Operation, Repair, Parts

ToughTek® M680a CS Mortar Sprayer

3A5275E

EN

Sprayer for water-based cementitious materials. Not for use with solvent-borne materials. For professional use only.

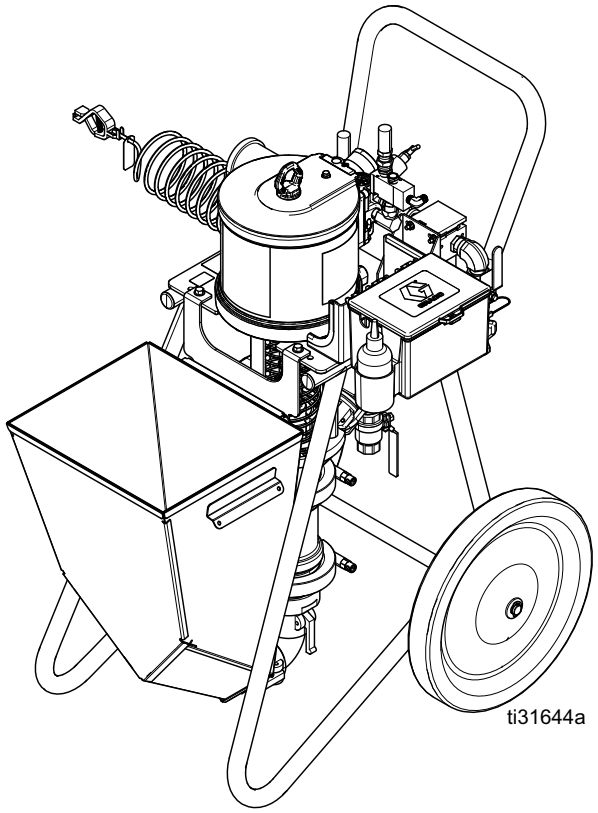
600 psi (4.1 MPa, 41 bar) Maximum Fluid Working Pressure

150 psi (1.0 MPa, 10 bar) Maximum Air Inlet Pressure

60 psi (0.41 MPa, 4.1 bar) Maximum Pump Air Regulator Pressure

See page 2 for model information, including model numbers and approvals.

Important Safety Instructions
Read all warnings and instructions in this manual. Save these instructions.



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CE Ex II 2 G Ex h IIA T5 Gb

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Contents

Related Manuals

Manuals are available at www.graco.com.

Component manuals in English:

Manual	Description
332651	Mortar Spraying Tips
332767	Mortar Spraying Applicators
332768	HTX™ 680 Applicator
312796	NXT® Air Motors

Models

Model	Description	CE	Ex II 2 G Ex h IIA T5 Gb
25M572	ToughTek M680a CS Mortar Sprayer	✓	✓
26A489	Flex Applicator Spray Package		✓
26A490	Pole Applicator Spray Package		✓
26A491	HTX Applicator Spray Package		✓

Spray Packages

Package		Included Applicator	
Part	**Description**	**Part**	**Applicator Type**
27A489	System, M680a CS, Flex Applicator, Package	24T947	Flex
27A490	System, M680a CS, Pole Applicator, Package	24T946	Pole
27A491	System, M680a CS, HTX Applicator, Package	24U209	HTX

Packages include:

- (1) ToughTek M680a CS Mortar Sprayer
- (1) Fluid hose bundle
- (2) Air hose bundle
- (1) Applicator camlock reducer
- (1) Applicator (see above table and **Applicators**, page 4)

Fluid Hose Bundle (27A004)

Includes 50 ft of 1 3/8 in. mortar hose with 1.5 in. camlock connections.

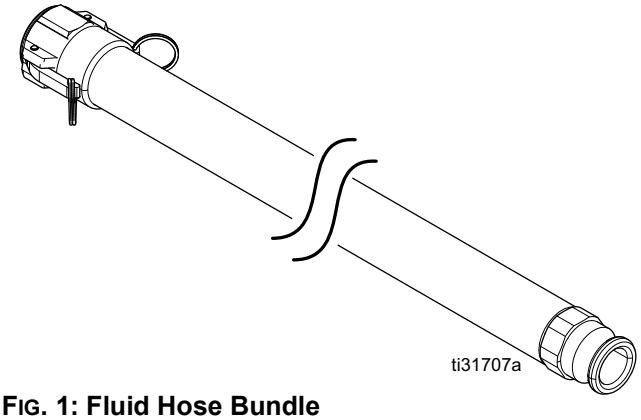

FIG. 1: Fluid Hose Bundle

Air Hose Bundle (24T852)

Includes 25 ft of air hose with 1/4 in. quick disconnect air fittings and 25 ft of air pilot line.

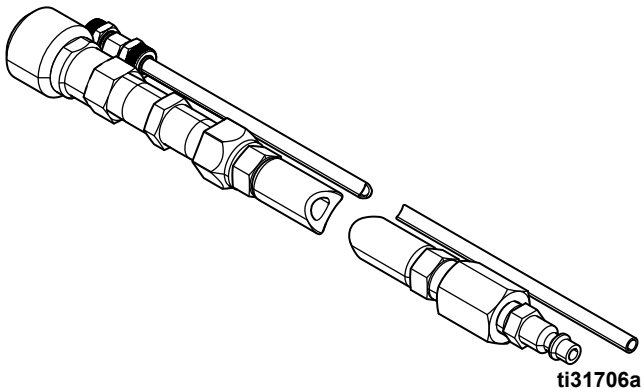

FIG. 2: Air Hose Bundle

Applicator Camlock Reducer (17G767)

Connects a 1.5 in. male camlock hose outlet to a 1 in. female camlock fitting on applicator.

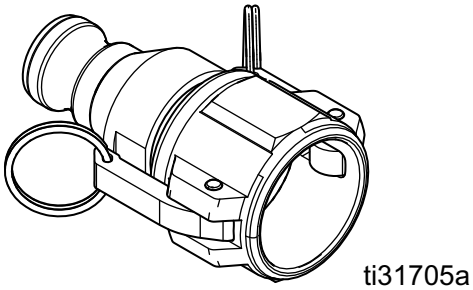

FIG. 3: Applicator Camlock Reducer

ToughTek M680a CS Mortar Sprayer (25M572)

Includes sprayer with 1.5 in. male camlock fluid outlet, 1/4 in. air quick disconnect, air pilot line connection, and 3/4 npt air supply inlet.

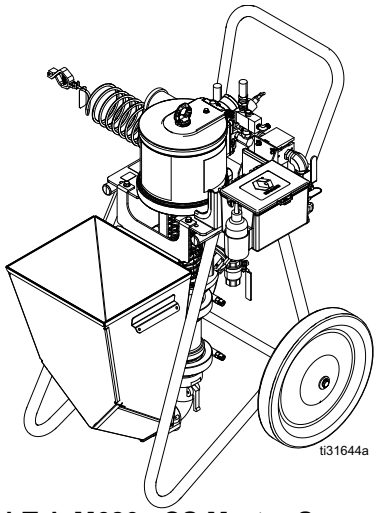

FIG. 4: ToughTek M680a CS Mortar Sprayer

Applicators

Flex Applicator

The **flex applicator** is for use in low pressure spraying of materials that packout easily and will be finish-troweled.

Includes 23 in. (58 cm) flexible hose with a 1 in. camlock fluid inlet, angled spray head, spray air volume control, spray air shut off valve, and motor pilot signal control valve; an adjustable-position center air injection tube, a rubber tip retainer, and three tip sizes.

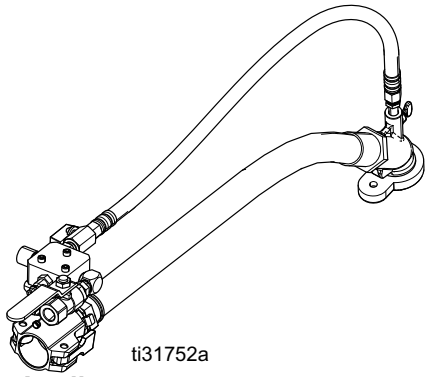

FIG. 5: Flex Applicator

Pole Applicator

The **pole applicator** is for use in low-pressure spraying in long-reach, open areas, using materials that packout easily and will be finish-troweled. The pole applicator is similar to the flex applicator but includes a pipe instead of a hose.

Includes a 30 in. (76 cm) aluminum pipe with a 1 in. camlock fluid inlet, angled spray head, spray air volume control, spray air shut-off valve, and motor pilot signal control valve; an adjustable-position center air injection tube, a rubber tip retainer, and three tip sizes.

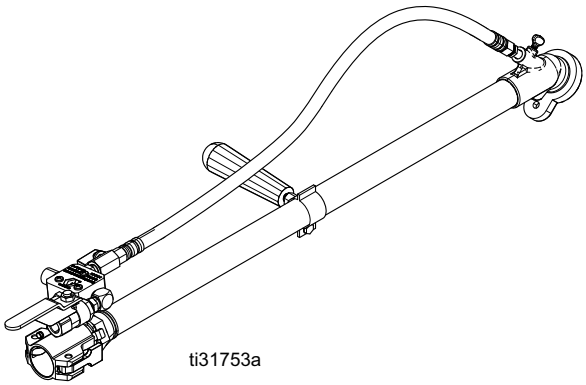

FIG. 6: Pole Applicator

HTX 680 Applicator

The **HTX 680 applicator** is for use in medium-pressure spraying of materials that do not packout easily.

The HTX 680 uses venturi-type air injection fluid nozzles and an aluminum screw on tip retainer. The applicator includes a 1 in. camlock fluid inlet, angled aluminum spray head, spray air volume control, spray air shut off valve, and motor pilot signal control valve. Also includes four nozzle sizes, a Fine Finish adapter, and four Fine Finish tips.

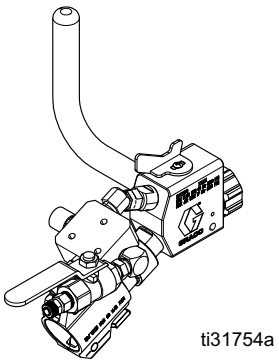

FIG. 7: HTX 680 Applicator

Warnings

The following warnings are for the setup, use, grounding, maintenance, and repair of this equipment. The exclamation point symbol alerts you to a general warning and the hazard symbols refer to procedure-specific risks. When these symbols appear in the body of this manual or on warning labels, refer back to these Warnings. Product-specific hazard symbols and warnings not covered in this section may appear throughout the body of this manual where applicable.

⚠ WARNING

FIRE AND EXPLOSION HAZARD

Flammable fumes, such as solvent and paint fumes, in **work area** can ignite or explode. Paint or solvent flowing through the equipment can cause static sparking. To help prevent fire and explosion:

- Use equipment only in well-ventilated area.
- Eliminate all ignition sources; such as pilot lights, cigarettes, portable electric lamps, and plastic drop cloths (potential static sparking).
- Ground all equipment in the work area. See **Grounding** instructions.
- Never spray or flush solvent at high pressure.
- Keep work area free of debris, including solvent, rags and gasoline.
- Do not plug or unplug power cords, or turn power or light switches on or off when flammable fumes are present.
- Use only grounded hoses.
- Hold gun firmly to side of grounded pail when triggering into pail. Do not use pail liners unless they are anti-static or conductive.
- **Stop operation immediately** if static sparking occurs or you feel a shock**.** Do not use equipment until you identify and correct the problem.
- Keep a working fire extinguisher in the work area.

SKIN INJECTION HAZARD

High-pressure fluid from dispensing device, hose leaks, or ruptured components will pierce skin. This may look like just a cut, but it is a serious injury that can result in amputation. **Get immediate surgical treatment.**

- Do not point dispensing device at anyone or at any part of the body.
- Do not put your hand over the fluid outlet.
- Do not stop or deflect leaks with your hand, body, glove, or rag.
- Follow the **Pressure Relief Procedure** when you stop dispensing and before cleaning, checking, or servicing equipment.
- Tighten all fluid connections before operating the equipment.
- Check hoses and couplings daily. Replace worn or damaged parts immediately.

⚠ WARNING

EQUIPMENT MISUSE HAZARD

Misuse can cause death or serious injury.

