bearing to the shaft on the drive side.
9. Lock tending side tape lock bearing on shaft with bearing unit centered in pillow block housing.
10. Move carriages out 1 inch or 24 turns of the screw jacks hand wheel. Square breast roll with couch roll. This can be done by measuring around both rolls on the drive end of the rolls and bringing the tending side to the same dimension to within 1/16th of an inch.
11. The tending side can be adjusted by the fine adjustment mechanism located on the screw jack end on the tending side of the machine. To adjust, loosen the disc clamp and rotate the disc with a spanner wrench. Lock the disc clamp when adjustment is completed
12. Once the rolls are aligned, the pillow block bearings should be pinned to prevent slippage and maintain alignment.

6.4 EQUIPMENT SET-UP: OPERATING CONDITIONS



Monitoring the DNT Operation: Emergency Conditions

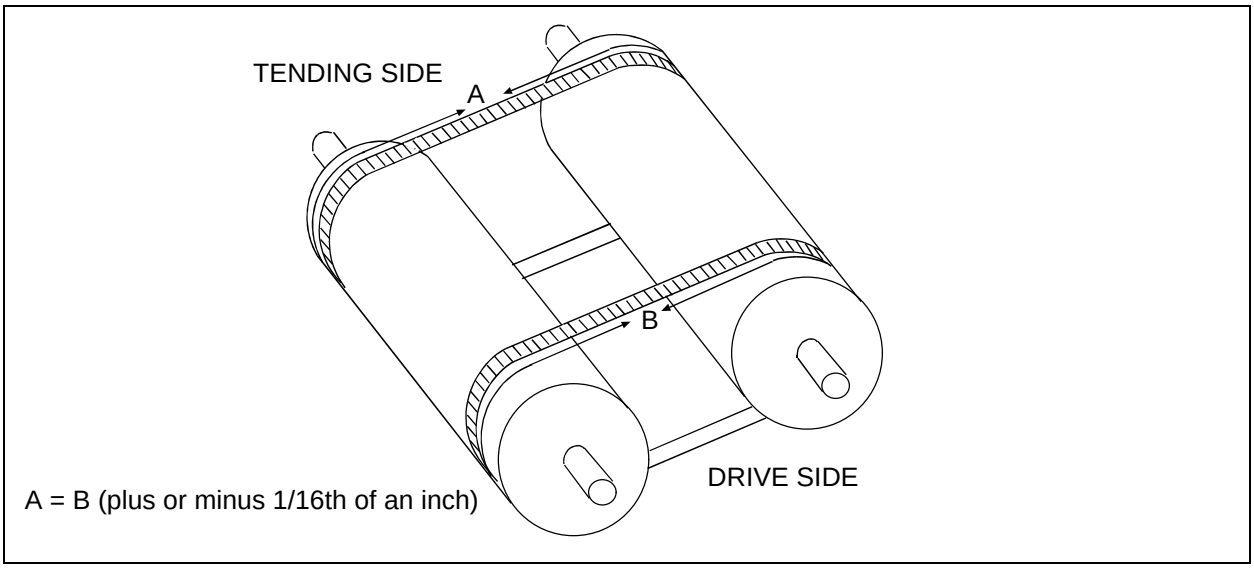


Monitoring the DNT Operation: Emergency Conditions

6.5 INTERNAL ALIGNMENTS AND ADJUSTMENTS

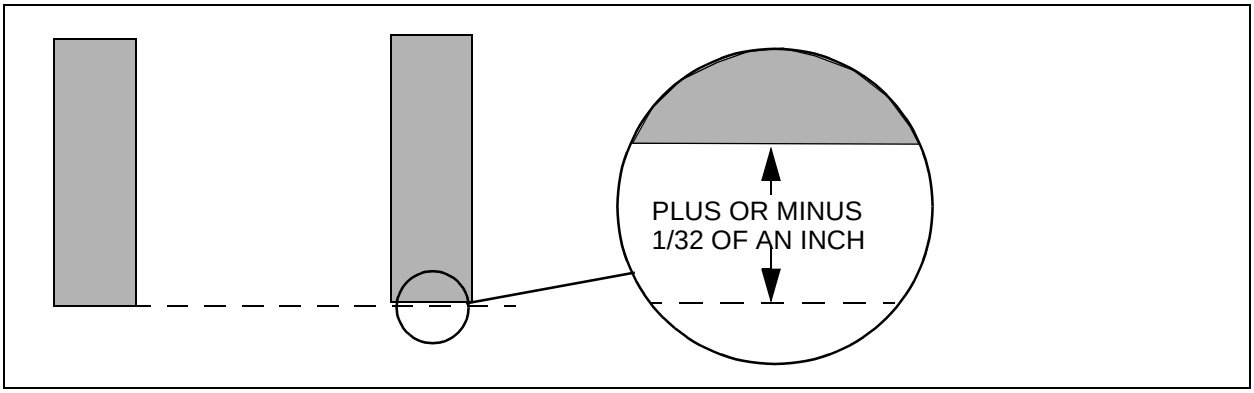
Alignment

- The breast/couch rolls and headbox must be correctly aligned and level.
- A maximum misalignment of plus or minus 1/16th of an inch can be tolerated. This is the measurement around the rolls on both the drive and the tending side of the machine.



Fabric Alignment

- The rolls must not be offset in relationship to each other.
- The tending side roll edges are to be in line to within a tolerance of plus or minus 1/32 of an inch.
- This measurement should be verified with fabric stretched along the outside roll edge on the tending side of the machine.



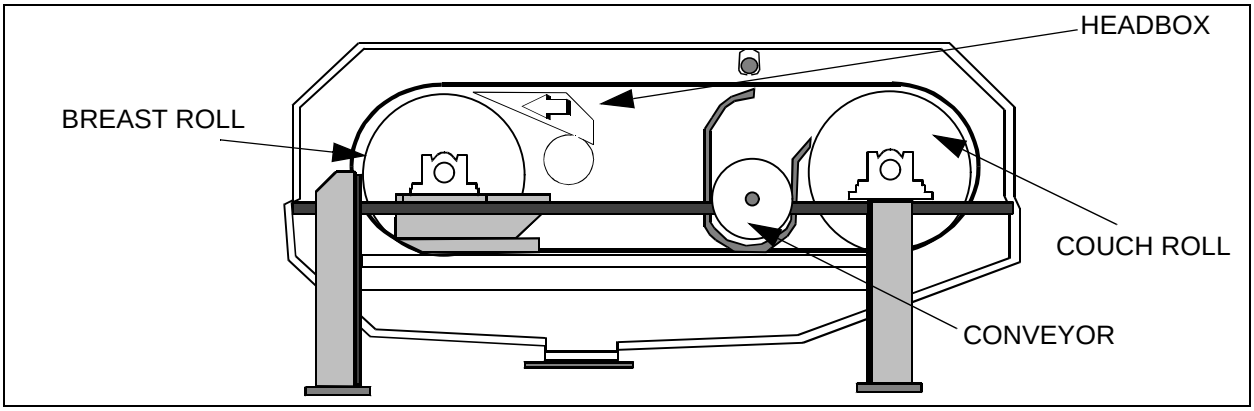
Roll Alignment

- The headbox injection angle is to be set so that the pulp slurry is injected directly into the

grooves at the nip and NOT UPWARD INTO THE FABRIC.

- The headbox is to be parallel to the breast roll to a tolerance of plus or minus 1/32 of an inch.

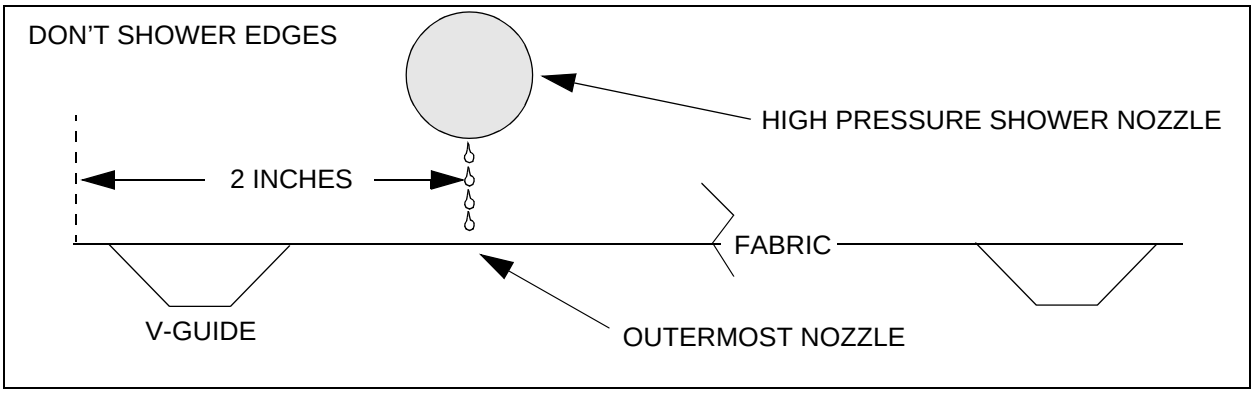
NOTE: When the breast roll is adjusted for tracking purposes, the relationship between the headbox and the breast roll will not change.



