

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR THE FOLLOWING MODELS

HD521-SR-S, HD721-SR-S & HD731-SR-S

SPRING RETURN SERIES

NACE TRIM PNEUMATIC ACTUATORS

PART NUMBER: 116145

REVISION: "A"

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1.0 INTRODUCTION

1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis HD521-SR-S, HD521-SR-M3-S, HD521-SR-M3HW-S, HD721-SR-S, HD721-SR-M3-S, HD721-SR-M3HW-S, HD731-SR-S, HD731-SR-M3-S, and HD731-SR-M3HW-S series Spring Return actuators. The -S for this model series actuators designates NACE trim, power cylinder mounted on right side of housing, spring cylinder mounted on left side of housing and spring cylinder is not pressurized.

1.2 **SAFETY STATEMENT:** Products supplied by Bettis, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by a well trained, equipped, prepared and competent technician.

WARNING: For the protection of personnel working on Bettis actuators, this procedure should be reviewed and implemented for safe disassembly and reassembly. Close attention should be noted to the **WARNINGS, CAUTIONS and NOTES** contained in this procedure.

WARNING: This procedure should not supersede or replace any customers plant safety or work procedures. If a conflict arises between this procedure and the customers procedures the differences should be resolved in writing between an authorized customers representative and a authorized Bettis representative.

1.3 DEFINITIONS:

WARNING: If not observed, user incurs a high risk of severe damage to actuator and/or fatal injury to personnel.

CAUTION: If not observed, user may incur damage to actuator and/or injury to personnel.

NOTE: Advisory and information comments provided to assist maintenance personnel to carry out maintenance procedures.

SR: Spring Cartridge

1.4 **BASIC SERVICE INFORMATION:** Complete actuator refurbishment requires the actuator be dismantled from the valve or device it is operating.

1.5 The maximum recommended service interval for this actuator series is five years. Storage time is counted as part of the service interval.

1.6 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator, allowing the spring to stroke and rotate the actuator to its fail position. Also, it is understood that the actuator has been removed from the valve as well as all piping and accessories that are mounted on the actuator have been removed.

2.0 SUPPORT ITEMS AND TOOLS

- 2.1 Support Items - Service/Seal Kit, commercial leak testing solution, and non-hardening thread sealant.

- 2.2 Tools - All tools are American Standard inch. Two each medium standard screwdriver, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet and a torque wrench (up to 2,000 in.lbs.). For recommended tool list refer to page 11.

3.0 REFERENCE BETTIS MATERIALS

- 3.1 Assembly Drawing Part Number 115763.

4.0 GENERAL DETAILS

- 4.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.
- 4.2 Numbers in parentheses, () indicate the bubble number (reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawings, and actuator parts lists.
- 4.3 This procedure is written using the stop screw side of the housing (1-10) as a reference and this side will be considered the front of the actuator. Housing cover (1-20) will be considered as top of the actuator.
- 4.4 To help in correct re-assembly all mating parts should be marked or tagged for ease of reassembly, i.e. with spring on same end of housing as was, cylinder to cylinder adapter, cylinder adapter to housing, and right and left stop adjustment screws, ect.
- 4.5 When removing seals from seal groove, use a commercial seal removing tool or a small standard screwdriver with the sharp edges rounded off.
- 4.6 Use a non-hardening thread sealant on all pipe threads.

CAUTION: Apply thread sealant per the manufacture's instructions.

- 4.7 Disassembly of actuator should be done in a clean area on a work bench.
- 4.8 LUBRICATION REQUIREMENTS: For use in all areas of the actuator. Lubricants, other than listed should not be used without prior written approval of Bettis Product Engineering. Use Bettis ESL-5, Kronaplate 100 lubricant. ESL-5 is contained in the Bettis Service/Seal Kit.

CAUTION: Pressure applied to the actuator is not to exceed the maximum operating pressure rating listed on the actuator name tag.

- 4.10 Before starting the general disassembly of the actuator, it is a good practice to operate the actuator with the pressure used by the customer to operate the actuator during normal operation. Notate and record any abnormal symptoms such as jerky or erratic operation.