- Do not operate the unit when fatigued or under the influence of drugs or alcohol.
- Do not exceed the maximum working pressure or temperature rating of the lowest rated system component. See **Technical Specifications** in all equipment manuals.
- Use fluids that are compatible with equipment wetted parts. See **Technical Specifications** in all equipment manuals. Read material manufacturer's warnings. For complete information about your material, request Safety Data Sheets (SDSs) from distributor or retailer.
- Do not leave the work area while equipment is energized or under pressure.
- Turn off all equipment and follow the **Pressure Relief Procedure** when equipment is not in use.
- Check equipment daily. Repair or replace worn or damaged parts immediately with genuine manufacturer's replacement parts only.
- Do not alter or modify equipment. Alterations or modifications may void agency approvals and create safety hazards.
- Make sure all equipment is rated and approved for the environment in which you are using it.
- Use equipment only for its intended purpose. Call your distributor for information.
- Route hoses and cables away from traffic areas, sharp edges, moving parts, and hot surfaces.
- Do not kink or over bend hoses or use hoses to pull equipment.
- Keep children and animals away from work area.
- Comply with all applicable safety regulations.

MOVING PARTS HAZARD

Moving parts can pinch, cut or amputate fingers and other body parts.

- Keep clear of moving parts.
- Do not operate equipment with protective guards or covers removed.
- Pressurized equipment can start without warning. Before checking, moving, or servicing equipment, follow the **Pressure Relief Procedure** and disconnect all power sources.

TOXIC FLUID OR FUMES HAZARD

Toxic fluids or fumes can cause serious injury or death if splashed in the eyes or on skin, inhaled, or swallowed.

- Read Safety Data Sheets (SDSs) to know the specific hazards of the fluids you are using.
- Store hazardous fluid in approved containers, and dispose of it according to applicable guidelines.

PERSONAL PROTECTIVE EQUIPMENT

Wear appropriate protective equipment when in the work area to help prevent serious injury, including eye injury, hearing loss, inhalation of toxic fumes, and burns. Protective equipment includes but is not limited to:

- Protective eyewear, and hearing protection.
- Respirators, protective clothing, and gloves as recommended by the manufacturer of the pumped material.

SUCTION HAZARD

Powerful suction can cause serious injury.

- Never place hands near the pump fluid inlet when pump is operating or pressurized.

Changing Materials

NOTICE

Changing the material types used in your equipment requires special attention to avoid equipment damage and downtime.

- When changing materials, flush the equipment multiple times to ensure it is thoroughly clean.
- Always clean the internal pump components after flushing.
- Check with your material manufacturer for chemical compatibility.

Component Identification

Overview

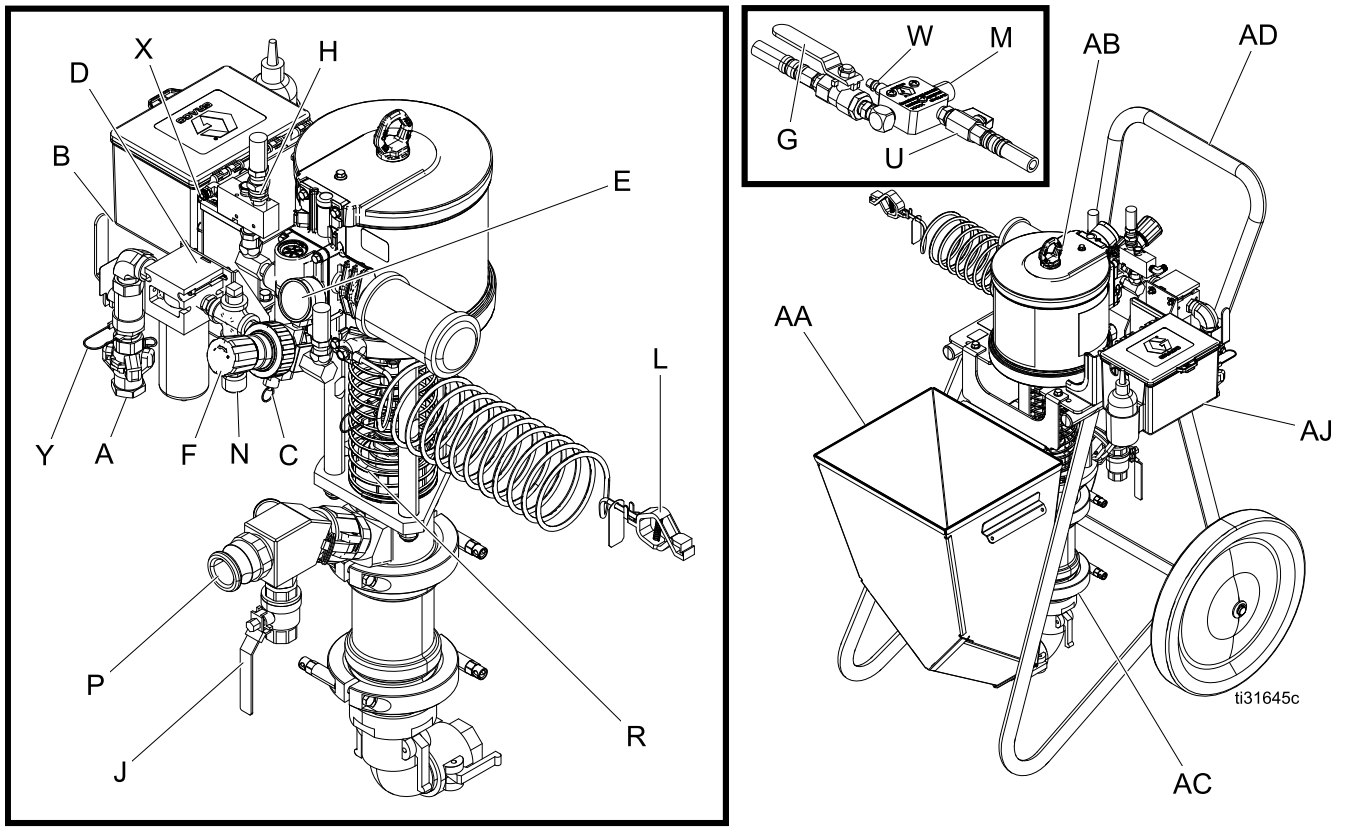

FIG. 8: Typical Installation

Key:

AA Material Hopper
AB Air Motor
AC Lower
AD Cart
AJ System Air Inlet
A Air Inlet, 3/4 npt(f) Claw (Chicago) Fittings
B Bleed Type Master Valve (required)
C Air Pressure Relief Valve
D Air Filter (40 micron)
E Motor Air Pressure Gauge
F Motor Air Pressure Regulator Adjustment Knob
G* Air Motor Pilot Ball Valve (starts/stops air motor from applicator)
H Motor Air Pilot Valve
J Pressure Relief Ball Valve
L Grounding Wire, required (see **Grounding**, page 10)
M* Needle Valve for Air Assist Flow Control
N Air Supply Quick Disconnect to Applicator Air Inlet Quick Disconnect
P Fluid Outlet, 1.5 in. Male Camlock Fitting
R Packing Nut/Wet Cup under Spring Guard
U* Air Assist Shutoff Ball Valve
W* Applicator Air Inlet Quick Disconnect
X Pilot Valve Signal (to Applicator)
Y Whip Check Hose Safety Cable

**Part of applicator*

System Components

NOTE: System requires use of an applicator with an air pilot line and air pilot valve to operate. See **Applicators**, page 4 for compatible applicators.

**Required system components*

To avoid tipping over, ensure cart is on a flat and level surface. Failure to do so could result in injury or equipment damage.

*Bleed Type Master Air Valve (B)

- Be sure the valve is easily accessible from the applicator.
- Required in your system to relieve air trapped between it and the air motor when the valve is closed.
  - Open to supply air to the motor.
  - Close to shut off air to the motor and bleed any trapped air from the motor.

*Air Pressure Relief Valve (C)

Automatically opens to relieve air pressure if set pressure exceeds preset limit.

Air Filter (D)

Removes harmful dirt and water from compressed air supply.

Air Regulator Adjustment Knob (F)

Adjusts air pressure to the motor and fluid outlet pressure of the pump. Read air pressure on gauge (E).

*Pressure Relief Ball Valve (J)

Open valve to relieve pressure if pump or hose packout occurs. Close valve when spraying.

NOTICE

To prevent material hardening in the pressure relief ball valve (J), flush the valve after each use. See **Flush the Equipment**, page 19.

To help avoid serious injury from splashing fluid, never open a camlock hose or applicator fitting while there is pressure in the fluid line. See **Pressure Relief Procedure**, page 12.

Installation

Grounding

The equipment must be grounded to reduce the risk of static sparking. Static sparking can cause fumes to ignite or explode. Grounding provides an escape wire for the electric current.

Tools Required

- Grounding wires and clamps for pails
- Two 5-gallon (19 L) metal pails

1. Connect the ground wire (L, 262908) to the ground stud on the air motor.

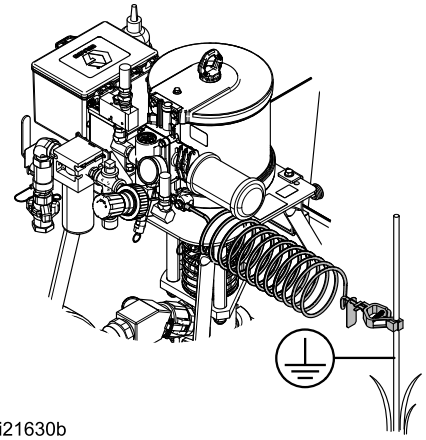

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FIG. 9: Grounding Wire

2. Connect the other end of the ground wire to a true earth ground.
3. Ground the object being sprayed, fluid supply container, and all other equipment in the work area. Follow your local code. Use only electrically conductive air and fluid hoses.
4. Ground all pails. Use only metal pails, which are conductive, placed on a metal surface. Do not place pail on a non-conductive surface, such as paper or cardboard, which interrupts grounding continuity.

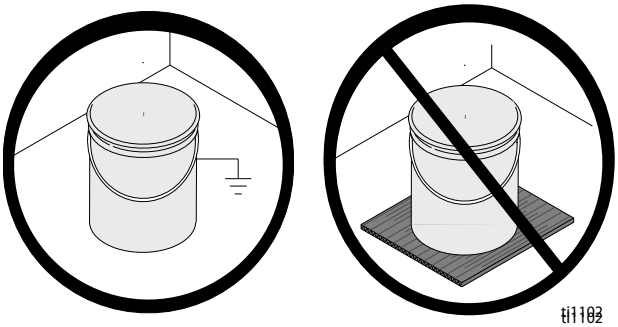

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FIG. 10: Properly Grounded Pail

Setup

Tools required:

- Two adjustable wrenches
- Non-sparking hammer or plastic mallet

1. Ground sprayer. See **Grounding**, page 10.
2. Check Throat Seal Liquid (TSL) level in packing nut (R). Fill 1/2 full with TSL.

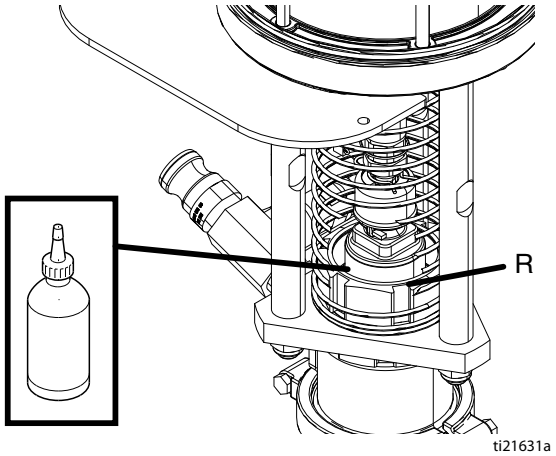


FIG. 11: Check Throat Seal Liquid Levels

3. Attach electrically conductive fluid hose to camlock at pump outlet.
4. Attach large air line from hose bundle to main air quick disconnect (N). See **Component Identification**, page 8.
5. Attach large air line from hose bundle to motor pilot valve signal (X). Use wrench to secure air tube in place. See **Component Identification**, page 8.
6. Attach applicator camlock reducer to applicator fluid inlet.
7. Attach large air line from hose bundle to applicator air inlet quick disconnect (W). See **Component Identification**, page 8.
8. Attach small air tube from hose bundle to air motor pilot ball valve (G) on applicator. Use wrench to secure air tube place. See **Component Identification**, page 8.
9. Wrap blue velcro camlock retaining straps around each camlock connection to secure.