Headbox Alignment

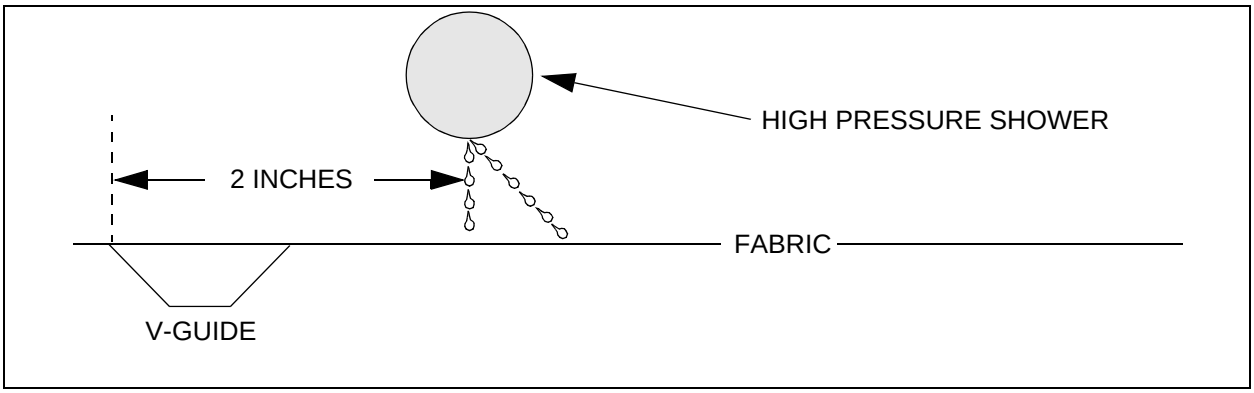
Showers and Oscillator

- Normal operating shower pressure is 300 PSI. Shower pressure should never exceed 350 PSI. Excessive shower pressure and poor oscillator action can cut grooves in the DNT fabric which may be approximately six inches on center across most or all of the fabric.
- All shower nozzles must be kept clean and unobstructed to ensure the efficient performance of the DNT fabric.
- To help reduce *edge bounce* of the DNT fabric, see the figure that follows.



Nozzle Rotation to Reduce Edge Bounce

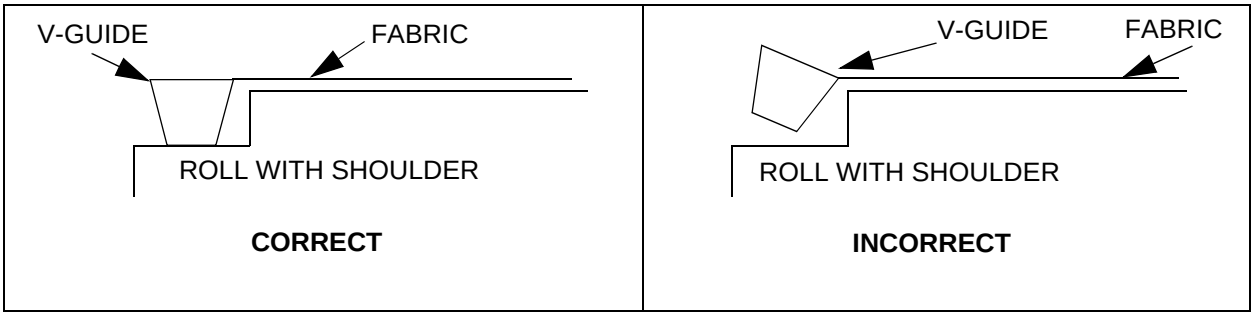
- The best cleaning results can be obtained by maintaining shower oscillator speed at 18.75 inches per minute with the machine speed of 3,000 feet per minute.
- The oscillator reversal must be instantaneous. This is even more critical as shower pressure increases.
- High pressure showers must not be operated without rotating the fabric.



Relationship Between Shower and Fabric

Guiding

- The DNT fabric has a tendency to gently float back and forth between the V-guides.
- The V-guide is shown in the correct position on the roll shoulder. See the drawing that follows.



Guide Alignment to Roll Shoulder

- In the incorrect position in the preceding illustration, the belt is being guided to the drive side of the machine. To correct, make a minor trim adjustment to the headroll which will properly realign the fabric. This adjustment can be made with the fine squaring mechanism located on the tending side of the DNT.

Precautions During Fabric Installation

- The fabric is synthetic--it can be damaged.
- Do not smoke near the fabric--ashes can melt the fabric.
- The fabric will be rolled out onto the floor. Remove all sharp objects from where fabric will be rolled out and cover all sharp objects and edges on the machine frame. The fabric might be cut or scored.
- Do not walk on the fabric or place objects on the fabric. Heels or other objects can cut or score the fabric.
- Inspect rolls for damage, wear, or stock build-up. Be sure rolls are clean and in proper condition before restarting the DNT.
- Inspect the headbox for any plugging. A plugged headbox can cause fabric guiding problems.

7.0 OPERATION

7.1 PRE-CHECKOUT

Many programmable solid state systems have the capability of simulating operation in a mode known as *Test Mode* or *Dry Run Mode*. These modes allow a user to check a program and correct obvious programming errors with outputs disabled. Unexpected machine motion and possible damage to equipment is avoided. These modes can also be used to verify proper system operation after a repair.

Many programmable systems provide for *Force On* and *Force Off* of inputs and outputs. These functions can reduce troubleshooting and maintenance time by enabling personnel to bypass certain operations without physically operating switches on a machine.

WARNING

Use care when using *Force* functions to avoid exposing personnel to hazardous machine motions or process operations which might cause severe personal injury or death.

Mechanical start up involves the following steps, which must be carried out in sequence:

- Inspect the installation before the power is connected.
- Disconnect motors and other devices that cause machine motion.
- Test inputs.
- Test outputs.
- Enter and verify your program.
- Test the system with motors and other motion-causing devices reconnected.
- Go through a *dry run* of the application.

The purpose of these procedures is to isolate such problems as wiring mistakes, equipment malfunction, and programming errors in a systematic, controlled manner. Go through these procedures very carefully. Following a given set of steps will help avoid possible personal injury and equipment damage.

WARNING

During all phases of motion check-out, station a person ready to operate the power switch if necessary.

- Inspect and make sure of the following before starting the unit: all guards and covers are in good condition and fastened in place; No parts are loose, worn, damaged, or missing; all personnel are clear of the equipment.

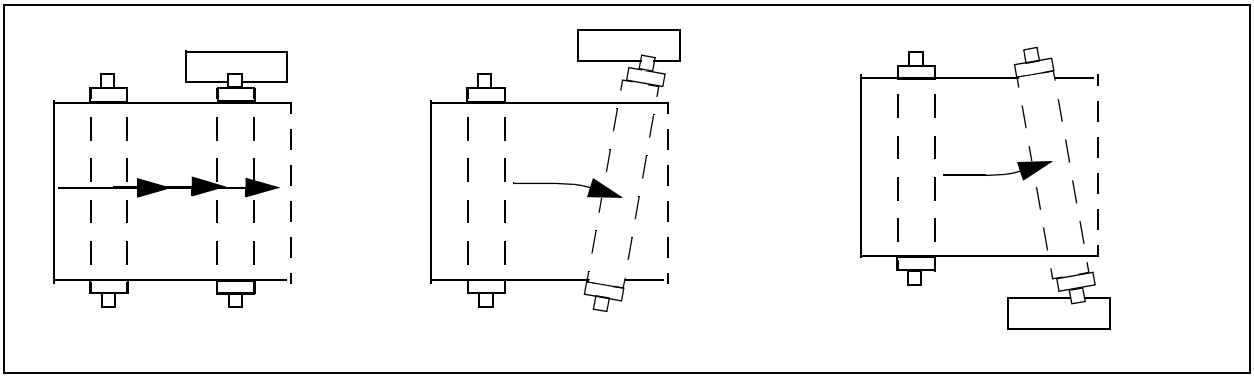
- The DNT Washer should not be operated unless all guards are in place. There are certain areas designated as high temperature surfaces. Wear gloves and protective clothing in these areas and also when handling doctor blades.
- Do not operate the DNT Washer unless valves are in proper position.
- Do not operate the shower at pressures above 350 PSI, and all hoses should be rated for these pressures.
- When the DNT Washer is in operation, use caution when obtaining samples. See "Taking Samples" on page 54.

A FIRST-TIME CHECKOUT SHOULD INCLUDE THE FOLLOWING:

Conduct the first-time checkout with the fabric off. Inspect the fabric for holes, slits, raveling, or other signs of fabric wear. Check the alignment of the rolls. The rolls should be parallel to one another; check by measuring the fabric path on each roll end. Check the rolls to ensure that the roll edges are in line to ensure fabric tracking. Check the headbox and screw conveyor housing for sharp edges or burrs that could damage the fabric during operation. After making your inspections, install the fabric.

