

GH BETTIS

OPERATING & MAINTENANCE INSTRUCTIONS

DISASSEMBLY & ASSEMBLY

FOR THE FOLLOWING MODELS

GT SERIES DOUBLE ACTING

AND SPRING RETURN ACTUATORS

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OPERATING & MAINTENANCE INSTRUCTIONS GT-SERIES PNEUMATIC ACTUATORS

SCOPE

This instruction manual provides Installation, Operation, Maintenance and Parts information for the GH-Bettis GT-Series Pneumatic Actuator.

DESCRIPTION

GT-Series Actuators are designed to open or close quarter-turn (90°) rotating mechanisms. The GT Actuators are available in double acting or spring return units, in both double or single cylinder configurations.

BASIC TOOLS

All tools are American Standard inch. Screwdriver, allen wrench set, 3/8 drive socket set, and set of open/box-end wrenches.

REFERENCE GH-BETTIS MATERIALS

Assembly Drawing 66298 for Model GT110/450/1350 Actuators
Assembly Drawing 66299 for Model GT225/900/2700 Actuators
Assembly Drawing 66295 for Model GT900-SR12 Actuator
Assembly Drawing 66297 for Model GT225/900/2700-SR Actuators
Assembly Drawing 66194 for Model GT110/450/1350-SR Actuators
Assembly Drawing 66195 for Model GT110/2-SR, GT450/2-SR and GT1350/2-SR Actuators.

SPECIFICATION

1. Maximum operating pressure ranges.

MAXIMUM OPERATING PRESSURE

TEST PRESSURE

PSI (BAR) 40(2.8) 60(4.2) 80(5.5) 100(6.9) 120(8.3)

200 (13.8)

2. Body Connections.

GT110/225 - 1/8 - 27 NPT

GT450/900/1350/2700 - 1/4 - 18 NPT

3. Temperature Capabilities.

-50°F (-46°C) to 200°F (93°C) - standard

0°F (-18°C) to 350°F (177°C) - high temp

4. **Mounting. (Millimeters in parenthesis).**

a. **Bottom mount or top mount**

GT110/225: (4) 1/4-20NC X .38 (9.7) deep on 2.75 (69.9) bolt circle

GT450/900: (4) 1/4-20NC X .38 (9.7) deep on 3.19 (81.00) bolt circle - same as CB315

GT1350/2700: (4) 5/16-18NC X .63 (16.0) deep on 3.19 (81.0) bolt circle

b. **Side mount (4) 10-24 UNC X .31 (7.9) holes for accessories or integral mounted subplate for control valves.**

5. **Approximate Weight - Lbs (Kilograms):**

GT110 = 4.1 (1.9) GT110-SR = 4.7 (2.1)

GT225 = 5.2 (2.4) GT225-SR = 6.5 (3.0)

GT450 = 9.25 (4.6) GT450-SR = 11.25 (5.6)

GT900 = 11.75 (5.3) GT900-SR = 15.50 (7.0)

GT1350 = 16.25 (7.4) GT1350-SR = 21.00 (9.5)

GT2700 = 23.1 (10.5) GT2700-SR = 32.0 (14.5)

INSTALLATION

The installation procedure may depend upon the type of valve and accessory equipment required for the actuator control system.

1. **Before installing actuator, inspect to be sure it is free of foreign material.**
2. **Be sure all connecting tubing is free of foreign material.**

CAUTION To avoid damage and possible operational impairment to the actuator, be careful not to get excessive pipe compound on the connections. Actuator damage may result if pipe compound is allowed to enter the actuator ports.

3. **Use acceptable piping practices when installing the actuator.**
4. **Do not install the actuator in a system where the working pressures exceed those presented in the specifications.**

PRINCIPAL OF OPERATION

Actuator can be mounted in the "FACE-UP" position (wide spaced 10-24 holed on port side toward top) or "FACE-DOWN" position (wide spaced 10-24 holes on port side toward bottom). When actuator (Double Acting or SR) is mounted in "up" position, bottom shaft will have "flats" aligned with actuator length when shaft is rotated to full CW position. Pressure applied to "top" port will turn torque shaft counter-clockwise, as viewed from top (compressing spring in SR unit). Pressure applied to "bottom" port will turn torque shaft clockwise, as viewed from the top. Spring Return units will be piped according to "closing Mode", specified by application. Loss of supply pressure will allow spring-force to rotate the actuator torque shaft.