5.0 GENERAL DISASSEMBLY

- 5.1 If not already done remove all operating pressure from actuator cylinder (3) or cylinder assy M3 (3-10), allowing the spring to stroke. The spring will rotate the yoke to the fail position.
- 5.2 If the actuator is equipped with a M3 jackscrew make sure that the jackscrew (3-20) does not engage the piston rod (2-10).

- 5.3 Actuators equipped with M3HW jackscrew with handwheel option, remove hex nut (8-30), lockwasher (8-20), and handwheel (8-10).
- 5.4 Remove three breathers (4-20). One is located in the end of spring cylinder (4-10) and the other two are located in the port of cylinder adapters (2-30).
- 5.5 Mark stop screws (1-60) left and right. Measure and record the exposed length of the right and left stop screws (1-60). The stop screws will be removed later in this procedure.
- 5.6 Record the locations of the ports in cylinder adapters (2-30).
- 5.7 Remove the socket cap screws (1-120) from position indicator (1-110) yoke weather cover (6-110) and remove position indicator/yoke weather cover.
- 5.8 Remove snubber (1-130) from top of housing (1-10).

6.0 SPRING CYLINDER REMOVAL

WARNING: When cylinder assembly (4-10) is installed on the actuator, spring cartridge (5) is under compression. Do not remove cylinder assembly (4-10) until actuator has the "pre-load" removed.

- 6.1 Remove cylinder assembly (4-10) stop screw "pre-load" as follows: Apply sufficient pneumatic pressure to the pressure inlet port, located in the out board end of cylinder (3) or cylinder assy M3 (3-10), to move the actuator load off of stop screw (1-60).
- 6.2 Loosen two jam nuts (1-70). Unscrew and remove two stop screws (1-60). Remove pressure from the pressure inlet ports.

CAUTION: Due to the weight and nature of a spring cartridge pre-loaded assembly, caution should be exercised when handling spring cartridge (5). The spring cartridge (5) is unattached and is only contained by cylinder assembly (4-10).

- 6.3 Secure the chain wrench around cylinder assembly (4-10) as close to the welded end cap as possible. Using a mallet, break the cylinder loose and then remove the cylinder by rotating in a counter clockwise direction.

CAUTION: When removing and setting cylinder assembly (4-10) aside, care should be taken to protect the chamfered edge and cylinder threads.

- 6.4 Carefully remove spring cartridge (5) from cylinder assembly (4-10) by slightly tilting open end of cylinder down.

WARNING: Under no circumstances should the spring cartridge (5) be disassembled, as the spring is pre-loaded.

- 6.5 Unscrew and remove standard hex lock nut (2-70) from piston rod (2-10).
- 6.6 Remove piston (2-20) from piston rod (2-10).

7.0 PRESSURE CYLINDER DISASSEMBLY

- 7.1 Secure the chain wrench around cylinder (3) or cylinder assy M3 (3-10) as close to the welded end cap as possible. Using the mallet, break the cylinder loose and then remove the cylinder by rotating in a counter clockwise direction. When setting cylinder aside, care should be taken to protect chamfered edge and cylinder threads.
- 7.2 Unscrew and remove hex lock nut (2-70) from piston rod (2-10).
- 7.3 Remove piston (2-20) from piston rod (2-10).
- 7.4 On power cylinder (3) or cylinder assy M3 (3-10) side of the actuator, unscrew and remove four ferry head screws (2-90), from cylinder adapter (2-30).
- 7.5 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).
- 7.6 On the spring cylinder (4-10) side of the actuator, unscrew and remove four ferry head screws (2-90) from remaining cylinder adapter (2-30).
- 7.7 Remove the cylinder adapter (2-30), taking care not to scratch the piston rod (2-10) or disengage the rod bushing (2-40).
- 7.8 For actuators equipped with M3 or M3HW jackscrew override, it is not necessary to disassemble the M3 Jackscrew from cylinder assembly -M3 (3-10). If the M3 stud or nut seal (3-30) needs replacement then refer to section 15.0, M3 Jackscrew Disassembly.