Guiding

A minor trim adjustment to the headroll will properly realign the fabric. This adjustment can be made with electrical trimmer control or fine squaring mechanism located on the tending side of the DNT.



Fabric Alignment

Next, turn on the high pressure water shower and check the nozzles for plugging. Engage the drive and the bring the rolls to the suggested speed. At this point, feed flow may be initiated and fabric tension adjusted.

Fabric Start Up Procedure

- After installing the fabric, align it so that it is square on the machine. If tension is applied with the belt off square, creases and wrinkles can be created at tensioning.
- Wet the fabric and rolls thoroughly and keep them wet while tracking and tensioning the fabric.
- Apply minimal tension (5 PLI). Do not over tension. Leave hood off.
- On machines with variable drives, begin to rotate the fabric at crawl speed. Slowly increase tension monitoring with tensometer if possible.
- On machines without variable drives, rotate the fabric manually for 10 or 20 revolutions, with each increase of 5 PLI, until you reach operating tension.
- The recommended operating tension is only enough to prevent slippage on the rolls. Generally, this is between 15 and 20 PLI at operational speed. Run final check with hood off at operational speed with fabric and rolls wet.
- This procedure should be repeated any time that the fabric is changed.
- Install the hood and follow Thermo Black Clawson's procedures for introducing stock.

7.2 CONTROL GUIDELINES

Safety considerations are an important element of proper troubleshooting procedures. Actively thinking about safety of yourself and others, as well as the condition of your equipment is of primary importance. Several safety areas are discussed below.

Power Supply

Before working on a power supply, always remove the AC power source at the main disconnect switch. When using more than one power supply, be sure to disconnect all of them.

Main Power Disconnect

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. Ideally, the disconnect switch is mounted on the outside of the enclosure so that it can be accessed without opening the enclosure. In addition to disconnecting electrical power, de-energize all other sources of power (pneumatic and hydraulic) before working on a panel controlled machine or process.

Activating Devices When Troubleshooting

When troubleshooting, never reach into the machine to actuate a device. Unexpected machine motion could occur.

Operation Safety Precaution

When troubleshooting any control panel problem, have all personnel remain clear of the machine. The problem could be intermittent, and sudden unexpected motion could occur. Have someone ready to operate an emergency stop switch in case it becomes necessary to shut off power to the machine.

Program Alteration

There are several causes of alteration to the user program, including extreme environmental conditions, electromagnetic interference (EMI), improper grounding, improper wiring connections and unauthorized tampering. If you suspect the memory has been altered, check the program against an approved version such as on the EEPROM memory module.

Hardwired Circuitry

WARNING

Circuits that are installed on the machine for safety reasons, including overtravel limit switches, stop push buttons, and interlocks, should always be hardwired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could occur.

Safety Recommendation for Maintenance Personnel

All maintenance work should be done by qualified personnel familiar with construction, operation, and hazards involved with the equipment.

Follow the appropriate work practices of the National Fire Protection Association (NFPA) for Electrical Standards for Industrial Machinery.

Make-Do testing devices such as incandescent lamps have low impedance. The low impedance of these devices can effectively change a voltage level from logic ***1*** condition to a logic ***0*** condition when attempting to make a measurement. Unexpected machine motion can result if an output to a controlled device is energized as a result. Neon lamps do not respond to voltages typically used in logic circuits (e.g. 32 VDC or less). Use of a neon lamp tester could lead to false conclusions about the voltage present in a circuit.

High input impedance meters are required to obtain accurate voltage measurements in high impedance circuits. Unless otherwise specified by the manufacturer, a meter with an input impedance of ten (10) megohms or greater is recommended for making voltage measurements. The meter must also have sufficient sensitivity to measure logic level voltages; some meters do not respond to low voltages.

Control Panels

The control panels are designed using all NEMA (National Electrical Manufacturer's) and UL (Underwriter's Laboratory) approved components suited for the environment in which it is being placed. Every effort is made to adhere to the NEC (National Electrical Code), OSHA (Occupational Safety and Health Act), ANSI (American National Standards Institute), and mill standards as they apply to your application.

The power feed should include an equipment grounding conductor to bond the enclosure to building earth ground.

DANGER

Touching exposed live electrical wires will cause serious personal injury or death.

- Power feed should have a disconnect or breaker capable of being locked in the open position.
- Fabric field devices per certified drawings furnished with the control panel.
- Route field wiring to separate the AC from the DC and low level signals.
- All the electronic instruments were factory programmed to a fail safe state (if a component failure occurs). The panels include a power push button that, when pushed, will power down the main panel.

Education and Knowledge Lead to Safety

Planning for an effective solid state circuit requires enough knowledge to make basic decisions that will render the system safe as well as effective. Everyone who works with a solid state control should be educated in its capabilities and limitations. This includes in-plant installers, operators, service personnel, and system designers.

7.3 OPERATION

Feed stock at 0.5 to 3% consistency enters the headbox and is distributed along the length of the breast roll entering the nip created by the fabric and the breast roll. The stock is centrifugally dewatered and is deposited on the fabric as it travels around the roll. The stock then travels on the fabric to the nip created by the fabric and the couch roll. The stock is pressed in this nip and the thick stock is doctored off the couch roll into a screw conveyor trough. The thick stock is carried out of the machine by the screw conveyor. The white water is directed downward into the pan by a baffle and is discharged out the white water flange on the couch roll end of the pan.

- The DNT Washer should not be operated unless all guards are in place. There are certain areas designated as high temperature surfaces. Wear gloves and protective clothing in these areas and also when handling doctor blades.
- Do not operate the DNT Washer unless valves are in proper position.
- Do not operate the high pressure shower at pressures above 350 PSI, and all hoses should be rated for these pressures.

Operating Parameters

Important Performance Variables

Stock consistency; Basis weight; Fabric speed; Fabric porosity; Stock freeness

Output Variables

Ash removal efficiency; Total solids loss; Thick stock consistency; Accept capacity; horsepower consumption

Operating Variables

		OUTPUT VARIABLE				
	Increase...	**ash removal efficiency**	**total solids loss**	**thick stock consistency**	**accept capacity (tonnage)**	**horsepower consump-tion**
CONTROL VARIABLE	***...feed stock consistency***	decreases	decreases	increases	increases	no change
	...basis weight	decreases	decreases	increases	increases*	increases*
	...fabric speed	no change	no change	no change	increases	increases
	...fabric porosity	no change	increases	no change	increases	no change
	...stock free-ness	no change	decreases	increases	increases	no change
*assumes feed consistency is constant						

The effect of these variables on one another are summarized in "Operating Variables" on page 49. The table assumes all conditions are kept constant, except the variable under consideration. For example, if basis weight increases with stock consistency remaining constant, then flow must increase.

Feed Stock Consistency

Feed consistency will have an effect on total solids loss, ash removal, thick stock consistency, and accept capacity. As feed consistency is increased, solids loss and ash removal efficiency decreases, especially above 2.5% feed consistency. Conversely, thick stock consistency and tonnage increases. Dramatic changes can be seen in tonnage capacities with changes in feed consistencies.

Basis Weight

The main consideration of basis weight is its effects on the washing efficiency (i.e., ash removal efficiency) of the DNT Washer. It has been shown that ash removal efficiency remains constant up to basis weights of approximately 80 grams per square meter. where it drops off rapidly beyond this basis weight.

Fabric Speed

Increasing fabric speed increases the capacity of the DNT Washer by increasing the nip volume opening up on the grooved (breast) roll. However, increasing fabric speed also increases horsepower consumption for a given flow rate and results in greater stresses and wear on the DNT Washer.

Fabric Type

There are many wires available in terms of material, porosity, type of weave, number of layers, fiber support points, etc. Each application must choose the proper fabric in terms of drainage, retention, cleanability, durability, etc. Generally, as the porosity or open area at the fabric decreases, the hydraulic capacity decreases while the retention increases. Some triple layer wires show both good retention and hydraulic characteristics; however, cost may become a factor.

Stock Freeness

Stock freeness has a dramatic influence on capacity, and also influences fiber losses and thick stock consistencies. An increase in stock freeness by definition means an increase in drainage rates, and therefore will increase capacities and thick stock consistencies. Losses are reduced due to longer average fiber length.