NOTE: This includes the two camlocks between the hopper and the pump lower, the camlock at the pump outlet, the camlocks on the fluid hoses, and the camlock on the applicator inlet. The retaining straps should be tight and must not be able to slide off the camlocks.

10. Going from applicator back to the system, wrap a zip tie around all hoses every few feet to secure them together.
11. Connect air supply hose:
    a. Close bleed type master air valve (B).
    b. Expand end of whip check cable (Y) and slide it over the end of your air hose.
    c. Connect air supply hose to 3/4 npt(f) claw fittings air inlet (A).
    d. Install safety clips in claw fittings.

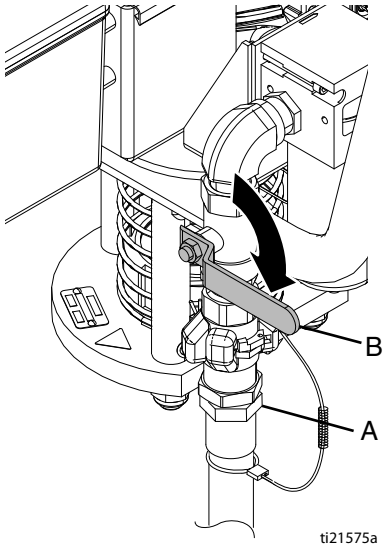


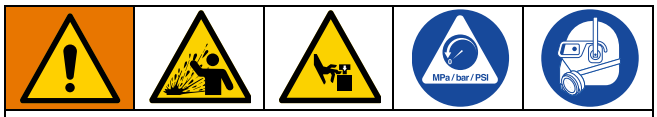
FIG. 12

12. Wet out the system with material flushing agent before using. See **Wet Out the System**, page 13.

Operation

Pressure Relief Procedure

Follow the Pressure Relief Procedure whenever you see this symbol.



This equipment stays pressurized until pressure is manually relieved. To help prevent serious injury from pressurized fluid, splashing fluid, and moving parts, follow the Pressure Relief Procedure when you stop spraying and before cleaning, checking, or servicing the equipment. Never open a camlock hose or applicator fitting while there is pressure in the fluid line.

1. Close the bleed type master valve (B).

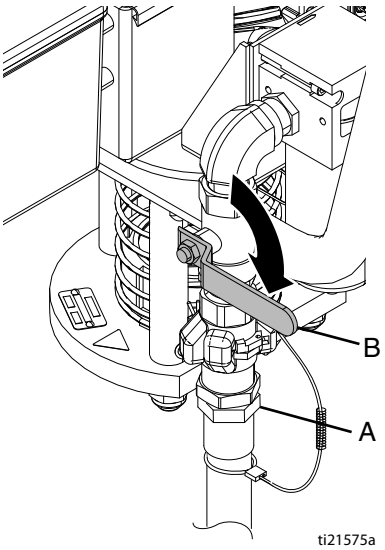


FIG. 13

2. Set air pressure regulator knob (F) to zero pressure.
3. Hold applicator firmly against a grounded metal pail.

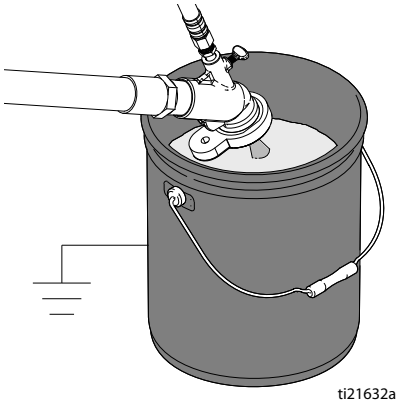


FIG. 14

4. If you suspect the applicator tip or hose is completely clogged, or that pressure has not been fully relieved after following the previous steps, slowly open the pressure relief ball valve (J) at the pump outlet. See **Component Identification**, page 8.

NOTICE

Material can harden inside of the pressure relief ball valve (J) if it is not flushed properly after use. If there is hardened material within the pressure relief ball valve, pressure may not be effectively relieved. See **Flush the Equipment**, page 19.

Wet Out the System

NOTICE

To prevent material curing in the system, never load material into a dry system. Loading material into a dry system will cause the material to stick to internal components and cure, causing damage and requiring replacement of those parts.

Always wet out the system by circulating water through the applicator back into the hopper before loading any mixed mortar. Resin or commercially available concrete pump priming fluids can be used depending on what material is being sprayed.

- Use the material flushing agent recommended on the material application data sheet.
- When finished, pump out the excess fluid. Then drain out remaining fluid by loosening the bottom cam fitting.

1. Close the bleed type master air valve (B).

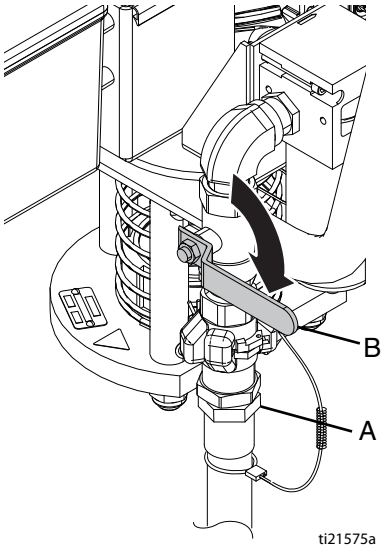


FIG. 15

2. Remove tip from applicator.

3. Partially fill the clean hopper with material flushing agent, depending on the material you will be spraying.

4. Turn air regulator adjustment knob (F) counterclockwise until it stops and gauge (E) reads zero.

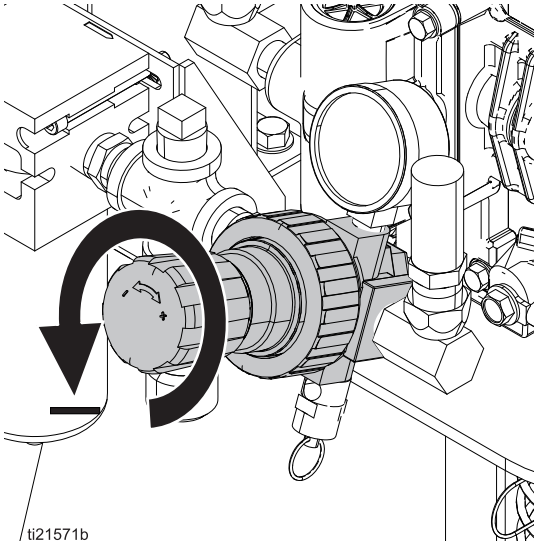


FIG. 16

5. Verify pressure relief ball valve (J) is closed.

6. Place applicator outlet in grounded pail.

7. Open the air motor pilot ball valve (G) located on the base of applicator.

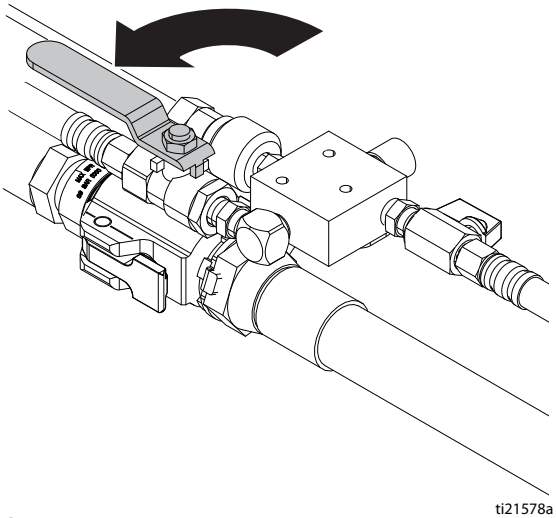


FIG. 17

8. Open bleed type master air valve (B).

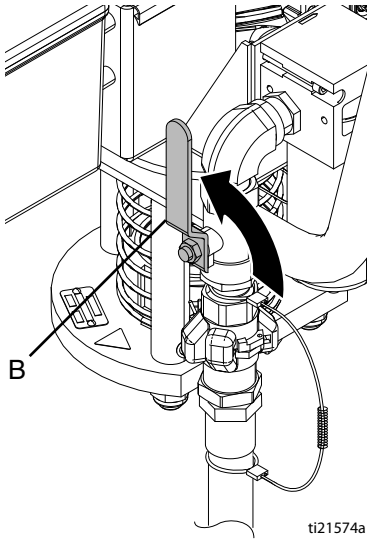


FIG. 18

9. Rotate the air regulator adjustment knob (F) clockwise until pump begins to move slowly.

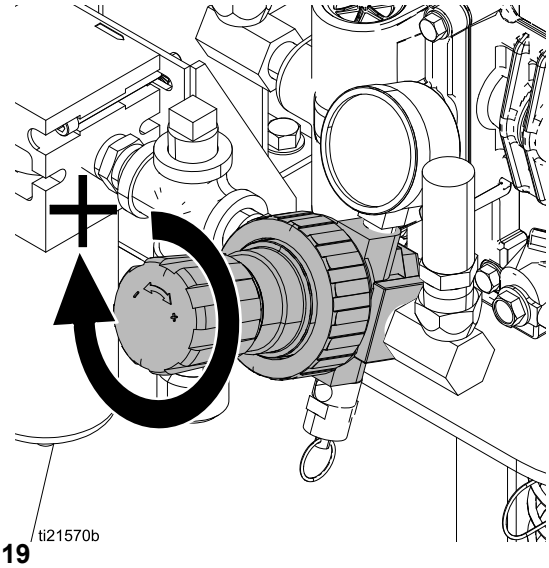


FIG. 19

NOTICE

To prevent damage to pump seals caused by cavitation, run the pump slowly until the system is primed.

10. Continue running the pump until all of the flushing fluid is dispensed into the pail. The system is now wetted out.

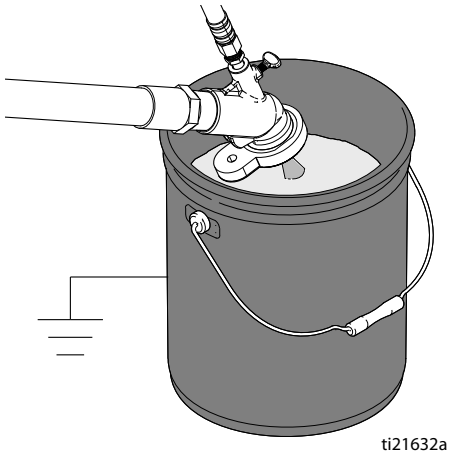


FIG. 20

11. To stop dispensing, close the air motor pilot ball valve (G) and the main bleed type master air valve (B).

12. If needed, drain remaining fluid from system.

NOTE: Materials that separate more easily may require draining the remaining fluid from the system. Check material data sheet to determine whether it is necessary to drain the remaining fluid from the system.

a. Place grounded metal drain pan beneath pump lower inlet fittings.

b. Remove hopper and fittings between hopper and pump lower.

c. Use a screwdriver to lift the pump lower inlet ball. This will drain the remaining material from the pump lower. When the pump stops draining, release the pump lower inlet ball.

d. Install fittings and hopper.

e. Install camlock retaining straps.

f. Starting at the pump, raise the hose bundle above your head and slowly move towards the applicator. As you move towards the applicator, the remaining fluid in the hose will drain from the applicator into the bucket.

Mix the Material

Always wet out the pump, hose, and applicator before loading the material. See **Wet Out the System**, page 13.

Always follow the material manufacturer's instructions for the material being sprayed. Mortar must be thoroughly mixed to a smooth consistency before loading it in the hopper.

- Always add the powder slowly to the fluid while mixing. Do not add fluid to the powder.
- In non-explosive atmospheres only: Use a powerful mixer drive such as a minimum 800 W, 1/2 in. drive, electric drill. Gear reduced drills work best. Drill should have high torque at 300-1200 rpm.
- A heavy-duty drywall mud "H" blade or large "Jiffy" blade generally works well for mixing.

NOTE: It will take most of the first batch of material to fill the pump and hoses.