OPERATING INFORMATION

INSTRUCTIONS FOR SETTING TRAVEL STOP SCREWS

Purpose

These instructions are to be used when setting travel stops on GT actuators prior to mounting on operated devices.

Procedure

1. Double Acting (DA) Actuator

The actuator must be oriented such that the cylinder(s) is parallel to ground, with the pressure ports up and wide spaced #10-24 UNC holes away from you. On "Bobtail" units, cylinders will be left of the housing. Milled flats on the torque shaft, facing you, are approximately perpendicular to the cylinder axis with the torque shaft fully rotated clockwise.

- a. Using a level on the housing, align the actuator to be horizontal. All the following adjustments must be made with the actuator in this leveled position.
- b. Place the level on the horizontal flat of the torque shaft end facing away from you.
- c. Apply only enough air pressure to the cylinder port, between the wide spread #10-24 UNC holes, to ensure the actuator is properly stroked against the stop screw.

CAUTION: DO NOT EXCEED AIR PRESSURE RATING ON NAMETAG AT ANY TIME. IT MAY BE NECESSARY TO RELIEVE THE AIR PRESSURE WHILE ADJUSTING THE STOP SCREWS.

- d. Using the level, adjust the bottom stop screw, located on the left end cap, so that the milled flats are horizontal and level.
- e. Apply only enough air pressure to the housing port, port nearest you, to stroke the actuator against the opposing stop screw.
- f. Place the level on the horizontal flat of the torque shaft end facing you.
- g. Using this level, adjust the top stop screw, located on the left end cap, so that the milled flats are horizontal and level.
- h. When the above procedure is performed correctly, the actuator will have a travel of 90° centered in its travel range. This will permit a maximum of 5° overtravel in both directions.

2. Spring Return (SR) Actuator

The actuator must be oriented such that the cylinder(s) is parallel to ground with the pressure ports up and wide spaced #10-24 UNC holes away from you. On "Bobtail" units, cylinders will be left of the housing. Milled flats on the torque shaft, facing you, are approximately perpendicular to the cylinder axis with the torque shaft fully rotated clockwise.

- a. Using a level on the housing, align the actuator to be horizontal. All the following adjustments must be made with the actuator in this leveled position.
- b. Place the level on the horizontal flat of the torque shaft end facing away from you.
- c. Using the level, adjust the bottom stop screw, located on the left end cap, so the milled flats are horizontal and level.
- d. Apply air pressure to the housing port, port nearest you, and stroke the actuator against the stop.

CAUTION: DO NOT EXCEED AIR PRESSURE RATING ON NAMETAG AT ANY TIME. IT MAY BE NECESSARY TO RELIEVE THE AIR PRESSURE WHILE ADJUSTING THIS STOP SCREW.

- E. Place the level on the horizontal flat of the torque shaft end facing you.
- f. Using the level, adjust the top stop screw, located on the left end cap, so that the milled flats are horizontal and level.
- g. When the above procedure is performed correctly, the actuator will have a travel of 90° centered in its travel range. This will permit a maximum of 5° overtravel in both directions.

3. **Completion**

The stop screw setting is now complete. Release all air pressure from the actuator and disconnect the air supply. The actuator is now ready to install.

CAUTION

AFTER INSTALLATION, THE STOP SCREWS MUST NOT BE ROTATED COUNTER-CLOCKWISE MORE THAN THE NUMBER OF TURNS ALLOWED IN TABLE I TO PRODUCE A TOTAL OF 5° OVERTRAVEL.

TABLE 1

<u>GT-ACTUATOR TURNS</u>	<u>NO. OF TURNS PER 1°-</u>	<u>TOTAL NO. OF TURNS TO PRODUCT 5°-</u>
GT-110/225	0.54	2.64
GT-450/900	0.84	4.2
GT-1350/2700	0.90	4.5

MAINTENANCE

GENERAL DISASSEMBLY

Actuator parts are subject to normal wear and must be inspected and replaced, as necessary. The frequency of inspection and replacement depends upon severity of service conditions. Be sure to note the orientation of all pressure connections to ensure proper actuator orientation upon assembly.