8.0 HOUSING GROUP DISASSEMBLY

- 8.1 Remove cover screws (1-30).
- 8.2 Remove housing cover (1-20). NOTE: Housing cover has a tight fit and will require the use of two pry bars or screw drivers to assist in removal.
- 8.3 Rotate the yoke arms to center position.
- 8.4 Remove upper yoke roller (1-50).
- 8.5 Remove yoke pin (1-40).
- 8.6 Holding rod bushings (2-40) in place, remove piston rod (2-10).
- 8.7 Remove lower yoke roller (1-50).
- 8.8 Remove both rod bushings (2-40) from housing (1-10).
- 8.9 Remove yoke (1-140) from the housing (1-10).

CAUTION: The yoke/housing bearing area must be lubricated and inspected to extend service life and prevent degradation of torque output. This can only be accomplished by removing the yoke from the housing which requires removing the actuator from the valve.

8.10 It is not necessary to remove housing pipe plug (1-100) or cylinder adapter pipe plug (2-110).

9.0 GENERAL RE-ASSEMBLY

CAUTION: Only new seals, that are still within the seals expectant shelf life, should be install back into actuator being refurbished.

9.1 Remove and discard all seals and gaskets.

9.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.

9.3 All parts should be thoroughly inspected for excessive wear, stress cracking, galling and pitting. Attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding or rotating motion. Sealing surfaces of the cylinder and piston rod must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

CAUTION: Actuator parts that reflect any of the above listed characteristics must be replaced with new parts.

9.4 Before installation coat all moving parts with a complete film of lubricant. Coat all seals with a complete film of lubricant, before installing into seal grooves. NOTE: The parts and seals used in the actuator housing assembly, power cylinder and spring cylinder will be assembled using lubricant as identified in step 4.8.

10.0 CENTER HOUSING GROUP RE-ASSEMBLY

10.1 If removed, install a pipe plug (1-100) into the drain port of the housing (1-10).

10.2 Apply lubricant to the yoke bore in the housing and arrange the housing so that the yoke bore is nearest to you. Lubricate the raised ribs in the bottom of the housing.

10.3 Install o-ring seal (6-20) into seal groove in the housing bore.

10.4 Apply a generous amount of lubricant to slots in the upper and lower yoke arms of yoke (1-140).

10.5 Coat the bearing surfaces of yoke (1-140) with lubricant and install yoke into housing (1-10). The wide yoke arm should be installed toward top of the housing.

10.6 Coat one of yoke rollers (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke.

10.7 Coat two rod bushings (2-40) with lubricant and install into both sides of housing (1-10).

10.8 Apply lubricant to piston rod (2-10) and install through rod bushings (2-40) in housing (1-10).

10.9 Coat yoke pin (1-40) with lubricant and install through piston rod (2-10) into lower yoke roller (1-50).

- 10.10 Coat remaining yoke roller (1-50) with lubricant and install over yoke pin (1-40) and into slot in the upper yoke arm.
- 10.11 Coat the yoke bore in cover (1-20) with lubricant.
- 10.12 Install remaining o-ring seal (6-20) into the housing cover (1-20).
- 10.13 Install cover gasket (6-60) onto housing (1-10).
- 10.14 Install housing cover (1-20) onto housing (1-10).
- 10.15 Install four gasket seals (6-100) onto four screws (1-30). NOTE: For 521/721-SR actuators, gasket seals will item number (6-100).
- 10.16 Install and tighten screws (1-30), with gasket seals, into housing cover (1-20).

11.0 PRESSURE CYLINDER RE-ASSEMBLY

- 11.1 Coat rod seal (6-30) with lubricant and install, lip first, into cylinder adapter (2-30).

CAUTION: Energizer ring of rod seal (6-30) must face into the cylinder adapter (piston side).