Horsepower Consumption

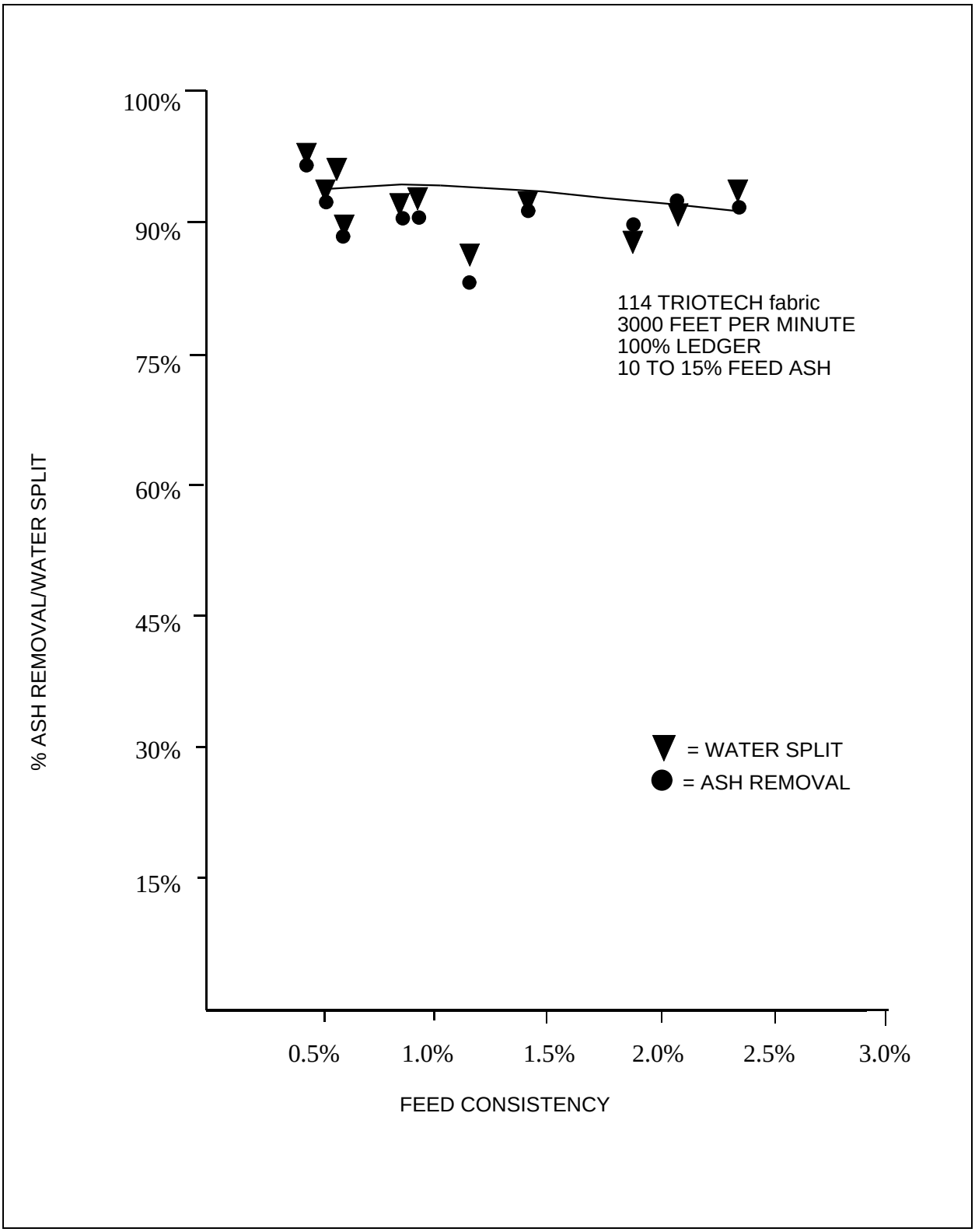
Horsepower consumption is a factor of feed flow rate and fabric speed. At a constant fabric speed, horsepower is directionally proportional to feed flow. Changing fabric speed will move horsepower versus gallons-per-minute curve up or down, but curves will remain essentially parallel to one another.

Decibel Levels

Decibel levels for Model 200 DNT Washer were measured with the following results:

Decibel Levels for Model 200 DNT Washer

Description	Measurement Results
Frequency of Measurement: 1.0 Kilohertz (gave highest decibel reading)	1.0 Kilohertz
Distance of Measurement	16 feet (5 meters)
Fabric Speed	3000 feet per minute (925 meters per minute)
Flow Rate	1325 gallons per minute (5000 liters per minute)
Sound Level	60 decibels
Background Sound Level	45 decibels



Ash Removal Versus Feed Consistency

Normal Start Up

Don't start the machine until the following conditions are met:

- All personnel are clear of the machine.
- All doors and hatches are closed.
- All guards and covers are in place.

When the preceding conditions are met, begin the start up procedure as follows:

- Check the fabric tension before starting the machine. The fabric tension should be 10 to 15 pounds per linear inch.
- Rotate the fabric by hand to assure correct fabric tracking.
- Start the discharge conveyor.
- Start the drive roll The target fabric speed should be 3000 feet per minute. Slowly start with 3 to 60 second start up time is required.
- Start the doctor oscillator.
- Start the shower oscillator.
- Start the high pressure shower pump.
- Start the fan shower water.
- Start the feed pump.
- Adjust the fabric speed to desired velocity.
- Adjust the flow to desired rate.
- Recheck the fabric tension, which should be 10 to 15 pounds per linear inch (tension may drop upon starting feed).

7.4 TAKING SAMPLES

When the DNT Washer is in operation, use caution when obtaining samples.

- Keep hands away from all moving parts.
- Wear gloves, face shield, and other protective clothing necessary.
- Do not reach up the chute or place any object into the discharge chute.
- Examine all sample ports and repair when machine is not in operation.
- Observe all mill safety procedures and precautions.
- Do not remove protective grating from hood door openings.

The three sample points are as follows:

- the feed
- the composite white water
- the thick stock

WARNING

To avoid severe personal injury, obtain only the samples described above and never reach inside the DNT Washer during operation.

7.5 OPERATING RECOMMENDATIONS

- Watch for edge flopping. If this occurs, it may be necessary to increase tension but not to exceed 20 PLI and/or turn the outside high pressure shower nozzles so that the water jet is hitting the fabric at a 90 degree angle.
- Check the movement of the high pressure shower oscillator. The turnaround must be instantaneous.
- Ideally, under operating loads, the fabric should float between the V-guides.
- Keep the inside of the machine clean and free from excessive stock buildup in the following areas:
  - On top of the headbox--stock buildup here could indicate the showers are plugged.
  - On the shelf behind the roof deflector blade.
  - On the conveyor hood (slide)--pulp can build up here and fall on the belt inside the loop, which would cause a tension spike that could destroy the fabric.
  - In and around the area of the screw conveyor.

NOTE: Stock can build up to the point of pushing the fabric into the shower header causing a catastrophic fabric failure.

- While watching the fabric path through the port hole on the tending side of the machine, introduce stock. If the fabric tracks to the drive side of the machine, make a manual adjustment to the grooved roll to regain fabric center on the machine. Use the fine squaring mechanism to make adjustments.