1. Remove all operating pressure from actuator cylinder ports. Remove all accessories and plumbing from actuator.

NOTE: On SR units, this will allow spring to stroke actuator.

2. Loosen jam nuts (3-50) and back-out stop screws (3-40). This will relieve "pre-loaded" spring force on SR units.
3. Remove tie bar nuts (3-30) and unscrew tie bars (3-10) and/or end cap studs (3-20). This will remove end caps (2-60) and/or (2-90) (cylinder and blind end cap), two sets of end cap gaskets (5-20) and cylinder seal plates (2-50).
4. ON dual-piston SR units, the spring assembly (4) will be removed. The spring assembly is an assembly made of spring retainer, spring retainer ring and spring(s).

WARNING: DO NOT ATTEMPT TO DISMANTLE THE SPRING CARTRIDGE OR PERSONAL INJURY MAY RESULT. REPLACE ENTIRE SPRING CARTRIDGE, IF DEFECTIVE.

5. Remove cylinder (2-10) and cylinder gasket (5-20).
6. Remove retaining rings (5-50) from the torque shaft (1-20).
7. Remove set screw from torque shaft assembly (1-20) and push yoke key into torque shaft, then remove torque shaft (1-20) from housing.

NOTE: Before removing the torque shaft, gently file off any raised burrs, sharp edges, or build-up of paint that may be on the ends of the torque shaft.

8. Slide housing assembly out by pulling on piston rod (2020) and/or guide track (1-80) until assembly emerges from housing (1-10). Remove exposed yoke pin (1-60). Reverse procedure to remove guide tracks from housing.
9. Slip out guide tracks (1-80) from housing (1-10).
10. Slide yoke pin(s) (1-60) from assembly. As yoke pins are removed, you will detach the piston rod(s) (2-30) from D.A. units or from single piston SR units.

GENERAL RE-ASSEMBLY

Remove all old seals and gaskets, taking care no to scratch or damage seal grooves.

Before starting the assembly of an actuator, all parts should be thoroughly cleaned, inspected and de-burred. Particular attention should be directed to threads, sealing surfaces and areas cleaned to remove all dirt, gaskets and other foreign material.

LUBRICATION REQUIREMENTS

Standard and high temperature service (20°F to 350°F) use Kronaplate 1217. Reference GH-Bettis Engineering Standard ESL 8.

ACTUATOR RE-ASSEMBLY

NOTE: Orient the housing so the pressure ports are facing up and the wide-spread

1. Grease all parts as they are assembled.
2. Check to assure yoke pins will slide freely in guide tracks and yoke arms.
3. Insert guide tracks (1-80) into right side of housing (1-10) but leave room for slots in guide tracks to be slightly exposed (at least one diameter of yoke pin).
4. Install one piston/piston rod assembly (2-20) into the lower right side of the housing and align the yoke pin hole in the piston rod with the guide tracks slots.
5. Slide one yoke pin (1-60) thru the lower guide track slot, thru the hole in the piston rod and into the opposing guide track slot.
6. Push the assembly into housing, after centering the yoke pin.
7. If the GT unit is equipped with two piston rods, perform the following steps. Otherwise proceed to step 8.
 - a). Push the guide tracks out the left side of the housing to expose the slots for at least one yoke pin diameter.
 - b). Install the second piston rod assembly into the upper left side of the housing and align the yoke pin hole in the piston rod with the guide track slots.
 - c). Slide the second yoke pin (1-60) thru the upper guide track slot, thru the hole in the piston rod and into the opposing guide track slot.
 - d). Push the assembly into the housing, after centering the yoke pin (1-60).
8. Insert first yoke arm into housing between piston rod and housing. Rounded edge side of yoke arm should face the guide track.

NOTE: a). For units with tow piston rods, pre-position yoke pins so that they are diametrically opposed and outside from slots of yoke arm.

 - b). Position keyway in yoke arm so that it is toward pressure port side of housing - to the right at 45°.
9. Slide yoke pins into slots of yoke arm by pushing piston rod(s) toward the center of the housing.
10. Install key (1-40) into the torque shaft key groove and thread socket set screw (1-50) into torque shaft only about five turns or until it is no longer protruding.
11. Install torque shaft partially into housing and through the first yoke arm (1-30).