- 11.2 Install cylinder adapter gasket (6-70) onto the left side of the housing for fail clockwise actuators or on the right side of the housing for fail counter clockwise actuators.
- 11.3 Install four gasket seals (6-80) onto four ferry head screws (2-90).
- 11.4 Install cylinder adapter (2-30) over end of piston rod (2-10) and onto the right side of the housing. Arrange the cylinder adapter with the pressure inlet port in the same position as recorded in step 5.6. The location of the port may be different on your actuator depending on customer, plumbing, and accessory requirements.

CAUTION: Care should be taken not to scratch the piston rod when installing the cylinder adapter.

- 11.5 Install and tighten ferry head screws (2-90) with gasket seals (6-80).
- 11.6 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in step 5.6.
- 11.7 Coat o-ring seal (6-40) with lubricant and install into cylinder adapter (2-30). NOTE: Install o-ring into the groove at inner end of the cylinder adapter inner diameter threads.
- 11.8 Install o-ring seal (6-50) onto piston rod (2-10). NOTE: The o-ring should be installed against the shoulder of the piston rod.
- 11.9 Install piston (2-20) onto piston rod (2-10). NOTE: One side of piston (2-20) has a raised boss in the center that is counter bored to accept the o-ring installed in step 11.8. The counter bore side of the piston should be installed against the shoulder of piston rod (2-10) and over o-ring seal (6-50).

- 11.10 Install hex lock nut (2-70) onto piston rod (2-10). Torque hex lock nut (2-70) to approximately 146 foot pounds.

CAUTION: When installing hex lock nut (2-70) the teflon insert should rest up against piston (2-20).

11.11 Piston Seal Installation

11.11.1 Coat piston seal grooves with lubricant.

11.11.2 Coat two u-cup seal (6-10) with lubricant.

11.11.3 Install one u-cup seal into innermost piston seal groove. The lip of the cup seal should point outward toward the side of the piston.

11.11.4 Install one u-cup seal into outermost piston seal groove. The lip of the cup seal should point outward toward the side of the piston.

- 11.12 For actuators equipped with a M3 jackscrew, and if the M3 was removed then refer to section 16.0 for reassembling the M3 into cylinder (3-10).

- 11.13 Apply a coating of lubricant to the cylinder outer diameter threads and the entire bore of cylinder (3) or cylinder assy M3 (3-10).

- 11.14 Install cylinder (3) or cylinder assy M3 (3-10) over piston (2-20). Rotate the cylinder clockwise and screw into the cylinder adapter. Tighten with a chain wrench.

CAUTION: Exercise caution during cylinder installation to prevent pinching lip of the u-cup seal during installation. It is necessary to depress the seal lip while working the cylinder over it.

12.0 SPRING CYLINDER RE-ASSEMBLY

- 12.1 Install one cylinder adapter gasket (6-70) on left side of housing (1-10).

- 12.2 Install four gasket seals (6-80) onto four ferry head screws (2-90).

- 12.3 Install cylinder adapter (2-30) over the end of piston rod (2-10) and onto the left side of the housing. Arrange the cylinder adapter with the pressure inlet port in the same position as recorded in step 5.6.

- 12.4 Install ferry head screws (2-90) with gasket seals (6-80) through the cylinder adapter and screw into housing (1-10).

- 12.5 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in step 5.6.

- 12.6 Coat o-ring seal (6-40) with lubricant and install into cylinder adapter (2-30). NOTE: Install o-ring into the groove at the inner end of the cylinder adapter inner diameter threads.

- 12.7 Install piston (2-20) onto piston rod (2-10). NOTE: One side of piston (2-20) has a raised boss in the center that is counter bored. The counter bore side of the piston should be installed against the shoulder of piston rod (2-20).
- 12.8 Install hex lock nut (2-70) onto piston rod (2-10). Torque hex lock nut (2-70) to approximately 146 foot pounds.

CAUTION: When installing hex lock nut (2-70) the teflon insert should rest up against piston (2-20).

- 12.9 Push the piston in towards the housing as far as it will go.
- 12.10 Coat the cylinder threads and the cylinder bore with lubricant.
- 12.11 Coat the outside of the spring with lubricant and insert spring cartridge assembly (5) into cylinder assembly (4-10).