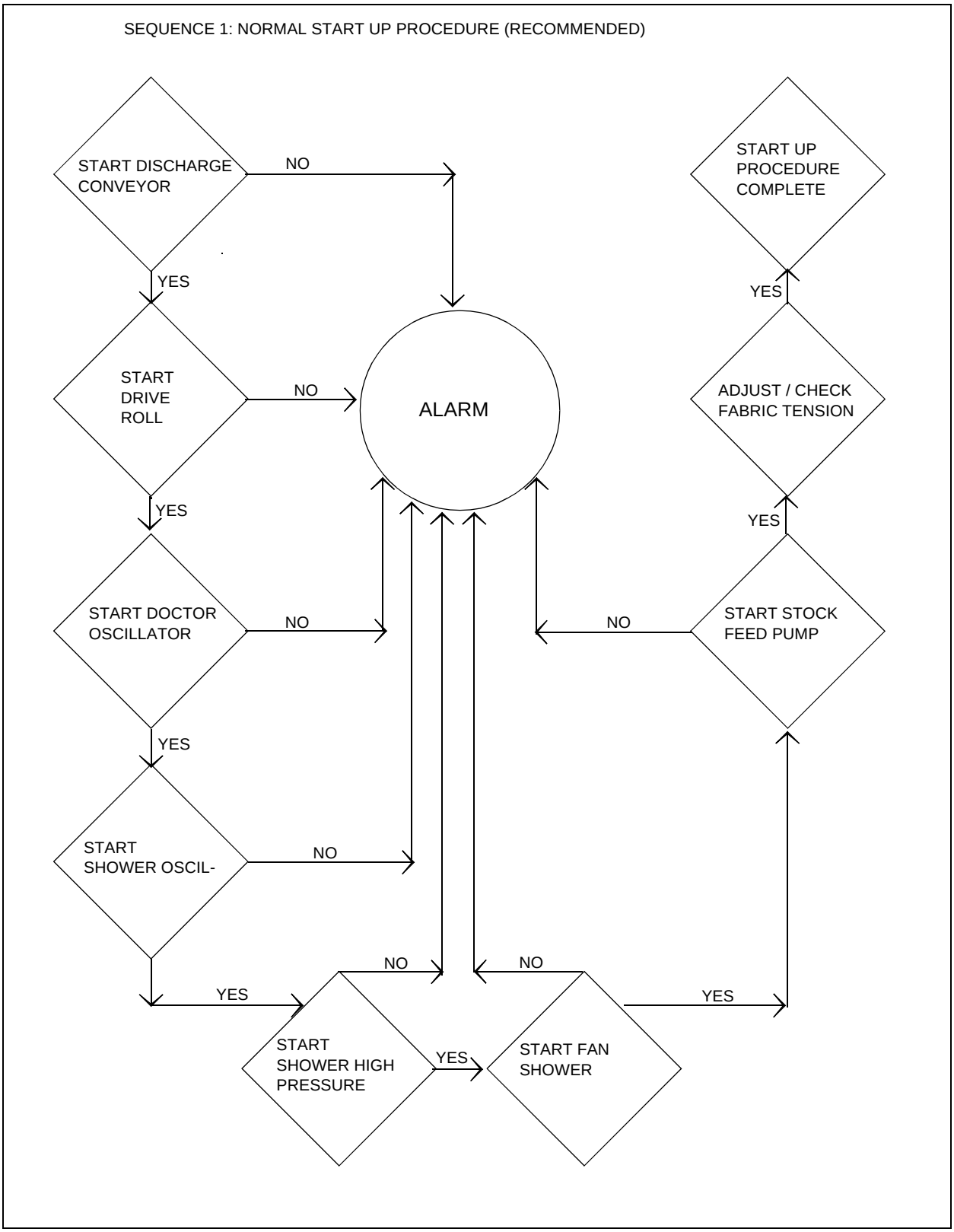


Diagram of Normal Start Up Procedure

Normal Shut Down

Prior to shut down: Check for any plugs in the headbox. Plugs can be detected by looking at the stock on the belt. If there are any machine direction sections of the belt that do not have stock, the headbox may be plugged in that groove. A plugged headbox can cause fabric guiding problems.

Check the injection angle of the headbox. The injection angle should be set so that the pulp slurry is injected directly into the grooves at the nip and not upward into the fabric.

Normal shut down procedure is basically the reverse of normal start up procedure

- Stop the feed pump.
- Flush out the distribution nozzles to prevent stock drying which will cause plugging when restarted.
- Allow for a 5-minute cleanout period.
- Stop the fan shower.
- Stop the high pressure pump and water supply.
- Stop the high pressure shower oscillator.
- Stop the doctor oscillator.
- Stop the drive roll.
- Stop the screw conveyor.

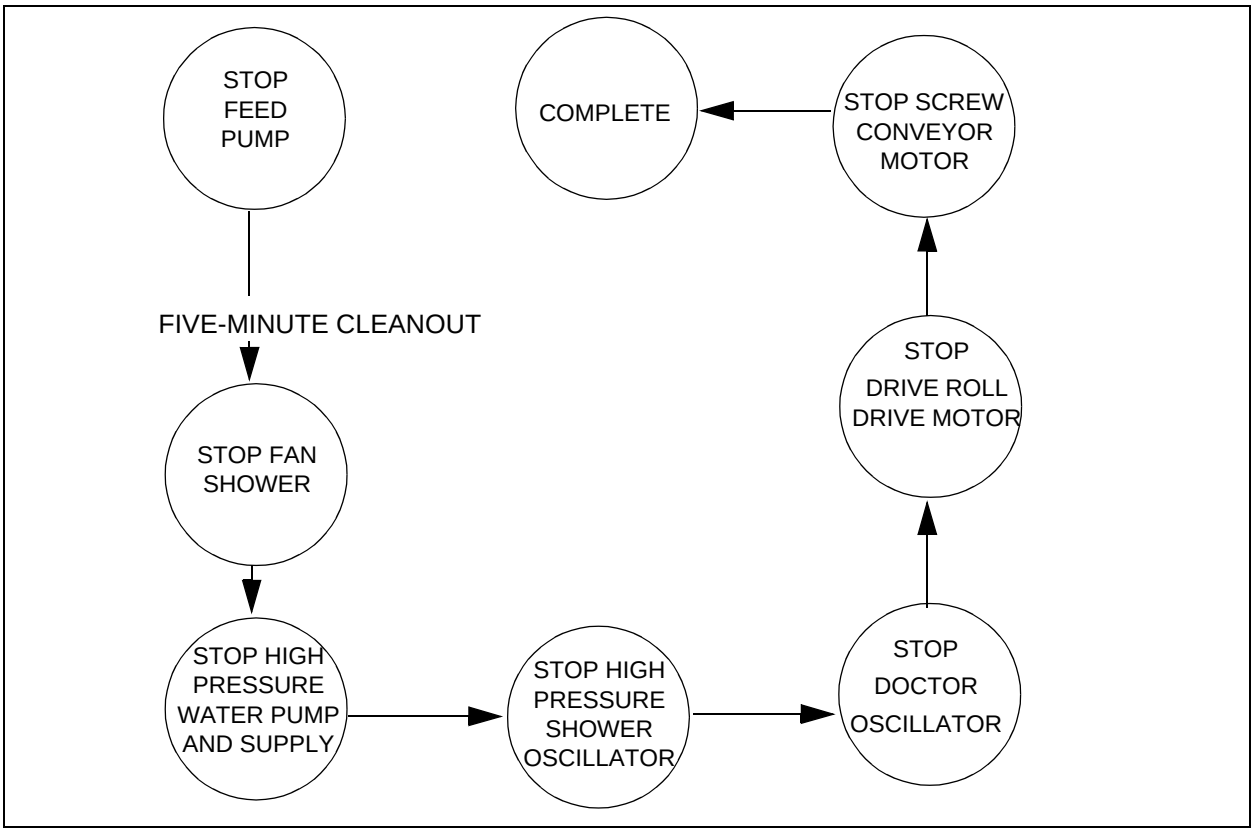


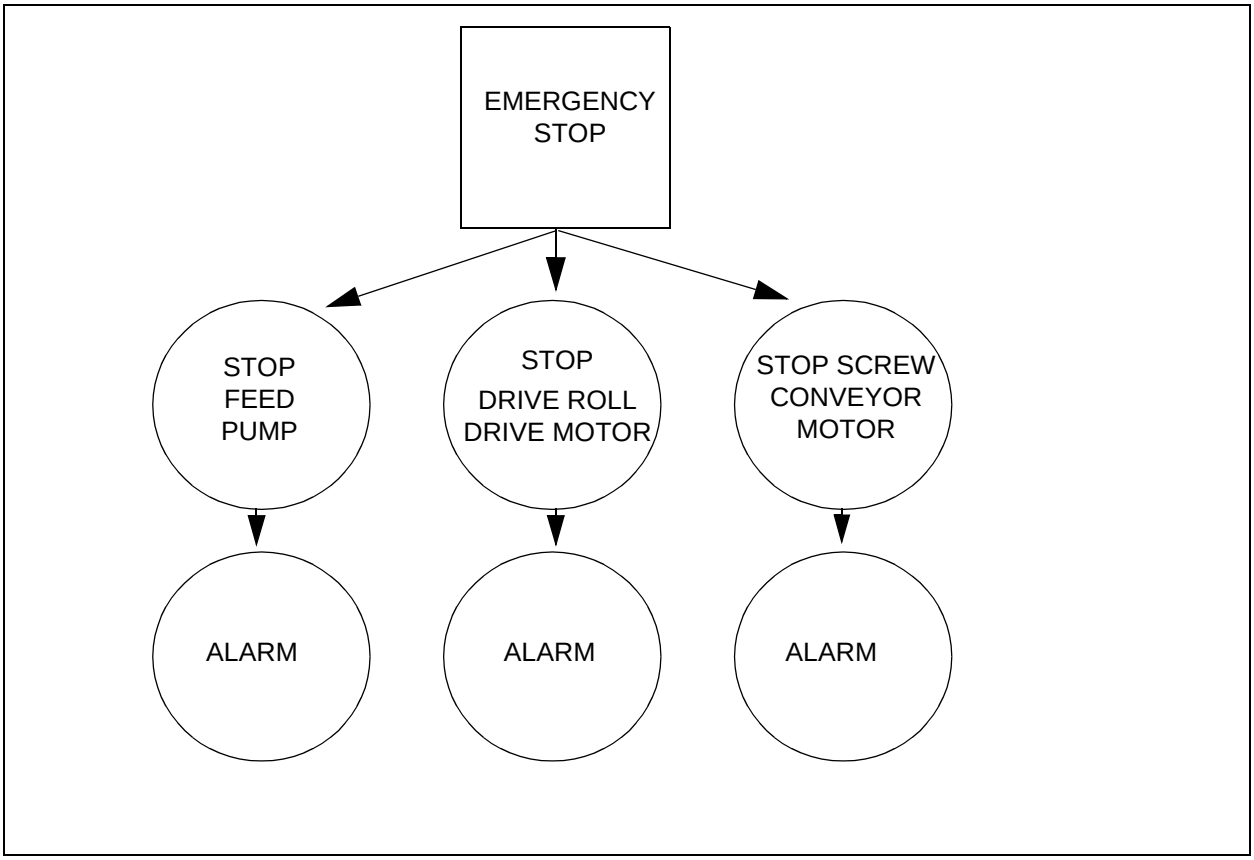
Diagram of Normal Shut Down Procedure

Emergency Shut Down

For operator safety and avoiding machine damage, emergency shut down is sometimes necessary. If emergency shut down is required, the following actions should be taken simultaneously:

- Stop feed pump.
- Stop drive roll motor.
- Stop screw conveyor motor.
- Sound alarm.