12. Insert second yoke arm (1-30) into housing (1-10), over torque shaft (1-20) and engage the piston yoke pins in both arms. Rounded edge side of yoke arm should face the guide track.
NOTE: Check orientation of yoke arm before installation. The keyway in the yoke arm must be facing up (toward pressure ports) and to the right at 45°.
13. Install one of the torque shaft o-rings (5-10) in the exposed groove on the torque shaft (1-20) and gently push the torque shaft through the housing just far enough to expose the opposing o-ring groove. Install o-ring (5-10) on the torque shaft (1-20) and return torque shaft to centered position.
NOTE: Lubricate the o-ring and torque shaft generously.
14. Install retaining rings (5-50) onto the torque shaft between yoke arms.
NOTE: With the yoke key facing to the right, install the retaining rings on the torque shaft in the left side of the housing. Key in torque shaft should be centered with the opening of the retaining rings.
15. Tighten socket set screw (1-50) in torque shaft (1-20) to properly engage the yoke key (1-40).
NOTE: When turning in on the set screw, make sure that the key slots in the yoke arms are properly aligned to ensure full engagement of the key.
16. Install piston seal(s) (5-30).
17. Install the tie bars (3-10) into the left side of the housing, and install the tie bars (3-10) or end cap studs (3-20) into the right side of the housing.
18. Install cylinder gasket (5-20) and cylinder (2-10) on left side of actuator. Make sure that the air passageway holes in the housing cylinder are aligned.
19. If applicable, insert spring cartridge into the lower left cylinder and align the spring retainer arms so that they are toward the top and bottom of the cylinder.
20. On cylinder side of actuator (left side), insert gasket (5-20), seal (2-50), and gasket (5-20).
NOTE: Make sure that the air passageway holes in the gaskets and seal plate are aligned with the air passageway hole in the cylinder.
21. Install the end cap (2-60) on the left side of the actuator as follows:
 - a). For all dual piston actuators, install the end cap that has two stop screws in it.
 - b). For all single piston and /2-SR actuators, install the end cap with the single stop screw in it, so this stop screw will be in the upper cylinder with the piston. The lower stop screw area in the end cap is plugged from the inside using socket set screw (2-70).
22. Install o-ring seals (5-60) onto all tie bar nuts (3-30).
23. Install tie bar nuts. Torque tie bar nuts to approximately 10 to 12 ft. lbs. (120-144 in. lbs.)

24. Install the right side of the actuator as follows:

- a). For all dual piston actuators, install cylinder gasket (5-20), cylinder (2-10), spring cartridge assembly (4) if required, cylinder gasket (5-20), seal plate (2-50), gasket (5-20) and blind end cap (2-90). Make sure the air passageway holes in the gaskets, cylinder, and seal plate are aligned before installing the end cap.

NOTE: If the spring cartridge assembly is used, align the spring retainer arms so that they are toward the top and bottom of the cylinder during installation.

- b). For all single piston double-acting actuators, install cylinder gasket (5-20), seal plate (250) and gasket (5-20), seal plate (2-50) and gasket (5-20).

NOTE: Install the gaskets and seal plate so that the air passage **IS BLOCKED-OFF** at the end cap and housing.

Next, install the spring cartridge assembly (4) into the upper cylinder and onto the piston rod. Align the spring retainer arms so that they are toward the top and bottom of the cylinder. Install end cap (2-60) so that the stop screw is in the upper part of the housing with the spring cartridge.

25. Install tie bar nuts (3-30) with o-ring seals (5-60) on right tie bars and torque tie bar nuts to approximately 10 to 12 ft.lbs. (120-144 in.lbs.).

26. If removed, install stop screws and adjust for 90° travel. (See stop screw adjustment section).

27. After adjustment, install thread seal (5-40) and hex jam nut (3-50).

TESTING DOUBLE ACTING ACTUATORS

A. Leakage Test

NOTE: All areas where leakage to atmosphere may occur are to be checked using a soapy solution.

Procedure

1. Apply air pressure (65 psig) to one side of the piston and allow the unit to stabilize. If any leakage to atmosphere is noted, the actuator must be disassembled and the cause of leakage must be determined and corrected.
2. If excessive leakage across the piston is noted, generally a bubble which breaks three (3) seconds or less after starting to form, cycle the actuator five (5) times to allow the seals to seek their proper working attitude and retest. If excessive leakage across the piston remains, the unit must be disassembled and the cause of leakage must be determined and corrected.