Managing Mortar After Mixing

- Pay close attention to the work life of the material being used.
- Only mix the mortar kits as needed. Do not let mixed mortar sit longer than necessary.
- Scrape mortar down the sides of the hopper as the hopper material level lowers. Do not let older mortar cure on the walls.
- Occasionally, do not refill the hopper until it is almost empty. This ensure all material in hopper is used while fresh.

Prime with Material

NOTICE

To prevent material curing in the system, never load material into a dry system. Loading material into a dry system will cause the material to stick to internal components and cure, causing damage and requiring replacement of those parts.

The applicator nozzle or tip must be removed during priming. Always push out any remaining "wet out" fluid into a waste container before circulating mortar. Always circulate clean mortar back into the hopper for a few minutes before beginning to spray.

1. Wet out the system. See **Wet Out the System**, page 13.
2. Mix the material. See **Mix the Material**, page 15.
3. Close the bleed type master air valve (B).

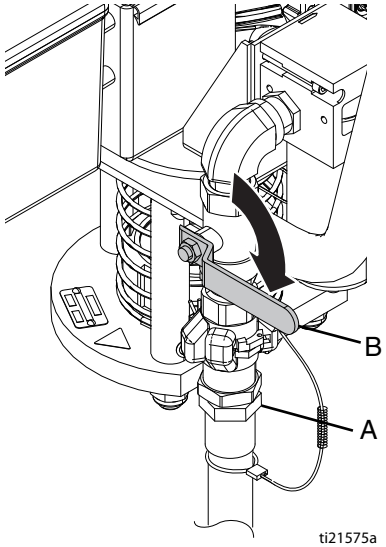


FIG. 21

4. Remove tip from applicator.
5. Fill the clean hopper with at least 5 gallons of the material to be sprayed. If using 60 ft of material hose, then fill with 6 gallons.

6. Turn air regulator adjustment knob (F) counterclockwise until it stops and gauge (E) reads zero.

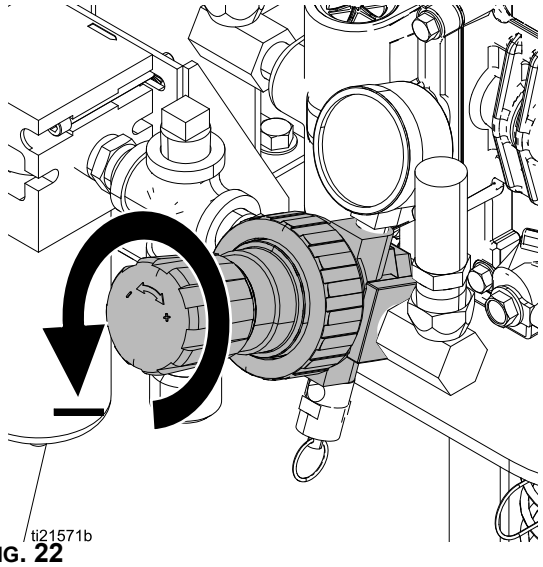


FIG. 22

7. Place applicator outlet in a 5-gallon, grounded metal waste container.

8. Open the air motor pilot ball valve (G) located on the base of applicator.

9. Open bleed type master air valve (B).

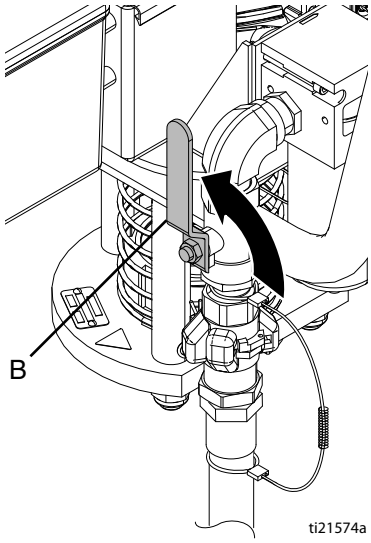


FIG. 23

NOTICE

To prevent damage to pump seals caused by cavitation, run the pump slowly until the system is primed.

10. Rotate the air regulator adjustment knob (F) clockwise until pump begins to move slowly.

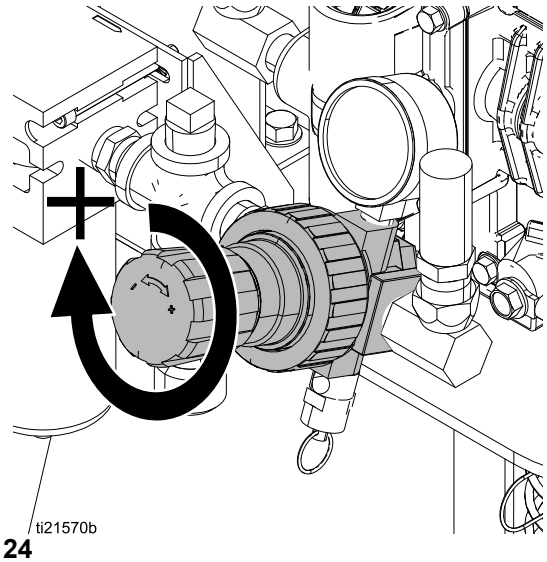


FIG. 24

11. Continue running the pump until a steady stream of material comes from the applicator.

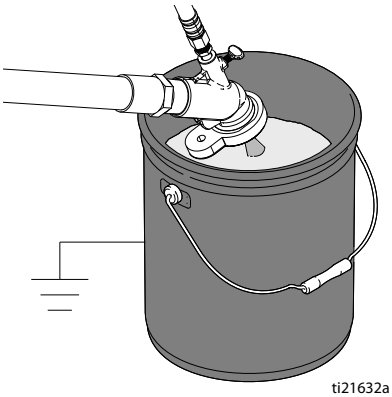


FIG. 25

12. To stop dispensing, close the air motor pilot ball valve (G).

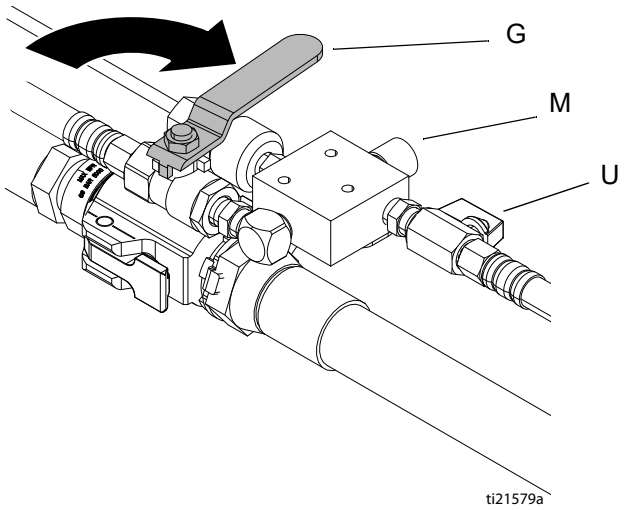


FIG. 26: Close Pilot Ball Valve (on Applicator)

13. Place the applicator outlet into the hopper.
14. Open the air motor pilot ball valve (G). Material will begin dispensing.
15. Recirculate a few gallons of material to be sure the material is flowing properly.
16. Install a tip onto applicator. The system is now primed and ready to spray.

Spray

Prevent Packout

To avoid material packout or interruption of material flow:

- Use the lowest pressure and largest nozzle size that provides an acceptable spray pattern. This will also result in seals and wear parts lasting much longer.
- Do not use any more fluid hose than is necessary.
- Use an applicator with a rubber tip retainer that will blow off if it plugs.

Before Starting or Stopping Material Flow

- Start and stop the fluid flow with the red-handled air motor pilot valve at the applicator.
- Always have the atomizing air turned on before and after spraying fluid.

Before Starting Material Flow

1. Always open the air assist shutoff ball valve (U) and adjust needle valve for air assist flow control (M) first.
2. Open (turn on) the air motor pilot ball valve (G) last.

Before Stopping Material Flow

1. Always close (turn off) the air motor pilot ball valve (G) first.
2. Turn off the air assist shutoff ball valve (U).

Spraying

NOTICE

Do not allow pump to run without material in the hopper. It will quickly accelerate to a high speed, causing pump seal damage.

NOTICE

To prevent material curing in the system, never load mortar into a dry system. Loading mortar into a dry system will cause the mortar to stick to internal components and cure, causing damage and requiring replacement of those parts.

1. **Wet Out the System**, page 13.
2. **Mix the Material**, page 15.
3. **Prime with Material**, page 15.

NOTICE

Failure to flush prior to material curing in the system will result in damage to system and may require replacement of all system parts in contact with material.

4. Turn air regulator adjustment knob (F) counterclockwise until it stops and motor air pressure gauge (E) reads zero.

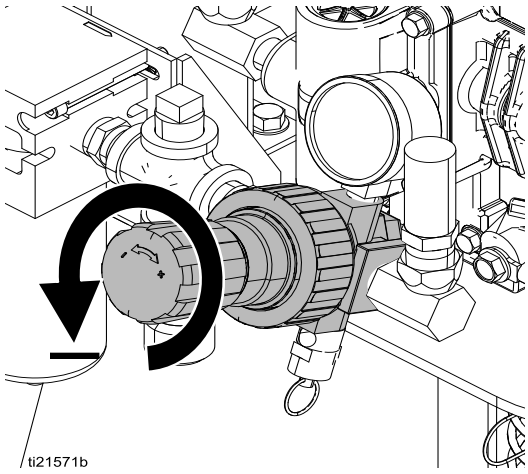


FIG. 27

5. Install tip on applicator by stretching rubber retainer with a screwdriver or screwing on retainer, depending on your application kit.

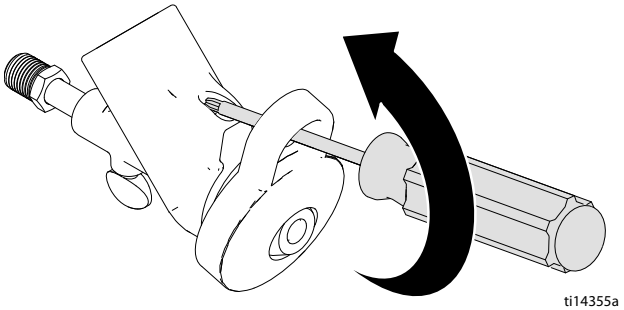


FIG. 28

6. Open air assist shutoff ball valve (U) and adjust the needle valve for the air assist flow control (M). See **Component Identification**, page 8.
7. Open the air motor pilot ball valve (G) located on base of applicator. See **Component Identification**, page 8. Material will begin dispensing.
8. Adjust air motor regulator adjustment knob (F) until desired material flow rate is achieved. Turn clockwise to increase pressure, counterclockwise to decrease pressure.

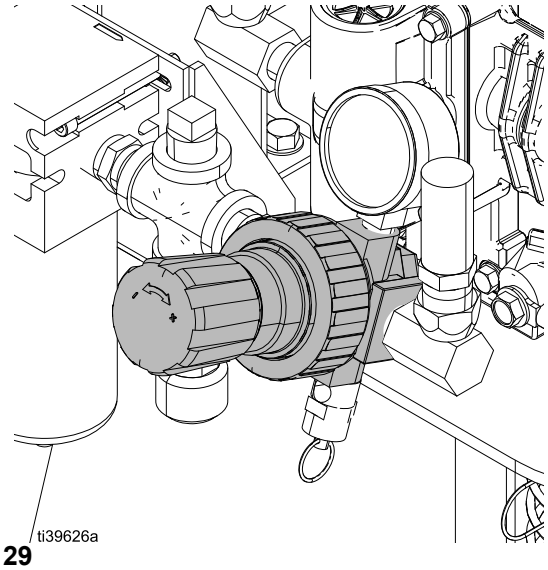


FIG. 29

NOTE: See applicator manuals in **Related Manuals**, page 2, for details about system spray adjustments.

9. If the system is approaching its cure time or the system will be idle for enough time for material to begin curing in the system, flush the system. See **Flush the Equipment**, page 19.

NOTICE

Failure to flush prior to material beginning to cure in the system will result in damage to system and may require replacement of all parts in contact with the material.

10. If the flushed system will be idle for more than 90 minutes, disassemble and clean the pump. See **Disassemble and Clean the Pump (Daily)**, page 22.

Flush the Equipment

To avoid fire and explosion, always ground equipment and waste container. To avoid static sparking and injury from splashing, always flush at the lowest possible pressure.