Above steps should be simultaneous.



Emergency Stop Diagram

8.0 MAINTENANCE

8.1 ROUTINE MAINTENANCE

Perform a general inspection of the equipment at least every three months or every 1,000 hours of running time.

Periodic Inspection

Perform a general inspection and tightening of the machine twice a year. Locating and eliminating minor problems will assure long and dependable service. In many instances, periodic inspections will eliminate costly shut downs and delays.

WARNING

Follow your prescribed safety procedures and those listed in this manual to prevent accidental starting while inspecting or servicing the unit.

To prepare for a maintenance check, shut down the unit according to “Normal Shut Down” on page 57 and bring it to a zero mechanical state (ZMS) and lockout all sources of energy. A wash down of internal parts and surfaces may be required.

After Machine Shut Down

- Inspect rolls for damage, wear, or stock buildup. Be sure that the rolls are clean and in proper condition before restarting the DNT. Clean all stock from the top of the headbox and slide area.
- Check alignment of the head/tail rolls. A maximum misalignment of plus or minus 1/16th of an inch can be tolerated. This refers to the measurement taken around the rolls on both the drive and tending sides of the machine.
- Check roll offset. The rolls must not be offset in relation to one another. The tending side roll edges are required to be in line to within a tolerance of plus or minus 1/32 of an inch. This can be verified with a wire along the outside roll edge on the tending side of the machine.
- Check headbox alignment. The headbox is required to be parallel to the breast roll to a tolerance of plus or minus 1/32 of an inch.
- Check for damage and general condition of the deflector blade. Verify clearance between the deflector blade and fabric path. The minimum clearance must be 3/32 of an inch.

NOTE; When the breast roll is trimmed for tracking purposes, the relationship between the headbox and the breast roll will not change.

CAUTION

To avoid damaging the fabric, remove all sharp objects from the roll area, do not walk on the fabric, cover all sharp objects and edges on the machine frame.

Components Requiring Routine Maintenance

COMPONENT	SERVICE	FREQUENCY
bearings - on all rolls, screw conveyor, and all of the doctor blade bearings	lubricate	weekly
Polychain belts and sprockets	check tension, alignment, and wear	weekly
doctor blade	check for wear; change if necessary	monthly
fabric	check for cleanliness and wear; clean or replace as necessary	monthly
machine interior	Clean interior of machine of stock	during shut downs

8.2 TENSOMETER CONVERSION TABLE

Load Cell Versus Tensometer for Fine DNT Fabric

Pounds per Linear Inch	Tensometer Reading
10	51
16	68
20	86
25	88
30	92
35	100

8.3 FABRIC CHANGES

Fabric changes on the DNT Washer take approximately three hours to complete. Before performing fabric changes, read and observe all precautions described on the safety page of this manual. The process is as follows:

1. Make sure that the unit is locked out, tagged out, and at zero mechanical state.
2. Disconnect the shower hose(s) and the shower oscillation.
3. Remove the hood and place it level on the floor.
4. Release tension from the fabric by cranking the hand wheel. Do not crank the hand wheel if the jack screws are in place. The breast roll carriages must be position so that the breast roll is centered on the machine frame leg.
5. Remove the guard from the breast (grooved) roll shaft and drive roll shaft on the drive side.
6. Remove eight pull block screws.
7. Remove the breast roll stainless steel panel on the tending side by removing the six bolts and lifting the panel away.
8. Remove the couch roll stainless steel panel on the tending side by removing the six bolts and lifting the panel away.
9. Remove the stainless steel pull block splash guard.
10. Cantilever (see glossary for definition of cantilever) the breast roll and couch roll.
    - Place the saddle over the shaft.
    - Insert jack screws into cantilevering plate jack screws and tighten to support full weight so that there is 1/8 inch clearance between frame and pull block.
11. Remove both pull blocks by sliding both blocks out.
12. Remove the fabric by slipping the drive side V-guide over the edge of the roll and pulling the fabric off the tending side.
13. Place the new fabric over the rolls and slide on rolls until guides are on the roll shoulders.
14. Replace the pull blocks and bolt blocks into frame base.
15. Lower tending side on top of pull blocks by unscrewing cantilever jack screws.
16. Remove the cantilevering jack screws and saddles.
17. Replace bolts in top of pull blocks.
18. Replace the stainless steel pull block splash panel and bolt into place.
19. Replace the couch roll stainless steel panel on the tending side and replace the six bolts.
20. Replace the breast roll stainless steel panel on the tending side by replacing the six bolts.

21. Make sure that the cantilevering jack screws have been removed
22. Set the desired fabric tension by turning the hand wheel.
23. Make sure no foreign objects have been left in the white water pan or interior of the DNT Washer.
24. Keep clear of all pinch points when fitting hood to pan. Replace the hood. All hood panels should sit on the inside of the panels on the main frame.
25. Connect the shower hose(s) and the air hoses for shower and doctor oscillators.
26. Replace the guard on the breast (grooved) roll shaft and drive roll shaft on the drive side.

8.4 BREAST ROLL CHANGES

Breast roll changes on the DNT Washer take approximately four hours to completes before changing the roll, read and observe the precautions described on the safety page of this manual. The process is as follows:

1. Make sure that the unit is locked out, tagged out, and at zero mechanical state.
2. Remove fabric (see “Fabric Changes” on page 62).
3. Remove breast roll shaft guard and support.

NOTE: Check the straps for fatigue and the crane for wear. Observe all safety precautions for hoisting heavy objects.

4. Remove the four bolts from the drive side bearing cap and remove the bearing pillow block cap.
5. Sling the roll using straps around the shafts and take the weight off the bearings.
6. Remove the four bolts from the tending side bearing and remove the bearing pillow block cap.
7. Lift the roll out with a crane and place it on a roll holding rack or similar device that supports the roll by the shafts at both ends of the rolls. To prevent roll surface damages, do not place the rolls on the floor.
8. Lift the roll and place it back in the pillow blocks.
9. Check the rolls for alignment.
10. Replace the bearing pillow block caps on the tending side by replacing the four bolts.
11. Replace the bearing pillow block cap on the drive side **by** replacing the four bolts.
12. Replace the strap in the center of the headbox and place the headbox back in the machine.
13. Replace the two bolts on the headbox bearing clamp.
14. Replace the headbox feed pipe and bolt back into place.
15. Remove the strap from the headbox.
16. Cantilever (see glossary for definition of cantilever) the machine to install fabric. Place the new fabric over the rolls and slide on rolls until guides are on the outer edges of the rolls.
17. Replace the pull blocks and bolt into place.
18. Replace the stainless steel panel on the tending side of the
19. framing and bolt into place.
20. Replace the couch roll stainless steel panel on the tending side and replace the six bolts.
21. Replace the breast roll stainless steel panel on the tending side by replacing the six bolts.

22. Next, the cantilevering jack screws can be taken out and the saddles removed.
23. Replace the guard on the breast roll shaft on the drive side.
24. Regain the desired fabric tension by turning the crank wheel.
25. Check to be sure that nothing has been left in the white water pan or anywhere in the positioning of the machine.
26. Replace the hood. All hood panels should sit on the inside of the panel in the main housing.
27. Connect the shower hose and the air hoses for shower and doctor oscillators.
28. Replace the guard on the breast (grooved) roll shaft on the drive side.
29. Connect the drive.

8.5 COUCH ROLL CHANGES

Couch roll changes on the DNT Washer take approximately six hours to complete. Before changing the roll, read and observe the precautions described on the safety page of this manual. The process is as follows:

1. Make sure that the unit is locked out, tagged out, and at zero mechanical state.
2. Disconnect the shower hose, the shower oscillation air hoses and doctor oscillation air hoses.
3. Remove the hood.
4. Remove all tension from the fabric by cranking the turn wheel. Do not crank the turn wheel if the cantilevering screws are in place.
5. Remove the guard on the breast (grooved) roll shaft on the drive side.
6. Cantilever (see glossary for definition of cantilever) the breast roll and couch roll.
    - Place the saddle over the shaft.
    - Insert jack screws into cantilevering plate and screw down until rolls are held level.
7. Remove the breast roll stainless steel panel on the tending side by removing the six bolts and lifting the panel away.
8. Remove the couch roll stainless steel panel on the tending side by removing the six bolts and lifting the panel off.
9. Remove the four stainless steel panel on the framing on the tending side by removing the bolts on the outer edges.
10. Remove both pull blocks by removing all four bolts and sliding both blocks out.
11. Remove the fabric by slipping the drive side V-guide over the edge of the roll and pulling the fabric off around the machine framing.
12. Remove screw conveyor housing's top panel by removing the eight bolts which connect it to the trough.
13. Remove the couch roll shaft guard.
14. Remove the belt and the sheave from the couch roll shaft.
15. Remove the four bolts from the drive side bearing and remove the bearing pillow block top.
16. Remove the four bolts from the tending side bearing and remove the bearing pillow block top.
17. Place two straps around the shafts on both sides of the rolls.