NOTE: One end of the spring cartridge assembly has a flat face with a deep hole in it, this end should be inserted into the cylinder first.

- 12.12 Install the spring cylinder (4-10), containing the spring cartridge, over the piston and screw into cylinder adapter (2-30). Tighten with a chain wrench.

- 12.13 Position Indicator Installation:

12.13.1 Rotate the yoke to the full clockwise (CW) position. Position the yoke weather cover (6-110) and position indicator (1-110) on the yoke (1-140) with the pointer pointing to the piston rod and perpendicular to the cylinder assemblies.

12.13.2 Install and tighten yoke position indicator/yoke weather cover screws (1-120).

NOTE: Screws (2-120) will require rechecking for tightness after the actuator has been cycled and tested.

- 12.14 Install gasket seals (6-90) and jam nuts (1-70) onto stop screws (1-60).
- 12.15 Install stop screws (1-60) with gasket seals (6-90) and jam nuts (1-70) into housing (1-10) in the position as recorded in step 5.5.
- 12.16 Adjust both stop screws (1-60) back to settings recorded in section 5 under General Disassembly.
- 12.17 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).

13.0 ACTUATOR TESTING

- 13.1 General Leak Testing: A small amount of leakage may be tolerated. Generally, a small bubble which breaks about three seconds after starting to form is considered acceptable.
- 13.2 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution.

WARNING: Pressure is not to exceed the maximum operating pressure rating listed on the name tag.

- 13.3 Unless otherwise listed all leak testing will use the nominal operating pressure (NOP) as listed on the actuator name tag or the pressure used by the customer to operate actuator during normal operation. NOTE: When testing the actuator use a proper adjusted regulator to apply pressure to the actuator.
- 13.4 Before testing for leaks, alternately apply and release pressure, as defined in step 13.3, to the pressure side of both pistons. Allow each application of pressure to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.
- 13.5 Apply pressure, as defined in step 13.3, to the pressure port in the end of cylinder (3) or cylinder assy M3 (3-10).
- 13.6 Apply leak testing solution to the breather port in the cylinder adapter (2-30), checks piston to cylinder and piston to piston rod seals.
- 13.7 If an actuator was disassembled and repaired, the above leakage test must be performed again.
- 13.8 Operation test the actuator to verify proper function of the actuator. This test is to be done off of the valve.
 - 13.8.1 Adjust the pressure regulator to the pressure as defined in step 13.3.
 - 13.8.2 Apply the above pressure to the pressure port in outboard end of cylinder (3) or cylinder assy M3 (3-10). Allow the actuator to stabilize. The actuator should stroke a full 90° degree travel.
- 13.9 Remove pressure from the pressure inlet port.

14.0 RETURN TO SERVICE

- 14.1 Install one breather (4-20) into port in outboard end cap of cylinder assembly (4-10).
- 14.2 Install two breathers (4-20) into cylinder adapters (2-30).
- 14.3 Replace software components of snubber (1-190) and then install snubber into housing (1-10).
- 14.4 For actuators equipped with a M3 jackscrew override and require an optional handwheel, M3HW, install the handwheel using the following procedure:
 - 14.4.1 Place the handwheel (8-10) onto the M3 nut (the handwheel hub has a cast hexagon hole that fits over the welded nut).
 - 14.4.2 Place lockwasher (8-20) onto M3 up against handwheel hub.
 - 14.4.3 Install and tighten hex nut (8-30) onto M3.

14.5 After actuator is reinstalled on the device it is to operate, all accessories, should be hooked up and tested for proper operation and replaced, if found defective.

14.6 The actuator is now ready for returning to service.

15.0 M3 JACKSCREW DISASSEMBLY

15.1 With cylinder (3-10) on a work bench, lubricate jackscrew assembly (3-20) threads with lubricant.

15.2 Using a 3/16 inch pin punch, drive out and remove the spirol pin from the slotted nut located on outboard end of M3 jackscrew assembly (3-20).