NOTICE

Failure to flush prior to material beginning to cure in the system will result in damage to system and may require replacement of all parts in contact with the material.

NOTICE

System and hoses must be flushed with water. Flushing equipment with non-water flushing agents (solvents) may cause damage to system and hoses.

NOTICE

The pressure relief ball valve (J) must be flushed to prevent material hardening. Hardening may cause damage to system.

- Flush before changing colors, before fluid can dry in the equipment, at the end of the day, before storing, and before repairing equipment.
- Flush at the lowest pressure possible. Check connectors for leaks and tighten as necessary.
- Flush if the materials in the system are about to reach their cure time.
- Flush any time the flow rate starts to decrease as this is a sign that material is starting to thicken and cure.
- Always flush the system at least twice, draining all material flushing agent between flushes and replacing it with clean material flushing agent.
- For some mortars, it is recommended to flush every 3-5 kits. Others can run continuously without flushing. See material manufacturer recommendation.

1. Close the bleed type master air valve (B).

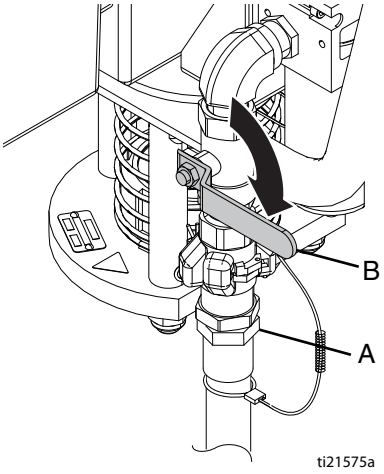


FIG. 30

2. Remove applicator tip and retainer.

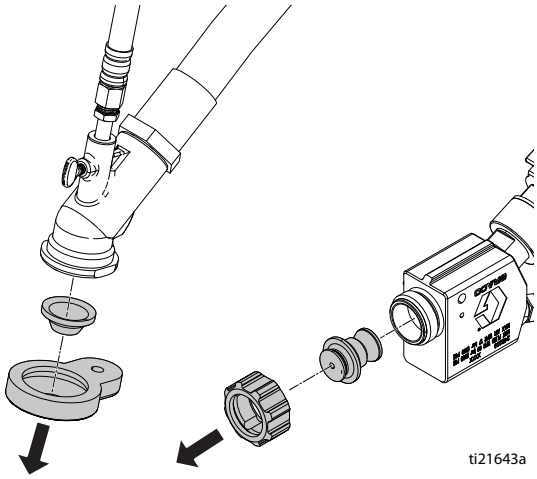


FIG. 31

3. Place applicator outlet in a waste container. The waste container must be large enough to hold all dispensed material.

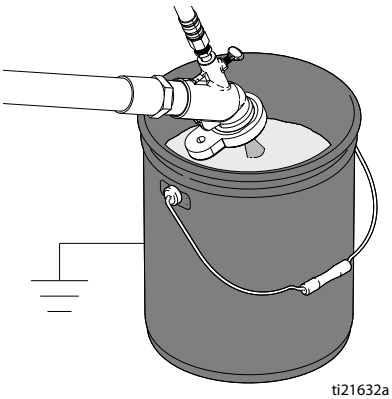


FIG. 32

4. With air assist air flowing, open the air motor pilot ball valve (G) located on base of applicator.
5. Open bleed type master air valve (B) to begin dispensing.

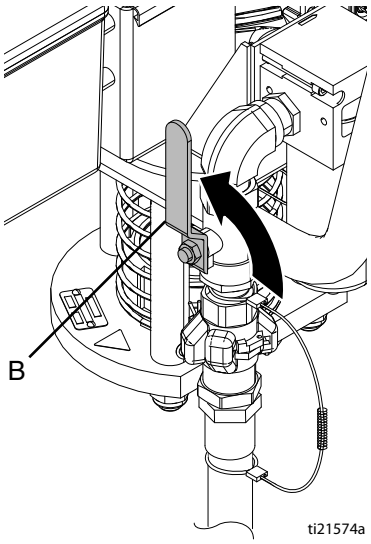


FIG. 33

6. When the material level in the hopper is within a few inches of the material inlet at the bottom:
   a. Scrape the material down the sides of the hopper.
   b. Fill the hopper with water as the material runs out. Continue dispensing.
7. Keep the hopper filled with water while dispensing.

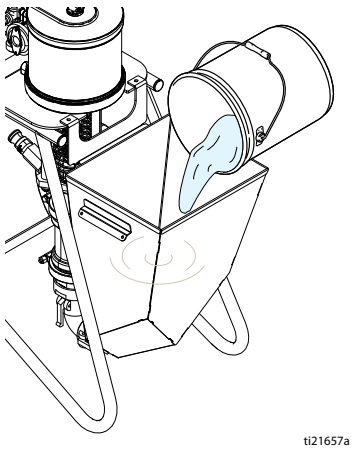


FIG. 34

NOTE: Be prepared to decrease the air pressure when the material exiting the hose changes to water. Water pumps more easily so pump speed will increase.

8. When water begins to exit the applicator outlet, close the air motor pilot valve (G) located on base of the applicator to stop dispensing.
9. Place applicator in the system hopper with the outlet pointing down to enable fluid circulation.
10. Circulate clean water:
    a. Fill the system hopper with clean water.

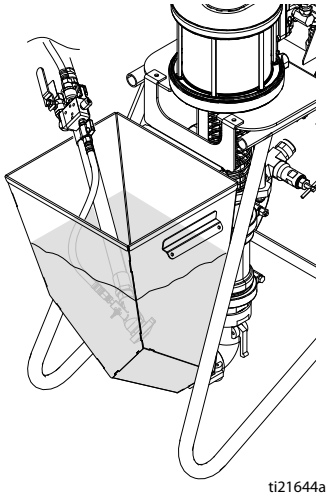


FIG. 35

    b. Use a scrub brush to scrub the walls of the hopper.
    c. Open the air motor pilot ball valve (G) on applicator to begin circulating water.
    d. Run the pump at 60-90 cycles per minute for 3-5 minutes. Adjust air pressure as necessary to maintain 60-90 cycles per minute.

NOTE: High flushing fluid velocity is the most important item for effective cleaning. The fluid hose should shake while the pump is running. This is necessary to maximize the cleaning effects of flushing.

    e. While pumping at 60-90 cycles per minute, close then open the air motor pilot ball valve (G) many times to clean it.
    f. Decrease air pressure to air motor back to operating pressure.
    g. Close the air motor pilot ball valve (G).
    h. Place applicator outlet in a grounded metal waste container.
    i. Open air motor pilot ball valve (G) to dispense into grounded metal waste container.

j. Place bucket under pressure relief ball valve (J). Open valve to flush out any additional material. Close valve.

k. Dispense into grounded metal waste container until hopper is almost empty, then close air motor pilot ball valve (G).

l. Repeat all of step 10 (“Circulate clean water”) one more time to ensure system is thoroughly flushed.

11. After performing the previous step at least twice, drain remaining water from system:

    a. Place grounded metal drain pan beneath pump lower inlet fittings.

    b. Remove hopper and fittings between hopper and pump lower.

    c. Use a screwdriver to lift the pump lower inlet ball. This will drain the remaining material from the pump lower. When the pump stops draining, release the pump lower inlet ball.

    d. Install fittings and hopper.

    e. Install camlock retaining straps.

    f. Starting at the pump, raise the hose bundle above your head and slowly move towards the applicator. As you move towards the applicator, the remaining fluid in the hose will drain from the applicator into the bucket.

12. Disassemble and clean the pump at the end of every day. The procedure takes about 10 minutes. See **Disassemble and Clean the Pump (Daily)**, page 22.

Disassemble and Clean the Pump (Daily)

Suggested Tools

- 5/8 in. box end wrench or 5/8 in. socket and ratchet
- Rubber mallet (to break items loose, if necessary)

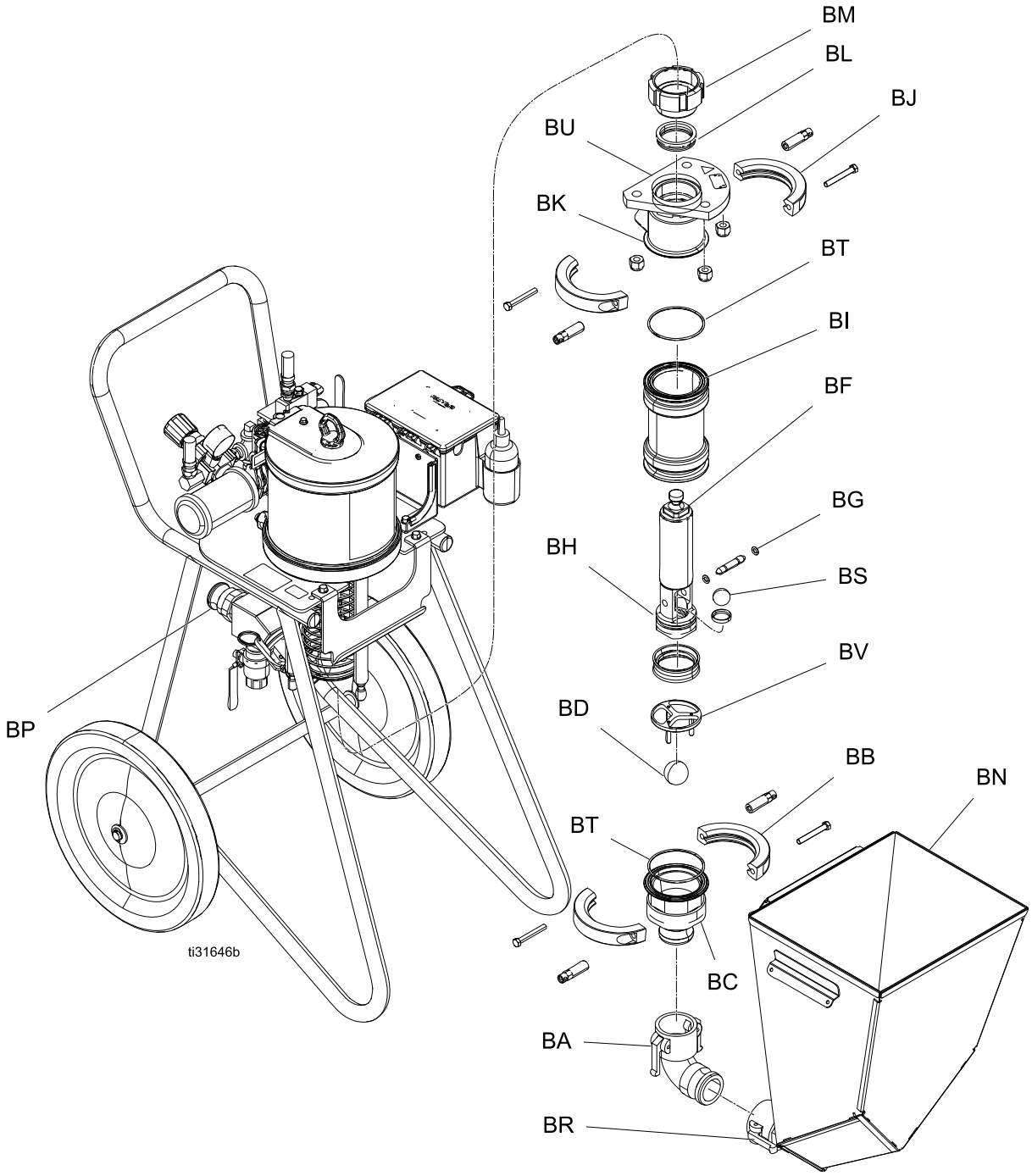


FIG. 36

Key

BA	Inlet Elbow with Camlock
BB	Inlet Housing Clamp
BC	Inlet Housing Assembly
BD	Inlet Ball
BF	Pump Rod Assembly
BG	Outlet Ball Stop
BH	Piston Seal
BI	Cylinder
BJ	Cylinder Clamp
BK	Outlet Housing
BL	Throat Packing
BM	Packing Nut (non-adjustable)
BN	Hopper
BP	Pump Outlet
BR	Hopper Release Camlock
BS	Outlet Ball
BT	Cylinder O-rings
BU	Outlet Housing Lock Nut
BV	Inlet Ball Cage

Always Keep Spare Parts Stocked

Always keep spare parts stocked to ensure getting back up and running as quickly as possible. Parts to keep stocked include:

- Cam and groove fitting gaskets
- Spray tips
- Tip retainer
- Rod and cylinder seals
- Cylinder o-rings
- Other parts as needed

Disassemble and Clean Pump

To help avoid serious injury from splashing fluid, never open a camlock hose or applicator fitting while there is pressure in the fluid line. See **Pressure Relief Procedure**, page 12.