NOTE: Check the straps for fatiguing and the crane for wear. Observe all safety precautions for hoisting heavy objects.

18. Remove the doctor blade from the roll and angle the blade straight up.
19. Lift the couch roll out with a crane and place it on a roll holding rack or similar device that supports the roll by the shafts at both ends of the roll.
20. Remove the bearings from the shaft ends and place on the shaft ends of the new roll. Locating the drive side bearing the same distance from the edge will save time realigning rolls.
21. Lift the roll and place it back in the pillow blocks.
22. Replace the bearing pillow block on the tending side by replacing the four bolts.
23. Replace the bearing pillow block on the drive side by replacing the four bolts.
24. Replace the sheave and belts and realign them with the motor.
25. Replace the top of the guard.
26. Place the doctor blade back into a position for reloading.
27. Replace the screw conveyor housing top panel and replace the bolts which connect it to the trough.
28. Place the new fabric over the frame and slide on rolls until guides are on the outer edges of the rolls.
29. Replace the pull blocks and bolt into place.
30. Replace the stainless steel panel on the tending side of the framing and bolt into place.
31. Replace the couch roll stainless steel panel on the tending side and replace the six bolts.
32. Replace the breast roll stainless steel panel on the tending side by replacing the six bolts.
33. Next, take out the cantilevering jack screws and remove the saddles.
34. Replace the guard on the breast roll shaft on the drive side.
35. Regain the desired fabric tension by turning the crank wheel.
36. Check to be sure that nothing has been left in the white water pan or anywhere in the positioning of the machine.
37. Replace the hood. All hood panels should sit on the inside of the panel in the main housing.
38. Connect the shower hose and the air hoses for shower and doctor oscillators.
39. Replace the guard on the breast (grooved) roll shaft on the drive side.
40. Connect the drive.

8.6 SCREW CONVEYOR CHANGES

Changing or removing the screw conveyor on the DNT Washer takes approximately six hours to complete. Before performing screw conveyor changes, read and observe all precautions described on the safety page of this manual. The process for removing the screw conveyor trough, flight, and assembly, is as follows.

1. Make sure that the unit is locked out, tagged out, and at zero mechanical state.
2. Follow steps 1-11. See “Fabric Changes” on page 62 for fabric removal.
3. Disconnect the conveyor discharge end.
4. Remove the two 3/8 inch bolts on the drive side that connect the screw conveyor trough to the framing.
5. Place straps around screw conveyor trough. Apply upward tension to take the weight off the fasteners.
6. Remove the two 3/4 inch bolts and two 3/8 inch bolts from the tending side of the conveyor.
7. Lift the conveyor vertically about one-half (1/2) inch and then move it to the drive side approximately five inches and then lift the assembly straight out of the machine vertically.

When replacing the screw conveyor, check to ensure that the screw conveyor trough is seated on the drive side so that the two bolts line up correctly and replace these two bolts.

Fine Squaring Adjustment

NOTE: This procedure is not necessary if electronically driven trimmer is used.

Before starting a new fabric, the rolls should be checked for alignment. A good check is to run a tape measure around the rolls on the tending side and compare this measurement to the drive side measurement. If this is within 1/8th inch then the rolls should be rotated by hand to see if the fabric climbs up or tries to mistrack. If not, the fabric is ready for start up. If the rolls do need to be aligned, follow the steps listed as follows.

1. Advance the breast roll carriages so that the fabric is in tension. Make sure the fabric has no sag in the bottom run between rolls.
2. By measuring the fabric path on the tending side edge and the drive side edge (a few inches in from edge), note the difference, and the direction you will want to move the tending side to reduce to difference.
3. By the hand wheel take the tension off the fabric. This will allow the fine squaring mechanism to turn freely.
4. Loosen the protective boot on the screw jack.
5. Loosen the clamp.
6. By rotating the adjustment disc clockwise, the measurement decrease on the tending side.

Note the position of the printer on the breast roll carriage and rotate the disc in the proper directions so that the carriage moves the total difference measured.

7. Lock clamp down.
8. Apply tension to the fabric and re-measure. Repeat steps 5, 6, 7, an 8, if necessary.
9. Reattach boot.

8.7 SHOWER CHANGES

See the shower manufacturer's manual for information on shower changes.

Make sure that the unit is locked out, tagged out, and at zero mechanical state before doing any work on the unit.

8.8 LUBRICATION

Bearing Lubrication Points

Every week lubricate the four roll bearings and two screw conveyor bearings and the doctor blade bearings.

NOTE: The bearing's usefulness will be longer with small amounts of lubrication at frequent intervals instead of large amounts of lubrication between long intervals.

Type of Lubrication

Use a lithium -based grease, NLGI 1, for bearings. This grease shall not contain fillers such as resin, resinous oils, soapstone, powered mica, asbestos, clay, or any other type of grit. Products such as Texaco's Starplex 1 meet this specification Note: Not all products are of the same quality.

Maintaining a clean work environment is critical when equipment greasing is performed. Grease fittings should be wiped clean prior to grease injection to prevent contaminants from entering the equipment. Overgreasing should be avoided because overgreasing can result in excessive heating. Periodic re-lubrication should be supplemented by complete cleaning and packing with fresh grease.

9.0 SERVICE PARTS

9.1 RECOMMENDED PARTS

We recommend that you keep the following parts on hand for repairs and routine maintenance. This list does not include specific part numbers for your unit. You should refer to your certified drawings for individual part numbers or, if you would like a list of part numbers for your unit, contact:

Thermo Black Clawson Inc.

605 Clark Street, Middletown, OH 45042-0160

Phone 1-513-424-7400

North America emergency 24-hour service: 1-800-448-5422

Global emergency 24-hour service: 1-513-391-0881

Customer Service Department

Fax: 1-513-424-1168

E-Mail: CUSTSERV@BLACKCLAWSON.COM

IMPORTANT: When ordering spare parts or requesting a parts list, refer to the certified drawings and give the item number, drawing number, and part description, along with the product numbers. (Product identification numbers include the serial number, shop order number and model number.) Generally, allow eight to twelve weeks for delivery.

Do not modify the equipment without written authorization from Thermo Black Clawson. Unauthorized modification may impair the function, shorten the machine life, and render built-in safety features useless.

Recommended Spare Parts

Description	Quantity
expansion bearing	two
non-expansion bearing	two
pillow block expansion bearing	one
main drive belt	one
nozzle	three
proximity switch	two
two-inch pressure gauge	one
breast roll	one
tending roll	one

Description	Quantity
airstroke actuator	one
shower bushing	one
screw conveyor belt	two

10.0 CUSTOMER INPUT

10.1 QUALITY ASSURANCE THROUGH CUSTOMER INPUT

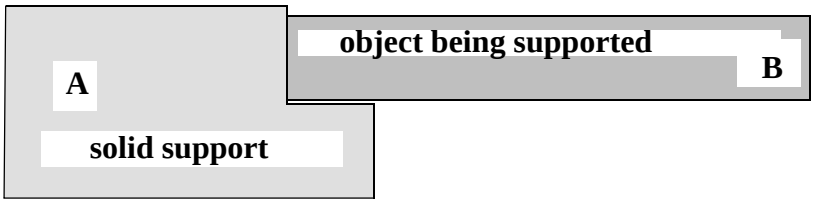
As a Thermo Black Clawson customer, you can help us toward our goal of providing high quality manuals that meet or exceed our customers' expectations. We would like to hear from you if you have suggestions or comments that would help us toward this effort. From procedures to safety issues and other areas, your input and concerns are important to us. Perhaps we haven't described something as much as you think we should have. Maybe you have a technique that you'd like to share with us. If you have input that would help us improve our manuals, write or fax your comments to us:

Thermo Black Clawson Inc.
Technical Writing
605 Clark Street
Middletown, OH 45042 USA
Fax: 1-513-424-1168

11.0 GLOSSARY

The following terms apply to all of Thermo Black Clawson's products.