15.3 Remove the slotted nut from jackscrew assembly (3-20).

15.4 Loosen and screw seal nut (3-30) off of jackscrew assembly (3-20).

15.5 Screw jackscrew assembly (3-20) into cylinder (3-10) until it is disengaged from the cylinder end cap.

15.6 Remove jackscrew assembly (3-20) from the open end of cylinder (3-10).

16.0 M3 JACKSCREW REASSEMBLY

16.1 Apply a light coating of lubricant to the threads of jackscrew assembly (3-20).

16.2 Insert jackscrew assembly (3-20) through the threaded end of cylinder (3-10). Screw the jackscrew into the cylinder end cap until the end of the assembly protrudes out of the end cap of the cylinder.

16.3 Turn the jackscrew until the welded nut comes into contact with the inside of the cylinders end cap.

16.4 Install seal nut (3-30) onto jackscrew assembly (3-20). Screw the seal nut until it is up against the cylinder end cap.

16.5 Screw the slotted nut onto the outboard end of the jackscrew stud with the slot facing toward the cylinder end cap. Screw the nut until one of the slots in the nut is aligned with the cross drilled "through hole" in the stud.

CAUTION: When aligning the slot and the cross drilled hole make certain that the back of the slot is at least one thread from being aligned with the hole.

16.6 Insert the spirol pin through the slotted nut and through the jackscrew stud making sure that equal amounts of the spirol pin is exposed on both sides of the slotted nut and the jackscrew stud.

16.7 Turn nut seal until fully tight against end cap.

16.8 If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, lubricant may be left on jackscrew to provide additional corrosion protection.

HDX21-SR-S TOOL STYLE AND WRENCH SIZES

ITEM NO.	WRENCH SIZE	QTY	DESCRIPTION	RECOMMENDED WRENCH STYLE
1-30	9/16"	4	Cover Screws	Socket
1-60	1/2"	2	Stop Screw	Open End or Adjustable
1-70	15/16"	2	Stop Screw Nut	Open End or Adjustable
1-100	7/16"	1	Pipe Plug	Open End
1-120	3/16"	4	Weather Cover Screws	Allen
1-130	7/8"	1	Snubber	Deep Socket
2-70	1-1/4"	2	Piston Rod Lok Nut	Socket
2-90	7/16"	8	Cylinder Adapter Screws	12 Point Socket (1) (4)
2-110	7/16"	2	Pipe Plugs	Open End
3-10	(1)	1	Power Cylinder	Chain (1) (2)
3-30	1-13/16"	1	M3 Seal Nut	Open End or Adjustable (3)
4-10	(1)	1	SR Cylinder	Chain (1) (2)
4-20	11/16"	2	Breather	Open End (1)
8-30	1-11/16"	1	M3HW Jam Nut	Open End or Adjustable (3)

HD731-SR-S TOOL STYLE AND WRENCH SIZES

1-30	3/4"	4	Cover Screws	Socket
1-60	7/8"	2	Stop Screw	Open End or Adjustable
1-70	1-5/16"	2	Stop Screw Nut	Open End or Adjustable
1-100	7/16"	1	Pipe Plug	Open End
1-120	3/16"	4	Weather Cover Screws	Allen
1-130	7/8"	1	Snubber	Deep Socket
2-70	1-5/8"	2	Piston Rod Lok Nut	Socket
2-90	1/2"	8	Cylinder Adapter Screws	12 Point Socket (1) (4)
2-110	7/16"	2	Pipe Plugs	Open End
3-10	(1)	1	Power Cylinder	Chain (2)
3-30	1-13/16"	1	M3 Seal Nut	Open End or Adjustable (3)
4-10	(1)	1	SR Cylinder	Chain (1) (2)
4-20	11/16"	2	Breather	Open End (1)
8-30	1-11/16"	1	M3HW Jam Nut	Open End or Adjustable (3)

(1) No alternate style recommended.

(2) Bettis recommends a short handled Chain wrench with a 40" chain.

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Released	December, 1994	A	COMPILED	BC	14 December 1994
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* Signatures on file Bettis Actuator & Controls, Waller, Texas