See FIG. 36 for part references.

Disassemble and clean the pump at the end of every day. The procedure takes approximately10 minutes.

NOTE: As items are disassembled, use a soft brush and water to clean components.

1. Flush the system. See **Flush the Equipment**, page 19. Stop pump near bottom of its stroke.
2. Relieve pressure. See **Pressure Relief Procedure**, page 12.
3. With fluid pressure relieved, remove material hose from pump outlet (BP).
4. Disconnect hopper at outlet camlock (BR) then remove hopper (BN).
5. Remove inlet elbow (BA).
6. Tip cart back so it rests on the back of the cart.

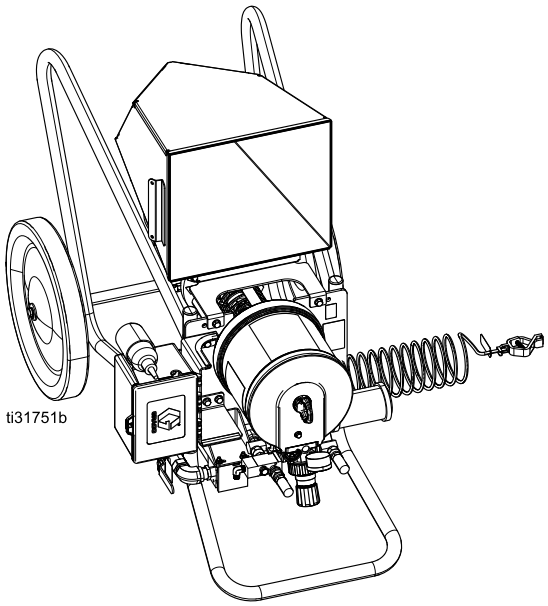


FIG. 37

7. While holding onto the inlet housing (BC), use a 5/8 in. wrench to loosen the two nuts on the inlet housing clamp (BB) then remove inlet housing (BC).
8. Remove inlet ball stop (BE).
9. Use 5/8 in. wrench (64) to loosen the two nuts on the cylinder clamp (BJ) then remove cylinder (BI).
10. Disconnect pump rod (BF). See FIG. 38.
    a. Push piston rod protective spring up and away from coupling assembly (BF1-BF3).
    b. Remove clip (BF1), and slide coupling cover (BF2) up to remove coupling (BF3).

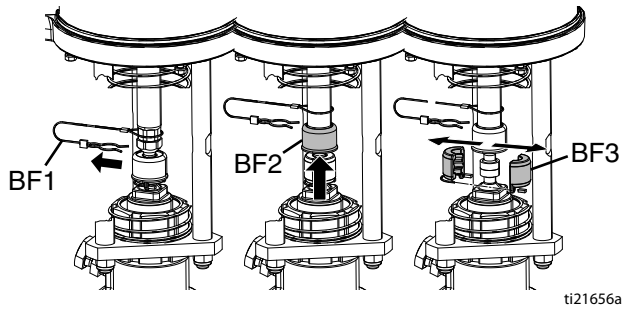


FIG. 38

11. Pull rod (BF) down and out of outlet housing (BK).
12. Remove outlet ball stop (BG) from rod (BF) by pushing o-rings off of ball stop (BG).
13. Loosen and remove packing nut (BM) then remove throat packing (BL).
14. Use a brush and clean water to clean all loose pieces.

NOTE: The pump rod (BF) is not disassembled unless the piston packing or seat needs to be replaced.

NOTE: The inlet housing (BC) is not disassembled unless the inlet seat needs to be replaced.

Assemble the Pump

1. Loosely install throat packing (BL) with the open end facing into the pump.
2. Install packing nut (BM) hand-tight.
3. Lubricate the balls (BS, BD) to ensure they do not stick.
4. Install outlet ball (BS), outlet ball stop (BG) with o-rings into rod (BF). Ensure outlet ball stop o-rings are in the grooves on the outlet ball stop rod.
5. Grease the packing on the rod (BF).
6. Gently slide rod (BF) through throat packing (BL).
7. Install coupling (BF3), slide coupling cover (BF2) over coupling, then install clip (BF1) to secure pump rod (BF) to air motor.
8. Use a flat-tip screwdriver and a plastic mallet to tighten packing nut (BM) until it stops.

NOTE: This is not an adjustable packing but the packing nut (BM) does need to be tight against the throat packing (BL).

9. Slide cylinder (BI) over rod (BF) with o-ring (BT) installed between outlet housing (BK) and cylinder (BI).

NOTE: If the o-ring (BT) does not stay in place while assembling the cylinder (BI) to the housing (BK), the cart may need to be tipped upright to install properly. After clamp is installed, tip cart back to horizontal position to finish assembly.

10. Use cylinder clamp (BJ) to secure cylinder (BI) to outlet housing (BK).

NOTE: Each clamp has one flat so that only one wrench is required to tighten clamp. Align bolt head with flat then use a wrench on the nut to tighten. Tighten both sides of the clamp evenly to approximately 10 ft-lb (14 N•m).

11. Install inlet ball (BD), ball cage spring (BV), and inlet ball stop (BE) in inlet housing (BC).
12. With inlet ball (BD), ball cage spring (BV), and inlet ball stop (BE) in place, place o-ring (BT) between cylinder (BI) and inlet housing (BC) then use inlet housing clamp (BB) to install inlet housing (BC) onto cylinder (BI).

NOTE: Each clamp has one flat so that only one wrench is required to tighten clamp. Align bolt head with flat then use a wrench on the nut to tighten. Tighten both sides of the clamp evenly to approximately 10 ft-lb (14 N•m).

13. Install inlet elbow (BA) onto inlet housing (BC).
14. Tip cart up.
15. Install hopper (BN) onto the hopper bracket and connect to inlet elbow (BA).
16. Install material hose onto pump outlet (BP).
17. Wrap blue velcro camlock retaining straps around each camlock connection to secure.

NOTE: This includes the two camlocks between the hopper and pump lower, the camlock at the pump outlet, the camlocks on the fluid hoses, and the camlock on the applicator inlet, The retaining straps should be tight and must not be able to slide off camlock.

18. Add TSL to the packing nut (BM) until 1/2 full.

Shutdown

NOTICE

To prevent rust, never leave water in pump for extended storage periods.

1. Flush the system. See **Flush the Equipment**, page 19.
2. Relieve pressure. See **Pressure Relief Procedure**, page 12.
3. Perform pump disassembly and cleaning procedure. See **Disassemble and Clean the Pump (Daily)**, page 22.

Maintenance

Preventive Maintenance

The operating conditions of your particular system determine how often maintenance is required. Establish a preventative maintenance schedule by recording when and what kind of maintenance is needed, and then determine a regular schedule for checking your system.

Daily Maintenance

1. Flush the system. See **Flush the Equipment**, page 19.
2. Relieve pressure. See **Pressure Relief Procedure**, page 12.
3. Perform pump disassembly and cleaning procedure at the end of every day. See **Disassemble and Clean the Pump (Daily)**, page 22.
4. Drain water from air filter.
5. Clean hopper with a scrub pad. It is recommended that you clean the outside of the sprayer using a cloth and water.
6. Check hoses, tubes, and couplings. Tighten all fluid connections before each use.
7. Check and replace camlock gaskets as needed.

Corrosion Protection

NOTICE

To prevent rust, never leave water in pump for extended storage periods.

Always flush the pump before the fluid dries on the displacement rod. First, flush with water then flush with oil. Relieve the pressure, but leave the oil in the pump to protect the parts from corrosion.

Cart Maintenance

Periodically lubricate the axle between points A and B with lightweight oil. See FIG. 39.

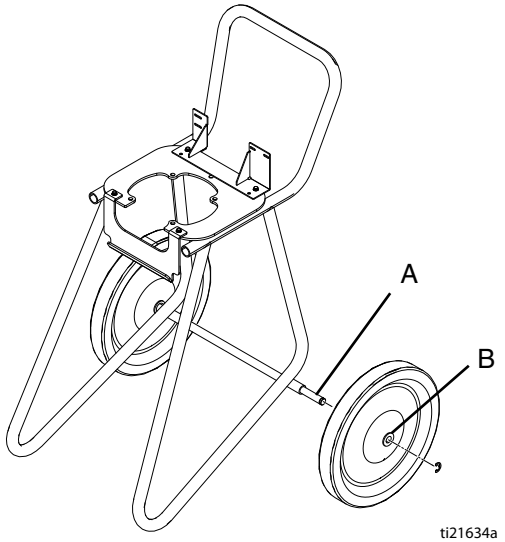


FIG. 39

Keep the cart clean by wiping up spills daily, using water.

Troubleshooting

To help avoid serious injury from splashing fluid, never open a camlock hose or applicator fitting while there is pressure in the fluid line. See **Pressure Relief Procedure**, page 12.

1. Follow **Pressure Relief Procedure**, page 12.
2. Check all possible problems, causes, and solutions listed below before disassembling pump.

Problem	Cause	Solution
Does not operate	Air motor pilot valve (211) is faulty	Remove valve by disconnecting swivel unions. Connect hose directly to air motor. Operate motor directly with air regulator (210).
	Valve closed or clogged	Clear air line; increase air supply. Check that valves are open.
	Fluid hose or applicator obstructed	Clean hose or applicator.◆
	Dried fluid on displacement rod or inlet ball	Clean rod; always stop pump at bottom of stroke. Keep wet-cup filled with throat seal liquid (74). Be sure inlet ball moves freely.
	Air motor parts dirty, worn, or damaged	Clean or repair air motor. See motor manual.
Output low on both strokes	Airline restricted or air supply inadequate; valves closed or clogged.	Clear air line; increase air supply. Check that valves are open.
	Fluid hose/applicator obstructed; hose internal diameter too small	Clear hose or applicator.◆ Use hose with larger internal diameter.
Output low on down-stroke	Open or worn intake valve	Clear or service intake valve.
Output low on up-stroke	Open or worn piston valve or packings	Clear piston valve; replace packings.
Erratic accelerated speed	Fluid supply exhausted, clogged suction	Refill hopper and prime pump.
	Open or worn piston valve or packings	Clear piston valve; replace packings.
	Open or worn intake valve	Clear or service intake valve.
Cycles or fails to hold pressure at stall	Worn check balls, seats, or piston packing	Service lower. See **Disassemble and Clean the Pump (Daily)**, page 22.
Poor finish or irregular spray pattern	Incorrect fluid pressure at applicator	See applicator manual; read fluid manufacturer's recommendations.
	Inadequate air assist air pressure	Adjust air assist needle valve.
	Dirty, worn, or damaged spray applicator.	Service spray applicator.◆ See spray applicator manual.

Problem	Cause	Solution
Cannot open or close air motor pilot ball valve (G) on applicator	Dirty air clogged the air motor pilot ball valve	Install new air motor pilot ball valve. If no ball valve is immediately available, bypass the air motor pilot valve so air is always supplied to air motor, regardless of applicator pilot valve position. Then control fluid flow by adjusting air regulator pressure up and down as needed. Install new pilot ball valve when one becomes available.
Motor powered but nothing comes out of hose	Pump is packed out with dry or cured material	See **Disassemble and Clean the Pump (Daily)**, page 22.
	Hose is packed out with dry or cured material	Reverse hose and try to push out bad material.
Material is too thick to push through hose without packing out	Hose is too restrictive	Remove any additional hoses.
		Thin and mix material thoroughly to a lower viscosity.
		Use a pump system priming fluid (slime). See **Wet Out the System**, page 13.

◆ *To determine if fluid hose or applicator is obstructed, follow **Disassemble and Clean the Pump (Daily)**, page 22. Disconnect fluid hose and place a container at pump fluid outlet to catch any fluid. Turn on air power just enough to start pump. If pump starts, the obstruction is in fluid hose or applicator.*

Repair

To help avoid serious injury from splashing fluid, never open a camlock hose or applicator fitting while there is pressure in the fluid line. See **Pressure Relief Procedure**, page 12.