3. Repeat the above procedure for the opposite side of the piston.

B. Operational (Functional) Test

NOTE: This test is used to verify proper function of the actuator.

Procedure:

1. Cycle the actuator at 10% of the maximum operation pressure as per Chart 1. Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity, must be corrected.

TESTING SPRING RETURN ACTUATORS

A. Leakage Test

NOTE: All areas, where leakage to atmosphere may occur, are to be checked using a soapy solution.

Procedure

1. Cycle the actuator five (5) times at the Normal Operating Pressure (NOP) as per Chart 1. This will allow the seals to seek their proper working attitude.
2. Apply air pressure from Chart 1, Column B, on the following pages for the model being tested) to stroke the actuator and allow the unit to stabilize.
3. The above leakage test is now to be performed. If any leakage to atmosphere is noted, the actuator must be disassembled and the cause of leakage must be determined and corrected.
4. If excessive leakage across the piston is noted (generally a bubble which breaks three (3) seconds or less after starting to form), the unit must be disassembled and the cause of leakage must be determined and corrected.

B. Operational (Functional) Test

NOTE: This test is used to verify proper function of the actuator.

1. Adjust the pressure regulator to the pressure rating indicated on Chart 1, Column B.

NOTE: Check the spring cartridge to insure that the vent is not plugged and is venting properly to the atmosphere.

2. Cycle the actuator five (5) times at the above pressure. This will allow the seals to seek their proper working attitude.
3. Apply the above pressure to the actuator and allow the unit to stabilize. The actuator should stroke a full (90°) travel with the stops properly set.
4. Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity must be corrected and the above test performed again.

CHART 1

PRESSURE REQUIREMENTS AND LIMITATIONS FOR GT-SERIES ACTUATORS

<u>ACTUATOR MODEL</u>	<u>NOMINAL OPERATING PRESSURE (NOP)</u>	<u>MAXIMUM OPERATING PRESSURE (MOP)</u>	<u>MAXIMUM TEST PRESSURE (MAWP)</u>	<u>MAXIMUM AIR ASSIST PRESSURE (MAAP)</u>	<u>COLUMN B SPRING SELECTION PRESSURE</u>
GT110	Cust. Spec. Or N.A.	120	200		
GT225	"	120	200		
GT450	"	120	200		
GT900	"	120	200		
GT1350	"	120	200		
GT2700	"	120	200		
GT110-SR4	40	135	200	120	36
-SR6	60	140	200	120	50
-SR8	80	145	200	120	60
-SR10	100	150	200	120	74
-SR12	120	160	200	120	94
GT225-SR4	40	135	200	120	36
-SR6	60	140	200	120	50
-SR8	80	145	200	120	60
-SR10	100	150	200	120	74
-SR12	120	160	200	120	94
GT450-SR4	40	135	200	120	30
-SR6	60	140	200	120	46
-SR8	80	145	200	120	56
-SR10	100	150	200	120	70
-SR12	120	165	200	120	90
GT900-SR4	40	135	200	120	30
-SR6	60	140	200	120	46
-SR8	80	140	200	120	56
-SR10	100	150	200	120	70
-SR12	120	165	200	120	90
GT1350-SR4	40	135	200	120	30
-SR6	60	140	200	120	46
-SR8	80	145	200	120	56
-SR10	100	150	200	120	70
-SR12	120	160	200	120	90
GT2700-SR4	40	135	200	120	30
-SR6	60	140	200	120	46
-SR8	80	145	200	120	56
-SR10	100	150	200	120	70
-SR12	120	160	200	120	90