Term	Synonyms, Definitions, and Functions
absolute viscosity	Absolute viscosity is the kinematic viscosity corrected to overcome the variations caused by the differences in specific gravity. The centipoise is one hundredth of a poise and is the unit of absolute viscosity most commonly used. The relation between absolute and kinematic viscosity is as follows: $\frac{\text{Centipoises}}{\text{Specific Gravity}} = \text{Centistokes; or Centipoises} = \text{Centistokes} \times \text{Specific Gravity}$
AGMA	American Gear Manufacturers
API gravity	An arbitrary scale (chosen by the American Petroleum Institute) in which the specific gravity of pure water is taken as 10. Liquids lighter than water have values greater than 10; liquids heavier than water have values less than 10. $\text{Degrees A.P.I.} = \frac{141.5}{\text{S.G. } 60/60\text{F}} - 131.5$ S.G. = specific gravity F = degrees Fahrenheit
backlash	The running clearance between mating gear teeth.
bangor irons	The bangor irons sweep across the wear plate and extraction plate to keep contaminants from getting under the rotor and rotor body.
cp	Centipoise One centipoise is 0.01 poise which is the absolute unit of viscosity. The centipoise is derived from the kinematic unit of viscosity, the centistoke, by multiplying it by the specific gravity of the fluid. By definition, the viscosity of water at 20 degrees Centigrade is one centipoise. centipoise = centistoke x specific gravity
CFM	cubic feet per minute

Term	Synonyms, Definitions, and Functions
cSt	Centistokes The unit of kinematic viscosity is the centistoke. Kinematic Viscosity in centistokes = Ct C = viscometer constant t = observed flow time in seconds
cantilever	To support something from one side only.  "A" is cantilevered using "B".
cavitation	The formation and collapse of vapor bubbles in a liquid.
cross tie braces	cross tie channels
DCS	distributed control system
D.O.D.	diameter of discharge
D.O.S.	diameter of suction
EMI	electromagnetic interference
expansion bearing	free bearing
extraction plate	bed plate, attrition plate A perforated plate through which stock is forced by rotor and pump.
friction head	h_f The head required to overcome the resistance to flow in the pipe and fittings. It is dependent upon the size and type of pipe, flow rate, and nature of the liquid.
gear box	drive A gear reducer which transmits high RPM of a horizontally motivated motor to lower RPM of a vertically mounted shaft.
GPM	gallons per minute
H	*see* total head
h_d	*see* total dynamic suction discharge head

Term	Synonyms, Definitions, and Functions
h_f	*see* friction head
HIC	hand indicator controller
HP	horsepower
h_s	*see* total dynamic suction lift and total dynamic suction head
h_v	*see* velocity head
head	The pressure at any point in a liquid can be thought of as being caused by a vertical column of the liquid which, due to its weight, exerts a pressure equal to the pressure at the point in question. The height of this column is called the static head and is expressed in terms of feet of liquid. The static head corresponding to any specific pressure is dependent upon the weight of the liquid accord to the following formula: $\text{Head in feet} = \frac{\text{Pressure in PSI x 2.31}}{\text{Specific Gravity}}$
junk trap	junk chamber, junk box, trashwell
kPa	kilopascal
kW	kilowatt
kinematic viscosity	The property measured when a fixed amount of oil flows through a capillary tube under the force of gravity. The unit of kinematic viscosity is the stoke or centistoke. An intermediate measurement in seconds can be converted to centistoke with the use of the viscometer (or viscosimeter) constant. Kinematic Viscosity, cs=Ct where C=Viscometer Constant t=Observed flow time in seconds
LPM	Liters per minutes
lantern ring	seal water ring, packing box bushing A nylon, Teflon, cast iron, or brass ring in a packing arrangement at which point water is injected.

Term	Synonyms, Definitions, and Functions
M.D.	mounting distance The axial position of a spiral bevel or hypoid gear and pinion in assembly is given by a dimension called the mounting distance. This is the linear dimension from the axial locating surface of a given member to a crossing point of its axis with that of its mate.
NPSH	net positive suction head The total suction head in feet absolute, determined at the suction nozzle and corrected to datum, less the vapor pressure of the liquid in feet absolute. It is an analysis of energy conditions on the suction side of a pump to determine if the liquid will vaporize at the lowest pressure point in the pump.
NPSHA	net positive suction head available NPSHA is a function of the system in which the pump operates. It is the excess pressure of the liquid in feet absolute over its vapor pressure as it arrives at the pump suction.
NPSHR	net positive suction head required NPSHR is a function of the pump design. As the liquid passes from the pump suction to the eye of the impeller, the velocity increases and the pressure decreases. There are also pressure losses due to shock and turbulence as the liquid strikes the impeller. The centrifugal force of the impeller vanes further increases the velocity and decreases the pressure of the liquid. The NPSHR is the positive head in feet absolute required at the pump suction to overcome these pressure drops in the pump and maintain the liquid above its vapor pressure. The NPSHR varies with speed and capacity within any particular pump.
non-expansion bearing	held bearing
OCC	old corrugated container
OD T/D	oven dried tons per day
PSI	pounds per square inch
PSIG	pounds per square inch gage In this manual, PSI and PSIG have the same meaning.
packing box	stuffing box A machined passage at the bottom center of a pulper which the shaft passes. The packing box contains compressed fibrous packing to control leakage.

Term	Synonyms, Definitions, and Functions
packing box water	gland water, seal water Water added to a packing box at the lantern ring to cool and lubricate the packing and shaft sleeve.
packing sleeve	wear sleeve A replaceable sleeve mounted to the shaft on which the packing *rides*.
pressure head	Pressure head must be considered when a pumping system either begins or terminates in a tank which is under some pressure other than atmospheric. The pressure in such a tank must first be converted to feet of liquid. A vacuum in the suction tank or a positive pressure in the discharge tank must be added to the system head, whereas a positive pressure in the suction tank or vacuum in the discharge tank would be subtracted. The following formula converts inches of mercury vacuum into feet of liquid: (Vacuum is abbreviated to Vac.) $\text{Vac., ft. of liq.} = \frac{\text{Vac., in. of Hg x 1.13}}{\text{Specific Gravity}}$
rotor	vane plate The propeller-like rotating element that sweeps the extraction plate.
rotor body	hub The hub of the rotating assembly which is fixed to the shaft and has the rotor affixed to it.
SUS	Saybolt Universal Seconds There are various instruments called viscometers or viscosimeters for measuring viscosity. The most widely used in the United States are the kinematic and the Saybolt Universal. The Saybolt Viscometer's unit of measure is time in seconds required for 60 ml of fluid to flow through an orifice at a given temperature. The results are reported as Saybolt Universal Seconds; for example 350 SUS at 100 degrees Fahrenheit (38 degrees Centigrade).
static discharge head	The vertical distance in feet between the pump centerline and the point of free discharge of the surface of the liquid in the discharge tank.
static head	*see* head

Term	Synonyms, Definitions, and Functions
static suction head	The vertical distance in feet from the centerline of the pump to the free level of the liquid being pumped.
static suction lift	The vertical distance in feet from the centerline of the pump to the free level of the liquid to be pumped.
suction head	Exists when the source of supply is above the centerline of the pump.
suction lift	Exists when the source of supply is below the centerline of the pump
spargers	Spargers are nozzles around the lower inside perimeter of a tank (in the sparger tank section) that create stock directional flow by streaming air.
temperature differential	The difference between the operating temperature and the cooling dilution temperature. If your operating temperature is 140 degrees Fahrenheit (60 degrees Centigrade), your minimum cooling dilution temperature is 90 degrees Fahrenheit (32 degrees Centigrade).
T/D	tons per day
TDH	total dynamic head The total dynamic discharge head minus the total dynamic suction head or plus the total dynamic suction lift. $TDH=h_d + h_s$ (with a suction lift) $TDH=h_d - h_s$ (with a suction head)
T.I.R.	total indicated runout (on a dial indicator)
total dynamic head	(see TDH)
total dynamic discharge head	h_d The static discharge head plus the velocity head at the pump discharge flange plus the total friction head in the discharge line. The total dynamic discharge head, as determined on pump test, is the reading of a gage at the discharge flange, converted to feet of liquid and corrected to the pump centerline, plus the velocity head at the point of gage attachment.
total dynamic suction head	h_s The static suction head plus the velocity head at the pump suction flange minus the total friction head in the suction line. The total dynamic suction head, as determined on pump test, is the reading of the gage on the suction flange, converted to feet of liquid and corrected to the pump centerline, plus the velocity head at the point of gage attachment.

Term	Synonyms, Definitions, and Functions
wear strips	deflector strips
viscosity	Viscosity is a measure of flowability at definite temperatures. Change in viscosity indicates contamination or oxidation instability.
viscosity index	The viscosity index is an empirical number indicating the rate of change in viscosity of an oil within a given temperature range. A low viscosity index signifies a relatively large change in viscosity with temperature, while a high viscosity shows a relatively small change in viscosity with temperature.
ZMS	zero mechanical state - (1) Every power source that can produce a machine member movement has been locked off; (2) Pressurized fluid (air, oil, or other) power lockoffs (shut-off valves), if used, will block pressure from the power source and will reduce pressure on the machine side port of that valve by venting to atmosphere or draining to tank; (3) All accumulators and air surge tanks are reduced to atmospheric pressure or treated as power sources to be locked off, as stated in paragraph 1 and 2; (4) The mechanical potential energy of all portions of the machine is at its lowest practical value--so that opening of pipe(s), tubing, hose(s), or actuation of any valve(s) will not produce a movement that could cause injury; (5) Pressurized fluid (air, oil, or other) trapped in the machines lines, cylinders, or other components is not capable of producing a machine motion upon actuation of any valve(s); (6) The kinetic energy of the machine members is at its lowest practical value; (7) Loose or freely movable machine members are secured against accidental movement; (8) A workpiece or material supported, retained, or controlled by the machine shall be considered as part of the machine if the workpiece or material can move or can cause machine movement.