Replace Pump Components

To replace any pump components (excluding the air motor), perform the pump disassembly and cleaning procedure. See **Disassemble and Clean the Pump (Daily)**, page 22.

Replace Air Motor

1. Perform **Pressure Relief Procedure**, page 12.
2. Note location of small air tube connections on air motor. Remove the air tubes.
3. Disconnect pump rod (see FIG. 40):
   a. Push piston rod protective spring up and away from coupling assembly (BF1-BF3).
   b. Remove clip (BF1) and slide coupling cover (BF2) up to remove coupling (BF3).

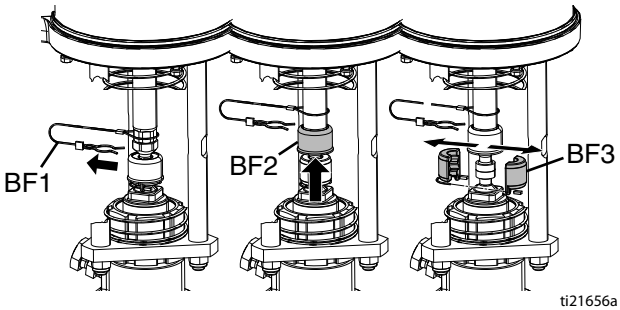


FIG. 40

4. Loosen three tie rod nuts (44), then loosen and remove tie rods (42) from air motor. See **Parts**, page 30.
5. Remove air motor.
6. Align air motor with tie rods (42) then tighten tie rods to air motor.
7. Tighten tie rod nuts (44).
8. Connect the pump rod. See FIG. 40.
9. Connect small air tubes to air motor.

Replace Pump Lower

Perform this procedure to replace the entire pump lower with a new or different pump lower. To repair or replace any internal components in the pump (excluding the air motor), perform **Disassemble and Clean the Pump (Daily)**, page 22.

1. **Flush the Equipment**, page 19.
2. Perform **Pressure Relief Procedure**, page 12.
3. Disconnect pump lower from hopper.
4. Disconnect material hose from pump lower outlet.
5. Disconnect pump rod (see FIG. 41):
   a. Push piston rod protective spring up and away from coupling assembly (BF1-BF3).
   b. Remove clip (BF1) and slide coupling cover (BF2) up to remove coupling (BF3).

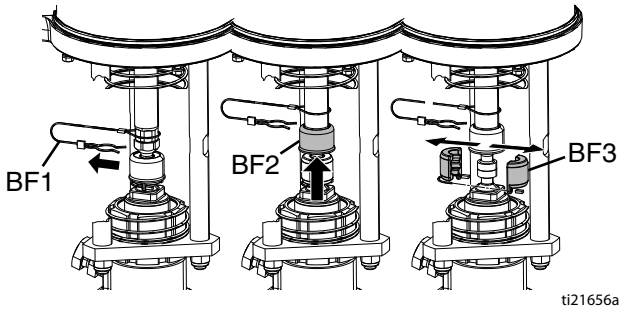
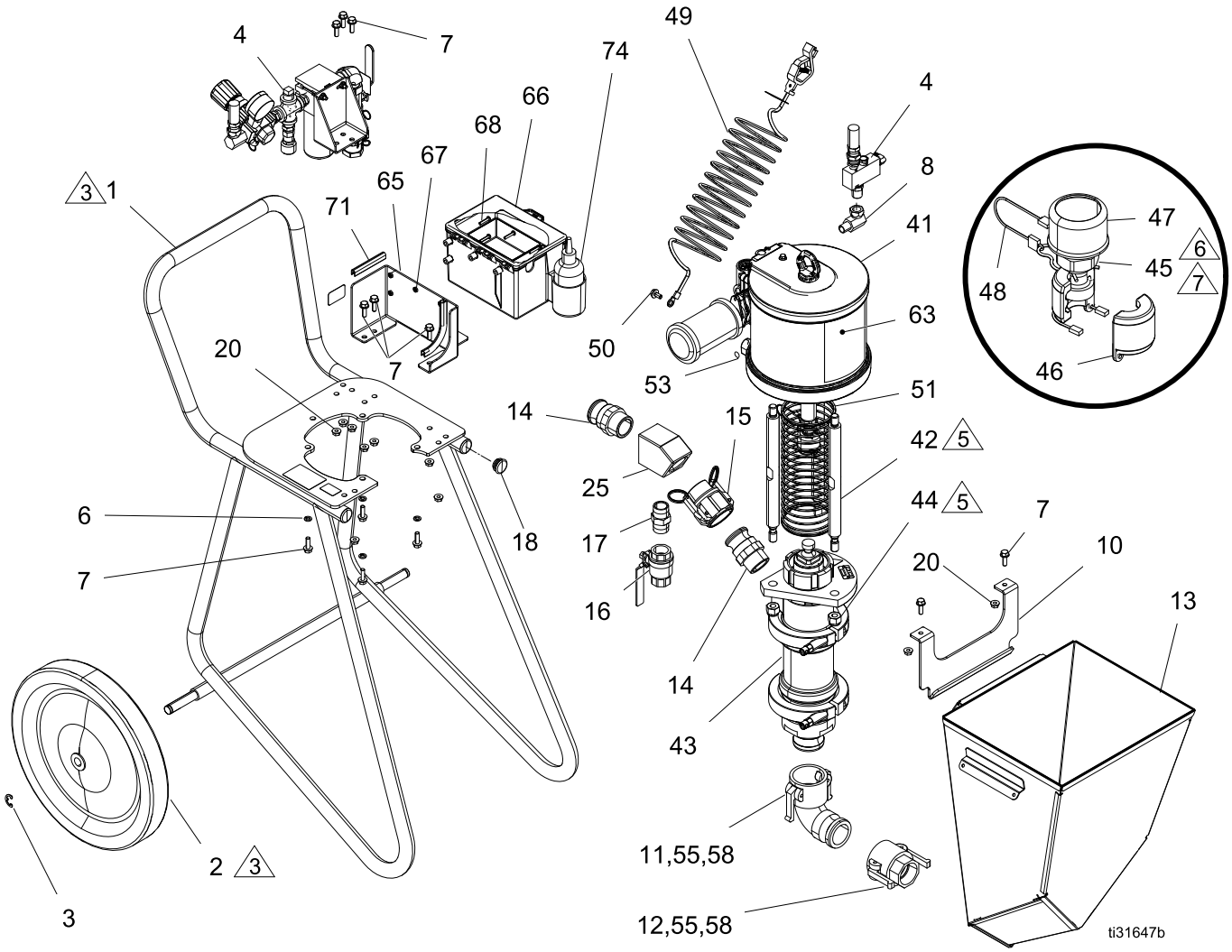


FIG. 41

6. Loosen three tie rod nuts (44), then loosen and remove tie rods (42) from air motor. See **Parts**, page 30.
7. Remove pump lower.
8. Align new pump lower with tie rods (42) then tighten tie rods to air motor.
9. Tighten tie rod nuts (44).
10. Connect pump rod. See FIG. 41.
11. Connect pump lower to hopper.

Parts

ToughTek M680a CS Systems



2 Apply pipe sealant to all non-swiveling pipe threads.

3 Apply clear liquid petrolatum to axles (1) before assembling wheels (2).

5 Torque to 50-60 ft-lb (68-81 N•m).

6 Torque to 145-155 ft-lb (197-210 N•M).

7 Apply medium strength thread-locking fluid to threads.

Part No./Description

Ref.	Part	Description	Qty.
1	262914	CART	1
2	116406	WHEEL	2
3	113436	RING, retaining	2
4	-----	MODULE, air controls; see AIR CONTROLS	1
6	104572	WASHER, lock spring	4
7*	114193	SCREW, machine, hex washer head	12
8	155470	SWIVEL, union, 90 degree	1
10*	-----	BRACKET, hopper	1
11*	16V510	CAM AND GROOVE, elbow, 2 inch	1
12*	16V509	CAM AND GROOVE, 2 inch x 1-1/2 npt	1
13*	16U536	HOPPER	1
14	128473	FITTING,1.50 cmlk m X 1.50 npt m	2
15	128758	FITTING,1.50 cmlk f X 1.50 npt m	1
16	127232	VALVE, ball,1000 psi,1 in.	1
17	17G388	FITTING, hose, 1-11 1/2 npt	1
18	-----	PLUG, tubing, cart	2
20*	-----	NUT, hex, flange, serrated	8
25	17G408	MANIFOLD, outlet, pump	1
41	M34LN0	MOTOR, air	1
42	16U817	ROD, tie, 10-5/8	3
43	25M583	LOWER, pump (M680 CS)	1
44	101712	NUT, lock	3
45	15H392	ROD, adapter	1
46	244819	COUPLING, assembly	1
47	197340	COVER, coupler	1
48	244820	CLIP, hairpin with lanyard	1
49	262908	WIRE, ground with clamp	1
50	111799	SCREW, cap, hex head	1
51	16V671	GUARD, spring	1
53▲	186620	LABEL, symbol, ground	1
55†	16W506	GASKET, 2 in., coupler, cam and groove (6-pack)	2
57†	18H242	O-RING, pump cylinder (10-pack)	2
58	240296	KIT, straps (4-pack)	3
63▲	15F674	LABEL, warning	1
64†	127265	TOOL, wrench, racket	1
65	-----	BRACKET, tool box	1
66	-----	KIT, tool box	1
67	113505	NUT, keps, hex head	4
68	107251	SCREW, machine, panhead	4
70†	24U173	KIT, rebuild, soft seal	1
74	206994	FLUID, TSL, 8 oz	1

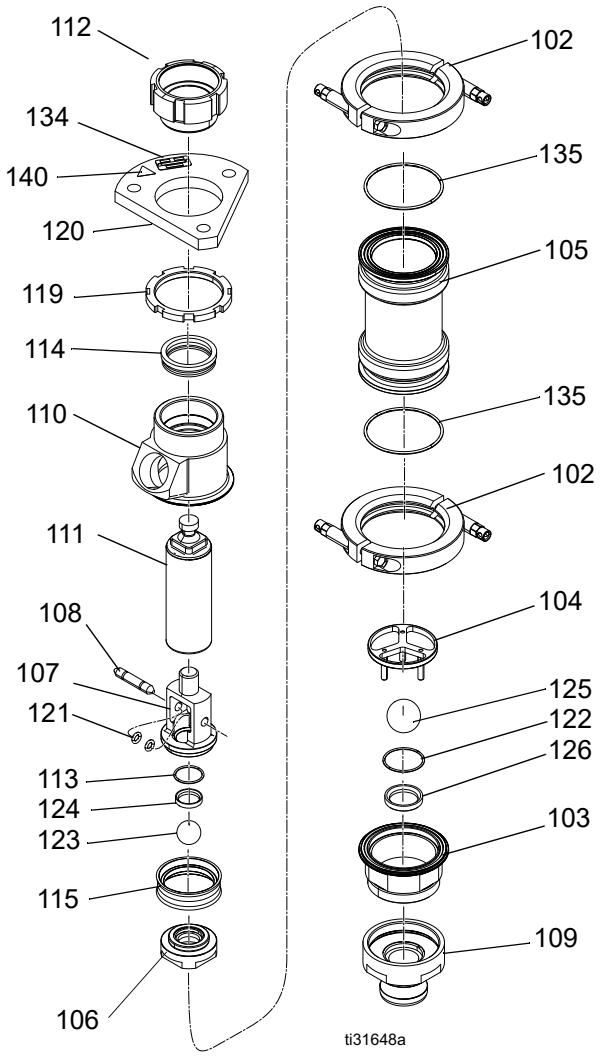
▲ *Replacement Danger and Warning labels, tags, and cards are available at no cost.*

* *Parts included in Hopper Replacement Kit 24T853 (purchase separately).*

† *Spare parts shipped with machine.*

----- *Not for sale.*

Pump Lower (25M583)



NOTE: Apply clear, liquid petrolatum to threads, o-rings, and seals.

NOTE: Tighten lock nut (119), keeping mounting plate (12) within +/- 0.060 in. (1.5 mm) of being flush with housing (11).