GT BILL OF MATERIAL - SPRING RETURN

ITEM #	DESCRIPTION	MATERIAL	SINGLE		DOUBLE	
			CYLINDER	CYLINDER	CYLINDER	CYLINDER
			QTY	QTY	QTY	QTY
1-10	HOUSING MACH	Aluminum Alloy 60061-T6	1		1	
1-20	TORQUE SHAFT ASSY		1		1	
1-30	YOKE ARM	Steel AISI-1010-CD	2		2	
1-60	YOKE PIN	Steel AISI 52100	1		2	
1-80	GUIDE TRACK	Steel AISI-1010 CD	2		2	
2-10	CYLINDER	Aluminum ASTM B221, Alloy 6063-T6	1		2	
2-20	PISTON	Aluminum ASTM B-211-75 Alloy 2024-T351	0		2	
2-30	PISTON ROD	Aluminum ASTM B-211-75 Alloy 2024-T351	0		2	
2-50	CYLINDER SEAL PLATE	Steel ASTM A-108-73 Gr. 1018 CD	2		2	
2-60	END CAP MACH	Aluminum Alloy ASTM B-85, Gr. 380	2		1	
2-90	BLIND END CAP	Aluminum Alloy ASTM B-85, Gr. 380	0		1	
3-10	TIE BAR	Steel	6		12	
3-20	END CAP STUD	Steel ASTM A-449 Gr. 5	6		0	
3-30	TIE BAR NUT	Stainless Steel AISI 416	12		12	
3-40	STOP SCREW	Stainless Steel	2		2	
3-50	STOP SCREW NUT	ASTM A-193-77 Stainless Steel Gr. B8, Class 2, AISI 304	2		2	
3-60	WASHER SEAL		2		2	
4	SPRING CART. ASSY.		1		2	
5-10	TORQUE SHAFT SEAL	Nitrile, 70 DURO	2		2	
5-20	CYLINDER GASKET	Nitrile, 90 DURO	5		6	
5-30	O-RING PISTON	Nitrile, 70 DURO	1		2	
5-40	THREAD SEAL	Nitrile, 75 DURO	2		2	
5-50	RETAINING RING	Carbon Spring Steel	2		2	
5-60	O-RING SEAL	Nitrile, 70 DURO	12		12	
7-10	IDENTIFICATION TAG	Commercial	1		1	
7-20	SPECIFICATION TAG	Commercial	2		2	
7-30	BETTIS LOGO	Commercial	2		2	

GT BILL OF MATERIAL - DOUBLE ACTING

ITEM #	DESCRIPTION	MATERIAL	SINGLE	DOUBLE
			CYLINDER	CYLINDER
			<u>QTY</u>	<u>QTY</u>
1-10	HOUSING MACH	Aluminum Alloy 60061-T6	1	1
1-20	TORQUE SHAFT ASSY		1	1
1-30	YOKE ARM	Steel AISI-1010-CD	2	2
1-60	YOKE PIN	Steel AISI 52100	1	2
1-80	GUIDE TRACK	Steel AISI-1010 CD	2	2
2-10	CYLINDER	Aluminum ASTM B221, Alloy 6063-T6	1	2
2-20	PISTON	Aluminum ASTM B-211-75 Alloy 2024-T351	0	2
2-30	PISTON ROD	Aluminum ASTM B-211-75 Alloy 2024-T351	0	2
2-50	CYLINDER SEAL PLATE	Steel ASTM A-108-73 Gr. 1018 CD	2	2
2-60	END CAP (MACH)	Aluminum Alloy ASTM B-85, Gr. 380	2	1
2-70	SOCKET SET SCREW	Stainless Steel Commercial		
2-90	END CAP (BLIND)	Aluminum Alloy ASTM B-85, Gr. 380	0	1
3-10	TIE BAR	Steel	6	12
3-20	END CAP STUD	Steel ASTM A-449 Gr. 5	6	0
3-30	TIE BAR NUT	Stainless Steel AISI 416	12	12
3-40	STOP SCREW	Stainless Steel	2	2
3-50	STOP SCREW NUT	ASTM A-193-77 Stainless Steel Gr. B8, Class 2, AISI 304	2	2
3-60	WASHER SEAL		2	2
5-10	TORQUE SHAFT SEAL	Nitrile, 70 DURO	2	2
5-20	CYLINDER GASKET	Nitrile, 90 DURO	5	6
5-30	O-RING PISTON	Nitrile, 70 DURO	1	2
5-40	THREAD SEAL	Nitrile, 75 DURO	2	2
5-50	RETAINING RING	Carbon Spring Steel	2	2
5-60	O-RING SEAL	Nitrile, 70 DURO	12	12
7-10	IDENTIFICATION TAG	Commercial	1	1
7-20	SPECIFICATION TAG	Commercial	2	2
7-30	BETTIS LOGO	Commercial	2	2

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