4 Torque to 25-35 ft-lb (34-47 N•m).

5 Torque to 90-110 ft-lb (122-149 N•m).

8 Apply medium strength thread-locking fluid to threads.

11 Assemble plate (120) within +/- 0.060 in. (1.5 mm) of being flush with housing (11), with 1 npt hole in line with flats on plate (120).

12 Torque to 190-210 ft-lb (258-285 N•m).

Ref.	Part	Description	Qty.
102	17G456	CLAMP, double-bolted, 4 in.	2
103	16U796	HOUSING, inlet	1
104	17K490	STOP, ball, with pins	1
105	16U798	CYLINDER, pump	1
106	16U799	VALVE, piston	1
107	16U800	HOLDER, valve piston	1
108	16U801	STOP, upper ball	1
109	16V143	HOUSING, inlet, 2 in. cam and groove	1
110	17G220	HOUSING, outlet	1
111	16U804	ROD, displacement	1
112	16U805	NUT, packing	1
113*‡◆	-----	O-RING, PTFE, 35 mm x 2.5 mm	1
114‡◆	16W492	BEARING, steel, throat (3-pack)	1
115‡◆	16W491	PACKING, cup, piston (3-pack)	1
119	16U977	NUT, jam	1
120	16U976	PLATE, mounting, cylinder	1
121‡◆	16W519	PACKING, o-ring, solvent-resistant (6-pack)	2
122†‡◆	-----	O-RING, 50 mm x 2.5 mm	1
123‡	102973	BALL, hardened stainless steel (3-pack: 16W493)	1
124*	-----	SEAT	1
125‡	112420	BALL, hardened stainless steel (3-pack: 16W494)	1
126†	-----	SEAT	1
134	-----	LABEL, identification	1
135‡◆	18H242	PACKING, o-ring, cylinder (10-pack)	2
140▲	15H108	LABEL, pinch point	1

▲ *Replacement Danger and Warning labels, tags, and cards are available at no cost.*

* *Parts included in Piston Seat Repair Kit 16W509 (purchase separately).*

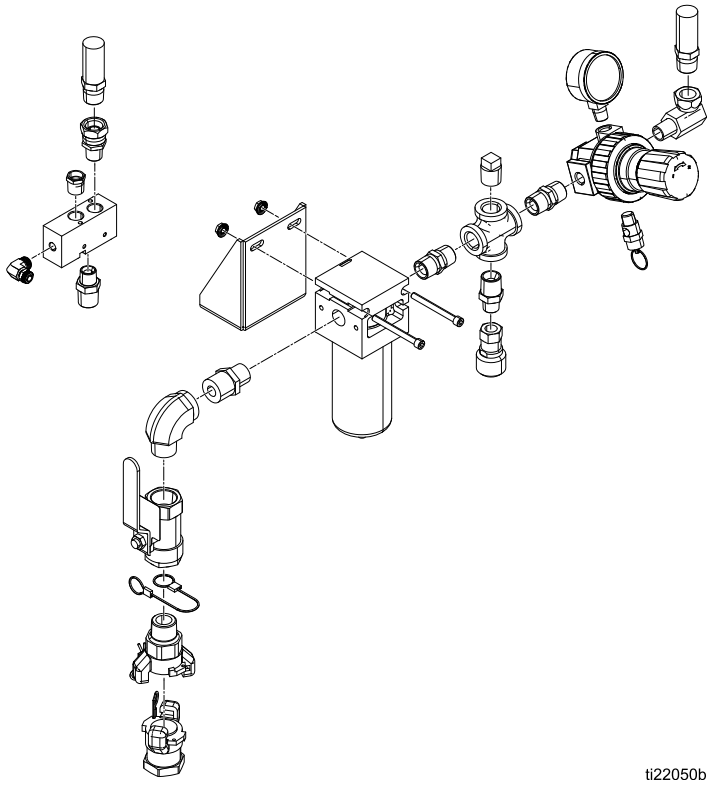
† *Parts included in Inlet Seat Repair Kit 16W510 (purchase separately).*

‡ *Parts included in Pump Rebuild Kit 16W508 (purchase separately).*

◆ *Parts included in Soft Seat Rebuild Kit 24U173 (purchase separately).*

----- *Not for sale.*

Air Controls



1 Apply pipe sealant to all non-swiveling pipe threads.

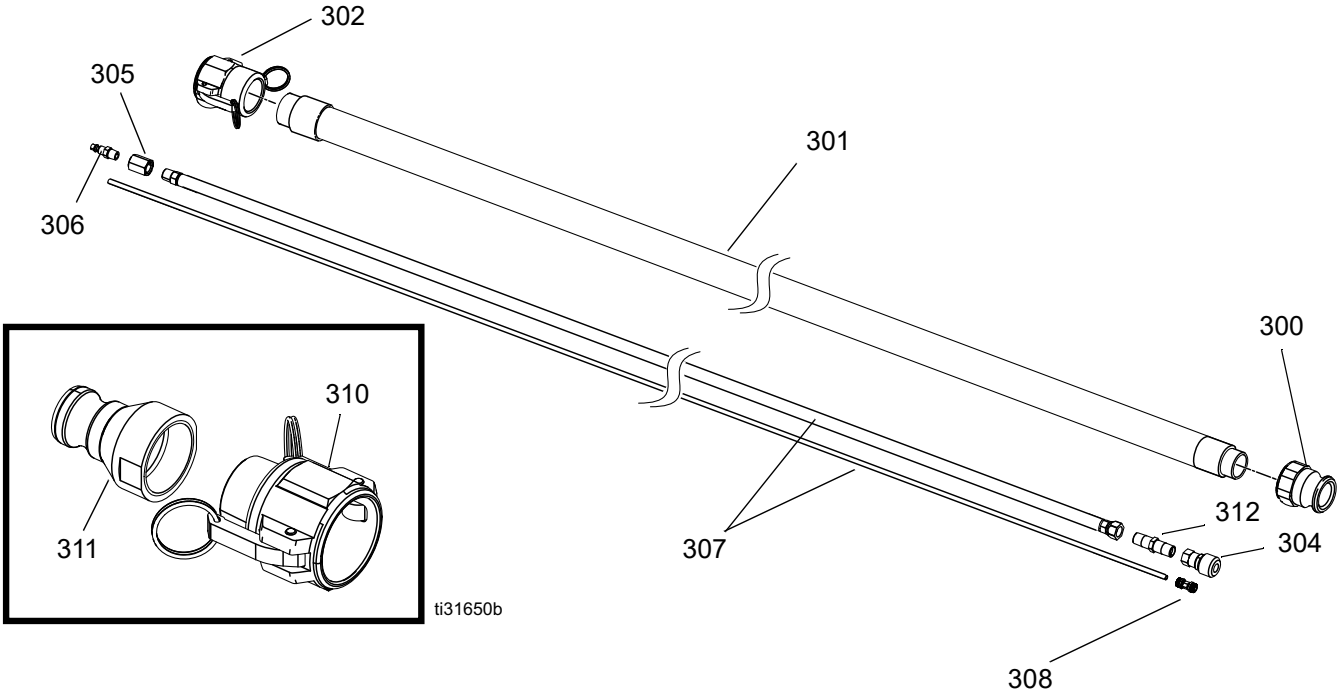
2 Assemble one end of lanyard between ball valve (207) and fitting (208). One end hangs loose.

Ref	Part	Description	Qty
201	262658	FILTER, air, 40 micron	1
202	158491	FITTING, nipple	2
203	C20432	FITTING, cross, pipe	1
204	C20461	FITTING, nipple, reducing, hex	1
205	-----	FITTING, elbow, street	1
206	159239	FITTING, nipple, pipe, reducing	2
207	113332	VALVE, ball, vented, 3/4 npt	1
208	113429	COUPLING, universal, 3/4-14 npt male	1
209	113430	COUPLING, universal, 3/4-14 npt female	1
210	104267	REGULATOR, air	1
211	16W146	VALVE, 3-way, pilot-operated	1
212	-----	BRACKET, air controls	1
213	160430	GAUGE, pressure, air	1
214	155470	FITTING, swivel, union, 90 degree	1
215	101950	SCREW, socket head cap, 1.4 x 2.5 in.	2
216	115942	NUT, hex, flange head	2
218	110198	COUPLER, line, air	1
219	127313	FITTING, elbow	1
220	111881	MUFFLER	1
221	100737	PLUG, pipe	1
222	218093	HOSE, coupled	1
223	162505	FITTING, union, swivel	1
224	110065	VALVE, safety, 60 psi	1
225	16W586	CABLE, lanyard, whip check	1

----- *Not for sale.*

Hose Bundle Repair Parts

Included in sprayer packages.



Ref	Part	Description	Qty.
300†	128474	FITTING, 1.5 camlock M x 1.5 npt F	1
301†	-----	HOSE, fluid	1
302†	128475	FITTING, 1.5 camlock F x 1.5 npt F	1
303‡	24U185	COVER, hose, plastic, 3 in. x 50 ft	1
304‡	110198	COUPLER, line, air	1
305‡	100083	COUPLING, 3/8 x 1/4 in.	1
306‡	169970	FITTING, line air	1
307‡	24T829	HOSE, bundle, air, 26 ft, includes 1/4 in. nylon tube	1
308‡	127312	FITTING, 1/4 to 1/4 tube	1
310❖	128758	FITTING, 1.5 camlock F x 1.5 npt M	1
311❖	-----	FITTING, 1 camlock M x 1.5 npt F	1
312‡	156850	FITTING, nipple, 3/8 npt	1

† *Parts included in fluid hose bundle 27A004 (purchase separately).*

‡ *Parts included in air hose bundle 24T852 (purchase separately).*

❖ *Parts included in applicator camlock reducer 17G767 (purchase separately).*

----- *Not for sale.*

Technical Specifications

ToughTek M680a CS Mortar Sprayer		
	US	**Metric**
Maximum Fluid Working Pressure	600 psi	4.1 MPa, 41bar
Maximum Air Inlet Pressure	100 psi	0.41 MPa, 4.1 bar
Minimum Inlet Air Flow (Typical)	30 standard cubic feet per minute	0.85 cubic meters per minute
Minimum Inlet Air Flow (Pump Only)	8 scfm per gallon at 100 psi	0.06 cubic meters per minute per liter at 7 bar
Pressure Ratio (Fluid to Air)	10:1	
Air Motor Piston Diameter	7.5 in.	191 mm
Stroke Length	4.75 in.	120 mm
Lower Output	41.9 cu. in. per cycle	686 cc per cycle
Flow Rate at 30 cycles per minute	5.44 gpm	20.6 lpm
Flow Rate at 60 cycles per minute	10.88 gpm	41.2 lpm
Air Inlet Size	3/4 npt(f) (Chicago fitting)	
Fluid Inlet Size	2 in. Cam Groove (male)	
Fluid Outlet Size	1.5 npt(f) with a 1.5 in. male Cam and Groove fitting	
Weight (without fluid)	250 lb	113 kg
Sound Pressure	Refer to applicable air motor and applicator manuals. See **Related Manuals**, page 2.	
Sound Power		
Dimensions		
Height	44.5 in.	113 cm
Width	27.5 in.	70 cm
Depth (pump on cart only)	32 in.	81 cm
Depth (pump on cart with hopper)	37 in.	94 cm
Maximum pump speed (Do not exceed the maximum recommended pump speed of fluid pump to prevent premature pump wear.)		
Spraying	40 cycles per minute (typically less than 10 cycles per minute)	
Flushing	60-90 cycles per minute (only when pumping flushing fluid)	
Wetted Parts		
Entire System	Stainless steel, UHMWPE, nylon, plated steel, anodized aluminum, FX-75	
Pump	Stainless steel, carbide, PTFE, UHMWPE, solvent-resistant o-rings, plated steel	

California Proposition 65

CALIFORNIA RESIDENTS

⚠ **WARNING:** Cancer and reproductive harm. – www.P65warnings.ca.gov.

Graco Standard Warranty

Graco warrants all equipment referenced in this document which is manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale to the original purchaser for use. With the exception of any special, extended, or limited warranty published by Graco, Graco will, for a period of twelve months from the date of sale, repair or replace any part of the equipment determined by Graco to be defective. This warranty applies only when the equipment is installed, operated and maintained in accordance with Graco's written recommendations.

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